TECHNICAL MEMORANDUM

TO: DAN BERGMANN

FROM: ALFONSO MANRIQUE, AM CONSULTING ENGINEERS

SUBJECT: SHELTER COVE WATER TREATMENT PLANT IMPROVEMENTS

DATE: 3/20/2019

This Technical Memorandum (TM) provides a description of feasible alternatives to improve to the Shelter Cove Surface Water Treatment Plant (SWTP).

A. BACKGROUND

The Shelter Cove Resort Improvement District No. 1 (District) provides water service to the community of Shelter Cove. Shelter Cove is an unincorporated residential community located in Southern Humboldt County on the Lost Coast of California. The District was formed for the purpose of installing and maintaining facilities that provide electric, water and sewer services for the community of Shelter Cove. The District also manages the greenbelt areas within the sub-division, the Shelter Cove Golf Links, children's playground, recreational trails, the day-use Shelter Cove Airport and the Shelter Cove Fire Department which provides emergency services such as fire protection, emergency medical and ocean rescue.

The District owns and operates a public community water system under a permit from the State Water Resources Control Board Division of Drinking Water. The District Public Water Supply Permit number is 1210022. The District's permit allows for a maximum of 990 connections. Currently, the District supplies water to approximately 700 connections. The District's maximum day demand (MDD) based on the last ten years of production is 0.476 MG.

The District's sources of water include Telegraph Creek, Rick Spring and fifteen (15) groundwater wells located throughout the sub-division. Telegraph Creek is the primary source of water for the community. Telegraph Creek supplies approximately 225 gpm from December to June. However, the flow of Telegraph Creek between July and November only allows the District to pump 100 gpm. The remaining flow to meet the community's demand during those months comes from the Rick Spring and the 15 groundwater wells.

The District maintains 12 storage tanks (welded steel and redwood) ranging in size from 0.03 MG to 1 MG. The combined storage capacity of the 12 tanks is approximately 2.25 MG. The tanks can supply water to the community for approximately 2 days. The distribution system consists of approximately 44 miles of water mains of varying size. The majority of the distribution system is

asbestos cement (AC) pipe, but some above ground cross-country steel and polyvinyl chloride (PVC) is also present.

The District's SWTP consists is an EIMCO conventional treatment package treatment plant. The SWTP includes coagulation, flocculation, sedimentation, dual media filtration and disinfection. The SWTP was constructed in 1965. Due to the corrosive environment that is exposed to, the SWTP is aged and in need of repair or replacement. Based on the age of the SWTP and the extent of the damages, it is recommended that the equipment at the existing SWTP treatment plant be replaced with new equipment.

B. NEW SWTP ALTERNATIVES

Two alternative technologies are being considered herein for the new District's SWTP: (1) A Packaged Filtration Plant and (2) Membrane Filtration Plant.

B.1. PACKAGED FILTRATION PLANT

This alternative consists of a packaged WTP filtration plant that provides clarification and filtration in a single tank. One of the leading manufacturers of these types of systems is WesTech Engineering. The name of their packaged system is Trident. A Brochure is included at the end of this TM. The SWTP will consist of two 175 gpm Trident systems for a combined capacity of 500,000 gpd. While not required, it is recommended that the units be housed in a building. Figure 1 shows a process flow diagram of the process.

The process consists of an up-flow adsorption clarifier followed by a mixed media filter. The equipment is packaged in a steel tank with the majority of the piping equipment pre-attached as part of the equipment package.

Raw water enters the adsorption clarifier from the bottom where it flows up through the buoyant adsorption media. A coagulant chemical is added to the influent raw water to aid in removing solids. Less coagulant chemical and less hydraulic retention time in the tank is required compared to a conventional treatment system since the objective is not to produce a settleable floc. Instead, the system relies on filtration through the buoyant media.

The buoyant adsorption media is held in place by a screen at the top of the clarifier tank. In normal operation, the natural buoyancy of the media and the upward process flow hold the media firmly in place against the top screen. The media surface is scarified to collect and hold solids as the water passes through. The adsorption clarifiers are typically designed to operate at a loading rate of between 5 and 15 gpm/ft2.

Because the adsorption clarifier typically backwashes 2–4 times per day, an air header is installed in the tank to inject air into the tank during backwash, also known as blowdown. The air makes the buoyant media less buoyant, allowing for the solids to release and be collected into an overflow trough in the basin and sent by gravity to a backwash recovery basin or clarifier. The flow produced during each blowdown event is equal to the influent flow and lasts for approximately 10 minutes.

Following the adsorption clarifier, flow passes through the mixed media filter. The mixed media filter consists of three or more media of differing particle size and density. Typically sand, garnet, and anthracite coal are used as the filtration media. Water flows through the media from the top down through the media, similar to any other multimedia filter.

The filters are loaded to 5gpm/ft2. The filters require, on average, one backwash cycle per day, however, this is highly dependent on the influent water quality and the effectiveness of the adsorption clarifier. The backwash flow rate normally extends up to 10 minutes in duration. Treated water is used for backwash of the filters so this would most likely be taken from the treated water storage tank. The filter backwash water would be sent to a backwash water recovery basin or some other basin for solid/liquid separation from which the supernatant could be pumped back to the headworks of the plant.

The Trident packaged filtration plant provides a multi-barrier protection and is particularly well-suited for surface waters that do not exceed 20 NTUs for extended periods of time. The multi-barrier process tends to produce consistent finished water quality and has a smaller footprint than that of conventional plants.

The Trident packaged filtration system does not work well if water turbidities exceed 20 NTUs. This alternative filtration technology has a 2.5-log giardia removal credit from DDW.

The following table contains an opinion of probable construction cost for a new packaged filtration system SWTP:

Table 1 – Packaged Filtration System – Opinion of Probable Construction Cost

Item	Description	Amount
Raw Water Pumps	Two (2) 350 gpm	$150,000
Packaged Filtration	Two (2) 175 gpm Packaged Filtration Trident Systems	$900,000
Metal Building	Metal Building of approximately 30' x 30'	$200,000
Backwash Supply Tank	One (1) 50,000 gal Tank	$150,000
Clearwell	One (1) 150,000 gal tank	$300,000
Finished Water Pump Station	Two (2) 350 gpm pumps	$200,000
Chemical Feed System	Two (2) skid-mounted dual pump systems	$100,000
Electrical and Instrumentation	Level sensors, flow meter, modulating valve, SCADA modifications	$500,000
Sludge Drying Beds	High-rate sludge dewatering bed	$250,000
Miscellaneous Site Improvements	Grading, fencing, lighting, paving…	$300,000
	Total	$3,050,000
Contingency (20%)		$610,000
Engineering (15%)		$457,500
	Total Project Cost	$4,117,500

B.2. MEMBRANE TREATMENT PLANT

This alternative consists of a new surface water treatment plant using microfiltration (or ultrafiltration) membrane treatment. Membrane plants provide a positive barrier against pathogens entering into the distribution system without the use of coagulants. Membrane water treatment plants typically require less treatment chemicals than conventional multi-

media filtration alternatives. Membrane filters rely on physically removing the particulate matter from the water. Water passes through the membrane filters and contaminates are trapped and prevented from passing across the filter. Pore sizes through membranes vary depending on the type of system.

There are a number of membrane manufacturers and system configurations approved for water treatment in California. One of the leading manufacturers of membrane filtration system is Evoqua (formerly Siemens). The name of their membrane treatment system is Memcor XP. A brochure is included at the end of this TM. Figure 2 shows a process flow diagram of the new membrane system. The new facilities would be housed in a building.

The membrane system proposed herein is in an outside-in single pass configuration with the membrane fibers oriented parallel to the direction of the feed flow. The filters are comprised of hollow tube fibers made of polyvinylidene fluoride (PVDF) with pore openings of 0.1 microns. Solids are dead-end filtered by the membrane and are generally removed when the filters are backwashed. Solids retained on the membranes are removed via periodic backwashing, air scrubbing and chemical cleaning.

The membrane system utilizes three different types of backwash and filter cleaning procedures. Every 20 to 30 minutes each filter module will undergo an air scrub/reverse flow cycle to remove inorganic particles and organic matter concentrated on the membrane surface. Up to once each day, depending on the solids loading and raw water quality, the membrane modules undergo an enhanced filter chemical wash cycle. The enhanced chemical wash is automated and designed to reduce trans-membrane pressure rise and minimize the feed pressure required for filtration. The enhanced chemical cleaning process involves soaking the membranes with a chlorine solution to remove organic fouling from the membrane surface. If required, the chlorine wash can be substituted with a citric acid solution wash (typically performed if the primary foulant is inorganic in composition). The cycle is completed in about 60 minutes. A Clean-in-place (CIP) process is performed on each filter membrane rack on a monthly basis. The CIP process utilizes more chemicals at higher concentrations to oxidize and remove residuals from the membrane surface. Chemicals include a sodium hydroxide and sodium hypochlorite solution rinse followed by a citric acid solution rinse to provide a more thorough cleansing of the membrane surface. The CIP process is normally initiated manually as part of the scheduled maintenance of the membrane system. The complete CIP process, including the chemical soaking and backwash periods takes approximately six hours to complete.

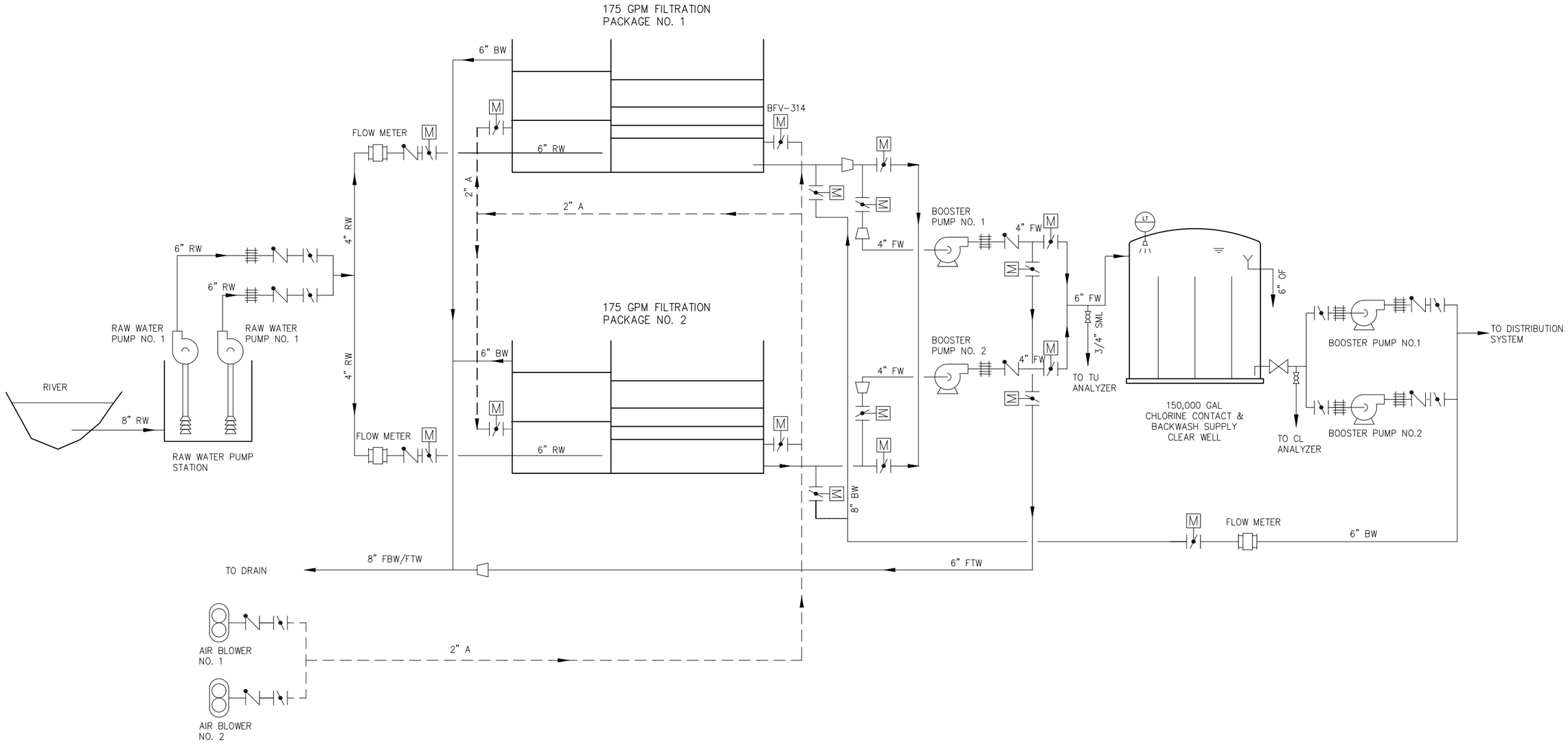
The frequency of backwash and cleaning cycles and the wastewater quantities produced during the backwash cycles will vary depending on the quality of the water entering the filters.

Membranes require diligent operational and maintenance activities such as back-flushing or they have a high likelihood of fowling. While very efficient, membrane water treatment plants are not necessarily easily operated. The rating of the plant may increase simply due to the increased complexity and more qualified operators would have to be hired to operate the plant.

The following table contains an opinion of probable construction cost for a new membrane filtration system SWTP:

Table 2 – Membrane Filtration System – Opinion of Probable Construction Cost

Item	Description	Amount
Raw Water Pumps	Two (2) 350 gpm	$150,000
Membrane Filtration	One 350 gpm Packaged Filtration Trident Systems	$1,300,000
Metal Building	Metal Building of approximately 30' x 30'	$200,000
CIP Tank	One (1) 10,000 gal Tank	$50,000
Clearwell	One (1) 150,000 gal tank	$300,000
Finished Water Pump Station	Two (2) 350 gpm pumps	$200,000
Chemical Feed System	Two (2) skid-mounted dual pump systems	$100,000
Electrical and Instrumentation	Level sensors, flow meter, modulating valve, SCADA modifications	$500,000
Sludge Drying Beds	High-rate sludge dewatering bed	$250,000
Miscellaneous Site Improvements	Grading, fencing, lighting, paving…	$300,000
	Total	$3,350,000
Contingency (20%)		$670,000
Engineering (15%)		$502,500
	Total Project Cost	$4,522,500



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IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

DESIGNED BY	AM
DRAWN BY	AM
CHECKED BY	AM
DATE	2/26/2019
PROJECT ENGINEER	ALFONSO MANRIQUE
REG NUMBER	C63673
EXP DATE	09/30/20
PROJECT NUMBER	
CADD STANDARDS	

REGISTERED PROFESSIONAL ENGINEER
ALFONSO MANRIQUE
No. C63673
Exp. 9/30/20
CIVIL
STATE OF CALIFORNIA

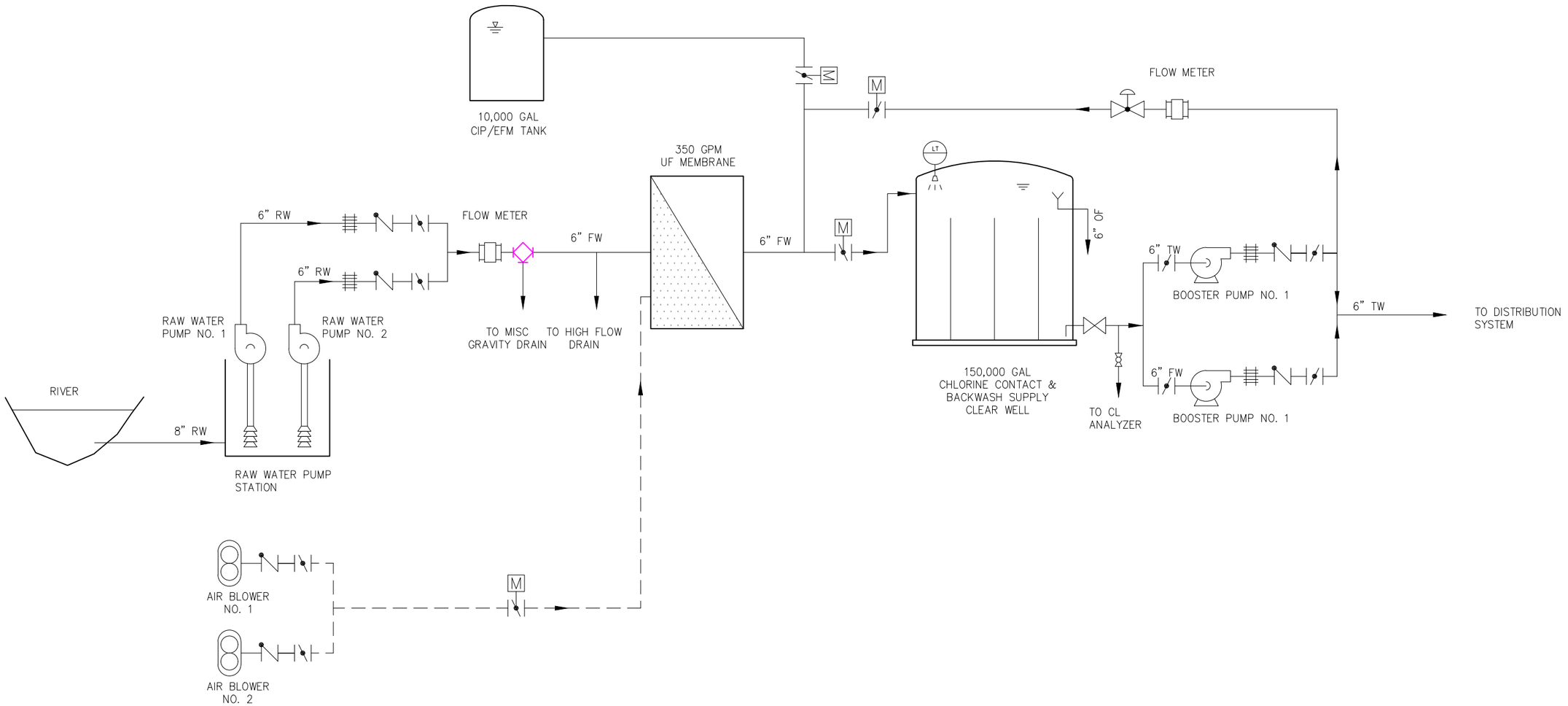
Consulting Engineers

SHELTER COVE SURFACE WATER PLANT

PACKAGED FILTRATION SYSTEM
PROCESS FLOW DIAGRAM

FIGURE

1



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Consulting Engineers

SHELTER COVE SURFACE WATER PLANT

MEMBRANE FILTRATION SYSTEM
PROCESS FLOW DIAGRAM

FIGURE
2

Trident®

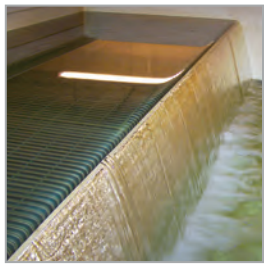
Package Water Treatment System

microfloc

The Trident® Package Water Treatment System

When Microfloc™ products first introduced the Trident technology, it represented a significant advancement in water and wastewater treatment for plant owners and operators. Not only did it remove turbidity, suspended solids, color, iron, manganese, odor, taste, and pathogens such as Giardia lamblia and Cryptosporidium, but it did so at a lower capital cost than conventional systems, in a smaller space, and at higher flow rates per unit area.

Today, more than 800 Trident technology systems, large and small, are at work all across North America and the world. Our Trident systems continue to evolve as we constantly strive to find ways to produce even higher quality treated water at higher flow rates per unit area and further reduce installation and operating costs.



Surface Water Treatment

- **Turbidity reduction**
- **Color removal**
- **Reduction of High TOC/DBP precursors**

Groundwater Treatment

- **Iron and manganese removal**
- **Arsenic**
- **Groundwater under the influence of surface water**

Tertiary Treatment

- **Water reuse**
- **Phosphorus removal**

Industrial Process Water

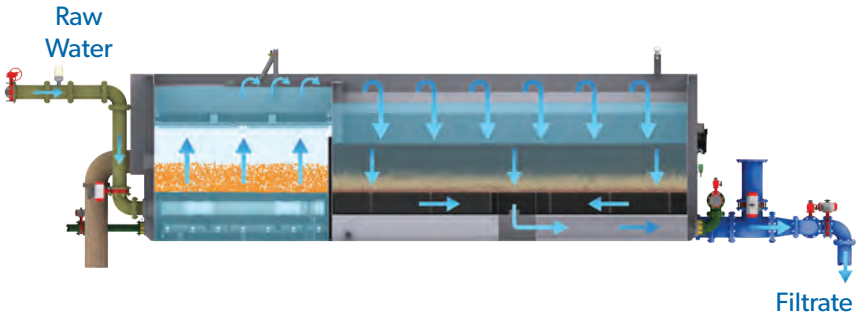
Trident Design Criteria

	Raw Water	Finish Water
Turbidity (NTU)	< 75	< 0.1
True Color (Pt-Co Units)	< 35	< 5
Combined Turbidity + Color	< 75	
Iron & Manganese (mg/L)	< 10	< 0.3 / 0.05

Proven and Efficient

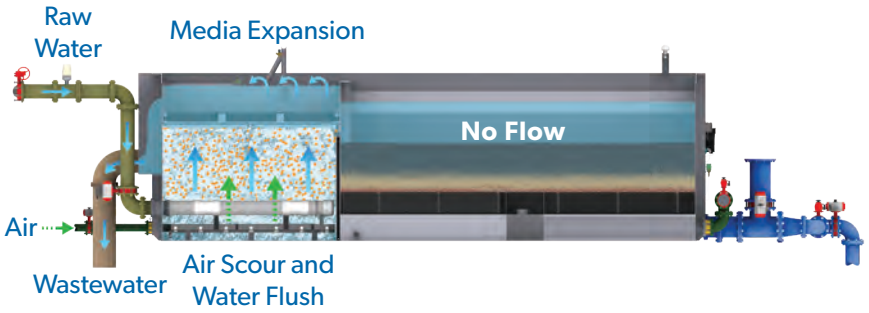
The Trident water treatment system utilizes a two-stage configuration consisting of an up-flow buoyant bead and compressible media Adsorption Clarifier® system followed by a conventional down-flow mixed media filter to produce high quality water.

Filtration Mode



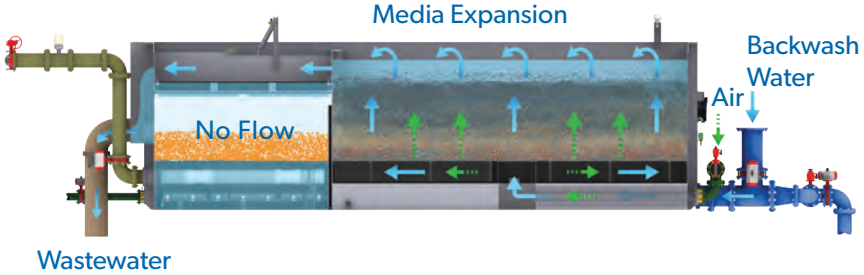
The treatment process is started when chemically dosed raw water enters the Adsorption Clarifier near the bottom of the tank where an upflow treatment process combines flocculation and clarification. From the Adsorption Clarifier, flow continues over a weir into the collection trough where it is distributed into the mixed media filtration chamber, after which it is collected by the MULTIBLOCK® underdrain with Laser Shield™ media retainer and exits the tank.

Buoyant Media Flush Mode



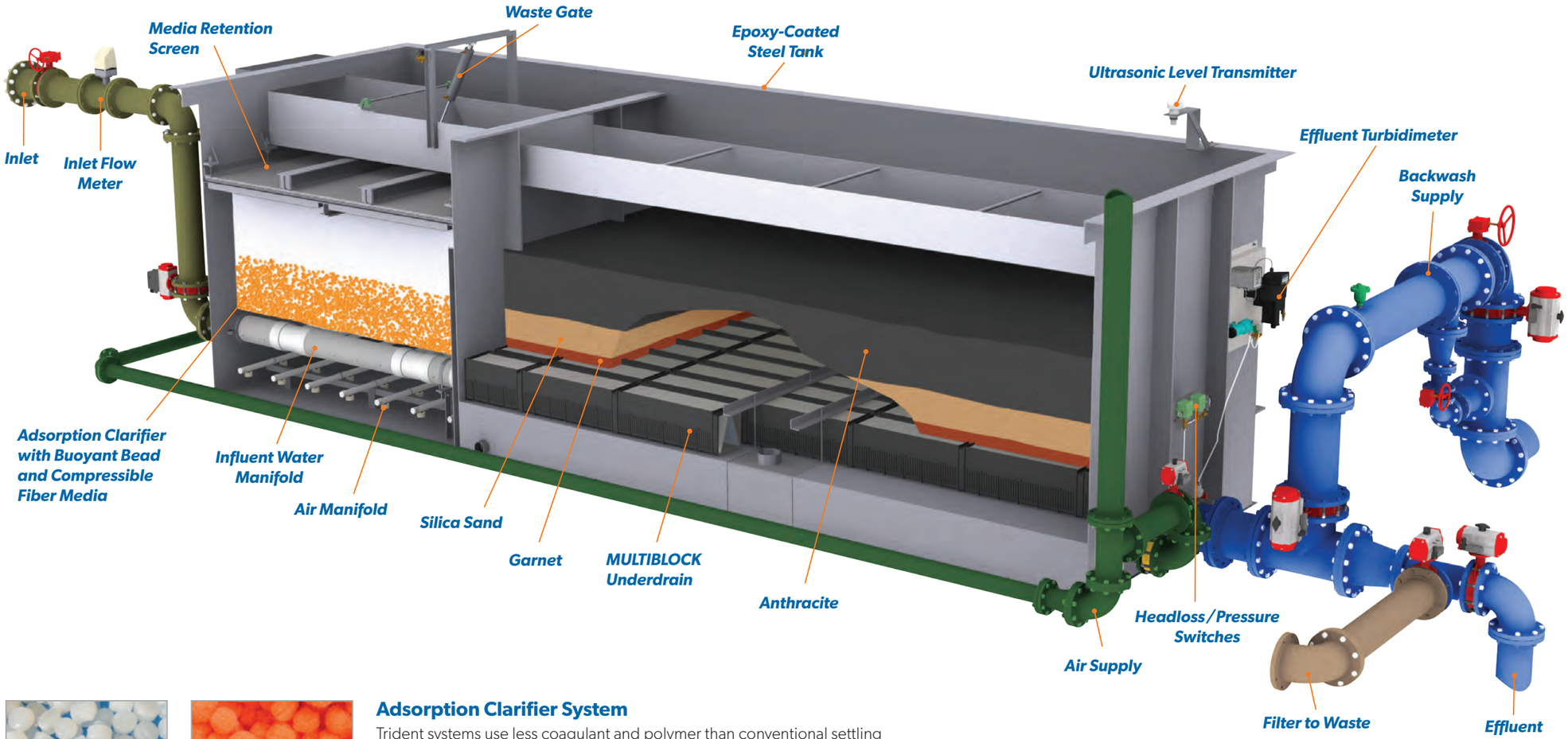
The Adsorption Clarifier is engineered to automatically initiate a flush cycle once headloss indicates that cleaning is required. When the cleaning is initiated, the waste gate and air scour valves are opened as raw water continues to flow. The air/water flush aggressively separates and removes the solids from the media. Solids are then discharged out through the waste pipe.

Backwash Mode



Like the Adsorption Clarifier flush, the backwash cycle is initiated when dirty bed headloss is reached in the mixed media filter section. The Trident inlet and outlet valves are closed and the air scour valve is opened to allow an air scour cycle. Solids from the backwash are then removed by water flowing up into the collection trough and discharged out through the waste pipe. A filter-to-waste sequence follows to ripen the filter media before returning the unit to service.

Complete Package Plant



Standard Components
Epoxy-coated steel tanks
Media
Internals
Actuated and manual valves
Inlet magnetic flow meter
Pressure transmitters
Ultrasonic level transmitter
Effluent turbidimeter
Automated PLC controls
Backwash control valves
Blower package
Chemical feed packages (coagulant and polymer)

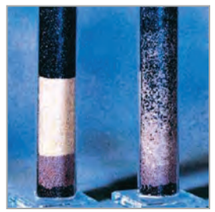
Optional Components
Air compressor package
Integrated plant PLC controls package
Backwash magnetic flow meter
Interconnecting walkways and platforms
Aluminum or stainless steel tanks
Inlet turbidimeter
pH monitor
Streaming current monitor
Static mixer

Adsorption Clarifier System

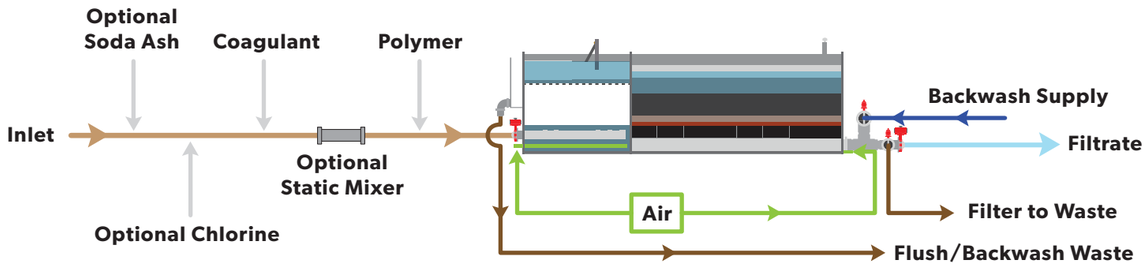
Trident systems use less coagulant and polymer than conventional settling type clarifiers. Within the Adsorption Clarifier system it is not necessary to form a settleable floc, which means floc size and settling time are not factors. The buoyant media is rolled and scarified to greatly improve particulate removal. The compressible fiber media is used to capture more solids. The buoyant and compressible fiber media are NSF-61 certified and typically will last the life of the system.

Mixed Media Filtration

Microfloc pioneered mixed media technology, which has become the industry filtration standard. By using three or more granular materials of differing size and specific gravity, the progressive coarse-to-fine mixed media produces superior quality finished water.



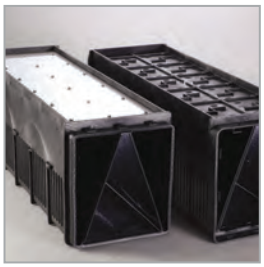
Trident Process Flow Diagram



Highly Efficient, Simple Operation

MULTIBLOCK

MULTIBLOCK underdrains provide a high-quality, low-cost, engineered product that is economical and versatile. MULTIBLOCK underdrains are fitted with the unique Laser Shield media retaining system that eliminates the need for support gravel. Combined air and water backwash is provided using this system.



- **Reduced profile underdrain**
- **Superior media retention capability**
- **Uniform distribution of water and air backwash**
- **NSF-61 approved**
- **Resistant to plugging and fouling**

Trident Process Controller Including the AQUARITROL® III

Trident package treatment units are supplied with fully automated programmable logic controls (PLC). These controls allow plant personnel to easily monitor operational parameters and control all treatment equipment and processes.

Changes in raw water characteristics and flow rate are automatically detected by the AQUARITROL III program. This PLC-based, feed-forward, loop control system monitors the filter effluent quality and continually evaluates and regulates influent chemical feed to maintain desired effluent water quality parameters. The operator sets an adjustable effluent quality setpoint and the Trident controls, utilizing the AQUARITROL III program, do the rest.

WesTech's electrical engineers and programmers can also integrate new whole plant operation or existing plant instruments into the Trident PLC controls. Complicated plant expansions are simplified by providing seamless integration of new and existing equipment.

- **Optimized and flexible process controls**
- **Chemical usage is maximized while maintaining performance**

Get More with Microfloc

Big Performance in a Small Water Treatment System

For lower flows, Microfloc offers the Tri-Mite® Package Water Treatment Plant. Using the same process as the Trident system, the Tri-Mite comes factory-assembled with pumps, controls, piping, valves, and an air scour blower mounted on the tank. These items are pre-plumbed and wired for simple, fast installation.

The Tri-Mite unit is available in five standard sizes as single units from 50 gpm to 350 gpm and as a two-unit system up to 700 gpm capacity. For flows less than 50 gpm, a single unit can be operated on an intermittent or reduced flow basis. These systems are perfect for new designs with future expansion in mind. The future additional tank would share the control panel, blower, and backwash pump of the first tank.

Equipment Upgrades and Expansions

If your unit is more than 10 years old, or has seen changes in raw water quality, it may be worthwhile to inquire about upgrading your Trident system. Common upgrades include enhanced PLC control systems, underdrain replacement accompanied with backwash upgrade, Trident HSR integrated presedimentation systems, and replacement of up-flow media. Retrofits are also available for other package treatment systems.

Stretch Customization

Some regulatory requirements may dictate a lower hydraulic loading through the filter cell. This is a simple change for the Trident system. An optional stretch filter cell is available to lower the hydraulic loading rate from 5 gpm/ft^2 to 4 gpm/ft^2. Other filter loading rates may also be achieved through custom design.

Standard Sizes

		Tri-Mite					Trident			
Influent Flow Rate GPM		**50**	**75**	**100**	**175**	**350**	**175**	**350**	**700**	**1400**
Tank Dimensions (Shipping)	Length	9 ft 0 in	9 ft 2 in	11 ft 2 in	13 ft 9 in	23 ft 2 in	10 ft 1 in	14 ft 6 in	27 ft 10 in	39 ft 10 in
	Width	5 ft 8 in	7 ft 10 in	7 ft 8 in	9 ft 11 in	10 ft 2 in	6 ft 11 in	8 ft 11 in	8 ft 11 in	11 ft 11 in
	Height	8 ft 5 in	8 ft 6 in	8 ft 6 in	8 ft 2 in	8 ft 3 in	8 ft 5 in	8 ft 5 in	8 ft 5 in	10 ft 1 in
Weights	Shipping (lbs)	6,300	8,100	9,600	9,200	14,600	7,000	10,250	17,000	34,000
	Operating (lbs)	14,000	20,000	25,000	43,000	78,000	35,000	70,000	140,000	330,000
Tank Connections	Influent	2 in	3 in	3 in	4 in	6 in	4 in	6 in	8 in	12 in
	Effluent	2 in	3 in	3 in	4 in	6 in	6 in	8 in	12 in	16 in
	Backwash Supply	3 in	4 in	4 in	5 in	8 in	6 in	8 in	12 in	16 in
	Waste/Overflow	4 in	6 in	6 in	8 in	10 in	8 in	10 in	14 in	20 in
	Air Wash (Clarifier)	1.5 in	2 in	2 in	2 in	3 in	2 in	3 in	4 in	6 in
	Air Wash (Filter)	1.5 in	2 in	2 in	2 in	3 in	3 in	4 in	6 in	8 in
Waste Production	Flushing Flow Rate (gpm)	50	75	100	175	350	175	350	700	1,400
	Flushing Volume Per Cycle (gal)	500	750	1,000	1,750	3,500	1,750	3,500	7,000	14,000
	Mixed Media Per Cycle (gal)	900	1,350	1,800	3,150	6,300	3,500	7,000	1,4000	28,000
	Filter to Waste Per Cycle (gal)	250	375	500	875	1,750	875	1,750	3,500	7,000

microfloc

Represented by:

WesTech®

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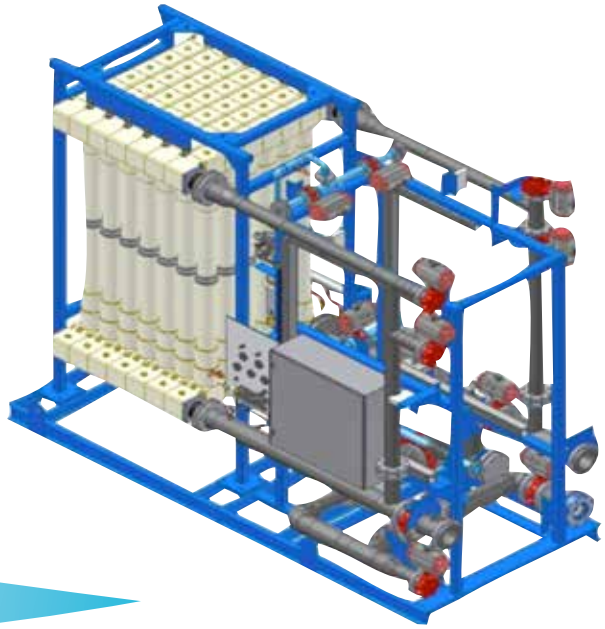
westech-inc.com
info@westech-inc.com
Salt Lake City, Utah, USA

evoqua
WATER TECHNOLOGIES



MEMCOR® XP^{MR} LOW PRESSURE MEMBRANE FILTRATION SYSTEMS

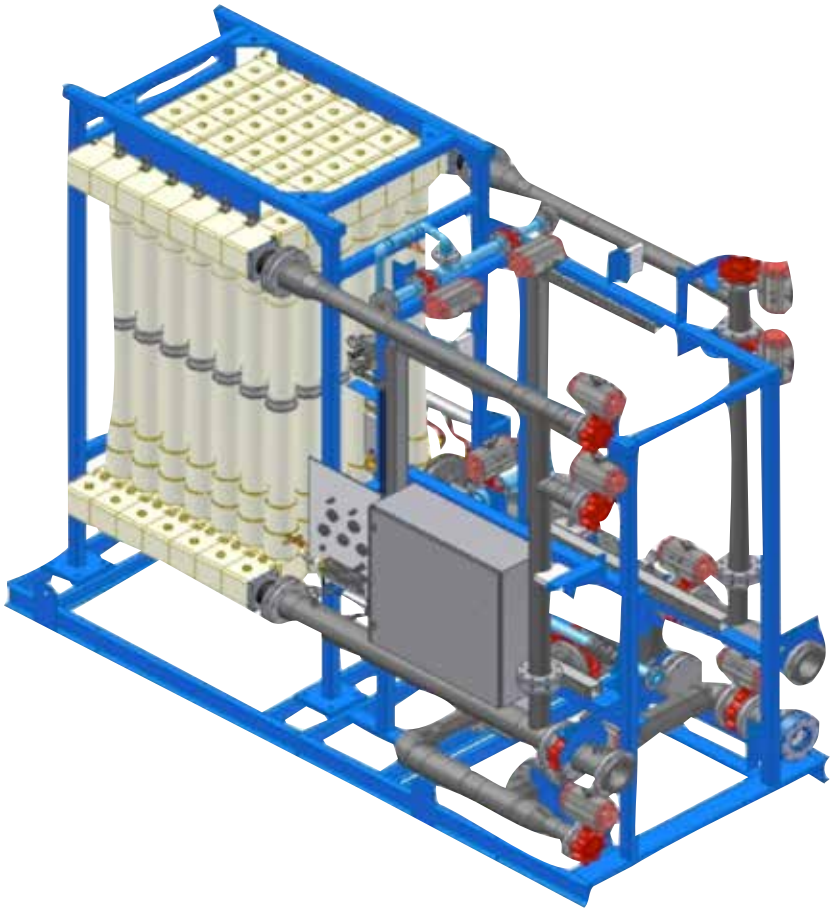
MEMCOR® XP^{MR} LOW PRESSURE MEMBRANE FILTRATION SYSTEMS

The MEMCOR® XP^{MR} system is a pre-engineered pressurised membrane filtration skid that utilises advanced membrane technology for a multitude of water treatment applications.

The factory assembled and tested membrane package comes as one skid delivered to site with:

- A fully assembled membrane array
- All valve, pipework, instrumentation and pump skid supplied in a supporting frame
- Integral process pump on skid
- System I/O and electrical panel

With their building block approach, MEMCOR XP^{MR} systems minimise design, installation and start up time while providing reliable, high quality water in a compact footprint.



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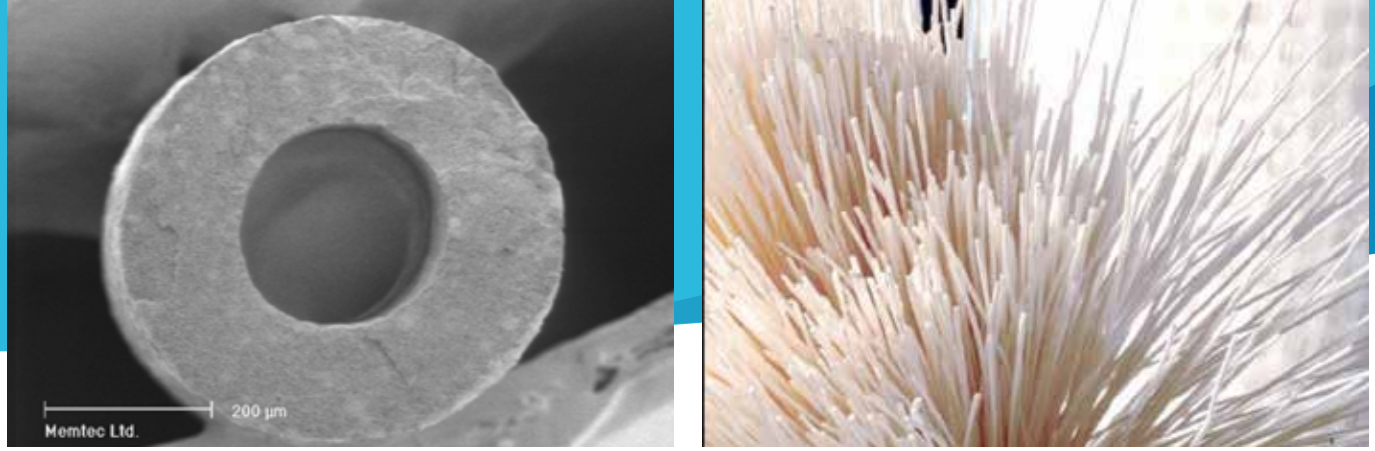


THE FIBERS WITHIN THE MODULE ARE ARRANGED VERTICALLY TO MINIMISE LESS STRESS ON THE MEMBRANE.

PVDF HOLLOW FIBRE ULTRA-FILTRATION MEMBRANE MODULE

The heart of the MEMCOR® XP[MR] system is the L20V membrane module (shown left) consisting of thousands of tubular hollow fibers. The L20V module weighs approximately 9 kg (20 lb) and is 1,800 mm (70.9") tall, making it easy to handle.

The module and module housing are separate components. This design feature results in lower cost of membrane module replacement and less waste generation during a membrane change out. The membrane is made from PVDF (polyvinylidene fluoride), which offers the following advantages:

- Homogeneous membrane (no risk of delaminating)
- Chlorine resistant to allow for removal of organic foulants
- Less brittle than polysulfone membranes and therefore not damaged by vigorous air scour used during backwash

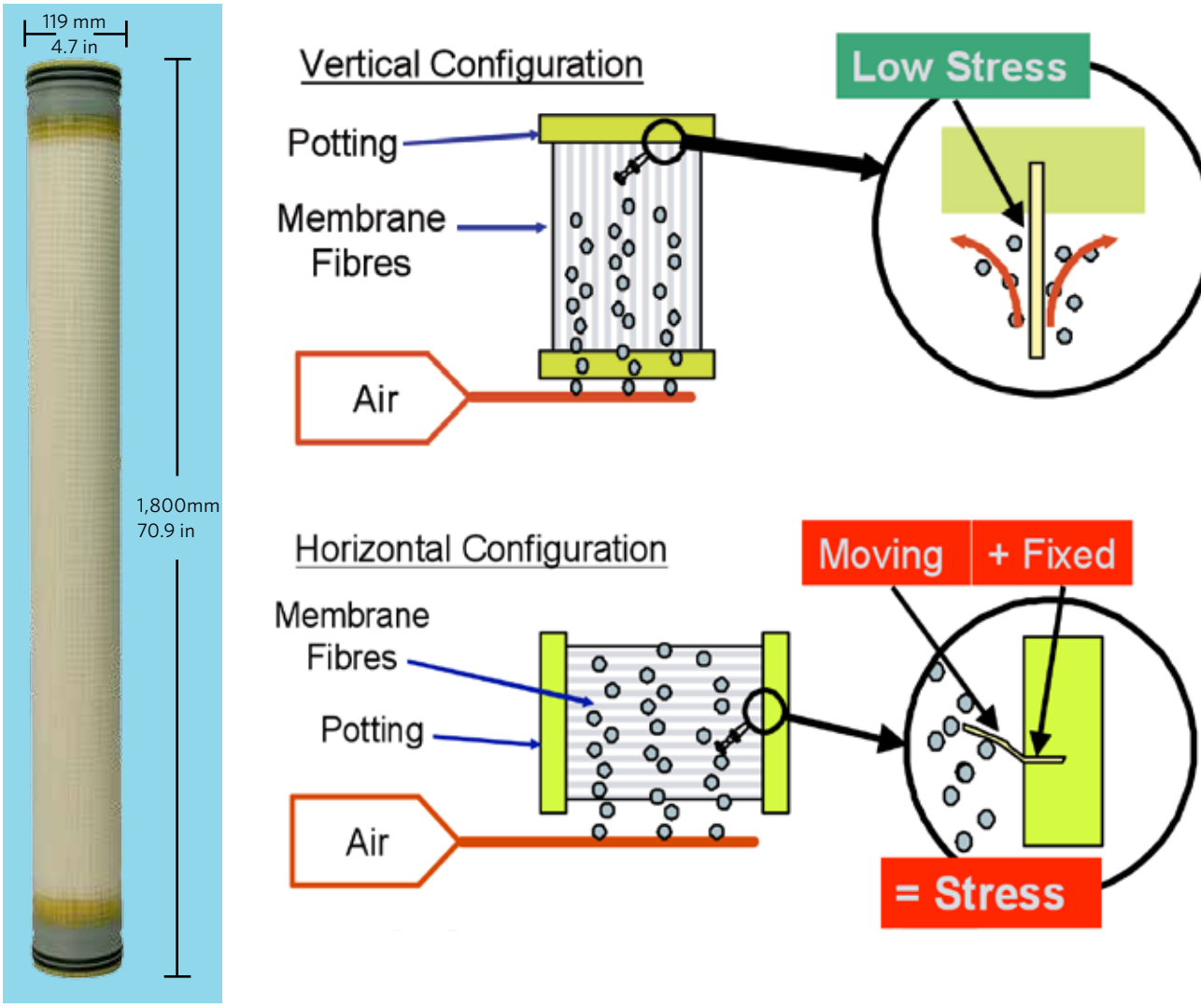
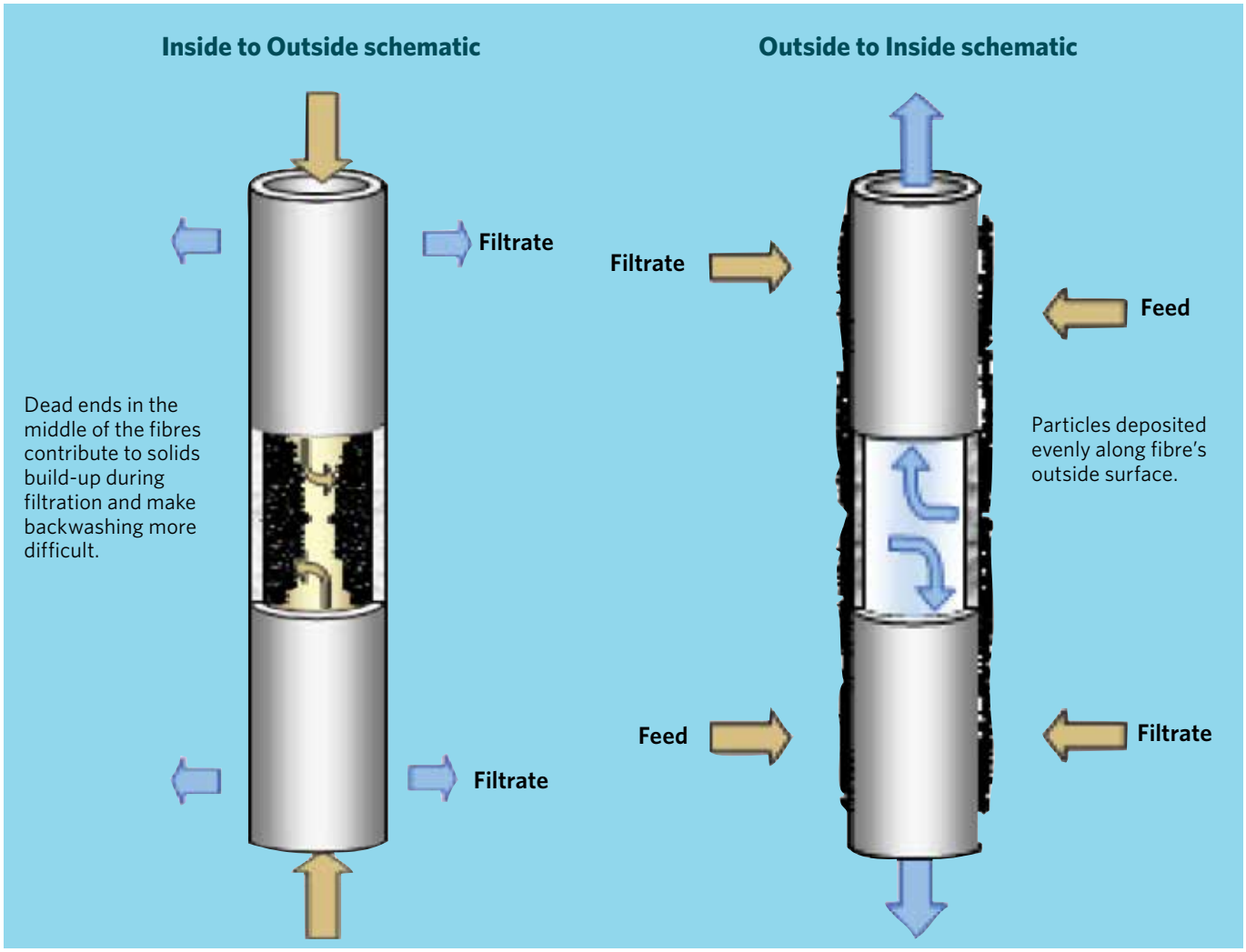


FIGURE 1: L20V MODULE

OUTSIDE TO INSIDE FILTRATION

Over 80% of the global installed membrane capacity is configured to filter from the outside of the membrane to the inside. The advantages of filtration from the outside to inside are as follows:

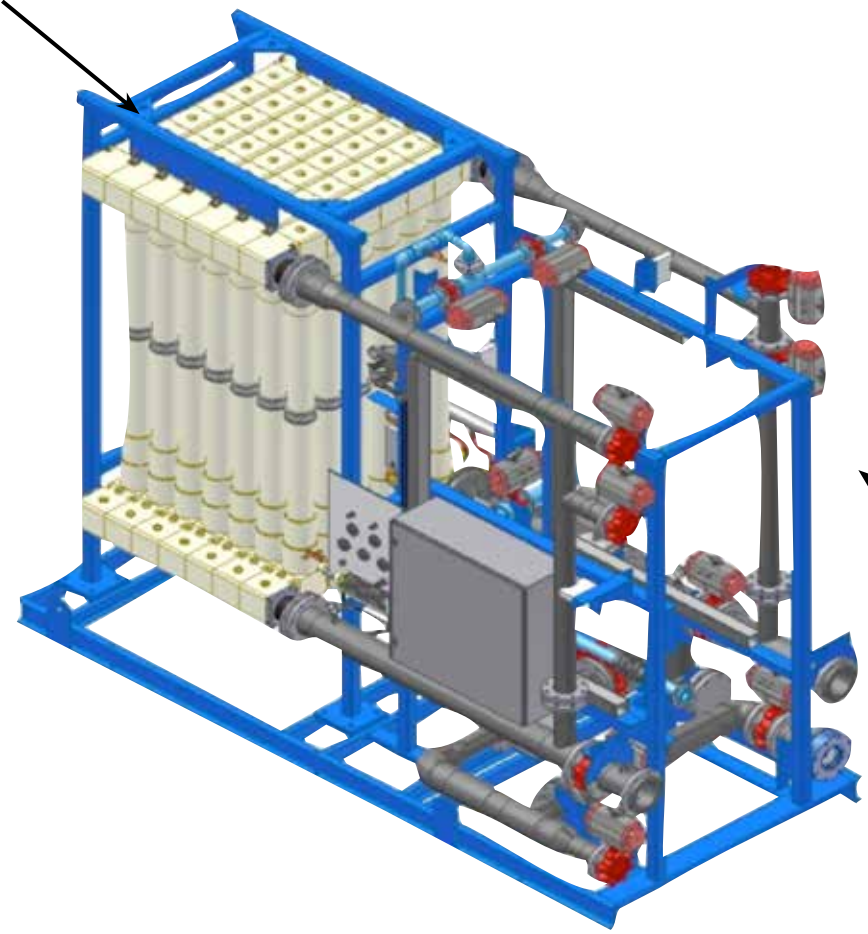
- Larger membrane surface area available for filtration for given length of membrane, which reduces the effective flux rate
- Higher solids handling capabilities, giving stable performance when there is a spike in feedwater turbidity (see below)
- Operate at higher feed recoveries (typically 7 – 8% higher)
- Reduce chemical waste from less frequent chemical cleaning sequences
- Outside to inside designs typically use low pressure air to backwash the membranes. This method minimises energy consumption compared to a filtrate backwash with chemical enhancement. This also allows outside to insides systems to do the following:



SIMPLE AND EFFICIENT INSTALLATION

MEMCOR® XP[MR] systems are fast, simple and safe to install. Enhanced system design shown below results in a very cost effective UF system:

Membrane modules are manifolded into arrays with up to 42 modules installed.



Valves, instrument and pipework are factory assembled and tested and shipped to site fully assembled to accelerate mechanical / electric al installation.

- XP[MR] systems are not 'erector-set' type membrane systems.
- Individual modules do not have to be installed at site as modules are pre-installed into a self supporting array. The arrays are sealed to preserve the modules, which results in less installation risk to the owner.
- Factory assembled and tested systems minimise startup time, reducing site work, site movements and improving site safety.
- No flushing of residual preservative chemicals from manufacturing is needed upon installation.

Note: It is recommended that MEMCOR XP[MR] low pressure, membrane filtration systems are installed in an area protected from freezing, under cover with protection from direct sunlight and weather.

TYPICAL OPERATIONS

Feed water enters the system directly by means of a feed pump or from a pressurised source after passing through an 80 - 500µm strainer. MEMCOR® XP[MR] systems use L20V membrane modules, each containing thousands of hollow fiber PVDF membranes surrounded by a protective plastic mesh. Each module is placed in a "center tube" or module housing that can be isolated from the rest of the system. Filtrate is collected from the top and bottom of the modules.

An intermittent backwash helps to minimise membrane fouling. The backwash is a physical process that uses a low pressure air scour and air-assisted liquid backwash to remove accumulated particles from the surface of the membrane hollow fibres.

A major advantage of the MEMCOR XP[MR] system is that no filtrate backwash pumps are required. This reduces the mechanical installation costs and the total installed power requirements.

The backwash cycle lasts approximately 4 minutes and occurs at an interval of 15 to 60 minutes, depending on feed water characteristics. A backwash can either be initiated after a pre-set period of time or when the change in resistance to flow exceeds a pre-set limit.

To ensure long term stable performance, the MEMCOR XP[MR] system includes the ability to perform chemical maintenance washes (MW) and clean-in-place (CIP) cycles. The CIP is initiated based either on trans membrane pressure (TMP) or time. CIP's are performed using acid or chlorine (sodium hypochlorite) based solutions. Each CIP sequence is generally 2 to 3 hours in duration (including rinsing time). The MW sequence is similar to that of the CIP although is shorter and uses a lower chemical concentration.

The typical acid CIP is 1 – 2% (by weight) citric acid solution heated to 38 °C (100 °F) while the typical chlorine solution is 500 – 600 mg/L and is heated only to 20 °C (68 °F) when required. Maintenance wash solutions are not heated and typically use a 100 – 200 mg/L chlorine solution. In some instances an acid maintenance wash may be used with phosphoric, hydrochloric or sulphuric acid in a 0.05 – 0.25% by weight solution depending on the application.

XP[MR] Production

Water type	Units	Average capacity	Typical flux range (@ 20 °C)	Units
Clarified water	MGD	0.22 - 0.74	35 – 50	GFD
	MLD	0.83 - 2.80	59.4 – 84.9	LMH
Ground water	MGD	0.25 - 0.89	40 – 60	GFD
	MLD	0.95 - 3.34	67.9 – 101.9	LMH
Secondary wastewater	MGD	0.12 - 0.45	20 – 30	GFD
	MLD	0.45 - 1.70	34 – 50.9	LMH
Surface water	MGD	0.15 - 0.67	25 – 45	GFD
	MLD	0.57 - 2.54	42.4 – 76.4	LMH

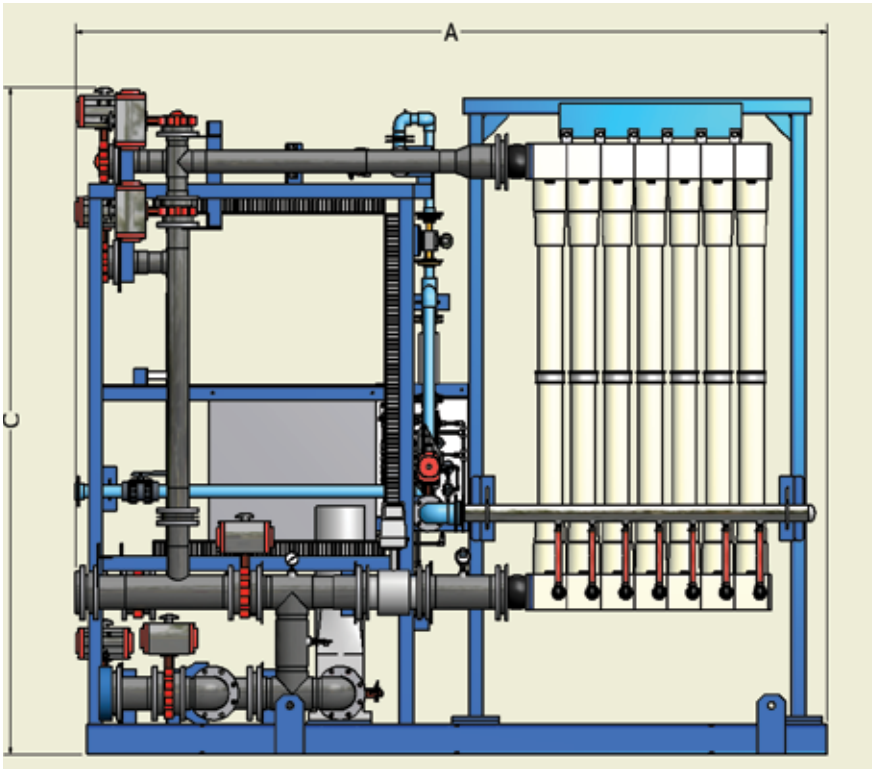
NOTE: CAPACITIES AND FLUX ARE FOR REFERENCE ONLY. CONTACT EVOQUA FOR SPECIFIC CAPACITY AND FLUX BASED ON RAW WATER CHARACTERISTICS.

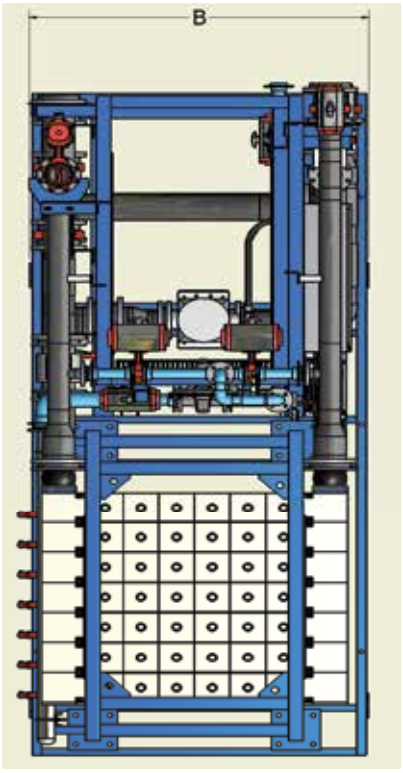
Feed Conditions

Water type	Turbidity (NTU)	Suspended solids (mg/L)
Clarified water	<1	0.1
Ground water	0.1	0.1
Secondary wastewater	1 – 10	1 – 50
Surface water	1 – 100	1 – 100

MEMCOR® XP^{MR} System Details

Number of modules fitted to the XP^{MR} system	Unit 18 – 42
Capacity range of the XP^{MR} system	0.45 – 3.34 MLD / 0.12 – 0.89 MGD
Module designation	L20V – 0.04 µm PVDF
Feed pre-screening required	250 - 500 µm.
Approximate mass Unit dry XP^{MR} system Unit operating	 3,175 kg / 7,000 lbs. (will be reduced if fewer than 42 modules) 4,535 kg / 10,000 lbs. (will be reduced is fewer than 42 modules)
Approximate dimensions XP^{MR} system (refer to figure below) Length Width Height	 4.12 m / 13.53 ft (Dimension 'A' above) 1.75 m / 5.74 ft (Dimension 'B' Above) 3.43 m / 11.25 ft (Dimension 'C' above)
Recommended minimum clearances: Front / Back Sides Above	 0.90 m / 3 ft 1.23 m / 4 ft 0.90 m / 3 ft





MEMCOR® XP^{MR} SYSTEM DETAILS

Materials of construction	
Membrane filtration modules	PVDF / Polyurethane / Nylon / EPDM
Module housings and end manifolds	Nylon
Pipe and valve skid frame	Epoxy painted mild steel
Pipework polyethylene	(PE3408) ASTM D3350
Nuts / bolts and washers	Galvanised MS (SS316 optional)
Valves (body / disc / seat)	CI / Nylon-Coated DI / EPDM
Gaskets, flexible couplings	EPDM

Electrical and control system	
Electrical panel	NEMA 4, Painted carbon steel (IP66 Rated)
Controls	(PLC not supplied on skid. See notes)
Communications protocol	Ethernet I/P
Feed flowmeter	Siemens - Sitrans electro magnetic
Pressure sensors	SS316 Diaphragm pressure transmitters
Flow control	Variable frequency drive (NEMA 4)
Solenoid valves	Common manifold, centrally mounted on system with IP67 rating

Process Control Panel Detail*	
PCP panel	NEMA 4, Painted Carbon Steel (IP66 Rated)
Control platform	(See notes)
Communications protocol	Ethernet I/P
Operator interface terminal	MP277, 10" Touch screen with color display
Data logging	Through OIT: Flow, temperature, pressure, integrity test in CSV format
SCADA interface	Standard ethernet

* PCP PANEL SHIPPED AND MOUNTED SEPARATE FROM SYSTEM(S)

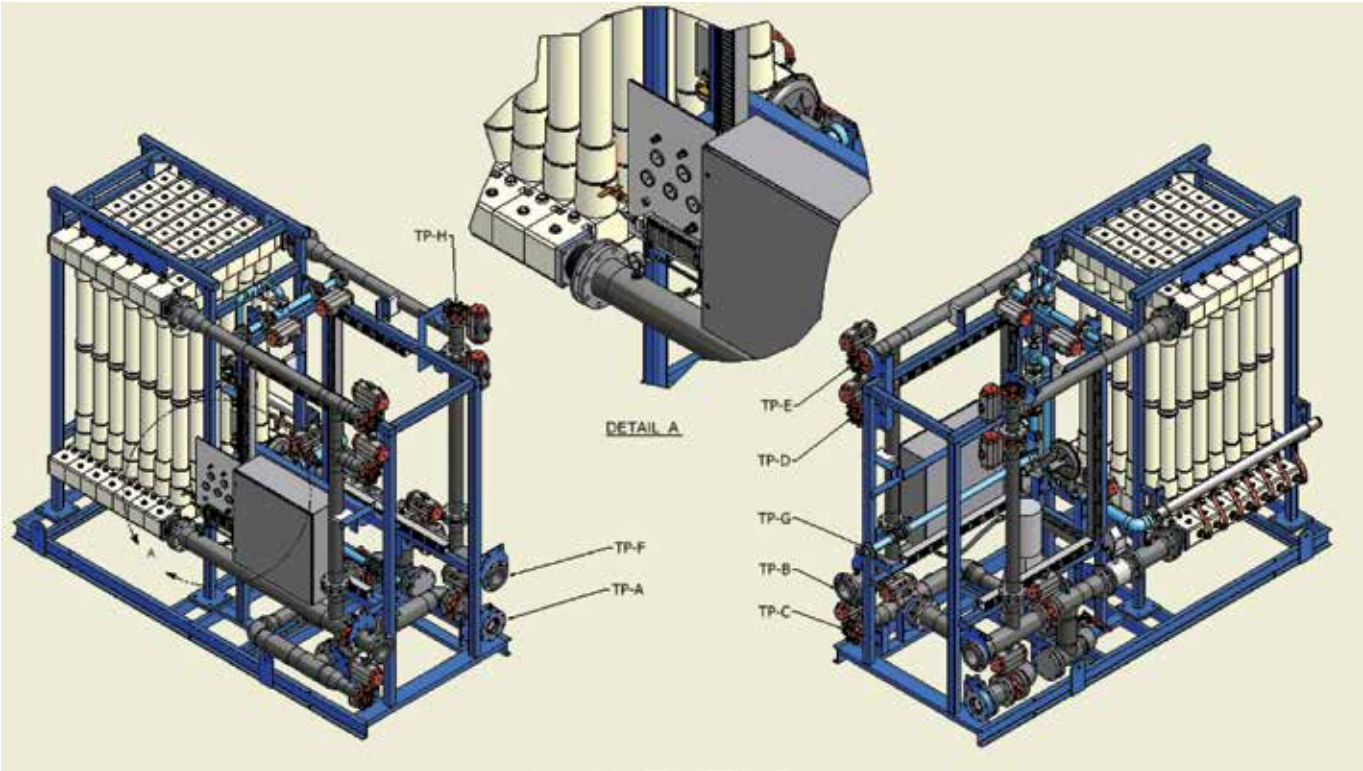
The XP^{MR} system requires a 4-wire, 4-20 ma analog signal level device in the filtered water storage tank or a customer supplied dry contact start / stop. These input devices will control the automatic starting and stopping of the system(s). Evoqua control system is limited to the integration of Evoqua supplied equipment only.

Notes:

Please consult Evoqua Water Technologies for information about PLC type and communications. Supply and installation of all electrical equipment external to the MEMCOR® XP^{MR} systems is the responsibility of the client unless noted otherwise.

TP No.	Description	Type	Size	Design requirement
TP-A	Feed water inlet	Flange	6″ / 150mm	2 – 15 psi 14 – 103 kPa
TP-B	Filtrate outlet	Flange	6″ / 150mm	3 psi / 7 kPa backpressure
TP-C	CIP inlet	Flange	4″ / 100mm	
TP-D	CIP outlet / return	Flange	4″ / 100mm	
TP-E	Filtrate exhaust	Flange	4″ / 100mm	To drain
TP-F	Backwash and waste outlet	Flange	6″ / 150mm	Gravity drain
TP-G	Process and control air inlet	Flange	2″ / 50mm	
TP-H	Feed vent	Flange	4″ / 100mm	To drain

NOTES: FOR TP SIZE CONFIRMATION PLEASE REFER TO RELEVANT SYSTEMS PROCESS AND INSTRUMENTATION DIAGRAM.



STANDARD ANCILLARY EQUIPMENT AND SERVICES

The MEMCOR® XP^{MR} system low pressure membrane filtration is the core component of the unit. Ancillary equipment external to the system is required to complete the system. Ancillary equipment requirements vary from site to site, but usually include the following:

Standard system equipment supplied:
Feed system (P&ID #9200780011-FD-1-A)

- Fluid engineering, Simplex basket strainer for feed system (250 – 500µm)

SYSTEM INTERCONNECTION (P&ID #9200780012-1-A) – DOES NOT INCLUDE PIPING

MEMCOR XP^{MR} system(s) (P&ID #9200780010-FD-1-2 and FD-2-2)

- SITRANS® process instrumentation
- Bray® double-acting pneumatic valves, with DI, nylon coated disc
- Hach® 1720E or FilterTrak 660™ filtrate turbidimeter
- Evoqua process control panel with OIT and ethernet communication
- AC Tech® variable frequency drive, external mounted in NEMA 4 enclosure

CIP System (P&ID #9200780013-FD-1-A)

- 3,218 L (850 gallon) FRP CIP Tank, Bray valves and Chromalox® 18 kW heating element

Chemical transfer (P&ID #9200780014-FD-1-A)

- LMI® Brand CIP chemical transfer equipment (acid and chlorine).

Compressed air system (P&ID #9200780015-FD-1-A)

- Atlas Copco® air compressor with integral 227 L (60 gallon) receiver tank and stand alone air receiver with standalone final air filter

STANDARD SUPPORT AND SERVICE:

- Dedicated project manager and support staff
- Ancillary system I/O and integration (Evoqa supplied equipment only)
- Standard engineering and product documentation submittal
- System commissioning by Evoqua field service engineers

Note: Items with 'EWT' label in the P&ID's will be supplied by Evoqua Water Technologies.

AVAILABLE OPTIONS

Various equipment options are available from Evoqua, at additional cost and if required should be requested at the time of ordering.

Number of modules fitted

The XP^{MR} membrane filtration system can be fitted with 18, 24, 30, 36, or 42 L20V modules.

Self-cleaning strainers

Evoqua can provide fluid engineering self cleaning strainers.

Common feed turbidimeter

Hach 1720E Turbidimeter.

Combined filtrate turbidimeter

Hach 1720 E or FilterTrak 660 Laser Turbidimeter for use in instances with multiple systems and where required.

Pressurised/gravity feed

The XP^{MR} system contains the flexibility to allow for gravity feed through the unit when site specifics allow. For available feed pressures above 35 psi – 50 psi (205 – 345 kPa) at TP-A, the XP^{MR} system uses an electro-pneumatic flow control valve to control flow through the system.

SS316 valve discs

The XP^{MR} system comes standard with Bray valves using a nylon coated ductile iron disc. Evoqua offers an option to use SS316 discs in the Bray valve package.

Double block and bleed valve kits

Double block and bleed valve kits are available for cross connection control to meet local regulations where applicable.

CIP waste diversion valves

A set of valves for each can be supplied to divert the CIP and MW waste streams to a different location if required.

CIP waste neutralisation

Evoqua can provide a skid mounted CIP neutralisation system, which neutralises the acid and chlorine solutions prior to discharge. The neutralisation skid is easily integrated into the overall supplied control system and contains chemical feed for the neutralisation agents.

Acid maintenance wash with HCl, H_2SO_4, or H_3PO_4

Some locations may benefit from an acid maintenance wash and offers a 3rd cleaning chemical option for the XP^{MR} systems.

Redundant air compressor

Evoqua offers a redundant air compressor to allow for a 2 x 100% design as a standard option.

SPECIAL TOOLS SUPPLIED AS STANDARD

Evoqua recommend that the special tools required for maintenance are available at each site. This optional equipment includes the:

- Module filtrate isolation valve tool;
- Module test vessel assembly and nylon repair pins;
- Sonic analyser to identify areas of suspect integrity during a sonic test;
- C spanner, strap wrench and other tools required for manual L20 Module removal and replacement. Please consult Evoqua for details of all maintenance equipment options.

ITEMS SUPPLIED BY OTHERS

- Feed and filtrate storage
- Backwash waste collection and disposal system
- Membrane preservative disposal
- CIP chemical supply and concentrate storage
- CIP waste collection and disposal (neutralisation) system
- Civil works and building modifications or construction to house the MEMCOR® XP^{MR} system equipment including all concrete work
- Pipe supports, interconnecting pipework / valves to / from the XP^{MR} system(s) and associated systems
- Pneumatic lines supplying air to the pneumatic actuators
- Floor drains
- Safety showers
- Platforms or equipment for maintenance
- Power supply
- Supply and installation of MCC's and disconnects
- Supply and installation of control wiring and power cabling
- Switchgear for ancillary equipment
- Off skid pump alignment and vibration analysis
- Lubricants
- Unloading, unpacking, storage, installation, assembly and field installation of the XP^{MR} system
- Supervision of installation
- Permits and approvals
- Anchor bolts and anchor bolt calculations
- Grouting
- Other site specific requirements, including laboratory analysis of feed and filtrate

evoqua
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