United States Government Accountability Office

Report to the Committee on Armed Services, U.S. Senate

November 2019

WATER SCARCITY

DOD Has Not Always Followed Leading Practices to Identify At-Risk Installations

GAO-20-98

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GAO Highlights

Highlights of GAO-20-98, a report to the Committee on Armed Services, U.S. Senate

Why GAO Did This Study

DOD reported in January 2019 that critical installations are at risk of water scarcity—that is, of not having sufficient water available to meet their mission needs. According to military department officials, installations depend on water for activities such as training, weapons testing, fire suppression, and sanitation. In its 2018 *Fourth National Climate Assessment*, the U.S. Global Change Research Program reported that warming temperatures will continue to cause worsening droughts and the decline of surface water quality.

Senate Report 115-262 included a provision for GAO to review DOD's identified or potential effects of water scarcity. For this report, GAO evaluated the extent to which DOD has assurance that it is using reliable information to identify installations at risk of water scarcity. GAO analyzed DOD's six assessments conducted from April 2017 through January 2019 to identify installations at risk of water scarcity and compared the assessments with five leading practices for identifying and analyzing water scarcity. GAO also interviewed officials from OSD and the military departments and contacted a nongeneralizable sample of 17 installations identified in OSD's assessments to reflect diversity in military service, mission, and water scarcity.

What GAO Recommends

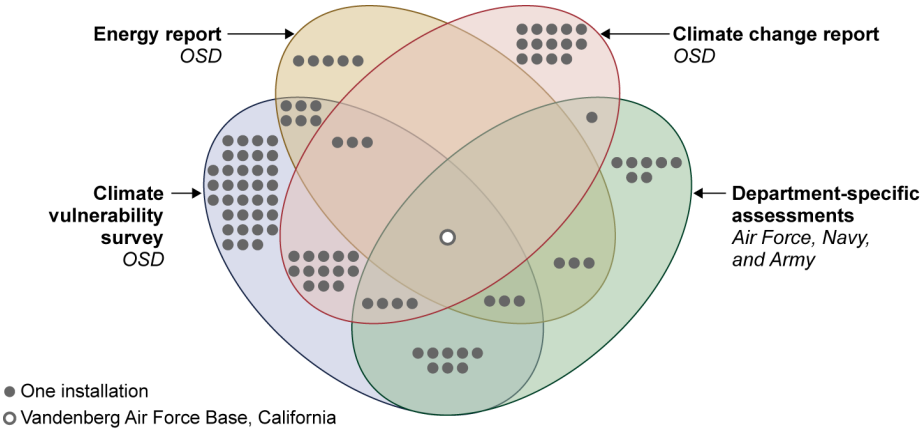
GAO recommends that the Office of the Secretary of Defense assess whether it should conduct a coordinated, department-wide assessment aligned with leading practices or rely on military department assessments to determine which DOD installations are at risk of water scarcity. DOD concurred with GAO's recommendation.

View GAO-20-98. For more information, contact Elizabeth Field at (202) 512-2775 or fielde1@gao.gov.

What GAO Found

GAO found that the Department of Defense (DOD) does not have assurance that it is using reliable information regarding which installations are at risk for water scarcity. When comparing the results of six Office of the Secretary of Defense (OSD) and military department assessments on installations vulnerable to water scarcity, GAO found that they varied markedly, raising questions about their quality and about which source of information DOD is using to determine which installations are vulnerable to water scarcity (see figure).

Installations Identified in the Office of the Secretary of Defense (OSD) and Military Department Assessments as Being at Risk of Water Scarcity



Source: GAO analysis of Department of Defense information. | GAO-20-98

An OSD official stated that the three OSD-produced assessments provided the best information available on which installations are at risk of water scarcity. However, GAO found that these assessments did not reflect four of five leading practices for identifying and analyzing water scarcity—practices that contribute to a reliable assessment of water availability. Specifically, OSD did not always (1) identify current water availability, (2) identify future water availability, (3) take into account all sources of water, or (4) precisely identify locations. Further, although GAO found that the three military department assessments aligned with all leading practices, OSD officials disagreed as to whether these assessments can and should be used to identify installations at risk of water scarcity across the defense enterprise. Until OSD resolves the question as to whether it should conduct a department-wide assessment of installations that aligns with leading practices or whether it should rely on the military department assessments, the department will not have assurance that it is using reliable information to assess water scarcity.

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Abbreviations

DOD	Department of Defense
OSD	Office of the Secretary of Defense

U.S. GOVERNMENT ACCOUNTABILITY OFFICE
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November 27, 2019

The Honorable James M. Inhofe
Chairman
The Honorable Jack Reed
Ranking Member
Committee on Armed Services
United States Senate

The Department of Defense (DOD) reported in January 2019 that critical installations are at risk of water scarcity—not having sufficient water available to meet their mission needs.[1] According to officials from the military departments, installations depend on water to support DOD missions—using water, for example, for training, weapons testing, fire suppression, and sanitation. According to DOD, water scarcity can impair testing activities and increase prohibitions on testing and training when combined with increased temperatures, and contributes to heat-related illnesses. In its 2018 *Fourth National Climate Assessment*, the U.S. Global Change Research Program reported that changes in precipitation and warming temperatures will continue to cause worsening droughts and the decline of surface water quality.[2] According to the assessment, these changes will reduce the availability of water in parts of the United States and increase the risk of water scarcity.

Because of the effects these and other changes in the climate could have on federal programs, we have included *Limiting the Federal Government's Fiscal Exposure by Better Managing Climate Change*

[1]Department of Defense, *Report on Effects of a Changing Climate to the Department of Defense* (January 2019). For the purposes of this report, we define water scarcity as referring to conditions in which the demand for water in a given area approaches or exceeds available water supplies. For the basis of this definition, see GAO, *Technology Assessment: Municipal Freshwater Scarcity*, GAO-16-474 (Washington, D.C.: Apr. 29, 2016).

[2]U.S. Global Change Research Program, *Fourth National Climate Assessment, Volume II: Impacts, Risks, and Adaptation in the United States* (Washington, D.C.: 2018). We have not assessed the underlying methodology used to generate the predictions of the National Climate Assessment; our use of its projections and findings is based on its credibility as a consortium of 13 federal member agencies mandated to assess the climate by the Global Change Research Act of 1990, Pub. L. No. 101-606 (1990). All projections within the *Fourth National Climate Assessment, Volume II,* are contingent on multiple factors, which may or may not change in the future.

Risks on our High Risk List since 2013.[3] We noted in our March 2019 High Risk report that disaster costs are projected to increase as extreme weather events become more frequent and intense due to climate change, as observed and projected by the National Academies of Sciences, Engineering, and Medicine and the U.S. Global Change Research Program. Further, we have previously reported about the challenges in managing water resources and the risks of water scarcity. In May 2014, we reported on the risk of water scarcity that state water managers face.[4] According to these managers, experts, and literature we reviewed, we found that freshwater shortages are expected to continue into the future and, in particular, 40 of 50 state water managers expected shortages in some portion of their states under average conditions in the next 10 years. In April 2016, we found that in times when water scarcity occurred, conflicts among users increased over the use of limited freshwater resources, including irrigation, power production, and municipal water use.[5]

Since 2015, Congress has directed DOD to conduct three assessments that, in part, required the department to identify installations at risk of water scarcity. The three military departments have also required such assessments. Senate Report 115-262, accompanying a bill for the John S. McCain National Defense Authorization Act for Fiscal Year 2019, included a provision for us to review DOD's water resource management practices and the identified or potential effects of water scarcity.[6] This report evaluates the extent to which DOD has assurance that it is using reliable information to identify installations at risk of water scarcity.

[3]GAO, *High-Risk Series: Substantial Efforts Needed to Achieve Greater Progress on High-Risk Areas*, GAO-19-157SP (Washington, D.C.: March 2019). Since the early 1990s, our high-risk program has focused attention on government operations with greater vulnerabilities to fraud, waste, abuse, and mismanagement, or that are in need of transformation to address economy, efficiency, or effectiveness challenges. This effort, supported by the Senate Committee on Homeland Security and Governmental Affairs and by the House of Representatives Committee on Oversight and Reform, has brought much needed attention to problems impeding effective government and costing billions of dollars each year.

[4]GAO, *Freshwater: Supply Concerns Continue, and Uncertainties Complicate Planning*, GAO-14-430 (Washington, D.C.: May 20, 2014).

[5]GAO-16-474.

[6]S. Rep. No 115-262, at 164 (2018).

To address our objective, we reviewed statutes and congressional committee reports that directed DOD to conduct assessments for climate-related purposes, including for identifying installations at risk of water scarcity.[7] We also analyzed information contained in the six DOD assessments conducted from April 2017 through January 2019 in response to congressional or military department reporting requirements that identify installations at risk of water scarcity—three Office of the Secretary of Defense (OSD) assessments and three military department assessments—to determine the extent to which the assessments identified the same or different installations.[8] To discuss the methodologies used in the six assessments, we interviewed officials who were knowledgeable about the various assessments: officials from OSD's Office of the Assistant Secretary of Defense for Sustainment; each of the military departments with responsibilities for water management at military installations; CNA,[9] which completed the Department of the Navy's assessment; and the University of Nebraska-Lincoln's National Drought Mitigation Center, which hosts the U.S. Drought Monitor map that shows parts of the United States in drought.

We compared the methodologies used to develop OSD's three assessments and the military departments' three assessments with five leading practices for identifying and analyzing risks of water scarcity. We derived the five leading practices from the Department of Energy's and

[7]Senate Report 114-57 at 13 (2015), which directed DOD to include an assessment of coastal erosion and potential flooding risks in the siting of proposed military construction projects; section 335 of the National Defense Authorization Act for Fiscal Year 2018, Pub. L. No. 115-91, (2017), which directed DOD to provide a report on vulnerabilities to military installations and combatant commander requirements resulting from climate change over the next 20 years; and two committee reports: Senate Report 114-237 at 9-10 (2016) and House Report 115-188 at 23 (2017), which directed DOD to report on military installations' water usage, water conservation, and vulnerability to water scarcity.

[8]Office of the Under Secretary of Defense for Acquisition, Technology and Logistics, *Department of Defense Climate-Related Risk to DOD Infrastructure Initial Vulnerability Assessment Survey (SLVAS) Report* (January 2018); Office of the Assistant Secretary of Defense for Energy, Installations, and Environment, *Department of Defense Annual Energy Management and Resilience Report (AEMRR), Fiscal Year 2017* (July 2018); Office of the Under Secretary of Defense for Acquisition and Sustainment, *Report on Effects of a Changing Climate to the Department of Defense* (January 2019); U.S. Air Force, *Summary Information on Installations with Water Hazards* (November 2018); CNA, *Assessing Water Risk at DON Installations—Identifying Hazards and Water Management Challenges,* report prepared for the U.S. Navy (December 2017); and U.S. Army, *FY17 Installation Status Report (Mission Capacity) Water Data Analysis (*April 2017*).*

[9]CNA is not an acronym and is a nonprofit research and analysis organization.

the United States Environmental Protection Agency's compilation of 14 water efficiency best management practices, and principles published in the University of Nebraska–Lincoln's National Drought Mitigation Center's *10-Step Drought Planning Process*. These leading practices are: (1) identify current water availability, (2) identify future water availability, (3) take into account all sources of water, (4) precisely identify locations, and (5) comprehensively include all locations.[10] According to the *10-Step Drought Planning Process*, data and information derived from these leading practices contribute to a reliable assessment of water availability. To obtain information about water scarcity at individual installations, we selected a nongeneralizable sample of active-duty installations in the contiguous United States. To develop this sample, we included installations that were identified by DOD assessments as having water-related vulnerabilities and by military department officials in interviews as having ongoing pilot studies or issues related to water scarcity. We also included installations that had historically experienced water scarcity, those that had recently experienced water scarcity, and those that are projected to experience water scarcity in the future. From these criteria, we selected a nongeneralizable sample of 17 installations that were identified in OSD's three assessments that reflected diversity in military service, mission, and water scarcity.[11] We visited five of the installations in person and sent the remaining 12 installations a list of questions similar to those used during our site visits. The installation officials provided information such as how water is being used for mission related activities

[10]For the purposes of this report, we selected the practices and principles most relevant to a large, federal agency responsible for installations across the United States and grouped them into five leading practices relevant for the purposes of identifying and analyzing installations at risk of water scarcity. See Department of Energy, Office of Energy Efficiency and Renewable Energy, *Best Management Practices for Water Efficiency: Water Management Planning.* The Federal Energy Management Program within the Department of Energy's Office of Energy Efficiency and Renewable Energy, worked with the United States Environmental Protection Agency to develop 14 water efficiency best management practices to help agencies increase water efficiency and meet federal requirements. The *10-Step Drought Planning Process* was first published by the University of Nebraska–Lincoln's National Drought Mitigation Center founding director, Dr. Donald A. Wilhite, in 1990. Its most recent update appeared as Donald A. Wilhite, Michael J. Hayes, and Cody L. Knutson, "Drought Preparedness Planning: Building Institutional Capacity," in *Drought and Water Crises: Science, Technology, and Management Issues*, Donald A. Wilhite, ed. (CRC Press, 2005).

[11]We originally contacted 20 installations, but we removed one installation (Fort Hunter Liggett, California) from our sample because it is a reserve installation, and we removed two installations (Dover Air Force Base, Delaware, and Naval Air Station Corpus Christi, Texas) from our sample because they were not listed in the OSD assessments as being at risk of water scarcity.

and whether water scarcity had affected or was expected to affect the installation's mission related activities. To determine the extent to which DOD has assurance it is using accurate and reliable information about installations at risk of water scarcity to manage water resources across the department, we compared the information DOD has from the various assessments with *Standards for Internal Control in the Federal Government* on using quality information to achieve agency objectives.[12] See appendix I for a more detailed description of our scope and methodology.

We conducted this performance audit from September 2018 to November 2019 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Background

Factors Affecting Water Scarcity in the United States

Water scarcity occurs when the demand for water in a given area approaches or exceeds available water supplies. In April 2016, we reported that drinkable water has traditionally been assumed to be reliable, cheap, and abundant.[13] However, with parts of the United States—especially the Southwest—facing recurring drought and persistent water scarcity, that view has been challenged. Water is also not always available when and where it is needed, in the amount or quality desired, or in a cost-effective manner. In times of water scarcity, there are often competing demands for water—such as irrigation, power production, municipal water supplies, and supporting aquatic life. As we reported in May 2014, state water managers expect freshwater shortages to continue into the future.[14]

[12]GAO, *Standards for Internal Control in the Federal Government*, GAO-14-704G (Washington, D.C.: March 2014).

[13]GAO-16-474.

[14]GAO-14-430.

According to the United States Global Change Research Program's *Fourth National Climate Assessment*, significant changes in water availability are evident across the country and are expected to persist in the future due to changes in precipitation and rising temperatures.[15] For example, droughts occurring from deficits in precipitation, soil moisture, and snow runoff will likely occur more frequently. Further, since a warmer atmosphere holds more water, when rain does fall high-intensity events can occur more frequently. These sudden downpours will increase the mobility of pollutants, such as sediments and nutrients, and of algae, which can reduce the quality and quantity of available drinking water. The assessment noted that in some regions of the United States, the supplies of water are already stressed by increasing consumption, and continued warming will add to this stress, adversely affecting the availability of water in parts of the United States and increasing the risk of water scarcity.

DOD's Reliance on Water for Mission-Critical and Support Activities

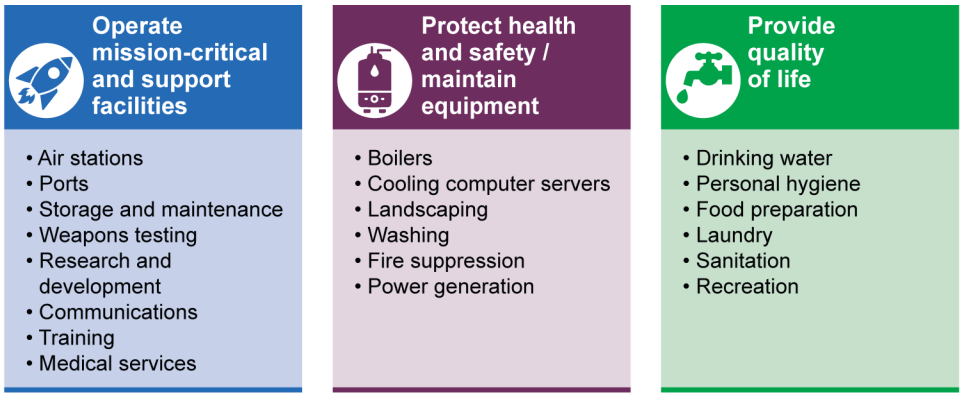
The military departments rely on water at installations to conduct and support their missions. For example, according to military department officials, water is necessary to operate missions such as rocket launches for cooling and for noise and fire suppression (see sidebar), to maintain temperatures to properly store equipment such as parachutes, and for firefighting training (see fig. 1).

Rocket Launch at Vandenberg Air Force Base, California

According to Vandenberg Air Force Base officials, water is used in multiple ways during rocket launch activities. For example, water is necessary for noise and vibration suppression, heat reduction, and fire suppression as needed. The officials stated that between 60,000 to 100,000 gallons of water are needed for each launch. In 2018, there were nine launches. With an anticipated increase in launches in the future, they expect the demand for water to increase as well.

Source: Joe Davila, U.S. Air Force. | GAO-20-98

Figure 1: Categories and Examples of Installation Activities That Require Water to Conduct and Support Military Missions



Source: GAO analysis of Department of Defense information. | GAO-20-98

[15]United States Global Change Research Program, *Fourth National Climate Assessment Volume II: Impacts, Risks, and Adaptation in the United States.*

According to our calculations based on OSD's baseline data and water consumption ratios, in fiscal year 2018 DOD consumed about 84 billion gallons of water. In July 2018, OSD stated that the department's drinking water consumption had decreased over time; however, according to military departments' officials, their respective departments continue to rely on water at installations to conduct and support their missions.[16]

OSD's and the Military Departments' Policy and Planning-Related Responsibilities for Managing Water Use

OSD officially reorganized its acquisition organization on January 31, 2018, in response to Section 901of the National Defense Authorization Act for Fiscal Year 2017.[17] Under the reorganization, responsibilities of the former Under Secretary of Defense for Acquisition, Technology and Logistics were divided between two new offices—the Under Secretary of Defense for Research and Engineering and the Under Secretary of Defense for Acquisition and Sustainment. According to DOD, responsibilities for energy, installations, and environment were transferred from the Office of the Undersecretary of Defense for Acquisition, Technology and Logistics to the newly created Office of the Under Secretary of Defense for Acquisition and Sustainment in 2018.[18] According to an OSD official, within this office, responsibilities for water management at military installations are delegated to two deputy assistant secretaries under the Office of the Assistant Secretary of Defense for Sustainment—the Office of the Deputy Assistant Secretary of Defense for Environment, who is responsible for water resources management in general, and the Office of the Deputy Assistant Secretary of Defense for Energy, who is responsible for overseeing planning for water at the installation level.

[16]Department of Defense, Office of the Assistant Secretary of Defense for Energy, Installations, and Environment, *Annual Energy Management and Resilience Report (AEMRR), Fiscal Year 2017*.

[17]Section 901 of the National Defense Authorization Act for Fiscal Year 2017, Pub. L. No. 114-328 (2016) directed the reorganization of the Office of the Secretary of Defense, and, in 2018, DOD created the Office of the Under Secretary of Defense for Acquisition and Sustainment.

[18]Deputy Secretary of Defense Memorandum, *Implementation Guidance for the Establishment of the Office of the Under Secretary of Defense for Research and Engineering and the Office of the Under Secretary of Defense for Acquisition and Sustainment* (Jan. 31, 2018).

Each of the military departments has designated an office or multiple offices with responsibilities for water policy and implementing programs to support that policy at installations. Specifically:

- **Air Force:** The Assistant Secretary of the Air Force for Installations, Environment, and Energy is responsible for procedures to manage the Air Force's water consumption, throughput, and requirements, in alignment with policies and strategic direction. Within this office, the Deputy Assistant Secretary of the Air Force for Environment, Safety and Infrastructure provides strategic direction, policy, and oversight for water management.
- **Navy:** The Office of the Assistant Secretary of the Navy for Energy, Installations, and Environment is responsible for establishing policy and overseeing water resource management. This office, along with the Office of the Chief of Naval Operations Shore Readiness Division, and the Commander, Navy Installations Command, makes policy, guidance, and many major investment decisions related to installations' water departments. Within the Department of the Navy, the Marine Corps also has its own offices responsible for water policy. Specifically, the Deputy Commandant for Installations and Logistics is responsible for establishing energy and water management policy for Marine Corps installations in accordance with the Commandant's direction. The Commander, Marine Corps Installations Command, is responsible for water management, such as overseeing program planning and execution, and serving as the Marine Corps Installations Energy Program Manager.
- **Army:** The Assistant Secretary of the Army for Installations, Energy, and Environment establishes policy, provides strategic direction, and supervises all matters pertaining to energy and environmental programs, among other responsibilities. Within this office, the Deputy Assistant Secretary of the Army for Energy and Sustainability provides strategic leadership, policy guidance, program oversight, and outreach for energy, water, and sustainability throughout the Army enterprise.

OSD's and the Military Departments' Six Assessments Identifying Installations at Risk of Water Scarcity

OSD-level entities and the three military departments conducted six assessments between April 2017 and January 2019 that, despite having varied focus areas, all included at least one component focused on vulnerability to water scarcity.[19] The Office of the Under Secretary of Defense for Acquisition and Sustainment conducted the most recently reported (January 2019) OSD-level assessment, in response to a congressional reporting requirement. OSD-level entities in place before OSD's 2018 reorganization conducted the other two assessments, reporting their results in January 2018 and July 2018—also responses to congressional reporting requirements. The Air Force's, Navy's, and Army's three assessments span different time frames, encompass different scopes, and respond to different internal reporting requirements. The Air Force reported its results in November 2018; the Navy's assessment conducted by CNA reported its results in December 2017; and the Army reported in April 2017. Table 1 provides a summary of these assessments, including responsible offices and focus areas.

[19]The *Department of Defense Climate-Related Risk to DOD Infrastructure Initial Vulnerability Assessment Survey (SLVAS) Report* responded to Senate Report 114-57 at 13 (2015) accompanying the fiscal year 2016 Military Construction, Veterans Affairs and Related Agencies appropriations bill, which directed DOD to include an assessment of coastal erosion and potential flooding risks in the siting of proposed military construction projects. The *Report on Effects of a Changing Climate to the Department of Defense* responded to section 335 of the National Defense Authorization Act for Fiscal Year 2018, Pub. L. No. 115-91 (2017), to provide a report on vulnerabilities to military installations and combatant commander requirements resulting from climate change over the next 20 years. The *Department of Defense Annual Energy Management and Resilience Report (AEMRR) Fiscal Year 2017* responded to two committee reports for DOD to report on military installations' water usage, water conservation, and vulnerability to water scarcity. See Senate Report 114-237 at 9–10 (2016) accompanying the Military Construction, Veterans Affairs, and Related Agencies appropriation bill for fiscal year 2017 and House Report 115-188 at 23 (2017) accompanying the Military Construction, Veterans Affairs, and Related Agencies appropriation bill for fiscal year 2018. Air Force, *Summary Information on Installations with Water Hazards;* CNA, *Assessing Water Risk at DON Installations—Identifying Hazards and Water Management Challenges,* report prepared for the U.S. Navy; and Army, *FY17 Installation Status Report (Mission Capacity) Water Data Analysis.*

Table 1: Department of Defense (DOD) Assessments Identifying Installations at Risk of Water Scarcity

Responsible office	Assessment title	Focus areas, including water scarcity components
Office of the Secretary of Defense (OSD) assessments		
Office of the Under Secretary of Defense for Acquisition and Sustainment	*Report on Effects of a Changing Climate to the Department of Defense* (January 2019)	Current and future (i.e., 20 years) vulnerabilities of 79 mission-assurance priority installations to five climate-related events (i.e., recurrent flooding, drought, desertification, wildfires, and thawing permafrost) in order to identify high risks to mission effectiveness.
The former Office of the Assistant Secretary of Defense for Energy, Installations, and Environment	*Department of Defense Annual Energy Management and Resilience Report (AEMRR) Fiscal Year 2017* (July 2018)	DOD's fiscal year 2017 performance toward achieving greater energy resilience through energy efficiency, demand reduction, and energy supply expansion efforts. Included a list of installations identified by OSD as vulnerable to water scarcity, which it defined as a condition of drought-prone areas. OSD superimposed a map of military installations on the April 2018 U.S. Drought Monitor map, providing a snapshot in time.
The former Office of the Under Secretary of Defense for Acquisition, Technology and Logistics	*Department of Defense Climate-Related Risk to DoD Infrastructure Initial Vulnerability Assessment Survey (SLVAS) Report* (January 2018)	All primary installations and associated DOD sites worldwide (i.e., over 3,500 individual sites). The web-based, self-reporting survey asked respondents to identify any negative effects they may have experienced from six extreme weather effects within the past 30 years: flooding due to storm surge, flooding due to non-storm-surge events, extreme temperatures, wind, drought, and wildfire.
Military department assessments		
Air Force	*Summary Information on Installations with Water Hazards* (Provided November 2018)	Summary information on installations with water hazards that may affect mission activities; includes severity ratings (i.e., catastrophic, critical, moderate, and negligible) and severity rationale. According to Air Force officials, this information is derived from the Installation Complex Encroachment Management Action Plans conducted between 2012 and 2016.
Navy: CNA	*Assessing Water Risk at DON Installations—Identifying Hazards and Water Management Challenges* (December 2017)	Summary of CNA's assessment of the risks to Department of the Navy installation water systems and recommended actions or policies to mitigate those risks. Included the following: literature review and data analysis to identify key water challenges; a Department of the Navy–wide analysis to identify exposure of installations and sites to specific water hazards; and an installation-level water risk and vulnerability assessment tool that allows a water manager to assess risk levels based on hazards, assets affected, and actions to reduce vulnerability.
Army	*FY17 Installation Status Report (Mission Capacity) Water Data Analysis* (April 2017)	According to Army officials, this report is an installation self-reporting status report that captures water effects, scored on a color-based scale that indicates severity. The report includes information such as: outside water utilities; water rights; water quantity; water quality; potable; and other water-related risks.

Source: GAO analysis of DOD information. | GAO-20-98

DOD Does Not Have Assurance That It Is Using Reliable Information to Identify Installations at Risk of Water Scarcity

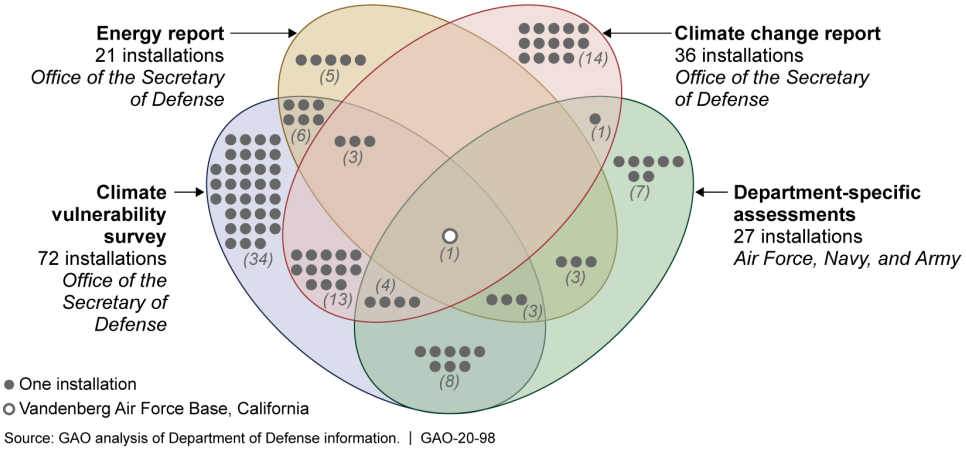
We found that DOD does not have assurance that it is using accurate and reliable information regarding which installations are at risk for water scarcity. When we compared the results of the OSD assessments and the military department assessments, we found that they varied markedly, raising questions about their quality and about which source of information DOD is using to determine which installations are vulnerable to water scarcity. An OSD official told us that the OSD assessments constitute the best DOD information available on installations at risk of water scarcity, but we found that the assessments do not align with leading practices for identifying and analyzing water scarcity—practices that contribute to a reliable assessment of water availability. In contrast, we found that the military department assessments do align with these leading practices, but OSD officials disagree as to whether these assessments can and should be used to identify installations at risk of water scarcity across the defense enterprise. As a result, DOD cannot be assured that it is using reliable information for water resource management.

OSD and Military Department Assessments Differ on Which Installations Are at Risk of Water Scarcity

The three OSD assessments and the three military department assessments varied markedly in their results regarding which installations are vulnerable to water scarcity. Collectively, the six assessments identified a total of 102 individual installations at risk of water scarcity, as shown in figure 2.[20] Only one installation, Vandenberg Air Force Base in California, was identified in all three OSD assessments and the applicable military department (Air Force) assessment.

[20]For a complete list of the 102 installations collectively identified in the DOD assessments, see app. II.

Figure 2: Installations Identified in Three Office of the Secretary of Defense and Three Military Department Assessments as Being at Risk of Water Scarcity



Source: GAO analysis of Department of Defense information. | GAO-20-98

Note: We shortened the assessment names for ease of readability. The full names, including the entities that conducted the assessments follow: Office of the Under Secretary of Defense for Acquisition, Technology and Logistics, *Department of Defense Climate-Related Risk to DOD Infrastructure Initial Vulnerability Assessment Survey (SLVAS) Report* (January 2018) (climate vulnerability survey); Office of the Assistant Secretary of Defense for Energy, Installations, and Environment, *Department of Defense Annual Energy Management and Resilience Report (AEMRR), Fiscal Year 2017* (July 2018) (energy report); Office of the Under Secretary of Defense for Acquisition and Sustainment, *Report on Effects of a Changing Climate to the Department of Defense* (January 2019) (climate change report); Air Force, Summary Information on Installations with Water Hazards (November 2018); Navy, including the Marine Corps, CNA, *Assessing Water Risk at DON Installations—Identifying Hazards and Water Management Challenges* (December 2017); and Army, *FY17 Installation Status Report (Mission Capacity) Water Data Analyses (*Apr. 27, 2017).

Of the 102 individual installations identified in the six assessments as vulnerable to water scarcity, 42 (41 percent) were included in multiple assessments. OSD identified more installations for each military department as at risk than did the military departments themselves. Specifically, across its three assessments, OSD identified 95 installations as being at risk—48 Air Force installations, 29 Navy or Marine Corps installations, and 18 Army installations. The military departments collectively identified a total of 27 installations as being at risk—14 Air Force installations, nine Navy or Marine Corps installations, and four Army installations.

Below is a more detailed description of the installations identified as being at risk of water scarcity in the six assessments, by the military departments.

- **Air Force:** Of the 48 Air Force installations identified across the OSD assessments, only three—Kirtland Air Force Base, New Mexico;

McConnell Air Force Base, Kansas; and Vandenberg Air Force Base, California—appeared in all of them. In addition, as noted above, only one Air Force installation was identified both in all three OSD assessments and the Air Force assessment—Vandenberg Air Force Base, California. Of the 14 Air Force installations identified within the Air Force assessment, 13 appeared in at least one of the OSD assessments.

- **Navy:** Of the 29 Navy or Marine Corps installations identified across the OSD assessments, three installations—Marine Corps Air Station Yuma, Arizona; Naval Base Coronado, California; and Naval Weapons Station Seal Beach, California—appeared in at least two of the OSD assessments. Of the nine Navy installations, including the Marine Corps installations identified within the Navy assessment, four appeared in at least one of the OSD assessments.
- **Army:** Of the 18 total Army installations identified across the OSD assessments, only one—White Sands Missile Range, New Mexico—appeared in all three. However, the Army's assessment did not identify that installation as being at risk. In addition, one of the OSD assessments—the climate vulnerability survey—identified more than three times as many Army installations as being at risk as the Army's own assessment. Of the four Army installations identified within the Army assessment, three appeared in at least one of the OSD assessments.

Given the different scopes of these assessments, it is understandable that they would produce different results. However, the substantial differences in results raise questions about whether the assessments that produced them were methodologically sound and about which source of information DOD is using to identify installations at risk of water scarcity—information needed for water resource management.

OSD's Assessments Do Not Align with Leading Practices

Although an OSD official told us that the OSD assessments constitute the best DOD information available on installations at risk of water scarcity, we found that they did not incorporate four of five leading practices for identifying and analyzing water scarcity. Specifically, our analysis shows that, in conducting their assessments, OSD officials did not always (1) identify current water availability, (2) identify future water availability, (3) take into account all sources of water, or (4) precisely identify locations, as shown in table 2.

Table 2: Assessment of the Office of the Secretary of Defense's Three Assessments Compared to Leading Practices for Determining Installations at Risk of Water Scarcity

Assessments	Leading practices				
	Identify current water availability	Identify future water availability	Take into account all sources of water	Precisely identify locations	Comprehensively include all locations
Climate vulnerability survey	●	○	○	●	●
Energy report	○	○	○	○	●
Climate change report	○	○	○	○	●

Legend:

● Leading practice followed

○ Leading practice not followed

Source: GAO analysis of Department of Defense information. | GAO-20-98

Note: We shortened the assessment names for ease of readability. The full names, including the entities that conducted the assessments follow: Office of the Under Secretary of Defense for Acquisition, Technology and Logistics, *Department of Defense Climate-Related Risk to DOD Infrastructure Initial Vulnerability Assessment Survey (SLVAS) Report* (January 2018) (climate vulnerability survey); Office of the Assistant Secretary of Defense for Energy, Installations, and Environment, *Department of Defense Annual Energy Management and Resilience Report (AEMRR), Fiscal Year 2017* (July 2018) (energy report); and Office of the Under Secretary of Defense for Acquisition and Sustainment, *Report on Effects of a Changing Climate to the Department of Defense* (January 2019) (climate change report).

Below is a detailed comparison of each OSD assessment against the five leading practices.

OSD's climate vulnerability survey. Of the three OSD assessments, the climate vulnerability survey reflects the most (3 out of 5) leading practices. Specifically, we found that the methodology used in the climate vulnerability survey

- *followed the leading practice for identifying current water availability.* The survey collected and analyzed drought-related information in a

timely and systematic manner by having a question about current drought conditions on its web-based self-reporting survey.[21]

- *did not follow the leading practice for identifying future water availability.* The survey focused only on current and past water availability.
- *did not follow the leading practice for taking into account all sources of water.* The survey did not account for all sources of water (e.g., precipitation, soil moisture, streamflow, groundwater levels, reservoir and lake levels, and snowpack) because it did not include a question about the sources of the water.
- *followed the leading practice for precisely identifying locations.* The survey went directly to all DOD installations and inquired about drought conditions at sites owned or managed by the installation, in addition to the installation itself. This enabled DOD to know the precise location of installations and their associated sites relative to identified drought-prone areas of the state or region and vulnerable economic sectors, individuals, or environments.
- *followed the leading practice for comprehensively including all locations.* The survey was completed for all primary installations and associated sites worldwide.

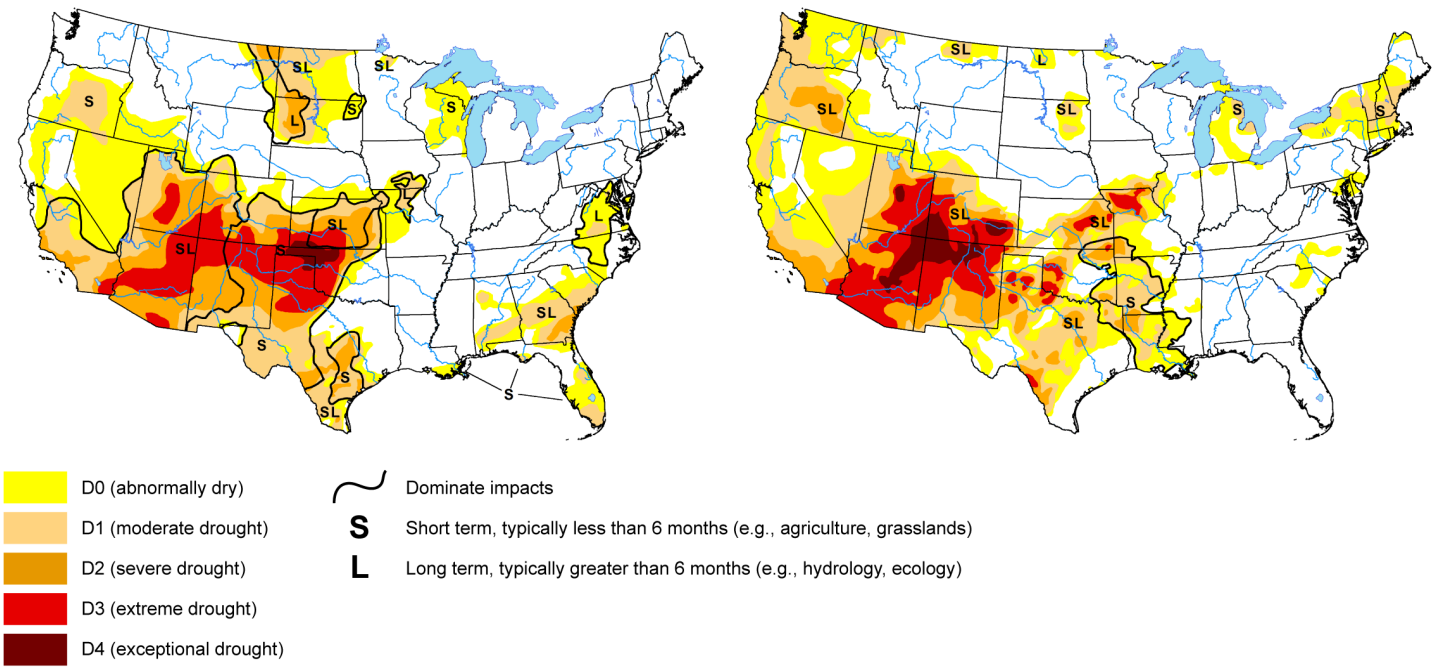
OSD's energy report and climate change report. OSD used the U.S. Drought Monitor map to conduct its assessments for both OSD's energy report and climate change report. According to an OSD official, use of the U.S. Drought Monitor map constitutes DOD's best approach for identifying military installations vulnerable to water scarcity. However, we determined that, in doing so, OSD did not follow four of the five leading practices. Specifically, using the U.S. Drought Monitor Map to produce the energy report and climate change report, OSD

- *did not follow the leading practice for identifying current water availability* and *did not follow the leading practice for identifying future water availability*. According to the cofounder of the U.S. Drought

[21]According to the U.S. Geological Survey, drought is a period of drier-than-normal conditions that results in water-related problems. When rainfall is less than normal for several weeks, months, or years, the flow of streams and rivers declines, water levels in lakes and reservoirs fall, and the depth to water in wells increases. If dry weather persists and water-supply problems develop, the dry period can become a drought. If drought is not properly managed or planned for, it can lead to not having sufficient water available to meet mission needs—that is, water scarcity.

Monitor, the conditions reflected on the U.S. Drought Monitor maps are retrospective—weekly assessments of drought conditions based on how much, if any, precipitation occurred from 1 week to several years before the day the map was issued. This is problematic because drought conditions can change from month to month (see fig. 3), and the months chosen may not be representative of the annual drought condition. An OSD official stated that OSD used data from the U.S. Drought Monitor map as of April 2018 for the energy report and only the summer months of 2018 for the climate change report, which is unlikely to reflect current water availability for an entire year. According to the cofounder of the U.S. Drought Monitor, the U.S. Drought Monitor maps also do not show projections of future water scarcity, which would be necessary to fully assess an installation's vulnerability to water scarcity.

Figure 3: U.S. Drought Monitor Differences during OSD Energy Report and Climate Change Report Time Frames



Source: National Oceanic and Atmospheric Administration. | GAO-20-98

- *did not follow the leading practice for taking into account all sources of water.* According to the cofounder of the U.S. Drought Monitor, U.S. Drought Monitor maps do not take into account all sources of water that might be available to a specific installation. The U.S. Drought Monitor maps do not fully assess the availability of water from groundwater sources (e.g., aquifers) or nonlocal sources (e.g., reservoir water delivered by canals).
- *did not follow the leading practice for precisely identifying locations.* According to the co-founder of the U.S. Drought Monitor, U.S. Drought Monitor maps only display regional drought conditions, not drought information applicable to precise locations. For this reason, the Drought Monitor Portal warns that the large-scale maps generated should not supersede locally provided information about water availability conditions. Therefore, OSD may have inaccurately identified installations as being at risk of water scarcity.
- *followed the leading practice for comprehensively including all locations.* Since the energy report used a map of all installations within the contiguous U.S. to conduct its analysis, and the climate change report included all 79 mission-assurance locations within its scope, these assessments constituted a comprehensive approach.

The information we collected from installations identified by OSD as being at risk of water scarcity also indicates weaknesses in OSD's approach. Of the 17 installations that were identified in OSD's assessments as being at risk of water scarcity and that we contacted or visited, officials from 12 stated that they did not anticipate water scarcity affecting their future mission-related activities, disagreeing with the conclusions of OSD's assessments. For example:

- Officials at Naval Weapons Station Seal Beach, California, told us the installation does not expect water scarcity to affect its mission-related activities because none of its water-using facilities (i.e., administrative facilities) on the installation are particularly water-intensive. They stated the installation's water is provided by the City of Seal Beach, which in turn is supplied by a larger water company. According to the officials, there are proposed plans to construct a nearby desalination[22] plant, which would prevent water scarcity issues.

[22]Desalination is the process of treating seawater to make it usable by communities as a water supply. It can be used to reduce dependence on groundwater sources.

- Officials at Moody Air Force Base, Georgia, stated that the installation is not vulnerable to water scarcity now or over the next 20 years because the base has its own water-treatment plant with wells that draw water from the Floridan aquifer, which spans an area of 100,000 square miles in the southeastern United States, underlying the entire state of Florida and parts of Alabama, Georgia, Mississippi, and South Carolina. According to the officials, use of the aquifer is unconstrained; in addition, Moody Air Force Base holds water permits that create a 64 percent surplus capacity of daily water availability to support current or new mission growth.
- Officials at Fort Bragg, North Carolina, stated that the installation is in the Southeast region of the United States, which is not known as a region with water scarcity issues. They stated that the region's primary threats, from a water scarcity perspective, are pollution and population growth. In addition, the officials said that the two public utilities from which it purchases its water are not expected to hit a critical demand for water until the year 2060 or later.

When we informed an OSD official of the results of our analysis, the official stated that OSD did not have any concerns about the information it provided to the Congress in its three assessments. Specifically, the official said the climate vulnerability survey might have had different responses depending on the perspective of the responder, but it provided useful qualitative data. The official also maintained that the U.S. Drought Monitor was the best source of information, and is a resource produced by the federal government. However, as outlined above, while the drought monitor is a useful source of information, it is not intended to be used in the manner in which DOD has employed it.

Military Department Assessments Align with Leading Practices

Unlike the OSD level assessments, we found that the assessments produced by the military departments are aligned with all five leading practices (see table 3).[23]

Table 3: Assessment of the Military Departments' Three Assessments Compared to Leading Practices for Determining Installations at Risk of Water Scarcity

Assessments	Leading practices				
	Identify current water availability	Identify future water availability	Take into account all sources of water	Precisely identify locations	Comprehensively include all locations
Department of the Air Force summary	●	●	●	●	●
Department of the Navy report	●	●	●	●	●
Department of the Army report	●	●	●	●	●

Legend:

● Leading practice followed

○ Leading practice not followed

Source: GAO analysis of Department of Defense information. | GAO-20-98

Note: We shortened the assessment names for ease of readability. The full names, including the entities that conducted the assessments follow: Air Force, Summary Information on Installations with Water Hazards (November 2018); Navy, including the Marine Corps, CNA, *Assessing Water Risk at DON Installations—Identifying Hazards and Water Management Challenges* (December 2017); and Army, *FY17 Installation Status Report (Mission Capacity) Water Data Analysis* (Apr. 27, 2017).

[23]We derived the five leading practices from the Department of Energy's and the United States Environmental Protection Agency's compilation of 14 water efficiency best management practices, and principles published in the University of Nebraska–Lincoln's National Drought Mitigation Center's *10-Step Drought Planning Process*. For the purposes of this report, we selected the practices and principles most relevant to a large, federal agency responsible for installations across the United States and grouped them into five leading practices relevant for the purposes of identifying and analyzing installations at risk of water scarcity. See Department of Energy, Office of Energy Efficiency and Renewable Energy, *Best Management Practices for Water Efficiency: Water Management Planning.* The Federal Energy Management Program within the Department of Energy's Office of Energy Efficiency and Renewable Energy worked with the United States Environmental Protection Agency to develop 14 water efficiency best management practices to help agencies increase water efficiency and meet federal requirements. The *10-Step Drought Planning Process* was first published by the University of Nebraska-Lincoln's National Drought Mitigation Center founding director, Dr. Donald A. Wilhite, in 1990. Its most recent update appeared as Donald A. Wilhite, Michael J. Hayes, and Cody L. Knutson, "Drought Preparedness Planning: Building Institutional Capacity," in *Drought and Water Crises: Science, Technology, and Management Issues*, Donald A. Wilhite, ed. (CRC Press, 2005).

Below are detailed examples of how the military department assessments were compared against the five leading practices. Specifically, we found that the military department assessments:

- *followed the leading practice for identifying current water availability.* For example, the Navy contacted installation staff directly and analyzed water use and billing data directly from departmental water-system databases to assess the extent to which the Navy was facing water-related challenges (which included water availability and quality).
- *followed the leading practice for identifying future water availability.* For example, the Air Force assessment considered future water availability by considering long-term effects from climate change, future water restrictions, and changes in water access rights. In addition, the Navy assessment considered future water availability by considering sea-level rise, water rights, diminishing groundwater supplies, and emerging water pollutants.
- *followed the leading practice for taking into account all sources of water.* For example, the Army assessment considered alternate water sources by requiring installations to identify and enumerate their potable sources of water as a measure of redundancy.
- *followed the leading practice for precisely identifying locations.* For example, the Navy assessment used geospatial data on hazards to water as well as data published by Naval Facilities Command. This enabled the Navy to precisely identify installation and site locations for water and sewer infrastructure, including pumps, storage, sewer lines, and water-treatment plants relative to those hazards.
- *followed the leading practice for comprehensively including all locations.* According to service officials and an agency document, the scope of each military department assessment included all respective installations within each military department.

Installations we contacted that were identified in the military department assessments as being at risk of water scarcity generally agreed with the assessments. Of the seven installations that were identified in military department assessments as being at risk of water scarcity and that we contacted or visited, officials from six (86 percent) agreed that they anticipated water scarcity may affect their future mission activities or

otherwise noted risks of water scarcity that could affect their installations.[24] For example:

- Officials at Mountain Home Air Force Base, Idaho, stated that water use on the installation was significantly curtailed in 2017 and 2018 (and was anticipated to be curtailed in 2019) due to the inability to produce sufficient quantities of water to meet demand.
- Officials from F. E. Warren Air Force Base, Wyoming, stated that drought is a continual threat to the area. The officials stated that if the area does not receive adequate precipitation or snowmelt, the city may place a water restriction for the installation.
- Officials from Marine Corps Air Station Yuma, Arizona, stated that future mission activities could be impacted by water scarcity, especially as the population of the installation continues to grow with the arrival of additional air squadrons.

OSD Officials Disagree on What Information They Should Use for Identifying Installations at Risk of Water Scarcity

As noted earlier in this report, the Office of the Assistant Secretary of Defense for Sustainment is responsible for water management at all military installations. Individuals from this office with whom we spoke agreed that having accurate information about water scarcity data across DOD is important to help fulfill these responsibilities and inform senior decision-making, including budget development, resourcing, and risk management. However, these officials disagree about whether it would be feasible to rely on the military department assessments, which we found align with leading practices, to identify installations at risk of water scarcity across DOD.

According to one OSD official, the military department assessments should not be used to consider water scarcity across DOD as a whole because their methodologies differed and therefore are not comparable to one another. The assessments do not reflect a coordinated, department-wide assessment. For example, the Air Force assessment reported vulnerability to water scarcity as four distinct qualitative ratings, each combining likelihood and severity, without any numerical data. The Army's assessment, in contrast, reported vulnerability using 34 distinct

[24]Of the seven installations we visited or contacted that were identified in military department assessments as being at risk of water scarcity, the one that did not agree with the assessments was Naval Air Facility El Centro, California. Officials from Naval Air Facility El Centro said they do not anticipate being affected by water scarcity over the next 20 years.

numerical scores for each installation, averaged into four distinct categories. While both assessments were aligned with leading practices, this OSD official believes that the differences in their specific approaches and subsequent results make it difficult to compare vulnerability to water scarcity across military departments.[25]

According to another OSD official, it would be appropriate for DOD to rely on the results of the military department assessments because responsibilities for prioritizing projects and for allocating funds to those projects lie with the military departments. As such, there is not a concern that the departments assessed vulnerability differently. According to this official, were the department to issue a new DOD-wide report on water scarcity, it would simply be a "rollup" of the military department assessments, with an update of current status.

According to *Standards for Internal Control in the Federal Government*, management should use quality information—information that is, among other things, appropriate, current, complete, and accurate—to achieve the entity's objectives.[26] In identifying information requirements, management should consider the expectations of both internal and external users, as well as the entity's objectives and related risks. Because the OSD-level assessments do not align with leading practices for identifying and analyzing water availability, OSD lacks assurance that it has quality information and risks potentially using or providing to Congress unreliable information. Further, while the military department assessments are aligned with leading practices, the Office of the Assistant Secretary of Defense for Sustainment has not determined whether they are sufficient for meeting its policy-making and oversight objectives and whether the risk presented by combining results from assessments that used varying methodologies is an acceptable level of risk. Until this question is resolved, the department will not have assurance that it is using accurate and reliable information to assess water scarcity.

[25]This official maintains that the OSD-level assessments are reliable and sound as the source of information that OSD uses to identify the installations at risk of water scarcity.

[26]GAO-14-704G.

Conclusions

DOD's installations rely on billions of gallons of water to operate and conduct their missions, but critical installations are at risk of water scarcity, and the risks are only projected to increase. The substantial differences in results of DOD's assessments to identify installations at risk of water scarcity raise questions about whether the assessments were methodologically sound and about which source of information OSD is using for water resource management. OSD's approach to assessing installations at risk of water scarcity did not consistently apply leading practices for identifying current and future water availability, taking into account all sources of water, and precisely identifying locations—yet an OSD official told us that the OSD assessments constitute the best DOD information available on installations at risk of water scarcity. In contrast, the military departments did apply all leading practices in their assessments on installations at risk of water scarcity; however, OSD officials were not in agreement as to whether these assessments could be used at a departmental level. By assessing and documenting whether OSD should conduct a coordinated, department-wide assessment aligned with leading practices or should rely on the military department assessments for identifying and analyzing water availability, OSD would have greater assurance that it has the information that it needs to manage water scarcity across the department and that Congress needs to better understand the threat of water scarcity to DOD's mission.

Recommendation for Executive Action

The Secretary of Defense should ensure that the Assistant Secretary of Defense for Sustainment (1) assesses whether DOD should conduct a coordinated, department-wide assessment aligned with leading practices for identifying and analyzing water availability or rely on military department assessments to determine which DOD installations are at risk of water scarcity and (2) documents this decision. (Recommendation 1)

Agency Comments

We provided a draft of this report for review and comment to DOD. In written comments, DOD concurred with our recommendation. DOD comments are reprinted in their entirety in appendix III. DOD also provided technical comments, which we incorporated as appropriated.

We are sending copies of this report to the appropriate congressional addressees; the Secretary of Defense; and the Secretaries of the Air Force, the Navy, and the Army. In addition, this report will be available at no charge on the GAO website at www.gao.gov.

If you or your staff have any questions about this report, please contact me at (202) 512-2775 or fielde1@gao.gov.

Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made key contributions to this report are listed in appendix IV.

Elizabeth Field, Director
Defense Capabilities and Management

Appendix I: Objective, Scope, and Methodology

In this report, we evaluate the extent to which the Department of Defense (DOD) has assurance that it is using reliable information to identify installations at risk of water scarcity.

We reviewed statutes and congressional committee reports that directed DOD to conduct assessments for climate-related purposes, including for identifying installations at risk of water scarcity.[1] We also analyzed information contained in the six DOD assessments conducted from April 2017 through January 2019 that identify installations at risk of water scarcity—three Office of the Secretary of Defense (OSD) assessments and three military department assessments—to determine the extent to which the assessments identified the same or different installations.[2] Specifically, we analyzed the following DOD assessments:

- two OSD assessments that focused on climate-related risks to installations:
  - Office of the Under Secretary of Defense for Acquisition, Technology and Logistics, *Department of Defense Climate-Related Risk to DOD Infrastructure Initial Vulnerability Assessment Survey (SLVAS) Report* (January 2018). We analyzed information on military installations vulnerable to drought in this assessment.
  - Office of the Under Secretary of Defense for Acquisition and Sustainment, *Report on Effects of a Changing Climate to the*

[1]Senate Report 114-57 at 13 (2015), which directed DOD to include an assessment of coastal erosion and potential flooding risks in the siting of proposed military construction projects; section 335 of the National Defense Authorization Act for Fiscal Year 2018, Pub. L. No. 115-91 (2017), which directed DOD to provide a report on vulnerabilities to military installations and combatant commander requirements resulting from climate change over the next 20 years; and two committee reports: Senate Report 114-237 at 9–10 (2016) and House Report 115-188 at 23 (2017), which directed DOD to report on military installations' water usage, water conservation, and vulnerability to water scarcity.

[2]Office of the Under Secretary of Defense for Acquisition, Technology and Logistics, *Department of Defense Climate-Related Risk to DOD Infrastructure Initial Vulnerability Assessment Survey (SLVAS) Report* (January 2018); Office of the Assistant Secretary of Defense for Energy, Installations, and Environment, *Department of Defense Annual Energy Management and Resilience Report (AEMRR), Fiscal Year 2017* (July 2018); Office of the Under Secretary of Defense for Acquisition and Sustainment, *Report on Effects of a Changing Climate to the Department of Defense* (January 2019); U.S. Air Force, *Summary Information on Installations with Water Hazards* (November 2018); CNA, *Assessing Water Risk at DON Installations—Identifying Hazards and Water Management Challenges*, report prepared for the U.S. Navy (December 2017); and U.S. Army, *FY17 Installation Status Report (Mission Capacity) Water Data Analysis* (Apr. 27, 2017).

Department of Defense (January 2019). We analyzed information on military installations vulnerable to drought in this assessment.

- one OSD assessment that focused on installation energy performance, which included an appendix with information on military installations vulnerable to water scarcity:
  - Office of the Assistant Secretary of Defense for Energy, Installations, and Environment, *Department of Defense Annual Energy Management and Resilience Report (AEMRR) Fiscal Year 2017* (July 2018). We analyzed the information on military installations vulnerable to water scarcity in this assessment.
- three military department assessments that contained information on water-related risks:
  - U.S. Air Force, *Summary Information on Installations with Water Hazards* (Provided November 2018). We analyzed information on military installations with catastrophic and critical water hazards in this assessment.
  - U.S. Navy, including the Marine Corps, CNA, *Assessing Water Risk at DON Installations—Identifying Hazards and Water Management Challenges* (December 2017). We analyzed information on military installations with water availability risk in this assessment.
  - U.S. Army, FY17 *Installation Status Report (Mission Capacity) Water Data Analysis* (April 2017). We analyzed information on military installations with minor and severe potable water risk.

In analyzing these six assessments, we focused on active-duty military installations in the contiguous United States at risk of water scarcity. Further, to discuss the methodologies used in the six assessments, we interviewed officials who were knowledgeable about the various assessments: officials from the OSD's Office of the Assistant Secretary of Defense for Sustainment, each of the military departments with responsibilities for water management at military installations, CNA, which completed the Department of the Navy's assessment, and the University of Nebraska–Lincoln's National Drought Mitigation Center, which hosts the U.S. Drought Monitor map that shows parts of the United States in drought.

We compared the methodologies used to develop OSD's three assessments and the military departments' three assessments with five leading practices for identifying and analyzing risks of water scarcity. We derived the five leading practices from the Department of Energy's and

the United States Environmental Protection Agency's compilation of 14 water efficiency best management practices, and principles published in the University of Nebraska–Lincoln's National Drought Mitigation Center's *10-Step Drought Planning Process*.[3] These leading practices are: (1) identify current water availability, (2) identify future water availability, (3) take into account all sources of water, (4) precisely identify locations, and (5) comprehensively include all locations. According to the *10-Step Drought Planning Process*, data and information derived from these leading practices contribute to a reliable assessment of water availability. We discussed these five leading practices we identified with officials from the Office of the Assistant Secretary of Defense for Sustainment and the military departments and gained their agreement about using these practices for determining installations at risk of water scarcity. We then determined whether, in their respective methodologies, OSD's and the military departments' assessments had followed each of these five leading practices. Specifically, we considered the

- "identify current water availability" leading practice as "followed" if OSD's and the military departments' assessment was annually reporting water use or status of water supply, and the leading practice as "not followed" if the assessment was not annually reporting water use or status of water supply;
- "identify future water availability" leading practice as "followed" if OSD's and the military departments' assessment noted whether climate change was a factor in their assessment or considered future water availability from non-climate-change-related factors and the leading practice as "not followed" if the assessment did not note

[3]See Department of Energy, Office of Energy Efficiency and Renewable Energy, *Best Management Practices for Water Efficiency: Water Management Planning.* The Federal Energy Management Program within the Department of Energy's Office of Energy Efficiency and Renewable Energy worked with the United States Environmental Protection Agency to develop 14 water efficiency best management practices to help agencies increase water efficiency and meet federal requirements. The *10-Step Drought Planning Process* was first published by the University of Nebraska–Lincoln's National Drought Mitigation Center founding director, Dr. Donald A. Wilhite, in 1990. Its most recent update appeared as Donald A. Wilhite, Michael J. Hayes, and Cody L. Knutson, "Drought Preparedness Planning: Building Institutional Capacity," in *Drought and Water Crises: Science, Technology, and Management Issues*, Donald A. Wilhite, ed. (CRC Press, 2005). For the purposes of this report, we selected the practices and principles most relevant to a large, federal agency responsible for installations across the United States and grouped them into five leading practices relevant for the purposes of identifying and analyzing installations at risk of water scarcity.

whether climate-change was a factor in their assessment or consider future water availability from non-climate-change-related factors;

- "take into account all sources of water" leading practice as "followed" if OSD's and the military departments' assessment noted consideration of alternate water sources (such as groundwater, purchase agreements, additional reservoirs, etc.) and the leading practice as "not followed" if the assessment did not note consideration of alternate water sources (such as groundwater, purchase agreements, additional reservoirs, etc.);
- "precisely identify locations" leading practice as "followed" if OSD's and the military departments' assessment noted the specific location of the installation they were reviewing and provided data specifically from that installation, and the leading practice as "not followed" if the assessment did not note the specific location of the installation they were reviewing and provide data specifically from that installation; and
- "comprehensively include all locations" leading practice as "followed" if OSD's and the military departments' assessment considered all the locations at potential risk of water scarcity within the scope of their assessment, and the leading practice as "not followed" if the assessment did not consider all the locations at potential risk of water scarcity within the scope of their assessment. Specifically, for OSD's *Department of Defense Climate-Related Risk to DOD Infrastructure Initial Vulnerability Assessment Survey (SLVAS) Report* and its *Department of Defense Annual Energy Management and Resilience Report (AEMRR) Fiscal Year 2017*, the scope of the assessments included all DOD installations; for OSD's *Report on Effects of a Changing Climate to the Department of Defense*, the scope of the assessment included 79 mission-assurance priority installations; and for the military department assessments, the scope included all respective installations within each military department.

To obtain information about water scarcity at individual installations, we selected a nongeneralizable sample of active-duty military installations in the contiguous United States. To develop this sample, we included installations that were identified by DOD assessments as having water-related vulnerabilities and by military department officials in interviews as having ongoing pilot studies or issues related to water scarcity. We also included installations that had (1) historically experienced water scarcity (prior to 2014); (2) recently experienced water scarcity (from 2014 to 2019); and (3) are projected to experience severe water scarcity (over the next 20 years or longer). From these criteria, we selected a nongeneralizable sample of 17 installations that were identified in OSD's

three assessments that reflected diversity in military service, mission, and water scarcity (see table 4).[4]

Table 4: Department of Defense Active-Duty Military Installations Identified in the Office of the Secretary of Defense Assessments as Being at Risk of Water Scarcity Contacted during this Review

Military department	Military installation
Department of the Air Force	F. E. Warren Air Force Base, Wyoming
	Langley Air Force Base (now Joint Base Langley-Eustis), Virginia
	Joint Base San Antonio, Texas
	Luke Air Force Base, Arizona
	McConnell Air Force Base, Kansas
	Moody Air Force Base, Georgia
	Mountain Home Air Force Base, Idaho
	Vandenberg Air Force Base, California
Department of the Navy	Naval Air Facility El Centro, California
	Naval Weapons Station Seal Beach, California
	Marine Corps Air Station Beaufort, South Carolina
	Marine Corps Air Station Yuma, Arizona
Department of the Army	Aberdeen Proving Ground, Maryland
	Fort Bragg, North Carolina
	Fort Carson, Colorado
	Fort Gordon, Georgia
	White Sands Missile Range, New Mexico

Source: GAO. | GAO-20-98

We visited five of these installations in person and contacted the remaining 12 installations by email. We selected the five installations to visit because three installations (Naval Air Facility El Centro, California; Marine Corps Air Station Yuma, Arizona; and Luke Air Force Base, Arizona) provided diversity among military services and were in close proximity to each other, which allowed us to visit multiple locations in one

[4]We originally contacted 20 installations, but we removed one installation (Fort Hunter Liggett, California) from our sample because it is a reserve installation and we removed two installations (Dover Air Force Base, Delaware, and Naval Air Station Corpus Christi, Texas) from our sample because they were not listed in the OSD assessments as being at risk of water scarcity.

trip; one installation (Vandenberg Air Force Base, California) had been identified in all three OSD assessments and the applicable military department assessment as being at risk of water scarcity; and one installation (Fort Bragg, North Carolina) provided geographic diversity and inclusion of at least one installation per military service in our sample. For the remaining 12 installations, we developed and sent by email a list of similar questions and document requests that we used during our site visits. We received responses from all 12 installations. Results from our nongeneralizable sample cannot be used to make inferences about all DOD installations. However, the information from these installations provides valuable insights about how water is being used by these installations for their mission-related activities and whether water scarcity had affected or was expected to affect their mission-related activities. To determine the extent to which DOD has assurance it is using accurate and reliable information about installations at risk of water scarcity to manage water resources across the department, we compared the information DOD has from the various assessments with *Standards for Internal Control in the Federal Government* on using quality information to achieve agency objectives.[5]

We conducted this performance audit from September 2018 to November 2019 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

[5]GAO, *Standards for Internal Control in the Federal Government*, GAO-14-704G (Washington, D.C.: March 2014).

Appendix II: List of Installations Identified in Department of Defense (DOD) Assessments as Being at Risk of Water Scarcity

Table 5 provides a list of the 102 individual active-duty military installations in the contiguous United States that were identified in at least one of six DOD assessments—three Office of the Secretary of Defense assessments and three military department assessments—as being at risk of water scarcity.

Table 5: Department of Defense (DOD) Active-Duty Installations in the Contiguous United States Identified in the Department's Assessments as Being at Risk of Water Scarcity

Military installation	DOD assessments			
	Climate vulnerability survey	Energy report	Climate-change report	Applicable military department assessment
Department of the Air Force				
Altus Air Force Base, Oklahoma	●	●	○	○
Beale Air Force Base, California	●	○	●	●
Buckley Air Force Base, Colorado	●	○	○	○
Cannon Air Force Base, New Mexico	●	●	○	●
Cape Cod Air Force Station, Massachusetts	○	○	●	○
Charleston Air Force Base, South Carolina	●	○	○	○
Columbus Air Force Base, Mississippi	●	○	○	○
Davis Monthan Air Force Base, Arizona	●	●	○	○
Dyess Air Force Base, Texas	●	○	○	○
Edwards Air Force Base, California	●	○	○	●
Eglin Air Force Base, Florida	●	○	●	○
F. E. Warren Air Force Base, Wyoming	●	○	○	●
Fairchild Air Force Base, Washington	●	○	○	○
Goodfellow Air Force Base, Texas	●	○	○	○
Grand Forks Air Force Base, North Dakota	○	○	○	●
Hanscom Air Force Base, Massachusetts	●	○	○	○
Hill Air Force Base, Utah	●	○	●	●
Holloman Air Force Base, New Mexico	●	●	○	○
Hurlbert Field, Florida	●	○	○	○
Joint Base Andrews, Maryland	●	○	●	●
Joint Base San Antonio, Texas	●	○	●	●
Kirtland Air Force Base, New Mexico	●	●	●	○
Langley Air Force Base, Virginia	●	○	○	○
Laughlin Air Force Base, Texas	●	●	○	○
Little Rock Air Force Base, Arkansas	●	○	○	○

Military installation	DOD assessments			
	Climate vulnerability survey	Energy report	Climate-change report	Applicable military department assessment
Department of the Air Force				
Los Angeles Air Force Base, California	●	●	○	○
Luke Air Force Base, Arizona	●	●	○	●
MacDill Air Force Base, Florida	●	○	○	○
Malmstrom Air Force Base, Montana	●	○	●	○
McConnell Air Force Base, Kansas	●	●	●	○
McGuire Air Force Base, New Jersey	●	○	○	○
Minot Air Force Base, North Dakota	●	○	●	○
Moody Air Force Base, Georgia	○	●	○	○
Mountain Home Air Force Base, Idaho	●	○	○	●
Nellis Air Force Base, Nevada	●	○	●	○
Offutt Air Force Base, Nebraska	●	○	●	○
Patrick Air Force Base, Florida	●	○	●	○
Schriever Air Force Base, Colorado	●	○	●	○
Scott Air Force Base, Illinois	●	○	○	○
Shaw Air Force Base, South Carolina	●	○	●	○
Sheppard Air Force Base, Texas	●	○	○	●
Tinker Air Force Base, Oklahoma	●	○	●	○
Tonopah Auxiliary Air Field, Nevada	●	○	○	○
Travis Air Force Base, California	●	○	○	○
United States Air Force Academy, Colorado	●	○	○	●
Vance Air Force Base, Oklahoma	○	●	○	●
Vandenberg Air Force Base, California	●	●	●	●
Whiteman Air Force Base, Missouri	●	○	●	○
Wright-Patterson Air Force Base, Ohio	●	○	●	○
Department of the Army				
Aberdeen Proving Ground, Maryland	●	○	○	○
Fort Bragg, North Carolina	●	○	○	○
Fort Carson, Colorado	●	○	○	○
Fort Detrick, Maryland	●	○	○	○
Fort Gordon, Georgia	●	○	○	○
Fort Hood, Texas	●	○	●	○
Fort Huachuca, Arizona	○	●	○	○
Fort Lee, Virginia	●	○	○	○

Military installation	DOD assessments			
	Climate vulnerability survey	Energy report	Climate-change report	Applicable military department assessment
Department of the Army				
Fort Riley, Kansas	○	●	○	○
Fort Sill, Oklahoma	●	○	○	○
Fort Stewart, Georgia	○	●	○	●
Hunter Army Airfield, Georgia	○	○	○	●
Iowa Army Ammunition Plant, Iowa	●	○	○	○
Joint Base Lewis-McChord, Washington	●	○	○	●
Military Ocean Terminal Concord, California	○	○	●	●
National Training Center Fort Irwin, California	●	○	○	○
Pueblo Chemical Depot, Colorado	●	○	○	○
Sierra Army Depot, California	●	○	○	○
White Sands Missile Range, New Mexico	●	●	●	○
Department of the Navy				
Allegany Ballistics Lab, West Virginia	●	○	○	○
Joint Base Anacostia Bolling, District of Columbia	○	○	●	○
Naval Air Facility El Centro, California	○	●	○	●
Naval Air Station Fallon, Nevada	○	○	○	●
Naval Air Station Key West, Florida	○	○	●	○
Naval Air Station Lemoore, California	●	○	○	●
Naval Air Station Oceana, Virginia	○	○	●	○
Naval Air Station Pensacola, Florida	●	○	○	○
Naval Air Weapons Station China Lake, California	○	○	○	●
Naval Base Coronado, California	●	○	●	○
Naval Base Kitsap Bangor, Washington	○	○	●	○
Naval Base Point Loma, California	●	○	○	○
Naval Base San Diego, California	○	○	●	○
Naval Base Ventura, California	○	●	○	○
Naval Magazine Indian Island, Washington	○	○	●	○
Naval Station Everett, Washington	●	○	○	○
Naval Station Norfolk, Virginia	○	○	●	○
Naval Submarine Base Kings Bay, Georgia	○	○	●	○
Naval Support Activity Hampton Roads, Virginia	○	○	●	○
Naval Support Activity Hampton Roads–Northwest, Virginia	○	○	●	○

Military installation	DOD assessments			
	Climate vulnerability survey	Energy report	Climate-change report	Applicable military department assessment
Department of the Navy				
Naval Support Activity Washington, District of Columbia[a]	●	○	○	○
Naval Support Facility Indian Head, Maryland	○	○	●	○
Naval Support Facility Naval Observatory, District of Columbia[a]	○	○	●	○
Naval Weapon Station Seal Beach, California	●	●	○	○
Washington Navy Yard, District of Columbia[a]	○	○	●	○
Marine Corps				
Marine Corps Air Ground Combat Center Twentynine Palms, California	●	○	○	●
Marine Corps Air Station Beaufort, South Carolina	○	●	○	○
Marine Corps Air Station Miramar, California	●	○	○	○
Marine Corps Air Station Yuma, Arizona	●	●	○	●
Marine Corps Base Camp Pendleton, California	○	○	○	●
Marine Corps Logistics Base Albany, Georgia	●	○	○	○
Marine Corps Logistics Base Barstow, California	○	○	○	●
Marine Corps Mountain Warfare Training Center Bridgeport, California	○	○	○	●
Marine Corps Recruiting Depot San Diego, California	●	○	○	○

Legend:

● Identified

○ Not identified

Source: GAO analysis of DOD information. | GAO-20-98

[a]Naval Support Activity Washington, District of Columbia, includes the Naval Support Facility Naval Observatory, District of Columbia; the Washington Navy Yard, District of Columbia; and other installations. The climate vulnerability survey identified the Naval Support Activity Washington as being at risk of water scarcity, and the climate change report identified the Naval Support Facility Naval Observatory and the Washington Navy Yard as being at risk of water scarcity.

Appendix III: Comments from the Department of Defense

OFFICE OF THE ASSISTANT SECRETARY OF DEFENSE
3500 DEFENSE PENTAGON
WASHINGTON, DC 20301-3500

SUSTAINMENT

Ms. Elizabeth Field
Director, Defense Capabilities Management
U.S. Government Accountability Office
441 G Street, NW
Washington, DC 20548

Dear Ms. Field,

Enclosed is the Department of Defense (DoD) response to the Government Accountability Office (GAO) Draft Report GAO Draft Report, GAO-20-98, "WATER SCARCITY: DoD has not Always Followed Leading Practices to Identify at Risk Installations," dated October 4, 2013 (GAO Code 103027). Thank you for the opportunity to review the draft report and provide our response.

Sincerely,

Maureen Sullivan
Deputy Assistant Secretary of Defense
(Environment)

Enclosures:
As stated

GAO DRAFT REPORT DATED OCTOBER 7, 2019
GAO-20-98 (GAO CODE 103027)

"WATER SCARCITY: DOD HAS NOT ALWAYS FOLLOWED LEADING PRACTICIES TO IDENTFIY AT RISK INSTALLATIONS"

DEPARTMENT OF DEFENSE COMMENTS
TO THE GAO RECOMMENDATION

RECOMMENDATION 1: The Government Accountability Office (GAO) recommends that the Secretary of Defense should ensure that the Assistant Secretary of Defense for Sustainment (1) assesses whether it should conduct a coordinated, department-wide assessment aligned with leading practices for identifying and analyzing water availability or rely on military department assessments to determine which Department of Defense (DoD) installations are at risk of water scarcity and (2) document this decision.

DoD RESPONSE: The DoD concurs with the recommendation. The diversity in the mission and water needs of each of the Military Departments require them to consider different factors in evaluating water scarcity according to specific mission needs. Although their approaches are different, the Military Departments all follow the leading practices for conducting water scarcity assessments in support of their mission.

Appendix IV: GAO Contact and Staff Acknowledgments

GAO Contact

Elizabeth Field, (202) 512-2775 or fielde1@gao.gov

Staff Acknowledgments

In addition to the contact named above, Brian Lepore (Director), Jodie Sandel (Assistant Director), Barbara Wooten (Analyst-In-Charge), Tracy Barnes, Chaneé Gaskin, Gina Hoover, Mae Jones, Mary Jo LaCasse, Amie Lesser, Shahrzad Nikoo, Paulina Reaves, and Edward Rice made key contributions to this report.