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AUDIT REPORT

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NASA'S EFFORTS TO REDUCE UNNEEDED INFRASTRUCTURE AND FACILITIES

OFFICE OF INSPECTOR GENERAL

National Aeronautics and
Space Administration

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Acronyms

BRAC	Base Realignment and Closure
CPRA	Civilian Property Realignment Act
CPM	Corporate Portfolio Management
CRV	Current Replacement Value
DoD	Department of Defense
GAGAS	Generally Accepted Government Auditing Standards
GAO	Government Accountability Office
GSA	General Services Administration
MSC	Mission Support Council
NTCD	NASA Technical Capabilities Database
OIG	Office of Inspector General
RPMS	Real Property Management System
SLS	Space Launch System

OVERVIEW

NASA'S EFFORTS TO REDUCE UNNEEDED INFRASTRUCTURE AND FACILITIES

The Issue

NASA is the ninth largest Federal Government real property holder, with more than 124,000 acres and over 4,900 buildings and other structures with a replacement value of more than $30 billion. The Agency's property is primarily located at 10 Centers in Alabama, California, Florida, Maryland, Mississippi, Ohio, Texas, and Virginia and includes technical facilities such as wind tunnels, rocket test stands, and launch complexes, and nontechnical facilities such as office buildings, roads, fences, and utility systems. Together, these assets enable approximately 64,000 civil servants, contractors, and other partners to advance the Nation's interests in aeronautical research, science, and space flight.

A large proportion of NASA's buildings and other structures were constructed in the 1960's during the Apollo era, and nearly 80 percent of the Agency's facilities are 40 or more years old. Since 2005, NASA's annual operations and maintenance costs have increased by $173 million or 44 percent, and as of 2010, the Agency has over $2.6 billion in annual deferred maintenance costs.[1] Nevertheless, the Agency continues to retain real property that is underutilized, does not have identified future mission uses, or is duplicative of other assets in its real property inventory. A 2012 Agency study estimated that NASA may have as many as 865 unneeded facilities with associated maintenance costs of over $24 million a year.

NASA's Office of Inspector General (OIG), the Government Accountability Office (GAO), and Congress have identified NASA's aging and duplicative infrastructure as a high priority and longstanding management challenge. The most recent formal congressional statement about NASA's excess infrastructure came in the NASA Authorization Act of 2010, which directs the Agency to examine its real property assets and downsize to fit current and future missions and expected funding levels "paying particular attention to identifying and removing unneeded or duplicative infrastructure."[2]

Despite this consensus, NASA has struggled to make significant headway in reducing its infrastructure and repeatedly failed to meet its own reduction goals. For example, in 1996 GAO reported that NASA would not meet its goal of reducing excess infrastructure

[1] NASA defines deferred maintenance as essential but unfunded work necessary to bring facilities up to required maintenance standards.

[2] Public Law 111-267, "NASA Authorization Act of 2010," October 11, 2010.

by 25 percent by the end of the decade and was actually building new facilities faster than it was consolidating or closing existing ones. Similarly, a 2005 internal NASA study conducted after the decision to end the Space Shuttle Program recommended closure or consolidation of three NASA Centers and three component sites because of a decline in overall workload.[3] Ultimately, with the exception of Santa Susana Field Laboratory, NASA took no action on the study's recommendations.

Implementing meaningful reductions to its infrastructure and facilities portfolio will continue to be a difficult challenge for NASA for several reasons. First, the Agency has undergone considerable changes in mission focus over the past 6 years with the end of the Space Shuttle Program, initiation and termination of the Constellation Program, and the early stages of development of the new heavy-lift rocket and crew capsule. At the same time, NASA must contend with a long history of decentralized governance, intense local and political interest in its Centers and their real property assets, and the likelihood of flat or reduced budgets.

In this audit, we reviewed NASA's efforts to reduce its underutilized and duplicative infrastructure. Specifically, we examined the extent to which the Agency is currently utilizing or has a future mission-related need for 153 key technical facilities including wind tunnels, test stands, thermal vacuum chambers, airfields, and launch-related infrastructure; identified the challenges that have hindered the Agency's past efforts to reduce underutilized infrastructure; and reviewed its ongoing and planned infrastructure management efforts. Details of the audit's scope and methodology are in Appendix A.

Results

During our fieldwork we identified a variety of facilities at multiple NASA Centers that the Agency was not utilizing or for which Agency officials could not identify a future mission use. These facilities ranged from smaller, low value post-World War II era thermal vacuum chambers to newer rocket test stands that cost several hundred million dollars to construct.

We concluded that previous efforts by NASA to reduce its underutilized facilities have been hindered by: 1) fluctuating and uncertain strategic requirements; 2) Agency culture and business practices; 3) political pressure; and 4) inadequate funding. The combination of these forces has frustrated NASA's efforts over the years to make meaningful reductions in the size of its real property portfolio.

We also found that NASA recently launched several promising initiatives to manage its infrastructure, including organizational changes, a new facilities strategy, an analytical framework for making infrastructure decisions, and improvements in managing its real property data. While we view these initiatives as positive steps, most are in the early stages of development. As noted above, NASA has attempted infrastructure reduction initiatives in the past with limited success. Absent strong and sustained leadership to see

[3] NASA Draft Report, "Real Property Mission Analysis," July 15, 2005.

its current efforts through and incorporate them into Agency policy, we are concerned that these latest efforts will meet a similar fate.

Key Infrastructure Underutilized and Unneeded for Future Missions. Through our on-site inspections, we found at least 33 facilities that were underutilized or for which NASA managers could not identify a future mission use.[4] The need for these facilities have declined in recent years as a result of changes in NASA's mission focus, the condition and obsolescence of some facilities, and the advent of alternative testing methods. NASA has taken steps to minimize the costs of continuing to maintain some of these facilities by placing them in an inactive state or leasing them to other parties.[5]

- *Wind Tunnels*. At least 6 of NASA's 36 wind tunnels are currently underutilized or NASA managers could not identify how these facilities are needed to support future missions. NASA's use of wind tunnels has declined in recent years due to a reduction in the Agency's aeronautics budget, fewer new aircraft developments by the Department of Defense (DoD) and private industry, newer and more capable foreign testing facilities, and the advent of alternative testing methods such as Computational Fluid Dynamics.[6]

- *Test Stands*. As many as 14 of the Agency's 35 rocket engine test stands are currently underutilized or NASA managers could not identify how these facilities are needed to support future missions. NASA's use of test stands has declined in recent years primarily due to a lack of new, large-scale propulsion test programs. The ongoing development of the heavy-lift rocket associated with NASA's Space Launch System (SLS) is not expected to alter this trend.

- *Thermal Vacuum Chambers.* At least 4 of the Agency's 40 large thermal vacuum chambers are currently underutilized or NASA managers could not identify how they will be needed to support future missions. NASA's use of the chambers has declined in recent years due to a lack of need by NASA programs and the poor condition of some chambers.

- *Airfields.* We found that two of the Agency's three airfields – Moffett Federal Airfield at Ames and Kennedy's Shuttle Landing Facility – are currently underutilized or NASA managers could not identify how they will be needed to support future missions. Moffett almost exclusively supports non-NASA entities. The Kennedy facility supports non-NASA space hardware deliveries and was last used for a NASA mission in September 2012 by the plane carrying Space Shuttle Endeavour to its final home at the California Science Center.

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[4] NASA policy requires that utilization of active facilities is normally at least 50 percent or the usage level exceeds 50 percent of the number of days that it is available.

[5] Inactive states are: 1) standby – facility not in current use but essential operating systems are maintained in a state of readiness for future use; 2) mothball – facility maintained to the extent necessary to prevent deterioration of essential systems; and 3) abandoned – only maintenance performed is that necessary to ensure the facility does not pose a safety hazard.

[6] This testing method uses supercomputers to create three-dimensional graphic illustrations of airflow around an aircraft, thus reducing the need to conduct as many tests in wind tunnels.

- *Launch Infrastructure.* Seven of NASA's launch-related facilities at Kennedy are underutilized or NASA managers could not identify how they will be needed to support future missions. These include solid rocket booster recovery facilities, a parachute refurbishment facility, a launch pad, and one Orbiter processing facility. NASA's need for this infrastructure ended last year as the Space Shuttle Program was phased out; however, timely decisions on the future of these facilities is vital in light of the amount of time the Agency had to plan for the Shuttle Program's end and the high costs associated with continuing to maintain them. To its credit, Kennedy has leased one Orbiter processing facility and is seeking commercial companies to lease several other sites. If tenants are not found by March 2013, the Center plans to place the facilities in inactive states and seek funds for eventual demolition.

Interrelated Challenges Hinder NASA's Ability to Reduce its Infrastructure. We identified four interrelated factors that have hindered past efforts to reduce NASA's infrastructure: 1) fluctuating and uncertain strategic requirements; 2) Agency culture and business practices; 3) political pressure; and 4) inadequate funding.

Fluctuating and Uncertain Requirements. Changes to the Nation's space policy initiated by Congress, the President, and NASA have increased the difficulty of determining which facilities the Agency needs to accomplish its mission. For example, NASA's Human Exploration and Operations mission has transitioned from the Space Shuttle Program to the Constellation Program to the Space Launch System (SLS) Program in just 6 years. Because decisions of whether to retain, consolidate, or dispose of specific facilities depend heavily upon the missions NASA undertakes, frequent changes to those missions complicate the task of managing the Agency's infrastructure.

A recent example of this issue is the A-3 test stand located at Stennis Space Center, which was built to meet special testing requirements associated with the rockets being built for NASA's Constellation Program. When the Constellation Program was cancelled in 2010, the test stand was approximately 65 percent complete. In accordance with direction in the NASA Authorization Act of 2010, the Agency will soon complete construction of the test stand at a total cost of nearly $350 million.[7] Because neither the SLS nor any other existing or planned NASA program requires the A-3's capabilities, NASA plans to mothball the test stand when construction is complete. The associated annual operations and maintenance costs of the mothballed A-3 test stand will exceed $1.5 million.

Agency Culture and Business Practices. Historically, NASA has practiced a decentralized approach to managing its infrastructure that creates a rivalry between the Centers to compete for work from the Agency's major programs and rewards a "keep it in case you need it" philosophy. This culture has fostered a propensity for Centers to build or preserve facilities that duplicate capabilities available elsewhere in the Agency or lack an identified mission use. For example, NASA currently has 36 wind tunnels at

[7] Public Law 111-267 (section 304), "NASA Authorization Act of 2010," October 11, 2010.

5 Centers, 35 rocket test stands at 6 sites, and 40 large thermal vacuum chambers at 7 locations.

Political Pressure. The political context in which NASA operates often impedes its efforts to reduce Agency infrastructure. During our review, we noted several examples where political leaders intervened in plans to close or consolidate Agency facilities. For example, members of Congress opposed NASA's decision to consolidate the Agency's Arc Jet operations at Ames, directed completion of the A-3 test stand even though the rocket engine for which it was being built had been cancelled, and contested the Agency's decision to seek alternatives for the future use of Hangar One and Moffett Federal Air Field at Ames. While pressure from Federal, state, and local officials is not unique to NASA, it creates additional difficulties for the Agency as it seeks to manage its aging and expansive infrastructure.

Inadequate Funding. Demolishing or disposing of facilities that NASA no longer needs to fulfill its mission is not without cost. In many instances, NASA must conduct environmental remediation before it can dispose of a facility. For example, NASA has estimated that the environmental cleanup of its Santa Susana Field Laboratory will cost between $25 and $209 million. Accordingly, the Agency's ability to reduce its real property footprint depends on available funding for cleanup and other costs associated with demolition and disposal. However, in this era of constrained Federal budgets, the amount of money dedicated to these activities is not likely to increase. In fact, the Office of Management and Budget reduced NASA's proposed recapitalization budget for renewing and replacing facilities for fiscal year (FY) 2013 through FY 2017 by approximately 60 percent.

NASA Has Recently Taken Positive Steps to Manage its Infrastructure, But Sustained Leadership Will be Required to Overcome Longstanding Challenges. NASA has recently launched several promising initiatives to manage its infrastructure: 1) organizational changes to strengthen central authority over infrastructure decisions; 2) development of an Agency Facility Strategy and Integrated Agency-wide Real Property Master Plan; 3) development of a Corporate Portfolio Management Process; 4) improvements in managing its real property data; and 5) development of a strategic technical capabilities assessment. However, these efforts are evolving and will require sustained leadership to overcome the longstanding challenges identified in this report.

Organizational Structure Changes. NASA has taken steps to centralize real property decision making, including establishing an Agency Council to oversee infrastructure decisions and a Directorate-level position to manage and provide additional authority over infrastructure decisions. We view these changes as positive steps to addressing the challenges resulting from the Agency's decentralized governance structure.

Facilities Strategy and Integrated Agency-wide Master Planning. NASA developed an Agency Facilities Strategy in 2009 that calls for consolidation of its technical and nontechnical facilities to achieve efficiencies and set goals to reduce infrastructure. To implement this strategy and better coordinate projected funding with facilities resource needs, NASA developed its first real property Agency-wide integrated master plan.

Although we believe these initiatives are positive steps toward reducing and better managing NASA's diverse real property assets, the Agency is still implementing a series of recommendations we made in a previous audit aimed at improving the Agency-wide Master Plan.[8]

Corporate Portfolio Management. NASA is developing a Corporate Portfolio Management (CPM) process, which is an analytical framework designed to assist managers in identifying, grouping, and evaluating the Agency's capabilities (defined as people, facilities, and other direct costs) into a set of portfolios to manage infrastructure needs. NASA originally planned to have CPM fully implemented by spring 2012; however, the effort is behind schedule. According to Mission Support Directorate officials, the delay was due to their decision to pilot the process by first analyzing possible consolidation of airfields, thermal vacuum chambers, test stands, and wind tunnels before examining other Agency assets.[9]

We reviewed the CPM pilot and found that while more analytical and transparent than past infrastructure reduction efforts, the process may still fall short of overcoming the cultural and fiscal challenges highlighted in this report. As of completion of the pilot process in July 2012, the Associate Administrator for the Mission Support Directorate recommended, and the Mission Support Council approved for divestiture, only 7 of the 101 facilities that were evaluated.[10] We are concerned about the small number of facilities selected, particularly because Mission Support Directorate officials told us the pilot process was targeted to facilities considered easy choices or "low hanging fruit," including facilities that, at the time of evaluation, were mothballed or not being utilized. Although we believe CPM is a positive step toward better facilities management, Agency leadership must be willing to move beyond the "low hanging fruit" when selecting facilities for elimination or consolidation to show maximum results.

Real Property Data. In conjunction with CPM, the Agency is developing the NASA Technical Capabilities Database (NTCD) to identify and track all Center technical capabilities and their associated resources (supply) and map them to projected mission requirements (demand) across the Agency. The creation of NTCD should help the Agency better analyze and determine its infrastructure needs; however, we found instances in which the data contained in the NTCD was inconsistent and incomplete. In addition, our previous audit work identified numerous data quality issues with NASA's Real Property Management System (RPMS) and ultimately deemed the data within that system unreliable because the Centers used inadequate processes to gather and update

[8] NASA OIG, "NASA's Infrastructure and Facilities: An Assessment of the Agency's Real Property Master Planning" (IG-12-008, December 19, 2011). We found that NASA is developing its initial master plan based on Center master plans that (1) were developed using funding assumptions that are no longer realistic and (2) are missing essential information. In addition, 5 out of the 10 Centers did not develop master plans to reduce their real property footprint in accordance with Agency goals.

[9] The pilot process is known throughout the Agency as the NASA Technical Capabilities Forum Phase II. The Agency held two capability forums (2010 and 2011) to determine the size of all Center technical capabilities and to identify capabilities with funding gaps. Officials decided to continue the work started at these forums by using the data to pilot the larger CPM process.

[10] Divestiture is the transfer, removal, or abandoning in place of an asset.

data.[11] In addition, we found that the Centers still lacked adequate records regarding past or planned usage for many of the facilities reviewed during this audit. Lack of complete and consistent data hampers the Agency's ability to identify whether key facilities are being utilized and to certify whether technical capabilities are available and appropriately sized to support current and future missions.

Comprehensive Technical Capabilities Assessment. In July 2012, the Agency – under the leadership of the Associate Administrator – began developing a process to complete a comprehensive technical capability assessment that will identify and evaluate the capabilities of individual NASA Centers against the current and future needs of the Agency. Through this assessment, NASA plans to rank each Center's principal capabilities and evaluate them against the needs of the Mission Directorates to identify capabilities that may be unnecessary or consolidated. Although we are encouraged that the Agency is structuring this process to minimize the historical predisposition for Centers to build up and retain capabilities and facilities to compete for work, the Agency faces several challenges in implementing this process, including the transparency of the process to internal and external stakeholders and the inevitable political opposition to eliminating or consolidating capabilities and associated infrastructure at NASA Centers.

Conclusion

NASA officials readily acknowledge that the Agency has more infrastructure than it needs to carry out current and planned missions. To its credit, NASA has a series of initiatives underway that, in our judgment, are positive steps towards "rightsizing" its real property footprint. The development of an Agency Facilities Strategy and Integrated Master Plan, capability assessments, and organizational changes to centralize decision authority over infrastructure matters should better position the Agency to strategically assess infrastructure needs, manage underutilized property, and divest itself of facilities that are duplicative or unneeded. However, many of these efforts are in the early stages and their ultimate effect on the Agency's ability to reduce its real property portfolio remains unclear.

Given the disparity between the Agency's infrastructure and its mission-related needs, as well as the likelihood of continued constrained budgets, it is imperative that NASA move forward aggressively with its infrastructure reduction efforts. To achieve this goal, the Agency will need to move away from its longstanding "keep it in case you need it" approach to managing its infrastructure and overcome historical incentives for the Centers to build up and maintain unneeded capabilities. In addition, NASA officials will need to manage the concerns of political leaders about the impacts eliminating or consolidating facilities will have on the Centers' missions and their workforces and on the local communities. Moreover abrupt changes in the strategic direction of the Nation's space policy by Congress, the President, and the Agency will continue to add an element

[11] NASA OIG, "NASA Infrastructure and Facilities: Assessment of Data Used to Manage Real Property Assets" (IG-11-024, August 4, 2011).

of uncertainty regarding the missions the Agency will pursue and therefore the facilities it will need to achieve those missions.

Against this complicated backdrop, successfully rightsizing NASA's real property footprint will require a sustained commitment from Agency leaders to see its ongoing infrastructure-related initiatives through to completion. Specifically, Agency leaders must ensure that these initiatives are institutionalized, coordinated, and communicated both inside and outside the Agency. In addition, they must be willing to make the difficult decisions to divest unneeded infrastructure, effectively communicate those decisions to stakeholders, and withstand the inevitable pressures from Federal, state, and local officials.

Finally, we acknowledge that NASA's best efforts to address these challenges may be insufficient to overcome the cultural and political obstacles to eliminating or consolidating Agency facilities and that an outside process similar to DoD's Base Realignment and Closure Commission (BRAC) may be necessary.

Management Action

To ensure that NASA's ongoing efforts to evaluate Center capabilities against the current and future missions of the Agency are completed and that such efforts are conducted on a regular basis and sustained over time, we recommended that NASA's Associate Administrator complete the Agency's ongoing comprehensive technical capabilities assessment and ensure that the assessment includes a process for communicating decisions to outside stakeholders and is established into Agency policy. We also recommended that NASA's Associate Administrator for Mission Support expedite implementation of CPM and develop processes to improve data accuracy with the NTCD.

In response to a draft of this report, the Associate Administrator for Mission Support concurred with our recommendations to complete the comprehensive capabilities assessment, implement CPM, improve the accuracy of NTCD or alternative systems, and establish all processes in Agency policy by September 2014. We find the Agency's proposed actions address the intent of our recommendations. Accordingly, we are resolving the recommendations and will close them upon completion and verification of the proposed corrective actions.

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INTRODUCTION

Background

NASA is the ninth largest Federal Government real property holder, with more than 124,000 acres and 4,900 buildings and other structures with an overall replacement value of over $30 billion. The Agency's property is primarily located at 10 Centers in Alabama, California, Florida, Maryland, Mississippi, Ohio, Texas, and Virginia and includes technical facilities such as wind tunnels, rocket test stands, and launch complexes, and nontechnical facilities such as office buildings, fences, and utility systems. Together, these assets enable approximately 64,000 civil servants, contractors, and other partners to advance the Nation's interests in aeronautical research, science, and space flight.

The NASA Authorization Act of 2010 directed NASA to examine its real property assets and, as appropriate, downsize to fit current and future missions and expected funding levels, "paying particular attention to identifying and removing unneeded or duplicative infrastructure."[12] Implementing this directive presents an extremely difficult challenge to NASA, an Agency with a considerable amount of aged and degraded infrastructure that has undergone significant changes in mission focus with the recent end of the Space Shuttle Program and ongoing development of the Space Launch System (SLS). To meet its infrastructure challenges, NASA managers must identify and assess the conditions, current utilization rates, and future need for thousands of structures to determine which the Agency should keep and how best to dispose of those that are no longer needed.

State of NASA Infrastructure. A large portion of NASA's infrastructure was constructed in the 1960's during the Apollo era and nearly 80 percent of the Agency's facilities are 40 or more years old. This aging infrastructure presents considerable risk to NASA's overall mission success as facilities degrade and become obsolete and considerably more expensive to maintain. Since 2005, NASA's annual operations and maintenance costs for its facilities have increased 44 percent to $567 million, and as of 2010 the Agency had more than $2.6 billion in annual deferred maintenance costs.[13]

Numerous studies and reports over the past decades by NASA, NASA's Office of Inspector General (OIG), the Government Accountability Office (GAO), and others have focused on NASA's aging and duplicative infrastructure. For example, a 2010 report by the National Research Council found that a steady and significant decrease in NASA's

[12] Public Law 111-267, "NASA Authorization Act of 2010," October 11, 2010.

[13] NASA defines deferred maintenance as essential but unfunded work necessary to bring facilities up to required maintenance standards.

laboratory capabilities had adversely affected the Agency's ability to make basic scientific and technical contributions to the Nation and to support NASA's own goals.[14]

Other key segments of NASA's technical infrastructure face similar problems. For example, nearly all of NASA's major wind tunnels were built between 40 and 70 years ago. Historically, some of these facilities have been perceived by potential industry users as lacking in terms of modern testing amenities and productivity.[15] As a result, U.S. aerospace manufacturers have increasingly opted to use European wind tunnels that are newer and more technologically advanced.[16]

In addition to issues related to the age and condition of its facilities, NASA officials acknowledged that they are retaining facilities the Agency no longer needs and that this is depleting funds for revitalization efforts. As a result, NASA has begun several initiatives to identify and dispose of unneeded infrastructure. For example, NASA's Program Analysis & Evaluation Office conducted a study in 2009 that identified 203 facilities that the Agency's Mission Directorates had no requirement for after 2012. These facilities, were located across all NASA Centers, included wind tunnels, test stands, and airfields; comprised approximately 1.9 million square feet; and cost the Agency nearly $14 million per year to operate and maintain. Similarly, in 2012 NASA's Facilities Engineering and Real Property Division completed an assessment that identified 865 assets as potential candidates for disposal, including research laboratories, wind tunnels, and test stands valued at approximately $2.2 billion and with annual operations and maintenance costs of over $24 million.

NASA's Options for Managing its Underutilized Infrastructure. NASA has several options for dealing with infrastructure it identifies as underutilized, including continuing to retain the property in an active state, placing the property in various inactive states, making the property available for lease to a government or private tenant, reporting the property to the General Services Administration (GSA) for sale or transfer to another entity, or demolition. Because maintaining property that is seldom used in an active state can be quite costly, NASA policy encourages Centers to place underutilized properties in an inactive state when lease, transfer, or demolition are not suitable options.[17] Inactive properties can be placed into one of several different categories: "standby" for facilities that are temporarily not in use but whose essential operating systems need to be maintained in a state of readiness for future use; "mothball " for facilities that are deactivated and maintained only to the extent necessary to prevent deterioration of

[14] National Research Council, "Capabilities for the Future: An Assessment of NASA Laboratories for Basic Research," 2010.

[15] NASA, Wind Tunnel Study Task Team Report, "Assessment of NASA's Major Wind Tunnel Facilities," August 1987.

[16] Congressional Research Service Report 95-103SPR, "Wind Tunnels: Proposal for a New National Wind Tunnel Complex," March 8, 1995.

[17] NASA Procedural Requirements (NPR) 8800.15B, "Real Estate Management Program," June 21, 2010.

essential systems; and "abandoned" for facilities on which the Agency performs only the maintenance necessary to ensure the facility does not pose a safety hazard.

NASA can also choose to dispose of unneeded properties, although it must consult with the GSA to sell property.[18] NASA has the option to report property without a current or foreseeable future use to the GSA as "excess" where it is first made available for transfer to other Federal agencies followed by possible public benefit conveyances, negotiated sales, or public land sales.[19] If the property is not claimed by another Federal agency, conveyed, or sold—a process that can take years—NASA can demolish it. Finally, NASA can lease underutilized property for which it may have a future mission use to external parties.

NASA's Infrastructure Management. A number of entities at both the Headquarters and Center levels have responsibility for managing NASA's infrastructure. At the Headquarters level, NASA's Associate Administrator for Mission Support has overall responsibility for managing the Agency's infrastructure. Under the leadership of the Associate Administrator, the Office of Strategic Infrastructure provides executive leadership, institutional support, guidance, and oversight for NASA's real property and management systems. The Office of Strategic Infrastructure's Facilities Engineering and Real Property Division provides leadership for all Agency facility engineering programs including facility planning, construction, maintenance, and real estate. NASA's other Headquarters Mission Directorates – Human Exploration and Operations, Aeronautics Research, and Science – are also involved in infrastructure management decisions, as they develop and manage the Agency's mission requirements and assist in identifying and funding facilities to support those requirements. The Aeronautics Research and Human Exploration and Operations Mission Directorates also oversee NASA's Aeronautics Test and Rocket Propulsion Test programs, which are responsible for the strategic utilization, operations, maintenance, and investment decisions for the Agency's wind tunnels and test stands.

Major infrastructure decisions are vetted through the Agency's Mission Support Council, which serves as NASA's senior decision-making body regarding facilities strategy and master planning.

While these Headquarters-based organizations are responsible for providing oversight and guidance relating to infrastructure management, the Directors of the NASA Centers have overall authority over the real property located at their sites. To guide their decisions, Center Directors consult Center Master Plans that articulate a vision for the future development of the Center's real property assets, including land, buildings, physical resources, and infrastructure. Each Center also has its own facilities management organization staffed with Real Property Accountable Officers, Facility Utilization Officers, and other support staff.

[18] 40 U.S.C., section 471, "Federal Property and Administrative Services Act of 1949."

[19] If excess property is not transferred to another Federal agency, GSA can "convey" or transfer the property to the public for certain uses, negotiate a sale at appraised fair market value with a state or local government, or conduct a competitive sale to the public, generally through a sealed bid or auction.

NASA Infrastructure Management Viewed as a High Risk. NASA, NASA's OIG, GAO, and Congress have identified NASA's real property management as a high-risk area or top challenge for a number of years. OIG reports have identified issues with the quality of facility data, deferred maintenance costs, leasing initiatives, and facility utilization. In the 1990's, GAO issued several reports and testified before Congress about NASA's challenges to achieving reductions and efficiencies in its infrastructure and in 2003, GAO designated Federal real property as a high-risk area. In 2004, the President issued an Executive Order directing all Federal agencies to recognize the importance of real property resources through increased management attention, the establishment of clear goals and objectives, and improved policies and levels of accountability. Congress compelled further action by mandating in NASA Authorization Acts from 2005 to 2010 that the Agency assess its real property, management structure, capabilities, and right-sizing directives.

Past Efforts to Reduce Infrastructure. For decades NASA has struggled with reducing its infrastructure and has failed to meet specific reduction goals. For example, in 1996 GAO reported that NASA would not meet its internal goal of reducing infrastructure by 25 percent by the end of the decade.[20] GAO also found that NASA was building new facilities faster than it was consolidating or closing older sites and duplicative capabilities existed in major program areas. Similarly, in 2005 following the decision to end the Space Shuttle Program, NASA's Administrator commissioned an internal study to assess the relevance of its facilities to its current and future work.[21] The study took a critical look at each of the Agency's 10 Centers and their principal component sites and made recommendations to close or consolidate 3 Centers and 3 component sites. The study found that due to a decline in aeronautics related work, Glenn could be closed and certain activities at Ames could be moved to other Centers. In addition, the study found that Plum Brook Station, Santa Susana Field Laboratory, Stennis Space Center, and Wallops Flight Facility had insufficient work to justify continued operations. With the exception of Santa Susana, NASA took no action to implement the study's recommendations.[22]

Current Progress in Reducing Infrastructure. As shown in Table 1, NASA has made recent progress in reducing its infrastructure by decreasing the number of technical and nontechnical facilities by 58 between 2006 and 2011 and decreasing the Current Replacement Value (CRV) of its facilities by $636 million.[23] While the Agency's square

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[20] GAO/NSIAD-96-187, "NASA Infrastructure: Challenges to Achieving Reductions and Efficiencies," September 1996.

[21] NASA Draft Report, "Real Property Mission Analysis," July 15, 2005.

[22] In April 2009, NASA formally notified Congress that it intended to declare its property at the Santa Susana Field Laboratory as excess to its needs.

[23] The Agency uses CRV to measure facility reduction progress because it better reflects certain high-dollar NASA assets. For example, many of the Agency's large capabilities – such as test stands, launch pads, and underground utilities – do not have square footage directly associated with them. Accordingly, tracking progress by reduction in square footage would not capture changes relating to these types of assets.

footage actually increased by 2.3 million, most of that increase is attributable to the 2011 transfer of a 1.6 million square foot facility from the U.S. Army to Stennis as part of the DoD Base Realignment and Closure process (BRAC). Despite this progress, our prior work has shown that 5 of the 10 NASA Centers (Dryden, Goddard, Jet Propulsion Laboratory, Johnson, and Kennedy) are not on track to meet NASA's goal of a 10 percent reduction in CRV by 2020 and 15 percent by 2055.[24,25]

Table 1. FYs 2006–2011 Square Footage, CRV, Building/Structure Changes[a] FYs 2013–2020[c] Planned CRV Changes

	Increase/Decrease			
NASA Center	**Square Footage**	**CRV**	**Building and Other Structure**	**FY 2013–2020 Planned CRV**
Ames Research Center	(101,411)	($553,781,488)	(24)	(17.3%)
Dryden Flight Research Center	(2,991)	($21,190,272)	(2)	(5.6%)
Glenn Research Center	(140,473)	($103,524,912)	(31)	(10.0%)
Goddard Space Flight Center	249,293	($2,184,090)	(60)	(3.5%)
Jet Propulsion Laboratory	139,956	$69,351,434	(49)	7.6%
Johnson Space Center	49,179	$30,820,451	(23)	(6.8%)
Kennedy Space Center	129,239	($216,121,982)	(15)	(5.1%)
Langley Research Center	(63,636)	($234,136,940)	(51)	(15.0%)
Marshall Space Flight Center	(33,120)	($103,671,883)	(13)	(11.7%)
Stennis Space Center[b]	2,128,375	$498,358,869	210	(10.0%)
Total Increase/ (Decrease)	**2,354,411**	**($636,080,813)**	**(58)**	

a. Data provided by the Facilities Engineering and Real Property Office.
b. In 2011, Stennis Space Center took possession of the former Mississippi Army Ammunition Plant, a 1.6 million square foot facility with approximately 200 facilities, from the U.S. Army as a result of the Base Realignment and Closure process.
c. Data obtained from IG Master Planning Report, IG-12-008.

Federal Property Management Best Practices. Infrastructure management is an issue that has confounded agencies across the Federal Government for many years. While no process to identify and reduce unneeded infrastructure is perfect, organizations that have studied the issue have identified several consistent and recurring problems that affect agencies' ability to reduce property and implement best practices that could assist in

[24] NASA OIG, "NASA's Infrastructure and Facilities: An Assessment of the Agency's Real Property Master Planning," (IG-12-008, December 19, 2011).

[25] Because of the varying mission requirements at each Center, NASA is currently in the process of revising its policy to set Agency-wide real property reduction goals rather than goals that are Center specific.

mitigating these issues and reaching their goals. For example, GAO has studied infrastructure issues across the Federal Government and found that agencies continue to experience difficulty disposing of unneeded property because they have not adequately addressed issues such as legal constraints, financial limitations, and stakeholder influences.[26] These issues have affected the ability of Federal agencies to reduce their real property footprints and became the driving force behind creation of the BRAC in 1988. To date, the BRAC process has resulted in the closure of more than 350 DoD installations and produced recurring cost savings of approximately $7 billion annually since 2001.

Both the President and Congress members have proposed legislation to create a Civilian Property Realignment Act (CPRA) modeled after the BRAC process.[27] In a June 2011 testimony before the U.S. Senate's Committee on Homeland Security and Governmental Affairs, GAO witnesses discussed key elements of the BRAC process that could be applicable to civilian agencies, including: 1) development of an organizational structure charged with making important decisions relating to infrastructure reduction goals; 2) establishing a common analytical framework; 3) standardizing decision criteria; and 4) independent verification of data accuracy.

Objectives

Our overall audit objective was to determine whether NASA is taking appropriate action to identify and reduce its underutilized and duplicative infrastructure. Specifically, we examined the extent to which the Agency is currently utilizing or has a future mission-related need for 153 key technical facilities, namely wind tunnels, test stands, thermal vacuum chambers, airfields, and launch related infrastructure; identified the challenges that have hindered the Agency's past efforts to reduce underutilized infrastructure; and reviewed its ongoing and planned infrastructure management efforts. (See Appendix A for details of the audit's scope and methodology, our review of internal controls, and a list of prior coverage.)

[26] GAO-11-704T Federal Real Property Proposed Civilian Board Could Address Disposal of Unneeded Facilities, June 2011.

[27] Civilian Property Realignment Act, H.R. 1734.

REDUCING NASA'S UNDERUTILIZED AND UNNEEDED INFRASTRUCTURE WILL REQUIRE SUSTAINED LEADERSHIP TO OVERCOME LONGSTANDING CHALLENGES

We found a variety of facilities at multiple NASA Centers that are underutilized or for which NASA officials could not identify a future mission-related use. These facilities ranged from smaller post-World War II era vacuum chambers to newer rocket test stands that cost several hundred million dollars to construct. NASA's efforts to manage and reduce the number of underutilized facilities in its portfolio have been hindered by several longstanding and interrelated challenges, including: 1) fluctuating and uncertain strategic requirements; 2) Agency culture and business practices; 3) political pressure; and 4) inadequate funding. However, NASA has recently launched several promising initiatives to manage its infrastructure, including organizational changes, a new facilities strategy, an analytical framework for infrastructure decisions, and data management improvements. Although we view these initiatives as positive steps, most are still in the early stages of development and their ultimate effectiveness remains unclear. Moreover, we note that NASA has attempted infrastructure reduction initiatives in the past with limited success. Therefore, we believe that without strong and sustained leadership to see current efforts through, NASA will continue to be frustrated in its effort to "right size" its real property footprint.

Key Infrastructure Underutilized and Not Needed for Future Missions

Through on-site inspections, we found at least 33 facilities – wind tunnels, test stands, thermal vacuum chambers, airfields, and launch-related infrastructure – that the Agency was not fully utilizing or for which Agency managers could not identify a future mission use.[28] The need for these 33 facilities – which cost the Agency more than $43 million to maintain in FY 2011 – has declined in recent years as a result of changes in NASA's mission focus, the condition and obsolescence of some of the facilities, and the advent of alternative testing methods. However, in many cases NASA has taken steps or developed plans to minimize the costs of maintaining these facilities by placing them in "mothball" or "standby" status. While deactivating facilities helps to reduce associated annual maintenance costs, in some cases the Agency may simply be incurring additional costs to maintain facilities that have aged beyond their useful life and are unlikely to be used again. In such cases, the costs associated with continuing to maintain the facilities may be greater than disposal costs.

[28] NASA policy requires that utilization of active facilities is normally at least 50 percent or the usage level exceeds 50 percent of the number of days that it is available.

Wind Tunnels. At least 6 of NASA's 36 wind tunnels are currently underutilized or NASA managers could not identify how these facilities will be needed to support future missions. In FY 2011, NASA spent approximately $3.7 million to maintain these tunnels. (See Table 2 for additional details on the tunnels.)

Most of NASA's 36 wind tunnels are located at three of the Agency's research Centers—Ames, Glenn, and Langley. They range in size from tunnels large enough to test a full-size airplane to those with a test section only a few inches square for testing small models.[29] Many NASA programs have utilized the wind tunnels in the past, including NASA's Fundamental Aeronautics Program, Integrated Systems Research Program, and the Space Shuttle Program. In addition, other Federal Agencies and commercial companies have used the tunnels (e.g., DoD, Boeing, and Lockheed Martin). Currently, NASA's SLS Program is conducting testing at Marshall's 14 x 14 Inch Trisonic Wind Tunnel and Engine Fluid Flow Facility. However, utilization of the Agency's wind tunnels has declined in recent years due to a reduction in NASA's Aeronautics budget, fewer new aircraft developments by the DoD and industry, newer and more capable foreign facilities, and the advent of new testing methods such as Computational Fluid Dynamics.[30]

Table 2. Wind Tunnels without Future Work

Facility Location	Facility Name	Year Built	Year Last Used	O&M* Costs	Reason for Declining Use	Future Plans
Ames	12-Foot Pressure Wind Tunnel	1946	2003	$159,335	Foreign competition and reduced funding	Remain in Standby
Ames	8 x 7 - Foot Supersonic Wind Tunnel	1955	1992	967,208	Reduced demand for high speed testing	Converted to storage
Glenn	Abe Silverstein 10 x 10 Supersonic Wind Tunnel	1955	2012	299,015	Used in 2012. Limited future requirements due to lack of funding	Remain Active
Langley	CF4 Tunnel Complex	1960	2010	241,806	Loss of funding	Abandon by 2012
Langley	Unitary Plan Wind Tunnel	1952	2012	1,962,344	Used in 2012. Closing due to duplicative testing capabilities	Mothball by 2014
Stennis	Atmospheric Calibration Equipment Building	1975	2011	20,960	Reduced demand	Remain Active

* Operations and Maintenance Costs

[29] NASA maintains various wind tunnels in order to test models at different wind speeds (subsonic, transonic, supersonic, and hypersonic) and for different reasons (aerodynamics, flight dynamics, propulsion, and icing).

[30] NASA engineers use supercomputers to create three-dimensional graphic illustrations of airflow around an aircraft, thus reducing the need to conduct as many tests in wind tunnels.

The six wind tunnels we identified are located at Ames, Glenn, Langley, and Stennis. At Ames, the 12-Foot Pressure Wind Tunnel and 8 x 7-Foot Supersonic Wind Tunnel have not been used in more than a decade and Center officials could not identify a future mission-related need. The 12-Foot Pressure Wind Tunnel (see Figure 1) was upgraded in 1994 at a cost of $115 million; however, it was last used in 2003 by the Department of Energy. Center officials attributed the lack of use to NASA's implementation of full-cost recovery, which made foreign testing facilities more cost-effective than NASA facilities.[31] The 8 x 7-Foot Wind Tunnel had not been used for nearly 20 years due to an overall lack of demand for its high-speed testing capabilities.

Figure 1. Ames's 12 Foot Pressure Wind Tunnel.

Glenn's Abe Silverstein 10 x 10 Supersonic Wind Tunnel faces a period of declining utilization due to a lack of demand for high-speed testing capabilities and Center officials told us they were uncertain whether the wind tunnel would be needed to support NASA-specific missions beyond 2013. Glenn officials also stated that the facility would be used on a limited basis by the European Space Agency for parachute tests in fall 2012 and nozzle calibration testing in winter 2013. However, the wind tunnel has no confirmed testing requirements beyond this timeframe. Further, Center officials stated that a lack of research funding as well as an overall lack of supersonic test programs is primarily responsible for declining utilization of the tunnel.

Langley is placing the Center's CF4 Tunnel Complex and Unitary Plan Wind Tunnel – which cost over $2 million to operate in FY 2011 – in inactive states due to a lack of demand for their testing capabilities and duplication with capabilities available at other Centers. Langley used the Unitary Plan Wind Tunnel through July 2012 to conduct tests for the SLS program and commercial space-flight capabilities testing and plans to conduct some other limited tests through January 2014. However, NASA has decided to mothball the facility after this testing is complete.

Lastly, Stennis's Atmospheric Calibration Equipment Building, which NASA also classifies as a wind tunnel, has gone through a period of limited utilization by NASA programs for the past several years and Center officials were uncertain how often it will be required in the future.

[31] In October 2003, NASA implemented full cost recovery, which requires NASA installations to charge non-NASA users for all costs associated with testing. Prior to 2003, some facilities and operations costs were not always charged to non-NASA users.

Of the six wind tunnels identified, NASA officials plan to: 1) maintain two in an active state (Glenn's Abe Silverstein 10 x 10 Supersonic Wind Tunnel and Stennis's Atmospheric Calibration Equipment Building); 2) mothball one (Langley's Unitary Plan Wind Tunnel); 3) keep one on standby (Ames's 12-Foot Pressure Wind Tunnel); 4) use one for storage (Ames's 8 x 7-Foot Supersonic Wind Tunnel); and 5) abandon one (Langley's CF4 Tunnel Complex).

Test Stands. We determined that as many as 14 of the Agency's 35 test stands are currently underutilized or NASA managers could not identify how these facilities will be needed to support future missions. NASA spent over $2.2 million maintaining these test stands in FY 2011. (See Table 3 for additional details on these test stands.)

Most of NASA's test stands are located at Glenn, Marshall, Stennis, and White Sands, and they range in height from several to 295 feet. The Agency has used these test stands to test propulsion systems for past NASA programs such as Apollo and the Space Shuttle, as well as for current programs like the SLS. However, utilization of some of the facilities has declined in recent years primarily due to a lack of new large-scale propulsion test programs.

Table 3. Test Stands without Future Work						
Facility Location	**Facility Name**	**Year Built**	**Year Last Used**	**O&M Costs**	**Reason for Declining Use**	**Future Plans**
Glenn's Plum Brook Station	Space Propulsion Research Facility (B-2)	1964	2012	$469,756	Used in 2012 for NASA's Balloon program. Propulsion testing is inoperable until funding is available for modifications	Remain Active
Glenn	Research Combustion Laboratory	1945	2010	207,220	Loss of funding	Remain Active
Stennis	A-3	Under Construction	Under Construction	0	Cancellation of Constellation Program	Mothball when construction completed
Stennis	E-2	1994	2012	13,944	Used in 2012. No requirements due to decreased demand for propulsion testing	Remain Active
Stennis	E-3	2000	2012	63,439	Used in 2012. No requirements due to decreased demand for propulsion testing	Remain Active
Marshall	Structural Dynamic Test Facility	1964	2012	738,373	Used in 2012 by the Center's Technology Investment Program. No requirements for full-scale dynamic testing	Remain Active
Marshall	Propulsion & Structural Test Facility	1957	1990s	76,234	Lack of large propulsion test programs	Remain in Mothball
Marshall	Cold Calibration Test Stand	1957	1960s	10,890	Poor facility condition and lack of programs	Demolish by 2013
Marshall	Advanced Engine Test Facility	1965	1999	221,570	Lack of large propulsion test programs	Mothball by 2014*
White Sands	302	1964	1995	151,713	Lack of hypergolic engine testing requirements	Remain in Mothball
White Sands	303	1995	2011	72,887	Lack of hypergolic engine testing requirements	Remain in Mothball
White Sands	402	1965	1993	182,095	Lack of hypergolic engine testing requirements	Remain in Mothball
White Sands	405	1987	2010	87,628	Lack of hypergolic engine testing requirements	Remain in Mothball
White Sands	406	2009	2010	2,843	Lack of hypergolic engine testing requirements	Mothball by 2013.

* NASA is conducting a trade study to determine if the Advanced Engine Test Facility can be used for SLS tests.

Marshall manages 4 of the 14 underutilized test stands–the Advanced Engine Test Facility (Figure 2), Propulsion & Structural Test Facility, Structural Dynamic Test Facility, and Cold Calibration Test Stand. All four of the test stands are experiencing declining utilization and Center officials were unable to identify requirements for their future use. Many of Marshall's test stands were built in the late 1950s and early 1960s to test Saturn rockets used in the Apollo program and later modified to test the Space Shuttle's propulsion systems. However, due to their deteriorating conditions and lack of new large - scale propulsion system test programs, the Agency has not used three of the four test stands since at least the 1990s. NASA is conducting a trade study to determine if the Advanced Engine Test Facility can be used for SLS tests.

Figure 2. Built in 1965, Marshall's Advanced Engine Test Facility was last used in 1999.

We found three underutilized test stands at Stennis, including the A-3 that is still under construction, but according to NASA officials, will not be needed to support any current or planned NASA mission. Accordingly, Stennis will place the facility in mothball status once construction is complete in 2013. At White Sands, NASA's primary location for testing hypergolic propellants, five of the Center's nine test stands are experiencing declining utilization, and Center officials could not identify plans for their future use.[32] We also found that Glenn's Research Combustion Laboratory is underutilized and lacks future uses due to the end of the Agency's Propulsion and Cryogenics Advanced Development project.[33] Lastly, Plum Brook's B-2 test stand was used in 2012 for ground tests on NASA's Balloon Program but the test stand has no future plans for propulsion tests and, even if it did, cannot undertake those tests without costly modifications.

Of the 14 underutilized test stands, NASA officials plan to: maintain 5 in an active state (Plum Brook's B-2, Glenn's Research Combustion Laboratory, Stennis's E-2, and E-3, and Marshall's Structural Dynamic Test Facility); have placed 5 in mothball status (Marshall's Propulsion and Structural Test Facility and White Sand's Test Stands 302, 303, 402 and 405); plan to mothball an additional 3 in the next 2 years (Stennis's A-3, Marshall's Advanced Engine Test Facility, and White Sand's Test Stand 406); and plan to demolish 1 in 2013 (Marshall's Cold Calibration Test Stand).

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[32] Hypergolic propellants are liquid fuels used to propel rockets and aircraft systems, including orbiting satellites, manned spacecraft, and deep space probes.

[33] The Propulsion and Cryogenics Advanced Development (PCAD) project developed propulsion system technologies for nontoxic or "green" propellant technologies for NASA's Orion Crew Capsule and Lunar Lander.

Thermal Vacuum Chambers. We determined that at least 4 of the Agency's 40 large thermal vacuum chambers are underutilized or NASA managers could not identify how these facilities will be needed to support future missions.[34] NASA spent $383,682 to maintain these facilities in FY 2011. (See Table 4 for additional details on these vacuum chambers.)

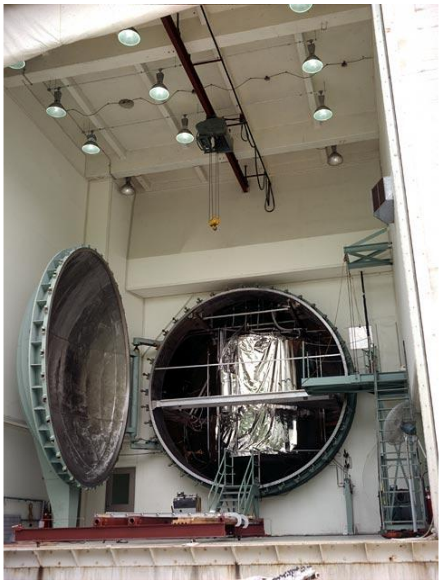


Figure 3. Plum Brook's K-Site.

NASA uses thermal vacuum chambers to test space vehicles and related hardware and components in a simulated space environment. The chambers create a vacuum through a series of pumps, while liquid nitrogen is pumped into the chambers to simulate the thermal environment of space. NASA has 40 large chambers located at Marshall, Glenn, Langley, Johnson, the Jet Propulsion Laboratory (JPL), Goddard, Kennedy, and Plum Brook Station. NASA's large thermal vacuum chambers range in size from 8 feet to the world's largest chamber, Plum Brook's Space Power Facility, which is 100 feet in diameter and 122 feet high. Among the materials that have been tested in the chambers are the mirrors for the James Webb Space Telescope and tools and hardware used in spacewalks outside of the International Space Station.

The Agency's utilization of several of its chambers has declined in recent years due to the lack of NASA program requirements or the deteriorating conditions of the facilities. For example, Glenn's Vacuum Facility 11 and Plum Brook's Cryogenic Propellant Tank Facility (K-site) are in poor condition and would require expensive renovation to be usable (see Figure 3). Johnson's two chambers – Energy Systems Test Area 20 Foot Chamber and Energy Systems Test Area Z Chamber – have not been used since the 1990's and Johnson officials were uncertain of any future uses for thermal vacuum testing.

Of the four underutilized vacuum chambers, NASA officials plan to maintain two in an active state (Glenn's Vacuum Facility-11 and Johnson's Energy Systems Test Area 20 Foot Chamber) and demolish one (Glenn's K-site). Johnson's Energy Systems Test Area Z Chamber has never been used, has been inactive since 2000, and therefore Center officials plan to demolish it in 2013.

[34] NASA defines large thermal vacuum chambers as chambers capable of handling test articles approximately 3 cubic meters or larger, are equal to or greater than 10 feet in diameter, and 10 feet in length or height.

Table 4. Thermal Vacuum Chambers without Future Work						
Facility Location	Facility Name	Year Built	Year Last Used	O&M Costs	Reason for Declining Use	Future Plans
Glenn	Vacuum Facility-11	1942	2003	$315,865*	Poor facility condition	Remain Active
Glenn	K-Site Cryogenic	1958	2004	0	Poor facility condition	Demolish by 2014
Johnson	Energy Systems Test Area 20 Foot Chamber	1964	1990s	67,817*	Reduced requirement for Lunar and/or Martian surface simulation testing	Remain Active
Johnson	Energy Systems Test Area Z Chamber	1964	Never used	0	Reduced requirement for Lunar and/or Martian surface simulation testing	Demolish by 2013

*Operations and Maintenance costs are for the entire building.

Airfields. NASA maintains airfields at Ames, Kennedy, and Wallops. We found the airfields at Ames (Moffett Federal Airfield) and Kennedy (Shuttle Landing Facility) are underutilized and NASA managers could not identify future mission-related uses for these facilities even though the Agency spent $7.8 million to maintain them in FY 2011. (See Table 5 for additional details on these airfields.)

Moffett (see Figure 4) almost exclusively supports non-NASA activities such as Air National Guard operations and other lease operations such as H211, LLC (corporate jets), and Airship Ventures, Inc. (Zeppelin tours). While the airfield periodically supports the Sensor Integrated Environment Remote Research Aircraft (SIERRA) Unmanned Aircraft System and Alpha Jet Atmospheric eXperiment (AJAX), NASA officials said those missions are limited and could be supported by nearby airfields.[35]

Figure 4. Ames's Moffett Federal Air Field.

The Space Shuttle Orbiters landed at Kennedy's Shuttle Landing Facility and the Agency last used the runway in September 2012 when Space Shuttle Endeavour was ferried to its final home at the California Science Center. Kennedy officials stated that while the landing strip periodically supports deliveries of space hardware for the DoD, National Reconnaissance Office, and other government agencies, NASA has no plans to use the airfield for its missions. In June 2012, NASA's Mission Support Council recommended that the Agency divest of the Shuttle Landing Facility. However, Kennedy is considering options for other potential uses.

[35] NASA's AJAX project conducts flights to measure ozone and greenhouse gases over California and Nevada. The SIERRA aircraft is an unmanned aircraft NASA utilizes to conduct remote sensing and atmospheric sampling missions in inaccessible regions.

Table 5. Airfields without Future Work						
Facility Location	**Facility Name**	**Year Built**	**Year Last Used**	**O&M Costs**	**Reason for Declining Use**	**Future Plans**
Ames	Moffett Federal Airfield	1944	2012	$6,429,935	Minimal NASA program use	Working with GSA to find alternative uses
Kennedy	Shuttle Runway	1976	2012	1,361,740	End of Space Shuttle Program	Remain Active

Launch Infrastructure. We determined that as many as seven of NASA's launch-related facilities at Kennedy are underutilized or as of November 2012 Agency managers could not identify future mission-related uses for these facilities. In FY 2011, NASA spent approximately $29 million maintaining these facilities. (See Table 6 for additional details concerning these facilities.)

Kennedy has more than 100 facilities that NASA uses to process, launch, and recover both manned and unmanned spacecraft. The underutilized facilities we identified include Solid Rocket Booster Recovery Facilities, a Parachute Refurbishment Facility, a Launch Pad (see Figure 5), and one of the Orbiter Processing Facilities.

NASA's need for this infrastructure ceased only in the past year with the end of the Space Shuttle Program; however, timely decisions on the future of these facilities are vital in light of the amount of time the Agency had to plan for the Shuttle Program's end and the high costs associated with continuing to maintain the facilities. Kennedy is seeking commercial companies to lease several of these structures including the Orbiter Processing Facilities and the Launch Pad. To date, Kennedy has entered into a lease arrangement through Space Florida for Boeing to use one of the two Orbiter Processing Facilities to manufacture and assemble its Crew Space Transportation CST-100 spacecraft.[36] For the remaining facilities, if a tenant is not found by the time Space Shuttle Program Transition and Retirement funding expires in March 2013, NASA plans to mothball, abandon, or demolish them.

Figure 5. Kennedy's Launch Pad 39A.

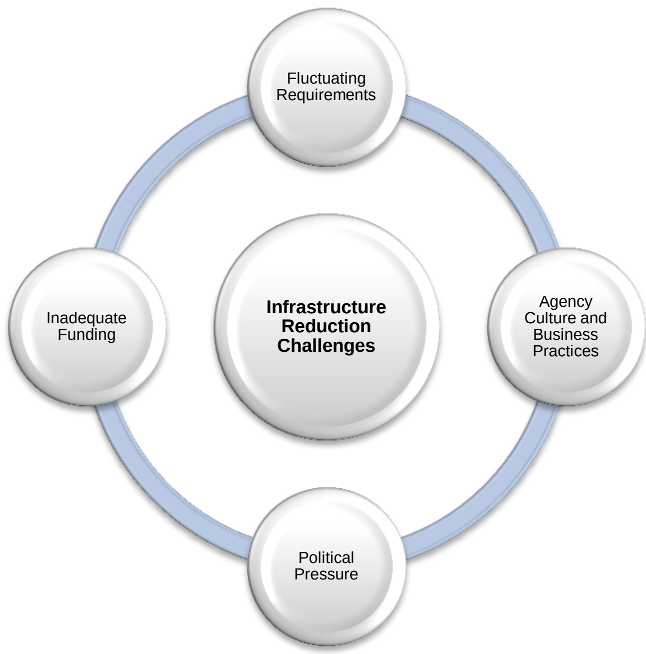
[36] Boeing's CST-100 (Crew Space Transportation) crew capsule is a spacecraft design proposed by Boeing in collaboration with Bigelow Aerospace as their entry for NASA's Commercial Crew Development (CCDev) program.

Table 6. Launch Infrastructure without Future Work						
Facility Location	**Facility Name**	**Year Built**	**Year Last Used**	**O&M Costs**	**Reason for Declining Use**	**Future Plans**
Kennedy	Parachute Refurbishment Facility	1964	2011	$ 544,140	End of Space Shuttle Program	Demolish by 2014
Kennedy	Orbiter Processing Facility	1977	2012	5,482,830	End of Space Shuttle Program	Abandon by 2013
Kennedy	First Wash Building (Solid Rocket Boosters)	1979	2011	245,275	Requirements in flux for retrieval of Solid Rocket Boosters for SLS	Mothball by 2013
Kennedy	Solid Rocket Booster Recovery Slip	1979	2011	131,655	Requirements in flux for retrieval of Solid Rocket Boosters for SLS	Undetermined
Kennedy	Hangar M Annex	1963	2012	220,022	End of Space Shuttle Program	Demolish by 2013
Kennedy	Hangar S	1958	2011	1,031,725	Requirements in flux for retrieval of Solid Rocket Boosters for SLS	Demolish by 2013
Kennedy	Pad 39A	1966	2011	21,393,926	End of Space Shuttle Program	Mothball by 2012

Interrelated Challenges Hinder NASA's Ability to Reduce its Infrastructure

Through discussions with NASA officials and analysis of previous studies of the Agency's infrastructure problems, we identified four interrelated and longstanding challenges that have hindered NASA's ability to reduce its infrastructure: 1) fluctuating and uncertain strategic requirements; 2) Agency culture and business practices; 3) political pressure; and 4) inadequate funding (see Figure 6).

Figure 6. NASA's Challenges to Reducing Infrastructure



Fluctuating and Uncertain Requirements. Frequent changes in the direction of the nation's space policy by Congress, the President, and the Agency have hindered the ability of NASA managers to determine which facilities will be needed to support NASA's mission needs. For example, NASA's Human Exploration and Operations mission has transitioned from the Space Shuttle Program, to the Constellation Program, to the new SLS Program in just 6 years. NASA's other missions have also experienced significant flux, with the Agency's role in aeronautics research altered by declining budgets that have resulted in NASA conducting more low-level, fundamental research and less full-scale testing of new systems and concepts. This in turn has reduced the Aeronautics Research Mission Directorate's demand for testing facilities such as wind tunnels. Similarly, the Science Mission Directorate has had to slow the pace at which it initiates new and smaller missions as cost increases experienced by large "flagship" missions such as the James Webb Space Telescope have absorbed a greater share of the Directorate's budget. Because decisions about which facilities the Agency needs are heavily dependent on the missions it is asked to perform, changes in direction complicate the task of managing NASA's infrastructure. In the absence of firm requirements stemming from a clear direction, NASA Programs and Centers often resort to a "wait-and-see" or "keep it in case you need it" approach to facilities management.

Figure 7. A-3 Test Stand at Stennis.

The Constellation Program is an example of problematic and expensive infrastructure issues caused by fluctuating mission requirements. Proposed in 2004 by President George W. Bush to enable human exploration beyond low Earth orbit, the major complements of the Constellation Program were the Ares I and Ares V launch vehicles, the Orion Multipurpose Crew Vehicle, and the Altair Lunar Lander. To power the upper stage of the Ares I and the Earth departure stage of the Ares V, NASA developed the J-2X engine. To test the J-2X, NASA required a test stand that could support the engine for long duration run times at vacuum pressure simulating the environmental conditions that it would encounter during a high altitude ignition in space. At the time, NASA had no other test stands capable of satisfying these testing requirements. Accordingly, in late 2007 the Agency began to build a test stand at Stennis known as the A-3 (see Figure 7) for an estimated $163 to $185 million. Shortly thereafter, NASA's requirement for a high-altitude ignition capability for the J-2X engine began to change and completely ceased with the decision to cancel the Constellation Program in February 2010. The SLS vehicles currently under development will not utilize high-altitude ignition engines and therefore several of NASA's existing test stands can be used to test their engines. Accordingly, when construction on the A-3 test stand is completed in late 2013, NASA plans to place the facility in a mothball status.[37] NASA estimates the total cost of the A-3 test stand at approximately $349 million. In addition, the Agency will expend an additional $1.5 million to $1.75 million annually to maintain the test stand in its mothball state.

[37] In the NASA Authorization Act of 2010, Congress mandated that NASA complete construction of the A-3 even though it had no use for the test stand given the cancellation of the Constellation Program.

Figure 8. Kennedy's Booster Recovery Slip.

NASA's retention of the booster recovery infrastructure at Kennedy (see Figure 8) is another example of the challenges, changes, and uncertainty related to the Agency's mission pose to infrastructure management. In the past, NASA utilized these facilities to refurbish the solid rocket boosters recovered after each Space Shuttle launch.[38] The booster recovery infrastructure is composed of a slip at which the recovery ships docked and specialized hangers and other buildings that were used to disassemble, clean, and refurbish the boosters. Although NASA plans to use solid rocket boosters for the first two SLS test flights scheduled for 2017 and 2021, it does not plan to recover the boosters after those flights. Moreover, the Agency has not decided whether it will use solid or liquid propellant boosters for later SLS flights. If the Agency ultimately opts for liquid propellant boosters, it will have no need for the booster recovery infrastructure at Kennedy, as the liquid propellant boosters will not be recovered for refurbishing. In addition, NASA has not determined whether Kennedy will continue to refurbish solid rocket boosters if that type of propellant is selected. NASA is not expected to make its booster decision until after 2015, and therefore plans to continue to maintain most of the booster recovery infrastructure until that time at a cost of nearly $2.6 million per year.

Agency Culture and Business Practices. Historically, NASA's culture has been one of decentralized facilities management and the Centers competing for work from the Agency's major programs. Both of these factors have contributed to a tendency for NASA Centers to build up capabilities with little regard for whether they exist elsewhere at the Agency and to maintain the associated facilities to better position themselves to compete for work.

NASA's decentralized governance structure has been part of the Agency's culture since its inception. NASA was formed in 1958 by consolidating three separate government research and development facilities that served as the foundation for the Agency's current Center-based governance structure.[39] At times, NASA managers have intentionally distributed program work across all of NASA's Centers. For example, in 2006 the NASA Administrator directed the Agency to maintain 10 "healthy" Centers by

[38] Following each Space Shuttle launch, NASA crews in two retrieval ships – Freedom Star and Liberty Star – would retrieve the Shuttle's two solid rocket boosters from a splashdown point nearly 140 miles off the coast of Florida, and tug the boosters back to Kennedy where they were reprocessed for future missions.

[39] When it began operations on October 1, 1958, NASA absorbed the 46-year-old National Advisory Committee for Aeronautics, including its 8,000 employees and 3 major research laboratories – Langley Aeronautical Laboratory, Ames Aeronautical Laboratory, and Lewis Flight Propulsion Laboratory (since renamed Glenn Research Center).

distributing Constellation Program-related work across the Agency.

One consequence of NASA's Center-based structure is a fragmented process for real property management. Specifically, NASA policy designates Center Directors as the "owners" of all real property associated with their Centers and assigns them the responsibility of assessing real property needs and determining whether facilities are appropriate for missions in size and type.[40] This, in turn, has blurred the lines of authority and limited NASA's ability to assess infrastructure needs from an overarching Agency perspective.

As previously mentioned, a major component of the Agency's decentralized management structure has been competition among Centers. According to several Agency officials, NASA Centers actively compete for work from the Agency's various programs. This in turn provides incentives for the Centers to maintain or grow their infrastructure capabilities. NASA officials stated that Centers maintain assets such as wind tunnels and test stands in a "ready-to-produce" state to remain competitive for future work. They further explained that disincentives exist to placing facilities in mothball or standby states because the costs and time associated with bringing facilities back on line may result in NASA work going elsewhere.

These factors have contributed to a tendency by the Centers to build or preserve facilities that duplicate capabilities available elsewhere in the Agency or that lack an identified mission use. For example, NASA currently has 36 wind tunnels at 5 different Centers, 35 rocket test stands at 6 different sites, and 40 large thermal vacuum chambers at 7 different locations. While not all of these facilities are redundant and some redundancy may be desirable to avoid single point failures or to accommodate heavy workloads, several recent studies have cited specific examples of capabilities overlap and potential duplication among NASA facilities.

For example, a 2012 NASA study found that the greatest area of capabilities overlap within NASA's test stand portfolio is between Marshall's East Test Area (Test Stands 115, 116, and 500) and Stennis's E-Complex (E-1, E-2, and E-3) and between Glenn's Altitude Combustion Stand and White Sands Test Stand 401.[41] The RAND Corporation performed reviews of NASA's wind tunnel facilities in 2004 and 2009 and the 2009 report identified two wind tunnels at Langley that it considered redundant to existing facilities at Ames and other facilities at Langley. The 2004 report also observed that a few of NASA's wind tunnels are redundant when considering the technical capabilities of the larger set of facilities maintained by commercial entities and DoD. Finally, NASA's Space Environment Testing Asset Group conducted a 2011 review examining NASA's large thermal vacuum chambers and noted that duplication appeared to be the most prevalent in the Electric Propulsion test area. The report identified 12 chambers at Glenn, the Jet Propulsion Laboratory, Marshall, and Johnson that it considered potentially duplicative.

[40] NASA Procedural Requirements (NPR) 8800.15B, "Real Estate Management Program," June 21, 2010.

[41] NASA Rocket Propulsion Test Program, "NASA Rocket Test Facility Right Sizing Study," February 1, 2012.

Another business practice that has contributed to Centers building up and maintaining capabilities is the way in which the Agency funds facilities' operations and maintenance costs. Specifically, the majority of these costs are paid through the Centers' Management and Operations accounts rather than the programs that utilize the facilities. This arrangement provides little incentive for programs to ensure the Agency is maintaining only those facilities needed to meet mission requirements. This issue also arises when programs end and the facilities built or modified for a particular use are left to the Centers to maintain. For example, Marshall has had to absorb continuing operations and maintenance costs for numerous test stands built by the Apollo, Space Shuttle, and other programs. Two of these test stands – the Cold Calibration Test Stand and Advanced Engine Test Facility–have not been used for decades. Despite the lack of NASA program requirements for their use, Marshall maintained the facilities in an active state for years and continued to fund their operation and maintenance costs. Only in the past few years has the Center taken steps to dispose of the Cold Calibration Test Stand. Marshall plans to place the Advanced Engine Test Facility in a mothball status in 2014.

Political Pressure. The political context in which NASA makes decisions about individual facilities also creates pressure and disincentives for the Agency to reduce its infrastructure. While these pressures are not unique to NASA, they nonetheless make it more difficult for the Agency to manage its aging and expansive infrastructure. During our review, we noted several examples in which political officials intervened in NASA's plans to close down or consolidate facilities.

Figure 9. Johnson's Arc Jet Facility.

For example, in January 2011 NASA's Mission Support Council announced its decision to close the Atmospheric Reentry Materials and Structures Evaluation Facility (Arc Jet) at Johnson and consolidate those operations at Ames, citing cost savings and Ames greater ability to support the operations (see Figure 9).[42] Over a year later in February 2012, 30 members of Congress, almost of all of whom represented Texas, sent a letter to the NASA Administrator requesting that the Agency suspend any action to close the facility until they had an opportunity to meet with NASA officials and review the situation. NASA officials met with the Members in April 2012 and attempted to assure them that consolidating Arc Jet facilities at Ames would not result in significant testing downtime or a reduction in Agency capability. However, the Congressional members were not convinced and in a subsequent letter strongly urged the NASA Administrator to halt any action to dismantle the Johnson Arc Jet until it could be determined that consolidating the facilities would not adversely impact testing of the

[42] NASA uses Arc Jet facilities to develop and certify thermal protection materials and systems for re-entry spacecraft for both human and robotic missions.

Orion Multipurpose Crew Vehicle. As of the date of our report, the Agency planned to consolidate Arc Jet capabilities at Ames through an incremental approach that will maintain testing capability at Johnson through 2013 or until the Ames Arc Jet is completely operational.

Another example of political intervention in NASA's facilities management is the A-3 test stand. As previously discussed, NASA began construction of the A-3 in 2007 to test the J2-X engine, a key component of the rockets intended for the Constellation Program. When that program was cancelled in 2010, construction on the A-3 was nearly 65 percent complete and NASA had expended $292 million. At the time, the Agency weighed several options ranging from completing construction and activating the test stand to completing only the awarded contracts with no activation. However, before the Agency could make a decision regarding the best option, members of Congress inserted language in the NASA Authorization Act of 2010 directing the Agency to complete construction of the test stand. Since then NASA has spent an additional $57 million on the A-3 and expects to complete construction by October 2013, at which time it will place the facility in mothball status.

Finally, in April 2012 the NASA Administrator notified Congress that NASA no longer needed the airfield and other associated property, such as Hanger One at Ames's Moffett Field, and that the Agency was working with the GSA to find alternative uses for the facilities.[43] This action generated significant opposition from Congress, community organizations, and local officials who urged NASA to retain the facilities even though the Agency had no current or future mission use for them.

Inadequate Funding. Demolishing or disposing of facilities that NASA no longer needs to fulfill its mission is not without cost. In many instances, NASA must conduct environmental remediation before it can dispose of a facility. For example, in April 2009 NASA informed Congress that it planned to dispose of the Agency's Santa Susana Field Laboratory in Ventura County, California. However, decades-long testing of rocket engines at Santa Susana caused significant environmental contamination at the site. NASA has estimated that the environmental cleanup at Santa Susana will cost between $25 and $209 million and will consume most of the Agency's environmental remediation funding for the next several years, possibly affecting the Agency's ability to fund other demolition or cleanup projects. Moreover, the amount of money dedicated to demolition activities is not likely to grow because of constrained Federal budgets. In addition, the Office of Management and Budget reduced NASA's proposed recapitalization budget for FY 2013 through FY 2017 by approximately 60 percent from $1.7 billion to $750 million. As of the date of our report, NASA had a list of approximately 108 projects for which it needs funds to demolish.

[43] 40 U.S.C. 524, "Duties of Executive Agencies."

NASA Has Recently Taken Positive Steps Toward Managing its Unneeded Infrastructure but Sustained Leadership will be Required to Overcome Longstanding Challenges

NASA has recently launched several promising initiatives to manage its infrastructure, including: 1) organizational changes to strengthen central authority over infrastructure decisions; 2) development of an Agency Facility Strategy and Integrated Agency-wide Real Property Master Plan; 3) development of a Corporate Portfolio Management Process; 4) improvements in managing its real property data; and 5) development of a strategic technical capabilities assessment. While we view these initiatives as positive steps, most are in early stages of development and it remains unclear how successful they will be. As noted above, NASA has attempted infrastructure reduction initiatives in the past with limited success. Accordingly, without strong and sustained leadership to see these efforts through, incorporate them into Agency policy, and make difficult decisions about what facilities the Agency will need going forward, NASA will continue to struggle with its excess infrastructure challenge.

Organizational Changes. Following a 2009 internal study, NASA recognized the risks of failing to right size its aging infrastructure and began to address facilities governance – an issue Agency managers believed was a major impediment to managing its real property. Since that time, NASA has implemented several organizational changes to centralize its real property decision making, including the establishment of an Agency Council to oversee infrastructure decisions and creation of a Directorate-level position to manage and provide additional authority over infrastructure decisions. NASA's new Council – the Facilities Program Board – was developed to bring Centers and program stakeholders together to make decisions about how to best invest infrastructure funds, rather than having Programs and Centers separately making facilities decisions.[44] In an effort to further streamline and improve the Council's decision making, the Agency reorganized the membership in 2011 to only six core members.[45] Center personnel are consulted on Council decisions as necessary, but are not final decision makers. In addition, NASA elevated its mission support functions and facilities decisions to the Directorate level in 2010 to align with its other Mission Directorates. Since assuming the role, the Associate Administrator for Mission Support has taken steps to centralize NASA's real property decision making, including the development of an Agency-wide Master Plan and a corporate framework for channeling facilities decision making.

We view these changes as positive first steps to addressing the challenges resulting from the Agency's decentralized governance structure and establishing the required leadership and foundation for identifying, vetting, and following through with difficult decisions about the facilities to retain or eliminate.

[44] In 2010, the Facilities Program Board dissolved and its functions were taken over by the Mission Support Council.

[45] The Mission Support Council is chaired by the Associate Deputy Administrator. Core members include the Associate Administrator, Associate Administrator for Mission Support, Chief Financial Officer, Chief Information Officer, and the Chief, Safety and Mission Assurance.

Facilities Strategy and Integrated Agency-wide Master Planning. NASA adopted a Facility Strategy in 2009 that established goals for consolidating and renewing the majority of its infrastructure by 2055. The strategy calls for consolidation of NASA's technical and nontechnical facilities to achieve efficiencies and sets goals for a 10 percent reduction in current replacement value of the Agency's infrastructure by 2020 and 15 percent by 2050. To implement the Facility Strategy, the Associate Administrator created NASA's first real property Agency-wide integrated master plan to better coordinate facilities resource needs across the Agency and to link those needs with projected funding. In 2010, Centers updated their Master Plans by defining specific improvement plans for each field installation. The integrated Agency-wide master plan incorporated individual Center master plans into one document, which serves as the Agency's roadmap for future development and redevelopment of Agency real property and provides a framework for conducting advanced facilities planning.

We also view NASA's Facility Strategy and master planning efforts as positive steps towards reducing and better managing NASA's diverse real property assets. However, in prior audit work we found deficiencies in individual Center's master plans that NASA is using to develop the integrated Agency plan. These deficiencies may limit the Plan's usefulness for making strategic real property decisions.[46] In our December 2011 report, we made a series of recommendations that the Agency is implementing to help improve future iterations of the Agency-wide Master Plan.

Corporate Portfolio Management. Another initiative developed by the Associate Administrator for Mission Support is Corporate Portfolio Management (CPM) – an analytical framework designed to assist managers in identifying, grouping, and evaluating the Agency's capabilities (defined as people, facilities, and other direct costs) into a set of portfolios to manage infrastructure needs. NASA originally planned to have CPM fully implemented by spring 2012; however, the effort is behind schedule. Mission Support Directorate officials explained that the delay was due to their decision to pilot the process by first analyzing possible consolidations of airfields, thermal vacuum chambers, test stands, and wind tunnels before examining other Agency assets.[47]

[46] NASA OIG, "NASA's Infrastructure and Facilities: An Assessment of the Agency's Real Property Master Planning" (IG-12-008, December 19, 2011). We found that NASA is developing its initial master plan based on Center master plans that: (1) were developed using funding assumptions that are no longer realistic; and (2) are missing essential information. In addition, 5 of the 10 Centers did not develop master plans to reduce their real property footprint in accordance with Agency goals.

[47] The pilot process is known throughout the Agency as the NASA Technical Capabilities Forum Phase II. The Agency held two capability forums (2010 and 2011) in order to determine the size of all Center technical capabilities and to identify capabilities with funding gaps. Officials decided to continue the work done at these forums by using the data to pilot the larger CPM process.

We reviewed the CPM pilot and found that while more analytical and transparent than

Table 7. CPM Pilot Process Results

Technical Capability Portfolio	Number of Facilities Reviewed	Number of Facilities Recommended for Divestiture	FY 2011 O&M Costs ($)Millions
Thermal Vacuum Chambers [a]	24	4	$10.2[e]
Wind Tunnels (*b*)	29	1	0.03
Airfields (*c*)	24	2	11.5
Rocket Test Stands (*d*)	24	0	0
Total	**101**	**7**	**$21.7**

(a) Includes chambers with some evidence for consolidation or disposal based on the vacuum chamber study
(b) Includes all identified wind tunnels excluding the Arc Jets
(c) Includes all identified NASA airfield assets
(d) Includes all test stands in the Rocket Propulsion Test study
(e) Includes O&M cost for the entire facility in which the thermal vacuum resides

past efforts, the process may still fall short of overcoming the cultural and fiscal challenges highlighted in this report. For example, as of July 2012 Mission Support Directorate officials evaluated 101 capabilities in each of the 4 portfolios during the CPM pilot process (see Table 7*).* However, the Associate Administrator for the Mission Support Directorate recommended for divestiture and the Mission Support Council approved only 7 of the 101 facilities.[48]

Although further refinement of CPM will continue, we are concerned that only 7 of 101 facilities were recommended for divestiture even though, according to Mission Support Directorate officials, the pilot process was designed to make recommendations on facilities considered the "low hanging fruit," including facilities that, at the time of evaluation, were mothballed or not utilized and that had little or no personnel assigned to them. As discussed previously, we determined that as many as 14 of the 35 test stands reviewed during this audit were underutilized and lacked future NASA mission requirements. However, Mission Support Directorate officials made no recommendations to divest any rocket test stands in the pilot process.[49] They told us these facilities were not included because more information and analysis was needed in light of the high environmental cleanup costs associated with divesting of test stands. We also find it instructive that despite the poor condition and lack of use of the facilities that were recommended for divestiture, the host Centers did not always concur with the recommendations, stating instead that there may be future mission use for the facilities.

Real Property Data. In order for CPM and the other initiatives the Agency is developing to be reliable and effective, NASA needs accurate data on its real property assets. To provide this data, NASA primarily relies on the Agency's Real Property Management System (RPMS). However, in conjunction with CPM, the Agency is also

[48] Divestiture is defined as the transfer, removal, or abandoning in place of an asset.

[49] Marshall's Cold Calibration Test Stand, which is one of the 14 test stands we questioned, was selected for demolition prior to the pilot process.

developing the NASA Technical Capabilities Database (NTCD) to identify and track all Center technical capabilities and their associated resources (supply) and map them to projected mission requirements (demand) across the Agency. NASA's Mission Support Directorate designed NTCD to identify unneeded technical capabilities by identifying possible funding gaps when it costs more to maintain a capability at a ready-to-produce state than what programs or customers have funded.[50] Mission Support Directorate officials expect that by analyzing these funding gaps and capabilities that have few or no programs and customers providing funding, planners can identify which capabilities and the associated facilities may not be utilized or needed.

While the creation of NTCD should help the Agency better analyze its infrastructure needs, we found the data contained within the NTCD to be inconsistent and incomplete. For example, the NTCD's gap analysis did not identify any of the wind tunnels or the test stands at Ames and Stennis that we identified during this review. One reason for this is that NTCD links multiple facilities into a single technical capability. In particular, the NTCD links Ames's 11 Foot Transonic Wind Tunnel, 9x7 Foot Supersonic Wind Tunnel, and 8x7 Foot Supersonic Wind Tunnel into the same technical category. As such, the database was not able to identify that the 8x7 tunnel was not being utilized and has no future uses because the overall capability has enough program dollars committed to it from other Ames tunnels that individual tunnels do not appear as a funding gap. By allocating program and customer funding to the whole capability rather than individual facilities, the database can mask funding gaps and overlook facilities that are underutilized.

Finally, our previous audit work identified numerous data quality issues with NASA's RPMS, which was designed to capture key information such as utilization, mission dependency, and condition of facilities. We deemed this data unreliable because the Centers used inadequate processes to gather and update it.[51] We made a series of recommendations for corrective action in our August 2011 audit report, including that the Agency establish a process for Centers to accurately capture utilization rates for facilities and improve the guidance to ensure mission dependency and condition data is consistently and accurately inputted into RPMS. In addition, during the review we found the Centers did not maintain adequate records of facilities past or future planned usage making it difficult to determine their utilization accurately.

Because our previous work has shown RPMS data to be unreliable and our current work uncovered issues with NTCD, we believe the Agency needs to take additional measures to independently validate and analyze its real property data. Other organizations have created multidisciplinary review teams or utilized the services of an audit organization to ensure data accuracy. We understand that incorporating validation processes either internally or externally to NASA creates another level of review, is costly, and can extend the time it takes to implement decisions. However, the lack of accurate and complete

[50] Ready-to-Produce captures the minimal resources (i.e., workforce and other direct costs) required to sustain a capability element.

[51] NASA OIG, "NASA Infrastructure and Facilities: Assessment of Data Used to Manage Real Property Assets" (IG-11-024, August 4, 2011).

data hampers the Agency's ability to identify whether key facilities are utilized and certify whether technical capabilities are available and appropriately sized to support current and future missions.

Comprehensive Technical Capabilities Assessment. In addition to the initiatives discussed previously, in July 2012 NASA began developing a process for a comprehensive technical capability assessment that will identify and evaluate Center capabilities against current and future Agency needs.[52] This assessment is being developed and conducted by the Agency's Associate Administrator – a higher organizational level than the Associate Administrator for Mission Support's development and implementation of CPM. In addition, while this process is similar to CPM in that it assesses technical capabilities, it differs in that it is designed so that each Center identifies its core capabilities followed by a process by which the Centers' assessments are evaluated and ranked against the near term needs of the Mission Directorates and the future needs of the Agency. According to the Associate Administrator, the process will work by scoring and ranking Centers' capabilities at the Center, Mission Directorate, and Agency levels. Based on those rankings, Agency officials will determine if certain capabilities require further evaluation. For example, if a Center capability such as Launch Operations scores a low ranking on Center, Mission Directorate, and Agency level assessments, Agency officials may determine whether it warrants further review to be considered for consolidation or excessing. In an effort to integrate and build upon other related initiatives, any capabilities identified for further review would be evaluated through the CPM process described above. To date, the Associate Administrator has requested the Centers to identify and rank their capabilities in order of importance. Officials expect to have the Center capabilities identified and ranked by December 2012 and to have the entire process implemented in early 2013.

We are encouraged by the development and implementation of a process to identify and prioritize the Centers' capabilities and by the Agency's efforts to address its culture of competition between Centers. However, we question whether the process can overcome the influence outside stakeholders historically have had on Agency infrastructure decisions.

Conclusion

NASA officials readily acknowledge that the Agency has more infrastructure than it needs to carry out current and planned missions. To its credit, NASA has a series of initiatives underway that, in our judgment, are positive steps towards rightsizing its real property footprint. The development of an Agency Facilities Strategy and Integrated Master Plan, capability assessments, and organizational changes to centralize decision authority over infrastructure matters should better position the Agency to strategically assess infrastructure needs, manage underutilized property, and divest itself of duplicative or unneeded facilities.

[52] NASA defines a capability as the necessary infrastructure, equipment, workforce, and other direct costs required to accomplish a given mission requirement.

However, many of these efforts are in the early stages and their ultimate effect on the Agency's ability to reduce its real property portfolio remains unclear.

Given the disparity between the Agency's infrastructure, its mission-related needs, and constrained budgets, it is imperative that NASA move forward aggressively with its infrastructure reduction efforts. To achieve such success, the Agency will need to move away from its longstanding "keep it in case you need it" approach to managing its infrastructure and overcome historical incentives for the Centers to build up and maintain unneeded capabilities. In addition, NASA officials will need to temper the concerns of political leaders about the impacts of eliminating or consolidating facilities will have on the Centers' missions and their workforces and on local communities. Moreover, abrupt changes in the strategic direction of the Nation's space policy by Congress, the President, and the Agency will continue to add an element of uncertainty regarding the missions the Agency will pursue and therefore the facilities it will need to achieve those missions.

Against this complicated backdrop, successfully rightsizing NASA's real property footprint will require a sustained commitment from Agency leaders to see its ongoing infrastructure-related initiatives through to completion. Specifically, Agency leaders must ensure that these initiatives are institutionalized, coordinated, and communicated both inside and outside the Agency. They also must be willing to make difficult decisions to divest unneeded infrastructure, effectively communicate those decisions to stakeholders, and withstand the inevitable pressures from Federal, state, and local officials.

Finally, we acknowledge that NASA's best efforts to address these challenges may be insufficient to overcome the cultural and political obstacles to eliminating or consolidating Agency facilities and that an outside process similar to BRAC may be necessary.

Recommendations, Management's Response, and Evaluation of Management's Response

To ensure that NASA's ongoing efforts to evaluate Center capabilities against the current and future missions of the Agency are completed and that such efforts are conducted on a regular basis and sustained over time, we made the following recommendations that the Associate Administrator:

Recommendation 1. Complete the ongoing comprehensive technical capabilities assessment and ensure the process is established into policy.

Management's Response. The Associate Administrator for Mission Support concurred with our recommendation, stating that the Agency would continue the technical capabilities assessment and incorporate its methodology into NASA policy by September 2014.

Evaluation of Management's Response. Management's comments are responsive; therefore, the recommendation is resolved and will be closed upon verification and completion of the proposed corrective actions.

Recommendation 2. Ensure the assessment includes a process for communicating decisions to outside stakeholders to promote transparency and agreement.

Management's Response. The Associate Administrator for Mission Support concurred with our recommendation, stating that NASA plans to communicate significant decisions from the technical capabilities assessment to external stakeholders by September 2014.

Evaluation of Management's Response. Management's comments are responsive; therefore, the recommendation is resolved and will be closed upon verification and completion of the proposed corrective actions.

We also recommended that NASA's Associate Administrator for Mission Support:

Recommendation 3. Expedite implementation of CPM and ensure the process is updated, documented, and established into policy.

Management's Response. The Associate Administrator for Mission Support concurred with our recommendation, stating that NASA will implement a CPM process and incorporate it into Agency policy by September 2014.

Evaluation of Management's Response. Management's comments are responsive; therefore, the recommendation is resolved and will be closed upon verification and completion of the proposed corrective actions.

Recommendation 4. a. Implement changes to NTCD to improve data accuracy, including developing a process to ensure multiple facilities are not captured under one capability.

Management's Response. The Associate Administrator for Mission Support concurred with our recommendation, stating that NASA will implement processes for capturing data in NTCD or alternative databases by September 2014.

Evaluation of Management's Response. Management's comments are responsive; therefore, the recommendation is resolved and will be closed upon verification and completion of the proposed corrective actions.

Recommendation 4. b. Implement changes to NTCD to improve data accuracy, including developing and implementing a process to validate data input by the Centers into NTCD.

Management's Response. The Associate Administrator for Mission Support concurred with our recommendation, stating that NASA will implement processes for validating data in NTCD or alternative databases by September 2014.

Evaluation of Management's Response. Management's comments are responsive; therefore, the recommendation is resolved and will be closed upon verification and completion of the proposed corrective actions.

APPENDIX A

Scope and Methodology

We performed this audit from September 2011 through December 2012 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. Our announced objectives included examining NASA's efforts to identify and reduce unneeded and duplicative infrastructure.

We reviewed Federal and NASA policies, regulations, and plans to determine the requirements and criteria for identifying and assessing the Agency's unneeded infrastructure. The documents we reviewed included Executive Order 13327, "Federal Real Property Management," February 6, 2004; "NASA Authorization Act of 2010," Public Law 111-267, Title XI, October 2010; NPR 8800.15B, "Real Estate Management Program," June 21, 2010; "NASA's Real Property Management Plan," November 2004; and the NASA Corporate Portfolio Management Implementation Plan, dated November 22, 2010. We also reviewed the past 20 years of Federal legislation regarding the reduction of NASA real property.

We interviewed NASA Headquarters and Center officials concerning the utilization and requirements for facilities, the challenges the Agency faces in reducing infrastructure, and the progress and plans the Agency has made towards reducing its infrastructure. We also reviewed various NASA and external studies concerning utilization and capabilities of the Agency's technical facilities. We had discussions with GAO concerning Federal property management best practices and the Department of Defense BRAC process. We reviewed the organizational structure of NASA's Mission Support Directorate and discussed the implementation of the new CPM program and NTCD.

We judgmentally selected 153 facilities and airfields located at the following nine Centers: Ames, Glenn, Goddard, Johnson, the Jet Propulsion Laboratory, Kennedy, Langley, Marshall, and Stennis. We selected mainly technical facilities because they account for the largest proportion of the Agency's operations and maintenance costs, directly enable specific NASA missions, and are used to justify the unique institutional capabilities of individual Centers. We distributed questionnaires to the nine Centers to determine the current utilization and future requirements for each facility. We performed facility inspections and held on-site discussions with facility managers during our visits to the following locations: Ames, Glenn, Johnson, Kennedy, Langley, Marshall, Plum Brook Station, Stennis, and White Sands.

Use of Computer-Processed Data. We used computer-processed data from the NASA Real Property Management System to perform this audit. We obtained data from the system for the period of October 2010 through September 2011 to select our judgmental sample of facilities. As discussed in the NASA OIG report "NASA Infrastructure and Facilities: Assessment of Data Used to Manage Real Property Assets," IG-11-024, dated August 4, 2011, we found the data in this system for utilization, mission dependency, and condition index was not reliable. However, the accuracy of that data did not affect our findings or conclusions.

Review of Internal Controls

We reviewed and evaluated the internal controls associated with the Mission Support Directorate organizational structure and the draft of the Corporate Portfolio Management Plan. As discussed in this report, the implementation of the plan was incomplete; however, we identified weaknesses in the plan. Our recommendations, if implemented, should correct the identified weaknesses.

Prior Coverage

During the past 5 years, the NASA OIG, the GAO, the National Research Council, and the Research and Development (RAND) Corporations have issued nine reports of particular relevance to the subject of this report. Unrestricted reports can be accessed on the Internet at http://oig.nasa.gov/ (NASA OIG), http://www.gao.gov (GAO), http://nap.edu/ (National Research Council) and http://rand.org (RAND Corporation).

NASA Office of Inspector General

"NASA's Infrastructure and Facilities: An Assessment of the Agency's Real Property Leasing Practices" (IG-12-020, August 9, 2012); "NASA's Infrastructure and Facilities: An Assessment of the Agency's Real Property Master Planning" (IG-12-008, December 19, 2011)

"NASA Infrastructure and Facilities: Assessment of Data Used to Manage Real Property Assets" (IG-11-024, August 4, 2011)

"Audit of NASA's Facilities Maintenance" (IG-11-015, March 2, 2011)

Government Accountability Office

"Federal Real Property: Proposed Civilian Board Could Address Disposal of Unneeded Facilities" (GAO-11-704T, June, 9, 2011)

"Federal Real Property: An Update on High Risk Issues" (GAO-09-801T, July 15, 2009)

"Federal Real Property: Government's Fiscal Exposure from Repair and Maintenance Backlogs Is Unclear;" (GAO-09-10, October 16, 2008)

National Research Council

"Capabilities for the Future: An Assessment of NASA Laboratories for Basic Research" (2010)

Research and Development Corporation

"An Update of the Nation's Long-Term Strategic Needs for NASA's Aeronautics Test Facilities" (2009)

MANAGEMENT COMMENTS

National Aeronautics and Space Administration
Headquarters
Washington, DC 20546-0001

February 8, 2013

Reply to Attn of: Mission Support Directorate

TO: Assistant Inspector General for Audits

FROM: Associate Administrator for Mission Support Directorate

SUBJECT: Response to OIG Draft Report, "*NASA's Efforts to Reduce Unneeded Infrastructure and Facilities*" (Assignment No. A-11-019-00)

The Mission Support Directorate (MSD) appreciates the opportunity to review and provide comments on the Office of Inspector General (OIG) draft report entitled, "*NASA's Efforts to Reduce Unneeded Infrastructure and Facilities*" (Assignment No. A-11-019-00) dated January 9, 2013. NASA's responses to the recommendations identified by OIG are as follows:

To ensure that NASA's ongoing efforts to evaluate Center capabilities against the current and future missions of the Agency are completed and that such efforts are conducted on a regular basis and sustained over time, the OIG recommends that the Associate Administrator:

Recommendation 1: Complete the ongoing comprehensive technical capabilities assessment and ensure the process is established into policy.

Management's Response: Concur. NASA will proceed with the ongoing technical capabilities assessment and incorporate the resultant methodology into standard NASA policy and practice. NASA intends to incorporate the technical capability assessment and guidance into the PPBE16 cycle, but not later than September 30, 2014.

Recommendation 2: Ensure the assessment includes a process for communicating decisions to outside stakeholders to promote transparency and agreement.

Management's Response: Concur. NASA believes that clear understanding of the methodology used to perform the assessment and make the resultant decisions is important for our key external stakeholders. NASA agrees that communicating significant decisions to affected stakeholders is appropriate and intends to provide pertinent information during the PPBE16 cycle, but not later than September 30, 2014.

The OIG also recommends that the Associate Administrator for Mission Support:

Recommendation 3: Expedite implementation of Corporate Portfolio Management (CPM) and ensure the process is updated, documented, and established into policy.

Management's Response: Concur. NASA will proceed with the implementation of a CPM process by incorporating findings and/or recommendations from various studies including the capabilities assessment into decisions related to divestment of assets, eliminating any redundancies where it is in the best interest of the Agency, and utilizing best practices in policies or procedures as a CPM process is implemented, but not later than September 30, 2014.

Recommendation 4: Implement changes to NASA Technical Capabilities Database (NTCD) to improve data accuracy, including:

- Developing a process to ensure multiple facilities are not captured under one capability.
- Developing and implementing a process to validate the data entered into NTCD by the Centers.

Management's Response: Concur. NASA either will implement changes to the NASA Technical Capabilities Database or utilize an alternative tool to improve the accuracy of data that is utilized for CPM. Agency personnel will explore and implement the most appropriate processes for capturing and validating data within the NTCD or any other data base that is used to support CPM not later than September 30, 2014.

Again, thank you for the opportunity to review and comment on the subject draft report. If you have further questions or require additional information on NASA's response to the draft report, please contact Calvin Williams at 202-358-2322.

Woodrow Whitlow, Jr.

Woodrow Whitlow, Jr.

cc:
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