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Development of an Army Water Security Strategy: Stateside Component

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Abstract: In October 2010, the Army Environmental Policy institute initiated the development of an Army water security strategy, which was ultimately published in December 2011. The purpose of this effort was to; (1) provide a complete workable definition for Army water security, (2) conduct the first comprehensive study of water security management in the Army, and (3) identify the key issues on which Army leadership can focus to ensure that the Army has enough water of suitable quality for the foreseeable future. A review of key policy drivers was followed by a series of interviews of personnel inside and outside the Army. The culminating effort identified four major goal areas, three of which apply to stateside military installations: (1) water resources sustainability – preserve sources, protect rights, (2) reduce demand, and (3) maintain infrastructure integrity and security. This paper provides a condensed view of the objectives associated with each of these three goals.

Keywords: *Military, strategic planning, water resources managment*

A recent Army paper concerning water security states:

> The availability of water is of strategic importance to all levels of the Army enterprise. Having continued access to adequate water resources and the ability to deliver treated water efficiently is essential for on-going and future Army missions. However, a widely favorable water supply situation cannot be assumed. Future water security will be directly affected by climate and demographic changes, making continued availability uncertain in many parts of the world where the Army operates (Assistant Secretary of the Army for Installations 2012).

As the U.S. Army protects and advances American security interests around the world, its stateside installations – the focus of this paper – play a vital role in support of global operations, preparing personnel and materiel for deployment overseas.

Figure 1 shows where active Army installations are currently located. Installations that were established in regions where the population density was low, economic activity was limited, and fresh water was relatively plentiful did not initially need to be particularly concerned about the sustainability of their long-term water supply. Regional growth across the country and the significant reduction of fresh water availability in some areas, however, has raised the level of interest in ensuring that every Army installation has the water it needs to fulfill its mission in support of national defense.

But there is no one-size-fits-all approach to providing water security for Army installations. Ensuring water security across the Army enterprise will involve addressing a complex interaction of interests and concerns. Appendix 1 characterizes the types of complexities that complicate water security planning and the attendant consequences for installations.

The Army Water Security Strategy (Department of the Army 2011) identifies a broad set of goals, objectives, and associated actions that can be undertaken at appropriate levels to address key facets of Army water resources management.

These factors provided a conceptual framework:

- Sources: The quantity and quality of natural, raw water (both surface and ground water) available to the region.
- Supply: Rights to water and water infrastructure.
- Sustainable Practices: Water use efficiency concepts.
- Survivability: Preventing and recovering from water supply disruption or contamination.
- Sponsorship: Identification and alignment of Army water management responsibilities.
- Stakeholders: Constructive engagement with regional water users.

Encompassing all of these facets, the Strategy offers this definition:

> Army water security is the assurance that water (potable and non-potable) of suitable quality will be provided at rates sufficient to fully support the Army wherever it has, or anticipates having, a mission in the future (Department of the Army 2011).

To develop water security goals and objectives, the research team supporting the development of the Army Water Security Strategy (Department of the Army 2011) conducted a thorough review of current policy drivers concerning Army water management and completed a series of interviews of personnel inside and outside the Army. The resulting goals and objectives are described below.

Goals and Objectives

Water Resources Sustainability – Preserve Sources, Protect Rights

Rationale: Regional population growth and land development tends to increase demands on regional water sources (Kenny et al. 2009), increase the variability in surface water flow rates (Brun and Band 2000), decrease surface water quality (Urbonas and Roesner 1993), and decrease ground water recharge rates (Viessman et al. 1977). These consequences may affect the availability of water to support current and future Army mission requirements, and diminished water quality may increase Army water treatment costs. Legal and administrative challenges to maintaining Army water rights highlight the importance of exercising

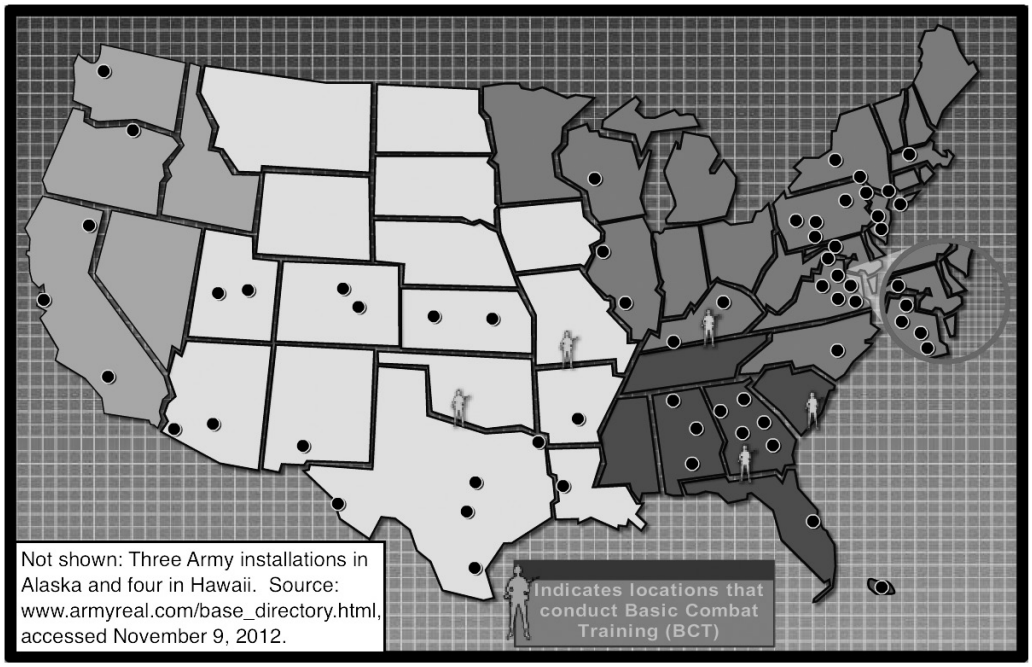


Figure 1. U.S. Army Installations in the United States.

diligence in protecting those rights.

Objectives for Protecting and Preserving Water Sources and Water Rights Include:

Anticipate Long-Term Water Requirements. Anticipating long-term water requirements involves maintaining up-to-date assessments of an installation's current and projected water needs in the context of regional water availability and verifying in advance that adequate water resources are available for future mission requirements as part of both the real property master planning process and the basing decision process for new or realigned functions. This objective can be advanced by:

- Sustaining support for use of water demand forecasting software. As computer technologies change and forecasting methods evolve, sustained support for the use of forecasting software will ensure that they are properly updated and continue to be useful (April and Abran 2008; Billings and Jones 2007).
- Establishing a long-term forecast period for water requirements at each installation that includes a regional water supply and demand analysis. A water demand forecast based on a number of conceivable scenarios (Billings and Jones 2007) provides a useful basis for discussing risks and the consequences of future actions taken by the Army and other regional water users.
- Designating a regular cycle or set of triggers for revising installation and regional forecasts. Diligence in refreshing forecasts, perhaps as part of existing planning requirements, will not only ensure that recent information is available to decision makers, but also provide valuable periodic feedback concerning costs and benefits of selected forecast methods (Walters 1986).

Protect Water Rights. Protecting water rights involves the development of a proactive policy to identify and protect Army water rights nationwide. Legal concerns pertaining to water rights will continue to encompass a variety of complex issues, including water rights associated with federal lands reserved out of the public domain, water rights associated with land transactions, benefits and consequences of participating in state permitting programs, and opportunities for banking and monetizing water rights. Issues are further complicated by the differences in water law among the states (Jungreis 2005; Sherk 2003). As the frequency and intensity of water rights issues may increase in the foreseeable future, Army water security will benefit from maintaining appropriate levels of vigilance concerning the protection of water rights for all Army installations.

Integrate Water Assessments into Strategic Decisions. Integrating water assessments into strategic decisions involves evaluating water resource requirements and the effects of installation water use early in all strategic planning actions. This includes base closure and realignment actions as well as designs, program basing, renewable energy siting, and procurement and acquisition decisions. Water availability is best evaluated ahead of basing decisions and associated environmental assessments. An early assessment of the availability of water to support each of several alternative courses of action being considered will shed light on any water security concerns that may affect the cost and consequences associated with each option. The time frame for Military Construction decisions is too slow to adapt to changing water needs and constraints. As the Army advances its capabilities in cyberspace (Department of the Army 2012a), the amount of water required for cooling new data centers makes the evaluation of water availability ahead of siting decisions even more critical. This objective can be advanced by:

1. Using water footprint analysis (Hoekstra et al. 2011) to make resource and mission decisions for different types of installation activity. Based on known measures, including recent metering data, the Army can establish reasonable ranges of water use for different missions and specialized sectors, such as renewable energy projects.
2. Amending Army facilities management and real property planning guidance. This guidance can include mission-based water planning requirements and community participation in water source protection and water supply planning activities, in a manner that is similar

to the Joint Land Use Study process (Office of Economic Adjustment 2006).

3. Assessing and tracking embedded water risks for critical items in the Army supply chain. This requires:
   - Compiling a master list of all the Army's suppliers;
   - Determining which supplies are critical; where criticality is based on the importance of what a supplier produces to a final product or service that cannot be obtained by any other suppliers;
   - Ranking all the critical supplies against one another with respect to the amount of risk of these suppliers' not being able to produce their product or service;
   - Using geo-spatial tools to physically locate the manufacturing location of each critical supplier; and
   - Determining what the current and future water availability is for that supplier.

Alternatively, suppliers of critical equipment can be required to report on the sustainability of the water supplies on which they depend to support their processing as a contract requirement. The supply chain contains an un-assessed amount of risk that cannot be determined and addressed in the absence of such data and analysis.

Influence Long-Term Water Management outside the Fence Line. Long-term water management of water outside of Army installations involves proactively engaging external stakeholders who have a role in the protection, use, and long-term availability of water in the watersheds and aquifers on which these installations also depend. Proactive engagement can:

- Provide installations with a situational awareness of trends that may affect regional water resources;
- Give installations the opportunity to make their water resources interests better understood; and
- Encourage collaborative efforts to address water issues that affect all the communities relying on a shared water source. Collaborative efforts may include, for example, the Army Compatible Use Buffer Program (Department of the Army 2008) to protect watersheds.

Coordinate, Refine, and Exercise Emergency Response Plans and Preparations. Emergency response involves robust planning and preparation for extreme events and supply disruptions that may affect water availability. This objective can be advanced by:

- Ensuring proper function of back-up water supply systems, and increasing emergency storage volumes within distribution systems.
- Developing strategies for sourcing, pre-placement and rotation of contingency drinking water drinking and material stockpiles and establishing procurement relationships with other sources that can be activated in times of acute shortage.
- Reviewing and updating installation and community Water System Emergency Response Plans and installation contingency water plans. The feasibility of implementing water contingency operations plans under actual emergency scenarios should be clear.
- Promoting favorable state policies concerning defense water requirements during drought. Research undertaken to support the Army Water Security Strategy found that only two states had established priorities concerning defense requirements for water during times of water scarcity.
- Ensuring that privatization contracts are sufficiently flexible to allow for facility operation adjustments and investments in a timely manner in an emergency or contingency response situation.

Eliminate Water Planning Inefficiencies. Eliminating inefficiencies involves consolidating and clarifying water information requirements so that different planning instruments developed at any one Army installation provide a consistent view of the water situation. Incorporating water planning consistently into installation master plans (Department of the Army 2005) can further enhance the planning process.

Provide Comprehensive Water Security

Guidance for Installations. This involves developing Army water security guidance materials that include sections focused on:

- Water rights protection;
- Water security responsibilities for garrison command and staff;
- Stakeholder engagement considerations regarding water;
- Water demand forecast methods;
- Investment priorities; and
- Water management support resources within the Army, Department of Defense, and other branches of government.

The USACE approach to Integrated Water Resources Management (U.S. Army Corps of Engineers 2012b) can be further adapted to this end.

Water Resources Sustainability – Reduce Demand

Rationale: Among current policy drivers pertaining to Army sustainability generally, water conservation is a recurring emphasis. Pursuing opportunities to manage demand should continue as a key water security goal, and it will be of particular importance where unilateral Army water management decisions can have a major influence on the sustainability of the Army's water supply.

Objectives for Reducing Demand Include

Reduce Water Withdrawal and Consumption Rates. Diminishing water consumption will minimize the net effect of Army water use on regional surface and ground water resources. Also, reducing rates of water use will reduce the costs associated with water treatment, storage, distribution, and heating, and wastewater collection and treatment. By setting a high standard for conservation and responsible water use, Army installations can serve as a model for surrounding communities to follow in preserving and protecting shared water sources. The Army's Net Zero Water initiative, begun in 2011 (Department of the Army 2012b; U.S. Army Corps of Engineers 2012a), will help to reduce water use, increase installation security, and increase the Army's sustainability of regional water sources of supply.

Match Water Quality to Water Use. Where feasible, potable water can be replaced with lower quality rainwater, ground water, or gray water (U.S. Department of Energy 2012). Given the expense of treating water to meet fresh water standards, those costs can be saved where fresh water can be replaced by alternative sources for such uses as irrigation and toilet flushing. Some water security advantages, such as the use of gray water and treated wastewater, however, will come at the cost of constructing and maintaining separate distribution systems, which may not be affordable or feasible to operate in some locations.

Sustain a Culture of Efficiency and Conservation. The Army's success in using water efficiently will be influenced by the choices made by individuals at all levels across the organization. Perpetuating an awareness of the importance of using water efficiently will encourage choices that collectively make a difference in how water is used across the enterprise. Sustaining a culture of efficiency and conservation will encourage the adoption of standard operating procedures, building standards, best management practices, procurement decisions, training practices, and individual behaviors that result in water savings. Programs that highlight and return benefits of efficiencies at the points of water consumption and, on the other hand, amplify negative consequences of wasting water will service as incentives to advance beyond awareness to higher levels of unit and individual commitment.

Tailor Expectations to Differences Among Installations. Adapting water conservation targets and conservation strategies among installations is important, in order to recognize variations in geographic settings and in water consumption reductions already achieved. Executive Order No. 13514 (2009) specifies water use reductions relative to a 2007 baseline for federal agencies, each agency evaluated as a whole. Using a 2007 baseline for setting individual installation goals, however, creates challenges for installations whose 2007 water use intensity was already low, either because of sizable deployments that year, or because of water consumption reductions already achieved. Identifying where the greatest additional decreases in water use intensity can be achieved and

prioritizing water conservation efforts accordingly may yield greater conservation reductions for the Army as a whole.

Mitigate Adverse Consequences of Aggressive Conservation. Infrastructure design and operation must be adapted to ensure that substantially reduced flows do not pose health hazards. Since residual chlorine levels in treated water diminish over time, low flow rates in water distribution systems can result in increased health risk from reduced disinfection at points of consumption. Low flow rates in pipes that carry wastewater can result in insufficient movement of waste through the system and, consequently, exceptionally high concentrations of contaminants entering a receiving wastewater treatment plant. High nitrogen concentrations in wastewater are particularly problematic, as inadequate treatment may result in National Pollutant Discharge Elimination System violations (Environmental Protection Agency 2010).

Strategic Investment – Maintain Infrastructure Integrity and Security

Rationale: Army water security requires robust funding to ensure that water and wastewater systems do not deteriorate or become obsolete. With the annual sustainment, restoration, modernization, and military construction funding levels routinely less than the amount required to fully revitalize and maintain these utilities, there is a systematic underfunding of Army-owned water and wastewater systems.

Utilities privatization projects, where implemented, have been largely successful in recapitalizing and upgrading Army water systems. Utilities privatization provides a stabilized utility rate platform by amortization of project costs and the accumulation of Repair and Restoration reinvestment funds. The Army Energy and Water Campaign Plan (Department of the Army 2007) cites utilities privatization as the Army's preferred strategy for upgrading identified deficiencies in existing utility infrastructure. The Army utilities privatization Program was reviewed and reauthorized on 28 January 2011 by the 3-star Budget, Requirements, and Programs Board and was subsequently validated for funding.

Privatizing infrastructure assets has raised questions about how to ensure that those assets are protected from accidents and malicious tampering. Relying on connections to external utilities exposes the installation to external vulnerabilities and introduces concerns about how an installation will function in a situation that requires it to be self-sufficient for an extended length of time.

Army research and development has a significant ongoing role ensuring that the Army uses the most efficient and effective water infrastructure technology. Research and development in the areas of contaminant sensing, control systems, water purification, and water quality analysis generates tools, techniques and internal knowledge specifically suited to Army water security concerns.

Objectives for Strategic Investment Include:

Develop Funding Baseline. Developing a baseline of all water system funding requirements for retained and privatized water systems is fundamentally important to the maintenance of infrastructure integrity and security. A baseline of funding requirements will indicate where the greatest water security needs and risks are, not only in terms of infrastructure condition, but also in terms of the criticality of the missions that the infrastructure supports.

Recapitalize. Recapitalization means funding sustainment, restoration, and modernization sufficiently to provide for water utilities recapitalization among installations whose water infrastructure assets have not been privatized. Chronic underfunding of Army-owned infrastructure perpetuates inefficiencies that exacerbate the scarcity of funds and introduces unnecessary risks to Army missions. Funding with a long-term view of costs and benefits will reduce waste and mitigate risk of infrastructure failure.

Anticipate Costs. This means estimating ahead of time the increased costs of water projects resulting from privatization, and budgeting

funds accordingly. Under privatization contracts, addressing years of previously deferred infrastructure maintenance can result in substantial increases in the cost of water.

Provide Advance Planning, Contractual Flexibility, and Adequate Staff Support to Implement and Administer Army Water Privatization Contracts. Adequate support involves ensuring that all Army water privatization contracts include advance planning that identifies and prioritizes initial water system improvement projects, with sufficient flexibility to accommodate future increases in installation missions and water consumption. The period of performance for privatization contracts may extend over several decades. Including planning services in these contracts, providing contractual flexibility, and maintaining robust staff support will help ensure that long-term privatization commitments deliver the greatest value to the Army and ensure the greatest level of security. Contracts should be explicit in granting full infrastructure access to Army Anti-Terrorism/ Force Protection personnel and to Public Health officials. Anti-Terrorism/Force Protection personnel and health personnel should be able to inspect the entire water system, review operational logs and laboratory procedures, collect and test water samples, ensure compliance with the National Primary Drinking Water Regulations, and make recommendations where improvements are needed. Contract language should be clear and specific concerning responsibilities for water infrastructure security. Security concerns should include how well a contractor will respond to a crisis situation and the degree to which installations have the flexibility and means to operate self-sufficiently, for a sufficient period of time.

Provide Internal/External Infrastructure Compatibility. This objective entails ensuring that Army installation infrastructure and external, privately owned infrastructure function together with a high degree of effectiveness and efficiency. Water and wastewater systems that were designed to serve separate communities face different performance requirements when they are expected to function together. Resolving these differences will increase operational efficiency and security.

Install Robust Contamination Risk Reduction Technologies. Deliberate or accidental contamination of critical infrastructure pipelines can disrupt installation operations, affect human health, and result in high economic costs associated with infrastructure downtime and recovery. A security system that provides ongoing monitoring, generates prompt alerts, and facilitates contaminant isolation within a water distribution system will reduce the risk of serious disruptions on Army installations should contamination occur (Ginsberg and Smith 2011).

Assess the Vulnerability of Water and Wastewater Infrastructure to Natural Mishaps. While installations have been required to complete a Water System Vulnerability Assessment (U.S. Army Environmental Command 2011) concerning risk of deliberate disruption or contamination of water supplies, there is not currently a requirement to assess vulnerabilities to natural mishaps. Flooding events in particular may disrupt the function of pumping stations and treatment plants. Climate change is widely expected to increase the severity of flooding inland and result in sea level rise along coastlines. The EPA Climate Ready Water Utilities initiative (Environmental Protection Agency 2012) offers tools that can be adapted to the assessment of flood risk.

Conclusion

Army water security is strengthened when focused attention is given to each of several different key facets of the water resources management challenge. These facets include regional water availability, water rights, water infrastructure, water use, and water consumption for production of materiel. The issues are complex and interrelated, the situation at each installation is different, funds are limited, and effective action will require strong leadership. The Army Water Security Strategy offers a way forward by highlighting the work that can be done to ensure best management of water resources in the interest of national defense.

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Appendix 1. Overview of Complexities of Army Water Security.

Complexity	Situation	Consequence
Diverse Missions	Every Army mission is different, some missions are joint, and missions change.	Rational allocation of resources among water security concerns will not simply rely on measures of water use intensity or per capita consumption, but will also consider the value of the military capabilities supported.
Diverse Leadership History Among Installations	The differences in the focus of various commanders over time, and changes in the leadership at any one location have led to different results. Some installations have established a tradition of thought leadership in water management and conservation.	The need for information, policy, guidance, and assistance in matters of water security varies greatly, and overall Army progress in this area would improve with wide-ranging leadership and commitments above the installation level. Practical solutions developed at one location may be of benefit at other locations.
Multiple Levels and Types of Responsibilities Across the Army Enterprise	Stakeholders across the Army enterprise have responsibility for different aspects of ensuring that water of suitable quality is provided. Water security encompasses medical, technical, financial, legal, doctrinal, logistic, managerial, research and community relations concerns among fixed facilities and contingency operations. Having many disparate stakeholders reporting to different commands and bill payers tends to weaken communications, management, and oversight of the overall water mission. Different key organization units include Logistics, Public Health, Assistant Chief of Staff for Installation Management/ Installation Managment Command, U.S. Army Corps of Engineers, research development test and evelualuation communities, and Antiterrorism/Force Protection interests.	A comprehensive approach to ensuring water security will involve coordination among Army offices with diverse and overlapping mandates. Leadership needs to encourage ongoing communication and cooperation among all stakeholders to prevent redundant effort and ensure that all stakeholders share a common goal and align their initiatives in support of that goal.
Multiple Resource Inputs to Army Missions	Water, while absolutely vital, is not the only essential resource that the Army has an interest in securing to meet mission needs.	In the context of ever-pressing funding constraints, proposed investments in water security solutions will always need to be weighed against other investment needs and opportunities.
Multiple Water Security Components	Water must typically be obtained from a natural water body, treated, distributed, and, following consumption, discharged. Upstream levels of land development, industrialization, and agriculture affect the quantity and quality of water running off into surface water bodies and percolating down into aquifers. Between the raw water source and consumer, the infrastructure and equipment needed for water treatment, storage, and delivery	Since water security can be affected at multiple points, a robust water security strategy will need to address the vulnerabilities at each of those points. An effective monitoring, surveillance, and protection program must be developed and incorporated into the installation of a water security plan to protect these components and to allow early detection of problems and rapid response to identified problems. Higher levels of security must be provided for infrastructure designated as critical.

Appendix 1. Overview of Complexities of Army Water Security (cont.)

Complexity	Situation	Consequence
	may lie both inside and outside installation boundaries. Each of these components is vulnerable to accidental and intentional compromise. Computerized control systems are vulnerable to cyber attack. For contingency bases, meeting water requirements presents more complex technical and logistics challenges. The mix of consumptive and non-consumptive uses by the Army determines the availability of water for other users downstream.	
Energy Requirements for Water	Without energy, water systems do not function. From source to tap, every aspect of water collection, transference, treatment, and distribution requires pumps and other equipment that require power. The energy delivery systems may be compromised by overload, natural, accidental, and intentional events, and may be local or widespread in nature.	Robust and redundant or backup energy delivery systems must be considered to be of paramount importance in developing a water security strategy. Employing gravity to the extent possible to move water through the water system can reduce the need to purchase energy, and should be considered when designing new systems.
Differences Among Freshwater Sources	Water sources include surface and ground water with different characteristics. Surface and ground water are connected. Water may be moved in substantial amounts across watershed boundaries. Watersheds, rivers and aquifers vary in size and water quality.	Evaluating water resource characteristics only within the watershed in which an installation lies will not necessarily be sufficient as a basis for identifying factors that influence water availability at an installation. Looking upstream of an installation may lead through external infrastructure to surface and ground water sources that originate many miles away. From one installation to the next, the scale of this kind of analysis may vary substantially.
Geographic Variability	The geographic conditions affecting water security vary considerably among Army locations. Climate differences are well known. The quality of raw water can be variously influenced by natural chemicals, agriculture, industry, and urbanization. Regional growth rates and patterns are different from one location to the next. Legal constraints on water rights vary across the United States and internationally.	An enterprise-wide Army water security strategy must encompass diverse solutions that are tailored to the specific conditions in and around the installation or contingency base. Programmatic goals and objectives that are tailored to regional and installation-specific circumstances will ensure maximum benefit for dollars invested
Vagaries of Weather and Climate	Weather will always vary naturally. The effects of climate change cannot be precisely predicted.	The consequences of Army action (or inaction) cannot be determined precisely. Addressing water security issues will necessarily require some judgment concerning the probability that adverse situations develop.

Appendix 1. Overview of Complexities of Army Water Security (cont.)

Complexity	Situation	Consequence
Multiple Water Users	The Army is one water user among many. The amount of raw water available from regional water sources is influenced by the behavior not only of the Army, but also of many other water users. Water is also needed to support ecosystem services.	Unilateral Army action with regard to its own water use may or may not have a significant effect on the sustainability of the supplies upon which the Army is relying. Army water conservation efforts alone will not necessarily result in substantial increases to water security.
Size and Extent of Army Water Systems	Individuals or groups who have issues with the government or the military, be they terrorists, disgruntled or former employees, angry citizens or student organizations recognize that threats and actions against military facilities or personnel get attention, and large water distribution systems can be vulnerable at many points.	Surveillance and vigilance, including education programs, detection equipment, and water system vulnerability assessments, need to be improved and increased to deter, delay, and respond rapidly to water system attacks of any kind.
Multiple Levels of Government Interest	States administer water rights and federal interests participate in state water rights adjudications. Army water use may involve government interests as close as the local public water utility, as broad as interstate water commissions, and as distant as host nations overseas. Host nation agreements would further involve allied/friendly governments.	States administer water rights and federal interests participate in state water rights adjudications. Army water use may involve government interests as close as the local public water utility, as broad as interstate water commissions, and as distant as host nations overseas. Host nation agreements would further involve allied/friendly governments.
Multiple Drivers for Water Conservation	Beyond the mandates of Executive Order No. 13514 (2009), conservation action may also be driven by cost savings opportunities, by legal constraints due to legislation such as the Endangered Species Act, by applicable state water law, and by limitations on the quantity and quality of raw water available.	A robust evaluation of the success of conservation efforts will examine more than progress toward consumption reduction goals relative to a baseline consumption rate. At any given allocation, a variety of factors will affect how much water use intensity can be reduced from prior years.
Differences in Arrangements Involving Non-Military Organizations	Water and wastewater utilities may be Army owned and operated, Army owned and privately operated, or privately owned and privately operated. External public utilities may supply all or part of the water needed.	Policies and procedures encompassing Army water and wastewater infrastructure will have implications for commercial and public organizations supplying these services.