# An Overview of the DOD Installations Enterprise

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With six aircraft carriers and dozens of cruisers, amphibious assault ships, guided missile destroyers, submarines, and other ships, Naval Station Norfolk is home to the world's largest concentration of naval power. Its ranges extend well into the Atlantic Ocean, offering those forces a place to train and establish their readiness for war. However, without a place to refuel and resupply, a place to repair and maintain its ships, a headquarters for their sailors and their families to live when those ships are not deployed, that incredible concentration of naval power would attenuate, lose its readiness, and become less effective over time.

In contrast with the enormity of Norfolk, the U.S. Army and Marine Corps and allied NATO forces maintain small forward bases across Afghanistan to support ongoing operations. These bases are usually comprised of fortified locations from which our forces can launch. They need to be resupplied continually, but, again, they give U.S. forces a place from which they can project power.

From one end of the spectrum to the other, from domestic locations to those in active combat zones, from the very largest base to the very smallest, installations are critical to maintaining and projecting our warfighting strength. As I testified before Congress many years ago, "Our warfighters cannot do their job without bases from which to fight, on which to train, or in which to live when they are not deployed. The bottom line is that installations support our military readiness."[1]

Today, however, despite its incredible value to the warfighter, the DOD installations enterprise faces serious challenges. Budget shortfalls (even with recent increases in the overall budget) continue to eat away at its foundations, encroachment challenges impose constraints even as requirements increase, and leaders struggle to build resilience to external impacts like cyberattacks and climate change.

## Scope and Scale

To begin to understand the impact and contribution of the Defense Department's installations enterprise, it helps to consider its sheer size. DOD maintains a global real property portfolio consisting of 568,383 facilities, valued at approximately $1.05 trillion, with more than 2.2 billion square feet of space located on 27.2 million acres of land at over 4,793 sites worldwide.[2]

The 568,383 facilities include more than 275,000 buildings, from operational facilities to administrative ones, from barracks to hospitals, from sophisticated research facilities to wastewater treatment plants. They also include a wide range of non-building structures including piers, runways, roads, fuel tanks, and utility lines. For comparison, the General Services Administration—in theory, the real estate manager for the federal government—maintains only 9,600 buildings. DOD's 2.2

TABLE 2

## Real Property Managed by Military Service, FY 2016

| Military Branch | Buildings | Total Facilities (including structures) | Plant Replacement Value (in billions) | Land (acres) |
|---|---|---|---|---|
| Army | 139,458 | 278,299 | $417.95 | 13,340,778 |
| Navy | 61,368 | 111,937 | $238.50 | 2,213,663 |
| Air Force | 47,738 | 126,215 | $302.58 | 9,126,467 |
| Marine Corps | 26,748 | 51,112 | $79.40 | 2,504,943 |
| **DOD Total** | **275,312** | **568,383** | **$1,038.43** | **27,185,851** |

**NOTE:** DOD total excludes Washington Headquarters Service.
**SOURCE:** U.S. Department of Defense, "Department of Defense Real Property Portfolio," https://www.acq.osd.mil/eie/Downloads/Fast_Facts_2016.pdf (accessed May 23, 2018).

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billion square feet dwarfs the GSA's 377 million square feet.[3]

DOD's 27.2 million acres is certainly smaller than the acreage held by other federal landholding agencies such as the Bureau of Land Management or the U.S. Forest Service, which maintain 245 million acres[4] and 193 million acres,[5] respectively, but DOD installations still comprise a land area that is roughly the size of the State of Virginia.

The DOD facilities footprint is dominated by the Army, which maintains about half of the buildings, facilities, and land managed by the department. (See Table 2.)

Another element of DOD's scale is its scope. As the number of buildings implies, there are many different kinds of facilities on DOD bases supporting a wide array of missions.

Consider a base like Fort Hood, Texas, home to the Army's III Corps and the 1st Cavalry Division. Fort Hood alone maintains more than 5,000 facilities on more than 200,000 acres with a value of approximately $9 billion.[6] These buildings include operational facilities like headquarters buildings, motor pools, aircraft hangars and runways, training centers, instrumented training ranges, weapons storage facilities, deployment railheads, and more. They also include the buildings that support the troops and their families including barracks; family housing; fitness centers; dining halls; a hospital and several medical clinics; exchanges and commissaries; and morale, welfare, and recreation facilities. Moreover, there is the basic infrastructure of the base: miles of roads, utilities infrastructure, fuel lines, dams and bridges, access control points, and fencing. Other federal agencies manage many similar facilities, such as Department of Veterans Affairs hospitals or GSA office buildings, but each DOD installation must contend with diverse arrays of facilities and a concomitant diversity of challenges.

Each base has its own mission and its own specialized facilities, and those facilities are critical to the forces that employ them. Where Fort Hood has motor pools and tank ranges, Norfolk Naval Base has piers and dry docks, and Nellis Air Force Base in Nevada has hangars and runways. A research-focused base like Fort Detrick or Wright-Patterson Air Force Base will have sophisticated lab facilities, intelligence-focused missions will require computer centers and communications equipment, and arsenals and depots will have industrial operations.

A final element of scale in the DOD installations enterprise is its global nature. DOD facilities are located in every state, in multiple

U.S. territories, and in 42 different nations.[7] The largest part of our international footprint is an artifact of World War II and the Cold War, with thousands of U.S. facilities located in East Asia (Japan and South Korea) and Europe (predominantly Germany, the United Kingdom, and Italy). This global presence not only deters aggression, but also allows the United States to respond quickly to regional crises as they emerge.

### How Installations Contribute to Military Power

With that context in place, consider how that trillion-dollar portfolio contributes to the military power of the United States. Our installations serve to generate the force, train it, and sustain it. From our bases, these forces can be projected and deployed, and once the mission is complete, they come back to those bases to recover, reconstitute, and ready themselves for redeployment.

Installations may contribute to combat power as power projection platforms, such as Fort Hood or Joint Base Lewis-McChord, which regularly deploy troops to theater, or an Air Force Base like Whiteman AFB, from which B-2 bombers can launch attack operations directly. Some bases conduct operations directly, whether it is a forward operating location in Afghanistan or an airman flying Reaper aircraft over Syria from a facility in the United States. Intelligence operations generally have reachback to critical hubs for processing intelligence and distributing it back out to the field. Transportation and logistics installations are critical elements of that ability to project power, moving people and equipment around the world.

America's global footprint is critical to that power projection capability. Our forces in Japan, for example, provide the ability to reach crises in the Western Pacific much more quickly than forces stationed in the continental United States can reach them. Similarly, Europe is a critical launch point for reaching theaters of operation in the Middle East. The Landstuhl Regional Medical Center in Germany has been a critical hub for casualties from Iraq and Afghanistan.

In addition to conducting operations and projecting power, installations are essential to building readiness in the first place. Installations from Parris Island, where they make Marines, to Columbus Air Force Base, Mississippi, which specializes in pilot training, are part of the enterprise that provides initial training to the force. Other bases, such as Fort Irwin, California, provide larger-scale maneuver training. In fact, readiness recovery is limited by the throughput capacity (the number of rotations you can schedule in a given year) at bases like this. Readiness is also sustained at logistics bases, whether they be shipyards or depots, where critical military platforms go through regular scheduled maintenance or recovery from battle damage so that they can be available for future operations.

Even as the military services look to equip the force, they turn to critical capabilities at installations. Research centers like Wright-Patterson Air Force Base enable the development of advanced technologies that are fed into new weapons and platforms, and test ranges like Naval Weapons Station China Lake or White Sands Missile Range provide the essential capabilities needed to confirm that our weapons operate as intended. These ranges are some of the most important assets in the installations enterprise, providing capabilities that would be nearly impossible to recreate elsewhere. For example, the pristine spectrum environment (the lack of background signals from cell phones, electronics, or other transmitters that corrupt test results) at a place like Fort Huachuca is a critical ingredient of its Electronic Proving Ground, just as the immense size of the fully instrumented White Sands Missile Range, at 3,200 square miles, makes it possible to test longer-range weapons than cannot be tested anywhere else in our enterprise.

Even the Base Realignment and Closure (BRAC) process evaluates installations based on their "military value." The legally defined definition used in BRAC has several elements, but it is comprised of:

- The current and future mission capabilities of the base and its impact on operational readiness;
- The availability and condition of land, facilities, and airspace;
- The ability to accommodate contingency, mobilization, surge, and future requirements; and
- The cost of operating at that location (in other words, a base that provides a capability cheaply has more military value than one that provides the same capability at a higher price).[8]

Explicit in these criteria is that a base brings military value to the force. It brings mission capabilities, affects operational readiness, provides essential resources such as training land or airspace, and offers the ability to support wartime surges in operations. When we measure military value for an evaluation like this, we recognize the truism that each base contributes military value to the enterprise.

## Current and Emerging Challenges

The DOD installations enterprise faces several categories of challenges as it seeks to support the warfighter, generate readiness, and ensure that the force is properly equipped. One recurring challenge is the budget, which even with recent increases continues to be a lower priority than other parts of DOD. Another is encroachment, a problem that emerges when development occurs at the installation-community boundary and negatively affects a unit's ability to train or DOD's ability to test equipment in development. One large category of challenges swirls around questions of resilience: a base's ability to continue to operate or to recover quickly from exterior shocks, whether they be power outages, severe weather damage, or cyberattacks.

**Budget Challenges.** When trying to maintain more than $1 trillion worth of infrastructure, the sheer scale demands a significant recurring investment in maintenance, repair, and recapitalization. If infrastructure is not maintained, it will decay and eventually have tangible readiness impacts. New facilities need to be built each year in response to new or growing mission requirements, and as maintenance backlogs grow, recapitalization needs increase.

In general, it is more compelling to speak about the tip of the spear or the tooth versus the tail, which tends to leave support programs like facilities at the back of the funding line. This is not necessarily the wrong choice. With the constraints imposed by the Budget Control Act (BCA), DOD certainly concluded that it made more sense to fund warfighting activities over construction. I testified before Congress that "facilities degrade more slowly than readiness, and in a constrained budget environment, it is responsible to take risk in facilities first."[9] However, that cannot go on indefinitely without affecting that spear tip that we have been fighting so hard to protect.

Reviewing the military construction budget is instructive as we see the historical support for facilities investment. In Chart 4, you can clearly see the increased investment in the most recent BRAC round (2005–2011) and the decrease imposed by the BCA. During the BCA period, DOD has focused its new construction on new mission requirements rather than recapitalizing failing facilities or increasing efficiency. As a result, buildings in poor condition have been retained, imposing higher maintenance costs on the enterprise.

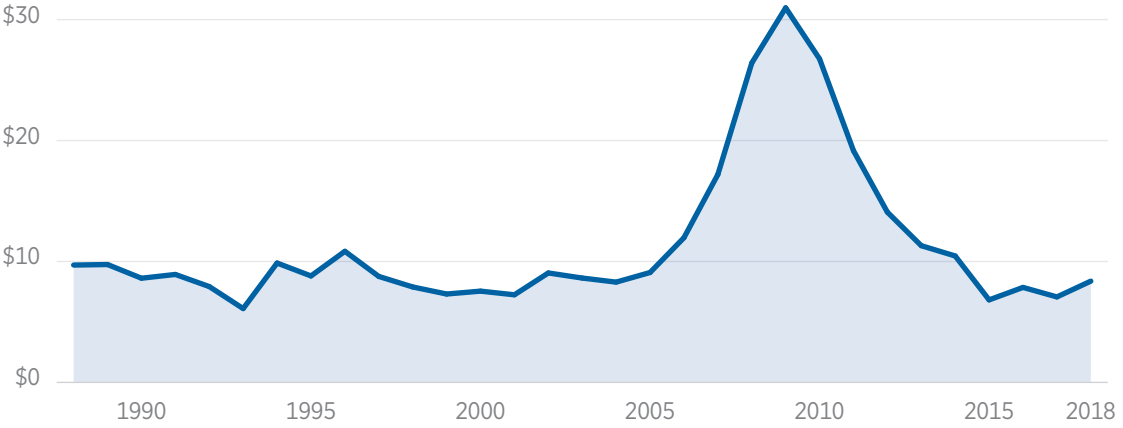
Recent trends are more positive, although the fiscal year (FY) 2018 military construction funding level of $8.4 billion is less than the historical average over the past 30 years, adjusted for inflation. This figure represents less than 1 percent of DOD's aggregate plant value, or a recapitalization rate of about 125 years. While DOD does not currently use a recapitalization rate goal, its historic goal was a 67-year rate.[10]

In addition to military construction, the Defense Department regularly takes risk by underfunding its Facilities Sustainment, Restoration and Modernization account, which

CHART 4

## Military Construction Funding

MILITARY CONSTRUCTION TOTAL OBLIGATION AUTHORITY, IN BILLIONS OF FY 2018 DOLLARS




**SOURCE:** U.S. Department of Defense, Under Secretary of Defense (Comptroller), "National Defense Budget Estimates for FY18," revised August 2017, http://comptroller.defense.gov/Portals/45/Documents/defbudget/fy2018/FY18_Green_Book.pdf (accessed May 22, 2018).

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includes regular and emergency maintenance of its buildings and facilities. The department maintains a model that recommends funding levels for this account, but those figures generally are not met except in some specialized accounts like medical facilities, which must be properly maintained to ensure accreditation.

For example, in its FY 2019 budget request, the Navy indicates that it includes 80 percent of the modeled requirement, up from 78 percent in its FY 2018 budget. When funding is short, it must be prioritized, so as it discusses this shortfall, the Navy's budget states, "The Navy continues to take risk in infrastructure funding but mitigates this risk by focusing investments on capabilities directly supporting critical warfighting readiness and capabilities."[11] In other words, the Navy is going to put its funding in runways and piers before fixing administrative facilities, and the other services have similar approaches. Underfunding perpetuates the deferral of preventive maintenance in favor of emergency repairs, a cycle that not only perpetuates itself, but also imposes much larger life-cycle costs on the department.

During the early BCA years, this was even worse. In FY 2013, the year in which sequestration was imposed, facilities accounts were severely curtailed. The U.S. Government Accountability Office reported that the Army, for example, cut back nearly 40 percent of its original budget.[12] Because operations and maintenance funds are relatively flexible, facilities funding could bear more of the burden of sequestration to insulate operations in theater.

As context for how much DOD should be investing in maintenance of its facilities, consider the National Research Council's recommendations on infrastructure maintenance. The NRC recommended funding levels of 2 percent–4 percent of plant replacement value as the appropriate benchmark for facilities maintenance.[13] That would result in a facilities maintenance budget requirement of $21 billion to $42 billion for DOD. In contrast, the FY 2018 appropriation was $9.9 billion.

Years of underfunded facilities maintenance accounts have resulted in widespread condition problems across DOD's facilities

portfolio. On April 18, 2018, the department reported that 23 percent of its facilities were in poor condition and another 9 percent were in failing condition. To address these and other maintenance challenges, it faces a maintenance backlog of more than $116 billion.[14]

Funding shortfalls can result in mission or readiness impacts. For example, deteriorating runways have immediate mission impacts, and debris could cause damage to expensive aircraft; burst pipes cause flooding damage with the potential to affect critical electrical systems; and inoperative air conditioning at a minimum can make life miserable for military personnel but could also cause sensitive computers to fail. Of course, mission facilities are prioritized, but that leads to worsening conditions in warehouses, maintenance shops, and other facilities that are not seen as the tip of the spear. Ultimately, failure of those facilities will affect the mission as well.

**Base Realignment and Closure.** The divestiture of excess infrastructure, saving money without undermining capability, is one of the most important tools that DOD has for reducing costs, particularly when it results in the closure of an entire installation. Due to the highly charged political dynamics that surround the prospect of closing a base and the prospect of losing a regional economic engine, the apolitical process known as BRAC was created. This apolitical, analytical process is focused on assessing excess capacity and realigning units by incorporating them within those installations that have the highest military value, closing those bases with the least military value and then reaping savings.

Through five rounds of BRAC (1988, 1991, 1993, 1995, and 2005), DOD has achieved recurring savings of more than $12 billion[15] that have resulted in 121 major closures, 79 major realignments, and 1,000 minor realignments and closures.[16] The department's most recent proposal for BRAC authority was projected to result in $2 billion in additional annual savings once fully implemented.[17] In theory, those savings could be plowed back into the enterprise to alleviate some of its funding pressures. From a practical perspective, however, the beneficiary of those savings is DOD as a whole, not the installations enterprise. There is no "fencing" of the dollars mandating that savings must be used on other installations requirements.

Despite the fact that BRAC is designed to remove political influence, requiring Congress to vote on an entire package of closures and realignments without making changes, the debate over giving DOD the authority to conduct a round of BRAC is extremely political. Members of Congress assess their prospective risk and generally will oppose even conducting the analysis in the first place for fear that they will be held responsible if the department's recommendations lead to the closure of a base in their district or state. Without question, the department's assessment of 19 percent excess capacity[18] begs for a good-government solution to eliminate waste, but Members of Congress cannot help but weigh the political risk against the prospect of $2 billion in annual savings that comes to fruition six years in the future.

Despite the prohibitions on BRAC, the department was able to conduct a review of its European infrastructure. DOD's 2013–2015 European Infrastructure Consolidation effort did not require congressional approval and did not evoke the same protective instincts that domestic bases evoke. That effort resulted in 26 recommendations designed to save more than $500 million annually when fully implemented without reducing the overall U.S. presence in Europe.

Recent arguments in favor of BRAC have focused on increasing lethality instead of securing savings,[19] harkening back to the 2005 round, which focused on "transformation." Without question, there are important management actions the department can take under BRAC authority that it cannot take otherwise, and many of these actions do not save money. In the 2005 BRAC round, for example, roughly half of the recommendations were never designed to save money. They resulted in $29 billion in costs and only $1 billion in savings but achieved DOD management objectives, such as collocation of law enforcement activities at Quantico

Marine Corps Base or the return of forces from Europe. The efficiency recommendations—the ones designed to save money—cost $6 billion up front but achieved $3 billion in recurring savings.[20] In total, the 2005 BRAC round alone is saving $4 billion every year, allowing $4 billion in other requirements to be funded within the budget caps.

As we consider future arguments about or alternatives to BRAC, particularly if the motivation is budget savings, it is important to recognize what drives those savings: reductions in personnel. While there are some savings to maintenance requirements or utilities from divesting individual buildings, the most significant recurring savings from BRAC are from civilian job cuts, particularly the number of cuts that come from complete closure of a base.

**Partnerships and Privatization.** Another approach that DOD takes to reducing costs is to find others to take on non-core functions. This might involve privatization, like the Military Housing Privatization Initiative in which DOD divested the preponderance of its family housing to private developers, or it could be as simple as turning to the local community to provide a service like trash collection.

To be a good candidate for privatization, a function should be generally commercial in nature (common in the installations world) and have an associated revenue stream that a private entity can leverage to secure financing. However, the department has taken on these tasks to shore up parts of the enterprise that have been chronically underfunded and is not commonly motivated to explore privatization where things are going well, even if a function is commercial in nature.

All of these factors come into play with the highly touted Military Housing Privatization Initiative. Under authority provided by Congress in 1996, the department has privatized approximately 200,000 housing units on its installations, conveying the homes and providing leases for the underlying land.[21] The families living in that housing receive Basic Allowance for Housing and pay rent just as if they were off base. Developers leveraged the projected income and conveyed assets to secure loans and front-load a huge recapitalization effort, dramatically improving the quality of on-base housing. DOD was able to leverage about $3.4 billion in government investment to generate $31 billion in private capital.[22]

Another successful example is the privatization of utilities. Again, in this part of the portfolio, the condition of DOD-owned assets was extremely poor, but electricity, water, and wastewater infrastructure are quite commercial in nature, and monthly utilities bills provide a regular revenue stream. Utilities privatization contractors accept the assets and make capital improvements up front, leveraging the economics of 50-year agreements.

Finally, the degree to which local communities are indispensable to the installations they surround is not always acknowledged. These communities provide a wide range of services to the base that it simply would not have the capacity to provide on its own. In most locations, communities provide utilities infrastructure, housing, education, transportation infrastructure, and a source of civilian employees and contractors. Absorbing those functions back into the base would be cost-prohibitive, and as they look for efficiencies, installations have been looking at more functions to divest to local municipalities. Congress recently provided the department with authority to sign Intergovernmental Service Agreements that allow bases to turn to their local municipalities to provide more services, saving money for both through economies of scale,[23] and the services have been working to leverage the new authority.

**Energy Efficiency.** Without question, there is inefficiency in the DOD installations enterprise, though it is not always easy to excise. Looking at the foregoing BRAC discussion, macro-level changes and cost reductions involve huge political hurdles, but they are the clearest route to achieving savings in the DOD enterprise. At the installation level, the two largest categories of costs are public works (as noted, maintenance is systematically underfunded) and utilities. Significant effort

has been made to reduce energy usage as the department looks to reduce costs.

In 2017, the Department reported that it spent $12.4 billion on energy in FY 2016: $8.7 billion for operational energy (largely fuel), of which $3.7 billion was attributable to installations energy costs, most of which pay for electricity and natural gas.[24] The department has been tracking its energy use since 1975 and has made significant progress over the years, reducing its energy intensity (BTUs per square foot) by 49 percent, but as its *Annual Energy Management and Resilience Report* explains:

> These reductions were a result of substantial low- and no-cost energy efficiency and conservation measures that impacted behavioral changes, and project investments such as insulation or lighting upgrades. As similar, viable low- and no-cost energy efficiency and conservation initiatives continue to diminish, DoD will be challenged to make broad reductions in energy intensity.[25]

This challenge is exacerbated by the underfunding of facility maintenance. To put it bluntly, there is a limit to how much improvement from sophisticated energy management systems is possible when there is a hole in the roof.

**Readiness and Encroachment Challenges.** Another set of challenges stems from encroachment, which is the negative impact on military readiness and base operations that stems from the growing competition for and limitations on land, sea, air, and even the electromagnetic spectrum that is increasingly crowded by the proliferation of cell phones and Wi-Fi.

Although a case could be made that huge bases like Camp Pendleton, Norfolk Naval Station, or Fort Bragg are the crown jewels of the DOD installations enterprise, the "hidden" gems are the testing and training ranges where our servicemembers have the land, sea, and airspace they need to test new weapons systems and train using the equipment they will bring to war. Mark Twain once said, "Buy land, they're not making it anymore." For DOD, the land that comprises these ranges is priceless.

From bases like Fort Irwin or Twentynine Palms Marine Corps Air Ground Combat Center, where soldiers and Marines practice large-unit operations to prepare for combat, to sophisticated weapons testing ranges like Naval Air Weapons Station China Lake or the White Sands Missile Range, which have sufficient space to conduct realistic testing of new weapons systems, to the pristine spectrum environment at Fort Huachuca's Electronic Proving Ground, DOD counts on its ranges to generate readiness and test its newest weapons systems.

The land, air, sea, and spectrum environments at these ranges have become increasingly constrained. Range managers have been able to use work-arounds to accommodate constraints, but they are exacerbated both by the increased requirements associated with weapons of greater speed and range and by the continual development in the surrounding civilian or commercial communities that creeps closer and closer to installations that once were completely isolated. DOD even set up a separate office to engage with wind companies whose proliferating turbines, if placed in the wrong locations, could affect DOD radars or block aircraft training routes.

DOD's *2017 Sustainable Ranges* report to Congress identifies the encroachment challenges that are of the highest concern:

- Managing threatened or endangered species, which includes requirements that troops ensure that they do not inadvertently affect these populations and that they adhere to the Endangered Species Act. More than 400 endangered species can be found on DOD bases, in no small part because they have held back the surrounding development and species have taken refuge on our bases.

- Commercial development near our ranges and bases, which can have a range of impacts including noise restrictions,

constrained munitions activities due to required safety zones, or cell phone signals that corrupt sensitive electronic testing.

- Foreign investment located near sensitive testing and training ranges that require DOD to conceal or change its activities to protect against intelligence gathering.

- Reallocation of electromagnetic spectrum to commercial activities, which forces DOD systems to change their operating parameters.

- Climate impacts such as increased high-heat days, which constrain soldier activities, or drought conditions that block the use of live-fire training or testing because of increased wildfire risk.[26]

The department has developed several ways to meet these challenges, aside from imposing constraints that force testing and training to be less realistic. One key response is the establishment of buffer land around bases, which is done in a variety of ways. In many of the western states, where the surrounding land is controlled by the Bureau of Land Management, the U.S. Forest Service, or the states themselves, DOD is able to collaborate with other government institutions to minimize development in locations that would affect training or testing.

In addition, buffer programs like the Readiness and Environmental Protection Integration (REPI) program leverage unique authorities that allow DOD to share the costs of conservation easements around our bases. In these cases, the department will pay a portion of the costs of an easement, as will a non-governmental conservation organization, and each side gets what it wants—an undeveloped natural resource next to a military installation—for half price or less.

Another key tool is the Joint Land Use Study (JLUS). Under this authority, DOD and local communities work together to inform future development efforts to minimize impacts to the base. Communities are able to pursue compatible development without jeopardizing the local military base, which is usually a principal economic engine.

In recent years, the construction of wind turbines near installations has presented a particular problem. The tip of a turbine blade moves quickly and is often picked up by radar as an aircraft, thereby interfering with radar operations and testing. Moreover, given their height, most commercial turbines present significant obstructions to military training routes. To address this issue, DOD established a DOD Siting Clearinghouse, providing developers and land-use authorities a single point of contact to ask whether a proposed turbine site would affect DOD operations. The clearinghouse reaches into the testing and training expertise of the services and works to mitigate unintended problems.

**Resilience Challenges.** An emerging category of challenges that the installations leadership is facing today are resilience or mission assurance challenges. Can the installation continue to operate and support its missions, or at least recover quickly, when there is a shock to or disruption of its systems? Recently, this has been focused on energy resilience and ensuring that an installation can continue to operate if the electricity grid is knocked out through severe weather, cyberattack, or even equipment failure. DOD reported 701 utility outages lasting eight hours or more in FY 2016.[27]

The most common way that DOD insulates itself from the impact of electricity outages is through diesel generators. Generators are relatively inexpensive and easy to acquire and for that reason are sometimes purchased by mission owners rather than by installation engineers. However, they are inefficient and are suboptimal solutions for medium-term or long-term outages, and DOD has pursued a more comprehensive strategy.

In addition to backup generators, DOD's energy resilience strategy notes that resilience can be achieved in a number of ways. Recent DOD studies describe increasing energy production on base, installing sophisticated

microgrids that can steer power across an installation and insulate key facilities from the impacts of outages, diversifying its fuel supplies, improving testing of its current backup generators, and creating non-energy solutions such as ensuring backup mission facilities at different installations.[28] It is reasonable to expect that the increased attention being paid to these issues will lead to increased investment in these options to ensure energy availability.

Cyberattacks and climate impacts will affect more than just the supply of energy to installations, and DOD has begun to explore the vulnerability of its installations to each of these threats. During his confirmation process, Secretary of Defense James Mattis stated:

> [T]he effects of a changing climate—such as increased maritime access to the Arctic, rising sea levels, desertification, among others—impact our security situation. I will ensure that the department continues to be prepared to conduct operations today and in the future, and that we are prepared to address the effects of a changing climate on our threat assessments, resources, and readiness.[29]

In January 2018, DOD reported that approximately half of its bases reported damage from climate impacts, including flooding and storm surge, wind damage, drought, and wildfires.[30] The Navy, with its preponderance of coastal installations, is already experiencing challenges from sea-level rise at bases like Norfolk or Annapolis,[31] and the Assistant Commandant of the Marine Corps has testified that he is considering a seawall to protect Parris Island.[32]

In many cases, this is about avoiding expenses and reducing risk by selecting where future facilities are placed. An illustrative example of the need to consider climate in planning is the multibillion-dollar radar site on Kwajalein Atoll,[33] which DOD estimates could be unable to support human habitation by as early as 2030.[34] Consideration of climate impacts might have helped planners choose a more enduring site for the investment. Congress has begun to focus on the impacts of climate on national security and has directed DOD to assess its overall vulnerability and develop mitigation plans for its most vulnerable installations.[35]

The cyber threat has received considerable DOD attention and investment, but the vulnerability of installations is only beginning to be understood. Industrial control systems are vulnerable to attack and intrusion, but DOD has no inventory of the systems inside its facilities. New guidance has been issued to govern the cybersecurity of these systems,[36] but installation personnel do not always have the specialized expertise needed to deal with cyber threats. Efforts to hire additional cyber experts will be undermined by the funding problems that DOD's installations face, particularly as they try to meet targets for staff reductions. The staffing challenge makes it even more important to have strong relationships with partners in the cyber community such as those at Cyber Command.

Outside the scope of this discussion but equally critical is the issue of vulnerability to military attack. This is ever-present in the minds of those in our contingency bases in Afghanistan, Iraq, or Niger, but we must begin to consider how to insulate the critical mission that our installations perform and the assets they support when we consider the threat from nations like Russia and China, whose weapons easily possess the range to reach our major enduring installations in Europe and the Western Pacific. Without these bases, our ability to project power in these regions would be severely diminished, and we ignore them at our peril. This is a challenge that the warfighters and the installations communities must address together.

## Conclusion

DOD's vast installations enterprise is essential to the military mission in an incredibly diverse number of ways. It faces decay from years of underfunding, tightening constraints from encroachment, and threats from cyberattack

and the climate itself, but the men and women of the enterprise continue to make it work and support the warfighter.

I have often been asked about the base of the future and what it would look like, and I have responded that if it continues along its current trajectory, it would be dilapidated, understaffed, underfunded, and underutilized. Just like a car owner who chooses to save money by choosing not to change the oil, the nation will have to pay a much larger price down the line.

The Administration and the Congress have an opportunity and an obligation to change this trajectory. Efficiency and reform are most certainly valuable and even essential when dealing with budgets that are short of the need, but they are not enough to solve the underlying problems that DOD faces. Ultimately, the department will need more money for its facilities and a holistic strategy for recovery. It needs to reinvest in its installations or divest them.

## Endnotes


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