Final Report
of the
Wisconsin Land Information System
Project Team

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I. Executive Summary

The following report provides a blue print for the development of the Wisconsin Land Information System (WLIS). The goal of the report is to provide the next steps in the implementation of WLIS that would leverage and capitalize on the State's investment in land information and maintain our leadership role in this technology. WLIS and the Project Team that prepared this report is a product of Wisconsin Statute16.023 (1) (f). The project team, made up of a cross section of individuals knowledgeable in information systems, volunteered hundreds of hours of collaboration to bring this design forward.

The report is made up of several sections that parallel the team's charge from the report of the Technical Working Group. These sections include requirements, project scope, preliminary conceptual design, system cost, project phase, and action items.

The team recognized that the success of WLIS would hinge upon addressing the needs of the broadest number of stakeholders. The team's first efforts identified who the stakeholders are and what their land information needs are. A list of stakeholders was compiled and interviews were conducted with a representative cross section of interested parties. This information gathering process identified several common themes that lead the project team in the design process. These themes included accessibility, distribution, indexing and retrieval, integration, dynamics, standards, and support of the decision-making process.

The underlying architecture of the proposed WLIS is a web-based distributive system where multiple nodes would support data access and use. The node concept provides for customization of data and the security of replicated data at several sites. While WLIS is primarily a distributive system, implementation and management are centralized for efficiency. The centralized function of WLIS (core node) would house parent databases, stage data replication to distributive nodes, and provide overall systems management.

Other design considerations include incremental development capitalizing on existing investments and standards; service of a wide audience; support of functions enhancing data creation, management, and dissemination; development and maintenance by multiple participants; common interface; and support land information applications. WLIS is designed to provide access to land information held by public as well as private organizations. The design and architecture will be as open as possible to facilitate applications development and economic incentives to participate.

Initial operations of WLIS should accommodate three levels of participation. The first level of participation would be simply providing documentation of existing databases and information (metadata). Metadata can provide a searchable database of who has what information as long as there is a common standard for the metadata. A first step in the development of WLIS is to develop a simple information indexing procedure and metadata entry software,

The second level of participation is providing actual digital data. At this level, the process becomes a bit more complicated because data formats vary from provider to provider. Level 2 participants would have several options available to provide data to the system. The options would allow for multiple levels of technical sophistication and numerous data formats. The system should be built to allow for these scenarios and yet be functional for all participants.

The third level is becoming a WLIS distributive node. At this level, the participant would need to be able to provide hardware, software, facilities, expertise, staff to maintain a node on the system, as well as all of the functions of levels one and two.

It is anticipated that WLIS would be developed in phases and different levels of functionality would be developed over several years. Organizations that routinely use land information systems and have the expertise and equipment would be able to participate in the system sooner than those who do not. It is the intent of WLIS to be open to anyone, however, a system of priorities needs to be established.

There is a vast supply of data available for WLIS. The Wisconsin Land Information Program has invested millions of dollars in the development of data on foundational elements. State and federal agencies maintain numerous holdings of data. Private sector organizations also maintain large data resources and will be encouraged to participate through commercial economic development. All WLIS data would conform to a structure and content standard to facilitate integration, exchange, and use. Metadata would be used for indexing and cross-walks table would be developed for data integration. WLIS must be available and easy to use and designed to accommodate all levels of sophistication. The system design will be flexible and extensible to serve a broad spectrum of stakeholders. It must be designed to be dynamic with the ability to grow, evolve, and expand.

The organization of WLIS would require oversight, operational management, and policy direction. The institutional structure of WLIS needs to balance statewide guidance with broad input into applications and operations. Primary authority for the system could be a function of the WLIB and/or WLC. Oversight of the system should be a function of the stakeholders or user. This could be accomplished through existing stakeholder organizations or creation of a new oversight body or users group.

Day-to-day function of the system would require a management team and/or systems manager. The day to day management would deal with efficient use of system resources, ongoing development, technical decisions, technology transfer, interfacing with advisory groups, and reporting to the WLIB and/or WLC.

The core node of WLIS could be operated within an existing organization with the primary requirement that the organization have the resources and expertise to facilitate the system. The siting of WLIS must be done so as to create a workable financial or staffing situation. Sufficient funding for WLIS must be provided for it to succeed.

It is anticipated that the WLIS project would require from 4 to 10 years to complete. The report outlines a time line for the first two years of WLIS that would take the system from conception to implementing the first data and web-distributed nodes. Development would continue beyond the first two years including applications development such as those that would support comprehensive planning and smart growth. The report also attempts to estimate the financial commitment for WLIS. Although the financial commitment is significant, it represent a fraction of what has been spent on land information in Wisconsin to date. More importantly, financing WLIS would leverage and capitalize on the existing land information investments.

Specific action items intended to move the system from concept to reality include cultivating a support base for WLIS, establishment of standards for data and metadata, policy and governance

structure, and appointment of a systems manager. This report and these action items are the next step in this important project.

The Team identified an extensive array of benefits, to both public and private sector stakeholders, that would emanate from a WLIS.

The direct benefits would include:

Improved Business Planning. Private businesses would gain low-cost, real-time access to information to support business siting and other strategic decisions. For example, a manufacturing company could evaluate alternative sites in terms of available land (including zoning, tax rate, incentives and similar factors), proximity to suppliers/markets, transportation and other physical infrastructure, available labor pool and educational/training resources. Links to other community sites (public and private sector) would offer additional sources of information (e.g., quality of life factors, available financial assistance and other data not strictly related to land). Compiling these and other data sets in a single, convenient location would give Wisconsin communities a competitive advantage in attracting desirable business development.

Expanded Citizen Access to Government Data. Wisconsin has been a leader in efforts to use information technology to enhance citizen access to government and the proposed WLIS will expand on this record by giving "24 X 7" access to information about zoning, tax assessments, recreational facilities and a long list of other data sets that they can use to interact with public officials or to obtain information for private use. By offering convenient, understandable information, the proposed WLIS will promote more informed input by citizens into land use planning, zoning and other community development issues.

Enhanced Educational Opportunities. Given the state's commitment to ensure Internet access for all levels of education in Wisconsin through such initiatives as TEACH (http://www.teachwi.state.wi.us/), an Internet-based WLIS would give teachers and students in Wisconsin (K-12 through college) dramatically enhanced opportunities to study the geographic, economic, demographic and other dimensions of their state.

More Efficient and Effective Government. By sharing resources and avoiding costly duplication of effort, the proposed WLIS will allow all levels of government in Wisconsin to compile and disseminate land-related information at a lower cost and in more useful formats that could be achieved individually. From the users' perspective, the integrated approach offered by the WLIS envisioned here will also reinforce Wisconsin's image as a state that responds to the real needs and resources of its citizens. By linking related databases, the proposed WLIS may also promote expanded dialog and cooperation among governmental bodies by highlighting shared resources, needs and opportunities.

Additionally, indirect benefits were also identified, where WLIS will provide the necessary foundation and framework for a wide variety of additional applications to be developed, potentially impacting all users of land information in the state. The project team hopes that the readers will share in our enthusiasm for this project and support the effort to its culmination.

II. Introduction

The WLIS Project Team believes that this report addresses the vision and spirit embodied in the Technical Working Group's Final Report and makes significant progress in the design and realization of the Wisconsin Land Information System (WLIS). This report is intended as a guide for the long-term development of a WLIS, recognizing that with the rapid pace of technological change, many specific recommendations may be modified or eliminated by the time they are ready to be addressed.

Wisconsin Statute 16.023 (1) (f), established "a technical working group that is composed of the State Cartographer, a representative of the University of Wisconsin system who has the expertise in land use issues and any other land use experts designated by the Council's chairperson, to study the development of a computer-based Wisconsin land information system and recommend to the governor legislation to implement such a computer system."

In the fall of 1998 the Wisconsin Land Council appointed the Technical Working Group and its first meeting was held on November 20, 1998. The Technical Working Group was comprised of 26 people knowledgeable in land information systems and technology. The group included representation from federal, state and local government; regional public and private planning organizations; private non-profit and for-profit organizations. Seven all-day meetings culminated with a May 26, 1999 final report. The final report went through a review process by both the Land Council and the Land Information Board and each body adopted a revised report on October 14, 1999 and November 17, 1999 respectively.

The final report of the Technical Working Group contained a vision for the WLIS: "The WLIS will be a computer-based system of land information distributed throughout all levels of government in Wisconsin. It supports land information applications such as comprehensive planning. A common interface will provide access to land information for interested citizens, professionals, and elected officials. The WLIS will be built incrementally, leveraging existing investments and standards for data and technology made by the Wisconsin Land Information Program* and many other public and private initiatives." The Technical Working Group's Final Report also recommended that a WLIS Project Team be created to continue the design and implementation planning of WLIS. The recommendations called for the appointment of the WLIS Project Team by the Land Council and Land Information Board to prepare a more detailed project proposal with costs and time estimates. The Land Council and Land Information Board implemented the recommendation by each appointing five members to the Team.

The chairs of the Land Council and Land Information Board appointed the 10-member WLIS Project Team (Appendix A) during the fall of 2000, and the first meeting was held on January 20, 2000. The WLIS Project Team scheduled 11 meetings to complete its work and report to the Land Council and Land Information Board by July 1, 2000. The Team was given specific tasks via resolutions by the Land Council (Appendix B) and Land Information Board (Appendix C), emanating from the recommendations in the Technical Working Group's Final Report.

The WLIS Project Team also recognized early that:

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* See Wisconsin Statute 16.967

1. It needed someone with experience in designing information systems using internet-based technologies. (Responding to this need, the Department of Administration loaned an experienced Information Technology Project Manager for ¾ time.)
2. It was constrained by the short time allotted to complete the report.
3. No funding was available to test or prototype the systems.

Owing to the lack of available funding and the limited time frame, the assigned tasks were modified by the Team (Appendix D) and submitted to the Land Council and Land Information Board. As modified, the charge of the Team was to:

1. Outline the requirements of shareholders that will participate in the system.
2. Develop and recommend a project scope.
3. Prepare a preliminary conceptual design for the system, including work plan and timeline.
4. Prepare cost estimates.
5. Prepare functional requirements, cost estimates and timeline for the 1st biennial phase of the project.
6. Draft decision item(s) language for WLIS*.

The modifications meant that the Team was not able to:

1. Perform a formalized needs assessment.
2. Design alternatives fully.
3. Develop and test prototypes.

Although unable to perform a formalized needs assessment, the Team did survey representative stakeholders, collecting needs through interviews and other means. The alternatives that were explored during team meetings have been incorporated in the discussions within this report and the best alternative is proposed. Although prototyping was not performed, it is recommended for future implementation phases.

Key Points - Introduction

1. We believe that this report represents the vision and spirit of the efforts of the Technical Working Group.
2. We recommend that this report be used as a guide for the long-term development of the system.
3. We concluded that because of time and money constraints we would not be able to do the needs-assessment, the alternatives, nor the prototyping.
4. We concluded that although there was inadequate resources for a formal needs-assessment, we would survey representative stakeholders for additional perspective.
5. We concluded that alternatives would be constructed within subject context within this report as best as possible.

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* It was later determined by the Team that this last item was not specifically requested by the Land Council and Land Information Board and, therefore, will not be found in this report.

6. We recognize the importance of prototyping and recommend that it be done in future implementation phases.

III. Requirements

Using the Technical Working Group's Final Report (Appendix E) as a springboard for the development of the system's requirements, the Team made a concerted effort to ensure that as many stakeholders as possible had an opportunity for express their needs of a WLIS. From the outset, the Team recognized the significance of addressing the needs the broadest possible selection of stakeholders in the development of the WLIS system requirements. The Team felt strongly that this input would:

1. Ensure the vitality of the system.
2. Generate broad-based support.
3. Encourage additional independent application development and enhancements to a system based on an open architecture.

The Team approached the collecting, creating and validating of system requirements primarily through four principal methods:

1. Summarize the requirements outlined in the Technical Working Group's Final Report.
2. Provide and promote a means of widespread input using a web-based requirements survey form.
3. Create an expansive list of as many potential stakeholders as possible and actively seek the input of as broad a cross-section of them as time allowed.
4. Seek input from members of the Land Council and Land Information Board.

The Team felt that these four methods served in place of a formal needs assessment for this report.

Technical Working Group's Final Report – Requirements Summarization

As the Team began addressing the entire corpus of specific requirements for a WLIS, individual requirements were suggested in the outline of the four architectures from the Technical Working Group's Final Report and were excerpted and incorporated into the list. Eventually, several of these requirements were combined, owing to the fact that the report was created in sections and some requirements were repeated in the different sections.

Web-based Requirements Survey

The web-based requirements survey form was activated and published in early March and is still available on the Team's web site.* Although use of this mechanism was widely-promoted (e.g., a link to this page was posted early on the web site for the Wisconsin Chapter of the American Planning Association and the President of the Wisconsin Land Information Association promoted its use in his column in the May issue of the *Land Records Quarterly*), this method proved to have limited results.

List Of All Stakeholders and Stakeholder Input

Beginning with existing lists of information users and providers, the stakeholders were organized into general groups including the general public, advocacy groups, educational groups and groups

* http://www.doa.state.wi.us/olis/wlis/index.asp

encompassing the various levels of government. The Team filled in the names of known stakeholders and identified their potential roles and relationships to the WLIS. The preliminary stakeholder list was posted to the Team's Internet site to elicit additional feedback from a wider user community. The final list of stakeholders developed by the Team is shown in Appendix F.

After developing this working list of stakeholders, the Team directed the Project Manager to contact and interview specific individuals, comprising a representative cross-section, to collect first-hand information regarding the perceived requirements, needs, constraints and products that a WLIS might provide. These individuals were interviewed by phone, e-mail or, in most cases, by on-site visits. The notes and analysis from this effort are found in Appendices G, H and I.

Input from Land Council and Land Information Board Members

In addition to reporting to and receiving feedback from Land Council and Land Information Board members at each of their general and executive committee meetings, the Team's co-chair actively sought contributions and advice on an informal basis.

Appendix J provides an inventory of the requirements from these efforts.

Requirements Analysis

Using a compilation of individual team member rankings, the resulting requirements list was prioritized. Several common themes emerged, which ultimately define the core functional requirements of the WLIS.

The Team determined that the WLIS will be:

1. A statewide system easily accessible to the public.
2. A web-based, distributed system.
3. A catalogue of external links to spatial and non-spatial Wisconsin land-related data and information through an indexing or retrieval system – i.e., a web gateway linking the user to non-WLIS web sites containing land information specific to Wisconsin.
4. A source for accessing and transferring spatial and non-spatial land information, data and metadata.
5. A platform supporting integrated and aggregated views of state and locally produced data, capitalizing on data already created by state agencies and local governments and other sources such as federal sources.
6. A dynamic system providing an application framework for web-mapping and non-spatial data integration and processing,
7. A means for promoting standards, and standardized data content and structure
8. A means for providing cross-walk functions between non-standard data and a standard WLIS data model.
9. A means of supporting land management decision-making activities, including comprehensive land use planning.

Key Points-Requirements

1. We recognize the importance of understanding stakeholder needs.

2. We used four methods to collect, create, and validate system requirements.
3. We conclude that the system should be a statewide system easily accessible by the public.
4. We conclude that the system should be web-based and distributed.
5. We conclude that the system should be—among other things—a catalogue of spatial and non-spatial links using an indexing retrieval system.
6. We conclude that the system should be a source for accessing and transferring spatial and non-spatial land information, data, and metadata.
7. We conclude that the system should be a platform supporting integrated and aggregated views of state and locally produced data, capitalizing on data already created by state agencies and local governments.
8. We conclude that the system should be dynamic, providing an application framework for web-mapping and non-spatial data integration and processing.
9. We conclude that the system should be a means for promoting standards, and standardized data content and structure.
10. We conclude that the system should be a means for providing cross-walk functions between non-standard data.
11. We conclude that the system should be a means of supporting land management decisions, including comprehensive land use planning.

IV. Project Scope

This section intentionally details a WLIS project scope using the structure common to major Information Systems projects to allow the eventual development of a request for proposal, or similar document, easier. The following sections:

1. Provide a narrative description of the entire project.
2. Enumerate deliverables, which, taken together, describe the project as a whole.
3. Identify specific "measurable" objectives, or critical success factors, to later be able to judge the success of the first phases of the project.
4. List benefits, assumptions and constraints acknowledged by the Team.
5. Discuss specific potential risks that the Team identified, as well as their impact and suggested mitigation strategies that may be employed.
6. Justify the pursuit of the development of a WLIS.

1. Project Narrative

One of the underlying architectural design premises for a WLIS is the distributed approach to data management and distribution. Multiple cooperative nodes will support data retrieval and simple information product development through a common web interface. Although all nodes would contain a standard selection of replicated data sets, these nodes are not simply clones of a central core repository; rather each one maintains additional data appropriate for a local context, as well as the capability to query and retrieve data from other nodes.* Replicating frequently requested data on multiple nodes is offered as an alternative to storing data at only one node in the system. A system supporting replication is less vulnerable to service failure and can be more efficient in serving clients than a single central repository alternative.

Notes are included in the Technical Working Group's Final Report regarding the use of "off-the-shelf software solutions", "industry standards", and tools for converting "commonly-used data formats, datums...". Although these statements allow for the development of a heterogeneous set of WLIS nodes, they do not require it. The Team chose the alternative which allows the support of multiple environments at WLIS nodes. An alternative not proposed is that all nodes be required to have specific hardware in order to participate. That alternative was rejected due to its disregard for existing investments at potential nodes and due to the belief that a standards-based, Internet-resident WLIS could succeed even with a heterogeneous computing environment.

Although fundamentally distributed, some of the implementation and management must be centralized for efficiency and effectiveness. For example, the development of a template for web presence of WLIS nodes, the programming of some core functions, and the subsequent deployment should be provided by a core of technical expertise. Users also expect a single source for commonly-used statewide information, built on the framework of the current WiscLINC clearinghouse.* The need to rely on some measure of core expertise and data management is meant to encourage and leverage the active involvement of a broad community of

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* The term local in the context of WLIS nodes could be any participating organization or unit of government, including state and regional agencies, as described later.

* http://badger.state.wi.us/agencies/wlib/sco/pages/wisclinc.html

land information professionals in the design and implementation of WLIS. Indeed, it is expected that many organizations and individuals will be involved in the development of WLIS components.

Moreover, a physical implementation of a core (for the want of a better term) node will need to exist, although the only characteristics that will distinguish it from any distributed node are that 1) it will house the 'parent' searchable metadata database and 2) it will be the initial staging point for data replication to the distributed nodes. Redistribution of key data and metadata from the WLIS core node to distributed WLIS data and web nodes would provide data to the WLIS core and distributed web applications and independently-developed custom applications. Replication can be implemented as batch or automatic (unattended) processes. The primary rationale for recommending a replication approach is that it would provide for redundant sources of data to optimize performance and availability.

The Team rejected the alternative embodied in the single server/service center approach. In that scenario, all data would be submitted to a central organization for WLIS distribution and publication and tools would be developed to allow data developers/custodians to upload data to the WLIS core. This approach was rejected as being too centralized for the WLIS community of interest and wasteful of the existing capabilities of systems and staff throughout the state.

The design and implementation of WLIS should proceed in phases. Although some organizations will be able to capitalize on the WLIS approach quickly, others will require longer time periods to accommodate the WLIS approach and make the needed investments. In the interim, there will be efforts to facilitate transition and limited use through outreach efforts, extension of technical assistance and the development of core standards for data themes. While it will not be designed for citizen use initially, the system will be publicly accessible and usable. Development of capabilities for the general public in the first phase of the WLIS was felt to be subordinate to the need to focus on the core components, and the use and development by experts and professional users in various organizations.

In summary, the WLIS will be an internet-based network of shared data and information that:

1. Builds incrementally on existing investments and standards in land information.
2. Serves a wide audience, including public agencies, private organizations and individual citizens.
3. Provides web-based access to information and support for functions oriented to "enhancing land-related data creation, management and dissemination".
4. Is developed and maintained by "multiple participants in the land information community" in a phased process.
5. Has a common user interface to local, multi-jurisdictional, and state agency data.
6. Will eventually support land information applications, such as zoning and the new Smart Growth Comprehensive Planning Legislation.

Jurisdictional Scope

WLIS is intended to provide access to land-related data held by all public agencies, as well as participating private organizations, in Wisconsin. Because certain state agencies and counties

are specifically mentioned in the Wisconsin Land Information Program*, these agencies will be one of the initial focuses of design and development efforts. Other state agencies may also be included in WLIS, as well as larger municipalities that already have land information systems. Smaller units of local government and many kinds of special districts may wish to collaborate with counties or regional planning commissions in order to participate in WLIS. Since they are already extensively involved in data collection and dissemination, regional planning commissions would be a likely place to maintain some of the early WLIS nodes. Also, many federal agencies could provide data in forms and formats useful to WLIS in its early stages.

It is also not only possible, but desirable for private organizations to contribute data and applications to WLIS. Although the initial focus of WLIS development will be to support local and state agency applications, this is not intended to deter others from developing additional applications. The design and architecture should be as open as possible to facilitate such additional application development by individuals and private organizations. The Team rejected an alternative approach of having a closed system that precludes the development of third party applications to utilize WLIS data.

Levels of Participation

The WLIS will be designed to accommodate three general levels of optional participation during its development and early operation:

I. Documenting existing databases and information

II. Providing digital land-related data

III. Maintaining a WLIS node

These three levels describe participation in, not use of, WLIS. Use of WLIS includes a much broader set of stakeholders. The designation of three levels is based on the premise that not all units of government or private concerns will have the funding or technical capacity to participate in WLIS in the same way. By providing differing levels of participation, WLIS will be able to incorporate a much broader range of data while minimizing any additional burden on data providers. It also provides a means for all organizations to participate in WLIS at a level they consider appropriate. It is possible for large organizations, such as state agencies, to participate at different levels for different program areas for any reason. Any number of arbitrary "groups" of participants in building the assets of the WLIS could have been identified. The Team chose three to provide for a range of participant capabilities and commitment that broke at logical divides.

The following matrix graphically illustrates the levels of participation and the corresponding levels of participant activity, software support and functional application support. Participants at both level I and II would provide data or documentation to a WLIS node; they would not provide direct support to WLIS users. Level II is subdivided into three sub-levels, based on increasing commitment of effort and resources. At the first sub-level (IIa), organizations would provide data as these are maintained within the agency. At the next two levels, organizations would provide additional services to make the data more useful in the WLIS context. At IIb, the organization would develop cross-walk tables and other parameters necessary to convert data

* See Wisconsin Statute 16.967

into WLIS standard objects, so that this could be done "on-the-fly" as needed to accommodate WLIS data requests. At the third sub-level, the organization would perform all the necessary conversions (e.g., coordinate, classification and terminology, format) and provide data in forms immediately useable within the WLIS framework.

Real time access to replicated data through WLIS can be provided through two mechanisms: 1) request routing and data replication among WLIS distributed nodes or 2) direct access to non-WLIS repositories. The staging of transferred data on WLIS distributed nodes provides better control over data form and availability, and direct access enhances the ability to provide up-to-date data. It eliminates the need for all WLIS participants to maintain local large-volume data storage facilities to store copies of the standard data sets.

Participation Level	Participant Activity	WLIS Software Support Requirements	WLIS Application-level Support
I 	Provide metadata and/or data indexes	Metadata entry and cataloging tools	Simple query processing, data indexing, metadata retrieval, outreach
II-a (path 4 Fig. 2)	Provide "raw" data via ftp and other batch transfer	Internet data tools, data transfer and storage protocols	Data download
II-b (path 1 Fig. 2)	Provide "raw" data with conversion information (e.g., cross-walk table	Database cross-reference tables and procedures	conversion to WLIS-standard formats
II-c  (path 2 & 3)	Provide data in WLIS-standard forms	Data server and Internet map server capability	On-line data access and integration; support custom developments
III-a 	Support WLIS Web interface	Web-server, WLIS protocols and templates	Advanced query processing, more efficient operation
III-b 	Support interactive WLIS data query	Web-server, WLIS protocols (non-WLIS user interface)	Limited query processing, interactive data access

Figure 1

Level I – Providing Information About Data

One goal of a WLIS is to provide an searchable database containing a minimum set of information about what data exists, where it exists, what it consists of, what format it is in, and how data sets can be obtained (minimal metadata, as described below). Ideally, the data referenced would be available from the source in a standard digital format, but could be in other forms, as well. It is not expected that WLIS will always be able to provide instant retrieval and display of data, but it should at least be able to provide an indication of its existence, location, and availability.

For spatial data, all agencies that receive funding from the Wisconsin Land Information Program are required to provide documentation of data sets generated through program funds. At a minimum, all state agencies and counties should be required to provide minimal WLIS-standard metadata. Non-spatial land related information, such as laws, rulings, procedures, and so forth, should also be documented using the structure of the WLIS-standard metadata and treated the same as spatial data within WLIS.

WLIS requirements for Level I participation would entail creating indices of agency-created or maintained information, and metadata that is minimally-compliant with the Federal Geographic Data Committee's Content Standard for Digital Geospatial Metadata, and providing this to a WLIS node. This would permit the use of search routines to rapidly query metadata and the indices and to retrieve information on the location, format, and structure of the data and its availability. However, it is not realistic to believe that all jurisdictions will be able to generate such high quality metadata in the short term, particularly organizations that continue to maintain data in analog formats. Therefore, an important first step in developing the WLIS is to develop simple information indexing procedures and metadata entry software that can be used to document both digital and paper records.

Level II – Providing Digital Data

Several options are available for data providers at level II, with differing levels of effort on the part of the providers and WLIS technical operations. These are shown as "paths" in Figure 2. In all cases, data would be delivered periodically to WLIS distributed nodes and staged for general availability[*]. The WLIS distributed node would support processing functions such as indexing, searching, conversion, analysis, mapping and data maintenance. The data node option works very well for organizations that have neither the capacity nor the interest in maintaining Internet accessible data. It does, however, require periodic transfer of data to a WLIS distributed node, potentially necessitating inter-organizational agreements.

This approach also requires the careful selection of additional, frequently used data, since the WLIS node need not duplicate all data generated by a jurisdiction. For example, a regional planning commission could manage a WLIS distributed node that maintains regional coverages and stores parcel data, orthophotography and other foundational elements from counties and other jurisdictions. Some jurisdictions may wish to provide local access to certain replicated data sets from their own databases, particularly commonly requested data, but without the added

[*] Specifying the periodicity of data updates to the WLIS was rejected. Identifying appropriate cycles for updating WLIS data was felt to be the charge of individual custodians or constituency groups that better understand their practices and business needs.

time and expense of maintaining a WLIS web node. This would allow sites that have already developed a web-delivery of data to participate in WLIS without having to do a complete conversion to the file formats of WLIS.

Inter-organizational agreements might be needed to specify technical linkages, fiscal arrangements (who bears which costs), legal considerations such as liability disclaimers and privacy protection provisions.

The Team designed a strategy to offer multiple options to participants for providing data to the WLIS, as depicted in the diagram below. This graphic depicts a model for the preparation and distributed deployment of land-related data; spatial and non-spatial, as well as metadata, for use by all WLIS participants. Although the model suggests the batch or automatic reprocessing of data into a WLIS-standard state, it is expected that dynamic cross-walk functionality will be developed for web-based applications, as well.

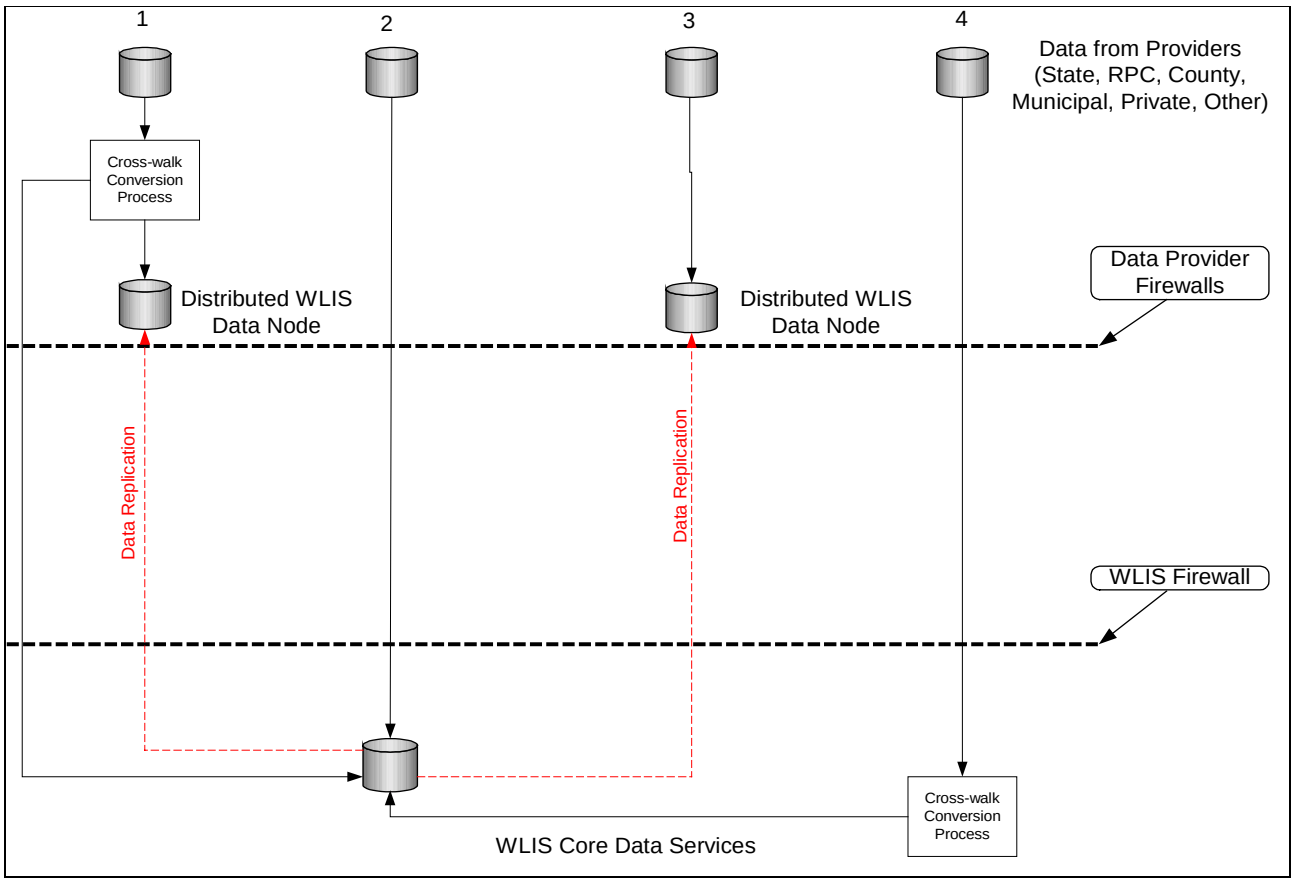


Figure 2

The Team felt that multiple data distribution paths were superior to a single-path approach because it provides flexibility in how an organization chooses to participate in Wisconsin Land Information System and it avoids potential bottlenecks caused by the movement of large volumes of data through a single point.

The Team's design for data distribution and deployment has two major components: 1) data replication throughout the system and 2) the provision of data by providers into the system.

Replication is addressed elsewhere, but the options available to data providers needs further description here.

There are four options available to Level II data providers, intended to offer a selection for the participants commensurate with their technical expertise and level of interest in becoming involved in the process. The design depends on two concepts: 1) a WLIS-standard data model and 2) the development of a software tool to provide a cross-walk, or conversion to this model from the existing format.

Path 1 – This option offers the data providers the ability to convert their data to WLIS standard-compliant format for staging of converted data and metadata to a WLIS distributed data node accessible via the Internet, or on the WLIS core node also accessible via the Internet. This option would require a minimal level of technical expertise and infrastructure and the establishment of a partnership with an organization hosting the distributed node.

Path 2 – This option provides for the staging of WLIS-standard formatted data and metadata directly on core WLIS data node, which is accessible via the Internet. This option requires that the data meet the WLIS standards in its native form.

Path 3 – This option varies from the preceding option only in that it stages the data and metadata on a distributed data node (which is then replicated to the core WLIS data node.)

Path 4 – This option requires the least effort and technical expertise on the part of the data provider and the most effort on the part of the core WLIS service effort. The core staff provides data conversion services for the data provided to the WLIS standard-compliant format and stages the data on core WLIS node for later replication to all nodes. The data submitted must have minimally sufficient metadata to provide the necessary information to allow the conversion.

Level III – Maintaining a WLIS Node

User access to WLIS need not emanate from a single web server (though casual users could have a single primary entry point). Instead, multiple nodes maintained at various levels of government and the private sector could provide data and services. The nodes would have a similar look and feel, but could be customized for geographic regions, domain areas, or other preferences. Node support staff would work out agreements for data transfer from Level II participants in their region or area. When a query involved integration with data created and maintained across a more extensive area, the node would seek this information from allied nodes. For example, if the query involved project permitting that required compliance with historic preservation statutes, a county WLIS node could retrieve the necessary information from a node containing data provided by the State Historical Society.

Specifications for maintaining a WLIS node (Level III-a) will depend on functional requirements that emerge from the development of detailed system design specifications. At a minimum, the site will need to maintain a web server and database/file server and all that this implies maintaining software and hardware, performing back-ups, providing a firewall, having sufficient Internet bandwidth and some degree of technical support to users. While all WLIS nodes will not have identical technical specifications or configurations, minimum levels of operational functionality will need to be maintained. It is desirable to design WLIS to accommodate a broad range of Internet connectivity, hardware and software, given the range of variability that already exists among different organizations.

Standard, customizable WLIS node templates providing basic WLIS functionality and a common look-and-feel should be designed and developed to function 'out-of-the-box' so that distributed node sites can be implemented without significant effort. Templates would be open files, ensuring a minimal functionality at all sites, and providing the basis for customizing sites for particular organizations.

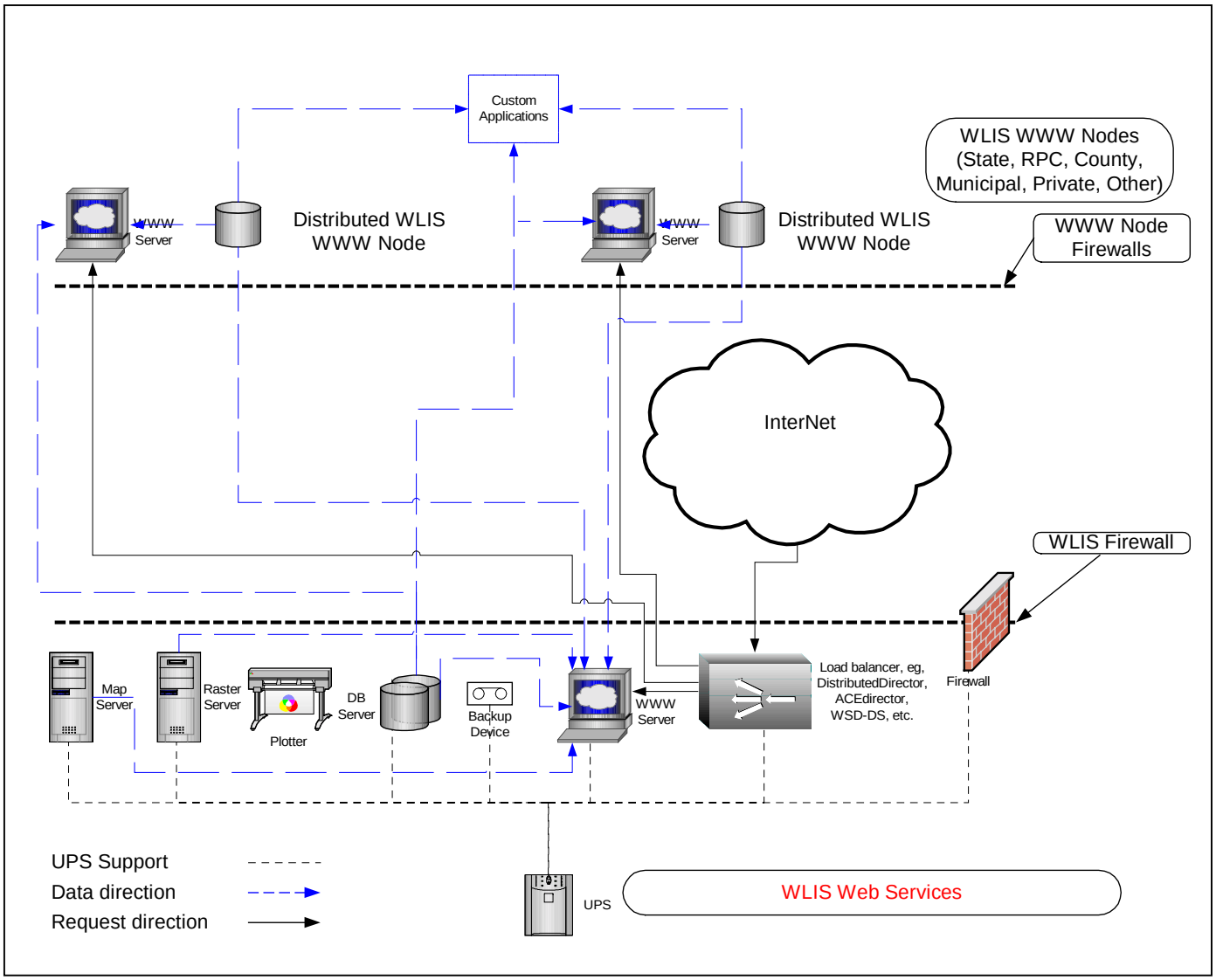


Figure 3

Level III-b is noted as a means to accommodate organizations that have already made substantial investment in providing on-line data resources and related functionality, to make these resources accessible through WLIS. It provides a mechanism to "enter" and retrieve data from Web-servers not built on the WLIS template. Level III-b data serving would carry two basic obligations. First, in addition to fully FGDC-compliant metadata about the data, a site providing on-line data sets would need to provide information to WLIS about the types of queries and access it can support, essentially metadata about its on-line services, including, for example, hardware, software, and operating system(s). Second, the data provider may be obliged to maintain some minimum level of query support. For example, for efficient operation of queries, it may be necessary to specify that local sites must be able to support an SQL-type database

query. Such requirements would emerge as more detailed specification of query support is identified. The diagram above depicts the medium stages of development of the WLIS and its web functionality. Although the core WLIS node is fully provisioned with hardware and software, it has already been noted that the only distinction between the core and distributed nodes is that the core serves as the source for the distribution of data and metadata common to all data nodes. The distributed nodes on the diagram only portray the required minimum infrastructure discussed above.

WLIS Project Phasing

The typical information system development lifecycle is comprised of analysis, design (often including prototyping), development, testing, implementation and operations/maintenance. Because WLIS is dealing with such a broad range of functions and participant environments, it should not be assumed that these steps will be linear. Rather, the development cycle might be thought of more as a series of smaller projects, ordered based on logical dependencies. For example, since data indexes and metadata are so crucial to the functioning of WLIS, development of the metadata entry and retrieval tools, training and other outreach activities should be pursued as soon as possible. Other activities, such as application development and development of distributed node models and web templates can only take place after core tools have been developed and documented. The participation levels table above provides initial suggestions for the sequencing of activities, such as metadata development and phasing for other activities. Given the nature of this approach, the Team has made the assumption that the design and implementation of WLIS will take place in phases, over at least two state budget biennium cycles. As a consequence, differing levels of functionality will become accessible to users in a sequence over several years. A "Develop the WLIS in one-shot" approach was rejected by the Team because of the overall system costs, the undetermined extent of the mature system, the need to establish fundamental operational standards and the differing abilities of various stakeholders to commit the necessary time and resources to become full participants. Moreover, a phased approach will permit the development of prototypes and solution testing that is considered necessary for the successful development of the system.

In general terms, as described in the Technical Working Group's final report, the first to benefit from the system will be those organizations and individuals already routinely using automated land information systems. These users have both the expertise and equipment to take advantage of a WLIS right away. It can enhance what they are already doing, and extend their capacity to acquire and integrate data from multiple sources. Another group that will realize early benefits from WLIS are those with applications that can be supported by WLIS, but have been stymied from using automated land information for many reasons, including lack of data access. However, those lacking appropriate tools to manage, analyze, and display the data will not benefit immediately but will need to wait until specific applications are developed within the WLIS framework. For example, local land use planning staff and officials clearly need land information, but may have to wait until a range of applications are developed to help them understand and use the information provided through WLIS. Initial priority of WLIS development is the infrastructure of the system. However, WLIS data and its resources will be available to support individual application development during its early development.

2. Project Deliverables

While there can be innumerable functions and products resulting from the phased development of a WLIS, there are several that stand out as deliverables from the first few phases of the project. For ease of consideration, these can be thought of as falling into three broad categories: design, development and operation.

Design

Before any development activity can begin, several fundamental design components must be completed. First, the WLIS metadata standard model must be developed, accepted by the state's land information community and published. Closely following this, a WLIS metadata database schema, addressing spatial and non-spatial data, needs to be developed. These two steps are prerequisite for the design and development of metadata entry, indexing and querying capabilities, as well as the design of dynamic cross-walk capability. These steps can also be initiated and pursued immediately.

Once the WLIS standard metadata model is established, selected WLIS standard data sets must be identified (see discussion below), and procedures and agreements established for the acquisition and regular updating of these key data sets. These data sets will make up the repository of data common to all nodes on the WLIS network. When the planning begins for the establishment of distributed data nodes, a data replication model will need to be designed to insure that the WLIS standard data sets are synchronized on a timely basis.

Also, with the development of the nodes on the WLIS network, the need for an effective security model to enable dynamic cross-walk capability becomes a critical component. Although the data within the WLIS network is virtually all copies, denial-of-service (DOS) attacks and the surreptitious alteration of data are very real concerns. The development of a distributed security model to permit authorized access to data on distributed nodes for legitimate applications across the open internet is not an insubstantial undertaking. The first central component of this model must be the configuration of the firewall and load balancing mechanisms at the WLIS core to provide data access to WLIS participants, as well as WLIS Web Services applications. This effort must also produce a set of instructions and protocols for access to independent applications development efforts by WLIS participants. The second component must be a model for a similar configuration for the WLIS nodes and the development of instructions for implementing them for the node custodians.

Development

Once the design stage of the project is largely complete, development of individual components of WLIS can proceed. The creation of the core elements would likely begin with the construction of the structure and framework of core user interface (which would become the basis for the templates for the distributed node web templates). These will be followed by the development of the metadata entry and query-retrieval tools.

Before the network begins to add the distributed nodes, several components must be developed. The cross-walk conversion batch process for both the core and distributed nodes must be designed and developed. As already indicated, the process must be designed to be extensible for independent customization, but it must also have the capability to accept non-destructive updates as they are made available by the core technical staff.

Central to the design of WLIS is its distributed nature; this necessitates the planning and design of an intelligent load-balancing or redirection mechanism for both performance and programmatic reasons.

One of the advantages that this network architecture affords is the ability for any participant to develop an application which accesses standard WLIS data, as well as any other data, locally stored, staged on a WLIS distributed or core node or otherwise made accessible on the internet. Therefore, local application protocol will be developed to permit the linking of locally developed applications to any accessible WLIS data source.

Operation

The WLIS core staff will provide for the ongoing maintenance and enhancement of WLIS applications (such as the cross-walk process), the development of standard information products, general data services and the creation and maintenance of the WLIS database schema.

It is assumed that another organizational structure will maintain WLIS data and metadata standards.

3. Critical Success Factors

The Team recognizes that it is critical to be able to establish benchmarks and milestones to measure the development progress and the success of the WLIS. Optimum support from the system stakeholders can be anticipated if they have clearly defined expectations. Ideally, by the end of the first year of operation:

1. There should be direct participation at all levels of government - 4 of the 7 state agencies represented on the Land Council, 1 RPC, 20 counties, as well as cities, towns, and the private sector and some participation by sovereign nations and federal agencies.
2. Data access should be available to local units of government.
3. There should be a metadata entry tool, and an indexing and query tool(s) as part of the system.
4. There should be significant progress on the development of theme core standards, cross-walk functionality and a prototype of an online mapping application.

By the end of the third year of operation, there should be a pilot of a distributed WLIS node with both data and web functionality.

4. Benefits

The Team identified an extensive array of benefits, to public and private sector stakeholders, that would emanate from a WLIS. One of the primary functions of the WLIS is to identify and make available the extensive land related data already in existence. Two existing “barriers” will be largely removed for the large audience; knowing what information already exists and having access to the information by viewing it online or the ability to obtain a copy for application development. As a result, the potential benefits of this system are numerous. The benefits can be grouped as a benefit directly obtainable from the WLIS. Also, WLIS could facilitate the creation of a wide range of applications by varying interest groups.

A list of the direct benefits include:

1. Economic impacts. A WLIS will directly provide the basis for a variety of business- related activities as well as the foundation and platform to build many more. The benefits cited below will benefit both state and local economies. The system will provide economic, demographic, and current business location information. Additionally it will have detailed information available to show the infrastructure of highways, railroads, waterways, and other transportation and infrastructure details. Locally, land available for development, property tax rates, and similar land related information can be provided. This would facilitate:

    - New business siting and expansions. Providing the base information for market research and analysis necessary for identification of potential sites for new or expanded business locations; additional linkages to local web sites could provide additional information about the communities; some examples include available labor pool, schools and parks and recreation options.

    - Direct marketing of sites. Linking the system to existing sites such as the Brownfields web application at the Department of Commerce [http://comgis1.commerce.state.wi.us] would further enhance the direct marketing of business location throughout the state, reaching a much broader potential audience than would be possible from numerous, independent, and "unconnected' sites if everyone did it on their own.

    - Enhance tourism. Linking to existing web sites, users will find maps of Wisconsin, such as the Ice Age Trail map [http://www.dnr.state.wi.us/org/at/et/geo/iceage/index.htm] which shows amenities available along the trail.

2. Public Access to government data. The list of potential data sets identified for inclusion is extensive, and much of the information would have broad interest. One of the major benefits of web technology is its accessiblity: 24 hours a day, 7 days a week. No longer would access to data be confined to "business hours" or to the time constraints of existing staff. Private citizens, businesses, non-profit organizations, as well as other government entities, could quickly and easily identify data that they need. This information might include: local zoning or assessment information; the size of the deer herds in locations around the state; information about the area where they are thinking of purchasing a summer cottage; viewing a digital orthophoto of their property; or viewing digital raster graphics showing the terrain and other information of their neighborhood, municipality, or county.

3. Educational benefits. The state has taken the lead in ensuring that schools throughout the state are able to connect to the web. All of the information described can thus be accessed by students and their teachers at all levels, from elementary grades through college. Geography classes are a natural for accessing this information, with the ability to access a wide range and significant number of maps and related databases. However, many others will find much to help them as well. Classes will find information on government boundaries, population profiles. The range of planning documents which could be accessed via the WLIS can help them understand how their community plans to change in the coming years. Orthophotos and similar products will provide the students with images of their areas for study and analysis.

4. Direct Government Benefits. The ***integration*** of state and local data would provide numerous benefits to all participants.

   - Having the data on WLIS means that applications developed using WLIS may be available statewide, for everyone; no longer must each unit of government develop the application themselves; rather they can benefit from the work of others.
   - With the promotion and support of data and the development of standards, costs can be reduced. Elimination of duplicative development efforts is possible.
   - Making data readily available reduces the costs for time and money spent on data discovery, access, and conversion, especially in the area of planning, although all government entities will benefit from the ease of access.
   - Increased intergovernmental cooperation is expected. Viewing shared resources and showing how their actions would affect their neighbors is now feasible.
   - The WLIS would support the directions outlined by the Kettl Commission, by looking at problems and service delivery from a new, more integrated, cross-boundary perspective.
   - The citizenry will be much better informed in a timely manner, especially when it comes to land use issues.
   - Less effort and resources spent by public agencies in providing data and information to the public in satisfaction of open records responsibilities.

Indirect benefits are also identified. They are classified as indirect as the ultimate benefit is dependent on another entity taking some action. The types of applications developed are wide-ranging given the variety and extent of the data that is expected to become part of the WLIS. These might include:

- A variety of real estate applications based on parcel maps, related attributes, and local and regional comprehensive plans; comparison of property values; comparison of tax rates, school districts, etc
- Business (re)location applications – Examples could include: Nursing home locations, based on current licensed facilities and population profiles based on age ("Where are elderly undeserved?")
- Research related – Farmland Preservation and related programs - available data could include acreage and location of farmland, over time, Medical research could include incidences of diseases and other medical problems, related to population profiles, business locations, natural environment, etc
- "General public" applications – such as where are good fishing streams near where I am planning to camp? What type of hunting is allowed around our cottage or vacation site? If I moved to this location, what school district would I be in; what would my property taxes be; etc
- Many of these applications can only be built if there is a WLIS, as they may require a combination of both state and local data, private sector data, and potentially federal data as well.

5. Assumptions

It is important in any information systems project to clearly address any and all assumptions made in the design and planning phases. The Team recognized the following assumptions in its work in developing the design of WLIS and would like to ensure that they are recorded.

1. There will be an administrative body, or bodies, to provide guidance, support, operation and decision-making services, as well as management of core assets. While there is not a comprehensive list of decisions to be addressed, initially or on an ongoing basis, a few might be:
   - The determination of the minimum standards for the addition of a new data set to the WLIS environment.
   - The addition of new data sets to the standard set of WLIS core data sets.
   - The technical and organizational requirements for participation as a distributed node.
2. A WLIS administrative body will establish and publish commonly accepted standards for data and metadata that will be used by direct participants in the WLIS and will be used as the target for participants who convert via the cross-walk process.
3. There will be sufficient bandwidth made available to accommodate significant data transfer requirements, both dynamic and automatic.
4. WLIS is a publicly-accessible system. Therefore, data providers and users can be any WLIS participant from any sector.
5. WLIS participants will have the option of selecting the publication path alternative that best suits their needs and interests. In this regard, state agencies are on a par with other data providers - they can provide data using any of the alternative publishing paths.
6. It is expected that there will be a gradual shift by WLIS participants from emphasis initially on data presentation and integration to future improvements in data models, storage and data collection.
7. Data can be passed through intermediaries. (e.g., Regional Planning Commissions can serve counties, municipalities, etc.; counties can serve municipalities, metropolitan multi-jurisdiction districts, etc.; private entities can serve any public and/or private organization)
8. Promotion of desired or preferred paths will probably require differential levels of incentives. (e.g., financial support for hardware, network connectivity, software, grants, etc.) It is expected that there will be a need to provide more incentives to encourage providers to act as a distributed WLIS node.
9. A single, central data services repository is not scalable to meet the potential demand of a fully-developed WLIS; Distributed WLIS nodes, with an intelligent load balancing mechanism, will be required to adequately serve the needs of such a system.
10. Although not to the exclusion of other entities, it seems that organizations with the scale and resources of state agencies, Regional Planning Commissions, and some counties are likely candidates to support a distributed node.

6. Constraints and Risk Analysis

Constraints

The Team recognizes that an endeavor on the scale of developing a statewide system predicated on the cooperation and support of numerous diverse stakeholders is an undertaking that is not without substantial risks. The Team identified a significant, though perhaps not exhaustive, list of potential risks to the successful implementation of WLIS, assessed the impact of each risk and developed some suggested strategies that may be employed to mitigate or avoid the adverse effects. In addition, the Team identified several constraints that will likely be present to some degree, which are not likely to be, or perhaps are unable to be, mitigated.

The constraints identified were:

1. Lack of confidence on the part of potential stakeholders in the ability for WLIS to be successful and beneficial.
2. Lack of local funding available to support participation by organizations with fewer resources.
3. The absence of a cost recovery pass-through for for-profit enterprises or public organizations required to recover the cost of production of information products.
4. Participation constraints (lack of technical staff, infrastructure, spending and staffing limits, etc.).
5. The perception that the existing local investment in land information will be compromised by participating in a system with differing standards and/or technology.

Risk Analysis

The fundamental long-term vision of WLIS can be embodied in the goal of enabling a seamless statewide view of multiple common attributes that can be used in analysis and decision-making. There appear to be a number of potential pitfalls in achieving that vision, but there are also some apparent means of managing the risks they pose.

One class of risks threatens the willingness to provide spatial and non-spatial data which would ultimately defeat attempts at building a statewide land base with the themes identified later. Copyright and redistribution restrictions may translate into holes or gaps in the statewide base, and potentially increase system costs owing to increased data acquisition expense, if the data set is deemed critical. In preparation for this contingency, alternate sources of critical data should be identified and budgeting funds for data that needs to be purchased should be considered. Concerns over liability once a provider's data is released into such a public environment, especially as it may be used with others' data, was a less pressing, but very real question during the requirements gathering. Most, but not all felt that a solid disclaimer associated with their data would suffice, but it would be prudent to consider *a priori* legal review and participant indemnification. Privacy concerns also ranked as a threat to participation, but the Team felt that clearly defined and published privacy standards, incorporating a provision for shielding or blocking personally identifiable information, where appropriate, would be prudent.

A second category of identified risks is essentially related to finances. It is important to emphasize that the cost of a WLIS is not in just building the pieces, but in the daily operation of a gradually growing system, as well. As a result, the lack of sufficient, continuous operational funding is critical risk. If this is absent or insufficient after initial development, there is a very real possibility of the loss of credibility in the system and a resulting delay in further

participation and a potential loss of progress. This is the reason that the Team has differentiated the operational portion of the first phase of the project from the start-up and development costs. A strategy for later justifying the operational costs (as well as new development costs) is to demonstrate the success of the system in delivering value; this led to the Team's decision to establish Critical Success Factors, or benchmarks, as a way of justifying these expenditures.

Another risk identified in this category is the perception that a revenue stream, especially for a public entity, is being displaced by WLIS. The Team generally felt that an analysis of most cost recovery mechanisms would prove that they are not effective in truly providing an added revenue stream and that some effort be considered to provide educational outreach on the benefits to the participants and the cost savings that might result. Closely related to this risk was the threat that WLIS might be perceived as an unfunded mandate, leading to reluctance to participate and potential opposition to the initiative. This consideration led to the Team's approach in designing the system such that participation could be easy and low-cost, at a level commensurate with participant's abilities, resources and interest, and to emphasize that participation is optional. Here, again an early outreach effort on the benefits to the participants, including potential cost savings would help satisfy this concern. This is an area that might benefit from providing incentives – financial and otherwise - for participation.

Another area of risk is technical. The proposed system is employing technologies that have not been long in general use, or used for these purposes. One of the greatest concerns is the impact on user perception and the limitation of functionality arising from the lack of available bandwidth. While limited steps have been made to date in building applications on the web using these kinds of data, nothing has been attempted on this scale in both scope and depth. The contour map base for Milwaukee County, for example, exceeds 20 gigabytes; transferring that data or other data sets like it will require careful network design and potential contingency funds to insure sufficient bandwidth. Similarly, other technical issues (e.g., existing software, hardware, and interoperability) can limit the use of the system and the functionality that can be provided. Therefore, designing the system to maximize the system's capability to accommodate continuous system upgrades and establishing clear minimum technical standards for participation is essential.

Two risks that are potentials for limiting the unqualified success of the system are the lack of buy-in by essential data providers and the failure of data custodians to maintain their contributions to WLIS. The former can threaten the completeness of key data themes, thus impinging on WLIS' credibility. The latter can have the same effect, bringing into question the quality of data available in WLIS. A number of suggestions emanated from the Team regarding ways to address these, including providing incentives, proposing legislation tying participation to state grants and aids, reinforcing the data sharing requirement in the Land Information Program, and insisting on enforcement minimum data and metadata standards in WLIS.

Finally, the Team focused on the lack of standards and lack of the observance of standards as a key risk. The cost, reduced functionality and lack of interoperability that WLIS is predicated on make this one of the most significant threats. Although the design we propose has cross-walk functionality as a central requirement, this is intended as an expedient to deal with the reality that these conditions exist and must be addressed. For WLIS to be successful in the long run, there must be strong continuous institutional support for the establishment and observance of standards.

7. Project justification

Currently, Wisconsin is experiencing unprecedented economic growth which is affecting all sectors of our economy. An expanding industrial sector, new business startups, business and home construction, low unemployment, a robust stock market and high consumer consumption are all part of the current good times. Continuing to fuel the expanding economy has put a burden on federal, state and local units of government to provide timely services and make educated land use decisions. These decisions have a long-term effect not only on the continued growth of the economy, but also on our environmental resources.

It has been said that "land record information is the currency of the future." Land record information filters through all levels of the economy. Decisions are made daily in both the public and private sectors, based on the most current information available. To keep land record information current and flowing, it must be captured, shared and delivered in a timely and efficient process.

In Wisconsin, dozens of state agencies, over 2000 units of local government, 72 counties, countless private concerns and innumerable multi-jurisdictional organizations make daily land use decisions with the most current information available. These decisions govern the future location of streets, homes, businesses, sewer, water and schools in towns, villages, cities and counties. Vast amounts of land information have been captured at the state and local level since the Wisconsin Land Information Program initiative in 1989. However, the availability of this information for decision making is limited and may not be available in a state or county computer in a format that can be shared. For the first time, a WLIS would make this information widely available, leveraging the investment made in land records modernization for over a decade.

The passage of the "Smart Growth" legislation requires local units of government by the year 2010 to base all land use decisions such as zoning changes, annexations, and subdivision approvals, ect. on an adopted comprehensive plan according to statutory requirements found in s. 66.0295, Wis. Stats. This is a worthy effort which should help guide future growth in Wisconsin's communities. These comprehensive plans are required to be updated at the minimum every ten years. Completion of a comprehensive plan requires a vast array of land record information e.g., existing land uses, soil survey, census information and transportation analysis. For local units of governments to gather or access the necessary land record information to complete a comprehensive plan per state statute, a vehicle such as a WLIS is needed. A WLIS will allow all units of government to access land record information to complete and update their comprehensive plans and to make informed land use decisions.

Beyond its support for Smart Growth, a WLIS will have other significant uses, such as providing the private sector access to land record information making them more competitive and reducing redundant costs and efforts, and providing public access to a wealth of information stimulating citizen involvement and participation in land related issues.

Key points – 1. Project Narrative

1. We recommend that the system be a distributed approach to data management and distribution.
2. We recommend that multiple cooperative nodes should support data retrieval and product development through a common Web interface.

3. We recommend that each node maintains additional data appropriate for a local context, as well as the capability to query and retrieve data from other nodes.
4. We conclude that a system supporting replication is less vulnerable to service failure and can be more efficient in serving clients than a single central repository alternative.
5. We conclude that many organizations and individuals will be involved in the development of the system components.
6. We conclude that some of the implementation and management should be centralized for efficiency and effectiveness.
7. We conclude that the only characteristics that will distinguish the "core" node from any distributed node are that 1) it will house the 'parent' searchable metadata database and 2) it will be the initial staging point for data replication to the distributed nodes.
8. We recommend that the design and implementation of the system should be done in phases based on the availability of data and the state of technology.
9. We recommend that the system build incrementally on existing investments and standards in land information.
10. We recommend that the system target should be to serve a wide audience, including public agencies, private organizations, and individual citizens.
11. We recommend that the system provide Web-based access to information and support for functions oriented to "enhancing land-related data creation, management and dissemination".
12. We recommend that the system be developed and maintained by "multiple participants in he land information community" in a phased process.
13. We recommend that the system have a common user interface to local, multi-jurisdictional, and state agency data.
14. We recommend that the system should support land information applications, such as zoning and the new Smart Growth Comprehensive Planning Legislation.
15. We conclude that the system should provide access to land-related data held by public agencies and private organizations.
16. We recommend that state agencies and counties specifically mentioned in the Wisconsin Land Information Program should be the initial focuses of design and development efforts.
17. We recommend that early nodes should be state agencies and larger municipalities that already have land information systems, smaller units of local government, and special districts who wish to collaborate with counties or regional planning commissions and regional planning commissions themselves.
18. We recommend that Federal agencies could provide data to the system.
19. We recommend that private organizations contribute data to the system, particularly if these data are created using public funds.
20. We recommend that the design and architecture of the system be as open as possible to motivate collateral application development by individuals and private organizations.

21. We recommend a model for the preparation and distributed deployment of land information systems data as show by a graphic in the document text.
22. We recommend that the system accommodate multiple levels of optional (input) participation.
23. We recommend that Level I have a searchable data base containing a minimum set of information about what data exists, where it exists, what it consists of, what format it is in, and how data sets can be obtained.
24. We recommend that at Level 1, for spatial data, all agencies that receive funding from the Wisconsin Land Information Program be required to provide documentation of data sets generated through program funds.
25. We recommend that at Level 1, at a minimum, all state agencies and counties should be required to provide minimal metadata. Non-spatial land related information, such as laws, rulings, and procedures, should also be documented.
26. We recommend that an important Level 1 first step is to create simple information indexing procedures and metadata entry software that can be used to document both digital and paper records.
27. We recommend that at Level II, the system should provide real-time access to data via request routing and via direct access.
28. We recommend that at Level II, data should be delivered periodically to the system nodes for general availability.
29. We recommend that the system nodes would support functions such as indexing, searching, converting, analyzing, mapping, and data maintenance.
30. We conclude that the node concept will allow some jurisdictions to provide local access to certain data sets from their own databases—particularly commonly requested data—without the added time and expense of maintaining their own Web presence.
31. We recommend the Level II carry two basic obligations: (a) to provide info about its capabilities and (b) to maintain a minimum level of query support.
32. We recommend multiple publication paths.
33. We recommend that Level II system design for data distribution and deployment have two major components: 1) data replication throughout the system and 2) the provision of data by providers into the system.
34. We recommend four data distribution and deployment options for Level II data providers.
35. We recommend that Level II, Option One offers the data providers the ability to convert their data to system standard-compliant format for staging of converted data and metadata to a system distributed data node accessible via the Internet, or on the system core node also accessible via the Internet.
36. We recommend that Level II, Option Two provides for the staging of system-standard formatted data and metadata directly on core system data node, which is accessible via the Internet.

37. We recommend that Level II, Option Three varies from the preceding option only in that it stages the data and metadata on a distributed data node (which is then replicated to the core system data node.)

38. We recommend that Level II, Option Four would have the core staff provide data conversion services for the data provided to the WLIS standard-compliant format and stage the data on core system node for later replication to all nodes.

39. We recommend that for Level III, multiple nodes maintained at various levels of government and the private sector to provide data and services.

40. We recommend that for Level III the nodes would be customized for geographic regions, domain areas, or other preferences.

41. We recommend that for Level III, the data archive would include primarily locally generated data and when a query involved integration with data created and maintained across a more extensive area, the node would seek this information from allied nodes.

42. We recommend that for Level III, specifications for maintaining a system will depend on functional requirements that emerge from the development of detailed system design specifications but it will have a minimum standard configuration.

43. We recommend that for Level III, standard, customizable WLIS node templates providing basic WLIS functionality and a common look-and-feel should be designed and developed to function 'out-of-the-box' so that distributed node sites can be implemented without significant effort.

44. We conclude that because the system deals with such a broad range of functions and participant environments, development is likely to occur in a non-linear sequence.

45. We conclude that the development cycle is likely to be a series of smaller projects, ordered based on logical dependencies.

46. We conclude that activities such as application development and development of distributed node models and web templates can only take place after core tools have been developed and documented.

47. We assume that the design and implementation of the system will take place in phases, over at least two state budget biennium cycles.

48. We conclude that a phased approach will permit the development of prototypes and solution testing that is considered necessary for the successful development of the system.

49. We conclude that the first to benefit from the system will be those organizations and individuals already routinely using automated land information systems.

50. We conclude that another group that will realize early benefits of the system are those with applications that can be supported by the system, but have been stymied from using automated land information for many reasons, including lack of data access.

51. We conclude that although the system will be open to anyone, including individual citizens, developing applications to meet specific interests will be a low priority, both because the needs are so disparate and diffuse, and because direct benefits are not compelling.

Key Points – 2. Project Deliverables

52. We conclude that the deliverables from the first two phases of the project fall into three broad categories: design, development and operation.

53. We recommend that a system metadata standard model be developed, accepted by the States' land information community, and published.

54. We recommend that a system metadata database—addressing spatial and non-spatial data—be developed.

55. We recommend that once the system metadata model is established, selected standard data sets should be identified, and procedures and agreements should be established for acquiring and regular updating these key data sets.

56. We recommend that when the planning begins for the establishment of distributed data nodes, a data replication model should be developed.

57. We recommend that the system be designed to insure that the WLIS standard data sets are synchronized on a timely basis.

58. We recommend that security measures should be developed as nodes are created.

59. We conclude that once the design stage of the project is largely complete, development of individual components of the system can proceed.

60. We conclude that the creation of the core elements would likely begin with the construction of the structure and framework of core user interface (which would become the basis for the templates for the distributed node web templates).

61. We conclude that these will be followed by the development of the metadata entry and query-retrieval tools.

62. We conclude that before the network begins to add the distributed nodes, the cross-walk conversion batch process for both the core and distributed nodes must be designed and developed.

63. We recommend that the process be designed to be extensible for independent customization and it must also have the capability to accept non-destructive updates as they are made available by the core technical staff.

64. We recommend that the systems distributed nature necessitates the planning and design of an intelligent load-balancing or redirection mechanism.

65. We conclude that this network architecture provides the ability for any participant to develop an application which accesses standard system data, as well as any other data, locally stored, staged on a WLIS distributed or core node or otherwise made accessible on the internet.

66. We recommend that local application protocol be developed to permit the linking of locally developed applications to any accessible system data source.

67. We conclude that the WLIS core staff will provide for the ongoing maintenance and enhancement of WLIS applications (such as the cross-walk process), the development of standard information products, general data services and the creation and maintenance of the WLIS database schema.

68. We assume that another organizational structure will maintain system data and metadata standards.

Key Points – 3. Critical Success Factors

69. We recommend the adoption of critical system success factors dealing with participation, access, data, prototypes, and participants.

Key Points – 4. Benefits

70. We conclude that access to data for both professional and public stakeholders will keep users better informed, will require fewer resources spent by public agencies in providing data and information to the public in satisfaction of open records responsibilities and will increase accountability of agencies providing data and information.
71. We conclude that participation will be flexible.
72. We conclude that the system will reduce or eliminate redundant costs and efforts in the integration of data and the development of data.
73. We conclude that data will be shared.
74. We conclude that economies-of-scale will occur by pooling of resources.
75. We conclude that there will be better, more informed decision-making.
76. We conclude that data quality will be improved.
77. We conclude that investment will be leveraged in existing land information.
78. We conclude that there will be increased interoperability among participants.
79. We conclude that there will be opportunities to produce new data.

Key Points – 5. Assumptions

80. We assume that there will be an administrative body, or bodies, to provide guidance, support, operation and decision-making services, as well as management of core assets.
81. We assume that a system administrative body will establish and publish commonly-accepted standards for data and metadata that will be used by direct participants in the system, and will be used as the target for participants who convert via the cross-walk process.
82. We assume that there will be sufficient bandwidth made available to accommodate significant data transfer requirements, both dynamic and automatic.
83. We assume that the system is a publicly accessible system. Therefore, data providers and users can be any the system participant from any sector.
84. We assume that the system participants will have the option of selecting the publication path alternative that best suits their needs and interests. In this regard, state agencies are on a par with other data providers - they can provide data using any of the alternative publishing paths.
85. We assume that there will be a gradual migration by the system participants from emphasis on presentation to data storage to data collection. In terms of publication paths, this might mean moving from Path 4 to 1 to 2 to 3.
86. We assume that data can be passed through intermediaries (e.g., Regional Planning Commissions can serve counties, municipalities, etc.; counties can serve municipalities,

metropolitan multi-jurisdiction districts, etc.; private entities can serve any public and/or private organization.)

87. We assume that promotion of desired or preferred paths will probably require differential levels of incentives such as financial support for hardware, network connectivity, software, and grants.

88. We assume that a single, central data services repository is not scalable to meet the potential demand of a fully-developed the system; Distributed the system Data Nodes, with an intelligent load balancing mechanism, will be required to adequately serve the needs of such a system.

89. We assume that although not to the exclusion of other entities, it seems that organizations with the scale and resources of state agencies, Regional Planning Commissions, and some counties are likely candidates to support a Distributed Data Node.

Key Points – 6. Constraints & Risk Analysis

90. We conclude that there are constraints on system development that include copyright, liability, lack of vision, lack of local funding, lack of program buy-in, privacy, custodial responsibility, lack of enforcement of existing standards, lack of standards, revenue stream replacement, perception of unfunded mandate, no cost recovery pass-through, participation constraints, lack of participation /cooperation, existing local investment in land information.

91. We conclude that risks facing the system include the willingness to provide information, copyright & redistribution restrictions creating data gaps, liability, privacy, perception of unfunded mandate, ownership, funding limitations, lack of standards, and lack of enforcement.

V. Preliminary Conceptual Design

1. Overview

The WLIS, by Wisconsin Statute 16.023, will be a web-based, distributed system, disseminating all types of land-related data, spatial and non-spatial. This system will serve as a 'Master Portal', or 'Catalog' of Wisconsin land-related information, as well as be the framework and platform for the development of applications employing land-related data.

All WLIS data will conform to general structure and content standards to facilitate integration, exchange, and use. Metadata documentation and indexing will be a prerequisite for the effective use of these data. Cross-walk tables will be developed and integrated into the system to facilitate data integration and application development as an interim measure while data is stored in different formats and using different structures. The WLIS will be a confederation of distributed repositories for all land-related data to support local, regional and statewide analysis, planning and decision-making. In particular, the WLIS will be designed to facilitate activities related to the comprehensive master planning requirements contained within the recently enacted "Smart Growth" legislation.

Toward this end, the WLIS must be available to and easy to use for the broadest range of Wisconsin citizens possible and be designed to accommodate all levels of sophistication. Data producers and custodians should be encouraged to actively participate in the WLIS initiative for this program to be a success. The WLIS system design and functionality should be flexible and extensible to serve the broadest spectrum of stakeholders in this system. User interfaces will require careful design to provide even the casual user with a clear, understandable, and intuitive means to access and use the exploding base of land-related information. The Wisconsin Land Information System must be a dynamic enterprise, which will require a phased implementation and a system flexibility to allow its growth, evolution and expansion.

The various conceptual components of the Wisconsin Land Information System are identified and described below.

2. Physical Design

As with the development of the logical functionality, the physical design – the hardware and network configurations – will develop and evolve from basic foundations. Beginning with the establishment of the basic core node – essentially a web server, a database server and associated support hardware (back-up device, uniterruptible power supply, etc.), the node will add special purpose hardware (e.g., internet map server, raster server, etc.) according to the current stage of development. This basic configuration and expansion model is the same for the distributed nodes that should be piloted in the third year of development. The only physical difference between the core and distributed nodes might be the establishment of a single load-balancing device; detailed network design by consultants will be required to address this issue. The Team is not recommending limiting the number of distributed nodes, but feels that desire and cost-benefit considerations by participants will be determining factors.

While the nodes can be openly accessed from the Internet, the interconnection of the nodes will need to be more dynamic and flexible. Again, this will require detailed network design by consultants to determine minimum capabilities. This may be an area where the State's BadgerNet service, or a private co-location service may be considered.

3. Logical Design

Ultimately, WLIS can be viewed as a framework on which to build applications, such as the mapping and spatial analysis functions of comprehensive planning. This section describes the components of that framework – the foundation and beams that give WLIS overall form. The main components of the WLIS framework include software functions, a database design, a set of standards, and a user interface. The software functions, general characteristics of the database schema and standards are described below; further specifications will emerge as part of the detailed system design process. The Team firmly believes that metadata and data content standards are critical components of WLIS; specific standards will need to be identified before and during the detailed design stages. Since the user interface will be designed in the first phase of the project and will evolve as the system matures, it is not specifically addressed here.

WLIS Software Functions

The general model that the Team used to identify the functionality of the software components relies on producers generating data that is accessed and processed by WLIS, and provided by WLIS to end users in forms that can be used with commonly available analysis and display software. A further discussion of this model is found in Appendix K. Using this model, the Team determined that the key software functions of WLIS are to locate, acquire, convert and disseminate data in forms useable and understandable to end users.

1. Query Processing. For spatial queries, jurisdiction-based bounding may be sufficient, though bounding rectangle support (interactive on-screen or coordinate based) would be more useful to some users. Jurisdiction-based bounding could also be done with text input or pick-lists. Since some level of metadata will exist for any WLIS-retrievable data, selection can be done through key-word searches or through pick lists of available data. Key-word searches using standard Internet search tools would expand the capability of the system to find data and documents, considerably extending the utility of the system for power users and application developers.

2. Searching. WLIS will contain metadata and indexes of documents and spatial data of "Level I" participants which can be searched with standard database management tools to return information to users about the existence of records. Similarly, "Level II" data and accompanying metadata that are stored at a WLIS node can be searched with standard database management tools. An Internet search engine will be needed to find "WLIS-linked" data stored in remote locations and/or accompanying metadata. It will also require ftp and possibly other Internet transfer tools to retrieve data for users.

3. Indexing. Since much of the data useful for WLIS remain relatively stable over time, it will be possible to build indexes of available data (data from all levels of participation). Robust and up-to-date indexes will substantially reduce the need for sophisticated search tools for most user queries. Because indexes will contain at least minimal metadata, they will provide users with enough information to consider whether data (or full metadata descriptions) are worth examining in more detail. Indexes should include location and subject attributes or cross-references.

4. Format Conversion. At least for spatial data, it is expected that WLIS will provide data in standard formats. Even for other kinds of data such as text or image documents, it might be necessary to limit the output to common formats such as .pdf and .jpg. The implication is that at some point it will be necessary to select a limited number of input and output formats supported by WLIS, and to make sure the necessary conversion utilities exist. Limitations on input format put the onus on data creators to write to a standard format; fortunately, input data conversion paths are known for most or all the GIS software in common use in Wisconsin. Output format limits, however, are based on logistic constraints and it may not be possible to support more than a few. The chosen formats should support basic spatial data models – area, line, and raster-based approaches. ArcView Shapefiles, AutoCad .dxf files, and geo-TIFF files would seem to be the likely candidates. Text-based documents could be provided as .pdf or ascii files. Database tables may need to be provided in both text format (e.g., comma-delimited ascii, fixed length) and in one or more common database formats (e.g., Dbase, Access).

5. Datum/projection Conversion. Ideally, the system should be able to convert geographic data between latitude/longitude, county coordinates, Wisconsin Transverse Mercator, Universal Transverse Mercator, and State Plane Coordinates. It should support NAD'27, NAD'83, and NAD'83-91. Based on experiences with *WISCON* and other conversion packages, there may be some limitations in what can be fully supported.

6. Classification Conversion and "Cross-walk Tables". It is not uncommon to map the same data objects with different classification systems. For basic geographic data, starting with the foundational elements, WLIS should have a standard set of geographic objects and accompanying attribute schemas. To the extent possible, these should be based on existing standards and common professional practice. This approach will be used for non-spatial data, as well. Terms and meanings should be described in sufficient detail such that a data producer can "map" their data into the WLIS standard objects. Through collaboration with major data providers, cross-classification tables should be developed to convert data from data creators' schemas to the WLIS-standard objects and attributes. Such cross-classification – or cross-walk - tables could be used in batch processing to convert entire data holdings into WLIS-supported forms, or could be used interactively in data retrievals for small or disparate data holdings. This is discussed in more detail below.

7. Standards Adherence and Compliance Checking Tool. WLIS must rely on standards for metadata, data and reference systems. To effectively promote the use of standards within the data creator community, effective standards education and incentives may be necessary. One component of the standards promotion effort is the development of software to create data in standard forms and help ensure compliance with standards. The software for creating FGDC-compliant metadata is a prime example of this.

8. File Transfer. WLIS may provide whole data sets in a limited number of spatial and non-spatial formats. Entire files of data are transferred and users; software provides the capability to analyze and display these data. Such file transfers can be made

nearly transparent to the end user, mediated by underlying software using file transfer protocol (ftp) based methods. The major design decisions will be choosing appropriate file formats for transfer. The choice is between the official federal standards (Spatial Data Transfer Standard) or any of several commercial packages such as ArcView "Shapefiles." For some kinds of data such as images in .tif format, transfer using .html, the web language, will be sufficient.

9. Mapping. Transfer of pre-formatted images of spatial data (i.e., already created maps in .jpeg or .gif formats) can be handled similar to file transfers with .html and ftp tools. Software for interactive retrieval and display of spatial data as thematic layers, known as WebGIS, will require considerable additional effort however. The software to support WebGIS has only been commercially available for a few years, and is rapidly evolving. It will require additional investigation during the first project phase to determine which packages are most suited to the WLIS environment. It is also likely that adding this capability to WLIS will require additional servers for Internet mapping services and for raster map services.

Database Design

A WLIS database design will organize known sets of data into a set of formats, tables and relations. The WLIS "database" consists of highly dynamic sets of data, developed and maintained in different formats, emanating from different intents, locations and purposes. To the extent that it can be described at this point, the WLIS database design is rooted in the system output side, since WLIS will support a limited set of output formats and objects. With a focus primarily on what comes out of the system, the WLIS database design consists primarily of data lists and indexes of available data, and standards guiding how data are acquired, processed and presented. A database design element necessary for the successful functioning of WLIS is a mapping of the WLIS nodes, including information about hardware, software, and network location; this is needed to access information across the WLIS environment and to support the load balancing needs of a distributed system.

Standards

The institution of a number of standards constitutes a critical element of the WLIS design. Defining the standards serves the same purpose as detailing form and content in traditional database design. Different levels of data standards will correspond to the different "levels of participation" in WLIS. Therefore, the standards needed to pass data into and through WLIS will vary. In general, these will be based on standards already adopted by state and federal agencies, and on commonly accepted professional practices. WLIS should have an on-going initiative for identification, development, promotion, and enforcement of standards.

Documentation of data – spatial and non-spatial - through the mechanism of metadata collection is the lynch-pin of WLIS. Without metadata, the heterogeneous collection of data envisioned as components of WLIS cannot be located, acquired, or manipulated in any meaningful way. In a sense, extensive development of metadata is the engine of WLIS.

4. Theme Core Standards and Data Cross-walks

The purpose for a core data standard for a theme is to better enable application development, and enable wide use of the data. The Team rejected the alternative of requiring all participants to use identical data models for all elements shared via WLIS as incompatible with the values of the land information community. The land-related information databases developed by local, regional, state and federal government and the private sector are not homogeneous. Data structures for foundational elements and commonly used geographic data layers cannot be applied comprehensively across jurisdictional boundaries. This makes it difficult to use data for a given land theme from adjacent jurisdictions. For example, a custom software application developed to analyze or present a theme for one county will not operate on the data from an adjacent county without modification, even if the two datasets reside in the same GIS software system.

However, most of the effort to reconcile or integrate these data is not on the spatial side of the database - the integration problems caused by the use of different coordinate systems are solvable. The bulk of the effort required to integrate diverse GIS data lies with the attribute, or tabular data tied to it. As you move across jurisdictional boundaries, data tables and field names vary, and the definitions and acceptable values for those fields often change significantly.

To address this problem, the Team proposes a systematic approach to set up processes to first, identify some essential subset or nucleus of the theme attribute structure and content, which we call a theme core table. Next, set up processes for data custodians to relate their data to the standard. Applications could be developed to use the standard, and through the relationships established, use the distributed data held by custodians.

Here's how the process might work for developing a core standard for a theme. A new workgroup or an existing committee accepts responsibility for drafting a core standard for a land information theme. These committees or workgroups could arise out of any number of agencies and associations, already focussing efforts on standards. Their work activities should be organized and conducted to maximize participation. Much of their internal communication and communication to reviewers could be accomplished through email and the Internet. Their meetings could take place at regularly-scheduled land information activities and conferences. The theme workgroup accepts the responsibility for posting their work on a WLIP web site and accepting comments, review and other input from interested parties. Ideally, this will include a healthy mix of resource and Information Systems professionals. They should identify a timeline for developing the standard, and for an open review period. A process will need to be developed for acceptance and incorporation of the content standard into the WLIS. After acceptance, the standard is published and available to all.

The core standard could include a data model, and a data dictionary with tables, fields, domains, and spatial feature representation. It could include a content standard, and identify unique identifiers to be supported. Minimum requirements for data elements can be specified. The structure and content of the theme cross-walk table would be specified.

Here's how the process might work for the development of a cross-walk. A cross-walk explicitly defines the relationship between the theme core standard and a real-world theme dataset. Cross-walks might be developed by a data custodian or designee. WLIS staff should provide guidance and assistance to help the data custodians in organizations populate cross-walk tables

for themes. Using the core standard, a theme custodian identifies which of their data fields match which fields in the core standard. The relationships between the two data sets are captured in a data table. The core WLIS staff would be responsible for keeping track of the tables and the relationships

Identification of WLIS-standard attributes and development of standard table structure and content will make possible the development of "generic" applications for a theme. Development of a cross-walk table relating a jurisdiction's specific data layer to the thematic core table will allow the use of that data by a generic theme application. For example, the theme core table for parcel data could include a field for assessed value in dollars. Given the parcel core table data dictionary, a generic end-user application could be developed to create a map with different colors for various ranges of assessed value. If two adjacent municipalities have developed parcel cross-walk tables, assessed value could be depicted on a single map for both municipalities, without any additional data conversion or modification.

Conceptual Diagram for WLIS Theme Core and Cross-walk

In the center of the diagram below, a WLIS user is running a groundwater well mapping and reporting application. Their computer is connected to a server on a WLIS node, which can dynamically connect to other distributed nodes, depicted near the bottom of the diagram. The WLIS theme tracking system contains information on the core standard themes available on the system, and identifies the data contributor, where the files can be found on the network, the cross-walk and identifier look-up tables, and the data tables. Some of the tracking information is shown in the table at the very bottom of the graphic. The theme core standards are linked to the tracking system, as shown here for the wells theme. Data dictionaries and metadata are also part of the system.

Moving up the page, the contents of cross-walk tables, data tables and identifier tables are presented for two different well data sets provided by two agencies in two different counties. On the left-hand side, the Soil and Water Conservation office in the fictional county of Cheddar has placed their data on a server maintained by a Regional Planning Commission – RPC1. The Cheddar County SWC data custodian used the theme core standard for wells and identified which of the Cheddar county data elements relate to the core standard elements. That information is presented in the cross-walk table "Wellcore" - it is linked to the Cheddar County data table "GW_Well", which contains records for individual wells. It is also linked to the Well_Id table, which relates the Cheddar County well numbering system to the Wisconsin Unique Well Number (a statewide numbering system).

The right hand side of the graphic depicts similar information for the Holstein County Health Department's well data. Their data are stored on the Holstein County server – HOL1. The Health Department well data custodian developed a cross-walk table based on the well theme core standard. The data table and identifier tables are present.

The linkages established allow the servers to access and serve the data to the well reporting application, which is able to create a report combining the data from the two counties.

Conceptual Diagram for WLIS Theme Core and Crosswalk

Application Report Output - Sorted by Wisconsin Unique Well Number (WUWN)						
County	**Owner**	**WUWN**	**MaxDepth**	**Elev(msl)**	**Diameter**	**Capacity-GPM**
Holstein	Joe Smith	AB123	50	640	6	1000
Cheddar	Mary Jones	DM123	230	750	6	10000

Contributor - Holstein County Health Department

Holstein Well Id's	
WUWN	Well#
AB123	52
AB456	53
AC222	61
more...	

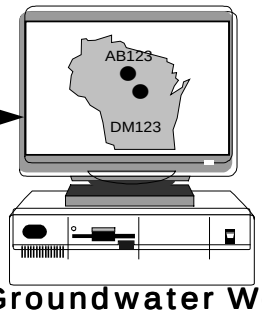
Cheddar Well Id's	
Well_Id	WUWN
K62	CZ444
K88	DM123
K39	KZ333
more...	
L24	NP1

Contributor - Cheddar County Soil and Water Conservation District

GW_Well Table
Wellowner: Mary Jones
Well_Id: K88
Depth: 230
Elevation: 750
Diam_Ft: 0.5
P_Cap: 10000
more...

WELLTAB1 Table
Owner: Joe Smith
Well#: 52
Bottom: 50
Z_MSL: 640
Diam_In: 6
GPM: 1000
more...

1012



Groundwater Well Application

CROSSWALK WELLCORE	
OWNER:	Wellowner
MAXDEPTH:	Depth
ELELVATION:	Elev
DIAMETER:	Diam_Ft
CAPACITY:	PCAP
more...	

CROSSWALK WELLDAT1	
OWNER:	Owner
MAXDEPTH:	Bottom
ELEVATION:	Z_MSL
DIAMETER:	Diam_In
CAPACITY:	GPM
more....	

RPC1 Server

WLIS Server

HOL1 Server

Metadata

Theme Core Data Dictionary

Theme Core
Standard - Wells
OWNER
MAXDEPTH
ELEVATION
DIAMETER
CAPACITY
More...

WLIS - Theme Tracking System					
Theme	**Contributor**	**Server**	**Crosswalk**	**Identifier**	**DataTable**
Wells	Cheddar SWCD	RPC1	.....Wellcore	Well_Id	.....GW_Well
Wells	Holstein Health Dept.	HOL1	.....Welldat1	Well#	.....WellTab1
...more...					

5. Standard WLIS Data

The Technical Working Group envisioned the WLIS to comprise four architectural components: Computer Applications, Data, Technology and Organization. Data is the one architectural component of the system that all others are dependent on. Data fuels the functions of government and industry and data will determine what the WLIS does and how it does it.

Owing to this key role, we must understand, in general terms, what data sets will be central to the WLIS and how they might be produced, maintained, and used. The Technical Working Group identified key characteristics of the WLIS data that compels the creation and existence of the WLIS and are worth repeating here.

Key Characteristics of the WLIS Data

1. The WLIS data will include land information. Wis. Stat. Sec. 16.967(1) sets forth the operative definition of land information used throughout this report. The definition is *inclusive* rather than *exclusive*. The definition is " . . . *any* physical, legal, economic or environmental information or *characteristics* concerning land, water, ground-water, subsurface resources, or air in this state." The use of the term *"any"* is expansive and is not limited by the words that follow. The word *"characteristics"* is emphasized to highlight the notion that land information is any information that can be geographically referenced to areas, lines and points on the earth. Non-traditional examples of "georeferenced" data include social, economic, health or other statistical information organized or aggregated by location such as parcels, census blocks, zip codes, minor civil divisions, the Public Land Survey System, counties, service regions, natural zones, or regions. The statutes provide an extensive, but not exhaustive, list of other examples including information relating to topography, soil, soil erosion, geology, minerals, vegetation, land cover, wildlife, associated natural resources, land ownership, land use, land use controls and restrictions, jurisdictional boundaries, tax assessment, land value, land survey records and references, geodetic control networks, aerial photographs, maps, planimetric data, remote sensing data, historic and prehistoric sites and economic projections.

2. The WLIS will be a distributed system. Its purpose will be to provide accessible current and historical data through the use of appropriate standards for structure and content to allow effective use by a wide range of applications.

3. Each WLIS data set will have identified custodian(s), for example, the WLIP data custodians. Data will be updated by custodians as part of their normal work flow with the goal of providing accurate and timely planning and decision-making.

4. The WLIS data structures and content will be designed to facilitate activities related to the comprehensive master plan definition found in the State Budget.

5. The WLIS data will be based on general structure and content standards to facilitate integration, exchange, and use. Local and specialized data will be kept in forms most appropriate for immediate or primary use, with well-defined cross-walk methods or templates to facilitate application development, integration, exchange, and use.

6. The WLIS data will have documentation and indexing (metadata) suitable for producers and end users.

7. The WLIS data and system will be dynamic, will be implemented in phases, and will continue to evolve.
8. The WLIS will support integrated and aggregated views of locally produced data, as needed to support regional and statewide analysis, planning and decision-making.
9. The WLIS will include status tracking of data and projects and provide reporting capabilities.
10. Development and implementation of the WLIS and its data will be integrated and coordinated with WLIP.
11. The WLIS will capitalize on existing land information investments made by WLIP, government agencies, the private sector, and others.
12. Data structure and content standards will support temporal views.
13. Data will be obtained from WISCLINC, as well as other local, regional, state and federal sources, e.g., standardized population statistics.
14. The WLIS should maximize the value of data collected by agencies for statutory purposes and to allow it to be used for land use planning. The system should provide information compiled using this data such as transformed data, studies, and research reports.

Data for the Wisconsin Land Information System

Land-related data for the WLIS have at a minimum 8 components that identify the data, suggest the necessary minimum elements of metadata and help us understand how data is organized and used in the WLIS.

1. Types of Data - Land-related data types of the WLIS are Spatial, Tabular and Document data. Spatial data is in vector (points, lines and polygons), raster (grid cells) or image (pixels) format. Tabular data can be spatial (e.g., attribution for spatial data) or non-spatial and is typified by computer databases or spreadsheets. Document data is information stored in electronic page format or as an image format. Some examples of these data are statutes, ordinances, regulations, plans, policies, plats and deeds. The implications for the data structures used for the WLIS include how the land-related data is stored, accessed and manipulated. The vendor software data structures and image formats to be supported by the WLIS must be determined for spatial data. There should be minimum standards for content and format for tabular data. Documents can largely be organized by theme, jurisdiction or author. The indexing and cataloging of land-related data should conform to emerging and/or standard schemes such as MAchine Readable Cataloging (MARC) records or Text Encoding and Interchange (TEI) headers. Document formats could include .SGML, .HTML, .PDF, .DOC, .XML and a variety of image formats for scanned documents.
2. Themes – Data themes describe the data. Themes can also impact how land-related data is organized, accessed or applied in the WLIS.
3. Custodians - Custodians are those who produce, maintain or update the data. Custodial arrangements for WLIS data could be modeled after the Wisconsin Land Information Program Custodial Arrangements for Data-related Foundational Elements (see Appendix L).

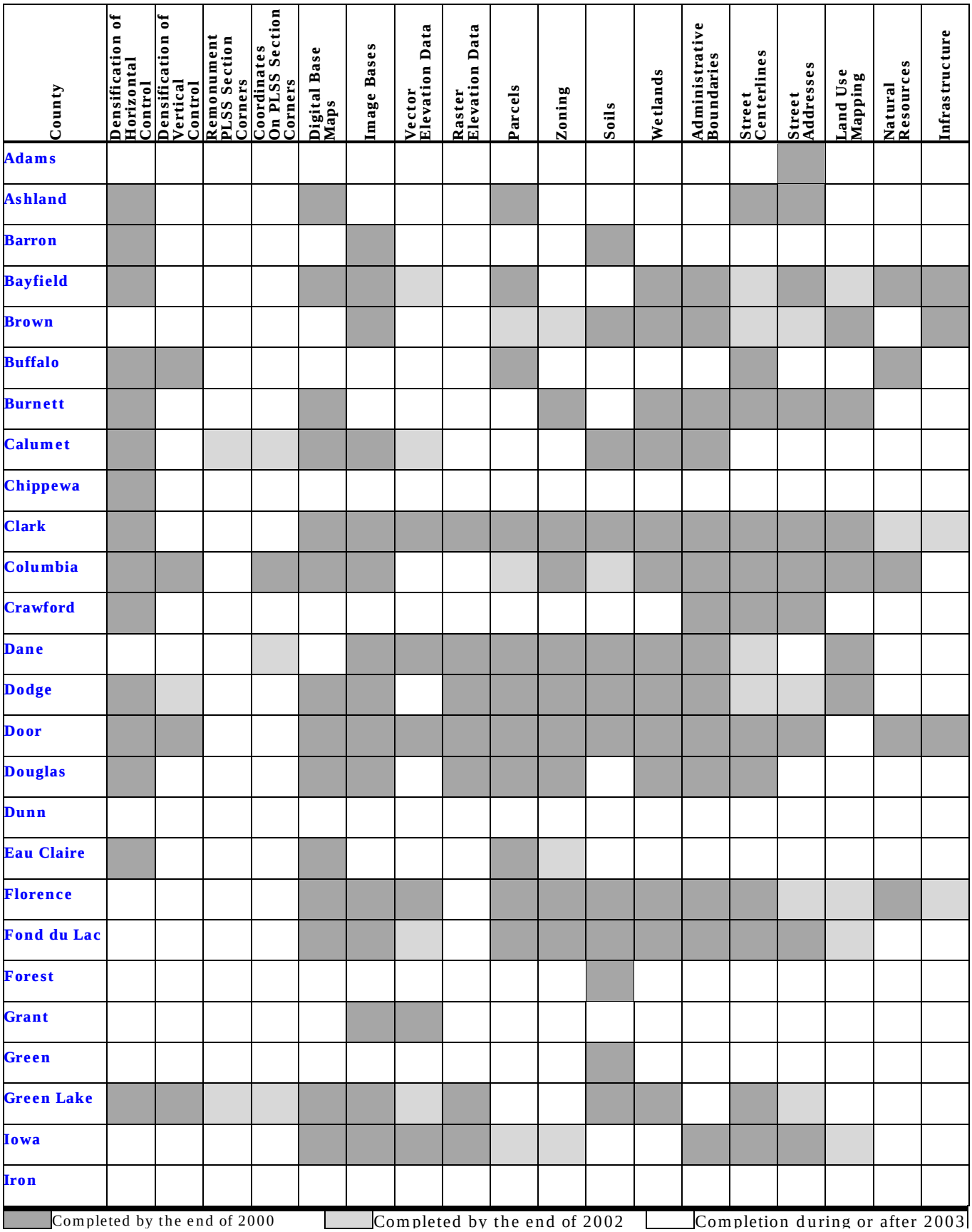
4. Functions Served – Some application functions of the WLIS land-related data could include comprehensive planning, property assessment and taxation, zoning administration, land conservation, town road maintenance and groundwater protection.
5. Availability – Current availability, as well as future availability, is necessary.
6. Timestamp - The timestamp is necessary to be able to manage the temporal aspects of the WLIS information.
7. Extent - Geographic or areal extent provides a spatial reference to the data and can be another way of organizing and facilitating access to the data. The extent of the data must be described with a geographic reference, e.g. a place or geographic coordinates.
8. Implementation - There is land-related data that is currently available from potential WLIS participants that could be implemented into the system. Some of this land-related data can be implemented within the 1st biennium of the WLIS project. The availability and the need of the users will drive the implementation of land-related data.

These components of the WLIS land-related data can be used as a guide for an analysis and description of the main terms, concepts, and relationships of the WLIS data and in developing the WLIS data organization.

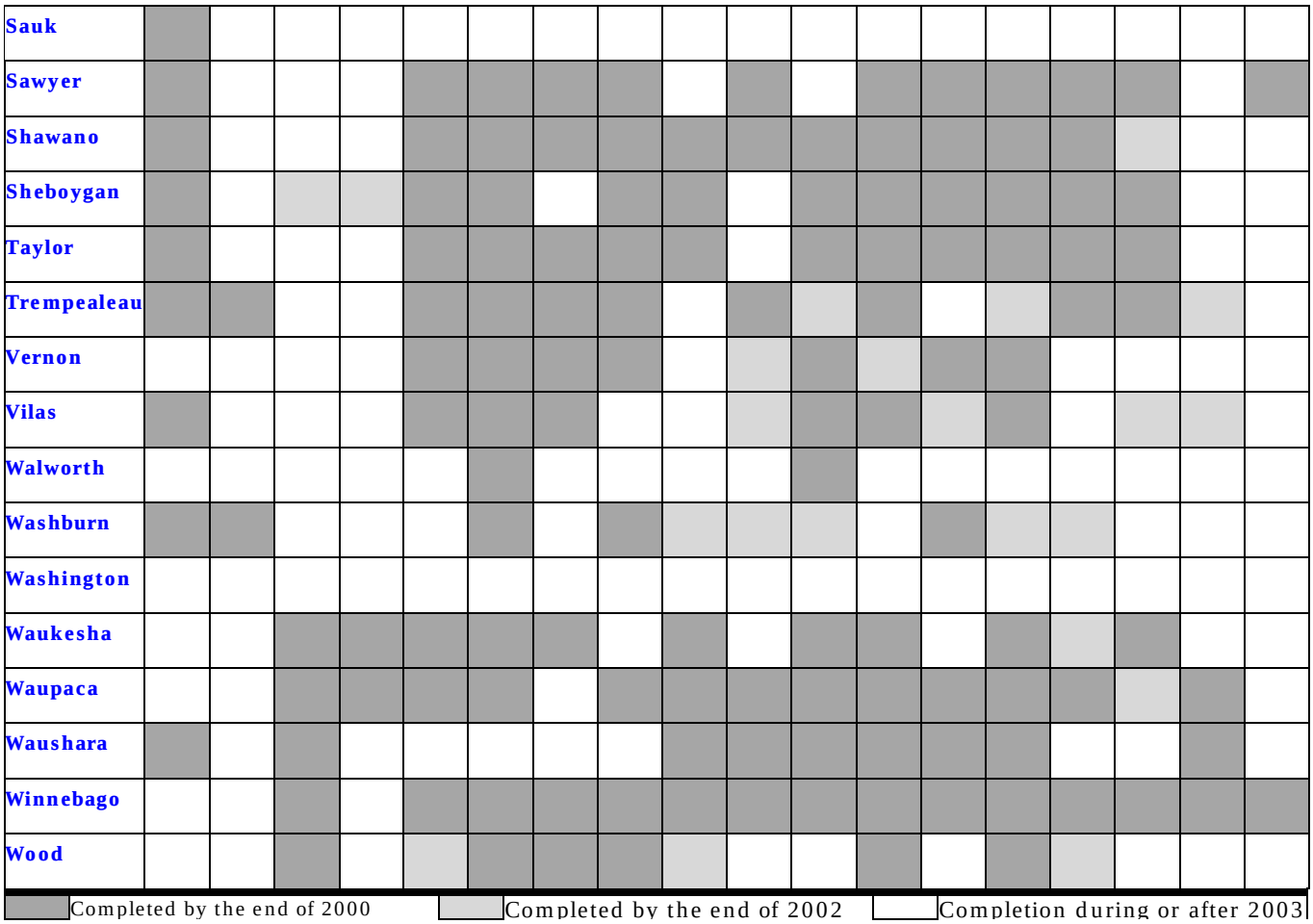
Wisconsin Land Information Program Foundational Elements

Fifteen foundational elements have been identified in the Wisconsin Land Information Program. However, eighteen data sets have been identified and inventoried from a 1998 WLIP survey of Wisconsin County Land Information Offices. The survey has produced baseline information on the current production status of eighteen data sets or land records modernization activities in Wisconsin counties. The Wisconsin Land Information System could draw from all eighteen data sets or activities and rely on their producers as participants and data contributors. A summary table and maps exhibiting the status of these activities from the survey are in Appendix M and the detailed listing of land information activity by county is in the table below. These three different "views" present the status of the Wisconsin Land Information Program. In the detailed listing in the table, the darker shaded cells indicate those activities that are completed or will likely be completed before 2001, or the beginning of the 2002-2003 biennium. The lighter shaded cells indicate those activities that are likely to be completed by the end of 2002, or during the 2002-2003 biennium. The cells that are not shaded indicate activities that will likely be completed during or after 2003, or completion was indeterminate at the time of the 1998 survey.*

* http://www.lic.wisc.edu/wlip2/


County
Densification of Horizontal Control
Densification of Vertical Control
Remonument PLSS Section Corners
Coordinates On PLSS Section Corners
Digital Base Maps
Image Bases
Vector Elevation Data
Raster Elevation Data
Parcels
Zoning
Soils
Wetlands
Administrative Boundaries
Street Centerlines
Street Addresses
Land Use Mapping
Natural Resources
Infrastructure
Adams
Ashland
Barron
Bayfield
Brown
Buffalo
Burnett
Calumet
Chippewa
Clark
Columbia
Crawford
Dane
Dodge
Door
Douglas
Dunn
Eau Claire
Florence
Fond du Lac
Forest
Grant
Green
Green Lake
Iowa
Iron
Completed by the end of 2000
Completed by the end of 2002
Completion during or after 2003


Jackson
Jefferson
Juneau
Kenosha
Kewaunee
La Crosse
Lafayette
Langlade
Lincoln
Manitowoc
Marathon
Marinette
Marquette
Menominee
Milwaukee
Monroe
Oconto
Oneida
Outagamie
Ozaukee
Pepin
Pierce
Polk
Portage
Price
Racine
Richland
Rock
Saint Croix
Rusk
Completed by the end of 2000
Completed by the end of 2002
Completion during or after 2003



Comprehensive Planning

Section 66.0295(2), Wisconsin Statutes states that a comprehensive plan shall contain nine elements including; an issues and opportunities element, a housing element, a transportation element, a utilities and community facilities element, an agricultural, a natural and cultural resources element, an economic development element, an intergovernmental cooperation element, a land use element and an implementation element. Various land-related data within each element are identified, however, the level of detail necessary to satisfy each element has not been clearly defined. Appendix N presents papers prepared by the East Central and West Central Wisconsin Regional Planning Commissions which outline the data and maps to necessary to satisfy the new comprehensive planning requirements. Also, Appendix O is a paper by the Office of Land Information Services that compares potential comprehensive planning data to the WLIP foundational elements.

In the early stages of WLIS development, robust sets of 1990 and 2000 decennial census data will be created at various levels of geography. Subsequently, 1980 Census data can be converted from digital tape and microfiche archives to many of those geographic levels or their close equivalent. Long term development of approximately equivalent 1970 Census data will provide four historical Census data for comprehensive planning which spans 30 years prior to the year 2010 census data.

State-wide spatial data sets currently managed by the Wisconsin Departments of Administration, Natural Resources and Transportation that will support comprehensive planning are ripe for early incorporation into the WLIS. These include planimetric features like water bodies, roads, highways and railroads; administrative or reference features such as minor civil division boundaries and Census geographies, digital elevation models, digital raster graphics and a representation of the Public Land Survey; and, resource related information like watersheds, WISCLAND land cover, and wetlands. Certainly the NRCS digital soil survey and its interpretations are valuable comprehensive planning information and statewide coverage should be incorporated when completed. Appendix P contains a list of a proposed set of comprehensive planning data that should be completed statewide and implemented in the WLIS as they become available.

State Agency Data

Every state agency produces and maintains land-related data. Appendix Data Q provides a listing of state agency land information derived from their Land Information Modernization and Integration Plans. Some information that state agencies produce that support comprehensive planning and other government functions, but are not listed in the Modernization and Integration Plans. The State Agency Resource Working Group (SARWG) report to the Wisconsin Land Council, November 1999 indicates the land use roles of state agencies and how those roles relate to local governments. The report suggests state agencies' resources can assist government functions. Appendix R contains a list of potential land-related data suggested by the SARWG report.

Tabular Data

There are vast amounts of tabular data, both spatial and non-spatial, generated and maintained by government. These are database files (e.g. flat text files exported from software like ORACLE or INFORMIX), spreadsheets (e.g. EXCEL or LOTUS 1-2-3) housed on a variety of computer platforms and in various formats. Much of this data could become available for WLIS distribution, but will depend upon the desire of custodians to release the data and the expressed demand for the data to be available statewide on the WLIS. The development of thematic core functions will be crucial to the implementation of such tabular data into the WLIS. Appendix Q presents a non-exhaustive list of potential WLIS tabular data.

Document Data

A challenging aspect of implementing the WLIS will be the development of qualifying criteria for the inclusion of various document data in the WLIS. Further, an indexing and cataloging system will need to be developed that organizes the documents for storage and retrieval. Standards for digital formats should include a wide variety of text, page and image formats that will support the easy access to this information from the WLIS. Ease of access to document data will add to the complexity of serving those documents. One example of the initiative to serve document data over the Internet is the TAPESTRY program by the state association of Registers of Deeds and other private initiatives. Development of the WLIS should take advantage of these efforts coordinating with these organizations to avoid potential redundancy. Appendix T lists potential types of document data that could be included in the WLIS and Appendix U provides resource information on digital document indexing and cataloging.

6. WLIS Metadata Standards

Reasons for metadata. There are three general purposes served by providing metadata for data files and land information:

1. It supplies the reader with information about the data/information that is needed to determine its suitability for use. It also answers the question: Is this what I am looking for?
2. It facilitates an integrated search routine that allows the user to:
    - Identify all data and information available for a given geographic area, such as a county, a watershed, etc;
    - Identify all areas that have a given data or information piece, such as all areas that have zoning ordinances on the system, or all places that have municipal boundary files.
3. It provides a basis for conversion and integration.

"Metadata – describe the content, quality, condition, and other characteristics of data" (Content Standard for Digital Geospatial Metadata Workbook-June 8, 1994).

In 1994 the Federal Geographic Data Committee approved the content standards now commonly known as FGDC metadata. The National Spatial Data Infrastructure requires Federal agencies to use the standard to document data that they produce beginning in 1994.

All references below to metatdata refer to this Federal standard. The standard consists of 7 general sections:

1. Identification – a general description of the data and how it was created; includes the geographic area covered by the data
2. Data Quality
3. Spatial Data Organization
4. Spatial Reference – the spatial reference frame for the data, e.g. map projection, coordinate system
5. Entity and Attribute Information – a description of the data fields associated with the file
6. Distribution – a description of how to obtain the data
7. Metadata Reference – use constraints, copyrights etc

Additionally, the metadata should indicate which, if any, of the 15 WLIP foundational elements it is related to and also which section of the comprehensive plan it supports. This function is supported in some of the software (as additional optional fields), or could be embedded in the key fields of section 1.

There are 3 general types of data and information that are to be included in WLIS and for which metadata are to be created. They are:

1. Spatial data – this includes the broadest category of data normally used in GIS, such as coverages, orthophotos, etc. It for this category that the FGDC standards were originally designed.

2. Spatially referenced data – this includes databases (in a wide variety of formats and structures) which have a reference key which allows them to be associated with a spatial data set. These keys would include such items as: street address, county FIPS code, parcel ID number, etc.

3. Document files – or information about land information. This broad category would include standard text documents of statutes and administrative rules, grants and grant applications, local ordinances, plans, reports (such as this report), and similar documents. Additionally this category would include scanned data, blueprints, photographs etc. The documents would generally apply to a given geographic area that could be identified – such as a county ordinance, or a statewide law.

The intended use of the data indicates the appropriate amount of metadata required for a given file. A description of the metadata requirements follows:

Spatial data

Level 1 Participation – WLIS knows about the existence of the data and includes it in query searches; a minimum of FGDC sections 1, 6, and 7 must be completed; it is strongly encouraged to always complete all applicable fields.

Level 2 Participation – WLIS has the data on a node; in this case all applicable sections of the metadata must be completed before the data is made available for viewing or downloading from a WLIS node

Spatially referenced data

Level 1 Participation - WLIS knows about the existence of the data and includes it in query searches; FGDC sections 1, 6, and 7 must be completed;

Level 2 Participation - WLIS has the data on a node, in this case FGDC sections 1, 5, 6, and 7 must be completed.

Document files

Level 1 Participation - WLIS knows about the existence of the data and includes it in query searches; FGDC sections 1, 6, and 7 must be completed;

Level 2 Participation - WLIS has the data on a node, in this case FGDC sections 1, 6 and 7 must be completed, plus other sections as appropriate, especially looking at section 5, attribute information;

Searches supported by metadata

For section 1, keywords -- a WLIS thesaurus must be adopted (or created) which would indicate the preferred key words for standard data layers, i.e. all foundational elements and data associated with comprehensive plans.

A listing of related words must be identified to support searches: e.g. water, hydro, river, lake

A standard for the primary and secondary key word for each type of data layer must identified, e.g. a file that has the street coverage for a municipality, could have the primary key word “street” , and not road, or streets, or the name of the municipality.

As metadata for all file and data types includes section 1, spatial searches are also supported.

Therefore, the following searches of metadata are supported:

1. All data for a given area, such as "What do you have in Watertown?"
2. All data of a given type, such as "Where do Zoning Ordinances exist?"
3. All data for a given comprehensive plan component or foundational element, such as "What exists for the Soils Foundational Element?

Additionally, these searches could be combined, such as "What information exists concerning Zoning Ordinances in northern Wisconsin?

7. WLIS Organizational Requirements

While it is not an explicit charge of the Team to make specific organizational recommendations regarding the oversight, operational management and policy direction of a WLIS, we felt it was important to identify the required roles that must or should be performed, and to suggest some logical options for consideration by the Land Council and the Land Information Board.

Institutional Structure

The Technical Working Group's Final Report defined the organizational structure of WLIS as a "matrix of several organizations." Key components included the recognition of "parallel and complementary state and local* activities" and the designation of "appropriate committees and teams … to guide, manage and implement WLIS" along with assignment of various roles and responsibilities. This section provides suggested approaches to organizing and coordinating a matrix of organizations that combines elements of both "top-down" and "bottom-up" structure. Completely top-down alternatives were not considered viable, as these do not effectively engage the full range of participants. Entirely bottom-up alternatives were rejected as too chaotic; these did not provide efficiencies realized in coordinated joint enterprises.

The institutional structure of WLIS needs to balance effective statewide guidance with broad input into its applications and operations. To the extent possible, it seems reasonable that WLIS should build on existing institutions while providing effective conduits for local ideas, beliefs, and expression of needs.

Primary authority for WLIS could be vested in the Land Information Board and the Land Council. The Memorandum of Understanding between the Land Information Board and the Land Council appears to provide a mechanism for collaboration on WLIS. Given the goals of WLIS, this would seem to be a logical location for oversight of components such as data and standards. Alternatively, the Technical Working Group in their Final Report recommended that the Land Information Board could be the "lead organization" for technical and land information policy matters; the Land Council could be responsible for how WLIS is deployed and used.

Oversight with Stakeholder Participation

As a confederated, distributed system, WLIS needs to have a mechanism for recognizing and addressing the concerns of stakeholders in the direction of its operation and development. At

*As WLIS has evolved in this document, it should be noted that the terms 'state and local' should be replaced with 'statewide and distributed' to connote a recognition of a single WLIS node providing data of statewide scope and distributed nodes providing more specialized data, whether these are maintained by local government or agency at any other level of government.

present, neither the Land Information Board nor the Land Council has explicit mechanisms for feedback from and interaction with two important sets of stakeholders in WLIS – users and participants. This could be done by bolstering existing functions or by creating new deliberative bodies. For example, the user community could use the Land Council's State-Local-Private Working Group and the Wisconsin Land Information Association as a means to provide input on system applications. The Technical Working Group could be re-constituted as a conduit between WLIS participants and the existing policy bodies.

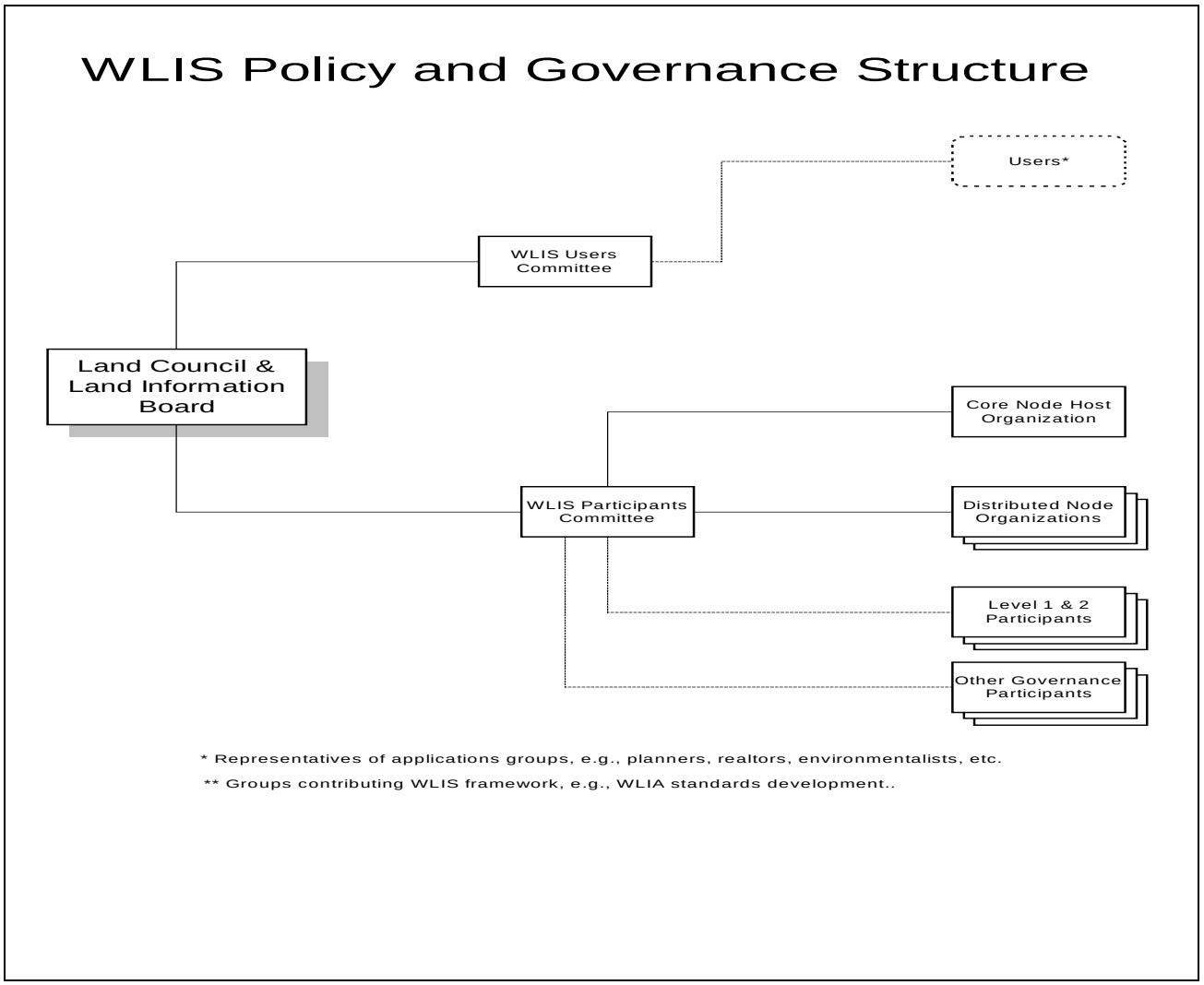
Another alternative could be the creation of new bodies specifically focused on WLIS applications and operations. Suggestions for two likely groups are:

A WLIS Participants Group. An oversight group should be established to provide direction on issues affecting WLIS, particularly the development and enforcement of standards, data development priorities, data security, privacy, access, cost-recovery, node funding, incentives for participation, and so forth. Such a group could assist the Land Information Board and the Land Council by providing feedback from WLIS participants – agencies providing data and/or supporting WLIS nodes. Day-to-day technical issues could be dealt with via direct interaction between technical staff at core and distributed nodes, with periodic consultation with the Participants Group, the Land Information Board and the Land Council, as necessary. The group would be comprised of individuals representing agencies at all levels of participation. Implementation of WLIS will involve significant policy issues affecting contributors, so this body would need to meet on a regular basis, perhaps quarterly.

A WLIS Users Group. An advisory group to the Land Information Board and the Land Council (WLIS Users Committee) could be formed to provide advice from WLIS users. This group would provide feedback on how well WLIS is serving intended audiences. It can also serve as a conduit for ideas about new initiatives, new application developments, and potential collaborations with public and private sector developers and data providers. This could be a deliberative body, broadly representative of potential users. Alternatively, or in conjunction with this WLIS Users Committee, an annual meeting of stakeholders could be used to discuss the functioning and directions of WLIS.

Governance of distributed nodes of WLIS might depend on their level of participation. Connections between WLIS and Level 1 participants, who are generally just providing metadata to WLIS, will be loose. The relation will be basically technical specifications for what and how to include in data indexes and metadata. As needed, this could be supported by a simple agreement of participation between the Land Information Board and the level 1 participant. The WLIS Participants Group could be the main conduit for level 1 participants to influence policy decisions. Interaction with WLIS distributed node staff and core staff could be the mechanism for Level 1 participants to specify technical preferences. Interaction with Level 2 participants, those that have agreed to provide data in WLIS specified forms, can be similar to Level 1 participants, though more formalized relations such as written cooperative agreements may be necessary, along with potential need for greater levels of technical support. Similar channels for participation in policy and technical decision-making would be available.

Level 3 participation in WLIS – maintaining a distributed WLIS node – entails a significantly greater commitment of staff and other resources to WLIS. All level 3 participants could be part of the WLIS Participants Group to help guide system policy.



Operational Structure

Although the Land Information Board and the Land Council, with appropriate standing committees, can provide oversight of WLIS, it is necessary to identify people who are responsible for the day-to-day decisions and activities of WLIS. A WLIS Management Team and/or WLIS System Manager will be necessary to:

- ensure efficient use of system resources,
- coordinate operations with ongoing development,
- make day-to-day technical decisions,
- initiate system design and technology transfer,
- interface with policy and advisory groups,
- and report to the Land Council and the Land Information Board.

Our initial budget recommendations include a full time system manager and technical support

staff. As distributed nodes become operational, key staff might also become part of the management team.

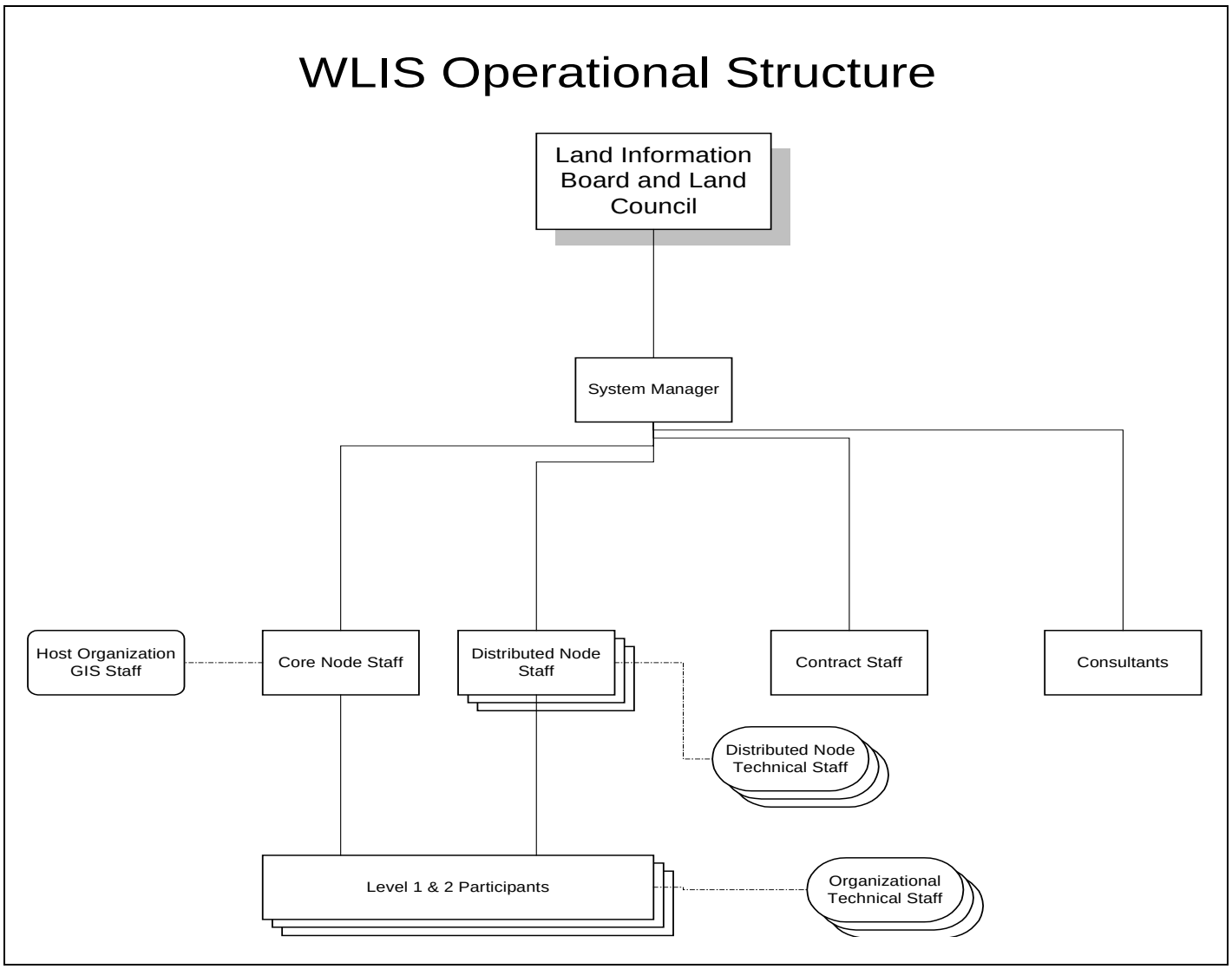
The core node of WLIS could be operated in conjunction with an existing GIS section of a state agency, regional planning commission, the university, or a private sector organization. The recommendation of an existing organization is made to leverage existing technical expertise in land-related technologies aligned with the initial needs of the system, and their staff is more likely to be familiar broad range of stakeholders. Larger organizations, such as those mentioned, are likely to have complementary assets, such as web and database development and operations expertise and capabilities. The siting of WLIS operation must be done without creating disincentives for the host organization, including appropriate placement of staff and adequate funding so economies of scale can be realized.

Various degrees of private involvement could also be considered for day-to-day operations. It has already been recognized in our budget recommendations that some aspects of system development are most efficiently done through contracting (and possibly only done this way, given a very tight labor market in the appropriate technical expertise). The use of private Internet Service Providers that could house and maintain the operations of the physical aspects and network components of the core and, optionally, distributed nodes of WLIS appear to offer a cost-effective option worth further investigation.. However, this does not preclude the need for a WLIS staff to develop new applications, set up new nodes, modify existing applications, and so forth. Final detailed design criteria should include specifications for evaluating which provides the most cost-effective and conducive environment for managing WLIS.

If WLIS core node staff is housed in a state agency, this does not preclude bringing other agencies and private sector firms into operations. In particular, it may be appropriate to sub-contract aspects of WLIS operations to groups with particular skill sets. For example, University outreach groups may be in the best position to do training and technology transfer. This could also become a function of staff hired in conjunction with WLIS distributed nodes. Private sector consultants may be retained for system design and application development. A variety of professional organizations should continue to play an important role in standards development and system promotion. The Land Information Board and the Land Council would have the responsibility for contractual arrangements as needed.

8. WLIS Time Line

The overall time-line for the development and full implementation cannot be estimated precisely due to the confederated nature of the WLIS participant base and to the rapid pace of technological change that characterizes Internet-related activities. However, the Team feels that, at a minimum, it will take at least four years and could require as much as ten years to fully develop WLIS. While this timeframe leads to understandably vague – even indefensible - estimates for the latter stages, the early phases of the development of WLIS can offer a clearer picture. The time-line outlined below represents the Team's best effort at defining a time-line for the first stages of development.



Pre-Phase 1 (prior to budget authorization)

- Begin system promotion and outreach activities,
- Finalize WLIS metadata and data standards,
- Finalize WLIS indexing requirements,
- Acquire and collect WLIS standard data sets and metadata,
- Begin to develop data element descriptions for subsequent design activities.

Phase 1 Project - 1st year

- Promote and disseminate WLIS metadata and data standards,
- Establish WLIS form and format standards,
- Establish procedures and core content development process,
- Begin web site and database design and development,
- Design and develop metadata entry, indexing and query tools.

Phase 1 Project - 2nd year

- Identify workgroups to develop theme core standards (may extend into 3rd year),
- Implement metadata and data transfer functions,
- Design and develop cross-walk applications (may extend into 3rd year),
- Design, develop and launch pilot data and web distributed nodes,
- Design, develop and launch pilot Internet mapping applications (may extend into 3rd year).

Post Phase 1 – 3rd year

- Implement applications based on theme core standards and cross-walks,
- Implement piloted Internet mapping applications,
- Implement first distributed node(s).

Key Points – 1. Overview

1. We acknowledge that Wis. Stat. Sc. 16.967 mandates The Wisconsin Land Information System.
2. We recommend that the system be a web-based distributed system and should include all types (spatial and non-spatial) of land information.
3. We recommend that this system will serve as a 'Catalog' of Wisconsin land information and function as a 'Server' of these data sets.
4. We recommend that all land based data sets will be contained within a general structure and adhere to content standards to facilitate integration, exchange, and use.
5. We recommend that metadata documentation and indexing will be an essential component of all data sets and will identify custodians for these data sets.
6. We recommend that metadata crosswalk tables be integrated into the system to facilitate data integration and application development.
7. We recommend that the system be a confederated, distributed repository for all locally produced land based data to support local, regional and statewide analysis, planning and decision-making, in particular, the system will be designed to facilitate activities related to the comprehensive master planning requirements contained within the recently enacted "Smart Growth" legislation.
8. We recommend that the system design and functionality must be flexible and durable to withstand the broad spectrum of stakeholders in this system.
9. We recommend that the system be a dynamic enterprise, which will require a phased implementation and a system flexibility to allow its growth, evolution and expansion.

Key Points – 2. Physical Design

10. We conclude that the physical design—hardware and network configurations—will develop and evolve from basic foundations.
11. We conclude that the only physical difference between the core and distributed nodes might be the establishment of a single load-balancing device.

12. We conclude that the desire and cost-benefit considerations of participants will determine the number of distributed nodes.

13. We recommend that the interconnection of the nodes be dynamic and flexible.

Key Points – 3. Logical Design

14. We recommend that the system be considered a framework for building applications such as the mapping and spatial analysis functions of comprehensive planning.

15. We recommend that the main components of the system framework include core software functions, a data base design, a set of standards, and a user interface.

16. We conclude that jurisdiction-based bounding may be sufficient, though bounding rectangle support— interactive on-screen or coordinate based—would be more useful to some users and that jurisdiction-based bounding be done with text input or pick-lists.

17. We conclude that an Internet search engine will be needed to find "the system-linked" data stored in remote locations and/or accompanying metadata.

18. We conclude that since much of the data useful for the system remain relatively stable over time, indexes of available data should be built from all levels of participation.

19. We recommend that at least for spatial data, the system will provide data in standard forms and formats.

20. We conclude that for other kinds of data such as text or image documents, it will be necessary to limit the output to common formats such as .pdf and .jpg.

21. We conclude that the chosen formats should support basic spatial data models – area, line, and raster-based approaches such as ArcView Shapefiles, AutoCad .dxf files, and geo-TIFF files.

22. We conclude that text-based documents should be provided as .pdf files.

23. We conclude that database tables should be provided in both text format such as delimited ASCII and in one or more common data base formats such as Dbase, Access, and Oracle.

24. We recommend that the system should be able to inter-convert geographic data between latitude/longitude, county coordinates, Wisconsin Transverse Mercator, Universal Transverse Mercator, and State Plane Coordinates.

25. We recommend that it should support NAD'27, NAD'83, and NAD'83-91.

26. We recommend that for basic geographic data, starting with the Foundational Elements of the Wisconsin Land Information Program, the system should have a standard set of geographic objects and accompanying attribute schemas.

27. We recommend that to the extent possible, these should be based on existing standards and common professional practice.

28. We recommend that the system rely on the use of standards for metadata, data and reference systems.

29. We conclude that to effectively promote the use of standards within the data creator/provider community, effective standards education and incentives will be necessary.

30. We recommend that one component of the standards promotion effort is to have software tools that help create data in standard forms and help ensure compliance with standards. Similar tools will be needed for other standards.

31. We conclude that the system may provide whole data sets in a limited number of spatial and non-spatial formats, and that such file transfers should be made nearly transparent to the end user.

32. We recommend that file transfer standards be defined.

33. We recommend that transfer of pre-formatted images of spatial data such as already created maps in *jpeg* or *gif* formats can be handled similar to file transfers with html and *ftp* tools.

34. We conclude that the system database exists primarily on the system output side—the system supports a limited set of standardized output formats and objects.

35. We conclude that regarding what comes out of the system, the system database design consists primarily of data lists and indexes of available data, and standards guiding how data are acquired, processed and presented.

36. We conclude that a somewhat unprecedented database design element that will be necessary for the successful functioning of the system is a dynamic mapping of the system nodes, including information about hardware, software, network architecture, and other information needed to successfully access and retrieve information from a heterogeneous environment.

37. We recommend that one element of the database design that should be maintained dynamically is a list of common data sets that the system users can expect the system to provide.

38. We recommend that such a list should be initiated as a concatenation of several existing lists, such as the Foundational Elements of the Wisconsin Land Information Program, the Framework Layers specified by the Federal Geographic Data Committee, and data sets required to support comprehensive planning.

39. We recommend that the system have an on-going process in place for identification, development, promotion, and enforcement of standards.

40. We conclude that documentation of data sets through various types of metadata is the lynchpin of the system.

41. We recommend that the system user interface and underlying search and query tools are the primary mechanisms for organizing data relations and presentation.

42. We recommend that the look and feel of the interface accommodate a range of sophistication of users, and will provide varying degrees of support for access and data dissemination At all levels though, it will be the means for traversing the relations and pointers inherent in metadata and indices.

43. We conclude that the system will need to maintain information about each site in an accessible form – essentially “the system node metadata” in a central repository, so that the characteristics of the entire system can be readily determined.

<u>Key Points – 4. Theme Core Standards and Data Cross-walks</u>

44. We recommend that the core of the system provide a number of services that currently impede easy transfer of data from creators to users in useable form.

45. We conclude that the key data processing functions of the system are to *acquire*, *convert* and *disseminate* data in forms useable and understandable to end users.

46. We conclude that the major functions necessary for conversion include software format conversion, semantic conversion ("cross-walk" tables), datum and projection changes, and standards compliance checking.

47. We recommend that a systematic approach to set up processes to identify some essential subset or nucleus of the theme attribute structure and content, which we call thematic core tables which can be thought of as core data dictionaries for the theme.

48. We recommend that a new workgroup or an existing committee draft a core standard for a land information theme.

49. We recommend that the theme workgroup post their work on a WLIP web site and accept comments, review and other input from interested parties.

50. We recommend that workgroup identify a timeline for developing the standard, and for an open review period.

51. We recommend that after acceptance, the standard be published and available to all.

52. We recommend that the workgroup activities be organized and conducted to maximize participation.

53. We recommend that the core standard include a data model, with tables, fields and spatial feature representation, a content standard, unique identifiers, minimum requirements for data elements and the structure and content of the theme crosswalk table.

54. We recommend that a data custodian or designee develop crosswalks.

55. We recommend that the system staff should provide guidance and assistance to help the data custodians in organizations populate crosswalk tables for themes.

Key Points – 5. Standard WLIS Data

56. We recommend that land-related data for the system have at least a minimum of eight components that identify the data, suggest the necessary minimum elements of metadata and help us understand how data is organized and used in the system.

57. We recommend that the system include spatial, tabular and document data.

58. We recommend data themes that describe the data.

59. We recommend data custodians are those who produce, maintain or update the data.

60. We recommend that a number of functions be served such as comprehensive planning, property assessment and taxation, zoning administration, land conservation, town road maintenance and groundwater protection.

61. We recommend that the system use currently available data and any future data as it becomes available.

62. We recommend that the system employ a timestamp to manage the temporal aspects of the WLIS information.

63. We recommend that the system consider geographic or areal extent to provide a spatial reference to the data and be considered as another way of organizing and facilitating access to the data.

64. We recommend consideration for implementation of land-related data that is currently available from potential WLIS participants that could be implemented into the system.

65. We recommend that the system use the inclusive definition of land information described in Wis. Stat. Sec. 16.967(1) " . . . *any* physical, legal, economic or environmental information or *characteristics* concerning land, water, ground-water, subsurface resources, or air in this state."

66. We recommend that the use of the term *"any"* be expansive and not limited by the words that follow.

67. We recommend that the word *"characteristics"* be emphasized to highlight the notion that land information is any information that can be geographically referenced to areas, lines and points on the earth.

68. We recommend that the system be a distributed system to provide accessible to current and historical data through the use of appropriate standards for structure and content to allow effective use by a wide range of applications.

69. We recommend that each system data set have identified custodian(s).

70. We recommend that the system data structures and content will be designed to facilitate activities related to the comprehensive master plan definition found in the State Budget.

71. We recommend that the system data will be based on general structure and content standards to facilitate integration, exchange, and use and that local and specialized data be kept in forms most appropriate for immediate or primary use, with well-defined cross-walk methods or templates to facilitate application development, integration, exchange, and use.

72. We recommend that the system have documentation and indexing (metadata) suitable for producers and end users.

73. We recommend that the system and data be dynamic and implemented in phases in a way to allow it to evolve.

74. We recommend that the system support integrated and aggregated views of locally produced data, as needed to support regional and statewide analysis, planning and decision-making.

75. We recommend that the system include status tracking of data and projects and provide reporting capabilities.

76. We recommend that development and implementation of the system and its data will be integrated and coordinated with WLIP.

77. We recommend that the system will capitalize on existing land information investments made by WLIP, government agencies, the private sector, and others.

78. We recommend that the data structure and content standards will support temporal views.

79. We recommend that data be obtained from WISCLINC, as well as other local, regional, state and federal sources.

80. We recommend that the system should maximize the value of data collected by agencies for statutory purposes and to allow it to be used for land use planning.

81. We recommend that the system should provide compiled information such as transformed data, studies, and research reports.

Key Points – 6. WLIS Metadata Standards

82. We recommend that the draw from all eighteen existing data sets or activities and rely on their producers as participants and data contributors.

Key Points – 7. WLIS Organizational Requirements

83. We recommend that that the system should build on existing institutions while providing effective conduits for local ideas, beliefs, and expression of needs.

84. We conclude that primary authority for WLIS could be vested in the Land Information Board and the Land Council.

85. We recommend that an oversight group should be established to provide direction on issues affecting WLIS, particularly the development and enforcement of standards, data development priorities, data security, privacy, access, cost-recovery, node funding, incentives for participation, and so forth.

86. We recommend that specific people be assigned to be responsible for the day-to-day decisions and activities of the system.

87. We conclude that various degrees of private involvement could also be considered for day-to-day operations.

88. We conclude that final detailed design criteria should include specifications for evaluating which provides the most cost-effective and conducive environment for managing the system.

VI. System Costs

An open-ended system like WLIS will be difficult to provide precise cost estimates owing to the length of the development cycle and the expectation that many participants will 'opt in' as distributed node hosts. It is not clear to what extent costs for the latter should be shared with the participants, although a general per node total cost figure can be estimated. Generally, current costs for the core node can be allocated in three categories: start-up, development and operations. Current costs for a distributed node can be allocated in two categories: start-up and operations.*

Startup (capital) costs – $250,000 - 300,000

The first step of putting metadata, indexing and search capabilities on the web will require a dynamic connection to the Internet, a domain name, servers and software licenses for the web server and the database server, and supporting systems such as a firewall, a data backup system and an uniterruptible power supply. (These are the minimum requirements for a distributed node – about $100,000 each, depending on existing capacity.)

For the addition of Internet mapping services, two additional NT servers with greater capabilities and software licenses will be needed for the development and production environments. A raster server will be needed will also be needed as the Internet mapping demands increase and if orthophotos will be served.

An FTP server with expandable disk storage and extensive communications throughput capabilities will also be required. A Spatial Data Engine Server with licensing will be needed to provide dynamic translation capabilities between formats. Additional hardware and software will be needed for WLIS staff will also have to be included.

Development costs – $400,000 – 500,000.

To select and customize or build the metadata entry and retrieval software and to develop the cross-walk functionality, as well as setting up the data transfer functionality will require approximately 30 staff months, costing from $165,000 to over $300,000, depending on the mix of State and contractor staff involved. Workstations for contract developers and project manager will add additional cost. Internet mapping development and other subsequent development activity will add to the cost of the first 3-4 years.

Operational (ongoing annual) costs – $175,000-325,000.

These costs are the minimum costs for continuing operation during and after the development projects. Hardware and software annual maintenance for the core WLIS node will likely exceed 25,000 annually and Internet connectivity will cost up to 10,000, including upgrades.

Permanent staffing will make up the majority of this category, although a portion of it could be mitigated by outsourcing some operational duties to a co-location service. A system manager (with web programming and administration capabilities), network operations support, database administrator, a WLIS outreach/customer support specialist are those roles identified that must be filled.

* Detailed cost estimates used for these breakdowns can be found in the description of the Phase 1 Project.

VII. Phase 1 Project

1. Narrative

It is essential that the WLIS become a viable entity as soon after implementation as possible. Toward this end, the WLIS must be an attractive, easy-to-use system. Data providers and users alike must "buy in" to the overall concept of a unified land information system and willingly contribute to its success. Cooperation and contributions from all sectors must be encouraged and nurtured.

Initial steps will require the acquisition of a design consultant, a system manager, a project manager and other necessary staff to design and develop the system, implement basic metadata rules, and work to encourage and facilitate early contributions to the program. The adoption of the comprehensive land use planning legislation lends urgency to the early establishment of the WLIS. Adequate funding for these early components is critical to long term program success.

Comprehensive Planning Support

The Wisconsin Land Information System, as its name implies, will be comprehensive in its applications and ability to access and query land-related data. The comprehensive land use planning legislation provides local governmental units (counties, cities, villages, towns, and regional planning commissions) the outline to create comprehensive plans by January 1, 2010. The "Smart Growth" legislation states that a comprehensive plan shall include 9 elements, 8 of which start "A compilation of objectives, policies, goals, maps, and programs...." Since the legislation does not define the level of detail or standards which these elements should follow, the WLIS should have the tools to provide local units of governments with the ability to access data and produce GIS maps to assist them in completing their comprehensive plans.

Cross-walk development

The purpose for a core data standard for a theme is to better enable application development and the wider use of the data. Theme custodians will need to develop a core content and structure, so that data providers will be able to relate their data to the standard WLIS schema through the use of cross-walk tables. Applications could later be developed to use the standard, and, through the cross-walk relationships established, can use the distributed data held by providers.

Mapping Services

A key component of any land information system is the ability to display the output in graphic format. WLIS will allow the local user to import data into their local computer for display, analysis and output. It is expected that the users of the WLIS will have access to suitable computer programs on their local computer to enable the user to manipulate, display and export (to an electronic file or printer/plotter) graphic output in the form of maps, charts, graphs, and tables. There are currently available desktop software programs in wide usage such as ArcView, Field View, GeoMedia, and MapInfo. A direct link to a free, downloadable GIS software such as Arc Explorer can also be provided. Future expectations are that users will develop mapping and other graphic manipulation programs and submit these to the WLIS for employment by all users.

Metadata Entry and Search

All land information requires some level of documentation that describes the origin, use and meaning of the data, and how to contact the data provider. Spatial data also carries the additional requirement to document the projection and coordinate systems used. All data submitted to the WLIS will be required to include a minimum level of metadata. No submitted data sets (spatial or non-spatial) will be accepted without the requisite metadata. As a result, early components of the WLIS will include the metadata entry and retrieval functions. The minimum metadata submittal requirements are discussed elsewhere in this document.

2. Timeline, Phase 1 Project

Note: although the following discussion refers to FTE (full time equivalent staff) customarily used by state agencies, the Project Team is not necessarily endorsing that the system be housed in a state agency. The use of this term and other discussions of options that follow are employed as a point of reference to develop a time frame and cost estimates within a commonly understood environment.

Year 1

- Hire permanent staff. With current labor market availability of people with the necessary skill sets, it typically takes 8-10 months to fill positions with the qualifications that will be required to staff WLIS. There should be at least a System Manager, responsible for the day-to-day operation and continuity between development phases, and an outreach/customer support specialist. There is also a need for operational support services, such as performing backups, data base administration, network support, etc.: this translates to 2 FTE. An alternative to consider for this last requirement is to contract with a co-location vendor.

  Several private sector companies are beginning to offer operational services on an ongoing contract basis. This line of business is usually referred to as co-location services. If the co-location services option is selected, temporary arrangements (e.g., contractors or loaned staff) for operational support will need to be made until the hardware is moved to the co-location facility for day-to-day operations.

- Acquire and configure hardware, software and network. This can be done at a development location, if the system will be operationally located at a co-location service, or in its permanent location, if it is not. In addition to hardware, software, network and personnel costs, space and environmental costs and concerns for both people and equipment will need to be addressed. These costs are not addressed in this budget.

- Retain and consultants and contractors. Identify and retain project manager about 6 months into the first year – either assigned from the host agency or contracted through the State Procurement Bulletin. Optimally, this person should be retained for the duration of the project, i.e., from the point the consultant is hired through the end of the first programming phase. There is a good argument to be made for continuing to retain this individual for succeeding projects, if they follow each other in quick succession or overlap.

  At the same time, a consultant to develop detailed design and programming specifications for contract staff should be hired. This type of work is usually priced on a per project basis and would probably take 3-6 months using this report and the Technical Working Group's Final Report as a starting point. This person would need to work closely with the project manager.

This consultant's work would need to be completed prior to retaining programming contractors to perform the work. Prior to hiring the design consultant, however, the identification of specific WLIS core content and procedures must be established, possibly by a short term workgroup from the land information community.

Finally, the contractor(s) can be retained through State Procurement Bulletin or through RFI/RFP to begin the development work.

Year 2

- Continued development. The second year of the project will continue the work of the contractor(s) to the point of implementation of the core WLIS node with a standard selection of downloadable data sets, a customized metadata entry tool, flexible metadata search functions and structured indexes. The system manager needs to be an integral part of the development team to gain an intimate knowledge of the structure of the system components as they are conceived and constructed.
- Development of WLIS cross-walk functions. Once the WLIS core node is in operation, the development team will shift to dividing their time between maintenance and the development of cross-walk functionality. This, of course, requires that the WLIS standardized data model already be established.
- Begin design and development of web-based mapping applications. Following closely behind the completion of the cross-walk structures, work can commence on the development of pilot web-based mapping applications. This may necessitate a shift in the make-up of contract staffing and will involve the acquisition of the necessary hardware and software for this functionality. The Team recommends that expert advice on the optimum configuration for such hardware and software be sought from a qualified consultant prior to proceeding with this step.
- Pilot a distributed node. During this period, a volunteer should be solicited to pilot the first distributed node, to better determine the technical requirements of a distributed web deployment of a land information system.

Operations options

Both distributed and core nodes have a number of options available for providing ongoing operations support. The ones presented below are several that can be considered for selection.

- WLIS distributed node operations options. It is not expected that every WLIS participant will have the necessary staffing and infrastructure to operate and support a node. Some of the options that may be considered to provide this needed support are:

    1. Direct participation by providers which have or will commit the resources (state agencies, some regional planning commissions, counties, cities, private sector organizations),
    2. Multi-jurisdictional data coordination – regional planning commissions and/or county Land Information Officers with the resources can assist local units of government and other organizations by acting as focal point for participation and the staging of data,

3. Outsourcing – WLIS participants may wish to contract with co-location or other services to operate a node. Private companies and the states Department of Administration's InfoTech Services Division provide possible avenues for this approach.

- WLIS core node operations options. The options for operating the core node is somewhat more limited than those for a distributed node, due to the need to provide central support for all WLIS participants and to maintain the 'front door' to the system.

    1. A state agency – currently, the departments of Administration, Natural Resources, and Transportation have staff and resources focused on geographic and land information systems; the State Cartographer's Office also offers a possible site,
    2. Outsourcing - private company or companies offering co-location services.

Costs

	First Year	Second Year	Total
Hardware	135,500	50,000	185,500
Software	20,500	17,500	38,000
Network	25,000	8,000	33,000
Consulting	75,000	75,000	150,000
Contractors	100,000	200,000	300,000
4 Additional FTE	300,000	300,000	600,000
Total	**$656,000**	**$650,500**	**$1,306,500**

Year 1

Web server hardware (Windows NT/2000) $12,000

FTP server hardware (Unix/Solaris) $30,000

Raster server hardware (Unix/Solaris) $30,000

Data base server hardware (Unix/Solaris) $30,000

Tape Backup system, if none exists or there is not available capacity $15,000

Uninterruptible power supply, if none exists or there is not available capacity $3,500

Hardware maintenance $15,000

Web server software $2,500

Application software $10,000

Data base server software (Oracle or SQL Server) $8,000

Firewall, if none exists or there is not available capacity (depends on size of network) . $12,000

Upgrade existing LAN capabilities, if necessary $5,000

Access to the internet T1/T3 (increases with bandwidth and redundancy requirements) $8,000

Consulting $75,000

Project manager (contractor)..... $100,000

Four FTE ($75,000 each) $300,000

Year 2

Internet Map server (Unix/Solaris) $35,000

Hardware maintenance..... $15,000

Internet Map Server software $10,000

Software maintenance $7,500

Access to the Internet..... $8,000

Design Consulting 25,000

Internet Mapping Consulting 50,000

Contractor $100,000

Project manager (contractor)..... $100,000

Four FTE ($75,000 each)..... $300,000

VIII. Next Steps

Wisconsin has long viewed itself as a leader in the area of land records and land records modernization. The development of WLIS is the next step for Wisconsin to maintain this leadership role.

The WLIS is the method by which an unlimited number of users will benefit from the significant work done in recent decades. A significant amount of data has already been created and is already in use in a variety of applications. The WLIS is a method by which this same data can be used by a much broader audience, and potentially in applications not even conceived of today. Care has been taken throughout the discussions, by both the Technical Working Group and the Team, to develop a system that is confederated in its data creation, yet integrated in its functionality. The report includes a number of specific recommendations that the Team felt were necessary to create the WLIS. A complete listing of these conclusions and recommendations is found in Appendix V.

While this report discusses a variety of technical issues at length and proposes methods for dealing with them, there are a number of items, generally viewed as policy issues, that are referred to the Land Information Board and Land Council for action. Although the proposed system would be built over a number of years, assuming specific funding for this effort is available by July 2001, there are a number of action items that must be completed before then for the WLIS to be successfully developed and implemented. These items are:

1. Building the support base for WLIS. While their appears to be broad support for many of the items proposed in this report, and a general consensus that the proposed functionality is needed, it is left to the Land Information Board and Land Council to build the broad base of support necessary to gain ultimate approval for the activities identified. This includes gaining support of the wide range of stakeholders identified, acceptance that the WLIS is the best method for achieving these goals, and most importantly, ***gaining budgetary support for this initiative***.

2. Appointment of a System Manager. Until now, the work on the development and design of a WLIS has been accomplished through the donated time of many organizations, both public and private. This model has worked to date, however, a full-time, permanent system manager should be assigned to this project.

   This report suggests an operational structure for the WLIS and an integral part of this structure is a system manager. While the general duties of the manager apply to an operational WLIS, background work on many items could begin immediately, if the individual was retained now. If a permanent system manager can not be retained prior to the beginning of development, a person should be assigned temporarily to serve as the interim focal point for pre-phase 1 activity. Items to be addressed include:

   - Work with and facilitate the activities of a policy and governance committee, identified above.
   - Present information on the nature and intended functions of the WLIS to a wide range of audiences over the next year.
   - Serve as a repository for the needs and requirements of the WLIS as the proposal moves through the review process.

- Interface with policy and advisory groups.
- Report to the Land Council and Land Information Board on issues as they arise.

Funding for this position is one of the base items found in the proposed budget. However, failure to fill this position either formally or by assigning these duties to specific staff could have a detrimental impact on the success of the overall system. While groups such as the Project Team and the Technical Working Group are effective at studying and drafting reports, there is a need for day-to-day work to be done in preparation for the development of WLIS, beginning immediately.

3. Creation of a policy and governance group. The body of this report identifies the need for a policy and governance group to facilitate a number of activities including:
   - Development and publication of a system metadata standard model, to be accepted by the State's land information community.
   - Design of a system metadata database, addressing spatial and non-spatial data.
   - Formal identification of the initial data sets to be included in the WLIS.
   - Development of data standards for all datasets that are included in the WLIS.

   It would be most beneficial to have this group identified this fall, so that they could begin their work on the above mentioned items. The WLIS system manager could play a key facilitative role for this group.
4. Establishment of standards. The ability of any group to build and maintain a WLIS is predicated on the existence of firmly established standards for both data and metadata. These standards will eventually apply to the data as it will exist on the WLIS nodes. Towards this end, the Land Information Board and the Land Council must identify the mechanism and timeline by which these standards can be set and confirmed. As the work of the standards-setting group proceeds, the Board and the Council should be prepared to officially recognize these standards, as they are key building blocks in the creation of a WLIS.

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