AIR FORCE TACTICS, TECHNIQUES, AND PROCEDURES 3-32.34 VOLUME 4

7 DECEMBER 2023

CONTINGENCY WATER SYSTEM

DEPARTMENT OF THE AIR FORCE

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BY ORDER OF THE SECRETARY OF THE AIR FORCE

AIR FORCE TACTICS, TECHNIQUES, AND PROCEDURES 3-32.34V4

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Tactical Doctrine

CONTINGENCY WATER SYSTEM

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This Air Force Tactics, Techniques, and Procedures (AFTTP) supports Air Force Instruction (AFI) 10-210, *Prime Base Engineer Emergency Force (BEEF) Program* and describes system components, installation, and operation of contingency water systems. This publication applies to the Regular Air Force, the Air Force Reserve, and the Air National Guard. This publication does not apply to the United States Space Force. Refer recommended changes and questions about this publication to the Office of Primary Responsibility using the Department of the Air Force (DAF) Form 847, *Recommendation for Change of Publication*; route DAF Forms 847 from the field through the appropriate functional chain of command and Major Command publications/ forms managers. Ensure all records generated as a result of processes prescribed in this publication adhere to AFI 33-322, *Records Management and Information Governance Program* and are disposed in accordance with the Air Force Records Disposition Schedule, which is located in the Air Force Records Information Management System. The use of the name or mark of any specific manufacturer, commercial product, commodity, or service in this publication does not imply endorsement by the DAF.

APPLICATION: This publication is intended for CE personnel tasked to site and setup the Basic Expeditionary Airfield Resources (BEAR) Water System at contingency locations. This AFTTP is nondirective and does not replace policy documents, technical orders and manuals, or any applicable mandatory procedures or instructions. Personnel should adhere to applicable technical, safety, and policy requirements when performing tasks addressed in this publication.

SCOPE: The data presented herein addresses siting, setup, and operational concepts of BEAR water system. It streamlines procedures, offers illustrations and examples, provides references, simplifies instructions, and includes lessons learned from the field. The information in this publication does not supersede any legal requirements (domestic United States law for operations in the United States and for operations outside the United States: United States law with extraterritorial application, applicable international agreement requirement, or combatant command directive) that specify how users must accomplish tasks related to contingency water and wastewater systems installation or operation.

Chapter 1

INTRODUCTION

1.1. General Information. The Basic Expeditionary Airfield Resources (BEAR) Water System, provides potable water and wastewater recovery at contingency locations, provided there is a source of potable water or water that can be made potable. The water system provides water to support base facilities and recovers the wastewater for appropriate disposal. The water system is modular in design and scalable to meet a variety of user deployment needs. It can draw raw water from a natural source (i.e., pond, lake, stream, sea, or ocean) and then purify, store, and distribute the potable water while maintaining sufficient pressure, quantity, and quality for an entire base. The selected modular configuration determines the amount of potable water the system will produce per day. With the appropriate adapters, the system can also draw and distribute water from other potable water sources.

1.2. System Overview. The BEAR water system consists of five subsystems: (1) Source Run Subsystem, (2) Water Production Subsystem with Reverse Osmosis Water Purification Units, (3) 550-Initial Subsystem, (4) 550-Follow-On Subsystem, and (5) the Industrial Operations and Flightline Extension Subsystem (**Figure 1.1**).

1.2.1. The system is semi-automatic in that the 3,000-gallon facility storage tanks will fill automatically if operators maintain the manually filled 20,000-gallon storage tanks at the appropriate level. After filling the system to full capacity, water should be available for 5 days given 30 gallons per person per day usage. The removal of facility wastewater is also automatic under normal circumstances and does not require manual intervention.

1.2.2. The water system has a series of color-coded piping, pumping, fluid control, and water storage components that comprise five distinct subsystems. **Figure 1.2** lists color assignment for subsystem components.

Figure 1.1. Contingency Water Subsystems.

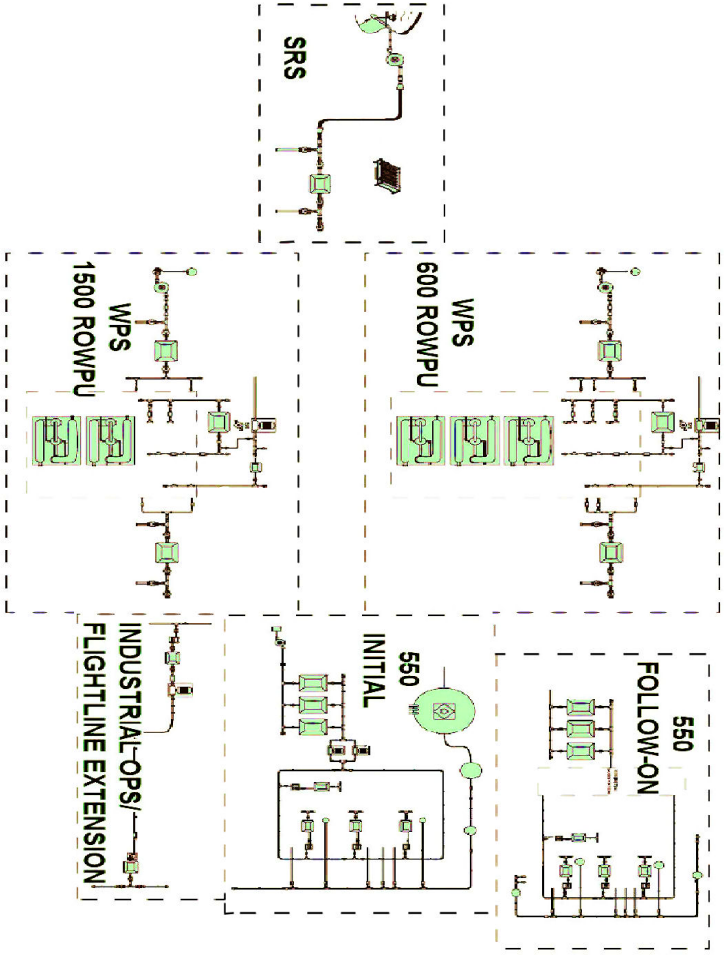
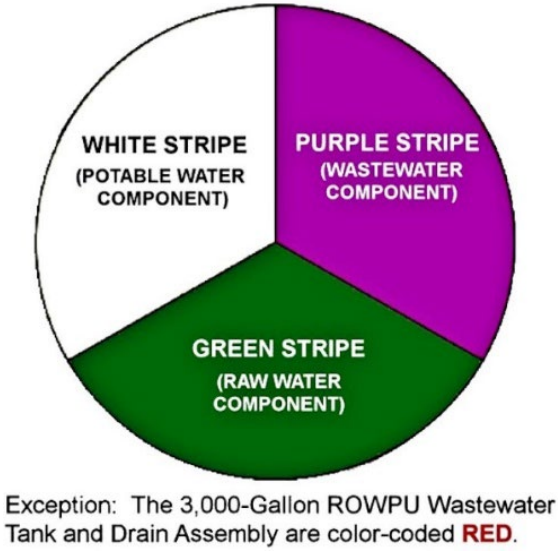


Figure 1.2. Color-Coding of Subsystem Components.



1.3. Technical Resources and Information. Refer to Technical Order 40W4-21-1-WA-1, *Basic Expeditionary Airfield Resources (BEAR) Water System PN 3000001*, for detailed information on the BEAR water system. It addresses information such as unpacking, preparation for use, safety, assembly, and operation and maintenance instructions. Further information on the installation and operation of the BEAR water system is available in the *Basic Expeditionary Airfield Resources (BEAR) Water System Course* on the myLearning system at https://lms-jets.cce.af.mil/moodle/**.** In addition, contact the Air Force Civil Engineer Center Reach-Back Center when looking for information not found in the references in **Attachment 1**. Contact the Reach-Back Center at 1-888-232-3721 (toll free), 1-850-283-6995 (commercial), Defense Switched Network 312-523-6995, or email at AFCEC.RBC@us.af.mil**.**

1.4. Environmental Considerations. Safe food and water, and proper disposal of waste is essential. The intention of environmental goals during contingencies is to minimize risks to human health and safety and prevent unnecessary damage to the environment while maximizing the natural resources available to support readiness and operational effectiveness. Further information on integrating environmentally responsible practices during contingency operations is available in Department of Defense Instruction 4715.22, *Environmental Management Policy for Contingency Locations* and Air Force Handbook 10-222V4, *Environmental Considerations for Overseas Contingency Operations*.

1.5. General Safety Practices. Every job or operation has its own safety hazards, and everyone involved should adhere to proper safety practices to prevent injury or illness. This is especially critical during force beddown at austere locations and base recovery activities. Exposure to construction, heavy equipment, power production equipment, fuel systems, mechanical systems, and water or wastewater systems create an assortment of job-related hazards. Be alert for water system hazards such as highly pressurized subsystems and components, flammable fuels, hazardous chemicals, and infectious black and gray water products from wastewater systems. Also guard against electrical, fire, tripping, and falling hazards. Remain vigilant to stay safe. **Note:** As used in this publication, black water refers to latrine wastewater containing human waste. Gray water refers to wastewater from non-latrine sources such as showers, laundries, kitchen operations, and handwashing devices.

1.5.1. Personnel should wear the appropriate protective clothing and equipment for the hazard present. Department of the Air Force Manual 91-203, *Air Force Occupational Safety, Fire, and Health Standards*, lists personal protective equipment for selected Civil Engineer activities. Workers have the ultimate responsibility to properly use, inspect, and care for individual protective equipment assigned to them.

1.5.2. When lethal voltages are involved, workers should adhere to Air Force Manual 32-1065, *Grounding & Electrical Systems*. Personal protective equipment that provides appropriate arc flash protection is required for all personnel working

on or near exposed energized electrical equipment operating at 50 volts or more. See Unified Facilities Criteria (UFC) 3-560-01, *Electrical Safety, O&M*, and National Fire Protection Association (NFPA) 70E, *Standard for Electrical Safety in the Workplace*, to identify tasks that require Arc Flash personal protective equipment.

Chapter 2

BASIC PREPARATIONS AND SITE LAYOUT

2.1. General Information. How CE teams setup, operate, and maintain contingency water systems vary by location and depend a great deal on the terrain features, water source, and the type and quantity of users. Since potential locations or sites may not need every available contingency water subsystem, the modular design of the BEAR water system allows planners to select specific subsystems based on the needs at the contingency location. However, to address overall system installation and operational concepts, here we describe all subsystems as interconnected, not stand-alone. Further, we used the Source Run Subsystem option for raw water collection and the Water Production Subsystem option for water production to illustrate collection and production capabilities.

2.2. Basic Preparations. A key factor to consider when preparing for contingency water operations is the establishment of access to an adequate water source to sustain operations, usually a municipal water supply or nearby raw water source. In addition, consider the site location, size of the base supported, and requirements for prepositioning equipment. Try to provide adequately detailed plans so a work crew can off-load selected subsystems at designated locations and assemble them in minimum time. Consider taking full advantage of Installation Geospatial Information and Services satellite imagery, global positioning system information and common installation picture databases, when making site preparations. The Air Force GeoBase system provides good resources for beddown planning of water systems in relation to site layout, terrain, and available water sources. Access the Air Force GeoBase system easily and securely through the Air Force Portal using the link in **Attachment 2**. For additional information on contingency water operations beyond those addressed here, refer to Air Force Pamphlet 10-219, Volume 6, *Planning and Design of Expeditionary Airbases*.

2.3. Site Layout. Wherever the base is located, there should be adequate real estate outside of the camp placement area to allow for the Water Operations Area. The Water Operations Area is an area identified for the Dual Water Pump Station,

Water Tank Farm, and Water Production subsystems (**Figure 2.1**). Site the Water Operations Area on terrain that is relatively flat and free of debris. **Table 2.1** provides Water Operations Area dimensions and the quantity of water production subsystems relative to the base or camp population. **Figure 2.2** shows a typical location for a Water Operations Area in relation to the camp facilities layout area. **Note:** Reverse Osmosis Water Purification Unit components not displayed.

Figure 2.1. Illustration of Subsystems within a Water Operations Area.

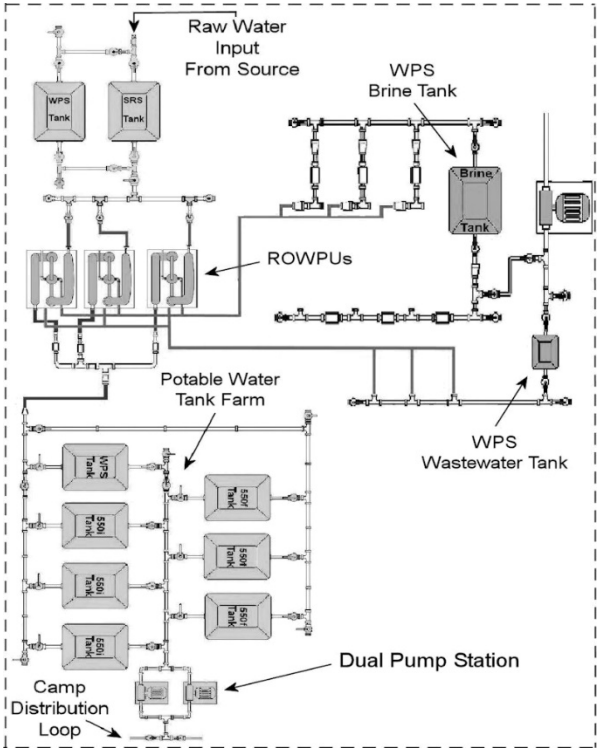
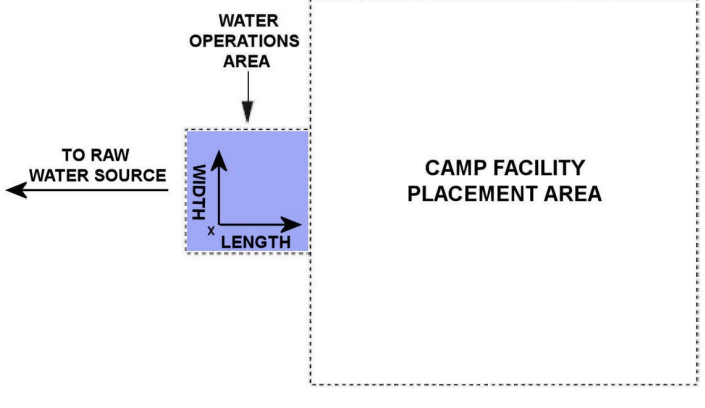


Table 2.1. Water Operations Area Layout Dimensions and Water Production Subsystems.

Camp Populace	Gallons Required per Day (30 Gallons per Person per Day)	Tank Farm ONLY Area in Feet (Width x Length)	Tank Farm w/1500 Water Production Subsystem	1500 Water Production Subsystem Quantities 60,000 Gallons per day (2 Reverse Osmosis Water Purification Units)
550	16,500	50 x 130	140 x 230	1
1100	33,000	80 x 130	140 x 230	1
1650	49,500	160 x 130	140 x 230	1
2200	66,000	160 x 160	210 x 260	2
2750	82,500	160 x 190	280 x 290	2
3300	99,000	160 x 190	280 x 290	2
4400	132,000	200 x 220	350 x 320	3

Figure 2.2. Location of Water Operations Area (Typical).



2.4. Equipment Preparation. Consider prepositioning equipment that is ready for installation in those areas where work crews will use the equipment. Preplanning should have included drop-off points, the establishment of temporary roads to the sites, and use off-loading equipment, such as forklifts and cranes (**Figure 2.3**). When the equipment arrives, work crews should unpack, inspect, and inventory equipment to verify required components and parts are on hand. Each subsystem contains all the parts listed in the technical order inventory, including extra parts left over after subsystem assembly. The extra parts are intentional to provide system flexibility and a source for replacement parts. **Attachment 3** illustrates common components for subsystems. Though addressed in the technical order, cold weather kits for these subsystems are currently under development and are not included. During inventory, personnel should quickly repair or replace unserviceable or missing equipment. Additionally, make sure to retain and store all serviceable packing material and shipping containers for reuse.

Figure 2.3. Heavy Equipment Needed to Preposition Water Subsystems.

2.5. System Flexibility. Work crews have the flexibility to configure the water system to meet the specific deployment needs of the unit; the planned or final installation at your base may not look exactly as depicted in this handbook. Regardless, the diagrams and illustrations presented in this publication are still applicable and can provide sufficient guidance to accomplish installation tasks even if a different configuration of equipment is required. Keep in mind the plumbing illustrations provided here depict basic subsystem plumbing using a typical layout and a standard water production subsystem. Users should refer to Technical Order 40W4-21-1-WA-1 for detailed configuration procedures.

2.6. Subsystems Interface. The interface to various subsystem components is normally accomplished using suction or discharge hoses with quick disconnect fittings. Connect these quick disconnect fittings using procedures in **Attachment 4**. In some instances, engineers may need to convert to Polyvinyl Chloride pipe connections in unusual areas where it is necessary to bury water distribution plumbing to prevent damage. Refer to Technical Order 40W4-21-1-WA-1 if it becomes necessary to use Polyvinyl Chloride pipe connections or to fabricate other threaded or non-threaded connections.

Chapter 3

SOURCE RUN SUBSYSTEM

3.1. General Information. The Source Run Subsystem provides raw water input (source water) for the contingency water system. It can pull water from a raw water source (i.e., river, lake, sea, or ocean) up to 100 feet away and 20 feet below the pumping station. The system can pump the source water a distance of 6000 feet and a height of 150 feet to a raw water storage tank.

3.2. Components. Illustrated in **Figure 3.1** and described in **Table 3.1** are the major components that make up the Source Run Subsystem. However, for a complete list of all subsystem components, including nomenclature and quantities per subsystem, refer to **Table 3.2** in this handbook and the Source Run Subsystem Illustrated Parts Breakdown in Technical Order 40W4-21-1-WA-1.

Figure 3.1. Source Run Subsystem.

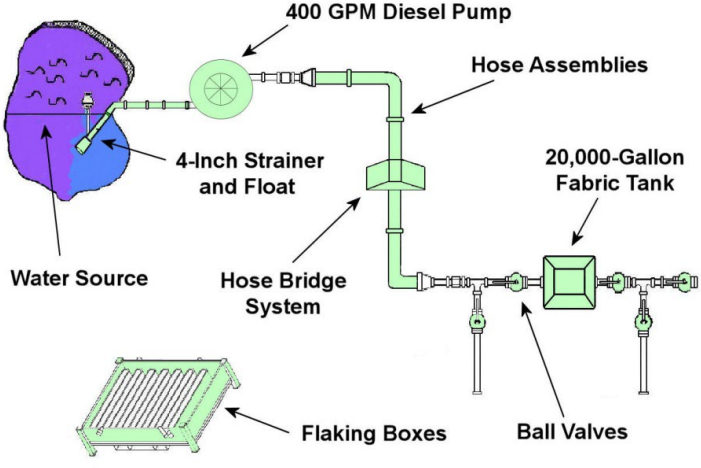


Table 3.1. Source Run Subsystem Major Components.

Component	Function/Use
4-Inch Strainer and Float Assembly	Provides a coarse filter to prevent impurities such as trash, twigs, and debris from entering the Source Run Subsystem. The float buoy, with cable, keeps the strainer end of the suction hose from lying on the bottom of the raw water source where dirt and gravel could enter the Source Run Subsystem. (Green Stripe)
400-Gallon per Minute Diesel Pump	Pumps water at a rate of 400 gallons per minute at 300-foot maximum head from a raw water source to the Source Run Subsystem storage tank. (Green Stripe)
20,000 Gallon Collapsible Fabric Tank	Stores raw water pumped from the source. (Green Stripe)
Hoses	Routes raw water from the source to the storage tank. Hoses are various sizes. (Green Stripe)
Hose Bridge System	Protects water distribution hoses when the hoses cross a roadway or similarly traveled area.
Ball Valves	Controls raw water input flow, output flow, and draining of the Source Run Subsystem storage tank. (Green Stripe)
Flaking Boxes (10 each)	Serve as a storage space for the hoses when not in use. Each box contains four 150-foot lengths of 6-inch hose.

3.3. Installation. Depending on the distance from the water source, it may be necessary to connect multiple Source Run Subsystems to reach the camp. Before installing the Source Run Subsystem, review the planned dimensions of the water operations area (see **Table 2.1**). Then, refer to component layout diagrams in this chapter and the list in **Table 3.2** to identify each numbered component when performing the steps below.

WARNING

To prevent injury to personnel and/or damage to equipment units, ensure adequate personnel and lifting equipment are available to preposition equipment.

3.3.1. Position 400-Gallons per Minute Pump and Assemble Strainer and Float Buoy. Position the 400-gallons per minute diesel pump and assemble the Source Run Subsystem strainer, float buoy, hoses, and associated components according to the following procedures and accompanying illustrations.

3.3.1.1. Position the trailer-mounted 400-gallons per minute pump assembly (**Figure 3.2**) within 100 feet of the raw water source. Then, set the trailer parking brake and chock the wheels to prevent the trailer from moving. Afterward, level the trailer and lower the stabilizer jacks.

Figure 3.2. 400-Gallons per Minute Diesel Pump (Typical).

WARNING

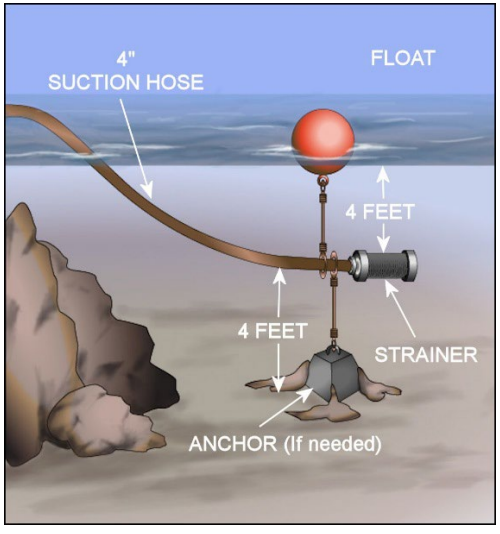
If required to enter the water for installation of the Float Buoy and Strainer, personnel must wear life preservers (personal flotation devices), be connected to a tag line, and have a safety observer.

CAUTION

When inflating the float buoy, it will become bulky and possibly hard to handle. Use care to prevent buoy from contacting sharp objects, which may cause damage to the buoy.

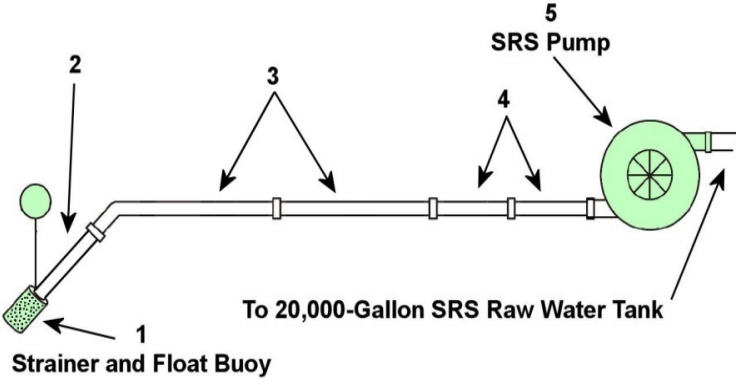
3.3.1.2. Inflate the buoy with the hand pump while being careful to avoid sharp objects or similar items that could damage the buoy. Then, connect the wire rope to the strainer and float buoy. Configure the wire to keep the strainer submerged at least four feet, when the strainer and buoy deploys. If possible, confirm the strainer is also at least four feet from the bottom of the raw water source to avoid sand or silt from entering the system. It may also be necessary to anchor the strainer and float buoy due to constant wave motion (**Figure 3.3**).

Figure 3.3. Positioning Float Buoy, Strainer, and Anchor.



3.3.1.3. Using **Figure 3.4** as a guide, connect enough Source Run Subsystem 4-inch suction hoses (2, 3, and/or 4) to the strainer and float buoy assembly to reach the 400-gallons per minute pump (5). Afterward, connect the assembled hose to the inlet of the pump. Ensure the hose is long enough to deploy the strainer and float buoy at least 25 feet from the shoreline. When determining the amount of hose length needed, consider the differences in shoreline location due to tide changes. **Note:** Always ensure hose couplings have neoprene gaskets properly installed before connecting hose assemblies.

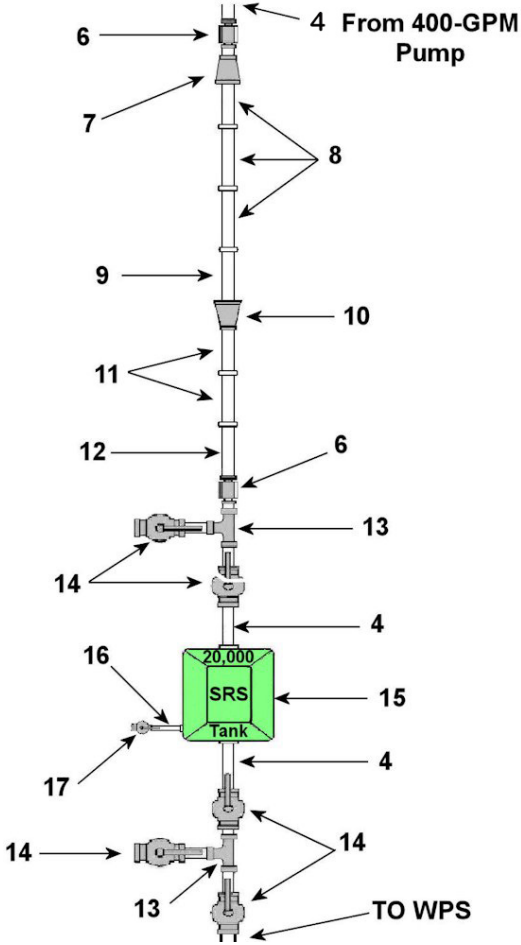
Figure 3.4. Strainer, Float Buoy, and Pump Inlet Component Layout.



3.3.2. Position and Assemble Pump Outlet Branch and 20,000-Gallon Tank. Install hoses and components from the 400-gallons per minute pump to the 20,000-gallon Source Run Subsystem raw water tank as illustrated in **Figure 3.5**.

3.3.2.1. From the outlet side of the 400-gallons per minute pump, connect a 4-inch x 15-foot suction hose (4) to the male quick disconnect fitting on the pump. Then attach, in order, a 4-inch swing check valve (6), and 6-inch x 4-inch reducer (7) to the hose.

Figure 3.5. Pump Outlet and 20,000-Gallon Tank Component Layout.



3.3.2.2. Now, move to the Water Operations Area and complete the following actions. Position the 20,000-gallon Source Run Subsystem tank (15) at the edge of the Water Operations Area as depicted in **Figure 3.6.** Then install the tank's vent, drain hose, and ball valve (16, 17), 4-inch inlet elbow (female-to-female), and outlet elbow (female-to-male) onto the tank (**Figure 3.7**). Next, attach a 4-inch x 15-foot suction hose (4) to each quick disconnect elbow. Afterward, connect 4-inch ball valve assemblies (14), pipe tee assemblies (13), and 15-foot suction hoses (4) as illustrated in **Figure 3.5**. **Note:** The 20,000-gallon raw water tank in the Source Run Subsystem will be interconnected and parallel to one or more Water Production Subsystem 20,000-gallon raw water tanks spaced 6 feet apart. Make sure the inlet and outlet 4-inch tee branch assemblies are facing toward the 20,000-gallon tank accepting these connections.

Figure 3.6. Source Run Subsystem Tank Placement in Water Operations Area (Typical).

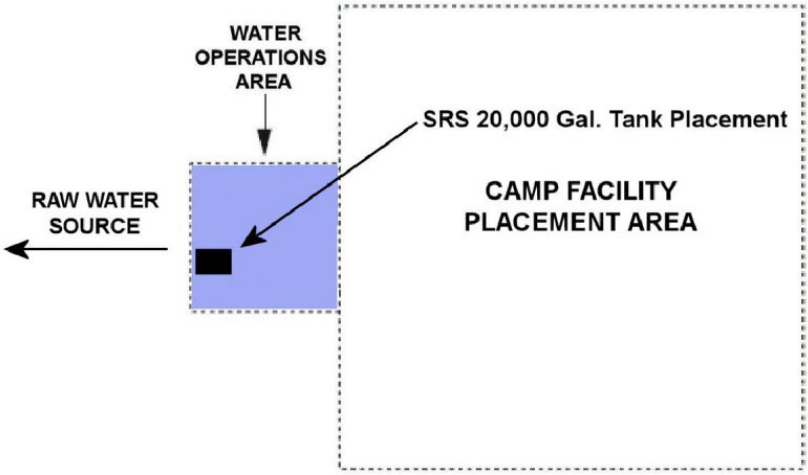
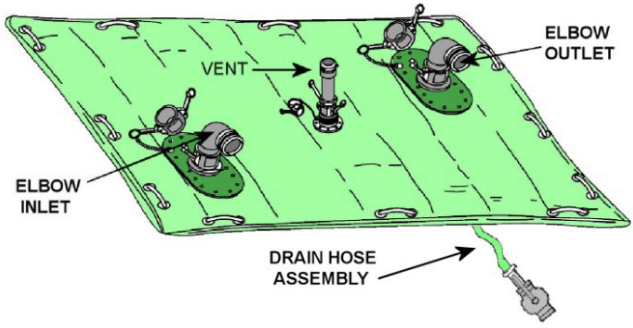


Figure 3.7. 20,000-Gallon Raw Water Tank.



3.3.2.3. Complete the Source Run Subsystem installation at the 400-gallons per minute pump as follows. Starting at the reducer assembly on the outlet side of the 400-gallons per minute pump (**Figure 3.8**), connect enough 6-inch x 150-foot raw water discharge hoses (8) until you are within 175 feet of the swing check valve (6) closest to the Source Run Subsystem raw water tank. Then, attach a 6-inch x 50-foot hose assembly (9). **Note:** If flaking boxes (**Figure 3.9**) are used to deploy 6-inch raw water hoses, follow the procedures in Technical Order 40W4-21-1-WA-1, Work Package (WP) 004 00. Deployment of hoses from flaking boxes requires at least three people: one to drive the truck and two to remove the hoses from the flaking boxes. One of the two, walking behind the truck, should also act as supervisor of the operation.

3.3.2.4. Next, install a 6-inch x 4-inch reducer (10) to the hose, then attach two 4-inch x 50-foot hoses (11), followed by a 4-inch x 25-foot hose (12). To finish, connect the hose to the swing check valve.

3.3.2.5. If the subsystem plumbing crosses roadways or similar heavy vehicular traffic areas, use the hose bridge system to provide hose rollover protection. Assemble the hose bridge system according to **Attachment 5**. This completes basic installation of the Source Run Subsystem.

Figure 3.8. 400-Gallons per Minute Pump Connections.

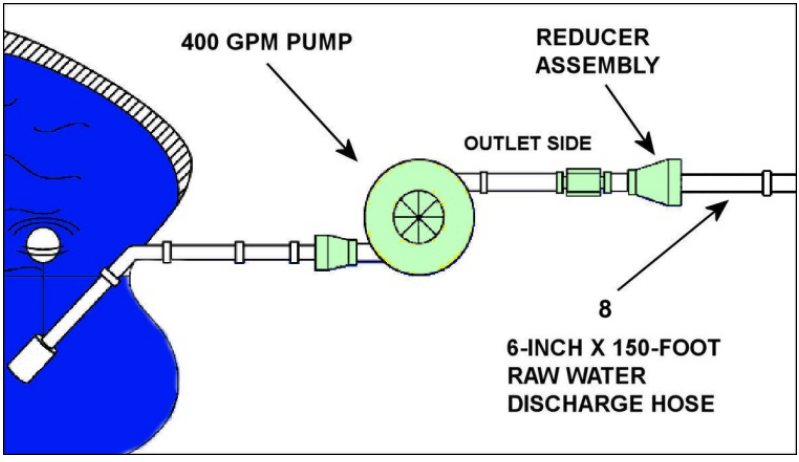
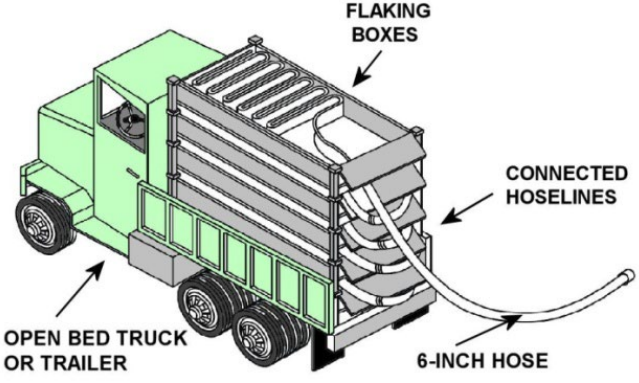


Figure 3.9. Deploying 6-Inch Hose from Flaking Boxes.



3.4. Operation. The following procedures address basic steps to operate the Source Run Subsystem. For detailed procedures, including pump engine prestart checks and start-up procedures, see Technical Order 40W4-21-1-WA-1.

3.4.1. Open the inlet and outlet 4-inch ball valves on the 20,000-gallon Source Run Subsystem raw water tank (and 20,000-gallon Water Production Subsystem tank if interconnected). Close the 2-inch ball valve on the tank drain, and then open the 4-inch ball valves on the pipe tee assemblies. See **Figure 3.5** on page 24 for typical Source Run Subsystem ball valve locations.

3.4.2. Ensure all hose assemblies (and pipes if transition kit installed), valves, and fittings on the 400-gallons per minute Diesel Pump are properly connected and tight. Check the strainer and float buoy for proper connection. **Note:** Always ensure hose couplings have neoprene gaskets properly installed before connecting hose assemblies.

3.4.3. Start the pump engine according to start-up procedures for existing environmental conditions (i.e. cold/warm weather) and allow the engine to warm up for approximately five minutes. Once the engine has warmed up, adjust the engine speed to recommended normal run speed, and apply load.

3.4.4. Ensure water is properly flowing from the pump to the Source Run Subsystem raw water tank and Water Production Subsystem raw water tank (if interconnected).

3.4.5. Once the pump is operating, shut the pump down when the raw water tanks are full; when service or maintenance is required; or when the pump is likely to experience a dead head condition for more than a brief period.

3.4.6. Be sure to periodically recheck all hoses, connections, pipes, valves, fittings, and 20,000-gallon raw water tank(s) for leaks. Make needed repairs and perform maintenance according to procedures in applicable technical orders and manuals. **Note:** Contingency water systems tend to leak a little, so small leaks are usually unavoidable and should not be a major cause of concern.

3.5. Component Descriptions. Table 3.2 provides a detailed description and quantity for each Source Run Subsystem component and its corresponding reference number. Refer to Technical Order 40W4-21-1-WA-1 for other subsystem component information.

Table 3.2. Source Run Subsystem Component Description and Item Number.

Ref #	Source Run Subsystem Component Description	Qty
1	4-Inch Strainer and Float Buoy Assembly, w Hand Air Pump, Green Stripe	1
2	4-Inch x 25-Foot Suction Hose Assembly, Green Stripe	2
3	4-Inch x 50-Foot Suction Hose Assembly, Green Stripe	2
4	4-Inch x 15-Foot Suction Hose Assembly, Green Stripe	8
5	Diesel Pump Assembly, w/4-Inch Female x 4-Inch Male Quick Disconnects, Green Stripe	1
6	Swing Check Valve Assembly, w/4-Inch Female x 4-Inch Male Quick Disconnects, Green Stripe	3
7	Reducer, 6-Inch Male x 4-Inch Female Quick Disconnects, Green Stripe	1
8	6-Inch x 150-Foot Discharge Hose Assembly, Green Stripe	42
9	6-Inch x 50-Foot Discharge Hose Assembly, Green Stripe	10
10	Reducer, 6-Inch Female x 4-Inch Male Quick Disconnects, Green Stripe	1
11	4-Inch x 50-Foot Discharge Hose Assembly, Green Stripe	4
12	4-Inch x 25-Foot Discharge Hose Assembly, Green Stripe	4

Ref #	Source Run Subsystem Component Description	Qty
13	4-Inch x 4-Inch x 4-Inch Pipe Tee Assembly w/Female x Male x Male Quick Disconnects, Green Stripe	3
14	4-Inch Ball Valve Assembly w/Female x Male Quick Disconnects, Green Stripe	6
15	20,000-Gallon Collapsible Fabric Tank w/Adapter, 2-Inch Male Quick Disconnect x Male National Pipe Thread, Green Stripe	1
16	2-Inch x 8-Foot Suction Hose Assembly w/Female Quick Disconnect, Green Stripe	1
17	2-Inch Ball Valve Assembly w/Female Quick Disconnect, Green Stripe	1
18	6 Inch Hose Mender, Hose Shank x Hose Shank	3
19	Hose Clamp, Worm Gear, 1/2-Inch Band Width, (or wider), Slotted Hex Screw, Range 1-3/4 Inch to 8-9/16 Inch	25
20	Hose Clamp, Worm Gear, 1/2-Inch Band Width, Slotted Hex Screw, Range 3-1/2 Inch to 5 Inch	25
21	Ratchet Wrench, 5/16 Drive, 60 Inch-Lb. Torque (For Worm Gear Hose Clamps)	2
22	Adapter, 4-Inch, Male Quick Disconnect x Male National Pipe Thread	5
23	Adapter, 6-Inch Male Quick Disconnect x 6-Inch Male National Pipe Thread	2
24	Coupler, 4-Inch Female Quick Disconnect x Male National Pipe Thread	3
25	Adapter, 6-Inch Male Quick Disconnect x Female National Pipe Thread	2

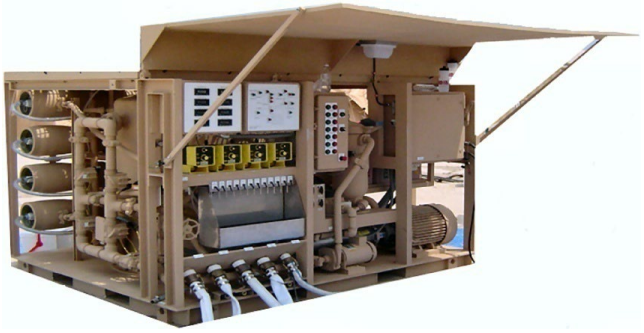
Ref #	Source Run Subsystem Component Description	Qty
26	Coupler, 6-Inch Female Quick Disconnect x Female National Pipe Thread	4
27	6.5-Inch Hose Bridge System	8
28	Coupler, 4-Inch Female Quick Disconnect x 4-Inch Female Quick Disconnect	2
29	Coupler, 6-Inch Female Quick Disconnect x 6-Inch Female Quick Disconnect	2
30	Adapter, 4-Inch Male Quick Disconnect x 4-Inch Male Quick Disconnect	2
31	Adapter, 6-Inch Male Quick Disconnect x 6-Inch Male Quick Disconnect	2
32	Tape, Anti-seize, Roll	50
33	Box, Flaking	10
34	J-Clamp 6-Inch Hose Repair Kit	1
35	Kit, Transition	1
36	Kit, Cold Weather, Source Run Subsystem (Optional) (Not Currently Available)	1

Chapter 4

WATER PRODUCTION SUBSYSTEM

4.1. General Information. The Water Production Subsystem generates potable water for distribution to user facilities within the contingency water system. Operators perform water purification using the 1500 Reverse Osmosis Water Purification Unit (**Figure 4.1**), usually set up in a parallel configuration. Raw water input for the Reverse Osmosis Water Purification Unit pumps first into 20,000-gallon storage tanks then goes to the Reverse Osmosis Water Purification Units through a series of hoses and fittings. The potable water generated by the Reverse Osmosis Water Purification Units runs through another series of hoses and fittings to 20,000-gallon potable water storage tanks. **Note:** Reverse Osmosis Water Purification Units contain additional hoses and electrical pumps (not addressed in this handbook) for connecting onto the rest of water system.

Figure 4.1. 1500 Reverse Osmosis Water Purification Unit.



4.1.1. By-products from the water purification process include both wastewater and reject water (also known as brine or concentrate). Wastewater and reject water (hereafter referred to as brine for clarity) routes or distributes separately. Wastewater goes to a 3,000-gallon wastewater tank. Brine goes to a 20,000-gallon brine storage tank and a Reverse Osmosis Water Purification Unit backwash tank.

4.1.2. The configuration of the brine tank and hoses allow reuse of brine output for controlling dust, construction purposes, improving electrical grounds, decontamination, and various other purposes. Units should not use brine output for washing aircraft and vehicles if it has a high salt content. Although personnel can use brine output for firefighting, units should not use it in their fire trucks. If not reusing brine output, it, along with Reverse Osmosis Water Purification Unit wastewater goes to waste disposal via a 35-gallons per minute electric pump (or backup 125-gallons per minute diesel pump). **Note:** Units should not use brine output for any purpose if suspected hazardous chemicals are present in the source water until tested for presence of said suspected chemicals.

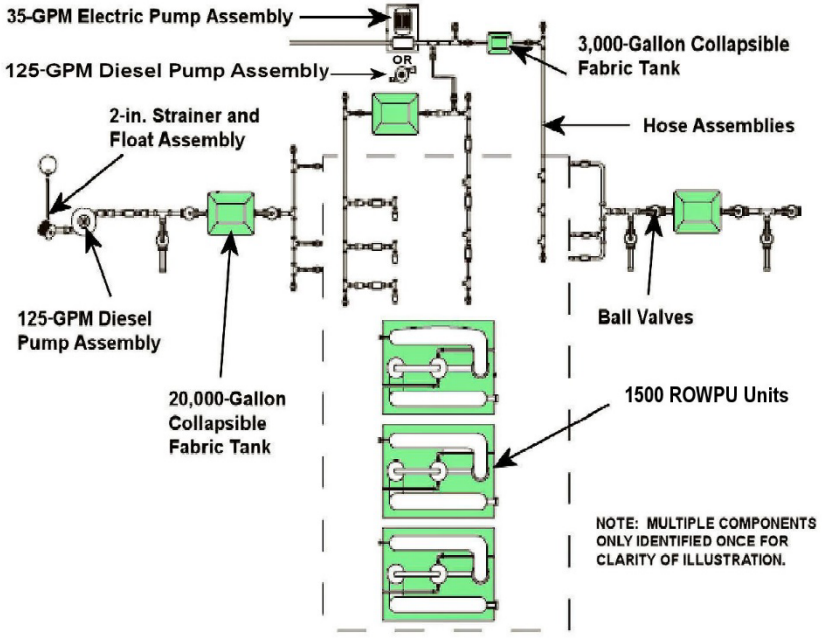
4.2. Components. Described in **Table 4.1** and illustrated in **Figure 4.2** are the major components of the Water Production Subsystem. However, for a complete list of all subsystem components, including nomenclature and quantity per subsystem, refer to **Table 4.2** in this handbook and the Water Production Subsystem Illustrated Parts Breakdown in Technical Order 40W4-21-1-WA-1.

Table 4.1. Water Production Subsystem Major Components.

Component	Function/Use
2-Inch Strainer and Float Assembly	Prevents trash, twigs, and debris from entering the Water Production Subsystem and keeps the strainer from lying on the bottom of the raw water source where dirt and gravel could enter the subsystem. Used for raw water processing when a Source Run Subsystem is not used as part of the water system configuration. (Green Stripe)
125-Gallons per Minute Diesel Pump (Raw Water)	Pumps raw water to Water Production Subsystem when not using the Source Run Subsystem as part of the water system configuration. (Green Stripe)

Component	Function/Use
35-Gallons per Minute Electric Pump Assembly (Wastewater)	Pumps Reverse Osmosis Water Purification Unit wastewater to a waste disposal area when prime power is available and adequate. Operators manually regulate pump operation for waste disposal operations. (Purple Stripe)
125-Gallons per Minute Diesel Pump (Wastewater)	Pumps Reverse Osmosis Water Purification Unit wastewater to a waste disposal area when prime power is not available or adequate. Used as a backup pump for the 35-gallons per minute electric pump. (Purple Stripe)
20,000-Gallon Collapsible Fabric Tanks	Stores raw water, potable water, and brine. The raw water tank is color-coded green. The potable water tank is color-coded white. The brine tank is color-coded purple. None of these tanks are interchangeable.
Reverse Osmosis Water Purification Unit	Produces potable water. The 1500 Reverse Osmosis Water Purification Unit produces potable water at a capacity equal to or greater than 1500 gallons per hour.
3,000-Gallon Collapsible Fabric Tank	Stores wastewater from the Reverse Osmosis Water Purification Unit water purification process. (Red Stripe)
Hoses	Routes raw water input for processing, potable water output for storage, and wastewater for disposal. The hoses are color-coded green, white, and purple, respectively, for their particular distribution function.
Ball Valves	Controls flow of raw water input for purification, potable water output for storage, and wastewater for disposal. Also used to isolate water flow to specific Reverse Osmosis Water Purification Units for maintenance while maintaining water purification operation.

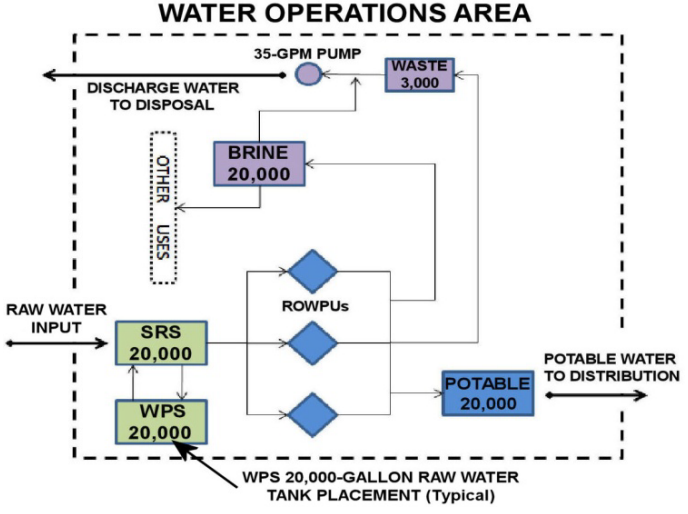
Figure 4.2. Water Production Subsystem Illustration Using Three Reverse Osmosis Water Purification Units.



4.3. Installation. Installation of the Water Production Subsystem is essentially the same regardless of the type of Reverse Osmosis Water Purification Unit used. There are two or three purification units in a Water Production Subsystem basic configuration, but if adding more Reverse Osmosis Water Purification Units, the configuration and number of components will obviously change. Using more Reverse Osmosis Water Purification Units or even interconnecting different types of Reverse Osmosis Water Purification Units is optional, so our discussion here will only address basic installation of a three-Reverse Osmosis Water Purification Unit Water Production Subsystem. Before installing the Water Production

Subsystem, review the planned dimensions of the Water Operations Area (see **Table 2.1**) and placement of the Water Production Subsystem 20,000-gallon raw water tank (**Figure 4.3**). Then, refer to component layout diagrams in this chapter and the list in **Table 4.2** to identify each numbered component when performing the steps below. **Note:** Reverse Osmosis Water Purification Units contain additional hoses and electrical pumps (not addressed in this handbook) for connecting onto the rest of water system.

Figure 4.3. Location of Water Operations Area Water Tanks and Reverse Osmosis Water Purification Units (Typical).



WARNING

To prevent injury to personnel and/or damage to equipment units, ensure adequate personnel and lifting equipment are available to preposition equipment.

4.3.1. Position Water Tanks, Reverse Osmosis Water Purification Units, and 35-Gallons per Minute Pump. Position water tanks, Reverse Osmosis Water Purification Units, and 35-gallons per minute pump as follows:

4.3.1.1. Position the Water Production Subsystem 20,000-gallon raw water tank at the edge of the Water Operations Area and alongside the Source Run Subsystem tank. Position tanks six feet apart and ensure the vent and drain assembly is on the tanks. Link the tanks together by connecting the 4-inch x 15-foot suction hoses from the Water Production Subsystem tank to the inlet and outlet branch assemblies on the Source Run Subsystem tank as illustrated in **Figure 4.4**. **Note:** Always ensure hose couplings have neoprene gaskets properly installed before connecting hose assemblies.

4.3.1.2. Before positioning Reverse Osmosis Water Purification Units verify that a 120-Volt Alternating Current, 1-phase, 60-Hertz and a 208-Volt Alternating Current, 3-phase, 60-Hertz power source is available. Then, position Reverse Osmosis Water Purification Units approximately 20 feet from the Water Production Subsystem raw water tank and make sure to provide 10 feet of clearance between each water purification unit.

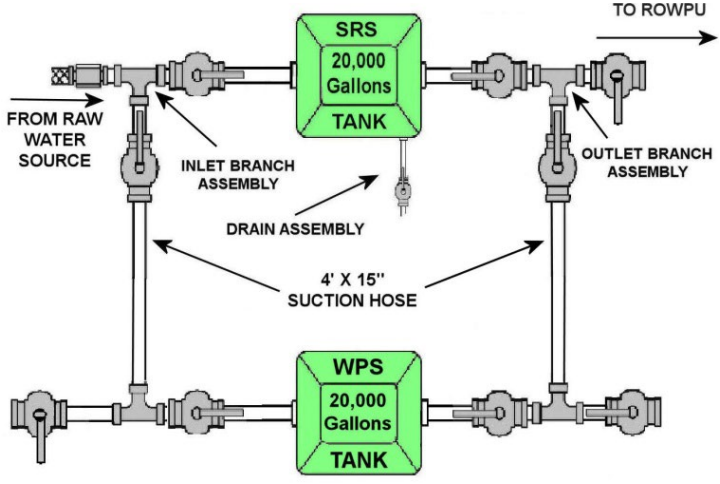
4.3.1.3. Position the 20,000-gallon potable water tank approximately 35 feet from Reverse Osmosis Water Purification Units, and then install the tank's vent, drain assembly, and 4-inch inlet elbow (female-to-female) and outlet elbow (female-to-male) onto the tank.

4.3.1.4. Position the 20,000-gallon brine tank approximately 50 feet from Reverse Osmosis Water Purification Units, and then install the tank's vent, drain assembly, and 4-inch elbows.

4.3.1.5. Place the 3,000-gallon wastewater tank approximately 25 feet from the brine tank, and then install the tank's vent and drain assembly. Also, connect the 2-inch female Quick Disconnect to the tank inlet and 2-inch male Quick Disconnect to the tank outlet.

4.3.1.6. Before positioning the 35-gallons per minute electric pump, verify that 208-Volt Alternating Current, 1-phase, 60-Hertz power is available. Then, place the electric pump approximately 25 feet from the 3,000-gallon wastewater tank. If power is not available, use the backup 125-gallons per minute diesel pump.

Figure 4.4. Water Production Subsystem and Source Run Subsystem Raw Water Tank Connections (Typical).

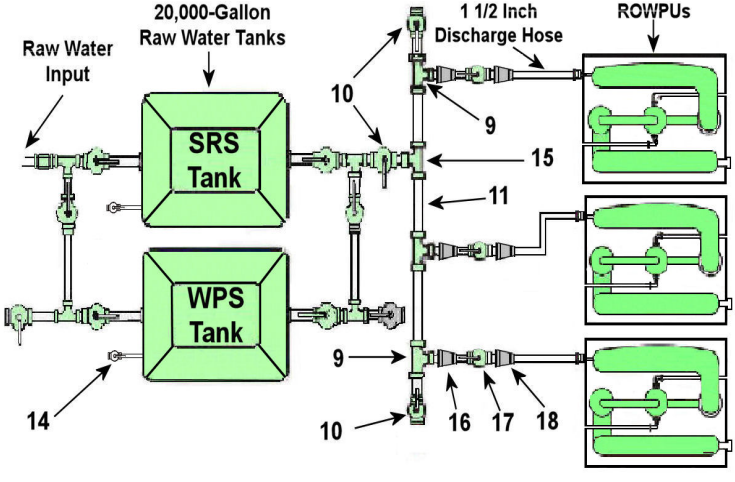


4.3.2. Assemble Raw Water Hoses and Components. Install hoses and components from the Water Production Subsystem and Source Run Subsystem raw water tanks to Reverse Osmosis Water Purification Unit locations as illustrated in **Figure 4.5**.

4.3.2.1. Starting at the outlet branch assembly of the Source Run Subsystem tank, attach a 4-inch tee assembly (15) to the previously assembled 4-inch ball valve (10). Then connect three 4-inch x 15-foot suction hoses (11) with three tee assemblies (9) and two 4-inch ball valves as shown in **Figure 4.5**. At each tee, attach in order, a 4-inch x 2-inch reducer (16), a 2-inch ball valve (17), and a 2-

inch x 1- 1/2-inch reducer (18). Each of these branches connects to a 1-1/2-inch raw water discharge hose leading to water purification units.

Figure 4.5. Raw Water Hoses and Component Layout.



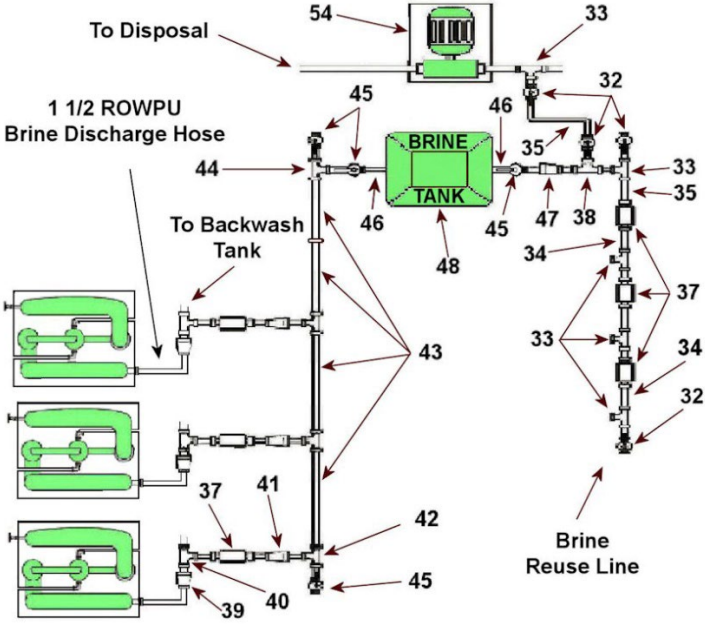
4.3.2.2. After connecting the 1-1/2-inch reducer to the Reverse Osmosis Water Purification Unit hoses, ensure the ball valves at the inlet and outlet sides of the Water Production Subsystem raw water tank are open and the ball valves on the three branch outlets are closed. Then confirm the ball valves (14) are closed on both Water Production Subsystem and Source Run Subsystem raw water tank drain hoses. After that, ensure the ball valves on the valve inlets to the Reverse Osmosis Water Purification Units are also closed. Keep this configuration until the subsystem is ready to begin water production operations.

4.3.3. Assemble Brine Hoses and Components. Install brine hoses and components from the Reverse Osmosis Water Purification Units to the brine storage tank as illustrated in **Figure 4.6**.

4.3.3.1. Starting at the 1-1/2-inch brine discharge hoses from the Reverse Osmosis Water Purification Units, attach in order, a 2-inch x 1-1/2-inch reducer (39), a 2-inch tee (40), a check valve (37), a 4-inch x 2-inch reducer (41), and a 4-inch tee (42) on each output hose.

4.3.3.2. Next, connect the 4-inch x 25-foot brine hoses (43) to the tee assemblies and position the hoses so they head towards the brine storage tank (48).

Figure 4.6. Brine Hoses and Component Layout.



4.3.3.3. Attach a 4-inch tee (44) on the end of the brine hose facing the brine storage tank. Then, connect a ball valve (45) to the open end of each tee assembly.

4.3.3.4. Next, connect one end of a 4-inch x 15-foot brine suction hose (46) to the ball valve facing the brine tank. Attach the other end of the hose to the brine tank inlet.

4.3.3.5. On brine tank outlet, attach another 4-inch x 15-foot brine hose, followed by a 4-inch ball valve (45), 4-inch x 2-inch reducer (47), and 2-inch tee assembly (38).

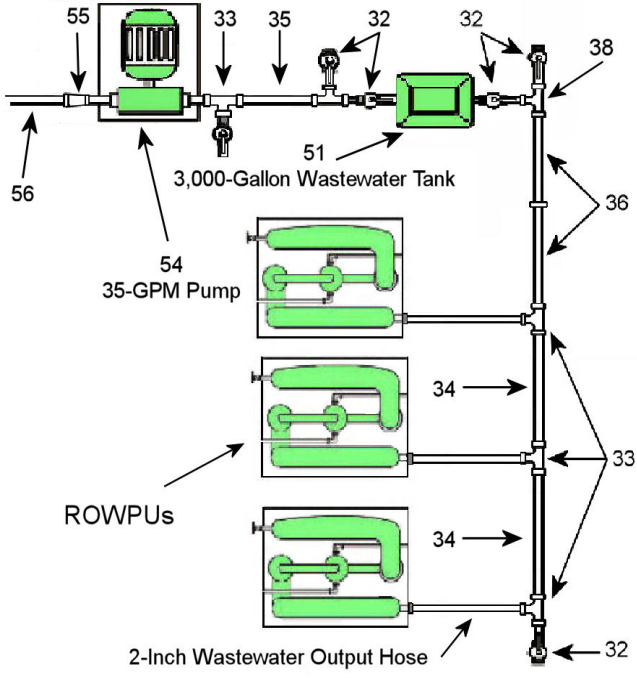
4.3.3.6. For brine disposal, start at the 2-inch tee (38) and attach a 2-inch ball valve (32) followed by a 2-inch x 50-foot discharge hose (35). Next, attach another 2-inch ball valve and 2-inch tee (33). Afterward, connect the tee to the 35-gallons per minute wastewater pump (54) for disposal.

4.3.3.7. For brine reuse, start at the 2-inch tee (38) and attach 2-inch tee (33) followed by a 2-inch ball valve on one end (32) and a 2-inch x 50-foot discharge hose (35) on the other. Next, attach a 2-inch check valve (37) followed by a 2-inch x 25-foot discharge hose (34), followed by a 2-inch tee (33) and then repeat this sequence two more times in order. Attach a 2-inch ball valve (32) to the last 2-inch tee (33). From this valve, brine can be drawn and reused for washing vehicles, decontamination, firefighting, wetting dusty roads, and other user purposes.

4.3.4. Assemble Wastewater Hoses and Components. Install wastewater hoses and components from the Reverse Osmosis Water Purification Units to the 3,000-gallon wastewater storage tank and disposal area as illustrated in **Figure 4.7**. **Note:** Always ensure hose couplings have neoprene gaskets properly installed before connecting hose assemblies.

4.3.4.1. Starting at the Reverse Osmosis Water Purification Units' 2-inch wastewater output hoses, attach a 2-inch tee (33) to each hose end. Then, connect two 2-inch x 25-foot wastewater discharge hoses (34) as shown in **Figure 4.7**. Attach a 2-inch ball valve (32) on the open end of the first tee. On the open end of the third tee assembly, connect enough 2-inch x 25-foot suction hoses (36) to reach the wastewater tank.

Figure 4.7. Wastewater Hoses and Component Layout.

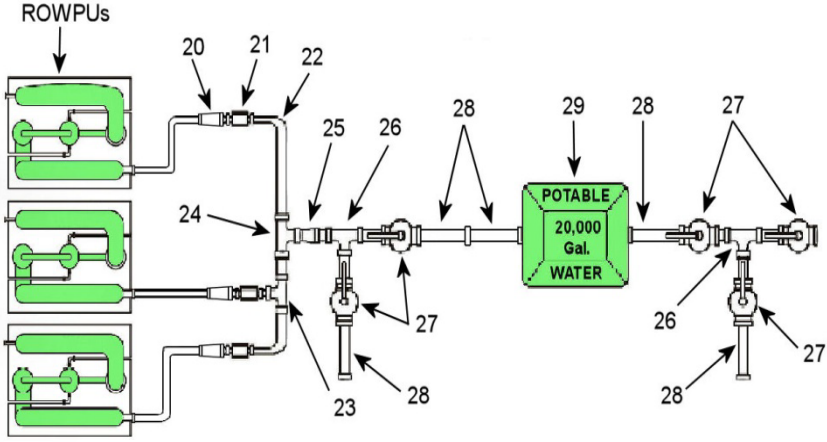


4.3.4.2. At the end of the suction hose, connect another 2-inch tee (38), followed by 2-inch ball valves (32) on the open ends of the tee. Afterward, attach the ball valve nearest the tank to the wastewater tank (51) inlet.

4.3.4.3. On the wastewater tank outlet, attach a 2-inch ball valve followed by a 2-inch tee assembly and a 2-inch x 50-foot wastewater discharge hose (35). Afterward, attach another 2-inch ball valve on the open end of the tee. Then, attach the discharge hose to the tee (33) that is closest to the 35-gallons per minute pump.

4.3.5. Assemble Potable Water Hoses and Components. Install potable water hoses and components from the Reverse Osmosis Water Purification Units to the potable water storage tank as illustrated in **Figure 4.8**.

Figure 4.8. Potable Water Hoses and Component Layout.



4.3.5.1. Starting at the 1-1/2-inch potable water output hoses from the Reverse Osmosis Water Purification Units, attach a 2-inch x 1-1/2-inch reducer (20) and 2-inch check valve (21) to each hose. Afterward, attach a 2-inch x 25-foot suction hose (22) to the first and third (outside) lines and install the 2-inch tees (23, 24) as shown.

4.3.5.2. At the 2-inch tee (24), install a 4-inch x 2-inch reducer (25) followed by a 4-inch tee (26) on the end of the reducer. Afterward, attach a 4-inch ball valve (27) to the free ends of the tee.

4.3.5.3. From the 4-inch ball valves, attach three 4-inch x 15-foot suction hoses (28): attach a line of two hoses to the ball valve that points towards the potable water tank (29), and attach the other hose to the ball valve that points away from the potable water tank. Afterward, connect the suction hose to the potable water tank inlet.

4.3.5.4. On the tank outlet, attach another 4-inch x 15-foot suction hose followed by a 4-inch ball valve and tee assembly. Attach two additional ball valves (27) and a suction hose (28) on the open ends of the tee. Potable water distributes from this branch tee assembly to the water distribution subsystems addressed in the next few chapters. The lone 20,000-gallon potable water tank in this configuration can be incorporated with the 550-Initial and 550-Follow-On Subsystems 20,000-gallon tanks to form an interconnecting potable water tank farm similar to that being erected in **Figure 4.9**. This completes basic installation of the Water Production Subsystem.

Figure 4.9. Erecting a Potable Water Tank Farm.

4.4. Operation. The following procedures address basic steps to operate the Water Production Subsystem after installation. If necessary, refer to the layout diagrams presented throughout this chapter for part identification when performing these steps. **Note:** Consult Technical Order 40W4-21-1-WA-1 and Technical Order 40W4-20-1-WA-1, *Operation and Maintenance Instruction with IPB – 1500 Reverse Osmosis Water Purification Unit (ROWPU)*.

4.4.1. Open the inlet and outlet 4-inch ball valves on the 20,000-gallon Water Production Subsystem raw water tank (and 20,000-gallon Source Run Subsystem tank if interconnected). Close the 2-inch ball valve on the tank drain(s) and open the 4-inch ball valves on the branch tees. Ensure proper connection and tightness of all hose assemblies, valves, and fittings for 20,000-gallon raw water tanks.

4.4.2. Repeat this procedure on the 20,000-gallon potable water tank. Also, verify all potable water fittings, valves, and hoses are color-coded white.

4.4.3. Open the 2-inch ball valve on the 3,000-gallon wastewater tank inlet and close the 2-inch ball valve on the end of the inlet branch tee. Ensure all hose assemblies, valves, and fittings associated with the wastewater tank is properly connected and color-coded purple.

4.4.3.1. Close the 2-inch ball valves on the wastewater tank outlet, the branch tee, and the tee leading to the brine system.

4.4.3.2. Ensure all hoses, valves, and fittings, associated with the discharge system of the wastewater tank, are properly connected, and color-coded purple.

4.4.4. Check the 35-gallons per minute Electric Pump for adequate power and verify that all fittings and connections are tight and color-coded purple. If adequate power is not available, use the 125-gallons per minute Diesel Pump.

4.4.5. Open the 4-inch ball valve on the 20,000-gallon brine tank and close the 4-inch ball valves on the branch tees.

4.4.5.1. Close the 2-inch ball valves on the branch tees and 2-inch ball valve on the tank drain.

4.4.5.2. Ensure all hoses, valves, and fittings, associated with the outlet of the 20,000-gallon brine tank, are properly connected, and color-coded purple.

4.4.6. Recheck all hose assemblies, valves, fittings, and the 20,000-gallon raw water tank for leaks and repair as required.

4.4.7. Startup Reverse Osmosis Water Purification Unit units according to procedures in the applicable Reverse Osmosis Water Purification Unit technical order (Technical Order 40W4-20-1-WA-1 for the 1500) and verify the flow of potable water into the 20,000-gallon potable water tank.

4.4.8. Recheck all hose assemblies, valves, and fittings with the potable water system, and the 20,000-gallon potable water tank for leaks and repair as required. Repeat these procedures for the brine and wastewater systems and tanks. **Note:** Contingency water systems tend to leak a little, so small leaks are usually unavoidable and should not be a major cause of concern. Always ensure hose couplings have neoprene gaskets properly installed before connecting hose assemblies.

4.4.9. Recheck all hose assemblies, valves, and fittings connected to the 35-gallons per minute Electric Pump for leaks and repair as required. **Note:** Deployed units should comply with DODI 4715.22 and the Environmental Annex of the OPLAN/OPORD and follow other applicable theater-specific procedures and guidance for wastewater disposal.

4.4.10. When the 3,000-gallon wastewater tank reaches its capacity, turn ON the 35-gallons per minute pump to discharge wastewater from the tank. Turn the pump OFF when the 3,000-gallon tank is empty. Restart as required to dispose of wastewater. If using the 125-gallons per minute Diesel Pump in lieu of the 35-gallons per minute pump, refer to Technical Order 40W4-21-1-WA-1 for startup and shutdown procedures.

4.4.11. If potable water production exceeds demand and the 20,000-gallon potable water storage tanks are full, stop water production by shutting down Reverse Osmosis Water Purification Unit operations in accordance with unit's technical order. Afterwards, terminate operation of the Source Run Subsystem's 400-gallons per minute Diesel Pump according to instructions in the *Commercial Operator's Manual for Power Tech 4.5/6.8 L Tier 2 OEM Diesel Engines.* See **Attachment 1** for specific references.

4.5. Water Production Subsystem Component Descriptions. Table 4.2 lists detailed descriptions and quantities for Water Production Subsystem components and their corresponding reference number used in this chapter. Refer to Technical Order 40W4-21-1-WA-1 for other subsystem component information.

Table 4.2. Water Production Subsystem Component Description and Item Number.

Ref #	Water Production Subsystem Component Description	Qty
1	Strainer And Float Buoy Assembly, 2-Inch, w/Pump, Air, Hand, Green Stripe	1
2	Suction Hose Assembly, 2-Inch x 25-Foot, Green Stripe	4
3	Pump Assembly, 2-Inch Diesel, w/Female x Male Quick Disconnects, Green Stripe	1
4	Reducer, w/3-Inch Male x 2-Inch Female Quick Disconnects, Green Stripe	1
5	Discharge Hose Assembly, 3-Inch x 100-Foot, Green Stripe	5
6	Swing Check Valve Assembly, 3-Inch, Polyvinylchloride, w/Female x Male Quick Disconnects, Green Stripe	1
7	Reducer, w/4-Inch Male x 3-Inch Female, Green Stripe	2
8	Suction Hose Assembly, 4-Inch x 50-Foot, Green Stripe	2

Ref #	Water Production Subsystem Component Description	Qty
9	Tee Assembly, 4-Inch x 4-Inch x 4-Inch, w/Female x Male x Male Quick Disconnects, Green Stripe	7
10	Ball Valve Assembly, 4-Inch, w/Female x Male Quick Disconnects, Green Stripe	8
11	Suction Hose Assembly, 4-Inch x 15-Foot, Green Stripe	8
12	20,000-Gallon Collapsible Fabric Tank w/Adapter, 2-Inch Male Quick Disconnect x Male National Pipe Thread, Green Stripe	1
13	Suction Hose Assembly, 2-Inch x 8-Foot, Green Stripe	1
14	Ball Valve Assembly, 2-Inch, w/Female Quick Disconnect x Female National Pipe Thread, Green Stripe	1
15	Tee Assembly, 4-Inch x 4-Inch x 4-Inch, w/Male x Male x Female Quick Disconnects, Green Stripe	2
16	Reducer, w/4-Inch Female x 2-Inch Male Quick Disconnects, Green Stripe	4
17	Ball Valve Assembly, 2-Inch, w/Female x Female Quick Disconnects, Green Stripe	4
18*	Reducer, w/2-Inch Male x 1-1/2-Inch Female Quick Disconnects, Green Stripe	4
19	Not Used	
20	Reducer, w/2-Inch Male x 1-1/2-Inch Female Quick Disconnects, White Stripe	4
21	Swing Check Valve Assembly, 2-Inch, w/Female x Male Quick Disconnects, White Stripe	4

Ref #	Water Production Subsystem Component Description	Qty
22	Suction Hose Assembly, 2-Inch x 25-Foot, White Stripe	2
23*	Tee Assembly, 2-Inch x 2-Inch x 2-Inch, w/Female x Male x Female Quick Disconnects, White Stripe	1
24	Tee Assembly, 2-Inch x 2-Inch x 2-Inch, w/Female x Female x Male Quick Disconnects, White Stripe	1
25	Reducer, w/4-Inch Male x 2-Inch Female Quick Disconnects, White Stripe	1
26	Tee Assembly, 4-Inch x 4-Inch x 4-Inch, w/Female x Male x Male Quick Disconnects, White Stripe	1
27	Ball Valve Assembly, 4-Inch, w/Female x Male Quick Disconnects, White Stripe	5
28	Suction Hose Assembly, 4-Inch x 15-Foot, White Stripe	5
29	20,000-Gallon Collapsible Fabric Tank, w/Adapter, 2-Inch Male Quick Disconnect x Male National Pipe Thread, White Stripe	1
30	Suction Hose Assembly, 2-Inch x 8-Foot, White Stripe	1
31	Ball Valve Assembly, 2-Inch, w/Female Quick Disconnect x Female National Pipe Thread, White Stripe	1
32	Ball Valve Assembly, 2-Inch, w/Female x Male Quick Disconnects, Purple Stripe	9
33	Tee Assembly, 2-Inch x 2-Inch x 2-Inch, w/Female x Male x Female Quick Disconnects, Purple Stripe	8
34	Discharge Hose Assembly, 2-Inch x 25-Foot, Purple Stripe	5

Ref #	Water Production Subsystem Component Description	Qty
35	Discharge Hose Assembly, 2-Inch x 50-Foot, Purple Stripe	3
36	Suction Hose Assembly, 2-Inch x 25-Foot, Purple Stripe	6
37	Swing Check Valve Assembly, 2-Inch, w/Female x Male Quick Disconnects, Purple Stripe	6
38	Tee Assembly, 2-Inch x 2-Inch x 2-Inch, w/Female x Male x Male Quick Disconnects, Purple Stripe	3
39*	Reducer, 2-Inch Male x 1-1/2-Inch Female Quick Disconnects, Purple Stripe	3
40	Tee Assembly, 2-Inch x 2-Inch x 2-Inch, w/Female x Female x Male Quick Disconnects, Purple Stripe	3
41	Reducer, w/4-Inch Male x 2-Inch Female Quick Disconnects, Purple Stripe	3
42	Tee Assembly, 4-Inch x 4-Inch x 4-Inch, w/Female x Male x Female Quick Disconnects, Purple Stripe	3
43	Suction Hose Assembly, 4-Inch x 25-Foot, Purple Stripe	4
44	Tee Assembly, 4-Inch x 4-Inch x 4-Inch, w/Female x Male x Male Quick Disconnects, Purple Stripe	1
45	Ball Valve Assembly, 4-Inch, w/Female x Male Quick Disconnects, Purple Stripe	4
46	Suction Hose Assembly, 4-Inch x 15-Foot, Purple Stripe	2
47	Reducer, w/4-Inch Female x 2-Inch Male Quick Disconnects, Purple Stripe	1

Ref #	Water Production Subsystem Component Description	Qty
48	20,000-Gallon Collapsible Fabric Tank, w/Adapter, 2-Inch Male Quick Disconnect x Male National Pipe Thread, Purple Stripe	1
49	Suction Hose Assembly, 2-Inch x 8-Foot, Purple Stripe	1
50	Ball Valve Assembly, 2-Inch, w/Female Quick Disconnect x Female National Pipe Thread, Purple Stripe	1
51	3,000-Gallon Collapsible Fabric Tank Assembly, w/ 2-Inch Female x Male x Male Quick Disconnects, Red Stripe	1
52	Suction Hose Assembly, 2-Inch x 8-Foot, Red Stripe	1
53	Ball Valve Assembly, 2-Inch, w/Female Quick Disconnect x Female National Pipe Thread, Red Stripe	1
54	Electric Pump Assembly, 2-Inch, w/Female x Male Quick Disconnects, Purple Stripe	1
55	Reducer, w/3-Inch Male x 2-Inch Female Quick Disconnects, Purple Stripe	1
56	Discharge Hose Assembly, 3-Inch x 100-Foot, Purple Stripe	5
57	Suction Hose Assembly, 2-Inch x 50-Foot, Green Stripe	1
58	Suction Hose Assembly, 4-Inch x 25-Foot, Green Stripe	1
59	Pump Assembly, 2-Inch Diesel, w/2 Inch Female x Male Quick Disconnects, Purple Stripe	1
60	Discharge Hose Assembly, 3-Inch x 25-Foot, Purple Stripe	1
61	Discharge Hose Assembly, 3-Inch x 50-Foot, Purple Stripe	2
62	Adapter, Swivel, 2-1/2 Inch National Standard Threads x 2-Inch Female National Pipe Thread	1

Ref #	Water Production Subsystem Component Description	Qty
63	Adapter, Swivel, 2-1/2 Inch Female National Standard Threads x 3-Inch Female National Pipe Thread	1
64	Adapter, Swivel, 2-1/2 Inch Female National Standard Threads x 3-Inch Male National Pipe Thread	1
65	Hose Clamp, Worm Gear, 1/2-Inch Band Width (or wider), Slotted Hex Screw, Range 1-3/4 Inch to 8-9/16 Inch	25
66	Hose Clamp, Worm Gear, 1/2-Inch Band Width, Slotted Hex Screw, Range 3-1/2 Inch to 5-Inch	25
67	Coupler, 4-Inch Female x 4-Inch Female Quick Disconnects	1
68	Adapter, 4-Inch Male x 4-Inch Male Quick Disconnects	1
69	Coupler, 2-Inch Female x 2-Inch Female Quick Disconnects	2
70	Adapter, 2-Inch Male x 2-Inch Male Quick Disconnects	2
71	Coupler, 1-1/2 Inch Female x 1-1/2 Inch Female Quick Disconnects	1
72	Adapter, 1-1/2 Inch Male x 1-1/2 Inch Male Quick Disconnects	1
74	Tape, Anti-seize, Roll	10
* Not a component of 1500 Reverse Osmosis Water Purification Unit Water Production Subsystem.		

Chapter 5

550-INITIAL SUBSYSTEM

5.1. General Information. The 550-Initial Subsystem is the primary potable water distribution subsystem of the contingency water system. Units may deploy this subsystem as a stand-alone potable water distribution subsystem; however, manufacturers designed the subsystem for expansion and buildup to meet varying user deployment and operational needs. The 550-Initial Subsystem (**Figure 5.1**) normally receives potable water input from the Water Production Subsystem discussed in **Chapter 4**. However, the adapters supplied with this subsystem do provide a means to draw potable water from other similar potable water sources. Potable water input to the subsystem typically goes to three 20,000-gallon fabric tanks for storage. The storage tanks, usually in tank farm configuration, distribute the potable water to a variable speed dual pumping station. The two pumps are parallel-configured, enabling dual or single pump operation, and single pump isolation for maintenance or repair purposes. The remaining operational pump maintains water pressure in the distribution line. Output from the pumping station runs to a distribution line, looped, and connected to form a pressurized feed line. User facilities, such as latrines, showers, and laundries, are branch fed from the pressurized feed line. Wastewater output from user facilities distributes via lift pumps and wastewater lines to a wastewater collection tank for disposal. Hose rollover protection ramps (hose bridges) are available in the event potable water distribution and/or wastewater distribution lines cross roadways or similar heavy vehicular traffic areas.

5.2. Components. Illustrated in **Figure 5.1** and described in **Table 5.1** are the major components that make up the 550-Initial Subsystem. However, for a complete list of all subsystem components, including nomenclature and quantity per subsystem, refer to **Table 5.4** in this handbook and the 550-Initial Subsystem Illustrated Parts Breakdown in Technical Order 40W4-21-1-WA-1.

Figure 5.1. 550-Initial Subsystem.

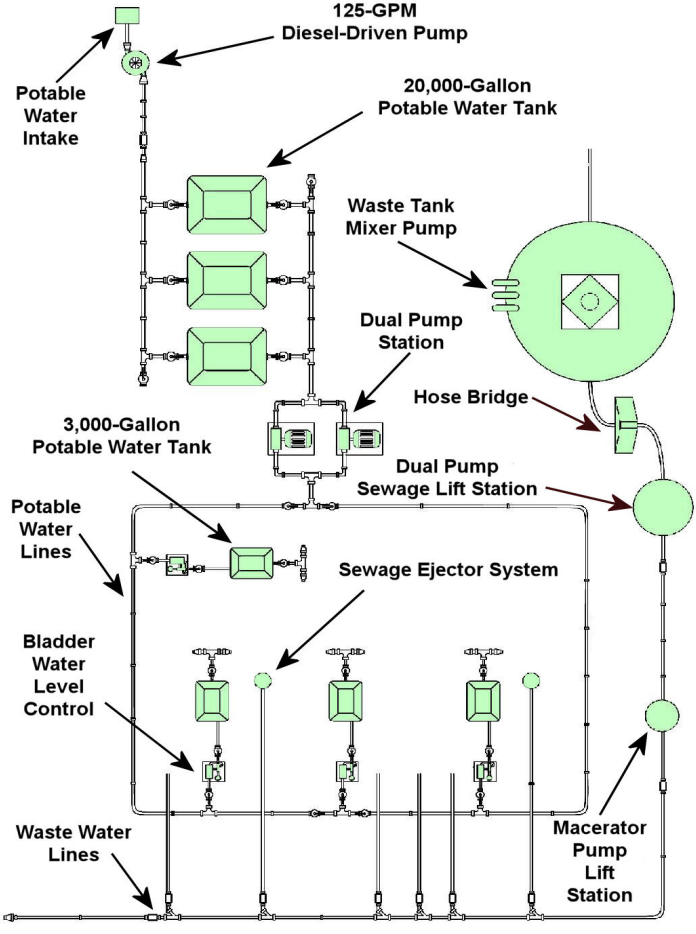


Table 5.1. 550-Initial Subsystem Major Components.

Component	Function/Use
125-Gallons per Minute Diesel Pump (Potable Water)	Pumps potable water into 20,000-gallon tanks for distribution to user facilities when not using the Water Production Subsystem as part of the water system configuration. (White Stripe)
20,000-Gallon Collapsible Fabric Tanks	Stores potable water in tank farm configuration. Tanks are color-coded white and are not interchangeable with raw, brine, or wastewater tanks.
Dual Pumping Station	Pressurizes potable water distribution lines and maintain chlorination of the water. Pumps can operate in dual or single configuration. (White Stripe)
3,000-Gallon Collapsible Fabric Tanks	Stores potable water at user facilities. (White Stripe)
Bladder Water Level Controllers	Maintains a preset maximum and minimum volume of potable water in 3,000-gallon water storage tanks.
Sewage Ejector Systems	Pumps raw sewage from latrines for output distribution to a wastewater collection tank. (Purple Stripe)
Macerator Pump Lift Station	Predigests raw sewage and pumps wastewater from user facilities to a waste collection system. (Purple)
Dual Pump Lift Station	Predigests raw sewage and pumps wastewater from user facilities for distribution to a waste collection tank. The two pumps can operate in either dual or single pump configuration. (Purple Stripe)

25,000 Gallon Wastewater Collection Tank w/Mixing System	Provides a 25,000-gallon storage capacity for wastewater and includes an aerator and pump assembly to mix and aerate wastewater to maintain liquid state for disposal. (Purple Stripe)
Hose Bridge System	Provides rollover protection for potable water and/ or wastewater distribution hoses when hoses cross roadways or similar heavy vehicular traffic areas.
Hoses	Route potable water to storage or user facilities, and routes wastewater for disposal. The hoses are color-coded white for potable water and purple for wastewater.
Ball Valves	Controls potable water flow. Also used to isolate water flow to specific components and user facilities to help facilitate maintenance and/or repair actions.
Check Valves (Wastewater)	Prevents waste from flowing back into the facilities, minimizes spills from unforeseen ruptures, and prevents sewage pump systems from over tasking.

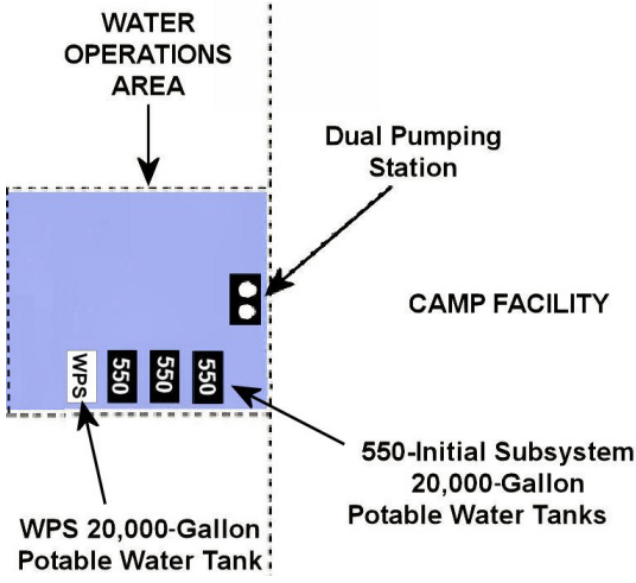
5.3. Installation. Before installing the 550-Initial Subsystem, review the planned dimensions of the water operations area (see **Table 2.1** on page 16) and the orientation of the subsystem in relation to the remaining subsystems. Then, refer to component layout diagrams in this chapter and the list in **Table 5.4** to identify each numbered component when performing the steps below.

WARNING

To prevent injury to personnel and/or damage to equipment units, ensure adequate personnel and lifting equipment are available to preposition equipment.

5.3.1. Position/Connect Dual Pump Station and 20,000-Gallon Tanks. Place the dual pumping station inside and at the center edge of the Water Operations Area (**Figure 5.2**) with its 3-inch outlet facing the camp facilities.

Figure 5.2. Siting Dual Pump Station and 20,000-Gallon Tanks (Typical).

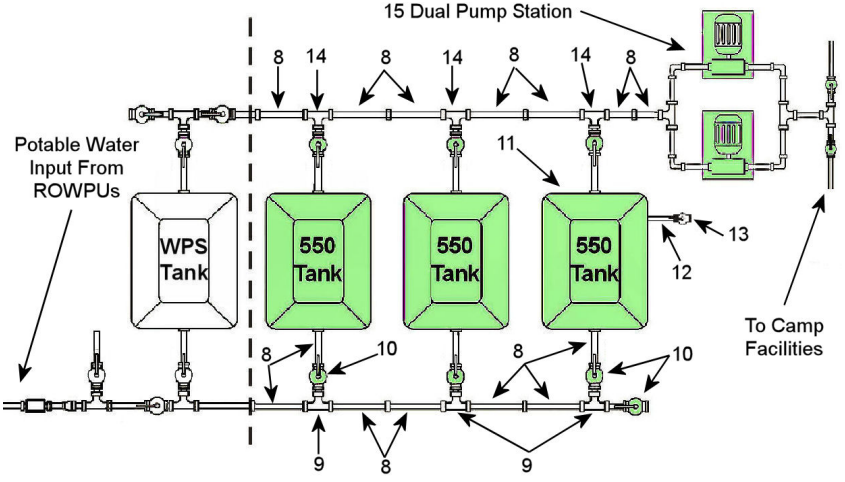


5.3.1.1. Starting on the inlet side of the dual pump station (**Figure 5.3**), attach two 4-inch x 15-foot suction hoses (8) to the 4-inch inlet of the pump station (15). Then, attach a 4-inch tee (14) to the hoses.

5.3.1.2. Position one 20,000-gallon potable water tank (11) approximately 30 feet from the dual pump station inlet and align the tank outlet with the 4-inch tee assembly branch. Position two more 20,000-gallon tanks spaced 6 feet apart and along the depth of the Water Operations Area.

5.3.1.3. Next, install the tank's vent, drain hose, and ball valve (12, 13), and 4-inch inlet elbow (female-to-female) and outlet elbow (female-to-male) onto each of the tanks. Then attach a 4-inch x 15-foot suction hose (8) to each tank inlet and outlet Quick Disconnect elbow. Afterward, connect 4-inch ball valves (10), outlet pipe tees (14), inlet pipe tees (9), and 15-foot suction hoses (8) to complete the tank inlet and outlet branches. **Note:** If setting up a 550 Follow-On subsystem with the Initial subsystem and both are on site, pre-install the 550-Follow-On tank outlet tees and ball valves according to **Paragraph 6.3.1.3**. This will prevent having to shut down water supply later for camp expansion.

Figure 5.3. 550-Initial Subsystem Dual Pump Station and 20,000-Gallon Potable Water Tanks Basic Component Layout.



5.3.1.4. Link the 550-Initial potable water tanks and the Water Production Subsystem potable water tank together by connecting the 4-inch x 15-foot suction hoses from the Water Production Subsystem tank to the inlet and outlet branches of the 550-Initial tanks, resulting in a four-tank farm configuration.

5.3.2. Position Sewage Ejector Systems. Sewage ejector systems should be located next to the facilities they support. Verify an adequate power source is available to the sewage ejector tank, and then position sewage ejector systems according to the following paragraphs. **Note:** When installing the sewage ejector system, a backhoe or similar digging equipment may be necessary for excavation and backfill operations.

CAUTION

Damage and/or destruction of Sewage Ejector System (Latrine) tank will result if accidental tip-over occurs due to equipment or similar contact occurring as the result of ground-level installation. To prevent tip-over damage, the tank should be installed in-ground to a depth of 24 inches.

5.3.2.1. Position sewage ejector systems alongside latrine facilities. To determine the exact location, first set up the latrine's drain system to verify its exact ending point. Then, assemble the inlet and outlet components to the sewage ejector tank and excavate a hole for the tank.

5.3.2.2. Excavate a hole large enough to accommodate the station tank to a depth of at least 24 inches. Prepare the bottom of the hole with 6 inches of backfill material of gravel or stone that is not less than 3/8-inch in diameter or larger than 3/4-inch in diameter (if available). Ensure the base is level and smooth.

CAUTION

In freezing conditions, backfill material must be dry and free of ice. Do not use other backfill materials unless approved by the manufacturer.

5.3.2.3. Lower the sewage ejector tank into the hole and insert backfill material until it reaches ground level (**Figure 5.4**).

Figure 5.4. Sewage Ejector System Placement (Typical).

5.3.3. Position 3,000-Gallon Potable Water Tanks. Position 3,000-gallon potable water tanks (24) next to their respective facilities (**Figure 5.5**) as follows:

5.3.3.1. Position one 3,000-gallon potable water tank about 25 feet away from the kitchen facility's water connection. Position additional 3,000-gallon tanks approximately 25 feet away and centered between each of the two shower/shave and latrine facilities. Each tank will feed one shower/shave and one latrine facility.

5.3.3.2. Position another 3,000-gallon tank directly behind and approximately 25 feet away from the laundry facility. Afterward, connect all vents and drain assemblies to the 3,000-gallon tanks. If a Basic Expeditionary Airfield Resources laundry facility is used, it comes equipped with its own 3,000-gallon tank that is usable in lieu of the tank from the 550-Initial Subsystem.

Figure 5.5. 3,000-Gallon Potable Water Tank at User Facility.

5.3.4. Assemble Potable Water Distribution Loop and Facility Connections. Begin assembling the potable water distribution loop and facility connections as depicted in **Figure 5.6**. **Note:** If using the 550-Follow-On Subsystem or multiple 550-Initial/Follow-On Subsystems, the loop on the 550-Initial Subsystem is NOT closed but connects to the next subsystem until the last subsystem assembled closes the loop. Always ensure hose couplings have neoprene gaskets properly installed before connecting hose assemblies.

5.3.4.1. Connect the 3-inch x 25-foot discharge hoses (16) to the outlet of the dual pump station. Use as many hoses as required to reach the loop starting point, which is along the perimeter of the facility placement area.

5.3.4.2. Connect one 3-inch tee (17) to the end of the discharge hose. Attach 3-inch ball valves (18) on each end of the 3-inch tee. Next, start laying the loop around the camp facility area toward the water-using facilities using 100, 50, and 25-foot discharge hoses.

5.3.4.3. Connect the first hose to the 3-inch ball valve at the dual pump station outlet branch (**Figure 5.7**) and if possible, route the hose to avoid exposure to high volumes of traffic. Use the 100-foot hose (5), 50-foot (19), and 25-foot (16) hoses where needed so the hose position ends up centered, and within 20 to 25 feet of the inlet side of 3,000-gallon facility tanks. **Note:** All water tanks (bladders or vessels) inserted into the water distribution loop or downstream but connected to the Dual Pump Station MUST have a bladder water level controller or be manually filled and isolated with a valve inserted on the inlet side of the bladder/vessel.

Figure 5.6. Potable Water Distribution Loop Starting Point.

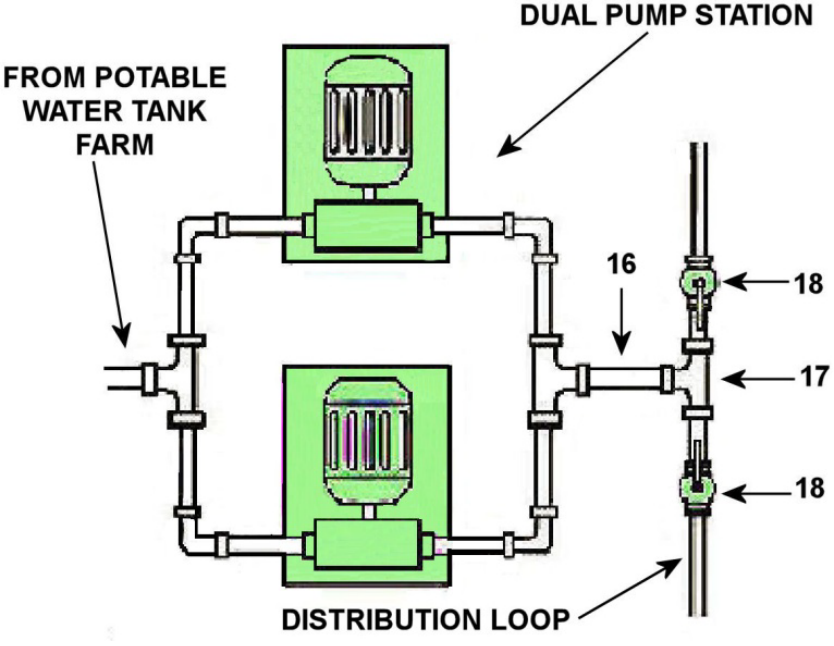
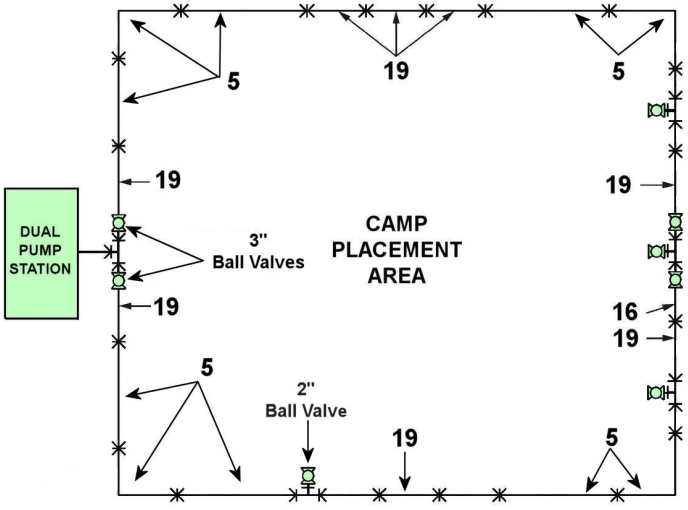


Figure 5.7. Water Distribution Loop Component Layout.



5.3.4.4. 3,000-Gallon Tank Inlet Connections. Starting at the water distribution loop adjacent to each 3,000-gallon facility tank (**Figure 5.8)**, install a 3-inch x 2-inch tee (20), and attach a 2-inch ball valve (21) on the tee assembly's branch outlet. Next, use one 2-inch x 25-foot discharge hose (22) and connect to the bladder water level controller (23). Attach another 2-inch ball valve to the inlet of the 3,000-gallon tank and connect the bladder water level controller directly to the 2-inch valve (**Figure 5.9**). **Note:** If necessary to connect facilities "directly" to the water distribution loop, installers must convey the potential consequences of this configuration and should install shut-off valves/pressure regulators and establish a quick response capability to mitigate damages if a failure occurs. The water distribution loop is constantly pressurized at about 45-55 pounds per square inch (depending on camp size). Those high pressures could damage equipment, flood areas, and deplete camp water supplies if the facility plumbing fail.

Figure 5.8. Inlet Connections for 3,000-Gallon Facility Tanks.

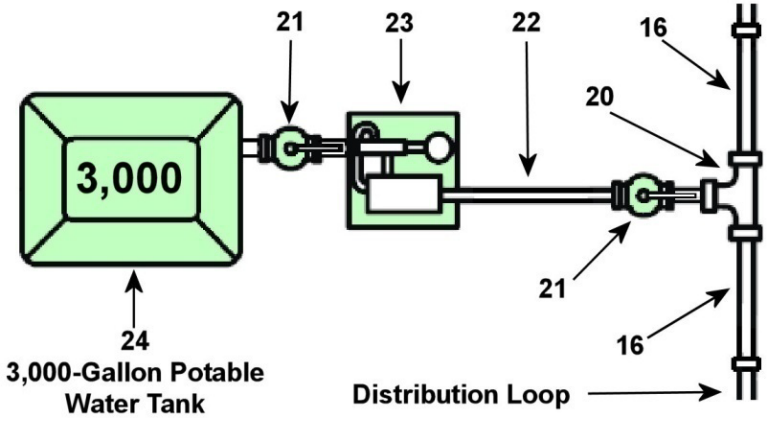
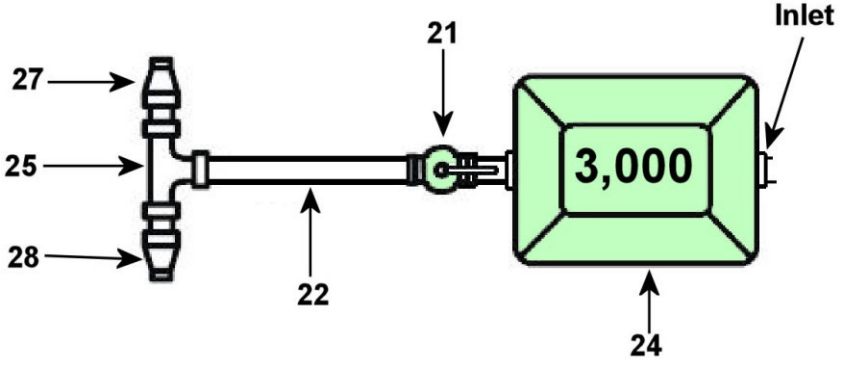


Figure 5.9. Bladder Water Level Controller Connections (Typical).

5.3.4.5. 3,000-Gallon Tank Outlet Connections. Assembly of the outlet connections on 3,000-gallon tanks (24) vary according to the type of facility the tanks support. Assemble the outlet manifold of each 3,000-gallon tank as follows:

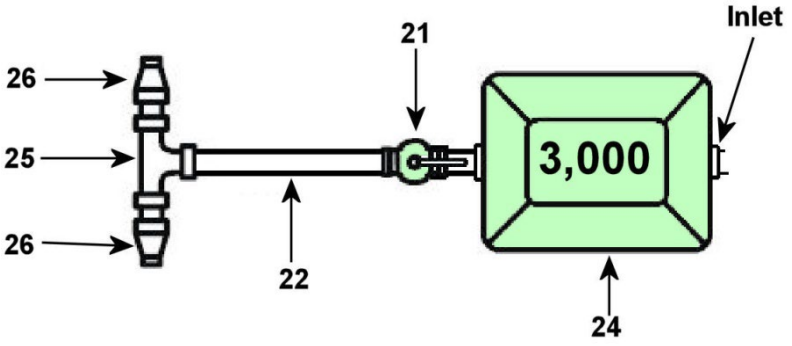
5.3.4.5.1. Shower and Latrine Facilities. As illustrated in **Figure 5.10**, connect a 2-inch ball valve (21) to the outlet of the 3,000-gallon tank. Then connect a 2-inch x 25-foot discharge hose (22) to the ball valve followed by a 2-inch tee. Afterward, connect a 2-inch x 3/4-inch reducer (27) for the latrine and one 2-inch x 1-inch reducer (28) for the shower to the tee assembly.

Figure 5.10. 3,000-Gallon Tank Outlet Connections (Shower/Latrine).



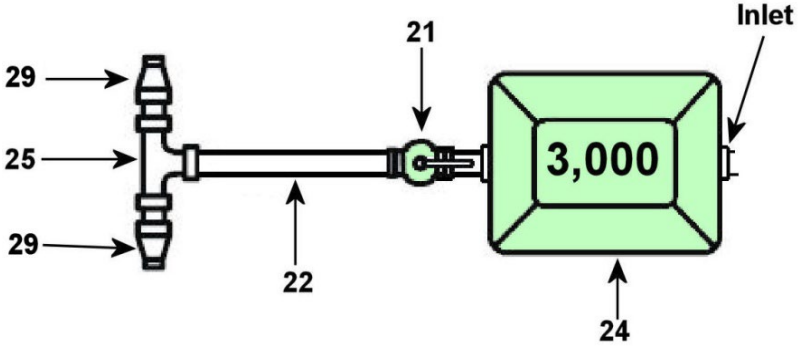
5.3.4.5.2. Laundry Facilities. As illustrated in **Figure 5.11**, connect a 2-inch ball valve (21) to the outlet of the 3,000-gallon tank (24). Then connect a 2-inch x 25-foot discharge hose (22) to the ball valve followed by a 2-inch tee. Afterward, connect two 2-inch x 1-1/2-inch reducers (26) to the tee assembly.

Figure 5.11. 3,000-Gallon Tank Outlet Connections (Laundry).



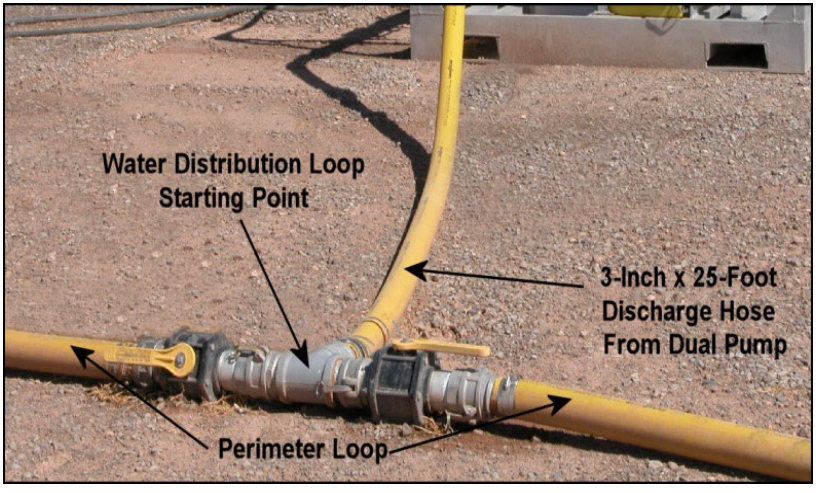
5.3.4.5.3. Kitchen Facilities. As illustrated in **Figure 5.12**, connect a 2-inch ball valve (21) to the outlet of the 3,000-gallon tank (24). Then connect a 2-inch x 25-foot discharge hose (22) to the ball valve followed by a 2-inch tee. Afterward, connect two 2-inch x 1-inch reducers (29) to the tee assembly.

Figure 5.12. 3,000-Gallon Tank Outlet Connections (Kitchen).



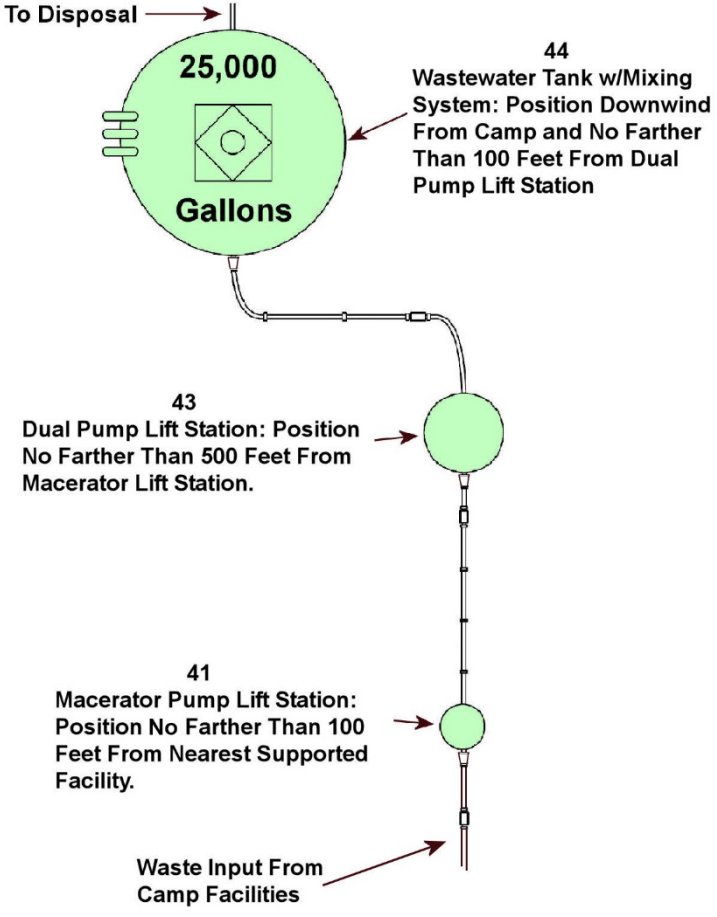
5.3.4.6. After connecting all the facilities, continue assembling 3-inch x 100-foot (5), 3-inch x 50-foot (19), and 3-inch x 25-foot (16) discharge hoses, forming a loop around the camp, until you come back to the 3-inch tee assembly (17). Then close the loop by connecting the last discharge hose to the ball valve as depicted in **Figure 5.13**.

Figure 5.13. Closed Water Distribution Loop (Typical).



5.3.5. Position and Assemble Wastewater Lift Stations and Tank. Position and assemble wastewater lift stations and tanks according to the following paragraphs and as illustrated in **Figure 5.14**. **Note:** The maximum distances of lift station placement in this section depend on the wastewater hose available in the 550-Initial Subsystem and not on pump capability. For maximum distances, refer to the manufacturer's pump specification data for each lift station pump.

Figure 5.14. Wastewater Lift Stations and Tank Component Layout.



CAUTION

Damage and/or destruction of Macerator Pump Lift Station Tank will result if accidental tip-over occurs due to equipment or similar contact occurring as the result of ground-level installation. To prevent tip-over damage, install the tank in-ground to a depth of 4-1/2 feet.

5.3.5.1. Position Macerator Pump Lift Station. Position the macerator pump lift station (41) on the backside of water-using facilities and away from areas subjected to high volumes of traffic. Locate the macerator pump lift station (**Figure 5.15**) as close as possible to the nearest facility it serves, but no farther than 100 feet. Prepare the area for the lift station as follows:

Figure 5.15. Macerator Pump Lift Station.

5.3.5.1.1. Excavate a hole large enough to accommodate the lift station tank to a depth of at least 4-1/2 feet. Prepare the bottom of the hole with 6 inches of backfill material of gravel or stone not less than 3/8-inch or larger than 3/4-inch in diameter (if available). Ensure the base is level and smooth.

CAUTION

In freezing conditions, backfill material must be dry and free of ice. Do not use other backfill materials unless approved by the manufacturer.

5.3.5.1.2. Lower the lift station tank into the hole and backfill the hole to ground level with available backfill material. Make sure an adequate power source is available to the lift station.

CAUTION

Damage or destruction of Dual Pump Lift Station Tank will result if accidental tip-over occurs due to equipment or similar contact occurring as the result of ground-level installation. To prevent tip-over damage, recommend the tank be installed in-ground to a depth of 2-1/2 feet.

5.3.5.2. Position Dual Pump Lift Station. Position the dual pump lift station (43) away from areas subjected to high volumes of traffic. Locate the dual pump lift station (**Figure 5.16**) no farther than 500 feet from the macerator pump lift station. Prepare the area for the dual pump lift station as addressed below. **Note:** Backhoe or similar digging equipment may be necessary for excavation and backfill operation.

5.3.5.2.1. Excavate a hole large enough to accommodate the lift station tank to a depth of at least 2-1/2 feet. Prepare the bottom of the hole with 6 inches of backfill material of gravel or stone not less than 3/8-inch or larger than 3/4-inch in diameter (if available). Ensure the base is level and smooth.

Figure 5.16. Dual Pump Lift Station.

CAUTION

In freezing conditions, backfill material must be dry and free of ice. Do not use other backfill materials unless approved by the manufacturer.

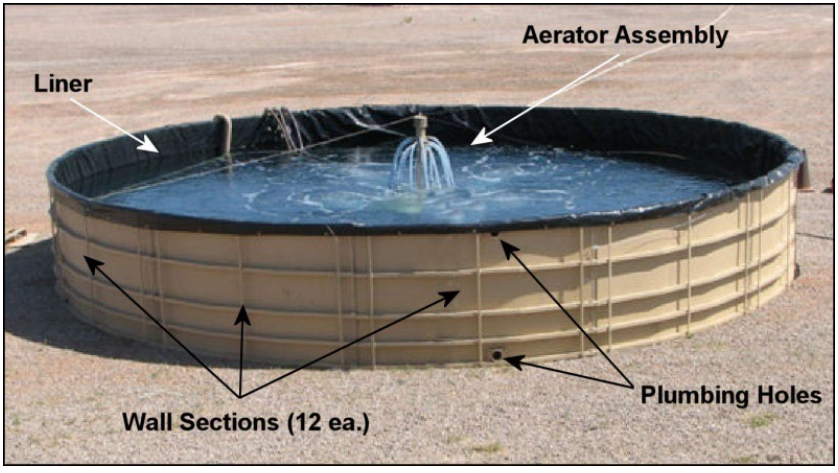
5.3.5.2.2. Lower the lift station tank into the hole and backfill the hole to ground level with available backfill material. Make sure an adequate power source is available to the lift station.

CAUTION

The wastewater mixing assembly (aerator) weighs about 290 pounds. To prevent injury and/or damage to equipment, ensure adequate (minimum of 4) personnel are available when positioning assembly within 25,000-gallon tank liner.

5.3.5.3. Position and Assemble 25,000-Gallon Wastewater Collection Tank. Determine the location for the 25,000-gallon wastewater collection tank (44). Locate the tank (**Figure 5.17**) downwind of the camp and no farther than 100 feet from the dual pump lift station (43). Ensure the area for the tank is flat and level, circular, and at least 40 feet in diameter. Remove any large rocks or sharp objects that could puncture the tank liner. Place components of the wastewater collection tank and mixing system adjacent to the selected location, then proceed as follows:

Figure 5.17. 25,000-Gallon Wastewater Collection Tank.



5.3.5.3.1. Spread out the ground cloth and verify there are no large wrinkles in the cloth material—smooth out the cloth if necessary. Spread the tank liner on the ground cloth, ensuring the liner is free of creases. After properly positioning the liner, place the aerator assembly in the center of the liner material.

5.3.5.3.2. Position the twelve (12) wall sections around the liner circumference. Note that current configuration tanks have two sections with holes for plumbing connections. Place the sections where inlet and outlet fittings will interface, typically 180 degrees from each other. The inlet faces in the direction of the outlet from the dual pump lift station. Newer configuration tanks will have four sections with holes for plumbing connections.

5.3.5.3.3. Select a wall section as the starting point and set the wall in place at the edge of the liner. Make sure there is no ground cloth or liner fabric stuck between the wall sections as they are set in place. Connect each wall section with the connecting rods as they are set in place. Ensure the top of the tank wall is level as assembly progresses.

5.3.5.3.4. After assembling the wall sections, pull the liner wall fabric up and over the wall sections. Attach the extension springs or bungees (**Figure 5.18**) from the grommets in the tank liner to the (middle) reinforcement rail on the exterior of the wall sections. Work from side-to-side when attaching extension springs to get the liner as even as possible.

5.3.5.3.5. Refer to instructions supplied with the bulkhead fittings to install the fittings to the wall sections using the plumbing holes.

5.3.5.3.6. After bulkhead fitting installation connect a reducer (3-inch female Quick Disconnect x 4-inch male National Pipe Thread) to the inlet port. Then, connect one 4-inch male Quick Disconnect x male National Pipe Thread to the outlet overflow and two 4-inch male Quick Disconnects to the two lower drain ports. Afterward, connect 4-inch ball valves (with female x male Quick Disconnects) to the 4-inch male Quick Disconnects on the tank ports.

5.3.5.3.7. Connect the three positioning cables to the top of the aerator assembly as depicted in **Figure 5.19**, and run the cables to the outside wall of the tank.

Figure 5.18. Extension Spring.

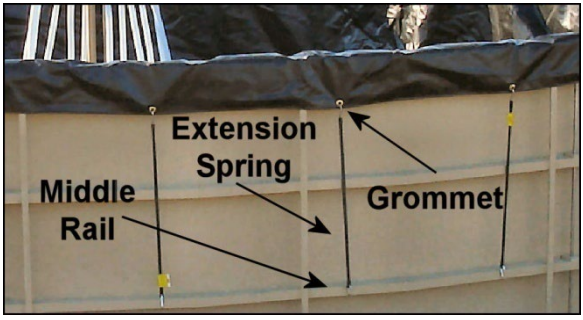
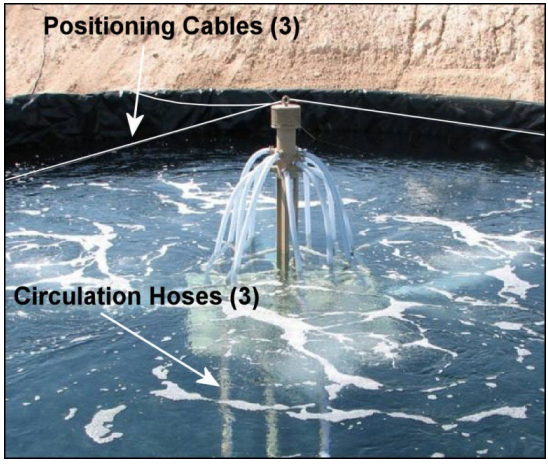
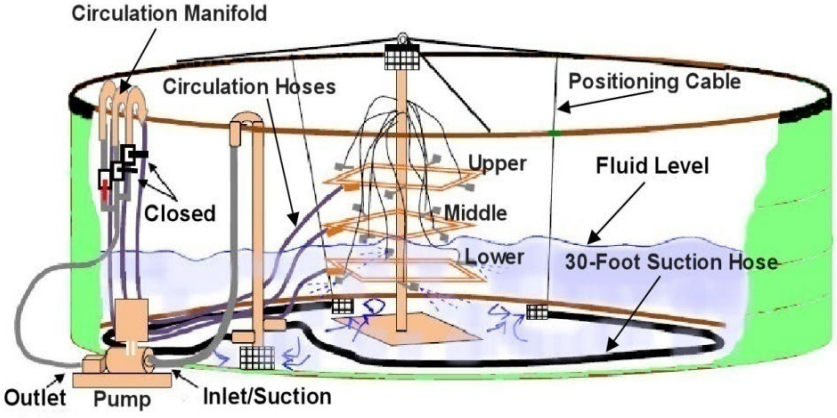


Figure 5.19. Three Positioning Cables Attached to Outside Wall.



5.3.5.3.8. Connect three circulation hoses to the lower, middle, and upper connection of the aerator assembly (**Figure 5.20**). Afterward, connect the circulation manifold to the top of the tank wall and tighten the clamps. Moving left to right, connect the hose assembly from the lower connection on the aerator assembly to the first manifold input. Sequentially connect the middle and upper hoses to the second and third manifold inputs.

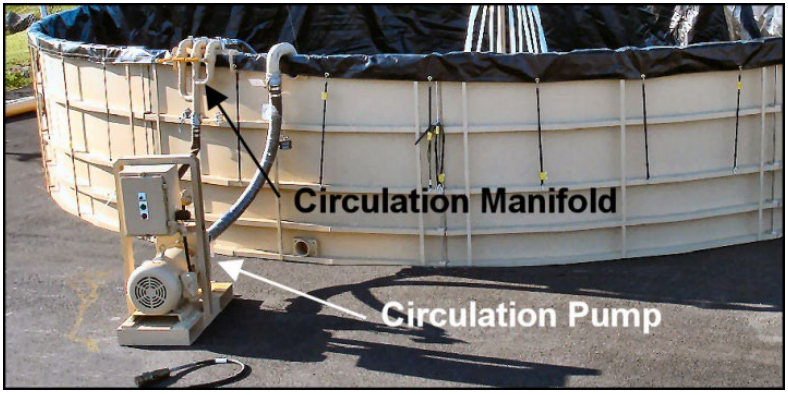
Figure 5.20. Configuration of Wastewater Tank and Mixing System.



5.3.5.3.9. Connect the two 30-foot suction hose assemblies to the discharge assembly. Then, attach the positioning cable to each hose assembly and place over the wall section.

5.3.5.3.10. Position the circulation pump outside the tank wall below the circulation manifold and connect the hose and pipe connections from the manifold to the pump assembly (**Figure 5.21**). Install the ground rods and connect them to the circulation pump. Afterward, connect the circulation pump to an adequate power source.

Figure 5.21. Circulation Pump Positioned Below Circulation Manifold.



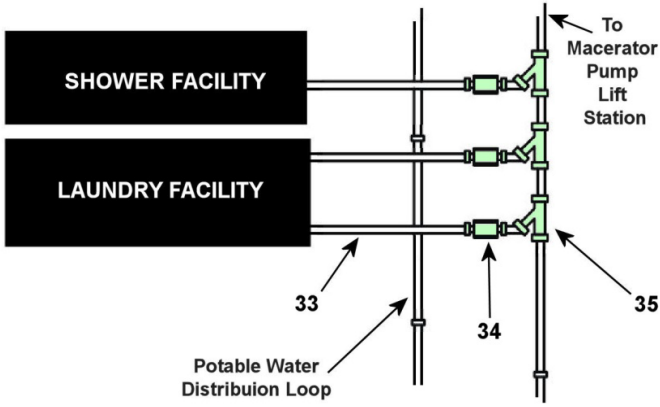
5.3.6. Connect Wastewater Hoses for Shower and Laundry Facilities. Begin assembling wastewater hoses for shower and laundry facilities as depicted in **Figure 5.22**, and proceed as follows:

5.3.6.1. Lay out one 2-inch x 50-foot discharge hose (33) for each shower facility, making sure to route it over the top of the 3-inch potable water distribution loop.

5.3.6.2. Lay out two 2-inch x 50-foot (33) discharge hoses for the laundry facility making sure to route them over the top of the 3-inch potable water distribution loop.

5.3.6.3. Connect a 2-inch check valve (34) to each 3-inch x 2-inch wye assembly (35), then attach the 2-inch x 50-foot discharge hoses (33). **Note:** Ensure the 2-inch wye branch on the 3-inch x 2-inch wye assemblies (35) all face away from the direction of wastewater flow to the Macerator Pump Lift Station.

Figure 5.22. Shower and Laundry Wastewater Hose Component Layout.



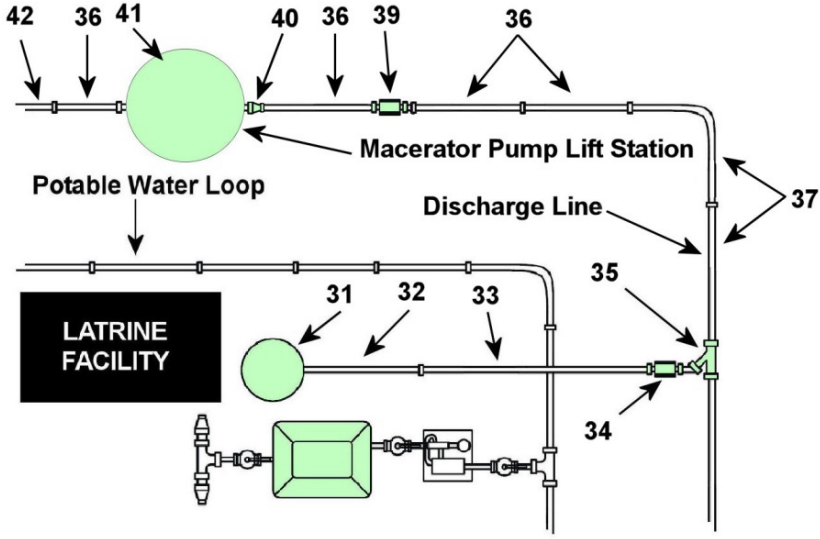
5.3.7. Connect Wastewater Hoses for Latrine Facilities. Confirm proper assembly of sewage ejector systems (31) with their pump and float switch and connection to an adequate power supply. Refer to Technical Order 40W4-21-1-WA-1 for assembly and maintenance of the sewage ejector system. Connect the wastewater hoses for latrine facilities as depicted in **Figure 5.23**. **Note:** Always ensure hose couplings have neoprene gaskets properly installed before connecting hose assemblies.

5.3.7.1. Connect one 2-inch x 25-foot discharge hose (32) to the outlet of each sewage ejector system adjacent to the latrines. Then connect one 2-inch x 50-foot discharge hose (33) to the 25-foot discharge hoses. After that, connect a 2-inch check valve (34) to each 3-inch x 2-inch wye assembly (35) and connect the check valves to the assembled 50-foot hoses.

5.3.7.2. Connect all wye assemblies together using necessary lengths of 3-inch discharge hoses (36, 37), and assemble the hoses until you are within 25 feet of the macerator pump lift station (41).

5.3.7.3. At the macerator pump lift station (41), install one 4-inch x 3-inch reducer (40) onto the inlet of the lift station and attach a 3-inch x 25-foot discharge hose (36) onto the reducer. Fasten a 3-inch check valve (39) onto the discharge hose and connect the check valve to the discharge hose coming from the facilities.

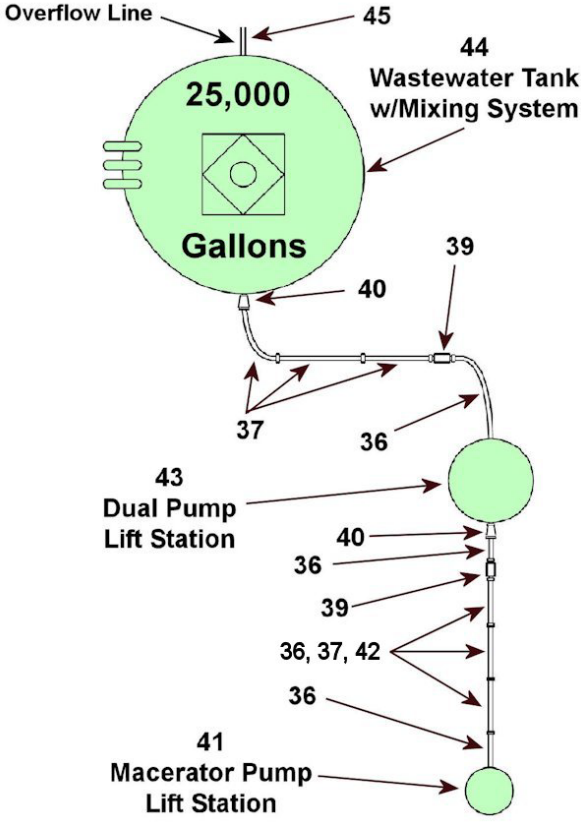
Figure 5.23. Latrine Wastewater Hose Component Layout.



5.3.7.4. Connect one 3-inch x 25-foot discharge hose (36) to the outlet of the macerator pump lift station, then attach enough 3-inch x 100-foot discharge hose assemblies (42) and other 3-inch discharge hose assemblies (36, 37) until you are approximately 25 feet from the dual pump lift station. **Note:** If using the 550-Follow-On Subsystem, the 3-inch check valve assembly (39) will attach to a 3-inch tee assembly (Waste), supplied with the 550-Follow-On Subsystem.

5.3.8. Assemble Dual Pump Lift Station Inlet and Outlet Branches. Begin assembling the dual pump lift station inlet and outlet branches as depicted in **Figure 5.24**.

Figure 5.24. Dual Pump Lift Station Inlet/Outlet Component Layout.



5.3.8.1. Starting at the dual pump lift station (43), attach one 4-inch x 3-inch reducer (40) onto the inlet of the lift station, followed by a 3-inch x 25-foot discharge hose (36). Fasten a 3-inch check valve (39) onto the discharge hose and connect the check valve to the discharge hose coming from the macerator pump lift station.

5.3.8.2. At the dual pump lift station outlet, connect one 3-inch x 25-foot discharge hose (36), followed by a 3-inch check valve (39). Then attach enough 3-inch discharge hoses (37) from the check valve to reach the inlet of the 25,000-gallon wastewater collection tank (44).

5.3.8.3. At the upper port ball valve outlet of the 25,000-gallon wastewater collection tank, connect the desired number of 4-inch x 50-foot discharge hose assemblies (45) to serve as the wastewater tank overflow.

5.3.8.4. If any of the subsystem plumbing crosses roadways or similar heavy vehicular traffic areas, use the hose bridge system to provide hose rollover protection. Assemble the hose bridge system as illustrated in **Attachment 5**. This completes basic installation of the 550-Initial Subsystem.

5.4. Operation. The following procedures address basic steps to operate the 550-Initial Subsystem after installation. If necessary, refer to basic layout diagrams presented throughout this chapter for component identification.

5.4.1. Perform 550-Initial Subsystem Preoperational Checks. Before operating the subsystem, complete the preoperational checks outlined in **Table 5.2**.

WARNING

To prevent injury or death to personnel, make sure Source Power is OFF before connecting power input to the Dual Pump Lift Station, Macerator Pump Lift Station, or Sewage Ejector System.

Table 5.2. 550-Initial Subsystem Preoperational Checks.

Preoperational Checks			
A	**25,000-Gallon Wastewater Collection Tank:**	**Y**	**N**
	(1) Aeration system properly installed (centered in tank).		
	(2) All hose assemblies connected properly, and connections are tight.		
	(3) All components are color-coded purple.		
	(4) Circulation pump assembly connected to adequate power source.		
B	**Wastewater Collection Hoseline:**		
	(1) All components are color-coded purple.		
	(2) Hoseline and fitting connections to Dual Pump Lift Station (43) connected properly and connections are tight. Pumps and float assemblies properly installed, and station connected to an adequate power supply.		
	(3) Hoseline and fitting connections to Macerator Pump Lift Station connected properly and connections are tight. Pumps and float assemblies properly installed, and station connected to adequate power supply.		
B	**Wastewater Collection Hoseline: (Continued)**		
	(4) Hoseline and fitting connections at facility connection to the wastewater collection hose connected properly and connections are tight.		

Preoperational Checks			
	(5) Hoseline and fitting connections to two Sewage Ejector Systems (Latrines) connected properly and connections are tight. Pump and float assemblies are properly installed, and system is connected to adequate power supply.	Y	N
	(6) Hoseline and fitting connections to four 2-inch branch hose lines connected properly and connections are tight.		
C	**Potable Water Distribution Loop:**		
	(1) All hose assemblies, valves, and couplings through the loop connected properly and connections are tight.		
	(2) All components are color-coded white.		
	(3) All ball valve assemblies throughout the loop are open.		
D	**3,000-Gallon Potable Water Tanks (All) Connections:**		
	(1) All hose assemblies, valves, and fittings on the 3,000-gallon tank connected properly and connections are tight.		
	(2) 2-inch ball valves, on tank outlet and tank drain, are closed. 2-inch ball valve on tank inlet is open.		
	(3) 2-inch ball valve on the inlet to the Bladder Water Level Control is open.		
	(4) Adequate power supplies to the Bladder Water Level Control.		
	(5) All components are color-coded white.		
E	**20,000-Gallon Potable Water Tanks (All) Outlet Manifolds:**	**Y**	**N**
	(1) All hose assemblies, valves, and fittings properly connected, and connections are tight.		

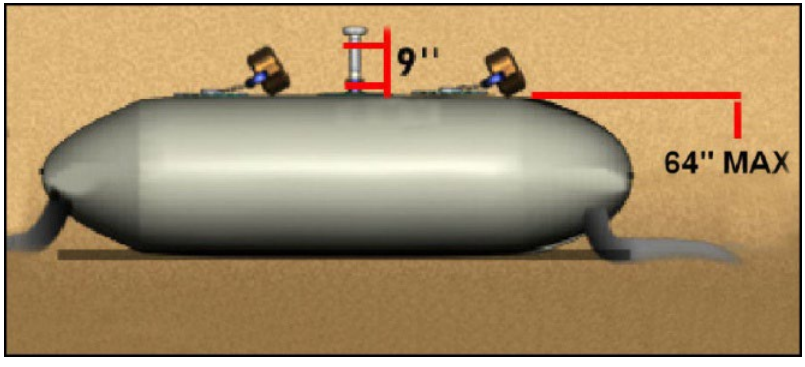
Preoperational Checks			
	(2) All components are color-coded white.		
	(3) 4-inch ball valve assemblies on outlet manifold system from in-use 20,000-gallon potable water tanks are open.		
	(4) 4-inch ball valve on outlet branch tee closed, unless other subsystems 20,000-gallon potable water tanks installed		
F	**20,000-Gallon Potable Water Tanks (All) Inlet Manifolds:**		
	(1) All hose assemblies, valves, and fittings connected properly, and connections are tight.		
	(2) All components are color-coded white.		
	(3) 4-inch ball valve assemblies on inlet manifold system from 20,000-gallon potable water tanks are closed; and only opened during filling operations.		

5.4.2. **Verify Potable Water Production.** Ensure potable water from the water production subsystem or alternate potable water collection system is flowing into 20,000-gallon potable water tanks. While the 20,000-gallon tanks are filling, recheck all hose assemblies, valves, fittings, and tanks for leaks. When 20,000-gallon tanks have sufficient water (at least 1/4 full), recheck all hose assemblies, valves, and fittings for leaks, and make needed repairs. Also, make sure that the dual pumping station connects to an adequate power source. Afterward, ensure the inlet and outlet valves on the dual pumping station are open. **Note:** During filling operations, it will be necessary to monitor the level of all 20,000-gallon potable water tanks. When tanks become full, it will be necessary to shut down the water production subsystem or potable water collection system.

WARNING

Serious injury or death to personnel could occur if tanks are overfilled and explode. When filling tanks, ensure the height of **20,000-gallon tanks do not exceed a maximum height of 64 inches**. (**Figure 5.25**) Tanks fill at different rates, and it will be necessary to turn on and turn off pumps as required so they do not overfill.

Figure 5.25. Maximum Fill Height (20,000-Gallon Bladder).



5.4.3. Fill Chlorine Feed Tank. Fill the chlorine feed tank on the dual pumping station as follows:

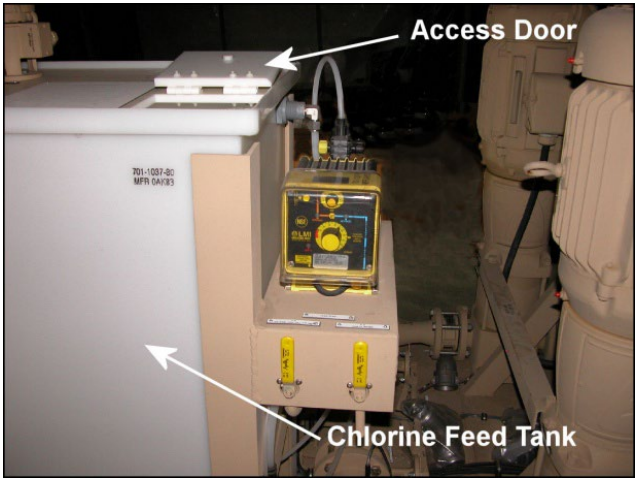
5.4.3.1. Open the access door on top of the chlorine feed tank (**Figure 5.26**) and fill the tank with 45 gallons of water using an external water source.

5.4.3.2. On the dual pumping station control panel (**Figure 5.27**), set the Chlorine Feed System–TANK MIXER–OFF/ON switch to ON. Then verify the TANK MIXER ON indicator is illuminated. Afterward, slowly add 30 pounds of granular Calcium Hypochlorite to the chlorine tank.

WARNING

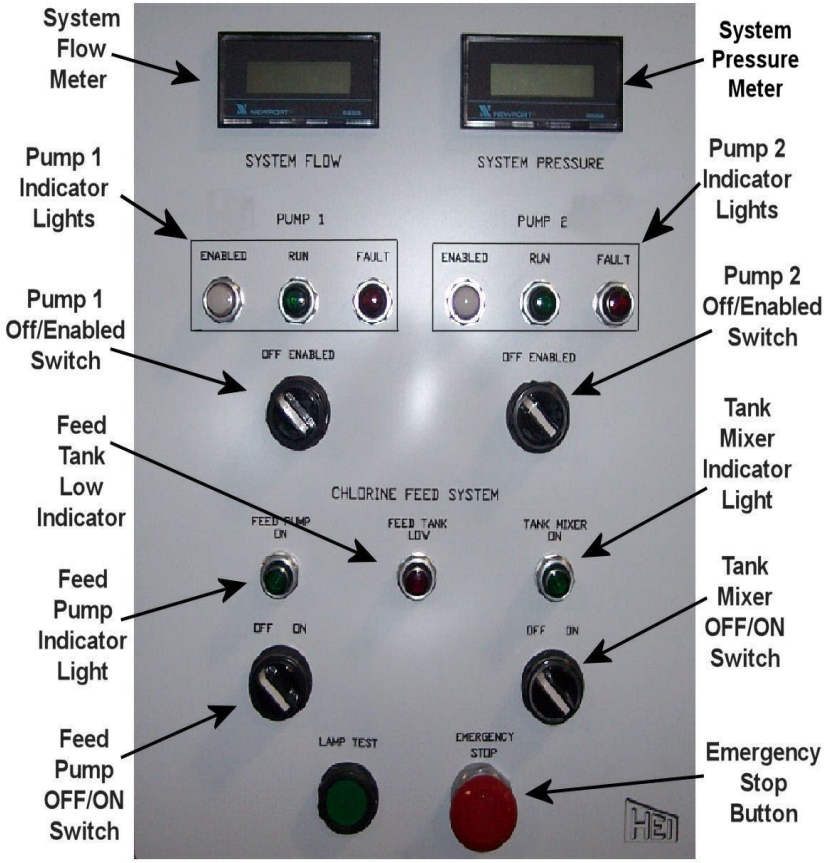
CALCIUM HYPOCHLORITE is harmful if contact occurs with skin or eyes or is inhaled or ingested. Do not take internally. Wear personal protective equipment. Avoid excessive heat and flame. Avoid contact with skin, eyes, or clothing. Upon contact with eyes or skin, flush with large amounts of water for at least 15 minutes. Call a physician at once. If clothes contact the product, remove them immediately and wash before reuse. If ingested, drink large amounts of water. Do not induce vomiting. Call a physician at once. If inhaled, move to fresh air. Give oxygen or artificial respiration as needed. Call a physician.

Figure 5.26. Access Door on Chlorine Feed Tank.



5.4.3.3. Also on the dual pumping station control panel, set the Chlorine Feed System–Tank Feed Pump-FEED PUMP–OFF/ON switch to ON. Then verify the FEED PUMP ON indicator is illuminated.

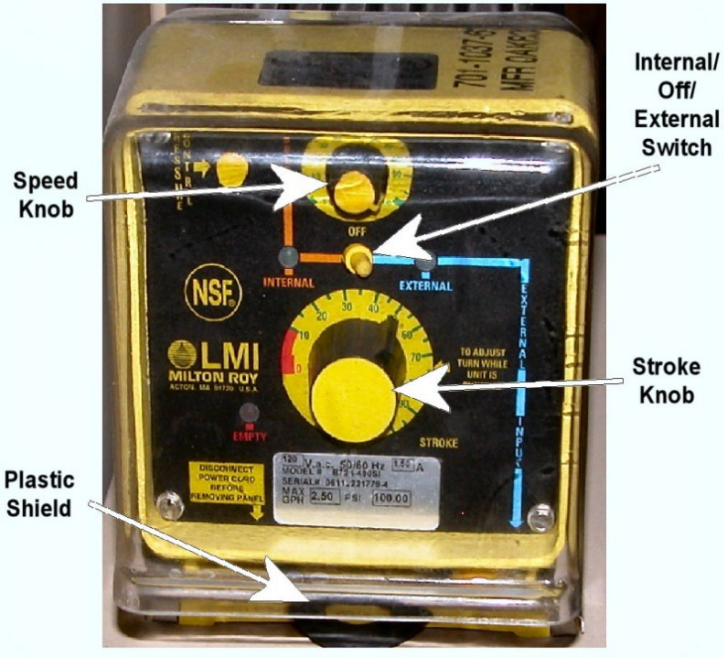
Figure 5.27. Dual Pumping Station Control Panel.



5.4.3.4. On the feed pump control panel (**Figure 5.28**), lift the plastic shield from the panel, and set the INTERNAL/OFF/EXTERNAL switch to INTERNAL position.

> **CAUTION**
> Equipment damage will result if anyone adjusts the STROKE knob without the chlorine feed pump running. Ensure chlorine feed pump is running before adjusting STROKE knob.

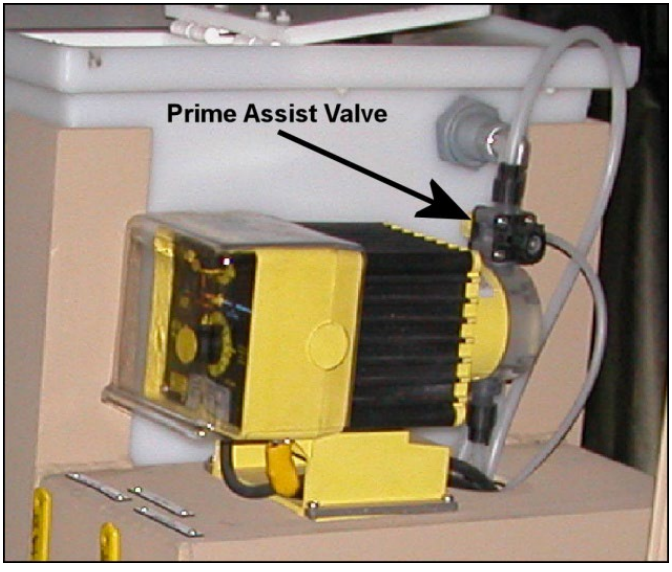
Figure 5.28. Feed Pump Control Panel.



5.4.3.4.1. Position the STROKE and SPEED knobs to their maximum setting.

5.4.3.4.2. Adjust the prime assist valve (**Figure 5.29**) to establish chlorine solution flow. When flow is established, release the priming knob, and set the INTERNAL/OFF/EXTERNAL switch to the EXTERNAL position and close the access door on top of the chlorine feed tank.

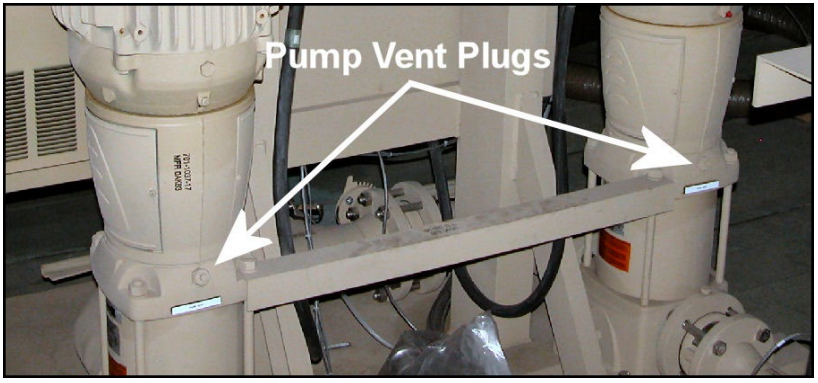
Figure 5.29. Prime Assist Valve (Priming Knob).



5.4.4. Configure Dual Pumping Station. Perform the following procedures on the dual pumping station:

5.4.4.1. On both pump assemblies, open the vent plug (**Figure 5.30**) until water flows from the vent. Afterward, close the vent.

Figure 5.30. Pump Vent Plugs.



5.4.4.2. Pull the EMERGENCY STOP button out on the control panel and set Pump 1–OFF/ENABLED switch to ENABLED. Verify Pump 1-ENABLED and RUN indicators are illuminated and that Pump 1 rotation is clockwise. Then, set Pump 2–OFF/ENABLED switch to ENABLED. Verify Pump 2-ENABLED and RUN indicators are illuminated and that Pump 2 rotation is clockwise. Then verify SYSTEM PRESSURE is preset to 45 pounds per square inch.

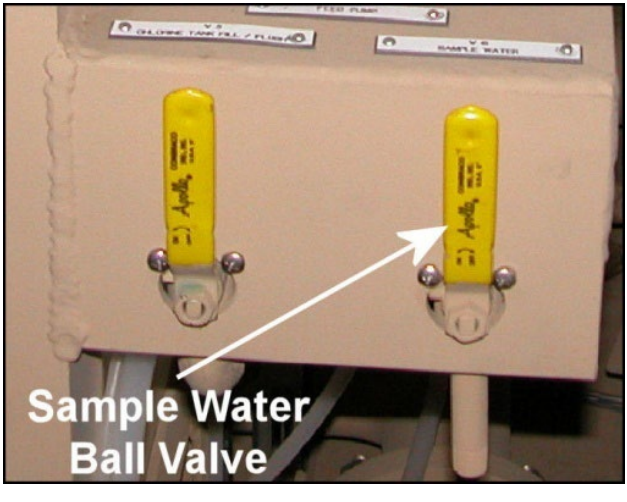
5.4.4.3. Verify the SYSTEM FLOW and SYSTEM PRESSURE meters stabilize after the entire system is pressurized.

5.4.4.4. Verify the Chlorine Feed System–FEED TANK LOW indicator light is off and that the fault indicators are not illuminated. If a fault indication is illuminated, open the panel and briefly press RESET then START pushbuttons. If indications recur, refer to the installation and operation manual to troubleshoot the problem.

5.4.4.5. On the chlorine feed tank, adjust the STROKE knob for the desired chlorine solution level. Use the SAMPLE WATER ball valve (**Figure 5.31**) to draw water into a container and check required chlorine level. It may be necessary

to readjust the STROKE knob and resample the water until achieving the desired chlorine level. When completed, lower the plastic shield on the feed pump control panel.

Figure 5.31. Sample Water Ball Valve.



5.4.5. Check Potable Water Distribution Loop. Ensure potable water is flowing through the water distribution loop. Then, connect bladder water level controllers to an adequate power source at each 3,000-gallon potable water tank. Adjust the bladder water level controls as necessary (see **Figure 5.32** and **Table 5.3** for Controls and Indicators) and verify 3,000-gallon tanks are being filled. Then, recheck all hoses, valves, and fittings throughout the potable water distribution loop and 3,000-gallon tanks for leaks. Make any needed repairs. **Note:** Contingency water systems tend to leak a little, so small leaks are usually unavoidable and should not be a major cause of concern. Always ensure hose couplings have neoprene gaskets properly installed before connecting hose assemblies.

Figure 5.32. Bladder Water Level Controls.

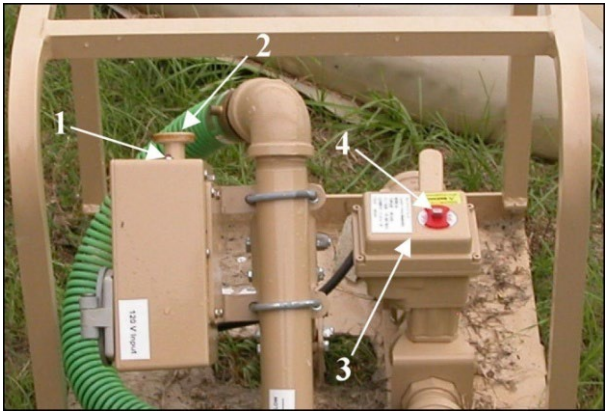


Table 5.3. Bladder Water Level Controller – Controls and Indicators.

Item	Name	Function
1	Power Indicator	Illuminates RED anytime power is applied.
2	Level Control Knob	Used to adjust level (height/capacity) of 3000-gallon tank. Turning knob clockwise raises the height of tank. Turning knob counterclockwise lowers the height of tank.
3	Control Valve Assembly OPEN CLOSED	Controls the main flow valve. Indicates main control valve is open. Indicates main control valve is closed.
4	Valve Shaft	In the event of a power failure, open or close the valve manually by turning the shaft to the desired position with a wrench.

5.4.6. Check Facilities Operation. Once the 3,000-gallon tanks for shower, latrine, laundry, and kitchen facilities have sufficient water, check the operation of these facilities according to their respective technical orders.

5.4.7. Verify Wastewater Collection. Check wastewater collection lines by first turning on and allowing water to run in connected facilities. Then complete the following procedures:

WARNING

To prevent injury or death to personnel, make sure Source Power is OFF before connecting power input to the Sewage Ejector System.

5.4.7.1. Connect the sewage ejector system to an adequate power source and verify correct pump operation by allowing the latrine holding tank to empty into the sewage ejector system. Repeat this step for each ejector system utilized.

5.4.7.2. Check the hose line, valves, and fittings leading to the macerator pump lift station for leaks and make needed repairs.

5.4.7.3. Set the macerator pump lift station HAND/OFF/AUTO power switch to AUTO (**Figure 5.33**) and verify the PUMP RUN indicator on the front of the control box is illuminated. Then, verify the SEAL FAIL indicator on the side of the control box is off and the macerator pump lift station is operating correctly.

5.4.7.4. Check the hose line, valves, and fittings leading to the dual pump lift station for leaks and make any needed repairs.

5.4.7.5. On the dual pump lift station, open the power panel door and set the Pump 1-HAND/OFF/AUTO power switch to AUTO (**Figure 5.34**). Then verify the Pump 1–PUMP RUNNING indicator on the front of the control box is illuminated and the Pump 1-SEAL FAIL indicator is off. Next, set the Pump 2-HAND/OFF/

AUTO power switch to AUTO and verify the Pump 2-SEAL FAIL indicator is off. Afterward, verify the dual pump lift station is operating correctly.

5.4.7.6. Check the hose line, valves, and fittings leading to the 25,000-gallon wastewater collection tank for leaks and make any needed repairs. When sufficient water has accumulated in the 25,000-gallon waste tank, open the lower (left) stage ball valve on the intake assembly, ensuring the middle and upper stage ball valves on feeding mixer assembly are closed. Then turn on the circulation pump and verify operation of the aerator assembly. As the tank level rises, sequentially turn on the middle (center) and upper stage ball valves for complete system operation. Then, check hose assemblies, valves, and fittings for leaks and make needed repairs.

Figure 5.33. Macerator Pump Lift Station Control Box.

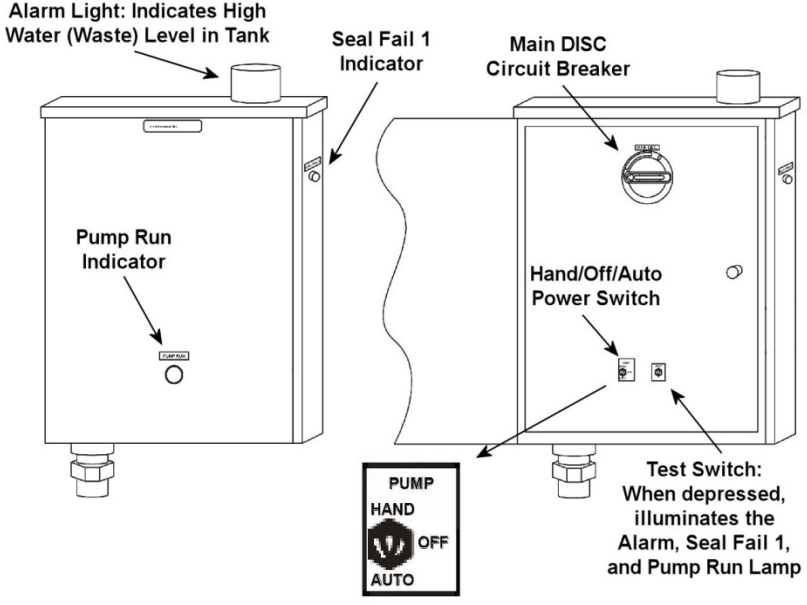
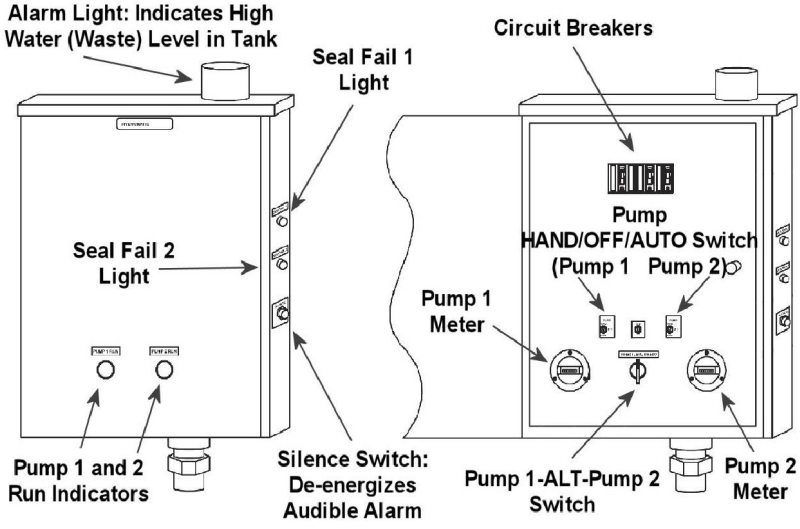


Figure 5.34. Dual Pump Lift Station Control Box.



5.4.7.7. The wastewater tank needs to be emptied periodically using either a sewage suction trailer/truck, or by contract. Make sure that either the mixing pump is shutdown, or the stage ball valves are shut off sequentially as the tank is emptied; top/right, middle, bottom/left. If suction is all the way down to the bottom stage, shut the pump down. **Note:** Keeping the system running while pumping the tank has advantages because the sludge keeps moving constantly minimizing bottom tank buildup and better tank evacuation.

5.4.8. Monitor Potable Water Tank Levels. Keep an eye on the water level of 20,000-gallon and 3,000-gallon potable water tanks throughout the operation of the system. Shut down and start up the Source Run Subsystem, the Water Production Subsystem, and/or the 125-gallons per minute Diesel Pump as necessary to maintain the required amount of water storage. **Attachment 6** lists normal operating steps after the system is initially filled and functioning normally.

5.5. Component Descriptions. Table 5.4 provides a detailed description and quantity for each 550-Initial Subsystem component and its corresponding reference number used in this chapter. See Technical Order 40W4-21-1-WA-1 for other subsystem component information.

Table 5.4. 550-Initial Component Description and Item Number.

Ref #	550 Initial Component Description	Qty
1	2-inch Strainer and Float Buoy Assembly w/Hand Air Pump, White Stripe	1
	Adapter Assembly, Hydrant, Swivel, 2-1/2 Inch, Female National Standard Threads x 2-Inch Female Quick Disconnect	1
	Coupler, 2-Inch Female Quick Disconnect x Male National Pipe Thread	1
2	Suction Hose Assembly, Potable Water, 2-Inch x 25-Foot, White Stripe	5
3	Pump Assembly, 2-Inch Diesel, Potable Water, w/2-Inch Female x Male Quick Disconnects, White Stripe	1
4	Reducer, w/3-Inch Male x 2-Inch Female Quick Disconnects, White Stripe	1
5	Discharge Hose Assembly, 3-Inch x 100-Foot, White Stripe	15
7	Reducer, w/4-Inch Male x 3-Inch Female Quick Disconnects, White Stripe	1
8	Suction Hose Assembly, 4-Inch x 15-Foot, White Stripe	20
9	Tee Assembly, 4-Inch x 4-Inch x 4-Inch, White Stripe, w/Female x Male x Male Quick Disconnects	5
10	Ball Valve Assembly, 4-Inch, w/Female x Male Quick Disconnects, White Stripe	10

Ref #	550 Initial Component Description	Qty
11	20,000-Gallon Collapsible Fabric Tank w/Adapter, 2-Inch Male Quick Disconnect x Male National Pipe Thread, White Stripe	3
12	Suction Hose Assembly, 2-Inch x 8-Foot, White Stripe	8
13	Ball Valve Assembly, 2-Inch, w/Female Quick Disconnect x Female National Pipe Thread, White Stripe	8
14	Tee Assembly, 4-Inch x 4-Inch x 4-Inch, w/Male x Female x Female Quick Disconnects, White Stripe	5
15	Dual Pump Station, Variable Speed, White Stripe	1
16	Discharge Hose Assembly, 3-Inch x 25-Foot, White Stripe	7
17	3-Inch x 3-Inch x 3-Inch Tee Assembly w/Male x Male x Female Quick Disconnects, White Stripe	2
18	Ball Valve Assembly, 3-Inch w/Female x Male Quick Disconnects, White Stripe	6
19	Discharge Hose Assembly, 3-Inch x 50-Foot, White Stripe	14
20	Tee Assembly, 3-Inch x 3-Inch x 2-Inch, w/3-Inch Female x 3-Inch Male x 2-Inch Male Quick Disconnects, White Stripe	7
21	Ball Valve Assembly, 2-Inch w/Female x Male Quick Disconnects, White Stripe	15
22	Discharge Hose Assembly, 2-Inch x 25-Foot, White Stripe	10
23	Bladder Water Level Control, Electric w/2-Inch Female x Female Quick Disconnects and 25-Foot Outdoor Extension Cord, White Stripe	4

Ref #	550 Initial Component Description	Qty
24	3,000-Gallon Collapsible Fabric Tank Assembly w/2-Inch Male x Male x Male Quick Disconnects, White Stripe	5
25	Tee Assembly, 2-Inch x 2-Inch x 2-Inch, w/Male x Male x Female Quick Disconnects, White Stripe	5
26	Reducer, 2-Inch Female x 1-1/2-Inch Female Quick Disconnects, White Stripe	3
27	Reducer, 2-Inch Female x 3/4-Inch Male Quick Disconnects, White Stripe	4
28	Reducer, 2-Inch Female x 1-Inch Female Quick Disconnects, White Stripe	3
29	Reducer, 2-Inch Female x 1-Inch Male Quick Disconnects, White Stripe	3
30	Adapter, 4-Inch Male Quick Disconnect x 4-Inch Victaulic/Grooved, Purple Stripe	3
31	Sewage Ejector System (Latrine), w/4-Inch Female Quick Disconnect Inlet x 2-Inch Male Quick Disconnect Outlet, 2-Inch Check Valve, and 2-Inch National Pipe Thread 90-Degree Elbow (For Field Assembly)	2
32	Discharge Hose Assembly, 2-Inch x 25-Foot, Purple Stripe	3
33	Discharge Hose Assembly, 2-Inch x 50-Foot, Purple Stripe	10
34	Check Valve Assembly, 2-Inch, w/Female x Male Quick Disconnects, Purple Stripe	8
35	Wye Assembly, 3-Inch x 3-Inch x 2-Inch, w/3-Inch Female x 3-Inch Male x 2-Inch Female Quick Disconnects, Purple Stripe	8
36	Discharge Hose Assembly, 3-Inch x 25-Foot, Purple Stripe	10

Ref #	550 Initial Component Description	Qty
37	Discharge Hose Assembly, 3-Inch x 50-Foot, Purple Stripe	8
39	Check Valve Assembly, 3-Inch, w/Female x Male Quick Disconnects, Purple Stripe	5
40	Reducer, w/4-Inch Male x 3-Inch Female Quick Disconnects, Purple Stripe	4
41	Macerator Pump Lift Station Assembly w/3-Inch Female Quick Disconnect Inlet x 3-Inch Male Quick Disconnect Outlet, Purple Stripe	1
42	Discharge Hose Assembly, 3-Inch x 100-Foot, Purple Stripe	5
43	Dual Pump Lift Station Assembly w/3-Inch Female Quick Disconnect Inlet x 3-Inch Male Quick Disconnect Outlet, Purple Stripe	1
44	25,000-Gallon Rigid Wall Tank Assembly w/Mixing System w/3-Inch Female Quick Disconnect Inlet and two 4-Inch Male Quick Disconnect Outlets w/4-Inch Ball Valve Assemblies w/Female x Male Quick Disconnects, Purple Stripe (For Field Assembly)	1
45	Discharge Hose Assembly, 4-Inch x 50-Foot, Purple Stripe	8
46	Wastewater Mixing System, Purple Stripe	1
47	Discharge Hose Assembly, 2-Inch x 100-Foot, White Stripe	1
48	Suction Hose Assembly, 2-Inch x 50-Foot, White Stripe	1
49	Swing Check Valve Assembly, 2-Inch, Polyvinylchloride, w/Female x Male Quick Disconnects, White Stripe	1
50	Hose Bridge System, 4-Inch	20

Ref #	550 Initial Component Description	Qty
51	Tunnel, 4-Inch	10
52	Tunnel Connector, 4-Inch	10
53	Reducer, w/4-Inch Female Quick Disconnect x 2-Inch Male Quick Disconnects, White Stripe	1
54	Reducer, w/4-Inch Male x 2-Inch Female Quick Disconnects, White Stripe	1
55	Reducer, w/4-Inch Female Quick Disconnect x 3-Inch Male Quick Disconnects, White Stripe	1
56	Ratchet Wrench, 5/16-Inch Drive, 60 Inch Lb. Torque (For Worm Gear Hose Clamps)	2
57	Hose Clamp, Worm Gear, 1/2-Inch Band Width (or wider), Slotted Hex Screw, Range 1-3/4 Inch to 8-9/16 Inch	25
58	Hose Clamp, Worm Gear, 1/2-Inch Band Width, Slotted Hex Screw, Range 3-1/2 Inch to 5-Inch	25
59	Coupler, 1-Inch Female x 1-Inch Female Quick Disconnects, White Stripe	2
60	Coupler, 3/4-Inch Female x 3/4-Inch Female Quick Disconnects, White Stripe	1
61	Male Quick Disconnect x Male National Pipe Thread, 4-Inch	3
62	Coupler, 2-Inch Female Quick Disconnect x Female Quick Disconnects	2
63	Adapter, 1-1/2 Inch Male x 1-1/2 Inch Male Quick Disconnects	1
64	Coupler, 1-1/2 Inch Female x 1-1/2 Inch Female Quick Disconnects	1
65	Adapter, 3-Inch Male x 3-Inch Male Quick Disconnects	2
66	Coupler, 3-Inch Female x 3-Inch Female Quick Disconnects	2

Ref #	550 Initial Component Description	Qty
67	Adapter, 1-Inch Male x 1-Inch Male Quick Disconnects	2
68	Adapter, 3/4-Inch Male x 3/4-Inch Male Quick Disconnects	1
69	Coupler, 3/4-Inch Female Quick Disconnect x 3/4-Inch Female National Pipe Thread	2
70	Faucet, 3/4-Inch Hose Bib x 3/4-Inch Male National Pipe Thread	2
71	Water Hose Assembly, Garden, 3/4-Inch x 50-Foot, 2 Ply	1
72	Band-It Tool	1
73	Band-It Band, Stainless Steel, 3/4-Inch x 100-Foot (per Ct)	1
74	Band It Buckles, Stainless Steel, 3/4-Inch Wide, (100 Ea. per Ct)	1
75	Kit, Cold Weather, 550 Initial Subsystem (Optional) (Not Currently Available)	1

Chapter 6

550-FOLLOW-ON SUBSYSTEM

6.1. General Information. The 550-Follow-On Subsystem expands and builds off the 550-Initial Subsystem; manufacturers did not design it to function alone. When used as an expansion to the 550-Initial Subsystem, this system functions identically to the 550-Initial Subsystem. User facilities, such as latrines, showers, laundries, and kitchen (**Figure 6.1**) are branch fed from the pressurized potable water distribution loop or feed line. Wastewater output from user facilities distributes via lift pumps and wastewater lines to a wastewater collection tank for disposal. Hose rollover protection ramps (hose bridges) are available if potable and/or wastewater distribution lines need to cross roadways or similar heavy vehicular traffic areas.

Figure 6.1. User Facilities (Typical).

6.2. Components. Illustrated in **Figure 6.2** and described in **Table 6.1** are the major components that make up the 550-Follow-On Subsystem. However, for a complete list of all subsystem components, including nomenclature and quantity per subsystem, refer to **Table 6.3** in this handbook and the 550-Follow-On Subsystem Illustrated Parts Breakdown in Technical Order 40W4-21-1-WA-1.

Figure 6.2. 550-Follow-On Subsystem.

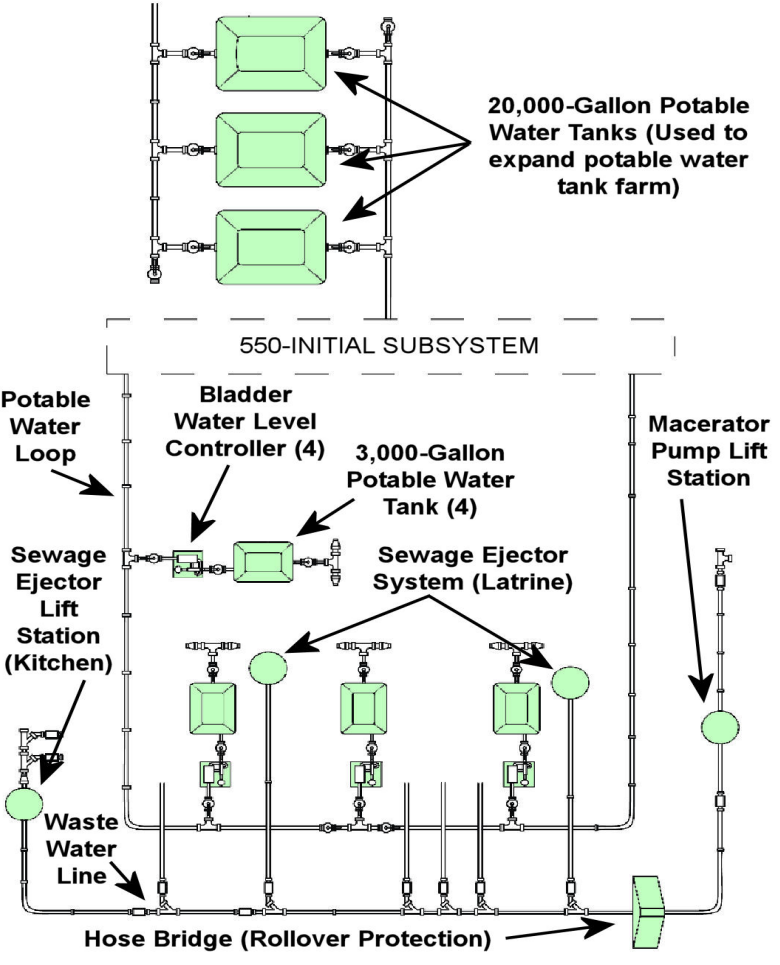


Table 6.1. 550-Follow-On Subsystem Major Components.

Component	Function/Use
20,000-Gallon Collapsible Fabric Tanks	Expands the potable water tank farm and are not exchangeable with raw, brine, or waste tanks. (White Stripe)
3,000-Gallon Collapsible Fabric Tank	Stores potable water at user facilities. (White Stripe)
Bladder Water Level Controllers	Maintains a preset maximum and minimum volume of potable water in 3,000-gallon water storage tanks.
Sewage Ejector Systems	Pumps raw sewage from latrines for output distribution to a wastewater collection tank. (Purple Stripe)
Sewage Ejector Lift Station (Kitchen)	Pumps kitchen waste to the wastewater collection tank. (Purple Stripe)
Macerator Pump Lift Station	Pre-digests raw sewage and pumps wastewater from user facilities to a waste collection system. (Purple Stripe)
Hose Bridge System	Provides rollover protection for potable water and/ or wastewater distribution hoses when hoses cross roadways or similar heavy vehicular traffic areas.
Hoses	Routes potable water to storage or user facilities and wastewater to disposal facilities or areas. The hoses are color-coded white for potable water and purple for wastewater.
Ball Valves	Controls water flow, including potable water input for storage, storage tank isolation for maintenance and/or repair actions, and isolation of each user facility branch feed from the distribution loop.

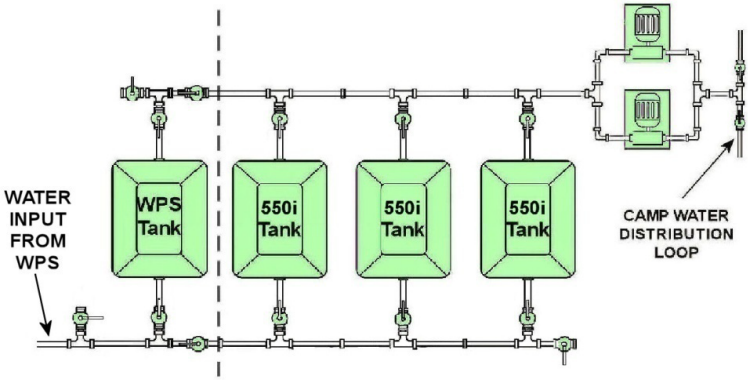
6.3. Installation. Before installing the 550-Follow-On Subsystem, orient the subsystem in relation to the other subsystems. Then, refer to component layout diagrams in this chapter and the list in **Table 6.3** to identify each numbered component when performing the steps below.

WARNING

To prevent injury to personnel and/or damage to equipment, ensure adequate personnel and lifting equipment are available to preposition equipment.

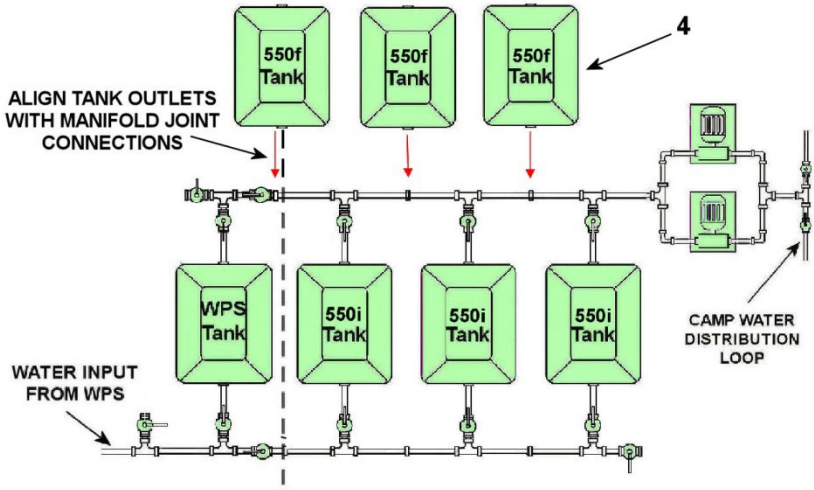
6.3.1. Expand the Potable Water Tank Farm. Expand the initial potable water tank farm (**Figure 6.3**) by using the 550-Follow-On Subsystem's 20,000-gallon tanks as follows.

Figure 6.3. Initial Tank Farm Configuration (Typical).



6.3.1.1. Using **Figure 6.4** as a guide, position additional 550-Follow-On Subsystem 20,000-gallon potable water tanks (4) across from the existing tanks by spacing them approximately 6 feet apart. Align the tank outlets with the manifold joint connections.

Figure 6.4. 550-Follow-On Subsystem 20,000-Gallon Tank Alignment.



6.3.1.2. Install the vent and drain assembly, 4-inch inlet elbow Quick Disconnect (female-to-female), and 4-inch outlet elbow Quick Disconnect (female-to-male) onto each of the tanks (**Figure 6.5**).

6.3.1.3. Working backwards from the dual pump station inlet, begin assembling each 550-Follow-On tank outlet branch as shown in **Figure 6.6**. On the first tank outlet, attach a 4-inch x 15-foot suction hose (1) followed by a 4-inch ball valve (3) and 4-inch tee (7). Align the tee with the manifold to gauge the final connection distance, but do not connect the tee to the manifold at this time. Repeat these procedures for the remaining 550F tanks. **Note:** When aligning the tee with the manifold, position the tee slightly passed the manifold because the suction hose will move back toward the tank during filling operations.

Figure 6.5. Location of 20,000-Gallon Tank Connections.

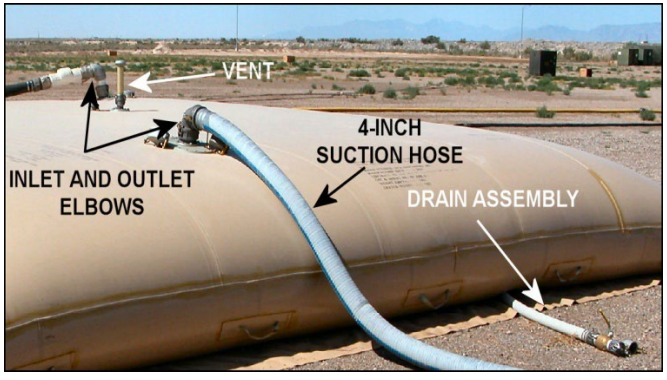
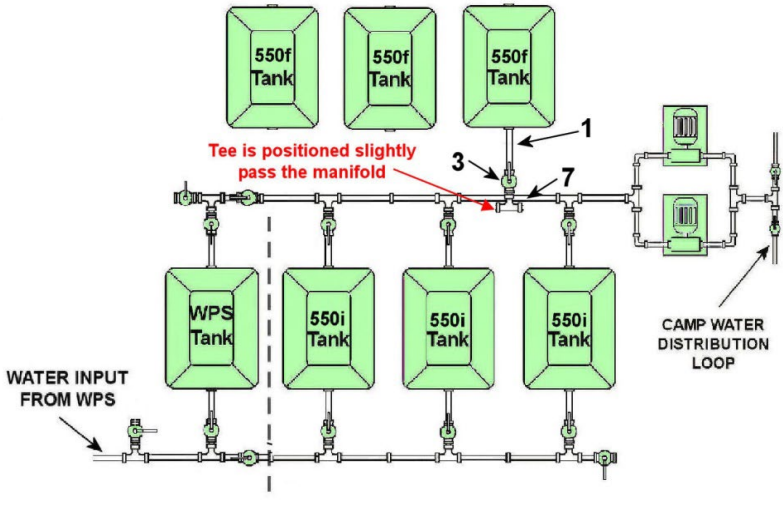
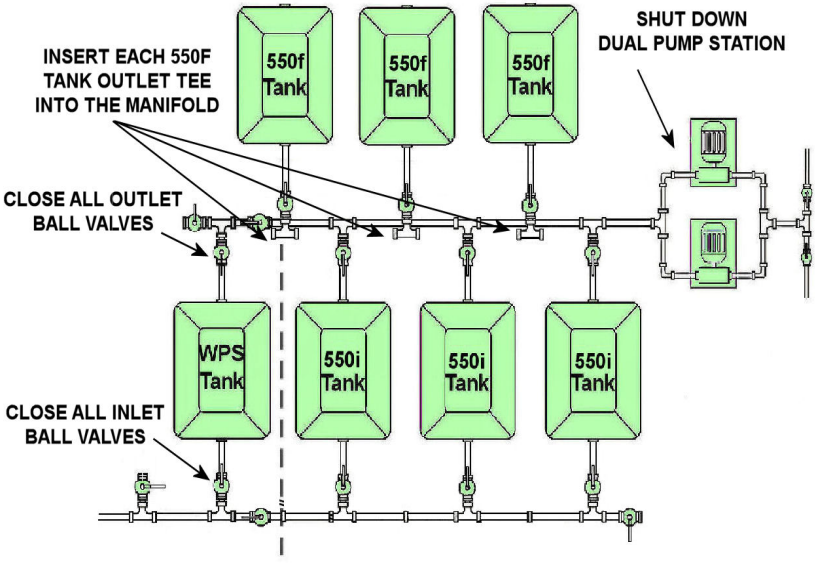


Figure 6.6. Assembly of 20,000-Gallon Tank Outlet Branches.



6.3.1.4. Using **Figure 6.7** as a guide, close the inlet 4-inch ball valves that supply water to the existing tank farm. Then, shut down the dual pump station and close the outlet 4-inch ball valves on all tanks within the tank farm. Next, insert each 550-Follow-On tank outlet tee into the 4-inch manifold. **Note:** Normally, operators should keep tank inlet ball valves closed except during filling operations. If valves remain open, a single tank leak can drain ALL tanks through back feeding.

Figure 6.7. Tank Farm Isolation and Insertion of 550F Tank Outlet Tees.



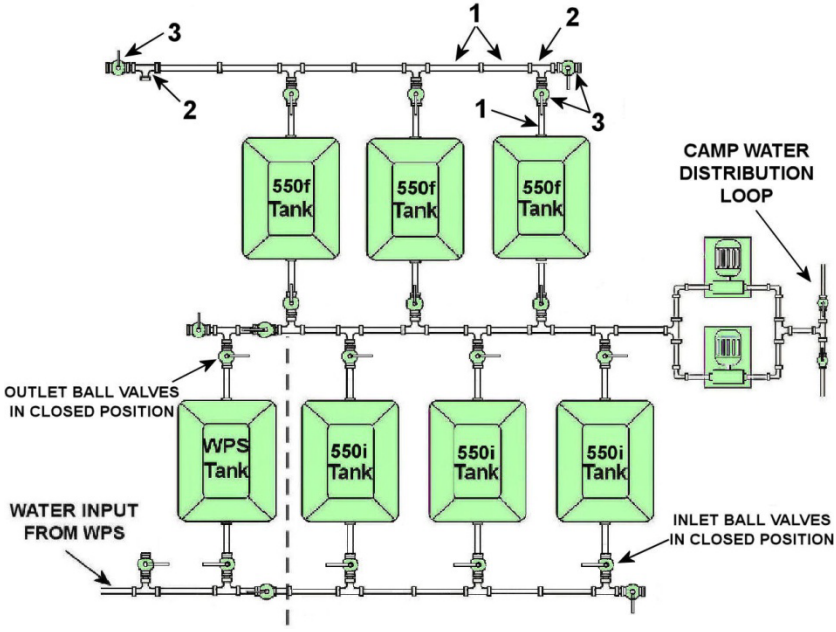
6.3.1.5. Assemble 550F 20,000-gallon tank inlet branches according to the following steps.

6.3.1.5.1. Connect a 4-inch x 15-foot suction hose (1) to each tank inlet followed by a 4-inch ball valve (3) and 4-inch tee (2) as illustrated in **Figure 6.8**.

6.3.1.5.2. At the tee assembly on the first tank, attach another 4-inch ball valve to the outlet end of the tee. Then, working away from the first tank, connect 4-inch suction hoses, ball valves, and tee assemblies to the remaining two tank inlets.

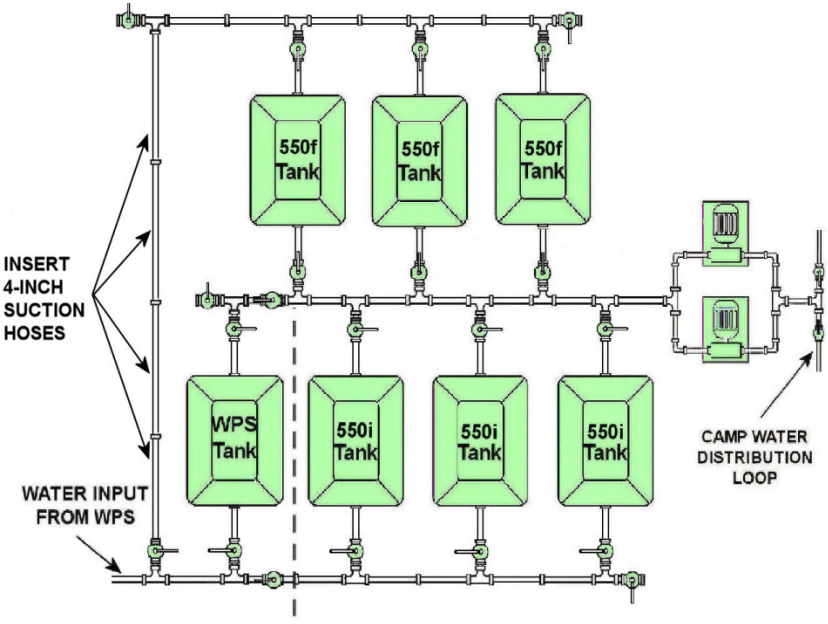
6.3.1.5.3. Next, insert two 4-inch x 15-foot hoses (1) between each 20,000-gallon tank. Connect the hoses to the 4-inch tee assemblies already in place. Then, connect two more 15-foot hoses to the tee assembly on the last tank. At the end of the 15-foot hose, attach the branch end of another 4-inch tee and install a 4-inch ball valve on the outlet end of the tee. **Note:** Always ensure hose couplings have neoprene gaskets properly installed before connecting hose assemblies.

Figure 6.8. Assembly of 20,000-Gallon Tank Inlet Branches.



6.3.1.6. Complete the tank farm expansion by inserting additional 4-inch suction hoses as depicted in **Figure 6.9** to close the water feed inlet lines to the Follow-On tanks.

Figure 6.9. Assembly of Water Feed Inlet Lines for Follow-On Tanks.



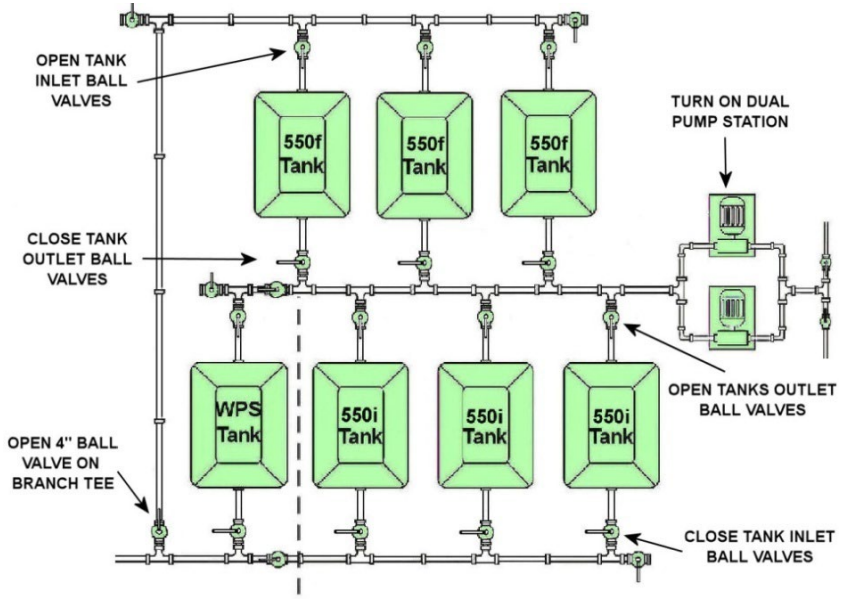
6.3.1.7. To recharge the potable water distribution loop and fill the 550F 20,000-gallon tanks after tank farm expansion, complete the following procedures.

6.3.1.7.1. Ensure the 550F tank outlet ball valves are in the closed position as illustrated in **Figure 6.10**. Then open the Water Production Subsystem and 550I tank outlet ball valves and turn on the Dual Pump Station (allows the Water Production Subsystem and 550I tanks to recharge the distribution loop).

Afterward, open the ball valve on the branch tee and begin filling 550F tanks (ensure tank inlet ball valves are in the OPEN position).

6.3.1.7.2. Once the 550F tanks are full, close tank inlets and begin normal use of the expanded tank farm. Make sure to rotate tank use throughout the tank farm to prevent water stagnation and refill tanks as needed.

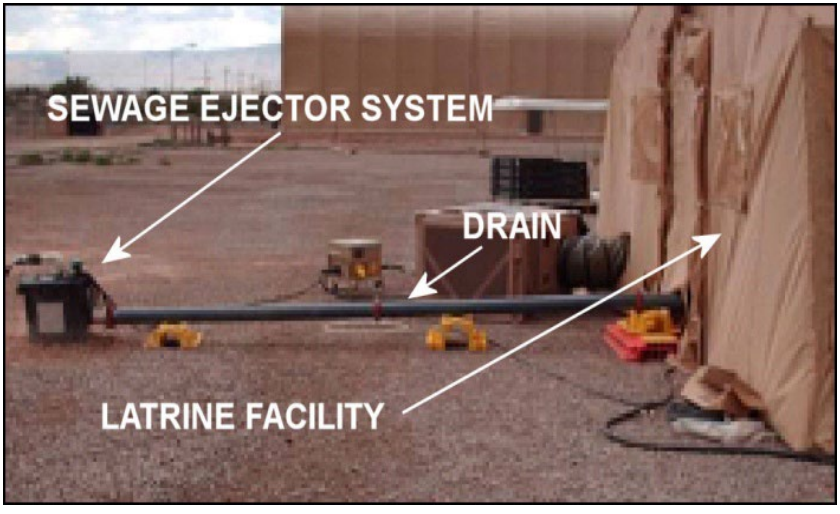
Figure 6.10. Positioning Ball Valves to Fill 550F Tanks and Recharge Distribution Loop Using Water Production Subsystem and 550I Tanks.



6.3.2. Install Latrine Sewage Ejector Systems. Install 550-Follow-On Subsystem sewage ejector systems (latrines) next to their respective facilities as follows.

6.3.2.1. Ensure an adequate power source is available to the sewage ejector tank and position the sewage ejector system alongside the latrine facility (**Figure 6.11**). To determine the exact location, first set up the latrine's drain system to verify its exact ending point. Then, assemble the inlet and outlet components to the sewage ejector tank. **Note:** When installing the sewage ejector system, a backhoe or similar digging equipment may be necessary for excavation and backfill operations.

Figure 6.11. Sewage Ejector System Installed Next to Latrine Facility.



6.3.2.2. Excavate a hole large enough to accommodate the sewage ejector tank to a depth of at least 24 inches. Prepare the bottom of the hole with 6 inches of backfill material of gravel or stone that is not less than 3/8-inch in diameter or larger than 3/4-inch in diameter (if available). Ensure the base is level and smooth.

CAUTION

In freezing conditions, backfill material must be dry and free of ice. Do not use other backfill materials unless approved by the manufacturer.

6.3.2.3. Lower the sewage ejector tank into the hole and insert backfill material until it reaches ground level.

6.3.3. Install Kitchen Sewage Ejector Lift Station. Similar to latrines, ensure an adequate power source is available to the lift station and position the kitchen sewage ejector lift station alongside the kitchen facility. To determine the exact location, first set up the kitchen's drain system to verify its exact ending point. Then assemble the inlet and outlet components to the lift station tank and perform the following procedures:

CAUTION

Damage or destruction of Sewage Ejector Lift Station (Kitchen) tank will result if accidental tip-over occurs due to equipment or similar contact occurring as the result of ground-level installation. To prevent tip-over damage, the tank should be installed in-ground to a depth of 18 inches.

6.3.3.1. Excavate a hole large enough to accommodate the lift station tank to a depth of at least 24 inches. Prepare the bottom of the hole with 6 inches of backfill material of gravel or stone that is not less than 3/8-inch in diameter or larger than 3/4-inch in diameter (if available). Ensure the base is level and smooth.

6.3.3.2. Lower the lift station tank into the hole and insert backfill material until it reaches ground level.

6.3.4. Position 3,000-Gallon Potable Water Tanks. Position the four 3,000-gallon potable water tanks from the 550-Follow-On subsystem next to their respective facilities or predesignated facility locations (**Figure 6.12**).

6.3.4.1. Position one 3,000-gallon potable water tank approximately 25 feet away from the kitchen's water connection.

6.3.4.2. Position the next two 3,000-gallon potable water tanks approximately 25 feet away and centered between each of the two shower/shave and latrine facilities to where each tank will feed one shower/shave and one latrine facility.

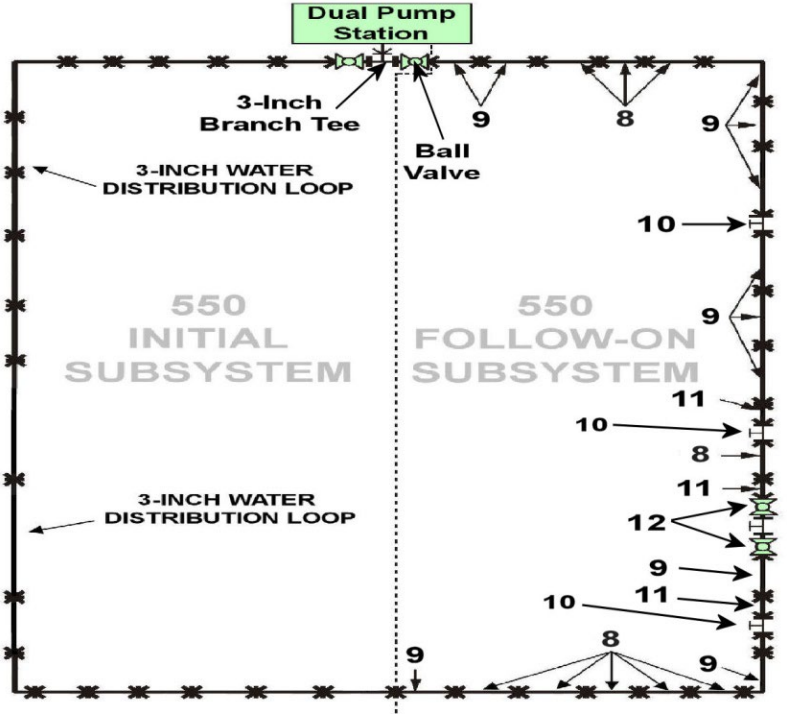
6.3.4.3. Position the last 3,000-gallon potable water tank directly behind and approximately 25 feet away from the laundry facility.

Figure 6.12. Placement of 3,000-Gallon Potable Water Tanks (Typical).

6.3.4.4. Finally, connect vent and drain assemblies to all 3,000-gallon tanks. **Note:** All water tanks (bladders or vessels) inserted into the water distribution loop or downstream but connected to the Dual Pump Station MUST have a bladder water level controller or be manually filled and isolated with a valve inserted on the inlet side of the bladder/vessel.

6.3.5. Expand Potable Water Distribution Loop and Facility Connections. Using the potable water components in the 550-Follow-On Subsystem, expand the 550-Initial Subsystem potable water distribution loop and facility connections according to requirements at the deployment location. **Figure 6.13** provides a basic example of a distribution loop expansion. **Note:** Always ensure hose couplings have neoprene gaskets properly installed before connecting hose assemblies.

Figure 6.13. Expanded Water Distribution Loop Component Layout.



6.3.5.1. Beginning at the outlet of the dual pump station's 3-inch branch tee, begin expanding the potable water distribution loop by connecting the 3-inch x 100-foot discharge hoses (9) to the 3-inch ball valve on the branch tee.

6.3.5.2. Using 3-inch discharge hoses in lengths of 100 feet (9), 50 feet (8), and 25 feet (11), lay out the potable water distribution loop toward the water-using facilities. If possible, route the hose away from high traffic areas. It may be preferable to use the 3-inch x 100-foot hoses first, then the 50-foot and 25-foot hoses where needed to properly position the hose so it is centered and within 20 to 25 feet of the inlet side of facility 3,000-gallon tanks. **Note:** If hose rollover protection becomes necessary, assemble, and install hose bridge system as illustrated in **Attachment 5**.

6.3.5.3. Assemble 3,000-Gallon Tank Inlet Connections. At the potable water distribution loop adjacent to each 3,000-gallon facility tank (**Figure 6.14**), install a 3-inch x 2-inch tee (10) and attach a 2-inch ball valve (13) on the tee assembly's branch outlet. Next, insert a 2-inch x 25-foot discharge hose (14) between the ball valve and the bladder water level controller (15). Finally, attach another 2-inch ball valve directly to the bladder water level controller and connect the other end of the valve to the inlet of the 3,000-gallon tank (16). **Note:** If necessary to connect facilities "directly" to the water distribution loop, installers must convey the potential consequences of this configuration and should install shut-off valves/pressure regulators and establish a quick response capability to mitigate damages if a failure occurs. The water distribution loop is constantly pressurized at about 45-55 pounds per square inch (depending on camp size), and pressures that high could damage equipment, flood areas, and deplete camp water supplies if the facility's plumbing fail.

6.3.5.4. Assemble 3,000-Gallon Tank Outlet Connections. Outlet connections on 3,000-gallon tanks vary according to the type of facility supported. Assemble the outlet manifold of each 3,000-gallon tank as follows.

6.3.5.4.1. Shower and Latrine Facilities. As depicted in **Figure 6.15**, connect a 2-inch ball valve (13) to the outlet of the 3,000-gallon tank (16). Next, connect a 2-

inch x 25-foot discharge hose (14) to the ball valve followed by a 2-inch tee (17). Afterward, connect a 2-inch x 3/4-inch reducer (19) to the tee for the latrine and a 2-inch x 1-inch reducer (20) on the opposite end of the tee for the shower.

Figure 6.14. Inlet Connections for 3,000-Gallon Facility Tanks.

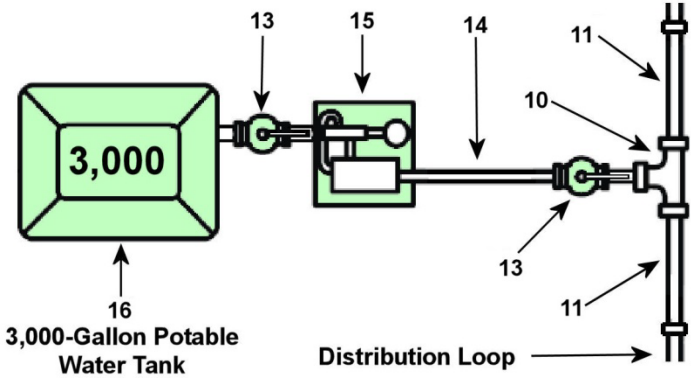
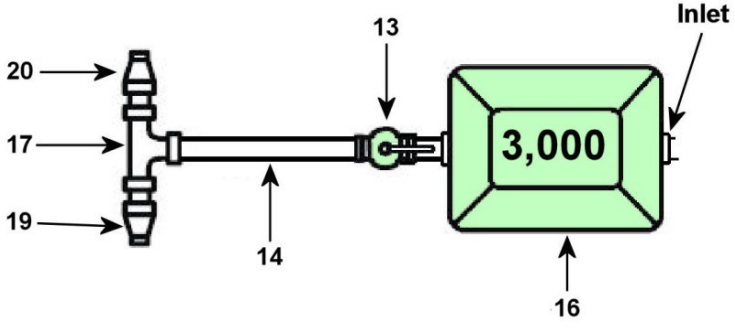
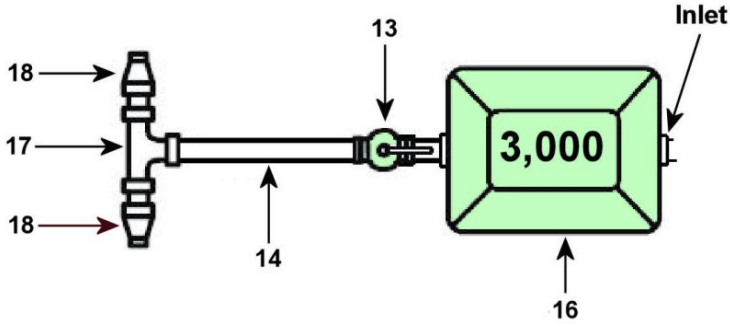


Figure 6.15. 3,000-Gallon Tank Outlet Connections (Shower/Latrine).



6.3.5.4.2. Laundry Facility. As illustrated in **Figure 6.16**, connect a 2-inch ball valve (13) to the outlet of the 3,000-gallon tank (16). Then connect a 2-inch x 25-foot discharge hose (14) to the ball valve followed by a 2-inch tee (17). Lastly, connect a 2-inch x 1-1/2-inch reducer (18) to each open end of the tee.

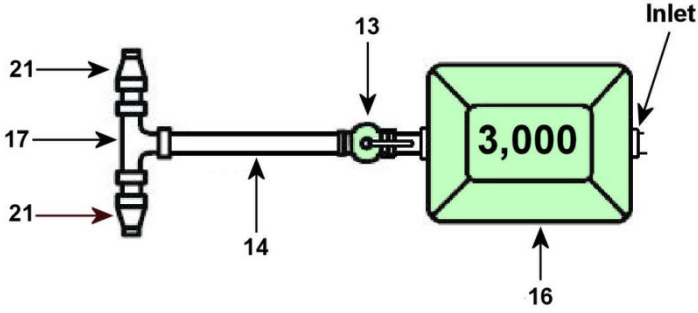
Figure 6.16. 3,000-Gallon Tank Outlet Connections (Laundry).



6.3.5.4.3. Kitchen Facility. Connect a 2-inch ball valve (13) to the outlet of the 3,000-gallon tank (16) as shown in **Figure 6.17**. Then connect a 2-inch x 25-foot discharge hose (14) to the ball valve followed by a 2-inch tee (17). Afterward, connect a 2-inch x 1-inch reducer (21) to each open end of the tee.

6.3.5.5. After connecting all facilities, continue assembling 3-inch x 100-foot (9) and 3-inch x 50-foot (8) discharge hoses (see **Figure 6.13**) until they connect or interface with the 550-Initial Subsystem's potable water distribution hose, forming a loop around the camp. **Note:** If using multiple 550 (Initial/Follow-On) subsystems, connect each subsystem to the next until the last subsystem assembled closes the loop.

Figure 6.17. 3,000-Gallon Tank Outlet Connections (Kitchen).



6.3.6. Assemble Wastewater Distribution Hoses and Components. Assemble the 550-Follow-On Subsystem wastewater hoses and components according to the following procedures and accompanying illustrations.

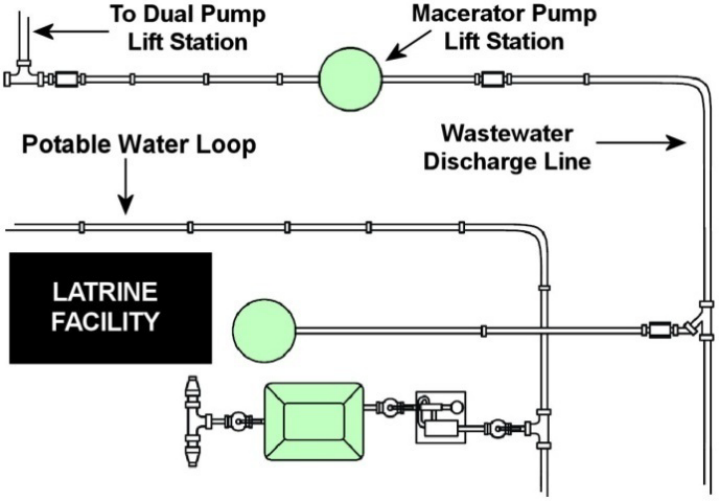
CAUTION

Damage or destruction of Macerator Pump Lift Station Tank will result if accidental tip-over occurs due to equipment or similar contact occurring as the result of ground-level installation. To prevent tip-over damage, recommend tank be installed in-ground to a depth of 4-1/2 feet.

6.3.6.1. Position Macerator Pump Lift Station. Ensure an adequate power source is available for the lift station and position the macerator pump lift station (34) on the backside of water-using facilities and away from areas with high volumes of traffic. Locate the lift station (**Figure 6.18**) as close as possible to, but no farther than 100 feet from the nearest facility it serves. Prepare the area for the lift station as addressed below. **Note:** The maximum distances of lift station placement in this section depend on the wastewater hose available in the 550-Initial Subsystem and

not on pump capability. For maximum distances, refer to the manufacturer's pump specification data for each lift station pump.

Figure 6.18. Placement of Macerator Pump Lift Station (Typical).



6.3.6.1.1. Excavate a hole large enough to accommodate the lift station tank to a depth of at least 4-1/2 feet. Prepare the bottom of the hole with 6 inches of backfill material of gravel or stone not less than 3/8-inch or larger than 3/4-inch in diameter (if available). Ensure the base is level and smooth.

CAUTION

In freezing conditions, backfill material must be dry and free of ice. Do not use other backfill materials unless approved by the manufacturer.

6.3.6.1.2. Lower the lift station tank into the hole and backfill the hole to ground level with available backfill material (**Figure 6.19**).

Figure 6.19. Installed Macerator Pump Lift Station.

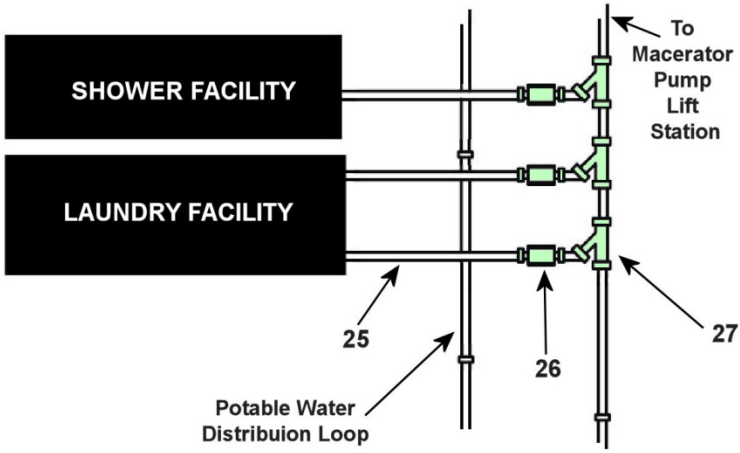
6.3.6.2. Connect Wastewater Hoses for Shower and Laundry Facilities. Assemble wastewater hoses for shower and laundry facilities as illustrated in **Figure 6.20**. **Note:** Always ensure hose couplings have neoprene gaskets properly installed before connecting hose assemblies.

6.3.6.2.1. Lay out one 2-inch x 50-foot discharge hose (25) for each shower facility, and route it over the top of the 3-inch potable water distribution loop.

6.3.6.2.2. Lay out two 2-inch x 50-foot discharge hoses for the laundry facility, and route them over the top of the 3-inch potable water distribution loop.

6.3.6.2.3. Assemble a 2-inch check valve (26) and 3-inch x 2-inch wye assembly (27) for each discharge hose from shower and laundry facilities. Connect the check valves to the discharge hoses. Ensure all three wye assembly branches direct wastewater flow to the Macerator Pump Lift Station.

Figure 6.20. Shower and Laundry Wastewater Hose Component Layout.

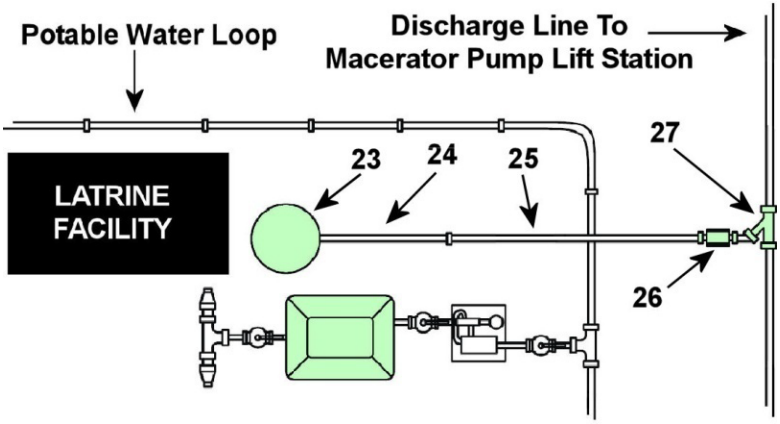


6.3.6.3. Connect Wastewater Hoses for Latrine Facilities. First, ensure proper installation of sewage ejector systems, including connection to an adequate power supply. Refer to Technical Order 40W4-21-1-WA-1 for installation and maintenance of the sewage ejector system. Connect wastewater hoses for latrine facilities as depicted in **Figure 6.21**. **Note:** Always ensure hose couplings have neoprene gaskets properly installed before connecting hose assemblies.

6.3.6.3.1. Connect one 2-inch x 25-foot discharge hose (24) to the outlet of each sewage ejector system (23) adjacent to the latrines. Then, attach a 2-inch x 50-foot discharge hose (25) to the 25-foot hose.

6.3.6.3.2. Connect a 2-inch check valve (26) and a 3-inch x 2-inch wye assembly (27). Then, attach the check valve to the discharge hose (25) of the latrine facility. Ensure the wye assembly branch directs wastewater flow to the Macerator Pump Lift Station.

Figure 6.21. Latrine Wastewater Hose Component Layout.



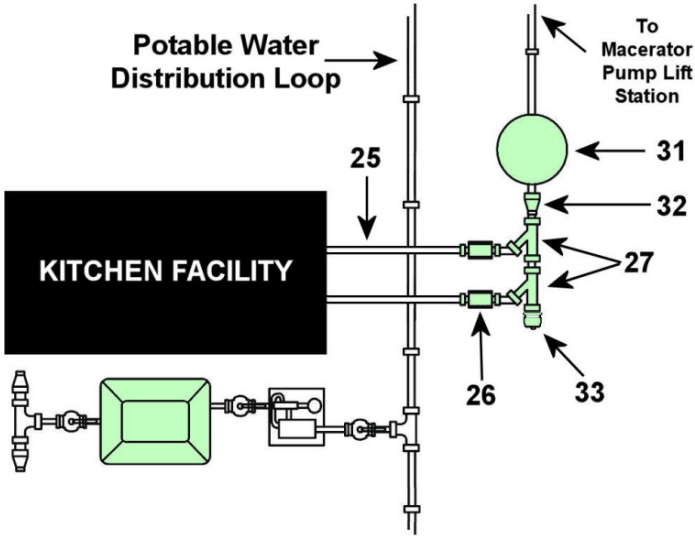
6.3.6.4. Connect Wastewater Hoses for Kitchen Facilities. Before connecting wastewater hoses for kitchen facilities ensure the sewage ejector lift station (31) is properly assembled (with the pump and float switch) and connected to an adequate power supply. If the pump and float switch have not been installed, refer to Technical Order 40W4-21-1-WA-1 for detailed installation instructions. Connect wastewater hoses for kitchen facilities as depicted in **Figure 6.22**.

6.3.6.4.1. Connect a 4-inch x 3-inch reducer (32) to the inlet of the sewage ejector lift station (31). Then, connect two 3-inch x 2-inch wye assemblies (27) together and connect them to the reducer. Ensure both wye assembly branches direct wastewater flow to the Macerator Pump Lift Station.

6.3.6.4.2. Next, connect a 2-inch check valve (26) to each wye assembly. Now, lay out two 2-inch x 50-foot discharge hoses (25) for the kitchen facility, and route them over the top of the 3-inch potable water loop. Then, connect one discharge hose to each check valve. Cap the end of the waste line by attaching the 3-inch male Quick Disconnect plug (33) to the open end of the first wye assembly.

6.3.6.4.3. At the sewage ejector lift station outlet, connect two 2-inch x 25-foot discharge hoses (24) followed by a 3-inch x 2-inch reducer (37) at the end of the discharge hose. Then connect two 3-inch x 50-foot discharge hoses (29) to the reducer followed by 3-inch check valve assembly.

Figure 6.22. Kitchen Wastewater Hose Component Layout.

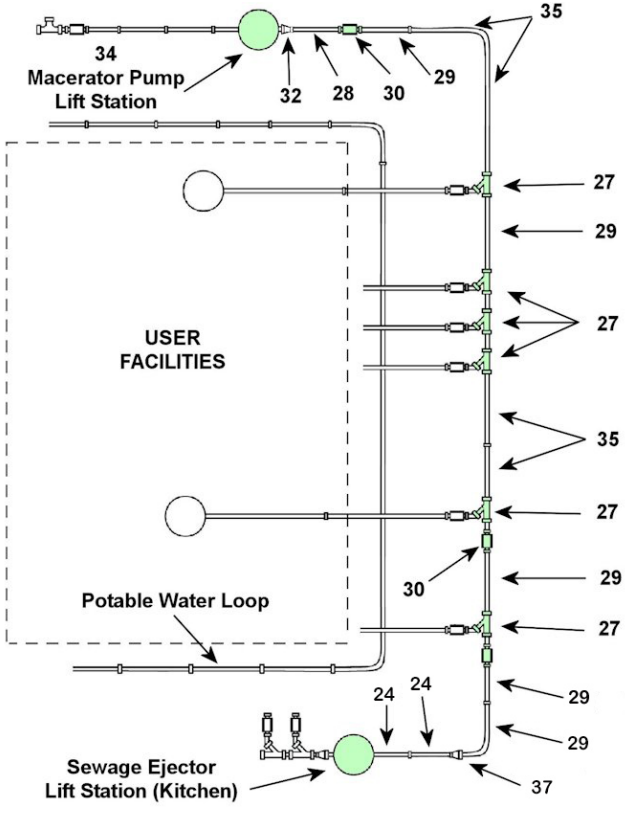


6.3.6.5. Assemble Wastewater Distribution Hoses and Components. Assemble wastewater hoses and components as depicted in **Figure 6.23** and **Figure 6.24**.

6.3.6.5.1. Connect all assemblies from sewage ejector lift stations outlets together using necessary lengths of 3-inch discharge hoses (28, 29, 35), and assemble the hoses until you are within 25 feet of the macerator pump lift station (34). **Note:** Always ensure hose couplings have neoprene gaskets properly installed before connecting hose assemblies.

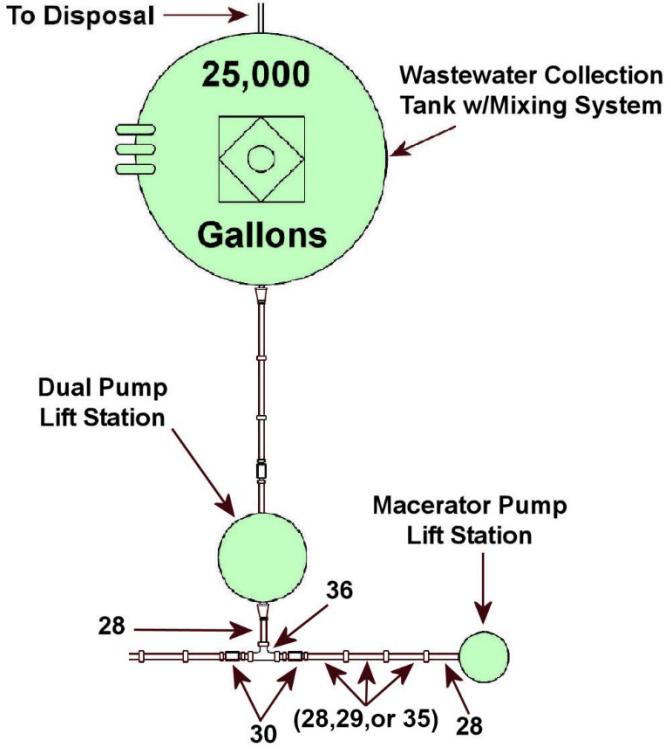
6.3.6.5.2. At the inlet of the macerator pump lift station, install one 4-inch x 3-inch reducer (32) followed by a 3-inch x 25-foot discharge hose (28). Next, connect a 3-inch check valve (30) onto the discharge hose and connect the check valve to the 3-inch discharge hose coming from the facilities.

Figure 6.23. Wastewater Distribution Hose and Component Layout 1.



6.3.6.5.3. At the macerator pump lift station outlet (**Figure 6.24**), connect one 3-inch x 25-foot discharge hose (28), and continue to lay out 3-inch discharge hoses (28, 29, or 35) until you are approximately 25 feet from the dual pump lift station. **Note:** If the 550-Initial Subsystem is operating, temporarily shut down all facility waste streams and pumps going to the 25,000-gallon waste tank to complete the next steps.

Figure 6.24. Wastewater Distribution Hose and Component Layout 2.



6.3.6.5.4. At the dual pump lift station, insert the branch end of the 3-inch tee (36) into the inlet side of the 3-inch x 25-foot discharge hose (28) that was already assembled to the dual pump lift station during 550-Initial Subsystem installation.

6.3.6.5.5. Connect a 3-inch check valve (30) from the 550-Initial Subsystem onto one end of the 3-inch tee. If not already preassembled during the initial subsystem installation, connect another 3-inch check valve onto the other end of the 3-inch tee. Now, complete the 550-Follow-On Subsystem wastewater piping by connecting the previously installed 3-inch discharge hose (28, 29, or 35) from the macerator pump lift station to the 3-inch check valve (30).

6.3.6.5.6. If any of the subsystem plumbing crosses roadways or similar heavy vehicular traffic areas, use the hose bridge system to provide hose rollover protection. Assemble the hose bridge system as illustrated in **Attachment 5**. This completes basic installation of the 550-Follow-On Subsystem.

6.4. Operation. The following procedures address basic steps to operate the 550-Follow-On Subsystem when integrated with the 550-Initial Subsystem. If necessary, refer to basic layout diagrams presented throughout this chapter for component identification.

6.4.1. Perform Subsystem Preoperational Checks. Before operating the subsystem, complete preoperational checks outlined in **Table 6.2**.

WARNING

To prevent injury or death to personnel, make sure Source Power is OFF before connecting power input to the Macerator Pump Lift Station or Sewage Ejector System.

Table 6.2. 550-Follow-On Subsystem Preoperational Checks.

Preoperational Checks			
A	**Wastewater Collection Hoseline:**	**Y**	**N**
	(1) All components are color-coded purple.		
	(2) Hoseline and fitting connections to Macerator Pump Lift Station (34) connected properly and connections are tight. Pumps, float assemblies installed properly, and station connected to an adequate power supply.		
	(3) Hoseline and fitting connections at facility connection to the wastewater collection hose properly connected and connections are tight.		
	(4) Hoseline and fitting connections to two Sewage Ejector Systems (Latrines) properly connected and connections are tight. Pump, float assemblies properly installed, and system connected to an adequate power.		
B	Hoseline and fitting connections to four 2-inch branch hose lines properly connected and connections are tight.		
C	**Potable Water Distribution Loop:**		
	(1) All hose assemblies, valves, and couplings through the loop properly connected and connections are tight.		
	(2) All components color-coded white.		
	(3) All ball valve assemblies open throughout the loop.		

Preoperational Checks			
	(4) On the branch connections to the 3,000-gallon potable tanks, verify the following:	**Y**	**N**
C	**Potable Water Distribution Loop: Cont'd.**		
	(4a) All hose assemblies, valves, and fittings on the 3,000-gallon tank properly connected and connections are tight.		
	(4b) 2-inch ball valves on the tank outlet and tank drain are closed. 2-inch ball valve assembly on the tank inlet is open.		
	(4c) 2-inch ball valve on the inlet to the Bladder Water Level Controller is open.		
	(4d) Adequate power supply connected to the Bladder Water Level Controller.		
	(5) Repeat step 4 above for remaining branch connections to 3,000-gallon tanks.		
D	**20,000-Gallon Potable Water Tank Outlet Manifold:**		
	(1) All hose assemblies, valves, and fittings properly connected, and connections are tight.		
	(2) All components are color-coded white.		
	(3) Three 4-inch ball valves on the outlet manifold system from 20,000-gallon potable water tanks are open (as needed).		
	(4) If additional 20,000-gallon potable water tanks installed from other subsystems, open the 4-inch ball valve on the outlet branch tee (as needed), otherwise close this valve.		

Preoperational Checks			
E	**20,000-Gallon Potable Water Tank Inlet Manifold:**	**Y**	**N**
	(1) All hose assemblies, valves, and fittings properly connected, and connections are tight.		
	(2) All components are color-coded white.		

6.4.2. Verify Potable Water Flow. Verify water is flowing in the 3-inch potable water distribution loop. Ensure an adequate power source connection to bladder water level controllers at each 3,000-gallon potable water tank. Verify 3,000-gallon tanks fills with water. Recheck all hoses, valves, and fittings throughout the 3-inch potable water loop and the 3,000-gallon tanks for leaks. Make repairs as necessary.

6.4.3. Check Facilities Operation. Once the 3,000-gallon tanks for shower, latrine, laundry, and kitchen facilities have sufficient water, check the operation of these facilities according to their respective technical orders.

6.4.4. Check Wastewater Collection. Check wastewater collection lines by first turning on and allowing water to run in connected facilities. Then complete the following procedures.

WARNING

To prevent injury or death to personnel, make sure Source Power is OFF before connecting power input to the Sewage Ejector System (Latrine).

6.4.4.1. Connect the sewage ejector system (latrine) to an adequate power source and verify correct pump operation by allowing the latrine holding tank to empty into the sewage ejector system. Repeat this step for each sewage ejector system (latrine) utilized.

6.4.4.2. Connect the sewage ejector system (kitchen) to an adequate power source and verify correct pump operation by allowing the kitchen holding tank to empty into the sewage ejector lift station (kitchen).

6.4.4.3. Check the hose line, valves, and fittings leading to the Macerator Pump Lift Station for leaks and make necessary repairs.

6.4.4.4. Set the macerator pump lift station HAND/OFF/AUTO power switch (on the control box) to AUTO (see **Figure 5.33** on page 94) and verify the PUMP RUN indicator on the front of the control box is illuminated. Then, verify the SEAL FAIL indicator on the side of the control box is OFF and the macerator pump lift station is operating correctly.

6.4.4.5. Check the hose line, valves, and fittings leading to the dual pump lift station for leaks and make any needed repairs. **Note:** Contingency water systems tend to leak a little, so small leaks are usually unavoidable and should not be a major cause of concern. Always ensure hose couplings have neoprene gaskets properly installed before connecting hose assemblies.

6.4.5. Monitor Potable Water Tank Levels. Keep an eye on the level of the 20,000-gallon potable water tanks and the 3,000-gallon potable water tanks throughout the operation of the system. Shut down and start up the Source Run Subsystem, the Water Production Subsystem, and/or the 125-gallons per minute Diesel Pump as necessary to maintain the required amount of water storage.

6.5. Component Descriptions. Table 6.3 provides a detailed description and quantity for each 550-Follow-On Subsystem component and its corresponding reference number used in this chapter. See Technical Order 40W4-21-1-WA-1 for other subsystem component information.

Table 6.3. 550-Follow-On Component Description and Item Number.

Ref #	550 Follow-On Component Description	Qty
1	Suction Hose Assembly, 4-Inch x 15-Foot, White Stripe	20
2	Tee Assembly, 4-Inch x 4-Inch x 4-Inch, w/Female x Male x Male Quick Disconnects, White Stripe	5
3	Ball Valve Assembly, 4-Inch w/Female x Male Quick Disconnects, White Stripe	10
4	20,000-Gallon Collapsible Fabric Tank, w/Adapter, 2-Inch Male Quick Disconnect x Male National Pipe Thread, White Stripe	3
5	Suction Hose Assembly, 2-Inch x 8-Foot, White Stripe	8
6	Ball Valve Assembly, 2-Inch w Female Quick Disconnect x Female National Pipe Thread, White Stripe	8
7	Tee Assembly, 4-Inch x 4-Inch x 4-Inch, w/Male x Female x Female Quick Disconnects, White Stripe	5
8	Discharge Hose Assembly, 3-Inch x 50-Foot, White Stripe	10
9	Discharge Hose Assembly, 3-Inch x 100-Foot, White Stripe	10
10	Tee Assembly, 3-Inch x 3-Inch x 2-Inch, w/3-Inch Female x 3-Inch Male x 2-Inch Male Quick Disconnects, White Stripe	7
11	Discharge Hose Assembly, 3-Inch x 25-Foot, White Stripe	6
12	Ball Valve Assembly, 3-Inch, w/Female x Male Quick Disconnects, White Stripe	4
13	Ball Valve Assembly, 2-Inch, w/Female x Male Quick Disconnects, White Stripe	15

Ref #	550 Follow-On Component Description	Qty
14	Discharge Hose Assembly, 2-Inch x 25-Foot, White Stripe	10
15	Bladder Water Level Controllers, Electric, w/2-Inch Female x Female Quick Disconnects and 25-Foot Outdoor Extension Cord, White Stripe	5
16	3,000-Gallon Collapsible Fabric Tank assembly, w/2-Inch Male x Male x Male Quick Disconnects, White Stripe	4
17	Tee Assembly, 2-Inch x 2-Inch x 2-Inch, w/Male x Male x Female Quick Disconnects, White Stripe	5
18	Reducer, w/2-Inch Female x 1-1/2-Inch Female Quick Disconnects White Stripe	3
19	Reducer, w/2-Inch Female x 3/4-Inch Male Quick Disconnects, White Stripe	4
20	Reducer, w/2-Inch Female x 1-Inch Female Quick Disconnects, White Stripe	3
21	Reducer, w/2-Inch Female x 1-Inch Male Quick Disconnects, White Stripe	3
22	Adapter, 4-Inch Male Quick Disconnect x 4-Inch Victaulic/ Grooved, Purple Stripe	3
23	Sewage Ejector System (Latrine), with 4-inch Female Quick Disconnect Inlet x 2-Inch Male Quick Disconnect Outlet, plus 2-Inch Check Valve, 2-Inch National Pipe Thread 90 Degree Elbow, and 25-Foot Extension Cord, Purple Stripe	2
24	Discharge Hose Assembly, 2-Inch x 25-Foot, Purple Stripe	5
25	Discharge Hose Assembly, 2-Inch x 50-Foot, Purple Stripe	10

Ref #	550 Follow-On Component Description	Qty
26	Check Valve Assembly, 2-Inch, w/Female x Male Quick Disconnects, Purple Stripe	10
27	Wye Assembly, 3-Inch x 3-Inch x 2-Inch, w/3-Inch Female x 3-Inch Male x 2-Inch Female Quick Disconnects, Purple Stripe	8
28	Discharge Hose Assembly, 3-Inch x 25-Foot, Purple Stripe	10
29	Discharge Hose Assembly, 3-Inch x 50-Foot, Purple Stripe	8
30	Check Valve Assembly, 3-Inch, w/Female x Male Quick Disconnects, Purple Stripe	4
31	Sewage Ejector Lift Station (Kitchen), w/4-Inch Female Inlet and 2-Inch Male Outlet Quick Disconnects, 2-Inch Check Valve, 2-Inch National Pipe Thread 90-Degree Elbow	1
32	Reducer, w/4-Inch Male x 3-Inch Female Quick Disconnects, Purple Stripe	3
33	Plug, 3-Inch Male Quick Disconnect, Purple Stripe	1
34	Macerator Pump Sewage Lift Station Assembly, w/4-Inch Female Quick Disconnect Inlet x 3-Inch Male Quick Disconnect Outlet, Purple Stripe	1
35	Discharge Hose Assembly, 3-Inch x 100-Foot, Purple Stripe	5
36	Tee Assembly, 3-Inch x 3-Inch x 3-Inch, w/Female x Male x Male Quick Disconnects, Purple Stripe	2
37	Reducer, w/3-Inch Male x 2-Inch Female Quick Disconnects, Purple Stripe	1
38	Suction Hose Assembly, 2-Inch x 25-Foot, White Stripe	1

Ref #	550 Follow-On Component Description	Qty
39	Suction Hose Assembly, 2-Inch x 50-Foot, White Stripe	1
40	Discharge Hose Assembly, 2-Inch x 100-Foot, White Stripe	1
41	Swing Check Valve, 2-Inch, Polyvinylchloride, w/Female x Male Quick Disconnects, White Stripe	1
42	Hose Bridge System, 4-Inch	20
43	Tunnel, 4-Inch	10
44	Tunnel Connector, 4-Inch	10
45	Pump Assembly, 2-Inch Diesel, w/2 Inch Female x Male Quick Disconnects, White Stripe	1
46	Reducer, w/4 Inch Female x 2-Inch Male Quick Disconnects, White Stripe	1
47	Reducer, w/4 Inch Male x 2-Inch Female Quick Disconnects, White Stripe	1
48	Reducer, w/4-Inch Female x 3-Inch Male Quick Disconnects, White Stripe	1
49	Wrench, Ratchet, 5/16-Inch Drive, 60 Inch-Pounds Torque, (For Worm Gear Hose Clamps)	2
50	Clamp, Hose, Worm Gear, 1/2-Inch Band Width (or wider), Slotted Hex Screw, Range 1-3/4 Inch to 8-9/16 Inch	25
51	Hose Clamp, Worm Gear, 1/2-Inch Band Width, Slotted Hex Screw, Range 3-1/2 Inch to 5-Inch	25
52	Meter, Water, 3-Inch, Mechanical, w/Female x Male Quick Disconnects	1

Ref #	550 Follow-On Component Description	Qty
53	Adapter, 4-Inch Male x 4-Inch Male Quick Disconnects	1
54	Coupler, 4-Inch Female x 4-Inch Female Quick Disconnects	1
55	Adapter, 2-Inch Male x 2-Inch Male Quick Disconnects	2
56	Coupler, 2-Inch Female x 2-Inch Female Quick Disconnects	2
57	Adapter, 1-1/2 Inch Male x 1-1/2-Inch Male Quick Disconnects	1
58	Coupler, 1-1/2 Inch Female x 1-1/2 Inch Female Quick Disconnects	1
59	Adapter, 3-Inch Male x 3-Inch Male Quick Disconnects	2
60	Coupler, 3-Inch Female x 3-Inch Female Quick Disconnects	2
61	Adapter, 1-Inch Male x 1-Inch Male Quick Disconnects	2
62	Coupler, 1-Inch Female x 1-Inch Female Quick Disconnects, White Stripe	2
63	Adapter, 3/4-Inch Male x 3/4-Inch Male Quick Disconnects	1
64	Coupler, 3/4-Inch Female x 3/4-Inch Female Quick Disconnects, White Stripe	1
65	Coupler, 3/4-Inch Female Quick Disconnect x 3/4-Inch Female National Pipe Thread	2
66	Faucet, 3/4-Inch Hose Bibb x 3/4-Inch Male National Pipe Thread	2
67	Hose Assembly, Water, Garden, 3/4-Inch x 50-Foot, 2 Ply	1
68	Cold Weather Kit, 550 Follow-On Subsystem (Optional), (Not Currently Available)	1

Chapter 7

INDUSTRIAL OPERATIONS AND FLIGHTLINE EXTENSION SUBSYSTEM

7.1. General Information. The Industrial Operations and Flightline Extension Subsystem is a potable water expansion subsystem for the 550-Initial, 550-Follow-On, or Water Production Subsystems. The extension subsystem can branch off any part of the 3-inch pressurized feed line from these systems and can supply potable water to isolated user facilities such as latrines, showers, and kitchens. Additionally, hose rollover protection ramps (hose bridges) safeguard hoses in the event potable water distribution lines need to cross roadways or similar heavy vehicular traffic areas.

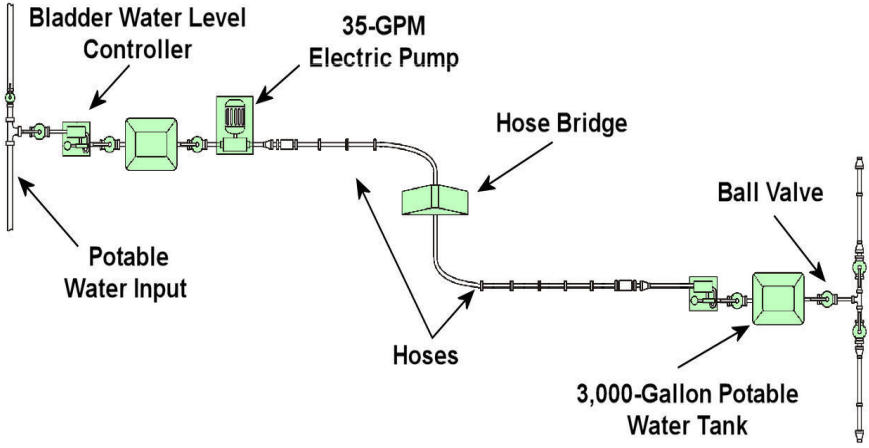
7.2. Components. Described in **Table 7.1** and illustrated in **Figure 7.1** are the major components of the Industrial Operations and Flightline Extension Subsystem. However, for a complete list of all subsystem components, including nomenclature and quantity per subsystem, refer to **Table 7.3** in this handbook and the Industrial Operations and Flightline Extension Subsystem Illustrated Parts Breakdown in Technical Order 40W4-21-1-WA-1.

Table 7.1. Industrial Operations and Flightline Extension Subsystem Major Components.

Component	Function/Use
3,000-Gallon Collapsible Fabric Tanks	Stores potable water at user facilities.
Bladder Water Level Controllers	Maintains a preset maximum and minimum volume of potable water in 3,000-gallon water storage tanks.

35-Gallons per Minute Electric Pump Assembly (Potable Water)	Pumps potable water up to 2500 feet to fill potable water storage tanks. An accumulator tank and pressure switch at the pump outlet controls pump output flow between 20 and 40 pounds per square inch.
Hose Bridge System	Provides rollover protection for potable water and/ or wastewater distribution hoses when hoses cross roadways or similar heavy vehicular traffic areas.
Hoses	Routes potable water to storage or user facilities. The hoses are color-coded white for potable water.
Ball Valves	Controls water flow, including potable water input for storage, storage tank isolation for maintenance and repair actions, and isolation of each user facility branch feed from the distribution loop.

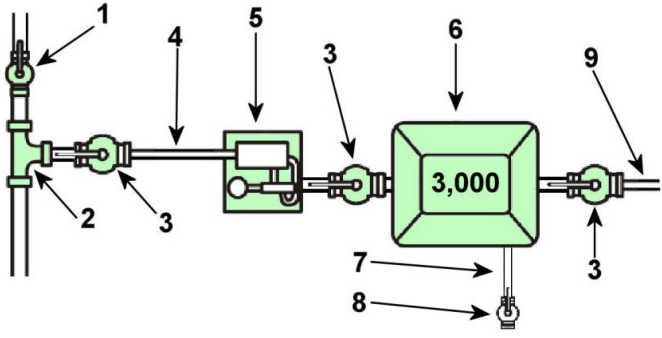
Figure 7.1. Industrial Operations and Flightline Extension Subsystem.



7.3. Installation. Before installing the Industrial Operations and Flightline Extension Subsystem, orient the subsystem in relation to the other subsystems. Then, refer to component layout diagrams in this chapter and the list in **Table 7.3** to identify each numbered component when performing the steps below.

7.3.1. Preposition all subsystem equipment at their designated installation locations and ensure the water-using facilities are no more than 2500 feet from the water distribution loop tie-in area. Then, temporarily shut down the water distribution loop and begin assembling the potable water distribution extension as illustrated in **Figure 7.2**.

Figure 7.2. Extension Subsystem Potable Water Loop Connection.



7.3.1.1. Locate a preferred quick disconnect fitting on the 3-inch water distribution loop. Then disassemble the quick disconnect fitting and insert a 3-inch x 3-inch x 2-inch tee (2) onto one end of the loop. Next, attach a 3-inch ball valve (1) onto the branch end of the 3-inch tee, and reconnect the loop.

7.3.1.2. After reconnecting the loop, attach a 2-inch ball valve (3) to the branch outlet of the newly installed tee. Ensure the 2-inch ball valve is closed and the 3-inch ball valve is open. Afterward, charge the water distribution loop. Next, attach a 2-inch x 50-foot discharge hose (4) to the 2-inch ball valve, and connect the

other hose end to the inlet side of the bladder water level controller (5). Then, attach another 2-inch ball valve to the outlet side of the controller. **Note:** Always ensure hose couplings have neoprene gaskets properly installed before connecting hose assemblies.

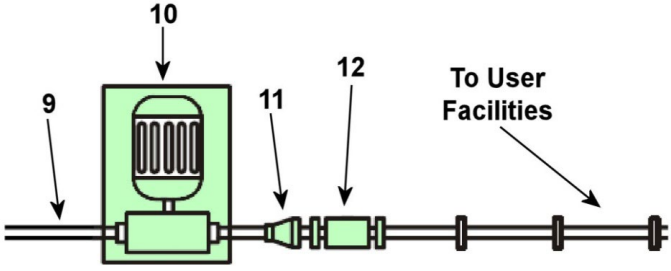
WARNING

To prevent injury to personnel and/or damage to equipment, ensure adequate personnel and lifting equipment are available to preposition equipment.

7.3.1.3. Position the 3,000-gallon tank (6) inlet in line with the 2-inch ball valve and connect them together. Then, connect the drain and vent assemblies (7, 8) to the 3,000-gallon tank. Next, connect another 2-inch ball valve (3) to the 3,000-gallon tank outlet, followed by a 2-inch x 25-foot suction hose (9).

7.3.1.4. Connect the 35-gallons per minute electric pump (10) as illustrated in **Figure 7.3**. Attach the inlet side of the pump to the 2-inch x 25-foot hose (9). Then connect a 3-inch x 2-inch reducer (11) to the pump outlet followed by a 3-inch check valve (12). Now, proceed to the facility tie-in area to complete the subsystem assembly.

Figure 7.3. Pump Placement and Connections Layout.

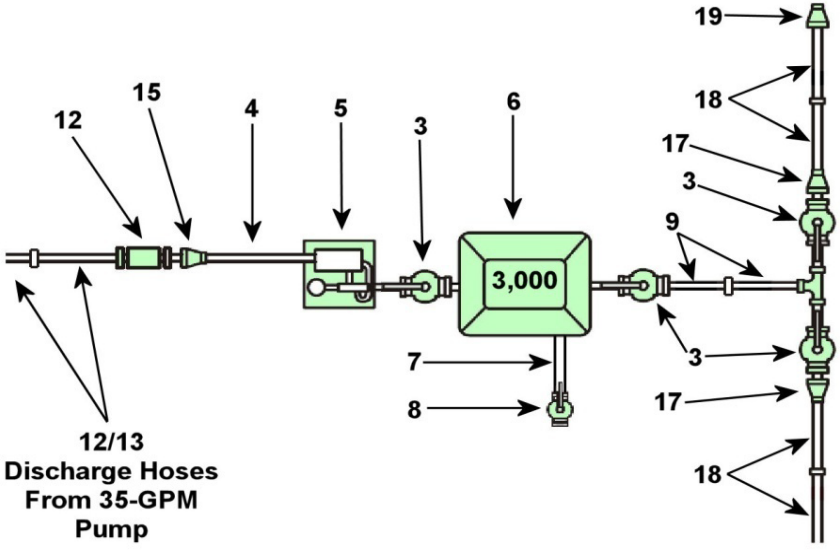


7.3.1.5. At the user-facility area, assemble the remaining extension subsystem as depicted in **Figure 7.4**.

7.3.1.5.1. Position the second 3,000-gallon potable water tank (6) no more than 50 feet away and centered between two facilities (or directly behind a single facility). Then, connect the drain and vent assemblies to the tank.

7.3.1.5.2. On the outlet side of the 3,000-gallon tank (6), connect a 2-inch ball valve (3) followed by two 2-inch x 25-foot suction hoses (9). Next, connect the branch end of a 2-inch x 2-inch x 2-inch tee (16) to the suction hoses. Afterward, attach 2-inch ball valves (3) to the ends of the tee.

Figure 7.4. Extension Subsystem User-Facility Connections.



7.3.1.5.3. At each 2-inch ball valve assembly, connect a 2-inch x 1-inch reducer (17), followed by two 1-inch x 25-foot discharge hoses (18). If needed, attach a 1-inch x 3/4 inch reducer (19) to the end of one of the discharge hoses. Then connect the discharge hoses to the user facilities.

7.3.1.5.4. On the inlet of the 3,000-gallon tank, connect a 2-inch ball valve (3); and the bladder water level controller (5). Next, connect a 2-inch x 50-foot discharge hose (4) to the controller, then attach a 3-inch x 2-inch reducer (15) to the other end of the hose. Then, connect a 3-inch check valve (12) to the reducer.

7.3.1.5.5. Starting at the check valve (12), connect enough 3-inch discharge hoses (13, 14) to reach the 35-gallons per minute pump and complete the connection to the water distribution loop.

7.3.2. If any of the subsystem plumbing crosses roadways or similar heavy vehicular traffic areas, use the hose bridge system to provide hose rollover protection. Assemble the hose bridge system as shown in **Attachment 5**. This completes basic installation of the Industrial Operations and Flightline Extension Subsystem assembly.

7.4. Operation. The following procedures address basic steps to operate the Industrial Operations and Flightline Extension Subsystem after installation. If necessary, refer back to the basic layout diagrams presented throughout this chapter for component identification.

7.4.1. Perform Extension Subsystem Preoperational Checks. Before operating the subsystem, complete the preoperational checks outlined in **Table 7.2**.

WARNING

To prevent injury or death to personnel, make sure Source Power is OFF before connecting power input to the 35-gallons per minute Electric Pump Assembly.

Table 7.2. Industrial Operations and Flightline Extension Subsystem Preoperational Checks.

Preoperational Checks			
A	**User-Facility 3,000-Gallon Potable Water Tank:**	**Y**	**N**
	(1) Inlet 2-inch ball valves are open, and outlet 2-inch ball valve and tank drain ball valves are closed.		
	(2) 2-inch ball valve to the inlet of the Bladder Water Level Controller is open.		
	(3) All hose assemblies, valves, and fittings connected properly, and connections are tight.		
	(4) All components are color-coded white.		
B	**First 3,000-Gallon Potable Water Tank:**		
	(1) 2-inch ball valve on the inlet of the Bladder Water Level Controller is open.		
	(2) Ball valve assembly at the inlet to the 3,000-gallon tank is open.		
	(3) Ball valve assembly at the outlet of the 3,000-gallon tank is closed.		
	(4) Tank drain and ball valve assembly to the 3,000-gallon tank are closed.		
	(5) 2-inch ball valve assembly on the inlet to the 2-inch hose line is closed.		
	(6) All hose assemblies, valves, and fittings connected properly and connections are tight.		
	(7) All components are color-coded white.		

Preoperational Checks			
	(8) 35-gallons per minute Electric Pump Assembly connected to an adequate power source.	Y	N

7.4.2. Initiate and Verify Potable Water Flow. Initiate and verify water flow to the extension subsystem as follows:

7.4.2.1. Open the 2-inch ball valve on the inlet to the 2-inch hose line and connect the bladder water level controller for the first 3,000-gallon tank to an adequate power source. Ensure the first 3,000-gallon tank begins to fill with water, and then recheck hoses, valves, and fittings to the outlet of the tank for leaks. Repair as required.

7.4.2.2. Once the 3,000-gallon tank is full, open the outlet ball valve and position the power ON/OFF switch for the electric pump to the ON position. Verify water is flowing from the first 3,000-gallon tank through the pump to the bladder water level controller on the facility tank. Then connect the second bladder water level controller to an adequate power source and verify water is flowing into the facility tank.

7.4.2.3. Recheck all hoses, valves, and fittings from the electric pump to the facility tank for leaks. Make any necessary repairs. **Note:** Contingency water systems tend to leak a little, so small leaks are usually unavoidable and should not be a major cause of concern. Always ensure hose couplings have neoprene gaskets properly installed before connecting hose assemblies.

7.4.2.4. When the 3,000-gallon facility tank is full, it is ready for service if the using facilities are connected. The 35-gallons per minute electric pump operates automatically and should not require any user input to maintain water level in the facility tank.

7.5. Component Descriptions. Listed in **Table 7.3** is a detailed description and quantity for each Industrial Operations and Flightline Extension Subsystem component and its corresponding reference number used in this chapter. See Technical Order 40W4-21-1-WA-1 for other subsystem component information.

Table 7.3. Industrial Operations and Flightline Extension Subsystem Component Description, and Item Number.

Ref #	550 Industrial Operations and Flightline Extension Component Description	Qty
1	Ball Valve Assembly, 3-Inch, w/Female x Male Quick Disconnects, White Stripe	1
2	Tee Assembly, 3-Inch x 3-Inch x 2-Inch w/3-Inch Female x 3-Inch Male x 2-Inch Male Quick Disconnects, White Stripe	2
3	Ball Valve Assembly 2-Inch w/Female x Male Quick Disconnects, White Stripe	8
4	Discharge Hose Assembly, 2-Inch x 50-Foot, White Stripe	2
5	Bladder Water Level Controller, Electric, w/ 2-Inch Female x Female Quick Disconnects and 25-Foot Outdoor Extension Cord, White Stripe	2
6	3,000-Gallon Collapsible Fabric Tank Assembly, w/2-Inch Male x Male x Male Quick Disconnects, White Stripe	2
7	Suction Hose Assembly, 2-Inch x 8-Foot, White Stripe	2
8	Ball Valve Assembly, 2-Inch, w/Female Quick Disconnect x Female National Pipe Thread, White Stripe	2
9	Suction Hose Assembly, 2-Inch x 25-Foot, White Stripe	3

Ref #	550 Industrial Operations and Flightline Extension Component Description	Qty
10	35-Gallons per Minute Electric Pump Assembly, 2-Inch, w/Female x Male Quick Disconnects, White Stripe	1
11	Reducer, w/3-Inch Male x 2-Inch Female Quick Disconnects, White Stripe	1
12	Check Valve Assembly, 3-Inch, w/Female x Male Quick Disconnects, White Stripe	2
13	Discharge Hose Assembly, 3-Inch x 50-Foot, White Stripe	6
14	Discharge Hose Assembly, 3-Inch x 100-Foot, White Stripe	20
15	Reducer, w/3-Inch Female x 2-Inch Male Quick Disconnects, White Stripe	1
16	Tee Assembly, 2-Inch x 2-Inch x 2-Inch, w/Male x Male x Female Quick Disconnects, White Stripe	1
17	Reducer, w/2-Inch Female x 1-Inch Male Quick Disconnects White Stripe	3
18	Discharge Hose Assembly, 1-Inch x 25-Foot, White Stripe	5
19	Reducer, w/1-Inch Female x 3/4-Inch Male Quick Disconnects, White Stripe	1
20	Hose Bridge System, 4-Inch	20
21	Tunnel Connector, 4-Inch	10
22	Tunnel, 4-Inch	10
23	Adapter, 3-Inch, Male Quick Disconnect x 3-Inch Male Quick Disconnect	1

Ref #	550 Industrial Operations and Flightline Extension Component Description	Qty
24	Coupler, 3-Inch Female Quick Disconnect x 3-Inch Female Quick Disconnect	1
25	Adapter, 1-Inch Male Quick Disconnect x 1-Inch Male Quick Disconnect	1
26	Coupler, 1-Inch Female x 1-Inch Female Quick Disconnects, White Stripe	1
27	Adapter, 3/4-Inch Male x 3/4-Inch Male Quick Disconnects	1
28	Coupler, 3/4-Inch Female x 3/4-Inch Female Quick Disconnects, White Stripe	1
29	Cold Weather Kit, Industrial Operations and Flight Line Extension Subsystem (Optional), (Not Currently Available)	1

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DCS/Logistics, Engineering & Force Protection

Attachment 1

GLOSSARY OF REFERENCES AND SUPPORTING INFORMATION

References

DoDI 4715.22, *Environmental Management Policy for Contingency Locations*, 18 February 2016

DAFMAN 91-203, *Air Force Occupational Safety, Fire, and Health Standards*, 25 March 2022

AFI 10-210, *Prime Base Engineer Emergency Force (BEEF) Program*, 25 October 2023

AFI 33-322, *Records Management and Information Governance Program*, 28 July 2021

AFH 10-222V4, *Environmental Considerations for Overseas Contingency Operations*, 1 September 2012

AFMAN 32-1065, *Grounding & Electrical Systems*, 17 July 2020

AFMAN 48-138_IP, *Sanitary Control and Surveillance of Field Water Supplies*, 1 May 2010

AFPAM 10-219, Volume 5, *Bare Base Conceptual Planning Guide*, 30 March 2012

T.O. 40W4-20-1-WA-1, *1500 Reverse Osmosis Water Purification Unit (ROWPU)*, 15 October 2020

T.O. 40W4-21-1-WA-1, *Basic Expeditionary Airfield Resources (BEAR) Water System PN 3000001*, 13 March 2009

UFC 3-560-01, *O&M: Electrical Safety*, 24 July 2017

NFPA 70E, *Standard for Electrical Safety in the Workplace*, 2021 Edition

Commercial Operator's Manual Power Tech 4.5/6.8 L. Tier 2 OEM Diesel Engines OMRG33324 Issue 16, February 2004

Prescribed Forms

No prescribed forms are implemented in this publication.

Adopted Forms

DAF Form 847, *Recommendation for Change of Publication.*

Abbreviations and Acronyms

AFI—Air Force Instruction

AFTTP— Air Force Tactics, Techniques, and Procedures

BEAR—Basic Expeditionary Airfield Resources

DAF—Department of the Air Force

OPR—Office of Primary Responsibility

ROWPU—Reverse Osmosis Water Production Unit

SRS—Source Run Subsystem

UFC—Unified Facilities Criteria

WPS—Water Production Subsystem

Office Symbols

AF/A4C—Air Force Directorate of Civil Engineers

AF/A4CX—Air Force Directorate of Civil Engineers, Readiness Division

Terms

Base—1. A locality from which operations are projected or supported. 2. An area or locality containing installations, which provide logistic or other support. 3. Home airfield or home carrier. (Joint Publication 4-0)

Basic Expeditionary Airfield Resources—A critical Agile Combat Support capability. It provides vital equipment and supplies necessary to beddown and

support combat forces at expeditionary sites with limited infrastructure and support facilities. As a minimum, each location must have a runway and parking ramp suitable for aircraft operations and a source of water that can be made potable. (Air Force Instruction 10-210)

Chemical, Biological, Radiological and Nuclear Defense—Measures taken to minimize or negate the vulnerabilities to, and/or effects of, a chemical, biological, radiological, or nuclear hazard or incident. (Joint Publication 3-11)

Contingency—A situation requiring military operations in response to natural disasters, terrorists, subversives, or as otherwise directed by appropriate authority to protect United States interest. (Joint Publication 5-0)

Contingency Location— A non-enduring location outside of the United States that supports and sustains operations during contingencies or other operations and is categorized by mission life-cycle requirements as initial, temporary, or semipermanent. (JP 4-04)

GeoBase—The common mapping framework for the United States Air Force, ensuring the provision of and access to standard, accurate and current geospatial information for all Air Force installations, ranges and property. GeoBase enables geospatial analysis and the integration into business processes of United States Air Force missions, installations, and facilities. GeoBase is comprised of four unique decision support environments: Garrison GeoBase, Expeditionary GeoBase, GeoReach, and Strategic GeoBase. (Air Force Instruction 10-404)

Attachment 2

ENGINEER REACHBACK AND OTHER LINKS

Table A2.1. Useful Organizational and Product Links.

Organization and Products Links
Air Force Civil Engineer Center (AFCEC): https://www.afcec.af.mil/
CE DASH (AFCEC Technical Support Portal): https://usaf.dps.mil/teams/CEDASH/scripts/homepage/home.aspx
CE Playbooks: https://www.ceplaybooks.com.
AF Publications and Forms: https://www.e-publishing.af.mil/
My Learning (Learning Management System): https://lms-jets.cce.af.mil/moodle/login/index.php
AF Design Guides (AFDG): https://www.wbdg.org/ffc/af-afcec
Whole Building Design Guide (WBDG): https://www.wbdg.org/
Air Force Global Information Management System (AFIGMS): https://maps.af.mil/geoportal/home/
US Army Corp of Engineers Official Publications, http://www.publications.usace.army.mil/Home.aspx
Unified Facilities Criteria (UFC): https://www.wbdg.org/ffc/dod/unified-facilities-criteria-ufc
Unified Facilities Guide Specifications (UFGS): https://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs
USACE Reachback Operations Center (UROC): https://uroc.usace.army.mil
USACE Protective Design Center: https://intelshare.in-telink.gov/sites/pdc/SitePages/Home.aspx
Army Publications and Forms: https://armypubs.army.mil/
Navy Doctrine Library System: https://doctrine.navy.mil/default.aspx
DOD Issuances: https://www.esd.whs.mil/DD/DoD-Issuances/
Joint Publications: https://jdeis.js.mil/my.policy
Armed Forces Pest Management Board: https://www.acq.osd.mil/eie/afpmb/

Attachment 3

COMPONENTS ILLUSTRATIONS

A3.1. Illustrated in **Figure A3.1** through **Figure A3.4** are different components of the BEAR water system. Although not all-inclusive, they provide a brief description of some of the more common components used in the various subsystems that makeup the contingency water system. Users should refer to Technical Order 40W4-21-1-WA-1 for more detailed descriptions of these and other subsystem components.

Figure A3.1. Common Water System Components.

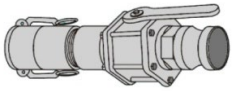
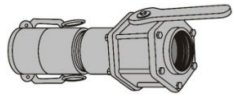
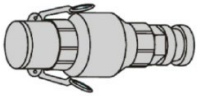
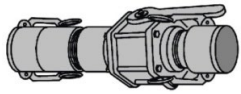
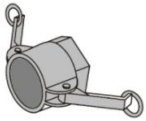
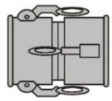
COMMON COMPONENTS	
 **Ball Valve Assembly w/Female X Male Quick Disconnect**	 **Ball Valve Assembly**
 **Swing Check Valve Assembly**	 **Ball Valve Assembly w/Female X Female Quick Disconnect**
 **Coupler, Female Quick Disconnect X Female National Pipe Thread**	 **Coupler, Female X Female Quick Disconnect**

Figure A3.2. Common Water System Components (Cont'd).

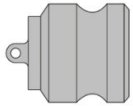
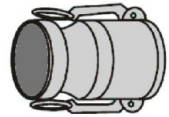
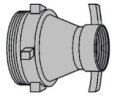
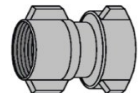
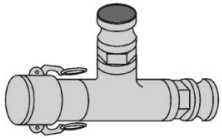
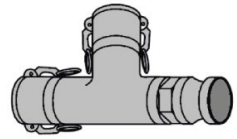
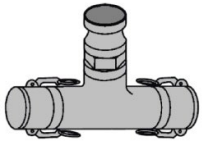
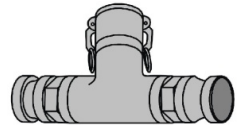
COMMON COMPONENTS	
 Plug, Male Quick Disconnect	 Reducer, Male X Female
 Adapter, Swivel, Female National Standard Threads X Male National Pipe Thread	 Adapter, Swivel, Female National Standard Threads X Female National Pipe Thread
 Pipe Tee Assembly, Female X Male X Male	 Pipe Tee Assembly, Female X Male X Female
 Pipe Tee Assembly, Female X Female X Male	 Pipe Tee Assembly, Male X Male X Female

Figure A3.3. Common Water System Components (Cont'd).

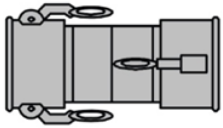
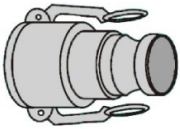
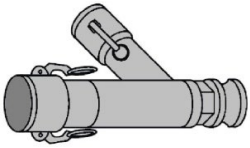
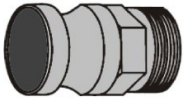
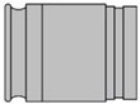
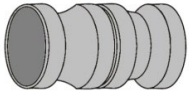
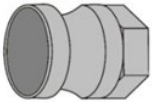
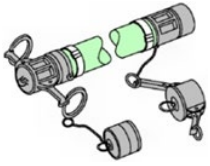
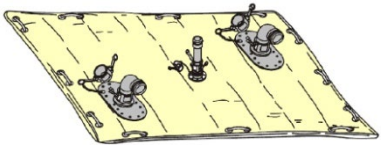
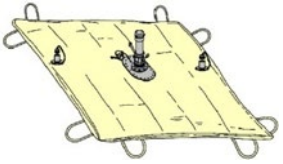
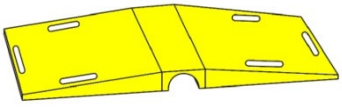
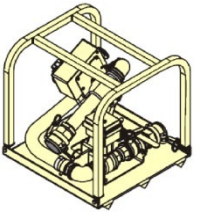
COMMON COMPONENTS	
 **Reducer, Female X Female Quick Disconnect**	 **Reducer, Female X Male**
 **Wye Assembly, Female X Male X Female**	 **Adapter, Male Quick Disconnect X Male National Pipe Thread**
 **Adapter, Male Quick Disconnect Victaulic/ Grooved**	 **Adapter, Male Quick Disconnect X Male Quick Disconnect**
 **Adapter, Male Quick Disconnect X Female National Pipe Thread**	 **Hose Assembly**

Figure A3.4. Common Water System Components (Cont'd).

COMMON COMPONENTS	
 **20,000-Gallon Bladder Tank**	 **3,000-Gallon Bladder Tank**
 **Hose Bridge System**	 **Bladder Water Level Controller**

Attachment 4

HOSE QUICK DISCONNECT COUPLING CONNECTIONS

A4.1. Quick Disconnect Couplings. Hoses are equipped with female quick disconnect couplings on one end and male couplings on the other.

A4.2. The following procedures describes the two quick disconnect coupling connections. See **Figure A4.1** and proceed as follows:

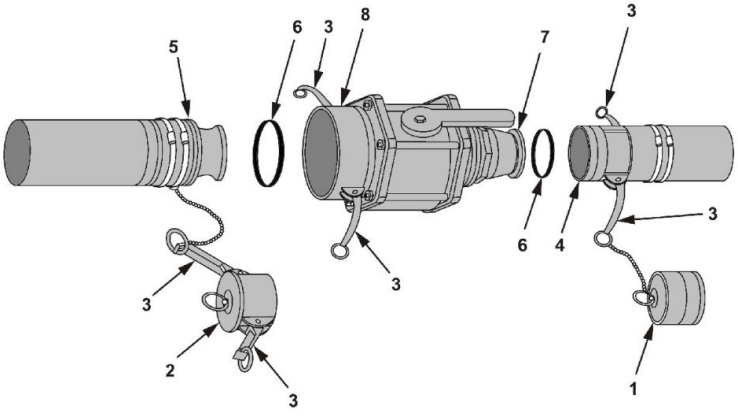
A4.2.1. If the plug (1) and cap (2) are installed; pull locking handles (3) forward to release them from the hose assemblies.

A4.2.2. Ensure that both female (4/8) and male (5/7) couplings are free of dirt, not corroded or damaged, and have serviceable gaskets (6).

A4.2.3. Make sure the locking handles (3) on female couplings (4 and 8) are facing forward (away from coupling).

A4.2.4. Ensure gasket (6) is inserted in female coupling (4) then position female coupling (4) over male coupling (7).

Figure A4.1. Typical Quick Disconnect Coupling.



A4.2.5. Rotate locking handles (3) backward and press down until they are in horizontal alignment with the hose assembly.

A4.2.6. Ensure gasket (6) is inserted in the female coupling (8), then position male coupling (5) in female coupling (8).

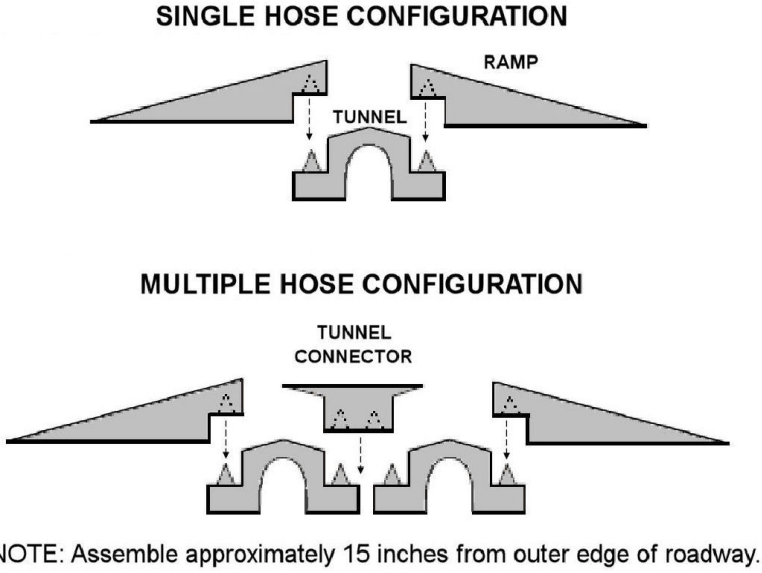
A4.2.7. Rotate the locking handles (3) backward and press down until they are in horizontal alignment with the hose assembly.

Attachment 5

HOSE BRIDGE SYSTEM ASSEMBLY

A5.1. The hose bridge system includes three types of components: ramps, hose tunnels, and tunnel connectors. The components assemble easily and provide good rollover protection to raw water, potable water, or wastewater hose assemblies.

Figure A5.1. Hose Bridge System Assembly.



Attachment 6

NORMAL OPERATION OF THE CONTINGENCY WATER SYSTEM

Table A6.1. Normal Operating Procedures.

NORMAL OPERATION	
The following procedures highlight basic operation of the Contingency Water System and do not have to be performed in the order presented here. These procedures assume the system was initially fully filled and currently functioning normally. Users should read and understand subsystem operational procedures in T.O. 40W4-20-1-WA-1 prior to system operation.	
A.	Inspect all tanks, hoses, valves, and connections for leaks and repair as required.
B.	Regularly check the level of the 20,000-gallon potable water tanks of the 550 Initial and 550 Follow-On (if equipped) Subsystems and proceed as follows: (1) If the height of all potable water tanks is at least 36 inches, proceed to Step C. (2) If the height of all potable water tanks is less than 36 inches and the source of potable water is the Water Production 1500 Reverse Osmosis Water Purification Unit Subsystem, proceed to Step C. (3) If the height of all potable water tanks is less than 36 inches and the source of potable water is the 125-gallons per minute Diesel Pump that is part of the 550 Initial Subsystem, proceed to Step E.
C.	Check the height of the 20,000-gallon raw water tanks from the Water Production 1500 Reverse Osmosis Water Purification Unit Subsystem(s) and Source Run Subsystem (if installed) and proceed as follows:

	(1) If the height of the tanks is at least 36 inches and potable water is not required for the 550 Initial and 550 Follow-On (if installed) Subsystems, continue to monitor tank levels. No action is required at this time. (2) If the height of the tanks is at least 36 inches and potable water is required for the 550 Initial and 550 Follow-On (if installed) Subsystems operate Reverse Osmosis Water Purification Units in accordance with applicable Technical Order as required. **NOTE** If operation of Reverse Osmosis Water Purification Units are required, it may be necessary to operate the 400-gallons per minute Diesel Pump (or 125-gallons per minute Diesel Pump if used) as required to supply sufficient raw water for Reverse Osmosis Water Purification Unit operation (refer to Step F). (3) If the height of the tanks is less than 36 inches and the Source Run Subsystem is installed, proceed to Step D. to startup 400-gallons per minute Diesel Pump. (4) If the height of the tanks is less than 36 inches and the Source Run Subsystem is not installed proceed to Step E. to startup 125-gallons per minute Diesel Pump.
D.	Monitor the height of the 20,000-gallon raw water tanks and proceed as follows: (1) Startup the 400-gallons per minute Diesel Pump in accordance with Operator's Manual Power Tech4.5/6.8 L Tier 2 Original Equipment Manufacturer Diesel Engines. (2) Allow pump to run and fill 20,000-gallon raw water tanks. Proceed to Step F.
E.	Energize the 125-gallons per minute Diesel Pumps at the 550 Initial and Follow-On Subsystems in accordance with the following steps:

CAUTION

Do not operate 125-gallons per minute Diesel Pump Assembly without water in pump case. Operating pump without liquid flowing through it will damage pump seals and make pump inoperative.

(1) Remove pump plug and fill pump case with water. Reinstall pump plug.

(2) Remove engine fuel fill cap and fill and/or verify tank is full. Reinstall engine fuel fill cap.

(3) Remove engine oil fill cap and check oil level. Add oil as required and reinstall fill cap.

(4) Open fuel valve.

(5) Move throttle lever to run position (right).

NOTE

When pulling engine pull start handle, pull with constant steady force. Do not jerk pull start handle cable violently.

(6) Grip engine pull start handle (3) with both hands. Commence pulling the pull start handle repeatedly with strong and even motion until engine starts. If engine starts, proceed to step (7).

(7) If after several unsuccessful attempts to start the pump the exhaust begins to emit white smoke, move the throttle lever to the STOP position (vertical). Pull engine pull start handle out slowly five times then repeat steps (5) and (6).

WARNING

Serious injury or death to personnel could occur if tanks are overfilled and explode. When filling tanks, ensure height of 20,000-gallon tanks do not exceed a maximum height of 64 inches. Tanks fill at different rates and it will be necessary to turn-on and turn-off pumps as required to ensure they do not overfill.

F.	Run all pumps and Reverse Osmosis Water Purification Units as required, until all raw water and potable water 20,000-gallon tanks are filled (maximum height of 64 inches), proceed as follows: (1) Shutdown 400-gallons per minute diesel pump in accordance with Operator's Manual Power Tech 4.5/6.8 L Tier 2 Original Equipment Manufacturer Diesel Engines. (2) Shutdown Reverse Osmosis Water Purification Units in accordance with T.O. 40W4-20-1-WA-1. (3) If used, shutdown 125-gallons per minute diesel pump(s) as follows: (a) Move throttle lever to idle position and maintain idle for approximately five minutes. (b) Stop engine. (c) Close fuel cock.