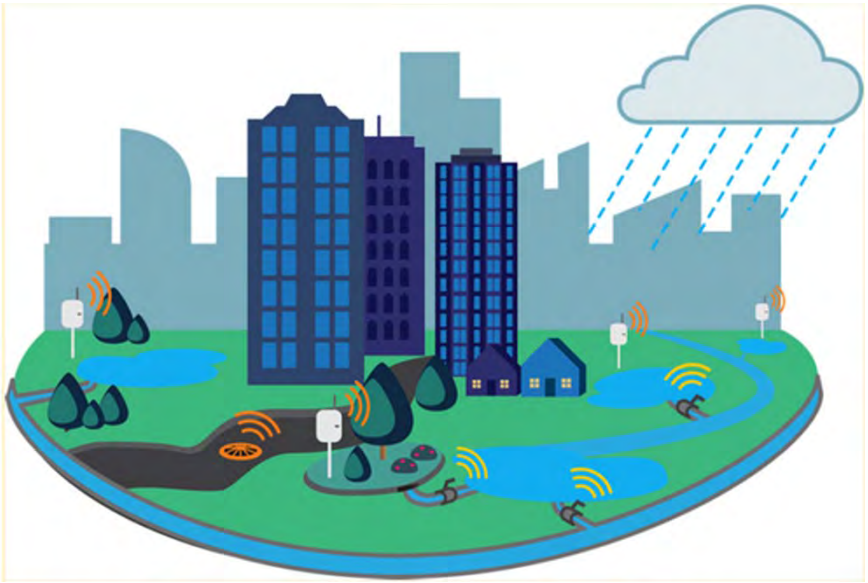


Emerging Technologies: Smart Filters

Florida Stormwater Association
2019 Annual Conference – Sanibel Harbor, Ft. Meyers, FL

Hydro International

Overview

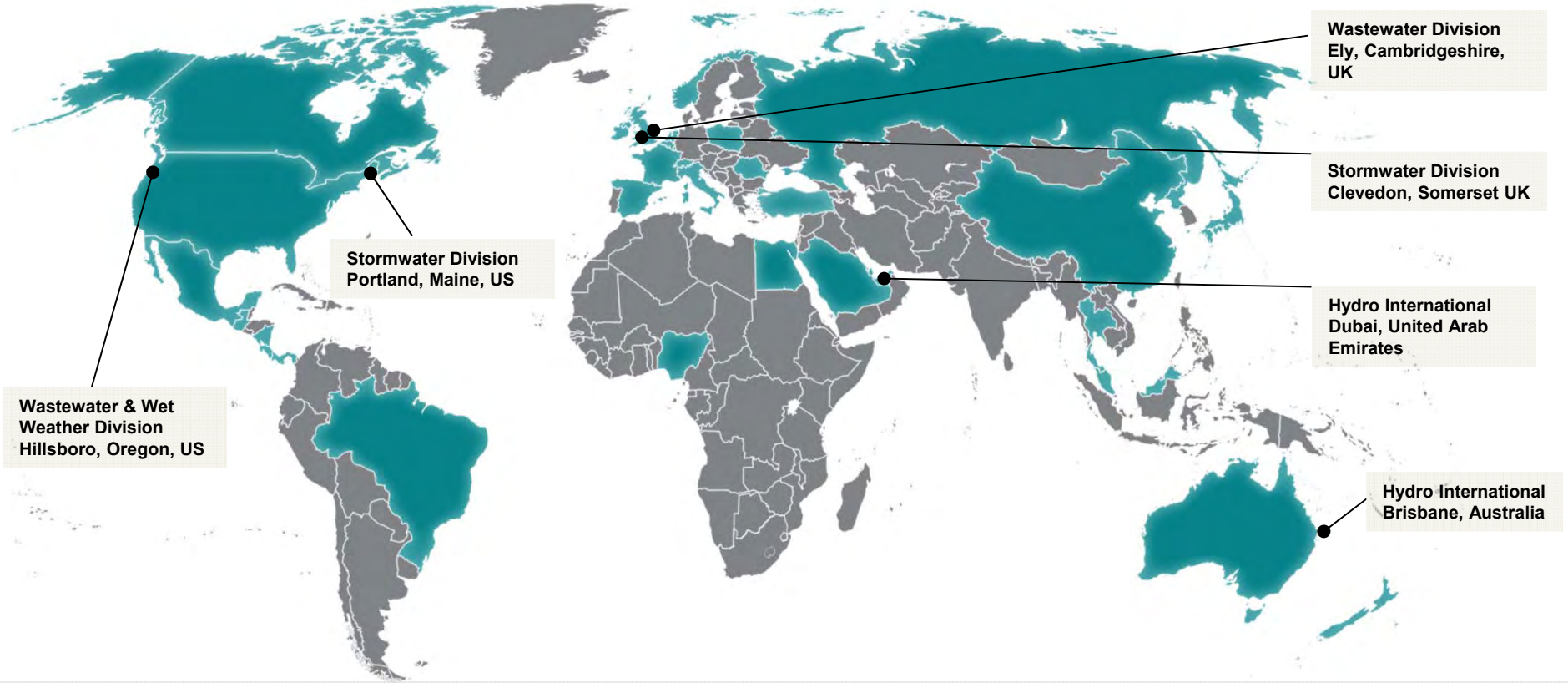
1. About Hydro
2. Product Overview
3. Up-Flo - Media
4. Up-Flo - Membrane
5. Sensors

About Us

- 20+ years of experience developing and testing structural BMPs to treat stormwater
- Thousands of separator and filter installs across the country and world
- World class hydraulics laboratory (one of the largest manufacturer-owned in the country)
- Third-party field monitoring to understand real-world applications

Hydro International

33 Countries



200+ Employees

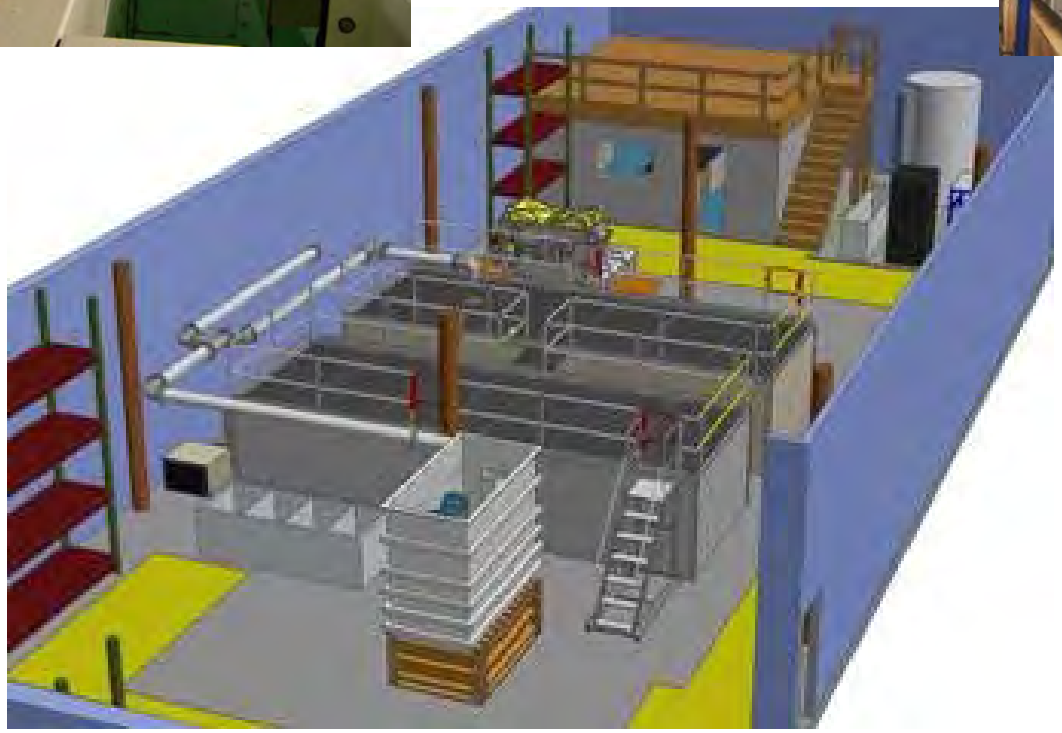
Our Specialty is Water Treatment

Hydro International®

Stormwater | Wastewater | Combined Sewer Overflows

Test Labs

Hydro International



University of Florida Field Monitoring

- Full-Scale 4-ft Manhole with 6 Filter Modules

Depending on the storm event intensity and wind direction the drainage area can vary from 5,400 to 8,600 ft^2 (0.12 to 0.20 acres) of pavement. The catchment drains to inlet A as shown in **Figure 4(b) and 4(a)**. Runoff captured by inlet A is the source of influent to the downstream Up-Flo® filter.

University of Florida Field Monitoring

- Storm Data and Pollutant Loads

Table 1: Hydrology summary for event 01 on 12 September 2015

Event Information		HI Upflow VCF Unit Treatment Information	
Event Date	12 September 2015	Influent Volume	2.089 m^3
Previous Dry Hours	109	Initial Fill Volume	1.105 m^3
Previous Flow Loading	0 (First Event)	Event Duration	52 min
Maximum Flow, Q_P	2.4 L/s	Influent Sample Sets	9
Median Flow, Q_{50}	0.27 L/s	Effluent Sample Sets	6
Mean Flow, Q_{mean}	0.7 L/s	Peak Rain Intensity	91.44 mm/hr
GNV Catchment	UF Reitz Union Surface Parking	Rain Depth	8.89 mm
TARP Qualifying	YES	Volumetric "C"	0.47

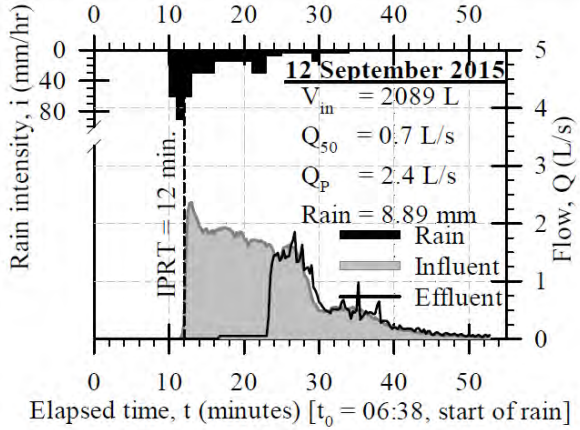


Figure 1: Event 01 hydrology, 12 September 2015 (IPRT: initial pavement residence time)

After controlled hydraulic testing at the UF SUOL, the HI Upflow VCF unit was loaded by the first rainfall-runoff event on 12 September 2015. The unit's filters were deployed in a washed and empty-bed condition and contained no PM specific deposit. The unit's volumetric tank was cleaned with potable water after hydraulic tests and drained before uncontrolled physical model testing in the field. Rainfall loadings generated the runoff response from the predominately paved UF Reitz Union drainage area. Table 1 summarizes antecedent and event conditions. Table 2 summarizes influent and effluent EMCs, EMVs and % differences produced by the unit. Since the unit had no antecedent retained volume the effluent hydrograph was attenuated in time.

Table 2 Monitored rainfall-runoff event hydrologic data

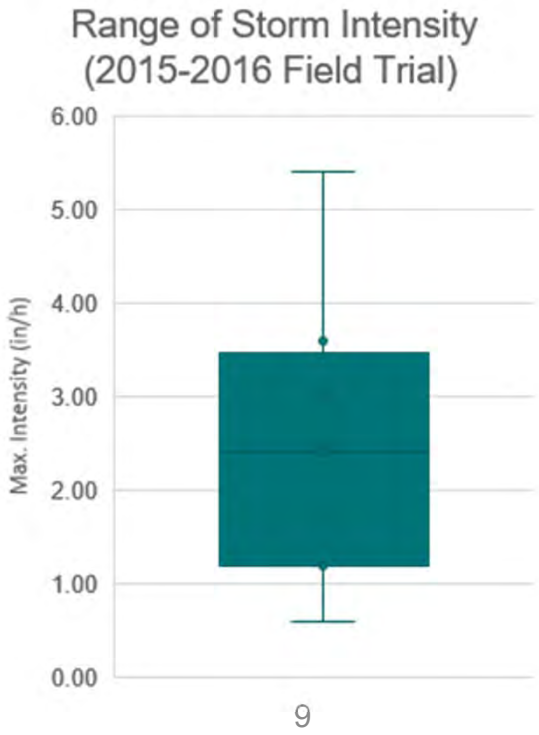
Event Date	t_{rain} (min)	d_{rain} (in)	$i_{rain-max}$ (in/hr)	IPRT (min)	V_{inf} (gal)	V_{eff} (gal)	Runoff Reduction %	Q_p (gpm)	Q_{med} (gpm)	n_{inf}	n_{eff}
12 Sep. 2015	52	0.35	3.60	12	552	242	52.90	38	4.28	9	6
12 Sep.	145	1.36	5.39	5	3606	3546	0.95	233	10.8	12	11
17 Dec.	80	0.24	1.20	12	365	354	9.86	27.7	3.8	7	5
22 Dec.	30	0.22	3.04	7	360	326	11.39	55.8	2.38	12	10
15 Jan. 2016	70	0.32	3.00	7	581	581	5.63	48	4.12	10	12
22 Jan.	60	0.20	2.40	10	452	432	12.39	60.5	3.33	12	12
4 Feb.	183	1.64	2.40	12	4095	4091	0.85	53.7	21.4	14	14
2 Apr.	165	0.68	0.60	55	1682	1632	3.16	28.5	8.72	13	12
22 Apr.	50	0.34	1.80	12	760	677	5.95	53.9	15.9	12	12
17 May	21	0.31	3.60	4	582	511	8.03	74.5	8.88	11	11
16 Jun.	85	0.31	1.80	36	784	699	7.11	72.9	9.51	10	10
7 Aug.	347	0.92	1.20	58	2518	2493	2.94	39.6	9.03	16	14
11 Aug.	31	0.19	1.20	10	490	472	8.46	59	8.72	12	12
16 Aug.	35	0.39	3.60	5	1211	1146	4.30	212	10.9	10	10
23 Aug.	35	0.10	1.20	12	223	205	27.22	55.5	3.01	9	9
1 Sep.	135	0.10	3.00	40	1761	1707	3.90	167	6.82	12	12
Mean	95	0	2	19	1251	1195	10	80	8	11	11
Median	65	0	2	12	671	629	7	56	9	12	12
St. dev.	85	0	1	18	1194	1207	13	64	5	2	2

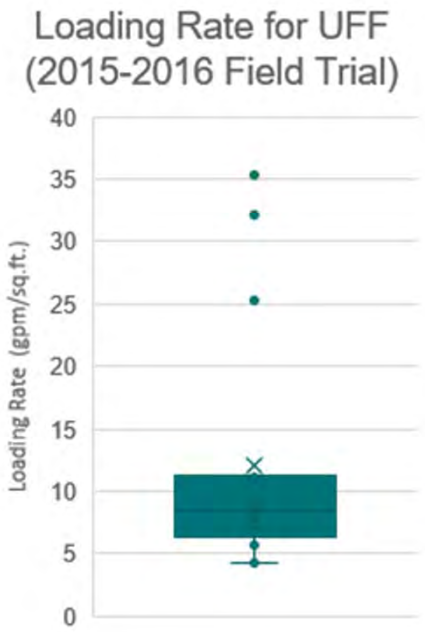
("i" stands for influent, "e" stands for effluent)

t_{rain}:	Event duration	V_{eff}:	Effluent volume
d_{rain}:	Rainfall depth	Q_p:	Maximum flow rate
$i_{rain-max}$:	Maximum rainfall intensity	Q_{med}:	Median flow rate
IPRT:	Initial pavement residence time	n_{inf}:	Number of influent samples
V_{inf}:	Influent volume	n_{eff}:	Number of effluent samples

- Testing performed by 3rd party – Dr. Sansalone
- One 6-module UFF Manhole
- One year's worth of storms captured
  - 16 storm events analyzed
- Sized for 25 gpm/sq-ft *peak flow rate*

The Reitz Union surface parking at the University of Florida – Gainesville





Our Collaborations

Hydro International

liverpool JMU

University of New Hampshire

PENNSTATE

University of BRISTOL

UNIVERSITY OF BRADFORD
MAKING KNOWLEDGE WORK™

CARDIFF UNIVERSITY
PRIFYSGOL CAERDYDD

University of Massachusetts Amherst

THE UNIVERSITY OF ALABAMA

UF UNIVERSITY of FLORIDA

The University Of Sheffield.

UNIVERSITY OF MINNESOTA
Driven to Discover℠

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stream
The Industrial Doctorate Centre for the Water Sector

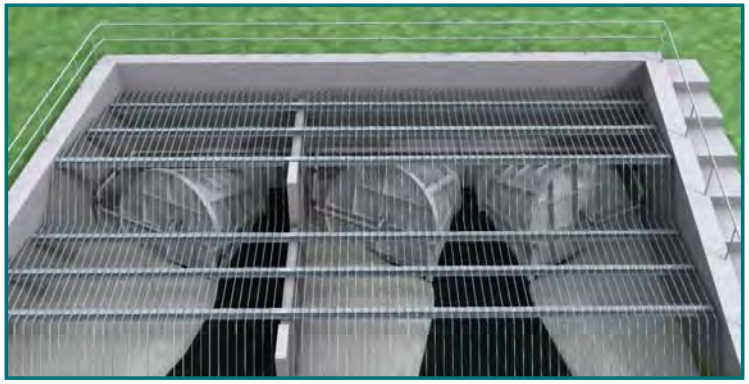
TRINITY COLLEGE DUBLIN
COLÁISTE NA TRÍONÓIDE, BAILE ÁTHA CLIATH
THE UNIVERSITY OF DUBLIN

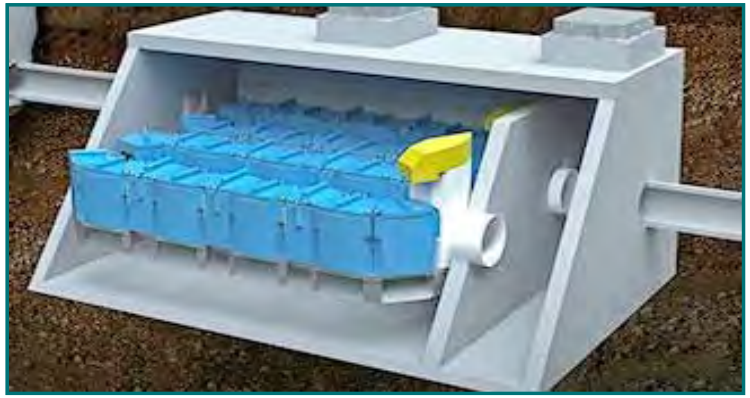
Regulatory Acceptance

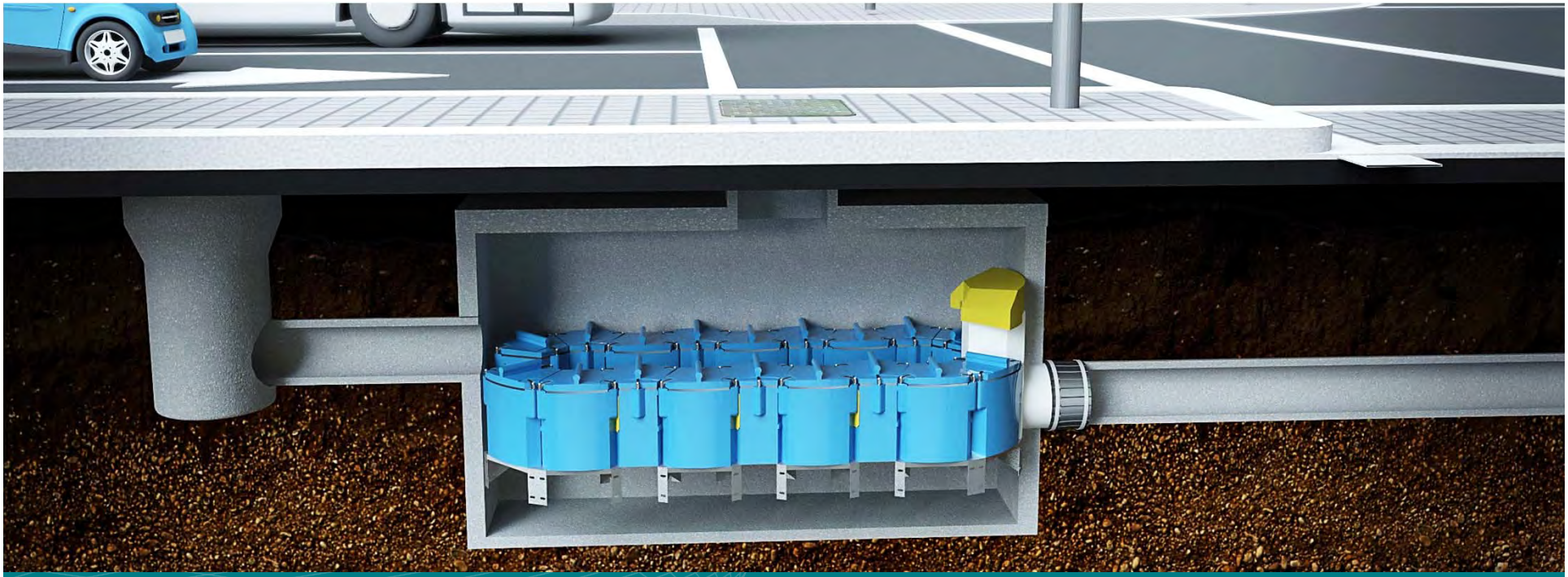
Hydro International

Separators, Screens, Filters, Valves

Hydro International





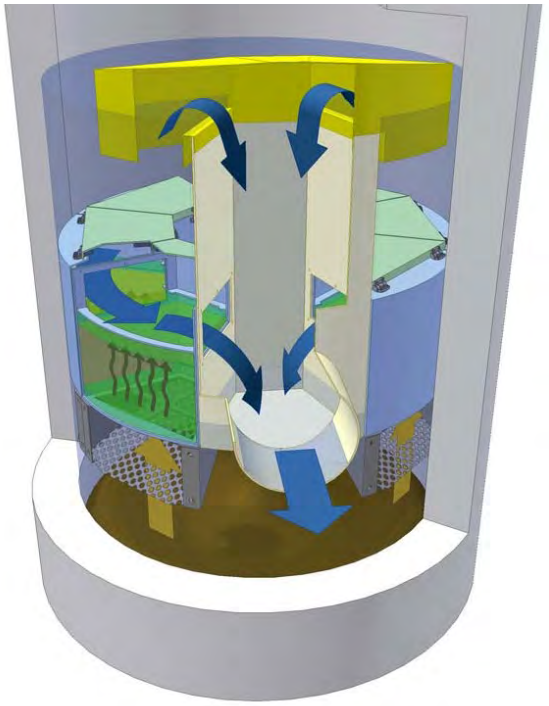


Up-Flo® Filter

Hydro International®

Media Filtration

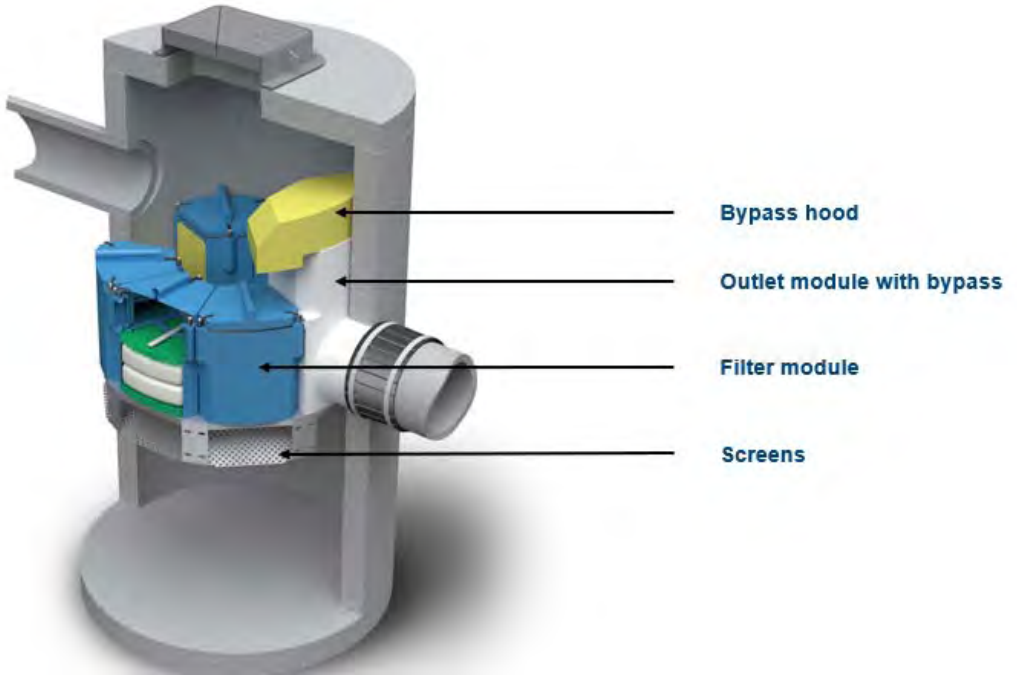
Austin Sand Filtration
(Downflow Filtration)



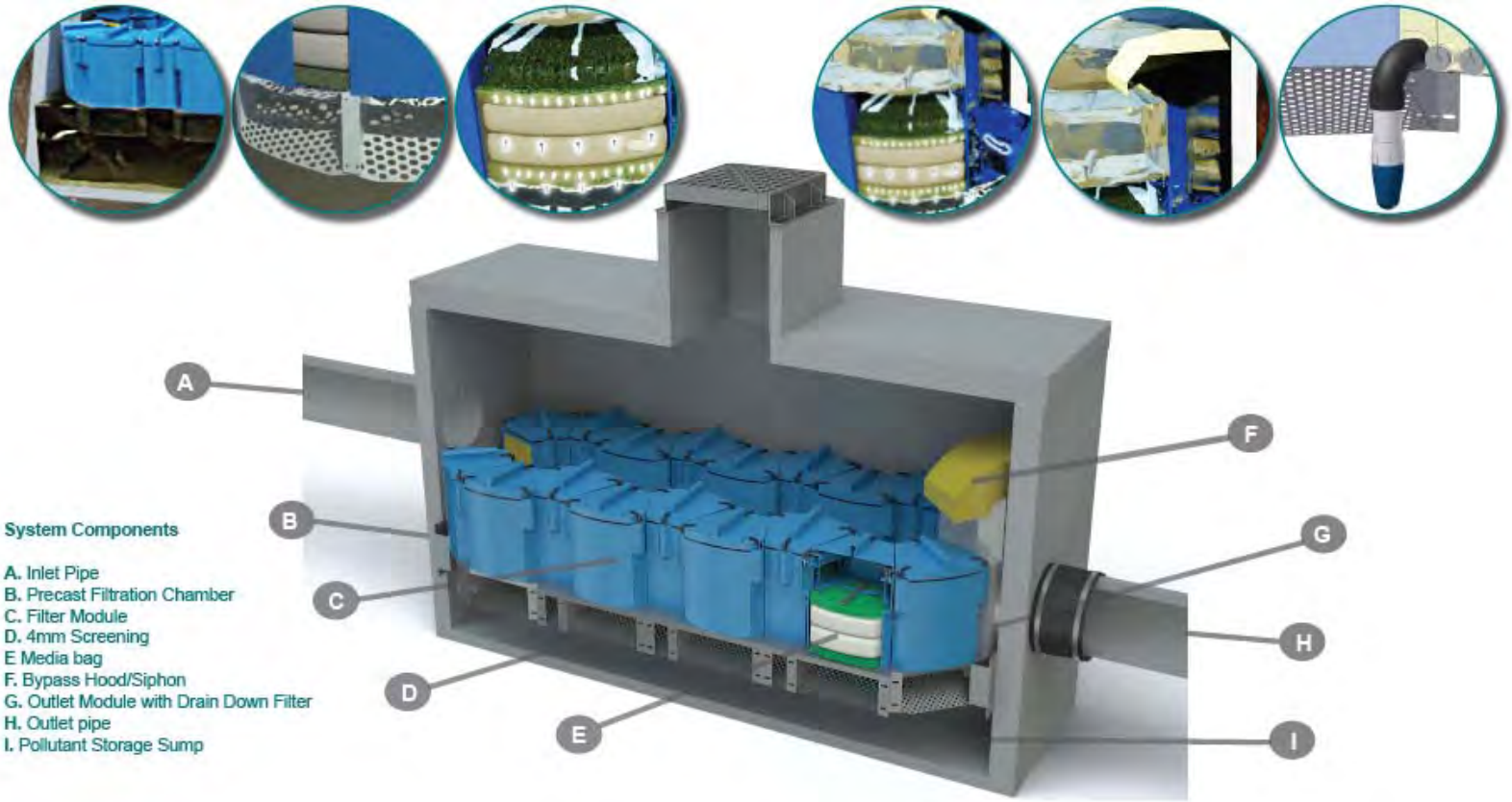
Up-Flo® Filter
(Upflow Filtration)

Up-Flo® Fluidized Bed Media Filter

- Multi-stage treatment
- Variety of media options available
- Drain down prevents media degradation
- Long media life
- Simple maintenance



Up-Flo® Filter – How it Works



System Components

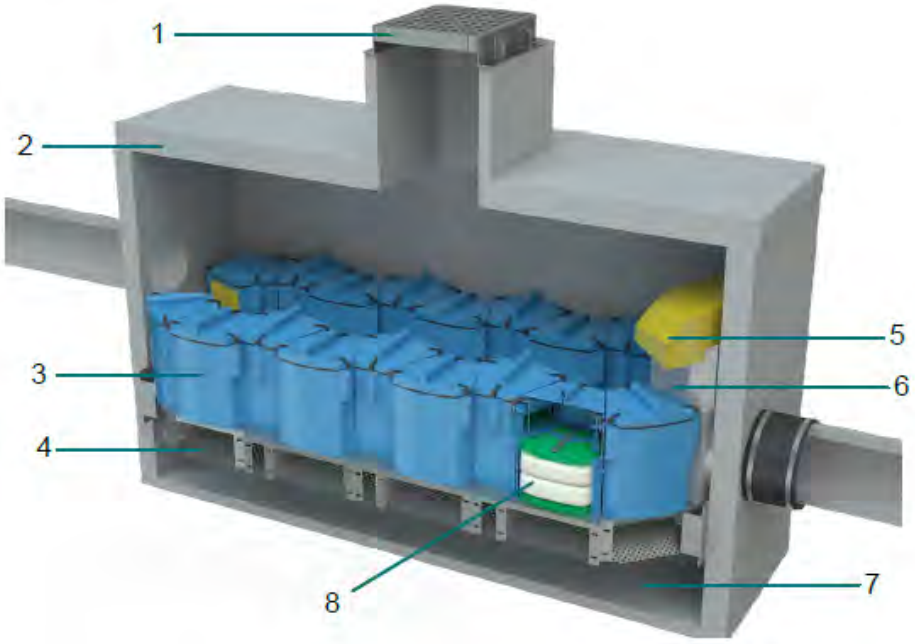
A. Inlet Pipe
B. Precast Filtration Chamber
C. Filter Module
D. 4mm Screening
E Media bag
F. Bypass Hood/Siphon
G. Outlet Module with Drain Down Filter
H. Outlet pipe
I. Pollutant Storage Sump

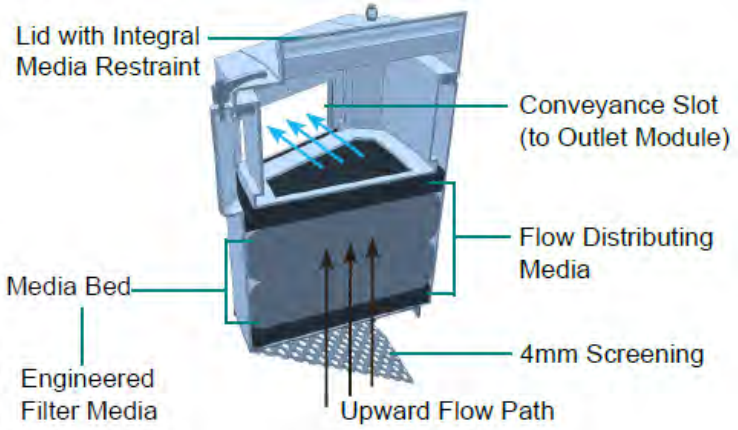
Up-Flo® Filter

Hydro International

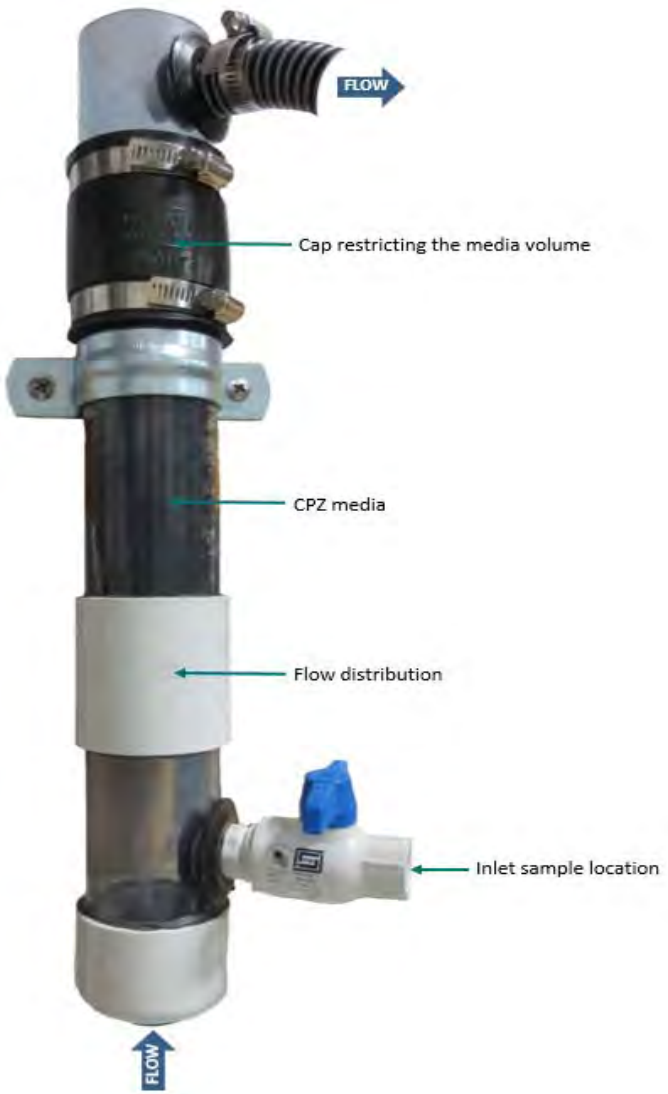
System Components

1. Inlet grate (pictured) or Inlet Pipe (not shown)
2. Precast Filtration Chamber
3. Filter Module
4. 4mm Screening
5. Bypass Hood/Siphon
6. Outlet Module with Drain Down Filter
7. Pollutant Storage Sump
8. Media bags





Media Benchmarking



Column testing mimics the technology used in a full scale Up-Flo® Filter unit.

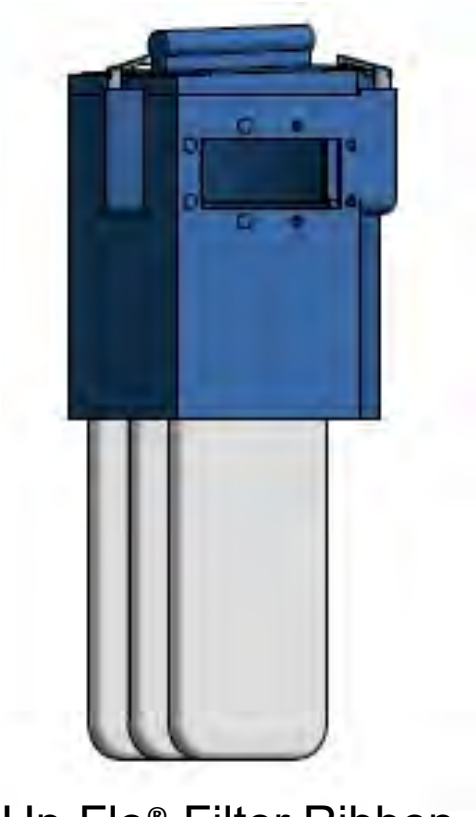
The “Swiss Army Knife” of Filtration

CPZ Media can tackle a wide variety of pollutants

- Granular Activated Carbon targets organic chemicals, pesticides and herbicides
- Peat targets dissolved Zinc and Copper
- Manganese coated Zeolite targets TSS, iron, manganese and ammonium

Membrane Filters

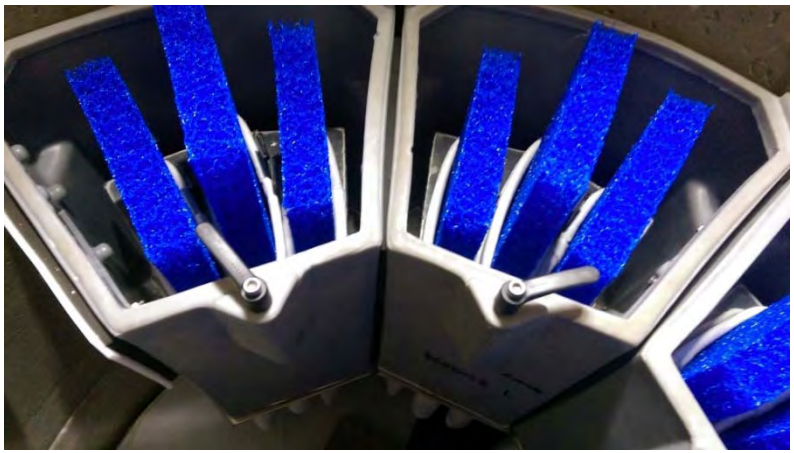
Cartridge membrane filter



Up-Flo® Filter Ribbon

Membrane Filtration

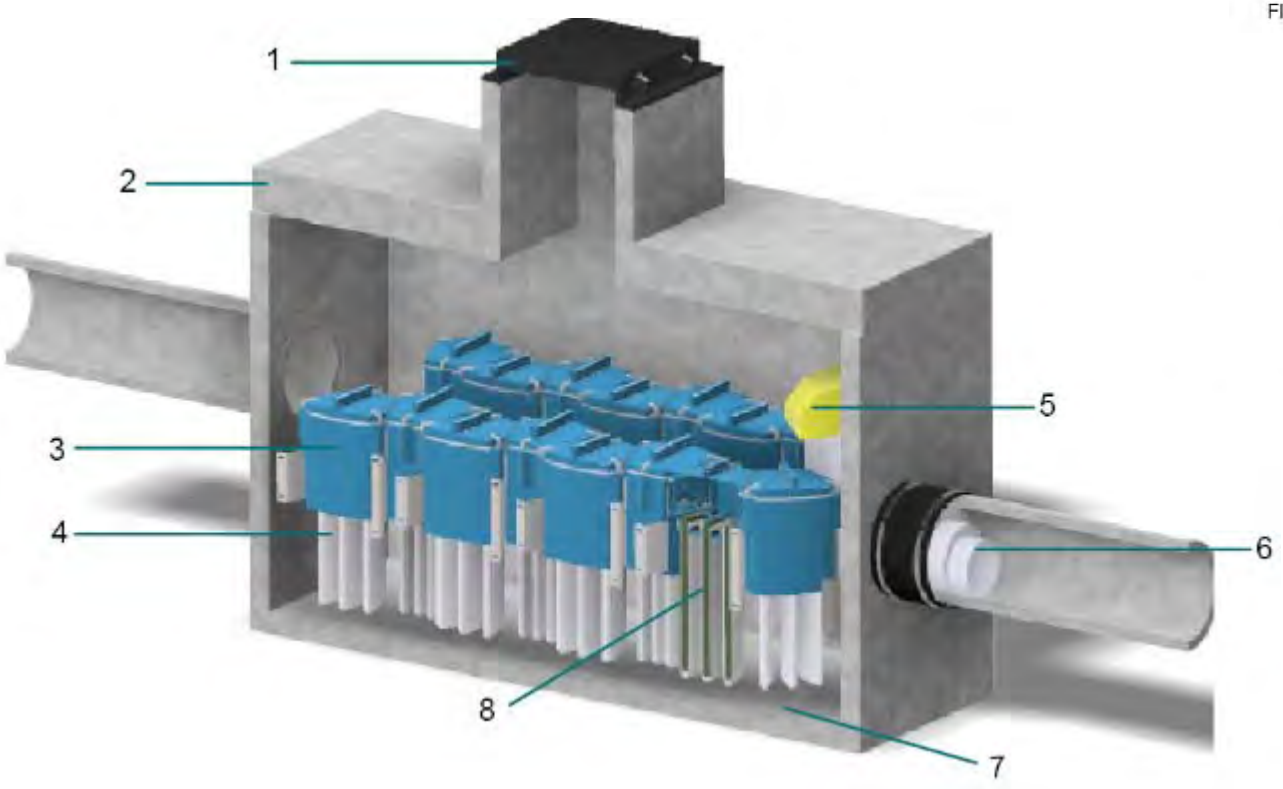
- Multi-stage treatment
- Very fine particulate capture
- Tailored membrane options
- High surface area
- Reliable performance

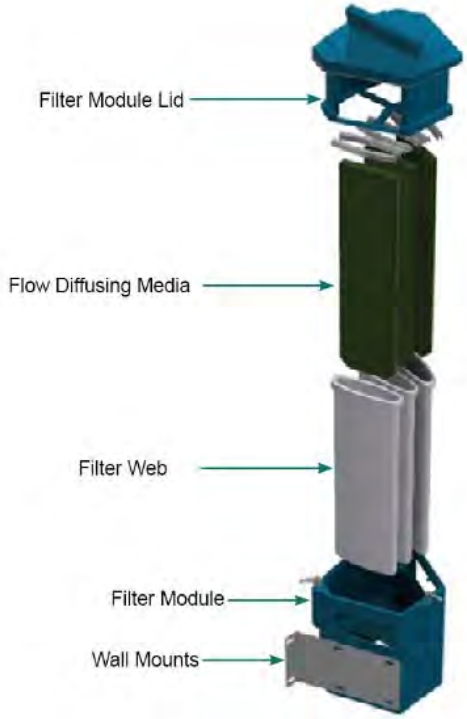


Product Profile

System Components

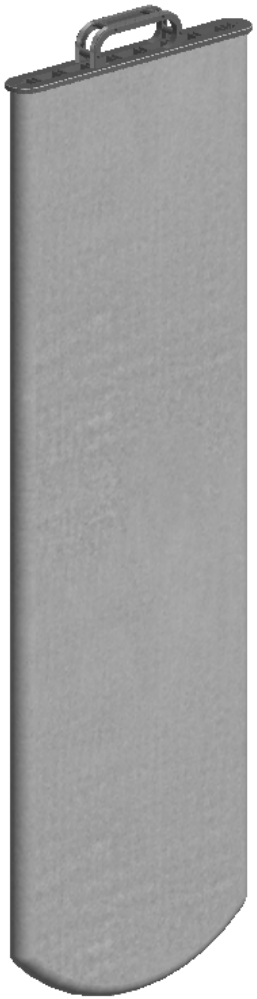
1. Inlet grate (pictured) or Inlet Pipe (not shown)
2. Precast Filtration Chamber
3. Filter Module
4. Filter Web
5. Bypass Hood/Siphon
6. Outlet Module
7. Pollutant Storage Sump
8. Cutaway of Filter Web

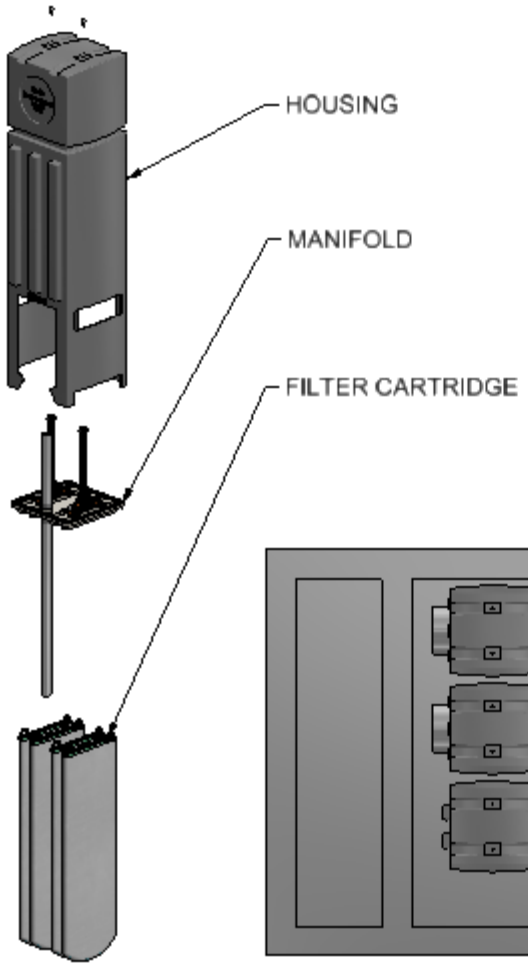


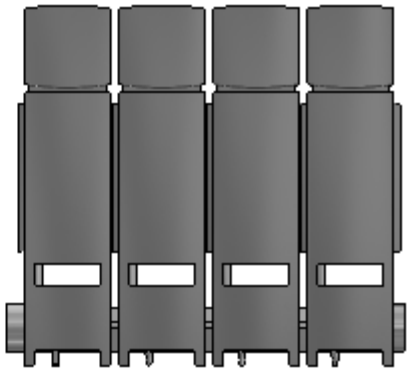


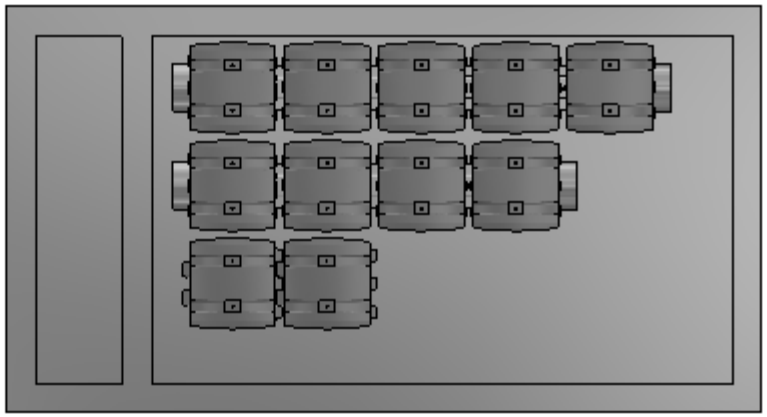
Home

Up-Flo Membrane “Next Gen”

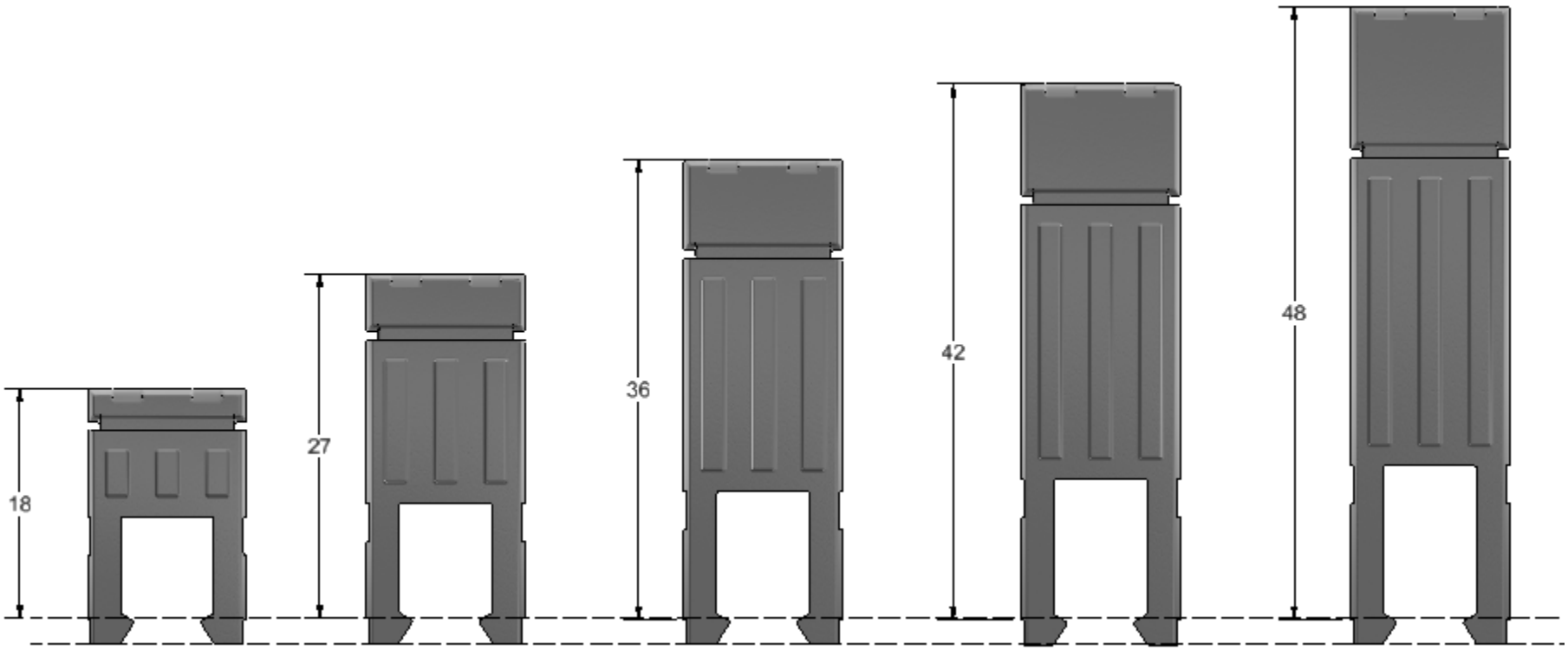






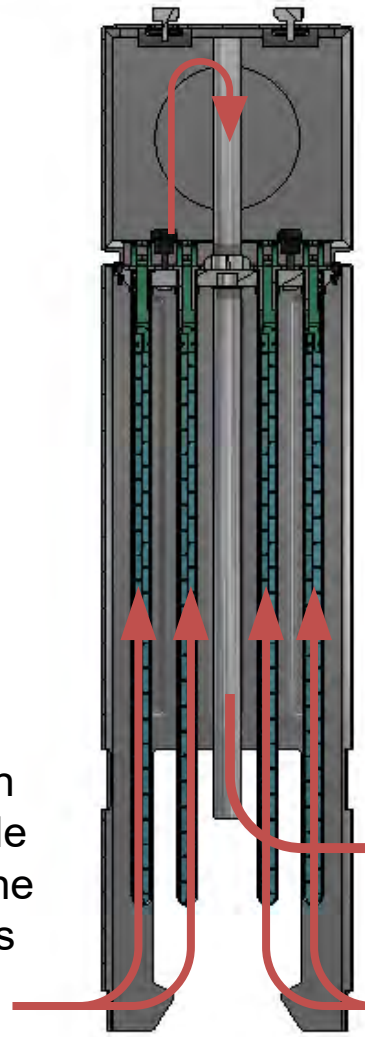


Flexibility



Filter Operation

Normal static operation



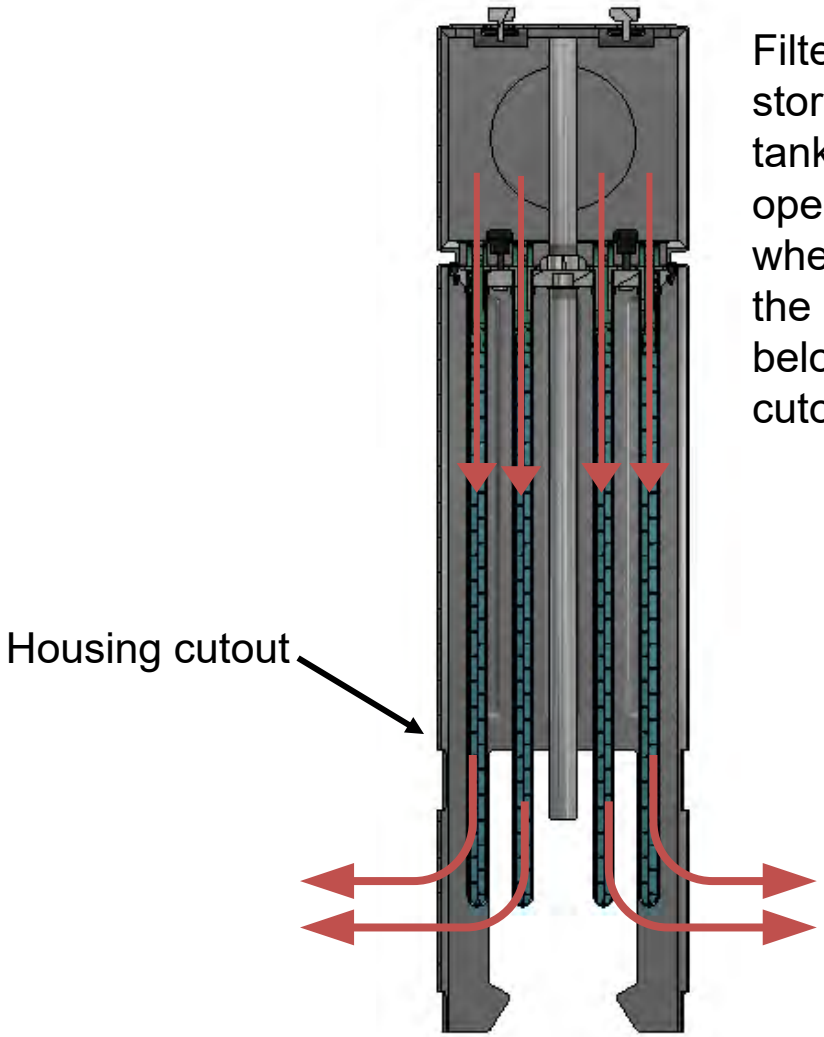
After the suspended solids are captured by the filter cartridges, water passes through the backwash tank into the siphon tube

Stormwater runoff is drawn into the module and through the filter cartridges by the siphon.

Treated water exits the module into an underdrain

Backwash Operation

Post weather event backwash



Filtered stormwater stored in the backwash tank during normal operation is released when the water level in the catch basin drops below the housing cutouts.

Operation

For context:
The filter module was installed inside of the windowed tank

Time lapse video started when feed water was shut off. The module remains full of water until the end, when the siphon breaks

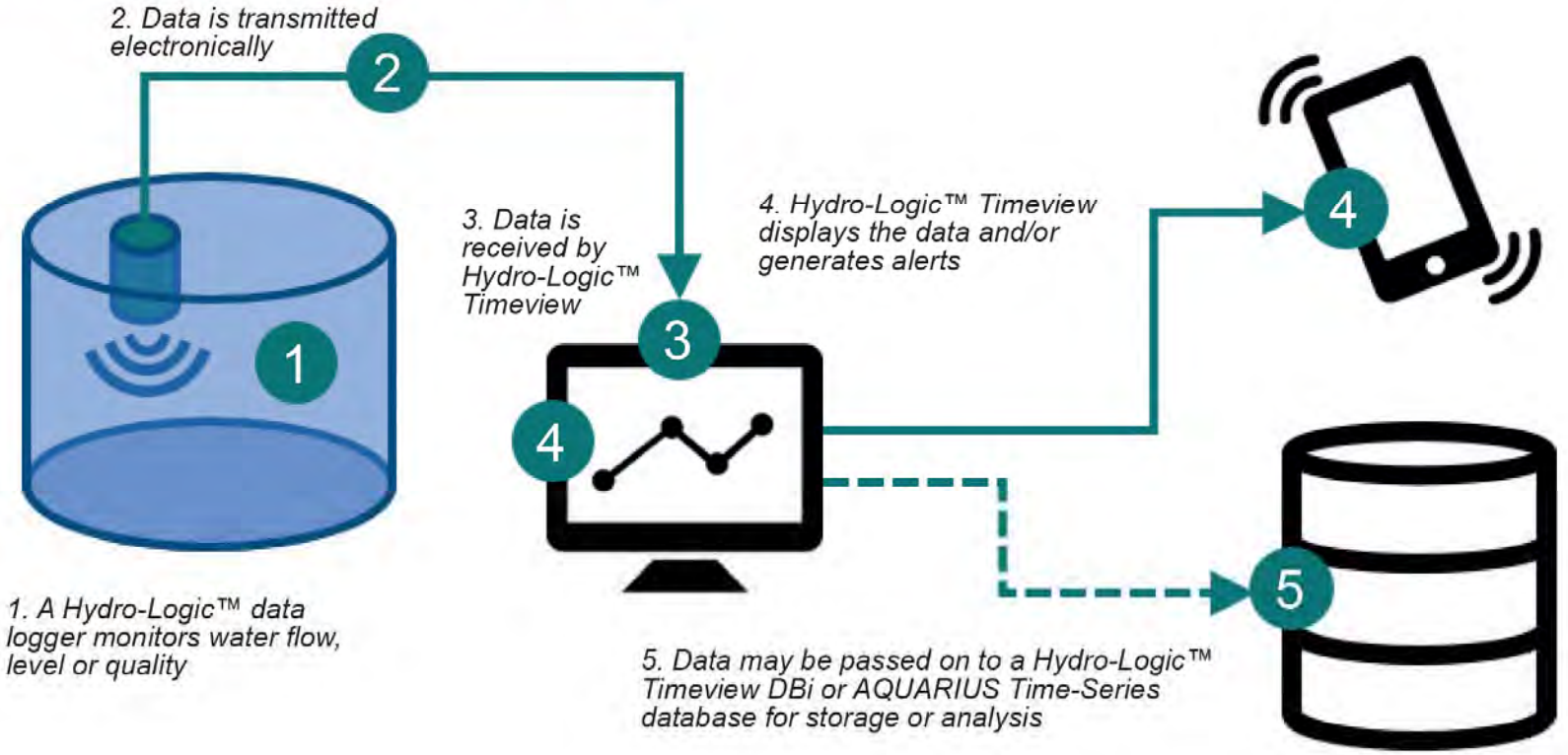
Smart Filters

Hydro International

Applying telemetry to enhance performance

Hydro International

The Hydro-Logic™ Smart Monitoring concept



Data Logging and Monitoring

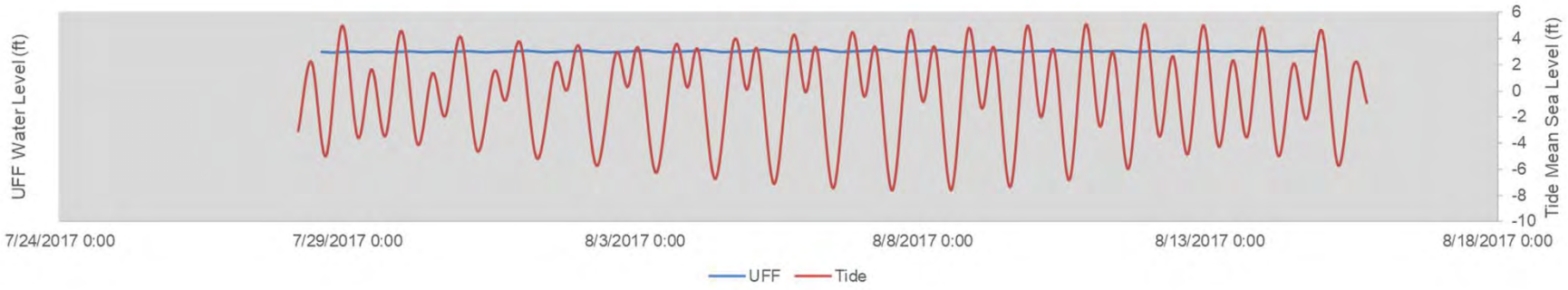
Maintenance: A critical component

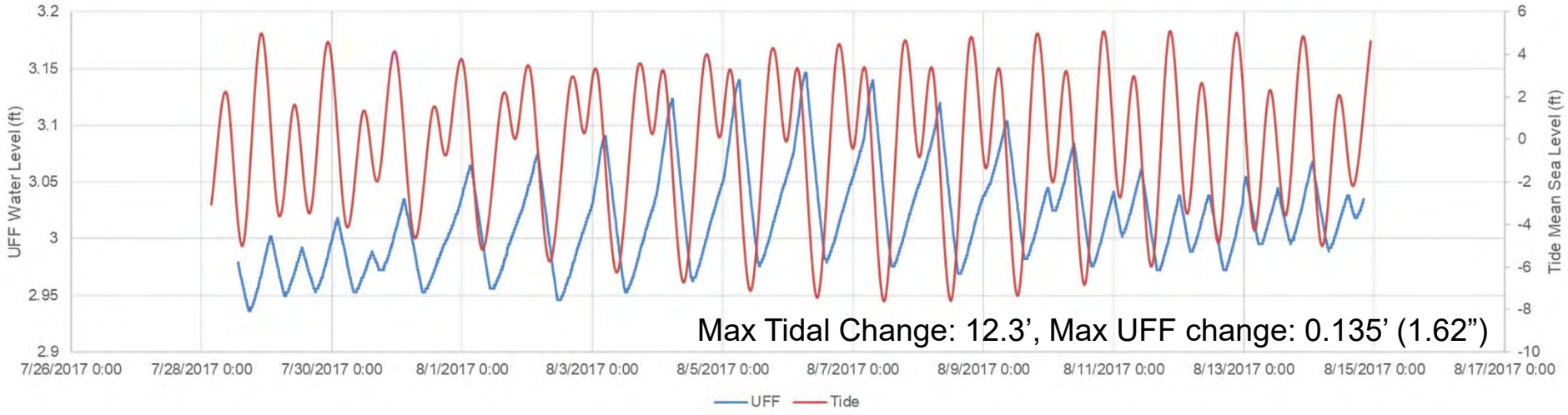
Media Packs New and Used

Spent Media

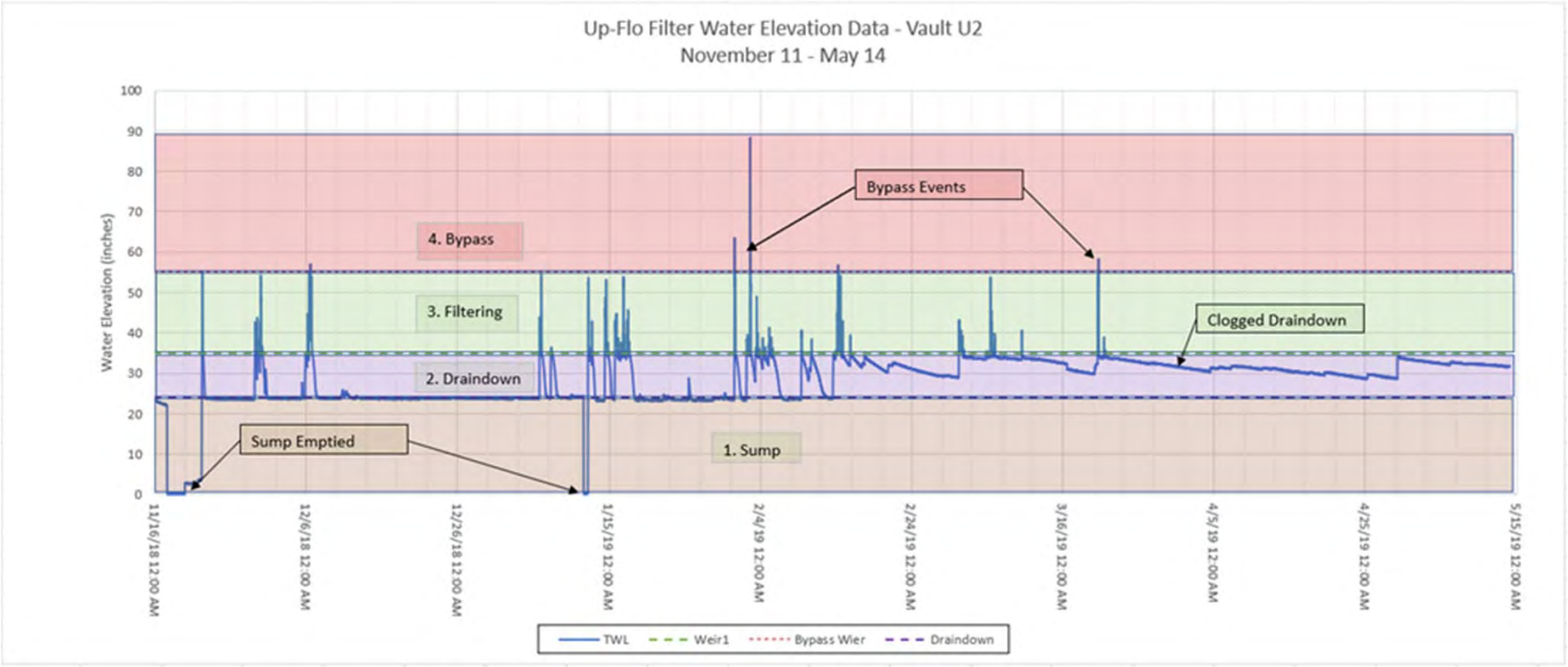
Fresh Media

Data Loggers with Water Level Sensor

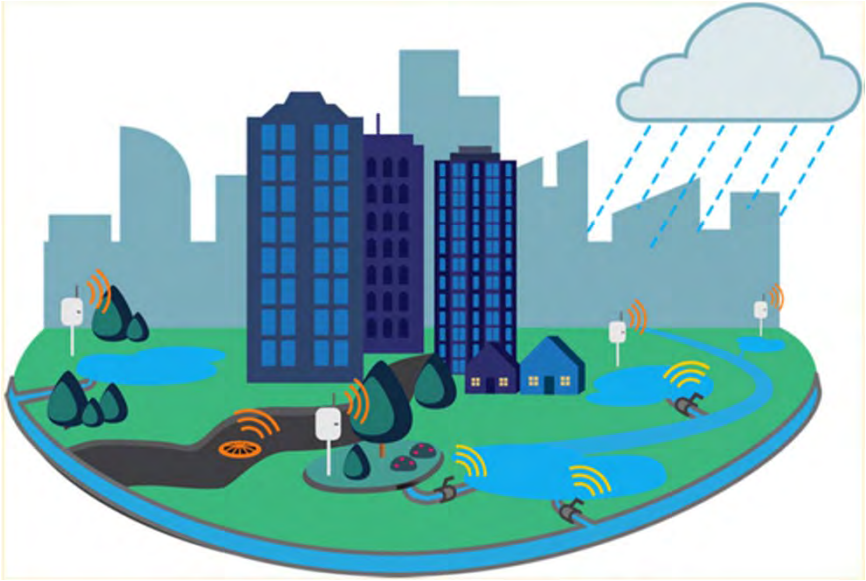




Data Loggers with Water Level Sensor



Maintenance = Performance



Thank you

David Scott – Product Manager
dscott@hydro-int.com

Hydro International