Telluride Regional Wastewater Treatment Plant Master Plan

This Master Plan addresses near- and long-term needs for wastewater treatment for Telluride, Mountain Village and surrounding communities in the service area.



Prepared for:
Town of Telluride

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Sign-off Sheet

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Executive Summary

Wastewater treatment is an industrial process that is designed to receive domestic, commercial, and industrial waste and create clean water that can be discharged back into the environment without adverse impacts. Biosolids, which are created as a by-product of wastewater treatment, must also be treated so that they can be beneficially reused as a soil amendment in agriculture, reclamation projects, parks, and even home gardens. In Colorado, all discharges are regulated by the Department of Public Health and Environment (CDPHE) through the Colorado Discharge Permit System (CDPS).

Over time, existing treatment systems age, waste streams increase, regulations expand, and new treatment technologies emerge. The Telluride Regional Wastewater Treatment Plant (TRWWTP) faces a combination of all of these challenges. This Master Plan is intended to provide a path forward to meet immediate and near-term needs over the next 5 years, and anticipated long term needs over the next 30 years.

The TRWWTP serves the Town of Telluride, the Town of Mountain Village, and the communities of Eider Creek, Sunset Ridge, Aldasoro, Hillside, and Lawson. Service area growth and seasonally high loading are pushing the TRWWTP to its design capacity. Research indicates that base population growth has been steady at about 1% to 1.5% annually, while visitors have had a significant seasonal impact, nearly tripling the population during peak events. Commercial businesses are also having an increasing impact as the number of businesses rise and existing enterprises expand. For this master planning effort, wastewater flows and loads to the TRWWTP were projected into the future by estimating and analyzing contributions from the service area and various specific sources, including residents, visitors, and commercial entities. Wastewater flows were projected to remain under the current permit limit for most of the 30-year planning period. However, wastewater loads, as characterized by biochemical oxygen demand (BOD_5) have increased significantly and will soon reach the current permit limit. BOD_5 is therefore a primary driver for required immediate and near-term improvements.

In addition to treating increasing loads, the TRWWTP faces new, more stringent discharge permit limits. This planning effort included investigations into whether current TRWWTP treatment processes can be enhanced to meet recent permit limits for metals and expected permit limits for nutrients. It also investigated alternative new technologies that might be more reliable and better suited to meet emerging challenges. While possible future limits for temperature and pharmaceuticals were a consideration, addressing these contaminants was not a central focus.

Treating more wastewater to higher standards creates more biosolids, which must be treated and properly disposed. Treating and managing the disposal of biosolids generated at the TRWWTP has always been challenging. With an eye toward creating a biosolids management program that is more flexible and reliable in the near-term, and results in a better end product in the long-term, this Master Plan offers a different approach and potential new technologies for consideration.

Metals Compliance

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 will 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 whether these high levels are real. If so, the TRWWTP would be required to incorporate a treatment process to remove low levels of selenium, which would challenge the current limits of technology.

Copper concentrations show consistently higher winter season concentrations that are occasionally above the permit limit. Further investigation identified corrosion of copper service lines and household plumbing in the Telluride drinking water distribution system as a concern. 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 to date indicates that Telluride's corrosion control program for drinking water is not sufficient on its own. Potential 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). In the near-term, the TRWWTP is considering pre-treatment agreements with commercial wastewater dischargers, seasonal restrictions on septage hauling to the TRWWTP, and a septage receiving station for storage of septage, which gives operators control of releases into the TRWWTP.

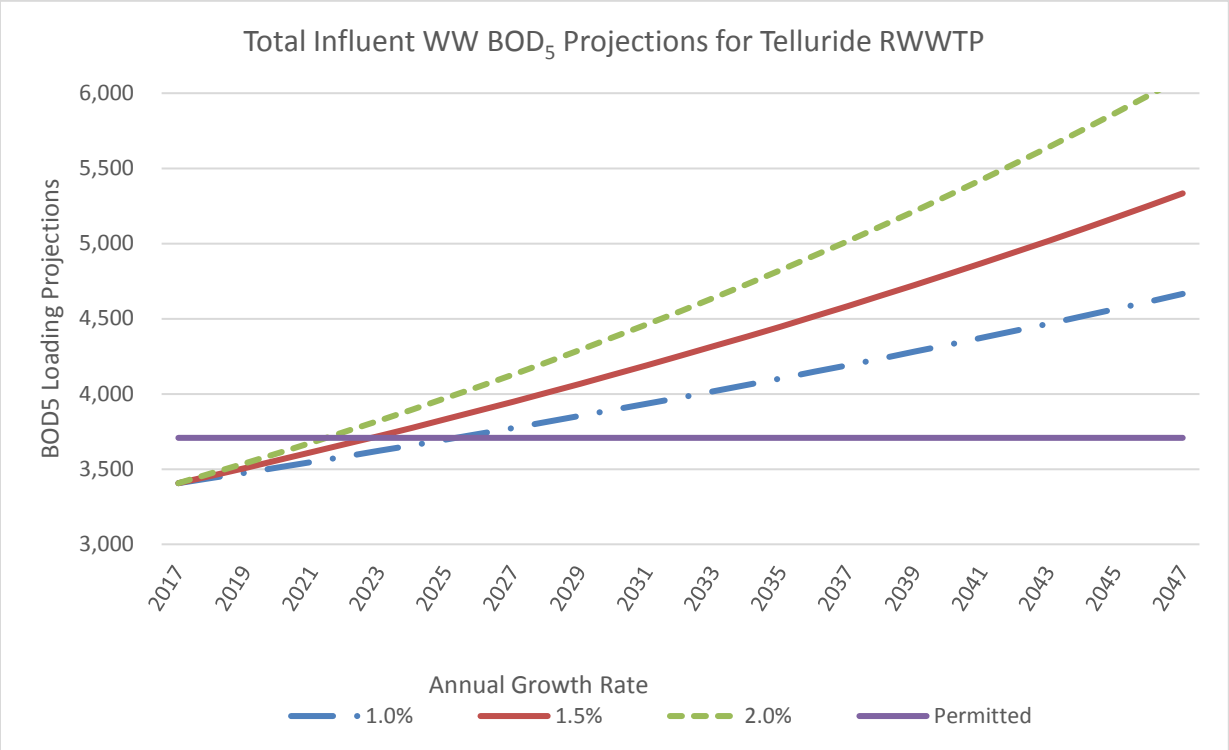


Figure ES-1 Loading Projections at Varied Population Growth Rates

At the TRWWTP, condition assessments of observable structures and electrical system components revealed several limitations that impact operations and maintenance. 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 should be incorporated into the plans.

Removing, drying and hauling settled solids from the three existing oxidation ditches is an immediate need. Operators require a dewatering process for the solids removed during maintenance. 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. Currently, 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 oxygen deficit will worsen. The first alternative for supplemental oxygen replaces the existing aeration system with larger units. Other alternatives to supplement the existing system use 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 added to the discharge permit. Colorado Regulation No. 85 nutrient limits are anticipated to take effect in 2027. The TRWWTP will require a plant expansion 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 estimated at 6,005 pounds per day (ppd).

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

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.

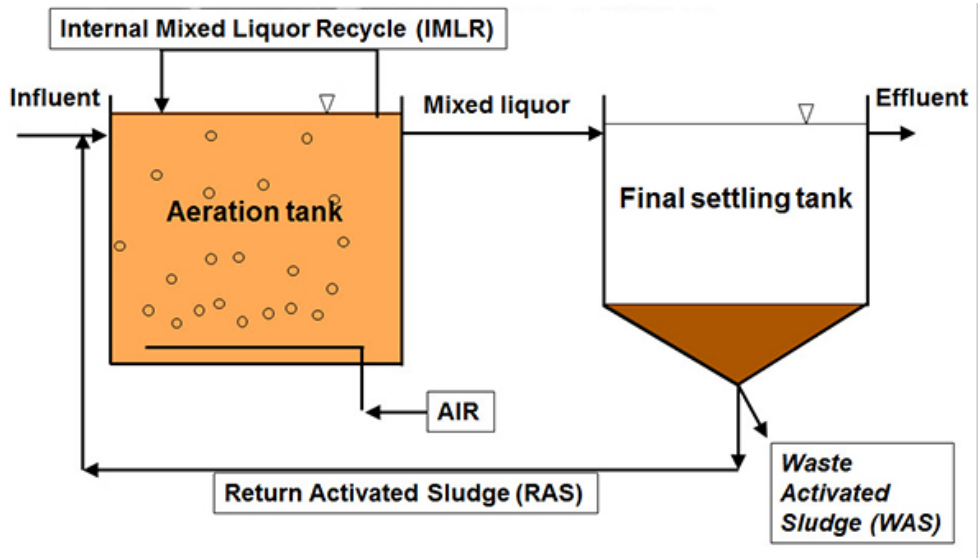


Figure ES-2 Conventional Activated Sludge Process Diagram

Image Source: Activated Sludge: Three Steps to Improve Your Process Efficiency, Dr. Rob Smith, Oct 13, 2016

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; membranes replace the final settling tank.

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

MBR provides superior filtration technology configured with an activated sludge process to treat 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 installed 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 less 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 identified as feasible:

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 than the MBR system; although the capital cost is roughly the same. A major disadvantage of 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.

<u>Expansion Project Cost Summary</u>
A present value comparison of capital and operation and maintenance costs in FY 2017 dollars, is shown below:

1. Headworks: Capital Cost = $2.5 MM

2. 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

3. 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. The Colorado Water Quality Control Division regularly updates Regulation 31 water quality requirements for each stream segment and many of the proposed changes indicate very low nutrient limits in the future. 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 treatment and disposal are complex needs 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 ultimate goal of treating to meet 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 that were considered 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.

1.0 INTRODUCTION

This report presents the Master Plan for the Telluride Regional Wastewater Treatment Plant (TRWWTP). The TRWWTP is owned by the Town of Telluride and the Town of Mountain Village in accordance with an intergovernmental agreement. The TRWWTP is permitted under the Colorado Discharge Permit System for discharge to the San Miguel River, just downstream of the Society Turn Bridge. The discharge permit identifies the terms for compliance with water quality standards, including limits for pollutant concentrations of coliform bacteria, oxygen demand, suspended solids, heavy metals and pH. The permit also defines monitoring requirements for wastewater flow and pollutant concentrations entering the TRWWTP. The wastewater entering the TRWWTP is also limited by the discharge permit, which is tied directly to its design capacity. As the community grows, the TRWWTP will continue to approach design capacity and the limits of their discharge permit.

The Master Plan addresses three areas of need:

1. Capacity to meet effluent limits for metals
2. Near-term improvements for immediate needs
3. Long-term improvements for expansion

1.1 CAPACITY TO MEET EFFLUENT LIMITS FOR METALS

The State of Colorado regularly implements new standards that are implemented with a compliance schedule when discharge permits are renewed. During the last permit renewal cycle, a compliance schedule was incorporated into the discharge limits for the TRWWTP with a new set of parameters scheduled for implementation on January 1, 2017. As part of the compliance schedule, the Town was required to evaluate the capacity of the TRWWTP to meet these limits and submit a letter to the State of Colorado with the results of the analysis.

Stantec collected available water quality data from the Town and mapped out areas for sampling within the wastewater collection system. The data was analyzed to identify potential sources of metals, whether they were entering from the drinking water supplies to the community, from wastewater entering the collection system or other sources, such as septage hauled to the TRWWTP. Section 2.0 of this report presents the findings from the data analysis and the investigation of metals sources to the plant.

1.2 NEAR-TERM IMPROVEMENTS

This report presents the findings from a detailed evaluation of the existing capacity and operational limits at the TRWWTP. Comparing these findings with projections for growth, several near-term needs were identified requiring improvements at the TRWWTP.

1.3 LONG-TERM PLANT EXPANSION

The long-term expansion of the TRWWTP was developed with alternative treatment technologies and site plans. The timeline and probable cost for implementation were estimated for selected alternatives.

2.0 METALS MONITORING AND ACTION PLAN

Dissolved metals have been monitored by staff at the Town of Telluride and the TRWWTP for many years. Until recently, the TRWWTP discharge permit only required reporting for compliance. When the discharge permit was renewed, a compliance schedule was issued requiring TRWWTP staff to evaluate whether the new limits for several new metals could be met. This section summarizes the findings of investigative activities into the source, treatment impacts and proposed strategies to mitigate arsenic, cadmium, copper, hexavalent chromium, lead, selenium and zinc at the Telluride Regional Wastewater Treatment Plant.

2.1 BACKGROUND

The Colorado Discharge Permit System (CDPS) Permit for the TRWWTP (CO-0041840) identified various actions required to be undertaken by the Town under Section 6 – Compliance Schedule(s). This section summarizes activities undertaken in support of responding to requirements under Section 6.c (Compliance Schedule) of the CDPS Discharge Permit. The final activity due December 31, 2016 was to show compliance is attainable with the final limitations. The Town applied for a modification to the permit to extend the compliance data for copper. Several other modifications to the permit had been issued by the Colorado Department of Public Health and Environment (CDPHE) since the permit was renewed June 1, 2013, as described in **Table 2.1**.

Table 2.1 CDPS Permit CO0041840 Summary

Permit Action	Reference	Description
Modification #4	Application submitted Oct. 2016; approved December 29, 2016 by CDPHE.	Modification #4 extends compliance date for Cu, PD to January 1, 2018 to allow additional monitoring and possible modification of the Town's corrosion control program.
Modification #3	Minor Modification- Issued March 16, 2015, Effective April 1, 2015 (Title page and I.B.6b)	Minor edits were made to the permit holder name, changing it from City of Telluride to Town of Telluride. The Town of Telluride also requested that in the Table under I.B.6.c, the requirements for Cr IV be modified to Cr VI.
Modification #2	Minor Modification- Issued February 25, 2015, Effective April 1, 2015 (Part I.A.2 and I.B.6b)	The Division has removed the total arsenic water quality based limitations of 0.076 µg/l for Outfall 001A that was set to begin on January 1, 2017 and has implemented a 'report only' requirement for the remainder of this permit term.

Modification #1	Minor Modification - Issued May 30, 2013, Effective June 1, 2013 (Part I.A.2 and I.B.6b)	NA
Permit Renewal	Issued April 30, 2013 and Effective June 1, 2013	Compliance schedules established.

2.2 METALS EFFLUENT LIMITATIONS

The Effluent Limitations for arsenic, cadmium, copper, hexavalent chromium, lead, selenium and zinc are provided in CDPS Permit Section 2. These limitations are summarized in **Table 2.2**.

Table 2.2 Summary of TRWWTP Metals Effluent Limitations Effective January 2017

Effluent Parameter	**Fraction**	**Effluent Limitations Maximum Concentration starting Jan 1, 2017**	
		Value	**Units**
Arsenic	Potentially Dissolved	Report only*	µg/L
Cadmium	Potentially Dissolved	0.56	µg/L
Copper	Potentially Dissolved	18	µg/L
Chromium +6	Dissolved	10	µg/L
Lead	Potentially Dissolved	6.2	µg/L
Selenium	Potentially Dissolved	6	µg/L
Zinc	Potentially Dissolved	190	µg/L

Table Notes
Arsenic was assigned an Effluent Limitations Maximum Concentration of 0.076 µg/L; however, in response to a modification request from the Town and based on the commission adaptation of the 'hybrid' temporary modification for the total recoverable arsenic on the receiving stream segment, the Division removed the total arsenic water quality based limitations of 0.076 µg/L set to begin on January 1, 2017 and implemented a 'report only' requirement for the remainder of the Permit term (December 31, 2021).

As stated in **Table 2.1**, a permit modification to extend the compliance date for effluent copper was requested in October 2016. The approval of this modification is pending further review by CDPHE.

2.3 STUDY DATA SET

The study involved collating and trending all available metals grab sample data and reviewing them to identify any trends that may indicate potential sources. The data set for the analysis comprised 544 sampling data points from grab samples for the period 2007 – 2016; the number of data points based on year and parameter are summarized in **Table 2.3** for reference.

Table 2.3 Summary of Sample Data Set Evaluated During Investigation

Parameter	Number of Sample Data Points Reviewed						Total
	Prior Years	2012	2013	2014	2015	2016	
Arsenic	10	3	25	72	16	39	165
Cadmium	10	3	16	12	16	10	67
Copper	10	13	19	12	69	38	161
Chromium VI	0	0	10	4	5	2	21
Lead	0	3	18	4	8	3	36
Selenium	0	3	18	4	7	3	35
Zinc	10	3	18	4	11	13	59
TOTALS	40	28	124	112	132	108	544

The complete sampling data set is included in **Appendix A.1** for reference.

2.4 SAMPLE COLLECTION

The samples collected represent many different sources of water/wastewater starting with instream sampling of raw water potentially being diverted to the Mill Creek water treatment plant or the Pandora water treatment plant. Background levels of contaminants were analyzed from samples collected at various sites along the San Miguel River, which is the receiving stream for the TRWWTP effluent. Drinking water samples have been obtained from locations in the Telluride water distribution system, some of which were collected in accordance with the requirements of the Lead & Copper Rule. In Mountain Village, several drinking water wells and household drinking water taps were sampled. Groundwater sampling in Telluride is limited to two samples collected recently at utility construction sites. The TRWWTP influent wastewater is a combination of flows from the Telluride interceptor, the Lawson interceptor, the Mountain Village interceptor (which is combined with wastewater collected from Lawson Hill), and the Aldasoro interceptor. Other sources of wastewater entering the TRWWTP include septage (hauled from residential septic tanks or from port-0-lets set up during festivals), and boiler water drain waste.

Most of the samples were collected using a single grab from a stream or sewer. The sampling of TRWWTP influent typically had several individual grab samples that were composited and sent to a lab for analysis. More recent TRWWTP influent sampling was conducted using an automatic composite sampler. The TRWWTP effluent samples are all individual grab samples.

2.5 SOURCES OF METALS TO THE TRWWTP

The purpose of this section is to review the available data to identify potential sources of arsenic, cadmium, copper, hexavalent chromium, lead, selenium and zinc to the TRWWTP. For the initial analysis, all available metals sample data were grouped based on the sampling location, as follows:

- Water System – comprised all source water samples, treated drinking water samples, tap water samples;
- Wastewater System – comprised all samples from the collection system, industrial discharges, septic discharges, TRWWTP influent, TRWWTP effluent, San Miguel River (receiving water body for the TRWWTP effluent).

Pivot tables from the Water System data analysis are presented in **Appendix A.2**.

Pivot tables from the Wastewater System data analysis are presented in **Appendix A.3**.

2.6 ANALYSIS

Summary comments from the analysis are presented in **Table 2.4.**

Table 2.4 Summary of Analysis of Sources of Metals

Parameter	Water System	Wastewater System
Arsenic "Report Only" Limit set at 0.000076 mg/L was retracted by permit mod. #2	• Mill Creek WTP raw water contains arsenic levels up to 0.01 mg/L; however, levels appear to reduce through the treatment process, with Mill Creek WTP treated water arsenic levels ranging from 0.001 – 0.002 mg/L. • Pandora WTP raw water has low arsenic levels (0.0005 mg/L). • Stillwell water collected at the tank and Cornet Creek has high arsenic levels (>0.010 mg/L).	• Collection system Arsenic concentration ~ 0.001 – 0.002 mg/L • Septage (discharge to TRWWTP): 0.002 – 0.003 mg/L • WWTP influent: 0.001 – 0.005 mg/L. Influent trend is generally steady over last 3 years, although a regular seasonal 2 – 3 fold increase is noted in summer months when Cornet WTP (Stillwell) was in operation until 2015. • WWTP effluent: 0.001 – 0.0035 mg/L • San Miguel River (receiving water body for the TRWWTP effluent) has arsenic levels 0.001 – 0.007 mg/L.
Cadmium Limit set at 0.00056 mg/L	• Limited sampling data (ten samples in watershed of the Pandora WTP from 2007 & 2008; one sample from Mtn Village tap from 2013). • Raw water for Pandora WTP contains Cd levels 0.0001 – 0.0002 mg/L.	• Single sample from Aldasoro wastewater collection system with level 0.0001mg/L (analysis limit of detection) from Nov 2013) • 51 samples from TRWWTP Effluent. 2012 – 2016 with only seven samples greater than 0.0001 mg/L (analysis limit of detection). • Since Oct 2015, 6 out of 22 samples had low level detections (0.0002 – 0.0005 mg/L), which could indicate a slight rising trend.

Parameter	Water System	Wastewater System
Copper Limit set at 0.018 mg/L	• Mill Creek WTP – Raw water 0.0004 – 0.003 mg/L, finished water 0.0004 mg/L • Pandora WTP - Raw water 0.0001 – 0.003 mg/L, finished water 0.001 – 0.002 mg/L • The WTP raw and treated water contain low copper (<0.002 mg/L) • Tap water samples show higher copper than the treated water (0.01 - 0.3 mg/L), which is attributed to corrosion of domestic copper plumbing.	• Boiler maintenance drain samples showed result of 16.8 mg/L in June 2015 and 1.15 mg/L in December 2015 – possible source of elevated copper to collection system • Septage samples show up to 0.0429 mg/L contribution • Collection system samples range 0.005 – 0.10 mg/L (Aldasoro 0.102 mg/L on Nov. 2013) • RWWTP influent similar to collection system data, range 0.005 to 0.10 mg/L • RWWTP effluent samples range 0.005 – 0.07 mg/L, average 0.02 mg/L. A declining trend in TRWWTP effluent copper is notable since summer 2014. • San Miguel River – 0.0013 – 0.008 mg/L
Chromium VI Limit set at 0.010 mg/L	• One sample collected from Mill Creek WTP, Mtn. Village tap and Stillwell tank (each at detection limit of 0.008 mg/L.	• RWWTP Effluent Cr+6 < 0.010 mg/L for period 2012 – 2016 • Total Chromium also monitored (not required by permit) 2012 – 2015 ranging from 0.001 to 0.0021 mg/L
Lead Limit set at 0.0062 mg/L	• Drinking Water Lead <0.0005 mg/L detection limit (one sample at Mill Creek WTP, one at Mtn. Village tap and one at the Stillwell tank)	• High School boiler drain sample June 2015 had lead 1.37 mg/L • Aldasoro Interceptor sample November 2013 had lead 0.036 mg/L • RWWTP effluent discharge results from 2012 – 2016 are < 0.005 mg/L, with exception of single outlier (March 2013, 0.04 mg/L)
Selenium Limit set at 0.006 mg/L	• Instream and Drinking Water Selenium at or below 0.001 mg/L	• 21 out of 24 TRWWTP Effluent sampling results for period 2012 – 2016 are <0.001 mg/L (analysis limit of detection) • The previous 2 samples (Jan and May 2016) had levels 0.019 and 0.005 mg/L, respectively.
Zinc Limit set at 0.190 mg/L	• Pandora Raw water at Bridal Veil Falls, Zinc 0.02 – 0.15 mg/L	• Single sample from wastewater collection system – level 0.129 mg/L (Nov 2013) • 24 samples from TRWWTP Effluent with average 0.06 mg/L (STDEV 0.02). • San Miguel River – 0.2 – 0.5 mg/L, indicating that background levels of zinc in the receiving water body exceed new permit effluent levels.

2.6.1 GIS-Grouped Data Review

Based on GIS mapping of all individual sampling locations (n = 84), each sampling site was assigned to a parent 'GIS Group' (n = 17). The purpose of grouping the sampling locations was to create larger sampling data sets across fewer locations, to provide another angle of data analysis. Maps were prepared using the GIS data layers to show the interrelationship of the sample sites and sources (e.g., Telluride drinking water vs. Telluride wastewater), identify sewer and water utilities, identify sample site locations, and to summarize test results. The map showing arsenic data is attached to **Appendix A.4** and the map showing copper is in **Appendix A.5**.

Table 2.5 shows the GIS Groups, the number of sampling sites assigned to each Group ('Sample Site Count') and a count of the annual samples per Group, for context during the following analysis.

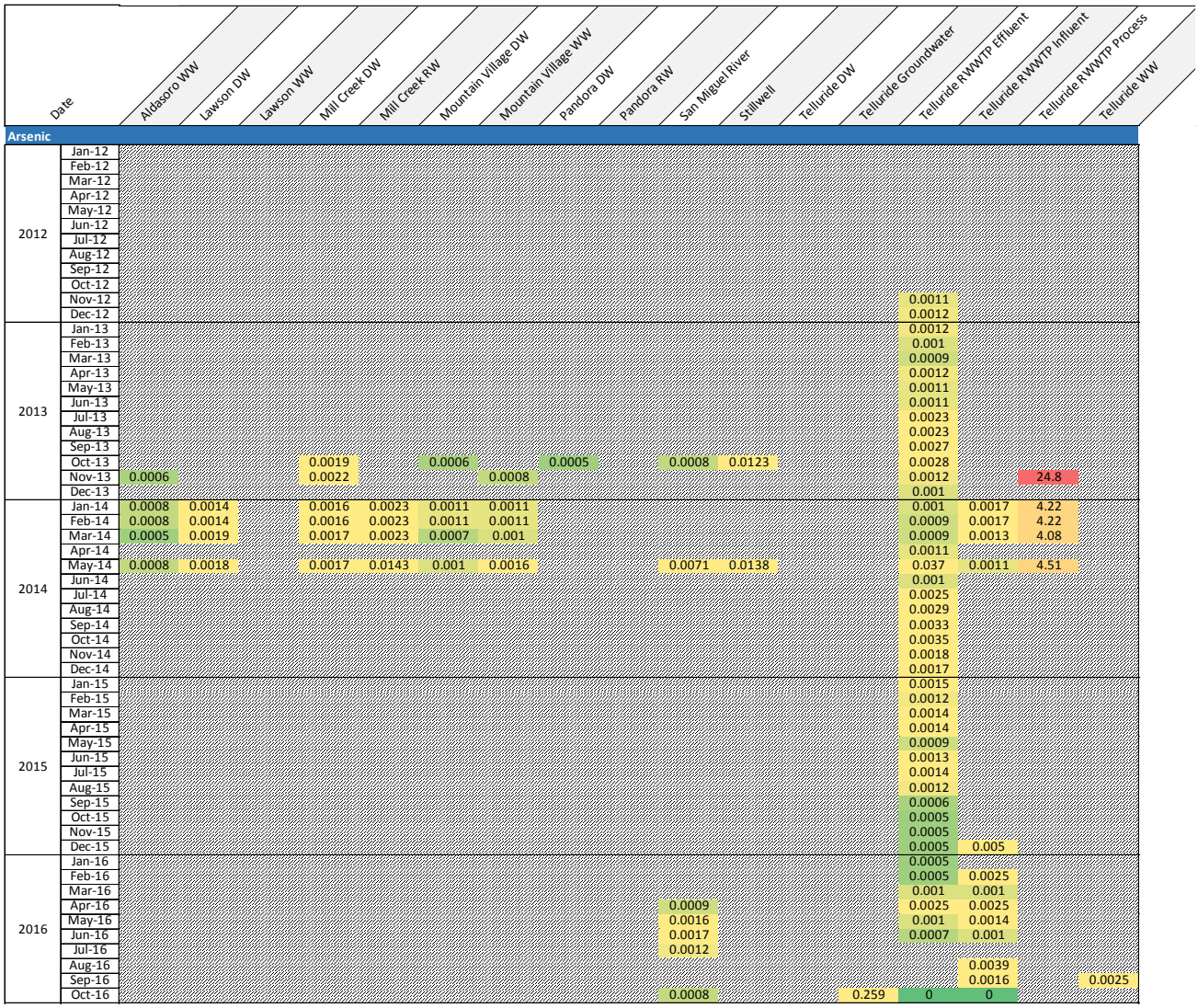
Note that the TRWWTP Process group contains a variety of samples including sludge, dry lime (chemical added to increase alkalinity) and several return flows that may indicate an internal source being returned to the head of the plant.

Table 2.5 GIS Groups: Sample Site and Count Summary

GIS Group Name	Sample Site Count	Year				
		2012	2013	2014	2015	2016
1. Aldasoro WW	3		7	7	3	
2. Lawson DW	3				3	
3. Lawson WW	2			4	3	
4. Mill Creek DW	5		11	8	2	
5. Mill Creek RW	3			8	2	
6. Mountain Village DW	3		11	5	1	
7. Mountain Village WW	11		1	5	11	
8. Pandora DW	2				2	
9. Pandora RW	7		10			
10. San Miguel River	9		11	3	8	34
11. Stillwell	2		10	1		
12. Telluride DW	1				1	
13. Telluride Groundwater	2					4
14. Telluride RWWTP Effluent	5	45	142	75	107	47
15. Telluride RWWTP Influent	13			7	12	28
16. Telluride RWWTP Process	6		1	7	7	
17. Telluride WW	7				4	7
Grand Total	**84**	**45**	**204**	**130**	**166**	**120**

Monthly maximum sampling data was then created through pivot analysis for the GIS Groups for the parameters of concern. Conditional formatting was applied on a 'per parameter' basis using gradations of red-amber-green to show highest to lowest values, respectively. The result is a color-coded table highlighting in which GIS Group(s) elevated metals are occurring.

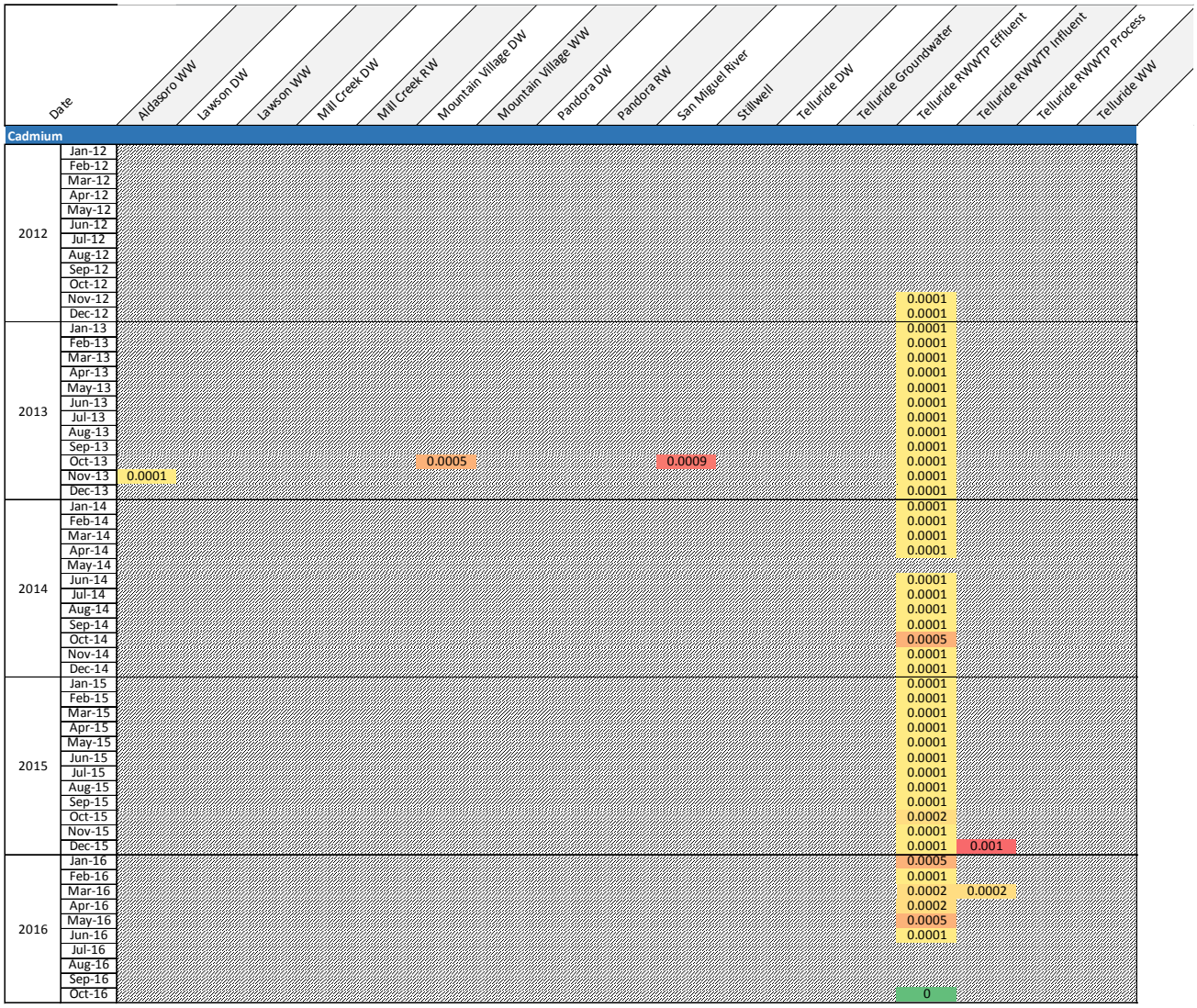
Results of this exercise for Arsenic, Cadmium, Chromium VI, Copper, Lead, Selenium and Zinc are shown in Figures 2.1 – 2.7, respectively. Note that the values presented in the figures are maximum values obtained from the group for each month. They do not necessarily indicate values over the future effluent limits.



Arsenic	Date	Aldasoro WW	Lawson DW	Lawson WW	Mill Creek DW	Mill Creek RW	Mountain Village DW	Mountain Village WW	Pandora DW	Pandora RW	San Miguel River	Stillwell	Telluride DW	Telluride Groundwater	Telluride RWWTP Effluent	Telluride RWWTP Influent	Telluride RWWTP Process	Telluride WW
2012	Jan-12																	
	Feb-12																	
	Mar-12																	
	Apr-12																	
	May-12																	
	Jun-12																	
	Jul-12																	
	Aug-12																	
	Sep-12																	
	Oct-12																	
	Nov-12													0.0011				
	Dec-12													0.0012				
2013	Jan-13													0.0012				
	Feb-13													0.001				
	Mar-13													0.0009				
	Apr-13													0.0012				
	May-13													0.0011				
	Jun-13													0.0011				
	Jul-13													0.0023				
	Aug-13													0.0023				
	Sep-13													0.0027				
	Oct-13				0.0019		0.0006		0.0005		0.0008	0.0123		0.0028				
	Nov-13	0.0006			0.0022			0.0008						0.0012		24.8		
	Dec-13													0.001				
2014	Jan-14	0.0008	0.0014		0.0016	0.0023	0.0011	0.0011						0.001	0.0017	4.22		
	Feb-14	0.0008	0.0014		0.0016	0.0023	0.0011	0.0011						0.0009	0.0017	4.22		
	Mar-14	0.0005	0.0019		0.0017	0.0023	0.0007	0.001						0.0009	0.0013	4.08		
	Apr-14													0.0011				
	May-14	0.0008	0.0018		0.0017	0.0143	0.001	0.0016			0.0071	0.0138		0.037	0.0011	4.51		
	Jun-14													0.001				
	Jul-14													0.0025				
	Aug-14													0.0029				
	Sep-14													0.0033				
	Oct-14													0.0035				
	Nov-14													0.0018				
	Dec-14													0.0017				
2015	Jan-15													0.0015				
	Feb-15													0.0012				
	Mar-15													0.0014				
	Apr-15													0.0014				
	May-15													0.0009				
	Jun-15													0.0013				
	Jul-15													0.0014				
	Aug-15													0.0012				
	Sep-15													0.0006				
	Oct-15													0.0005				
	Nov-15													0.0005				
	Dec-15													0.0005	0.005			
2016	Jan-16													0.0005				
	Feb-16													0.0005	0.0025			
	Mar-16													0.001	0.001			
	Apr-16										0.0009			0.0025	0.0025			
	May-16										0.0016			0.001	0.0014			
	Jun-16										0.0017			0.0007	0.001			
	Jul-16										0.0012							
	Aug-16														0.0039			
	Sep-16														0.0016			0.0025
	Oct-16										0.0008		0.259	0	0			

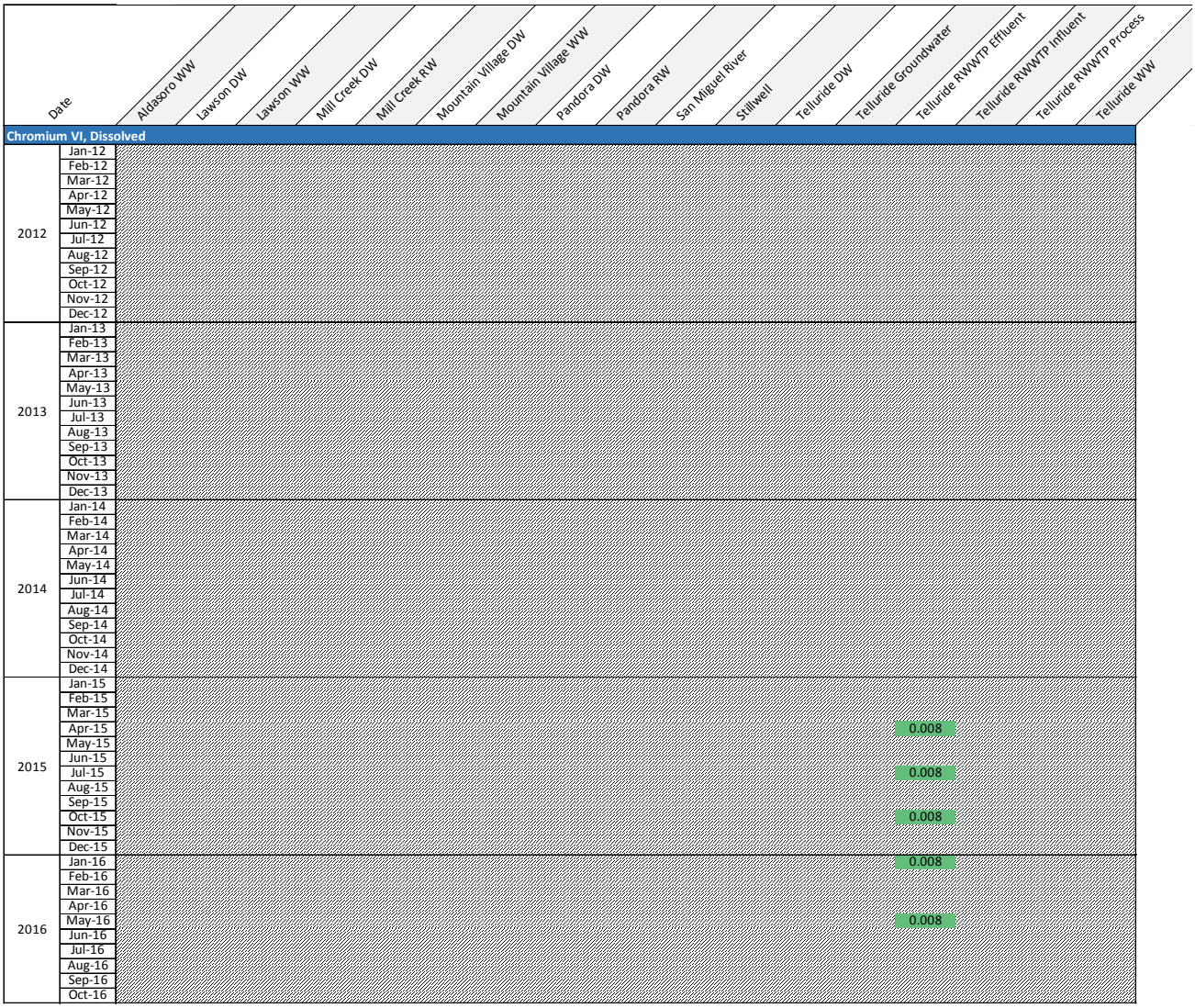
Figure 2.1 GIS Group Analysis: Arsenic Data

The high value from the 'Process' group has units mg/kg. Lime addition and return flows from thickening sludge may be impacting effluent water quality.



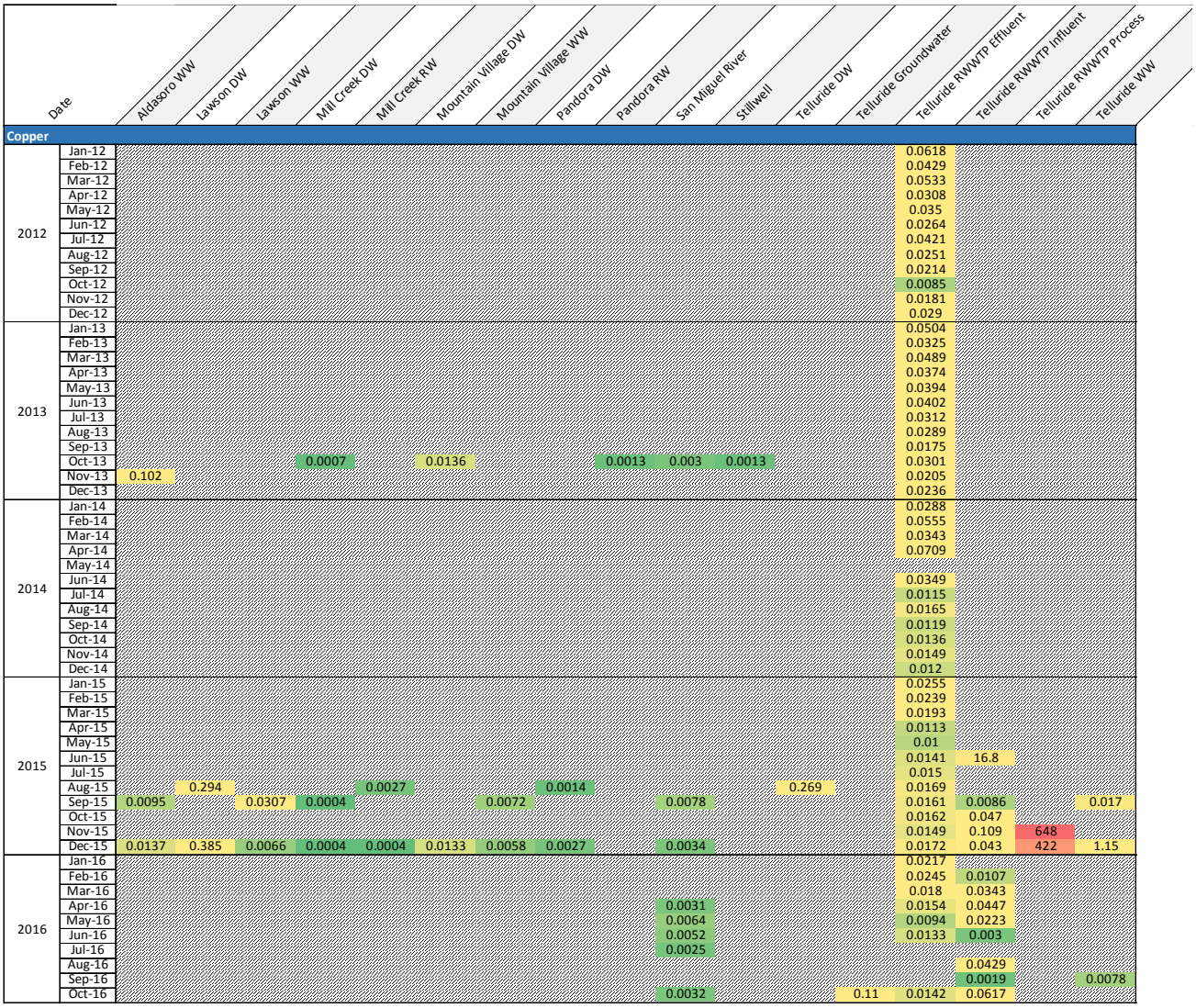
Date	Aldasoro WW	Lawson DW	Lawson WW	Mill Creek DW	Mill Creek RW	Mountain Village DW	Mountain Village WW	Pandora DW	Pandora RW	San Miguel River	Stillwell	Telluride DW	Telluride Groundwater	Telluride RWWTP Effluent	Telluride RWWTP Influent	Telluride RWWTP Process	Telluride WW
Cadmium																	
2012 Jan-12																	
2012 Feb-12																	
2012 Mar-12																	
2012 Apr-12																	
2012 May-12																	
2012 Jun-12																	
2012 Jul-12																	
2012 Aug-12																	
2012 Sep-12																	
2012 Oct-12																	
2012 Nov-12																	
2012 Dec-12													0.0001				
2013 Jan-13													0.0001				
2013 Feb-13													0.0001				
2013 Mar-13													0.0001				
2013 Apr-13													0.0001				
2013 May-13													0.0001				
2013 Jun-13													0.0001				
2013 Jul-13													0.0001				
2013 Aug-13													0.0001				
2013 Sep-13													0.0001				
2013 Oct-13					0.0005				0.0009				0.0001				
2013 Nov-13	0.0001												0.0001				
2013 Dec-13													0.0001				
2014 Jan-14													0.0001				
2014 Feb-14													0.0001				
2014 Mar-14													0.0001				
2014 Apr-14													0.0001				
2014 May-14																	
2014 Jun-14													0.0001				
2014 Jul-14													0.0001				
2014 Aug-14													0.0001				
2014 Sep-14													0.0001				
2014 Oct-14													0.0005				
2014 Nov-14													0.0001				
2014 Dec-14													0.0001				
2015 Jan-15													0.0001				
2015 Feb-15													0.0001				
2015 Mar-15													0.0001				
2015 Apr-15													0.0001				
2015 May-15													0.0001				
2015 Jun-15													0.0001				
2015 Jul-15													0.0001				
2015 Aug-15													0.0001				
2015 Sep-15													0.0001				
2015 Oct-15													0.0002				
2015 Nov-15													0.0001				
2015 Dec-15													0.0001	0.001			
2016 Jan-16													0.0005				
2016 Feb-16													0.0001				
2016 Mar-16													0.0002	0.0002			
2016 Apr-16													0.0002				
2016 May-16													0.0005				
2016 Jun-16													0.0001				
2016 Jul-16																	
2016 Aug-16																	
2016 Sep-16																	
2016 Oct-16													0				

Figure 2.2 GIS Group Analysis: Cadmium Data



Date	Aldasoro WW	Lawson DW	Lawson WW	Mill Creek DW	Mill Creek RW	Mountain Village DW	Mountain Village WW	Pandora DW	Pandora RW	San Miguel River	Stillwell	Telluride DW	Telluride Groundwater	Telluride RWWTP Effluent	Telluride RWWTP Influent	Telluride RWWTP Process	Telluride WW
Chromium VI, Dissolved																	
2012	Jan-12																
	Feb-12																
	Mar-12																
	Apr-12																
	May-12																
	Jun-12																
	Jul-12																
	Aug-12																
	Sep-12																
	Oct-12																
	Nov-12																
	Dec-12																
2013	Jan-13																
	Feb-13																
	Mar-13																
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2014	Jan-14																
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	Mar-14																
	Apr-14																
	May-14																
	Jun-14																
	Jul-14																
	Aug-14																
	Sep-14																
	Oct-14																
	Nov-14																
	Dec-14																
2015	Jan-15																
	Feb-15																
	Mar-15																
	Apr-15												0.008				
	May-15																
	Jun-15												0.008				
	Jul-15																
	Aug-15																
	Sep-15												0.008				
	Oct-15																
	Nov-15																
	Dec-15																
2016	Jan-16												0.008				
	Feb-16																
	Mar-16																
	Apr-16																
	May-16												0.008				
	Jun-16																
	Jul-16																
	Aug-16																
	Sep-16																
	Oct-16																

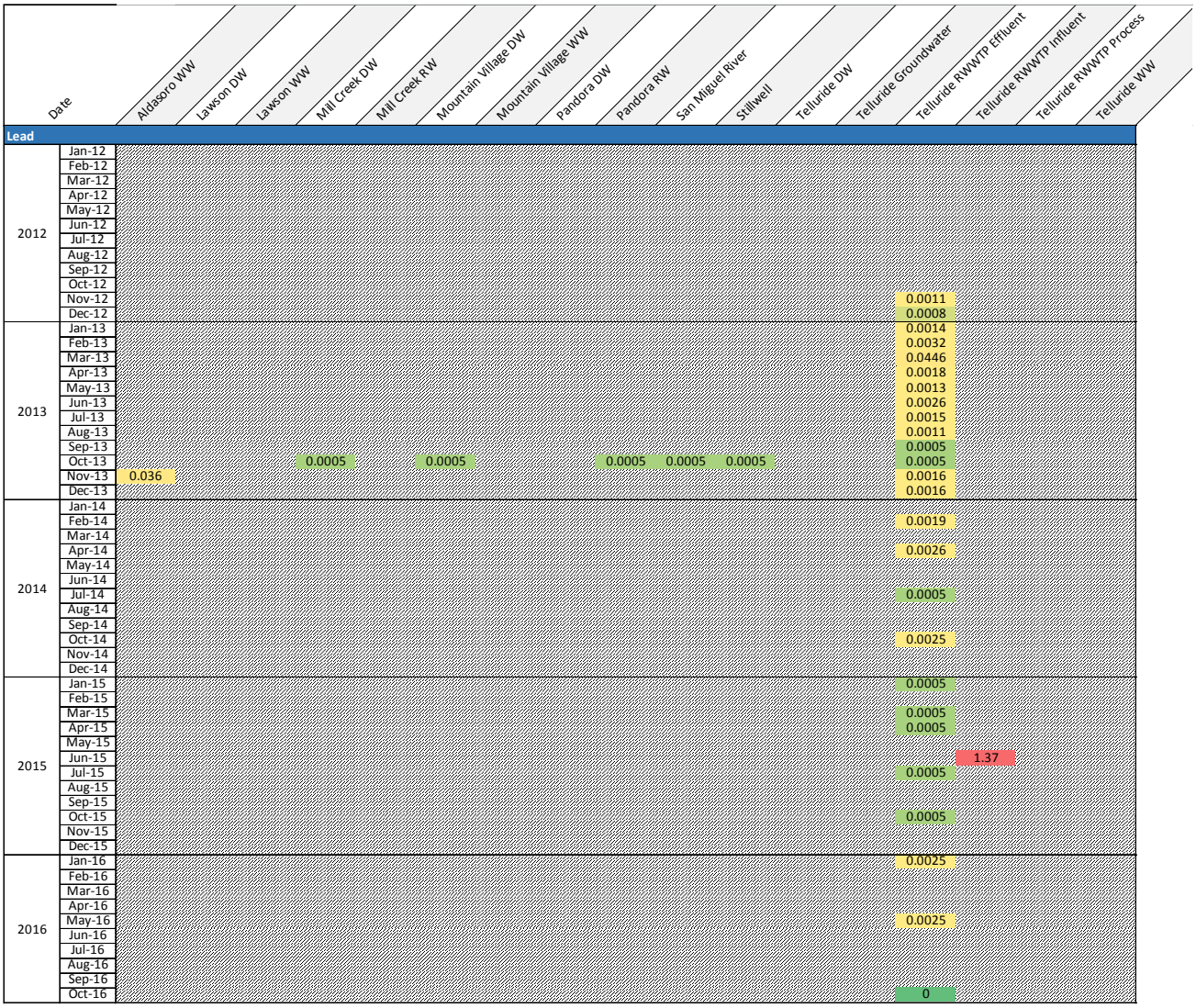
Figure 2.3 GIS Group Analysis: Chromium VI Data



Date	Aldasoro WW	Lawson DW	Lawson WW	Mill Creek DW	Mill Creek RW	Mountain Village DW	Mountain Village WW	Pandora DW	Pandora RW	San Miguel River	Stillwell	Telluride DW	Telluride Groundwater	Telluride RWWTP Effluent	Telluride RWWTP Influent	Telluride RWWTP Process	Telluride WW
Copper																	
2012 Jan-12													0.0618				
2012 Feb-12													0.0429				
2012 Mar-12													0.0533				
2012 Apr-12													0.0308				
2012 May-12													0.035				
2012 Jun-12													0.0264				
2012 Jul-12													0.0421				
2012 Aug-12													0.0251				
2012 Sep-12													0.0214				
2012 Oct-12													0.0085				
2012 Nov-12													0.0181				
2012 Dec-12													0.029				
2013 Jan-13													0.0504				
2013 Feb-13													0.0325				
2013 Mar-13													0.0489				
2013 Apr-13													0.0374				
2013 May-13													0.0394				
2013 Jun-13													0.0402				
2013 Jul-13													0.0312				
2013 Aug-13													0.0289				
2013 Sep-13													0.0175				
2013 Oct-13				0.0007		0.0136			0.0013	0.003	0.0013		0.0301				
2013 Nov-13	0.102												0.0205				
2013 Dec-13													0.0236				
2014 Jan-14													0.0288				
2014 Feb-14													0.0555				
2014 Mar-14													0.0343				
2014 Apr-14													0.0709				
2014 May-14																	
2014 Jun-14													0.0349				
2014 Jul-14													0.0115				
2014 Aug-14													0.0165				
2014 Sep-14													0.0119				
2014 Oct-14													0.0136				
2014 Nov-14													0.0149				
2014 Dec-14													0.012				
2015 Jan-15													0.0255				
2015 Feb-15													0.0239				
2015 Mar-15													0.0193				
2015 Apr-15													0.0113				
2015 May-15													0.01				
2015 Jun-15													0.0141	16.8			
2015 Jul-15													0.015				
2015 Aug-15		0.294			0.0027		0.0014					0.269	0.0169				
2015 Sep-15	0.0095		0.0307	0.0004		0.0072			0.0078				0.0161	0.0086		0.017	
2015 Oct-15													0.0162	0.047			
2015 Nov-15													0.0149	0.109	648		
2015 Dec-15	0.0137	0.385	0.0066	0.0004	0.0004	0.0133	0.0058	0.0027	0.0034				0.0172	0.043	422	1.15	
2016 Jan-16													0.0217				
2016 Feb-16													0.0245	0.0107			
2016 Mar-16													0.018	0.0343			
2016 Apr-16									0.0031				0.0154	0.0447			
2016 May-16									0.0064				0.0094	0.0223			
2016 Jun-16									0.0052				0.0133	0.003			
2016 Jul-16									0.0025								
2016 Aug-16														0.0429			
2016 Sep-16														0.0019		0.0078	
2016 Oct-16									0.0032			0.11	0.0142	0.0617			

Figure 2.4 GIS Group Analysis: Copper Data

The high values in the 'Process' group are related to sludge testing.



Lead	Date	Aldasoro WW	Lawson DW	Lawson WW	Mill Creek DW	Mill Creek RW	Mountain Village DW	Mountain Village WW	Pandora DW	Pandora RW	San Miguel River	Stillwell	Telluride DW	Telluride Groundwater	Telluride RWWTP Effluent	Telluride RWWTP Influent	Telluride RWWTP Process	Telluride WW
2012	Jan-12																	
	Feb-12																	
	Mar-12																	
	Apr-12																	
	May-12																	
	Jun-12																	
	Jul-12																	
	Aug-12																	
	Sep-12																	
	Oct-12																	
	Nov-12													0.0011				
	Dec-12													0.0008				
2013	Jan-13													0.0014				
	Feb-13													0.0032				
	Mar-13													0.0446				
	Apr-13													0.0018				
	May-13													0.0013				
	Jun-13													0.0026				
	Jul-13													0.0015				
	Aug-13													0.0011				
	Sep-13													0.0005				
	Oct-13			0.0005		0.0005			0.0005	0.0005	0.0005			0.0005				
	Nov-13	0.036												0.0016				
	Dec-13													0.0016				
2014	Jan-14																	
	Feb-14													0.0019				
	Mar-14																	
	Apr-14													0.0026				
	May-14																	
	Jun-14																	
	Jul-14													0.0005				
	Aug-14																	
	Sep-14																	
	Oct-14													0.0025				
	Nov-14																	
	Dec-14																	
2015	Jan-15													0.0005				
	Feb-15																	
	Mar-15													0.0005				
	Apr-15													0.0005				
	May-15																	
	Jun-15														1.37			
	Jul-15													0.0005				
	Aug-15																	
	Sep-15																	
	Oct-15													0.0005				
	Nov-15																	
	Dec-15																	
2016	Jan-16													0.0025				
	Feb-16																	
	Mar-16																	
	Apr-16																	
	May-16													0.0025				
	Jun-16																	
	Jul-16																	
	Aug-16																	
	Sep-16																	
	Oct-16													0				

Figure 2.5 GIS Group Analysis: Lead Data

The high value in the 'Influent' group is from the High School boiler sample.

Date	Aldasoro WW	Lawson DW	Lawson WW	Mill Creek DW	Mill Creek RW	Mountain Village DW	Mountain Village WW	Pandora DW	Pandora RW	San Miguel River	Stillwell	Telluride DW	Telluride Groundwater	Telluride RWWTP Effluent	Telluride RWWTP Influent	Telluride RWWTP Process	Telluride WW
Selenium																	
2012 Jan-12																	
2012 Feb-12																	
2012 Mar-12																	
2012 Apr-12																	
2012 May-12																	
2012 Jun-12																	
2012 Jul-12																	
2012 Aug-12																	
2012 Sep-12																	
2012 Oct-12																	
2012 Nov-12														0.001			
2012 Dec-12														0.001			
2013 Jan-13														0.001			
2013 Feb-13														0.001			
2013 Mar-13														0.001			
2013 Apr-13														0.001			
2013 May-13														0.001			
2013 Jun-13														0.001			
2013 Jul-13														0.001			
2013 Aug-13														0.001			
2013 Sep-13														0.001			
2013 Oct-13			0.001		0.001			0.001	0.001	0.001				0.001			
2013 Nov-13	0.001													0.001			
2013 Dec-13														0.001			
2014 Jan-14																	
2014 Feb-14														0.001			
2014 Mar-14																	
2014 Apr-14														0.001			
2014 May-14																	
2014 Jun-14																	
2014 Jul-14														0.001			
2014 Aug-14																	
2014 Sep-14																	
2014 Oct-14														0.005			
2014 Nov-14																	
2014 Dec-14																	
2015 Jan-15														0.001			
2015 Feb-15																	
2015 Mar-15														0.001			
2015 Apr-15														0.001			
2015 May-15																	
2015 Jun-15																	
2015 Jul-15														0.001			
2015 Aug-15																	
2015 Sep-15																	
2015 Oct-15														0.001			
2015 Nov-15																	
2015 Dec-15																	
2016 Jan-16														0.0189			
2016 Feb-16																	
2016 Mar-16																	
2016 Apr-16																	
2016 May-16														0.005			
2016 Jun-16																	
2016 Jul-16																	
2016 Aug-16																	
2016 Sep-16																	

Figure 2.6 GIS Group Analysis: Selenium Data

Date	Aldasoro WW	Lawson DW	Lawson WW	Mill Creek DW	Mill Creek RW	Mountain Village DW	Mountain Village WW	Pandora DW	Pandora RW	San Miguel River	Stillwell	Telluride DW	Telluride Groundwater	Telluride RWWTP Effluent	Telluride RWWTP Influent	Telluride RWWTP Process	Telluride WW
Zinc																	
2012 Jan-12																	
2012 Feb-12																	
2012 Mar-12																	
2012 Apr-12																	
2012 May-12																	
2012 Jun-12																	
2012 Jul-12																	
2012 Aug-12																	
2012 Sep-12																	
2012 Oct-12																	
2012 Nov-12																	
2012 Dec-12													0.0456				
2013 Jan-13													0.0581				
2013 Feb-13													0.0733				
2013 Mar-13													0.117				
2013 Apr-13													0.121				
2013 May-13													0.0658				
2013 Jun-13													0.0773				
2013 Jul-13													0.0793				
2013 Aug-13													0.0725				
2013 Sep-13													0.052				
2013 Oct-13			0.0037		0.005				0.0242	0.296	0.0567		0.0445				
2013 Nov-13	0.129												0.0608				
2013 Dec-13													0.0642				
2014 Jan-14													0.0488				
2014 Feb-14													0.0576				
2014 Mar-14																	
2014 Apr-14													0.0778				
2014 May-14																	
2014 Jun-14																	
2014 Jul-14													0.0529				
2014 Aug-14																	
2014 Sep-14																	
2014 Oct-14													0.0623				
2014 Nov-14																	
2014 Dec-14																	
2015 Jan-15													0.0706				
2015 Feb-15																	
2015 Mar-15													0.058				
2015 Apr-15													0.0611				
2015 May-15																	
2015 Jun-15										0.466							
2015 Jul-15													0.0532				
2015 Aug-15																	
2015 Sep-15										0.192							
2015 Oct-15													0.0466				
2015 Nov-15																	
2015 Dec-15																	
2016 Jan-16													0.055				
2016 Feb-16																	
2016 Mar-16																	
2016 Apr-16										0.2							
2016 May-16										0.372			0.034				
2016 Jun-16										0.316							
2016 Jul-16										0.314							
2016 Aug-16																	
2016 Sep-16																	
2016 Oct-16													0.0581				

Figure 2.7 GIS Group Analysis: Zinc Data

2.6.2 Data Analysis Conclusions

Conclusions regarding the source of metals to the TRWWTP are summarized in **Table 2.6**.

Table 2.6 Conclusions of Sources of Metals

Parameter	Conclusions
Arsenic Limit set at 0.000076 mg/L was retracted	• Groundwater from utility construction dewatering samples in Telluride show high levels up to 0.26 mg/L. Infiltration & inflow to collection system could be prominent source of high arsenic levels entering the TRWWTP. • Stillwell and Cornet Creek water source have Arsenic levels up to 0.01 mg/L. • Levels within the wastewater collections system and at the TRWWTP effluent (range of 0.001 – 003 mg/L) are generally lower than background levels within Cornet Creek and Mill Creek (up to 0.014 mg/L).
Cadmium Limit set at 0.00056 mg/L	• Historical data indicates very low concentration of cadmium from all sampling locations (generally beneath analysis limit of detection). • Several recent TRWWTP effluent samples (Oct 2015 – present) have shown low level detections in the range 0.0002 – 0.0005 mg/L, which is consistent with one drinking water sample observed in Mtn. Village. • One sample from San Miguel River at Society Turn Bridge (2013) at 0.0009 mg/L.
Copper Limit set at 0.018 mg/L	• Raw and treated drinking water samples prior to distribution (Mill Creek WTP, Pandora WTP, Stillwell and Mtn. Village wells) have low levels (<0.003 mg/L) • Sampling at customer taps show elevated copper (~0.013 mg/L in Mtn. Village and in Telluride up to 0.38 mg/L) compared to treated water, indicating an increase from the WTP, which is attributed to copper leaching from domestic plumbing. • Boiler system discharges (up to 16.8 mg/L) and septage sampling (0.002 – 0.04 mg/L) indicate high levels of intermittent sources of copper entering the TRWWTP. • Wastewater collection system sampling of interceptors from Telluride, Mtn. Village, Lawson Hill and Aldasoro indicate significant variability over time. **Example:** RWWTP influent and effluent copper compared to levels from sources. TRWWTP Effluent = 0.0217 mg/L 1/20/2016 TRWWTP Influent, headworks = 0.043 mg/L 12/29/2015 TRWWTP Influent, Raw Lift Station = 0.0034 12/29/2015 Aldasoro Interceptor = 0.0137 mg/L 12/29/2015 Lawson Interceptor = 0.0066 mg/L 12/29/2015 Mtn. Village Interceptor = 0.0058 mg/L 12/29/2015 Telluride Interceptor = 0.0025 mg/L 12/29/2015 Excluding the Aldasoro collection system, these sources show low copper levels in spite of the high copper tested in residential drinking water taps on the same day. Likely source: <u>Boiler drain waste sample tested at the TRWWTP had copper at 1.15 mg/L on 12/29/2015.</u>
Chromium VI	• All samples tested at 0.008 mg/L (detection limit); new limit set at 0.010 mg/L.

Parameter	Conclusions
Lead Limit set at 0.0062 mg/L	• No tap water samples available; however, a possible source of lead is leaching from older properties containing lead-bearing plumbing elements. • Boiler water sample had a high result of 1.37 mg/L, indicating the potential for elevated contributions. • Aldasoro interceptor tested high at 0.036 mg/L on 11/5/2013 • WWTP effluent discharge results generally below lead limit; one outlier at 0.045 mg/L on 3/5/2013.
Selenium Limit set at 0.006 mg/L	• Historical data indicates very low concentrations of selenium (less than analysis limit of detection). • Note that two samples in 2016 (Jan and May) are close to or over the new limit.
Zinc Limit set at 0.190 mg/L	• Pandora raw water (tested at diversion or Falls Crest in 2007 & 2008) contributed levels of zinc of 0.07 – 0.15 mg/L; similar levels have been detected in the collection system. • Aldadoro interceptor test on 11/5/2013 had zinc at 0.129 mg/L • WWTP effluent is consistently beneath 0.08 mg/L for past 3 years.

2.7 ABILITY OF TRWWTP TO MEET METALS FINAL LIMITATIONS

The purpose of this section is to review the anticipated ability of the TRWWTP to meet the Metals Final Limitations. Plots of the available TRWWTP influent and effluent data for each metals parameter are presented herein, with the relevant Metals Final Limitations highlighted for reference.

2.7.1 Arsenic

Figure 2.8 shows a plot of the available TRWWTP influent and effluent arsenic data over time. Note that the January 2017 Effluent Limitations Maximum Concentration originally proposed at 0.000076 mg/L was removed from the compliance schedule. It is likely that a numeric limit will be included in the next permit renewal cycle.

The TRWWTP is not currently able to meet an effluent arsenic limit below 0.001 mg/L without additional treatment.

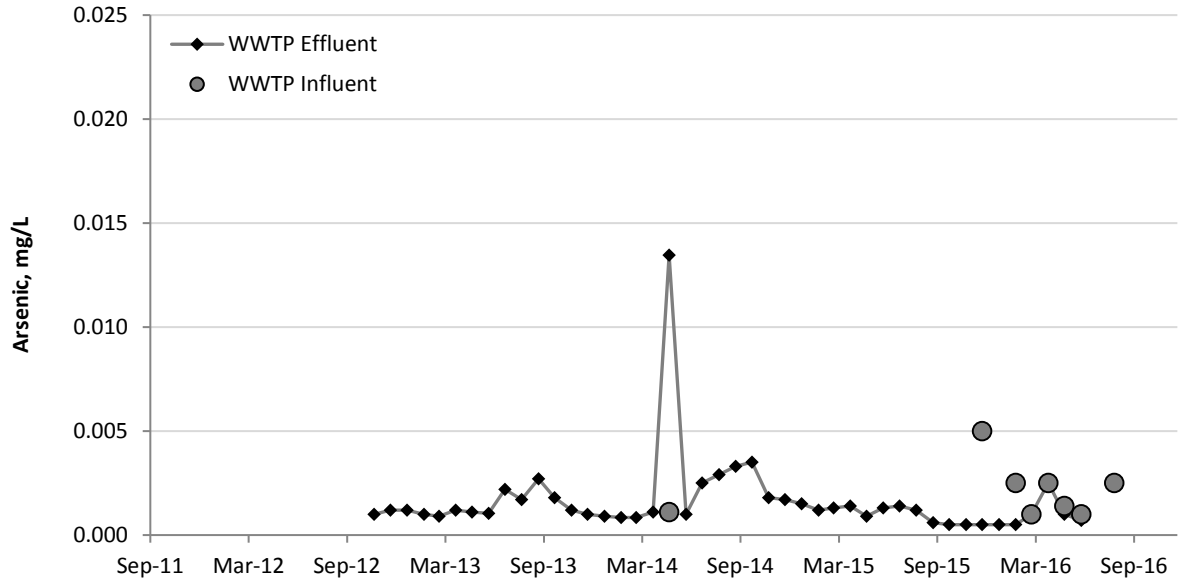


Figure 2.8 TRWWTP Arsenic Data

2.7.2 Cadmium

Figure 2.9 shows a plot of the available TRWWTP influent and effluent cadmium data over time, with the January 2017 Effluent Limitations Maximum Concentration indicated for reference.

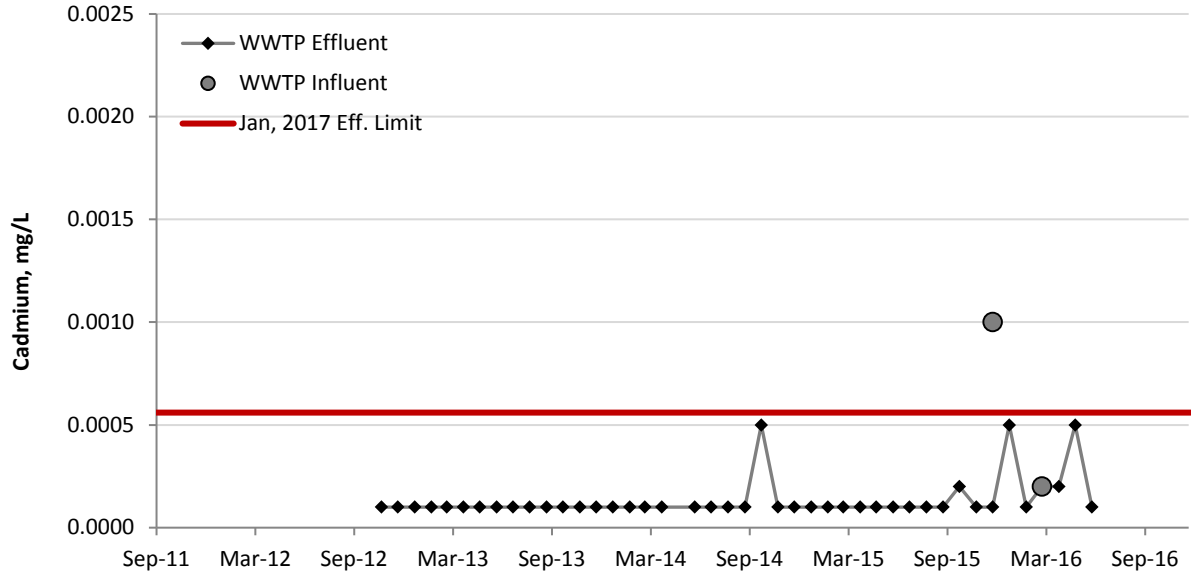


Figure 2.9 TRWWTP Cadmium Data

NOTE: Upon review of the sampling results, much of the variation in effluent cadmium data appears to correspond with the lab analysis detection limits, either 0.0001 or 0.0005 mg/L.

2.7.3 Copper

Figure 2.10 shows a plot of the available TRWWTP influent and effluent copper data over time, with the January 2017 Effluent Limitations Maximum Concentration indicated for reference.

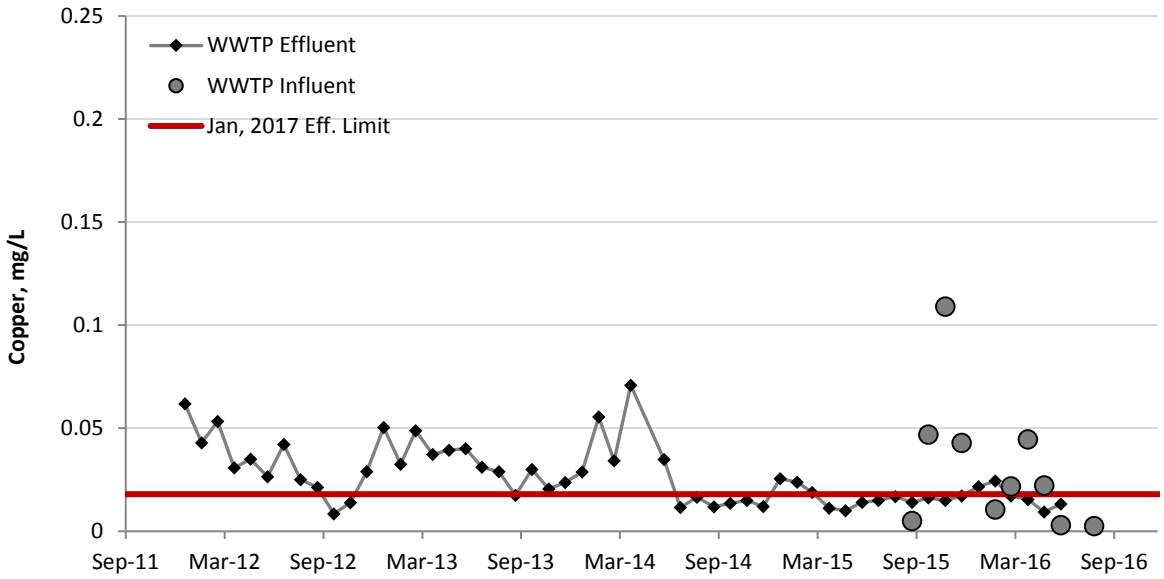


Figure 2.10 TRWWTP Copper Data

A seasonal variation of copper in the wastewater effluent is apparent with spikes occurring in the winter months. Potential causes could be that wastewater treatment processes are impacted by colder temperatures or that influent copper is more concentrated during that period each year. Effluent copper levels have decreased since 2014 but are not consistently below the new effluent limit of 0.018 mg/L.

2.7.4 Chromium VI

Figure 2.11 shows a plot of the available TRWWTP effluent chromium VI data over time, with the January 2017 Effluent Limitations Maximum Concentration indicated for reference.

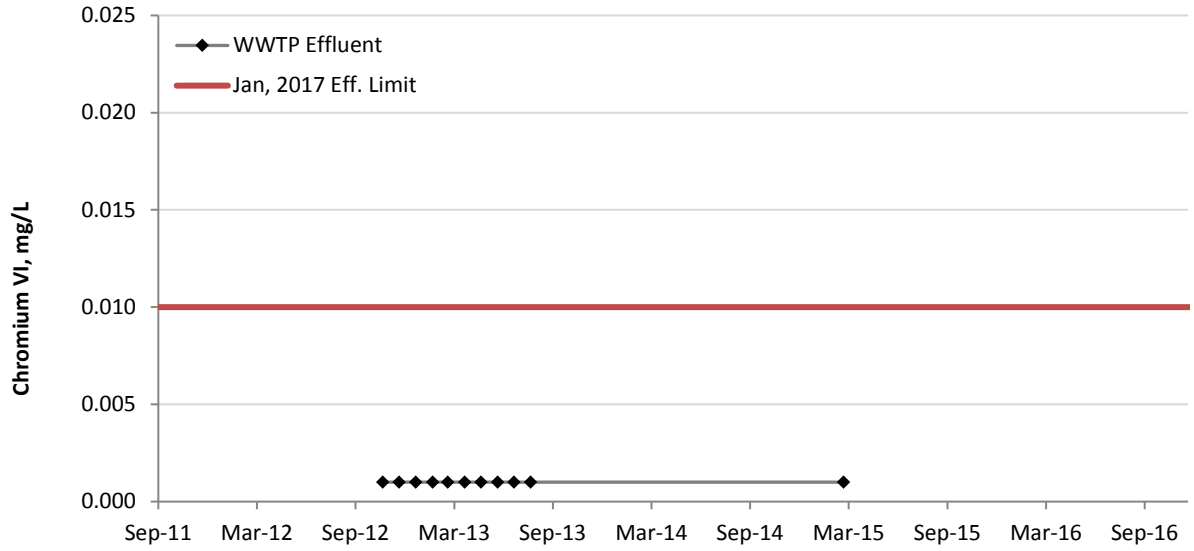


Figure 2.11 TRWWTP Chromium VI Data

2.7.5 Lead

Figure 2.12 shows a plot of the available TRWWTP effluent lead data over time, with the January 2017 Effluent Limitations Maximum Concentration indicated for reference.

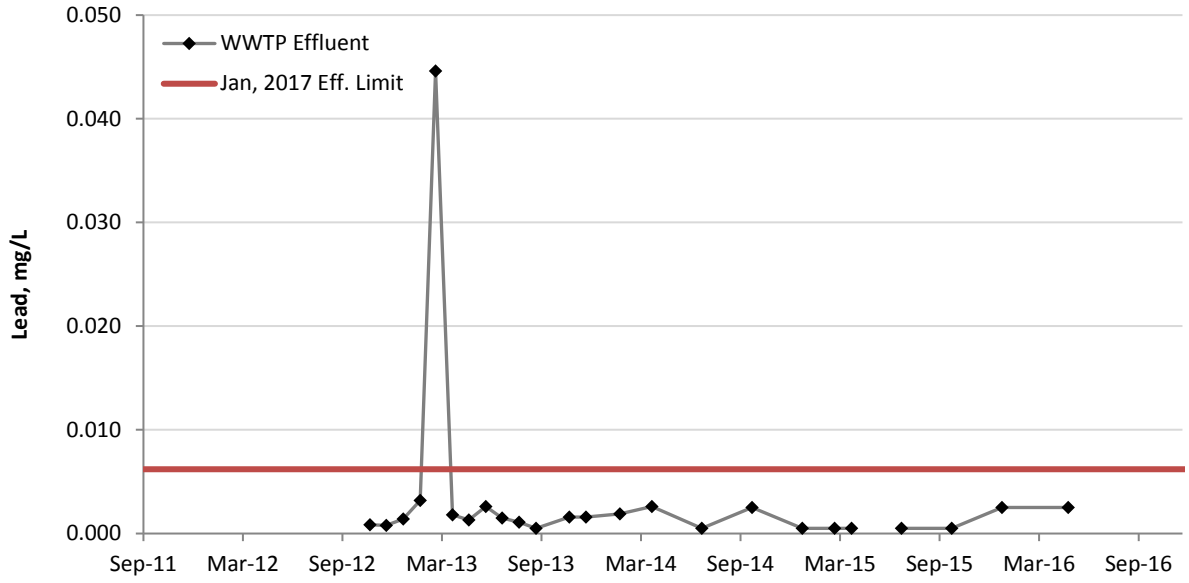


Figure 2.12 TRWWTP Lead Data

The single point above the limit on March 2013 is considered an outlier as all others show compliance.

2.7.6 Selenium

Figure 2.13 shows a plot of the available TRWWTP effluent selenium data over time, with the January 2017 Effluent Limitations Maximum Concentration indicated for reference.

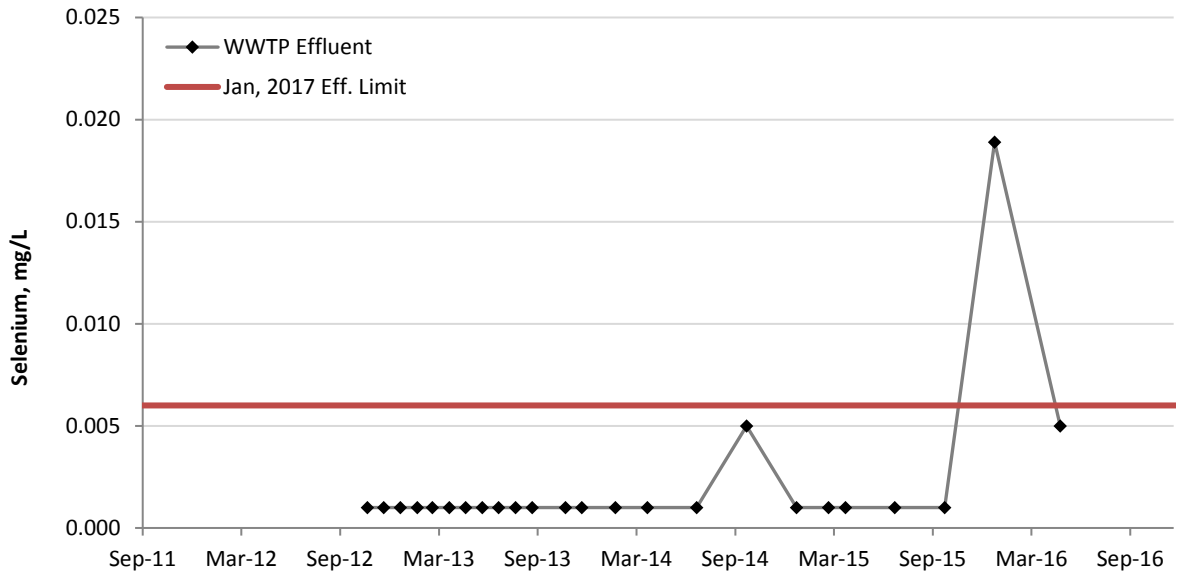


Figure 2.13 TRWWTP Selenium Data

Selenium in the wastewater effluent is typically at or below the detection limit of the lab analysis. The one sample in 2016 testing above the numeric standard of 0.006 mg/L could be an anomaly or an error in analysis. Selenium in the effluent is being closely monitored to determine if further action is needed.

2.7.7 Zinc

Figure 2.14 shows a plot of the available TRWWTP effluent zinc data over time, with the January 2017 Effluent Limitations Maximum Concentration indicated for reference.

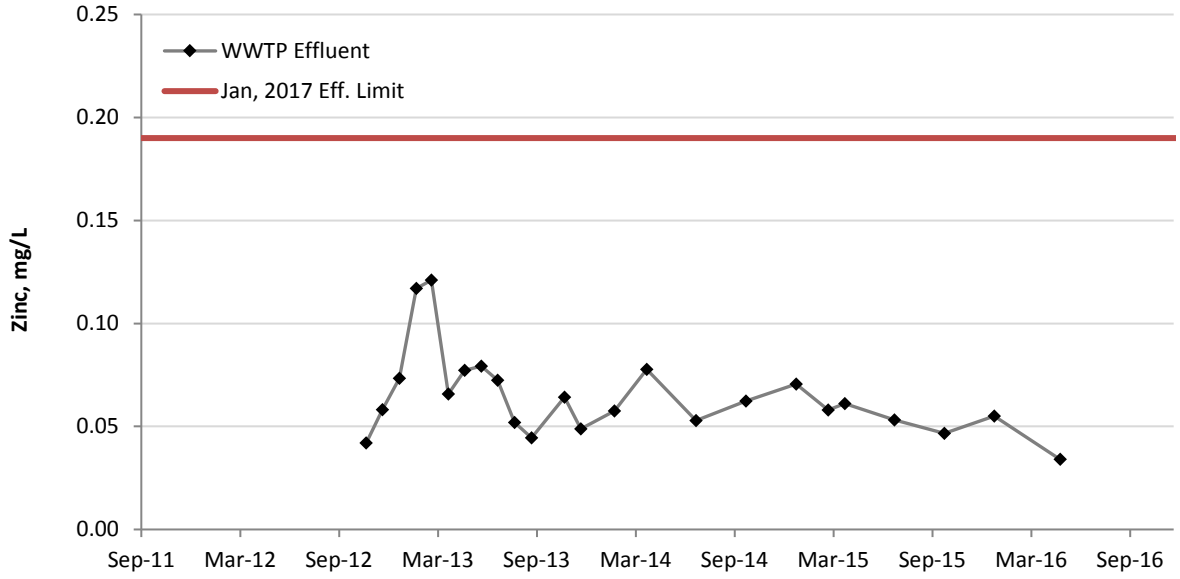


Figure 2.14 TRWWTP Zinc Data

2.7.8 Summary

The following metals are present in the TRWWTP effluent at historical concentrations less than the January 2017 limits:

- Chromium VI
- Cadmium
- Lead (the TRWWTP discharge effluent value of 0.045 mg/L lead reported in March 2013 is considered an anomalous outlier)
- Zinc

  Note: Arsenic was modified to a 'report only' requirement

The following parameters are present in the TRWWTP effluent at historical concentrations that can exceed the January 2017 limits, and are therefore carried forward for further analysis:

- Copper
- Selenium

A review was undertaken to establish what are 'typical' levels of copper and selenium in wastewater. Of the various citations reviewed, the most comprehensive and peer reviewed source was *Biological Wastewater Treatment: Principles Modelling and Design, 2008* published by IWA Publishing, London, UK, which provides typical wastewater characterization data as

reproduced in **Table 2.7** to show the metals data as pertinent to this study, along comparative data from the Telluride Regional wastewater treatment system.

Table 2.7 Typical Content of Metals in Municipal Wastewater with Minor Contributions of Industrial Wastewater

Metal	High (mg/L)	Medium (mg/L)	Low (mg/L)	TRWWTP Influent Range
Cadmium	0.004	0.002	0.001	Max = 0.001 mg/L Avg. = 0.0005 mg/L (n = 3)
Chromium	0.040	0.025	0.010	All data = 0.001 mg/L
Copper	0.100	0.070	0.030	Max = 0.045 mg/L Avg. = 0.029 mg/L (n = 14)
Lead	0.080	0.060	0.025	Aldasoro = 0.036 mg/L (n = 1)
Zinc	0.300	0.200	0.100	Aldasoro = 0.129 mg/L (n = 1)

Table Notes
1. Source: Biological Wastewater Treatment: Principles Modelling and Design, 2008
2. No data was available for Selenium typical ranges in wastewater.

2.8 REVIEW OF ALTERNATIVES TO ELIMINATE SOURCE OR REMOVE BY TREATMENT

The purpose of this section is to provide an overview of TRWWTP treatment alternatives for copper and selenium, which were identified as parameters that could exceed the January 2017 TRWWTP Permit Effluent Limitations Maximum Concentration.

2.8.1 Copper

Copper levels in the TRWWTP influent are on the low end of the spectrum of typical domestic wastewater characteristics. Opportunities to reduce copper levels in the collection systems are limited as testing did not identify any areas having high concentrations. The exception is for intermittent waste streams for maintenance of boilers commonly used in building heating systems. The drinking water system could potentially reduce copper levels by enhanced corrosion control. The Town has requested a modification of the CDPS permit compliance schedule to allow more time to determine what enhancements are needed.

2.8.1.1 Reduce Copper Levels in Water System

Enhancing the existing pH control program and potentially adding alkalinity could reduce copper leaching from domestic plumbing systems. Telluride has two primary water treatment plants that receive different water sources. These sources are characteristically low in alkalinity. The current program uses caustic soda to raise the pH to 8.5 but inconsistent pH throughout the

Telluride distribution system is a greater issue that may be contributing to leaching of household plumbing.

2.8.1.2 Eliminate Boiler Water Discharges to the Collection System

It is recommended that the Town of Telluride and the Town of Mountain Village amend their Utility Ordinances to prohibit discharge of boiler water drainage to the collection system. The discharger would be required to notify the TRWWTP for instructions on sampling and testing. Our recommendation is to have the boiler waste hauled to the plant and discharged into a dedicated tank for pH adjustment and precipitation before blending it with the influent wastewater entering the plant.

2.8.1.3 Groundwater Infiltration and Inflow into the Collection System

Limited groundwater data is available but the samples of groundwater from utility maintenance construction trenches show high levels of copper. Approximately 30% of the Telluride wastewater collection pipes are submerged. Samples collected from manholes in Telluride in September 2016 do not indicate high copper. Additional sampling of the Telluride collection system during spring conditions is needed to determine impacts from groundwater.

2.8.1.4 Enhance Copper Removal at TRWWTP

Removal of copper at the wastewater treatment has some merit using a cationic organic/inorganic coagulant added to the aeration basin. Several coagulants have been tested in full-scale plants using sulfide based metal precipitants showing removal of copper to below 1 µg/L in the wastewater effluent. Near-term improvements could include treating a side stream of effluent as needed.

2.8.2 Selenium

Treatment to remove selenium from the wastewater effluent to meet the future limit has many challenges involving specialized processes in controlled environmental conditions. The required conditions can create conflicts in treatment at a high cost. Sludge dewatering can also create problems with selenium recycle.

Influent data for selenium is limited. If effluent test results continue to show increasing levels of selenium, an expanded sampling plan will be needed. It is recommended that additional sampling be conducted at the plant influent, interceptor sewers and from various septage haulers.

2.8.3 Arsenic

The effluent limitation on arsenic is not likely to be issued during the next permit renewal cycle for the TRWWTP in 2018. Stantec recommends waiting until a new limit is established before considering the alternatives for arsenic removal. The US EPA did not approve the Colorado Water Quality Division's standards for arsenic and is conducting new research on arsenic

toxicology. This research is not expected to be completed for several more years. The Colorado Water Quality Control Division would require additional time to establish an arsenic limit for the TRWWTP after the US EPA provides guidance.

The concentration of arsenic entering the TRWWTP ranges from 0.0005 to 0.004 mg/L. The San Miguel River, which is the receiving stream for wastewater effluent, has background levels of arsenic at approximately 0.0005 mg/L.

> "Arsenic compounds cause acute and chronic effects in individuals, populations and communities at concentrations ranging from a few micrograms to milligrams per litre, depending on species, time of exposure and end-points measured. These effects include lethality, inhibition of growth, photosynthesis and reproduction, and behavioural effects. Arsenic-contaminated environments are characterized by limited species abundance and diversity. If levels of arsenate are high enough, only species which exhibit resistance may be present."[1]

Most arsenic treatment systems for municipal use target compliance with the drinking water standard of 0.010 mg/L. Ion exchange is a candidate technology for species of arsenic that are negatively charged, such as As(V). The neutral form, As(III), is not effectively removed by ion exchange without pretreatment with an oxidant. Activated alumina is a sorption process with ion exchange properties that may also be an effective technology. Several other types of media are currently available, such as titanium based media, zirconium based media, and iron based media. (Note: Granular titanium oxide is currently used for drinking water treatment at the Stillwell WTP.) Iron based sorbants are showing promise in emerging arsenic treatment technologies due to the affinity of arsenic to iron. Another option is to add an iron salt such as ferric chloride with alum as part of a coagulation/filtration system. An appropriate treatment strategy should be further investigated after the Town has a better understanding of the timing and level of treatment required.

2.9 RECOMMENDATIONS

The recommended next step is to optimize the corrosion control program in the Telluride water distribution systems in 2017 to limit leaching of copper from plumbing systems, and continue to monitor influent concentrations at the TRWWTP to determine its impacts. The trend for copper shows effluent concentrations decreasing since 2014. Decreasing corrosion is one step to lower the concentrations to meet the future limit. Water samples need to be analyzed for corrosion potential from the distribution systems at Mountain Village and at Aldasoro.

We also recommend the installation of tanks specifically to receive boiler waste and to precipitate metals through pH adjustment. Finally, we recommend that the Town establish pre-treatment requirements for commercial sources, such as brewery waste. Finally, the TRWWTP may need to consider a tertiary treatment process specifically targeting copper removal through precipitation and filtration if copper levels in the effluent exceed permit limit.

[1]Greenfacts, IPCS "Environmental Health Criteria for Arsenic and Arsenic compounds", www.greenfacts.org/en/arsenic/.

3.0 TRWWTP SERVICE AREA AND GROWTH

Growth within the service area of the Telluride Regional Wastewater Treatment Plant has several components that create challenges for planners. The service area includes residents from the towns of Telluride and Mountain Village, Lawson Hill, and portions of unincorporated San Miguel County, which make up a relatively small percentage of the overall contribution of wastewater collected at the plant. The population of visitors to the area during winter and summer has a significant impact to the economy and the infrastructure. Visitors add to the growth of commercial businesses and the service industry. Restaurants, hotels/lodges, and the local brewery have seen significant growth in recent years. This section presents our analysis of flow and loading records from the TRWWTP and our findings to support growth estimates for the planning period.

3.1 SERVICE AREAS

3.1.1 Telluride Service Area

The Town of Telluride's wastewater service area includes the historic downtown area. The year-round population in Telluride in 2016 is reported to be 2,457 people. The US Census in 2010 lists the population for Telluride as 2,325 persons. Annual growth is approximately 0.9% since 2010. Affordable housing project goals for the Town of Telluride would increase the base population at about 1% annually. Growth of the base population of Telluride will likely remain low (1 to 2% annually) over the planning period.

Visitors to the Town of Telluride are housed in hotels, condominiums and residential properties not occupied by year-round residents. The capacity to accommodate visitors in 2017 is estimated using the vacancy rate of housing units, the number of licensed rental units and the capacity of hotels and lodges. For a major event, we assumed 2 persons per available housing unit.

2017 Telluride Resident & Visitor Estimates:

Telluride resident population = 2,457 people

Telluride visitors in available housing units = 3,840 people

Hotels and Lodging capacity = 610

Total Residents + Visitors in Telluride accommodations = 6,907

3.1.2 Mountain Village Service Area

The service area for Mountain Village is well defined with population equivalents for built and unbuilt accommodations. Population estimates for Mountain Village indicate 1,378 year-round

residents currently. The report on the 2011 housing inventory for Mountain Village showed 2,066 units available with a vacancy rate of nearly 64%. Discussions with Mountain Village staff indicate approximately 60% buildout of residential properties and 90% buildout of hotel and condominium properties.

Based on density and land use records for the Town of Mountain Village, the following estimates were developed:

2017 Mountain Village Resident & Visitor Estimates:

Mountain Village resident population = 1,378 people

Mountain Village visitors in available housing units = 2,460 people

Hotels and Lodging capacity = 400

Total Residents + Visitors in Mountain Village accommodations = 4,238

3.1.3 Aldasoro, Lawson Hill and Unincorporated San Miguel County

Outside the Town boundaries, the developed areas of unincorporated San Miguel County within the TRWWTP service area include Hillside, Eider Creek, Aldasoro, and Lawson Hill developments.

2017 Unincorporated County Resident & Visitor Estimates within TRWWTP Service Area:

Unincorporated area resident population = 825 people

Unincorporated area visitors in available housing units =210 people

Total Residents + Visitors in Unincorporated area accommodations = 1,035

3.1.4 Total Estimated Service Area Resident and Visitor Populations

2017 Resident Population = 4,660

2017 Visitor Population = 7,520

Total: 12,180

3.2 POPULATION PROJECTIONS

The 30-year planning period was established for the wastewater treatment plant master plan based on several factors:

1. Near-term improvements will need to allow the TRWWTP to meet the current permit requirements and provide enough time to plan and construct a plant capable of meeting the long-term needs of the community.
2. The compliance schedule for Regulation 85 will require the TRWWTP to meet defined nutrient limits by 2027, which is the best indication for CDPHE's implementation of the regulation within the non-priority watershed of the San Miguel River.

3. New regulations (that would supersede Reg. 85) are being considered by State regulators. These would have significant impacts to the long-term design requirements for the treatment plant. The criteria and timing of these regulations are still unknown.

For the planning period, population projections to the year 2047 assume a constant annual growth rate for both residents and visitors. The year-round resident population of the service area is relatively small. In the last five to ten years, the resident populations have grown at a low rate (1% to 2% annually). The available accommodations are likely to be developed at a rate that paces residential population growth. Projections for Mountain Village assume a 1.5% annual growth rate for both residents and visitors over the 30-year planning period from 4,060 in 2017 to 6,350 people by the year 2047. As a comparison, the projections for growth by the Mountain Village planning department show the total built-out properties and the associated density allocations at 7,630 residents and visitors.

For Telluride, we also assumed a 1.5% annual growth rate for residents and visitors. **Figure 3.1** shows the resident and visitor populations during the peak seasons at three annual growth rates, 1.0%, 1.5% and 2.0%, over 30 years.

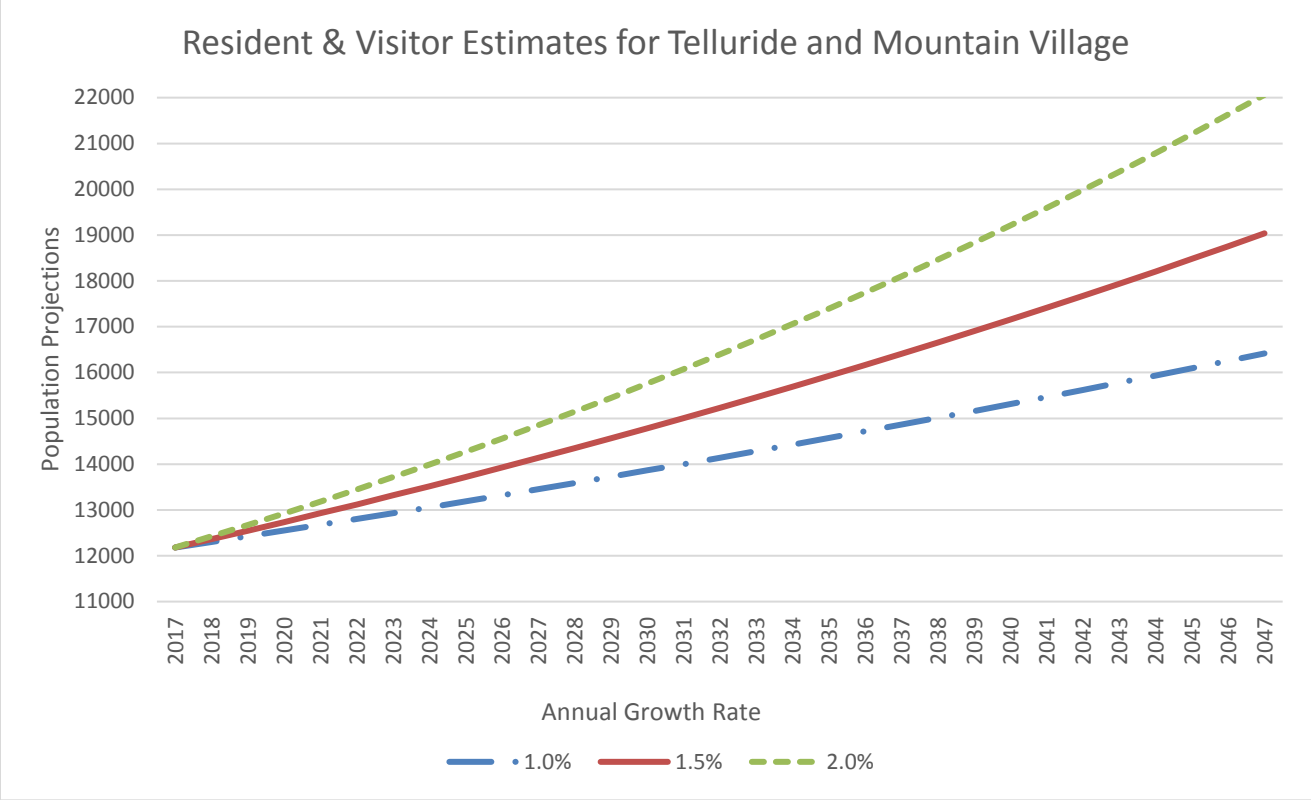


Figure 3.1 Resident and Visitor Projections for TRWWTP Service Area (2017 – 2047)

3.3 ADDITIONAL SOURCES OF WASTEWATER

The population projections developed above form the primary basis for estimating the future flows and pollutant loading for domestic wastewater to the TRWWTP. However, additional sources of wastewater may have significant impacts that must be considered, including:

- Septage – typically trucked from portable toilets or individual disposal systems outside the service area,
- Commercial businesses - restaurants/bars, breweries, distilleries, hotels (laundry), car washes, grocery stores (fresh produce), automobile service stations, dry cleaners/laundromats, and airports,
- Institutions – Schools, hospitals, and prisons

This section presents the sources of wastewater that enter the TRWWTP that are considered "non-residential".

3.3.1 Septage

Septage has been received at the TRWWTP for many years. Plant records show that approximately 230,000 gallons of septage were received in 2015. As a high strength waste, septage has the potential to upset the plant performance due to shock loading. Portable toilets from festivals is considered to be a source of septage. Septage is also commonly pumped from septic tanks where domestic wastewater is digested and concentrated over time. The major septage haulers pay a nominal fee to discharge at the TRWWTP. Haulers discharge into a manhole just outside the plant; no storage is provided to attenuate flows. Operators should have the ability to control how and when septage is discharged to the plant headworks. A receiving station is recommended as part of the near-term improvements plans for the facility. At a minimum, the station would consist of a storage tank and an odor treatment system.

3.3.2 Commercial Businesses

Additional sources of loading for the various commercial businesses are accounted in different ways. For instance, the wastewater from restaurants and bars is really an extension of the resident and visitor populations. Therefore, the population estimates cover the flow and loading from these sources. 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.

Hotels are like restaurants where the visitor population estimates cover the domestic wastewater generated. The exception is when a hotel operates its own laundry facility. We have assumed that the minor flow and pollutant concentrations are included in the visitor estimates. Telluride also has an independent laundromat and a dry cleaner. The estimates for flow and pollutant loading from laundry facilities are included in the overall projections.

Another source of high strength waste that is commonly discharged into the sewer comes from boilers used to heat buildings and infrastructure. Spent glycol-based boiler water is often discharged during maintenance activities into the wastewater collection system or transported by septage haulers to the plant. The used boiler water has the potential to add a significant amount of BOD_5 and dissolved metals to the plant influent. As it is associated with maintenance activities and very unpredictable, the Town will need to develop a utility ordinance and public education program to control the discharge of boiler waste streams into the sewer. The ordinance should describe acceptable terms for notification and transport of boiler wastewater to the TRWWTP.

Telluride has a brewery and a distillery. The waste streams from both are discharged to the TRWWTP with no restrictions. In 2015, the brewery used approximately 1 million gallons of water. For a small craft brewery, it takes approximately 5 gallons of water to produce 1 gallon of beer. The wastewater from the brewery is 80% of the total water used. The beer-making process does not produce the same waste stream every day but on average, the Telluride Brewery might discharge 2,000 to 2,500 gallons per day (gpd). A peak discharge may be as high as 4,000 to 5,000 gpd.

The Telluride Brewery is currently planning an expansion at a new location. The Town has an opportunity to develop pretreatment standards for brewery waste prior to discharge to the sewer collection system. The standards should include flow measurement, solids separation (measured by Total Suspended Solids), acceptable cleaning chemicals (to limit nitrogen and phosphorus loading), and segregation of readily biodegradable carbon waste streams, which could be beneficial for special use in meeting future nutrient regulations at the TRWWTP.

Although the Telluride Distillery operates on a much smaller scale, many of these same principles apply. Estimates of flow and pollutant loading are based on a discussion with the owner.

Automobile service stations may include maintenance and repair shops and car washes. Car wash facilities can be sources of pollutants like suspended solids (dust and dirt), dissolved solids (road salt) and cleaning agents. The Town should require car wash facilities to install and maintain solids separation tanks on their sewer service lines. Maintenance and repair shops should be completely isolated from the sewer collection system. If floor drains from a shop are connected to the sewer, the service line should be diverted to a storage tank for proper disposal of potentially hazardous materials typically used in a mechanic's shop.

3.3.3 Institutions

Schools are the only large institutions in the area served by the TRWWTP. The high school has contacted the TRWWTP in the past when they plan to discharge boiler water. Otherwise, the domestic wastewater from schools is accounted for in the resident population estimates.

Small hospitals and urgent care facilities in the service area are required to dispose of biological waste properly. The normal domestic waste streams that are discharged from these institutions are also covered by the resident and visitor population estimates.

4.0 WASTEWATER FLOW AND LOADING PROJECTIONS

The flow and pollutant characteristics for each component of wastewater generated are estimated and compared with historical records. Population equivalents provide a way to normalize each source of wastewater and compare them with actual experience during average and peak conditions. Using a range of growth rate projections, the future flow and loading conditions are characterized to forecast needed improvements and plan for improvements.

4.1 POPULATION EQUIVALENTS

A summary of the loading and population equivalents from the assessment of wastewater sources is provided in **Table 4.1**. The table shows how septage and commercial waste loads compare with domestic sources.

For example, at the standard domestic loading rate of 0.17 pounds per day (ppd) per person, the septage received on a peak day at 502 ppd of BOD_5 is equivalent to nearly 3,000 people. Similarly, the estimated population equivalent for brewery and distillery wastewater ranges from 690 to 1,380 people (based on average to peak day BOD_5 estimates).

Likewise, the impacts of visitors during peak season activity can be compared with the base population of year-round residents. The comparison of peak and average conditions is complicated as the base population varies seasonally.

4.2 HISTORICAL INFLUENT FLOW AND LOADING

The daily flow records for influent to the TRWWTP were analyzed by frequency during each year from 2011 to 2015. The terms of the plant's discharge permit refer to the maximum month average flow and BOD_5 loading per day. As such, the frequency analysis cannot be directly compared to this maximum monthly value from the permit. However, we estimate that the 95th percentile value correlates closely with the maximum month average value.

Table 4.1 TRWWTP Wastewater Loading and Population Equivalents (2017 Estimates)

SOURCE OF WASTEWATER	ORGANIC LOADING (pounds BOD_5 per day)		POPULATION EQUIVALENT	
2017	Average	Peak Day	Average	Peak Day
Base Population	*	**		
Telluride	418	835	2,457	4,914
Mountain Village	234	469	1,378	2,757
Lawson Hill, Aldasoro & Unincorporated Co.	140	280	825	1,650
Visitor Accommodations				
Telluride	756	1,512	4,450	8,900
Mountain Village	486	972	2,860	5,720
Lawson Hill, Aldasoro & Unincorporated Co.	36	72	210	420
Septage Receiving †	41	502	240	2,953
Brewery / Distillery Waste ‡	117	234	689	1,378
Laundromat / ECO Cleaners	2	4	11	22
Totals	2,230 ppd	4,880 ppd	13,120	28,713

* Assumes 0.17 ppd BOD_5 per person for standard residential domestic wastewater.
**Assumes 200% of average annual loading.
† Assumes average septage loading of 7000 mg/L BOD_5 (1750 mg/L peak from portable toilets)
‡ Assumes average waste concentration at 5200 mg/L BOD_5 and 0.17 ppd BOD_5 per person for small craft breweries and distillers. Other industrial waste may include boiler drain waste (not accounted for in estimate).

The influent flow data from 2011 to 2015 associated with recurrence percentiles are presented in **Table 4.2.** The increase in flow over the previous year was calculated for the associated frequency. Up to 2013, the table shows flows to the plant were decreasing. In 2014 and 2015, the flows for most occurrences increased over the previous year dramatically.

Table 4.2 TRWWTP Influent Flow (2011 - 2015)

	TRWWTP Influent Flow, mgd					% increase over previous year				
Frequency	2011	2012	2013	2014	2015	2011	2012	2013	2014	2015
Minimum	0.37	0.35	0.38	0.30	0.33	-	-5%	9%	-21%	9%
25th %	0.56	0.54	0.52	0.55	0.54	-	-3%	-3%	5%	-1%
Average	0.69	0.62	0.63	0.65	0.71	-	-9%	0%	3%	9%
75th %	0.82	0.71	0.72	0.74	0.83	-	-12%	0%	3%	12%
90th %	0.93	0.79	0.81	0.85	0.99	-	-15%	3%	5%	16%
95th %	1.00	0.86	0.86	0.91	1.05	-	-14%	-1%	6%	15%
Maximum	1.27	1.01	1.03	1.06	1.39	-	-20%	2%	3%	30%

Assuming the 95th percentile value from 2015 is increased by 15% annually, the 2017 projected maximum month average flow is 1.4 million gallons per day (mgd).

Table 4.3 shows a similar analysis of the frequency of Influent BOD_5 as reported in pounds per day (ppd). The data is slightly skewed as the BOD_5 concentrations collected on Wednesday and Thursday of each week are flow weighted with the daily flow rate measured during the week. However, the data appears to be representative and the analysis valid. The organic loading of the plant shows an increase over the previous year for all years evaluated. The increases seen in 2015 are substantial and the data from 2016 indicate a similar increase.

Table 4.3 TRWWTP Influent BOD5 (2011 – 2015)

	TRWWTP BOD_5 Loading, ppd					% increase over previous year				
	2011	2012	2013	2014	2015	2011	2012	2013	2014	2015
Minimum	590	590	540	620	620	-	0%	-8%	15%	0%
25th %	980	1,070	1,080	1,110	1,300	-	9%	1%	3%	17%
Average	1,490	1,490	1,580	1,690	1,900	-	0%	6%	7%	12%
75th %	1,830	1,850	1,960	2,170	2,270	-	1%	6%	11%	5%
90th %	2,120	2,240	2,320	2,520	3,050	-	6%	4%	9%	21%
95th %	2,390	2,580	2,740	2,830	3,460	-	8%	6%	3%	22%
Maximum	3,630	3,390	3,460	4,010	4,730	-	-7%	2%	16%	18%

The maximum month load for 2017 is projected using the 90th percentile at a 20% annual increase to obtain a value of 4,380 ppd. This value would exceed the plant's rated capacity of 3,708 ppd.

The daily influent flow data recorded and reported in 2015 was evaluated per criteria listed in **Table 4.4**. The criteria define how variations in flow occur daily and seasonally.

Table 4.4 TRWWTP 2015 Influent Flow

CRITERIA	INFLUENT FLOW	% of AVG	COMMENTS
	(mgd)		
Minimum Day	0.33	47%	
Low Season Avg Month	0.49	70%	
Avg Annual	0.70		
Maximum Month Avg	1.04	149%	Occurred June 2015
Peak Day:	1.39	199%	Use 200% for design
Peak Hour Estimate	2.80		Assumed 2x the Peak Day

The Influent loading reported by the TRWWTP was also broken down per minimum day, annual and monthly averages, and the peak day. These data are compared with the average annual value to determine appropriate factors to be used for planning and design. **Table 4.5** shows how the 2015 influent BOD_5 loading varies with time.

Table 4.5 TRWWTP 2015 Influent BOD5 Loading

CRITERIA	INFLUENT BOD_5	% of AVG	COMMENTS
	(ppd)		
Minimum Day	703	38%	
Low Season Avg Month	1,161	63%	
Avg Annual	1,843		
Maximum Month Avg	2,417	131%	Use 150% for design
Peak Day:	3,646	198%	Use 200% for design
Peak Hour Estimate	7,372		Use 400% for design

The maximum month average flow and loading are the criteria used for permit compliance. Our flow and loading estimates for 2017 are based on the annual average values. The ratio calculated from the influent flow records in **Table 4.4** show the maximum monthly average is 150% of the annual average. This ratio is lower for the BOD_5 loading values (131%) from **Table 4.5**. With the uncertainty of the loading data, we have determined that the maximum monthly average loading should be 150% of the annual average to be consistent with the flow estimates.

4.3 WASTEWATER CHARACTERIZATION

Domestic wastewater generated by residents and visitors is characterized using standard per capita flow and loading rates. For a luxury resort, the standard published unit rate for BOD_5 is 0.17 pounds per day (ppd) per person for standard domestic wastewater. The standard flow per person averages 80 gallons per day (gpd). The chemical oxygen demand is not typically measured at the TRWWTP but can be estimated at 2.0 to 2.2 times the BOD_5 concentration.

Influent to the TRWWTP was sampled during the peak winter conditions from December 20, 2016 to January 1, 2017 using a 24-hour composite sampler. These samples were analyzed for a variety of parameters to characterize Biochemical Oxygen Demand, Chemical Oxygen Demand, phosphorus, and nitrogen in various forms. **Table 4.6** presents the results of the analysis.

Table 4.6 Influent Wastewater Characterization for TRWWTP (December 2016)

	BOD	cBOD	COD	sCOD	TP	sTP	TN	NO2+ NO3	TKN	sTN	sNO2+ NO3	sTKN	NH3-N	Inf Flow
Dec	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(MGD)
20-21	421	339	1053	409	7.1	4.3	62.0	1.0	61.5	48.6	0.6	48.0	36.0	0.755
21-22	509	428	1057	456	7.2	4.7	44.3	0.9	43.4	41.1	0.7	40.4	36.0	0.78
22-23	479	422	1074	711	7.1	4.1	54.5	1.4	53.0	43.5	1.1	42.4	34.9	0.803
24-25	350	285	811	309	6.1	3.8	47.2	0.7	46.6	43.0	0.3	42.8	29.1	0.809
25-26	559	415	1800	376	6.1	4.0	49.3	1.3	47.9	44.2	0.4	43.8	27.9	0.82
27-28	474	413	1430	431	8.7	4.9	67.5	1.1	66.5	49.6	0.3	49.3	39.1	0.948
28-29	462	396	1050	402	7.1	4.2	57.5	1.0	56.5	46.5	0.7	45.8	37.6	0.998
29-30	448	373	1075	470	7.6	4.8	59.5	1.1	58.5	52.5	1.0	51.5	42.6	1.006
30-31	366	287	944	377	7.2	4.6	55.5	0.9	54.5	47.9	0.4	47.5	35.3	1.159
31-1/1	481	387	1227	438	8.1	5.7	60.5	0.9	59.5	50.5	0.5	49.9	37.9	1.059
Avg	455	374	1152	438	7	5	56	1.0	55	47	0.6	46	36	0.91

The results of the testing verify that nutrient concentrations to the TRWWTP are strong compared with typical domestic wastewater. It is likely that septage and commercial sources contribute high concentrations of nutrients that are further estimated below.

4.3.1 Septage Characterization

The characteristics of septage can vary significantly depending on the source. The USEPA Handbook "Septage Treatment and Disposal" provides suggested design values for physical and chemical characteristics of septage[2], as follows:

- Five-day Bio-chemical Oxygen Demand (BOD_5) 7,000 mg/L.
- Total Suspended Solids (TSS) 15,000 mg/L
- Chemical Oxygen Demand (COD) 15,000 mg/L
- Total Kjeldahl Nitrogen (TKN) 700 mg/L
- Ammonia Nitrogen (NH_3-N) 150 mg/L
- Total Phosphorus (TP) 250 mg/L

The maximum month loading from septage estimated for 2017 assumes that one in ten septic systems in San Miguel County are pumped over a 2-month period every year. As such, the maximum month flow from septic systems is 3,400 gpd, and loading is 201 ppd BOD_5 assuming a BOD_5 concentration of 7,000 mg/L.

On the other hand, peak septage loading to the TRWWTP occurs during large summer festivals when haulers are reported to line up at the plant. It is estimated that the wastewater delivered is primarily collected from temporary toilets set up for visitors. This wastewater is not concentrated to the same degree as typical septage and has been estimated to have a BOD_5 concentration of 1,750 mg/L. Assuming a typical 2,000-gallon load of septage takes 0.5 hour to dump and this occurs for 10 hours on a peak day, the total received is 40,000 gpd. The estimated peak day organic load to the plant from septage could be as high as 2,335 ppd BOD_5, which is 63% of the permitted organic load.

4.3.2 Brewery and Distillery Waste Stream Characterization

The 2017 loading estimates for the Telluride Brewery are based on studies of other craft brewers. Production estimates indicate 165 ppd BOD_5 is being discharged to the collection system on a maximum month basis. The brewery is planning to increase capacity in the future which could have a significant impact on loadings to the TRWWTP. If the Telluride Brewery expands production as planned, the flows and loading could increase by 400 percent. Without implementing a plan to reduce the proposed loading, the Town would be required to expand the TRWWTP capacity.

The Telluride Distillery is operated seasonally discharging high strength wastewater to the collection system at a fraction of the volume as the brewery. Waste stream estimates are based

[2] USEPA Handbook, Septage Treatment and Disposal, 1984, EPA-625/6-84-009, Table 3-4.

on the weekly water use with 75% being wasted. The maximum monthly flow and BOD_5 load being discharged from the distillery is estimated to be 190 gpd and 8 ppd, respectively.

4.3.3 Commercial Laundry Wastewater characterization

Water usage in 2015 for the laundromat in Lawson Hill was 306,000 gallons and for the ECO Cleaners, 50,000 gallons. Waste water generated was assumed to be 90% of usage and relatively dilute in terms of BOD_5 at 260 mg/L. The impacts from laundry facilities are very minor if phosphorus free detergents are used.

4.4 WASTEWATER FLOW PROJECTIONS

We have assumed a unit flow rate of 80 gallons per capita per day (gpcpd) for the annual average flow. The maximum monthly average flow of 120 gpcpd (1.5 x annual average) is applied to the domestic wastewater projections for residents as shown in **Table 4.7.**

The wastewater flow estimates for visitors staying in available accommodations are based on the same per capita flow rates as for residents (described above). **Table 4.8** presents the projections for the visitor population.

Table 4.7 Wastewater Flows Estimated for the Residential Base Population

Service Area	2017 Estimated Flow (gpd)	2047 Projected Flow (gpd) [2]
Telluride Residential[1]	197,000	307,000
Mtn Village Residential[1]	110,000	173,000
Aldasoro, Lawson Hill & Unincorp. Co[1]	66,000	103,000
Avg Daily Flows (base population) [1]	372,800	582,700
Max Month Flows (base population)[3]	**560,000**	**874,000**
Max Week Flows (base population)[4]	588,000	1,020,000
Peak Day Flows (base population)[5]	672,000	1,165,400

[1] Based on population at 80 gallons per capita per day (gpcpd).
[2] Projection assumes **1.5% annual growth rate**.
[3] Estimated at 1.5 x Average Daily Flow
[4] Estimated at 1.75 x Average Daily Flow
[5] Estimated at 2.0 x Average Daily Flow

Table 4.8 Wastewater Flows Estimated for the Visitor Population

Service Area	2017 Estimated Flow (gpd)	2047 Projected Flow (gpd) [2]
Telluride Visitors[1]	356,000	556,000
Mtn Village Visitors[1]	229,000	358,000
Aldasoro, Lawson Hill & Unincorp. Co[1]	25,200	17,000
Avg Daily Flows (visitor population) [1]	601,600	940,000
Max Month Flows (visitor population)[3]	**902,400**	**1,411,000**
Max Week Flows (visitor population)[4]	**1,053,000**	**1,646,000**
Peak Day Flows (visitor population)[5]	1,203,200	1,881,000

[1] Based on population at 80 gpcpd.
[2] Projection assumes **1.5% annual growth rate**.
[3] Estimated at 1.5 x Average Daily Flow
[4] Estimated at 1.75 x Average Daily Flow
[5] Estimated at 2.0 x Average Daily Flow

4.4.1 Septage

Septage has two primary sources that may be delivered to the TRWWTP: a) residential septic systems, and b) portable facilities set up for special events. We have assumed that residential septic systems are located throughout San Miguel County and typically serve single family homes. Using county population estimates, the estimated number of septic systems in 2017 in San Miguel County outside the service area is 2,100. If 1,000 gallons are pumped from each septic system every ten years, then 210,000 gallons would be pumped annually and trucked to the TRWWTP. Per 2015 records, the total volume of septage received was 230,000 gallons. For 2017, the assumed annual average volume is 250,000 gallons, or 700 gpd. The annual growth rate is assumed to be 3% for septage hauled to the TRWWTP. To estimate the maximum month average septage volume, we assumed that septic haulers operate during the summer only (3 months of the year). Peak daily flows assume the source is from portable facilities set up for the festivals. **Table 4.9** shows the projected flows associated with septage.

Table 4.9 Wastewater Flows Estimated for Septage Delivered to TRWWTP

Septage	2017 Estimated Flow (gpd)	2047 Projected Flow (gpd) [2]
Avg Daily Flows[1]	700	1,700
Max Month Flows [3]	**2,300**	**5,600**
Max Week Flows[4]	4,600	11,200
Peak Day Flows[5]	40,000	56,000

[1] Based on 1,000 gallons per home once every 10 years.
[2] Projection assumes **3.0% annual growth rate**.
[3] Assumes annual volume is delivered within a 3 month period.
[4] Estimated at 2.0 x Max Month Flow
[5] Assumes port-o-let waste at 4,000 gal/hr delivered over 10 hours for peak day event in 2017.

4.4.2 Other Sources of Commercial Wastewater

As presented above, many commercial businesses discharge wastewater to the TRWWTP including brewery / distillery wastewater, laundromats/cleaners and boiler drainage. The volume of boiler water waste is assumed to be minimal although it has a significant load impact, which is discussed below. For brewery wastewater, we estimated 820,000 gallons were discharged in 2015. **Table 4.10** presents brewery wastewater projections including a planned expansion by 2020 and an additional small brewery potentially opening within the 30-year planning period.

Table 4.10 Estimated Brewery Wastewater Flows

Brewery Wastewater	2015 Estimated Flow (gpd) [1]	2020 Estimated Flow (gpd)	2047 Projected Flow (gpd)
Avg Daily Flows [2]	2,540	10,160	12,700
Max Month Flows [3]	**3,800**	**15,250**	**19,100**
Max Week Flows[4]	4,450	17,800	22,230
Peak Day Flows[5]	5,100	20,300	25,500

[1] Based on 1,000,000 gallons used in 2015 with 80% wastewater yield.
[2] Based on **400% brewery expansion project at new location in 2020 and speculation that another brewery would open in Telluride by 2047**.
[3] Estimated at 1.5 x Average Daily Flow
[4] Estimated at 1.75 x Average Daily Flow
[5] Estimated at 2.0 x Average Daily Flow

The distillery was contacted and reported an average weekly water usage of 1,200 gallons. Assuming 4 gallons used to produce 1 gallon of liquor, we estimate 130 gpd of wastewater is generated. This is a very small volume that is added to the brewery waste projections.

Commercial laundry businesses include a laundromat and a dry cleaner who uses ecologically based products. Water use records from 2015 show the ECO Cleaners used 50,000 gallons and the laundromat used 306,000 gallons of water. Assuming 10% consumptive use, the average daily flow in 2017 is 900 gpd. The 30-year projections assume 3% annual increase in flows. **Table 4.11** provides the estimated commercial laundry wastewater flows.

Table 4.11 Estimated Commercial Laundry Wastewater Flows

Laundry Wastewater	2015 Estimated Flow (gpd) [1]	2047 Projected Flow (gpd) [2]
Avg Daily Flows	900	2,200
Max Month Flows [3]	**1,350**	**3,300**
Max Week Flows[4]	1,575	3,800
Peak Day Flows[5]	1,800	4,400

[1] Based on water records for 2015 with 10% consumptive use.
[2] Based on Projection assumes **3.0% annual growth rate**.
[3] Estimated at 1.5 x Average Daily Flow
[4] Estimated at 1.75 x Average Daily Flow
[5] Estimated at 2.0 x Average Daily Flow

The estimates for total influent flow to the TRWWTP are provided in **Table 4.12**.

Table 4.12 Estimated Influent Flow for the TRWWTP

Influent WWTP	2017		2047	
Annual Avg Daily Flow	1.00	mgd	1.54	mgd
Maximum Month Flow	**1.50**	mgd	**2.30**	mgd
Maximum Weekly Flow	1.75	mgd	2.70	mgd
Peak Day Flow	2.00	mgd	3.10	mgd

The increase in maximum month average flow reported in 2015 to the projected flow in 2017 is consistent with the historical increase between 2014 and 2015. **Figure 4.1** shows how resident and visitor population growth variations would impact flow projection through the 30-year planning period. NOTE: **Table 4.12** flow projections for 2047 are based on a population growth of 1.5% annually.

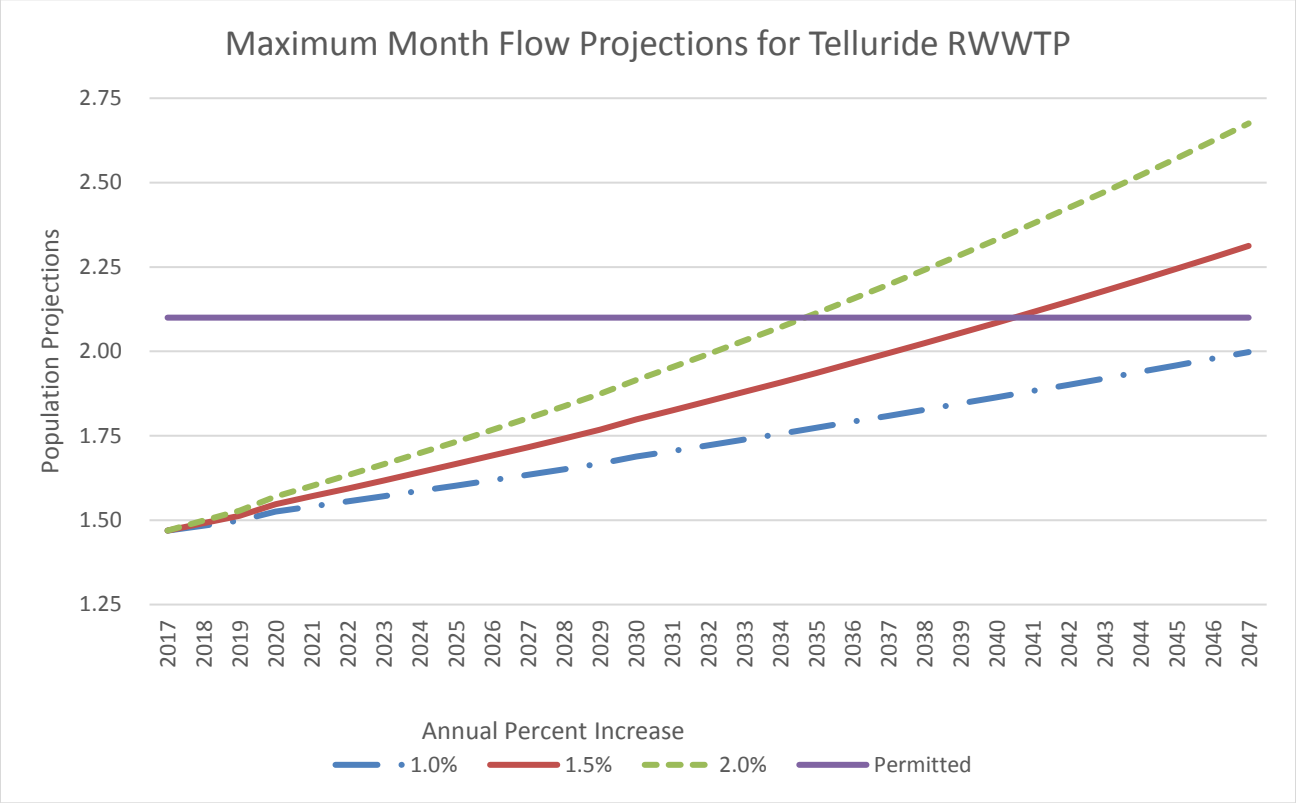


Figure 4.1 Influent Wastewater Flow Projections for TRWWTP (with Brewery expansion)

The graphical representation of flow projections in **Figure 4.1** show that the existing facility is not flow restricted within the foreseeable future. The BOD_5 loading will control when an expansion is required.

4.5 BOD_5 LOADING PROJECTIONS

The population estimates for year-round residents and the visitors using accommodations in both Telluride and Mountain Village were used with the BOD_5 loading per person (0.17 pounds per capita per day) to establish the average annual daily values. A 150% increase of the average annual values establishes the maximum month average loading estimates. The peak day estimates used a 200% increase from the annual average values. Annual growth over the 30-year planning period is estimated at 1.5% in Mountain Village and in Telluride (including Aldasoro, Lawson Hill and the unincorporated areas inside the service area boundary). The domestic wastewater loading projections for the residential base population is shown in **Table 4.13.** The estimated domestic waste load for the visitor population is presented in **Table 4.14**.

Table 4.13 Wastewater BOD5 Loading Estimated for the Residential Base Population

Service Area	2017 Estimated BOD_5 Load (ppd)	2047 Projected BOD_5 Load (ppd) [2]
Telluride Residential[1]	418	653
Mtn Village Residential[1]	234	366
Aldasoro, Lawson Hill & Unincorp. Co[1]	140	220
Avg Daily Load (base population) [1]	792	1,240
Max Month Load (base population)[3]	**1,190**	**1,860**
Max Week Load (base population)[4]	1,390	2,167
Peak Day Load (base population)[5]	1,585	2,477

[1] Based on population at 0.17 pounds BOD_5 per capita per day (ppcpd).
[2] Projection assumes **1.5% annual growth rate**.
[3] Estimated at 1.5 x Average Daily Load
[4] Estimated at 1.75 x Average Daily Load
[5] Estimated at 2.0 x Average Daily Load

Table 4.14 Wastewater BOD5 Loading Estimated for the Visitor Population

Service Area	2017 Estimated BOD_5 Load (ppd)	2047 Projected BOD_5 Load (ppd) [2]
Telluride Visitor[1]	757	1,019
Mtn Village Visitor[1]	487	760
Unincorp. Service Area Visitors[1]	36	56
Avg Daily Load (base population) [1]	1,278	2,000
Max Month Load (base population)[3]	**1,917**	**3,000**
Max Week Load (base population)[4]	2,237	3,500
Peak Day Load (base population)[5]	2,557	4,000

[1] Based on population at 0.17 pounds BOD_5 per capita per day (ppcpd).
[2] Projection assumes **1.5% annual growth rate**.
[3] Estimated at 1.5 x Average Daily Load
[4] Estimated at 1.75 x Average Daily Load
[5] Estimated at 2.0 x Average Daily Load

4.5.1 Septage Loading

Septage receiving at the facility is categorized as residential septic systems or from port-o-lets. Using published data from EPA on residential septic waste (average concentration of 7,000 mg/L BOD_5), the average annual daily load from typical residential systems was established. Knowing that most residential systems are pumped during the warm season, a maximum monthly load was assumed to be significantly higher. However, peak day deliveries of septage are likely associated with the height of the summer festivals at 25% the typical residential septage concentration. The annual and maximum month averages were assumed to increase at an annual rate of 3%. **Table 4.15** presents the load projections for septage deliveries to the TRWWTP.

Table 4.15 Wastewater BOD5 Loading Estimated for Septage

Septage Load	2017 Estimated BOD_5 Load (ppd)	2047 Projected BOD_5 Load (ppd) [2]
Avg Daily Load [1]	41	99
Max Month Load [3]	**134**	**330**
Max Week Load [4]	268	660
Peak Day Load [5]	584	817

[1] Based on 7,000 mg/L BOD_5 concentration.
[2] Projection assumes **3.0% annual growth rate**.
[3] Assumes annual volume is delivered within a 3 month period.
[4] Estimated at 2.0 x Max Month Load
[5] Assumes port-o-let waste volume at 1,750 mg/L BOD_5 concentration.

4.5.2 Other Sources of Commercial Waste Loads

The rare discharges of boiler water are low volume but high strength as they are glycol based solutions. These discharges typically pass through the system without being captured in samples. However, they may impact plant performance by causing a drop in dissolved oxygen levels in the aeration basins. The boiler water may also have a significant copper concentration, which is a primary concern with meeting new discharge limits. As noted above, public education and a utility ordinance may be the best way to control discharges associated with boiler maintenance.

Laundry waste loads are high volume, low strength sources of waste. The calculated BOD_5 waste loads from the laundromat and the eco-cleaners are very low compared to the total influent load to the plant.

Brewery and distillery waste loads were estimated using BOD_5 concentrations from studies of small craft breweries in Colorado. The average concentration of 5,200 mg/L BOD_5 was applied

to the flow estimates to determine the annual and maximum month averages and the peak day load as shown in **Table 4.16**.

Table 4.16 Wastewater BOD5 Loading Estimated for Brewery and Distillery Waste

Brewery Waste Load	2015 Estimated BOD_5 Load (ppd)[1]	2020 Estimated BOD_5 Load (ppd)[2]	2047 Projected BOD_5 Load (ppd)
Avg Daily Load	117	468	573
Max Month Load [3]	**176**	**670**	**846**
Max Week Load [4]	205	820	1,025
Peak Day Load [5]	234	938	1,170

[1] Based on 5,200 mg/L BOD_5 concentration.
[2] Based on **400% brewery expansion at new location in 2020 and 2nd brewery opening by 2030**.
[3] Estimated at 1.5 x Average Daily Flow
[4] Estimated at 1.75 x Average Daily Flow
[5] Estimated at 2.0 x Average Daily Flow

These estimates for brewery waste assume that no pre-treatment occurs prior to being discharged from the brewery. Further discussion of options for brewery discharge limits requirements occurs below.

The estimates for total influent BOD_5 loading to the TRWWTP are shown in **Table 4.17**.

Table 4.17 Estimated Influent BOD5 Loading for the TRWWTP

Influent WWTP	2017		2047 [1]	
Annual Avg Daily BOD_5 Load	2,267	ppd	4,003	ppd
Maximum Month BOD_5 Load	**3,400**	ppd	**6,005**	ppd
Maximum Weekly BOD_5 Load	3,970	ppd	7,005	ppd
Peak Day BOD_5 Load	4,534	ppd	8,005	ppd

[1] The values projected include the anticipated brewery expansion by 2020 and a small brewery opening in 2030 (with no additional pretreatment).

The values presented in **Table 4.17** are based on conservative estimates for planning purposes. For comparison, if the Telluride Brewery maintained 2017 estimates for waste load throughout the 30-year planning period, the maximum month load projected would be reduced by approximately 500 ppd. This is graphically shown in **Figure 4.2** (with the brewery expansion) and **Figure 4.3** (without any increases in brewery waste load). Each figure presents how growth rate (1.0%, 1.5% and 2.0%) for resident and visitor populations impact the overall loading.

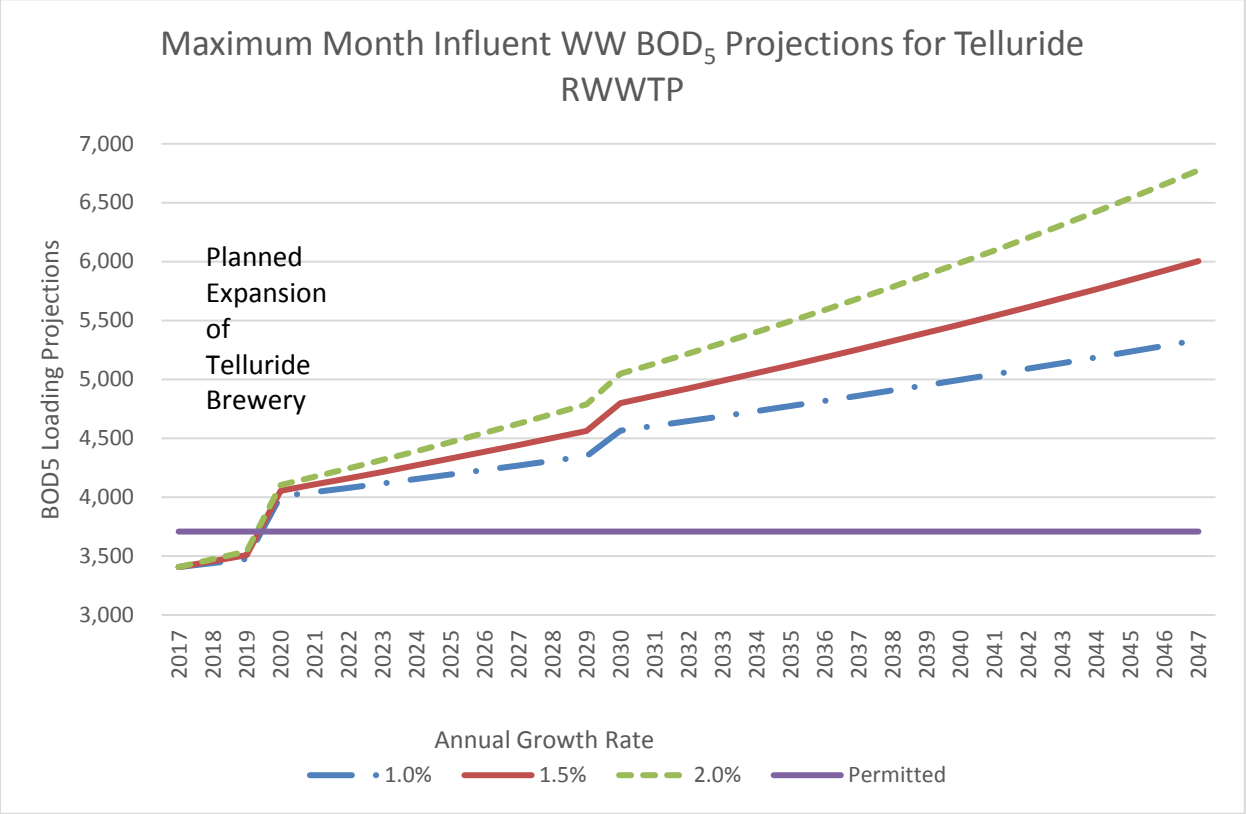


Figure 4.2 Loading Projections at Varied Population Growth Rates (with Brewery Expansion)

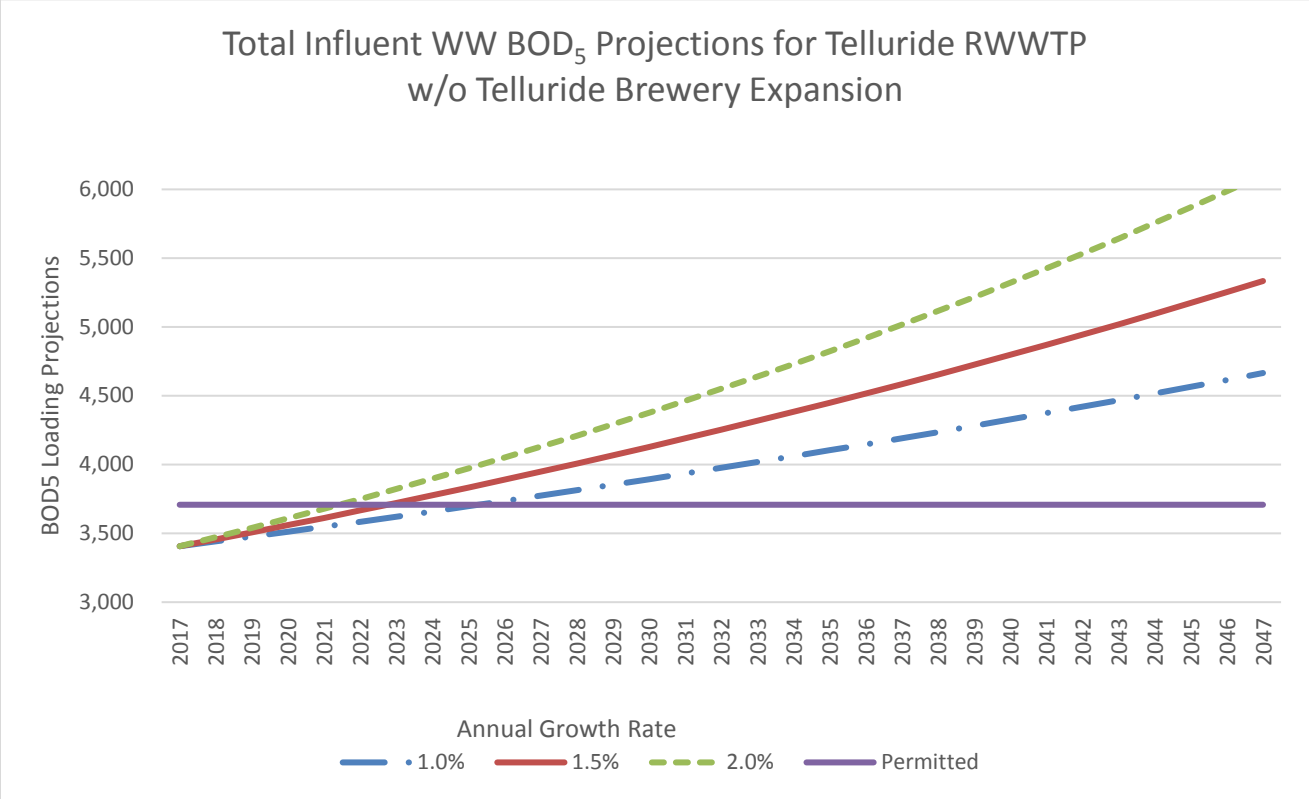


Figure 4.3 Loading Projections at Varied Population Growth Rates (w/o Brewery Expansion)

4.6 SUMMARY OF GROWTH PROJECTIONS

Growth projections for the TRWWTP service area considered three primary sources of influent wastewater to the plant.

1. Domestic wastewater from residents and visitors – Growth from the base populations of Telluride and Mountain Village has averaged slightly more than 1% over the last 5 – 6 years. Visitor populations during peak season events are estimated to increase the population significantly for the short duration of the event. The annual increases in visitors during large events has not been tracked directly but flow and loading records show substantial increases since 2013.
2. Septage from temporary facilities and rural customers – Visitors who attend events and camp in the area are typically served by temporary facilities. The septage from these facilities is high strength and may represent the largest single impact of organic loading to the plant. Septic systems serving rural residential properties may have septic haulers provide services once every five to ten years. The overall volume of septage hauled to the plant is not as significant as the rate and time of day it enters the plant. The TRWWTP

should consider constructing a septage receiving station to store and discharge at a controlled rate.

3. Commercial waste streams – Breweries, distilleries, laundomats/cleaners and facilities with boilers are non-classified commercial dischargers. The operation and maintenance activities of most small breweries change as they grow in size and sophistication. The Telluride Brewery disposes the spent grains separately as feed for livestock. The remaining wastes are more difficult to treat and are commonly discharged to the wastewater collection system. The brewery has announced plans to expand capacity. The owners of the brewery have an opportunity to work with the Town to reduce their impact on the TRWWTP during this expansion. The towns should consider modifying their wastewater utility ordinances to address the impacts that these types of commercial loads have on the TRWWTP.

   The waste load from boiler water has significant impacts on the TRWWTP, but on a less frequent basis than septage or brewery wastewater. The evidence on volume or frequency of discharges during boiler maintenance is lacking and difficult to estimate. The Town will need to educate the public and encourage cooperation to determine how best to control this source. Boiler waste could be hauled to the TRWWTP and placed in a separate tank for special treatment such as pH adjustment and precipitation.

The records of plant influent flow and loading show that each of these parameters have a combined impact that is rapidly influencing the need to expand capacity and redundancy. The equivalent population of these major sources was presented in **Table 4.1** showing the average and peak day impacts to the treatment plant. The frequency analysis also indicates that the rate of growth has accelerated since 2013 and that planning for both near-term and long-term improvements should not be delayed.

5.0 NEAR-TERM IMPROVEMENTS PLAN

5.1 OVERVIEW

This section was prepared to guide the Town of Telluride and the Town of Mountain Village in planning for operational and capital improvements over the near-term (next 5 years). These improvements are intended to allow the Telluride Regional Wastewater Treatment Plant (TRWWTP) to meet the needs of the service area until a large-scale project would be required (no later than 2028). Additional improvements may develop that are not specifically identified herein, which could include treatment for metals removal. The major improvements to be implemented by 2028 are considered long-term improvements that are based on criteria projected to the year 2047. The long-term improvements are presented in Section 5 of this Master Plan.

Near-term improvements are required to allow the TRWWTP to continue to meet current permit requirements and plan for expansion of the plant. The TRWWTP has several limitations that are becoming more critical as peak loading increases. Redundancy of major processes has become a significant limitation for maintenance activities and for implementing process improvements. Condition assessments have identified treatment system weeknesses, major structural issues and electrical limitations. The most immediate needs are addressed in this near-term improvements plan.

Process improvements are needed to expand capacity, improve treatment, allow for maintenance activities and correct deficiencies at the TRWWTP. In 2016, plant staff implemented corrective maintenance to the grit removal system. A new pump and suction pipe were installed to remove grit from the vortex chamber providing significant improvement to the process. Unfortunately, a large amount of grit had accumulated in the oxidation ditches. The accumulation of grit has reduced the effective volume for treatment in the oxidation ditches. The ditches also need repairs to equipment and coatings of structural supports. The window of opportunity to conduct oxidation ditch maintenance occurs twice a year during a two-month period when loading to the plant drops seasonally. A sludge de-watering process is needed to allow the oxidation ditches to be cleaned and repaired during these down times.

5.2 OXIDATION DITCH SOLIDS DEWATERING IMPROVEMENTS

The process of cleaning an oxidation ditch consists of taking it out of service; draining the mixed liquor to expose the settled material, process sludge and inert grit on the bottom; removing this settled material; and drying it before hauling it to a landfill. In the past, operators used pumps to transfer these settled materials to the aerobic digesters. However, the grit was too abrasive for the transfer pumps that feed the rotary drum thickeners. These pumps were not designed to move this material. The solids and grit that must be removed from the oxidation ditches requires a dedicated sludge transfer pump and processes to dewater, store and dispose of these solids.

The TRWWTP does not have a place to store or dewater the sludge and grit removed from the oxidation ditches. These improvements will require review and approval by both CDPHE and San Miguel County Board of Commissioners. Locating these unit processes within existing structures will be difficult. A new exterior structure will need to be constructed requiring an amendment to the Board of County Commissioner Resolution 1986-35, approving the TRWWTP. Design review and approval by CDPHE can be accomplished through the Application Procedures for Amendment of Existing Site Location Approval described in Regulation 22. To initiate the process, the Town must submit a request form for review fees to CDPHE. Once the fees are paid, the design documentation can be submitted for the streamline review process.

The minimum capacity for the proposed sludge dewatering process is based on an estimate of 27,000 gallons of sludge at 4 percent solids content during each two-month period during the spring and fall season. The primary dewatering processes evaluated are:

- Sand drying beds
- Containerized filter system with polymer feed
- Geotextile dewatering tubes

5.2.1 Dewatering Alternative 1: Sand Drying Beds

The conceptual layout in **Figure 5.1** calls for 4,000 square feet for each of two beds assuming 12 inches of wet solids depth. The beds would be located on top of the digester structures with access for solids removal from the north end. The beds would be constructed using cast-in-place concrete floor and walls. The media consists of layers of gravel and coarse sand with an underdrain system to collect water that seeps into the bed. The substrate water removed from the solids would be discharged to the digester(s) below. A skid steer would access the beds using ramps to remove the dried solids from the surface of the media. Dewatered solids would be hauled by truck to the land fill.

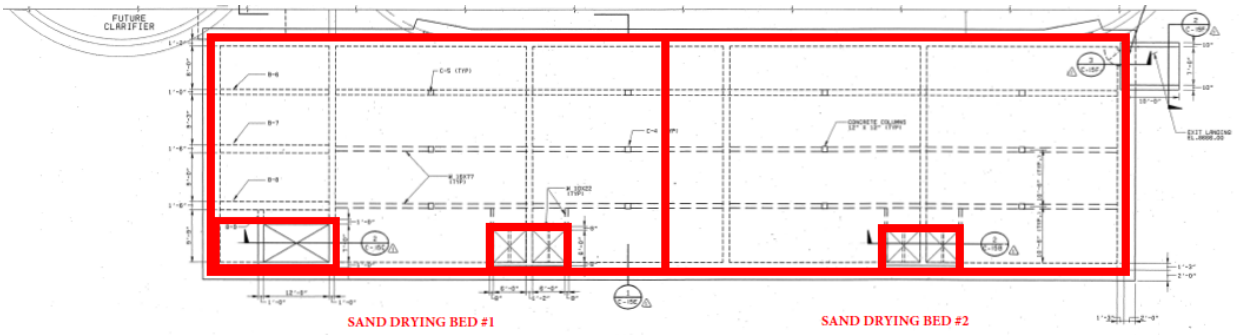


Figure 5.1 Conceptual Layout of Sand Drying Beds over Digester Basins

The conceptual layout provides for excavation and grading for the area above the digesters, forming and cast-in-place concrete for retaining walls and slab-on-grade, PVC pipe underdrain system (schedule 80), gravel and sand media, and the general requirements of the construction

contract. A 15 percent contingency is added to the conceptual level opinion of cost. The estimate of probable construction cost for Dewatering Alternative 1: Sand Drying Beds is $200,000.

5.2.2 Dewatering Alternative 2: Containerized Filter System

Several companies offer containerized filter systems using modified dumpsters or roll-off containers and polymer feed. These specialty systems require polymer addition to process the settled material removed from the oxidation ditches. The containers would be stored on site during the dewatering process. It is necessary to let the material dewater for 24 to 48 hours after the last dump to pass the paint filter test. The containers are supplied as a roll off unit or a trailer mounted unit. Both systems would require the appropriate vehicle to haul the solids to the landfill.

A dewatering container can process around 1,000 gallons of 1 to 1-1/2 % solids per cubic yard (cy). The thicker the material, the less volume you can dewater at a time. For example, at 3% solids, you can process around 500 gallons per cubic yard. Based on this calculation, a 25-cy roll off can process 25,000 gallons of 1 to 1-1/2% solids material at a time before it is full. At 4% solids content, three 50-cy units would be required.

The major drawback to a containerized system for dewatering material removed from the oxidation ditches is that there is limited space on site to store the units. The aesthetics of the containers is a detraction.

A mobile polymer feed system could be leased for short durations or purchased and stored on site. The cost to lease the units is approximately $2,000 per unit per month ($2,000 x 3 units x 4 mo/year = $24,000. Add $700 per month to rent a polymer feed unit. The annual cost for leasing 3 containerized dewatering units for 4 months each year is $26,800. The cost to purchase three 50-cy units is approximately $100,000.

5.2.3 Dewatering Alternative 3: Geotextile Dewatering Tubes

Geotextile tubes can be used to dewater the settled material pumped from the oxidation ditches. They are high strength, permeable geotextiles that are resistant to ultra-violet light and the abrasion, tearing, puncturing and flattening stresses associated with placement on site and filling with material pumped from the oxidation ditches. The tubes hold the solids and allow water to escape through the fabric. Polymer can be mixed into the solids during the filling process which speeds up dewatering. When the dewatering is completed, the tubes are cut open to allow removal of the solids. The estimated tube length for each 27,000-gallon filling is approximately 100 feet. The geosynthetic tube has a single use and then it must be disposed of in the landfill.

Like the media in a sand drying bed, the tubes must be placed in a contained area so that water from the tubes drains into the plant for further treatment. A concrete pad with

containment walls and access ramps are necessary for placement of the tubes and removal of the solids. Our estimate of construction cost for the concrete containment pad with drain piping is $180,000. The annual cost to purchase two geotextile tubes (2 per year), and rent the polymer feed system for 4 months at $700 per month equates to $6,000 per year.

5.2.4 Dewatering Recommendations

Alternative 1, Sand Drying Beds, has the highest construction cost. However, the appeal of this alternative is that it can be used without polymer to achieve a very dry solids product. It does not require advanced purchasing or leasing of equipment or chemicals. Drawbacks include a longer processing time to achieve dewatering, a large surface area that would be exposed to the atmosphere.

Alternative 2, Containerized Filter System, could be implemented for the least cost but the site constraints make this option less attractive for storing roll-offs or trailer mounted units. The system requires polymer to be effective. The containers are also used to haul the material to the landfill which reduces the cost of handling.

Alternative 3, Geosynthetic Dewatering Tubes, is like the sand drying bed option with tubes instead of media. The tubes would be placed on a concrete pad with containment walls. The material is not directly exposed to the atmosphere, which limits vector attraction. Polymer allows a 20% solids content to be produced very quickly in a smaller area than Alternative 1. The drawback is that the tubes must be purchased for one-time use and disposed of at the landfill with the solids.

Stantec recommends either Alternative 1 or 3 for dewatering material removed from the oxidation ditches. As this is a critical component needed for maintenance and further process improvements, it is necessary to move forward with implementation quickly.

5.3 INFLUENT GRIT SEPARATION

Preliminary treatment at the TRWWTP consists of coarse screening, raw sewage pumping, fine screening, and grit removal. Coarse screening occurs at the Raw Sewage Pump Station located on the TRWWTP site but separate from the main treatment facility structure. Fine screening via step screen is located within the Headworks area. A grit chamber is located immediately downstream of fine screening to remove small, inert particles commonly referred to as grit. If not effectively removed from the influent, these particles can shorten the effective life span of equipment such as pumps, valves, and pipelines. Grit may also settle out in process tankage and can build over time. Excessive grit buildup leads to operational issues including inefficient and ineffective liquid stream processing and extensive removal and disposal costs.

The grit removal facilities at TRWWTP have continually been an operational and maintenance issue despite dedicated efforts of plant staff to maintain this equipment. Recently, Oxidation Ditch No. 3 was taken offline exposing a significant volume of settled materials, including grit

and organics. It is difficult to remove the settled solids and liquid mixture. There are currently no facilities to dewater or dry the settled solids, making removal and disposal difficult. The following section provides a summary of the existing facilities and recommends both near and longer term improvements for grit removal improvements.

5.3.1 Existing Grit Removal System

The existing grit removal system utilizes a vortexing grit removal chamber composed of a circular concrete vessel, tank internals, pumping, and classifying equipment. The classifying equipment washes the grit to remove organics which are returned back into the main process. A screw auger conveys the dewatered grit to a container for landfill disposal and the excess water is returned to the process downstream of grit removal. **Table 5.1** contains a summary of the existing grit systems design criteria.

The grit removal equipment that is above the liquid level is coated carbon steel. In this application, the age of the equipment is beginning to show signs of deterioration. The coating is failing in several places and small holes are present in the main grit suction pipe above the water surface. The grit removal equipment relies upon a vacuum pump and a pinch valve to pull settled grit from the bottom of the removal chamber and deliver it up to the grit classifier. This pumping system has been quite difficult to maintain and regularly requires significant maintenance time and expense. Several other utilities throughout Colorado have had similar issues with this manufacturer's equipment. Without redundancy, plant staff work very hard to keep the system operational but there are times when the system is out of service and no grit removal is being performed. This material then settles out in the oxidation ditches causing challenges with accumulation, ineffective processes and costs associated with removal and disposal, as stated in the "Oxidation Ditch Solids Dewatering" section. Within the grit chamber galvanized steel baffles and a plate aid in creating the right conditions for efficient settling of grit. Typically, these below water structures do not wear or rust. Plant staff have indicated they believe the baffles to be in good condition.

Table 5.1 Design Criteria for Existing Grit Removal System

Parameter	Units	Value
Grit Removal System Configuration		Vortex
# of Grit Removal Chambers		1 duty, 0 standby
Chamber Volume, approximate	gal	1,200
Hydraulic Retention Time (HRT) at Rated Max. Month Average Daily Flow (2.1 mgd)	sec	49.5
HRT at Peak Hourly Flow (4.5 mgd)	sec	23.1
Design Manual HRT at Peak Hourly Flow	sec	20 - 30 (1)

(1) Source: MOP-8 (WEF, 2010)

5.3.1.1 Grit Classifier

The existing grit classifier system is galvanized steel and was installed with the Phase 1 improvements in 1988. The classifier steel is significantly corroded and there is clear evidence of a bent auger shaft. The hydrocyclone, which sits atop the classifier and pre-concentrates the grit slurry, is a replacement unit for the original and appears to be in adequate condition. The hydrocyclone manufacturer cannot locate specific design documentation for this exact unit and therefore the design criteria is unknown. The original submittal information for the hydrocyclone and grit classifier is not available, but the grit chamber manufacturer submittal indicates a grit removal (Turbo) pump capacity of 225 gpm and 35 ft of discharge head. Thus, we have assumed the hydrocyclone and classifier system each have similar design capacities.

5.3.1.2 Temporary Pump Replacement

Recently, operators decided to remove the problematic vacuum grit pumping system from service and utilize an existing, unused self-priming pump to pull settled grit from the chamber bottom. The temporary 7.5 horsepower (hp) pump is estimated to operate at about 220 gallons per minute (gpm) at about 35 feet of water pressure using flexible hose for suction and discharge piping. With the new pump in operation, plant staff have noticed a significant improvement in the operation of the grit system in terms of volume of grit removed and time spent maintaining the system. Estimates indicate the grit dumpster was filling twice as quickly as before.

While the pump system appears to be performing well, there are several issues with this installation that should be corrected, including:

- Pump motor must be rated for a Class 1, Division 1 environment as defined by the National Fire Protection Association (NFPA) 820.
- Replacement Pump (Dayton Model 12N807) not considered to be reliable in this application over the long-term due to materials and construction – more robust pumping systems are required and available.
- Suction and discharge piping should be hard piped with corrosion resistant stainless steel.

If the temporary pump needs to be replaced for any reason, a new permanent pump is recommended per design criteria indicated in **Table 5.2**. The suction and discharge pipes would also require replacement with custom-fabricated stainless steel (Schedule 40 Type 304). The suction pipe will need to extend down the existing 4-inch withdrawal tube. A pipe with an outside diameter of 3 inches should fit down the existing suction tube. The largest hard piping possible will be expected to wear better than a smaller pipe having higher velocities (> 8 feet per second) of abrasive slurry being pumped. At the design flow rates and smaller piping it may need to be replaced on a more frequent basis than is typical for grit piping. On the discharge side, piping shall be 4 inch nominal schedule 40 Type 304 Stainless Steel.

Table 5.2 Permanent Grit Pump Criteria

Parameter	Units	Value
Pump Type	--	Self-priming centrifugal
Pump Supplier / Model	--	Gorman Rupp T4B
Quantity	#	1 duty, 0 standby
Maximum Hydraulic Capacity	gpm	250 (1)
Maximum Pressure at Maximum Capacity	ft	35 (1)
Motor Size / Type	Hp	7.5 / Constant speed
Classification	--	Class 1, Division 1

(1) Estimated value, to be confirmed during detailed design phase

Our estimate of probable cost to implement grit removal improvements is $130,000.

5.3.2 Conclusion for Near-Term Grit Removal Improvements

For the near-term, the temporary grit pumping equipment modifications are adequate. Permanently replacing the grit pump would be warranted if the existing headworks were to be integrated as part of the plant expansion. However, as part of the long-term planning, it is likely that a new headworks will be constructed and the existing grit removal system will become obsolete.

5.4 OXYGEN TRANSFER IN THE OXIDATION DITCHES

The oxygen transfer capacity of the existing surface aerators in the oxidation ditches limits the TRWWTP's ability to process influent organic loads. The relatively high organic loading to the TRWWTP quickly exhausts the available oxygen. Supplemental oxygen transfer is needed to increase the organic treatment capacity permitted by the Colorado Department of Public Health and Environment (CDPHE). It is estimated that organic loading to the TRWWTP will reach 95 percent of the permitted capacity by as early as year 2020 and no later than 2023. The 95-percent threshold is identified in the TRWWTP discharge permit as the point when construction of capacity improvements must be underway. These capacity improvements would allow the TRWWTP to continue operation of the existing facility for another 5 to 10 years.

Projections for the year 2028 establish the criteria for organic capacity based on the total 5-day Biochemical Oxygen Demand ($tBOD_5$) of 4,900 lb/day. Near-term improvements for supplemental aeration would allow the Town to operate the TRWWTP before a major expansion and upgrade is required to meet the Regulation 85 discharge limits. To meet this $tBOD_5$ rating, the total actual oxygen requirement for BOD_5 and Total Kjeldahl Nitrogen (TKN) would be 8,934 lbs O_2/day. The existing aerators' actual oxygen transfer capacity at 12 inches of immersion is

currently 5,765 lbs O_2/day. The required amount of actual supplemental oxygen would be 3,169 lbs O_2/day.

Adjusting the actual oxygen requirement to standard conditions, the total standard oxygen required to supplement the existing capacity was determined to be 8,265 lbs O_2/day or 2,755 lbs O_2/day per ditch. The total standard oxygen requirement (existing + supplemental) to meet anticipated loading in the year 2028 is approximately 22,000 lbs O_2/day.

The alternatives considered for supplemental oxygen in the oxidation ditch wastewater use the following primary types of aeration systems:

- Supplemental Oxygen Alternative 1: Mechanical Surface Aeration
- Supplemental Oxygen Alternative 2: Diffused Aeration
- Supplemental Oxygen Alternative 3: Jet Aeration
- Supplemental Oxygen Alternative 4: Liquid Oxygen Saturator

5.4.1 Supplemental Oxygen Alternative 1: Mechanical Surface Aeration

The existing aeration system uses horizontal shaft surface aerators driven by 40-HP motors to entrain air within the top several feet of wastewater. The aerators also push wastewater flow around the oxidation ditch channel to maintain a minimum horizontal velocity. Deflector plates located downstream from the aerators are designed to force the flow of wastewater deeper into the channel to increase the contact time for air bubbles before they reach the surface. The transfer of oxygen is greater when air bubbles remain in contact with the wastewater longer.

The wastewater entering the oxidation ditches exerts a demand for oxygen, measured as biochemical oxygen demand, or BOD. As the wastewater travels around the ditch, specialized micro-organisms consume carbon compounds and ammonia while metabolizing the available dissolved oxygen. As flow passes by the aerators, dissolved oxygen is added to the wastewater. The amount of oxygen transfer corresponds with the motor horsepower driving the aerators and the volume of wastewater entering the basins.

The aerators installed at the TRWWTP are manufactured by Lakeside. Per the manufacturer, the existing aerators cannot be expanded simply by increasing motor horsepower. To obtain an increase in oxygen transfer, the entire aeration system must be replaced with a larger system. There are two surface aerators in operation in each oxidation ditch. An expanded system was offered by Evoqua that would upgrade the current 40-HP drives to 60-HP units for a maximum power requirement of 360-HP. Variable frequency drives could be added to the system to save energy since the demand for oxygen changes daily and seasonally. It is likely that new motor starters, control panels, conduit and wiring are required to upsize the drives. Torque Tubes, bearings, splash shields, and anchor bolts should be reused to the extent possible. Other improvements to supports and electrical systems may be required. Evoqua proposes six 60-HP gearboxes and motors with 186 discs be supplied as new equipment. **Figure 5.2** shows the

proposed disc surface aerators for replacement of the existing brush type aerators. The photo does not show the hood that covers the discs in a typical application.

The current aerator starters for the 40 HP motors are size 3; therefore, a new size 4 starter would be required for each motor. It is possible that the new size 4 starter may fit into the existing MCC bucket for each motor, both in the Siemens lineup and the Square-D lineup. It is important to note that this replacement still must maintain the UL listing of the MCC. There may be some hidden costs associated with maintaining the UL listing, for example instead of allowing just the replacement of the starter, the whole bucket may need to be replaced.

With the upsize in motor and starter we would also be required to upsize the wiring from the starter to the motor from #8's to #2's (3#2, 1#8 GND/ motor). Assuming the controls for these aerators would stay the same we would assume the control wiring could remain intact. We also concluded that existing raceways could be utilized from the MCC to the motor. Each disconnect would need to be replaced to accommodate the upsize in HP. The current disconnects are 100-A and we would recommend a new 200-A disconnect for each aerator.



Figure 5.2 Disc-type Surface Aerators

Image source: Evoqua.

Refer to **Appendix B.1** for the conceptual proposal to replace the mechanical aerators using the Evoqua disc aeration system. The estimated cost to complete the full replacement of the mechanical surface aerators is $850,000.

5.4.2 Supplemental Oxygen Alternative 2: Diffused Aeration

Diffused aeration uses compressed air from a blower piped to the bottom of the oxidation ditch and distributed to a series of diffusers. This creates small bubbles that release into the wastewater. Diffused aeration is typically installed in deep aeration basins (depth greater than 15 feet) to maximize oxygen transfer. The water depth in the oxidation ditches is approximately 12.5 feet. The benefit to cost ratio of diffused aeration decreases in shallower basins.

At the TRWWTP, diffused aeration would augment oxygen transferred by the existing surface aerators. The major drawbacks to adding diffusers in the TRWWTP oxidation ditches are:

- Requires materials installed to withstand the velocity of flow around the ditch channels
- Obstructs solids removal and regular maintenance activities because diffusers are installed at the bottom of the ditch
- Requires new blowers, air piping and electrical equipment within limited space

Based on these drawbacks and the decreased benefit at the shallow water depth, diffused aeration is not considered a viable alternative.

5.4.3 Supplemental Oxygen Alternative 3: Jet Aeration

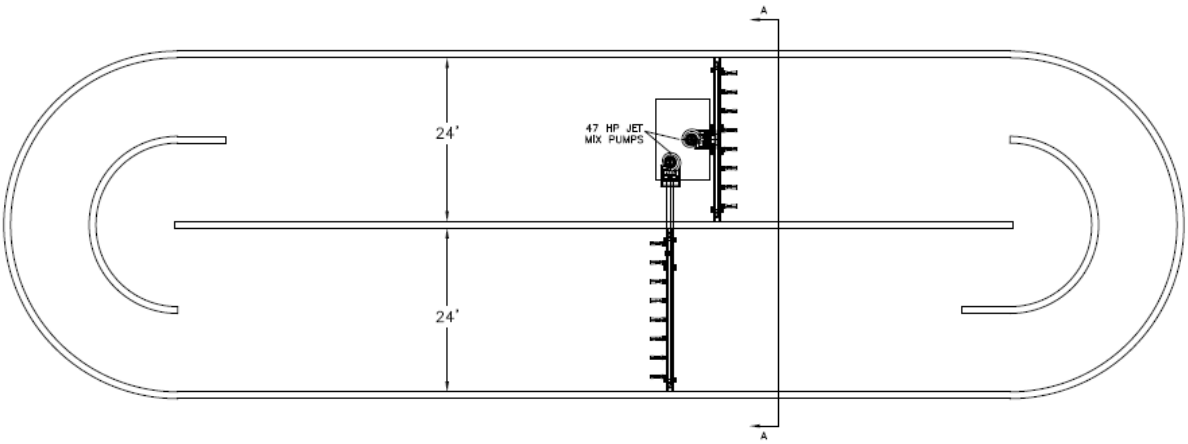
Jet aeration uses pumps to draw air into the pumped discharge. The water and air mixture is jetted into the wastewater using nozzles. Two types of jet aerators were evaluated:

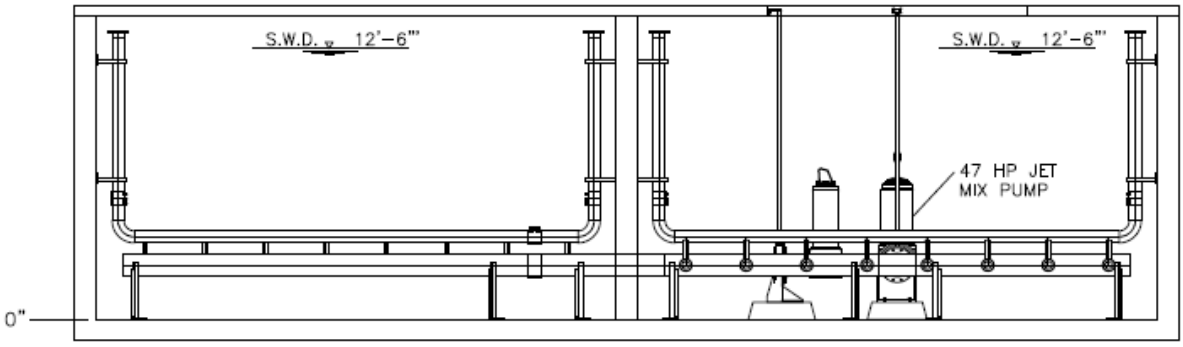
- Jet Aeration Option A: Submersible pumps and floor-mounted nozzles
- Jet Aeration Option B: Bridge mounted pump and regenerative blower

<u>Jet Aeration Option A</u>

Option A features submersible pumps and floor-mounted nozzles on a header at the bottom of each oxidation ditch to increase dissolved oxygen. The jet of water also increases the velocity of flow moving around the ditch channel. Jet aeration can also use blowers to force air into the pumped discharge which decreases the pump motor size. A proposal from Fluidyne Corp. presents a conceptual design and cost for two units for each oxidation ditch. Each unit consists of a submersible pump on a guiderail, and a pipe header with a row of nozzles across the bottom of the basin. Access would be through one or two openings cut into the roof structure. Option A for jet aeration requires an additional 282-HP over the existing 240-HP used for the existing 6 surface aerators for a total of 522 HP. **Figure 5.3** shows a photo and concept plan of the nozzles and pumps running along the bottom of an oxidation ditch. Proposals for equipment by Fluidyne are provided in **Appendix B.2.**







SECTION A–A

Figure 5.3 Jet Aeration Nozzle and Pump Configuration
Image source: Fluidyne Corp

The major drawback of the floor-mounted jet nozzles and submersible pump of Option A is the time required for the oxidation ditch to be drained and cleaned to allow installation. The time required for the installation of floor-mounted nozzles would not work within the 2-month timeframe that an oxidation ditch could be taken out-of-service. Maintenance activities would not be significantly hindered since the floor-mounted jets cover a relatively small area of the oxidation ditches. The estimate of cost for Option A is approximately $1,000,000.

Jet Aeration Option B

Option B uses a pump and regenerative blower combination that is attached to the bridge structure adjacent to the existing surface aerators. Each unit has a single jet tube that extends into the wastewater as shown in **Figure 5.4**. Option B requires an estimated 175-HP for the pumps and blowers in addition to the power rating of the existing aerators (refer to **Appendix B.3**).



Figure 5.4 Aire-O2® Triton Series Jet Aeration System with Regenerative Blower
Photo source: Aeration Industries International

The benefit of the bridge mounted unit is that it can be installed independently of the existing aeration system. This allows flexibility in the placement of equipment and how it is powered. The power supply and control panels could be located on top the ditches using weather proof enclosures. The drawback of both Jet Aeration options is the operating cost, which is estimated at $60,000 to $75,000 annually depending on usage. The estimated cost for Option B to install jet aerators mounted to the side of the basin is $800,000.

5.4.4 Supplemental Oxygen Alternative 4: Liquid Oxygen Saturator

High purity oxygen gas can be dissolved into water, or a side stream of wastewater, using a pressurized tank. The highly-oxygenated water would be combined with the main stream or to each oxidation ditch. The system requires liquid oxygen on site which is typically delivered by a

contract supplier. Several options were offered by BlueInGreen using their SDOX® process (see **Appendix B.4**). Each SDOX® unit is skid-mounted, factory tested, complete with pump, stainless-steel vessel, instrumentation and control panel, and all interconnection piping.

Two capital purchase options are offered: a) three SDOX-300 units, each dedicated to one oxidation ditch; and, b) one SDOX-600 unit for a single point of injection prior to the split between the oxidation ditch basins. The unit(s) would be installed in a new building with a liquid oxygen tank placed outdoors near the building.

The estimate of probable cost for the equipment, a new building, the electrical supply and the pipe connections for Option a), using three units is $900,000. The cost estimate to implement Option b) is approximately $700,000.

The cost for liquid oxygen supplied by Praxair, Inc. in Loveland, Colorado would likely range from $100 to $200 per day ($37,000 to $74,000 per year).

A third option allows for leasing on a short-term or long-term basis. A short-term rental for a containerized unit is $11,000/month with a three-month minimum period. The long-term lease option provides the TRWWTP with terms for ownership after 5 years.

5.4.5 Recommended Alternative for Supplemental Oxygen

The estimated cost to replace the surface aeration equipment with new discs, 60-HP motors and gearboxes is similar in cost to the alternative jet aeration equipment. The biggest benefit of Alternative 3B with surface mounted jet aerators and blowers is the system can be installed and maintained without taking the existing system out of service. Energy costs for the surface aerators is approximately 20% less than the anticipated cost of the jet aerators. However, jet aerators can easily be turned off during low loading seasons allowing the existing surface aerators to operate as the base aeration equipment. The floor-mounted jet aeration option cannot be implemented without negatively impacting operations. The pure oxygen system proposed by BlueInGreen is competitively priced and could be integrated into the long-term expansion plan. Alternative 2B or 4 is the preferred process for supplemental oxygen.

The process to expand the aeration system capacity and re-rate the organic capacity of the TRWWTP should be started in 2017. CDPHE requires approval of all processes that increase or decrease the rated capacity of the TRWWTP per Regulation 22, Site Location and Design Review. This process to rerate plant capacity is significantly more exhaustive than the amendment process to approve construction of sand drying beds. Design should be completed and approved before the end of 2017 so that bidding and construction can start in 2018.

The CDPHE was originally scheduled to implement nutrient removal requirements of Regulation 85 for the TRWWTP in the year 2023. An option was considered for re-rating the hydraulic capacity to 1.99 MGD (from the current rating of 2.1 MGD). This minor hydraulic modification is

intended to extend the timeline for Regulation 85 from 2023 to 2028. Thus, by re-rating the TRWWTP hydraulic capacity and increasing the aeration capacity, the TRWWTP would meet temporary permit limits until the year 2028. This may be moot as the San Miguel River basin is considered a low-priority watershed and the requirements of Regulation 85 appear at this time to have been modified to apply to the TRWWTP in 2027. Therefore, no hydraulic re-rating is recommended.

5.5 STRUCTURAL ASSESSMENT

A condition assessment was conducted in November 2016 to identify limitations or defects in visible structures at the TRWWTP. A report of findings is presented in a technical memo in **Appendix C**. The most notable finding is that the coatings on structural steel supports in Oxidation Ditch #1 are failing. These steel supports are located inside the basin exposed to a corrosive environment. Where the coating has failed (i.e., delaminated), the steel is corroding. Rehabilitation is recommended as part of improvements to be implemented within Oxidation Ditch #1.

The extent and cost of coating system rehabilitation in Oxidation Ditch #1 needs to be further developed by contractors who specialize in this type of work. The goal for rehabilitation efforts is to gain at least ten more years of useful life, such that, when the plant is expanded in 2027, the long-term plan for the existing structure will dictate any additional rehabilitation.

5.6 ELECTRICAL ASSESSMENT

An assessment of the condition of electrical system components at the TRWWTP was performed in November 2016. The electrical system appears to be in good condition but several violations of the current electrical code were identified. Some of these code issues are basic (wires not in conduit, or junction boxes not enclosed). Others have greater ramifications that would require explosion-proofing and additional ventilation.

The potential to add equipment to existing motor control centers and distribution panels is of critical concern. The space constraints at the TRWWTP limits options for adding new electrical equipment, such as Motor Control Centers.

A report of findings is presented in a technical memo in **Appendix D**.

5.7 SUMMARY

The Telluride RWWTP requires several near-term improvements to address capacity and operational limitations. **Table 5.3** lists each improvement with advantages and disadvantages. Each are summarized below:

- The most immediate need is for a drying process to accommodate maintenance of the oxidation ditch basins. Sand drying beds provide options for multi-purpose use, such as

biosolids drying. The conceptual plan is to construct drying beds using cast-in-place concrete on top the digester basins. Stantec recommends sand drying beds for the maintenance needs of the oxidation ditches at the TRWWTP. Construction approvals for drying beds by CDPHE and San Miguel County should be implemented immediately for construction to start in 2017.

- Aeration improvements are needed to expand the oxygen transfer capacity and the organic capacity rating of the TRWWTP. The two mechanical alternatives that were developed have similar cost impacts and are both capable of meeting future demands projected to the year 2028.

  - Alternative 1: Replacing the existing aerators with disc aerators requires a staged approach because each ditch must be taken out of service. Alternative 1 has the highest capital cost but low operating cost with lower motor horsepower.

  - Alternative 2: Surface-mounted jet aerators could be constructed while each oxidation ditch remains in service. Alternative 2 would be easy to install but incur higher operating cost with greater motor horsepower.

  Alternative 4 is a viable alternative using a pressure vessel to dissolve liquid oxygen in a side stream of influent wastewater, which is blended with the full flow. Alternative 4 could be implemented for the least capital cost and could be utilized in the future expansion project for the long-term. The main drawback is the safety concerns with storing liquid oxygen on site.

  Stantec recommends Alternative 4.

- Several structures were identified as having corrosion that can be addressed during the near-term improvements. Specifically, the corrosion found in the oxidation ditches should be corrected while each basin is taken out of service for cleaning. The extent of the work should be further developed when each basin is drained.

- Electrical upgrades are required to meet building and fire protection codes. The improvements include upgrades for explosion-proofing, motor control centers and control systems that are directly related to unit process modifications. Depending on the improvements that are implemented, the required electrical upgrades may differ greatly between options.

- Grit removal equipment is currently operating adequately using the temporary grit pump and piping modifications. Permanent upgrades should include a new grit pump with improved suction and discharge piping connections. However, the plant expansion will require new equipment in a new building that would make the existing grit removal system obsolete. The grit system improvements are currently considered low priority.

Table 5.3 Summary of Near Term Improvements Analysis. Recommended option is in bold.

ISSUE	OPTIONS ANALYZED	ADVANTAGES	DISADVANTAGES	PROBABLE COST, $
1. OXIDATION DITCH SOLIDS DEWATERING IMPROVEMENTS				
	Sand Drying Beds	- **No polymer needed.**	- **Highest construction cost.** - **Influenced by precipitation**	**Annual O&M[1] = 2,000 ?** **Capital = 200,000**
	Containerized Filter System		- Most expensive annually - Polymer needed - There is limited space at TRWWTF to place the units - Poor aesthetics	Annual O&M[2] = 2,000+6,000+1400 Annual Container Rental = 24,000 Container Purchase, 3 units = 100,000
	Geotextile Dewatering Tubes	- **Simplified clean up**	- **Polymer needed**	**Annual O&M[2] = 2,000+6,000** **Capital = 180,000**
2. INFLUENT GRIT SEPARATION IMPROVEMENTS				
	Existing system, including vortexing grit removal chamber, grit classifier, pumps	- Most cost-effective option until future plant expansion	- Not the ideal system, but it is working well enough	0.00
3. OXYGEN TRANSFER IN OXIDATION DITCHES				
	Mechanical surface aeration, Evoqua disc aeration	- Uses existing layout - Energy costs ~20% less than for jet aeration		Annual O&M = Capital = 850,000
	Diffused Aeration		- Requires materials installed to withstand velocity of flow - Obstructs solids removal and regular maintenance activities - Requires new blowers, air piping and electrical equipment	

ISSUE	OPTIONS ANALYZED	ADVANTAGES	DISADVANTAGES	PROBABLE COST, $
	Jet Aeration A, submersible pumps and floor-mounted nozzles		- Installation would require taking an oxidation ditch out of service for longer than 2 months - Would interfere with solids removal and regular maintenance activities	Annual O&M, est. energy cost = 60,000 – 70,000 Capital = 1,000,000
	Jet Aeration B, bridge-mounted pump and regenerative blower	- Can be installed and maintained without taking existing system out of service. - Can be turned off during low loading, allowing existing surface aerators to operate		Annual O&M, est. energy = 60,000 – 70,000 Capital = 800,000
	Liquid Oxygen Saturator		- **Requires a separate new building** - **Requires purchase and storage of liquid oxygen**	**Annual O&M, liquid oxygen supply = 37,000 – 74,000** **Capital = 700,000 – 900,000**
4. STRUCTURAL IMPROVEMENTS TO EXISTING STRUCTURE				
	Rehabilitate Oxidation Ditch #1	- **Gain up to 10 years of useful life**		
5. ELECTRICAL IMPROVEMENTS TO EXISTING STRUCTURE				
	Upgrades for explosion-proofing, motor control centers, and control systems	- **Brings site up to code.**		

[1] Baseline O&M is assumed to include a skid steer or mini-excavator to remove material from the drying beds and trucks to haul the material to the dump, includes tipping fees.
[2] Cost to remove each container or filled tube and haul it to the dump, includes tipping fees.

6.0 LONG-TERM IMPROVEMENTS PLAN

The towns of Telluride and Mountain Village are planning the expansion of the Telluride Regional Wastewater Treatment Plant (TRWWTP) to meet the needs of the communities served and the requirements of the discharge permit. The TRWWTP serves three distinct areas:

1. Town of Telluride
2. Town of Mountain Village
3. Unincorporated Areas of the County within the service area (including Lawson Hill, Aldasoro, and Hillside)

In addition, the TRWWTP receives wastewater from commercial sources including septic haulers and the local brewery.

This section presents the design criteria and conceptual alternatives for the long-term planning for the facility expansion. The projected flow and loading conditions, and anticipated discharge permit limits establish the design criteria for the plant expansion. Several options for liquid stream treatment are described and the most appropriate are further developed for planning. Two site alternatives are presented for expanding the plant:

1. Retrofit and expand existing plant
2. New plant on adjacent site

One additional option for a new plant on a new site was discussed briefly. The plant would be a small liquid processing facility treating wastewater collected from the Town of Telluride. The plant size would be less than 0.5 MGD allowing the existing TRWWTP to be upgraded but not expanded.

The immediate need for treatment and disposal of biosolids was discussed in the near-term improvements plan. However, the long-term goal is to treat biosolids to Class A standards. This section lays out a plan to achieve this goal.

6.1 DESIGN CRITERIA

Flow and loading criteria for the expansion of the TRWWTP were developed from past and present resident and visitor populations, estimates of commercial wastewater generated, and wastewater monitoring of the influent sewage. Design parameters for the long-term planning period extend to the year 2047. A summary of the characterization of influent wastewater is presented, along with a discussion of current and anticipated water quality requirements.

6.1.1 Wastewater Characterization

Wastewater influent varies significantly depending on the time of day, the day of the week, and the season. The flow projections assume a standard unit flow rate for residents and visitors, and estimated flow rates for commercial customers. A frequency analysis of existing flow data provided the ratios applied to the annual average flow to estimate the maximum month average, maximum week average, and peak day estimates. Similar criteria are used for the organic loading of the plant. These design criteria giving the facility the flexibility to function during varying conditions. **Table 6.1** shows influent flow projections from each area for the year 2047.

Table 6.1 Projected TRWWTP Influent Wastewater Design Flow Criteria (2047)

Influent Flow Criteria (MGD)	Town of Telluride	Town of Mountain Village	Unincorporated Areas Serviced	Commercial & Septage	Total
Annual Avg Daily	0.756	0.464	0.113	0.017	1.350
Max Month Avg Daily	1.134	0.696	0.170	0.028	2.028
Max Week Avg Daily	1.323	0.812	0.198	0.034	2.367
Peak Day	1.512	0.928	0.226	0.054	2.720
Peak Hour					5.250

The 2047 projections for BOD_5 loading to the TRWWTP are summarized in **Table 6.2**. These projections were developed using standard unit loading rates for domestic and commercial/ septage wastewater.

Table 6.2 Summary of Projected TRWWTP BOD_5 Loading Criteria (2047)

Influent BOD_5 Criteria (lbs/day)	Town of Telluride	Town of Mountain Village	Unincorporated Areas Serviced	Commercial & Septage	Total
Annual Avg Daily	1,840	1,130	280	753	4,003
Max Month Avg Daily	2,760	1,700	420	1,125	6,005
Max Week Avg Daily	3,220	1,980	490	1,315	7,005
Peak Day	3,680	2,260	560	1,505	8,005

The five-day Biochemical Oxygen Demand, BOD_5, is calculated using the following equation:

BOD_5, mg/L = BOD_5, lbs/day / (8.34 x Flow, MGD)

= 4,003 lbs/day / (8.34 x 1.35 MGD)

BOD_5, mg/L = 356 mg/L

The calculated BOD_5 concentration compares well with operating records from 2015 and 2016. The wastewater parameters shown in **Table 6.3** are proposed for conceptual design of the expanded TRWWTP.

Table 6.3 Proposed Design Parameters for Influent Wastewater to the TRWWTP

Design Parameter	Avg Annual Value (mg/L)
Five-day Biochemical Oxygen Demand, BOD_5	350
Carbonaceous BOD_5, $cBOD_5$	290
Chemical Oxygen Demand, COD	880
Soluble COD, sCOD	350
Total Phosphorus, TP	7.0
Soluble TP, sTP	5.0
Total Nitrogen, TN	50
Nitrate + Nitrite, NO_2+NO_3	1.0
Total Kjeldahl Nitrogen, TKN	49
Soluble TN, sTN	42
Soluble NO_2+NO_3, sNO_2+NO_3	0.6
Soluble TKN, sTKN	40
Ammonia-Nitrogen, NH3-N	35
Total Suspended Solids, TSS	250
Volatile Suspended Solids, VSS	225

The values in **Table 6.3** were determined based on ratios calculated from the influent monitoring from 24-hour composite samples collected by plant staff in December 2016, which represent the maximum week wastewater loading conditions. The maximum week condition provides design parameters that are representative of peak events for the service area. Test results from sampling over the peak loading in December 2016 are summarized in **Table 6.4** below.

Table 6.4 Influent Wastewater Test Results (December 20, 2016 – January 1, 2017)

Test Parameter	Average (mg/L)
Five-day Biochemical Oxygen Demand, BOD_5	455
Carbonaceous BOD_5, $cBOD_5$	374
Chemical Oxygen Demand, COD	1152
Soluble COD, sCOD	438
Total Phosphorus, TP	7.0
Soluble TP, sTP	5.0
Total Nitrogen, TN	56
Nitrate + Nitite, NO_2+NO_3	1.0
Total Kjeldahl Nitrogen, TKN	55
Soluble TN, sTN	47
Soluble NO_2+NO_3, sNO_2+NO_3	0.6
Soluble TKN, sTKN	46
Ammonia-Nitrogen, NH3-N	36
Total Suspended Solids, TSS	709
Volatile Suspended Solids, VSS	694

6.2 FUTURE EFFLUENT LIMITS

This section summarizes potential future effluent regulations as they may apply to the TRWWTP. After summarizing the effluent water quality regulations, there is discussion about the recommended approach for TRWWTP at the Master Planning level. The current political climate nationally and locally is increasing the uncertainty about what limits may be applied and when they might be adopted into a new discharge permit.

6.2.1 Water Quality Requirements

The Colorado Water Quality Control Division sets policy and adopts regulations that drive effluent limits and water quality requirements for the San Miguel River, the receiving stream identified by the Hydrologic Unit Code 14030003b. The Division is in the process of revising Regulation No. 85 and the effluent limits that will impact the TRWWTP. Regulation No. 31 establishes the basic standards and methodologies for surface water.

6.2.2 Regulation No. 85

Regulation No. 85 (Water Quality Control Commission [WQCC], 2012] implements technology-based nutrient control requirements for the entire state and was adopted by the WQCC to promote progress toward reducing nutrient loadings to surface waters based on existing economically-viable treatment technologies. Regulation No. 85 effluent nutrient limits are summarized in **Table 6.5**.

Table 6.5 Regulation No. 85 Effluent Water Quality Limits

Parameter	Units	Effluent Quality Limitations(1)	
		Annual Median(2)	95th Percentile(3)
Total Phosphorus (TP)	mg/L	1.0	2.5
Total Inorganic Nitrogen (TIN)(4)	mg/L	15	20

(1) Regulation No. 85 – Nutrient Management Control Regulation (WQCC, 2012)
(2) Median on all samples taken in the most recent 12 calendar months
(3) 95th percentile of all samples taken in the most recent 12 calendar months
(4) Defined as the sum of nitrate (NO3-N), nitrite (NO2-N), and ammonia (NH3-N)

6.2.3 Regulation No. 31

Regulation No. 31 (WQCC, 2013) sets forth nutrient surface water quality criteria that form the basis for water quality based effluent limits (WQBELs). Data collection and evaluation are conducted to establish sound wastewater treatment requirements based on the applicable water quality standards. The nutrient rule was approved by the WQCC in 2012 with the presumption that the criteria would not be established as enforceable water quality standards until May 2022, except in limited cases. The in-stream total phosphorus (TP) and total nitrogen (TN) values for warm-water and cold-water streams are indicated in **Table 6.6**. The San Miguel River is considered a cold water receiving body.

Table 6.6 Regulation No. 31 Effluent Nutrient Limits

Parameters	Units	Water Quality Standards(1) (2)	
		Cold Water	Warm Water
Total Phosphorus (TP)	mg/L	0.11	0.17
Total Nitrogen (TN)	mg/L	1.25	2.01

(1) *R*egulation *No. 31* – Nutrient Management Control Regulation (WQCC, 2013)
(2) Annual median, allowable expedience frequency, once in five years

Both regulations will have a very significant impact on existing facilities, requiring a substantial upgrade to existing secondary processes. Tertiary treatment will be required to meet Regulation No. 31 limits, whose effluent values push the limits of technology for nutrient removal.

6.3 RECOMMENDED PLANNING TO MEET FUTURE LIMITS

Historically, the TRWWP has only had to meet 30-day effluent permit limits. Some utilities in Colorado are required to meet limits with tighter time-frames, such as maximum week or maximum daily criteria. Generally, these requirements are due to downstream drinking water supplies in more populated areas than southwest Colorado. These shorter duration limits do allow for higher effluent values than the 30-day averages, but can become problematic for some utilities, especially utilities like TRWWTP which experience dramatic swings in plant loading due to the impacts of large festivals and winter activities. Currently, such limits are not expected for TRWWTP. However, they may occur in the future and such limits may require an upgrade to existing secondary precesses, or implementation of new tertiary treatment processes.

The following subsection discusses the planning-level limits considered for the Master Plan.

6.3.1 Nutrient Limits

Regulation 85 would lower effluent nutrient limits for the TRWWTP unless the Division decides to designate the San Miguel basin as a low-priority watershed, which appears imminent. Low-priority watersheds may be allowed additional time before Regulation 85 limits are adopted into discharge permits. **Table 6.7** summarizes the first phase of effluent limits recommended for consideration with this Master Planning effort. The timing and certainty of these limits is unclear; however, there is a long-term general trend nationwide to reduce effluent nutrients and over the long-term this trend is expected to continue for effluent nutrients such as phosphorus and nitrogen.

Table 6.7 Near-Term Effluent Limits (< 10 years out)

Parameters	Units	Value
$tBOD_5$	mg/L	30
TSS	mg/L	30
NH_3-N	mg/L	1.0
Total Phosphorus (TP)	mg/L	1.0
Total Inorganic Nitrogen (TIN)	mg/L	10

(1) *All effluent limits assumed to be 30-day averages, year-round*

Longer-term effluent nutrients limits for phosphorus and/or nitrogen species may continue to move lower towards the limits of current technology. For reference, the effluent nutrient values

proposed in Regulation 31 (shown in **Table 6.6**) are at the limit of current technologies for nutrient removal. This shift on effluent nutrients is expected to be longer-term, 10 to 20 years. Longer-term effluent nutrient limits considered for the Master Plan are summarized in **Table 6.8**.

Table 6.8 Long-Term Effluent Nutrient Limits (10 - 20 years out)

Parameters	Units	Value
$tBOD_5$	mg/L	5
TSS	mg/L	5
NH_3-N	mg/L	1
Total Phosphorus (TP)	mg/L	0.2
Total Inorganic Nitrogen (TIN)	mg/L	3 - 5

(1) *All effluent limits assumed to be 30-day averages*

Reducing effluent nitrogen to both the near and long-term limits can be achieved using biological means. Long-term nitrogen limits may require an external carbon source to facilitate denitrification to levels below 8 mg/L. The typical source of carbon is methanol, which has health and safety implications. A local, low-cost alternative may include the carbon in weak wort, a waste product of the Telluride Brewing Company. Additional investigation and testing would be required to confirm this carbon source is acceptable for use, and reliably available in sufficient quantity. Achieving effluent TP limits lower than 1.0 mg/L leads toward a tertiary removal process involving metal salt addition and a filtration unit process.

6.3.2 Metals Limits

The TRWWTP discharge permit currently limits several metals in the plant effluent. Three of these regulated metals have limits that plant operators are watching closely: copper, arsenic and selenium. Selenium monitoring showed occasional spikes in the effluent that may simply be outliers or errors in sampling or testing. The selenium test results from influent and effluent monitoring at the TRWWTP normally showed levels below the detection limit.

Arsenic occurs in streams throughout the watershed and may require additional treatment depending on the results of toxicology studies by the US EPA. These studies may not be completed for several years and the impacts on the TRWWTP effluent limits are unknown.

The compliance schedule for copper was extended to January 1, 2018. The sources of metals in the TRWWTP influent appear to be associated with corrosion of copper drinking water service lines. Telluride and Mountain Village should continue assessing their water sources and adjust their corrosion control programs, as needed. The Aldasoro water system should also investigate potential copper corrosion from their drinking water. Additional treatment may have to be implemented at the TRWWTP if these efforts are unsuccessful.

6.3.3 Emerging Contaminants of Concern

Several landmark studies have reported adverse impacts of endocrine disrupting chemicals (EDCs), pharmaceuticals, and personal care products (PPCPs) to the reproductive health and survival of various aquatic species. Since regulations are in place to protect aquatic species from adverse impacts caused by effluent discharges, reduction and/or elimination of these contaminants are expected to be part of future regulations. However, there is no clear indication of how or when these emerging contaminants of concern will be regulated. As a start, the TRWWTP could begin monitoring classes of contaminants to establish background levels. **Table 6.9** gives a partial list of contaminants to be considered for monitoring.

Table 6.9 List of Emerging Contaminants of Concern

Group	Constituents
Hormones	Estradiol, Estrone
Pharmaceuticals	Gemfibrozil, Ibuprofen, Naproxen, Triclosan, Diazepam, Fluoxetine, Primidone, Trimethoprim, Atorvastatin, Azithromycin, Caffeine, Ciprofloxacin, Cotinine, Meprobamate, Sulfamethoxazole, Methadone, Atenolol, Carbamazepine, Dilantin, Diclofenac, Amoxicillin, Phenytoin, Salicylic Acid
Flame Retardants	TCEP, TCPP, TDCPP
Industrial EDCs	Bisphenol A, Octylphenol, Nonylphenol monoehtoxylate
Organics	DEET, Musk Ketone, BHA, Atrazine, Benzophenone, 1,4-Dioxane
Ozone By-Products	Formaldehyde, Acetaldehyde, Ethyl Glyoxal, Propanol, NDMA

Research has shown that many of these contaminants can be destroyed or transformed using advanced oxidation, which uses a combination of an oxidant, such as chlorine, and UV irradiation. Oxidation using CleanB® treatment may also destroy some emerging contaminants in biosolids but no definitive studies have been conducted to date.

6.3.4 Temperature

Recent work sessions by the Colorado Water Quality Control Division have produced some preliminary criteria being considered for temperature standards in the San Miguel River through Telluride. The Town has been monitoring water temperature in the San Miguel River for many

years and will continue monitoring at existing and new locations to assess impacts from the TRWWTP effluent.

6.4 PRETREATMENT PROCESS ALTERNATIVES

The existing headworks at the TRWWTP are in poor shape. Equipment and concrete are aging and showing signs of significant corrosion. Furthermore, the existing headworks are in a confined space with little opportunity to complete significant improvements while maintaining treatment. Therefore, it is recommended that a new headworks be constructed. A new headworks building would house new pretreatment equipment compatible with the secondary and tertiary processes proposed.

The goals of pretreatment are to protect subsequent processes and equipment and provide for the end use of biosolids. For example, the existing oxidation ditch basins and pumping equipment benefit from wastewater that is free from grit and trash. Likewise, trash mixed in biosolids is detrimental for some applications/beneficial uses.

Most advanced wastewater treatment processes require higher removal capabilities for headworks equipment. For membranes and many new technologies, the equipment should be protected, and to ensure a long life, more intensive pretreatment is required to remove inorganic particles and fibers. Fine screens with 1 to 2 mm perforated plate openings are the industry standard for membranes. Effective grit removal is also necessary. "Traditional" vortex-type grit chambers, like the existing unit at TRWWTP, are not preferred and higher performing technologies such as Pista-Grit V-baffle and the Eutek Headcell are preferred for the application. Screenings and grit removed from the raw wastewater would be further processed for disposal at the landfill.

Improved headworks have several benefits for TRWWTP, including:

- Improved rotating equipment wear, longer life and less maintenance costs
- Reduced accumulation of grit in process reactors
- Improved biosolids quality and appearance – this is especially important for Class A biosolids facilities to improve the consistency and aesthetics of the product, and help in reducing the "yuck factor"
- A new headworks building, separate from the other process buildings will allow systems to be compliant with National Fire Protection Association (NFPA) 820 requirements

The cost to construct a new headworks building assumes equipment would be installed to accommodate the influent sewer elevations. Pretreatment equipment includes redundant fine-screening units, grit removal, flow measurement, and influent sampling. The capacity of the headworks is based on a peak hour hydraulic flow rate of 5.25 MGD. The building footprint is assumed to have 1,200 square feet (refer to **Figure 6.1**). Headworks are classified spaces that must meet applicable building codes that address fire hazards associated with explosive gasses. The estimated cost for headworks construction is $2,000,000.



Figure 6.1 Proposed TRWWTP Headworks Building

6.5 SECONDARY TREATMENT PROCESS ALTERNATIVES

Secondary treatment of wastewater is normally achieved using conventional activated sludge processes using aeration basins and clarifiers to grow micro-organisms in balance with the incoming food (wastewater load). The micro-organisms are separated from the clarified water and returned to the process (return activated sludge) or removed (waste activated sludge) for digestion, thickening, dewatering, and beneficial reuse. The existing oxidation ditch process used by the TRWWTP is an extended aeration activated sludge process characterized by long retention times and large aeration basins. The large aeration basins provide flexibility to handle varying wastewater loads while meeting BOD_5, TSS and NH_3-N limits. However, near-term effluent nutrient limits require an upgraded process capable of meeting future limits for very low nitrogen and phosphorus. Phosphorus can be removed in two general ways, biologically through uptake by microbes and by chemical coagulation and settling. In both situations, the phosphorus is collected with the biosolids for disposal. Biological removal requires an anaerobic pretreatment zone, or selector basin. Chemical removal requires continuous feed of a metal salt, such as alum. In the long-term, the effluent limits are expected to only become more stringent.

The alternatives considered for upgrades and expansion of the TRWWTP were evaluated according to project drivers described in **Table 6.10**.

Table 6.10 TRWWTP Upgrade Project Drivers

Project Driver	Discussion, Notes
Footprint	The existing site is almost entirely built out and the land adjacent to the site is expensive to acquire. The footprint of a new secondary process must be small, whether it is constructed within the site boundaries or outside.
Track Record	A successful record of operation over time is important for systems that must perform to high standards continuously for many years. New technologies may or may not be capable of performing at this level and this timeframe.
Flexibility	Due to the highly variable contaminant load, the TRWWTP must be able to vary its biosolids inventory adjusting for the proper food to mass ratio and Solids Retention Time.
Effluent Quality	In the long-term, tight effluent nutrient limits are expected to become more stringent for nitrogen and phosphorus. Effluent phosphorus limits below 1.0 mg/L are likely, which may require a separate tertiary treatment process for some secondary processes.
Expandability	For long-term nitrogen limits, an additional process reactor (post-anoxic tank) is required. Biological phosphorus removal may also require process expansion.
Constructability	It is assumed that with temporary treatment improvements, one ditch and clarifier can be removed from service for a plant. If additional land is obtained for the expansion, the existing facility can maintain operation without interruption.
Capital Costs	Project costs will be relatively high whether they occur on the existing site or on the adjacent land. Construction on the existing site is encumbered by confined spaces and limited access. Telluride is remote and has a limited construction window. New construction on adjacent land allows for efficient use of space and access. The cost to acquire additional land will offset the savings realized from new site construction.
O&M Costs	Minimizing operation and maintenance costs is always an important consideration for the future. O&M costs include energy, chemicals, process control, solids processing and disposal, and routine maintenance.

6.5.1 Description of Alternative Secondary Treatment Processes

This section provides a description of treatment expansion options capable of meeting TRWWTP's goals. We have considered the following five alternatives:

1) Conventional Activated Sludge
2) Membrane Bioreactor (MBR)
3) Oxidation Ditches
4) Integrated Fixed-film Activated Sludge (IFAS)
5) BioMag® enhancements to existing oxidation ditch process

6.5.1.1 Conventional Activated Sludge (CAS) Process

The CAS process incorporates a 4-stage process consisting of both pre- and post-denitrification, in a single sludge system. **Figure 6.2** shows a diagram of a basic process showing an aeration basin and clarifier. The basic process is expanded for the TRWWTP with an initial anoxic zone followed by an aerobic zone. In the future, a post-anoxic zone would provide denitrification of the portion of the flow that is not recycled to the primary anoxic zone. The fourth and final zone is a re-aeration zone that serves to strip any nitrogen gas and increase the dissolved oxygen (DO) concentration before clarification. The second anoxic zone after the aerobic zone can achieve additional nitrogen removal by denitrifying that portion of the flow that is not recycled to the first anoxic zone. Because the BOD_5 has been removed in the aerobic zone, denitrification in a post-anoxic zone often requires a supplemental carbon source, such as methanol.

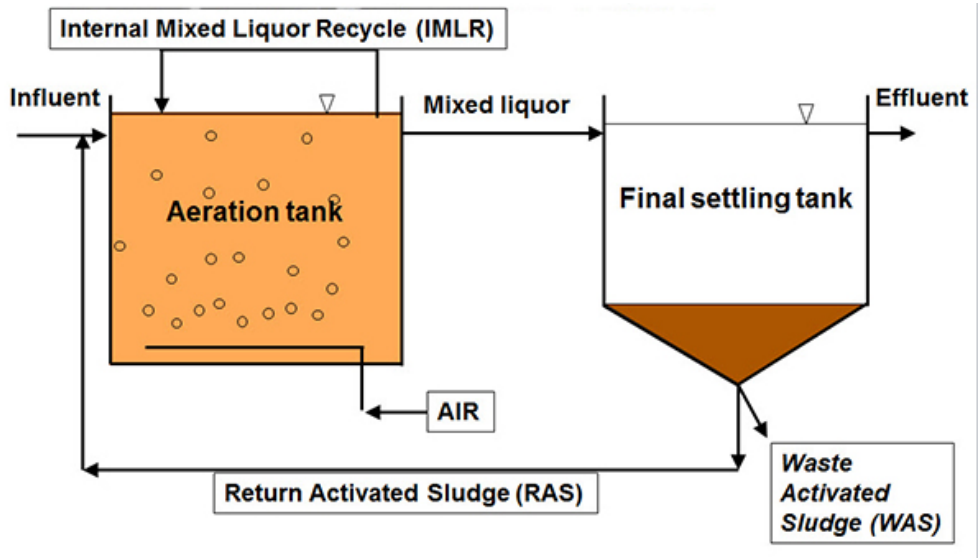


Figure 6.2 Conventional Activated Sludge Process Diagram

Image Source: Activated Sludge: Three Steps to Improve Your Process Efficiency, Dr. Rob Smith, Oct 13, 2016

Biological phosphorus removal (BPR) adds a 5th stage using an anaerobic zone, or selector basin to the front of the process. Chemical phosphorus removal can serve as a backup using metal salts for coagulation with filtration in case an upset occurs in the biological process. A conceptual design of a CAS retrofit within the existing oxidation ditches at the TRWWTP was initially considered. The retrofit would require new walls and baffles to create the stages of treatment in an "out and back" configuration. Jet or diffused aeration systems would replace the horizontal shaft aerators. The single pass configuration allows recirculation of nitrified mixed liquor to the pre-anoxic zones using high flow, low-head pumps.

The challenges with the CAS concept for retrofitting the existing TRWWTP include:

- Limited access; expansion plans would be more effective on adjacent land
- Shallow oxidation ditch basins are not effectively aerated with diffused aeration, jet aeration is preferred despite low oxygen transfer efficiency
- Staging construction while maintaining operation would be challenging

Considering these challenges, the CAS retrofit in the existing plant is considered infeasible; reactor basins would have to be constructed on the adjacent site and the existing clarifiers would be integrated with the new system. The benefits of new basin construction include deep basins with fine bubble diffused aeration within a flexible, multi-train footprint.

6.5.1.2 **Membrane Bio-Reactor Configured with a 4-stage Activated Sludge Process**

Membrane Bio-Reactors (MBR) use membranes placed in the last aerobic zone of a 4-stage treatment system for liquid-solid separation instead of conventional clarification. Membrane materials are either organic polymers or inorganic materials such as ceramics. They are designed in modular units and are typically configured as either hollow fiber bundles or plate membranes. All membrane systems use an air scour technique to reduce buildup on the membranes. Membranes require periodic cleaning (typically 2 to 4 times per year) using acid and/or sodium hypochlorite solutions. Operational issues include membrane biofouling, chemical costs, loss of production for cleaning, and increased pumping requirements with increased electricity costs. MBR systems overall produce less waste activated sludge (WAS) than conventional systems because they tend to be operated at higher Solids Retention Times (SRTs). When operated at the same SRTs there is very little difference, with the MBR system producing slightly more WAS because of greater effluent suspended solids capture.

Low-pressure membranes (ultrafiltration or microfiltration) are commonly used. Systems can be pressure or vacuum driven (see image in **Figure 6.3**). MBR systems operate at a higher mixed liquor suspended solids (MLSS) concentration, which results in smaller tanks and smaller space requirements than biological nitrogen removal systems with secondary clarifiers. In addition, membrane separation provides for greatly reduced total suspended solids (TSS) in the effluent, typically well below 1.0 mg/L, and, hence, slightly greater removal of nitrogen and phosphorus.

Membranes can be submersed in the biological reactor or located in a separate stage or compartment. The MBR filtration system includes membrane modules, membrane air scour system, permeate pumps, return activated sludge pumps, piping, chemical cleaning and back pulsing systems. The conceptual layout considered within the existing site shows Phase 1 construction occurring within oxidation ditch #3, clarifier #3. After the initial MBR system is commissioned and operational, additional anoxic tanks would be constructed in a portion of oxidation ditch #2. Phase 1 concepts meet the total nitrogen limit of 10 mg/L and total phosphorus limit of 1 mg/L. Phase 2 concepts meet stringent nitrate limits in the future using clarifiers #1 and #2 retrofitted as post-anoxic basins with mixers and a carbon feed system.

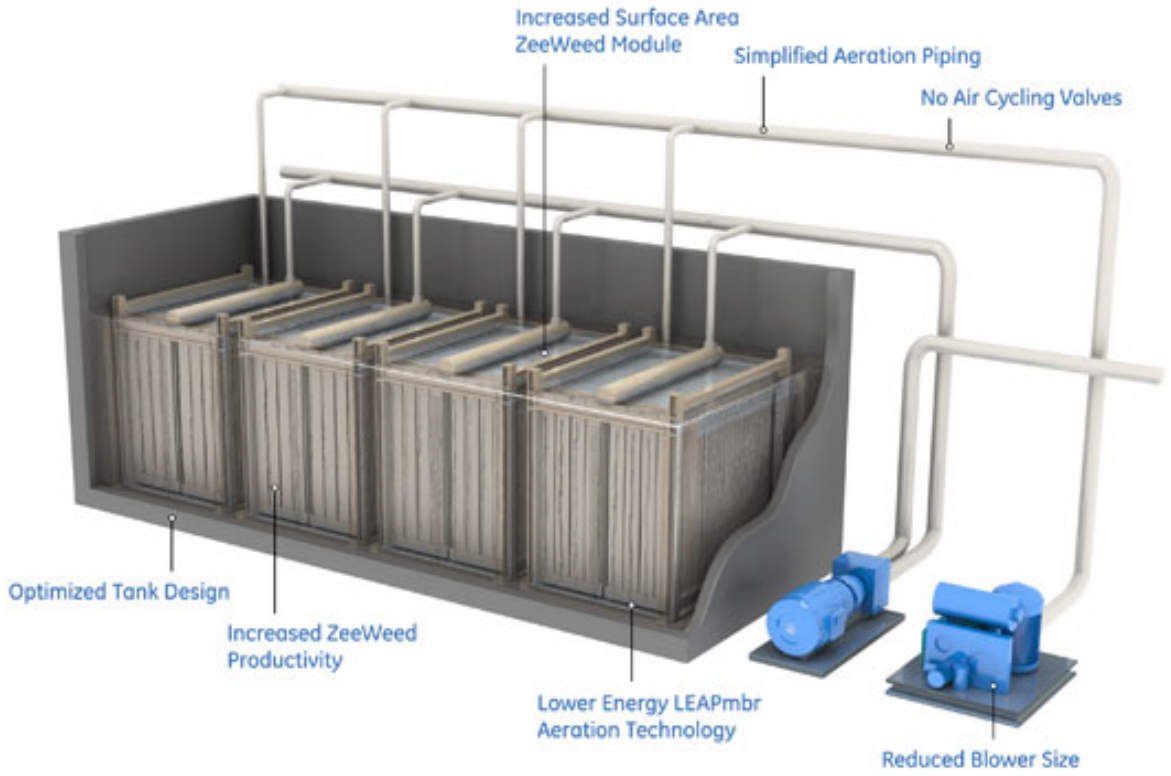


Figure 6.3 MBR Configuration using Submerged Membranes
Image Source: GE Water and Process Technologies

6.5.1.3 Oxidation Ditch with Anoxic Zones and Anaerobic Selector

Most oxidation ditches can be operated to remove a substantial amount of nitrogen due to:

- Long retention times that ensure complete nitrification
- MLSS concentrations (often in excess of 3,000 mg/L) that encourage simultaneous nitrification-denitrification
- DO profiles along the flowpath that can be manipulated by controlling oxygen transfer by the rotor mixing systems.

The design to remove nitrogen alternates the flow within the ditch between aerobic and anoxic conditions or routes flow through a separate anoxic basin. Nitrogen removal can be enhanced by using automatic controls (typically DO or Oxidation Reduction Potential) to turn rotors/mixers on and off to maintain desired DO setpoints along the flow path. Biological phosphorus removal can be enhanced through an anaerobic selector at the head of the ditch.

To achieve the biological nutrient removal targets of total nitrogen < 10 mg/L and total phosphorus < 1 mg/L, new oxidation ditches would be constructed on the adjacent site and tie into the existing clarifiers and UV disinfection system. The land area required for construction of the initial expansion is estimated to be nearly 3 acres.

Future nutrient limits would require additional basins for anaerobic selectors and post-anoxic basins with an external carbon source and feed system similar to the activated sludge processes described above. This Phase 2 work would integrate existing basins, chemical additional and filtration equipment to achieve anticipated total nitrogen < 5 mg/L and total phosphorus < 0.5 mg/L.

6.5.1.4 **Integrated Fixed-Film Activated Sludge Process**

Integrated fixed film activated sludge (IFAS) is a relatively new technology that describes any suspended growth system that incorporates an attached growth media within the suspended growth reactor (either aerobic or anoxic). Total nitrogen removal by this basic configuration has been improved by the use of attached growth filters for nitrification (e.g, Biological Aerated Filters) or attached growth media in the anoxic and/or aerobic basin to increase solids retention times and reduce the risks of washout. The IFAS process can be integrated with anaerobic and anoxic zones to enhance biological nutrient removal.

Free suspended media is the most common type of fixed film media used to retrofit an activated sludge process (see **Figure 6.4**). High aeration rates using coarse bubble diffusers maintain the mixing energy to keep the media in suspension. Slotted pipe or screens are used on transfer piping to keep the media contained within the IFAS basins. The diffused air system must be designed to support the media as it settles when the process is taken out of service.

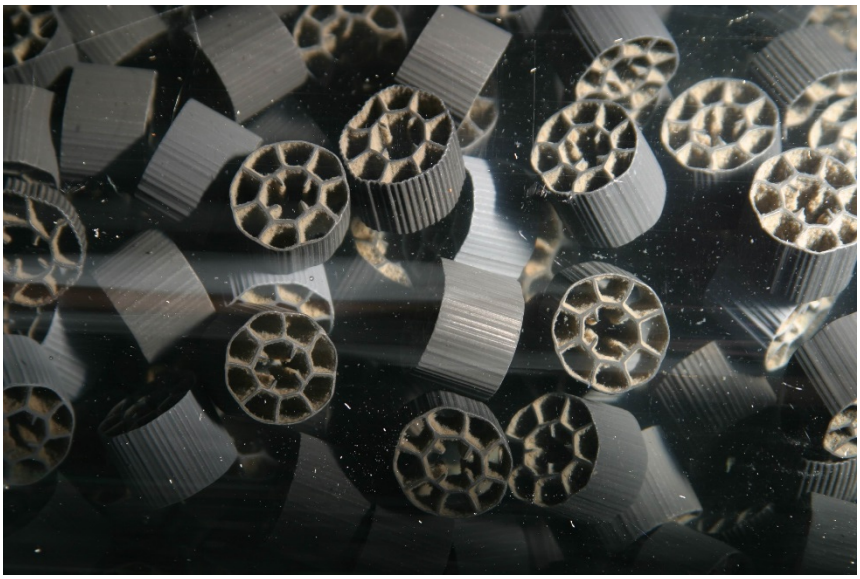


Figure 6.4 IFAS Media

Alternatively, manufacturers are applying trickling filter media cubes on a fixed support stand over fine or coarse bubble diffusers in IFAS applications. The wastewater moves vertically through the pathways in the media cubes using the air lift from aeration (**Figure 6.5**).



Figure 6.5 IFAS Media – Structured Sheet PVC

Image Source: Brentwood Industries

The conceptual plan using IFAS requires construction of new basins for fixed-film media, diffused aeration, and anoxic stages of treatment. Since it would be difficult to retrofit the existing oxidation ditches with the extensive requirements for new equipment, construction on adjacent land is necessary. Phase 1 construction would require approximately 2 acres. Deep basins would provide for efficient aeration and use of space. Diffused aeration requires blowers in a new building with electrical and mechanical rooms.

To address future limits for nitrogen and phosphorus, the existing site would be retrofitted for post-anoxic treatment, chemical addition, and filtration for phosphorus removal.

6.5.1.5 **BioMag®**

The BioMag® system infuses magnetite as fine, fully oxidized, iron ore particles into biological floc to make it heavier, enhancing clarification performance. The BioMag system is primarily used to improve secondary wastewater treatment by allowing operators to control the sludge blanket, achieve high contaminant removal, and manage loads and flows. Rapid and reliable settling enables a 200 to 300 percent increase in MLSS concentrations without the risk of upset. Operating at higher MLSS concentrations allows for treatment in a smaller space and increased capacity to meet the projected flows and loading. The enhanced solids removal enables TRWWTP to free up reactor capacity to enhance removal of nitrogen. It is likely that chemical addition for phosphorus removal could achieve low concentrations without tertiary filters.

The BioMag® system can be incorporated into any type of activated sludge treatment and the biological process operation remains relatively unchanged. **Figure 6.6** shows the integration of BioMag® into a 4-stage CAS process. However, the existing oxidation ditch process at TRWWTP could be retrofitted with BioMag® with new aeration and mixing systems to control aerobic and anoxic zones more effectively during variable loading conditions.

Evoqua is the sole manufacturer of the system. Evoqua describes their process as follows:

- BioMag® equipment processes the WAS stream without impacting the main liquid stream (clarified effluent).
- Magnetite is readily available (iron ore commodity), fully inert, non-abrasive (particle size is 10-15 microns), and magnetically retrievable (high recovery rates).
- BioMag® equipment is easy to operate. The key piece of operating equipment has been successfully applied for decades in other industries. The system is fully automated.
- Magnatite is recycled through return activated sludge and from the drum separator. Additional magnetite is fed to maintain a target ratio of magnetite to mixed liquor suspended solids concentration.

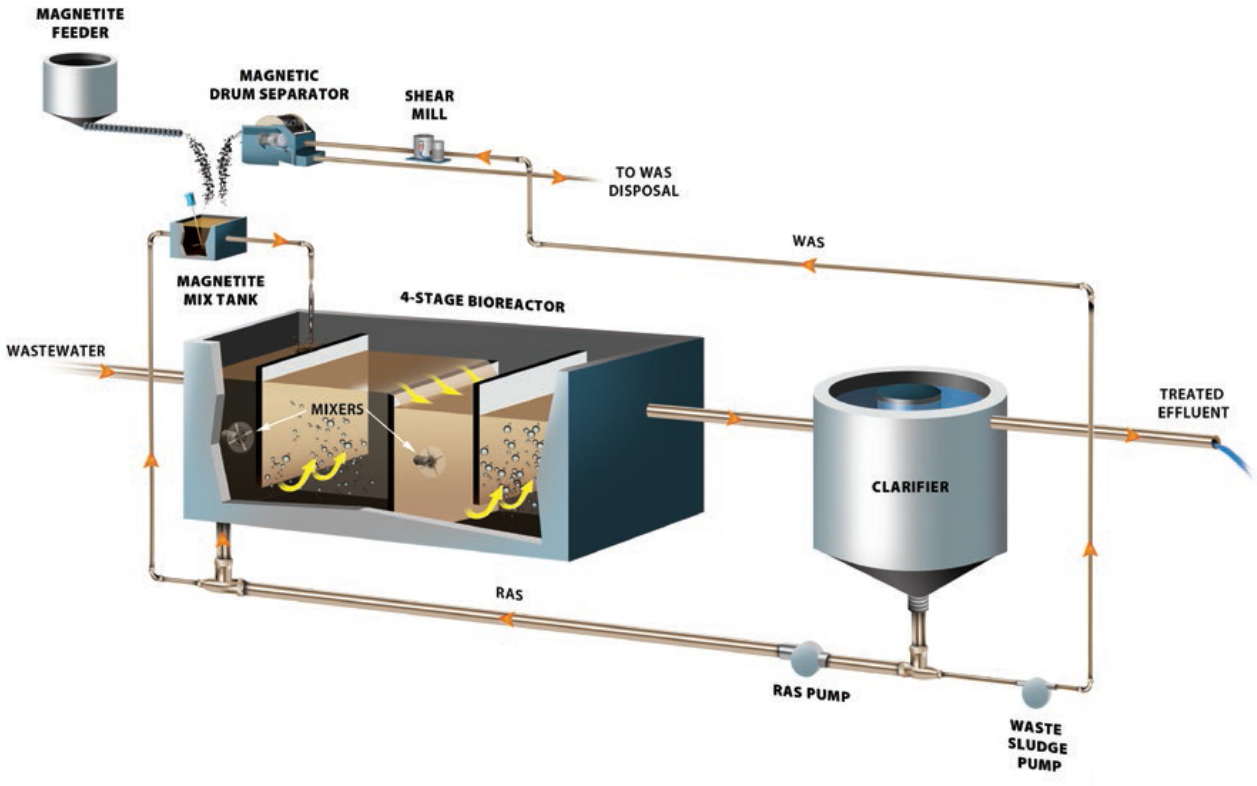


Figure 6.6 Diagram of BioMag® Enhancements of Conventional Activated Sludge System

Image Source: Evoqua Water Technologies

Additional process improvements required for implementation of BioMag® at the TRWWTP include:

1. Aeration system expansion
2. Mixing equipment in the oxidation ditches, primarily in anoxic zones

The BioMag® equipment would be housed in a new building. The magnetite feed system has two components, one for new material and one for recovered pellets from the WAS.

For more stringent nutrient limits in the future, it is likely that post-anoxic basins with external carbon addition for nitrate removal, and anaerobic selector tanks and/or chemical addition for phosphorus removal would be required. These future improvements would not be supported within the current site boundaries.

6.5.2 Evaluation of Secondary Treatment Alternatives

A qualitative evaluation of the five technologies considered for improvement are presented in **Table 6.11**. The table ranks each technology on a scale from 1 – 5 with five being most favorable. Note there is only one of each number for a given category.

Table 6.11 Qualitative Alternative Evaluation for Near-term Improvements

Process Technology	Foot-print	Track Record	Flexibility	Effluent Quality	Cost to Construct	O&M Cost	Total
CAS	2	5	4	3	2	5	21
MBR	5	3	5	5	4	1	23
Ox. Ditch	1	4	1	1	1	4	16
IFAS	3	2	2	2	3	3	15
BioMag®	4	1	3	4	5	2	19

Considering the comparative weighing in **Table 6.11**, it is apparent oxidation ditches and IFAS are ranked low enough they should not be considered further. Additional discussion of the reasons for elimination are included below:

- Oxidation ditches require the most space to construct. Considering the extremely tight footprint of the TRWWTP site, there is no reasonable way to upgrade and expand the existing ditches to meet future needs.
- IFAS systems are most suitable for expanding existing activated sludge systems to enhance biological nutrient removal. However, the existing system is not amenable to IFAS upgrades and new construction on the adjacent site is required. The system is less flexible than other systems when taking basins out of service due to the use of fixed-film media.

Of the remaining three technologies, CAS, BioMag®, and MBR, the CAS process operates at low mixed-liquor concentrations (~3,000 mg/L) whereas the other two technologies operate at much higher bio-mass concentrations (4,000 – 10,000 mg/L). As such, BioMag® and MBR allow for the most cost effective use of the existing site. Depending on the cost to acquire land, new CAS construction could provide a cost-effective alternative on the adjacent site.

6.6 SITE ALTERNATIVE ANALYSIS

The development of conceptual alternatives for the expansion of the TRWWTP considers two options for implementation:

1. Retrofit TRWWTP within the existing site

2. Expand TRWWTP on adjacent site

With both options, it is assumed that a new headworks building with pretreatment equipment will be constructed south of the plant within the boundaries of the existing site. Biosolids treatment and handling options would have to be integrated with the preferred alternatives. The existing aerobic digesters for biosolids treatment must remain in operation through the construction of the near-term improvements. Refer to Section 7.0 for Biosolids Handling and Treatment.

6.6.1 Site Alternative 1 – Retrofit TRWWTP

Conceptually, the existing site can accommodate a complete retrofit within existing basins and clarifiers. Practically, the staging of construction while maintaining plant operations would be challenging. The existing TRWWTP is constructed within approximately 3 acres with little space remaining for construction equipment access or materials storage. At a minimum, a temporary construction easement having 50 to 100 feet surrounding the site would be required for staging construction.

Of the five processes considered for the TRWWTP expansion, the only two that could be completed within the existing site boundaries are MBR and BioMag®.

6.6.1.1 Membrane Bio-Reactor Retrofit of the TRWWTP

Supporting rationale for MBR upgrades includes the following:

- Best retrofit option – most existing tankage and site left open for future use
- While initial capital costs are high, future improvements projects will be the least expensive with MBR due to the superior effluent quality and highest mixed-liquor concentration (meaning smallest reactor sizing).
- Ability to achieve very tight effluent phosphorus limits (< 0.2 mg/L) with metal salt addition at the MBR units
- By completing MBR improvements, coating improvements in oxidation ditch No. 1 are not required
- MBR is the most capable process when considering treatment for emerging contaminants of concern.

Drawbacks of the MBR process are:

- Membrane life is typically 10 – 14 years
- Membrane replacement costs are high
- Chemical cleaning of membranes is required

Conceptual design criteria for the MBR upgrade is provided **Table 6.12**.

Table 6.12 MBR Upgrade Design Criteria

Parameter	Units	Value
Bioreactor MLSS	(mg/L)	7,000 – 8,000
MBR Reactor MLSS	(mg/L)	9,000 – 10,000
Anoxic Volume	(gal)	270,000
Aerobic Volume	(gal)	620,000
MBR Tank Volume	(gal)	70,000 – 100,000
SRT	(days)	15-25

The MBR process improvements costs were estimated for implementation while two oxidation ditches and clarifiers remain in operation. **Figure 6.7** shows the conceptual site plan for the MBR retrofit within the existing TRWWTP site.

Conceptual level proposals for MBR equipment from 2 manufacturers are provided in **Appendices E.1 and E.2**, respectively. The scope of supply and estimates include general descriptions of sizing for anoxic and aerobic basins using preliminary design requirements provided by Stantec.

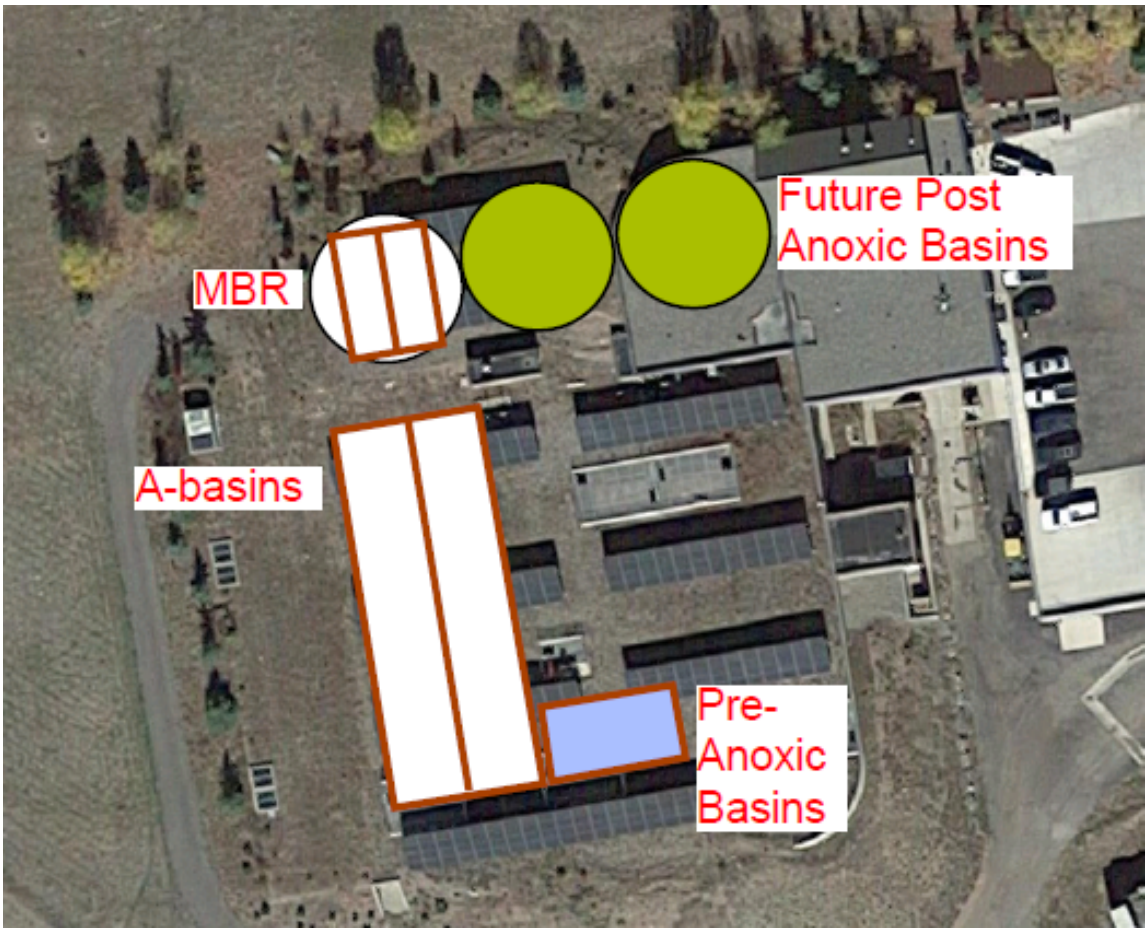


Figure 6.7 Membrane Bio-Reactor Retrofit – Conceptual Layout

The layout for the MBR retrofit on the existing site could easily be modified to use oxidation ditch #1 and clarifier #1 instead of #3. However, one inevitable consequence is the loss of solar panels on site.

The estimate of probable construction cost includes staging construction and integrating the system with the existing lift station following the headworks. The new headworks are costed separately (see Pretreatment Alternatives). **Table 6.13** gives the MBR cost breakdown.

Table 6.13 MBR Retrofit (On-site) Conceptual Design Level Cost Estimate

Telluride Regional Wastewater Treatment Plant - Phase 1 Membrane Bio-Reactor (on-site) Conceptual Design Level Estimate of Cost			
Divisions	Item Descriptions	Total Cost	Notes and References
Division 1 - General Requirements	Mobilization/Demobilization	$ 1,240,680	At 6.0% of subtotal construction cost
	Insurances and bonds	$ 723,730	At 3.5% of subtotal construction cost
	Construction staging, and material and equipment storage	$ 413,560	At 2% of subtotal construction cost
	Permit applications as required for the construction	$ 82,712	At 0.4% of subtotal construction cost
	Site maintenance including cleaning, drainage, erosion control, access roads, mud and dust control, noise control, fueling containment, spills response, contingency plans etc.	$ 103,390	At 0.5% of subtotal construction cost
	Construction quality control testing	$ 41,356	At 0.2% of subtotal construction cost
	Construction survey	$ 5,000	
	Temporary facilities including offices, sanitary facility, electrical system, HVAC, water supply, first aid, signs and barricades etc.	$ 50,000	
	Contractor's project management services including meetings, coordinations, submittals, etc.	$ 206,780	At 1% of subtotal construction cost
	Start-up, testing and commissioning, and O&M	$ 82,712	At 0.4% of subtotal construction cost
	Temporary Construction Easement – 2 acres minimum	$ 200,000	estimated
	Total Division 1 work cost	$ 3,150,000	
Division 2 - Site Work	Demolition, protection, shoring and staging construction	$ 2,000,000	
	Excavation	$ 150,000	
	Total Division 2 work cost	$ 2,150,000	
Division 3 - Concrete	CIP Conc Floors, Walls & Foundations	$ 3,850,000	
	Basin Covers, Platforms and Elevated Walkways	$ 240,000	
	Total Division 3 work cost	$ 4,090,000	
Division 5 - Metals	Misc. stairways, decks, supports and anchoring systems	$ 1,125,000	
	Total Division 5 work cost	$ 1,125,000	
Division 7 - Thermal and Moisture Protection	Concrete Basin coatings and repairs, existing basins	$ 300,000	
	Total Division 7 work cost	$ 300,000	
Division 11 - Equipment	MBR Equipment Package, inc. membranes, pumps, valves, controls, mixers, chemical Clean-In-Place system, instrumentation	$ 7,500,000	
	Aeration Systems (blowers, pumps, diffusers, air pipe)	$ 1,680,000	
	Post-anoxic basin retrofits in Clarifiers #1 + #2	$ 280,000	

	Total Division 11 work cost	$ 9,460,000	
Division 14 - Conveying System	Crane Hoist systems	$ 90,000	
	Total Division 14 work cost	$ 90,000	
Division 15 - Mechanical	Pipe and fittings	$ 337,500	
	HVAC	$ 225,000	
	Total Division 15 work cost	$ 563,000	
Division 16 - Electrical	Secondary power systems and controls, wiring, conduit	$ 2,100,000	
	Demolition of existing electrical equipment	$ 500,000	
	Total Division 16 work cost	$ 2,600,000	
Division 17 - Instrumentation and Control	Integration of Vender provided equipment to SCADA	$ 300,000	
	Total Division 17 work cost	$ 300,000	
Subtotal excluding Div 1 work cost		$ 20,678,000	
Subtotal including Div 1 work cost		$ 23,828,000	
Estimator's Contingency (25% of subtotal)		$ 5,957,000	
Grand Total (2017 dollar)		$ 29,800,000	

Constructability for an MBR Expansion

For an upgrade to an MBR facility on the existing site, consider the following project sequencing:

1. Install supplemental aeration system in Ditches No. 1 and 2.
2. Construct and start up new headworks.
3. Remove Oxidation Ditch No 3 and Secondary Clarifier No. 3 from service.
4. Demolish Ditch No. 3. Expand building over Clarifier No. 3 and begin to modify the tank for MBR modules and pumping and aeration systems.
5. Construct new aeration basins in the footprint of Ditch No. 3. Basins would operate at about 17 feet of sidewater depth and utilize efficient fine bubble aeration.
6. Begin to operate the new aeration basins and MBR tanks.
7. Demolish Ditch No. 2 and construct new anoxic treatment reactors.
8. Begin to operate anoxic tanks with new MBR process.

MBR Operation and Maintenance

Operation and maintenance of the Membrane Bio-Reactor process assumes:

- Chemical usage and labor for 2 membrane cleanings per year
- Labor for equipment maintenance (pumps, mixers, blowers, etc.)
- Instrumentation calibration and cleaning
- Sampling

The annual operation and maintenance costs for the MBR process are summarized in **Table 6.14**.

Table 6.14 Membrane Bio-Reactor Operation and Maintenance Costs

Category	2027	2047
Chemical Use		
Hypochlorite	$ 200	$ 360
Acid Solution	$ 2,400	$ 4,400
Labor		
Chemical CIP	$ 1,935	$ 3,500
Equipment	$ 4,000	$ 7,300
Instru & Sampling (compliance reporting not included)	$ 4,000	$ 7,300
Energy		
Pumps	$ 44,000	$ 79,300
Blowers	$ 176,000	$ 317,200
Membrane Replacement (in 2037 and 2047 assuming 10 yr service life)		$2,122,000
Total	$ 232,000	$2,541,000

* annual interest rate = 3%

Note that membranes have a useful life of 10 to 14 years. The cost for membrane replacement in 2017 is approximately $800,000. Carrying the cost for membrane replacement to FY 2037 dollars ($1,445,000) and FY 2047 dollars ($2,122,000) assumes a 3% annual increase. The operation and maintenance costs from 2027 to 2047 were totaled and the present value in 2017 is $5.6MM.

6.6.1.2 **BioMag® Retrofit of Existing Oxidation Ditch Process**

For the BioMag® process, the 3 oxidation ditches would be upgraded using the disc aeration system expansion and in-basin mixing to maintain suspension of the weighted floc. The BioMag® proposal for equipment needed for the expansion of the existing plant is provided in **Appendix E.3**.

The BioMag® process benefits include:

- Low initial cost for equipment and construction
- The plant would operate as an enhanced oxidation ditch process, similar to existing process

Negative aspects of the BioMag® process are:

- Limited number of installations; very short track record
- Relatively limited knowledge about impacts on operation and maintenance of existing processes, such as accumulation of ballasted floc in dead zones, and wear and tear on pumps
- Equipment replacement and upgrades required for aeration, mixing, pumping, electrical and ventilation systems
- Limited capacity to address emerging contaminant of concern; may require expansion onto adjacent site in future

The estimate for the BioMag® retrofit includes costs for staging construction and integrating the system with the existing lift station following the headworks. It is assumed that pumps and the electrical and ventilation systems would be replaced. The new headworks are costed separately (see Pretreatment Alternatives). **Table 6.15** gives the BioMag® process enhancements breakdown of costs.

Table 6.15 BioMag@ Process Enhancements Conceptual Design Level Cost Estimate

Telluride Regional Wastewater Treatment Plant - Phase 1 BioMag® Process Enhancements(on-site) Conceptual Design Level Estimate of Cost			
Divisions	Item Descriptions	Total Cost	Notes and References
Division 1 - General Requirements	Mobilization/Demobilization	$ 795,300	At 6.0% of subtotal construction cost
	Insurances and bonds	$ 463,925	At 3.5% of subtotal construction cost
	Construction staging, and material and equipment storage	$ 265,100	At 2% of subtotal construction cost
	Permit applications as required for the construction	$ 53,020	At 0.4% of subtotal construction cost
	Site maintenance including cleaning, drainage, erosion control, access roads, mud and dust control, noise control, fueling containment, spills response, contingency plans etc.	$ 66,275	At 0.5% of subtotal construction cost
	Construction quality control testing	$ 26,510	At 0.2% of subtotal construction cost
	Construction survey	$ 5,000	
	Temporary facilities including offices, sanitary facility, electrical system, HVAC, water supply, first aid, signs and barricades etc.	$ 50,000	
	Contractor's project management services including meetings, coordinations, submittals, etc.	$ 132,550	At 1% of subtotal construction cost
	Start-up, testing and commissioning, and O&M	$ 53,020	At 0.4% of subtotal construction cost
	Temporary Construction Easement – 2 acres minimum	$ 100,000	estimated
	Total Division 1 work cost	$ 2,011,000	
Division 2 - Site Work	Demolition	$ 500,000	
	Basin Cleaning	$ 135,000	
	Total Division 2 work cost	$ 635,000	
Division 3 – Concrete	CIP Conc walls and foundation - new BioMag building	$ 90,000	
	Pre-cast Conc - Ext. walls and roof	$ 450,000	
	Total Division 3 work cost	$ 540,000	
Division 5 – Metals	Misc. stairways, decks, supports and anchoring systems	$ 75,000	
	Total Division 5 work cost	$ 75,000	
Division 7 - Thermal and Moisture Protection	Concrete Basin coatings and repairs, existing basins	$ 300,000	
	Clean and recoat structural members in Oxidation Ditches for corrosion protection.	$ 165,000	
	Total Division 7 work cost	$ 465,000	

Division 8 - Doors and Windows	New BioMag building overhead door and access doors	$ 45,000	
	Total Division 8 work cost	$ 45,000	
Division 11 - Equipment	BioMag Equipment Package, inc. mills, screens, pumps, valves, controls, mixers, instrumentation	$ 3,000,000	Vender proposal by Evoqua
	Aeration Systems (upgrades for full expansion)	$ 1,280,000	
	Mixing Sysetms (within existing basins)	$ 640,000	
	Total Division 11 work cost	$ 4,920,000	
Division 14 - Conveying System	Crane Hoist systems	$ 30,000	
	Total Division 14 work cost	$ 30,000	
Division 15 - Mechanical	Pipe and fittings	$ 45,000	
	HVAC (upgrades)	$ 600,000	
	Total Division 15 work cost	$ 645,000	
Division 16 – Electrical	Secondary power systems and controls, wiring, conduit (replacement and upgrades)	$ 5,250,000	
	Demolition of existing electrical equipment	$ 500,000	
	Total Division 16 work cost	$ 5,750,000	
Division 17 - Instrumentation and Control	Integration of Vender provided equipment to SCADA	$ 150,000	
	Total Division 17 work cost	$ 150,000	
Subtotal excluding Div 1 work cost		$ 13,255,000	
Subtotal including Div 1 work cost		$ 15,266,000	
Estimator's Contingency (25% of subtotal)		$ 3,817,000	
Grand Total (2017 dollar)		$ 19,100,000	

Operation and maintenance of the BioMag® process assumes:

- Magnetite usage at 200 lbs/year
- Labor for equipment maintenance (pumps, mixers, etc.)
- Oxidation ditch cleaning (1 ditch per year)
- BioMag® equipment operation and cleaning
- Sampling
- Energy Costs for major equipment

The annual operation and maintenance costs for the BioMag® process enhancements assume the plant starts operation in 2027 and runs until 2047 (**Table 6.16**). The O&M costs for this period were totaled and adjusted to a present value of $4.5 MM (FY 2017).

Table 6.16 BioMag® Operation and Maintenance Costs

Category	2027	2047
Chemical Use		
Magnetite (assumes 200 lb/MGD)	$ 90	$ 160
Labor		
Equipment (pumps, aerators and mixers)	$ 3,400	$ 6,100
Basin Cleaning (1 basin/year)	$ 6,700	$ 12,100
BioMag® Equipment O&M	$ 8,100	$ 14,600
Sampling	$ 2,000	$ 3,600
Energy		
Pumps	$ 52,700	$ 95,200
Disc Aeration	$ 210,800	$ 380,700
Total	$ 283,700	$ 512,400

* annual interest rate = 3%

6.6.2 Preferred Treatment Process for Site Alternative 1, Retrofit TRWWTP

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

- 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

6.6.3 Site Alternative 2 – Expand TRWWTP on Adjacent Site

Two processes are developed for expansion on the adjacent site:

1. New Membrane Bio-Reactor
2. Conventional Activated Sludge Process

Both alternatives will require provisions for biological nutrient removal associated with the Phase 1 and Phase 2 effluent limits. Phase 1 plans include anaerobic selectors, a pre-anoxic stage (with mixers and internal recycle of nitrified effluent), and aeration basins with fine-bubble diffusers. Phase 2 options include post anoxic basins for nitrate removal with chemical feed (for external carbon source).

6.6.3.1 Membrane Bio-Reactor (New Construction)

Using the MBR process to expand the facility on the adjacent site allows for the smallest footprint. The cost estimate for an MBR process with anoxic and aeration basins on a new site includes buried concrete basins, and equipment rooms for MBR systems and controls, pumps, blowers, and electrical panels constructed above the buried basins (refer to **Table 6.17**).

The basins and equipment would fit within a half-acre footprint and require approximately 1 acre of total land area for construction access and staging. The layout includes redundant trains for the secondary liquid processes as well as the membrane basins. Phase 1 construction provides for anaerobic selector basins, pre-anoxic basins, and pre-aeration basins and membrane reactor basins. Phase 2 construction requires additional basins for pre-aeration and post-anoxic zones for advanced biological nutrient removal.

Operation and maintenance of the Membrane Bio-Reactor process assumes the same costs as a retrofit of the existing plant (refer to **Table 6.14** above).

Table 6.17 MBR Expansion (New Site) Conceptual Design Level Cost Estimate

Telluride Regional Wastewater Treatment Plant - Phase 1 Membrane Bio-Reactor (on-site) Conceptual Design Level Estimate of Cost			
Divisions	Item Descriptions	Total Cost	Notes and References
Division 1 - General Requirements	Mobilization/Demobilization	$ 1,146,840	At 6.0% of subtotal construction cost
	Insurances and bonds	$ 668,990	At 3.5% of subtotal construction cost
	Construction staging, and material and equipment storage	$ 382,280	At 2% of subtotal construction cost
	Permit applications as required for the construction	$ 76,456	At 0.4% of subtotal construction cost
	Site maintenance including cleaning, drainage, erosion control, access roads, mud and dust control, noise control, fueling containment, spills response, contingency plans etc.	$ 95,570	At 0.5% of subtotal construction cost
	Construction quality control testing	$ 38,228	At 0.2% of subtotal construction cost
	Construction survey	$ 5,000	
	Temporary facilities including offices, sanitary facility, electrical system, HVAC, water supply, first aid, signs and barricades etc.	$ 50,000	
	Contractor's project management services including meetings, coordination, submittals, etc.	$ 191,140	At 1% of subtotal construction cost
	Start-up, testing and commissioning, and O&M	$ 76,456	At 0.4% of subtotal construction cost
	Land Cost	$ 800,000	Estimated for 1 acres
	Total Division 1 work cost	$ 3,531,000	
Division 2 - Site Work	Excavation, Backfill and Site Grading	$ 264,000	
	Total Division 2 work cost	$ 264,000	
Division 3 – Concrete	CIP Conc. – Buried Tanks – Phase 1 & 2	$ 5,600,000	
	CIP Conc Tank Covers	$ 477,000	
	Total Division 3 work cost	$ 6,077,000	
Division 5 – Metals	Misc. stairways, decks, railings, supports and anchoring systems	$ 750,000	
	Total Division 5 work cost	$ 750,000	
Division 7 - Thermal and Moisture Protection	Basin Roof Moisture Protection	$ 48,000	
	Concrete Basin coatings (new basins)	$ 75,000	
	Total Division 7 work cost	$ 123,000	
Division 8 – Doors and Windows	Overhead Doors and Access Hatches	$ 90,000	
	Total Division 8 work cost	$ 90,000	
Division 11 - Equipment	MBR Equipment Package, incl. membranes, pumps, valves, controls, mixers, CIP, instrumentation	$ 6,250,000	

	Aeration & Mixing Systems (blowers, diffusers)	$ 1,000,000	
	Total Division 11 work cost	$ 7,250,000	
Division 14 - Conveying System	Crane Hoist systems	$ 45,000	
	Total Division 14 work cost	$ 45,000	
Division 15 - Mechanical	Pipe and fittings	$ 315,000	
	HVAC	$ 225,000	
	Water Supply Piping	$ 30,000	
	Total Division 15 work cost	$ 570,000	
Division 16 – Electrical	Primary Service	$ 75,000	
	Secondary power systems and controls, wiring, conduit	$ 3,750,000	
	Total Division 16 work cost	$ 3,825,000	
Division 17 - Instrumentation and Control	Integration of Vender provided equipment to SCADA	$ 120,000	
	Total Division 17 work cost	$ 120,000	
Subtotal excluding Div 1 work cost		$ 19,114,000	
Subtotal including Div 1 work cost		$ 22,645,000	
Estimator's Contingency (25% of subtotal)		$ 5,662,000	
Grand Total (2017 dollar)		$ 28,300,000	

6.6.3.2 Conventional Activated Sludge (New Construction)

The conventional activated sludge process is adaptable to variable flow and loading events that occur seasonally. Basins can be put in service and taken out of service quickly. Therefore, the CAS alternative is a good option to implement on the adjacent site. The existing clarifiers are integrated with this option as they have many years of useful life.

The construction of the Phase 1 expansion project allows for biological nutrient removal using an anaerobic selector, pre-anoxic basins with internal recycle pumping, and aeration basins. The existing clarifiers are to be used with the new construction. Process equipment includes new return activated sludge (RAS) and new waste activated sludge (WAS) pumps, mixers in anoxic zones, and process control systems for biological nutrient removal.

The expansion on the adjacent site will require the purchase of approximately 2 acres for structures, construction access and staging, and for Phase 2 improvements associated with advanced nutrient removal (additional basins and equipment). Our estimate of probable construction cost for Conventional Activated Sludge process expansion on a new site adjacent to the TRWWTP is presented in **Table 6.19**.

Operation and maintenance of the CAS process includes the energy to run pumps, mixers and blowers for diffused aeration, and the labor to maintain them. Estimates for annual O&M costs are presented for 2027 and 2047 in **Table 6.18**. The present value in 2017 for O&M is $3.4 MM.

Table 6.18 Conventional Activated Sludge Process Operation and Maintenance Costs

Category	2027	2047
Chemical Use		
Labor		
Equipment	$ 2,700	$ 4,900
Instru & Sampling (compliance reporting not included)	$ 2,000	$ 3,600
Energy		
Pumps	$ 35,100	$ 63,400
Diffused Aeration	$ 175,700	$ 317,200
Total	$ 215,500	$ 389,200

* annual interest rate = 3%

Table 6.19 Conventional Activated Sludge Process Expansion (New Site) Conceptual Design Level Cost Estimate

Telluride Regional Wastewater Treatment Plant - Phase 1 Conventional Activated Sludge Process Expansion (on-site) Conceptual Design Level Estimate of Cost			
Divisions	Item Descriptions	Total Cost	Notes and References
Division 1 - General Requirements	Mobilization/Demobilization	$ 1,044,180	At 6.0% of subtotal construction cost
	Insurances and bonds	$ 609,105	At 3.5% of subtotal construction cost
	Construction staging, and material and equipment storage	$ 348,060	At 2% of subtotal construction cost
	Permit applications as required for the construction	$ 69,612	At 0.4% of subtotal construction cost
	Site maintenance including cleaning, drainage, erosion control, access roads, mud and dust control, noise control, fueling containment, spills response, contingency plans etc.	$ 87,015	At 0.5% of subtotal construction cost
	Construction quality control testing	$ 34,806	At 0.2% of subtotal construction cost
	Construction survey	$ 5,000	
	Temporary facilities including offices, sanitary facility, electrical system, HVAC, water supply, first aid, signs and barricades etc.	$ 50,000	
	Contractor's project management services including meetings, coordination, submittals, etc.	$ 174,030	At 1% of subtotal construction cost
	Start-up, testing and commissioning, and O&M	$ 69,612	At 0.4% of subtotal construction cost
	Land Cost	$ 1,600,000	Estimated for 2 acres
	Total Division 1 work cost	$ 4,092,000	
Division 2 - Site Work	Excavation, Backfill and Site Grading	$ 440,000	
	Total Division 2 work cost	$ 440,000	
Division 3 – Concrete	CIP Conc. – Buried Tanks – Phase 1	$ 7,280,000	
	Platforms and Elevated Walkways	$ 900,000	
	Total Division 3 work cost	$ 8,180,000	
Division 5 – Metals	Misc. stairways, decks, railings, supports and anchoring systems	$ 1,125,000	
	Total Division 5 work cost	$ 1,125,000	
Division 7 - Thermal and Moisture Protection	Basin Roof Moisture Protection	$ 168,000	
	Concrete Basin coatings (new basins) & repairs (existing clarifiers)	$ 150,000	
	Total Division 7 work cost	$ 318,000	
Division 8 – Doors and Windows	Overhead Doors and Access Hatches	$ 45,000	
	Total Division 8 work cost	$ 45,000	
Division 11 - Equipment	Pumps (pretreated, internal recycle, RAS, WAS); Mixers; and instrumentation	$ 2,250,000	

	Aeration Systems (blowers, diffusers)	$ 1,400,000	
	Total Division 11 work cost	$ 3,650,000	
Division 15 - Mechanical	Pipe and fittings	$ 225,000	
	HVAC	$ 225,000	
	Water Supply Piping	$ 30,000	
	Total Division 15 work cost	$ 480,000	
Division 16 – Electrical	Secondary power systems and controls, wiring, conduit	$ 75,000	
		$ 3,000,000	
	Total Division 16 work cost	$ 3,075,000	
Division 17 - Instrumentation and Control	Integration of Vender provided equipment to SCADA	$ 90,000	
	Total Division 17 work cost	$ 90,000	
Subtotal excluding Div 1 work cost		$ 17,403,000	
Subtotal including Div 1 work cost		$ 21,495,000	
Estimator's Contingency (25% of subtotal)		$ 5,374,000	
Grand Total (2017 dollar)		$ 26,900,000	

For the expansion alternatives on the adjacent (new) site, the capital and operation and maintenance costs in FY 2017 dollars are summarized below:

- 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

6.6.4 Off-Site Expansion in Telluride

Off-site expansion was briefly investigated as a third option. With tight site constraints, the MBR process is most applicable for a small undefined site. This third option would place a new treatment plant on property currently owned by the Town of Telluride or by Mountain Village. A new pump station would be installed in the collection system to divert a consistent flow of raw wastewater to the new plant site, potentially 500,000 gallons per day or less. The existing TRWWTP would be re-rated to treat the reduced flows. Biosolids treatment would remain at the current plant site. Having a second plant site and discharge permit incurs more stringent nutrient limits, additional compliance monitoring and reporting, and greater demands on plant staffing.

A new waste sludge pipeline would be constructed from the new site to the TRWWTP. As such, the waste sludge produced at a new site would likely be pumped. A pipeline running along existing road right-of-way is likely to cost $1.5 MM to $2.5 MM.

A new outfall pipe would also be constructed from the new site to the San Miguel River. The new site would require good access and clearance for construction. The site would impact no less than ½ acre for buried reactor tanks, equipment rooms, control and electrical rooms and a new headworks. Odor control systems are recommended for treatment of all reactor headspaces. It is likely that bed rock would impact subsurface construction.

6.7 PREFERRED ALTERNATIVE FOR THE TRWWTP EXPANSION

Selecting a preferred alternative for the expansion of the TRWWTP is more than choosing the least cost option. The selection process and criteria used are often judged differently by operators, engineers and administrators. Stantec developed a selection matrix to integrate the non-monetary aspects of the alternatives. The first stage of the process employs a method for assessing the relative importance of a set of criteria. The result of this initial assessment is weighted for criteria relative to each other. The second phase of the evaluation is the comparison of alternatives. An overall scoring is calculated for each alternative using this two-stage process.

In **Table 6.20**, the selection criteria are rated where the criteria in the row is compared with the one in the column. The combined numeric score equals 6 between the same paired items in a column to a row. The scoring is assessed according to the following list:

Evaluation Criterion	Entered Score	Paired Score
Substantially More Important	5	1
Somewhat More Important	4	2
Equal Importance	3	3
Somewhat Less Important	2	4
Substantially Less Important	1	5

Table 6.20 Relative Importance of Selection Criteria

	Capital Costs	O&M Costs	Ease of Maintenance	Ease of Operation	Level of Proprietary Components	Performance Range	Local Support / Repair	Equipment History	Sustainability	Relative Weight
Capital Costs		3	3	2	3	2	3	2	4	*22*
O&M Costs	3		3	3	5	2	2	3	4	*25*
Ease of Maintenance	3	3		3	5	3	4	3	3	*27*
Ease of Operation	4	3	3		5	3	4	4	4	*30*
Level of Proprietary Components	3	1	1	1		1	2	2	3	*14*
Performance Range	4	4	3	3	5		4	2	3	*28*
Local Support/Repair	3	4	2	2	4	2		2	3	*22*
Equipment History	4	3	3	2	4	4	4		4	*28*
Sustainability	2	2	3	2	3	3	3	2		*20*

The relative weights calculated (right column) are carried to the next stage of the selection process.

6.7.1 Comparison of MBR and BioMag® Options for Retrofitting the TRWWTP

A discussion of the two technologies being compared for the retrofit are presented in **Table 6.21**.

Table 6.21 Comparison of BioMag® and MBR Technologies

	MBR (Retrofit)	BioMag®
Capital Costs	Capital Cost = $29.8 MM	Capital Cost = $19.1 MM
O&M Costs	O&M Cost (PV2017) = $5.6 MM	O&M Cost (PV2017) = $4.5 MM
Ease of Maintenance	Maintenance is minimized with robust pretreatment systems in the new headworks. Systems are self-monitoring and initiate routine back-pulsing cycles. Chemical clean-in-place of all membranes required twice a year.	Magnetite recovery system must operate continuously. Redundant units allow maintenance. Actual maintenance requirements are not well understood. Regular cleaning of oxidation ditches required to prevent accumulation in dead zones.
Ease of Operations	Operation of aeration and anoxic basins must consider nutrient removal objectives. Higher biomass concentrations change the process control concepts but overall operations are simplified with membrane filtration. Small tankage allows adding or removing tanks from service quickly.	Operation is similar to existing plant. The biomass calculations must consider the added mass of magnetite. Higher concentrations of biomass decrease the volume of sludge being wasted.
Level of Proprietary Components	The membranes must be replaced every 10 – 14 years. The membranes are not necessarily proprietary but they are integrated into a 'system' of cassettes or modules.	Magnetite is readily available but the specifications for the material used in the proprietary recovery system may make it less so.
Performance Range	Operate over a wide range of mixed-liquor conc. (6,000 – 10,000 mg/L). Effluent quality is superior.	The three oxidation ditches can be rotated to match seasonal loading similar to existing. Nitrogen removal performance should be better than the existing system. Effluent quality not as good as MBR.
Local Support /Repair	Basic support from common trades	Support from manufacturer is not local.

Equipment History	Many system suppliers integrate membranes manufactured by a limited number of companies. A range of system suppliers, some with significant track record, some are entering the market. The technology is well established and reliable. Thousands of installations in the US and abroad. Five major suppliers (GE, Evoqua, Koch, Ovivo, and Fibracast)	New application of this technology to municipal wastewater treatment market with little track record, one supplier, sole-source.
Sustainability	Use of Pumps for normal operation of membranes is significant. Chemicals used for membrane cleaning. Membrane life is approximately 10 yrs.	Added process to existing oxidation ditch system uses more energy to mix and aerate. The feed and recovery of magnetite is the heart of the system.

The two viable alternatives for retrofitting the existing TRWWTP, MBR and BioMag® are scored against each other in **Table 6.22.**

Table 6.22 Scoring of Alternatives for Retrofit of the TRWWTP

		Comparative Score (Total Must Equal 10)		Criterion Score (Relative Weight Times Comparative Score)	
Criteria	***Relative Weight***	**MBR**	**BioMag**	**MBR**	**BioMag**
Capital Costs	*22*	2	8	44	176
O&M Costs	*25*	3	7	75	175
Ease of Maintenance	*27*	6	4	162	108
Ease of Operation	*30*	9	1	270	30
Level of Proprietary Components	*14*	6	4	84	56
Performance Range	*28*	8	2	224	56
Local Support / Repair	*22*	5	5	110	110
Equipment History	*28*	7	3	196	84
Sustainability	*20*	7	3	140	60
			TOTAL SCORE	1305	855

6.7.2 Comparison of MBR and CAS Options for Expansion of the TRWWTP on Adjacent Site

A discussion of the two technologies being compared for the expansion on the adjacent land are presented in **Table 6.23**.

Table 6.23 Comparison of MBR and CAS Technologies

	MBR (New)	CAS
Capital Costs	Capital Cost = $28.3 MM	Capital Cost = $26.9 MM
O&M Costs	O&M Cost (PV2017) = $5.6 MM	O&M Cost (PV2017) = $3.4 MM
Ease of Maintenance	Maintenance is minimized with robust pretreatment systems in the new headworks. Systems are self-monitoring and initiate routine back-pulsing cycles. Chemical clean-in-place of all membranes required twice a year.	The maintenance is familiar as a conventional process with similar equipment as currently in use.
Ease of Operations	Operation of aeration and anoxic basins must consider nutrient removal objectives. Higher biomass concentrations change the process control concepts but overall operations are simplified with membrane filtration. Small tankage allows adding or removing tanks from service quickly.	Operation will be more complex with continued reliance on process control for effective settling in the existing clarifiers. Adding or removing tanks from service can be done quickly and efficiently.
Level of Proprietary Components	The membranes must be replaced every 10 – 14 years. The membranes are not necessarily proprietary but they are integrated into a 'system' of cassettes or modules.	All process components can be supplied by many different manufacturers without reliance on proprietary technologies.
Performance Range	Operate over a wide range of mixed-liquor conc. (6,000 – 10,000 mg/L). Effluent quality is superior.	Limited operating range for mixed liquor concentration. Must use various volume configurations to manage variable flows and loadings.
Local Support/Repair	No local support	Common equipment components have local support.
Equipment History	Many system suppliers integrate membranes manufactured by a limited number of companies. A range of system suppliers, some with	System components have been used for decades. Many manufacturers have been competing for a long time.

	significant track record, some are entering the market. The technology is well established and reliable. Thousands of installations in the US and abroad. Five major suppliers (GE, Evoqua, Koch, Ovivo, and Fibracast)	
Sustainability	Use of Pumps for normal operation of membranes is significant. Chemicals used for membrane cleaning. Membrane life is approximately 10 yrs.	Process would require upgrades to address future regulations. Otherwise the system would function for planning period and beyond.

The two viable alternatives adjacent to the existing TRWWTP, MBR and CAS are scored against each other in **Table 6.24.**

Table 6.24 Scoring of Alternatives for Expansion of the TRWWTP on Adjacent Site

		Comparative Score (Total Must Equal 10)		Criterion Score (Relative Weight Times Comparative Score)	
Criteria	***Relative Weight***	**MBR**	**CAS**	**MBR**	**CAS**
Capital Costs	*22*	4	6	88	132
O&M Costs	*25*	4	6	100	150
Ease of Maintenance	*27*	5	5	135	135
Ease of Operation	*30*	9	1	270	30
Level of Proprietary Components	*14*	2	8	28	112
Performance Range	*28*	8	2	224	56
Local Support / Repair	*22*	4	6	88	132
Equipment History	*28*	3	7	84	196
Sustainability	*20*	6	4	120	80
			TOTAL SCORE	1137	1023

6.8 CONCLUSIONS

The alternatives for expansion of the TRWWTP were developed for two site options. Neither process option for on-site expansion (Site Alternative 1) is recommended.

6.8.1 Site Alternative 1: Retrofitting the Existing TRWWTP

The comparison of process improvements for retrofitting the TRWWTP are

- BioMag® improvements as a relatively low-cost alternative with little track record, reliance on existing infrastructure that requires replacement and upgrades, and little room of future improvements for nitrogen control or biosolids handling and treatment

- MBR installation within a congested site requiring complex construction staging. The capital cost is the highest. The process achieves the best effluent quality both now and in the future. A large portion of the site can be demolished for future improvements.

6.8.2 Site Alternative 2: Expand the Existing TRWWTP on Adjacent Site

The MBR expansion on a new site compares well with the Conventional Activated Sludge process. The comparison of the process options for expansion on the adjacent site (Site Alternative 2) feature two excellent choices.

- MBR installation on adjacent site features the most advanced treatment process available. The capital and the operation and maintenance costs are relatively high. The process achieves the best effluent quality both now and in the future. Construction can be accommodated within a 1-acre site and still have some space for future improvements. The existing site would be freed up for future needs such as biosolids treatment and storage.

- The Conventional Activated Sludge process is highly adaptable to meet current and future needs for the community. The new construction would fit on 1 acre requiring a land purchase of approximately 2 acres. The capital cost is lower using the existing clarifiers. The biggest benefit is the lower operation and maintenance costs.

6.9 SUMMARY

The recommended site option for the expansion of the TRWWTP is to build a new facility on the adjacent site. The process selection for the expansion will be decided based on the project drivers, which include non-monetary criteria. Of the monetary drivers, the CAS process is preferred based on the significantly lower O&M cost.

7.0 BIOSOLIDS HANDLING AND TREATMENT

7.1 OVERVIEW

The TRWWTP treats waste activated sludge (WAS) from the clarifiers using aerobic digestion within four aerated basins. The aeration system for the digestion process consists of coarse-bubble diffusers fixed to the bottom of each basin. Air is supplied to the diffusers by three 100-HP multistage centrifugal blowers (2 duty, 1 standby). Small propeller mixers are also fixed to the bottom of the basins to provide additional mixing of WAS during digestion. The WAS typically enters the basins at a rate that varies seasonally with the loading to the plant. When sufficiently digested, the WAS is termed "biosolids". Biosolids that are dewatered can be disposed of in landfills or beneficially used on permitted land application sites. Beneficial land application of biosolids recycles nutrients back into the environment, typically on agricultural land. The TRWWTP currently contracts with a hauler to beneficially use biosolids at permitted sites.

The operation of the digesters involves intermittent aeration and decanting cycles. Decant water is returned to the oxidation ditches. Decanting benefits the process by allowing biosolids to remain in the digesters longer by increasing solids concentrations, thereby achieving more sufficient stabilization. Following digestion, biosolids are typically thickened for storage in either of two tanks located below grade in the headworks area. From these tanks biosolids are pumped into tanker trucks to be hauled offsite and land applied. The contract hauler mandates loadout performance and operators must thicken biosolids and have both storage tanks full to accommodate the contract hauler's requirements. Operation in this manner is completed with little buffer for any change or delay. If the contract hauler is delayed, biosolids must be stored in the digesters or throughout the treatment system by increasing concentrations of solids in various unit processes, exceeding their design criteria. Additionally, cold weather conditions have an impact on the operation of the TRWWTP digestion and decanting cycles such that solids become harder to separate from the water.

Thickened sludge in the digesters has the potential to create odors because the efficiency of oxygen transfer decreases as the percent solids increases. The existing coarse-bubble diffusers are good for mixing, but not very efficient for oxygen transfer which allows for stabilization and mitigation of odors. Under current 'normal' conditions, the sludge can be thickened to 1.0 percent solids by turning off the air supply, allowing the basin to settle and decanting the clear water from the surface. When operators use the rotary drum thickeners to pre- or post- thicken, oxygen transfer efficiency in the digesters is decreased. If the residual dissolved oxygen in the biosolids goes below 0.5 mg/L, which occurs during the decanting cycle, odorous compounds can form and re-aeration releases them to the atmosphere.

The current practice is limited by many process conditions, physical limitations of handling solids and even through the contract operations and final disposal options. Future end uses should be expanded to ensure more disposal or beneficial use options. Even the best designed and

operated solids processing facilities have challenges and require alternatives for end use markets. At a minimum, biosolids treatment processes must be capable of processing solids projected for the long-term, and operators must have greater flexibility to handle and store solids prior to hauling and beneficial reuse.

Shortly, the renewal option for the third party contract operations will come. The TRWWTP has an opportunity to end this contract for hauling and disposal of biosolids. There are no other local contract operations available, and allowing the hauling and disposal contract to lapse would require the Town to assume responsibility for final disposal or beneficial use. However, before this decision is made, the TRWWTP must assess the long term viability of the alternatives and their ability to take on this process.

An option that the TRWWTP has used in the past is to resume application on the 1,200 acres of agricultural land that is permitted for biosolids that the TRWWTP has access to. However, biosolids have not been applied to this site for several years until recently, in 2017. Land application practices are based largely upon the assimilative capacity for nitrogen and without agricultural land management practices and the growth of crops the land will only be suitable for very low application rates and volumes. The limits on assimilative capacity would only qualify this land as an emergency outlet and not an annual long-term solution assuming the same land management practices continue. Thus, the TRWWTP must have a biosolids program integrated with the near- and long-term plans for wastewater treatment.

7.2 BIOSOLIDS REGULATIONS

A biosolids program is defined by the type and the end use of biosolids produced. The requirements of treatment and the options for disposal are provided in Colorado Regulation No.64. There are four options for meeting land application requirements for biosolids:

- Exceptional Quality option,
- Pollutant Concentration option,
- Cumulative Pollutant Loading Rate option,
- Annual Pollutant Loading Rate option.

Each option has a combination of requirements for treatment, testing, and reporting that allow program managers to adapt to meet specified criteria.

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.

The aerobic digestion process currently used is a Process to Significantly Reduce Pathogens. To meet vector attraction reduction requirements, operators test biosolids for Specific Oxygen

Uptake Rate (SOUR). Biosolids are then hauled as a bulk liquid meeting Class B requirements for land application on permitted sites.

Changing the biosolids program to meet Exceptional Quality Class A criteria provides for unrestricted land application, which has no site restrictions, general requirements, management practices, or requirements to track added pollutants. The cost of producing Class A biosolids should be offset to some degree by the access to inexpensive disposal options.

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. Beneficial reuse options may include:

- General distribution to individuals for home gardens and lawns (usually stored for access by the public or sold in bags)
- Municipal projects involving reclamation, restoration or construction (normally short-term), such as parks and roadsides
- Mine reclamation sites
- Application to burn areas following a wildfire
- Soil amendment for landscape construction on public or private sites, such as golf courses
- Cover material for interim operations and final closure of landfills
- Agricultural land application
- Range land application

7.2.1 Alternative Class B Biosolids Treatment Systems

Two processes were evaluated for treatment of biosolids to meet Class B standards. These processes would provide additional flexibility because additional volume for storage on-site would be available.

- Mesophilic aerobic digestion (1st stage of the Autothermal Thermophilic Aerobic Digestion system) by Thermal Process Systems Inc.
- CleanB® chemical treatment process marketed by BCR Environmental Corporation

7.2.1.1 Mesophilic Aerobic Digestion

A proposal by Thermal Process Systems, Inc. to upgrade the existing aerobic digestion process uses two of the four digester basins retrofitted with jet aeration (jet nozzles on headers mounted to the basin floor, recirculation pumps, and progressive displacement blowers), temperature monitoring and control systems, and a biofilter for odor control. A new building would be

required to house the blowers, pumps and control systems. Ventilation equipment would pull odorous air from the digesters and convey it to a biofilter constructed outside the plant. The existing digester blowers would be used to aerate the two remaining digesters providing storage. Thermal Process Systems, Inc. describes their MesoAer™ process for the TRWWTP as follows:

> The MesoAer™ process operates at a design of 21 day HRT, in either a semi-batch or continuously fed operation mode. In fact, preliminary design calculations and studies conducted on similar waste streams indicate that this HRT should provide optimal destruction and removal efficiencies at minimal operating costs. The proposed pricing includes the MesoAer™ system, including jet aeration header, jet motive pump, blower, foam control system, process controls and control logic, and in-basin piping to operate the MesoAer™ process. Accordingly, TPS has developed an operation and cost scenario that has been tailored to the facility's specific needs and provides for maximum flexibility.
>
> Our design calculations are based upon the biological solids and net nitritation/denitritation oxygen requirements. Mixing is controlled by the jet mix pump and may operate at various speeds depending on whether the system is in the oxic or anoxic mode of operation, providing additional shear and as such better oxygen transfer efficiency during oxic conditions, and mixing while conserving energy during anoxic periods. The 'gassing rate' (air/liquid ratio) in the jet system is the only parameter that changes drastically, and so that makes this particular enhanced digestion system even more operationally attractive given the complexities and uncertainties of the operation of WWTPs especially during start-up and scale up operations. The MesoAer™ system is quite unique and can process up to ~4% TS depending on temperature, viscosity, VS, and HRT. Our initial design calculations are based on the maximum design loading of about 3,000 ppd of waste activated material at about 3% TS. Aeration is sized at 3,000 ppd for the corresponding loading for operation on a 7-day per week loading schedule. TPS has several WWTPs operating under this similar design scenario. The MesoAer™ aeration system is designed to meet 100% of the daily oxygen uptake requirement in the reactor in a 75% air on and 25% air off operation strategy.

The MesoAer™ process would typically be operated as an automated or semi-automated system. A local control panel monitors tank levels, pH, temperature, and oxidation-reduction potential (ORP). Temperature is maintained within the mesophilic range (below thermophilic) using cooling fans. Thermal Process Systems, Inc's complete proposal is presented in **Appendix F.1.** Their scope of supply includes vent fans and biofilter components that would be installed in a biofilter constructed of cast-in-place concrete, possibly above a digester.

This option requires pre-thickening of waste activated sludge (WAS) to function as described above. The existing limitations for biosolids handling at the TRWWTP make pre-thickening a challenge. To overcome these challenges, operators would have to use a rotary drum thickener to thicken WAS, then feed it to the digesters from the aerated storage tank. The digested biosolids from the MesoAer™ system would be stored in the two remaining digesters. At least two of the existing blowers currently used for digestion would remain for aeration and mixing of the digested biosolids until they are hauled off-site.

This process would require a new building to be constructed on site. The vender has proposed locating this building under the roadway west of the digester basins. The estimate of probable construction cost is $3,500,000. The estimated annual power cost is $60,000.

7.2.1.2 CleanB® Chemical Treatment

CleanB® is a patented technology which takes sodium chlorite ($NaClO_2$) and sulfuric acid (H_2SO_4) and generates a small amount of chlorine dioxide (ClO_2). The ClO_2 is then injected into a small liquid stream which is then injected into the larger WAS stream. After the WAS has been in contact with the chemical solution for 8 to 10 minutes the WAS will have been oxidized and treated to Class B standards, ready for further thickening or dewatering prior to disposal. **Figure 7.1** contains a process flow diagram of the CleanB® treatment process.

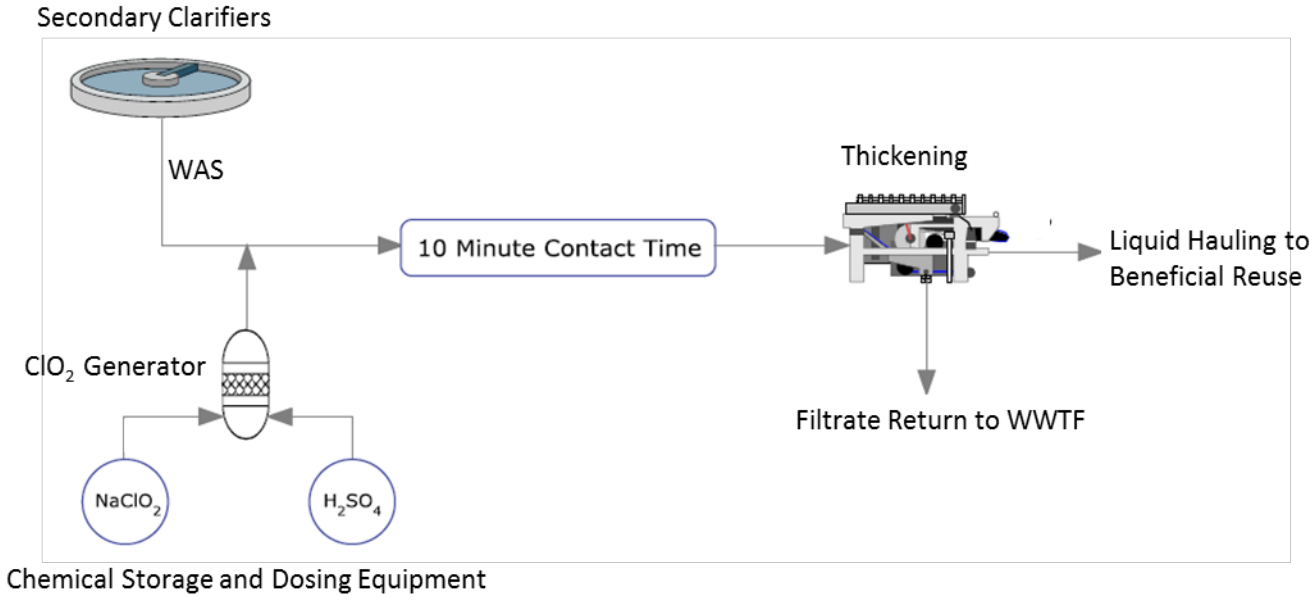


Figure 7.1 CleanB® Process Flow Diagram
Image Source: nuTerra; with modified labels

On February 12, 2015, the United State Environmental Protection Agency (USEPA) recognized the CleanB® system as a Process to Substantially Reduce Pathogens (PSRP) equivalency for Class B biosolids stabilization (refer to **Appendix F.2**). The CleanB® process is not yet approved by the Engineering Section of the CDPHE Water Quality Control Division (WQCD). However, considering the technology has received USEPA PSRP approval, and the supplier has ample operating data from several full-scale and pilot applications, it is likely the technology can receive state approval. Furthermore, a mobile demonstration of the CleanB® technology is recommended before proceeding with full-scale design. A successful local pilot will improve the likelihood of approval.

To date, the CleanB® system has been primarily used in the southeast region of the U.S., but has been growing in interest and acceptance in other parts of the country. **Appendix F.2** contains a reference list for operating installations; NuTerra (the supplier of CleanB®) has several more installations under various stages of design or construction as of March 2017.

The CleanB® system is a modularized design that has been pre-engineered by the supplier to treat up to 270 gallons per minute (gpm) of WAS. The system design is refined as necessary for each application / site, and is designed for installation within a conditioned space approximately 36 feet by 46 feet. **Figure 7.2** displays a labeled schematic of a typical CleanB® system.

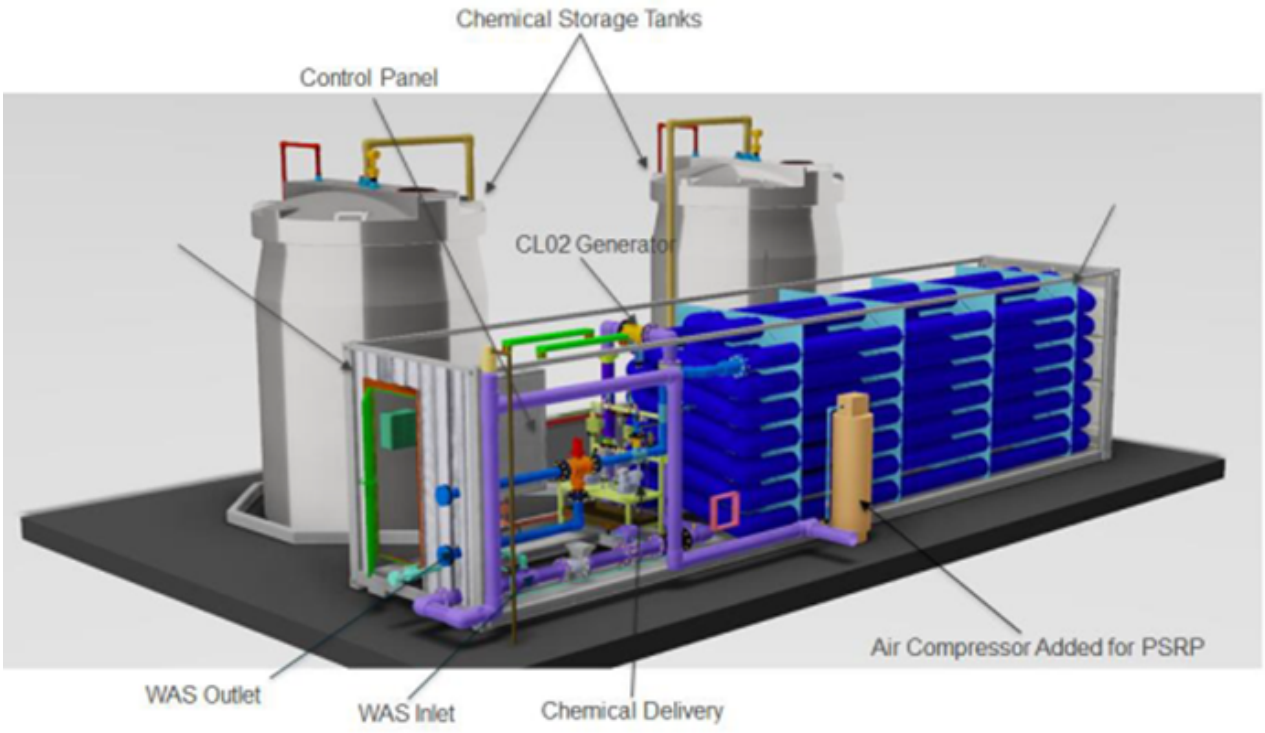


Figure 7.2 Typical CleanB® System Schematic
Image Source: nuTerra

7.2.1.3 Safety Considerations

There were several safety considerations identified during the evaluation of the CleanB® process. These considerations were generally with the chemicals and chemical handling within the system, which are typical of water and wastewater treatment facilities that apply chemical treatment. Material Safety Data Sheets (MSDS) for the chemicals used in the CleanB® process are included in **Appendix F.2**. Detailed MSDS procedures for all chemicals used in the process must be generated and strictly followed for all chemicals.

Sodium chlorite ($NaClO_2$) – Sodium chlorite is available in either dry or aqueous form. For this evaluation we assumed TRWWTP would prefer the aqueous form for ease of handling and preparation. Sodium chlorite solution is a corrosive chemical and is incompatible with materials such as organics, oxidizers, reducing agents, acids, paints, and combustible materials. The concentration of the solution was assumed at 15%. Operator must consult and strictly follow manufacturer MSDS procedures to handle this chemical.

Sulfuric acid (H_2SO4) – Sulfuric acid is a corrosive strong acid. The main risk posed by the acid are skin contact which can lead to burns especially at high concentrations. The sulfuric acid concentrations we assumed for CleanB® are approximately 50%. Operator must consult and strictly follow manufacturer MSDS procedures to handle this chemical.

Chlorine dioxide (ClO_2) – Chlorine dioxide would be produced on site by combining sodium chlorite and sulfuric acid. In the gas form, ClO2 is an explosive and hazardous chemical. However, the small amounts of chlorine dioxide generated from the CleanB® process are injected directly into the WAS stream as a dissolved gas, which minimizes safety concerns. Nevertheless, the operator must consult and strictly follow manufacturer MSDS procedures to handle this chemical. The manufacturer indicates that gas detection alarms are standard and required with their units and they have had no safety incidents with the chlorine dioxide.

Biosolids – The CleanB® treated sludge is considered Class B and can be handled in a similar fashion as digested sludge and poses no additional risk to the TRWWTP.

7.2.1.4 Preliminary Occupancy Classification Review for CleanB® Chemicals

The storage of sulfuric acid and sodium chlorite chemicals for the CleanB® process must consider building code occupancy classification requirements. References checked for this preliminary discussion include:

- 2012 International Building Code (IBC), Chapter 3
- Product Specific Safety Data Sheets (SDS's)
- Hazardous Materials Classification Guide

Building occupancy requirement for these chemicals are summarized below:

15% Sodium Chlorite CAS#7758-19-2, 2,500 Gallons

- Firefighter Warning Placard
    - Health Hazard: Class 3
    - Fire Hazard: –
    - Reactivity Hazard: –
    - Special Hazard: Oxidizer, Corrosive
- Physical Properties: OX2

- Health Properties: COR, OHH, TOX
- Preliminary Occupancy Classification: Likely to be H3 (driven by OX2 designation)
    - H3 is meant for occupancies where material pose a physical hazard and/or are easily combustible.

<u>50% Sulfuric Acid CAS#7664-93-9, 2,500 Gallons</u>

- FireFighter Warning Placard
    - Health Hazard: Class 3
    - Fire Hazard: –
    - Reactivity Hazard: 1
    - Special Hazard: Corrosive, Water Reactive
- Physical Properties: WR1
- Health Properties: COR, TOX
- Preliminary Occupancy Classification: Likely to be H4 (driven by TOX designation)
    - H4 is meant for occupancies where materials pose a health hazard, meaning they are toxic, highly toxic, and/or corrosive materials

Hazardous occupancy classifications often require a building to include the following safety items: automatic fire suppression system (fire sprinklers), automatic fire detection and alarm, increased ventilation requirements, chemical leak detection and alarm, emergency chemical containment, signage, and special egress provisions.

7.2.1.5 **Disinfection By-Products**

Use of chlorine dioxide is known to generate disinfection byproducts (DBP) when used in drinking water or treated wastewater effluent. Compared to other disinfectants, ClO_2 is known for having a lower DBP generation potential. The main chemical byproducts of ClO_2 treatment are: Chlorite (ClO_2^-), Chlorate (ClO_3^-), and Chloride (Cl^-) ions. Studies show for every 10,000 gallons WAS processed with CleanB treatment, 10 moles of Chloride, 0.9 moles of Chlorate, and a negligible amount of Chloride are produced.

Because chlorine dioxide oxidizes but does not chlorinate, chlorinated organic by-products (e.g., THMs, HAAs, dioxins, furans) are not produced. By-products generated in this process will be delivered to the secondary process via the filtrate and will exit the plant with the treated effluent. Additional investigation is warranted prior to electing to proceed with the CleanB® system. It is noted that DBP effluent limits are expected perhaps in the 15 - 30 year timescale, if not longer.

7.2.1.6 Conceptual Design of CleanB® Improvements at the TRWWTP

The conceptual design criterial of a CleanB® system for TRWWTP includes the following considerations:

- Continued use of existing progressing cavity WAS pump and construction of a new small diameter pipeline to the system.
- Construction of a new dedicated building with a small (< 5,000 gallon) wetwell below or adjacent to the building. Duty standby dry-pit WAS pumps for returning treated sludge to the existing Rotary Drum Thickeners (RDTs) for post-thickening
- Delivery of the thickened, treated sludge to the two existing, aerated thickened sludge storage tanks below the RDTs
- Use of existing thickened sludge pumps to deliver liquid sludge to sludge hauling trucks.
- Land application by the Town on the Town's existing land, as well as adjacent land.

Table 7.2 contains the major design criteria for a CleanB® system. Advantages and disadvantages of the system are considered in **Table 7.3**.

Table 7.1 Design Criteria for CleanB® System

Year	Loading Condition	WAS Load (1)	Assumed WAS Concentration	WAS Flow	Operating Time (2)	Chemical Usage, Each (3)	Storage Time (4)
		(lb/day)	(mg/L)	(gal/day)	(hr/day)	(gal/day)	(days)
2017	Annual Average	1,370	5,000	32,854	2.8	14.9	167
	Maximum Month	2,650	5,000	63,549	5.5	28.9	87
2047	Annual Average	3,000	5,000	71,942	6.2	32.7	76
	Maximum Month	6,000	5,000	143,885	12.4	65.4	38

(1) Refer to the Projected Flow and Loading section
(2) Assumes unit runs at 270 gpm, 5 days per week
(3) Same quantity for both sodium chlorite and sulfuric acid
(4) Assumes 2,500-gallon storage tank for each chemical

Table 7.2 Advantages and Disadvantages of CleanB® System

Advantages	Disadvantages
Small footprint, slab on grade construction	Hazardous chemical handling and storage required
Significantly reduced odors (1)	Potential to generate DBPs
Short treatment / stabilization time	Sole-source supplier
Existing aerobic digester and sludge storage tankage can continue to be used for short-term aerated storage of pre- and post-treated biosolids	Requires additional footprint of a tight site
Between 1 and 3 of the existing digesters can likely be converted to other uses	Not approved for use in Colorado
Easy to operate, supplier to provide all maintenance and chemical supply	
Low recycle of nitrogen and phosphorus back to the liquid stream	

(1) Manufacturer claims that treated product can be stored for 1 week aerated and not generate odors. Claim needs to be verified with piloting and talking to existing installations

Figure 7.3 provides a conceptual piping and new building location site plan for a CleanB® system. **Figure 7.4** includes a modification to the existing plant process flow diagram to incorporate the CleanB® system. A process and instrumentation diagram (P&ID) of a typical system is included in **Appendix F.2**.

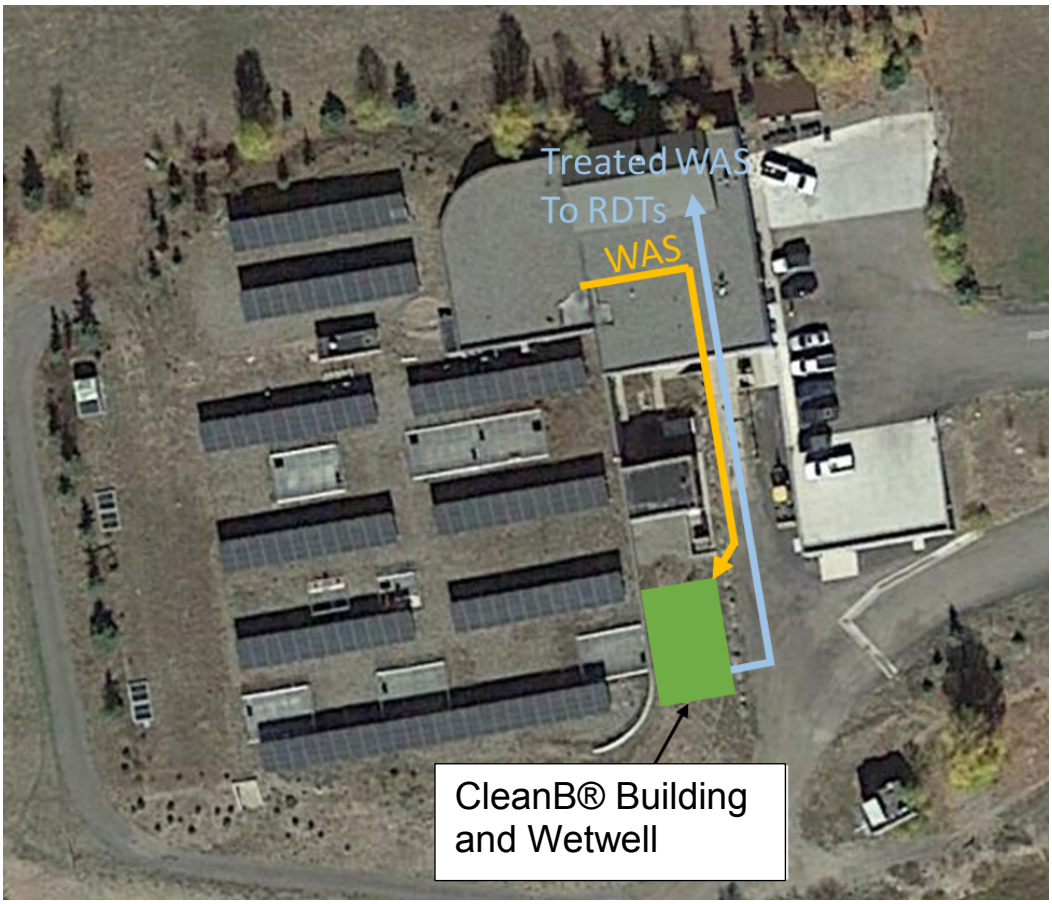


Figure 7.3 Conceptual Site Plan for CleanB® Building

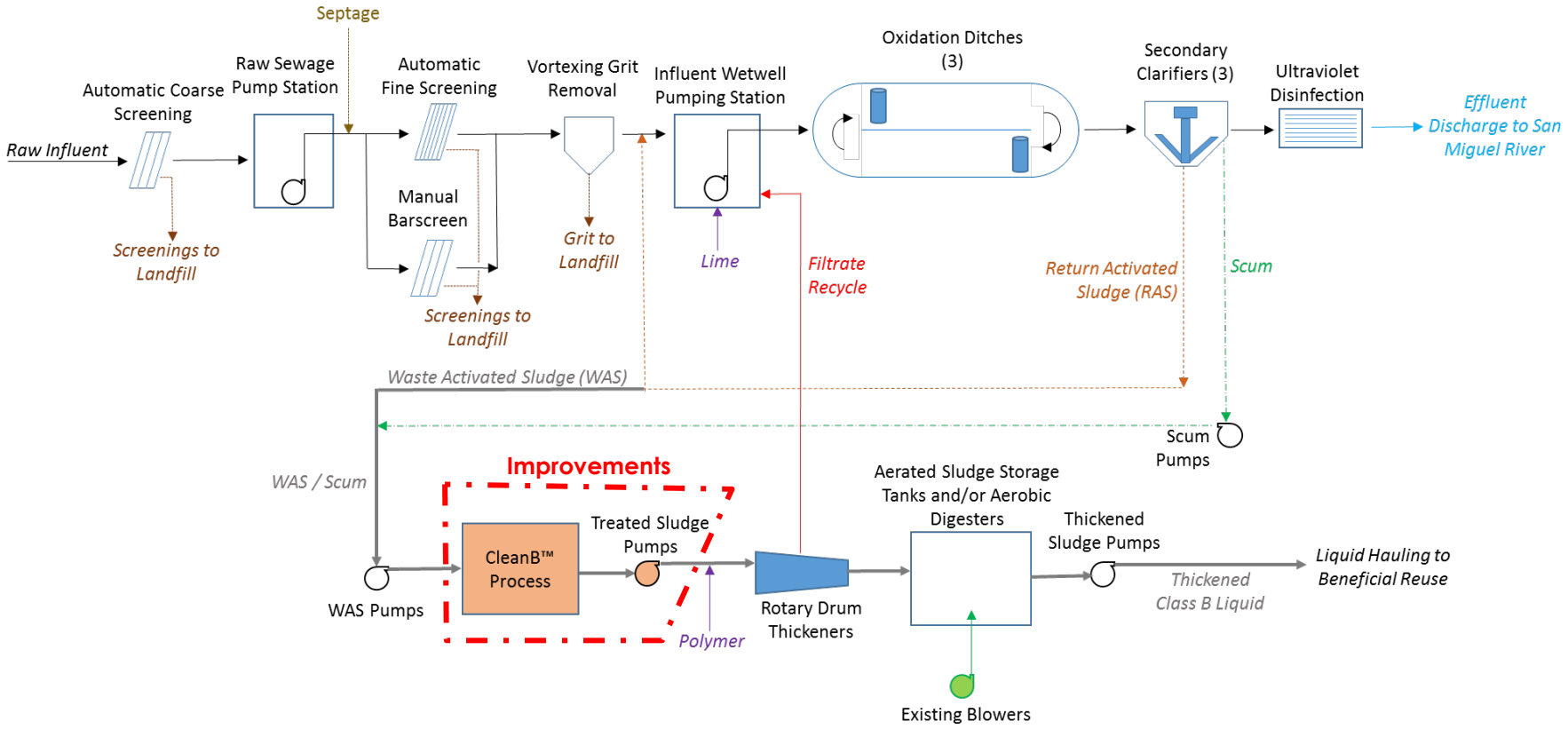


Figure 7.4 Revised TRWWTF Process Flow Diagram

7.2.1.7 Capital Costs

The capital costs are assumed to include the following items:

- Packaged CleanB® process unit (includes CleanB® treatment module with integrated SCADA controls, CleanB® contact system, and chemical storage system.
- ~36 ft x ~46 ft pre-engineered metal building (Butler Building style) located to the east of Oxidation Ditch No. 1 and to the south of the existing generator building.;
- Foundation;
- Electrical for building;
- Piping from existing WAS line to CleanB® package unit;
- Piping from CleanB® to a small wetwell;
- Pumps and piping to deliver treated solids to the existing rotary drum thickener for post-thickening.

The total capital cost for a CleanB® system sized for the 30-year planning period is expected to be approximately $2,000,000.

7.2.1.8 Operating Costs

Operating costs for the CleanB® system are assumed to include the following items:

- Chemical – 2,500 gallons each of sodium chlorite and sulfuric acid delivered as indicated in Table 3.
- Power – Power includes the CleanB® process unit, pumps, and building needs
- Heat – Natural gas will be needing to keep the building above 50° F
- Operator time – 25% of one operators time has been assumed to operate the CleanB® system and the existing rotary drum thickeners (RDTs)

Refer to **Table 7.4** for estimated O&M costs for the CleanB® system assuming 2017 and 2047 sludge generation rates. Note that costs are for the CleanB® treatment only; up and downstream operating costs for aeration, thickening or dewatering, hauling, and tipping are not included in this table. Also, operator time and building heat have been excluded from this table.

Table 7.3 Estimated CleanB® Operating Costs

Item	Annual Costs (1)	
	2017	2047 (2)
Chemicals (3)	$36,000	$46,000
Electricity (4)	$300	$300
Total	$36,300	$46,300

(1) Annual costs for operation of the CleanB® system only, costs for land application not included. Building heat and operator costs also not included.
(2) 2047 costs are indicated in 2017 dollars
(3) Value provided by CleanB® supplier, nuTerra for chemical management, operator training, remote monitoring, system support, and repair and maintenance.
(4) Assumes $0.08 per kW-hr

It is noted that the chemical costs and chemical usage values included in **Table 7.4** are provided by the supplier of the CleanB® technology. This chemical cost includes all annual chemicals, as well as a chemical management plan, operator training, remote system monitoring, system support, and repairs and maintenance activities. TRWWTP staff will be responsible for the proper feeding of the system, turning it on/off, providing the up and downstream aerated storage, and operating the post-thickening rotary drum thickener (RDT). Refer to a sample "memorandum of understanding" provided by the supplier for review located in **Appendix F.2**.

Contracts with nuTerra typically run from 10-20 years. The cost adjustments are typically associated with Consumer Price Index (CPI) increases but that is negotiable. All installations require remote monitoring and all of installations receive chemicals from nuTerra because they have experienced issues where an Owner ordered the wrong chemical which resulted in the CleanB® not functioning properly. While nuTerra will supply the necessary chemicals for TRWWTP, they will be transparent with the costs they are paying allowing the Town the ability to competitively price shop in search of a better deal.

7.3 ALTERNATIVE CLASS A BIOSOLIDS TREATMENT SYSTEMS

The biosolids treatment processes evaluated per Class A criteria are:

- CleanB® Class A Upgrades
- Thermophilic Aerobic Digestion by Thermal Process Systems Inc.
- Off-site Composting by 3rd Party
- Closed Alkaline Process by Schwing Bioset, Inc.

7.3.1 CleanB® Class A Upgrades

The CleanB® system has two paths to achieve Class A requirements, including:

- Neutralizer - The Neutralizer system utilizes additional steps downstream of CleanB® to achieve a Class A product. Dewatering rather than thickening is also typically incorporated to provide for a Class A cake for beneficial reuse.
- Accelerated Composting -- The Accelerated Composting approach includes dewatering downstream of CleanB® followed by an actively managed composting system which converts the Class B dewatered cake to a Class A product.

7.3.2 Thermophilic Aerobic Digestion

The second generation Autothermal Thermophilic Aerobic Digestion (ATAD) process adds a second stage of reactors to the mesophilic aerobic digestion process for Class B biosolids described above. The process is illustrated in **Figure 7.5** below. The ATAD process treats "batches" of WAS sequentially through a highly-automated system. The time required for operation and maintenance is significant to keep all the equipment/instruments running properly. Operators must pre-thicken WAS for each batch and dewater the finished product to 15 to 20 percent solids.

The advantages and disadvantages of an ATAD process are listed in **Table 7.5**.

Table 7.4 Advantages and Disadvantages of ATAD Process

Advantages	Disadvantages
Reduced odors (includes an odor control system)	Process upset is prone to odors (relies on odor control system)
Uses existing digester basins	Sole-source supplier
Highly automated	Pre- and post-treatment systems must be coordinated with ATAD processing
Stable end-product	Relies on multiple levels of instrumentation for stable operation
	Sequence of construction requires to digesters to be retrofitted while two remain in operation (may not be feasible at current plant loading)
	New pumps, blowers, and control systems need to be installed in a new building

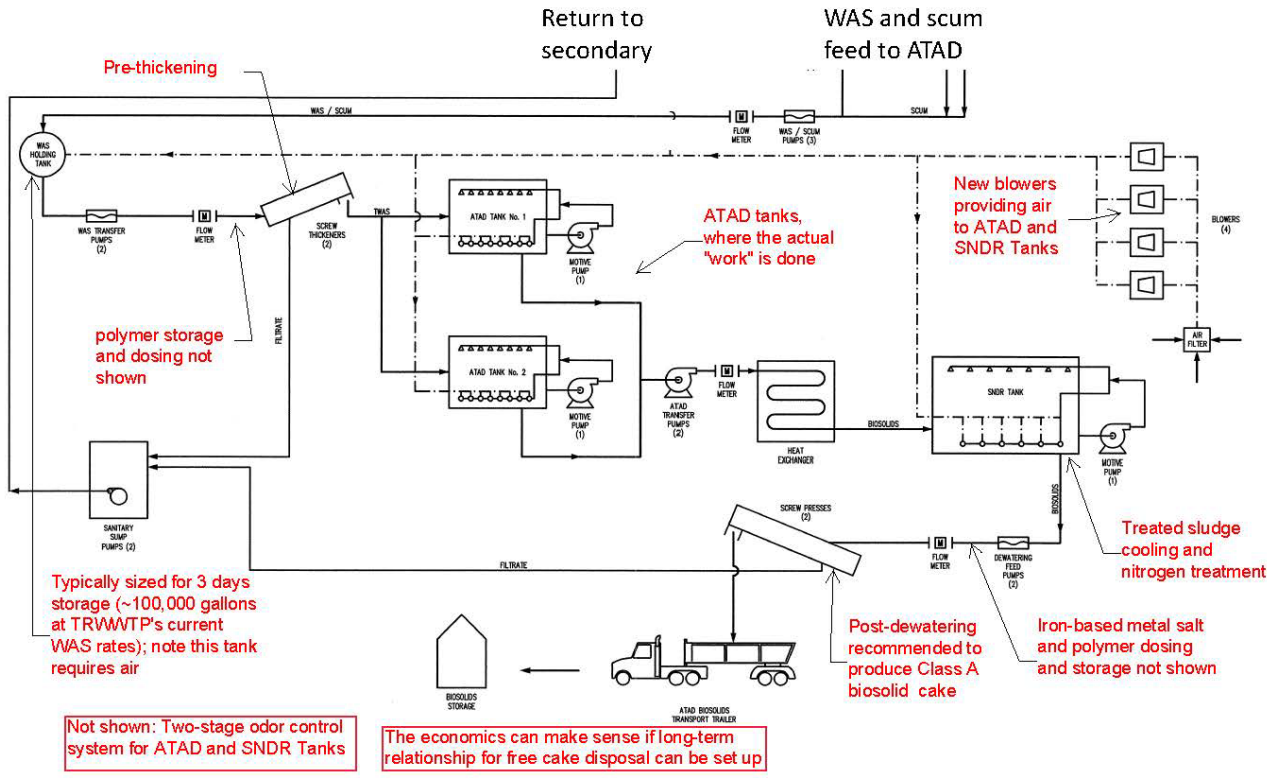


Figure 7.5 Typical Process Flow Diagram for Biosolids Treatment using ATAD

The construction of the ATAD system requires all four digester basins and the construction of a new building on-site for the new blowers, pumps and control systems. In addition, the new building would need to accommodate dewatering equipment, biosolids storage and conveyance for truck loading. The existing rotary drum thickeners would be used for pre-treatment of the WAS. The required improvements would be very challenging to construct within the boundaries of the existing site while the existing TRWWTP remains operational.

7.3.3 Off-site Composting by Third Party

The owner of a privately-operated composting facility in Olathe, Colorado, indicated that a mutually beneficial agreement might be reached if Class B biosolids were delivered to their site. The composting facility is not currently permitted to receive biosolids. The owner would obtain permits if an agreement was reached. The terms of an agreement might include quantity and quality of biosolids delivered. The owner would be responsible distributing the composted material and meeting permit requirements. The primary drawback is that there are no guarantees that the composting operation would remain viable or sustainable for the long-term. The advantage is that the composter has the experience, equipment and bulking materials required for a successful composting operation.

7.3.4 Closed Alkaline Process

The closed alkaline process marketed by Schwing Bioset Inc. (**Appendix F.3**) combines two types of treatment in a closed reactor. Thermal treatment occurs using the heat generated by reacting quick lime with biosolids (water) per the time-temperature requirements of the biosolids regulations. The second process uses the increase in pH to meet the requirements for vector attraction reduction. The system is primarily driven by the addition of quick lime, a dry powder that requires storage in an outdoor silo. The WAS feed to the process is first dewatered and then mixed with the quick lime. The heat of hydration brings the biosolids temperature above 50°C while it moves through the closed reactor. Ammonia off-gasses at high pH so a scrubber captures it in solution and returns it as a side stream back to the head of the plant.

The Closed Alkaline Process requires an outdoor silo for quick lime storage. Pre-dewatering of WAS makes sizing of the closed reactor reasonable; the system can handle a feed stock up to 50% solids content. Thus, all related systems need to convey, store, haul and land apply a drier solids product. The process equipment would fit in a small footprint. Dewatering and conveyance equipment would replace the rotary drum thickeners. Storage and handling of biosolids becomes more efficient as there is less water.

The major drawback of this system is that biosolids are high in pH, but it is possible that nitrogen or metals in the biosolids would limit the land application rate before pH would. Neutralization may be needed for land application on Colorado soils.

7.4 BIOSOLIDS HANDLING AND DISPOSAL

After treatment and dewatering, the biosolids must be stored until hauled off-site. The two thickened biosolids storage tanks below the headworks have limited capacity. Thickening biosolids would provide additional storage capacity as water is removed and volume decreases. However, the existing facility is not equipped with dewatering equipment. Once dewatered, biosolids would be stored and conveyed as a wet cake instead of pumped as a slurry.

Hauling biosolids offsite becomes critical when the thickened sludge storage tanks fill to capacity. This limitation in storage could be managed more effectively if the Town takes over their hauling and disposal operations. The TRWWTP would have to hire staff and purchase equipment to haul biosolids and apply it to their own permitted land. The immediate need for equipment includes:

- Tanker truck, 4000-gallon minimum capacity, estimated cost $150,000
- Liquid spreader equipment mounted on new truck with flotation tires, estimated cost $50,000

To be a viable long-term solution, the Town will need to find additional end uses and/or land for biosolids application. The TRWWTP has opportunities to work with land owners in the region to

secure access to agricultural lands in exchange for providing biosolids, either Class A or B. Developing additional disposal options involves negotiating the agreements with landowners, and obtaining regulatory permits for land application sites (Class B only). To meet nitrogen application criteria, the land area will need to be expanded. For the 30-year planning projections, we estimate that 15,000 acres of rangeland or 7,000 acres of cultivated farmland be permitted for Class B biosolids land application. Even though Class A biosolids can be distributed without restriction, end uses must be developed.

Strategies for developing end uses for Class A biosolids may include:

- Public distribution from the TRWWTP, open bay
- Bag and sell, distribute to retailers
- Public projects such as parks, highways, golf courses, etc.
- Reclamation of mine sites, landfills or other private properties

The County is interested in using dewatered biosolids as part of their plans for capping and reclaiming the Broad Canyon landfill. The county landfill would take either Class A or B biosolids if sufficiently dewatered. For emergency disposal, the current cost for disposal of biosolids at the county landfill is $12/cy. This tipping fee is not advantageous when hauling 4% s.c. biosolids (96% water).

7.5 SUMMARY OF BIOSOLIDS HANDLING AND TREATMENT OPTIONS

Advantages and limitations were identified with each option for treatment and handling of biosolids. This is a complex issue that must consider implications for the future. The following is a summary of options for biosolids treatment and for handling/disposal:

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. Composing 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. Open up 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 for more time for transition.

7.6 RECOMMENDED BIOSOLIDS TREATMENT IMPROVEMENTS

The complexity of the biosolids alternatives and the implications on a plant expansion project cannot be overstated. For the immediate need, Stantec recommends leasing a mobile CleanB® system that allows pilot-testing on site and data gathering for design, operation and permitting. If the CleanB® system meets the needs and expectations of plant staff, then the full implementation is recommended at an estimated capital cost of $1,900,000 (FY 2017). This still allows for upgrades to achieve Class A at a later timeframe. And, the option to expand the TRWWTP within the existing site boundaries is still open.

If the CleanB® pilot testing does not meet expectations, the options to upgrade the existing digesters using either mesophilic or thermophilic aerobic digestion could prevent the plant from being expanded within the existing site. If the plant is expanded onto the adjacent site, upgrades to the existing digesters would still be viable but difficult to implement while the existing facility remains in operation. The closed alkaline stabilization process would be an effective option to achieve Class A biosolids. The problem with alkaline stabilization is that the soils in the region are already high in alkalinity.

APPENDICES

Appendix A METALS SAMPLING DATA

A.1 COMPLETE METALS SAMPLING DATA SET

GIS Layer	Sample ID	Descriptor (1)	Descriptor (2)	Date	Parameter	Conc.	Units
Pandora RW	Blue Lake	Raw Pandora WTP	Telluride Source Water	7/18/2007	Aluminum		mg/L
Pandora RW	Bridal Veil Power Stn	Raw Pandora WTP	Telluride Source Water	7/18/2007	Aluminum	0.051	mg/L
Pandora RW	Bridal Veil Power Stn	Raw Pandora WTP	Telluride Source Water	10/2/2007	Aluminum		mg/L
Pandora RW	Bridal Veil Power Stn	Raw Pandora WTP	Telluride Source Water	3/13/2008	Aluminum		mg/L
Pandora RW	Falls Crest Diversion	Raw Pandora WTP	Telluride Source Water	7/18/2007	Aluminum	0.13	mg/L
Pandora RW	Falls Crest Diversion	Raw Pandora WTP	Telluride Source Water	10/2/2007	Aluminum		mg/L
Pandora RW	Falls Crest Diversion	Raw Pandora WTP	Telluride Source Water	3/5/2008	Aluminum		mg/L
Pandora RW	Lewis Lake	Raw Pandora WTP	Telluride Source Water	7/18/2007	Aluminum	0.093	mg/L
Pandora RW	Mud Lake	Raw Pandora WTP	Telluride Source Water	7/18/2007	Aluminum	0.046	mg/L
Pandora RW	Tail Race	Raw Pandora WTP	Telluride Source Water	10/2/2007	Aluminum		mg/L
Aldasoro WW	Ald2	Aldosoro Interceptor	WW Collection	1/27/2014	Arsenic	0.0005	mg/L
Aldasoro WW	Ald2	Aldosoro Interceptor	WW Collection	2/1/2014	Arsenic	0.0005	mg/L
Aldasoro WW	Ald2	Aldosoro Interceptor	WW Collection	3/3/2014	Arsenic	0.0005	mg/L
Aldasoro WW	Aldosoro	Aldosoro Interceptor	WW Collection	5/29/2014	Arsenic	0.0008	mg/L
Aldasoro WW	Site #2	Aldosoro Interceptor	WW Collection	11/5/2013	Arsenic	0.0006	mg/L
Aldasoro WW	Site #2	Aldosoro Interceptor	WW Collection	1/27/2014	Arsenic	0.0008	mg/L
Aldasoro WW	Site #2	Aldosoro Interceptor	WW Collection	2/1/2014	Arsenic	0.0008	mg/L
Aldasoro WW	Site #2	Aldosoro Interceptor	WW Collection	3/3/2014	Arsenic	0.0005	mg/L
Lawson WW	Lawson 2 (3-inch Parshall flm)	Lawson Interceptor Sewer	WW Collection	3/3/2014	Arsenic	0.0019	mg/L
Lawson WW	Lawson 2 (3-inch Parshall flm)	Lawson Interceptor Sewer	WW Collection	5/29/2014	Arsenic	0.0018	mg/L
Lawson WW	Lawson 2 (3-inch Parshall flm)	Lawson Interceptor Sewer	WW Collection	1/27/2014	Arsenic	0.0014	mg/L
Lawson WW	Lawson 2 (3-inch Parshall flm)	Lawson Interceptor Sewer	WW Collection	2/1/2014	Arsenic	0.0014	mg/L
Mill Creek DW	MC3	Finish Mill Creek WTP	Clearwell discharge	5/29/2014	Arsenic	0.0017	mg/L

Mill Creek DW	MC3	Finish Mill Creek WTP	Clearwell discharge	3/3/2014	Arsenic	0.0017	mg/L
Mill Creek DW	MC3	Finish Mill Creek WTP	Clearwell discharge	5/29/2014	Arsenic	0.0017	mg/L
Mill Creek DW	MC3	Finish Mill Creek WTP	Clearwell discharge	1/27/2014	Arsenic	0.0016	mg/L
Mill Creek DW	MC3	Finish Mill Creek WTP	Clearwell discharge	2/1/2014	Arsenic	0.0016	mg/L
Mill Creek DW	Site #3	Finish Mill Creek WTP	Clearwell discharge	11/5/2013	Arsenic	0.0022	mg/L
Mill Creek DW	Site #4A	Finish Mill Creek WTP	Clearwell discharge	10/7/2013	Arsenic	0.0019	mg/L
Mill Creek DW	MC2.5 sink at plant	Finish Mill Creek WTP	Drinking Water - Finish Mill Creek WTP	5/29/2014	Arsenic	0.0017	mg/L
Mill Creek DW	MC2.5 sink at plant	Finish Mill Creek WTP	Drinking Water - Finish Mill Creek WTP	5/29/2014	Arsenic	0.0017	mg/L
Mill Creek DW	MC2.5 sink at plant	Finish Mill Creek WTP	Drinking Water - Finish Mill Creek WTP	3/3/2014	Arsenic	0.001	mg/L
Mill Creek RW	MC1 - head gate	Raw Mill Creek WTP	Telluride Source Water	5/29/2014	Arsenic	0.0143	mg/L
Mill Creek RW	MC1 - head gate	Raw Mill Creek WTP	Telluride Source Water	1/27/2014	Arsenic	0.0022	mg/L
Mill Creek RW	MC1 - head gate	Raw Mill Creek WTP	Telluride Source Water	2/1/2014	Arsenic	0.0022	mg/L
Mill Creek RW	MC1 - head gate	Raw Mill Creek WTP	Telluride Source Water	3/3/2014	Arsenic	0.0021	mg/L
Mill Creek RW	MC2 - RW tap in plant	Raw Mill Creek WTP	Telluride Source Water	5/29/2014	Arsenic	0.0137	mg/L
Mill Creek RW	MC2 - RW tap in plant	Raw Mill Creek WTP	Telluride Source Water	1/27/2014	Arsenic	0.0023	mg/L
Mill Creek RW	MC2 - RW tap in plant	Raw Mill Creek WTP	Telluride Source Water	2/1/2014	Arsenic	0.0023	mg/L
Mill Creek RW	MC2 - RW tap in plant	Raw Mill Creek WTP	Telluride Source Water	3/3/2014	Arsenic	0.0023	mg/L
Mountain Village DW	MV1 - tap @ PH's apt.	Mtn Village tap - PH's	Drinking Water	1/27/2014	Arsenic	0.0011	mg/L
Mountain Village DW	MV1 - tap @ PH's apt.	Mtn Village tap - PH's	Drinking Water	2/1/2014	Arsenic	0.0011	mg/L
Mountain Village DW	MV1 - tap @ PH's apt.	Mtn Village tap - PH's	Drinking Water	5/29/2014	Arsenic	0.001	mg/L
Mountain Village DW	MV1 - tap @ PH's apt.	Mtn Village tap - PH's	Drinking Water	5/29/2014	Arsenic	0.001	mg/L
Mountain Village DW	MV1 - tap @ PH's apt.	Mtn Village tap - PH's	Drinking Water	3/3/2014	Arsenic	0.0007	mg/L
Mountain Village DW	Site #3A	Mtn Village tap - PH's	Drinking Water	10/7/2013	Arsenic	0.0006	mg/L
Mountain Village WW	MV2 - 9" Parshall flm	MV WW Collection	MV WW Collection	5/29/2014	Arsenic	0.0016	mg/L
Mountain Village WW	MV2 - 9" Parshall flm	MV WW Collection	MV WW Collection	5/29/2014	Arsenic	0.0016	mg/L
Mountain Village WW	MV2 - 9" Parshall flm	MV WW Collection	MV WW Collection	1/27/2014	Arsenic	0.0011	mg/L
Mountain Village WW	MV2 - 9" Parshall flm	MV WW Collection	MV WW Collection	2/1/2014	Arsenic	0.0011	mg/L
Mountain Village WW	MV2 - 9" Parshall flm	MV WW Collection	MV WW Collection	3/3/2014	Arsenic	0.001	mg/L
Mountain Village WW	Site #5	MV WW Collection	MV Sewer Interceptor	11/5/2013	Arsenic	0.0008	mg/L
Pandora RW	Blue Lake	Blue Lake	Telluride Source Water	7/18/2007	Arsenic	0.0005	mg/L

Pandora RW	Site #6A	Bridal Veil Falls	Pandora Source Water	10/7/2013	Arsenic	0.0005	mg/L
Pandora RW	Bridal Veil Power Stn	Bridal Veil Falls	Telluride Source Water	7/18/2007	Arsenic	0.0005	mg/L
Pandora RW	Bridal Veil Power Stn	Bridal Veil Falls	Telluride Source Water	10/2/2007	Arsenic	0.0005	mg/L
Pandora RW	Bridal Veil Power Stn	Bridal Veil Falls	Telluride Source Water	3/13/2008	Arsenic	0.0005	mg/L
Pandora RW	Falls Crest Diversion	Bridal Veil Falls	Telluride Source Water	7/18/2007	Arsenic	0.0005	mg/L
Pandora RW	Falls Crest Diversion	Bridal Veil Falls	Telluride Source Water	10/2/2007	Arsenic	0.0005	mg/L
Pandora RW	Falls Crest Diversion	Bridal Veil Falls	Telluride Source Water	3/5/2008	Arsenic	0.0005	mg/L
Pandora RW	Lewis Lake	Lewis Lake	Telluride Source Water	7/18/2007	Arsenic	0.0005	mg/L
Pandora RW	Mud Lake	Mud Lake	Telluride Source Water	7/18/2007	Arsenic	0.0005	mg/L
Pandora RW	Tail Race	Tail Race	Telluride Source Water	10/2/2007	Arsenic	0.0005	mg/L
San Miguel River	Gondola Gage	Gondola Gage	Instream	4/4/2016	Arsenic	0.0009	mg/L
San Miguel River	Gondola Gage	Gondola Gage	Instream	5/9/2016	Arsenic	0.0007	mg/L
San Miguel River	Gondola Gage	Gondola Gage	Instream	6/29/2016	Arsenic	0.0007	mg/L
San Miguel River	Gondola Gage	Gondola Gage	Instream	5/31/2016	Arsenic	0.0005	mg/L
San Miguel River	Gondola Gage	Gondola Gage	Instream	7/25/2016	Arsenic	0.0005	mg/L
San Miguel River	Lawson Park	Lawson Park	Instream	10/10/2016	Arsenic	0.0008	mg/L
San Miguel River	Lawson Park-San Miguel R (d/s)	Lawson Park	Instream	5/29/2014	Arsenic	0.006	mg/L
San Miguel River	San Miguel R - up	Society Turn Bridge	Instream	10/10/2016	Arsenic	0.0008	mg/L
San Miguel River	SM Upstream (Society Turn Bridge)	Society Turn Bridge	Instream	5/29/2014	Arsenic	0.0071	mg/L
San Miguel River	SM Upstream (Society Turn Bridge)	Society Turn Bridge	Instream	5/29/2014	Arsenic	0.0071	mg/L
San Miguel River	Site #2A	Society Turn Bridge	Instream above outfall	10/7/2013	Arsenic	0.0008	mg/L
San Miguel River	WWTP Gage	WWTP Gage	Instream	6/29/2016	Arsenic	0.0017	mg/L
San Miguel River	WWTP Gage	WWTP Gage	Instream	5/9/2016	Arsenic	0.0016	mg/L
San Miguel River	WWTP Gage	WWTP Gage	Instream	5/31/2016	Arsenic	0.0013	mg/L
San Miguel River	WWTP Gage	WWTP Gage	Instream	7/25/2016	Arsenic	0.0012	mg/L
San Miguel River	WWTP Gage	WWTP Gage	Instream	4/4/2016	Arsenic	0.0009	mg/L
Stillwell	Cornet Creek	Cornet Creek	Telluride Source Water	5/29/2014	Arsenic	0.0138	mg/L
Stillwell	Site #5A	Stillwell tank	Drinking Water	10/7/2013	Arsenic	0.0123	mg/L
Telluride Groundwater	Pipe Replacement Trench-pumped	Colorado & Pine	Construction Dewater	10/6/2016	Arsenic	0.259	mg/L
Telluride Groundwater	Pipe Replacement Trench-settled	Colorado & Pine	Construction Dewater	10/6/2016	Arsenic	0.0674	mg/L

Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	12/5/2012	Arsenic	0.0012	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	11/13/2012	Arsenic	0.0011	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	11/7/2012	Arsenic	0.0009	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	9/11/2013	Arsenic	0.0027	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	8/13/2013	Arsenic	0.0023	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	7/16/2013	Arsenic	0.0023	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	7/16/2013	Arsenic	0.0021	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	10/15/2013	Arsenic	0.0018	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	4/10/2013	Arsenic	0.0012	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	1/15/2013	Arsenic	0.0012	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	8/13/2013	Arsenic	0.0011	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	6/4/2013	Arsenic	0.0011	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	5/14/2013	Arsenic	0.0011	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	12/10/2013	Arsenic	0.001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	6/4/2013	Arsenic	0.001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	2/6/2013	Arsenic	0.001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	3/5/2013	Arsenic	0.0009	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	5/12/2014	Arsenic	0.037	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	10/7/2014	Arsenic	0.0035	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	9/2/2014	Arsenic	0.0033	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	9/2/2014	Arsenic	0.0033	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	8/4/2014	Arsenic	0.0029	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	7/15/2014	Arsenic	0.0025	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	11/11/2014	Arsenic	0.0018	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	12/8/2014	Arsenic	0.0017	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	5/29/2014	Arsenic	0.0017	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	4/8/2014	Arsenic	0.0011	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	6/2/2014	Arsenic	0.001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	1/7/2014	Arsenic	0.001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	2/11/2014	Arsenic	0.0009	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	3/18/2014	Arsenic	0.0008	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	1/14/2015	Arsenic	0.0015	mg/L

Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	7/8/2015	Arsenic	0.0014	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	4/22/2015	Arsenic	0.0014	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	4/22/2015	Arsenic	0.0014	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	3/11/2015	Arsenic	0.0014	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	3/11/2015	Arsenic	0.0014	
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	6/15/2015	Arsenic	0.0013	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	8/4/2015	Arsenic	0.0012	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	2/4/2015	Arsenic	0.0012	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	3/2/2015	Arsenic	0.0011	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	5/4/2015	Arsenic	0.0009	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	9/1/2015	Arsenic	0.0006	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	11/3/2015	Arsenic	0.0005	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	10/7/2015	Arsenic	0.0005	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	4/20/2016	Arsenic	0.0025	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	5/17/2016	Arsenic	0.001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	3/23/2016	Arsenic	0.001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	3/17/2016	Arsenic	0.001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	6/1/2016	Arsenic	0.0007	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	2/3/2016	Arsenic	0.0005	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	1/20/2016	Arsenic	0.0005	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	10/10/2016	Arsenic	ND	mg/L
Telluride RWWTP Effluent	Site #1	WWTP Effluent		11/5/2013	Arsenic	0.0012	mg/L
Telluride RWWTP Effluent	Site #1	WWTP Effluent		3/3/2014	Arsenic	0.0009	mg/L
Telluride RWWTP Effluent	Site #1	WWTP Effluent		1/27/2014	Arsenic	0.0008	mg/L
Telluride RWWTP Effluent	Site #1	WWTP Effluent		2/1/2014	Arsenic	0.0008	mg/L
Telluride RWWTP Effluent	Site #1A	WWTP Effluent		10/7/2013	Arsenic	0.0028	mg/L
Telluride RWWTP Effluent	TWWTP: Effluent Composite	WWTP Effluent		12/29/2015	Arsenic	0.0005	mg/L
Telluride RWWTP Influent	Tri-State 9/1/16	Septage	Power generating station	9/1/2016	Arsenic	0.0016	mg/L
Telluride RWWTP Influent	Coyote Septic	Septage	Septic Discharge	8/19/2016	Arsenic	0.0039	mg/L
Telluride RWWTP Influent	Coyote Septic	Septage	Septic Discharge	8/26/2016	Arsenic	0.0035	mg/L
Telluride RWWTP Influent	Coyote Septic	Septage	Septic Discharge	8/19/2016	Arsenic	0.0015	mg/L
Telluride RWWTP Influent	Inf Flume	WWTP Influent @ flm	Flume in WWTP HWs	5/29/2014	Arsenic	0.0011	mg/L
Telluride RWWTP Influent	Influent	WWTP Influent @ flm	Flume in WWTP HWs	4/20/2016	Arsenic	0.0025	mg/L

Telluride RWWTP Influent	Influent	WWTP Influent @ flm	Flume in WWTP HWs	2/3/2016	Arsenic	0.0025	mg/L
Telluride RWWTP Influent	Influent	WWTP Influent @ flm	Flume in WWTP HWs	5/17/2016	Arsenic	0.0014	mg/L
Telluride RWWTP Influent	Influent	WWTP Influent @ flm	Flume in WWTP HWs	6/1/2016	Arsenic	0.001	mg/L
Telluride RWWTP Influent	Influent	WWTP Influent @ flm	Flume in WWTP HWs	3/23/2016	Arsenic	0.001	mg/L
Telluride RWWTP Influent	Influent	WWTP Influent @ flm	Flume in WWTP HWs	3/17/2016	Arsenic	0.001	mg/L
Telluride RWWTP Influent	Influent	WWTP Influent @ flm	Flume in WWTP HWs	10/10/2016	Arsenic	ND	mg/L
Telluride RWWTP Influent	Influent 9-in Parshall Flume in HWs	WWTP Influent @ flm	Flume in WWTP HWs	5/29/2014	Arsenic	0.0011	mg/L
Telluride RWWTP Influent	Influent 9-in Parshall Flume in HWs	WWTP Influent @ flm	Flume in WWTP HWs	5/29/2014	Arsenic	0.0011	mg/L
Telluride RWWTP Influent	Influent: 24 Hr Comp 8/27-8/28/2016	WWTP Influent @ flm	WWTP Influent	8/28/2016	Arsenic	0.0025	mg/L
Telluride RWWTP Influent	Influent: 24 Hr Comp 8/28-8/29/2016	WWTP Influent @ flm	WWTP Influent	8/29/2016	Arsenic	0.0025	mg/L
Telluride RWWTP Influent	TWWTP: Influent Composite	WWTP Influent @ flm		12/29/2015	Arsenic	0.005	mg/L
Telluride RWWTP Influent	Site #8	WWTP Influent @ flm		1/27/2014	Arsenic	0.0017	mg/L
Telluride RWWTP Influent	Site #8	WWTP Influent @ flm		2/1/2014	Arsenic	0.0017	mg/L
Telluride RWWTP Influent	Site #8	WWTP Influent @ flm		3/3/2014	Arsenic	0.0013	mg/L
Telluride RWWTP Influent	Site #9	WWTP Influent @ flm		3/3/2014	Arsenic	0.0009	mg/L
Telluride RWWTP Process	Site #4	Lime	WWTP Chemical Feed	11/5/2013	Arsenic	24.8	mg/kg dry
Telluride RWWTP Process	Lime	Lime	WWTP Chemical Feed	1/27/2014	Arsenic	0.697	mg/kg dry
Telluride RWWTP Process	Sodium Bicarbonate	Sodium Bicarbonate	WWTP Chemical Feed	1/30/2014	Arsenic	1	mg/kg dry
Telluride RWWTP Process	Sludge	WWTP Sludge		5/29/2014	Arsenic	4.51	mg/L
Telluride RWWTP Process	Sludge	WWTP Sludge		1/27/2014	Arsenic	4.22	mg/kg dry
Telluride RWWTP Process	Thickened Sludge	WWTP Sludge		5/29/2014	Arsenic	4.51	mg/L
Telluride RWWTP Process	Thickened Sludge	WWTP Sludge		2/1/2014	Arsenic	4.22	mg/kg dry
Telluride RWWTP Process	Thickened Sludge	WWTP Sludge		3/3/2014	Arsenic	4.08	mg/kg dry
Telluride WW	Telluride Manhole #1	Telluride Collection System		9/1/2016	Arsenic	0.0025	mg/L
Telluride WW	Telluride Manhole #2	Telluride Collection System		9/1/2016	Arsenic	0.0025	mg/L
Telluride WW	Telluride Manhole #3	Telluride Collection System		9/1/2016	Arsenic	0.0009	mg/L
Telluride WW	Telluride Manhole #4	Telluride Collection System		9/1/2016	Arsenic	0.0025	mg/L
Pandora RW	Blue Lake	Raw Pandora WTP	Telluride Source Water	7/18/2007	Barium	0.02	mg/L
Pandora RW	Bridal Veil Power Stn	Raw Pandora WTP	Telluride Source Water	10/2/2007	Barium	0.065	mg/L
Pandora RW	Bridal Veil Power Stn	Raw Pandora WTP	Telluride Source Water	7/18/2007	Barium	0.032	mg/L

Pandora RW	Bridal Veil Power Stn	Raw Pandora WTP	Telluride Source Water	3/13/2008	Barium	0.022	mg/L
Pandora RW	Falls Crest Diversion	Raw Pandora WTP	Telluride Source Water	10/2/2007	Barium	0.072	mg/L
Pandora RW	Falls Crest Diversion	Raw Pandora WTP	Telluride Source Water	7/18/2007	Barium	0.04	mg/L
Pandora RW	Falls Crest Diversion	Raw Pandora WTP	Telluride Source Water	3/5/2008	Barium	0.082	mg/L
Pandora RW	Lewis Lake	Raw Pandora WTP	Telluride Source Water	7/18/2007	Barium	0.018	mg/L
Pandora RW	Mud Lake	Raw Pandora WTP	Telluride Source Water	7/18/2007	Barium	0.033	mg/L
Pandora RW	Tail Race	Raw Pandora WTP	Telluride Source Water	10/2/2007	Barium	0.068	mg/L
Aldasoro WW	Site #2	Aldosoro Interceptor	WW Collection	11/5/2013	Cadmium	0.0001	mg/L
Mountain Village DW	Site #3A	Mtn Village tap - PH's	Drinking Water	10/7/2013	Cadmium	0.0005	mg/L
Pandora RW	Blue Lake	Blue Lake	Telluride Source Water	7/18/2007	Cadmium	0.0001	mg/L
Pandora RW	Bridal Veil Power Stn	Bridal Veil Falls	Telluride Source Water	7/18/2007	Cadmium	0.0001	mg/L
Pandora RW	Bridal Veil Power Stn	Bridal Veil Falls	Telluride Source Water	10/2/2007	Cadmium	0.0001	mg/L
Pandora RW	Bridal Veil Power Stn	Bridal Veil Falls	Telluride Source Water	3/13/2008	Cadmium	0.0001	mg/L
Pandora RW	Falls Crest Diversion	Bridal Veil Falls	Telluride Source Water	7/18/2007	Cadmium	0.0001	mg/L
Pandora RW	Falls Crest Diversion	Bridal Veil Falls	Telluride Source Water	10/2/2007	Cadmium	0.0001	mg/L
Pandora RW	Falls Crest Diversion	Bridal Veil Falls	Telluride Source Water	3/5/2008	Cadmium	0.0001	mg/L
Pandora RW	Lewis Lake	Lewis Lake	Telluride Source Water	7/18/2007	Cadmium	0.00088	mg/L
Pandora RW	Mud Lake	Mud Lake	Telluride Source Water	7/18/2007	Cadmium	0.0001	mg/L
Pandora RW	Tail Race	Tail Race	Telluride Source Water	10/2/2007	Cadmium	0.0001	mg/L
San Miguel River	Site #2A	Society Turn Bridge	Instream above outfall	10/7/2013	Cadmium	0.0009	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	12/5/2012	Cadmium	0.0001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	11/7/2012	Cadmium	0.0001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	11/13/2012	Cadmium	0.0001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	12/10/2013	Cadmium	0.0001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	10/15/2013	Cadmium	0.0001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	9/11/2013	Cadmium	0.0001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	8/13/2013	Cadmium	0.0001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	7/16/2013	Cadmium	0.0001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	6/4/2013	Cadmium	0.0001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	5/14/2013	Cadmium	0.0001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	4/10/2013	Cadmium	0.0001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	3/5/2013	Cadmium	0.0001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	2/6/2013	Cadmium	0.0001	mg/L

Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	1/15/2013	Cadmium	0.0001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	10/7/2014	Cadmium	0.0005	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	12/8/2014	Cadmium	0.0001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	11/11/2014	Cadmium	0.0001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	9/2/2014	Cadmium	0.0001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	9/2/2014	Cadmium	0.0001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	8/4/2014	Cadmium	0.0001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	7/15/2014	Cadmium	0.0001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	6/2/2014	Cadmium	0.0001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	4/8/2014	Cadmium	0.0001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	3/18/2014	Cadmium	0.0001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	2/11/2014	Cadmium	0.0001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	1/7/2014	Cadmium	0.0001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	10/7/2015	Cadmium	0.0002	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	11/3/2015	Cadmium	0.0001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	9/1/2015	Cadmium	0.0001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	8/4/2015	Cadmium	0.0001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	7/8/2015	Cadmium	0.0001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	6/15/2015	Cadmium	0.0001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	5/4/2015	Cadmium	0.0001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	4/22/2015	Cadmium	0.0001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	4/22/2015	Cadmium	0.0001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	3/11/2015	Cadmium	0.0001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	3/11/2015	Cadmium	0.0001	
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	3/2/2015	Cadmium	0.0001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	2/4/2015	Cadmium	0.0001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	1/14/2015	Cadmium	0.0001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	5/17/2016	Cadmium	0.0005	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	1/20/2016	Cadmium	0.0005	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	4/20/2016	Cadmium	0.0002	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	3/23/2016	Cadmium	0.0002	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	3/17/2016	Cadmium	0.0002	mg/L

Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	6/1/2016	Cadmium	0.0001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	2/3/2016	Cadmium	0.0001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	10/10/2016	Cadmium	ND	mg/L
Telluride RWWTP Effluent	Site #1	WWTP Effluent		11/5/2013	Cadmium	0.0001	mg/L
Telluride RWWTP Effluent	Site #1A	WWTP Effluent		10/7/2013	Cadmium	0.0001	mg/L
Telluride RWWTP Effluent	TWWTP: Effluent Composite	WWTP Effluent		12/29/2015	Cadmium	0.0001	mg/L
Telluride RWWTP Influent	Influent	WWTP Influent	Flume in WWTP HWs	3/23/2016	Cadmium	0.0002	mg/L
Telluride RWWTP Influent	Influent	WWTP Influent	Flume in WWTP HWs	3/17/2016	Cadmium	0.0002	mg/L
Telluride RWWTP Influent	TWWTP: Influent Composite	WWTP Influent		12/29/2015	Cadmium	0.001	mg/L
Mill Creek DW	Site #4A	Finish Mill Creek WTP	Clearwell discharge	10/7/2013	Chromium	0.001	mg/L
Mountain Village DW	Site #3A	Mtn Village tap - PH's	Drinking Water	10/7/2013	Chromium	0.0021	mg/L
Pandora RW	Site #6A	Bridal Veil Falls	Pandora Source Water	10/7/2013	Chromium	0.001	mg/L
San Miguel River	Site #2A	Society Turn Bridge	Instream above outfall	10/7/2013	Chromium	0.0011	mg/L
Stillwell	Site #5A	Stillwell tank	Drinking Water	10/7/2013	Chromium	0.0011	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	12/5/2012	Chromium	0.001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	11/7/2012	Chromium	0.001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	11/13/2012	Chromium	0.001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	8/13/2013	Chromium	0.001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	7/16/2013	Chromium	0.001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	6/4/2013	Chromium	0.001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	5/14/2013	Chromium	0.001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	4/10/2013	Chromium	0.001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	3/5/2013	Chromium	0.001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	2/6/2013	Chromium	0.001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	1/15/2013	Chromium	0.001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	3/11/2015	Chromium	0.001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	3/11/2015	Chromium	0.001	
Telluride RWWTP Effluent	Site #1A	WWTP Effluent		10/7/2013	Chromium	0.0015	mg/L
Mill Creek DW	Site #4A	Finish Mill Creek WTP	Clearwell discharge	10/7/2013	Chromium III	0.008	mg/L
Mountain Village DW	Site #3A	Mtn Village tap - PH's	Drinking Water	10/7/2013	Chromium III	0.008	mg/L
Pandora RW	Site #6A	Bridal Veil Falls	Pandora Source Water	10/7/2013	Chromium III	0.008	mg/L
San Miguel River	Site #2A	San Miguel River	Instream above outfall	10/7/2013	Chromium III	0.008	mg/L
Stillwell	Site #5A	Finish Still Well tank	Drinking Water	10/7/2013	Chromium III	0.008	mg/L

Telluride RWWTP Effluent	Site #1A	WWTP Effluent		10/7/2013	Chromium III	0.008	mg/L
Aldasoro WW	Site #2	WW Collection	Aldosoro Interceptor	11/5/2013	Chromium VI	0.008	mg/L
Mill Creek DW	Site #4A	Finish Mill Creek WTP	Clearwell discharge	10/7/2013	Chromium VI	0.008	mg/L
Mountain Village DW	Site #3A	Mtn Village tap - PH's	Drinking Water	10/7/2013	Chromium VI	0.008	mg/L
Pandora RW	Site #6A	Bridal Veil Falls	Pandora Source Water	10/7/2013	Chromium VI	0.008	mg/L
San Miguel River	Site #2A	San Miguel River	Instream above outfall	10/7/2013	Chromium VI	0.008	mg/L
Stillwell	Site #5A	Finish Still Well tank	Drinking Water	10/7/2013	Chromium VI	0.008	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	12/10/2013	Chromium VI	0.008	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	9/11/2013	Chromium VI	0.008	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	10/7/2014	Chromium VI	0.008	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	7/15/2014	Chromium VI	0.008	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	5/12/2014	Chromium VI	0.008	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	3/18/2014	Chromium VI	0.008	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	4/22/2015	Chromium VI	0.008	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	2/3/2015	Chromium VI	0.008	mg/L
Telluride RWWTP Effluent	Site #1	WWTP Effluent	WWTP Compliance Pt	11/5/2013	Chromium VI	0.008	mg/L
Telluride RWWTP Effluent	Site #1A	WWTP Effluent	WWTP Compliance Pt	10/7/2013	Chromium VI	0.008	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	10/7/2015	Chromium VI, Dissolved	0.008	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	7/8/2015	Chromium VI, Dissolved	0.008	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	4/22/2015	Chromium VI, Dissolved	0.008	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	5/17/2016	Chromium VI, Dissolved	0.008	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	1/20/2016	Chromium VI, Dissolved	0.008	mg/L
Aldasoro WW	Aldosoro	Aldosoro Interceptor	WW Collection	12/29/2015	Copper	0.0137	mg/L
Aldasoro WW	Aldosoro	Aldosoro Interceptor	WW Collection	9/17/2015	Copper	0.0095	mg/L
Aldasoro WW	Aldosoro	Aldosoro Interceptor	WW Collection	9/30/2015	Copper	0.0074	mg/L
Aldasoro WW	Site #2	Aldosoro Interceptor	WW Collection	11/5/2013	Copper	0.102	mg/L
Lawson DW	533 Society Drive: Final Draw	Tap water	L&C Rule sample	12/29/2015	Copper	0.385	mg/L
Lawson DW	533 Society Drive: Long Draw	Tap water	L&C Rule sample	12/30/2015	Copper	0.026	mg/L

Lawson DW	BG House	Tap water	L&C Rule sample	8/6/2015	Copper	0.294	mg/L
Lawson WW	Lawson Sewer	Lawson Interceptor Sewer	WW Collection	9/30/2015	Copper	0.0307	mg/L
Lawson WW	Lawson Sewer	Lawson Interceptor Sewer	WW Collection	12/29/2015	Copper	0.0066	mg/L
Lawson WW	Lawson Sewer	Lawson Interceptor Sewer	WW Collection	9/17/2015	Copper	0.0057	mg/L
Mill Creek DW	Site #4A	Finish Mill Creek WTP	Clearwell discharge	10/7/2013	Copper	0.0007	mg/L
Mill Creek DW	Mill Creek Clearwell	Finish Mill Creek WTP	Telluride Drinking Water	12/29/2015	Copper	0.0004	mg/L
Mill Creek DW	Mill Creek Clearwell	Finish Mill Creek WTP	Telluride Drinking Water	9/30/2015	Copper	0.0004	mg/L
Mill Creek RW	Mill Creek	Raw Mill Creek WTP	Telluride Source Water	8/18/2015	Copper	0.0027	mg/L
Mill Creek RW	Mill Creek	Raw Mill Creek WTP	Telluride Source Water	12/29/2015	Copper	0.0004	mg/L
Mountain Village DW	Mountain Village Tap	Mtn Village tap - PH's	Drinking Water	12/29/2015	Copper	0.0133	mg/L
Mountain Village DW	Site #3A	Mtn Village tap - PH's	Drinking Water	10/7/2013	Copper	0.0136	mg/L
Mountain Village WW	Well 10	Groundwater	MV water supply	9/30/2015	Copper	0.0043	mg/L
Mountain Village WW	Well 14	Groundwater	MV water supply	9/30/2015	Copper	0.002	mg/L
Mountain Village WW	Well 27	Groundwater	MV water supply	9/30/2015	Copper	0.0007	mg/L
Mountain Village WW	Well 29	Groundwater	MV water supply	9/30/2015	Copper	0.0014	mg/L
Mountain Village WW	Well 4	Groundwater	MV water supply	9/30/2015	Copper	0.0006	mg/L
Mountain Village WW	Well 7	Groundwater	MV water supply	9/30/2015	Copper	0.0005	mg/L
Mountain Village WW	Well 8	Groundwater	MV water supply	9/30/2015	Copper	0.0005	mg/L
Mountain Village WW	Well 9	Groundwater	MV water supply	9/30/2015	Copper	0.0008	mg/L
Mountain Village WW	Mountain Village Sewer	Mtn Village Interceptor	WW Collection	9/17/2015	Copper	0.0072	mg/L
Mountain Village WW	Mountain Village Sewer	Mtn Village Interceptor	WW Collection	12/29/2015	Copper	0.0058	mg/L
Mountain Village WW	Mountain Village Sewer	Mtn Village Interceptor	WW Collection	9/30/2015	Copper	0.0057	mg/L
Pandora DW	Pandora WTP	Drinking Water - Pandora WTP	Telluride Drinking Water	8/6/2015	Copper	0.0014	mg/L
Pandora DW	Pandora WTP Clearwell	Drinking Water - Pandora WTP	Telluride Drinking Water	12/28/2015	Copper	0.0027	mg/L
Pandora RW	Blue Lake	Blue Lake	Telluride Source Water	7/18/2007	Copper	0.0001	mg/L
Pandora RW	Site #6A	Bridal Veil Falls	Pandora Source Water	10/7/2013	Copper	0.0013	mg/L
Pandora RW	Bridal Veil Power Stn	Bridal Veil Falls	Telluride Source Water	7/18/2007	Copper	0.016	mg/L
Pandora RW	Bridal Veil Power Stn	Bridal Veil Falls	Telluride Source Water	10/2/2007	Copper	0.0001	mg/L
Pandora RW	Bridal Veil Power Stn	Bridal Veil Falls	Telluride Source Water	3/13/2008	Copper	0.0001	mg/L
Pandora RW	Falls Crest Diversion	Bridal Veil Falls	Telluride Source Water	7/18/2007	Copper	0.0001	mg/L
Pandora RW	Falls Crest Diversion	Bridal Veil Falls	Telluride Source Water	10/2/2007	Copper	0.0001	mg/L
Pandora RW	Falls Crest Diversion	Bridal Veil Falls	Telluride Source Water	3/5/2008	Copper	0.0001	mg/L

Pandora RW	Lewis Lake	Lewis Lake	Telluride Source Water	7/18/2007	Copper	0.0001	mg/L
Pandora RW	Mud Lake	Mud Lake	Telluride Source Water	7/18/2007	Copper	0.0001	mg/L
Pandora RW	Tail Race	Tail Race	Telluride Source Water	10/2/2007	Copper	0.0001	mg/L
San Miguel River	Gondola Gage	Gondola Gage	Instream	5/31/2016	Copper	0.0064	mg/L
San Miguel River	Gondola Gage	Gondola Gage	Instream	5/9/2016	Copper	0.0049	mg/L
San Miguel River	Gondola Gage	Gondola Gage	Instream	6/29/2016	Copper	0.0044	mg/L
San Miguel River	Gondola Gage	Gondola Gage	Instream	4/4/2016	Copper	0.0019	mg/L
San Miguel River	Gondola Gage	Gondola Gage	Instream	7/25/2016	Copper	0.0013	mg/L
San Miguel River	Lawson Park	Lawson Park	Instream	10/10/2016	Copper	0.0031	mg/L
San Miguel River	SM Downstream	Lawson Park	Instream	9/30/2015	Copper	0.0076	mg/L
San Miguel River	SM Downstream	Lawson Park	Instream	12/29/2015	Copper	0.0034	mg/L
San Miguel River	San Miguel R - up	Society Turn Bridge	Instream	10/10/2016	Copper	0.0032	mg/L
San Miguel River	SM Upstream (Society Turn Bridge)	Society Turn Bridge	Instream	9/30/2015	Copper	0.0078	mg/L
San Miguel River	SM Upstream (Society Turn Bridge)	Society Turn Bridge	Instream	12/29/2015	Copper	0.0019	mg/L
San Miguel River	Site #2A	Society Turn Bridge	Instream above outfall	10/7/2013	Copper	0.003	mg/L
San Miguel River	WWTP Gage	WWTP Gage	Instream	5/31/2016	Copper	0.0054	mg/L
San Miguel River	WWTP Gage	WWTP Gage	Instream	6/29/2016	Copper	0.0052	mg/L
San Miguel River	WWTP Gage	WWTP Gage	Instream	5/9/2016	Copper	0.0043	mg/L
San Miguel River	WWTP Gage	WWTP Gage	Instream	4/4/2016	Copper	0.0031	mg/L
San Miguel River	WWTP Gage	WWTP Gage	Instream	7/25/2016	Copper	0.0025	mg/L
Stillwell	Site #5A	Stillwell tank	Drinking Water	10/7/2013	Copper	0.0013	mg/L
Telluride DW	873 Pandora	Telluride Tap Water	L&C Rule sample	8/6/2015	Copper	0.269	mg/L
Telluride Groundwater	Pipe Replacement Trench-pumped	Colorado & Pine	Construction Dewater	10/6/2016	Copper	0.11	mg/L
Telluride Groundwater	Pipe Replacement Trench-settled	Colorado & Pine	Construction Dewater	10/6/2016	Copper	0.0951	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	1/10/2012	Copper	0.0618	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	3/6/2012	Copper	0.0533	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	2/7/2012	Copper	0.0429	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	7/16/2012	Copper	0.0421	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	5/8/2012	Copper	0.035	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	4/3/2012	Copper	0.0308	mg/L

Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	12/5/2012	Copper	0.029	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	6/5/2012	Copper	0.0264	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	8/14/2012	Copper	0.0251	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	9/11/2012	Copper	0.0214	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	11/7/2012	Copper	0.0181	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	11/13/2012	Copper	0.0096	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	10/9/2012	Copper	0.0085	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	1/15/2013	Copper	0.0504	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	3/5/2013	Copper	0.0489	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	6/4/2013	Copper	0.0402	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	5/14/2013	Copper	0.0394	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	4/10/2013	Copper	0.0374	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	2/6/2013	Copper	0.0325	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	7/16/2013	Copper	0.0312	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	10/15/2013	Copper	0.0301	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	8/13/2013	Copper	0.0289	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	12/10/2013	Copper	0.0236	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	9/11/2013	Copper	0.0175	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	4/8/2014	Copper	0.0709	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	2/11/2014	Copper	0.0555	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	6/2/2014	Copper	0.0349	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	3/18/2014	Copper	0.0343	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	1/7/2014	Copper	0.0288	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	8/4/2014	Copper	0.0165	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	11/11/2014	Copper	0.0149	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	10/7/2014	Copper	0.0136	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	12/8/2014	Copper	0.012	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	9/2/2014	Copper	0.0119	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	9/2/2014	Copper	0.0119	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	7/15/2014	Copper	0.0115	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	1/14/2015	Copper	0.0255	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	2/4/2015	Copper	0.0239	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	3/11/2015	Copper	0.0193	mg/L

Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	3/11/2015	Copper	0.0193	
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	3/2/2015	Copper	0.0178	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	8/4/2015	Copper	0.0169	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	10/7/2015	Copper	0.0162	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	9/1/2015	Copper	0.0161	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	7/8/2015	Copper	0.015	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	11/3/2015	Copper	0.0149	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	6/15/2015	Copper	0.0141	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	4/22/2015	Copper	0.0113	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	4/22/2015	Copper	0.0113	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	5/4/2015	Copper	0.01	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	2/3/2016	Copper	0.0245	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	1/20/2016	Copper	0.0217	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	3/17/2016	Copper	0.018	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	3/23/2016	Copper	0.0163	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	4/20/2016	Copper	0.0154	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	6/1/2016	Copper	0.0133	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	5/17/2016	Copper	0.0094	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	10/10/2016	Copper	0.0142	mg/L
Telluride RWWTP Effluent	Site #1	WWTP Effluent		11/5/2013	Copper	0.0205	mg/L
Telluride RWWTP Effluent	Site #1A	WWTP Effluent		10/7/2013	Copper	0.0104	mg/L
Telluride RWWTP Effluent	TWWTP: Effluent Composite	WWTP Effluent		12/29/2015	Copper	0.0172	mg/L
Telluride RWWTP Effluent	WWTF: Effluent	WWTP Effluent		9/17/2015	Copper	0.0138	mg/L
Telluride RWWTP Effluent	WWTF: Effluent	WWTP Effluent		9/30/2015	Copper	0.0123	mg/L
Telluride RWWTP Influent	H.S Boiler	Boiler Drain Waste	Boiler Water discharge	6/22/2015	Copper	16.8	mg/L
Telluride RWWTP Influent	Tri-State 9/1/16	Septage	Power generating station	9/1/2016	Copper	0.0019	mg/L
Telluride RWWTP Influent	Coyote Septic	Septage	Septic Discharge	8/19/2016	Copper	0.0429	mg/L
Telluride RWWTP Influent	Coyote Septic	Septage	Septic Discharge	8/26/2016	Copper	0.0074	mg/L
Telluride RWWTP Influent	Coyote Septic	Septage	Septic Discharge	8/19/2016	Copper	0.0055	mg/L
Telluride RWWTP Influent	Raw Lift Station	WWTP Influent	Collection System	9/30/2015	Copper	0.0086	mg/L
Telluride RWWTP Influent	Raw Lift Station	WWTP Influent	Collection System	9/17/2015	Copper	0.007	mg/L
Telluride RWWTP Influent	Raw Lift Station	WWTP Influent	Collection System	12/29/2015	Copper	0.0034	mg/L

Telluride RWWTP Influent	Influent	WWTP Influent	Flume in WWTP HWs	11/3/2015	Copper	0.109	mg/L
Telluride RWWTP Influent	Influent	WWTP Influent	Flume in WWTP HWs	10/7/2015	Copper	0.047	mg/L
Telluride RWWTP Influent	Influent	WWTP Influent	Flume in WWTP HWs	4/20/2016	Copper	0.0447	mg/L
Telluride RWWTP Influent	Influent	WWTP Influent	Flume in WWTP HWs	3/23/2016	Copper	0.0343	mg/L
Telluride RWWTP Influent	Influent	WWTP Influent	Flume in WWTP HWs	5/17/2016	Copper	0.0223	mg/L
Telluride RWWTP Influent	Influent	WWTP Influent	Flume in WWTP HWs	2/3/2016	Copper	0.0107	mg/L
Telluride RWWTP Influent	Influent	WWTP Influent	Flume in WWTP HWs	3/17/2016	Copper	0.0093	mg/L
Telluride RWWTP Influent	Influent	WWTP Influent	Flume in WWTP HWs	6/1/2016	Copper	0.003	mg/L
Telluride RWWTP Influent	Influent	WWTP Influent	Flume in WWTP HWs	10/10/2016	Copper	0.0617	mg/L
Telluride RWWTP Influent	Influent: 24 Hr Comp 8/27-8/28/2016	WWTP Influent	WWTP Influent	8/28/2016	Copper	0.0025	mg/L
Telluride RWWTP Influent	Influent: 24 Hr Comp 8/28-8/29/2016	WWTP Influent	WWTP Influent	8/29/2016	Copper	0.0025	mg/L
Telluride RWWTP Influent	TWWTP: Influent Composite	WWTP Influent		12/29/2015	Copper	0.043	mg/L
Telluride RWWTP Influent	WWTF: Headworks	WWTP Influent		9/17/2015	Copper	0.0052	mg/L
Telluride RWWTP Influent	WWTF: Headworks	WWTP Influent		9/30/2015	Copper	0.0048	mg/L
Telluride RWWTP Process	Digester 1 Decant	WWTP Return Flow	Internal Recycle	12/21/2015	Copper	0.0201	mg/L
Telluride RWWTP Process	Sludge	WWTP Sludge		11/13/2015	Copper	648	mg/kg dry
Telluride RWWTP Process	Sludge	WWTP Sludge		11/27/2015	Copper	524	mg/kg dry
Telluride RWWTP Process	Sludge	WWTP Sludge		11/19/2015	Copper	452	mg/kg dry
Telluride RWWTP Process	Sludge	WWTP Sludge		11/23/2015	Copper	426	mg/kg dry
Telluride RWWTP Process	Sludge	WWTP Sludge		12/7/2015	Copper	422	mg/kg dry
Telluride RWWTP Process	Sludge	WWTP Sludge		12/8/2015	Copper	397	mg/kg dry
Telluride WW	TWWTP: Boiler	Boiler Drain Waste		12/29/2015	Copper	1.15	mg/L
Telluride WW	Telluride Manhole #1	Telluride Manhole #1	Telluride Collection System	9/1/2016	Copper	0.0031	mg/L
Telluride WW	Telluride Manhole #2	Telluride Manhole #2	Telluride Collection System	9/1/2016	Copper	0.0078	mg/L
Telluride WW	Telluride Manhole #3	Telluride Manhole #3	Telluride Collection System	9/1/2016	Copper	0.0064	mg/L
Telluride WW	Telluride Sewer	Telluride Collection System	WW Collection	12/29/2015	Copper	0.0025	mg/L
Telluride WW	Town of Telluride	Telluride Interceptor	MH prior to mixing with MV	9/30/2015	Copper	0.017	mg/L
Telluride WW	Town of Telluride	Telluride Interceptor	MH prior to mixing with MV	9/17/2015	Copper	0.0047	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	3/11/2015	Cyanide, Total	0.01	mg/L
Pandora RW	Blue Lake	Raw Pandora WTP	Telluride Source Water	7/18/2007	Iron	1.2	mg/L
Pandora RW	Bridal Veil Power Stn	Raw Pandora WTP	Telluride Source Water	10/2/2007	Iron	0.43	mg/L
Pandora RW	Bridal Veil Power Stn	Raw Pandora WTP	Telluride Source Water	7/18/2007	Iron	0.2	mg/L

Pandora RW	Bridal Veil Power Stn	Raw Pandora WTP	Telluride Source Water	3/13/2008	Iron	0.05	mg/L
Pandora RW	Falls Crest Diversion	Raw Pandora WTP	Telluride Source Water	7/18/2007	Iron	0.26	mg/L
Pandora RW	Falls Crest Diversion	Raw Pandora WTP	Telluride Source Water	10/2/2007	Iron	0.05	mg/L
Pandora RW	Falls Crest Diversion	Raw Pandora WTP	Telluride Source Water	3/5/2008	Iron	0.05	mg/L
Pandora RW	Lewis Lake	Raw Pandora WTP	Telluride Source Water	7/18/2007	Iron	0.05	mg/L
Pandora RW	Mud Lake	Raw Pandora WTP	Telluride Source Water	7/18/2007	Iron	0.05	mg/L
Pandora RW	Tail Race	Raw Pandora WTP	Telluride Source Water	10/2/2007	Iron	0.32	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	12/5/2012	Iron	0.055	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	11/7/2012	Iron	0.05	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	5/14/2013	Iron	0.144	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	7/16/2013	Iron	0.106	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	6/4/2013	Iron	0.102	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	8/13/2013	Iron	0.1	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	2/6/2013	Iron	0.088	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	1/15/2013	Iron	0.087	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	3/5/2013	Iron	0.076	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	4/10/2013	Iron	0.07	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	9/11/2013	Iron	0.062	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	12/10/2013	Iron	0.05	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	10/7/2014	Iron	0.05	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	7/15/2014	Iron	0.05	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	4/8/2014	Iron	0.05	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	2/11/2014	Iron	0.05	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	5/12/2014	Iron	0.0001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	7/8/2015	Iron	0.509	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	10/7/2015	Iron	0.05	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	9/1/2015	Iron	0.05	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	4/22/2015	Iron	0.05	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	4/22/2015	Iron	0.05	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	1/14/2015	Iron	0.05	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	5/17/2016	Iron	0.25	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	1/20/2016	Iron	0.05	mg/L

Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	10/10/2016	Iron	ND	mg/L
Aldasoro WW	Site #2	WW Collection	Aldosoro Interceptor	11/5/2013	Lead	0.036	mg/L
Mill Creek DW	Site #4A	Finish Mill Creek WTP	Clearwell discharge	10/7/2013	Lead	0.0005	mg/L
Mountain Village DW	Site #3A	Mtn Village tap - PH's	Drinking Water	10/7/2013	Lead	0.0005	mg/L
Pandora RW	Site #6A	Bridal Veil Falls	Pandora Source Water	10/7/2013	Lead	0.0005	mg/L
San Miguel River	Site #2A	San Miguel River	Instream above outfall	10/7/2013	Lead	0.0005	mg/L
Stillwell	Site #5A	Finish Still Well tank	Drinking Water	10/7/2013	Lead	0.0005	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	11/13/2012	Lead	0.0011	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	12/5/2012	Lead	0.0008	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	11/7/2012	Lead	0.0006	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	3/5/2013	Lead	0.0446	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	2/6/2013	Lead	0.0032	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	6/4/2013	Lead	0.0026	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	4/10/2013	Lead	0.0018	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	12/10/2013	Lead	0.0016	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	7/16/2013	Lead	0.0015	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	1/15/2013	Lead	0.0014	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	5/14/2013	Lead	0.0013	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	8/13/2013	Lead	0.0011	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	9/11/2013	Lead	0.0005	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	4/8/2014	Lead	0.0026	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	10/7/2014	Lead	0.0025	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	2/11/2014	Lead	0.0019	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	7/15/2014	Lead	0.0005	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	10/7/2015	Lead	0.0005	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	7/8/2015	Lead	0.0005	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	4/22/2015	Lead	0.0005	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	4/22/2015	Lead	0.0005	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	3/11/2015	Lead	0.0005	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	3/11/2015	Lead	0.0005	
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	1/14/2015	Lead	0.0005	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	5/17/2016	Lead	0.0025	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	1/20/2016	Lead	0.0025	mg/L

Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	10/10/2016	Lead	ND	mg/L
Telluride RWWTP Effluent	Site #1	WWTP Effluent	WWTP Compliance Pt	11/5/2013	Lead	0.0016	mg/L
Telluride RWWTP Effluent	Site #1A	WWTP Effluent	WWTP Compliance Pt	10/7/2013	Lead	0.0005	mg/L
Telluride RWWTP Influent	H.S Boiler	Boiler Drain Waste	High School Boiler Maintenance	6/22/2015	Lead	1.37	mg/L
Mill Creek DW	Site #4A	Finish Mill Creek WTP	Clearwell discharge	10/7/2013	Manganese	0.001	mg/L
Mountain Village DW	Site #3A	Mtn Village tap - PH's	Drinking Water	10/7/2013	Manganese	0.0005	mg/L
Pandora RW	Site #6A	Bridal Veil Falls	Pandora Source Water	10/7/2013	Manganese	0.0112	mg/L
Pandora RW	Blue Lake	Raw Pandora WTP	Telluride Source Water	7/18/2007	Manganese	0.013	mg/L
Pandora RW	Bridal Veil Power Stn	Raw Pandora WTP	Telluride Source Water	10/2/2007	Manganese	0.01	mg/L
Pandora RW	Bridal Veil Power Stn	Raw Pandora WTP	Telluride Source Water	7/18/2007	Manganese	0.006	mg/L
Pandora RW	Bridal Veil Power Stn	Raw Pandora WTP	Telluride Source Water	3/13/2008	Manganese	0.01	mg/L
Pandora RW	Falls Crest Diversion	Raw Pandora WTP	Telluride Source Water	7/18/2007	Manganese	0.042	mg/L
Pandora RW	Falls Crest Diversion	Raw Pandora WTP	Telluride Source Water	10/2/2007	Manganese	0.012	mg/L
Pandora RW	Falls Crest Diversion	Raw Pandora WTP	Telluride Source Water	3/5/2008	Manganese	0.0005	mg/L
Pandora RW	Lewis Lake	Raw Pandora WTP	Telluride Source Water	7/18/2007	Manganese	0.13	mg/L
Pandora RW	Mud Lake	Raw Pandora WTP	Telluride Source Water	7/18/2007	Manganese	0.0005	mg/L
Pandora RW	Tail Race	Raw Pandora WTP	Telluride Source Water	10/2/2007	Manganese	0.01	mg/L
San Miguel River	Site #2A	San Miguel River	Instream above outfall	10/7/2013	Manganese	0.0633	mg/L
Stillwell	Site #5A	Finish Still Well tank	Drinking Water	10/7/2013	Manganese	0.0005	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	12/5/2012	Manganese	0.0055	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	11/7/2012	Manganese	0.0034	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	3/5/2013	Manganese	0.0083	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	6/4/2013	Manganese	0.0076	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	1/15/2013	Manganese	0.0073	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	5/14/2013	Manganese	0.007	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	7/16/2013	Manganese	0.0067	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	9/11/2013	Manganese	0.0051	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	8/13/2013	Manganese	0.0048	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	2/6/2013	Manganese	0.0047	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	12/10/2013	Manganese	0.0036	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	4/10/2013	Manganese	0.0036	mg/L

Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	7/15/2014	Manganese	0.0032	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	2/11/2014	Manganese	0.0014	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	4/8/2014	Manganese	0.0012	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	10/7/2014	Manganese	0.0011	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	1/14/2015	Manganese	0.0033	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	7/8/2015	Manganese	0.0031	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	4/22/2015	Manganese	0.0017	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	4/22/2015	Manganese	0.0017	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	10/7/2015	Manganese	0.0016	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	1/20/2016	Manganese	0.0033	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	5/17/2016	Manganese	0.0025	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	10/10/2016	Manganese	0.0009	mg/L
Telluride RWWTP Effluent	Site #1A	WWTP Effluent		10/7/2013	Manganese	0.002	mg/L
Mill Creek DW	Site #4A	Finish Mill Creek WTP	Clearwell discharge	10/7/2013	Mercury	0.0002	mg/L
Mountain Village DW	Site #3A	Mtn Village tap - PH's	Drinking Water	10/7/2013	Mercury	0.0002	mg/L
Pandora RW	Site #6A	Bridal Veil Falls	Pandora Source Water	10/7/2013	Mercury	0.0002	mg/L
San Miguel River	Site #2A	San Miguel River	Instream above outfall	10/7/2013	Mercury	0.0002	mg/L
Stillwell	Site #5A	Finish Still Well tank	Drinking Water	10/7/2013	Mercury	0.0002	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	12/5/2012	Mercury	0.002	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	11/7/2012	Mercury	0.0002	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	11/13/2012	Mercury	0.0002	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	1/15/2013	Mercury	0.0004	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	12/10/2013	Mercury	0.0002	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	9/11/2013	Mercury	0.0002	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	8/13/2013	Mercury	0.0002	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	7/16/2013	Mercury	0.0002	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	6/4/2013	Mercury	0.0002	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	5/14/2013	Mercury	0.0002	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	4/10/2013	Mercury	0.0002	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	3/5/2013	Mercury	0.0002	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	2/6/2013	Mercury	0.0002	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	10/7/2014	Mercury	0.0002	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	7/15/2014	Mercury	0.0002	mg/L

Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	4/8/2014	Mercury	0.0002	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	2/11/2014	Mercury	0.0002	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	10/7/2015	Mercury	0.0002	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	7/8/2015	Mercury	0.0002	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	4/22/2015	Mercury	0.0002	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	4/22/2015	Mercury	0.0002	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	3/11/2015	Mercury	0.0002	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	3/11/2015	Mercury	0.0002	
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	1/14/2015	Mercury	0.0002	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	5/17/2016	Mercury	0.0002	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	1/20/2016	Mercury	0.0002	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	10/10/2016	Mercury	ND	mg/L
Telluride RWWTP Effluent	Site #1A	WWTP Effluent		10/7/2013	Mercury	0.0002	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	11/13/2012	Molybdenum	0.0017	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	3/11/2015	Molybdenum	0.0009	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	3/11/2015	Molybdenum	0.0009	
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	12/5/2012	Nickel	0.005	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	11/13/2012	Nickel	0.0048	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	11/7/2012	Nickel	0.0037	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	1/15/2013	Nickel	0.0056	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	7/16/2013	Nickel	0.0052	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	6/4/2013	Nickel	0.0052	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	3/5/2013	Nickel	0.0049	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	2/6/2013	Nickel	0.0046	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	5/14/2013	Nickel	0.0044	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	4/10/2013	Nickel	0.0041	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	8/13/2013	Nickel	0.004	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	3/11/2015	Nickel	0.0038	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	3/11/2015	Nickel	0.0038	
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	7/8/2015	Nonylphenol	0.002	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	3/11/2015	Phenolics	0.01	mg/L
Aldasoro WW	Site #2	Aldosoro Interceptor	WW Collection	11/5/2013	Selenium	0.001	mg/L

Mill Creek DW	Site #4A	Finish Mill Creek WTP	Clearwell discharge	10/7/2013	Selenium	0.001	mg/L
Mountain Village DW	Site #3A	Mtn Village tap - PH's	Drinking Water	10/7/2013	Selenium	0.001	mg/L
Pandora RW	Site #6A	Bridal Veil Falls	Pandora Source Water	10/7/2013	Selenium	0.001	mg/L
San Miguel River	Site #2A	Society Turn Bridge	Instream above outfall	10/7/2013	Selenium	0.001	mg/L
Stillwell	Site #5A	Stillwell tank	Drinking Water	10/7/2013	Selenium	0.001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	12/5/2012	Selenium	0.001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	11/7/2012	Selenium	0.001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	11/13/2012	Selenium	0.001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	12/10/2013	Selenium	0.001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	9/11/2013	Selenium	0.001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	8/13/2013	Selenium	0.001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	7/16/2013	Selenium	0.001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	6/4/2013	Selenium	0.001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	5/14/2013	Selenium	0.001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	4/10/2013	Selenium	0.001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	3/5/2013	Selenium	0.001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	2/6/2013	Selenium	0.001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	1/15/2013	Selenium	0.001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	10/7/2014	Selenium	0.005	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	7/15/2014	Selenium	0.001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	4/8/2014	Selenium	0.001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	2/11/2014	Selenium	0.001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	10/7/2015	Selenium	0.001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	7/8/2015	Selenium	0.001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	4/22/2015	Selenium	0.001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	4/22/2015	Selenium	0.001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	3/11/2015	Selenium	0.001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	3/11/2015	Selenium	0.001	
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	1/14/2015	Selenium	0.001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	1/20/2016	Selenium	0.0189	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	5/17/2016	Selenium	0.005	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	10/10/2016	Selenium	ND	mg/L
Telluride RWWTP Effluent	Site #1	WWTP Effluent		11/5/2013	Selenium	0.001	mg/L

Telluride RWWTP Effluent	Site #1A	WWTP Effluent		10/7/2013	Selenium	0.001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	12/5/2012	Silver	0.0001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	11/7/2012	Silver	0.0001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	11/13/2012	Silver	0.0001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	8/13/2013	Silver	0.0001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	7/16/2013	Silver	0.0001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	6/4/2013	Silver	0.0001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	5/14/2013	Silver	0.0001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	4/10/2013	Silver	0.0001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	3/5/2013	Silver	0.0001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	2/6/2013	Silver	0.0001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	1/15/2013	Silver	0.0001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	3/11/2015	Silver	0.0001	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	3/11/2015	Silver	0.0001	
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	9/11/2013	Sulfate	75	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	12/10/2013	Sulfate	61	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	7/15/2014	Sulfate	74	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	10/7/2014	Sulfate	67	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	2/11/2014	Sulfate	52	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	4/8/2014	Sulfate	49	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	5/12/2014	Sulfate	0.0007	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	1/14/2015	Sulfate	80	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	7/8/2015	Sulfate	78.7	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	10/7/2015	Sulfate	68	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	4/22/2015	Sulfate	50	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	4/22/2015	Sulfate	50	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	1/20/2016	Sulfate	69.7	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	5/17/2016	Sulfate	49.9	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	10/10/2016	Sulfate	42.9	mg/L
Aldasoro WW	Site #2	Aldosoro Interceptor	WW Collection	11/5/2013	Zinc	0.129	mg/L
Mill Creek DW	Site #4A	Finish Mill Creek WTP	Clearwell discharge	10/7/2013	Zinc	0.0037	mg/L
Mountain Village DW	Site #3A	Mtn Village tap - PH's	Drinking Water	10/7/2013	Zinc	0.005	mg/L

Pandora RW	Blue Lake	Blue Lake	Telluride Source Water	7/18/2007	Zinc	0.25	mg/L
Pandora RW	Site #6A	Bridal Veil Falls	Pandora Source Water	10/7/2013	Zinc	0.0242	mg/L
Pandora RW	Bridal Veil Power Stn	Bridal Veil Falls	Telluride Source Water	7/18/2007	Zinc	0.056	mg/L
Pandora RW	Bridal Veil Power Stn	Bridal Veil Falls	Telluride Source Water	10/2/2007	Zinc	0.021	mg/L
Pandora RW	Bridal Veil Power Stn	Bridal Veil Falls	Telluride Source Water	3/13/2008	Zinc	0.066	mg/L
Pandora RW	Falls Crest Diversion	Bridal Veil Falls	Telluride Source Water	10/2/2007	Zinc	0.15	mg/L
Pandora RW	Falls Crest Diversion	Bridal Veil Falls	Telluride Source Water	7/18/2007	Zinc	0.1	mg/L
Pandora RW	Falls Crest Diversion	Bridal Veil Falls	Telluride Source Water	3/5/2008	Zinc	0.071	mg/L
Pandora RW	Lewis Lake	Lewis Lake	Telluride Source Water	7/18/2007	Zinc	0.3	mg/L
Pandora RW	Mud Lake	Mud Lake	Telluride Source Water	7/18/2007	Zinc	0.001	mg/L
Pandora RW	Tail Race	Tail Race	Telluride Source Water	10/2/2007	Zinc	0.055	mg/L
San Miguel River	Gondola Gage	Gondola Gage	Instream	5/9/2016	Zinc	0.372	mg/L
San Miguel River	Gondola Gage	Gondola Gage	Instream	5/31/2016	Zinc	0.351	mg/L
San Miguel River	Gondola Gage	Gondola Gage	Instream	6/29/2016	Zinc	0.316	mg/L
San Miguel River	Gondola Gage	Gondola Gage	Instream	7/25/2016	Zinc	0.314	mg/L
San Miguel River	Gondola Gage	Gondola Gage	Instream	4/4/2016	Zinc	0.2	mg/L
San Miguel River	SM Downstream	Lawson Park	Instream	9/30/2015	Zinc	0.176	mg/L
San Miguel River	SM Upstream (Society Turn Bridge)	Society Turn Bridge	Instream	9/30/2015	Zinc	0.192	mg/L
San Miguel River	San Miguel	Society Turn Bridge	Instream above outfall	6/15/2015	Zinc	0.466	mg/L
San Miguel River	San Miguel	Society Turn Bridge	Instream above outfall	6/15/2015	Zinc	0.448	mg/L
San Miguel River	Site #2A	Society Turn Bridge	Instream above outfall	10/7/2013	Zinc	0.296	mg/L
San Miguel River	WWTP Gage	WWTP Gage	Instream	5/9/2016	Zinc	0.275	mg/L
San Miguel River	WWTP Gage	WWTP Gage	Instream	5/31/2016	Zinc	0.27	mg/L
San Miguel River	WWTP Gage	WWTP Gage	Instream	6/29/2016	Zinc	0.244	mg/L
San Miguel River	WWTP Gage	WWTP Gage	Instream	7/25/2016	Zinc	0.238	mg/L
San Miguel River	WWTP Gage	WWTP Gage	Instream	4/4/2016	Zinc	0.181	mg/L
Stillwell	Site #5A	Stillwell tank	Drinking Water	10/7/2013	Zinc	0.0567	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	12/5/2012	Zinc	0.0581	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	11/7/2012	Zinc	0.0456	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	11/13/2012	Zinc	0.0383	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	3/5/2013	Zinc	0.121	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	2/6/2013	Zinc	0.117	mg/L

Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	6/4/2013	Zinc	0.0793	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	5/14/2013	Zinc	0.0773	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	1/15/2013	Zinc	0.0733	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	7/16/2013	Zinc	0.0725	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	4/10/2013	Zinc	0.0658	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	8/13/2013	Zinc	0.052	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	12/10/2013	Zinc	0.0488	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	9/11/2013	Zinc	0.0445	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	4/8/2014	Zinc	0.0778	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	10/7/2014	Zinc	0.0623	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	2/11/2014	Zinc	0.0576	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	7/15/2014	Zinc	0.0529	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	1/14/2015	Zinc	0.0706	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	4/22/2015	Zinc	0.0611	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	4/22/2015	Zinc	0.0611	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	3/11/2015	Zinc	0.058	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	3/11/2015	Zinc	0.058	
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	7/8/2015	Zinc	0.0532	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	10/7/2015	Zinc	0.0466	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	1/20/2016	Zinc	0.055	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	5/17/2016	Zinc	0.034	mg/L
Telluride RWWTP Effluent	Effluent	WWTP Effluent	WWTP Compliance Pt	10/10/2016	Zinc	0.0581	mg/L
Telluride RWWTP Effluent	Site #1	WWTP Effluent		11/5/2013	Zinc	0.0642	mg/L
Telluride RWWTP Effluent	Site #1A	WWTP Effluent		10/7/2013	Zinc	0.0608	mg/L
Telluride WW	Telluride Manhole #4	WW Collection		9/1/2016			

A.2 PIVOT TABLES FOR THE WATER SYSTEM DATA

Table A.1 Summary of Arsenic Levels Upstream of the Wastewater Collection System

Sampling Location →		Finish Mill Creek WTP	Mtn Village tap	Raw Mill Creek WTP	Raw Pandora WTP	Raw Still Well WTP	San Miguel River	Septage Discharge	Septic Discharge
Year	Month	Arsenic	Arsenic	Arsenic	Arsenic	Arsenic	Arsenic	Arsenic	Arsenic
2007	7				0.0005				
	10				0.0005				
2008	3				0.0005				
2014	1		0.0011	0.0020					
	2		0.0011	0.0020					
	3	0.0010	0.0007	0.0020					
	5	0.0017	0.0010	0.0099		0.0138	0.0066		
2016	4						0.0009		
	5						0.0010		
	6						0.0012		
	7						0.0005		
	8								0.0030
	9							0.0016	

Table A.2 Summary of Copper Levels Upstream of the Wastewater Collection System

Sampling Location →		Finish Mill Creek WTP	Ground Water	Industrial Discharge	Mtn Village tap	Pandora Water	Raw Mill Creek WTP	Raw Pandora WTP	San Miguel River	Septage Discharge	Tap water
Year	Month	Copper	Copper	Copper	Copper	Copper	Copper	Copper	Copper	Copper	Copper
2007	7							0.0033			
	10							0.0001			
2008	3							0.0001			
2015	6			16.8000							
	8					0.0014	0.0027				0.2940
	9	0.0004	0.0014						0.0077		
	12	0.0004		1.1500	0.0133	0.0027	0.0004		0.0027		
	(blank)				0.0103						
2016	4								0.0025		
	5								0.0053		
	6								0.0048		
	7								0.0019		
	8									0.0186	
	9									0.0019	

Table A.3 Summary of Zinc Levels Upstream of the Wastewater Collection System

Sampling Location →		Raw Pandora WTP	San Miguel River
Year	Month	Zinc	Zinc
2007	7	0.141	
	10	0.075	
2008	3	0.069	
2015	9		0.184
2016	4		0.191
	5		0.317
	6		0.280
	7		0.276

Table A.4 Summary of Cadmium Levels Upstream of the Wastewater Collection System

Sampling Location →		Raw Pandora WTP
Year	Month	Cadmium
2007	7	0.0003
	10	0.0001
2008	3	0.0001

Lead

A single lead sample was collected from a location upstream of the wastewater collection system in June 2015, as follows: Industrial Discharge – 1.37 mg/L.

Chromium and Selenium

There were no data available for chromium or selenium for sampling locations upstream of the wastewater collection system.

A.3 PIVOT TABLES FOR THE WASTEWATER SYSTEM DATA

Results for arsenic sampling are summarized in **Table A.5** where results are color coded based on a red-amber-green gradation from highest to lowest values, respectively.

Table A.5 Summary of Arsenic Levels Downstream of the Water System

Sampling Location		Boiler Discharge	MV Sewer Interceptor	MV WW Collection	Septage Discharge	Septic Discharge	WW Collection	WWTP Effluent	WWTP Influent
Year	Month	Arsenic	Arsenic	Arsenic	Arsenic	Arsenic	Arsenic	Arsenic	Arsenic
2012	11							0.001	
	12							0.0012	
2013	1							0.0012	
	2							0.001	
	3							0.0009	
	4							0.0012	
	5							0.0011	
	6							0.00105	
	7							0.0022	
	8							0.0017	
	9							0.0027	
	10							0.0018	
	11		0.0008				0.0006	0.0012	
	12							0.001	
2014	1			0.0011			0.0009	0.0009	
	2			0.0011			0.0009	0.00085	
	3			0.001			0.000967	0.00085	
	4							0.0011	
	5			0.0016			0.0013	0.013467	0.0011
	6							0.001	
	7							0.0025	
	8							0.0029	
	9							0.0033	
	10							0.0035	
	11							0.0018	
	12							0.0017	
2015	1							0.0015	
	2							0.0012	
	3							0.0013	
	4							0.0014	
	5							0.0009	
	6							0.0013	
	7							0.0014	
	8							0.0012	
	9							0.0006	
	10							0.0005	
	11							0.0005	
	12							0.0005	0.005
2016	1							0.0005	
	2							0.0005	0.0025
	3							0.001	0.001
	4							0.0025	0.0025
	5							0.001	0.0014
	6							0.0007	0.001
	7	0.001							
	8					0.002967			0.0025
	9				0.0016		0.0021		

Table A.6 Summary of Chromium Levels Downstream of the Water System

Sampling Location →		WWTP Effluent
Year	Month	Chromium
2012	11	0.001
	12	0.001
2013	1	0.001
	2	0.001
	3	0.001
	4	0.001
	5	0.001
	6	0.001
	7	0.001
	8	0.001
2015	3	0.001

Copper

Results from copper sampling downstream of the water system are summarized in **Table A.7**; results are color coded based on a red-amber-green gradation from highest to lowest values, respectively.

Table A.7 Summary of Copper Levels Downstream of the Water System

Sampling Location →		Boiler Discharge	Industrial Discharge	Septage Discharge	Septic Discharge	WW Collection	WWTP Effluent	WWTP Influent
Year	Month	Copper	Copper	Copper	Copper	Copper	Copper	Copper
2012	1						0.0618	
	2						0.0429	
	3						0.0533	
	4						0.0308	
	5						0.035	
	6						0.0264	
	7						0.0421	
	8						0.0251	
	9						0.0214	
	10						0.0085	
	11						0.01385	
	12						0.029	
2013	1						0.0504	
	2						0.0325	
	3						0.0489	
	4						0.0374	
	5						0.0394	

Appendix A Metals Sampling Data
June 27, 2017

Sampling Location →		Boiler Discharge	Industrial Discharge	Septage Discharge	Septic Discharge	WW Collection	WWTP Effluent	WWTP Influent
Year	Month	Copper	Copper	Copper	Copper	Copper	Copper	Copper
	6						0.0402	
	7						0.0312	
	8						0.0289	
	9						0.0175	
	10						0.0301	
	11					0.102	0.0205	
	12						0.0236	
2014	1						0.0288	
	2						0.0555	
	3						0.0343	
	4						0.0709	
	6						0.0349	
	7						0.0115	
	8						0.0165	
	9						0.0119	
	10						0.0136	
	11						0.0149	
	12						0.012	
2015	1						0.0255	
	2						0.0239	
	3						0.0188	
	4						0.0113	
	5						0.01	
	6		16.8				0.0141	
	7						0.015	
	8						0.0169	
	9					0.01035	0.014067	0.005
	10						0.0162	0.047
	11						0.0149	0.109
	12		1.15			0.0064	0.0172	0.043
	(blank)					0.00575		
2016	1						0.0217	
	2						0.0245	0.0107
	3						0.01715	0.0218
	4						0.0154	0.0447
	5						0.0094	0.0223
	6						0.0133	0.003
	7	0.0512						
	8				0.0186			0.0025
	9			0.0019		0.005767		

Zinc

Results from zinc sampling downstream of the water system are summarized in **Table A.8.**

Table A.8 Summary of Zinc Levels Downstream of the Water System

	Sampling Location →	WW Collection	WWTP Effluent
Year	Month	Zinc	Zinc
2012	11		0.04195
	12		0.0581
2013	1		0.0733
	2		0.117
	3		0.121
	4		0.0658
	5		0.0773
	6		0.0793
	7		0.0725
	8		0.052
	9		0.0445
	11	0.129	0.0642
	12		0.0488
2014	2		0.0576
	4		0.0778
	7		0.0529
	10		0.0623
2015	1		0.0706
	3		0.058
	4		0.0611
	7		0.0532
	10		0.0466
2016	1		0.055
	5		0.034

Table A.9 Summary of Cadmium Levels Downstream of the Water System

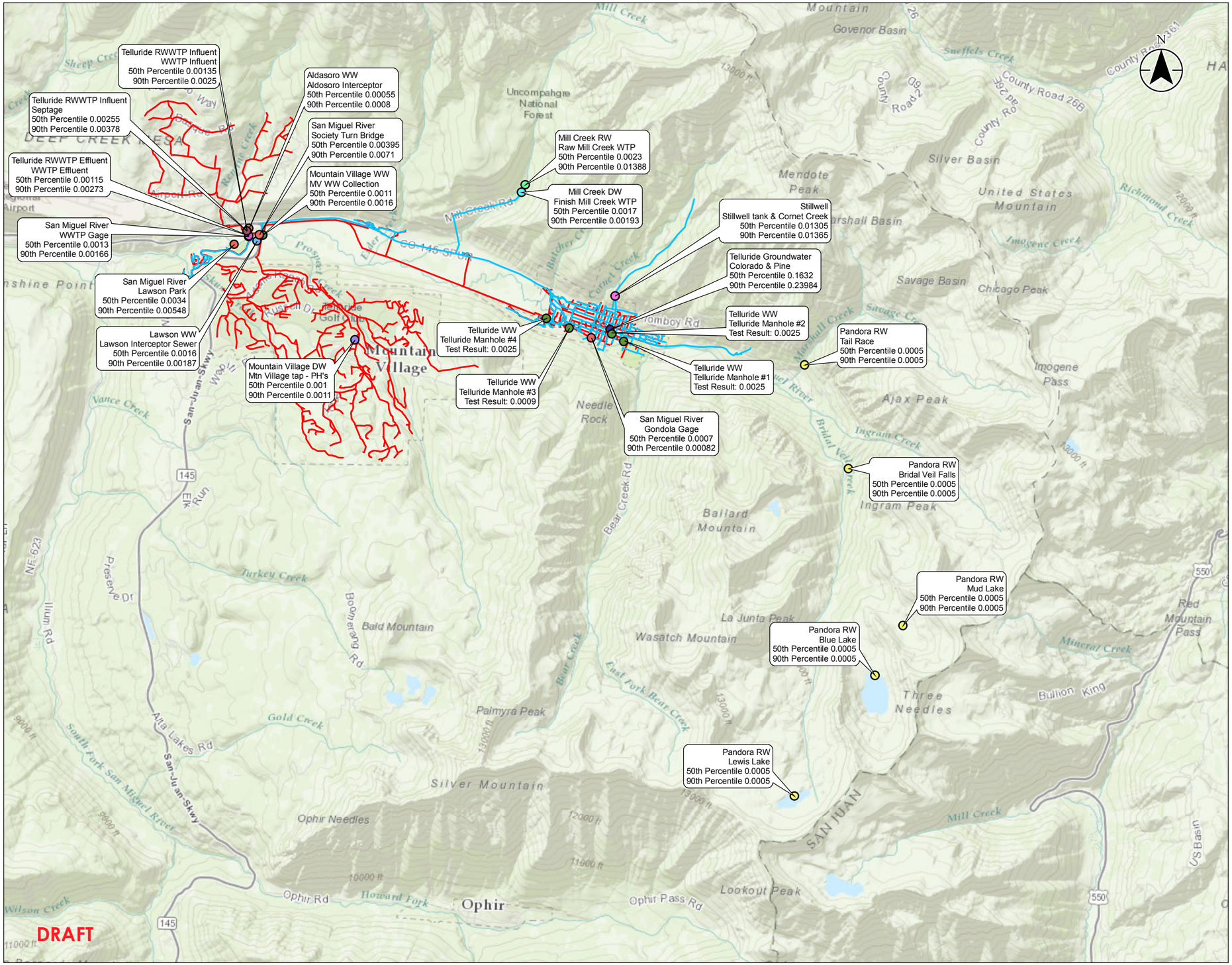
Sampling Location →		WW Collection	WWTP Effluent	WWTP Influent
Year	Month	Cadmium	Cadmium	Cadmium
2012	11		0.0001	
	12		0.0001	
2013	1		0.0001	
	2		0.0001	
	3		0.0001	
	4		0.0001	
	5		0.0001	
	6		0.0001	
	7		0.0001	
	8		0.0001	
	9		0.0001	
	10		0.0001	
	11	0.0001	0.0001	
	12		0.0001	
2014	1		0.0001	
	2		0.0001	
	3		0.0001	
	4		0.0001	
	6		0.0001	
	7		0.0001	
	8		0.0001	
	9		0.0001	
	10		0.0005	
	11		0.0001	
	12		0.0001	
2015	1		0.0001	
	2		0.0001	
	3		0.0001	
	4		0.0001	
	5		0.0001	
	6		0.0001	
	7		0.0001	
	8		0.0001	
	9		0.0001	
	10		0.0002	
	11		0.0001	
	12		0.0001	0.001
2016	1		0.0005	
	2		0.0001	
	3		0.0002	0.0002
	4		0.0002	

Sampling Location →		WW Collection	WWTP Effluent	WWTP Influent
Year	Month	Cadmium	Cadmium	Cadmium
	5		0.0005	
	6		0.0001	

Table A.10 Summary of Lead Levels Downstream of the Water System

Sampling Location →		Boiler Discharge	Industrial Discharge	WW Collection	WWTP Effluent
Year	Month	Lead	Lead	Lead	Lead
2012	11				0.00085
	12				0.0008
2013	1				0.0014
	2				0.0032
	3				0.0446
	4				0.0018
	5				0.0013
	6				0.0026
	7				0.0015
	8				0.0011
	9				0.0005
	11			0.036	0.0016
	12				0.0016
2014	2				0.0019
	4				0.0026
	7				0.0005
	10				0.0025
2015	1				0.0005
	3				0.0005
	4				0.0005
	6		1.37		
	7				0.0005
	10				0.0005
2016	1				0.0025
	5				0.0025
	7	0.001			

A.4 MAP OF ARSENIC SAMPLING SITES



Stantec

- Aldasoro WW
- Lawson WW
- Mill Creek DW
- Mill Creek RW
- Mountain Village DW
- Mountain Village WW
- Pandora RW
- San Miguel River
- Stillwell
- Telluride Groundwater
- Telluride RWWTP Effluent
- Telluride RWWTP Influent
- Telluride WW
- Water Pipe
- Sewer Pipe

0 1 2 Miles

1:60,000 (At original document size of 11x17)

Notes

1. Units for all Arsenic data in mg/L.
2. Permit requires "Report Only" for Effluent Arsenic Concentration.
3. Coordinate System: NAD 1983 StatePlane Colorado South FIPS 0503 Feet



Project Location
Telluride, Colorado

205305088
Prepared by BT on 2016-12-02
Technical Review by TM on 2016-12-02
Independent Review by ABC on 2015-07-01

Client/Project
Town of Telluride
Metals Monitoring
Telluride Regional WWTP Master Plan

Figure No.
A.4

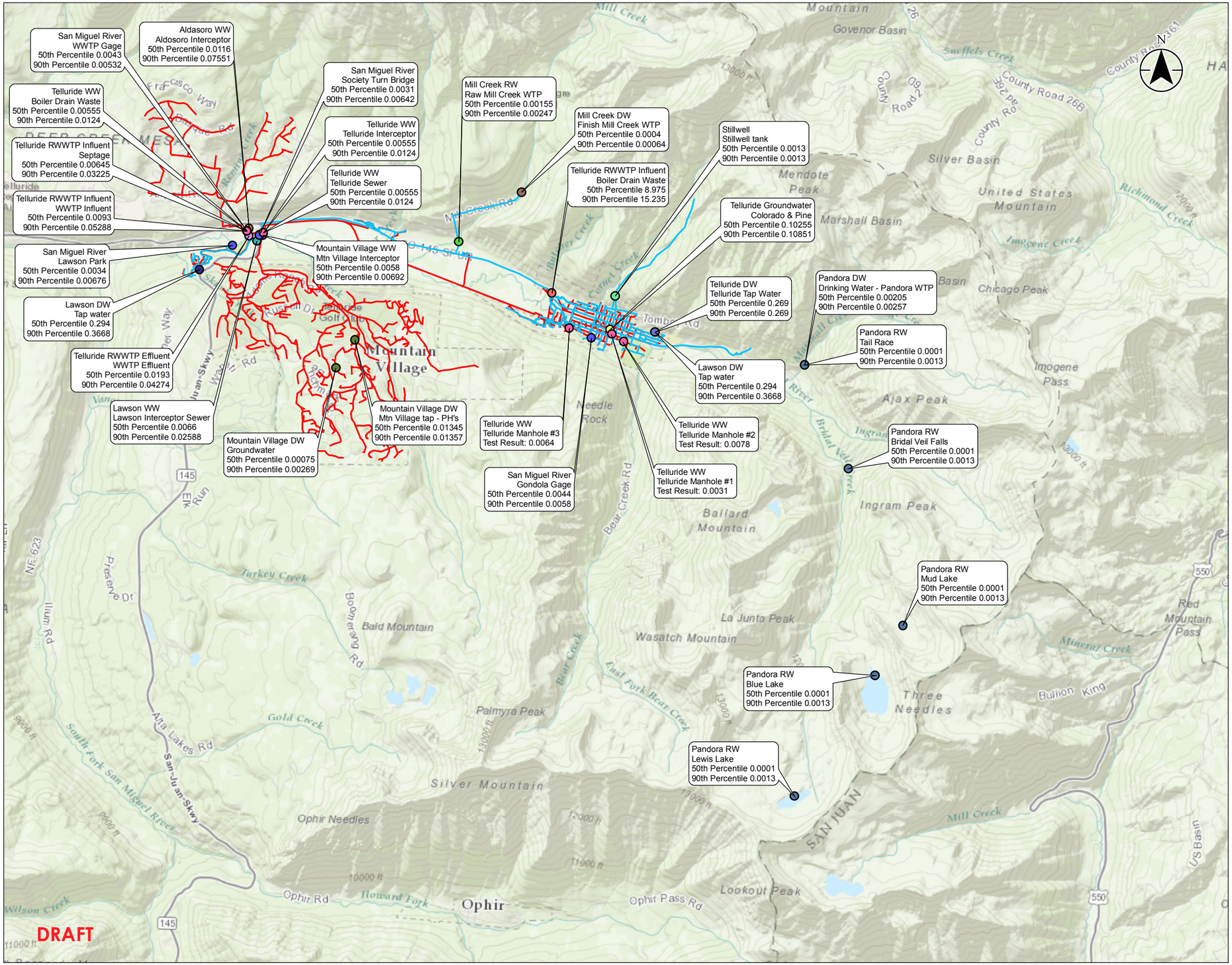
DRAFT

Title
Arsenic Water Sample Locations

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A.5 MAP OF COPPER SAMPLING SITES



Notes

1. Units for all Copper data in mg/L.
2. Permit requires "Report Only" for Effluent Copper Concentration.
3. Coordinate System: NAD 1983 StatePlane Colorado South FIPS 0503 Feet

Project Location
Telluride, Colorado

205305088
Prepared by BT on 2016-12-02
Technical Review by TM on 2016-12-02
Independent Review by ABC on 2015-07-01

Client/Project
Town of Telluride
Metals Monitoring
Telluride Regional WWTP Master Plan

Figure No.
A.5

DRAFT

Title
Copper Water Sample Locations

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Appendix B PROPOSALS FOR SUPPLEMENTAL OXYGEN

B.1 PROPOSAL FOR DISC AERATION EQUIPMENT BY EVOQUA

evoqua
WATER TECHNOLOGIES





OX™ disc aerators can add nutrient removal performance without additional tanks

REPLACE AGING BRUSH ROTORS WITH OX™ DISC AERATORS

INCREASE CAPACITY AND ADD NUTRIENT REMOVAL WHILE REDUCING MAINTENANCE AND ENERGY COSTS

Easy & Flexible Installation

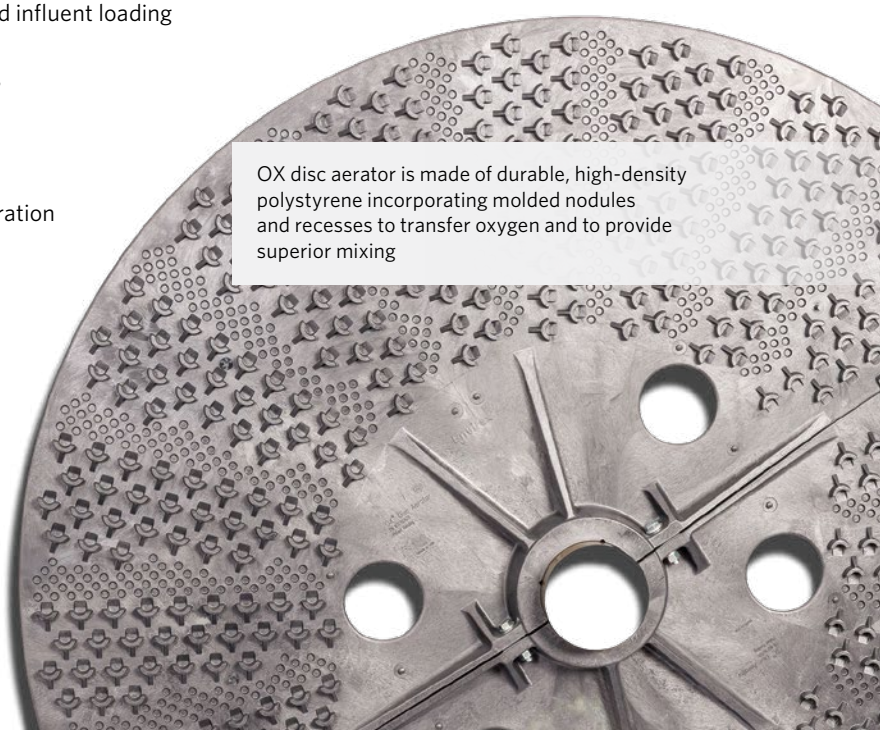
- Replaces all brush rotors on a 14" shaft
- Fits all single & multichannel oxidation ditches
- Offers installation by Evoqua service technicians

Benefits:

- Lasts longer than steel brushes because nonmetallic discs do not rust
- Delivers additional aeration capacity to handle increased influent loading
- Eliminates dead zones
- Eliminates splashing that clogs mechanical components
- Keeps equipment cleaner to lengthen service life
- Provides biological nutrient removal with existing tanks in series operation
- Reduces energy costs by up to 40 percent in series operation
- Reduces misting



Aging brush rotors can be easily upgraded to low-maintenance disc aerators



OX disc aerator is made of durable, high-density polystyrene incorporating molded nodules and recesses to transfer oxygen and to provide superior mixing

Contact:

Freddy Kade
Technical Sales Manager
Tel: +1.262.422.7129
Email: fred.kade@evoqua.com

Schedule an on-site equipment evaluation

OX™ DISC AERATORS

A More Affordable, Durable, Low-Maintenance Brush Rotor Alternative

We recommend OX™ disc aerators to replace brush rotors. Because non-metallic OX disc aerators do not deteriorate or corrode like carbon steel brush rotors, the expected life of the system is at least 20 years. In contrast, brush rotors typically last an average of only five to 10 years.

Operators prefer OX disc aerators because they slice through the water, rather than striking it, which results in substantially less operational noise and eliminates messy excess splashing that clogs mechanical components and requires constant cleanup. And OX disc aerators may require fewer drives, which reduces noise.

Operators also prefer OX disc aerators because they generate excellent oxygenation within the basins. Dead zones are eliminated because the OX disc aerators provide more uniform mixing throughout the entire basin.

With better mixing capabilities, the OX disc aerator can operate at lower speeds that require less power. In fact, OX disc aerators can use up to 40 percent less power than conventional brush rotors if operated in series.

Unlike other companies that sell brush rotors, Evoqua also can install brush rotors or OX disc aerators with its own dedicated field service support teams.

Series Operation Enables Biological Nutrient Removal & Stormflow Management

Facilities using OX disc aerators can upgrade to biological nutrient removal if they operate their oxidation ditches in series. Series operation requires less space, enhances energy efficiency and does not require additional tankage. During series operation, any oxidation ditch using the OX disc aerator can achieve biological phosphorus removal or up to 90 percent total nitrogen removal. Series operation also enables stormflow management capability.

These series operation capabilities can also be automated by adding a SmartBNR™ process control system, which empowers operators, reduces energy costs and enhances system reliability.

Evoqua: Offering Brush Rotors & Disc Aerators

At Evoqua, we have more than 40 years of expertise in both brush rotors and disc aerators. Evoqua is the OEM for Passavant Mammoth brush rotors. We also pioneered the disc aerator in the 1970s. So, we can replace your existing brush rotors or upgrade your ditches with OX disc aerators.

Comparing Conventional Brush Rotors to OX Disc Aerators

These charts allows you compare the features and benefits of conventional brush rotors to OX disc aerators.

	Brush Aerator	OX Disc Aerator
Mixing Horsepower	40 HP/MG	10 HP/MG
Pounds of oxygen transferred per ft. of shaft	4-6	8-12
Energy consumption		Up to 40% less
Average life expectancy	5-10 years	20+ years
Requires baffles/mixers	Yes	No
Eliminates dead zones	No	Yes
Allows full automation with SmartBNR controls	Yes	Yes
Resists corrosion	No	Yes
Reduces noise levels	No	Yes
Reduces aerosols/misting	No	Yes
Eliminates splashing that clogs mechanical components	No	Yes

Series Operation Benefits

	Brush Aerator	OX Disc Aerator
Offers total nitrogen (TN) removal	No	Yes
Offers biological phosphorus removal	No	Yes
Handles excess stormflows without clarifier overflow	Yes	Yes

2607 N Grandview Blvd #130, Waukesha, WI 53189

+1 (800) 524-6324 (toll-free) **+1 (262) 547-0141** **www.evoqua.com/oxdisc**

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DISC AERATION SPECIFICATIONS

EQUIPMENT

THE AERATION EQUIPMENT WILL CONSIST OF (6) COMPLETE ROTARY AERATOR ASSEMBLIES TO SPAN THE CHANNELS AS SHOWN ON THE PLANS. THE ROTARY AERATORS WILL BE DESIGNED FOR OPERATION AT A CONTROLLED RANGE IN THE LIQUID LEVEL IN THE CHANNELS OF 9 TO 18 INCHES, SO THAT THE OXYGEN TRANSFER RATE AND POWER REQUIREMENTS CAN BE VARIED WITH THE FLOW AND TREATMENT REQUIREMENTS. THE ROTARY AERATOR ASSEMBLIES TO BE FURNISHED AND INSTALLED IN THE AERATION BASIN WILL DELIVER THE FOLLOWING REQUIRED QUANTITY OF OXYGEN TO EACH CHANNEL AT EACH LOCATION AS DESCRIBED BELOW. THE OXYGEN VALUES ARE MEASURED AT STANDARD OPERATING REQUIREMENTS OF 20° C AND 760 mm Hg.

AERATION REQUIREMENTS

OXYGEN DELIVERED AT AVERAGE SUBMERGENCE (11.5 INCHES)

# OF AERATORS	HP	RPM	DITCH NO 3	DITCH NO 4
3	50	43	54–DISCS = 54.5 LBS O_2/HR	54–DISCS = 54.5 LBS O_2/HR
TOTAL	50	43	162–DISCS = 163.5 LBS O_2/HR	162–DISCS = 163.5 LBS O_2/HR

OXYGEN DELIVERED AT MAXIMUM SUBMERGENCE (18.0 INCHES)

3	50	60	54–DISCS = 135.0 LBS O_2/HR	54–DISCS = 135.0 LBS O_2/HR
TOTAL	50	60	162–DISCS = 405.0 LBS O_2/HR	162–DISCS = 405.0 LBS O_2/HR

EACH 50 HP DISC AERATOR ASSEMBLY SHALL BE CAPABLE OF TRANSFERRING AT MAXIMUM DESIGN CONDITIONS 135.00 LBS OXYGEN/HR. WITH (54) DISCS OPERATING AT 60 RPM AND 18" IMMERSION.

AERATION DISCS

A MINIMUM OF (324) DISCS WILL BE PROVIDED. THE DISCS WILL BE 4'–6" DIAMETER, FABRICATED FOR A 1/2" THICK MOLDED PLASTIC COMPOUND RESISTANT TO ANY CORROSIVE ACTION OF THE MIXED LIQUOR BEING AERATED. A MULTIPLICITY OF OPENINGS WILL BE PROVIDED IN THE DISC TO CAUSE ENTRAINED AIR TO BE DISPENSED IN THE MIXED LIQUOR.

THE AERATION DISCS WILL BE FIRMLY ATTACHED TO THE SHAFTING BY MEANS OF A SHAFT LOCATING COLLAR. THIS SHAFT LOCATING COLLAR WILL BE AN INTEGRAL PART OF THE AERATION DISCS. TO ENABLE THE INDIVIDUAL DISCS TO BE ATTACHED, ADJUSTED, OR REMOVED FROM THE SHAFTING WITHOUT DISASSEMBLING THE SHAFTING, DISCS WILL BE SPLIT INTO HALF SECTIONS, HELD IN POSITION BY BOLTS AT THE SHAFT.

AFTER TRIAL OPERATIONS, THE CONTRACTOR WILL ADJUST DISC DISTRIBUTION AS REQUIRED TO MEET THE SPECIFICATIONS AND THE TREATMENT PROCESS AS DETERMINED BY SIEMENS AND THE ENGINEER.

SHAFTING

THE DISC AERATOR ASSEMBLY SHALL INCLUDE A 12–INCH (12.75" OD) DIAMETER STEEL TORQUE TUBE WITH A MINIMUM 0.688–INCH WALL THICKNESS HAVING FLANGED ENDS. END FLANGES SHALL BE MACHINED PARALLEL TO EACH OTHER IN A LATHE FOLLOWING ALL WELDING ON THE PIPE. EACH END OF THE TORQUE TUBE SHALL HAVE A CAST DUCTILE IRON HUB AND SHAFT EXTENSION BOLTED THERE TO PREVENT LIQUID FROM ENTERING THE PIPE. TORQUE TUBE SHALL BE INSTALLED BY THE INSTALLATION CONTRACTOR.

THE TORQUE TUBE MATERIAL SHALL BE ASTM–A53, GRADE B STEEL OR BETTER.

THE TORQUE TUBE SHALL BE SUPPORTED AT BOTH ENDS BY A FLANGED STUB SHAFT, WHICH IS INDEXED TO THE TORQUE TUBE TO ALLOW FOR POSSIBLE FIELD REPLACEMENT. STUB SHAFTS SHALL BE FIELD INSTALLED BY THE INSTALLATION CONTRACTOR.

STUB SHAFTS SHALL BE FABRICATED OF ONE–PIECE ASTM–A536 CAST DUCTILE IRON.

EACH SHAFT SECTION WILL BE SUPPORTED BY SELF–ALIGNING. PRESSURE GREASE LUBRICATED, ROLLER BEARING PILLOW BLOCKS SET ON ADJUSTABLE BASE PLATES.

THE PILLOW BLOCKS WILL HAVE A SPLIT HOUSING, DOUBLE ROW TAPERED BEARINGS WITH DOUBLE LOCKING COLLARS. EACH LOCKING COLLAR WILL HAVE TWO (2) SETSCREWS. A POSITIVE CONTACT NEOPRENE SEAL WILL BE PROVIDED TO INSURE POSITIVE SEALING AGAINST CONTAMINANTS. THE SEAL WILL BE DESIGNED FOR OPERATION IN A MOISTURE LADEN ENVIRONMENT AND WILL SEAL EFFECTIVELY, EVEN DURING MISALIGNMENT. MINIMUM B–10 BEARING LIFE WILL BE 500,000 HRS.

WEATHER PROTECTION (COLOR = WHEAT–NH613)

WEATHER HOODS WITH SUPPORT STRUCTURES WILL BE PROVIDED TO PREVENT THE AERATION DISCS FROM ICING IN COLD WEATHER. THE HOODS WILL BE CONSTRUCTED OF 3/16" THICK FIBERGLASS WITH DIMENSIONS SUFFICIENT TO ASSURE CLEARANCE BETWEEN THE ROTATING DISCS AND SHAFTING. THE HOOD SUPPORT STRUCTURES WILL BE 6 x 4 STRUCTURAL TUBING. HOLD DOWN LATCHES WILL BE PROVIDED TO PREVENT UPLIFT DUE TO WIND. HOODS WILL BE HINGED AND OF SUFICIENT LIGHT WEIGHT SO THAT INDIVIDUAL HOOD SECTIONS CAN BE RAISED BY ONE PERSON. SUPPORT BARS WILL BE PROVIDED WITH SELF LOCKING CONNECTIONS AT EACH END THAT WILL HOLD THE HOOD IN AN OPEN POSITION AND PREVENT UPLIFT DUE TO WIND.

PAINT NOTE:

1. BEARINGS AND COUPLINGS TO REMAIN MANUFACTURERS' STANDARD.
2. DISCS TO REMAIN UNPAINTED.
3. GALVANIZED, STAINLESS STEEL AND ALL NON–FERROUS MATERIALS TO REMAIN UNPAINTED.
4. DRIVE WILL BE FURNISHED WITH MANUFACTURERS' STANDARD PAINT.
5. SHAFTING TO BE BLAST CLEANED PER SSPC–SP10–63, FOLLOWED BY TWO (2) COATS OF SHERWIN–WILLIAMS DURA–PLATE 235 B67A235 HAZE GRAY. EACH COAT SHALL BE APPLIED AT 6.0 TO 8.0 MILS DRY FILM THICKNESS. TOTAL D.F.T. FOR BOTH COATS SHALL BE 12.0 TO 16.0 MILS DRY THICKNESS. MACHINED ENDS TO RECEIVE ONE (1) COAT OF RUST VETO 344 (3.0–4.5 MILS D.F.T.)
   SPECIFIED COATING (ABOVE) WILL ENSURE PROPER FIT–UP AND GRIP BETWEEN THE AERATION DISCS AND THE DISC AERATOR SHAFTS. NO ALTERNATIVE COATING WILL BE ACCEPTABLE. NO ADDITIONAL FIELD PAINTING OF THE AERATOR SHAFTS IS REQUIRED.
6. ALL STEEL SHAPES AND PLATES TO BE BLAST CLEANED PER SSPC–SP10–63 FOLLOWED BY ONE (1) COAT OF SHERWIN–WILLIAMS DURA–PLATE 235 NSF EPOXY PRIMER (5.0–6.0 MILS D.F.T.)
7. TOUCH–UP AND ALL ADDITIONAL COATS OF PAINT BY CONTRACTOR.
8. WEATHERHOOD SUPPORT MEMBERS WILL BE HOT–DIP GALVANIZED PER ASTM A123.

CUSTOMER NOTE:

CORRECTIONS OF MINOR MISFITS AND A REASONABLE AMOUNT OF CUTTING AND REAMING ARE CONSIDERED A PART OF ERECTION. ANY SITUATION WHICH PREVENTS ASSEMBLY BY MODERATE USE OF DRIFT PINS, CUTTING AND WELDING, IS TO BE REPORTED AND APPROVAL OF MODIFICATION OR CHANGE IS TO BE AGREED UPON BY MANUFACTURER BEFORE PROCEEDING. FAILURE TO COMPLY COULD BREACH MANUFACTURES STATED WARRANTY LIABILITY.

FIELD NOTE:

DO NOT INSTALL DISCS, BEARING STOP BLOCKS, OR WEATHER HOODS, AND DO NOT GROUT UNDER BEARING BASE PLATES UNTIL AN SIEMENS FIELD SERVICE REPRESENTATIVE HAS INSPECTED AND APPROVED THE INSTALLATION.

ALL GROUT TO BE NON–SHRINK. USE A POUR TYPE GROUT UNDER THE DOUBLE BEARING BASEPLATES.

SIEMENS MATERIAL DESCRIPTIONS

CAST IRON

GENERAL PURPOSE HIGH STRENGTH GRAY IRON. CONFORMS TO ASTM A48, CLASS 30B. OPTIONAL TEST PER ASTM A–438. TENSILE STRENGTH (MINIMUM 1.2 IN. OR 30.5 MM DIA. TEST BAR B)= 30,000 PSI (207 MPa). MAXIMUM HARDNESS TO BE 229 BHN.

STEEL

MILD CARBON H.R. STEEL PLATE, STRUCTURAL QUALITY. STANDARD AISI TOLERANCES. CHEMICAL ANALYSIS = CARBON .15%–.25%, MANGANESE .30%–.60%, PHOSPHORUS .04% MAXIMUM, SULPHUR .05% MAXIMUM.

STRUCTURAL STEEL

ALL ROLLED STRUCTURAL STEEL SHAPES WILL CONFORM TO ASTM A36.

BRONZE

HIGH LEADED TIN BRONZE SAND OR CONTINUOUS CAST CONFORMS TO ASTM B144 NO. 3B, 81%–85% COPPER, 6.25%–7.5% TIN, 6%–8% LEAD, 2%–4% ZINC. TENSILE STRENGTH 30,000 PSI MINIMUM SAE–660.

HOT DIP GALVANIZED STEEL

ALL HOT DIP GALVANIZED STEEL TO BE PER ASTM A123.

SPARE PARTS:

NONE

LIST OF COMPONENTS

ESTIMATED FINISHED WEIGHT

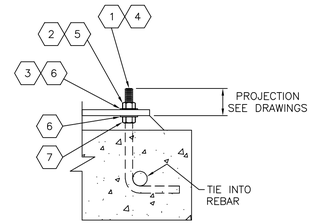
DRAWING NUMBER 44544–101

TITLE: GENERAL ARRANGEMENT SPECIFICATIONS

ALL LENGTHS ARE FINAL LENGTHS UNLESS OTHERWISE SPECIFIED

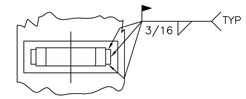
PROJECT NUMBER 1190/044544

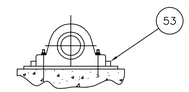
ADVANCE ORDER	REF. SYMBOL	QUANTITY	PART NUMBER	DESCRIPTION
	ANCHOR BOLTS FURNISHED BY SIEMENS (SET BY CONTRACTOR)			
	1	12	W2T120044	5/8" DIA x 9.00 HOOK ANCHOR 304SS
	2	12	W2T117616	5/8" DIA HEX NUT 316SS
	3	12	W2T118929	5/8" DIA WASHER 316SS
	4	48	W2T120204	3/4" DIA x 9.00 HOOK ANCHOR 304SS
	5	48	W2T122467	3/4" DIA HEX NUT 316SS
	6	96	W2T122482	3/4" DIA WASHER 316SS
	7	48	W2T116813	3/4" DIA JAM NUT 316SS
	8	1	W3T17690	ANCHOR BOLT TEMPLATE 4 x 22
	9	1	W3T17692	ANCHOR BOLT TEMPLATE 4 x 26
	10	6	W3T21873	BASE PLATE–3.938" DIA DODGE, SINGLE
	11	6	W3T21876	BASE PLATE–4.938" DIA DODGE, SINGLE



ANCHOR BOLTS & SHIMMING

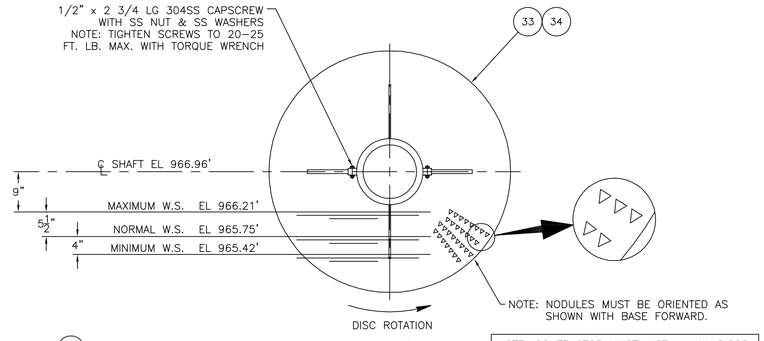
COAT STAINLESS STEEL FASTENER THREADS WITH ANTI–SEIZE COMPOUND SUCH AS FEL PRO, C5A LOCKTITE OR EQUAL (NOT BY SIEMENS)





AFTER PROPER ALIGNMENT OF BEARINGS, FIELD WELD STOP BLOCKS IN PLACE

BEARING STOP BLOCKS



NOTE: CONTRACTOR MUST INSTALL ALL DISCS BEFORE FINISH PAINTING THE SHAFT, FAILURE TO DO SO MAY CAUSE DISC DAMAGE.

SECTION S–S/103

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
0	ISSUE FOR CONSTRUCTION	01–30–12	KWP	KWP	GCM	

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DATE	08–19–11
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ENGINEER	
DATE	
MANAGER	GCM
DATE	08–19–11
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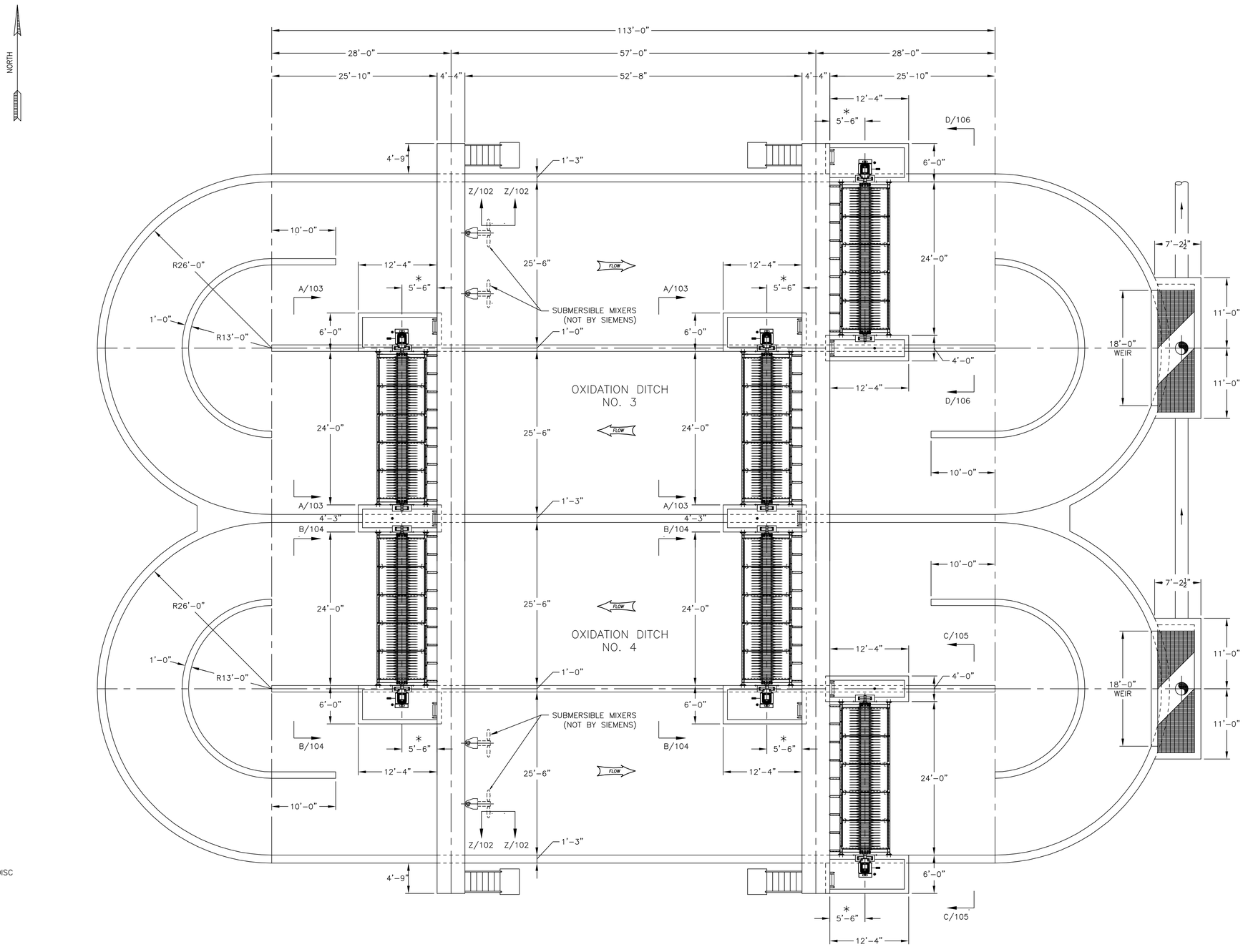
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(2) OXIDATION DITCHES NO. 3 & NO. 4
(6) 50 HP DISC AERATORS, WEATHERHOODS &WEIRS

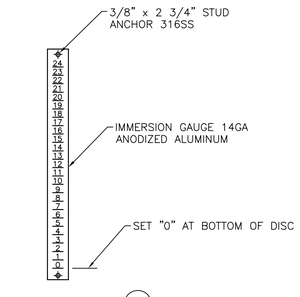
CUST.: RICE LAKE CONSTRUCTION GROUP
LOC.: PRINCETON, MN
ENG.: SEH

SIEMENS Industry Waukesha, WI 262–547–0141

PROJECT	CODE	DRAWING	SHEET	REV
1190/044544	6471 A	44544–101	1 OF 1	0

STD: 1–0200–24X36D1 | INTL REF: | BAR = 1" AT PLOT SCALE





IMMERSION GAUGE (44)

LOCATE (1) PER DITCH
IN VISIBLE LOCATION
BY CONTRACTOR

SECTION Z/102

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
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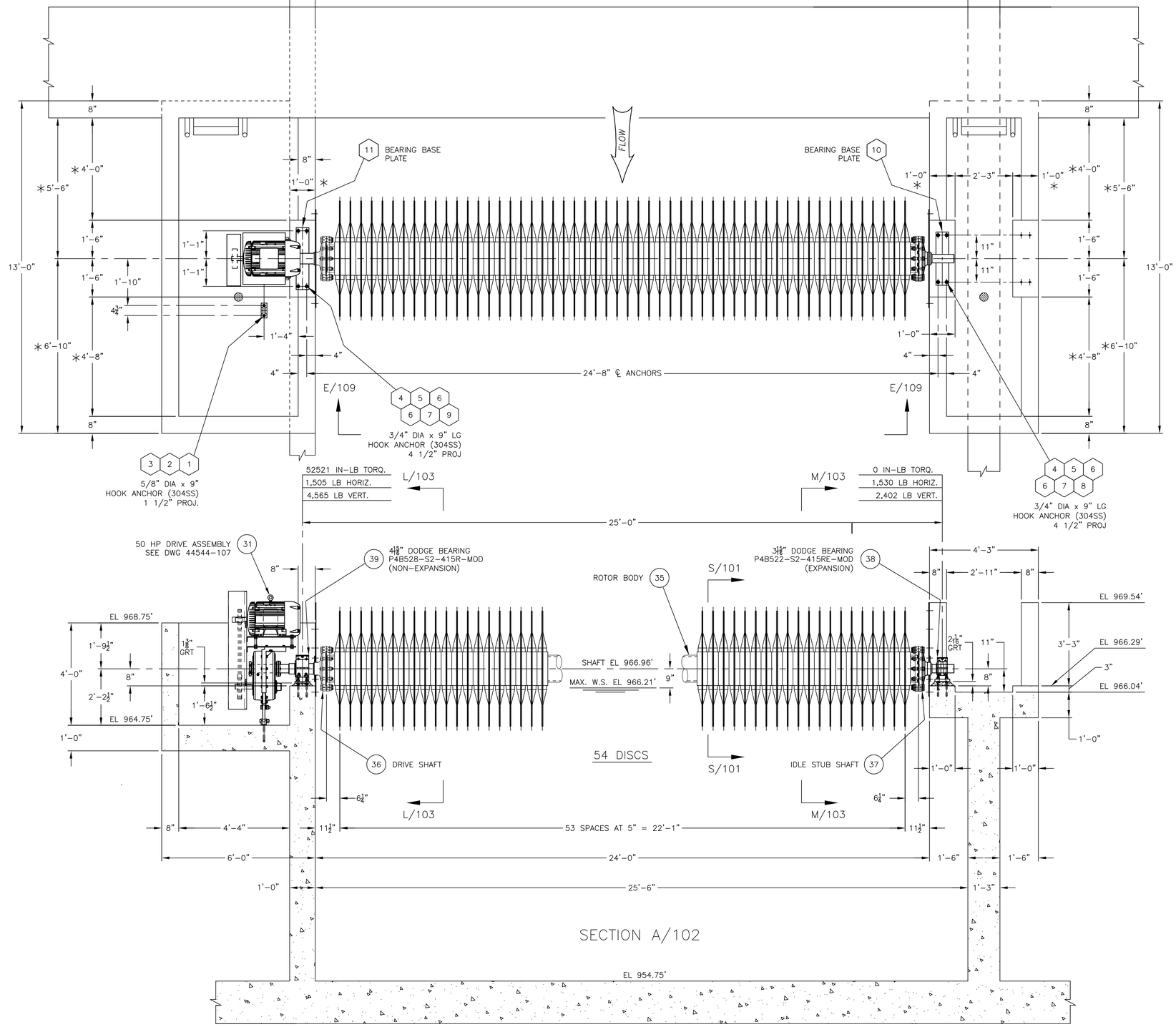
TITLE: GENERAL ARRANGEMENT – PLAN VIEW
(2) OXIDATION DITCHES NO. 3 & NO. 4
(6) 50 HP DISC AERATORS, WEATHERHOODS &WEIRS

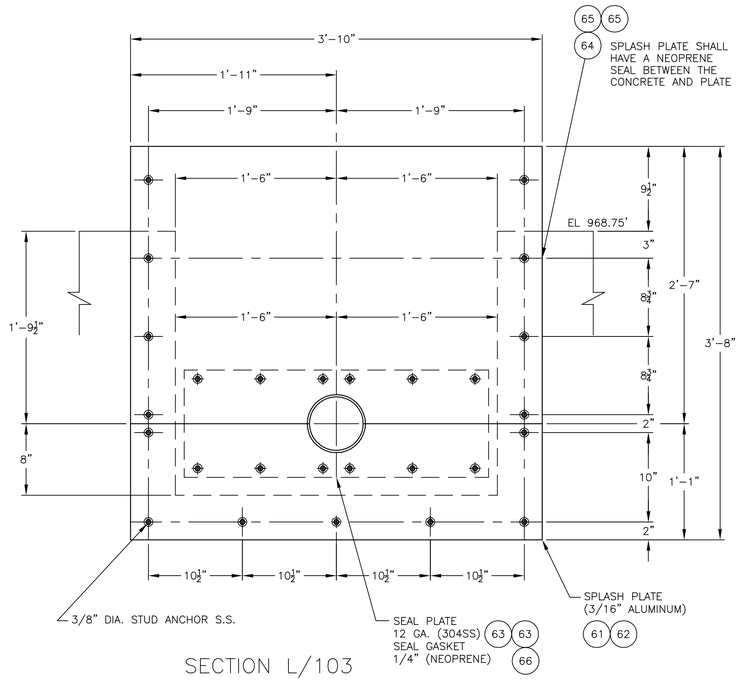
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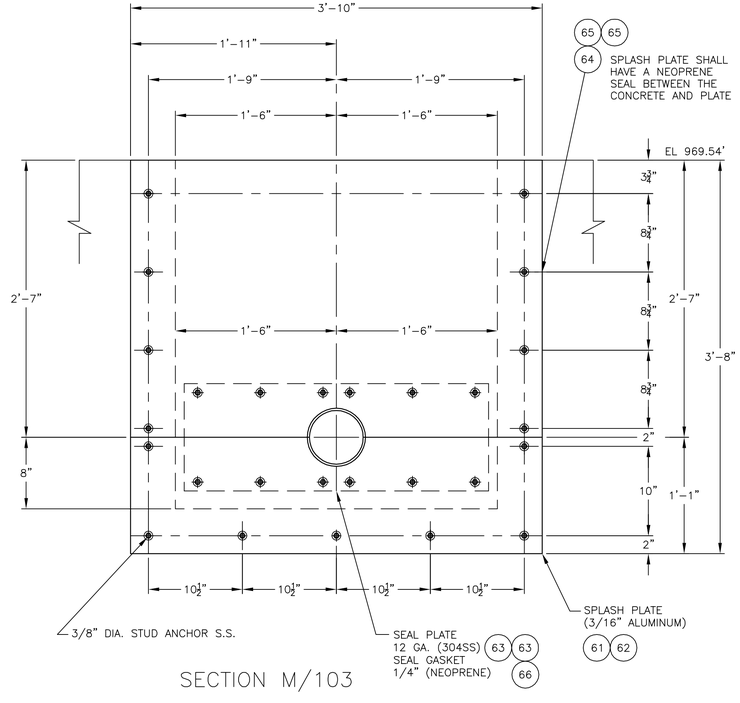
PROJECT	CODE	DRAWING	SHEET	REV
1190/044544	6471 A	44544-102	1 OF 1	0

STD: 1-0200-24X36D1 | INTL REF: | BAR = 1" AT PLOT SCALE





SECTION L/103



SECTION M/103

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
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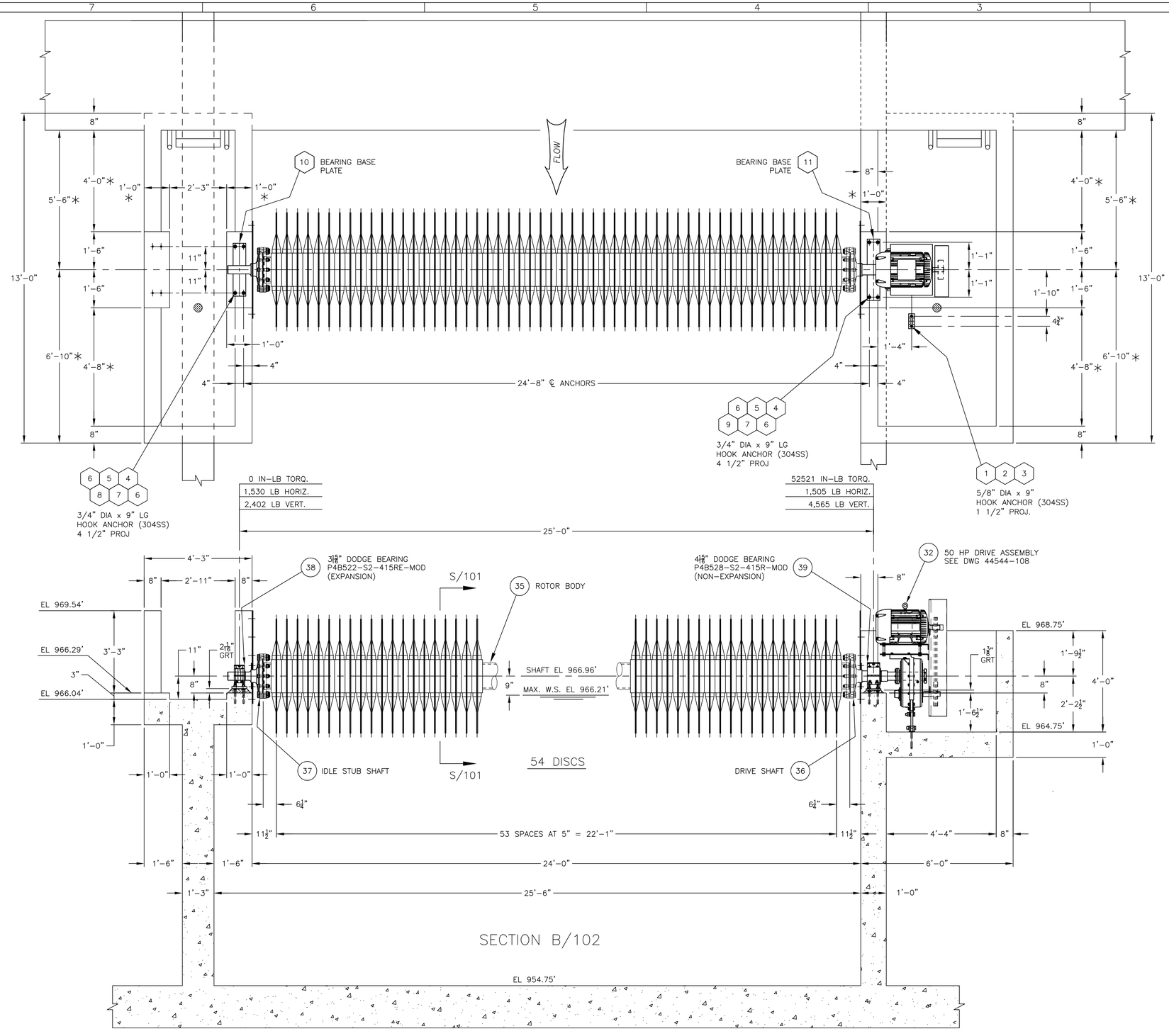
TITLE: GENERAL ARRANGEMENT – SECTION VIEW
(2) OXIDATION DITCHES NO. 3 & NO. 4
(6) 50 HP DISC AERATORS, WEATHERHOODS &WEIRS

CUST.: RICE LAKE CONSTRUCTION GROUP
LOC.: PRINCETON, MN
ENG.: SEH

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PROJECT	CODE	DRAWING	SHEET	REV
1190/044544	6471 A	44544-103	1 OF 1	0

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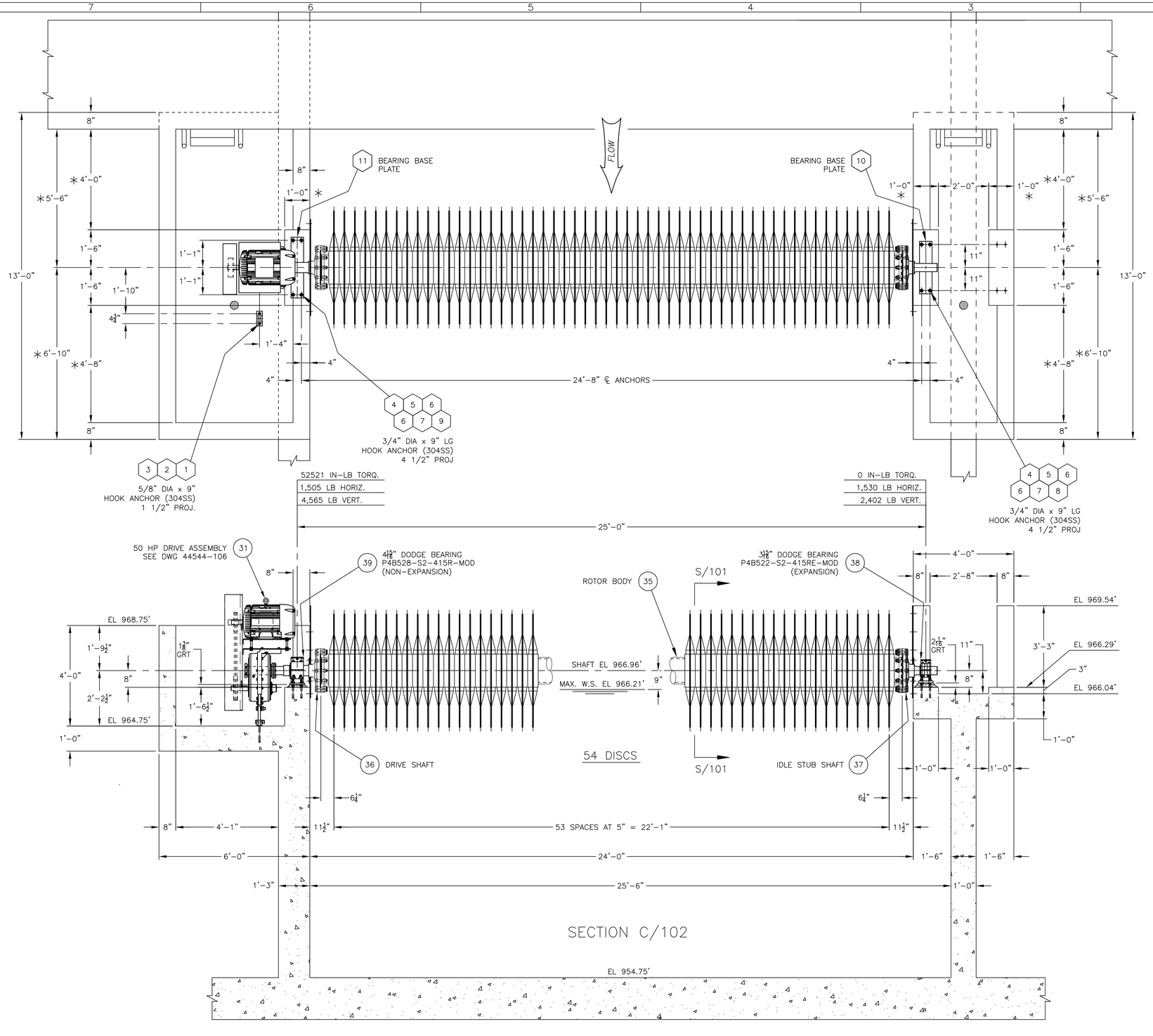
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1190/044544	6471 A	44544–104	1 OF 1	0

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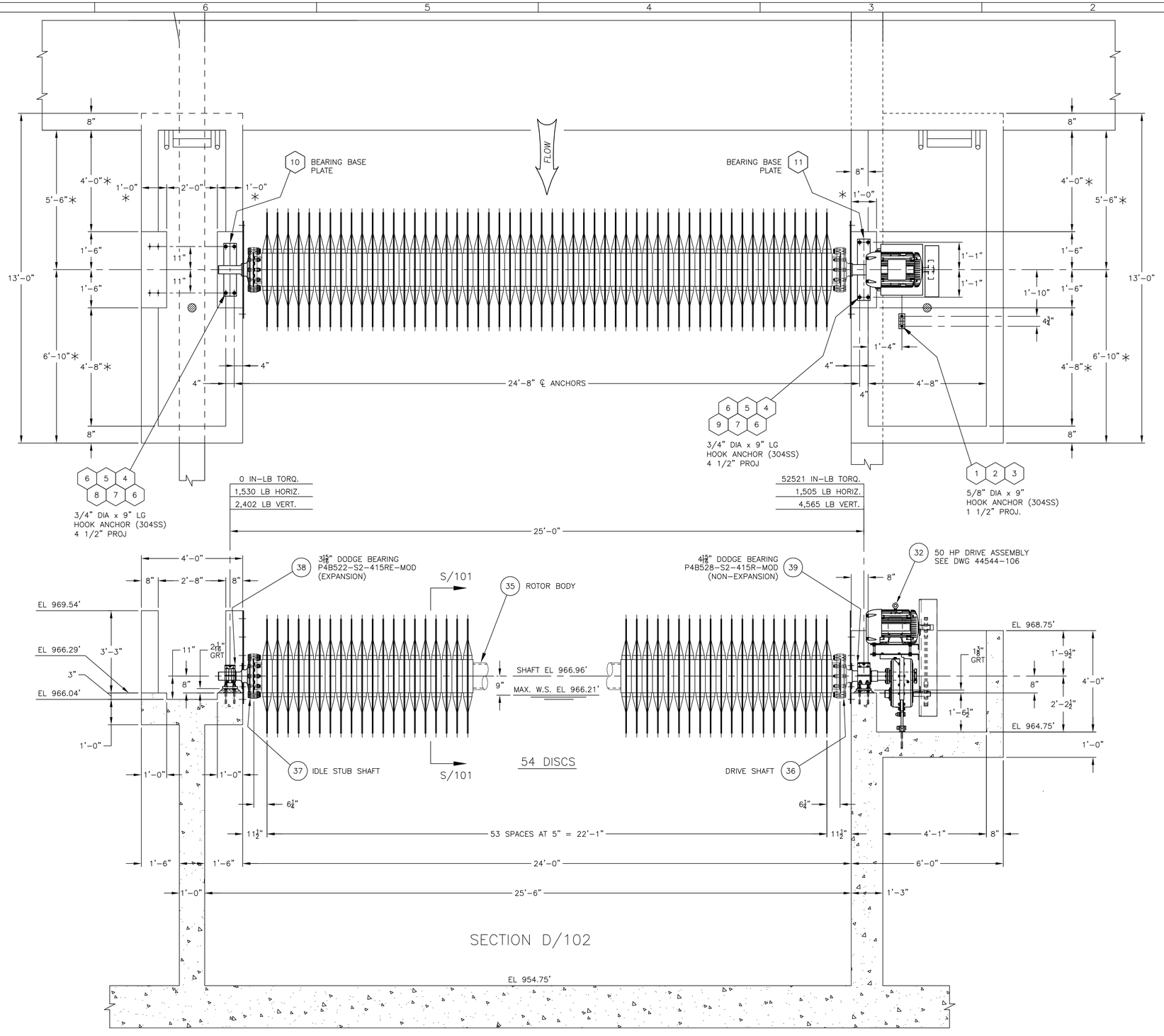
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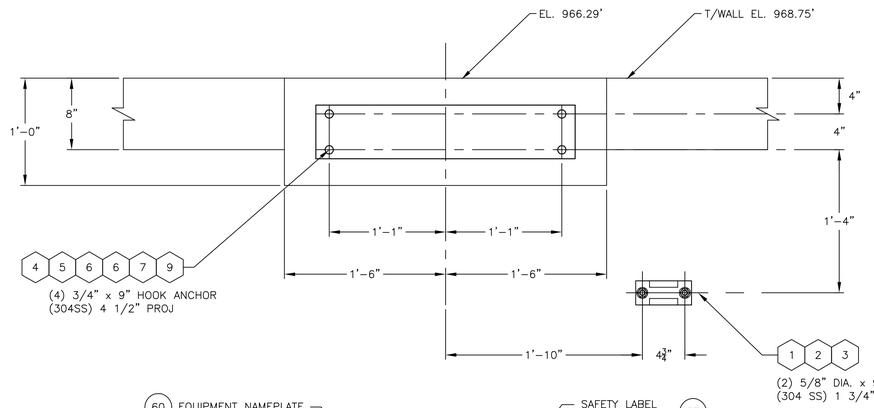
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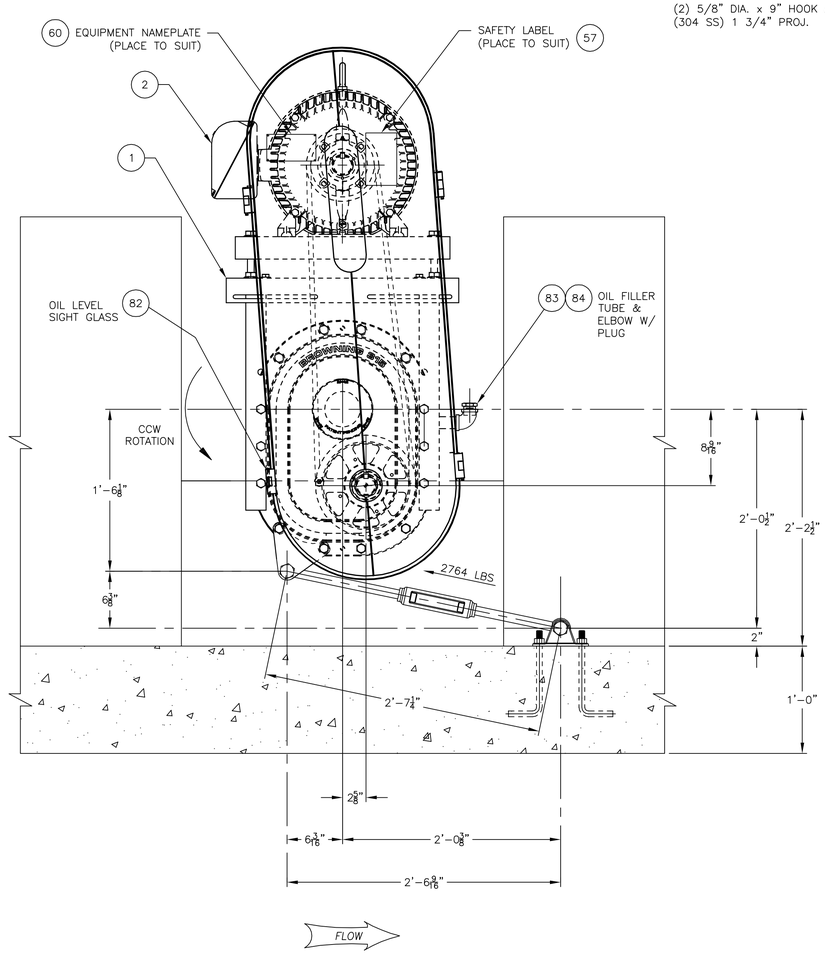
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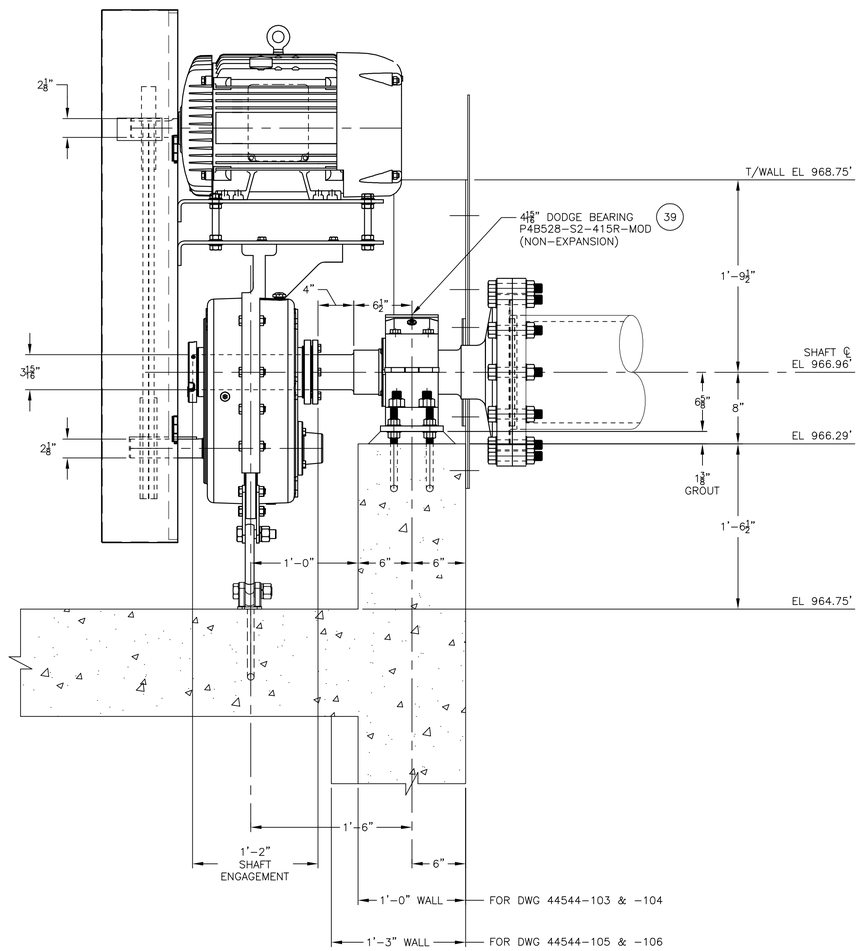
SIEMENS Industry Waukesha, WI 262-547-0141

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1190/044544	6471 A	44544-106	1 OF 1	0

STD: 1-0200-24X36D1 | INTL REF: | BAR = 1" AT PLOT SCALE







REF. SYMBOL	QUANTITY	PART NUMBER	DESCRIPTION
		MATERIAL FOR ONE W3T210672	ESTIMATED FINISHED WEIGHT: 1,400#
*	1	1	ASSEMBLED ORBAL DRIVE MACHINERY. (LM SHIPPING ITEM 31)
			ASSEMBLE IN 6 O'CLOCK POSITION. SIEMENS
			TO SUPPLY MOTOR TO VENDOR FOR ASS'Y.
	1	315SMTP25	MANUFACTURER: BROWNING
			MODEL: SHAFT MOUNTED HELICAL GEAR REDUCER
			UNIT SIZE: CLASS II
			HORIZONTAL SHAFT MOUNTING POSITION: 6 O'CLOCK
			REDUCTION: DOUBLE
			EXACT RATIO: 24.4118:1
			SHAFT DIAMETER: 3-15/16"
			MOTOR FRAME: 326T
			OUTPUT SPEED: 60 RPM
	1	315TBP315	BUSHING WITH KEY
	1	315TAP-H	TORQUE ARM KIT (FACTORY INSTALL MOUNTING BRACKET TO RED.)
	1	MB315	MOTOR BASE
	1	MMA315	MOTOR MOUNT ADAPTER
	1	MMS315L	MOTOR MOUNT SUPPORT
	1	315FKP	FAN KIT
	1	BGP24 24-38	BELT GUARD KIT
	1	315BGMKPT	MOUNTING BRACKET KIT
	1	3B5V90	DRIVER SHEAVE
	1	B 2 1/8"	BUSHING WITH STD KS
	1	3B5V110	DRIVEN SHEAVE
	1	B 2 1/8"	BUSHING WITH STD KS
	3	5VX1000	BELT: 34.13" CENTERS (1.75 S.F.)
*	2	1	W2T532913
		MANUFACTURER: SIEMENS OR EQUAL	VOLTAGE: 460
		MOTOR: 50 HP	PHASE: 3
		ENCLOSURE: TEFC-INVERTER DUTY, NEMA MG1 PART 31	HERTZ: 60
		PREMIUM EFFICIENT 94.5% AT FULL LOAD, SEVERE DUTY, CLASS 1, DIVISION 2, GROUP D, HAZARDOUS LOCATION	
		CT SPEED RANGE: 4:1	
		FULL LOAD SPEED: 1780 RPM	SERVICE FACTOR: 1.15 ON SINE WAVE & 1.0 ON PWM
		FRAME: 326T	
		MOUNTING: HORIZ. FOOT MOUNT	CLASS INSUL: F
		TERMINAL BOX LOCATION: F-1 (LARGE CONDUIT BOX)	AMBIENT TEMP: 40° C
		DESIGN: B	
		DUTY CYCLE: CONTINUOUS DUTY	
		NAMEPLATE: STAINLESS STEEL & STAMPED TO INCLUDE : HORSEPOWER (NOT INCLUDING 15% S.F.), SPEED, TIME RATING, FREQUENCY, PHASES, MODEL NUMBER, RATED VOLTAGE, SERVICE FACTOR, FULL LOAD AMPS (BASED ON NAMEPLATE HP), INSULATION CLASS, NEMA DESIGN, NEMA CODE LETTER, MAXIMUM AMBIENT & BEARING IDENTIFICATION.	
		THERMAL PROTECTION: (2) CLASS F THERMOSTATS WITH NC CONTACTS	
		TESTS: SUPPLY ROUTINE LINE TEST PER NEMA MG1-12.54 & IEEE-112, METHOD B.	

* MOTOR AND REDUCER TO BE FACTORY ASSEMBLED BY BROWNING

VENDOR TO FURNISH :

1-CERTIFIED DIMENSION SHEETS
1-OPERATION AND MAINTENANCE MANUALS
1-SPARE PARTS LIST
1-DATA SHEETS TO INCLUDE FULL LOAD CURRENT, LOCKED MOTOR CURRENT, MOTOR CODE NO. AND MODEL NO.

VENDOR NOTE :

REDUCER WILL DRIVE EQUIPMENT AT VARIED SPEEDS (43 TO 60 RPM) USING VFD CONTROLS DEPENDING ON FIELD REQUIREMENTS.

AT 43 RPM THE REQUIRED BRAKE HP IS 22.47 HP W/ 54 DISCS @ 18" IMMERSION
AT 60 RPM THE REQUIRED BRAKE HP IS 46.02 HP W/ 54 DISCS @ 18" IMMERSION

SAFETY HAZARD WARNING LABELS

LABELS ARE AFFIXED ON "SIEMENS" EQUIPMENT WHEN A VISUAL WARNING IS APPROPRIATE. THE EQUIPMENT OWNER IS RESPONSIBLE FOR KEEPING THESE LABELS VISIBLE AND IN GOOD CONDITION. REPLACEMENT LABELS ARE AVAILABLE FROM THE SIEMENS PARTS DEPARTMENT.

VENDOR TO PLACE OR INSTALL APPROPRIATE OSHA GUARD AND SAFETY LABELS AS REQUIRED PRIOR TO SHIPPING.

SPECIFICATION SECTION 46 53 61 & 26 05 10

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
1	ADD L/M ITEM NUMBERS	01-30-12	KWP	KWP	GCM	
0	RELEASE FOR FABRICATION	09-09-11	KWP	KWP	GCM	

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	DESIGNER	DATE
	KWP	08-19-11
	CHECKER	DATE
	KWP	08-19-11
	ENGINEER	DATE
	MANAGER	DATE
	GCM	08-19-11
	MADE FROM :	
	SCALE:	1 1/2"=1'-0"

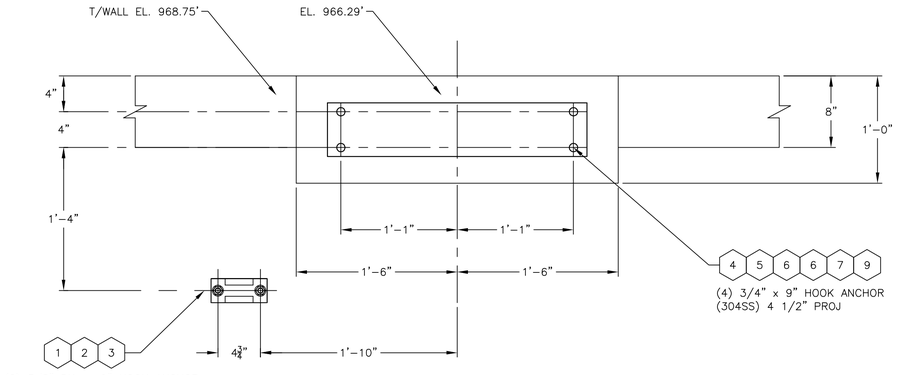
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50 HP SHAFT MOUNT DRIVE ASSEMBLY
ORBAL-DISC AERATOR

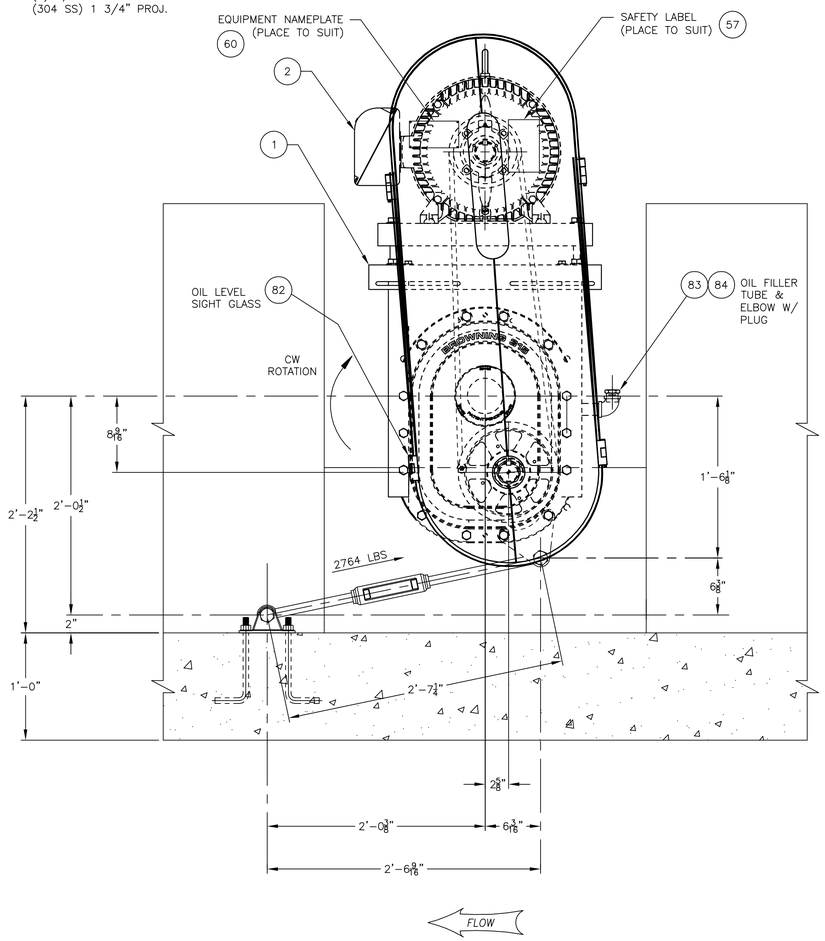
CUST.: RICE LAKE CONSTRUCTION GROUP
LOC.: PRINCETON, MN
ENG.: SEH

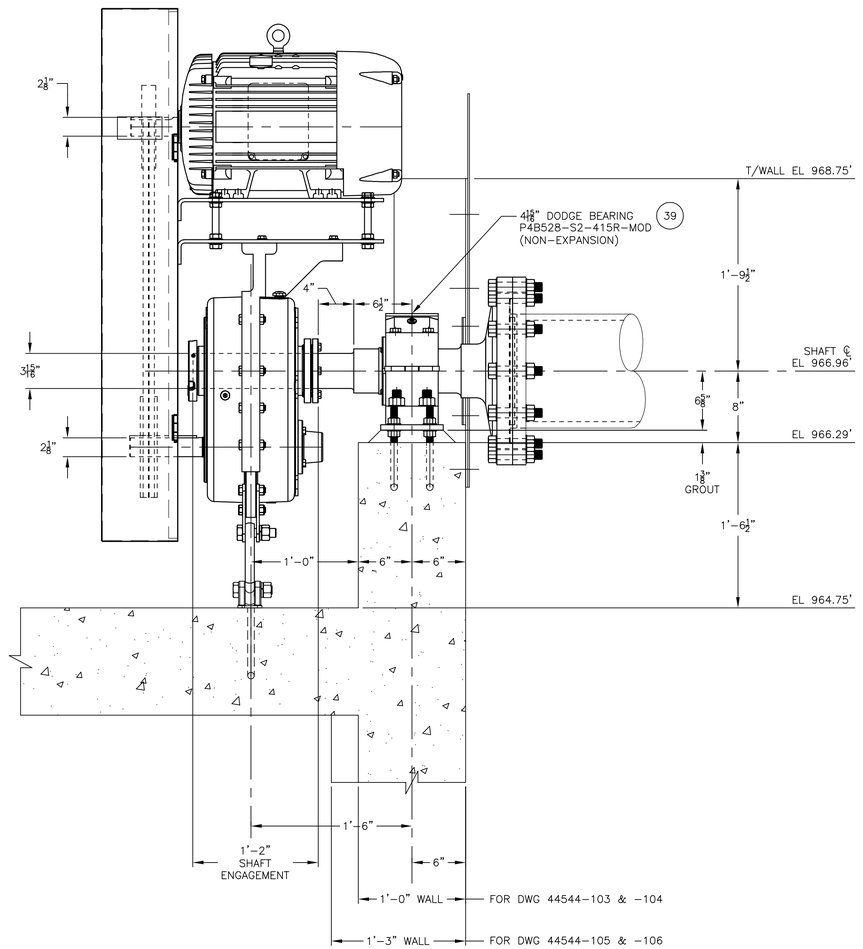
SIEMENS *Water Technologies*
WAUKESHA, WI
262-547-0141

PROJECT	CODE	DRAWING	SHEET	REV
1190/044544	6471 A	44544-107	1 OF 1	1

STD: 1-0200-24X36D1 | INTL REF: X:\ACAD Drawings\Contracts\43xxx\43921\01 orbal\43921-104 | 02/2/2012 - 7:52 AM | BAR = 1" AT PLOT SCALE







REF. SYMBOL	QUANTITY	PART NUMBER	DESCRIPTION
		MATERIAL FOR ONE W3T210673	ESTIMATED FINISHED WEIGHT: 1,400#
*	1	1	ASSEMBLED ORBAL DRIVE MACHINERY. (LM SHIPPING ITEM 32)
			ASSEMBLE IN 6 O'CLOCK POSITION. SIEMENS
			TO SUPPLY MOTOR TO VENDOR FOR ASS'Y.
	1	315SMTP25	MANUFACTURER: BROWNING
			MODEL: SHAFT MOUNTED HELICAL GEAR REDUCER
			UNIT SIZE: CLASS II
			HORIZONTAL SHAFT MOUNTING POSITION: 6 O'CLOCK
			REDUCTION: DOUBLE
			EXACT RATIO: 24.4118:1
			SHAFT DIAMETER: 3-15/16"
			MOTOR FRAME: 326T
			OUTPUT SPEED: 60 RPM
	1	315TBP315	BUSHING WITH KEY
	1	315TAP-H	TORQUE ARM KIT (FACTORY INSTALL MOUNTING BRACKET TO RED.)
	1	MB315	MOTOR BASE
	1	MMA315	MOTOR MOUNT ADAPTER
	1	MMS315L	MOTOR MOUNT SUPPORT
	1	315FKP	FAN KIT
	1	BGP24 24-38	BELT GUARD KIT
	1	315BGMKPT	MOUNTING BRACKET KIT
	1	3B5V90	DRIVER SHEAVE
	1	B 2 1/8"	BUSHING WITH STD KS
	1	3B5V110	DRIVEN SHEAVE
	1	B 2 1/8"	BUSHING WITH STD KS
	3	5VX1000	BELT: 34.13" CENTERS (1.75 S.F.)
*	2	1	W2T532913
		MANUFACTURER: SIEMENS OR EQUAL	VOLTAGE: 460
		MOTOR: 50 HP	PHASE: 3
		ENCLOSURE: TEFC-INVERTER DUTY, NEMA MG1 PART 31	HERTZ: 60
		PREMIUM EFFICIENT 94.5% AT FULL LOAD, SEVERE DUTY, CLASS 1, DIVISION 2, GROUP D, HAZARDOUS LOCATION	
		CT SPEED RANGE: 4:1	
		FULL LOAD SPEED: 1780 RPM	SERVICE FACTOR: 1.15 ON SINE WAVE & 1.0 ON PWM
		FRAME: 326T	
		MOUNTING: HORIZ. FOOT MOUNT	CLASS INSUL: F
		TERMINAL BOX LOCATION: F-1 (LARGE CONDUIT BOX)	AMBIENT TEMP: 40° C
		DESIGN: B	
		DUTY CYCLE: CONTINUOUS DUTY	
		NAMEPLATE: STAINLESS STEEL & STAMPED TO INCLUDE : HORSEPOWER (NOT INCLUDING 15% S.F.), SPEED, TIME RATING, FREQUENCY, PHASES, MODEL NUMBER, RATED VOLTAGE, SERVICE FACTOR, FULL LOAD AMPS (BASED ON NAMEPLATE HP), INSULATION CLASS, NEMA DESIGN, NEMA CODE LETTER, MAXIMUM AMBIENT & BEARING IDENTIFICATION.	
		THERMAL PROTECTION: (2) CLASS F THERMOSTATS WITH NC CONTACTS	
		TESTS: SUPPLY ROUTINE LINE TEST PER NEMA MG1-12.54 & IEEE-112, METHOD B.	

* MOTOR AND REDUCER TO BE FACTORY ASSEMBLED BY BROWNING

VENDOR TO FURNISH :

1-CERTIFIED DIMENSION SHEETS
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VENDOR NOTE :

REDUCER WILL DRIVE EQUIPMENT AT VARIED SPEEDS (43 TO 60 RPM) USING VFD CONTROLS DEPENDING ON FIELD REQUIREMENTS.

AT 43 RPM THE REQUIRED BRAKE HP IS 22.47 HP W/ 54 DISCS @ 18" IMMERSION
AT 60 RPM THE REQUIRED BRAKE HP IS 46.02 HP W/ 54 DISCS @ 18" IMMERSION

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SPECIFICATION SECTION 46 53 61 & 26 05 10

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
1	ADD L/M ITEM NUMBERS	01-30-12	KWP	KWP	GCM	
0	RELEASE FOR FABRICATION	09-09-11	KWP	KWP	GCM	

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DESIGNER	KWP	DATE 08-19-11
CHECKER	KWP	DATE 08-19-11
ENGINEER		DATE
MANAGER	GCM	DATE 08-19-11
MADE FROM :		
SCALE:	1 1/2"=1'-0"	

TITLE: GENERAL ARRANGEMENT - CLOCKWISE 50 HP SHAFT MOUNT DRIVE ASSEMBLY ORBAL-DISC AERATOR
CUST.: RICE LAKE CONSTRUCTION GROUP
LOC.: PRINCETON, MN
ENG.: SEH

SIEMENS *Water Technologies* *WAUKESHA, WI* *262-547-0141*

PROJECT	CODE	DRAWING	SHEET	REV
1190/044544	6471 A	44544-108	1 OF 1	1

STD: 1-0200-24X36D1 | INTL REF: X:\ACAD Drawings\Contracts\43xxx\43921\01 orbal\43921-104 | 02/2/2012 - 7:51 AM | BAR = 1" AT PLOT SCALE

B.2 PROPOSALS FOR JET AERATION EQUIPMENT BY FLUIDYNE CORP.

McEnany, Terry

From: Nathan Brown <Nathan.R.Brown@mwhglobal.com>
Sent: Wednesday, January 25, 2017 10:25 AM
To: McEnany, Terry
Subject: FW: Supplemental Jet Aeration - Telluride Oxidation Ditch
Attachments: Telluride, CO - 1 - Plan View.pdf; Telluride, CO - 2 - Elevation View.pdf

Jet aeration is twice as much capital as replacing surface aerators. I have another vendor for jets looking at it, but Evoqua is typically more $$ than Fluidyne. Surface aerators looks like the way to go.

HOWEVER, I have Blue In Green looking at this. They do gas to liquid x-fer systems and can lease or sell units that take liquid O2 to add to O2 w/out any loss of oxygen.

I don't think its worth costing up jet aeration (assuming Evoqua isn't at a game changing difference).

From: Steve Hansen [mailto:shansen@ambienteh2o.com]
Sent: Wednesday, January 25, 2017 9:24 AM
To: Nathan Brown <Nathan.R.Brown@mwhglobal.com>
Cc: Erick Mandt <erickm@fluidynecorp.com>
Subject: Supplemental Jet Aeration - Telluride Oxidation Ditch

Nathan,

Quick and dirty as you requested. Please see below,

Steve

Steven G. Hansen, PE
AMBIENTE H2O INC. Wastewater & Water Treatment Specialists
Colorado/Corporate Headquarters
1500 W. Hampden Ave., Ste. 5-D
Sheridan, CO 80110
303-433-0364 phn 303-380-0664 fax 303-638-1608 cell
shansen@ambienteh2o.com
Visit us on Facebook

From: Erick Mandt [mailto:erickm@fluidynecorp.com]
Sent: Wednesday, January 25, 2017 8:41 AM
To: shansen@ambienteh2o.com
Subject: RE: Supplemental Jet Aeration - Telluride Oxidation Ditch

Steve,

Please see the attached preliminary layout drawings for one ditch. The other two ditches would be similar.

Fluidyne proposes the following:

Six (6) Fluidyne model# DM3JAS8 Jet Aspirating Headers fabricated out of 304 stainless steel including all in basin air and liquid piping, jet aspirating nozzle assemblies and supports.
Six (6) 47 HP Submersible Jet Mixing Pumps (pumps operating at approximately 38 BHP) with discharge fitting guide rail, guide rail brackets, power cord and lifting cable.
One (1) Shelf Spare Mixing pump

Budgeted pricing for the equipment is $425,000 including freight and service. The price does not include mechanical or electrical installation, controls, VFDs, motor starters, field wiring, conduit, junction box, disconnect, pump retrieval mechanism, anchor bolts or taxes.

I also looked at a jet aeration system requiring compressed air. This would allow the use of one jet aerating and mixing pump but would require external blowers. This would require the following:

Three (3) Fluidyne model# DM2JA16 Jet Aeration Headers fabricated out of 304 stainless steel including all in basin air and liquid piping, jet aspirating nozzle assemblies, backflush and supports
Three (3) 25 HP Submersible Jet Mixing Pumps with discharge fitting guide rail, guide rail brackets, power cord and lifting cable.
One (1) Shelf Spare Mixing pump
Four (4) 30 HP Positive Displacement Blower Packages with full sound enclosure (one unit to be a 100% spare).

Budget pricing for the equipment is $400,000 including freight and service. The price does not include mechanical or electrical installation, out of basin or interconnecting air piping or accessories; controls, VFDs, motor starters, field wiring, conduit, junction box, disconnect, pump retrieval mechanism, anchor bolts or taxes.

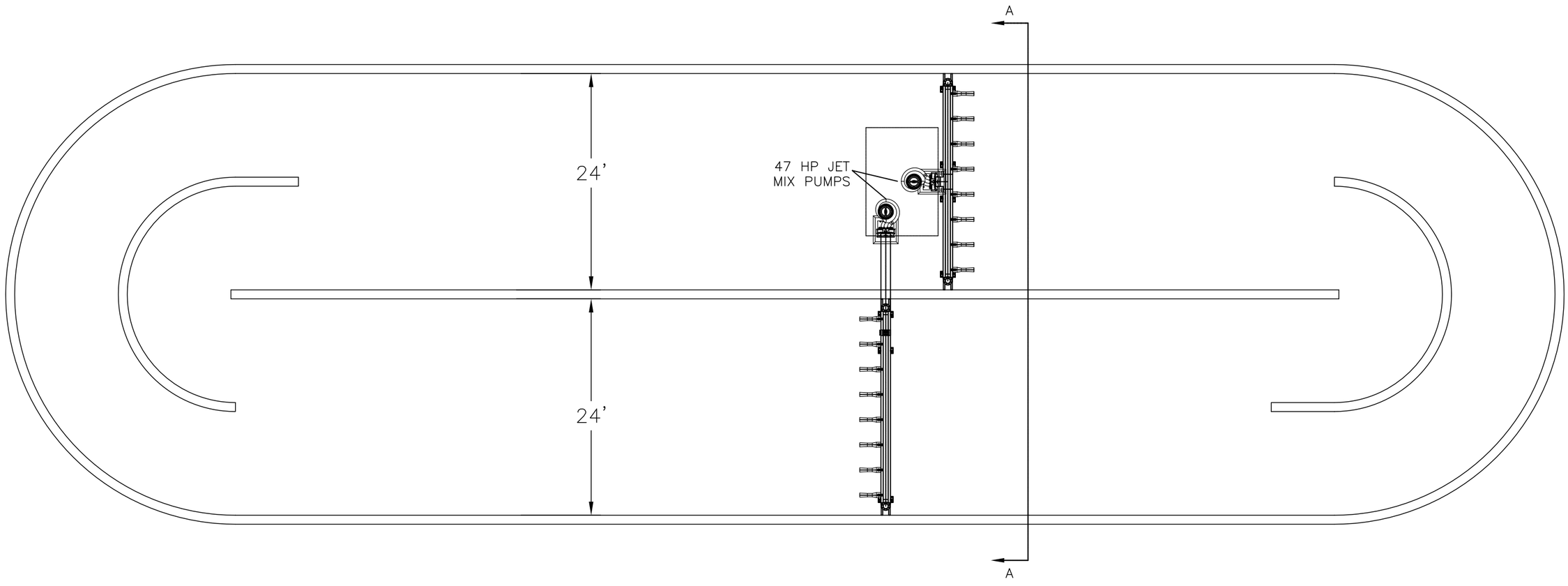
Let me know if you have any questions.

Thanks,

Erick Mandt
319-266-9967


This email has been checked for viruses by Avast antivirus software.
www.avast.com

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED



NOTES:

1. THOROUGHLY REVIEW INSTALLATION INSTRUCTIONS PRIOR TO BEGINNING FIELD WORK. IF YOU HAVE ANY QUESTIONS PLEASE CONSULT FACTORY.
2. ALL NOZZLES TO BE LEVELED AND AT THE SAME ELEVATION ± 1/4".
3. (FJ) MAY REQUIRE CUT–TO–FIT OR ADDITIONAL PIPE FOR FIELD ADJUSTABILITY.
4. SEE INSTALLATION INSTRUCTIONS FOR PROPER PREPARATION TO ENSURE PROPER FITTING OF ALL COMPONENTS BEFORE FIELD WELDING AND FIELD LAMINATING.
5. CORDINATION AND INTERFACING OR SUPPORTS TO TANK WALL IS BY OTHERS
6. ALL SPOOL PIECES, WALL PENETRATIONS, EMBEDDED ITEMS, OUT OF BASIN PIPING, GUIDE RAILS, FREEZE PROTECTION, INTERCONNECTING HARDWARE AND GASKETS BY OTHERS
7. ALL DIMENSIONS ARE NOMINAL ±

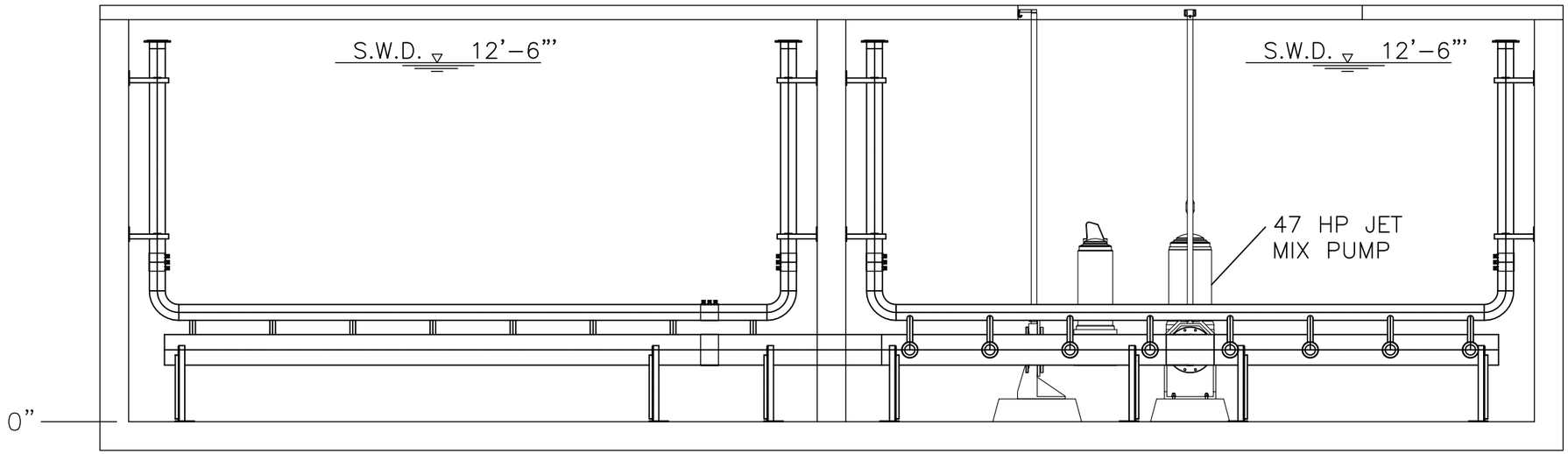
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FLUIDYNE

TELLURIDE, CO – 1 – PLAN VIEW

DRAWN	DATE	JOB #	CAD FILE
NWS	1/24/17		Telluride, CO – 1 – Plan View
CHECKED	DATE	SCALE	SHEET 1 OF 2

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED



SECTION A–A

NOTES:

1. THOROUGHLY REVIEW INSTALLATION INSTRUCTIONS PRIOR TO BEGINNING FIELD WORK. IF YOU HAVE ANY QUESTIONS PLEASE CONSULT FACTORY.
2. ALL NOZZLES TO BE LEVELED AND AT THE SAME ELEVATION ± 1/4".
3. ⟨FJ⟩ MAY REQUIRE CUT–TO–FIT OR ADDITIONAL PIPE FOR FIELD ADJUSTABILITY.
4. SEE INSTALLATION INSTRUCTIONS FOR PROPER PREPARATION TO ENSURE PROPER FITTING OF ALL COMPONENTS BEFORE FIELD WELDING AND FIELD LAMINATING.
5. CORDINATION AND INTERFACING OR SUPPORTS TO TANK WALL IS BY OTHERS
6. ALL SPOOL PIECES, WALL PENETRATIONS, EMBEDDED ITEMS, OUT OF BASIN PIPING, GUIDE RAILS, FREEZE PROTECTION, INTERCONNECTING HARDWARE AND GASKETS BY OTHERS
7. ALL DIMENSIONS ARE NOMINAL ±

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FLUIDYNE

TELLURIDE, CO – 2 – ELEVATION VIEW

DRAWN	DATE	JOB #	CAD FILE
NWS	1/24/17		Telluride, CO – 2 – Elevation View
CHECKED	DATE	SCALE	SHEET 2 OF 2

B.3 PROPOSALS FOR JET AERATION EQUIPMENT BY AERATION INDUSTRIES

PRELIMINARY PROCESS DESIGN REPORT

OXIDATION DITCH RETROFIT

Project Name: Telluride, CO Oxidation Ditch Supplemental Aeration

Design #17-4-7294

Option: AIRE-O_2® Triton

4/5/2017

Designed by: Alan Rice, EIT, Aeration Industries International, LLC.

The enclosed information is based on preliminary data provided by the owner/engineer. This data has been reviewed and has been utilized as the basis of the following design recommendations. There may be unknown factors which would alter the design recommendation. Aeration Industries International assumes no responsibility for the validity or any risks associated with the use of modeling software or industry standard assumptions. Aeration Industries International assumes no responsibility for or liability resulting from the use of the recommendations provided as part of the subject design.

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Aeration Industries International
AIRE-O_2

1. Design Considerations

1.1 Pre-Biological Unit Process

Neutralization is recommended / required ahead of the biological unit process if the pH is expected to fall outside of 6.5 – 8.5 for significant durations.

1/4" fine screen solids removal / reduction is recommended prior to the biological unit process (by others).

1.2 Biological Unit Process Aeration

The aeration system has been designed to support a maximum AOR of 3,169 lbs O_2/day at an elevation of 8,800ft above mean sea level and a maximum water temperature of 20^{o}C.

No denitrification credits have been assumed. No assimilation credits have been assumed.

The aeration system has not been designed to meet a specific mixing requirement. Basin dimensions have not been provided to Aeration Industries.

1.3 Process Conditions

Sufficient alkalinity is required for nitrification at approximately 7.1 mg alkalinity (as $CaCO_3$) for each mg of NH_3-N nitrified. If the raw water alkalinity cannot support this consumption while maintaining a residual concentration of 50 mg/l supplemental alkalinity shall be provided (by others).

To achieve nitrification a minimum water temperature of 10^{o}C is required. Although nitrification may occur at lower temperatures, reaction rates may be slower and ammonia removal will be unreliable.

The effluent quality is predicated upon the ability of the sludge to settle to reasonable levels to prevent the discharge of TSS. An SVI of 150 is assumed.

Maximum fats, oils and grease to the biological unit process is 100 mg/L. Depending upon the nature of the FOG, reduction in activated sludge treatment is unpredictable. If FOG effluent requirements exist, FOG should be reduced to the effluent limit required prior to the biological unit process. High FOG levels may also cause poor settling and excessive foaming resulting in effluent quality degradation.

1.4 Site Conditions

The biological unit process tanks are to be provided by others. Basin dimensions have not been provided to Aeration Industries.

1.5 Design Summary

See attached.

Aeration Industries International
AIRE-O_2

2. Oxidation Ditch Equipment Summary

2.1 Aerator/Mixers

Six (6) TR25 (29HP) Aire-O_2 Triton® Aerators, consisting of:

- 25 HP, TEFC, 230/460 volt, 3 phase, 60 Hz, 900 RPM motor with thermal overload and heater
- 4 HP regenerative blower with heater
- Field replaceable, water lubricated lower bearing
- Field replaceable, wear-resistant sleeve
- 316 SS, dual-bladed primary PowerMix™ propeller
- 304 SS Saturn Ring diffuser
- 304 SS housing, mounting flange, & hollow shaft

Six (6) Universal Bridge Mounts, consisting of:

- Stainless steel rails and mounting hardware
- Vortex shield attached to aerator housing
- Handwinch retrieval assembly

Note: Bridge mounts devices require minimal field assembly

2.2 Controls and Cable

Three (3) Aerator Starter Panels

- NEMA rated enclosure
- Main fuse disconnect
- 480/240-120VAC control transformer
- 480/120VAC IEC starters
- Circuit protection
- Alarm and run lights
- H-O-A selectors
- Thermal overload and heater protection

100’ 10/4 SEOOW Electrical Cable
100’ 12/4 SEOOW Electrical Cable

Note: Type and length of cable required are dependent on oxidation ditch dimensions and subject to change.

2.3 Other

Installation checkout and startup services (one trip, one day)
Freight FOB Jobsite

Three (3) Year Warranty (see terms and conditions)

PRICE: $349,000

Aeration Industries International
AIRE-O2

EXCLUSIONS:	Installation, duties and taxes are not included. DO controls and instrumentation, cord grips, and all items not specifically listed above are excluded.
NOTE:	If required, submittals will be done four to six weeks from receipt of purchase order. Delivery is ten to twelve week from submittal approval. Quotation valid for 30 days. Three year non prorated warranty
TERMS:	General Terms and Conditions Attached (2 pages).

Aeration Industries International

Tri-Oval Oxidation Ditch System

Supplemental Aeration		Date:	4/5/2017
17-4-7294		Prepared By:	APR
Municipal		Revision:	-

Section 1: Aerobic Aeration/Mixing System Design

AOR Calculation

	OXYGEN REQUIRED kg O_2/day	OXYGEN REQUIRED lb O_2/day
Total AOR	1,437	3,169

SOR Calculation

$$SOR = \frac{(AOR) * (C_{s20})}{(\alpha)*\{\beta * C_s - C_w\} * (1.024)^{T-20}}$$

Where:

α	= 0.80	Cs =	6.11
β	= 0.95	Cw =	2.0
τ	= 0.99	Cs20 =	9.092
Ω	= 0.68	Temp =	20

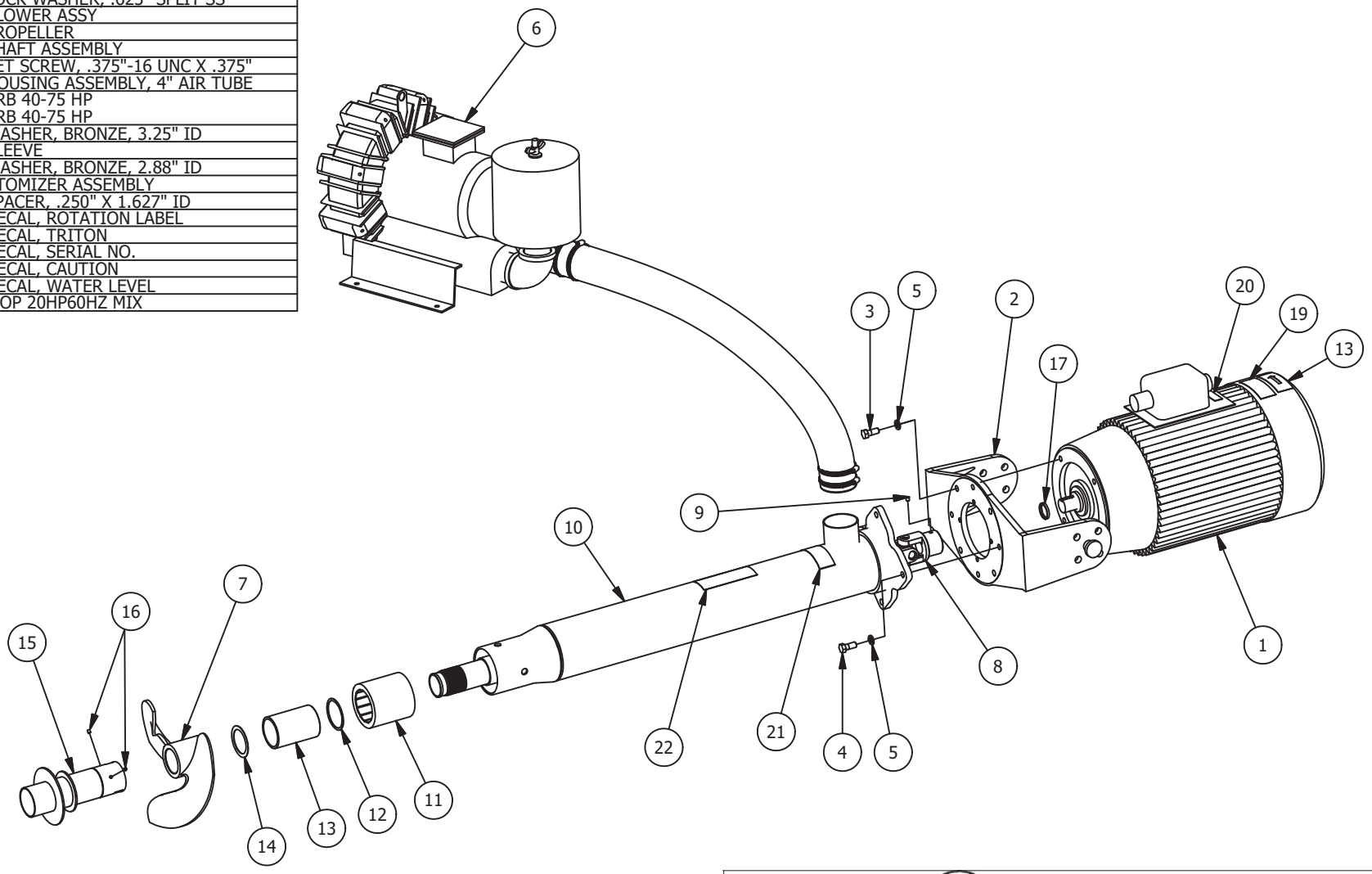
Therefore:

SOR =	9,472	lb O_2/day	394.7	lb O_2/hr
	4,306	kg O_2/day	179	kg O_2/hr
Total HP required:	172.1	HP	128.35	kW
No. of Tritons:	6			
HP per Triton:	29.0	HP	21.63	kW
Total Aeration HP:	174	HP		

Aeration Industries recommends installing six (6) TR25 (29HP) Triton Aerators to meet the design oxygen demand. Mixing requirements have not been considered.

PARTS LIST			
ITE	QTY	PART NUMB	DESCRIPTION
1	1	1	MOTOR, 50/60 HZ NEMA
2	1	2	MOUNTING FLANGE
3	2	2	HEX HEAD BOLT # 1
4	2	2	HEX HEAD BOLT # 2
5	8	215-151	LOCK WASHER, .625" SPLIT SS
6	1	1	BLOWER ASSY
7	1	1	PROPELLER
8	1	1	SHAFT ASSEMBLY
9	2	215-127	SET SCREW, .375"-16 UNC X .375"
10	1	330-107	HOUSING ASSEMBLY, 4" AIR TUBE
11	1	213-054 213-027	ARB 40-75 HP CRB 40-75 HP
12	1	215-628	WASHER, BRONZE, 3.25" ID
13	1	247-033	SLEEVE
14	1	215-559	WASHER, BRONZE, 2.88" ID
15	1	223-074	ATOMIZER ASSEMBLY
17	1	215-777	SPACER, .250" X 1.627" ID
18	1	224-152	DECAL, ROTATION LABEL
19	1	224-114	DECAL, TRITON
20	1	224-013	DECAL, SERIAL NO.
21	1	224-021	DECAL, CAUTION
22	1	224-154	DECAL, WATER LEVEL
23	1	234458S	PROP 20HP60HZ MIX

REVISION HISTORY				
REV	ECO NO	DESCRIPTION	BY	DATE
-	14-2657	RELEASED FOR PRODUCTION	R.P.H.	10/17/14
A	14-2658	MODIFIED NOTE 2, MOTOR HP	R.P.H.	11/13/14
B	15-2667	ADDED SHEET 2, MODIFICATIONS TO SELECTION TABLE	R.P.H.	01-16-15



1. CONSULT AIII WHEN ORDERING REPLACEMENT MOTORS, PROPELLERS, OR BLOWERS

2. SEE PART SELECTION TABLE ON SHEET 2 OF THIS DRAWING FOR SPECIFIC PART NUMBERS THAT VARY WITH MOTOR SIZE

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EXCEPT AS NOTED
REMOVE BURRS & SHARP EDGES
FINISH 125
TOLERANCES:
FRACTIONS ± 1/32
ANGLE ± 1°
DECIMAL
ONE PLACE ± 0.06
2 PLACE ± 0.03
3 PLACE ± 0.015

DRAWN	DATE
Ray.Hedelson	10/17/2014
CHECKED	DATE
Jing.Huang	10/17/2014

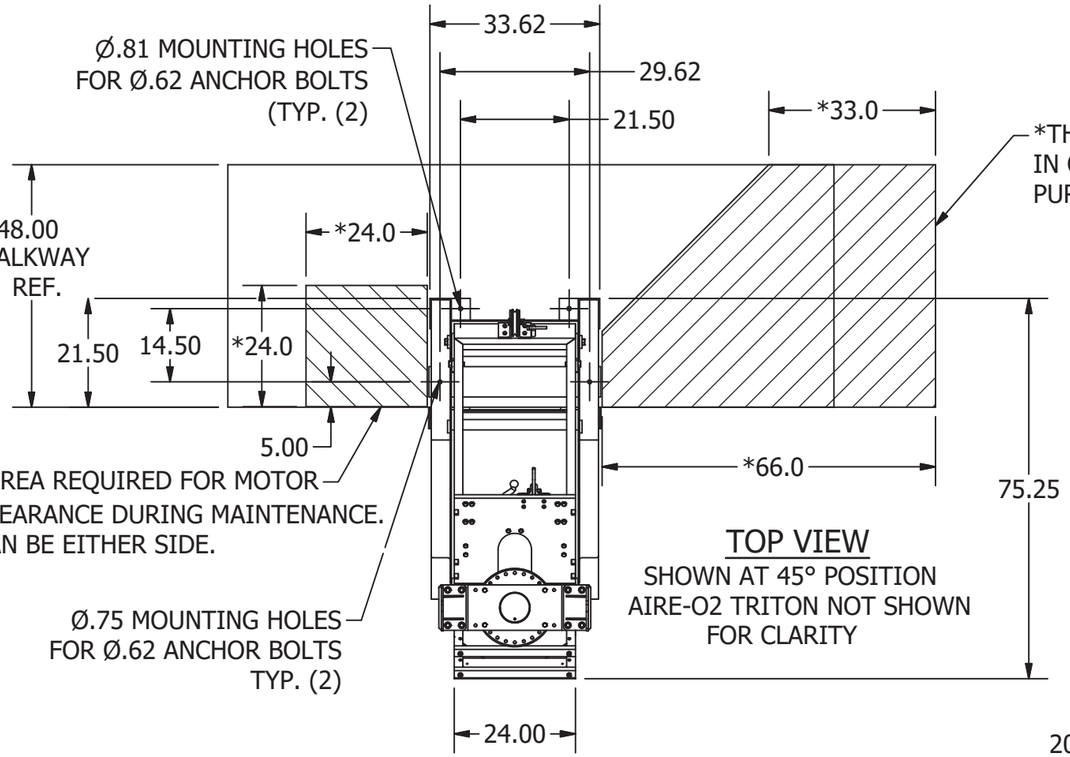
Aeration Industries International, LLC.
4100 Peavey Rd, Chaska MN 55318 USA. www.aireo2.com
Phone: +1-952-448-6789. Fax: +1-952-448-7293. aii@aireo2.com

TITLE
TRITON ASSEMBLY 20-60 HP 50/60HZ
NEMA LARGE HOUSING

DRAWING NO.	REV.
360-584	B

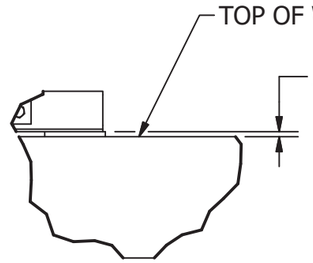
SCALE	SIZE	SHEET
-	A4	1 OF 2

REVISION HISTORY				
REV	ECO NO.	DESCRIPTION	BY	DATE
-	15-2675	RELEASED FOR PRODUCTION	JFW	04-09-15

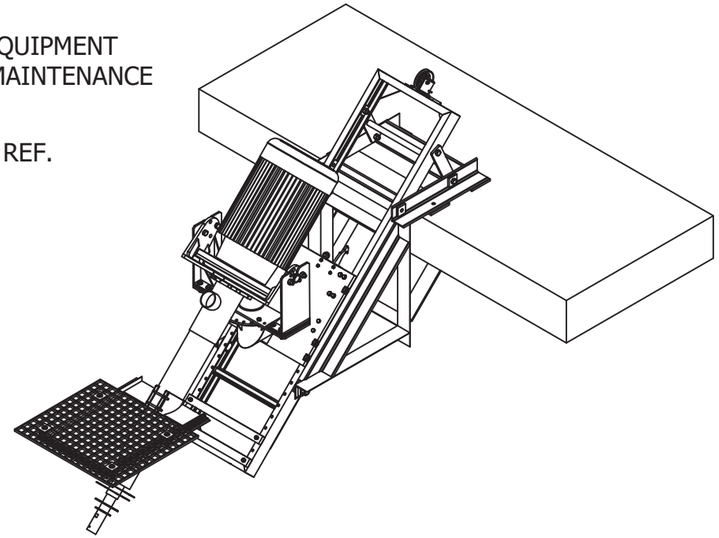


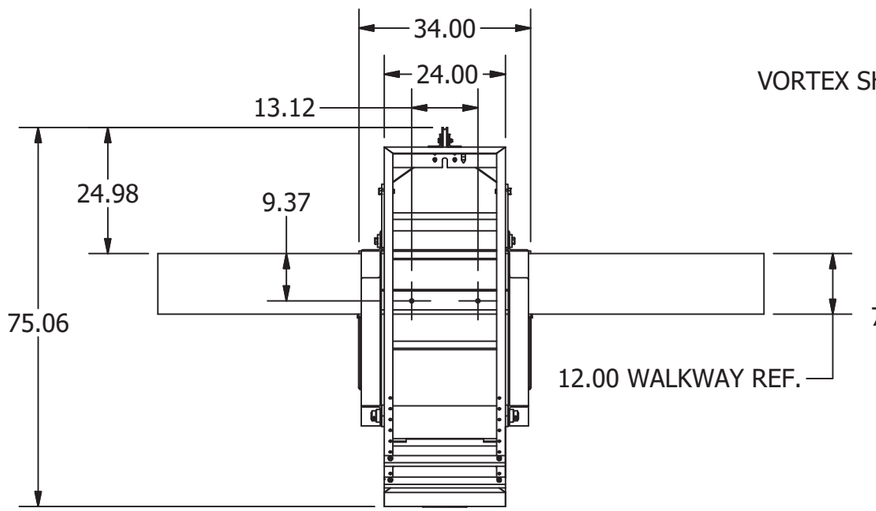
TOP VIEW
SHOWN AT 45° POSITION
AIRE-O2 TRITON NOT SHOWN FOR CLARITY

*THIS AREA TO REMAIN FREE OF OBSTRUCTIONS AND EQUIPMENT IN ORDER TO ALLOW 45° ROTATION OF AERATOR FOR MAINTENANCE PURPOSES. CAN APPLY TO EITHER SIDE OF AERATOR.

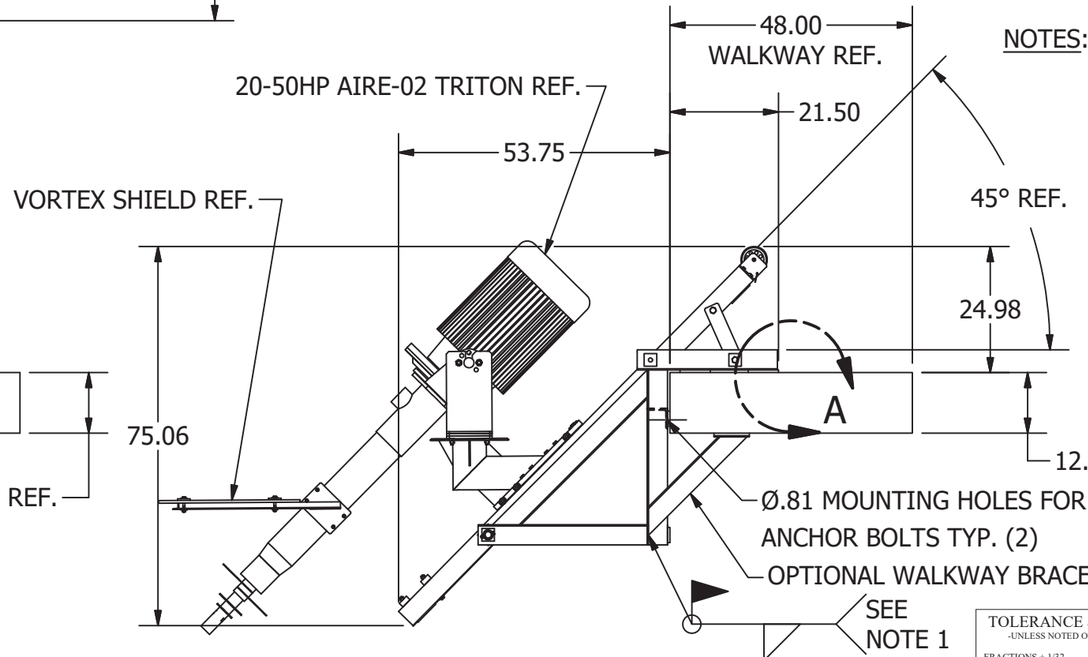


DETAIL A





FRONT VIEW
SHOWN AT 45° POSITION
AIRE-O2 TRITON, ROTATION PLATE WELDMENT & MOUNTING FLANGE SUPPORT ASSY NOT SHOWN FOR CLARITY



SIDE VIEW

NOTES:
1. IN APPLICATIONS WHERE THE WALKWAY BRACE WELDMENT IS USED, ONE END MUST BE FLUSH AGAINST THE BOTTOM OF THE WALKWAY BEFORE THE OPPOSITE END IS WELDED TO THE SLIDE FRAME SUPPORT ASSEMBLY AS SHOWN.

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DIMENSIONS AND TOLERANCES SHALL BE INTERPRETED IN ACCORDANCE WITH ANSI Y14.5-2009 STANDARDS

DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED

BREAK ALL SHARP EDGES AND REMOVE BURRS

TOLERANCE & FINISH
-UNLESS NOTED OTHERWISE-
FRACTIONS ± 1/32
ANGLE ± 1°
FINISH 125
WELDMENTS
ONE PLACE ± 0.06 | 2 PLACE ± 0.03 | 3 PLACE ± 0.015
MACHINED PARTS
ONE PLACE ± 0.03 | 2 PLACE ± 0.01 | 3 PLACE ± 0.005

DRAWN	DATE
Joe.Widman	4/9/2015
REVISED	DATE

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Phone: +1-952-448-6789. Fax: +1-952-448-7293. aii@aireo2.com

TITLE
OUTLINE DIMENSIONS 20-50HP UBM ASSEMBLY

DRAWING NO.	REV.
360-606	-

SCALE	SIZE	SHEET
-	B 11" X 17"	1 OF 5

Aeration Industries International
AIRE-O_2

Aire-O_2 Triton® TR Series



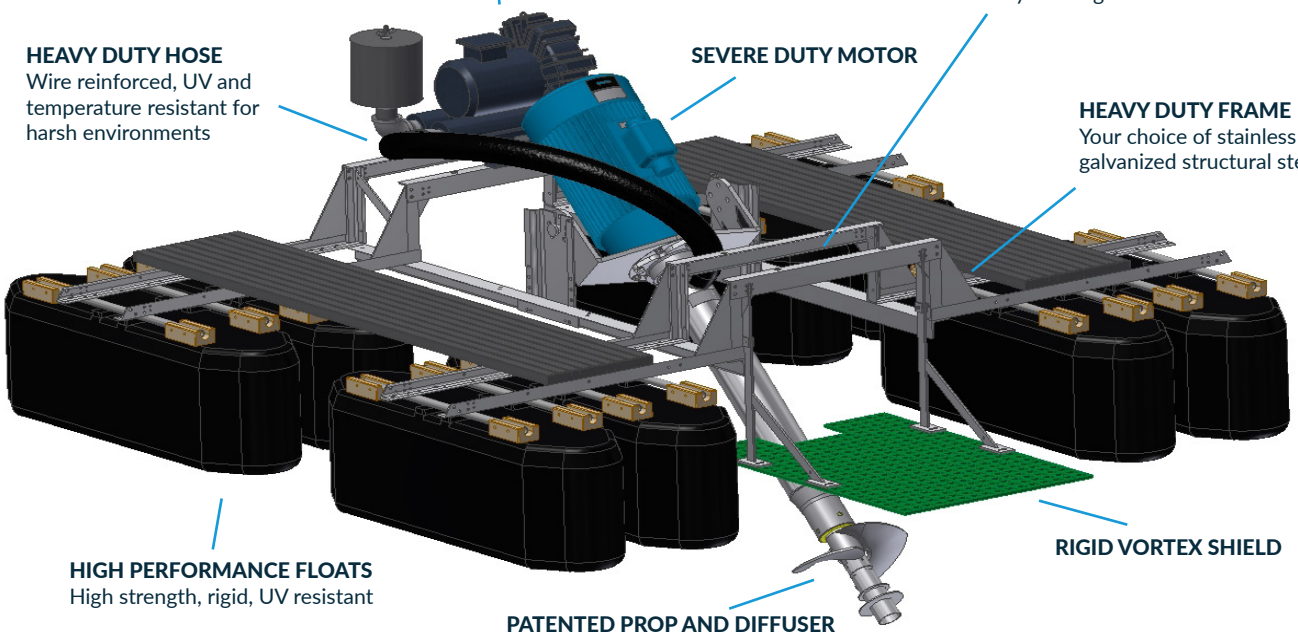
The effective, reliable solution to deliver more oxygen

Unique features allow the Aireo-O_2 Triton® TR Series to perform in harsh conditions, while optimizing performance, efficiency, and maximizing oxygen transfer and mixing capabilities.

WHY CHOOSE THE TRITON?

- Delivers more oxygen capacity per unit with upgraded propeller
- Trusted performance
- Maintain without removing or draining the basin
- Performs in challenging, heavy debris conditions
- Fine bubble aeration with a mixing only option for BNR applications
- Operates for years with minimal maintenance
- Surface mounted, horizontal mixing provides better dispersion and directional control with no splashing or aerosoling
- More than 72,000 units delivered in the US and over 93 countries since 1974

The trusted way to deliver oxygen



Universal Mounts available to fit wall or bridge geometries.

FEATURING

Rentals available!*

**Check for availability*

- High efficiency TEFC, 8-pole severe duty motor (900 RPM 60HZ/ 750 RPM 50 HZ)
- Tropicalized/anodized blower to prevent corrosion
- Stainless steel dual-bladed Power Mix propeller
- Field replaceable, water lubricated lower bearing with wear resistant sleeve
- Hoses and fittings with UV protection built-in for harsh environments
- Option of galvanized or stainless steel float mounts, blower pedestal, and bridge or wall mount
- Stainless steel Saturn Ring diffuser
- Available in 5-60hp (4-52.5kW/50Hz) sizes with worldwide voltage and frequency combinations
- Variable mounting angle offers flexibility

Aeration Industries® International | +1-952-448-6789 | 4100 Peavey Road Chaska, MN 55318, USA | aii@aireo2.com
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AERATION INDUSTRIES INTERNATIONAL, LLC

General Terms and Conditions

1. **Price.** Published prices are subject to change without notice and shall not be binding on Seller until reduced to writing signed by Seller. All prices are F.O.B. Chaska, MN, and do not include transportation cost or charges relating to transportation, which costs and charges shall be solely the responsibility of Purchaser. Prices quoted include standard packing according to Seller's specifications. Special packing requested by Purchaser, including packing for exports, shall be paid by the Purchaser as an additional charge.

2. **Taxes.** To the extent legally permissible, all present and future taxes, imposed by any Federal, State, Local or foreign authority, which Seller may be required to pay or collect upon or with reference to the sale, purchase, transportation, delivery, storage, use or consumption of goods or services, including taxes upon, or measured by the receipts therefrom, shall be paid by Purchaser. Amounts covered hereby shall be added to the price, or billed as a separate item as the law may require or as the Seller may determine. No offset against or reduction in price shall be allowed Purchaser by reason of taxes owed, paid or payable by Purchaser, or charged by Purchaser's account.

3. **Credit and Payment.** Credit accounts will be opened only with firms or individuals approved by Seller's Credit Department. Unless otherwise provided, in any case where delivery is made on credit, Purchaser shall have thirty (30) days from date of the invoice in which to make payment for the goods. Seller reserves the right at any time upon notice to Purchaser, to alter or suspend credit, or to change the credit terms provided herein, when in its sole opinion the financial condition of the Purchaser so warrants. In addition, the Seller may at any time, with or without notice to Purchaser, and at its option, suspend work and shipment under this contract if, in the Seller's sole opinion, the financial condition of the Purchaser so warrants. In such cases, in addition to any other remedies herein, or by law provided, cash payment or satisfactory security from the Purchaser may be required by the Seller before credit is restored or Seller continues performance. If the Purchaser fails to make payment or fails to furnish security satisfactory to Seller, then Seller shall also have the right to enforce payment of the full contract price of the work completed and in process. Upon default by Purchaser in payment when due, Purchaser shall pay immediately to Seller the entire unpaid amounts for any and all shipments made to purchaser irrespective of the terms of said shipment and whether said shipments are made pursuant to this contract or any other contract of sale between Seller and Purchased, and Seller may withhold all subsequent shipments until the full account is settled. Acceptance by the Seller of less than full payment shall not be a waiver of any or its rights hereunder. The seller reserves the right, at its discretion, to charge up to 1½% per month for amounts not paid within stated terms.

4. **Cancellation.** Cancellation of orders once placed with and accepted by us can only be made by us. Should the Purchaser, due to change in design or other good and sufficient cause, desire to effect cancellation of the order, same will be accepted on the following basis:

Purchaser shall pay in full the costs of all material, dies, tools, patterns and fixtures provided for this order, that are on hand or for which we are obligated, together with all labor and other expense incurred in connection therewith. Invoices covering said costs shall be due and payable immediately upon our acceptance of cancellation.

5. **Patents.** To the best of our knowledge, the articles purchased hereunder do not infringe any Letters Patent granted to others by the United States of America or by any country foreign thereto. We do not assume any responsibility or liability for any claim of infringement brought against the Purchaser, its successors, assigns, customers or udders of its product. The Purchaser agrees to hold us harmless against any claim of infringement which arises out of compliance by us with specifications furnished by Purchaser.

6. **Risk of Loss, Title.** The risk of loss of the goods shall pass to the Purchaser as soon as they are deposited with the carrier for shipment to the Purchaser, but title to the goods shall remain in the seller until the purchase price therefore has been paid.

7. **Shipment.** All shipments shall be F.O.B. Chaska, MN, and the date of shipment shall be contingent upon the date of acceptance of Seller's offer. Seller's obligation with respect to shipments of the goods shall not extend beyond a) putting the goods in the possession of such a carrier and making such a contract for the transportation thereof as may be reasonable having regard to the nature of the good; b) obtaining and delivering within a reasonable time such documents as may be necessary for Purchaser to obtain possession of goods; and c) notifying the Purchaser of the shipment within a reasonable time. Seller shall have the right to ship all of the goods at one time or in portions from time to time within the time of shipment. This contract shall be deemed separable as to the goods sold. Purchaser may not refuse to accept any lot or portion of the goods shipped hereunder on the grounds that there has been a failure to ship any other lot or that goods in any other lot were nonconforming. Any such default by Seller will not substantially impair the value of this contract as a whole and will not constitute a breach of the contract as a whole. The goods shall be deemed to have been tendered to Purchaser when they have been deposited with the carrier.

8. **Inspection and Acceptance.** Purchaser shall have the right to inspect the goods upon receipt of them and shall have the opportunity, at that time, to run adequate tests to determine whether the goods shipped conform to the specification of this contract.

Purchaser shall recompense Seller, at the contract price, for all goods used in testing and Purchaser shall bear any expense incurred in the inspection of the goods used in testing, whether or not the goods are non-conforming. Failure to inspect the goods or failure to notify the Seller in writing that the goods are nonconforming with ten (10) days of the receipt of the goods by Purchaser, shall constitute a waiver of Purchaser's rights of inspection and rejection for nonconformity and shall be equivalent to an irrevocable acceptance of the goods by Purchaser. Acceptance – Unless we receive notification to the contrary promptly from you, we will consider the foregoing conditions as been acceptable to you.

9. **Excuse in Seller's Performance.** This contract is subject to an the Seller shall not be responsible or liable for any delay directly or indirectly resulting from or contributed limitations on Seller's production, capabilities, prompt settlement of all details relating to the materials covered by this proposal, and to delays due to fires, explosions, acts of God, strikes or other differences with workmen, shortage of utility, facility, components or labor, delay in transportation, breakdown or accident, war and acts of war, compliance with or other action taken to carry out the intent of purposes of any law or regulation, changes, or revisions, accidents or any other causes or contingencies not caused by Seller or other which Seller had no reasonable control. In the event that any one or more deliveries hereunder is suspended or delayed by reason of any one or more of the occurrences or contingencies aforesaid, any and all deliveries so suspended or delayed shall be made after such disabilities have ceased to exist, and nothing herein contained shall be construed as lessening in any event the full amount of goods herein purchased and sold, but only as deferring delivery and payment in the events and to the extent herein provided for. Neither shall any delay in shipment be considered as a default under this contract or give rise to any liability on the part of Seller for items of incidental, special consequential damage unless such delay was directly and proximately caused by the willful and wanton act of gross negligence of Seller. Acceptance of material on delivery shall constitute a waiver of any claims against seller for damages on accounts of delay.

10. **Warranty.** Seller warrants that it will, at its option, repair or replace the goods, or return the purchase price thereof, which are found to be defective in material or workmanship or not in conformity with the contract requirements provided that, within three (3) year of shipment thereof, Purchaser gives written notice of such defect to Seller, the Purchaser returns the goods to Seller at point of original manufacture, with transportation charges prepaid by Purchaser, and an examination by Seller discloses to its satisfaction the existence of such defect or nonconformity with the contract requirements. In no event shall Seller be liable for any incidentals, special or consequential damages resulting from said effects or nonconformity. This warranty specifically excludes all labor charges that could be incurred.

THE FOREGOING DOES NOT APPLY TO COMPONENTS WHERE WERE NOT MANUFACTURED BY SELLER, AND IS EXPRESSLY IN LIEU OF OTHER WARRANTIES EXPRESSED OR IMPLIED, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE OR USE. THERE ARE NO WARRANTIES WHICH EXTEND BEYOND THE FOREGOING, NO AGENT, EMPLOYEE OR REPRESENTATIVE OF THE SELLER HAS ANY AUTHORITY TO BIND THE SELLER TO ANY AFFIRMATION, REPRESENTATION OR WARRANTY CONCERNING THE GOODS SOLD UNDER THIS SALES CONTRACT, AND UNLESS AN AFFIRMATION, REPRESENTATION OR WARRANTY MADE BY AN AGENT EMPLOYEE OR REPRESENTATIVE IS SPECIFICALLY INCLUDED WITHIN THIS WRITTEN AGREEMENT, IT SHALL NOT BE ENFORCEABLE TY THE PURCHASER.

11. **Remedies of Purchaser.** If goods are tendered which do not conform with the specifications under the sales contract and these goods are rejected by Purchaser, Seller shall have the right to cure the tender by either correcting the goods or substituting conforming goods. In the event that such substituted goods fail to conform to the contract or in the event of any other breach or repudiation of this contract by Seller, Purchaser shall not be entitled to recover any incidental or consequential damages as those terms are defined in Section 2-715 of the Minnesota Uniform Commercial Code and Purchaser's right to damages shall be limited to the difference between the contract and the market price of the goods as provided in Section 2-713 of the Minnesota Uniform Commercial Code. Purchaser shall not have the right to "cover" as provided in Section 2-712 of the Minnesota Uniform commercial code nor any rights to recover damages for any loss resulting in the ordinary course of events from nonconformity of tender as contained in Section 2-714(1) of the Minnesota Uniform Commercial Code.

12. **Assignments.** No right to interest in this contract shall be assigned by Purchaser, without the written permission of Seller, and no delegation of any obligation owned by Purchaser shall be made without permission of the Seller. Any attempted assignment of delegation shall be wholly void and totally ineffective for all purposed.

13. **Alterations, Interpretations and Definitions.** This contract shall be governed by the laws of Minnesota and is intended also as a complete and exclusive statement of the terms of their agreement. No course of prior dealings between the parties, and no usage of the trade shall be relevant to supplement or explain any term used in this contract. Acceptance or acquiescence to a course of performance rendered under this contract shall not be relevant to determine the meaning of this contract, even though the accepting or acquiescing party has knowledge of the nature of the performance and an opportunity for objection. Waiver by Seller of a breach by Purchaser of any provision of this contract shall not be deemed a waiver of future compliance therewith, and such provision shall remain in full force and effect. Any term used in this contract which is not defined herein shall have the same definition as that contained in the Minnesota Uniform Commercial Code.

B.4 PROPOSAL FOR OXYGEN SATURATION EQUIPMENT BY BLUE-IN-GREEN INC.

BlueInGreen
solutions for water quality

February 1, 2017

Mr. Nathan Brown
MWH Global a Stantec Company
1560 Broadway, Suite 1800
Denver, Colorado 80202

RE: Telluride, CO Biological Supplemental Aeration System

Mr. Brown,

Thank you for the opportunity to review the Telluride, CO aeration system opportunity and for your interest in the SDOX aeration system from BlueInGreen. BlueInGreen appreciates the opportunity to present our technology for your application. The SDOX® technology is designed to take a side stream from the oxidation ditches, saturate it with oxygen, and re-inject the oxygenated water back into the process such that it is effectively distributed. By leveraging Henry's law, BlueInGreen is able to cost-effectively provide oxygen to the aeration basins without concern for mixed liquor content or water depth.

As a reminder, BlueInGreen SDOX® offers the following features and benefits:

- **Plug-and-Play:** Single point connections for inlet and outlet wastewater, as well as incoming electrical supply make design and installation fast and efficient.
- **Energy Smart:** Sophisticated controls allow generators and pumps to be turned down to save energy, while ensuring aeration control objectives are accomplished.
- **Communications Ready:** Cellular modems allow real-time monitoring from internet browsers and smart phones, and industry leading PLCs make SCADA connectivity simple.
- **Single Source Responsibility:** Fully integrated and skid mounted oxygen generation, dissolution, and injection system - including blower, separation unit, compressor, pump/motor, VFD, control panel - all provided by BlueInGreen.
- **Quality Guaranteed:** Attention to design details, industry leading components, and superior materials and workmanship ensure quality. Factory tested for functionality and performance to minimize construction and start-up time.
- **Stellar Support:** From design through long-term operation, our experienced engineers and technicians are committed to collective success and providing the tools and resources needed along the way.

The SDOX offers several additional benefits over alternate aeration methods, specifically the following:

1. BlueInGreen operates at transfer efficiencies significantly greater than alternate aeration technologies. With a typical transfer efficiency of greater than 90%, there are cases where 95%+ is achievable.
2. The SDOX is installed outside of the water body meaning that maintenance does not require area shut-down or safety risks to access the equipment especially in this covered basin application.
3. Simplified installation costs as compared to other types of in-basin technology.

BIG
700 W. Research Center Blvd.
Suite 1207
Fayetteville, AR 72701
479.527.6378 | blueingreen.com

BlueInGreen
solutions for water quality

After review of the information we have several options available outlined below. Each SDOX unit will be skid-mounted, factory tested, complete with pump, SST vessel, instrumentation and control panel, and all associated piping within skid boundaries. Please note that LOX (liquid oxygen) is not included in the options below and BlueInGreen can assist with LOX supply and coordination.

Capital Purchase:

Option A:

If Telluride would like to move forward with an equipment Capital Purchase, BlueInGreen can provide three (3) SDOX-300 units with one (1) unit dedicated per basin to meet the oxygen requirements of 3,960 ppd. This option provides the most flexibility if Telluride operates only 1 basin during the summer and three during the winter. The price of $449,900 is based on purchase or commitment to purchase within 2017 and delivery NLT July 2018. This price includes start-up assistance and estimated freight to job-site. BlueInGreen can provide submittals within 4-6 weeks of receipt of approved purchase order and delivery in 10-14 weeks of approved submittals. Taxes are not included. We can provide a formal offer for sale if this is of interest.

Option B:

This option is a single injection point in the line to the flow distribution box prior to the 3 aeration basin trains. BlueInGreen can provide one (1) SDOX-600 meeting the oxygen requirement of 3,960 ppd at a price of $327,600 based on a purchase or commitment to purchase within 2017 and delivery NLT July 2018. This price includes start-up assistance and estimated freight to job-site. BlueInGreen can provide submittals within 4-6 weeks of receipt of approved purchase order and delivery in 10-14 weeks of approved submittals. Taxes are not included. We can provide a formal offer for sale if this is of interest. Further investigation of piping layout, line tap and hydraulics is necessary to confirm this option.

Quick Response Rental

If Telluride would like to move forward more quickly, BlueInGreen has several containerized pilot units available that we can have on site within 2 weeks from receipt of signed rental contract. Typical short term quick response rental is $11,000/month with a 3 month minimum rental period. Pricing includes start up assistance and does not include LOX. Timing of rental will determine the unit size available and oxygen delivery. If this is of interest, BlueInGreen can provide a rental contract for your review and confirm sizing.

Long Term Lease-To-Own

Another option for your consideration is a long-term lease to own option based on the anticipated permit changes to a nutrient removal system coming in 5 years. With a 5-year contract commitment, BlueInGreen can reduce the monthly payment to $6,800 (single unit) or $8,500 (three units), provide an immediate quick response unit on site while we build the new unit(s) for Telluride. At the end of the 5-year period, Telluride will own the unit(s). BlueInGreen can also arrange the financing. If this is of interest, we can provide additional information.

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BlueInGreen
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Oxygen Supply

A typical range for liquid oxygen supply is from $0.03/lb O2 to $0.07/lb O2 with an average of $0.05/lb O2 depending upon area suppliers and supply coverage. Assuming oxygen supply will range from 2,286 lb/day to 3,960 lb/day the anticipated oxygen cost could range from $68.58/day to $277.20. Many LOX suppliers provide a tank with a gas supply contract.

Pure Oxygen and Activated Sludge

- BlueInGreen has performed a significant amount of work with the Membrane BioReactor (MBR) process including developing patents in conjunction with Ovivo.

- We have extensive third-party research from UNESCO with MBRs, conventional AS, and aerobic digestion. www.unesco-ihe.org

- One of our longer running installations is at Del Monte Foods in Siloam Springs, AR in an activated sludge earthen basin providing more than 6,000 lbs O2/day. Decatur and Huntsville, Arkansas are two additional activated sludge applications providing supplemental aeration. We are more than willing to provide a site tour at your convenience.

- Jefferson Parish in New Orleans purchased two (2) units to aerate a collection system line with the requirement to pass 3-inch solids through the unit. The units provide approximately 12,000 lbs/day of oxygen to the line.

Attachments

- BIG_HPOAS_Short (High Purity Oxygen Activated Sludge) - This is a basic oxygen presentation, highlighting BlueInGreen's activity in several applications with biological processes being one of them. It also includes a few key slides specifically related to HPOAS and BIG technology.

- HPOAS_FWQA - This is just one reference identifying the benefits of HPOAS. Most importantly, this is the study referenced in the presentation related to lbO2/lbBOD removed. It is a relatively long document so a great place to start is the abstract and jump to the summary.

Thank you again for this opportunity and we look forward to further discussions on how BlueInGreen can be of assistance to MWH and Telluride.

Best Regards,

Thomas Sichz, PE
National Sales Manager
Thomas.sichz@blueingreen.com
479.305.1526

BlueInGreen
solutions for water quality

ADAPTABLE AERATION

WHAT WE DO

OUR MISSION
We provide highly efficient solutions for aeration, pH adjustment, oxidation and odor control to lower treatment costs and improve water quality.

OUR METHOD
Using Henry's Law, we inject dissolved oxygen, carbon dioxide or ozone into a small sidestream, providing the most efficient delivery methods on the market.

OUR SOLUTIONS
Since 2004, we have expanded our core technology into two product lines: the Core Series, the ultimate in precision and control, and StreamLine, a more simplified solution. Each unit is custom-engineered to meet your needs.

OUR TEAM
We employ the industry's top talent. Our team of experienced designers, engineers, technicians and salespeople work together to deliver an efficient, effective solution for your water treatment needs.



AWARDS

2015 **GCCA GRAND PRIZE WINNER**
Recipient of the Global Cleantech Cluster Association's Later Stage Award

2010 **WEF INNOVATIVE TECHNOLOGY AWARD**
Recognized by the Water Environment Federation for our groundbreaking dissolution system

Side by Side SOLUTIONS

SDOX | **StreamLineO2**

Our SDOX and StreamLine02 utilize a pressurized process to rapidly and efficiently dissolve oxygen in a sidestream, offering multiple benefits in a host of municipal, industrial and ecological water treatment applications.

SDOX: greater control and precision with a lower life-cycle cost
StreamLineO2: industry-leading efficiency at a lower upfront cost

Proven APPLICATIONS

- BIOLOGICAL TREATMENT
- EFFLUENT REAERATION
- ENVIRONMENTAL REMEDIATION
- ADVANCED AQUACULTURE

Standard FEATURES

PLUG & PLAY
We make installation simple. Just provide our factory-tested, skid-mounted unit with piping, electricity and an Ethernet connection, and your system will be ready to go in no time.

REDUCE/ELIMINATE BASINS
Don't build a basin if you don't have to. Conventional technologies often need large concrete basins, which require significant civil work. Our technology can eliminate the need for unnecessary construction, further reducing costs.

BUBBLE CONTROL
In competing systems, bubbles reach the surface without ever being absorbed. Our dissolution method can control bubble size, quantity or eliminate bubbles altogether - keeping gas in the water and money in your pocket.

CONTACT US

304.TALK.BIG
blueingreen.com
info@blueingreen.com

THE NEXT GENERATION OF AERATION TECHNOLOGY IS HERE

Winner of the WEF Innovative Technology Award, BlueInGreen's SDOX and StreamLineO2 are capable of treating water in a wide variety of locations and applications using dissolved oxygen.

ADAPTABLE AERATION
Treat your water your way. We offer customized aeration solutions - from in-pipe reaeration to lake and lagoon depths to activated sludge and aerobic digestion - capable of instantaneously increasing dissolved oxygen when and where you want it.

SHALLOW WATER
No job is too big or too small for BIG. Our technology can achieve maximum transfer efficiencies in as little as one foot of water, giving you additional flexibility throughout your treatment process.

LOWEST COST
The more efficient your water treatment system is, the more money you save. Luckily, BIG has an industry-leading 98% transfer rate, designed to treat your water and reduce your costs simultaneously.

DISSOLUTION EXPERTS
With over 10 years of experience, BIG employs a team of industry-leading designers, engineers and technicians. We are the gas dissolution experts, and we can prove it.

START TO FINISH
We can assist in all stages of the project process: designing, testing, training, start-up and even providing aftermarket needs throughout the life of your product. Our team is here to help you every step of the way.

PROUD PARTNERSHIP
With BIG, you're in good company. We directly partner with multiple oxygen generator manufacturers as well as gas storage and feed providers to offer a fluid, streamlined purchasing process.

COMPLETE SOLUTION
With BIG, you get it all. Our fully integrated and skid-mounted units include pump/motor, VFD, control panel with PLC and HMI, multiple operation modes and all associated piping, valves and instrumentation.

QUALITY GUARANTEED
We stand behind our technology. Every unit is factory-tested by our expert team of engineers at our U.S. manufacturing facility to ensure your equipment works both before and after it's installed.

When you think aeration, Think BIG.

POWER SAVINGS
By using variable frequency drives, our units offer the lowest cost of ownership on the market. With our efficient treatment technology, you pump less water, use less power and save more money.

CUSTOM SOLUTION
We design each unit with your project in mind. Our systems are available in several standard sizes and can be customized to meet your requirements. No job is too big or too small for BIG's proven solutions.

REMOTE CONTROL
You control the way you treat your water: automatically based on plant flow rates or to a preset delivery amount. Plus, this can all be controlled and monitored anytime, anywhere by phone or by web.

THINK BIG

Appendix C STRUCTURAL ASSESSMENT MEMORANDUM

Stantec

Memo

To:	Bill Goldsworthy, Karen Guglielmone, Paul Ruud, Greg Clifton, Drew Lloyd	From:	Jed Iverson
	Town of Telluride		Denver, CO Office
File:	205305088	Date:	February 2, 2017

INTRODUCTION

The objective of this technical memorandum (TM) is to describe the structural condition and deficiencies observed of the Telluride Regional Wastewater Treatment Plant (TRWWTP) based upon visual observations. The condition assessment was completed on Tuesday November 22nd 2016. The assessment covers the entire TRWWTP with emphasis on the headworks, clarifiers, oxidation ditches, digesters, and ancillary areas between those structures.

This facility has been upgraded over time and therefore the ages of the structures vary. The original 1988 construction consisted of the Headworks, Oxidation Ditch No.1, Clarifier No.1, the Admin Building including the below grade pump room, garage and generator room, and the below grade portion of the Raw Sewage Pump Station. Around 1995 the facility added Clarifier No.2, Oxidation Ditch No.2, a new Generator Building, Digester No.1 thru 4, a new blower and pump room, and added an above ground building to the Raw Sewage Pump Station. In 2002, the facility added Clarifier No.3, Oxidation Ditch No.3, and upgraded equipment in the original construction. Finally in 2013, the facility added a chemical storage building with an above grade parking lot on the roof of the enclosed concrete storage room.

This assessment was conducted as a visual assessment only, surfaces buried under/against backfill materials or covered under snow were not assessed and will not be included in this report. Findings and recommendations are only of those items witnessed during the visual inspection. Some of the structures were in operation and filled with process water and access to some areas was limited, therefore not all surfaces were visible and inspected. Because not all surfaces were inspected, this is not an all-inclusive list of every deficiency that might be occurring at the TRWWTP.

GENERAL CONDITION

Overall the structural condition of the TRWWTP facility varies from good to poor based upon the location and type of materials used. Because the facility has been upgraded many times and there are different structural materials, each area may have different levels of acceptability based upon the material and type of stress or exposure it's endured. Materials are affected by age, environmental exposure, chemical exposure, physical stress, and dynamic fatigue.

The majority of the concrete in the facility is in fair condition with areas where limited exposure to the elements show better signs of performance than ones exposed to external weather or chemicals. Walls, slabs and suspended composite slabs that are coated tend to be in better condition than walls and slabs that are exposed to process water. Those items exposed to the more harsh conditions are showing signs of wear within localized areas which need repair.

There are many different types of metal structural elements at the facility, including aluminum, stainless steel, and galvanized steel. The galvanized steel members are performing much better than the carbon steel members that were coated with an epoxy type system. It was apparent that many of the external epoxy coated members have not been re-coated since the original installation, hence

the members are showing signs of corrosion, delamination, and deterioration. The galvanized steel and aluminum members are only showing minimal localized signs of corrosion and are performing as designed.

Besides concrete, some of the walls are constructed of concrete masonry unit (CMU) block and morter. Most of the CMU walls that were observed appear to be in good condition with only localized areas that have been damaged. Most areas can be easily patched with a cement-based grout and then re-coated to protect the surface.

Roof insulation and membranes were not able to be fully inspected due to the earth backfill and snow at the time of inspection, but the areas that were exposed seem to be intact and performing as designed. Inside the facility, there were many leaks where the newer constructed concrete interfaces with the older constructed concrete. Many of the leaks were concentrated to where the wall intersects the roof composite slab and can be an indication that the external membrane system is not performing as designed. With the membrane system obstructed by soil, the overall performance of the membrane system is not known. Therefore, it should be assumed that the membrane system needs to be replaced or repaired.

Besides the membrane system, some of the external wall flashing around the roof over Clarifier No.1 is showing localized signs of damage. It is advised to have a roofing company assess the functionality of the flashing and to verify the membrane system is still pliable and functioning as designed. Above the external stair access where the roof system slopes to galvanized steel scuppers, the water is allowed to drain directly off the roof onto the ground below the scupper. This is very close to the foundation and could be pooling around the roof to wall connections and contributing to the leaking that was observed in the facility. It is recommended that this water be routed away from the foundations.

Coating systems seem to be the worst part of the facility. There are many coating systems at the facility and were visible on internal concrete, internal CMU, external steel, external concrete, concrete above process water lines, steel exposed to process water, and others. Many of the coating systems observed are past their service life and should be replaced. It is important to pay attention to the areas that are more effected by chemical or abrasive exposures and replace those areas first.

Table 1 below notes the general structural condition of most of the elements within the TRWWTP. The observed conditions are listed as good, fair, poor, or replace.

Good – Material visually shows no signs of deterioration, corrosion, excessive wear or need for replacement.

Fair – Material visually shows localized signs of deterioration, corrosion, excessive wear and may require repair or replacement.

Poor – Material or critical sections visually shows signs of deterioration, corrosion or excessive wear. Member or area may be missing parts or damaged that result in potential hazards to personnel. Member or area may require replacement upon further investigation.

Replace – Material visually shows signs of delamination or failure. Material or area is damaged beyond repair and needs replacement.

***Table 1**. Area Condition Classification Table*

Area	Condition	Comments
Raw Sewage Pump Station		
• concrete, below grade	Poor	Exposed to raw sewage, un-coated surface
• CMU, above grade walls	Good	Built in 1995, no signs of damage
• roof, internal	Good	Coating system performing as designed
• roof, external	N/A	Not accessible and snow covered
• coating, above grade walls	Fair	Nearing end of service life
Generator Building		
• concrete, slab	Fair	Minor surface cracks, fluid spills
• shared oxidation ditch wall	Fair	Multiple cracks showing signs of past leaks
• other walls	Good	Built in 1995, no signs of damage
• equipment pad	Good	
• joists	Good	
• roof, exterior	N/A	Not accessible and snow covered
• coating, floor	Fair	Nearing end of service life
Headworks		
• main concrete floor	Fair	Few areas where reinforcement is exposed
• CMU walls	Good	
• columns	Fair	Base plate and anchorage corrosion
• 1st floor joists	Fair	Localized corrosion needs repair
• second floor metal deck	Fair	Localized corrosion needs repair
• 2nd floor joists	N/A	Minimal access
• 2nd floor composite slab	Good/Fair	Partial inspection, was not able to access entire area
• HVAC ducting	Replace	Many locations where corrosion has damaged seam welds and duct walls
• grating and support angles	Fair	Localized corrosion, chemical attack
• roof, exterior	N/A	Not accessible, visually looks to be same condition as roof flashing (Fair)
• concrete, lower level	Poor	No coating, chemical attack, abrasion
• guardrail	Fair	Localized corrosion at beam connection
• lower level beams	Fair	Localized corrosion on beam and anchors
• coating, CMU walls	Replace	Delaminating
• coating column, joists, beams	Fair	Localized damage
Clarifiers		
• no.1 concrete, slab and walls	Fair	Minor slab and wall cracks, normal abrasion
• no.1 walkway and support steel	Good	
• no.1 joists	Fair	Localized corrosion
• no.1 roof, deck	Fair	Localized corrosion

• no.1 roof, external	N/A	Snow covered, visible membrane looked functioning, flashing damaged
• no.1 coating, weir	Replace	Delaminated
• no.1 coating, walls	Fair	Near end of service life
• no.1 coating, joists	Fair	Localized delamination
• no.2 concrete, below water	N/A	In service could not inspect
• no.2 walkway and support steel	Good	
• no.2 joists	Good/Fair	Minimal localized corrosion
• no.2 roof, deck	Good/Fair	Minimal localized corrosion
• no.2 roof, external	N/A	Buried, but internal evidence of leaks
• no.2 coating, weir	N/A	In service could not inspect
• no.2 coating, walls	Fair	Near end of service life
• no.2 coating, joists	Good	
• no.2 external stair	Fair/Poor	Stairs and railing in fair condition, stair anchorage corroded, roof metal decking and support angles in poor condition, wall coating needs replacing
• no.2 storage room	Poor	Wood siding damaged from water leaks, door frame rotting, coating need replacing
• no.3 concrete, slab and walls	Good/Fair	Minor slab and wall cracks, normal abrasion
• no.3 walkway and support steel	Good	
• no.3 joists	Good/Fair	Minimal localized corrosion
• no.3 roof, deck	Good/Fair	Minimal localized corrosion
• no.3 roof, external	N/A	Buried, but internal evidence of leaks
• no.3 coating, weir	Fair	Near end of service life
• no.3 coating, walls	Fair	Near end of service life
• no.3 coating, joists	Good/Fair	Minimal localized corrosion
Blower Room		
• concrete, floor and walls	Good/Fair	Minimal localized cracking
• concrete, ceiling	Fair	Localized cracking that has self-healed
• concrete, equipment pads	Good	
• coating, floor	Good/Fair	Needs to be cleaned, minimal touchup
• coating, walls	Good	
Digester Pump Station		
• concrete, floor and walls	Fair	Localized cracking that has self-healed
• concrete, ceiling	Good/Fair	Minimal localized cracking
• concrete, equipment pads	Fair	Corrosion of metal frame where installed
• coating, floor	Replace	Multiple failed areas
• coating, walls	Fair	Near end of service life
• concrete, pipe penetrations	Poor	Needs to be re-sealed and cleaned

Digester Gallery		
• concrete, floor and walls	Fair	Localized cracking that has self-healed
• concrete, ceiling	Fair/Poor	Many self-healed cracks
• coating, floor and walls	Fair	Needs to be cleaned and touched up
• guard rail	Replace	Missing or not adequate
Digester No.1 thru 4		
• concrete, floor	N/A	Sludge covering floor or tanks in service
• No.1&3 concrete, walls / columns	Fair	Localized cracking that has self-healed
• No.2&4 concrete, walls and columns	Fair	Tank in service, only inspected above waterline, localized cracking
• roof, decking	Fair	Localized corrosion
• roof, support beams	Fair/Poor	Localized corrosion of main support beams, ledger angle should be recoated or replaced
• concrete, external access	Poor	Localized cracking needs sealing
• access frame, internal	Replace	
• coating, tank internal	Replace	Low water line to roof
• coating, access frame	Replace	
Oxidation Ditches		
• no.1 concrete, slab	Fair	Localized cracking, need debris removal
• no.1 concrete, walls	Fair	Localized cracking, some repair
• no.1 concrete, external access	Poor	Surface erosion, vegetation growth
• no.1 concrete, rotor support	Fair	Localized cracking, vegetation growth
• no.1 concrete, pipe gallery	Good	
• no.1 roof deck	Fair	Localized corrosion
• no.1 steel beams and anchors	Fair	Localized corrosion
• no.1 grating, external access	Good	
• no.1 aluminum ladders	Fair	Missing slip resistance
• no.1 coating, all external steel	Replace	Delaminated causing localized corrosion
• no.2 concrete, slab, walls, external access, rotor support, roof deck, beams and anchors	N/A	In service
• no.2 grating, external access	Good	
• no.2 aluminum ladders	Fair	Missing slip resistance
• no.2 coating, external	Fair	Localized failures
• no.2 coating, pipe gallery wall	Fair	Nearing end of service life
• no.3 concrete, slab	Fair	Localized cracking, need debris removal
• no.3 concrete, walls	Fair	Localized cracking, some repair
• no.3 concrete, external access	Fair	Minor cracking, vegetation growth
• no.3 concrete, rotor support	Fair	Minor cracking, vegetation growth

• no.3 concrete, pipe gallery	Fair	Major leaks in northeast corner, minor in northwest corner, walls minor cracking
• no.3 roof deck	Fair	Minimal corrosion
• no.3 steel beams and anchors	Good/Fair	Localized bearing plate issues, minimal bolt corrosion.
• no.3 grating, external access	Good	
• no.3 aluminum ladders	Fair	Missing slip resistance
• no.3 coating, all external steel	Fair	Minimal localized failure
• no.3 coating, pipe gallery	Fair	Nearing end of service life
Pipe Gallery		
• Concrete, base slab	Fair	Exposed rebar and leaks at wall to slab joint between ditch 2 and 3
• Concrete, walls	Fair	Ditch no.1 beam cracking, Ditch no.2 and 3 localized cracking, wall to external roof leaks
• Concrete, top slab	Fair	Localized cracking, wall to external roof leaks
• Coating, adjacent to ditch no.3	Fair	Coating nearing end of service life
• Coating, adjacent to ditch no.2	Poor	Localized areas of failure, rebar corrosion showing through coating
• Coating, adjacent to ditch no.1	Replace	Multiple failure areas
• Grating	Fair	Minimal corrosion
• Monorail	Fair	steel in good condition, coating needs touching up
• UV area	Fair	Walkway, railing, steel supports, and concrete in fair condition, coating nearing end of service life
Lower Level Admin Building		
• Concrete, floor	Fair	Minimal cracking
• Concrete, walls	Fair	Minimal cracking
• Concrete Columns and top slab	Good	
• CMU, infill walls	Fair	Minor patching, top filler pushing out of joint
• Doors	Fair	Missing hardware
• Monorail steel and trolley	Good	
• Grating	Fair	Minimal corrosion
• Coating, walls	Poor	End of service life
• Coating, floor	Replace	Has failed, fluid spills attacking concrete
• Coating, steel	Fair	Touch up
• Storage Area	Good/Fair	Minimal concrete cracking, mezzanine stairs should be re-coated.

Raw Sewage Pump Station

The Raw Sewage Intake Pump Station was part of the original construction with the addition of an above grade building during around 1995. The above grade portion of the RSPS is in good condition with only the internal coating system nearing the end of its service life. Joists and roof decking are showing only minimal signs of deterioration. The exterior roof and flashing were not inspected due to snow covering the area and no access to the roof. Below the above ground structure is the original concrete pump station. There are multiple floor hatches that are in working condition, but the concrete around the hatches is not protected by a coating system and is showing signs of chemical attack. The Owner has indicated that when the addition was installed, there were many areas where new anchorage was drilled into weak or damaged concrete. This is most likely due to the chemical attack from raw sewage gasses combining with humid air. Over time, this has attacked the exposed surface of the concrete and ultimately should be repaired and coated to prevent further surface damage.

Generator Building

The Generator Building was not part of the original construction, but was included in the 1995 expansion and shares a wall with the original Oxidation Ditch No.1. This structure is slab on grade concrete construction with concrete walls and acoustical wall paneling with intake and exhaust louvers. The flat roof is constructed of steel joists supporting metal decking, insulation, a flexible membrane system, and ballasted with gravel. The Generator sits on an isolated concrete slab and the floor is coated as are the walls, but only to three feet above the floor surface. The coating system is near the end of its service life and has failed in localized areas. The floor is stained, dirty, and in need of being cleaned to prevent any slip hazards. This coating system should be thoroughly cleaned to see if the entire floor needs to be replaced or just re-coated in localized areas.

The walls that are not shared with the Oxidation Ditch No.1 were not visible because the acoustical paneling being installed over the concrete surface. The acoustical panels are in fair condition with a few locations showing signs of improper installation or damage. The paneling coating system appears to be intact, but is also nearing the end of its service life. The louvers and other miscellaneous galvanized steel appear to be in good condition. Roof joists are true and not showing signs of deterioration other than localized areas where the coating system is failing. This is minor in nature and can be easily fixed. The only other area showing signs of deterioration is the concrete wall that is part of the Oxidation Ditch No.1. There are a few vertical cracks that seem to have self-healed due to the presence of calcium carbonate. This is a white substance found along the crack surface. Because the ditch was not in service, it is not known if the cracks are actively leaking, but should be monitored. If the cracks are actively leaking while the ditch is in service, the cracks should be sealed with a hydrophobic crack injection system.

Refer to the appendices for photos showing these areas.

Headworks

The Headworks area is on the Northeast side of the facility. Below grade it consists of the influent wetwell, grit chamber, influent flume, influent channels, and sludge storage tanks. All the below grade structures are cast-in-place concrete. Above grade is the processing area where the presses, chemical storage, sludge thickeners, and other miscellaneous equipment are located. There is also a second story loft that houses HVAC equipment and other miscellaneous building mechanical equipment.

At the time of inspection the headworks was in service so only the areas above the water surface were inspected. The influent wetwell, grit chamber area, parshall flume, and influent channels appeared to have surface deterioration due to chemical attack. The surfaces are not coated and

from the smell in the room, there is high concentrations of hydrogen sulfide (H_2S). These types of gasses can be corrosive to the concrete surface and will continue to erode the surface if left unchanged. It is recommended to clean, repair, and then coat the concrete surfaces with a chemical resistant coating system designed for waste water applications. Most of the embedded steel or grating in the lower areas are galvanized and appear to be in poor condition. These should be repaired or replaced.

The galvanized beams and metal decking that support the main level concrete slab appear to be in fair condition with only minimal localized areas of corrosion. The beams are also adjacent to the opening in the main floor and support the guardrail attachment. Where the guardrail attaches to the beam, the coating system was not properly repaired after the support was welded to the beam. There is evidence of corrosion at this connection and should be repaired. The ships ladder that goes to this area and the one that goes to the second story loft appears to be in fair condition with only minor localized areas of corrosion.

On top of the beams and metal decking is a concrete slab. The slab is in poor to fair condition with any previous coating system delaminated and rubbed off the concrete surface. There was also one location adjacent to the floor opening where welded wire rebar was seen on the surface and has started to corrode. This will need to be repaired and the surface grouted. Next to the influent wet well, there are many bags of lime stored on the main floor. It is apparent by all the lime debris on the floor that any excess lime is not properly washed off the concrete surface. This also leads to corrosion of the concrete since the coating system is no longer protecting the concrete. It is recommended to thoroughly clean the floor and re-coat with a chemically resistant coating system. The galvanized steel grating over the openings is in fair condition, but needs to be cleaned to maintain its service life. Some embedded steel is damaged and corroding, but a majority is still functioning as designed.

Above the main floor there are steel columns, beams, joists, and metal decking that support the second story loft and roof. Surrounding the steel elements is a CMU infill wall. The CMU does not take gravity loads, but serves as a durable wall surface for the corrosive environment. However, the coating system on the CMU has completely failed and is peeling off the surface. This will need to be removed and replaced. Fortunately the coating system on the steel support members is holding up fairly well, with only localized areas of coating failure. These areas need to be repaired before serious section loss of the steel members occur. Some of the damaged areas are around the column base plates and anchors. It appears that lime or other chemical debris has accumulated around the columns and is attacking the coating system. In a few locations, the coating system has failed and the steel is corroding.

Besides the structural elements, the HVAC galvanized steel duct work is in bad condition and has completely corroded through the duct in many locations. The duct work should be replaced as soon as possible to prevent debris from falling on the operators. Stainless steel ducting might be a better material for this corrosive environment. There is also a steel monorail which appears to be in working order with no signs of corrosion. The coating system on the monorail appears to be in fair condition, but further inspection of the monorail should be conducted to see if any portion needs to be touched up.

Refer to the appendices for photos showing these areas.

Clarifiers

There are three clarifiers at the facility. No.1 was constructed with the original facility around 1987, No.2 was constructed with the expansion around 1995, and No.3 was constructed with the last major expansion around 2002. All clarifiers are cast-in-place concrete with the slab founded on compacted subgrade. Only No.1 was out of service, so the other two clarifiers could not be fully inspected.

In general, the concrete is in good condition with limited localized cracking that appears to have self-healed. There is a 2" layer of concrete grout on top of the slab, so assessing the condition of No.1 base slab was not possible. There were a couple large cracks, but that might just be in the topping. Further investigation would need to be performed to assess whether the crack goes through the full depth of the base slab. If there is a crack through the base slab, it would need to be fixed with a hydrophobic crack injection system.

All steel walkways and railings were in fair condition with little to no visible signs of corrosion. The clarifier mechanisms were not fully inspected during the visual assessment, but the mechanical assessment will provide further information regarding the condition of these mechanisms. It was apparent from the inspection that the coating system on the mechanism and weir plates of Clarifier No.1 has failed and needs to be replaced. The condition of other internal wall coatings varies by when the concrete was constructed, but Clarifier No.2 seems to have the worst coating system. The other areas are nearing the end of their service life and it would be recommended to re-coat most areas.

The roofs have different styles between the three clarifiers. Clarifier No.1 uses open web steel joist to support the roof, whereas the other two clarifiers use galvanized steel beams to support the roof. Clarifier No.1 also has an exposed above ground roof and parapet system, where the other two roofs are buried under a few feet of soil. At Clarifier No.1 the steel joist are in fairly good condition, but the coating system is at the end of its service life and there are localized areas of corrosion starting to develop. This is also the situation at the other clarifiers, the coating system has failed in localized areas only, however the galvanized beams are performing better than the open web steel joists.

Above ground externally, the CMU wall that is around Clarifier No.1 shows signs of damage and is in the same location where the adjacent 1995 Clarifier No.2 is showing signs of leaking. There is also metal flashing damage around the parapet that could be contributing to snow and water getting past the barrier and leaking into the structure below. Adjacent to Clarifier No.2, the south observation gallery was actively leaking. Because this area is buried, a cause of the leak could not be determined, but it is in a similar condition where the water might be getting past the stair CMU and draining down to the structure below. To properly fix these areas, the soil would need to be removed and the roof inspected for tears or areas where the water might be by-passing the membrane system. The leak adjacent to Clarifier No.2 on the south side is also damaging the storage room wooden walls. The particle board siding is wicking the moisture up the wall and the wood is rotting. This is also happening around the door to the storage room. Once the roof leak is fixed, this wood will need to be replaced.

There is one stair well adjacent to Clarifier No.2 that exits out the west side externally and exits at roof level. The top of the stairwell is above grade and can be colder than the rest of the building. There have been numerous complaints from staff that there is water dripping from the ceiling and even at the time of inspection, condensation was observed on the underside of the roof's metal decking. In observing the situation, condensation is collecting on the low side (east) of the roof. This condensation along with a failing coating system is causing the support steel to corrode in localized areas. At the end of the inspection the condensation had dissipated and the metal was dry. This means that the roof is not leaking, but the conditions are allowing condensation to form on the underside of the roof and concentrate on the low side. In order to keep this situation from occurring, an HVAC engineer will need to design a better system to move air through this area, or the external CMU will need to be insulated.

Refer to the appendices for photos showing these areas.

Blower Room

The Blower Room is one of the better areas of the facility. This was constructed at the time of the 1995 expansion and seems to be holding up well. All walls and slabs are concrete construction with minimal cracking. The few cracks that have occurred in the top roof slab have self-healed and were not leaking at the time of inspection. The coating system seems to be intact and still performing. The walls might have been re-coated with the 2002 upgrades, but even if they were, that coating system is close to needing to be re-coated or touched up. The floor was slightly dirty and appeared to not have been cleaned in a while. The floor should be cleaned to determine if there are any localized areas that need the coating touched up. All other miscellaneous HVAC metal ducting seemed to be in good condition and performing as designed.

Refer to the appendices for photos showing these areas.

Digester Pump Station

The Digester Pump Station is physically below the Blower Room and was also constructed around the 1995 time frame. All construction is cast-in-place concrete with the floors and walls showing some signs of cracking. The externally facing west wall appears to be showing more signs of cracking than the other surfaces, but that is where a majority of the piping penetrates the structure and there is a large soil load. The cracking is typical for the conditions, and it appears that most have self-healed. The appearance of the calcium carbonate coming out of the crack makes the situation appear worse than it is. The cracks were not actively leaking at the time of inspection, so it is recommended to monitor the situation and crack inject any active leaks with a hydrophobic crack injection system. The pipe penetrations are showing signs of active leaking. It is recommended to assess the condition of the Link-Seal and replace if necessary.

The floor coating system has failed in many locations and needs to be replaced. This is also occurring at localized areas along the wall surface. The entire room should be cleaned and re-coated. Most of the equipment pads are in fair shape with no spalling. The only pad that is damaged is where the washer and drier sit. The metal banding around the pad is corroding and pulling away from the surface. This should be replaced with just a concrete pad which is coated to resist any corrosive materials. The stairs appear to be in good condition and the anchorage was not showing signs of corrosion.

Refer to the appendices for photos showing these areas.

Digester Gallery

The Digester Gallery is the hallway that is between the Oxidation Ditch No.3 and the Digesters No.1 thru No.4. This hallway was constructed with the 2002 expansion and allows access to the Digesters from inside the facility. All surfaces are cast-in-place concrete including the roof. Most of the concrete is in fair condition except the roof slab which has many cracks perpendicular to the gallery. It is not known why these cracks occurred, but since the walls do not show this same pattern, it can be presumed that either the concrete was not cured properly or something was wrong with the concrete mix. This type of cracking is indicative of temperature and shrinkage cracking and does not relate to the flexural overstressing of the concrete. None of the cracks were actively leaking at the time of inspection and many of the cracks appear to have self-healed. The cracks should be monitored, and injected with a hydrophobic crack injection system if any active leaks are observed. If no leaks are observed, the concrete should be left alone and it should function as designed.

The walls and floor did not have many cracks. The minimal cracking is expected for this type of construction. The coating system on the walls and floor is in fair condition, but is nearing the end of its service life. All surfaces should be cleaned and the coating system should either be touched up or

re-coated. Along the gallery, there are concrete stairs that access a small door to the digesters. Some of these stairs have a guardrail and some do not. A guardrail should be installed along all stairs.

Refer to the appendices for photos showing these areas.

Digesters

The Digesters are the concrete tanks on the west side of the facility and were constructed during the 1995 expansion. These are cast-in-place concrete tanks founded on compacted subgrade. There are four tanks and two were not in service at the time of inspection. The tanks can be accessed by an access shaft externally, or through a small hatch located in the Digester Gallery. The roof is a galvanized composite concrete deck supported by galvanized steel beams.

In the tanks that were drained, the slab was still covered by layer of sludge, so a full inspection of the concrete could not be conducted. The walls were not washed down, but some of the surface could be observed. The walls appeared to be performing as designed and no major cracks or deterioration were observed. The galvanized steel beams appeared to be in fair condition, but further investigation of each tank should be performed when they are drained to determine if any localized corrosion is occurring. One concern is the steel support angle at the edge of the composite roof. This appeared to be heavily corroded but might not be a critical support for the roof. The 1994 construction drawings are unclear about whether the slab continues over the wall and the angle was only necessary for construction of the composite deck. It is recommended to re-coat the angle, install a new angle, or remove it so it does not become a safety hazard.

All observation hatches from the Digester Gallery are in poor shape and should be replaced. The metal framing and coating systems have corroded through the steel in many locations. There are also a couple of locations where the telescoping valve hand wheel is missing or broken and should be repaired. Externally, the access shafts are combined for every two tanks. These shafts are also cast-in-place concrete with minimal cracking, however, on both shafts, there are major cracks in the middle of the shafts on the east and west sides. These cracks are exposed to water and can spall from freeze thaw cycling. These cracks should be routed and filled with sealant. The access ladders and grating at the shafts are in working condition and appear to be in fair condition, but there is vegetation growth around the openings that should be removed during periodic maintenance of the tanks.

Refer to the appendices for photos showing these areas.

Oxidation Ditches

Similar to the Clarifiers, there are three Oxidation Ditches that were constructed at the same time. Oxidation Ditch No.1 was constructed around 1987, No.2 around 1995, and No.3 around 2002. These are cast-in-place concrete tanks founded on compacted subgrade. The concrete composite roofs are supported by steel framing and are buried under a layer of soil. There are two large access areas per ditch that house rotors that circulate the water. The only other opening is approximately at the middle of ditch no.3. This opening allows access to the submersible propeller mixers. At the time of inspection, Ditches No.1 and No.3 were drained and only No.2 was in service.

The concrete walls and slabs appeared to be in fair condition with Ditch No.1 showing more signs of abrasive wear. This is to be expected considering the ditches were constructed at different times. This did not appear to be of any concern and only minor cracks were observed in the walls or slabs. There is a coating applied to the walls in the above-water zone. This coating system appeared to be past its service life and should be replaced. There were large debris piles covering most the slab surface in Ditch No.1 and Ditch No.3, so a complete inspection of the slab was not performed.

The biggest area of concern was the support steel in Ditch No.1. The steel is not galvanized, but coated with an epoxy system. This system is failing and has delaminated in many locations. In some areas where the coating has delaminated, the steel is starting to corrode. If the steel continues to corrode without being protected, the beam could become overstressed and fail. This is not an immediate threat, but should be addressed in the next major upgrade to the facility. The other ditches are supported with galvanized steel beams and are performing much better. There are only localized areas where the galvanization has failed and corrosion of the steel is occurring.

In the rotor support structures, all grating is in fair condition and so is the concrete. There are only minor localized cracks, which should be sealed to prevent future spalling. Grating support steel and anchorage varies per ditch with No.1 being the worst and No.3 being the best. In No.1 there are many locations where the coating system has failed and the steel is corroding. There are also some locations where the beam bearing surface is damaged or not properly grouted. This should be fixed if the ditch is to remain in service. Ditch No.2 was not inspected because it was in service, but No.3 was inspected and in much better condition. There were only minor areas where localized corrosion is occurring. These areas should be repaired. Vegetation growth was observed in all access areas and should be removed on a regular basis. The access walls of Ditch No.1 and the middle access walls of Ditch No.3 were in poor condition. The surfaces received a skim coat of a concrete slurry, which has cracked in multiple locations and is no longer protecting the retaining walls. These walls should be replaced using cast-in-place concrete construction. All access ladders are in fair condition with many of the slip protective covers missing from the rungs. Slip protection should be installed on all aluminum round bar rungs.

Where the roof of Oxidation Ditch No.2 ties into the pipe gallery between the ditches and clarifiers, there are major active leaks. These areas should be investigated further to determine ways to prevent water from infiltrating the galleries. One alternative might be to seal all joints with a flexible membrane. This would require removing the soil adjacent to the joints. Other methods of crack injecting might be feasible, but should be investigated further prior to implementation.

Refer to the appendices for photos showing these areas.

Pipe Gallery

The Pipe Gallery is the lower area between the Oxidation Ditches and the Clarifiers. This area was constructed in different stages along with the ditches and clarifiers, so the west end is the newest and is in the best condition. The worst areas are where the different construction intersects. All concrete in this area is in fair condition with minimal surface cracking. The coating systems vary depending on the age of the sections. The coating of the area adjacent to Clarifier No.3 are nearing the end of its service life. The coating of the area adjacent to No.2 is failing and should be replaced. The coating of the area adjacent to No.1 has failed and should be replaced.

The door openings from No.3 to No.2 has many leaks at the wall to slab interfaces and previously cut rebar is corroding through the coating system. These cut bars should be been burnt back and grouted to prevent surface corrosion. There is also a piece of slab rebar that is exposed on the base slab surface which is spalling the concrete and corroding. This needs to be repaired. Above the opening, the joint is actively leaking and water is dripping onto the floor creating a slip hazard and corroding the electrical conduit. The leak should be fixed and the coating system replaced.

At Oxidation Ditch No.3 there are two small rooms that are adjacent to the circular portion of the ditch. The west room houses a HVAC unit and is showing signs of condensation and corrosion of the ducting. It is not known whether condensation has been forming on the unit because Oxidation Ditch No.3 was out of service and colder than usual, or there is an active leak in the roof. Further investigation is needed to determine a cause. Either way, the ducting and unit might need to be

replaced. On the east side the room has some major leaks at the 1995 to 2002 construction interface. The drawings were unclear on how the two structures were to be sealed, so further investigation would need to be performed to determine a cause of the leaks. The easiest way to fix the leak might be to crack inject the joints with a hydrophobic crack injection system.

At the end of the pipe gallery on the east side adjacent to Ditch No.1 the main support beam leading into the sludge pump room has flexural and shear cracks. It appears that the reinforcement has engaged and is keeping the cracks small, but the operators should continue to inspect this area to verify the cracks are not getting larger. There is also a small UV system and monorail in this area. All steel appears to be in fair condition with only localized areas of corrosion. Any areas where the coating system has failed should be re-coated. The concrete of the UV system is also in fair condition with only minor surface cracks. All floor grating along the pipe gallery appears to be in good condition. The coating system on the Pipe Gallery floor is past its service life and should be replaced.

Refer to the appendices for photos showing these areas.

Lower Level Admin Building

The lower level of the Admin Building consists of the pumping room, storage room, garage, and old generator room. The base slab is cast-in place concrete founded on compacted subgrade and the walls are CMU infill surrounded by concrete columns and beams supporting the upper level concrete floor. This was part of the original construction of the facility but has been upgraded with each major expansion. The concrete is in fair condition with only minor surface cracking and the floor grating is also in fair condition. All embedded steel supports are in good condition showing minor localized areas of corrosion. The floor coating system has failed and there are fluid spills in a few locations. The floor needs to be thoroughly cleaned and a new coating system applied.

The CMU walls are in good condition with only localized areas needing patching, but the joint filler at the top of the wall is pushing out in many locations. Backer rod and sealant should be applied at the joint to help keep the filler material in place. The CMU wall coating is in fair condition, but is nearing the end of its service life. All coated steel appeared to be in fair condition with only minor areas of localized corrosion. The garage also appears to be in fair condition with only the main loading dock door missing some hardware. All monorail steel is in good condition.

The storage room was added to the facility when the main parking and chemical building were added to the facility. This room is all cast-in-place concrete and is in good condition with minor self-healed cracks in the concrete roof. There is a wooden mezzanine that appears to be in sound condition with a wooden stair case that needs to be re-coated or replaced with a more durable material. The rollup door was not operated, but appears to be in working condition.

Refer to the appendices for photos showing these areas.

CONCLUSIONS

Structurally the facility is in okay condition, however, several localized areas require upgrading or attention. Currently there are a few areas of concern that should be addressed as soon as possible. The areas shown below are the most deficient in the facility. The longer these items are left as is, the more difficult and costly it will be to repair in the future.

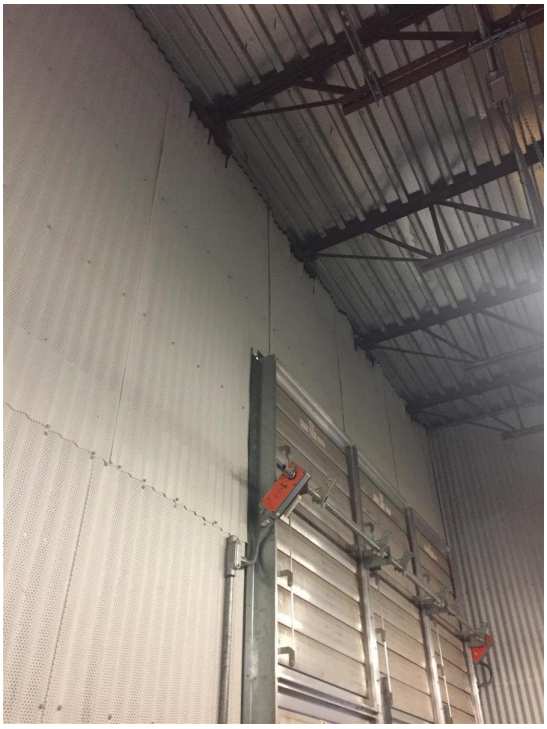
Area	Picture	Notes
Headworks		HVAC ducting is severely corroded and poses a safety hazard to operators.
Clarifier No.2, Upper Level South Side		Wall to composite slab interface is actively leaking. Wall coating has failed and leaks are creating a slip hazard and damaging adjacent room wooden walls.

Oxidation Ditch No.1, Roof Support Beams		Coating system on roof support beams is delaminating and allowing the structural steel to corrode. If the beam corrodes too much, the capacity of the beam will be compromised. This is occurring on all beams that were coated with an epoxy based system.

Most of the other issues identified in **Table 1** are maintenance issues and should be incorporated into a long-term maintenance program. Simple annual inspections which identify items that need to be addressed could go a long way in maintaining the facility. The other issues regarding concrete surface corrosion specifically in the Raw Water Pump Station and influent areas of the Headworks would take a lot of work and require those areas to be out of service for longer than is currently allowed. Repairing these areas should be part of a longer term renovation project as influent might need to be bypassed to another unit or temporary system while upgrading the surface condition of the concrete.

APPENDIX A

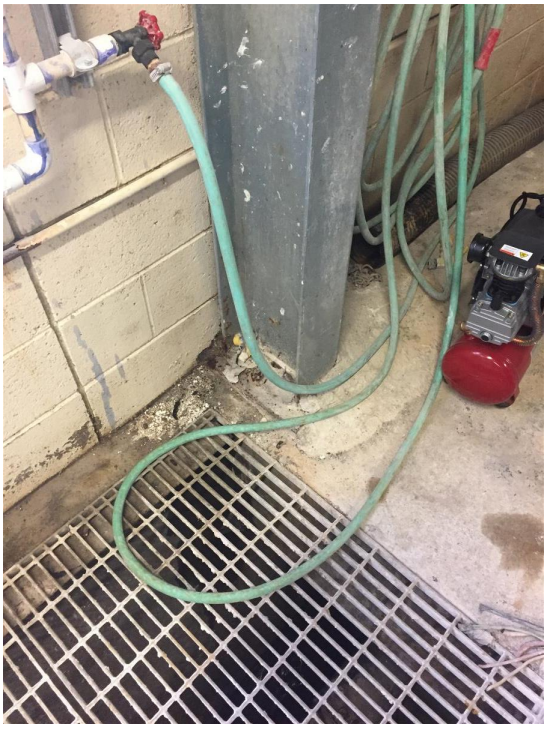
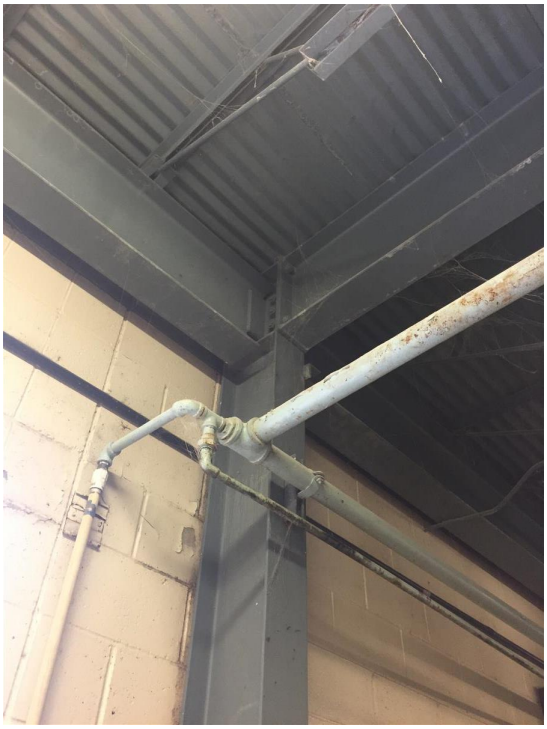
Client:	**Town of Telluride, Colorado**	**Project:**	**Structural Condition Assessment**
Site Name:	**Telluride Waste Water Treatment Plant**	**Site Location:**	**Telluride, CO**

Photograph ID: 1 **Photo Location:** Generator Building **Direction:** Looking North at Louvers **Survey Date:** 11/22/2016 **Comments:** Joists, walls, and louvers in good condition	
Photograph ID: 2 **Photo Location:** Generator Building **Direction:** Looking West **Survey Date:** 11/22/2016 **Comments:** Self-healed cracks at Oxidation Ditch No.1 shared wall, slab coating system should be cleaned and maintained.	

Client:	**Town of Telluride, Colorado**	**Project:**	**Structural Condition Assessment**
Site Name:	**Telluride Waste Water Treatment Plant**	**Site Location:**	**Telluride, CO**

Photograph ID: 3 **Photo Location:** Generator Building **Direction:** Looking East, Gen connection to outside at floor **Survey Date:** 11/22/2016 **Comments:** Concrete curb and slab stained from leaking fluid, fix leaks and clean up fluid. Duct Shroud in good condition and sealed properly.	
Photograph ID: 4 **Photo Location:** Headworks **Direction:** Looking North **Survey Date:** 11/22/2016 **Comments:** Typical grating condition. embedded channel in okay condition, powdered lime coats the floor and grating.	

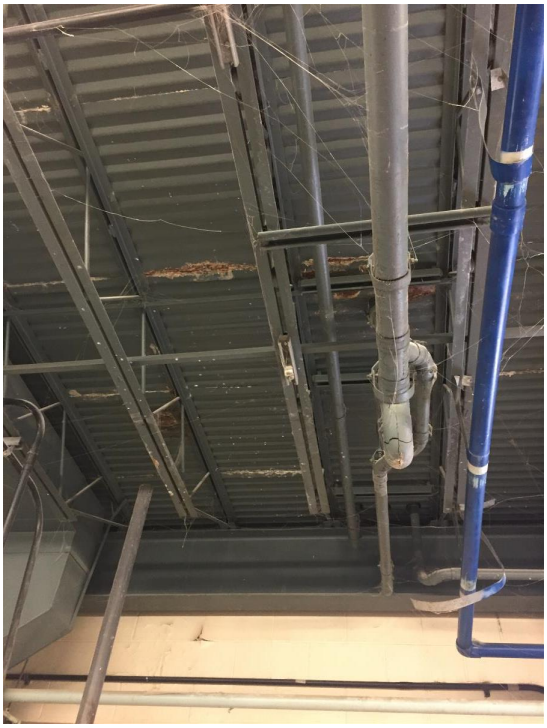
Client:	**Town of Telluride, Colorado**	**Project:**	**Structural Condition Assessment**
Site Name:	**Telluride Waste Water Treatment Plant**	**Site Location:**	**Telluride, CO**

Photograph ID: 5 **Photo Location:** Headworks **Direction:** Looking Northeast at first column **Survey Date:** 11/22/2016 **Comments:** Column baseplate, anchorage, and wall coating showing signs of corrosion or damage	
Photograph ID: 6 **Photo Location:** Headworks **Direction:** Looking Northeast at first column **Survey Date:** 11/22/2016 **Comments:** Typical Column to roof framing. Coating in okay condition. Wall coating pealing in localized location, needs to be re-coated.	

Client:	**Town of Telluride, Colorado**	**Project:**	**Structural Condition Assessment**
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Photograph ID: 7 **Photo Location:** Headworks **Direction:** Looking East **Survey Date:** 11/22/2016 **Comments:** HVAC ductwork heavily corroded, needs to be replaced.	
Photograph ID: 8 **Photo Location:** Headworks **Direction:** Looking North **Survey Date:** 11/22/2016 **Comments:** Column base corroding and failure of coating system. Multiple leaks on adjacent valves. Minor chemical attack of concrete surface.	

Client:	**Town of Telluride, Colorado**	**Project:**	**Structural Condition Assessment**
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Photograph ID: 9 **Photo Location:** Headworks **Direction:** Looking North mid room **Survey Date:** 11/22/2016 **Comments:** Localized coating failure of upper floor metal deck resulting in metal corrosion. Joists with minor coating failure and initial stages of metal corrosion.	
Photograph ID: 10 **Photo Location:** Headworks **Direction:** Looking Northeast at stairs **Survey Date:** 11/22/2016 **Comments:** CMU wall coating has failed, stair galvanization in okay condition, railing kick plate needs adjustment	

Client:	**Town of Telluride, Colorado**	**Project:**	**Structural Condition Assessment**
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Photograph ID: 11 **Photo Location:** Headworks **Direction:** Lower Influent Channels looking west **Survey Date:** 11/22/2016 **Comments:** Grating and supporting concrete heavily corroded. Large areas of chemical attack along channel walls and concrete slabs. Not coated.	
Photograph ID: 12 **Photo Location:** Headworks **Direction:** Underside of main floor slab looking South **Survey Date:** 11/22/2016 **Comments:** Galvanized metal deck in okay condition. Support beam and connection okay with minor localized corrosion.	

Client:	**Town of Telluride, Colorado**	**Project:**	**Structural Condition Assessment**
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Photograph ID: 13 **Photo Location:** Headworks **Direction:** Guardrail connection at stairs looking south **Survey Date:** 11/22/2016 **Comments:** Guardrail to beam connection plate is corroding where coating system is damaged.	
Photograph ID: 14 **Photo Location:** Headworks **Direction:** Floor slab looking west - mid room **Survey Date:** 11/22/2016 **Comments:** Slab reinforcement corroding and spalling slab surface. Not enough cover over reinforcement.	

Client:	**Town of Telluride, Colorado**	**Project:**	**Structural Condition Assessment**
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Photograph ID: 15 **Photo Location:** Headworks **Direction:** Main Slab looking Northeast **Survey Date:** 11/22/2016 **Comments:** Typical slab surface with failed coating system.	
Photograph ID: 16 **Photo Location:** Headworks **Direction:** Monorail looking Northeast **Survey Date:** 11/22/2016 **Comments:** Beam coating system and hoist in okay condition	

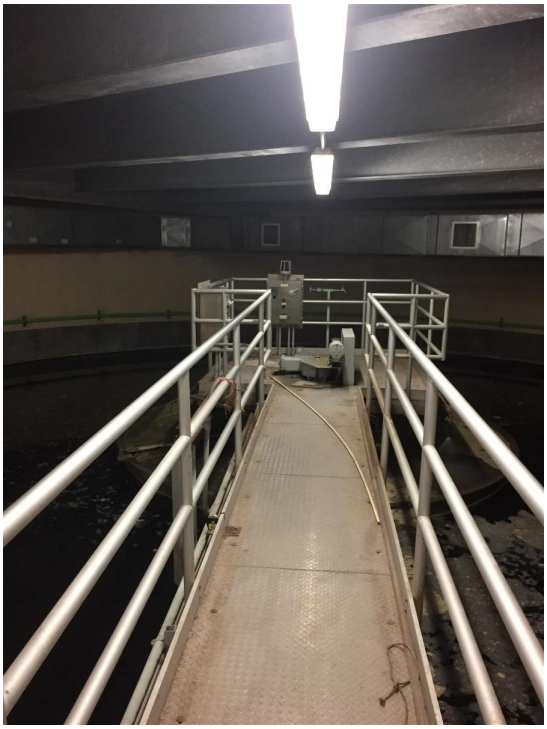
Client:	**Town of Telluride, Colorado**	**Project:**	**Structural Condition Assessment**
Site Name:	**Telluride Waste Water Treatment Plant**	**Site Location:**	**Telluride, CO**

Photograph ID: 17 **Photo Location:** Headworks **Direction:** Looking west **Survey Date:** 11/22/2016 **Comments:** Typical failed CMU coating system	
Photograph ID: 18 **Photo Location:** Clarifier No.1 **Direction:** Looking west **Survey Date:** 11/22/2016 **Comments:** Mechanism and walkway support in okay condition	

Client:	**Town of Telluride, Colorado**	**Project:**	**Structural Condition Assessment**
Site Name:	**Telluride Waste Water Treatment Plant**	**Site Location:**	**Telluride, CO**

Photograph ID: 19 **Photo Location:** Clarifier No.1 **Direction:** Launder wall and slab looking north **Survey Date:** 11/22/2016 **Comments:** Weir coating system has failed and minor cracks in concrete slab	
Photograph ID: 20 **Photo Location:** Clarifier No.1 **Direction:** Middle of base slab looking down **Survey Date:** 11/22/2016 **Comments:** Large crack in base slab	

Client:	**Town of Telluride, Colorado**	**Project:**	**Structural Condition Assessment**
Site Name:	**Telluride Waste Water Treatment Plant**	**Site Location:**	**Telluride, CO**

Photograph ID: 21 **Photo Location:** Clarifier No.2 **Direction:** looking North **Survey Date:** 11/22/2016 **Comments:** In service, limited inspection, but exposed surfaces appeared to be in okay condition. Roof joists were galvanized steel beams and connections were in good condition. Minor surface cracking, but most have self-healed.	
Photograph ID: 22 **Photo Location:** Clarifier No.2 **Direction:** Looking northwest **Survey Date:** 11/22/2016 **Comments:** walkway, support frame, and guardrail in good condition.	

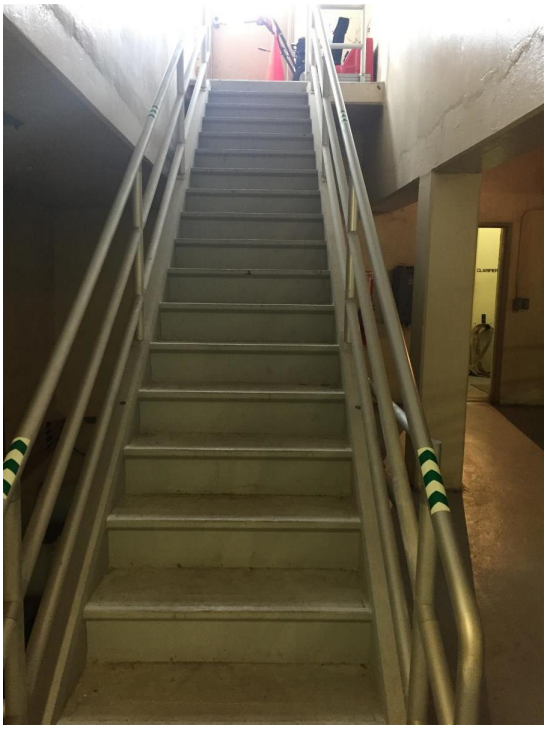
Client:	**Town of Telluride, Colorado**	**Project:**	**Structural Condition Assessment**
Site Name:	**Telluride Waste Water Treatment Plant**	**Site Location:**	**Telluride, CO**

Photograph ID: 23 **Photo Location:** Clarifier No.2 **Direction:** Looking west **Survey Date:** 11/22/2016 **Comments:** wall coating okay, concrete surfaces have minor cracking, but appear to be self-healed	
Photograph ID: 24 **Photo Location:** Clarifier No.2 **Direction:** Looking Southeast **Survey Date:** 11/22/2016 **Comments:** Roof leak at end of walkway, south side of stairway. Failed Coating system, Failed roof membrane.	

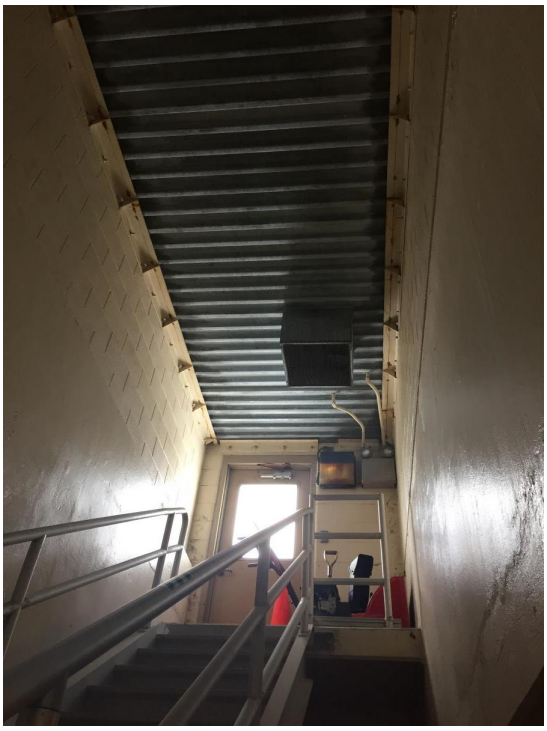
Client:	**Town of Telluride, Colorado**	**Project:**	**Structural Condition Assessment**
Site Name:	**Telluride Waste Water Treatment Plant**	**Site Location:**	**Telluride, CO**

Photograph ID: 25 **Photo Location:** Clarifier No.2 **Direction:** Looking Southwest at bottom of stairs **Survey Date:** 11/22/2016 **Comments:** Base of storage room walls damaged from leaking water	
Photograph ID: 26 **Photo Location:** Clarifier No.2 **Direction:** Looking Southwest at storage room door **Survey Date:** 11/22/2016 **Comments:** Base of storage room door damaged from leaking water	

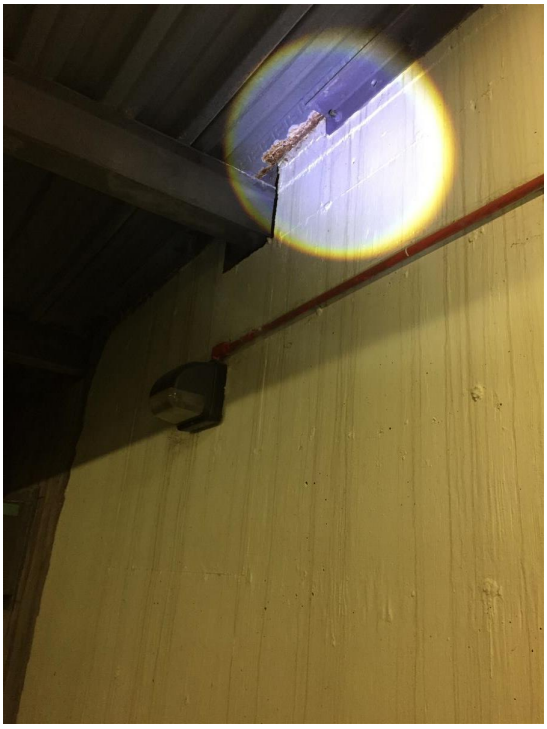
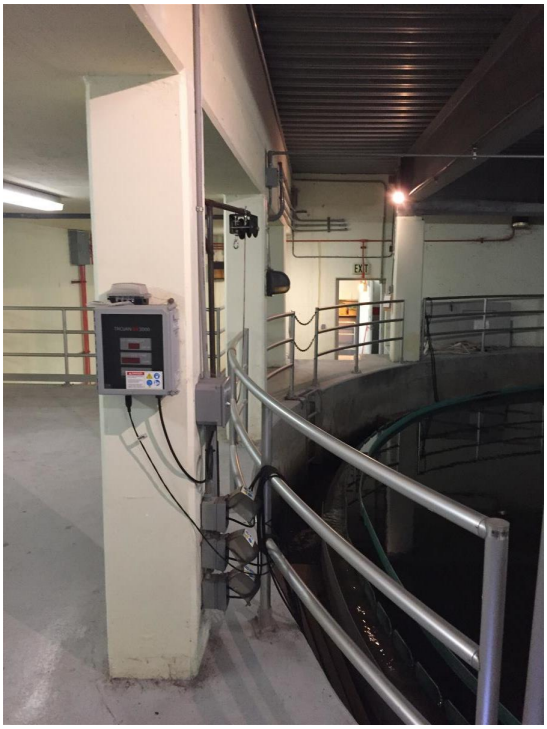
Client:	**Town of Telluride, Colorado**	**Project:**	**Structural Condition Assessment**
Site Name:	**Telluride Waste Water Treatment Plant**	**Site Location:**	**Telluride, CO**

Photograph ID: 27 **Photo Location:** Upper Stair adjacent to Clarifier No.2 **Direction:** Looking northwest **Survey Date:** 11/22/2016 **Comments:** Base of stair connection corroded	
Photograph ID: 28 **Photo Location:** Upper Stair adjacent to Clarifier No.2 **Direction:** Looking west **Survey Date:** 11/22/2016 **Comments:** Stair, guardrail, and handrail in okay condition. Connections also in okay condition.	

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Site Name:	**Telluride Waste Water Treatment Plant**	**Site Location:**	**Telluride, CO**

Photograph ID: 29 **Photo Location:** Upper Stair adjacent to Clarifier No.2 **Direction:** Looking up **Survey Date:** 11/22/2016 **Comments:** Condensation on east side of roof deck. This side is approx. 4" lower than the west door side. Where coating system has failed, steel is starting to corrode.	
Photograph ID: 30 **Photo Location:** Upper Stair adjacent to Clarifier No.2 **Direction:** Looking west **Survey Date:** 11/22/2016 **Comments:** condensation dries out faster on higher west side, therefore less corrosion.	

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Photograph ID: 31 **Photo Location:** Clarifier No.3 **Direction:** Looking northeast **Survey Date:** 11/22/2016 **Comments:** roof leak along decking to wall interface. Roof membrane breach and corroding exposed steel.	
Photograph ID: 32 **Photo Location:** Clarifier No.3 **Direction:** Looking west **Survey Date:** 11/22/2016 **Comments:** Clarifier in service. Wall coating, galvanized steel roof support beams, decking, concrete surfaces all in okay condition	

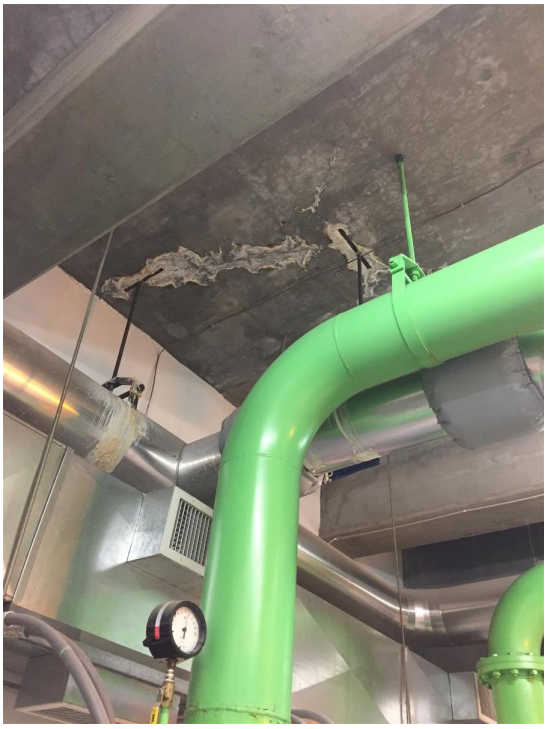
Client:	**Town of Telluride, Colorado**	**Project:**	**Structural Condition Assessment**
Site Name:	**Telluride Waste Water Treatment Plant**	**Site Location:**	**Telluride, CO**

Photograph ID: 33 **Photo Location:** Clarifier No.3 **Direction:** Looking northwest **Survey Date:** 11/22/2016 **Comments:** walkway, support frame, and guardrail in good condition.	
Photograph ID: 34 **Photo Location:** Hallway between Clarifier No.3 and Blower Room **Direction:** Looking up **Survey Date:** 11/22/2016 **Comments:** localized corrosion of roof deck at concrete support beam connection	

Client:	**Town of Telluride, Colorado**	**Project:**	**Structural Condition Assessment**
Site Name:	**Telluride Waste Water Treatment Plant**	**Site Location:**	**Telluride, CO**

Photograph ID: 35 **Photo Location:** Blower Room **Direction:** Looking southwest **Survey Date:** 11/22/2016 **Comments:** Roof, walls, floor, coating, slab, stairs all in okay condition	
Photograph ID: 36 **Photo Location:** Blower Room **Direction:** Looking west **Survey Date:** 11/22/2016 **Comments:** Stairs to pump room in okay condition. minimal corrosion at connections	

Client:	**Town of Telluride, Colorado**	**Project:**	**Structural Condition Assessment**
Site Name:	**Telluride Waste Water Treatment Plant**	**Site Location:**	**Telluride, CO**

Photograph ID: 37 **Photo Location:** Blower Room **Direction:** Looking south and up **Survey Date:** 11/22/2016 **Comments:** minor slab cracks in top concrete slab that have self-healed. No active leaking at the time of inspection.	
Photograph ID: 38 **Photo Location:** Blower Room **Direction:** Looking east **Survey Date:** 11/22/2016 **Comments:** Stairs and connections in okay condition	

Client:	**Town of Telluride, Colorado**	**Project:**	**Structural Condition Assessment**
Site Name:	**Telluride Waste Water Treatment Plant**	**Site Location:**	**Telluride, CO**

Photograph ID: 39 **Photo Location:** Pump Room **Direction:** Looking northwest **Survey Date:** 11/22/2016 **Comments:** stairs of pump room in okay condition, minor coating damage.	
Photograph ID: 40 **Photo Location:** Pump Room **Direction:** Looking south **Survey Date:** 11/22/2016 **Comments:** slab coating system has failed in many locations. concrete is in okay condition including walls, slab, columns, equipment pads, and top deck.	

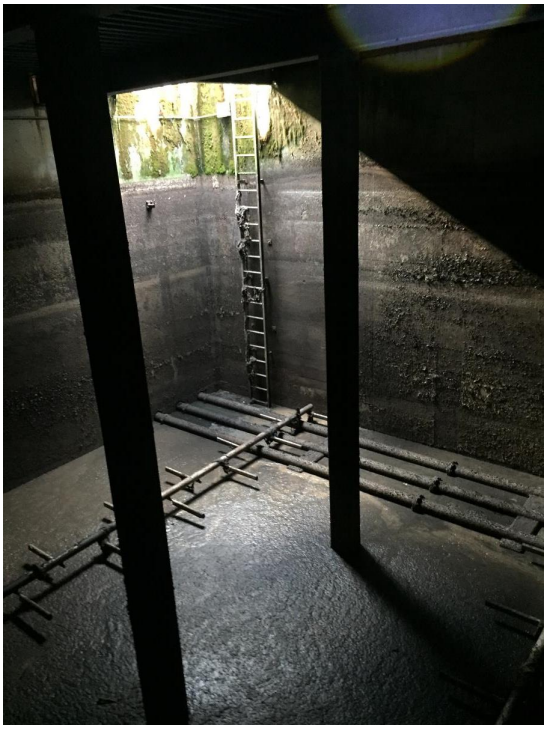
Client:	**Town of Telluride, Colorado**	**Project:**	**Structural Condition Assessment**
Site Name:	**Telluride Waste Water Treatment Plant**	**Site Location:**	**Telluride, CO**

Photograph ID: 41 **Photo Location:** Pump Room **Direction:** Looking southwest **Survey Date:** 11/22/2016 **Comments:** west wall has horizontal stress cracks and multiple old leaks adjacent to pipe penetrations. crack injection appears to be holding but coating system has failed.	
Photograph ID: 42 **Photo Location:** Pump Room **Direction:** Looking west **Survey Date:** 11/22/2016 **Comments:** washer dryer equipment pad steel band corroding and not fully attached to pad.	

Client:	**Town of Telluride, Colorado**	**Project:**	**Structural Condition Assessment**
Site Name:	**Telluride Waste Water Treatment Plant**	**Site Location:**	**Telluride, CO**

Photograph ID: 43 **Photo Location:** Pump Room **Direction:** Looking northwest **Survey Date:** 11/22/2016 **Comments:** Horizontal cracks have self-healed and link seal around pipe penetrations show signs of previous leaking. No active leaks at the time of inspection.	
Photograph ID: 44 **Photo Location:** Pump Room **Direction:** Looking Southwest **Survey Date:** 11/22/2016 **Comments:** Horizontal cracks have self-healed and link seal around pipe penetrations show signs of previous leaking. No active leaks at the time of inspection.	

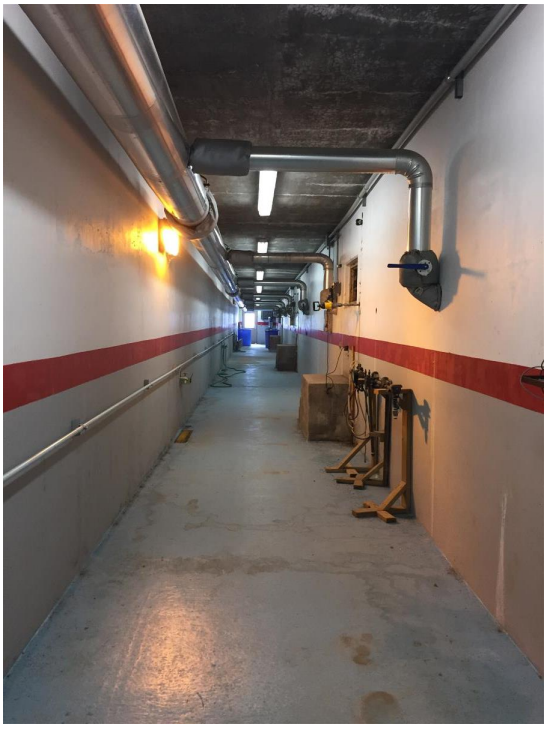
Client:	**Town of Telluride, Colorado**	**Project:**	**Structural Condition Assessment**
Site Name:	**Telluride Waste Water Treatment Plant**	**Site Location:**	**Telluride, CO**

Photograph ID: 45 **Photo Location:** Pump Room **Direction:** Looking down and north **Survey Date:** 11/22/2016 **Comments:** typical failed slab coating system	
Photograph ID: 46 **Photo Location:** Digester No.1 **Direction:** Looking southwest **Survey Date:** 11/22/2016 **Comments:** digester empty, minor concrete surface erosion typical for age of structure. A lot of debris and growth along walls and slab. Piping appears to be in working condition	

Client:	**Town of Telluride, Colorado**	**Project:**	**Structural Condition Assessment**
Site Name:	**Telluride Waste Water Treatment Plant**	**Site Location:**	**Telluride, CO**

Photograph ID: 47 **Photo Location:** Digester No.1 **Direction:** Looking west **Survey Date:** 11/22/2016 **Comments:** deck support angle corroded and needs to be replaced.	
Photograph ID: 48 **Photo Location:** Digester No.1 **Direction:** Looking northwest at access frame **Survey Date:** 11/22/2016 **Comments:** access frame coating system has failed and steel is corroding	

Client:	**Town of Telluride, Colorado**	**Project:**	**Structural Condition Assessment**
Site Name:	**Telluride Waste Water Treatment Plant**	**Site Location:**	**Telluride, CO**

Photograph ID: 49 **Photo Location:** Observation Gallery between Digesters and Oxidation Ditch No. 3 **Direction:** Looking south **Survey Date:** 11/22/2016 **Comments:** Minor wall surface cracks, most are self-healed, floor coating system ending its service life, top deck slab has multiple cracks, no active leaks at time of inspection.	
Photograph ID: 50 **Photo Location:** Digester No.2 **Direction:** Looking northwest **Survey Date:** 11/22/2016 **Comments:** No guardrail or handrail on stairs. Valve stem and wheel missing	

Client:	**Town of Telluride, Colorado**	**Project:**	**Structural Condition Assessment**
Site Name:	**Telluride Waste Water Treatment Plant**	**Site Location:**	**Telluride, CO**

Photograph ID: 51 **Photo Location:** Digester No.2 **Direction:** Looking northwest **Survey Date:** 11/22/2016 **Comments:** access frame coating system has failed and steel is corroding	
Photograph ID: 52 **Photo Location:** Digester No.2 **Direction:** Looking southwest **Survey Date:** 11/22/2016 **Comments:** access frame coating system has failed and steel is corroding	

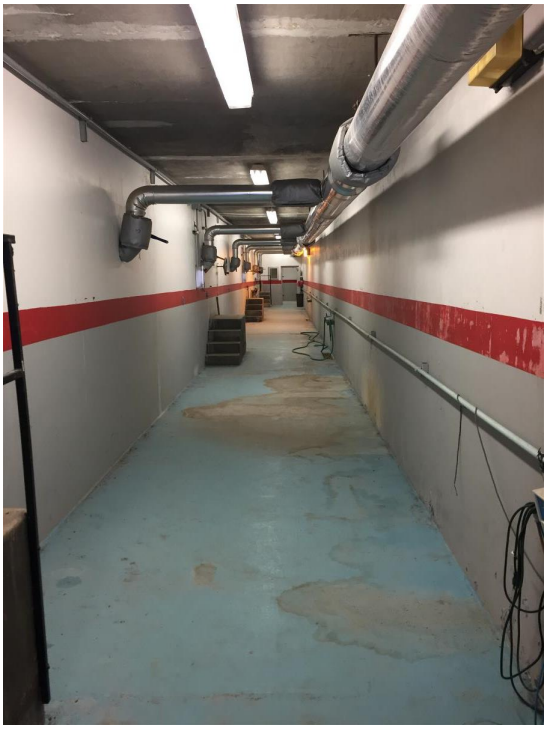
Client:	**Town of Telluride, Colorado**	**Project:**	**Structural Condition Assessment**
Site Name:	**Telluride Waste Water Treatment Plant**	**Site Location:**	**Telluride, CO**

Photograph ID: 53 **Photo Location:** Digester No.2 **Direction:** Looking west **Survey Date:** 11/22/2016 **Comments:** galvanized deck and support beams okay, vegetation growth near entrance, tank in service so full inspection not able to be performed	
Photograph ID: 54 **Photo Location:** Digester No.3 **Direction:** Looking southwest **Survey Date:** 11/22/2016 **Comments:** access frame coating system has failed and steel is corroding. similar internal condition as Digester No.1	

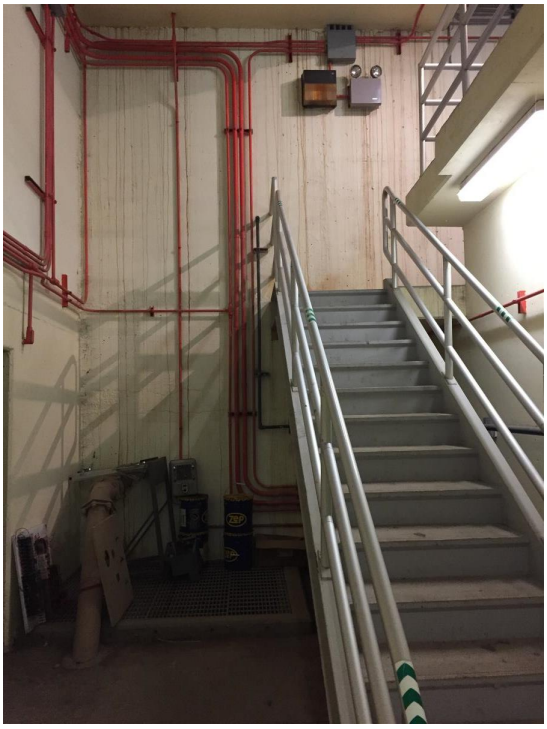
Client:	**Town of Telluride, Colorado**	**Project:**	**Structural Condition Assessment**
Site Name:	**Telluride Waste Water Treatment Plant**	**Site Location:**	**Telluride, CO**

Photograph ID: 55 **Photo Location:** Digester No.3 **Direction:** Looking southeast **Survey Date:** 11/22/2016 **Comments:** upper roof deck support angle corroding and might not have been properly galvanized. Need to replace	
Photograph ID: 56 **Photo Location:** Digester No.4 **Direction:** Looking northwest **Survey Date:** 11/22/2016 **Comments:** access frame coating system has failed and steel is corroding, but is not as bad as the other digesters.	

Client:	**Town of Telluride, Colorado**	**Project:**	**Structural Condition Assessment**
Site Name:	**Telluride Waste Water Treatment Plant**	**Site Location:**	**Telluride, CO**

Photograph ID: 57 **Photo Location:** Digester No.4 **Direction:** Looking west **Survey Date:** 11/22/2016 **Comments:** galvanized deck and support beams okay, vegetation growth near entrance, tank in service so full inspection not able to be performed	
Photograph ID: 58 **Photo Location:** Observation Gallery between Digesters and Oxidation Ditch No. 3 **Direction:** Looking north **Survey Date:** 11/22/2016 **Comments:** Failed floor coating system and no guard rail on Digesters 2 and 3	

Client:	**Town of Telluride, Colorado**	**Project:**	**Structural Condition Assessment**
Site Name:	**Telluride Waste Water Treatment Plant**	**Site Location:**	**Telluride, CO**

Photograph ID: 59 **Photo Location:** Pipe Gallery west side 2002 to 1995 construction **Direction:** Looking west **Survey Date:** 11/22/2016 **Comments:** Stairs and concrete in okay condition, connection between 2002 and 1995 construction shows signs of roof leaking	
Photograph ID: 60 **Photo Location:** Pipe Gallery west side **Direction:** Looking east **Survey Date:** 11/22/2016 **Comments:** Base slab, clarifier No. 3 and Oxidation Ditch No.3 concrete walls in okay condition. Coating system at end of service life	

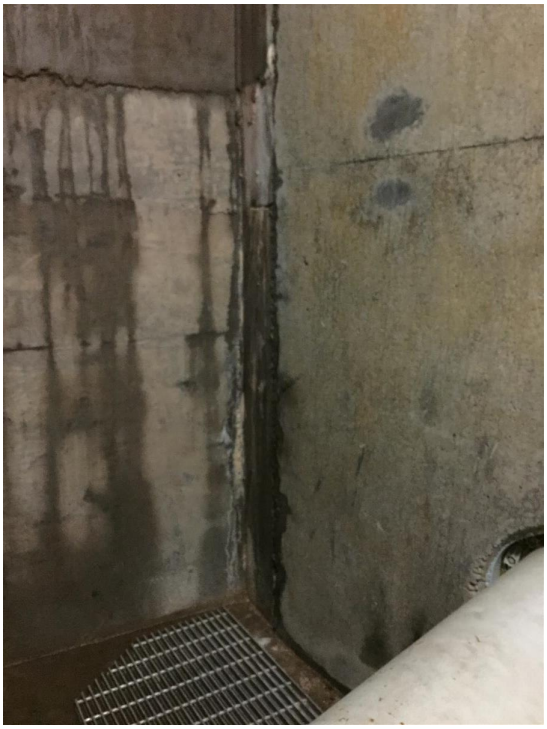
Client:	**Town of Telluride, Colorado**	**Project:**	**Structural Condition Assessment**
Site Name:	**Telluride Waste Water Treatment Plant**	**Site Location:**	**Telluride, CO**

Photograph ID: 61 **Photo Location:** Oxidation Ditch No.3 **Direction:** Northwest corner at lower level looking up **Survey Date:** 11/22/2016 **Comments:** Condensation observed on HVAC ducts. Steel is corroding	
Photograph ID: 62 **Photo Location:** Oxidation Ditch No.3 **Direction:** Northwest corner at lower level looking up **Survey Date:** 11/22/2016 **Comments:** Concrete in okay condition, small active leak at roof slab to older construction	

Client:	**Town of Telluride, Colorado**	**Project:**	**Structural Condition Assessment**
Site Name:	**Telluride Waste Water Treatment Plant**	**Site Location:**	**Telluride, CO**

Photograph ID: 63 **Photo Location:** Pipe Gallery at Oxidation Ditch No.3 **Direction:** North side lower level looking east **Survey Date:** 11/22/2016 **Comments:** concrete in good condition, none to a few hairline cracks, coating system nearing end of life.	
Photograph ID: 64 **Photo Location:** Pipe Gallery at Oxidation Ditch No.3 **Direction:** Lower level between Oxidation Ditch No.2 and 3 looking down **Survey Date:** 11/22/2016 **Comments:** Exposed slab rebar corroding. unprotected cut rebar from 1995 construction	

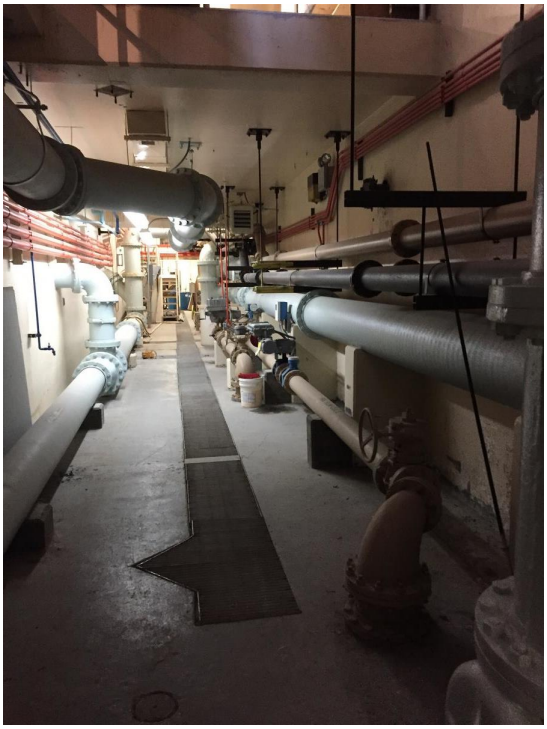
Client:	**Town of Telluride, Colorado**	**Project:**	**Structural Condition Assessment**
Site Name:	**Telluride Waste Water Treatment Plant**	**Site Location:**	**Telluride, CO**

Photograph ID: 65 **Photo Location:** Oxidation Ditch No.3 **Direction:** Northeast corner lower level looking up **Survey Date:** 11/22/2016 **Comments:** a lot of condensation / leaks between roof slab and Oxidation Ditch No.2 concrete walls. 2002 to 1995 concrete connections	
Photograph ID: 66 **Photo Location:** Oxidation Ditch No.3 **Direction:** Northeast corner lower level looking southeast **Survey Date:** 11/22/2016 **Comments:** active leak at Oxidation Ditch No.3 wall to 1995 construction	

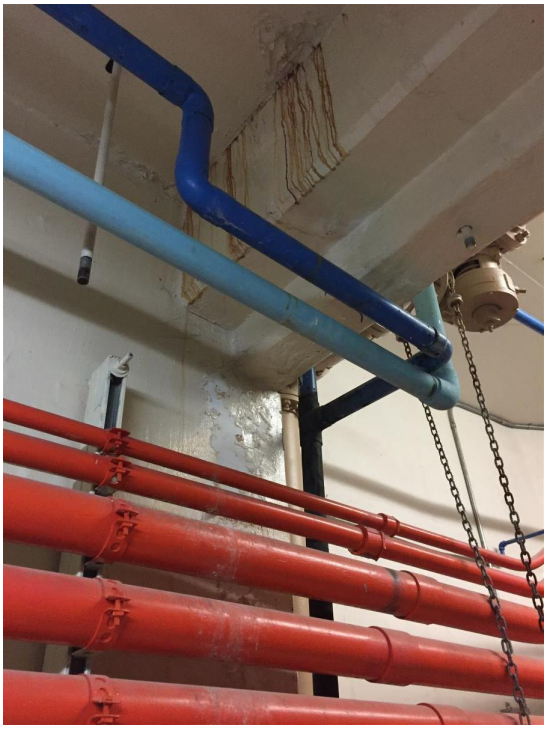
Client:	**Town of Telluride, Colorado**	**Project:**	**Structural Condition Assessment**
Site Name:	**Telluride Waste Water Treatment Plant**	**Site Location:**	**Telluride, CO**

Photograph ID: 67 **Photo Location:** Pipe Gallery at Oxidation Ditch No.3 **Direction:** Northeast corner lower level looking southeast at corner entrance **Survey Date:** 11/22/2016 **Comments:** Leak at foundation between 1995 walls/slab to 2002 slab construction	
Photograph ID: 68 **Photo Location:** Pipe Gallery at Oxidation Ditch No.3 **Direction:** Northeast corner lower level looking northeast at top of opening **Survey Date:** 11/22/2016 **Comments:** leak from 2002 top slab to 1995 wall connection	

Client:	**Town of Telluride, Colorado**	**Project:**	**Structural Condition Assessment**
Site Name:	**Telluride Waste Water Treatment Plant**	**Site Location:**	**Telluride, CO**

Photograph ID: 69 **Photo Location:** Pipe Gallery at Oxidation Ditch No.2 **Direction:** Northwest corner lower level looking southwest **Survey Date:** 11/22/2016 **Comments:** corrosion of 1995 cut wall rebar starting to show signs of corrosion through coating system. Leak at wall to slab intersection	
Photograph ID: 70 **Photo Location:** Pipe Gallery at Oxidation Ditch No.2 **Direction:** Northwest corner lower level looking east **Survey Date:** 11/22/2016 **Comments:** Concrete walls, beams, slabs, columns okay with minor wall and slab surface cracks. Coating at end of service life	

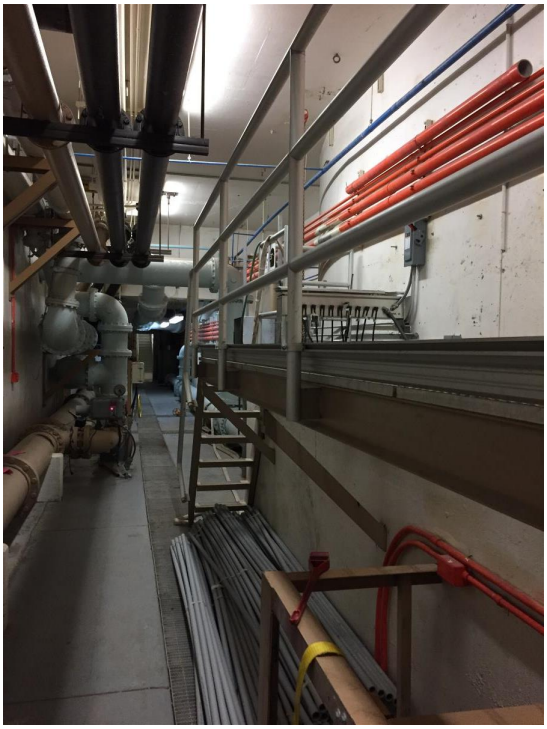
Client:	**Town of Telluride, Colorado**	**Project:**	**Structural Condition Assessment**
Site Name:	**Telluride Waste Water Treatment Plant**	**Site Location:**	**Telluride, CO**

Photograph ID: 71 **Photo Location:** Pipe Gallery at Oxidation Ditch No.2 **Direction:** Northeast corner lower level looking southeast **Survey Date:** 11/22/2016 **Comments:** failed coating system at 1995 to 1987 construction	
Photograph ID: 72 **Photo Location:** Pipe Gallery at Oxidation Ditch No.2 **Direction:** Northeast corner lower level looking southeast at upper beam **Survey Date:** 11/22/2016 **Comments:** leak at 1995 slab/beam construction to 1987 beam connection	

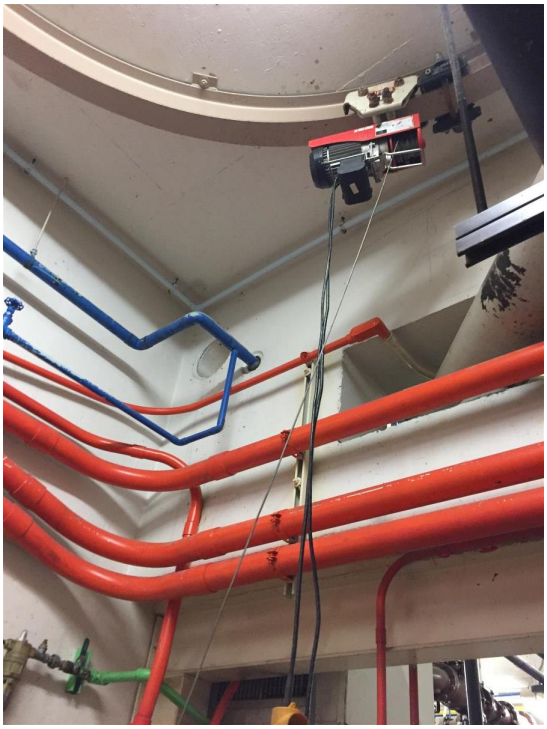
Client:	**Town of Telluride, Colorado**	**Project:**	**Structural Condition Assessment**
Site Name:	**Telluride Waste Water Treatment Plant**	**Site Location:**	**Telluride, CO**

Photograph ID: 73 **Photo Location:** Pipe Gallery at Oxidation Ditch No.2 **Direction:** Northeast corner lower level looking southeast at upper beam **Survey Date:** 11/22/2016 **Comments:** tension crack at mid-span of beam, leak at old to new construction	
Photograph ID: 74 **Photo Location:** Pipe Gallery at Oxidation Ditch No.2 **Direction:** Northeast corner lower level looking southeast at upper beam **Survey Date:** 11/22/2016 **Comments:** shear crack at end of beam	

Client:	**Town of Telluride, Colorado**	**Project:**	**Structural Condition Assessment**
Site Name:	**Telluride Waste Water Treatment Plant**	**Site Location:**	**Telluride, CO**

Photograph ID: 75 **Photo Location:** Pipe Gallery at Oxidation Ditch No.2 **Direction:** Northeast corner lower level looking southwest at Oxidation Ditch No.2 wall to slab connection **Survey Date:** 11/22/2016 **Comments:** small leak at wall to floor slab connection	
Photograph ID: 76 **Photo Location:** Pipe Gallery at Oxidation Ditch No.1 **Direction:** Northeast corner lower level looking west **Survey Date:** 11/22/2016 **Comments:** UV channel, walkway and guard railing in okay condition. Wall coating system at end of life.	

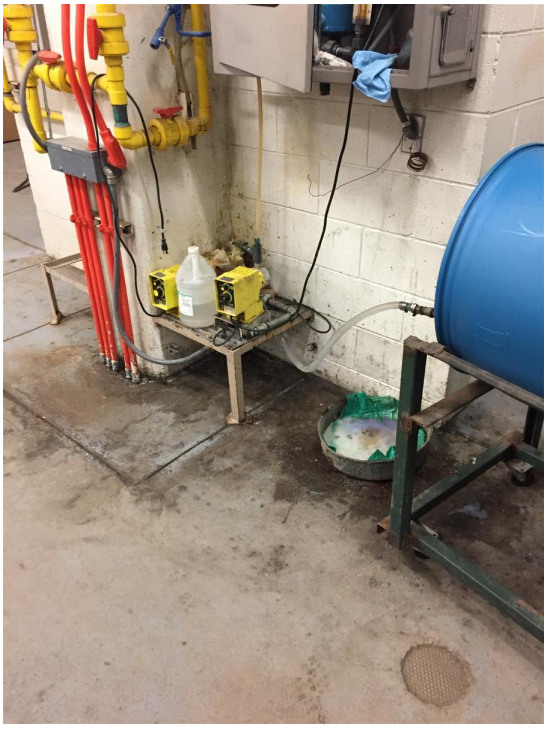
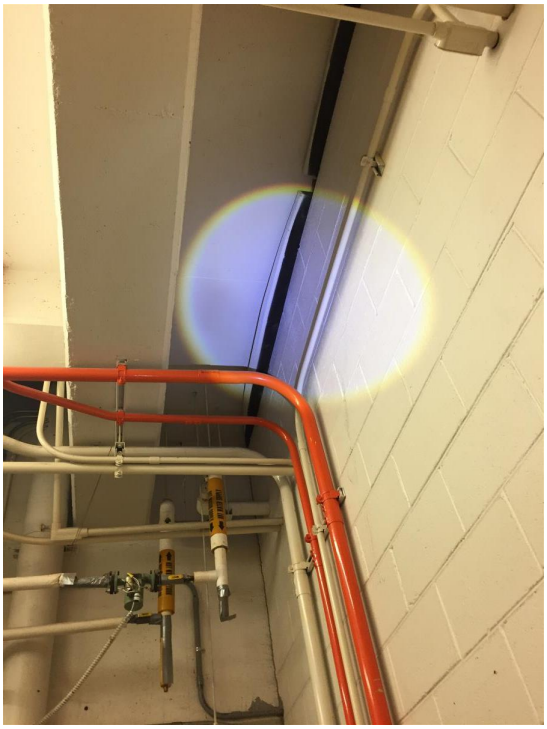
Client:	**Town of Telluride, Colorado**	**Project:**	**Structural Condition Assessment**
Site Name:	**Telluride Waste Water Treatment Plant**	**Site Location:**	**Telluride, CO**

Photograph ID: 77 **Photo Location:** Pipe Gallery at UV channel **Direction:** Mid channel looking down **Survey Date:** 11/22/2016 **Comments:** Concrete grout in okay condition, coating failure along wall under grating support angles	
Photograph ID: 78 **Photo Location:** Pipe Gallery at Oxidation Ditch No.1 **Direction:** Northeast corner lower level looking northeast **Survey Date:** 11/22/2016 **Comments:** monorail and hoist over UV channel in okay condition. Beam between gallery and pump room in okay condition	

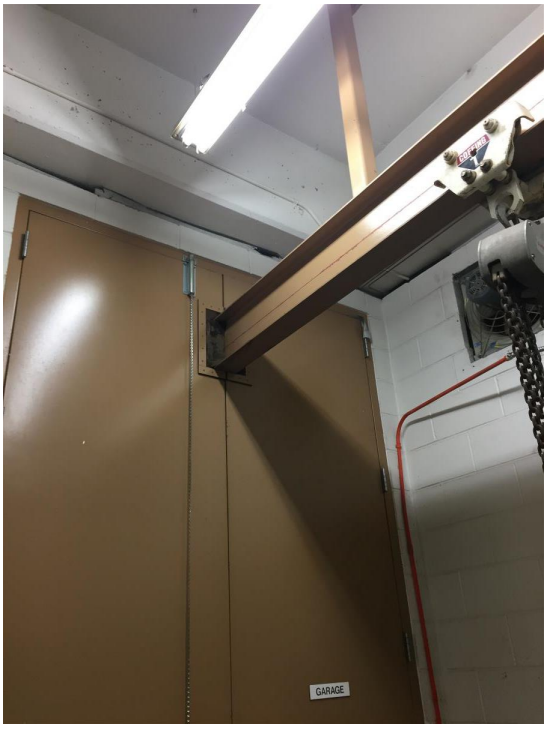
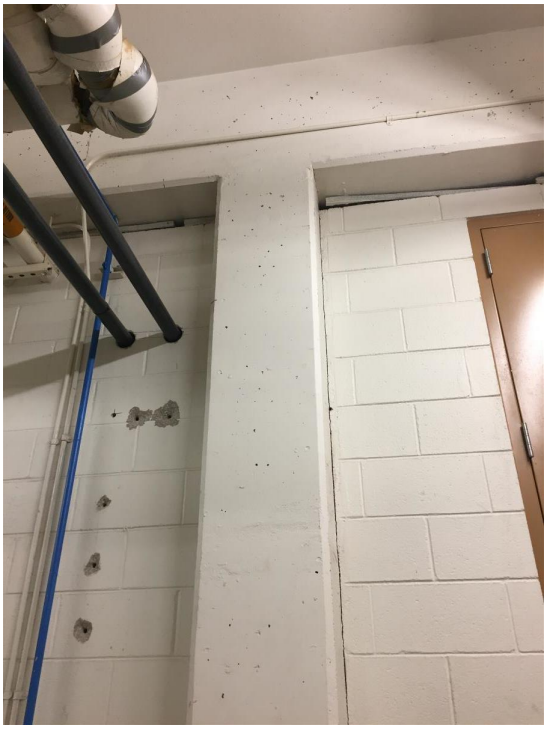
Client:	**Town of Telluride, Colorado**	**Project:**	**Structural Condition Assessment**
Site Name:	**Telluride Waste Water Treatment Plant**	**Site Location:**	**Telluride, CO**

Photograph ID: 79 **Photo Location:** Oxidation Ditch No.1 **Direction:** Northeast Corner lower level corner room **Survey Date:** 11/22/2016 **Comments:** roof, wall, and floor in okay condition. no visible leaks, but ditch was not in service	
Photograph ID: 80 **Photo Location:** East Sludge Pump Room **Direction:** Southwest corner looking northeast **Survey Date:** 11/22/2016 **Comments:** Floor grating in okay condition, some areas showing minor corrosion. CMU wall infill in okay condition, concrete columns and upper floor in okay condition. coating system near end of service life.	

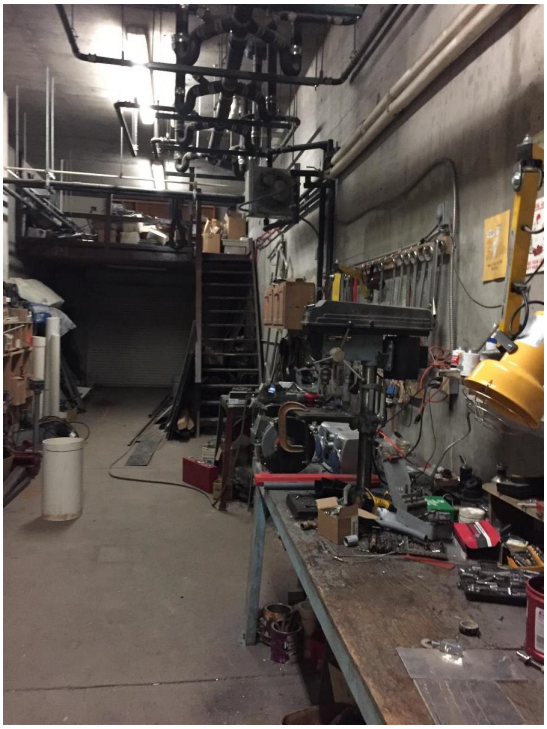
Client:	**Town of Telluride, Colorado**	**Project:**	**Structural Condition Assessment**
Site Name:	**Telluride Waste Water Treatment Plant**	**Site Location:**	**Telluride, CO**

Photograph ID: 81 **Photo Location:** East Sludge Pump Room **Direction:** Southwest corner looking southeast **Survey Date:** 11/22/2016 **Comments:** potentially corrosive chemicals spilled on concrete floor. coating system is damaged.	
Photograph ID: 82 **Photo Location:** East Sludge Pump Room **Direction:** Up **Survey Date:** 11/22/2016 **Comments:** Typical CMU joint filler at top of wall sliding out of joint	

Client:	**Town of Telluride, Colorado**	**Project:**	**Structural Condition Assessment**
Site Name:	**Telluride Waste Water Treatment Plant**	**Site Location:**	**Telluride, CO**

Photograph ID: 83 **Photo Location:** East Sludge Pump Room **Direction:** South side looking east **Survey Date:** 11/22/2016 **Comments:** garage monorail beam, hoist and door in good condition. Door is missing hardware	
Photograph ID: 84 **Photo Location:** East Sludge Pump Room **Direction:** South side looking east **Survey Date:** 11/22/2016 **Comments:** un-patched CMU holes adjacent to Garage door	

Client:	**Town of Telluride, Colorado**	**Project:**	**Structural Condition Assessment**
Site Name:	**Telluride Waste Water Treatment Plant**	**Site Location:**	**Telluride, CO**

Photograph ID: 85 **Photo Location:** East Sludge Pump Room **Direction:** East side looking southwest **Survey Date:** 11/22/2016 **Comments:** Tank concrete supports in okay condition	
Photograph ID: 86 **Photo Location:** Storage Room **Direction:** North side looking south **Survey Date:** 11/22/2016 **Comments:** concrete walls and slabs in okay condition. minor surface cracking. Mezzanine supports and stairs in okay condition	

APPENDIX B

MWH

Photographic Log

Client:	**Town of Telluride, Colorado**	**Project:**	**Structural Condition Assessment**
Site Name:	**Telluride Waste Water Treatment Plant**	**Site Location:**	**Telluride, CO**

Photograph ID: 1	
Photo Location: Digester No. 1 and 2 external entry from west side	
Direction: East side of opening looking west	
Survey Date: 11/22/2016	
Comments: concrete tensile crack at top surface	
Photograph ID: 2	
Photo Location: Digester No. 3 and 4 external entry from west side	
Direction: East side of opening looking west	
Survey Date: 11/22/2016	
Comments: concrete tensile crack at top surface	

Client:	**Town of Telluride, Colorado**	**Project:**	**Structural Condition Assessment**
Site Name:	**Telluride Waste Water Treatment Plant**	**Site Location:**	**Telluride, CO**

Photograph ID: 3 **Photo Location:** Oxidation Ditch No.3 south entry **Direction:** Center looking north **Survey Date:** 11/22/2016 **Comments:** Galvanized stl beams in okay condition, concrete has minor surface wear and cracking. Vegetation growth on some surfaces. Bad bearing support for roof support beam	
Photograph ID: 4 **Photo Location:** Oxidation Ditch No.3 south entry **Direction:** Center looking west **Survey Date:** 11/22/2016 **Comments:** Walkway along Oxidation Rotor in okay condition. Grating support beams and anchorage in okay condition	

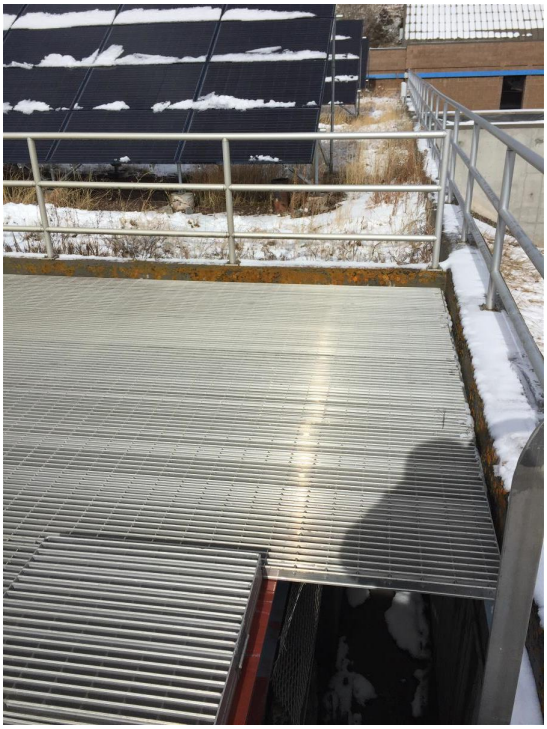
Client:	**Town of Telluride, Colorado**	**Project:**	**Structural Condition Assessment**
Site Name:	**Telluride Waste Water Treatment Plant**	**Site Location:**	**Telluride, CO**

Photograph ID: 5 **Photo Location:** Oxidation Ditch No.3 south entry **Direction:** Center looking northeast **Survey Date:** 11/22/2016 **Comments:** Vegetation growth along Oxidation Rotor	
Photograph ID: 6 **Photo Location:** Oxidation Ditch No.3 south entry **Direction:** Center looking east **Survey Date:** 11/22/2016 **Comments:** Normal wear on concrete surfaces. coating system above water line is past its service life. Minor concrete cracks in base slab and walls. Debris accumulated on support beams	

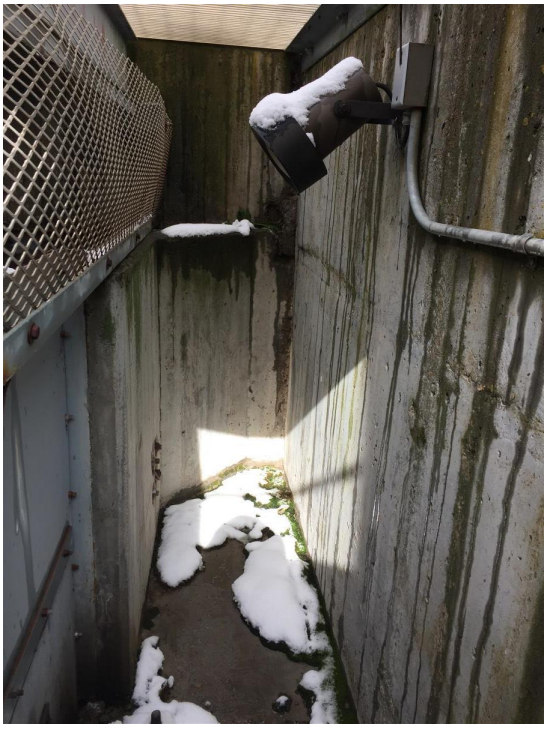
Client:	**Town of Telluride, Colorado**	**Project:**	**Structural Condition Assessment**
Site Name:	**Telluride Waste Water Treatment Plant**	**Site Location:**	**Telluride, CO**

Photograph ID: 7 **Photo Location:** Oxidation Ditch No.3 south entry **Direction:** Center looking north **Survey Date:** 11/22/2016 **Comments:** Large pile of settled solids.	
Photograph ID: 8 **Photo Location:** Chemical Storage Building **Direction:** West looking east **Survey Date:** 11/22/2016 **Comments:** Chemical building is relatively new and in good condition	

Client:	**Town of Telluride, Colorado**	**Project:**	**Structural Condition Assessment**
Site Name:	**Telluride Waste Water Treatment Plant**	**Site Location:**	**Telluride, CO**

Photograph ID: 9 **Photo Location:** Raw Sewage Pump Station **Direction:** South looking southeast **Survey Date:** 11/22/2016 **Comments:** RSPS above ground building in okay condition, below grade structure is un-coated and cannot be isolated. Concrete surfaces exposed to influent is experiencing chemical attack, depth of attack is unknown.	
Photograph ID: 10 **Photo Location:** Oxidation Ditch No.1 south entry **Direction:** East side looking north **Survey Date:** 11/22/2016 **Comments:** Grating in okay condition, surrounding retaining wall is in pour shape. Vegetation growth is occurring and damaging the surface.	

Client:	**Town of Telluride, Colorado**	**Project:**	**Structural Condition Assessment**
Site Name:	**Telluride Waste Water Treatment Plant**	**Site Location:**	**Telluride, CO**

Photograph ID: 11 **Photo Location:** Oxidation Ditch No.1 south entry **Direction:** East side looking north **Survey Date:** 11/22/2016 **Comments:** Vegetation growth on concrete surface. Minor concrete racking. Steel bolts corroding and protective mesh guard damaged and un-secured	
Photograph ID: 12 **Photo Location:** Oxidation Ditch No.1 south entry **Direction:** East side looking northwest and down **Survey Date:** 11/22/2016 **Comments:** Oxidation Rotor bearing exposed to elements and not protected	

Client:	**Town of Telluride, Colorado**	**Project:**	**Structural Condition Assessment**
Site Name:	**Telluride Waste Water Treatment Plant**	**Site Location:**	**Telluride, CO**

Photograph ID: 13 **Photo Location:** Oxidation Ditch No.1 south entry **Direction:** East side looking south and down **Survey Date:** 11/22/2016 **Comments:** Some ladder rungs no longer have their non-slip coating, minor surface abrasion of concrete floor, walkway grating in okay condition	
Photograph ID: 14 **Photo Location:** Oxidation Ditch No.1 south entry **Direction:** East side looking west **Survey Date:** 11/22/2016 **Comments:** Vegetation growth on concrete walls and oxidation rotor, Beam connections working, but starting to loose its coating system and steel is corroding in localized areas	

Client:	**Town of Telluride, Colorado**	**Project:**	**Structural Condition Assessment**
Site Name:	**Telluride Waste Water Treatment Plant**	**Site Location:**	**Telluride, CO**

Photograph ID: 15 **Photo Location:** Oxidation Ditch No.1 south entry **Direction:** East side looking northwest **Survey Date:** 11/22/2016 **Comments:** Beam anchorage staring to corrode, wall coating system has failed and past its service life	
Photograph ID: 16 **Photo Location:** Oxidation Ditch No.1 south entry **Direction:** Center looking north **Survey Date:** 11/22/2016 **Comments:** Beam coating system has failed in multiple locations and is delaminated. Steel is starting to corrode	

Client:	**Town of Telluride, Colorado**	**Project:**	**Structural Condition Assessment**
Site Name:	**Telluride Waste Water Treatment Plant**	**Site Location:**	**Telluride, CO**

Photograph ID: 17 **Photo Location:** Oxidation Ditch No.1 south entry **Direction:** Center looking north **Survey Date:** 11/22/2016 **Comments:** Anchor bolts starting to corrode	
Photograph ID: 18 **Photo Location:** Oxidation Ditch No.1 south entry **Direction:** West Side looking northwest **Survey Date:** 11/22/2016 **Comments:** Beam coating system delaminating, beam flanges corroding, vegetation growth on concrete surfaces	

Client:	**Town of Telluride, Colorado**	**Project:**	**Structural Condition Assessment**
Site Name:	**Telluride Waste Water Treatment Plant**	**Site Location:**	**Telluride, CO**

Photograph ID: 19 **Photo Location:** Oxidation Ditch No.1 south entry **Direction:** West side looking west **Survey Date:** 11/22/2016 **Comments:** Beam coating system delaminating, beam flanges corroding, vegetation growth on concrete surfaces	
Photograph ID: 20 **Photo Location:** Oxidation Ditch No.1 south entry **Direction:** West side looking west **Survey Date:** 11/22/2016 **Comments:** Coating system on roof support beams failing and delaminating, normal wear on concrete wall surfaces, Wall coating system past service life, minor concrete cracking on walls	

Client:	**Town of Telluride, Colorado**	**Project:**	**Structural Condition Assessment**
Site Name:	**Telluride Waste Water Treatment Plant**	**Site Location:**	**Telluride, CO**

Photograph ID: 21 **Photo Location:** Oxidation Ditch No.1 south entry **Direction:** West side looking north **Survey Date:** 11/22/2016 **Comments:** bearings and motor exposed to elements. coating system past service life and steel is corroding	
Photograph ID: 22 **Photo Location:** Oxidation Ditch No.1 south entry **Direction:** West side looking north **Survey Date:** 11/22/2016 **Comments:** Large pile of settled solids.	

Client:	**Town of Telluride, Colorado**	**Project:**	**Structural Condition Assessment**
Site Name:	**Telluride Waste Water Treatment Plant**	**Site Location:**	**Telluride, CO**

Photograph ID: 23 **Photo Location:** Oxidation Ditch No.1 south entry **Direction:** West side looking south **Survey Date:** 11/22/2016 **Comments:** Coating system on grating support beams delaminating. Anchor bolts starting to corrode	
Photograph ID: 24 **Photo Location:** Oxidation Ditch No.3 center **Direction:** East side looking northwest **Survey Date:** 11/22/2016 **Comments:** CMU block wall and cap cracking and allowing water intrusion creating freeze thaw damage	

Client:	**Town of Telluride, Colorado**	**Project:**	**Structural Condition Assessment**
Site Name:	**Telluride Waste Water Treatment Plant**	**Site Location:**	**Telluride, CO**

Photograph ID: 25 **Photo Location:** Oxidation Ditch No.3 center **Direction:** North side looking southwest **Survey Date:** 11/22/2016 **Comments:** CMU block wall and cap cracking and allowing water intrusion creating freeze thaw damage	
Photograph ID: 26 **Photo Location:** Oxidation Ditch No.3 center **Direction:** North side looking southeast **Survey Date:** 11/22/2016 **Comments:** Coating system on grating support angles past service life and steel is starting to corrode. Vegetation growth. Multiple surface cracks in wall	

Client:	**Town of Telluride, Colorado**	**Project:**	**Structural Condition Assessment**
Site Name:	**Telluride Waste Water Treatment Plant**	**Site Location:**	**Telluride, CO**

Photograph ID: 27 **Photo Location:** Oxidation Ditch No.3 north entry **Direction:** East side looking north **Survey Date:** 11/22/2016 **Comments:** Vegetation growth on walls, walkway in okay condition	
Photograph ID: 28 **Photo Location:** Oxidation Ditch No.3 north entry **Direction:** East side looking west **Survey Date:** 11/22/2016 **Comments:** Grating support beams in okay condition, minor localized coating failure. Grating in okay condition with localized vegetation growth	

Client:	**Town of Telluride, Colorado**	**Project:**	**Structural Condition Assessment**
Site Name:	**Telluride Waste Water Treatment Plant**	**Site Location:**	**Telluride, CO**

Photograph ID: 29 **Photo Location:** Oxidation Ditch No.3 north entry **Direction:** Center looking north **Survey Date:** 11/22/2016 **Comments:** Normal concrete surface wear, coating system past service life	
Photograph ID: 30 **Photo Location:** Oxidation Ditch No.3 north entry **Direction:** Center looking north **Survey Date:** 11/22/2016 **Comments:** Minor cracking in concrete walls	

Client:	**Town of Telluride, Colorado**	**Project:**	**Structural Condition Assessment**
Site Name:	**Telluride Waste Water Treatment Plant**	**Site Location:**	**Telluride, CO**

Photograph ID: 31 **Photo Location:** Oxidation Ditch No.3 north entry **Direction:** West side looking southwest **Survey Date:** 11/22/2016 **Comments:** vegetation growth on Oxidation Rotor, grating support beam anchorage in working condition	
Photograph ID: 32 **Photo Location:** Oxidation Ditch No.3 north entry **Direction:** West side looking south **Survey Date:** 11/22/2016 **Comments:** Equipment exposed to elements, concrete in okay condition with minor surface cracks, support beams in okay condition	

Client:	**Town of Telluride, Colorado**	**Project:**	**Structural Condition Assessment**
Site Name:	**Telluride Waste Water Treatment Plant**	**Site Location:**	**Telluride, CO**

Photograph ID: 33 **Photo Location:** Oxidation Ditch No.3 north entry **Direction:** West side looking west **Survey Date:** 11/22/2016 **Comments:** Roof decking and support beam in okay condition, normal wear on concrete surfaces, concrete coating system past service life. Couple minor active leaks in external concrete walls	
Photograph ID: 34 **Photo Location:** Oxidation Ditch No.1 north entry **Direction:** West side looking south **Survey Date:** 11/22/2016 **Comments:** Vegetation growth on concrete, minor concrete surface cracks	

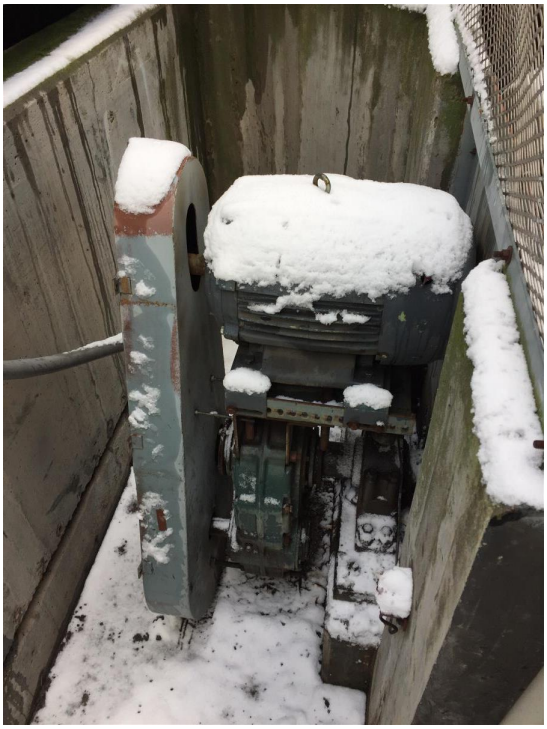
Client:	**Town of Telluride, Colorado**	**Project:**	**Structural Condition Assessment**
Site Name:	**Telluride Waste Water Treatment Plant**	**Site Location:**	**Telluride, CO**

Photograph ID: 35 **Photo Location:** Oxidation Ditch No.1 north entry **Direction:** West side looking north **Survey Date:** 11/22/2016 **Comments:** Normal concrete surface wear, coating system past service life, minor active leaks along wall surface, pipe in okay condition	
Photograph ID: 36 **Photo Location:** Oxidation Ditch No.1 north entry **Direction:** West side looking east **Survey Date:** 11/22/2016 **Comments:** Vegetation growth around Oxidation Rotor, vegetation growth on concrete surfaces, walkway in okay condition with localized areas of vegetation growth	

Client:	**Town of Telluride, Colorado**	**Project:**	**Structural Condition Assessment**
Site Name:	**Telluride Waste Water Treatment Plant**	**Site Location:**	**Telluride, CO**

Photograph ID: 37 **Photo Location:** Oxidation Ditch No.1 north entry **Direction:** West side looking northeast and down **Survey Date:** 11/22/2016 **Comments:** Normal concrete surface wear, coating system past service life, minor active leaks along wall surface, pipe in okay condition	
Photograph ID: 38 **Photo Location:** Oxidation Ditch No.1 north entry **Direction:** Center looking northwest **Survey Date:** 11/22/2016 **Comments:** Support beam coating system has failed and is delaminating from steel surface	

Client:	**Town of Telluride, Colorado**	**Project:**	**Structural Condition Assessment**
Site Name:	**Telluride Waste Water Treatment Plant**	**Site Location:**	**Telluride, CO**

Photograph ID: 39 **Photo Location:** Oxidation Ditch No.1 north entry **Direction:** East looking northeast **Survey Date:** 11/22/2016 **Comments:** Support beam coating system has failed and is delaminating from steel surface. Flanges are corroding	
Photograph ID: 40 **Photo Location:** Oxidation Ditch No.1 north entry **Direction:** East looking south **Survey Date:** 11/22/2016 **Comments:** Equipment exposed to elements, minor surface cracking along concrete walls, vegetation growth	

Client:	**Town of Telluride, Colorado**	**Project:**	**Structural Condition Assessment**
Site Name:	**Telluride Waste Water Treatment Plant**	**Site Location:**	**Telluride, CO**

Photograph ID: 41 **Photo Location:** Oxidation Ditch No.1 north entry **Direction:** East looking south **Survey Date:** 11/22/2016 **Comments:** Delaminated coating system, vegetation growth on concrete	
Photograph ID: 42 **Photo Location:** Oxidation Ditch No.1 north entry **Direction:** East looking southwest **Survey Date:** 11/22/2016 **Comments:** Debris accumulating along roof support beam, grating support beam anchorage functioning but starting to corrode	

Client:	**Town of Telluride, Colorado**	**Project:**	**Structural Condition Assessment**
Site Name:	**Telluride Waste Water Treatment Plant**	**Site Location:**	**Telluride, CO**

Photograph ID: 43 **Photo Location:** Roof at Clarifier No.1, Headworks, and Admin roof **Direction:** West looking northeast **Survey Date:** 11/22/2016 **Comments:** Damaged flashing, possibly allowing water intrusion	
Photograph ID: 44 **Photo Location:** Roof at Clarifier No.1 and Admin Roof **Direction:** West looking southeast **Survey Date:** 11/22/2016 **Comments:** Typical Roof construction, could not determine membrane condition due to snow. Flashing joints okay. Localized coating failure on wall flashing	

Client:	**Town of Telluride, Colorado**	**Project:**	**Structural Condition Assessment**
Site Name:	**Telluride Waste Water Treatment Plant**	**Site Location:**	**Telluride, CO**

Photograph ID: 45 **Photo Location:** Stairway roof west of Clarifier No.1 and Oxidation Ditch No. 1 **Direction:** North side looking southeast **Survey Date:** 11/22/2016 **Comments:** Typical roof scupper. Membrane appears to be properly adhered. Ice buildup preventing water draining. Water drains against foundation / below grade roof walls.	
Photograph ID: 46 **Photo Location:** Stairway north side of Oxidation Ditch No.2 **Direction:** East side looking west **Survey Date:** 11/22/2016 **Comments:** Roof membrane appears to be sealed, block in okay condition, support wall in okay condition with minor surface cracks, flashing in okay condition, but coating system is nearing the end of its service life	

Client:	**Town of Telluride, Colorado**	**Project:**	**Structural Condition Assessment**
Site Name:	**Telluride Waste Water Treatment Plant**	**Site Location:**	**Telluride, CO**

Photograph ID: 47

Photo Location:
Stairway north side of Oxidation Ditch No.2

Direction:
Southeast corner looking northwest

Survey Date:
11/22/2016

Comments:
No roof downspout or splash block, drains against foundation



Appendix D ELECTRICAL ASSESSMENT MEMORANDUM

Stantec

Memo

To:	Bill Goldsworthy, Karen Guglielmone, Paul Ruud, Greg Clifton, Peter Hayes	From:	Lindsey Rafter
	Town of Telluride		Denver, CO Office
File:	205305088	Date:	February 2, 2017

INTRODUCTION

The objective of this technical memorandum (TM) is to describe the electrical equipment condition of the Telluride Regional Wastewater Treatment Plant (TRWWTP) and indicate any code violations observed. The condition assessment was completed on Tuesday November 22, 2016. The assessment covers the entire Wastewater Treatment Plant with emphasis on the existing electrical service and headworks area.

At the time of the assessment the areas within the TRWWTP have not been formally classified per the National Electrical Code (NEC) article 500 or National Fire Protection Association (NFPA) 820. The information included in this TM is the Engineer's interpretation of NEC article 500 as it applies to this facility. At the time of the assessment ventilation air changes per hour were not available and therefore the following report is based on the strictest interpretation of NFPA 820.

The San Miguel Power Association is the Electrical Utility supplying the TRWWTP. The San Miguel Power Association is reporting average demands of 270 KW per month for the last year, with peak demand around 300 KW. These values in conjunction with individual MCC metered data, as discussed in subsequent paragraphs, will require further investigation to understand the extent of available capacity for retrofit at either MCC.

This assessment was conducted as a visual assessment only. Motor Control Centers (MCC), panels, and other enclosures were not opened to inspect wiring and electrical components inside. This report includes visual inspection findings and recommendations.

GENERAL CONDITION

The electrical equipment within the TRWWTP is generally in good condition. The equipment has been housed in conditioned spaces or has been adequately maintained throughout the life of the installation.

The incoming utility service transformer is in fair condition. The TRWWTP main switchboard is in good condition. The utility Service transformer is located to the east of the generator building while the switchboard is located inside the generator building with the 1000KW Cat Generator. Per discussions with operations staff at the time of the assessment, the generator and ATS operate as expected during utility service power outage. The operations staff also runs the generator for maintenance purposes several times a year and has had no issues to report.

Both MCCs remain in good condition. MCC-1 is nearing 30 years old while MCC-2 is approximately 20 years old. MCC-1 is located within an electrical room and is therefore inside a conditioned space. MCC-2 is located in the corridor between the blower room and the digester gallery and is not separately conditioned. MCC-2 does not show visual signs of deterioration even though it is in an unconditioned space.

Control panels, panelboards, switches, disconnects, and associated electrical equipment are generally in good condition throughout the plant, with the exception of those items noted in this TM and shown in Appendix A. All conduit and fittings associated with MCC's, panelboards, control panels, switches, disconnects, motors and instrumentation are in good condition as well, with the exception of specific items noted in this TM and shown in Appendix A. Motors and their associated electrical equipment are mostly in good condition with some showing initial signs of wear. No motors are noted at this time as needing replacement.

Lighting, receptacles and grounding appear to be in good condition. Some lighting and receptacles are not rated for the space they occupy and therefore are in conflict with the requirements of the NEC. Those items are noted in this TM.

Table 1 below notes the general electrical equipment condition of each space within the TRWWTP. The condition possibilities are listed as Good, fair or poor.

Good – Equipment visually shows no signs of deterioration, corrosion, excessive wear, need for replacement. No observed NEC code violations.

Fair – Equipment visually shows some signs of deterioration, corrosion, excessive wear, and may require replacement. Observed NEC code violations.

Poor – Equipment visually shows signs of deterioration, corrosion or excessive wear. Equipment may be missing parts that result in potential hazards to personnel. Equipment may require replacement upon further investigation. Observed NEC code violations.

Table 1 Area Condition Classification Table

Area	Condition	Comments
Raw Sewage Intake Pump Station	Good/Fair	Some NEC article 500 code violations noted. All equipment in good condition with only initial signs of corrosion and rust due to outdoor location.
Generator Building	Good	No NEC code violations to note. Equipment in this building is in good condition and has been well maintained. Based on operations staff, generator and ATS function as expected.
MCC-1 Electrical Room	Good	The electrical equipment within this room is visually in good condition. Appendix A indicates various NEC code violations.
MCC-2	Good	MCC-2 and it's associated panelboard and transformer are in good condition. No code violations observed in this area.
Headworks	Fair/Poor	The headworks area has several NEC code violations. The classification of the area is interpreted to be Class I Div I. A significant amount of the equipment in this area does not meet the interpreted classified area requirements.

Clarifier Room	Fair/Poor	The Clarifier room electrical equipment is in fair to poor condition. The classification of the area is interpreted to be Class I Div II. The electrical equipment in this area does not meet the interpreted classified area requirements.
Blower Room	Good	The electrical equipment within this room is in good condition. No NEC code violations observed in this area.
Digester Pump Station	Good	The equipment within this room is in good condition. See Appendix A for DSP-2 recommendations.
Digester Gallery	Fair	The Digester Gallery electrical equipment is in good condition. The classification of the area is interpreted to be Class I Div II. The electrical equipment in this area does not meet the interpreted classified area requirements.
Oxidation Ditches	Good	The electrical equipment servicing the oxidation ditches, located outside the building, is in good condition. Cable routing for submersible mixers is recommended to be routed in accordance with the NEC. See appendix A for additional information.
Pipe Gallery	Good/Fair	The pipe gallery electrical equipment is in good condition. Appendix A notes observed NEC code violation.
Lower Level Sludge Area	Good/Fair	The sludge area electrical equipment is in good condition. Appendix A notes observed NEC code violations.

SERVICE ENTRANCE AND MCC CONDITION

The utility transformer, service switchboard, ATS, Generator and miscellaneous panelboards and transformers inside the generator building are all in good condition. Equipment inside this building does not show signs of deterioration, corrosion or any need for replacement at this time.

MCC-1

MCC-1 is a Square D Model 5 lineup and spare parts are still attainable, however low availability, long lead times and high cost should be considered if modifications to this MCC are required in the future. If a minor amount of expansion is required within the plant it is possible MCC-1 could be retrofitted to accommodate such expansion through the use of spare parts. If a significant amount of additional load is required to be added to MCC-1 it is recommended the MCC be replaced in its entirety. Replacement of MCC-1 would most likely require a smaller footprint, but would require detailed coordination with existing conduit and cable routing.

The difference between a minor and a significant amount of expansion is unknown at this time, the availability for either would require an understanding of demand load for MCC-1. Currently MCC-1 is not continuously metered and therefore per NEC 220.87 the 1-year maximum demand data is not

available at this time. Any expansion or retrofit of MCC-1 would require TRWWTP to meter the maximum demand for a 30-day period as an exception to the 1-year requirement. Once this data is obtained an accurate depiction of expansion or retrofit capability would be available, and it could be determined if MCC-1 is a candidate for either.

The MCC-1 electrical room is currently in violation of NEC article 100. The room has several exposed wires running the length of the room that are not supported, protected or routed properly. The working clearance above the panelboards has been violated by the addition of a computer shelf above these panels. There is a code violation case where an extension cord is being used for a permanent installation. In general the housekeeping of this room does not meet NEC article 110 requirements.

MCC-1 Main Breaker Concerns

During the condition assessment, operations staff expressed concern regarding the MCC-1 main breaker. The Main breaker is listed as a 1600A frame solid state circuit breaker by Square D. This breaker has a 100,000A interrupting rating at 480V. The trip setting is listed at 1000A. This particular Square D breaker has an under voltage feature that senses line voltage on the upstream side of the breaker. In the event of a power outage the breaker will trip on under voltage prior to the generator startup. This condition results in the generator coming on-line while MCC-1's main breaker is tripped therefore not feeding the required plant loads. If operations staff is not available at the time of the power outage the generator will continue to run while MCC-1 is offline.

Based on preliminary research it seems the under voltage feature is an add-on to the main breaker. It is assumed this add-on could be removed by qualified electrical personnel. Additional research and inspection with the help of qualified electrical staff is required to determine if and how the under voltage piece of equipment could be removed.

If the under voltage add-on is removed the under voltage would be exclusively sensed at the ATS, rather than at both the ATS and MCC-1.

MCC-2

MCC-2 is a Siemens Model 95 lineup. MCC-2 was installed during the 1995 expansion, is in good condition and shows no visual sign of wear or deterioration. MCC-2 looks as though it may have five available spaces and three spare breakers of varying sizes available for potential expansion.

At the time of the condition assessment, 1-year demand metered data, per NEC 220.87, for MCC-2 was not available. Any expansion or retrofit of MCC-2 would require TRWWTP to meter the maximum demand for a 30-day period as an exception to the 1-year requirement.

HEADWORKS CONDITION

The Headworks is original to the 1988 facility construction. This space does not currently meet the code requirements of NEC article 500 and NFPA 820. The Headworks was not originally classified and therefore the observations and recommendations noted in this section are based on the engineer's interpretation of NEC article 500 and NFPA 820. Further investigation is required to formally classify the Headworks and surrounding rooms.

The Headworks is interpreted to be a Class 1 Division 1 space per NFPA 820 Table 5.2.2 Row 2a. The electrical equipment currently housed within the space is in violation of the NEC article 500 and 501. If improvements or modifications are required for this area, per NFPA 820 Section 1.3, any modifications are required to reflect the requirements of NFPA 820 and NEC article 500. Any

affected wiring, conduits, fittings, enclosures, instrumentation, motors, HVAC equipment, receptacles and lighting would need to be modified to match NEC 500 and NFPA 820 requirements.

The space currently houses only two explosion proof enclosures; however these enclosures were not properly maintained at the time of the assessment. All other control panels, disconnects and other various enclosures were visually not in compliance with above mentioned articles. Various conduit installations were missing the required conduit seals and fittings to meet code requirements. All receptacles within the space do not meet the code requirements as referenced above. See Appendix A for additional photographs depicting specific instances of code violations.

ADDITIONAL CLASSIFIED AREAS

Raw Sewage Intake Pump Station

The Raw Sewage Intake Pump Station is interpreted to be a Class I Division I space per NFPA 820 Table 4.2.2 Row 16a. The above grade portion of the pump station was not physically separated from the wetwell at the time of the assessment. If physical separation, as defined by NFPA 820, can be confirmed through further investigation, the above grade portion of the pump station has the potential to be declassified. The condition assessment indicated that original design and construction, of the pump station, accounted for the requirements of the NEC and NFPA 820. Modifications made to the space after the original construction did not account for the requirements of the classified space and therefore some equipment is observed to be in violation of NEC article 500. Observed instances are noted in Appendix A.

Air Blower Room

The Air Blower Room, adjacent to the headworks, is considered to be a Class I Div. I space. During the condition assessment it could not be confirmed that a physical separation is maintained between the Air Blower Room and the Headworks. The definition of physical separation within NFPA 820 requires a gastight partition between two adjacent spaces with no means of gas communication between the spaces. If this requirement can be verified through further investigation of the space the Air Blower Room has the potential to be declassified.

Clarifier Room/Scum Pits/Lower Level Pipe Gallery/Lower Level Sludge Pump Station

The Clarifier Room and Scum Pits are considered a Class I Div. II space per NFPA 820 Table 6.2.2 Row 8b and Row 9a respectively. The Clarifier Room and Scum Pits share the same air space as the lower level pipe gallery and sludge pumping room; therefore, the pipe gallery and sludge pumping room are also considered to be Class I Div. II spaces. This interpretation results in violations of NEC article 500 throughout the above mentioned spaces. Additional investigation of each space would be required to formally classify these spaces. Observed instances of code violations are noted in Appendix A.

Digester Gallery

The Digester Gallery is interpreted to be a Class I Div. II space per NFPA 820 Table 6.2.2 Row 10b. Although the Digesters are Aerobic, in the event the blower system is lost there is a potential to form methane gas within the system. The gallery is not considered to be physically separated from the digesters per the NFPA definition of physical separation; therefore, the gallery is considered to be classified. This classification results in violations of NEC article 500 and such instances are noted in Appendix A.

Oxidation Ditches

The Oxidation Ditches are interpreted to be a Class I Div. II within the envelope described in Table 5.2.2 Row 7c. Further investigation is required to determine level of NEC article 501 implications throughout the area. Items within the envelope are considered to be in violation of NEC article 501. Noted violations have been noted in Appendix A.

Table 2 describes the interpreted classified spaces within the TRWWTP. Again, further investigation is required to formally classify these spaces.

Table 2 Classified Space Designations

Area	NFPA Classification	Assumed Air Changes Per Hour
Raw Water Pump Station (above ground portion)	Class I Div. I	<12
Headworks	Class I Div. I	<12
Air Blower Room	Class I Div. I	<12
Clarifier Room	Class I Div. II	12
Scum Pits	Class I Div. II	12
Lower Level Pipe Gallery	Class I Div. II	12
Lower Level Sludge Pump Station	Class I Div. II	12
Digester Gallery	Class I Div. II	12
Oxidation Ditches	Class I Div. II	N/A

CONCLUSIONS

The TRWWTP has generally maintained all electrical equipment and equipment is therefore in good condition. Equipment that is in less than good condition has been noted in Table 1 and Appendix A.

Further investigation is required to determine if additional loads can be added to the current electrical distribution system. The 30-day metered maximum demand data is recommended to be performed at the TRWWTP's earliest convenience for future design considerations. In the event that additional load demands are too large for current system capacity, a new MCC would be required. The condition assessment revealed a lack of additional space for such an addition and a new MCC would most likely require the addition of an electrical room outside of the main TRWWTP.

Each space that has been interpreted as either Class I Div. I or Class I Div. II has been noted within this TM and Table 2. With the understanding that some portions of the TRWWTP were built prior to the NEC and NFPA requirements for classified spaces, the classified space code violations are recommended to be addressed as a whole with any future modifications or expansion to noted spaces. It is recommended that these spaces be formally classified by a qualified design engineer.

APPENDIX A

Client:	**Town of Telluride Colorado**	**Project:**	**Electrical Condition Assessment**
Site Name:	**Telluride Waste Waster Treatment Plant**	**Site Location:**	**Telluride CO**

Photograph ID: 1 **Photo Location:** Outside Generator Building **Direction:** West **Survey Date:** 11/22/2016 **Comments:** Utility Service Transformer is in good condition. It is showing some signs of weather related corrosion. Access is limited.	
Photograph ID: 2 **Photo Location:** Generator Building **Direction:** South **Survey Date:** 11/22/2016 **Comments:** Switchboard, transformer, panelboard, and misc electrical devices are in good condition. Conduit and fittings in good condition.	

Client:	**Town of Telluride Colorado**	**Project:**	**Electrical Condition Assessment**
Site Name:	**Telluride Waste Waster Treatment Plant**	**Site Location:**	**Telluride CO**

Photograph ID: 3 **Photo Location:** Generator Building **Direction:** South **Survey Date:** 11/22/2016 **Comments:** Zenith ATS in good condition. Associated conduit in good condition.	
Photograph ID: 4 **Photo Location:** Generator Building **Direction:** East **Survey Date:** 11/22/2016 **Comments:** 1000 KW CAT Generator is in good condition. When speaking with operations staff, generator is operated throughout the year in both emergency and maintenance scenarios. No issue to mention from operations staff.	

Client:	**Town of Telluride Colorado**	**Project:**	**Electrical Condition Assessment**
Site Name:	**Telluride Waste Waster Treatment Plant**	**Site Location:**	**Telluride CO**

Photograph ID: 5 **Photo Location:** Outside Generator Building **Direction:** West **Survey Date:** 11/22/2016 **Comments:** Solar Power cabinet is in good condition. Associated conduit is in good condition.	
Photograph ID: 6 **Photo Location:** Raw Sewage Pump Station **Direction:** East **Survey Date:** 11/22/2016 **Comments:** Electrical equipment at the Raw Sewage Pump Station is generally in good condition. This pump station is interpreted to be Class I Div I classified. Some electrical equipment within this structure does not meet the classification requirements of NEC article 501.	

Client:	**Town of Telluride Colorado**	**Project:**	**Electrical Condition Assessment**
Site Name:	**Telluride Waste Waster Treatment Plant**	**Site Location:**	**Telluride CO**

Photograph ID: 7

Photo Location:
Raw Sewage Pump Station

Direction:
East

Survey Date:
11/22/2016

Comments:
Disconnects, junction boxes, conduits and fittings located on the outside of the pump station are beginning to shown signs of rust and corrosion. In general these items are considered to be in fair condition. The conduits routed to each disconnect shown in this photograph are properly sealed from the Class 1 Div 1 space. Some conduits shown are not properly sealed from the Class 1 Div 1 space and are therefore in violation of NEC article 501.



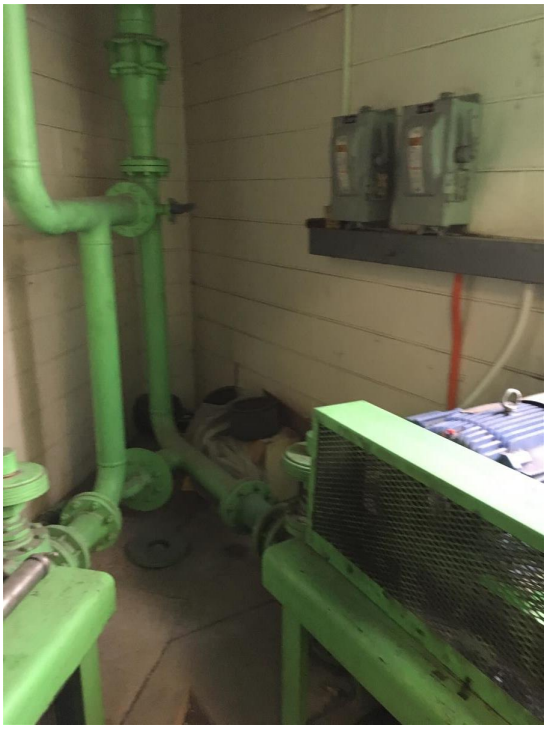
Client:	**Town of Telluride Colorado**	**Project:**	**Electrical Condition Assessment**
Site Name:	**Telluride Waste Waster Treatment Plant**	**Site Location:**	**Telluride CO**

Photograph ID: 8 **Photo Location:** Raw Sewage Pump Station **Direction:** South **Survey Date:** 11/22/2016 **Comments:** Disconnects, control panels, conduits and fittings located on the North side of the pump station are in good condition. The conduits routed to each disconnect shown in this photograph are properly sealed from the Class 1 Div 1 space.	
Photograph ID: 9 **Photo Location:** Raw Sewage Pump Station **Direction:** East **Survey Date:** 11/22/2016 **Comments:** The screen shown in the photograph was added after the original construction of the pump station. This is a vendor packaged system including the control panel shown below. The packaged system does not meet the requirements of a Class I Div I classified space and are therefore in violation of NEC article 501.	

Client:	**Town of Telluride Colorado**	**Project:**	**Electrical Condition Assessment**
Site Name:	**Telluride Waste Waster Treatment Plant**	**Site Location:**	**Telluride CO**

Photograph ID: 10 **Photo Location:** Raw Sewage Pump Station **Direction:** West **Survey Date:** 11/22/2016 **Comments:** The screen control panel shown is in good condition. Conduits and fittings associated with the panel are also in good condition. This panel is interpreted to be in violation of NEC article 501.115.B due to the classified space requirements.	
Photograph ID: 11 **Photo Location:** Raw Sewage Pump Station **Direction:** West **Survey Date:** 11/22/2016 **Comments:** This level indicator indicates level within the raw sewage wetwell. This instrument is in good condition but is in violation of NEC article 501. The instrument assembly itself is in violation along with the conduit and cable connections to the instrument.	

Client:	**Town of Telluride Colorado**	**Project:**	**Electrical Condition Assessment**
Site Name:	**Telluride Waste Waster Treatment Plant**	**Site Location:**	**Telluride CO**

Photograph ID: 12 **Photo Location:** Raw Sewage Pump Station **Direction:** West **Survey Date:** 11/22/2016 **Comments:** The level instrument shown does not have the proper conduit seals per NEC article 501.	
Photograph ID: 13 **Photo Location:** Headworks Air Blower Room **Direction:** West **Survey Date:** 11/22/2016 **Comments:** The Air Blower Room is located to the west of the headworks. The interpretation is that this room would be considered Class I Div II classified. The equipment located within the Air Blower Room including, control panels, disconnects, conduit and fittings is in violation of NEC article 501.	

Client:	**Town of Telluride Colorado**	**Project:**	**Electrical Condition Assessment**
Site Name:	**Telluride Waste Waster Treatment Plant**	**Site Location:**	**Telluride CO**

Photograph ID: 14 **Photo Location:** Headworks Air Blower Room **Direction:** South **Survey Date:** 11/22/2016 **Comments:** The Air Blower Room is located to the west of the headworks. The interpretation is that this room would be considered Class I Div II classified. The equipment located within the Air Blower Room including, control panels, disconnects, conduit and fittings is in violation of NEC article 501.	
Photograph ID: 15 **Photo Location:** Headworks **Direction:** South **Survey Date:** 11/22/2016 **Comments:** The disconnects located in the headworks are in violation of NEC article 501. These disconnects are not explosion proof and they are only rated NEMA 4, the NEMA rating for this space requires NEMA 7 or 8 . The conduits entering and exiting these disconnects do not have the appropriate seal fittings required by NEC article 501.	

Client:	**Town of Telluride Colorado**	**Project:**	**Electrical Condition Assessment**
Site Name:	**Telluride Waste Waster Treatment Plant**	**Site Location:**	**Telluride CO**

Photograph ID: 16

Photo Location:
Headworks

Direction:
South

Survey Date:
11/22/2016

Comments:
The control panels and receptacles located in the headworks are in violation of the NEC article 501. The control panel and it's components are not rated for an explosion proof environment. The receptacle shown is not the appropriate receptacle for this space. The conduits entering and exiting the control panel do not have the required seal fittings per NEC 501.



Client:	**Town of Telluride Colorado**	**Project:**	**Electrical Condition Assessment**
Site Name:	**Telluride Waste Waster Treatment Plant**	**Site Location:**	**Telluride CO**

Photograph ID: 17

Photo Location:
Headworks

Direction:
South

Survey Date:
11/22/2016

Comments:
The control panels located in the headworks are in violation of NEC article 501. The control panel and it's components are not rated for an explosion proof environment. The conduits entering and exiting the control panel do not have the required seal fittings per NEC 501.



Client:	**Town of Telluride Colorado**	**Project:**	**Electrical Condition Assessment**
Site Name:	**Telluride Waste Waster Treatment Plant**	**Site Location:**	**Telluride CO**

Photograph ID: 18

Photo Location:
Headworks

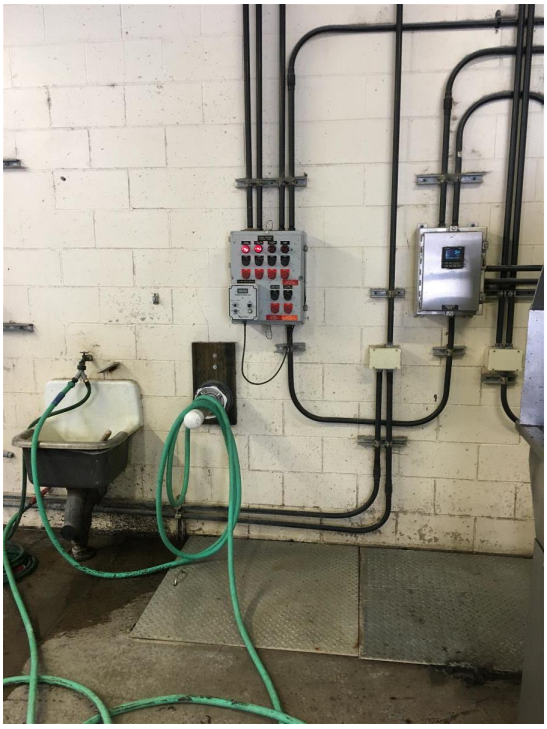
Direction:
South

Survey Date:
11/22/2016

Comments:
The control panel shown is properly construction for the Class I Div I classification of the headworks. The conduit associated with this control panel also has the required seal fittings. The controller to the right of the explosion proof control panel is not rated for the classified space and does not have the appropriate conduit and fittings. The receptacle positioned below the control panels is not rated for the classified space.



Client:	**Town of Telluride Colorado**	**Project:**	**Electrical Condition Assessment**
Site Name:	**Telluride Waste Waster Treatment Plant**	**Site Location:**	**Telluride CO**

Photograph ID: 19 **Photo Location:** Headworks **Direction:** South **Survey Date:** 11/22/2016 **Comments:** The control panels located in the headworks are in violation of NEC article 501. The control panel and it's components are not rated for an explosion proof environment. The conduits entering and exiting the control panel do not have the required seal fittings per NEC 501.	
Photograph ID: 20 **Photo Location:** Headworkds **Direction:** West **Survey Date:** 11/22/2016 **Comments:** The lighting located within the headworks is not constructed to meet the requirements of NEC article 501. Note conduits and fittings shown in the photograph do not comply with the seal fitting requirements of NEC article 501.	

Client:	**Town of Telluride Colorado**	**Project:**	**Electrical Condition Assessment**
Site Name:	**Telluride Waste Waster Treatment Plant**	**Site Location:**	**Telluride CO**

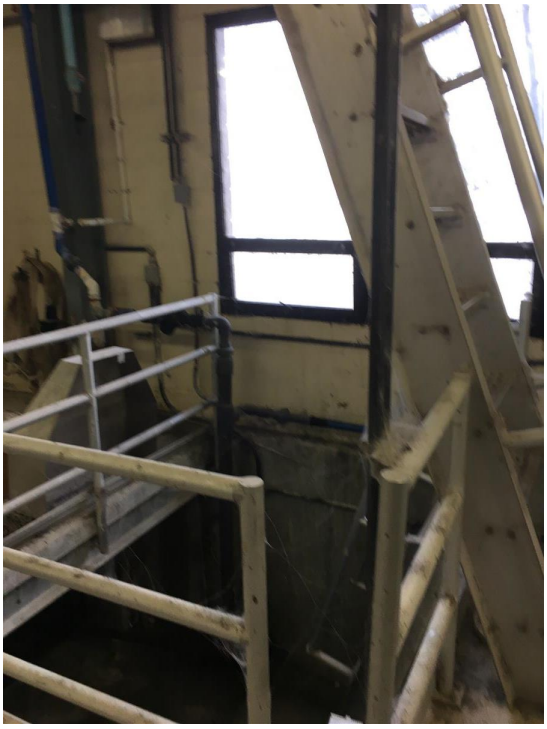
Photograph ID: 21

Photo Location:
Headworks

Direction:
North

Survey Date:
11/22/2016

Comments:
The staircases located in the headworks that allow access to the parshall flume and mechanical loft were observed to be open to the headworks under normal operating conditions, therefore classifying them as Class I Div I spaces. Both areas have hatches that allow them to be separated from the Class I Div I spaces, it's recommended hatches remain closed under normal operating conditions.



Client:	**Town of Telluride Colorado**	**Project:**	**Electrical Condition Assessment**
Site Name:	**Telluride Waste Waster Treatment Plant**	**Site Location:**	**Telluride CO**

Photograph ID: 22 **Photo Location:** Headworkds **Direction:** East **Survey Date:** 11/22/2016 **Comments:** The bar screen and its associated electrical components are not properly rated for the classified space. Conduit and fittings do not have the required seal fittings per NEC article 501.	
Photograph ID: 23 **Photo Location:** Headworks **Direction:** North **Survey Date:** 11/22/2016 **Comments:** The electrical equipment associated with the grit classifer are not rated for the Class 1 Div 1 space and are therefore in violation of NEC article 501.	

Client:	**Town of Telluride Colorado**	**Project:**	**Electrical Condition Assessment**
Site Name:	**Telluride Waste Waster Treatment Plant**	**Site Location:**	**Telluride CO**

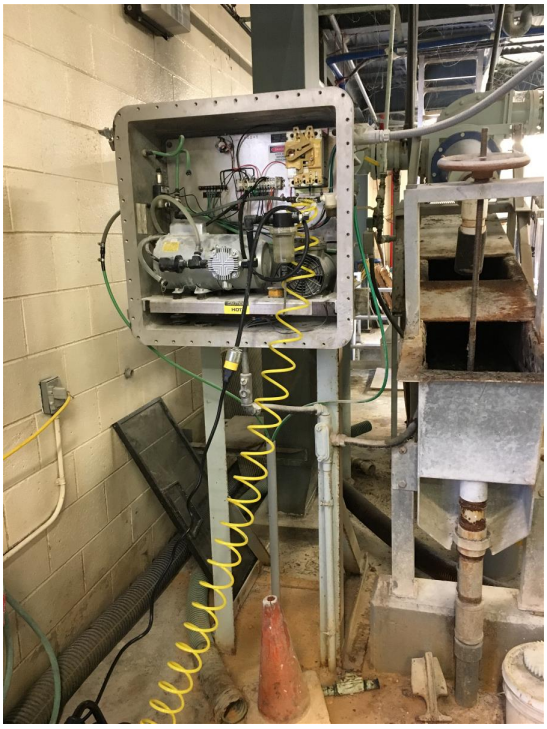
Photograph ID: 24

Photo Location:
Headworks

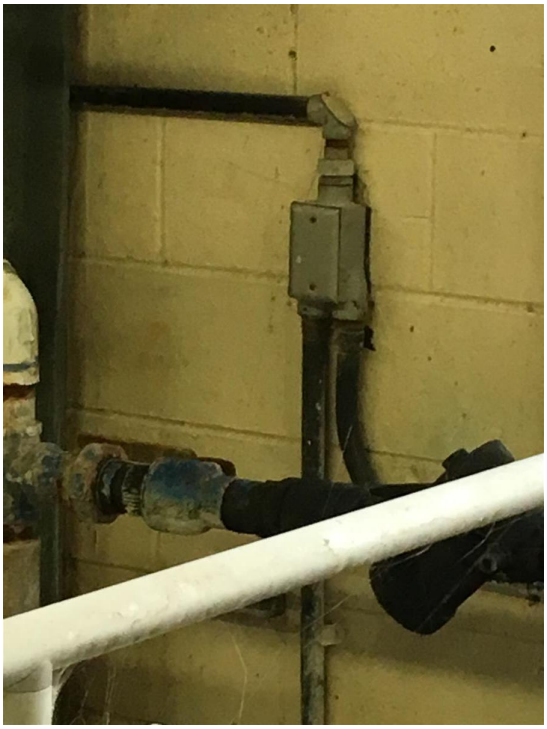
Direction:
East

Survey Date:
11/22/2016

Comments:
The grit classifier control panel is an explosion proof panel rated for the the classification of the space. This panel under normal operating conditions should have it's cover on and securely bolted down. During the condition assessment walk this cover was off and live electrical components were exposed. With the cover off as shown this panel is in violation of NEC article 501. Conduits and fittings associated with this panel have the required seal fittings per NEC article 501. The receptacle shown is not properly rated for this space, nor is the conduit associated with the receptacle.



Client:	**Town of Telluride Colorado**	**Project:**	**Electrical Condition Assessment**
Site Name:	**Telluride Waste Waster Treatment Plant**	**Site Location:**	**Telluride CO**

Photograph ID: 25 **Photo Location:** Headworks **Direction:** South **Survey Date:** 11/22/2016 **Comments:** Electrical conduit and fittings for equipment within the headworks are not rated for the classified space and are in violation of NEC 501.	
Photograph ID: 26 **Photo Location:** Headworks **Direction:** South **Survey Date:** 11/22/2016 **Comments:** Electrical conduit and fittings for equipment within the headworks are not rated for the classified space and are in violation of NEC 501.	

Client:	**Town of Telluride Colorado**	**Project:**	**Electrical Condition Assessment**
Site Name:	**Telluride Waste Waster Treatment Plant**	**Site Location:**	**Telluride CO**

Photograph ID: 27

Photo Location:
Clarifier Room

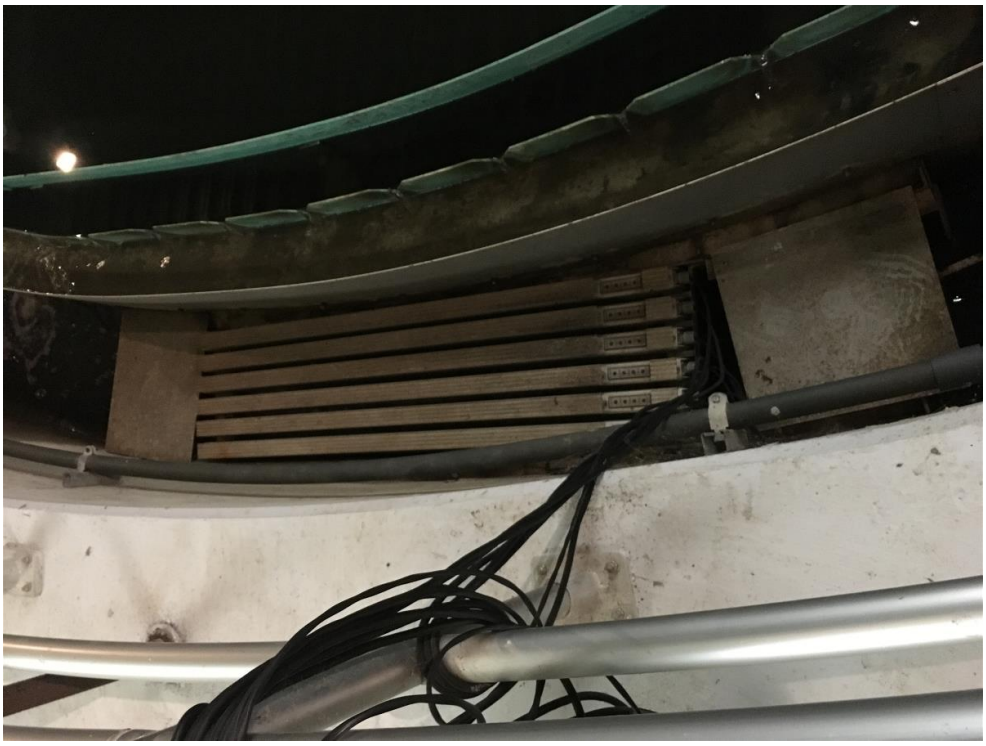
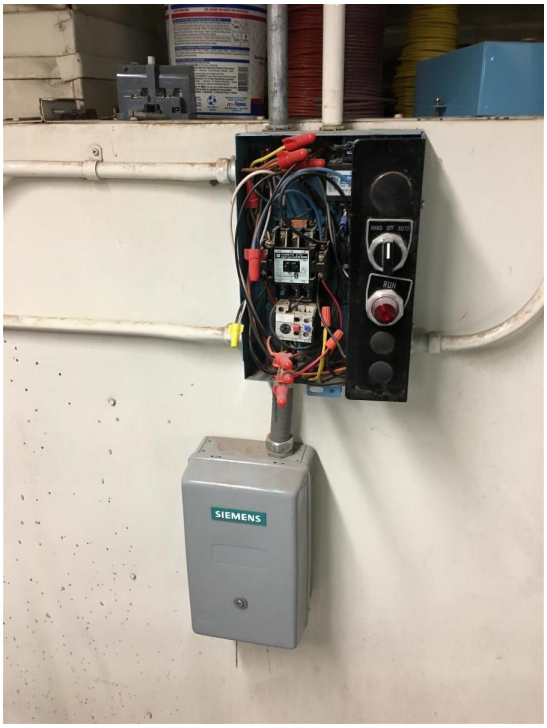
Direction:
West

Survey Date:
11/22/2016

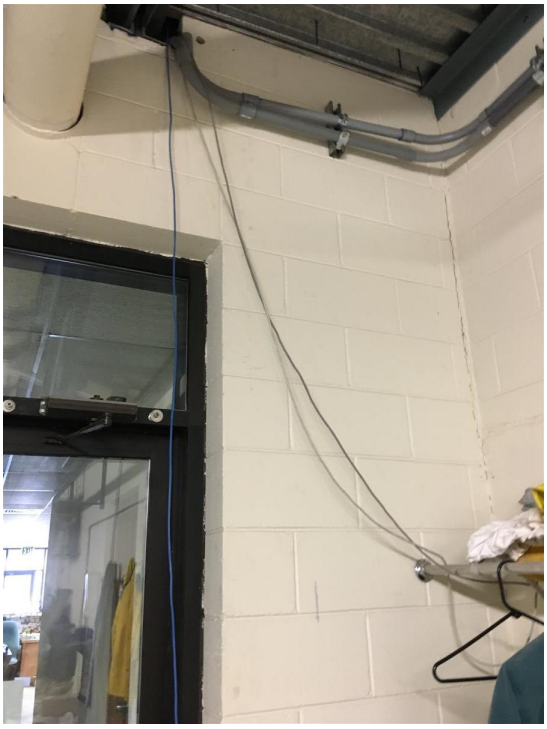
Comments:
UV Instrumentation is in good condition. Cables running from Trojan panel to the UV lights are currently supported via the handrail as shown. This is in violation of the 2012 IBC section 1012.4 and various OSHA regulations regarding the standards for construction of handrail. It's recommended these cables be routed properly in accordance with the NEC.



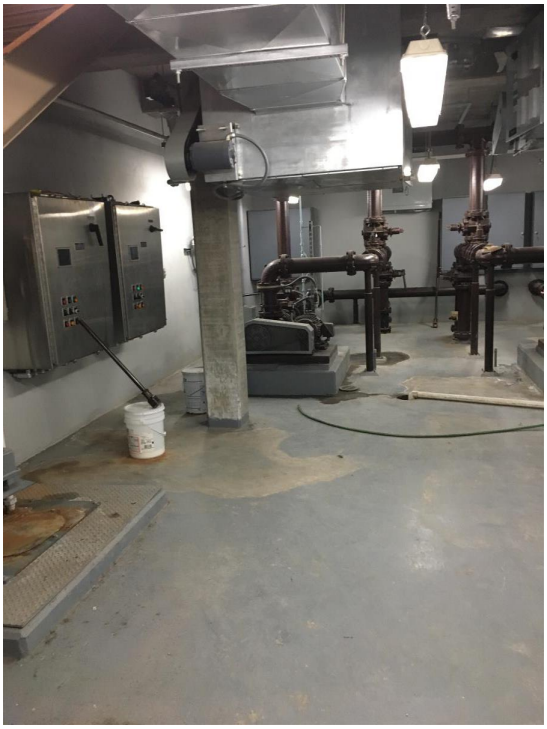
Client:	**Town of Telluride Colorado**	**Project:**	**Electrical Condition Assessment**
Site Name:	**Telluride Waste Waster Treatment Plant**	**Site Location:**	**Telluride CO**

Photograph ID: 28 **Photo Location:** Clarifier Room **Direction:** North **Survey Date:** 11/22/2016 **Comments:** Cables running from Trojan panel to the UV lights are currently supported via the handrail as shown. This is in violation of the 2012 IBC section 1012.4 and various OSHA regulations regarding the standards for construction of handrail. It's recommended these cables be routed properly in accordance with the NEC.	
Photograph ID: 29 **Photo Location:** Clarifier Room **Direction:** East **Survey Date:** 11/22/2016 **Comments:** The cover for this control panel is missing. Wiring and terminations are exposed, this poses a potential hazard to personnel. This panel is interpreted to be inside the Class I Div II space and is therefore not rated for the requirements of NEC article 501.	

Client:	**Town of Telluride Colorado**	**Project:**	**Electrical Condition Assessment**
Site Name:	**Telluride Waste Waster Treatment Plant**	**Site Location:**	**Telluride CO**

Photograph ID: 30 **Photo Location:** Clarifier Room **Direction:** East **Survey Date:** 11/22/2016 **Comments:** Cables routed from the Admin Room to the Clarifier Room network cabinet are unsupported. Communications wires and cables shall be routed and supported per the NEC article 800.110 .	
Photograph ID: 31 **Photo Location:** Clarifier Room **Direction:** South **Survey Date:** 11/22/2016 **Comments:** Cables routed from the Admin Room to the Clarifier Room network cabinet are unsupported. Communications wires and cables shall be routed and supported per the NEC article 800.110 .	

Client:	**Town of Telluride Colorado**	**Project:**	**Electrical Condition Assessment**
Site Name:	**Telluride Waste Waster Treatment Plant**	**Site Location:**	**Telluride CO**

Photograph ID: 32 **Photo Location:** Blower Room **Direction:** South **Survey Date:** 11/22/2016 **Comments:** Motor, instrumentation, conduit and fittings associated with each blower are in good condition.	
Photograph ID: 33 **Photo Location:** Blower Basement **Direction:** East **Survey Date:** 11/22/2016 **Comments:** Motors, panels, lighting, instrumentation, conduit and fittings and miscellaneous electrical equipment is in good condition. See photo 35 & 36 for exceptions.	

Client:	**Town of Telluride Colorado**	**Project:**	**Electrical Condition Assessment**
Site Name:	**Telluride Waste Waster Treatment Plant**	**Site Location:**	**Telluride CO**

Photograph ID: 34

Photo Location:
Blower basement

Direction:
South

Survey Date:
11/22/2016

Comments:
Actuators and associated conduit and fittings are in good condition.



Client:	**Town of Telluride Colorado**	**Project:**	**Electrical Condition Assessment**
Site Name:	**Telluride Waste Waster Treatment Plant**	**Site Location:**	**Telluride CO**

Photograph ID: 35

Photo Location:
Blower Basement

Direction:
North

Survey Date:
11/22/2016

Comments:
DSP-2 control panel "No Fluid Reset" is currently being reset continuously through the use of a metal rod. This is observed to be bypassing a protection element of the pump controls. By continuously bypassing this pump protection device it could result in accelerated maintenance requirements for the pump in question. It's recommended that this "No Fluid" sensing element be adjusted or replaced to meet the requirements of the intended pump protection.



Client:	**Town of Telluride Colorado**	**Project:**	**Electrical Condition Assessment**
Site Name:	**Telluride Waste Waster Treatment Plant**	**Site Location:**	**Telluride CO**

Photograph ID: 36

Photo Location:
Blower Basement

Direction:
North

Survey Date:
11/22/2016

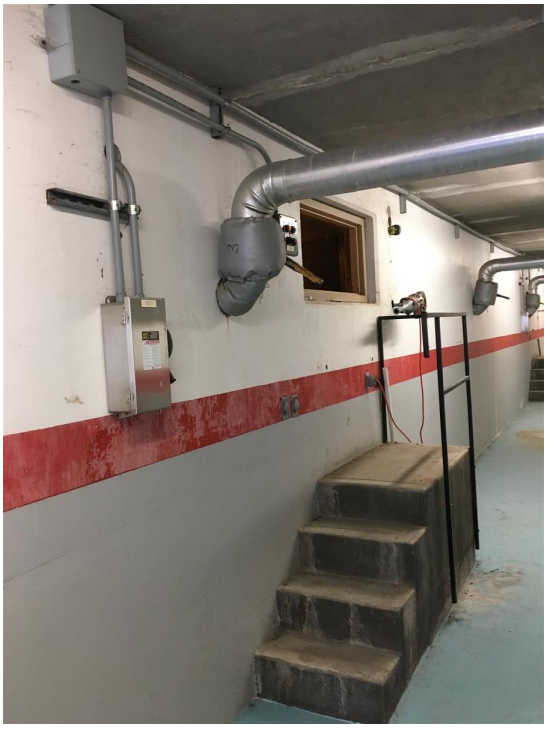
Comments:
DSP-2 control panel "No Fluid Reset" is currently being reset continuously through the use of a metal rod. This is observed to be bypassing a protection element of the pump controls. By continuously bypassing this pump protection device it could result in accelerated maintenance requirements for the pump in question. It's recommended that this "No Fluid" sensing element be adjusted or replaced to meet the requirements of the intended pump protection.



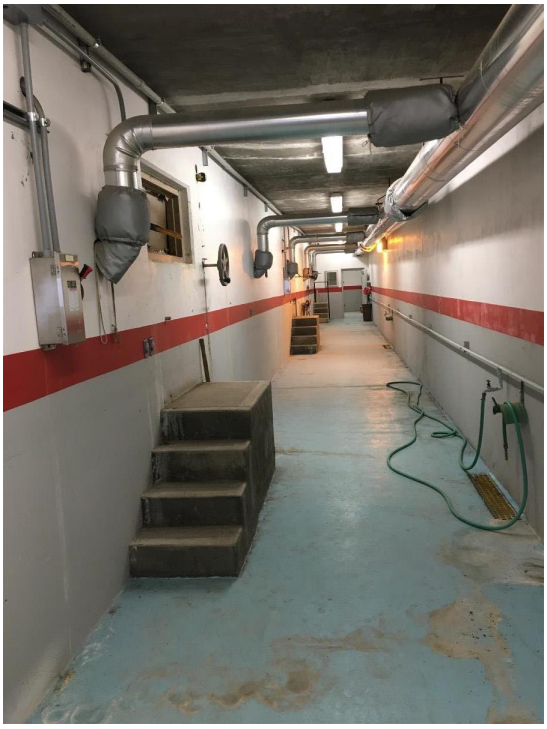
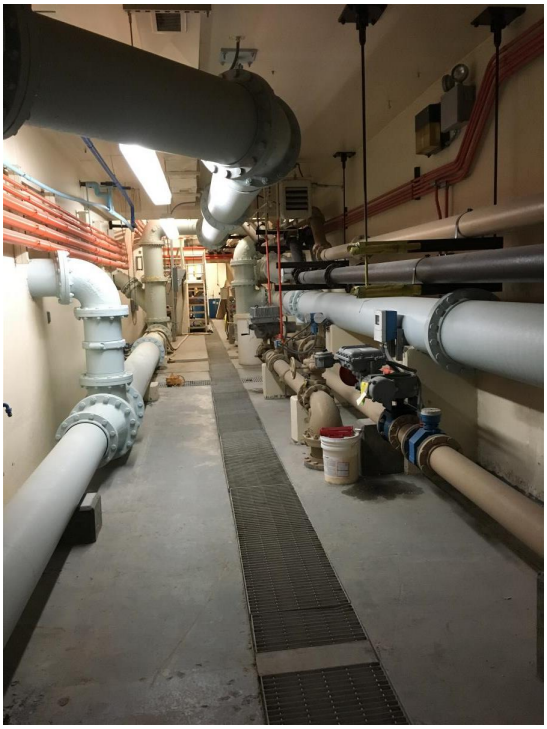
Client:	**Town of Telluride Colorado**	**Project:**	**Electrical Condition Assessment**
Site Name:	**Telluride Waste Waster Treatment Plant**	**Site Location:**	**Telluride CO**

Photograph ID: 37 **Photo Location:** Blower Basement **Direction:** East **Survey Date:** 11/22/2016 **Comments:** Motors, conduit and fittings are in good condition.	
Photograph ID: 38 **Photo Location:** Blower Basement **Direction:** North **Survey Date:** 11/22/2016 **Comments:** Instrumentation, conduit and fittings are in good condition.	

Client:	**Town of Telluride Colorado**	**Project:**	**Electrical Condition Assessment**
Site Name:	**Telluride Waste Waster Treatment Plant**	**Site Location:**	**Telluride CO**

Photograph ID: 39 **Photo Location:** Digester Gallery **Direction:** North **Survey Date:** 11/22/2016 **Comments:** The digester gallery is considered a Class I Div II space. Per this interpretation the disconnects for each mixer are not properly rated for the classified area. The conduits and fittings do not meet the requirements of NEC article 501. The conduit penetrations between the gallery and each digester require a seal as well.	
Photograph ID: 40 **Photo Location:** Digester Gallery **Direction:** West **Survey Date:** 11/22/2016 **Comments:** The digester gallery is considered a Class I Div II space. Per this interpretation the disconnects for each mixer are not properly rated for the classified area. The conduits and fittings do not meet the requirements of NEC article 501.	

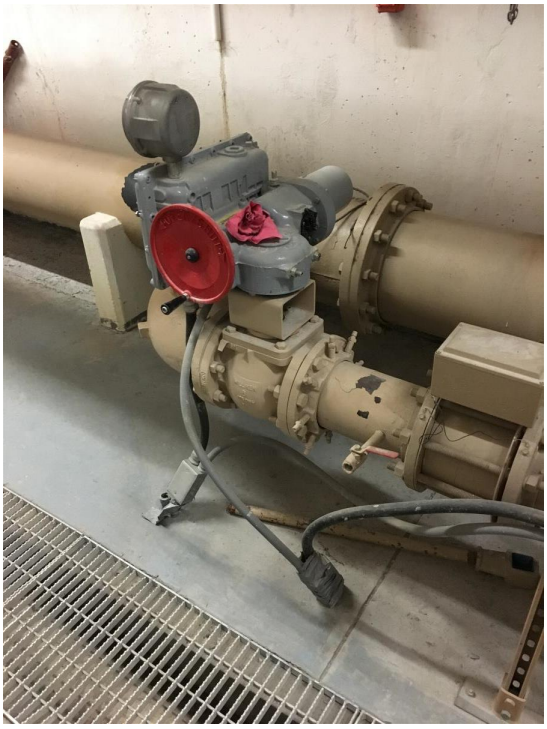
Client:	**Town of Telluride Colorado**	**Project:**	**Electrical Condition Assessment**
Site Name:	**Telluride Waste Waster Treatment Plant**	**Site Location:**	**Telluride CO**

Photograph ID: 41 **Photo Location:** Digester Gallery **Direction:** North **Survey Date:** 11/22/2016 **Comments:** Electrical equipment, conduits, fittings, luminaires and disconnects are in good condition. These components do not meet the requirements of the Class I Div II rating of the space per article 501 of the NEC.	
Photograph ID: 42 **Photo Location:** Pipe Gallery **Direction:** East **Survey Date:** 11/22/2016 **Comments:** Electrical equipment, instrumentation, conduit, switches, lighting and panelboards within the gallery are in good condition.	

Client:	**Town of Telluride Colorado**	**Project:**	**Electrical Condition Assessment**
Site Name:	**Telluride Waste Waster Treatment Plant**	**Site Location:**	**Telluride CO**

Photograph ID: 43 **Photo Location:** Pipe Gallery **Direction:** South **Survey Date:** 11/22/2016 **Comments:** Instrumentation, conduit and conduit fittings within the gallery are in good condition.	
Photograph ID: 44 **Photo Location:** Pipe Gallery **Direction:** South **Survey Date:** 11/22/2016 **Comments:** Actuators and instrumentation in good condition.	

Client:	**Town of Telluride Colorado**	**Project:**	**Electrical Condition Assessment**
Site Name:	**Telluride Waste Waster Treatment Plant**	**Site Location:**	**Telluride CO**

Photograph ID: 45 **Photo Location:** Pipe Gallery **Direction:** South **Survey Date:** 11/22/2016 **Comments:** Valve actuator is in good condition. Conduit and conduit fittings are in violation of the NEC. Per NEC article 350.30 liquidtight flexible metal conduit shall be securely fastened in place.	
Photograph ID: 46 **Photo Location:** Lower Level Sludge Area **Direction:** North **Survey Date:** 11/22/2016 **Comments:** The cable connecting the flow sensor to the flow transmitter should be supported such that is is not hanging from the transmitter as shown in the photograph.	

Client:	**Town of Telluride Colorado**	**Project:**	**Electrical Condition Assessment**
Site Name:	**Telluride Waste Waster Treatment Plant**	**Site Location:**	**Telluride CO**

Photograph ID: 47 **Photo Location:** Lower Level Sludge Area **Direction:** North **Survey Date:** 11/22/2016 **Comments:** Motors, panelboards, switches, instrumentation, conduit, conduit fittings and other miscellaneous electrical equipment in this room is in good condition.	
Photograph ID: 48 **Photo Location:** Lower Level Sludge Area **Direction:** South **Survey Date:** 11/22/2016 **Comments:** This Dynablend cabinet and Milton Roy variable speed pump are in violation of the NEC. Per article 110.27 live parts shall be guarded. During the condition assessment it was interpreted that this cabinet remains open under normal operating conditions.	

Client:	**Town of Telluride Colorado**	**Project:**	**Electrical Condition Assessment**
Site Name:	**Telluride Waste Waster Treatment Plant**	**Site Location:**	**Telluride CO**

Photograph ID: 49 **Photo Location:** Lower Level Sludge Area **Direction:** South **Survey Date:** 11/22/2016 **Comments:** The cabinet looks as though it is providing temporary power to the Milton Roy variable speed pump located below. Temporary power sources are only allowed for a period of 90 Days per NEC article 590.	
Photograph ID: 50 **Photo Location:** Lower Level Sludge Area **Direction:** South **Survey Date:** 11/22/2016 **Comments:** The Milton Roy variable speed drive is indicated to be a	

Client:	**Town of Telluride Colorado**	**Project:**	**Electrical Condition Assessment**
Site Name:	**Telluride Waste Waster Treatment Plant**	**Site Location:**	**Telluride CO**

Photograph ID: 51 **Photo Location:** Oxidation Ditch **Direction:** East **Survey Date:** 11/22/2016 **Comments:** Instrumentation, conduit and fittings associated with each oxidation ditch are in good condition.	
Photograph ID: 52 **Photo Location:** Oxidation Ditch **Direction:** East **Survey Date:** 11/22/2016 **Comments:** Instrumentation, conduit and fittings associated with each oxidation ditch are in good condition.	

Client:	**Town of Telluride Colorado**	**Project:**	**Electrical Condition Assessment**
Site Name:	**Telluride Waste Waster Treatment Plant**	**Site Location:**	**Telluride CO**

Photograph ID: 53 **Photo Location:** Oxidation Ditch **Direction:** South **Survey Date:** 11/22/2016 **Comments:** Motors, conduit and fittings associated with each oxidation ditch are in good condition.	
Photograph ID: 54 **Photo Location:** Oxidation Ditch **Direction:** West **Survey Date:** 11/22/2016 **Comments:** Disconnect switches associated with each oxidation ditch motor are in good condition. Conduit and fittings associated with each disconnect are in good condition.	

Client:	**Town of Telluride Colorado**	**Project:**	**Electrical Condition Assessment**
Site Name:	**Telluride Waste Waster Treatment Plant**	**Site Location:**	**Telluride CO**

Photograph ID: 55 **Photo Location:** Oxidation Ditch **Direction:** South **Survey Date:** 11/22/2016 **Comments:** The control panels, junction boxes, conduit and fittings associated with each mixer are in good condition. The cabling shown is in violation of the 2012 IBC section 1012.4 and various OSHA regulations regarding the standards for construction of handrail. It's recommended these cables be routed properly in accordance with the NEC.	
Photograph ID: 56 **Photo Location:** Chemical Building **Direction:** East **Survey Date:** 11/22/2016 **Comments:** The chemical building electrical equipment including lighting, conduit and fittings, instrumentation, panelboards, fire alarm system are in good condition.	

Client:	**Town of Telluride Colorado**	**Project:**	**Electrical Condition Assessment**
Site Name:	**Telluride Waste Waster Treatment Plant**	**Site Location:**	**Telluride CO**

Photograph ID: 57 **Photo Location:** Chemical Building **Direction:** East **Survey Date:** 11/22/2016 **Comments:** The chemical building electrical equipment including lighting, conduit and fittings, instrumentation, panelboards, fire alarm system are in good condition.	
Photograph ID: 58 **Photo Location:** Chemical Building **Direction:** West **Survey Date:** 11/22/2016 **Comments:** The chemical building electrical equipment including lighting, conduit and fittings, instrumentation, panelboards, fire alarm system are in good condition.	

Client:	**Town of Telluride Colorado**	**Project:**	**Electrical Condition Assessment**
Site Name:	**Telluride Waste Waster Treatment Plant**	**Site Location:**	**Telluride CO**

Photograph ID: 59 **Photo Location:** Chemical Building **Direction:** West **Survey Date:** 11/22/2016 **Comments:** The chemical building electrical equipment including lighting, conduit and fittings, instrumentation, panelboards, fire alarm system and transformer are in good condition.	
Photograph ID: 60 **Photo Location:** MCC-1 Electrical Rm **Direction:** South **Survey Date:** 11/22/2016 **Comments:** MCC-1 is the original power supply for the plant and is dated 1988. This lineup is in good condition visually from the outside.	

Client:	**Town of Telluride Colorado**	**Project:**	**Electrical Condition Assessment**
Site Name:	**Telluride Waste Waster Treatment Plant**	**Site Location:**	**Telluride CO**

Photograph ID: 61 **Photo Location:** MCC-1 Electrical Room **Direction:** West **Survey Date:** 11/22/2016 **Comments:** The west side of the electrical room has several working clearance violations per NEC article 110. Per 110.26.3.B working spaces shall not be used as storage space. The condition of panelboards, transformers, control panels, conduit and fittings in this area are in good condition.	
Photograph ID: 62 **Photo Location:** MCC-1 Electrical Room **Direction:** West **Survey Date:** 11/22/2016 **Comments:** The west side of the electrical room has several working clearance violations per NEC article 110. Per 110.26.3.B working spaces shall not be used as storage space. The condition of panelboards, transformers, control panels, conduit and fittings in this area are in good condition.	

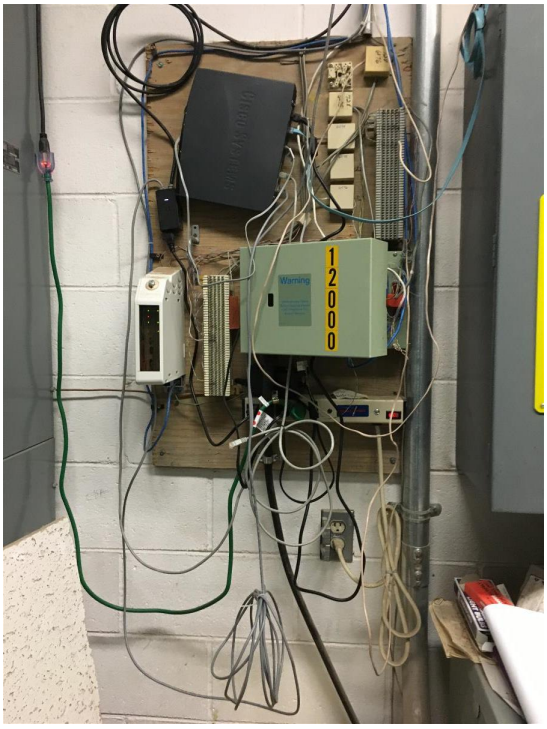
Client:	**Town of Telluride Colorado**	**Project:**	**Electrical Condition Assessment**
Site Name:	**Telluride Waste Waster Treatment Plant**	**Site Location:**	**Telluride CO**

Photograph ID: 63 **Photo Location:** MCC-1 Electrical Room **Direction:** West **Survey Date:** 11/22/2016 **Comments:** There are several cables/wires strung from the north wall to the south wall of the electrical room. These cables/wires are not routed per NEC requirements.	
Photograph ID: 64 **Photo Location:** MCC-1 Electrical Room **Direction:** West **Survey Date:** 11/22/2016 **Comments:** The shelving installed above the spare fuse cabinet and westinghouse circuit breaker shown is in violation of the dedicated electrical space requirements of NEC article 110. Per article 110 the dedicated electrical space extends to 6 ft above the equipment or to the structural ceiling, whichever is greater.	

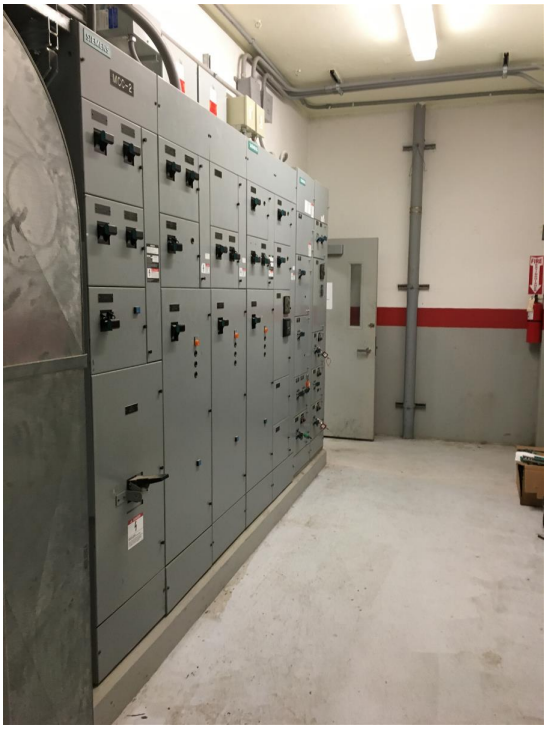
Client:	**Town of Telluride Colorado**	**Project:**	**Electrical Condition Assessment**
Site Name:	**Telluride Waste Waster Treatment Plant**	**Site Location:**	**Telluride CO**

Photograph ID: 65 **Photo Location:** MCC-1 Electrical Room **Direction:** East **Survey Date:** 11/22/2016 **Comments:** In the second section of MCC-1 the upper panel has been removed leaving exposed wiring. This is a potential hazard to personnel and should be replaced.	
Photograph ID: 66 **Photo Location:** MCC-1 Electrical Room **Direction:** East **Survey Date:** 11/22/2016 **Comments:** The door for the raw sewage pumps was open during the condition assessment, and the electrical components inside were energized. This door should remain closed under normal working condition.	

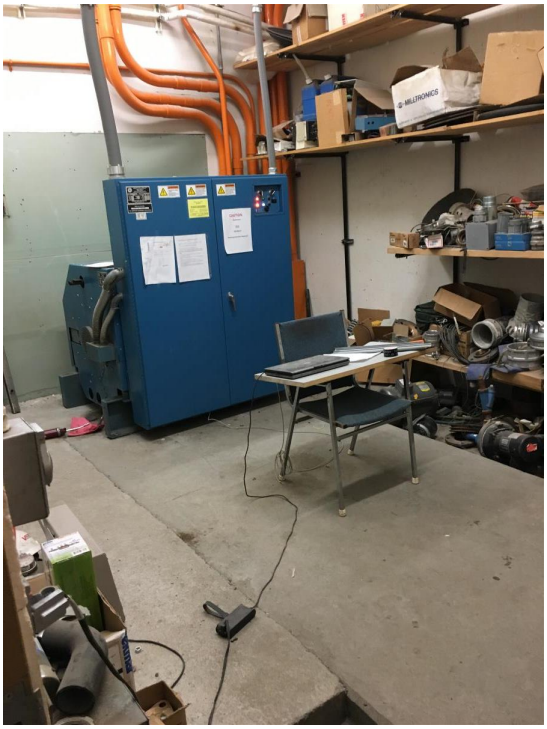
Client:	**Town of Telluride Colorado**	**Project:**	**Electrical Condition Assessment**
Site Name:	**Telluride Waste Waster Treatment Plant**	**Site Location:**	**Telluride CO**

Photograph ID: 67 **Photo Location:** MCC-1 Electrical Room **Direction:** West **Survey Date:** 11/22/2016 **Comments:** The communications panel shown is in violation of the NEC article 800.23.	
Photograph ID: 68 **Photo Location:** MCC-1 Electrical Room **Direction:** West **Survey Date:** 11/22/2016 **Comments:** The shelving installed above the spare fuse cabinet and westinghouse circuit breaker shown is in violation of the dedicated electrical space requirements of NEC article 110. Per article 110 the dedicated electrical space extends to 6 ft above the equipment or to the structural ceiling, whichever is greater.	

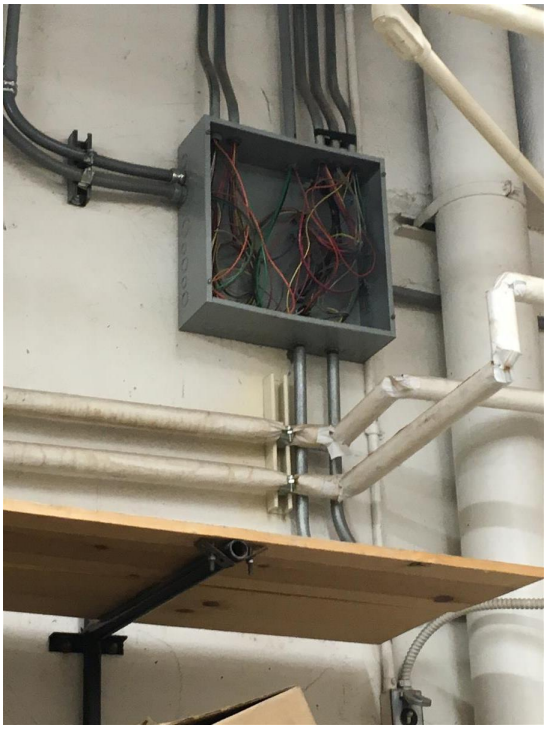
Client:	**Town of Telluride Colorado**	**Project:**	**Electrical Condition Assessment**
Site Name:	**Telluride Waste Waster Treatment Plant**	**Site Location:**	**Telluride CO**

Photograph ID: 69 **Photo Location:** MCC-1 Electrical Room **Direction:** West **Survey Date:** 11/22/2016 **Comments:** The conduits and fittings installed within the electrical room are in good condition. The exposed wiring shown in this photograph is in violation of the NEC and is not routed properly.	
Photograph ID: 70 **Photo Location:** MCC-2 **Direction:** West **Survey Date:** 11/22/2016 **Comments:** MCC-2 was added during the 1995 expansion of the plant. This MCC is in good condition.	

Client:	**Town of Telluride Colorado**	**Project:**	**Electrical Condition Assessment**
Site Name:	**Telluride Waste Waster Treatment Plant**	**Site Location:**	**Telluride CO**

Photograph ID: 71 **Photo Location:** MCC-2 **Direction:** West **Survey Date:** 11/22/2016 **Comments:** MCC-2 associated panelboard and transformer are in good condition. All conduit and fittings in this area are in good condition.	
Photograph ID: 72 **Photo Location:** Written Pole Room **Direction:** South **Survey Date:** 11/22/2016 **Comments:** The written pole motor is in good condition and still functions properly according to plant staff. Conduit and fittings associated with this piece of equipment are in good condition.	

Client:	**Town of Telluride Colorado**	**Project:**	**Electrical Condition Assessment**
Site Name:	**Telluride Waste Waster Treatment Plant**	**Site Location:**	**Telluride CO**

Photograph ID: 73 **Photo Location:** Written Pole Room **Direction:** East **Survey Date:** 11/22/2016 **Comments:** Electrical equipment including disconnects, junction boxes, conduit and fittings are in good condition.	
Photograph ID: 74 **Photo Location:** Written Pole Room **Direction:** West **Survey Date:** 11/22/2016 **Comments:** This junction box located on the west wall is missing its cover leaving exposed wiring. This cover should be replaced.	

Appendix E PROPOSALS FOR TRWWTP EXPANSION EQUIPMENT

E.1 MEMBRANE BIOREACTOR SYSTEM BY GE WATER & PROCESS TECHNOLOGIES

Project Name: Telluride, CO
Prepared For: Nathan Brown, MWH - Stantec
Date: February 14, 2017
GE Contact: Grant MacInnis, Regional Manager (Grant.MacInnis@ge.com)

This memo will describe two process options that will demonstrate different benefits for the City of Telluride.

The **Membrane Bioreactor Process (MBR)** is well established and is well suited for both the initial "low-nutrient" phase of effluent criteria as well as the future "ultra-low nutrient" criteria. In fact, the initial and the future phase will differ only in the inclusion of some additional anoxic zones that allow for additional denitrification to meet the goal of 3 mg/L.

In addition to meeting the stringent (and yet more stringent) nutrient criteria, the MBR provides an effluent that is essentially free of TSS (typically ND) and a simple and easy to operate process.

The **Membrane Aerated Biofilm Reactor (MABR or ZeeLung)** is an innovative technology designed specifically to add biomass to existing plants in order to help them meet more stringent nutrient limits. The installation of the MABR equipment is very simple, requires little to no civil or electrical work, has very low constructed costs and has the added benefit of reducing energy consumption.

The ZeeLung, however, is an oxygen transfer technology and not a filtration technology. While the expectation is that the ZeeLung would provide a very cost-effective solution for the Phase 1 nutrient limits (compared to MBR), the very low phosphorous limits required for Phase 2 would certainly require the addition of a filtration component, preferably an ultrafilter. At that point, the cost savings of ZeeLung MABR are significantly reduced when compared to MBR.

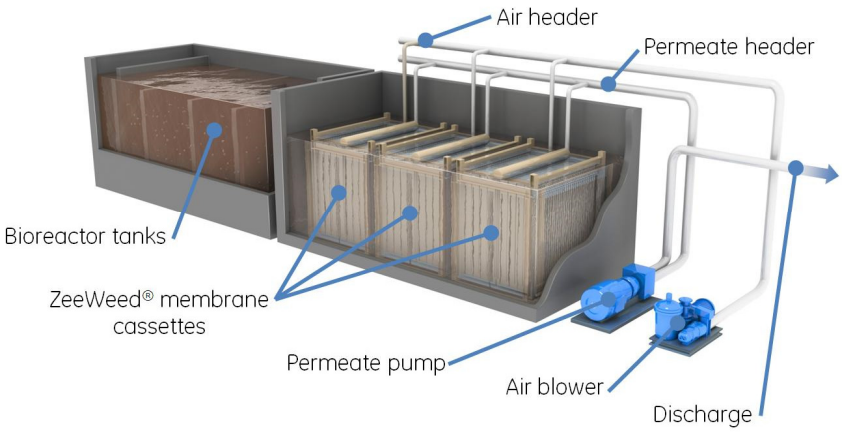
I would expect that the decision will come down to funding availability and timing. If the Phase 2 nutrient limits are deemed distant in the future, then the significant Phase 1 cost savings of a ZeeLung MABR solution are likely very attractive. If the Phase 2 effluent limits are deemed to be relatively near in the future, and if there is significant added value to the water quality advantages of the MBR, then the MBR is likely a more attractive option.

This memo will describe both a Phase 1 and Phase 2 MBR solution as well as a Phase 1 ZeeLung-MABR solution.

The ZeeWeed® Membrane Bioreactor Process

The ZeeWeed® Membrane Bioreactor (MBR) process consists of a suspended growth biological reactor integrated with a membrane filtration system, using the ZeeWeed® hollow fiber ultrafiltration membrane. The membrane filtration system essentially replaces the solids separation function of secondary clarifiers and sand filters used in a conventional activated sludge process.

ZeeWeed® ultrafiltration membranes are immersed, in direct contact with mixed liquor. Through the use of a permeate pump, a vacuum is applied to a header connected to the membranes. The vacuum draws the treated water through the hollow fiber membranes. Permeate is then directed to downstream disinfection or discharge facilities. Air, in the form of large bubbles, is introduced below the bottom of the membrane modules, producing turbulence that scours the outer surface of the hollow fibers to keep them clean.



The proposed MBR design includes LEAPmbr, GE's latest technology advancement for wastewater treatment, which offers the lowest cost of ownership in the industry. LEAPmbr incorporates several innovations, including the latest ZeeWeed® 500 module with increased membrane surface area, increased productivity through proven MBR design flux improvements, an optimized membrane tank design, along with a more efficient membrane aeration system (known as LEAPmbr Aeration Technology) that simplifies the aeration system and reduces aeration requirements. These innovations combine to offer:

- 15% productivity improvement
- 20% footprint reduction
- 50% reduction in membrane aeration equipment
- 30% energy savings

Scope of Supply by GE

- ZeeWeed® 500 Membrane Cassettes and Modules
- Bioreactor equipment – aerators, mixers, process air blowers, etc.
- Permeate and Air Scour Header Piping
- Permeate and Backpulse Pumps
- Backpulse Tank
- Membrane Air Scour Blowers
- Membrane Cleaning System
- Electrical and Control Equipment
- Compressed Air System
- Instrumentation and Valves Integral to ZeeWeed® System
- Electrical and Mechanical Engineering Submittals
- Operation & Maintenance Manuals
- Installation, Commissioning & Start-up Assistance
- Operator Training

Scope of Supply by Others

- Concrete and civil work, assembly of loose-ship equipment, interconnecting piping, balance of plant design and construction, etc.

Design Assumptions:

As per memo provided by MWH – Stantec titled "Design Criteria for BNR Improvements Project", dated January 29, 2017.

Ultrafiltration System Design

The ultrafiltration design of this system is described in the table below where membrane modules are assembled into cassettes and cassettes are installed in concrete tanks.

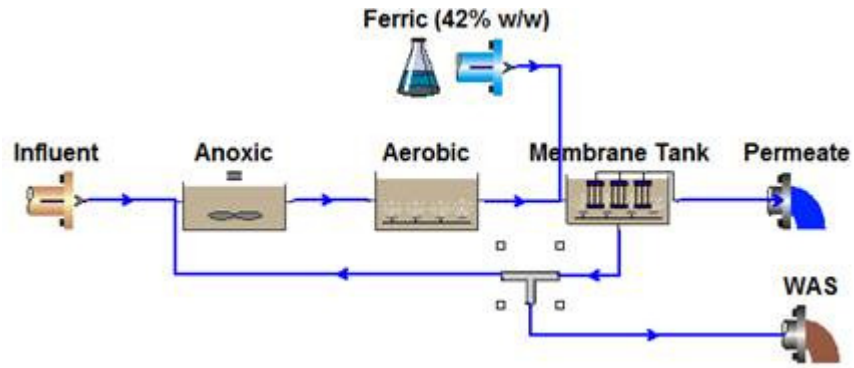
	Phase 1 Nutrient Limits	Phase 2 Nutrient Limits
1 Train Out of Service – 24 Hours	3.0 MGD **	3.0 MGD **
Type of Membrane	ZeeWeed® 500d	ZeeWeed® 500d
Number of Trains	3	3
Number of Cassette Spaces per Train	2	2
Type of Module	370 ft2	370 ft2
Membrane Tank Dimensions (each)	28'4" x 9' x 13'H	28'4" x 9' x 13'H

** Note that the MDF redundancy is currently the dominant design condition in sizing the MBR. A lower redundancy requirement would directly reduce the size and cost of the MBR.

Biological Design

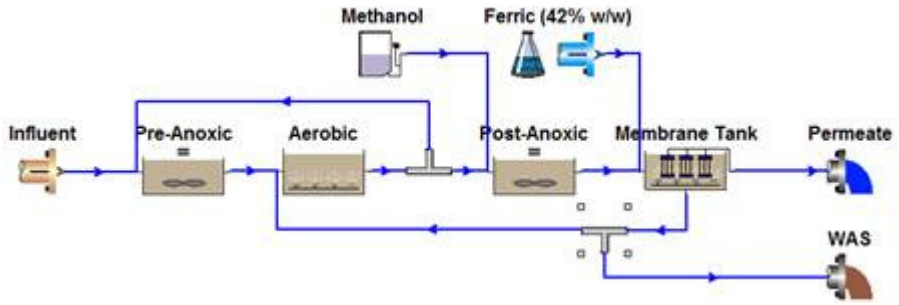
	Phase 1 Nutrient Limits	Phase 2 Nutrient Limits
Pre-Anoxic Volume	250,000 gal	250,000 gal
Aerobic Volume	600,000 gal	1,100,000 gal
Post-Anoxic Volume	NA	360,000 gal
Estimated Membrane Life	~10 to 14 years	~10 to 14 years
Complete Membrane Replacement Cost	$768,000 (Complete Set)	$768,000 (Complete Set)
Budgetary Cost	**$3.2MM - $3.5MM**	**$3.3MM - $3.6MM**
Estimated Liquid Train Construction Cost (From headworks through disinfection)	**$7.5MM to $8.5MM**	**$9.0MM to $10.0MM**

Phase 1 Biowin Output



Flow	2.59 mgd
Ammonia N	0.78 mgN/L
Nitrate N	3.45 mgN/L
Nitrite N	0.30 mgN/L
Filtered TKN	2.65 mgN/L
Total N	6.40 mgN/L
Total P	0.15 mgP/L
Total suspended solids	0.00 mg/L
Total COD	32.95 mg/L
Total Carbonaceous BOD	1.04 mg/L
pH	6.79

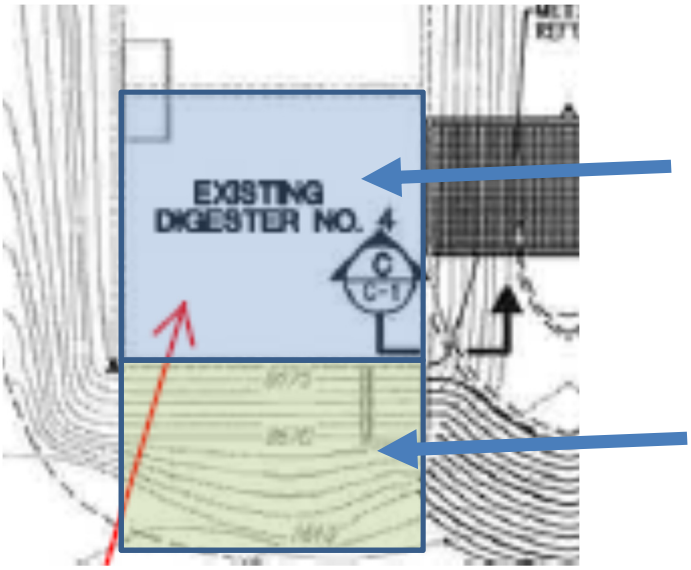
Phase 2 Biowin Output



Flow	2.58 mgd
Ammonia N	0.92 mgN/L
Nitrate N	0.32 mgN/L
Nitrite N	0.09 mgN/L
Filtered TKN	2.39 mgN/L
Total N	2.80 mgN/L
Total P	0.09 mgP/L
Total suspended solids	0.00 mg/L
Total COD	32.97 mg/L
Total Carbonaceous BOD	0.96 mg/L
pH	6.81

Phase 1 Construction Sequence

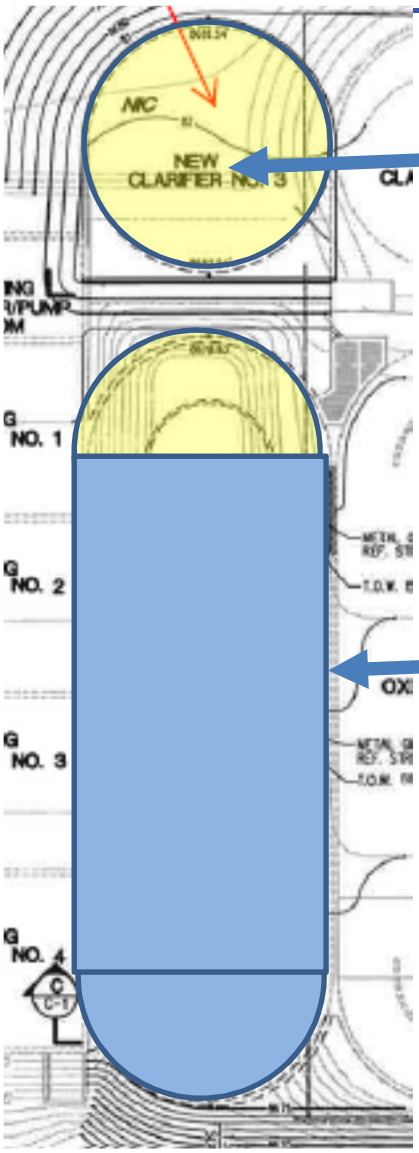
The biological design was put together with the existing tankage in mind to try to minimize downtime and maximize the use of existing assets. It should be possible to minimize the downtime in one of the existing oxidation ditch – clarifier trains, while leaving the other two untouched.



New Membrane Filtration System

Ancillary equipment, including membrane air scour blowers, permeate pumps, dry-pit RAS pumps, pipe gallery, CIP and BP equipment, MCCs and Controls

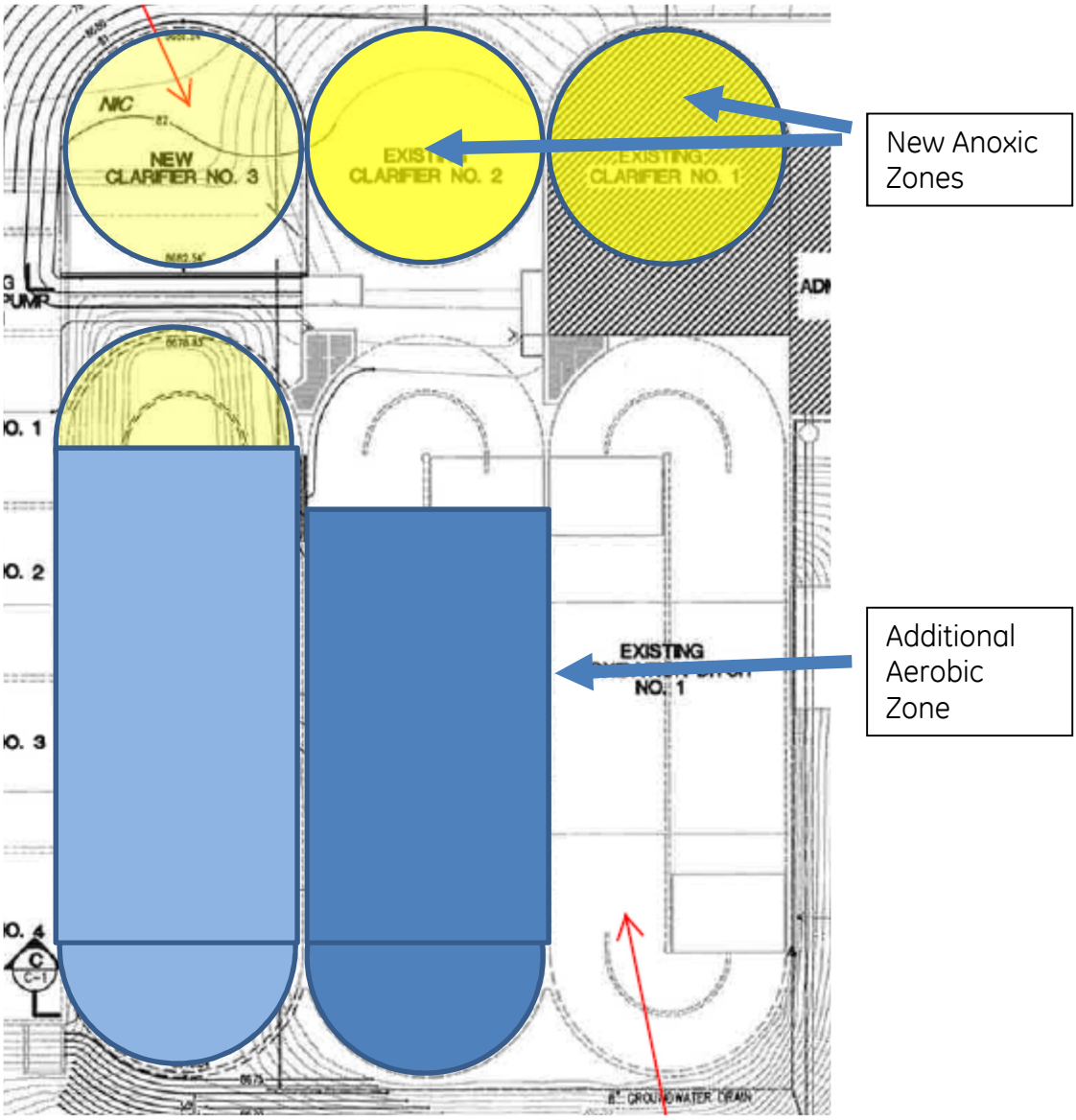
It would seem that this part of construction could be completed prior to impacting any of the oxidation ditch and clarifier capacity.



Anoxic Zone - 250,000 gallons

Aerobic Zone – 600,000 gallons

Phase 2 Layout Concept

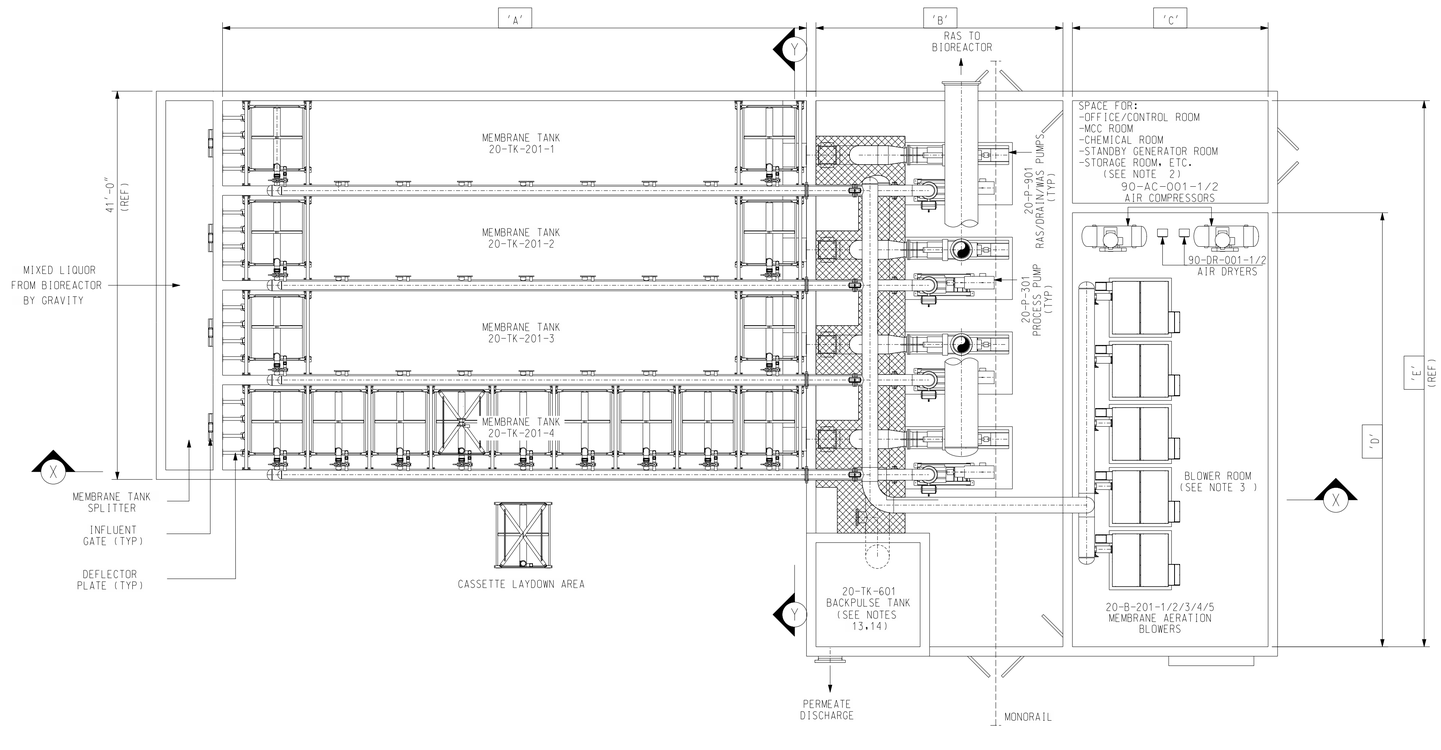


Typical Drawing:

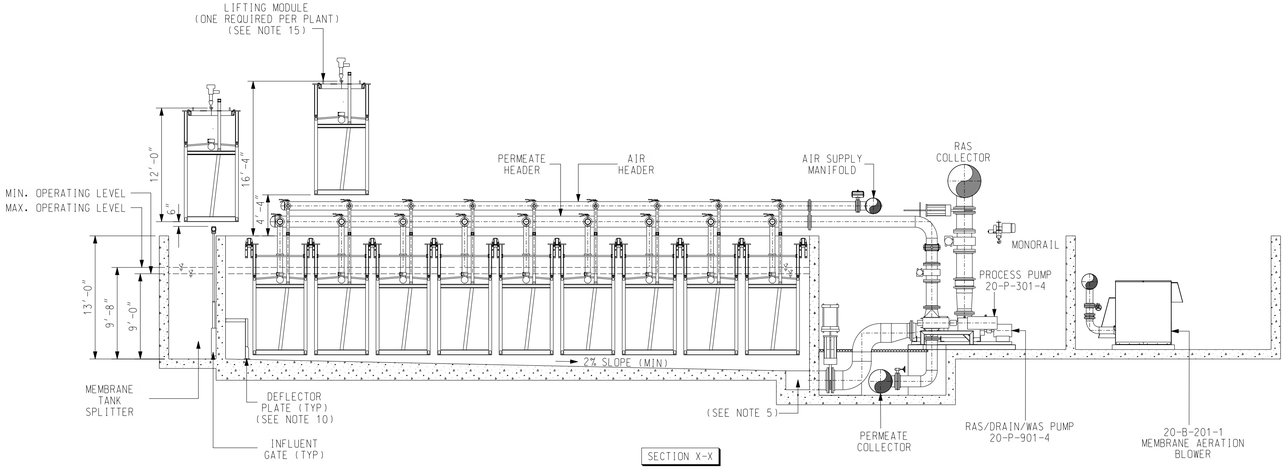
The drawing below depicts a typical 4-train system with a chart depicting different membrane tank dimensions based on the number of trains.

The proposed system would have 4 trains, each with 4 cassettes. The dimension listed as "A" would therefore be 28'4".

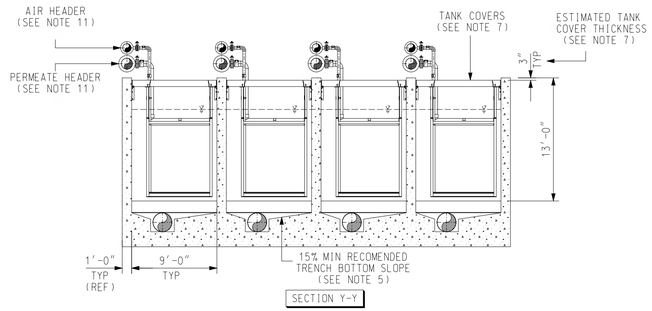
Biological basins are not shown on this drawing but sizes are described above.



PLAN VIEW



SECTION X-X



SECTION Y-Y

MAJOR TANK & BUILDING DIMENSIONS

CASSETTES 'N' PER TRAIN	'A'	'B'	'C'	'D'	'E'
1	8'-5"	15'-6"	12'-0"	44'-4"	57'-0"
2	15'-0"	15'-6"	12'-0"	44'-4"	57'-0"
3	21'-8"	15'-6"	13'-0"	44'-4"	57'-0"
4	28'-4"	17'-0"	15'-0"	45'-10	58'-6"
5	35'-0"	17'-0"	18'-0"	45'-10	58'-6"
6	41'-8"	17'-0"	18'-0"	45'-10	58'-6"
7	48'-4"	19'-4"	18'-0"	45'-10	58'-6"
8	55'-0"	26'-2"	20'-8"	45'-10	58'-6"
9	61'-8"	26'-2"	20'-8"	45'-10	58'-6"

ALL EQUIPMENT AND PIPING SIZE SHOWN ON THIS DRAWING IS FOR THE LARGEST TRAIN SIZE (9 CASSETTES).EQUIPMENT LAYOUT CAN CHANGE WITH SMALLER TRAIN SIZES.

NOTES

1. FOR SCOPE OF GE-SUPPLIED EQUIPMENT AND TECHNICAL DATA REFER TO THE PROPOSAL AND P&IDs.
2. SIZE AND LOCATION OF LISTED ROOMS ARE PRESENTED FOR REFERENCE ONLY. SYSTEM INTEGRATOR TO DETERMINE SIZE AND LOCATION OF ALL AMENITIES.
3. BIOLOGICAL PROCESS AERATION BLOWERS ARE NOT INCLUDED IN THE BLOWER ROOM. BOTH GROUPS OF BLOWERS CAN BE PLACED IN THE SAME ROOM.
4. SYSTEM INTEGRATOR IS RESPONSIBLE FOR DESIGN OF CONCRETE TANKS.GRAVITY CHANNELS INFLUENT GATES. EMERGENCY OVERFLOW. WALKWAYS/HANDRAILS ON TOP OF WALLS (IF REQUIRED). THESE ARE NOT SHOWN IN THIS DRAWING FOR CLARITY.
5. TANK BOTTOM AND DRAIN SUMP DESIGNS ARE NOT BY GE. HOWEVER IT IS RECOMMENDED THAT MEMBRANE TANK BOTTOM IS TO BE CONFIGURED AS A ONE WAY SLOPE TOWARDS DRAIN TRENCH CROSSING THE ENTIRE TANK WIDTH. DRAIN SUMP CAN BE LOCATED ANYWHERE INSIDE THE TRENCH. WITH A TRENCH SLOPE TAPERING INTO THE SUMP ON ONE OR BOTH SIDES OF IT, DEPENDING ON THE LOCATION OF THE DRAIN SUCTION NOZZLE.
6. DRAIN SUCTION NOZZLE OPENING HAS TO BE AT LEAST 6" BELOW ELEVATION OF A TANK BOTTOM AT ITS SHALLOW END.
7. TANKS TO BE COVERED FOR ACCESS TO CASSETTES AND EQUIPMENT. DESIGN, SUPPLY AND INSTALLATION OF MEMBRANE TANK COVERS ARE BY OTHERS (TANKS MUST BE VENTED). GE-SUPPLIED CASSETTE SUPPORT BEAMS INCLUDE A 3" ALLOWANCE FOR TANK COVERS THAT HAVE TO BE FLUSH WITH TOP OF TANKS. SPECIFIC DESIGN HAVE TO BE COORDINATED WITH GE. FOR ADDITIONAL INFORMATION REFER TO THE GE DESIGN GUIDELINE LISTED BELOW (NOTE 16a).
8. MEMBRANE TANK INTERNALS WILL BE IN CONTACT WITH MEMBRANE CLEANING CHEMICALS - TYPICALLY SODIUM HYPOCHLORITE OR CITRIC ACID SOLUTIONS. FOR ADDITIONAL INFORMATION REFER TO THE GE DOCUMENT LISTED BELOW (NOTE 16b).
9. ALL INTERNAL DIMENSIONS ARE GIVEN TO THE FINISHED CONCRETE AND COATING SURFACE; CONTRACTOR TO CALCULATE THE THICKNESS OF THE COATING BEFORE POURING THE CONCRETE (NOTE 16c).
10. DEFLECTOR PLATE DESIGN AND SUPPLY ARE BY OTHERS. FOR ADDITIONAL INFORMATION REFER TO THE GE DESIGN GUIDELINE LISTED BELOW (NOTE 16d).
11. DESIGN AND SUPPLY OF SUPPORTS FOR PERMEATE AND AIR HEADERS ARE BY OTHERS. SYSTEM INTEGRATOR TO DETERMINE DESIGN, NUMBER AND LOCATION OF SUPPORTS. GE TIE POINTS MUST NOT BE USED TO SUPPORT INTERCONNECTING PIPING.
12. SYSTEM INTEGRATOR TO CONSIDER PROVISION FOR FOAM/SLUDGE SURFACE WASTING AT THE DETAILED ENGINEERING STAGE.
13. MINIMUM OPERATING LEVEL IN THE BACKPULSE TANK (IF APPLICABLE) TO ALWAYS STAY ABOVE TOP OF CASING OF THE BACKPULSING PUMP.
14. THE BACKPULSE TANK IS OF IN-LINE (FLOW-THROUGH) CONFIGURATION IF PD PROCESS PUMPS ARE USED: IT IS OF OFF-LINE CONFIGURATION IF CENTRIFUGAL PROCESS PUMPS ARE USED. NOTE THAT BACKPULSE TANK IS USED ON SMALLER SYSTEMS ONLY.
15. ESTIMATED CASSETTE SHIPPING WEIGHT 4,500 LBS [2,040 KG]. ESTIMATED CASSETTE MAX WEIGHT(SLUDGED) 10,000 LBS [4,535 KG]. MEMBRANE LIFTING DEVICE (TRAVELING BRIDGE-CRANE) TO BE SIZED FOR 5,000 KG (NOTE 16e).
16. THE FOLLOWING DESIGN GUIDELINES ARE AVAILABLE FROM GE UPON REQUEST:

a. TANK COVER GUIDELINES FOR ZEEWEED 500 SYSTEMS.
b. MG-09012-C CONCRETE TANK COATING GUIDELINES FOR ZEEWEED SYSTEMS.
c. MG-09011-A MEMBRANE TANK TOLERANCES.
d. BEP #2007-04 BAFFLE DESIGN.
e. ZEEWEED 500 SERIES MEMBRANE LIFTING EQUIPMENT GUIDELINE.

GE Water & Process Technologies
ZENON Membrane Solutions

REFERENCE ONLY
DO NOT USE FOR CONSTRUCTION

REV.	DESCRIPTION	ECO	DWN	APVD	DATE	CHKD
A	INITIAL RELEASE		T.O	C.B	24OCT11	J.G

TOLERANCES UNLESS NOTED
DECIMALS .X .030 .XX .015 .XXX .010
ANGLES .5 FRAC 1/8
DIMENSIONS IN INCHES DO NOT SCALE
THIRD ANGLE

DRAWN BY	T.O	DATE 24OCT11
CHECKED BY	J.G	DATE 24OCT11
APPROVED BY	C.B	DATE 24OCT11
APPROVED BY		DATE

GE Water & Process Technologies
GLOBAL HEADQUARTERS : TREVOSE, PA USA +1-215-355-3300 WWW.GEWATER.COM

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CLIENT/JOB	PRE ENGINEERED LEAPMBR 4 TRAINS PUMP FROM
FILE	MICROSTATION
TITLE	PLOT PLAN PD PROCESS PUMP-(SIDE MOUNT)
MATERIAL	
SIZE	D
DRAWING NO.	4100000A-AG-04
REV	A
PROJECT	4100000
SCALE	1:96
SHEET	1OF 1

P/N 1161662-RHP01

The ZeeLung® Membrane Aerated Biofilm Reactor Process

Upgrading existing wastewater treatment plants or designing new facilities for nutrient removal is challenged by process complexity, the need for larger tank volumes and increased energy consumption.

The Membrane-Aerated Biofilm Reactor (MABR) process enables simple, low-energy nutrient removal in a small footprint. GE's ZeeLung MABR technology, when coupled with energy recovery from solids, can cost effectively achieve energy-neutral wastewater treatment.

MABR Technology

The MABR process employs a gas transfer mem-brane to deliver oxygen to a biofilm that is attached to the surface of the membrane (Figure 1).

The MABR process leverages the synergy between a gas transfer membrane and an attached growth biofilm. Oxygen is delivered by diffusion to the bio-film with very high efficiency while substrate, such as ammonia and organics, diffuses from the bulk solution into the biofilm.

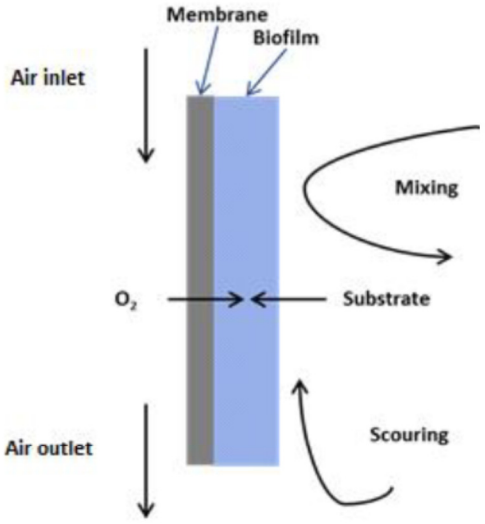


Figure 1: MABR operation principle

ZeeLung Product

ZeeLung is an innovative gas transfer membrane product that is designed specifically for MABR applications.

Hollow fiber oxygen-permeable gas transfer membranes are distributed longitudinally around the circumference of a yarn-based reinforcing core (Figure 2).

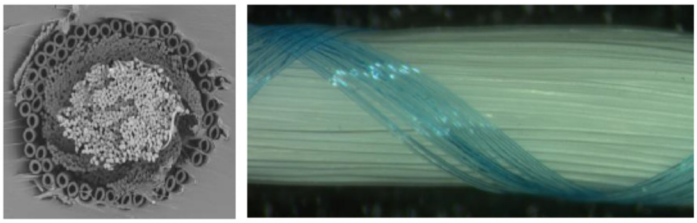


Figure 2: Scanning electron microscope image of ZeeLung cord

The resulting construction - referred to as a "cord" - is flexible yet unbreakable. Multiple cords are potted into top and bottom headers to create a module (Figure 3). The top header delivers and dis-tributes air to the inside of the fiber lumens and exhaust gas is collected in the bottom header. Modules are installed in cassettes for deployment in biological reactors.

Reactor mixing and biofilm thickness control is pro-vided with minimal energy input by a coarse bubble aeration system integrated into the ZeeLung cassette.

ZeeLung cassettes are installed directly into the bio-reactor (Figure 4) with minimal impact on the existing equipment and operations.



Figure 3: ZeeLung modules

Customer Benefits

Key customer benefits include:

- ✓ Simple – ZeeLung membranes are installed directly into existing bioreactor tanks, minimizing the impact on plant hydraulics and operations
- ✓ Low Energy – oxygen is delivered at an efficiency 4X greater than fine bubble aeration
- ✓ Nutrient Removal – increasing biomass inventory by supplementing a suspended growth system with attached growth enables nutrient removal
- ✓ Small Footprint – nutrient removal and capacity expansion in existing bioreactor volumes, avoiding the need to construct new bioreactor tanks

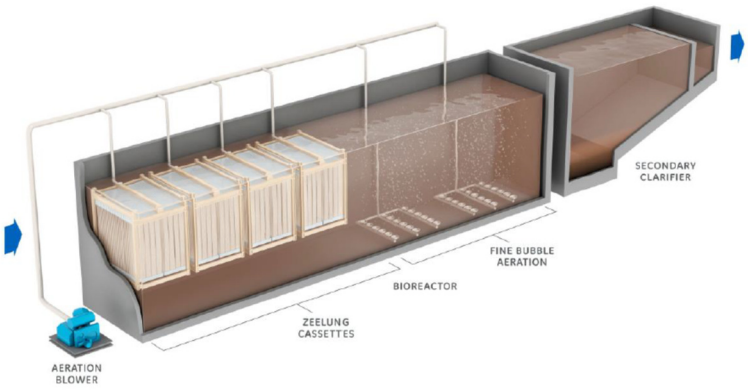


Figure 4: ZeeLung MABR process flow diagram

Scope of Supply by GE

- ZeeLung® MABR Cassettes and Modules
- Air Laterals and Connections
- PLC Control Equipment and Programs
- Instrumentation and Valves Integral to ZeeWeed® System
- Electrical and Mechanical Engineering Submittals
- Operation & Maintenance Manuals
- Installation, Commissioning & Start-up Assistance
- Operator Training

Scope of Supply by Others

Connection to Existing Blowers
Installation of ZeeLung® Cassettes in Existing Basins

Design Assumptions:

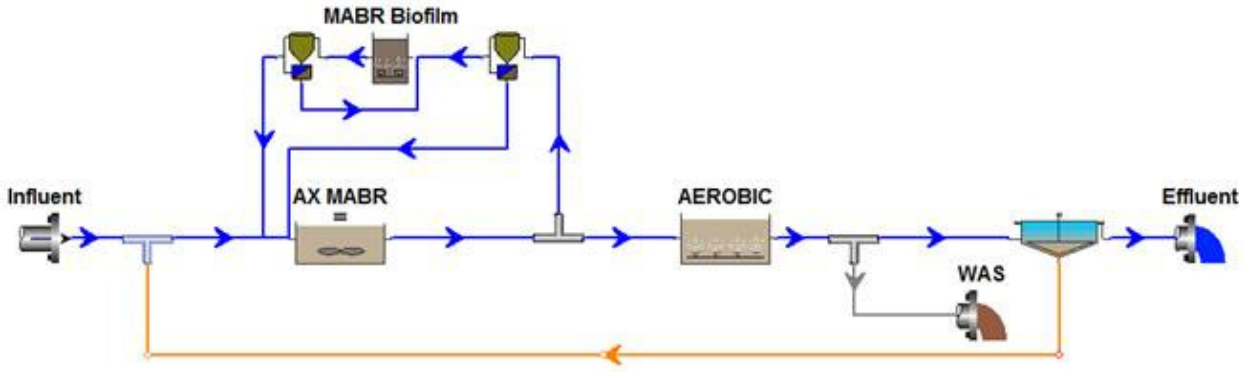
As per memo provided by MWH – Stantec titled "Design Criteria for BNR Improvements Project", dated January 29, 2017.

MABR System Design

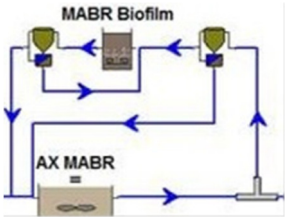
The ultrafiltration design of this system is described in the table below where membrane modules are assembled into cassettes and cassettes are installed in concrete tanks.

Type of Membrane	ZeeLung®
Number of Installed Cassettes	28
Approximate Footprint of ZeeLung Cassettes	~ 4,900 ft2 per Oxidation Ditch
Budgetary Cost	**$2.0MM - $2.4MM**
Estimated Liquid Train Construction Cost (From headworks through disinfection)	**$3.0MM to $3.5MM**

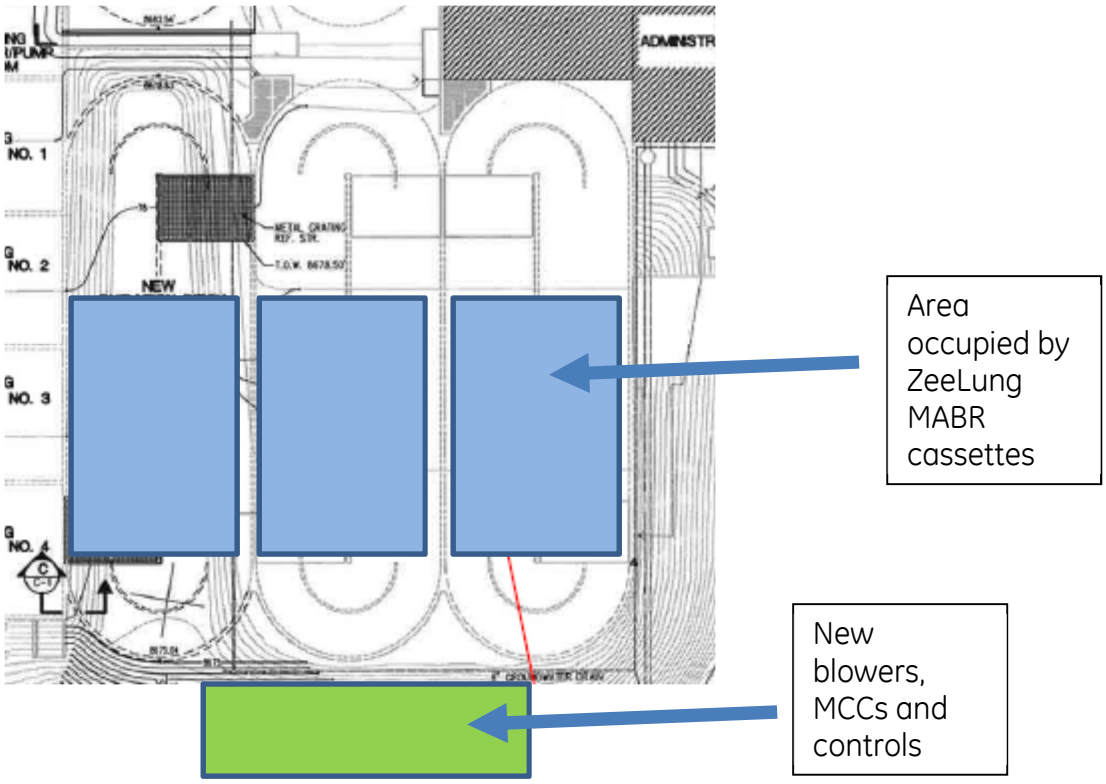
Phase 1 Biowin Output



Please note that the slightly complex looking MABR set-up has more to do with manipulating the software than with actual mechanical configurations. In truth, this entire symbol is actually just ZeeLung MABR cassettes submerged in what is otherwise an anoxic zone.



Layout Concept



Please note that most applications would not typically require additional blowers. Oxidation ditches are slightly unusual in that they typically use surface aeration, so blower capacity is required in this case.

E.2 MEMBRANE BIOREACTOR SYSTEM BY OVIVO



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MBR Preliminary Proposal

Telluride WWTP, CO

Feb 13th, 2017

Ovivo Proposal #022616-1-AK-R1

Prepared For

Nathan Brown, PE

MWH- Stantec

1560 Broadway, Suite 1800

Denver, CO 80202

Phone: (303) 291-2139

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February 13th, 2017

Nathan Brown, PE
MWH- Stantec
1560 Broadway, Suite 1800
Denver, CO 80202
Phone: (303) 291-2139

RE: Telluride WWTP, CO– Preliminary Proposal #022616-1-AK-R1, Membrane Bioreactor System

Mr. Brown:
Thank you very much for your interest in the Ovivo Membrane Bioreactor (MBR) system and for giving us the opportunity to propose our system.

For over 15 years, Ovivo has been supplying our MBR technology offering simple membrane equipment packages to meet project specification or complete solutions to wastewater treatment problems. Ovivo's multidisciplinary staff brings more true MBR system experience than any other company. Our MBR systems include multiple, proven technologies allowing flexible, adaptable operation. This adaptability to operate over a range of different conditions improves overall system performance compared to conventional treatment processes and MBRs with hollow-fiber membranes. At Ovivo, our goal is to provide customers with comprehensive system solutions to their wastewater problems.

With this proposal, we have included Design summary, Scope of supply, Preliminary Layout, Operation and Maintenance estimates. Please let us know if you need any more information to help you with your analysis.

Main advantages of proposed MBR design for Telluride,CO:

Design

The proposed MBR can hydraulically and biologically handle 2.25MGD MMF and 4.5MGD PDF lasting for up to 24 hours at a time. Equalization will not be required if peak daily flow of 4.5MGD lasts for less than 24 hours. The design is robust and can easily meet the TN8 and TP1 limit at the low wastewater temperature of 9C without adding any chemicals.

Future Upgrades

To meet possible future limits of TN3, one more clarifier would have to be retrofitted as Pre-AX basin and one more o-ditch would have to be retrofitted as PA and Post AX basin. Some carbon addition would be required. Alum addition will be required if TP 0.1 has to be met.

The MBR basins have room to add 4 more total membrane units. This can increase the hydraulic capacity of the plant to 2.6MGD MMF, 5.2MGD PDF.

Retrofit

No new construction. All process basins and MBR basins will be retrofitted in existing structures. This design would lead to low construction/ installation cost and speedier total project execution schedule. We have proposed to retrofit Pre-Anoxic basin in one clarifier, Pre-air and Post Anoxic basin in one oxidation ditch and MBR basins in two existing aerobic digesters.

Treating wastewater during construction

While one train would be in process of retrofit with the MBR, the other two trains would be available for continued uninterrupted wastewater treatment

Operational Flexibility

We have included two PA basin trains for two reasons-
1. Taking advantage of existing wall thereby reducing demolition cost
2. Providing flexibility to turn one basin down for maintenance or during low flows for energy savings

Solids handling

Sludge will be periodically wasted from the MBR basins where the mixed liquor concentration is the highest (8,000mg/l-12,000mg/l). This results in reduced sludge volume in comparison with other technologies and hence reduced solids processing requirement.

Equipment and service Price

The budgetary pricing for the proposed attached scope of supply is approximately **$3,590,000.** This includes field service and freight.

This Preliminary Proposal constitutes a non-binding estimate of price for certain goods and/or services. We look forward to working with you on this project. Please do not hesitate to contact me or our local representative, Steve Hansen of AmbienteH2O at 303-433-0364, shansen@ambienteh2o.com, if you have any questions.

Ashwini Khare
Regional Manager, MBR Systems
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Austin Texas, 78758 U.S.A.
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Email: ashwini.khare@ovivowater.com

Enclosure

Cc: Steve Hansen, AmbienteH20

Basis of Design

Parameter	Flow	Temperature	Typical Event Duration	Design Durations
Average Annual Flow (AAF)	1.50 MGD	14 °C *	9 consecutive months	9.0 months *
Max Month Flow (MMF)	2.25 MGD	9 °C	3 consecutive months	3.0 months *
Peak Week Flow (PWF) **	2.64 MGD	9 °C *	3 non-consecutive weeks	3.0 weeks *
Peak Day Flow (PDF) **	4.50 MGD	9 °C *	8 non-consecutive days	8.0 days *
Peak Hourly Flow (PHF) **	4.50 MGD	9 °C *	4 hrs with 24 hrs between PHF	4.0 hours *

Parameter	Influent	Effluent Limits
BOD	312 mg/L	< 30 mg/L
TSS	275 mg/L	< 30 mg/L
TKN	37 mg/L	N/A
NH_3	26 mg/L *	< 1 mg/L
TP	6 mg/L	< 1 mg/L
TN	37 mg/L *	< 8 mg/L
Maximum Wastewater Temperature	22 °C	
Elevation	8,750 ft	

* Value assumed by Ovivo, to be verified by consulting engineer.

** Peak values assumed to occur during MMF, to be verified by consulting engineer.

MBR Zone (Membrane) Design

Parameter	Value	Notes
No. of Membrane Basins	2	
No. of Membrane Rows per Basin	6	
No. of Membrane Units per Basin	22	44 units total. 2 out of 44 units being redundant
Membrane Unit Type	OV480	Cassette: OC480
No. of Cassettes per Unit	1	44 membrane Cassettes total
Surface Area per Cassette	5166.68 ft2/cartridge	227,334 sq ft total
Flux @ 1.50 MGD (AAF)	6.60 gal/(ft2 x day)	
Flux @ 2.25 MGD (MMF)	9.90 gal/(ft2 x day)	
Flux @ 2.64 MGD (PWF)	11.61 gal/(ft2 x day)	
Flux @ 4.50 MGD (PDF)	19.79 gal/(ft2 x day)	
Flux @ 4.50 MGD (PHF)	19.79 gal/(ft2 x day)	
Membrane Basin Volume	136,136 gal/basin	40ft x 35ft x 13ft SWD (EXISTING ANAEROBIC DIGESTERS USED)
Membrane Air Scour Rate for Sizing	76.0 scfm/unit	@ 6.5 PSIG discharge
Total System AOR	6,458 lb O2/day	
AOR Satisfied by Air Scour	2,488 lb O2/day	
MBR Basin MLSS	11,789 mg/L	

Pre-Anoxic Zone Design

Parameter	Value	Notes
Basin Volume	235,546 gal/basin	235,546 gal total
SWD	16ft SWD	
Anoxic MLSS	10,105 mg/L	USE EXISTING CLARIFIER- SEE DRAWING
Recycle Rate	6 Q	From MBR to Anoxic Basin

PA Zone Design

Parameter	Value	Notes
Basin Volume	195,578 gal/basin	391,156 gal total
SWD	14ft SWD	USE EXISTING O DITCH- SEE DRAWING
Pre-Aeration MLSS	10,105 mg/L	
Fine Bubble Diffuser AOR	3,969 lb O2/day	

Post Anoxic Zone Design

Parameter	Value	Notes
Basin Volume	339,518 gal/basin	339,518 gal total
SWD	13.5ft SWD	USE EXISTING O DITCH- SEE DRAWING

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MBR Waste Activated Sludge Production Parameters		
Parameter	**Value**	**Notes**
WAS Sludge Production	4,106 lbs sludge / day	
Sludge Concentration	1.2%	solids
Sludge Flow	43,122 gal sludge / day	
WAS Volatile Fraction	0.75	Assumed

System Design Parameters		
Parameter	**Value**	**Notes**
Plant HRT	13.1 hrs	
Design Plant SRT	26 days	
F:M ratio	0.05	

Traditional Recycle Pump Design		
Parameter	**Value**	**Notes**
Traditional Recycle Pumps	3	2 Duty, 1 Stdby
Type	SUBMERSIBLE	
Unit Capacity	4,688 GPM	
TDH	20.0 ft	

Permeate Pump Design		
Parameter	**Value**	**Notes**
Permeate Pumps	6	4 Duty, 2 Stdby
Type	CENTRIFUGAL	Suction Design
Unit Permeate Pump Capacity	868 GPM	
TDH	42.0 ft	

Blower Design		
Parameter	**Value**	**Notes**
MBR Blowers	3	2 duty, 1 Stdby
Type	POSITIVE DISPLACEMENT	
Unit MBR Blower Capacity	1,923 SCFM	
MBR Blower Discharge Pressure	6.49 PSIG discharge	
Pre-Aeration (PA) Blowers	3	2 duty, 1 Stdby
Type	POSITIVE DISPLACEMENT	
Unit PA Blower Capacity	1,094 SCFM	
PA Blower Discharge Pressure	7.51 PSIG discharge	

Chemical Cleaning Design		
Parameter	**Value**	**Notes**
Cleaning chemical (organic fouling)	Sodium Hypochlorite	2 times/yr
Typical Cleaning Schedule	1-2	cleanings/basin/yr
Volume per Membrane	190.20 gal/cassette	
Volume of Cleaning Solution	4,184.49 gal/basin	
Cleaning Solution Concentration	0.001	
Volume of 12.5% Stock solution	33 gal/basin/cleaning	
Cleaning chemical (inorganic fouling)	Oxalic Acid	2 times/yr
Typical Cleaning Schedule	1-2	cleanings/basin/yr
Volume per Membrane	190.20 gal/cassette	
Volume of Cleaning Solution	4,184.49 gal/basin	
Cleaning Solution Concentration	0.01	
Volume of 100.0% Stock solution	42 gal/basin/cleaning	

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Pre Anoxic Zone General Equipment Information

Function	Name	Type	Size or Unit Capacity	Value	Material	Manufacturer	Model or Specification	Motor HP	QTY
BASIN MIXING	MIXER	SUBMERSIBLE	235,000	GALLONS	SS304	WILO	TR40.114-6/24	9.2	3
MIXER SUPPORT	MIXER SUPPORT HARDWARE & GUIDE RAIL	RAIL MOUNT	SS	N/A	N/A	N/A	N/A	N/A	3
LEVEL MEASUREMENT	LEVEL TRANSMITTER	HYDROSTATIC	23	FEET	SS	BLUE RIBBON	BC001-10-40	N/A	1
LEVEL MEASUREMENT	LEVEL SWITCH	FLOAT	N/A	N/A	POLYURETHANE	CONERY	N/A	N/A	2

Internal Recycle General Equipment Information

Function	Name	Type	Size or Unit Capacity	Value	Material	Manufacturer	Model or Specification	Motor HP	QTY
Traditional Recycle	PUMP	SUBMERSIBLE	4,688	GPM	CAST IRON	WILO	FA30.93-65HP	65	3
PUMP ISOLATION	VALVE	#N/A	16	INCH	#N/A	#N/A	#N/A	N/A	3
FLOW DIRECTION	VALVE	SWING CHECK	16	INCH	CAST IRON	KEYSTONE	815-160	N/A	3
PUMP INLET PRESSURE	GAUGE	COMPOUND	-30-+15	INCH Hg/PSI	SS	MCDANIEL	MPB/SCA-GF	N/A	3
PUMP OUTLET PRESSURE	GAUGE	PRESSURE	0-15	PSI	SS	MCDANIEL	MPB/SCU-GF	N/A	3
Traditional Recycle FLOW METER	FLOW METER	ELECTROMAGNETIC	16	INCH	POLYURETHANE	ENDRESS & HAUSER	PROMAG 10W4H-ULGA1RA0B4AA	N/A	2
MBR BASIN ISOLATION	VALVE	#N/A	16	INCH	#N/A	#N/A	#N/A	N/A	2

PRE-AERATION General Equipment Information

Function	Name	Type	Size or Unit Capacity	Value	Material	Manufacturer	Model or Specification	Motor HP	QTY
AERATION	DIFFUSER SYSTEM	FINE BUBBLE	1,094	SCFM / basin	N/A	AEROSTRIP	N/A	N/A	2
DIFFUSER CIP	AUTOMATED VALVE	SOLENOID	1.5	INCH	BRASS	ASCO	TBD	N/A	2
DISSOLVED OXYGEN MEASURMENT	DO PROBE	LDO	0-10	mg/L DO	SS	HACH	57900-00	N/A	2
DO TRANSMITTER	ANALOG TRANSMITTER	SC200	N/A	N/A	N/A	HACH	LXV404.99.70112	N/A	2

Post Anoxic Zone General Equipment Information

Function	Name	Type	Size or Unit Capacity	Value	Material	Manufacturer	Model or Specification	Motor HP	QTY
BASIN MIXING	MIXER	SUBMERSIBLE	339,000	GALLONS	SS304	WILO	TR40.114-6/24	9.2	4
MIXER SUPPORT	MIXER SUPPORT HARDWARE & GUIDE RAIL	RAIL MOUNT	SS	N/A	N/A	N/A	N/A	N/A	4

MBR Zone General Equipment Information

Function	Name	Type	Size or Unit Capacity	Value	Material	Manufacturer	Model or Specification	Motor HP	QTY
MEMBRANE FILTRATION	OVIVO MEMBRANE UNIT	FLAT SHEET	N/A	N/A	SS	OVIVO	OV480	N/A	44
DIFFUSER CIP	AUTOMATED VALVE	SOLENOID	1.5	INCH	BRASS	ASCO	TBD	N/A	2

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DIFFUSER INLET ISOLATION	VALVE	BUTTERFLY	2.50	INCH	CAST IRON	KEYSTONE	221-025	N/A	44
PERMEATE BRANCH ISOLATION	VALVE	BALL	4.00	INCH	PVC	ASAHI	1602-040	N/A	44
LEVEL MEASUREMENT	LEVEL SWITCH	FLOAT	N/A	N/A	POLYURETHANE	CONERY	N/A	N/A	4
CHEMICAL CLEANING ISOLATION	VALVE	BALL	4	INCH	PVC	ASAHI	1602-040	N/A	3
CIP VENT	VALVE	BALL	4	INCH	PVC	ASAHI	1602-040	N/A	12
PERMEATE HEADER ISOLATION	VALVE	BUTTERFLY	8	INCH	PVC	ASAHI	3730-080	N/A	12
FABRICATION	FASTENERS	N/A	N/A	N/A	SS304	OVIVO	N/A	N/A	44
FABRICATION	OVIVO UNIVERSAL MOUNTING KIT	N/A	N/A	N/A	SS304	OVIVO	N/A	N/A	44
FABRICATION	OVIVO UMK LIFTING TOOL	N/A	N/A	N/A	SS304	OVIVO	N/A	N/A	1
FABRICATION	OVIVO UMK PLATFORM	N/A	N/A	N/A	SS304	OVIVO	N/A	N/A	6
FABRICATION	IN-BASIN PIPING & SUPPORTS FOR OMUs	N/A	N/A	N/A	SS304	OVIVO	N/A	N/A	44

Permeate Control General Equipment Information

Function	Name	Type	Size or Unit Capacity	Value	Material	Manufacturer	Model or Specification	Motor HP	QTY
TMP MEASUREMENT	PRESSURE TRANSMITTER	DIAPHRAGM	-15-+15	PSI	N/A	ENDRESS & HAUSER	CERABAR T PMC 131-A22F1V6N/Q4H	N/A	4
PERMEATE PUMP	PUMP	CENTRIFUGAL	868	GPM	GRAY IRON	GORMAN RUPP	T8A3S-B	10	6
VIBRATION ISOLATION	EXPANSION JOINT	BULB	10	INCH	SYNTHETIC RUBBER / SS	API	AMS210	N/A	12
PUMP ISOLATION	VALVE	BUTTERFLY	10	INCH	PVC	ASAHI	3730-100	N/A	16
PUMP INLET PRESSURE	GAUGE	COMPOUND	-30-+15	INCH Hg/PSI	SS	MCDANIEL	MPB/SCA-GF	N/A	6
PUMP OUTLET PRESSURE	GAUGE	PRESSURE	0-15	PSI	SS	MCDANIEL	MPB/SCU-GF	N/A	6
FLOW DIRECTION (PUMPED)	VALVE	SWING CHECK	10	INCH	CAST IRON	KEYSTONE	810-100	N/A	6
ON/OFF	VALVE	NEEDLE	0.25	INCH	POLYPROPYLENE	ASAHI	5313.002	N/A	1
FLOW MEASUREMENT	FLOW METER	ELECTROMAGNETIC	10	INCH	POLYURETHANE	ENDRESS & HAUSER	PROMAG 10W2F-ULGA1RA0B4AA	N/A	4
FLOW CONTROL	AUTOMATED VALVE	MODULATING BUTTERFLY	10	INCH	PVC	ASAHI / BETTIS	XV3-100 / EM810F-15-C4-02-103	N/A	4
TURBIDITY MEASUREMENT	TURBIDITY METER	OPTICAL	0-100	NTU	N/A	HACH	60101-01	N/A	3
TURBIDITY / PH TRANSMITTER	ANALOG TRANSMITTER	SC200	N/A	N/A	N/A	HACH	LXV404.99.70112	N/A	3

MBR Aeration General Equipment Information

Function	Name	Type	Size or Unit Capacity	Value	Material	Manufacturer	Model or Specification	Motor HP	QTY

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MBR BLOWER	BLOWER	POSITIVE DISPLACEMENT	1,923	SCFM	CAST IRON	AERZEN	GM80L-125	125	3
MBR NOISE SUPPRESSION	SOUND ENCLOSURE	WITH BLOWER	N/A	N/A	N/A	AERZEN	N/A	N/A	3
MBR BLOWER TEMP	TEMPERATURE GAUGE	WITH BLOWER	N/A	N/A	N/A	AERZEN	N/A	N/A	3
MBR BLOWER PRESSURE	PRESSURE GAUGE	WITH BLOWER	N/A	N/A	N/A	AERZEN	N/A	N/A	3
MBR BLOWER TEMP SWITCH	TEMPERATURE SWITCH	WITH BLOWER	N/A	N/A	N/A	AERZEN	N/A	N/A	3
MBR BLOWER FLOW CONTROL	VALVE	CHECK (WITH BLOWER)	N/A	N/A	N/A	AERZEN	N/A	N/A	3
MBR BLOWER PRESSURE RELIEF	VALVE	PRESSURE RELIEF (WITH BLOWER)	N/A	N/A	N/A	AERZEN	N/A	N/A	3
MBR BLOWER PRESSURE	PRESSURE TRANSMITTER	DIAPHRAGM	-15-+15	PSI	N/A	ENDRESS & HAUSER	CERABAR T PMC 131-A22F1V6N/Q4H	N/A	3
MBR AIR ISOLATION	VALVE	BUTTERFLY	12	INCH	CAST IRON	KEYSTONE	221-120	N/A	5
MBR AIR FLOW MEASUREMENT	FLOW METER	MASS AIR FLOW	6	INCH	SS	ENDRESS & HAUSER	65I-60AA0AD1ACBBBA	N/A	2

PA Air Supply General Equipment Information

Function	Name	Type	Size or Unit Capacity	Value	Material	Manufacturer	Model or Specification	Motor HP	QTY
PA BLOWER	BLOWER	POSITIVE DISPLACEMENT	1,094	SCFM	CAST IRON	AERZEN	GM60S-100	100	3
PA NOISE SUPPRESSION	SOUND ENCLOSURE	WITH BLOWER	N/A	N/A	N/A	AERZEN	N/A	N/A	3
PA BLOWER TEMP	TEMPERATURE GAUGE	WITH BLOWER	N/A	N/A	N/A	AERZEN	N/A	N/A	3
PA BLOWER PRESSURE	PRESSURE GAUGE	WITH BLOWER	N/A	N/A	N/A	AERZEN	N/A	N/A	3
PA BLOWER TEMP SWITCH	TEMPERATURE SWITCH	WITH BLOWER	N/A	N/A	N/A	AERZEN	N/A	N/A	3
PA BLOWER FLOW CONTROL	VALVE	CHECK (WITH BLOWER)	N/A	N/A	N/A	AERZEN	N/A	N/A	3
PA BLOWER PRESSURE RELIEF	VALVE	PRESSURE RELIEF (WITH BLOWER)	N/A	N/A	N/A	AERZEN	N/A	N/A	3
PA BLOWER PRESSURE	PRESSURE TRANSMITTER	DIAPHRAGM	-15-+15	PSI	N/A	ENDRESS & HAUSER	CERABAR T PMC 131-A22F1V6N/Q4H	N/A	3
PA AIR FLOW MEASUREMENT	FLOW METER	MASS AIR FLOW	10	INCH	SS	ENDRESS & HAUSER	65I-100AA0AD1ACBBBA	N/A	1
PA AIR ISOLATION	VALVE	BUTTERFLY	8	INCH	CAST IRON	KEYSTONE	221-080	N/A	3

OMU CIP General Equipment Information

Function	Name	Type	Size or Unit Capacity	Value	Material	Manufacturer	Model or Specification	Motor HP	QTY
MAZZIE INJECTOR	INJECTOR	VENTURI	4	INCH	POLYPROPYLENE	MAZZEI INJECTOR CORP	4091	N/A	1
WATER SUPPLY VALVE	AUTOMATED VALVE	2 POSITION BALL	4	INCH	PVC	ASAHI / BETTIS	1601-040 / EM500F-15-C4-02-102	N/A	1
CIP THROTTLING	VALVE	BALL	4	INCH	PVC	N/A	N/A	N/A	2

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INJECTOR PRESSURE	GAUGE	PRESSURE	0-15	PSI	SS	MCDANIEL	MPB/SCU-GF	N/A	2
DRAIN	VALVE	BALL CHECK	1	INCH	PVC	ASAHI	1210-010	N/A	1
CHEMICAL ISOLATION	VALVE	BALL	4	INCH	PVC	ASAHI	1602-040	N/A	1
PRESSURE CONTROL	VALVE	PRESSURE REGULATOR VALVE	4	INCH	N/A	WILKINS	600/DUC	N/A	1
CHEMICAL FLOW	FLOW METER	ROTOMETER	1	GPM	POLYSULPHONE	KOBOLD	KSM-4005	N/A	1
FLOW MEASUREMENT	FLOW METER	ELECTROMAGNETIC	4	INCH	POLYURETHANE	ENDRESS & HAUSER	PROMAG 10W1H-ULGA1RA0B4AA	N/A	1
INJECTOR ASSEMBLY	PIPE SPOOL	SUCTION	N/A	N/A	N/A	OVIVO	N/A	N/A	1
CHEMICAL TRANSFER TO MBR	HOSE	SUCTION	1	INCH	PVC	TIGERFLEX	W100	N/A	1

Controls General Equipment Information

Function	Name	Type	Size or Unit Capacity	Value	Material	Manufacturer	Model or Specification	Motor HP	QTY
PLANT CONTROL	SCADA	SOFTWARE	N/A	N/A	N/A	WONDERWARE	N/A	N/A	1
PLANT CONTROL	HMI	PANEL MOUNT/DESKTOP PC	N/A	N/A	N/A	N/A	N/A	N/A	1
PLANT CONTROL	PLC PANEL	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1

Miscellaneous General Equipment Information

Function	Name	Type	Size or Unit Capacity	Value	Material	Manufacturer	Model or Specification	Motor HP	QTY
PROJECT KICKOFF MEETING	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1
MECHANICAL INSPECTION	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	4
START-UP / COMMISSIONING / TRAINING	N/A	N/A	20	DAYs	N/A	N/A	N/A	N/A	1
QC & INSPECTION	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1
SHIPPING & RECEIVING	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1
INBOUND FREIGHT	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1
OUTBOUND FREIGHT	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1

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O & M costs based on Average Annual Flow (AAF) are listed below, and have been broken down into four categories.

- Category 1: Annual Chemical Use Summary

Table 1: Chemical Usage		
Parameter	**Value**	**Notes**
Number of Cassettes	44 Cassettes	
Volume of Chemical Needed per Cassette	190.20 gal/Cassette	
Sodium Hypochlorite (Membrane CIP)		
Volume of Dilute Sodium Hypochlorite	8,369 gal	
Concentration of Dilute Solution	0.10%	
Concentration of Stock Solution	12.5%	
Volume of Stock Solution of Sodium Hypochlorite	67 gal	vol. per single plant clean
Sodium Hypochlorite Buyout Cost	$0.10/lb	Assumed
Cleanings per Year	2 times/yr	
Total Annual Sodium Hypochlorite Chemical Cost	$134	Specific Gravity: 1.2
Oxalic Acid (Membrane CIP)		
Volume of Dilute Oxalic Acid	8,369 gal	
Concentration of Dilute Solution	1%	
Concentration of Stock Solution	100%	
Volume of Stock Solution of Oxalic Acid	84 gal	vol. per single plant clean
Oxalic Acid Buyout Cost	$0.71/lb	Assumed
Cleanings per Year	2 times/yr	
Total Annual Oxalic Acid Chemical Cost	$1,635	Specific Gravity: 1.65
Total Annual Chemical Cleaning Costs	**$1,769**	

- Category 2: Annual Labor Costs for Membrane Cleaning

Table 2: Membrane CIP Labor		
Parameter	**Value**	**Notes**
Operator Hourly Wage	25	per hour
Total Cleaning Man-hours	24	hr/yr
Total Annual Labor Cost for Cleaning	$600 /yr	Estimated

- Category 3: Annual Plant Operation and Maintenance Costs

Table 3: Plant Maintenance & Sampling Costs		
Parameter	**Value (hr/yr)**	**Notes**
Blowers	30	(Oil & filter change)
Influent Screens	0	
Permeate Pumps	12	(Inspection/lube)
RAS Pumps	6	(Inspection/lube)
Instrumentation	25	(calibrate and/or clean)
Sampling	25	
Mixers	1.4	(replace seals)
Total Annual Labor Manhours	99.4 hr/yr	hr/yr (membrane clean not included)
Operator Hourly Wage	25	per hr
Total Annual Labor Cost for O&M	$2,485 /yr	Estimated

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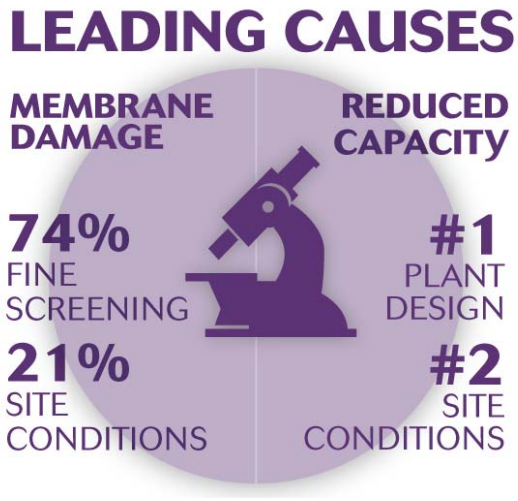
Membrane Technology Experience

As an MBR system supplier, Ovivo has multiple membrane technologies available. Ovivos's approach is to utilize the membrane technology that can provide the best value to each project. For the Whitefish MT project, Ovivo's proposal includes OV-416 membrane units which utilize Microdyn-Nadir membrane technology. The OV416 Membrane Unit is simply an upgraded version of the BIO-CEL Module (made by Microdyn-Nadir) using PES Nadir® UP150 membranes (also made by Microdyn-Nadir). Microdyn-Nadir is a premier membrane manufacturer that has an exclusive long-term commitment with Ovivo. Ovivo's membrane units OV100, 200, 300, 416, 460, and 1900 all use the same membrane, the UP-150, which has been produced by Microdyn-Nadir since 1991, and it is Title 22 approved.



OV400 Membrane Technology

Ovivo's decision to develop OV technology using Microdyn-Nadir membrane sheets was both data driven and based on experiential factors. For example, we know that; screen by-pass (damaging debris) is responsible for 76% plate failures. We also know the plant design and site conditions can lead diffuser clogging and or localized dewatering. Once diffusers are clogged, or dewatered solids collect in the channels between the plates, air scouring is selectively pushed to specific areas. Sustained higher air scouring in some areas can lead to excessive aeration, also called over aeration. Dewatering and over-aeration are the second leading causes of reduced capacity and have caused 21% of the plate damage identified in a recent survey of 185 facilities. In fact, over-aeration will soon take the number one spot as the primary cause of membrane failure/replacement. For these reasons and others, Ovivo engineers set out to design a membrane unit that uses non-clogging diffusers and is:



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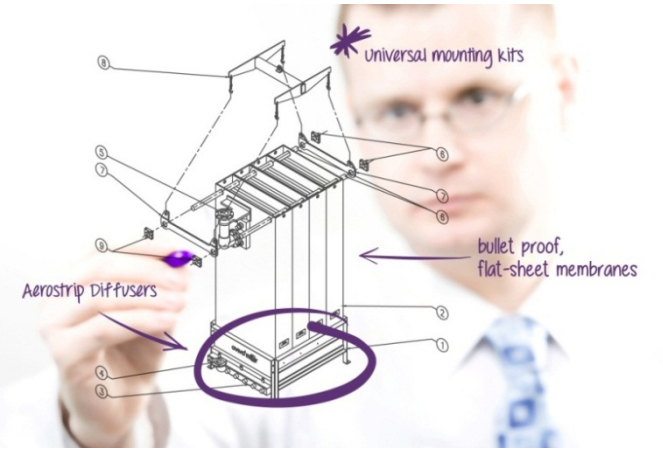
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1. Resistant to debris damage
2. Easy to recover from dewatering
3. Easily installed in any size, shape tank
4. Easily retrieved

To accomplish these performance goals, Ovivo chose the Microdyn BIO-CEL technology using UP150 membranes as the basis for the OV416.

The UP150 membrane that is used in the OV416 has been **in production since 1991** and is **installed in 1,000s of locations** worldwide through a network of partners. The BIO-CEL Membrane Module was introduced to the market in 2005 and since then approximately 1,700 modules and approximately **1,200,000 m^2 of membrane area have been installed worldwide**. Applications range from municipal to food production plants to electronics, from tuna processing in Mexico to Dairies in South Africa and the United Kingdom.

Ovivo improved on the BIO-CEL design by replacing the OTT tube-style diffuser with **Aerostrips (1,500 installations)**. Since becoming the licensee in 2013, there are already **31 U.S. MBR projects**, multiple Membrane Thickening Projects (MBTs) and 7 KUBOTA replacement projects underway.



Some of the key U.S. projects underway include a 4 MGD job in KY, a 2.5 MGD job in FL (expandable to 5.0 MGD), a 1.0 MGD (expandable to 2.0 MGD). The OV is selected for all of the jobs and dozens of others. 5 plants are operating now and 7 should be online before the end of April. For comparison, the SP technology Ovivo use to integrate the Canton project (world's largest MBR) is installed in U.S. plants. The quick acceptance of the technology was due in large part to the intuitive advantages of the non-clogging diffuser and the pliability of the flat-sheets (versus rigid plates).

Diffuser clogging is virtually eliminated using Aerostrip Diffusers as is the potential for membrane dewatering. At the moment, if localized dewatering occurs, the plates must be manually (physically) cleaned.



Diffuser Module – Side



Diffuser Module – Top View



Diffuser

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In the event a system upset, the OV unit can be serviced quickly. The main reason for this is the flexibility of the pliable flat sheets. If dewatering occurs the solids simply fall out once lifted and or aerated. Another advantage of the fused, 2 mm, pliable sheets, instead of the 6mm, rigid plates (or fibers for that matter) is the resistance to debris damage. Damaged sheets heal within about 4 minutes even from severe damage such as cuts, tears or abrasions. This sheet maximizes self-healing and is truly **BulletProof**.



For these reasons, the OV416 membrane has longer life compared to other manufacturers and so we can offer upto **10-yr non-prorated membrane warranty if required at an additional cost**. For Life Cycle Cost Analysis, the membrane replacement should be based on the membrane warranty offered by the supplier. For Ovivo MBR systems, with 10 yr warranty there is only one membrane replacement in a 20 yr period.

The manufacturing process of OV-416 is sophisticated and efficient. Its fully automated and goes through the following steps:

- Casting of polyethersulfone (PES) on non-woven polyester sheet
- Drying process
- Coated sheets along with polyester spacer layer and adhesion layers are ultrasonically welded
- Measuring, cutting of membrane sheet
- Placement of attachments, grommets and connections
- Assembly of membrane cassette

The membranes are currently manufactured in Germany and the diffusers assembled in Austin. The current lead time is 8-10 weeks for membrane units, however we always have spare in our stock which can be shipped immediately if required. It is anticipated that membrane manufacturing would begin in US in the next couple of years at which point the lead time will be reduced to 4-6 weeks.

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To summarize, market feedback and field observations suggested that ideal membrane unit should have the following features and we were to achieve all these through the OV416 membrane unit:

1. Easily fit into any geometry tank for retrofit projects (square, circular, shallow or deep)
2. Use **UF** membranes as another barrier for (direct potable) reuse or RO feed
3. Be less susceptible to poor screening and debris
4. Allow for overaeration
5. Have non-clogging diffusers
6. Minimize dewatering potential
7. Have a higher packing density
8. Meet **Buy America**

As System Supplier, Ovivo is focussed on all the system components and how well they work with each other to provide a user-friendly and efficient system for the end user. Membrane is just one part of the equation; system effciency, ease of operation and maintenance should all be considered.

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Ease of operation is often the least appreciated aspect of MBR technology. Put simply, by eliminating phase separation (sludge settling) from the treatment process, MBR technology greatly reduces the amount of operator oversight required to keep the system running efficiently. Like any modern wastewater treatment plant, MBR systems do require periodic maintenance and calibration of mechanical equipment and instrumentation. Ovivo's MBR system takes the ease of operation to the next level with a low I/O count and equipment. See *Replacement Schedule* for equipment life and scheduled maintenance frequencies.

Ovivo estimates that the man hours required to operate the plant would be approximately 105 hours per year. Duties would range from general cleaning to equipment repair. Operators must be capable of understanding the safety requirements and potential hazards that exist in a wastewater treatment plant.

The following table is a general breakdown of the estimated or recommended intervals related to the operations and maintenance of the MBR System. For permit compliance, local regulatory agencies may require an alternate schedule or specific testing/reporting procedures. While as complete as possible, the tasks listed are for estimating purposes only. Interval and tasks may change based on plant flow, loadings, site specific issues, and may not include all items necessary to keep the plant up and running trouble free.

Table Key:
I = Inspect, clean, adjust, and repair as necessary
P = Perform procedure as needed
C = Clean
R = Check/Replace

General Site Inspection

Task	Service Interval					
	Daily	Weekly	Quarterly	Semi-Annually	Annually	Comments
Check system for overall cleanliness	-	C	-	-	-	
Inspect structure for damage or deterioration	-	-	I	-	-	
Inspect electrical outlets	-	I	-	-	-	

Preparation for Foul Weather

Task	Service Interval					
	Daily	Weekly	Quarterly	Semi-Annually	Annually	Comments
Programming review and check	I	-	-	-	-	
Clean Membrane Units, if TMP is high	P	-	-	-	-	Clean-in-Place (CIP)
Diffuser flush	P	-	-	-	-	
Inspect rotating equipment	-	I	-	-	-	
Check valves to ensure proper operation	-	I	-	-	-	Manually operate valves
Cycle offline equipment to ensure proper operation	-	-	P	-	-	

PLC

Task	Service Interval					
	Daily	Weekly	Quarterly	Semi-Annually	Annually	Comments
Monitor and trend	I	-	-	-	-	
Check programming functions	I	-	-	-	-	
Check Alarms & interlocks	I	-	-	-	-	

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Monitoring Parameters

Task	Service Interval					
	Daily	Weekly	Quarterly	Semi-Annually	Annually	Comments
Permeate flow	1/min	-	-	-	-	Automatically logged at the SCADA
Air flow	1/min	-	-	-	-	Automatically logged at the SCADA
Water Temperature	1/min	-	-	-	-	Automatically logged at the SCADA
TMP (Transmembrane Pressure)	1/min	-	-	-	-	Automatically logged at the SCADA
DO (Dissolved Oxygen)	1/min	-	-	-	-	Automatically logged at the SCADA if included
Filterability	**P**	**P**	-	-	-	Daily for first 3 months, weekly after that
Turbidity	1/min	-	-	-	-	Automatically logged at the SCADA if included
BOD_5	-	**P**	-	-	-	
COD	-	**P**	-	-	-	
NH_3-N (Ammonia)	-	**P**	-	-	-	
NO_3-N (Nitrate)	-	**P**	-	-	-	
TP (Phosphorus)	-	**P**	-	-	-	
Mixed Liquor Suspended Solids (TSS & VSS)	-	**P (2/week)**	-	-	-	Twice per week
FOG (Fats, Oils, & Grease)	-	**P**	-	-	-	
pH	-	**P (2/week)**	-	-	-	Twice per week

Membrane Unit

Task	Service Interval					
	Daily	Weekly	Quarterly	Semi-Annually	Annually	Comments
Membrane Cleaning (CIP)	-	-	**P**	-	-	Clean-in-Place (CIP)
Diffuser flush	-	**P**	-	-	-	
Inspect roll pattern	-	**I**	-	-	-	Visual inspection
Waste	-	**P (2/week)**	-	-	-	As needed

Fine Screens

Task	Service Interval					
	Daily	Weekly	Quarterly	Semi-Annually	Annually	Comments
Inspect fine screen operation	**-**	**I**	**-**	-	-	Visual inspection

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Recycle & Permeate Pumps

Task	Service Interval					
	Daily	Weekly	Quarterly	Semi-Annually	Annually	Comments
Cycle offline equipment to ensure proper operation	-	P	-	-	-	
Belts and seals	-	-	-	I/R	-	See *Replacement Schedule* for more details

Blowers

Task	Service Interval					
	Daily	Weekly	Quarterly	Semi-Annually	Annually	Comments
Cycle offline equipment to ensure proper operation	-	P	-	-	-	
Belts and filters	-	-	I	-	-	See *Replacement Schedule* for more details

UV System

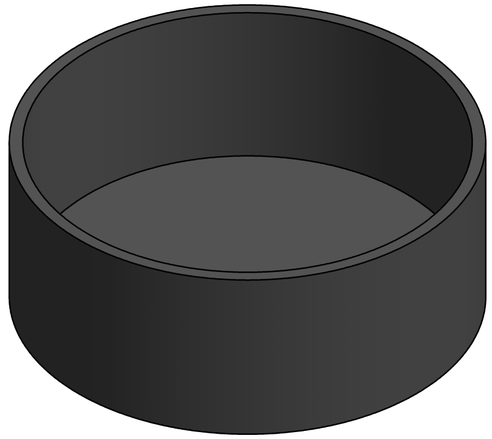
Task	Service Interval					
	Daily	Weekly	Quarterly	Semi-Annually	Annually	Comments
Inspect UV System	-	-	I	-	-	
Replace Lamps	-	-	-	P	-	

Instrumentation

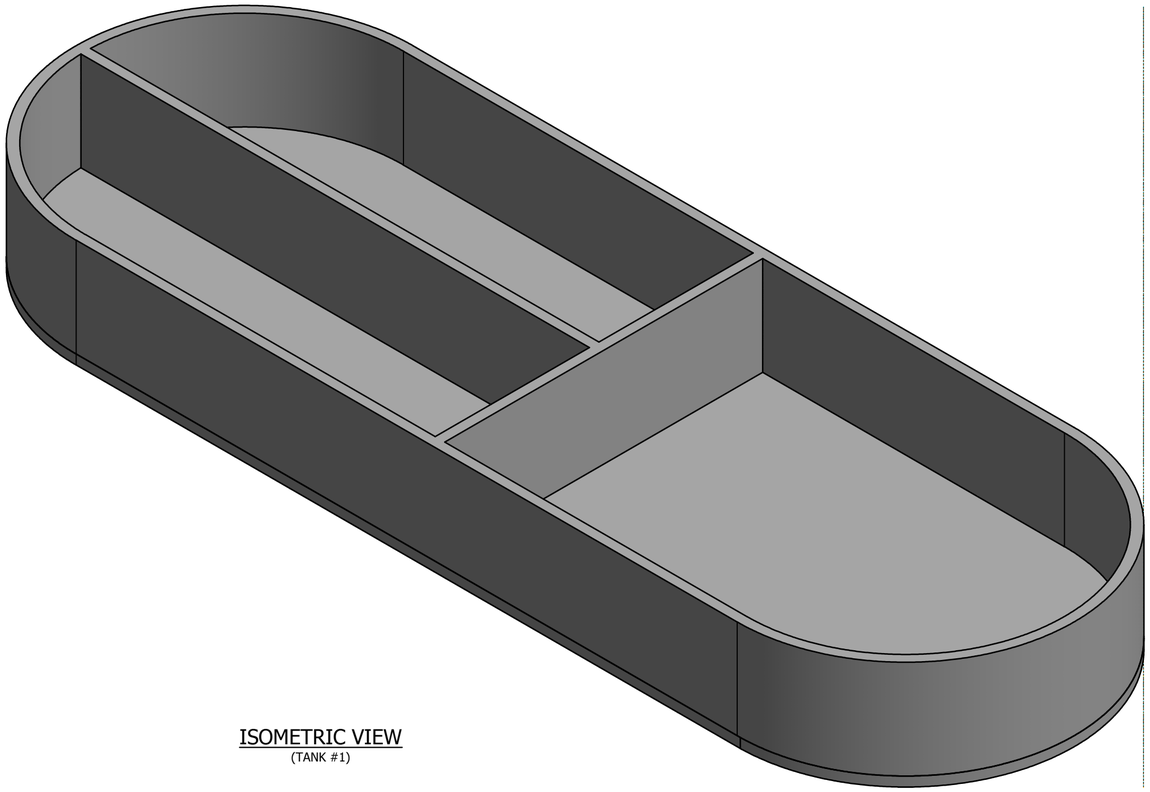
Task	Service Interval					
	Daily	Weekly	Quarterly	Semi-Annually	Annually	Comments
Calibrate all instruments	-	-	P	-	-	
Turbidimeter	-	-	I/C	-	-	
DO Probe	-	-	I/C	-	-	
Float switch	-	-	I/C	-	-	
Flow meter	-	-	I/C	-	-	
Level Transmitter	-	-	I/C	-	-	

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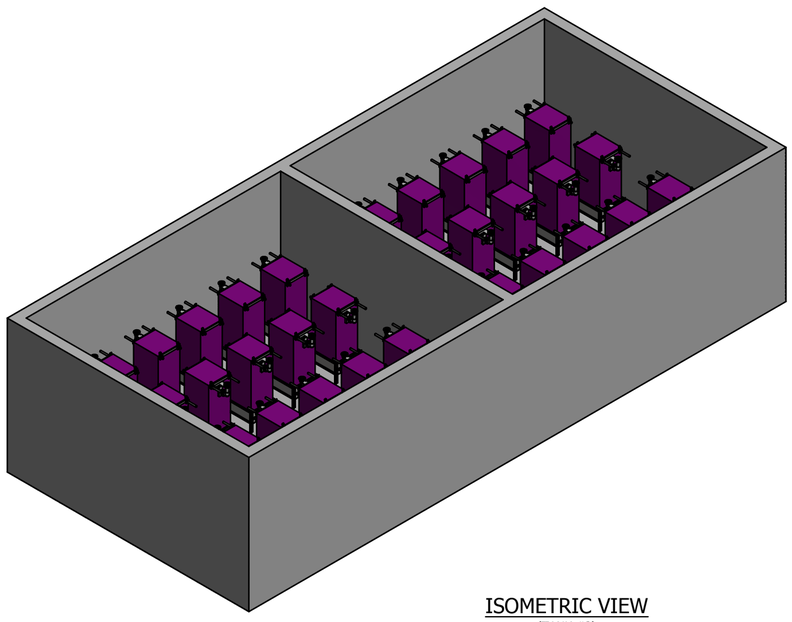
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ISOMETRIC VIEW
(TANK #3)



ISOMETRIC VIEW
(TANK #1)



ISOMETRIC VIEW
(TANK #2)

CONCEPT ONLY
NOT FOR CONSTRUCTION

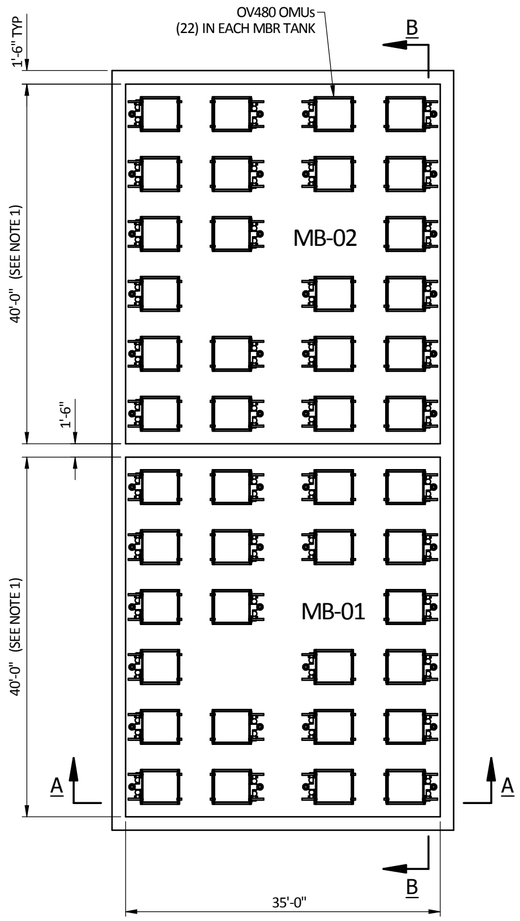
INITIAL RELEASE					A
REVISION DESCRIPTION	EN/ECO	BY	CHECK'D	DATE	REV

D	THIRD ANGLE PROJECTION	OVIVO
		Worldwide Experts in Water Treatment
REF. FROM	-	DO NOT SCALE PRINTS
DATE (mm/dd/yy)	2/9/2017	WORKMANSHIP STANDARD WI-7501-01 APPLIES
DRAWN	NPR	ORIGINAL S.O.
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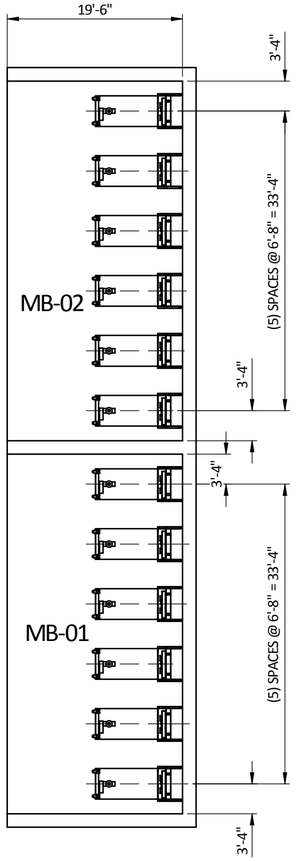
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LAYOUT PROPOSAL
(2.25 MGD MBR)

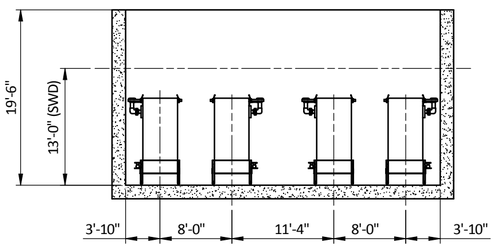
DWG. NO.		SHEET	REV
	S-022616-1-AK-R1	1 OF 2	A



PLAN

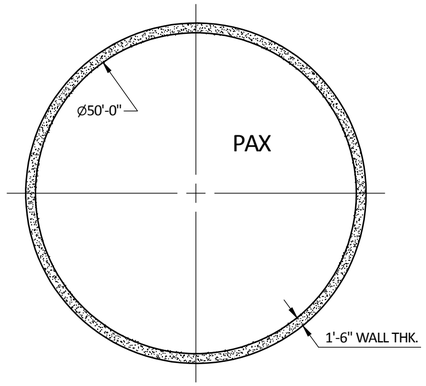


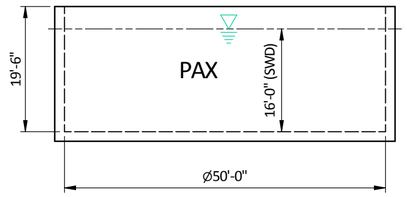
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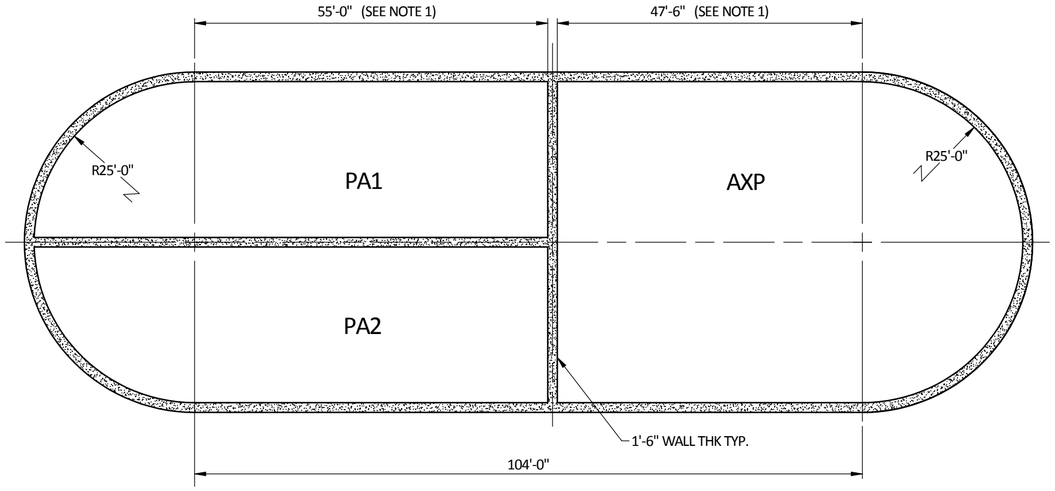
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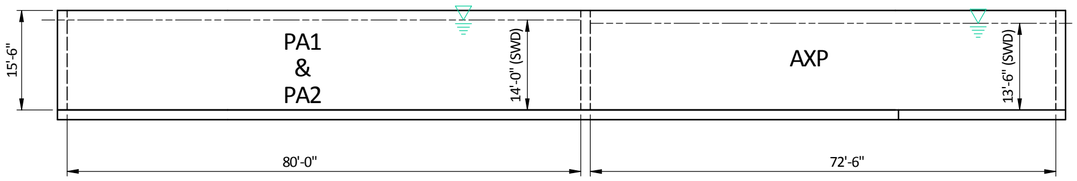
TANK #2





TANK #3





TANK #1

NOTE:
1. DIMENSION IS BASED ON WALL AND FLOOR THICKNESSES OF 1'-6" AND IS FOR REFERENCE, ONLY. ACTUAL DIMENSION OF WALLS AND FLOORS ARE THE RESPONSIBILITY OF THE ENGINEER AND NO ACCURACY OR RESPONSIBILITY FOR THE REFERENCE DIMENSIONS ARE TO BE INFERRED OR IMPLIED FROM THIS DRAWING.

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D	DO NOT SCALE PRINTS	DWG. NO.	S-022616-1-AK-R1	SHEET 2 OF 2	REV A

WORKMANSHIP STANDARD WI-7501-01 APPLIES

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E.3 PROPOSAL FOR BIOMAG® EQUIPMENT BY EVOQUA

TELLURIDE WWTP

CITY OF TELLURIDE, CO

BIOMAG™ CONCEPTUAL PROPOSAL

MWH - STANTEC

February 2017



Evoqua Sales Contact:
Nate Antonneau
nathan.antonneau@evoqua.com

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2 BIOMAG OPERATING COSTS 4

3 FUTURE DESIGN EVALUATION NEEDS 5

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5 PROCESS DESIGN SUPPORT/RECOMMENDATIONS 6

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Evoqua Water Technologies is pleased to present a preliminary BioMag system proposal. The BioMag system is a proven, reliable, treatment process using magnetite to ballast the biological floc in an activated sludge process. This high density ballast (specific gravity of 5.2) allows the plant to operate at high mixed liquor concentrations while achieving exceptional settling rates.

The treatment goal for this facility, in applying the BioMag system, are:

- to reduce overall bioreactor footprint;
- to add anoxic volume within existing tankage to achieve denitrification and an effluent nitrate concentration of 8 mg/L;
- to handle peak flows and storm flows more reliably; and
- to achieve an effluent phosphorus concentration of 1.0 mg/L

1 DESIGN SUMMARY

Table 1 summarizes the design flows used as the basis for the proposed BioMag system.

Table 1: Design flows.

Parameter	Units	Value
Average Daily Flow	MGD	1.5
Max Month Flow	MGD	2.6
Peak Daily Flow	MGD	3.0
Peak Hourly Flow	MGD	4.0

Table 2 summarizes the design influent water quality used as the basis for the proposed BioMag system.

Table 2: Design influent water quality.

Parameter	Units	Value
Biochemical Oxygen Demand (BOD_5)	mg/L	311
Total Suspended Solids (TSS)	mg/L	274
Ammonia Nitrogen (NH_3-N)	mg/L	32
Total Kjeldahl Nitrogen (TKN)	mg/L	36.8
Total Phosphorus (TP)	mg/L	5.0
Alkalinity	mg/L as $CaCO_3$	350
Maximum Influent Temperature	°C	20
Minimum Influent Temperature	°C	9

Table 3 summarizes the effluent performance requirements used as the basis for the proposed BioMag system.

Table 3: Effluent performance requirements.

Parameter	Units	Value
Total Suspended Solids (TSS)	mg/L	30
Total Phosphorus (TP)	mg/L	1.0

Table 4 summarizes the preliminary process parameters for the proposed BioMag system.

Table 4: Design and process parameters.

Parameter	Units	Value
Number of treatment trains		3
Total bioreactor volume	gallons	2,000,000
MLSS	mg/L	4,300
Aeration/Mixing System		Orbal discs
WAS (for mag drum sizing)	lb/d	5,492
RAS rate (for clarifier solids loading)	MGD	75% at ADF 100% at PHF
Number of clarifiers, existing		2+1
Clarifier diameter	ft	50
Number of new clarifiers required		0

2 BIOMAG OPERATING COSTS

As a guidance and reference, Table 5 lists the main consumables associated with the BioMag system recommended for this project.

Table 5: Estimated BioMag consumables.

Item	Guidance
Magnetite consumption (@ ADF)	100-150 lb/MGD (≈ $0.30/lb.)
Magnetite feed/recovery equipment power	1,240 kWh/d
Polymer – as dry active	As backup only (1 mg/L)
Coagulant	Proportional to P limit and water chemistry

3 FUTURE DESIGN EVALUATION NEEDS

The following design features will need to be evaluated and discussed in more detail as the BioMag design progresses:

- Secondary clarifier mechanism
- Secondary clarifier side water depth
- Peak flow duration
- Selector design
- Return sludge and waste sludge pumping capacity
- Headworks screening
- Biosolids wasting strategy
- Chemical feed system, chemical preference

4 SCOPE OF SUPPLY

Evoqua will supply the following equipment and services with the BioMag system. All equipment or services not specified in Table 6 are to be supplied by others.

Table 6: Evoqua scope of supply.

Item	Qty.	Description
Ballast Storage & Feed System		
Ballast mix tank mixer	1	3 HP, vertical shaft
Magnetite storage	1	25 ton silo
Magnetite dry feeder	1	10-foot stinger
Ballast Recovery System		
Rotary sludge screen	1	2 mm
Magnetic drum separator	2	7.5 HP each
Shear mill	1	40 HP each
Pump – ballast mix tank discharge	1+1	Positive displacement, 200 gpm, 7.5 HP
Pump – shear mill feed	1+1	Positive displacement, 150 gpm, 5 HP
Pump – WAS (after magnetite re-covery) Pump	1+1	Positive displacement, 150 gpm, 5 HP
Flow control valves	4	Motor operated plug valve (mag drum feed, ballast tank feed)

Item	Qty.	Description
Flow meters	4	Mag drums and ballast tank feed
Level sensors/switches	4	Mag drum, ballast addition tank
Control System Hardware		
Control panel	1	Control panel, HMI, PLC, I/O
Services		
Engineering support		Site visits/design kickoff; basis of design engineer support
Installation oversight, start-up, commissioning, performance testing and training		Up to 21 days

5 PROCESS DESIGN SUPPORT/RECOMMENDATIONS

It is our assumption that the aeration system for the existing plant will require upgrading due to the equipment age or replacement due to a significant plant capacity increase, therefore, Orbal disc aeration / mixing is recommended as previously proposed.

6 BUDGETARY PRICING

The budgetary price for the Evoqua BioMag system, as defined herein, including process and design engineering, field services, and equipment supply is provided under separate cover.

This price makes no provision for taxes, tariffs, duties, permitting fees and other fees and charges that are not made explicit above.

All pricing is quoted at FOB, Factory (full freight allowed). No taxes, regulatory fees or other costs related to the procurement and installation of the system are included.

The initial magnetite charge for the proposed system will require approximately 73 tons of virgin magnetite at design conditions. Evoqua can provide magnetite at a cost of **$515** per ton plus freight.

The scope of supply and pricing are based on Evoqua standard equipment selection, standard terms of sale and warranty terms. Any variations from these standards may affect this budgetary quotation. Additionally, please note this budgetary quotation is for review and informational purposes only and does not constitute an offer for acceptance.

Should you have any questions regarding this quotation, or would like to request a firm proposal and order form, please contact the following Evoqua Regional Representative:

Scott A. Marshall
MISCOwater
651 Corporate Circle, Suite 100
Golden, CO 80401
Office (303) 309-6150
Cell (303) 601-5215

Appendix

A. Frequently Asked Questions

APPENDIX A – FREQUENTLY ASKED QUESTIONS

1. GENERAL QUESTIONS ABOUT MAGNETITE, THE FUNDAMENTAL ELEMENT USED IN BIOMAG TO INCREASE SETTLING RATES AND RELIABILITY.

Q What is magnetite?

A Magnetite is fully oxidized iron ore (Fe_3O_4). It is completely inert; it cannot rust; it doesn't degrade with time or usage; it has no effect on biological floc; and it is not magnetic itself.

Q How does magnetite improve the performance of clarifiers and biological treatment systems?

A Magnetite is a very dense material with a specific gravity of 5.2. By comparison, the specific gravity of water is 1.0; a chemical hydroxide floc is fractionally over 1.0; and a biological floc is ~1.25. By infusing magnetite into either a chemical or biological floc, the specific gravity is increased by 50 to 100%, thereby significantly increasing the settling rate of the floc and gaining consistent control of the sludge blanket in the clarifier and greater stability for the whole system.

Q Is magnetite readily available?

A Yes, magnetite is mined and processed at multiple sites around the world. In the USA, Evoqua has identified multiple vendors that will provide magnetite to our specifications.

Q What is the cost of magnetite?

A Magnetite is very inexpensive, ranging from $0.20 to $0.50 per pound delivered, depending on the location of the distributor and the facility. Moreover, since the recovery rates of magnetite in BioMag systems are so high, daily consumption is very low. In fact, while evaluating the operating cost of a BioMag system, the ongoing cost of magnetite is negligible.

Q Is the magnetite abrasive? Does magnetite cause excessive wear to pumps?

A Unlike micro-sand, the ballast used by a competing technology, Evoqua specified magnetite is so fine that it has the consistency of talcum powder; hence, it is not abrasive and doesn't cause abnormal wear and tear on a treatment system pumps, mixers, valves and other components.

Q Does magnetite degrade at high temperatures (or low temperatures) or with changes in pH?

A Magnetite does not undergo any physical or chemical changes at the temperature and pH ranges associated with almost all municipal and industrial wastewater treatment.

Q Does magnetite affect pH or the chemical characteristics of the effluent?

A No, magnetite is completely inert. It has no effect on pH or the chemical characteristics of a system's effluent.

Q Does magnetite affect the oxygen content of wastewater?

A Since magnetite (Fe_3O_4,) is fully oxidized, it does not consume dissolved oxygen in wastewater being treated.

Q How much magnetite is recovered on the magnetic drum and where does the remainder go?

A *Evoqua has modified the design of conventional magnetic drums to optimize the capture and reuse of magnetite. In BioMag systems, the capture reuse rate is more than 96%. Any magnetite not captured by the drum is carried away in the sludge where we have found no effect on downstream sludge management systems or processing.*

Q How does magnetite in the effluent effect the performance of a downstream UV disinfection system?

A Since very little of the magnetite escapes the system, the direct effect is not discernable.

2. QUESTIONS ABOUT BIOMAG AND THE USE OF MAGNETITE IN BIOLOGICAL PROCESSES.

Q To what types of biological treatment systems can BioMag be applied?

A BioMag is most effective in enhancing the capacity and/or nutrient removal performance of activated sludge systems, including oxidation ditch, conventional air, extended air, HPO, and SBR based systems.

Q Does BioMag work with HPO?

A Yes, Evoqua has successfully tested the ability of BioMag to infuse and recapture magnetite from the relatively small and weak HPO biological floc. Hence, we are confident that magnetite can be effectively used to ballast mixed liquor from HPO facilities.

Q What is the optimum MLSS concentration for various activated sludge applications: conventional, extended air, SBR, oxidation ditches etc.

A There is no simple answer to this question as the MLSS concentration targets depend on plant objectives for capacity and nutrient removal, the type of activated sludge technology employed, economic practicality and how the above are expected to change over time. With this said, Evoqua has achieved excellent results with MLSS ranging from 5,000 to 12,000mg/L.

Q What is the optimum ratio of magnetite to MLSS in a BioMag enhanced system?

A We typically design for 1:1 ratio and optimize the system during commissioning to meet a project's specific need. Note that the amount of magnetite in the system can be varied as needed to control the blanket in the secondary clarifier; for example, a ratio of 1.2 magnetite to MLSS would be desirable to manage high wet weather flows passing through the biological treatment system.

Q How much magnetite is maintained in a typical activated sludge system enhanced by BioMag?

A This depends on the size of the system and the density of the mixed liquor. But consider a 1,000,000 gallon bioreactor enhanced with BioMag technology. Assume the system is running 8,000 mg/L MLSS ballasted with 8,000 mg/L of magnetite (a 1:1 ratio). The weight of the water is ~8.34million pounds; the weight of the MLSS is ~67,000 pounds as is the magnetite. Note the magnetite increases the mass of the system by ~ 0.8%. While this is sufficient to manage the settling of the blanket, it is a very small addition to the overall mass of the system.

Q Keeping an MLSS of 10,000 mg/L that is infused with 10,000 mg/L of magnetite must create challenges in keeping the resulting 20,000 mg/L of solids suspended in the bioreactor. How does Evoqua solve this problem?

A Much depends on an assessment of the existing or proposed aeration system and the objectives of incorporating BioMag. An increase in MLSS density for the purpose of increasing treatment capacity will necessarily require increased aeration for purposes of oxygen transfer to a larger biomass, a byproduct of which is increased mixing energy. Additional mechanical mixing may also be necessary to maintain full suspension especially if anoxic zones are incorporated. Consideration also has to be given to the type of aeration equipment: course bubble diffusers often provide sufficient mixing energy to keep the magnetite and MLSS in suspension while fine bubble diffusion usually requires additional mechanical mixing.

Q What types of mixing systems are best suited to achieve the mixing required to impregnate biological floc with magnetite and to keep the floc in suspension?

A Mixing can be achieved with mechanical mixers, diffused air, jet mixers/aerators, or a combination thereof. Anoxic and anaerobic zones are typically mixed with either submerged or floating mechanical mixers. Aerobic zones are normally mixed with either coarse bubble, jet aeration or a combination of fine bubble and mechanical mixing.

Q How much mixing energy is required to maintain magnetite infused biological floc in suspension?

A The mixing equipment for magnetite ballasted systems is designed to ensure suspension of the particles from a cold start which equates to an installed power requirement of approximately 55HP per million gallons of tankage.

Q Does magnetite addition suppress or exacerbate foaming in an activate sludge process?

A Foaming is a function of the operation of the biological treatment system. The inert characteristics of magnetite neither enhances or diminishes the production of foam.

Q What effect does magnetite have on the density for the sludge at the bottom of the secondary clarifier?

A Magnetite infused in the biological floc increases the thickening of the sludge blanket to ~ 2% solid.

Q With magnetite increasing the density of the sludge blanket at the bottom of the clarifier, can the RAS flow and the cost of pumping be reduced?

A It depends on the application. If magnetite is added to a system to improve only settling, and average forward flow and MLSS is not increased, there will be an increase in RAS concentration and RAS flow can be decreased accordingly. In typical BioMag applications, however, magnetite is added to enable an increase in MLSS to handle additional flow/loading or increased treatment; these applications will require AN increase in RAS flow commensurate with the increase in flow.

Q What is the effect of the magnetite to the WAS flow?

A. The very same effect as described in the above description of the effect of magnetite on RAS flow.

Q What is defined as well mixed? What mixing tests are performed and how are they measured?

A Well mixed is defined by TSS testing at various depths and locations throughout the bioreactor to maintain MLSS concentrations at ±15%.

Q Can coagulants be added to a BioMag enhanced activated sludge system? Does one type of coagulant work better than others?

A The addition of coagulants to the BioMag system results in precipitation of phosphorus and a higher quality effluent. Extensive testing has been carried out proving that BioMag works equally well with all common coagulants. The selection of coagulant type is typically dependent on client preference.

Q What happens to ortho phosphates?

A Three potential fates: (1) precipitated by coagulant and removed with the sludge; (2) assimilated by the biomass and removed with the sludge; and (3) passed through untreated.

Q When a power outage occurs, what will happen to the biomass ballasted with magnetite? And what happens when the power returns?

A A full power outage will adversely affect all the systems associated with the activated sludge system, including the plant's aeration system and mechanical mixers. Without any mixing the ballasted biological floc will settle to the floor of the reactors. The same would happen without the enhancement of BioMag. Once the power returns, the ballasted biomass would easily get re-suspended since the biological floc remains approximately 99% water.

Q How does the cost of operating a BioMag system compare to that of an MBR, IFAS or expanded ASP system.

A While much depends on the application, the annual operating costs of a BioMag enhanced activated sludge system are about the same as an IFAS, MBBR, or a conventional ASP. Compared to an MBR system, the operating costs are approximately 60% less.

Q What are the characteristics of the sludge produced from thickener underflow, SG, dry solids concentration and how does the inclusion of magnetite affect the flow?

A The WAS has very little magnetite after the recovery process. Most of the filamentous bacteria have been broken apart by the shear mill, so the sludge thickens well to the 3-5% solids range. This benefit enables smaller belt press, filter press, centrifuge etc., and therefore, lower Capex and Opex.

McEnany, Terry

From: Brown, Nathan
Sent: Friday, April 07, 2017 10:09 AM
To: McEnany, Terry
Subject: FW: City of Telluride, CO WWTF Improvements - Budgetary BioMag Proposal Request
Attachments: Telluride BioMag State-point 02-13-17.pdf; Telluride CO BioMag Proposal 02-13-17.pdf; BioMag Building Layout - 6ft Drum 2Drum 1Mill.pdf

---

From: Scott Marshall [mailto:smarshall@miscowater.com]
Sent: Wednesday, February 15, 2017 3:13 PM
To: Nathan Brown <Nathan.R.Brown@mwhglobal.com>
Subject: FW: City of Telluride, CO WWTF Improvements - Budgetary BioMag Proposal Request

Nate,

Sorry for the delay – I was attending the Rural Water show.

Thanks.

Scott A. Marshall, P.E.
MISCOwater
651 Corporate Circle, Suite 100
Golden, CO 80401
Office (303) 309-6150
Cell (303) 601-5215

From: Nathan T. Antonneau [mailto:nathan.antonneau@evoqua.com]
Sent: Monday, February 13, 2017 11:35 PM
To: Scott Marshall <smarshall@miscowater.com>
Cc: Scott Perry <sperry@miscowater.com>; Avinash T. Bhat <avinash.bhat@evoqua.com>; Patrick J. Regan <patrick.regan@evoqua.com>; Robert C. Backman <robert.backman@evoqua.com>; Sergio A. Pino Jelcic <sergio.pinojelcic@evoqua.com>; Michael C. Whittier <michael.whittier@evoqua.com>; Tony Orchard <tony.orchard@evoqua.com>
Subject: RE: City of Telluride, CO WWTF Improvements - Budgetary BioMag Proposal Request

Scott,

Please find the attached BioMag® option for Telluride. Here is a quick recap:

- Plan to use Orbal discs for both aeration / mixing in proposed configuration by Orbal team (in series) – this is not include in the scope at this time.
- The only new construction anticipated for the initial upgrade is a splitter box and magnetite feed/recovery equipment enclosure (see attached layout)
- Future post-anoxic zone will be required to meet future TN limit (possibly use digester?)
- BioMag® provides:
    - Ability to operate with two ditches and/or two clarifiers to allow for maintenance / down-time

- Ability to run existing plant on one train during construction while two other trains are being retrofit
- Ability to meet future TP limit without the need to add filtration (will be verified during initial operation)

The budget price is $1,555,000 for scope described in the attached proposal. Please let us know if you or Nate has any follow-up questions / comments.

Respectfully,

Nathan Antonneau, P.E.

Evoqua Water Technologies LLC
Phone: +1 (414) 418-9994
nathan.antonneau@evoqua.com

www.evoqua.com

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From: Nathan Brown [mailto:Nathan.R.Brown@mwhglobal.com]
Sent: Monday, January 30, 2017 12:50 PM
To: Scott Marshall <smarshall@miscowater.com>
Subject: City of Telluride, CO WWTF Improvements - Budgetary BioMag Proposal Request

Scott:

Attached is a info package for Evoqua to quote BioMag options to retrofit the existing oxidation ditch tankage at the Telluride WWTF. The retrofit will need to take place with one ditch / clarifier train offline at a time. You'll note in the request that we're needing to plan for TN < 8 mg/L in the near-term with a TN < 3 mg/L as an option in the future. Assume a complete secondary process scope of supply.

Holler with any questions/comments you have. If a quick call will help Evoqua out, let me know and I'm happy to set that up. Please return budgetary proposals to me no later than COB February 13th.

Thanks, Nate

MWH now part of Stantec

Nathan Brown, PE
Lead Process-Mechanical Engineer

1560 Broadway
Suite 1800
Denver, CO 80202

Tel: 303 291 2139
Mobile: 720 326 8817
Fax: 303 291 2221

nathan.brown@mwhglobal.com
www.mwhglobal.com

Appendix F PROPOSALS FOR BIOSOLIDS TREATMENT EQUIPMENT

F.1 PROPOSAL FOR MESO-AER® EQUIPMENT BY THERMAL PROCESS SYSTEMS INC.



Thermal Process Systems

March 17, 2017

Greg Woodward
Stantec
2000 South Colorado Blvd
Suite 2-300
Denver, CO 80222

Dear Mr. Woodward:

Thermal Process Systems (TPS) is pleased to offer the following proposal for the Temperature Controlled Mesophilic Aerobic Digester™ (MesoAer™) system for the aerobic treatment and ammonia removal of the Waste Activated material for the Telluride, CO WWTP based on the information provided. Note that TPS supplies only quality equipment and state-of-the-art technology in its MesoAer™ Process. Please find attached the following:

- This Letter of Transmittal;
- Thermal Process Systems' Terms and Conditions.

We look forward to working with you on this project. Please feel free to contact me with questions and/or comments at (765) 412-1474 or by email jeloff@thermalprocess.com.

Sincerely,

Jim Eloff

Jim Eloff
Cc: Bill Peretti, The Coombs-Hopkins Company



Thermal Process Systems

Thermal Process Systems is pleased to offer the following budgetary proposal and preliminary scope of supply for the aerobic portion of the solids handling and processing option at the Telluride WWTP operations located in Telluride, CO as requested. The information for the basis of this proposal is derived from the original data provided to Thermal Process Systems (TPS) by Greg Woodward of Stantec. The following proposal explains the fundamental theory behind Thermal Process Systems' Temperature Controlled Mesophilic Aerobic Digester™ (MesoAer™) and the components involved in the successful operation of these types of high solids, high nutrient aerobic digestion processes. Most of the attention is given to the TPS MesoAer™ system, as these specific types of applications are substantially different from the other typical treatment processes available in the market today. Additionally, information is provided on the ancillary components required for these types of high solids process operations. A scope of services and supply, and a budgetary estimate are provided for your review.

The Thermal Process Systems' MesoAer™ was specifically developed and designed for extraordinarily high concentrations of ammonium with the specific intent of transferring oxygen in high solids applications. Therefore, this is not a system that is being 'adapted' to the Telluride WWTP application, but rather a natural extension of the original design parameters. The TPS MesoAer™ will provide the Telluride WWTP with a process capable of meeting the aeration demands as well as provide a cost effective process for substantial volume reduction and odor free, stabilized biosolid material. TPS is an innovative provider of aeration process operations providing comprehensive solutions for WWTP operations for over fourteen years and sincerely appreciates the opportunity to work with you on this unique project.

The TPS MesoAer™ Process can provide state-of-the-art treatment to the current design option as outlined in the request for proposal. This preliminary design incorporates the use of existing tankage for the MesoAer™ digestor system. The MesoAer™ system proposed here includes a process operation capable of treating 3,000 dry pounds per day (ppd) of waste activated material at an average of ~3% total solids as the maximum design load condition to the MesoAer™ system. .

The MesoAer™ system described here consists of utilizing existing tanks as the main method of digestion and ammonia oxidation and subsequent removal. This tank, initially sized at 40' x 35' x 18' high with a proposed SWD of ~12' for this operation. Due to the solubilized material being further aerobically digested, the shear energy supplied by the jet motive pumping systems, is able to transfer oxygen at increased levels and at higher solids concentrations than typically designed for in standard mesophilic aerobic applications. The ability to nitrify and also denitrify will provide for a thoroughly digested effluent biosolids prior to dewatering and land application operations as well as, greatly reduced levels of nutrients (N & P) being returned to the headworks of the plant taxing the wet treatment streams ability to appropriately perform its function.

The MesoAer™ process operates at a design of 21 day HRT, in either a semi-batch or continuously fed operation mode. In fact, preliminary design calculations and studies conducted on similar waste streams indicate that this HRT should provide optimal destruction and removal efficiencies at minimal operating costs. The proposed pricing includes the MesoAer™ system, including jet aeration header, jet motive pump, blower, foam control system, process controls and control logic, and in-basin piping to operate the MesoAer™ process. Accordingly, TPS has developed an operation and cost scenario that has been tailored to the facility's specific needs and provides for maximum flexibility.

Our design calculations are based upon the biological solids and net nitritation/denitritation oxygen requirements. Mixing is controlled by the jet mix pump and may operate at various speeds depending on whether the system is in the oxic or anoxic mode of operation, providing additional shear and as such better oxygen transfer efficiency during oxic conditions, and mixing while conserving energy during anoxic periods. The 'gassing rate' (air/liquid ratio) in the jet system is the only parameter that changes drastically, and so that makes this particular enhanced digestion system even more operationally attractive given the complexities and uncertainties of the operation of WWTPs especially during start-up and scale up operations. The MesoAer™ system is quite unique and can process up to ~4% TS depending on temperature, viscosity, VS, and HRT. Our initial design calculations are based on the maximum design loading of about 3,000 ppd of waste activated material at about 3% TS. Aeration is sized at 3,000 ppd for the corresponding loading for operation on a 7-day per week loading schedule. TPS has several WWTPs operating under this similar design scenario. The MesoAer™ aeration system is designed to meet 100% of the daily oxygen uptake requirement in the reactor in a 75% air on and 25% air off operation strategy.

The ability to adjust both the liquid flow rate and air flow rate independently allows for the flexibility in this design to operate the system at a given dissolved oxygen concentration based on the actual solids loadings. Furthermore, this aeration system is designed to operate intermittently throughout the daily dynamic process cycle. The pump and blower are equipped with variable frequency drives to provide the ability to vary the oxygen delivery capacity; to increase flows during high oxygen demand periods and under oxic conditions and also to decrease flows during low oxygen demand periods and thus conserve energy, or under anoxic conditions. This is an extremely important design consideration for this project. The daily cycles have large swings in the oxygen uptake requirement.

Process control is based upon pH and oxidation-reduction potential (ORP) probe signals. This feature, along with the specially designed oxygen delivery system, offers the solids processing treatment operation the ability to meet the high uptake demands that occur during the initial feed cycles and aeration cycles and lower oxygen demands during the later aeration cycles. In addition, this function can aid in the control of the reactors operating temperature throughout the process. This is accomplished by either conserving or wasting heat with the blower airflow rate (Heat Balance and associated calculations, available upon request). Evaporative heat losses are the main method of heat control after attaining the appropriate temperature level from the initial transfer, and volatile solids, ammonium, and VFA oxidation processes. The ability to vary the liquid recycle rate and airflow delivery independently, in addition to the retention time provides the most effective method of reactor temperature control while maintaining optimum process metabolic conversion.

TPS has designed this system as a completely automated process, however, it can easily be operated as a semi-automated process. As such, a PLC processor package is included along with a PanelView™ operator interface touch screen. Outputs are provided to tie this local control system into an existing processor elsewhere in the plant. The instrumentation necessary to properly monitor the process is included and directed into the PLC for the convenience of the operations personnel. The primary function of the processor is to control the reactor mixing intensity and aeration delivery rate. This is accomplished by receiving the primary signal from a pH probe mounted on the pump suction piping and 'fine-tuning' with secondary signals (foam, temperature and ORP). The pH signal is read by the PLC and then appropriate settings are sent to the pump and blower VFDs. During the oxic period cycle alkalinity is consumed and the pH will decrease and ORP will increase. As the reactor switches to anoxic conditions, the pH will increase and the oxidation-reduction potential decreases. Inflection points in the ORP signal can be used to optimize and control the degree of aeration and cycle time (see figure 1).

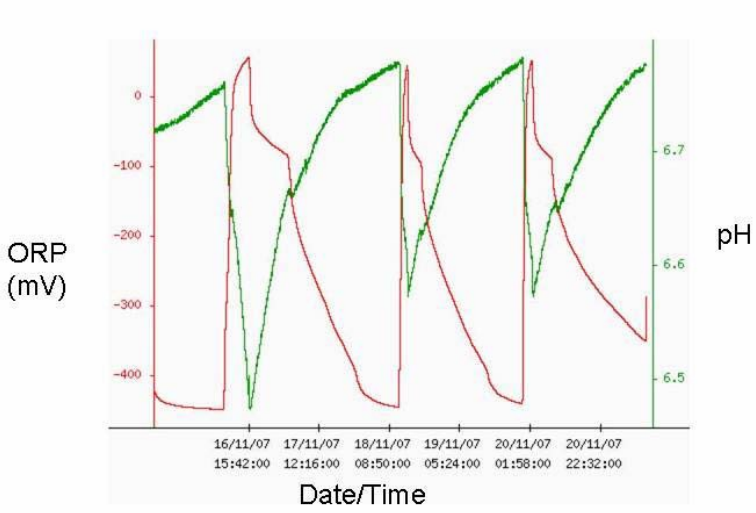


Figure 1. Single MesoAer tank system representative curve of pH and ORP Set on daily batch feed cycles on a 5-day/week feed cycle

Oxygen demand is based upon the amount of soluble carbonaceous oxygen demand (COD) and nitrogenous oxygen demand (NOD) available to the microbial community as a food substrate. Therefore, process stability is at its highest when the feed cycle is extended over a relatively long period. The process is designed to be self regulating and therefore is adaptable to several feed cycle protocols providing the instantaneous uptake demand does not exceed the maximum capability of the aeration equipment. Secondary signals are received from temperature probes mounted near the pH and ORP probe and from our proprietary foam control monitoring system. Liquid and air-flows are controlled independently to sustain optimum reactor performance.

The calculated oxygen requirement is based upon 45% VS destruction rate (mass balance) for waste activated sludge. The actual destruction may vary. The aeration system is designed with a positive displacement blower for the air delivery system. At this time, positive displacement blowers have been selected because of their ability to operate with variable backpressure created by changing liquid depths and reactor temperature and turndown ability.

A hydraulic foam control system is also included as part of our package. Foam suppression nozzles connected to a side stream from the jet motive pump supplies the energy source. The pump is designed to operate at sufficient volume and pressure to recycle reactor contents which primary function is breaking down the foam. The foam bubbles are ruptured by the mixing intensity of the nozzle and return SplashCone™ unit.

The tank serves as a wide spot in the line allowing for the operation of a floating volume. This material may be removed slowly each day, or campaign dewatered on weekly batch runs provided a sufficient volume of head space is maintained for operating conditions. Additionally, aerobically treated and well-digested biosolids release a portion of the entrained water within the cell structure and commonly found in the exopolymeric substances (EPS). These phased process operations denature and consume EPS, a form of protein which can bind water, up to 5 grams H_2O/gram EPS. Therefore, digested material has the ability to release a higher percentage of free water during dewatering. TPS process units typically experience an increase to approximately 25-30% in cake solids as compared to undigested WAS, depending on downstream unit processes. The increased cake solids in conjunction with the additional TS destruction rate have a significant impact on the economics of this project. The combination of reducing the mass and increasing the cake solids will decrease the overall amount of material necessary to treat in all downstream unit process operations, material handling, and ultimately removal from site reducing transportation and disposal or land application costs significantly.

Thermal Process Systems provides process and design engineering and design support to the design engineer. Technical instructions for the MesoAer™ unit, start-up, as well as, operation and maintenance manuals are also included. Thermal Process Systems' personnel will be there every step of the way to ensure a smooth transition to MesoAer™ Process operations, from initial training and information sessions, access to design data, assistance in permitting, equipment shakedown, startup, operation, and trouble shooting.

Provide MesoAer™ treatment for solids produced at Telluride WWTP.

Design Approach

Proposed design maximum daily loading of ~3,000 ppd of WAS material as dry solids in two (2) MesoAer™ reactors to be loaded on a 7-day work week.

Telluride WWTP – MesoAer™ Package

Sludge Type	
- WAS	3,000 ppd @ 3.0% TS
Reactors	2
%TS Average	~ 3%
%TS Range	3 - 4%
%VS Average	~ 75%

Mesophilic Aerobic Digester™ (MesoAer™)

Two Existing Concrete Tanks 40 ft. x 35 ft. x 18 ft. deep. (Modifications By Contractor)

Two (2) MesoAer™ Tanks each Complete with:

1) One (1) 50 HP, 43-12 jet motive pump.
2) One (1) 40 HP positive displacement blower.
3) One (1) in-basin FRP piping for the MesoAer™ system including the 12" liquid and 8" air jet aeration system header with 6 nozzles, pipe supports, connection hardware and anchor bolts for this piping.
4) Two (2) Foam control SplashCone™ with assemblies.
5) One (1) ORP probe and analyzer with temperature readout.
6) One (1) pH probe and analyzer with temperature readout.
7) One (1) Vacuum gauge sensor.
8) One (1) Liquid level sensor with local readout.
9) One (1) Local instrument control panel.

Additional Equipment

1) One (1) Spare 40 HP PD blower.
2) Two (2) Actuated dilution dampers.
3) Four (4) 4" Actuated Valves.
4) One (1) 4" flow meter.
5) One (1) Alkalinity Feed System.

BiofiltAer Odor Control Unit
One new concrete Biofilter tank – 16 ft. x 12 ft. x 10 ft. deep (By others)

One (1) Biofilters each complete with:
1) One (1) 15 HP 3,000 SCFM @ 9" WC Fan.
2) One (1) Scrubber Unit.
3) One (1) Aluminum Cover.
4) One (1) Lot, Biofilter plenum for even air flow distribution.
5) One (1) Lot, inorganic Biofilter media.
6) One (1) Lot, organic Biofilter media.
7) One (1) RTD temperature sensor.
8) One (1) Biofilter instrument cabinet.

Electrical Package MCC/VFDs
MCC mounting arrangement with Allen Bradley 6 pulse VFDs.

1) Two (2) MesoAer Jet Motive Pump 50 HP VFD.
2) Two (2) PD blower 40 HP VFD.
3) One (1) Spare PD blower 40 HP VFD.
4) One (1) Biofilter Fan 15 HP VFD.
5) One (1) 120/240 VAC Lighting Panel w/ 10 – 20 Amp Breakers.
6) One (1) Control Panel Power Monitor.
7) One (1) Control Panel Transformer.
8) One (1) Main Disconnect.

MesoAer™ Base Proposal Package Pricing $1,127,929.00

TPS has the ability and is quite often asked to provide competitive pricing control valves and polymer feed systems for your dewatering. If you are interested, and pending a final design, TPS can supply these additional items for the advantage of having single source supplier with a single source of responsibility.

Start-up services and O&M manuals are included in the above listed price. Tank modification, cover, equipment installation, and electrical service to the facility control room are assumed to be provided by the general contractor. As stated above, we have included the MesoAer™ facility and hardware and patented control logic system for the MesoAer™.

Notes

1) Performance test labor, test equipment and laboratory services are to be Contractor or Owner supplied.
2) Purchased equipment such as electric motors, pumps, blowers, valves, gear reducers, instrumentation, etc. will be furnished with manufacturer's standard finish.
3) Prepaid truck freight to the job site is included.
4) Prices are valid for one hundred and twenty (120) days from date of quotation.
5) Price quoted is exclusive of any Local, State or Federal taxes of any sort

Work and material not included

1) The Contractor shall provide the necessary pump, fan and blower pads, anchor bolts and leveling required for proper setting of all equipment associated with the MesoAer™ system.
2) The Contractor shall supply all connections, sample taps, drains, interconnecting spool pieces, and miscellaneous 'small' valves for each pump, blower and fan as shown on drawings.
3) The Contractor shall supply the seal water supply pipe, seal arrangements, pressure regulators, and flow control, drain and accessories for the MesoAer™ pumps, and coatings (if required by the Engineer).
4) The Contractor shall supply all tank penetrations,
5) The Contractor shall supply all covers for the MesoAer™(s) as shown on the drawings.
6) The Contractor shall supply all the tank cover penetrations, flanges, seals, hatches and man ways as shown on the drawings.
7) The Contractor shall supply interconnecting bolts, gaskets, welds, and other miscellaneous fasteners.
8) The Contractor shall supply a communication cable from the MesoAer™ control panels to the VFDs.
9) The Contractor shall supply all conduits and interconnecting electrical wire for all motors, instruments, and controls.

10) The Contractor shall supply field welds for the in-basin and out-of-basin stainless steel supports associated with the liquid and air headers provided by the MesoAer™ supplier.
11) The Contractor shall supply all miscellaneous plant service water supply piping.
12) The Contractor shall supply any field installation including delivery point rigging, offloading and storage.
13) The Contractor shall supply all penetrations, nipples, and mounting accessories for field installed instruments and probes.
14) The Contractor shall supply any such items but not limited to as; structural steel, platforms, walkways, ladders, guards, handrails, gratings, supports, piping, valves, weirs, flexible connections, anchor bolts, starters, panel boards, field painting, insulation, or electrical work or material other than that specifically mentioned in the offering which may be required by site specific conditions, federal, state or local requirements.

Field Assembly, Erection, Installation

All equipment will be delivered as fully assembled as possible. When certain items must be delivered partially disassembled because of shipping limitations or other special conditions, field assembly will be the responsibility of the customer. This will normally consist of joining sections by mechanical means such as with bolts, nuts and screws. Equipment installation is the responsibility of the others.

Site Services

TPS shall furnish the services of a technician for a period of approximately eight (8) days to be covered in two (2) trips to the job site to check the installation, supervise the start-up, supervise performance testing as required by the specifications, and provide operator instruction for the items included in our scope of supply. Service time noted above includes follow-up services for system controls required by the specifications. Additional service is available at our portal to portal per diem rate in effect at the time of service delivery, plus air fare. The current per diem supervision rate is Seven Hundred Fifty dollars ($750.00) plus travel.

Engineering Submittals

Drawings for approval and certified specifications will be submitted within eight-ten (8-10) weeks after date of receipt of acceptable purchase order.

Shipment

Shipment will be made thirty (30) weeks after receipt by *TPS* of written approved Engineering Submittal.

Installation, Operation and Maintenance Manuals

Operation and Maintenance Manuals will be provided per specification.

Equipment Warranty

See “Guarantee" in our "Terms and Conditions".

Patents

TPS owns the exclusive rights to Patents 5,948,261; 6,168,717; 6,203,701 and 6,514,411. This offering is considered a single use license agreement.

Validity of Quotation

Prices are valid for one hundred-twenty (120) days from date of quotation.

Terms of Payment

Net thirty (30) days from date of invoice.

Conditions of Sale

See attached Thermal Process Systems "Terms and Conditions," which are hereby made part of this quotation.

****

TPS looks forward to working with the WWTP staff on this project. If you have any questions regarding this proposal, please do not hesitate to contact Thermal Process Systems or our local representative.

Jim Eloff Thermal Process Systems 627 East 110th Ave Crown Point, IN 46307 jeloff@thermalprocess.com (765) 412-1474	Bill Peretti The Coombs-Hopkins Company 4390 So. Syracuse Street Denver, CO 80207 bill@coombshopkins.com (303) 477-1970

THERMAL PROCESS SYSTEMS TERMS AND CONDITIONS

DEFINITIONS

TPS - Thermal Process Systems
Purchaser - Party issuing purchase order
Owner - Party ultimately owning equipment
Offering - Offer to sell by TPS
Purchase Order - Acceptance of order
Acknowledgment - Confirmation by TPS of terms of agreement

CONTROLLING PROVISIONS

The terms and conditions set forth herein constitute the entire agreement between the parties. The selling price is based on the terms and equipment in the TPS Offering. The TPS acknowledgment of purchase order confirms the offered price, terms and equipment. The acknowledgment does not recognize any other price, terms or equipment contained in the purchase order which conflict with the TPS offering, unless specifically noted in the acknowledgment or otherwise confirmed in writing.

1. ACCEPTANCE - Acceptance of purchase order is indicated only by the acknowledgment of purchase order. Commencement of performance by TPS does not constitute acceptance.

2. OFFERING - Unless otherwise stated by TPS the price contained herein is firm, subject to acceptance within 30 days. Typographical or clerical errors in quotations are subject to correction by TPS.

3. TERMS OF PAYMENT - All invoices will be dated day of shipment. This includes 5% of the contract price within 30 days of receipt of PO. Submittal invoice shall be 15% of the purchase price. Unless otherwise stated by TPS, payment terms are net 30 days from date of each invoice. Interest at the lawful maximum rate on sums past due and related collection fees will be added to the delinquent amount and paid by Purchaser. If at any time in the judgment of TPS the financial condition of the Purchaser does not justify continuance of production or shipment, TPS may require adequate assurance of performance.

4. TAXES - Prices on the products specified herein are exclusive of any city, state, federal and foreign excise taxes, duties and customs, including, but not necessarily limited to taxes on manufacture, sales, receipts, gross income, occupation, use, and similar taxes. If any are imposed they are to be paid by the Purchaser. Whenever applicable, Purchaser shall provide TPS with tax exemption documentation acceptable to the taxing authorities.

5. SHIPMENT - Unless otherwise stated, all prices are F.O.B. TPS shipping point. Method and route of shipment are at the discretion of TPS, unless purchaser supplies explicit instructions. Identification of the goods to the contract shall occur as each shipment is placed in the hands of the carrier.
   Cost of unloading equipment and any demurrage charges on shipments to Purchaser are to be borne by Purchaser. In order to maintain scheduled shipment dates TPS reserves the right to ship equipment less certain "buy-out" items. These items, when available from the manufacturer, will be shipped to the job site for installation by Purchaser. The installation and fit up, if necessary, will be for the account of Purchaser.

6. DELIVERIES - Statements as to expected dates of shipment from factory represent the best judgment of TPS and are based upon prompt receipt of all necessary information, including but not limited to, the return of approved drawings.

7. DELAYS - TPS will not be liable for any delay in the performance of order or contracts or in the delivery or shipment of goods, or for any damages suffered by Purchaser by reason of such delay nor shall the order be subject to cancellation, when such delay is directly or indirectly caused by, or in any manner arises from, fires, floods, accidents, riots, acts of God, war, governmental interference or embargoes, strikes, labor difficulties, shortage of labor, fuel, power, materials or supplies, transportation delays, or any other cause or causes (whether or not similar in nature to any of these hereinbefore specified) beyond the control of TPS.
   It is not feasible for TPS to hold equipment within its facilities beyond the scheduled completion date. If Purchaser cannot accept delivery on the scheduled delivery date, TPS will, if circumstances permit, arrange for storage of the equipment for a reasonably limited period of time provided that Purchaser remits full payment for the equipment plus Purchaser shall assume cost of storage risks incident to storage.

8. GUARANTEE - TPS warrants that the material and workmanship going into the TPS Product is of good quality and in conformity with the best commercial practice.
   Unless otherwise stated parts found to be defective in material or workmanship under normal use and service within one (1) year after shipment will be repaired or replaced without charge F.O.B. original point of shipment, the responsibility of TPS being limited to the cost of the defective parts. Decomposition by chemical action and wear caused by the presence of abrasive materials shall not constitute defects. In no event shall TPS be liable for consequential or special damages, or for transportation, installation, adjustment, or other expenses which may arise in connection with such replacement or repair.
   THIS WARRANTY IS EXPRESSLY MADE IN LIEU OF ANY AND ALL OTHER WARRANTIES EXPRESS OR IMPLIED INCLUDING THE WARRANTIES OF MERCHANTABILITY AND FITNESS.
   Equipment may be returned for credit or replacement only after written TPS authorization and shipping instructions.

9. PATENTS - TPS agrees to defend, at its own expense, any suit brought against Owner on a complaint that any product furnished on this order constitutes an infringement of a patent, provided that TPS is notified in writing of such suit within 10 days after service of process therein on Owner, and all papers therein are delivered to TPS and TPS is given the authority, information and assistance to defend against the suit. TPS agrees to pay all damages and costs awarded therein against Owner. The foregoing states the entire liability of TPS for patent infringement. Purchaser and/or Owner shall hold TPS harmless for any expense or loss resulting from infringement of patents or trademarks arising from compliance with Purchaser's and/or Owner's designs or specifications.

10. SERVICE - The price quoted is for machinery and equipment. Service, if included in the quotation is an obligation to the Owner and will be rendered only after full payment of purchase price by the Purchaser.

11. CANCELLATION - Cancellation or suspension of order will be accepted only upon terms which reimburse TPS for costs incurred plus normal mark-up, and must be agreed to in writing by an officer of TPS.

12. EQUIPMENT CHANGES - Changes in equipment design or specifications quoted by TPS will be made only with the consent of TPS and on terms acceptable to TPS.

13. CLAIMS - After TPS has delivered the equipment to the carrier, the carrier is responsible for its safe and complete delivery to the Purchaser or Owner. It is consignee's responsibility to inspect and accept these goods and promptly report to the carrier and TPS any shortages, damages or other problems that might arise that will unfavorably influence the installation and/or operation of this equipment. Any of these conditions must also be noted on the carriers receipt.

14. CODES - TPS equipment and accessories are all designed in good faith with the intent of complying with all applicable codes existing at time of quotation. TPS shall not be responsible for any failure to comply with such codes which results from non-conforming location, operation, use or maintenance of the equipment or from alteration of the equipment not authorized by TPS, or from any option or accessory to the equipment which was available to the Purchaser or Owner but omitted at his direction, or from any design or instructions furnished by Purchaser or by Owner. Any liability to TPS for violations of codes shall be limited to modifications or replacement of the equipment so that it complies with the codes. TPS shall not be liable for any fines, penalties, or consequential damages. The TPS price does not include the cost of inspection, permits or fees related to verifying compliance with codes, regulations, standards or specifications.

15. BACK CHARGES - Back charges will not be accepted by TPS unless an officer of TPS has approved them in advance in writing.

16. INDEMNIFICATION - Purchaser shall indemnify and hold TPS harmless from all damages, liability and expense (including reasonable attorney's fees) arising out of claims or law suits of third parties based on or involving the equipment or its use, handling or operation.

17. LIMITATION OF LIABILITY - TPS's liability, howsoever arising with respect to any of the obligations which it may have assumed by reason of its performance of the work, is specifically limited as provided herein, and in no event shall TPS, its employees, agents and/or subcontractors be liable for any special, indirect or consequential damages whatsoever, including without limitation, any delays or loss of time in putting the system into operation, or any delays or loss of time to other parts of OWNER'S plant, or loss of production, profits, products, chemicals, utilities, etc. Under no circumstances shall TPS's total liability for any cause including without limitation tort, performance guarantee, contract warranty (expressed or implied), strict liability or otherwise arising out of this Agreement, exceed the lesser of the actual loss, harm or damage or the original purchase price of the involved equipment or system sold by TPS to this purchaser.

18. ARBITRATION - Any controversy or claim arising out of or relating to this agreement or the performance or breach thereof that cannot be settled by the officers of each party shall be settled by arbitration in the city of Arlington Heights - Cook County, Illinois, in accordance with the then current rules and procedures of the American Arbitration Association.

F.2 PROPOSAL FOR CLEAN-B® EQUIPMENT BY NUTERRA INC.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON D.C., 20460

Office of Water

February 12, 2015

Dr. Fred Mussari
BCR Environmental
11235 St. Johns Bluff Rd. S.
Suite #21
Jacksonville, FL 32224

Dear Dr. Mussari:

Re: Request for National Equivalency of BCR Environmental's "Clean B™" Process

Thank you for your October 2014 letter with the request for National Equivalency of BCR Environmental's Clean B™ Process and accompanying documentation. These documents were submitted to Laura Boczek and Dr. Bob Brobst, Chairpersons of the U.S. EPA's Pathogen Equivalency Committee (PEC) for consideration. The PEC reviewed the submitted material, including the documentation, data, and Appendixes.

Based on the information / data provided, the PEC believes that the facilities currently utilizing the "Clean B™" process located at the following Florida addresses: 1) 4145-1 Savannah Glen Dr. Orange Park, FL 32073; 2) 2878-1 Tuscarora Trail, Middleburg, FL 32068; 3) 1601 Bartlett Ave. Orange Park, FL 32073, 4) 1770 Radar Rd., Orange Park, FL 32003; and 5) the plant at the City of Alachua Advanced water reclamation facility, are operating as a Process to Significantly Reduce Pathogens (PSRP) equivalent processes when operated as described in the provided Clean B™ Process Operation and Maintenance Manuals specific to each location. The following conditions must be attained when using the Clean B™ process as listed in the PSRP report and O&M manual.

The CleanB™ process is a plug-flow, chemical oxidation / aeration process that utilizes chlorine dioxide to achieve Class B PSRP equivalent waste activated sludge disinfection. Chemical addition consists of the addition of site-generated chlorine dioxide into a closed contact chamber and providing 10 minutes of contact time.

Chlorine dioxide is a chemical oxidant that preferentially reacts with certain chemical species or compounds. In order for the process to consistently achieve disinfection goals, two specific conditions must be met.

- *The aeration step in the process prior to chlorine dioxide addition assures that the disinfectant is not being consumed to meet a general oxidant demand (for septic sludge) and is available to effect disinfection.*
- *The reaction of chlorine dioxide with some compounds (H2S as an example) is instantaneous; therefore the DO must be raised prior to the addition of the oxidant to ensure consistent process performance.*

The chemical oxidant addition must be sufficient to maintain an oxidation reduction potential (ORP) of > +300 mV at the end of the 10 minute contact time. The ORP is much higher directly after injection and decrease to > +300 mV at the end of the contact time.

After chlorine dioxide injection, treated sludge passes through the contact chamber which is comprised of continuous diameter piping. This provides adequate mixing at the specified flow rates, and allows for sufficient contact time of 10 minutes or greater.

The CleanB™ process will achieve a greater than or equal to 2-log reduction in fecal coliforms under the following conditions:

1. *Treatment Input Waste activated sludge (WAS) with a dissolved oxygen (DO) content of ≥ 1.0 mg/L*
2. *Total solids < 2%*
3. *Temperature* >9° C (48° F) and < 35° C (95° F)*
4. *ORP after Contact Time Oxidant (chlorine dioxide) is added as required to elevate WAS ORP in the sludge so that the ORP at the end of the 10 minute contact time is >+300 mV*
5. *Contact time > 10 min*
6. *Minimum ClO2 concentration 50 ppm or as required to achieve ORP > +300 mV at the end of the prescribed contact time*

***Process Description*:** Process steps for PSRP Equivalency are described below:

- *Waste sludge is sent to the CleanB™ process.*
- *Air is added before chlorine dioxide addition to raise the DO above 1.0 mg O2/L. Air addition is accomplished by means of air induction (Mazzei inductor).*
- *An air release valve is incorporated prior to the chlorine dioxide generator to remove any large air pockets prior to ClO2 addition.*
- *A static mixer after the air release valve is utilized to entrain small air bubbles in the sludge prior to ClO2 addition.*
- *Oxidant (chlorine dioxide) is added at an initial concentration of 50 mg/L. This initial oxidant concentration is controlled with a flow meter signal to a Process Logic Controller (PLC) for chemical addition. An ORP monitor signals PLC to maintain adequate ORP through the addition of more oxidant as needed to maintain the treated ORP at ≥+300 mV at the end of the 10 minute contact time.*

- *A second static mixer is utilized immediately after ClO2 addition to enhance mixing prior to the treated sludge entering the contact system piping.*
- *Contact time of sludge and ClO2 is ≥10 min prior to dewatering or other process.*
- *Dosing is controlled by monitoring the ORP at the end of the contact time and adjusting the dosage as required to maintain +300 mV at the end of the 10 minute contact time. If, for any reason, the ORP drops below +300 mV after the 10 minute contact time, the product line will automatically shut and the material diverted from dewatering to an on-site lift station. This will ensure that treated biosolids that do not meet process requirements are not discharged from the plant (i.e. sent to dewatering).*

EPA's Office of Science and Technology (OST) acknowledges that the "Clean B" process when operated in accordance with the above process description is a National PSRP equivalent process as described in CFR 503.32 (b)(4). You will of course also need to meet the requirements for vector attraction reduction.

Best wishes and I wish you much success with your municipal sludge treatment process. If you have any questions, please contact Laura Boczek (513-569-7282) or Bob Brobst (303-312-6129).

Sincerely,

Rick Stevens, Senior Scientist (4304T)
Biosolids Team
Health and Ecological Criteria Division
Office of Science and Technology

cc. PEC
Michael Hom, Region 4
Maurice Barker, Florida DER

Biosolids and Organics Projects and Industry References



nuTerra™
trusted partner of people & planet

trusted partner of people & planet
P.O. Box 551500, Jacksonville, Florida 32255
6621 Southpoint Drive N, Suite 200, Jacksonville, Florida 32216 | 904.819.9170 | www.nuterra.green

Project References and Corporate References

To Whom It May Concern:

BCR Environmental Corporation (BCR) created NuTerra™ in 2014 to assume the project development and operations business of BCR. All staff, operational capabilities and corporate infrastructure associated with these activities operate within NuTerra. BCR has remained as a pure technology and equipment manufacturing company.

BCR Overview

BCR Environmental Corporation (BCR) is a U.S.-based developer of innovative, scalable, economical, and environmentally advantageous wastewater treatment and conversion technologies. BCR's patented solutions — CleanB®, CleanB-AC™, Neutralizer® and Bio-Scu® —are EPA-approved technologies for reducing solid mass of biosolids and producing high-value marketable end products. The company has a 100 percent successful track record and has delivered an average savings of 40-plus percent in operating costs and 90-plus percent in energy consumption.

NuTerra™ Overview

NuTerra™ provides the entire suite of design, construction, operation, financing and where appropriate ownership services for long-term sustainable organic waste and biosolids management solutions. Its "progressive" project delivery method is the most cost-effective approach for addressing population growth, urban encroachment, and failing infrastructure with a dramatic reduction in facility size. NuTerra™ further reduces investment and risk by using the industry's only before-and-after financial and risk models based on verifiable operational and financial data, feasibility analysis, and approved advanced technologies. The company offers municipalities total waste reutilization by recycling nutrients into high-value, marketable end products that address diminishing disposal outlets, restrictive landfill capacity, escalating unit costs, increasing environmental regulations and rising energy costs.

Aaron F. Zahn
Chairman and Chief Executive Officer
BCR Environmental Corporation
and NuTerra™ Management, LLC
Phone: (904) 819-9170
Email: azahn@bcrenv.com

The project list below references multiple CleanB projects that have been in operation for several years. The operators and superintendents are well aware of the value that the CleanB solution brings to their waste water treatment plant. Feel free to reach out to any of them directly if you would like to hear a first hand account of their experiences.

City of Alachua CleanB® Treatment Facility, Alachua, FL

Owner: City of Alachua
Contact: John Swilley, Wastewater System Supervisor / 386-462-7590
Contract Type: System Delivery
Project Duration: 2 Months
Completion Date: November 2010



Naval Air Station Jacksonville CleanB® Facility, Jacksonville, FL

Owner: Naval Air Station Jacksonville
Contact: Gerald "Jay" Caddy, Utilities Commodity Manager / 904-542-6440
WWTP Capacity: 0.6 MGD (ADF)
Contract Type: System Delivery
Project Duration: 4 Months
Completion Date: September 2012



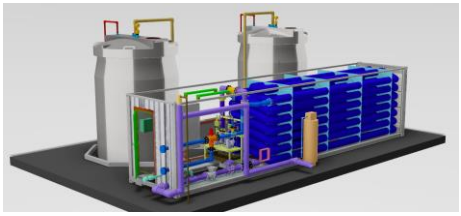
Fort Pierce CleanB® Treatment Facility, Fort Pierce, FL

Owner: Fort Pierce Utility Authority, Florida
Contact: Mark Kobbe, Superintendent of Wastewater / 772-466-1600 ext. 3298
WWTP Capacity: 8.0 MGD
Contract Type: Design-Build-Operate
Project Duration: 12 Months
Completion Date: May 2014



Lake Wales WWTP CleanB™

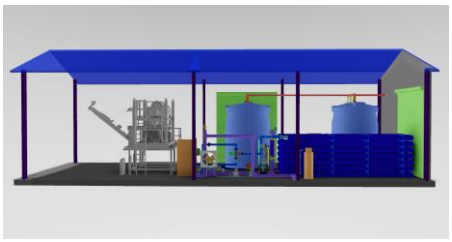
Owner: Lake Wales, FL
Contact: Ted Long, Chief Wastewater Operator/(863)678-4114
WWTP Capacity: 2.1 MGD
Contract Type: Design-Build-Operate-Finance
Project Duration: 6 Months
Completion Date: April 2016



Projects Contracted and Under Development:

Vero Beach WWTP CleanB®

Owner: Vero Beach, FL
Contact: Robert Bolton, Utility Director/772-978-5228
WWTP Capacity: 3.0 MGD
Contract Type: Design-Build-Operate
Project Duration: 20 Months
Completion Date: July 2017



Industry References:

Mr. Tom Morris, Executive Director
Clay County Utility Authority
3176 Old Jennings Road
Middleburg, FL 32068-3907
(904) 272-5999

Mr. Mike Stripling
Public Works/Utilities Director
P.O. Box 1507
Haines City, FL 33845
United States of America
(863) 421-9972

Mr. Maurice Barker, State Residuals Coordinator
Florida Department of Environmental Protection
2600 Blair Stone Rd
Tallahassee, FL 32399-2400
(850) 245-8614

Mr. Greg Strong, District Director
Florida Department of Environmental Protection
8800 Baymeadows Way West, Suite 100
Jacksonville, FL 32256
(904) 256-1504

Dr. James Smith, Retired Chairman of U.S. EPA Committee for Residuals Policies
U.S. EPA
5821 Marlborough Dr
Cincinnati, OH 45230-3513
(513) 655-0217

Mr. Brian Stahl, Partner
Infrastructure Solutions Services
7331 Office Park Place, Suite 500
Melbourne, FL 32940
(321) 622-4646

Mr. Curtis Keller, Utility Director
Berkeley County Public Services and Sanitation Department
Po Box 944
Martinsburg, WV 25402
(304) 263-8344

Mr. Riley Smith, Utilities Operations Manager
City of Pembroke Pines
13975 Pembroke Road
Pembroke Pines, FL 33027
(954) 437-1111

Michael Hom, Clean Water Enforcement Branch, Region 4
U.S. EPA
61 Forsyth Street SW
Atlanta, GA 30303
(404) 562-9748

Mr. Rich Koller, Senior Vice President
Jones Edmunds & Associates
3910 S Washington Ave, #210
Titusville, FL 32780
(321) 269-2950

Mr. Chibby Alloway, Partner
Alloway and Associates
(925) 209-5087

Mr. John Polley, Utilities & Solids Waste Director
Martin County Utilities
Po Box 9000
Stuart, FL 34995-9000
(772) 223-7942

Jay Caddy, Navy Public Works Department Jacksonville Air Station
Po Box 5, Building 27
NAS Jacksonville, FL 32212
(904) 542-6444

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ERCO Worldwide

SODIUM CHLORITE SOLUTION 15% - 41%
WHMIS CONTROLLED PRODUCT
Date Issued:04/28/2009
Revision #:4

MATERIAL SAFETY DATA SHEET
REV. 4 Issued: April 28, 2009

1. Chemical Product And Company Information

Chemical Name: Sodium Chlorite Solution 15% - 41%
Synonyms/Trade Names: Sodium Chlorite Solution, ERCOPURE
Chemical Family:
Formula: $NaClO_2$
Molecular Weight: 90.45
CAS No.: 7758-19-2
Uses: Generation of chlorine dioxide for use as a disinfectant or for use as an oxidant. Bleaching of textiles and other fibers.

Manufacturer & Supplier:
ERCO Worldwide, a division of Superior Plus LP
302 The East Mall, Ste. 200
Toronto, Ontario Canada M9B 6C7
(416) 239-7111

Transportation Emergency Telephone Numbers :
CANADA: (613) 996-6666
CANUTEC

USA: 1-800-424-9300
CHEMTREC

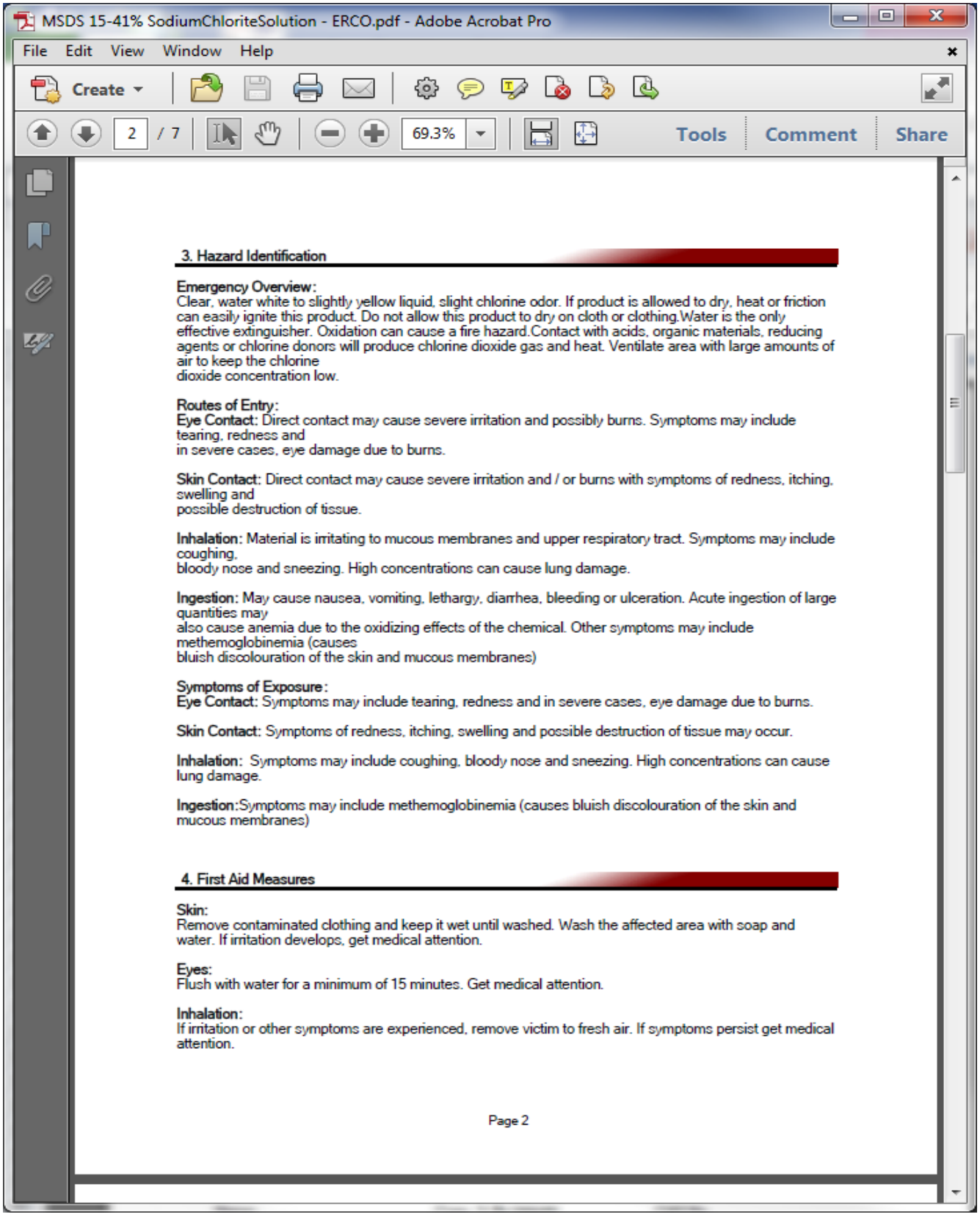
Canadian WHMIS Classification (s):

D1B - Very Toxic | C - Oxidizing | E - Corrosive



2. Composition / Information On Ingredients

Name:	Conc. % By Weight	CAS No.
Sodium Chlorite	15-41	7758-19-2
Water	Balance	7732-18-5



3. Hazard Identification

Emergency Overview:
Clear, water white to slightly yellow liquid, slight chlorine odor. If product is allowed to dry, heat or friction can easily ignite this product. Do not allow this product to dry on cloth or clothing.Water is the only effective extinguisher. Oxidation can cause a fire hazard.Contact with acids, organic materials, reducing agents or chlorine donors will produce chlorine dioxide gas and heat. Ventilate area with large amounts of air to keep the chlorine
dioxide concentration low.

Routes of Entry:
Eye Contact: Direct contact may cause severe irritation and possibly burns. Symptoms may include tearing, redness and
in severe cases, eye damage due to burns.

Skin Contact: Direct contact may cause severe irritation and / or burns with symptoms of redness, itching, swelling and
possible destruction of tissue.

Inhalation: Material is irritating to mucous membranes and upper respiratory tract. Symptoms may include coughing,
bloody nose and sneezing. High concentrations can cause lung damage.

Ingestion: May cause nausea, vomiting, lethargy, diarrhea, bleeding or ulceration. Acute ingestion of large quantities may
also cause anemia due to the oxidizing effects of the chemical. Other symptoms may include methemoglobinemia (causes
bluish discolouration of the skin and mucous membranes)

Symptoms of Exposure:
Eye Contact: Symptoms may include tearing, redness and in severe cases, eye damage due to burns.

Skin Contact: Symptoms of redness, itching, swelling and possible destruction of tissue may occur.

Inhalation: Symptoms may include coughing, bloody nose and sneezing. High concentrations can cause lung damage.

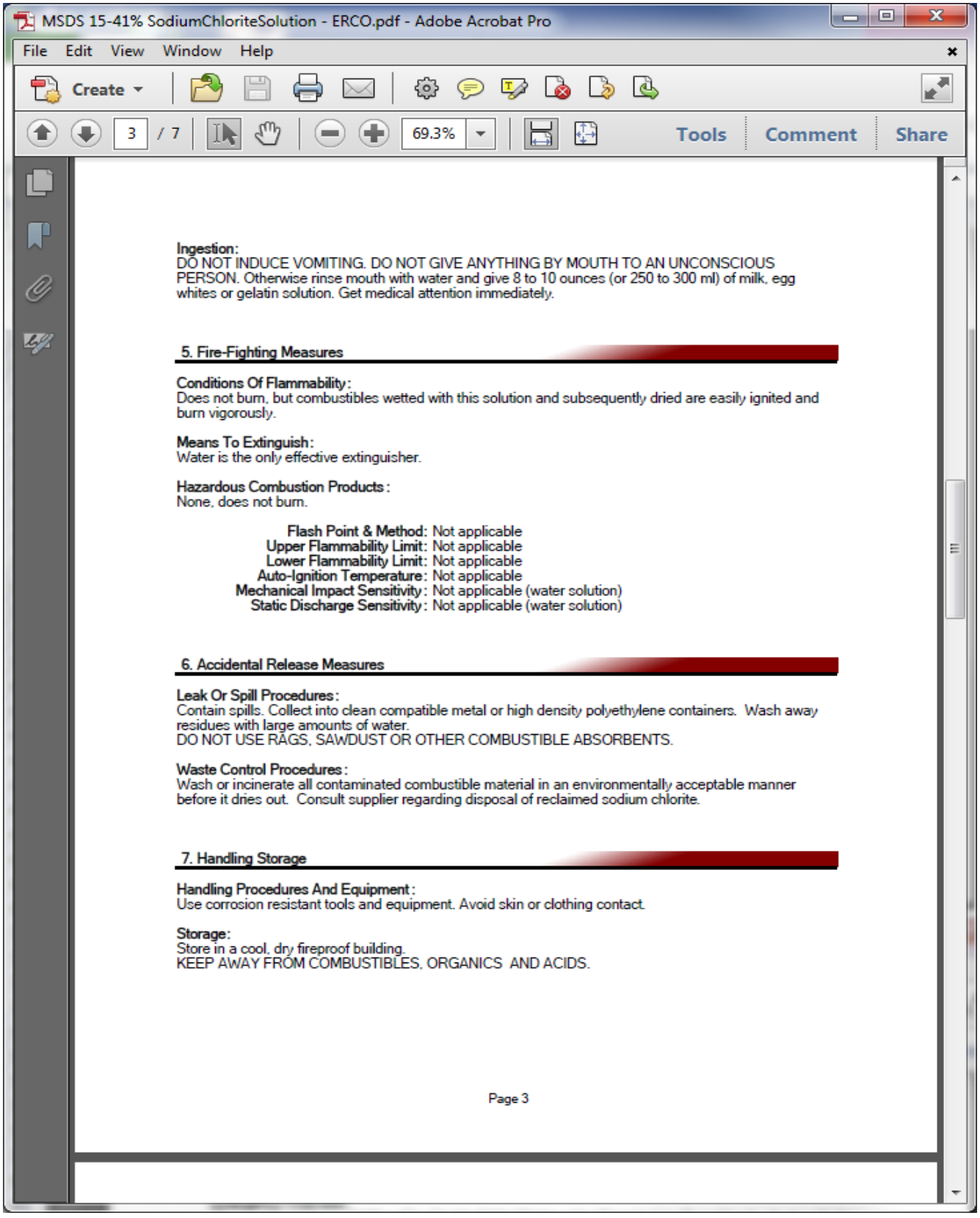
Ingestion: Symptoms may include methemoglobinemia (causes bluish discolouration of the skin and mucous membranes)

4. First Aid Measures

Skin:
Remove contaminated clothing and keep it wet until washed. Wash the affected area with soap and water. If irritation develops, get medical attention.

Eyes:
Flush with water for a minimum of 15 minutes. Get medical attention.

Inhalation:
If irritation or other symptoms are experienced, remove victim to fresh air. If symptoms persist get medical attention.



Ingestion:
DO NOT INDUCE VOMITING. DO NOT GIVE ANYTHING BY MOUTH TO AN UNCONSCIOUS PERSON. Otherwise rinse mouth with water and give 8 to 10 ounces (or 250 to 300 ml) of milk, egg whites or gelatin solution. Get medical attention immediately.

5. Fire-Fighting Measures

Conditions Of Flammability:
Does not burn, but combustibles wetted with this solution and subsequently dried are easily ignited and burn vigorously.

Means To Extinguish:
Water is the only effective extinguisher.

Hazardous Combustion Products:
None, does not burn.

Flash Point & Method: Not applicable
Upper Flammability Limit: Not applicable
Lower Flammability Limit: Not applicable
Auto-Ignition Temperature: Not applicable
Mechanical Impact Sensitivity: Not applicable (water solution)
Static Discharge Sensitivity: Not applicable (water solution)

6. Accidental Release Measures

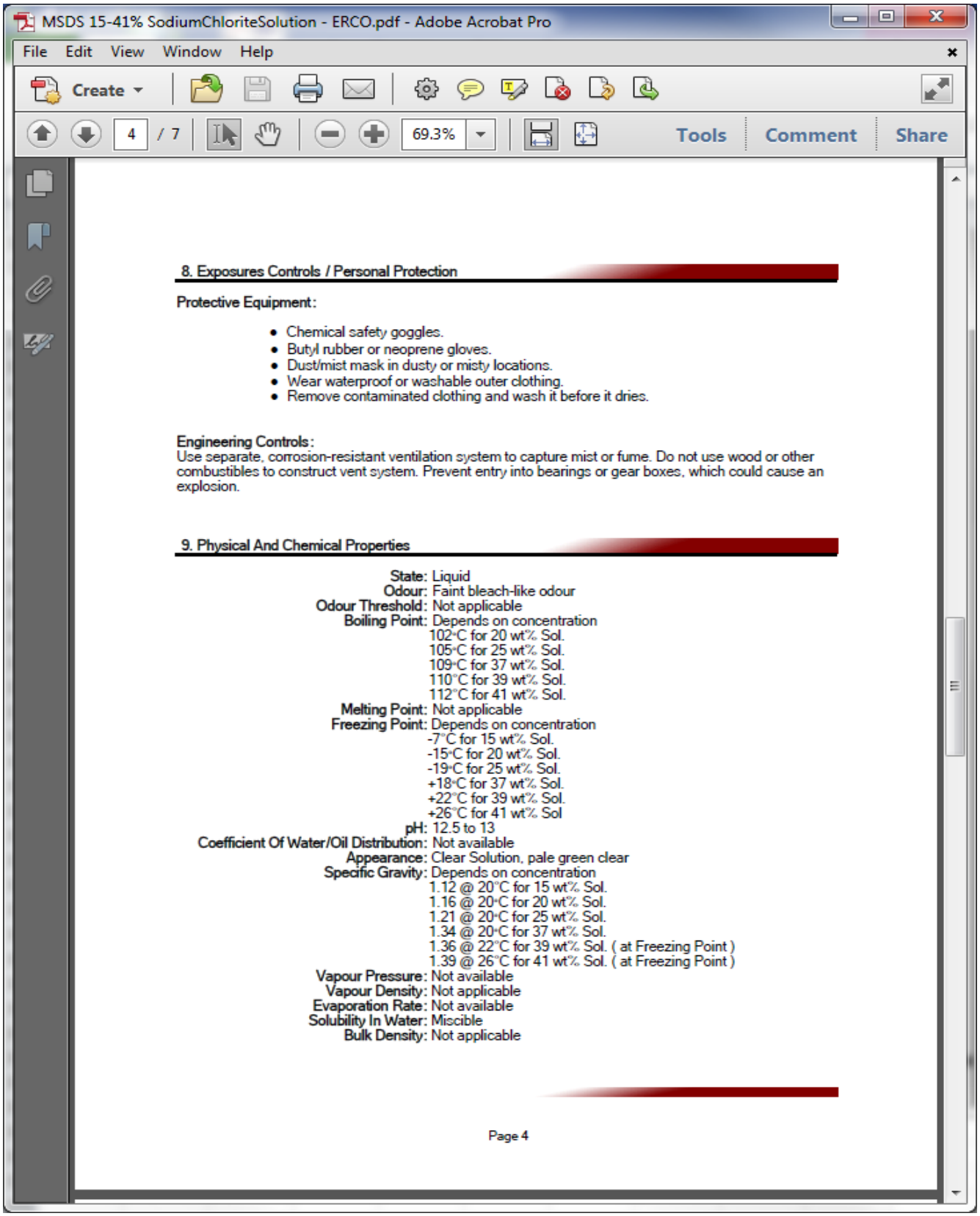
Leak Or Spill Procedures:
Contain spills. Collect into clean compatible metal or high density polyethylene containers. Wash away residues with large amounts of water.
DO NOT USE RAGS, SAWDUST OR OTHER COMBUSTIBLE ABSORBENTS.

Waste Control Procedures:
Wash or incinerate all contaminated combustible material in an environmentally acceptable manner before it dries out. Consult supplier regarding disposal of reclaimed sodium chlorite.

7. Handling Storage

Handling Procedures And Equipment:
Use corrosion resistant tools and equipment. Avoid skin or clothing contact.

Storage:
Store in a cool, dry fireproof building.
KEEP AWAY FROM COMBUSTIBLES, ORGANICS AND ACIDS.



8. Exposures Controls / Personal Protection

Protective Equipment:

- Chemical safety goggles.
- Butyl rubber or neoprene gloves.
- Dust/mist mask in dusty or misty locations.
- Wear waterproof or washable outer clothing.
- Remove contaminated clothing and wash it before it dries.

Engineering Controls:
Use separate, corrosion-resistant ventilation system to capture mist or fume. Do not use wood or other combustibles to construct vent system. Prevent entry into bearings or gear boxes, which could cause an explosion.

9. Physical And Chemical Properties

State: Liquid
Odour: Faint bleach-like odour
Odour Threshold: Not applicable
Boiling Point: Depends on concentration
102°C for 20 wt% Sol.
105°C for 25 wt% Sol.
109°C for 37 wt% Sol.
110°C for 39 wt% Sol.
112°C for 41 wt% Sol.
Melting Point: Not applicable
Freezing Point: Depends on concentration
-7°C for 15 wt% Sol.
-15°C for 20 wt% Sol.
-19°C for 25 wt% Sol.
+18°C for 37 wt% Sol.
+22°C for 39 wt% Sol.
+26°C for 41 wt% Sol
pH: 12.5 to 13
Coefficient Of Water/Oil Distribution: Not available
Appearance: Clear Solution, pale green clear
Specific Gravity: Depends on concentration
1.12 @ 20°C for 15 wt% Sol.
1.16 @ 20°C for 20 wt% Sol.
1.21 @ 20°C for 25 wt% Sol.
1.34 @ 20°C for 37 wt% Sol.
1.36 @ 22°C for 39 wt% Sol. (at Freezing Point)
1.39 @ 26°C for 41 wt% Sol. (at Freezing Point)
Vapour Pressure: Not available
Vapour Density: Not applicable
Evaporation Rate: Not available
Solubility In Water: Miscible
Bulk Density: Not applicable

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10. Stability And Reactivity

Chemical Stability:
Stable in itself, but reactive as detailed below.

Reactivity Conditions:
Reacts on mixing with acids to give toxic chlorine dioxide and chlorine gases. Mixtures with combustibles, if allowed to dry out, are easily ignited by heat or friction and burn vigorously or may explode.

Incompatible Substances:
Incompatible with all combustibles and reducing agents, especially phosphorus, sulfur-containing materials, powdered metals, ammonium compounds. Incompatible with acids.

Hazardous Decomposition Products:
Residues of sodium chlorite, from dried-out solution, will give off oxygen on being heated strongly.

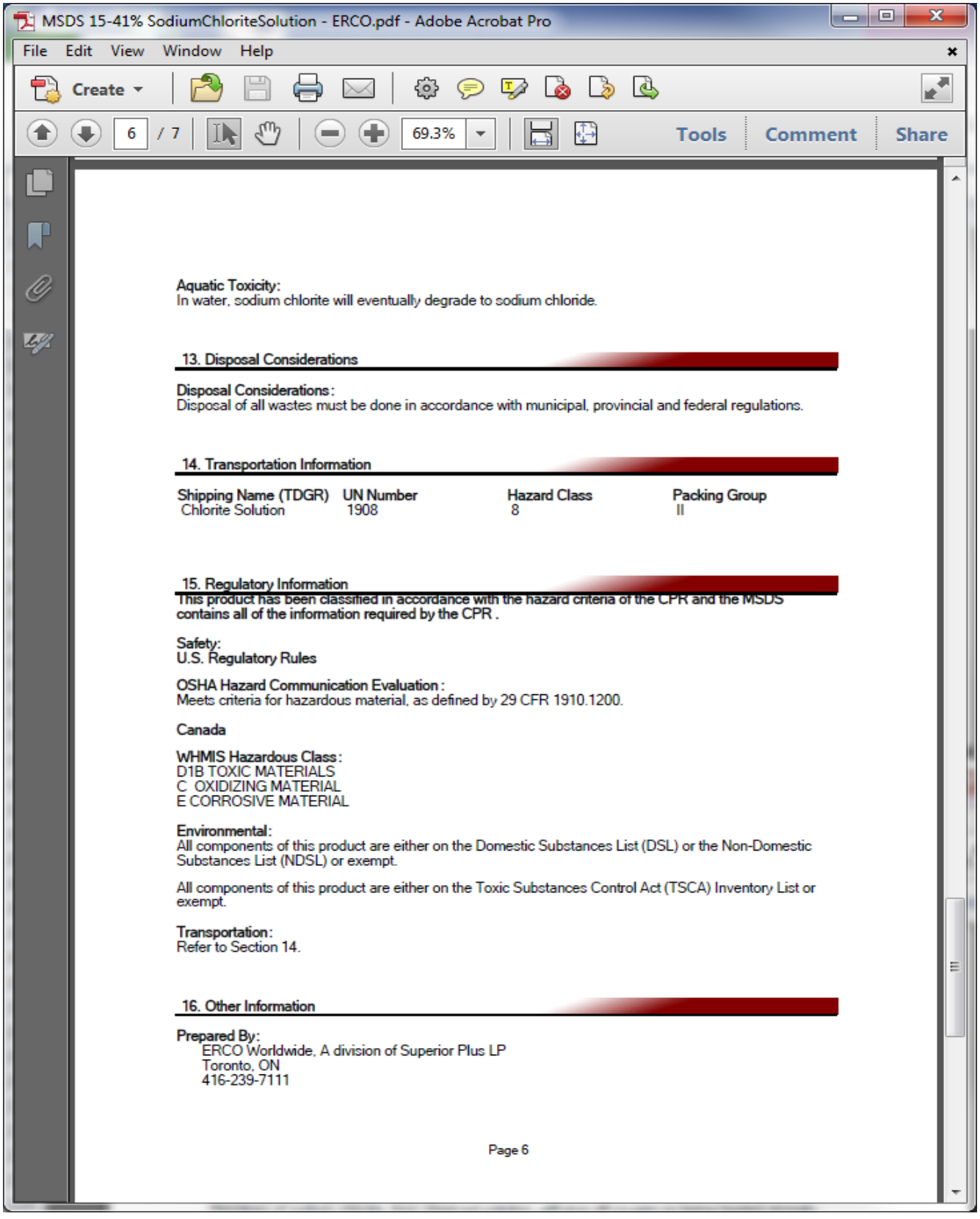
11. Toxicological Information

Skin Contact: Irritating to the skin if not washed off promptly. Dermatitis is likely to occur from repeated or prolonged contact.
Skin Absorption: Not available
Eye Contact: Causes severe eye irritation. May cause permanent damage because of its corrosive properties.
Inhalation: Spray or mist is irritating to the nose and throat.
Ingestion: Will irritate and may cause corrosion of the gastrointestinal tract. May cause vomiting, nausea, diarrhea, cramps and pain. May damage blood cells, liver or kidney.
LD_{50}: 660 mg/kg (rat) for 25 wt% Soln.
Can be estimated from above for other concentrations
LC_{50}:
Exposure Limits: Not available
Irritancy: Severe (corrosive)
Sensitization: Not reported as a human sensitizer.
Carcinogenicity: Does not appear in reference lists.
Teratogenicity & Mutagenicity: Not teratogenic even at maternally toxic doses. Mutagenicity has been demonstrated in bacteria and mammalian cell cultures, but not in experiments involving whole animals.
Reproductive Toxicology: Shown to be toxic to mammalian fetuses only at doses toxic to the mother. In one study, sodium chlorite given in drinking water showed a small but statistically significant increase in the percentage of abnormal sperm; another study was negative.
Toxicological Synergism: Not available.

12. Ecological Information

Ecological Information:
This product is toxic to aquatic life. Do not discharge into lakes, streams, ponds, sewers or other waters unless in accordance with the permitting authority.

Biodegradability:
In soil, will degrade to sodium chloride but may form chlorine dioxide in contact with acidic soils. Chlorate is an intermediate product of decomposition; it will slowly degrade to chloride.



Aquatic Toxicity:
In water, sodium chlorite will eventually degrade to sodium chloride.

13. Disposal Considerations

Disposal Considerations:
Disposal of all wastes must be done in accordance with municipal, provincial and federal regulations.

14. Transportation Information

Shipping Name (TDGR)	UN Number	Hazard Class	Packing Group
Chlorite Solution	1908	8	II

15. Regulatory Information

This product has been classified in accordance with the hazard criteria of the CPR and the MSDS contains all of the information required by the CPR.

Safety:
U.S. Regulatory Rules

OSHA Hazard Communication Evaluation:
Meets criteria for hazardous material, as defined by 29 CFR 1910.1200.

Canada

WHMIS Hazardous Class:
D1B TOXIC MATERIALS
C OXIDIZING MATERIAL
E CORROSIVE MATERIAL

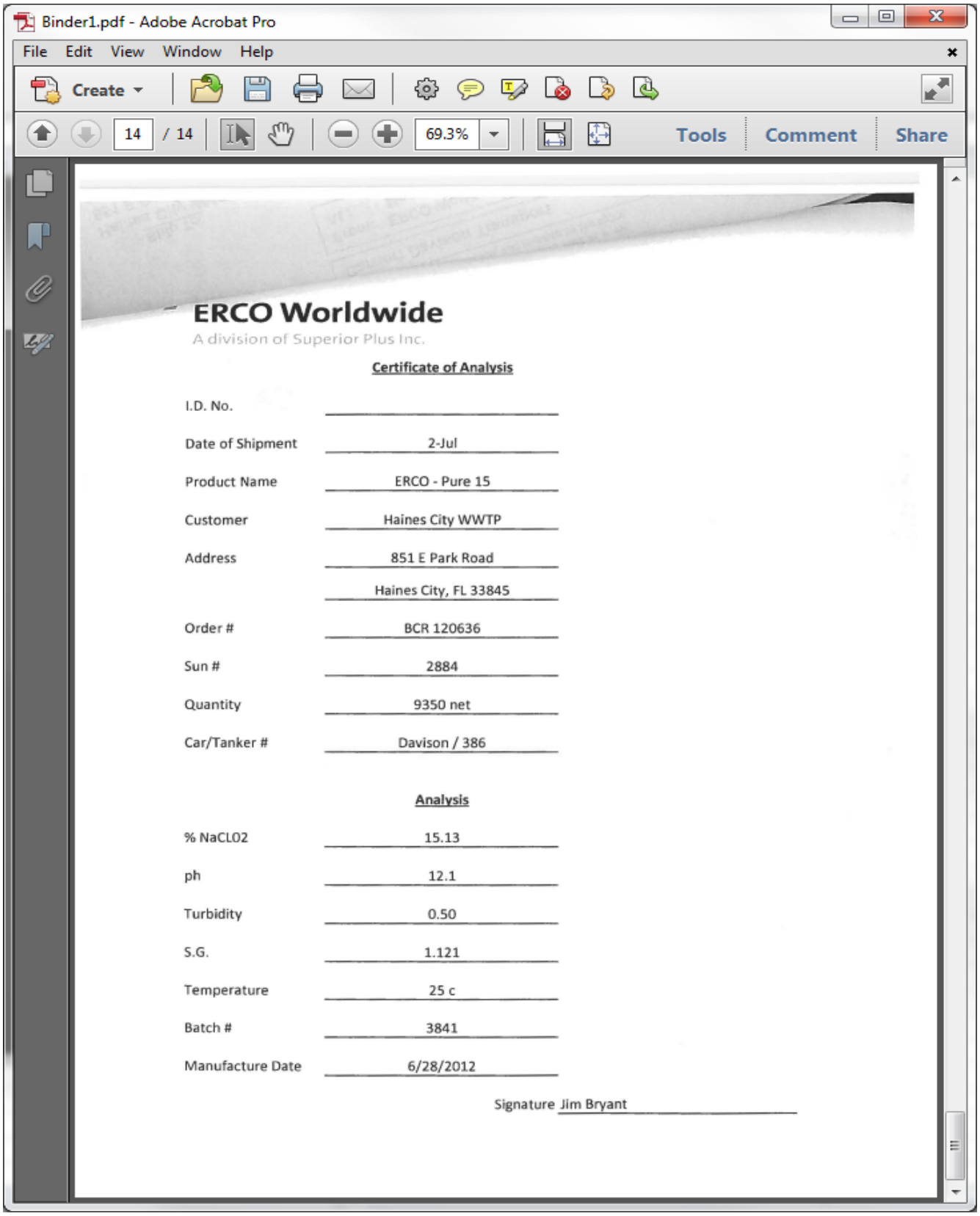
Environmental:
All components of this product are either on the Domestic Substances List (DSL) or the Non-Domestic Substances List (NDSL) or exempt.

All components of this product are either on the Toxic Substances Control Act (TSCA) Inventory List or exempt.

Transportation:
Refer to Section 14.

16. Other Information

Prepared By:
ERCO Worldwide, A division of Superior Plus LP
Toronto, ON
416-239-7111



ERCO Worldwide

A division of Superior Plus Inc.

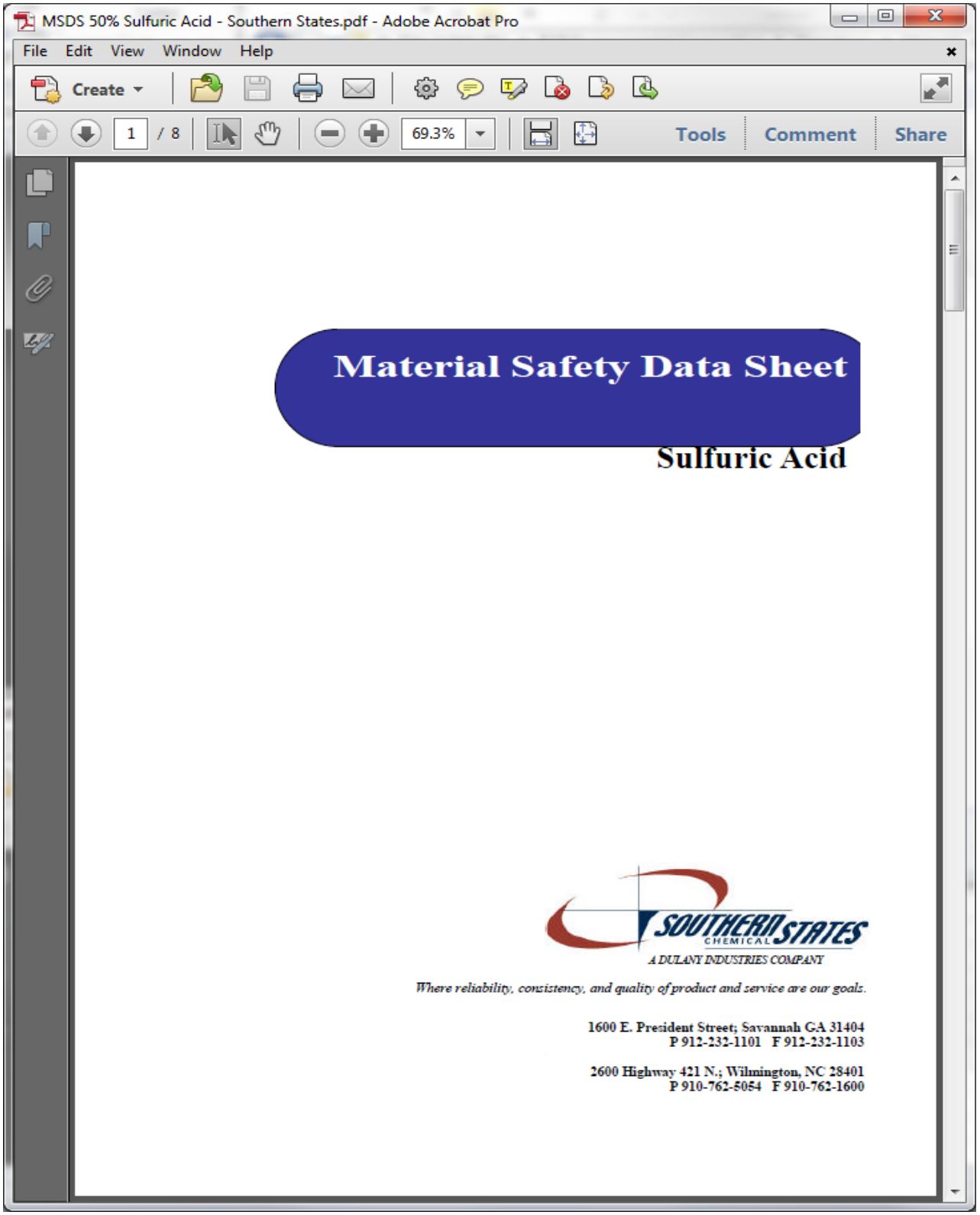
Certificate of Analysis

I.D. No.	
Date of Shipment	2-Jul
Product Name	ERCO - Pure 15
Customer	Haines City WWTP
Address	851 E Park Road
	Haines City, FL 33845
Order #	BCR 120636
Sun #	2884
Quantity	9350 net
Car/Tanker #	Davison / 386

Analysis

% NaCL02	15.13
ph	12.1
Turbidity	0.50
S.G.	1.121
Temperature	25 c
Batch #	3841
Manufacture Date	6/28/2012

Signature Jim Bryant



Material Safety Data Sheet

Sulfuric Acid

SOUTHERN STATES CHEMICAL
A DULANY INDUSTRIES COMPANY

Where reliability, consistency, and quality of product and service are our goals.

1600 E. President Street; Savannah GA 31404
P 912-232-1101 F 912-232-1103

2600 Highway 421 N.; Wilmington, NC 28401
P 910-762-5054 F 910-762-1600

MSDS 50% Sulfuric Acid - Southern States.pdf - Adobe Acrobat Pro
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A. CHEMICAL PRODUCT & COMPANY IDENTIFICATION

Trade Name: SULFURIC ACID
CAS Number: 7664-93-9
Synonym: OIL OF VITRIOL
Manufacturer: Southern States Chemical, Inc.
Supplier: 1600 E. President Street
Savannah, GA 31404

and 2600 Hwy. 421 N.
Wilmington, NC 28401

24 Hour Emergency Assistance:
Chemtrec: 800-424-9300

General Assistance , 8 AM - 5 PM (M-F EST)
Savannah, GA 912-232-1101
Wilmington, NC 910-762-5054

B. COMPOSITION /INFORMATION ON INGREDIENTS

Ingredient Name	CAS Number	Concentration
SULFURIC ACID	7664-93-9	7 - 100 %*

Exposure Limits / Health Hazards:
1 mg/m3 8-Hour TWA (OSHA)
1 mg/m3 8-Hour TWA (ACGIH)
3 mg/m3 15-Min STEL (ACGIH)
*Values do not reflect absolute minimums and maximums; these values are typical which may vary from time to time.

C. HAZARDS IDENTIFICATION

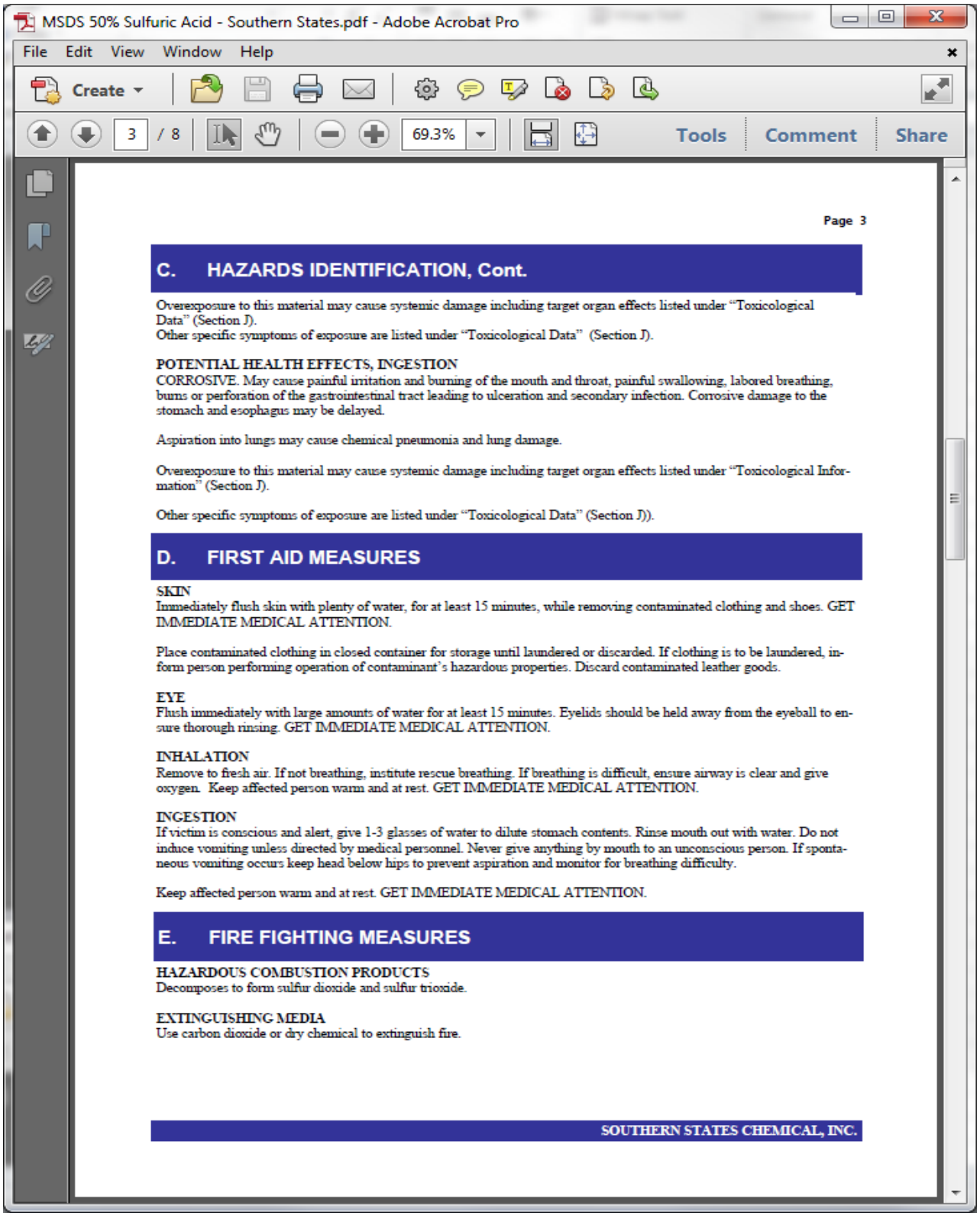
EMERGENCY OVERVIEW: DANGER!
HEALTH HAZARD: MAY BE CORROSIVE TO THE SKIN, EYES & RESPIRATORY TRACT
ASPIRATION HAZARD IF SWALLOWED-CAN ENTER LUNGS AND CAUSE DAMAGE
CANCER HAZARD
SEE "TOXICOLOGICAL INFORMATION" (SECTION J) FOR MORE INFORMATION

FLAMMABILITY HAZARDS: NON-COMBUSTIBLE
REACTIVITY HAZARDS: MAY REACT VIOLENTLY WITH WATER

POTENTIAL HEALTH EFFECTS, SKIN
CORROSIVE. Contact may cause reddening, itching, inflammation, burns, blistering and possibly severe tissue damage. Repeated or prolonged contact may result in drying, reddening, itching, pain, inflammation, cracking and possible secondary infection with tissue damage.

POTENTIAL HEALTH EFFECTS, EYE
CORROSIVE. Exposure may cause severe burns, destruction of eye tissue and possible permanent injury or blindness. Prolonged or repeated exposure may cause irritation and conjunctivitis.

POTENTIAL HEALTH EFFECTS, INHALATION
EXTREMELY IRRITATING AND CORROSIVE. May cause severe burns and tissue damage to the respiratory tract. Symptoms may include throat burns, constriction of the windpipe (bronchospasms), severe pulmonary edema and death, depending on the concentration and duration of exposure.



C. HAZARDS IDENTIFICATION, Cont.

Overexposure to this material may cause systemic damage including target organ effects listed under "Toxicological Data" (Section J).
Other specific symptoms of exposure are listed under "Toxicological Data" (Section J).

POTENTIAL HEALTH EFFECTS, INGESTION
CORROSIVE. May cause painful irritation and burning of the mouth and throat, painful swallowing, labored breathing, burns or perforation of the gastrointestinal tract leading to ulceration and secondary infection. Corrosive damage to the stomach and esophagus may be delayed.

Aspiration into lungs may cause chemical pneumonia and lung damage.

Overexposure to this material may cause systemic damage including target organ effects listed under "Toxicological Information" (Section J).

Other specific symptoms of exposure are listed under "Toxicological Data" (Section J)).

D. FIRST AID MEASURES

SKIN
Immediately flush skin with plenty of water, for at least 15 minutes, while removing contaminated clothing and shoes. GET IMMEDIATE MEDICAL ATTENTION.

Place contaminated clothing in closed container for storage until laundered or discarded. If clothing is to be laundered, inform person performing operation of contaminant's hazardous properties. Discard contaminated leather goods.

EYE
Flush immediately with large amounts of water for at least 15 minutes. Eyelids should be held away from the eyeball to ensure thorough rinsing. GET IMMEDIATE MEDICAL ATTENTION.

INHALATION
Remove to fresh air. If not breathing, institute rescue breathing. If breathing is difficult, ensure airway is clear and give oxygen. Keep affected person warm and at rest. GET IMMEDIATE MEDICAL ATTENTION.

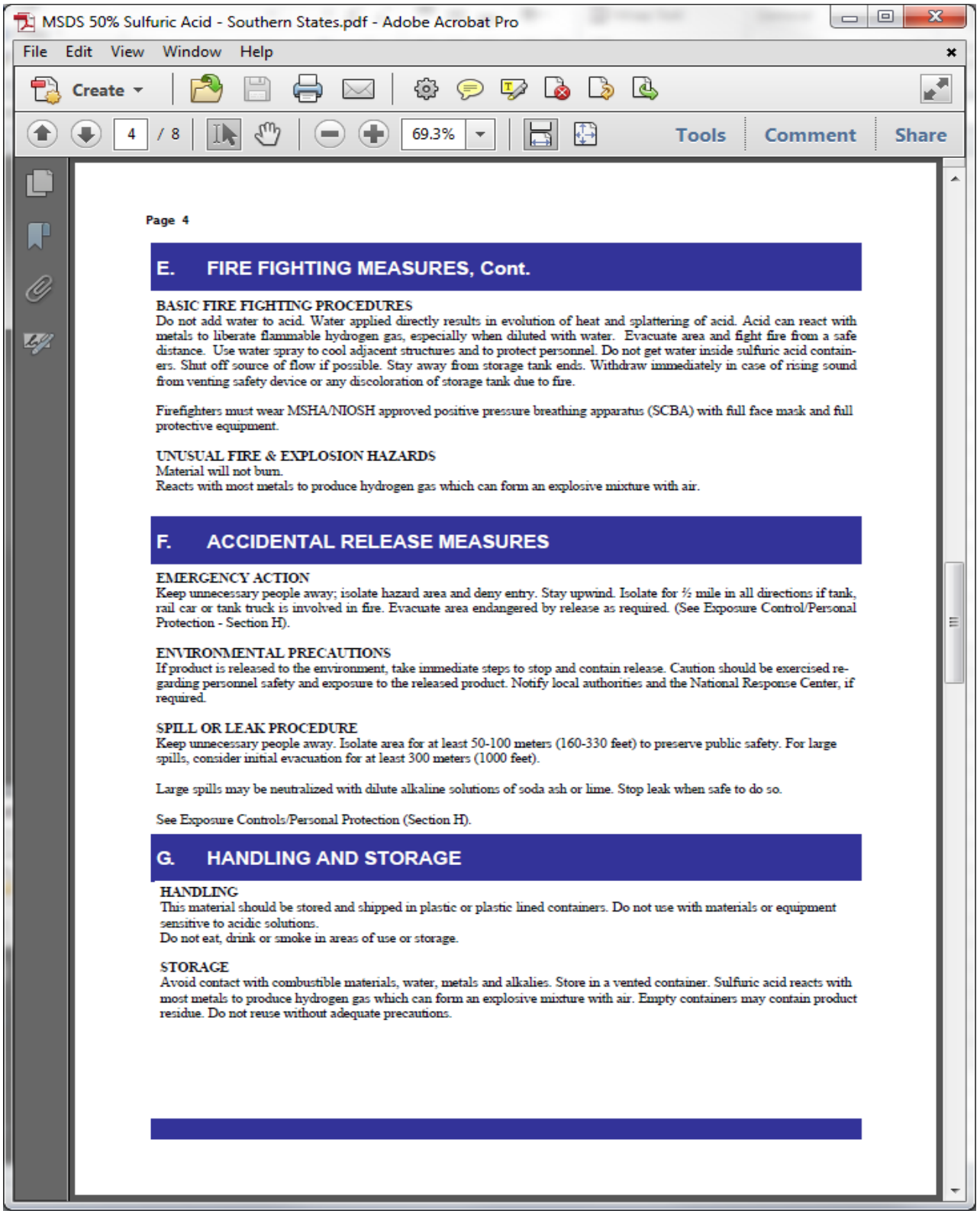
INGESTION
If victim is conscious and alert, give 1-3 glasses of water to dilute stomach contents. Rinse mouth out with water. Do not induce vomiting unless directed by medical personnel. Never give anything by mouth to an unconscious person. If spontaneous vomiting occurs keep head below hips to prevent aspiration and monitor for breathing difficulty.

Keep affected person warm and at rest. GET IMMEDIATE MEDICAL ATTENTION.

E. FIRE FIGHTING MEASURES

HAZARDOUS COMBUSTION PRODUCTS
Decomposes to form sulfur dioxide and sulfur trioxide.

EXTINGUISHING MEDIA
Use carbon dioxide or dry chemical to extinguish fire.



E. FIRE FIGHTING MEASURES, Cont.

BASIC FIRE FIGHTING PROCEDURES
Do not add water to acid. Water applied directly results in evolution of heat and splattering of acid. Acid can react with metals to liberate flammable hydrogen gas, especially when diluted with water. Evacuate area and fight fire from a safe distance. Use water spray to cool adjacent structures and to protect personnel. Do not get water inside sulfuric acid containers. Shut off source of flow if possible. Stay away from storage tank ends. Withdraw immediately in case of rising sound from venting safety device or any discoloration of storage tank due to fire.

Firefighters must wear MSHA/NIOSH approved positive pressure breathing apparatus (SCBA) with full face mask and full protective equipment.

UNUSUAL FIRE & EXPLOSION HAZARDS
Material will not burn.
Reacts with most metals to produce hydrogen gas which can form an explosive mixture with air.

F. ACCIDENTAL RELEASE MEASURES

EMERGENCY ACTION
Keep unnecessary people away; isolate hazard area and deny entry. Stay upwind. Isolate for ½ mile in all directions if tank, rail car or tank truck is involved in fire. Evacuate area endangered by release as required. (See Exposure Control/Personal Protection - Section H).

ENVIRONMENTAL PRECAUTIONS
If product is released to the environment, take immediate steps to stop and contain release. Caution should be exercised regarding personnel safety and exposure to the released product. Notify local authorities and the National Response Center, if required.

SPILL OR LEAK PROCEDURE
Keep unnecessary people away. Isolate area for at least 50-100 meters (160-330 feet) to preserve public safety. For large spills, consider initial evacuation for at least 300 meters (1000 feet).

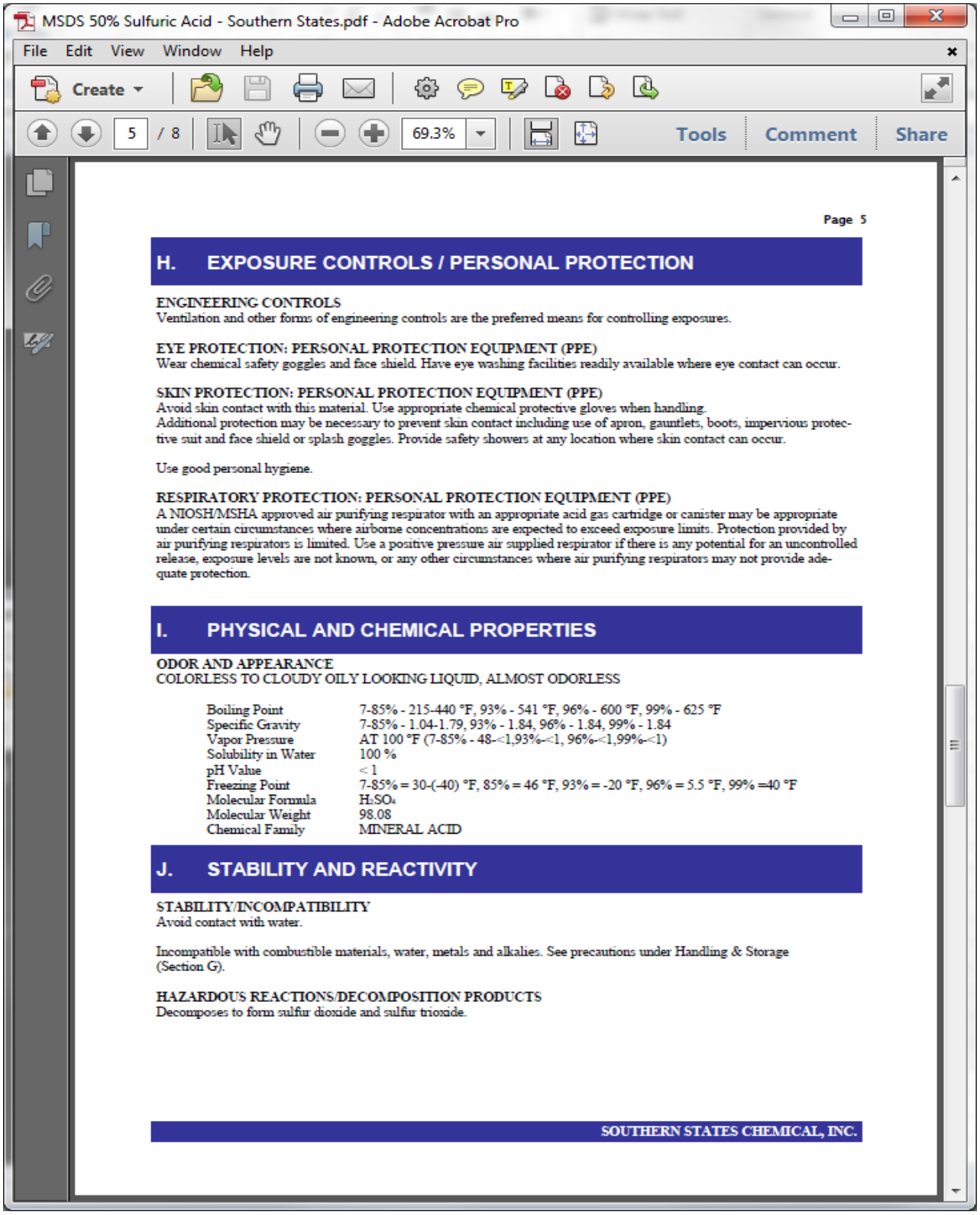
Large spills may be neutralized with dilute alkaline solutions of soda ash or lime. Stop leak when safe to do so.

See Exposure Controls/Personal Protection (Section H).

G. HANDLING AND STORAGE

HANDLING
This material should be stored and shipped in plastic or plastic lined containers. Do not use with materials or equipment sensitive to acidic solutions.
Do not eat, drink or smoke in areas of use or storage.

STORAGE
Avoid contact with combustible materials, water, metals and alkalies. Store in a vented container. Sulfuric acid reacts with most metals to produce hydrogen gas which can form an explosive mixture with air. Empty containers may contain product residue. Do not reuse without adequate precautions.



H. EXPOSURE CONTROLS / PERSONAL PROTECTION

ENGINEERING CONTROLS
Ventilation and other forms of engineering controls are the preferred means for controlling exposures.

EYE PROTECTION: PERSONAL PROTECTION EQUIPMENT (PPE)
Wear chemical safety goggles and face shield. Have eye washing facilities readily available where eye contact can occur.

SKIN PROTECTION: PERSONAL PROTECTION EQUIPMENT (PPE)
Avoid skin contact with this material. Use appropriate chemical protective gloves when handling.
Additional protection may be necessary to prevent skin contact including use of apron, gauntlets, boots, impervious protective suit and face shield or splash goggles. Provide safety showers at any location where skin contact can occur.

Use good personal hygiene.

RESPIRATORY PROTECTION: PERSONAL PROTECTION EQUIPMENT (PPE)
A NIOSH/MSHA approved air purifying respirator with an appropriate acid gas cartridge or canister may be appropriate under certain circumstances where airborne concentrations are expected to exceed exposure limits. Protection provided by air purifying respirators is limited. Use a positive pressure air supplied respirator if there is any potential for an uncontrolled release, exposure levels are not known, or any other circumstances where air purifying respirators may not provide adequate protection.

I. PHYSICAL AND CHEMICAL PROPERTIES

ODOR AND APPEARANCE
COLORLESS TO CLOUDY OILY LOOKING LIQUID, ALMOST ODORLESS

Boiling Point	7-85% - 215-440 °F, 93% - 541 °F, 96% - 600 °F, 99% - 625 °F
Specific Gravity	7-85% - 1.04-1.79, 93% - 1.84, 96% - 1.84, 99% - 1.84
Vapor Pressure	AT 100 °F (7-85% - 48-<1,93%-<1, 96%-<1,99%-<1)
Solubility in Water	100 %
pH Value	< 1
Freezing Point	7-85% = 30-(-40) °F, 85% = 46 °F, 93% = -20 °F, 96% = 5.5 °F, 99% =40 °F
Molecular Formula	H_2SO_4
Molecular Weight	98.08
Chemical Family	MINERAL ACID

J. STABILITY AND REACTIVITY

STABILITY/INCOMPATIBILITY
Avoid contact with water.

Incompatible with combustible materials, water, metals and alkalies. See precautions under Handling & Storage (Section G).

HAZARDOUS REACTIONS/DECOMPOSITION PRODUCTS
Decomposes to form sulfur dioxide and sulfur trioxide.

MSDS 50% Sulfuric Acid - Southern States.pdf - Adobe Acrobat Pro
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K. TOXICOLOGICAL INFORMATION

ROUTES OF EXPOSURE
Inhalation, ingestion, skin and eye contact.
LD50
LD50: Sulfuric Acid, Rat, Oral, 2140 mg/kg.

TOXICOLOGICAL DATA
Acute or chronic overexposure to this material or its components may cause systemic toxicity, including adverse effects to the following: kidney, liver, teeth, respiratory and cardiovascular systems.

Exposure to components of this material may cause the following specific symptoms, depending on the concentration and duration of exposure: attacks enamel of teeth, vomiting, clammy skin, weak and rapid pulse.

Other symptoms of exposure may include the following: shallow respiration, chronic bronchitis, lung function changes and scanty urine.

CARCINOGENICITY
IARC has determined that there is sufficient evidence for the carcinogenicity of occupational exposure to strong inorganic acid mists containing sulfuric acid in humans (IARC Class 1).

PRE-EXISTING CONDITIONS AGGRAVATED BY EXPOSURE
Pre-existing medical conditions which may be aggravated by exposure include disorders of the skin and respiratory system.

L. ECOLOGICAL INFORMATION

ECOTOXICOLOGICAL INFORMATION
ND

M. DISPOSAL CONSIDERATIONS

WASTE DISPOSAL
This product as supplied, when discarded or disposed of, is a hazardous waste according to Federal regulations (40 CFR 261) due to its corrosivity and reactivity. Under the Resource Conservation and Recovery Act (RCRA), it is the responsibility of the user of the product to determine, at the time of disposal, whether the material is a hazardous waste subject to RCRA.
The transportation, storage, treatment and disposal of RCRA waste material must be conducted in compliance with 40 CFR 262, 263, 264, 268 and 270. Disposal can occur only in properly permitted facilities. Check state and local regulations for any additional requirements as these may be more restrictive than federal laws and regulations. Chemical additions, processing or otherwise altering this material may make the waste management information presented in this MSDS incomplete, inaccurate or otherwise inappropriate. Disposal of this material must be conducted in compliance with all federal, state and local regulations.

MSDS 50% Sulfuric Acid - Southern States.pdf - Adobe Acrobat Pro
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N. TRANSPORT INFORMATION

BILL OF LADING - BULK (U. S. DOT)
RQ, Sulfuric Acid, 8, UN 1830, PG II (use with more than 51% acid)
RQ, Sulfuric Acid, 8, UN 2796, PG II (use with not more than 51% acid) ,
BILL OF LADING - NON-BULK (U. S. DOT)
RQ, Sulfuric Acid, 8, UN 1830, PG II (use with more than 51% acid)
RQ, Sulfuric Acid, 8, UN 2796, PG II (use with not more than 51% acid)

U. S. Department of Transportation (DOT) requirements
General Transportation Information for Bulk Shipments

Proper Shipping Name	Sulfuric Acid
Hazard Class	8
UN/NA Code	UN 1830, UN 2796
Packaging Group	PG II
Labels Required	Corrosive
Placards Required	Corrosive, UN 1830 (>51%), UN 2796 (<=51%)
Reportable Quantity	See Regulatory Information (Section N)

General Transportation Information for Non-Bulk Shipments

Proper Shipping Name	Sulfuric Acid
Hazard Class	8
UN/NA Code	UN 1830, UN 2796
Packaging Group	PG II
Labels Required	Corrosive
Placards Required	Corrosive, UN 1830 (>51%), UN 2796 (<=51%)
Reportable Quantity	See Regulatory Information (Section O)

The above description may not cover shipping in all cases. Please consult 49 CFR 172.101 for specific shipping information.

O. REGULATORY INFORMATION

FEDERAL REGULATIONS
All ingredients are on the TSCA inventory or are not required to be listed on the TSCA inventory.
This product, as supplied, contains sulfuric acid, a Hazardous Substance as per 40 CFR Part 302.4 and an Extremely Hazardous Substance as per 40 CFR Part 355. The reportable quantity for sulfuric acid is 1000 pounds. Any release of this product equal to or exceeding the reportable quantity must be reported to the National Response Center (800-424-8802) and appropriate state and local regulatory agencies as described in 40 CFR Part 302.6 and 40 CFR 355.40, respectively. Failure to report may result in substantial civil and criminal penalties. Check state and local regulations for any additional requirements as these may be more restrictive than federal laws and regulations.
This product contains one or more components designated as hazardous substances or toxic pollutants pursuant to the Federal Clean Water Act (40 CFR 116.4 Table A; 40 CFR 401.15). Any unpermitted introduction of this product into a facility stormwater or wastewater discharge may constitute a violation of the Clean Water Act. Facilities must notify the appropriate permitting agency prior to introducing this product into the aforementioned discharges.
This product contains one or more substances listed as hazardous, toxic or flammable air pollutants under Section 112 of the Clean Air Act.
There may be specific regulations at the local, regional or state/provincial level that pertain to this product.

STATE REGULATIONS
Based on available information this product does not contain any components or chemicals currently known to the State of California to cause cancer, birth defects or reproductive harm at levels which would be subject to Proposition 65. Reformulation, use or processing of this product may affect its composition and require re-evaluation.

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O. REGULATORY INFORMATION, CONT.

SARA TITLE III RATINGS
Immediate Hazard: X Delayed Hazard: X Fire Hazard: Pressure Hazard: Reactivity Hazard: X

NFPA RATINGS

Health	3	Flammability	0	Reactivity	2	Special Hazards	W

HMIS RATINGS

Health	3*	Flammability	0	Reactivity	2

Following ingredients of this product are listed in **SARA313**

SARA Listed Ingredient Name	CAS Number	Maximum %
SULFURIC ACID	7664-93-9	100.0

P. OTHER INFORMATION

DISCLAIMER

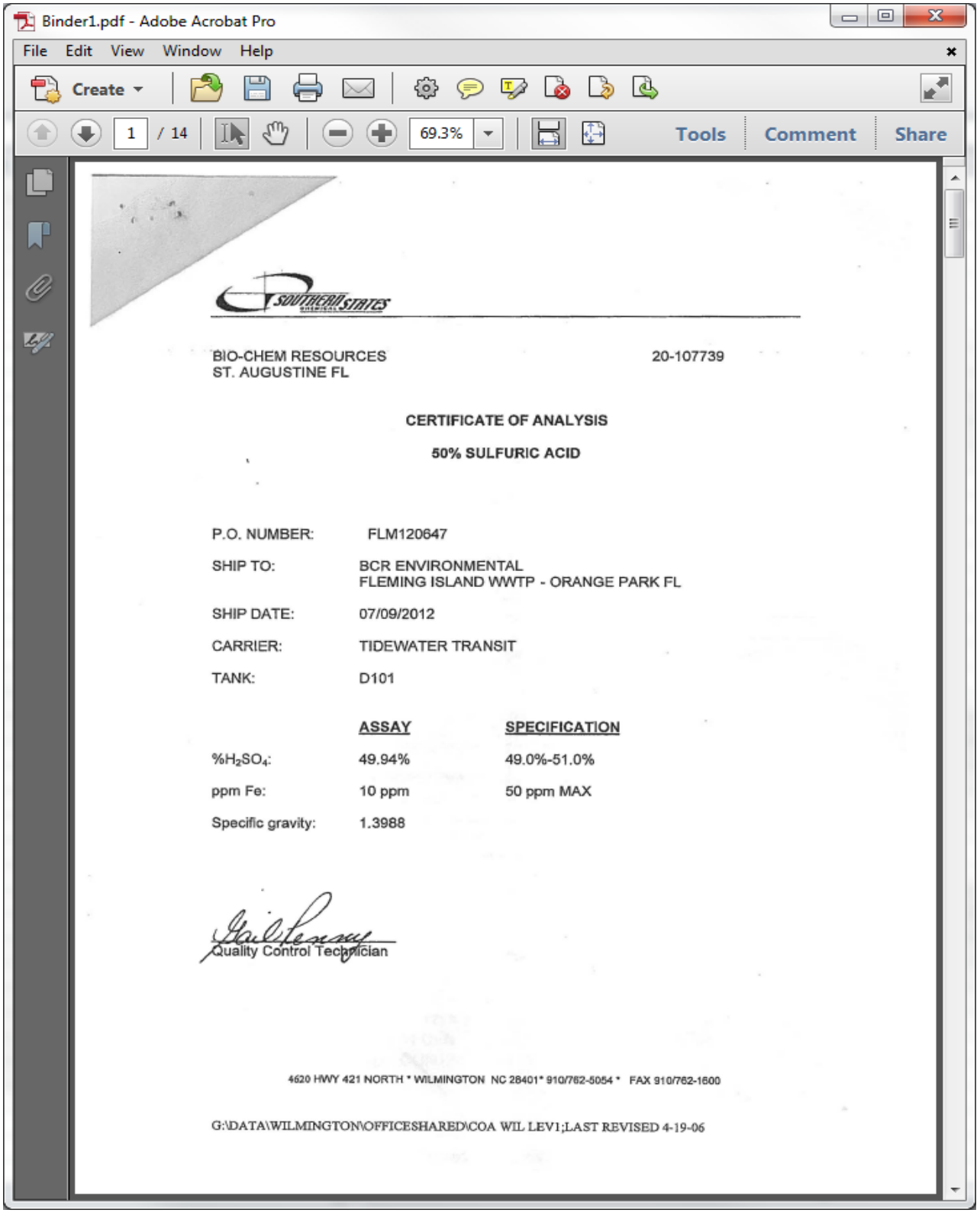
NOTICE: The information presented herein is based on data considered to be accurate as of the date of preparation of this Material Safety Data Sheet. However, MSDS may not be used as a commercial specification sheet of manufacturer or seller, and no warranty or representation, expressed or implied, is made as to the accuracy or comprehensiveness of the foregoing data and safety information, nor is any authorization given or implied to practice any patented invention without a license. In addition, no responsibility can be assumed by vendor for any damage or injury resulting from abnormal use, from any failure to adhere to recommended practices, or from any hazards inherent in the nature of the product.

SOUTHERN STATES CHEMICAL

PO Box 546
Savannah, GA 31402
Phone: 912-232-1101
Fax: 912-232-1103

2600 Highway 421 N.
Wilmington, NC 28401
Phone: 910-762-5054
Fax: 910-762-1600

Last Updated 01/01/02



BIO-CHEM RESOURCES
ST. AUGUSTINE FL

20-107739

CERTIFICATE OF ANALYSIS

50% SULFURIC ACID

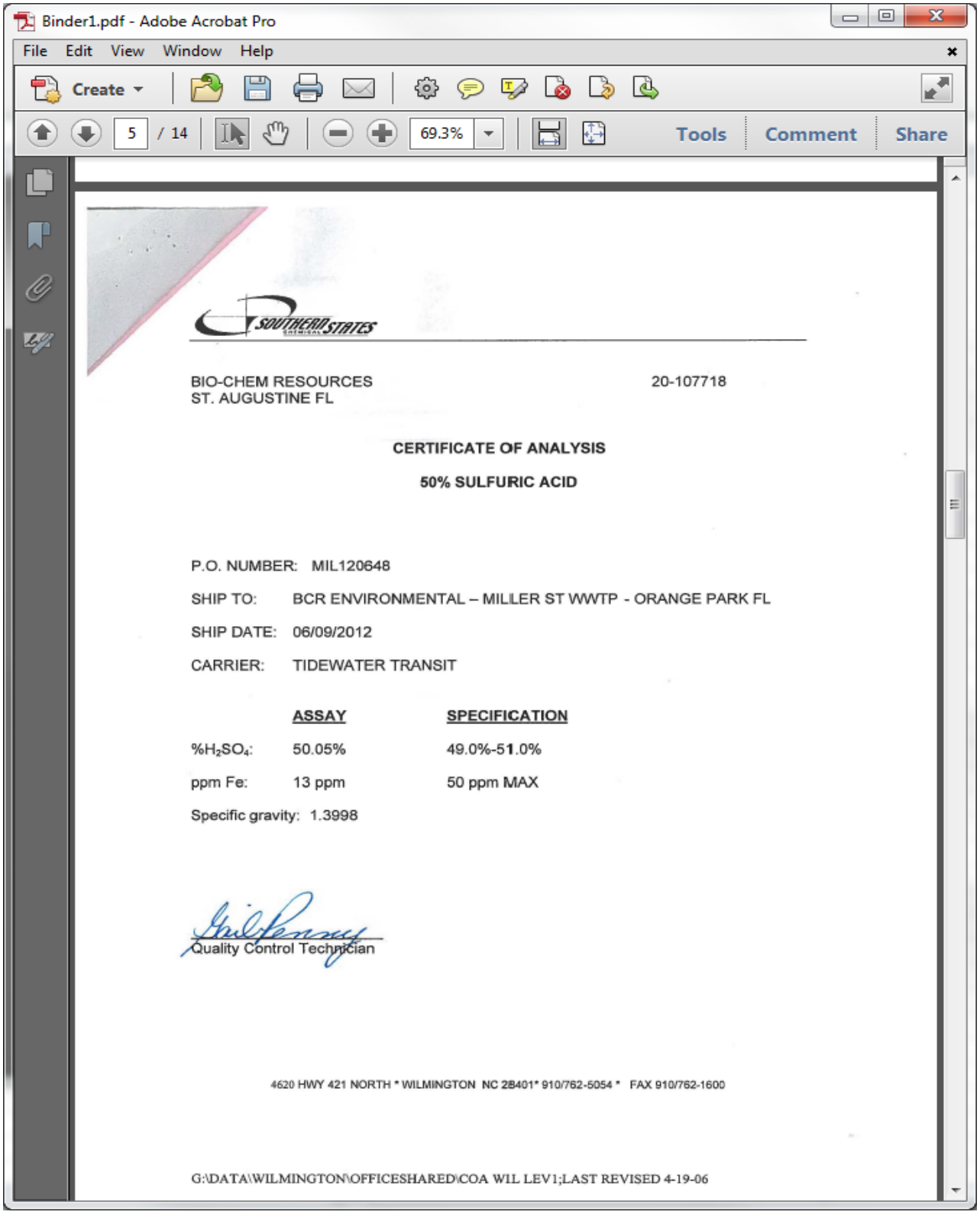
P.O. NUMBER:	FLM120647
SHIP TO:	BCR ENVIRONMENTAL FLEMING ISLAND WWTP - ORANGE PARK FL
SHIP DATE:	07/09/2012
CARRIER:	TIDEWATER TRANSIT
TANK:	D101

	ASSAY	SPECIFICATION
$\%H_2SO_4$:	49.94%	49.0%-51.0%
ppm Fe:	10 ppm	50 ppm MAX
Specific gravity:	1.3988	

Quality Control Technician

4620 HWY 421 NORTH * WILMINGTON NC 28401* 910/762-5054 * FAX 910/762-1600

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SOUTHERN STATES

BIO-CHEM RESOURCES
ST. AUGUSTINE FL

20-107718

CERTIFICATE OF ANALYSIS

50% SULFURIC ACID

P.O. NUMBER: MIL120648

SHIP TO: BCR ENVIRONMENTAL – MILLER ST WWTP - ORANGE PARK FL

SHIP DATE: 06/09/2012

CARRIER: TIDEWATER TRANSIT

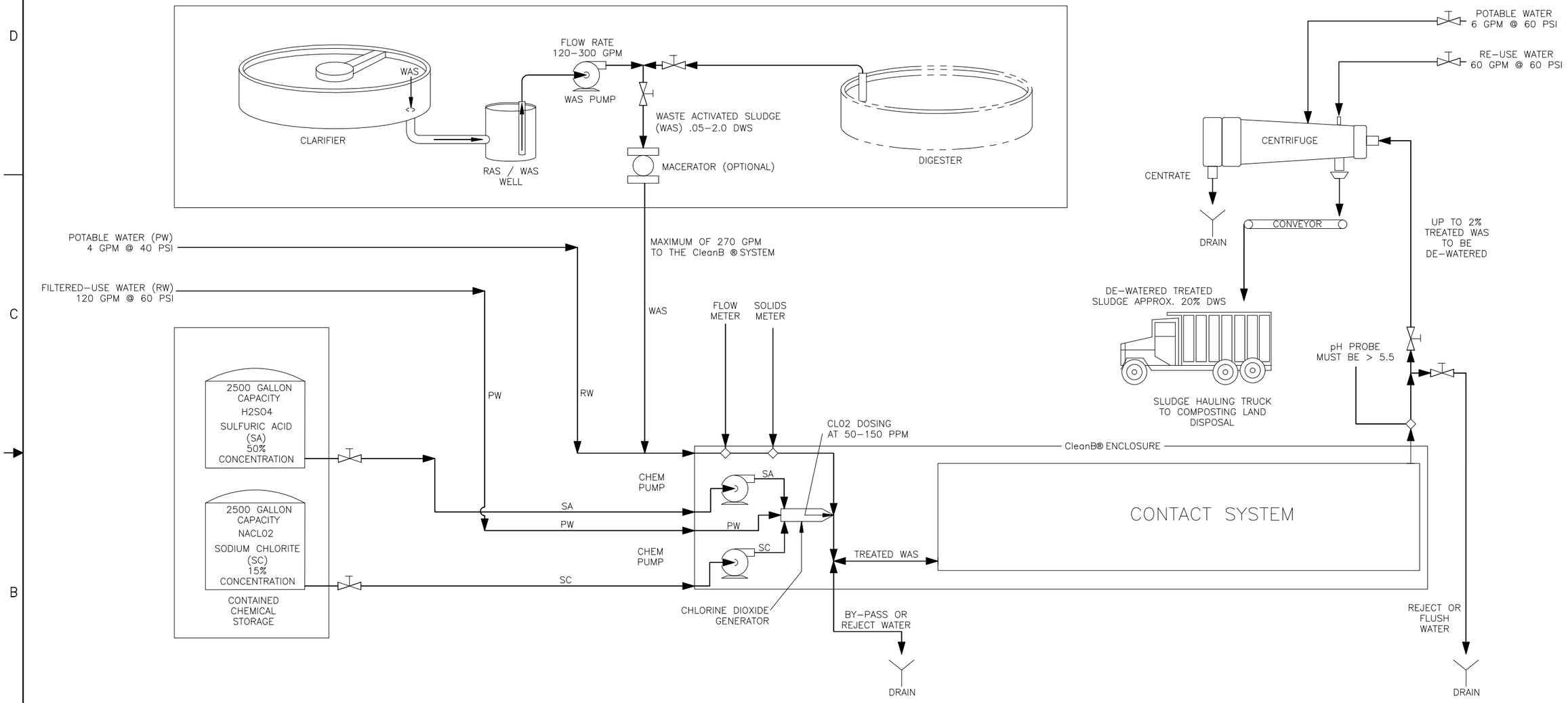
	ASSAY	SPECIFICATION
$\%H_2SO_4$:	50.05%	49.0%-51.0%
ppm Fe:	13 ppm	50 ppm MAX

Specific gravity: 1.3998

Quality Control Technician

4620 HWY 421 NORTH * WILMINGTON NC 28401* 910/762-5054 * FAX 910/762-1600

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CleanB® PROCESS FLOW DIAGRAM
(HIGH FLOW MODEL)

DISTRIBUTION STATEMENT
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bcr ENVIRONMENTAL
3740 St. Johns Bluff Road S. Suite 21, Jacksonville, Florida 32224

SIZE	DWG NO	REV
D	1021-E-10001	1
SCALE NTS	WT.(LBS.)	SHEET 3 OF 3

March 21, 2017

OWNER (“Commission”)
Attn: CONTACT
ADDRESS

BCR Environmental Corporation (“BCR”)
Attn: Aaron Zahn
Po Box 551500
Jacksonville, FL 32255

Re: Memorandum of understanding of general terms (“MOU”) outlining the non-binding agreement between Authority and BCR (collectively, the “Parties”) CleanB Project (the “Project”) at the OWNER’S FACILITY (“WWTF”)

1. GENERAL AGREEMENT BETWEEN PARTIES

Owner:	Commission
General Contractor:	_____
Engineer of Record:	_____
CleanB® Equipment Provider:	BCR
Equipment Rep Firm:	**_____**
MOU Effective Date:	**_____**
Additional Conditions:	In addition to the matters contemplated in this MOU, the Definitive Documents shall contain provisions providing for the following conditions: a) all Parties obtaining all necessary third party, shareholder, governmental and regulatory consents; b) the delivery by the Parties to each other of a full and complete release of claims against one another at the time of execution of the Definitive Agreements for all matters on or prior to the date of execution of the Definitive Agreements.

2. AGREEMENT BY AND BETWEEN COMMISSION AND BCR

Service Agreement: BCR is proud of its 100% project success. We attribute this track record to 'living with our projects'. Accordingly, BCR proposes and Commission agreed to enter into a mutually agreeable continuing services agreement with the following major conditions.

Term: Twenty (20) years starting on date of substantial completion of Project with three (3) additional five (5) year option terms upon mutual agreement.

Services: During the Term, BCR will deliver Services to the Commission of:

Biosolids Testing/Sampling – Perform lab testing on the end-product that results from the system in accordance with the County's permit requirements.

Total Chemical Management Plan – During the term, BCR will provide the City with all chemicals necessary to operate the system.

The System Monitoring Plan, Annual System Inspection, Annual Operator Training and Technical Support shall all be included as Base Services ("Base Services").

System Monitoring Plan - Remote monitoring of data output from the CleanB to ensure proper operation throughout the life of the contract with BCR;

Quarterly Reporting - BCR shall produce a written quarterly report for the benefit of the Commission detailing operations of the CleanB and provide helpful information to operators based on lessons learned.

Annual System Inspection - A certified and trained technician shall inspect the CleanB each year of the contract term to ensure proper operations and maintenance. During the annual inspection BCR technicians shall provide Commission with additional training and troubleshooting techniques. BCR shall produce a written annual report for the benefit of the Commission. The Annual System Inspection and Annual Operator Training shall be a minimum of a complete 8-hour day.

Annual Operator Training – BCR shall provide annual CleanB operator training to include instruction on overall operations and standard operating procedures, repair and maintenance procedures, safety procedures, testing and compliance procedures associated with the CleanB. The Annual System Inspection and Annual Operator Training shall be a minimum of a complete 8-hour day.

Technical Services – BCR shall provide up to eight (8) hours per quarter of technical support in response to Commission inquiries via computer, email, or telephone, as reasonably determined appropriate by BCR, regarding the operation of the CleanB. A maximum of 5 unused hours may be used but only in the next quarter for a maximum potential total of 13 in any quarter.

Additional elective services for the Commission shall be as follows:

Supplemental Technical Services. BCR will provide to the Commission supplemental technical services in the event the Commission requests additional Technical Services after exhausting the monthly allowance of Technical Services. In the event Supplemental Technical Services are required, a BCR representative will begin providing such Supplemental Technical Services within forty-eight (48) hours of BCR's written acceptance to provide the same.

Repair and Maintenance Support - Upon the sole discretion of Commission and upon written request by Commission, and written acceptance by BCR, BCR shall coordinate with Commission to provide repair or maintenance services for the CleanB and/or WWTF;

Operational Improvements. During the Term, BCR may introduce certain services, equipment, designs, software or other offering (each an "Operational Improvement") into the market. BCR will inform the Commission, in writing, when such Operational Improvements become available and if such Operational Improvements are applicable to Commission. Commission shall, in its sole discretion, procure such Operational Improvement from BCR.

Service Fees:

Base Service Fee: the Base Services shall be provided for a fee equal to ###### per year payable in monthly installments. The Base Service Fee shall be escalated annually by the greater of the Consumer Price Index or ##%, but for each annual escalation no more than ##% per year.

Supplemental Technical Service Fees - In consideration of the Supplemental Technical Services provided by BCR, if any, the Commission will pay BCR (i) an Hourly Rate per hour for each BCR representative that provides such Supplemental Technical Services, (ii) reimbursement for travel expenses, and (iii) all validated and documented additional costs and expenses incurred by BCR in conjunction with providing such Supplemental Technical Services requested by the Commission. The hourly rate ("Hourly Rate") shall be ##### for BCR representatives that are professional engineers ("PE") and ##### for BCR representatives that are BCR trained

technicians, which hourly rate will be increased annually by the greater of (A) the annual increase in the overall Consumer Price Index, or (B) ##%, but for each annual escalation no more than ##% per year.

Repair and Maintenance Support Fee: For repair and maintenance items not covered by the System warranty, Client shall pay BCR a Repair and Maintenance Fee in the amount of the repair and maintenance parts at cost plus a markup of ##% plus labor required to install parts at the Hourly Rate.

Operational Improvements Fee: In the event the Commission elects to purchase such Operational Improvements, BCR will provide the Commission with written (a) a description of the Operational Improvements to be provided, (b) the rates payable to BCR in consideration of the provision of the Operational Improvements, and (c) any other relevant conditions, provisions and terms applicable to the Operational Improvements.

F.3 PROPOSAL FOR ALKALINE TREATMENT SYSTEM BY SCHWING BIOSET INC.

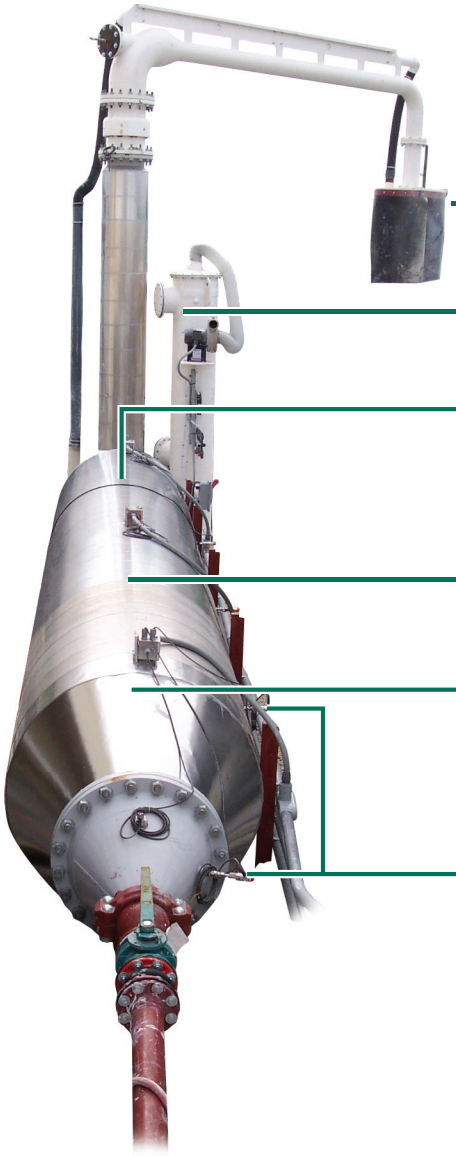
Bioset Process

Alkaline Stabilization/Pasteurization - Class ‘A’



SCHWING BIOSET

Features



Odor control hood

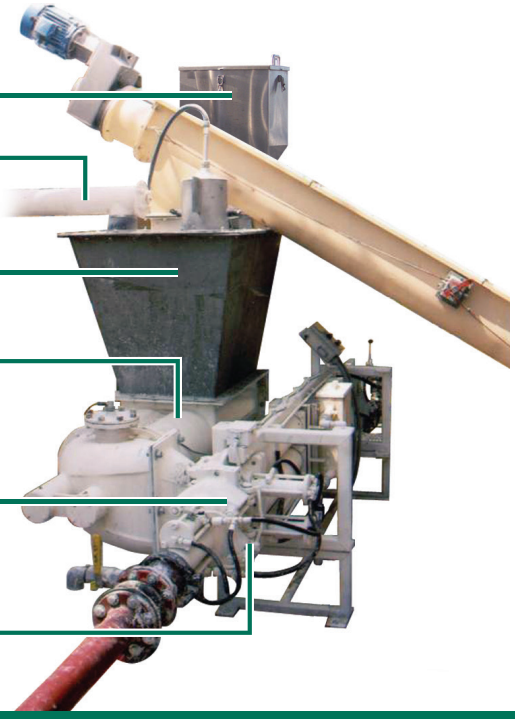
Ammonia scrubber and collection line, 3 gpm of water flow.

Biosolids exposed to high temperature and high pH within reactor. Ammonia kills pathogens before temperature does enabling PFRP approval to reduce operating temperature from 70C to 55C. This approval results in a reduction of the already low operating costs

No external heat is required. All energy is produced by chemical reactions.

Enclosed reactor contains odor and dust

Temperature sensors monitor process



Sulfamic acid feeder

Quicklime screw feed

Totally enclosed hopper that contains all dust and odors

Counter-rotating, intermeshing, twin-screw auger provides efficient homogenized mixing of the biosolids and chemicals.

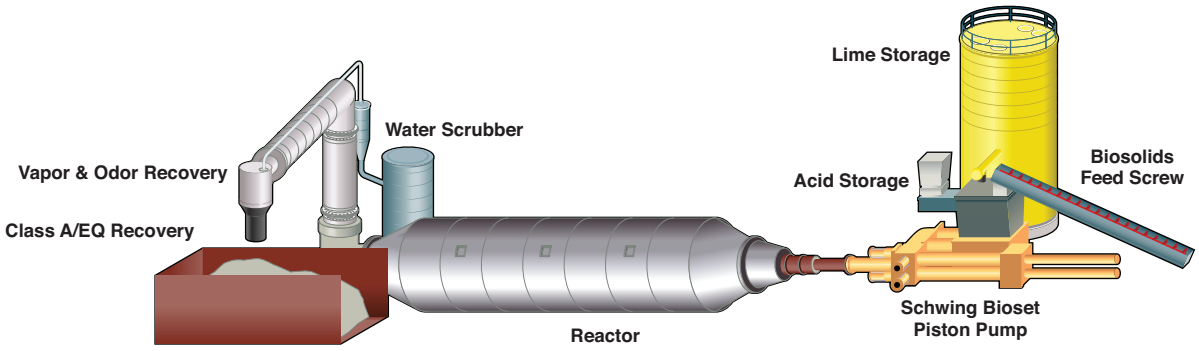
Schwing Bioset positive displacement piston pump capable of pumping organic materials up to 50% solids content at pressures over 1,500 psi.

Poppet valve discharge assembly that allows use of Schwing Bioset's Sludge Flow Measuring System (SFMS™) which measures, to within +/-5%, the amount of biosolids pumped.

Benefits

The Bioset process achieves Class ‘A’ biosolids via the time vs. temperature equation and pH adjustment per the EPA 503 regulations. Additionally, the USEPA has granted PFRP approval such that the Bioset process can also operate at 55C for 40 minutes. Operating under the PFRP approved conditions reduces operating expenses by 25-30% offering end-users a significant savings on the already low operating costs. Temperature is achieved through the addition of Quicklime and Sulfamic acid and the high pH is achieved through the addition of the Quicklime. Biosolids and chemicals are homogenously mixed in a Schwing Bioset twin screw feeder and pumped with a Schwing Bioset piston pump through an insulated reactor.

As the Bioset process is totally enclosed within the reactor the process operates odor free. The reactor discharge provides the only location for gases to escape and they are easily collected and scrubbed utilizing a small water scrubber. The resulting final product has an odor that is similar to wet-concrete.



Easy operation and reliable results

From start-up to shut-down the Bioset process remains the easiest to operate and most reliable Class ‘A’ system available. Even on shut-down, biosolids that remain in the reactor are treated to Class ‘A’ levels and discharged as such on the next start-up.

Cleanliness

The Bioset process is a clean system to operate as it is totally enclosed from start to finish. Being totally enclosed prevents dust and odors from escaping at the inlet, prevents biosolids from spilling during the process, and allows point source odor capture at the discharge.

No supplemental heat

All of the heat to operate the Bioset process is achieved via chemical addition. No expensive and maintenance intensive supplemental heat sources are required.











Odor control

As the Bioset process is contained within the reactor the process operates odor free. The reactor discharge is where gases are emitted and they are easily captured at this single point with a small water scrubber. The final Class ‘A’ material has an odor, due to the high lime content, similar to wet concrete.

Operating cost

With ever-rising energy costs the Bioset process stands out as the most economical method of producing Class ‘A’ biosolids as it is not reliant on auxiliary electrical, steam or thermal oil based heating systems.

Reuced operating costs through PFRP approval

PFRP approval to reduce the operating temperature is possible as the ammonia that is generated through lime addition is entrained with the biosolids inside the reactor and kills the pathogens. The EPA has recognized this phenomena and has granted site specific approval to reduce operating temperatures from 158F (70C) to 131F (55C).

A Name You Can Trust

Piston Pumps



Schwing Bioset, Inc. is the regonized leader in sludge pump technology. SBI units pump dewatered biosolids from Presses and Centrifuges with dry solids content up to 55%. These versatile pumps were born in the concrete industry, but have been used successfully in wastewater plants since the mid 1980's.

Sliding Frame



Sliding frame systems, whether used as truck receiving, truck loading, or as intermediate storage, offer a flexible means of storing dewatered solids while eliminating bridging. The flexible design allows for various process requirements.

Fluid Bed Dryer



Schwing Bioset's fluid bed dryer offers a thermally efficient means of producing dust-free Class A biosolids. The automated system allows for unattended operation, and produces a very simple product to store, transport, and apply.

Container Wagon



Due to plant layout restrictions, many facilities face the challenge of transporting solids from one loading / unloading point into and out of the process stream. The SBI Container Wagon system provides a variety of solutions.

Operating & Marketing Services



Schwing Bioset's partnership with Biosolids Distribution Services Inc. creates the unique ability to offer complete handling solutions with engineering, equipment, and distribution of Class A biosolids, responsibly offered by a single provider.

Screw Press



SBI's Screw Press provides excellent dewatering capabilities with a system that is virtually maintenance free, and can be run unattended.

Contact Information

Wisconsin:
350 SMC Drive
Somerset, WI 54025
TEL 715-247-3433
FAX 715-247-3438
www.schwingbioset.com

Connecticut:
98 Mill Plain Ste. 2B
Danbury, CT 06811
TEL 203-744-2100
FAX 203-744-2837

SCHWING BIOSET

Printed on Recycled Paper

PB-BP-0411

Screw Press

Dewatering Systems



SCHWING BIOSET

Fully Automated Dewatering System

Your Partner in Dewatering

- Mobile pilot units available for testing your biosolids.
- Widest range of unit models available.
- Includes polymer dosing and control systems for complete solutions.

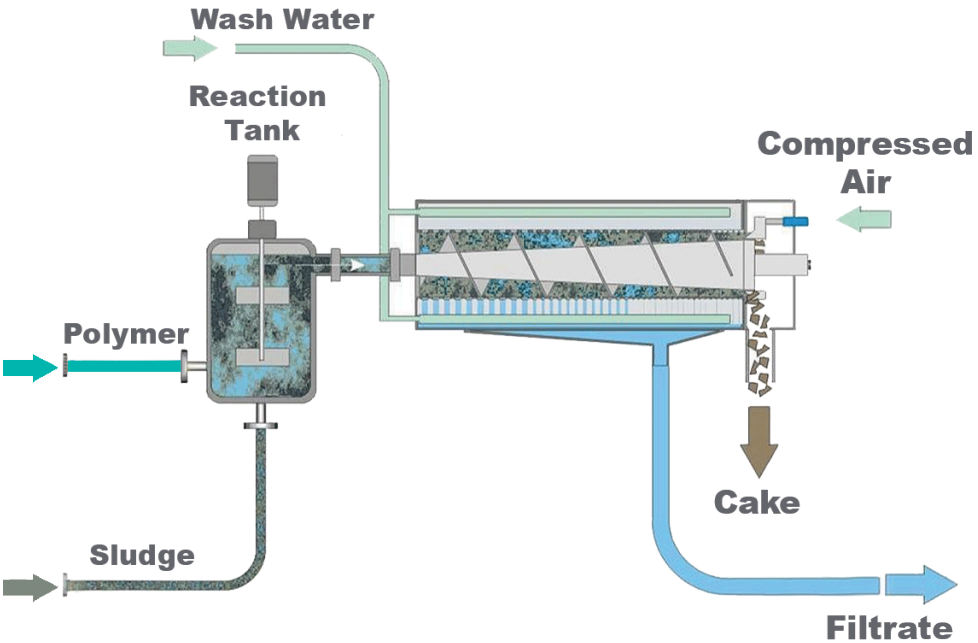
Your Partner in Solids Processing

Schwing Bioset's solids handling expertise with piston pumps, screw conveyors, sliding frames, live bottoms, Class 'A' systems, and hauling and marketing services make us your ideal partner to provide one-stop biosolids processing and management solutions.






The Features You Want



Features

- Low speeds and automated control.
- Long lifespan due to slow speeds and robust construction.
- All wetted parts are Stainless Steel.
- Split screen casing to simplify screw removal and minimize footprint requirements.
- Sealing lip and screen can be replaced with screw in place.
- Dewatering operations do not need to be suspended during cleaning. Cleaning cycle is typically once per day for 3 – 5 minutes.
- Unattended operation requires no additional personnel or specialized training.

Engineering That Matters

Features

- Dewatering results similar to high speed centrifuges.
- Fifteen models available for all your dewatering needs.
- No vibration loads.
- Enclosed system provides odor containment.
- Low power requirements.
- Low wash-water requirements.
- Machined screens provide tighter tolerance allowing superior performance over other commercially available units.



Performance You Can Count On

Screw Press								Reaction Tank			Washwater	
Model	Capacity Aerobic 2.5% DS (dry lb/hr)	Capacity Anaerobic 3.5% DS (dry lb/hr)	Length (in)	Width (in)	Height (in)	Weight (lb)	Power (hp)	Model	Volume (gal)	Power (hp)	Washwater (gal/cycle)	Washwater Pump (gpm @ 60-90 psi)
FSP 302	130	185	107	32	42	1,720	0.75	RT 30	53	0.50	10	5
FSP 403	280	355	151	34	48	3,200	1.5	RT 40	106	0.50	30	15
FSP 502	415	450	164	39	56	4,850	1.5	RT 50	153	0.75	30	15
FSP 503	435	525	196	39	56	5,200	3.0				40	20
FSP 602	610	860	189	43	60	6,330	3.0	RT 70	225	1.5	40	20
FSP 603	700	990	218	43	60	6,830	3.0				60	20
FSP 703	970	1300	255	57	72	11,640	5.0				70	30
FSP 803	1310	1790	279	60	78	14,990	7.5	RT 80	344	2.0	85	40
FSP 903	1630	2220	319	64	82	18,740	7.5	RT 100	503	2.0	105	45
FSP 1002	1890	2570	267	68	86	18,960	7.5				105	45
FSP 1003	1970	2670	327	68	86	22,270	10				130	55
FSP 1102	2430	3240	303	74	90	22,930	10	RT 110	661	3.0	130	55
FSP 1103	2870	3820	362	74	90	27,560	10				155	65
FSP 1202	2760	3720	327	81	106	28,660	13	RT 120	925	5.0	155	65
FSP 1203	3090	4170	398	81	106	34,830	13				170	75

A Name You Can Trust

Piston Pumps



Schwing Bioset, Inc. is the regonized leader in sludge pump technology. SBI units pump dewatered biosolids from Presses and Centrifuges with dry solids content up to 55%. These versatile pumps were born in the concrete industry, but have been used successfully in wastewater plants since the mid 1980's.

Sliding Frame



Sliding frame systems, whether used as truck receiving, truck loading, or as intermediate storage, offer a flexible means of storing dewatered solids while eliminating bridging. The flexible design allows for various process requirements.

Fluid Bed Dryer



Schwing Bioset's fluid bed dryer offers a thermally efficient means of producing dust-free Class A biosolids. The automated system allows for unattended operation, and produces a very simple product to store, transport, and apply.

Container Wagon



Due to plant layout restrictions, many facilities face the challenge of transporting solids from one loading / unloading point into and out of the process stream. The SBI Container Wagon system provides a variety of solutions.

Operating & Marketing Services



Schwing Bioset's partnership with Biosolids Distribution Services Inc. creates the unique ability to offer complete handling solutions with engineering, equipment, and distribution of Class A biosolids, responsibly offered by a single provider.

Bioset Process



Schwing Bioset offers the Bioset lime stabilization process, which is approved to EPA's 503 regulations. The Bioset process provides municipalities a low cost Class A system that is affordable to operate and easy to maintain.

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