



# USEPA Office of Research and Development HOMELAND SECURITY RESEARCH PROGRAM



## **WATER-ON-WHEELS MOBILE EMERGENCY WATER TREATMENT SYSTEM (WOW CART)**

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# Background and Purpose

Following a disaster, communities need access to clean water (*not just truck loads of bottled water*).

## Water-On-Wheels (WOW) Emergency Water Treatment Cart

- Mobile, inexpensive and versatile water treatment cart
- Configured with multiple treatment technologies
- Ready with alternative power sources

Utilized Cooperative Research and Development Agreement (CRADA) with a Louisville, KY non-profit organization, WaterStep





# CRADA Collaborations Established

- 1980 – Congress established
  - Stevenson Wilder and Bye-Dole Act
    - Directs Government Labs to Transfer Technology to the private sector
- 1986 - Stevenson Wilder and Bye-Dole Acts Amended
  - Federal Technology Transfer Act (FTTA) 1986
    - Established “Cooperative Research and Development Agreements”
    - Priority given
      - Small Business
      - US Manufactured Technologies
    - Provides Intellectual Property Protection
    - Authorizes licensing fees and royalty distribution guidelines
    - <https://www.epa.gov/ftta/federal-technology-transfer-act-and-related-legislation>



# The Technology Transfer (T<sup>2</sup>) Playing Field

## Federal labs **can**:

- Research/Collaboratively
- Develop/Prototype
- Protect IP (Patent)
- License technology
  - Exclusive and Non-exclusive
- Receive Royalties
- Test and evaluate
- Publish/present results
- Support validation

## Federal labs **cannot**:

- Mass Manufacture
- Market
- Endorse (in the USA)
- Invest

## Also Good to **Know**:

- Company CBI is protected
- Not subject to FOIA Requests



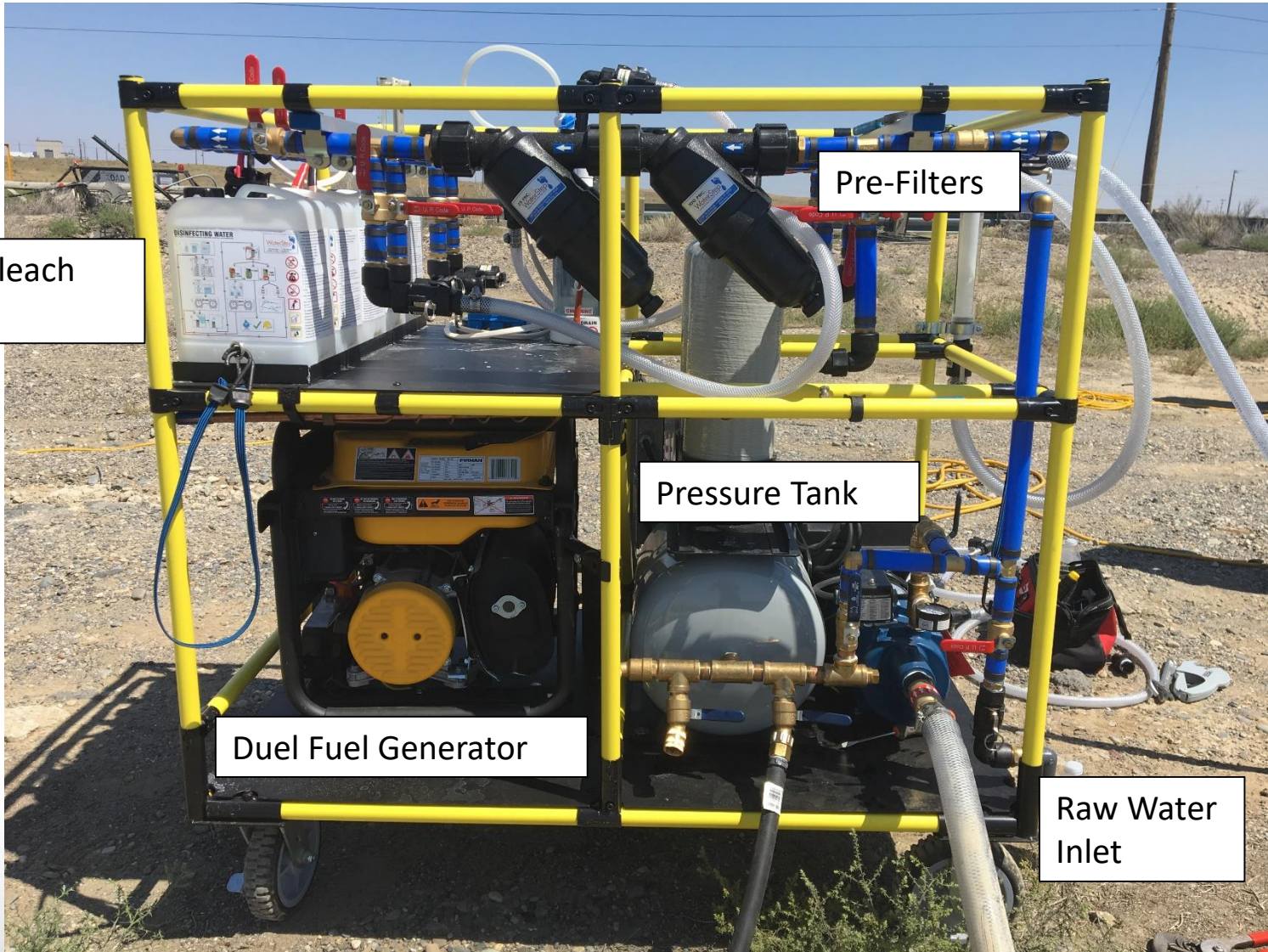
- <https://www.youtube.com/watch?v=Db9M1Si0Jkk&feature=youtu.be>

- Decontamination of wide-area wash water produced during building mitigation
- Treatment of contaminated drinking water
  - Flushed from a distribution system for safe discharge to environment or collection system
  - Provision of drinking water from compromised distribution system
  - Pre-deployed at critical institutions (hospitals, prisons, nursing homes)





# Capabilities - Front View



Liquid Bleach  
Maker

Pre-Filters

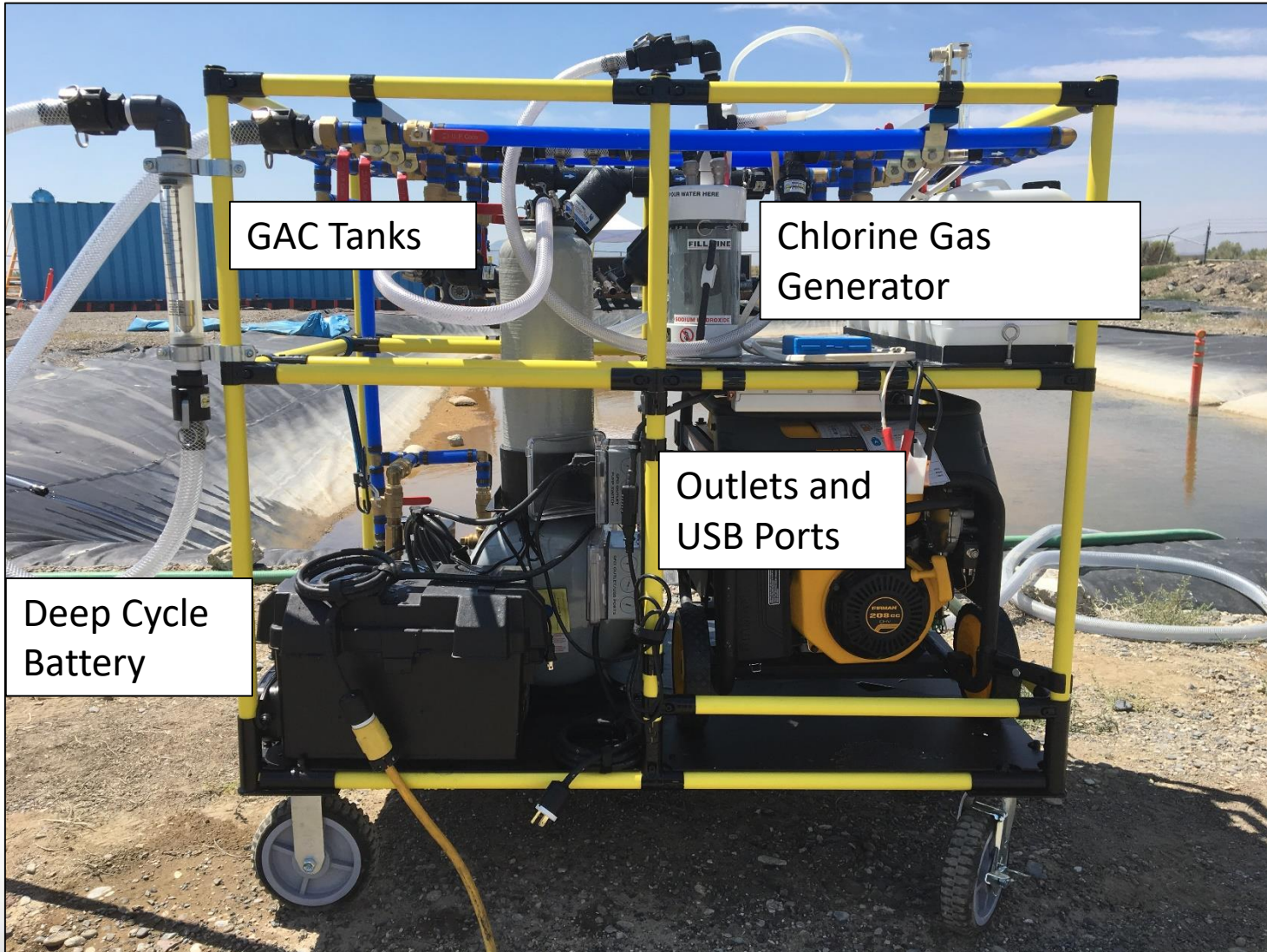
Pressure Tank

Dual Fuel Generator

Raw Water  
Inlet



# Capabilities – Back View



GAC Tanks

Chlorine Gas Generator

Outlets and USB Ports

Deep Cycle Battery



- Pre-filtration to reduce turbidity, increase additional filter life, and improve disinfection
  - 100 micron and 25 micron washable disc filters



# GAC Media Tanks

- Two media filtration/adsorption tanks for targeted chemical contaminant removal (e.g. GAC)





# Chlorine Gas and Bleach Maker

- On-site chlorine gas and liquid bleach generation for disinfection



- 110 V and Generator Power Supplies
- USB Ports





# Treated Water Storage and/or Recirculation

- 1,250 Gallon Bladder Tank and Single Hole Recirculation Manifold

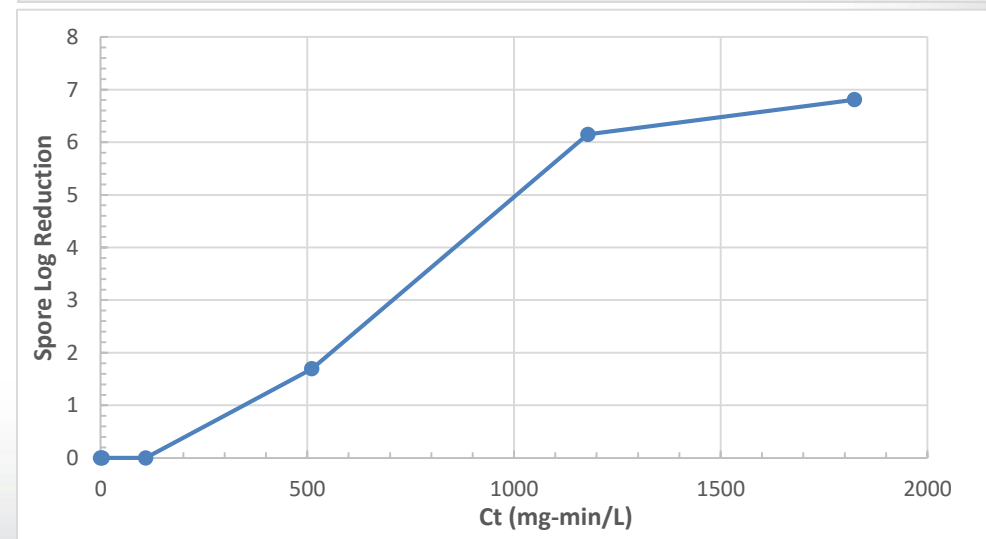
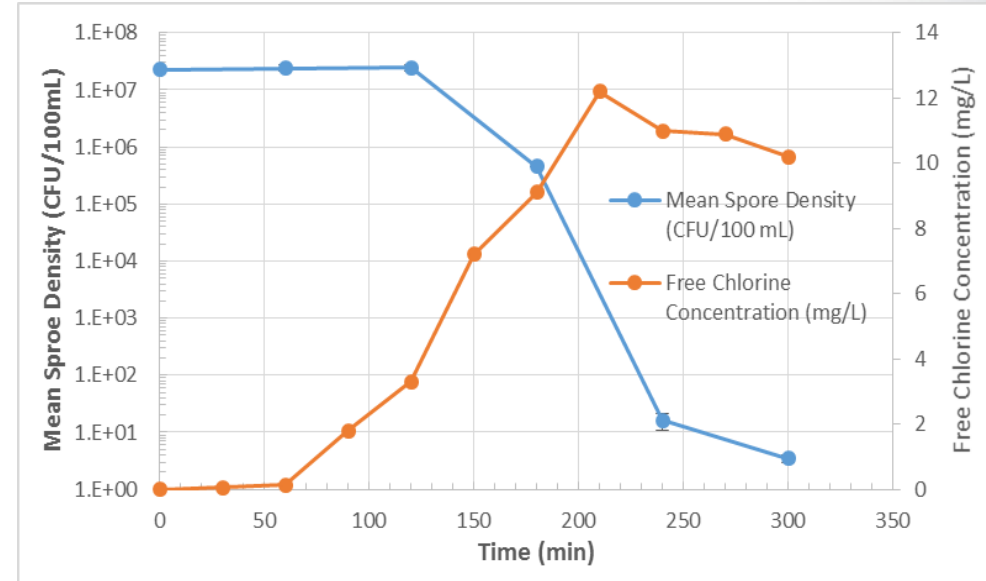


- Bench-scale microbial disinfection challenges undertaken at the Test & Evaluation (T&E) Facility
- Pilot-scale cart evaluated at the Water Security Test Bed
- Pilot-scale cart deployed in Puerto Rico hurricane response
- Revised full-scale cart challenged with secondary wastewater at the T&E Facility
- Current WOW Cart challenged at the Water Security Test Bed with microbial and diesel contaminated surface water



# WSTB Pilot-Scale Batch Operation

- Free chlorine concentration (orange) and spiked *Bacillus globigii* spores (blue line) density over time in the 1,250 gallon bladder tank
- *BG* spores Log Reduction and Ct Value





# Microbial and Diesel Fuel Flow-Through Operation

WOW Cart Inlet (Lagoon Source Water)			Treated WOW Cart Outlet to Bladder Tank		Recirculated Treated Bladder Tank	
Sample Time	Total Coliforms (MPN/100 ml)	E. coli (MPN/100 ml)	Total Coliforms (MPN/100 ml)	E. coli (MPN/100 ml)	Total Coliforms (MPN/100 ml)	E. coli (MPN/100 ml)
15:15	>2.4E+06	1.5E+04	2.1E+05	8.4E+03	1.7E+01	2.0E+00
16:00	>2.4E+06	3.5E+03	1.0E+00	1.0E+00	1.0E+00	ND
16:45	>2.4E+06	5.6E+04	1.0E+00	ND	1.0E+00	ND
17:30	2.4E+06	1.5E+05	1.2E+05	1.5E+04	2.0E+01	5.1E+01
18:15	1.3E+06	1.1E+04	ND	ND	2.0E+01	ND
19:00	1.4E+06	1.3E+03	ND	ND	ND	ND

E. coli and Diesel fuel added to the lagoon at 14:25 and 14:27 respectively  
 ND – non-detect (<1 MPN/100mL)

WOW Cart Inlet (Lagoon Source Water)				Treated WOW Cart Outlet to Bladder Tank				
Sample Time	DRO (mg/L)	ORO (mg/L)	GRO (mg/L)	TPH (mg/L)	DRO (mg/L)	ORO (mg/L)	GRO (mg/L)	TPH (mg/L)
15:15	6.500	1.300	0.110J	7.910	U	U	U	U
16:00	U	0.120	U	0.120	0.110	U	U	0.110
16:45	U	0.120	0.200J	0.320	U	U	U	U
17:30	0.150	0.140	0.170J	0.460	0.140	0.120	0.120J	0.380
18:15	0.170	0.170	0.140J	0.480	0.250	0.120	U	0.370
19:00	0.190	0.140	0.120J	0.450	0.140	0.110J	0.120J	0.370



- *BG* spores showed 7-log reduction with 10 mg/L free chlorine residual in *batch* mode in spiked Water Security Test Bed (WSTB) lagoon
- 4 and 5-log reduction in *E.coli* and Total Coliforms respectively in flow-through secondary wastewater and WSTB lagoon
- Diesel fuel levels reduced to non-detect in WSTB lagoon
  - GAC tanks clogged after 2 hours in 120 NTU



## Future Research Areas

- Evaluation/integration of additional and innovative treatment technologies
  - UF membranes
  - Multi-media filtration
  - UV-C LED
- Fabrication Costs and Speed
  - ~ \$20,000 to commercially build? (components \$ 7,000)
  - Days/weeks to build?
- Real-time remote operating and reporting capabilities
  - Flow rate, on/off, pressure, other?



# Thank you

WSTB Video:

<https://www.youtube.com/watch?v=pQvsBC-U4a8>

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