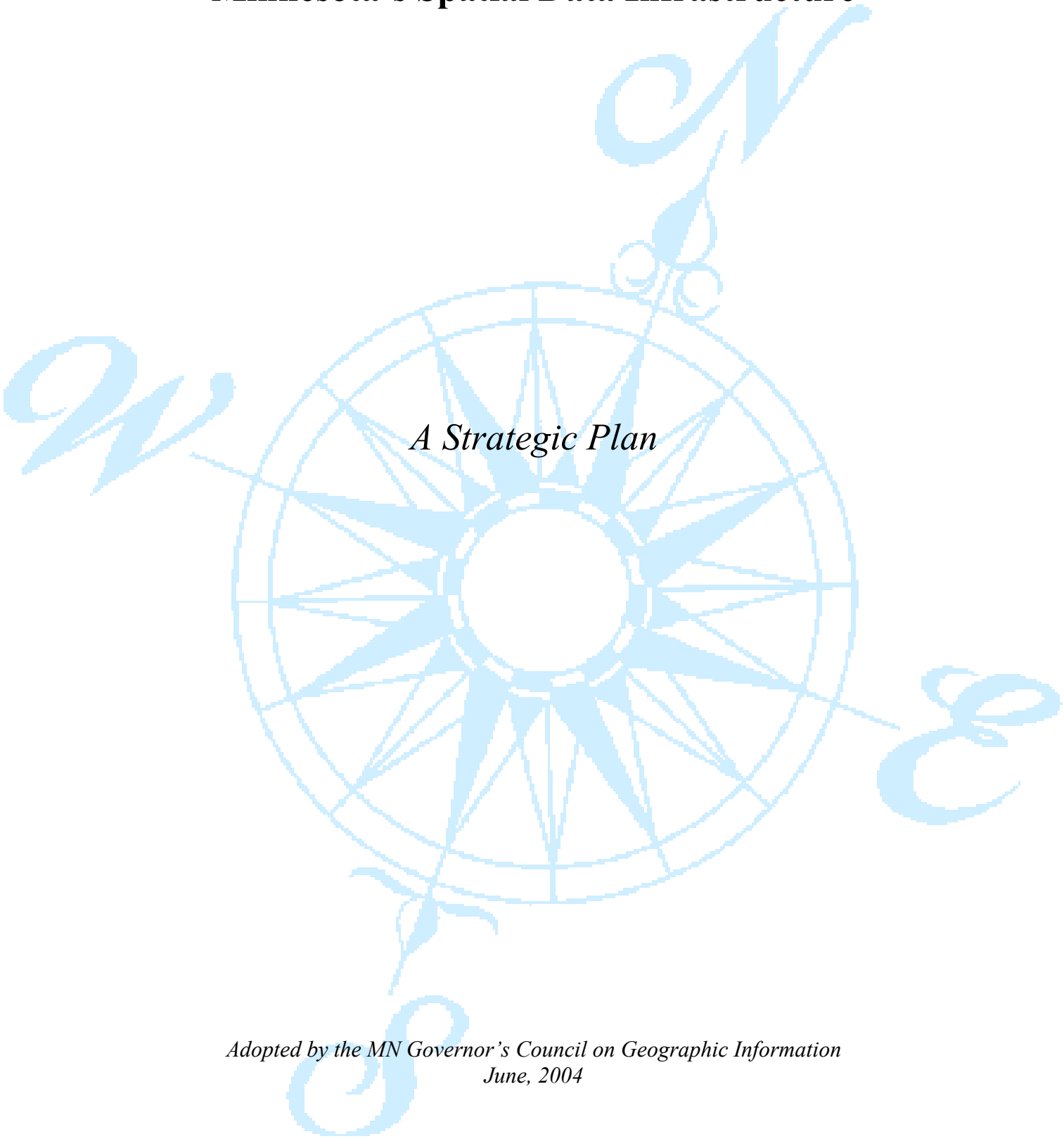
A Foundation for Coordinated GIS
Minnesota's Spatial Data Infrastructure



A Strategic Plan

Adopted by the MN Governor's Council on Geographic Information
June, 2004

The **Minnesota Governor's Council on Geographic Information** was created by an Executive Order of the Governor to provide leadership in the development, management and use of geographic information and related technology in Minnesota. With administrative support from the Land Management Information Center in the Minnesota Department of Administration, the council provides policy advice and makes recommendations regarding efficient investments, management practices, institutional arrangements, and data standards and education.

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A Foundation for Coordinated GIS is available on the council's web site at www.gis.state.mn.us. Upon request, the document will be available in alternate formats, such as Braille, large print or audiotape. For TTY, contact Minnesota Relay Service at 800-627-3529 and ask for the Land Management Information Center. For additional printed copies, contact the Land Management Information Center at 651-296-1211.

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A Foundation for Coordinated GIS
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Executive Summary

A Foundation for Coordinated GIS: Minnesota's Spatial Data Infrastructure was developed as a roadmap to help Minnesota organizations more effectively achieve their business goals by using GIS. It presents the results of a two-year process to identify solutions to common technology and data needs of organizations using geospatial technologies to serve the people of Minnesota. The envisioned MSDI framework includes policies, standards, and practices that would improve the availability of needed data, promote integration of technology, encourage collaboration among organizations, and extend access to geospatial technologies to organizations that would not otherwise benefit from them. Achieving this vision would dramatically improve the effectiveness of state, local and regional programs ranging from public safety to natural resource management while also reducing technology costs. This document describes the foundation and its importance, identifies critical shared geospatial data and technology needs and how they are being met, and recommends actions required to implement a sustainable Minnesota Spatial Data Infrastructure.

The MSDI will address the business needs of Minnesota's governments and will be consistent with objectives of the national I-Plan Initiative,[1] which seeks to build a National Spatial Data Infrastructure (NSDI).[2] Like the I-Plan strategy, Minnesota seeks to leverage ongoing data development by local, regional, state, and national organizations to meet common needs. The national strategy emphasizes stakeholder production of data development and maintenance plans that clearly identify needs and priorities and serve to focus and accelerate federal investments. This document expresses support of the national I-Plan strategy and a commitment to collaborative development and management of geospatial technology resources to improve government services and enhance the quality of life for all Minnesotans.

When fully operational, the MSDI will be comprised of three major integrated components:

- "Framework data"[3] that serve as a common base for program-specific data.
- Services and web applications for discovering and distributing data.
- An organizational structure that promotes, nurtures, and guides the development and management of the MSDI.

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[1] For more information about the national I-Plan initiative, see http://www.fgdc.gov/I-Team/. Strategic partners include the Federal Geographic Data Committee, the Office of Management and Budget, the Council for Excellence in Government, the National States Geographic Information Consortium, the National Association of Counties, the International City/County Managers Association, and the OpenGIS Consortium.

[2] For more information about the national I-Plan initiative, see http://www.fgdc.gov/nsdi/nsdi.html.

[3] "Framework data" collectively serve as a common map base for other data. The MSDI framework data elements are geodetic control, imagery, elevation, parcels, administrative boundaries, transportation, hydrography, and soils.

A Foundation for Coordinated GIS focuses on the first of these three components, framework data: describing their use and value, clarifying needs and priorities, assessing whether needs are being met, and recommending policies and actions that ensure meeting them in the future. It also affirms that coordinated approaches to data discovery and distribution built upon earlier recommendations of the MN Governor's Council on Geographic Information[4] are appropriate and viable strategies. Finally, It recommends actions and policies needed to strengthen the organizational capacity for a successful MSDI.

A Foundation for Coordinated GIS summarizes I-Plans for the eight data themes that comprise the MSDI framework: seven framework themes adopted for the National Spatial Data Infrastructure plus soils. NSDI elements are geodetic control, elevation data, orthoimagery, cadastral or parcels, administrative boundaries, transportation, and hydrography. The plans are being developed by I-Teams chartered by the Minnesota Governor's Council on Geographic Information under guidelines established by the Council. I-Team membership is open to all stakeholders and includes participants with broad organizational and professional backgrounds. The plans follow a template designed to address guidelines promoted by the U.S. Office of Management and Budget and the Federal Geographic Data Committee and endorsed by the Council. The template is included as Appendix A. The plans, which will be completed and updated as resources permit, will serve as implementation guides and will be monitored for progress and effectiveness.

To achieve the MSDI vision, *A Foundation for Coordinated GIS* also recommends the following steps concerning organizational structure and relationships, policy, and funding.

- Explicit authority and responsibility for overseeing the development and implementation of the MSDI should be assigned to a state cabinet level agency, supported by legislation if necessary. This report includes specific recommended responsibilities. The Minnesota Governor's Council on Geographic Information should work with appropriate state agencies and stakeholder organizations to prepare recommendations for such changes.

- Adequate resources should be provided to support the sustained development and implementation of the MSDI, including necessary funding to sustain the coordination effort.

- Public expenditures in geospatial data and technology should reflect MSDI priorities, updated by stakeholders through policies and procedures adopted for maintenance of the MSDI.

- GIS implementation by state agencies should be coordinated within guidelines established for the state's IT architecture framework and consistent with policies of the state's Office of Technology and Department of Finance.

- GIS implementation by state, local and regional agencies should be coordinated with similar efforts by state and federal agencies as they relate to the MSDI.

[4] See the Council report *Laying the Foundation for a Minnesota Geographic Information Clearinghouse* at http://www.mnplan.state.mn.us/pdf/gisclear.pdf.

- A strong emphasis should be placed on identifying emerging opportunities for effectively using GIS, identifying opportunities for joint projects and leveraging private and federal resources not otherwise available to Minnesota.

- The designated authority should serve as an advocate for Minnesota's GIS stakeholders and as the state's designated liaison and representative to federal mapping agencies and national GIS organizations.

- The continued development of the MN Geographic Data Clearinghouse should be supported, emphasizing e-government solutions for distributing geospatial data.

A Foundation for Coordinated GIS: Minnesota's Spatial Data Infrastructure was developed with extensive involvement of Minnesota's GIS community and is endorsed by the Minnesota Governor's Council on Geographic. It represents a beginning, not an end. Next steps include collaborative actions to create an organizational structure, secure needed resources, and complete the thematic I-Plans.

Section 1: The Case for a Minnesota Spatial Data Infrastructure

Having pioneered the development and effective use of geographic information technology to guide public policy more than thirty years ago, Minnesota maintains a well-deserved reputation for innovative and cooperative solutions to the geospatial data and technology needs of its public and private organizations.[5] These collaborations have not merely been manifestations of "Minnesota Nice"; they represent an effective strategy for meeting common needs while minimizing redundant efforts and investments. As the uses of geospatial data and technology has expanded from natural resources to issues ranging from redistricting to emergency response, the need for a framework of standards, practices, and policies that support shared development and implementation has become increasingly important. This framework for collaboration comprises Minnesota's Spatial Data Infrastructure.

The MSDI parallels the National Spatial Data Infrastructure (NSDI)[6], a nationwide strategy established in 1994, but is adapted to focus upon Minnesota's business needs and priorities. The NSDI calls for technologies and policies that support sharing of geospatial data among all levels of government, the private and non-profit sectors, and the academic community. It provides a base or structure of practices and relationships among data producers and users that facilitates data sharing and use. The intended result is to reduce the costs of developing geospatial data while maximizing its value through widespread availability and use. The NSDI vision is fully compatible with Minnesota's vision, embodied in the following strategic guiding principles of the Minnesota Governor's Council on Geographic Information:

- Promote efficient investments in geographic information.
- Promote geographic information as a public resource that should be widely shared with and available to interested parties.
- Support the establishment and use of geographic data standards and guidelines to better exchange and share information resources.
- Promote the beneficial uses of geographic information in the development of policy and the management of public resources.

The Minnesota Governor's Council on Geographic Information formally agreed to become a formal cooperator in the development of the NSDI in November 1995.[7] MetroGIS, representing the Twin Cities region, has actively supported NSDI initiatives since 1997.[8]

The MSDI, like the NSDI, focuses upon standards, policies, procedures, and relationships that support the development, management, maintenance and distribution of commonly used classes

[5] See http://www.mnplan.state.mn.us/Report.html?Id=972 for an overview of the historical development, usage, and organizational capacities of Minnesota organizations.

[6] See http://www.fgdc.gov/nsdi/nsdi.html for more about the National Spatial Data Infrastructure.

[7] See minutes of the November Council meeting at http://www.gis.state.mn.us/gcnotes/gn_95nov.htm.

[8] See http://www.metrogis.org/about/affiliations/index.shtml#nsdi for more about MetroGIS support of the NSDI.

of geospatial data, known as *framework* data. For Minnesota, eight framework data classes have been selected as essential for the MSDI. Others, such as land cover and land use may be added in the future. The data, which serve as a common basis for most GIS applications, are illustrated by Figure 1.

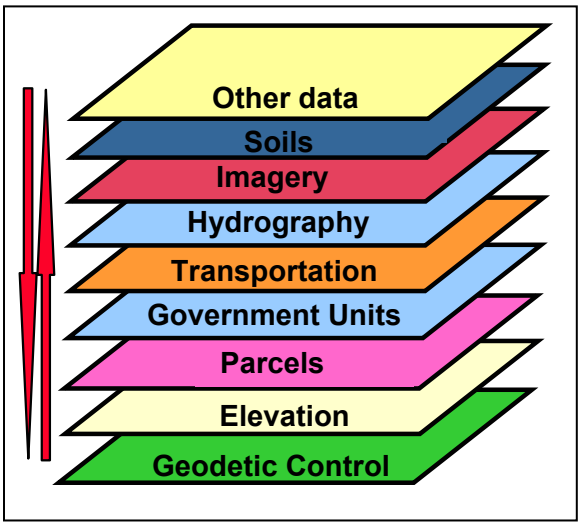

Figure 1
Minnesota's Framework Data
as a Foundation for Other Data

The first seven of the MSDI framework data layers are NSDI framework data. Soils data has special importance for Minnesota and is included for the MSDI. Taken together, these framework data elements provide for a common base for mapping other features – for example, parks, housing locations, hospitals, power plants, or bus routes – data needed to support the efficient and effective delivery of services to Minnesotans.

The effective and efficient use of geospatial data to deliver services also requires that the data is available when needed, wherever needed. Too often, geospatial data that can benefit the public goes unused because effective distribution policies or mechanisms are not in place. At times, cost or licensing restrictions limit data use. While restricted access to geospatial data may be appropriate in some instances – privacy or public safety are two notable cases – the public benefit will be greatest when geospatial data becomes available through a well integrated data distribution infrastructure, supported by clear policies and well-defined organizational relationships. Like the data itself, such technology, policy and organizational issues are essential components of the MSDI.

This document collects plans for data development, management and distribution prepared by teams of professionals that depend upon each of the framework data themes in their work. In their reports, these Implementation Teams describe the uses of the data, document its current availability within Minnesota, identify needs for new or improved data, estimate costs, and outline strategies for meeting those needs. The proposed solutions build upon collaborative efforts that reflect Minnesota's historical tradition.

Section 2: The National I-Team Initiative

The national I-Team Initiative was launched in early 2000 by staff at the U.S. Office of Management and Budget (OMB). Through this initiative, OMB hoped to better understand the growing demand for spending on geospatial data and GIS technology by federal agencies and to identify partnerships that leveraged investments being made by all organizations with common data needs. Its intent is to promote plans that lead to action -- I-Team is short for Implementation Team.

Since its inception, the national I-Team Initiative has focused upon addressing institutional and financial barriers to developing a National Spatial Data Infrastructure (NSDI). Partnerships are at its core, extending beyond core federal agencies such as the OMB and the Federal Geographic Data Committee (FGDC) to include other partners, such as the Council for Excellence in Government, the National States Geographic Information Council (NSGIC), the National Association of Counties (NACO), the International City/County Managers Association, and the OpenGIS Consortium.[9]

A Minnesota I-Plan can produce significant benefits for the state while adding value beyond the scope of the national initiative. By focusing on our own issues and priorities, a Minnesota I-Plan would:

- provide a clearly documented basis for coordinating geospatial technology investments within the state;
- help shape federal geospatial technology initiatives so that they address Minnesota's needs and increase the likelihood of federal funding for Minnesota projects;
- address data needs that have special importance for Minnesota but which are not addressed in the national I-Plan initiative, such as soils data;
- specify data characteristics that meet local needs within the state rather than national needs, such as specifications for scale, resolution, and coordinate systems; and
- involve a broader range of stakeholder organizations than are required for the national initiative.

In developing their plans, Minnesota I-Teams agreed to adhere to the following guidelines established for the national I-Team initiative:[10]

- Be inclusive and foster community-wide participation; nurture collaboration and make decisions by consensus; treat data as a public good; be a steward of the data in their care; and comply with the policies and principles of the National Spatial Data Infrastructure.

[9] For more about the I-Team Initiative partners, see http://www.fgdc.gov/I-Team/strategic.html.

[10] The principles are described at http://www.fgdc.gov/I-Team/iprocess.html.

- Focus on data as strategic, capital assets; coordinate data planning and implementation activities among all levels of government and the private sector; identify the most effective and efficient ways to produce, steward and exchange data; and agree upon and use common investment criteria.

- Align roles, responsibilities, and resources; and pool and leverage investments.

- Develop a strategic plan that serves as an I-Plan.

- Implement the strategic plan.

- Sustain the process through continuous update of the strategic plan and implementation activities that maintain current and timely data assets.

- Produce, steward and exchange current, accurate framework and other data.

An important strategic outcome envisioned for the I-Plan process was the clear articulation of geospatial data investments needed to implement the NSDI from best available sources, predominantly local, regional and state. Recognizing that federal data investments could be most effective by aligning them with clearly defined needs of those other sources, OMB offered to use state I-Plans in its investment recommendations. This expectation was a powerful incentive for states to form I-Teams and develop plans. Twelve states have now submitted I-Plans and more than forty have made commitments to the process, Minnesota among them. In addition, several I-Teams have been created that cover regions crossing state lines or other geographies.[11] In August 2002, MetroGIS became the first metropolitan organization within the nation to commit to the I-Plan process.[12] The proactive commitment to cooperation represents the strong commitment within Minnesota to I-Plan process and the MSDI vision.

[11] For more about the status of current I-Plan activities, see http://www.fgdc.gov/I-Team/iteams/network.html.

[12] See http://www.metrogis.org/about/affiliations/index.shtml#iteam for more about MetroGIS I-Team involvement.

Section 3: Building the Minnesota Spatial Data Infrastructure

The Minnesota Governor's Council on Geographic Information responded to the National I-Team Initiative by formalizing a commitment to the Minnesota Spatial Data Infrastructure. The MSDI builds upon Minnesota's historical tradition of collaborative approaches to addressing the geospatial technology needs within the state, while also clarifying Minnesota's relationship with the national program.

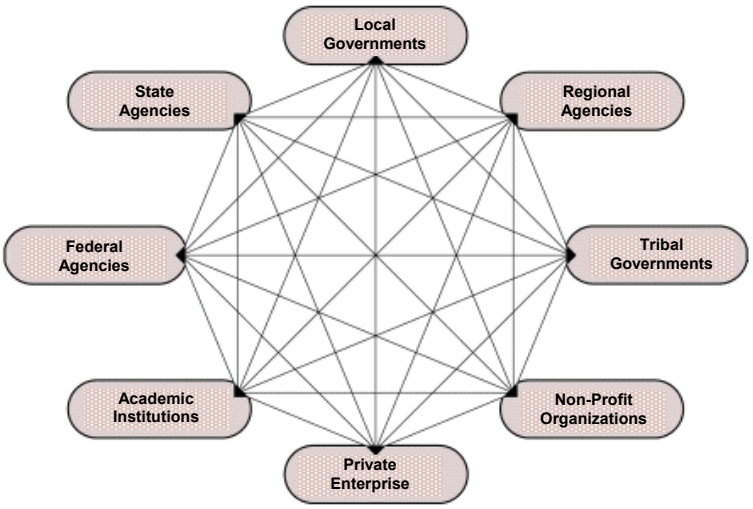

Figure 2
The MSDI will support all organizations in Minnesota

3.1 The MSDI Vision

The Council's vision is that the Minnesota Spatial Data Infrastructure will support the development and use of geospatially-enabled computer applications that enhance the efficiency, effectiveness, and economic competitiveness of both public and private organizations serving the people of Minnesota.

Successfully implemented, the MSDI will:

- **Benefit users and producers of geospatial data.** Geospatial technology users will have timely access to the data they need, appropriately formatted to support business applications ranging from public safety to environmental protection. Data producers will expand the availability of their geospatial data while reducing their distribution costs by sharing distribution mechanisms that complement and add value to their own business solutions.

- **Benefit organizations through shared technology.** The MSDI will include a shared technology infrastructure that provide cost-effective and responsive technology solutions for

data management, data distribution, and specialized applications that complement and add value to solutions that organizations implement to meet their own needs.

- **Benefit Minnesota through effective collaboration.** The MSDI will provide a policy and organizational framework that promotes effective collaboration among public and private organizations that use geospatial technologies to support their business activities.

Taken together, the MSDI will result in strategic guidance of investments in geospatial data and technology, complementing and leveraging federal investments that support the National Spatial Data Infrastructure and supporting faster, better, and financially responsible services for the people of Minnesota.

3.2 Organizing for the Minnesota Initiative

The Minnesota Governor's Council on Geographic Information began discussing the National I-Team initiative shortly after the initiative was introduced in July 2000, and formally committed to developing a Minnesota I-Plan in January 2002. By endorsing the national initiative, members recognized that I-Plans offered an opportunity to address Minnesota's strategic geospatial data needs within a national framework, while also focusing federal initiatives on locally defined needs. The Council emphasized the importance of maintaining a strong connection between the I-Plan and the National Spatial Data Infrastructure, which the Council continues to support.

At the January meeting, the Council designated its existing Land Records Modernization Committee as Minnesota's Cadastral I-Team and requested that the Council's Data Committee develop a strategy for preparing I-Plans for cadastral data and the other six framework data elements of the national initiative: geodetic control, transportation, government units, elevation, hydrography, and imagery. Soils data was later added to the plan's scope, reflecting the importance of agricultural and environmental issues for Minnesota. The Data Committee formed a smaller I-Plan Coordinating workgroup to carry out its assignment. The Council reorganized the Data Committee as the MSDI Committee in September 2003.

The organizational structure devised for the process, depicted in Figure 3, assigns responsibility for the I-Plan process to the Council on Geographic Information while relying upon I-Teams comprised of thematic experts to develop components of the plan. With advice from the Council and its Executive Committee, one or more representatives of producer or steward organizations were designated as I-Team theme conveners, with the responsibility to recruit content experts representing a range of appropriate stakeholders to develop a plan. Surveys, focus groups, extrapolation from successful sub state collaborative initiatives have been among the methods used by I-Teams to identify priority needs.

The I-Plan coordinating workgroup provided a common template for producing the thematic plans. Each team was asked to clarify its vision, agree to common guiding principles, identify data needs, and define policies and best practices necessary to implement and sustain a solution for its framework data theme. Where appropriate, teams were asked to include data content guidelines and custodian roles and responsibilities for data development, documentation, and maintenance. The coordinating workgroup also was responsible for reviewing drafts, overseeing revisions, and integrating the individual plans into a comprehensive strategic planning document.

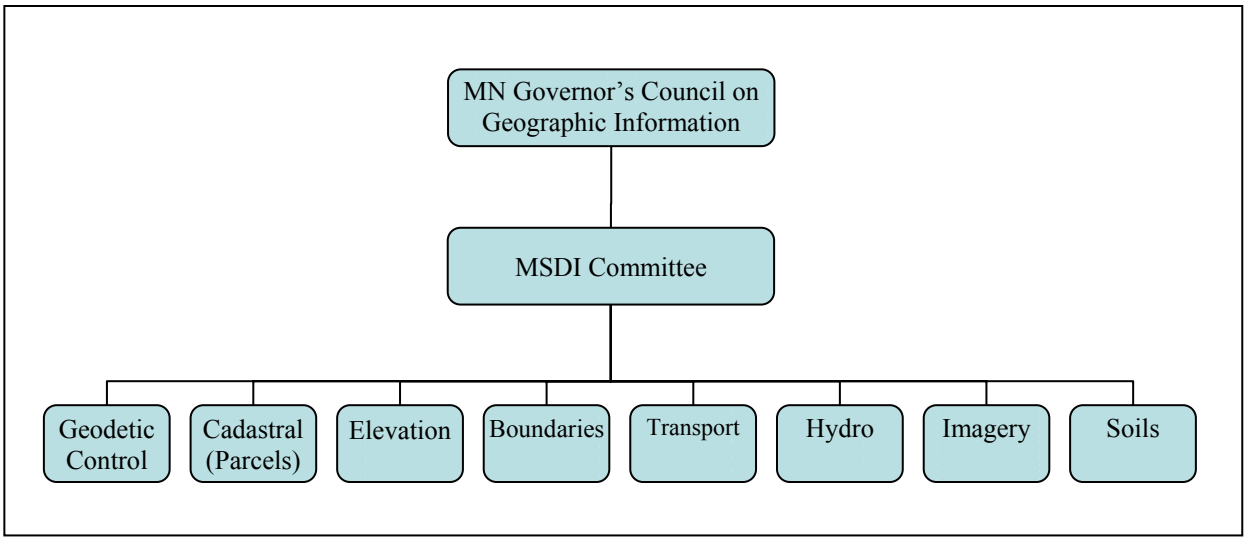

Figure 3
Organizing for Minnesota's I-Plan

More details about the organizational structure and the MSDI, including current coordinators for the MSDI data implementation plans and their affiliations are available at the MSDI web site, www.gis.state.mn.us/MSDI along with other details about the initiative.

3.3 Guiding Principles for the MSDI

Common principles guide policymaking, implementation, and long-term management of solutions for each of the components of the MSDI. These principles were derived, in part, from the successful experiences of MetroGIS, a multi-participant geospatial data collaborative that serves the seven-county, Minneapolis-St. Paul Metropolitan Area.[13] In addition to the core principles described here, others were adopted to address specific needs of individual thematic data plans, where appropriate.

- **Define Roles and Responsibilities.** Roles and responsibilities for establishing and maintaining the MSDI will be clearly identified and defined.

- **Respect Business Need**. No organization will be required to perform a task to meet a statewide need that conflicts with its business needs.

- **Focus on Commonly Needed Data**. Data specifications will be defined through a broadly representative and collaborative process that respects differences among the regions of the

[13] MetroGIS's core stakeholders are the 300 local and regional units of government that serve the seven county, Minneapolis-St. Paul Metropolitan Area. MetroGIS received recognition as a regional (substate) I-Team in August 2002. Its intent is to serve as an operational component of the MSDI, as well as, a functional component of the NSDI. MetroGIS's core philosophy has incorporated, nearly since its outset, concepts central to realizing the vision of the NSDI; philosophies that are also important to achieving the MSDI vision. For more information about MetroGIS see www.metrogis.org.

state. Specifications for statewide solutions will comprise a common subset of data specifications defined for substate areas.

- **Minimize Modifications.** When data is assembled from multiple sources, original data will not be modified except for appropriate projections required to achieve a common coordinate base or with explicit permission of the primary producer.

- **Respect and Accommodate Differences.** Data specifications endorsed to meet statewide needs will be designed with adequate flexibility to accommodate the business needs of primary producers and area aggregators[14].

- **Promote Data Integration.** Aggregations of data for each theme will work together as if one dataset. Where practicable, data for that theme will be consistent with data from adjoining areas and with other data layers that comprise the Minnesota Spatial Data Infrastructure.

- **Promote Access While Respecting Access Policies.** Within the legal framework of the Minnesota Data Practices Act, public-sector producers of framework data adopt their own policies on licensing requirements and fees. MSDI data solutions will promote no fees for government access to government-produced framework data, while also respecting access policies adopted by data producers.

3.4 Data Distribution and the MSDI

Institutional and technological resources that support efficient and effective data discovery and distribution are essential elements of Minnesota's Spatial Data Infrastructure. While much of the MSDI initiative concerns strategies for developing and maintaining framework geospatial data, benefits will derive from data use. A successful MSDI requires widespread data availability, supported by policies and technologies that promote easy data access at minimal cost. Minnesota has made a strong commitment to institutional agreements and technology solutions that facilitate data distribution, building upon standards developed for the NSDI and by the OpenGIS Consortium.

Minnesota's data distribution strategy is based upon the Governor's Council on Geographic Information 1997 report *Laying the Foundation for a Geographic Information Clearinghouse*.[15] The report recommended that the Land Management Information Center serve as the lead agency for the Minnesota Geographic Data Clearinghouse. It also recommends a technical architecture featuring decentralized data storage by producing organizations coupled with integrated data search and distribution functions through a single site accessed using the World Wide Web. *Laying the Foundation* endorsed metadata standards and search protocols adopted for NSDI clearinghouse nodes and serves as a basis for Minnesota's continued commitment to OpenGIS standards as they are developed.

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[14] "Area aggregator" or "area integrator" are terms used to describe organizations that assemble data produced by other organizations to create a consistent dataset for a larger region. An example is the Metropolitan Council, which compiles a regional parcel dataset from county data for MetroGIS.

[15] The report *Laying the Foundations for a Geographic Information Clearinghouse* is available on the web at http://www.mnplan.state.mn.us/pdf/gisclear.pdf.

Today, the Minnesota Geographic Data Clearinghouse serves as a comprehensive "one stop shop" that offers a variety of services to help users identify and acquire geospatial data about Minnesota.[16] Services include phone support, a comprehensive web site with information about data, data documentation, standards, and web self-service tools for data searching and retrieval of data maintained by Minnesota's data developers. LMIC works closely with state agencies and other data producers, offering training and technical assistance to help them publish and distribute their data as Clearinghouse partners. MetroGIS offers similar services within the Minneapolis-St. Paul metropolitan area, collectively called DataFinder.[17]

Both the Clearinghouse and MetroGIS take advantage of web-based solutions for data discovery and distribution. Web resources include:

- searchable data catalogs;
- a shared data discovery search engine called GeoGateway that searches standardized metadata records from multiple sources and which uses national standards that support searches through the FGDC Clearinghouse gateway; and
- shared web technology for viewing and retrieving data offered by producers and maintained on their own servers.

The Clearinghouse web distribution service, called GeoIntegrator, and the equivalent MetroGIS service, called DataFinder Café, implement adopted OpenGIS standards and specifications. LMIC and MetroGIS are collaborating to develop future enhancements of a common distribution service that comply with emerging OpenGIS standards and that support federal initiatives such as The National Map[18] and Geospatial One-Stop.[19]

Although this document does not comprehensively address the technology infrastructure for distributing data, the I-Plans identify issues that affect distribution and access – licenses, restrictions, fees, and cost-recovery, for example – and recommends roles and responsibilities, policies and practices that are needed to address those issues.

3.5 Organizational Issues and the MSDI

Successfully implementing the MSDI requires fresh thinking about roles and responsibilities, organizational relationships and, in some cases, may require significant change to current policies and practices. At a minimum, sustained success will require organizational mechanisms that effectively support knowledge sharing and consensus building among core stakeholders. Important functions of this mechanism will include the capacity to:

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[16] See www.lmic.state.mn.us/chouse/index.html for more about the Minnesota Geographic Data Clearinghouse.

[17] See www.metrogis.org for more about MetroGIS.

[18] See http://nationalmap.usgs.gov/ for more about The National Map project.

[19] See http://www.geo-one-stop.gov/ for more about Geospatial One-Stop.

- foster activities to share knowledge among diverse interests with common needs;
- support trusted processes to define and implement best management practices, guidelines, standards, and roles and responsibilities needed to achieve MSDI goals;
- monitor performance of data producers and custodians and provide a trusted process to appropriately modify roles and responsibilities, as required for a successful and sustainable MSDI;
- monitor user satisfaction and provide a trusted process to implement modifications to guidelines and policies needed for a successful MSDI;
- foster collaborative investments in MSDI development, minimizing duplication and leveraging resources and investments by others; and
- ensure opportunities for meaningful participation of all affected parties in the development of the MSDI.

Section 4: Challenges, Opportunities and Recommendations

This plan reflects the strong commitment made by Minnesota organizations using GIS to coordinated solutions that meet their common needs. Members of Minnesota's GIS community overcame significant constraints to reach this milestone: devoting much time and expertise to develop a common vision and identify needs despite the absence of a legislative mandate or dedicated funding. These constraints still exist and represent significant challenges to implementing the MSDI vision. Success will result in a significant return on investment to Minnesota, but will require a sustained commitment, clearly defined responsibilities and authorities, and adequate funding.

4.1 Sustained Commitment

Individuals representing a wide range of organizations, public and private, have made an enormous commitment to develop this document. Well over one hundred individuals from local, regional, state, and federal agencies, joined by representatives of educational institutions, business, and nonprofit organizations, have spent thousands of hours to develop plans, known as I-Plans, that address specific MSDI data issues. Others have guided and coordinated the effort. The challenge is to sustain this collective effort despite competing priorities for staff time, funding and other resources. Implementing the individual I-Plans will require contributions by many organizations over several years. If properly planned and coordinated, they will be able to contribute to the MSDI while meeting their own business needs. But without their sustained commitment to work towards common needs, achieving the MSDI vision will not be possible.

4.2 Recognized Authority

No agency or organization has been formally designated to develop or implement a statewide GIS infrastructure plan. Also, clear statutory authority does not exist to develop and maintain the MSDI framework data elements, except as they are needed to support existing statutory mandates and business processes. These constraints will become increasingly problematic once the emphasis shifts from planning to implementation and support for the MSDI.

Designation of an organization is needed, with responsibilities clearly defined to oversee implementation and management of a statewide GIS infrastructure and coordination of GIS activities of other Minnesota agencies and organizations. Rather than centralizing GIS capabilities, this organization should focus on complementing GIS programs supporting existing business activities, especially those defined as statutory mandates. In carrying out its duties, this state GIS authority would work closely with state agencies with existing review and oversight responsibilities, such as the Department of Finance and Office of Technology, and actively involve state, regional and local governments as essential partners. The designated organization would:

- Oversee the development and implementation of the MSDI, including the individual thematic I-Plans that comprise the MSDI.

- Monitor the effectiveness of adopted MSDI policies and recommend actions.

- Coordinate implementation of GIS by state agencies within guidelines established for the state's IT architecture framework.

- Coordinate state agency GIS initiatives to better identify opportunities for joint projects and to leverage private and federal resources not otherwise available to Minnesota.

- Work with state, regional, local government and tribal governments, and nongovernmental stakeholders to identify GIS needs and investment priorities and to recommend initiatives that support the state's GIS infrastructure.

- Work with stakeholders, the Office of Technology, and Department of Finance to identify new and emerging opportunities that improve the effectiveness of state programs through use of GIS.

- Serve as an advocate for Minnesota's GIS stakeholders to the executive branch and legislature within Minnesota.

- Serve as an advocate for Minnesota's GIS stakeholders to federal agencies and other organizations.

- Serve as the state's designated liaison and representative to appropriate federal mapping agencies and national GIS organizations.

- Develop and maintain MN Geographic Data Clearinghouse services, including e-government solutions for distributing geospatial data.

- Receive and spend appropriations, receive and spend grant funds, enter into contracts, memoranda of understanding and other legal commitments.

The challenge for the GIS community is to devise an organizational structure that is capable of achieving these outcomes. The Governor's Council on Geographic Information has agreed to consider alternatives and prepare a recommendation to guide the needed organizational changes, working with appropriate state agencies and stakeholders.

4.3 Adequate Funding

The third constraint is funding, both for coordination and implementation. Despite leadership by several Minnesota organizations, none of them has an adequate source of funding to devote exclusively to these essential activities. The current climate of fiscal austerity affects all levels of government within Minnesota, but stable funding is needed to ensure the benefits of successful coordination – including efficiencies that will result in long-term savings. Adequate funding is especially important to support the responsibilities described in Section 4.2. The challenge is to identify an appropriate way to fund a more integrated statewide approach to GIS. In addition, organizations must continue investing resources to meet their own data needs, especially those that are identified within I-Plans, and continue to make the data available to other organizations through mechanisms adopted for the MSDI.

4.4 Related Challenges

In addition to organizational adjustments recommended to develop and implement an infrastructure for effective GIS in Minnesota, improved capacity for GIS services also is needed. A growing number of state, local and regional agencies have recognized the value of GIS to their business activities, but many of them cannot efficiently maintain programs on their own. The Land Management Information Center currently helps fill the gap, providing project services through formal agreements on a cost-recovery basis. As the organizational structure for GIS is assessed, consideration should be given to fund GIS projects that are outside of the business scope of existing agencies but which offer operational efficiencies that benefit Minnesota. Projects should be selected by a steering committee representing executive branch agencies, local and regional governments, and other key stakeholders.

4.5 Recommendations

To achieve the MSDI vision, *A Foundation for Coordinated GIS* also recommends the following steps concerning organizational structure and relationships, policy, and funding.

- Explicit authority and responsibility for overseeing the development and implementation of the MSDI should be assigned to a state cabinet level agency, supported by legislation if necessary.

- Adequate resources should be provided to support the sustained development and implementation of the MSDI, including necessary funding to sustain the coordination effort.

- Public expenditures in geospatial data and technology should reflect MSDI priorities, updated by stakeholders through policies and procedures adopted for maintenance of the MSDI.

- GIS implementation by state agencies should be coordinated within guidelines established for the state's IT architecture framework and consistent with policies of the state's Office of Technology and Department of Finance.

- GIS implementation by state, local and regional agencies should be coordinated with similar efforts by state and federal agencies as they relate to the MSDI.

- A strong emphasis should be placed on identifying emerging opportunities for effectively using GIS, identifying opportunities for joint projects and leveraging private and federal resources not otherwise available to Minnesota.

- The continued development of the MN Geographic Data Clearinghouse should be supported, emphasizing e-government solutions for distributing geospatial data.

Section 5: Status of MSDI

The Minnesota Spatial Data Infrastructure, viewed in its broadest sense, is comprised of data, technology infrastructure, policies, and organizational relationships. The recommendations contained within *A Foundation for Coordinated GIS* address policies and organization issues that will result in a robust and sustainable MSDI. Many of its components already are in place, resulting from several decades of cooperation by Minnesota organizations that have cooperatively invested in geospatial data and technologies. They include:

- **A collaborative culture.** Minnesota organizations actively collaborate to meet common data and technology needs. Minnesota is widely recognized for collaborative investments to produce statewide data and technology, much of it documented at the Minnesota Geographic Data Clearinghouse.[20]

- **A supportive institutional framework.** State organizations (the Minnesota Governor's Council on Geographic Information and the Land Management Information Center), regional organizations (MetroGIS), and professional associations (MN GIS/LIS Consortium) provide institutional support for achieving the goals of the MSDI.

- **Shared technology services.** Minnesota organizations have shared technology services that support the distribution of geospatial data, notably services that allow users to find and download data using the Internet.[21]

- **A commitment to standards.** Minnesota has embraced standards that promote collaboration and interoperability. These include standards endorsed by the Minnesota Governor's Council on Geographic Information and adopted as Minnesota state standards.[22] Minnesota also has embraced the emerging standards being developed by the Open GIS Consortium.[23]

A Foundation for Coordinated GIS pays special attention to data: the seven framework themes of the National Spatial Data Infrastructure framework data plus soils, which has special importance for Minnesota. For each of these themes, knowledgeable stakeholders from government agencies, professional associations, educational institutions, nonprofit organizations, and business have been assembled to identify data needs and a plan to meet them. These plans, called I-Plans, are consistent with guidelines established for the national I-Plan Initiative, but

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[20] See http://www.lmic.state.mn.us/chouse/index.html for more about data and services resulting from collaborations within Minnesota.

[21] The Land Management Information Center, the Department of Natural Resources, the Department of Transportation, the Minnesota Pollution Control Agency, the Metropolitan Council, and other organizations provide data services integrated through the Minnesota Geographic Data Clearinghouse. These include the Minnesota GeoGateway (http://geogateway.state.mn.us/documents/index.html), a portal that searches catalogs based upon adopted technology standards.

[22] Geospatial standards are among the first data standards adopted by the state of Minnesota. The adopted standard for data documentation has been especially effective. Geospatial standards of interest to Minnesota are documented at http://www.gis.state.mn.us/standards.htm#State%20GIS%20Standards.

[23] Minnesota has been especially active in supporting Open GIS Consortium standards for web mapping and web services. For more about the Open GIS Consortium, see http://www.opengis.org/.

more importantly, that they would shape a strategy for meeting the needs of Minnesota's organizations.

By July 2003, plans were either drafted or completed for five of the eight themes: parcels (cadastral), geodetic control, elevation, hydrography, and imagery. The cadastral plan was endorsed by the full Council in February 2003. The MSDI coordinating committee subsequently reviewed the first generation plans, identified issues related to scope, content, and consistency. Based upon this review, the MSDI coordinators subsequently have recommended reformatting the I-Plans and expanding their scope to focus more clearly on data access, organizational relationships and implementation strategies. A revised template has been prepared to guide preparation of second generation of I-Plans and is included as Appendix A.

Progress made on preparing and implementing I-Plans will be carefully monitored and summarized as a "scorecard" that will be posted on the web site for the MN Governor's Council on Geographic Information.

Section 6: Next Steps

A Foundation for Coordinated GIS: Minnesota's Spatial Data Infrastructure provides a roadmap to effectively meet Minnesota's geospatial data needs. It portrays a comprehensive assessment of those needs, identifies financial and organizational challenges, and recommends implementation strategies. The Minnesota Governor's Council on Geographic Information endorses this document as an appropriate plan to guide future policies and investment decisions related to GIS by Minnesota's state, regional and local governments.

As a strategic plan, *A Foundation for Coordinated GIS* represents a beginning, not an end. Ideally, its recommendations will be implemented, resulting in satisfaction of many of Minnesota's most pressing geospatial data and technology needs. But even the best of plans are rarely implemented in their entirety. Moreover, circumstances and needs change over time. Economic conditions that have resulted in staff reductions, organizational restructuring, and reduced public expenditures, in particular, are likely to affect implementation strategies identified in this document. In endorsing *A Foundation for Coordinated GIS*, the Council recognizes the need to continually monitor progress against its goals and the need to periodically review and adjust the plan.

6.1 Short-Term

The Council will either continue or initiate the following actions and activities during 2004 through the end of June 2005, when the state's 2005 fiscal year ends.

- Submit *A Foundation for Coordinated GIS* to appropriate federal authorities as Minnesota's I-Plan.

- Complete I-Plans for all of the eight framework data themes.

- Review recommendations made by each completed data plan, reconcile them with recommendations made by other MSDI data plans, and endorse all plans that are consistent with the cooperative vision established by *A Foundation for Coordinated GIS*.

- Monitor progress made towards achieving the goals identified within the completed data plans and revise *A Foundation for Coordinated GIS* to reflect that progress.

- Work with the Department of Administration to prepare and seek support for organizational change and budget initiatives that address issues identified in *A Foundation for Coordinated GIS* concerning roles and responsibilities, funding, organizational structures, and policies for the MSDI.

- Support initiatives and activities made by organizations that address the data needs identified in *A Foundation for Coordinated GIS* and which are consistent with its recommendations regarding organization, responsibilities, and policies.

- Review legislative and budget initiatives developed for the 2005 legislative session and, if consistent with the recommendations made in *A Foundation for Coordinated GIS*, support them through Council endorsement.

- Work with government organizations and others to seek federal funds to help meet Minnesota's geospatial data needs, based upon *A Foundation for Coordinated GIS*.

- Conduct outreach to refine and build support for the MSDI vision, including making presentations at the MN GIS/LIS Consortium conference and using the Council web site to post information and promote feedback.

6.2 Mid-Term

The Council or its successor as recommended in Section 4.2 should plan to continue or initiate the following actions and activities during the period between July 1, 2005 and December 31, 2006.

- Thoroughly assess progress made towards achieving the goals identified in *A Foundation for Coordinated GIS* and implementing its recommendations and, if appropriate, recommend that additional thematic I-Plans be developed.

- Research and evaluate issues identified in the I-Plans and recommend strategies for effectively addressing those needs.

- Revise *A Foundation for Coordinated GIS* so that it reflects progress made towards meeting Minnesota's data needs, newly identified data needs, organizational and policy changes that have occurred, and to adjust the implementation plan.

- Refine and seek support for organizational change and budget initiatives that address issues identified in *A Foundation for Coordinated GIS* concerning roles and responsibilities, funding, organizational structures, and policies for the MSDI.

- Review legislative and budget initiatives developed for legislative sessions and seek support for them when they are consistent with recommendations made by *A Foundation for Coordinated GIS*, its revisions or successors.

- Seek federal funding to meeting Minnesota's geospatial data needs based upon the needs identified by *A Foundation for Coordinated GIS*, its revisions or successors.

- Continue to conduct outreach to refine and build support for the MSDI vision.

6.3 Long-Term

The Council or its successor should plan to continue or initiate the following actions and activities beyond January 1, 2007 to ensure the effective implementation of the MSDI vision and the sustained maintenance and operation of its components.

- Continue to assess progress made towards implementing an effective MSDI and make recommendations about investments, policies, procedures, and organizational roles needed to ensure the sustainability of effective support for GIS within Minnesota.

- Continue to monitor Minnesota's geospatial data needs and, if appropriate, recommend that additional thematic I-Plans be developed.

- Prepare or revise strategic planning documents that guide development and implementation of the MSDI.

- Revise *A Foundation for Coordinated GIS* so that it reflects progress made towards meeting Minnesota's data needs, newly identified data needs, organizational and policy changes that have occurred, and to adjust the implementation plan.

- Support initiatives and activities that help implement and sustain the goals of the MSDI.

- Review legislative and budget initiatives developed to support GIS.

- Seek federal funding to meeting Minnesota's geospatial data needs based upon the needs identified by *A Foundation for Coordinated GIS*, its revisions or successors.

Appendix A: Template for MSDI Data Plans

Minnesota Spatial Data Infrastructure Data Plan
Theme Name

1. Overview

1.1. Theme Description

Briefly describe the theme in terms that are easily understood by a nontechnical person. Be sure to explain why this data is important by describing how the data is used, focusing upon the activities and functions that benefit Minnesota. Where the theme includes data used at several scales, examples of how each is used should be identified. If this theme has been identified as an important element of the NSDI, either as framework data or projects such as The National Map, describe the relationship.

1.2. Plan Purpose

Describe the purpose of this document. If appropriate, adapt the following general statement so that it more completely describes the purpose of this data plan.

"The purpose of this document is to identify Minnesota's need for (*theme name)*, describe how this need is currently being addressed, and recommend resources, processes, organizational structures and strategies required to develop an effective Minnesota Spatial Data Infrastructure."

1.3. Vision

Imagine that enough time has passed to implement all of the recommendations for data production, maintenance, management and distribution made by this plan. Then write a statement that describes how Minnesota is meeting those needs at that point in the future.

1.4. Guiding Principles

Identify the principles that will guide the effort to develop and implement a plan for meeting our needs for this data. These principles should reflect the basic principles adopted for the MSDI, but may be adapted as needed. The core principles are described in Section 3 of this document.

2. Importance of Theme

2.1. Business Needs

Identify the principal stakeholders who need this data, specifying activities and functions that are affected. This does not necessarily need to be an exhaustive list, but ideally is representative of all levels of government within Minnesota, especially state, regional and local. If federal, nonprofit, or private stakeholders also depend on this data, identify how they use it as well. Be sure to include any issues that affect the urgency of addressing this data need.

2.2. Benefits

Identify and describe, as best you can, specific benefits that will result from meeting the goals of this plan. Do not focus on general statements of benefit unless they are accompanied by some quantifiable estimate, such as cost savings, increased productivity, improved response time, reduced risk, minimized environmental damage, etc. Where appropriate, include examples that represent statewide, regional and local uses.

2.3. Business Impacts

Describe any changes to current business practices that are likely to occur if the goals of this plan are met, focusing especially upon how they may be reflected in changes in processes, organizational structure, or relationships among organizations. These impacts may include results that are less quantifiable than those discussed in section 2.2. For example, the shifting of responsibility for acquiring and managing a data type that had previously been independently acquired and managed by many units of government to a single organization.

3. The Data Environment

3.1. Data Description

Describe the data that is needed in as much detail as possible, identifying characteristics such as scale, resolution, positional accuracy, frequency of update and any other characteristics that affect the suitability of the data to meet the business needs identified for the business cases noted within the theme description.

3.2. Data Priorities

Where meeting the business needs associated with this data theme requires several different datasets, distinguished by characteristics such as scale, resolution, accuracy, frequency of update or appropriate, identify the relative priorities for each. Priorities should reflect the projected benefits to Minnesota resulting from addressing the business needs.

3.3. Data Sources

Identify the principal sources for the subject data theme. Where more than one type of data, distinguished by characteristics such as scale, resolution, accuracy, frequency of update or appropriate, identify the sources for each type.

3.4. Data Standards

Identify all standards related to this theme, whether or not they have been adopted or implemented within Minnesota. Identify all organizations that have made formal commitments to using the standards or promoting their use. If the standards are still being developed and reviewed, as is the case with many national standards, describe how Minnesota plans to participate in the process. When identifying standards, be explicit about their name, adopting organization and cite references for further information.

4. What's Being Done

Describe what already has been done to meet the needs for development or maintenance of this data theme. Where possible, distinguish among statewide, regional and local solutions.

For each of the categories of data associated with this theme, identify data that already exists. For each dataset, identify or describe the following:

- producing organization
- geographic coverage
- coordinate system
- positional accuracy
- completion date
- maintenance cycle
- distribution policies

5. Funding

5.1. Estimated Total Investments in Theme

Identify the total investment that will have been made through the end of 2003 to develop and maintain each class of data covered by this them. Estimate investments made by local, regional, state, and federal units of government. If appropriate, investments made by other sectors also should be identified.

5.2. Costs for Completing Theme

Estimate both the one-time development costs for completing the theme and the costs for maintaining the data once it has been developed. If data must be newly acquired on a periodic schedule to meet identified business needs, identify the cycle and the projected costs.

5.3. Maintenance Costs

Estimate the costs for maintaining the data for this theme once the data has been developed for the entire state so that it meets the specifications identified in this plan.

5.4. Current Funding Allocated

Identify funding that is known to have been committed to developing or maintaining the data associated with this theme. Be as specific as possible about the commitments made. At a minimum, estimate investments made by local, regional, state, and federal units of government.

5.5. Overcoming the Funding Gap

Describe the alternative strategies for funding the development and maintenance of the data covered by this theme. The strategies should identify the funding sources and any steps required to secure them. If possible, recommend those that are appropriate for implementation.

6. Data Management and Distribution

6.1. Data Management

Describe how data will be managed, identifying who will be responsible for ensuring reliable data storage and overseeing policies and procedures for storage and management, including backups, backups and disaster recovery.

6.2. Data Updates

Describe the update requirements for the data, addressing whether the data is updated through transactions, through periodic changes, or completely replaced when changed. Identify the current update cycle and the responsible party for updates. If no update strategy currently exists, or if changes are appropriate, recommend procedures and the responsible party for the updates. Where constraints exist, such as funding limitations, describe them.

6.3. Data Integration

Where aggregation or assembly of data originally produced by several organizations is required, either for regional or statewide use, identify the organizations that are recommended to assume this responsibility and assess whether or not they are currently equipped to support the activity. Where integration is not practicable, for either technical or organizational reasons, describe the constraints and recommend how they may be overcome.

6.4. Data Distribution

Describe how data will be distributed, identifying where data will be stored and the policies and technologies that would be used for distribution. If fees or license agreements are likely to be used, identify them. Also, identify how the costs of management and distribution will be funded.

7. Organizational Relationships

Describe the organizational relationships and policies that will be needed to implement a solution to the data needs identified for this theme. Where explicitly assigned roles and responsibilities and formal agreements are likely to be required, they should be identified. Where it is judged that new organizations are needed or business practices need to be redesigned that affect how organizations currently conduct their business, these changes should be described.

8. Implementation Strategy

Describe any recommendations related to implementing actions needed to address the data needs identified for this theme. Organize the recommendations into those that should be taken within the next twelve months, within the next three years, and long-term. For each time period, distinguish among actions recommended for local, regional, state and national organizations.

8.1. Short-Term

Identify actions or steps that should be taken by December 31, 2004 by local, regional, state, and national organizations. This can be a bulleted list with milestones. Be aware of strategically important dates for recommendations requiring budgetary or legislative actions. Note that the legislative session that considers the next biannual state budget will begin in January 2005.

8.2. Mid-term

Identify actions or steps that should be taken between January 1, 2005 and December 31, 2006 by local, regional, state, and national organizations.

8.3. Long-term

Identify actions or steps that should be taken after January 1, 2007 by local, regional, state, and national organizations.

9. I-Team Members

Identify the people involved in the preparation of this document and the organizations they represent.

Appendix B: MSDI Theme Overviews

This appendix includes two page summaries for each of the MSDI thematic data plans, referred to in this document as I-Plans. They are included here as overviews of Minnesota's data needs and strategies and recommendations that are being considered to address them. For the most recent information about any of these data needs and activities to address them, see the MSDI web site at www.gis.state.mn.us/MSDI or the specific I-Plans.

Cadastral [Parcels]

Elevation

Geodetic Control

Government Boundaries

Hydrography

Imagery

Soils

Transportation

MSDI DATA THEME OVERVIEW: CADASTRAL (PARCELS)

DESCRIPTION

Commonly referred to as "parcel data," cadastral data consist of the boundaries of land ownership parcels and attributes of those parcels. The spatial accuracy of parcel boundary data varies according to the needs of data producers, generally county governments, which also maintain a wide variety of attributes for each parcel to support their property taxation functions. These attributes generally include information about the property owner, taxpayer, structures located on the parcel, financial interests, and descriptors related to the value and use of land. Both components – boundaries and attributes - change rapidly as new property is created and existing property is reevaluated, improved, sold or redeveloped. Thus, county producers often continuously update these data.

DATA USES

Parcel data rank among the top data needs of Minnesota governments and support a wide variety of day-to-day business functions. Aside from mapping ownership, uses include analyzing site locations, mapping results of program evaluations, contacting property owners, evaluating development proposals, estimating community growth potential, managing natural resources, and road management.

DATA STATUS

The goal of the Cadastral I-Plan is that all parcel data within Minnesota be maintained by primary producers, generally counties, in digital formats that can be assembled easily for multi-county and statewide applications. As of 2004, 57 of the state's 87 counties reported they had developed some digital parcel boundaries, but 38 had not completed the task and only 37 could link their boundaries to tax roll databases. Data accuracies vary greatly among counties.[24]

Although the principal producers of parcel data within Minnesota are its 87 counties, cities, state and federal governments, and tribal governments own considerable land. Collectively, federal agencies own and manage 3.4 million acres within Minnesota. With more than 5.6 million acres, the state is the third largest landowner in the nation. Completing a comprehensive statewide cadastral layer will require participation of all organizations owning land within Minnesota.

Few ongoing programs exist to assemble parcel data across county boundaries. An exception is a regional aggregation assembled for the seven metropolitan counties by MetroGIS. The MetroGIS project demonstrates the value of best management practices, technical standards, and organizational agreements when assembling a consistent parcel dataset from county sources.

[24] For more about the status of parcel mapping within Minnesota, see www.lmic.state.mn.us/chouse/SPMI.

The MetroGIS regional parcel dataset retains the original accuracy and includes a subset of common attributes from the county sources. Statewide, the Department of Revenue annually collects parcel valuation data from counties and aggregates them to support its tax analysis and equalization functions, but the data does not include maps or parcel boundaries.

PLAN STATUS

Version 1.2 of the Cadastral I-Plan was completed in 2003 and is now being updated. A revised plan will be completed by the summer of 2005.

COSTS AND FINANCING

Developing and maintaining accurate parcel data is expensive, costing Minnesota's counties and cities an investment estimated at about $9 million. In addition, several state agencies and tribal governments maintain parcel data for their holdings. An additional $10 to $15 million will be required to complete parcel mapping for the entire state, with annual maintenance costs estimated at several million dollars to maintain current data.

Additional investments will be required to achieve interoperability of data produced by primary producers so that data can be integrated across county boundaries. The annual costs for technical integration can be minimized through adherence to best practices and technical standards, but based upon the experience of MetroGIS[25], the costs associated with local policies establishing agreements and implementing processes and procedures can be significant and must be revisited every few years.

KEY ISSUES

- Digital parcel mapping must be initiated and maintained in 31 counties that do not currently have programs of their own. Funding often is the critical constraint.
- Institutional relationships between the primary producers and those responsible for assembling parcel data for larger areas are critical but difficult to establish and nurture.
- Best practices, guidelines, and standards are needed to insure that digital parcel boundary data and attribute data produced by adjoining counties can be assembled for regions and, ultimately, for a statewide aggregation.
- Funding is inadequate, not only to support primary production of parcel boundary data but also to support data aggregation across jurisdictional boundaries.
- Licensing restrictions and cost recovery policies of data producers can inhibit joint data development, data availability, and data aggregation across jurisdictional boundaries.

MORE INFORMATION

See www.gis.state.mn.us/MSDI for more information about the MSDI and the Cadastral data plan.

[25] MetroGIS fosters the collaborative environment necessary to integrate data for regional solutions to several common information needs, including parcel data. MetroGIS is a designated regional I-Team. See www.metrogis.org for more about MetroGIS.

MSDI DATA THEME OVERVIEW: ELEVATION

DESCRIPTION

Elevation refers to a spatially referenced vertical position above or below a reference datum surface for the earth. Elevations are most often represented on maps as contour lines, but are more usefully created as Digital Elevation Models (DEM) or Digital Terrain Models (DTM). A DEM contains elevation or height values *(z)* at regularly spaced intervals in the *x* and *y* directions. A DTM represents elevations *(z)* at irregularly or randomly spaced *(x,y)* intervals or as a DEM that has been augmented discontinuities known as break lines.

The resolution of elevation data depends upon the spacing of the *(x,y)* measurement grid: the denser the spacing, the better the data can represent the actual topography. Elevation data rarely changes except where large-scale construction, mining, and grading activity alter topography and create the need for periodic updates.

DATA USES

Elevation data are used for engineering studies, flood hazard mitigation and prevention, watershed management, transportation planning, mapping and site design, and soil analysis. Elevation data is often combined with other digital data for modeling and mapping applications, such as regional hydrologic modeling studies. Elevation also is used as input to create orthoimagery, watershed, floodplain, flow modeling data, and elevation contour lines.

DATA STATUS

The only elevation data product available statewide for Minnesota is produced by the U.S. Geological Survey (USGS) as a DEM using 10 or 30 meter grid spacing for 7.5 by 7.5 minute blocks corresponding to 1:24,000 quadrangle maps that are widely used by hikers and campers. Many uses of elevation data can be supported by medium-resolution data available for the entire state, but some applications require higher resolution sources that will require additional investments.

Statewide 30-Meter DEM. When the U.S. Geological Survey produced digital orthophoto quads for Minnesota in the late 1980s and early 1990s, it also produced DEMs using a 30 meter grid from contours published on its 1:24,000 topographic maps. Benefiting from technology changes since this USGS program, DEMs for Minnesota have now been completed using newer "level 2" technology. This data is being augmented by the Minnesota Department of Natural Resources, which is working to improve watershed delineations by producing 'hydrologically-corrected' DEMs incorporating DNR stream data.

Higher-resolution data. Existing statewide data is not precise enough for some needs, although it often is the best available source. For example, half of the flood plain maps for Minnesota

show no elevations and those that do show imprecise elevations derived from USGS quadrangle maps. Several initiatives are underway to improve elevation data available for Minnesota, including a committee working with the DNR to seek funding for a partnership with the Federal Emergency Management Agency (FEMA) to produce 2-foot contour maps statewide. A recent white paper[26] outlines the need, benefits and the funding needed to produce this result.

A U.S. Army Corps of Engineers study of the Red River Basin[27] recommends development of a seamless 10-meter DEM for the entire Red River Basin, with higher-resolution data for the 1997 flood boundary. Some high accuracy maps have been created for the Red River Basin using Light Detection and Ranging (LIDAR) technology. The Fargo-Moorhead, Wahpeton, and Lower Wild Rice River areas have been completed and other pilot projects are planned. Some local and state agencies have created more precise elevation data for specific projects.

STATUS OF PLAN

A draft MSDI Elevation data plan was prepared and presented to the Data Committee in January 2003. The plan will be complete by the summer of 2005.

COSTS AND FINANCING

The high-resolution elevation white paper estimated that $41 million would be needed to produce a DEM or DTM for the nearly 84,000 square miles of Minnesota, not including data management costs. A concerted effort is being made to combine state funds with federal funding through FEMA to finance this effort. A proposal has been presented to the State Legislature.

KEY ISSUES

- Obtain funding for more accurate mapping thereby, as an example, save millions annually by utilizing data collected to mitigate and prevent flooding.
- Focus on commonly needed data for collaborative data exchange statewide.
- Collect and make available information on the active and planned projects in Minnesota.
- Create standards identifying best practices and conventions to insure interoperability of data collected among primary data providers.
- Take advantage of any opportunity to leverage funding that will assist in completing a more accurate statewide DEM that will support a myriad of uses.

MORE INFORMATION

See http://www.gis.state.mn.us/MSDI for more information about the MSDI and the Elevation data plan.

[26] *High Resolution Digital Elevation Model (DEM) and Floodplain Mapping Program*, Mn DNR and partners, June 2002.

[27] *Basin-Level Digital Elevation Models: Availability and Applicatiosn: The Red River of the North Basin Case Study*, Institute for Water Resources, U.S. Army Corps of Engineers, January 2004.

MSDI DATA THEME OVERVIEW: GEODETIC CONTROL

DESCRIPTION

Geodetic control can be described as a common reference system for establishing the coordinate positions of all geographic data. Traditionally, geodetic control points are established as permanent physical monuments placed in the ground and precisely marked, located, and documented. Specifying locations of features relative to geodetic control makes it possible to assess the locational accuracy of these features. Interest and activity regarding geodetic control has dramatically increased, corresponding to the need for accurate maps and surveys for geographic and land information systems.

The MSDI Plan for geodetic control envisions a state-local collaborative solution. The state assembles an electronic database about geodetic connected monuments and makes it readily available to all users over the Internet. The database features control survey monument data that are readily useable and meet the broad user community's desired specifications for accuracy. Many organizations contribute information to the geodetic control network. A statewide solution for real time kinematic GPS surveying enables greater efficiencies to the data producing organizations. Funding and other incentives enable state agencies and local units of government to add to the control survey network and encourage participation and publication of their data.

DATA USES

The Geodetic Control network is a very high priority for professional surveyors, GIS developers and spatial data gatherers in Minnesota. Control surveys establish precise horizontal and vertical positions of geodetic monuments. These serve as the basis for originating or checking subordinate surveys for projects such as topographic and hydrographic mapping, property boundary delineation, route and construction planning, and design and layout. They are also essential as a reference framework for giving locations of data entered in Land Information Systems (LIS) and Geographic Information Systems (GIS).

DATA STATUS

- The primary source for geodetic data is the National Geodetic Survey (NGS), which maintains a nationwide geodetic control network. This network of stations, the National Spatial Reference System, is documented in a national database available through the Internet.
- The Minnesota Department of Transportation's (Mn/DOT) Geodetic Unit supplements the NGS survey stations with additional stations to establish control for Mn/DOT projects. The survey data for these stations is submitted to the NGS for final computation and publication. The Mn/DOT's Geodetic Unit also publishes its data through the Internet.

- Mn/DOT's Geodetic Unit has completed the densification of the High Accuracy Reference Network (HARN) system to a 25-kilometer grid. The Geodetic Unit is working with Minnesota counties to place permanent physical monuments at three-mile intervals. These densification projects are helping to develop a statewide geodetic control network with centimeter accuracy. This accuracy provides better geodetic control for right-of-way acquisition, construction, maintenance, and GIS data collection.
- Global Positioning System (GPS) technology and the completion of the Continuously Operation Reference Stations (CORS) has given the Minnesota surveying and mapping communities the ability to develop georeferenced databases with a one-to-three-meter accuracy. Higher accuracies are still needed in many areas of surveying and mapping.
- Mn/DOT has completed testing a Virtual Reference System (VRS) in the Twin Cities. This wireless communication system allows GPS users with differential signal collection capabilities to gather real-time location information. A proposed statewide network of 125 permanent continuously operating GPS base stations, broadcasting and storing centimeter accuracy GPS signal correction messages, along with the positioning technology of the GPS, will provide the ability to obtain precise horizontal and vertical measurements in real-time.

PLAN STATUS
The MSDI Data Plan for geodetic control (version 1.1) was completed in May 2003 and reformatted in August 2003. A revised plan will be completed by the summer of 2005.

COSTS AND FINANCING
The current state geodetic control network is supported in Mn/DOT's operating budget. Costs to complete densification, expand the GPS referencing system, facilitate data entry, and expand local participation have not been determined.

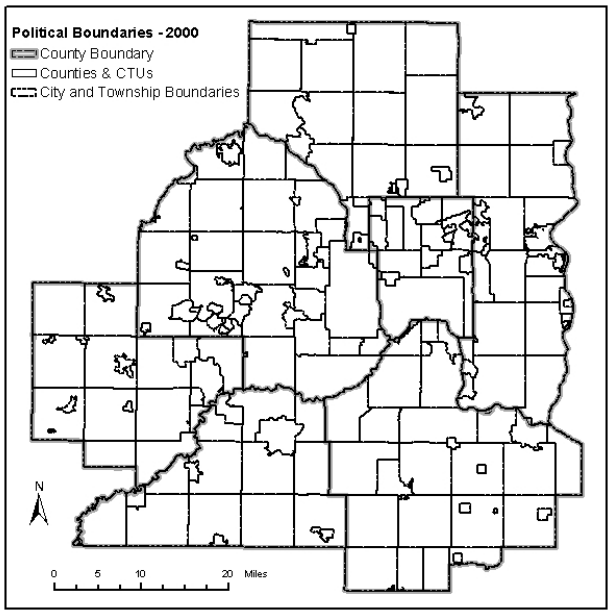
KEY ISSUES

- Formalize Mn/DOT's role as data steward. An expanded statewide geodetic control network would be built by the state of Minnesota and made accessible to all users.
- Improve tools to allow counties and other land holding entities to add their data to the statewide geodetic control database.
- More local participation is needed to densify the geodetic control system.
- Funding and other incentives are needed to encourage state and local units of government to publish their data to the statewide control survey framework.

MORE INFORMATION
See www.gis.state.mn.us/MSDI for more information about the MSDI and the Geodetic Control data plan.

MSDI DATA THEME OVERVIEW: GOVERNMENT BOUNDARIES

DESCRIPTION



The MSDI Data Plan for Government Boundaries pertains to the jurisdictional boundaries of Minnesota and the counties, cities, townships, school districts, watershed districts, and tribal governments within it. Boundaries for the state and its counties are well established and do not change, but boundaries for cities, townships, and school districts change routinely.

The plan will document the methods by which government boundaries are recorded as digital data, managed, and maintained; recommend actions and investments needed to ensure maintenance of accurate and current boundary data; and recommend strategies to ensure that like-boundary data, produced by multiple entities, can be easily assembled to minimize duplication of effort and coordinate like processes.

DATA USES

Boundary data support a variety of government functions, locally and statewide, and serve as visual reference elements for most maps. The state relies upon boundaries for purposes that include state aid calculations and voter registration support. Accurate boundaries are important for all jurisdictions with taxing authority or are concerned about legal authorities, rights, responsibilities and liabilities.

DATA STATUS

Many organizations maintain versions of boundary data to meet their operational needs, although in most cases no official version has been designated or endorsed. As a result, few authoritative statewide boundary maps exist. Statuses for widely used boundary data are described below.

Municipal Boundaries. The Department of Transportation maintains statewide boundary data to support its highway state aid program. The data are widely used, but generally need processing to serve other purposes. Scale is sometimes an issue as the statewide data are produced for medium-scale mapping. Counties also maintain municipal boundary data to support their taxation responsibilities. The results sometimes meet larger-scale needs, but the absence of standards makes aggregating these sources across county lines difficult. MetroGIS is assembling county data to create a regional solution to large-scale mapping needs within the Twin Cities Metropolitan area. Participating counties have agreed to minimum data standards and custodial responsibilities to support this regional dataset.

School Districts. Working with the Department of Education, the Land Management Information Center is compiling a new statewide data set, updated through local school district

reviews. The results are suitable for medium-scale mapping. Some counties also produce school district boundary data that are useful for larger scale mapping needs. However, the absence of standards hampers regional and statewide aggregation of these sources. Washington County prototyped a proposed standard for Twin Cities metropolitan counties in 2000.

Watershed Districts and Watershed Management Organizations. These watershed management entities are organized under the auspices of the Minnesota Board of Water and Soils Resources, which maintains statewide data suitable for small-scale mapping. Some districts and counties also maintain watershed jurisdictional boundaries for larger-scale mapping needs. The absence of data standards hampers aggregation from these sources for regional and statewide applications. Washington County is coordinating a study to propose data content standards and custodial responsibilities for the Twin Cities metropolitan area.

STATUS OF PLAN

An MSDI data plan for Government Unit Boundaries is in its early stages of development. The plan will be completed by the summer of 2005.

COSTS AND FINANCING

Costs for producing and maintaining boundary data currently are borne by organizations that need the data for their own needs. Sharing costs for maintaining common data that support operational needs of many organizations is recognized as prudent and cost effective, but estimates of these costs have not been made. Most boundary data available statewide are designed for small-scale or medium-scale applications and have been maintained independently of local efforts. Ideally, leveraging these efforts to develop and maintain boundary data for the entire state will improve the quality of available data and reduce total costs for data production. A statewide survey is needed to help identify existing data development activities and opportunities for collaboration.

KEY ISSUES

- Data specifications that support common business needs, including formats and scales, need to be clarified and documented to facilitate aggregation of like-boundary data and alignment with other boundary data.
- Processes for developing and maintaining data, especially those that change frequently, need to be assessed and possibly reengineered to improve the product and reduce costs.
- In most cases, explicit responsibility needs to be defined and accepted by primary data stewards and area aggregators, supported through formal agreements, if necessary.

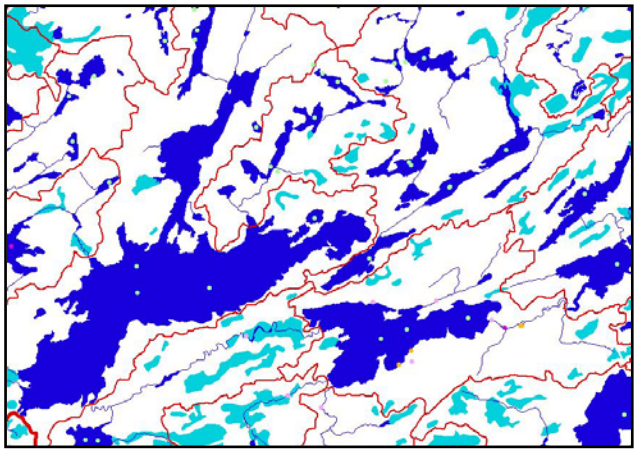
MORE INFORMATION

See www.gis.state.mn.us/MSDI for more information about the MSDI and the Government Boundaries data plan.

MSDI DATA THEME OVERVIEW: HYDROGRAPHY

DESCRIPTION

MSDI framework hydrography data includes surface water features – lakes, rivers, wetlands, and watersheds, structured to reference data related to those features. Referenced data include stream flow measured at gage locations; trout stream designations; point discharger locations; or water quality, water levels, or zoning as lake descriptors.



Surface water features described in this plan need the following characteristics:

- Good spatial representation
- Stable and consistent identification codes tied to established state and federal standards
- Vertical integration among river, lake, wetland, and watershed features if maintained as separate GIS layers
- For rivers, the ability to identify a location for a stream-related characteristic, feature or activity through an 'addressing' scheme
- For rivers, connectivity through lakes, wetlands, and two-dimensional river features

Changes in hydrology and data capture improvements necessitate periodic updates to these data. The current hydrography data plan focuses on "framework" data. Geology, hydrogeology, aquifers, wells, ground water extent or quality data will be addressed at a later time.

DATA USES

- Maps of rivers, lakes, wetlands, and watersheds at various scales as reference layers
- Maps of water characteristics, such as impaired waters maps or trout stream maps
- Analysis of relationships among water-related features, such as discharges into rivers in relation to surface water intakes
- Analysis of upstream/downstream relationships among river features, characteristics, or activities, especially useful for assessing impacts of hazardous spills or discharges on downstream water users
- Engineering applications, such as hydraulic analysis for bridge and road construction and inputs to engineering models

DATA STATUS

Through coordination and significant collaborative investments by many agencies, Minnesota has developed several statewide hydrography datasets consistent with federal standards.

- **DNR 24K Streams and Lakes**. This statewide dataset represents basic lines for river and lake features. DNR derived rivers from the Mn/DOT base map data and lakes from the National Wetland Inventory. Development is completed.
- **National Hydrography Dataset, High-Resolution.** With production spearheaded by the MPCA, the High-Resolution National Hydrography Dataset (NHD) is 95 percent completed for the state. Using the DNR 1:24,000 streams and lakes as input and software provided by federal agencies, the NHD offers consistency with national standards.
- **Wetlands.** The National Wetlands Inventory for Minnesota was completed in the early 1990s. The data update issue is being studied by the Comprehensive Wetland Assessment, Monitoring and Mapping Strategy Project and the U.S. Fish and Wildlife Service.
- **Watersheds.** The last statewide watershed layer was completed by the DNR in 1999. The DNR has completed 30 percent of a project to improve delineation of watersheds and add delineations for all lakes greater than 100 acres. Additional work is needed to bring the DNR's watershed data into full compliance with the federal Watershed Boundary Dataset .
- **Hydrographic Events.** The statewide 1:24,000 NHD layer provides the consistent, networked data that supports mapping of hydrographic events. An MPCA project to reference key data about rivers and lakes to the NHD will begin in fall 2004.

PLAN STATUS

A draft MSDI Data Plan for hydrography was prepared in March 2003 and revised in February 2004. The plan will be completed by the summer of 2005.

COSTS AND FINANCING

Data development has been dependent largely on short-term grants. There is no long-term funding plan for data completion and update for all hydrography layers.

KEY ISSUES

- **Scale.** Statewide databases are produced at a 1:24,000 scale. Larger scale sources are needed for some state and local government applications, engineering applications, and some legal designations. Some uses that cross state boundaries require smaller scales.
- **Roles and responsibilities.** With a few exceptions, roles and responsibilities have not been defined for updating key hydrography data layers or for maintaining vertical integrity among the various data sets.
- **Long-term funding.** Long-term funding sources for completing and maintaining these databases have not been identified or secured.
- **Data standards.** The Hydrography Committee has established standards for naming and feature identification of lakes, rivers, and watersheds, and will complete a hydrographic event standard next year.

MORE INFORMATION

See www.gis.state.mn.us/MSDI for more information about the MSDI and the Hydrography data plan.

MSDI DATA THEME OVERVIEW: IMAGERY

DESCRIPTION

Imagery, especially digital photographs derived from planes or satellites and registered to real-world coordinates, is fundamental to the effective use of GIS. All aerial images are valuable, but images that have been adjusted by removing distortions resulting from terrain relief and camera or sensor orientation are especially valuable. These orthophotographs have the geometric characteristics of maps and the image quality of photographs. The MSDI plan for imagery concerns all forms of photographic sources, but primarily focuses upon orthoimagery.

Up-to-date orthoimagery can support many GIS-supported business functions within Minnesota, but orthoimages with complementary specifications are required to meet all needs. Scale, resolution, color, and time of year are especially important considerations for some applications. Orthoimagery also serves as a basis for developing other geospatial data, including data related to transportation, hydrography, critical infrastructure, and land use/land cover. New imagery must be acquired periodically, especially where development, construction, natural processes, and other factors change the physical landscape.

DATA USES

Representative applications of orthoimagery and the specifications they require are:

Engineering. These applications require the greatest detail and accuracy. Detailed imagery is especially useful along highway and infrastructure construction corridors. Typical specifications: 6-inch to 1-foot resolution, black and white images, leaf-off conditions.

Local and strategic planning. These applications require moderate detail and resolution. Examples include emergency planning, crime analysis, site planning, and comprehensive plan preparation. Typical specifications: 1-foot to 1-meter resolution, black and white or color images, leaf-on or leaf-off conditions.

Natural resource and land use interpretation and management. These uses generally require less detail and spatial accuracy. Examples include change detection, wetland management, lakeshore protection, and timber harvest management. Typical specifications: 1-meter to 30-meter resolution, natural color, color infrared, or multispectral images, leaf-on conditions.

Broad-stroke or generalized characterization of landscape. These uses generally depend upon identifying the relative location of a feature at an economical cost. Use with detailed vector data is not common. Examples include natural hazard and pollution monitoring, mineral exploration, natural reserve management, and land cover mapping. Typical specifications: 1-meter to 30-meter natural color, leaf-on conditions.

DATA STATUS

Statewide orthophotography for Minnesota has been acquired only twice, during the 1989-1992 period and in 2003. The first-generation products, contracted through the U.S. Geological Survey and costing about $5 million, were black and white images and flown under leaf-off conditions, which is especially useful for revealing infrastructure. The 2003 images, contracted through the U.S. Department of Agriculture Farm Services Agency, were produced in color, which is especially useful for agricultural and natural resources applications. The total cost for the second-generation images was under $1 million. All data are available through the Minnesota Geographic Data Clearinghouse as well as other sources.

Higher resolution imagery is produced on a periodic basis for specific purposes, especially by local units of government. For example, Minneapolis has an active program to acquire 6-inch resolution color imagery for the Minneapolis area every 3 years. The Metropolitan Council acquires 2-foot imagery on a three to five year cycle. Some sharing of available imagery occurs through word of mouth and organizations such as MetroGIS, LMIC and DNR. Limited coordination of planned imagery projects occurs primarily through informal communication networks.

PLAN STATUS

A draft MSDI data plan for imagery was prepared in May 2003 and updated in September, 2003. The plan will be completed by the summer of 2005.

COSTS AND FINANCING

Costs for imagery acquisition vary, depending on product criteria. Recently acquired six-inch resolution color orthoimagery for urbanized areas such as Scott County and the City of Minneapolis cost $700 to $1,000/square mile. Recently produced one-meter color imagery for the entire state cost about $11/square mile. Satellite imagery is becoming competitive for some applications and is available from commercial sources costs at about $11/square mile for 2.5-meter black and white images. Some agencies that use imagery depend upon a periodic budget for image acquisition.

KEY ISSUES

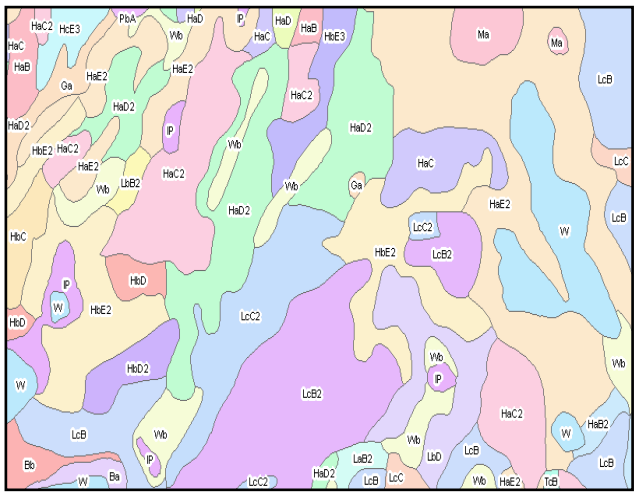
- To remain up-to-date and useful, orthoimagery must be periodically replaced.
- Statewide orthophotography meets many needs, but future success depends upon strong coordination among state agencies and other units of government and their ability to contribute towards total project costs.
- A mechanism is needed to publicize available imagery and planned imagery projects to facilitate cost sharing and expand data availability.
- Conflicting specifications for orthoimagery limit their shared use. Standardizing a "menu" of specifications for resolution, spatial accuracy, color, flight height, and time of year can create opportunities for cost sharing.

MORE INFORMATION

See www.gis.state.mn.us/MSDI for more about the MSDI and the imagery data plan.

MSDI DATA THEME OVERVIEW: SOILS

DESCRIPTION



Minnesota soils have been mapped at scales and complexities ranging from page-size state maps with general soil features to detailed site plots. Minnesota is part of the National Cooperative Soil Survey, which creates detailed soil maps at the county level. The county soil survey program was established in 1899 within the U.S. Department of Agriculture to help farmers determine the crops and management practices most suitable for the soils on their farm. As scientists learned more about soils, they investigated soil characteristics for other land uses. Modern soil surveys can be used for such diverse activities as highway construction, farm planning, tax assessment, forest management and ecological research. Soils GIS data sets include delineations identifying soils with similar characteristics and tables describing various attributes of each delineated soil type.

DATA USES

- **Site-level management and engineering.** Detailed applications such as precision agriculture or the siting of septic tanks require on-site investigation by a professional soil scientist to augment the county soil survey (if available). Scale: up to 1:5,000
- **Local planning.** In addition to agricultural uses, county soil surveys usually provide sufficient detail to support comprehensive planning for residential and commercial development, transportation, recreation, open space and natural areas. Scale: 1:20,000
- **Generalized characterization of the landscape.** Statewide data sets, with generalized resolution or attributes, often provide sufficient information to support broader management and ecological research projects. Scale: 1:250,000 – 1:1,000,000.

DATA STATUS

County-level data. The National Cooperative Soil Survey (NCSS) provides the source material for Minnesota's county digital soils data. To meet today's uses, the surveys must have attributes based on a modern classification and be referenced to an orthophoto base. Surveys for 49 Minnesota counties meet this standard, 35 do not, and three have no survey at all. The Natural Resources Conservation Service (NRCS) and the University of Minnesota (U of M) are working to upgrade many of the outdated surveys to produce the Soils Survey Geographic dataset, known as SSURGO, the highest quality digital soils data available. Half of Minnesota's counties are completed; 29 more are planned or in progress. Soils data produced by the University of Minnesota for the Soil Survey Information System (SSIS) and by the Metropolitan Council for the Twin Cities metropolitan area will be superseded as SSURGO is completed. SSIS is

available for 18 counties outside the Twin Cities; the metropolitan area data cover five Twin Cities counties. SSURGO is a medium-scale dataset at 1:20,000 or 1:15,840.

Statewide data. Several sources of digital data are complete for the entire state, although they are best suited for very small-scale applications and not for applications such as precision agriculture, for example.

- **STATSGO.** Produced by the Natural Resources Conservation Service, STATSGO shows a more generalized soil association level that used for the county surveys. Scale: 1:250,000.
- **Minnesota Soil Atlas.** Produced by the University of Minnesota, the Atlas characterizes soils by combining soil landscape units and geomorphic regions. Scale: 1:250,000.
- **Soils and Land Surfaces of Minnesota – Cummins & Grigal.** This University of Minnesota data classifies soils using major factors influencing soil formation. Scale: 1:1,000,000.

PLAN STATUS

An MSDI Data Plan for soils is being developed and will be completed by the summer of 2005.

COSTS AND FINANCING

The Natural Resources Conservation Service (NRCS) has contributed the major share of funding to create Minnesota's county-level soils data; augmented by several million dollars from the state. In most cases, counties have had to contribute cost-share funds. For FY05, the Legislative Commission on Minnesota Resources (LCMR) is recommending that Minnesota contribute $300,000 to update Crow Wing County's soil survey and to create a survey for Pine County. LCMR is also recommending $200,000 for the Board of Water and Soils Resources for continuation of the *Internet Delivery of Digital Soils Data* project.

KEY ISSUES

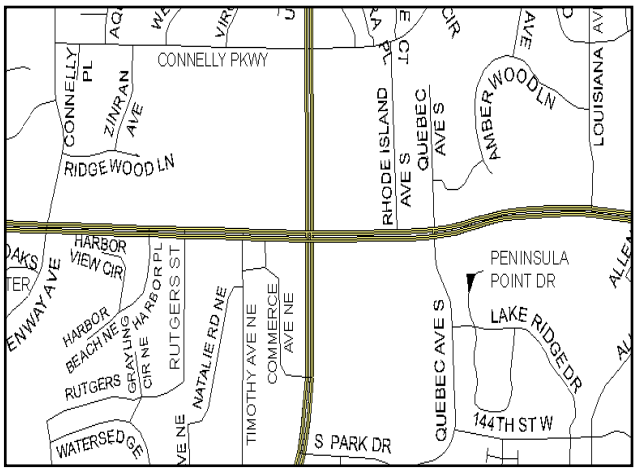
- Update county soil surveys and create additional SSURGO data sets to reach the goal of statewide coverage.
- Soils data is complex to use because of its data structure. To address this issue, the NRCS has created Soil Data Viewer software. This software needs to be expanded to support more GIS software options.
- Make data more understandable and accessible to the non-GIS user and to people who are not soils experts.

MORE INFORMATION

See www.gis.state.mn.us/MSDI for more information about the MSDI and the Soils data plan. Also, see www.lmic.state.mn.us/chouse/soil.html for current information about soils data availability.

MSDI DATA THEME OVERVIEW: TRANSPORTATION

DESCRIPTION



Transportation framework data includes six components: roads, trails, railroads, waterways, airports/ports, and bridges/tunnels. Of these, roads are the most widely used to support GIS and have the highest priority. As critical transportation infrastructure, often roads serve as a base layer or as the primary reference for other map features. Depending upon scale, a variety of road types may be displayed, from interstates to city streets. Road data are challenging to maintain, especially in rapidly growing areas, and public and private organizations may both be involved in monitoring changes. Data producers strive to maintain positionally accurate centerlines and attributes, especially road names and address ranges, but completeness of the data often is inversely proportional to the rate of growth in a given area.

DATA USES

Tied inextricably to the economy and land use, transportation information is critical to private and public enterprise. Typical uses include: enhanced-911 dispatch and routing, school bus routing, commercial routing and delivery, pavement inventory and planning, land records integration, bikeways mapping, infrastructure planning and management, transit planning and routing, and network analysis.

Many transit and transportation departments use geographic street databases as the foundation for data collection, data integration, and analysis within GIS applications. Road characteristics, such as speed limit, pavement type, and activities, such bus and snowplow routes, can be linked to features directly or through a linear referencing system. Accurate address ranges enable automated geocoding of activities and events. For many organizations, the primary use of road datasets is as a reference layer for maps.

DATA STATUS

Several organizations in Minnesota maintain road datasets for a variety of business needs. Nationwide databases are available from the Census Bureau and USGS, but are of limited use due to their coarse resolution. User needs are more likely to be met by other databases:

Mn/DOT "Basemap" Data. This dataset is updated continuously by Mn/DOT's Geographic Information and Mapping Unit, using information obtained internally and from local government units. Basemap data are available to external users, many of whom agree that it is the "best available" source for statewide transportation base data, particularly in rural areas. Road information is distributed as county shapefiles, with built-in linear referencing capabilities. For more information see: www.dot.state.mn.us/tda/basemap/metadata/Roads.htm. Mn/DOT is also developing a Location Data Manager (LDM) to serve as a standard road-referencing system, which will foster data integration and sharing.

The Lawrence Group (TLG) Street Centerline and Address Ranges. This proprietary dataset covers 23 counties in two states, including the Twin Cities metropolitan area. Endorsed by MetroGIS for address matching, it is issued quarterly with updated centerlines and attributes. Mn/DOT and the Metropolitan Council have funded a licensing agreement making this dataset available to all state and local government agencies and colleges and universities in the state.

Local large-scale Data Sources. County engineers and municipal officials in many areas compile high-accuracy, large-scale data, often to support parcel mapping or infrastructure management. Frequently developed in automated drafting systems, these data can be imported into GIS applications and integrated with geospatial data. They will continue to be created and maintained for locally specific large-scale applications, and they are an important potential source of updates in any transportation data sharing efforts.

Pre-Assembled Data. Some rural areas support GIS applications with vendor-specific packages of street networks, which are often spatially imprecise and incomplete. They remedy this with custom improvements generated from local knowledge; this is another potential source of updates in any transportation data sharing efforts.

PLAN STATUS

Work on the MSDI Data Plan for roads will be completed by the summer of 2005.

COSTS AND FINANCING

No solid information on costs and financing is currently available. Mn/DOT's LDM project will likely meet the needs of many, but not all users. Integrating TLG data and local datasets with the LDM may pose a significant increase in maintenance costs for those data producers. MetroGIS is working to estimate these cost for the Twin Cities area.

KEY ISSUES

- Road layers must be continually updated to remain useful. Data producers maintain these updates to meet their internal business needs, which do not always translate directly to the needs of the greater community of users.
- Data development and maintenance responsibilities are spread across disparate organizations with strikingly different accuracy and content standards. A collaborative strategy needs to be defined and implemented in order to aggregate data critical to the MSDI Roads Element.
- While Mn/DOT is attempting to establish a "common denominator" for referencing, integrating, and sharing road data, common definitions and best practices must be established by producers and users in order to maximize the effectiveness of this system.
- Significant investments have been made in the TLG dataset and similar public-private ventures, but licensing restrictions may inhibit complete integration with other datasets.

MORE INFORMATION

See www.gis.state.mn.us/MSDI for more information about the MSDI and the Roads data plan.