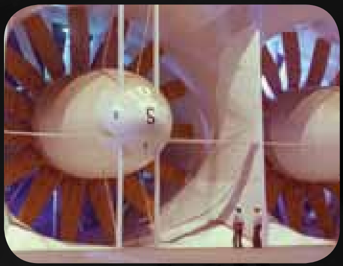
National Aeronautics and Space Administration

AGENCY MASTER PLAN



REPORT ON THE 2011 PLAN

This
Agency Master Plan
reflects an iterative process involving close consultation between Agency organizational, functional, and program leadership with its field installations. It serves as a resource of information regarding NASA facility land use, constraints, and opportunities. This plan serves as a roadmap for future development and redevelopment of Agency real property, and is a baseline against which later proposals are to be evaluated. While accomplishment of specific proposed projects is necessarily subject to approval based on evolving NASA mission requirements and the availability of funds, the Plan provides an invaluable internal framework for conducting advanced facilities planning.

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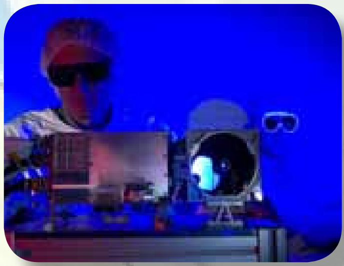

LaRC

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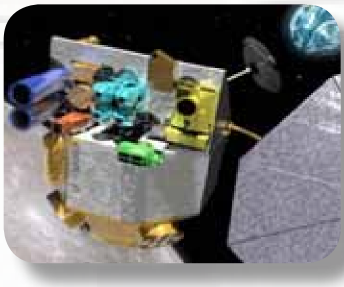


WSTF

SSC

Executive Summary

As Sputnik ascended in 1957, NASA was formed as geopolitics and public perceptions prompted a shotgun wedding of American military and civilian research organizations. Like many a newly-married couple, hand-me-downs sufficed for a while, but soon a new challenge – travel to the Moon – exceeded those legacy capabilities and NASA needed to grow.

To accommodate sudden growth, NASA needed new ground facilities, and in the next 5-7 years NASA built time and a half more than all it acquired over 45 years of predecessor activities. The building boom ended as the Agency moved from a critical front in the Cold War to a prestigious but expensive symbol of American technological prowess. NASA facilities today are one third from predecessor organizations, another half constructed by 1965, and only the remaining sixth acquired since 1965. As it shrank from 4.5% of Federal outlays to less than 0.5%, the need to build new has faded.

Just as its mission evolves with time, so do NASA's facilities. Current science, exploration, and technology work far exceeds what 1960's builders could envision, serving about 43,000 civil servants, contractors, and partners, but those 1960's facilities largely continue in service. Now 82% of NASA's $32 billion of highly-specialized real property assets (almost twice its annual budget) are at or beyond their design lifespan, representing a significant and growing risk to the Agency's success. **Figure 1** is an example of an historic asset still being maintained by NASA.

Figure 1. Construction of the Ames Full-Scale 40x80ft Wind Tunnel (June, 1943)

There's little institutional memory of the 1960's building boom, and substantial constraints on investing to replace or rehabilitate them. Recognizing this as a crossroads, stakeholders within and beyond the Agency called for a coherent, integrated strategy for managing the risks of its aging facilities inventory on its overall performance.

After considering its alternatives, NASA chose an Agency Facilities Strategy calling for renewing and sustaining a capability set similar in scope to its current one, but also for consolidating to the maximum extent practical. The Agency translates this general intention into objectives for renewal (62% by value under age 40) and consolidation (15% by value) by 2055, and into specific nearer-term objectives with which to measure progress. It also chose a planning level for facilities investments consistent with these objectives.

NASA has long prepared facilities master plans to ensure that program requirements are met at its field installations. While responsive to local needs, these plans were not scoped to address broader Agency challenges, have not been linked to budgets, and did not project specific outcomes expected from their implementation. Thus in addition to transforming its facilities, NASA began to transform its institutional planning by developing, recording, and conveying its intentions in ways that respond to both local and national needs.

This first Agency Master Plan is the embodiment of the Agency Facilities Strategy, one striving for sustainability, meaning mission success, affordability, and wisely stewarding assets (whether natural or built). Implementing the plan helps NASA manage down the mission risks, financial costs, and stewardship challenges inherent in its current facilities. No plan solves problems alone, and this plan certainly can be strengthened in future iterations. Still, it sets a course for the Agency to take charge of its own fate, sustaining the next generation's pursuit of the Nation's dynamic science, technology, and exploration agenda.

I. Introduction and Purpose

This year marks a milestone for institutional asset management at NASA. For the first time ever, a cohesive, comprehensive, and integrated plan charts a path towards more sustainable infrastructure Agency-wide. See **Figure 2** for an example of sustainable building practices in action at Kennedy Space Center. In spite of a more-strategic-than-tactical orientation, institutional managers must routinely match scarce resources to the most pressing demolition, consolidation, and renewal needs, without much left over to plan for the future. Grateful for the opportunity to work at an agency that pushes the boundaries of science, technology, and exploration, NASA professionals often "make do" with infrastructure that barely meets their needs.

Prompted by stakeholders within and beyond the Agency (e.g., Congress and the Government Accountability Office), NASA leadership chose a Facilities Strategy in 2009 based on goals in the Strategic Plan. Institutional leadership revised

Figure 2. The Propellants North Administrative and Maintenance Facility in the Launch Complex 39 area of Kennedy Space Center in Florida is one of NASA's most environmentally friendly facilities. The walls of Propellants North are made of a THERMOMASS® concrete wall insulation system, which is cost-effective, energy-efficient and durable.

"In summary, this report brings to light the advances made over the past decade in institutional management and highlights the first product from an improved planning process – an Agency-wide Master Plan."

master planning guidance, and Centers responded with more rigorous installation plans, proposing projects tied to anticipated resource levels. Under Headquarters guidance, the Agency integrated Center proposals into a strategic, comprehensive, budget-linked product.

Institutional stewards, and indeed all NASA employees, have a reason to be proud of this accomplishment. The link between program and institution "sides of the house" is much more evident in this new Agency Master Plan. This plan helps facilities managers and master planners gain perspective on their efforts to provide institutional assets that enable NASA's programs to succeed, and to see how Centers each contribute to the Agency's collective transformation. Centers make differing progress toward Agency consolidation or renewal goals, but all contribute to the Agency Facilities Strategy.

The Agency Master Plan also helps stakeholders, particularly NASA's organizational and program leadership, understand how institutional stewards are working to provide suitable, resilient facilities to enable mission success. In summary, this report brings to light the advances made over the past decade in institutional management and highlights the first product from an improved planning process – an Agency-wide Master Plan. The latter half describes master plan highlights from each Center and the largest component facilities. This is NASA's first attempt at making a consolidated, integrated Agency Master Plan. Undoubtedly, lessons learned along the way will lead to both an improved process and an improved plan in the future. Master plans are designed specifically to be dynamic – they are continually updated and improved to reflect current conditions and plan for future needs.

II.
Agency Mission and Supporting Strategic Plan

NASA continues to inspire the Nation through its pursuit of ambitious goals for human space exploration, earth and space science research, and aeronautics research. Its physical infrastructure is critical to enable mission success. NASA's Strategic Plan is the starting place for naming those mission elements and priorities such that the supporting infrastructure can then be retained. NASA's 2011 Strategic Plan names six goals, each with desired outcomes and objectives. Sub-objectives provide additional detail on how the objectives are to be achieved such that the desired outcomes can be realized.

Strategic Goal 5 is directly relevant to institutional assets. Objectives 5.2, 5.3, and 5.4 address important institutional assets. Sub-objective 5.2.3 addresses more specifically the nature of planning and decision-making processes for long-term infrastructure plans that link to mission.

NASA set a new Facilities Strategy in 2009 to achieve similar capabilities, but with a more sustainable footprint.

NASA will renew and modernize its facilities to sustain its capabilities, and to accommodate those capabilities in the most efficient facilities set practical.

NASA is committed to an integrated risk management approach that recognizes that facilities, as with all enabling capital, are worthy of systematic study to ensure alignment with mission. Planning follows a strategic, rather than tactical, path to advance toward a sustainable infrastructure portfolio.

Strategic Goal 5: Enable program and institutional capabilities to conduct NASA's aeronautics and space activities.

5.2 Ensure vital assets are ready, available, and appropriately sized to conduct NASA's missions.

Objective 5.2.3: Develop and implement long-range infrastructure plans that address institutional capabilities and critical assets, directly link to mission needs, ensure the leveraging of external capabilities, and provide a framework for Agency infrastructure decision-making.

5.3 Ensure the availability to the Nation of NASA-owned, strategically important test capabilities.

5.4 Implement and provide space communications and launch capabilities responsive to existing and future science and space exploration missions.

III.

Facilities Requirements and Master Planning Principles

Currently, more than 80% of NASA's infrastructure and facilities (by value) are beyond their design life (**Figure 3**); therefore only about 20% are considered to support NASA's readiness objective. Under ordinary maintenance, most NASA facilities were designed to ensure at least 40 years of reliable, resilient service even under dynamic use patterns. They were designed so that some components are replaced or renovated during that time period. Some buildings may continue to serve beyond the 40-year mark, but often buildings beyond this age have lost the flexibility to adapt to continuing changes in customer requirements. Continuing to operate within non-renewed buildings greater than 40 years old poses substantial risk to mission success. As a large percentage of the asset set continues to age past the 40-year mark, the Agency incurs greater risk, incurs greater overall costs by making more stopgap repairs, and misses opportunities to save energy and water costs compared with more sustainable assets. The design criteria of the Apollo-era buildings did not include energy efficiency or sustainable materials.

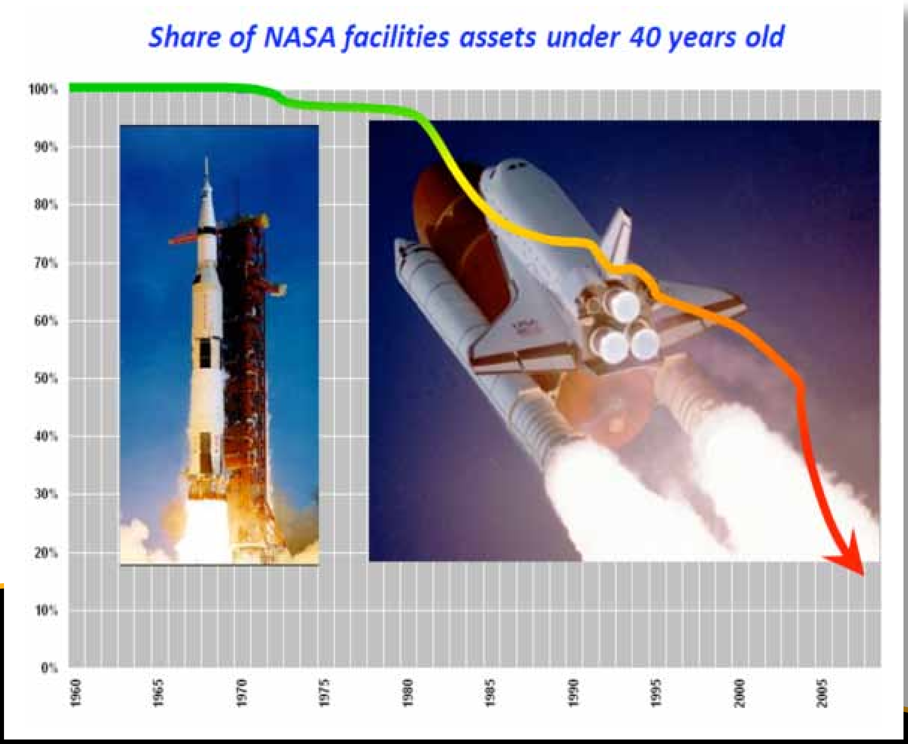


Figure 3. At least 80% of NASA's infrastructure and facilities are beyond their design life and almost no assets have been renewed.

The increasing risk to mission success posed by an aging and ill-suited infrastructure set has not escaped the notice of Agency leadership. Out of six goals for the Agency in the 2011 Strategic Plan, one of five goals devoted largely to facilities. As noted in the previous chapter, the Strategic Plan sets broad parameters for this goal for NASA institutional assets – "…assets are ready, available, and appropriately sized to conduct NASA's missions." The accompanying objective describes requirements for plans to provide those ready, available, and appropriately sized assets:

long-range infrastructure plans that
1) address institutional capabilities and critical assets,
2) directly link to mission needs,
3) ensure the leveraging of external capabilities, and
4) provide a framework for Agency infrastructure decision-making.

These statements establish the fundamental requirements for the Agency's Master Planning initiatives. Further refining the requirements, the Agency Facilities Strategy calls for an institutional portfolio that provides similar capabilities in as cost-effective a manner as possible, consolidating wherever practical. Following the Facilities Strategy will advance the Agency toward its vision for a sustainable infrastructure set. The vision for "sustainable infrastructure" is defined in terms of mission success, affordability, and proactive asset stewardship (for both natural and built assets). Broad objectives to achieve these elements of the vision include readiness, right-sizing, and environmental stewardship.

For each of these objectives, NASA adopted metrics against which to track progress:

Mission readiness is measured in terms of assets (by total value) that are less than 40 years old. The Agency aims to achieve 62% assets under 40 years by 2055.

Right-sizing refers to consolidating the infrastructure portfolio both to reduce environmental impacts and to lower operating costs. The Agency seeks a 15% reduction in overall Current Replacement Value by 2055. An interim "stretch goal" is to reduce by 10% by 2020.

Environmental stewardship measurements relate both to built and natural assets. Energy and water conservation goals are met primarily through changes to built assets. An overarching objective is to ensure compliance with all Federal mandates for environmental protection, including energy and water conservation. The current Master Plan projects energy usage as a prime indicator of environmental

"Continuing to operate within non-renewed buildings greater than 40 years old poses substantial risk to mission success."

stewardship through the year 2032; energy usage slowly declines as renewal and consolidation goals are met. In addition, usage of energy from renewable resources increases as new green buildings with solar and geothermal energy sources are brought on line.

Guided by these requirements, Center and Headquarters master planners set about the task of developing plans to meet the objectives for mission readiness, affordability, and asset stewardship. **Figure 4** depicts an example of a green building design. Master planning and master planners follow a discipline embodying specific principles, each characterized by certain traits or qualities. Fundamentally, master planners develop, record, and convey a comprehensive plan for facilities development and stewardship. Resultant master plans are intended to ensure that real property and related systems enable mission success.

Figure 4. An overarching objective is to ensure compliance with all federal mandates for environmental protection, including energy conservation. The New Town administrative building at LaRC uses daylighting extensively to reduce energy requirements.

Specific qualities characterize the three primary tasks that master planners complete.

DEVELOP

Develop Master Plans in a process that is:

Inclusive of stakeholders – engages Center and program leadership, NASA program customers, tenants, institutional stewards at the Center and Agency, the workforce, and the external community to the appropriate degree and at the appropriate time.
Thorough – takes appropriate care to understand and document current conditions (capabilities, opportunities, constraints), and facilities requirements.
Analytical – considers an appropriate range of solutions, developed far enough to evaluate against plan requirements.
Equitable – defines evaluation criteria that span the full range of stakeholder interests, and prioritizes against evaluation criteria in a consistent fashion.
Traceable – documents the process to show that resulting proposals are responsible choices among the alternatives, and to show that choices are considered in a manner consistent with required Agency risk management practices.

RECORD

Record relevant information that is:

Predictive – responds not only to current circumstances but would remain responsive across a range of possible future circumstances
Useful – materially helps Center and Agency leadership prioritize, select, and advocate for the right implementation choices
Responsive – addresses all identified requirements, whether current or future, whether quantitative or qualitative, including required flexibility, reliability, and configuration
Sustainable – addresses plan requirements in ways that use resources responsibly, creating and maintaining a suitable (productive, safe, secure, and healthy) workplace with a responsible level of financial investment from a life cycle perspective
Feasible – meets codes, statutes, regulations, policies, ensuring that proposals are constructible
Complete – takes appropriate care to understand and document current conditions (capabilities, opportunities, constraints), and facilities requirements

CONVEY

Convey plans that are:

Clear – intents, logic, outcomes, and resource implications are evident. Planners are responsible for conveying the "story" to various audiences;
Accessible – appropriate plan information is available to stakeholders with the minimum difficulty;
Accountable – plan is in terms that can be readily understood and measured over time; documents the program of needs clearly and fully enough that plan implementation can be traced against baseline. Planner develops implementation costs and schedules to a responsible degree, and updates those specifics annually

IV.
Response to Facilities Management Requirements

No one document, initiative, or fund source governs all aspects of NASA's facilities management program. Instead, several initiatives and on-going programs together move the agency towards its goal of a sustainable set of infrastructure assets. This chapter describes the primary initiatives, programs, and supporting studies that drive the facilities management program at NASA. These programs, initiatives, and studies respond to requirements issued to NASA from both external and internal parties.

"NASA follows a prescribed process to determine if and when an asset no longer meets Agency needs."

Demolition

The Government Accountability Office reported in 2003 that Federal agencies were carrying too many underutilized properties that unnecessarily drained off Federal maintenance funding. The requirement in essence asked agencies to stop growing. In response, NASA refocused its efforts to shed unneeded facilities to reduce its inventory of assets. NASA dedicates funding to remove abandoned structures that constitute liabilities and divert scarce resources. NASA follows a prescribed process to determine if and when an asset no longer meets Agency needs. Criteria include factors such as mitigating safety and environmental risks, uniqueness of the asset, value (cost to replace), life-cycle cost to maintain, condition, community considerations and local planning objectives, stewardship issues (e.g., historic preservation, environmental impacts), and alternative solutions. If an asset cannot be reused or repurposed, deconstruction or demolition is planned. Centers nominate stranded assets for dedicated Agency demolition/deconstruction funding. A focus on much-needed demolition projects helped the Agency to reach a zero net-growth state during the first decade of this century, offsetting all new construction. This marked an important point in the Agency's facilities management history. See **Figure 5** for an example of demolition projects.

The overall plan for facilities consolidation contains ambitious goals for the future. NASA has set master planning goals including a 10% reduction by 2020 and 15%

by 2055. This can be realized both by continuing to fund the Demolition Program at a level adequate to meet Centers' needs to excess stranded assets and by requiring a robust business case approach to all Recapitalization (renewal and consolidation) investment decisions. It is important to note that while the Agency's workforce and funding have fallen in real terms over the past couple of decades, facilities have grown. This suggests an opportunity to consolidate (right-size) to better match the Agency's needs.

Strategic Investments

Over the past decade, NASA leadership acknowledged that funding levels for facilities were sufficient only to manage near-term program risks. Recognizing that strategic investment is critical to ensuring suitable NASA facilities, NASA established a funding category to help fill the resource gap for more long-term investments, now referred to as Recapitalization. The Recapitalization Program supplies funding for projects that advance both renewal and consolidation objectives.

The Agency Facilities Strategy was developed to prioritize and invest funding for renewal construction, with a multi-year phase-in intended to moderate impacts to other activities and to build capacity to ensure successful implementation. Implementation of the Agency Facility Strategy will allow for replacement of aging, inefficient facilities and horizontal infrastructure with more sustainable facilities aligned to future requirements. Prudent risk management means reconsidering not only implementation particulars and timelines but making decisions based on NASA's future programmatic needs. In short, NASA is using the master planning process as a tool to make better long-term strategic investments. As such, as new data becomes available through the 5-year budget planning process, mission requirements and infrastructure assessments, the Centers' and Agency master plans will be modified to incorporate the new information.

Figure 5. Demolition of a wind tunnel at LaRC in 2011 demonstrates NASA's commitment to right-size agency assets.

Governance

Demolition and Strategic Investment Initiatives help the Agency to shed stranded assets, thus enabling a readier, more cost-effective institution. As important as these changes are in themselves, they also reflect important changes in Agency facilities governance. Agency leadership more fully realizes the consequences of coordinated, strategic decision-making for its facilities. These processes are intended to ensure coherent, business-driven cases for facilities renewal and consolidation Agencywide.

Three main objectives form the backbone of NASA's Facilities Strategy:

- **Readiness** - measured in terms of the collective stock of assets that are within their design life
- **Right-Sizing** - measured as how closely asset supply matches asset demand, with minimum redundancies
- **Environmental Stewardship** - measured in terms of reducing energy and water needs and allowing for opportunities to use renewable resources.

Agency Facilities Strategy

A 2009 Agency Facilities Study helped Agency leadership to recognize facilities as a significant and rising source of mission risk, and to determine that even in light of recent initiatives, those risks had grown unacceptable. In response, NASA needed a Facilities Strategy to guide change well beyond prior goals. After considering current circumstances and several alternatives, the resulting Agency Facility Strategy:

NASA will renew and modernize its facilities to sustain its capabilities, and to accommodate those capabilities in the most efficient facilities set practical.

This strategy (often referred to as the "Similar-Smaller" Strategy) sets NASA on the path towards sustaining its capabilities in fewer, more effective facilities. The Strategy advocates the reduction of the infrastructure footprint, while maintaining a similar level of capabilities, through demolition as noted above, or consolidation where appropriate. The Strategy calls for consolidation of technical and non-technical facilities to achieve efficiencies and reduce footprint, getting more use out of less inventory.

NASA HQ uses modeling tools to project progress over time in meeting these objectives. Chapter VII describes the projected outcomes of these three measures if the current Master Plan were implemented.

V. NASA Strategic Master Planning Process

Chapter IV summarizes the evolution of NASA's facility management programs over the past decade that enabled appreciable progress towards sustainability. This evolution prompted a refocused master planning process in which Centers and Headquarters partner to bring about a comprehensive Agency-wide Master Plan. In 2009, NASA defined its Agency Facility Strategy (see facing page). The shorthand for this strategy "similar capability, smaller size" tells the story succinctly: protect the capabilities to fully enable the mission, in a smaller, more cost-effective, more environmentally sound footprint.

The Strategy calls for consolidation of technical and non-technical facilities to achieve efficiencies and a more sustainable infrastructure set, as well as managing space in a tighter fashion by getting more use out of less square footage. Recent analyses have called for more rigorous master planning and for more coordinated decision-making for investment funding to integrate and maximize benefit across the Agency.

In response to the new Agency Facility Strategy, NASA developed new guidance for Centers developing master plans. In 2010, Centers updated their Master Plans, defining specific improvement plans for each field installation. This newest round of Master Plan improvements builds upon a 2006-2007 initiative to standardize and better aggregate master plan proposals Agency-wide. Master planners at NASA Centers apply a professional discipline to develop, record, and convey a comprehensive plan for facilities development and stewardship. The resultant plans are intended to ensure that real property and related systems enable mission success, or at a minimum, do not present an obstacle to mission success. Centers overlay Agency direction with local circumstances, resources, and requirements in their facilities planning.

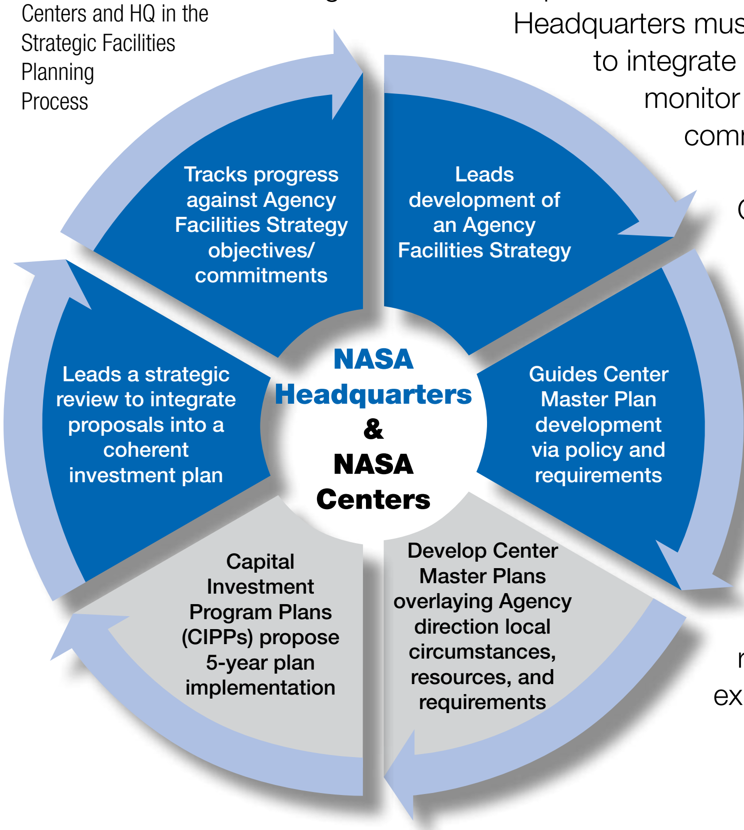
"... protect the capabilities to fully enable the mission, in a smaller, more cost-effective, more environmentally sound footprint."

Center Master Plans contain a summary briefing that describes the current infrastructure assets and how they support the Center's mission. The master plans also contain a 5-year and a 20-year Capital Investment Program Plan. Technical documents in the plans specify development, tracking of projected progress vs. goals relating to readiness, right-sizing, stewardship, and implementation.

This move towards consistency in master planning processes and products was a necessary preparation step towards true integration across the Agency. For the first time, Centers translated their plans into investment proposals. This resource-linked approach enables an integrated Agency Master Plan that collectively addresses Agency goals for a sustainable infrastructure set. **Figure 6** depicts the master planning process within the context of the overall integrated facilities planning process at NASA. This figure reflects lead roles for Headquarters (deep blue) and Centers (grey) in consecutive stages of this cycle.

Headquarters initiates the process with strategy, and Centers integrate corporate guidance to their particular circumstances, resources, and requirements. Finally Headquarters must understand Center proposals in detail to integrate them coherently, and must baseline and monitor progress against the Agency's objectives and commitments.

Figure 6. Roles for Centers and HQ in the Strategic Facilities Planning Process



One of the newer tools developed to help implement the Facilities Strategy is an expanded Capability Portfolio Management (CPM) Program. NASA mission success is founded on capabilities located at NASA Centers and component sites geographically dispersed across the nation. The objective of this program is to provide Agency leadership the insight required to effectively manage the Agency's capability components, thereby ensuring they are appropriately sized and optimized to support the current and future requirements of NASA's aeronautics, science, exploration, and space operations missions.

VI.
Center Master Plans

This section contains highlights of the 2010 Center Master Plans prepared as part of NASA's newest guidance on the master planning process described in Section V. For each Center, a two-page summary provides:

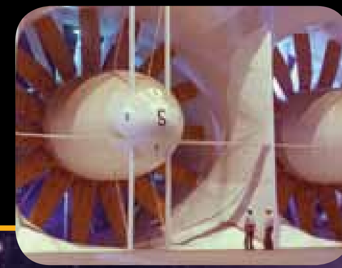
- current and projected site plans
- site history and data
- major mission programs supported
- plan objectives and approaches
- implementation phasing
- facilities readiness projections
- facilities resource projections
- 2013-17 investment patterns

For Centers with major Component Facilities (see list at right), a one-page summary describes the site history, data, plans and capabilities for: GRC's Plum Brook Station, GSFC's Wallops Flight Facility, JPL 's Goldstone Deep Space Communications Site, JSC's White Sands Test Facility, and MSFC's Michoud Assembly Facility.

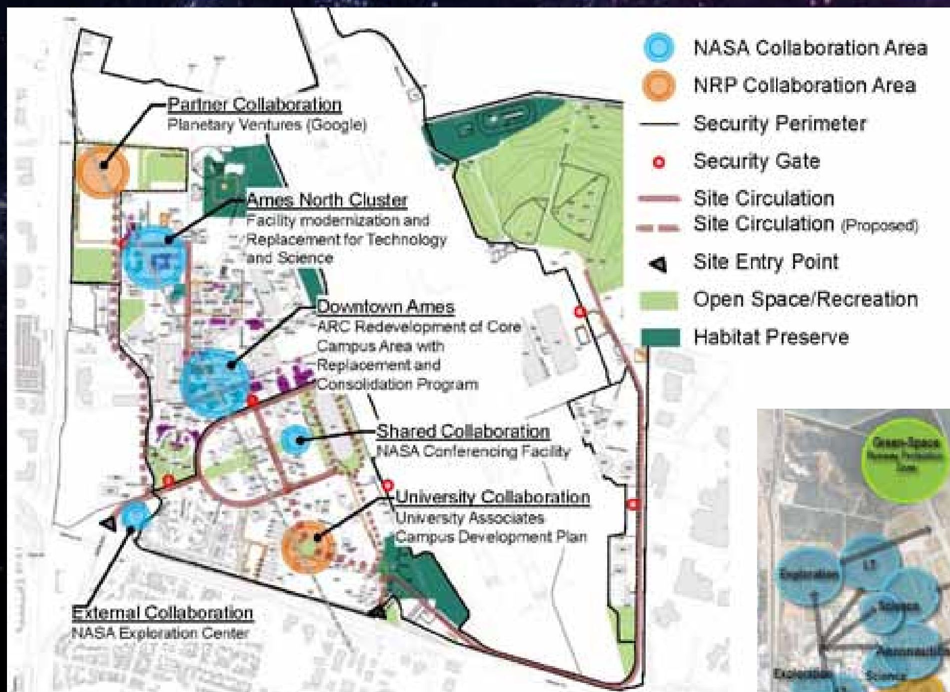
centers and component facilities

ARC

Ames Research Center



2032



Today

site data

NASA Ames Research Center, located at Moffett Field, California, was founded Dec. 20, 1939 as an aircraft research laboratory by the National Advisory Committee for Aeronautics (NACA) and in 1958 it became part of the National Aeronautics and Space Administration (NASA).

Infrastructure/Facilities

Land Area: 1,850 acres

Valuation: $4.8B

Enclosed Area: 4.0M sq ft

Population On-Site: 3,700

NASA Ames Research Center occupies approximately 1800 acres in California's Silicon Valley, along the southwest shore of San Francisco Bay. As a leader in information technology research with a focus on supercomputing, networking and intelligent systems, Ames conducts critical research and develops enabling technologies that make NASA missions possible. Ames also is a leader in nanotechnology, fundamental space biology, biotechnology, aerospace and thermal protection systems, and human factors research. Research in astrobiology focuses on the effects of gravity on living things, and the nature and distribution of stars, planets and life in the universe. The Center works collaboratively with the FAA, conducting research in air traffic management to make safer, cheaper and more efficient air travel a reality. Ames engages in information and education outreach, forms collaborative partnerships, and fosters commercial application of NASA technologies.

The Center is developing NASA Research Park, an integrated, dynamic research and education community cultivating diverse partnerships with academia, industry and non-profit organizations in support of NASA's mission. Ames includes the majority of the former Naval Air Station Moffett Field. The Center houses tenants including the California Air National Guard, US Army, and Federal Emergency Management Agency. Moffett Federal Airfield is used by military and emergency response agencies for actions critical to the Nation and by NASA for research. Other airports in the Bay Area are built on fill material and thus may be vulnerable to damage from earthquakes. Moffett Federal Airfield is a critical national asset, especially in times of emergency response.



Objectives of Master Plan

Mission - Enable mission success with reliable facilities that address current quality and configuration limitations

Ensure flexibility to accommodate mission transformation

Cost-Effectiveness - Consolidate and reduce inventory to increase operational efficiency and reduce deferred maintenance

Environmental Responsibility - Consistent with prior Environmental Impact Statement, emphasize existing green features, and apply green building principles in a broader context of Center-wide sustainability

Workforce Effectiveness - Improve workforce effectiveness through enhanced interactions within and across functions, within and across fencelines

Approaches

Renew aging assets with focus on critical technical capabilities, particularly labs, shops, and infrastructure

Consolidate like functions to improve workforce effectiveness, increase operational efficiency, and reduce cost

Develop collaborative and conferencing space within and between functional areas

Interconnect functional areas with collaboration spaces within and beyond NASA security

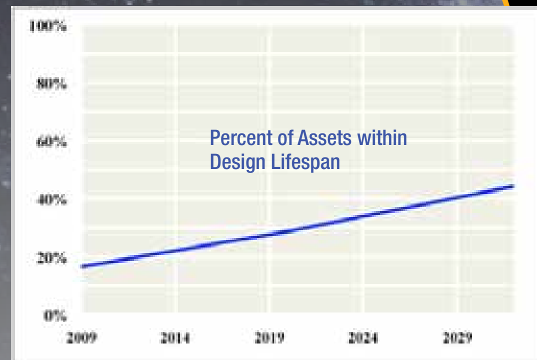
Implementation Phasing

FY13-17: Renew and consolidate to bring like functions together; continue ongoing electrical site distribution rehabilitation

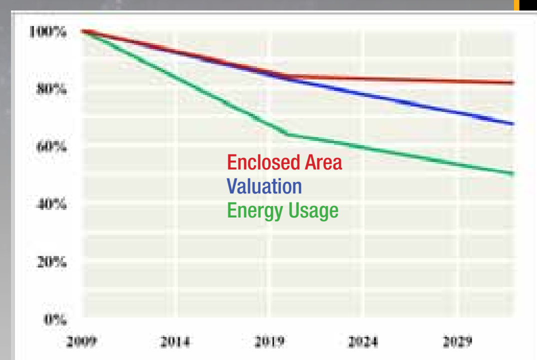
FY18-22: Continue renewal and consolidation with focus on substantial refurbishment of heavy technical capabilities, and create a core facility to connect functional areas

FY23-32: Continue substantial rehabilitation of key technical capabilities; renew and consolidate supporting facilities by replacement; continue rehabilitating horizontal infrastructure

Readiness

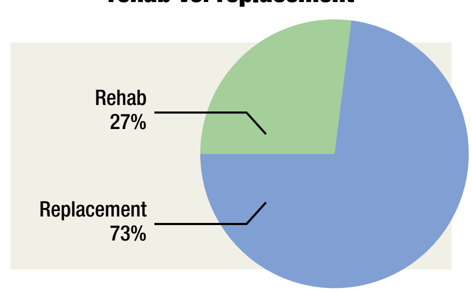


Resources

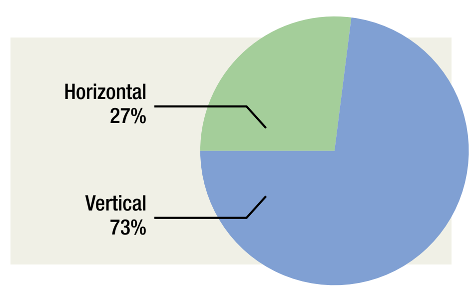


2013-17 Implementation

Investment plan for rehab vs. replacement



Investment plan for horizontal vs. vertical infrastructure



DFRC

Dryden Flight Research Center

Today and 2029

Members of NASA's precursor organization arrived at the Muroc Army Airfield in 1946 to initiate a new era in aeronautics research. Located at Edwards, California, in the western Mojave Desert, Dryden is uniquely situated to take advantage of the excellent year-round flying weather, remote area, and visibility to test some of the nation's most exciting air vehicles.

site data

Infrastructure/Facilities

Land Area: 840 acres

Valuation: $.4B

Enclosed Area: 0.9M sq ft

Population On-Site: 1200

The Dryden Flight Research Center is NASA's primary center for atmospheric flight research and operations. NASA Dryden is critical in carrying out the agency's missions of space exploration, space operations, scientific discovery, and aeronautical research and development (R&D).

In support of space exploration, Dryden is managing the launch abort systems testing and integration, in partnership with the Johnson Space Center and Lockheed Martin, for the Crew Exploration Vehicle that will replace the Space Shuttle. Dryden is the primary orbital support for the International Space Station.

Dryden contributes to scientific discovery by managing the Stratospheric Observatory for Infrared Astronomy (SOFIA) program - a flying telescope aboard a Boeing 747 aircraft - in partnership with the Ames Research Center and the German Aerospace Center. Aeronautical R&D work includes many aspects of the Fundamental Aeronautics and Aviation Safety programs, including the X-48 Blended Wing Body and Ikhana – Predator B (in the subsonics program) and Adaptive Flight Controls (in the aviation safety program).

For 60 years, Dryden projects have led to major advancements in the design and capabilities of many state-of-the-art civilian and military aircraft. The newest, the fastest, the highest - all have made their debut in the vast, clear desert skies over Dryden.

Objectives of Master Plan

Mission: Serve growing mission program needs by ensuring necessary capabilities, and lower risks by renewing facilities that most directly support the mission

Cost-Effectiveness: Reduce infrastructure size and renew institutional capabilities aligned with mission

Environmental Responsibility: Meet environmental responsibilities and improve energy resiliency

Workforce Effectiveness: Improve workforce effectiveness

Approaches

Renew aging assets to align with evolving needs, to consolidate like functions, and to lower program risks

Meet environmental requirements for energy, water, and greenhouse gas emissions reductions, and advance renewable energy use

Rationalize circulation patterns to protect flight lines and improve vehicular and pedestrian flow

Expand Dryden Aircraft Operations Facility leasing to meet peak facilities demands while consolidating NASA's owned facilities

Implementation Phasing

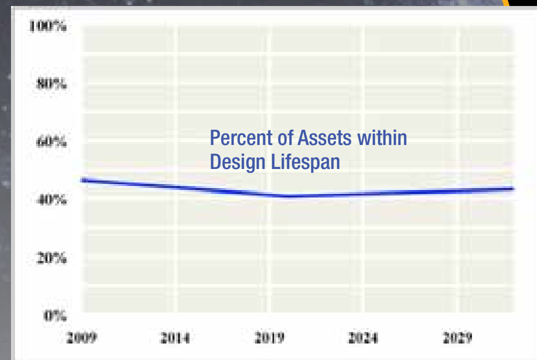
FY13-17: Complete the cleanup of the flight-line, improve energy efficiency, renew horizontal infrastructure, consolidate like functions, and disposition unneeded Shuttle infrastructure

FY18-22: Improve security and safety, address flood risks, and begin consolidating people in a central campus

FY23-27: Continue to address flooding issues, construction of central campus, and further reduce horizontal infrastructure

FY28-32: Complete central campus and remove remaining outlying buildings to realize the overall consolidation goals and corresponding horizontal infrastructure

Readiness



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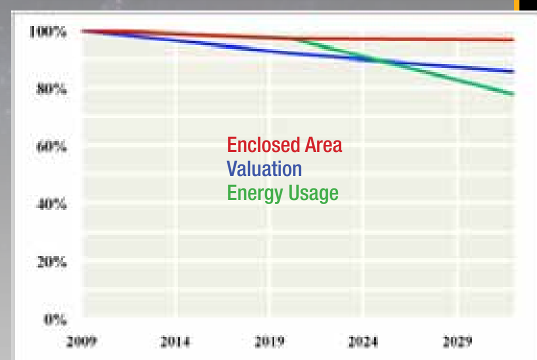
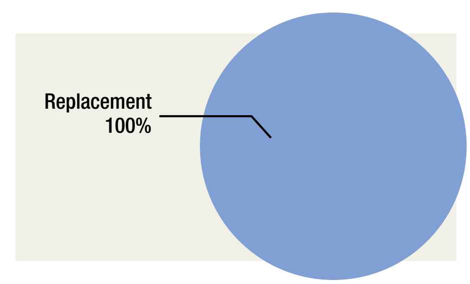
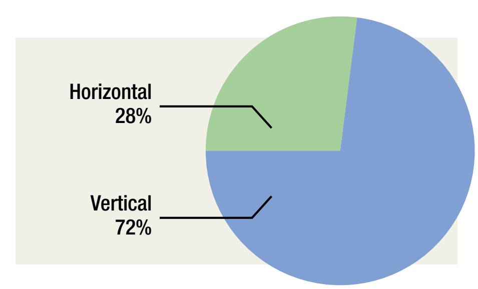


2013-17 Implementation

Investment plan for rehab vs. replacement



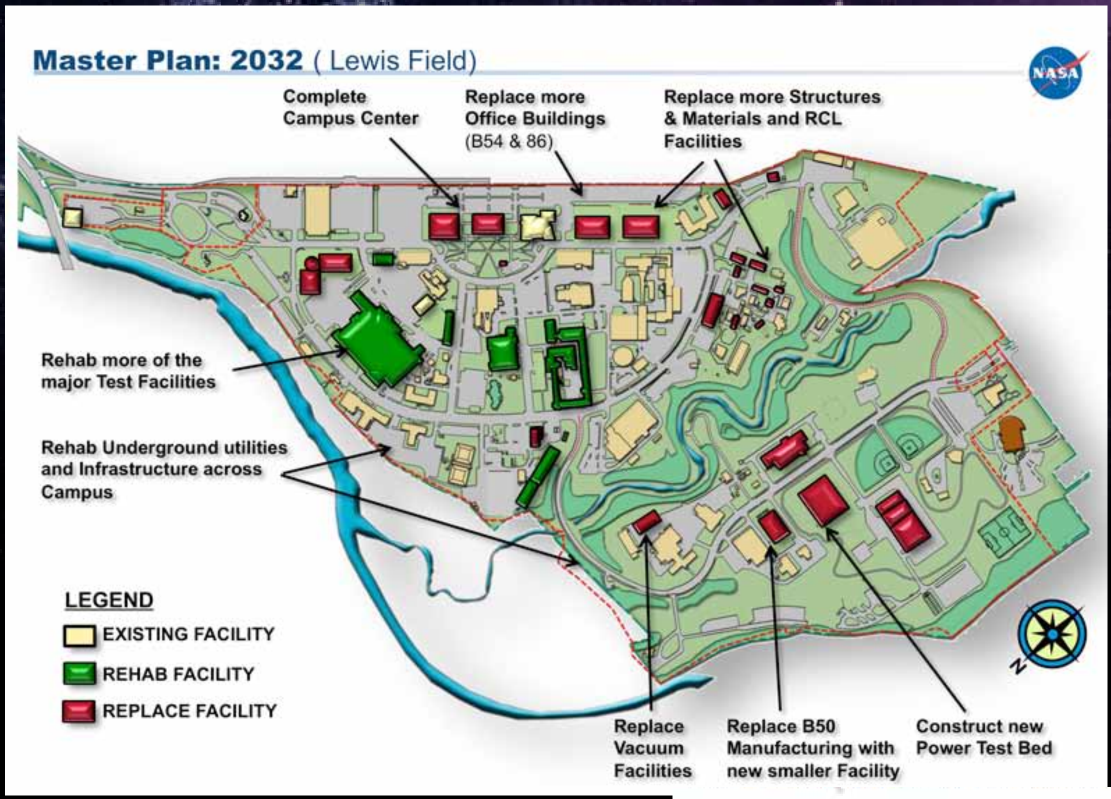
Investment plan for horizontal vs. vertical infrastructure



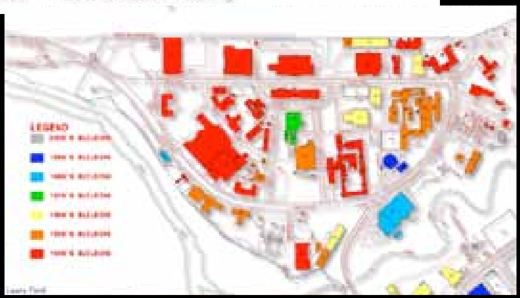
GRC

Glenn Research Center

2032



Today



Glenn Research Center was founded in 1941 by the National Advisory Committee for Aeronautics (NACA) and initially called the Aircraft Engine Research Laboratory. After several name changes, in 1999 it received its current name, the John H. Glenn Research Center, in honor of the former senator, an Ohioan who was the first American to orbit Earth when he piloted “Friendship 7” around the globe three times in 1962.

Infrastructure/Facilities

Land Area: 350 acres

Valuation: $3.3B

Enclosed Area: 3.5M sq ft

Population On-Site: 3500

site data

NASA’s Glenn Research Center in Cleveland, Ohio researches, designs, develops and tests innovative technology for aeronautics and spaceflight. GRC personnel design game-changing technology for spaceflight that enables further exploration of the universe and create cutting-edge aeronautical technology that revolutionizes air travel. Core research and development capabilities include: Air-Breathing Propulsion Technologies to conserve energy, improve operations safety, and reduce costs; Communications Technology to enable increases in mission data transfer; In-Space Propulsions and Cryogenic Fluids Management for fuels improvements; Power, Energy Storage and Conversion for advanced aerospace vehicles, Materials and Structures for Extreme Environments; and Physical Sciences and Biomedical Technologies to support safe, sustainable space exploration. A multitude of NASA missions have included elements from Glenn, from the Mercury and Gemini projects to the Space Shuttle Program and the International Space Station.

Located near Cleveland Hopkins International Airport and the Cleveland Metroparks’ Rocky River Reservation, Glenn’s main campus, Lewis Field, is situated on 350 acres of land and contains more than 150 buildings. The specialized facilities at Lewis Field include wind tunnels, drop towers, vacuum chambers and an aircraft hangar.

Objectives of Master Plan

Mission – Serve mission program needs and support Glenn core competencies; Sustain safe, efficient, reliable facilities and horizontal infrastructure

Cost-Effectiveness – Lower the cost to operate and maintain needed facilities

Environmental Responsibility – Meet environmental responsibilities

Workforce Effectiveness – Ensure a collaborative, quality workplace

Approaches

Renew aging assets (70% over 60) via replacement, rehabilitation, sustainment, or disposition of assets as matches mission requirements

Consolidate like functions to improve workforce effectiveness; reduce horizontal infrastructure and building area

Meet environmental requirements for energy, water, and greenhouse gas emissions reductions, and advance renewable energy use

Rationalize circulation patterns to protect flight lines and improve vehicular and pedestrian flow

Implementation Phasing

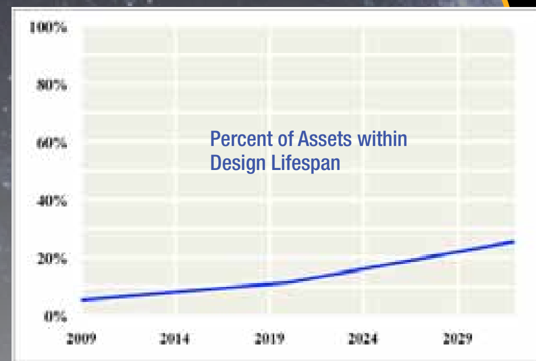
FY13-17: Begin renewal of the horizontal communications infrastructure. Begin renewal and consolidation of key capabilities including Structures & Materials, Aerospace Communication Research, Administration and Operations facilities, and begin renewal of the Engine Research Complex

FY18-22: Continue horizontal infrastructure renewal and renew the Engine Research Complex. Begin renewal of Central Air Equipment Building and the 8x6 Wind Tunnel, and continue renewal and consolidation of Operations Support facilities

FY23-27: Continue renewal of the horizontal infrastructure elements, the 8x6 Wind Tunnel, and renewal and consolidation of Operations Support facilities. Begin renewal of Propulsion Research facilities

FY28-32: Continue renewal of horizontal infrastructure elements, Central Air Equipment Building; begin renewal of Engineering and Secure Research facilities and the second phase of the Structures & Materials facilities complex

Readiness



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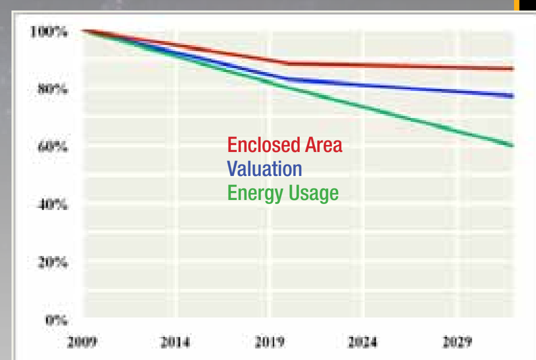
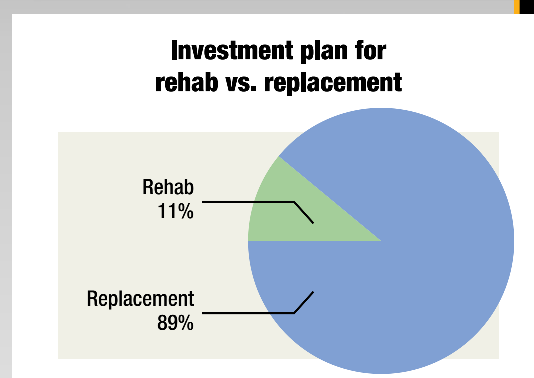
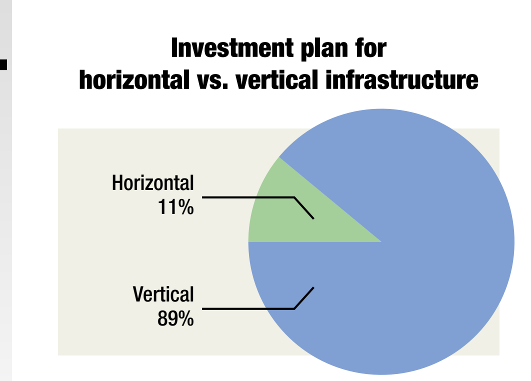


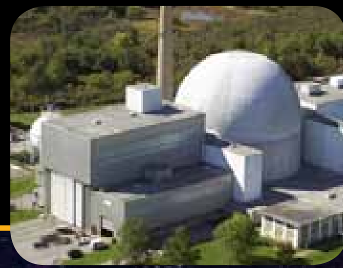
2013-17 Implementation

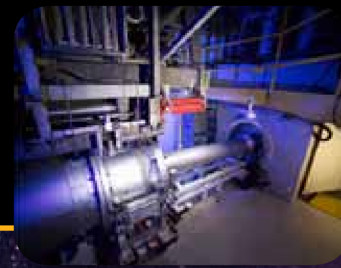




PBS

Plum Brook Station
(GRC component facility)





2032

Today

Plum Brook Station is located at a 1940s era War Department munitions plant that stayed in production until the end of WWII. In 1956, the National Advisory Committee for Aeronautics obtained 500 acres for the construction of a nuclear research reactor. The Reactor Facility, designed to study the effects of radiation on materials used in space flight, was the first of fifteen test facilities eventually built by NASA at Plum Brook Station.

Infrastructure/Facilities

Land Area: 6,800 acres

Valuation: $1.0B

Enclosed Area: .8M sq ft

Population On-Site: 50

site data

Plum Brook Station is the home of Glenn Research Center's four world-class test facilities which are available for use by research customers interested in planning and scheduling test programs and test-related activities. Plum Brook Station's mission is to assure safe, cost-effective, responsive and reliable performance of research testing at Plum Brook Station to accomplish the R&D mission of the Glenn Research Center, other government agencies, and the private sector.

The Station houses many specialized test facilities:

- Space Power Facility (SPF): Home of the world's largest space environment simulation chamber, the facility has tested parts of rockets, Mars landers and space stations.
- Spacecraft Propulsion Research Facility (B-2): This is the world's only test facility capable of full-scale rocket engine firings and launch vehicle system level tests at high-altitude conditions.
- Cryogenic Components Laboratory (CCL): A new, state-of-the-art facility for research, development and qualification of cryogenic materials, components and systems.
- Cryogenic Propellant Tank Facility (K-Site): This smaller space-environment test chamber allows safe, large-scale experiments using super-cold liquid hydrogen. Together with the CCL facility, these facilities compose the Cryogenic Test Complex.
- Hypersonic Tunnel Facility (HTF): A unique wind tunnel designed to test air-breathing propulsion systems at speeds exceeding 5 times the speed of sound.

GSFC

Goddard Space Flight Center

2032

Today

The Greenbelt Campus started in 1959 with a few score Naval Research Laboratory personnel, and has grown to a diverse workforce of many thousands of civil servants, contractors, and partners around the world. Today, Goddard remains a major player in developing and operating unmanned scientific craft, including data-gathering satellites.

site data

Infrastructure/Facilities

Land Area: 1,270 acres

Valuation: $2.2B

Enclosed Area: 4.8M sq ft

Population On-Site: 9,800

NASA's Goddard Space Flight Center's main campus is located within Greenbelt, Md., about 6.5 miles northeast of Washington, D.C. The Center is a major U.S. laboratory for developing and operating robotic scientific spacecraft. The Center manages many of NASA's Earth observation, astronomy, and space physics missions. The Center includes several other facilities: the Wallops Flight Facility at Wallops Island., Va.; The Goddard Institute for Space Studies in New York City; and the Independent Verification and Validation Facility in West Virginia.

Goddard is home to the nation's largest organization of scientists, engineers and technologists that build spacecraft, instruments and new technology to study the Earth, the sun, our solar system, and the universe. From astronomy to planetary geology, from biodiversity to oceanography, researchers use data from spacecraft, balloons, sounding rockets, and comprehensive ground-based field campaigns to make new discoveries about the birth and evolution of the universe, the complex interactions between our Sun and the Earth, and the natural and human-induced causes of change on the Earth's long-term climate.

The Greenbelt site includes more than 33 major buildings that provide almost 5 million square feet of research, development and office space. Goddard is unique in that these facilities provide for the construction and development of spacecraft software, scientific instruments as well as the spacecraft themselves.

Objectives of Master Plan

Mission - Recognize that mission success begins with safety, and focus on overall mission performance

Cost-Effectiveness - Optimize available resources

Environmental Responsibility - Employ and encourage sustainable practices

Workforce Effectiveness - Unify the organization (Greenbelt and Wallops) and work more closely with partners

Approaches

Use renewal of aging assets to ensure a safe and secure workplace, and to ensure flexible facilities in accordance with mission demand

Consolidate like functions to improve workforce effectiveness

Align NASA planning with partner growth; optimize teamwork across organizations

Reduce dependence on non-renewable resources, and reduce energy consumption

Be a "smart buyer" and leverage partnerships to make the most of limited funding

Institute unified approach for Greenbelt and Wallops sites

Implementation Phasing

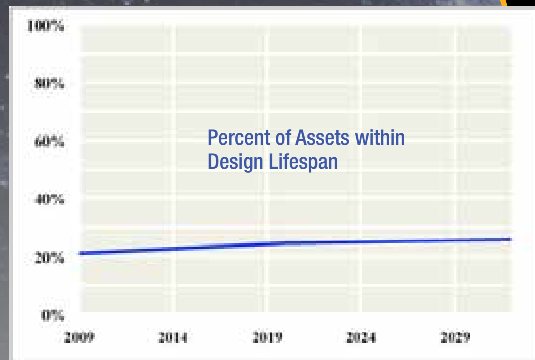
FY13-17: Continue consolidating like activities and rationalizing workflow and interconnection across each site; address key horizontal infrastructure risks

FY18-22: Continue horizontal infrastructure work; create a commons facility and begin Systems Development Facility at Greenbelt

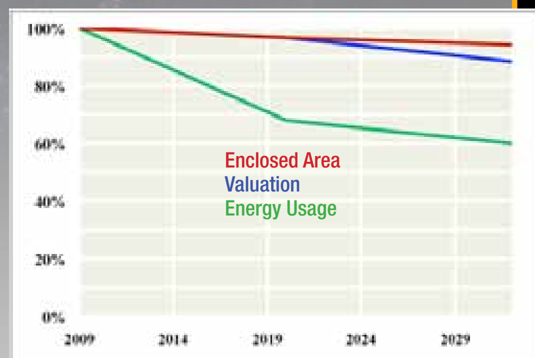
FY23-27: Continue Systems Development Facility and begin spacecraft integration facilities renewal and consolidation at Greenbelt; continue horizontal infrastructure renewal at Wallops

FY28-32: Complete Systems Development Facility at Greenbelt; renew Range Control and Science facilities at Wallops

Readiness

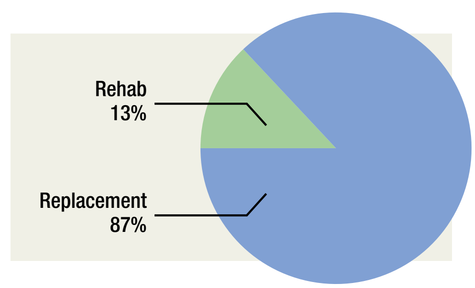


Resources

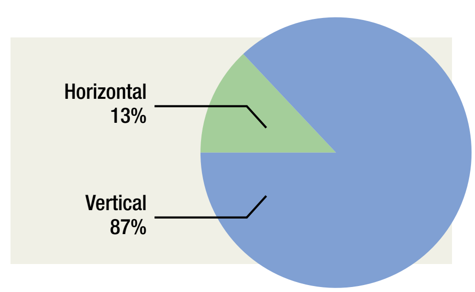


2013-17 Implementation

Investment plan for rehab vs. replacement



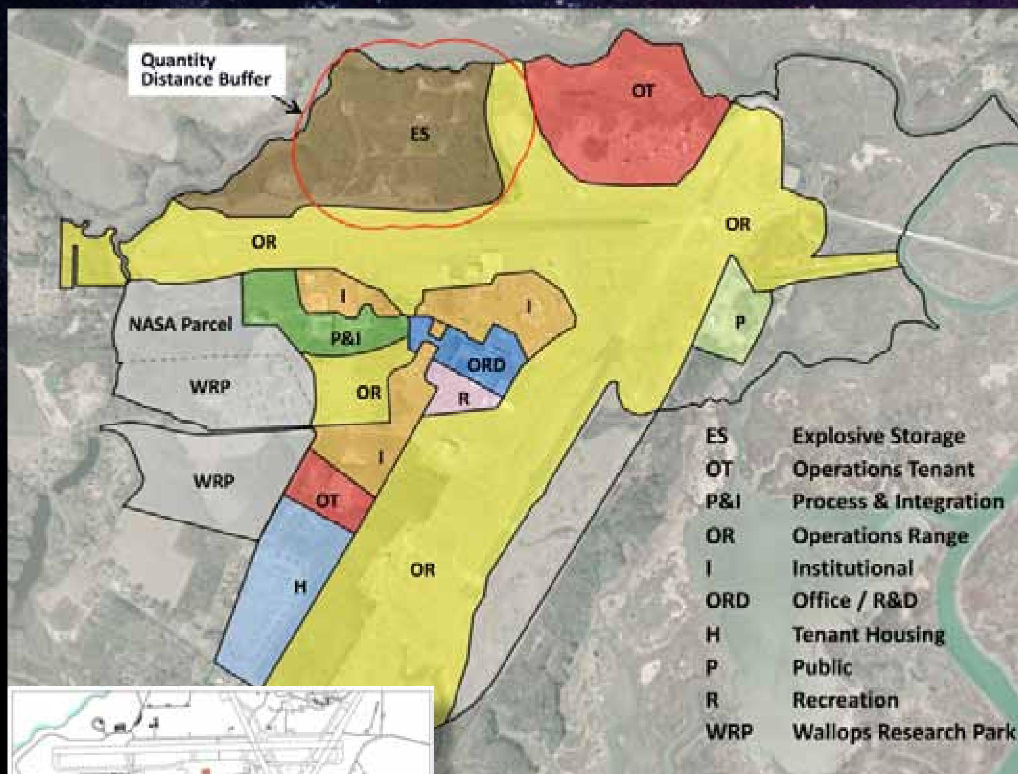
Investment plan for horizontal vs. vertical infrastructure



WFF

Wallops Flight Facility
(GSFC component facility)

2032



Today

Goddard Space Flight Center's Wallops Flight Facility, located on Virginia's Eastern Shore, was established in 1945 by the National Advisory Committee for Aeronautics, as a center for aeronautic research. Wallops is now NASA's principal facility for management and implementation of suborbital research programs.

site data

Infrastructure/Facilities

Land Area: 6,500 acres

Valuation: $.8B

Enclosed Area: 1.2M sq ft

Population On-Site: 1300

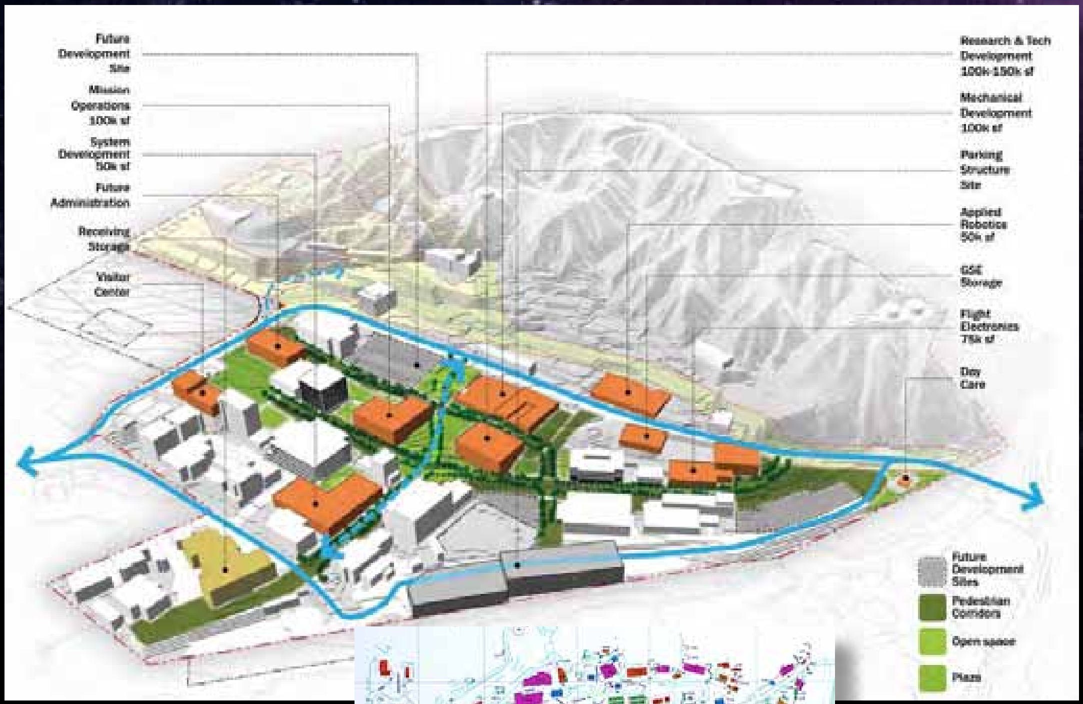
The research and responsibilities of Wallops Flight Facility are centered around providing a fast, low cost, highly flexible and safe response to meet the needs of the United States' aerospace technology interests and science research. Wallops aims to enable scientific, educational, and economic advancement by providing the facilities and expertise to enable frequent flight opportunities for a diverse customer base. The civil service and contractor employees act as a team to accomplish a key goal - operational test, integration, and certification of NASA and commercial next-generation, low-cost orbital launch technologies.

Wallops' permanent facilities support NASA's Sounding Rocket and Balloon Programs. Communications, telemetry and radar facilities enable tracking of orbiting spacecraft. Wallops' launch range and research airport have access to virtually unrestricted airspace. The Wallops restricted area connects Wallops and the Mid-Atlantic Test Range warning area. An extended area can be coordinated with governing agencies to meet specific mission requirements. Two commercial launch pads provide support to commercial clients through the Virginia Space Flight Center that resides at Wallops; the research airport supports aircraft-launched rockets. Wallops also provides customers with a variety of services and facilities during the planning, execution and data analysis phases of their projects. Wallops expects an increase in commercial launch activity in the very near future.

JPL

Jet Propulsion Laboratory

2030



Today

In the 1930's a group of Caltech enthusiasts conducted pioneering experiments in rocket propulsion, and by World War II, the organization was doing research for the US Army. With the creation of NASA, JPL was transferred to the new civilian space agency, bringing its extensive background in solid and liquid rocket propulsion systems, guidance, control, systems integration, broad testing capability, and expertise in telecommunications.

site data

Infrastructure/Facilities

Land Area: 155 acres

Valuation: $1.6B

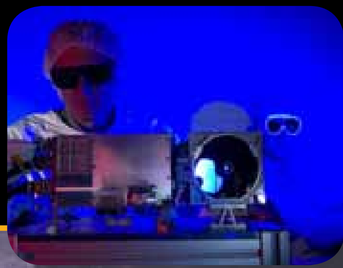
Enclosed Area: 2.5M sq ft

Population On-Site: 5,000

The Jet Propulsion Laboratory is NASA's lead center for the robotic exploration of space. In total, JPL has 20 spacecraft and nine instruments conducting active missions. All of these are important parts of NASA's program of exploration of Earth, the solar system and the universe beyond. Managed by JPL, NASA's Deep Space Network is an international network of antenna complexes on several continents that serves as the communication link between spacecraft and the Earth-based teams that guide them. While carrying out exploration missions, JPL also conducts a number of space technology demonstrations in support of national security and develops technologies for uses on Earth in fields from public safety to medicine, capitalizing on NASA's investment in space technology.

Besides the robotics expertise used in space exploration, a contingent of Earth-orbiting satellites monitors the lands, oceans and atmosphere of our own planet, returning important information on topics ranging from atmospheric ozone to El Nino events. For example, in June 2010 JPL launched the Aquarius instrument on a mission to make global maps of salt across the surface of Earth's ocean.

JPL's main Oak Grove site is near Pasadena, California, at the northern end of the Arroyo Seco watershed. JPL includes additional facilities, including Deep Space Network stations in Madrid, Spain; Canberra, Australia; and near Barstow, California. JPL installations also include an astronomical observatory at Table Mountain, California, and a launch operations site at Cape Canaveral, Florida.



Objectives of Master Plan

Mission - Enable JPL mission success by progressively replacing aging/inefficient facilities, and reconfiguring assets as appropriate

Consolidation - Use consolidation to drive operational efficiencies and workforce collaboration and to improve sitewide workflow

Environmental Responsibility - Create highly sustainable facilities

Workforce Effectiveness - Use the workplace to attract and retain the workforce

Approaches

Renewal - **Renew** facilities and otherwise improve the physical environment to support scientific research and foster collaboration

Consolidation - **Consolidate** like functions to improve workflow and workforce effectiveness

Environmental Responsibility - **Conduct** phased program to conserve energy, protect natural resources, and promote human health

Configuration - **Improve** site access and flow by adding a parking facility and adapting roadways to end reliance on leased arroyo lot

Renew horizontal infrastructure and explore renewable energy strategies in support of Deep Space Network program at Goldstone

Implementation Phasing

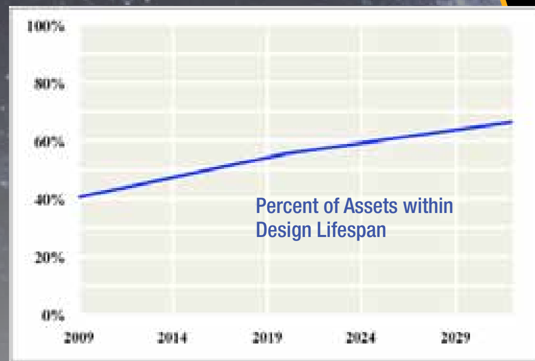
FY13-17: Create Flight Electronics and Robotics facility and renew enabling horizontal infrastructure

FY18-22: Create new Mechanical Development Laboratory

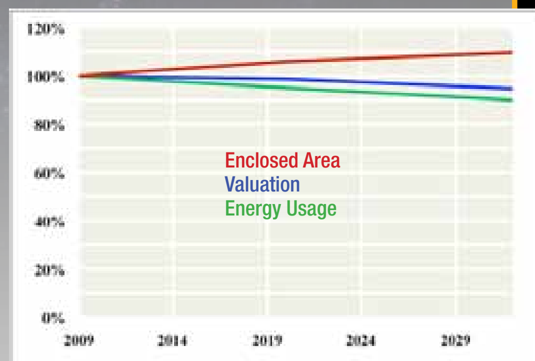
FY23-27: Create new Research and Technology Development Facility

FY28-32: Create new System Assembly and Testing Facility

Readiness

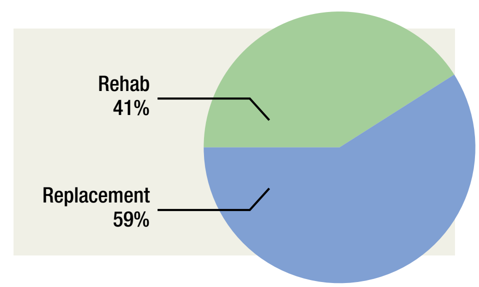


Resources

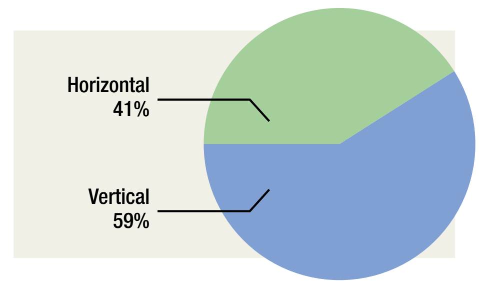


2013-17 Implementation

Investment plan for rehab vs. replacement



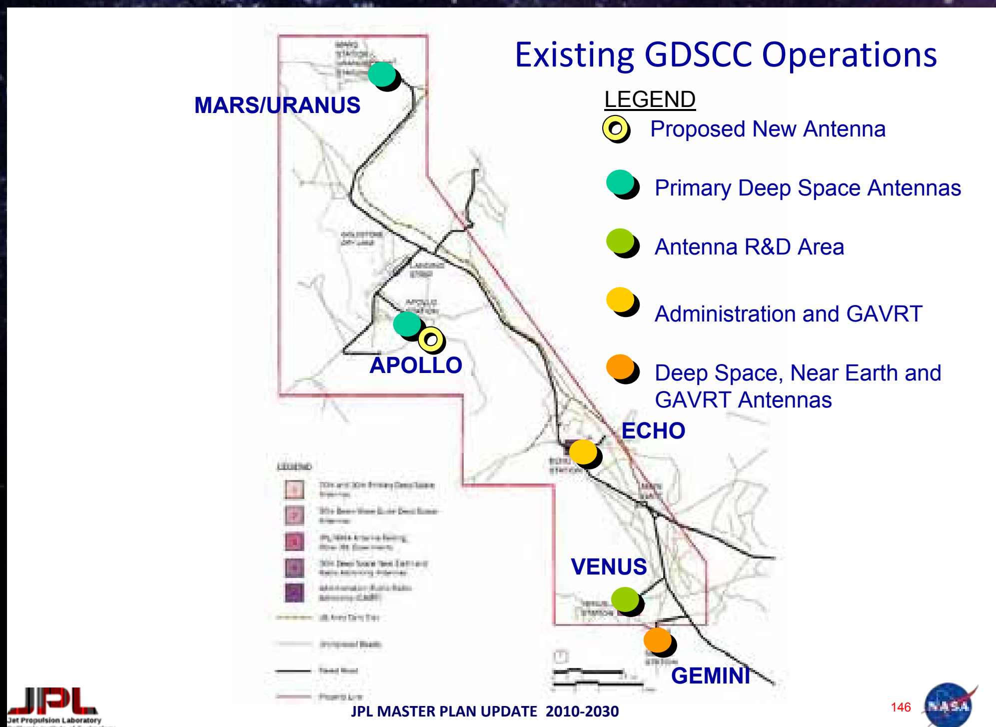
Investment plan for horizontal vs. vertical infrastructure



GDSC

Goldstone Deep Space Communications
(JPL component facility)

Today and 2032



site data

The Goldstone complex is located on the U.S. Army's Fort Irwin Military Reservation, approximately 72 kilometers (45 miles) northeast of the desert city of Barstow.

Infrastructure/Facilities

Land Area: 33,400 acres

Valuation: $.3B

Enclosed Area: .2M sq ft

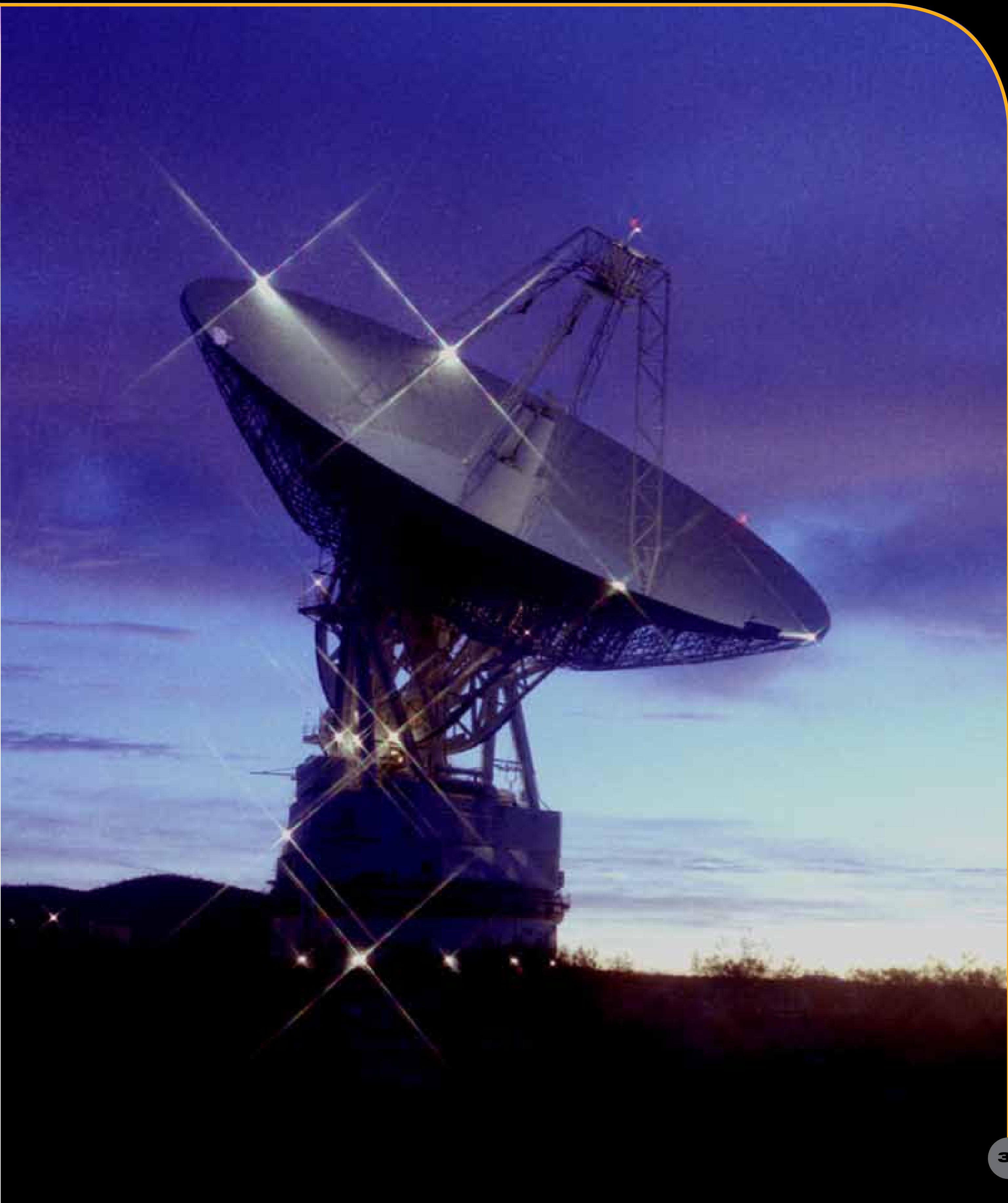
Population On-Site: 170

The NASA Deep Space Network - or DSN - is an international network of antennas that supports interplanetary spacecraft missions and radio and radar astronomy observations for the exploration of the solar system and the universe. The network also supports selected Earth-orbiting missions. DSN consists of three facilities placed approximately 120 degrees apart around the world: at Goldstone, in California's Mojave Desert; near Madrid, Spain; and near Canberra, Australia. This configuration permits constant observation of spacecraft as the Earth rotates, and helps to make the DSN the largest and most sensitive scientific telecommunications system in the world.

Goldstone is equipped with ultrasensitive receiving systems and large parabolic dish antennas:

- One 34-meter (111-foot) diameter High Efficiency antenna.
- Three 34-meter Beam Waveguide antenna.
- One 26-meter (85-foot) antenna.
- One 70-meter (230-foot) antenna.

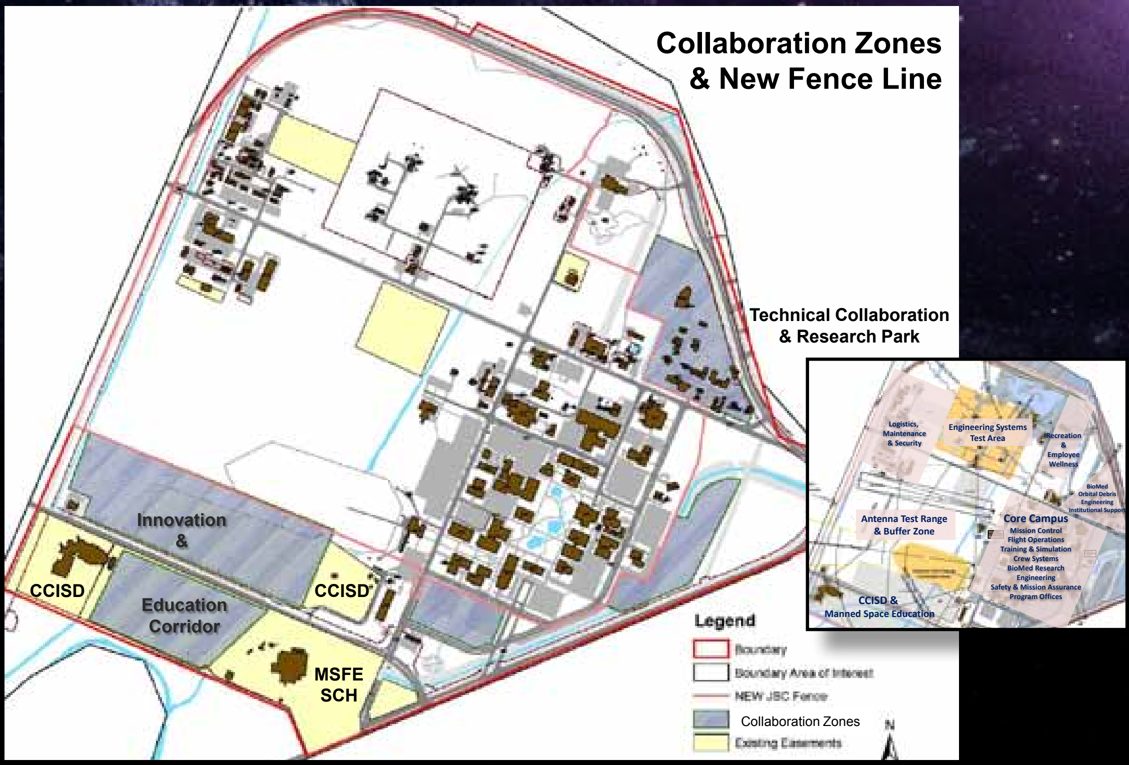
The DSN Centers house the electronic subsystems that point and control the antennas, receive and process the telemetry data, transmit commands, and generate the spacecraft navigation data. Once the data is processed at the complexes, it is transmitted to JPL for further processing and distribution to science teams over a modern ground communications network.



JSC

Johnson Space Center

2032



Today

Johnson Space Center was established in 1961 as the Manned Spacecraft Center and in 1973 renamed in honor of the late President and Texas native, Lyndon B. Johnson. From the early Gemini, Apollo and Skylab projects to today's space shuttle, International Space Station and Exploration Programs, the Center continues to lead NASA's efforts in human space exploration.

Infrastructure/Facilities

Land Area: 1,700 acres

Valuation: $2.3B

Enclosed Area: 5.2M sq ft

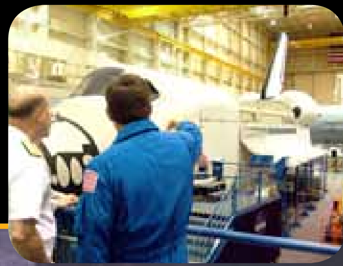
Population On-Site: 9,400

site data

Johnson Space Center leads NASA's flight-related scientific and medical research efforts. The Center strives to make revolutionary discoveries and advances to benefit all humankind. Technologies developed originally for spaceflight are already applied in medicine, energy, transportation, agriculture, communications and electronics. JSC's dedicated professionals manage the development, testing, production and delivery of all U.S. human spacecraft and all human spacecraft-related functions. This includes life support systems, power systems, crew equipment, electrical power generation and distribution, guidance, navigation and control, cooling systems, structures, flight software, robotics, spacesuits and spacewalking equipment.

JSC is home to NASA's astronaut corps. The Center is responsible for the training of space explorers from the United States and space station partner nations, including International Space Station Expedition crews. Astronauts receive training in station programs at the Integrated Training Facility. The Center's famed Mission Control Center, or MCC, is often referred to as the nerve center for America's human space program.

The Space Vehicle Mockup Facility is where space flight professionals learn skills and procedures to help operate equipment during a mission. This facility houses space shuttle orbital trainers, an International Space Station trainer, a precision air-bearing floor and a partial gravity simulator. The precision air-bearing floor and the partial gravity simulator are engineering tools used in the development and evaluation of spacewalk equipment and techniques.


Objectives of Master Plan

Mission - Serve a dynamic mission (including fluid program goals and faster response timelines)

Address risks associated with declining and ill-configured facilities

Environmental Responsibility - Support Agency institutional goals to renew, sustain, consolidate, and conserve

Approaches

Renew facilities and consolidate like functions to enhance density of utilization and lower facilities risk to programs

Consolidate real property assets to reduce long-term and near-term operational costs

Improve collaboration and outreach by consolidating near-site contract activities onsite where practical, and by creating public/private collaboration zones

Improve sustainability through improving workforce awareness, pursuing renewable energy initiatives, eliminating waste, and ensuring sustainable facilities design and operation

Increase density of office space

Consolidate/"Right Size" White Sands Test Facility

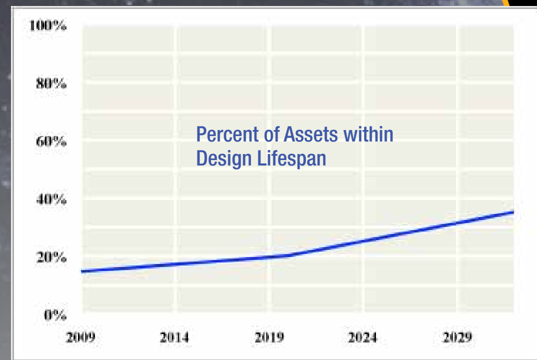
Implementation Phasing

FY13-17: Focus on campus consolidation and renewal in central campus area as best investment through mission transition

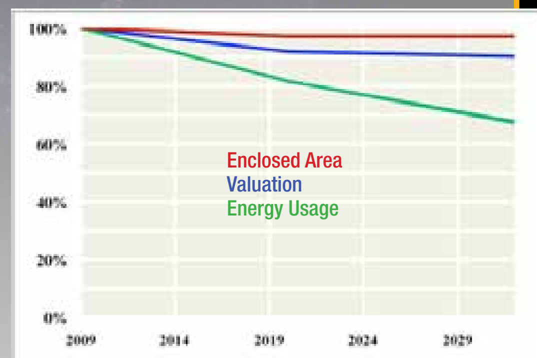
FY18-22: Complete clearance of "Eastside/200 Area" by consolidating activities into renewed core area facilities

FY23-32: Complete replacement of "North/300 Area" Logistics and O&M facilities; partner occupancy begins in Eastside/200 Area

Readiness

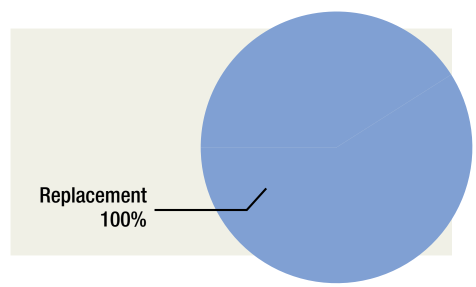


Resources

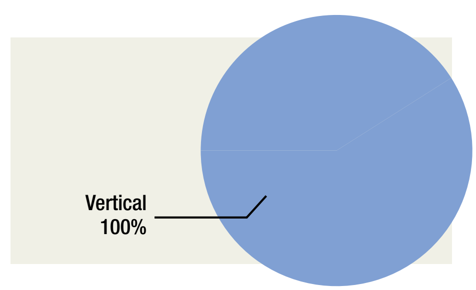


2013-17 Implementation

Investment plan for rehab vs. replacement



Investment plan for horizontal vs. vertical infrastructure

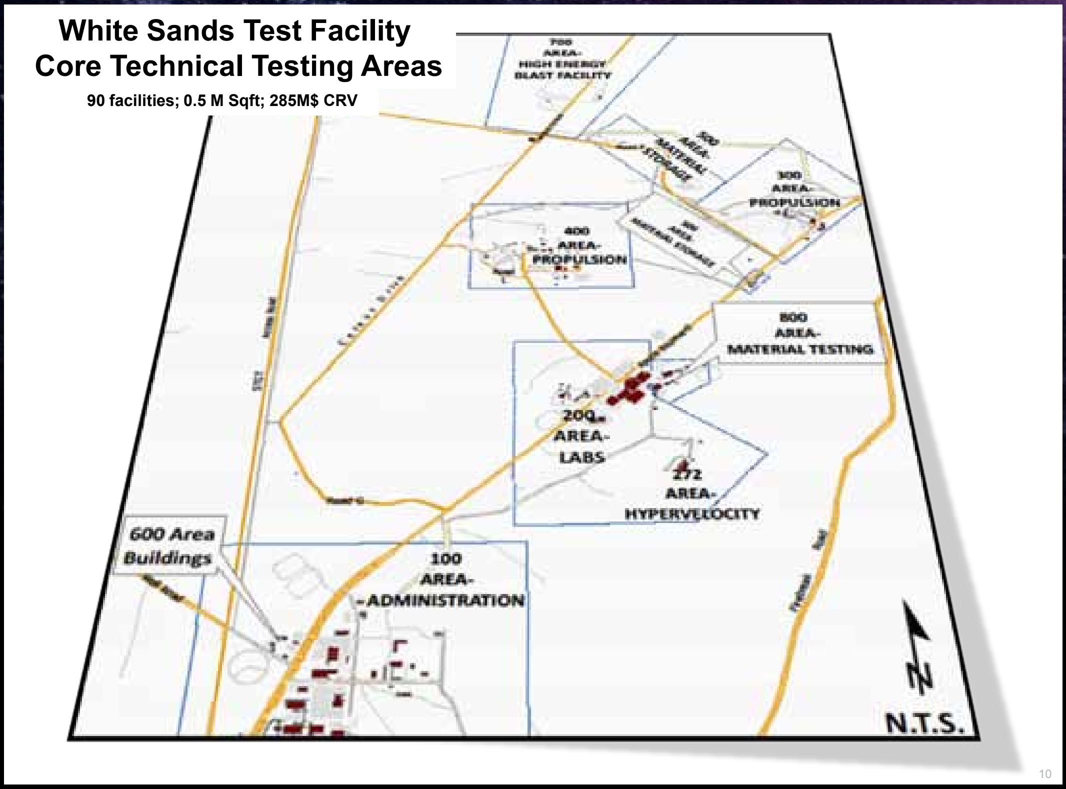


WSTF

White Sands Test Facility

(JSC component facility)

Today and 2032



site data

Originally White Sands Test Facility was known as the Apollo site, because it was established to support the development of the Apollo Spacecraft propulsion and power systems. Located east of Las Cruces, New Mexico, construction began in 1962; the first rocket engine was tested on Sept. 22, 1964.

Infrastructure/Facilities

Land Area: 500 acres

Valuation: $.4B

Enclosed Area: .6M sq ft

Population On-Site: 700

White Sands Test Facility is a preeminent resource for testing and evaluating potentially hazardous materials, space flight components, and rocket propulsion systems. The laboratory services at WSTF are available to NASA, the Department of Defense, other Federal agencies, universities, and commercial industry. The facility conducts simulated mission duty cycle testing to develop numerous full-scale propulsion systems. These systems were developed for the Apollo Service Propulsion and Lunar modules, Shuttle Orbiter, and the International Space Station (ISS). WSTF is formally certified to perform precision cleaning and depot-level refurbishment of flight-critical propulsion systems components.

The scientific investigation of explosion phenomena at WSTF is aimed at improving safety at launch facilities and other areas where hazardous materials are used. Ultra-high-speed instrumentation helps better define safety and structural requirements for new and existing launch facilities by measuring the effects of exploding liquid and solid propellants. WSTF is a center of technical excellence in the fields of high-pressure oxygen systems/materials and rocket propellant safety. WSTF offers:

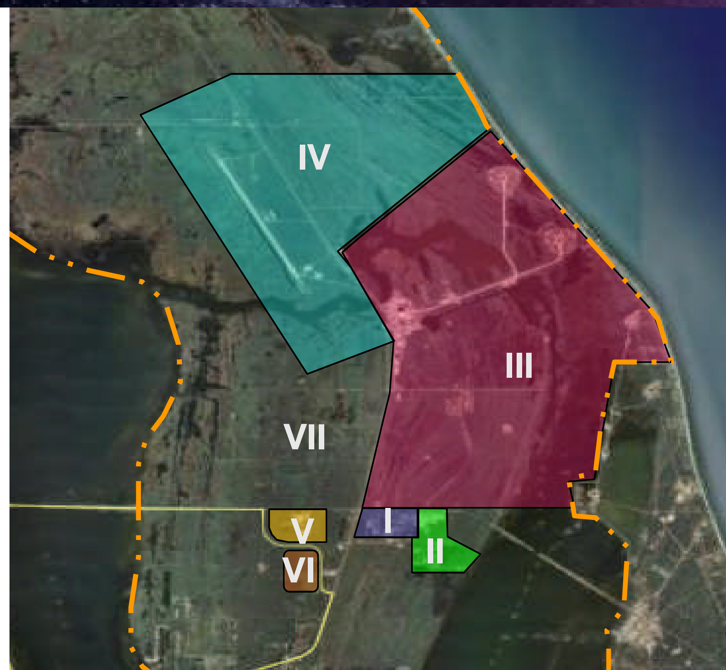
- Functional and performance evaluation tests
- Hazards/failure analyses of materials, components, and complete systems
- System design evaluation and recommendations
- Safety training courses and manuals

KSC

Kennedy Space Center

Today

I. Central Campus
II. Payload Processing
III. Vertical Launch
IV. Horizontal Launch & Landing
V. Public Outreach
VI. Exploration Park
VII. Miscellaneous



site data

In July 1962, NASA established its Launch Operations Center on Florida's east coast, and renamed it in late 1963 to honor the president who put America on the path to the moon. The site is strategically located near the Cape Canaveral Air Force Station, which also has significant launch capabilities.

Infrastructure/Facilities

Land Area: 140,000 acres

Valuation: $5.4B

Enclosed Area: 6.6M sq ft

Population On-Site: 13,800

NASA's John F. Kennedy Space Center is the nation's gateway to exploring, discovering and understanding our universe. Approximately 72 square miles of coastal and inland habitat in the Center of Florida's eastern coast comprise the area known as the Space Coast. Centered on NASA's Kennedy Space Center and DoD's Cape Canaveral Air Force Station, the location provides a critical asset for the Nation – launches to orbits that cannot be easily accessed anywhere else in the US. As NASA transitions from the Shuttle Program to future endeavors, the Kennedy workforce remains focused on NASA's core values: safety, integrity, teamwork and excellence. The Center will continue to support International Space Station operations as the orbiting laboratory enters its second decade of discoveries. Kennedy is also home to NASA's Launch Services Program. This program is responsible for launching satellites and robotic missions on journeys to learn more about our home planet and to unlock the secrets of the universe. KSC is working together with commercial partners to make tomorrow's missions a reality.

Objectives of Master Plan

Mission - Address the mission requirement to transition NASA's role in space transportation

Address risks associated with deteriorating facilities and infrastructure assets

Consolidation - Use consolidation to reduce overhead, enhance sustainment, and lower the total cost of facilities ownership

Environmental Responsibility - Support Agency institutional goals and green government initiatives

Approaches

Leverage assets no longer aligned with KSC requirements with partners where feasible or disposition

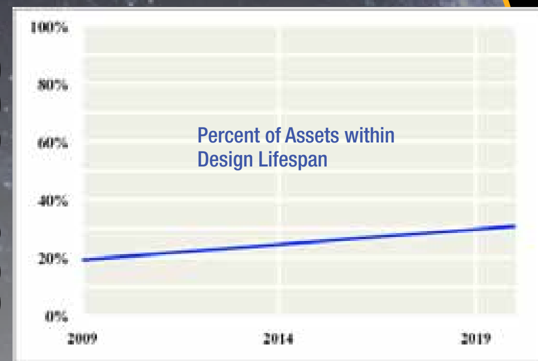
Continue renewal/consolidation of Central Campus to maximize workforce performance and collaboration, and leverage external partnerships on land outside NASA security

Implementation Phasing

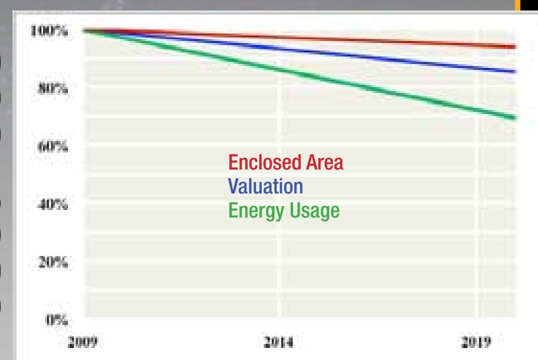
FY13-20: Initiate renewal and consolidation of Central Campus, and renew critical bridges and other infrastructure

FY20-32: TBD; anticipated KSC mission changes will affect planning significantly

Readiness

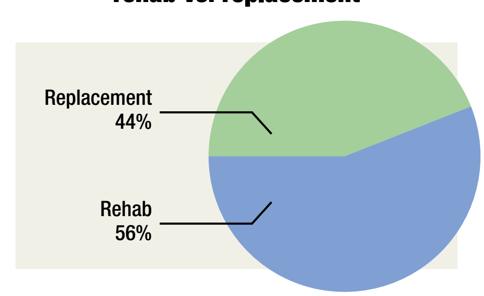


Resources

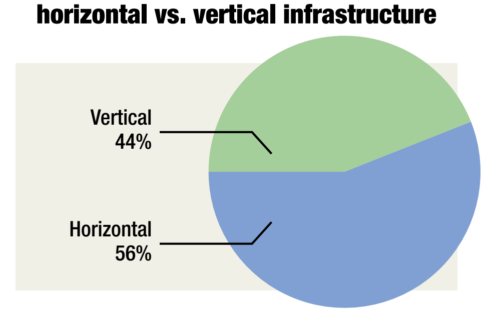


2013-17 Implementation

Investment plan for rehab vs. replacement



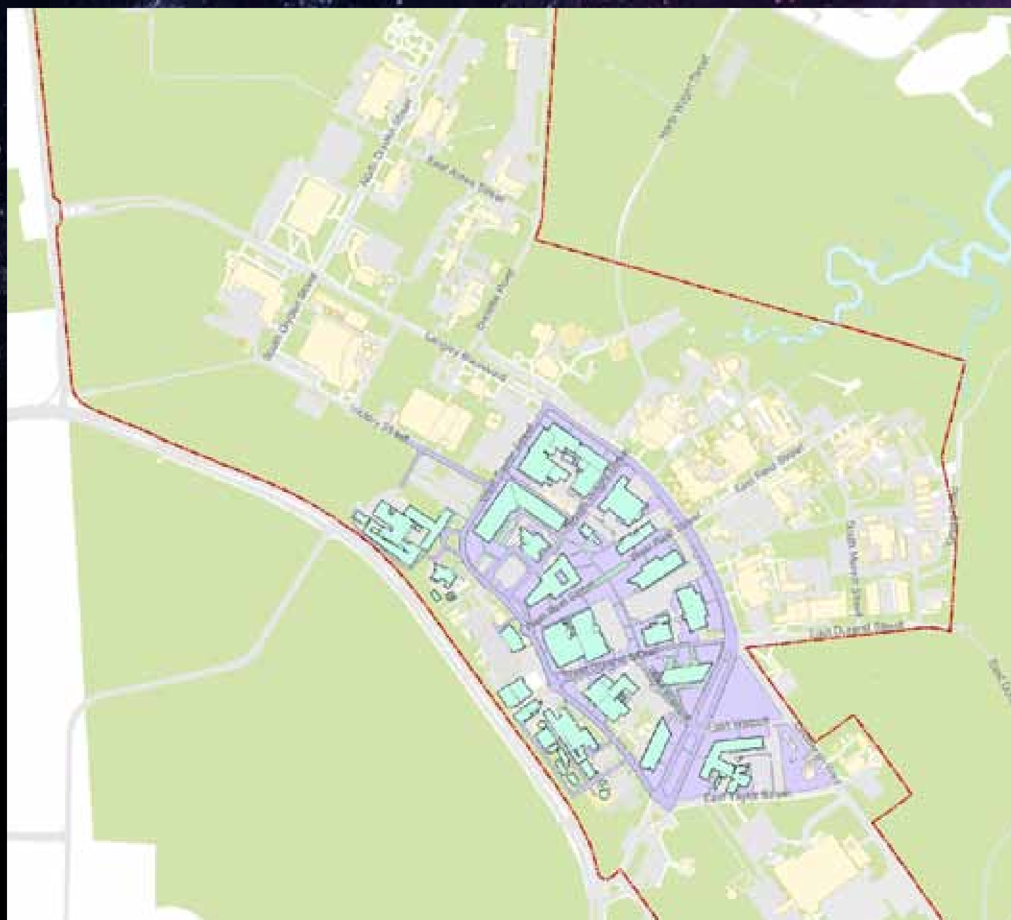
Investment plan for horizontal vs. vertical infrastructure



LaRC

Langley Research Center

2032



site data

NASA Langley, founded in 1917, is the nation's first civilian aeronautical research facility and NASA's original field center.

Infrastructure/Facilities

Land Area: 800 acres

Valuation: $3.4B

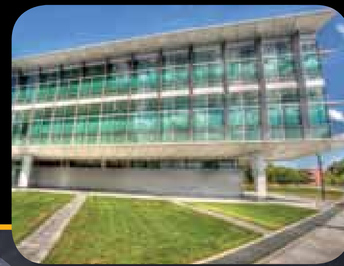
Enclosed Area: 3.2M sq ft

Population On-Site: 3,800

Researchers at Langley focus on some of the biggest technical challenges of our time: global climate change, access to space and revolutionizing airplanes and the air transportation system. Originally focused on aeronautics research, the unique skills (e.g., computational analysis) and research and testing facilities (e.g., Gantry and Wind Tunnels) at LaRC make critical contributions to the development of NASA's next generation of heavy-lift rockets and capsules for the upcoming phase of space exploration. Aeronautics engineers and scientists continue to research ways to make aircraft greener, quieter, faster, and safer.

LaRC research leads to possible applications of innovative technologies beyond NASA including transportation, public health, and recreation. The Innovative Partnerships Program at LaRC promotes the progression of LaRC technologies from the lab to the marketplace.

LaRC, together with Langley Air Force Base, is the foundation of the area's space exploration and aeronautics identity. These Federal agencies, plus the National Institute of Aeronautics and the Virginia Air & Space Center, mentor, educate, entertain, and inspire citizens in the surrounding communities, and draw millions of visitors every year. The science and engineering presence within the community results in many science, technology, engineering, and mathematics educational opportunities for students of all ages in the area.



Objectives of Master Plan

Mission - Provide appropriate, flexible capabilities to enable a balanced program of mission activities

Ensure reliable facilities of appropriate quality

Consolidation - Encourage consolidation of antiquated facilities into smaller, more modern facilities to reduce cost and increase productivity

Environmental Responsibility - Support Agency institutional goals to renew, sustain, consolidate, and conserve

Workplace Effectiveness - Foster workforce productivity and collaboration

Approaches

Renew facilities to extend current Langley New Town program and protect key research capabilities to enable Langley of the Future (wind tunnel, system development and fab, etc.)

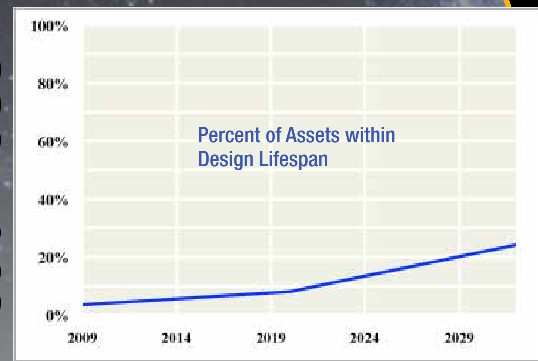
Implementation Phasing

FY13-17: Continue New Town renewal and consolidation per business case

FY18-22: Complete initial New Town plan and begin extending; begin major horizontal infrastructure upgrades

FY23-32: Continue the extended New Town plan including modular wind tunnel; continue major horizontal infrastructure upgrades

Readiness



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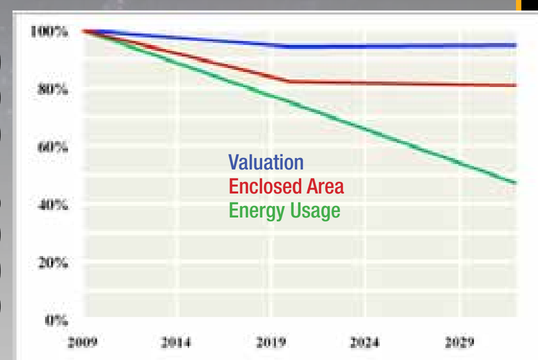
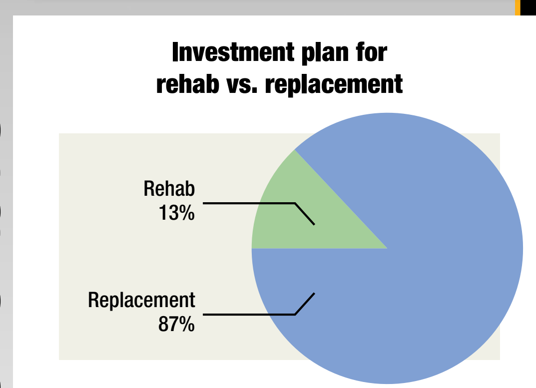
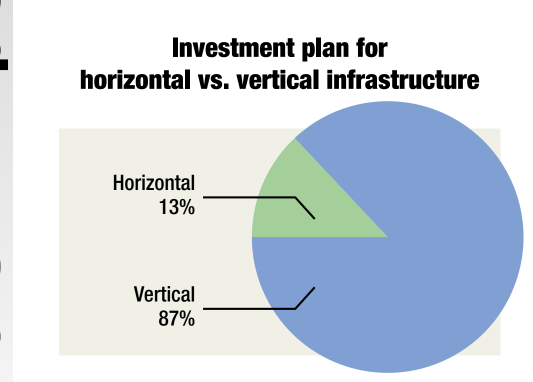


2013-17 Implementation





MSFC

Marshall Space Flight Center

Located on Redstone Arsenal in Huntsville, Ala., Marshall provides the multidiscipline engineering expertise behind propulsion and transportation systems. It was established as a field center in 1960.

site data

Infrastructure/Facilities

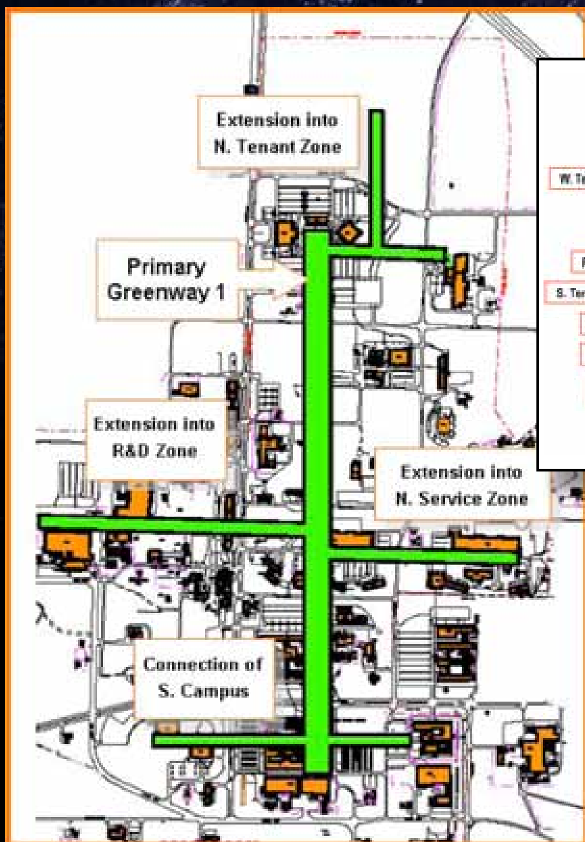
Land Area: 1,800 acres

Valuation: $3.3B

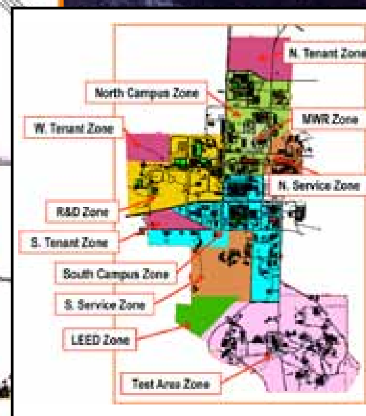
Enclosed Area: 8.3M sq ft

Population On-Site: 11,900

2032



Today



From Apollo to Space Shuttle, the Marshall Space Flight Center has played a critical role in transporting people, supplies, and science experiments into low Earth orbit. For the International Space Station (ISS), Marshall develops systems to support life on the station, managing logistic modules for transporting science experiments, managing the Payload Operations Center, and coordinating all experiments on the station. Providing air and water purification systems for ISS supports the development of related technologies that will enable extended human missions in the future.

Marshall plays a significant role in maturing and developing advanced propulsion technologies to support NASA's future exploration goals. Their Propulsion Research Laboratory is pursuing technologies ranging from advanced combinations of chemical fuels and propellants to systems that use the sun for propulsion or leverage a planet's atmosphere for braking. These propulsion concepts could significantly reduce cost, the size of spacecraft or travel times, enabling or benefiting more ambitious NASA space science missions between planets.

Scientists at Marshall are studying everything from the birth of planets and the death of stars to the inner workings of hurricanes and other global climate conditions. Their scientific breakthroughs in space will enhance life on Earth by helping farmers improve agricultural methods and enabling governments to manage water resources more effectively. Other benefits for humankind include more accurate worldwide weather forecasting, advanced methods for locating archeological sites, and the development of numerous materials and tools that can be applied to tasks on Earth.

Objectives of Master Plan

Mission - Serve a dynamic mission (including fluid program goals and faster response timelines)

Address degradation of aging facilities in both administrative and technical facilities

Environmental Responsibility – Leverage opportunities to reduce resource consumption (energy, water, facilities operational costs)

Workforce Effectiveness - Ensure that the workplace contributes to attracting and retaining tomorrow's workforce

Approaches

Renew aging assets to support core capabilities and respond to mission changes

Consolidate and enhance existing functional activity zones to ensure workforce effectiveness

Focus on an open, collaboration-friendly workplace, reducing cost of future changes and enabling workforce success

Interconnect functional zones with a primary north-south greenway

Lower costs and mission risks by positioning the Michoud Assembly Facility for mission change and by enabling partner growth in part of the site

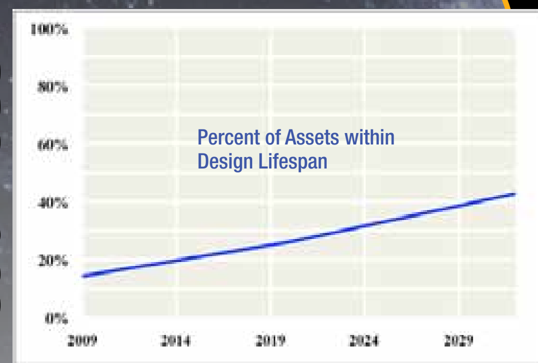
Implementation Phasing

FY13-17: Renew and consolidate aging infrastructure and facilities to mitigate risks to mission success and workforce safety; continue implementing demolition program to balance reducing the Center footprint with sustaining required capabilities

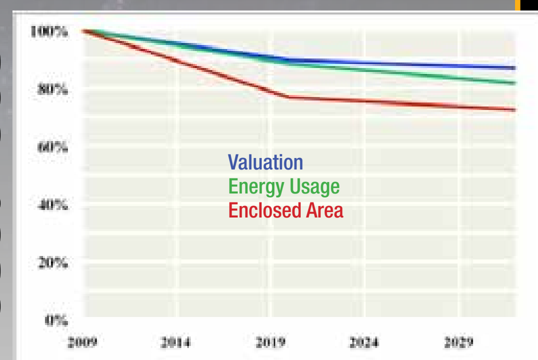
FY18-22: Continue renewal and consolidation to ensure high performance facilities that support consolidation and mission success in a collaborative work environment; continuing focus on executing the Center's demolition program

FY23-32: Continue focus on renewing aging infrastructure and facilities to sustain capabilities that meet current and future mission requirements

Readiness

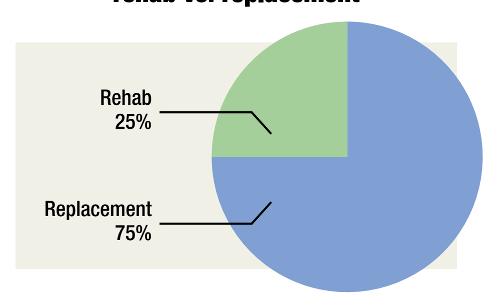


Resources

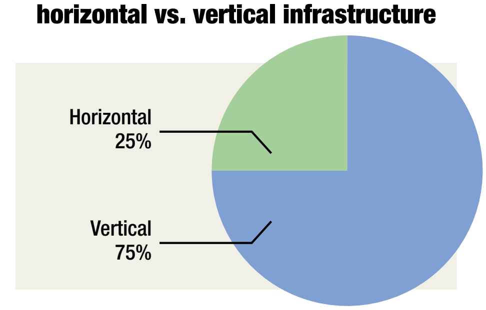


2013-17 Implementation

Investment plan for rehab vs. replacement



Investment plan for horizontal vs. vertical infrastructure



MAF

Michoud Assembly Facility
(MSFC component facility)

Today and 2032

101 Admin Bldg	203 Reclamation Storage	303 X-Ray Mod & Staging	404 Structures Test
102 Engr Bldg	207 Boiler House	318 Component Ablator Fac.	420 Acceptance & Prep
103 MFG Bldg.	220 Vehicle Component Supply Bldg	320 Facilities Ops. Bldg	450 Main Pumping Station
110 Vert Assy Bldg	221 Hazard Mats Storage	350 Office & Engr. Bldg	451 LH2 Pneumatic Test

site data

The Michoud Assembly Facility was originally a WWII site for construction of plywood cargo planes and later for Army Sherman and Patton tanks. NASA acquired the facility in 1961 for the manufacture of large space launch vehicles requiring water transportation to launch sites.

Infrastructure/Facilities

Land Area: 850 acres

Valuation: $1.7B

Enclosed Area: 3.7M sq ft

Population On-Site: 3,700

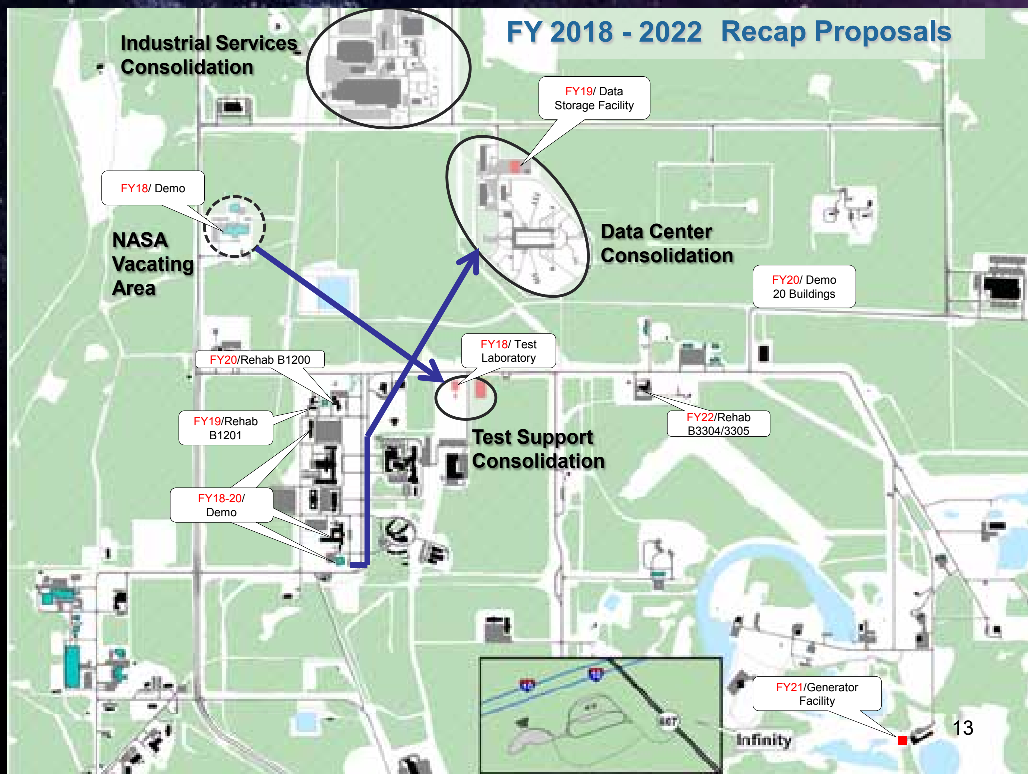
The Michoud Assembly Facility provides NASA with extensive world class site/production capabilities for the manufacturing of large scale aerospace structures. Notably MAF is equipped to manufacture the liquid hydrogen and liquid oxygen external fuel tanks that enable space exploration. The Michoud facility contains one of the largest production buildings in the nation, a vertical assembly building for stacking external tank components, pneumostatic and systems test buildings, a deep-water port for shipment, manufacturing support buildings and administrative offices.

Other government agencies such as the National Finance Center for the U.S. Department of Agriculture, the Defense Contract Audit Administration and the Defense Contract Management Agency share space with NASA. The U.S. Coast Guard Integrated Services Command relocated to the MAF after Hurricane Katrina destroyed a nearby facility. The University of New Orleans operates the National Center for Advanced Manufacturing at the Michoud site.

SSC

Stennis Space Center

2032



In October 1961, an historic announcement was made: the Federal government had selected an area in Hancock County, Miss., to be the site of a static test facility for launch vehicles to be used in the Apollo manned lunar landing program. The land was chosen because of its water access, essential for transporting large rocket stages, components and loads of propellants.

Infrastructure/Facilities

Land Area: 13,800 acres

Valuation: $2.5B

Enclosed Area: 2.5M sq ft

Population On-Site: 5,400

site data

From its origins, the Stennis Space Center focused on propulsion testing to support NASA's earliest space exploration efforts. Today, Stennis' mission is to 1) Perform flight certification and acceptance testing of large space transportation and rocket propulsion systems, subsystems, and components, and 2) Provide, operate, maintain and manage the SSC institutional resources to support propulsion system testing, earth sciences, oceanography, training, data center operations, shared service centers, and other government functions.

Stennis Space Center's extensive experience in propulsion systems testing, its facilities, its geographic size and location, its topographical properties, its broad range of scientific programs, its advanced test facilities, and its highly skilled personnel all contribute to making its capabilities unique within the Agency.

To support the highly specialized and complex activities required to carry out its mission, SSC provides some of the most highly specialized and unique facilities, equipment, and expertise available anywhere. Add to this experience in applied research and development in the fields of remote sensing, data processing, instrumentation, acoustics, meteorology, cryogenics, component testing, oceanography, environmental studies, chemical analysis and other technologies, SSC's capabilities assume national and world stature.

Objectives of Master Plan

Mission - Ensure Stennis' mission in rocket propulsion testing and supporting services in light of an aging facilities set

Provide a safe, sustainable, and cost efficient workplace, reducing institutional risk to mission

Consolidation - Reduce institutional size through consolidations, demolition, and property transfers

Environmental Responsibility - Ensure Stennis continues to comply with all applicable Federal, state, local and agency laws and regulations

Workforce Effectiveness - Consolidation of like activities into new, more flexible workspace to increase workforce effectiveness

Approaches

Renew aging assets with focus on critical technical capabilities, particularly test area underground infrastructure

Leverage newly-transferred Mississippi Army Ammunition Plant to dispose scattered and degraded institutional facilities

Lower total cost of NASA facilities ownership through enhanced partnerships with suitable onsite tenant activities

Ensure Stennis, its tenants, and partners continue to comply with all applicable Federal, state, local and agency laws and regulations

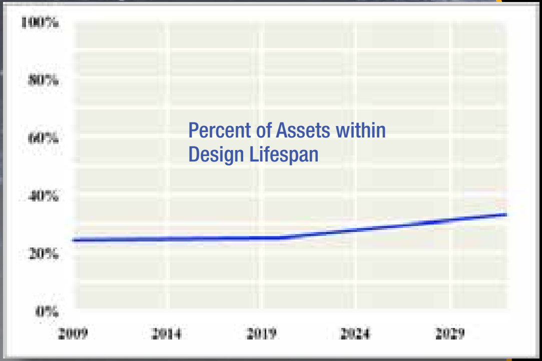
Infill development along existing "Project Ready" horizontal infrastructure and consolidate like activities to allow for more workforce effectiveness and reduce both horizontal and built infrastructure needing long-term maintenance

Implementation Phasing

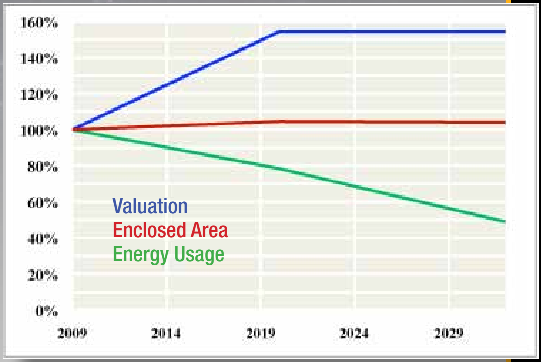
FY13-22: Take advantage of testing pause to address test infrastructure and safety issues; consolidate similar activities to reduce footprint, and address asset aging issues and meet environmental responsibilities

FY 23-32: Continue to address asset aging issues and environmental responsibilities, and the requirement for net-zero energy consumption facilities

Readiness

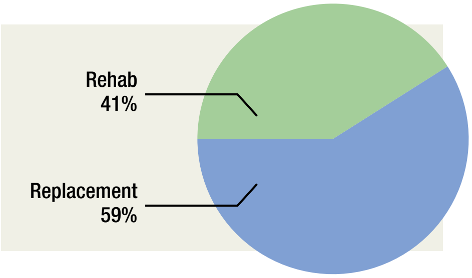


Resources

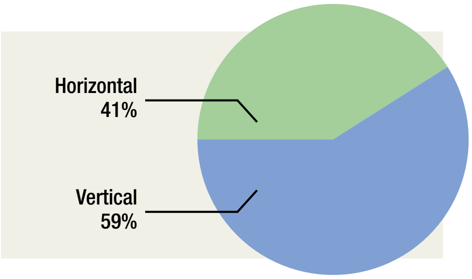


2013-17 Implementation

Investment plan for rehab vs. replacement



Investment plan for horizontal vs. vertical infrastructure



VII. Outcomes of the Agency Master Planning Process and Assessment

"This gradual, but appreciable, improvement over time…indicates a reduction of risk associated with carrying a large number of assets beyond their design lifespan."

Agency Master Plan Outcomes

As described on page 7, NASA measures progress against three priority goals for its portfolio of institutional assets: Readiness, Right-Sizing, and Environmental Stewardship. The following text describes the projected outcomes if NASA were to implement the Agency Master Plan as currently envisioned and if fully funded. Overall, the Plan shows modest, but positive gains in all three measures. Current budgets do not provide the funding necessary to implement the plan according to the schedule proposed. The Agency Facility Strategy, and the resultant Agency Master plan, nevertheless provide the best available path toward a sustainable infrastructure set. NASA is aware that the plan, and the process to produce it, can be improved. A description of possible improvements going forward follows the outcomes discussion.

Readiness

Figure 7 depicts how NASA could reverse the downward trend of facilities ready to enable the Agency's mission success in a reliable fashion. This readiness measure is quantified by assessing the percentage of assets that are within their design lifespan. An asset within its design lifespan is generally expected to be a good fit for current and future usage. As noted on page 6, under 20% of institutional assets are at an age considered likely suitable, or ready, to support the mission. Implementing its demolition, consolidation, and renewal plans as outlined in this Agency Master Plan can bring the readiness percentage close to the 40% mark by 2030. This gradual, but appreciable, improvement over time corresponds to reducing the risk associated with carrying a large number of assets beyond their design lifespan.

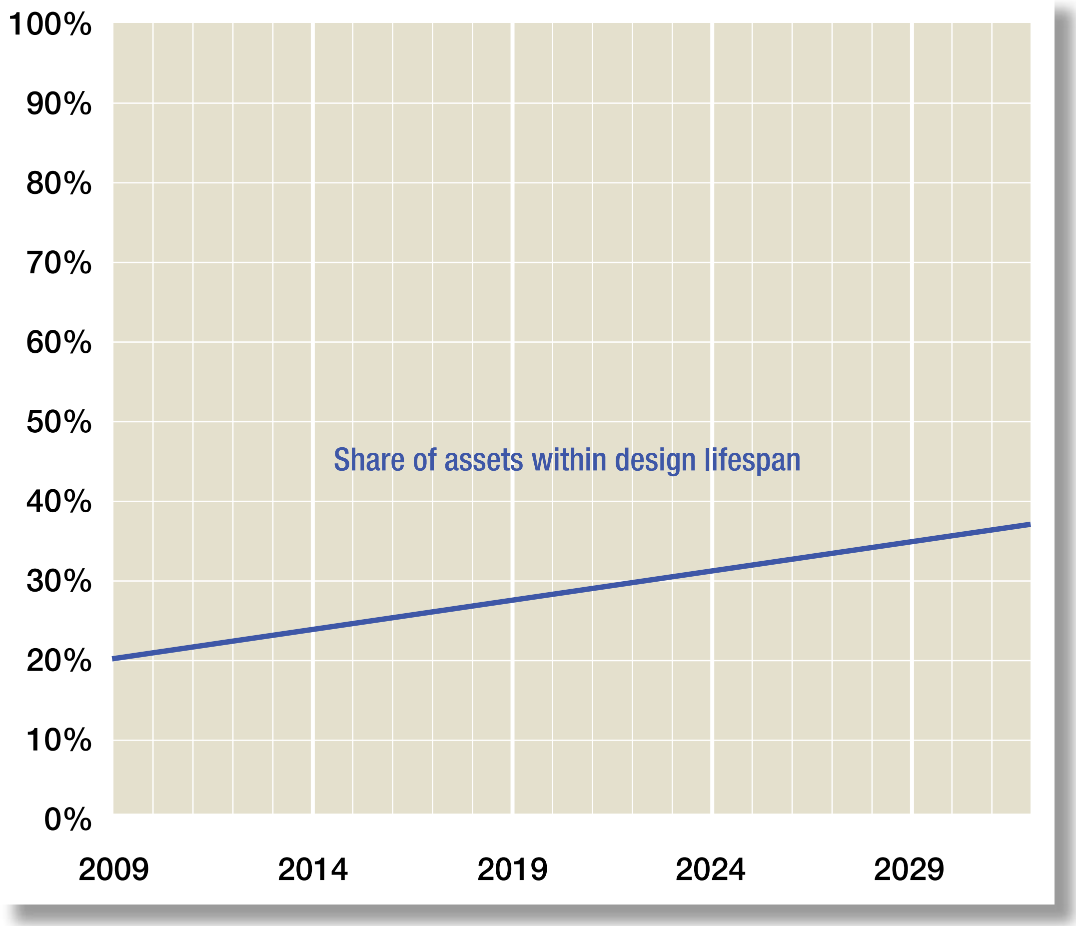


Figure 7. If the Agency Master Plan were implemented, the percentage of assets within their design lifespan (indicating their suitability for serving NASA's needs) would rise over time.

Right-Sizing

Figure 8 shows how implementing the master plan can enable NASA to reduce the size and operating cost associated with facilities, reflecting continuing progress toward a sustainable infrastructure base. The blue line shows a steady reduction in the real-dollar valuation of assets; the red line projects a reduction in enclosed area. Both of these measures correspond to reduction in the overall asset base as the Agency is able to consolidate capabilities and dispose of underutilized assets.

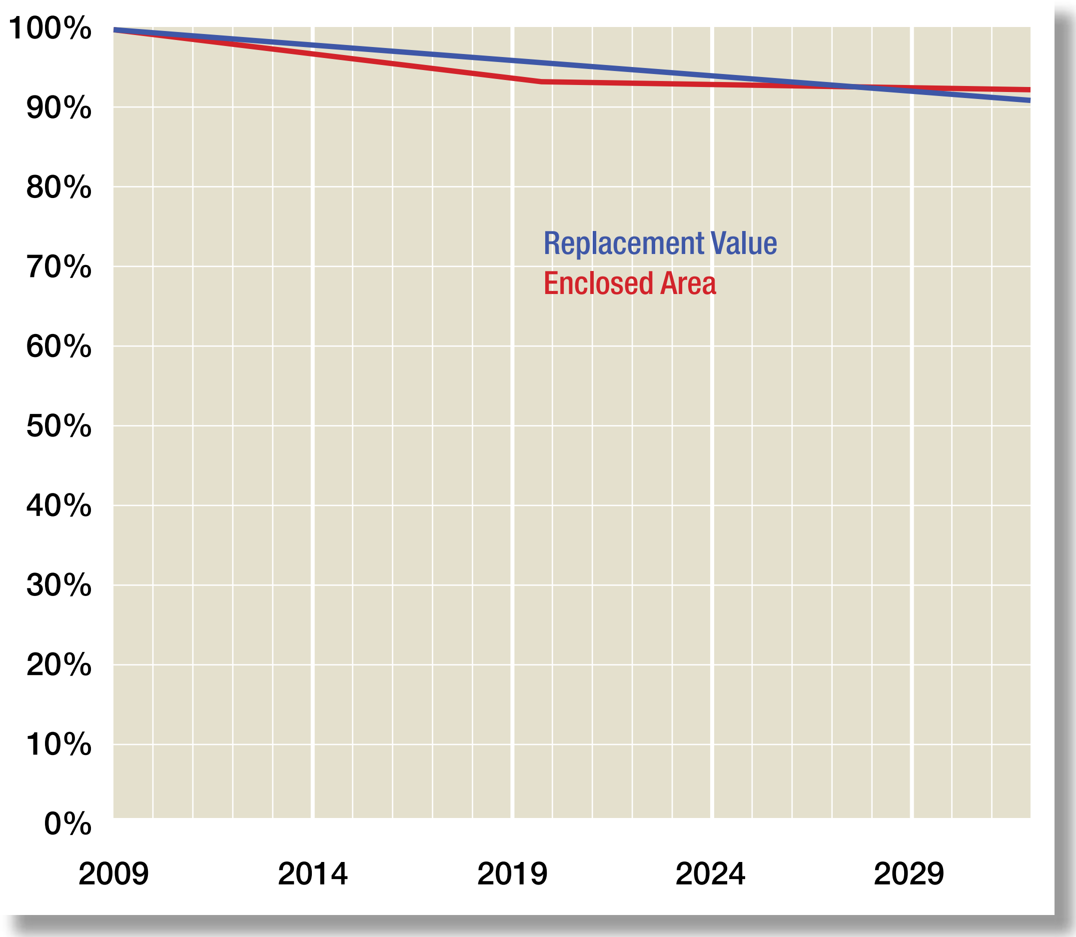


Figure 8. The value of assets held by NASA and the enclosed area within those assets will slowly decline over time, indicating a better management of financial resources.

Environmental Stewardship

NASA is committed to a sustainable institution, in planning, design, construction, and operations. One indicator of NASA's progress toward sustainable facilities is energy consumption. **Figure 9** illustrates a key aspect of NASA's continuing dedication to improving environmental performance of its assets. The solid green line indicates a reduction in projected energy demand, while the dashed green line shows additional progress at reducing energy from non-renewable resources. NASA's environmental stewardship goals for facilities extend beyond energy usage reduction. Executive Order (EO) 13514, "Federal Leadership in Environmental, Energy, and Economic Performance," requires integrated strategic planning relating to, among other things, high-performance sustainable design/green buildings. The goals set in EO 13514 for sustainable buildings dovetail well with NASA's capital investments plans for new facilities that would help reduce energy and water consumption, greenhouse gas emissions, unsustainable commuting habits, and ensure that facilities are resilient to the likely impacts of climate risks.

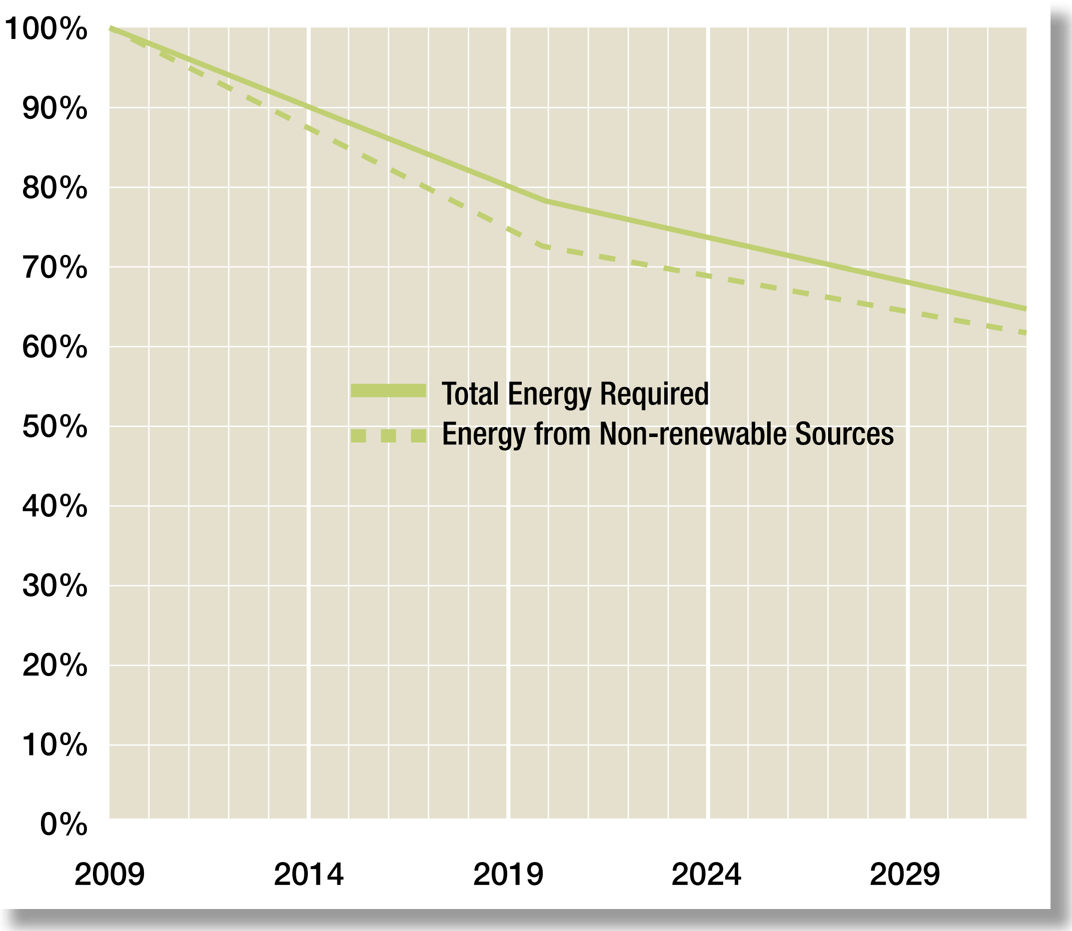


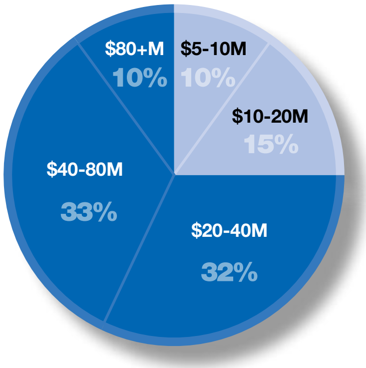
Figure 9. Implementing the Agency Master Plan will lead to reduced energy demand and a decreased use of non-renewable energy.

By implementing the Agency Master Plan, NASA lowers mission risk, reduces costs and achieves environmental stewardship benefits, while reducing the overall infrastructure footprint.

Agency Master Plan Implementation

A key test of the plan is whether the implementation projects are consistent with achieving plan objectives. Assessing the scale, approach, and content of the first five years of implementation proposals helps illustrate how NASA can walk its agency master plan talk.

Figure 10. 75% of renewal investments would be devoted to projects over $20 million, in step with the renewal of NASA's major capabilities.



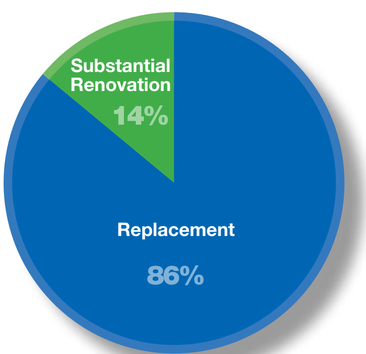


Figure 11. Renewal proposals mostly renew by replacement to best align with current and future requirements.

NASA seeks to make its renewal (Recapitalization) investments to address risks posed to the Agency by continuing to carry excess real property and deferring investments. Prudent risk management means reconsidering not only implementation particulars and timelines but making decisions based on NASA's future programmatic needs. A master plan is necessarily more defined at the outset and more general toward the latter part of its 20-year timeframe, so the first five years offer the best opportunity to evaluate and realign implementation as a whole. In short, NASA is using the master planning process as a tool to make better long-term strategic investments. As new budget, program, and infrastructure data emerge, Center and Agency Master Plans will be modified in response.

Project Scale

Figure 10 illustrates that Recapitalization projects are scaled to enable larger, more valued assets to be thoroughly renewed consistent with their strategic value to the agency. Instead of spreading the funds across many lower-value assets, specific high-value properties are targeted to align their capabilities with mission requirements. Routine NASA capital facilities projects average about $5 million, so the proposals in this plan reflect a dramatic shift away from mitigating only the most pressing risks in aging facilities and toward strategic renewal, fully "resetting the clock" for critical assets.

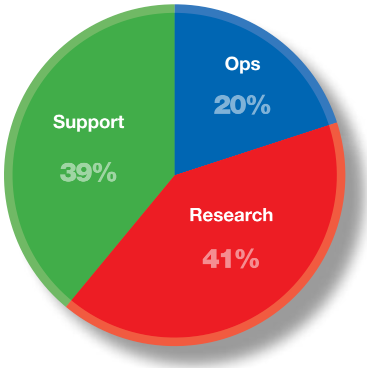
Project Approach

Figure 11 illustrates the share of Recapitalization resources intended for replacement as compared with substantial renovation. While both approaches should be considered, a substantial renovation complicates full "resetting of the clock" by retaining elements from an asset built at or before the dawn of the Space Age. Over-reliance on substantial renovation might indicate that NASA's proposals were trying to stretch funding across more assets by reusing old structures, a tactic likely to constrain the ability to optimize facilities against current and projected requirements. The preponderance of replacements in implementation proposals confirms NASA's commitment to strategic renewal.

Capability Type

Figure 12 illustrates another important dimension of the first five years of implementation proposals: their distribution across different agency capabilities. The plan devotes resources to support facilities (administrative buildings, utilities, roads, bridges, fences, etc.) in proportion to their share of current assets. Among the technical assets, though, more funds are directed towards research than operations assets. This too reflects a strategic intent: while human space flight operations are in transition, the plan focuses on addressing risks identified in the National Research Council's 2010 study of NASA's basic research capabilities.

Figure 12. Renewal proposals would apply resources to remedy key weaknesses in research capabilities.



Infrastructure Type

Finally, while it is clear that vertical infrastructure (buildings and test structures) are the central focus of the plan, horizontal infrastructure (roads, fences, and underground utilities, many of which are out of view) are supported slightly more than their 20 percent share of current holdings, as shown in **Figure 13**.

Much as was true for Capability Type, the balance between infrastructure types results from a strategic choice: while human space flight plans are in transition, the plan focuses on putting critical horizontal infrastructure in order; as mission plans firm, vertical infrastructure renewal would increase in later phases as mission program requirements are clarified.

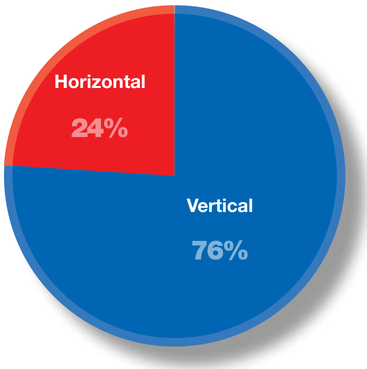


Figure 13. Renewal proposals invest in horizontal infrastructure as well as buildings and test facilities.

Opportunities for Improvement

No plan is perfect or final. NASA acknowledges that master planning is a continuing responsibility; its first full plan will be improved in successive iterations. Even a strong first product of a significantly revised planning process is bound to include some gaps. NASA leadership and institutional planners are formulating plans to address them. While none is simple enough for a simplistic or quick resolution, none is so different that it fundamentally changes the strategy reflected in the Agency Facilities Strategy and its implementation via this Agency Master Plan.

Identified Gaps

While the Agency Master Plan reflects significant progress, identifying cross-Center consolidation opportunities is a strategic opportunity for further advancement. This is a key opportunity for the Agency to reduce infrastructure. Centers need additional guidance on how to streamline their requirements and participate in an integrated fashion to yield the optimal Agency-wide capabilities. In fact, current processes at NASA already seek and capitalize on consolidation opportunities (e.g., testing alliance with the Department of Defense and the private sector for aeronautical and rocket propulsion testing, the Strategic Capabilities Asset Program, and targeted studies to identify consolidation and renewal plans for particular capabilities, such as arc jets and thermal vacuum chambers). Center master plans already show the positive results of consolidation decisions; nevertheless, the master planning process should reflect that the Agency is advancing efforts in this regard.

"NASA remains firmly committed to transitioning to a sustainable, mission-aligned infrastructure."

Recent changes in Agency human space flight strategies are a second opportunity for improvement. Much of the current plan was defined in 2010, when Agency strategies were still in flux. Mission flux kept facilities requirements in flux, most significantly at the Kennedy Space Center. While KSC participated actively in the master planning process, their proposals look only 5-10 years forward rather than the 20-year timeframe used at other Centers. Leadership and staff at the Center have coordinated closely with Headquarters and are already at work on an update to their input, but that work has not yet advanced to the point at which its products can be integrated into the Agency plan.

Technical Capability Portfolio Management

NASA struggles with defining its demand for and supply of technical capabilities, and is now implementing a Technical Capability Portfolio Management program. The process is newly re-invigorated with a robust database tool to provide the timely, accurate, detailed information necessary to support decision-making. This process will provide the "how" for identifying opportunities to achieve greater efficiencies through consolidation across Center assets. The new process was not in place in time to guide the recent Agency master planning effort, but now presents a significant opportunity for advancing the assessment of critical capabilities. Specifically, guidance from Headquarters can help Centers work more efficiently and collaboratively within Agency resource constraints.

Commitment to a Sustainable Mission

The Agency is already using this Agency Master Plan as the basis for prioritizing near-term investments. NASA will continue to follow the process described above, which promotes smart facilities decisions driven by prudent business principles. NASA remains firmly committed to transitioning to a sustainable, mission-aligned infrastructure.

Though implementation may change in response to new budget constraints, NASA believes the planning process is sound:

1 Agency leadership develops an Agency Facilities Strategy, based on careful consideration of Executive and Legislative direction and available resources;
2 NASA translates the strategy into specific guidance for the field Centers;
3 Installations update their plans;
4 Installations develop specific, resource-linked implementation proposals;
5 The Agency integrates these proposals into a coherent, prioritized capital plan;
6 The Agency tracks progress toward its objectives, reassessing periodically and adjusting to strategy and tactics as appropriate.

Following this process promotes smart facilities decisions driven by prudent business principles. NASA continues to assess all relevant factors, including mission adjustments, budget cycles, and risks posed by an aging infrastructure, to make smart, strategic investments to enable mission success.

Definitions

The discipline of master planning, as with all disciplines, comes with its own set of associated definitions. Some of the following definitions are common to other Federal agency master planning programs; several have nuances specific to NASA's usage of the terms.

Agency Facilities Strategy – A brief summary statement encapsulating top-level guidance from Agency leadership, specifically "NASA will renew and modernize its facilities to sustain its capabilities, and to accommodate those capabilities in the most efficient facilities set practical."

Agency Master Plan – A comprehensive strategic facilities plan integrating long-term asset investment strategies to address overall Agency priorities; prepared at the Headquarters level through a partnership with Centers in which Centers propose projects for construction, renewal, or consolidation. Includes 20-year and 5-year investment plans.

Capital Improvement Program Plan – The CIPP is a tabular listing of projects required to implement a Center Master Plan over a twenty year period. Investments are organized by date and by the nature of the investment (sustainment, renewal, or transition). The listing identifies projects by title, date, and proposed funds source, whether from NASA or other parties.

Center Master Plan – A statement of concept for the orderly management and future development of a Center's real property assets, including land, buildings, physical resources, and infrastructure. It is the overall plan for Center development. It provides a narrative, statistical, and graphic record of current capabilities and conditions (natural features, buildings, structures, utilities, transportation systems, and other improvements), as well as proposed capabilities necessary to support Agency mission success. The plan outlines the characteristics of the desired end-state of the Center, and identifies the changes necessary to reach that end-state.

Current Replacement Value (CRV) – An estimated value of facilities assets, calculated by escalating the investments to construct or improve assets to current year dollars. Useful for understanding the relative valuation of large sets of assets, CRV is unreliable at the individual asset level (the determination of which would involve a detailed engineering analysis).

Future Development Concept - A diagram illustrating key changes proposed for a Center over twenty or more years. Briefed to Agency leadership, and together with supporting documentation, it enables Agency concurrence with the direction the Center proposes for facilities development and redevelopment prior to the more rigorous and detailed full technical master plan documentation.

Master Planning – The process by which Center and Agency master planners work with stakeholders to establish the Center/Agency concept for the orderly management and future development of real property assets, ensuring that the future real property development of the Center effectively and efficiently supports the portions of NASA's missions assigned to the Center. The resultant plans act as a central communication tool for conveying the basic concepts to all stakeholders and coordinating implementation (guiding both the sequence and character of component projects). Master planning involves developing, documenting, and conveying the Center/Agency concept for the future development of real property assets.

Recapitalization – An internal categorization of NASA's capital investment funding dedicated to enabling renewal and consolidation.

Renewal – Investments intended primarily to remedy facilities degradation resulting from usage at or beyond reliable asset service life. Such renewal generally occurs through asset replacement, but in some cases through a substantial rehabilitation project.

Sustainment – Investments intended to keep a facilities asset in proper working order during its service life. Projects include maintenance, repairs, and normal component systems replacements to keep assets performing properly during their expected service life.

Transition – Investments intended primarily to respond to changes other than renewal or sustainment. Projects respond either to changes in program requirements or to natural disasters that interfere with reliable facilities performance.

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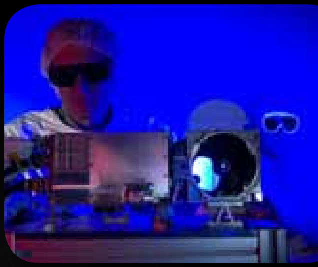

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