



PROPOSAL

WSP Fire Training Academy – 20 GPM PAC-FILTRIX

Submitted to:

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1. Project Information

This proposal is based on a collection of inputs from the client captured in discussions, emails, and documentation. For the purpose of this proposal, the following inputs are of material importance.

Site Location

Washington State Patrol Fire Training Academy
50810 SE Grouse Ridge Road
North Bend, WA 98045

The Washington State Patrol Fire Training Academy is located at the foot of Mailbox Peak in North Bend, WA. The site is intended to operate under zero discharge with MBR + UV + chlorine wastewater reclamation providing non-potable reuse water supply for fire training activities. Training ponds 1-3 are lined to prevent infiltration. During rain events in which capacity may exceed available storage in the training ponds, stormwater is redirected to two infiltration basins to absorb additional stormwater flow.



System Sizing

The project engineer calculated the required treatment system flow rate at 20 GPM. This design flow will enable single-pass treatment of all three training ponds within 3 months of continuous operation.

- Training Pond 1: 940,000 gal
- Training Pond 2: 930,000 gal
- Training Pond 3: 550,000 gal
- Total Training Pond Volume: 2.4 MG

Water Quality Objectives

Client seeks to remove PFAS from Training Ponds to protect, (a) FTA personnel from inadvertent PFAS inhalation due to exposure to fine aerosols during routine hose training activities, and, (b) the environment in the event of wastewater discharge from the site.

Client is dealing with legacy PFAS contamination as a result of long-term onsite use of aqueous fire-fighting foam (AFFF). Historical sampling suggests contamination by PFOS, PFOA, PFNA, PFHxA and PFHpA at concentrations ranging from 28 – 623 ng/L. Training Pond 1 receives a blend of reclaimed wastewaters resulting from oil/water

gravimetric separation and advanced domestic wastewater reclamation and therefore is expected to contain a mix of natural organic matter (NOM) and effluent organic matter (EfOM). Although modern AFFF composition does not contain PFAS, legacy contamination has resulted in PFAS partitioning to soils, resulting in continuous solids-liquids leaching resulting in ambient detectable concentrations in Training Ponds.

Influent & Effluent Scope

Source ponds and projected treated effluent water quality are tabulated below.

FLOW	SOURCE	COMPOSITION
Influent	Training Pond 1	PFOS: 623 ng/L; PFOA: 41.4 ng/L; PFNA: 28.9 ng/L; PFHxA: 110.0 ng/L; PFHpA: 29.2 ng/L
Influent	Training Pond 2	PFOS: 504 ng/L; PFOA: 28.4 ng/L; PFNA: 15.1 ng/L; PFHxA: 80.1 ng/L; PFHpA: 17.5 ng/L
Influent	Training Pond 3	PFOS: 588 ng/L; PFOA: 19.6 ng/L; PFNA: 13.6 ng/L; PFHxA: 62.6 ng/L; PFHpA: 14.3 ng/L
Effluent	PAC/UF - IX	< 4 ng/L PFOS, PFOA, PFNA, PFHxA, PFHpA

2. System Process Description

The objective of this multi-stage water treatment system is to provide a design that can accommodate varying water characteristics while meeting 4 ng/L PFAS discharge benchmarks. The system proposed will meet the total flowrate requirement of 20 GPM.

Process 1: Pre-Filtration: Cartridge Filtration

Influent wastewater is first screened to remove large debris then is pumped through a 1-micron prefilter to remove large settleable solids. Following cartridge filtration, water is characterized according to flowrate, pH and turbidity to provide system tuning capability according to influent feedback.

Process 2: Adsorption: Powdered Activated Carbon (PAC)

Water then flows to the PAC adsorption reactor, where a 50 g/L concentrated fine PAC slurry is added to pre-filtered wastewater and mixed for a minimum hydraulic retention time of 5 minutes. In this stage, PAC's well-developed pore structure and variety of surface functional groups remove soluble organic matter, including NOM and EfOM, along with long-chain PFAS. PAC dosing is adjusted on the basis of influent organic loading according to influent flowrate, pH and turbidity.

Process 3: Clarification: Ultrafiltration (UF)

NOM/EfOM/PFAS-loaded PAC is then separated from water by UF modules. The tandem Veolia Zeeweed 1500 UF modules operate in parallel and have a nominal pore size of 20 nanometers, enabling removal of particles, pathogens, and a significant fraction of any remaining dissolved organics. This stage provides a robust barrier to ensure removal of PAC, prevent bypass of microbes, and protect sensitive downstream ion exchange equipment.

Process 4: Ion Exchange: Anion Exchange Resin

Prior to final discharge, UF permeate flows through a packed column reactor containing Purolite Purofine PFA694 anion exchange resin. This anion exchange resin is a polystyrene crosslinked with divinylbenzene with complex amino surface functional groups and has a mean diameter of 675 ± 75 microns. PFA694 is designed for PFAS removal from industrial, wastewater and process effluents, and offers very high operating capacity and excellent kinetics. This step is integrated to the treatment train to remove stubborn hydrophilic short- and ultrashort-chain PFAS species that may bypass PAC/UF. Following ion exchange, effluent is characterized according to flowrate, pH and turbidity to provide simple evaluation of post-treatment water quality.

Process 5: Residuals Management: Coagulation

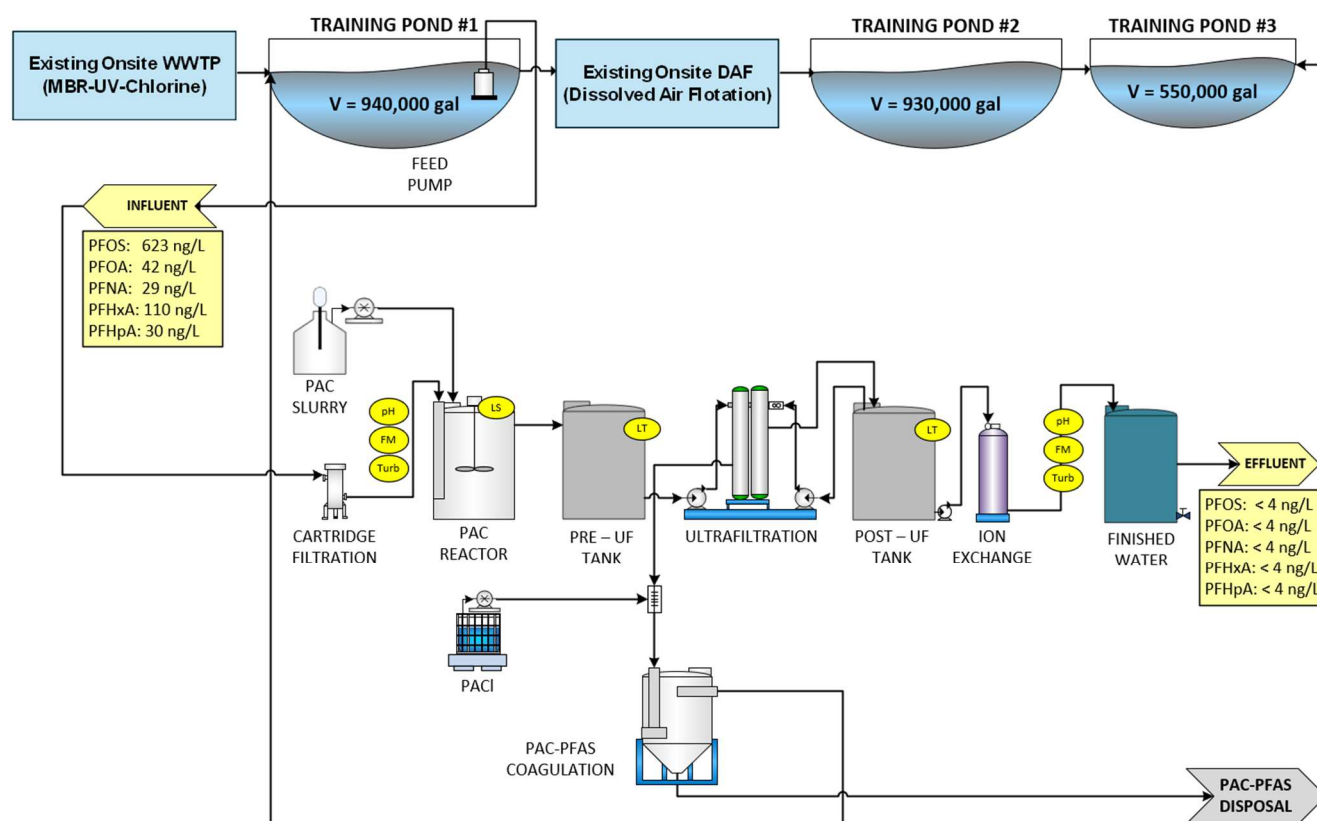
Residuals generated during treatment will be further treated to maximize water recovery prior to disposal. During routine UF operation, modules will be periodically backwashed to remove PAC and organics that have accumulated on the membrane surface in order to restore permeability and decrease the transmembrane pressure required to drive adequate flux. This backwash slurry is blended with polyaluminum chloride coagulant inline prior to clarification in a conical tank. Here, PAC separates, settles, and is removed as a PAC-PFAS slurry for offsite disposal.

3. Equipment Process Flow Diagram

The following equipment process flow diagram is preliminary and not to scale. It identifies the major components of the system utilizing a standard configuration with 500 gallon standard poly tanks.

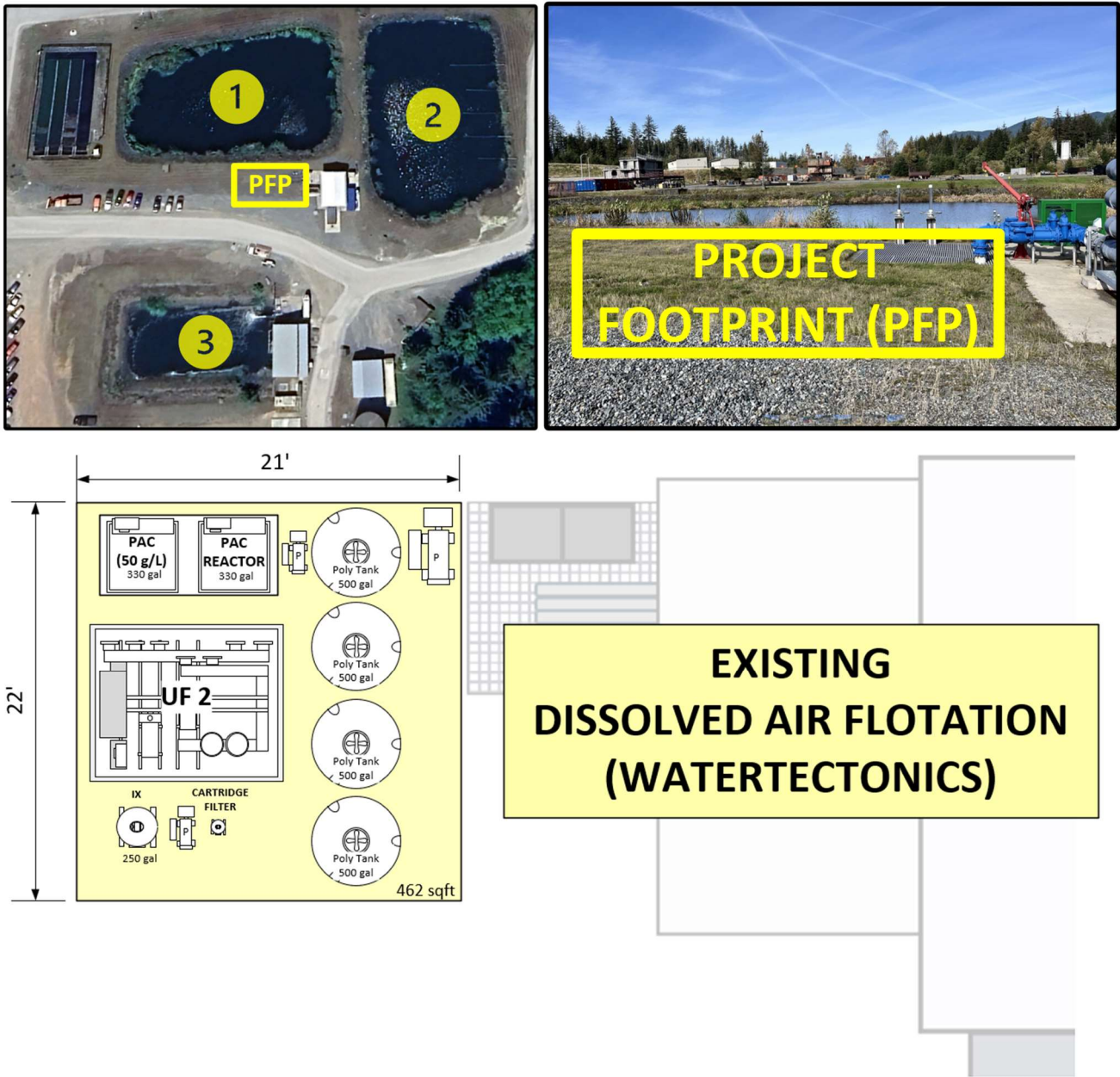
Wavelonics Automated Operator System + Eagle Eye II (Deluxe)

Regardless of the configuration of treatment equipment shown below, all system processes will be controlled by the Wavelonics Automated Operator system. This system incorporates control and adjustment of all system processes to a single touch-screen user interface. This interface allows the operator to visualize system performance and operations to quickly see if there are any elements that require operator attention. In standard operation, the system is set to run automatically. For this application, the Eagle Eye II deluxe package has been incorporated to enable remote supervision and control, with communications integrated to alert operators via text or email regarding real-time system status.



4. Equipment Site Layout

The following equipment process flow diagram is preliminary and not to scale. It identifies the major components of the system utilizing a standard configuration with 500 gallon standard poly tanks.



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5. System Pictures



Ultrafiltration



Ion Exchange



Water Quality Monitoring



Touch-Screen User Interface

6. System Summary Detail

EQUIPMENT SUMMARY

COMPONENT	DESCRIPTION
Ultrafiltration System	Skid Mounted System Pumps, Automated Valves, PLC and HMI
Ion Exchange Vessel	250 gal; Fiberglass vertical tank
500 gal Tanks (4)	48" x 72" vertical poly tanks
330 gal IBC Totes (2)	Steel frame; fixed and variable mixing integrated
Cartridge Filters	1-micron polymeric with supplemental cartridges

INSTALLATION & COMMISSIONING SUMMARY

COMPONENT	DESCRIPTION
Install Inspection and Commissioning	3 Technicians on site for 2 days to perform commissioning and verify operation
System Testing and Operator Training	3 Technicians on site for 2 days to test, verify operation, and provide training for operators.

7. Cost Schedule

COST SUMMARY – 20 GPM SYSTEM

ITEM NO.	QUANTITY	ITEM	COST
1.1	1	20 GPM PAC/UF + IX System	\$472,084
1.2	2 (years)	Eagle Eye II Deluxe Package	\$18,015
1.3	1	Commissioning and Training	\$10,500.00
TOTAL			\$500,599

*Freight of equipment to client site included in total price.

PURCHASE TERMS

BILLING MILESTONE	ITEM	PERCENTAGE
1	Deposit; Due Upon Order	50%
2	Notice of Ready to Ship Equipment; Net 30 Days	40%
3	Installation/Commissioning; Net 30 Days (Not To Exceed 60 days past Notice To Ship)	10%

Delivery

Based on standard design, the integrated treatment train can be delivered in 22 – 24 weeks from receipt of purchase order. Specific production/delivery timelines will be determined at the time of order.

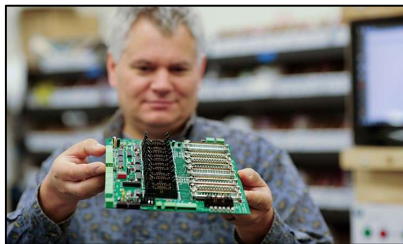
8. Statement of Qualifications

Executive Summary

Established in 1999, WaterTectonics designs, manufactures, deploys, and services integrated water treatment solutions for clients in industrial, construction, oil & gas, and mining applications worldwide. The company specializes in advanced technologies including electrocoagulation, electrochemical oxidation, dissolved air flotation, media filtration, ultrafiltration, and reverse osmosis. WaterTectonics focuses on delivering leading-edge technology that is easy to implement and effective with complex, high-volume waste streams.

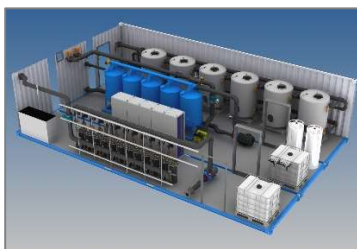
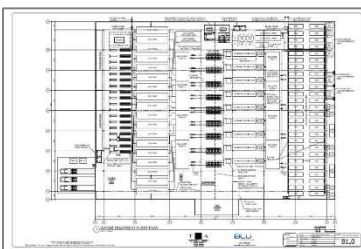
Technical Expertise

The strength of our solutions is rooted in the expertise of our technical leadership. The WaterTectonics team has a deep understanding of water treatment in temporary and permanent applications. Our technologies are recognized and used by Fortune 500 companies around the world to treat complex waste streams in various applications. WaterTectonics has treated water on challenging sites throughout the world over the past 25 years.



Product Manufacturing & Fulfillment

Superior manufacturing relies on precise engineering, defined processes, and skilled production personnel. The WaterTectonics team operates state-of-the-art manufacturing facilities which provide specialized manufacturing, assembly, and equipment staging and testing. Dimensional layout drawings, documented control logic, design specifications, wiring schematics, three-dimensional renderings, and other documents are used to ensure that every product meets the client's exact requirements. The WaterTectonics team has built equipment to some of the most stringent requirements in the world, including UL, CSA, Class 1 Div 1, Class 1 Div 2, DNV, and more.



WaterTectonics Company Snapshot

WATERTECTONICS BY THE NUMBERS

1,200+
COMPLETED PROJECTS

FOUNDED IN
1999

OPERATED IN
11 & 22
COUNTRIES STATES

0.6
EMR


\$150+M
TOTAL GENERATED LIFETIME REVENUE





COMPLETED CONTRACT VALUES BETWEEN
\$100k–\$50M

150+
PERMANENT INSTALLATIONS

40+
RENTAL ASSETS

TREATS OVER
500 MILLION GALLONS
OF WATER ANNUALLY



Project Manager	Technical Lead	Design and Fabrication
<p>Thomas Igou, Ph.D. Director of Innovation Cell: 404-408-0000 thomas.igou@watertectonics.com</p> 	<p>Denney Eames, P.E. Technical Director Cell: 815-222-2379 denney.eames@watertectonics.com</p> 	<p>WaterTectonics 6300 Merrill Creek Parkway Suite C-100 Everett, WA 98203 Tel: 425.349.4200 Fax: 425.349.4890</p>  

9. Project References

Custom PFAS Treatment System

MAINE, USA

An engineering firm requested a partnership to design, engineer, and build a mobile pilot treatment system to specifically target the removal of PFAS (Per- and polyfluoroalkyl substances) in extreme climates at various facilities around the US. The partnership included an international engineering team incorporating proprietary treatment equipment with logic and controls for operation, remote access control/operations, monitoring, and logging. The “plug-and-play” automated unit has and will continue to perform at facilities with PFAS contamination for full-scale plant design studies and implementation.



Oil Terminal - PFAS Cleanup

NORTHERN CALIFORNIA, USA

Firefighting foams can be a significant source of pfas. When deployed in an emergency situation, they have the potential to impact surface water and groundwater runoff. This client experienced significant, unplanned firefighting activities at their facility that resulted in elevated levels of pfas in their stormwater and groundwater. The client's engineer reached out to WaterTectonics to develop a mobile solution that could be trailer-mounted and deployed in a quick timeframe on a rental basis. The client's engineer preferred to use lead-lag carbon adsorption and lead-lag pfas-selective ion exchange but wanted better pre-treatment than what they had seen at other facilities.

WaterTectonics implemented an ultrafiltration membrane pre-treatment solution that resulted in media and resin lifespans far beyond what had been seen on previous projects. After 18 months of successful operation at a 100gpm flowrate, the client opted to upgrade the system to 300gpm to deal with added flows on site.



10. Exclusions

Equipment Offloading

This proposal does not cover the cost of equipment off-loading that will be required for system components and materials.

Electrical and Mechanical Interconnections and Infrastructure

This proposal does not cover the design, material or labor related to interconnect supplied equipment with client's supporting infrastructure and/or connect separate pieces/skids supplied by WaterTectonics. Client is responsible for electrically and mechanically powering and/or connecting supplied equipment together and to the client's infrastructure.

Operational/Maintenance Consumables

This proposal does not include the consumables required with the operations and maintenance of the system including, but not limited to, the consumables described in the above proposal.

Laboratory Sampling Fees

This proposal does not include any costs for fees related to analytical sample analysis that may be conducted by a third-party laboratory.

Permitting

This proposal does not include any costs for mechanical/electrical/other permitting and/or engineering drawings related to this effort.

Electrical Connection or Usage

This proposal does not include any costs to provide the necessary power requirement, nor does it cover any costs for the electrical usage consumed by the unit.

Code/Company Compliance

WaterTectonics designs its equipment to UL508 standards however proposal does not cover equipment requirements required for site or local electrical code requirements are excluded from this proposal.

Environmental Containment

This proposal does not cover the cost to house/cover components external to the skidded system.

State & Local Sales Tax

State & local sales tax are not included in this proposal but will be charged as required by law.

11. Warranty

WaterTectonics equipment is backed by WaterTectonics' reputation as a quality manufacturer, and by many years of experience in the design of reliable equipment.

Equipment manufactured or sold by Water Tectonics Inc., once paid for in full, is backed by the following warranty:

For the benefit of the original user, WaterTectonics warrants all new equipment supplied and manufactured by WaterTectonics to be free from defects in material and workmanship, and will replace or repair, F.O.B. its factories or other location designated by it, any part or parts returned to which WaterTectonics' examination shall show to have failed under normal use and service by the original user within one (1) year following initial start-up, or fifteen (15) months from Water Tectonics notification of equipment completion to the purchaser, whichever occurs first.

Such repair or replacement shall be free of charge for all items within the U.S. except for those items such as resin, filter media and the like that are consumable and normally replaced during maintenance, with respect to which, repair or replacement of these items shall be subject to a pro-rata charge based upon WaterTectonics' estimate of the percentage of normal service life realized from the part. WaterTectonics obligation under this warranty is conditioned upon its receiving prompt notice of claimed defects, which shall in no event be later than thirty (30) days following expiration of the warranty period, and is limited to repair or replacement as aforesaid. After review and discussion with the client, items determined not to be warranty related will be billed at Water Tectonics standard travel and service rates.

This warranty is expressly made by WaterTectonics and accepted by purchaser in lieu of all other warranties, including warranties of merchantability and fitness for particular purpose, whether written, oral, express, implied, or statutory. WaterTectonics neither assumes nor authorizes any other person to assume for it any other liability with respect to its equipment. WaterTectonics shall not be liable for normal wear and tear, corrosion, operator negligence or any contingent, incidental, or consequential damage or expense due to partial or complete inoperability of its equipment for any reason whatsoever.

This warranty shall not apply to equipment or parts thereof which have been altered or repaired outside of a WaterTectonics factory, or damaged by improper installation, application, or maintenance, or subjected to misuse, abuse, neglect, accident, acts of God, or incomplete adherence to all manufacturer's requirements, including, but not limited to, Operations & Maintenance Manual guidelines & procedures.

This warranty applies only to equipment made or sold by Water Tectonics, Inc.

WaterTectonics, Inc. makes no warranty with respect to parts, accessories, or components purchased by the customer from others. The warranties which apply to such items are those offered by their respective manufacturers.