

# **SUFFOLK COUNTY'S I/A OWTS DEMONSTRATION PROGRAM AND PERFORMANCE EVALUATION**

*6th Northeast Onsite Wastewater Treatment  
Short Course and Equipment Exhibition*



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# PRESENTATION OVERVIEW

- ❑ Overview of Septic Demonstration Programs
  - ❑ Phase I Demo – NSF 245 / ETV Systems
  - ❑ Phase II Demo – NSF 245 / ETV Systems
  - ❑ Phase II Demo – Pressurized Shallow Drainfields
  - ❑ Phase II Demo – Experimental Systems
- ❑ Performance during Demonstration Program
- ❑ Long-Term System Performance

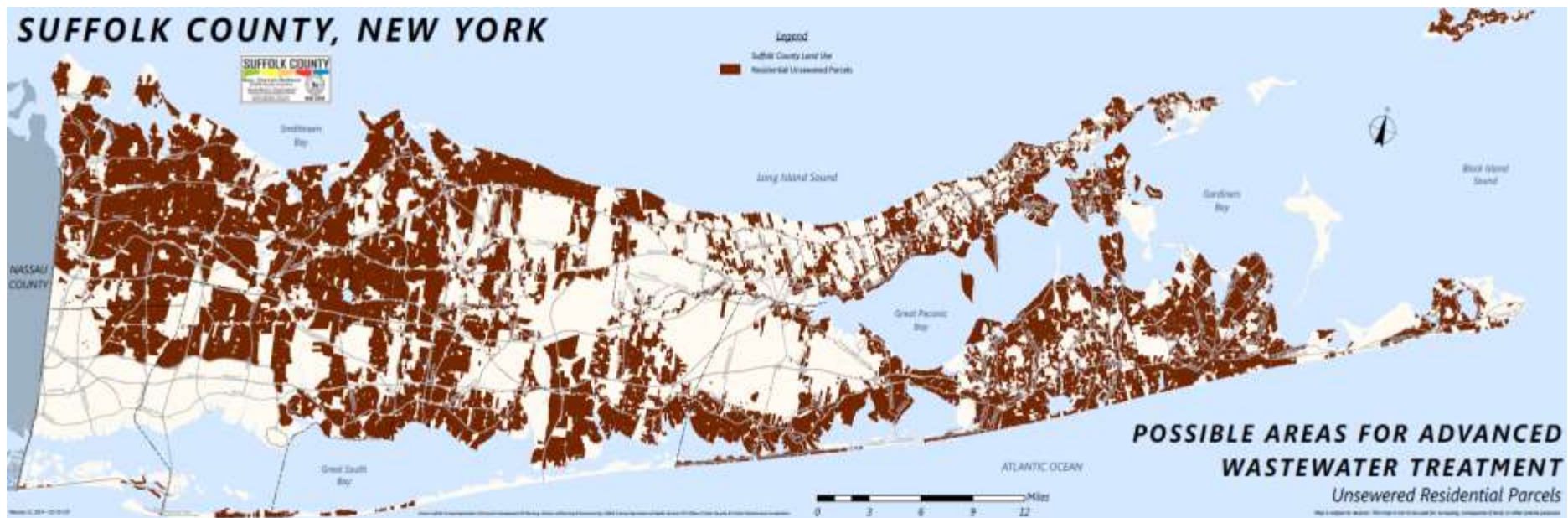






## 74% NON-PERFORMING WASTEWATER TREATMENT

- Approximately 360,000 onsite sewage disposal system
- 209,000 systems in priority areas
- Approximately 252,530 pre-date requirement for septic tank





# REQUESTS FOR EXPRESSION OF INTEREST

A DEMONSTRATION OF  
INNOVATIVE AND ALTERNATIVE  
ONSITE WASTEWATER TREATMENT  
SYSTEMS IN SUFFOLK COUNTY:

PHASE 1: (2014-2016)

PHASE 2: (2016-PRESENT)

EXPERIMENTAL SYSTEMS

PRESSURIZED SHALLOW DRAINFIELD  
(PSD'S) (2016-2017)





# RFEI FOR DENITRIFICATION SYSTEMS

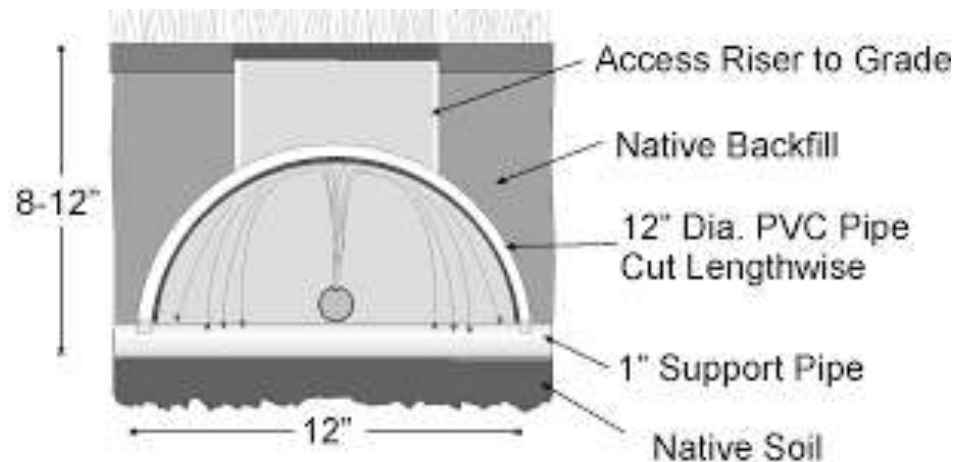
- I/A OWTS (up to five per system – Phase 1; up to three per system – Phase 2) to be provided by the manufacturer free of charge
- All maintenance and warranty costs for five years, with the exception of electric, to be borne by the manufacturer
- All cost of installation to be borne by the manufacturer
- Systems certified to NSF 245 or EPA ETV are eligible for “fast track” field testing. For Phase 2, also allowed NSF 40 + approval for TN of 19 mg/l in three other jurisdictions in similar climate conditions to Suffolk County.
- Monthly sampling for BOD, TSS and Total Nitrogen (six month required for “fast track” provisional approval), followed by quarterly sampling for the following 18 months
- Systems must be capable of removing 50% nitrogen as compared to effluent from a standard septic tank.





## THE PRESSURIZED SHALLOW DRAINFIELD RFEI:

- 2 to 3 pressurized shallow drainfields per technology at no cost to the homeowner.
- Inclusive of 5 year warranty & maintenance
- Pressurized drainfields that evenly and horizontally distribute treated effluent within 12 to 24 inches of the top soil horizon.
- Emphasis on increased microbial activity and nutrient absorption.





# PRESSURIZED SHALLOW DRAINFIELD

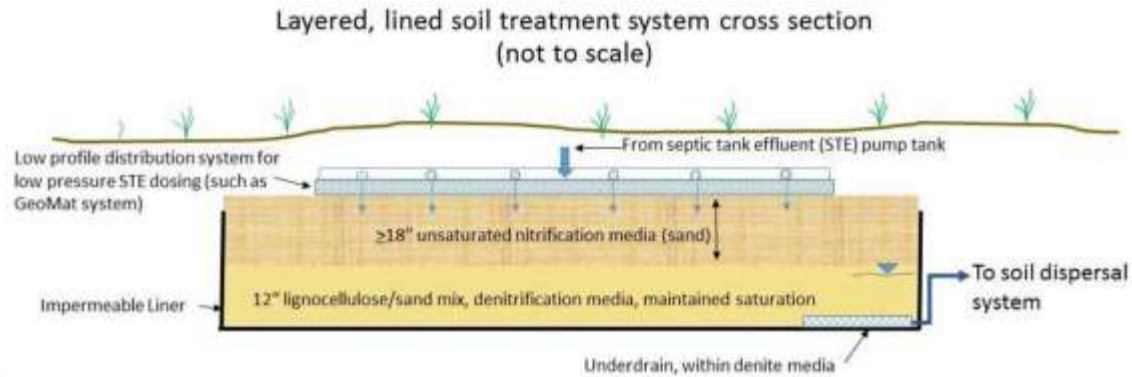
## A Cheaper and Better Performing Alternative to Mounded Systems

- Typical cost of I/A OWTS to PSD  
\$26,000
- Typical Cost of Conventional System  
with Mounded Retaining Wall  
\$45,000









# EXPERIMENTAL SYSTEMS RFEI INSTALLATION ON COUNTY PROPERTY





# Suffolk County I/A OWTs Approval Process

## Comparison of Septic Demo vs Piloting

Septic Demo	Piloting	Provisional	General Use
			
1-5 Systems Required	8-12 Systems Required	Minimum of 20 Systems Required	Greater than 20 Systems
Dataset of 75% of systems must average 19 mg/L or less	Dataset of 75% of systems must average 19 mg/L or less	Entire dataset must average 19 mg/L or less	Entire dataset must average 19 mg/L or less
Procedures for excluding outliers; Streamlined path to Provisional	Procedures in place for excluding outliers	Cannot exclude outliers	Cannot exclude outliers
NSF 245 or USEPA ETV only	NSF 245, USEPA ETV or approval for N reduction in 2 comparable jurisdictions	NSF 245, USEPA ETV or approval for N reduction in 2 comparable jurisdictions	NSF 245, USEPA ETV or approval for N reduction in 2 comparable jurisdictions
Only installed in households who met specific criteria & agreed to routine visits & monthly sampling by SCDHS	Must be year round residences that agree to routine visits & monthly sampling by SCDHS	20 year round residences sampled every 60 days for 2 years by manufacturer with SCDHS QA/QC	All residential systems sampled every 3 years by O&M Provider with SCDHS QA/QC
Proven technologies with >20,000 installed in similar jurisdictions. Great confidence systems will reduce TN by 50% as certified by NSF & ETV	Proven technologies with >20,000 installed in similar jurisdictions. Great confidence systems will reduce TN by 50% as certified by NSF & ETV	Proven technologies with >20,000 installed in similar jurisdictions. Great confidence systems will reduce TN by 50% as certified by NSF & ETV. Proven ≥ 70% TN reduction on limited dataset in Suffolk County (i.e. achieved 19 mg/L)	Great confidence systems will reduce TN by 70%. Large dataset showing reduction of TN to 19 mg/L in Suffolk County

*Note - SCDHS is the first jurisdiction to have a program designed with US EPA statistical analysis. Approval process also allows for an experimental phase which requires an additional 12 months of sampling prior to a technology being accepted into the piloting phase.*

# Sampling Responsibilities

- *Experimental and Piloting Phases*
  - SCDHS to perform monthly sampling
- *Provisional Phase*
  - Manufacturer to perform bimonthly sampling of 1<sup>st</sup> 20 year-round systems
  - Manufacturer to perform yearly sampling (TN only) for all other systems during the Provisional Phase
  - SCDHS to take at least 1 sample from at least 20 Provisionally Approved systems per I/A Manufacturer per year (Check)



# I/A OWTS DEMONSTRATION PROGRAMS







# SEPTIC DEMONSTRATION PROGRAM (I/A OWTS)

## ➤ *Phase 1 - Septic Demo Program*

- Manufacturer Selection
  - 4 manufacturers selected to install 6 types of systems for a total of 19 systems
- Homeowner Selection
  - 19 homes selected throughout the County via lottery by Legislative District

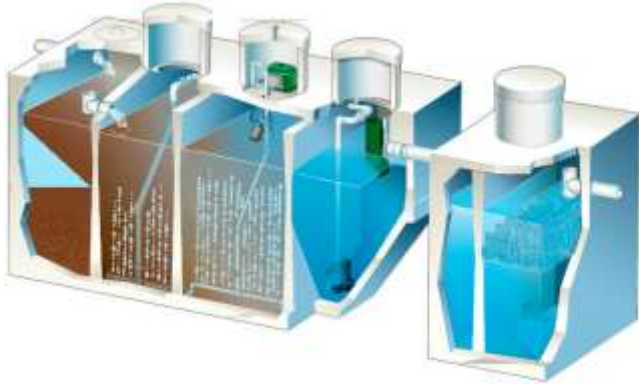
## ➤ *Phase 2 - Septic Demo Program*

- 6 manufacturers applied to install 8 types of systems
- Homeowner Selection - over 207 Applicants
- 20 homeowners selected on July 26, 2016





# SEPTIC DEMO PHASE 1 SYSTEMS



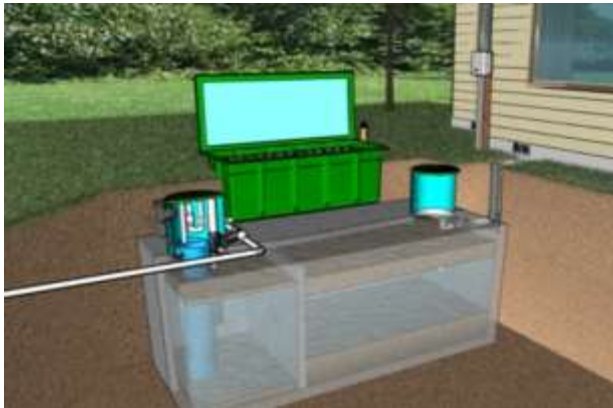
Norweco Hydro-Kinetic



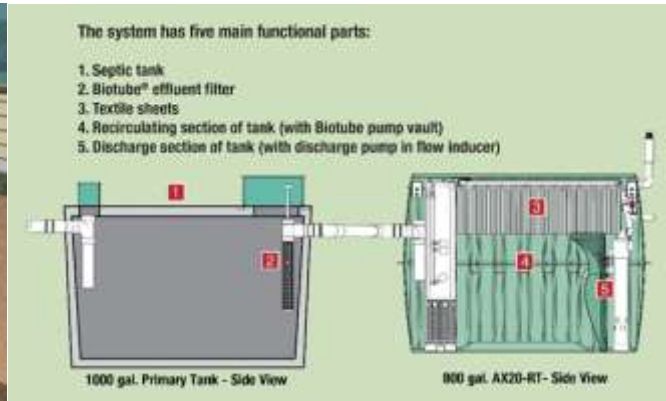
Norweco Singlair  
TNT



Busse



Orenco AdvanTex  
AX20



Orenco AdvanTex AX-RT



Hydro-Action





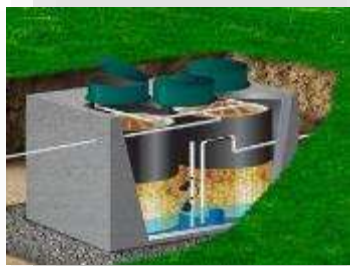
# SEPTIC DEMO PHASE 2 SYSTEMS



1. EcoFlo Coco Filter



2. Amphidrome



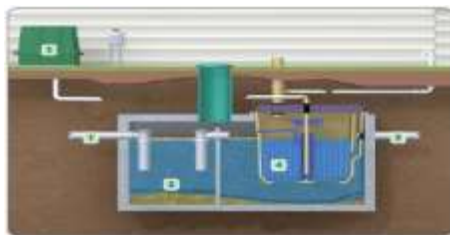
3. Waterloo BioFilter



4. Pugo Systems



5. Fuji Clean USA



6. BioMicrobics:  
MicroFAST



7. BioMicrobics: SeptiTech  
STAAR



8. BioMicrobics: BioBarrier  
MBR





# LIST OF INSTALL BY TECHNOLOGY

Technology	# of Septic Demo Installs	# of SIP Jobs	Approval Status	Other Installations or Pending Applications
Hydroaction AN Series	5	56	Provisional	250
Norweco Singulair TNT	5	38	Provisional	194
Orengo Advantex AX20-RT	2	9	Provisional	20
Norweco Hydro-Kinetic	6	0	Provisional	2
Fuji Clean CEN Series	4	74	Provisional	308
Orengo Advantex AX-20	3	0	Demonstration	0
Orengo AX-MAX-225	1	0	Demonstration	1
BUSSE	2	0	Demonstration	0
Pugo	4	0	Demonstration	0
Ecoflo Cocofilter	2	0	Demonstration	0
Waterloo BioFilter	2	0	Demonstration	0
Amphidrome	2	0	Demonstration	0
BioMicrobics BioBarrier	2	0	Demonstration	0
BioMicrobics SepticTech STAAR	2	1	Provisional	2
BioMicrobics microFAST	0	0	Demonstration	0
Constructed Wetlands	2	0	Demonstration	1
Nitrogen Reducing BioFilters (NRB's)	9	0	Experimental	0
<b>Totals</b>	<b>53</b>	<b>178</b>		<b>778</b>

**Total Combined Applications (Installed, Under Review, or Permitted) is 1020**

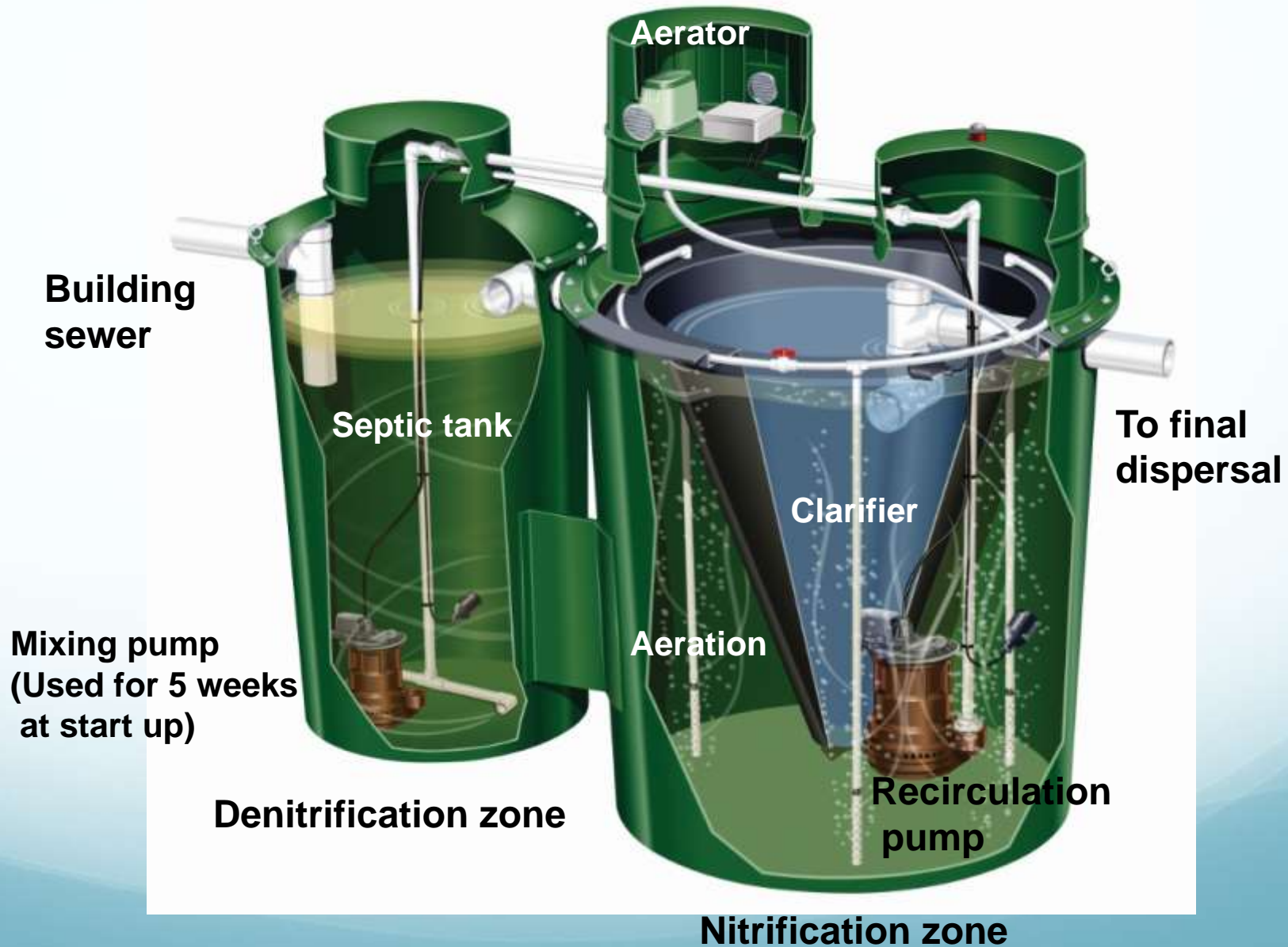
**Total Installs = 187 (53 Septic Demo, 74 SIP, 60 Other)**



# PROCEDURES FOR EVALUATING SEPTIC DEMO SYSTEMS

- Technologies in the Demonstration Program were subject to a streamlined path to Provisional approval (75% of systems need to maintain 6-month rolling average of 19 mg/l or less TN)
  - ✓ I/A OWTS Vendors agreed to install their treatment units within Suffolk County at selected residential sites while allowing an all access pass by SC, NYSDEC, NYSDOH, NGO's, Towns Residents, and Industry Professionals
  - ✓ Vendors were restricted from selling their products for use on residential lots until satisfactory completion of the Piloting phase established under the demonstration program
  - ✓ Demonstration sites are selected with strict scrutiny (e.g., non-seasonal, sufficient residents, etc.) to ensure appropriate conditions for validation
  - ✓ Vendors donated up to 5 systems of a specific technology for the Department to evaluate in terms of performance, operation and maintenance, installation requirements
  - ✓ Only households who met specific criteria were allowed to submit applications
  
- Samples may be invalidated from TN average:
  - ✓ Laboratory/Sample Error
  - ✓ Mechanical or Electrical Failure
  - ✓ Homeowner Error

# Hydro-Action Industries AN Series







# HYDROACTION AN SERIES – SEPTIC DEMO RESULTS

Site #	Sample Date	State (1)(2)	Calculate (Yes or No) (5)	TN(mg/l) (6)	TKN (mg/l)	Ammonia (as N)	NO3 (Nitrate as N)	NO2 (Nitrite as N)	BOD	TSS	PH	Temp	Alkalinity
SDS#18	5/16/16-5/17/16	Steady	No	18.7	2.4	< 0.5	15.8	0.5	16	16	6.56	60.3	18
	6/20/16 - 6/21/16	Steady	No	24.8	8.5	0.8	16.3	< 0.5	67	67	6.77	70.8	26.8
	7/18/16 - 7/19/16	Steady	No	10.6	5.3	< 0.5	5.3	< 0.5	18	53	7.07	80	65
	8/15/16 - 8/16/16	Steady	No	4.5	< 0.5	< 0.5	4.5	< 0.5	< 9	< 10	7.17	80	68
	9/12/16 - 9/13/16	Steady	No	9	2.3	< 1	6.7	< 0.5	< 10	< 10	7.13	73	54.4
	11/14/16-11/15/16	Steady	No	10.1	7.9	3.8	2.2	< 0.5	18	33	6.57	56	23.3
SDS#10	5/9/16 - 5/10/16	Steady	Yes	5.7	< 0.5	< 0.5	3.6	2.1	19	16	6.6	59.3	22
	6/13/16-6/14/16	Steady	Yes	9.7	2	< 0.5	7.7	< 0.5	< 17	< 10	7.34		
	7/11/16-7/12/16	Steady	Yes	14.1	2.2	< 0.5	11.9	< 0.5	9	10	6.94	77	318
	8/8/16 - 8/9/16	Steady	Yes	8.8	< 1	1.4	8.8	< 0.5	< 17	14	7.08	78	45.6
	9/12/16 - 9/13/16	Steady	Yes	9.7	2.9	< 1	6.8	< 0.5	< 10	10	7.33	73	48
	10/17/16 - 10/18/16	Steady	Yes	9.3	2	< 0.5	7.3	< 0.5	11	10	7.32		58
SDS#12	5/9/16 - 5/10/16	Steady	Yes	14.1	5.1	< 0.5	9	< 0.5	27	< 25	7.09	58.5	52
	6/13/2016-6/14/16	Steady	Yes	12.2	2	< 0.5	10.2	< 0.5	< 16	< 10	7.75	72.4	111
	7/11/16-7/12/16	Steady	Yes	14.5	4.9	< 0.5	9.6	< 0.5	22	53	7.63	69	138
	8/8/16 - 8/9/16	Steady	Yes	10.4	6.1	3.5	4.3	< 0.5	55	90	6.88	74	176
	9/12/16 - 9/13/16	Steady	Yes	12.1	1.8	< 1	10.3	< 0.5	< 10	10	7.64	72	110.2
	10/17/16 - 10/18/16	Steady	Yes	11.1	1.7	< 0.5	9.4	< 0.5	< 7	< 10	7.52		76
SDS#11	5/9/16 - 5/10/16	Steady	Yes	5.2	< 0.5	< 0.5	2.4	2.8	37	< 25	7.08	59.2	72
	6/13/16 - 6/14/16	Steady	Yes	10.8	2.3	< 0.5	8.5	< 0.5	< 17	< 10	7.16	71.6	35
	7/11/16 to 7/12/16	Steady	Yes	10.5	2.6	< 0.5	7.9	< 0.5	11	11	6.83	72.4	27
	8/8/16 - 8/9/16	Steady	Yes	10.1	< 1	< 0.5	10.1	< 0.5	10	< 10	6.69	73	23
	9/12/16 - 9/13/16	Steady	Yes	13.4	3.2	< 1	10.2	< 0.5	22	22	6.02	80	10
	10/17/16-10/18/16	Steady	Yes	12.6	3.3	< 0.5	9.3	< 0.5	14	23	6.67	71	20
SDS#6	5/16/16-5/17/16	Steady	Yes	11.3	5.5	3.6	5.2	0.6	< 16	13	7.49	58.6	54.5
	6/20/16 - 6/21/16	Steady	Yes	24.2	4.9	< 0.5	19.3	< 0.5	< 10	< 10	7.22	70.4	23.5
	7/18/16 - 7/19/16	Steady	Yes	12.8	0.9	< 0.5	11.9	< 0.5	< 9	< 10	7.42	80	54
	8/15/16-8/16/16	Steady	Yes	13.9	9.3	1.2	2.2	2.4	10	< 10	7.75	75	163
	9/12/16 - 9/13/16	Steady	Yes	4.3	1.8	< 1	2.5	< 0.5	< 10	< 10	7.72	72	88.6
	11/14/16-11/15/16	Steady	Yes	19.6	3.8	< 0.5	15.2	0.6	7	< 10	7.19	50	53.2
				<b>11.68333333</b>	<b>2.970833333</b>	<b>0.904166667</b>	<b>8.483333333</b>	<b>0.75</b>	<b>17.42105263</b>	<b>18</b>	<b>7.18167</b>	<b>69.8286</b>	<b>77.3304</b>
				<b>11.93666667</b>	<b>3.273333333</b>	<b>0.96</b>	<b>8.48</b>	<b>0.7</b>	<b>17.04347826</b>	<b>20.7</b>	<b>7.121</b>	<b>69.8704</b>	<b>70.1414</b>



## HYDROACTION AN SERIES – SUMMARY

### ➤ Septic Demo (5 systems installed)

- 75% of systems sampled averaged

- ✓ 11.6 mg/L TN
- ✓ 17.4 BOD
- ✓ 18 TSS

- 100% of systems sampled averaged

- 11.9 mg/L TN
- 17 mg/L BOD
- 20.7 mg/L TSS

### ➤ Provisional Sampling (18 Systems, 121 samples)

- ✓ 13.3 mg/L TN
- ✓ 9.4 BOD
- ✓ 18.6 TSS



# Norweco Singulair TNT



- One tank system: 1,500 gallon (up to 4 bedrooms)
- \$11/month to run





# NORWECO SINGULAIR TNT– SEPTIC DEMO RESULTS

Site #	Sample Date	Calculate (Yes or No) (5)	TN(mg/l) (6)	TKN (mg/l)	Ammonia (as N)	NO3 (Nitrate as N)	NO2 (Nitrite as N)	BOD	TSS	PH	Temp	Alkalinity	
SDS#21	9/19/16 - 9/20/16	No	23	12.4	6.2	1.1	9.5	79	62	6.96	74	82	
	10/3/16-10/4/16	No	42.6	36.6	35.7	5.4	0.6	197	108		74		
	11/21/16-11/22/16	No	57.4	52.2	40.1	< 0.5	5.2	197	88	7.43	64	262	
SDS#27	5/9/16 - 5/10/16	Yes	15.3	15.3	<0.5	< 0.5	< 0.5	86	110	6.82	59	131	
	6/13/16 - 6/14/16	Yes	26.1	23.5	1.1	2.6	< 0.5	96	232	7.15	73.6	142.5	
	7/11/16-7/12/16	Yes	31.1	22.5	3.9	8.6	< 0.5	111	190	6.87	70	150	
	8/8/16 - 8/9/16	Yes	10.7	< 0.1	< 0.5	10.7	< 0.5	19	16	7.64		123	
	9/19/16 - 9/20/16	Yes	46.2	30.2	8.1	16	< 0.5	171	384	6.85	76	116	
	10/3/16-10/4/16	Yes	44.6	20.2	2	24.4	< 0.5	124	232	6.34	64		
	11/28/16-11/29/16	No	Blower Failure	208	1	19.1	< 0.5	1009	3620	6.29			83.5
	SDS#15	3/21/16 - 3/22/16	Yes	14	14	2.3	< 0.5	< 0.5	48	90	6.81	62	102
	4/18/16-4/19/16	Yes	14.8	14	14.2	0.8	< 0.5	< 16	27	7.12	57.6	146	
	5/16/16-5/17/16	Yes	22.2	5.6	2.3	16.6	< 0.5	21	32	6.57	66.8	38.75	
	6/20/16 -6/21/16	Yes	15.8	5.2	1.5	10.6	< 0.5	61	61	6.87	77.7	62	
	7/18/16 - 7/19/16	Yes	17.3	12	< 0.5	5.3	< 0.5	78	82	6.88	81	110	
	8/15/16 - 8/16/16	Yes	53.1	< 0.5	< 0.5	44.6	< 0.5	55	160	6.49	84	51.2	
	9/19/16 - 9/20/16	Yes	10.1	6.8	3.2	2.4	0.9	48	32	6.8	81	71	
	10/3/16-10/4/16	Yes	6.3	3.3	< 0.5	2.3	0.7	33	25	6.71	74		
	11/21/2016-11/22/16	Yes	17.2	15.1	9.1	< 0.5	2.1	64	34	6.84	65	93	
SDS#26	3/14/16 - 3/15/16	Yes	15.4	15.4	5.4	< 0.5	< 0.5	73	87	6.77	47.6		
	4/18/16-4/19/16	Yes	12.5	12.5	7.1	< 0.5	< 0.5	55	53	6.72	57.6	122	
	5/9/16 - 5/10/16	Yes	12.8	12.8	5.3	< 0.5	< 0.5	53	81	6.66	58	77	
	6/13/16 - 6/14/16	Yes	14.1	14.1	9.8	< 0.5	< 0.5	18	20	7.15	75.3	116	
	7/11/16-7/12/16	Yes	13.7	13.7	10.6	< 0.5	< 0.5	25	37	6.94	77	112	
	8/8/16 - 8/9/16	Yes	11.8	11.1	12.7	< 0.5	0.7	13	19	7.04	74	122	
	9/19/16 - 9/20/16	Yes	2.9	2.9	1.5	< 0.5	< 0.5	21	17	6.06	76	74	
	10/3/16-10/4/16	Yes	3.7	2.3	2	1.4	< 0.5	11	10		68		
	11/28/16-11/29/16	Yes	9.1	5.2	0.6	3.9	< 0.5	25	60	6.57			49.6
		100% Average		20.88148	20.98214286	6.951851852	6.475	1.078571429	101.7037037	213.1785714	6.821154	69.488	105.937
		75% Average		18.36667	19.452	4.404166667	6.972	0.596	94.70833333	228.44	6.79	69.32727	99.64524



## NORWECO SINGULAIR TNT – SUMMARY

### ➤ Septic Demo (4 systems)

- 75% of Systems Sampled

- ✓ 18.4 mg/L TN
- ✓ 54.9 BOD
- ✓ 87.1 TSS

100% of systems sampled averaged

20.9 mg/L TN  
101 mg/L BOD  
213 mg/L TSS

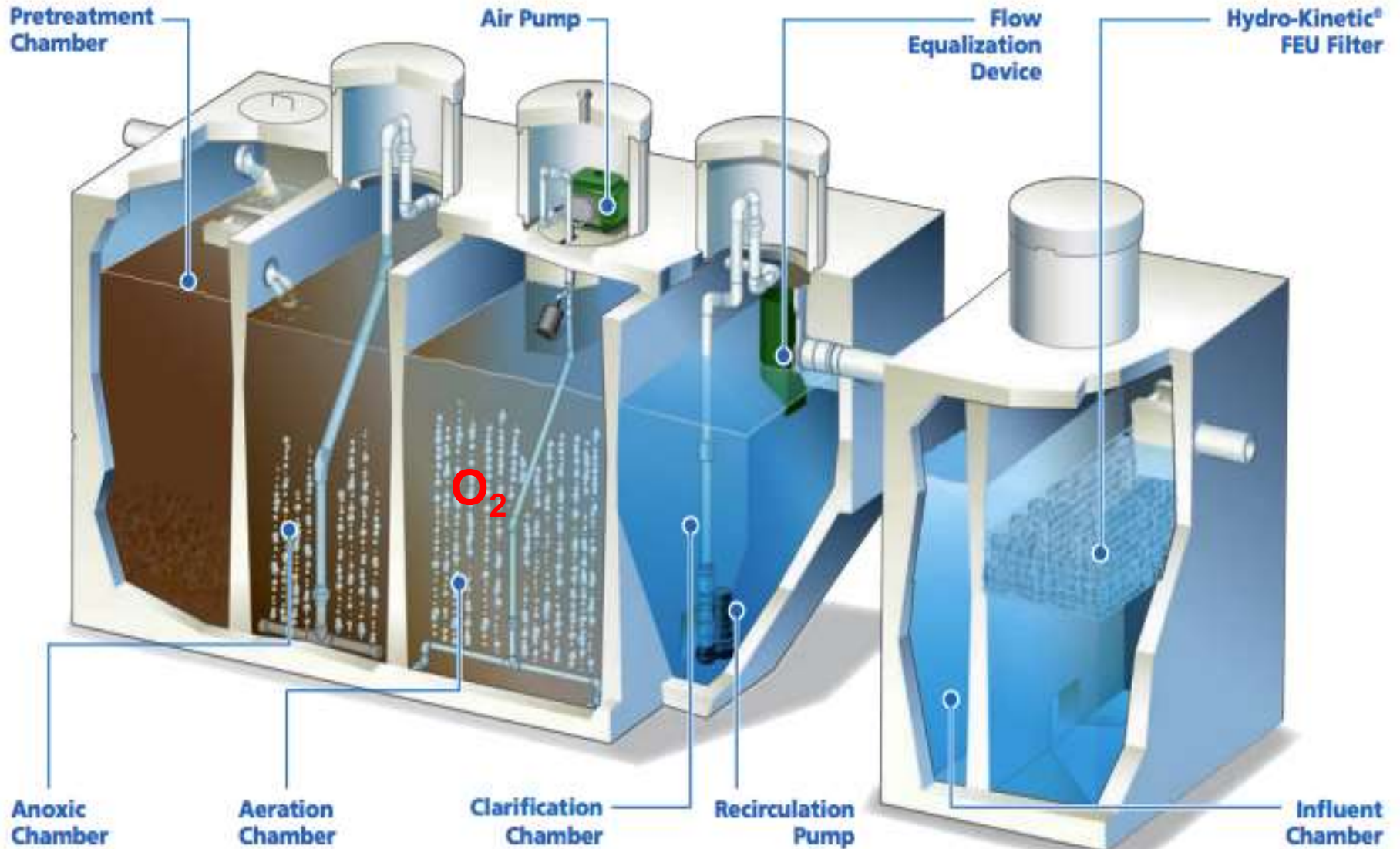
### ➤ Provisional Sampling

- 12 systems sampled over 107 samples

- ✓ 25.85 mg/L TN
- ✓ 6.8 BOD
- ✓ 34.1 TSS



# Norweco Hydro-Kinetic FEU







# NORWECO HYDROKINETIC – SEPTIC DEMO RESULTS

Site #	Sample Date	State (1)(2)	Compare Sample (Yes or No) (4)	Calculate (Yes or No) (5)		TN(mg/l) (6)	TKN (mg/l)	Ammonia (as N)	NO3 (Nitrate as N)	NO2 (Nitrite as N)	BOD	TSS	PH	Temp	Alkalinity
SDS#4	8/22/16 - 8/23/16	Steady	No	Yes		4.2	< 1	0.5	4.2	< 0.5	< 9	25	7.53	81	136
	9/26/16 - 9/27/16	Steady	Yes	Yes		8.7	1.4	< 0.5	7.3	< 0.5	9	12	7.43	77	185
	10/17/16-10/18/16	Steady	No	Yes		10.2	2.3	1.2	7.9	< 0.5	< 7	< 10	7.13		134
	11/28/16-11/29/16	Steady	Yes	Yes		11.7	2.4	< 0.1	9.3	< 0.5	9	48.4	6.98	57	99
	12/12/16-12/13/16	Steady	No	Yes		13.6	1.4	< 0.5	12.2	< 0.5	< 5	< 10	6.93		93.2
	1/23/17-1/24/17	Steady	Yes	Yes		13.4	0.8	< 0.5	12.6	< 0.5	< 6	< 10	7.03	49	111.25
	2/27/17-2/28/17	Steady	Yes	Yes		8.5	< 0.5	< 0.5	8.5	< 0.5	< 9	10	6.94	48.2	93.4
	3/27/17-3/28/17	Steady	Yes	Yes		11.8	6.9	5.3	0.7	4.2	5	< 10	3.97		115.6
	4/17/17-4/18/17	Steady	Yes	Yes		5.4	2.1	1.3	3.3	< 0.5	< 5	7	6.92		110.8
SDS#24/25	9/26/16 - 9/27/16	Steady	No	No		7	3.5	0.9	3.5	< 0.5	11	12	7.31	73	176.2
	10/17/16-10/18/16	Steady	Yes	No		13.8	6.9	4.9	6.9	< 0.5	20	10	7.33		182
	11/28/16-11/29/16	Steady	No	No		33.8	< 1	< 0.5	33.8	< 0.5	< 5	< 10	6.84		54.4
	12/12/16-12/13/16	Steady	No	No		52.3	< 1	< 0.5	52.3	< 0.5	< 5	< 10	6.36		29.8
	1/23/17-1/24/17	Steady	Yes	No		83.6	12.9	8.4	70.7	< 0.5	< 6	< 10	4.9	45	25
	2/27/17-2/28/17	Steady	No	No		75.4	5.1	7.6	70.3	< 0.5	< 7	< 10	5.62	54.2	
	3/27/17-3/28/17	Steady	Yes	No		59.6	6.6	4.3	53	< 0.5	6	< 10	5.86	44	6.2
	4/17/17-4/18/17	Steady	Yes	No		55.7	3.9	4.9	51.8	< 0.5	7	< 5	5.69		5
SDS#19	8/22/16 - 8/23/16	Steady	Yes	Yes		2.3	< 1	< 0.5	2.3	< 0.5	< 11	< 10	7.43	78	222
	9/19/16-9/20/16	Steady	Yes	Yes		7.7	2	0.8	5.7	< 0.5	10	10	7.28	76	200
	10/17/16-10/18/16	Steady	Yes	Yes		7.7	2.3	0.8	5.4	< 0.5	8	< 10	7.14		192
	11/28/16-11/29/16	Steady	Yes	Yes		10.6	3.2	0.7	7.4	< 0.1	7	6.4	7.02	57	125
	12/5/16-12/6/16	Steady	Yes	Yes		11.1	1.5	< 0.5	9.6	< 0.5	8	< 10	7.09	56	107.6
	1/9/17-1/10/17	Steady	Yes	Yes		21.6	1.8	< 0.5	19.8	< 0.5	< 5	< 10	6.94		78.8
	2/6/17-2/7/17	Steady	No	Yes		9.4	< 1	< 0.5	9.4	< 0.5	< 5	< 10	6.86	48	130.75
	3/20/17-3/21/17	Steady	Yes	Yes		17	< 1	< 0.5	< 0.5	< 0.5	< 5	< 10		45	
	4/10/17-4/11/17	Steady	Yes	Yes		<b>50.1</b>	<b>49.6</b>	<b>50.8</b>	<b>0.5</b>	<b>&lt; 0.5</b>		<b>12</b>	<b>7.38</b>	<b>54.3</b>	
SDS#17	11/14/16-11/15/16	Steady	Yes	Yes		16.6	1.5	1.1	15.1	< 0.5	7	< 10	6.74	59	114
	12/5/16-12/6/16	Steady	No	Yes		40.4	3.1	1.1	37.3	< 0.5	< 5	11.6	6.55	54	40.8
	1/9/17-1/10/17	Steady	No	Yes		71.3	< 1	< 0.5	71.3	< 0.5	< 7	24	6.77		80.4
	2/6/17-2/7/17	Steady	No	Yes		24.2	8.3	6	15.9	< 0.5	< 5	140	7.02	46	236
	3/6/17-3/7/17	Steady	Yes	Yes		27.5	6	2.6	21.5	< 0.5	7	15.2	6.86	45.5	
	4/3/17-4/4/17	Steady	Yes	Yes		30.5	2.1	< 0.5	28.4	< 0.5	< 6	< 10	6.75	46.4	
SDS#14	11/14/16 - 11/15/16	Steady	No	Yes		35.4	9.9	8.3	25.5	< 0.5	< 5	< 10	6.74	50	133
	12/5/16 - 12/6/16	Steady	No	Yes		28.9	18	17.4	10.9	< 0.5	9	< 10	6.92	53	147.2
	1/9/17-1/10/17	Steady	Yes	Yes		10.7	< 1	< 0.5	10.7	< 0.5	6	< 10	6.57		82
	2/8/17 - 2/7/17	Steady	No	Yes		17.7	< 0.5	< 0.5	17.7	< 0.5	< 5	< 10	6.23	48	39.75
	3/6/17-3/7/17	Steady	Yes	Yes		8.5	< 0.5	< 0.5	8.5	< 0.5	< 9	10	6.94	47.6	
	4/3/17-4/4/17	Steady	No	Yes		17.6	1.2	< 0.5	16.4	< 0.5	8	< 10	6.37	50.36	
					<b>75 % AVG</b>	<b>18.5038</b>	<b>3.115384615</b>	<b>2.019230769</b>	<b>14.84230769</b>	<b>0.626923077</b>	<b>6.807692308</b>	<b>17.02307692</b>	<b>6.7596</b>	<b>53.3716</b>	<b>121.55</b>
					<b>100 % AVG</b>	<b>24.6184</b>	<b>4.636842105</b>	<b>3.618421053</b>	<b>19.68684211</b>	<b>0.586842105</b>	<b>7.27027027</b>	<b>15.22631579</b>	<b>6.7127</b>	<b>55.4831</b>	<b>112.456</b>



# NORWECO HYDROKINETIC— SUMMARY

## ➤ Septic Demo (4 systems)

- 75% of systems sampled averaged

- ✓ 18.5 mg/L TN
- ✓ 6.8 BOD
- ✓ 17.5 TSS

- 100% of systems sampled averaged

- 24.6 mg/L TN
- 7.5 mg/L BOD
- 15.2 mg/L TSS

## ➤ Provisional Sampling

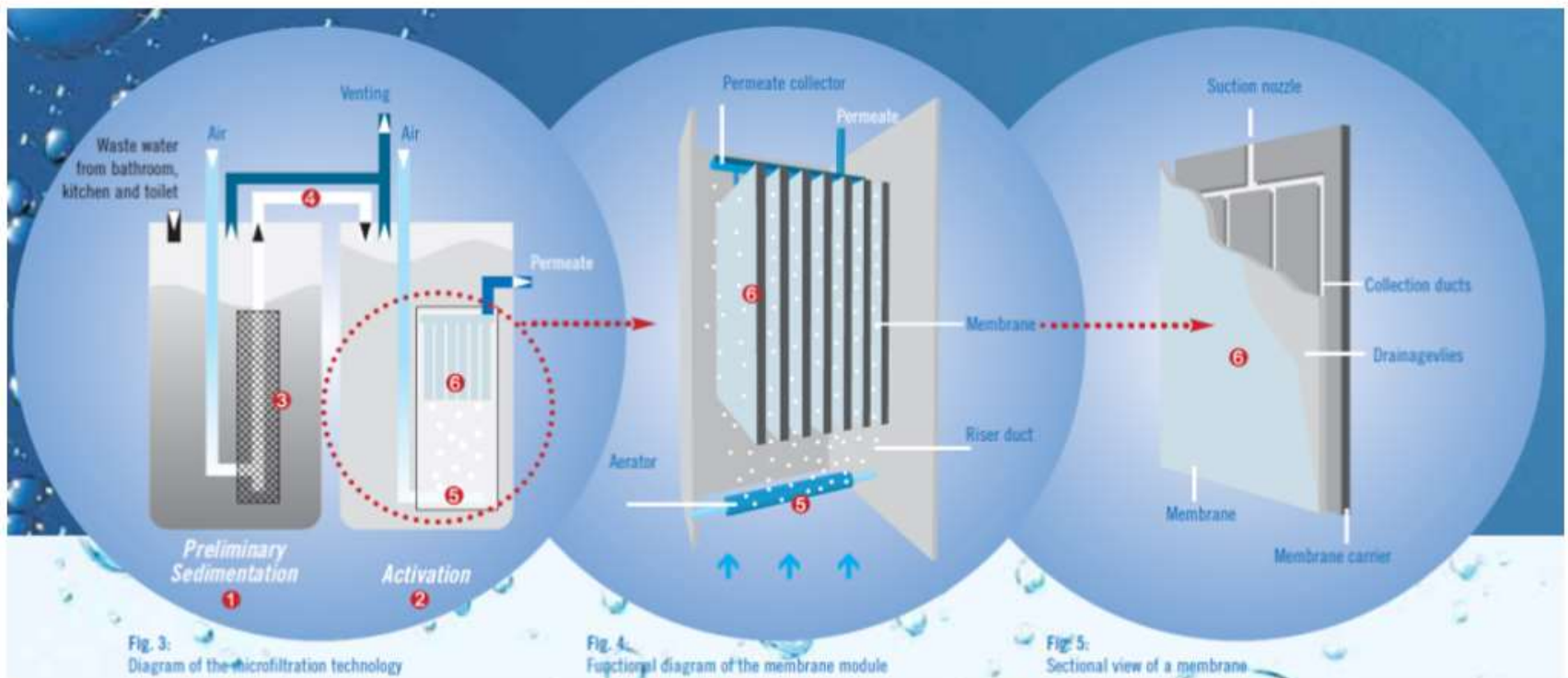
- 5 systems sampled over 70 samples

- ✓ 20.95 mg/L TN
- ✓ 4.5 BOD
- ✓ 10.3 TSS





# BUSSE MEMBRANE FILTRATION PROCESS







# BUSSE MBR– SEPTIC DEMO RESULTS

Site #	Sample Date	Compare Sample (Yes or No) (4)	Calculate (Yes or No) (5)		TN(mg/l) (6)	TKN (mg/l)	Ammonia (as N)	NO3 (Nitrate as N)	NO2 (Nitrite as N)	BOD	TSS	PH	Temp
SDS#7	3/28/16 - 3/29/16	No	No		58.6	33.9	1.1	24.7	< 0.5			5.49	
	4/18/16 - 4/19/16	Yes	No		102.4	34.3	29	68.1	< 0.5	< 8	< 10	4.08	64
	5/16/16-5/17/16	No	No		76.3	27.3	22.3	48.9	< 0.5	< 10	< 10		59.8
	6/20/16 - 6/21/16	No	No		108.2	46.7	28.9	61.5	< 0.5		< 10	3.84	
	8/15/16 - 8/16/16	No	No		13.4	13.4	15.3	< 0.5	< 0.5	< 7	< 10	3.57	80
	9/19/16 - 9/20/16	Yes	No		80.8	30.2	26.9	50.6	< 0.5	7	< 10	3.7	72
	10/3/16-10/4/16	No	No		70.1	22.7	17.3	47.4	< 0.5	8	10	3.62	74
	6/19/17-6/20/17	Yes	No		113.1	6.1	4	107	< 0.5	< 5	< 10	3.5	71.96
	7/24/17-7/25/17	Yes	No		140	NR	7.3	140	< 0.5				73.4
	1/7/19-1/8/19	Yes			58.6	13.4	12.3	45.2	< 0.5	< 5	< 25	9.66	11.9
SDS#3	9/26/16 - 9/27/16	Yes	No		68.5	16.8	20.9	51.7	< 0.5	7	< 10	3.68	74
				Average	80.90909	24.48	16.84545	58.69091	0.5	7.125	11.66667	4.571111	64.56222



## BUSSE – SUMMARY

### ➤ Septic Demo (2 systems)

- 100% of systems sampled averaged

- ✓ 80.9 mg/L TN

- ✓ 7.1 BOD

- ✓ 11.7 TSS



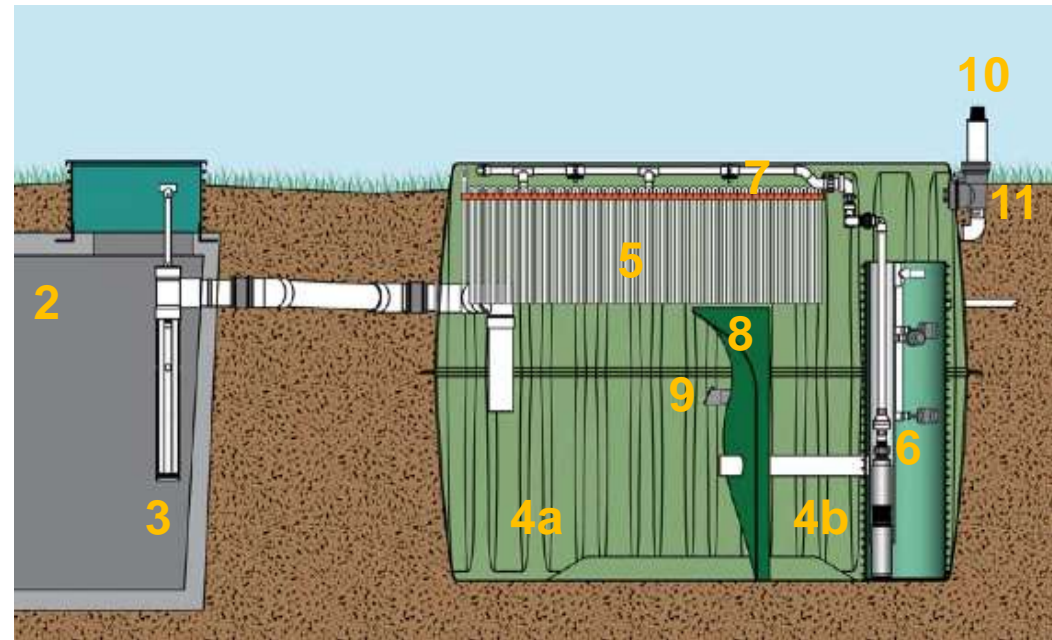


# ADVANTEX<sup>®</sup> OVERVIEW - AXRT

## MAIN COMPONENTS

### Pressure and Timed-dosed media filter

1. Control panel (not shown)
2. Primary tank
3. Biotube effluent filter
4. Treatment tank
  - a. recirc / blend chamber
  - b. recirc / filtrate chamber
5. AdvanTex textile filter
6. Recirc pumping system
7. Manifold & spin nozzles
8. Tank baffle
9. Recirc-return valve
10. Passive vent
11. External splice box
12. Primary return line (not shown)







# ORENCO AX-RT – DEMO RESULTS

Site #	Sample Date	Compare Sample (Yes or No) (4)	Calculate (Yes or No) (5)	TN(mg/l) (6)	TKN (mg/l)	Ammonia (as N)	NO3 (Nitrate as N)	NO2 (Nitrite as N)	BOD	TSS	PH	Temp	Alkalinity
SDS#2	2/22/16 - 2/23/16	No	Yes	18.9	1	1.2	17.9	< 1	< 13		6.38	48	68
	3/21/16 - 3/22/16	No	Yes	21.2	3.6	1.8	17.6	< 0.5	< 13	< 10	6.24	54.3	64
	4/11/16-4/12/16	Yes	No	70.9	68.1	42.2	0.5	2.3	12		6.14		47
	5/16/16-5/17/16	Yes	No	35	3.8	3.2	31.2	0.5	< 10	< 10	6.16	66.8	45.5
	6/20/16 - 6/21/16	Yes	Yes	24.5	7.9	7.1	16.6	< 0.5		< 10		69.9	
	7/18/16 - 7/19/16	No	Yes	19.7	12	0.5	7.7	0.8	< 9	< 10	6.55	78	135
	8/22/16 - 8/23/16	No	Yes	13.6	3.2	2.8	9.9	0.5	< 9	< 10	6.21	77	118.6
	9/26/16 - 9/27/16	Yes	Yes	19.6	19.6	16.1	< 0.5	< 0.5	24	13	9.87	77	228
	10/3/16-10/4/16	No	Yes	14.5	14.5	19.7	< 0.5	< 0.5	25	13		64	
	11/21/16-11/22/16	Yes	No	29.7	< 1	1.2	29.7	< 0.5	< 5	3.2	6.18	57	11
	12/5/16-12/6/16	Yes	No	25.6	1.7	1.5	23.9	0.5	< 5	< 10	6.46	55	25
	1/9/17-1/10/17	Yes	No	26.11	7.4	< 0.5	17.91	0.8	6	< 10	6.65		35.6
	2/6/17-2/7/17	Yes	No	21.7	4.1	4	17.6	< 0.5	< 5	< 10	6.16	50	47
	3/20/17-3/21/17	Yes	No	22.3	3.2	3.7	18.5	0.6	< 5	< 10	6.83	49	
				Average	25.95071	10.79285714	7.535714286	15.00071429	0.714285714	10.84615385	9.933333333	6.6525	62.16667
			7 -month Rolling Avg	18.85714	9.5	6.881818182	9.581818182	0.6	15	10.9	7.235	70.00909	136.9



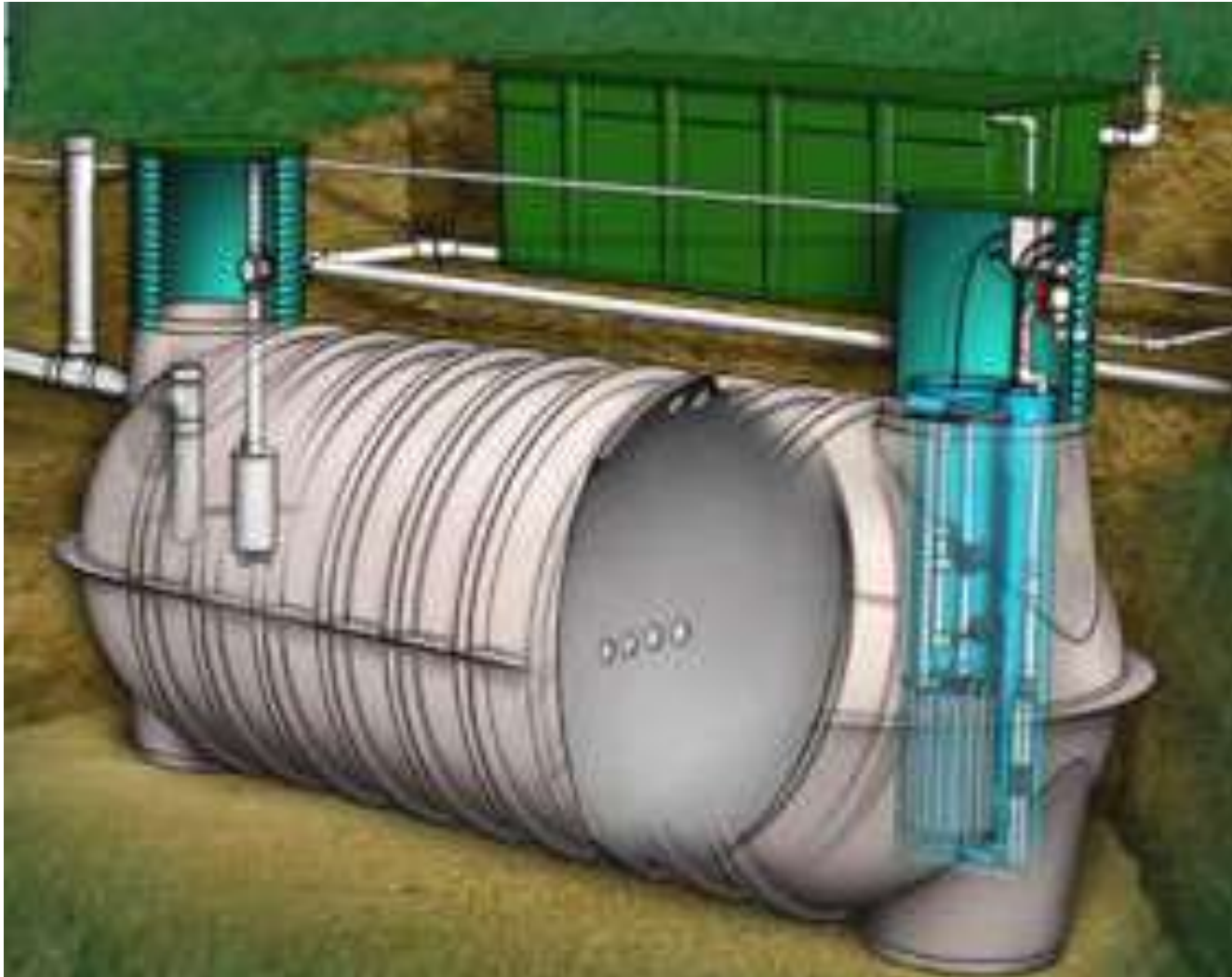
## ORENCO AX-RT – SUMMARY

- Septic Demo (1 system)
  - 7 month rolling average
    - ✓ 18.8 mg/L TN
    - ✓ 15 BOD
    - ✓ 10.9 TSS
  - 100% of samples averaged
    - 25.9 mg/L TN
    - 10.8 mg/L BOD
    - 9.9 mg/L TSS
- Provisional Sampling
  - 4 systems sampled 23 samples
    - ✓ 26.2 mg/L TN
    - ✓ 4.3 BOD
    - ✓ 6.7 TSS
    - ✓ 46.3 Alkalinity





# ORENCO AX-20





# ORENCO AX-20 – DEMO RESULTS

Site #	Sample Date	Calculate (Yes or No) (5)	TN(mg/l) (6)	TKN (mg/l)	Ammonia (as N)	NO3 (Nitrate as N)	NO2 (Nitrite as N)	BOD	TSS	PH	Temp	Alkalinity
SDS#13	11/14/16-11/15/16	No	23.9	8	4.2	15.2	0.7	10	< 10	6.64	54	37
	12/12/16-12/13/16	No	51.3	37.1	5.2	14.2	0.7	182	380	6.84	55	65.6
	2/6/17-2/7/17	No	33.2	23.4	9.8	9.8	< 0.5	93	< 10	6.81	53	124
	3/20/17-3/21/17	No	19.9	11.9	8.1	8	< 0.5	18	12	6.86	51	90
	4/24/17-4/25/17	No	14.1	11	10.7	2.2	0.9	42	16	7.14		113
	6/26/17-6/27/17	Yes	14.9	7	6	7	0.9	22	< 10	7.07	71.96	105
	8/14/17-8/15/17	Yes	15.8	3.8	4.9	12	< 0.5	14	11	7.44	72.14	105.4
	8/28/17-8/29/17	Yes	16.9	5.2	5.7	11.7	< 0.5	11	5	7.16	69.8	113
	10/2/17-10/3/17	Yes	14.7	3.5	2.6	11.2	< 0.5	9	< 20	7.46	69.8	130
	11/13/17-11/14/17	Yes	11.4	1.2	3.6	10.2	< 0.5	9	< 10	7.29	62.1	106
	12/11/17-12/12/17	Yes	15.1	7.5	4.2	7.6	< 0.5	19	7	6.96	56.5	66
SD # 33	12/18/17-12/19/17	Yes	16.2	3.4	0.8	3.3	9.5	17	18	6.96	58.3	NR
	2/5/18-2/6/18	Yes	14.1	2.8	0.6	7.2	4.1	9	6	7.25	51.3	69
	3/19/18-3/20/18	Yes	14.4	3.6	1.1	10.8	< 0.5	9	< 10	7.22	50.2	63
	4/16/18-4/17/18	Yes	13	3.2	1	9.8	< 0.5	11	< 10	7.09	52.9	69
	5/14/18-5/15/18	Yes	17.2	3.9	1.3	13.3	< 0.5	6	< 10	6.88	63.5	50
	6/18/18-6/19/18	Yes	20.7	20.7	14.7	< 0.5	< 0.5	41	20	7	72.5	296
	7/16/18-7/17/18	Yes	48.7	38.1	1.9	10.6	< 0.5	< 5	< 10	6.71	77.9	66
	8/13/18-8/14/18	Yes	23.6	15.5	7.5	8.1	< 0.5	40	116	6.68	24.9	96
	9/17/18-9/18/18	Yes	11.9	5.3	4.9	6.6	< 0.5	6	< 10	NR	24.1	78
	10/22/18-10/23/18	Yes	14	1.7	1.4	11.8	0.5	NR	NR	6.95	18.1	NR
	11/26/18-11/27/18	Yes	15	4	2.7	11	< 0.5	< 6	2	6.85	13.7	NR
	12/17/18-12/18/18	Yes	14.9	7.4	5	7.5	< 0.5	< 5	< 12.5	6.59	13	NR
	SD # 34	8/28/17-8/29/17	Yes	24.2	8.7	5.7	10	5.5	< 5	< 5	6.4	74.7
10/2/17-10/3/17		Yes	20.9	2.4	2.3	18.5	< 0.5	< 5	< 10	6.2	73.4	17
11/13/17-11/14/17		Yes	44.9	40.5	42.2	4.4	< 0.5	7	< 10	7.13	65.7	203
12/11/17-12/12/17		Yes	63.4	54.4	44.7	8.1	0.9	94	190	6.9	63	211
1/22/18-1/23/18		Yes	22.7	5.6	3.2	17.1	< 0.5	7	< 10	5.63	57.6	162
3/5/18-3/6/18		Yes	28.5	4.9	3.1	23.6	< 0.5	7	< 5	5.52	60.3	10
4/2/18-4/3/18		Yes	22.1	4.5	4.3	17.6	< 0.5	< 5	< 5	5.31	61.9	NR
4/30/18-5/1/18		Yes	18.4	8.2	5	10.2	< 0.5	< 5	< 5	6.05	64.4	25
6/11/18-6/12/18		Yes	28.9	11.9	7	17	< 0.5	20	21	6.3	73.22	39
7/2/18-7/3/18		Yes	24	7.5	4.4	16.5	< 0.5	< 7	< 10	6.08	76.28	NR
7/30/18-7/31/18		Yes	28.9	6.7	5.6	22.2	< 0.5	< 11	< 12.5	5.95	78.08	19
8/27/18-8/28/18		Yes	24.7	10.8	9.6	13.9	< 0.5	< 5	< 10	6.41	27.3	NR
10/15/18-10/16/18		Yes	26	6.7	9.6	19.3	< 0.5	< 6	< 10	NR	21.2	NR
11/19/18-11/20/18		Yes	19.2	4.2	4.7	15	< 0.5	< 6	< 10	5.76	19.4	16.6
12/10/18-12/11/18	Yes	15.2	0.9	2.4	14.3	< 0.5	< 6	< 10	4.17	14.9	NR	
1/7/19-1/8/19	Yes	17.2	1.7	< 1	15.5	< 0.5	< 2	< 18.75	6.1	14.9	24	
Average			22.66923	10.48205	6.641463	11.44634	0.970732	20.225	27.31875	6.588108	50.182	86.88667
6 Month AVG			19.33889	8.35	4.2	9.608333333	0.533333333	13.27272727	19.40909091	7.014545	47.83333	96.15556



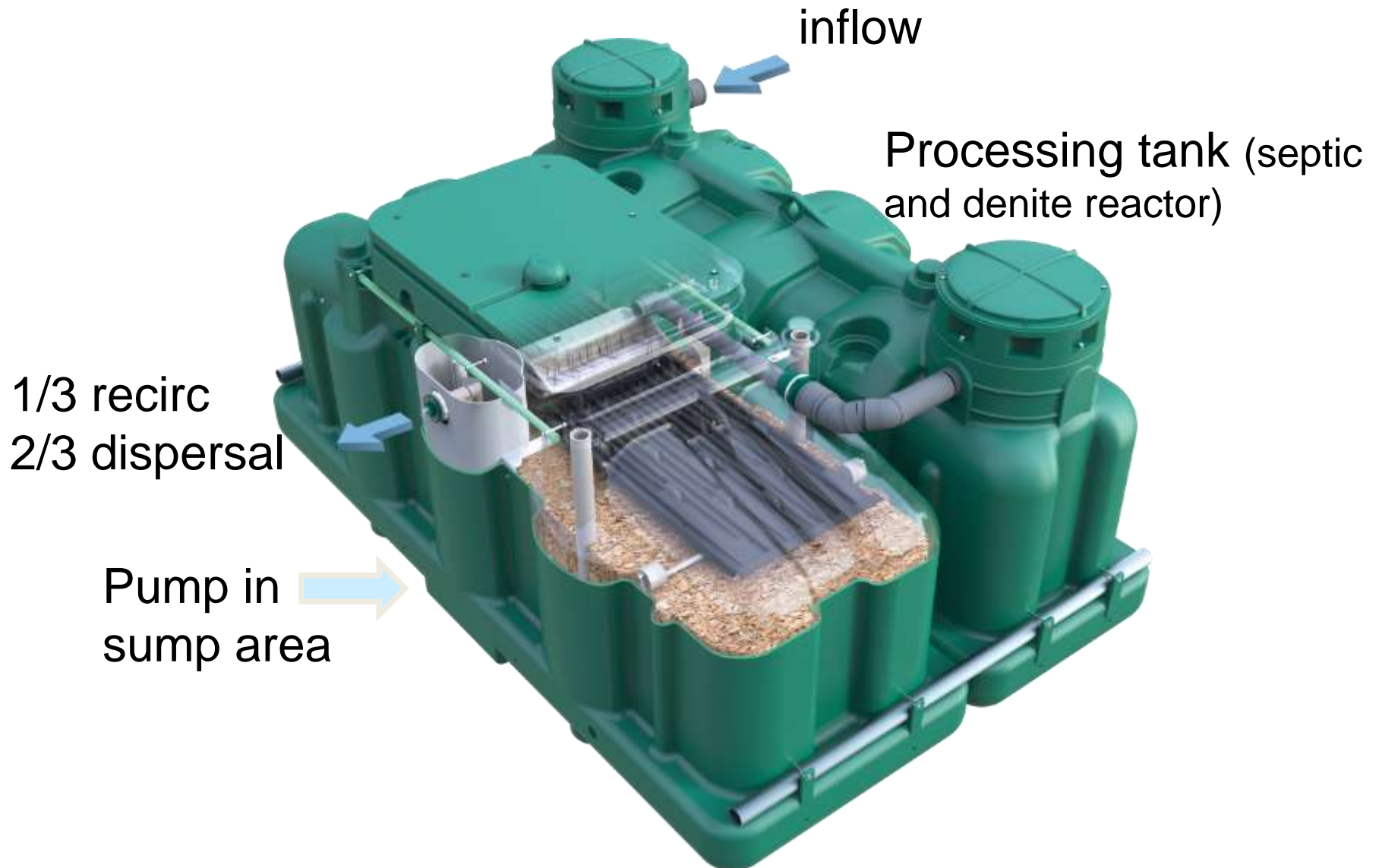
## ORENCO AX-20 – SUMMARY

- Septic Demo (3 system)
  - 6 month rolling average
    - ✓ 19.3 mg/L TN
    - ✓ 13.3 BOD
    - ✓ 19.4 TSS
  - All of samples averaged
    - 22.6 mg/L TN
    - 20.2 mg/L BOD
    - 27.3 mg/L TSS





# ECO FLO COCO FILTER





# EcoFLO COCO FILTER – DEMO RESULTS

Site #	Sample Date	Calculate (Yes or No) (5)	TN(mg/l) (6)	TKN (mg/l)	Ammonia (as N)	NO3 (Nitrate as N)	NO2 (Nitrite as N)	BOD	TSS	PH	Temp	Alkalinity	
SDS#9	12/12/16-12/13/16	No	93	93	82.2	< 0.5	< 0.5	< 5	12.8	7.78		503.2	
	1/23/17-1/24/17	No	84.4	82.7	70.6	0.6	1.1	< 6	< 10	7.78		512.5	
	2/27/2017-2/28/17	No	97.1	91.1	75.5	6	< 0.5	11	< 10	7.47	47.5	NR	
	3/27/17-3/28/17	No	62.9	57.2	55.1	4.3	1.4	18	< 10	7.24	47	312	
	4/17/17-4/18/17	No	52.3	38.2	35	9.6	4.5	11	5	6.99		253.6	
	5/15/17-5/17/17	No	N/A	NR	46.3	3.3	0.9	24	< 10	7.04	63.86		NR
	7/24/17-7/25/17	No	86.6	86.6	99.1	< 0.5	< 0.5	55	33	7.61	75.2		NR
	8/21/17-8/22/17	No	88.3	83	69.9	0.5	4.5	14	10	7.26	78.8		NR
	9/25/17-9/26/17	Yes	44.8	37.2	34.2	7.6	< 0.5	32	25	7	71.8		244
	10/30/17-10/31/17	Yes	37.3	20.2	23	17.1	< 0.5	33	13	7.26	67.1		236
	12/4/17-12/5/17	Yes	NR	NR	2.2	9.6	< 0.5	22	< 3	7.11	57.6		296
	1/22/18-1/23/18	Yes	46.4	31.5	25.8	12.3	2.6	26	14	6.92	53.1		220
	3/5/18-3/6/18	Yes	48.3	28.4	29.7	17.3	2.6	26	12	7.15	53.1		251
	4/2/18-4/3/18	Yes	61.8	40.5	30.3	19.1	2.2	25	19	7.03	48.7		252
	4/30/18-5/1/18	Yes	64.4	59.6	44.2	2	2.8	42	16	6.98	57.9		345
	6/4/18-6/5/18	Yes	80	76.5	67	2.3	1.2	49	25	7.08	66.38		411
	7/2/18-7/3/18	Yes	82.2	65.5	63.2	16.7	< 0.5	20	< 10	7.12	72.5		NR
	7/30/18-7/31/18	Yes	110.3	97.8	94.3	12.5	< 0.5	< 13	< 13	7.27	75.02		382
8/27/18-8/28/18			77	57	54.4	20	< 0.5	12	< 10	7.1	24.6		NR
SDS#8	3/6/17-3/7/17	No	47.5	47.5	35	< 0.5	< 0.5	12	10	NR	48.6		NR
	4/3/17-4/4/17	No	54.4	54.4	50.8	< 0.5	< 0.5	< 6	< 10	7.71	47.6		NR
	5/1/17-5/2/17	No	61.7	44.8	45.7	13.3	3.5	9	< 10	7.2	58.82		324
	6/5/17-6/6/17	Yes	10.8	1	< 0.5	9.8	< 0.5	< 5	12	6.92	60.98		241
	7/10/17-7/11/17	Yes	13	3.6	1.1	9.4	< 0.5	< 5	< 10	7.05	75.92		202
	8/7/17-8/8/17	Yes	2.4	2.4	1.4	< 0.5	< 0.5	< 5	8	6.95	73.22		196
	9/11/17-9/12/17	Yes	19.3	1.3	< 0.5	18	< 0.5	< 5	< 5	7.04	70.2		127
	10/16/17-10/17/17	Yes	16	< 0.5	< 0.5	16	< 0.5	< 5	< 5	6.92	67.3		122
	11/20/17-11/21/17	Yes	15.1	1.4	0.5	13.7	< 0.5	< 5	< 10	7.42	62.4		106
	1/29/18-1/30/18	Yes	22.5	< 1	< 1	22.5	< 0.5	< 5	< 10	6.99	41.5		75
Average			54.80741	44.5888889	39.2758621	9.17241379	1.251724138	17.44827586	12.096552	7.1925	60.25769	267.2048	
6-month Avg			39.28333	26.01666667	22.1	12.4833333	1.241666667	18.16666667	12	7.054167	61.85167	209.7273	

# ECOFLO COCO FILTER W/ ADDITIONAL DENITE – DEMO RESULTS

Site #	Sample Date	Calculate (Yes or No) (5)	TN(mg/l) (6)	TKN (mg/l)	Ammonia (as N)	NO3 (Nitrate as N)	NO2 (Nitrite as N)	BOD	TSS	PH	Temp	Alkalinity
SDS#9	12/12/16-12/13/16	No	87.5	88	82.7	< 0.5	< 0.5	< 5	< 10	7.64		478.4
	1/23/17-1/24/17	No	77.9	78	76.7	< 0.5	< 0.5	< 6	< 10	7.52		496
	2/27/17 - 2/28/17	No	91.9	92	75.6	< 0.5	< 0.5	< 7	< 10	7.47	47.5	NR
	3/27/17-3/28/17	No	66.2	64	58.4	1.4	0.5	15	< 10	7.36	47	339.6
	4/17/17-4/18/17	No	41.1	34	33.9	7.1	< 0.5	10	< 5	7.19		298
	5/15/17-5/16/17	No	43.3	43	46.2	0.5	0.5	21	< 10	7.15	63.86	NR
	6/19/17-6/20/17	No	87.4	87	75	< 0.5	< 0.5	131	< 10	7.27	73.4	510
	7/24/17-7/25-17	No	87.7	88	106	< 0.5	< 0.5	153	14	7.1	75.2	NR
	8/21/17-8/22/17	No	82.6	82	74.6	< 0.5	0.8	12	11	7.38	78.8	NR
	10/30/17-10/31/17	Yes	20	20	24.4	< 0.5	< 0.5	15	11	7.31	67.1	267
	12/4/17-12/5/17	Yes	27.2	27	21.7	< 0.5	< 0.5	< 7	8	7.19	57.6	333
	1/22/18-1/23/18	Yes	29.5	30	28.5	< 0.5	< 0.5	8	< 10	7.26	53.1	302
	3/5/18-3/6/18	Yes	34.2	29	30.7	3.4	2.2	10	4	7.3	53.1	NR
	4/2/18-4/3/18	Yes	36.4	36	34.1	< 0.5	< 0.5	< 5	< 10	7.03	48.7	387
4/30/18-5/1/18	Yes	64.7	65	47.9	< 0.5	< 0.5	29	40	7.19	57.9	392	
SDS#8	3/6/17-3/7/17	No	40.6	41	35.5	< 0.5	< 0.5	12	< 10	7.58	48.6	328.4
	4/3/17-4/4/17	No	51.8	52	51.1	< 0.5	< 0.5	< 6	< 10	7.53	47.6	NR
	5/1/17-5/2/17	No	44.7	45	46.7	< 0.5	< 0.5	10	< 10	7.11	58.82	352
	6/5/17-6/6/17	No	1.1	1.1	< 0.5	< 0.5	< 0.5	< 5	12	7.18	60.98	343
	7/10/17-7/11/17	No	1.3	1.3	1	< 0.5	< 0.5	< 5	< 10	7.28	75.92	294
	8/7/17-8/8/17	No	1.5	1.5	1.4	< 0.5	< 0.5	< 5	< 5	7.27	73.22	271
	9/11/17-9/12/17	No	1.1	1.1	0.6	< 0.5	< 0.5	< 5	< 5	7.48	70.2	235
	10/16/17-10/17/17	No	0.8	0.8	< 0.5	< 0.5	< 0.5	< 5	< 5	7.54	67.3	244
	11/20/17-11/21/17	No	4	2.3	1.3	1.7	< 0.5	< 5	< 10	7.57	62.4	157
	1/29/18-1/30/18	No	5.2	4.4	3.3	0.8	< 0.5	< 5	< 10	7.41	41.5	167
		<b>Average</b>	<b>41.188</b>	<b>45</b>	<b>42.84</b>	<b>1.610345</b>	<b>0.568966</b>	<b>21.03448</b>	<b>11.18621</b>	<b>7.331034</b>	<b>60.31923</b>	<b>333.0667</b>
		<b>6-month Avg</b>	<b>18.825</b>	<b>18.15</b>	<b>16.2833333</b>	<b>0.866666667</b>	<b>0.641666667</b>	<b>8.666666667</b>	<b>10.66666667</b>	<b>7.319167</b>	<b>60.67</b>	<b>277.1818</b>

# ECOFLO COCO FILTER - SUMMARY

## ➤ Without Denite Polishing Unit – 2 systems sampled

- Site 9 had 6-month average of 82.7 mg/L TN
- Site 8 had 6-month average of 14.1 mg/L TN
- 6-month average of 54.8 mg/L TN
- BOD average 17.4 mg/L
- TSS average 12 mg/L

## ➤ With Denite Polishing Unit - 2 Systems Sampled

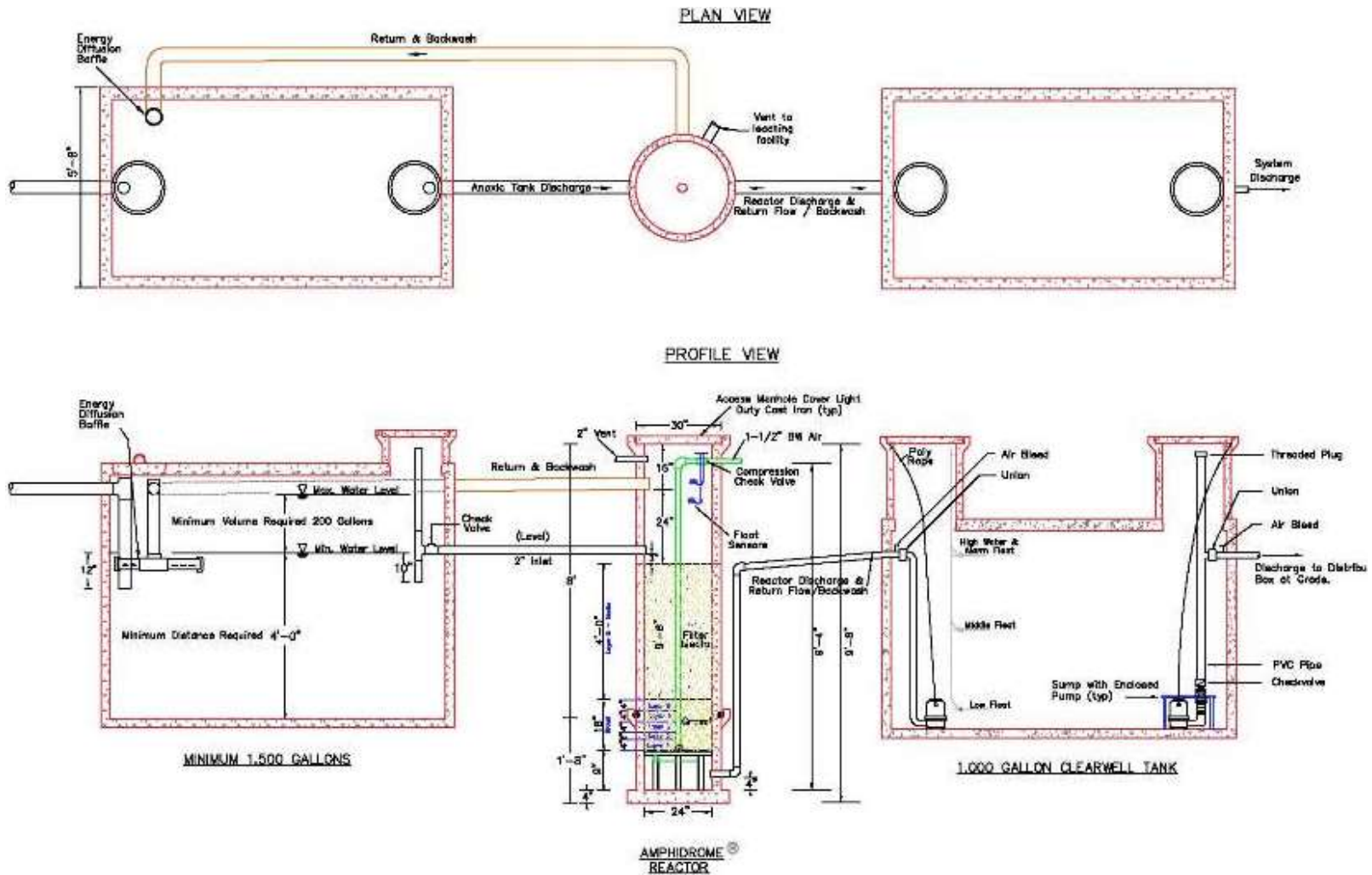
- Site 9 had 6-month average of 35.3 mg/L TN
- Site 8 had 6-month average of 2.31 mg/L TN
- 6-month average of 18.8 mg/L for both systems
- BOD average 8.6 mg/L
- TSS average of 10.6 mg/L







# AMPHIDROME





# AMPHIDROME DEMO RESULTS

Site #	Sample Date	Calculate (Yes or No) (5)	TN(mg/l) (6)	TKN (mg/l)	Ammonia (as N)	NO3 (Nitrate as N)	NO2 (Nitrite as N)	BOD	TSS	PH	Temp	Alkalinity
SDS#28	3/20/17-3/21/17	No	44.6	44.6	43.5	< 0.5	< 0.5	20	12	7.45	45	267.6
	4/10/17-4/11/17	No	30.7	29.3	33.2	1.4	< 0.5	NR	10	7.53	53	NR
	5/8/17-5/9/17	No	47.7	46.8	47.1	< 0.5	0.9	11	20	7.66	59.36	236
	6/19/17-6/20/17	No	9.5	6.1	1.2	< 0.5	3.4	12	12	7.61	68.37	183
	7/24/17-7/25/17	Yes	9.9	1.8	< 0.5	8.1	< 0.5	< 5	7	7.53	73.4	NR
	8/21/17-8/22/17	Yes	5.7	3.6	< 0.5	2.1	< 0.5	12	31	7.65	78.08	NR
	10/4/17-10/5/17	Yes	15.5	2.2	< 0.5	13.3	< 0.5	NA	NA	NA	73	NA
	10/30/17-10/31/17	Yes	11.9	< 1	< 1	11.9	< 0.5	6	12	7.16	63.9	46
	12/4/17-12/5/17	Yes	24.4	< 0.5	0.8	24.4	< 0.5	< 5	< 10	NR	54.9	NR
	1/22/18-1/23/18	Yes	42.9	8.5	6.2	34.4	< 0.5	15	18	5.31	46	50
SD#35	10/2/17-10/3/17	Yes	18.8	1.5	< 0.5	17.3	< 0.5	7	< 10	7.27	74.5	48
	11/13/17-11/14/17	Yes	18.1	1.8	< 0.5	16.3	< 0.5	7	< 10	7.49	66.4	64
	12/11/17-12/12/17	Yes	46.1	46.1	34.2	< 0.5	< 0.5	> 168	26	7.24	63.9	212
	1/22/18-1/23/18	Yes	73.2	48.2	12	25	< 0.5	244	476	6.81	57.6	72
	3/5/18-3/6/18	Yes	36.6	13.8	5	8.9	13.9	48	48	6.81	55.9	48
	4/2/18-4/3/18	Yes	44.3	44.3	34.3	< 0.5	< 0.5	53	66	7.17	60.1	211
	4/30/18-5/1/18	Yes	54.5	45.1	21.1	< 0.5	9.4	13	17	7.17	64.4	123
	6/4/18-6/5/18	Yes	22.1	2.6	< 0.5	19.5	< 0.5	6	< 10	6.9	66.74	35
	7/2/18-7/3/18	Yes	13.8	2.7	< 0.5	11.1	< 0.5	6	< 10	7.03	72.32	NR
	7/30/18-7/31/18	Yes	16.9	3.1	0.7	13.8	< 0.5	13	13.5	7.25	74.3	198
	8/27/18-8/28/18	Yes	10.8	1.3	< 0.5	9.5	< 0.5	< 5	< 10	NR	24.8	NR
	10/15/18-10/16/18	Yes	7.6	1.7	< 1	5.9	< 0.5	6	< 10	7.62	21.1	195
	11/19/18-11/20/18	Yes	11	0.8	< 1	10.2	< 0.5	< 6	< 10	7.54	17.4	188
	12/10/18-12/11/18	Yes	10.7	0.5	< 0.5	10.2	< 0.5	< 6	< 10	7.92	15.2	216
		Average	26.1375	14.9125	10.28333333	10.2625	1.566666667	30.63636364	37.32608696	7.24381	56.23625	140.7412
		6-month Avg	15.09167	2.308333333	1.141666667	12.90833333	0.5	7.727272727	12.86363636	7.223333	51.2	148.8333



## AMPHIDROME— SUMMARY

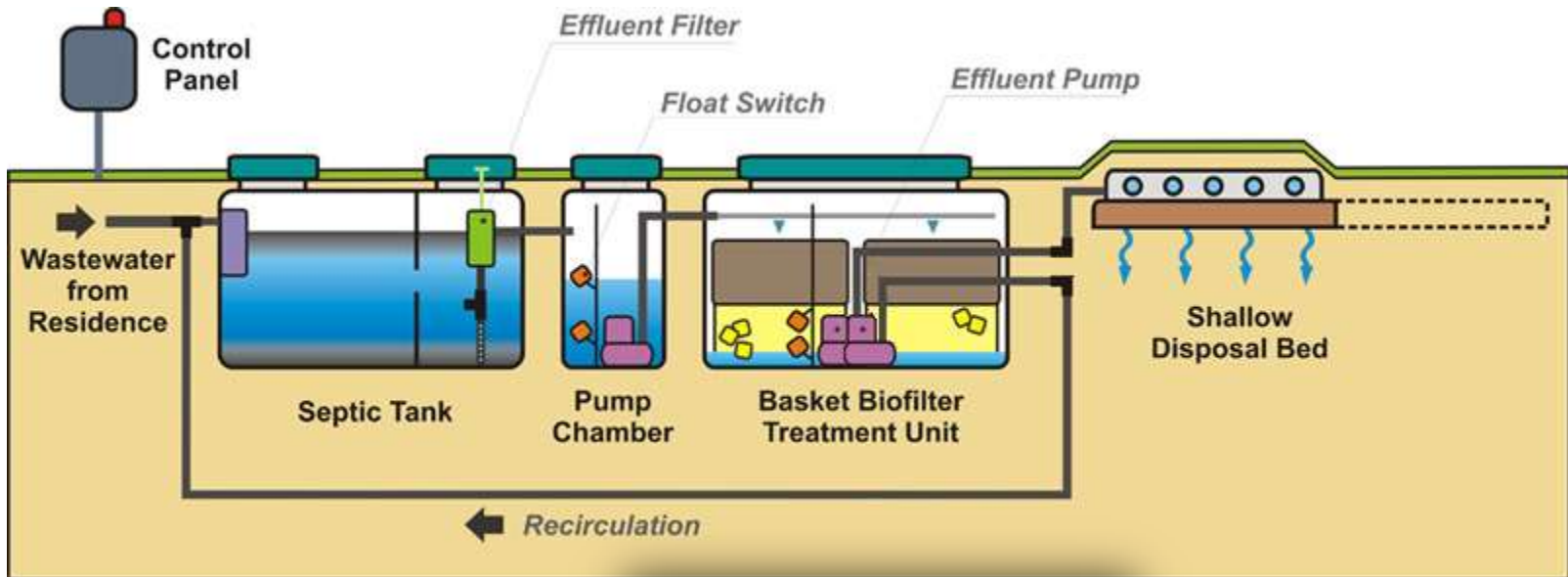
- Septic Demo (2 systems)
  - 6 month rolling average
    - ✓ 15.1 mg/L TN
    - ✓ 7.7 3 BOD
    - ✓ 12.9 TSS
  - 100% of samples averaged
    - 26.1 mg/L TN
    - 30.6 mg/L BOD
    - 37.3 mg/L TSS







# WATERLOO BIOFILTER





# WATERLOO BIOFILTER DEMO RESULTS

Site #	Sample Date	Calculate (Yes or No) (5)	TN(mg/l) (6)	TKN (mg/l)	Ammonia (as N)	NO3 (Nitrate as N)	NO2 (Nitrite as N)	BOD	TSS	PH	Temp	Alkalinity
SD #37	6/12/17-6/13/17	No	42.3	40.4	37.4	0.6	1.3	26	< 10	7.31	70.7	267
	8/14/17-8/15/17	Yes	23.9	17.5	22.8	5.7	0.7	14	< 10	7.04	79.88	223
	9/18/17-9/19/17	Yes	31.6	22.1	23	8.7	0.8	15	10	7.09	74.1	NR
	10/23/17-10/24/17	Yes	31.7	16.3	17.7	15.4	< 0.5	14	7	7.07	70.9	188
	11/27/17-11/28/17	Yes	38.6	29.5	22.8	8.6	0.5	18	9	6.96	59.5	203
	1/29/18-1/30/18	Yes	48.8	43.1	36.8	4.6	1.1	27	15	7.07	50.7	233
	3/12/18-3/13/18	Yes	43.2	39.4	28.1	3.2	0.6	35	20	7.01	46.6	264
	4/9/18-4/10/18	Yes	62.1	60.8	51.8	0.7	0.6	61	24.5	7.15	53.8	318
	5/7/2018-5/8/2018	Yes	59.7	58.7	52.5	1	< 0.5	33	10.8	7.15	65.7	305
	6/11/18-6/12/18	Yes	72.2	69.7	39.3	2.5	< 0.5	38	17.5	7.35	68.9	270
7/9/18-7/10/18	Yes	54.1	53	49.7	1.1	< 0.5	70	13.2	7.07	74.66	303	
SD #38	6/12/17-6/13/17	No	118.7	118	93.8	< 0.5	0.7	28	17	9.7	72.14	450
	7/17/17-7/18/17	No	82.5	79	83	3.5	< 0.5	19	14	7.33	80.42	450
	8/14/17-8/15/17	No	84.5	81	90.1	3.5	< 0.5	12	< 10	7.42	77.54	455
	9/18/17-9/19/17	No	74.9	62.4	12.5	11.4	1.1	7	6	7.43	75.2	376
	10/23/17-10/24/17	No	53.5	39.6	39.4	13.9	< 0.5	NR	NR	NR	70.2	NR
	11/27/17-11/28/17	No	68.3	48.9	36.5	19.4	< 0.5	5	< 5	7.22	58.6	258
	1/8/18-1/9/18	No	61.2	44.5	33.4	13.8	2.9	< 5	6	7.19	47.6	263
	2/26/18-2/27/18	No	47.7	40.4	36.5	6.5	0.8	17	7	7.25	51.8	33
	3/26/18-3/27/18	No	69.7	60.7	73.3	7.4	1.6	10	8	7.72	48.2	334
	4/23/18-4/24/18	No	113.9	101	92.2	12	0.9	10	5	7.53	54.1	349
	5/21/18-5/22/18	No	85.7	75.6	67.1	9.3	0.8	25	< 5	7.54	63.5	204
	6/25/18-6/26/18	No	96.1	78.6	65.8	15.9	1.6	20	10.4	7.5	72.68	348
	7/23/18-7/24/18	No	94.3	71.2	63	22.1	1	< 9	< 10	7.42	76.82	297
	5/21/18-5/22/18	No	85.7	75.6	67.1	9.3	0.8	25	< 5	7.54	63.5	204
	6/25/18-6/26/18	No	96.1	78.6	65.8	15.9	1.6	20	10.4	7.5	72.68	348
	7/23/18-7/24/18	No	94.3	71.2	63	22.1	1	< 9	< 10	7.42	76.82	297
	<b>AVERAGE</b>			<b>64.96667</b>	<b>56.30833333</b>	<b>48.6875</b>	<b>7.970833333</b>	<b>0.875</b>	<b>22.52173913</b>	<b>10.88695652</b>	<b>7.370435</b>	<b>58.98296</b>
<b>6-Month Average</b>			<b>74.35833</b>	<b>64.625</b>	<b>54.16666667</b>	<b>8.975</b>	<b>0.883333333</b>	<b>31</b>	<b>12.65</b>	<b>7.31</b>	<b>65.53</b>	<b>282.5833</b>



# WATERLOO BIOFILTER WITH DENITE DEMO RESULTS

Site #	Sample Date	Calculate (Yes or No) (5)	TN(mg/l) (6)	TKN (mg/l)	Ammonia (as N)	NO3 (Nitrate as N)	NO2 (Nitrite as N)	BOD	TSS	PH	Temp	Alkalinity
37	6/12/17-6/13/17	No	42.5	42.5	40.7	< 0.5	< 0.5	16	< 10	7.38	70.7	321
	7/17/17-7/18/17	Yes	23.9	23.9	23.4	< 0.5	< 0.5	28	< 10	7.28	78.44	340
	3/12/18-3/13/18	Yes	42.4	41.3	24.5	< 1	1.1	26	< 5	7.13	46.6	308
	4/9/18-4/10/18	Yes	60.9	59.8	55	1.1	< 0.5	43	< 13	7.2	53.8	359
	5/7/2018-5/8/2018	Yes	64	64	56.3	< 0.5	< 0.5	38	13.6	7.17	65.7	396
	6/11/18-6/12/18	Yes	61.1	61.1	43.1	< 0.5	< 0.5	27	< 10	7.47	68.9	356
	7/9/18-7/10/18	Yes	47.6	47.6	47.1	< 0.5	< 0.5	26	< 10	7.14	74.66	336
38	6/12/17-6/13/17	No	96.8	96.8	87.4	< 0.5	< 0.5	20	< 10	7.56	72.14	448
	7/17/17-7/18/17	No	73	73	73.3	< 0.5	< 0.5	20	18	7.34	80.42	459
	2/26/18-2/27/18	No	33.5	33.5	31.5	< 0.5	< 0.5	15	6	7.19	51.8	362
	3/26/18-3/27/18	No	56.1	56.1	61.3	< 0.5	< 0.5	6	< 5	7.67	48.2	334
	4/23/18-4/24/18	No	106	106	87.9	< 0.5	< 0.5	9	< 5	7.45	54.1	387
	5/21/18-5/22/18	No	75.4	75.4	64.9	< 0.5	< 0.5	11	28	7.31	63.5	400
	6/25/18-6/26/18	No	84.1	84.1	70.8	< 0.5	0.5	13	< 10	7.55	72.68	433
	7/23/18-7/24/18	No	78.7	78.7	72.9	< 0.5	< 0.5	10	< 10	NR	76.82	NR
<b>AVERAGE</b>			<b>63.06667</b>	<b>62.92</b>	<b>56.00666667</b>	<b>0.573333333</b>	<b>0.54</b>	<b>20.53333333</b>	<b>10.90666667</b>	<b>7.345714</b>	<b>65.23067</b>	<b>374.2143</b>
<b>6-Month Average</b>			<b>61.14167</b>	<b>60.95833333</b>	<b>53.225</b>	<b>0.591666667</b>	<b>0.55</b>	<b>21</b>	<b>10.46666667</b>	<b>7.323636</b>	<b>62.93333</b>	<b>364.6364</b>





# WATERLOO BIOFILTER— SUMMARY

## ➤ Without Denite Add-on(2 systems)

- 6 month rolling average
  - ✓ 74.3 mg/L TN
  - ✓ 31 BOD
  - ✓ 12.6 TSS
- 100 % Average
  - ✓ 64.9 mg/L TN
  - ✓ 22.5 BOD
  - ✓ 10.9 TSS

## ➤ With Denite Add-On

- 6 month rolling average
  - ✓ 61.1 mg/L TN
  - ✓ 21 BOD
  - ✓ 10.4 TSS
- 100 % Average
  - ✓ 63 mg/L TN
  - ✓ 20.5 BOD
  - ✓ 10.9 TSS



# PUGO SYSTEM





# PUGO DEMO RESULTS

Site #	Sample Date	State (1)(2)	Compare Sample (Yes or No) (4)	Calculate (Yes or No) (5)	TN(mg/l) (6)	TKN (mg/l)	Ammonia (as N)	NO3 (Nitrate as N)	NO2 (Nitrite as N)	BOD	TSS	PH	Temp	Alkalinity	
SDS#1	2/27/17-2/28/17	Jon-Steady	No	No	58.2	54.6	44.6	3.6	< 0.5	14	72	7.31	44.4	NR	
	3/27/17-3/28/17	Steady	Yes	Yes	23.3	5.2	2.2	14.4	-3.7	16	< 10	6.72	59	23.8	
	4/17/17-4/18/17	Steady	Yes	Yes	12	4.6	3	< 0.5	7.4	10	5.2	7.03	69.9	55.4	
	5/15/17-5/16/17	Steady	Yes	Yes	27.1	8.3	4.9	17.9	0.9	59	33.2	6.71	67.82	NR	
	6/19/17-6/20/17	Steady	Yes	Yes	22.5	6.1	3.7	16.4	< 0.5	18	17	6.99	73.76	32	
	7/24/17-7/25/17	Steady	Yes	Yes	20.8	19.8	21.8	1	< 0.5	31	21	7.61	77	NR	
	8/21/17-8/22/17	Steady	Yes	Yes	24.4	24.4	20.5	< 0.5	< 0.6	53	23	7.44	82.4	NR	
	9/25/17-9/26/17	Steady	Yes	Yes	24.7	24.7	22.6	< 0.5	< 0.5	64	33	7.24	79.3	76	
	10/30/17-10/31/17	Steady	Yes	Yes	30.4	28.6	31.3	1.8	< 0.5	29	13	7.69	72	188	
	12/4/17-12/5/17	Steady	Yes	Yes	31	31	31.3	< 0.5	< 0.5	24	26	7.47	64	195	
	1/8/18-1/9/18	Steady	Yes	Yes	45.6	45.6	38.1	< 0.5	< 0.5	37	23	7.34	55.4	232	
	2/26/18-2/27/18	Steady	Yes	Yes	36.3	36.3	28.7	< 0.5	< 0.5	45	21	7.48	63.7	197	
	3/26/18-3/27/18	Steady	Yes	Yes	23.5	23.5	22.9	< 0.5	< 0.5	< 6	21.2	7.51	61	170	
	4/23/18-4/24/18	Steady	Yes	Yes	36.4	34.6	30.8	1.8	< 0.5	47	26	7.42	63.1	128	
	5/21/18-5/22/18	Steady	Yes	Yes	45.8	25.3	18.7	19.9	0.6	67	48	7.25	70.34	60	
	7/23/18-7/24/18	Steady	Yes	Yes	23.9	6.9	4.5	17	< 0.5	16	25.2	6.97	79.7	21.1	
	8/20/18-8/21/18	Steady	Yes	Yes	17.9	1.9	1.6	16	< 0.5	67	43	6.64	24.8	49	
	9/24/18-9/25/18	Steady	Yes	Yes	21.9	4.7	3.5	17.2	< 0.5	14	4.4	NR	23.7	NR	
	10/15/18-10/16/18	Steady	Yes	Yes	21.2	2	4.2	19.2	< 0.5	NR	NR	NR	21.3	NR	
	11/19/18-11/20/18	Steady	Yes	Yes	17.4	2.5	1.2	14.9	< 0.5	21	36	6.55	15	27.6	
12/10/18-12/11/18	Steady	Yes	Yes	45.7	11.4	16.3	34.3	< 0.5	29	21.5	3.84	14.2	NR		
1/28/19-1/29/19	Steady	Yes	Yes	30.1	5.4	4.1	< 0.5	24.7	17	18		11.4			
SDS#20	4/10/17-4/11/17	Jon-Steady	Yes	No	70.7	69.8	72.5	0.9	< 0.5		< 10	8.12	58.6	NR	
	5/8/17-5/9/2017	Steady	Yes	Yes	22	< 1	< 0.5	< 0.5	22	12	< 10	7.21	62.42	51.5	
	6/12/17-6/13/17	Steady	Yes	Yes	33.2	< 1	< 1	32.2	1	15	< 10	7.16	70.34	NR	
	7/17/17-7/18/17	Steady	Yes	Yes	17.5	1.9	< 1	15.6	< 0.5	7	< 10	7.53	73.76	93.4	
	8/21/17-8/22/17	Steady	Yes	Yes	24.1	2.8	0.5	20.1	1.2	14	6	7.29	77.9	NR	
	9/25/17-9/26/17	Steady	Yes	Yes	31.2	6.6	2.1	23.4	1.2	36	37	7.32	76.3	150	
	10/30/17-10/31/17	Steady	Yes	Yes	20.9	< 1	1.1	20.9	< 0.5	18	21	7.16	67.1	48	
	11/27/17-11/28/17	Steady	Yes	Yes	NR	NR	27.1	20.1	< 0.5	20	9	6.65	60.6	NR	
	1/8/18-1/9/18	Steady	Yes	Yes	60.2	25.6	31.1	34.6	< 0.5	16	12	7.19	48.2	106	
	2/26/18-2/27/18	Steady	Yes	Yes	44.5	21.6	16.7	22.9	< 0.5	26	15	7.1	55.6	60	
	3/26/18-3/27/18	Steady	Yes	Yes	59.9	28.8	30	30.6	0.5	13	< 10	7.4	51.8	104.4	
	4/23/18-4/24/18	Steady	Yes	Yes	80.5	39.3	35.6	41.2	< 0.5	< 6	5	7.14	54.1	88	
	5/21/18-5/22/18	Steady	Yes	Yes	56.4	20.8	13.4	35.6	< 0.5	< 6	7	7.29	63.5	85	
	7/23/18-7/24/18	Steady	Yes	Yes	18	14	7.1	4	< 0.5	129	27.5	7.43	73.4	177	
	8/20/18-8/21/18	Steady	Yes	Yes	16.3	3.9	1.4	12.4	< 0.5	16	71.6	7.31	24.3	123	
	9/24/18-9/25/18	Steady	Yes	Yes	21.4	2.5	2.6	18.9	< 0.5	9	< 10	NR	25.6	NR	
	10/15/18-10/16/18	Steady	Yes	Yes	20.4	3.8	3.8	17.8	0.8	38	31	7.33	20.3	109	
	11/19/18-11/20/18	Steady	Yes	Yes	30.8	3.3	5.6	27.5	< 0.6	15	< 12.5	6.92	14.1	54	
	12/10/18-12/11/18	Steady	Yes	Yes	68.6	40	19.2	28.6	0.8	33	20	5.66	11.1	NR	
	1/7/19-1/8/19	Steady	Yes	Yes	21.1	8.6	5	11.8	0.7	21	< 25	7.25	10.4	7.25	
SDS#5	4/10/17-4/11/17	Jon-Steady	Yes	No	37.7	32.9	30.1	< 0.5	4.8		< 10	7.97	64	NR	
	5/8/17-5/9/17	Steady	Yes	Yes	9.3	< 1	0.5	3.8	5.5	< 7	16	7.15	68.36	NR	
	6/12/17-6/13/17	Steady	Yes	Yes	15.3	1.1	< 1	14.2	< 0.5	< 5	< 10	NR	77.54	NR	
	7/17/17-7/18/17	Steady	Yes	Yes	41.7	18	15.9	23.7	< 0.5	18	79	6.71	79.88	33	
	9/18/17-9/19/17	Steady	Yes	Yes	22.7	20.2	15.8	2.5	< 0.5	45	75	7.07	77.7	36.4	
	10/23/17-10/24/17	Steady	Yes	Yes	37.1	16.1	0.6	21	< 0.5	9	23	6.64	70.5	NR	
	11/27/17-11/28/17	Steady	Yes	Yes	NR	NR	5.6	20.8	< 0.5	14	9	6.46	95.9	NR	
	1/8/18-1/9/18	Steady	Yes	Yes	47.2	26.1	16	21.1	< 0.5	31	33	6.38	52	20	
	2/26/18-2/27/18	Steady	Yes	Yes	20.2	6.9	3.1	13.3	< 0.5	22	26	6.58	62.8	20	
	3/26/18-3/27/18	Steady	Yes	Yes	41	21	9.2	20	< 0.5	< 6	< 10	NR	57.4	NR	
	4/23/18-4/24/18	Steady	Yes	Yes	38	20.2	14.9	17.8	< 0.5	19	43	6.63	63.1	19	
	5/21/18-5/22/18	Steady	Yes	Yes	48.8	37.8	32.8	11	< 0.5	37	23	7.57	67.3	138	
	7/23/18-7/24/18	Steady	Yes	Yes	26.6	23.3	7.6	3.3	< 0.5	35	234	7.07	80.96	60.2	
	8/20/18-8/21/18	Steady	Yes	Yes	13.8	10.3	2.2	3.5	< 0.5	41	40	6.92	26.9	35	
	9/24/18-9/25/18	Steady	Yes	Yes	11.2	5.8	1.8	5.4	< 0.5	26	38.4	NR	24.2	NR	
	10/15/18-10/16/18	Steady	Yes	Yes	10.2	5.8	2.6	4.4	< 0.5	16	21	6.97	22.2	42	
	11/26/18-11/27/18	Steady	Yes	Yes	12.6	6.9	2	0.8	4.9	11	16.5	6.87	14.6	NR	
	12/17/18-12/18/18	Steady	Yes	Yes	16.8	1	2	15.8	< 0.5	14	17.5	4.12	14.2	NR	
	SDS#29	5/1/17-5/2/17	Jon-Steady	Yes	No	10.2	7.2	2.6	< 0.5	3	27	15	7.14		120
		6/5/17-6/6/17	Jon-Steady	Yes	No	39	39	34.5	< 0.5	< 0.5	20	17	7.29	65.12	245
7/10/17-7/11/17		Jon-Steady	Yes	No	47.2	46.1	38.8	< 0.5	1.1	86	22	7.32	74.66	285.6	
8/7/17-8/8/17		Jon-Steady	Yes	No	81	81	74.7	< 0.5	< 0.5	70	12	7.45	74.66	376	
9/11/17-9/12/17		Jon-Steady	Yes	No	53.8	53.8	50.9	< 0.5	< 0.5	30	27	7.41	72.9	267	
10/16/17-10/17/17		Steady	Yes	Yes	19.8	< 0.5	< 0.5	19.8	< 0.5	< 5	< 5	6.64	70.3	15	
11/20/17-11/21/17		Steady	Yes	Yes	2.9	2.9	< 0.5	< 0.5	< 0.5	< 5	< 10	6.5	59.9	11	
2/5/18-2/6/18		Steady	Yes	Yes	25.9	2.2	2	23.7	< 0.5	< 5	< 5	6.26	47.7	11	
3/19/18-3/20/18		Steady	Yes	Yes	27.1	4.6	1.8	22.5	< 0.5	10	76	6.4	49.6	NR	
4/16/18-4/17/18		Steady	Yes	Yes	26.5	4.1	2	22.4	< 0.5	< 6	< 10	6.39	55	15	
5/14/15-5/15/18		Steady	Yes	Yes	11.3	4.6	< 1	6.7	< 0.5	11	< 10	6.94	62.1	41	
6/18/18-6/19/18		Steady	Yes	Yes	24.2	3	2.1	21.2	< 0.5	< 5	< 10	6.49	68	22	
7/16/18-7/17/18		Steady	Yes	Yes	11.9	6.4	< 0.8	5.5	< 0.5	10	16.8	7.05	73.4	NR	
8/13/18-8/14/18		Steady	Yes	Yes	10.3	7.6	2	2.7	< 0.5	< 9	16.5	6.97	25.4	79.6	
AVERAGE					30.54306	16.95972	13.71757	12.8027	1.527027	25.19718	25.71233	6.97	53.84216	93.94388	
75 % 6-month AVG					19.97826	6.808695652	3.304347826	12.89130435	0.708695652	19.45454545	34.55454545	6.305789	30.74609	47.475	



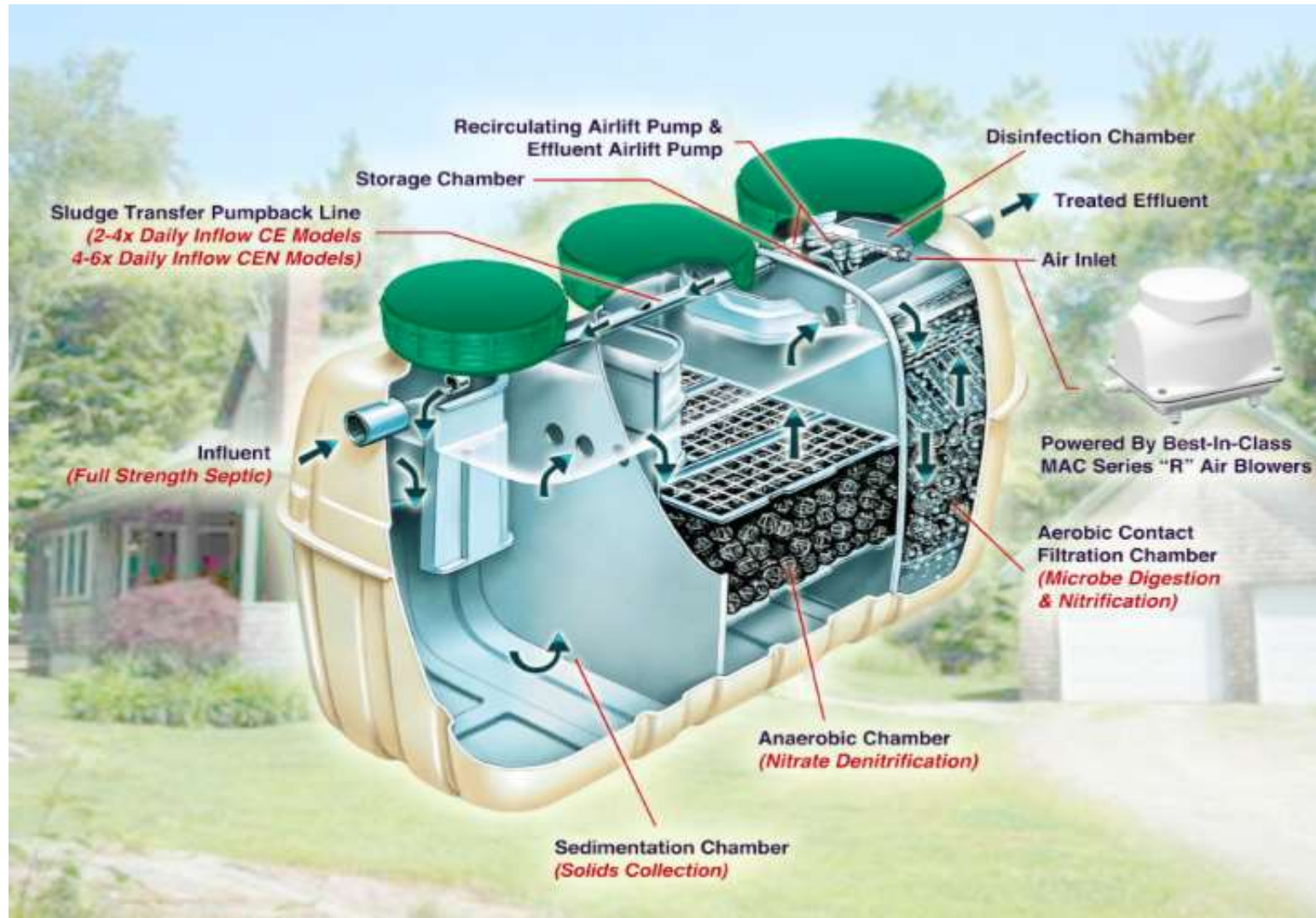
## PUGO SYSTEM— SUMMARY

- Septic Demo (4 systems)
  - 6 month rolling average of 3 systems
    - ✓ 19.9 mg/L TN
    - ✓ 19.5 BOD
    - ✓ 34.5 TSS
  - 100% of samples averaged
    - 30.5 mg/L TN
    - 25.2 mg/L BOD
    - 25.7 mg/L TSS





# FUJI CEN SERIES







# FUJI CEN SERIES

Site #	Sample Date	Calculate (Yes or No) (5)	TN(mg/l) (6)	TKN (mg/l)	Ammonia (as N)	NO3 (Nitrate as N)	NO2 (Nitrite as N)	BOD	TSS	PH	Temp	Alkalinity
SDS #30	4/24/17-4/25/17	No	85.7	85.7	92.9	< 0.5	< 0.5	28	16	8.05	62.78	380
	5/22/17-5/23/17	No	72.8	72.8	68.2	< 0.5	< 0.5	119	24	7.49	65.5	338
	6/26/17-6/27/17	Yes	22.4	22.4	22.1	< 0.5	< 0.5	< 5	< 10	7.4	71.6	167
	7/31/17-8/1/17	Yes	9.9	1.8	< 0.5	7.3	0.8	10	18.5	7.25	78.98	98
	8/28/17-8/29/17	Yes	71.4	70.5	68.7	< 0.5	0.9	24	27	?318?	76.8	N/R
	10/2/17-10/3/17	Yes	27.6	27.6	25.4	< 0.5	< 0.5	47	22	7.67	69.1	183
	11/13/17-11/14/17	Yes	16.6	5.8	<0.5	10.8	< 0.5	< 5	< 10	7.41	59.9	86
	12/11/17-12/12/17	Yes	10.7	1.2	< 0.5	8.9	0.6	< 5	< 5	7.24	52.9	74
SDS #31	4/24/17-4/25/17	No	117	117	123	< 0.5	< 0.5	45	60	8.1		503.6
	5/22/17-5/23/17	No	74.9	70.2	65.6	< 0.5	4.7	103	56	7.67	65.5	319
	6/26/17-6/27/17	Yes	25.6	24.8	23.9	< 0.5	0.8	54	42	7.56	75.2	197
	7/31/17-8/1/17	Yes	4.3	1.4	1	2.1	0.8	< 5	< 10	7.48	78.26	138
	8/28/17-8/29/17	Yes	8.7	3.8	< 0.5	1.6	3.3	11	8	7.49	73.9	96
	10/2/17-10/3/17	Yes	5.8	4.5	< 0.5	1.3	< 0.5	13	12.5	7.66	69.4	122
	11/13/17-11/14/17	Yes	8.5	0.9	< 0.5	7.6	< 0.5	6	< 10	7.5	55.9	83
	12/11/17-12/12/17	Yes	19.9	19.2	18.5	< 0.5	0.7	16	< 5	7.66	52.5	167.4
SDS #32	4/24/17-4/25/17	No	58.2	58.2	58.1	< 0.5	< 0.5	44	38	7.64		75
	5/22/17-5/23/17	No	45.3	41.5	42.7	2.7	1.1	15	12	7.71	65.5	209
	6/26/17-6/27/17	Yes	27.7	26.7	17.5	< 0.5	1	23	12	7.49	73.4	159
	7/31/17-8/1/17	Yes	4.1	1.9	< 0.5	< 0.5	2.2	9	12.5	7.77	77.36	229
	8/28/17-8/29/17	Yes	17.1	13.8	4.3	< 0.5	3.3	77	52	6.96	74.7	99
	10/2/17-10/3/17	Yes	11.6	6.3	< 0.5	4.8	0.5	21	10	7.63	72.1	80
	11/13/17-11/14/17	Yes	4.1	2.9	< 0.5	1.2	< 0.5	19	14	8.17	53.8	NR
	12/11/17-12/12/17	Yes	3.2	1.4	< 0.5	1.8	< 0.5	6	< 5	7.46	52	160
SD #36	7/10/17-7/11/17	No	23.8	2.1	< 0.5	21.7	< 0.5	6	< 10	7.63	76.28	88
	8/7/17-8/8/17	No	33	1.1	1.5	31	0.9	21	44	7.12	72.14	53
	9/11/17-9/12/17	No	4.7	3.1	< 0.5	1.6	< 0.5	< 5	< 5	7.48	66.9	54
	10/16/17-10/17/17	No	23.4	< 0.5	< 0.5	23.4	< 0.5	< 5	< 5	6.56	65.7	14.4
	11/20/17-11/21/17	No	17.7	2.2	< 0.5	15.5	< 0.5	< 5	< 10	7.01	56.1	28
	12/18/17-12/19/17	No	29.9	1.3	< 0.5	28.6	< 0.5	21	65	6.4	50.2	NR
	1/23/18-1/30/18	No	30.2	1.6	0.5	28.6	< 0.5	18	< 10	6.07	42.1	50
	3/12/18-3/13/18	No	25.3	1.3	< 0.5	24	< 0.5	< 6	< 5	7.02	45.3	21
			<b>STEADY STATE AVG</b>	<b>17.93333</b>	<b>10.2875</b>	<b>8.213043478</b>	<b>7.2125</b>	<b>0.891666667</b>	<b>17.33333333</b>	<b>16.0625</b>	<b>7.31913</b>	<b>64.3375</b>
		<b>75% 6-month Avg</b>	<b>16.62222</b>	<b>13.16111111</b>	<b>10.93529412</b>	<b>2.855555556</b>	<b>1.022222222</b>	<b>19.77777778</b>	<b>15.86111111</b>	<b>7.517647</b>	<b>67.65556</b>	<b>133.65</b>



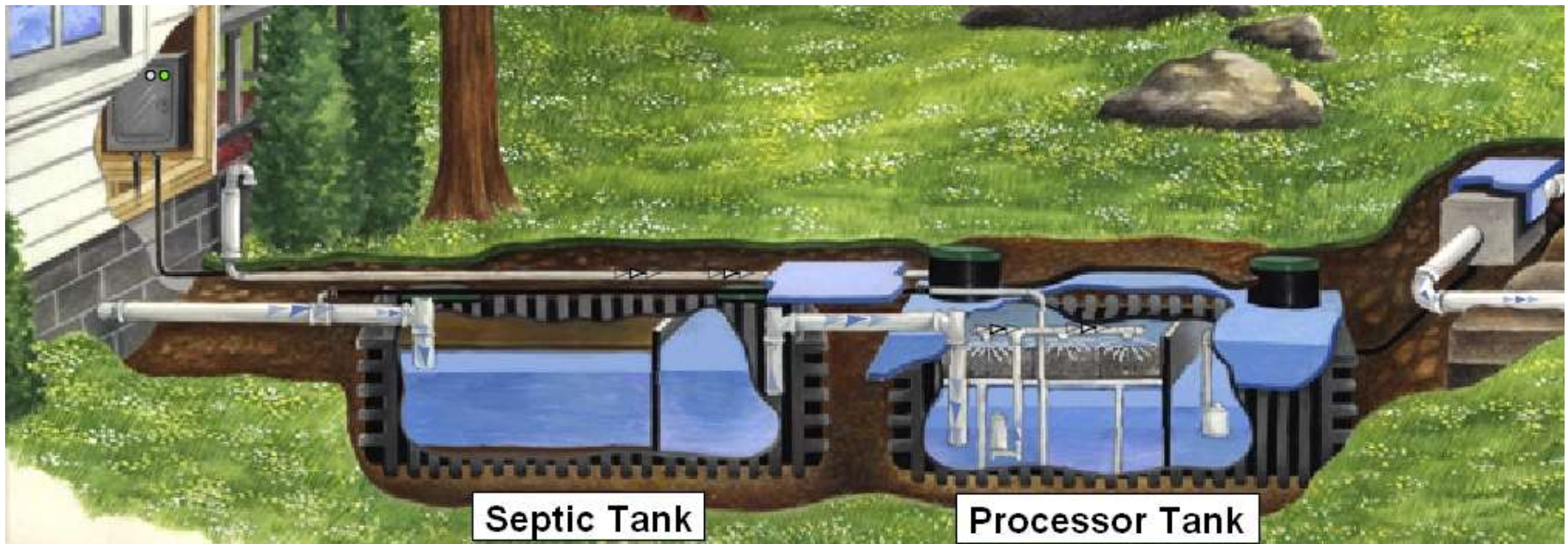
## FUJI CEN SUMMARY

- Septic Demo (4 systems)
  - 6 month rolling average of 3 systems
    - ✓ 16.6 mg/L TN
    - ✓ 19.7 BOD
    - ✓ 15.8 TSS
  - 100% of samples averaged
    - ✓ 17.9 mg/L TN
    - ✓ 17.3 mg/L BOD
    - ✓ 16 mg/L TSS
- Provisional Long Term Sampling (13 systems, 46 samples)
  - ✓ 9.3 mg/L TN
  - ✓ 7.6 mg/L BOD
  - ✓ 7.2 mg/L TSS





# SEPTITECH STAAR







# SEPTITECH STAAR

Site #	Sample Date	Calculate (Yes or No) (5)	TN(mg/l) (6)	TKN (mg/l)	Ammonia (as N)	NO3 (Nitrate as N)	NO2 (Nitrite as N)	BOD	TSS	PH	Temp	Alkalinity
SD #41	12/4/17-12/5/17	No	9.4	< 0.5	< 0.5	9.4	< 0.5	8	5	7.02	57.6	NR
	1/22/18-1/23/18	Yes	15.7	8.6	1	7.1	< 0.5	31	25	6.21	52.3	50
	3/5/18-3/6/18	Yes	9.1	3.1	4.2	6	< 0.5	76	45	6.76	51.1	52
	4/2/18-4/3/18	Yes	17.2	11.5	2.2	5.7	< 0.5	62	77	6.44	47.8	42
	4/30/18-5/1/18	Yes	8.9	6.4	2.8	2.5	< 0.5	35	21	6.97	57.2	52
	6/4/18-6/5/18	Yes	6	2.2	1.3	3.8	< 0.5	8	< 10	7.04	65.66	40
	7/2/18-7/3/18	Yes	12.2	2.1	< 0.5	10.1	< 0.5	< 5	< 10	6.61	75.74	NR
SD #42	12/18/17-12/19/17	No	53.1	47	46.4	< 0.5	6.1	NR	11	1.86	58.3	NR
	1/29/18-1/30/18	Yes	10.1	7.2	3	< 0.5	2.9	23	< 10	7.21	52.5	75
	3/12/18-3/13/18	Yes	13.3	0.6	0.5	9	3.7	14	< 5	6.95	54.3	32
	4/9/18-4/10/18	Yes	22.1	6.6	2.4	15.5	< 0.5	12	< 10	6.77	57.7	31
	5/7/18-5/8/18	Yes	12.5	7.6	3.3	4.9	< 0.5	42	20	7.07	67.5	47
	6/11/18-6/12/18	Yes	14.4	6.5	2.6	7.1	0.8	9	< 10	7.1	75.2	46
	7/9/18-7/10/18	Yes	21.4	9.4	6.5	12	< 0.5	8	< 10	7.1		53
<b>Steady State AVG</b>			<b>13.575</b>	<b>5.983333333</b>	<b>2.525</b>	<b>7.016666667</b>	<b>0.991666667</b>	<b>27.08333333</b>	<b>21.08333333</b>	<b>6.8525</b>	<b>59.727</b>	<b>47.27273</b>



# SEPTITECH STAAR

## ➤ Septic Demo (2 systems)

- 100% of samples averaged
  - ✓ 13.6 mg/L TN
  - ✓ 27.1 mg/L BOD
  - ✓ 21.1 mg/L TSS

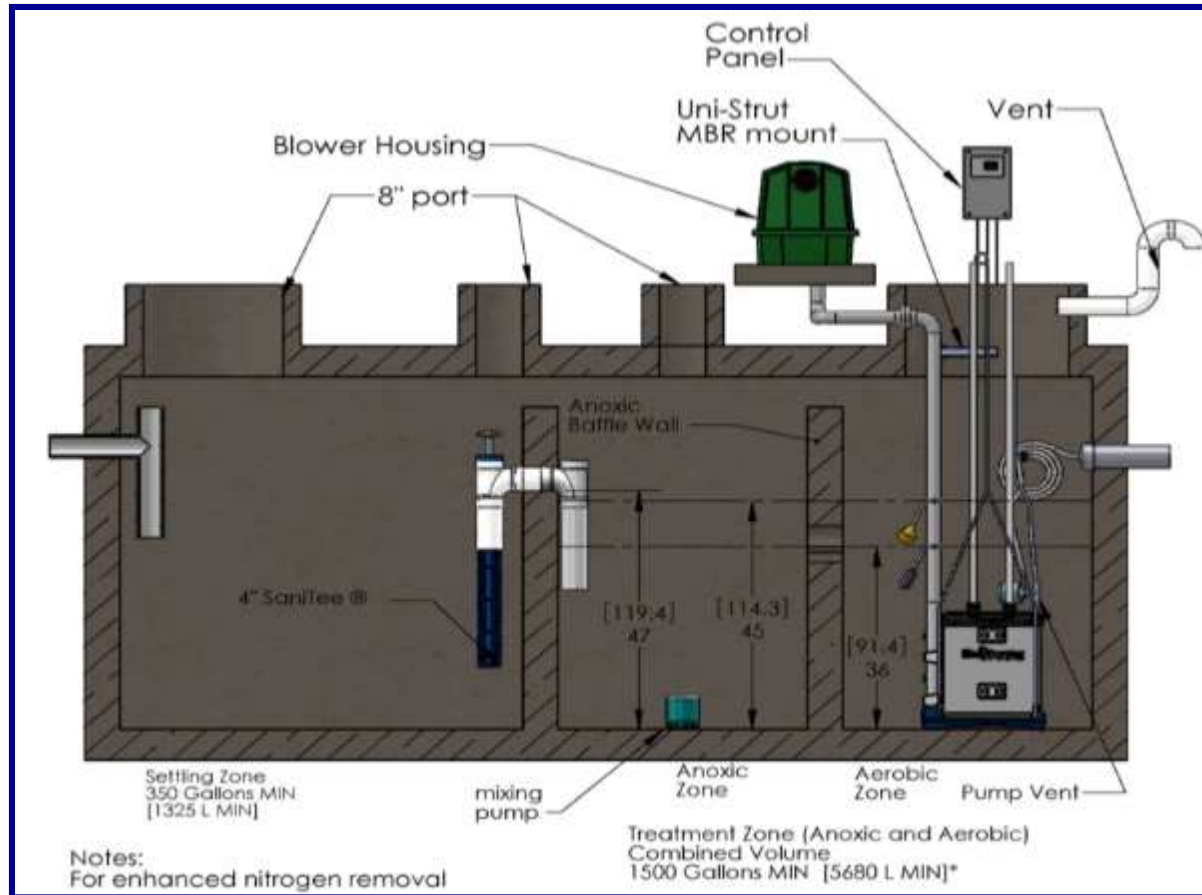
## ➤ Provisional Long Term Sampling (2 systems, 4 samples)

- ✓ 17.5 mg/L TN
- ✓ 5.7 mg/L BOD
- ✓ 13.9 mg/L TSS





# BIO MICROBICS BIO BARRIER





# BIO MICROBICS BIO BARRIER

Site #	Sample Date	Calculate (Yes or No) (5)	TN(mg/l) (6)	TKN (mg/l)	Ammonia (as N)	NO3 (Nitrate as N)	NO2 (Nitrite as N)	BOD	TSS	PH	Temp	Alkalinity
SD #39	7/24/17-7/25/17	No	63.9	5.8	19.2	58.1	< 0.5	33	8	6.83	75.2	NR
	8/21/17-8/22/17	No	61	14.5	14.5	44.9	1.6	33	< 0.5	6.08	79.16	NR
	10/4/17-10/5/17	No	69.8	18	18.8	51.8	< 0.5	NA	NA	NA	70.2	NA
	10/30/17-10/31/17	Yes	N/A	NR	20.9	47.9	< 0.5	< 6	< 10	6.42	65.1	NR
	12/4/17-12/5/17	Yes	60.6	29.3	29.5	31.3	< 0.5	< 5	< 3	7.43	48.6	112
	1/8/18-1/9/18	Yes	64.9	14.4	17.5	50.5	< 0.5	< 5	< 5	6.07	44.8	NR
	2/26/18-2/27/18	Yes	73.4	26.7	22.3	46.7	< 0.5	< 5	< 10	5.3	45.7	NR
	3/26/18-3/27/18	Yes	77.1	17.1	26.9	60	< 0.5	< 4	< 5	4.43	47.7	NR
	4/23/18-4/24/18	Yes	56.2	12.7	11.1	43.5	< 0.5	< 5	< 5	5.02	51.8	NR
	5/21/18-5/22/18	Yes	100.2	44.8	18.3	55.4	< 0.5	< 6	< 5	6.01	63.86	NR
	6/25/18-6/26/18	Yes	25	< 0.5	< 0.5	25	< 0.5	< 5	< 10	7.03	69.26	19.4
	7/23/18-7/24/18	Yes	42.4	4.4	4.2	38	< 0.5	< 5	< 10	5.44	76.82	NR
	8/20/18-8/21/18	Yes	42.4	1.2	1.3	41.2	< 0.5	< 6	< 10	5.62	23.3	NR
SD #40	7/17/17-7/18/17	Yes	22.74	3.74	4.1	1	18	< 5	< 10	6.92	78.8	32
	8/14/17-8/15/17	Yes	36.2	9.1	10.2	20.9	6.2	< 5	< 10	6.88	76.64	18
	9/18/17-9/19/17	Yes	33.7	9.1	8.9	24.6	< 0.5	< 5	< 10	5.32	73.8	NR
	10/23/17-10/24/17	No	N/A	NR	3.5	20.9	< 0.5	< 5	< 10	6.28	69.1	6.28
	1/29/18-1/30/18	Yes	51.8	27.4	17.6	18.5	5.9	56	< 20	7.07	50.5	50
	3/12/18-3/13/18	Yes	31.4	6.6	10.4	23.8	1	8	< 5	4.75	42.1	NR
	4/9/18-4/10/18	Yes	24.6	1.6	< 0.5	23	< 0.5	< 5	< 10	6.24	43.3	NR
	5/7/18-5/8/18	Yes	25.5	2.6	< 0.5	22.9	< 0.5	< 5	< 10	6.04	59	NR
	6/11/18-6/12/18	Yes	33.8	4.6	3.6	29.2	< 0.5	< 5	< 10	4.05	64.58	NR
	7/9/18-7/10/18	Yes	21	1	< 0.5	20	< 0.5	< 5	< 10	6.08	75.02	NR
	8/6/18-8/7/18	Yes	88.7	27.9	25.7	60.8	< 0.5	< 5	< 10	4.61	27.2	NR
	9/10/18-9/11/18	Yes	69.5	18.8	11.4	50.7	< 0.5	< 6	< 10	4.51	22.6	NR
	1/7/19-1/8/19	Yes	16.1	2.1	< 1	14	< 0.5	< 4	< 18.75	7.12	7.5	NR
	9/10/18-9/11/18	Yes	69.5	18.8	11.4	50.7	< 0.5	< 6	< 10	4.51	22.6	NR
	1/7/19-1/8/19	Yes	16.1	2.1	< 1	14	< 0.5	< 4	< 18.75	7.12	7.5	NR
<b>AVERAGE</b>			<b>49.13615</b>	<b>12.49384615</b>	<b>11.26071429</b>	<b>35.33214286</b>	<b>1.578571429</b>	<b>9.148148148</b>	<b>9.407407407</b>	<b>5.895556</b>	<b>52.91929</b>	<b>39.61333</b>
<b>6-Month AVG</b>			<b>52.01667</b>	<b>12.61666667</b>	<b>9.441666667</b>	<b>39.44166667</b>	<b>0.5</b>	<b>5.083333333</b>	<b>10.20833333</b>	<b>5.625</b>	<b>41.26333</b>	<b>19.4</b>





# BIOMICROBICS BIOBARRIER

- Septic Demo (2 systems)
  - 6 month rolling average
    - ✓ 52 mg/L TN
    - ✓ 5.1 BOD
    - ✓ 10.2 TSS
  
  - 100% of samples averaged
    - ✓ 49.1 mg/L TN
    - ✓ 9.1 mg/L BOD
    - ✓ 9.4 mg/L TSS

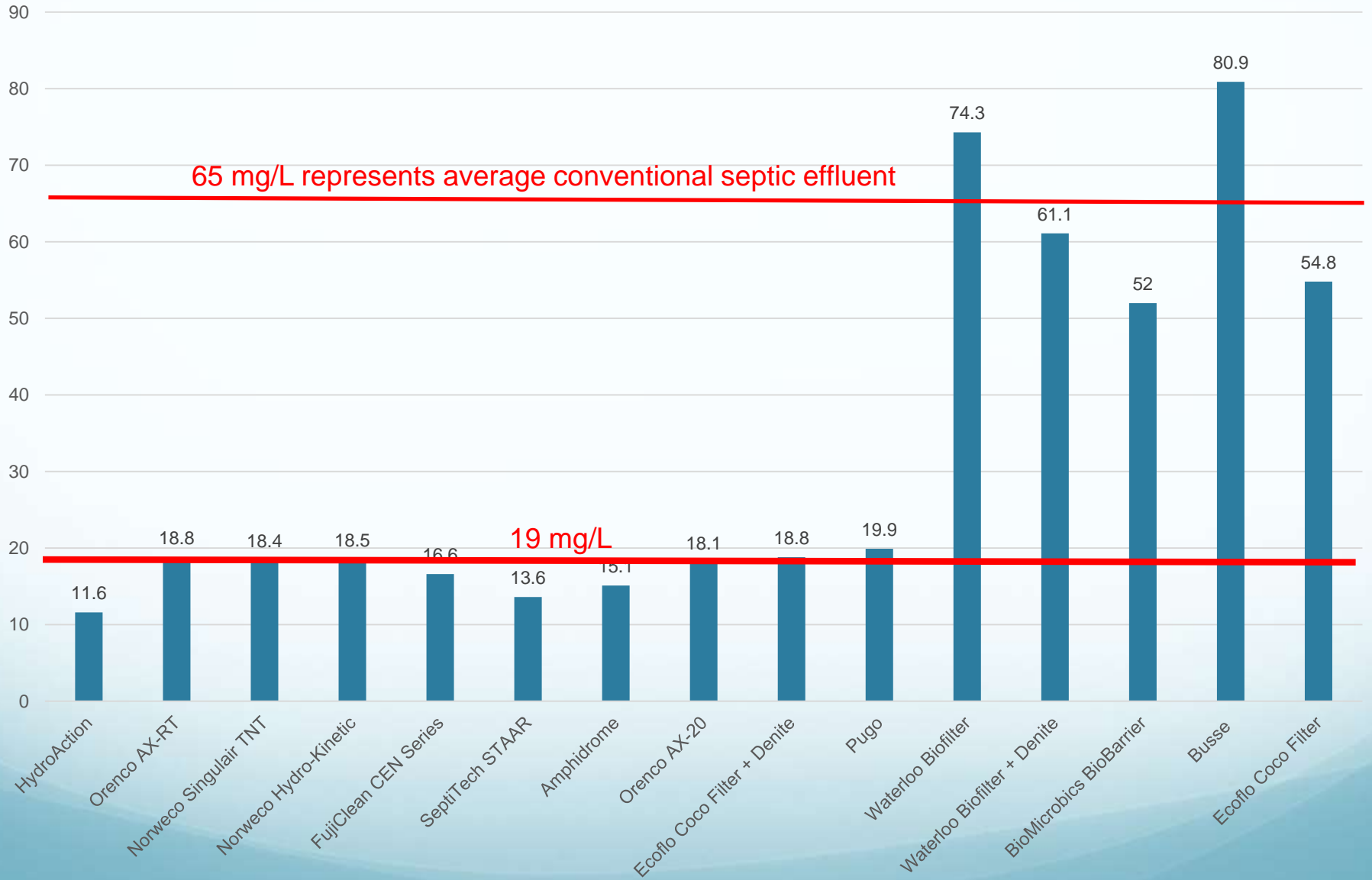


# Performance Summary of I/A OWTS Demonstrated in Suffolk County and Approved for Provisional Use

Technology	AVG (mg/L)*	Provisional Approval
Hydro-Action AN Series	11.6 mg/L	Approved in September 2016
Norweco – Singulair TNT	18.3 mg/L	Approved in October 2016
Orenco Advantex – RT	18.8 mg/L	Approved in March 2017
Norweco – Hydro-Kinetic	17.4 mg/L	Approved in April 2017
Fuji Clean System	16.6 mg/L	Approved in January 2018
SeptiTech STAAR	13.6 mg/L	Approved in July 2018
Amphidrome	15.1 mg/L	To be Approved in April 2019
Orenco AX Series	18.1 mg/L	To be Approved in April 2019
Ecoflo Coco Filter +	18.8 mg/L	To be Approved in April 2019

\*Standard is 19mg/L

# Suffolk County's I/A OWTS Demonstration Sampling Results 3/24/19





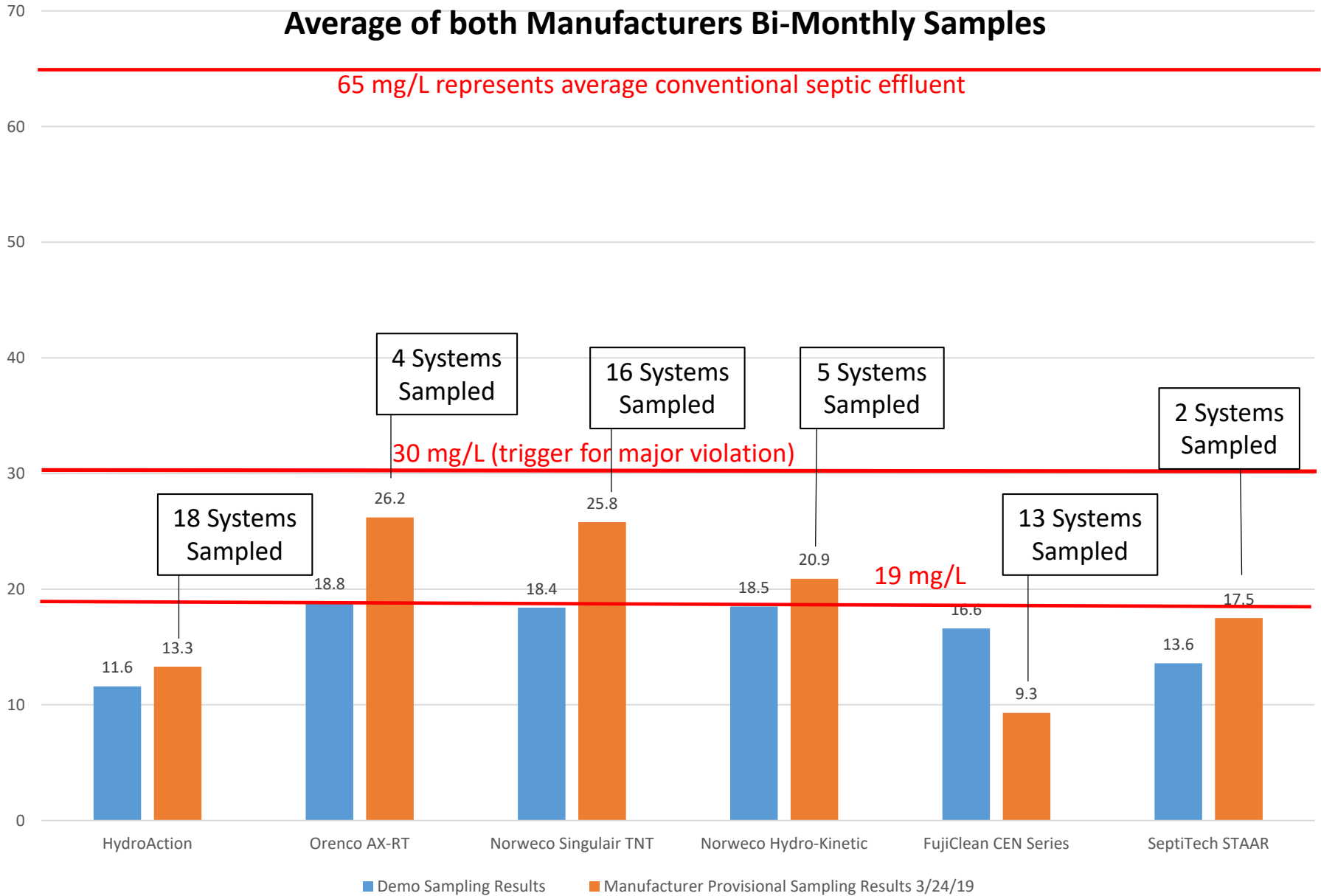
# Provisional Sampling Data as of 3/24/2019

## Average of both Manufacturers Bi-Monthly Samples

65 mg/L represents average conventional septic effluent

30 mg/L (trigger for major violation)

19 mg/L



**Cumulative Average of 18.7 mg/L for all samples combined**



# DENITRIFICATION POLISHING UNITS

## ➤ Provide additional TN removal after I/A OWTS

- Examples:

- ✓ Sulfur/Limestone Chamber
  - EcoFlow Denite Unit
- ✓ Wood Chips
  - Nitrex Unit
  - CCWT Box Unit Denite Tank



## ➤ Revision to Standards

- Provide Minimum Specifications
  - ✓ Performance Requirements (Reduction %)
  - ✓ Loading to the units
    - TSS and BOD
  - ✓ Construction Requirements
    - Access, materials, setbacks, etc.

## ➤ Draft Updates to Standard Scheduled to be completed Late Fall 2018





# PERFORMANCE OF DENITE POLISHING UNITS

Manufacturer	Site ID #	% Nitrate Removal
Ecoflow	#8	84.4 %
Ecoflow	#9	93.7%
Waterloo	# 37	88.6%
Waterloo	#38	94.5%







# NITROGEN REDUCING BIOFILTER PERFORMANCE

Data

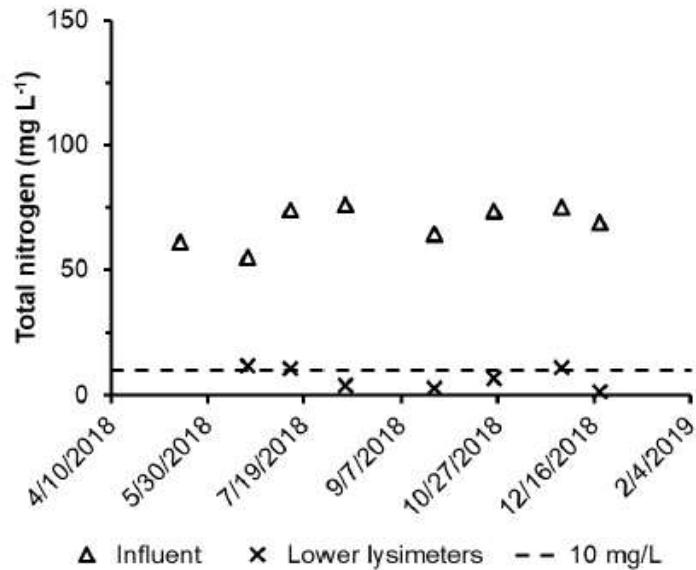


Figure 1: Total nitrogen concentrations measured in the septic tank and lower lysimeters at 59 River Rd.

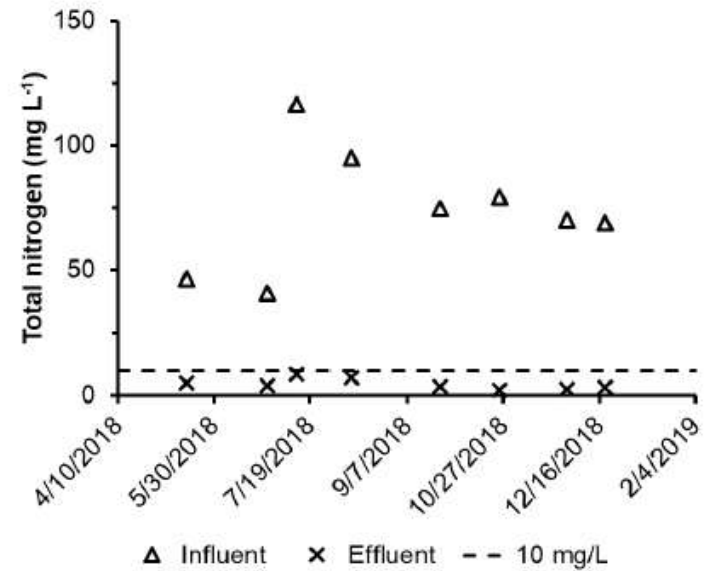
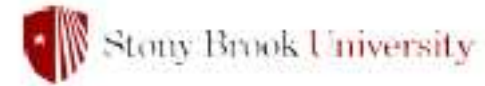


Figure 2: Total nitrogen concentrations measured in the septic tank and effluent at 9 Private Rd.



# EMERGING CONTAMINANTS



Initial recommendations:

- Continue to monitor performance (SBU CCWT, SCDHS)
- Identify recalcitrant compounds
- Evaluate alternate designs to enhance removal (SBU CCWT)
- Follow up study through CCWT, LINAP, or other initiative

	LINED NRB Influent (ng/L)	LINED NRB Effluent (ng/L)	Removal LINED NRB (%)	WOODCHIP BOX Influent (ng/L)	WOODCHIP BOX Effluent (ng/L)	Removal WOODCHIP BOX (%)	UNLINED Influent (ng/L)	UNLINED Effluent (ng/L)	Removal UNLINED NRB (%)
Acetaminophen	98,000	<MDL (61)	>99	67,000 ± 6,000	<MDL (64)	>99	99,000	<MDL (55)	>99
Atenolol	480	19	96	480 ± 10	45 ± 0.8	90	450	<MDL (17)	96
Caffeine	40,000	<MDL (56)	>99	36,000 ± 2,000	<MDL (58)	>99	40,000	<MDL (50)	>99
Cotinine	1,800	<MDL (39)	98	1,800 ± 70	<MDL (40)	98	1,700	<MDL (35)	98
DEET	22,000	70	>99	22,000 ± 1,000	35 ± 2	>99	20,000	14	>99
Diphenhydramine	400	<MDL (19)	95	360 ± 30	<MDL (20)	95	340	<MDL (17)	95
Metoprolol	420	76	82	440 ± 7	160 ± 1	63	390	<MDL (8.2)	98
Nicotine	1,100	<MDL (20)	98	1,400 ± 70	<MDL (20)	99	1,200	<MDL (18)	98
Paraxanthine	17,000	<MDL (51)	>99	12,000 ± 700	<MDL (53)	>99	11,000	<MDL (46)	>99
Sulfamethoxazole	1,400	120	92	1,500 ± 60	22 ± 1	99	1,400	35	97
Trimethoprim	300	<MDL (17)	94	340 ± 9	<MDL (18)	95	330	<MDL (15)	95



# PRESSURIZED SHALLOW DRAINFIELD PERFORMANCE



<b>4 Sheppard Lane, Stony Brook (unit: mg/ L)</b>			
Total nitrogen in system effluent <sup>(1)</sup>		9.4	
Depth	NH <sub>4</sub> <sup>+</sup>	NO <sub>3</sub> <sup>-</sup>	Dissolved Inorganic Nitrogen
6"	2.27	4.63	6.90
24"	0.04	3.01	3.06
<b>2 Sandys Lane, Remsenburg (unit: mg/ L)</b>			
Total nitrogen in system effluent <sup>(1)</sup>		53.1	
Depth	NH <sub>4</sub> <sup>+</sup>	NO <sub>3</sub> <sup>-</sup>	Dissolved Inorganic Nitrogen
12"	9.41	3.07	12.48
24"	0.02	7.91	7.92

<sup>(1)</sup> TN measurements from proprietary system supplied by Suffolk County



# COMMERCIAL DEMONSTRATION PROJECTS

- *Sylvester Manor Educational Farm - Completed*
  - \$209,000 County Funding
  - Vegetated gravel recirculating filter
  - Construction Complete Spring 2017
- *Meschutt County Park - Completed*
  - \$ 300,000 County Funding
  - Orenco AXMAX-225 Unit (Packed Bed Textile Recirculating Filter)
  - Construction completed May 2016
  - Average Total Effluent Nitrogen 17.2 mg/l (7-months composite sampling)
- *Lake Ronkonkoma Park - Completed*
  - \$408,000 County Funding (Enhanced Water Quality funding)
  - Norweco Hydro-Kinetic I/A OWTS with Eljen geotextile gravelless sand filter leaching





# VEGETATED RECIRCULATING GRAVEL FILTER

- Sylvester Manor Shelter Island
  - Sampled for 2 seasons
    - ✓ 10.9 mg/L TN
    - ✓ 97 BOD
    - ✓ 31.1 TSS







**[www.ReclaimOurWater.info](http://www.ReclaimOurWater.info)**

**Questions?**

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