

The background of the entire page is a grayscale aerial photograph. It shows a wide, winding river or stream that meanders through a landscape of agricultural fields. The fields are arranged in a regular grid pattern, separated by thin lines that likely represent roads or field boundaries. The overall scene is a typical rural landscape from a high-angle perspective.

**A BLUEPRINT FOR WISCONSIN'S STATEWIDE
AERIAL IMAGERY PROGRAM**

APRIL 26, 2013

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INTRODUCTION

This document, A Blueprint for Wisconsin's Statewide Aerial Imagery Program, proposes a business case and implementation strategy to support the development of a sustainable statewide aerial imagery program for Wisconsin. The ultimate goal of the plan is to provide recommendations for an implementation strategy that will assure Wisconsin has aerial imagery available to the broad and diverse user community that can be relied upon to be current, of a consistent standard, and cover the entire state. To accomplish this, the document sets out recommendations for funding, program governance, and program management. These recommendations were developed following an open and participatory process where imagery users from throughout Wisconsin provided their insights and requirements.

MAJOR FINDINGS

There is a very large and diverse community of aerial imagery users in Wisconsin. Users depend on available imagery to support a wide variety of business processes. Based on the feedback provided by the user community, we can make the following high-level observations:

- There is a long and successful tradition of voluntary collaborative imagery projects in Wisconsin. Past efforts have resulted in statewide data sets, but are generally not perceived by the imagery user community as sustainable and repeatable programs or sufficient to meet their long-term business needs.

Aerial Imagery refers to photography or digital pictures taken from the air. The method chosen to obtain and use imagery will depend on the needs of an organization. Differences in acquiring the imagery include:

- Equipment and aircraft
- Photographic versus digital imagery
- Image (color) type
- Pixel size
- Projection coordinates (location and registration)
- Uncorrected versus corrected (ortho)

Source: URISA Aerial Imagery Guidelines, 1999

- Public entities in Wisconsin spend an average of \$2.3 million annually on a wide variety of aerial imagery projects
- While the vast majority of funding for aerial imagery projects has been provided by city and county governments, the benefits derived from that data flows to users at every level of government and in the private sector. Through an on-line survey imagery, users in Wisconsin identified at least \$8.4 million per year in benefits from having imagery available.
- Many users rely on current and historic aerial imagery from public domain (no cost) sources to support their business processes.
- Opportunities for cost savings through "economies of scale" are not maximized under the current piecemeal approach to aerial imagery projects in Wisconsin. Past collaborative efforts that have been successful in reducing costs to participants the additional savings

could be gained through improved efficiencies in contracting, data delivery, and quality control/quality assurance procedures.

- Specialization in imagery related activities such as quality control evaluation and on-line web service provision could improve efficiency. The potential savings are not maximized under the current aerial imagery procurement system. Federal and private partnership opportunities may not be maximized and are difficult to implement due to the lack of an on-going and formal coordinated statewide program resulting in missed opportunities for cost savings.
- Communications and transparency in past projects have been limited by the voluntary nature of their leadership.
- Contrary to the assumptions of many politicians, the availability of aerial imagery on commercial internet sites for viewing (Bing, Google Maps, Google Earth, etc.) does not meet the needs of many government business activities.
- The satellite imagery currently available is not of sufficient spatial resolution to meet the needs of most organizations in the state.

The diversity of the imagery user community in Wisconsin requires that any program implemented be structured to allow participants the flexibility to purchase optional products and services such as higher resolution imagery, imagery derived data products, and variable projections or other upgrades from the standard product.

Information gathered from stakeholders through participation in an on-line survey, four regional workshops, and a web based workshop served as the foundation for this Business Plan.

SUMMARY OF RECOMMENDATIONS

Built on the information provided by the user community it is clear that Wisconsin should move forward to implement a statewide program of aerial imagery that is sustainably funded, provides a predictable and regular update of aerial imagery, and is governed with input from the user community. This section presents a summary of recommendations, additional detail can be found throughout the text of this Business Plan.

Identify a source of sustainable funding. A critical issue will be sustainable annual funding for any statewide program. Wisconsin has opportunities based on existing programs to provide the necessary funds without requiring an increase in taxes or user fees. Potential sources of funds with a direct relationship and rational nexus for funding statewide geospatial programs include the current "retained fees" for land records program and the E-911 charges that are designed to support the implementation and maintenance of that system. In both cases aerial imagery is critical to the ability of those program areas to function. However, neither source of funds has been leveraged to support a coordinated statewide program of data development or maintenance. No matter the source of this funding it must be driven by business needs and justified by an ongoing return on investment.

Establish a participatory governance structure. Any program that is implemented will require participation from the user community to be effective and to make sure that over time the imagery produced by the program meets their needs. This plan presents several models for implementation of the program, but constant to each is the need for the user community to be directly involved in determining imagery standards and schedules. It is valuable to have an advisory group of highly skilled technical professionals assist in this governance by providing the guidance necessary to ensure that the State continues to procure imagery that keeps pace with the rapidly evolving nature of image collection and processing technologies.

Identify a program administrator. An organization must be identified as the permanent home of the aerial imagery program. This administrative home should have a tradition of working cooperatively with local and county governments and administering cooperatively funded programs. This organization would provide the initial leadership in developing partnership opportunities and manage the outreach and communication to the user community. The Wisconsin Department of Administration (DOA) should be explored as the administrative home of this function. The DOA Division of Intergovernmental Relations currently provides a broad array of services to the public and state, local and tribal governments. Among the programs the DOA manages are those designed to support counties and municipalities with support services for land use planning, land information and records modernization,

municipal boundary review, plat review, demography and coastal management.

Identify an aerial imagery services organization. To maximize the efficiencies possible from technical specialization, an organization in government should be identified and accept responsibilities for providing the technical services to support the statewide program. While not an absolute necessity for the success of a program, a service provider within government would help to assure that specialization in quality assurance of spatial data products, user training, and on-line distribution of digital imagery. This would be the most efficient and means to create an additional ROI for the program.

Establish a State Minimum Imagery Standard. Once a governance structure has been identified and established by the imagery user community a state minimum imagery standard should be established. This standard would then drive the collection of statewide imagery. The imagery user community in Wisconsin's consensus during the outreach portion of this project supports the following as a potential standard:

- During "leaf-off" collection periods
- True color
- 12 inch GSD (pixel resolution) in rural areas
- 6 inch GSD (pixel resolution) in urban areas
- Establish a Regular Schedule of Imagery Acquisition.
- Imagery collected on a 3-year cycle

PROJECT OVERVIEW

In 2012, the State Cartographer's Office was awarded a Federal Geographic Data Committee (FGDC) Cooperative Agreements Program (CAP) grant to develop a "Business Plan for a Wisconsin Aerial Imagery Program." The grant has been used in part to fund the development of a blueprint for an aerial photography program for Wisconsin based on the identified needs of the State. This CAP grant application was developed by the SCO in cooperation with the North Central Wisconsin Regional Planning Commission, and the Wisconsin Department of Military Affairs.

Why does Wisconsin need a "business plan" for aerial imagery? Many people in our community have talked about the need for a statewide imagery program for many years, even as there have been successful voluntary efforts like WROC, there is a recognized need for some formality to the efforts. There is a perception among the imagery user community that the valuable statewide projects of the past have succeeded based on the efforts of a few individuals and organizations acting outside of their traditional strategic focus. The sustainability of those efforts is questioned because of these project characteristics. The first step in reaching the ultimate goal of a having a statewide program that provides

recent up to date imagery for the entire state in the public domain is to develop a solid business plan outlining the needs, benefits, and costs of such a program.

Below are what we consider to be the top 5 reasons for developing an aerial imagery business plan for Wisconsin:

1. Leaders expect to see a solid and defensible plan when asking for resources.
2. Resources are scarce, so having a solid and consistent plan that outlines how best to cooperate is critical.
3. Many local governments will acquire imagery in 2015. Now is the time to shape future plans based on an objective analysis of past lessons learned.
4. How can a future budget be developed if you don't have a plan?
5. A plan gives the community a goal for in the future.

The intent of this plan is to build on the work previously accomplished in Wisconsin. This includes building on the Wisconsin Land Information Association (WLIA) Orthophoto Task Force recommendations and

supporting various other planning activities in the State including the State of Wisconsin Homeland Security Strategic Plan call for the creation of a “land imaging strategy” with a sustainable and recurring statewide aerial photography program. Wisconsin’s statewide GIS Strategic Plan published in 2007, “Wisconsin Location Matters,” called for the creation of statewide and regional programs with “...reliable funding mechanisms dedicated to the coordinated development of GIS resources..” provides additional justification for supporting a statewide aerial imagery program. Finally, the 2012 final report by the Wisconsin White-Tailed Deer Trustee (aka the “Kroll Report”) supported the development of a statewide geospatial information system to provide seamless support to all state resource managers across agencies, which also supports economic development, emergency planning and response, and a host of citizen services. Aerial imagery is a foundational element of any statewide geospatial program.

PROJECT HISTORY AND APPROACH

This business plan builds on previous strategic planning efforts and successful aerial imagery programs. Wisconsin has a long history of collaborative geospatial programs and sustained support for the implementation of GIS and land information systems. The project to create this plan was initiated in 2012 when the State Cartographer’s Office (SCO) was awarded a Federal Geographic Data Committee (FGDC) Cooperative Agreements Program (CAP) grant to develop a “Business Plan for a Wisconsin Aerial Imagery Program.” This CAP grant application was developed by

the SCO in cooperation with the North Central Wisconsin Regional Planning Commission, and the Wisconsin Department of Military Affairs.

An open and participatory approach to development of this plan was undertaken to ensure that this business plan is based on the specific needs and desires of the geospatial community of Wisconsin. Broad outreach to the user community was accomplished throughout much of 2012 through an on-line survey, 5 regional workshops (Waukesha, Middleton, Stevens Point, Neenah, and Eau Claire), a series of 4 web based meetings, and presentations to statewide organization meetings (Wisconsin Land Information Association (WLIA), Esri Wisconsin User Group (EWUG)). Notes from each of the regional workshops were provided to attendees to allow them to review and comment. This document has been made available in draft form to the user community and their comments will be documented in Appendix C of this plan.

The Wisconsin User Community provided input to this plan:

- 974 Survey Responses
- 109 Workshop Attendees
- 99 Webinar Participants
- 25 In-depth Interviews
- 75+ WLIA Presentation Attendees

PROJECT GOALS

This project has been undertaken to develop a statewide business plan for a Wisconsin aerial imaging program. Initially anticipated outcomes from the project are:

- a comprehensive and participatory information-gathering process that assesses the needs, benefits, drawbacks, and risks associated with a statewide imagery program;
- a written business plan outlining the steps necessary to implement a statewide imagery program;
- an improved understanding of business planning procedures that may be used in the future to support the development or enhancement of other geospatial data themes such as elevation, parcels, or street centerlines.

Ultimately, the citizens of Wisconsin will benefit from an aerial imagery program that presents them with the imagery they need to meet critical business activities under a predictable cycle. The ultimate goal of any statewide aerial imagery program is to provide referential aerial imagery on a statewide basis that can be acquired online in a public domain setting. Predictability and availability are the two hallmarks of a successful statewide program. Clearly, no single imagery program can be all things to all users, but the vast majority of users can have their needs accommodated through a state program.

The business plan provides a blueprint for the development of a sustainable aerial imagery program with stable funding and

an accepted and supported governance structure that will provide statewide imagery with predictable refresh rates. Produced by an open, comprehensive, and participatory information-gathering process, the impressions presented in this document represent the collective thoughts and concerns of over 700 of Wisconsin's aerial imagery users.

PROJECT METHODOLOGY

To make certain the widest possible group of imagery users had ample opportunity to participate in this project, a four-tier approach to information gathering was undertaken. An on-line survey that was extensively promoted, including direct e-mails to over 2,100 imagery users in Wisconsin. The survey was also made available via a web link what was widely promoted through State Cartographers' Office publications and by affiliated organizations.

Regional workshops were held in 5 locations around the State to encourage face-to-face interaction with the imagery user community. A series of 4 web-based meetings were also held to supplement the information received in the survey and at the regional workshops.

At a meeting of the WLIA, a presentation and facilitated discussion was held to discuss the direction of a statewide aerial imagery program. The consulting team was on-site for the entire WLIA meeting and the EWUG meeting that immediately followed that event to meet individually with interested persons.

Finally, interviews were conducted with 25 carefully selected individuals to serve as

representatives of the broad user community.

The complete results of the on-line survey can be found in Appendix A of this report.

Table 2: Key Outreach Activities

Activity	Location	Date
On-Line Survey	On-line	21-Aug to 21-Sept
Regional Meeting	Stephens Point	24-Sep
Regional Meeting	Middleton	25-Sep
Regional Meeting	Waukesha	26-Sep
Regional Meeting	Neenah	27-Sep
Regional Meeting	Eau Claire	28-Sep
Webinar		16-Oct
Webinar		17-Oct
Webinar		18-Oct
Webinar		19-Oct
WLIA Presentation	Appleton	23-Oct
WLIA Meeting(s)	Appleton	24-Oct
EWUG Meeting	Appleton	25-Oct

OUTREACH PARTICIPANTS

The data used in this business plan was gathered through over 1,000 interactions with aerial imagery users or producers from all over Wisconsin. The majority of those, a total of 974, represent completed on-line surveys. Another 109 participated in a ½ day regional workshop and 99 individuals provided their feedback via an on-line workshop.

Participation was fairly distributed amongst individuals from all levels of government and the private sector as well. This is demonstrated by the distribution of participants by organization outlined in Table 2. Those participants categorized as “local” government may be from Cities, Towns, or Villages. “Non-profit” participation includes individuals from not-for-profit

organizations, public utilities, school districts, and universities or colleges.

The distribution of job titles and presumed level of responsibility of those participating in the on-line survey also represent a broad cross section of the aerial imagery user community. Table 3 shows the reported titles of those completing the survey. Individuals with assumed control or significant influence over the procurement and/or specifications for imagery represent 65% of all responses (Analyst, Manager, Executive, Director, Land Information Officer, Elected Official, or City/Village/Town/County Manager). Fully 94.9% of the survey respondents are currently employed in an organization that actively uses aerial imagery. This is demonstrated in Table 4. 71% of the respondents are users of imagery, while 20.7% are users and managers of aerial imagery products.

Table 2. Participation in Project

Interaction Method	Federal	State	Regional	County	Local	Tribal	Private	Non-Profit	Unknown	Total
On-Line Survey	28	204	16	223	80	5	253	131	34	974
Regional Workshop	4	17	9	33	10	1	23	10	2	109
Web Workshop	8	22	2	28	8	0	22	6	3	99

Table 3. Job Titles of Participants

Job Title	Response Percent	Response Count
Analyst [senior technical staff]	20.6%	199
Manager [influence decisions, supervise staff, manage projects]	20.2%	195
Other user of aerial imagery [GIS is not my primary job but use imagery to support my primary responsibilities]	12.3%	119
Executive/CEO/CIO [principal decision maker for organization's technology and budgets]	8.6%	83
Technician [junior technical staff]	7.2%	69
Director [make decisions for department or program]	6.7%	65
Other	6.5%	63
Educator	5.6%	54
Land Information Officer	5.0%	48
Elected Official	3.3%	32
Student	2.3%	22
Administration	1.0%	10
City/Village/Town/County Manager [jurisdiction senior management staff]	0.6%	6
Other		82

OVERVIEW OF CURRENT AERIAL IMAGERY AVAILABILITY AND USES

Aerial imagery is fundamental to a number of critical business functions for government. In addition to the traditional applications of imagery to support updating of tax records and supporting emergency response professionals, it is used to support natural resource management, economic development, and long range land use planning. While imagery is generally available to meet the needs of many of the State’s users, there are many actions that should be undertaken to improve the utility of imagery and improve the return on taxpayer investment in the collection, quality control, and distribution of this valuable data set.

Table 4. Interaction with Imagery

Primary Interaction with Imagery	Count	Percentage
A user of aerial imagery	644	71.00%
Producer/manager of aerial imagery products	30	3.31%
I do both	188	20.73%
My job doesn't require use of imagery	31	3.42%
Other	14	1.54%

AERIAL IMAGERY USE AND NEEDS

Imagery currently in use by most members of the aerial imagery user community has been acquired from public sources. Survey respondents were permitted to identify use of more than one source of the imagery so the numbers reported here exceed the total number of survey responses. However, the responses make it clear that most organizations use imagery from freely available sources. As Table 5 illustrates, fully 1,279 instances were reported on the survey where organization are pulling information from government imagery sources.

Table 5. Source of Imagery

Source of Imagery	Responses	Percent
Local/County/Regional government sources	543	62.9%
State government sources	411	47.6%
Federal sources	325	37.7%
Contract for purchase commercially produced new imagery (your organization owns and can distribute the imagery)	247	28.6%
Commercially licensed aerial imagery (your organization pays to use data and can NOT distribute the imagery)	101	11.7%
Produce our own aerial imagery in our organization	86	10.0%
Other (please specify)	50	5.8%
Unknown source	29	3.4%
Do not use aerial imagery	8	0.9%
Total Responses	863	100.0%

The greatest number of aerial imagery users in Wisconsin would benefit from an imagery program that collects imagery:

- Over 1/3 of the state on a rolling annual basis.
- During “leaf-off” collection periods.
- In true color.
- At 12 inch GSD (pixel resolution) in rural areas.
- At 6 inch GSD (pixel resolution) in urban areas.

Meanwhile, in 247 instances imagery is procured commercially for their organization and in 101 instances of the use of commercially licensed imagery was used. Only 86 organizations indicated they produce aerial imagery within their organization.

Generally, the imagery that is available meets the needs of organizations using it. In fact, for over 59% of all survey respondents, the aerial imagery available is sufficient to meet their needs. For over 35%, the imagery currently available partially meets their needs, and for 2.3%, the available imagery is insufficient.

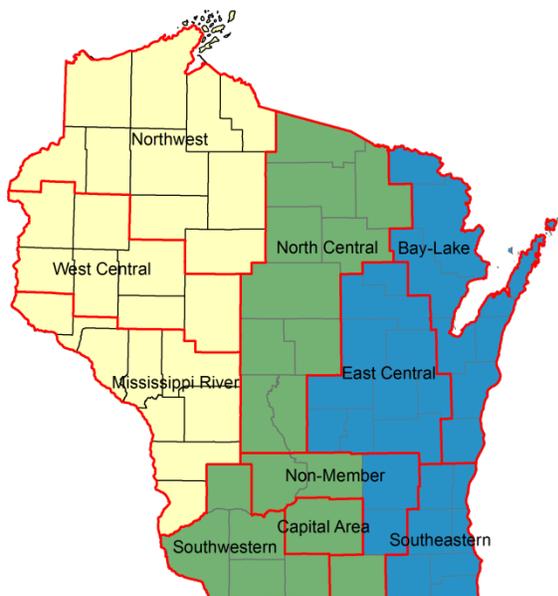
Moving forward with an aerial imagery plan and understanding of the shortcomings of the current imagery is important. Survey respondents indicated, as identified in Table 6, that the age of imagery and the lack of sufficient spatial resolution were the largest impediments to maximizing the return on the investment in imagery. While there was no

clear consensus voiced during the workshops, interviews, or web conferences on the specific frequency of aerial imagery acquisition, there was a general agreement that a refresh cycle shorter than the current 5-year cycle would be preferred. There are a few user groups, most notably some Regional Planning Commissions, that have business needs for collection of imagery on the census cycle (every 10 years) that should be maintained.

Generally, a program that has 1/3 of Wisconsin flown on a rotating annual basis would meet the broadest needs of the user community. Under this schedule the oldest any imagery for any jurisdiction at any one time would be 3 years. The existing regional planning commission (RPC) boundaries would be respected and the annual data collection zones would be wide area from north to south, making it more likely that leaf-off imagery could be acquired for the

Reason Available Imagery is Insufficient to Meet Needs	Response Percent	Response Count
Age of imagery	65.7%	222
Insufficient spatial resolution/pixel size	60.7%	205
Access/Availability	44.4%	150
Cost	28.4%	96
Poor accuracy	20.7%	70
Need multi-band imagery	13.3%	45
Insufficient systems, devices, or software	10.4%	35
Need true ortho (no building lean)	9.8%	33
Wrong projection	8.3%	28
Need oblique imagery	7.1%	24
Wrong file format	5.0%	17
Other (please specify)		34
Answered Question (multiple responses permitted)		338

entire area during the scheduled year.



evolve, the program must be flexible enough to accept advances in sensor and aerial platforms. Satellite imagery or unmanned aerial vehicles (UAV) based imagery programs may ultimately unseat traditional aircraft based imagery as a key data source for a multitude of geospatial applications.

This schedule should be flexible enough to provide for those regions that have an absolute need for collection during a census year to have imagery from that reference period.

Any program providing public domain imagery base must also provide an opportunity for participants to acquire additional geospatial products derived from the collected imagery or to purchase incrementally higher resolution imagery.

The user community should have a means for providing input and contributing to priority-setting for any statewide imagery program. This will include establishing annual collection priorities on an annual basis. This would give the program the potential to support NAIP or other off-year or off-cycle imagery programs. As technologies continue to

Table 6. Imagery Necessary to Meet Needs

Table 7. Characteristics of Imagery

Nearly 50% of survey responses selected

Type of Imagery	Pixel Resolution								Total Responses
	~3"	~6"	~12"	~18"	~24"	~1 Meter	Over 1 Meter	Other Unknown	
Natural Color	141	237	217	73	51	100	26	80	674
False Color Infrared	39	78	106	46	30	62	26	169	442
Black & White	86	123	127	52	34	53	19	123	488
Hyperspectral	24	39	60	26	20	47	25	200	382
Leaf-On	56	96	133	53	42	72	30	122	475
Leaf-Off	131	228	207	69	44	70	22	99	650
Other (please specify)								41	41

Insufficient spatial resolution was a key characteristic of available imagery that made it less than fully useful. As with the timing of missions, there was no clear consensus on the spatial resolution/pixel size necessary. In part this is driven by the widely variable business needs of the user community. There was a general agreement that 12 inch pixel sizes for rural areas and 6 inch for urban areas would meet most requirements. There was a strong consensus that any statewide program

should be structured to allow locally funded upgrades in image resolution and the purchase of additional imagery derived products, if necessary to meet local business needs. Survey respondents identified that natural color leaf-off imagery meets the majority of needs of the largest number of business users. Variable pixel size imagery identified as required by survey respondents, primarily ranging from 3 to 12 inches, supports the recommendation for a “buy-up” option for any statewide imagery program.

“every two to four years” as the frequency required to guarantee that the imagery available was sufficient to meet business needs. Another 30% selected “every year” to the same question.

Based on the guidance suggested by many of the individuals that participated in this project, the minimum state standard for ortho imagery should be 12 inch pixels, natural color, collected at least every 3 years during leaf-off conditions. We recommend a program where 1/3 of the state, approximately 19,000 square miles, is collected on a rolling basis. This will provide for a majority of the business needs expressed during the project.

Supplementing imagery meeting the recommended minimum standard would be options for partnership based “buy-ups” to include higher pixel resolution, additional spectral bands, oblique imagery, feature compilation, LiDAR, and 3D models.

It is important to note that this imagery, even with buy-up options, will not meet all the needs of every organization in Wisconsin. There will continue to be some need for custom collection of imagery to support

special projects or collection of wide area imagery during leaf-on conditions to support natural resource applications.

The scheduling of acquisition areas will need to be reviewed on an annual basis. The recommended program would fund collection of 1/3 of the state on an annual basis. Setting of annual priorities would allow organizations with critical time sensitive acquisition scheduled to be accommodated. For example, a number of planning organizations suggested that imagery is required to coincide with the census years to perform change detection and support long range planning activities. For these organizations a carefully managed and appropriately prioritized imagery program should be able to meet their needs.

EXISTING IMAGERY PROJECTS STRENGTHS AND WEAKNESSES

A key element to the development of a statewide aerial imagery program is an understanding of the user communities' perceived strengths and weaknesses of past and current projects. It is important to make sure that any implemented plan builds on the positive attributes of current projects and mitigates the identified weaknesses of those programs

CURRENT PROJECT STRENGTHS

As noted, Wisconsin has a long history of successful regional cooperation in geospatial projects. This history spans many decades in the case of some of the Regional Planning Commissions (RPCs), notably Southeastern Wisconsin Regional

Planning Commission (SEWRPC) regional aerial imagery projects. Other examples include the State's participation in the National Agricultural Imagery Program (NAIP)s, Fly Dane (the Dane County aerial imagery cooperative), and Wisconsin Regional Orthophotography Consortium (WROC) . Several smaller cooperative projects between county and city governments have been successful and will continue to be undertaken.

Projects like Fly Dane and WROC are effective because they allow partners to benefit from the "economies of scale" that are not available to a single entity. The flexibility offered in these programs to "buy up," or purchase improved imagery or other derived products, has been an important element to their success.

The ability of these programs to facilitate partnerships and encourage outside investment from federal and state sources has been a key element in their success since it further reduces the costs to local participants. WROC was particularly successful in 2010 by securing \$1.2 million from federal and state sources that allowed all areas of the state to have imagery available, even if it was at a lower, less than ideal, resolution.

The ability of these projects to place imagery in the public domain, without requiring use licenses or fees, has generated significant benefits for the very large imagery user community. Standard product availability across the entire state is important for many users, particularly private

sector and state communities, since they often span multiple counties in their areas of interest.

Previous cooperative projects have benefitted from vendor relationships with a long and trusted history in Wisconsin. The vendors chosen to provide the imagery have been very helpful in building support by potential participants into the project funding and have been viewed as expert consultants more than simply providers of a product.

For the most part, participants have found collaborative efforts beneficial since they ease the difficulties in procurement and project management. By participating in a cooperative effort, the partners can avoid having to issue an RFP on their own, thereby reducing the need for each participant to become “expert” in the language of aerial imagery specifications and eliminating requirements for proposal evaluations. Responsibilities for project management and quality control efforts have sometimes been taken on by the lead group in the project, further benefiting participants since they don’t have to devote staff resources to these tasks.

CURRENT PROJECTS WEAKNESSES

Moving forward, an implemented comprehensive program of aerial imagery for Wisconsin must focus on making sure that the weaknesses identified by the imagery user community with the current imagery projects are avoided. Identified weaknesses include a lack of stable funding, a lack of predictability and reliability, and a poor

understanding of the program products and how to best use them.

FINANCIAL SUPPORT

One of the universally identified weaknesses of cooperative imagery projects has been a lack of stable, predictable, sustainable, and significant financial support. Fly Dane has shown that a predictable and sustainable program is possible and that funding can be generated from fees for data from non-partners and by encouraging new partners to join.

While there are a large number of users of statewide imagery, many users have only sporadic needs for imagery or have no mandate to use imagery. These users typically use imagery to make their business processes or communications more efficient and effective, but could continue to fulfill their mission if imagery wasn’t available. Other groups depend on imagery but don’t have a history of providing regular financial support for acquiring the imagery.

These users benefit from public domain imagery, but are generally unable or unwilling to provide financial support to the imagery program. Users that rely heavily on public domain data are often viewed by other organizations as providing no material contribution to acquiring or delivering the imagery. Users of public domain data typically pay taxes to some jurisdiction that assists in funding the collection, processing, quality control, and distribution of the imagery. Even in those cases where the actual user of the imagery is not a taxpayer in the jurisdiction that contributed funding

for the imagery, it can be assumed that the use of the imagery ultimately benefits the area in some way—either through more efficient decision making or more effective services that are ultimately reflected in improved services or reduced costs to customers.

PREDICTABILITY AND RELIABILITY

The level of use and overall utility of statewide imagery, as well as the likelihood of a successful program or project, is boosted tremendously by users having faith that the imagery will be available when they need it, will be reasonably up to date, and be of reliable quality across the entire state.

Current programs, like WROC, that are voluntary in nature do not provide the predictability that allows users to have confidence that the imagery will be continuously available, updated regularly, and of standard quality. Current programs have tended to generate excellent high quality data in areas that are well-resourced. In areas where allocation of financial resource for imagery is more challenging, the data produced has tended to be of lower resolution and often diminished spatial accuracy.

Differences between adjoining counties or regions in terms of image quality or projections make using them for analysis beyond a single local jurisdiction (county or city) problematic for many users. Variability in projections and datum from area to area add additional work to those organizations

attempting to use imagery from variable sources.

Variation in the season or date of image acquisition for adjoining areas can be problematic if the gap between the collection dates is significant. Making decisions on data of variable ages leads to increased uncertainty.

Image processing and quality control standards and methodologies variability may also mean that data may not “match up” at county boundaries. Spatial accuracies may vary, pixel resolutions may not match, and spectral properties will vary, thus the value of the imagery for many applications is diminished.

IMPROVED RESOLUTION

For many users the imagery that has been generated across the state does not provide the resolution they believe necessary to apply it to the maximum effectiveness for business processes. WROC provided a statewide data set with an 18 inch GSD. In many workshops and via survey responses, the necessity of higher resolution imagery across the entire state was voiced.

Existing projects, with limited funding, may not be maximizing the utility of products because they don't most efficiently take advantage of potential partnership funds (public and private) or leverage to the highest level the economies of scale that are possible.

TECHNICAL SUPPORT AND TRAINING

During the regional workshops and individual interviews a frequently cited issue was the lack of solid technical expertise in imagery from many of the individuals charged with funding projects to acquire imagery. Typically these individuals serve roles as GIS managers or department heads and do not have the background in remote sensing to confidently make decisions relative to the characteristics of that imagery.

A lack of technical expertise on the part of those making procurement decisions increases the dependency of the vendor community to recommend imagery standards and quality control metrics. While consistently stressing that they believe the aerial imagery vendor community is ethical in their business dealings, this lack of a truly independent broker of information about imagery makes some of the organizations funding the imagery project uncomfortable.

Related to this dependency on the vendor community, a frequently identified issue is a need for training. There is a general belief in the user community that the investment that has been made in imagery is not being fully leveraged because the total potential uses of these data are not understood. Of the 328 individuals that responded to the question about what would allow them to maximize the utility of the aerial imagery fully 27% (88) identified the need for additional training. Over 70% (231) felt that web services, if provided by the State would allow them to maximize their use of imagery in their business processes.

TRANSPARENCY AND COMMUNICATION

Most of the cooperative projects that have been successful have been driven by volunteer leadership, sometimes a single individual, that takes on responsibilities for moving the project forward outside of their typical employment responsibilities. These leaders, while universally complimented for their effort toward the "greater good," only have a limited amount of time to devote to these efforts and often the activities related to project communication are those that tend to be overlooked.

Since the leadership of these projects is largely on a volunteer basis, the resulting project activities are a testament to the level of time and attention available in an otherwise full professional calendar. They are subject to the willingness of individuals and organizations to provide the leadership. WROC, for example, has been largely driven by the involvement of a small group of individuals at the RPC level. As long as those individuals and organizations are committed to its success then it will continue. But, that type of project is fragile in that a policy change within a single organization or a change in staff can result in the end of a historically successful project.

Project close out and transparency can suffer under a voluntary leadership scenario. Since the negotiated prices and contributions from private and public partners are not fully understood by many participants, the financial management of the project can be subject to question. Frequently partner funding is tied to a specific geography, USGS 133 Cities

program funding for example. There can be a sense that somehow some areas are benefiting more than others from partnership funds.

Since purchasing arrangements have been between the vendor and the individual purchasing the imagery there are opportunities for a manipulation of costs. Individual contracts between county and vendor also mean that some of the economies of scale that could be realized from a regional or state contract are lost.

AERIAL IMAGERY

USES AND BENEFITS

Aerial imagery offers many benefits including improved decision making, improved efficiency of operation, and enhanced services and products as discussed in detail below. A coordinated statewide approach to aerial imagery production and distribution can ensure that public and private investments offer the highest return possible. It is important to the success of any aerial imagery program to understand that the benefits, as well as costs, must be shared across the entire spectrum of imagery users. At several of the user community workshops, participants pointed out that the state would benefit greatly if there was less concern about individuals and organizations receiving credit for a successful program and more focus on providing a service to the community. Also stressed during the workshops was the need to change the perspective on potential funding streams to understand that public funds should be viewed as a whole, and not “belonging” to the level of government that collects them.

WROC is an example of how cooperative aerial imagery programs can serve as the catalyst for breaking down these barriers. Cooperative funding from a variety of partners to create data placed in the public domain provides an excellent example of what can be accomplished.

Government has an obligation to assure that public funds are being used in the most effective and efficient way possible. Cooperative approaches to imagery

acquisition, processing, QA/QC, and distribution present the best way to ensure efficient and effective use of the tax money entrusted to the government.

In general, the benefits most often realized by having up to date aerial imagery available include the following factors:

Operational and Efficiency Gains. Expected gains in current personnel efficiency and productivity allowing work to be accomplished in less time and at less expense. These benefits can include reduced efforts for completing tasks, reduction in expenditures for infrastructure or assets, elimination of redundancies of processes, better decision-making, and more efficient use of resources. Over 82% of survey respondents indicated that imagery has allowed them to “improve mission performance” and “improved staff productivity.” While these benefits can be difficult to quantify, clearly they are enjoyed by a majority of organizations.

Customer Benefits. Benefits realized by providing better services or products directly to the citizen and/or customer. These benefits can be found in government as well as in private firms using aerial imagery. These benefits can include faster delivery of services, more convenient access to information, and a better experience receiving products or services. More efficient and effective interaction with citizens saving them time and money is a clear example of this type of benefit. Just

over 80% of survey respondents reported 'improved customer satisfaction' was a benefit from having imagery available for use.

Cost Savings and Cost Avoidance.

Reduction in current monetary expenses such as contract costs and direct expenses. Lowering or completely avoiding increased costs that would be incurred without the use of imagery when new programs, regulatory requirements or other new demands are placed on existing organizations. Cost savings from improved asset management and from jointly funded projects were identified by 41% of respondents as a benefit from imagery availability. Another significant benefit (claimed by 55% of survey respondents) was reduced travel times and more effective management of field services (69% of survey respondents).

Revenue Enhancement. Use of imagery and derived data in applications and business processes that result in increased revenue collection from existing or new sources. This type of benefit was identified by 29% of survey respondents. While not a large number, this is likely based on the mission of specific survey respondent's organizations—those not directly involved with revenue collection or would be unlikely to identify this as a benefit. Several municipal and county governments identified circumstances where they were able to increase tax collection based on identification of improvements to real property not noted in the tax rolls.

As a result of these benefits, organizations can better meet their varied missions for economic stimulation, environmental management, public safety, public education, and increased revenue or profit, among many others.

During the outreach portion of this project, survey respondents were asked to identify specific benefits from having up to date aerial imagery available. The survey revealed that over 90% of all respondents had demonstrated benefits from improved decision making, improved timeliness of data and services, improved mission performance, and improved staff productivities or labor cost savings. More detailed information on the benefits from aerial imagery can be found in Appendix A, Summary of On-line Survey Results, and Appendix B, Regional Meeting Notes.

PROGRAM SPECIFIC EXAMPLES OF BENEFITS

The benefits of a cooperative and coordinated approach to maintaining current aerial imagery are many. A few key areas that represent clear opportunities for making a real difference in saving money, saving lives, and supporting economic development in Wisconsin include:

Improved Customer Service and

Communication. Several agencies reported that having aerial imagery allows them to improve customer service and to improve communications. Wisconsin Department of Natural Resources (DNR) has effectively used aerial imagery to support ground and drinking water programs. Several users

reported using aerial imagery to improve the understanding of situations prior to making decisions on zoning adjustment boards and city councils/county boards. Using imagery to identify existing conditions for the decision makers was reported to have improved decision-making and it also reduced the time necessary to evaluate potential alternatives.

Property Tax Assessment – Tax assessors currently rely on field evaluations to determine if additions to property have been accurately recorded for taxation. In some instances, additions are not viewable or accessible to the field evaluators, increasing the potential of missing property improvements that have not been recorded on tax rolls. Using aerial imagery to confirm accuracy in tax records enhances the equity of the real property taxation system and ensures that everyone is treated equally. Aerial imagery allows for these assessors to view additions on properties without field visits, saving time spent in the field and increasing the probability of finding unrecorded additions to tax property owners more equitably. A single Wisconsin county was able to use aerial imagery to identify parcels that had not been appropriately listed on the tax rolls. There were 27 parcels with an assessed value of \$1.6 million. This find added revenue, improved equity, and improved credibility of that county’s taxation system.

Emergency Management, Response, and Recovery – Wisconsin faces risks from natural and man-made disasters. Aerial imagery and derived data, when applied to

applications such as evacuation route planning, mitigation, flood zone management and damage assessment, can assist Wisconsin communities tremendously. Aerial imagery helps improve public safety agencies and leads to improved decision-making that ultimately leads to lives saved, and helps to minimize the impact of lost property. Emergency response times have been improved through the use of imagery to identify helicopter landing areas quickly. Wildfire suppression has been made more efficient with an understanding of how best to approach the fire and to prepare evacuation plans.

One example of this type of application can be found in the response to severe storms in the summer of 2011. These storms caused extensive damage to woodlands in northwest Wisconsin. The WDNR contracted for the acquisition of imagery for the affected areas to assist the local foresters’ efforts in educating the public and reducing fuel loads to mitigate wildfire potential. Reclamation of downed timber was accelerated thereby boosting the economic return to Wisconsin and removing potential fuel for wildfires in ensuing years.

Public Safety/Homeland Security – The operations of law enforcement often require collaboration and communication across jurisdictional boundaries and between government organizations. Aerial imagery increases public safety, including improved 911 services, and emergency response management integration. Emergency response through E-911 is aided through the

use of aerial photography available to first responders, such as firefighters, and to aid dispatchers in routing those responders appropriately. Aerial imagery is also used to support tactical surveillance and in planning for police tactical and homeland security units.

Asset Management – Benefits have been demonstrated by several jurisdictions in improved management of assets through the availability of aerial imagery. The Wisconsin National Guard has approximately 80 sites around the state and uses aerial imagery to update real property databases without extensive fieldwork. Available imagery saved a significant amount of time and resources on the update of their GIS database. By eliminated over 60 field visits through the use of imagery allowed the resulting GIS to be efficiently updated and used to more cost effectively manage the maintenance of assets.

Available imagery was reported to reduce potential confusion from road maintenance and other field crews when they are sent to make repairs. With an aerial image they can clearly see the context of the area where they are to be working, making it less likely that mistakes will be made.

The Village of Brown Deer has been able to reduce or eliminate the need for field engineering for some capital improvement projects such as road resurfacing and water main relay projects.

Economic Development – Activities that boost the economic opportunities for Wisconsin's citizens benefit from aerial

imagery availability. Traditional site selection for industry and commerce is made more efficient and effective through the use of this data. Extractive and agriculture industries use aerial imagery to improve the efficiencies of operations, and to better manage timber and row crop agricultural production.

Natural and Cultural Resource Protection – Users reported a number of specific examples where imagery was used to preserve resources. One specific example cited involved determining a new roadway through an original Savanna Oaks stand, in Muskego, where the major trees were preserved through developing a roadway alignment that protected this significant natural resource.

The Department of Natural Resources uses aerial imagery for wetlands and habitat delineation.

BENEFITS SPECIFIC TO COORDINATED EFFORTS

There are a number of tangible benefits from improving coordination; these benefits are those where a specific dollar amount of savings or other benefit can be identified.

Activities as simple as improved coordination in the timing of aerial imagery acquisition flights offer the potential for significant savings through cooperative funding and cost avoidance.

Improved coordination with potential Federal and private sector partners may also result in an enhanced ability to avoid

direct costs to taxpayers by leveraging increased partnership contributions.

There is an active tradition of coordination of aerial imagery projects within Wisconsin. With Federal initiatives (NAIP, 133 Cities), WROC, Fly Dane, Southeast Wisconsin Regional Planning Commission, and a number of city/county joint initiatives, with over half (55.1%) of imagery users actively participating in a cooperative effort. 41% of the organizations reported that these benefits have resulted in reduced costs through joint funding. The value of the savings from cooperative programs was reported on the on-line survey to be \$710,000 over the last 5 years. This value represents the savings reported by just 24 of the several hundred survey responses received. Additional cost avoidance opportunities are found through recommendations for identification of a single organization to provide QA/QC services to entities funding aerial mapping projects in Wisconsin, technical support in procurement for all entities, and support for data discovery, training of imagery users, and dissemination activities.

TANGIBLE BENEFITS FROM AERIAL IMAGERY AVAILABILITY

Clearly there are many benefits that support the development of a statewide aerial imagery program. Anecdotal evidence and survey responses point out many of the difficult to measure benefits: improved decision-making, improve timeliness of data and services, and improved public satisfaction are a few of the benefits. While these are all important justifications for investing in a program, it is appropriate to explore the tangible benefits (those that can be measured in dollars) that the residents of Wisconsin can expect from investing in aerial imagery.

Respondents to the on-line survey of aerial imagery users identified \$8.4 million per year in tangible benefits from aerial imagery and identified an average of \$2.4 million per year over the last 5 years. Oblique imagery was identified as having provided an additional \$753,000 in annual benefits to governments on an investment of \$230,000. The projected total benefits are a conservative estimate that does not take into account benefits accruing to the private sector. Nor are these benefits expanded to account for the type of benefit across the entire State. There has been no attempt as part of this project to forecast benefits across the universe of users in Wisconsin. Instead these benefits are the sum of those actually reported on the survey responses or through interviews with imagery users.

Table 8. Value of Tangible Benefits from Aerial Imagery

Type of Benefits (Estimated Value)	Reported Total 5 Year	Annual Average	Number of Responses
Asset Management	\$4,809,967	\$961,993	34
Avoid new costs	\$4,789,967	\$957,993	35
CIP Design	\$4,759,965	\$951,993	36
Economic Development	\$4,589,971	\$917,994	30
Increased Productivity	\$4,539,948	\$907,990	53
Management/Allocation of Field Services	\$4,449,955	\$889,991	45
Infra Maintenance	\$4,339,970	\$867,994	31
Reduced Costs Joint Funding	\$3,969,975	\$793,995	26
Reduction in Duplication	\$3,249,964	\$649,993	36
Revenue Increase	\$2,539,980	\$507,996	21
Other	\$49,999	\$10,000	1

shown in Table 8, several types of tangible benefits were reported by survey respondents collectively to approach \$1 million per year each: Asset Management, New Cost Avoidance, Capital Improvement Program (CIP), Economic and Business Development, and Increased Productivity. The benefits from reduced costs through joint funding of aerial imagery projects were reported at \$793,995 per year. While the overall total benefit for this type of activity is not the leading response, the 26 that identified savings from joint mapping projects exceeded \$30,000 per year. This clearly demonstrates that although there is not a formal statewide program in place, organizations are working together to maximize the benefits to their organizations.

Our survey of imagery vendors suggested that by simply acquiring imagery for the entire state, even allowing for local options and buy-ups, would save at least 5% of total costs from simplifying contracting and approval requirements.

OBLIQUE IMAGERY USES AND BENEFITS

Oblique imagery (in which the siting of the sensor from the aerial platform to the ground is at an angle from the vertical) provides a better view of the sides of buildings, structures, and landforms as compared with traditional vertical imagery. This imagery has become increasingly commonplace in government settings and for private users in public safety, real property evaluation, and infrastructure inventory.

Overall, 223 of the survey respondents noted that they are currently using oblique imagery in their organization and another 140 would like to have oblique imagery available. Over the last 5 years, over \$1.4 million has been invested in this type of imagery.

The primary uses for this imagery have predominantly been at the local and county government levels where the imagery is used for a variety of functions. Anecdotal evidence from workshop comments suggest that the primary uses for these data are code enforcement, supporting assessment for property taxes, and for supporting public safety applications in fire and police departments.

While these data are rapidly becoming more common, they are far from ubiquitous. Historically, there has been a single predominant vendor in the oblique imagery market (i.e., Pictometry) making procurement sometimes problematic and the ability to select variable resolutions, formats, licensing schemes, and viewer

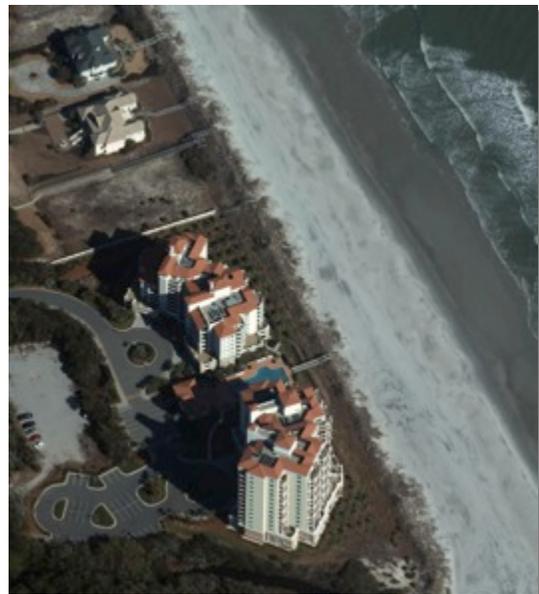


FIGURE 1. OBLIQUE IMAGERY SAMPLES PROVIDED BY PICTOMETRY AND FUGRO EARTHDATA

functionality limited. There are now several national mapping firms that offer oblique imagery collected simultaneously with traditional orthographic aerial imagery using a variety of camera configurations and technologies. It can be reasonably forecasted that within the next several years oblique deliveries along with traditional ortho imagery will become commonplace.

The majority of this business plan focuses on the traditional ortho imagery product and since there are limited oblique requirements from state and federal organizations, over the short term oblique imagery should be viewed as a local option “buy-up” to traditional ortho imagery collection. However, it should be viewed as an essential option in any statewide procurement program.

Oblique imagery does have significant positive benefits to many jurisdictions. With software and customized applications, many governments in Wisconsin are supporting emergency response, economic development, property tax appraisal, and code enforcement. Applications that allow for remotely sensed imagery to be used to measure building facades and other details and the ability to view building faces have enabled many organizations to reduce the quantity of field work required to update tax records.

COMMERCIAL WEB MAPPING SERVICES

A significant impediment to securing the funding necessary to acquire aerial imagery has been a lack of understanding that imagery currently available on Google

Maps, Google Earth, Microsoft Bing Maps, or other similar on-line commercial mapping services. That is to say that they are not sufficient to meet the needs of government. Participants indicated that they encounter resistance from elected officials and organizational leadership making budget decisions that believe that imagery available for viewing on public web sites should meet all of the needs of their organization.

Imagery that is available for viewing on commercial web sites and other sources of aerial photography does not meet the needs of government entities for a number of reasons:

- There is no control over specifications or scheduling so the timing of imagery collection is not linked to any particular business needs.
- The date of acquisition is often not available so they cannot be used for certification of tax rolls or to support decisions or detect changes since when the imagery is acquired can be of critical importance to those processes.
- Spatial accuracy of the imagery cannot be validated so measurements cannot be authoritatively derived.
- Quality control procedures are not documented or are too vague to be of value.
- The best, highest resolution, and most up-to-date imagery is usually available for populated areas.

- Ability to use and distribute imagery outside of a single web site is restricted by technology or licensing so the utility of the imagery is limited. For example, you can't blow up a Google map to a clear poster size image for display at a plan commission meeting.
- A clear chain of custody is impossible to establish so using the imagery to support code enforcement actions based on activities seen in the imagery may not be possible.
- There is no metadata.

Despite the inability to use imagery available from these publically accessible web services as a definitive and authoritative data source these sources do

have utility for many aerial imagery users. For simple situational awareness, planning fieldwork, and attempting to communicate locations to citizens these data sources can prove valuable.

As the Wisconsin's statewide aerial imagery program and commercial entities involvement in collection and distribution evolve attention should continue to be paid to these private sources. Ultimately these web based imagery services may prove to be valuable private participants in a program, or may replace traditional aerial imagery vendors in the collection and processing of imagery.



Figure 2: Illustration of quality differences between imagery obtained from Google Maps (left) and orthophotography obtained by a government-sponsored orthophotography program (right).

AERIAL IMAGERY PROGRAM IMPLEMENTATION MODELS

SUMMARY

Wisconsin has enjoyed several extremely successful cooperative regional and statewide aerial imagery projects. The South Eastern Wisconsin Regional Planning Commission (SEWRPC) has implemented a successful regional mapping program including aerial imagery for over 50 years for their 7-county region. Dane County has a long history of success with their Fly Dane program. On a statewide basis the Wisconsin Regional Orthophotography Consortium (WROC) was successful in 2010 building the voluntary collaborative partnerships necessary to accomplish a statewide ortho photo collection.

There have been countless other cooperative aerial imagery projects as well as demonstrated by the survey results that that over 55% of aerial imagery users have benefited from a cooperative program, see Table 9. The largest single response to this question indicates widespread participation in these historically successful regional initiatives, 35.8%.

While each of these projects have been successful, they all fall somewhat short in meeting the objectives of having a

predictable and repeatable program that provides a standard level of statewide imagery in the public domain for users of all varieties.

Since the majority of imagery users in Wisconsin are not at the city, county, or regional government level, it is important that any implemented statewide program consider the needs of the entire user community.

This section will review a variety of statewide program models with the goal of identifying the user community's perception of the strengths and weakness of each. While each option is presented as a unique and distinct components from each may be pulled together into a single statewide program. In fact it is likely the any program ultimately implemented in Wisconsin will be a hybrid taking portions of each model to form a program to meet the State's unique needs.

Table 9. Cooperative Project Participation

Cooperative Imagery Project	Response Percent	Response Count
Federal (e.g. 133 Urban Area Initiative, NAIP)	14.9%	131
State	22.2%	195
Regional (e.g. WROC, SEWRPC)	35.8%	315
Other	11.7%	103
No	44.9%	395
If OTHER, please briefly identify the partners:		113

predictable and repeatable program that

CONSORTIUM (WROC)

This model represents the status quo in Wisconsin and would involve a regular repeat of the successful 2010 WROC project. Under this model there is little to compel participation by units of government other than the ability to potentially save costs through a cooperative procurement mechanism and some support for QA/QC..

Leadership is provided by a coordinator that is employed by an organization willing to support coordination and procurement activities beyond the normal scope of their business functions or outside of the traditional regional areas. This type of effort may be led by a Regional Planning Commission (as has been the case with WROC) or an existing formalized community of users such as WLIA.

WROC is an outstanding example of a voluntary collaborative effort, with success in 2010 and planning well underway for 2015. Fundamental to the success of voluntary cooperatives is the willingness of an organization or individual to assume a leadership role in the effort. Wisconsin has been fortunate that volunteer leadership has been provided by the RPCs.

A particular strength of this type of effort is that it has been successful and has very minimal impact on the business processes of the participating governments. Unfortunately, without formalized support or governance this type of effort may ultimately fall short of the goal of providing a statewide coverage available in the public domain that can be relied upon for regular updates.

In 2010 the voluntary WROC effort was able to secure state and federal partners contributing to get the state completed at a low resolution. These types of partnership funding opportunities must be cultivated over the long term and are increasingly more difficult to accomplish without a formal mechanism in place to solicit and receive funds.

SUPPORTED VOLUNTARY COLLABORATIVE (WROC 2.0)

Under the Supported Voluntary Collaborative model, there is a voluntary working together of organizations requiring aerial imagery that is supported by dedicated funding from a state entity. Typically, one of the easiest methods to encourage participation is to buy it and this model attempts to do this by making funding available to cooperating partners that agree to provide imagery meeting a minimum standard to a public domain data distribution service.

Organizations voluntarily agree to participate in order to secure the supporting funds. There is no way to force participation and the local or county collaborating partner retains full control of the procurement process, QA/QC, and distribution of products that are beyond the minimum required contribution to a statewide data clearinghouse. This method maximizes local control over the contracts, vendor relationships, quality control, and the products that are purchased. External support encourages placing of data into the public domain to maximize availability of imagery to the entire user community.

While this model can be attractive to fairly well resourced counties and regions it falls short on some measures of a successful stated aerial imagery program. Notably, it does not guarantee that it will result in a statewide coverage of imagery that is of a standard quality and recently collected enough to be useful for the diverse imagery user community in Wisconsin.

There is also little transparency into the savings, if any, which are generated by this program. The potential or economies of scale in imagery acquisition, processing, quality control, and distribution are limited.

This sort of model has been somewhat successfully implemented in a few states, such as South Carolina, where funds from E-911 fees designed to support next generation systems (NG911) are devoted to an aerial imagery grant program to county and regional governments. A limited pool of funding is available on an annual basis to assist county and regional governments to acquire aerial imagery. Imagery meeting the State's minimum standard is provided to the state to be included in state geospatial web servers so it become part of the public domain.

DISTRIBUTED SYSTEM

This type of statewide aerial imagery program recognizes that there are a wide variety of stakeholders in an imagery program and each of these stakeholders has distinct needs, advantages, and abilities to provide something to the program.

A single entity handles all procurement and contractual matters. Local collaborating partners in this process enter into

agreements with the contracting partner and thus avoid the costs associated with procurement, including drafting and evaluation of an RFP, negotiation of contract language with the vendor, and contract management. The contracting partner may fund only a portion of the overall cost of image acquisition and processing. The contracting entity may be responsible for negotiation of partnerships with public and private organizations to assist funding the program.

Each participant provides the QA/QC necessary to evaluate the vendors work products and determine if they meet the contracted standards for spatial accuracy, resolution, and color balancing. Ground control and QA/QC services may be structured to be an in-kind contribution to the aerial imagery acquisition and processing.

Another entity is responsible for providing the web services necessary to make the imagery available to the imagery user community. In some cases yet another organization is charged with developing the necessary technical skills to provide the State with an unbiased source of information on imaging technologies, image formats, and procurement specifications. The organization with responsibilities for sharing the latest imagery technical knowledge with the user community is also charged with providing training to the user community on accessing the imagery and how it can be most effectively used.

The main strength of this model include that local levels of users retain some control and responsibility for the imagery and its quality.

Organizations that have a specialization in technology, contract management, project management, and training can fully leverage those specializations to better serve the State.

However, this model does not guarantee statewide imagery coverage of a consistent quality from county to county. This runs the risk of development of a patchwork of imagery with different accuracies, tonal balance, and technical qualities that may make using the imagery from adjoining counties difficult.

TOP-DOWN

Under this model the state provides the technical leadership, program management, and funding to assure a base level of referential imagery for Wisconsin. Statewide imagery procurement is based on a single contract between a state agency and a vendor or pool of selected vendors. The contract would be flexible enough to allow for local agencies to purchase all of the imagery based spatial data products they require as a locally funded “buy-up” to the base imagery. All vendor contracts, quality assurance, and data distribution are handled by a State organization.

The local option “buy-up” program would require local funding of the incremental costs of the additional products to be purchased. These products would be contracted through the state’s contracting officials and all vendor payments would be through the state organization. The state would enter into inter-agency agreements with local government jurisdictions to provide the products from the vendor and would act as the payment entity to the

vendor. (Local government pays the state organization that then pays the vendor.)

An advisory committee would be established to provide the technical guidance to the procurement agency on the specifications and priorities for each contract period. This committee would be the voice of the user community and be responsible for making recommendations to ensure that as technologies and business uses of imagery change that the procurement of imagery keeps pace with those changes.

A key advantage to this model is that the economies of scale are maximized to the largest degree possible. Specialization in the skills necessary to perform procurement, program management, and QA/QC are all highly developed and with paid staff to focus exclusively on these tasks there is a high probability that they will be efficiently and effectively completed. All local and county governments need to do, if they desire imagery based spatial products, is to purchase them through the buy-up program. There is complete transparency in the fees being paid for these buy-ups.

If a county only desired the base imagery they do absolutely nothing and the State provides that imagery on a regular basis.

A drawback to this model is that it shifts all responsibilities for the program away from the user community. The state organization doing the procurement is not required to follow the advice provided by the advisory committee. If the organization that is given responsibility for the program over time views the imagery produced as being for “their” specific organization’s use the

priorities of that organization may take precedent over the needs of the entire user community.

MODEL SUMMARY

The table below identifies the potential models for development of a statewide aerial imagery program. It would be preferable, for Wisconsin to draw from several of these models to move the program forward. It is unlikely that either financial or political support can be found to jump immediately to the fully state-run statewide imagery program, intended to meet the needs of all users, which ideally would be the best option. Instead, the development of a program should be a process where the transition from the current Voluntary Collaborative to higher orders of program management, are facilitated to take the State to the next generation of program so that it may reap the fullest benefits from economies of scale, technical specialization, and unified distribution methodologies.

AERIAL IMAGERY PROGRAM IMPLEMENTATION MODELS SUMMARY

Type	WROC	WROC 2.0	Distributed Management	Top Down
Description	Entirely volunteer program. Leadership is provided by an organization willing to step outside of its normal business lines. Program undertaken every 5 years.	Remains an entirely voluntary program with participation actively encouraged by not mandated. Funding made available on an annual basis to support collection of imagery over a portion of the State.	Responsibility for program management and implementation is shared by a number of organizations. A program management entity handles contract matters, vendor payments and program administration. Participants provide local QA/QC. Single contract with management group for acquisition and processing to provide for image distribution to user community.	State provides technical and financial leadership for the program. Base level of imagery full supported along with all related expenses for ground control survey, QA/QC, project management, procurement and contracting, and distribution to user community.
Governance	None.	Provided by a formal organization from the user community (WLIA, WIGICC, AWRPC)	Provided by a formal organization from the user community (WLIA, WIGICC, AWRPC). No authority to compel the source of funding to take any specific action.	Advisory Committee of users provides leadership with guidance on product needs and priorities. Staff support for advisory committee provided by State agency host.
Procurement	A "statewide" contract would be issued but all contracts remain between program participant and vendor.	The user community establishes a minimum imagery standard. Individual participants issue their own RFPs and contracts for imagery meeting this standard.	State or some other entity issues and RFP and selects a vendor (or pool of qualified vendors) and manages vendor contracting and payment. State administratively handles contracts and fund transfers between participants and the vendor. Local government pays state for buy-ups, state pays the vendor.	A single state contract in place for base imagery and all associated "buy-ups." Organizations pay a pre-negotiated rate on buy-ups to the State's program manager who pays the vendor upon completion of QA/QC on the deliverable.
Funding	Each collection area is view as individual projects. No dedicated funding for statewide initiatives. Partnership funds from Federal or Private sources limited.	Some level of cost share is available for participants providing imagery meeting the minimum standards to include in a statewide data warehouse. Share would be pro-rated based on area collected.	Dedicated state funding is in place to support collection of a base level of referential imagery on a regular and recurring cycle. Products or services above the minimum standard that is fully funded would be available but need to be fully funded from local sources. Partnership funds from Federal government private entities would be best leveraged under this model.	All cost associated with making base level referential imagery available to the user community are handled by the State and the service bureau.

Type	WROC	WROC 2.0	Distributed Management	Top Down
			QA/QC and distribution costs may still rest with participants.	
QA/QC	Handed on an individual participant basis.	The organization providing the cost share would have some minimal QA/QC to assure that minimum standards are achieved. Bulk of QA/QC costs fall to individual participant	QA/QC would remain with project participants as an "in kind" contribution to the final products. Minimal QA/QC would be undertaken by contracting organization to ensure minimum standards achieved. County governments or, in some cases, regional planning commissions, would fill this roll but may lack the staff resources or skills to handle it effectively or efficiently.	QA/QC handled by a service provider that is expert in spatial data and geodetic science. Maximizes efficiency and effectiveness by having individual trained in this type of work doing it regularly.
Strengths	Has been successful. Requires no change in procurement or business practices.	Maintains local control of programs (schedule, contractor selection, QA/QC, most distribution). Minor impact on procurement and business practices currently in place.	Maximizes contracting efficiencies. Maintains some local control of process through the QA/QC. Final statewide imagery products would be available provided in-State partners are willing to contribute "in-kind" services for QA/QC and distribution. Reduces burden on Counties and other partners for administration of funds and contract management. Also removes burden of procurement from participants since this is one on a single RFP. Benefits to vendor arise from a "guaranteed" level of work and simplified contracting thus reducing the cost to taxpayers.	Maximizes efficiencies in data collection, QA/QC, and distribution. Offers lowest overall cost to taxpayers for base referential statewide imagery and for the local buy-up options. Assures a standardized product will be available throughout the entire state to all users.
Weaknesses	Dependent on voluntary cooperation. May not result in statewide coverage. Imagery may not become public domain, data distribution and QA/QC handled by participants so no statewide assurance of availability of high quality.	Does not assure statewide coverage of minimum standard imagery. Since this would be a cost share model those areas unable or unwilling to provide the rest of required funding would not be collected. Does not maximize potential	QA/QC remaining with participants does not guarantee a standard quality of product across the entire State.	Control of process shifts from participants to State.

Type	WROC	WROC 2.0	Distributed Management	Top Down
	Potentially limited savings because economies of scale are missed.	economies of scale since each collection is an independent contract. QA/QC cost and burden remain with participants.		
Risks	No governance. Flying takes place in a single season every 5 years placing significant burden on contractor. Partner funding is uncertain and difficult to administer. Acquisition costs higher because of contracting and uncertainty volume from vendor. Lack of transparency in allocation of partnership funds.	Since funding doesn't support acquisition of entire state in a single year potential participants may be unfunded during "critical" collection years such as census years. Coverage gaps remain possible since counties are not required to participate or fund their portion of collection. Some organization must be willing to administer program funds and minimal QA/QC process. Overhead of administration of program may be a burden--costs for distribution of funds to participants may be high.	Since QA/QC is potentially handled by a variety of program participants there is no assurance that the adjoining areas will be of the same quality. This may ultimately result in the lack of ability to use imagery from a region or adjoining counties.	Since the role of the user community is merely advisory there can be not guarantee that the imagery produced on an on-going basis will continue to meet the broadest possible needs. Additionally, the program could become bureaucratic and unresponsive.

PROGRAM IMPLEMENTATION

RECOMENDATIONS

This section details the requirements for an effective implementation of a sustainable statewide aerial imagery program.

STATEWIDE PROGRAM GOVERNANCE

A collaborative governance structure is necessary to support a sustainable aerial imagery program. This governance structure must be transparent to the stakeholder community and fully engage the user community in activities to the extent possible. Any statewide aerial imagery program must remain connected to the primary imagery users in the state to ensure that the products of the program are aligned with users' needs. A key method for accomplishing this is to establish an Aerial Imagery Advisory Committee (AIAC) comprised of representatives of the user community. The AIAC should be supported by technical advisory committees (TACs) whenever necessary to recommend detailed specifications, methods, and programmatic priorities.

As with many of the activities associated with a potential statewide aerial imagery program, there is no clear consensus in Wisconsin as to the correct organization to serve this role. The Wisconsin Geographic Information Coordination Council (WIGICC) and the Wisconsin Land Information Association (WLIA) were the two groups most prominently mentioned by users during workshops and interviews. While either organization could be successful in serving this role, the WLIA has longstanding support among key constituent groups and a history

of involvement in aerial imagery coordination efforts. Past efforts by the WLIA and their Wisconsin Orthoimagery Task Force (WOTF) should be leveraged to fill some of this need. The WLIA is connected to the County Land Information Officers and advocates for funding the statewide Land Information Program.

The statewide land information program requires regular updates to land record plans for each county. Those plans include elements targeting the development and custodial maintenance of critical foundational data elements including "Orthoimagery and Georeferenced Image Base Data." This direct tie to a critical user community, a funding source in the retained fees program, and a long history of success suggests the WLIA will be the best home for an Aerial Imagery Advisory Committee. The committees should include representatives from other organizations such as: state government, regional planning organizations, federal agencies, and the private sector to assure those needs are also being addressed.

PROGRAM ADMINISTRATION

It is critically important that an organization dedicate resources to the development of this program if it is to succeed. A single individual should be assigned management responsibility of the statewide imagery program with a full-time focus on expanding communication, building partnerships, providing training, and managing a coordinated QA/QC and data distribution function.

There are several committees and organizations within Wisconsin that have an interest in helping to facilitate a governance structure along with program management and coordination. There is no current consensus among the user community on the best institutions or organization to fulfill this role.

The aerial imagery coordinator should be attached to an organization that can provide administrative support, and the day to day guidance and supervision necessary to be successful. An advisory committee like the AIAC simply does not provide the necessary structure to assure the success of a full time employee.

A strong case can be made for these activities to be administratively supported out of the State Cartographer's Office at the University of Wisconsin, the Department Administration (DOA) Enterprise Technology under the Geographic Information Officer, or the DOA Division of Intergovernmental Relations. The administrative support of this program will require dedication of staff resources to coordinate outreach to potential partners (public as well as private),

improve overall communication with the user community, and to provide continuity for the program over time.

Given the institutional focus of the two areas of the DOA, the Division of Intergovernmental Relations is the more appropriate a home for aerial imagery program coordination. That Division is responsible for the review and approval of Land Information Plans for each county and the administration of the retained fee program. The Division provides a broad range of services to state, local, and tribal governments and businesses as it supports land use planning, land information records modernization, municipal boundary review, coastal management programs, and demography. The Division of Enterprise Technology, the home of the GIO, is focused primarily on management and provision of IT services to improve government efficiently and service delivery.

In consultation with the user community the appropriate organization to manage a long term program of imagery distribution and DOA or it may be a formalization of the role of WisconsinView and establishing sustainable support for that service.

AERIAL IMAGERY SERVICE PROVIDER

Several of the key improvements to current aerial imager projects identified by the user community during the development of this business plan are not addressed by simply providing an administrative program that will fund collection, processing, and distribution of aerial imagery. Among the improvement cited by the user community that can be provided by an aerial imagery

service provider include: un-biased technical advice about imagery technologies and accuracies that are generally believed to be unavailable through the vendor community; training in the most appropriate methods for applying remotely sensed imagery to business processes; and more general training in the availability of imagery based services and products.

This service provider should perform QA/QC and technical contract evaluation services for aerial imagery.

Determination of who is appropriate to serve this role will require an evaluation of the potential host organizations and their commitment to the long-term support. Among the items that will need to be evaluated include in-house technical support available for high end and high volume web services, ability to provide secure computing facilities, redundancy in all critical systems, and sufficient bandwidth.

Once a host agency for these services is identified, a formal analysis of the technology requirements must be conducted. This study will be necessary to fully define the massive and ever increasing data storage requirements, bandwidth needs, and other technologies required for the optimization of web services.

Funding will be required during the startup phase of the service bureau to support the purchase of hardware and software and to complete the detailed implementation study. Ongoing funds will be necessary to sustain the operation of the warehouse. A full-time equivalent employee (FTE) will be required during the start-up phase of the

project and approximately .5 a FTE for systems maintenance duties including systems administration and technical management after the first year of the program.

Annual funding will be necessary to support on-going operations for hardware, software, and Internet connectivity.

Consideration for the organization to fill this function must include an evaluation of in-house resources and expertise in high precision field surveying using Global Positioning Systems (GPS). As mapping technologies become ever more sophisticated and relationships between traditional surveying, aerial imagery, LIDAR, and GPS become more tightly linked. Wisconsin will need to continue to expand expertise in these spatial technologies to ensure that they are appropriately leveraged to the maximum benefit of the State.

Given the research component of this function, the need for seasonal yet knowledgeable employees to perform QA/QC services, and requirements for access to high bandwidth and large digital storage, the State Cartographers' Office at the University of Wisconsin should be considered to fill this role. This recommendation is an acknowledgement that mapping sciences are important to many of the business functions of the State. Further it is recognition that within the government system it is wise to have expertise in these critical technologies to evaluate performance of contractors. It is also driven by the need for efficiency so this

expertise does not have to be developed and maintained in multiple organizations.

This service provider will become the focus of services related to aerial imagery in Wisconsin, including implementation of a quality control methodology for imagery, sharing of information related to new and emerging mapping technologies, and training spatial professionals throughout the state on these technologies.

PROGRAM IMPLEMENTATION

REQUIREMENTS

A statewide aerial imagery program will require regular and on-going investment. There are demonstrated benefits on an annual basis for such a program that far exceed the annual costs. However, it is important that the minimum investment in the program be made every year or the credibility of the program and its ability to deliver the necessary orthophotography to partners will be jeopardized. The efficiencies and benefits accrue in large part from partners having faith their needs will be met. This will prevent duplication of efforts and wasted resources.

There are four primary activities necessary to support an ongoing orthophotography program: imagery acquisition and processing, quality assurance/quality control (QA/QC), distribution, and program management. Many organizations that procure imagery consider only the direct costs paid to the vendor for the acquisition and processing of the imagery. In this plan we attempt to capture the entire life cycle of costs associated with imagery projects including procurement management, QA/QC, and distribution which are frequently not considered by county governments during their imagery projects.

In the first year of the program additional investment will be required for QA/QC and distribution to support the start-up of these two critical activities. The QA/QC start-up will require development of a standard methodology for the process that may need to be supported with the procurement or development of additional software.

Hardware expenses may be anticipated for both QA/QC activities and distribution. Initiation of the distribution activities will have additional start-up costs associated with careful study of the system needs and user requirements to make sure that the implemented system has adequate performance and expandability to meet anticipated needs.

ANNUAL INVESTMENT DETAILS

The investment required to establish and maintain a program of statewide aerial ortho imagery will be \$1.9 million in the first year and \$1.7 million in subsequent years. These costs are based on the assumption that 1/3 of the State, approximately 19,000 square miles, will be acquired and processed on an annual basis. Included in this figure are the acquisition and processing costs for a base product of 12-inch resolution, color, leaf-off ortho imagery. This minimum imagery was identified as meeting the needs of most users in the State. Of course, the program would be administered to allow partnership “buy-ups” of associated geospatial products derived from imagery including higher resolution imagery, LiDAR, oblique imagery, and other imagery derived datasets.

The costs presented in Table 9 represent an estimate of the “fully loaded” costs of these functions. That is, they consider all benefits and administrative support costs rather than simply the salary that might be paid to an

individual to perform a task. Too often when the costs of aerial imagery are discussed there is a single focus on the cost per square mile charged by a vendor to acquire,

process, and delivery digital data. While this figure represents the majority of costs associated with making these vital data available, the costs for program management (procurement, contract management, etc.), reviewing the quality of the data delivered by the vendor, and making these data available are current carried by the citizens of Wisconsin often without an explicit evaluation of what those cost actually total.

Acquisition and processing costs presented represent the average of values submitted by the following aerial imagery companies: Ayres, Aerometric, Fugro EarthData, Photoscience, Sanborn, and Surdex. Since this figure is an average it is a conservative figure. A multi-year contract for approximately 19,000 square miles per year would generate significant interest from aerial mapping firms and would likely result in a per square mile cost of below the \$61

estimated that the cost per square mile on an acquisition program covering 1/3 of the State could be as low as \$42/square mile for 12 inch resolution if existing ground control is used and airborne GPS and IMU technologies are applied.

The QA/QC and distribution estimates are based on anticipated costs for hardware and software acquisition and testing and any tool development necessary. The forecasted investment also contemplates in years after Year 1 the need to continuously update these items to assure adequate performance and state of the art technology solutions. If an existing organization, such as WisconsinView, is identified to provide these services these expenses still should be anticipated. Existing services will need to be evaluated in detail to understand specific hardware, software, and bandwidth requirements. After year 1 the costs for QA/QC assume that technical staff will be hired to undertake these responsibilities.

Program management and support costs include hiring a full time staff person, with

Table 10. Aerial Imagery Program Investment

Activity	Year 1		Subsequent Years		3 Year Totals
	Per Square Mile	Total	Per Square Mile	Total	Total
Orthophotography Acquisition and Processing	\$61	\$1,159,000	\$61	\$1,159,000	\$3,477,00
Quality Assurance/Quality Control	\$12	\$220,000	\$5	\$95,000	\$410,000
Distribution		\$330,000		\$220,000	\$770,000
Program Management/Support		\$200,000		\$200,000	\$600,000
Totals	\$101	\$1,909,000	\$96	\$1,674,000	\$5,257,000

used for this estimate. Some vendors have

benefits, and sufficient administrative

support for travel, and communications materials. These figures are rolled up based on an assumed \$80,000 salary, \$40,000 for benefits, \$40,000 for administrative support, and a \$40,000 operational budget.

While this nearly \$2 million per year investment seems large, it should be viewed in the context of the current investment of public funds as all levels in aerial imagery today. Survey respondents identified \$2.3 million per year currently being spent on aerial imagery and related activities. While this figure includes what would be considered local option buy-ups, the figure does represent a significant investment in taxpayer money already in imagery that is likely not providing the optimal benefits to citizens.

SOURCES OF INVESTMENT

While Wisconsin has lacked an ongoing statewide aerial imagery program, it has successfully completed statewide efforts in the past through leveraging a combination of local/county sources with supplemental funding from state and federal programs. The WROC project in 2010 was successful in completing statewide coverage largely through leveraging access to Federal funds and some supplemental funding through State government sources. The South Eastern Wisconsin Regional Planning Commission has a long history of collecting ortho imagery for a large area around Milwaukee. Those efforts have been largely supported through directing Federal transportation planning grants toward this critical data element supporting regional planning efforts.

The funding from Federal and private organizations has the potential to be increased through the implementation of a formal and coordinated program. Private entities, most notably utility providers and large property owners, have benefits from the availability of ortho imagery for many years without the requirements to contribute to its collection or distribution. Project outreach to those groups indicated some willingness to support a statewide program if there were a formal effort made to request that support. It is possible that in future years the contributions from private firms and the Federal government will increase to reduce the funding burdens on state and local government..

A successful program will require dedicated funding. A funding model that leverages partnership funding, local government investment and a newly secured dedicated funding source is critical to a successful program. Dedicated funding for aerial imagery could come from any number of sources that have been identified by the imagery user community. These include programming a portion of the document recording fees collected to support land records programs (“retained fees”) to support statewide data programs in addition to continuing to fund land record modernization at the county level.

Table 11. Potential Sources of Investment

Potential Sources of Investment	Year 1		Subsequent Years		3-Year Cycle
	Total	Square Mile	Total	Square Mile	Total
New Funding Source*	\$1,000,000	\$53	\$1,000,000	\$53	\$3,000,00
State Appropriations	\$500,000	\$27	\$375,000	\$20	\$1,250,00
Federal or Private Partnerships	\$220,000	\$12	\$220,000	\$12	\$660,000
Local or Regional Partnerships	\$189,000	\$10	\$79,000	\$12	\$347,000
Totals	\$1,909,000	\$101	\$1,674,000	\$96	\$5,257,00
*The "New Funding Source" could be any of the potential identified existing programs being modified to support statewide imagery programs					

Another option that was suggested as a potential source during this project is the 911 fees levied on cell phones since the functionality associated with the next generation 911 systems are dependent on solid and up to date geospatial information to function. An expansion of the existing Wisconsin Land Information Program (WLIP) fees to be dedicated to statewide data

programs was also suggested. WLIP grant fund have been used by some counties to fund aerial imagery programs.

Finally, a new state appropriation to support a statewide geospatial information system to provide seamless support to all state resource managers and support economic development, emergency planning and response, and host of citizen services as recommended in the Wisconsin White-Tailed Deer Trustee and Review Committee in 2012 was identified as possibly attainable. In each of these cases a shifting of funding from one program to another may be required and may be politically difficult.

Table 10 outlines the potential sources and distribution of funding for a statewide

imagery program. Developing a consensus of which of these is most likely to be successful and taking the steps necessary to achieve them should be a high priority action item for the entire aerial imagery user community but most notably the WLIA, DOA, and the SCO. A funding source of \$1,000,000 from the land record retained fees (WLIP) program or E-911 should be attainable given the critical nature of these data to support both of those program areas.

This should be supported by state appropriations for the staff support necessary to manage this program and support the QA/QC process and the imagery survey bureau. This state appropriation acknowledges that among the large beneficiaries of this program will be state agencies supporting natural resources, economic development, and emergency response.

Additional funding from partnerships of less than \$575,000 per year would benefit the program and should be obtainable with a full-time individual devoted to seeking partnerships and managing the program.

Partnership funds will be more easily obtained once a statewide program is in place. Federal authorities have indicated that it will be easier to support imagery programs in Wisconsin if there is a single entity with this to do business. A number of the private organizations within Wisconsin that participated in the development of this business plan also indicated that they are willing and able to support a statewide imagery initiative provided the resulting products meet their needs. We believe that the level of private and public partnership funds available on an annual basis will ultimately surpass \$500,000.

ANNUAL INVESTMENT DETAILS

In the first year of the program an estimated \$130 per square mile collected will be necessary. In subsequent years \$120 per square mile will be sufficient to support the program since the initial investments in hardware, software, tool development, and standards will have been completed. Table 11 provides details on the breakdown of the annual investment requirements.

Table 12. Orthophotography Acquisition Program Costs

Activity	Year 1		Subsequent Years	
	Per Square Mile	Total	Per Square Mile	Total
Orthophotography Acquisition and Processing	\$95	\$2,090,000	\$95	\$2,090,000
Quality Assurance/Quality Control	\$10	\$ 220,000	\$ 5	\$ 110,000
Distribution	\$15	\$ 330,000	\$10	\$ 220,000
Program Management/Support	\$10	\$ 220,000	\$10	\$ 220,000
Totals	\$130	\$2,860,000	\$120	\$2,640,000

IMPLEMENTATION MILESTONE SEQUENCING

Table 13 provides a high-level overview of the implementation activities that will be required to implement the statewide aerial imagery program.

Activity	Priority	Primary Responsibility	Success Criteria
Statewide Imagery Program Governance			
Identify Host Organization for Aerial Imagery Advisory Committee (AIAC)	Very High	WLIA, SCO, DOA	Identify lead organization
Develop Draft Charter for Aerial Imagery Advisory Committee	Very High	Lead Organization	In collaboration with WLIA, SCO, and there key user communities identify the constituent organizations and method of membership selection
Appoint Members	Very High	Participating Organizations	Members are appointed to the AIAC
Develop operating documents, elect officers	Very High	AIAC Membership	Operating documents have been prepared, officers elected.
Ratify AIAC Charter and operating documents	Very High	Membership Organizations	The charter and operational procedures for the AIAC are ratified.
Identify Imagery Technical Advisory Committee (TAC)	Very High	AIAC Membership	A Technical Advisory Committee (TAC) for Imagery is created with members representing diverse users across Wisconsin
Approve Orthophotography Minimum Standards	High	AIAC Membership	The TAC approved minimum standards are validated and accepted in a formal action by the AIAC
Approve QA/QC Methodology and Standards	High	AIAC Membership	The TAC approved methodology and standards for QA/QC are validated and accepted in a formal action by the AIAC
Approve Service Bureau Recommendation	High	AIAC Membership	The TAC recommendation for assignment of Aerial Imagery Service Bureau functions is validated and accepted in a formal action by the AIAC
Approve Mapping Priorities	High Annual	AIAC Membership	The TAC annual recommendations for mapping priorities are reviewed and approved by the AIAC

Technical Advisory Committee for Imagery			
Organize Committee	Very High	AIAC Membership	The TAC is organized, meetings schedules, members participating, and agendas advanced.
Formalize Minimum Orthophotography Standards	Very High	TAC	The TAC revises and formally recommends to the AIAC for approval a minimum standard for orthophotography.
Establish QA/QC Methodology & Standard for Orthophotography	High	TAC	The TAC develops and forwards to the AIAC for approval a QA/QC methodology and standard for orthophotography.
Analyze and recommend Service Bureau host agency	High	TAC	The TAC considers options for assignment of stewardship responsibilities for the Statewide Imagery Data Warehouse and formally recommends to the AIAC an implementation lead agency.
Develop Orthophotography contract specifications (buy-up options)	Very High	TAC	Contract specifications for orthophotography procurement are developed by the TAC with careful consideration of standards and optional "buy-up" products. These specifications are provided to DOA for securing vendor(s) for the Statewide mapping program.
Recommend Annual Mapping Priorities	High Annual	TAC	Recommendations for annual orthophotography priorities are provided to the AIAC for formal approval.
Program Administration			
Identify Host Organization for Program Administration	Very High	WLIA, SCO, DOA	A host agency is identified and formally agrees to take responsibility for program administration
Define Staff Resource Requirements	Very High	Host Agency	A position description is prepared that outlines the responsibilities of the statewide aerial imagery program coordinator (communication, collaboration, support for AIAC, project management)
Secure Funding for Position	Very High	Host Agency, WLIA, SCO, AIAC, User Community	A state appropriation will be required to fund the position of Aerial Imagery Program Coordinator. This will require active support from all agencies involved in the aerial imagery planning process.
Hire a Program Coordinator	Very High	Host Agency, with advice from AIAC	An individual is hired to perform the duties of the program coordinator.
Secure Funding for the Imagery Program	Very High	Host Agency, WLIA, SCO, AIAC, User Community	A stable funding source will need to be identified and secured.

Activity	Priority	Primary Responsibility	Success Criteria
Develop and Issue and RFP for a Statewide Aerial Imagery Program	High	Program Coordinator	Building on the contract technical specifications developed by the TAC and approved by the AIAC, an RFP should be issues and a vendor selected.
Develop and Execute a Memorandum of Understanding with host organization for Service Bureau	High	Program Coordinator, Host Agency, Service Bureau Host Agency	A formal agreement between the agency hosting the program manager and the agency providing service bureau services should be development and put into place to support the imagery program over the long term.
Build and sustain partnerships	On-going	Program Coordinator	Building partnerships with public and private stakeholders will be essential to the long-term sustainability of the program. These must be built with public partners (most notably State agencies, county governments, federal agencies, and tribal entities) and private sector firms.
Outreach to stakeholder community	Ongoing	Program Coordinator	Continued outreach to the stakeholder community must be an on-going responsibility of the staff of the Center. This outreach will be important to sustained partnerships and to building an efficient orthophotography program for the State.
Aerial Imagery Service Bureau			
Host Organization Formally Accepts MOU	Very High	Program Management Host Agency, Service Bureau Host Agency	The host organization for the service bureau formally accepts responsibilities for QA/QC and data distribution functions.
Establish Bureau Mission/Vision	High	Service Bureau Host	The management of the Service Bureau Host agency adopts and formalizes the mission and vision of the Bureau.
Assign staff responsibilities	Very High	Service Bureau Host	Existing staff duties are modified to acknowledge new roles in the Bureau If modification of responsibilities or restructuring of positions is necessary this has been completed.
Plan structure and workflow	High	Service Bureau Host	Establish a strategic plan for the Bureau and identify specific functions, responsibilities, and workflows. Acknowledge participation of AIAC and TACs in activities and clarify the relationship between the Bureau and those organizations.

Activity	Priority	Primary Responsibility	Success Criteria
Conduct study on hardware, software, web services	High	Service Bureau Host	A complete study of the technology requirements for an orthophotography data warehouse has been established
Procure hardware and software	High	Service Bureau Host	Upon completion of requirements study the hardware and software necessary to support the data warehouse is purchased and installed.
Develop web services. Promote and maintain them	High On-going	Service Bureau Host	Based on identified user needs, web services are development and put into operation.
Develop and maintain metadata inventory of historic and current imagery	Very High	Service Bureau Host	The on-line directory of historic, current, and planned imagery is available for users to query via the data warehouse.
Implement QA/QC Process	High	Service Bureau	Based on the QA/QC methodology and standard endorsed by the TAC and the AIAC, implement the process on all newly acquired orthophotography for Wisconsin without regard to the source of that imagery.

Activity	Year 1												Year 2												Year 3											
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Approve Service Bureau Recommendation					█	█																														
Approve Mapping Priorities									█	█													█													█
Technical Advisory Committee for Imagery																																				
Organize Committee					█	█																														
Formalize Minimum Orthophotography Standards							█	█																												
Establish QA/QC Methodology & Standard for Orthophotography									█	█																										
Analyze and recommend Service Bureau host agency				█	█																															
Develop Orthophotography contract specifications (buy-up options)					█	█	█	█					█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
Recommend Annual Mapping Priorities										█											█									█			█			
Program Administration																																				
Identify Host Organization for Program Administration	█	█																																		
Define Staff Resource Requirements					█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
Secure Funding for Position								█	█																											

Activity	Year 1												Year 2												Year 3											
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Hire a Program Coordinator																																				
Secure Funding for the Imagery Program																																				
Develop and Issue and RFP for a Statewide Aerial Imagery Program																																				
Develop and Execute a Memorandum of Understanding with host organization for Service Bureau																																				
Build and sustain partnerships																																				
Outreach to stakeholder community																																				
Aerial Imagery Service Bureau																																				
Host Organization Formally Accepts MOU																																				
Establish Bureau Mission/Vision																																				
Assign staff responsibilities																																				
Plan structure and workflow																																				
Conduct study on hardware, software, web services																																				
Procure hardware and software																																				

Activity	Year 1												Year 2												Year 3											
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Develop web services. Promote and maintain them																																				
Develop and maintain metadata inventory of historic and current imagery																																				
Implement QA/QC Process																																				

