FEI ENGINEERS

PRELIMINARY ENGINEERING REPORT

FOR

WASTEWATER TREATMENT PLANT IMPROVEMENTS

Village of Taos Ski Valley

THE VILLAGE OF Taos Ski Valley

Prepared by

FEI Engineers, Inc.

April 26, 2016

PATRICK J. O'BRIEN NEW MEXICO 17575 LICENSED PROFESSIONAL ENGINEER 4/26/16

1485 Florida Road, Suite C206
Durango, CO 81301

Ph 970-247-0724

www.feiengineers.com

Focused. Engaged. Innovative.

This page intentionally blank.

TABLE OF CONTENTS

Tables

Figures

Appendices

1. EXECUTIVE SUMMARY

1.1. INTRODUCTION

The Village of Taos Ski Valley (Village) is proposing to upgrade and increase their existing wastewater treatment facility (WWTF) to a hydraulic capacity of 0.31 million gallons per day (MGD). The Village owns and has operated the existing wastewater treatment facility since acquiring the facility in 2001 after dissolving the Twining Water and Sanitation District. The existing WWTF is permitted to discharge 0.167 MGD of treated effluent to the Rio Hondo, under National Pollution Discharge Elimination System (NPDES) Permit Number NM0022101, located in the Rio Grande Basin (Waterbody Segment Code No 20.6.4.129). The segment is classified as Category 2 and the designated uses of this receiving water are domestic water supply, high quality cold water aquatic life, irrigation and wildlife habitat. The Rio Hondo Basin is a sub-basin of the Upper Rio Grande.

A significant WWTF upgrade was completed in 2005 resulting in a permitted capacity of 0.2 MGD; however, the plant capacity was de-rated to 0.167 MGD in the 2011 permit renewal. This upgrade modified the existing conventional activated sludge process to add secondary treatment capacity and biologic nutrient removal (BNR) capacity. The facility utilizes an integrated fixed film (IFAS) activated sludge process along with a Modified Ludzack-Ettinger (MLE) internal recycle for biological treatment and removal of organics and nitrogen from the wastewater. However, the ability to meet the currently-permitted strict nitrogen effluent discharge standards and the projected future more-stringent nitrogen and phosphorus limits is challenged due to cold influent wastewater temperatures, highly variable flows and loadings, and treatment equipment/unit process capacity limitations.

Plant operations data indicate that the facility's capability becomes challenged at peak flows of approximately 0.120 MGD. Based on information regarding these capacity limitations, the permitted capacity was reduced to 0.167 MGD in the 2011 permit renewal. The existing secondary clarifier process is performance-limited at high flow rates with periodic solids carry-over caused by the high clarifier solids loading at high flow rates and biomass concentrations.

The Village is expecting that the planned re-development and new development in its wastewater service area will further challenge the performance of the current WWTF. Village staff estimate that planned development in the service area will add approximately 0.072 MGD of peak day wastewater flow by the year 2020. With the expected future growth and current construction, it is estimated that the design flow of 0.31 MGD will be reached by approximately 2040.

This Preliminary Engineering Report (PER) present's information describing the proposed WWTF improvements necessary to increase treatment capacity to meet current peak flow periods and to meet the expected increased wastewater flows as development and population in the Village increase. Additionally, this PER modifies and supersedes the Village of Taos Ski Valley PER prepared by McLaughlin Water Engineers in 2011. The prior PER recommended the Village replace the existing IFAS facility with a new sequencing batch reactor (SBR) facility with a design capacity of 0.4 MGD.

1.2. PROJECT PURPOSE AND NEED

The two primary purposes of the project are to:

1. Replace and upgrade the existing WWTF equipment and processes to allow for continued compliance with the facility discharge permit during the Village service area peak period flow and loading time periods; and
2. Provide a 0.16 MGD increase in the Village WWTF capacity sufficient to accommodate the current Village service area peak flows and the additional growth projected for the next 20-year period.

The WWTF service area encompassing the Village is growing with the addition of new hotel/condominium lodging, single family housing and restaurant/retail base area infrastructure. The 2005 modifications to the existing WWTF were not designed to address the recent surge in service area growth and the required capacity increases. Additionally, due to the Total Maximum Daily Load (TMDL) component of the discharge permit structure; ammonia, total nitrogen, and phosphorus limits are expected to be more stringent in the new pending permit for the increased capacity plant (in addition to BOD and TSS limits).

Preliminary process design calculations indicate that at an estimated influent ammonia concentration of 45 mg/l and Total Kjeldahl Nitrogen (TKN) of 66 mg/l, the current IFAS with MLE treatment train is process-limited and likely not capable of reliably reducing Total Nitrogen (TN) to meet the estimated discharge limit of 5.2 mg/l (at design flows of 0.31 MGD) due to the MLE nitrogen mass balance constraints. To meet the TN limit, the selected treatment train will either require the addition of a second post-anoxic zone (consistent with the Bardenpho or Modified Bardenpho Process) or a tertiary treatment nitrogen removal process (such as an upflow denitrification bed process.)

Based on updated service area growth projections, the proposed WWTF Improvements project will increase the permitted WWTF hydraulic capacity from 0.167 MGD (current capacity) to a design capacity of 0.31 MGD with the ability to treat peak period flows of 0.44 MGD for four consecutive weeks; and will increase the permitted organic capacity to 911 lbs/day of BOD_5 (corresponding to 350 mg/l influent BOD loading at 0.31 MGD). The required plant capacity corresponding to the projected service area growth results in a 1.85x multiplier to the existing permitted capacity to meet the estimated future capacity.

The proposed increase in capacity associated with the upgrade is necessary to ensure that the facility can accommodate the existing and future flows and continue to remove greater than 90 percent of the impurities from the wastewater. Currently, the WWTP is stressed beyond ideal capacity during peak flows, which has resulted in some permit violations over the past several years because of the plants limited hydraulic capacity to treat peak flows to permitted standards.

1.3. SELECTED ALTERNATIVE

1.3.1. Project Overview

Based on the alternatives analysis that considered both cost and non-cost evaluation criteria, and environmental impacts and benefits, the selected alternative for the Village of Taos WWTF improvements is to replace the existing IFAS/MLE biologic treatment system and clarifiers with a membrane bioreactor (MBR) system. The upgraded facility will be designed to treat a maximum month average daily flow of 0.31 MGD, along with an organic loading of 911 lbs/day of BOD_5.

Construction of the proposed MBR treatment process includes retrofitting and re-purposing the existing concrete treatment tanks, in addition to, constructing additional new treatment tanks and replacing the existing building or constructing a new building to encompass the new tanks.

The primary factors considered in the selection of the MBR treatment system over the alternate secondary treatment process options are:

1. High Effluent Quality – Consideration of this factor alone sets the MBR alternative apart. With the cold water, wide range of flows/loading, and very stringent TN and TP effluent limits, the ability of the MBR process to consistently and reliably produce effluent meeting the standards (without the need for either a separate clarifier or tertiary filtration step) is not matched by the other options.
2. Reduced Footprint – The MBR process operates at MLSS concentrations in the range of at least a 2-3x of the other activated sludge processes (reducing the required tank volumes) and does not require either a secondary clarifier or a tertiary filter. The resulting compact footprint results in lower capital costs.
3. Process Stability and Flexibility – The technology is well-proven and is not susceptible to problems associated with biological processes; such as, plant upsets and sludge age, to produce a settleable sludge due to the membrane separation of solids. This factor gives the MBR process a significant advantage in terms of ease of operation.
4. Cost Effective – The capital costs, inclusive of secondary treatment, solids separation equipment and concrete tankage; and the operating costs are lower than the other treatment alternatives. MBR aeration efficiency and costs have been significantly improved upon over the past 10 -15 years.

The conceptual-level layout places the additional below-grade concrete tanks adjacent to the existing treatment building tanks and houses the blower, mechanical rooms, chemical storage on a partial upper level and access to the new, covered tanks on the lower level. The existing clarifiers will be retrofitted for placement of the two, parallel MBR tanks.

The upgrades project will also include headworks improvements which includes a new 3mm fine screen, working in conjunction with the existing screen and following the existing grit chamber, and ultraviolet (UV) effluent disinfection system improvements. Biosolids handling system improvements will include the addition of increased aerated sludge holding capacity, adding either a second centrifuge or a screw press and covering the outdoor sludge cake storage area.

1.3.2. Overall Cost

The estimated project preliminary estimate of probable capital cost is $6.5 million including contingency and engineering services ($6.6 million including New Mexico Gross Receipts Tax). The Village has developed a preliminary project financing plan through a combination of grants and loans; which are supported through appropriate user rate and sewer tap fee adjustments. It is anticipated the financing Plan selected for implementation will include a substantial fraction of the total in a State Revolving Funds (CWSRF) Loan at 0% to 3%

interest, plus an administrative fee of 2%.

1.3.3. Overall Project Schedule

The Final Design engineering for the Project would begin in the early fall of 2016 with construction projected to start in 2017 and completed in 2018.

1.3.4. Community Engagement

The Village has presented information concerning the ongoing WWTF planning at several Village Council meetings and will continue to provide updated information at these Monthly meetings as milestone schedule targets are developed. The Village Council meets on the second Tuesday of every month and the meetings are open to the public.

Consistent with the requirements for conducting an environmental review of the proposed wastewater facility construction project under the National Environmental Policy Act (NEPA), public comment periods and/or appropriately-noticed public meetings and hearings will be held depending on the type of action specified in the Environmental Information Document (EID). A Public Hearing to review the draft PER/EID will be held after NMED review of the draft documents.

1.3.5. Environmental Benefits

The completed project improvements at the WWTF will provide high quality treated effluent that meet or exceed NMED requirements and will utilize high efficiency treatment equipment to reduce energy costs. The new facility will accommodate projected growth for twenty years, be designed to facilitate future improvements to increase hydraulic and organic treatment capacity, and meet future regulations if needed.

2. PROJECT PLANNING AREA

2.1. PLANNING AREA

The Village WWTF service area comprises the Base Village, Intermediate Zone, and Kachina Village. Amizette is another area within the incorporated area of the Village, and it is anticipated that Amizette will be added to the WWTF service area following installation of a sewer collection system at some poi. At present Amizette wastewater flows are disposed of using holding vaults and individual septic systems.

Figure 1 shown on the following page is the existing service areas and Amizette.

2.2. ENVIRONMENTAL RESOURCES

Based on a preliminary assessment of the proposed action, it is intended to categorically exclude the proposed action from documentation in an environmental assessment or an environmental impact statement under 36 CFR 220.6(e)(3) – "Approval, modification, or continuation of minor special uses of NFS lands that require less than five contiguous acres of land."

Attached as Appendix G is the Categorical Exclusion (CE) Request to the NMED Construction Programs Bureau as prepared by SE Group, a land planning and environmental consulting firm. This form addresses the criteria for CE and provides information on the basis for determination and documentation.

2.3. GROWTH AREAS AND POPULATION TRENDS

2.3.1. Growth within Village Primary Growth Areas

The Village primary growth factors are tied to the annual ski season and skier visits, and second home/condominium growth. The population in the WWTF service area was classified into permanent (year around) and transient (seasonal skiers). The permanent population is expected to remain approximately flat, while the seasonal skier population is expected to increase over the coming years. The Village is aggressively renovating existing buildings and constructing new buildings to accommodate this growth segment of the population. Numerous discussions with the Village Community Development Director led to development of the equivalent residential unit (EQR) factor, based on the expected future transient population. Emails with the Community Development Director are attached in Appendix A.

FEI ENGINEERS

VILLAGE OF TAOS SKI AREA
WASTEWATER TREATMENT FACILITY PRELIMINARY ENGINEERING REPORT
CURRENT AND FUTURE SERVICE AREA

FIGURE No. 1

W:\VTSV-S14-0132 – WWTP\PER FIGURES\FIGURE 1 LAST SAVED:1/14/2016 4:41 PM LAST PLOTTED: 1/20/2016 4:40 PM BY: KEITH

2.3.2. Equivalent Residential Unit (EQR)

McLaughlin Water Engineers Ltd. in 2011 developed a Preliminary Engineering Report (PER) for a Wastewater Treatment Facility (WWTF) expansion/upgrade. In the 2011 PER, the EQR was determined for the WWTF service areas including Amizette. Numerous discussions with the Village Community Development Director led FEI and the Village to the development of a new updated EQR based on the 2011 PER and the updated future seasonal population. The EQR schedule from the 2011 PER was used to develop the updated EQR. Emails with the Community Development Director are attached in Appendix A.

Table 1 below presents the EQR from the 2011 PER and the updated EQR.

Table 1. 2011 EQR and Future Estimated EQR

	2011 PER	2015 Estimate	Notes
Base Village	930	1080	Parcel D (50.65)+Parcel G (107.65)-Demolition of skier building(8.15)+930
Intermediate Zone	200	200	
Kachina Village	350	410	Increased based on conversations with Community Development Director and Public Works Director
Amizette	300	300	
Total	**1780**	**1990**	

The 2011 PER presented typical design values of 220 gallons/day/EQR for flow rates and 0.6 lbs BOD_5/day/EQR for organic loading. These previously established values are used for developing the future flow and loading to the WWTF.

2.4. WASTEWATER FLOW FORECASTS

2.4.1. Maximum Monthly, Annual Average Daily and Peak Period Flows

In a typical WWTF design, maximum monthly daily flow, annual average daily flow and peak day flow are established. Since the majority of the Village population is tied to skier visits and second homes and condominiums (transient population), the peak day flow terminology for characterizing wastewater flows is replaced with Peak Period Flow (PPF) for the Village WWTF. The peak period flow occurs with the transient population visiting the Village for skiing. Historically, these periods are typically Christmas season (late December-early January) and spring break (March).

Historical daily flow data and maximum month daily flow (MMDF) data from 2010-2014 was analyzed and used to calculate the annual average daily flows (AADF) and peak period flows (PPF). In the historical data set, flow that occurs for consecutive days and above 0.09 MGD was averaged to determine historical peak period flow. The Peak Period Flow occurs for up to two weeks. It is anticipated following the completion of developments at the Village, the PPF may last for four weeks continuously.

These historical flows were used to determine relative ratios between the flow terminologies (MMDF, AADF and PPF). Table 2 presents the ratio (peaking factor) between these flow rates.

Table 2. Peaking Factors for Flow Rates

	Startup Flow	AADF	Design Flow-MMDF	Peak Period Flow (PPF)[2]
Flow Ratio (Peaking Factor)[1]	0.3	0.64	1	1.4

1. Peaking factor established based on 5 years of historical data
2. Average of sustained high flow days

The peaking factor/flow ratios in Table 2 are within the theoretical design range used for flowrates for a wastewater treatment facility design. Based on typical design flow rate used by the Village for the EQR and the total EQR from Table 1, peak period flow was developed using the following formula:

EQR * 220 gallons/day/EQR = 1990*220 = 437,800 gallons/day (0.44 MGD)

The PPF 0.44 MGD flow corresponds to the future full-buildout scenario during the projected two to four week Christmas/New Year Holiday or Spring Break period when the service areas for the WWTF are at full capacity. Using the peaking factors in Table 2, flow rates in Table 3 were developed.

Table 3. Flows Based on Peaking Factor

	Startup Flow	AADF	Design Flow-MMDF	Peak Period Flow[2]
Flow Ratio (Peaking Factor)[1]	0.3	0.64	1	1.4
Flow, MGD	0.09	0.20	0.31	0.44

1. Peaking factor established based on 5 years of historical data.
2. Average of sustained high flow days.
3. Theoretical flow based on peak factor.

2.4.2. Peak Hour Flows

Influent flows to plant have historically been recorded as daily average flows rather than hourly flows. Using the newly installed Supervisory Control and Data Acquisition (SCADA) system, hourly influent flow recording data collection was initiated in November 2015 which enabled collection of PPF hourly data occurring during the Christmas season. Analysis of the data from November 2015 to January 15th, 2016 indicated peak hourly flow ranged from approximately 0.15MGD to 0.235 MGD for the PPF days. The peaking factor for the peak hourly flow in relation to the design flow (0.31 MMDF) is 3.2.

2.5. WASTE LOAD FORECASTS

2.5.1. Biochemical Oxygen Demand (BOD_5)

Historical influent BOD_5 data is limited and indicates a maximum concentration of 481.5 mg/L and a 90th percentile concentration of 307 mg/L. The 90th percentile of historical data will be used as the design influent BOD_5 concentration. The BOD_5 concentration was also calculated using the EQR method described above with a resulting value 459 mg/L or 1194 lbs/day at

0.31 MGD, which is on the high end of the typical range and the historical 90th percentile is approximately 300 mg/L. Adhering to a typical design approach and applying an approximate 15 percent factor to be conservative, an influent BOD_5 concentration of 350 mg/L is proposed for use in the WWTF design. The corresponding organic loading to the design flow of 0.31 MGD is calculated to be 911 lbs/day.

2.5.2. Ammonia Nitrogen (NH_3)

Since the plant does not routinely collect influent ammonia sample data, the limited 5 year historical influent ammonia data set indicates a maximum concentration of 60 mg/L and a 90th percentile concentration of 40 mg/L. To be conservative, a design influent ammonia concentration of 45 mg/L will be used for the design.

2.5.3. Total Phosphorus

The 5 year historical influent data indicate a maximum concentration of 28 mg/L and a 90th percentile concentration of 12 mg/L. A total Phosphorus design influent concentration of 12 mg/L will be used.

2.6. TEMPERATURE AND ALKALINITY

2.6.1. Temperature

The microorganisms involved in the treatment of wastewater have reduced growth rates and activity at low temperatures. The available historical influent data set is limited to a 5 year period and indicates a maximum temperature of 18.5° C, a 10th percentile temperature of 8.6° C and a minimum temperature of 6.7° C. The 10th percentile temperature will be considered for design instead of the minimum temperature to avoid being overly conservative. The process design temperature proposed for the WWTP design modifications will be 8° C.

2.6.2. Alkalinity

Historical 5 year data set has an average alkalinity of 150 mg/L as $CaCO_3$. This average concentration will be used for the design.

2.7. DESIGN POLLUTANT CONCENTRATIONS AND LOADINGS

The design flow, pollutant concentration and design loadings are presented in the Table 4.

Table 4. Design Pollutant Concentration and Loading

Parameter	Design Flow - 0.31 MGD	
	mg/L	lbs/day
BOD_5	350	911
Total Phosphorus (TP)	12	31
Ammonia	45	117
Total Kjeldahl Nitrogen (TKN)	66	172
Design Temperature, ° C	8	
Alkalinity, mg/L	150	

This page intentionally blank.

3. EXISTING FACILITIES

3.1. SERVICE AREA MAP AND SCHEMATIC LAYOUT

3.1.1. History

The existing WWTP is located at the lower end of the parking lot of the ski area on land that has been leased from the U.S. Forest Service. Under terms included in the Town Site Act passed by Congress in the Spring of 2015, the parcel is being transferred from the U.S. Forest Service to the Village. In 2001, the Village overtook ownership and management of the WWTF from the previous entity, Twining Water and Sanitation District. Currently, the plant serves most of the incorporated Village area with the exception of the Amizette area. The Amizette area is at a lower elevation than the rest of the Village and is currently served by holding tanks or septic systems. If this area is served by the WWTF in the future, a lift station would be required. The WWTF effluent discharges into the Rio Hondo River, which runs west down the valley to the Rio Grande River.

An outline of the WWTF history is as follows:

- 1982 - Existing facility was expanded and upgraded. Plant capacity 95,000 gal/day.
- 1996 – Louis Bacon purchases the base-area property of the ski valley and begins to develop a master plan for the ski area and Village.
- 2000 – NPDES Permit No. NM0022101.
- 2001 - The owning and managing entity, Twining Water and Sanitation District, was dissolved and the Village of Taos Ski Valley became the owning and managing entity.
- 2004/2005 – The existing facility was again upgraded. Plant capacity 200,000 gal/day.
- 2006 – NPDES Permit No. NM0022101 supersedes and replaces previous permit. Effective April 1, 2006 to March 31, 2011.
- 2011 – Plant capacity downgraded to 167,000 gal/day.
- 2011 – Preliminary Engineering Report for Expansion/Upgrade of the WWTF prepared by McLaughlin Water Engineers, Ltd. The original PER was dated August 2011. A Supplement to the PER and letter dated August 29, 2011 were also submitted to the NMED. The NMED in a letter dated September 16, 2011 and signed by Andrea Telmo of the Construction Programs Bureau recommended approval of the PER to the NMFA.
- 2011 – A new NPDES permit is issued effective October 1, 2011 and expires on September 30, 2016.
- 2012 – The United States Forest Service (USFS) approves the Taos Ski Valley expansion plan.
- 2013- The long time Taos Ski Valley ownership family, the Blake family, sells the Ski Valley to Louis Bacon, whom already owns the base-area.
- 201x – The Village recognizes the need to re-evaluate the WWTF capacity and the ability to serve long term expansion and growth plans.
- 2015 – The Village received $500,000 in loan and grant funding from the NMED Construction Programs Bureau for WWTF planning and preliminary engineering.
- 2016 – Interim wastewater improvements are constructed to temporarily add operational flexibility.

3.2. CONDITION OF FACILITIES

3.2.1. Wastewater Treatment Plant – Overview

The existing facility has a design capacity of 0.167 MGD and utilizes an integrated fixed film (IFAS) activated sludge process along with an MLE internal recycle for biological treatment and removal of organics and nitrogen from the wastewater. A WWTF audit was completed in the form of a Comprehensive Performance Evaluation (CPE) that consisted of a two-day onsite evaluation of the performance and capacity of the unit processes and equipment. The CPE was completed by FEI Engineers on behalf of the Village in September 2014 and is included as Appendix H. Refer to Appendix B for the existing treatment plant site plan and flow schematic.

3.2.2. Unit Process Descriptions

The following information summarizes individual treatment system processes.

3.2.2.1. Headworks

The Headworks process area includes the following processes and equipment:

- Influent Channels,
- Screenings Removal System,
- Grit Removal System,
- Flow Metering, and
- Air Handling System.

The Headworks building consists of two levels; the upper level at grade and the lower level below grade. Influent wastewater enters the building via buried collection piping. At the main level of the building, influent is screened through a mechanical screen and grit is removed by a vortex grit chamber. Influent wastewater then flows to a Parshall Flume with flume effluent passing to a 12" ductile iron pipe that conveys screened influent to the secondary treatment process. A summary follows:

A. Cylindrical Bar Screen
   - Type: ....Mechanical ¼" screen
   - Number: 1
   - Capacity: ....1.0 MGD (Note: actual capacity reduced to 0.5 MGD due to 3" Parshall Flume size)
   - Bypass: ....Manual ¼" bar screen

B. Vortex Grit Removal
   - Type: ....Vortex with grit classifier
   - Number: 1
   - Capacity: ....1.0 MGD

C. Headworks - Influent Flow Measurement
   - Flume Type: ....3" Parshall
   - Sensor Type: ....Ultrasonic
   - Capacity: ....0.75 MGD

3.2.2.2. Equalization Basin

A. Circular steel tank
- Size:........................60 feet Diameter, 12 feet deep
- Working volume: ....220,000 gallons
- Used intermittently during high flows

B. Rectangular Concrete tank
- Size:........................65’ x 17’ x 16.5’ deep
- Working volume: ....83,000 gallons

3.2.2.3. Biological/Aeration Basins (IFAS / MLE)

Screened, equalized flow is combined with RAS in the Anoxic Basin 1 which then flows to the Aerobic Basins 2, 3 and 4A. The Village IFAS activated sludge process is operated as an MLE process which incorporates a recycle stream of mixed liquor from the oxic zone to the anoxic zone with the recycle flow rate varied to attain the desired denitrification. Mixed liquor suspended solids (MLSS) leaving the aerobic basins flows to Anoxic Basin 4B and then to the clarifiers. Selector pumps in Anoxic Basin 4B pump the recycle flow to Basin 1.

A. Basins – 5 total; 2 anoxic and 3 aeration

B. Basin Dimensions (15 ft)
1. Anoxic Basin 1 (Basin #1) – 15 ft x 15 ft; 25,245 gallons
   a. Preliminary effluent (screened and degritted wastewater)
   b. Return activated sludge
   c. Recycled mixed liquor
   d. Chemicals for alkalinity addition and phosphorus removal
2. Aerobic Basin 1 (Basin #2) – 15 ft x 15 ft; 25,245 gallons
   a. 65 % fill ratio IFAS media
   b. Coarse bubble diffusers
3. Aerobic Basin 2 (Basin #3) – 15 ft x 15 ft; 25,245 gallons
   a. No IFAS media
   b. Coarse bubble diffusers
4. Aerobic Basin 3 (Basin #4) – 15ft x 10ft; 16,830 gallons
   a. DO depletion zone
5. Anoxic Basin 2 (Basin #5) – 15ft x 4ft; 6,732 gallons
   a. Final denitrification zone and mixed liquor return pump suction

3.2.2.4. Clarifiers

The secondary clarifiers are each 15-foot diameter steel tanks with an 11-foot side water depth and inboard effluent troughs and v-notch weirs. The clarifiers are each fitted with a circular sludge collection mechanism. Due to the current poor sludge settling characteristics, the clarifiers are limited in the solids flux that they can handle and operations staff indicate that clarifier bulking occurs at peak period flows of approximately 0.120 MGD.

A. Number of clarifiers:...........2

B. I.D: .... 15’-0”

C. Side Water Depth:....... 12’-0”

3.2.2.5. Tertiary Filtration

Two (2), 4-foot diameter multimedia pressure vessels, piped in parallel, are used to filter the clarified effluent. Clarified effluent is typically in the range of 3 mg/l TSS. Two (2), 12 HP submersible pumps take suction from the filter wet well and convey through the pressure filters and the UV disinfection reactors.

A. Number of Filters:.........2 pressure filters
   1. Dimension:.........................6’-10” ID
   2. Design flux rate:.............. 4 gpm/sq.ft
   3. Capacity: ....400,000 gpd, ea.

B. Number of feed pumps: ....2 pumps
   1. Capacity: ....600 gpm, ea.
   2. Design head:............................29 feet

3.2.2.6. UV Disinfection

Secondary clarifier effluent is disinfected using a low pressure - high intensity ultraviolet (UV) system with two pressurized reactors operated in series.

A. Number of Reactors:.............. 2 pressure vessel reactors; retrofitted with new bulbs, ballasts, wiring, and power supply in 2015.

B. Capacity: .... 300 gpm

3.2.2.7. Waste Sludge

A. WAS Pump
   1. Model:........................1- seepex progressive cavity pump
   2. Installed:.....................Fall 2015
   3. Capacity: ....20 gpm

B. Sludge Holding tank
   1. Dimension:.................2, 20 feet diameter tank
   2. Capacity: ....52,000 gallons each

C. Dewatering equipment
   1. Centrifuge

3.2.2.8. Current Overall Energy Consumption Estimate for the Existing Facility

Estimated energy consumption of the existing WWTF is presented in a table in Appendix I. Equipment motor size (or equipment equivalent kW), operating load, annual run time, and estimated annual power cost is presented in tablular format. The estimated annual energy consumption cost is approximately $68,000 annually.

3.2.3. Existing WWTF Useful Life

A significant WWTF upgrade was completed in 2005 resulting in a previously permitted capacity of 0.2 MGD, modifying the existing conventional activated sludge process to add secondary treatment capacity and biologic nutrient removal (BNR) capacity. Plant operations data indicate the facility's capability becomes challenged at peak flows of approximately 0.120 MGD, and due to observed capacity limitations, the permitted capacity was reduced to 0.167 MGD in the current permit. The existing concrete tanks are in good condition and are believed to have an additional 20 years of useful life (this will be verified during design phase). The existing metal building components, with the exception of the steel columns and beams, are near the end of useful life. The majority of the remaining major equipment is generally in good condition with an estimated 10 years of useful life remaining.

3.2.4. Wastewater Flows

3.2.4.1. Operational Parameters

Operational parameters are discussed below in Section 5.0. Table 5 provides a summary of effluent permit limits for the existing WWTF taken from the existing 2011 NPDES Discharge Permit.

Table 5. 2011 NPDES Discharge Permit

	30-day Avg. lbs/day	Daily Max. lbs/day	7-day Avg. lbs/day	30-day Avg. mg/L	Daily Max. mg/L	7-day Avg. mg/L
Biological Oxygen Demand (BOD), 5-day						
Nov. 1-April 30	23.8	N/A	35.7	30	N/A	45
May 1 - Oct 31	23.8	N/A	35.7	30	N/A	45
Total Suspended Solids (TSS)						
Nov. 1-April 30	23.8	N/A	35.7	30	N/A	45
May 1 - Oct 31	23.8	N/A	35.7	30	N/A	45
E. Coli Bacteria	N/A	N/A	N/A	126	235	N/A
Fecal Coliform Bacteria	N/A	N/A	N/A	200	400	N/A
Total Residual Chlorine	N/A	N/A	N/A	N/A	19 ug/L	N/A
Ammonia-Nitrogen						
Nov. 1-April 30	5.34	N/A	5.34	3.2	N/A	3.2
May 1 - Oct 31	5.34	N/A	5.34	3.2	N/A	3.2
Total Nitrogen						
Nov. 1-April 30	13.65	N/A	20.5	8.2	N/A	12.3
May 1 - June 30	46.55	N/A	68.8	27.9	N/A	41.2
July 1 - August 31	27.7	N/A	41.6	16.6	N/A	24.9
Sept 1 - Oct 31	21.1	N/A	31.7	12.7	N/A	19
Total Phosphorous						
Nov. 1-April 30	0.8	N/A	1.2	0.5	N/A	0.75

	30-day Avg. lbs/day	Daily Max. lbs/day	7-day Avg. lbs/day	30-day Avg. mg/L	Daily Max. mg/L	7-day Avg. mg/L
May 1 - June 30	1.6	N/A	2.4	1	N/A	1.5
July 1 - August 31	1.2	N/A	1.8	1.5	N/A	2.25
Sept 1 - Oct 31	0.8	N/A	1.2	2.5	N/A	3.75
pH	6.6			8.8		

3.2.4.2. Plant Performance

A review of operations data and available permitting correspondence with NMED and EPA indicate the compliance history has been very good since the 2005 WWTF improvements project. The very limited violations have been primarily limited to ammonia exceedances during peak loading periods.

3.2.4.3. Influent Characteristics, Discharge Permits and Overload Conditions

Plant operations data indicate the clarifiers become overloaded at approximately 0.120 MGD with the potential for solids carry-over when flows approach this level. Typically, both the peak hydraulic loading, which approaches 0.110 to 0.120 MGD, and the peak organic loading occur simultaneously during the ski season peak organic loading periods. The peak period loading conditions for this facility occur as a result of peak skier/visitor timeframes; such as, the Holidays and Spring Break.

The Village is expecting planned re-development and new development in its wastewater service area will further challenge the performance of the current WWTF. Village staff estimate planned development in the service area would add approximately 0.072 MGD of peak day wastewater flow by the year 2020. Additionally, with the ambitious future growth and present construction, it is estimated the design flow of 0.31 MGD will be reached by approximately 2040.

3.2.4.4. Peak Flows and Inflow and Infiltration

Since the majority of the Village population is tied to skier visits/second homes and condominiums the peak period flow occurs with the influx of skiers/visitors during the Christmas season (late December-early January) and spring break (March) periods. Historical data from 2010-2014 flow occurring for consecutive days and above 0.09 MGD was averaged to determine historical peak period flow, which occurs for a period of approximately two to four weeks at a time. The current peak flows approach 0.110 to approximately 0.120 MGD, which stresses the operation of the secondary clarifiers, as evidenced by the potential for solids carryover and decreased performance.

Inflow and infiltration (I&I) flows are typically at a maximum in late spring. During this time period, the plant flow rates including I&I flows are estimated to be approximately 0.080 MGD. At present, flow meter data for the main collection lines (basins) has not been developed; however, the Village has instituted a collection system maintenance and repair program which will likely result in a reduction in I&I flows over the next several years and will evaluate the need to develop a collection system flow study dependent on the results of the maintenance and repair program.

3.3. FINANCIAL STATUS AND USERS

3.3.1. Overview

The Village of Taos Ski Valley receives revenue to support the water and sewer systems by billing each customer. The Village also charges new development system impact fees but typically the revenue from impact fees is earmarked for specific system improvements. Financial data is attached as Appendix F and includes:

- 2015 Budget for All Department;
- 2015 Budget for Water & Sewer;
- 2015 Sewer Depreciation;
- 2016 Budget Summary and Explanation; and
- Current Water & Sewer Rate Structure.

3.3.2. Operations and Maintenance Costs

The water and sewer operating budget is provided in Appendix F. Since many expenses such as operator salaries serve both the water and sewer systems and because revenue is combined for both systems, the annual budget is therefore also combined.

3.3.3. Existing Debt

The Village received a Clean Water State Revolving Fund loan and grant for $500,000 for the engineering, studies, design, surveying and other required items for design of the proposed WWTP improvements. The funding included $350,000 loan and up to $150,000 in grant funds. The loan will be repaid over a 5 year period at a 3% interest rate. In order to fund construction of the WWTP improvements, the Village will apply for additional funding through the Public Project Revolving Fund (PPRF) and/or Clean Water State Revolving Fund (CWSRF).

Attached in Appendix F are two debt structures, prepared by George K. Baum & Company, for the WWTP using a 25 and 30 final year maturity and current market interest rates with the addition of a 50 basis points buffer. The two debt structures assume a bond component of approximately $6.8 million. With a 25 year maturity, the interest paid on the bond is estimated to be $3.6 million with an average annual debt service of $417,818. With a 30 year maturity, the interest paid on the bond is estimated to be $4.7 million with an average annual debt service of $383,578.

In addition, the Village has applied for a Water Trust Board (WTB) grant in the amount of $1.8 million for construction of the finished water storage tank, the Kachina Tank. With this grant, the Village would be required to match 20% of the total grant. The Kachina Tank will be constructed in 2016. In 2015, the Village also applied for WTB funding for the Gunsite Spring Infiltration Gallery for the amount of $640,000.

3.3.4. Current Rate Structure

The billing rate is based on Equivalent Residential Units (EQRs) and different rates apply for four categories of user: Commercial A, Commercial B, Residential A and Residential B. The latest rate schedule is attached in Appendix B.

3.4. CAPITAL IMPROVEMENT PROGRAM

The Village has developed and maintains an Infrastructure Capital Improvements Plan (ICIP) that his using data collected by the Departments, development of Water/Wastewater Department asset inventories and identification of capital plan line items for 5- year and 10 year plans.

4. NEED FOR PROJECT

4.1. HEALTH, SANITATION AND SECURITY

The following sections discuss the current and projected permit conditions and WWTF performance in terms of the health and sanitation criteria. Due to the fairly well-controlled access points to the existing facility the security criterion not a project needs driver.

The high-level need for completion of this project is to protect both the local community health and sanitation and downstream Rio Hondo River uses through completion of the proposed treatment plant improvements project. The two primary purposes for this project are as follows:

1. Replace and upgrade the existing WWTF equipment and processes to allow compliance with the facility discharge permit during the Village service area peak period flow and loading time periods experienced during both the ski seasons; Christmas/New Year Holiday and Spring Break, approximately two to four week time periods; and
2. Provide a 0.16 MGD increase in the Village WWTF capacity sufficient to accommodate the current, ongoing ski corporation base/core area available dwelling unit's construction, current Village service area population growth expansion and the projected 20 year anticipated service area population growth.

4.1.1. Current Discharge Permit Conditions and Compliance

The VTSV WWTF is authorized to discharge to the Rio Hondo, National Pollution Discharge Elimination System (NPDES) permit No. NM0022101, located in the Rio Grande Basin, Waterbody Segment Code No 20.6.4.129.

The segment is classified as Category 2 and the designated uses of this receiving water are domestic water supply, high quality cold water aquatic life, irrigation and wildlife habitat. The Rio Hondo Basin is a sub-basin of the Upper Rio Grande. The current VTSV NPDES discharge permit became effective on October 1, 2011, with an expiration date of September 30, 2016. This 2011 permit superseded the pre-existing April 1, 2006 permit and the design capacity of the WWTF was de-rated from 0.2 MGD in 2006 to 0.167 MGD in 2011.

The 2011 permit also contained both total phosphorus and total nitrogen seasonal 30-day average (lbs/day), 30-day average (mg/L), and 7-day average (mg/L) limits. The limits vary by season and are summarized in Table 5 above.

A review of operations data, and available permitting correspondence with NMED and EPA, indicate the compliance history has been very good since the 2005 WWTF Improvements Project. The very limited violations have been primarily limited to ammonia exceedances during peak loading periods.

4.1.2. Future Discharge Permit Conditions and Compliance

For planning purposes, it is assumed the future permit will have the same limits as the existing permit and is based on Total Maximum Daily Load (TMDL). The assumed projected future effluent limits are summarized below in Table 6.

Table 6. Estimated Effluent Concentrations

Existing TMDL NPDES Permit Based Estimation of Future Effluent Limits-30-Day Avg.						
Parameter	**MMDF (0.31 MGD)**		**AADF (0.20 MGD)**		**PPF (0.44 MGD)**	
	lbs/day	**mg/L**	**lbs/day**	**mg/L**	**lbs/day**	**mg/L**
BOD_5	23.8	9.1	23.8	14.3	23.8	6.5
Ammonia- Nitrogen	5.34	2.1	5.34	3.2	5.34	1.5
Total Nitrogen (Lowest from existing permit)	13.65	5.2	13.65	8.2	13.65	3.7
Total Phosphorus (Lowest from existing permit)	0.8	0.31	0.8	0.48	0.8	0.22
TSS	23.8	9.1	23.8	14.3	23.8	6.5

1. Existing TMDL based NPDES permit. Loadings expected to remain the same for future permit

As the project progresses, the effluent limits will continue to be evaluated in conjunction with the NMED requirements for the stream segment. The permit limits may be affected by TMDL wasteload allocation, water quality based limits (if applicable), and antidegradation-based limits (if applicable). In addition, future tie-in of the existing septic system in the Amizette area may also affect the permit limits and allowable discharge concentrations.

4.1.3. Security

Currently, the majority of the treatment equipment and all controls are located within an area that has access-control, locked buildings and is accessed by authorized personal only. The occurrence of petty crime and vandalism in the Village is typically minimal.

4.2. SYSTEM OPERATIONS AND MAINTENANCE

In addition to the significant operations challenges associated with extreme variations in flows, excessive flows due to I&I (limited typically to May and June which are low flow and loading months), cold temperatures and inadequately sized processes, the plant operation is also constrained by the following:

1. Peak period loading of the clarifiers that can translate into solids carryover and total phosphorus exceedances;
2. Lack of load equalization for peak period ammonia spikes;
3. Lack of facility instrumentation and automation;
4. Inadequate space for necessary laboratory facilities including inadequate office and operations meeting room space;
5. Questionable back-up power supply (used emergency generator); and
6. Aging infrastructure nearing end of useful life.

4.3. GROWTH

With new ownership at the Taos Ski Valley Resort, there is already expansion and re-development of the resort and base Village underway. The new owner has long-term plans for additional growth. Currently, the WWTP's capacity is limited by the existing secondary clarifiers to flow rates of approximately 0.12 MGD.

The plant and operators are under stress to maintain compliance during the peak holidays, spring break resort skier visits and extensive infiltration periods during late spring and early summer. The proposed improvements are sized for growth over the next 25 years with peak period flow reaching 0.44 MGD by the year 2040.

This page is intentionally blank.

5. ALTERNATIVES CONSIDERED

In order to meet short-term and long-term flow demand and to meet more stringent effluent requirements, upgrades to the existing WWTF are necessary.

The treatment technologies considered for upgrading the Village WWTF are:

1. Integrated Fixed Film Activated Sludge (IFAS) with tertiary treatment;
2. Sequencing Batch Reactor (SBR) with tertiary treatment; and
3. Membrane Bioreactor (MBR).

The following alternatives were not considered:

1. Optimizing the current facilities (without upgrade): Optimization and interim measures have taken place in 2015. Additional optimization without significant infrastructure and/or process upgrades would not be able to meet the future demand and effluent quality requirements.
2. Interconnecting with another existing system: Due to the remote location of the Village, it is not practical to connect with other systems.
3. Small cluster or individual facilities: The Village is located in a small, narrow valley surrounded by steep terrain. Currently, the sewer collection system conveys the majority of the Village wastewater to the existing wastewater treatment plant. Since the Village land position is limited to small, clustered parcels of land, it is most practical to maintain one central treatment facility in the existing treatment location.

5.1. OVERALL DESIGN CRITERIA

Tables 7 and 8 present a summary of the overall basis of design for the proposed Village WWTF improvements. Each evaluated alternative is sized and configured to meet this design criteria.

Table 7. Overall Design Criteria

Design Flows, MGD		
Maximum Month Average Daily Flow (MMDF)		0.31
Annual Average Daily Flow (AADF)		0.2
Peak Period Flow. (PPF)		0.44
Design Concentrations and Loadings		
	mg/L	**lbs./day**
BOD_5	350	911
Total Phosphorus (TP)	12	31
Ammonia	45	117
Total Kjeldahl Nitrogen (TKN)	66	172
Other Design parameters		
Temperature, Min/ Max (degree Celsius)		8/20
Alkalinity, mg/L		150
Elevation, ft		9260

Table 8. Effluent Requirements at Design Flow

Effluent Requirements at Design Flow, 30-Day Average[1]		
Parameter	**mg/L**	**lbs./day**
BOD_5	9.1	23.8
TSS	9.1	23.8
Ammonia- Nitrogen	2.1	5.34
Total Nitrogen	5.2	13.65
Total Phosphorus	0.31	0.8
E. Coli (#/100 ml)	126	
Fecal Coliform (#/100 ml)	200	
Total Residual Chlorine, µg/L, Daily Max	19	

1. Existing TMDL based NPDES permit. Loadings expected to remain the same for future permit.

It should be noted that these limits are very stringent and, when considered in combination with the large variation in plant flows and the cold influent flow temperature, these limits are extremely challenging for a treatment facility; requiring implementation of advanced treatment technology that is significantly upgraded from a conventional activated sludge treatment process.

5.2. COMMON ELEMENTS FOR TREATMENT ALTERNATIVES EVALUATION

The Village WWTF improvements focus on upgrades to the secondary and tertiary treatment processes. Other aspects of the WWTF will generally remain the same regardless of the secondary and tertiary treatment process chosen. The common elements applicable to each alternative are described below. If any changes to a common project element are unique to a specific alternative, these modifications are noted in the alternative description.

5.2.1. Development of Operations and Maintenance Costs Net Present Value

For each evaluated alternative, the operational and maintenance cost is summarized as the 20 year net present value. This is calculated by estimating operational costs at the annual average daily flow over an entire year of operation, using today's operational costs, an inflation rate of 2.1 percent over 20 years and a discount rate of 3.1 percent over 20 years.

5.2.2. Preliminary Treatment / Headworks Improvements

The existing headworks consist of a mechanical fine screen with manual screen bypass, grit removal system and Parshall flume. As described in Section 3.2.2 above, the hydraulic capacity of the screen is reduced from 1.0 MGD to 0.5 MGD by the 3" flume downstream of the screen. However, the screen capacity can be regained by upsizing the flume. Noting the current capacity limitation of the screen, the existing equipment has adequate capacity and is in useable condition. All evaluated alternatives will reuse the existing bar screen and grit removal system with upgrades to the existing air handling unit including repair/replace the existing exhaust fan system to allow for attainment of the required minimum air change outs. The MBR alternative will also require the addition of a new 3mm fine screen.

5.2.3. Influent Equalization Tank

The existing WWTF has two influent equalization tanks: a circular steel tank and a rectangular concrete tank. The steel tank roof is believed to be structurally compromised and the tank is not routinely in use. The rectangular concrete tank was retrofitted in 2015-2016 to be utilized as an anoxic reactor/influent equalization tank. For all evaluated alternatives, the rectangular concrete tank will be kept in service pending an analysis of structural integrity, which is recommended during the design phase. The tank will be utilized as an influent load equalization tank instead of flow equalization only. The change will help attenuate shock loads of ammonia to the treatment process during peak period flows.

5.2.4. Biosolids Handling

At present, the sludge from the clarifier is pumped to the aerated sludge holding tanks. Sludge is dewatered by centrifuge, stored in uncovered drying beds and then hauled to landfill. The existing equipment is aging, the centrifuge requires constant operator attention and the uncovered drying beds are problematic during precipitation events. The existing equipment does have adequate capacity to meet future demand. Although upgrades to the biosolids handling system are desired to reduce operational costs, these upgrades will be postponed until additional funding is available. At that time, the biosolids handling options should be evaluated more fully. For this PER, all evaluated alternatives continue to use the existing aerated sludge tanks, centrifuge and drying beds.

5.2.5. Disinfection

Ultraviolet (UV) disinfection is utilized to meet permitted limits for E. Coli and Fecal Coliform. In 2014-2015, the Village retrofitted the existing UV units; replacing bulbs, ballasts, wiring and power panels; these units are in good condition. For all evaluated alternatives, the existing units will be utilized and two new units will be added to provide required redundancy during peak period flow.

5.2.6. Reuse, Energy Efficiency/Renewable Energy and Carbon Emission Reduction

5.2.6.1. Reuse

For all alternatives, the additional treatment equipment such as filters, pumps, piping, and tank storage were not included in the development of the alternative; however a limited-scope reuse system such as might be applicable for WWTF grounds irrigation may be evaluated during design phase. It should be noted that the MBR alternative produces water quality that approaches Class 1B, and perhaps Class 1A (dependent on parameters developed in design phase) reuse water quality requirements without requiring additional filtration or disinfection.

5.2.6.2. Energy Efficiency/Renewable Energy

For all alternatives, premium-efficiency motors, high-efficiency blowers with dissolved oxygen (DO) control, energy recovery air handling systems, and similar reduced-energy consumption equipment will be included in the system design, as applicable. At the current conceptual-level of WWTF planning, specific renewable energy components have not been included.

5.2.6.3. Carbon Emission Reduction

For all alternatives, incorporation of equipment that incorporate the type of reduced-energy consumption components identified in Section 5.2.6.2 will reduce the overall carbon emissions from the WWTF as compared to the use of lower energy-efficient equipment.

5.2.7. Insurance, Administrative Costs, Monitoring and Testing, Short-Lived Assets, Maintenance and Replacement, Professional Services and Residuals Disposal

For all evaluated alternatives, the cost for Insurance, Administrative Costs and Professional Services were assumed to be the same for all alternatives and have been included in the Appendix D cost tables, based on a 0.5 percent of the estimated annual Operation and Maintenance (O&M) cost. The estimated costs for Monitoring and Testing, Maintenance and Replacement, and Residuals Disposal were estimated for each alternative and included in the cost tables in Appendix D. The cost for short-lived assets are included in other cost categories such as chemicals and equipment replacement.

5.2.8. Land Requirements

The parcel in which the WWTF is located was transferred to the Village from U.S. Forest Service as per the Townsite Act of 2014. Any upgrades to the treatment process regardless of the alternative will be within the existing WWTF parcel.

5.2.9. Emergency Operations

5.2.9.1. Unit Redundancy

For all evaluated alternatives, system redundancy will be in conformance with NMED redundancy requirements. Where two units are proposed, each unit shall have a design flow of at least 50 percent of the total design flow. The hydraulic capacity of the remaining units shall be sufficient to handle the peak wastewater flow without overflow with the largest unit out of service.

5.2.9.2. Alarms

For all evaluated alternatives, critical process parameters, equipment status and facility operating conditions will be monitored with instrumentation integrated into a new supervisory control and data acquisition (SCADA) system. An auto-dialer will be utilized to contact operations staff in the event of an alarm condition.

5.2.9.3. Back-up Power

At present the WWTF has a backup generator. Based on the additional load added, the backup generator may need upgrading or a second generator will be provided to meet the power requirements.

5.2.9.4. Emergency Operation Plan

As discussed in Section 3.2.2, the steel EQ tank, with a working volume of approximately 220,000 gallons, can be used in an emergency situation. Additionally, the WWTF operations staff maintains a spare parts and equipment inventory.

5.3. TREATMENT ALTERNATIVE NO. 1 – INTEGRATED FIXED FILM ACTIVATED SLUDGE (IFAS)

5.3.1. Description

Alternative No. 1: Integrated Fixed Film Activated Sludge (IFAS) includes utilization and re-configuration of the existing process train (Train #1 - 0.1 MGD capacity) and construction of seven new partially-buried, covered process tanks (Train #2 – 0.34 MGD capacity). In addition, Alternative No. 1-IFAS includes new clarifiers, new tertiary filtration units, upgrades to the UV disinfection, a new operations building housing the new process equipment, reuse of the existing influent equalization tank, reuse of the existing sludge holding tank, reuse of the existing centrifuge, new electrical and controls, new aeration blowers and site work. Overall, the treatment technology and process equipment is similar in nature to the existing WWTF treatment process.

Alternative No. 1 would use the IFAS process with an MLE internal recycle. The process would include the following treatment zones in series: a pre-anaerobic selector, two pre–anoxic tanks, two aerobic tanks, a post-anoxic zone and a post-aerobic zone. The process is followed by secondary clarification for settling of the activated sludge in the mixed liquor. Some of the settled activated sludge is pumped out of the clarifier for wasting and a portion of sludge is pumped back to the head of the secondary treatment process.

The MLE process will incorporate the IFAS media in the aerobic (oxic) zones and will be followed by an oxygen depletion zone. This is to reduce the amount of air being introduced to the pre-anoxic zone. The mixed liquor will be pumped from the depletion zone to first pre-anoxic zone at a higher rate, usually 2Q to 4Q where Q is the influent flow rate.

The combination of anoxic and oxic zones will result in treatment and removal of total nitrogen in the wastewater. The secondary effluent in the secondary clarifier will be pumped to the tertiary filters. The tertiary filters depend on chemical addition, usually alum or ferric, for coagulation and removal of phosphorus.

The upflow sand filter tertiary filtration process consists of metal salt addition, pH adjustment and conditioning, and conveyance of the conditioned process water to the upflow sand filter. Process water flows upward though a sand media bed (usually 60 to 80” deep) at typical hydraulic loading rates ranging from 3 – 6 gpm/ft2. Insoluble metal phosphates are trapped by the filter media and thus, removed from the filter effluent. During filtration, sand is continuously pumped from the bottom of the filter using an air-lift pump and washed in a wash box located at the top of the filter. The clean sand falls back down onto the top of the media bed. A continuous reject steam from the sand wash/separation box is returned to the facility headworks or secondary clarifier inlet. Moving bed sand filters can be configured in either concrete tanks or packaged steel tank systems. Moving bed filter technology may be applied as a conventional upflow sand bed such as Parkson Corporation’s Dynasand; or alternately as a reactive iron-coated sand filter bed using a proprietary chemical pre-reaction process and media. The reactive bed technology variation combines co-precipitation and sorption to remove both particulate and soluble phosphorus. Ferric chloride is mixed into the process water, which coats the sand particles, forming a hydrous ferric oxide. The reactive sand process variation is offered solely by Blue Water Technologies, Inc., under the trade name Blue PRO (www.blueH20.net).

Figure 2 shows a typical IFAS media supplied by AnoxKaldness, which is similar to the media in the existing treatment plant.

Figure 2. IFAS Media Photo

Table 9 presents a summary description of the facility components included with this alternative. Manufacturer literature further describing the IFAS process is included in the Appendix C2. Figures 3 and 4 present a Preliminary Site Schematic and Process Flow Diagram.

Table 9. IFAS Alternative Components

Process Area	Description of Included Components
Headworks Improvements	• Reuse the existing bar screen and the grit removal system • Refurbish the existing air handling unit
IFAS Process Tanks	• Existing process tanks re-configuration (Train #1 – 0.1 MGD capacity) • Partially-buried, covered, new concrete tanks (Train #2 – 0.33 MGD capacity) • Influent flow splitter box and MLSS diversion box • Dedicated anoxic, IFAS media and post aeration tanks
Tertiary Filtration	• Moving bed upflow sand filters; utilizing new tanks
Equipment & Process Piping	• Aeration system (blowers, aeration piping, and diffusers) • Submersible mixers and Internal MLSS recycle pumps • Waste activated sludge pumps • Biomass carrier media and media retention screens • PLC- based control system
Equipment and Operations Building	• 7100 SF (Process tanks+ Clarifiers + Tertiary Filters) • House blowers, pumps, electrical / MCC, mechanical chemical storage
Biosolids Storage	• Reuse the existing sludge storage tanks • Reuse the existing centrifuge
Disinfection	• Continue to use existing UV units • Add new units to provide redundancy at PPF
Site Work	• Yard piping
Electrical and Controls	• New electrical service, equipment, and an additional generator

IMPROVEMENT NOTES:

1. EXISTING EQ TANK TO BE REUSED AS LOAD EQ.
2. TRAIN 1 (0.1 MGD): USE OF EXISTING TANKS
   - A. ANAEROBIC SELECTOR FROM EXISTING ANOXIC / EQ TANK.
   - B. 4 EXISTING AERATION BASINS
   - C. CONVERT EXISTING SECONDARY CLARIFIERS TO AEROBIC A/S REACTORS, POST-ANOXIC REACTOR AND UTILIZE EXISTING OZONE CONTACT TANK FOR RE-AERATION.
3. NEW 30' SECONDARY CLARIFIERS (2 TOTAL).
4. NEW TERTIARY FILTER (4 TOTAL).
5. NEW PRE-FABRICATED BUILDING METAL BUILDING TO HOST NEW TREATMENT TRAIN, CLARIFIERS, TERTIARY FILTERS, PUMPS, BLOWERS, LABORATORY, OPERATIONS, CONTROL ROOM, SHOWER, AND RESTROOM.
6. TRAIN 2 (0.34 MGD): NEW TANKAGE

GENERAL NOTES:

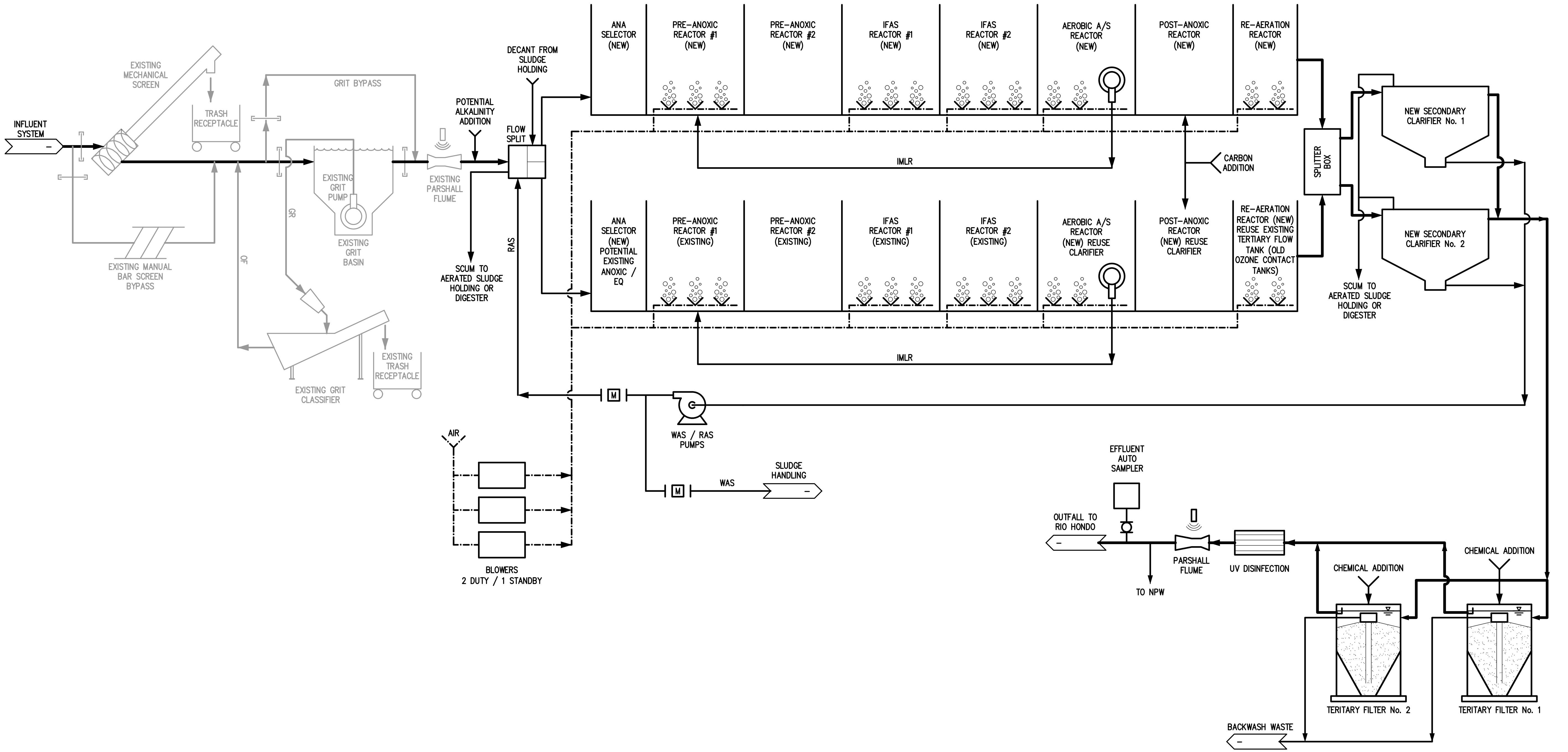
1. UNDERGROUND UTILITIES ARE APPROXIMATE ONLY. CONTRACTOR SHALL FIELD LOCATE EXISTING UTILITIES PRIOR TO COMMENCING WORK.
2. TERTIARY FILTRATION BUILDING BASED ON BLUE-PRO FILTER VENDOR GENERAL ARRANGEMENT DRAWING.

W:\VTSV-S14-0132 - WWTP\PER FIGURES\FIGURE 3 LAST SAVED:1/20/2016 4:41 PM LAST PLOTTED: 1/20/2016 4:41 PM BY: KEITH

FEI ENGINEERS

VILLAGE OF TAOS SKI AREA
WASTEWATER TREATMENT FACILITY PRELIMINARY ENGINEERING REPORT
IFAS WITH MLE SCHEMATIC SITE PLAN

FIGURE No. 3



VILLAGE OF TAOS SKI AREA
WASTEWATER TREATMENT FACILITY PRELIMINARY ENGINEERING REPORT
IFAS WITH MLE PROCESS FLOW DIAGRAM

FIGURE No. 4

FEI ENGINEERS

W:\VTSV-S14-0132 - WWTP\PER FIGURES\FIGURE 4 LAST SAVED:1/20/2016 4:41 PM LAST PLOTTED: 1/20/2016 4:41 PM BY: KEITH

5.3.2. Design Criteria

Preliminary sizing and evaluation of this alternative has been performed in order to satisfy the design criteria for flow, loading and effluent quality. The preliminary sizing is summarized in Table 10.

Table 10. IFAS Alternative Design Criteria

Design Parameter	Value
Total Basin Volume	285,000 gallons
Bulk Volume of Biofilm Carrier	4,545 ft^3
Fixed Media	27,374 ft^3
IFAS Reactor-Biofilm Carrier Fill Ratio	60%
Design MLSS	2,500 to 3,000 mg/L
Equivalent Design SRT (total)	>30 days

5.3.3. Site Plan

Refer to Figure 3 above for the IFAS alternative schematic layout.

5.3.4. Environmental Impacts

The IFAS alternative is contained entirely within the existing site. There are no environmental impacts identified or expected.

5.3.5. Land Requirements

The current WWTF site has sufficient area and no additional land is needed.

5.3.6. Construction Problems

Within the Village WWTF property parcel, the subsurface conditions likely include large cobbles, boulders and possibly bedrock. The presence of large boulders and rock may increase construction excavation costs. Additionally, because the area required for this alternative is large and the slope layback areas would be extensive, access to maintain and operate the existing facility would be difficult.

5.3.7. Operational Aspects

The IFAS alternative is similar in nature to the current IFAS process at the Village WWTF. The tertiary filters for phosphorus removal proposed in this alternative will be moving bed upflow sand filters; different from the existing pressure filters used at the WWTF. Operators will need training on operations and maintenance of the tertiary filter proposed with this alternative.

5.3.8. Comparative Opinion of Probable Construction Cost

A summary of the project costs for this alternative is shown in Table 11. The cost estimate includes the treatment equipment, installation of equipment, civil site work, concrete work and a pre-engineered building. Annual O&M costs were based on chemical and labor costs for diffuser replacement and annual plant O&M.

Table 11. IFAS Alternative Cost

Net Present Worth Cost Inputs	Amount
Construction Cost[1]	$6,841,500
Engineering Cost[2]	$1,026,300
Total Capital Cost	$7,867,800
Annual O&M Cost[3]	$115,500
Energy Cost (Note: included in Annual O&M Cost)	$55,300
20 Year Present Worth of Annual O&M Costs[4]	$2,043,000
20 Year Present Worth of Short lived Assets Minus Salvage Value	-$549,000
Total 20 Year Present Worth Cost	**$9,361,800**

1) Includes CSI 16 Divisions costs, Contractor OH&P, Bonds and Insurance and Contingency.
2) Includes engineering cost for final design and construction phase services. Engineering cost are calculated as 15% of construction cost for preliminary cost estimation.
3) Includes labor cost, energy cost, and chemical cost.
4) Based on 20 year life cycle, annual inflation rate of 2% and discount rate of 3.2%.

5.3.9. Advantages/Disadvantages

The IFAS alternative is capable of producing high-quality effluent that meets the required effluent requirements. The hybrid, fixed-film/suspended growth BNR process is capable of reliably meeting the ammonia and total nitrogen effluent requirements. The Village's very cold wastewater temperatures result in slow nitrifier growth rates and long required solids retention (SRT). With the IFAS process, the combined biomass from mixed liquor suspended solids (MLSS) and attached to the biofilm carriers result in an efficient and stable nitrification process. Much of the nitrifier population is retained in the basins on the biomass carriers with a resultant high nitrification rate.

Due to the effluent phosphorus limits for the Village WWTF, Alternative No. 1-IFAS requires additional tertiary filters to be added to the treatment process.

Construction of new aeration basins and anoxic basins, a new clarifier, the addition of new tertiary sand filters and a new building to enclose all of the above improvements contributes to the highest capital cost of all the three alternatives considered.

The IFAS alternative is structured to meet the Village's needs for the proposed WWTF improvements project. However, since the costs are higher than the other alternatives, the debt payment burden would be significantly higher. This alternative is also capable of meeting the anticipated discharge permit limits and both the environmental and public concerns; however, the IFAS alternative has an overall slightly lower operational margin of safety as compared to the MBR alternative, primarily due to the clarification step, which requires constant fine control of factors which control sludge settleability. The MBR alternative uses a membrane filtration step so that sludge settleability is not an operational issue.

5.4. TREATMENT ALTERNATIVE NO. 2 – SEQUENCING BATCH REACTOR (SBR)

A sequencing batch reactor (SBR) is a modified, activated sludge wastewater treatment process that treats batches of wastewater via a "fill and draw" strategy within a single reactor (or reactor train), including the clarification process. A typical SBR includes two parallel trains that operate on opposite time phases to provide constant treatment. The SBR process is well suited for BNR since alternating aerobic and anoxic conditions can be programmed into operating cycle phases.

The BNR operation strategy generally includes the following phases: Fill, React with Anoxic conditions followed by Aeration, Settling and Decant. Due to the sequence of operations, multiple processes take place in a single basin and therefore, SBRs generally have a smaller and more efficient overall footprint than conventional activated sludge systems with separate aeration basins and clarifiers. Effluent equalization is typically required to attenuate the high decant rates used in SBRs and reduce the hydraulic throughput required for downstream processes, such as disinfection or advanced wastewater treatment.

In addition to the SBR process, tertiary filtration will be required for phosphorus removal. The proposed tertiary filtration process is an upflow sand filter process, which includes metal salt addition, pH adjustment and conveyance of the conditioned process water to the upflow sand filter. Please refer to the upflow sand filter process description included under Section 5.3 – Treatment Alternative No. 1.

The SBR alternative includes: new partially-buried, covered SBR process tanks, a new effluent equalization tank, new tertiary filtration units, upgrades to the UV disinfection, a new operations building housing the new process equipment, reuse of existing influent equalization tank, reuse of existing sludge holding tank, reuse of existing centrifuge, new electrical and controls, new aeration blowers and site work.

Two different SBR process configurations were considered for this project:

1. Intermittent Cycle Extended Aeration System (ICEAS) SBR; and
2. Integrated Surge Anoxic Mix (ISAM™) SBR

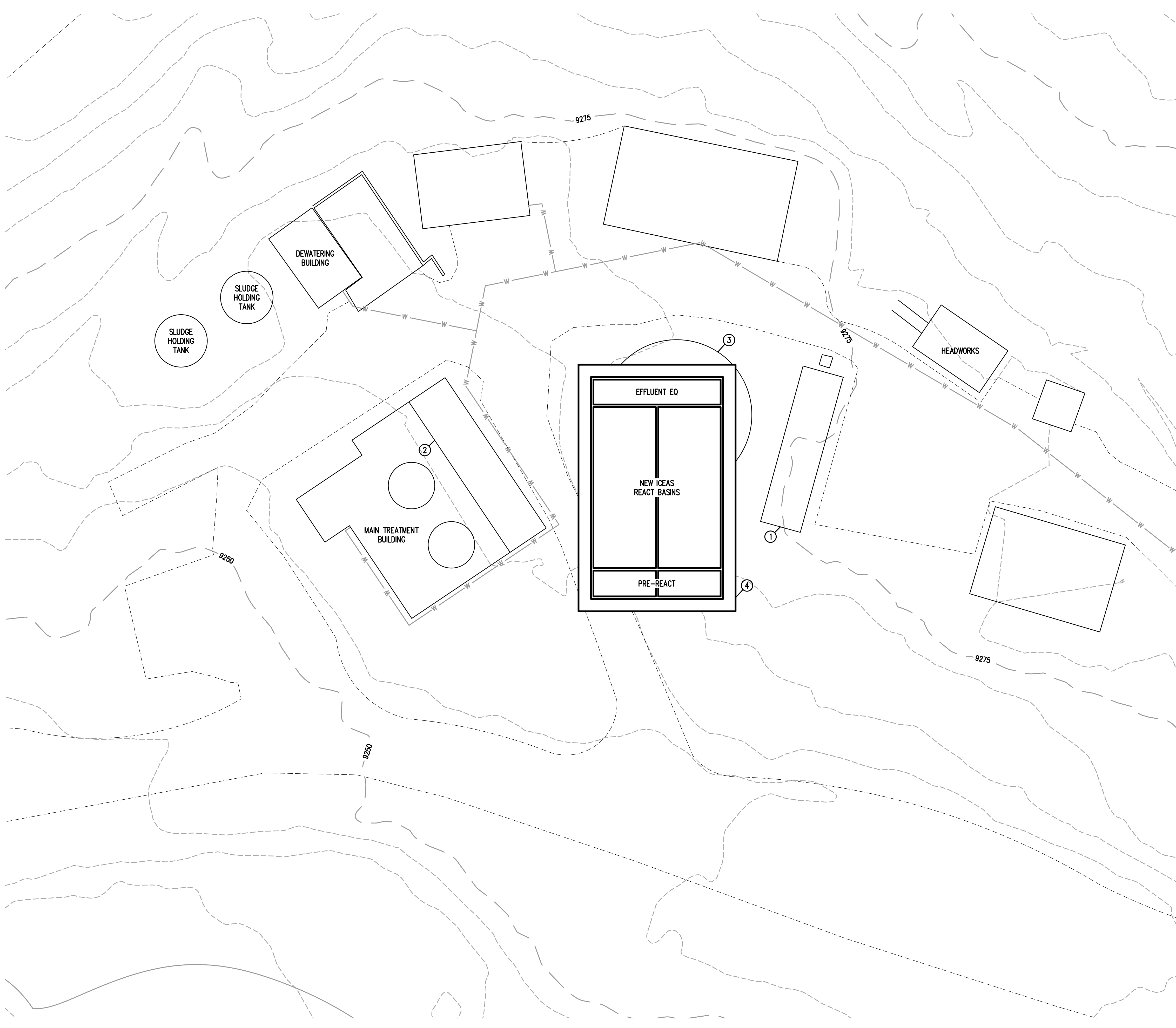
A description of the ICEAS SBR and ISAM SBR is presented in the following sections and manufacturer literature describing the process is included in the Appendix C1. The ICEAS SBR configuration was used for the evaluation of Alternative No. 2.

Table 12 presents a summary description of the facility components included with this alternative. Figures 5 and 6 present a Preliminary Site Schematic and Process Flow Diagram.

Table 12. SBR Alternative Components

Process Area	Description of Included Components
Headworks Improvements	• Reuse the existing bar screen and the grit removal system • Refurbish the existing air handling unit
SBR Process Tanks	• Partially buried, dual train concrete tanks • Influent flow splitter box; Dedicated anoxic, sequencing batch reactor, and post-EQ tanks

Process Area	Description of Included Components
SBR Equipment and Process Piping	• Aeration system (blowers, aeration piping, and diffusers) • Submersible mixers and Internal MLSS recycle pumps • Waste activated sludge pumps • Solids-excluding decanter • PLC- based control system • Process piping and valves • New effluent EQ pumps
Equipment and Operations Building	• 5000 SF (Building on top of partially-buried, covered SBR tanks) • House blowers, pumps, electrical/ MCC, mechanical chemical storage
Tertiary Filters	• Moving bed upflow sand filters; Retrofit of the existing aeration basins.
Disinfection	• Continue to use existing UV units • Add new units to provide redundancy at PPF
Biosolids Storage	• Reuse the existing sludge storage tanks • Reuse the existing centrifuge
Site Work	• Yardpiping
Electrical and Controls	• New electrical service, equipment, and an additional generator



SCALE: 1"=40'

NOTES:

1. EXISTING EQ TANK TO BE REUSED AS LOAD EQ TANK.
2. EXISTING AERATION BASINS TO BE RETROFITTED TO HOIST TERTIARY PHOSPHOROUS FILTERS.
3. EXISTING STEEL EQ TO BE DEMOLISHED.
4. PROPOSED PREFABRICATED METAL BUILDING.

GENERAL NOTES:

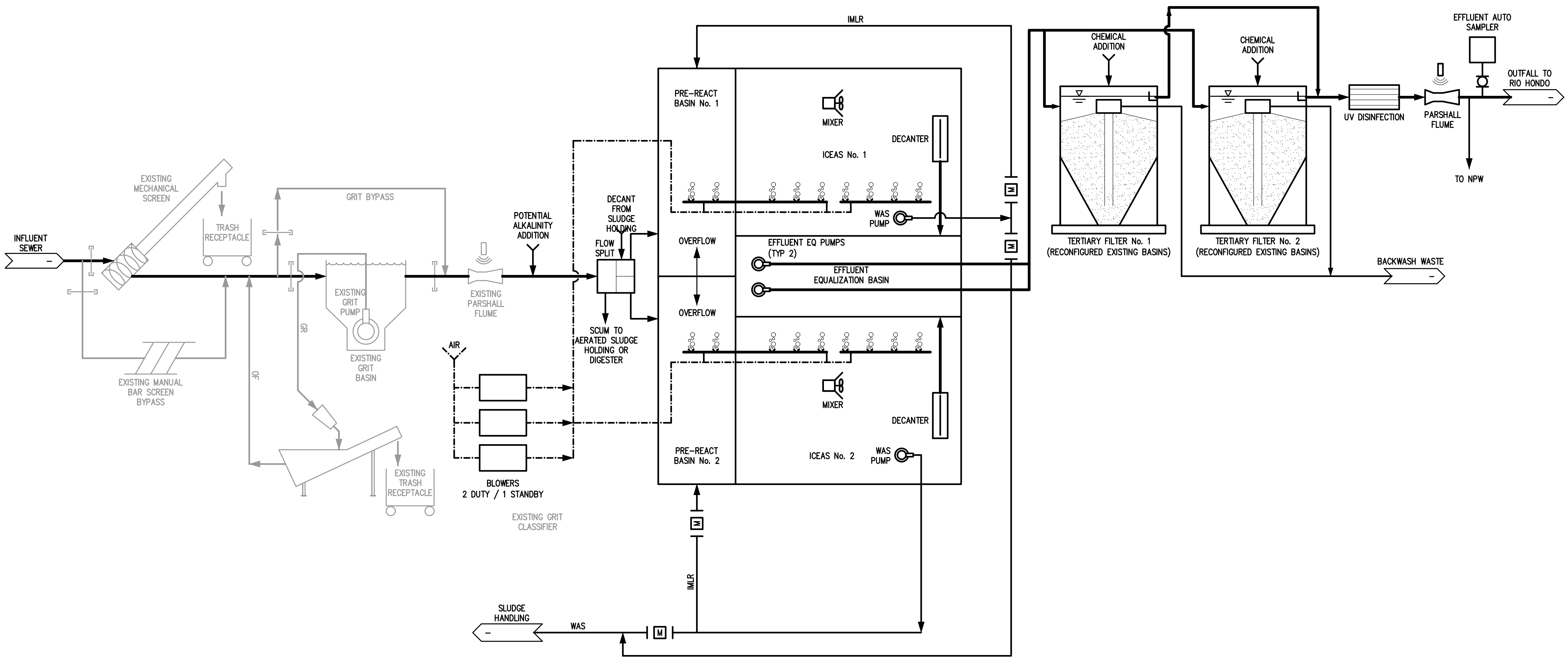
1. UNDERGROUND UTILITIES ARE APPROXIMATE ONLY. CONTRACTOR SHALL FIELD LOCATE EXISTING UTILITIES PRIOR TO COMMENCING WORK.
2. TERTIARY FILTERS BASED ON BLUE-PRO FILTER VENDOR GENERAL ARRANGEMENT DRAWING.

FEI ENGINEERS

VILLAGE OF TAOS SKI AREA
WASTEWATER TREATMENT FACILITY PRELIMINARY ENGINEERING REPORT
ICEAS SBR BASINS SCHEMATIC SITE PLAN

FIGURE No. 5

W:\VTSV-S14-0132 - WWTP\PER FIGURES\FIGURE 5 LAST SAVED:1/20/2016 4:41 PM LAST PLOTTED: 1/20/2016 4:42 PM BY: KEITH



VILLAGE OF TAOS SKI AREA
WASTEWATER TREATMENT FACILITY PRELIMINARY ENGINEERING REPORT
ICEAS SBR BASINS PROCESS FLOW DIAGRAM

FIGURE No. 6

FEI ENGINEERS

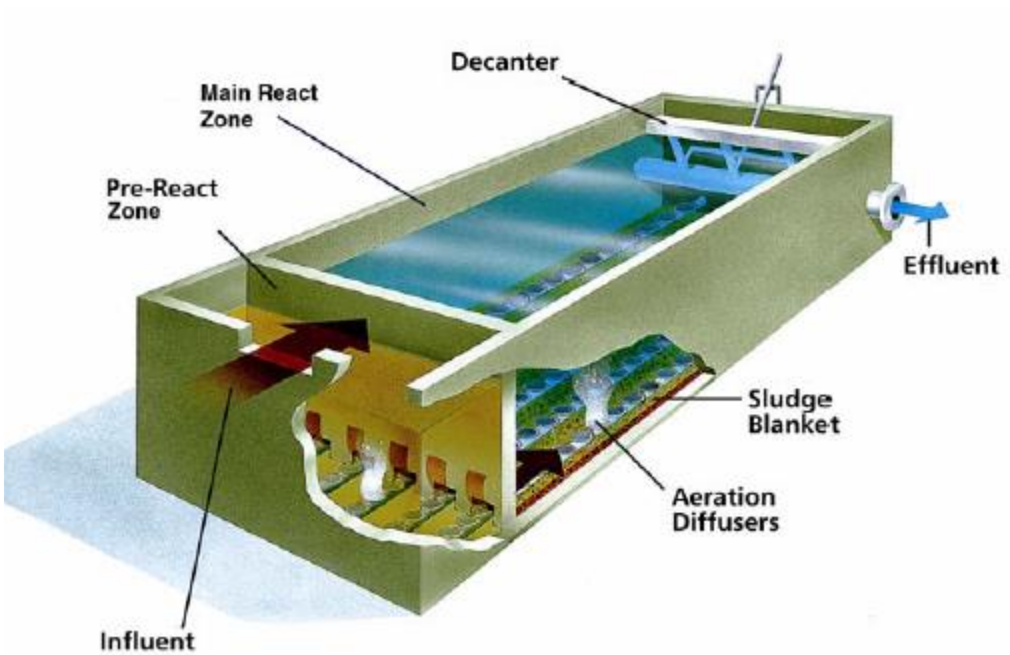
W:\VTSV-S14-0132 - WWTP\PER FIGURES\FIGURE 6 LAST SAVED:1/15/2016 8:38 AM LAST PLOTTED: 1/20/2016 4:42 PM BY: KEITH

5.4.1. Description- Sanitaire ICEAS SBR

The ICEAS SBR is an advanced version of conventional SBR and allows continuous inflow of wastewater to the basins. Influent flow to the ICEAS basins is not interrupted during the settle and decant phases or at any time during the operating cycle.

The ICEAS basins are divided into two zones; the pre-react zone and the main react zone as shown in Figure 7. The influent flows continuously into the pre-react zone and is directed down through engineered orifice openings at the bottom of the baffle wall into the main react zone. The pre-react wall baffles the incoming flow and prevents short-circuiting.

Figure 7. ICEAS Basin



Within the SBR reactors, three level and/or time-based cycles occur to biologically treat the mixed liquor and discharge treated effluent.

A brief description of each SBR cycle is included below in their chronological order of occurrence:

1. Fill/ React Phase: During this phase, raw wastewater flows into the pre-react zone and to the main react zone to react with the mixed liquor suspended solids for simultaneous biological oxidation/reduction reactions that provide biological treatment of the wastewater.
2. Settle Phase: At the onset of the “settle” phase, the basin mixing is stopped. The SBR becomes quiescent to provide appropriate conditions for clarification. Gravity sedimentation causes MLSS to separate with more dense solids on the SBR tank bottom and lighter supernatant at the surface.
3. Decant Phase: Upon completion of the timer-based settle phase, the decant phase

begins and supernatant flows through a fixed solids-excluding decanter. The decanter is fitted with a motor and multiple limit switches that monitor and adjust the position of the decanter throughout the SBR processes (fill, react and settle).

The process can be operated in three different cycles based on the influent flowrate. They are: normal operation cycle, storm cycle/intermediate cycle and second storm cycle.

5.4.2. Design Criteria

Preliminary sizing and evaluation of this alternative has been performed in order to satisfy the design criteria for flow, loading and effluent quality. The preliminary sizing is summarized in Table 13 below.

Table 13. SBR Alternative Design Criteria

Parameter	Value
Total Basin Volume	511,600 gallons
Cycle Time	4.8 hours
Cycles per day (at MMF)	5
Design MLSS	4,500 to 5,500 mg/L
Design HRT, total	>24 hours
Design SRT, total	28 days
Design SBR Basin DO residual	2 mg/L

5.4.3. Site Plan

Refer to Appendix B for ICEAS SBR alternative schematic layout and process flow diagram

5.4.4. Environmental Impacts

The alternative is contained entirely within the existing site. There are no environmental impacts identified or expected

5.4.5. Land Requirements

The current WWTF site has sufficient area. No additional land is needed for this alternative.

5.4.6. Construction Problems

The larger size and foot print required for this alternative will make winter construction difficult. Within the Village WWTF property parcel, the subsurface conditions likely include large cobbles, boulders and possibly bedrock. The presence of large boulders and rock may increase construction excavation costs. During late Spring and early Summer, the ground is often saturated with melting snow and runoff.

5.4.7. Operational Aspects

Operation and process control of an SBR is similar to other activated sludge processes designed for BNR. Critical operational variables include: control of solids inventory (biomass) to maintain the target SRT, dissolved oxygen monitoring and aeration system control, and optimization of the required internal recycle rate. The SBR operation is a time-based process that treats wastewater in batches which is contrasted with constant level and continuous flow processes, such as the IFAS and MBR processes.

5.4.8. Comparative Opinion of Probable Construction Cost

A summary of the project costs for this alternative is shown in Table 14. The annual O&M cost was based on chemical and labor costs for diffuser replacement and for annual plant O&M.

Table 14. SBR Alternative Costs

Net Present Worth Cost Inputs	Amount
Construction Cost[1]	$6,133,400
Engineering Cost[2]	$920,100
Total Capital Cost	$7,053,500
Annual O&M Cost[3]	$107,100
Energy Cost (Note: included in Annual O&M Cost)	$46,900
20 Year Present Worth of Annual O&M Costs[4]	$1,895,000
20 Year Present Worth of Short lived Assets Minus Salvage Value	-$561,000
Total 20 Year Present Worth Cost	**$8,387,500**

1) Includes CSI 16 Divisions costs, Contractor OH&P, Bonds and Insurance, and Contingency
2) Includes engineering cost for final design and construction phase services. Engineering cost are calculated as 15% of construction cost for preliminary cost estimation.
3) Includes labor cost, energy cost, and chemical cost
4) Based on 20 year life cycle, annual inflation rate of 2% and discount rate of 3.2%.

5.4.9. Advantages/Disadvantages

SBR's are flexible and adaptable to treat the seasonally variable flows by adjusting cycle times. However, in order to fully nitrify at the Village's very cold wastewater temperatures, a long SRT is required. Additionally, the ability of the SBR process to reliably attain the stringent TN and TP limits is questionable, and thus, a tertiary treatment process (such as an upflow, continuously-regenerating tertiary sand filter) is required for the removal of both nitrate/nitrate and phosphorus.

Since the SBR is solely a suspended growth process, the MLSS concentration must be limited to allow for effective gravity settling during the "settle" phase. These design conditions result in large basins and long hydraulic retention times for the SBR Alternative. Further noted, the SBR alternative will need to equalize the decanted effluent prior to tertiary filtration and disinfection, and the effluent equalization basin required for SBR's is significantly larger.

Due to the strict effluent phosphorus limits for the Village WWTF, the SBR technology will also require additional tertiary filters to be added to the treatment process.

The capital cost for SBR alternative is lower than IFAS alternative due to reduced foot print for the new building and the reuse of existing aeration tanks in SBR alternative for tertiary filters.

The SBR alternative is structured to meet the Village's needs for the proposed WWTF improvements project. However, the costs are higher than the MBR alternative and the debt payment burden would be impacted correspondingly. This alternative is also capable of meeting the anticipated discharge permit limits and both the environmental and public concerns; however, the SBR alternative has an overall slightly lower operational margin of safety as compared to the MBR alternative, primarily due to the sludge settling and disengagement required in the SBR operational cycles, which requires constant fine control of factors which control sludge settleability. The MBR alternative uses a membrane filtration step so that sludge settleability is not an operational issue.

5.5. TREATMENT ALTERNATIVE NO. 3 – MEMBRANE BIOREACTOR (MBR)

5.5.1. Description

A membrane bioreactor (MBR) is a modification of a standard activated sludge process that incorporates an engineered membrane barrier to separate solids and liquid instead of using a clarifier. The MBR process produces reuse-quality effluent and allows the biological treatment process to be operated at high MLSS concentrations that can range from approximately 8,000 to 12,000 mg/L. High mixed-liquors allow for a reduction in the size of treatment tankage, making the process well-suited for retrofits and facility upgrades.

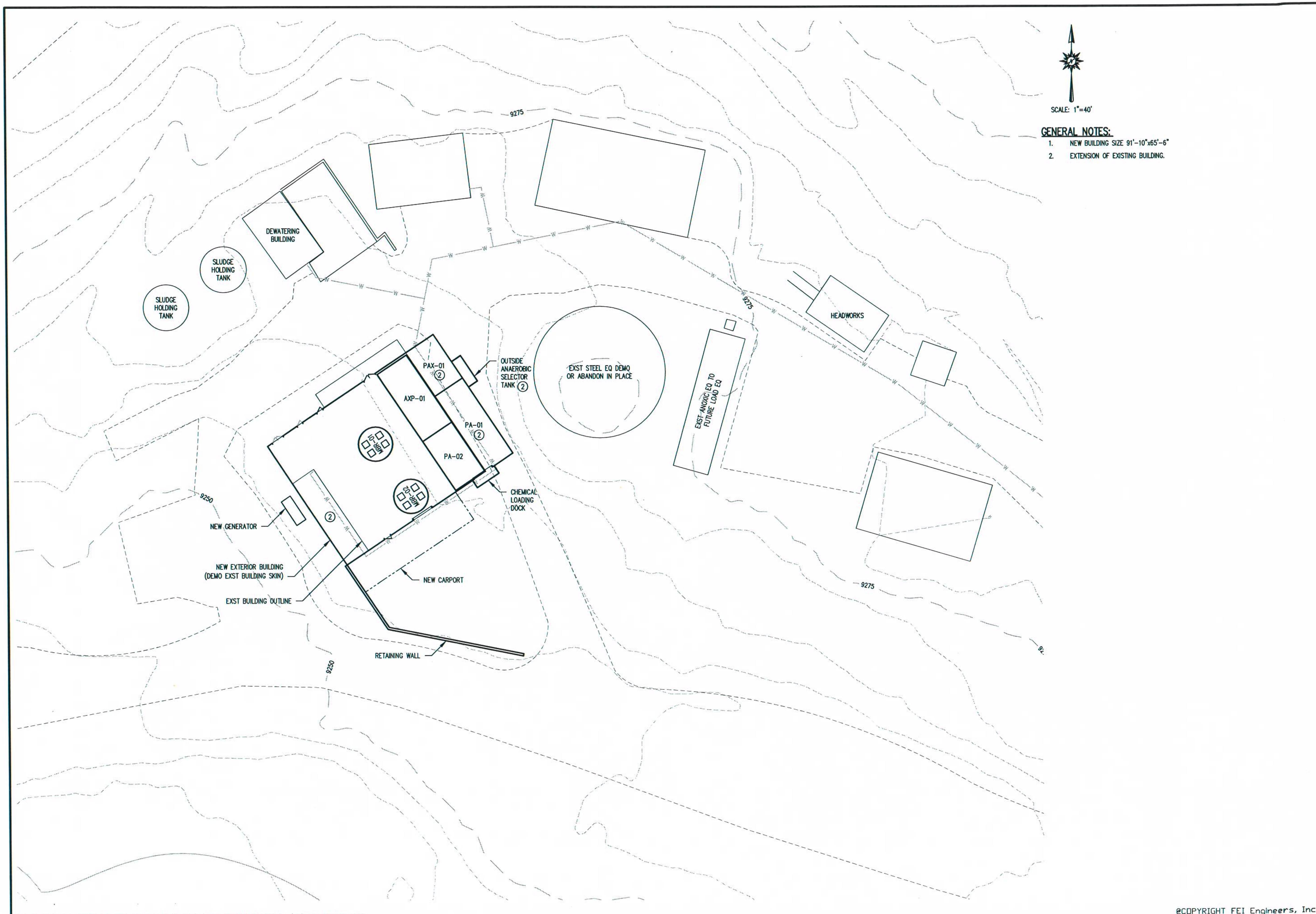
There are two basic configuration for the membranes; hollow fiber and flat sheet membrane packaging. Regardless of the configuration chosen, the membranes are assembled in a frame typically referred to as a cassette. These cassettes are lowered into an existing aeration tank (to increase the capacity of the treatment train) or in a single tank. For the purpose of this PER, the flat sheet membranes will be used for the evaluation of Alternative No. 3.

The MBR alternative includes: new partially-buried, covered MBR process tanks, a new effluent equalization tank, upgrades to the UV disinfection, a new operations building housing the new process equipment, reuse of existing influent equalization tank, reuse of existing headworks with the addition of a 3mm fine screen, reuse of existing sludge holding tank, reuse of existing centrifuge, new electrical and controls, new aeration blowers and site work.

With MBR options, tertiary filtration is not required as a separate treatment process since the membrane filtration operation removes coagulated metal phosphates following chemical addition.

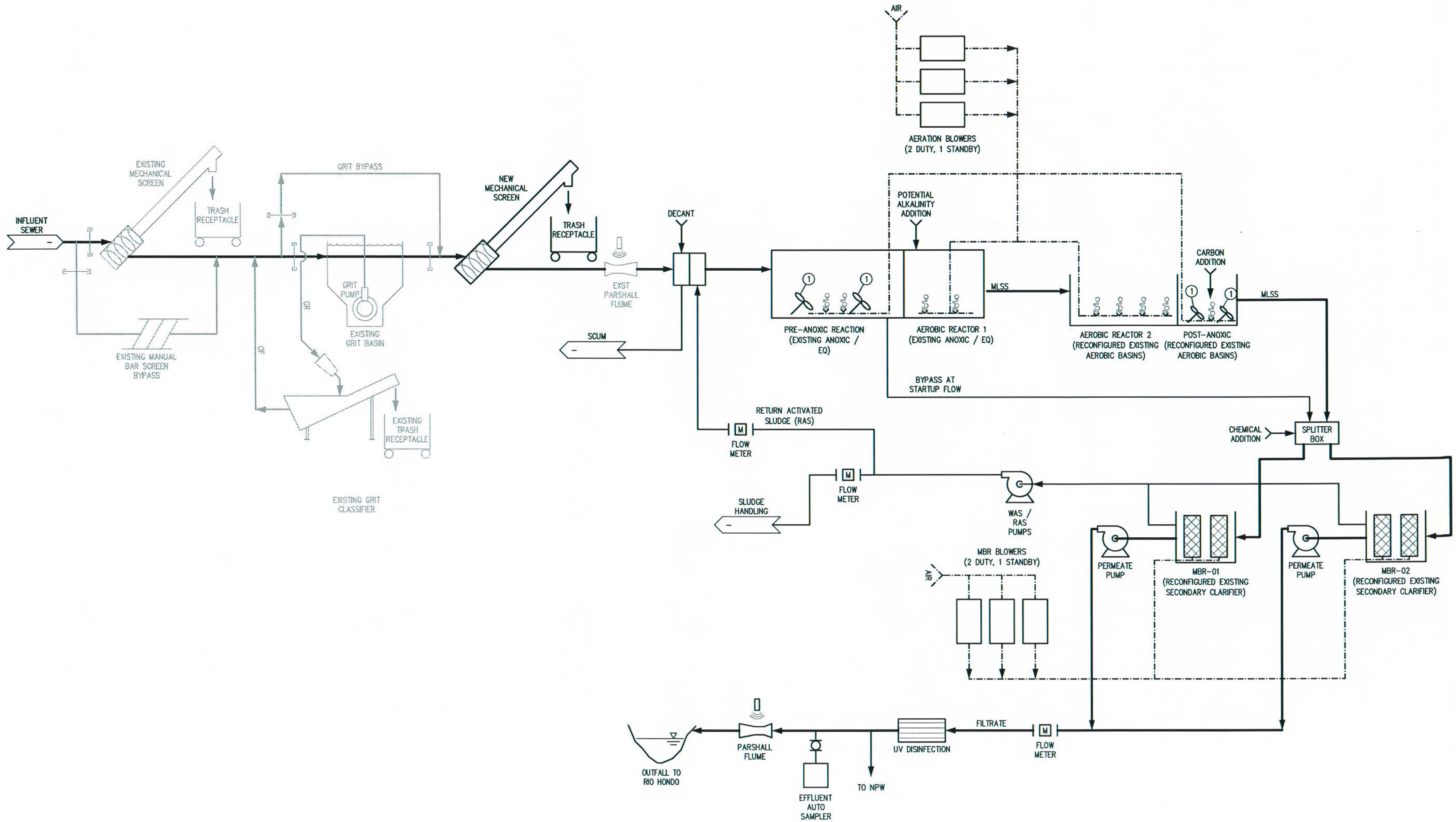
Selected excerpts of the representative MBR manufacturer’s literature is included in the Appendix C3.

Figures 8 and 9 present a Preliminary Site Schematic and Process Flow Diagram.



VILLAGE OF TAOS SKI AREA
WASTEWATER TREATMENT FACILITY PRELIMINARY ENGINEERING REPORT
MEMBRANE BIOREACTOR SCHEMATIC SITE PLAN

FIGURE No. 8



FEI ENGINEERS

VILLAGE OF TAOS SKI AREA
WASTEWATER TREATMENT FACILITY PRELIMINARY ENGINEERING REPORT
MEMBRANE BIOREACTOR PROCESS FLOW DIAGRAM

FIGURE No. 9

W:\VTSV-514-0132 - WWTP\PER FIGURES\FIGURE 10 LAST SAVED:1/15/2016 8:39 AM LAST PLOTTED: 1/20/2016 4:43 PM BY: KEITH

Table 15 below presents a summary description of the MBR alternative facility components.

Table 15. MBR Alternative Components

Process Area	Description of Included Components
Headworks Improvements	• Reuse existing fine screen with 6 mm openings • New fine screen with 3mm openings within the existing headworks building downstream existing grit removal system • Construction of new channel within the existing headworks building for the new screen. • Reuse existing grit removal system downstream of existing fine screen • Refurbish the existing air handling unit
Anoxic and Pre-Air	• New partially-buried, covered tanks adjacent to the existing treatment plant building for anaerobic basin, pre-anoxic and aeration tanks. • New aeration piping, diffusers and divider walls in the existing aeration tanks • Reuse existing aeration tanks as aeration and post- anoxic tanks.
MBR Tanks	• Reuse the existing two- secondary clarifiers as MBR tanks
Equipment & Process Piping	• Aeration system (blowers, aeration piping, and diffusers) • Submersible mixers and Internal recycle system • Waste activated sludge pumps • Membrane modules, sized for cold temp flux • Permeate pumps/ backpulse pumps • Membrane chemical cleaning system • Overhead monorail • PLC- based control system
Equipment and Operations Building	• Add new tankage to the east side of the existing building. • 6100 SF existing building expansion and replacement: Replace steel support members/steel walls / metal roof with new metal building or pre-stressed concrete engineered composite walls and concrete double-T roof • Reconfigure the upper level of the existing building to include blower, electrical/MCC, and mechanical rooms chemical storage; office/lab/shower/bathroom; and the lower level new tankage)
Biosolids Storage (aerated)	• Reuse the existing sludge storage tanks • Reuse the existing centrifuge
Disinfection	• Continue to use existing UV units • Add new units to account for redundancy at PPF
Site Work	• Yard piping
Electrical and Controls	• New electrical service, equipment, and generator

5.5.2. Design Criteria

In addition to the overall design criteria applicable to all alternatives, the preliminary sizing and evaluation for this alternative are based on the criteria shown in Table 16. Note, the system design is based on suspended growth MLSS kinetics, membrane flux rates and cleaning requirements (aeration required for air scour).

Table 16. MBR Alternative Design Criteria

Design Parameter	Value
Total Basin Volume	247,900 gals
Membrane Flux at 8° C	7.5 gal/sf/day
Design MLSS	8000 to 10,000 mg/L
Design HRT (total) at MMF	18 hours
Design SRT (total)	24 days

5.5.3. Site Plan

Refer to Appendix B for the MBR alternative schematic layout and process flow diagram

5.5.4. Environmental Impacts

The MBR alternative is contained entirely within the existing site. There are no environmental impacts identified or expected.

5.5.5. Land Requirements

This alternative would result in the relatively small footprint. The current WWTF site has sufficient area and no additional land is needed.

5.5.6. Construction Problems

No construction problems specifically related to this alternative are envisioned.

5.5.7. Operational Aspects

Operation and process control of an MBR is similar to other activated sludge processes designed for BNR, with the additional need to monitor membrane flux rates and air flow for membrane cleaning (air scour). However, since an MBR relies on a membrane process for solids separation, there is no requirement for any process adjustments to obtain good sludge settling properties, as is required for operating any other activated sludge process. From an operations perspective, this is a substantial advantage for the MBR process. Critical operational variables include: control of solids inventory (biomass) to maintain the target SRT, dissolved oxygen monitoring and aeration system control, and optimization if the required internal recycle rate. In addition, since the system hydraulic throughput is controlled by permeate pumps, automated basin levels and pump flow controls are required. The PLC/SCADA based process control system provides an effective operator interface to minimize the operational complexity compared to the SBR and IFAS alternatives. Similar to the SBR-Alternative No. 2, some additional operations training would be needed for this technology. In addition, this alternative requires periodic chemical cleaning and membrane backpulsing.

5.5.8. Comparative Opinion of Probable Construction Cost

A summary of the project costs for this alternative is shown in Table 17 below. The cost estimate includes: civil site work, concrete, equipment and pre-engineered building. This cost does not take into account cost for electrical, HVAC, engineering, construction management, contractor fee, overhead and profit, permitting cost and any cost that is not mentioned in the cost estimate item list. Annual O&M cost was based on chemical and labor costs for diffuser replacement and for annual plant O&M.

Table 17. MBR Alternative Costs

Net Present Worth Cost Inputs	Amount
Construction Cost[1]	$5,660,700
Engineering Cost[2]	$849,200
Total Capital Cost	$6,509,900
Annual O&M Cost[3]	$97,600
Energy Cost (Note: included in Annual O&M Cost)	$45,000
20 Year Present Worth of Annual O&M Costs[4]	$1,727,000
20 Year Present Worth of Short lived Assets Minus Salvage Value	$151,000
Total 20 Year Present Worth Cost	**$7,928,900**

1) Includes CSI 16 Divisions costs, Contractor OH&P, Bonds and Insurance, and Contingency
2) Includes engineering cost for final design and construction phase services. Engineering cost are calculated as 15% of construction cost for preliminary cost estimation.
3) Includes labor cost, energy cost, and chemical cost.
4) Based on 20 year life cycle, annual inflation rate of 2% and discount rate of 3.2%.

5.5.9. Advantages/Disadvantages

The MBR alternative is capable of producing a very high-quality effluent that meets the project's strict effluent requirements. Due to the use of a membrane for solids–liquid separation and the relatively high MLSS concentrations, the process is reliable and, due to the fact that sludge settling characteristics are removed as an operations factor, the process is more operationally-robust than either the IFAS or SBR processes over a wide range of influent loading and process operating conditions. With chemical addition, the MBR process is also capable of removing phosphorus to the required effluent levels. The alternative has the lowest capital cost due to maximum reuse of existing tankage and reduction in new tank construction.

The MBR alternative is structured to meet the Village's needs for the proposed WWTF improvements project. Also, the costs are lowest for the MBR alternative and the debt payment burden would be lower than the other alternatives. This alternative is also capable of meeting the anticipated discharge permit limits, and both the environmental and public concerns with a higher margin of safety as compared to the other alternatives. Since the MBR alternative incorporates a membrane filtration step, this alternative has several process advantages that are beneficial when applied to the proposed Village WWTF improvements project. The membrane filtration provides a positive filtration barrier, removing the operational concerns regarding sludge settleability and results in a single membrane filtration process step that removes sludge to produce TSS in the effluent lower than either the IFAS or SBR alternatives. It also filters precipitated phosphorus and removes a high percentage of the E. coli and Fecal bacteria across the membrane.

5.6. BNR ALTERNATIVES COMPARISON AND RECOMMENDATION

All of the BNR alternatives would allow the Village to comply with current and pending regulatory requirements. However, the BNR alternatives differ with regard to other criteria and considerations such as: cost, operations, facility aesthetics/footprint, process reliability and treatment effectiveness.

5.6.1. Alternatives Comparison

Table 18 presents an alternatives comparison summary using an evaluation matrix that considers relative importance (weight) for the identified criteria and calculates a “score” for each alternative. Cost criteria takes into account annual estimated energy cost for each of the alternatives considered. The alternative with the highest score is considered to be the “best” alternative.

Table 18. BNR Alternatives Comparison Matrix

Selection Criteria	Weight	SBR		IFAS		MBR	
		Rating	Score	Rating	Score	Rating	Score
Aesthetics / Footprint	10%	2	4	4	8	5	10
Cost	25%	4	20	3	15	5	25
Implementation	10%	3	6	4	8	5	10
Reliability	20%	3	12	4	16	5	20
Operations	15%	4	12	4	12	4	12
Treatment Effectiveness	20%	1	4	4	16	5	20
Total	**100%**	**--**	**58**	**--**	**75**	**--**	**97**

From Table 18, it is clear that lower capital cost and the treatment effectiveness of MBR process resulted in a higher score due to site-specific factors described above that make the application of the MBR technology the best-fit for the proposed Village WWTF improvements project.

5.6.2. Environmental Impacts for Treatment Alternatives

The information areas listed in Section 2.1 may be covered in a future separate document, an Environmental Information Document (EID), which will be prepared by SE Group.

6. PROPOSED PROJECT (RECOMMENDED ALTERNATIVE)

Based on the alternatives analysis that considered both cost and non-cost evaluation criteria, and environmental impacts and benefits, the selected alternative is to replace and upgrade the Village's existing WWTF at the existing site with Membrane Bio Reactor (MBR) process for Biological Nutrient Removal to produce high-quality effluent.

The proposed improvements will provide enhanced BOD_5 and TSS removal, and Total Nitrogen (TN) and phosphorus control to comply with the facility's current and pending discharge permits, and protect and improve the quality of Rio Hondo and downstream drinking water supplies.

6.1. PROJECT DESIGN OVERVIEW

This section presents a summary of the Village's selected alternative, the MBR, for a WWTF rated at 0.31 MGD and 911 lbs/day BOD_5 to meet the wastewater treatment needs of the projected population growth over the 20 year planning period. The justification for selecting this alternative and the related preliminary opinion of probable capital and O&M costs are presented in the following sections. In addition, Appendix B presents Preliminary Design Drawings including:

1. General Notes and Major Equipment Design Criteria;
2. Process Flow Diagram;
3. Schematic Site Plan;
4. Process Overview- Operations Building, Upper and Lower Level Plans; and
5. Section of Operations building.

6.1.1. Technical Description

There are two types of membranes; hollow fiber and flat sheet membranes. Regardless of the configuration chosen, the membranes are assembled in a frame typically referred to as cassette and these cassettes are installed in an existing aeration tank (to increase the capacity of the treatment train) or in a standalone tank.

Figure 10 shows a typical flat sheet membrane. Figure 11 shows a typical hollow fiber membrane.

Figure 10. Flat Sheet Membrane

Figure 11. Hollow Fiber Membrane.

Figure 12 illustrates a module, its location in a cassette and cassette in a treatment basin. This is a typical cassette assembly in a treatment train.

Figure 12. Typical cassette assembly in a treatment train

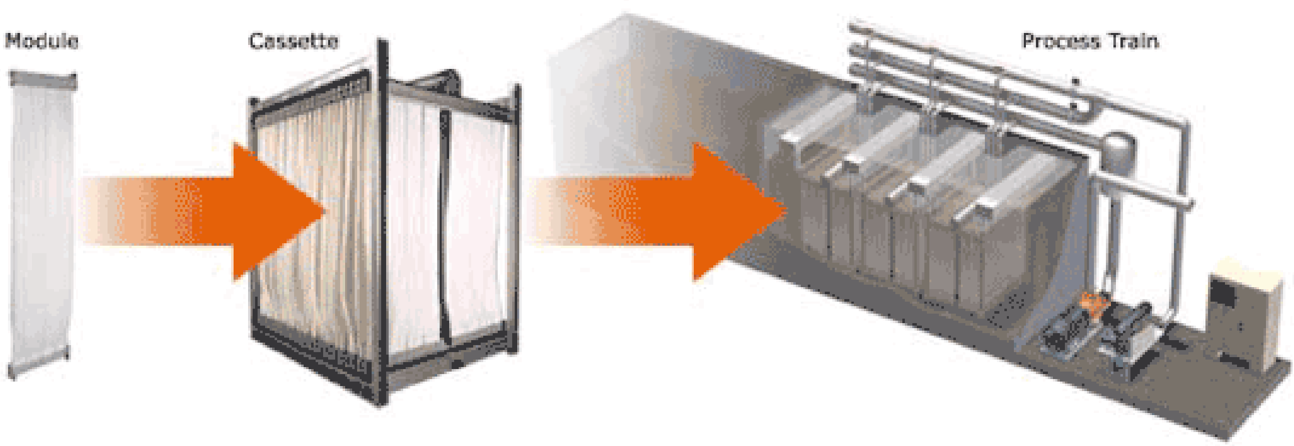
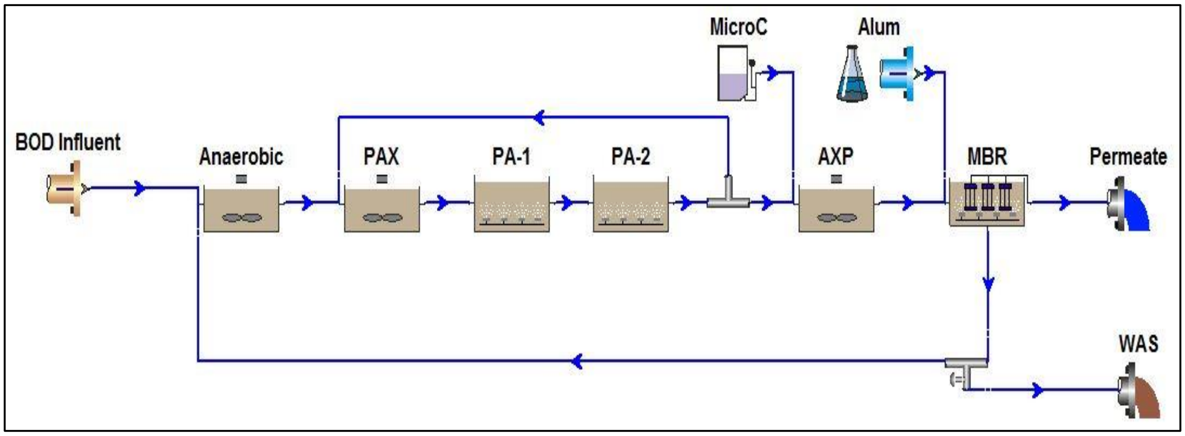


Figure 13 shows a BioWin model with various treatment basins considered for the proposed MBR for the Village WWTF.

Figure 13. BioWin Model of The MBR Process



The improvements to the existing WWTF will include the following new or upgraded facilities and processes:

1. Headworks improvements with addition of new mechanical fine screen downstream of existing grit chamber;
2. Refurbishment of headworks mechanical air handling unit;
3. Conversion of newly retrofitted Anoxic/equalization tank to influent load equalization tank;
4. Construction of two new tanks as an add-on to the existing treatment plant. One of the tank will be operated as pre-anoxic tank while the other will operated as aeration tank;
5. Conversion of existing aeration basins into post anoxic by constructing a new divider wall and installation of new fine bubble diffusers in the aeration basin;
6. Convert existing secondary clarifiers to 2 new MBR basins;
7. Installation of additional UV disinfection units as a redundancy to the existing UV disinfection units;
8. Installation of new aeration blowers and permeate pumps;
9. New chemical storage and feed system for process needs;
10. Replacing the existing building with new building to include the new add-on aeration tanks;
11. Upgraded facility electrical service and motor control center, including a new emergency generator;
12. Upgraded facility instrumentation and controls, including SCADA;
13. Site grading and landscaping; and,
14. Miscellaneous improvements.

6.1.2. Description of Major Facility Components

The following Table 19 describes the major unit processes and features of the project. In addition, refer to Appendix B for Preliminary Design Drawings including:

1. General Notes and Major Equipment Design Criteria;
2. Process Flow Diagram;
3. Schematic Site Plan;
4. Process Overview- Operations Building, Upper and Lower Level Plans;
5. Section of Operations building.

Table 19. WWTF Improvements Description

Process Area	Description
Headworks Improvements	• New Mechanical fine Screen (3 mm opening) to be used in conjunction with the existing screen and install it within the existing Headworks building. • Refurbish the existing mechanical air handling unit
Equalization Tank	• Reuse the existing influent/anoxic equalization tank as influent load equalization tank
MBR Process Tanks	• New partially-buried, covered anaerobic, pre-anoxic and aeration tank • Reuse the existing aeration tanks, partially as aeration tanks and rest as post-anoxic tank • Convert existing 2 secondary clarifiers into 2 new MBR basins
MBR Equipment & Process Piping	• Aeration system blowers, aeration piping, and fine bubble diffusers • Submersible mixers, permeate pumps, backpulse pumps, chemical feed pumps and Internal MLSS recycle pumps • Membrane cassettes and associated permeate pump piping.
Equipment & Operations Building	• 6100 SF existing building expansion and replacement: Replace steel support members/steel walls / metal roof with pre-stressed concrete engineered composite walls and concrete double-T roof • Lower level: pump and piping gallery for RAS/WAS, • First level: Permeate pumps, UV disinfection, electrical/ MCC room, operations room, and break room • Second Level: HVAC room, aeration blowers, chemical storage and feed equipment
Biosolids Handling	• Reuse the existing sludge storage tanks • Reuse the existing centrifuge
Disinfection	• Continue to use existing UV units • Add new units to account for redundancy at PPF
Site Work	• Yard piping • Convert south side of the building into a new carport and construct new retaining wall. • Construct new loading dock adjacent to the carport

Process Area	Description
Electrical/Controls	• New 3-phase-480 V electrical service, equipment, MCC and emergency generator • New process instrumentation including DO/ ORP probes, RAS and MLSS recycle flow meters; SCADA
(Bid Alternate) *New Biosolids Holding Tanks and Dewatering building upgrades*	• *Construct new aerated biosolids holding tanks in place of the abandoned steel equalization tank, upgrade dewatering equipment and install new cover for drying bed.*

6.1.3. Hydraulic Calculations

Detailed calculations including hydraulic calculations and construction of a hydraulic profile will be developed in the preliminary design phase. Preliminary process parameters for the selected alternative were developed using BioWin wastewater treatment software to simulate the MBR treatment process.

Refer to Appendix E for preliminary process calculations and to Table 20 for process parameters used in the design.

Table 20. Process Design Parameters

Design Parameter	Value
MMF, MGD	0.31
Total Basin Volume	247,900 gals
Membrane Flux at 8° C	7.5 gal/sf/day
Design MLSS	8000 to 10,000 mg/L
Design HRT (total) at MMF	18 hours
Design SRT (total)	24 days

6.2. OPINION OF PROBABLE CONSTRUCTION COST

Table 21 presents the preliminary estimates of probable cost by Division. A detailed presentation of estimated costs by Division is presented in Appendix D.

Table 21. MBR Process – Preliminary Estimate of Probable Cost

Division	Description	Cost
1	General Condition	
2	Civil / Site Work	$154,300.00
3	Concrete	$674,800.00
4	Masonry	$25,800.00

Division	Description	Cost
5	Metals	$14,100.00
6	Wood and Plastic	
7	Thermal and Moisture Protection	
8	Doors and Windows	$27,500.00
9	Finishes	$20,000.00
10	Specialties	$6,900.00
11	Equipment	$1,598,100.00
12	Furnishings	$6,500.00
13	Special Construction	
14	Hoists and Cranes	$19,500.00
15	Mechanical / HVAC	$174,800.00
16	Electrical and Instrumentation & Controls	$682,500.00
	Subtotal 1	$3,404,800.00
Construction Prorates	18% of Subtotal 1	$612,900.00
Contractor's Overhead and Profit	15 % of Subtotal 1	$510,800.00
	Subtotal 2	$4,528,500.00
Contingency	25 % of Subtotal 2	$1,132,200.00
	Subtotal 2	$5,660,700.00
Engineering Cost	15% of Subtotal 3	$849,200.00
	Total	**$6,509,900.00**

In addition to the cost analysis summarized in Sections 6.2 and 6.3 with a preliminary estimate of probable capital cost total of $6.5 million, the cost analysis was also completed with the inclusion of the New Mexico Gross Receipts Tax with a cost total of $6.6 million. This parallel cost development is presented in detail in Appendix D.

6.3. ESTIMATED ANNUAL OPERATION AND MAINTENANCE COSTS

The projected O&M costs include energy, chemical and labor costs. The energy cost is based on kWh/day which is provided by the vendor and used in the cost analysis at a cost of nine cents per kWh. The labor cost is based on estimated man hours from the vendor at a cost of $25 per hour. The chemical cost is based on estimated chemical usage for membrane clean-in-place from the vendors for phosphorus removal and external carbon dosing. In summary, the projected annual O&M cost for the new WWTF is $97,600.00. Refer to Appendix D2 for MBR cost estimation including: O&M costs (with the energy cost broken out), short lived asset cost, and salvage cost.

6.4. ANNUAL OPERATING BUDGET

6.4.1. Income

Income projections for the Water/Sewer Department are made using historical water usage income (sales), with adjustments based on observed trends. The 2014 budgeting cycle (projecting for 2015) had used a five year average water usage of 9,888,247 gallons. Recognizing a 4 year downward trend due primarily to low-flow fixtures and the fact that the current level of increased construction and increased occupancy had not yet started, the 2015 budgeting cycle utilized the 2014 actual usage for the 2016 usage projection.

The Water/Sewer Department revenue consists of the "Combined Utility Billing Sales" category which includes water and sewer monthly billings. The "Combined Utility Billing Sales" FY2015 Budget was $684,081 and the "Combined Utility Billing Sales" FY2016 Budget was $754,155. Additional detail is presented in Appendix F.

6.4.2. Operation and Maintenance Costs and Budget

Annual O&M projections for the Water/Sewer Department are made using historical information with adjustments tied to changed conditions. The "Total Expenses" FY2015 Budget was $684,080 and the "Total Expenses" FY2016 Budget was $706,113. Additional detail is presented in Appendix F.

6.4.3. Capital Improvements

The Village has instituted a capital improvements plan development beginning with data collection, water/sewer department, asset inventories and identification of capital plan line items for 5 year and 10 year planning periods.

6.4.4. Debt Repayment

The remaining balance on an existing CWSRF loan for the planning engineering studies associated with the proposed WWTF improvements was $315,000 at the close of 2015.

Assuming a bond is obtained for approximately $6.8 million for construction of the WWTF, the annual debt service is estimated to be $417,818 with a 25 year maturity or $383,578 with a 30 year maturity.

6.4.5. Reserve

The 2015 year end reserve account totals were $507,314 for the Water Depreciation Reserve and $528,269 for the Sewer Depreciation Reserve. The 2015 budgeting cycle (projecting for 2016) set aside the following into reserve accounts: $5,000 for Water, $25,000 for Sewer, an additional $322,511 from the Drinking Water State Revolving Loan Fund into the Water reserve account and an additional $620,651 from the Clean Water Revolving Fund Loan. The 2016 budgeted reserve account totals are $1.07 million in the Water Fund and $1.11 million in the Sewer Fund. The Village FY2015 Budget and proposed FY2016 Budget information is presented in Appendix F.

6.5. PROJECT FINANCING AND 20 YEAR CASH FLOW PROJECTION

The Town is applying for funding for the project through the CWSRF. Thus, the project financing analysis conducted in this PER will be based on the funding terms ultimately obtained through this program. It is anticipated the following loan terms may be representative:

1. Loan terms of 20 years plus the construction period;
2. Zero to Three percent interest rate; and
3. Zero to Two percent administrative fees.

If the Village's application for CWSRF funds is approved for the total minimum project cost of $6.51 million, there is some potential to receive a portion of the funding as a grant. If the Village were to receive a $2.0 million grant, the loan amount under this projected scenario would be $4.51 million with a zero percent interest rate for 20 years.

George K. Baum & Company also prepared two debt structures based on a bond of approximately $6.8 million and current market interest rates with the addition of a 50 basis points buffer (approximately 3.8 percent). The two debt structures, with 25 year and 30 year maturity, are attached in Appendix F.

6.6. PUBLIC HEARING

It is recognized that a public meeting will be required to allow the Village residents to learn more about the project described in the PER and to understand that the Village is planning to request SRF funding for completion of the project. The meeting will be properly announced and recorded, and will be reported to the NMED CPB. Appropriate documentation of the announcement and meeting will be transmitted to the NMED CPB as soon as available, if not included in the loan application package.

7. Conclusion and Recommendations

7.1. CONCLUSIONS

Based on the alternatives analysis that considered both cost and non-cost evaluation criteria, and environmental impacts and benefits, the selected alternative for the Village of Taos WWTF improvements is to replace the existing IFAS/MLE biologic treatment system and clarifiers with a membrane bioreactor (MBR) system. The upgraded facility will be designed to treat a maximum monthly average daily flow of 0.31 MGD, along with an organic loading of 911 lbs/day of BOD_5.

The primary factors that drive the selection of the MBR treatment system over the alternate secondary treatment process options are: high effluent quality, reduced footprint, process stability, flexibility and cost effectiveness.

7.2. RECOMMENDATIONS

The Village WWTF service area is comprised of these general areas: the Base Village, Intermediate Zone and Kachina Village. It is recommended that the Village consider various means of connecting Amizette to the WWTF service area. Some of the methods that may be feasible include: septic and holding vault hauling to the WWTF, and the installation of a fully functional sewer collection system to replace the existing holding vaults and individual septic systems.

The Village has the opportunity to utilize various equipment and methods to achieve energy efficiency as part of the WWTF improvements project. The energy efficiency opportunities listed below require further investigation during design phase for financial and technical feasibility. The energy efficiency opportunities are:

1. Use of insulated pre-stressed concrete panel walls for the treatment building;
2. High efficiency aeration blowers;
3. Energy recovery utilizing the steep slopes present in the gravity sewer collection system;
4. Energy recovery from the effluent leaving the plant;
5. Use of jet nozzles at the pump discharges to induce mixing;
6. High efficiency regenerative heating ventilation and air conditioning unit;
7. Installation of solar panels;
8. Stepped roof and skylights to promote natural lighting;
9. Heat reflective coating in skylights and interior walls when possible;
10. Energy efficient lights such as Light Emitting Diode (LED); and
11. High efficiency ultraviolet (UV) disinfection units.