Innovative Removal of Agricultural Related Water Pollutants in the Chesapeake Bay Watershed

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Presentation Outline

- Introduction
- Study Objectives and Design
- Treatment Technology Introduction
- Water Sample Locations
- Testing and Analysis Results
- Summary

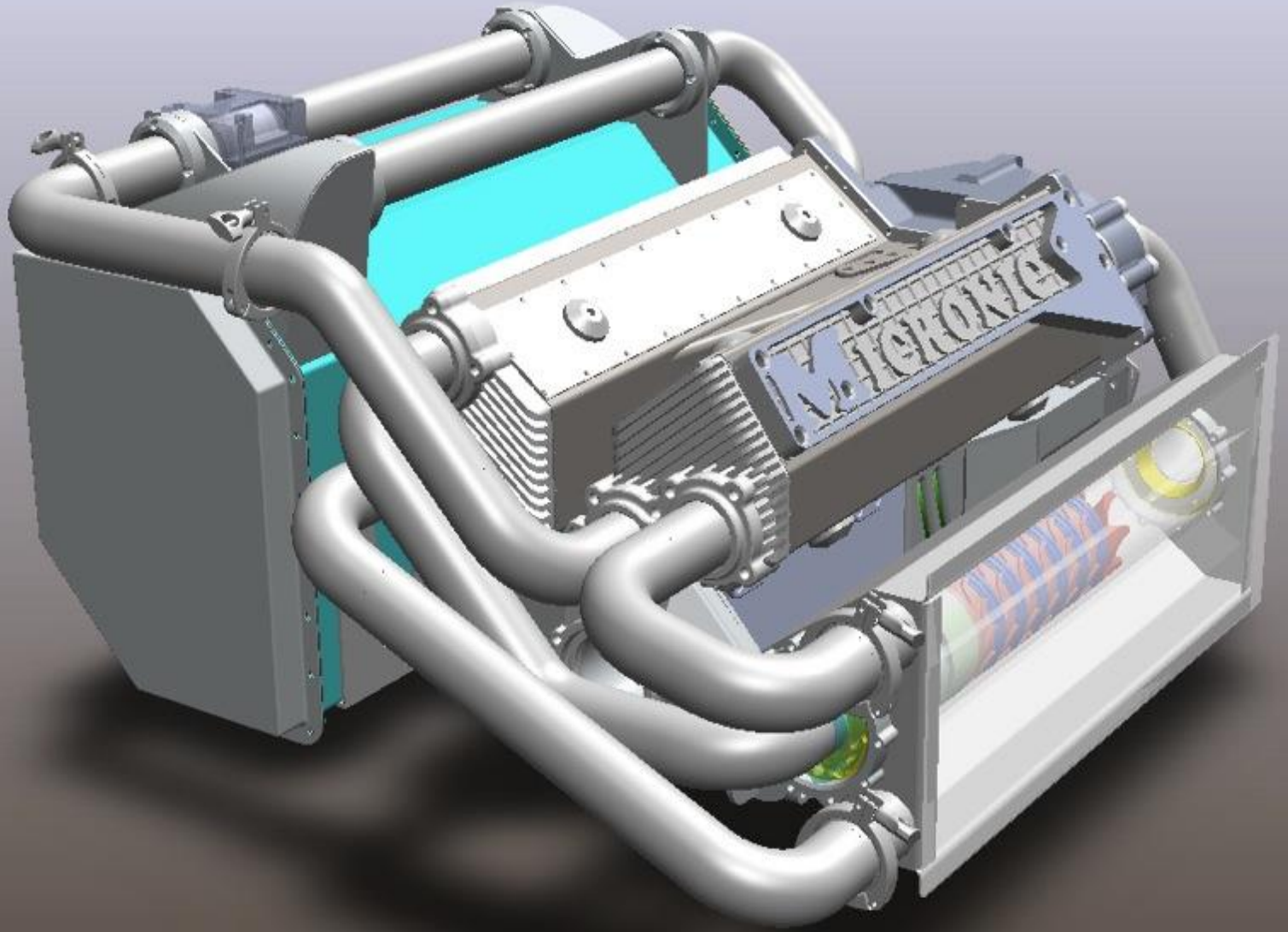
Sponsor and Partners

- USDA, National Institute of Food and Agriculture, Phase I SBIR
- Potomac River Keepers
- Shenandoah River Keepers
- Choptank River Keepers
- Nanticoke River Keepers

Study Objective

- **Evaluate the technical feasibility for superior treatment of Chesapeake Bay watershed River waters with the MicroDesal™ System**
- **Tasks:**
  - Confirm candidate contaminants and plan testing program,
  - Identify and observe testing protocols,
  - Collect water samples and process through MicroDesal™,
  - Submit samples and documentation for testing and analysis by a certified water testing laboratory, and
  - Evaluate test results.

MicroDesal™ Prototype 2.2



(PPM or mg/L unless otherwise noted)	Feed	Product	Reduction
Alk_CaCO3	1402	129	90.80%
Ammonia as N, PPM	10.48	5.56	46.95%
Arsenic	0.10	0.08	20.00%
Barium (Ba)	0.08	0.01	87.50%
Boron	205	0.74	99.64%
Bromide (Br)	2	0.2	90.00%
Bromine	120	0.16	99.87%
Calcium	4170	3.1	99.93%
Chloride (CaCO3)	4365.24	5.94	99.86%
Chloride (Cl)	120	18	85.00%
Chloride as Cl, PPB	1,261,000	13,143	98.96%
Chlorine	8500	15	99.82%
Chlorine	428.50	22.80	94.68%
Conductivity (µmho/cm)	12700.0	567.5	95.53%
Conductivity at 25°C	1300	100	92.31%
Florine	0.50	0.40	20.00%
Hardness	2296.06	3.93	99.83%
Iron as Fe, PPM	26	0.038	99.85%
Magnesium	788	0.418	99.95%
Magnesium (CaCO3)	1785.78	5.95	99.67%
Magnesium (Mg)	11	0.96	91.27%
Mercury (ppb)	203	12.3	93.94%
Mollybdenium	0.44	0.08	81.82%
Nickel	17.3	10	42.20%
Nitrate	446.10	0.40	99.91%
Nitrate (CaCO3)	34	0.28	99.18%
Nitrate (NO3)	42	0.34	99.19%
Nitrate as N, PPB	334,000	138	99.96%
Nitrite	27.00	0.40	98.52%
Nitrite (NO2)	2	0.36	82.00%
pH	8.07	7.81	3.22%
Phosphate as PO_4, PPB	205	20	90.24%
Phosphorus (P)	2	0.03	98.50%
Potassium	108.81	0.92	99.15%
Selenium	93.3	10	89.28%
Selenium as SE, PPB	59	10	83.05%
Silica (SiO2)	330.56	0.4	99.88%
Silicon (Si)	28	0.37	98.68%
Sodium	2413.50	5.12	99.79%
Strontium	2.16	0.08	96.30%
Sulfate	1200	0.52	99.96%
Sulfate	3688.1	5.2	99.86%
Sulfate (CaCO3)	110	2.4	97.82%
Sulfate (SO4)	110	2.3	97.91%
Sulfur	1174.05	1.5	99.87%
TDS	9150	50	99.45%
TDS, (calc.) PPM, Micronic	22,500	41.3	99.82%
Total Hardness (CaCO3)	6151.02	11.89	99.81%
Vanadium (V)	0.07	0.01	85.71%

Sample Performance Results

ONE-Pass to Water Treatment

Raw Water Intake

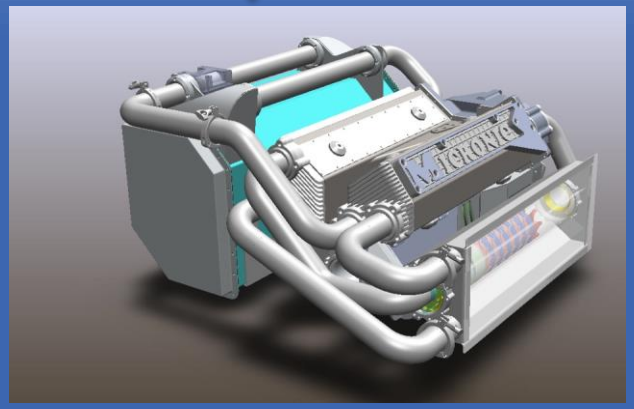
Oil and Grease
FLOTATION

Total Suspended Solids
FLOCCULATION ✓

Inorganics/Metals
CHEMICALS ✓

Bacteria
OZONATION/UV ✓

Total Dissolved Solids ✓
FILTRATION/DISTILLATION

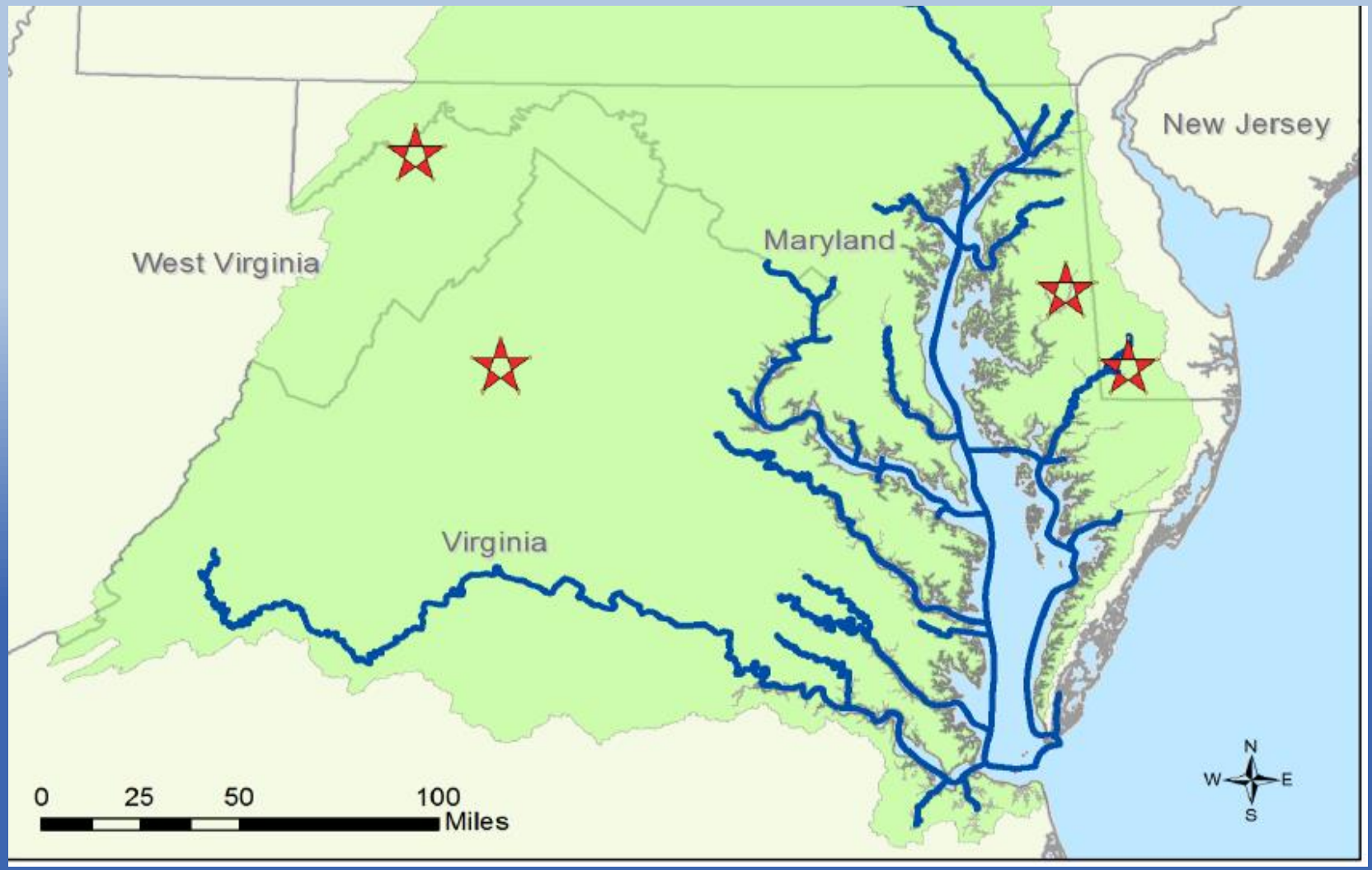


Patent

Technology Summary

Cleans	• Exceptional cleaning ability
New	• Disruptive PATENTED technology
Powerful	• Removes contaminants in one pass
Value	• Reduces life cycle costs
Versatile	• Plays in many markets
Green	• Reduced footprint

Water Sample Locations



Sample Locations and Season

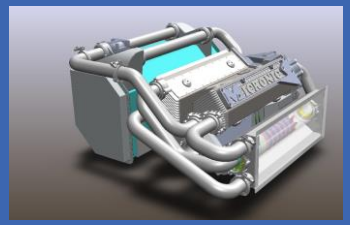
River Locations	Number of Summer Samples/Locations	Number of Fall Samples/Location	Total Samples
Shenandoah	2	2	4
Upper Potomac	2	2	4
Choptank	2	2	4
Nanticoke	2	2	4
Total	8	8	16

Water Test Constituents

Group 1 Metals	Aluminum, Antimony, Arsenic, Barium, Beryllium, Boron, Cadmium, Calcium, Chromium, Copper, Iron, Lead, Magnesium, Manganese, Mercury, Nickel, Potassium, Selenium, Silver, Sodium, Thallium and Zinc
Group 2 Inorganics	Bromide, Chloride, Fluoride, Nitrate, Nitrite, Sulfate, Hardness (as CaCO3), pH and Alkalinity (as CaCO3), Total Dissolved Solids, Turbidity, Color, Corrosivity, Foaming Agents, Odor Threshold, Ortho Phosphate, and Phosphorus

Water Collection & Testing Procedures

- Water collection points were identified in collaboration with four River Keeper Organizations for locations in the Chesapeake Bay watershed representative of water influenced by agricultural operations.
- Chain of custody requirements were followed.
- All samples were placed on ice from collection to treatment.
- Testing of water occurred within 24 hours of collection.

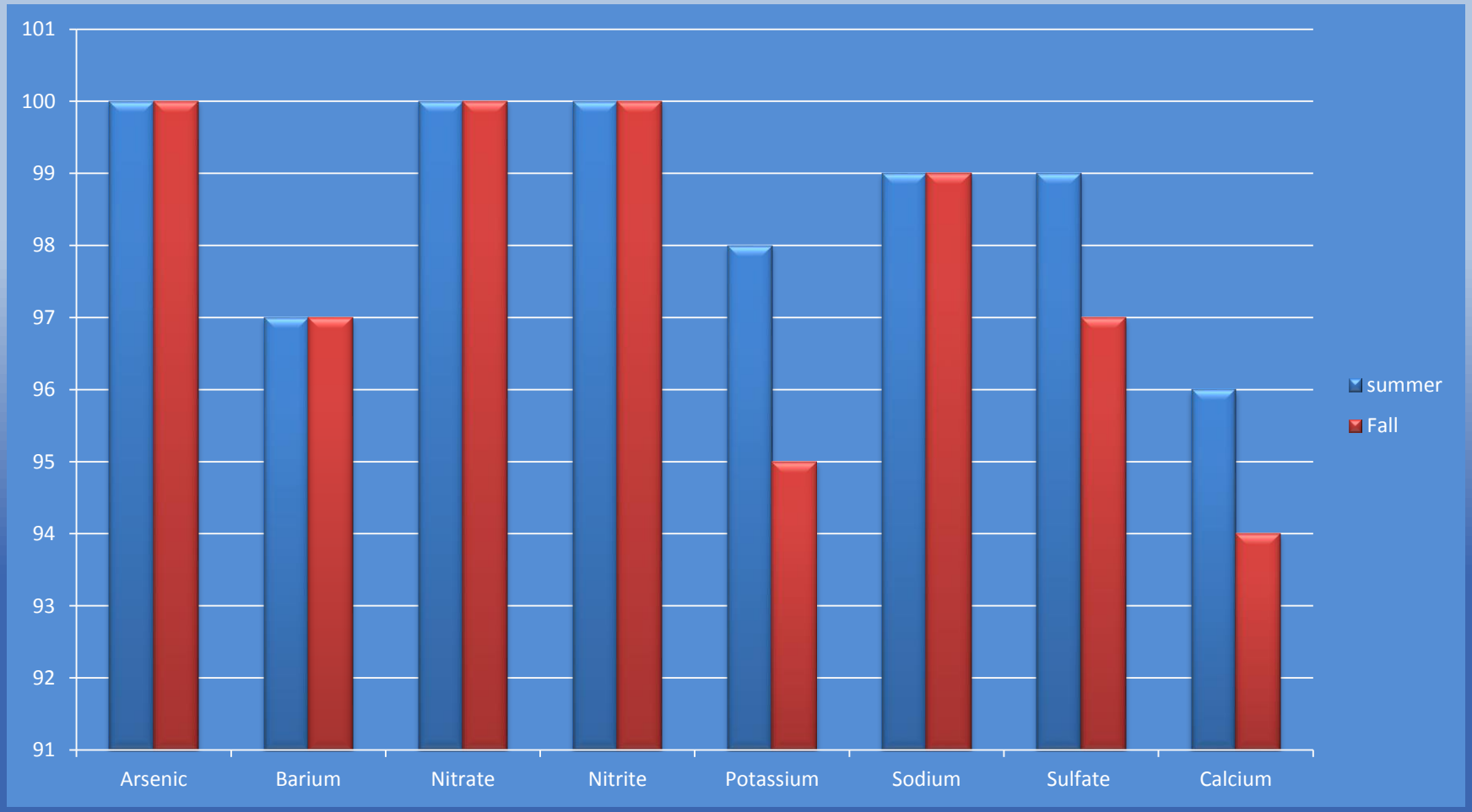


Primary Constituents of Interest

- Arsenic
- Barium
- Nitrate
- Nitrite
- Potassium
- Sulfate
- Sodium
- Calcium

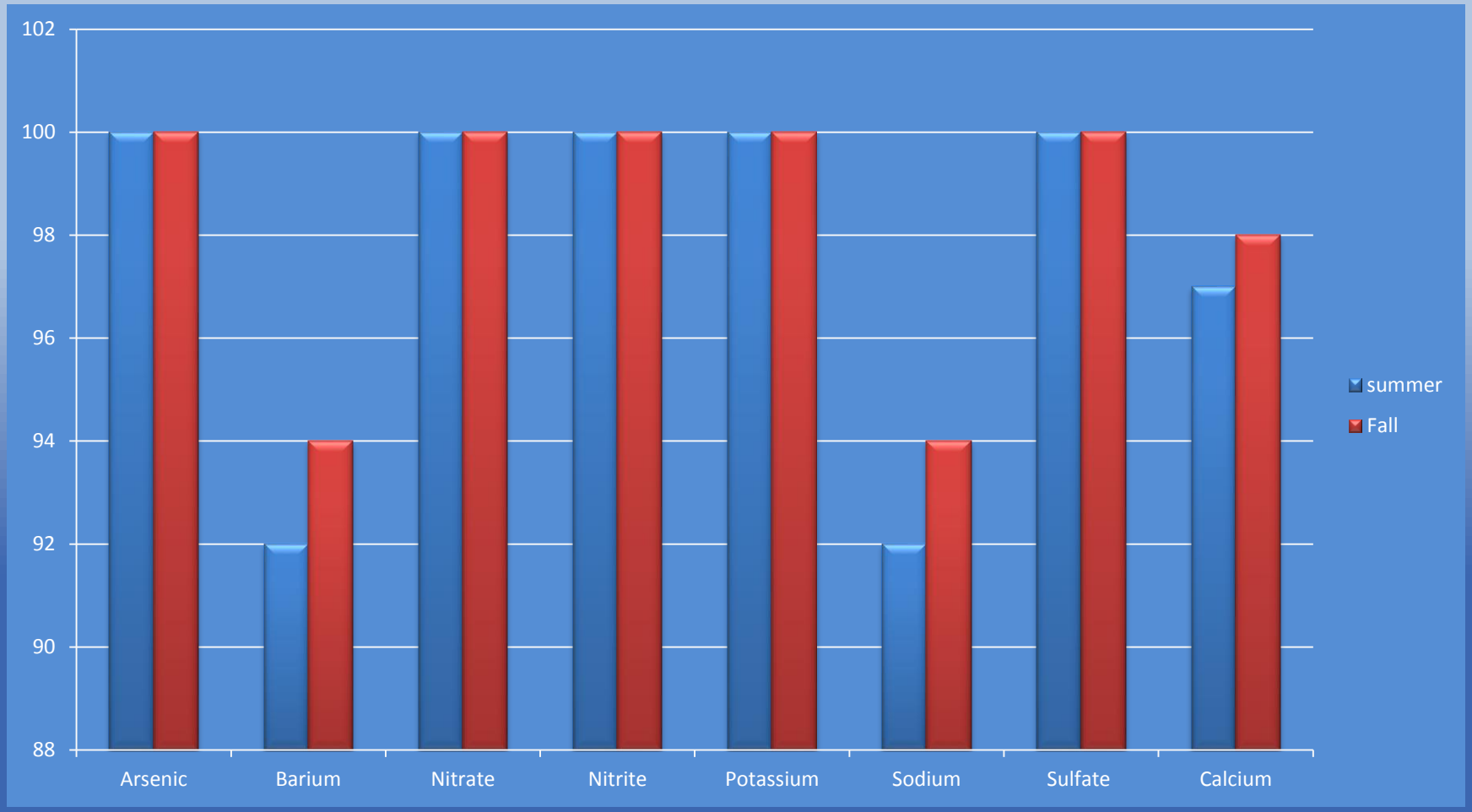
South Fork of the Shenandoah River near Port Republic, VA

Percent Reduction from the South Fork of Shenandoah River



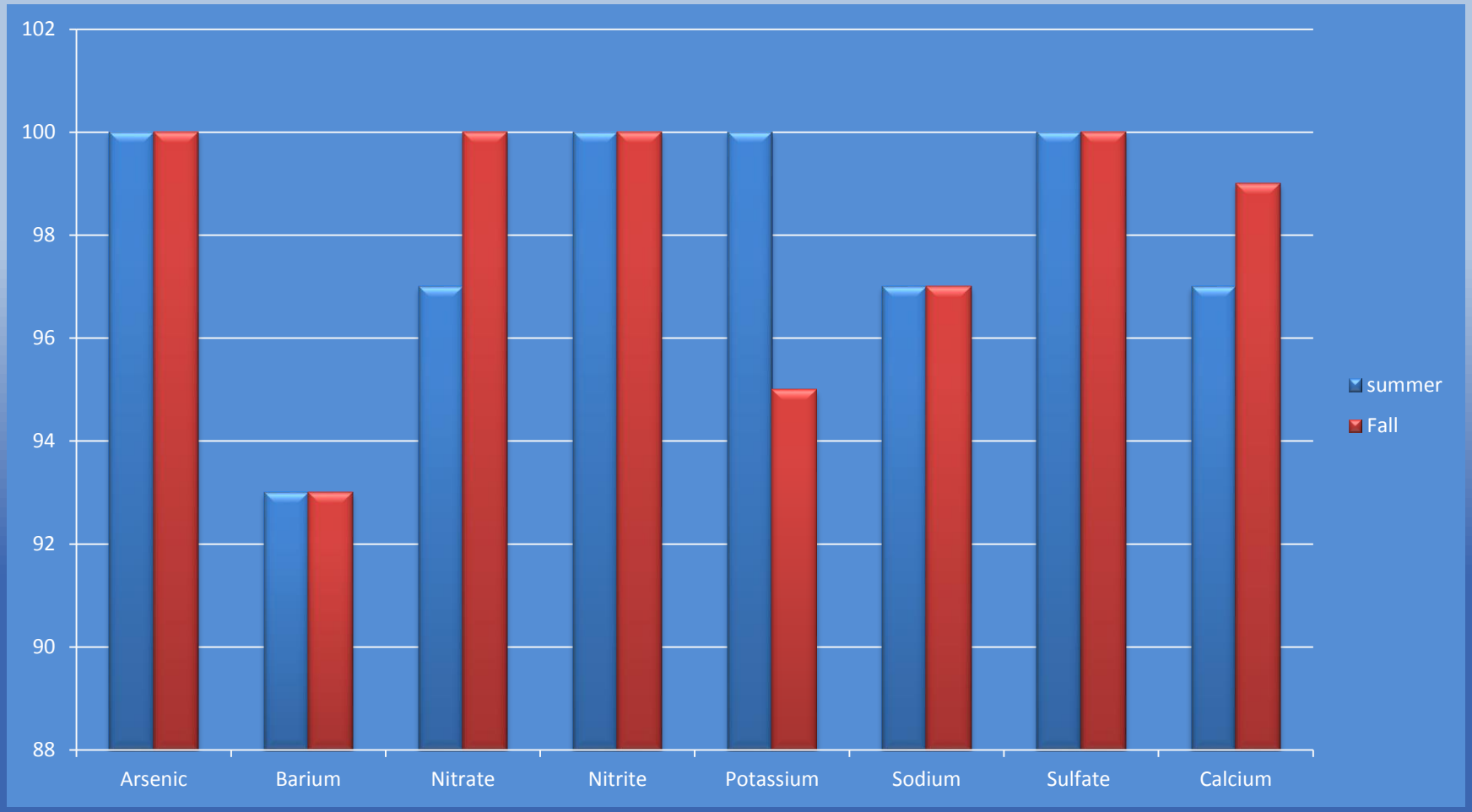
South Branch Potomac River, Near Moorefield, WV

Percent Removal from South Branch of the Potomac River



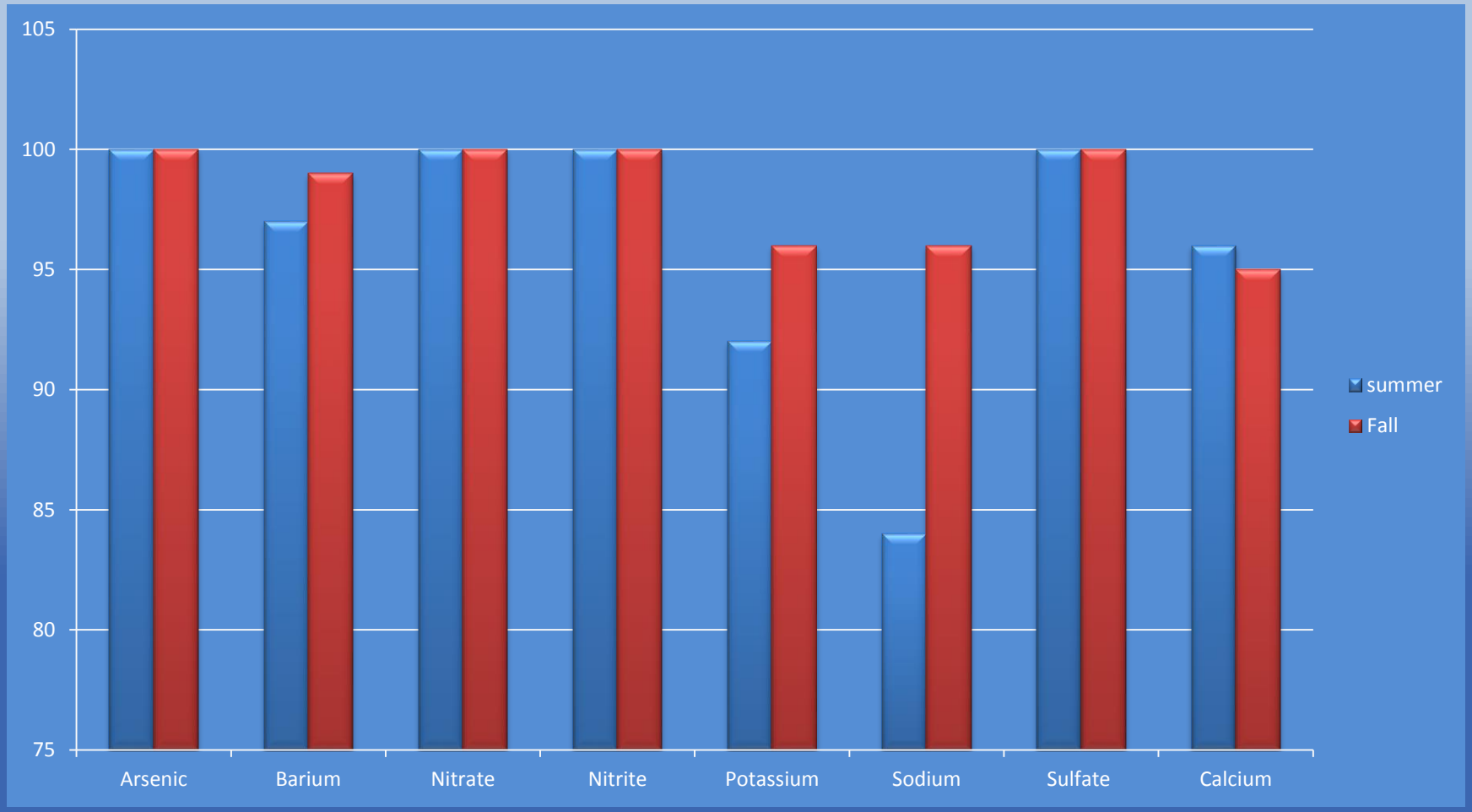
Choptank River near Denton, MD

Percent Removal from the Choptank River



Nanticoke River near Laurel, DE

Percent Removal from the Nanticoke River



Treatment Results Summary

Contaminant	Average % Reduction in Contaminants at all Locations
Arsenic	100.0
Barium	93.0
Nitrate	99.4
Nitrite	100.0
Potassium	95.3
Sulfate	98.6
Sodium	91.2
Calcium	89.1

Summary

- Arsenic, sulfate, nitrate and nitrite were removed at a rate 98.5% to 100%
- Potassium was removed at a rate of 95.3 %
- All treatments were achieved in one pass with no chemicals, filters, or membranes
- Treatment throughput efficiency was 90% treated water and 10% brine
- Met or exceeded all SBIR Phase I objectives
- An SBIR Phase II proposal has been submitted to USDA for treatment of large feedlot runoff pond water in Kansas for reuse as drinking water for livestock

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AAERC Appalachia America Energy Research Center

Occupancy: March 2015

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