



U.S. Geological Survey
National Land Imaging Program
Strategic Plan
2016 to 2021

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1. Introduction

The U.S. Geological Survey's (USGS) National Land Imaging (NLI) Program is responsible for ensuring the continuous availability of moderate resolution and other remotely sensed imagery for the Nation. Additionally, the program supports worldwide access to Landsat satellite systems by deploying ground stations and processing centers to enhance the international acquisition and distribution of Landsat data and derived products.

The NLI Program also pursues remote sensing applications and technology priorities that include innovative uses of remote sensing technology, development of fundamental science data products, specific science applications, and application of remote sensing systems to support resource management and scientific assessments of land surface change. NLI also conducts analyses of land imaging requirements and capabilities to ensure the program delivers the types of data, information products, and services necessary to meet the evolving needs of the NLI user community. To do this effectively, the program maintains an understanding of the science questions and land management problems that are of significance to USGS programs, bureaus within the Department of the Interior, and other Federal agencies.

The Nation's economic security and environmental vitality rely on continual observations of the Earth's land surface to understand changes on the landscape at local, regional and global scales. Improving the ability to monitor change, analyze, and permanently record these changes promotes continued informed economic expansion, well-managed natural resources, environmental awareness, national security, and the advancement of scientific knowledge. This information is vital to the formulation of effective public policy and is used by officials and decision-makers in fulfilling their public-service responsibilities.

2. Business Drivers

The Congress passed the Land Remote Sensing Policy Act of 1992 (P.L. 102-555) to endorse the need for continuous monitoring of the Earth and maintain a readily available record of information displaying the status of the Nation's resources and environment. The Act requires the Department of the Interior (DOI) to establish a permanent Government archive, the National Satellite Land Remote Sensing Data Archive (NSLRSDA), containing satellite remote sensing data of the Earth's land surface—and to make these data easily accessible and readily available for use in a broad array of research and operational applications.

In October 2000, President Clinton directed the National Aeronautics and Space Administration (NASA) and DOI/USGS to partner in Landsat Program Management under a revision of Presidential Decision Directive National Science and Technology Council (NSTC)-3. This directive assigned DOI/USGS the responsibility to:

- Operate the Landsat flight and ground systems
- Maintain the national archive,

- Coordinate future Federal-agency requirements for civil operational National Land Imaging data,
- Work with NASA and other agencies to develop a strategy for maintaining continuity of Landsat-type data in a manner consistent with each agency's expertise and mission

U.S. National Space Policy (NSPD) 49, dated August 31, 2006, provides further guidance:

"The Secretary of the Interior, through the Director of the U.S. Geological Survey, shall collect, archive, process, and distribute land surface data to the United States Government and other users and determine operational requirements for land surface data."

This role was reconfirmed in the subsequent National Space Policy, released on June 28, 2010, stating:

"The Secretary of the Interior, through the Director of the United States Geological Survey (USGS), shall:

- *Conduct research on natural and human-induced changes to Earth's land, land cover, and inland surface waters, and manage a global land surface data national archive and its distribution;*
- *Determine the operational requirements for collection, processing, archiving, and distribution of land surface data to the United States Government and other users; and*
- *Be responsible, in coordination with the Secretary of Defense, the Secretary of Homeland Security, and the Director of National Intelligence, for providing remote sensing information related to the environment and disasters that is acquired from national security space systems to other civil government agencies.*

In support of these critical needs, the Secretary of the Interior, through the Director of the USGS, and the NASA Administrator shall work together in maintaining a program for operational National Land Imaging observations."

Further guidance to USGS and NASA was provided by OSTP in the July 18, 2014 National Plan for Civil Earth Observations, which stated:

"The NASA Administrator, together with the Secretary of the Interior through the Director of USGS, will implement a 25-year program of sustained land-imaging for routine monitoring of land-cover characteristics, naturally occurring and human-induced land-cover change, and water resources, among other uses."

3. Approach to Strategy

This section describes the program's vision, mission, and performance measures for the next five years. The NLI Program, using the plan as guidance, will provide essential NLI data, information products, and services in support of DOI and USGS science and management efforts at the national and regional levels while continuing to support and promote the widespread use of its Earth observation (EO) portfolio through its partners around the globe.

The NLI Program provides continuity for the persistent population and preservation of the bureau's scientifically priceless data archives and develops high-value remotely sensed data products contributing to current and future science programs, investigations, and evaluations, delivering knowledge-based information to inform issues of national and global importance for the USGS, its cooperators, customers, and constituents.

The NLI Program will position its services to be an effective contributor to enhancing Earth observation practices and contribute to the solution of significant natural resource, environmental, and other scientific challenges. To achieve these objectives, the strategy is based on the following organizing principles:

- *Lifecycle Management* for customer requirements, products and services, and technologies.
- *Service Management* to ensure high-value service to customers, including product and delivery readiness and availability.
- *Service Quality* to ensure high-quality services to retain and grow NLI product use and increase its customer base.
- *Customer-Driven Requirements* to ensure that the NLI Program improves outcomes for its customers.
- *Customer Outreach* to increase the return on the capital investment in Landsat systems, the archive, partner agreements, and new remote sensing technologies.
- *Product and Portfolio Management* to evaluate the quality and value of NLI products and science activities so that the resources of the NLI Program are invested in the best possible manner, consistent with customer needs.

3.1 Vision

The NLI Program delivers a national and international capability to effectively record, preserve, evaluate, and disseminate observations of the Earth's land surface to:

- Improve the Nation's ability to monitor, analyze, and understand dynamic Earth systems pursuant to the protection of America's treasured landscapes and the advancement of scientific knowledge.
- Help protect lives and property.
- Preserve and support the Nation's economic resources, security, and environmental vitality.
- Create, preserve, and ensure access to a long-term record of the Earth's landscape at local, regional, and global scales.

- Support scientists, decision makers, and policy officials in fulfilling their public-service responsibilities through sustained access to, and application of, a long-term remote sensing record at local, regional, and global scales.
- Support the USGS EarthMAP vision in the development of a data architecture capable of facilitating Earth observation data interoperability towards an operational data science strategy.

3.2 Mission

The NLI Program:

- Ensures the continuous availability of moderate-resolution imagery and other remotely sensed data for the Nation through maintenance and continued population of the NSLRSDA, as directed under the Land Remote Sensing Policy Act of 1992 (P.L. 102-555) and National Space Policy.
- Maintains operational capability of Landsat flight and ground systems to continue to collect, preserve, and ensure access to an uninterrupted, long-term, global, calibrated moderate-resolution record of Earth observations.
- Coordinates current and future Federal user needs for civil operational moderate-resolution NLI data and systems.
- Shares responsibility with NASA and other relevant entities to develop and execute a 25-year strategy for maintaining continuity of Federal civil land imaging capabilities beyond the currently deployed Landsat systems. Utilizes the 2017 Decadal Survey, "Thriving on Our Changing Planet: A Decadal Strategy for Earth Observations from Space" (2017 ESAS) as a guide to addressing critical science questions with the development of future remote sensing capabilities.
- Provides critical support for evaluating climate variability and land use-change science by maintaining and perpetuating a long-term record of observations and enhancing the understanding of the applied value of remote sensing data with respect to scientific evaluations. NLI plays a vital role in supporting and developing interdisciplinary knowledge of patterns, processes and consequences of changes in ecosystems, climate, land use, natural resources, and environmental health, thus enhancing the understanding of natural systems and their interaction with human activities.
- Provides access to, and fosters the use of historical, current, and future remotely sensed data and derived scientific information to facilitate monitoring, scientific assessment, and understanding of natural hazards and their effects on natural systems, property, and people.

- Investigates and exploits Unmanned Aircraft Systems (UAS) technology to support the research and operational missions of the USGS and DOI bureaus. These activities include leading the research and integration investigations to make the UAS platforms and sensors as efficient, safe and cost-effective as possible; performing proof-of-concept missions to support the development of operational procedures, evaluation of new technology, and the establishment of the operational benefits that include increased safety, reduced cost, and improved data quality.

3.3. Performance Measures to Inform Investment Strategy

The NLI program has developed a user needs-based analytical approach for informing its science and technology investment decisions. NLI is actively collecting and increasingly relying upon its requirements, capabilities and analysis (RCA) process to inform investments and prioritize mission engagement and approaches. The RCA process is being used to inform future Landsat capabilities under the NASA/USGS SLI program. An expanded set of system-agnostic user needs, system capabilities database, and analysis tool suite will be used to model/measure the performance of a set of land imaging architecture capabilities (or products) against requirements to prioritize mission engagement across the US, international, and commercial land imaging sectors. The goal is to most effectively leverage the diversity of spectral, spatial and temporal characteristics of the entire enterprise to meet the diverse data needs of the science and application communities. The process also identifies the connections between the users and uses of land imaging and can quantify the impacts of new products and data sources within the USGS, DOI and other civil agencies. This information also informs outreach, product evolution, and science support.

The NLI Program provides a wide variety of customers with valuable data and information products and services from its flagship system, the NSLRSDA, and other geospatial data sets including high-resolution aerial photos. Landsat products and other valuable Earth observation datasets managed in the archive provide one of the richest records characterizing the Earth's land surface. The NLI Program will continue collaborative and investigative work with its global cooperators, distributors, and customers. Additionally, the NLI Program will focus on increasing the Government's use of its products and creating higher order value-added products that provide greater benefits to its key customers (Table 1).

The NLI Program will also focus on key organizations that are involved in advancing science-based land and resource management solutions that, now or in the future, rely on NLI Earth observation products and services. With targeted customer understanding and outreach, the NLI Program will be able to collaborate and create higher value solutions while continuing to promote its traditional suite of products and services. The program will increase the number of organizations that it engages through its requirements collection process, and other methods, to broaden the reach and impact of its products or to add operational capabilities.

Table 1 – Key Customers

Customer Category	Organizational Name	Organization's Roles	Engagement Strategy	Scope
<i>Landsat Partners</i>	<i>Ground Station Affiliates, International Cooperators</i>	<i>Flight and Ground Operations (Australia) Data Acquisition and Distribution</i>	<i>Partnerships and Cooperative Agreements.</i>	<i>Global</i>
Federal	<i>DOI: United States Geological Survey</i>	<i>Scientific Research for Climate, Geology, Water, Geography, etc....</i>	<i>Requirements Elicitation</i>	<i>National/ Global</i>
Federal	<i>DOI: Bureau of Land Management</i>	<i>Land and Resource Management, Ecosystems</i>	<i>Requirements Elicitation</i>	<i>National</i>
Federal	<i>DOI US Fish and Wildlife Service</i>	<i>Land and Resource Management, Ecosystems</i>	<i>Requirements Elicitation</i>	<i>National</i>
Federal	<i>DOI Office of Surface Mining</i>	<i>Land and Resource Management, Ecosystems</i>	<i>Requirements Elicitation</i>	<i>National</i>
Federal	<i>DOI: National Park Service</i>	<i>Land and Resource Management, Ecosystems</i>	<i>Requirements Elicitation</i>	<i>National</i>
Federal	<i>DOI: Bureau of Reclamation</i>	<i>Land and Resource Management, Ecosystems</i>	<i>Requirements Elicitation</i>	<i>National</i>
Federal	<i>USDA: United States Forest Service</i>	<i>Land and Resource Management, Ecosystems</i>	<i>Requirements Elicitation</i>	<i>National</i>
Federal	<i>USDA: National Resource Conservation Service</i>	<i>Land and Resource Management</i>	<i>Requirements Elicitation</i>	<i>National</i>
Federal	<i>Department of State</i>	<i>International Activities</i>	<i>Foreign Agreements</i>	<i>Global</i>
Federal	<i>Commerce: National Oceanic and Atmospheric Administration</i>	<i>Atmosphere and Oceans and Operational Weather Satellites</i>	<i>Jointly developing requirements data and analysis infrastructure</i>	<i>Global</i>
Federal	<i>National Aeronautics and Space Administration</i>	<i>Lead Civil Space Agency and Earth Systems Science Research</i>	<i>Partner in the Landsat Satellite Series</i>	<i>Global</i>
Federal	<i>Environmental Protection Agency</i>	<i>Environmental Regulatory</i>	<i>Requirements Elicitation</i>	<i>National</i>
Advisory	<i>National Geospatial Advisory Committee</i>	<i>Advice and Recommendations Related to Management of Federal and National Geospatial Programs</i>	<i>Department of the Interior Federal Advisory Committee Act (FACA)</i>	<i>Global</i>

<i>Civil Governments</i>	<i>State, Local, Tribal, Regional</i>	<i>Land Use Land Cover, Vegetation mapping, forestry etc....</i>	<i>Customer Survey</i>	<i>State, Local, Tribal, Regional</i>
<i>International</i>	<i>European Space Agency</i>	<i>Sentinel Mission coordination and other partnerships</i>	<i>Government to Government</i>	<i>Global</i>
<i>States</i>	<i>AmericaView</i>	<i>Academic Consortium: Remote sensing research and education, applications development, and resource monitoring</i>	<i>Competitive Grant</i>	<i>National</i>
<i>Universities</i>	<i>Numerous</i>	<i>Research and grants</i>	<i>Surveys and science collaboration</i>	<i>Global</i>
<i>Regional Organization</i>	<i>Western States Water Council (Governors of 18 States)</i>	<i>Cooperation among Western States in the Conservation, Development and Management of Water Resources</i>	<i>Collaboration</i>	<i>Western U.S.</i>
<i>non-governmental organization (NGO)</i>	<i>Numerous Entities</i>	<i>Land Use Land Cover, Vegetation mapping, forestry etc....</i>	<i>May include: customer Surveys, grants, limited data purchases</i>	<i>Global</i>
<i>Commercial</i>	<i>Commercial Remote Sensing Space Providers</i>	<i>Commercial data and services</i>	<i>Forums and Surveys through FACA</i>	<i>Global</i>
<i>Commercial*</i>	<i>Google Earth Engine, ESRI, and Amazon Web Services</i>	<i>Geospatial data, Services, and Information Providers</i>	<i>Forums and Surveys through FACA</i>	<i>Global</i>

(*) Specific company names are for example only and do not represent endorsement by the Government

4. Program Goals and Objectives

The NLI Program goals and objectives are presented within the overall context of the DOI Strategy and USGS Science Strategy addressing NLI support for assessment of ecosystems, Land Resources change, natural resource assessment, and natural hazards monitoring and assessment. The NLI goals and objectives support the science goals of the USGS Land Resources Mission Area, including the understanding of land use and land cover change rates, causes and consequences.

The NLI Program has four comprehensive goals, each having a set of objectives covering the landscape of the program. Although the goals are functionally oriented to facilitate implementation, they are intended to support the larger science and management objectives of DOI, USGS and the Land Resources Mission Area. They are intended to enable NLI remote sensing applications and technology priorities, fundamental science data products, and assessments of land surface change based on documented needs of the user community.

These goals and objectives, in combination, define the strategic path to the future and the means to measure its progress. The four goals include:

1. Operational Capabilities
2. Research, Development and Innovation
3. Product and Service Management and Innovation
4. Customer Engagement and Communication

This section describes NLI goals and objectives in the context of organizational responsibilities, timing, performance measures, and managed improvements. Through these management metrics, NLI will provide essential NLI data, information, and knowledge in support of USGS and DOI science directions and contribute toward the resolution of national and global issues. This strategy substantiates the USGS's position as a national and world leader in the acquisition, archiving, products and standards innovation, and application of remotely sensed data and technology.

In conjunction with the NLI Program, the Earth Resources Observation and Science (EROS) Center, located in Sioux Falls, South Dakota, represents a national asset regarding its stewardship of the largest collection of civil remote sensing data in the world, as a leader in scientific and technical applications of remote sensing data and technology, and as a multi-mission satellite operations and data management entity.

In addition to EROS, the NLI Program utilizes the scientific capabilities of four nationally distributed Science Centers: The Alaska Science Center in Anchorage, AK; the Western Geographic Science Center in Menlo Park, CA; the Geosciences and Environmental Science Center in Lakewood, CO; and the Fort Collins Science Center in Fort Collins, CO.

The following section describes the goals and associated objectives for the NLI Program.

Goal 1 - Operational Capabilities

Implement, maintain and optimize operational capabilities to acquire, preserve, produce, and deliver National Land Imaging data products and services to address Earth observation requirements.

This goal focuses on improving the overall performance (cost, efficiency, quality etc.) of the systems that collect, store and produce the products and services to meet end user requirements.

Operational Capabilities Objectives:

The objectives associated with the Operational Capabilities goal are to effectively provide the following:

- Data Acquisition – the processes and methods for collecting data sets from multiple current and future remote sensing sources.
- Archive – the systems for preservation of Earth observation data sets.
- Production – the data-production systems to meet user needs for products and services.
- Delivery – the data access and dissemination systems that provide products and information to Earth observation users.

Goal 2 - Research, Development and Innovation

Sponsor science research and investigations, and apply technological innovations, to improve and develop NLI products and services, to meet user needs and enable scientific research and application development.

This goal involves the development of the best possible remote sensing capabilities to enhance the NLI Program's product and service portfolio and advance scientific research and applications development. NLI products and services, satellite and aerial flight and ground systems, data processing, and information exploitation and service delivery all depend on effective product and technology lifecycle management using new and evolving technologies. The NLI Program is committed to maintaining an orderly process to manage these lifecycles, to maintain efficiency, to enable and perform scientific research, and to maximize service to the user community. This commitment includes the intention to demonstrate innovative remote sensing system concepts, such as new technology and data integration, cloud-based computing, exploitation of AI/ML technology, and algorithm development, resulting in new capabilities that enhance scientific research and applications results.

Research, Development and Innovation Objectives:

The objectives associated with the Research, Development and Innovation goal are driven by the need to continuously research and identify or establish new data sources and products, Earth observation technologies, and platforms to address high-value end user requirements or establish substitute solutions to improve costs of operations:

- Technology – Identify or establish new Earth observation technologies and datasets to meet user needs and enable scientific research and operational applications.

- Products and Services – Investigate the feasibility of and prototype new or enhanced remote sensing products or services and estimate how such improvement will advance scientific research and operational applications that are otherwise unavailable to meet user needs.
- Scientific Research – Sponsor research to support USGS and DOI science and operational activities through remote sensing technologies, data analysis, products and services.
- Innovation – Evaluate and demonstrate promising remote sensing technologies and applications, or methods of data management, manipulation and integration (e.g., cloud, AI/ML, big data science), which show potential for addressing future science and operational needs.

Goal 3 - Product and Service Management and Innovation

Collaborate with strategic partners and end users to develop agreements, funding approaches, and products that will create the highest potential value for the NLI user community.

This goal focuses on the continued development and enrichment of the highly valued NLI product and service portfolio, including new approaches for managing product and service lifecycles, to create the greatest value to NLI customers while controlling costs. The NLI Program will advance methods for collecting, analyzing and applying user needs to drive changes in its product and service portfolio, to expand the user base, and better meet user needs.

The NLI Program will establish and maintain business policies and cooperative support structures that encourage and expand partnerships with Federal, commercial, academic, and foreign cooperators. The NLI Program will work with Federal partners, satellite business partners, commercial data providers, the Group on Earth Observations (GEO), the Committee on Earth Observation Satellites (CEOS), the European Commission (EC) and European Space Agency (ESA) and other foreign remote sensing system cooperators, to expand the understanding of, access to, and value of NLI products and services.

The National Civil Applications Center (NCAC), as a component of the NLI Program, will serve as the operational hub for providing Federal civil agencies with access to appropriate remote sensing resources of the intelligence community. NCAC services will provide NLI customers with the acquisition, exploitation, and dissemination of classified and selected commercial remote sensing data in support of civil missions. The NCAC provides leadership and expertise in the application of a unique suite of remote sensing resources.

Product and Service Management and Innovation Objectives:

The objectives associated with the Product and Service Management and Innovation goal are designed to support the continuous enhancement of the NLI Program's product and service portfolio based on creating increasing value for its consumers. The product and service management and innovation operational objectives are defined as:

- Improve user requirements collection and management processes
- Evaluate the quality and user impacts of NLI products and services to support portfolio-management decisions
- Enhance or develop new products and services to address high-priority user needs
- Develop or enhance partnerships, agreements or contracts to support NLI products and services and better meet user needs in a more productive and cost-efficient manner.

Goal 4 - Customer Engagement and Communication

Ensure that the NLI Program products and services are well known, understood, and available to the broadest constituency to maximize a tangible return on investment and provide the greatest value to the remote-sensing community.

Communicating the value of the NLI Program's information, data, products, and services, both internally and externally, is critical to the success of the program. The true value of NLI data, products and services can only be realized if they are presented in a readily consumable and discoverable fashion such that they can support user needs. Lifecycle requirements-management and information-management principles applied across the NLI Program are key to the successful presentation of valuable data and information products. The principal task at hand for effective communications is to interact with the program components and resources to provide an effective window to a broad constituency of users to whom the NLI Program's products and services provide value. Connect NLI data, information, services, and knowledge to current and potential stakeholder needs, by providing user friendly communication and education capabilities, to ensure that the value of NLI products and services are well known, understood, and applied to best meet user needs.

Customer Engagement and Communication Objectives:

The objectives associated with the Customer Engagement and Communication goal are focused on improving the awareness of NLI capabilities, building a larger community of users and ensuring that the program understands the value it creates for its customers.

- Enhance awareness and reach of the NLI Program Portfolio – Increase engagement with NLI end users to improve awareness of the value and utility of its products in effecting customer outcomes.
- Enhance outreach through education– Increase engagement with NLI end users to promote the value and awareness of the portfolio and brand.