Small-Scale Black Water Processing Systems

Presented to the

Society of
American Military Engineers
Small-Scale Black Water Processing Systems (BWPS)

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The Operational Need: Black water management at small contingency bases by one Tricon
Introduction - Small-Scale BWPS

TRL8+ Readiness is the Key To Rapid Equipping Success – EEC Global already delivered!

EEC Global’s twenty years of experience delivering over 600 packaged Waste Water Treatment Plants (WWTP) includes support to the US Military in Iraq and Afghanistan.

EEC’s goal has been the delivery of mobile WWTP to remote locations. EEC is currently negotiating CRADA with TARDEC to test a black water system.

EEC delivers mobile wastewater treatment in a range of standard configurations from Mini Plants (above) to CON Series (below). Image below is of 480K gpd system at Baghdad International Airport.

EEC Global WWTP Expeditionary Capabilities

Highly Mobile: Transportable within ISO containers
Plug and Play: Completely self-contained system operable connecting electrical and in/out lines
Simple Operation: Simplest operation requirements of any package plant. No odor, no vectors
Exceptional Treatment Standards: Exceeds OEBGD standards for domestic wastewater effluent.
Rapid Startup: Minimal site preparation 20 man hours required. 7 days from startup to treatment
Energy Efficient: Minimal power draw (e.g.: <12 kW per 100 personnel)
Small Footprint: EEC offers the most compact, membraneless, aerobic WWTP on the market
Readily Scalable: Configurable to support any population size from Forward Operating Base (FOB) (50-150 personnel) to Main Operating Base (MOB)
Complementary Logistics: Readily adaptable to all US Army Force Provider configuration requirements.
**Introduction - Small-Scale BWPS**

**EEC Past Performance**

This table provides a sampling of projects over the past ten years to include EEC Global's support to the US Military in Iraq and Afghanistan. The range of requirements indicates the EEC platform's ability to readily adapt to varying client needs.

<table>
<thead>
<tr>
<th>Project Title</th>
<th>Description</th>
<th>Client</th>
<th>Year of Delivery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kandahar Airfield</td>
<td>1,200,000 gpd system installed for US Army Corps of Engineers and NATO over 3 phases at Kandahar, Afghanistan</td>
<td>US Army Corps of Engineers funded, KBR</td>
<td>2006 - 2010</td>
</tr>
<tr>
<td>US Embassy to Haiti</td>
<td>6,000 gpd system producing effluent that is used to irrigate the embassy's grounds</td>
<td>US Department of State</td>
<td>2007</td>
</tr>
<tr>
<td>Aramco Drilling Sites</td>
<td>Four systems provided (1,700 gpd to 5,200 gpd) for remote drilling locations in Saudi Arabia</td>
<td>Arabian Drilling Schlumberger</td>
<td>2008</td>
</tr>
<tr>
<td>Jirau Electric Plant</td>
<td>2,000,000 gpd system for large construction site for a dam building project in Brazil</td>
<td>Camargo Correa</td>
<td>2009</td>
</tr>
<tr>
<td>Baghdad International Airport</td>
<td>480,000 gpd system installed to manage wastewater for airport population</td>
<td>US Army Corps of Engineers</td>
<td>2009</td>
</tr>
<tr>
<td>IKEA Athens</td>
<td>20,000 gpd system to manage residential wastewater for IKEA store in Athens, Greece</td>
<td>Terna, S.A.</td>
<td>2010</td>
</tr>
<tr>
<td>Afghan Military Training Camp</td>
<td>60,000 gpd system installed at a NATO funded training facility in Heart, Afghanistan</td>
<td>NATO funded, ARAO Co.</td>
<td>2011</td>
</tr>
<tr>
<td>Avtex Superfund Site</td>
<td>72,000 gpd system processing hydrogen disulfide polluted groundwater to enable river discharge in Front Royal, Virginia</td>
<td>Parsons Environmental</td>
<td>2012</td>
</tr>
<tr>
<td>Iraqi Health Clinics</td>
<td>Six systems of 30,000 gpd each including membrane and filtration components to treat medical waste streams</td>
<td>Iraqi Ministry of Health</td>
<td>2013</td>
</tr>
<tr>
<td>Port Louis Harbor</td>
<td>35,000 gpd system installed to treat shipboard wastewater at Port Louis, Mauritius</td>
<td>WestTech</td>
<td>2016</td>
</tr>
</tbody>
</table>
Snapshot of What We’ll Present:

1. Operational Impacts
   
   *How does managing black water impact mission and resources?*

2. System Requirements
   
   *What are the performance requirements for black water solutions?*

3. Technology Overview
   
   *What is the current technical state-of-the art?*

4. Operational Footprint
   
   *What will implementation look like?*
Objective 1: Operational Impacts
Objective 1: Scope of Operational Impacts

“The Army needs improved capability to enable sustainment independence/“self-sufficiency” and to reduce sustainment demands at contingency bases. It is too costly, too unpredictable, and too labor intensive for a Small Unit to carry all required consumables (fuel & water) to last for weeks or months at a COP/PB to small FOB (up to 1000 PAX). As a result, contingency bases are highly dependent on resupply/backhaul, which can be unpredictable and are costly in terms of soldiers at risk in convoys, and reduced mission availability, etc.”

- Problem Statement.
  Sustainability/Logistics – Basing Technology Enabled Capability Demonstration
Objective 1: Scope of Operational Impacts

Needs, Drivers, and Analyses:

- Small deployed units cannot organically treat wastewater:
  - Result is discharging untreated sewage or incur costs and security risks by transporting wastewater to off-site treatment facilities

- A 600 soldier FOB requires a convoy of 22 trucks per day to supply the base with fuel or water and to truck away wastewater and solid waste” SERDP Sustainable FOBs

- **Case Study:** Untreated wastewater discharge from a small UN unit supporting the Haiti earthquake caused a cholera outbreak resulting in 10,000+ deaths and 800,000 illnesses. Cholera remains a problem; The UN is working to provide a $2.3B fund to eradicate cholera in Haiti and the Dominican Republic

Drivers:
- Preserving environment to maintain community
- Self-sufficient to maximize resources
- Minimize back haul
- Maximize on-site security
- Minimize physical footprint
- Minimize operational requirements
- Maximize mobility
- Minimize mobilization/demobilization requirements

Available Options:
- Hauling via contractor
- Burn pit,
- sewerage lagoon,
- Port-o-let with hauling
- Mobile WWTP
Objective 1: Scope of Operational Impacts

Why is a BWPS Essential?

- Managing black water fits into Expeditionary solutions for all water issues

Application: Contingency bases located at the tactical edge supporting platoon to company-sized units (25 to 250 personnel)

The Target: Manage black and gray water in separate waste streams

What is Getting Done: US Army Tank Automotive Research, Development and Engineering Center (TARDEC) working to develop a Force Provider component to support black water management with an FY19 procurement
Objective 2: System Requirements
**Objective 2: System Requirements**

**TARDEC specification for black water systems:**

1. **Treatment Requirements:** Parameters are defined in the “Overseas Environmental Baseline Guidance Document” (OEBGD)(DoD 4715.05-G).
   - Effluent suitable for discharge in local environment, chlorine disinfection
   - Capacity: sufficient to treat black water produced by a population of 250 personnel
   - All technologies included in this presentation possess the capabilities to meet these performance parameters.

2. **Operational Requirements:** Effectively work within a contingency environment with minimum operational staffing time and expertise.
   - **Key parameters:**
     - Physical Size
     - Operator requirements
     - Mobility
     - Minimal Inputs/outputs: energy to operate, waste products
   - While all technologies presented can treat to technical parameters, not all of them can do so while meeting the operational requirements.

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**Technical Parameters**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Influent (mg/L)</th>
<th>Effluent (mg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOD</td>
<td>1,170</td>
<td>30</td>
</tr>
<tr>
<td>TSS</td>
<td>1,450</td>
<td>30</td>
</tr>
</tbody>
</table>

**Operational Requirements**

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size</td>
<td>Delivered and operated within Tricon container</td>
</tr>
<tr>
<td>Operator Expertise</td>
<td>Non-MOS specific staff with minimal training</td>
</tr>
<tr>
<td>Energy Consumption</td>
<td>Less than 2 kW/hr maximum draw</td>
</tr>
<tr>
<td>Mobility</td>
<td>Set up and demobilization time less than one day</td>
</tr>
<tr>
<td>Maintenance Period</td>
<td>30 minutes/24 hour period</td>
</tr>
<tr>
<td>Operator Attendance</td>
<td>Unattended for 24 to 72 hours</td>
</tr>
<tr>
<td>Weight</td>
<td>Less than 7,000 lb</td>
</tr>
</tbody>
</table>
Objective 3: Technology Overview
Objective 3: Technologies Overview

There are a fairly wide range of technical solutions. A finite selection of leading technologies under consideration; following is our overview of the most relevant and malleable technologies for the mission requirements:

1. Moving Bed Biological Reactor (MBBR)
2. Membrane Biological Reactor (MBR)
3. Trickling Filter
4. Electrocoagulation
1. Moving Bed Bio-Reactor (MBBR)

**Process type:** Biological Treatment, Aerobic  
**Process Description:** Variation on extended aeration process using thousands of plastic bio media to maximize biofilm impact  
**Vendor:** EEC Global Operation  
**Strengths:** Compact footprint, durable process, proven improvement on pre-dominant WWTP technology  
**Weaknesses:** Extended time may be required to achieve full capacity, may require external equalization

**System Schematic and Description**

Influent enters the system at:

1. **EQ:** Equalization tank which receives an uneven daily flow and then provides a consistent flow to  
2. **MBBR Bioreactors** where bio media treats the influent within two reactors.

3. **Clarification,** via a lamella unit, removes remaining solids and recycles them to the bioreactors  
4. **Disinfection** is achieved by tablet chlorination to complete the process.

Technology has been successfully fielded in comparably-scaled units for over 20 years.
Objective 3: Technologies Overview

2. Membrane Bio-Reactor

Process type: Aerobic Biological Treatment combined with Filtration  
Process Description: Introduces a membrane filter after aerobic treatment to more effectively eliminate solids  
Vendor: A3 Water Solutions GmbH  
Strengths: High quality effluent, compact footprint, no clarifier required  
Weaknesses: Sensitivity of membranes to fouling requires expert operators for effective ongoing operation

System Schematic and Description

Influent enters the system at:

1. **EQ**: Equalization tank which receives an uneven daily flow and then provides a consistent flow to
2. **Aeration** tank where bubble diffusers mix air with influent.

(3) **Membrane Filter** removes remaining solids and recycles them to the Aeration step and
(4) **Disinfection** is achieved by ultraviolet units to complete the process.

Technical Differentiator: Membrane filter. Removes remaining solids in step 3 to ensure high quality effluent.

MBR units have been deployed in theater within a package configuration and contracted by Veolia for the Norwegian military.
3. Trickling Filter

Process type: Biological Treatment

Process Description: Implements the trickling filter process in a package plant using a block of geotextile to host biofilm

Vendor: Active Water Solutions, Orenco

Strengths: Compact footprint, low energy requirement, proven treatment process

Weaknesses: Extended time may be required to achieve full capacity, potential for clogging

System Schematic and Description

In

1. EQ

2. Trickling Filter

3. Clarifier

4. Disinfect

Out

Influent enters the system at:

1) EQ: Equalization tank which receives an uneven daily flow and then provides a consistent flow to

2) Trickling Filter: the influent is poured over the filter.

(3) Clarifier: removes remaining solids and recycles them to the trickling filter

(4) Disinfection: is achieved by ultraviolet units to complete the process.

Technical Differentiator: Trickling filter media fabricated of plastic textile located in the Trickling Filter tank.

Trickling filter package plants have been tested by USACE ERDC and fielded in theater.
**Objective 3: Technologies Overview**

### 4. Electrocoagulation

**Process type:** Short wave electrolysis  
**Process Description:** Electric current passed through influent removes its contaminants  
**Developer:** Terragon Environmental Technologies  
**Strengths:** Immediate startup, adapts to varying flow rates and concentrations, immediate startup  
**Weaknesses:** Frequent replacement of electrodes, system complexity

**Technical differentiator:** Electrical current is passed between metal plates submerged in influent providing the main treatment action.

**System Schematic and Description**

1. **EQ** (Equalization tank)  
2. **EC** (Electrocoagulation tank)  
3. **Sludge** (Sludge is precipitated influent’s solids and removed from tank bottom)  
4. **Skimmer** (Skimmer removes solids that were floated by the EC current)

Influent enters the system at:

1. EQ: Equalization tank which receives an uneven daily flow and then provides a consistent flow to  
2. EC: Electrocoagulation tank introduces electrical charge which

A demonstration EC unit has been tested by TARDEC in consideration of this requirement.
Objective 4: Operational Footprint
Objective 4: Operational Footprint

System Configuration and Resource Requirement

The small-scale black water processing system is targeted to support platoon- to company-sized base populations (e.g.: 25 to 250 personnel). TARDEC plans for the system to possess the following configuration and resource requirements.

System Configuration Requirements

- Transportable within one tricon shipping container (top right image)
- Weight: 7,000 lb – manageable using 10K lb forklifts at base camp
- ‘Plug and Play’ system: only required to establish connections for influent, effluent, and power to enable system operation
- Start up time (key challenge): 48 hours to full treatment capacity
- Automatic operation (may include remote monitoring capability)

Notional EEC MBBR configuration presented in center and lower images to right.

Required Resources

- Staffing expertise: Non-MOS specific soldier operator, trained 3 to 7 days
- Maintenance time: 15 minutes/day, with additional 3 hr/month
- Power: 3 kWh system to support 250 personnel
- Minimal Site Preparation: level ground with loading of 350 lb/SF
- Any remote monitoring will require signal (e.g.: internet connection)
- Consumables may be as simple as approx. 40 lb/month of chlorine tablets and replacing the system’s air filter every two months
### Basic Required Operational Activities

Anticipated activities based on notional EEC system

<table>
<thead>
<tr>
<th>Fielding</th>
<th>Item</th>
<th>Description</th>
<th>Resources</th>
<th>Man Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mobilization</td>
<td>Placement of system, establish connections, initial loading routine</td>
<td>Forklift for placement, 500 gallons potable water</td>
<td>20 plus site preparation</td>
</tr>
<tr>
<td></td>
<td>Demobilization</td>
<td>Draining, cleaning, and packing system for transport</td>
<td>500 gallons potable water, chlorine tablets, forklift for transport loading</td>
<td>16</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Preventive Maintenance Checks and Services</th>
<th>Item</th>
<th>Frequency</th>
<th>Description</th>
<th>Man Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Inspection</td>
<td>Daily</td>
<td>Perform inspection checklist routine to ensure proper system function</td>
<td>0.25</td>
</tr>
<tr>
<td></td>
<td>Chlorine Feed</td>
<td>Weekly</td>
<td>Re-load pellet dispenser, check for proper operation</td>
<td>0.25</td>
</tr>
<tr>
<td></td>
<td>Greasing</td>
<td>Monthly</td>
<td>Grease mechanical equipment as appropriate</td>
<td>0.25</td>
</tr>
<tr>
<td></td>
<td>Air Filter Cleaning</td>
<td>Monthly</td>
<td>Clean blower air filter</td>
<td>0.25</td>
</tr>
<tr>
<td></td>
<td>Air Blower Current</td>
<td>Monthly</td>
<td>Check current to motor is correct</td>
<td>0.25</td>
</tr>
<tr>
<td></td>
<td>Wastewater Transfer</td>
<td>Monthly</td>
<td>Pull pump out and clean out intake strainer</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Sludge Drainage</td>
<td>Monthly</td>
<td>Remove sludge and dispose</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Air Filter Replace</td>
<td>Bi-Monthly</td>
<td>Replace air blower filter</td>
<td>0.25</td>
</tr>
<tr>
<td></td>
<td>Air Diffuser Cleaning</td>
<td>Annually</td>
<td>Remove diffusers from tank and clean out apertures</td>
<td>4</td>
</tr>
</tbody>
</table>
Conclusion: The successful solution will be a by-product of operational and integration readiness with minimal adaptation to meet the current mission need as defined by the U.S. Army in Slide 6 of this Presentation.

The capacity to interoperate between Black Water and Gray Water Systems while maintaining separate waste streams is a key value to the most optimal Water Management System capability.

The TARDEC FY19 Procurement Objectives are already taking into account these factors, as reflected in the CRADA almost in the implementation Phase as of today.

The Capability is out there, and EEC Global is closely coupled to it...
Conclusion: Q&A and Contact Information

Q&A Session

Point of Contact:

Carlos Rivera – EEC Global
Email: cr@eec-govt.com
Cell: (572) 218-5713

Thank you!
Backup

A. Operational Tables

B. Current EEC System Small-Unit Configurations

C. Questions and Answers
# A.1. Operational Tables

## System Startup

<table>
<thead>
<tr>
<th>Step</th>
<th>Item</th>
<th>Comment</th>
<th>Man Hours</th>
<th>Skill Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Location Preparation</td>
<td>Level location, preferably on conc. pad, provide effluent out flow</td>
<td>Varies</td>
<td>Unskilled</td>
</tr>
<tr>
<td>2</td>
<td>Set unit in place</td>
<td>Unload unit, unit must be leveled</td>
<td>6</td>
<td>Equip. operator, Unskilled</td>
</tr>
<tr>
<td>3</td>
<td>Piping</td>
<td>Influent and effluent. Quick coupler hoses</td>
<td>0.25</td>
<td>Soldier Operator</td>
</tr>
<tr>
<td>4</td>
<td>Electrical connection</td>
<td>Connect to on-site power (e.g.: generator), check drive rotation</td>
<td>1</td>
<td>Licensed Electrician</td>
</tr>
<tr>
<td>5</td>
<td>Internet connection</td>
<td>Link system into C4 network</td>
<td>0.25</td>
<td>Unskilled</td>
</tr>
<tr>
<td>6</td>
<td>Fill 1/2 with water</td>
<td>Use clean water</td>
<td>2</td>
<td>Unskilled</td>
</tr>
<tr>
<td>7</td>
<td>Turn system on</td>
<td>Check cycling</td>
<td>1</td>
<td>Soldier Operator</td>
</tr>
<tr>
<td>8</td>
<td>Install bio-media</td>
<td>Place in bio-reactor chambers. Include bio-starter pack</td>
<td>2</td>
<td>Unskilled</td>
</tr>
<tr>
<td>9</td>
<td>System calibration</td>
<td>Manage items such as flow meter and timers</td>
<td>6</td>
<td>Soldier Operator</td>
</tr>
</tbody>
</table>

## System Demobilization

<table>
<thead>
<tr>
<th>Step</th>
<th>Item</th>
<th>Comment</th>
<th>Man Hours</th>
<th>Skill Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Drain System</td>
<td>Let system complete treatment or empty with pump truck</td>
<td>8</td>
<td>Soldier Operator, Unskilled</td>
</tr>
<tr>
<td>2</td>
<td>Clean System (optional)</td>
<td>If not re-used in short-term, clean system interior (24 hr cycle)</td>
<td>4</td>
<td>Unskilled</td>
</tr>
<tr>
<td>3</td>
<td>Disconnect feed lines</td>
<td>Influent, effluent lines: quick coupler hoses</td>
<td>0.25</td>
<td>Unskilled</td>
</tr>
<tr>
<td>4</td>
<td>Disconnect electrical</td>
<td>Disconnect from power source</td>
<td>0.5</td>
<td>Licensed electrician</td>
</tr>
<tr>
<td>5</td>
<td>Load for transport</td>
<td>Use forklift to place on transportation from location</td>
<td>4</td>
<td>Soldier Operator, Unskilled</td>
</tr>
</tbody>
</table>
## A.2. Operational Tables

### Daily Inspection Checklist

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow Check</td>
<td>Identify any blockages in the flow of the wastewater. (e.g.: screens at bio reactor outflow, baffles, weirs)</td>
<td>Clear blockage.</td>
</tr>
<tr>
<td>Equipment check</td>
<td>Listen for unusual sounds of equipment.</td>
<td>Alert electrician of any unusual sounds.</td>
</tr>
<tr>
<td>Voltage</td>
<td>Ensure proper voltage delivered to equipment</td>
<td>Adjust power input to proper voltage.</td>
</tr>
<tr>
<td>Leaks</td>
<td>Identify leaks at any point in the system.</td>
<td>Respond as necessary.</td>
</tr>
<tr>
<td>Uniform aeration in bio-reactors</td>
<td>Open top hatches and visually inspect for even aeration.</td>
<td>May require cleaning out holes in coarse air diffusers.</td>
</tr>
<tr>
<td>Control panel bulb check</td>
<td>Ensure bulbs are operating</td>
<td>Replace burned out bulbs.</td>
</tr>
<tr>
<td>Snow Removal</td>
<td>Snow needs to be removed from around the equipment to allow for required air circulation</td>
<td>Remove any accumulated snow from the top of equipment and near blower intake.</td>
</tr>
</tbody>
</table>
B. Current EEC Small-Unit System Configurations

- **Treatment Types:** These configurations are based on treating the total wastewater (gray and black) produced by a base camp.
- **Sizing:** System can be configured to support a broad range of populations (20 to 10,000+ personnel).
- **Shipping:** All equipment is manufactured to fit within standard ISO containers from Tricons to 40' High Cubes.
- **Components:** The main process functions (equalization, bioreactors, clarification, and sludge storage) can be combined into one container for a Mini Sewage Treatment Plant (STP) or expanded to individual containers with each container performing separate process functions.

### Sizing Table

This table shows Mini STP and Bioreactor system sizes (length of unit fitting into standard ISO container) for platoon, company, and battalion sized units in an expeditionary environment. Sizing based on standard EEC system configurations. Reconfigurations will allow for more compact solutions.

<table>
<thead>
<tr>
<th>Unit Size</th>
<th>Platoon</th>
<th>Company</th>
<th>Battalion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soldiers</td>
<td>50</td>
<td>150</td>
<td>600</td>
</tr>
<tr>
<td>Total Wastewater (gpd)</td>
<td>2,650</td>
<td>13,250</td>
<td>31,800</td>
</tr>
<tr>
<td>Mini STP Length</td>
<td>12'</td>
<td>30'</td>
<td>2 x 32'</td>
</tr>
</tbody>
</table>

EEC systems can support the full range of contingency population sizes. EEC Mini Plants (above) have supported ARAMCO man camps in Saudi Arabia. EEC CON Series (below) has supported a main operating base population at Kandahar Airfield.
C. Questions and Answers

Answers to questions asked during the presentation

**Q1:** What are the Operating Temperature ranges for the EEC system (and possibly the others briefed)? Is one configuration equally deployable in Siberia as it is in the Congo (these are examples I made up)

**A1:** EEC’s system employs a biological process to treat wastewater. The system equipment can perform in an ambient temperature range of -30°C through 50°C. The biological process’ functional range is for the influent at temperatures from 8°C through 45°C. The optimum influent temperature for a biological system is 25°C for best balance of effluent quality and sludge production. Ambient temperatures have the potential to affect the temperature of the influent in process within the EEC system. A fielded system will be configured to include features to keep the influent temperature within the functional range of the biological process (e.g.: insulation, cold weather kit) regardless of ambient temperatures.

The temperature range identified here shows the range where the biological process is active. This temperature range may not enable the system to process the maximum daily wastewater treatment capacity. System will be designed to deliver targeted capacity at the limits of functional range of biological process.

**Q2:** What are the benefits of having a primary and secondary clarifier? Is this a necessary configuration?

**A2:** Standard EEC systems possess both primary and secondary clarifiers. The proposed BWPS will include these features as required by the Army’s final specification. Currently, the proposed EEC BWPS will screen incoming influent for large objects (e.g: greater than ½") and all floating objects. Equalization tankage provides settling for remaining grit. Treated effluent exiting the MBBR bioreactors is passed through a plate lamella clarifier for secondary clarification.

**Q3:** Provide a Technical description of the Influent Characteristics used as a baseline for building the Small Scale BWPS. What influent is anticipated in the CRADA?

**A3:** Targeted influent parameters for CRADA are the same as those used as a baseline for the BWPS. These are identified in slide 10. BOD 1,170 mg/L. TSS: 1,450 mg/L. Influent is to be received from Force Provider Kit kitchen and latrine components.
C. Questions and Answers (cont.)

Q4: What options do you provide for Sludge Management? Describe each option.
A4: Current EEC systems possess a sludge tank that reduce the sludge to 2% solids which are targeted for bi-monthly removal via vacuum trucks. The BWPS will treat to this same level of solids. A solution for managing sludge beyond this point has not yet been finalized although we are considering including a bag filter dewatering system. This dewatering system will reduce sludge output and minimize footprint of sludge management within our proposed solution.

Q5: Describe what type of configuration you provide to keep the influent free from solids / waste that may impede the system.
A5: Expectation is that waste flows within Force Provider kit components (latrine, kitchen units) will possess some basic screening. EEC BWPS will include a screening unit to eliminate ½”+ objects from influent flow. Equalization tankage will settle out remaining large objects and grit.

Q6: Can you provide a picture of what the expected configuration will look like for the FP Kit?
A6: Notional diagram of EEC BWPS is included in the illustration in slide 18. System will include equalization/sludge tankage (green), bioreactors (blue), and clarifier (light blue). Mechanical system and controls will be located in void located below clarifier.

Q7: Is Non-MOS a realistic approach to provide soldier O&M and PMCS support after minimal training?
A7: This is the goal of the successful candidate desired by TARDEC. EEC’s BWPS solution will include a remote monitoring capability built into its controls. It is proposed this remote monitoring will be supported by wastewater SME’s in the States to ensure operational quality and alert non-MOS staff on the ground to perform pre-defined trouble-shooting routines as required. Effectiveness of this approach will be validated during the CRADA.

Q8: Is the manpower footprint expected levels of effort for the soldier based on today’s capabilities, and do you envision the support required to decrease?
A8: The non-MOS manpower levels are based on effective remote monitoring performance described in preceding answer. Current systems operate with this same level of effort only with more skilled operators.
C. Questions and Answers (cont.)

**Q9:** Provide examples of influent and processing volumes as correlated to Sludge production; are there systems that already have preferred interfaces for sludge processing? If so, what are they?

**A9:** Sludge reduction within current EEC MBBR is approximately 1% of incoming solids. Current practice is to remove sludge from EEC MBBR on a bi-monthly basis via vacuum truck. This sludge will be approximately 2% solids. Proposed EEC BWPS will likely include a bag filter to perform dewatering function to raise the sludge solids content of 20% to 30%. Disposal of sludge will depending on available resources and accepted practices (e.g.: incineration within Force Provider Kit component, hauling, or drying bed and land application).

**Q10:** How often are the Bio Media changed out?

**A10:** AMB Bio Media ([http://www.dasusa.com/](http://www.dasusa.com/)) is used in the EEC MBBR. This bio media comes with a 20 year guarantee.