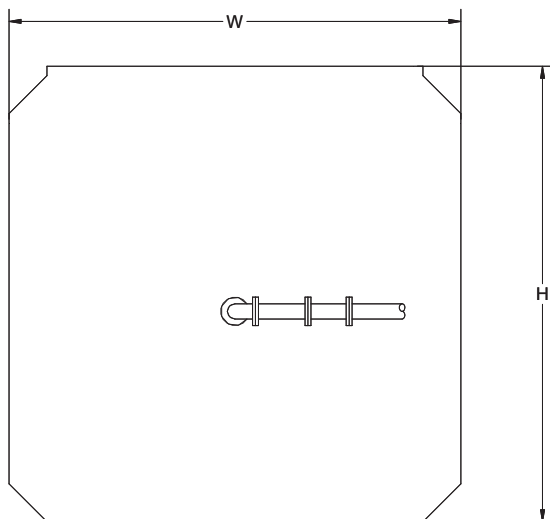
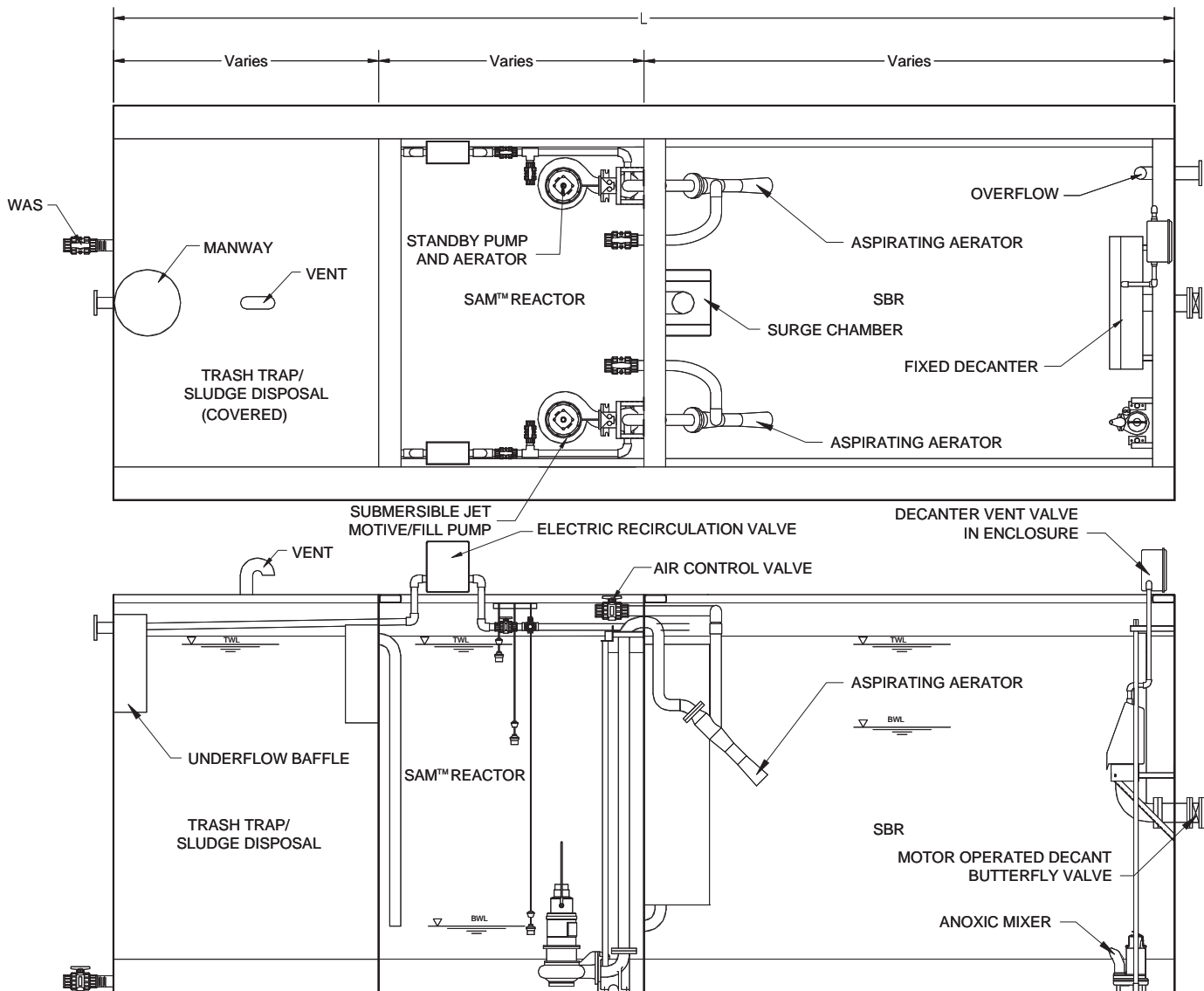


THE EXPERIENCED LEADER IN SEQUENCING BATCH REACTOR TECHNOLOGY



FLUIDYNE SAM™ SBR - BARONA, CA - WEEKLY REPORTS

DATE	INFLUENT					EFFLUENT						
	BOD <sub>5</sub>	TSS	NH <sub>3</sub> -N	TKN	FOG	BOD <sub>5</sub>	TSS	NH <sub>3</sub> -N	NO <sub>3</sub>	NO <sub>2</sub>	TKN	FOG
02/16/05	632	327	20.2	36.0	64.8	2.0	ND	ND	0.1	0.02	0.50	<1.0
02/23/05	338	226	6.7	7.8	45.5	ND	ND	ND	ND	0.02	0.60	ND
03/02/05	813	390	23.5	35.0	75.8	4.6	ND	2.0	0.1	0.01	0.80	ND
03/09/05	653	328	15.1	22.7	88.8	4.9	ND	0.2	0.3	ND	1.10	ND
03/16/05	640	237	23.7	35.9	79.4	2.7	ND	0.2	0.3	0.02	1.10	ND
03/23/05	385	445	24.1	38.2	80.7	2.2	ND	2.0	0.2	0.13	0.70	ND
03/30/05	736	358	15.2	19.3	217.0	10.0	ND	0.1	0.1	0.03	0.50	ND
04/06/05	627	338	28.3	34.5	97.0	9.0	ND	0.4	ND	ND	0.40	ND
04/13/05	784	356	23.0	27.2	31.0	12.0	ND	0.5	ND	ND	0.70	ND
04/20/05	336	223	14.0	16.6	8.4	3.5	1.9	0.4	ND	ND	3.30	<1
04/27/05	579	485	6.7	8.9	27.5	<2	ND	0.3	ND	ND	3.10	<1
05/04/05	940	334	1.0	33.1	48.9	2.9	2.5	1.0	0.1	0.08	2.60	<1
05/11/05	622	330	22.2	74.2	66.7	<2	ND	ND	ND	ND	1.80	ND
05/18/05	718	329	20.8	28.0	492.0	2.2	ND	ND	ND	ND	0.49	ND
05/25/05	575	322	13.1	13.3	450.0	4.6	ND	0.5	ND	ND	0.50	ND
06/01/05	711	688	24.0	25.8	327.0	12.3	ND	0.5	0.2	ND	0.50	ND
06/08/05	508	277	22.4	27.9	52.6	2.4	NO	0.1	0.4	ND	0.70	<1
06/15/05	343	155	14.9	22.5	90.8	<2	ND	0.5	0.4	ND	1.00	ND
06/22/05	661	477	27.6	33.5	87.2	<2	ND	0.2	0.4	ND	0.70	1.1
06/29/05	444	345	32.6	50.5	61.5	2.0	ND	0.1	0.3	0.03	0.50	ND
07/06/05	925	379	27.6	48.1	87.5	1.7	ND	0.2	0.3	0.03	0.80	ND
07/13/05	673	346	33.1	52.5	99.5	<2	ND	0.5	0.5	ND	0.90	<1.0
07/20/05	650	109	29.1	43.0	84.9	<2	ND	0.1	ND	0.04	0.70	<1.0
07/27/05	694	305	33.0	43.0	83.1	<2	ND	0.2	0.3	0.08	0.40	ND
08/03/05	580	324	26.3	28.0	65.9	3.6	ND	0.6	0.3	0.02	0.80	ND
AVG. YTD	623	337	20.9	32.2	116.5	4.6	ND	0.4	0.2	0.03	1.01	ND



MODEL	W	L	H	HP*
ISAM™ 05	6.5	16	10.0	3
ISAM™ 10	8.5	24	10.0	5
ISAM™ 15	8.5	24	12.0	5
ISAM™ 20	11.9	24	12.0	7.5
ISAM™ 25	11.9	30	12.0	7.5
ISAM™ 30	11.9	34	12.0	10
ISAM™ 40	11.9	45	12.0	10
ISAM™ 42	11.9	48	12.0	10
ISAM™ 50	11.9	56	12.0	15
ISAM™ 60	11.9	68**	12.0	20
ISAM™ 70	11.9	72**	12.0	20
ISAM™ 75	11.9	80**	12.0	25
ISAM™ 80	11.9	90**	12.0	25
ISAM™ 90	11.9	96**	12.0	30
ISAM™ 100	11.9	112**	12.0	40
ISAM™ 110	14.0	112**	12.0	40

\* EACH PUMP (ONE IS STANDBY)

\*\* TWO TANKS (EACH TANK IS HALF OF TOTAL LENGTH)



## THE EXPERIENCED LEADER IN SEQUENCING BATCH REACTOR TECHNOLOGY

### The Fluidyne ISAM™ SBR system provides the following benefits,

1. Ability to handle highly variable flows and loading associated with small, to medium size plants. The ISAM™ is more flexible than continuous flow plants. Regardless of flows or loading, aeration and mixing can automatically be adjusted to optimize power and prohibit filamentous growth.
2. At high flows, solids cannot wash out as with extended aeration plants as the ISAM™ SBR process utilizes quiescent settle and decant.
3. ISAM™ facilities are easily expandable by adding a new tank. The additional tank does not require major changes in controls; only a new tank and associated equipment.
4. ISAM™ provides a small footprint with no digesters, secondary clarifiers, RAS piping and pumping.
5. ISAM™ produces the highest quality effluent. Typical Fluidyne ISAM™ facilities are achieving less than 10 mg/l BOD and TSS, less than 1 mg/l NH<sub>3</sub>-N, less than 5 mg/l total N, and less than 2 mg/l phosphorous.
6. Easy to operate and maintain as mechanical equipment is minimized with no chasing of sludge associated with extended aeration plants.
7. Use of self-aspirating jet aerators eliminate blowers and blower accessories.
8. Built in sludge reduction system using the anaerobic selector chamber significantly reduces sludge handling and hauling costs.
9. 100% stand-by aerator is included with the system to allow continuous operation with one unit out of service.
10. Built in flow equalization is provided in the ISAM™ reactor to handle peak hourly flows.
11. Automatic scum skimming prior to effluent discharge provides highest quality effluent.
12. Exceptional after sales service by Fluidyne technicians. Fluidyne employees have been granted over 40 patents in wastewater and water treatment technology and equipment.
13. Reduced operation and maintenance costs as power usage is controlled through the Fluidyne control panel.
14. Installed cost is lower as the system comes with the in-basin equipment pre-installed
15. The anaerobic selector chamber is covered and raw wastewater reacts immediately with mixed liquor in an aerated environment, there are no odor concerns.

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## APPENDIX C.2

### IFAS

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# AnoxKaldnes™

Moving Bed Biofilm Reactor (MBBR)

Integrated Fixed-Film Activated Sludge (IFAS)

and ANITA™ Mox Deammonification

**WATER TECHNOLOGIES**

# AnoxKaldnes™ MBBR and Hybas™ Processes

## AnoxKaldnes™

is the global leader in MBBR and IFAS technologies. Veolia provides the most advanced MBBR and IFAS technologies supported by more expertise and with more installations (600+) than any other MBBR and IFAS system provider.

## AnoxKaldnes™ MBBR

(Moving Bed Biofilm Reactor) is a biological wastewater treatment process that utilizes specialized polyethylene carriers (media) to create a large protected surface on which biofilm can attach. The media is mixed in the reactor, and the large surface area provides more treatment capacity in a smaller volume compared to activated sludge.

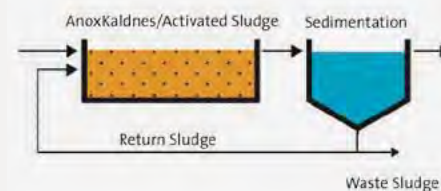
## AnoxKaldnes Hybas™

(Hybrid Biofilm Activated Sludge) technology is an application of the IFAS process in which moving media is mixed into an activated sludge environment. The result is both fixed-film and suspended growth biomass working together and lending the strengths of each to the hybrid process. The Hybas process is excellent for retrofitting existing activated sludge plants to improve ammonia and nitrogen removal.

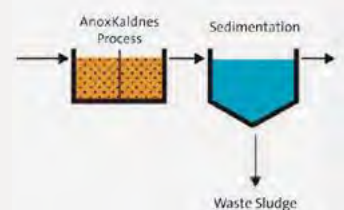
## Advantages

- Simple and reliable operation
- Excellent for ammonia and total nitrogen limits ( $\text{NH}_3\text{-N} < 1 \text{ mg/L}$ ,  $\text{NO}_3\text{-N} < 1 \text{ mg/L}$ )
- Smaller footprint than activated sludge
- Increase plant capacity for nitrification and/or denitrification
- Effective in cold water
- Accommodates a wide range of flow and load fluctuations
- Non-clogging media with a long lifespan
- Flexible design for almost any tank configuration

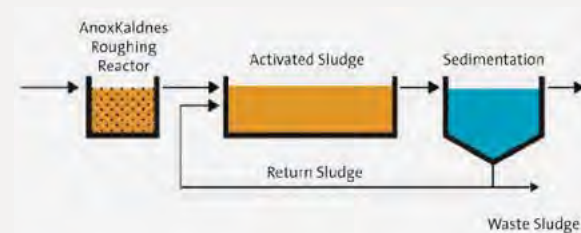
## Hybas™ Technology



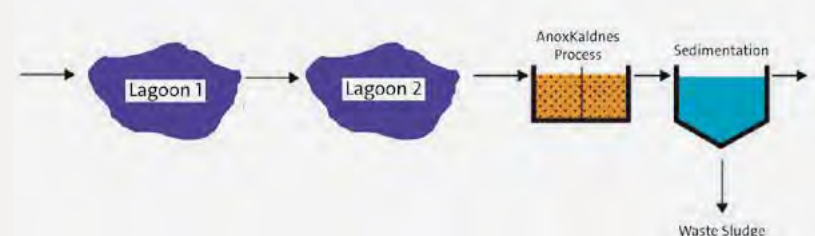
## MBBR



## Biofilm Activated Sludge



## LagoonGuard® MBBR





## Air Grids and Media Retention Screens



### Aerobic Applications

- AnoxKaldnes stainless steel air diffuser system is robust, non-clogging and maintenance free
- Diffusers provide oxygen for process needs and media mixing for optimal biological performance
- Cylindrical screens at reactor's effluent wall retain media while allowing treated water and suspended solids to pass through

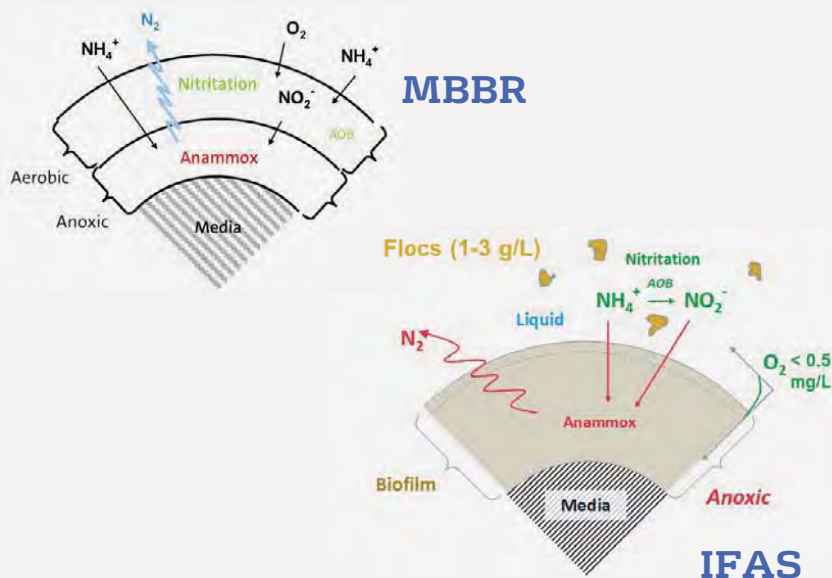
## Mixers and Flat Screens



### Anoxic Applications

- AnoxKaldnes stainless steel air diffuser system is robust, non-clogging and maintenance free
- Diffusers provide oxygen for process needs and media mixing for optimal biological performance
- Flat screens at reactor's effluent wall retain media while allowing treated water and suspended solids to pass through

## ANITA™ Mox Deammonification



### System Supplier Scope of Supply

- Complete process design with effluent guarantees and performance bonds
- Process equipment including media, screens, air grids, blowers, pumps, mixers and valves
- Field Instruments and process control
- Customized SCADA for the highest level of operations monitoring and control

The ANITA Mox process combines aerobic nitritation and anammox reactions simultaneously in a single reactor. With MBBR, the reactions take place in different layers of biofilm on the AnoxKaldnes media. With IFAS ANITA Mox, most of the nitritation reaction occurs in the suspended biomass, while the anammox reaction takes place on the carrier media. The MBBR and IFAS ANITA Mox platforms both provide a robust, stable process with simple operation, energy and chemical savings, and efficient ammonia removal.

# AnoxKaldnes Technology Can Benefit A Wide Range of Plant Sizes



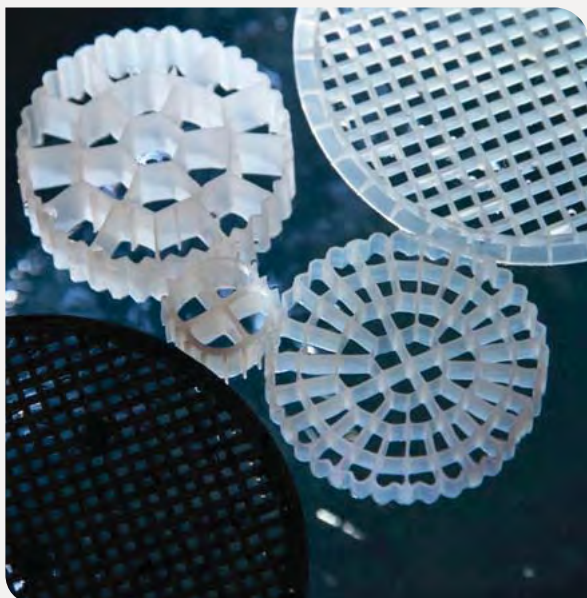
## ***Cheyenne, WY*** ***AnoxKaldnes MBBR***

- In 2005, MBBR replaced trickling filters and was chosen because it is a biofilm process that is compatible with the existing clarifiers.
- Consists of two trains of two pre-anoxic and four aerobic reactors in series to treat 6.5 MGD and achieve BOD <10 mg/L and ammonia <2 mg/L, NO<sub>x</sub>-N <9 mg/L.



## ***Providence, RI*** ***AnoxKaldnes Hybas Technology***

- Ten parallel process trains with a treatment capacity of 77 MGD
- Existing aeration basins converted to a 4 stage process with one IFAS zone per train
- Pre-anoxic stage for denitrification using the influent BOD as a carbon source
- Aerobic Nitrification stage for BOD and Nitrification – IFAS Zone. 52% fill using AnoxKaldnes K3 media type. Total media surface area of 36.3 million square feet
- Post-anoxic stage for additional denitrification using an external carbon source
- Clarification stage for solids separation and collection



## **Winning Combinations**

- *High rate clarification with ACTIFLO®*
- *Primary clarification with MULTIFLO*
- *Filtration with Hydrotech Discfilter*



[illegible]

## South Adams County, CO

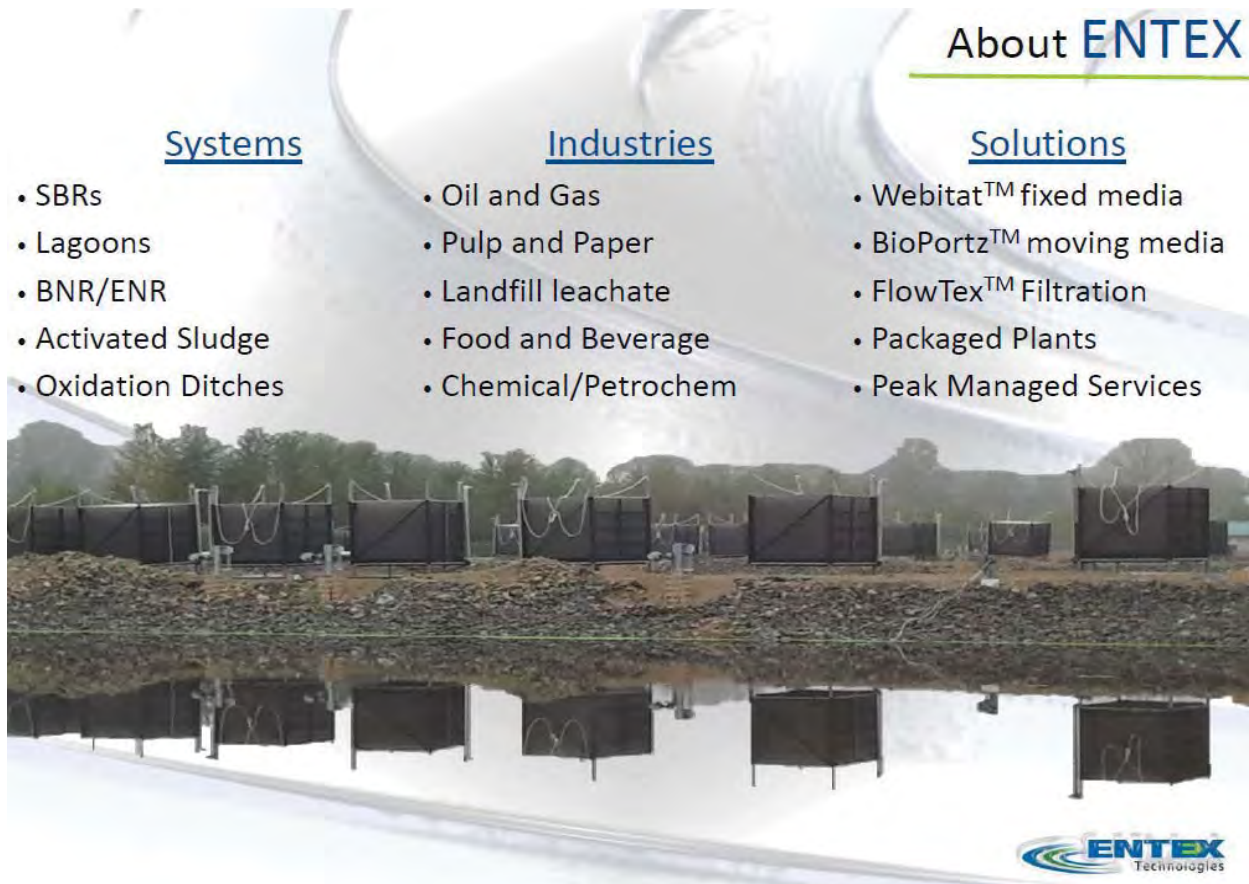


## About Entex

Entex offers an unequalled selection of advanced wastewater treatment solutions. Our solutions effectively address space constraints and budget concerns, as well as ever increasing demands for higher quality effluent and increased plant capacity. Technologies provided by Entex have been selected with confidence to treat more than 60 million gallons per day of design capacity.


Entex provides biological systems for carbon and nutrient removal, including phosphorus and nitrogen control. As a provider of both fixed media (BioWeb) and moving media (BioPortz) processes, Entex offers an unbiased design assessment. The Entex team has been involved in over 750 installations with over a combined 100 years of experience. Additionally, Entex offers a flexible suite of tertiary filtration systems that have been Title 22 approved by the State of California for reuse quality effluent. Entex's filtration systems are designed to further polish final effluent and reduce turbidity for reuse and irrigation purposes.

Entex provides the ability to upgrade treatment facilities to meet the needs of increased capacity and improved effluent discharge requirements, often without the need for additional treatment basins. These systems provide powerful solutions to the challenges facing wastewater treatment systems, offering extraordinary levels of performance typically at a substantially lower cost than conventional solutions.



## About **ENTEX**

<u>Systems</u>	<u>Industries</u>	<u>Solutions</u>
<ul style="list-style-type: none"><li>• SBRs</li><li>• Lagoons</li><li>• BNR/ENR</li><li>• Activated Sludge</li><li>• Oxidation Ditches</li></ul>	<ul style="list-style-type: none"><li>• Oil and Gas</li><li>• Pulp and Paper</li><li>• Landfill leachate</li><li>• Food and Beverage</li><li>• Chemical/Petrochem</li></ul>	<ul style="list-style-type: none"><li>• Webitat™ fixed media</li><li>• BioPortz™ moving media</li><li>• FlowTex™ Filtration</li><li>• Packaged Plants</li><li>• Peak Managed Services</li></ul>



## **About BioWeb™**

Entex's BioWeb is a patented, high strength (+1,000 lbs), lock-knit polyester textile designed to enhance and stabilize microorganism colonization within biological wastewater treatment applications. By introducing a protected surface, microorganisms are allowed to immobilize and increase in concentration, thereby increasing the ability to degrade wastewater constituents and nutrients. Individual filaments form small ½-inch loops that extend from the textile, providing growth sites for biomass. Since the material is lock-knit, it will not unravel and will not dislodge during operation. Each BioWeb row is secured to a horizontal cross member at the top and bottom of the frame, ensuring the BioWeb will remain intact. Additionally, BioWeb is installed in a continuous sheet with 4-inches between vertical rows to allow a greater open area to reduce hydraulic drag. Flow is typically directed parallel to the vertical rows.



### **Intro to BioWeb Fixed Media**

#### **BioWeb fixed-media**

- Lock-knit polyester (will not unravel)
- 16+ years in industry
- 1,000+ lbs break strength
- Optimized design for scour
- 30+ years projected lifespan

#### **Frames**

- Complete welded 304L SS
- Integrated scour aeration
- Custom engineered solutions

#### **Installation**

- Modules delivered fully assembled
- No onsite frame assembly required



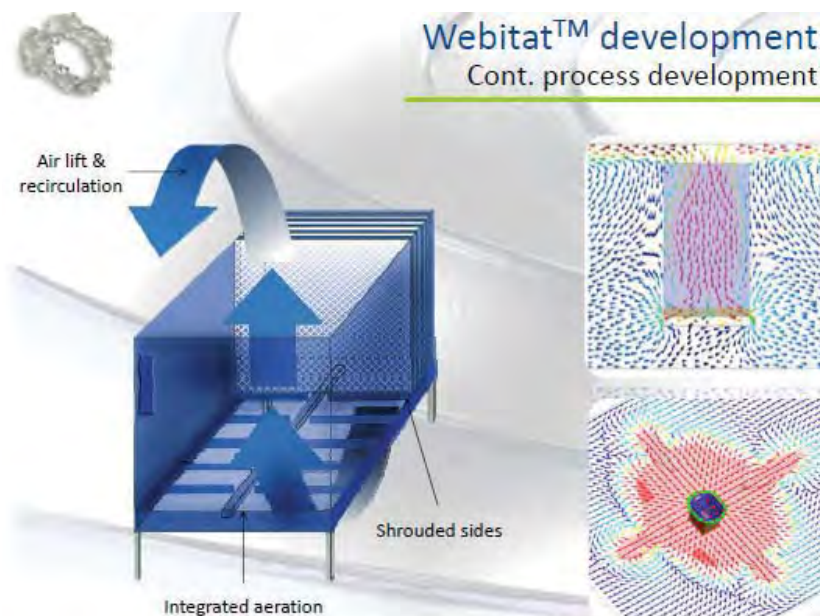
### **BioWeb Fixed media**





## About Webitat™

Entex's Webitat process utilizes BioWeb media and allows a proactive control of the attached biofilm thickness by incorporating an integrated aeration mechanism below each Webitat frame. This dedicated aeration ensures a high rate of shear and serves to create an air lift effect, enabling continuous circulation of influent substrate. As a result, substrate transfer and diffusion rates can be optimized. Each Webitat is shrouded to confine and direct the integrated aeration into the BioWeb media, increasing scour efficiency. The integral aeration flux rate can be controlled via dedicated Webitat process valving to provide proactive operation and process control. The enclosed Webitat module operates as its own high-rate biological reactor, enhancing mixing and biomass inventory. By regulating Webitat aeration, performance can be optimized to meet plant specific needs.



- Baseplate, for lagoon applications

- Shrouded sides confine aeration pattern and create air lift pump, substrate is drawn into Webitat unit

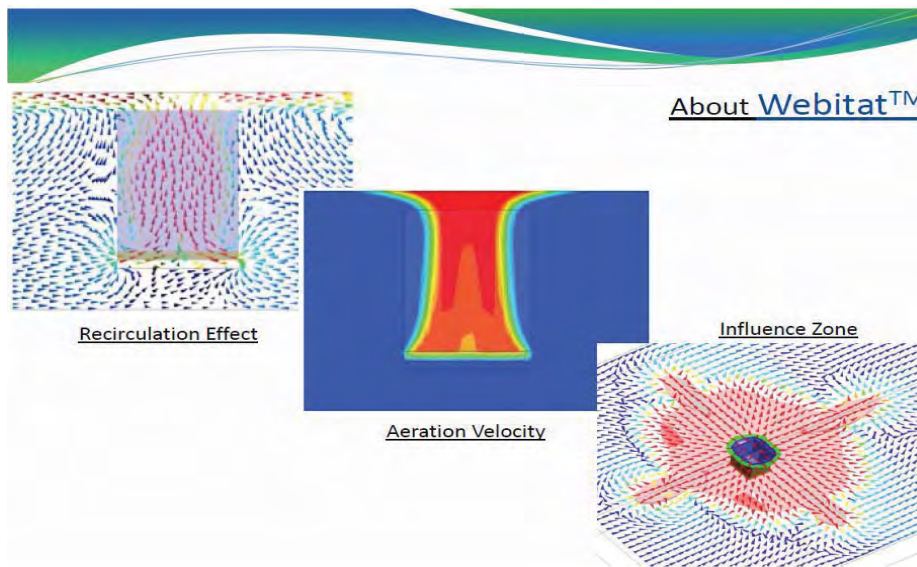


- Integral aeration

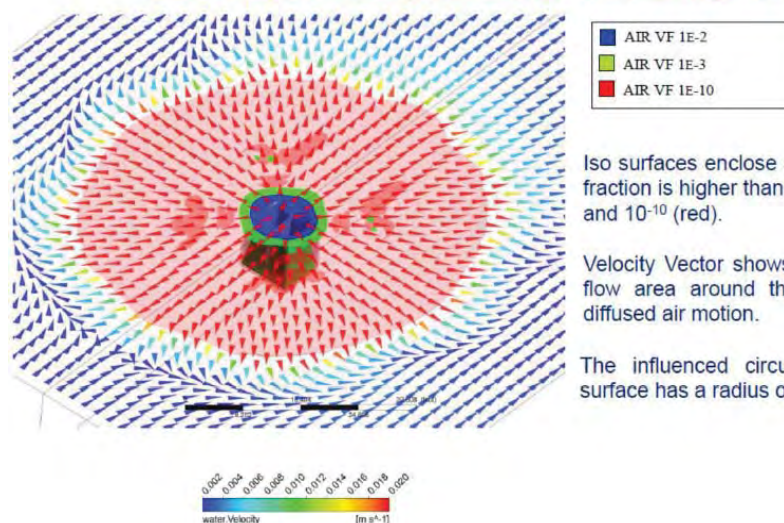


## About Webitat cont...

Each Webitat module can be programmed to operate independent of other Webitat modules to allow additional process flexibility, aeration adjustment and mixing control. When operated in activated sludge systems, the Webitat aeration process minimizes bypass potential and forces substrate to be recirculated continuously. Complex CFD analysis has been performed to demonstrate the recirculation effects and mixing intensity of the Webitat aeration (see below). Under normal aeration rates, Webitat modules can recirculate in excess of 4 MGD per module and can impact liquid movement to negate bypass. This ensures conventional processes are well mixed.



## Iso surfaces plot and velocity vectors



Iso surfaces enclose areas where air volume fraction is higher than  $10^{-2}$  (blue),  $10^{-3}$  (green) and  $10^{-10}$  (red).

Velocity Vector shows the extent of induced flow area around the Webitat due to the diffused air motion.

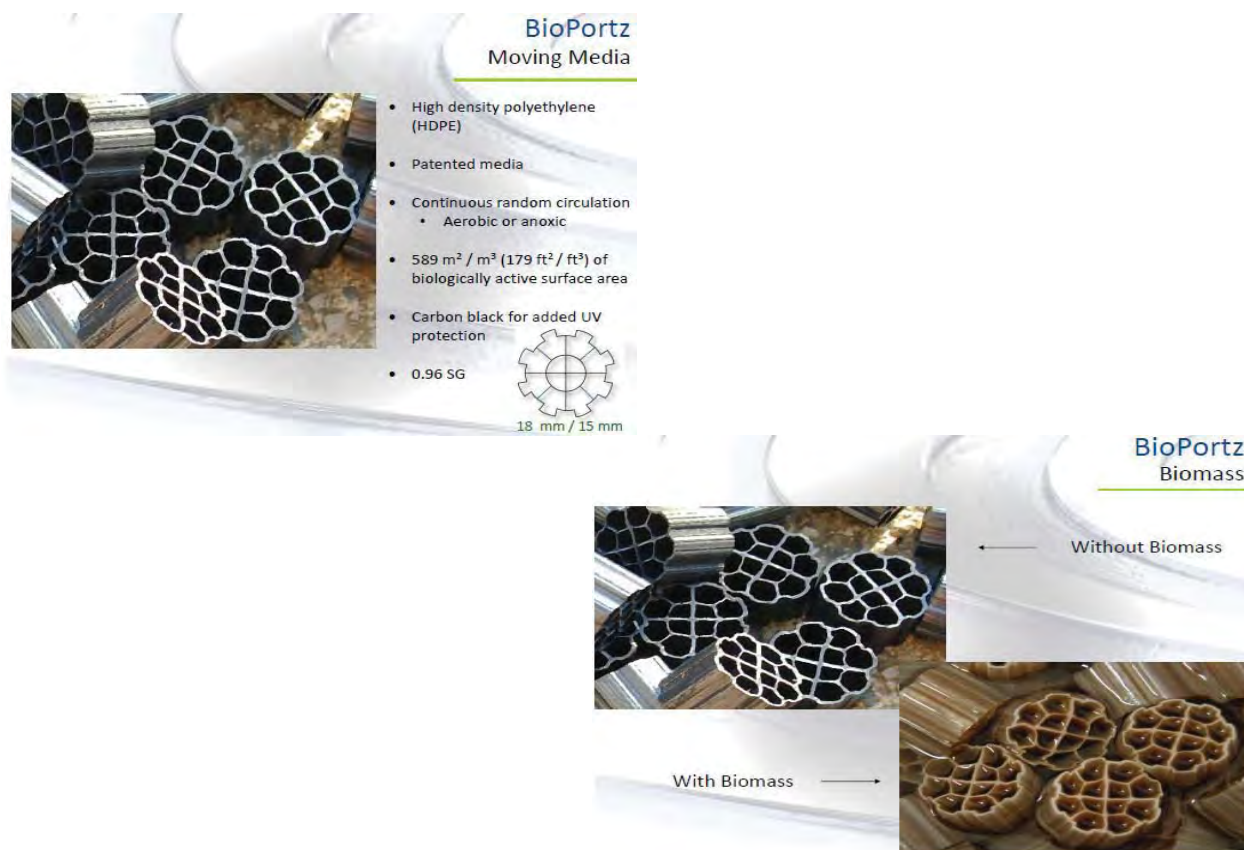
The influenced circular area at the free surface has a radius of 32'.

## About BioPortz

BioPortz is a high density polyethylene (HDPE) extruded media designed to enhance and stabilize microorganism colonization within biological wastewater treatment applications. By introducing a protected surface, microorganisms are allowed to immobilize and increase in concentration, thereby increasing the ability to degrade wastewater constituents. Independently moving BioPortz carriers continually circulate through the treatment basin in a random motion, ensuring excellent oxygen and substrate transfer to the biomass. Because little or no additional tankage is typically required, BioPortz offers an effective solution for plants with limited room for expansion. Additionally, it is also an excellent solution for space efficient, high performance new treatment basins.

BioPortz moving media provides  $589 \text{ m}^2/\text{m}^3$  of protected biological surface area for biomass growth. The attached biomass populations can more than double the effective MLSS concentration. The vigorous motion of the media through the basin provides a high shear, creating higher biological kinetics.

BioPortz media is approximately 18mm in diameter and 15 mm in cylinder length. This allows for a more open effluent media retention screen design, minimizing head loss and plugging or blinding potential. Entex's design incorporates a 10-mm slot width. Inlet screening is thereby less stringent and can be as large as 6-mm.



# Resourcing the world

**Veolia Water Technologies**

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**APPENDIX C.3**  
**MBR PRELIMINARY PROPOSAL**

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78758  
USA  
**Telephone:** 512.834.6000  
**Facsimile:** 512.834.6039  
**www.ovivowater.com**

# MBR Preliminary Proposal

Village of Taos Ski Valley MBR, NM

October 28th, 2015

Ovivo Proposal #100215-1-AK-R1

## Prepared For

**FEI Engineers**

Kee Venkatapathi, CWP

5325 S Valentia Way

Greenwood Village, CO 80111

Phone (303) 300-3464

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October 28th, 2015

Kee Venkatapathi, CWP  
FEI Engineers  
5325 S Valentia Way  
Greenwood Village, CO 80111  
Phone (303) 300-3464

**RE: Village of Taos Ski Valley, NM– Preliminary Proposal #100215-1-AK-R1, Membrane Bioreactor System**

Mr. Venkatapathi:

Thank you very much for your interest in the Ovivo Membrane Bioreactor (MBR) system and for giving us the opportunity to propose our system. We are providing the revised proposal based on the revised design criteria and your suggestions as of 10/13/2015

For over 15 years, Ovivo has been supplying our MBR technology offering simple membrane equipment packages to meet project specification or complete solutions to wastewater treatment problems. Ovivo's multidisciplinary staff brings more true MBR system experience than any other company. Our MBR systems include multiple, proven technologies allowing flexible, adaptable operation. This adaptability to operate over a range of different conditions improves overall system performance compared to conventional treatment processes and MBRs with hollow-fiber membranes. At Ovivo, our goal is to provide customers with comprehensive system solutions to their wastewater problems.

With this proposal, we have included Design summary, Biowin modeling reports, Scope of supply, Preliminary Layout, Operation and Maintenance estimates and Screening requirements. Please let us know if you need any more information to help you with your analysis.

## Main advantages of proposed MBR design for Village of Taos Ski Valley:

### Minimal construction requirement

All process basins will be retrofitted in existing structures. The pre-anoxic basin could be retrofitted in the existing rectangular EQ/AX basin by partitioning the basin. The required Pre-aeration volume can be retrofitted partly in EQ/AX basin and partly in Aeration basin and would work in series. The Post Anoxic basin would be retrofitted in aeration basin as well by partitioning the basin. The membranes can be retrofitted in the two existing clarifiers. This design would lead to low construction cost and speedier total project execution schedule.

### Ability of the proposed MBR system to handle the 0.44MGD Peak

The proposed design can handle the peak of 0.44MGD both hydraulically and biologically and meet the treatment limits specified in the attached Design Summary. The membranes can handle 2Q or 0.62MGD peak hydraulically. The equipment and process basins are sized to handle 0.44MGD max

## Flexibility to handle startup flows

OVIVO MBR presents unique ability to handle start up flows and loads because the plant can be run at low MLSS of about 5,000mg/l. With ability to bypass certain process basins at startup, the system can meet the required limits. Biowin report for startup condition is attached for review

## Solids handling

Sludge will be periodically wasted from the MBR basins where the mixed liquor concentration is the highest (10,000mg/l-12,000mg/l). This results in reduced sludge volume in comparison with other technologies and hence reduced solids processing requirement.

## Intermittent treatment during construction

OVIVO's deployable MBR system- microBLOX is available for rental for treating the incoming flow during construction. Based on the startup conditions provided on 10/23/2015, we would require Two (2) microBLOX units of size 8.5'W x 45'L x 12'H. These are permit compliant units that would be provided complete with screens to permeate pumps (and UV disinfection if required) and meet the startup treatment limits. They would need a 6" equipment pad for installation.

## Evaluation of MBR technology

MBR technology has both cost based and non-cost based advantages over conventional technologies. While comparing costs, the total installed costs need to be taken into account. **Conventional technologies would require clarifier, tertiary treatment and higher disinfection capacity to achieve good effluent quality.**

1. **Modular expansion capability:** MBR systems are normally designed and built in modular formats. Existing MBR systems can be extended by adding further modules
2. **Smallest footprint:** Decoupling of HRT and SRT and running at high MLSS allows MBR to accomplish treatment in a small footprint
3. **Consistent and high quality effluent:** Value of MBR process is not only in high quality but more so in consistency of it independent of shock loads and flows.
4. **No tertiary treatment equipment:** MBR does not need any tertiary treatment to achieve the required effluent quality.
5. **Reduced Disinfection:** Membranes being ultrafiltration, create a physical barrier for microorganisms (pathogens, bacteria and viruses) to permeate. The effluent is nearly "disinfected" quality. This means reduced disinfection requirements saving equipment , O&M and energy costs
6. **Consistent effluent quality:** Operation at higher MLSS concentration results in more consistent performance with concentrated active biomass. The typical MLSS in MBR basins are 8,000 – 12,000 mg/l, compared to 3,000 – 7,000mg/L for CAS systems. This can reduce the HRT significantly. The elevated biomass concentration allows for very effective removal of both soluble and particulate biodegradable materials at higher loading rates. It also tolerates for wider changes in hydraulic loading without going into shock. Furthermore, increased SRT, usually exceeding 10 days, ensures complete nitrification, an important consideration in securing consistent effluent quality.
7. **Reduced operations costs:** MBR systems operation needs no permanent operator attendance, no operating chemicals, long sludge discharge intervals, little processing sequences and consistent effluent quality, will guarantee the minimum operating cost. To operate and maintain MBR minimal daily and weekly operator tasks are required. It can be remote operated. MBR technology is nearly "Plug & Forget" system.
8. **Lower waste sludge production:** The ability of MBR hold higher concentrations of MLSS, and having much longer SRT than in CAS, allowed the MBR system to produce less waste sludge compared to CAS systems and consequently needs less sludge disposal frequency

9. Less sludge dewatering: MBR systems are designed to work with higher MLSS concentration and less frequent SRT (compared to CAS systems), resulting in low frequency sludge dewatering. Sludge dewatering takes place directly from the MBR basin tank-no need for process-clarifier/sludge holding tank.
10. Ease of operation and less operator attention: In CAS systems, there are many factors that sludge settling characteristics can change from one day to another. This requires time spent in lab analysis of several sludge samples. Subsequent adjustments to the plant (i.e. adjusting process cycles of CAS) might be needed, to maintain good settling characteristics. MBR process is not dependent on sludge settleability and can be remote monitored.

## Equipment and service Price

The preliminary pricing for the proposed attached scope of supply is approximately **\$1,059,000**. This includes field service and freight. The cost of microBLOX rental would be **\$20,000/unit** and does not include freight.

This Preliminary Proposal constitutes a non-binding estimate of price for certain goods and/or services. We look forward to working with you on this project. Please do not hesitate to contact me or our local representative, Steve Hansen of AmbienteH2O at 303-433-0364, [shansen@ambienteh2o.com](mailto:shansen@ambienteh2o.com), if you have any questions.

## Ashwini Khare

Regional Manager, MBR Systems  
2404 Rutland Drive  
Austin Texas, 78758 U.S.A.

Tel: 512.834.6036

Fax: 512.834.6039

Email: [ashwini.khare@ovivowater.com](mailto:ashwini.khare@ovivowater.com)

*Enclosure*

Cc: Steve Hansen, AmbienteH2O



## Membrane Technology Experience

As an MBR system supplier, Ovivo has multiple membrane technologies available. Ovivo's approach is to utilize the membrane technology that can provide the best value to each project. For the Whitefish MT project, Ovivo's proposal includes OV-416 membrane units which utilize Microdyn-Nadir membrane technology. The OV416 Membrane Unit is simply an upgraded version of the BIO-CEL Module (made by Microdyn-Nadir) using PES Nadir<sup>®</sup> UP150 membranes (also made by Microdyn-Nadir). Microdyn-Nadir is a premier membrane manufacturer that has an exclusive long-term commitment with Ovivo. Ovivo's membrane units OV100, 200, 300, 416, 460, and 1900 all use the same membrane, the UP-150, which has been produced by Microdyn-Nadir since 1991, and it is Title 22 approved.



## OV400 Membrane Technology

Ovivo's decision to develop OV technology using Microdyn-Nadir membrane sheets was both data driven and based on experiential factors. For example, we know that; screen by-pass (damaging debris) is responsible for 76% plate failures. We also know the plant design and site conditions can lead diffuser clogging and or localized dewatering. Once diffusers are clogged, or dewatered solids collect in the channels between the plates, air scouring is selectively pushed to specific areas. Sustained higher air scouring in some areas can lead to excessive aeration, also called over aeration. Dewatering and over-aeration are the second leading causes of reduced capacity and have caused 21% of the plate damage identified in a recent survey of 185 facilities. In fact, over-aeration will soon take the number one spot as the primary cause of membrane failure/replacement. For these reasons and others, Ovivo engineers set out to design a membrane unit that uses non-clogging diffusers and is:

## LEADING CAUSES

**MEMBRANE DAMAGE**

**REDUCED CAPACITY**

**74%**  
FINE  
SCREENING

**#1**  
PLANT  
DESIGN

**21%**  
SITE  
CONDITIONS

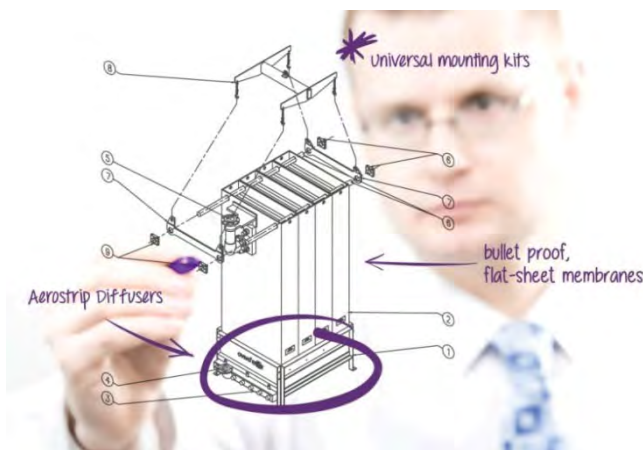
**#2**  
SITE  
CONDITIONS

1. Resistant to debris damage
2. Easy to recover from dewatering
3. Easily installed in any size, shape tank
4. Easily retrieved

To accomplish these performance goals, Ovivo chose the Microdyn BIO-CEL technology using UP150 membranes as the basis for the OV416.

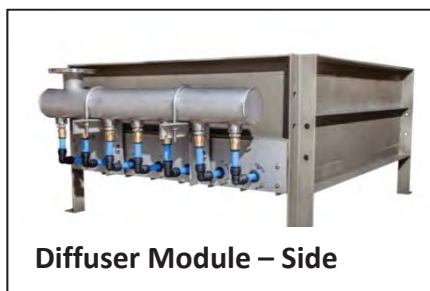
The UP150 membrane that is used in the OV416 has been **in production since 1991** and is **installed in 1,000s of locations** worldwide through a network of partners. The BIO-CEL Membrane Module was introduced to the market in 2005 and since then approximately 1,700 modules and approximately **1,200,000 m<sup>2</sup> of membrane area have been installed worldwide**. Applications range from municipal to food production plants to electronics, from tuna processing in Mexico to Dairies in South Africa and the United Kingdom.

Ovivo improved on the BIO-CEL design by replacing the OTT tube-style diffuser with **Aerostrips (1,500 installations)**. Since becoming the licensee in 2013, there are already **31 U.S. MBR projects**, multiple Membrane Thickening Projects (MBTs) and 7 KUBOTA replacement projects underway.



Some of the key U.S. projects underway include a 4 MGD job in KY, a 2.5 MGD job in FL (expandable to 5.0 MGD), a 1.0 MGD (expandable to 2.0 MGD). The OV is selected for all of the jobs and dozens of others. 5 plants are operating now and 7 should be online before the end of April. For comparison, the SP technology Ovivo use to integrate the Canton project (world's largest MBR) is installed in U.S. plants. The quick acceptance of the technology was due in large part to the intuitive advantages of the non-clogging diffuser and the pliability of the flat-sheets (versus rigid plates).

Diffuser clogging is virtually eliminated using Aerostrip Diffusers as is the potential for membrane dewatering. At the moment, if localized dewatering occurs, the plates must be manually (physically) cleaned.



In the event a system upset, the OV unit can be serviced quickly. The main reason for this is the flexibility of the pliable flat sheets. If dewatering occurs the solids simply fall out once lifted and or aerated. Another advantage of the fused, 2 mm, pliable sheets, instead of the 6mm, rigid plates (or fibers for that matter) is the resistance to debris damage. Damaged sheets heal within about 4 minutes even from severe damage such as cuts, tears or abrasions. This sheet maximizes self-healing and is truly **BulletProof**.

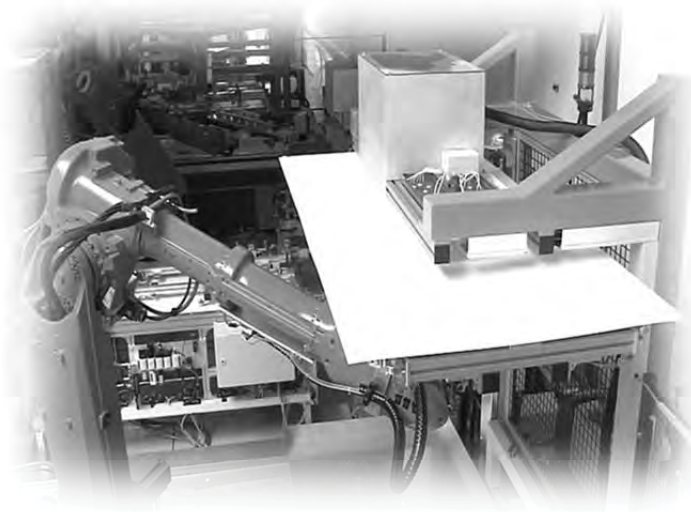


For these reasons, the OV416 membrane has longer life compared to other manufacturers and so we can offer upto **10-yr non-prorated membrane warranty if required at an additional cost**. For Life Cycle Cost Analysis, the membrane replacement should be based on the membrane warranty offered by the supplier. For Ovivo MBR systems, with 10 yr warranty there is only one membrane replacement in a 20 yr period.

The manufacturing process of OV-416 is sophisticated and efficient. Its fully automated and goes through the following steps:

- Casting of polyethersulfone (PES) on non-woven polyester sheet
- Drying process
- Coated sheets along with polyester spacer layer and adhesion layers are ultrasonically welded
- Measuring, cutting of membrane sheet
- Placement of attachments, grommets and connections
- Assembly of membrane cassette

The membranes are currently manufactured in Germany and the diffusers assembled in Austin. The current lead time is 8-10 weeks for membrane units, however we always have spare in our stock which can be shipped immediately if required. It is anticipated that membrane manufacturing would begin in US in the next couple of years at which point the lead time will be reduced to 4-6 weeks.



To summarize, market feedback and field observations suggested that ideal membrane unit should have the following features and we were to achieve all these through the OV416 membrane unit:

1. Easily fit into any geometry tank for retrofit projects (square, circular, shallow or deep)
2. Use **UF** membranes as another barrier for (direct potable) reuse or RO feed
3. Be less susceptible to poor screening and debris
4. Allow for overaeration
5. Have non-clogging diffusers
6. Minimize dewatering potential
7. Have a higher packing density
8. Meet **Buy America**

As System Supplier, Ovivo is focussed on all the system components and how well they work with each other to provide a user-friendly and efficient system for the end user. Membrane is just one part of the equation; system efficiency, ease of operation and maintenance should all be considered.



Screening requirements vary widely between different MBR manufacturers. It is dictated by variety of reasons like spacing between individual membrane sheets/plates or fibers, susceptibility to clogging due to presence of fiber in influent.

Ovivo recommends a **3 mm perforated** plate fine screen and **no RAS screening** for our Ovivo membrane unit. These simple screening requirements result in lower capital and O&M costs, as well as less plant complexity, and should be taken into account when evaluating different MBR technologies.

### **Coarse Screening**

Coarse screens are required if the fine screens have 2mm apertures or smaller in order to protect the screen. They should be considered in front of 3mm bar screens if the influent is a combined sewer that flows by gravity to the MBR (not pumped)

### **Grit Removal**

Many Ovivo MBR Systems are installed without grit removal. In most cases, the drivers for including grit removal is either protection of fine screens, especially for fine screen apertures less than 3mm, or for reducing the overall risk of damaging membranes, especially in larger systems. In general, grit concentration in the raw influent flow should be less than 5 mg/l.

### **Fine Screening**

All Ovivo MBR Systems are required to have fine screens. Ovivo MBR System warranty requires that influent be pre-screened. Screening requirements are as follows:

1. 3.0 mm (3.2 mm acceptable) aperture size or less for perforated plate type screens
2. 1.0 mm slot size for bar type screens

In addition to the above requirements, it is recommended that the Coarse Suspended Solids (CSS) concentrations should be maintained at < 200 mg/l. No warranty limit is imposed on it my Ovivo.

It is up to the screen supplier to guaranty screen performance. Moreover, membrane damage caused by screenings is not covered under warranty unless the screen is furnished by Ovivo as part of the MBR System.

### **FOG Removal**

Generally we recommend FOG be no more than 20% of BOD5, by weight, for municipal applications.

GE Power & Water  
Water & Process Technologies

# LEAPmbr

*simple • reliable • efficient*



Taking ZeeWeed\* MBR technology to the next level



GE imagination at work

## Addressing Our Customer's Challenges

GE has always strived to help our customers create sustainable water supplies to alleviate scarcity issues, provide cleaner water bodies, meet the needs of growing populations and the world's highest standards for water reuse. As the global membrane bioreactor leader, with over 5,000,000 m<sup>2</sup>/d (11.32 BGD) of ZeeWeed MBR capacity, our MBR systems have continued to combine proven ultrafiltration technology with biological treatment for municipal, commercial and industrial wastewater treatment and water reuse applications.

With over 25 years of proven MBR experience, GE continues to set the industry standards for research & development, membrane manufacturing, system design and customer support. When our customers challenged us to find a solution to their biggest challenges: productivity, footprint, operation simplicity and energy costs, we answered. Building on two decades of ZeeWeed MBR product innovation, GE now introduces the new LEAPmbr to address our customers key wastewater treatment challenges and provide the low energy and advanced performance solution demanded by the global wastewater treatment and reuse market.

At GE we manufacture our membranes utilizing the most advanced mass production methods, while delivering the most reliable MBR membrane product in the world, living up to our reputation as quality leaders. With LEAPmbr, we continue this tradition with the release of our most robust, highest performing ZeeWeed 500 series product to date, delivering the lowest installed and operating costs in the history of our ZeeWeed products.

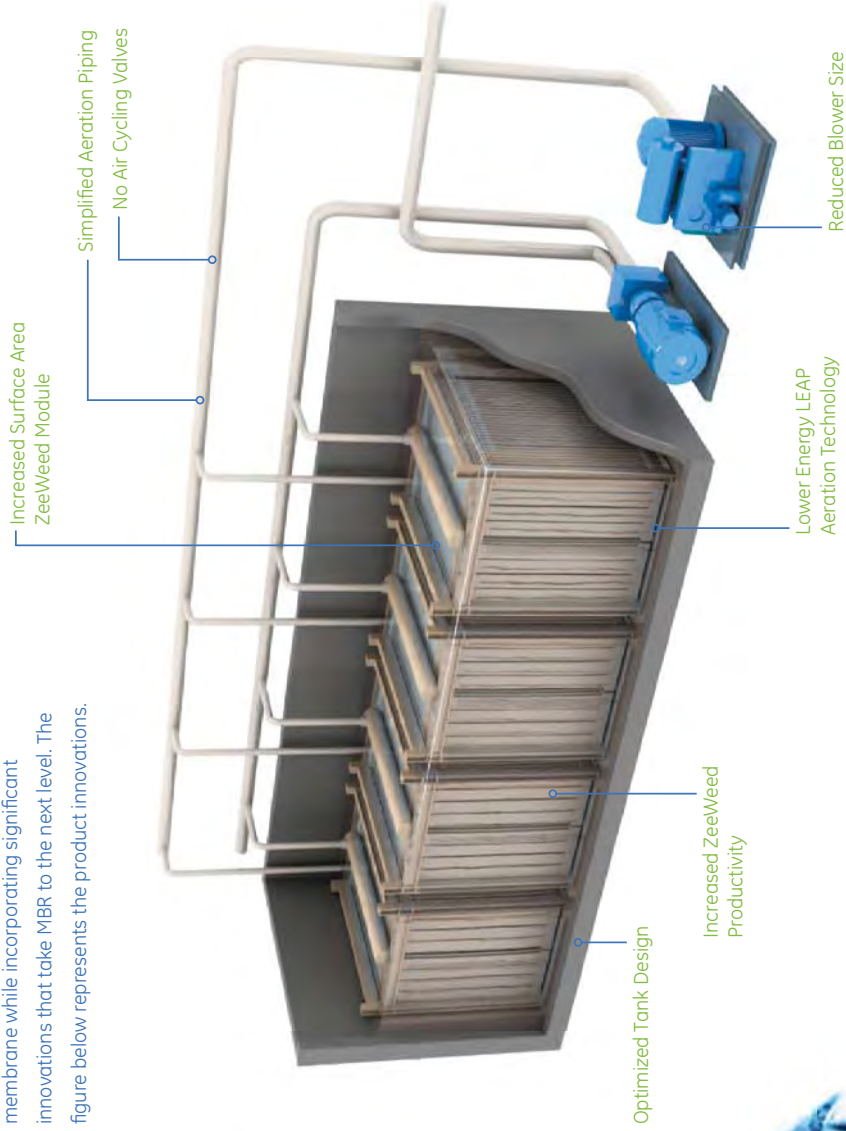
The design of an MBR plant is a balance between flexibility and simplicity, both in design and operation. GE's approach is to incorporate maximum flexibility into our plant designs to give operators a complete toolbox to manage all events; GE achieves this by providing automation that simplifies operator touch. With the new LEAPmbr we have achieved a new level of simplicity, while not compromising on flexibility.

## What is LEAPmbr?

Our new level of ZeeWeed MBR technology was developed to address our customers' challenges of productivity, footprint, simplicity and energy savings. LEAPmbr builds on our 25 years of MBR experience to deliver the most advanced ZeeWeed MBR solution to date. At its core, LEAPmbr uses the industry's most trusted leading ZeeWeed membrane while incorporating significant innovations that take MBR to the next level. The figure below represents the product innovations.

# LEAPmbr

simple • reliable • efficient



**Increased Productivity**  
Boost your productivity 15% with our latest ZeeWeed membrane.

**Smaller Footprint**  
Save on construction costs with a flexible design that reduces your MBR footprint by 20%.

**Simplified Design**  
Simplify your design by reducing membrane aeration equipment and controls by 50%.

**Energy Savings**  
Reduce your operating costs with a 30% energy savings.

**Guaranteed Reliability**  
Have the confidence of the strongest, most reliable membrane in the industry.

# Case Studies

## Marco Island Florida, USA

During the winter months, the population of Marco Island, Florida can double due to tourism, which places an increased demand on the wastewater treatment facility. In 2007, the existing conventional treatment facility was expanded to a membrane bioreactor (MBR) since it required an increased treatment capacity but lacked space to expand plant footprint.

The effluent produced at Marco Island exceeds the discharge requirement and provides high-quality reuse water which is a continuous and reliable supply of irrigation water for golf courses and residential properties.

Marco Island was selected for testing of the LEAPmbr technology beginning in May 2010. Process testing was done compared to previous aeration and performance standards. The results of over a year of testing have demonstrated significant energy savings and productivity improvements.



## Facility in Southern Ontario, Canada

The population of Southern Ontario continues to steadily grow, and several membrane bioreactors facilities with GE ZeeWeed membranes have been installed to treat the increased capacity demand and address tighter regulatory requirements. An existing MBR facility in Southern Ontario utilizing ZW500d membrane modules was retrofitted with LEAPmbr technology in early 2011.

Process testing was done to verify product performance at various operating conditions.

Test results showed considerable increased system performance at reduced aeration flow rates compared to previous aeration methods. Not only that, but LEAPmbr also eliminated foaming issues that had previously existed at the wastewater facility.

Increased performance, lower energy levels and simplified operation were successfully demonstrated for LEAPmbr in this full scale application.



Contact our team of global experts for more information or a plant specific presentation.

Global Headquarters  
4636 Somerton Road  
Trevose, PA 19053  
USA  
Tel. +1 215 355 3300

[www.ge-energy.com/LEAPmbr](http://www.ge-energy.com/LEAPmbr)

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GEA19111 (07/2011)



GE imagination at work



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**APPENDIX C.4**  
**FINE SCREEN**

---

## Lakeside's *RAPTOR*® Micro Strainer

**Ideal for small  
treatment plants**



- Removes solids that pass through other screens
- Single operational unit screens, compacts and dewateres
- Minimizes maintenance costs

## Innovative Screening Solutions

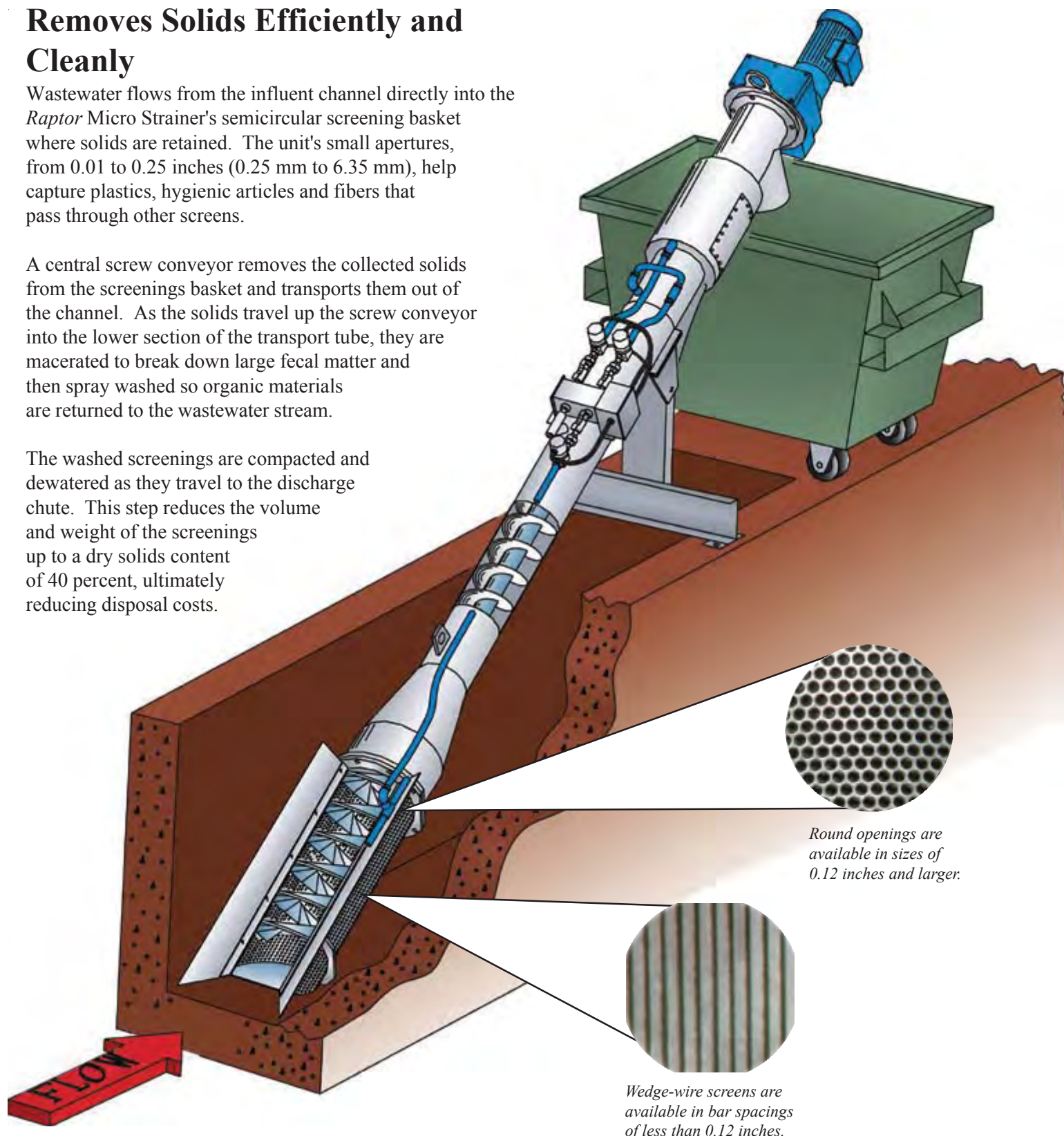
The Lakeside *Raptor* Micro Strainer meets and exceeds the expectations of operators worldwide by providing innovative screening solutions. Not only does the *Raptor* Micro Strainer remove solids from narrow channel installations but it also washes and dewateres the captured screenings. The *Raptor* Micro Strainer features simple design and operation and high removal efficiency with low disposal costs.

### Removes Solids Efficiently and Cleanly

Wastewater flows from the influent channel directly into the *Raptor* Micro Strainer's semicircular screening basket where solids are retained. The unit's small apertures, from 0.01 to 0.25 inches (0.25 mm to 6.35 mm), help capture plastics, hygienic articles and fibers that pass through other screens.

A central screw conveyor removes the collected solids from the screenings basket and transports them out of the channel. As the solids travel up the screw conveyor into the lower section of the transport tube, they are macerated to break down large fecal matter and then spray washed so organic materials are returned to the wastewater stream.

The washed screenings are compacted and dewatered as they travel to the discharge chute. This step reduces the volume and weight of the screenings up to a dry solids content of 40 percent, ultimately reducing disposal costs.



Round openings are available in sizes of 0.12 inches and larger.

Wedge-wire screens are available in bar spacings of less than 0.12 inches.



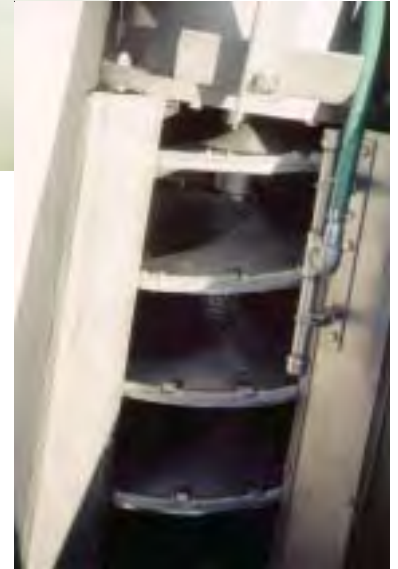
# Design Features

## Superior Design and Construction

- All stainless steel construction for superior corrosion resistance.
- The simple mechanical design requires very little maintenance which is ideal for small plants.
- A hinged structural support permits the unit to pivot out of the channel so all maintenance can be done above floor level.
- An uncomplicated drive assembly makes the unit easier to service and reduces maintenance costs.
- The unit is shipped fully assembled to minimize installation expenses.
- Lower polymer bearing blocks promote longer brush life and can be replaced without disassembling the screen.
- Thicker materials than competing units (0.25 in. thick outer tube and 0.12 in. thick basket) provide longer life.
- All mating parts are machined to ensure proper rotation.



*The Raptor Micro Strainer's enclosed drive assembly reduces maintenance expenses.*



*The stainless steel, shaftless screw conveyor improves screening performance.*



## Exceptional Efficiency and Handling

- The unique screening basket and 35° to 45° angle of inclination provide high removal efficiency.
- A two-stage screenings wash water system aids in returning organic material to the wastewater stream.
- An integrated screening press reduces the volume and weight of screenings for lower disposal costs and cleaner operation.
- An enclosed transport tube and optional bagging attachment reduce odors and offer a clean working environment to the operator.
- An optional insulation and heating system permits operation in cold climates.



## Additional *Raptor* Micro Strainer Features

### Control Panel

Lakeside control panels are PLC equipped for versatile and efficient operation. Explosion-proof designs are available.



*Operation is completely automatic.*

### Factory Pre-Wired

*Factory pre-wired solenoid valves save installation costs.*



### Optional Bagging Attachment

*The optional continuous bagging attachment provides a clean work area.*



### Optional Weather Protection System

Available for all sizes of screens and transport tubes, the Lakeside weather protection system protects to 13° below zero (minus 25° C).



*Constructed of fiberglass reinforced polyester laminate.*

## Lakeside *Raptor* Screening Products

**Fine Screen** - Unique 3-plane screen design provides greater screenings removal efficiency without blinding.

**Complete Plant** - Screens inorganics and removes grit in one self-contained unit.

**Rotating Drum Screen** - With bar spacings as narrow as 0.01 inches, screens the finest solids.

**Septage Acceptance Plant** - Removes inorganic solids from municipal, industrial and septic tank sludge.

**Wash Press** - Lowers disposal costs by reducing the volume and weight of screenings.

## Other Lakeside Screening Products

CSO Screens

Stormwater Screens

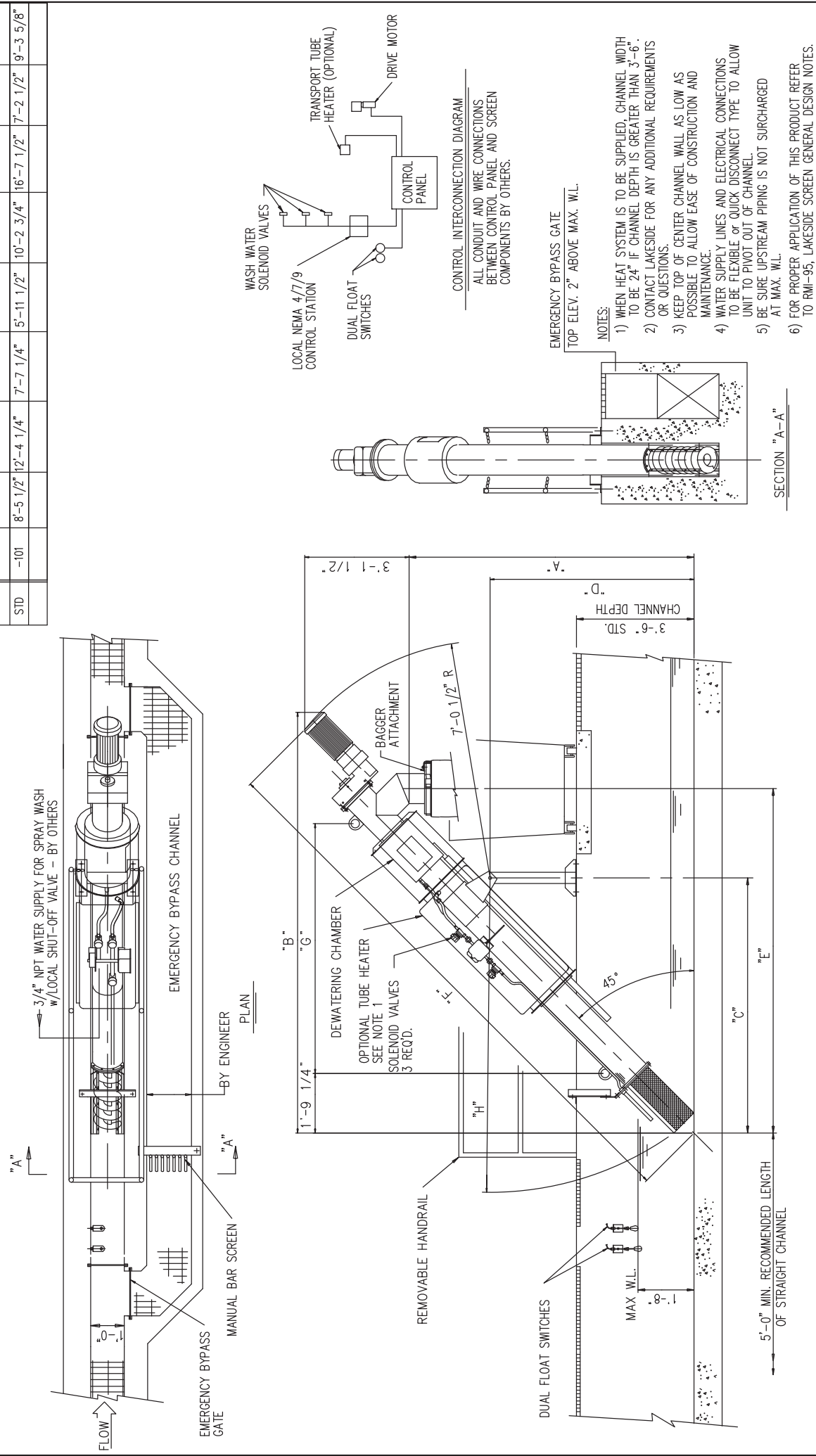
Water Intake Screens

Hydronic T telescoping rake bar screen cleaner



1022 E. Devon, P.O. Box 8448  
Bartlett, IL 60103  
630/837-5640, FAX: 630/837-5647  
E-mail: [sales@lakeside-equipment.com](mailto:sales@lakeside-equipment.com)

12MS	PART No	A	B	C	D	E	F	G	H
STD	-101	8'-5 1/2"	12'-4 1/4"	7'-7 1/4"	5'-11 1/2"	10'-2 3/4"	16'-7 1/2"	7'-2 1/2"	9'-3 5/8"

[illegible]

11/4/2015

LAKESIDE EQUIPMENT CORPORATION  
PO Box 8448 Bartlett, IL 60103-8448

LAKESIDE MICRO STRAINER

Maximum Water Level= 19.88 in.

LEC: 1.4

**JOB: Taos Ski Valley, New Mexico**

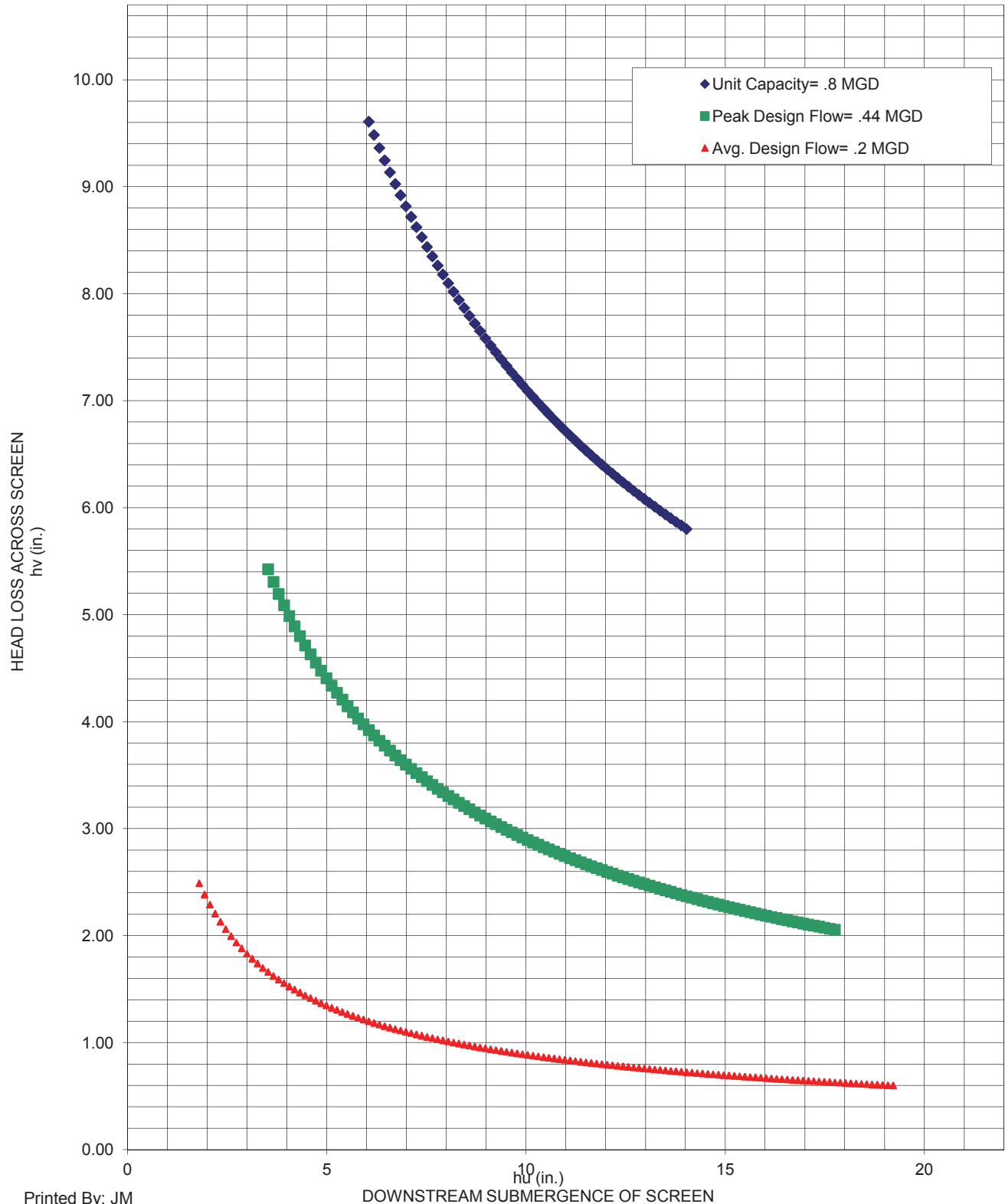
(Hu + Hv)

Diameter: 12"

ENG: TEC

Model: 12MS-0.125

: 1/8"



Printed By: JM







#### PRODUCT BENEFITS

- Dual lamp efficiency processes up to 300 gallons per minute
- 75% smaller footprint compared to standard UV systems
- May be mounted vertically or horizontally
- Up to four units may be controlled with a single micro-control box
- Built for 120V or 230V single phase power providing maximum flexibility
- No flow, no problem – guaranteed 60 minutes
- Water contact finish – Ra-15
- Controller- Remote
- Alarms, Remote Control, 4-20 mA output
- Real time dosimetry, 100% dosage assurance – with constant flow
- UV monitor is NIST traceable
- Sanitization in place – hot water or steam
- No-tool lamp change
- NSF Standard 50 certified
- Warranty one year parts and labor

#### SPECIFICATIONS

Flow Rate - gpm (m <sup>3</sup> /hr.) - 99% UVT @ 40m/cm <sup>2</sup> A	300 (68)
Flow Rate - gpm (m <sup>3</sup> /hr.) - 99% UVT @ 30m/cm <sup>2</sup> A	300 (68)
Flow Rate - gpm (m <sup>3</sup> /hr.) - 95% UVT @ 40m/cm <sup>2</sup> A	226 (51.3)
Flow Rate - gpm (m <sup>3</sup> /hr.) - 95% UVT @ 30m/cm <sup>2</sup> A	300 (68)
Number of High Output Amalgam Lamps	2
*Lamp Life - Hours	9000
Operating Power - watts	235
Operating Pressure - psi (bar)	150 (13)
Operating Temperature - 9F (°C)	36 - 104 (2 - 40)
Pressure Drop at rated flow - psi (bar)	2.8 (0.24)
Dry Weight - pounds (kg)	54.8 (24.9)
Dimensions (L x H x D) - inches	30.6 x 7.9 x 11.4
Dimensions (L x H x D) - millimeters	776 x 201 x 290
*Sanitary Fittings - Standard	3 in.

\* At rated pressure drop.  
\* Lamp life is based on a maximum of one on-off cycle per day and room temperature water.  
\* All units come standard with sanitary tri-clamp fittings for improved reliability, sanitation, and ease of installation. Alternative connections are available upon request.



5893 Oberlin Drive, Suite 104, San Diego, California 92121  
Toll-Free 888.718.5040, ph: 858.571.6590, Web: neotechqua.com, info@neotechqua.com

The NeoTech D428™ is specially designed to disinfect water and is an essential component in advanced oxidation processes.

This high-efficiency UV system utilizes NeoTech Aqua's patented ReFlex™ chamber technology, reflecting over 99% of the 254nm UV generated. It is the highest efficiency, smallest footprint, and lowest operating cost UV system in the water treatment industry.

With only two twenty-eight inch lamps, the D428™ provides users the most convenient and lowest cost service schedule of any low pressure or medium pressure UV system today.

#### MAXIMUM UV PENETRATION

The NeoTech D428™ provides users an unparalleled level of engineering sophistication by maximizing UV distribution in a patented 99% reflective chamber. This unique technical advantage also reduces the number of lamps and power requirements by up to 90% compared to standard UV systems.

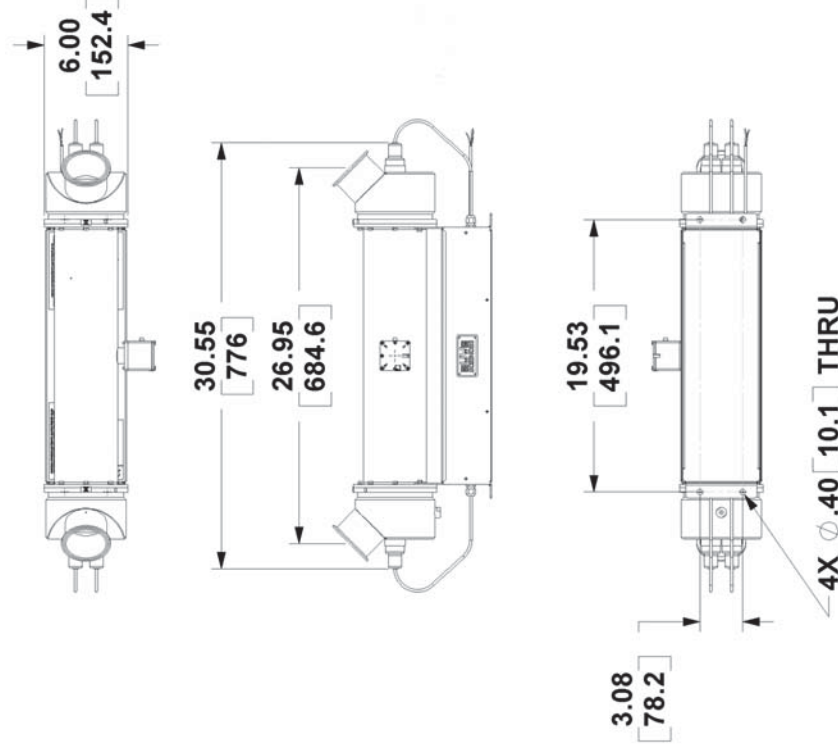
#### MINIMAL MAINTENANCE AND SERVICE

The service and maintenance requirements for the NeoTech D428™ are limited to three basic requirements:

- Lamp Replacement: No Tools Required
- UV Monitor: May be changed with a single screwdriver while the system is operating
- Cleaning: May be cleaned as needed in a CIP loop or manually brushed.

#### UNPARALLELED EFFICIENCY

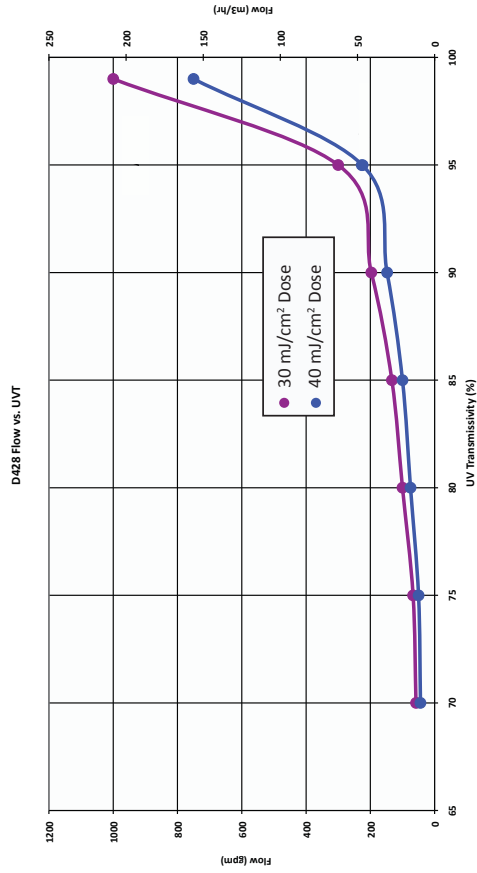
The NeoTech D428™ boasts the smallest footprint in its class. With as few as one-tenth as many bulbs compared to standard UV systems, it has the lowest operating cost and maintenance schedule in the field.



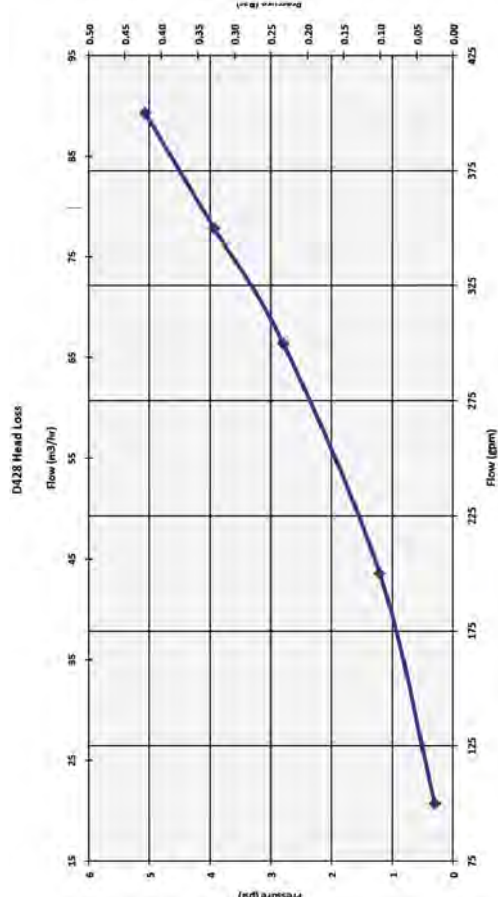
#### OPTIONS AND SPARES

Description	Part Number
*Light Trap Kit	UVTK-4
Cleaning Kit	CK-4-1
Amalgam Lamp Kit	LK-28
Lamp Sleeve Kit	QSK-28
UV Monitor Calibration	UVIM-CAL
Ballast Kit, 120V	BK-120
Ballast Kit, 230V	BK-230

\* Reflected UV light may be harmful to nonmetallic surfaces, such as RPL, PVC, and other plastics. Therefore, it is recommended that a light trap be installed on your unit.



The UV transmittance (UVT) of the treated water, combined with the flow rate through the unit, determine the UV dosage applied to the water. Particles in water typically absorb or reflect UV light which affects the water's UV transmittance. NeoTech Aqua's units are rated based on a UVT of 95%. The above graph illustrates the appropriate rating for the D428 based on varying UVT levels. The NeoTech Aqua Solutions technical team provides complimentary UVT analysis on customer-supplied water samples to ensure proper UV equipment sizing. Please contact your NeoTech Aqua representative for assistance.





#### PRODUCT BENEFITS

- Dual lamp efficiency processes up to 500 gallons per minute
- 75% smaller footprint compared to standard UV systems
- May be mounted vertically or horizontally
- Up to four units may be controlled with a single micro-control box
- Built for 120V or 230V single phase power providing maximum flexibility
- No flow, no problem – guaranteed 60 minutes
- Water contact finish – Ra-15
- Controller- Remote
- Alarms, Remote Control, 4-20 mA output
- Real time dosimetry, 100% dosage assurance – with constant flow
- UV monitor is NIST traceable
- Sanitization in place – hot water or steam
- No-tool lamp change
- NSF Standard 50 certified
- Warranty one year parts and labor

#### SPECIFICATIONS

Flow Rate - gpm (m <sup>3</sup> /hr.) - 99% UVT @ 40m/cm <sup>2</sup> A	500 (90.8)
Flow Rate - gpm (m <sup>3</sup> /hr.) - 99% UVT @ 30m/cm <sup>2</sup> A	500 (90.8)
Flow Rate - gpm (m <sup>3</sup> /hr.) - 95% UVT @ 40m/cm <sup>2</sup> A	329 (74.7)
Flow Rate - gpm (m <sup>3</sup> /hr.) - 95% UVT @ 30m/cm <sup>2</sup> A	500 (90.8)
Number of High Output Amalgam Lamps	2
Lamp Life - Hours*	9000
Operating Power - watts	303
Operating Pressure - psi (bar)	150 (13)
Operating Temperature - °F (°C)	36 - 104 (2 - 40)
Pressure Drop at rated flow - psi (bar)	10.9 (0.95)
Dry Weight - pounds (kg)	63 (28.6)
Dimensions (L x H x D) - inches	40.6 x 7.9 x 11.4
Dimensions (L x H x D) - millimeters	1030 x 201 x 290
Sanitary Fittings - Standard*	3 in.

\* At rated pressure drop.

\* Lamp life is based on a maximum of one on-off cycle per day and room temperature water.

\* All units come standard with sanitary tri-clamp fittings for improved reliability, sanitation, and ease of installation. Alternative connections are available upon request.



5893 Oberlin Drive, Suite 104, San Diego, California 92121  
Toll-Free 888.718.5040, ph: 858.571.6590, Web: neotechqua.com, info@neotechqua.com

The NeoTech D438™ is specially designed to disinfect water and is an essential component in advanced oxidation processes.

This high-efficiency UV system utilizes NeoTech Aqua's patented ReFlex™ chamber technology, reflecting over 99% of the 254nm UV generated. It is the highest efficiency, smallest footprint, and lowest operating cost UV system in the water treatment industry.

With only two thirty-eight inch lamps, the D438™ provides users the most convenient and lowest cost service schedule of any low pressure or medium pressure UV system today.

#### MAXIMUM UV PENETRATION

The NeoTech D438™ provides users an unparalleled level of engineering sophistication by maximizing UV distribution in a patented 99% reflective chamber. This unique technical advantage also reduces the number of lamps and power requirements by up to 90% compared to standard UV systems.

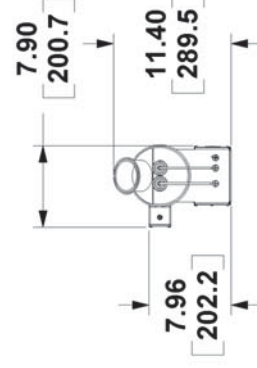
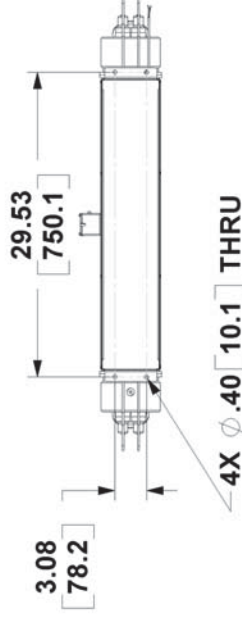
#### MINIMAL MAINTENANCE AND SERVICE

The service and maintenance requirements for the NeoTech D438™ are limited to three basic requirements:

- Lamp Replacement: No Tools Required
- UV Monitor: May be changed with a single screwdriver while the system is operating
- Cleaning: May be cleaned as needed in a CIP loop or manually brushed.

#### UNPARALLELED EFFICIENCY

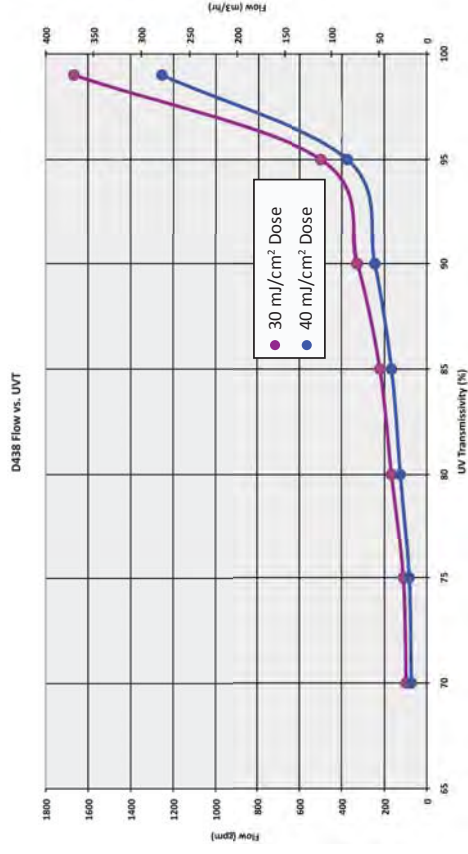
The NeoTech D438™ boasts the smallest footprint in its class. With as few as one-tenth as many bulbs compared to standard UV systems, it has the lowest operating cost and maintenance schedule in the field.



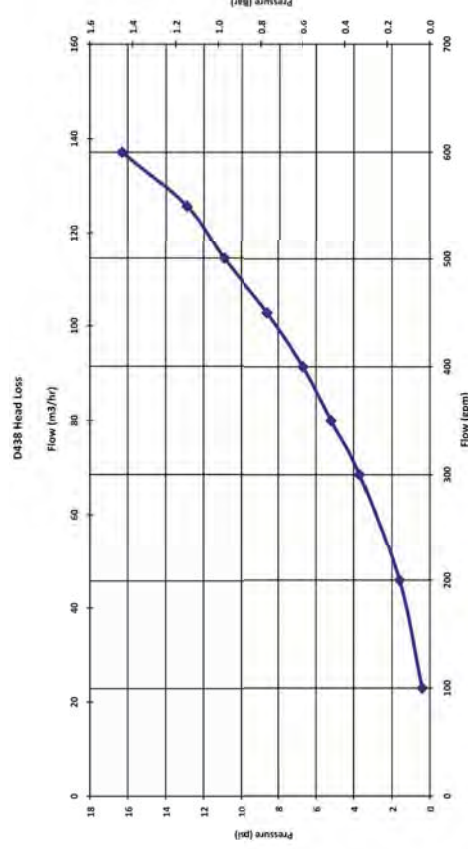
#### OPTIONS AND SPARES

Description	Part Number
Light Trap Kit*	UVTK-4
Cleaning Kit	CK-4-1
Amalgam Lamp Kit	LK-38
Lamp Sleeve Kit	QSK-38
UV Monitor Calibration	UVM-CAL
Ballast Kit, 120V	BK-120
Ballast Kit, 230V	BK-230

\* Reflected UV light may be harmful to nonmetallic surfaces, such as RPL, PVC, and other plastics. Therefore, it is recommended that a light trap be installed on your unit.



The UV transmittance (UVT) of the treated water, combined with the flow rate through the unit, determine the UV dosage applied to the water. Particles in water typically absorb or reflect UV light which affects the water's UV transmittance. NeoTech Aqua's units are rated based on a UVT of 95%. The above graph illustrates the appropriate rating for the D438 based on varying UVT levels. The NeoTech Aqua Solutions technical team provides complimentary UVT analysis on customer-supplied water samples to ensure proper UV equipment sizing. Please contact your NeoTech Aqua representative for assistance.





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## **APPENDIX C.6**

### **TERTIARY FILTRATION**

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# PHOSPHORUS REMOVAL

## Advanced Phosphorus Removal

Blue Water Technologies, Inc. is the industry leader in the development of technologies for phosphorus removal from wastewater. With advanced control techniques and patented nutrient removal systems, Blue Water can provide you with a cost effective solution to meet your phosphorus level needs.

The Blue PRO® system provides a unique approach **to chemical dosing, with significantly lower chemical use** across the entire wastewater treatment plant than competitors. No other chemical dosing is required in the plant to achieve the lowest phosphorus discharge requirements. Current Blue PRO® installations are meeting permit limits as low as 0.05 mg/L with a chemical dose of only 10 mg/L as Fe. Blue Water's unique chemical control **system provides an advantage due to its cost efficiency** and ability to seamlessly integrate into and respond to the needs of existing wastewater treatment systems. The chemical dose used with Blue PRO® methods is so much lower than the competition that the comparative savings represent a return on the capital investment in less than three years.

The Blue PRO® process is the leading technology for phosphorus reduction to any level. Whether the targeted phosphorus discharge limit is 10 mg/L P or as low as 0.01 mg/L P, Blue PRO® methods provide reductions in chemical usage, equipment footprint, and associated operations and maintenance costs over alternative technologies. The Blue PRO® platform is the most effective and most inexpensive tertiary treatment solution where additional **considerations are needed, such as denitrification or metals removal.**



A Blue PRO® installation in Grangeville, Idaho for 0.05 mg/L phosphorus

## Blue PRO®

### The Blue PRO® System

How does the Blue PRO® process work? Using Blue Water's Centra-flo® continuous backwash gravity sand filters, a unique control system, and the patented Blue PRO® process for reactive filtration, phosphorus is removed from wastewater streams through an array of mechanisms. Most importantly, Blue PRO® systems optimize adsorption.

**Blue Water's reactive filtration process overcomes a critical obstacle to achieving efficient phosphorus removal** in bulk aqueous solutions by providing reactive surface sites within the media bed, resulting in forced contact of chemical species with high adsorptive capacity. The adsorptive surface in Blue PRO® filters **is a continuously regenerated hydrous ferric oxide (HFO) coating that forms on the surface of the sand media. Coagulation followed by filtration simply cannot compare to the efficiency of adsorptive phosphorus removal.**

Waste HFO, phosphorus, and solids are removed **from the filter through the backwash or reject stream. Recycling this reject upstream provides the added benefit of removing phosphorus in plant clarification systems,** further guaranteeing the achievement of the discharge phosphorus target as well as lowering the chemical dose. The phosphorus is chemically bound, leaving the plant **with the sludge, rather than releasing in effluent streams or digestion.** Integration of Blue Water's phosphorus removal technology does not require change in the plant's sludge handling system. The Blue PRO® system uses over 30% less chemical than other technologies, therefore producing less sludge. The waste HFO also helps with odor control and can reduce water content in biosolids.

### Blue PRO® Applications:

- Advanced total phosphorus removal
- Metals removal, including mercury
- Combined denitrification
- Algae mitigation

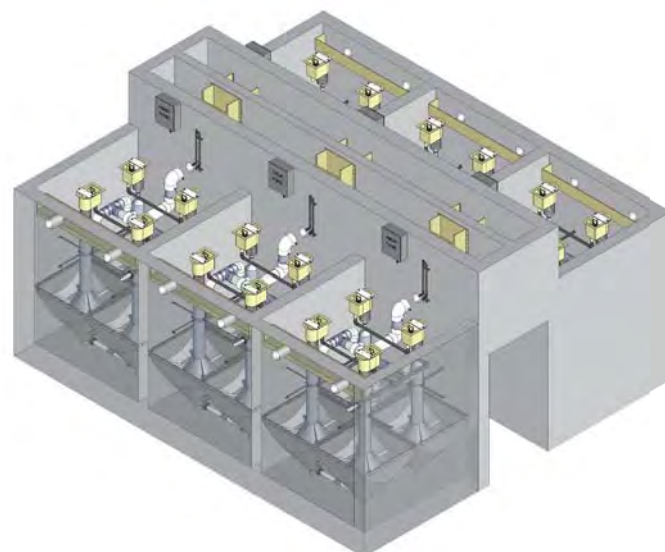


The Blue PRO® system is available in several models and configurations. The modular nature of the filters allows for easy system expansion. The filters are available as freestanding fiberglass or stainless steel units or as in-ground concrete cells. Control systems and smaller filters may be skid mounted for mobility or ease of commissioning.

## Additional Features

Since many plants requiring phosphorus mitigation also require nitrogen control, Blue Water provides the option to simultaneously denitrify in the same vessel with the Blue PRO® process. With slight modifications, Blue Water can provide a unique and efficient system for total nutrient reduction.

Besides phosphorus, Blue PRO® methods are effective at removing many other contaminants, such as mercury, arsenic, chromium, and uranium. Minor adjustments in water chemistry may be implemented for the removal of metals and other contaminants, including zinc, lead, copper, iron, and manganese. Blue Water has installations for removal of these contaminants in wastewater plants as well as groundwater systems, including self-contained package treatment systems.



4.3 MGD Blue PRO® system design for 0.07 mg/L TP in a Massachusetts WWTP

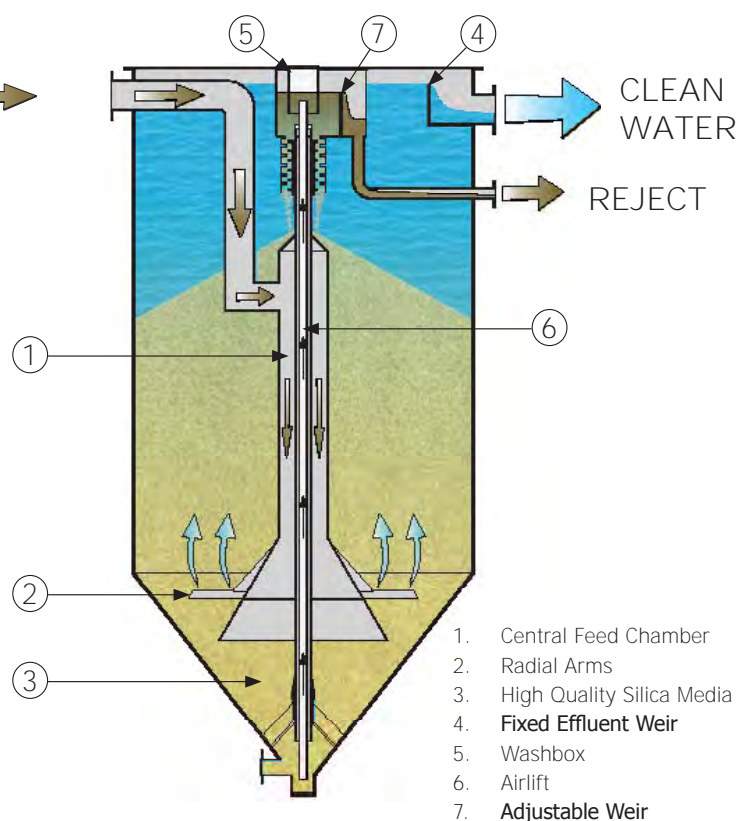
INFLUENT → + CHEMICAL →

# Blue PRO®

Blue Water's Blue PRO® technology is covered by multiple patents and patents pending.

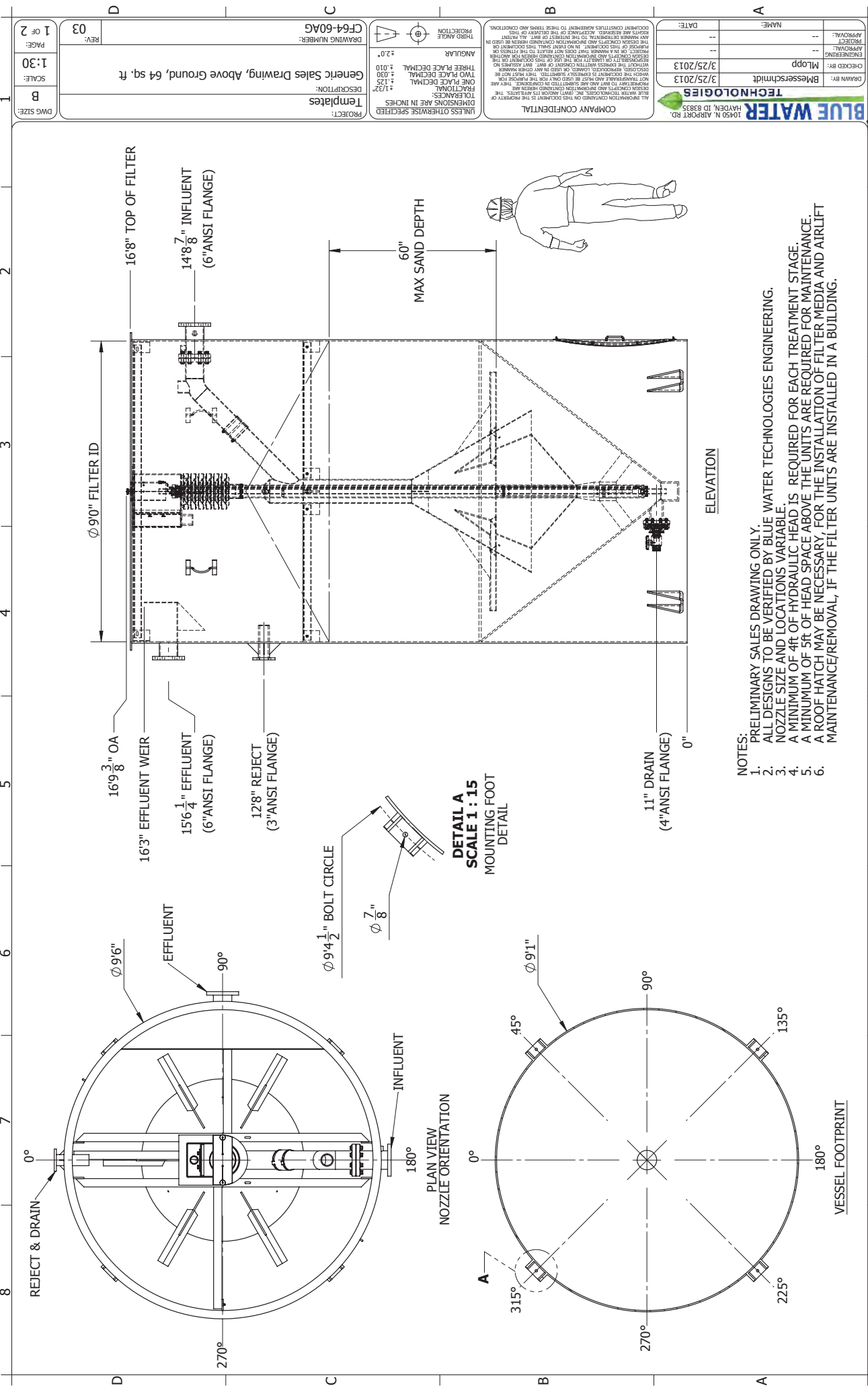
## The Blue PRO® Advantages:

- Low capital and O&M costs
- **Continuous flow – no interruption** for backwash or changing media
- Modular design easily handles capacity increases
- Simple operation & low chemical use













PROJECT:	APPROVAL:
NAME:	APPROVAL:
DATE:	APPROVAL:
01/19/15	APPROVAL:
01/19/15	APPROVAL:
01/19/15	APPROVAL:

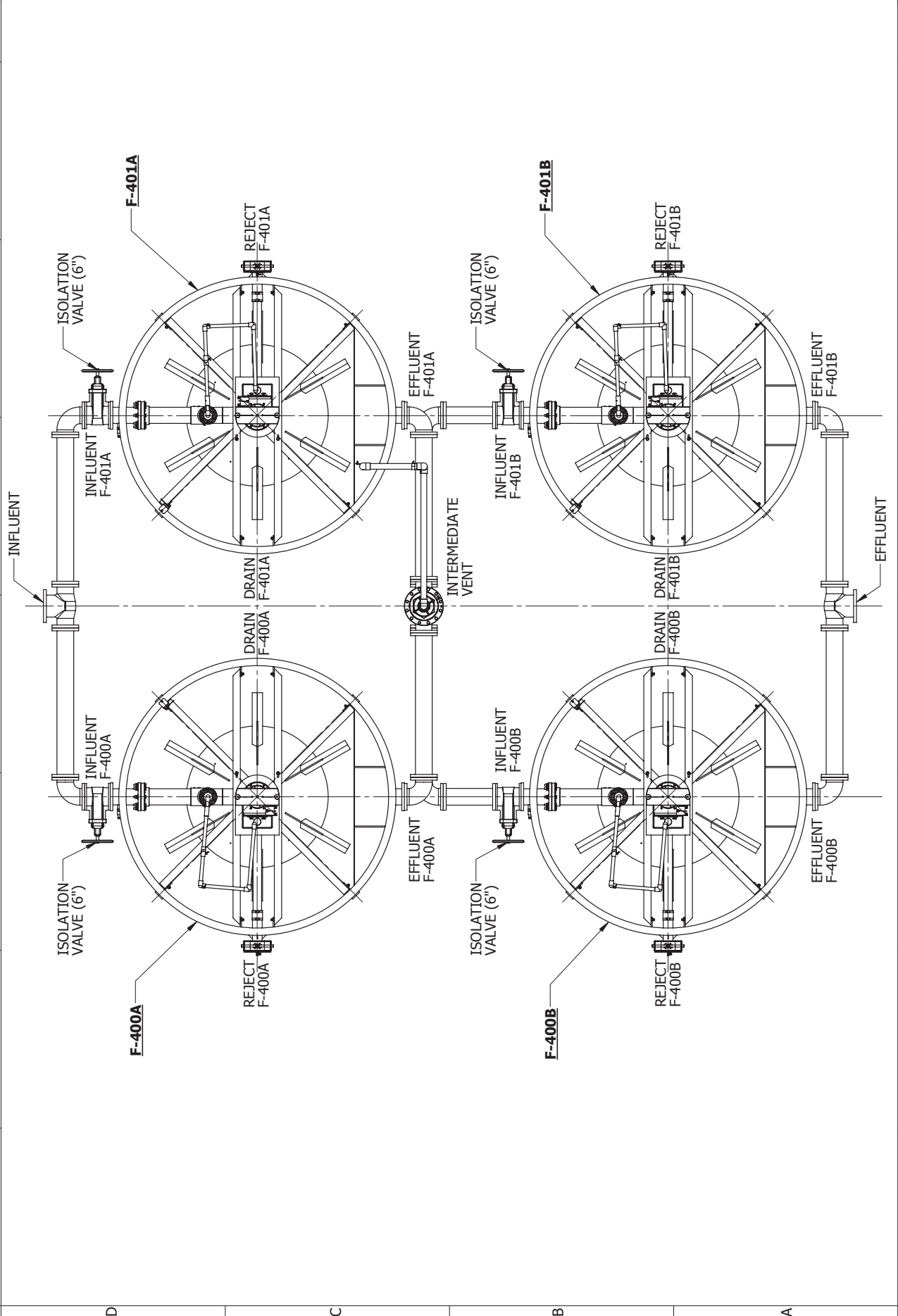
BLUE WATER  
10450 N. AIRPORT RD.  
HAYDEN, ID 83835  
TECHNOLOGIES

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THIRD ANGLE  
PROJECTION  
ANGULAR  
TOLERANCES:  
FRACTIONAL  
ONE PLACE DECIMAL  
TWO PLACE DECIMAL  
THREE PLACE DECIMAL  
±.020  
±.010  
±.005  
UNLESS OTHERWISE SPECIFIED  
DIMENSIONS ARE IN INCHES

PROJECT:  
910151 Citronelle  
DESCRIPTION:  
General Arrangement Drawing, (4X) CF64-80AG, Dual  
Pass  
DRAWING NUMBER:  
910151-GA

REV:	02
PAGE:	3 OF 3
SCALE:	1:36
DWG SIZE:	B







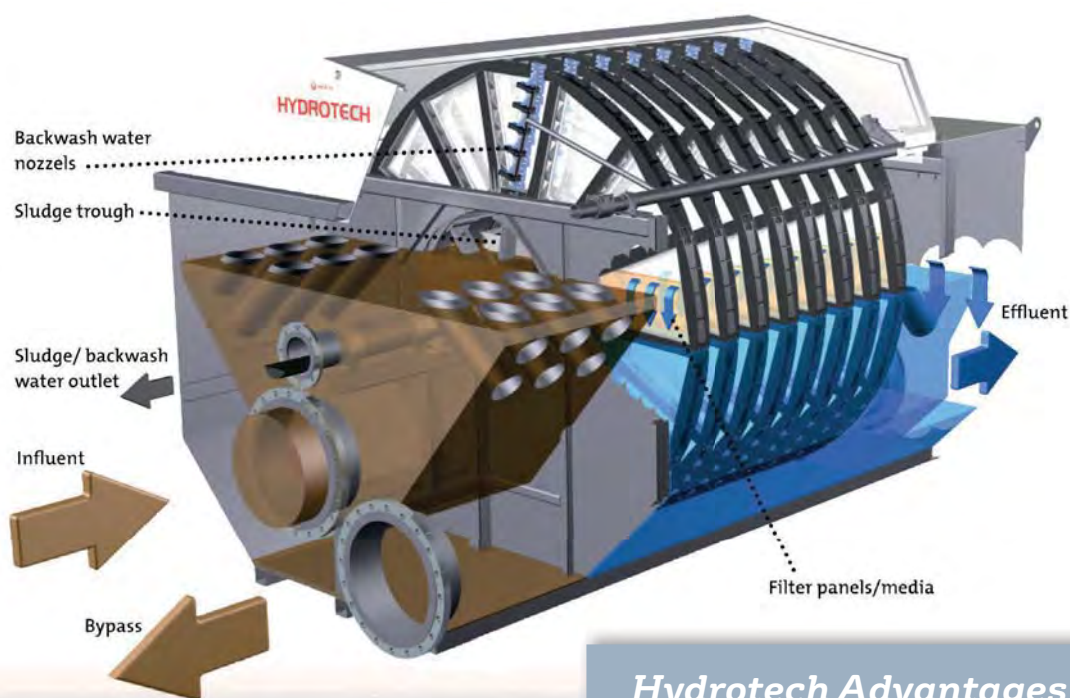
# Hydrotech Discfilter Pure Performance

**WATER TECHNOLOGIES**

## The Discfilter Process

The Hydrotech Discfilter provides proven experience for today's demanding wastewater treatment applications through an efficient, yet easy-to-operate design. Influent flows by gravity into the center drum and then passes through the filter media mounted on both sides of the discs. The solids are retained on the media within the discs. Only purified water flows to the collection tank. The inside-out flow path prevents solids accumulation in the tank.

As solids collect on the inside of the media the influent water level rises. Maximum head loss through the media is <12 inches. The inlet water level is measured and the control system automatically initiates backwashing. The filtered effluent is pumped to the backwash spray nozzles, washing solids into the sludge trough as the discs rotate. The backwash water is typically 1% to 2% of the total flow to the filter, while the sludge return is typically <1%. Filtration is continuously maintained, even during backwash.



### *Hydrotech Advantages*

- Unmatched experience and performance
- Innovation: patented designs offer real savings
- Robust construction with 304 or 316 SSTL
- Proven media: durable and chemically resistant
- Meets or exceeds Title 22 requirements at hydraulic loading rates up to and above 6 gpm/ft<sup>2</sup>
- Consistently produces high quality effluent despite high-solids loadings and upset conditions
- Ideal for "retro-fit" projects in existing basins
- Compact design requires far less space
- Simplified control system and lower installation costs than other filtration technologies
- Improved backwash efficiency reduces operating costs and carbon footprint



## Progressive Innovation

The Hydrotech Discfilter utilizes many patented designs including the oscillating backwash spray header, which provides efficient media cleaning while reducing water consumption by 20 percent. Ongoing research ensures the most cost effective filtration methods available.

The Hydrotech Discfilter is available in a variety of models:

### 1700 series

- Up to 8 discs
- Up to 1 MGD per unit in effluent polishing
- Ideal for small scale projects



### 2200 series

- Up to 24 discs
- Up to 9 MGD per unit in effluent polishing
- Excellent for a wide range of project sizes

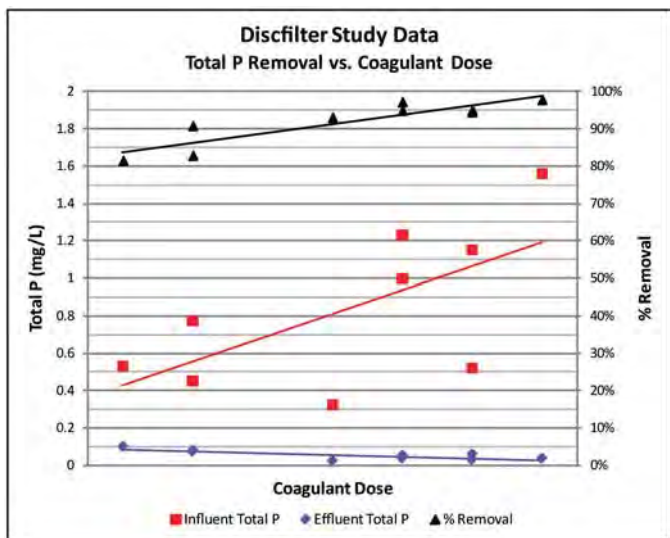


### 2600 series

- Up to 30 discs for 15 MGD per unit in effluent polishing
- Provides highest filtration area and most compact footprint
- High flow rates maximize treatment in a given footprint
- Energy reduced 15% and footprint by 25%
- User-friendly design for minimal maintenance



## Advanced Treatment



The Hydrotech Discfilter enables facilities to meet stringent performance requirements.

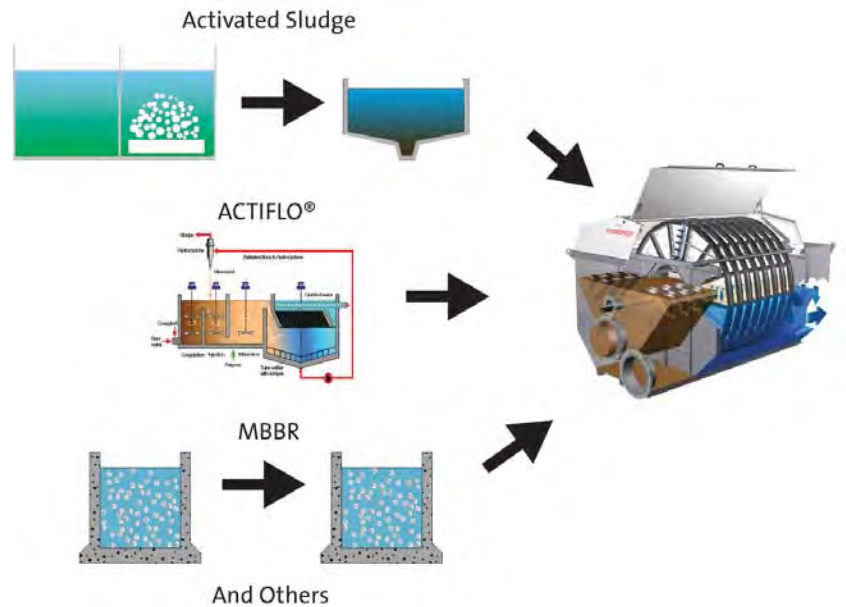
Veolia has pioneered use of the discfilter in combination with coagulation/ flocculation as a cost effective means to reduce effluent phosphorus to < 0.1 mg/L.

## Proven Performance

The compact Hydrotech Discfilter is used in a wide range of applications:

- Effluent polishing of wastewater
- Phosphorus removal
- Water reuse (Title 22 approved)
- Retrofit/replacement of existing systems
- CSO, SSO, and primary treatment
- Process water filtration
- Membrane pre-treatment

The Hydrotech Discfilter is ideal for treating effluent from a variety of processes (e.g., activated sludge, fixed film, etc.). Veolia offers full-scale pilots to demonstrate performance.



## Designed To Save

Hydrotech systems enable customers to achieve performance with lower cost and straight-forward maintenance. Hydrotech Discfilters provide a large filter area in a small footprint; up to 75% smaller than sand filters and up to 20% smaller than other cloth filters.

The discfilter is delivered as an assembled unit. Other cloth filters require substantial labor for site assembly and a larger footprint for backwash pumps and valves. The discfilter eliminates these concerns and costs. Installation is as simple as off-loading from a trailer, anchoring the unit, and completing mechanical and electrical connections.

O&M is simple and reduces operating costs. Fabrication is in 304 or 316 SSTL for trouble-free operation in the toughest conditions. Durable filter media provides long life without frequent and costly replacement. The efficient backwash process reduces energy costs.



*Hydrotech Discfilters are easy to inspect and maintain, saving time and money.*



## Experience You Can Trust

Today's demanding applications require proven experience. Hydrotech Discfilters lead the market with over 400 installed units in the United States and over 1,900 worldwide.



### **Oconomowoc, WI**

Retrofit of tertiary  
sand filters  
12 MGD



### **Fox Lake, IL**

Retrofit of tertiary  
sand filters  
30 MGD



### **Mesquite, TX**

Effluent polishing  
48 MGD



### **Holly Springs, NC**

Water reclaim and  
phosphorus removal  
15 MGD



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**APPENDIX D**  
**COST ESTIMATES AND LIFE CYCLE COST ANALYSIS**

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## Life Cycle Cost Analysis of Treatment Alternatives

	IFAS Alternative	SBR Alternative	MBR Alternative
<b>Capital Cost</b>	<b>\$8,572,000</b>	<b>\$8,265,000</b>	<b>\$7,954,000</b>
<b>O&amp;M Annual Costs</b>			
Year 1	\$249,395	\$241,036	\$231,285
Year 2	\$248,154	\$239,837	\$230,134
Year 3	\$246,919	\$238,644	\$228,989
Year 4	\$245,691	\$237,457	\$227,850
Year 5	\$244,468	\$236,275	\$226,717
Year 6	\$243,252	\$235,100	\$225,589
Year 7	\$242,042	\$233,930	\$224,466
Year 8	\$240,838	\$232,766	\$223,350
Year 9	\$239,640	\$231,608	\$222,238
Year 10	\$238,447	\$230,456	\$221,133
Year 11	\$237,261	\$229,309	\$220,033
Year 12	\$236,081	\$228,169	\$218,938
Year 13	\$234,906	\$227,033	\$217,849
Year 14	\$233,737	\$225,904	\$216,765
Year 15	\$232,575	\$224,780	\$215,686
Year 16	\$231,417	\$223,662	\$214,613
Year 17	\$230,266	\$222,549	\$213,546
Year 18	\$229,120	\$221,442	\$212,483
Year 19	\$227,981	\$220,340	\$211,426
Year 20	\$226,846	\$219,244	\$210,374
	<b>\$4,760,000</b>	<b>\$4,600,000</b>	<b>\$4,414,000</b>
<b>Salvage Value</b>	<b>(\$582,000)</b>	<b>(\$699,000)</b>	<b>(\$347,000)</b>
<b>Net Present Value (NPV)</b>	<b>\$12,750,000</b>	<b>\$12,166,000</b>	<b>\$12,021,000</b>

Calculation utilizes the Real Discount rate of 0.5% for 20-Year horizon per OMB Circular No. A-94, Appendix C, effective for 2017



**IFAS Alternative**  
**Opinion of Probable Construction Costs**

Division	Description	Quantity	Units	Cost per Unit (\$)	Cost (nearest \$100)
<b>1</b>	<b>GENERAL CONDITIONS</b>				<b>\$100,000</b>
		1	LS	\$100,000	\$100,000
<b>2</b>	<b>CIVIL / SITEWORK</b>				<b>\$78,800</b>
	Erosion Control & Site Preparation	1	LS	\$3,000	\$3,000
	Excavation For New Basins and Clarifiers	1200	CY	\$10	\$12,000
	Hauling of Excavation	1500	CY	\$9	\$13,500
	Subgrade Preparation for Concrete Treatment Basins	200	CY	\$30	\$6,000
	Yard Piping, Excavation, Installation. Material, Bedding, Compacting	300	LF	\$80	\$24,000
	Excavation For Sludge Holding Tanks	747	CY	\$10	\$7,500
	Subgrade Preparation for Sludge Holding Tanks	111	CY	\$40	\$4,500
	New Concrete Pad For New Generator On West Side of Existing Building	1	SY	\$5,000	\$5,000
	Crushed Aggregate Resurfacing	78	SY	\$35	\$2,800
	Topsoil and Seeding	50	SY	\$10	\$500
<b>3</b>	<b>CONCRETE</b>				<b>\$1,071,500</b>
	Influent Parshall Flume approach	1	LS	\$2,000	\$2,000
	Misc. Concrete For Headworks Retrofit	10	CY	\$800	\$8,000
	New Aeration Tanks	150	CY	\$900	\$135,000
	Clarifiers	100	CY	\$900	\$90,000
	Misc Concrete	10	CY	\$900	\$9,000
	Precast Insulated Walls	12036	SF	\$34	\$409,300
	Precast Double Tee Roof	12036	SF	\$16	\$192,600
	New Sludge Holding Tanks	167	CY	\$900	\$150,700
	Splitter Box and Feed Channel	1	LS	\$40,000	\$40,000
	Misc. Concrete For Clarifier Base Slab Levelling	1	LS	\$2,500	\$2,500
	Pad For Generator	13	CY	\$800	\$10,400
	Chemical Storage Secondary Containment	2	CY	\$800	\$1,800
	Effluent Manhole	1	EA	\$5,000	\$5,000
	Concrete Footers for Biosolids Storage Area Roof Structure	4	EA	\$800	\$3,200
	Misc. Concrete	15	CY	\$800	\$12,000
<b>4</b>	<b>MASONRY</b>				<b>\$25,800</b>
	Chemical Storage Room Walls	645	SF	\$40	\$25,800
	Interior Building Walls	0	SF	\$40	\$0
<b>5</b>	<b>METALS</b>				<b>\$22,800</b>
	Hand Rails, Misc Metal Grating	1	LS	\$10,800	\$10,800
	Grating over Treatment Basins	1	LS	\$12,000	\$12,000
<b>6</b>	<b>WOOD AND PLASTIC</b>				<b>\$2,100</b>
	Interior Wall Framing	1050	SF	\$2	\$2,100
<b>7</b>	<b>THERMAL &amp; MOISTURE PROTECTION</b>				<b>\$3,000</b>
	Misc Sealants	1	LS	\$3,000	\$3,000
<b>8</b>	<b>DOORS &amp; WINDOWS</b>				<b>\$36,000</b>
	Garage Doors	2	EA	\$5,000	\$10,000
	Double Doors	2	EA	\$3,000	\$6,000
	Windows	10	EA	\$1,000	\$10,000
	Single Exterior Doors	3	EA	\$2,500	\$7,500
	Single Interior Doors	5	EA	\$500	\$2,500
<b>9</b>	<b>FINISHES</b>				<b>\$25,500</b>
	Interior Walls Sheet Rock and Paint	1050	SF	\$10	\$10,500
	Paints On Door And Frames, Exposed Piping, Bollards	1	LS	\$15,000	\$15,000
<b>10</b>	<b>SPECIALITIES</b>				<b>\$6,300</b>
	Fire Extinguishers	1	EA	\$2,350	\$2,400
	Bathroom Fixtures and Accessories	1	LS	\$3,850	\$3,900
<b>11</b>	<b>EQUIPMENT</b>				<b>\$1,897,700</b>
	Influent Flow Measurement, Nested Parshall Flume	1	EA	\$5,000	\$5,000
	IFAS Vendor Quote	1	LS	\$876,700	\$876,700
	Tertiary Filters for P=Removal and Denite	1	LS	\$450,000	\$450,000
	Carbon Chemical Skid	1	LS	\$5,000	\$5,000
	UV Disinfection	3	EA	\$33,000	\$99,000
	Chemical Feed Equipment (PaCl and Micro C)	2	EA	\$12,000	\$24,000
	Secondary Treatment Process Installation	1	LS	\$437,910	\$438,000

IFAS Treatment Process Alternative  
Opinion of Probable Construction Cost

<b>12</b>	<b>FURNISHINGS</b>					<b>\$5,000</b>
	Lab, Operations Room	1	LS	\$5,000		\$5,000
<b>13</b>	<b>SPECIAL CONSTRUCTION</b>					<b>\$300,300</b>
	Metal Roof over Biosolids Storage Area - Materials	1	LS	\$15,000		\$15,000
	Metal Roof over Biosolids Storage Area - Installation	1	LS	\$8,000		\$8,000
	Temporary Treatment Equipment, Delivery & Start-up	1	LS	\$37,250		\$37,300
	Temporary Treatment Equipment, Monthly Rental	12	MONTH	\$20,000		\$240,000
<b>14</b>	<b>HOISTS AND CRANES</b>					<b>\$0</b>
	Mono Rail And Hoists	0	LS	\$37,500		\$0
<b>15</b>	<b>MECHANICAL / HVAC</b>					<b>\$196,500</b>
	Process Piping, Valves, and Accessories (blowers and treatment)	1	LS	\$95,000		\$95,000
	HVAC	1	LS	\$75,000		\$75,000
	Hot Water System	1	LS	\$2,500		\$2,500
	Plumbing Piping	1	LS	\$12,000		\$12,000
	Gravity Piping, Bathroom	1	LS	\$12,000		\$12,000
<b>16</b>	<b>ELECTRICAL and INSTRUMENTATION &amp; CONTROLS</b>					<b>\$875,000</b>
	New Scada System, MCC, Misc Electrical Connection, Controls	1	LS	\$850,000		\$850,000
	New Generator	1	EA	\$25,000		\$25,000
<b>SUBTOTAL 1</b>						<b>4,646,300</b>
	CONSTRUCTION PRORATES( See Note 1)	10.0%	of Subtotal 1	464,630	1.0	464,700
	CONTRACTOR'S OVERHEAD & PROFIT (See Note 2)	15.0%	of Subtotal 1	696,945	1.0	697,000
<b>SUBTOTAL 2</b>						<b>5,808,000</b>
	CONTINGENCY (See Note 4)	10.0%	of Subtotal 2	580,800	1.0	580,800
<b>SUBTOTAL 3</b>						<b>6,388,800</b>
	NMGRT 8.9125%	8.9125%	of Subtotal 3	569,402	1.0	569,500
<b>SUBTOTAL 4</b>						<b>6,958,300</b>
<b>ENGINEERING COSTS</b>						<b>1,380,000</b>
	PER and Environmental			95,000		
	Basic Services			925,000		
	Full Time RPR Services			340,000		
	Additional Services			0		
	Reimbursables			20,000		
	NMGRT 5.125%	5.1250%				70,725
<b>ENGINEERING TOTAL</b>						<b>1,450,725</b>
<b>NON CONSTRUCTION COSTS</b>						<b>155,000</b>
	Local Attorney Services			15,000		
	Financial Advisor			100,000		
	Filing Fees/Reimbursables			25,000		
	Bond Counsel			15,000		
	NMGRT 5.125%	5.1250%				7,944
<b>NON CONSTRUCTION TOTAL</b>						<b>162,944</b>
<b>TOTAL</b>						<b>8,572,000</b>

Notes:

Notes

- 1 Construction Prorates <sup>(a) (b)</sup> 10%
- (a) General conditions includes cost associated with permits, licenses, insurance, environmental safe guards, sediment and drainage control, and special construction practices to
- 2 Contractor's Overhead & Profit <sup>(a)</sup> 15.0%
- (a) Contractor's overhead and profit include costs for mobilization/demobilization, administration, and contractor/subcontractor overhead costs and profits.
- 4 Design Contingency <sup>(a)</sup> 10.0%
- (a) The design contingency is added to the subtotal based on the conceptual nature of information developed for this evaluation.

## IFAS Alternative Life Cycle Cost Analysis

Annual Operating and Maintenance Costs	
Chemicals & Reagents Delivered <sup>3</sup>	\$58,500
Energy Cost <sup>2</sup>	\$68,000
Personnel (i.e. salary, benefits, payroll tax, insurance, training) <sup>3</sup>	\$43,673
Administrative Costs (e.g. office supplies, printing, etc.) <sup>3</sup>	\$11,950
Management and Legal Services <sup>3</sup>	\$18,960
Insurance <sup>3</sup>	\$8,000
Monitoring & Testing <sup>3</sup>	\$25,500
Professional Services <sup>3</sup>	\$3,000
Residuals Disposal <sup>2</sup>	\$13,058
<b>Subtotal</b>	<b>\$250,642</b>

**Notes:**

- 1 - Equipment Manufacturer Chemical Consumption Estimate
- 2 - Developed from Equipment Loads/Usage (reference attached Operations and Maintenance Cost Estimate Sheet)
- 3 - Developed from Village Cost Data 2008, 2009 (Reference attached Village Cost Summarized Data Sheet)

Assets & Salvage Value	Life Expectancy	Replacement Cost	Short Lived Assets Annual Cost
<b>Short Lived Assets</b>			
Existing Bar Screen	15	\$86,000	\$5,733
Existing Grit Pump	15	\$15,000	\$1,000
Existing Grit Classifier	15	\$35,000	\$2,333
Influent EQ tank Mixer 1	15	\$13,800	\$920
Influent EQ tank Mixer 2	15	\$13,800	\$920
Submersible Mixers	15	\$55,200	\$3,680
Aerobic Diffusers	10	\$10,000	\$1,000
Blowers (3 duty)	15	\$240,000	\$16,000
IMLR Pump (2 Duty)	15	\$30,000	\$2,000
Clarifier Mechanism (2 Duty)	15	\$25,000	\$1,667
RAS/WAS Pumps (2 Duty)	15	\$30,000	\$2,000
Tertiary Filter Feed Pump	15	\$15,000	\$1,000
Tertiary Filter- Polymer Pump	15	\$5,000	\$333
Tertiary Filter- Ferric Pump	15	\$5,000	\$333
Chemical Skid- Alum	15	\$5,000	\$333
Chemical Skid- Carbon	15	\$5,000	\$333
Short Lived Assets Annual Cost Total			\$39,587
<b>Long Life Assets</b>			
New Concrete Structures	50	\$1,071,500	\$642,900
<b>Present Value of Salvage Costs</b>			<b>\$582,000</b>

### Net Present Value Calculation

End of Year	O&M Costs	Present Value of O&M Costs (0.5% Discount Rate)
1	\$250,642	\$249,395
2	\$250,642	\$248,154
3	\$250,642	\$246,919
4	\$250,642	\$245,691
5	\$250,642	\$244,468
6	\$250,642	\$243,252
7	\$250,642	\$242,042
8	\$250,642	\$240,838
9	\$250,642	\$239,640
10	\$250,642	\$238,447
11	\$250,642	\$237,261
12	\$250,642	\$236,081
13	\$250,642	\$234,906
14	\$250,642	\$233,737
15	\$250,642	\$232,575
16	\$250,642	\$231,417
17	\$250,642	\$230,266
18	\$250,642	\$229,120
19	\$250,642	\$227,981
20	\$250,642	\$226,846
<b>Capital Costs</b>		\$8,572,000
<b>O&amp;M Costs</b>		\$4,760,000
<b>Salvage Value</b>		\$582,000
<b>NPV</b> NPV = Capital Costs + O&M Costs - Salvage Value		<b>\$12,750,000</b>

**Notes:**

Real Discount rate is 0.5% for 20-Year horizon per OMB Circular No. A-94, Appendix C, effective for 2011

**SBR Alternative**  
**Opinion of Probable Construction Costs**

Division	Description	Quantity	Units	Cost per Unit (\$)	Cost (nearest \$100)
<b>1</b>	<b>GENERAL CONDITIONS</b>				<b>\$100,000</b>
		1	LS	\$100,000	\$100,000
<b>2</b>	<b>CIVIL / SITEWORK</b>				<b>\$122,200</b>
	Erosion Control & Site Preparation	1	LS	\$3,000	\$3,000
	Excavation For Additional Concrete Treatment Basins	3240	CY	\$10	\$32,400
	Hauling Excavation	4050	CY	\$9	\$36,500
	Subgrade Preparation for Concrete Treatment Basins	200	CY	\$30	\$6,000
	Yard Piping, Excavation, Installation. Material, Bedding, Compacting	300	LF	\$80	\$24,000
	Excavation For Sludge Holding Tanks	747	CY	\$10	\$7,500
	Subgrade Preparation for Sludge Holding Tanks	111	CY	\$40	\$4,500
	New Concrete Pad For New Generator On West Side of Existing Building	1	SY	\$5,000	\$5,000
	Crushed Aggregate Resurfacing	78	SY	\$35	\$2,800
	Topsoil and Seeding	50	SY	\$10	\$500
<b>3</b>	<b>CONCRETE</b>				<b>\$1,286,800</b>
	Influent Parshall Flume approach	1	LS	\$2,000	\$2,000
	Misc. Concrete For Headworks Retrofit	10	CY	\$800	\$8,000
	New Treatment Basins	800	CY	\$900	\$720,000
	Misc Concrete	10	CY	\$900	\$9,000
	Precast Insulated Walls	6300	SF	\$34	\$214,200
	Precast Double Tee Roof	6300	SF	\$16	\$100,800
	Retrofit to Existing Aeration Tank	9	CY	\$800	\$7,200
	New Sludge Holding Tanks	167	CY	\$900	\$150,700
	Splitter Box and Feed Channel	1	LS	\$40,000	\$40,000
	Misc. Concrete For Clarifier Base Slab Levelling	1	LS	\$2,500	\$2,500
	Pad For Generator	13	CY	\$800	\$10,400
	Chemical Storage Secondary Containment	2	CY	\$800	\$1,800
	Effluent Manhole	1	EA	\$5,000	\$5,000
	Concrete Footers for Biosolids Storage Area Roof Structure	4	EA	\$800	\$3,200
	Misc. Concrete	15	CY	\$800	\$12,000
<b>4</b>	<b>MASONRY</b>				<b>\$25,800</b>
	Chemical Storage Room Walls	645	SF	\$40	\$25,800
	Interior Building Walls	0	SF	\$40	\$0
<b>5</b>	<b>METALS</b>				<b>\$22,800</b>
	Hand Rails, Misc Metal Grating	1	LS	\$10,800	\$10,800
	Grating over Treatment Basins	1	LS	\$12,000	\$12,000
<b>6</b>	<b>WOOD AND PLASTIC</b>				<b>\$2,100</b>
	Interior Wall Framing	1050	SF	\$2	\$2,100
<b>7</b>	<b>THERMAL &amp; MOISTURE PROTECTION</b>				<b>\$2,400</b>
	Misc Sealants	1	LS	\$2,400	\$2,400
<b>8</b>	<b>DOORS &amp; WINDOWS</b>				<b>\$36,000</b>
	Garage Doors	2	EA	\$5,000	\$10,000
	Double Doors	2	EA	\$3,000	\$6,000
	Windows	10	EA	\$1,000	\$10,000
	Single Exterior Doors	3	EA	\$2,500	\$7,500
	Single Interior Doors	5	EA	\$500	\$2,500
<b>9</b>	<b>FINISHES</b>				<b>\$25,500</b>
	Interior Walls Sheet Rock and Paint	1050	SF	\$10	\$10,500
	Paints On Door And Frames, Exposed Piping, Bollards	1	LS	\$15,000	\$15,000
<b>10</b>	<b>SPECIALITIES</b>				<b>\$6,300</b>
	Fire Extinguishers	1	EA	\$2,350	\$2,400
	Bathroom Fixtures and Accessories	1	LS	\$3,850	\$3,900
<b>11</b>	<b>EQUIPMENT</b>				<b>\$1,434,600</b>
	Influent Flow Measurement, Nested Parshall Flume	1	EA	\$5,000	\$5,000
	SBR Vendor Quote	1	LS	\$490,500	\$490,500
	Effluent Equalization Tank	2	EA	\$15,000	\$30,000
	Tertiary Filters for P=Removal and Denite	1	LS	\$450,000	\$450,000
	Carbon Chemical Skid	1	LS	\$5,000	\$5,000
	UV Disinfection	3	EA	\$33,000	\$99,000
	Chemical Feed Equipment (PaCl and Micro C)	2	EA	\$12,000	\$24,000
	Secondary Treatment Process Installation	1	LS	\$331,050	\$331,100



### SBR Treatment Process Alternative

#### Opinion Of Probable Construction Cost

12	FURNISHINGS				\$5,000	
	Lab, Operations Room	1	LS	\$5,000	\$5,000	
13	SPECIAL CONSTRUCTION				\$300,300	
	Metal Roof over Biosolids Storage Area - Materials	1	LS	\$15,000	\$15,000	
	Metal Roof over Biosolids Storage Area - Installation	1	LS	\$8,000	\$8,000	
	Temporary Treatment Equipment, Delivery & Start-up	1	LS	\$37,250	\$37,300	
	Temporary Treatment Equipment, Monthly Rental	12	MONTH	\$20,000	\$240,000	
14	HOISTS AND CRANES				\$0	
	Mono Rail And Hoists	0	LS	\$37,500	\$0	
15	MECHANICAL / HVAC				\$196,500	
	Process Piping, Valves, and Accessories (blowers and treatment)	1	LS	\$95,000	\$95,000	
	HVAC	1	LS	\$75,000	\$75,000	
	Hot Water System	1	LS	\$2,500	\$2,500	
	Plumbing Piping	1	LS	\$12,000	\$12,000	
	Gravity Piping, Bathroom	1	LS	\$12,000	\$12,000	
16	ELECTRICAL and INSTRUMENTATION & CONTROLS				\$875,000	
	New Scada System, MCC, Misc Electrical Connection, Controls	1	LS	\$850,000	\$850,000	
	New Generator	1	EA	\$25,000	\$25,000	
					SUBTOTAL 1	4,441,300
	CONSTRUCTION PRORATES( See Note 1)	10.0%	of Subtotal 1	444,130	1.0	444,200
	CONTRACTOR'S OVERHEAD & PROFIT (See Note 2)	15.0%	of Subtotal 1	666,195	1.0	666,200
					SUBTOTAL 2	5,551,700
	CONTINGENCY (See Note 4)	10.0%	of Subtotal 2	555,170	1.0	555,200
					SUBTOTAL 3	6,106,900
	NMGR 8.9125%	8.9125%	of Subtotal 3	544,277	1.0	544,300
					SUBTOTAL 4	6,651,200
	ENGINEERING COSTS					1,380,000
	PER and Environmental			95,000		
	Basic Services			925,000		
	Full Time RPR Services			340,000		
	Additional Services			0		
	Reimbursables			20,000		
	NMGR 5.125%	5.1250%				70,725
					ENGINEERING TOTAL	1,450,725
	NON CONSTRUCTION COSTS					155,000
	Local Attorney Services			15,000		
	Financial Advisor			100,000		
	Filing Fees/Reimbursables			25,000		
	Bond Counsel			15,000		
	NMGR 5.125%	5.1250%				7,944
					NON CONSTRUCTION TOTAL	162,944
					TOTAL	8,265,000

Notes:

## Notes

- |     |  |              |
|-----|--|--------------|
| 1   | <u>Construction Prorates</u> <sup>(a) (b)</sup>  | <u>10%</u>   |
| (a) | General conditions includes cost associated with permits, licenses, insurance, environmental safe guards, sediment and drainage control, and special construction practices to |              |
| 2   | <u>Contractor's Overhead &amp; Profit</u> <sup>(a)</sup>   | <u>15.0%</u> |
| (a) | Contractor's overhead and profit include costs for mobilization/demobilization, administration, and contractor/subcontractor overhead costs and profits.                       |              |
| 4   | <u>Design Contingency</u> <sup>(a)</sup>   | <u>10.0%</u> |
| 4   | The design contingency is added to the subtotal based on the conceptual nature of information developed for this evaluation.   |              |

SBR Treatment Process Alternative  
Net Present Value Calculations

**SBR Alternative**  
**Life Cycle Cost Analysis**

Annual Operating and Maintenance Costs	
Chemicals & Reagents Delivered <sup>3</sup>	\$ 58,500
Energy Cost <sup>2</sup>	\$ 59,600
Personnel (i.e. salary, benefits, payroll tax, insurance, training) <sup>3</sup>	\$ 43,673
Administrative Costs (e.g. office supplies, printing, etc.) <sup>3</sup>	\$ 11,950
Management and Legal Services <sup>3</sup>	\$ 18,960
Insurance <sup>3</sup>	\$ 8,000
Monitoring & Testing <sup>3</sup>	\$ 25,500
Professional Services <sup>3</sup>	\$ 3,000
Residuals Disposal <sup>3</sup>	\$ 13,058
<b>Subtotal</b>	<b>\$ 242,242</b>

**Notes:**

1 - Equipment Manufacturer Chemical Consumption Estimate

2 - Developed from Equipment Loads/Usage (reference attached Operations and Maintenance Cost Estimate Sheet)

3 - Developed from Village Cost Data 2008, 2009 (Reference attached Village Cost Summarized Data Sheet)

Assets & Salvage Value	Life Expectancy	Replacement Cost	Short Lived Assets Annual Cost
<b>Short Lived Assets</b>			
Existing Bar Screen	15	\$86,000	\$5,733
Exisitng Grit Pump	15	\$15,000	\$1,000
Exisitng Grit Classifier	15	\$35,000	\$2,333
EQ tank Mixer 1	15	\$13,800	\$920
EQ tank Mixer 2	15	\$13,800	\$920
Submersible Mixer (2 duty)	15	\$27,600	\$1,840
Aerobic Diffusers	10	\$10,000	\$1,000
Blowers (2 duty)	15	\$160,000	\$10,667
IMLR/WAS Pump (2 duty)	15	\$30,000	\$2,000
Effluent Equilization Pump (2 duty)	15	\$30,000	\$2,000
Tertiary Filter- Polymer Pump	15	\$5,000	\$333
Tertiary Filter- Ferric Pump	15	\$5,000	\$333
Chemical Skid- Alum	15	\$5,000	\$333
Chemical Skid- Carbon	15	\$5,000	\$333
Short Lived Assets Annual Cost Total			\$29,747
<b>Long Life Assets</b>			
New Concrete strucutres	50	\$1,286,800	\$772,080
<b>Present Value of Salvage Costs</b>			<b>\$699,000</b>

Net Present Value Calculation		
End of Year	O&M Costs	Present Value of O&M Costs (0.5% Discount Rate)
1	\$242,242	\$241,036
2	\$242,242	\$239,837
3	\$242,242	\$238,644
4	\$242,242	\$237,457
5	\$242,242	\$236,275
6	\$242,242	\$235,100
7	\$242,242	\$233,930
8	\$242,242	\$232,766
9	\$242,242	\$231,608
10	\$242,242	\$230,456
11	\$242,242	\$229,309
12	\$242,242	\$228,169
13	\$242,242	\$227,033
14	\$242,242	\$225,904
15	\$242,242	\$224,780
16	\$242,242	\$223,662
17	\$242,242	\$222,549
18	\$242,242	\$221,442
19	\$242,242	\$220,340
20	\$242,242	\$219,244
<b>Capital Costs</b>		<b>\$8,265,000</b>
<b>O&amp;M Costs</b>		<b>\$4,600,000</b>
<b>Salvage Value</b>		<b>\$699,000</b>
<b>NPV</b>		
NPV = Capital Costs + O&M Costs - Salvage Value		<b>\$12,166,000</b>

**Notes:**

Real Discount rate is 0.5% for 20-Year horizon per OMB Circular No. A-94, Appendix C, effective for 2017

**MBR Alternative**  
**Opinion of Probable Construction Costs**

Division	Description	Quantity	Units	Cost per Unit (\$)	Cost (nearest \$100)
<b>1</b>	<b>GENERAL CONDITIONS</b>				<b>\$100,000</b>
		1	LS	\$100,000	\$100,000
<b>2</b>	<b>CIVIL / SITEWORK</b>				<b>\$110,900</b>
	Erosion Control & Site Preparation	1	LS	\$2,703	\$2,800
	Demolition in Headworks & Treatment Building	1	LS	\$15,000	\$15,000
	Excavation For Additional Concrete Treatment Basins	4241	CY	\$10	\$42,500
	Subgrade Preparation for Concrete Treatment Basins	151	CY	\$30	\$4,600
	12" DIP Yard Piping, Excavation, Installation. Material, Bedding, Compacting	100	LF	\$80	\$8,000
	8" WAS Yard Piping, Excavation, Installation. Material, Bedding, Compacting	75	LF	\$65	\$4,900
	8" Decant Yard Piping, Excavation, Installation, Material, Bedding, Compacting	150	LF	\$65	\$9,800
	8" Discharge Yard Piping, Excavation, Installation, Material, Bedding, Compacting	45	LF	\$65	\$3,000
	Excavation For Sludge Holding Tanks	747	CY	\$10	\$7,500
	Subgrade Preparation for Sludge Holding Tanks	111	CY	\$40	\$4,500
	New Concrete Pad For New Generator On West Side Of Existing Building	1	SY	\$5,000	\$5,000
	Crushed Aggregate Resurfacing	78	SY	\$35	\$2,800
	Topsoil and Seeding	50	SY	\$10	\$500
<b>3</b>	<b>CONCRETE</b>				<b>\$637,300</b>
	Influent Parshall Flume approach	1	LS	\$2,000	\$2,000
	Misc. Concrete For Headworks Retrofit	10	CY	\$800	\$8,000
	New Treatment Basins	446	CY	\$900	\$401,700
	New Sludge Holding Tanks	167	CY	\$900	\$150,700
	Splitter Box and Feed Channel	1	LS	\$40,000	\$40,000
	Misc. Concrete For Clarifier Base Slab Levelling	1	LS	\$2,500	\$2,500
	Pad For Generator	13	CY	\$800	\$10,400
	Chemical Storage Secondary Containment	2	CY	\$800	\$1,800
	Effluent Manhole	1	EA	\$5,000	\$5,000
	Concrete Footers for Biosolids Storage Area Roof Structure	4	EA	\$800	\$3,200
	Misc. Concrete	15	CY	\$800	\$12,000
<b>4</b>	<b>MASONRY</b>				<b>\$25,800</b>
	Chemical Storage Room Walls	645	SF	\$40	\$25,800
	Interior Building Walls	0	SF	\$40	\$0
<b>5</b>	<b>METALS</b>				<b>\$22,800</b>
	Hand Rails, Misc Metal Grating	1	LS	\$10,800	\$10,800
	Grating over Treatment Basins	1	LS	\$12,000	\$12,000
<b>6</b>	<b>WOOD AND PLASTIC</b>				<b>\$2,100</b>
	Interior Wall Framing	1050	SF	\$2	\$2,100
<b>7</b>	<b>THERMAL &amp; MOISTURE PROTECTION</b>				<b>\$30,900</b>
	Treatment Building Insulation (Walls & Roof)	11943	SF	\$2	\$23,900
	Treatment Building Ice & Water Sheild	6955	SF	\$1	\$7,000
<b>8</b>	<b>DOORS &amp; WINDOWS</b>				<b>\$38,000</b>
	Garage Doors	3	EA	\$5,000	\$15,000
	Double Doors	1	EA	\$3,000	\$3,000
	Windows	10	EA	\$1,000	\$10,000
	Single Exterior Doors	3	EA	\$2,500	\$7,500
	Single Interior Doors	5	EA	\$500	\$2,500
<b>9</b>	<b>FINISHES</b>				<b>\$80,500</b>
	Interior Walls Sheet Rock and Paint	1050	SF	\$10	\$10,500
	Paints On Door And Frames, Exposed Piping, Bollards	1	LS	\$30,000	\$30,000
	Concrete Coatings	1	LS	\$40,000	\$40,000
<b>10</b>	<b>SPECIALITIES</b>				<b>\$6,300</b>
	Fire Extinguishers	1	EA	\$2,350	\$2,400
	Bathroom Fixtures and Accessories	1	LS	\$3,850	\$3,900
<b>11</b>	<b>EQUIPMENT</b>				<b>\$1,770,500</b>
	Halliday Debris Basket	1	EA	\$2,000	\$2,000
	Headworks New Fine Screen by Huber	1	EA	\$145,000	\$145,000
	Manual Bar Screen, 3mm	1	EA	\$2,500	\$2,500
	Influent Flow Measurement, Nested Parshall Flume	1	EA	\$5,000	\$5,000
	Relocation of Lakeside Grit Classifier	1	LS	\$2,500	\$2,500
	Headworks Equipment Installation	1	LS	\$47,100	\$47,100
	Ovivo MBR Equipment	1	LS	\$1,048,891	\$1,048,900
	UV Disinfection	3	EA	\$33,000	\$99,000
	16" x 16" Isolation Headgates	4	EA	\$2,500	\$10,000
	Actuated Butterfly Valve	2	EA	\$3,500	\$7,000
	16" Weir Gates	2	EA	\$3,000	\$6,000
	Actuated Pinch Valve	1	EA	\$2,000	\$2,000
	Pumps (WAS)	2	EA	\$4,000	\$8,000
	Chemical Feed Equipment (Alkalanity, PaCl, and Micro C)	2	EA	\$12,000	\$24,000
	Secondary Treatment Process Installation	1	LS	\$361,470	\$361,500

MBR Treatment Process Alternative  
Opinion Of Probable Construction Cost

12	FURNISHINGS					\$5,000	
	Lab, Operations Room	1	LS	\$5,000		\$5,000	
13	SPECIAL CONSTRUCTION					\$503,100	
	Metal Walls & Roof on Existing Steel Treatment Building - Materials	5257	SF	\$17		\$89,400	
	Metal Walls & Roof on Existing Steel Treatment Building - Installation	1	LS	\$25,000		\$25,000	
	New Metal Building Addition (Steel, Walls, Roof) - Material:	2015	SF	\$24		\$48,400	
	New Metal Building Addition - Installation	1	LS	\$40,000		\$40,000	
	Metal Roof over Biosolids Storage Area - Materials	1	LS	\$15,000		\$15,000	
	Metal Roof over Biosolids Storage Area - Installation	1	LS	\$8,000		\$8,000	
	Temporary Treatment Equipment, Delivery & Start-up	1	LS	\$37,250		\$37,300	
	Temporary Treatment Equipment, Monthly Rental	12	MONTH	\$20,000		\$240,000	
14	HOISTS AND CRANES					\$62,500	
	Mono Rail And Hoist For Moving Of Membrane Cassettes	1	LS	\$37,500		\$37,500	
	Mono Rail And Hoist For Other Process Equipment	1	LS	\$10,000		\$10,000	
	Mono Rail and Hoist For Blowers	1	LS	\$15,000		\$15,000	
15	MECHANICAL / HVAC					\$196,500	
	Process Piping, Valves, and Accessories (blowers and treatment)	1	LS	\$95,000		\$95,000	
	HVAC	1	LS	\$75,000		\$75,000	
	Hot Water System	1	LS	\$2,500		\$2,500	
	Plumbing Piping	1	LS	\$12,000		\$12,000	
	Gravity Piping, Bathroom	1	LS	\$12,000		\$12,000	
16	ELECTRICAL and INSTRUMENTATION & CONTROLS					\$641,500	
	Basic Electrical, Lighting Inside Treatment Building	1	LS	\$2,000		\$2,000	
	Ultrasonic Flow Meters (Influent)	1	EA	\$6,000		\$6,000	
	Magmeters (RAS, WAS, Filtrate, Effluent)	4	EA	\$6,000		\$24,000	
	Variable Frequency Drives and Control Equipment	4	EA	\$20,000		\$80,000	
	New Scada System, Mcc, Misc.Electrical Connection, Controls	1	LS	\$500,000		\$500,000	
	Data Acquisition Computer	1	LS	\$4,500		\$4,500	
	New Generator	1	EA	\$25,000		\$25,000	
						SUBTOTAL 1	4,233,700
	CONSTRUCTION PRORATES( See Note 1)	10.0%	of Subtotal 1	423,370	1.0	423,400	
	CONTRACTOR'S OVERHEAD & PROFIT (See Note 2)	15.0%	of Subtotal 1	635,055	1.0	635,100	
						SUBTOTAL 2	5,292,200
	CONTINGENCY (See Note 4)	10.0%	of Subtotal 2	529,220	1.0	529,300	
						SUBTOTAL 3	5,821,500
	NMGRT 8.9125%	8.9125%	of Subtotal 3	518,841	1.0	518,900	
						SUBTOTAL 4	6,340,400
						ENGINEERING COSTS	1,380,000
	PER and Environmental			95,000			
	Basic Services			925,000			
	Full Time RPR Services			340,000			
	Additional Services			0			
	Reimbursables			20,000			
	NMGRT 5.125%	5.1250%				70,725	
						ENGINEERING TOTAL	1,450,725
						NON CONSTRUCTION COSTS	155,000
	Local Attorney Services			15,000			
	Financial Advisor			100,000			
	Filing Fees/Reimbursables			25,000			
	Bond Counsel			15,000			
	NMGRT 5.125%	5.1250%				7,944	
						NON CONSTRUCTION TOTAL	162,944
						TOTAL	7,954,000

**Notes:**

Ovivo MBR supply includes MBR cassettes, diffusers, forward feed pumps, mixers, and associated controls and valves

**Notes**

- 1 Construction Prorates<sup>(a) (b)</sup> 10%
- (a) General conditions includes cost associated with permits, licenses, insurance, environmental safe guards, sediment and drainage control, and special construction practices to
- 2 Contractor's Overhead & Profit<sup>(a)</sup> 15.0%
- (a) Contractor's overhead and profit include costs for mobilization/demobilization, administration, and contractor/subcontractor overhead costs and profits.
- 4 Design Contingency<sup>(a)</sup> 10.0%
- (a) The design contingency is added to the subtotal based on the conceptual nature of information developed for this evaluation.



MBR Treatment Process Alternative  
Net Present Value Calculations

MBR Alternative  
Lift Cycle Cost Analysis

Annual Operating and Maintenance Costs	
Chemicals & Reagents Delivered <sup>1</sup>	\$50,600
Energy Cost <sup>2</sup>	\$57,700
Personnel (i.e. salary, benefits, payroll tax, insurance, training) <sup>3</sup>	\$43,673
Administrative Costs (e.g. office supplies, printing, etc.) <sup>3</sup>	\$11,950
Management and Legal Services <sup>3</sup>	\$18,960
Insurance <sup>3</sup>	\$8,000
Monitoring & Testing <sup>3</sup>	\$25,500
Professional Services <sup>3</sup>	\$3,000
Residuals Disposal <sup>3</sup>	\$13,058
<b>Subtotal</b>	<b>\$232,442</b>

Notes:

1 - Equipment Manufacturer Chemical Consumption Estimate

2 - Developed from Equipment Loads/Usage (reference attached Operations and Maintenance Cost Estimate Sheet)

3 - Developed from Village Cost Data 2008, 2009 (Reference attached Village Cost Summarized Data Sheet)

Assets & Salvage Value	Life Expectancy	Replacement Cost	Short Lived Assets Annual Cost
<b>Short Lived Assets</b>			
Existing Bar Screen	15	\$86,000	\$5,733
Exisitng Grit Pump	15	\$15,000	\$1,000
Exisitng Grit Classifier	15	\$35,000	\$2,333
New Bar Screen	15	\$86,000	\$5,733
EQ Tank Mixer 1	15	\$13,800	\$920
EQ Tank Mixer 2	15	\$13,800	\$920
Anaerobic Mixer	15	\$13,800	\$920
Anoxic Mixer (2 Duty)	15	\$27,600	\$1,840
Aerobic Diffusers	10	\$10,000	\$1,000
MBR Membrane Year 11	11	\$28,930	\$2,630
MBR Membrane Year 12	12	\$28,930	\$2,411
MBR Membrane Year 13	13	\$28,930	\$2,225
MBR Membrane Year 14	14	\$28,930	\$2,066
MBR Membrane Year 15	15	\$28,930	\$1,929
Blowers (3 Duty)	15	\$240,000	\$16,000
IMLR/WAS Pump	15	\$15,000	\$1,000
Permeate Pump (2 Duty)	15	\$30,000	\$2,000
Chemical Skid- Alum	15	\$5,000	\$333
Chemical Skid- Carbon	15	\$5,000	\$333
Short Lived Assets Annual Cost Total			\$51,328
<b>Long Life Assets</b>			
New concrete structures	50	\$637,300	\$382,380
Present Value of Salvage Costs			\$347,000

Net Present Value Calculation		
End of Year	O&M Costs	Present Value of O&M Costs (0.5% Discount Rate)
1	\$232,442	\$231,285
2	\$232,442	\$230,134
3	\$232,442	\$228,989
4	\$232,442	\$227,850
5	\$232,442	\$226,717
6	\$232,442	\$225,589
7	\$232,442	\$224,466
8	\$232,442	\$223,350
9	\$232,442	\$222,238
10	\$232,442	\$221,133
11	\$232,442	\$220,033
12	\$232,442	\$218,938
13	\$232,442	\$217,849
14	\$232,442	\$216,765
15	\$232,442	\$215,686
16	\$232,442	\$214,613
17	\$232,442	\$213,546
18	\$232,442	\$212,483
19	\$232,442	\$211,426
20	\$232,442	\$210,374
<b>Capital Costs</b>		\$7,954,000
<b>O&amp;M Costs</b>		\$4,414,000
<b>Salvage Value</b>		\$347,000
<b>NPV</b>		
NPV = Capital Costs + O&M Costs - Salvage Value		<b>\$12,021,000</b>

Notes:

Real Discount rate is 0.5% for 20-Year horizon per OMB Circular No. A-94, Appendix C, effective for 2017

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## APPENDIX E

### SRT CALCULATION, NITRIFICATION AND DENITRIFICATION CALCULATION

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**OBJECTIVE**

SRT Calculation, Nitrification and Denitrification Calculation

**PROJECT**

Village of Toas Ski Valley WWTF Improvements

**CALCULATED BY**

KV

**CHECKED BY**

MAD

**DATE**

1/20/16

**References****Ref 1** Wastewater Engineering Treatment and Reuse, Metcalf and Eddy: 4th Edition**Ref 2** Biological Wastewater Treatment, Grady, Daigger, Lim: 2nd Edition**Ref 3** Phosphorus and Nitrogen Removal from Municipal Wastewater Principles and practice, 2nd edition, Richard Sedlak**Calculations****SECTION 1 - A-BASIN DESIGN CRITERIA****DESIGN CRITERIA**

A-Basin Temp, Deg C		8
pH		7.2
DO, mg/l		2
NH3 Discharge Limit, mg/L		1
A-Basin NH3, mg/L	set equal to discharge limit	1

**SECTION 2 - CALCULATE SRT and REQUIRED AEROBIC BIOMASS for COMPLETE NITRIFICATION****2.A**

<b>Calc SRT</b>		
Temp Term, T	$e^{(0.098 \cdot (T-15))}$	0.50
DO Term, DO	$DO/(K_o + DO)$ , $K_o = 1.3$	0.61
pH term, pH	$1 - 0.833 \cdot (7.2 - pH)$	1.00
Ammonia Term, NH3	$NH_3 - N / (K_n + NH_3 - N)$	0.85
	$K_n = 10^{(0.051 \cdot T - 1.158)}$	
Nitrifier Growth Rate, (days) <sup>-1</sup>	$.50 \cdot (T)(pH)(DO)(NH_3)$	0.130
Minimum Solids Age, days	$(\text{Nitrifier Growth Rate})^{-1}$	7.72
Safety Factor (typ range 1.5 - 2.5x)	2	
Design Aerobic SRT, Days	Min. Solids Age * Safety Factor	15.44
	(at optimum pH = 7.2)	
Adopted SRT		18.00

**2.B Calc Mass Aerobic Biomass**

Flow, MGD Design flow/Basin		
Influent BOD Conc, mg/L (no primary treatment)		0.31
Effluent BOD conc, mg/L		350
Influent NH3, mg/L		5
Influent TKN, mg/L- Assume 99% hydrolysis to NH3		45
Effluent NH3, mg/L		66
Effluent NO3, mg/L		1
Yield TSS, lb/lb		1
BOD Load, lb/day /Basin	AVG BOD*Qm	0.6
WAS Produced, lb/day/Basin	AVG	905
Required Aerobic Mass, lb	Mass=SRT*WAS	543
		9773

**SECTION 3 - DETERMINE REQUIRED MLSS FOR COMPLETE NITRIFICATION AND A-BASIN SIZING****3.A CALC REQUIRED MLSS**

Total Volume of A-Basin (aeration + MBR), MG =		0.141
Volume of Pre- anoxic, MG		0.036
Volume of Post- anoxic, MG		0.057

**3.A CALC ACTIVATED SLUDGE DESIGN VARIABLES - MINIMUM REQUIREMENTS**

MLSS Required for Complete Nitrif. (to Permit Limit), mg/l =		8313
BOD Space Loading @ nominal loading, lb/day - ft3 =		48.0
Hydraulic Retention Time (HRT) @ Qm , hrs =		10.9
Volatiles Fraction, fv =		0.75
F/M =		0.12
Amount of NO3 to denitrify	Nitrogen converted - Nitrogen lost in sludge	
Nitrogen lost in sludge, lb/d	7 % in VSS as nitrogen, WAS NOT destroyed = 75%, Effluent BOD 5 mg/L Ref 3	19.7
Amount of NO3 to denitrify, lb/d	Nitrogen converted-lost in sludge-	144
Amount of NO3 to denitrify, mg/L	Nitrate in effluent(1 mg/L)	56

SECTION 4 - DETERMINE AMOUNT OF NO3 DENITRIFIED

F/Mb ratio	(Q*inf. BOD)/(Vax*MLVSS)	0.482881924
Q*BOD		108500000
Vax*MLVSS		224692610.5
Specific Denite raate @ 20 C, from figure 8-23, Ref 1 based on F/Mb ratio	SDNR 20	0.12
Specific Denite rate@ 8 C, mg NO3/mg MLVSS	SDNR20 * (1.026)^(8-20)	0.088
Volume of Reactor, MG		0.036
Volume of reactor, L		136403.83
VSS in reactor	mg VSS	850461530.8
AX HRT	hr/day	4.54
Amount of NO3 denitrified in MLSS	mg NO3 denitrified/day	14187707
	lb NO3/day	31



Ref 1- Table 8-20

	10 C
y	0.17
kd	0.04
um	0.52
K	3.1
ks	12.6

Assume post-Ax SRT, d	5
Residual methanol concentration, S	$=K_s(1+kd \cdot SRT)/(YK-kd)-1$ 10.53658537
$K_s(1+kd \cdot SRT)$	15.12
$SRT(YK-kd)-1$	1.435

Nitrate to be reduced, mg/l	44
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bCOD/NO3-N	$=2.86/(1-1.42Y_n)$ 3.580
$Y_n$	$=Y/(1+kd \cdot SRT)$ 0.141666667

Methanol Dose, mg/L or g/m3 as COD	166.7588568
Methanol Dose, g/L as CH3OH	111.1725712

Daily Methanol Consumption, lb/day	287.4255655
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## APPENDIX F

### EXISTING WWTF ENERGY USAGE

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