NEBRASKA STATEWIDE IMAGERY PROGRAM

Business Plan

"Produce a sustainable statewide imagery program for the state that facilitates the acquisition, historical preservation, maintenance, and distribution of high quality digital imagery products to be utilized through various governmental uses and for public consumption."

Approved: February 15, 2017

NEBRASKA INFORMATION TECHNOLOGY COMMISSION GIS COUNCIL
AND
OFFICE OF THE CHIEF INFORMATION OFFICER

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Foreword

This business plan was coordinated through the Nebraska Information Technology Commission (NITC) GIS Council. Administrative and staff support was provided through the Geographic Information Office within the State of Nebraska, Office of the Chief Information Officer (OCIO). This plan follows national guidelines of the Federal Geographic Data Committee (FGDC) Fifty States Initiative, Cooperative Agreements Program (CAP). The Fifty States Initiative is a joint effort between FGDC and the National States Geographic Information Council (NSGIC) to advance the National Spatial Data Infrastructure (NSDI) through planning and coordination of diverse stakeholders involved with geospatial data, applications and services.

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Executive Summary

The NITC GIS Council recommends putting in place the Nebraska Statewide Imagery Program as a recurring program that facilitates the acquisition, historical preservation, maintenance, and distribution of high quality digital imagery and related products.

Imagery is the foundation of many of our Nebraska Spatial Data Infrastructure (NESDI) layers. The NESDI is a framework of geospatial data layers that have multiple applications and are used by a vast majority of stakeholders. These layers meet quality standards and have data stewards to maintain and improve the data on an ongoing basis. These layers are consistent with the Federal National Spatial Data Infrastructure (NSDI) and provide additional layers of particular importance to Nebraska.

The use of imagery has become a necessity and requirement for specific business functions through all levels of government and users in Nebraska. The business uses and needs of imagery vary by application. Each governmental entity (i.e., city, county, state) and political subdivision have varying requirements on timing and budgets. There are other components tied to acquired imagery that need to be considered such as, additional derived products, data hosting and map services. There is a need to develop a coordinated effort to support a recurring and sustainable imagery program for Nebraska. This program must also have flexibility to handle specific applications by its partners.

The imagery program will provide authoritative data that meets state imagery standards and will correspond with other NESDI layers. It will provide a level of visual registration and QA/QC in the derivation process of other NESDI layers. For example, it will provide parcel placement with respect to other land features and point addresses located at centroids of buildings. It will also be able to support future 3D visual representations when combined with LiDAR elevation data.

In general terms, a standard base product will include a minimum of a 30-cm (12-inch) pixel resolution “leaf-off” statewide orthoimagery product with ancillary data products and services. This is a recurring imagery program with orthoimagery collected every two or four years, depending on urban and rural area priorities. This will ensure that base orthoimagery would never be more than four years old for any part of the state. It will also allow partners to be included in an overarching contract and allow buy-ups of additional packages such as higher resolution imagery, oblique imagery, and planimetric layers such as building footprints. The program will also implement a preservation plan for the digital conversion and archiving of historical aerial imagery.

A statewide project has costs related to consistency, quality, completeness, maintenance of infrastructure for positional reference, data management, and public access to information. The minimum expected costs the initial year will be around $1.8 million. This includes the acquisition of a statewide orthoimagery product, data hosting and distribution, and program management.

Plans are to begin in early 2017 to identify funding sources and implement a procurement and vendor selection process that allows multiple levels of government, universities and other political subdivisions to purchase imagery and related products as soon as spring of 2018.

Budget shortfalls and goals to find cost savings provide the motivation to develop partnerships to reduce costs and explore all funding possibilities to ensure the success of the program. As more data is provided to the user community, the value of this data will gain further recognition. This will be accomplished by expanding existing data sharing and distribution methods to leverage historical and newly acquired imagery products so they are accessible. This program will also facilitate technical assistance and education outreach activities supporting the efficient utilization of imagery products. These activities will validate further support and funding to ensure the program has long term sustainability and success.

1.0 Program Justification

1.1 Program Needs

State and local governments, political subdivisions, and federal agencies working in Nebraska have demonstrated a need for accurate and precise aerial imagery data and services. Imagery products and services help them meet their varied business requirements for planning and management to support public services involving:

- property assessment
- public safety
- emergency management
- E9-1-1 / NG9-1-1
- utilities
- natural resources
- infrastructure
- transportation
- environment
- agriculture
- economic development
- planning
- recreation and public spaces

Why should Nebraska have an imagery program?

The answer to this question is based on a variety of factors that will be discussed throughout this business plan. These include the need for accuracy and uniformity in orthoimagery; timing and flexibility of imagery acquisition; reducing costs and duplication; preserving historical aerial imagery; and enhancing data distribution and consumption of imagery products.

Accuracy and Uniformity

There is a need for an authoritative orthoimagery data layer with survey and geodetic control that we can rely on for visual registration and compilation of data sets. The figure in Appendix I illustrates how imagery serves as a foundation for many other NESDI data layers. It provides the framework to conduct other map compilations and necessary visual registration processes to support data and mapping systems.

The level of required accuracy and uniformity of imagery products depends on the intended use of the data. Imagery is classified as either authoritative or referential (NSGIC, 2012). Authoritative imagery has specific mathematical and geometric properties necessary for creation of geospatial framework layers, while referential imagery refers to imagery having distortions from ground control.

The type of imagery required is dependent on its application and use. Appendix II illustrates examples of applications and identifiable features that can be measured at various spatial resolutions.

The context and intended application of current orthoimagery services do not meet existing needs and in many cases, standards. For example, the USDA Farm Services Agency (FSA) National Agriculture Imagery Program (NAIP) imagery is designed for assessment of governmental agriculture programs of crop, forestry, and other vegetation cover. Over the past 10 years, this product has been typically flown “leaf-on,” which does not allow for other necessary “leaf-off” applications. The pixel resolution for this product, typically 0.6 to 2 meters, as well as the horizontal accuracy, do not meet current Nebraska state standards. The acquisition schedule is currently on a two-year rotation and there is the uncertainty or risk of the continuation of the program.

The Nebraska Elevation Program plays an important role in the accuracy of imagery products. This program is established to acquire LiDAR data across Nebraska on an ongoing basis. Data such as LiDAR provide ground control and accurate elevation information that are used to process orthoimagery. Several LiDAR projects have been completed or will be finalized in 2018. This LiDAR data needs to be used in relation to imagery whenever it is available as long as it meets standards.

Using a set of uniform state imagery products for ongoing applications is critical, particularly when making comparisons in ground features across different locations. It also improves the proper classification of land use patterns derived from vegetative to bare soil conditions.

A recommendation of the Nebraska Statewide Imagery Program is the acquisition of orthoimagery for the entire state in a short 6-month time frame (i.e., fall to spring). This will avoid a "hit or miss" imagery acquisition on a piecemeal basis. Obtaining a standard orthoimage in a single time period is most beneficial as it provides a more uniform product, with similar color contrasts to ground features (i.e., drought versus wet year).

Once imagery has been acquired, it is important to implement proper quality control (QC) procedures that involve data users. Experiences gained from earlier projects have found that aerial images are time-sensitive and vendors need to deliver the products to the user to review as quickly as possible, even before they complete their own QC analysis. This way, the users get to see and use the imagery in a timely manner and also gain an opportunity to address potential imperfections prior to final delivery of the product. This type of workflow assumes that the imagery has already met a horizontal accuracy standard. There is a need to have a QC process where there are as many users evaluating it as possible.

Timing and Flexibility

A program that continues with ongoing re-flights is needed to capture feature changes on the earth's surface (i.e., new developments, roads). Having a program that rotated every two to four years depending on the needs and applications would be ideal.

Timing of imagery acquisition must be considered in relation to vegetation condition. It is important to consider whether vegetative cover or no vegetative cover best meets a user's needs. Imagery acquired "leaf-on" provides data for numerous agricultural and natural resource applications. Imagery that is flown in "leaf-off" conditions provides a clear view of ground conditions underneath tree canopies and other defoliated vegetation. This type of imagery is especially important for urban applications, such as property assessment and registering road centerlines and address points where heavy tree cover may obscure these features. The best time for flight acquisitions for leaf-off conditions are typically between mid-February to late-April. Re-flights may also be needed to account for feature changes on the earth's surface (i.e., new developments, roads).

Not all geographic locations use the same orthoimagery deliverable products. Different areas of the state may have varying needs, depending on topography, population, and application requirements. There is a need for a program that would provide flexibility beyond a single baseline orthoimagery product. The program would need to provide opportunities for the buy-up of oblique imagery, higher resolution orthoimagery, and other specialized data such as thermal and infrared spectral imagery.

Reducing Costs and Duplication

Every effort should be taken to reduce duplication of imagery product acquisition and services. For example, if a city plans to fly a large portion of its area in a county, it may want to involve other nearby counties and cities. Putting aircraft in the air and planning flights over larger areas can cost about the same as flying to and from several small land areas within a region. Since certain costs are generally fixed, the overall costs can be reduced through using the economies of scale of the larger project.

There is also a need to reduce government staff time and multiple procurement procedures for duplicate acquisitions. Having a coordinated procurement process will promote cost savings and improve program auditing and evaluation.

Once data has been acquired for a joint effort, additional cost benefits can be gained in data hosting and shared technology applications. A data analysis application developed by one organization can be easily shared by other users using the same data. Web applications, once developed, can be used by multiple entities, thus leveraging costs even more.

Preserving Historical Aerial Imagery

Historical aerial imagery is a valuable resource, offering insight into the past, allowing us to know what existed in certain locations at a given time. Once it is digitized and georeferenced, it can be compared to other NESDI framework data and show changes that have taken place over time. For example, it can provide a context to historical surveys and deeds and the placement of boundaries. Many of the map surveys completed in the early 1900s referenced aerial photographs where boundaries followed old stream channels that no longer exist or have meandered over time. Other benefits of historical aerial imagery include the ability to monitor changes in natural habitats and understand environmental conditions caused by human activity. Some examples include, old contaminated sites such as buried landfills and man-made wetlands.

Enhancing Data Distribution and Consumption of Imagery Products

There is a need to leverage existing and new imagery products for a variety of applications. Imagery data files are large in size and it is not cost effective to host it in multiple locations. There is a need to enhance current methods that inventory, catalogue, and distribute large data sets. The state's Geospatial/GIS Enterprise system and NebraskaMAP have been established to begin this process. They provide a centralized repository for distributing data by several methods, including image tile downloads (i.e., clip/zip/ship) and web map services that allow users to consume imagery into their desktop mapping programs and online map viewers. There is a need for application programming interfaces (API) or plug-ins that can easily be incorporated into other applications. These add additional functionality in not just displaying data but also working with the data, such as making measurements or enabling other geoprocessing analyses. Along with the various ways to connect to and consume data products, there is a need for technical assistance and education to support the adoption of these technologies.

1.2 Strategic Foundation for a Business Plan

One of the four goals of the 2012 Nebraska Geospatial Strategic Plan is to facilitate the creation, maintenance, analysis, and publication of quality geospatial data. Imagery is classified as part of the NESDI and is defined as data that is obtained through aerial, satellite, and other sensor platforms to capture features about the surface of the earth. The NITC GIS Council has directed that a business plan for the acquisition, maintenance, and distribution of these imagery layers be developed. Furthermore, the NITC formally identified the NESDI as a new statewide strategic initiative in 2013 and identified the Nebraska Statewide Imagery Program as an action item to support the Governor's Statewide Technology plan.

Initial work has been the development and adoption of imagery standards by the NITC GIS Council (NITC 3-204 Imagery Standard, October 28, 2014). These involve data content standards, data schema descriptions, data compilation and accuracy standards, and metadata standards. A formal process will also be defined for the exchange of data and information between data stewards and the geospatial community of users.

There are other catalysts that have prompted the need for a statewide imagery program. These include coordinated efforts to improve and sustain an ongoing orthoimagery acquisition effort to meet federal and state requirements for property assessment, transportation, address point placement, and boundary

improvement projects. The state currently does not have a seamless statewide orthoimage that meets state standards. It will be necessary to collect a statewide orthoimage product in order to derive many of the essential NESDI data layers, including those that support current and future public safety and emergency services (i.e., enhanced/NG9-1-1) and various U.S. Census 2020 projects.

2.0 Goals and Objectives

2.1 Goal

The goal of the Nebraska Statewide Imagery Program is to produce a sustainable statewide imagery program for the state that facilitates the acquisition, historical preservation, maintenance, and distribution of high quality digital imagery products to be utilized for various governmental uses and for public consumption.

2.2 Objectives

The following objectives are essential to the success of the program.

1.0 Establish a program management team and operations plan with administrative coordination from the Geographic Information Office within the Office of the Chief Information Officer.

2.0 Establish and maintain standards, policies and strategies to emphasize cooperation and coordination among state, federal, county, municipality, utilities, university and other political subdivisions and organizations.

3.0 Identify and develop funding sources for program implementation and long term sustainability.

4.0 Implement a procurement and vendor selection process that allows multiple levels of government, university and other political subdivisions to purchase imagery and related products.

5.0 Develop and implement a preservation plan for the digital conversion and archiving of historical aerial imagery.

6.0 Expand existing data sharing and distribution methods to leverage historical and newly acquired imagery products so they are accessible, both publicly and for secure uses.

7.0 Provide communications, technical assistance and education outreach activities supporting the efficient utilization of imagery products.

8.0 Develop and implement an acquisition plan for statewide orthoimagery coverage and other products targeted for data collection beginning the spring of 2018.

9.0 Conduct a biennial evaluation and make necessary programmatic adjustments to procurement, standards, and other processes that impact activities and outcomes of the program.

3.0 Benefits

3.1 Anticipated Benefits

Orthoimagery products are easily recognized and can provide a useful framework layer for a variety of applications. Because many land features can be seen on an orthoimage, it can serve as a backdrop for visual reference, saving the expense of creating additional reference files. Orthoimagery helps users answer questions about identities, locations, distances, connections, proximities, surface waters, and structures. Timely emergency response, accurate and fair property tax assessment, more effective land use planning by local governments, efficient soil and water management, and timely delivery of products are examples of public and private benefits of regular, high resolution orthoimagery.

The Imagery for the Nation (IFTN) Cost Benefit Analysis describes non-quantifiable benefits of an orthoimagery program (USDA/USGS, 2007). Benefits may be organized into three categories: end-user value, governmental operational value, and private industry value.

Many benefits of an orthoimagery program to end-users are not quantifiable but are valuable in efficient and effective mapping, analysis, planning and decision support. End-user value may be expressed as:

- Access to current and historical imagery in the public domain, including access and distribution through NebraskaMAP
- Reliability of product and schedule
- Continuity of process and funding
- Opportunities to meet additional business requirements with buy-up options such as oblique imagery, increased resolution, or extracted map features
- Increased interoperability across jurisdictions through consistent datasets and cross-jurisdictional applications
- Common source data and metadata
- Higher resolution imagery for local users than previously available
- Access to consistent historical products to better understand landscape changes over time
- More applications available for decision support
- Increased user base through easier discovery of and access to imagery products

An orthoimagery program benefits governmental operations at all levels of government. These sources of value may be described as:

- Quality and consistency in operating data within and across jurisdictions
- Reliability of product and schedule to support planning, budgeting and analysis
- Standardization of procurement processes
- Application of standard data specifications and best practices
- Creation of economies of scale through consolidation of planning, budgeting, contracting and project management
- Interagency interoperability and consolidation of data storage and distribution
- Increased government user base through direct applications and service provider solutions
- More effective use of resources for other projects and programs that may include framework datasets such as elevation, thematic datasets such as building outlines, and analysis such as current land use.
- Coordinated and pre-planning of imagery acquisition helps budget and local planning expectations and timelines
- Improved government efficiencies through streamlined contracts and structured Request For Proposals (RFP) to guide contracting and auditing of acquisition programs

- Technical assistance and framework data modernization efforts that are also in sync with other NESDI efforts.

In emergency response by local government operations, benefits may be described as:

- Emergency responders can quickly assess how to get to the incident
- Emergency response has a better understanding of what may be required when they arrive
- Emergency response is better prepared in case assistance is needed outside of their region
- Time savings in call answering and response from better quality orthoimagery available to call centers (quality = consistency, currency, detail)
- Reduced confusion from multiple imagery datasets (e.g., reliance on a statewide "common operating picture")
- Improved existing GIS data framework layers to support enhanced and next generation 911

There are public examples of benefits stemming from improved government operations, some of which include:

- Imagery that informs accurate and fair assessment of local property taxes based on property boundaries and structures
- Natural hazard mitigation tasks that rely on imagery of prior conditions to better define ways to limit damage
- Understanding locations of specific public service needs
- Orientation and documentation of land, buildings, transportation and other features important to economic developers
- Geospatial information dissemination
    - Road Centerline gathering
    - Structure collection
    - Parcel information gathering
    - Time savings in local tax offices, GIS operations and related local operations
- Improved taxpayer satisfaction through partnership efforts that reduce costs on collective imagery

An orthoimagery program benefits the geospatial data industry and other private businesses. Service providers include contractors or subcontractors for aerial image acquisition, image processing, quality control, maintenance of base mapping layers, creation and maintenance of thematic layers, custom mapping, and mapping applications.

Orthoimagery producers in Nebraska have included large firms that are national in scope, medium firms with regional scope, and small firms that work primarily within the state. There are many small firms in Nebraska that benefit from a market dominated by frequent locally-funded imagery projects.

Private industry value may include:

- Increased opportunity for value-added services such as feature extraction, base mapping, and processing of color infrared imagery
- Guidance for coordinating efforts across counties and in service to state agencies
- Common source data for applications across the state
- Improved planning and scheduling of workflow for professional service providers
- Positive economic impact
- Increased customer base

Many more private and nonprofit organizations derive benefits from current, high resolution imagery in applications related to real estate, product delivery, engineering, planning, environmental assessment, and a variety of other uses.

The Nebraska-Iowa Regional Orthoimagery Consortium (NIROC) has indicated several qualitative benefits of a regional imagery acquisition program. The following are some examples from that program:

- More volume = more negotiating power = lower prices
- Pooled internal technical knowledge and experience
- Seamless imagery products across jurisdiction lines. This becomes useful for public safety and natural resource applications.
- Larger projects typically mean higher priority and response from the vendor
- The ability to spread payments over multiple fiscal years enables smaller and more rural communities to participate
- Improved collaboration, networking, and communication between various agencies

3.2 Return on Investment and Shared Value

The returns one would expect to find in the initial investment of imagery products and services are typically a measurement of cost savings and shared value among users.

Since Nebraska has not obtained a statewide orthoimagery product, there is no exact data to predict a return on investment. However, you can determine from other state programs, who have been conducting their program for many years, that statewide imagery programs prove themselves valuable and benefit taxpayers.

Based on the findings from other states, adopting a state-wide imagery program has been cost effective.

- Indiana reports a 34:1 return on investment over a three-year period for an initial investment of $7,432,625 that included data acquisition and distribution.
- Florida has predicted that an ongoing annual investment of $2.9 million that supports statewide orthoimagery in their state that yield $31.1 million in annual benefits. The greatest reported benefits were from a reported $1.96 million per year staff productivity and labor cost savings. The benefits from reduced costs through joint funding of orthoimagery projects were reported at $1.82 million per year. This clearly demonstrates that even if there is not a formal coordination effort in place, organizations are working together to maximize the benefits to their organizations.
- Maine has shown annual investment returns in their program of 421% to 1264%, based on net benefits ranging from $10 to $30 million. Their program further leverages their state funds at better than a 2.5 to 1 ratio.

The resources to support these state imagery programs were predominately supported through enhanced 911, emergency management, and other transportation funded projects.

Measuring and translating benefits to dollars is difficult and approximate, but useful in framing the value of statewide orthoimagery. The following descriptors of benefits can be translated to return on investment: a) time / efficiency for informing public decisions, b) currency of imagery and features (cost of misinformation), and c) time for handling, storing, retrieving, displaying, and archiving imagery data. These descriptors for return on investment will be documented through the life of the program ensuring ongoing investments match the need and benefits of the program.

4.0 Background

4.1 Remote Sensing 101 and the Context of Products in this Business Plan

There are several different remote sensing platforms that capture digital imagery. For example, aircraft (i.e., aerial), satellites, Unmanned Aerial Systems (UAS), and physical mounted platforms. The most commonly used platforms for the majority of governmental applications include data collections from aerial, satellite and UAS platforms.

The type of sensor and analysis techniques used with these platforms produce a digital data product. The most widely used products include: orthoimagery, oblique aerial imagery, and Light Detection and Ranging (LiDAR). Today, newer technologies use photon and geiger sensors. Combinations of these platforms and sensors allow for the depiction of physical structures on the earth's surface.

Orthoimagery

Orthoimagery data typically are high resolution aerial images that combine the visual attributes of an aerial photograph with the spatial accuracy and reliability of a 2-dimensional horizontal map. An orthoimage is a uniform-scale image where corrections have been made for feature displacement such as building tilt and for scale variations caused by terrain relief, sensor geometry, and camera tilt.

Oblique Imagery

Oblique imagery is what the name suggests. It is a technique of aerial photography that provides detail from a 45 degree angle with the ground. It more closely resembles how people normally view their landscape compared to traditional orthogonal (straight down) imagery. Many counties, municipalities, and projects are interested in oblique imagery as it provides additional details around buildings and tall structures. The data products for oblique imagery acquisition vary by vendor and application.

Historic Aerial Photography

Historical aerial images are derived from analog photography that is imaged onto film. These uncorrected images are not digitized. Once scanned, they go through an orthorectification and geo-referencing process to put them in a digital format that provides a level of accuracy for making measurements.

Historical aerial photos are an invaluable resource for farmers and land owners, consultants, and government agencies. Uses can include land use/land cover change detection, applications for environmental studies, community planning, historical records of boundaries and many others.

Other Remote Sensing Technologies

Other products can be provided through remote sensing instruments. There are two types of remote sensing instruments—passive and active. Both types are able to potentially detect traits of objects that may not be visible to the human eye, such as infra-red, thermal, multispectral and hyperspectral characteristics. Both passive and active sensors can be deployed from a variety of platforms that include satellites, airplanes and UAS.

Passive instruments detect natural energy that is reflected or emitted from the observed scene. They sense only radiation emitted by the object being viewed or reflected by the object from a source other than the instrument. Sunlight is the most common external source of radiation sensed by passive instruments. Examples include cameras and specialized devices such as radiometers and spectrometers, which measure electromagnetic radiation using a variety of detectors.

Active instruments provide their own energy (electromagnetic radiation) to illuminate the object or scene they observe. They send a pulse of energy from the sensor to the object and then receive the radiation that is reflected or backscattered from that object. Examples of active sensors include radar and LiDAR.

4.2 History of Nebraska's Imagery

Historically, the consumption and usage of digital imagery across Nebraska has relied mostly on the federal programs and local projects across the state. Aerial photographs were collected as far back as the late 1800s using black and white print film. Since 1993, it is estimated that more than $14.2 million has been spent on some level of aerial acquisition in our state. The following is a brief summary of those acquisition projects.

US Geological Survey (USGS)

Nebraska's first statewide orthoimagery was the delivery of US Geological Survey (USGS) digital orthophoto quarter-quads (DOQQs) in 1993 and 1999. This was a partnership between the NDNR and USGS. This effort implemented the National Mapping Standards for primary digital ortho-photoquadrangle (DOQ) requiring a 1-meter ground resolution for quarter-quadrangle (3.75-minutes of latitude by 3.75-minutes of longitude) image. It was casted on the Universal Transverse Mercator Projection (UTM) on the North American Datum of 1983 (NAD83) and mapped to 1:12,000 scale. The vertical accuracy of the verified USGS format DEM is equivalent to or better than a USGS level 2 DEM. There is no record on the total cost for these two years of imagery.

USDA FSA National Agriculture Imagery Program (NAIP)

The primary goal of the NAIP program is to maintain common land unit (CLU) boundaries and assist with farm programs (i.e., estimation of crop and other vegetative cover). The NAIP imagery program has been predominately financed at the federal level with the opportunity for local "buy-ups" of higher resolution data. The NAIP imagery resolution collected for Nebraska is a 1-meter ground sample distance (GSD) for 2003, 2006, 2007, 2009, 2010, 2012, and 2014. In 2004 and 2005, imagery was collected for compliance uses at the resolution of a 2-meter GSD. As technology and sensors continued to improve, the cost effectiveness also improved, so the 2016 imagery was acquired at 0.6-meter. The spectral resolution is provided in 4-bands, containing red, green, blue, and near-infrared bands. NAIP quarter quads are formatted to the UTM coordinate system using NAD83. Total estimated cost spent on this imagery through USDA to date is $8,751,364.20 for Nebraska.

University of Nebraska

Since 1986, the Center for Advanced Land Management Technologies (CALMIT) at the University of Nebraska-Lincoln has been acquiring remotely sensed satellite (primarily Landsat and MODIS) imagery. CALMIT's mission is to enhance and expand research and instructional activities in remote sensing, geographic information systems (GIS), automated cartography and image processing. Until much of the imagery became available for free in 2008, acquisitions by CALMIT were made on an as-needed basis and purchased using research grant funds. Nebraska Landsat images related to research projects are available to the public via the NebraskaView website (http://nebraskaview.unl.edu/), although that data is now also readily available through various federal data gateways.

Over its history, CALMIT has also been involved in a number of landuse mapping activities in conjunction with various Nebraska state agencies. The 2005 Nebraska Land Use map was developed through funding by the NDNR, while irrigation maps from the late 1990s through the mid-2000s were developed under the auspices of the Platte River Cooperative Hydrology Study, a multi-agency effort with the objective of improving the understanding of the hydrological conditions in the Platte River watershed in Nebraska upstream of Columbus, Nebraska.

The School of Natural Resources, University of Nebraska at Lincoln (UNL), houses the largest public archive of historical Nebraska aerial photos in the state. The 9" x 9" black and white photos are at a scale of approximately 1:20,000 and were obtained through UNL's Conservation and Survey Division (CSD) from the U.S. Department of Agriculture's (USDA) Farm Service Agency (FSA). The archive is cataloged by county for each year available. Although complete statewide coverage is not available, the archive includes photos from the 1930s to the 1970s and generally includes one set of photos for each decade.

Nebraska-Iowa Regional Orthoimagery Consortium (NIROC)

The Nebraska-Iowa Regional Orthoimagery Consortium (NIROC) consists of cities, counties, natural resource districts, and state and federal agencies in the eastern most part of Nebraska. It has involved the core Nebraska and Iowa urbanized areas but has also been open to other entities to participate. The project is currently on a three year acquisition cycle that started in 2007 and most recently collected data in 2016. The latest acquisition included collection of 3, 4 and 6 inch orthoimagery and obliques. Total investment to date for imagery acquisition is $5.3 million.

Central Nebraska Consortium

The Central Nebraska Consortium involves eight cities and two counties. It collected data in 2007 with 6 and 12 inch imagery.

4.3 Imagery for the Nation

Imagery for the Nation (IFTN) is a National States Geographic Information Council (NSGIC) led effort to encourage the federal government to fund consistent, regular orthoimagery acquisitions across the U.S. (http://www.nsgic.org/imagery-for-the-nation). NSGIC is currently examining options to work with all states to pursue improved contracting mechanisms to further reduce costs on orthoimagery products.

Recent discussions have involved working with federal government partners such as the USDA FSA NAIP program. Thus far, no funding has been appropriated by USDA or other federal government agencies for this effort.

As sensor technology improves over time, it may become more affordable and timely to handle high-quality imagery acquisition for state needs at a regional rather than federal level.

5.0 Program Requirements

The NITC GIS Council recommends establishing a recurring program that can periodically re-fly the state to make high quality imagery and related products available statewide. Several requirements to achieve the goal of this program are addressed in this business plan. These are summarized in the following components:

Program Requirement Components

- Organizational structure
- Legislative support
- Data, application and product components
- Standards
- Technology requirements
- Human resource requirements
- Costs
- Finance and Procurement Strategy
- Reduction of Risk

5.1 Organizational Structure

The NITC GIS Council and the Imagery Working Group are responsible for the development and recommendations found in this business plan. These individuals are identified in the acknowledgement section of this business plan. The following groups have a role in the governance and responsibilities for planning and implementation of a statewide imagery program.

NITC GIS Council

The NITC Geographic Information Systems Council was established by the Legislature in 1991 (Reissued Revised Statutes of Nebraska, 1943, §86-569 through §86-573). The Council serves as the state's primary oversight group for the development of standards, strategies, and policies as they relate to the creation and use of geospatial data and technologies. The Council emphasizes cooperation and coordination among agencies, organizations, and government entities. These coordinated efforts lead to creating public and private partnerships, greater geospatial productivity, less redundancy, and more informed policy across all disciplines and business lines involving geospatial data and technologies in the state. The GIS Council mission is to:

> *"Encourage the appropriate utilization of GIS technology and to assist organizations to make public investments in GIS technology and geospatial data in an effective, efficient, and coordinated manner."*

This council is made up of twenty six representatives appointed by the Governor representing diverse stakeholders. The stakeholders are representatives from state, county, municipal and federal government agencies, and other public and private entities using GIS/geospatial technologies as they relate to the geographic area of the State of Nebraska. The main purpose of this body is to represent the needs and ideas of the broad statewide NESDI community and to serve in an advisory role to the NITC, the Office of the CIO, and legislative body.

Imagery Working Group

The GIS Council implemented an Imagery Working Group in 2012 (NITC GIS Council, 2016). This Working Group takes the lead in identifying issues, soliciting input, and recommending solutions for imagery products and services paid by taxpayers. As part of this process, the working group pursues input and feedback on all aspects of the program geospatial imagery from partners not directly participating on the working group.

The Working Group was directed to develop a business case outlining the need for a statewide imagery program. The Working Group has submitted this business plan as a recommendation to the NITC GIS Council. The Council may accept, modify, or reject those recommendations. It is more than likely that members of the Imagery Working Group will transition into the Nebraska Statewide Imagery Program Management Team.

Nebraska Information Technology Commission

The Nebraska Information Technology Commission (NITC) is a nine-member commission established by the Legislature (Neb. Rev. Stat. § 86-515 to 86-86-518) to provide advice, strategic direction, and accountability on information technology investments in the state. To achieve its mandate, the NITC relies on coordination and collaboration to influence a wide range of information technology issues. The NITC annually prepares a Statewide Technology Plan, provides biannual recommendations on technology investments to the Governor and the Legislature, and adopts technical standards, guidelines, and architectures. The NITC is assisted by six advisory groups: the Community, Education, eHealth, GIS, and State Government Councils and the Technical Panel. Standards and guidelines recommended by the GIS Council are sent to the Technical Panel for 30 day review prior to submission to NITC for review and approval.

Office of the Chief Information Officer

The Office of the CIO (OCIO) (Neb. Rev. Stat. § 86-519) is located within the Department of Administrative Services which provides administrative and budgetary services for the office. The OCIO provides overall IT policy, governance, planning and oversight, IT coordination for state agencies, and development, oversight, and operation of enterprise shared systems. It provides administrative oversight to the Geographic Information Office and the NITC GIS Council. The Chief Information Officer is a designated member seat on the GIS Council.

Geographic Information Office

The Geographic Information Office resides in the OCIO and serves as the state's governmental operations and management body for GIS and the NESDI. The office is led by the State GIS Coordinator. Staff is currently being expanded through consolidation efforts to respond to increased requirements for the NESDI coordination and operational support and administration of the Geospatial/GIS Enterprise platform. This group provides the necessary coordination of funding and procurement activities to support the NESDI strategic initiative action items designated by the NITC. The State GIS Coordinator has authority to enter in statewide contracts and has support for administrative and budgetary services.

5.2 Legislative Support

The Nebraska Imagery Program is a strategic initiative identified by the NITC and the Governor's Statewide Technology Plan. According to Neb. Rev. Stat. § 86-572(2), committees, duties. The NITC GIS Council shall: *"(1) Make recommendations to the Legislature and the Nebraska Information Technology Commission for program initiatives and funding."*

The member representation on the NITC GIS Council includes the same partners involved in recommending a statewide imagery program. These partners represent several levels of government that have different responsibilities and governance when making decisions.

Nebraska's challenge is to coordinate several systematic statewide data layer acquisition efforts around various funding cycles and other constraints. This requires making plans for acquisition, procurement, stewardship, distribution, and coordinating future programs in a way that they also work together. These organizational needs would be more efficient and effective if addressed under a state program.

Legislation plays an important role when it comes to building cooperation among various political and governmental entities. It is important that the Nebraska Legislative body is aware of these efforts and the recommendations outlined by this business plan. It recommends legislation in support of a coordinated statewide effort that has many cost benefits to taxpayers.

Legislative support is needed in several ways. One is the overall awareness and recognized value of NESDI data layers such as imagery. Particularly, how they benefit the public and are used in various government applications to support public services.

The Legislative body can also make a difference by making sure that existing and newly introduced legislative bills support common themes of the business plan. These items can include:

- Recognizing that there is a coordinated effort through the NITC GIS Council, the Office of the CIO, and a Program Management Team to advise and manage operations of a statewide imagery program. These entities have expertise and efficiencies in acquiring, using, and distributing data.
- Ensuring that legislated programs are using taxpayer funds efficiently. This ensures that data and services are not being duplicated.
- Supporting funding for sustainable and timely acquisition and distribution of NESDI data for meeting specific program requirements at all levels of government. For example, future

coordinated GIS data expenditures to support public safety (i.e., enhanced/NG9-1-1), emergencies, and economic development.

5.3 Data, Application and Product Components

The following data, application and product components are organized by orthoimagery, obliques, historical imagery, and other remote sensing products. It includes consideration of data formats, hosting, and related map services and viewers to support the distribution and consumption of the data.

5.3.1 Statewide Orthoimagery

Produce an orthoimagery product with seamless coverage across the state and across navigable waterways to other state shorelines (i.e., Missouri River coverage) that has the following characteristics.

- Acquisition of orthoimages at a minimum 30-cm (12-inch) pixel resolution, delivered in 5,000 x 5,000 foot grid tiles.
  - Provide the option, if cost effective, for buy-up of 15-cm (6-inch) and 7.5-cm (3-inch) resolution imagery for specific counties, municipalities, or project areas with varying sizes of coverage areas.
- 4-band (RGB+IR) imagery
- Leaf-off (i.e., majority of deciduous and other vegetation have no leaves)
- Data acquisition occurs during fall to spring and meets specific ground and atmospheric conditions, and other specifications identified in state standards.
- After the first year of statewide imagery coverage, the frequency will continue at every 2 years for urban and prioritized areas and every 4 years for the entire state.
  - Rural counties can have the option to buy-up every two years, if needed. The determination of urban versus rural areas are dependent on local needs and when these acquisition periods should occur.
- The following formats and services to support this data.
  - Data hosting for raw tiles, inventoried electronically, and/or mosaic of imagery files
  - Option for formats and derived products such as Enhanced Compression Wavelet (ECW) and Mr. SID, 3D (end lap/side lap) capture, planimetric capture and other analysis for feature extraction, impervious surfaces, building footprints, land use / land cover, and other vegetative indices.
  - Web map services that deliver and support OGC Web Map Service (WMS)
  - Application viewers and API capabilities for data review, measurement tools, and integration with other web mapping applications and viewers.

Additional data, application and product specifications for orthoimagery are provided in more detail in the Imagery Standards (NITC 3-204, 2014).

5.3.2 Obliques

Produce low-level oblique images at four cardinal directions with the following characteristics.

- Acquisition of oblique imagery at a minimum 15-cm (6 inch) pixel resolution for urban areas and 30-cm (12-inch) for rural areas.
- 3-band (RGB) imagery
- Leaf-off (i.e., majority of deciduous and other vegetation have no leaves)

- The frequency of data collection depends on the intended application and the level of imagery needed for property assessment. Consideration for data frequency should be made to support the Standards for Mass Appraisal of Real Property. Whereas, obliques must be collected no less than every two years for urban areas and 6 to 10 years in slow growth areas.
- Data acquisition occurs during fall to spring and meets specific ground and atmospheric conditions, as wells as other related specifications similar to those found in the orthoimagery standards.
- The following formats and services to support this data.
    - Data hosting for original images that are cataloged/indexed and have metadata
    - Application viewers and API capabilities for data review, measurement tools, and integration with other web mapping applications and viewers.

5.3.3 Historical Aerial Imagery

Produce a digital library of historical aerial photographs from paper and film with the following characteristics.

- A comprehensive discovery and inventory process to identify the various historical photographs in paper and film and determine if they are of quality to be digitized.
- Preservation of historical imagery follows best practices and other standards for proper indexing, scanning and digitizing, geo-referencing, rectification, and attribution.
- The following formats and services to support this data.
    - Data hosting for raw tiles, inventoried electronically, and/or mosaic of imagery files
    - Web map services that deliver and support OGC Web Map Service (WMS)
    - Application viewers and API capabilities for data review, measurement tools, and integration with other web mapping applications and viewers.

5.3.4 Other Remote Sensing Products

There are other remote sensing technologies and value-added services for use with imagery-based products. Many of these products are specific to certain users and applications and are best handled as separate contracts due to their nature and timing. They deserve mention in this business plan as they are recommended for meeting specific business needs. The following are a few notable remote sensing products and deliverables that are commonly used in Nebraska.

- Aerial platforms that provide multi-spectral, hyperspectral, and thermal sensory wavelengths to support applications that need to go beyond the typical color and infrared bands.
- Light Detection and Ranging (LiDAR) that provides highly accurate digital elevation data. This data comes in the form of point clouds indicating heights of objects above the ground surface.
    - A separate NESDI business plan was completed in 2014 for a Statewide Elevation Program. There are state standards for supporting the acquisition of LiDAR for elevation in Nebraska (NITC 3-203, 2014).
- Satellite provides a different resolution and scale of orthoimagery and obliques including other sensory bands and wavelengths (i.e., RGB, IR, multispectral, thermal). This information has been used in the past due to the quick turnaround of imagery for remediation response to emergencies and natural hazards such as tornados, grass/forest fires, and flooding.
- Unmanned Aerial Systems (UAS) are designed for low-level and small-scale projects and can be equipped with various sensors to support many uses and applications. There are federal laws and policies in place through the Federal Aviation Administration (FAA) that limit the operation of UAS under certain areas and circumstances.
- There are other derived products from imagery using software and computational methods either as standalone products or for use in combination with other imagery products. These can include planimetric capture and other analyses for feature extraction; change detection;

classification procedures for determination of impervious surfaces and land use / land cover; vegetative or bare soil indices; stereo imagery; and 3-D data/models.

5.3.5 Data Distribution and Sharing of Data

All data obtained through this effort would be made public and are subject to the Nebraska Public Records Law. There is no foreseen requirement for data sharing agreements other than where specific licensing and service agreements are in place at the time of procurement or usage during events initiated by declared states of emergencies and national/homeland security. This includes data that is restricted by licensing or privacy restrictions and only shared on a limited basis according to terms specified in the license.

The data will also be made available through multiple formats (i.e., raw tiles, web map services). This will further leverage imagery for use in core function areas and business functions that inventory and reference ground based features, analyze and model relationships with other data, and provide basic visualization processes.

All data deliverables will be made available through the NebraskaMAP geospatial data clearinghouse by the program stakeholders. NebraskaMAP provides a centralized enterprise-level data-sharing platform intended for users needing access to geospatial data in the state. A NebraskaMAP Data and Content Management Policy was established to outline processes to share data and define responsibilities among data stewards (NebraskaMAP, 2016).

5.4 Standards

5.4.1 Nebraska Imagery Standards

Initial work has been completed to develop required specifications for orthoimagery acquisition to be used through the statewide imagery program. These specifications went into the development of standards and have been approved for orthoimagery acquisition for Nebraska. These were approved October 28, 2014 by the NITC (NITC 3-204, 2014). These standards will be updated to reflect the American Society for Photogrammetry and Remote Sensing (ASPRS) standards that were finalized November of 2014.

Data acquisition of imagery products are expensive and require preplanning. This standard provides requirements necessary for the creation, development, delivery, and maintenance of aerial imagery acquisition to support a statewide Nebraska Imagery Program. Since there are multiple uses for imagery, these standards are set at a minimum such that the majority of applications and needs are met across the state. These standards do not take into consideration other imagery products such as obliques and satellite products.

5.4.2 Other Referenced Standards

Other standards and guidelines were used in the development of Nebraska's state standards. These include ASPRS, NENA, and Mass Appraisal guidelines.

American Society for Photogrammetry and Remote Sensing (ASPRS)

The ASPRS Positional Accuracy Standards for Digital Geospatial Data were finalized in November of 2014. (ASPRS, 2014). These standards outline positional accuracy standards based on RMSE thresholds for digital orthoimagery.

1. Accuracy Requirements for Aerial Triangulation:

$$RMSE_{x(AT)} \text{ or } RMSE_{y(AT)} = \tfrac{1}{2} * RMSE_{x(orthoimagery)} \text{ or } RMSE_{y(orthoimagery)}$$

$RMSE_{z(AT)} = RMSE_{x(orthoimagery)}$ or $RMSE_{y(orthoimagery)}$

2. Accuracy Requirements for Ground Control Used for Aerial Triangulation:

$RMSE_x$ or $RMSE_y = 1/4 * RMSE_{x(orthoimagery)}$ or $RMSE_{y(orthoimagery)}$,

$RMSE_z = 1/2 * RMSE_{x(orthoimagery)}$ or $RMSE_{y(orthoimagery)}$

3. Accuracy Requirements for Orthoimagery:

Orthoimagery for this program should be produced to meet the following horizontal accuracy figures:

Orthoimagery Pixel Size (cm)	Horizontal Accuracy Class	Absolute Accuracy			Orthoimagery Mosaic Seamline Mismatch (cm)
		$RMSE_x$ and $RMSE_y$ (cm)	**$RMSE_r$ (cm)**	**Horizontal Accuracy at 95% Confidence Level (cm)**	
	X-cm	≤*X*	≤1.4142* *X*	≤2.4477**X*	≤ 2**X*
7.5	*11.25*-cm	≤*11.25*	≤15.90	≤27.53	≤ 22.5
15.0	*22.5*-cm	≤*22.5*	≤31.82	≤55.07	≤ 45.0
30.0	*45*-cm	≤*45*	≤63.64	≤110.15	≤ 90.0

National Emergency Number Association (NENA)

The use of imagery products for deriving other map coverages are outlined in the NENA GIS Data Collection and Maintenance Standards (NENA, 2007). These standards outline the minimum requirements of using orthoimagery for use in compiling source maps. Digital orthoimagery or raster data shall have a scale of 1:2400 or better with a minimum 12 inch pixel resolution which produces a NSSDA Horizontal RMSE (Root Mean Squared Error) Accuracy level of five feet or better. These standards are in the process of being modified for next generation 911 purposes and will potentially either increase in accuracy requirements or stay the same.

International Association of Assessing Officers (IAAO)

The IAAO has produced a standard on Mass Appraisal of Real Property (IAAO, 2013). The objective of the standard is to provide a systematic means by which concerned assessing officers can improve and standardize the operation of their offices. These standards are advisory in nature and the use of, or compliance with, such standards are purely voluntary. The defined digital imagery is acceptable for use in property assessment. These data products include high-resolution street-view images and data obtained from aerial platforms such as orthoimagery, low-level oblique images, and LiDAR.

The standard states that orthoimagery must have a minimum 6 inch pixel resolution in urban and 12 inch in rural areas. Low level oblique images capable of measuring for verification purposes, should be collected in four cardinal directions, with a minimum pixel resolution of 6 inches in urban and 12 inch in rural areas. The frequency for orthoimagery and obliques should be collected within a minimum of every 2 years for rapid growth areas, and 6 to 10 years in slow

growth areas. The standard suggests that either one of these products can be obtained in those time frames, since it is used for verification purposes.

Nebraska Information Technology Commission (NITC)

Other references are made to imagery standards through the following NITC standards.

- *NITC 3-201 Geospatial Metadata Standard*
  State agencies and other applicable state funded entities shall complete ISO 19115-compliant metadata documentation of existing and applicable geospatial data holdings.

- *NITC 3-205 Street Centerline Standard*
  Capture scale for digitizing is 1:2400. Street centerline placement can be completed using aerial imagery that meets verified horizontal accuracy requirements for spatial resolution (12 inch minimum), preferably leaf-off.

- *NITC 3-206 Address Standard*
  Capture scale for digitizing is 1:2400. Address point placement can be completed by visual registration using aerial imagery, site plans or other graphical resources that have been spatially adjusted to meet minimum spatial accuracy requirements. Using aerial imagery that meets verified horizontal accuracy requirements for spatial resolution (12 inch minimum), preferably leaf-off.

5.5 Technology Requirements

The necessary technology requirements to fulfill this program will consist of internal and external resources. The acquisition, quality control, and specific deliverables of imagery products are best handled from external industry partners. There are many qualified photogrammetric, engineering, and surveying firms who are experienced with this technology, and are interested in competing for the State's business. The state Imagery Standards will serve as the necessary specifications for obtaining orthoimagery products. Other imagery products to be acquired will still need to be scoped out for meeting specific needs and timelines.

State government agencies have begun enhancing their technology infrastructure the past two years to support the distribution and leveraging of large data sets such as imagery and other remotely sensed products. The OCIO Geographic Information Office is leading this effort with the Geospatial/GIS Enterprise solution as part of state government's IT Consolidation Plan. It is currently finalizing the migration of several state agencies into a shared data and map services platform.

This platform provides a secure file server and database infrastructure that reduces duplication of data, promotes data sharing, and further builds efficiencies when leveraging geospatial data to support business functions. This infrastructure builds support from external software and service companies. Additional efforts are underway to further reduce data storage costs by utilizing other cloud based solutions.

The Conservation and Survey Division at UNL currently supports the necessary technology requirements for the preservation of historical aerial photographs. They plan to continue the historical preservation of aerial photographs for the state as resources permit. They are in the process of scanning and geo-referencing approximately 250,000 aerial photos. Support for this effort comes from grant funds provided by the USDA Natural Resources Conservation Service.

The statewide orthoimagery product and other deliverables used by state agencies will be hosted with the enterprise platform and extended through NebraskaMAP. The clearinghouse provides both public and secure access to authoritative geospatial data commonly used across the state. It provides a mechanism to "roll-up" data to a statewide framework to support many regional and statewide business functions.

Imagery metadata and indexing of pertinent data files will make it easier for partners and data users to search and find data. The clearinghouse is also propagated with ISO taxonomy and keywords that meet federal standards so that it can easily be rolled up into federal clearinghouses such as GISInventory.net and data.gov.

Partners who participate with the statewide imagery acquisition portion of the program can participate with these solutions. Certain applications and web map viewers may have license or usage restrictions to certain data types such as oblique imagery. The procurement plan will provide other options to host data and provide map services to support these types of imagery products.

As technology and interoperability of data between mapping systems improve, it is possible there will be ways to reduce duplication of data hosting and other cost efficiencies.

5.6 Human Resource Requirements

5.6.1 Program Coordination

From a statewide program management level, the program will rely on the existing infrastructure to implement this plan by relying on existing lines of communication and processes. The State GIS Coordinator oversees current statewide contracts and can initiate and implement into agreements that support state government and other political subdivisions. The OCIO Procurement Team and Department of Administrative Services will provide support for the procurement, award selection, and billing for product and services rendered under this program. A representative of the OCIO Project Management Office will also be assigned to keep program objectives on time. A percentage of time from the program manager, procurement, and project management support staff will be dedicated to provide sufficient oversight and coordination for the Nebraska Imagery Program.

5.6.2 Program Management Team

A Program Management Team will be formed in an advisory capacity to assist in the development and maintenance of the operations plan, request for proposal (RFP) and communicate the business plan objectives to stakeholders. The program management team will be led by the State GIS Coordinator within the OCIO Geographic Information Office and will consist of representatives in state, county, city, University and federal government.

A similar recommendation for a program management team has been made as a result of the Nebraska Elevation Program. There are similar roles and partners involved in that program management team. This business plan recommends to evolve these two program management teams into one group, covering both imagery and elevation efforts in the state since much of the procurement processes are the same.

5.6.3 Other Expertise and Support

At the local level, many counties that participate in the procurement and delivery of imagery products have staff to develop scopes of work, contract negotiation and management, quality assurance/quality control and even distribute and work with the data. The primary changes from their process will be management of funding and working with state level procurement contracts for acquisition and delivery of imagery products and services.

Cities and counties that have their own GIS staff will continue to leverage the imagery products to support their current business operations. They will also participate in evaluating imagery products prior to delivery.

There currently exists information technology support staff at the state government level through the OCIO and other supporting state agencies to accept the delivery of imagery products and leverage them into state business operations. This support relies on current industry contracts for software and services to deliver and analyze imagery products.

- The OCIO staff will oversee the data hosting, map services, and distribution of data and deliverables within the Geospatial/GIS Enterprise platform. They will leverage data holdings current map applications and NebraskaMAP.

- The Department of Roads has expertise in photogrammetry and has experienced staff who are efficient in using photogrammetric software. They are responsible for incorporating imagery products and ground control in to their workflows to produce map designs for planning and litigation for roadway projects.

Additional expertise from the Conservation Survey Division at UNL and research community will be available in preserving historical imagery and developing geoprocessing tools to support imagery products. There is a need to expand expertise among the research community in developing and proving geoprocessing tools in this area. These tools require research and would improve confidence levels over time so they could be implemented within local and state government business operations. Some examples include: developing models for change detection that support various geometric features from vegetation to structures, assisting in improving data quality and other analysis techniques with various remote sensing data sources.

5.7 Costs

A request for information (RFI) was initiated in late 2015 to acquire specific cost estimates for the acquisition and delivery of various imagery products. There were five photogrammetry companies that provided information to the request.

Orthoimagery

For orthoimagery acquisition, minimum and maximum cost estimates were obtained by specific sized coverage areas in square miles (Table 1). Orthoimagery estimates are based on products meeting the imagery standards. Acquisition services vary depending on how they handle costs for quality control and delivery of the final product.

Table 1. Estimated minimum to maximum costs for orthoimagery acquisition by size of coverage area measured in square miles.

	Minimum – Maximum Costs *$ / square mile*		
Coverage Area *square miles*	**12 inch***	**6 inch**	**3 inch**
30,000+	$22 - $52	$55 - $109	$175 - $275
10,000-30,000	$55 - $109	$60 - $110	$179 - $300
400-10,000	$43 - $125	$66 - $250	$196 - $450

*One vendor produces a 9 inch product rather than 12 inch at $75 for all coverage sizes.

Cost data presented here suggests economies of scale (i.e., large areas acquired reduce costs per unit of orthoimagery delivery). The total estimated costs for statewide coverage for a 12 inch resolution product would be approximately $1,780,000. This is assuming an average price of $23.00 per square mile.

Many states have statewide initiated imagery programs. Other states have acquired a minimum 12 inch resolution orthoimagery product similar to our state standards. During the past seven years they have reported costs between $40 to $104 per square mile. This averages to $72 per square mile. The costs

differ depending on how the product is acquired and delivered (e.g., buy-up features and other processing costs). Table 2 shows some example states data acquisition costs by product type and year.

Table 2. Other state examples of orthoimagery acquisition costs by year.

State	Year	Description	Cost Per Square Mile
Florida	2012	$2.86 million/year investment benefits back $32 million/year	$95
Kansas	2014	12 inch, leaf-off, RGB+IR	$22
Indiana	2013	$4.7 million one time for 4-band. Map entire state over a 3 year period.	$126
Michigan	2016	base 4-band, additional costs for buy-ups.	$28
North Carolina	2010	6 inch, RGB	$250

It is also important to note that image acquisition has dropped in price over the past several years largely due to improved efficiencies in the technology.

The expense to acquire and process imagery is exponential in costs as you acquire higher resolution information (e.g., 1 foot going to 6 inch) to depict out ground features.

Oblique Imagery

Oblique imagery products come in various resolutions ranging from 1 inch to 12 inch. Some of the most common resolutions used by municipalities are between 2 and 9 inch resolutions. Costs for oblique imagery obtained in the RFI are summarized in Table 3.

Table 3. Estimated average minimum to maximum costs for 4-way oblique imagery acquisition by resolution.

Resolution	Estimated Costs, $/sq. mile
9 inch	$140 - $205
6 inch	$197 – 435
4 inch	$278 - $541
3 inch	$340 - $592
2 inch	$325 – $584

Acquisition services vary by imagery provider

Assuming an average size county (i.e., 840 square miles) in Nebraska wanting full coverage of a 4 inch oblique imagery. This would equate to $344,400 for that county for the acquisition of oblique imagery.

Historic Aerial Photography

The RFI did not capture information in regards to costs associated to scanning, digitizing and orthorectification of historical imagery. These costs will be sought in a separate implementation plan.

Minimum Cost Estimates for a Statewide Orthoimagery

The recommendations of this business plan is to support the primary orthoimagery product. Costs for other add-ons and buy-ups are additional and would be covered by those entities interested. The program would still provide the necessary coordination and procurement for those services. Table 4 represents estimated costs for the Nebraska Statewide Imagery Program.

Table 4. Total estimated costs for the Nebraska Statewide Imagery Program.

Activity	Year 1	Year 2	Year 3	Year 4	Year 5
Orthoimagery Acquisition and Processing Including: Quality Assurance / Quality Control	$1,780,000		$450,000		1,780,000
Distribution and Hosting	$6,400	$6,400	$6,400	$6,400	$6,400
Program Management / Support	$25,000	$10,000	$25,000	$10,000	$25,000
Total	$1,811,400	$16,400	$481,400	$16,400	$1,811,400

Years 1 and 5 are assuming statewide coverage of orthoimagery. Year 3 is assuming 25% coverage of urbanized and other prioritized areas in the state. This amounts to a cost on the order of $23.42 per square mile. The costs associated during Years 2 and 4 are due to ongoing data hosting and distribution and contract preparation for successive year collections and ongoing buy-ups.

5.8 Finance and Procurement Strategy

The statewide imagery program is based upon partnerships between state, county and federal sources. This consortium of partners, seek an annual acquisition program that is continuously funded. However, funding for the overall program is still contingent upon the availability of state, county, local, federal, and other funding from year to year. The national trend in funding statewide imagery programs has been an accumulation of partners at the local and state government level. Involving a consortium of partners at the state level builds capacity and instills competitiveness among the orthoimagery service industry. This further promotes competitive and affordable prices, high quality products, and timely services for large orthoimagery projects.

5.8.1 Funding Sources

Funding for a statewide imagery program depends on budgeting, planning, negotiating, and factors that may not be apparent. As a framework, the recommended funding strategy for the statewide program is to work with the following groups to obtain funding that will support the recommendations contained in this plan. This framework involves imagery acquisition, data access and distribution, program management and investment in geodetic control.

1. ***State agencies and statewide organizations, including the 9-1-1 Board on behalf of local operations, that use state funds and apply geospatial data to business processes.*** Specific amounts depend on project locations in relation to state program requirements, restrictions, timing and budgets.
2. ***Local governments.*** Specific amounts depend on project locations in relation to local program requirements and availability of funds.
3. ***Other political subdivisions and organizations, including electric power districts, natural resource districts, and other governed districts.*** In partnership with public entities, political subdivisions and organizations are potential sources for cost-share in selected counties where those groups have business requirements for current high resolution imagery.
4. ***Federal organizations, including cooperative agreements led by the Federal Geographic Data Committee.*** Funding from federal organizations depends on project locations, federal program initiatives and requirements, availability of funds, and limitations based on location and purpose.

State Funding

This business plan recommends state agencies and existing sources of funds (i.e., those created by statute that have relevance) are used to support the base orthoimagery product for the state. The other option is that an existing or new state appropriated fund is enhanced or created to support the NESDI data layer development and distribution of data. A majority of states in the nation are funded through 9-1-1 boards, local contributions and state agencies. Nebraska has a legislative appropriated Universal Service Fund Act, where many counties are funding several geospatial data sets to support enhanced 9-1-1 operations.

At the time of writing this business plan, there are decreases in revenues at the state level. State agencies have been asked to reduce their budget submissions so that core operations and business functions are met. The state agencies have already submitted their next biennium budgets for fiscal years 2018-2019. In order to get orthoimagery acquisition into those budgets, a specific request would need to be submitted to the Governor's office or funding allocated through legislation in early 2018.

The success of this imagery program depends on state level funding. Participating state agencies and stewards of state appropriated funds may want to begin addressing this data in their budgets moving forward. State Agencies that have participated in imagery projects in the past include Nebraska Department of Roads and the Nebraska Department of Natural Resources.

Additional imagery product and services that go beyond the primary orthoimagery data layer can be purchased by entities having needs for those to support their applications (i.e., oblique imagery, increased resolution of orthoimagery, UAS).

Local Funding

Many of the larger metropolitan cities and counties have routinely purchased orthoimagery and oblique imagery on an ongoing basis. Current funding for these products has relied mainly on local budgets. Although funding may not be consistent and reliable across the state, and although products specifications do not meet state standards, there are steps that can be taken to ensure all funding opportunities are pursued.

Local governments are the source for most of our geospatial data layers. It is important to recognize this role. Applications to support property assessment and public safety rely on orthoimagery and other products such as oblique imagery. There are political subdivisions that work with multiple municipalities and counties across the state. Public Power Districts have a need for high-resolution orthoimagery for utility planning. Natural Resources Districts have a need for imagery for water management regulation and monitoring.

Local governments and political subdivisions will not be able to support the program by itself due to inequality of budgets and timing. However, they can be a source of funding when supporting the core orthoimage product, if and when, the state funding options are limited.

Having the core orthoimagery product covered for all municipalities and counties frees up local and political subdivision budgets to support value-added imagery products such as oblique imagery.

Federal Funding and Grants

Some state agencies currently receive federal funding as part of their business model. The Nebraska Department of Roads receives funding from the Federal Highway Administration for various projects including GIS framework data and occasionally funding is set up in federal budgets to specifically target data acquisitions. There will be inquiries to other state agencies to determine if any existing federal funding is suited for acquisition of orthoimagery. Other federal agencies that might potentially

contribute to a Nebraska imagery program include US Army Corps of Engineers and the Federal Emergency Management Agency.

Federal funding can be requested through Nebraska's U.S. Senators. These funding requests are made annually to the Senators office where all requests are compiled and evaluated. If approved, the Senator includes it in their budget request through the appropriate committee. This process usually begins early in the year in hopes of including it in the final budget which is usually approved at the end of the year. Once the request is in the approved budget, the appropriate federal agency is notified and the grant process begins. Project summaries, proposals, details, and budgets are required to be submitted through the grants online process. After approval, the grant is awarded and work typically begins at the beginning of the next fiscal year. This entire process can take as little as 18 months, or it could take years. Project proposals for this program will be developed and submitted for consideration before February of 2018 to be considered in the 2019 budget.

Occasionally there are federal grants advertised for data acquisition. This process goes through the Federal Grants service which oversees all grant funding for the federal government. This office provides the notifications about the requirements and terms of the grant, oversees the application and review process, and manages the reporting and funding. Without prior notice, the time frame for submission of all material is usually short, so enlisting staff with prior grant writing experience must be utilized to ensure deadlines are met and the state has a reasonable chance of securing grant funds. Existing personnel resources with grant writing experience within state government will be enlisted to provide assistance.

5.8.2 Fiscal and Procurement Management

A coordinated procurement process will cut down on the inefficiency of multiple procurements for the same type of data and services within a jurisdiction and across jurisdictions. To achieve this efficiency, it is recommended that the fiscal authority and management of funds for procuring imagery products and services will need to be supported within the OCIO and Nebraska Department of Administrative Services.

The OCIO is located within the Department of Administrative Services (DAS) which provides administrative and budgetary services for the office and other state agencies and partnering entities. The OCIO provides overall IT policy, governance, planning and oversight, IT coordination for state agencies, and development, oversight, and operation of enterprise shared systems.

The Geographic Information Officed within the OCIO will be responsible for coordination of funds, facilitating procurement and participate in management of the program to assure deliverable products meet procurement requirements. This effort is currently led by the State GIS Coordinator for similar statewide geospatial data programs.

The OCIO can provide the necessary administrative support to handling contracts, procurement and follow through on acquisition products and services. Other state agencies and partners through the program management team will participate in the management and decisions made for fund allocations towards the Nebraska Statewide Imagery Program.

Once initial steps are in place for identifying partners and source of funds, the OCIO Geographic Information Office can initiate the process for coordinating funds and initializing the acquisition process of services. They can also establish agreements with other state funded entities in this process to acquire cost sharing of funds.

The fiscal and procurement process will need to address several issues identified by our partners prior to finalizing an acquisition plan. The following are some of the needs to address for an effective fiscal and procurement process to occur:

- Documented and communicated procurement steps with timelines to allow partners to plan, budget, procure, and accept delivery of products and services.

- Designated customer service at DAS and OCIO to support ongoing questions and assistance to fulfill purchases.
- Ability to select from several vendors depending on the application requirements.
- Ability to pay for products and services over several years.
- Flexibility for finance and procurement of product and services among partners with varying fiscal year start and end dates.
- Ability to choose from various add-on products and services at different times than the overall orthoimagery acquisition product timelines.
- Ability to readjust procurement process if it does not meet partner needs and requirements.

5.9 Reduction of Risk

It is important to identify potential risks prior to implementing a large scale program such as the Nebraska Statewide Imagery Program. Risks are typically associated to financial, organizational, and technical aspects to any program. By identifying these types of risks before they arise in program, it can speed up the process for remediation or corrective action before costs and efficiencies become difficult to manage.

Financial Risks

Financial risks can be associated with sustaining the allocation of funding and resources for imagery implementation work. This includes internal decisions inside partner organizations that impact funding streams and timing, external economic changes that impact resources, and potential problems with implementation, planning or management resulting in over budget of projects.

Coordinating funding under these conditions can be challenging and must be proactive to be effective. One of the main challenges is reducing risk in the timing and allocation of resources across varying start times and fiscal year budgets. Potential partners will have different budget processes and timelines. Budgets range from one to two year cycles and start dates differ during the year depending on the government entity. The federal fiscal year runs from October 1st until September 30 of the following year. State Agencies maintain a two-year budget cycle and the state fiscal year runs from July 1st until June 30th of the following year. Political subdivisions and counties run similar fiscal years as the state but budget for one year at a time. Counties and cities may have similar or different budget processes. Funds may become available from one source as the opportunity for funding from another source closes.

The following are additional examples of financial risk:

- Sustainable funding over time does not materialize. Local governments may become dependent on state-funded orthoimagery acquisition and may not be prepared when state program funds are not available.
- Insufficient internal funding allocation or funding diverted to other projects
- Expected external funding does not materialize
- Dedicated vendor services and internal staff resources not sufficient
- Cost projections do not meet actual costs
- Poor contractor performance results in increased costs

Organizational Risks

Organizational risks involve the organizational, political, or legal aspects of imagery acquisition and delivery of products. This includes all aspects of partner organizational relationships, management, staff assignments, governance structure, high-level legislative and executive support, legal and policy rulings, and all types of political and media influences on implementation work.

The following are a few specific examples for this program:

- Expected legislative support is not provided
- Lack of sufficient senior executive awareness and support at various partner levels
- Expected level of participation from stakeholder groups is not delivered
- Administrative delays in procurement and policy approval of organizational/legal obstacles in forging formal partnerships
- Contract discrepancies impact timing and quality of contracted work
- Poor management and coordination creates delays and obstacles to consensus
- Political battles reduce level of collaboration and joint project participation
- Inability to build trusted relationship with the geospatial user community

Technical Risks

These risks are associated with the technological and operational aspects of the program, including procedural workflows associated with imagery acquisition and technology infrastructure to support delivery and distribution of data. These risks reflect potential technical obstacles in the program's development and implementation plans that could impact costs or the schedule.

The following are a few specific examples for this program:

- Weather conditions limit the number of days and hours suitable for capturing aerial exposures that meet specifications for sun angle, cloud-free skies, and leaf-off conditions.
- Natural disasters, particularly flooding, may obscure ground features.
- Delays in adhering to technical standards to be used as basis for imagery acquisition and data delivery.
- Problems with information technology infrastructure to support dissemination and delivery of imagery products.
- Network communication performance limitations impact access to imagery data and services.

6.0 Implementation Plan

6.1 Implementation Details and Timeline

The success of the Nebraska Statewide Imagery Program will be realized when certain objectives have been met. The following is a summary of activities that support the accomplishment of each program objective. The figure in Appendix III represents a timeline for the first four years of when objectives begin and end for the program.

1.0 Establish a program management team and operations plan with administrative coordination from the Geographic Information Office within the Office of the Chief Information Officer.

The expectation for the team is to have participants be in their role for the first two years. Thereafter, team members can rotate on an annual basis if they choose. The important thing is to maintain representation across all stakeholders. The formation of the planning team and development of an operations plan will begin as soon as the business plan is approved. This is a voluntary team of members. The State GIS Coordinator will solicit volunteers to be on the team that will include state, county, city, University and federal government individuals who have vested in interest in the imagery program.

The first meeting of team members will be to develop operational plans including a procurement plan. This will lead into a request for proposal (RFP) and outline methods to communicate the business plan objectives to stakeholders.

Start Date: February 2017
Duration: 5 months development, and implementation ongoing. After two years, new members can rotate annually during February.

2.0 Establish and maintain standards, policies and strategies to emphasize cooperation and coordination among state, federal, county, municipality, utilities, university and other political subdivisions and organizations.

The process will begin by defining the partners and relationships that exist between local, state and federal agencies. Areas of agreement will be identified and incorporated into strategies and policies to guide the program in order to promote cooperation.

Standards for orthoimagery acquisition have already been completed. However, with changes in technology and usage in applications, it may require these standards to be updated over time. Existing policies and procedures will be documented with timelines for the procurement and acquisition process.

Start Date: January 2017
Duration: 9 months development, and implementation/modifications ongoing

3.0 Identify and develop funding sources for program implementation and long term sustainability.

Initial funding for the first statewide orthoimagery acquisition and sustainable funding long term for orthoimagery are two of the strategies to address for this program. The program management team will further define funding from state, local and federal sources so they can be communicated to get necessary commitments from stakeholders. This will become important for budgeting, identify potential risks upfront, and be able to adjust the program in times of economic downturn.

The NITC GIS Council and OCIO need to work with the current administration and legislation to obtain a budgetary line item that will be sufficient to cover the anticipate annual costs. Once a budgetary program is in place then the OCIO will initiate a procurement process to purchase photogrammetric services covering the necessary acquisition cycles, project phases, and allowing for additional buy-up provisions from the program. Additional strategies and approaches for this objective are further outlined in section 4.8.Finance and Procurement Strategy.

Start Date: February 2017
Duration: 9 months development, and implementation ongoing. Planning efforts are re-evaluated during times of annual budgeting between June through September.

4.0 Implement a procurement and vendor selection process that allows multiple levels of government, university and other political subdivisions to purchase imagery and related products.

Program partners interested in participating in the program will be identified and specific information about their needs and funding processes will be documented. A Request for Information (RFI) was conducted in 2015 to obtain cost estimates as it relates to statewide imagery acquisition and data hosting services. The RFI provided information about additional buy-up options of imagery including oblique imagery, data hosting, and map services.

The program management team will further summarize needs of partners and the RFI information

along with strategies in the acquisition plan to develop a Request for Proposal (RFP). Depending on the scope and procurement issues there could possibly be several RFPs outlined for the various products and services needed. The RFPs will outline clear specifications and requirements for imagery acquisition and obtain updated costs in order to choose appropriate services from the contract. The members of the program management team will serve as evaluators for selecting contractors. They will follow DAS policies and procedures when selecting vendor contract awards. Once funding is secured, State of Nebraska DAS purchasing and OCIO will issue the RFP and then initiate contracts to selected contractors.

The RFP for orthoimagery acquisition will be constructed to allow only one award for the first acquisition event, with contingency to extend to multiple years if needed. This allows for the procurement process to be readjusted without being locked into a long-term contract that is difficult to modify or end.

Initial flight planning meetings will be required with contractors prior to data acquisition. This will be outlined in the RFP requirements. The program management team along with partners involved in the program will have the opportunity to evaluate products and services prior to accepting final delivery of the contract. Once the final products are delivered the OCIO will work with distribution activities outlined in objective 6.

Additional strategies and approaches for this objective are further outlined in section 4.8.Finance and Procurement Strategy.

Start Date: April 2017
Duration: 6 months development and implementation efforts are set in advance to flight acquisitions in fall and/or spring of each year.

5.0 Develop and implement a preservation plan for the digital conversion and archiving of historical aerial imagery.

This objective will need to be further defined in order to outline the information requirements and best practices for preserving historical aerial photographs. The Conservation Survey Division at UNL and the OCIO Geographic Information Office will lead in the development and implementation plans for this objective. There are several processes in the plan that will need to be considered. At a minimum, this involves indexing, rectification, attribution, metadata documentation, and distribution in order to deliver quality historical imagery.

Indexing

Tabular Index
Imagery will be indexed in a tabular format, referencing all significant areas/portions of the image in a table by section, township, and range and any other useful agency-specific grid system. This level of indexing does not require scanning.

Generalized Spatial Index
Create a spatially-referenced, generalized bounding box that represents the approximate boundaries of the imagery which can be represented within and searched for within a GIS. This process can be done with or without scanning of imagery.

Geo-Referencing and Rectification

Geo-Referenced
Imagery must first be scanned for this level of indexing/rectification. Guidelines and best practices will be used or developed where necessary for proper scanning of aerial photographs. It will require spatial coordinates on a minimum of four points that have a reasonable distribution

around the image. Geo-referencing steps may vary if one's end goal is a standalone, geo-referenced image (with collar info) or mosaic imagery.

Suggested reference material to be used for geo-referencing

1. Best available imagery
2. PLSS
3. 7.5 minute topo quad maps
4. Metadata to be used to record reference material used in geo-referencing

Ortho-rectification

Imagery must first be scanned. Requires information on several parameters of imagery to accurately complete the process (e.g., altitude, DEM, camera focal length)

Attribution

Proposed Attribution for Historic Imagery and/or Maps

- Document reference (number or ID on imagery or map)
- Document Year
- Media Type of original document. This includes a possible choice between aerial imagery film, aerial imagery enlargement on paper, aerial imagery enlargement on mylar, paper maps, and other document types.
- Color of imagery: B/W, color, infrared
- Physical size of original
- Approximate scale of original document
- Approximate geographic location of image
- County
- Section, Township, Range
- Map Index? Y/N
- Index Name (if available)
- Original Project Name
- Original Project Date
- Date inventory information collected
- Contact info for custodian of original
- Current storage location of orginal

Proposed Attribution as Historic Imagery and/or Maps are Scanned

- Document reference (number or ID on imagery or map)
- Scanning resolution
- Scanning parameters (if available)
- Date of scan
- Scanning vendor
- Scan file name
- Contact info for custodian of scanned document

Distribution

The distribution of imagery will include provisions for cataloging and indexing data files through NebraskaMAP. The indexing and metadata will be required for this activity.

Start Date: April 2017
Duration: 3 months development and implementation ongoing.

6.0 Expand existing data sharing and distribution methods to leverage historical and newly acquired imagery products so they are accessible, both publicly and for secure uses.

Imagery data must be easily accessible to the community of users to achieve the highest return on investment. Current imagery data sets are continuing to be cataloged and registered within the State of Nebraska Geospatial/GIS Enterprise platform and extended through NebraskaMAP. Additional geoprocessing tools to enable analysis and downloading of large raster files are under development and will start to be released in the fall of 2017.

The primary data hosting for raw tiles, cached, and/or mosaic of the orthoimagery files will be through the State of Nebraska Geospatial/GIS Enterprise platform. The Conservation Survey Division at UNL will continue to host the satellite and historical imagery through their programs. The state's enterprise solution can catalog imagery data holdings in other locations so it can be leveraged through NebraskaMAP and other application viewers. The OCIO will work with the University of Nebraska to develop methods to connect users to data with little, to no, data duplication.

Imagery products are large in size and are costly for ongoing hosting of the data. Efforts are underway by the State to outsource large raster files such as imagery to third party cloud hosting solutions. Ongoing efficiencies will be implemented to reduce costs in data hosting and application technologies. Other techniques using Enhanced Compression Wavelet (ECW) or Mr. SID formats for data compression will also be used in the process.

There are additional methods that will be addressed to distribute and consume imagery products. The following are some examples for this objective:

- Online image services map viewer for allowing visual quality control of the processed imagery before physical delivery of the final product
- Implement an online map viewer to show existing coverages of all imagery data products
- Provide server-based map services to allow partners to connect to data through desktop and other online map applications
- Online geoprocessing tools to further analyze and develop derivatives from imagery such as change detection and land use classifications.
- Appropriate web-based plug-ins or APIs to allow users to view, rotate and make measurements with oblique imagery
- Imagery products are registered and cataloged within NebraskaMAP so that users can quickly search and find data on a map.

Start Date: January 2017
Duration: 9 months development, and implementation ongoing.

7.0 Provide communications, technical assistance and education outreach activities supporting the efficient utilization of imagery products.

The existing relationships between the members of the NITC GIS Council and program partners will be used as the foundation for communications. Communication of standards, guidelines, and procedures from the state level will be incorporated into the existing county organizational structure. Modifications to this process will include incorporating data standards that meet wider audience needs. This will encourage county government to collaborate with entities around their county. This feedback will assist in updating the existing contracting process to ensure all contracts include the requirements needed for their applications. Meanwhile, these efforts support the data standards, procedures, and scope of work needed to meet the goals of the program.

Specific strategies to support communications, technical assistance and education outreach activities are located in section 7.0 Communications and Outreach.

Start Date: October 2017
Duration: 4 months development and implementation ongoing.

8.0 Develop and implement an acquisition plan for statewide orthoimagery coverage and other products targeted for data collection beginning the spring of 2018.

This plan will focus on the first year of orthoimagery and other imagery deliverables set for the spring of 2018. This is assuming we have funding sources and the procurement process in place. Input on product and service needs will be gathered early on from local, state and federal governments interested in partnering in the program. The plan will include a RFP, and procurement steps will be established to accept bids and award contracts as outlined in Objective 4. The plan will outline starting areas to begin flight acquisition, estimated costs from partners, procurement and agreement deadlines, acceptance of deliverables for review, and approval of deliverables. Municipalities and high priority areas wanting additional add-on products will be organized to assure efficient flight plans by the contractor.

The acquisition plan will be reviewed by all funding partners to assure accuracy prior to the initial flying season. Specific processes and timelines for procurement and acceptance of deliverables will be communicated at various steps. The program management team will conduct face-to-face meetings, webinars and develop other print materials to support communication during these steps. On an ongoing basis, the process will be repeated and all acquisition plans will be formally presented to any potential state, federal, or local partners as early as possible to encourage feedback, comments, and any information about potential funding.

Start Date: January 2017
Duration: 9 months development, and implementation fall and/or spring of every two years on a cycle.

9.0 Conduct a biennial evaluation and make necessary programmatic adjustments to procurement, standards, and other processes that impact activities and outcomes of the program.

The program management team will lead an assessment of the program. It will document how each of the objectives were met, lessons learned, and provide appropriate recommendations to readjust the overall program. A questionnaire will be developed to facilitate data gathering internally and an online survey will be used to monitor feedback from other stakeholders involved in the process. This information will be compiled into a biennial report and will be submitted to the NITC GIS Council for review and further recommendations in the fall every two years. Specific desired outcomes that will be assembled and evaluated are further outlined in section 8.0 Measuring Success and Feedback for Recalibration.

Start Date: October 2018
Duration: 2 months development, and ongoing modifications until development starts again in two years.

7.0 Communications and Outreach

7.1 Communications

Develop a communications plan through the program management team by incorporating some of the following objectives:

- Establish necessary branding and overall message that can be marketed to a wide variety of audiences at the local, state and federal levels.
- Maintain a comprehensive contact database of partners including government, associations and industry that may benefit from imagery products.
- Develop a web-based coverage map through NebraskaMAP showing imagery data availability across the state.
- Share impact statements aimed at key decision makers who are managers, directors and elected officials at the federal, state and local levels showing impact and uses of the data through the program and how benefits outweigh program costs.
- Develop other explanatory and promotional materials that provide information on needs, applications, and benefits of the program to users of the data.
- Provide timely face-to-face meetings, webinars, and teleconferences for partners to respond to and provide input on imagery acquisition opportunities as they become available.
- Maintain a statewide electronic mailing list for emailing frequent communication, news, and updates about imagery acquisition among partners. Use other electronic social media and web sites to also communicate information.
- Conduct presentations, seminars, lectures, posters and displays at various statewide association and other meetings where appropriate. A few example meetings and conferences can include:
    - Nebraska GIS LIS Association Biennium Symposium
    - Annual Water Symposia conducted by the Nebraska Water Center
    - Annual meetings and conferences for Nebraska Association of County Officials (NACO), League of Nebraska Municipalities, Nebraska Association of Resources Districts (NARD), Natural Resources Districts, Soil and Water Conservation Society, Nebraska American Water Works Association (AWWA), American Public Works Association (APWA), Nebraska Water Environment Association (NWEA), other Water Resource related associations, United States Geological Survey, Natural Resources Conservation Service, Federal Emergency Management Agency, and Army Corp of Engineers.

7.2 Technical Assistance and Education Outreach

Develop a technical assistance and education outreach plan through the program management team by incorporating some of the following objectives:

- Identify appropriate target audiences and package promotional, educational, and technical assistance materials to support their needs.
- Develop illustrative content for use in both printed and web based media.
    - Fact sheets
    - Technical “How-To” guides
    - Electronic presentations made available as either stand alone or through web-based communication such as webinars.
- Partner with University of Nebraska entities that are in line with our program goals to assist in facilitating and conducting educational activities across the State. For example, leverage groups such as NebraskaView, Center for Advanced Land Management Information Technology (CALMIT), and Extension Service.

- Develop and implement hands-on workshops on how to use imagery data through various applications such as GIS and other mapping and interpretive software.
- Support technical assistance needs of users by providing them connectivity to a statewide expert list of volunteers who manipulate and use imagery data for a variety of applications. This group would be listed as a contact list on the NebraskaMAP web site for assistance.

8.0 Measuring Success and Feedback for Recalibration

The successful implementation of this business plan should manifest itself in realization of a statewide imagery program to support multiple products of sufficient quality to support the majority of Nebraska's needs. As the most current and the most accurate imagery products are provided, it would constitute the authoritative imagery products for Nebraska. As such, it would be carefully managed, systematically improved, and widely distributed. To ensure that imagery efforts are bearing fruit, the imagery project management team would assemble and evaluate the following specific elements of success:

1. State standards and guidelines are developed for Nebraska imagery products and adopted by the NITC
2. Core imagery requirements are identified and documented to aid in the selection of imagery products to pursue
3. Awareness of the importance of imagery data in local, regional, state, and federal activities and in the activities of private concerns is elevated resulting in an increase in appreciation and support of statewide imagery efforts.
4. A statewide imagery program is authorized and funding aligned by the stakeholders.
5. Acquisition, marketing and outreach, stewardship, and distribution plans are written to guide the imagery program into the future.
6. Imagery projects resulting in statewide imagery coverage are systematically and efficiently executed.
7. Historical aerial photographs are preserved digitally meeting standards.
8. Imagery investments are leveraged by stewardship and distribution of the data is made available through NebraskaMAP.

The imagery program management team will identify specific actions for recalibration of the implementation of this plan as needed. This will be accomplished from ongoing feedback of program participants, the evaluation of objectives being met, and overall maturity of the program based on sustainable funding and return on investment.

9.0 References

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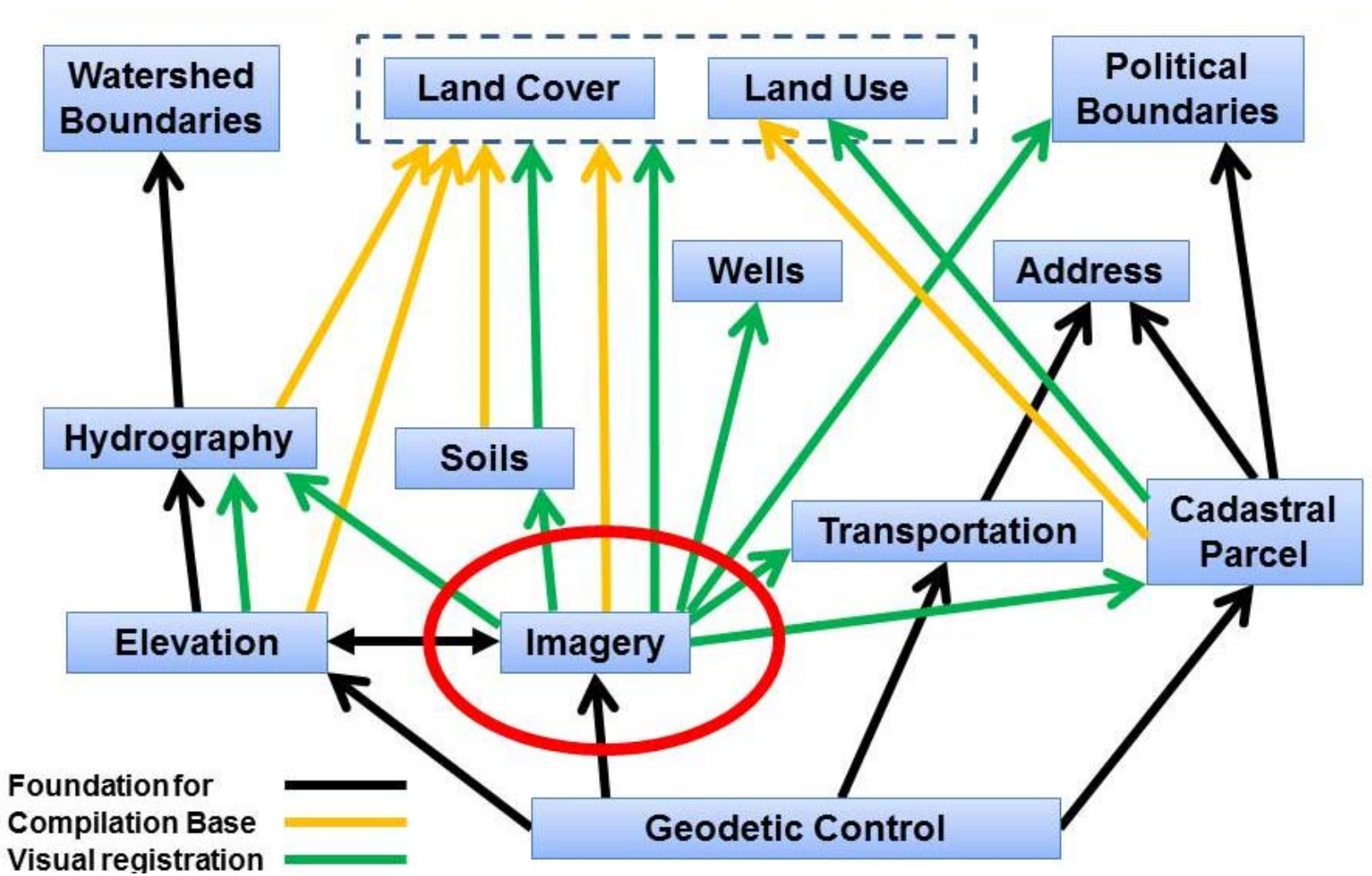
Appendix I – Relationship of Imagery to other Nebraska Spatial Data Infrastructure Layers



Appendix II – Orthoimagery Applications and Feature Recognition Examples by Resolution

Ortho-Imagery Applications and Feature Recognition by Resolution

	3-4 Inch	6 Inch	1 Foot	0.5 Meter	2 Foot	1 Meter
Applications	Utilities Engineering Roadside Feature Inventory	Central Business District (CBD) Mapping Public Works Management Transportation Engineering Urban Forestry	Urban Municipal Mapping Traffic Control Management	Urban Municipal Mapping Bridge Maintenance Large structure damage assessment	Semi-Urban Mapping Parks and Recreation Management	General Land Cover and Vegetation Type Identification Rural Mapping Mapping Large Scale Storm Debris
Identifiable and Measurable Features	Utility Boxes Fire Hydrants Reflective Road Markings Parking Meters Golf course flags Power and Communication Lines	Road Centerlines Culverts Manholes Train Tracks Fence Posts	Turning Lanes Marked Pedestrian Crossings Speed Bumps Fences Park Benches Communication Towers	Sidewalks Nature Trails Overhead Rail Bridges Housing and Roof Structures Cattle Guard Crossings	Driveways Medians Bike Lanes Car Ports Sheds	County and Gravel Roads Railroads Alleys Trees in Sparse Areas Stock Ponds Wind Turbines Large Commercial and Livestock Buildings with Add-ons

Appendix III – Implementation Timeline