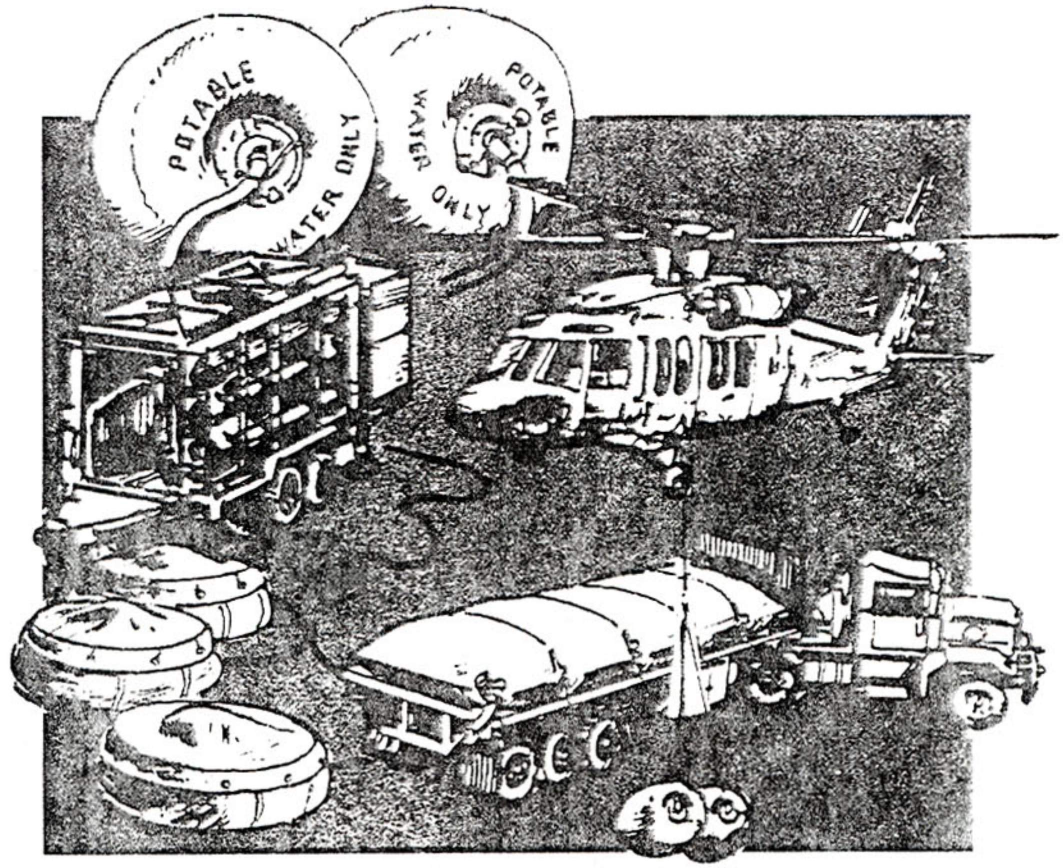
FM 10-52



WATER SUPPLY IN THEATERS OF OPERATIONS

HEADQUARTERS, DEPARTMENT OF THE ARMY

Approved for public release; distribution is unlimited

FIELD MANUAL
NO 10-52

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, DC, 11 July 1990

WATER SUPPLY IN THEATERS OF OPERATIONS

DISTRIBUTION RESTRICTION: Approved for public release; distribution is unlimited.

**This publication supersedes FM 10-52, 27 February 1985.*

PREFACE

PURPOSE

This manual is a guide for commanders, staff officers, and other persons concerned with planning, organizing, and operating an Army water supply system in a TO. Concepts and doctrine are presented to enable the planner to design a water purification, storage, and distribution system that will ensure units can provide necessary water support to US forces.

SCOPE

The doctrine in this manual is oriented toward operations in a tactical theater and in field training exercises. Water supply at fixed and semifixed installations and in peacetime garrison operations is a Corps of Engineers responsibility and is discussed in depth in the TM 5-813 "Water Supply" series manuals and FM 5-104. Doctrine for the development and operation of a theater water supply system is discussed separately for arid and nonarid regions in both developed and undeveloped theaters. Doctrine for the employment and operation of water point equipment will be in FM 10-52-1 when printed.

Planning factors for water supply in arctic, arid, temperate, and tropical climates are presented for use by logistics planners. Responsibilities for the command, control, and operation of water units in the theater are discussed in detail. Potable water quality standards and surveillance practices are presented. Procedures for management and accountability of water supplies are discussed. The systems described are applicable in LIC, conventional warfare, and operations in an NBC environment on the integrated AirLand battlefield. This manual may not be cited as authority for requesting personnel or equipment.

USER INFORMATION

The proponent of this publication is HQ TRADOC. Users of this manual are encouraged to recommend changes and submit comments for its improvement. Key comments to the specific page and paragraph in which the change is recommended. Provide a reason for each comment to ensure understanding and complete evaluation. To send changes or comments, prepare DA Form 2028 (Recommended Changes to Publications and Blank Forms) and forward it to:

Commander
US Army Quartermaster Center and School (Provisional)
ATTN: ATSM-DTP
Fort Lee, VA 23801-5036

INTERNATIONAL AGREEMENTS

The provisions of this publication are the subject of the following international agreements:

STANAG 2136-Minimum Standards of Water Potability
STANAG 2885-Procedures for the Treatment, Acceptability and Provision of Potable Water in the Field
QSTAG 245-Minimum Requirements for Water Potability (Short and Long Term Use)
QSTAG 479-Water Quality Analysis Set (Engineer and Preventive Medicine)

Unless otherwise stated, whenever the masculine gender is used, both men and women are included

CHAPTER 1

WATER SUPPORT

AIRLAND BATTLE

The mission of the US Army is to deter war. Failing that, its goal is to destroy the opposing force. Tactics and logistics are joined on the AirLand battlefield. AirLand Battle doctrine, which shows how the Army will conduct its combat operations, stresses the approach to take when fighting to maximize the potential of US forces. This doctrine stresses tactics, procedures, organizations, support, equipment, and training. Initiative, depth, agility, and synchronization are the directing points used in executing this doctrine. More detailed information on AirLand Battle is in FM 100-5.

COMBAT SERVICE SUPPORT

The ability of the Army to perform its mission rests on sound CSS planning, timely support, and proper use of CSS resources. The most critical resource is water.

Commanders and staff officers should know the capabilities of their CSS units, as well as the CSS assistance available from the next higher echelon. The CSS system develops and maintains maximum combat power by sustaining combat forces. It includes personnel, administration, religion, food, water, finance, legal, maintenance, medical, supply, transportation, and other personnel and logistical services and support.

The US Army may become involved in a conflict in either of the following scenarios in which water support will be required.

Forward-deployed

Support to forward-deployed US Army forces normally involves combined operations in which US forces, pre-deployed in a foreign country, operate with allied nations in an established theater. NATO and Korea (Combined Forces Command) are examples of where US joint forces are forward-deployed in a foreign country where an established formal allied command structure exists and where HNS agreements are in being. PWRMS are in the theater, and the theater water support is established to support peacetime operations and allow for expansion to support wartime operations. The chance of conflict in this situation would be low. However, if a conflict did arise, potential losses of personnel and equipment could be quite high. The most likely threat would come from the Soviet Union's Warsaw Pact force and other armies equipped and trained by the Soviets. More information on Soviet doctrine, organization, and equipment is in the FM 100-2 series.

Nonforward-deployed

Support to nonforward-deployed US forces involves a contingency operation by which a joint US contingency force, with or without allied assistance, deploys and operates in a tombat zone without a significant pre-established water support base. It is envisioned that this conflict will have limited objectives and be of short duration. However, planning for water support must include a follow-on buildup and sustainment capability to ensure US forces can perform the mission in the time required. This situation involves initial deployment of joint US forces to a country before or after the outbreak of hostilities.

THEATER ARMY WATER SUPPORT

A TA mission is to provide water support to Army forces in the theater. These forces include the corps, forces in the COMMZ, and other Army forces in the theater. Water support provided to the corps is chiefly GS while support to COMMZ units includes both DS and GS. The TA provides water support through its subordinate functional commands and through area- oriented commands.

The Army component of a US unified command responsible for water support to US Army forces in a theater of operations is normally the TA. TA water support is provided by subordinate groups, battalions, and CSS commands aligned and organized to provide water support. An important element is flexibility. The TA has an organizational flexibility which allows for its expansion or change depending on the situations met in the conflict.

In joint operations, PWRMS may be austere in the theater and HNS agreements may not provide enough water resources. Contingency combined operations may afford nominal land or naval theater pre-positioning of water as well as implementing existing or hastily negotiated HNS agreements for water resources with the country or countries in the AO. In contingency operations, water support units are structured to permit situation dependent growth and maturity. This built-in flexibility enhances the Army component commander's capability to support the battle.

Each area command provides water support through subordinate area organizations and coordination with functional command organizations. The number and size of the area commands are initially determined by the size of the supporting force and the composition of the force to be supported. The nature of the operations, geographical features of the area, and known international boundaries also influence the number of area commands established in the COMMZ.

WATER SUPPORT RESPONSIBILITIES

The responsibilities of Army elements for water supply are covered in detail in AR 700-136. These responsibilities are briefly described below.

US Army Engineer School

The Engineer School compiles the water resources data base of surface water sources, potential ground water resources, and existing water supply facilities. It also produces water resources overlays for 1:250,000-scale maps for user commands. The Engineers assemble and deploy water detection response teams to detect potential ground water resources and select well drilling sites. They develop operational concepts, doctrine, tactics, organizational structures, training programs, and user materiel requirements for well drilling equipment. They also monitor testing and evaluation of materiel systems under development and monitor their procurement and fielding Engineers develop policy for and operate water supply facilities at fixed and semifixed installations. Tactical Engineer units drill and construct wells and provide construction support for water point improvements. They also provide diving support in the TA development of offshore water operations.

US Army Quartermaster School

The Quartermaster School develops operational concepts, doctrine, tactics, organizational structure, training programs, and user materiel requirements for water purification, storage, distribution, and cooling equipment. QM personnel monitor testing and evaluation of materiel systems under development and their procurement and fielding. They also conduct training programs on water supply doctrine and equipment. Tactical QM units provide potable water to supported units. Water Treatment Specialists (MOS 77W) conduct reconnaissance for raw water sources. They recommend potential locations for water treatment and supply points; make minor site improvements; and set up, operate, and maintain water purification, storage, and distribution equipment. They operate and maintain ground water well pumps and equipment and conduct routine tests of source and product water to adjust treatment processes and ensure potability. They also establish and operate PWS/DS and lay, operate, and retrieve TWDS.

US Army Ordnance School

The Ordnance School develops and conducts training programs for maintenance and repair of water purification, storage, and distribution equipment. The Quartermaster and Chemical, Equipment Repairer (MOS 63J) performs unit and intermediate direct and general support level maintenance and repair of water purification, storage, and distribution equipment.

US Army Academy of Health Sciences and the US Army's Command Surgeon General

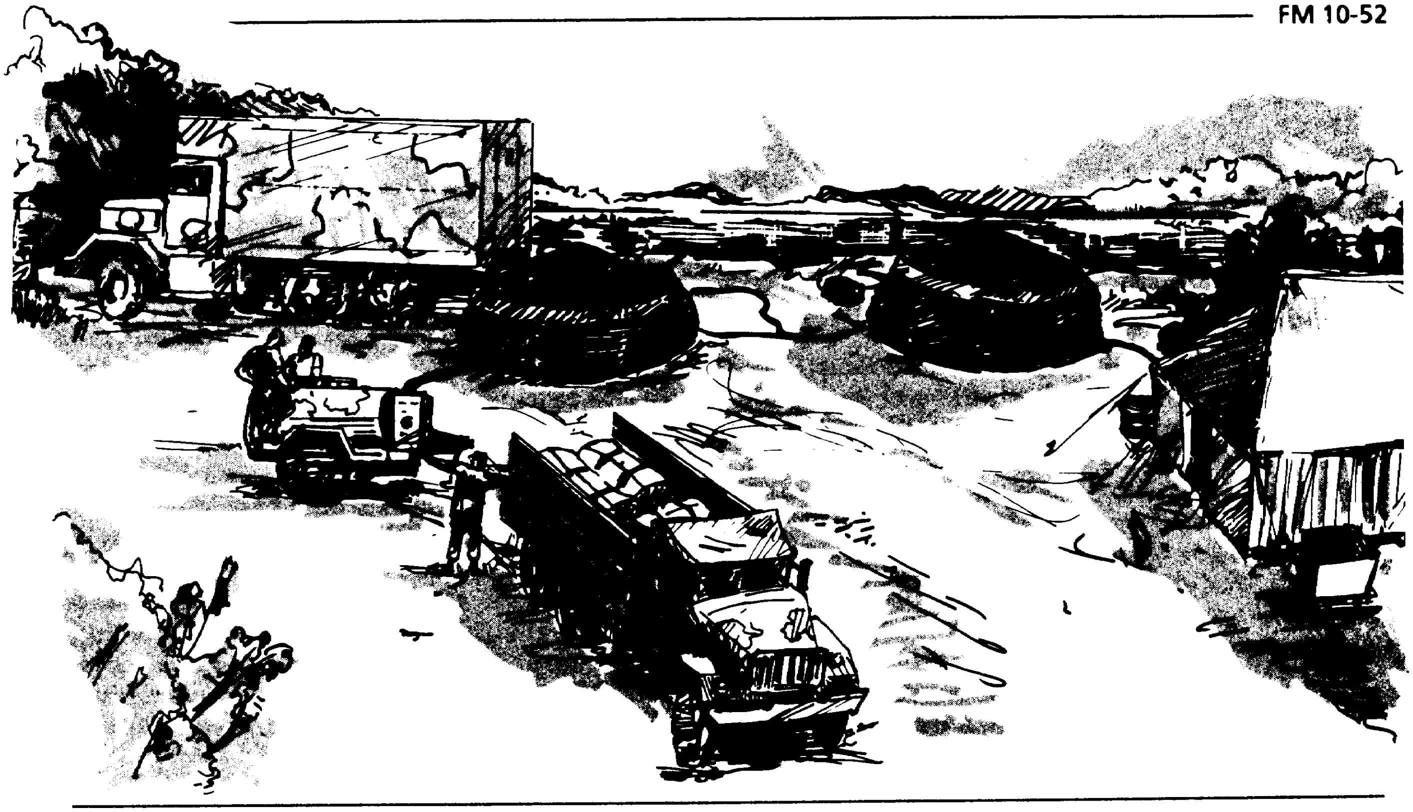
The Academy of Health Sciences and the Command Surgeon General monitors preventive medicine water inspection programs, define degree of water treatment required, and approve treated water for distribution. The Preventive Medicine Specialist (MOS 91S) assists water purification units in water source reconnaissance, approves water sources, inspects water points, inspects potable water containers, and analyzes treated water to ensure water quality standards are met. When appropriate medical authorities are not available in the TO for potability certification of water supplies, the Senior Water Treatment Specialist (MOS 77W) will certify potability. This is to allow water to be issued to supported units as an interim action pending the arrival of qualified medical personnel. This authority is conditional on the drinking water having been treated by reverse osmosis water purification equipment and the chlorine residual maintained at 5 ppm. Sanitary engineers (SSI 68P) and environmental science officers (SSI 68N) of the Medical Department provide technical guidance on water treatment and water quality standards.

Logistics Staffs

The headquarters logistics staffs of the TA and subordinate commands project. force water requirements, allocate water supply resources, provide water distribution schedules to supported units, and control water supplies and storage reserves.

Commanders

The commanders provide soldiers with safe drinking water and ensure they understand the dangers of drinking unapproved water. They also provide higher headquarters with water requirement estimates based upon climate-related consumption factors. Commanders ensure soldiers drink adequate amounts of potable water for the climate region and type of operation. They safeguard unit water supplies with good sanitation habits.



CHAPTER 2

WATER SUPPORT PLANNING AND OPERATIONS

Section I
Planning Considerations

WATER SUPPORT CONSIDERATIONS

Water is a critical support item for the soldier. The water support mission is to get water to individual fighting positions. Each service (Air Force, Marines, and Navy) provides water support to its force. When other services exceed their capabilities, the Army provides backup water support. The supported service must then provide Army planners with detailed water requirements. When the Army is not the main service, that service determined by the joint commander to be the main service provides such support.

Water supply is provided on an area basis by QM CSS units using supply point distribution. (See exceptions to light infantry divisions, paragraph 2-5.) CSS units will maintain and operate a potable-only water supply system. Although not all water required in a TO has to be potable, a potable-only system minimizes health hazards and is more efficient. An exception to this is a water point OIC may commit collapsible tanks to raw water storage. This allows water points to continue water supply operations when faced with decreased well production, water source limits imposed by the host nation, and to meet peak demand requirements.

Water storage policy depends on the environmental region. Where water sources can support water purification operations, supported units need only maintain water in organic water containers and optional equipment from the CTAs. For a normal unit, this means maintaining enough water to get through today's operations. Under these conditions, units must resupply water daily, Tactical units and their applicable divisional supply and nondivisional water supply units will not normally be augmented with additional water purification, storage, or distribution equipment. Readily available water sources (wells, lakes, and rivers) will be considered as sources of raw water that can be purified on demand.

In arid regions, water sources are nonexistent or extremely limited. Commanders will make use of all organic water storage and distribution equipment and must draw and use all CTA water equipment. In arid regions, combat brigades, divisions, and hospitals will be assigned additional water storage and distribution equipment. This will ensure that one DOS is maintained in each echelon level. GS storage and distribution systems are provided to maintain the required supply levels.

There is no formal supply accountability for water. In regions with an extreme environment, the commander may use water management procedures to conserve and prioritize water supplies (Chapter 5).

Allied forces are responsible for their own water support systems. However, if they exceed their capabilities, the joint commander may direct the Army to provide backup water support.

The key to a successful water support mission is innovative and flexible planning. Forces are structured so that there is enough water production and distribution to meet requirements. The buildup of theater forces must be scheduled so that water support and preventive medicine units arrive on time to ensure adequate and continuous water support.

The staff logistics officer at each level must include water supply guidance in logistics support plans (Appendix A). Some specific areas that are critical to any water support plan are as follows:

- Development of detailed inland distribution plans that itemize units by UIC and their anticipated grid square of operations.
- Recognition of specific water support requirements for the other services, allied forces, or host nation labor forces.
- Recognition of applicable STANAG.
- Recognition and development of OPROJ stocks that support specific operational plans. This is critical in arid regions where a great deal of GS water equipment will be required. The OPROJ is linked to the detail inland distribution plan at the UIC level and to any theater equipment pre-positioning initiatives.
- Full development of a force that supports the required water purification, storage (to include DOS), and distribution mission of the theater.

All levels of command must be concerned with water quality. Preventive medicine personnel approve water supplies and provide routine surveillance to ensure that water quality meets appropriate standards. Water purification equipment operators analyze both untreated and treated water to ensure purification equipment is operating properly. They ensure that the treated water meets applicable standards. Unit sanitation teams must ensure that water supplies are maintained according to health standards.

HOST NATION CONSIDERATIONS

Whenever possible, use host nation water sources, facilities, and equipment. However, in both developed and undeveloped theaters, water planners must be aware of the following.

Article 54 of the Geneva Convention

This article "prohibits attacking, destroying, or rendering useless drinking water installations and supplies and irrigation works. In no event shall actions against these objects be taken which may be expected to leave the civilian population with such inadequate food or water as to cause its starvation or force its movements."

Labor Force Personnel

The host nation must provide for the needs of its labor forces unless otherwise provided in HNS agreements. In the absence of an agreement, US forces may have to assume some responsibility for the care of labor forces.

Refugees

Article 55 of the Geneva Convention states that the host country, as the territorial sovereign, is responsible for refugees on its territory. In the event its resources are strained by an influx of refugees, the host country may request assistance from US forces. US forces would have a legal responsibility to provide refugee care where they have occupied enemy territory and have established a military government. This would include providing food supplies and water to the population, if the resources of the occupied territory were inadequate.

EPWs

Article 26 of the Geneva Convention requires the US to provide humane treatment to POWs in its custody. This includes providing sufficient daily food rations and enough drinking water. Army military police have organic water trailers and will pick up water for EPWs from the QM supply company providing area support.

HNS in Arid Regions

Planners should assume no host nation water is available in arid regions. Minimal water sources and poor water quality will limit any operation that depends on HNS. In the early days of deployment, host nation processed or bottled water maybe used if certified as potable by preventive medicine personnel.

Use of host nation municipal or private fixed facilities is dependent on the above stipulations and local policies as directed by the theater commander.

WATER FORCE STRUCTURE PLANNING

The proper force structuring of water support and the time-phased deployment of units in that structure is an iterative process. It is done by organizational integrators who consider the operational scenario, strategic lift availability (sorties), and pre-positioned supplies and equipment.

The process normally begins with the identification of the force size and planned troop deployment rate. Time-phased water requirements are then estimated, using consumption planning factors (Chapter 3). Units are then selected and scheduled for deployment so that purification, storage, and distribution capabilities are consistent with requirements.

Early deployment of CSS water units can be expected in arid regions. This is necessary because of the increased consumption requirements, limited availability of aircraft for aerial resupply, and the need for centralized production. Centralized production will be near the shore or offshore; tank trucks for distribution will be required early on. The purification teams and detachments needed to operate barges and other high-capacity ROWPU equipment, as well as water supply companies that operate potable water storage and distribution systems, will appear early in most TPFDL.

Since the capability of Army divisions and other services to produce their own requirements will be difficult to predict, logistics planners must provide a force structure adequate to purify, store, and distribute the daily requirement for the force. Logistics planners should develop contingency plans with host nations for identifying and determining the availability of water resources for use by US forces. Existing HNS communication channels should be used to determine the ability of the host nation to assist in meeting water requirements.

Section II
Water Support Operations and Supply

WATER SUPPORT OPERATIONS

Water support management, equipment, and operations vary from one organizational level to another. Responsibilities, procedures, and operations at the unit, brigade, corps, division, and theater levels are discussed in more detail below.

Unit

During initial deployment and in emergency situations, airlift of 55-gallon and 250-gallon fabric drums and the FAWPSS will be the primary means of resupply of water to units in forward operating bases. As BSAs are established and ground LOC are developed, units pick up water at brigade water points using organic 400-gallon trailers, 160-gallon pillow tanks, 250-gallon fabric drums, and FAWPSS. Commanders must emphasize water conservation and increased consumption by individuals to minimize heat casualties. In arid regions, the routine mechanical cooling of drinking water will be done using the small mobile water chillers issued prior to deployment. As the theater matures and ground LOC operate effectively, units will be able to provide necessary cooking, hygiene, and morale functions.

Brigade

The brigade sets procedures and allocations for subordinate units. Water support for the brigade will come from the division S&T battalion or MSB. They are equipped with 600-GPH ROWPUs. They will be augmented with bulk storage and distribution systems in arid regions. They will produce potable water to meet essential requirements when local surface water sources are available in the BSA. Normally, in arid regions this will not be possible. Bulk storage tanks will have to be replenished, depending on terrain and tactical situation, by the SMFTs of medium truck companies in the division and corps. In some situations, water may have to be supplied by air. Sufficient storage capability is to maintain one DOS for the brigade. In arid zones, this is done by augmentation with a 40,000-gallon storage and distribution system. Water supply point operations will be coordinated by the FSB or the FASCO. Water quality will be monitored by water equipment operators and by personnel from the division surgeon's office. During the development of the BSA, a capability must exist for aerial (helicopter) resupply of water to subordinate units not having ground LOC.

Division

The DMMC or the S&T battalion in the LID provides centralized water resources management. In addition to control measures taken at unit and brigade level, the DMMC assumes management responsibility for division area water sources detection, purification, storage, distribution, and cooling. The DMMC will assign priorities for distribution of water resources in the division and to nondivisional elements located in divisional boundaries. Units in the division rear will pick up water from supply points located in the same area. These supply points will be operated by MSB or S&T battalion water sections and will have storage capacity for one DOS for the division. Water for purification will come from surface water or well sites. If new wells are needed, corps engineer drilling support will be required. Limited distribution to dry water points in the division or BSAs is made using organic SMFTs.

Corps

The COSCOM MMC manages water resources in the corps. If the corps is part of a joint task force, the MMC coordinates the Army water responsibilities. Other services normally provide their own water support. In arid regions, the Army may have to provide water purification and limited transportation support to other services or al lies. The MMC will receive requirements from other services and incorporate them into overall priorities following guidance from the joint task force, corps, and COSCOM commanders. The corps force structure for water support is not fixed. It is based on the supported force size, the mission, and the water sources in the AO.

Theater

The TA DCSLOG develops the water distribution plan for the theater and supervises the TA commander's priorities and allocation procedures. The Army will provide GS, as required, to other services in the theater. The TA MMC monitors water priorities and allocation procedures and provides the TA commander with supply data information. GS will be provided by water supply companies. DS in the COMMZ will be provided on an area basis by water elements of TAACOM S&S battalions. These elements will draw and purify water from available sources and establish water supply points in DS of units in the COMMZ. Water is provided on an as-required basis by supply point distribution.

DIRECT SUPPORT WATER SUPPLY

The force structure for water support in a TO divides water support into DS and GS levels. DS capabilities are sufficient to meet requirements in temperate, tropical, and arctic regions. However, in arid regions where sufficient water sources are not available, GS water systems are established. DS is provided to both nondivisional and divisional units as described below.

Nondivisional

Nondivisional water support is provided on an area basis by corps and EAC Quartermaster supply companies (see Figure 2-1) operating ROWPUs. (These companies will retain their erdlators until they are replaced by 3,000-GPH ROWPUs.) The organic water supply section of the company provides water purification and storage at water supply points using approved water sources. By using the SMFT, the section can deliver water to major users unable to support themselves. In addition, the SMFTs may be used to establish dry water point distribution sites. The nondivisional DS water section of the QM supply company has four 3,000-GPH ROWPUs, forty 3,000-gallon onion tanks (120,000 gallons), four 3,000-gallon SMFTs (12,000 gallons), and four FAWPSSs (12,000 gallons). With this equipment, it can establish four water purification points that can each produce 60,000 GPD of potable water from fresh water or 40,000 GPD of potable water from salt water. It can produce a total of 240,000 GPD using a fresh water source and 160,000 GPD using salt water. In addition, each water point can store 30,000 gallons of potable water using the ten 3,000-gallon onion tanks that are organic to each ROWPU. This gives the water section the capability of storing 120,000 gallons of potable water. The water section can distribute water to users using the user's organic equipment (for example, 400-gallon water trailers) or CTA equipment (for example, 260-gallon collapsible drums). It can also distribute water to major consumers that have no organic transportation assets by using the 3,000-gallon SMFT. The FAWPSS permits limited aerial or ground resupply to isolated units. The system provides a potable water delivery and storage system for units in a remote area. It consists of six 500-gallon collapsible

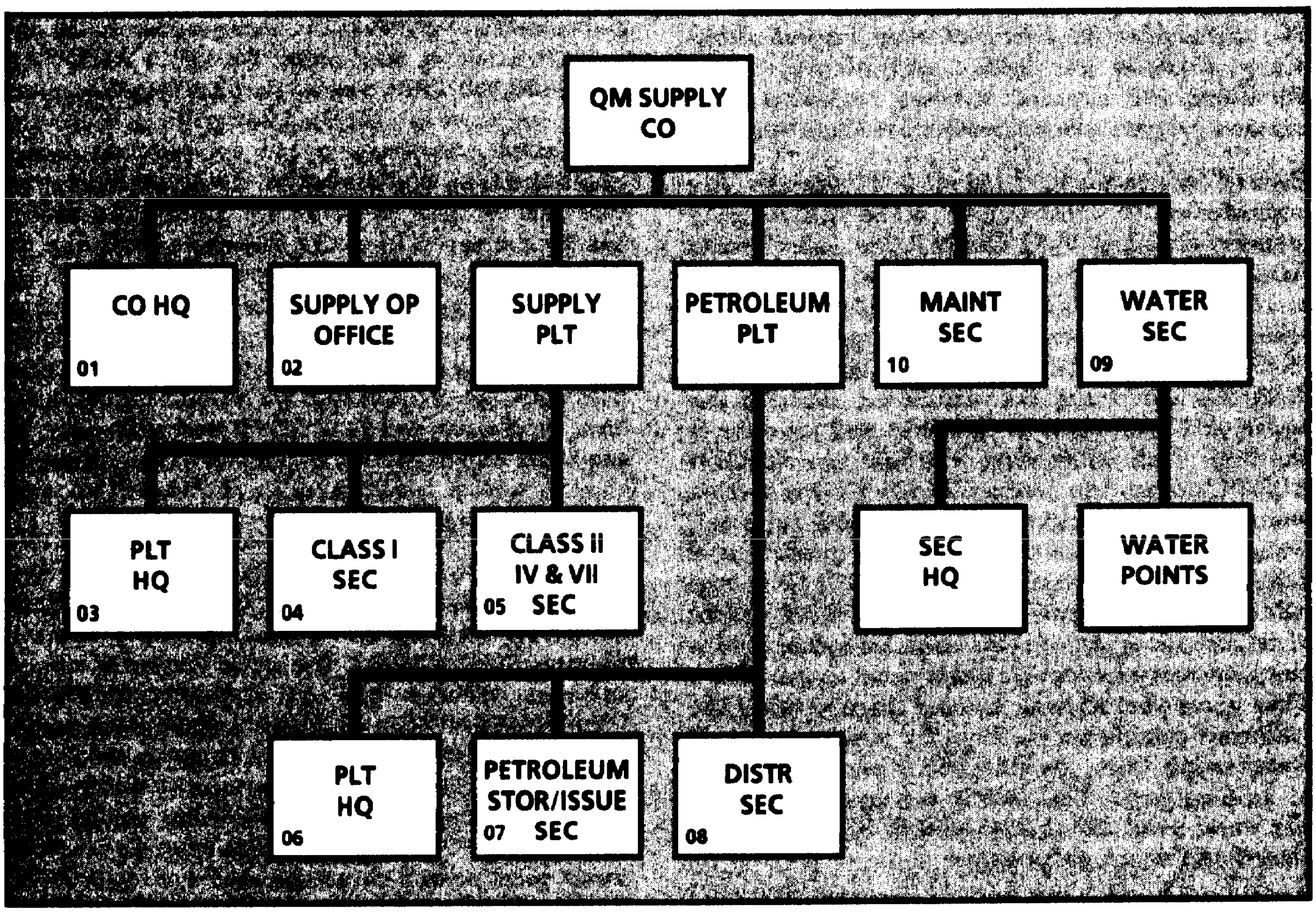


Figure 2-1. QM supply company (TOE 42447L)

fabric water drums, a 125-GPM water pump, connecting hose assemblies, and nozzles. The system can be delivered by helicopter sling load, airdrop, LAPE, or cargo trucks. The expected use of the six 500-gallon drums is for two to be in use distributing water to the soldiers, two being filled at the water point, and two being transported from the water point to the distribution site, usually an isolated unit.

Divisional

Divisional water support is provided by the MSB S&S company. Water purification points are setup at water sources in each BSA and at up to two points in the DSA. Depending on METT-T factors, division and brigade Class I distribution points may be colocated with the water points. Where surface water is not available, a dry water point distribution system may be setup and supported by the units organic SMFTs. The organization for divisional water support within heavy, airborne, air assault, and infantry (light) divisions; the armored calvary regiment; and separate brigade is described in more detail below.

Heavy divisions. Figure 2-2 depicts the organization for water support in the S&S company of heavy divisions (TOE 42007 L). The water section in armored, infantry, and mechanized divisions has ten 600-GPH ROWPUs, thirty 3,000-gallon onion tanks (90,000 gallons), two 3,000-gallon SMFTs (6,000 gallons), and three FAWPSSs (9,000 gallons). With this equipment, the section can establish one water purification site in each BSA and two sites in the DSA. Each water point will have two 600-GPH ROWPUs. They can produce 24,000 GPD of potable water from fresh water and 16,000 GPD from salt water. This gives the division a total production of 120,000 GPD from fresh water or 80,000 GPD from salt water. Each water point can store 6,000 gallons of potable water in two of the onion tanks and use the third for backwashing and waste removal operations. This gives the division a total storage of 60,000 gallons of potable water. As in the nondivisional QM water supply units, the FAWPSS is used for resupply to isolated units. The SMFTs are used to establish dry water point distribution sites in BSAs and DSAs that do not have a water source.

Airborne divisions. Figure 2-3 depicts the organization for water support in the headquarters and supply company (S&T battalion) of airborne divisions (TOE 42056 L). The water section in airborne divisions has eight 600-GPH ROWPUs (96,000/64,000 GPD), twenty-four 3,000-gallon onion tanks, two 3,000-gallon SMFTs (6,000 gallons), and three FAWPSSs (9,000 gallons). With this equipment, the water section can establish one water purification site in each BSA and one in the DSA. It can also establish several dry water points using the SMFTs and resupply isolated units with the assigned FAWPSSs. The division's daily total is 96,000 GPD of potable water from fresh water and 64,000 GPD from salt water. The division can store 48,000 gallons of potable water. (Eight of the 24 onion tanks are used for brine and backwashing operations.)

Air assault divisions. Figure 2-4 depicts the organization for water support in the headquarters and supply company (S&T battalion) of air assault divisions (TOE 42066 L). The water section of the air assault division has eight 600-GPH ROWPUs (96,000/64,000 GPD), twenty-four 3,000-gallon onion tanks, and three FAWPSSs (9,000 gallons). With this equipment, the division can conduct the same operations as the airborne division with the exception of those involving the SMFT. The SMFT has been dropped from the division's TOE due to airlift requirements and reduced mobility. Therefore, the water section cannot deliver large quantities of water to consumers. Additionally, only the FAWPSS can be used as dry water point distribution centers. This gives the division 96,000 GPD of potable water from fresh water and 64,000 GPD from salt water. It can store 48,000 gallons of potable water. (Eight of the 24 onion tanks are used for brine and backwashing operations.)

Infantry division (light). Figure 2-5 depicts the organization for water support in the headquarters and supply company (S&T battalion) of light infantry divisions (TOE 42026 L). The water section of a light infantry division has six 600-GPH ROWPUs (72,000/48,000 GPD), eighteen 3,000-gallon onion tanks, three 3,000-gallon SMFTs (9,000 gallons), and five FAWPSSs (15,000 gallons). With this equipment, it can establish three water purification points in the BSA. Rear area units must go to a BSA water point or to a corps operated water point for water support. Because of the limited vehicular mobility of the LID, water distribution will be by unit

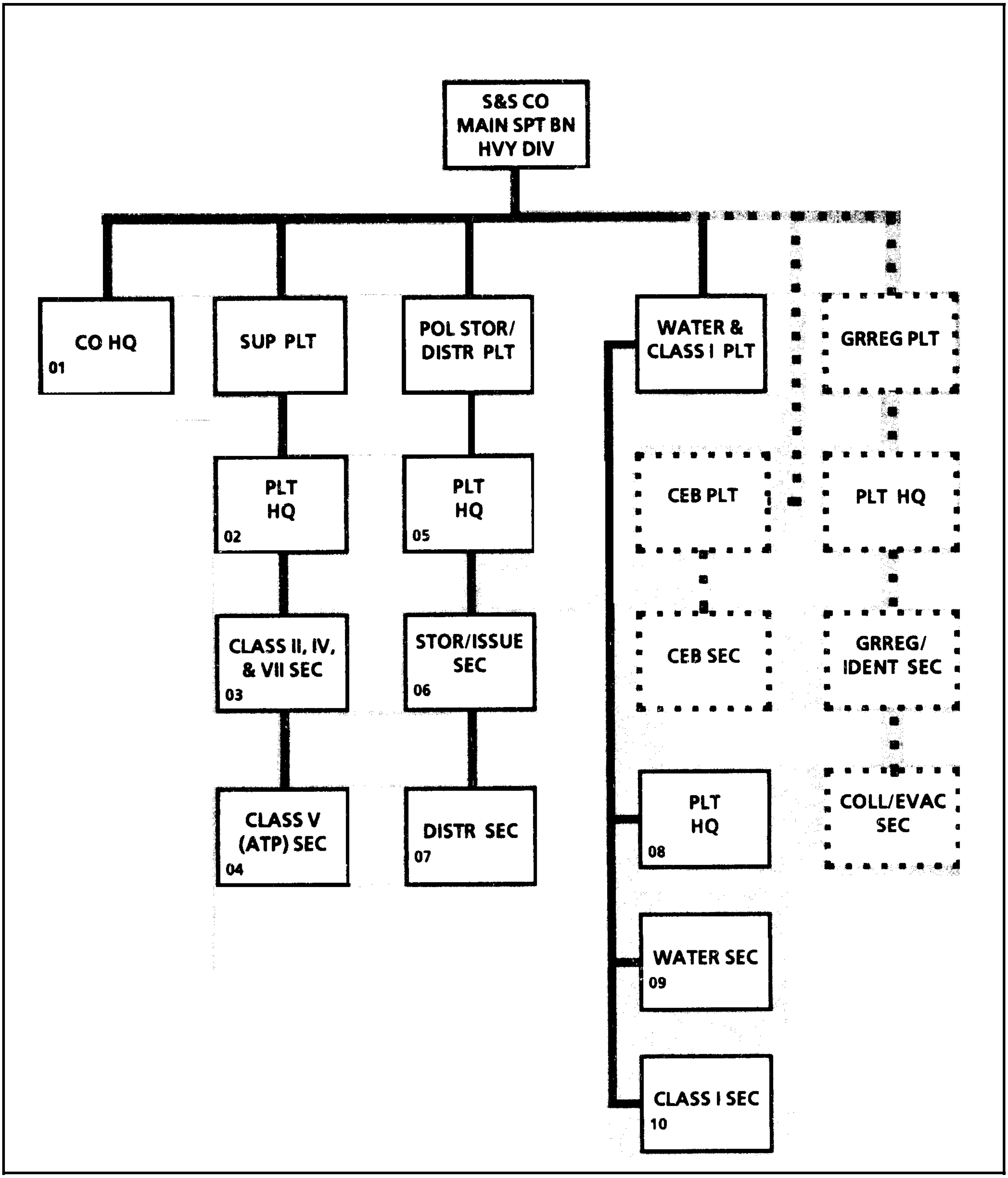


Figure 2-2. S&S company, main support battalion,heavy division (TOE 42007L)

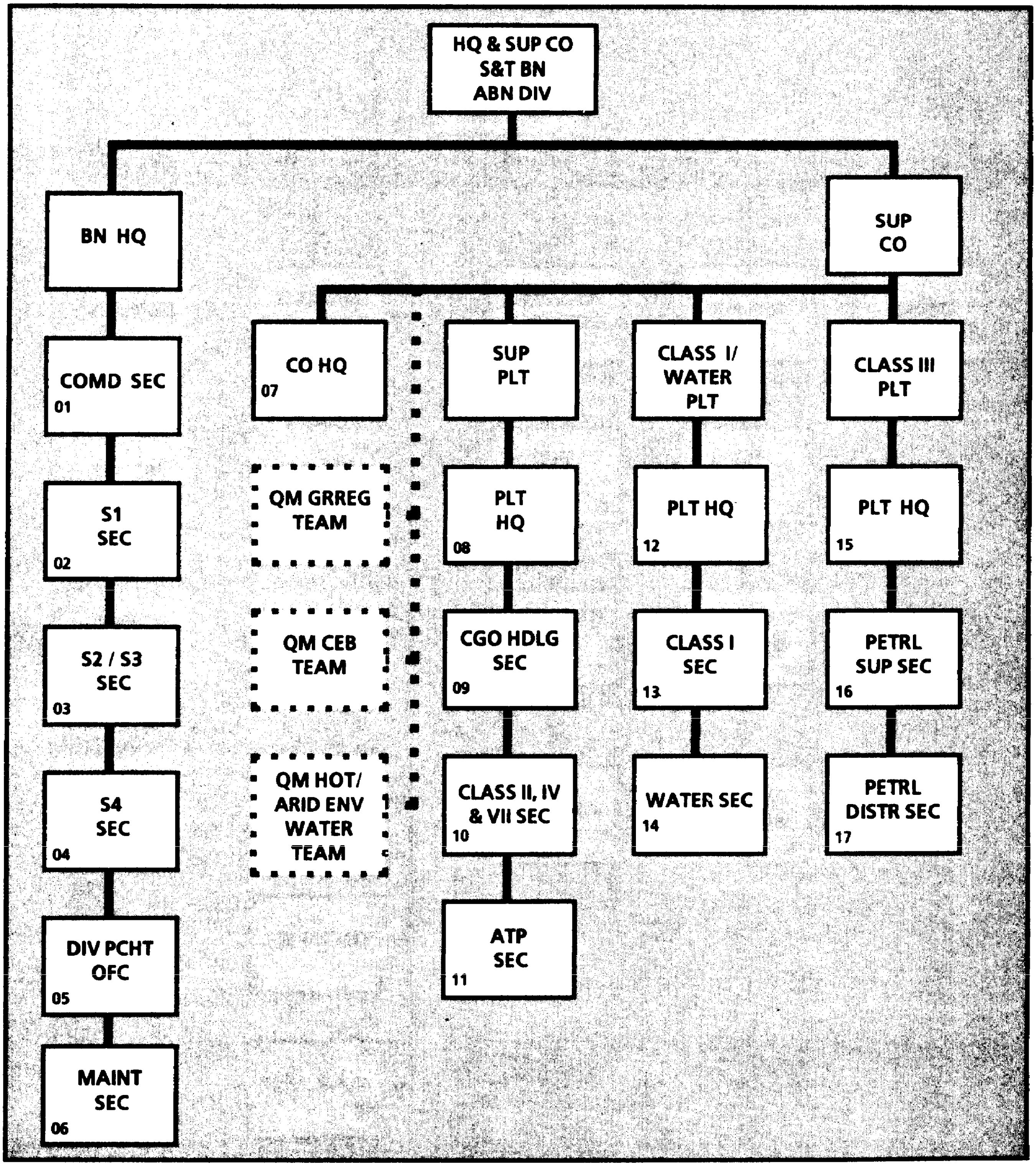


Figure 2-3. Headquarters and supply company, S&T battalion,airborne division (TOE 42056L)

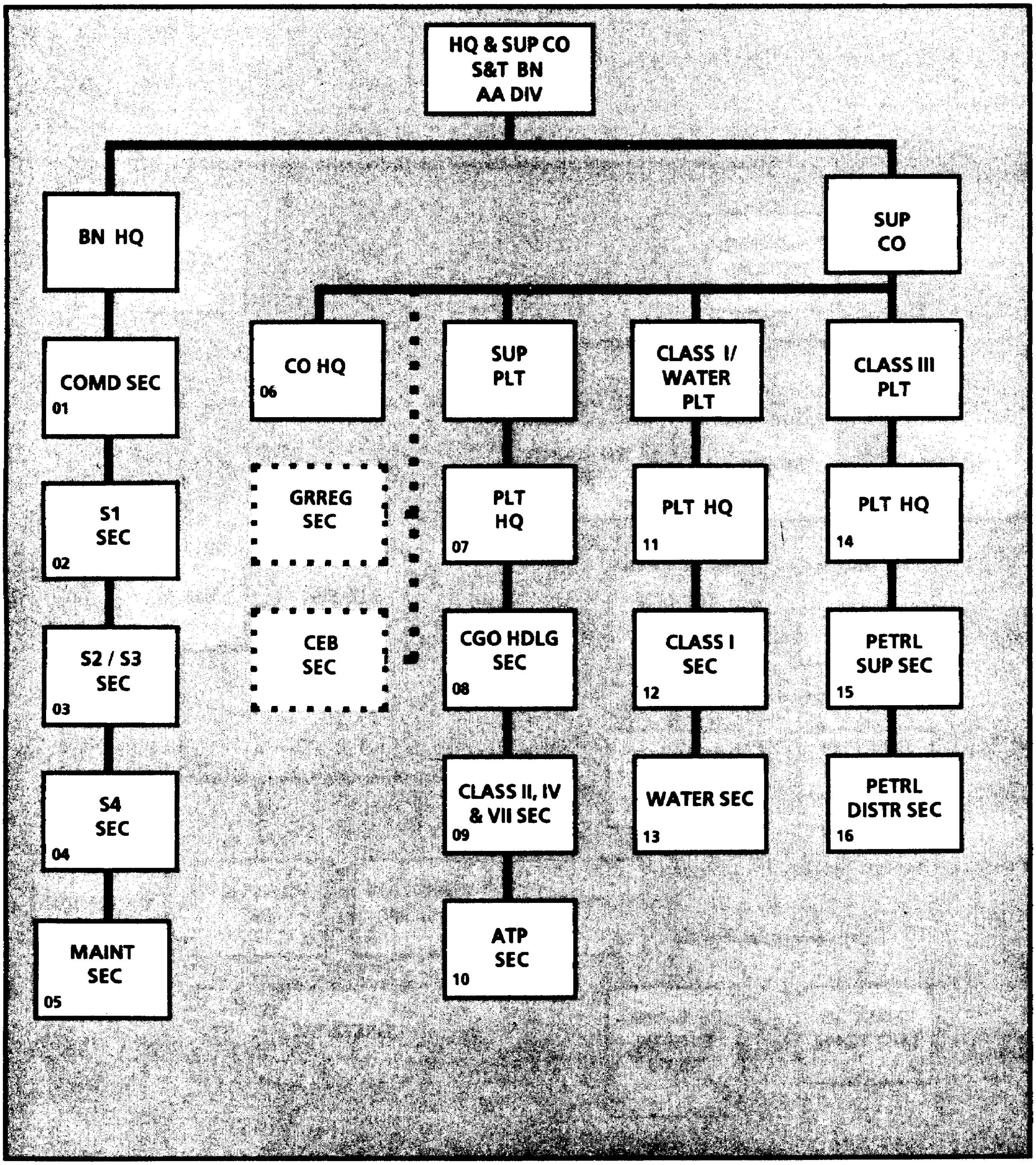


Figure 2-4. Headquarters and supply company, S&T battalion,air assault division (TOE 42066L)

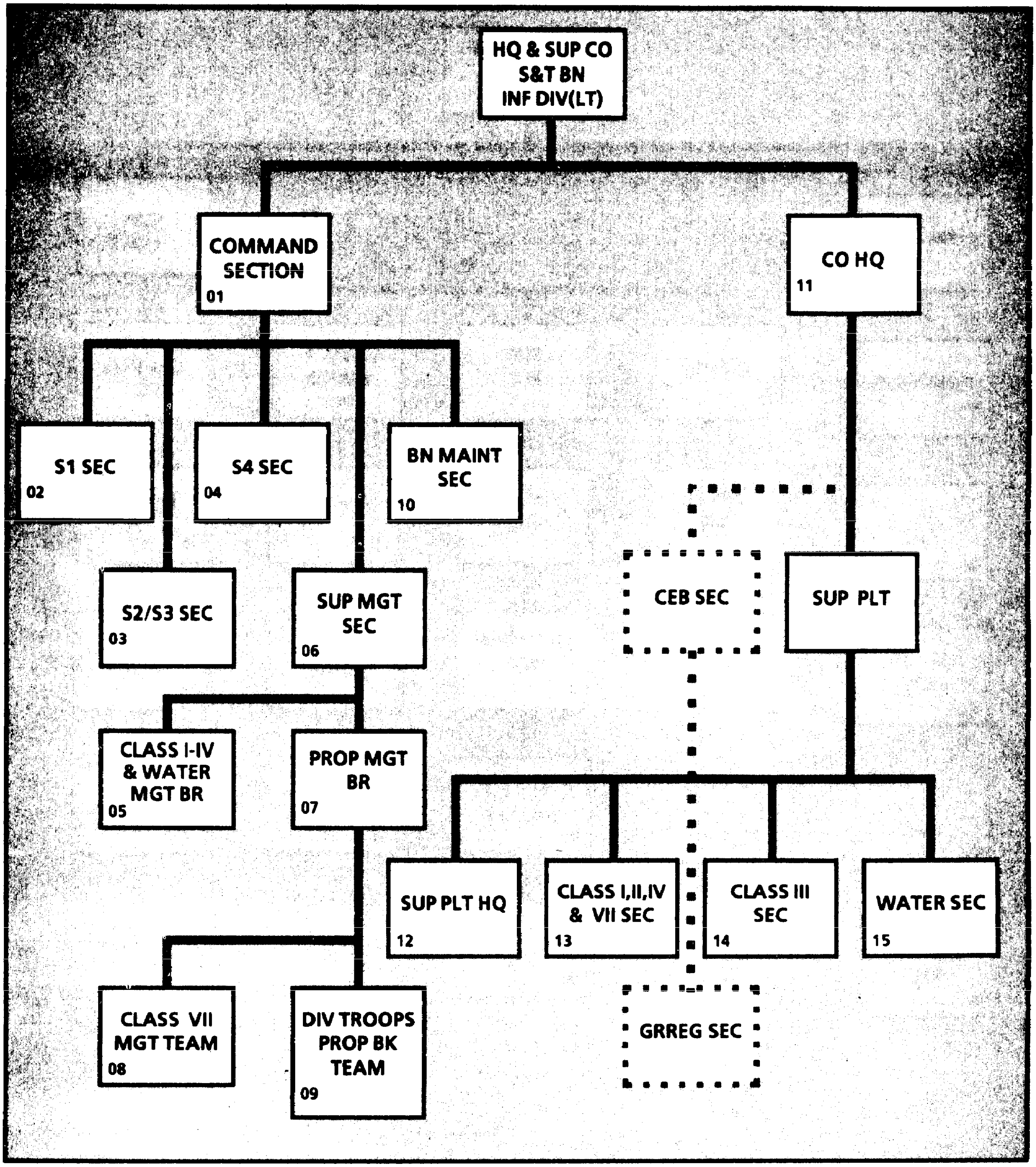


Figure 2-5. Headquarters and supply company, S&T battalion, infantry division (light) (TOE 42026L)

distribution to light infantry battalions. Water will be moved forward from the BSA to these battalions by using five FAWPSSs and the organic ROWPU's 5-ton prime mover. Water will be transferred from the FAWPSS to 160-gallon pillow tanks located in the equipment operated by the battalion supply trains. Units must pick up supplies at battalion distribution points. The water section can produce 72,000 GPD of potable water from fresh water and 48,000 GPD from salt water. It can store 36,000 gallons of potable water. (Six of the 18 onion tanks are used for brine and backwashing operations.) While it does have SMFTs, it has no trucks to move them. It must request transportation assistance.

Armored cavalry regiment. Figure 2-6 depicts the organization for water support in the S&T troop support squadron of ACRs (TOE 42077L). The water section in the support squadron has four 600-GPH ROWPUs (48,000/32,000 GPD), twelve 3,000-gallon onion tanks, and two FAWPSSs (6,000 gallons). With this equipment, it can establish two water purification points that can produce 48,000 GPD of potable water from fresh water and 32,000 GPD from salt water. It can store 24,000 gallons when using eight onion tanks. (Four of the 12 onion tanks are used for brine and backwashing operations.)

Separate brigades. Figure 2-7 depicts the organization for water support in the S&T company, support battalion, of separate heavy brigades (TOE 42084L). The water section in a separate brigade has four 600-GPH ROWPUs (48,000/32,000-GPD), twelve 3,000-gallon onion tanks, two 3,000-gallon SMFTs (6,000 gallons), and two FAWPSSs (6,000 gallons). With this equipment, it can establish two water purification points that can produce 48,000 GPD of potable water from fresh water and 32,000 GPD from salt water. It can store 24,000 gal Ions of potable water using the onion tanks. (Four of the 12 onion tanks are used for brine and backwashing operations.) The SMFTs can be used **to** resupply consumers with no organic transportation and as dry water points. The FAWPSSs can be used to resupply isolated units by air or ground.

In some cases, such as for desert operations, there may be only one water source for the division. It may not be in the DSA. Therefore, its destruction or disruption by threat forces could directly affect operations. This would require the establishment of a GS water supply system. In such a situation, the water supply sections in DSUs will be assigned additional resources (arid operations teams) to operate water storage and distribution systems. These teams can consist of a 300,000-gallon PWS/DS, 40,000-gallon PWS/DSs, and one to eight FAWPSS sets. Purified water will be delivered (by SMFTs) to DSUs from GSUs located in corps and EAC. See Table 2-1 for a listing of equipment and personnel, by TOE, for arid operations teams,

GENERAL SUPPORT WATER SUPPLY

In arid zones where DS water units cannot provide enough water, GSUs provide this capability. Purified water enters the water distribution system from onshore or offshore purification points. Water is stored in collapsible fabric tanks at a base terminal storage facility. It is distributed to other terminals in the TA and forward to the corps area by TWDS. Terminals also provide water support for units nearby on a supply point basis. The petroleum group in the COMMZ and the COSCOM in the corps provide command and control of all GS water assets (see Figure 2-8). These assets include a water supply battalion, water supply companies, tactical water distribution teams, water purification teams and detachments, a water purification barge team, and transportation medium truck companies. These organizations/assets are described in more detail below.

QM HHD, Water Supply Battalion

The QM HHD of the water supply battalion (see Figure 2-9) provides command, administrative, technical, and operational supervision of two to five assigned or attached water supply companies, truck companies, water purification teams and detachments, and tactical water distribution teams. The number of teams and detachments will be determined by the tactical situation. The HHD, normally located in the TA, depends on other units for support. Some operations may require elements of the battalion to function in the divisional DS area as well as the corps GS area. During the build up of a theater, POL supply, POL pipeline, QM S&S battalions, or other logistical HQ may provide command and control of water supply units prior to establishment of a water supply battalion.

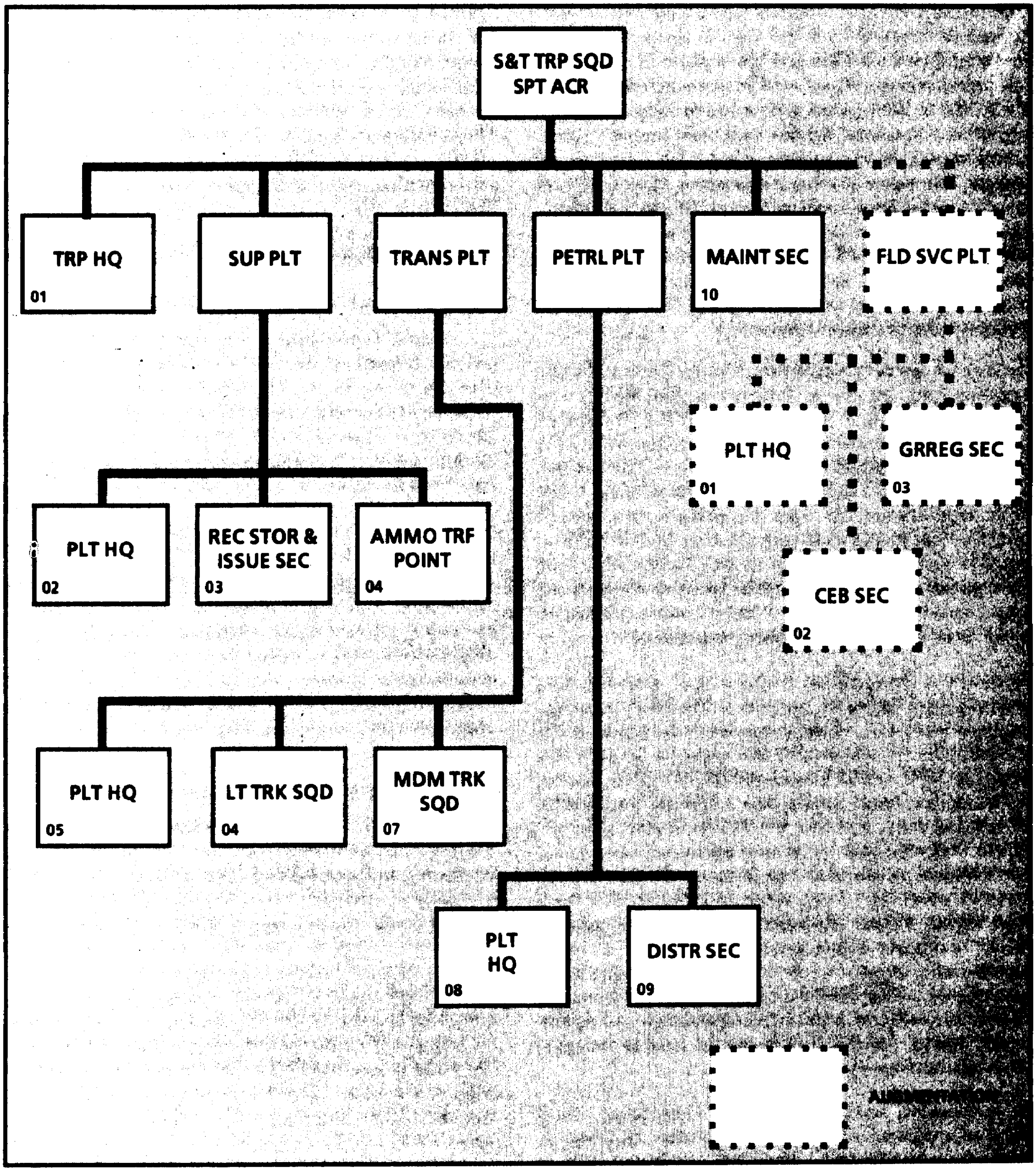


Figure 2-6. S&T troop support squadron, ACR (TOE 42077L)

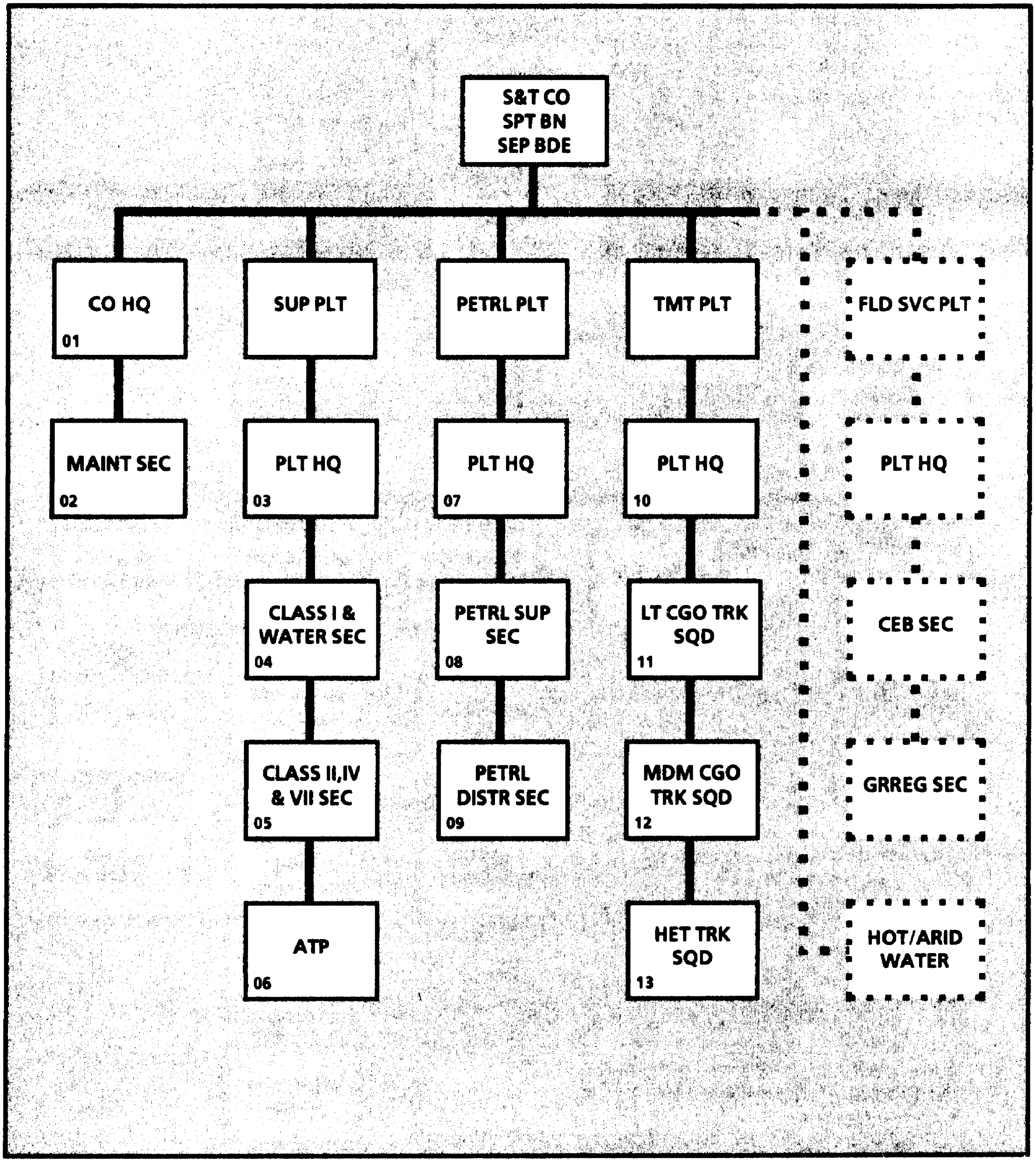


Figure 2-7. S&T company, support battalion, separate brigade (TOE 42084L)

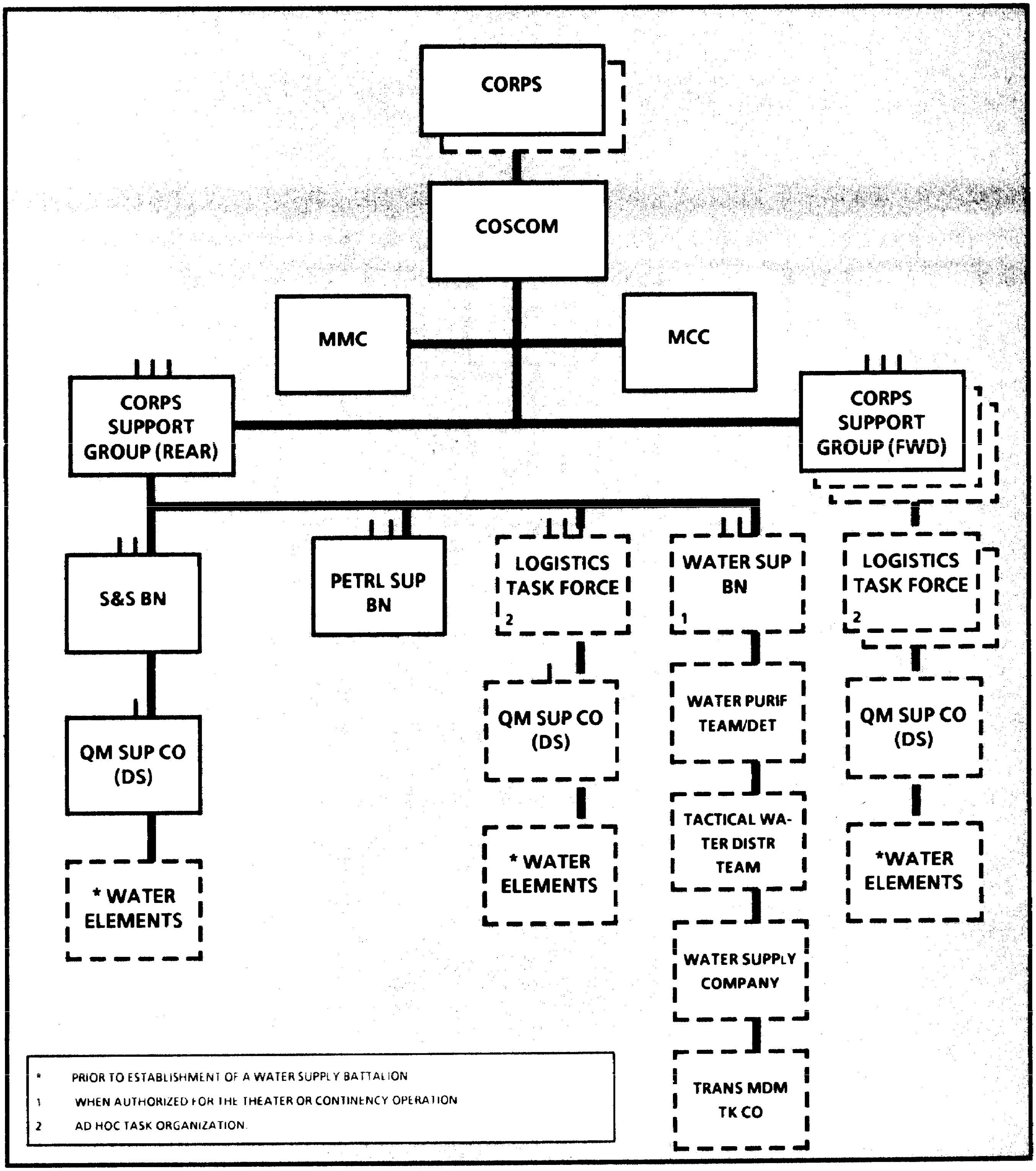


Figure 2-8. Corps water supply structure

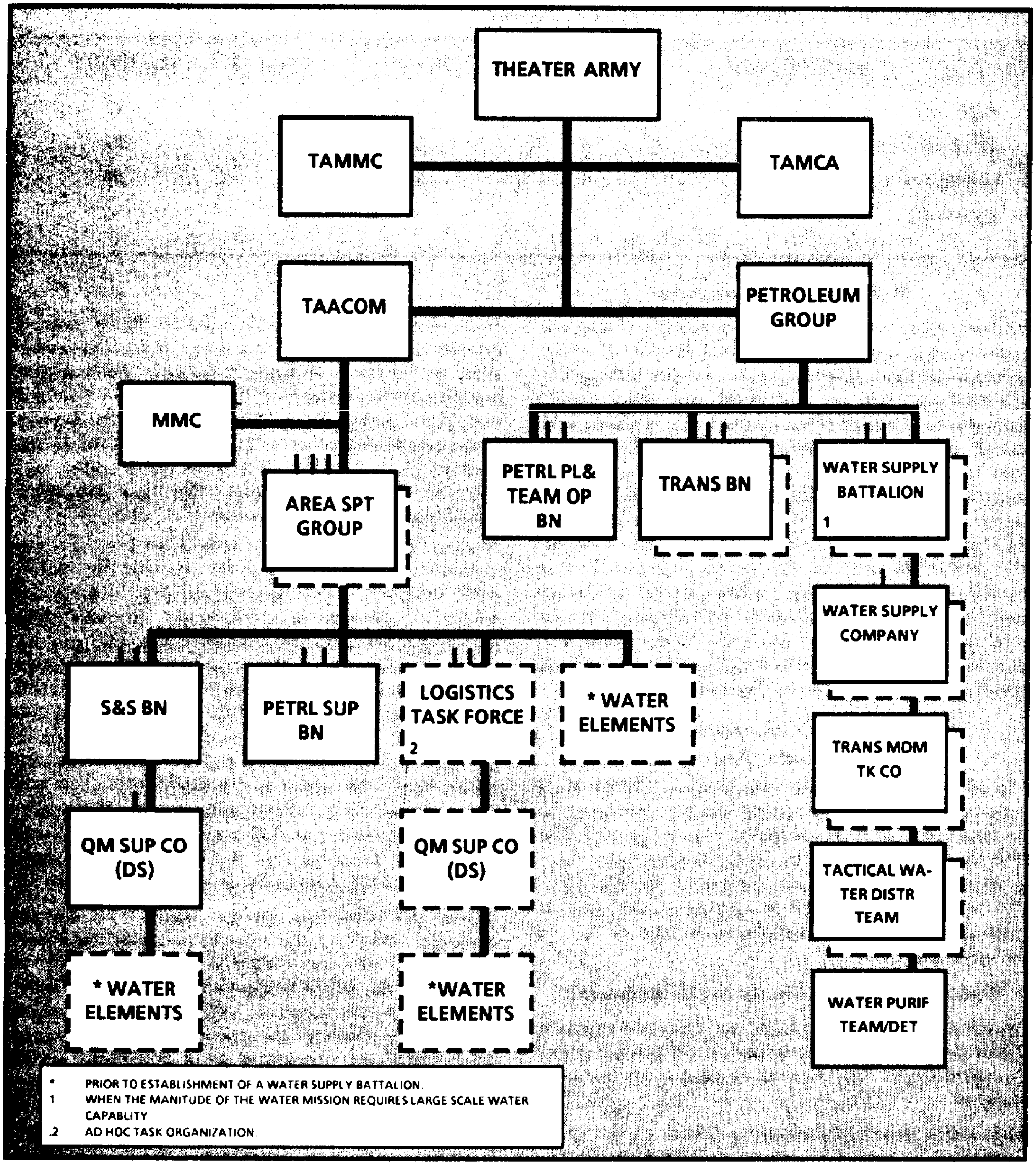


Figure 2-9. Theater army water supply structure.

Table 2-1. Equipment and personnel for arid operations teams

TOE	300K PWS/DS	40K PWS/DS	FAWPSS	OFFICER	ENLISTED
42507LC	1	3	8	1	21
42526LC		6	8	1	32
42556LF		6	8	0	26
42577LC		1	2	0	1

Water Supply Companies

Water supply companies (see Figure 2-10) operate bulk storage and distribution facilities for GS water operations. Each company has two 800,000-gallon PWS/DS with two organic TWDS each. Each TWDS comes with 10 miles of 6-inch hose line, six 600-GPM water pumps, two 20,000-gallon collapsible tanks, and two hypochlorinators. A company can be augmented with up to six TWDS teams, giving it 80 miles of hose line. The 800,000-gallon PWS/DS consists of sixteen 50,000-gallon collapsible tanks. The PWS/DSs and TWDSs can be deployed in any configuration, depending on the tactical situation and the commander's desires. The largest storage and distribution system the water supply company operates is the 1.6 million-gallon base terminal (thirty-two 50,000-gallon collapsible tanks).

QM Tactical Water Distribution (Hose Line) Teams

These teams lay, operate, and retrieve TWDS. They normally augment a water supply company to supplement its GS water distribution capability. The TWDS consists of quick-laying water hose line, pumps, and fittings. It can pump up to 600,000 GPD. The system is packaged in sections; each section contains all items of equipment needed to lay 10 miles of hose line.

Water Purification Teams and Detachments

Water purification teams and detachments augment DS water systems and produce all GS potable water in the theater. They depend on other units for basic support.

QM water purification teams. These teams (TOE 1057LC) operate the tactical 3,000-GPH ROWPU. They are deployed in the corps area to augment corps-level DS purification units. They can be grouped together to meet increased production needs, such as for large storage terminals. Each water purification team has four 3,000-GPH ROWPUs and forty 3,000-gallon onion tanks. With this equipment, it can establish four water purification points. It can produce up to 240,000 GPD from fresh water and 160,000 GPD from salt water. The team can store 120,000 gallons of potable water.

Water purification detachments. These detachments (see Figure 2-11) operate the 3,000-GPH ROWPU. They operate on any large water source and are near base terminals. However, they may be located in the division area, depending on the tactical situation. Each water purification detachment has ten 3,000-GPH ROWPUs and 100 3,000-gallon onion tanks. With this equipment, the detachment can establish five water purification points. It can produce up to 600,000 GPD of potable water from fresh water and 400,000 GPD from salt water. It can store 300,000 gallons of potable water. It cannot deliver treated water to other storage facilities in the corps area or COMMZ, but depends on medium truck companies or a TWDS to do this.

Water purification barge team. The barge-mounted ROWPU system is used to purify sea water. It consists of two ROWPUs, each capable of producing 150,000 GPD of potable water from a fresh water source. The barge (an M231A offshore floating platform) is towed to an anchorage by a powered watercraft and connected to a shoreside water storage facility. It can operate at full capacity through a hose line to shore terminals from up to 2,000 feet away, at up to sea state 3. The barge is run by water purification detachments assigned to either a water supply company or a water supply battalion.

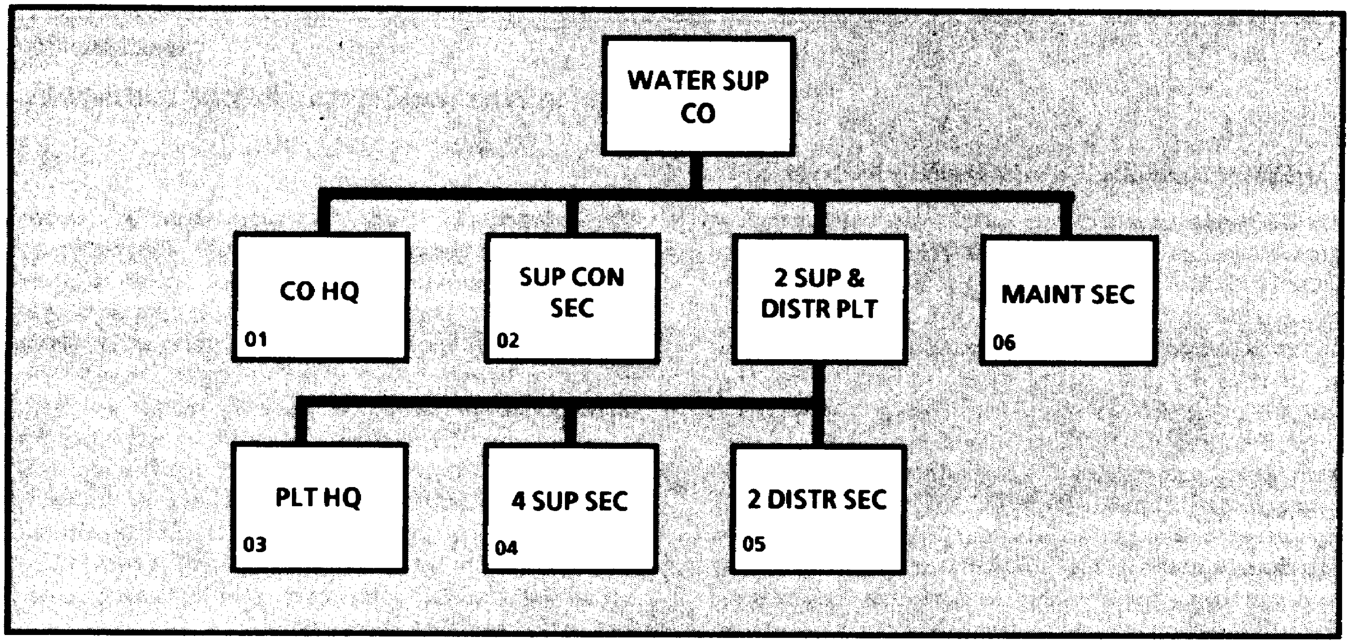


Figure 2-10. Water supply company (TOE 10468L)

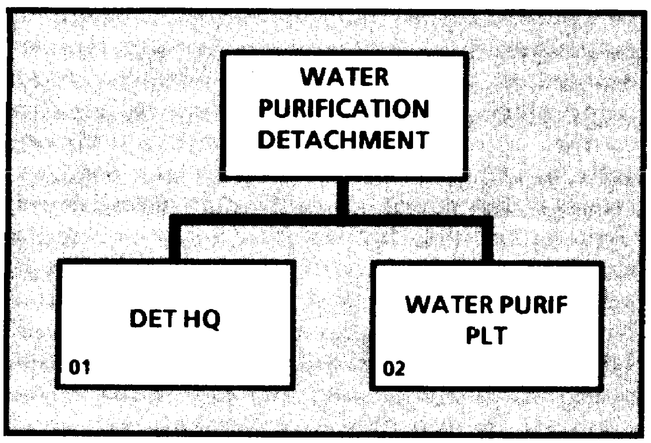


Figure 2-11. Water purification detachment (TOE 10469L)

These water units are part of the GS supply operations. Currently, there are three ROWPU barges with one additional barge proposed. The operational plan is to pre-position two barges at classified locations in southwest Asia. When forces deploy on contingency operations, trained teams (TOE 10570LA) will deploy to activate and operate the barges. The number of barges activated and their locations will depend on the situation and the commanders tactical plans. The barge is anchored at four points and is not self-propelled. lt has sufficient on-board equipment to purify 225,000 GPD of sea water and store 15,000 gallons in its on-board, internal holding tanks. The barge has a 2,500 foot, on-board ship-to-shore hose line that is used to discharge water to on shore storage and distribution systems.

Transportation medium truck companies. Transportation medium truck companies (TOEs 55727L and 55728L) are issued SMFTs to perform the line-haul mission. This mission is required early in theater development. It is the primary means of distribution pending the emplacement of base terminals, tank farms, and TWDSs. SMFTs come in two sizes--3,000 and 4,570 gallons. (The 4,570-gallon SMFT is issued only in arid environments.) The transportation medium truck company (TOE 55727L) uses the M-872, 34-ton semitrailer to line-haul potable water in the 4,570-gallon SMFT to units in the corps and EAC. The medium truck company (TOE 55728L) uses the M-871, 22-ton semitrailer to line-haul potable water in the 3,000-gallon SMFT to division and brigade support areas from the PWS/DS in the corps support area.

Section III

Operations in Arid and Nonarid Environments

OPERATIONS IN AN ARID ENVIRONMENT

TA water purification teams and detachments operate onshore and offshore ROWPUs and introduce water into the PWS/DS located on shore. Water supply companies then distribute the water forward to the corps using the TWDS. Lateral movement of water in the TA and corps areas is done using the SMFTs or the TWDS hose line. Water reaching the corps rear area PWS/DS is loaded into SMFTs of medium truck companies and moved forward into the divisional and brigade PWS/DS. No hose line is laid forward of the corps. Additionally, SMFTs are used to distribute water in the COMMZ and corps rear area to major consumers with no organic transportation. The DS divisional water sections, having no local water source, cannot produce water until engineer units drill wells. Therefore, these units are augmented with a PWS/DS. The medium truck companies use their SMFTs to deliver water from the corps rear PWS/DS into the division 300,000-gallon PWS/DS and the brigade 40,000-gallon PWS/DS. The divisional units will still have their SMFTs and FAWPSS to distribute water as required, as well as the FAWPSSs that are part of the arid augmentation packet for DSUs.

Water supply points are established as far forward as possible, considering the location of water sources, the location of consuming units, and commanders' tactical plans. The most forward point is located in the BSA. Supported units draw water from supply points using organic transportation, except for the LIB where unit distribution procedures apply.

Water support operations in an undeveloped arid theater occurs in three phases. These phases are described below.

Deployment Phase

The deployment phase may start as an airborne, airmobile, or amphibious assault or as an uncontested debarkation at a friendly port. The first elements entering the AO may be combat forces with little CSS. These forces will carry only sufficient quantities of water for immediate survival purposes. They will use canteens, 5-gallon cans, and other CTA equipment. Resupply must thus be rapid. Resupply will be by tactical aircraft. Allocations of air support must consider these water supply requirements. During this phase, prepackaged potable water will be provided primarily from offshore or nearby third country support bases. The nonexpendable equipment used for aerial resupply (such as the FAWPSS) must be continuously recovered and reused. Commanders must exploit all water sources while keeping the impact on the local population to a minimum. As a field expedient, bottled water may be purchased from local authorities, but only after prior certification by Army preventive medicine personnel.

Lodgement Phase

The arrival of follow-on forces in the AO will increase the requirements for water beyond the capability to continue resupply by air, except for the most forward-deployed or isolated units. An in-country water supply system will be established near the seashore or other major water source. CSS units will initially arrive by air with later arrivals by sea. Engineer elements will provide ground water detection and begin well drilling. GS CSS units, specially designed for arid operations, will provide large scale purification, storage, and distribution of water. Combat units entering the AO during this phase will bring 400-gallon water trailers, collapsible fabric drums, small cooling units, and other water-related material. To ease the requirements for aerial resupply of combat forces and to allow commanders to use aircraft for other priorities, DISCOMs will exploit any source of surface water in their AO using organic 600-GPH ROWPUs. To ensure that forward operating bases receive adequate water until fully operational supply routes can be established, it may be necessary to use the combined efforts of fixed-wing aircraft and helicopters for water delivery.

Buildup Phase

Once the lodgement area is established, expansion of the logistics base begins. Additional water units will arrive, and hose line distribution systems will be expanded. Bulk water will be introduced via LOTS and the barge-mounted ROWPU. Barge operations will include deploying and maintaining the 2,500-foot, ship-to-shore water delivery system; purifying sea water; and delivering water to a beach-based water storage system. The barge will be operated by barge-mounted ROWPU teams. The onshore water storage and distribution systems will be operated by QM water supply companies. Water can then be moved from the PWS/DS by TWDS and transportation medium truck companies equipped with SMFTs. Development of well sites and local sources will be pursued. Aerial support of isolated task forces with no ground LOC will be maintained. Stocks will be developed so that one DOS is maintained at each echelon.

OPERATIONS IN A NONARID ENVIRONMENT

There are three distinct nonarid environments or regions--temperate, tropical, and arctic. Planning considerations are discussed in detail below.

Temperate Regions

Temperate regions have seasonal variations. Some regions in winter can have near arctic conditions. Other regions in summer can have high temperatures and humidity that resemble tropical or arid environments. Water supply planners must consider any seasonal variations which may increase or decrease water requirements. Requirement factors for all environmental regions are provided in Appendix B. Seasonal variations in temperate regions can have a great impact on where water supply points are located. In spring and fall, heavy rains may flood streams and rivers. In summer, a lack of rain may reduce the size of streams and rivers to where they cannot provide sufficient flow for purification operations. These factors require water supply unit leaders to maintain close coordination with the S2 meteorology section and to conduct good aerial and ground reconnaissance for siting water supply points.

Tropical Regions

Water sources in tropical regions are often contaminated with waterborne diseases and parasites due to poor hygiene and sanitary practices by the local people. Preventive medicine units should be deployed early in the TPFDL to detect these organisms. Disinfection and filtration of raw water may be required for bath and laundry operations. As a result, water purification operations and additional water storage tanks may need to be provided to purify and disinfect the raw water. If purification equipment is unavailable, plans should provide for the use of SMFTs to supply water to these units or for collocating these units with the water supply point, In tropical regions, poor ground LOC may inhibit water distribution by truck and place greater reliance on aerial resupply. In areas with developed river networks, water may be distributed by collapsible fabric tanks or drums carried on boats or barges.

Arctic Regions

Water supply points in arctic regions must be augmented with equipment to prevent or retard freezing. Such equipment includes shelters, heaters, ice augurs, and arctic camouflage nets. Water sources in such areas will pose unusual problems. These problems include increased freezing depths of ice due to source exploitation, difficulty in driving grounding rods through frozen ground, and reduced ground mobility resulting from the spring thaw. When heaters are used to prevent equipment from freezing, equipment should be placed on timbers or pallets to ensure the snow or ice does not thaw and refreeze, thereby trapping the equipment. Precautions must be taken to prevent ROWPU equipment from freezing during movement.

Establishment of water support operations in the undeveloped nonarid theater is described below. Water support operations will be developed in phases.

Deployment Phase

The first elements entering the AO are usually combat forces with little CSS. These forces will carry only a sufficient amount of water for immediate survival purposes. They will use canteens, 5-gallon cans, and collapsible drums. Commanders must exploit all water sources while keeping the impact on the local population to a minimum. Although units may be able to meet some of their requirements, resupply must be rapid. Since resupply may be by tactical aircraft, allocations of air support must consider water supply requirements. During this phase, prepackaged potable water will be provided by offshore or nearby third country support bases. The nonexpendable collapsible fabric drums (including the FAWPSS) used for aerial resupply must be continuously recovered and reused.

Lodgement Phase

The arrival of follow-on forces in the AO will increase the requirements for water beyond the capability to continue resupply by air. DS water units will begin operations in the BSA and the DSA. ACRs and separate brigades set up their own equipment in their operating areas. Most forces in the AO will pick up water from water points using organic 400-gallon water trailers or collapsible fabric drums. However, isolated units may continue to be resupplied by FAWPSS, which may be filled in the BSA or DSA and airlifted to the unit. Limited transport to establish dry water distribution points using SMFTs may be provided.

Buildup Phase

Once the lodgement area is established, expansion of the logistics base begins. Corps units brought into the AO are supplied by nondivisional QM supply companies. As in the lodgement phase, most units will pick up water from the water supply point. Deliveries to major users, such as hospitals, would commence using the 3000-gallon SMFT.

Section IV
Unit Distribution Operations

HISTORICAL BACKGROUND

The critical link in water supply operations is internal unit distribution within consuming units. If this link fails, the soldier is denied adequate quantities of water. His health and combat effectiveness and the success of the mission are thus jeopardized.

Historically, each company-size unit was assigned a mess section. Each section was equipped with a 400-gallon water trailer. It was sufficient for food preparation, drinking, and personal hygiene. Traditionally, units looked to the company mess as the source of potable water for the soldiers. The mess section would pick up water from the water point, and at the same time, receive rations from the Class I distribution point. The implementation of the AFFS has changed this approach to unit water resupply operations.

With the advent of the AFFS, mess sections have been consolidated at the battalion level and have almost eliminated unit level Field Feeding at divisions, ACRs, and separate brigades. The fielding of the MKT and T Rations has increased the feeding capability for each mess team. This has increased the water requirements for mess operations.

RESPONSIBILITIES

Mess section feeding teams, companies, and dispersed units have individual responsibilities for the use and distribution of water supplies. These responsibilities are discussed below.

Field Feeding Teams

The field feeding teams of the mess section must ensure that they have sufficient water to support the current ration policy of two hot meals and one MRE per day. The teams will obtain water from the water point using the organic distribution equipment assigned to them. This water will be used for food preparation, sanitation, and beverages. It will not be used for filling canteens, personnel hygiene, or other water needs. Each team's truck will make daily trips to the Class I point for resupply of rations. The truck will also haul the 400-gallon water trailer for filling at the water point. Additional trips to the water point will be made if necessary or at the discretion of the section sergeant.

Companies

Each company (less light infantry companies) will use its organic water distribution equipment to obtain water from the approved water point and distribute it in the company. There is no single vehicle used solely for water transport. When water is required, the company dispatches any available prime mover with the 400-gallon water trailer or 250-gallon collapsible drums to the water point. The full water containers are returned to the AO. Based on the tactical situation, the commander may maintain the containers with the individual unit or leave them in the battalion trains. In the latter case, water will be brought forward with the LOGPAC during routine resupply operations. Units will establish a water point in the company area for filling canteens and 5-gallon cans. Where there is increased water consumption, additional resupply of water may be required independently of the LOGPAC resupply. Where a unit cannot return to the water point due to the tactical situation, it is the commander's responsibility to request emergency resupply. This resupply will then be accomplished by other divisional vehicles or aircraft. In addition to the organic distribution equipment that is authorized by unit MTOE, supplemental equipment is available through CTA.

Light Infantry Companies

The light infantry battalions and companies do not have enough vehicles to use a supply point distribution of water. QM water purification personnel will provide unit deliveries to the LIB combat trains using the FAWPSS. The water is delivered to the combat trains and transferred to 160-gallon lightweight collapsible pillow tanks. It is then taken to the battalion distribution point and put into 5-gallon cans and 5-quart collapsible water carriers. These containers will then be transported to the company and platoon locations by the organic HMMWVs of the LIB during routine resupply operations. The water will normally be taken forward as part of the LOGPAC. It may be necessary to make additional resupply trips when water consumption increases. When the water is delivered to the company and platoon locations, the soldiers will fill their canteens from the 160-gallon pillow tanks. Squad members may pick up water for their squads using the 5-quart collapsible water carriers. This unit distribution of water is provided ONLY to the LIB. All other elements in the light infantry division will use supply point distribution.

Dispersed Units

Some units operate remotely from their parent organization. Examples of these units are military police teams, signal nodes, and maintenance teams. These units will carry 5-gallon cans and 5-quart collapsible water carriers when they deploy. They will resupply by visiting the local water point of other company-size units nearby or by aerial resupply. If the unit is operating independently and no other unit is nearby, water may have to be obtained by local foraging. When this occurs, the water must be purified and disinfected.

WATER DISTRIBUTION EQUIPMENT

Each unit will have sufficient organic distribution equipment authorized by unit MTOE to use supply point distribution. This equipment will have enough capacity to supply the minimum requirements for water in a temperate region while making only one resupply trip to the water point per day. When the tactical situation allows, additional water can be obtained by making multiple trips to the water point. Brief descriptions of the various pieces of distribution equipment and their basis of issue are provided below.

400-Gallon Water Trailer

The 400-gallon water trailer is the optimum method of internal water distribution depending upon the quantity required, the size of the unit, and the availability of a prime mover. The primary disadvantage is the loaded weight of 5,600 pounds. This weight requires a prime mover of at least 2 1/2 tons or larger. The trailer is authorized under AR 71-13 as a TOE item of equipment. It will be issued to each team in the mess sections and to companies, detachments, or teams having 100 personnel and available prime mover. Collapsible drums or pillow tanks will be used if detachments or units are without a prime mover.

250-Gallon Collapsible Drum

The 250-gallon collapsible drum can be transported in 1 l/4-ton vehicles or trailers. It can also be delivered by sling load, airdrop, or LAPES. It comes with a towing kit which allows it to be towed short distances over relatively flat terrain. The drum is authorized under AR 71-13. It is authorized for companies, teams, and detachments of 100 personnel when they are not authorized a 400-gallon water trailer.

160-Gallon Pillow Tank

The 160-gallon pillow tank weighs less than 1,500 pounds when full. It will fit in the HMMWV or 3/4-ton trailer. It can be ground mounted for distribution operations. The tank is authorized under AR 71-13. It is issued on a basis five per LIB. It is available (as a CTA item) to other units as supplemental distribution equipment.

55-Gallon Collapsible Drum

The 55-gallon collapsible drum can be transported in any Army vehicle. It weighs 470 pounds when full. It can be delivered by sling load, airdrop, or LAPES. It is authorized under CTA 60-909. The drum (on a basis of three per unit) provides supplemental distribution equipment to companies, teams, and detachments operating in tropical and arid regions. It is also authorized to each air assault division, and field artillery battalion.

5-Gallon Water Can

The 5-gallon water can is authorized under CTA 50-970 on a basis of one per five individuals. The can weighs approximately 42 pounds when full.

5-Quart Collapsible Water Carrier

The 5-quart collapsible water carrier is authorized under CTA 50-970 on a basis of eight per infantry squad. this container holds 5 quarts of water. When empty, it folds to pocket size. It is used to resupply the rifle squads on a direct exchange basis. When water is delivered to the unit location, a squad member will return empty containers and exchange them for a full one. He will then return them to the squad.

AERIAL RESUPPLY

Water weighs 8.34 pounds per gallon. This weight and the limited number of aircraft available for resupply operations make aerial resupply of water unreasonable on a routine basis. Water can be aerial resupplied with the FAWPSS 250-gallon or 55-gallon collapsible drum. This resupply effort is only performed during emergency conditions or in the early stages of deployment. When sling load support is required, the supported unit must coordinate with both the water section and the supporting aviation elements of the parent division. Airdrop support may be required from the corps airdrop supply company when helicopters are not available or their use is not practical.

FORAGING

Conditions may arise when units will be operating remotely without land LOC and where aerial resupply of water is not available. Personnel may be required to forage water from streams, lakes, or other unapproved water sources. In these cases, individual purification and disinfection is important. The commander must ensure that soldiers use iodinetablets. The unit field sanitation team should monitor this.

PLANNING CONSIDERATIONS

Getting water to the soldier in the individual fighting position is the critical link in water distribution operations. If this link fails, it does not matter what the condition of the purification, storage, and distribution assets are at brigade, division, corps, or echelons above corps. Each unit commander must use the planning factors given in this manual to determine what the daily water requirements are. This daily requirement must then be compared with the capability of the unit's organic equipment available for water distribution operations. If a significant shortage exists or a commander desires additional flexibility, he must program resources and procure the necessary items from the CTA. Throughout military history, the vast majority of casualties in war have been from disease and nonbattle injury. This loss of manpower can be drastically reduced by ensuring that soldiers have adequate supplies of potable water.

CHAPTER 3

WATER SUPPLY PLANNING

WATER REQUIREMENTS

Planning for water support begins with determining the amount of water required. This will depend upon the battlefield environment, the expected time of hostilities, and the size of the force. Water requirements are flexible. Some may be denied indefinitely and some for several weeks. Some are always essential.

WATER CONSUMPTION REQUIREMENTS

A number of water consumption requirements are directly related to the number of people in the force structure. These are described below.

Drinking

Drinking water must be potable. The amount needed depends on the climate, intensity of work, and type of battlefield. Since the water reserve of the body is small, soldiers must replace water as it is lost.

Heat Treatment

Water needed for heat treatment includes ice or cold water to reduce the body temperature quickly of a heatstroke patient. It should be potable. However, in an emergency, use any available water. Heatstroke affects about one of every 1,000 soldiers in arid and tropical zones. The water needed for heat treatment is small in temperate and arctic zones. Wearing MOPP for long periods will increase heat treatment requirements.

Personal Hygiene

These requirements include water for shaving, brushing teeth, and washing. This water first be potable. Daily shaving is needed since the protective mask does not fit properly over a beard. Since showers are scheduled only once a week, daily sponge baths are necessary. Teeth usually are brushed after each meal.

Centralized Hygiene

These requirements include water used in showers. Potability is not mandatory, but treated water may be required by local medical personnel. The Surgeon General recommends showering at least weekly regardless of location, season, or level of combat activity.

Food Preparation

Use potable water to prepare food, sanitize kitchen utensils, and clean individual mess equipment. To reduce water requirements, use disposable eating utensils with B-Rations or use MREs frequently.

Laundering

Laundering is done at the rear of the division. Climatic conditions and troop health set the requirement. Under normal conditions laundering may be done weekly. Base laundry water requirements on one change of clothing per man per week. Potable water is not required. Develop hospital laundry requirements separately.

Medical Staff

Division medical personnel use water for wash down of ambulance interiors and litters, patient cleanup, and instrument and medical personnel washing. Use only potable water for medical use.

Some water consumption requirements are not directly related to numbers of people. The work load or the number of equipment items sets the requirements described below.

Hospital Medical Treatment

These requirements include water uses common to medical facilities in EAD. Not included are staff requirements common to all personnel in the theater. Only potable water is recommended due to the increased susceptibility of patients to infections. Water use by medical facilities depends on the number of each type of facility in the theater of operations and the number of casualties treated. Hospital requirements include water used in the laundering of linens, gowns, towels, and other medically related articles.

NBC Decontamination

These requirements include water for decontaminating personnel and equipment. The water needed depends on the frequency, intensity, and location of enemy attacks. Currently recommended are 12.4 gallons for biological or radiological decontamination of an individual, 100 gallons for hasty equipment decontamination, and 450 gallons for deliberate decontamination of a major end item. Water for NBC decontamination does not have to be potable. Showering is not normally required for chemical decontamination. However, water to decontaminate personnel must meet the standards that local medical personnel set for shower water.

Vehicle Maintenance

These requirements include water to replace vehicle coolant. For the best estimate, find out the number of vehicles and the radiator capacity of each. If only the number of vehicles with radiators is known, use a factor of 0.5 gallons per vehicle per day in temperate, tropical, and arctic zones. Use a factor of 1 gallon per vehicle per day in an arid zone. If the number of vehicles is unknown, use 0.2 gallons per man per day as an estimate in all zones. This water does not need to be potable.

GRREG

These requirements include water to prepare remains for processing and shipment and to clean up vehicles and GRREG personnel. The water required ranges from 6 gallons per KIA for temporary burial in the division area to 50 gallons per KIA for full mortuary services. This water does not need to be potable.

Engineer Construction

These requirements include water for road and airfield construction, quarry operations, asphalt plant operations, well drilling, pipeline testing, and concrete construction. Such water does not need to be potable. However, water with high salt content may cause long-term corrosion and reduce the strength of concrete. Water requirements for engineer construction cannot be computed on a per man per day basis due to construction variables in various theaters. Since nonpotable water consumption must be estimated in an arid zone, use 0.5 gallons per man per day as a factor at the division level. Use 1.5 gallons per man per clay at the corps level and above.

Aircraft Washing

These requirements include water for washing turbines and for flight operations. Potable water is not required, but salt content must be extremely low. Because the numbers and types of aircraft in units vary, these requirements do not lend themselves to a per man per day planning factor. For a realistic estimate, find out the total number of aircraft engines and the number of aircraft with and without APUs. In nonarid environments, aircraft washing requires 5 gallons per engine per day. Arid environments require 10 gallons per engine and an additional 5 gallons for aircraft with on-board APU. However, since nonpotable water consumption must be estimated in an arid zone, use 0.2 gallons per man per day where aircraft density is unknown. This estimate is based on total Army aircraft densities.

Water consumption also depends on the zone of operation. In temperate, arctic, and tropical zones, water sources are normally abundant. These include lakes, ponds, streams, rivers, and wells. Convenient water sources are easy to locate and develop. Since nonpotable water is abundant in these zones, consumption estimates only deal with potable water requirements. In arid zones, water sources are so sparse that water must be purified at coastal areas and sent to the point of use. To preclude two separate water systems in arid regions, requirements for both potable and nonpotable water will be met with potable water. Total potable water requirements will thus increase. In all zones, 10 percent is lost through waste or evaporation. Increase water requirements by 10 percent to offset this loss.

When enough potable water cannot be produced to meet all requirements, all but essential consumption is curtailed. Essential water requirements include those for drinking, personal hygiene, field feeding, medical treatment, heat casualty treatment, and, in arid zones, vehicle and aircraft maintenance. Consumption rates under these conditions are classified as “minimum” enough for a force to survive up to one week. Requirements for periods exceeding one week are classified as “sustaining.” In this category, nonessential consumption includes that for centralized hygiene, laundry, and construction.

ENVIRONMENT PLANNING FACTORS

General consumption planning factors exist for various environments and for various locations on the battlefield. These factors are based upon a ration policy of two T-rations and one MRE per day. The actual factor to use depends on the ration policy established by the commander. Water requirements for MREs are 0.25 gallons per meal. B-rations require 1.25 gallons per meal per soldier for dehydration and kitchen sanitation. While T-rations require no water for food dehydration, 0.5 gallons are required to heat each T-ration. If individual mess equipment is used, 1 gallon per soldier is required to sterilize utensils and clean up. More information on specific requirements for each of the climate zones is given below.

Temperate Zone

In temperate regions water sources are normally abundant. They include ponds, streams, rivers, wells, and local water systems. Sources convenient for water support operations should be easy to locate and develop. Drinking water does not need to be cooled. Sources discovered by combat forces maybe exploited by use of individual or small unit purification procedures or devices. In temperate regions, use potable water only when required. In the battalion and company areas, potable water is needed for drinking, personal hygiene, and field feeding. In the brigade support and division rear areas, add the water requirement for division-level medical treatment to those in forward areas. In EAD (corps and EAC), potable water needs increase due to the need for water for hospital medical treatment. Hospital water requirements depend on the number of each type of hospital in the supported area. Where exact numbers and types of hospitals are unknown, use 0.7 gallons per man per day to estimate hospital water requirements. Table 3-1 provides specific temperate zone consumption factors.

Tropical Zone

In tropical regions, water sources are expected to be abundant. Rivers, streams, lakes, ponds, wells, and

Table 3-1. Temperate zone consumption factors (gallons per man per day)

Unit	Sustaining	Minimum
Company	3.9	2.9
Battalion	6.6	3.6
BSA/DSA	7.0	4.1
Corps/EAC	7.8	4.8

Table 3-2. Tropical zone consumption factors (gallons per man per day)

Unit	Sustaining	Minimum
Company	5.7	4.7
Battalion	8.5	5.5
BSA/DSA	8.9	5.9
Corps/EAC	9.9	6.9

local water systems are possible water sources. Dense vegetation and lack of roads may pose significant and unusual problems in exploiting these sources. Individual consumption for drinking will increase due to high temperatures and humidity. Water sources discovered by combat forces may be exploited by use of individual or small unit purification procedures or devices. Poor ground LOC may inhibit water distribution by truck and place greater reliance on aerial resupply of water to engaged forces. Cool drinking water to encourage soldiers to drink the large quantities of water needed to prevent heat injuries. Waterborne diseases, infections, and parasites capable of transmission through body contact are very high in tropical zones. This requires the disinfection and filtration of water prior to its use for bathing and laundering. Use potable water in the tropical zone only when required. In the battalion and company areas, potable water is required for drinking, personal hygiene, field feeding, and heat casualty treatment. In the brigade support and division rear areas, add the water requirement for medical treatment to those in forward areas. In EAD (corps and EAC) potable water needs increase due to water requirements for hospital medical treatment. Where exact numbers and types of hospitals are unknown, use 0.9 gallons per man per day to estimate hospital water requirements. Table 3-2 provides specific tropical zone consumption factors.

Arctic Zone

In arctic regions, melting of snow and ice will-provide only enough water for emergency use by individuals and small units. It is impractical for supply of larger units due to the extensive fuel requirements. Dominant water sources are unfrozen water underlying frozen rivers and lakes and civilian- and military-constructed wells. Location and exploitation of water sources convenient for water support operations will pose unusual support problems. The dispersion of suitable water sources will increase distribution requirements. Water purification, storage, and distribution elements must be augmented with equipment to prevent or retard freezing. Encourage soldiers to drink large quantities of water to prevent dehydration. Use potable water in arctic zones only when required. In the battalion and company areas, potable water is needed for drinking, personal hygiene, and field feeding. In the brigade support and division rear areas, add the water requirement for medical treatment to those in forward areas. In EAD (corps and EAC) potable water needs increase due to the need for hospital medical treatment. Where exact numbers and types of hospitals are unknown, use 0.7 gallons per man per day to estimate hospital water requirements. Table 3-3 provides specific arctic zone consumption factors.

Table 3-3. Arctic zone consumption factors (gallons per man per day)

Unit	Sustaining	Minimum
Company	4.4	3.4
Battalion	7.2	4.2
BSA/DSA	7.6	4.6
Corps/EAC	8.4	5.4

Arid Zone

In arid regions, available water sources are limited and widely dispersed. Water must therefore be transported to the point of use. Surface fresh water is almost nonexistent, and available subsurface water varies from region to region. Detailed planning for water supply in an arid region is essential. Individual water consumption must be much greater than in a temperate region to prevent heat casualties. Cool drinking water to encourage soldiers to drink the large quantities of water required. Cooling is most efficiently done close to the point of actual consumption. Commanders and supervisors will ensure that drinking water is available and that soldiers drink sufficient quantities to maintain effectiveness. Use potable water to meet nonpotable water requirements when untreated water is not available. Provision of a separate nonpotable water distribution system will not be feasible. The lack of water sources will mean a large storage and distribution requirement. General support units provide this capability. Major tactical operations may be aimed at controlling scarce water sources. Total potable water requirements increase since potable water is used to meet nonpotable water requirements. Nonpotable water requirements include centralized hygiene, laundry, vehicle maintenance, construction, and aircraft maintenance. In the battalion and company areas, potable water is needed for drinking, personal hygiene, field feeding, heat casualty treatment, and vehicle maintenance. In the brigade support and division rear areas, add the water requirement for medical treatment, centralized hygiene, construction, and aircraft maintenance to those in forward areas. In EAD (corps and EAC), water requirements increase due to water requirements for laundering and hospital medical treatment. Where exact numbers and types of hospitals are unknown, use 2.8 gallons per man per day to estimate hospital water requirements. Table 3-4 provides specific arid zone consumption factors.

Table 3-4. Arid zone consumption factors (gallons per man per day)

Unit	Sustaining	Minimum
Company	5.9	5.0
Battalion	8.7	5.7
BSA	11.1	6.2
DSA	11.9	6.4
Corps/EAC	18.4	9.5

WATER REQUIREMENTS COMPUTATIONS

A number of computations must be made to determine supply, purification, and storage requirements for water. Personnel strength data are used by the MMC managers to compute water requirements. The MTOE and TDA provide authorized strengths for planning before hostilities begin. Data from the SIDPERS and subsisted strength reports may be used to modify requirements after units are established in the theater.

Supply Requirement

To compute the total daily water requirement of the force, multiply the strength (authorized, actual, or subsisted) by the proper consumption factor. The total, expressed as gallons per day, includes 10 percent for waste due to spills and evaporation.

Purification Requirement

The size and composition of the water supply section, detachment or team needed to provide for the total daily requirement must often be computed. To do this, divide the total daily requirement by the daily production capability of one purification unit. The daily production capability depends on several factors. These include the GPH rating of the unit (600 GPH, 1500 GPH, 3000 GPH), type and temperature of the water source (fresh, brackish, or saline), and the daily hours of operation. This information is in Section I of the appropriate TOE for each section, detachment, or team. Under normal conditions, water purification equipment is operated 20 hours per day with four hours downtime for operator and crew maintenance. Temperature affects the production capability of purification equipment. At a raw water temperature of 50 of ROWPU production capability is reduced by 50 percent.

Storage Requirement

Temperate, tropical, and arctic regions usually do not require large amounts of potable water to be stored. Their nonpotable water requirements can be met by raw water sources, and their potable water requirements can be met by the water purification section's organic storage tanks. In arid regions, large quantities of potable water must be stored because such water is used for both potable and nonpotable requirements. Brigades and divisions deployed in arid regions will have additional storage teams assigned. Raw water storage may be needed to provide source water for purification equipment. To compute the total storage requirement, determine the location and daily requirement on the battlefield (brigade, division, corps, or EAC). Double the daily requirement at corps and EAC to provide an additional day of supply at these levels. Then, compute the number of water supply companies needed to store the total requirement by dividing it by 1.6 million (the storage capacity, in gallons, of one water supply company). Allocate the companies in the corps and COMMZ to store that portion of the total requirement found in each area.

CHAPTER 4
WATER QUALITY STANDARDS

WATER QUALITY

Potable water must be free of anything that would degrade human performance. Also, it should not damage the materials used in its transportation and storage. Potable water must be suitable for maintaining human health (personal hygiene, medical treatment, and field feeding). Water quality standards give a basis for selecting or rejecting water intended for human use. These standards provide minimum accepted values for safeguarding human health.

Hydrologic Cycle

The hydrologic cycle is the term used to describe the natural circulation of raw water in, on, and above the earth. Water occurs in many forms as it moves through this cycle. The steps in the hydrologic cycle include precipitation, evaporation, infiltration, transpiration, and runoff. Water is placed in the air by evaporation from water and land surfaces and by transpiration from plants. It then condenses to produce cloud formations and returns to earth as rain, snow, sleet, or hail. Some of this evaporates, while some flows as runoff into lakes and streams. The remainder goes into the soil and then into underlying rock formations by seepage or infiltration. The water which has seeped through the earth will finally find its way to the surface through springs. It can also flow through porous media until intercepted by streams, lakes, or oceans. The cycle does not always progress through a regular sequence; steps may be omitted or repeated at any point. For example, precipitation in hot climate may be almost wholly evaporated and returned to the atmosphere.

Impurities in Water

As water goes through the hydrologic cycle, it gathers many impurities. Dust, smoke, and gases fill the air and can contaminate rain, snow, hail, and sleet. As runoff, water picks up silt, chemicals, and disease organisms. As it enters the earth through seepage and infiltration, some of the suspended impurities may be filtered out. However, other minerals and chemicals are dissolved and carried along. As ground water in underground deposits, it may contain disease organisms as well as harmful chemicals. In addition to the impurities in water resulting from infiltration, many are contributed by an industrialized society. Garbage, sewage, industrial waste, pesticides, and NBC agents are all possible contaminants of raw water. Impurities in raw water are either suspended or dissolved. Suspended impurities include diseases organisms, silt, bacteria, and algae. They must be removed or destroyed before the water is consumed by soldiers. Dissolved impurities include salts, (calcium, magnesium, and sodium), iron, manganese, and gases (oxygen, carbon dioxide, hydrogen sulfide, and nitrogen). These impurities must be reduced to levels acceptable for human consumption.

RAW WATER CLASSIFICATIONS

Water is classified as fresh, brackish, or salt water (seawater) based on the concentration of TDS. Fresh water has a TDS concentration of less that 1,500 ppm. Brackish water is high in minerals and has a TDS concentration between 1,500 ppm and 16,000 ppm. Salt water has a TDS concentration greater than 15,000 ppm.

Generally, ground water (subsurface) has less chemical or biological contaminants than surface water, provided reasonable care is exercised in the selection of the well site. Harmful microorganisms are usually reduced to tolerable levels by passage through the soil.

TREATED WATER CLASSIFICATIONS

Treated water may be classified as potable and palatable. These classifications are discussed below.

Potable Water

Potable water is water that has been treated and disinfected so that it is free from disease-producing organisms, poisonous substances, chemical or biological agents, and radioactive contaminants which make it unfit for human consumption or other uses. It is water that has been approved by the command surgeon or his representative for soldier issue and consumption.

Palatable Water

Palatable water is water that is pleasing in appearance and taste. It is significantly free from color, turbidity, taste, and odor. It should also be cool and aerated. Water may be palatable and at the same time not be potable.

POTABLE WATER QUALITY STANDARDS

Water for soldiers will be of the highest quality possible. Quality standards for treated water reflect the values of substances allowed in potable water. Standards exist to measure the physical, chemical, microbiologic, and radiologic quality of water and to test for the presence of chemical agents.

Physical Quality

The principal physical characteristics of water are color, odor and taste, turbidity, and temperature. These characteristics and their related quality standards are described below.

Color. Color in water comes from colored substances, such as vegetable matter, dissolved from roots and leaves, from humus, or from inorganic compounds such as iron and manganese salts. The color standard is designed to make drinking water more palatable.

Odor and taste. There are no set standards for odor and taste as there are no specific tests for these. Odor and taste found in water are most commonly caused by algae, decomposed organic matter, dissolved gases, or industrial waste. Remove tastes and odors which make water unpalatable.

Turbidity. Turbidity refers to a muddy or unclear condition of water caused by suspended clay, silt, organic and inorganic matter, and plankton and other microorganisms. The turbidity standard was established to improve the efficiency of disinfection by reducing particles to which microorganisms could attach.

Temperature. Warm water tastes flat. Cooling water suppresses odors and tastes and makes it more palatable. Temperature also effects the chlorination and purification of water. Disinfection takes longer when water is colder, and purification capacity is reduced with reverse osmosis treatment equipment. Water having physical characteristics exceeding the limits or making it less palatable should not, as a general rule, be used for drinking. Otherwise, reduced consumption and increased risk of dehydration may result. When water of low physical quality must be used, the appropriate command level will make that decision based on medical recommendations.

Chemical Quality

The chemical quality of water depends on the chemical substances it contains. These substances include TDS, chlorides, sulfates, and other ions. The chemical quality of water involves its hardness, alkalinity, acidity, and corrosiveness. Chemical substances having an adverse health effect have established standards that will not be exceeded without medical approval.

Potential hydrogen. The pH is a measure of the acidic or alkaline nature of water. It is technically defined as the negative logarithm of the hydrogen in concentration. It ranges from 0 to 14. A pH of 7 is neutral. The pH influences the corrosiveness of the water, the amount of chemicals needed for proper disinfection, and the ability of an analyst to detect contaminants. Water with a pH below 7 is regarded as acidic while that with a pH above 7 is regarded as alkaline. The pH standard was established to ensure effective purification and disinfection.

Arsenic. Arsenic can be present in natural water sources in a wide range of concentrations. It can come from either natural or industrial sources. Ingestion of low concentrations of arsenic can cause nausea, vomiting, abdominal pain, or nerve damage. In high enough doses it can kill. The standard for arsenic was established to ensure that no adverse health effects would occur to degrade soldier performance.

Chloride. Chloride exists in most natural waters. It is the main anion found in seawater. Chloride comes from natural salt deposits, domestic and industrial waste, and agricultural runoff. Even in low concentrations, chloride can produce an objectionable taste in water. The chloride standard ensures that potable water is also palatable. This will reduce the chance that soldiers will reject the water and suffer from dehydration or heat injury.

Cyanide. Cyanide can be present in natural water. It can come from industrial sources, such as metal processing, coke production, mining, or photograph development. Chlorination of water containing hydrogen cyanide results in the formation of cyanogen chloride, a toxic chemical agent. Ingestion of low concentrations of cyanide can cause headaches, nausea, or nerve tremors. In high doses, cyanide can result in convulsions, paralysis, respiratory arrest, or death. The standard for cyanide was established to ensure that no adverse health effects would occur to degrade soldier performance.

Lindane. Lindane is a widely used agricultural insecticide. It enters water sources from aerial spraying, runoff, or direct application for mosquito control. Wells may be contaminated with lindane when the chemical is spilled around the well during mixing operations or from prolonged exposure to repeated applications in surrounding areas. When ingested in small doses lindane can cause dizziness, headaches, nausea, vomiting, or tremors. At higher doses, severe seizures, respiratory failure, cardiovascular collapse, or death may occur. The standard for lindane was established to prevent toxic effects which would degrade soldier performance.

Magnesium. Magnesium is the eighth most abundant element on earth. It is a principal cation contributing to water hardness. When ingested in moderate doses, magnesium acts as a laxative. The magnesium standard was established to prevent chemically induced diarrhea, which could interfere with soldier performance.

Sulfates. Sulfates occur naturally in water as the result of dissolution of sulfur-bearing minerals. Significant concentrations also result from industry sources, such as coal mine drainage, pulp paper mills, tanneries, textile mills, and domestic waste water. When ingested, sulfates have a laxative effect. They also can produce a bad taste in water. The sulfate standard was established to prevent chemically induced diarrhea, which could interfere with soldier performance.

Hardness. Hardness, a characteristic of water, is chiefly due to the carbonates and sulfates of calcium, iron, and magnesium. It is commonly computed from the amounts of calcium and magnesium in the water and expressed as equivalent calcium carbonate.

Total dissolved solids. The TDS of water is composed of mineral salts and small amounts of other inorganic and organic substances. The proportion of each constituent is the result of weathering of rocks found in the drainage basin and of any industrial contributions. Since TDS is composed of chloride, magnesium, sulfate, and other ions, its ingestion in water has the same effects. Therefore, the TDS standard was established to prevent chemically induced diarrhea, which could interfere with soldier performance.

Chemical water quality standards are based on the effect the water will have on the health of the soldier. The effect of a particular chemical substance determines if a limit is established for that substance. Chemical substances having a negative physical effect will have a mandatory limit that should not be exceeded. Some substances, such as iron and manganese, have no significant negative physical effect, but may restrict the use of the water, such as for the laundering of clothes.

Microbiological Quality

The microbiological quality of potable water shows its potential for transmitting waterborne diseases. These diseases may be caused by viruses, bacteria, protozoa, or higher organisms. A microbiological test will reveal the quality of the raw water source and aid in determining any treatment required. The test is necessary to maintain the quality of the water. The testing for microorganisms in water is extremely difficult. The number of these organisms is usually very low, even in a badly polluted water supply, and the test used to find them is difficult. For these reasons, indicator organisms are used to detect the presence of contamination. The bacterial organisms used as an indicator of possible contamination are total coliform. These organisms occur in large quantities in the intestines of warm-blooded animals. The presence of any coliform organism in treated potable water is an indication of either inadequate treatment or the introduction of undesirable materials to the water after treatment. While the detection of many disease-causing microbes is difficult, the test to detect a surrogate organism, E. coli, is simple and effective for field use. Because of its relative simplicity and field adaptability, the membrane filter technique has gained wide acceptance throughout the military as the preferred technique for the presumptive determination of the presence of coliform organisms in potable water. This test is conducted by Preventive Medicine Specialists working on behalf of the Division, Corps, or Theater Surgeon. The microbiological standard was established to ensure infectious microorganisms would not cause diseases in soldiers.

Radiological Quality

Radioactive elements may appear in water supplies as a result of naturally occurring contamination. Radioactive elements may also enter water from indiscriminate disposal of hospital or industrial nuclear waste as well as a result of leakage from reactors. These are all in addition to the deliberate effect of nuclear weapons directed at soldiers engaged in combat on the active NBC battlefield.

Chemical Agent Standards

Chemical agents have been used recently in Afghanistan, Southwest Asia, and in the Iran-Iraq War. Their purpose is to incapacitate or kill enemy soldiers and allow friendly forces to seize the initiative. All chemical agent standards were established to prevent degradation of soldier performance by low levels of agents. The M272 Water Testing Kit-Chemical Agents is used to detect the following chemical agents.

Hydrogen cyanide. This agent interferes with enzymes which facilitate the use of oxygen by cells. Its effects in small or large doses are the same as those for cyanide.

Lewisite. The active ingredient in Lewisite is arsenic. Arsenic disrupts the digestive, circulatory, and nervous systems.

Mustard. This agent causes skin blistering and blindness. If ingested, it can cause vomiting and fever as it burns the lining of the stomach and intestines.

Nerve agents. These agents attack the enzymes which control the nervous system. They cause drooling, difficulty in breathing, nausea, vomiting, and involuntary defecation. In large doses, they can cause convulsions, respiratory failure, or death.

Radiological Standards

Radiological water quality standards are based on the fact that radiation has an adverse physical effect on soldiers. Any treated water that contains nuclear contamination should be avoided. When ingested, radioactive isotopes interfere with the reproduction of human cells. They cause nausea, vomiting, and hair loss and weaken the body's defenses to infections. Current water treatment methods are able to provide potable water of the desired radiological quality. Water purification operators and preventive medicine personnel are responsible for measuring levels of radioactivity in water supplies.

DEVELOPMENT OF STANDARDS

Field water quality standards have been developed by international agreements among the NATO and Quadripartite forces. These organizations have agreed, when operating on land, to adopt minimum requirements for potability of drinking water to be issued to soldiers in combat zones or in any other strict emergency situations. STANAG 2136 provides guidance on short term (1 to 7 days) standards under these conditions while QSTAG 245 provides guidance on both short-term and long-term (greater than 7 days) standards. STANAG 2885 provides guidance on the development, treatment, acceptability, and provision of water in the field. QSTAG 479 specifies minimum requirements for conducting water quality analyses. As a member of both organizations, the US has agreed to accept and provide water meeting these standards when participating in mutual logistical water support under field conditions (see Appendix C, Tables C-1 through C-4).

Water quality standards for the usc of potable water in the field are based on the length of time the water is to be consumed. Some of these standards were also developed to set limits for the palatability of water.

Emergency situations. No standards apply when soldiers are cut off from supply lines and treated water is not available from QM supplies. Each soldier should select the clearest, cleanest water with the least odor and then treat the water using individual water purification procedures. Such procedures are limited to disinfection using iodine tablets, chlorine ampules, or boiling (FM 21-10, Chapter 2, Section IV).

Short-term consumption. The short-term standards in Appendix C, Table C-2, apply to units operating for 7 consecutive days or less when the commander, upon medical advice, determines that a field operational condition exists which prevents soldiers access to potable water meeting long-term consumption standards. The commander must accept potential soldier performance degradation, increased incidence of disease, casualties from toxic substances, and reduced combat efficiency with each day the standards remains in effect. These units would rely on water treatment by man-portable water purification devices, if available, or by individual water purification procedures. Untreated water sources should be tested for compliance with the standards. Unit personnel should use the M272 Water Testing Kit if chemical warfare is suspected in their operating area.

Long-term consumption. The long-term standards in Appendix C, Table C-3, apply to all situations of more than 7 days where treated water is produced by water purification units.

The classifilcations of water use in Appendix C, Table C-4, are set to protect soldiers from contracting diseases from water that comes in contact with their skin or that is incidentally inhaled or ingested in small amounts. These classifications are also designed to protect equipment and clothing from deterioration. Water of the next higher quality may be used for any of the purposes listed in Table C-4 when water conservation considerations permit. Water of the next lower quality will not be used unless an emergency exists. The command surgeon will recommend the use of lower quality water. In areas where diseases transmitted through skin contact with water are present, only potable water will be used for showering, bathing, or other bodily contact.

DISEASES AND DISINFECTION

Potable water supplies will be disinfected because no other treatment processor combination of processes will reliably remove disease-producing organisms from water. The unit commander will instruct soldiers not to drink unapproved water which could cause disease. The nature of waterborne diseases and disinfection methods are discussed below.

Waterborne Diseases

Water is a carrier of many organisms which cause intestinal disease. An epidemic of one of these diseases among Army soldiers can be more devastating than enemy action and can cause great damage to morale. A heavy responsibility thus rests upon water purification personnel and the unit field sanitation team to maintain proper disinfectant residuals. The water treatment methods to be used when certain chlorine-resistant organisms are found should be prescribed by the command surgeon who can recognize or anticipate the presence of these organisms. The command surgeon will recommend such additional chlorination or other treatment as may be necessary. A waterborne disease rarely produces immediate symptoms in its victims. An incubation period must pass before the victim comes down with the disease. During this period, the disease organisms are growing and multiplying in the host. Therefore, an absence of symptoms for several days after drinking untreated water is no guarantee that the water is safe. The absence of disease among the local inhabitants is also no assurance of safety because they may have developed immunity.

Disinfection

Chlorination will be used for disinfection of potable water in all cases with the exception of individual or small unit water purification for which iodine tablets may be used. The efficiency of chlorine disinfection is affected by the following:

- The form of chlorine present, the pH of the water, and the contact time. As the pH of the water increases from 5 to 9, the form of the chlorine residual changes from hypochlorous acid (HOC1) the most effective form to hypochlorite ion (OC1) which is less effective. The most effective disinfection occurs when the pH is between 5.5 and 6.5. At the same pH, a longer contact time also results in increased disinfection.

- The type and density of organisms present (virus, bacteria, protozoa, helminth, or others) and their resistance to chlorine. Bacteria are the most susceptible to chlorine disinfection while the cysts of the protozoa Entamoeba histolytica and Giardia lamblia are the most resistant.

- The concentration of substances other than disease-producing organisms that exert a chlorine demand. During disinfection, chlorine demand can be exerted by chemical compounds such as those containing ammonia and organic material. Many of these compounds are not effectively removed in conventional water treatment processes and may be present to exert chlorine demand during disinfection.

- Adequate mixing of chlorine and chlorine demanding substances. The disinfecting agent must be well dispersed and thoroughly mixed to ensure that all of the disease-producing organisms come in contact with the chlorine for the required contact time.

Under normal operating conditions, water purification personnel will add sufficient chlorine to treated water to produce a chlorine residual of at least 5.0 ppm after 30 minutes contact time at a pH between 6.5 and 7.5. If chlorine supplies are low and there is a need to conserve remaining supplies, the command surgeon may authorize reduced chlorine residuals. Disease-producing organisms such as Entamoeba histolytica and Giardia lamblia are resistant to normal chlorine residuals. In areas where they are widespread, the command surgeon may require higher than normal residuals and longer contact times.

CHAPTER 5
WATER MANAGEMENT

THEATER ARMY WATER MANAGEMENT

The TA carries out the theaterwide CSS operation. This is done through area-oriented commands and specialized organizations. Based on the priorities and tactical plans of operational commanders, the TA will divide forces and give support to the deployed Army and other component forces.

The TA petroleum group gives centralized distribution of bulk petroleum products to US forces in the theater. It also commands GS water supply battalions. In doing this, the petroleum group provides theaterwide command of all TA water purification, storage, and distribution; command of US interzonal hose lines; and host nation liaison for water support. It also interfaces with the TAMMC for the movement and distribution of water into the COMMZ and corps rear areas. When hose line systems are in use, other transportation methods provide the extension from the terminal to the users. The petroleum group permits growth as the theater develops and requirements are increased.

One petroleum group is assigned for each TA. It commands from two to five water supply battalions. Central management of water supply is accomplished at the TA by the TAMMC. Requirements are sent from supported units. They are consolidated at the troop support materiel division of the TAM MC. These needs are then submitted to the petroleum directorate where they are joined with other US forces needs and sent to the petroleum group.

The TA petroleum group manages a theater water quality surveillance program, stores and maintains the TA water supply, and provides for alternate means of distribution of water. It also works together with the TAMMC petroleum directorate on theater water needs. Maximum use is made of existing facilities for water purification, storage, and distribution.

The theater GS water supply system is an automatic resupply operation. It is based on the storage policy and capability of receiving units. The forward movement of water supply is thus based on available empty storage space. When demand exceeds supply, the theater commander will establish an allocation system, based on priority, to support, the theater plan of operations. This system is refined by the TA commander and provided to the petroleum group through the TAMMC in the form of allocation instructions. These instructions are issued instead of MROs. Requirements for water are sent from supported units to water points. The water points pass the information through the MMCs to the petroleum group. Transactions for GS water issues are posted at the MMC after issues are made (post-post transaction). In all cases, however, issues are made within allocation instructions sent through the TAMMC (see Figure 5-1).

The TAACOM carries out the functions assigned by the TA commander. The functions include command of subordinate units that provide GS and DS CSS. Also, the functions include out-of-sector support and support for the corps as directed by the TA commander through the TAMMC. TAACOM units perform bulk POL and water pipeline system operations, when this task is not assigned to a petroleum group at the theater level.

DS in the COMMZ is provided on an area basis by water elements of the TAACOM S&S battalions. The TAACOM S&S battalion water elements draw and purify water from available sources. They also establish water supply points collocated with class I distribution points in DS of units in the COMMZ. Water is provided on an "as required" basis by supply point distribution (see Figure 5-2).

CORPS-LEVEL WATER MANAGEMENT

To fulfill its mission, the COSCOM MMC performs the following:

- Directs storage and distribution of water supplies.
- Provides inventory management of GS water supplies stocked with the corps.
- Receives and processes requirements for water from supported activities.
- Passes requirements to TAMMC or directs issue from available stocks.
- Collects, sorts, and analyzes water supply and maintenance data.
- Sends data to the MCC or forecasts needs for water movement in the corps for the MCC's use in creating the corps movement plan.

Personnel in the CMMC handle water for the corps. They manage:

- Day-to-day water support needs.
- Production, storage, and distribution of water.
- Reports and information needed for routine activity.
- Planning for water supply. Daily operations of CMMC personnel include directing production, storage and distribution of water, and reviewing and analyzing demands. They evaluate and balance work loads and resources of water supply units in the combat zone.

CMMC personnel should know the capabilities of the transportation system and its ability to move water. Water is processed and distributed in divisions by using their own assets. Potable water supply throughout the corps is on a demand basis from water supply points. When divisions, ACRs, and separate brigades are unable to provide enough water, water supply will be provided by the COSCOM. CMMC personnel will develop plans for processing requirements and distribution based on needs of the corps.

DIVISION-LEVEL WATER MANAGEMENT

The DISCOM plans, directs, and supervises the division's water purification and water distribution support.

The DISCOM commander guides the DMMC in the handling of water functions for the division. Based on this guidance, the DMMC prepares, reviews, and approves detailed plans and policies on water functions. These functions include the operating of water production and distribution points.

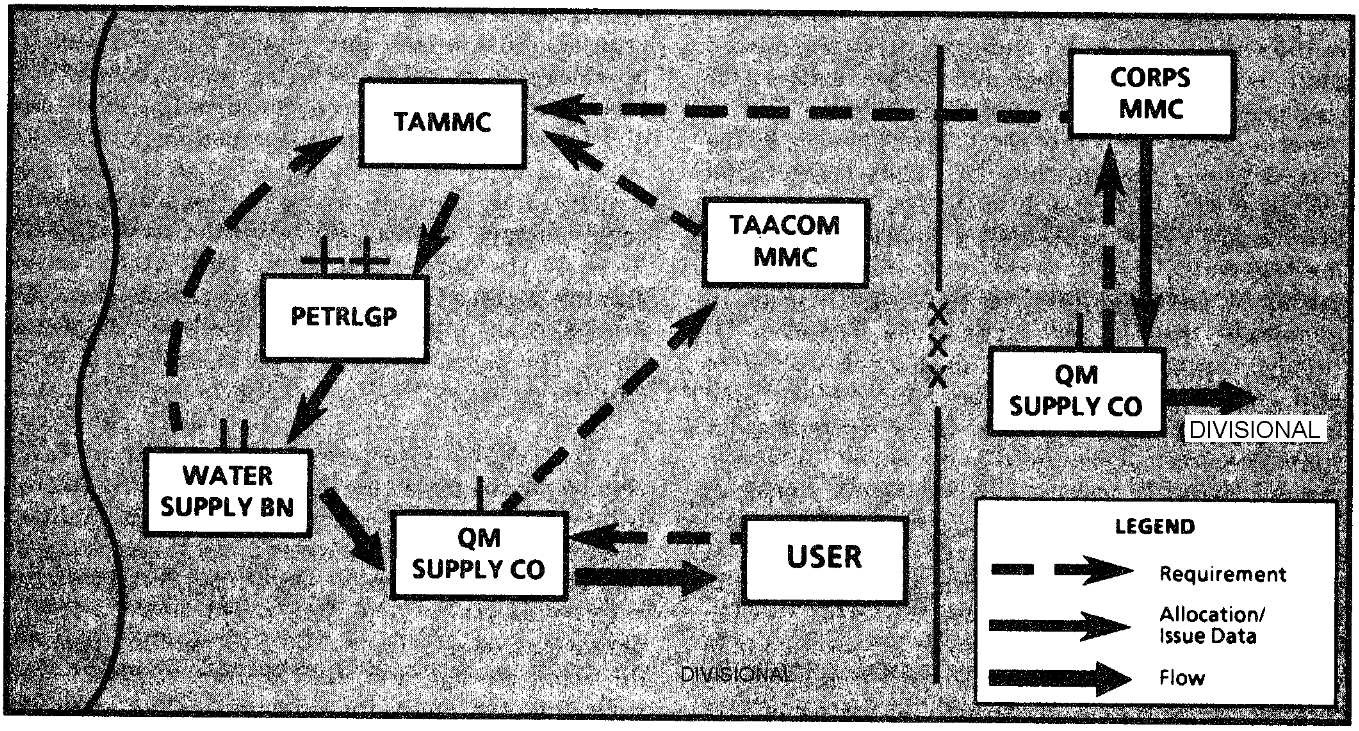


Figure 5-1. Water supply arid operations-general support

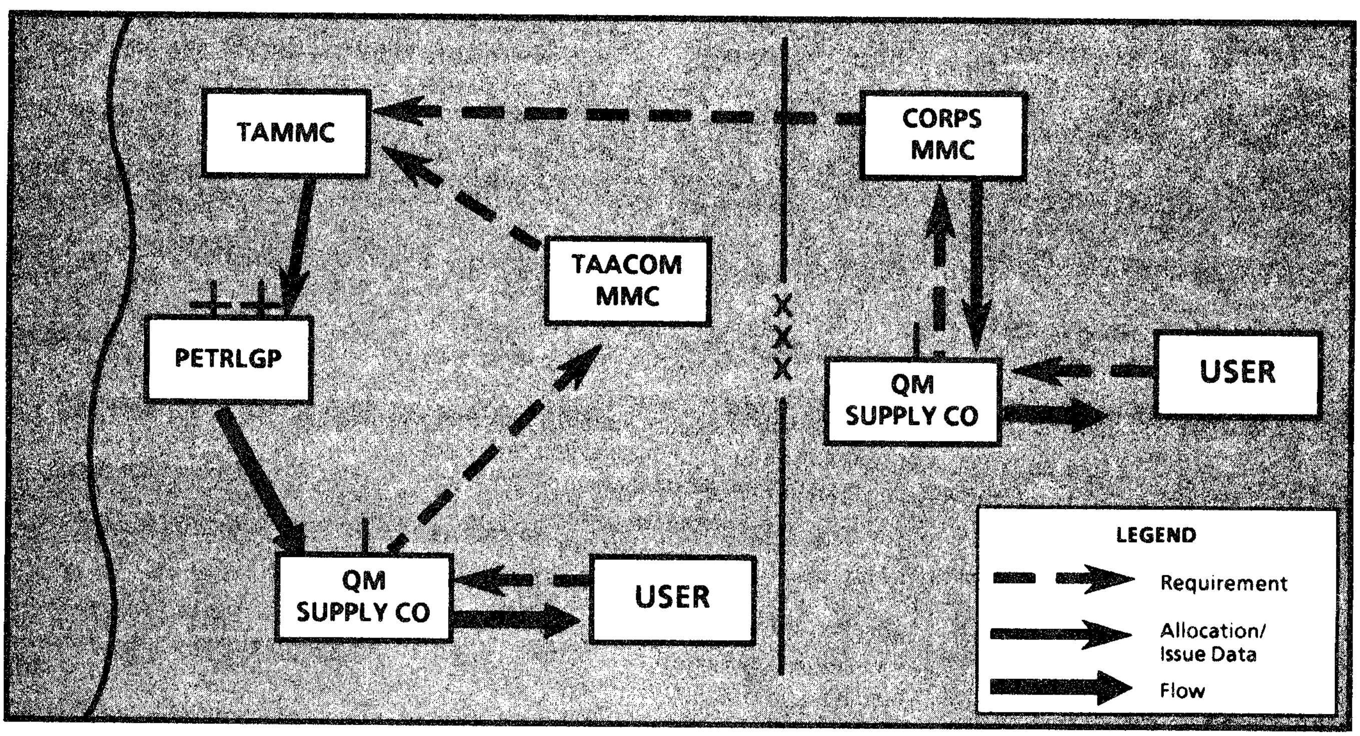


Figure 5-2. Water supply nonarid operations-direct support

The DMMC manages receipt and processing of requirements for water supplies from supported units. It also gives direction and mode of delivery for the issue of water supplies to divisional units. The general supply section of the DMMC consists of the class I supply branch, class III supply branch, and classes II and IV supply branch. The class I supply branch provides centralized command supply management, supply data, and information on division water supply support operations in temperate, tropical, and arctic areas. The class III supply branch provides this management function in arid areas. It maintains water supply status and monitors water allocations and division priorities for water resources. It ensures that maneuver units have enough stocks to meet needs. It diverts stocks as necessary. The branch directs water shipments according to plans for specific operations. It consolidates division water needs and sends them to COSCOM MMCs. It coordinates with the division engineer staff on needs for help in preparation, site access, or other construction support requirements for water sites. It coordinates with the corps engineer staff on division needs for water source detection support and water well drilling. It provides data and other help to the division G4 for planning requirements and water support operations. It provides staff expertise on water quality control and treatment standards and coordinates with the division surgeon's office on water quality.

Division units submit water supply requirements, usually consolidated at battalion level, to the supporting water point. The water section uses standard computations data to determine the total daily water needs for supported units. The supporting water point sends the total daily needs to the DMMC.

The DMMC water section receives total daily requirements from the forward and main water points. It checks purification and storage capabilities of each water point and diverts stock if necessary. It combines and submits the total daily water requirements to the COSCOM MMC. Daily operations of COSCOM MMC personnel include directing storage and distribution of water and reviewing and analyzing demands. They evaluate and balance work loads and resources of water supply units in the combat zone.

CHAPTER 6

NBC OPERATIONS

TOXIC CHEMICAL AGENTS

Personnel who purify, store, distribute, and issue water supplies must know NBC operations. Operators and supervisors must be alert to avoid NBC contamination. They must know NBC requirements related to field water supply.

Water supply personnel in the TO may work for long periods in a toxic environment. The commander must adopt a MOPP based on the threat and mission requirements. The commander must consider:

- Mission operations in a NBC environment.
- Handling and operations of water supplies in purification, storage, and distribution at various MOPP levels. This includes requirements for group protection.
- Degradation of units and individuals performing service and maintenance at various MOPP levels.
- NBC training status of assigned individuals.
- Availability of NBC school-trained personnel.
- Requirement and responsibility for large-scale decontamination.
- The effect of various MOPP levels on morale, discipline, and fatigue.

The effect of toxic chemical agents on potable water supplies is well-known. Potable water contamination will be a direct result of:

- The degree to which potable water is exposed. (This will be limited considering the closed systems involved in handling, transfer, and storage.)
- The type of chemical agent involved. Nerve agents (GB and VX) pose a great threat to water supplies because of their high toxicity at low

concentrations. Blister agents (mustard and lewisite) are lesser threats due to low solubility.

- The extent to which air-breathing pumps would contaminate the water in a toxic chemical environment.

- The concentration and duration of the toxic agent.

- The extent to which air-breathing pumps or engines will accept chemical agents designed to disrupt pump mechanical operations. Clogged air filters or congealed pump fuel will require replacement action.

In the face of possible contaminated water supplies, the commander must consider:

- The method for identifying the contamination and the degree of hazard involved. You can identify chemical agent contamination of water supplies by using the M272 Water Testing Kit-Chemical Agents.

- The use of assets to remove contamination from potable water supplies instead of purifying raw water.

- The decontamination of equipment used for the purification, storage, and distribution of contaminated water.

- The safe and rapid disposal of contaminated purification equipment components (filters and reverse osmosis membranes).

There are no test results to show the effects of toxic agents on collapsible fabric tanks or drums, hose lines, or SMFTs. Data on toxic agent effects on rubber indicate that adverse results would be based on the degree of contamination. Data on the toxic effects of chemical agents on potable water storage and distribution equipment will appear in all operations manuals when such data become available. Current doctrine dictates a rapid decontamination of these systems to preclude excessive absorption and degeneration of the material. These water systems, when operational, are under significant pressure. The pressure and an increase in temperature may release toxic agents. Based on the amount of prior absorption, ruptures caused by degenerated material may lead to large losses of potable water supplies.

The commander must provide for rapid and complete decontamination of all water purification, storage, and distribution equipment. He should consider:

- Decontaminant available as opposed possible needs.

- Training level of unit personnel to perform NBC decontamination operations.

- Decontamination expertise available to the unit (trained personnel).

- Supplemental decontamination support available to the unit.

- Mission requirements and operations during the decontamination process.

- Soldier safety during decontamination and MOPP levels.

- Replacement of subassemblies that cannot be decontaminated.

NUCLEAR WEAPONS

The blast, heat, and nuclear radiation effects of nuclear weapons are hazards to the water supply system and personnel. Details pertaining to defense against nuclear attack are in FM 3-100.

The chief hazard of nuclear weapons to water supplies and facilities is the blast effect. It is most destructive to supplies and facilities that are direct targets. Facilities above ground are exposed to air, surface, and subsurface bursts. Blast damage depends on dynamic pressure, terrain conditions, atmospheric conditions, nuclear burst yield, and height of burst. The greatest blast damage is delivered by a high-yield nuclear weapon detonated as an airburst.

Thermal effects of nuclear explosions extend over a wide area. Heat from a nuclear explosion may cause flammable surfaces to ignite on contact.

NIGA may be found in some equipment, but the greater hazard is from NIGA in the surrounding terrain. Nuclear contamination of water is a result of fallout. Like radioactive fallout that settles on the ground, rain washes NIGA in the soil into lakes, rivers, and other raw water sources. Radioactive isotopes in raw water must be removed during the purification process to be sure potable water supplies do not contain radioactive contamination. The AN/PDR 27 Radiac Meter is used to measure radioactivity in water sources and supplies.

BIOLOGICAL AGENTS

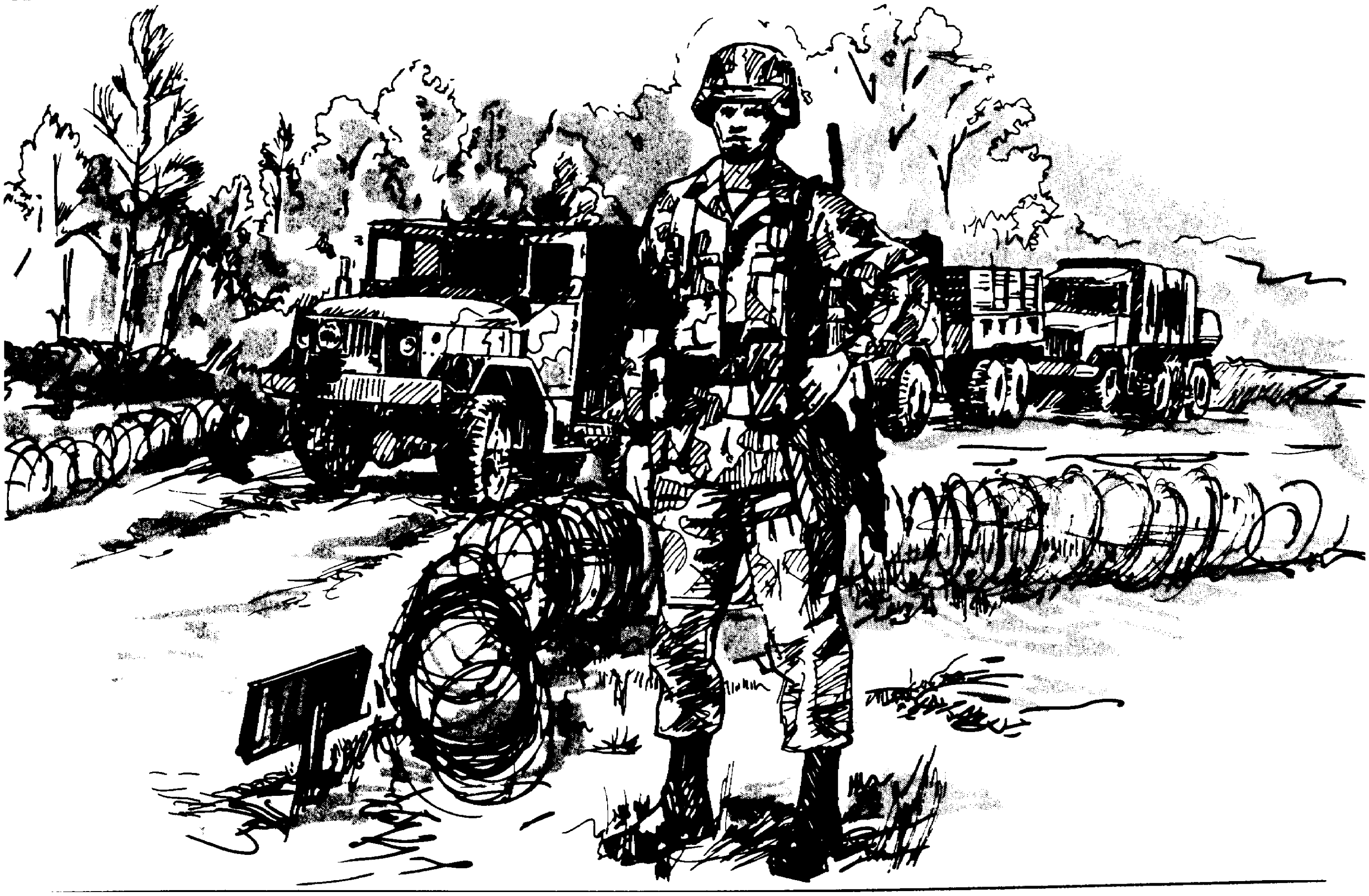
Biological agents inflict casualties and damage to personnel, animals, and food. They normally do not damage equipment or facilities. Biological agents consist of infectious live organisms and toxins.

Infectious live organisms include viruses, bacteria, rickettsia, protozoa, and fungi. They can cause disease or death. To reduce danger to these organisms, commanders must consider:

- Immunizing personnel before deployment.
- Enforcing personal hygiene and field sanitation practices.
- Controlling insects and rodents which carry infectious agents.

Toxins are poisonous chemicals produced by bacteria, algae, and fungi. They can cause illness or death. The protective mask protects against toxins, which are usually distributed by aerosol sprays.

Army ROWPUs remove or destroy infectious organisms and toxins in raw water sources.



CHAPTER 7
REAR OPERATIONS

REAR OPERATIONS OBJECTIVE

The objective of rear operations is to ensure freedom of maneuver and continuity of operations through sustainment. Conduct rear operations by using the basic tenets of AirLand Battle. These tenets are initiative, depth, agility, and synchronization.

Initiative. Aggressively denies the enemy landing areas, restricts access to critical bases, and ensures continuous logistic support.

Depth. Ensures a distribution of support so that close and deep operations are not dependent on only one facility to continue the fight. This includes plans for alternate support and being prepared to shift support without interruption.

Agility. Anticipates and reacts to any rear threat by planning for and moving the necessary forces to meet and defeat the threat. This is done throughout the width and depth of the rear area.

Synchronization. Sustains CS and CSS forward support and coordinates combat assets simultaneously. This will neutralize the rear threat without degradation of forward support.

In addition to the basic tenets of AirLand Battle, rear operations consist of the major functional areas of security, terrain management, sustainment, and movement.

Water support for rear operations includes the following:

- Combat, CS, and CSS units located in the rear.
- Maneuver units passing through or temporarily located in the rear.
- Units conducting tactical operations in the rear area.

Threat forces will seize the potential for disruption of water support of close and deep operations. Plans must be made for the protection of key water facilities and the LOC identified to support committed maneuver units. Water teams and water supply units must be positioned to provide redundancy and flexibility and must be prepared to move should the tactical situation so dictate. Airfields in the rear area will be used to deliver ALOC water supplies.

THREAT LEVELS

Use three levels of responses to threat activities to serve as a guide for planning rear operations. Rather than focusing on the size or type threat, these levels focus on the nature of friendly actions needed to defeat the threat. The three levels of threat are described below:

Level I threats. Defeat these threats by base or base cluster self-defense measures. Examples of what a level I threat may involve are:

- Enemy-controlled agent activities.
- Sabotage by enemy sympathizers.
- Terrorist activities.

Level II threats. These threats are beyond base or base cluster self-defense capabilities. Defeat these threats by response forces, normally MP with supporting fires. Examples of what a level II threat my involve are:

- Diversion and sabotage operations conducted by unconventional forces.
- Raid, ambush, and reconnaissance operations conducted by small combat units.
- Special or unconventional warfare missions.

Level III threats. Force the command decision to commit a combined arms TCF to defeat them. Examples of what a level III threat may involve are:

- Heliborne operations.
- Airborne operations.
- Amphibious operations.
- Ground forces deliberate operations.
- Infiltration operations.

These threat activities will not necessarily occur in a specific order, nor is there a necessary interrelationship between threat levels. Units may face one or more threat-level activities at one time. Some level I and II threat activities will likely begin well ahead of general hostilities.

Based on a thorough IPB, rear operations planning must include the following:

- Base and base c1uster self-defense.
- Response to defeat level II attack which exceeds base and base cluster defense capabilities.
- Commitment of a TCF to defeat a level III threat.

REAR CP

The theater, corps, and division commanders will exercise command and control through the ATCCS from three command posts and a command group. The command posts consist of a TAC CP, a main CP, and a rear CP. The rear CP conducts rear operations. This function entails command and control of rear security operations, terrain management in the rear area, sustainment, control of administrative moves, and other associated functions. The rear CP is organized into three cells (CP headquarters cell, operations cell, and CSS cell). Each cell is functionally organized, but interacts with the others.

The CP headquarters cell consists of the rear operations commander and his supporting staff. This cell coordinates and synchronizes activities of the operations and CSS cells of the rear CP. It also provides guidance to the staff of the rear CP and analyzes the situation for its impact on current and future operations.

The operations cell's primary functions include the following:

- Planning and controlling rear security operations.
- Terrain management of the rear area.
- Synchronizing combat, CS, and CSS in support of rear security operations.

It maintains the current situation by monitoring the close and deep operations through communication with the TAC and main CPs. It also completes and continuall y updates the IPB of the rear area.

The CSS cell's primary functions are to collect, analyze, and provide CSS information for the sustainment of close, deep, and rear operations and plan and control administrative moves. The CSS cell must maintain the personnel and logistic status. It must also control personnel and logistics operations to provide required information to the CSS cell at the main CP. The major functions of the CSS cell are:

- To collect, analyze, and provide CSS situation information.
- To control personnel, finance, and logistics operations.
- To recommend the positioning of CSS units in the rear area to best support the overall operations.
- To identify key CSS units and activities which require priority protection.
- To plan and control administrative moves.
- To designate MSRs and alternate MSRs.
- To establish priorities for administrative moves.
- To coordinate and reroute administrative moves so as not to conflict with tactical moves.
- To assist in the planning and control of tactical moves in the rear area.
- To monitor incoming augmentation units.
- To maintain CA status and control CA operations.
- To coordinate public affairs support.
- To coordinate HN or LOGCAP support
- To support reconstitution efforts as directed.
- To coordinate a tactical airlift.

The RTOC plans and coordinates rear security for the TA. The RTOCs organization size depends on the echelon HQ it supports. Although RTOCs are organized and staffed differently at each echelon, planning functions are basic in each level. These functions include: security, terrain management, movement, operations, intelligence, fire support, and logistics.

Due to the vast expanse of a typical corps rear area, the corps rear CP executes rear operations through subordinate RAOCs. Area RAOCs execute rear operations functions in AOR assigned to them by the corps rear CP. These AOR and HQ locations normally coincide with corps support groups and, when possible, MP battalions. RAOCs normally collocate with corps support groups for life support, local security, and ease of coordination.

The corps rear CP normally provides liaison to adjacent corps rear CPs. TAACOM ASGs supporting the corps, the main CP, and HN organizations has the responsibility to provide security to the rear of the corps rear boundary.

DIVISION REAR OPERATIONS

The ADC-S is normally the rear operations officer. The ADC-S commands and controls the planning and execution of division rear operations. The ADC-S exercises his rear operations responsibilities through the division rear CP and the DISCOM CP. Both are normally collocated for 1ife support, local security, and ease of coordination.

The rear CP synchronizes the rear operations function of terrain management, security, sustainment, and movements with the divisions close and deep operations. This is performed with the division commander's concept and intent in mind.

Terrain Management

While the division G3 is the overall division terrain manager, the DISCOM commander is responsible for the DSA and the FSB commander for his BSA. The rear CP positions units in the division rear area which have not been positioned by the G3 to support current or future operations. The rear CP positions units based on the corps and division mission, concept of operation, current rear area IPB, and the mission requirements of the unit being positioned. Water elements entering or desiring to move within the DSA must coordinate with the RTOC. This will ensure that their proposed locations do not conflict with current or projected operations, rear CP positioning, or move priorities. Those entering the BSA must coordinate their terrain requirements with the FSB S2 and S3.

Base and base cluster commanders are responsible for positioning water elements in their respective AOR. Bases and base clusters fall under the control of the division rear CP for positioning, security, and movement within the division rear area.

The rear CP, through the division G5, must coordinate with HN authorities. This will ensure that positioning of division and HN water facilities are not in conflict and are integrated into the concept of operation.

Movement Control

Movement control includes the planning, prioritizing, synchronization, and execution of movement plans. The ADC-S is responsible for prioritizing and synchronizing moves within the division rear area and planning for security and sustainment of tactical moves within the division rear.

The ADC-S identifies critical points along MSRs to the G4. The G4 is responsible for designating MSRs in the division and for coordinating with corps for MSRs to support corps sustainment. The ADC-S then coordinates with the division provost marshal and the ADE for security, ADC, and MSR maintenance.

The G3 establishes priorities for moves along division MSRs based on the overall sustainment priorities in support of the operation. The G3 passes move priorities to the division provost marshal who enforces them.

Synchronization of Sustainment

The CSS cell of the rear CP plans and directs sustainment operations in the division. The rear operations functions ensure that sustainment is not degraded and does not limit the division commander's freedom of maneuver and continuity of operations. When possible, logistics facilities are dispersed to reduce the effect of threat attacks. The CSS cell must expect, plan, and coordinate the movement of logistics units in the rear area in response to changing situations.

The DISCOM executes the sustainment plan. It recommends the location of the DSA and also positions units in the DSA. The DISCOM directs subordinate units, monitors their ability to provide support, and makes sustainment recommendations to the rear CP. The division rear CP coordinates with the G5 for HN water support for sustainment operations in the division rear area.

Security

The rear CP operations cell plans and executes rear security operations based on guidance of the ADC-S. The following components of rear area security form the framework of rear security operations. These components include: intelligence, base and base cluster self-defense, response operations, and combined arms TCF operations.

Intelligence cell. The operations cell in the rear CP is responsible for the rear area IPB. The rear operations cell collates IPB products produced by the intelligence cell at the division main CP and combat information provided by units passing through the division rear area. It then produces a predictive intelligence estimate, identifying likely threat targets and intentions. This estimate, along with information on the current threat situation, is issued to all units in the division rear area. It also forms the basis for planning and conducting the other three components of rear security operations.

Base and base cluster self-defense. Each base and base cluster commander must develop a defense plan. They design the plan to detect, defeat, and reduce the effects of level I and II threat attacks on his base or base cluster. They base this plan on the IPB provided by the division rear CP, his own IPB, the current intelligence situation, and an analysis of this units mission requirements. To increase unit mission accomplishment, defense plans must be flexible and allow for differing degrees of security based on the probability of threat activities. Defense plans should address the following:

- Defense command and control.
- Detection of threat forces through the use of OPs, LPs, and patrols.
- Assignment of defense sectors of responsibility for subordinates.
- Integration of available weapons into the defense.
- Identification of unit response forces to boost the defense during an attack.
- Air, ground, and NBC attack alarm systems obstacle planning.

- ADC.
- Internal air defense measure.
- Fire support planning.

Response force operations. The rear operations cell will designate forces to respond to bases or base clusters under attack by level II threat forces. Once designated, response forces must coordinate with supported bases or base clusters to perform the following:

- Conduct a joint IPB.
- Review base or base cluster self-defense plans.
- Exchange S0I.
- Identify response force contingency plans (to include checkpoints and fire control measures) to counter likely threat activities.

The purpose of response force operations is to help bases or base clusters return to mission accomplishment rather than devote sustainment resources to self-defense or limited tactical operations. Once the threat has been forced to break off its attack, the response force should fix and destroy it by using close combat techniques. It can apply artillery and close air support, as available.

TCF operations. As part of the division's overall task organization, the G3 will designate a TCF to stop and defeat level III threat forces which may attempt to operate in the division rear area. The TCF is normally a task-organized, battalion-sized combined arms force. This force consists of ground maneuver, attack helicopter, and DS field artillery units under the command and control of the designated TCF HQ. When designated, but not immediately committed, the TCF commander coordinates with the ADC-S and division rear operations cell. They then develop multiple contingency plans for the future employment of the TCF in the division rear area.

DIVISION OFFENSIVE OPERATIONS

The primary purpose for conducting rear operations in offensive operations is to keep the division's freedom of maneuver and continuity of operations. During the attack, position water elements as far forward as possible to sustain the attacking units. Water elements must expect critical requirements and prepare push packages to sustain the momentum of the attack. The division rear CP and the DISCOM monitor the progress of attacking brigades. They also redirect the priority of CS and CSS to support changes to the division main effort. Consider using captured enemy water supplies to augment existing division stocks.

The FSB or FAST, with attached water elements from the MSB, will normally closely follow the attacking brigades where they can support without interfering with maneuver units. The rest of the DISCOM is positioned to best support the FSB or FAST and weigh the main effort. The DISCOM will displace forward, as required, to shorten the supply lines as the tactical situation dictates. In the event of rapidly advancing division attacks, rear DISCOM water elements will support by bounds or support on the move. DISCOM water elements establish dry water points in forward assembly areas to help and maintain the momentum of the attack.

DIVISION DEFENSIVE OPERATIONS

The division plans and conducts rear defensive operations to assure freedom of maneuver and to sustain its operations. Do not allow operations in the rear to divert forces from the main effort. The division has the responsibility for securing the rear area from level III threats from the forward brigade rear boundary to the division rear boundary.

The G4 and the DISCOM commander must understand the intent of the division and corps commanders to develop a support plan to sustain the defense. Knowing the intent and concept of operation allows them to expect water requirements. The G4 develops a concept of support and recommends priorities for support to the division commander. In coordination with the DISCOM commander, the G4 recommends placing specific water capability in the CSS forward organizations in support of the division defensive plan. The task organization of the brigade's DS FSB or FAST is tailored by the DISCOM commander. This is done to meet specific needs of units operating within the maneuver brigade's AO. The DISCOM must look beyond the defense to expect water support requirements as the division transitions to the offense.

Key differences between planning and conducting defense rear operations to other division operations include:

- The ability to take greater advantage of existing water facilities. These facilities include water treatment plants, storage tanks, and fixed distribution systems.
- The defender's lack of initiative must be offset through detailed planning and coordination of all water activities and requirements through the rear CP and the DISCOM. ADC water requirements require the prioritization and establishment of specific responsibilities. This will ensure continuous water support and the immediate restoring of operations.

CORPS REAR OPERATIONS

Corps rear operations are those activities from the corps rear boundary forward to the rear boundaries of committed maneuver units. Conduct these activities to assure the corps freedom of maneuver and continuity of operations, including sustainment and command and control. The corps must synchronize the rear operations function of terrain management, security, sustainment, and movements with the corps close and deep operations. This is done with the corps commander's concept and intent in mind. Plan and integrate each of the rear operations functional areas (terrain management, security, sustainment, and movements) into a comprehensive rear operations concept. This concept, accomplished by the rear CP, supports the corps commander's concept and intent.

COSCOM supports corps units, whether they are operating in the division area or corps rear area. To provide responsive water support, the COSCOM will provide a logistics task force to provide DS water to corps units operating in the division area. The QM Supply Company (TOE 42-447), with its organic water production, storage, issue and limited distribution capability, has that responsibility. The COSCOM will also provide LOs to work with the DISCOM and the corps units operating in the division area. LOs are usually assigned from the CSG and will normally collocate with the HQ of the DISCOM and FSB.

Water support for the corps rear operations includes the following:

- Water support to CS and CSS units located in the corps rear.
- Maneuver units passing through or temporarily' located in the corps rear.
- Units conducting tactical operations in the corps rear area.

Of greater importance may be the potential for disruption of water support of the close and deep operations. In arid environments the corps must plan for the protection of key water facilities and the LOC identified to support committed maneuver units. Water units must be positioned to provide redundancy and flexibility. Water units must also be prepared to move should the tactical situation so dictate. Airfields in the corps rear area will be used to deliver ALOC water supplies.

Terrain Management

The corps G3 is the overall corps terrain manager. The rear CP operations cell is responsible for positioning water units in the corps rear area in coordination with the G3. The operations cell, in coordination with the CSS cell, positions water units based on the corps mission, concept of operation, and commander's intent. Other factors affecting positioning of water units or teams include the following:

- Current rear area IPB.
- Subordinate units mission requirements.
- Considerations of the water unit or teams being positioned.

Terrain management involves the positioning of units. The rear IPB, analysis of METT-T, and the commander's risk assessment, dictate whether water elements are dispersed throughout the corps rear. This will enhance their survivability or grouped together in mutual support. Based on the above factors, the corps deception plan consideration, and the COSCOM commander's recommendation, the rear CP (through subordinate RAOCs) position water units or teams in the corps rear area. Corps support groups desiring to position subordinate water elements in division rear areas must coordinate directly with responsible division rear CPs and DISCOM or FSB S2 and S3 as necessary.

The responsible RAOC assigns the positioned water units or teams located in the corps rear. They are assigned to either bases (unit or multi-unit positions with definite perimeters) or base clusters (grouping of bases, based on mission or security requirements lacking a clearly defined perimeter). The responsible RAOC designates a commander for each base and base cluster. Base and base cluster commanders are responsible for positioning water units in their respective AOR. Bases and base clusters fall under the OPCON of the corps rear CP and its subordinate RAOCs for rear operations. Normal water mission guidance and prioritization remains the responsibility of water activity's parent commands.

Based on the tactical situation or direction from the G3, the rear operations cell, in coordination with the CSS cell, directs the repositioning of water units in the corps rear area. The appropriate RAOC accomplishes the repositioning. When required, coordinate such directed relocations with the affected water activity's higher HQ to ensure continuity of mission accomplishment.

Water units or teams entering or desiring to move within the corps rear must coordinate with the operations cell and affected RAOCs. This will ensure that their desired locations do not conflict with or projected rear operations positioning or move priorities. Refer unresolved conflicts, by the rear CP, to the rear operations commander for resolution.

The operations cell, through the G5, must coordinate with HN authorities. This will ensure that corps and HN water facility and water unit positioning do not conflict and are integrated in the overall concept of operation.

Security

The corps conducts rear security operations to assure freedom of maneuver and continuity of operations. The operations cell and subordinated RAOCs plan and execute rear security operations based on guidance from the rear operations commander. They must support the overall corps deception plan which may also include rear operations deception efforts. The four components of corps rear security operations are: intelligence, base and base cluster self-defense, response operations, and combined arms TCF force operations. These components form the frame work for rear security operations.

Intelligence cell. The operations cell is responsible for the rear area IPB. The corps area of interest for rear operations planning extends forward to the rear boundaries of committed brigades within committed divisions. The operations cell collates IPB products. These products are produced by the intelligence cell at the corps main CP and raw data provided by units in or passing through the corps rear area. They also produce an intelligence estimate, identifying likely enemy targets and intentions. This estimate, along with information on the current enemy situation, is issued through subordinate RAOCs to all units in the corps rear area. It also forms the basis for planning and conducting the other three components of rear security operations.

Base and base cluster self-defense. Water supply battalion commanders may be designated as base or base cluster commanders. Each base and base cluster commander must develop a defense plan based on the IPB provided by the corps rear CP, his own IPB, the current intelligence situation, and the analysis of his units mission requirements. The plan must be designed to detect, defeat, and reduce the effects of level I and limited level II threat attacks (to include chemical attacks) on the commander's base or base cluster. To increase unit mission accomplishment, defense plans must be flexible and allow for differing degrees of security based on the probability of threat activity.

Response force operations. The operations cell will designate forces, normally MP, to respond to bases or base clusters under attack by level II threat forces. Once designated, response forces must coordinate with supported RAOCs and bases or base clusters. They will conduct a joint IPB, review base and base cluster self-defense plans, exchange CEOI information, and identify response force contingency plans to counter likely enemy activities. This will also include rallying points and fire control measures. The purpose of response force operations is to help bases or base clusters to return to mission accomplishment rather than diverting sustainment resources to self-defense. Another objective of response force operations is to remove a threat without requiring premature commitment of the TCF.

TCF operations. As part of the corps overall organization for combat, the G3 designates a TCF capable of defeating level III forces which may attempt to operate in the corps rear area. The G3 also develops contingency plans for the commitment of a TCF to support subordinate division responses to level III attacks in division rear areas. Commitment of TCF to perform rear operations under the OPCON of the rear operations commander is a decision made by the corps commander. The operations cell of the rear CP designates an AO for the TCF. The operations cell also establishes priorities and procedures. However, subordinate RAOCs must coordinate the handover of combat responsibility from response forces to the TCF.

Sustainment

The CSS cell of the rear CP plans and directs water support operations in the corps. Synchronization of water support, in keeping with the corps deception plan, is critical for the success of close, deep, and rear operations. This is performed with the corps commanders concept of operation and intent, Critical water support functions accomplished by the CSS cell of the rear CP include:

- Analyzing the commander's concept and intent and developing an integrated water support plan.
- Recommending the positioning of water units to the operations cell where they can best support the command.
- Identifying to the operations cell those critical water facilities and moves which require priority protection.
- Developing a water support plan and coordinating CSS support for units in the corps rear area.
- Monitoring the status of water operations in the corps.

Positioning of water units requires a thorough knowledge of the current IPB and the corps commander's concept and intent. Water units are normally positioned close to MSRs to help timely support. Do not position them along likely threat avenues of approach or near likel y threat LZs or DZs. Position water units in depth to reduce the effect of threat attacks on the overall sustainment effort. The CSS cell must expect, plan, and coordinate the relocation of water units in the rear area. This is in case that the tactical situation so dictate or the adjustment of the corps commander's concept of operation.

COSCOM executes the CSS cell's water support plan. The COSCOM recommends the location of water units to the operations cell. It directs water units, monitors their ability to provide water support, and makes rear operations recommendation to the rear CP.

The CSS cell coordinates with HN authorities for water support of corps rear operations. It identfies HN capabilities and negotiates with HN authorities to ensure water support is provided according to existing agreements. It also coordinates with the HN to ensure the HN water activities do not interfere with corps sustainment operations.

Movement

Tactical and nontactical movements of water units within the rear area may be critical to close, deep, and rear operations. In arid environments, movement of water units within the corps area is an integral part of the corps deception plan. Movement control includes the planning, coordination, and execution of movements both internal to the corps and those external (other US forces and HN) to the corps.

Tactical movement. The G3 establishes priorities and designates routes or zones for these tactical moves. The rear CP is responsible for ensuring the following:

- Nontactical moves do not conflict with tactical moves (CSS cell).
- Designating alternate routes for nontactical moves (CSS cell).
- Planning for sustainment of tactical moves within the corps rear (operations and CSS cell).

The MCC will provide assistance in planning, coordinating, and supporting all tactical moves crossing the corps rear area.

The operations cell plans the tactical move of the corps TCF in keeping with the TCFs concept of operation. It is responsible for coordinating the rerouting of water movements with the CSS cell during the movements of the TCF. It must also coordinate for rerouting water movements around areas designated as TCF AO.

Should the corps TCF be tasked to combat a level III threat in a division rear area, the division gains OPCON of the TCF and plans its movement within the division area. Should corps commit its reserve through the division rear area, the division rear CP operations cell supports the corps movement. The operations cell ensures division water movements are rerouted so as not to conflict with the corps tactical movement.

Nontactical movement. The CSS cell designates MSRs in the corps rear area and from the corps rear to forward positioned major corps-controlled forces. MSRs are established between corps support groups, from corps support groups to supported divisions, and laterally to support the rapid shifting of water support and other sustainment forces through the corps rear. The corps CSS cell coordinates with division CSS cells to ensure that designated corps MSRs support division water operations. The CSS cell plans alternate MSRs and identifies critical points which require either positive control or special security considerations. Pass this information to the operations cell for coordination with the corps provost marshal and to the corps engineer. The corps engineer ensures that ADC contingency plans are developed should MSRs be interdicted by threat forces.

The CSS cell establishes priorities for nontactical water movements along corps MSRs. Movement priorities reflect both the water support priorities in support of the overall corps concept of operations and the deception plan. They are passed through the operations cell to the corps provost marshal who develops a plan to ensure movement priorities are enforced.

CORPS OFFENSIVE OPERATIONS

The fluidity and quick tempo of corps offensive operations pose challenges to corps rear operations planning. The forward movement of units and the water support they need are critical if the corps is to maintain the initiative necessary for successful offensive operations. In arid environments the corps must keep the LOC open to ensure enough water support to its attacking maneuver units. Prepare the LOC to detect and defeat enemy forces which intend to interrupt the corps rear operations efforts.

CORPS DEFENSIVE OPERATIONS

Regardless of whether the mission requires the retention of terrain or focuses on destruction of the enemy force, the corps rear operations must retain freedom of action for the corps in the rear area. Rear operations begin before the enemy closes with the corps and continues throughout the entire battle. Water support to ground maneuver operation requires that water units be near maneuver forces. In arid environments careful consideration of water support required during defensive operations often requires a change in the controlled supply rate and pre-positions of water. The duration of the operation, follow-on missions, and possible linkup all affect the water support organization and execution. Corps augmentation in arid regions is a critical sustainment action.

Only those water assets immediately essential to the operation should be positioned forward. They may be withdrawn when no longer required or the risk of their loss becomes unacceptably high. Water support for a covering force with a defend mission requires the pre-positioning of supplies. A delay mission requires the allocation of more time for more water to be pre-positioned at additional delay positions to support the planned operation.

Water support of combat in the MBA will normally generate the largest water requirement. In a protracted defense, the ability of the corps to sustain its forces will greatly influence the outcome of the battle. The MBA defense will require a mix of forward deployed and echeloned water units to allow for their orderly withdrawal or advance. CSS efforts must stress adequate supply of water as far forward as possible.

The following planning consideration and operational techniques improve the water support provided to a defending unit.

- Push packages of water are dispatched from rear areas on a scheduled basis so that interruption in communication do not disrupt the flow of supplies.

- Water resupply during periods of limited visibility reduces changes of enemy interference. Resupply vehicles infiltrate forward to reduce changes of detection.

- Water units are echeloned in depth throughout the defensive area. When a forward water unit is required to displace to the rear, it normally displaces in echelon so limited water support can still be provided. However, if the entire water unit displaces at one time, another water unit picks up the workload until the displacing unit is again operational.

THEATER REAR OPERATIONS

The TA commander is responsible for water support to all US Army forces in a theater. He is also responsible for all rear operations functions. Normally, the TA commander divides the theater into a combat zone and a COMMZ. The boundary is defined primarily to assign territorial responsibilities to land operations and support echelons. The boundary normally coincides with the rear boundaries of the largest forward tactical formations (corps). The boundaries of both may change as the theater campaign progresses. Using the COMMZ configuration, the TA commander may subdivide his AOR into TAACOMs which may be further subdivided into ASGs. TAACOM commanders plan and coordinate rear security operations where ASG commanders execute such operations.

The RTOC plans and coordinates rear security for the TAACOM and ASG commander. RTOCs coordinate terrain management and monitor movement and sustainment efforts so they correlate with the overall rear security operation. The RTOC staff coordinates with base commanders from other services and HN forces to develop an overall scheme of defense for the TA rear area.

The concept of base defense is built on the mutual support and integration of all rear area defense plans and units. This concept is to defeat enemy attacks in the COMMZ with the least force required. Bases generally have a defined perimeter and established access controls. They include assets such as water supply points, and water purification, storage, and distribution elements. Bases are the basic building blocks upon which commanders plan and conduct rear security operations. Each base establishes a BDOC. For rear security planning and execution, the base commander communicates directly with the ASG RTOC responsible for the area if the base is independent of other bases. If it is part of a base cluster, the base commander communicates with the BCOC.

Base clusters are composed of a number of bases grouped in the same geographic area to enhance the support mission and collective security. Each cluster is unique and has a variety of characteristics that are dependent on location, mission, and relative importance. For example, the port security and harbor defense group, where the ROWPU barge is located, will function as a base cluster. This is due to its unique mission and interface with the ASG RTOC in the harbor area.

Base clusters generally have no defined perimeter or access controls; however, they are aligned with HN government and national boundaries when possible. The senior commander with an adequate staff to establish and operate the BCOC usually becomes the base cluster commander. Typically, the majority of bases in the rear area are integrated into base cluster configurations. This will reduce the span of control of the RTOCs, to help HN interface, and to focus the major rear security responsibilities on the base cluster commander. Large bases may constitute base clusters in and of themselves and will exercise all coordination and support responsibilities. This could be the case for the water supply battalion in arid environments.

All bases or base clusters in the COMMZ will perform similar roles in defense of their resources. The BDOC and BCOC will vary in size, structure, and capability, depending on which assets the commander can divert to create these organizations. The BDOC and BCOC are configured by the base or base cluster commander to function as the command and control cell. From this cell, the commander prepares for and conducts his segment of rear security operations.

BDOC

The base commander is responsible for establishing defense plans for the base. To accomplish this, he creates a BDOC from available base assets. The BDOC is the tactical operations center for the base and the focal point for base rear security operations. This command and control element frees the senior unit staff for its primary mission. Elements of the senior commander's HQ (if it is a water battalion) or elements from water elements as tenants may make up the BDOC. If the base is independent of other bases, the base commander communicates directly with the ASG RTOC for security planning and execution.

Water elements as tenants at a base should provide a suitable share of the staff required to establish a functional command and control cell. This cell should be capable of addressing all requirements, to include water. Its mission is to plan, direct, coordinate, integrate, and control all base defense efforts; water support being only one. The BDOC must accomplish the following critical functions: operations (planning and execution), intelligence (gathering and analysis), and communication.

Operations section. The operations section is mainly concerned with planning and coordinating current and future operations. It is responsible for preparing and implementing base defensive plans. It also serves as the central point of contact for coordination with the ASG RTOC, other BDOCs and BCOCs, MP forces, HNS, and ADC teams. Larger bases or base clusters which occupy critical sites (coastal or shore side purification operations) or perform sensitive missions (water storage sites in arid environments) may receive permanent liaison teams. These teams will assist in coordinating defensive efforts.

The operations section maintains defensive status boards, develops response force plans, recommends MOPP levels, and prepares overlays, fire support plans, and requests. The operations cell requests combat response forces from the ASG RTOC when threat forces exceed the capability of base initial response forces. It is the interface for the TCF commanders and the base during level II and III operations. Also, the operations section plans training and rehearsals for defense forces.

Intelligence cell. Depending on the size of the BDOC, the intelligence cell may or may not be an entity distinct from the operations section. The intelligence cell functions as the channel through which the base commander receives and transmits intelligence information concerning his AO. The cell develops information by exploiting all indigenous sources. These include: area security MP patrols, convoys, adjacent bases, RTOC intelligence communications, and TA and TAACOM sources.

The intelligence ceil serves as a focal point for the rear area NBC contamination control effort. The bases distance to civil population centers, transportation routes, communication links, and HN water purification and distribution networks enables base intelligence assets to provide the echelon RTOC with early warning and real-time assessment of local NBC conditions. This assessment enables the RTOCs to discern potential problem areas and develop the proper response to reduce the impact of threat NBC operations in the COMMZ.

Communications system. Communications assets must closely link all rear area activities. A secure and robust high-efficiency communications system between BDOC, BCOC, RTOC, and base defense elements is critical. Automated battlefield communication systems that include intercommunication and intracommunication 1inks are essential to base defense operations. Communications interface capability between response forces from HN or US assets is critical to a coordinated response.

BCOC

The base cluster commander establishes the BCOC from organic and tenant unit assets. The BCOC differs from the BDOC mainly in size and depth of organization and generally parallels that of the echelon operations center. Due to the size and available resources, BCOCs are more likely to have distinct and separate operational elements. These elements will provide command and control planning, intelligence, and communication functions in support of defensive operations.

Operations section. The operations section is the planning and execution center of the base cluster. It reviews, coordinates, and ensures the necessary links between individual base defense plans in its cluster. The BCOC is the clearinghouse for subordinate BDOC requests for support. These requests include ADC, HNS, response force augmentation, fire support, NBC and smoke, and other requests. Since water is essential for ADC (firefighting), NBC (decontamination), and minimal sustainment, the operations center arid BCOC representatives must provide water requirements for rear operations to the water support element. They will also provide operational and planning assistance to subordinate bases to develop their defense plans. The BCOC operations section develops, coordinates, and issues plans which subordinate commanders use to coordinate base and base cluster defense efforts with initial MP (response forces) and a TCF when necessary. The operations cell may also include HN representation from the civil-military infrastructure.

Intelligence cell and communications system. Responsibilities of intelligence cells and structure of communication systems are like those in the BDOC.

Base defense forces, response forces, or TCFs conduct rear security operations. Response units are usually MP or other assigned units found in the COMMZ. They may also include other available elements such as newly arrived or reconstituting units. They may also be HN assets. If the HN is viable, it retains responsibility for the response force and TCF operations.

Theater operational reserve forces may be located in the COMMZ and could possibly be used to counter large enemy incursions. Therefore, the Army component commander must have the flexibility to move and position reserves and reinforcements as necessary. The HQ of the TA commander, subordinate TAACOMs, and ASGs must maintain close coordination.

The ASG commander is responsible for rear security operations in his assigned area. He conducts detailed IPB of the area and prioritizes resources and measures to protect key assets, such as water purification, storage, and distribution. The prioritization is keyed to base assessments conducted by subordinate commanders, commanders of other services, and HN water installations or facilities. The ASG commander continuously reviews provisions for the employment of water assets to augment assigned forces on an emergency basis. He must have definite communication links established with TA, corps rear CP, corps support command, or corps RAOCs. Links must also be established with other service components and with allied organizations, installations, and assets located in the ASGs AOR.

THEATER FUNCTIONAL AREAS

Three other rear operations functional areas, besides security, are critical to the success of the theater water support plan of the rear security mission. These areas include: terrain management, sustainment, and movements. ASG command and control responsibilities and how they relate to water support in rear security operations are described below.

Terrain Management

The effective management of terrain, organizations, and facilities in the ASGs AO is critical to successful water support in rear security operations. Terrain management involves two functions. The first function is the positioning of water units. This is the process of assigning water units to a specific area or command. This function is an operations responsibility and is handled through the G3, DCSOPS, and SPO channels from TA to ASG levels of command. The second function is the stationing of water units. This is the process of assigning water units to specific facilities. This is normally the responsibility of the engineers at each level of command. RTOCs coordinate with operations and engineer staffs at every command level to ensure security implications of terrain management are addressed. They also coordinate with HN and with bases and base clusters to advise them on this subject.

Sustainment

TAACOMs and ASGs conduct sustainment operations as outlined in FM 63-4. Some specific sustainment missions conducted by TAACOMs and ASGs areas follows:

- Provide water support to units passing through or located in their assigned areas.
- Supporting the corps with GS water supply and backup DS water supply in arid environments.
- Supporting other forces and activities with water in the COMMZ when directed by the TA commander.

The TAACOM and ASG RTOCs monitor these water sustainment operations and advise their respective commanders on security implications resulting from sustainment efforts.

Movements

The TRANSCOM has responsibility for all TA movement operations. It is the principal Army transportation HQ in the theater and, although located in the COMMZ, provides theater wide transportation services. The TRANSCOM is functionally organized and may include motor transport, terminal, rail, and transportation aviation units which provide the capability to accomplish the theater transportation mission. While the TRANSCOM and its subordinate units command the transportation operating units in the COMMZ, the movement control agency is responsible for tasking of the overall transportation effort. While the water supply battalion has its own organic transportation assets, missions may require the use of TRANSCOM assets to accomplish water distribution in arid environments.

The ASG RTOC monitors water unit locations and relocation through coordination with the TAACOM staff, the MCC, HN interface elements, and adjacent, supporting and subordinate commands. The RTOC uses the information to combine static and moving water assets into the ASGs rear security support plans. The RTOC also uses all available assets such as vehicle drivers to enhance its capability to gather information, provide early warning, and transmit information.

HNS

The ASG also coordinates with HN authorities for water support of rear security operations in the area. It identifies HN water capabilities and negotiates with HN authorities to ensure water support is provided according to existing agreements. The ASG also coordinates with the HN to ensure that HN water activities do not interfere with US sustainment operations.

THEATER ADC

ADC measures are taken before, during, and after hostile action or natural disasters. These measures will help to reduce the probability of damage, to reduce its effects, and to aid in the continuation or reestablishment of normal operations. The TA commander is responsible for ADC in the COMMZ and established overall priorities. The TAACOM commanders and ASG commanders are responsible for planning ADC operations which employ water assets in their areas. They plan ADC operations through their respective RTOCs. Plans identify expected water requirements for ADC which exceed capabilities and the relative priorities of those ADC missions.

Base and base cluster commanders in the COMMZ coordinate requirements for ADC with the TA commander. Base and base cluster commanders establish priorities for ADC missions as part of their planning process. All units are responsible for providing integral ADC in their bases to the extent of their resources and capabilities.

The TAACOM RTOC, ASG RTOC, and base or base cluster commanders are responsible for ADC measures in the COMMZ. ADC measures to be taken before, during, and after the incident are listed in figure 7-1.

BEFORE INCIDENT

Bases and base clusters-

- Disperse and harden units and facilities to minimize damage.
- Designate responsibilities for ADC operations.
- Establish ADC priorities and assess unit vulnerabilities.
- Prepare, coordinate, and rehearse ADC plans and SOPs.
- Organize, equip, and train personnel and units for ADC operations.
- Establish communications and warning procedures.
- Designate alternate operational sites or alert areas.
- Maintain personnel roster for each facility and activity to expedite casualty search and rescue operations.
- Identify food, water, medical, and other critical supplies available for emergency distribution
- Identify assets available for NBC operations.

The ADC plans section of the TAACOM RTOC and ASG RTOC-

- Prepares ADC plans to support the bases and base clusters.
- Identifies, coordinates, and recommends missions for assets to support ADC operations.
- Recommends ADC priorities to the rear operations commander and identifies weaknesses in the ADC plan.
- Maintains an ADC status board to include commitment of engineer, chemical, MP, and base assets to ADC operations.
- Coordinates with ADC assistance from nonorganic units.
- Coordinates HNS.
- Integrates ADC with the operations center effort through constant analysis of rear, close, and deep operations in coordination with the RTOC intelligence officer.

DURING AND AFTER INCIDENT

Bases and base clusters-

- Reestablish communications.
- Assess damage, isolate danger areas, and provide updates as necessary to the RTOC.
- Prevent and fight fires.
- Administer medical aid and evacuate casualties.
- Restore mission-essential operations.
- Remove and dispose of unexploded ordnance.
- Conduct NBC reconnaissance, survey, and decontamination when required.
- Clear rubble, debris, and inoperative vehicles to restore mission support.
- Distribute emergency food,clothing, water, and fuel.

The TAACOM RTOC and ASG RTOC-

- Coordinate with engineer HQ for ADC support.
- Coordinate with MP to provide traffic control to allow emergency vehicles access to and from the area.
- Control refugees and crowds using HNS assets where possible.
- Monitor, maintain, and update an ADC map to include the position of incidents, NBC contamination, base responses, and assets available and committed.

Figure 7-1. ADC measures

APPENDIX A
WATER SUPPORT PLAN CHECKLIST

A-1. Water Support Requirements.

a. Water Consumption Planning Factors.
(1) Environment.
(2) Level of Command.
(3) Potable Requirements.
(4) Nonpotable Requirements.

b. Supported Force Structure.
(1) Army Forces.
(2) Other Services.
(3) Allied Forces.
(4) Local Nationals.
(5) Enemy Prisoners of War/Civilian Internees.

c. Total Water Requirement.
(1) Potable.
(2) Nonpotable.
(3) Additional Days of Supply.

A-2. Water Sources.

a. Type.
(1) Fresh.
(2) Brackish.
(3) Salt/Seawater.
(4) Groundwater.
(5) Existing Water Supply Systems.

b. Location.
(1) Grid Coordinates.
(2) Road Access.

c. Estimated Quantity Available.
(1) Gallons per Day (flowing sources).
(2) Gallons/Acre-feet (standing sources).
(3) Gallons per Minute (groundwater).

d. Development Requirements.
(1) Surface Source Site.
(2) Groundwater Well Site.
(3) Engineer Support Required.

A-3. Groundwater Development.

a. Detection.
(1) Map Overlays Available from Engineer Topographic Laboratory.
- Terrain Analysis Center.

(2) Water Detection Re sponse Team.

b. Aquifer Characteristics.
(1) Estimated Yield (gallons per minute).
(2) Quality (fresh, brackish, salt).
(3) Depth to Water (feet).

c. Units Required.
(1) Engineer Equipment Operations Teams (TOE 05520LF00).

A-4. Purification Requirements.

a. Quantity.
(1) Total Daily Requirement.
(2) Additional Days of Supply Storage Requirement.

b. Units Required.
(1) General Support.
- QM Water Team Barge Mounted (ROWPU) (TOE 10570LA00).
- QM Water Purification Team (12,000-GPH) (TOE 10570LC00).
- Water Purification Detachment (TOE 10469L000).

(2) Direct Support.
- QM Supply Company (TOE 42447L000).
- Division Water Section.
- Separate Brigade Water Section.
- Armored Cavalry Regiment Water Section.

A-5. Storage Requirements.

a. Quantity.
(1) Total Daily Requirement.
(2) Additional Days of Supply Storage Requirement .

b. Units Required.
(1) General Support.
- Water Supply Company (TOE 10468L000).

(2) Direct Support.
- QM Supply Company (TOE 42447L000).
- Division Water Section.
- Separate Brigade Water Section.
- Armored Cavalry Regiment Water Section.

(3) Arid Teams.
- QM Hot/Arid Environment Water Team (TOE 42526LC00).
- Aug-Arid Environment Water Section (TOE 42556LC00).
- QM CEB Team (TOE 42577LB00).

A- 6. Distribution Requirements.

a. Quantity.

(1) Total Daily Requirement.

(2) Hoseline Percentage.

(3) Truck (SMFT) Percentage.

b. Units Required.

(1) General Support.
- QM Tactical Water Distribution (Hoseline) (TOE 10570LG00).
- Transportation Medium Truck Company 40 ft CNR/CGO (TOE 55727L100).

(2) Direct Support.
- Division Water Section.
- Separate Brigade Water Section.

A-7. Command and Control.

a. Total Water Support Force Structure Required.

b. Units Required.

(1) General Support.
- QM HHD, Water Supply Battalion (TOE 10466L000).

(2) Direct Support.
- HHC, Area Support Group (TOE 63622L000).

A-8. Water Quality Surveillance.

a. Coordinate with Command Surgeon.

b. Coordinate with supporting Medical Brigade/Group/Battalion Staff.

A-9. Water Cooling.

a. Necessary in hot (arid, tropic) environments.

b. Equipment Required.

(1) Small Mobile Water Chiller (NSN 4130-01-131-2685).

APPENDIX B

WATER CONSUMPTION TABLES

Table B-1. Temperate zone factors

COMPANY

Function	Daily Gallons-Per-Man Requirements	
	Sustaining	*Minimum*
Drinking	1.5	1.5
Personal Hygiene	1.7	0.3
Field Feeding	0.3	0.8
Subtotal	3.5	2.6
+10% waste	0.4	0.3
TOTAL	3.9	2.9

BATTALION

Function	Daily Gallons-Per-Man Requirements	
	Sustaining	*Minimum*
Drinking	1.5	1.5
Personal Hygiene	1.7	1.0
Field Feeding	2.8	0.8
Subtotal	6.0	3.3
+10% waste	0.6	0.3
TOTAL	6.6	3.6

BRIGADE AND DIVISION

Function	Daily Gallons-Per-Man Requirements	
	Sustaining	*Minimum*
Drinking	1.5	1.5
Personal Hygiene	1.7	1.0
Field Feeding	2.8	0.8
Division-Level Medical Treatment	0.4	0.4
Subtotal	6.4	3.7
+10% waste	0.6	0.4
TOTAL	7.0	4.1

Function	Daily Gallons-Per-Man Requirements	
	Sustaining	*Minimum*
Drinking	1.5	1.5
Personal Hygiene	1.7	1.0
Field Feeding	2.8	0.8
Division-Level Medical Treatment	0.4	0.4
Hospital-Level Medical Treatment	0.7	0.7
Subtotal	7.1	4.4
+10% waste	0.7	0.4
TOTAL	7.8	4.8

	Sustaining	*Minimum*
Drinking	3.0	3.0
Personal Hygiene	1.7	1.0
Field Feeding	2.8	0.8
Heat CasualtyTreatment	0.2	0.2
Subtotal	7.7	5.0
+ 10% waste	0.8	0.5
TOTAL	8.5	5.5

BRIGADE AND DIVISION

Function	**Daily Gallons-Per-Man Requirements**	
	Sustaining	*Minimum*
Drinking	3.0	3.0
Personal Hygiene	1.7	1.0
Field Feeding	2.8	0.8
Heat Casualty Treatment	0.2	0.2
Division-Level Medical Treatment	0.4	0.4
Subtotal	8.1	5.4
+ 10% waste	0.8	0.5
TOTAL	8.9	5.9

CORPS AND ECHELON ABOVE CORPS

Function	**Daily Gallons-Per-Man Requirements**	
	Sustaining	*Minimum*
Drinking	3.0	3.0
Personal Hygiene	1.7	1.0
Field Feeding	2.8	0.8
Heat Casualty Treatment	0.2	0.2
Division-Level Medical Treatment	0.4	0.4
Hospital-Level Medical Treatment	0.9	0.9
Subtotal	9.0	6.3
+ 10% waste	0.9	0.6
TOTAL	9.9	6.9

Table B-3. Arctic zone factors

COMPANY

Function	Daily Gallons-Per-Man Requirements	
	Sustaining	*Minimum*
Drinking	2.0	2.0
Personal Hygiene	1.7	0.3
Field Feeding	0.3	0.8
Subtotal	4.0	3.1
+10% waste	0.4	0.3
TOTAL	4.4	3.4

BATTALION

Function	Daily Gallons-Per-Man Requirements	
	Sustaining	*Minimum*
Drinking	2.0	2.0
Personal Hygiene	1.7	1.0
Field Feeding	2.8	0.8
Subtotal	6.5	3.8
+10% waste	0.7	0.4
TOTAL	7.2	4.2

BRIGADE AND DIVISION

Function	Daily Gallons-Per-Man Requirements	
	Sustaining	*Minimum*
Drinking	2.0	2.0
Personal Hygiene	1.7	1.0
Field Feeding	2.8	0.8
Division-Level Medical Treatment	0.4	0.4
Subtotal	6.9	4.2
+10% waste	0.7	0.4
TOTAL	7.6	4.6

CORPS AND ECHELON ABOVE CORPS

Function	Daily Gallons-Per-Man Requirements	
	Sustaining	Minimum
Drinking	2.0	2.0
Personal Hygiene	1.7	1.0
Field Feeding	2.8	0.8
Division-Level Medical Treatment	0.4	0.4
Hospital-Level Medical Treatment	0.7	0.7
Subtotal	7.6	4.9
+10% waste	0.8	0.5
TOTAL	8.4	5.4

Table B-4. Arid zone factors

COMPANY		
Function	**Daily Gallons-Per-Man Requirements**	
	Sustaining	***Minimum***
Drinking	3.0	3.0
Personal Hygiene	1.7	0.3
Field Feeding	0.3	0.8
Heat Casualty Treatment	0.2	0.2
Vehicle Maintenance	0.2	0.2
Subtotal	5.4	4.5
+10% waste	0.5	0.5
TOTAL	5.9	5.0

BATTALION		
Function	**Daily Gallons-Per-Man Requirements**	
	Sustaining	***Minimum***
Drinking	3.0	3.0
Personal Hygiene	1.7	1.0
Field Feeding	2.8	0.8
Heat Casualty Treatment	0.2	0.2
Vehicle Maintenance	0.2	0.2
Subtotal	7.9	5.2
+10% waste	0.8	0.5
TOTAL	8.7	5.7

BRIGADE		
Function	**Daily Gallons-Per-Man Requirements**	
	Sustaining	***Minimum***
Drinking	3.0	3.0
Personal Hygiene	1.7	1.0
Field Feeding	2.8	0.8
Heat Casualty Treatment	0.2	0.2
Vehicle Maintenance	0.2	0.2
Division-Level Medical Treatment	0.4	0.4
Centralized Hygiene	1.8	0.0
Subtotal	10.1	5.6
+10% waste	1.0	0.6
TOTAL	11.1	6.2

Table B-4. Arid zone factors (continued)

DIVISION		
Function	**Daily Gallons-Per-Man Requirements**	
	Sustaining	***Minimum***
Drinking	3.0	3.0
Personal Hygiene	1.7	1.0
Field Feeding	2.8	0.8
Heat Casualty Treatment	0.2	0.2
Vehicle Maintenance	0.2	0.2
Division-Level Medical Treatment	0.4	0.4
Centralized Hygiene	1.8	0.0
Construction	0.5	0.0
Aircraft Maintenance	0.2	0.2
Subtotal	10.8	5.8
+ 10% waste	1.1	0.6
TOTAL	11.9	6.4

CORPS AND ECHELON ABOVE CORPS		
Function	**Daily Gallons-Per-Man Requirements**	
	Sustaining	***Minimum***
Drinking	3.0	3.0
Personal Hygiene	1.7	1.0
Field Feeding	2.8	0.8
Heat Casualty Treatment	0.2	0.2
Vehicle Maintenance	0.2	0.2
Division-Level Medical Treatment	0.4	0.4
Centralized Hygiene	1.8	0.0
Construction	1.5	0.0
Aircraft Maintenance	0.2	0.2
Laundry	2.1	0.0
Hospital-Level Medical Treatment	2.8	2.8
Subtotal	16.7	8.6
+ 10% waste	1.7	0.9
TOTAL	18.4	9.5

APPENDIX C

WATER QUALITY STANDARDS

Table C-1. Raw water constituents (maximum allowable)

CONSTITUENT	STANDARD
Physical and Chemical:	
Chloride	30,000 mg/l
Chlorine demand	No limit
Color	No limit
Hardness, total	No limit
Magnesium	No limit
pH	4 - 10 units
Sulfates	No limit
TDS	55,000 mg/l
Turbidity	150 NTU
Bacteriological:	
Coliform	1 x (10)6 per 100 ml (as measured with the membrane filter technique)
Chemical Agents:	
Cyanide	20 mg/l
Lewisite	20 mg/l
Mustard	20 mg/l
Nerve agents	20 mg/l
Radiological:	
Gross beta activity	100,000 pci/l

Table C-2. Short -term consumption

CONSTITUENT	STANDARD
Physical:	
Turbidity	Reasonably clear
Chemical:	
Arsenic	2.0 mg/l
Cyanide	20.0 mg/l
Bacteriological:	
Coliform	1.0 per 100 ml (as measured with the membrane filter technique)
Chemical Agents:	
Hydrogen cyanide	20.0 mg/l
Lewisite	2.0 mg/l
Mustard	0.2 mg/l
Nerve agents	0.02 mg/l
Radiological:	
No short term radiological standards have been established at this time.	

Table C-3. Long-term consumption

CONSTITUENT	STANDARD
Physical:	
Color	15 units
Turbidity	1 NTU
Chemical:	
Arsenic	0.05 mg/l
Chloride	600.0 mg/l
Cyanide	0.5 mg/l
Magnesium	150.0 mg/l
pH	5.0 - 9.2 units
Sulfates	400.0 mg/l
TDS	1500.0 mg/l
Bacteriological:	
Coliform	1.0 per 100 ml
Virus	1.0 per 100 ml
Spores/cysts	1.0 per 100 ml (as measured with the membrane filter technique)
Chemical Agents:	
Hydrogen cyanide	0.5 mg/l
Lewisite	0.2 mg/l
Mustard	0.05 mg/l
Nerve agents	0.005 mg/l
Radiological:	
Gross Beta activity	1000 pc/l
Strontium 90	10 pc/l

Table C-4. Classification of water uses

WATER TYPE	USES
Potable water	Field feeding operations Personal hygiene Medical treatment Photo processing Ice production
Disinfected nonpotable	Centralized hygiene Personnel decontamination Retrograde cargo washing Heat casualty treatment Graves registration Well development
Nonpotable fresh water	Vehicle coolant Aircraft washing Pest control Field laundry Concrete construction Well drilling
Seawater	Vehicle washing* Electrical grounding Fire fighting* Equipment decontamination Road construction

* Seawater may lead to significant corrosion of mechanical parts. Use nonpotable fresh water when available.

GLOSSARY

Section I - ACRONYMS AND ABBREVIATIONS

aa	air assault
abn	airborne
ACR	armored cavalry regiment
ADC	area damage control
ADC-S	assistant division commander for suppor
ADE	assistant division engineer
AFFS	Army Field Feeding System
agcy	agency
ALOC	air lines of communication
ammo	ammunition
AO	area of operations
AOR	areas of responsibility
APU	auxiliary power unit
AR	Army regulation
ARC	accounting requirements code
ASG	area support group
ATCSS	Army Tactial Command and Control System
ATP	Army Training Program
attn	attention
BCOC	Base Cluster Operations Center
BDOC	Base Defense Operations Center
bde	brigade
bk	book
br	branch
BSA	brigade support area
bn	battalion
CA	commercial activities
CEB	clothing, exchange and bath
cen	center
CEOI	Communications Electronics Operation Instructions
CFFS	Combat Field Feeding System
cfs	cubit feet per second
cgo	cargo
cl	class
CMMC	Corps Materiel Management Center
co	company
coll	collection
comd	command
COMM	communications
con	control
COSCOM	corps support command
CP	command post
CS	combat support
CSG	combat service group
CSS	combat service support
CTA	common table of allowance
DA	Department of the Army
DCSLOG	Deputy Chief of Staff for Logistics
DCSOPS	Deputy Chief of Staff for Operations and Plans
det	detachment
DISCOM	division support command
distr	distribution
div	division
DMMC	division materiel management center
DOS	days of supply
DS	direct support
DSA	division support area
DZ	drop zone
EAC	echelons above corps
env	environment
EPW	enemy prisoner of war
evac	evacuation
FAST	Freight Automated System for Traffic Management
FAWPSS	Forward Area Water Point Supply System
fld	field
FM	field manual
FSB	fire support base OR forward support battalion/brigade?
G3	Assistant Chief of Staff, G3 (Operations and Plans)
G4	Asst Chief of Staff, Logistics
G5	Assistant Chief of Staff, G5 (Civil Affairs)
gpd	gallons per day
gph	gallons per hour
gpm	gallons per minute
GPW	Geneva Convention Relative to the Treatment of Prisoners of War
GRREG	graves registration
GS	general support
hdlg	handling

HET	heavy-equipment transporter
HHD	headquarters and headquarters detachment
HMMWV	High Mobility Multi-purpose Wheeled Vehicle
HN	host nation
HNS	host nation support
HOCl	hypochlorous acid
HQ	headquarters
hvy	heavy
ident	identification
IPB	intelligence preparation of the battlefield
JTU	Jackson turbidity units
KIA	killed in action
LAPE	Low Altitude Parachute Extraction
LIB	Light Infantry Battalion
LIC	low intensity conflict
LID	Light Infantry Division
LO	Liaison Officer
LOC	lines of communication
log	logistics
LOGPAC	logistics packaging
LOGCAP	logistical civil augmentation program
LOTS	Logistics Over the Shore Operations
LP	listening post
lt	light
LZ	landing zone
maint	maintenance
mat	materiel
MBA	main battle area
MCC	movement control center
mdm	medium
METT-T	mission, enemy, terrain, troops, time
mgd	million gallons per day
mg/l	milligrams per liter
mgt	management
MKT	mobile kitchen trailer
ml	milliliter
MMC	Materiel Management Center
MOPP	mission-oriented protection posture
MOS	military occupational specialty
MOV	military owned vehicle
MP	military police
MPN	Most Probable Number
MRE	meal, ready-to-eat
MRO	materiel release order
MSB	main supply battalion
MSR	main supply route
MTOE	modification table of organization and equipment
NATO	North Atlantic Treaty Organization
NBC	nuclear, biological, and chemical
NIGA	neutron induced gamma activity
NTU	nephelometric turbidity units
OCl-	hypochlorite ion
ofc	office
OIC	officer in charge
op	operations
OP	observation post
OPCON	operational control
OPROJ	Operational Project
PCHT	packaging, crating, handling, and transportation
pCi	Picocuri
pci/l	Picocuri per liter
petrl	petroleum
pH	potential Hydrogen
plt	platoon
POL	petroleum, oils and lubricants
POW	prisoner of war
ppm	parts per million
prop	property
purif	purification
PVNTMED	preventive medicine
PWRMS	pre-positioned war reserve materiel stocks
PWS/DS	potable water storage and distribution systems
QM	quartermaster
QSTAG	quadripartite standardization agreement
RAOC	rear area operations center
RAP	rear area protection
rec	record
ROWPU	reverse osmosis water purification unit
RTOC	rear tactical operations center
S1	Adjutant (US Army)
S2	Intelligence Officer (US Army)
S3	Operations and Training Officer (US Army)
S4	Supply Officer (US Army)
S&S	supply and service
S&T	supply and transport
SIDPERS	Standard Installation/Division Personnel System
SMFT	semi-trailer mounted fabric tank
SOD	special operations detachment
SOI	signal operation instructions
SOP	standing operating procedure
spt	support
SPO	security, plans, and operations

sqd	squad
sqdn	squadron
SSI	silica silt index
STANAG	NATO Military Standardization Agreement
stor	storage
sup	supply
svc	service
TA	theater Army
TAACOM	Theater Army Area Command
TAC	Tactical Air Command
TAMMC	theater army materiel management center
TCF	tactical combat force
TDA	table of distribution and allowances
TDS	total dissolved solids
tk	truck
TM	technical manual
TMT	transportation motor transport
TO	theater of operations
TOE	table of organization and equipment
TPFDL	Timed-Phased Forced Deployment Lists
trans	transportation
TRANSCOM	transportation command
trf	transfer
trk	truck
trp	troop
TU	turbidity units
TWDS	tactical water distribution systems
UIC	unit identification code
US	United States
USA	United States Army
USAF	United States Air Force
VA	Virginia

Section II - DEFINITIONS

Absorption - The process of taking in or soaking up liquids (not to be confused with adsorption).

Acid - A compound, usually having a sour taste, which is able to neutralize an alkali or base. A substance that dissolves in water with a formation of hydrogen ions.

Acidity - A quantitative measurement of the total acid constituents of a water, both in the ionized and unionized states expressed as pH.

Aerobic - Requiring the presence of free oxygen.

Algae - *(1)* Tiny plant life, usually microscopic, existing in water. They are mostly green, blue-green, or yellow-green, and are the cause of most tastes and odors in water. *(2)* Microscopic plants which contain chlorophyll and live floating or suspended in water. They also may be attached to structures, rocks, or other submerged surfaces. Excess algae growths can impart tastes and odors to potable water. Algae produce oxygen during sunlight hours and use oxygen during the night hours. Their biological activities appreciably affect the pH and dissolved oxygen of the water.

Alkali - Various soluble salts, principally of sodium, potassium, magnesium, and calcium, that have the property of combining with acids to form neutral salts and may be used in chemical water treatment processes.

Alkaline - The condition of water or s oil which contains a sufficient amount of alkali substances to raise the pH above 7.0.

Alkalinity - A term used to represent the content of carbonates, bicarbonates, hydroxides, and occasionally borates, silicates, and phosphates in water.

Anaerobic - Requiring the absence of free oxygen.

Aquifer - A water-bearing formation or stratum beneath the earth's surface which transmits water from one point to another.

Backwash - The reversal of flow through a filter to wash clogging material out of the filtering medium and reduce conditions causing loss of head. Also called filter wash.

Bacteria - Primitive microscopic plants, generally free of pigment, which reproduce by dividing. They do not require light for their life processes.

Bacteria Count - An estimate of the total number of bacteria of all kinds in 1 milli-liter sample which will grow at the stated temperature, usually 37C. Also known as standard plate count.

Base - An alkali or hydroxide of the alkali metals, and of ammonia, which neutralized acids to form salts and water. Ionizes to form (OH-)ions. A hydroxide. An Alkali.

Brackish Water - Water rendered unfit for drinking because of salty or unpleasant tastes caused by the presence of excessive amounts of dissolved chemicals, chlorides, sulfates, and alkalis.

Chloramines - Compounds of organic amines or ammonia with chlorine.

Chlorination - Treatment of water by the addition of chlorine either as a gas or liquid, or in the form of hypochlorite, usually for the purpose of disinfection and oxidation.

Chlorinator - A device to apply chlorine to water at a known, controlled rate.

Chlorine - A powerful disinfectant used extensively in water treatment. As a gas, its color is greenish yellow and it is about 2 1/2 times heavier than air. As a liquid it is amber colored and about 1 1/2 times heavier than water. It is toxic to all organisms and corrosive to most metals.

Chlorine Demand - The difference between the amount of chlorine added to water and the amount of residual chlorine remaining at the end of a specified contact period. Chlorine demand may change with dosage, time, temperature, pH, nature, and amount of the impurities in the water.

Chlorine Dose - The amount of chlorine applied to a given amount of water. Usually measured in mg/l or ppm. The chlorine dose is equal to the chlorine demand plus the chlorine residual, when breakpoint chlorination is being used.

Chlorine Requirement - The amount of chlorine which must be added to produce the desired result under stated conditions. The result (the purpose of chlorination) may be based on any number of criteria, such as a stipulated coliform density, a specified residual chlorine concentration, the destruction of a chemical constituent, or others. In each case a definite chlorine dosage will be necessary. This dosage is the chlorine requirement.

Chlorine Residual - The total amount of chlorine (combined and free available chlorine) remaining in water at the end of a specified contact period following chlorination.

Coliform Organisms - A group of bacteria, predominantly inhabitants of the intestine of humans, but also found on vegetation, including all aerobic and faculative anaerobic bacilli, that ferment lactose to produce a gas as one of the byproducts.

Color, Apparent - Pigmentation due to the presence of suspended solids in a water supply.

Color, True - Pigmentation due to the presence of finely divided particles or droplets either dispersed, or in solution, in a water supply.

Command Surgeon - The brigade surgeon, division surgeon, or corps surgeon responsible for provision of medical support at the brigade, division, or corps concerned.

Compound - A substance containing molecules or two or more different elements which have entered into chemical combination with each other to form another substance unlike any of the constituent elements.

Concentration - A measure of the amount of dissolved substances contained per unit volume of solution. May be expressed as grains per gallon, pounds per million gallons, milligrams per liter.

Contaminant - As referred to in QSTAG and STANAG, any physical chemical, biological, or radiological substance or matter in water.

Contamination - A general term signifying the introduction into water of micro-organisms, chemicals, wastes, or sewage, which renders the water unfit for its intended use. Usually considered to imply the presence, or possible presence, of disease-producing bacteria. A specific type of pollution.

Corrosion - *(1)* The destruction of a substance; usually a metal, or its properties because of a reaction with its (environment) surroundings. *(2)* A complex chemical or electro-chemical action in which metals are converted into metallic ions and are carried into solution resulting in damage to pipes, fittings, and other metal components.

Dehydrate - To lose water from body tissues.

Discharge - *(1)* As applied to a stream, the rate of flow or volume of water flowing at a given place within a period of time. *(2)* The process of water or other liquid passing through an opening or along a conduit or channel. *(3)* The water or other liquid which emerges from an opening or passes along a conduit or channel.

Disinfectant - Any oxidant, including but not limited to chlorine, chlorine dioxide, chloramines, and ozone added to water in any part of the treatment or distribution process, that is intended to kill or inactivate pathogenic micro-organisms.

Disinfection - The process of killing most (but not necessarily all) of the harmful and objectionable micro-organisms in a fluid by various agents such as chemicals, heat, ultraviolet light, ultrasonic waves, and radiation.

Dissolved Solids - Solids that are present in solution.

Dose Equivalent - The product of the absorbed dose from ionizing radiation and such factors as account for differences in biological effectiveness due to the type of radiation and its distribution in the body as specified by the International Commission on Radiological Units and Measurements.

Escherichia Coli (E. Coli) - One of the species of bacteria in the coliform group. Its presence is considered indicative of fresh fecal contamination.

Evaporation - *(1)* The process by which water passes from a liquid state, at temperatures below the boiling point, to vapor. It is the principal process by which surface or subsurface water is converted to atmospheric vapor. *(2)* The quantity of water, measured as liquid water, removed from a specified surface per unit of time - generally in inches or centimeters per day, month, or year.

Field Water Supply System - That assemblage of collection, purification, storage, transportation, and distribution equipment and personnel to provide potable water to field units in both training and actual employment environments.

Filter - A device or structure for removing solid or colloidal matter (which usually cannot be removed by sedimentation) from water, or other liquids or semi-liquids, by a straining process whereby the solids are held on a medium of some kind (granular, diatomaceous earth, woven, and porous) while the liquid passes through.

Fixed Installation - An installation that, through extended use, has gained those structures and facilities not initially found or intended for use at a *"temporary"* standard facility (paved roads, fixed electrical distribution systems, fixed water treatment facilities, and underground distribution lines).

Fresh Water - Fresh water has a TDS concentration of less than 1,500 ppm. Brackish waters are highly mineralized and have a TDS concentration between 1,500 ppm and 15,000 ppm. Saltwaters have a TDS concentration greater than 15,000 ppm.

Ground Water - Water occurring in a stratum (aquifer) below the surface of the ground. The term is not applied to water which is percolating or held in the top layers of the soil, but to that below the water table.

Hardness - A characteristic of water, chiefly due to the existence therein of the carbonates and sulfates (and occasionally the nitrates and chlorides) of calcium, iron, and magnesium; causes *"curding"* of water when soap is used, increased consumption of soap, deposition of scale in boilers, injurious effects in some industrial processes and sometimes objectionable taste in the water. Commonly computed from the amounts of calcium and magnesium in the water and expressed as equivalent calcium carbonate.

Head - The height of the free surface of a fluid above a specified point in a hydraulic system. Head is expressed in linear units (or fractions thereof) such as feet or meters. Head is usually identified as static, dynamic, friction, velocity, and total.

Health Hazards - Any condition, including any device or water treatment practice, that may create an adverse effect on a person's well-being.

Host - A living animal or plant in which a pathogenic organism grows.

Hydrogen-ion Concentration (pH) - A measure of the acidity or alkalinity of a solution. A value of seven is neutral; low numbers are acid, large numbers are alkaline. Strictly speaking, pH is the negative logarithm of the hydrogen-ion concentration.

Hydrologic Cycle - The complete cycle of phenomena through which water passes, beginning as atmospheric water vapor, passing into liquid or solid form as precipitation, thence along or into the ground surface, and finally again returning to the form of atmospheric water vapor.

Hypochlorinators - Hypochlorinators are devices that are used to feed calcium or sodium hypochlorite as the disinfecting agent.

Incubation Period - The time required between infection by a pathogenic organism and the appearance of the signs of a disease.

Infiltration - *(1)* The flow or movement of water through the pores of a soil or other porous medium. *(2)* The absorption of liquid water by the soil, either as it falls as precipitation, or from a stream flowing over the surface. Also called seepage.

Inorganic Matter - Chemical substances of mineral origin; not of basically carbon structure.

Installation Medical Authority - Installation medical authority refers to the unit surgeon, command chief surgeon, US Army Medical Department Activity/US Army Medical Center commanders, and the Director of the Health Services or his representative responsible for provision of medical support at the unit, command or installation concerned in consultation with sanitary engineers and environmental science officers when appropriate.

Ion - An atom or molecule that has gained or lost one or more electrons.

Ionization - The process of the formation of ions by the splitting of molecules of electrolytes in solution.

Maximum Permissible Concentration - The maximum permissible level of a contaminant in water which is delivered to a free flowing outlet of the ultimate user of a military water system, except in the case of turbidity where the maximum permissible level is measured at the point of entry to the distribution system. Contaminants added to the water under circumstances controlled by the user, except those resulting from corrosion of piping and plumbing caused by water quality, are excluded from this definition.

Membrane Filtration - A method of quantitative or qualitative analysis of bacterial or particulate matter in a water sample by filtration through membrane capable of retaining bacteria.

Micro-Organism - A minute plant or animal in water or earth that is visible only through a microscope.

Milligrams Per Liter - A unit of the concentration of water or wastewater constituent. It has replaced the parts per million unit, to which it is approximately equivalent, in reporting the results of water analyses.

Mineral -*(1)* Any of a class of substances occurring in nature, usually comprising inorganic substances (such as quartz and feldspar) of definite chemical composition and usually of definite crystal structure, but sometimes also including rocks formed by these substances as well as certain natural products of organic origin, such as asphalt and coal. *(2)* Anysubstance that is neither animal or vegetable.

Molecule - The smallest portion of an element or compound retaining or exhibiting all the properties of the substance.

Most Probable Number (MPN) - *(1)* The best estimate, according to statistical theory, of the number of coliform (intestinal) organisms present in 100 ml of a water sample. *(2)* In the testing of bacterial density by the dilution method, that number of organisms per unit volume which, in accordance with statistical theory, would be more likely than any other possible number to yield the observed test result or which would yield the observed test result with the greatest frequency. Expressed as density of organisms per 100 ml.

Nonpotable Water - Water that has not been examined, properly treated, and approved by appropriate authorities as being safe for soldiers consumption. All water is considered nonpotable until declared potable.

Organic - *(1)* Characteristic of, pertaining to, or derived from living organisms. *(2)* Pertaining to a class of chemical compounds containing carbon.

Osmosis - The passage of a liquid from a weak solution to a more concentrated solution across a semipermeable membrane. The membrane allows the passage of the water (solvent) but not the dissolved solids (solutes). This process tends to equalize the conditions of either side of the membrane.

Palatable Water - Water that is pleasing to the taste; significantly free from color, turbidity, taste, and odor. Does not imply potability.

Peak Demand - The maximum load placed on a water system. This is usually the maximum average load over a period of time such as peak hourly demand, peak daily demand, or instantaneous peak demand.

pH - A measure of the acidity or alkalinity of a solution. A value of seven is neutral; low numbers are acid, large numbers are alkaline. Strictly speaking, pH is the negative logarithm of the hydrogen-ion concentration.

Picocuri (pCi) - That quantity of radioactive material producing 2.22 nuclear transformations per minute.

Pollution - The addition of sewage, industrial wastes, or other harmful or objectionable material to water. A general term that does not necessarily signify the presence of disease-producing bacteria.

Potable - *(1)* Water which does not contain any objectionable substances or pollution, and is satisfactory for human consumption. (2) Water that is free from disease-producing organisms, poisonous substances, and chemical or biological agents and radioactive contaminants which make it unfit for human consumption and many other uses. Potable water may or may not be palatable.

Precipitation - *(1)* The total measurable supply of water received directly from clouds, as rain, snow, hail, and sleet, usually expressed as depth in a day, month, or year, and designated as daily, monthly, or annual precipitation. *(2)* The process by which atmospheric moisture is discharged onto a land or water surface. *(3)* The phenomenon which occurs when a substance held in solution in a liquid passes out of solution into solid form.

Pressure - *(1)* The total load or force acting upon a surface. *(2)* In hydraulics the term when usedwithout qualifications usually means pressure per unit area (pounds per square inch, or kilograms per square centimeter) above local atmospheric pressure.

Product Water - This water is the product from the water treatment process and is ready to be consumed (also called FINISHED WATER).

Rate of Flow - The volume of water per unit of time which is passing a certain observation point at a particular instant. Common expressions are cubic feet per second (cfs), gallons per minute (gpm), gallons per day (gpd), million gallons per day (mgd).

Raw Water - Untreated water; usually the water entering the first treatment unit of a water purification unit. Water used as a source of water supply taken from a natural or impounded body of water, such as a stream, lake, pond, or ground water aquifer.

Reverse Osmosis - The application of pressure to a concentrated solution which causes the passage of a liquid from the concentrated solution to a weaker solution across a semipermeable membrane. The membrane allows the passage of the solvent (water) but not the dissolved solids (solutes). The liquid produced is a demineralized water.

Runoff - *(1)* In the general sense, that portion of the precipitation which is not absorbed by the deep strata, but finds its way into the streams after meeting the persistent demands of evapotranspiration. *(2)* That part of the precipitation which runs off the surface of a drainage area and reaches a stream or other body of water or a drain or sewer.

Sanitary Defects - Conditions that may permit the contamination of a water supply during or after treatment. These include connections to unsafe water supplies, raw water bypasses in treatment plants, plumbing fixtures improperly designed and installed, and leaking water and sewer pipes in the same trench.

Sanitary Survey - An inspection conducted in order to evaluate site specific geographic and environmental conditions in a watershed for the purpose of rendering a recommendation concerning use of the watershed for a particular purpose.

Sedimentation - Process of subsidence and deposition by gravity of suspended matter carried by water or other liquids. Also called settling, it is usually accomplished by reducing the velocity of flow of the liquid below the point where it can transport the suspended material.

Solution - A gas, liquid, or solid dispersed homogeneously in a gas, liquid, or solid.

Solution Feeder - A feeder for dispensing a chemical or other material in the liquid or dissolved state to water at a rate controlled manually or automatically by the quantity of flow. The constant rate is usually volumetric.

Spring - A surface feature where water issues from a rock or soil onto the land or into a body of water, the place of issuance being relatively restricted in size. Springs are classified in accordance with many criteria, including character of water, geologic formation, and geographical location.

Stratum - A geological term used to designate a single bed or layer of rock which is more or less homogeneous in character.

Suspended Solids - All visible material in water which at the time of sampling is not dissolved, and which can be removed by filtration.

Suspension - A system consisting of small particles kept dispersed by agitation or by molecular motion in the surrounding water. The permanence of suspension is dependent on the degree of agitation and the size of particles. A colloid is a special kind of suspension.

Temperature - *(1)* The thermal state of a substance with respect to its ability to communicate heat to its environment. *(2)* The measure of the thermal state on the arbitrarily chosen numerical scale, usually Centigrade or Fahrenheit.

Total Dissolved Solids - All of the dissolved solids in a water. TDS is measured on a sample of water that has passed through a very fine mesh filter to remove suspended solids. The water passing through the filter is evaporated and the residue represents the dissolved solids.

Transpiration - The process by which plants dissipate water into the atmosphere through their leaves and other surfaces.

Treated Water - Water that has undergone processing such as sedimentation , filtration softening, disinfection,and is ready for consumption. Included is purchased potable water which is retreated (chlorinated and fluoridated). Does not imply potability until inspected by PVNTMED personnel and approved by the command surgeon.

Turbidity - *(1)* A condition in water caused by the presence of suspended matter, resulting in the scattering and absorption of light rays. *(2)* A measure of fine suspended matter in liquids. *(3)* An analytical quantity usually reported in arbitrary turbidity units determined by measurements of light diffraction.

Turbidity Units (TU) - Turbidity units are a measure of the cloudiness of water. If measured by a nephelometric (deflected light) instrumental procedure, turbidity units are expressed in nephelometric turbidity units (NTU) or simply TU. Those turbidity units obtained by visual methods are expressed in Jackson turbidity units (JTU) which are a measure of the cloudiness of water, they are used to indicate the clarity of water. There is no real connection between NTUs and JTUs. The Jackson Turbidimeter is a visual method and the nephelometer is an instrumental method based on deflected light.

Vector - An insect or other organism that carries and transmits a pathogenic amoeba, bacterium, fungus, virus, or worm.

Virus - The smallest (10 to 300 millimicrons in diameter) form capable of producing infection and diseases in humans or other large species. The true viruses are insensitive to antibiotics. They multiply only in living cells where they are assembled as complex macromolecules utilizing the cells' biochemical systems. They do not multiply by division as do intracellular bacteria.

Water - A chemical compound consisting of two parts of hydrogen and one part of oxygen and usually having other solid, gaseous, or liquid materials in solution or suspension.

Water-Bearing Formation - A term, more or less relative, used to designate a geological formation that contains considerable ground water. It is usually applied to formations from which the ground water may be extracted by pumping.

Water Quality - The chemical, physical, and biological characteristics of water with respect to its suitability for a particular purpose. The same water may be of good quality for one purpose or use, and bad for another, depending on its characteristics and the requirements for the particular use.

Water Rights - The rights, acquired under the law, to use the water occurring in surface or ground waters, for a specified purpose and in a given manner and usually within the limits of a given period. While such rights may include the use of a body of water for navigation, fishing, and hunting, other recreational purposes, the term is usually applied to the right to divert or store water for some beneficial purpose or use, such as irrigation, generation of hydroelectric power, and water supply for human consumption.

Water Table - The upper surface of a zone of saturation (in ground water) where the aquifer is not confined by an overlying impermeable formation.

Well - An artificial excavation that derives water from the interstices of the rocks or soil which it penetrates.

Well, Artesian - A well tapping a confined or artesian aquifer in which the static water level stands above the bottom of the confining bed and the top of the aquifer. The term is used to include all wells tapping such basins or aquifers. Those in which the head is insufficient to raise the water to or above the land surface are called sub-artesian wells.

REFERENCES

ARMY REGULATIONS

40-5	Preventive Medicine
71-13	The Department of the Army Equipment Authorization and Usage Program
200-1	Environmental Protection and Enhancement
310-25	Dictionary of United States Army Terms (Short Title: AD)
310-31	Management System for Tables of Organization and Equipment (The TOE System)
310-49	The Army Authorization Documents System (TAADS)
310-50	Authorized Abbreviations and Brevity Codes
700-136	Land Based Water Resources Management in Contingency Operations

COMMON TABLE OF ALLOWANCES

50-909	Field and Garrison Furnishings and Equipment
50-970	Expendable/Durable Items (Except: Medical, Class V, Repair Parts and Heraldic Items)

DEPARTMENT OF THE ARMY FORM

2028	Recommended Changes to Publications and Blank Forms

FIELD MANUALS

3-3	NBC Contamination Avoidance
3-4	NBC Protection
3-5	NBC Decontamination
3-100	NBC Operations
3-101	Chemical Staffs and Units
5-100	Engineer Combat Operations
5-104	General Engineering
5-105	Topographic Operations
5-166	Well Drilling Operations
8-8	Medical Support in Joint Operations
8-10	Health Service Support in a Theater of Operations
8-15	Medical Support in Divisions, Separate Brigades, and the Armored Cavalry Regiment
8-20(TEST)	Health Service Support in a Combat Zone
8-21	Health Service Support in a Communications Zone
8-33	Control of Communicable Diseases in Man
8-55	Planning for Health Service Support
10-13	Supply and Service Reference Data
10-24	Ration Distribution Operations
10-27	General Supply in a Theater of Operations
10-60	Subsistence Supply and Management in Theaters of Operations
10-115	Quartermaster Water Units
10-280	Mobile Field Laundry, Clothing Exchange, and Bath Operations
10-501	Airdrop of Supplies and Equipment: Rigging Containers
19-4	Military Police Team, Squad, Platoon Combat Operations

19-30	Physical Security
21-10	Field Hygiene and Sanitation
27-10	The Law of Land Warfare
29-51	Division Supply and Field Service Operations
31-70	Basic Cold Weather Manual
31-71	Northern Operations
34-81	Weather Support for Army Tactical Operations
41-10	Civil Affairs Operations
54-23	Materiel Management Center, Corps Support Command
54-40	Area Support Group
55-1	Army Transportation Services in a Theater of Operations
55-2	Division Transportation Operations
55-10	Movement Control in a Theater of Operations
55-30	Army Motor Transport Units and Operations
55-40	Army Combat Service Support Air Transport Operations
55-50	Army Water Transport Operations
55-60	Army Terminal Operations
63-1	Combat Service Support Operations, Separate Brigade
63-2	Combat Service Support Operations - Division (How to Support)
63-3	Combat Service Support Operations - Corps (How to Support)
63-4	Combat Service Support Operations - Theater Army Area Command
63-20	Forward Support Battalion
63-21	Main Support Battalion, Armored, Mechanized and Motorized (Spt Main)
63-22	Headquarters and Headquarters Company, and Division Material Management Center Division Support Command, Armored, Mechanized, and Motorized Divisions
90-2	Battlefield Deception
90-3(HTF)	Desert Operations (How To Fight)
90-5(HTF)	Jungle Operations (How to Fight)
90-6	Mountain Operations
90-10(HTF)	Military Operations on Urbanized Terrain (MOUT) (How to Fight)
90-14	Rear Battle
100-1	The Army
100-2-1	Soviet Army Operations and Tactics
100-2-2	Soviet Army Specialized Warfare and Rear Area Support
100-2-3	The Soviet Army Troops Organization and Equipment
100-5	Operations
100-10	Combat Service Support
100-15(TEST)	Larger Unit Operations
100-16	Support Operations: Echelons Above Corps
100-20	Low Intensity Conflict
100-27	US Army/US Air Force Doctrine for Joint Airborne and Tactical Airlift Operations
101-5	Staff Organization and Operations
101-5-1	Operational Terms and Symbols
101-10-1/1	Staff Officers Field Manual - Organizational, Technical and Logistical Data (Volume 1)
101-10-1/2	Staff Officers Field Manual - Organizational, Technical, and Logistical Data, Planning Factors (Volume 2)
704-28	Classes of Supply

TECHNICAL BULLETINS

MED 576	Occupational and Environmental Health: Sanitary Control and Surveillance of Water Supplies at Fixed Installations
MED 577	Occupational and Environmental Health: Sanitary Control and Surveillance of Field Water Supplies

TECHNICAL MANUALS

5-343	Military Petroleum Pipeline Systems
5-813-1	Water Supply: Sources and General Considerations
5-813-3	Water Supply: Water Treatment
5-813-4	Water Supply, Water Storage
5-813-5	Water Supply, Water Distribution
5-813-6	Water Supply: Water Supply for Fire Protection
5-813-7	Water Supply for Special Projects, Vol 7
5-813-8	Water Desalination

JOINT CHIEF OF STAFF PUBLICATION

JCS PUB 4.01	Joint Logistics Policy and Guidance

DEPARTMENT OF DEFENSE DIRECTIVE

DODD 4705.1	Management of Land-Based Water Resources in Support of Joint Contingency Missions

* QUADRIPARTITE STANDARDIZATION AGREEMENTS

QSTAG 245	Minimum Requirements for Water Potability (Short and Long Term Use)
QSTAG 479	Water Quality Analysis Set (Engineer and Preventive Medicine)

** STANDARDIZATION AGREEMENTS

STANAG 2136	Minimum Standards of Water Potability
STANAG 2885	Procedures for the Treatment, Acceptability and Provision of Potable Water in the Field

TABLES OF ORGANIZATION AND EQUIPMENT

05520LF	Engineer Equipment Operation Teams
10466L	Quartermaster Headquarters and Headquarters Detachment, Water Supply Battalion
10468L	Water Supply Company
10469L	Water Purification Detachment
10570LA	Quartermaster Water Team, Barge-Mounted (ROWPU)
10570LC	Quartermaster Water Purification Team (12000 GPH)
10570LG	Quartermaster Tactical Water Distribution (Hoseline)
42007L	Supply and Service Company, Main Support Battalion, Heavy Division
42026L	Headquarters and Supply Company, Supply and Transport Battalion, Infantry Division (Light)

*** Quadripartite standardization agreements are available from Commanding Officer, Naval Publication and Forms Center, ATTN: NPFC 106,5801 Tabor Avenue, Philadelphia, PA 19120-5099.**

**** Standization agreements are available from Commanding Officer, Naval Publication and Forms Center, ATTN: NPFC 106,5801 Tabor Avenue, Philadelphia, PA 19120-5099.**

42056L	Headquarters and Supply Company, Supply and Transport Battalion, Airborne Division
42066L	Headquarters and Supply Company, Supply and Transport Battalion, Air Assault Division
42077L	Supply and Transport Troop Support Squadron, Armored Cavalry Regiment
42084L	Supply and Transport Company, Support Battalion, Separate Heavy Brigade
42447L	Quartermaster Supply Company
42507LC	Augmented-Arid Environmental Water Section
42526LC	Quartermaster Hot/Arid Environmental Water Team
42556LC	Augmented-Arid Environmental Water Section
42556LF	Quartermaster Hot/Arid Environmental Water Team
42577LB	Quartermaster Clothing Exchange and Bath Team
42577LC	Quartermaster Graves Registration Team
55727L	Transportation Medium Truck Company, 40-Foot Container/Cargo
55728L	Transportation Medium Truck Company, 20-Foot Container/Cargo
63622L	Headquarters and Headquarters Company, Area Support Group

Projected Publication

FIELD MANUAL

10-52-1	Water Supply Point Equipment and Operations

INDEX

By Order of the Secretary of the Army:

CARL E. VUONO
General, United States Army
Chief of Staff

Official:

WILLIAM J. MEEHAN II
Brigadier General, United States Army
The Adjutant General

DISTRIBUTION:

Active Army,USAR, and ARNG: To be distributed in accordance with DA Form 12-11-E, requirements for FM 10-52, Field Water Supply (Qty rqr block no. 875).

☆U.S. GOVERNMENT PRINTING OFFICE : 1995 O - 388-421 (02487)

PIN: 057490-000