



**TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.**

## **Army Portable Water Treatment Units**

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- **TARDEC Overview**
- **Force Projection Technology Overview**
- **Water Supply Mission Background**
- **Water Treatment Units**
- **Future System**
- **Questions**



# Mission



**TARDEC develops, integrates, and sustains the right technology solutions for all manned and unmanned DOD ground systems and combat support systems to improve Current Force effectiveness and provide superior capabilities for the Future Force.**

## Accomplished by

- **Leading Systems Integration excellence across the Life Cycle**
- **Continuous pursuit of innovation in our technology focus areas**
- **Living our core and enterprise values**

*TARDEC - Responsible for Research, Development and Engineering Support to **2,800** Army systems and many of the Army's and DOD's top joint warfighter development programs.*

## Combat Vehicles

- Heavy Brigade Combat Teams
- Strykers
- MRAPs
- Ground Combat Vehicles (Future)



## Force Projection

- Fuel & Water Distribution
- Force Sustainment
- Construction Equipment
- Bridging
- Assured Mobility Systems



## Tactical Vehicles

- HMMWVs
- Trailers
- Heavy, Medium and Light Tactical Vehicles



## Watercraft

- High Speed Vessel
- Causeways
- Harbor Craft
- Landing Craft



## Robotics

- Technology Components
- Demonstrators
- Military Relevant Test & Experimentation
- Transition and Requirements Development



TARDEC Engineers Provide Cradle-To-Grave Engineering Support



# TARDEC is Connected



## 1st Tier Automotive Industry



## Department of Defense



## 2nd and 3rd Tier Industry Suppliers



## Engineering Societies



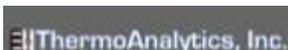
## Defense Industry



## Non Profit Org



## Power Management Industry



## Academia



*“Leveraging Opportunities to Fill Technology Gaps.”*

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# Force Projection Technology Mission



- Serve as the DoD responsible agent for all ground fuels and lubricants and the lead DoD Lab for Water Supply and Wastewater Treatment
- Perform research, development and engineering support:
  - **Fuel Handling & Quality Surveillance Equipment**
  - **Water Purification, Handling, & Quality Equipment**
  - **Material Handling Equipment**
  - **Tactical Military Bridging**
  - **Combat Engineer (Construction) Equipment**
  - **Mechanical Countermine & Counter IED Equipment**
  - **Fuels and Lubricants for Ground Systems**
  - **TARDEC Fuels & Lubricants Research Facility at Southwest Research Institute (GOCO)**
  - **Army Petroleum Laboratory**
- Recognized experts in Commercial Off-The-Shelf (COTS) & Non Developmental Items (NDI)
- Respond to MANSCEN (EN, MP) and CASCOM (TC, QM)

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# Force Projection Technology Facilities



- POL Labs
  - Fuel, oil, grease, coolants, etc.
  - Oil filter test rig
  - Fuels & Lubricants Research Facility (Southwest Research Institute)
  - Army Petroleum Lab – New Cumberland, PA
- Water lab
  - Basic water quality parameters used to monitor performance of field water treatment systems
- Water equipment test area
  - Bench scale testing
  - Useful for concept evaluation
- Fresh water test site at Selfridge Air National Guard Base (SANG-B)
  - Both pilot and full scale testing
  - New Equipment Training site
- Seawater test site at Port Hueneme, CA
  - Both pilot and full scale system testing
- Dynamic Structural Load Simulation Lab at Selfridge Air National Guard Base
  - Sub-scale to full scale structure testing rig
  - Static and dynamic load testing
  - Accommodates testing by other TARDEC groups

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# Water Treatment Testing Capability



## Freshwater Test Facility @ SANG B350

- Year Round Water Access
- Approved NPDES discharge permit for 500K GPD
- 6" exterior sanitary drain and interior drains are easily accessible
- 7,500 square feet of heated floor space; 1,500 square feet of loft area over office for storage
- 440V, 240V and 120V power available
- Military water purifiers (TWPS, LWP, ROWPUs) are available for use



## Seawater Test Facility – Port Hueneme, CA

- Year-round access to natural seawater
- Approved discharge permit
- Military water purifiers (TWPS, LWP, ROWPUs) are available for use



## Water Quality Lab – B210

- organic and inorganic analysis

## Water Treatment Test Lab – B210

- Reverse osmosis membrane test stands
- Water and wastewater treatment component testing
- GAC/IX testing



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## Background



- **Drinking Water Related Health Problems in WWI lead to development of the Mobile Water Purification Unit**
- **The Mobile Water Purification Unit found to be only partially effective during WWI**
- **After WWII, multiple units developed for various types of source water**
  - **Seawater Distillation Unit**
  - **NBC Treatment Unit**
  - **Fresh Water Purifier (ERDLATOR)**
- **Use of multiple units led to logistics and training problems**
- **US Government funded research in Reverse Osmosis led to fielding of Reverse Osmosis Water Purification Units (ROWPUs) in the 1980's**

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- *Water weighs ~8.3 pounds per gallon*
- *3-4% Water deficit (2-3 quarts) significantly reduces performance (up to 48%)*
- *6-8% Water deficit (4-6 quarts) renders a soldier completely ineffective*
- *Minimum water consumption is 1 gallon/ soldier/ day to 3 gallon/ soldier/ day*
- *Universal unit level average is 6.6 gallon/ soldier/ day (53 pounds)*
- *Water is projected to be 30 to 40% of the daily sustainment requirement*
- *Fully developed theater requires 15.6 gallon/ soldier/ day or 129.5 pounds*





# Primary Water Storage & Distribution Equipment



## Distribution

**TWDS** - Tactical Water Distro System (10 mi hoseline sets)

**SMFT** - Semi-Trailer Mounted Fabric Tank (3k and 5k sizes)

**FAWPSS** - Forward Area Water Point Supply System

**400 Gallon Water Trailer**

**M149A2 Water Trailer**

**Camel**

**800 Gallon Water Trailer**

**Hippo**

**2000 Gallon Tank Rack**



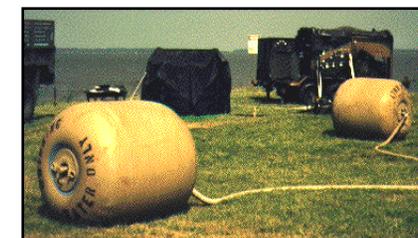
The **HIPPO**



400 Gallon Water Trailer (400 Gal)



The **CAMEL**



**FAWPSS**  
Six 500 gallon drums, one 125 GPM pump, and hoses



SMFTs two sizes (3K & 5K)

**TWDS**--10 miles of hoseline; six 600 GPM pumps; two 20K storage tanks; two 125 gpm pumps

## Storage Systems

**SDS** - Storage & Distro Systems consist of 50K and 20K bags

**Onion Bag** - 3,000 gal thin skinned bag for temp storage



**SDS** come in 800K, 300K, 40K and 20K sizes complete with bags, hoses, & pumps.



# 600 GPH Reverse Osmosis Water Purification Unit (ROWPU)



- Produce potable water that meets Tri-Service Standards from any available source
- System produces 600 gallons per hour on seawater (35,000 ppm) and 900 gallons per hour on freshwater
- Raw water intake system – strainer and raw water pump
- Clarification system – multi-media filter, cartridge filter, chemical injection pumps
- Purification system – high pressure pump, 8 6-inch reverse osmosis elements
- NBC decontamination system – activated carbon, mixed-bed ion exchange
- Disinfection by Chlorination



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## 600 GPH ROWPU Characteristics



- 30 kW Generator (Army only)  
2850 lb
- 5 ton Trailer (Army only)  
5595 lb
- Skid mounted (USMC and AF)
  - 9.5 L x 7 W x 5.7 H ft
  - 7300 lb
- Trailer Mounted with 30Kw generator
  - 19 L x 8 W x 8 H ft
  - 16,975 lb
- Three - 3K onion tanks packed w/ROWPU
- GAC, IX and chlorination post treatment for NBC removal
- Chlorination to 2 ppm
- Feed flow – 30 gpm
- Multi-media filtration  
6-7 gal/min/sq. ft
- 5um cartridge filtration  
8 ea - 2.5 inch dia x 40 inch long filters  
String wound, polypropylene
- Reverse osmosis  
8 ea – 6 inch dia. X 40 inch long polyamide RO elements  
Avg salt rejection – 99.4%  
All elements in series  
50% recovery on freshwater and 33% on seawater

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- Produce potable water that meets Tri-Service Standards from any available source
- System produces 2000 gallons per hour on seawater (35,000 ppm) and 3000 gallons per hour on freshwater
- Raw water intake system – strainer, raw water pump, and cyclone separator
- Clarification system – multi-media filter, cartridge filter, chemical injection pumps
- Purification system – high pressure pump, 12 8-inch reverse osmosis elements
- NBC decontamination system – activated carbon, mixed-bed ion exchange
- Disinfection by Chlorination



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## 3000 GPH ROWPU



- Contained in a special ISO container with skid mounted external components
  - Mounted on a standard 30ft M871 military trailer
  - Powered by a 60kw diesel generator also mounted on the trailer
  - Dimension & Weight: 20'L x 8'H x 8'W, 15,100lbs (fully packed container/ROWPU only)
  - Dimension & Weight: 30'L x 13'H x 8'W, 37,960lbs (fully packed and mounted on trailer w/generator)
  - Three - 3K onion tanks packed w/ROWPU, seven additional tanks come with the system for a total of ten at 135lbs each
- Feed flow – 100 gpm
  - Multi-media filtration  
12-13 gal/min/sq. ft
  - 3um cartridge filtration  
12 ea - 2.5 inch dia x 40 inch long filters  
String wound, polypropylene
  - Reverse osmosis  
2 ea – 8 inch dia. X 40 inch long polyamide RO elements  
Avg salt rejection – 99.4%  
2x1x1 array  
50% recovery on freshwater and 33% on seawater
  - GAC, IX and chlorination post treatment for NBC removal
  - Chlorination to 2 ppm

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# 1500 GPH Tactical Water Purification System (TWPS)



- Produce potable water that meets Tri-Service Standards from any available source
- System produces 1200 gallons per hour on seawater (45,000 ppm) and 3000 gallons per hour on freshwater
- Pretreatment System - 0.2 micron Microfiltration membranes
- Desalination System - Ten (10) RO elements, two (2) FMC composite pumps, energy recovery device
- Compressed Air - Three stage compressor supplies air for automatic valves, controls and MF backflushing process
- Chemical Injection System - Sodium bisulfite (chlorine removal); Anti-scalant, and Chlorine
- Product Water Distribution - 6000 gallon storage, one 125 gpm pumps
- NBC Post-Treatment - activated carbon and ion exchange resin



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# 1500 GPH TWPS Characteristics



- USMC and Army version have the same base skid-mounted system
- Army system is mounted in a ISO flatrack and includes a 60kW TQG and the following kits:
  - Cold Weather
  - Chemical Cleaning Wastewater Storage
  - NBC Water Treatment
  - NBC Survivability
  - Ocean Intake Structure
- USMC orders the kits separately as required
- Dimensions and Weight
  - Army: 8'H X 8'W X 20'L, 23,300 lbs
  - USMC: 6'H X 7.16' X 13.75' L  
10,000 lbs
- Transportability
  - Army – HEMTT LHS or PLS
  - USMC - MTRV
- Feed flow – 50 gpm
- Product Flow
  - Freshwater – 1800 GPH
  - Brackish/seawater 1500 GPH
- Strainer - 60 micron
- Microfiltration
  - MEMCOR system – 0.2 micron hollow fibers
  - 12 MF modules/outside-in filtration
  - Backflushes every 15 mins for approx 1 min
- Reverse osmosis
  - 10 ea – 8 inch dia. X 40 inch long polyamide RO elements
  - Avg salt rejection – 99.4%
  - 50% recovery on freshwater and 40% on seawater
- GAC, IX and chlorination post treatment for NBC removal
- Chlorination to 2 ppm

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# Lightweight Water Purifier (LWP)



- Produce potable water that meets Tri-Service Standards from any available source
- System produces 75 gallons per hour on seawater (45,000 ppm) and 125 gallons per hour on freshwater
- Raw water, booster and distribution pumps run off 3kW Tactical Quiet Generator (TQG)
- Diesel driven HP pump
- Treatment by settling, ultrafiltration and Reverse Osmosis (RO)
- Disinfection by chlorine addition
- Coagulant, Sodium Bi-Sulfite and Anti-Scalant injection pumps
- GAC for removal of NBC contamination



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# Lightweight Water Purifier Characteristics



- **Base Unit**
  - Pretreatment Module
  - Pump Module
  - Control Module
  - 3 kW generator
  - High Pressure Pump Module
  - RO Module
  - Chemical Injection/Cleaning Module
  - 2 ea 1000 gal onion tanks
- **Supplemental Cold Weather Kit**
- **Transportability**
  - M1097 HMMWV
  - UH-60 Helicopter
  - C130
  - Air Droppable
- **System Dimensions and Weight**
  - 2000 lbs
  - 4.25'L X 2.25'W X 4' H (HMMWV bed size)
- **Feed flow – 5.0 gpm**
- **Product Flow**
  - Freshwater – 125 GPH
  - Brackish/seawater 75 GPH
- **Ultrafiltration**
  - Koch system – 0.05 micron hollow fibers
  - 3 UF modules/inside-out filtration
  - Backflushes every 15 mins for approx 1 min
- **Reverse osmosis**
  - 7 ea – 2.5 inch dia. X 40 inch long polyamide RO elements
  - Avg salt rejection – 99.4%
  - 50% recovery on freshwater and 30% on seawater
- **GAC, IX and chlorination post treatment for NBC removal**
- **Chlorination to 2 ppm**

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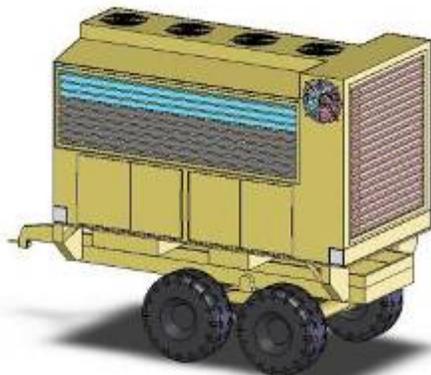
# Military Water Purification Equipment Summary



Note: Values presented based on Seawater	LWP	600 ROWPU	3k ROWPU	Army TWPS	EUWP
• Production Rate (gph)	75	600	2,018	1,500	4,170
• Avg RO Flux (gfd)	8.9	12	13.7	7.6	11
• MF/UF Flux (gfd)	25	na	na	25	40
• RO Recovery (%)	30	31	33	40	50
• Weight (gpd/lb.)	1.09	1.40	1.88	1.26	2.62
• Cube (gpd/cu.ft.)	12.9	31.3	28.8	22.5	38.9
• C-130 Lift (gpd)	na	43,200	48,500	28,800	100,000

- Able to purify any source - lake, river, ocean, NBC contaminated - in sufficient quantities **BUT**
  - Systems have large energy (fuel) requirements
    - 20 to 50 kW-Hr/ Kgal
  - Systems have a large footprint (size/weight)
    - Systems require operational changes for certain contaminants
  - Systems are a logistics burden - large volume of consumables (filters, membranes, chemicals)

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**Purpose:**

- Develop the capability to produce drinking water by harvesting water from humidity sources.
- Develop distributed water generation/storage technology.

**Results:**

- 7.5-ton trailer-mounted 500 gpd water production system.
- Performance testing and field experimentation to evaluate military utility.

**Payoff:**

- Enables deployed units to have water production and storage capability.
- Reduces the logistical footprint associated with water storage and distribution.
- Transitions to PM PAWS, PM FCS (BCT) by FY12.

MILESTONES	FY09	FY10	FY11
<i>Design &amp; Fabricate trailer-mounted water production demonstrators</i>			
<i>Conduct Contractor In-Plant &amp; Gov't Performance Testing</i>			
<i>Conduct Realistic Testing w/ soldiers</i>			6
<i>Address issues identified during testing; Transition to PM PAWS, PM FCS (BCT)</i>			6

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**THE WORLDS ULTIMATE WEAPON RUNS ON WATER...  
EVERYTHING ELSE RUNS ON FUEL.**





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**Questions?**

**Back up Slides**



# Military Water Treatment Equipment



- **600 ROWPU – Fielded 1981**
- **3000 GPH ROWPU - Fielded 1989**
- **1500 GPH Tactical Water Purification System (TWPS)  
Fielded 2004**
- **Lightweight Water Purifier (LWP) – Fielded 2005**

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# ROWPU Shortfalls



- Insufficient water production
- Outdated pretreatment technology (media filtration and cartridge filtration)
  - High cartridge filter and RO element replacement costs when operating on turbid source waters (greater than 20 NTU)
  - Increased time required for additional preventive maintenance checks and services (PMCS), filter backwash and filter replacement when operating on turbid waters
  - Operation on a very turbid water source (150 NTU) would be impractical from maintenance and logistics perspective.
- Will not operate adequately in freezing temperatures (below 32°F)
- Not capable of providing acceptable quantities of potable water from seawater with extremely high total dissolved solids (TDS) levels (< 35,000 ppm), such as those encountered during Operation Desert Shield and Desert Storm.
- Not capable of providing acceptable quantities of potable water from low temperature (e.g. 32 degrees Fahrenheit) water sources

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**Production---Tactical Water Purification System (TWPS) and Light Weight Water Purifier (LWP)**



**TWPS** is transported by HEMMT LHS and produces 1500 GPH from fresh and 1200 from salt water. Each TWPS replaces two 600 ROWPUs.



The **LWP** can be transported in the back of a HMMWV and produces 125 GPH from fresh or 75 GPH from salt water.

**Distribution--Water Tankrack--(HIPPO) and Unit Level Water Distribution (CAMEL)**



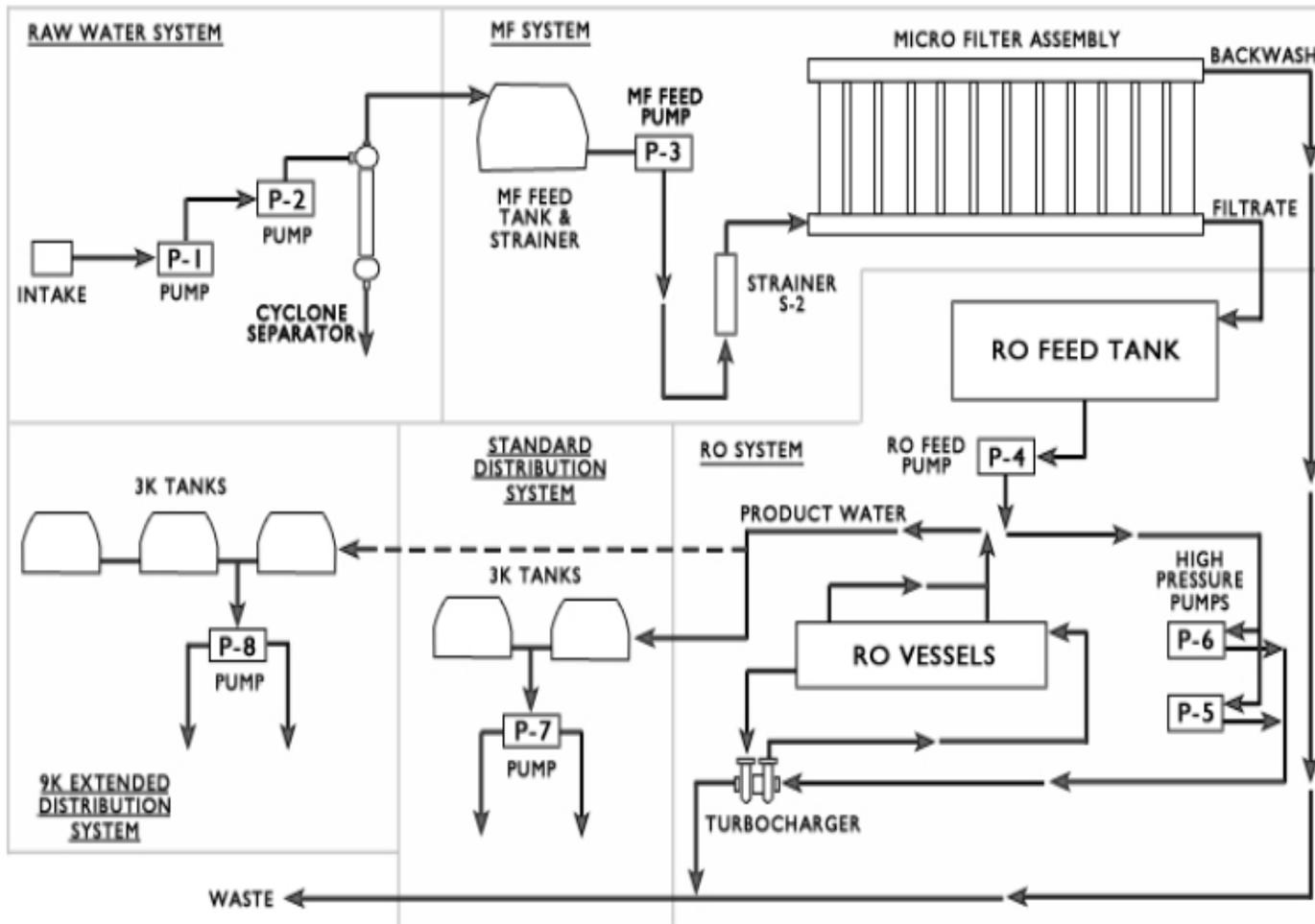
The **HIPPO** is a 2000 gallon hardwall tank, mounted on a tankrack. It includes a hose reel, 125 gpm pump, and a canteen fill stand.

The **CAMEL** replaces the current water buffalo in units with 5-ton trucks. It will carry 800 gallons and includes a heater and chiller.



800 gal

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# Developmental Efforts



- Military Unique Requirements
- Increase Production Capacity
- Reduce Power
- Reduce Maintenance (fouling)
- Minimize Logistics
- Maximize Reliability
- Evaluation of Commercial Products
  - RO Pretreatment Studies
    - UF/MF (PDVF)
    - Improved Filtration
    - Automated Screens
  - Chemicals
  - Seawater materials
  - Energy Recovery
- Cyanide, Arsenic, & Other Difficult to Remove Contaminants
- RO/GAC – nerve agent removal
- Ion Exchange
- Improve Palatability Water Provided
- Water Reuse and Recycle

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# Current Pre-Planned Product Improvement Efforts



- **TWPS**
  - Coagulant study
  - Improved chemical cleaners
  - Increase production rate
  - Training aids
- **LWP**
  - Noise Reduction
  - Improved chemical cleaners
  - Increase production rate
  - UF integrity testing
  - Improved solenoid valves
  - Energy recovery

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# TB MED 577 Water Quality Standards



Table C-2. Long-term field water quality standards (less than 1 year)

CONSUMPTION RATE	U.S. Tri Service (June 1996)		QSTAG 245 (Sep 1985)	STANAG 2136 (Sep 1995)
	5 L/Day	15 L/Day	5 L/Day	5 L/Day
<u>Physical Properties</u>				
Color (Color Unit)	15	15	15	15
Odor (TON)	3	3	--	3
pH	5 - 9	5 - 9	5 - 9.2	5 - 9
Temperature (Degrees C)	15 - 22	15 - 22	15 - 22	15 - 22
TDS (mg/L)	1000	1000	1500	1000
Turbidity (NTU)	1	1	1	1
<u>Chemical Properties</u>				
Arsenic (mg/L)	0.06	0.02	0.05	0.06
Cyanide (mg/L)	6	2	0.5	6
Chloride (mg/L)	600	600	600	600
Lindane (mg/L)	0.6	0.2	--	--
Magnesium (mg/L)	100	30	150	100
Sulfate (mg/L)	300	100	400	300
<u>Microbiological</u>				
Coliform (#/100 mL)	0	0	1	1
Virus (#/100 mL)	--	--	1	1
Spores/Cysts (#/100 mL)	--	--	1	1
<u>Radiological</u> ( $\mu$ Ci/L)	0.1	0.05	0.06	2.2 Bq/mL

Current EPA Std was reduced to .01 mg/L in Jan. 2006

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## Michigan Army National Guard & Army Reserve Units Water Purification Units



- the numbers of water purification systems in the
- Michigan Army National Guard and an Army Reserve unit:
  
- one National Guard unit in Michigan - the
  
- 714TH QM CO. The assets they have are:
  - LWP - 3
  - TWPS - 0
  - 3K ROWPU - 5
  - 600 ROWPU - 0
  
- The Army Reserve unit in Michigan (301ST QM Co) which has the following:
  - LWP - 2
  - TWPS - 1
  - 3K ROWPU 6

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