National Aeronautics and
Space Administration

Kennedy Space Center Master Plan

Executive Summary

2012 - 2032

Success: it's our history and our future.

Robert D. Cabana, Director
Kennedy Space Center

Photo: From left to right. The Saturn V rocket sits at Launch Pad 39-A; Space Shuttle Atlantis lifts off and an artist's concept of the Space Launch System with Orion Multi Purpose Crew Vehicle lifting off from Launch Pad 39-B. *Image Credit: NASA*

The Master Plan's central focus remains in support of NASA achieving its programmatic mission objectives but additionally it is also designed to maximize the provision of excess capabilities and assets in support of non-NASA access to space.

Preparing for the Future

The Kennedy Space Center (KSC) Master Plan describes a 20-year transformation from a single, government user launch complex to a multi-user spaceport. This multi-user spaceport will be developed in concert with NASA's programmatic missions and requirements to explore destinations outside of low Earth orbit.

The Master Plan's central focus remains in support of NASA achieving its programmatic mission objectives but additionally it is also designed to maximize the provision of excess capabilities and assets in support of non-NASA access to space. This transformation to a multi-user spaceport will allow NASA to subsidize costs of expensive infrastructure and facilities and still maintain the country's ability to push the boundaries of our understanding of the universe.

This Master Plan varies from a traditional facility-centric plan and is designed to be a plan that facilitates change. This neo-traditional approach combines the traditional plan attributes, including: land use, facility assets, transportation, and infrastructure but expands the scope to include analysis of space market opportunities and future non-NASA demand. This approach is designed to balance continued support for NASA programs with the ability to fully leverage KSC's land and facilities in support of future space market demand to maximize the unique resources, capabilities, and competencies that have made KSC successful for over 50 years.

Transitioning to a Multi-User Spaceport will require:

- Modifying policies and practices to support a multi-user spaceport on federal property.
- Divest without diminishing capability to serve government missions and programs while also encouraging commercial space growth.
- Analyze cost and revenue impacts to project financial needs/considerations to become economically sustainable.
- Capturing space market share.
- Integration of non-space related commercial opportunities.
- Attracting new business supported by efficient procedures.

NASA Programs and Projects at KSC

The KSC Master Plan's primary objective is to support the fulfillment of current and future NASA requirements and missions while making access to space less costly and more routine. Through the application of KSC's Core Competencies, the Master Plan supports NASA Program objectives while providing for the opportunity for non-NASA entities to utilize excess capabilities not required providing the opportunity for more diverse, less costly access to space. Building on 50 years of experience and success, the following NASA programs and projects are vital to the KSC's future as a hub for launch and exploration activities.

KSC Core Competencies

- Acquisition and management of Launch Services and Commercial Crew development
- Launch vehicle and spacecraft processing, launching, landing and recovery, operations, and sustainment
- Payload and flight science experiment processing, integration, and testing
- Designing, developing, operating, and sustaining flight and ground systems, and supporting infrastructure
- Development, testing, and demonstration of advanced flight systems and transformational technologies to advance exploration and space systems

Ground Systems Development and Operations Program (GSDO)

http://www.nasa.gov/exploration/systems/ground/

GSDO's primary mission is to process and launch the next-generation vehicles and spacecraft designed to achieve NASA's goals for space exploration. GSDO's program personnel are developing the necessary ground systems while also refurbishing and upgrading infrastructure and facilities to meet tomorrow's demands. A key aspect of the approach to long-term sustainability and affordability is making processing and launch infrastructure available to commercial and other government entities, thereby distributing the fixed cost burden among multiple users and reducing the cost of access to space for the United States. This modernization effort keeps flexibility in mind to accommodate a multitude of government, commercial, and other customers.

NASA's Next-Generation Crew Vehicle and Launch System

Orion Multi-Purpose Crew Vehicle (MPCV)

http://www.nasa.gov/orion

Orion MPCV will utilize the Space Launch System (SLS) and will serve as both the crew and service vehicle for long duration, deep space missions beyond low Earth orbit (LEO). Orion MPCV also has the capability to be a backup system for International Space Station cargo and crew delivery.

Space Launch System (SLS)

http://www.nasa.gov/sls

SLS is an advanced, heavy-lift launch vehicle designed to carry the Orion MPCV, as well as cargo, equipment and science experiments to deep space. SLS will be the most powerful rocket in history and will expand our reach in the solar system by bringing astronauts to near-Earth asteroids, Lagrange points, the moon, and ultimately Mars.

Photo: An Atlas V carrying the Mars Science Laboratory (MSL) launches from Cape Canaveral on November 26, 2011 on a mission to Mars. MSL's components include a car-sized rover, Curiosity, which has 10 science instruments designed to search for signs of life on the Red Planet. NASA's Launch Services Program selected the Atlas V-541 vehicle for the MSL mission because it had the right liftoff capability to successfully deliver heavyweight payload to the surface of Mars. *Image Credit: NASA/Scott Andrews*

Commercial Crew Program (CCP)

http://www.nasa.gov/exploration/commercial/crew/

CCP is an innovative partnership to help the aerospace industry in the United States develop space transportation systems that can safely launch astronauts to the International Space Station (ISS) and other low-Earth orbit destinations. Using a non-traditional approach featuring public partnerships, NASA is facilitating the development of several designs of spacecraft, which enables NASA to choose which ones it wants to use to send astronauts into space. The end result could be multiple systems providing safe, reliable and affordable access to space.

Launch Services Program (LSP)

http://www.nasa.gov/centers/kennedy/launchingrockets/

LSP's responsibility is to act as a broker, matching spacecraft with launch vehicles. Spacecraft destination requirements, coupled with the mass and volume of the spacecraft, determine the launch vehicle required. Once the right vehicle is selected, LSP buys that spacecraft a ride to space and works diligently to ensure mission success. LSP provides technical guidance from pre-mission planning to the post-launch phase of their spacecraft. If not for LSP, customers would be required to provide their own commercial launch license, vehicle provider, research and development, payload processing facility, as well as airspace coordination and monitoring capability.

ISS Ground Processing and Research Project Office

http://abram.ksc.nasa.gov/

The ISS mission is to fully utilize a permanent human outpost in space. The mission of the ISS Ground Processing and Research Project Office (ISSGP&R) is to manage all ISS KSC ground processing requirements and to promote full utilization of the ISS through fundamental biological research capabilities. The ISSGP&R manages the ISS Program and Research activities for KSC. These activities include experiment and orbital replacement unit ground processing in addition to enabling ISS research and National Lab requirements.

Planning Strategy

The KSC Master Plan describes how the Center will transform to an economically sustainable multi-user spaceport. The planning strategy incorporates anticipated development in support of continuing NASA Programs, future NASA missions, and emerging non-NASA opportunities. To sustain this transformation, the Plan's strategy integrates NASA programming with these emerging non-NASA opportunities and outlines development factors, future land use, and a right-sizing asset strategy to enable the core strategies of the Future Development Concept (http://fdc.ksc.nasa.gov/).

Development Factors

Factors affecting development were analyzed to determine the highest and best use of land resources incorporating environmental sensitivity, operational requirements, and safety regulations. This approach identified land areas which would provide for the anticipated NASA and non-NASA development in a way that best preserves KSC's environmentally-sensitive areas.

Future Land Use

The Center's development factors are complemented by a future land use plan that promotes the clustering of compatible uses and the separation of hazardous and non-hazardous operations. Such a clustering will encourage synergy between users, efficiency in operations, safety for the multi-user workforce, infill development, and preservation of the critical habitats that contributes to the appeal of KSC as a location for more than spaceflight.

Asset Strategy

Facility initiatives achieve a sustainable end state for the Center that supports continuing NASA programs, projected future missions, and identified commercial needs, including out-grants and divestitures. A key element of the Asset Strategy is the right-sizing of real property inventory. The transition to a multi-user spaceport will require a reduction of aging NASA-funded facilities and infrastructure and a reduced NASA operational footprint that is appropriately sized to accomplish NASA program objectives while supporting the proliferation and relative independence of non-NASA operations.

Transformation

The Master Plan includes a description of the necessary stages identified to facilitate the transition to a multi-user spaceport. These operational stages are guided by tactics and operational considerations that will enable the success of NASA objectives and create an environment where non-NASA objectives can be equally successful.

The KSC Master Plan supports the core strategies from the Future Development Concept, including:

- **Evolution To A Multi-User Spaceport:** Moving from a monolithic NASA program field installation to a multi-user spaceport on federal property. The evolution to a multi-user spaceport is not necessarily time-line dependent, but rather based on increased users and operators in line with space market demand.
- **Leaner And Greener:** Operational, fiscal and environmental sustainability.
- **Divest Without Diminishing:** Divesting of assets without eliminating capability to serve both critical government missions and programs while encouraging the growth of commercial space transportation market needs.

Photo: Inside the Operations and Checkout Facility high bay at KSC, a technician prepares the Orion MPCV for Exploration Flight Test 1, or EFT-1. EFT-1 will be Orion's first unpiloted test flight and is scheduled to launch in 2014. *Image Credit: NASA/Charisse Nahser*

Emerging Opportunities

The emerging commercial space flight market offers an opportunity for KSC to take advantage of its established history and demonstrated capabilities to capture this market as it develops. To position KSC at the forefront of space commerce, the following key concepts should be considered to take advantage of emerging opportunities in the overall global space market:

Market Position

KSC should promote itself as a multi-user spaceport with unmatchable advantages. Implementing a strategy as a low cost, differentiated service provider will position KSC well in the space flight market. NASA programs operating alongside non-NASA space transportation and technologies, satellite systems and payloads, ground and operations support systems, adventure tourism, and next-generation renewable energy projects, will provide a solid base of economic activities for KSC.

Design Reference Market Focus

The Design Reference Mission should become the Design Reference Market for the emerging space flight industry. Markets and customer relationships must be sustained as KSC provides technological and launch service expertise to customers to promote and support ongoing, evolving relationships as the dynamic market develops.

Space Achievement Leader

The space flight industry is at an important crossroads and market participants are waiting for significant market movements to indicate a change in the economic environment. Until a dramatic technology breakthrough, an operationally-focused price change, or unforeseen demand occurs, the market will grow cautiously. KSC must develop needed technological improvements and foster customer-focused pricing to push this market forward toward its potential.

Market Strategies

Based on identified movements, forecasts, and benchmark data, the following key market strategies will promote KSC's success in the commercial space flight market:

- Leverage human capital; people are the critical path
- Support commoditized launches
- Transition culture to a Design Reference Market from a Design Reference Mission
- Refine space flight market manufacturing data
- Create an assembly of Ground Support Operations
- Partner with Economic Development Organizations

Space Market Summary

- The commercial space flight market is emerging, complex in its nature, and waiting for technological and demand unknowns.
- The KSC competitive position is based on market research, KSC strengths, risks, other market participants, and customers.
- KSC's competitive position at the beginning of the commercialization process must be refined as planning efforts progress and the market continues to evolve.
- KSC has the potential to be a leading market participant and a catalyst moving the space flight market forward.

Development Factors

The unique relationship between space flight and protection of natural resources is carefully orchestrated to ensure that both objectives are achieved with minimal conflict. KSC has designated undeveloped portions of its land to be managed for wildlife habitat conservation, and, as a conditional and non-interfering use, public access for recreation to pristine coastal beaches, inland waterways, and nature trails.

In addition to development constraints associated with sensitivity to KSC's natural environment, the built environment has key characteristics unique to a spaceport that influence development suitability and development capacity. These considerations include Quantity Distance (QD) arcs, lines of site and vehicle impact limit lines. Principles that have historically guided land use planning at KSC include risk avoidance for the general public and risk management for KSC personnel. This includes separating the general public from launch hazards by establishing significant safety buffers, and limiting access to hazardous areas by KSC personnel except as appropriate.

Open water constitutes 56,385 acres of area unsuitable for development, including the Mosquito Lagoon, portions of the Indian and Banana Rivers and associated waterways.

KSC encompasses 41,425 acres of wetlands. Destruction or effects to wetland areas or upland scrub critical to species preservation may require significant mitigation and associated development costs.

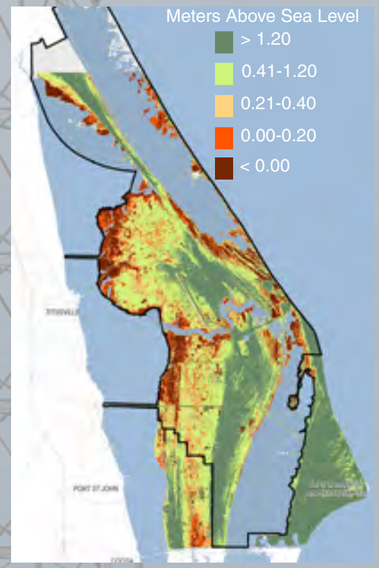
25,000 acres of KSC land should be preserved for potential Florida Scrub Jay habitat in order to meet federally mandated goals and objectives.

Quantity Distance (QD) arcs encompass 1,842 acres and are concentrated in the vertical and horizontal launch, assembly integration and testing, and space systems test and processing areas.

There are 477 acres of paved and unpaved existing road network infrastructure connecting the mainland and quinti-modal network, and provides access to expanded development.

Climate Change

Much of KSC land areas are low-lying, poorly drained, and vulnerable to inundation by periodic storm events. These low-lying areas are also most at risk to be affected by global climate change in future decades. Areas of existing facilities or structures that are in 0-1.20 meters NAVD (North American Vertical Datum) should be assessed relative to anticipated future climate and weather conditions. Where practical, the function within existing facilities should be relocated to ground 1.82 meters (approximately 6 feet) or above where required. Future critical facilities shall be constructed outside the 500-year flood plain. Where practical, existing critical facilities should be hardened to withstand a 500 year flood event, or their functions moved to an area outside the 500-year flood plain.



Sea Level Risks to KSC Property

Photo: A SpaceX Falcon 9 rocket carrying a Dragon spacecraft lifts off from Space Launch Complex 40 on March 1, 2013. The SpaceX Dragon capsule is being utilized to resupply the International Space Station through a partnership between NASA and SpaceX. The landmark public-private partnership will result in at least 12 flights of the Dragon spacecraft to bring supplies and experiments to the astronauts on board the orbiting laboratory. *Image Credit: NASA/Tony Gray and Robert Murray*

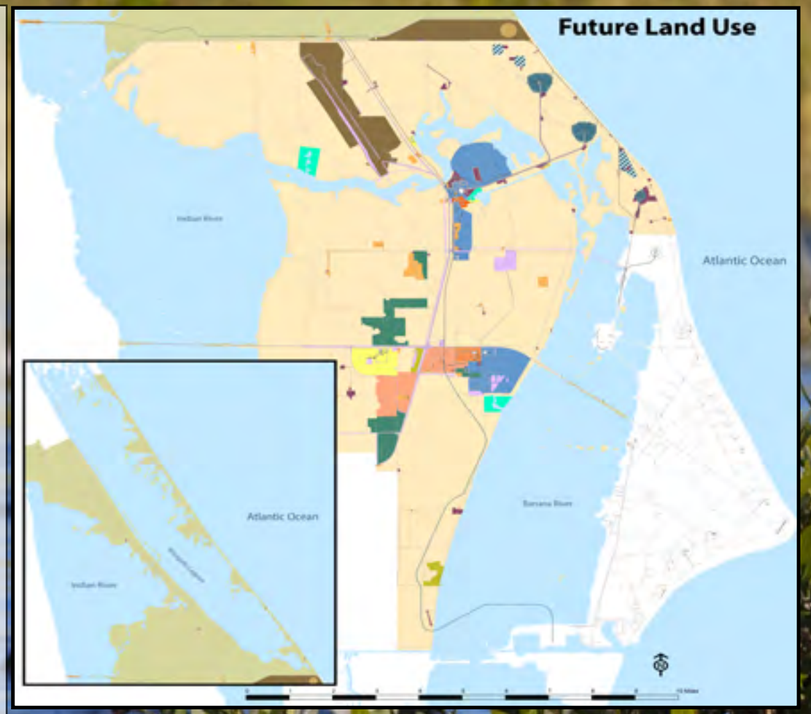
Future Land Use

The Future Land Use Plan is the basis of the planning framework supporting continuing NASA Programs and future non-NASA opportunities. It promotes compatible relationships between adjacent land uses, encouraging infill development, consolidation of NASA operations, and preserving environmentally-sensitive areas.

The Future Land Use Plan outlines where development can occur, how land can be used, and how strategic capabilities can be expanded to support KSC's evolution to a multi-user spaceport. Right-sizing NASA operations and the attraction of non-NASA investment is enabled by the expanded operational autonomy resulting from the Master Plan. Consolidation of NASA operations into a smaller, more-efficient, geographic footprint is a major component of the Master Plan.

The Central Campus concept supports efforts to slowly, but strategically, recapitalize dispersed non-hazardous functions and capabilities into more efficient facilities with a smaller operational footprint. Likewise, directing future NASA and non-NASA operations into functional areas with well-defined activities will streamline safety and security considerations while promoting the maximum use of KSC's horizontal infrastructure.

The Master Plan also supports the expansion of the Center's quinti-modal capabilities to provide increased support for all users of the multi-user spaceport, including expanded rail network connectivity.



- Planned Vertical Launch
- Existing Vertical Launch
- Vertical Landing
- Horizontal Launch and Landing
- Launch Operations and Support
- Assembly, Testing and Processing
- Central Campus
- Administration
- Support Services
- Operational Buffer/Conservation
- Operational Buffer/Public Use
- Utility Systems
- Public Outreach
- Research and Development
- Seaport
- Renewable Energy
- Recreation

Photo: A great blue heron sits over an assortment of birds in the surrounding waters at Kennedy Space Center. KSC is home to the Merritt Island National Wildlife Refuge which contains a wide variety of habitats, including: coastal dunes, saltwater estuaries and marshes, freshwater impoundments, scrub, pine flat-woods, and hardwood hammocks. These habitats provide sanctuary for more than 1,500 species of plants and animals, including about 331 species of birds.
Image Credit: NASA/Jim Grossman

Expanded Launch Capabilities

Three areas have been identified that would be ideal for the locations of new vertical launch pads intended for launch of smaller vehicles. Two new vertical launch pads, 39C and 39D, could be sited to the north of the existing pad 39B. One additional launch pad is sited to the south of 39A and to the north of pad 41 consistent with a 2007 KSC Vertical Launch Site Evaluation Study.

To enable the expansion of developing technologies and facilities that support horizontal launch and landing and vertical landing capabilities, an east-west corridor just south of Beach Road has been identified.

Shuttle Landing Facility (SLF)

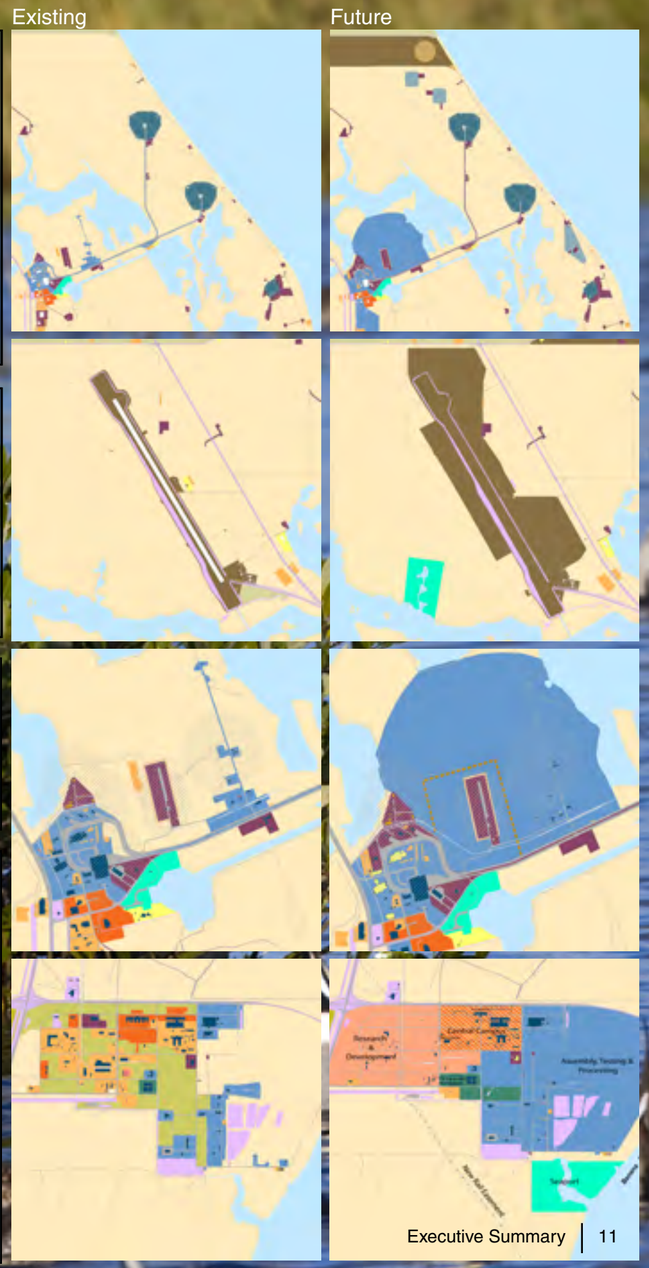
Apron areas and associated support facilities supporting the SLF can be expanded to accommodate future horizontal launch and landing activities and customers. Initial development will be focused on the east side of the runway and future development, if required, will be accommodated to the west side. An ideal location for a seaport facility has been identified which would leverage quinti-modal connectivity.

VAB Area

Additional land area is designated as Assembly, Testing and Processing areas to provide support for anticipated increased future launch activity. Construction of sea walls will mitigate a potential rise in sea level.

Central Campus and Industrial Area

Central Campus will include new non-hazardous NASA development in support of NASA programs and/or as part of the recapitalization process. Facilities to be relocated to Central Campus through recapitalization efforts can include Administration, Research and Development, and non-hazardous Support Services functions. Criteria for these relocations will include age-related operational inefficiencies, consolidation of redundant/duplicative operations, excessive maintenance requirements, and decreased Current Replacement Value (CRV) and Operations & Maintenance (O&M) costs. Additional land is provided for expanded research and development and assembly, testing and processing needs. Expanded areas for alternative energy production are provided along with an additional seaport for water borne transportation connectivity.



Asset Strategy

A primary objective of the Asset Strategy is to reduce facility inventory to an economically sustainable state. Historically, the metric used to gauge economic sustainability within the Agency is the aggregate Current Replacement Value (CRV). CRV is indicative of the extent of real estate holdings and the corresponding costs to operate and maintain these facilities.

Though CRV reductions have been an influential data point in determining the fiscal health of the Agency and Center, KSC believes that the CRV methodology and subsequent goals only tell a partial story in the work that KSC is doing to evolve to a multi-user spaceport. Traditionally, the only way to reduce CRV is through demolition. While KSC recognizes that there are many facilities that need to be shed, many of the assets are one of a kind, and demolition is not the only solution to right-size KSC's asset base. KSC will pursue transformation through the consolidation of NASA operations, asset partnering, and agreements development in order to preserve the Center's and nation's crucial launch infrastructure.

The KSC multi-user spaceport will be composed of NASA, State, and commercially owned and operated facilities. Facilities and infrastructure will be funded through a mix of federal, state, and commercial dollars. Federal, state, and private investments will all be used in concert with one another for the benefit of the spaceport.

NASA Dedicated Assets

Operations and Checkout Facility

Launch Abort System Facility

Non-NASA Dedicated Assets

Commercial Crew Cargo Processing Facility

Hangar N

Multi-Use Assets

Shuttle Landing Facility

Hangar AF

State Assets

Space Life Sciences Laboratory

RLV Hangar

Photo: The Vehicle Assembly Building and other facilities in the VAB Area. In front of the VAB is the Launch Control Center and in the foreground is the Turn Basin which provides sea access to the VAB Area. These facilities are integral to KSC's transformation from a historically government-only launch complex to a spaceport that can safely handle a variety of rockets and spacecraft. *Image Credit: NASA/Kim Shiflett*

KSC will pursue transformation through consolidation of NASA operations, asset partnering, and agreements development in order to preserve the Center's and nation's crucial launch infrastructure.

Photo: Backdropped by the blackness of space and the thin line of Earth's atmosphere, the International Space Station is seen from Space Shuttle Discovery as the two spacecraft begin their relative separation on March 25, 2009. *Image Credit: NASA*

The transition from one stage to the next is not time-specific, but is largely dependent on federal funding, economic influences, and financial commitment from non-NASA entities.

Transformation

Pre-2012	Near Term	Medium	Term	Long Term	Future: Beyond 2032

Dedicated NASA Programs

Theme: Focused support for NASA Programs

KSC is sustaining continuing NASA Programs with diminished federal funding while planning for a future that includes commercial partnerships with non-NASA organizations. KSC has begun this process by either out-granting or divesting real property not needed to support NASA Programs to commercial entities and by planning for increased commercial activities in the future. The asset strategy also includes preserving capability that may be needed in the future by temporarily maintaining facilities in a mothball status and demolishing obsolete facilities.

NASA Programs with Increasing Commercial Users

Theme: Focused Support for Continuing NASA Programs with Emerging Commercial Integration; Economic Sustainability

KSC will continue to support NASA Programs while capitalizing on the emerging space market with: expanded launch and landing capabilities; expanded assembly testing and processing areas; upgraded roadway and utilities infrastructure; continued leveraging of assets to accommodate commercial integration, expanded research and development; leveraging of KSC's unique quinti-modal transportation network, and a more business friendly environment supported by dedicated commercial zones, a streamlined contracting process, and market-based pricing.

NASA Programs with Emerging Multi-User Spaceport

Theme: Continuing Support for NASA Programs with Balanced Commercial Integration

In the long term, KSC will augment the support of NASA Programs with revenue from growing commercial integration. Launch and landing, assembly, testing and processing, and research and development areas will continue to be expanded in the context of KSC's quinti-modal transportation network proportional to market demand. Economic sustainability will be achieved via continued out granting and divestiture of assets, with commercial zones being self-supporting. KSC will fund and operate program-specific facilities.

Multi-User Spaceport/NASA Programs Integrated

Theme: Continued Support for NASA Programs; Fully Leverage All Assets and Land Area Resources; Optimized Diversified Commercial Integration

Beyond the KSC Master Planning horizon of 2032, KSC will be a fully-operational, self-sustaining multi-user spaceport with a balance of federally funded NASA Programs and diversified commercial activities. Similar to other transportation hubs, such as airports and harbors that are operated by a third-party entity, the KSC spaceport could be operated by a Spaceport Authority. The Spaceport Authority will have the ability to execute contracts and raise capital to benefit the spaceport. The highest and best use of all assets and land resources will be achieved by fully leveraging all available facilities and developable land to promote diversified development opportunities.

For time and the world do not stand still. Change is the law of life. And those who look only to the past, or the present, are certain to miss the future.

John F. Kennedy

Planning Background

- Vision + Mission
- Purpose + Need
- Planning Process
- Planning Horizon
- Goals and Objectives
- Emerging Opportunities
- Core Competencies
- Strategic Partnerships

Planning Conditions

- Existing Built Environment
- Existing Natural Environment
- Environmental Sensitivity
- Developable Areas
- Existing Land Use
- Existing Transportation Network
- Existing Utility Systems

Future Development Plan

- Planning Strategy
- Development Program
- Future Land Use Plan
- Asset Plan
- Transportation Plan
- Utilities System Plan
- Implementation

For more information, please visit our website at:

http://masterplan.ksc.nasa.gov

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