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Environmental Spatial Information for Transportation

A Peer Exchange on Partnerships

SUMMARY OF A WORKSHOP

Woods Hole, Massachusetts
June 23–24, 2003

TRANSPORTATION RESEARCH BOARD
OF THE NATIONAL ACADEMIES

TRANSPORTATION RESEARCH BOARD
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David R. Fletcher, *Rapporteur*

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Committee for Environmental Geospatial Information for Transportation: A Peer Exchange on Partnerships

Sponsored by
Office of National Environmental Policy Act Facilitation,
Federal Highway Administration

Transportation Research Board
Washington, D.C.
2004

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This report has been reviewed by a group other than the authors according to the procedures approved by a Report Review Committee consisting of members of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine.

The views expressed in the presentations contained in this report are those of the authors and do not necessarily reflect the views of the committee, the Transportation Research Board, the National Research Council, or the sponsor of the conference.

The conference was sponsored by the Office of National Environmental Policy Act Facilitation of the Federal Highway Administration, U.S. Department of Transportation.

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Preface

On June 23–24, 2003, the Transportation Research Board (TRB) held a workshop titled "Environmental Spatial Information for Transportation: A Peer Exchange on Partnerships." The event, sponsored by the Office of National Environmental Policy Act Facilitation of the Federal Highway Administration, was intended to share information and document lessons learned by early adopters of innovative environmental data-sharing practices. Participants came from a range of organizations, including state departments of transportation, metropolitan planning organizations, nonprofit organizations, and natural resources and regulatory agencies.

To plan this peer exchange, TRB assembled a committee, appointed by the National Research Council (NRC), to organize and develop the workshop program. The planning committee was chaired by Ellen Oman, Washington State Department of Transportation. The summary of what occurred at the workshop was prepared by the rapporteur, David R. Fletcher, Geographic Paradigm Computing, Inc., with assistance from Thomas Palmerlee of the TRB staff. A more detailed introduction to the objectives of the peer exchange and the contents of this report are included in the Introduction.

This report has been reviewed in draft form by individuals chosen for their diverse perspectives and technical expertise, in accordance with procedures approved by the NRC Report Review Committee. The purpose of this independent review is to provide candid and critical comments that will assist the institution in making its published report as sound as possible and to ensure that the report meets institutional standards for objectivity, evidence, and responsiveness to the study charge. The review comments and draft manuscript remain confidential to protect the integrity of the deliberative process. TRB thanks the following individuals for their review of this report: Steven Carter-Lovejoy, Virginia Division of Natural Heritage; John F. Conrad, Washington State Department of Transportation; and Anita Vandervalk, Cambridge Systematics, Inc., Tallahassee, Florida.

Although the reviewers listed above provided many constructive comments and suggestions, they did not see the final draft of the report before its release. The review of this report was overseen by Lester A. Hoel, University of Virginia. Appointed by NRC, he was responsible for making certain that an independent examination of this report was carried out in accordance with institutional procedures and that all review comments were carefully considered.

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Introduction

David R. Fletcher, *Geographic Paradigm Computing, Inc.*

Transportation organizations are seeking better methods to deliver highway improvement projects that preserve and enhance communities and protect the natural environment. Emerging best practices encourage innovative design and mitigation strategies that address ecosystem and habitat conservation needs and at the same time expedite environmental review and clearance processes. One approach offering promise is partnering with natural resource agencies and nongovernmental organizations (NGOs) to develop more general-purpose data resources that can be applied to multiple transportation projects as well as to other uses. Current spatial information technologies such as geographic information systems (GIS) enable national, regional, statewide, and project-specific databases. In addition to GIS, spatial information technologies include satellite navigation systems, aerial photography, and remote sensing, along with the computer and communications technologies that permit wide-scale use of spatial data. A basic premise of the peer exchange was that these rapidly evolving technologies are opening the door to new ways of developing and sharing data. Building multiorganizational partnerships to develop and share these databases is an attractive strategy to ensure that relevant environmental information is available as needed in the transportation project development process.

The Federal Highway Administration (FHWA) Office of National Environmental Policy Act Facilitation sponsored a peer exchange workshop to document lessons learned by early adopters of innovative environmental data-sharing practices. The Transportation Research Board (TRB) organized the workshop. TRB is a unit of the National Research Council, a private, nonprofit institution that is the principal operating agency of the National Academy of Sciences and the National Academy of Engineering. TRB's mission is to promote innovation and progress in transportation by stimulating and conducting research, facilitating the dissemination of information, and encouraging the implementation of research results.

At this event, teams of practitioners from four states—Washington, Virginia, Texas, and Florida—representing transportation organizations, environmental regulators, and NGOs shared their experiences in partnering to develop environmental databases that meet the needs of multiple organizations and permit improved transportation decisions. Their presentations highlighted successful partnering strategies and issues, including

- Balancing differing stakeholder goals,
- Sharing resources by many organizations,
- Using information technology (IT) for sharing environmental information, and
- Eliminating barriers to further data-sharing activities.

An additional perspective on the role and potential contribution of environmentally focused NGOs was provided by NatureServe, the informatics arm of the Nature Conservancy.

IMPETUS FOR THE MEETING

This workshop was motivated by many factors, including but not limited to the following:

- Increasing congressional demand on the U.S. Department of Transportation (USDOT) and federal environmental agencies to improve internal operations,
- The need to improve and shorten the entire transportation project environmental review and permitting process,
- FHWA's performance goals for environmental stewardship and streamlining processes, and
- The necessity for all levels of government to reengineer outdated business processes by incorporating better information management practices.

Although TRB has a large number of technical committees concerned with the environment, transportation data, and IT issues, no single committee focuses specifically on environmental data. This important topic includes the use of modern spatial data technologies to develop environmental databases in advance of project-specific uses. Since the topic encompasses many complex aspects, the workshop's organizing committee decided to emphasize spatial data partnerships between state departments of transportation and the environmental stewardship community in this peer exchange.

The overarching objective of the peer exchange was to identify and document best-in-business practices for other states facing the same pressures. This report presents a summary of the information provided by the participants. The information may allow others to more confidently pursue partnership strategies with less institutional and technical risk. As the phrase suggests, a peer exchange focuses on the sharing of the experiences of the participants.

MEETING OBJECTIVES

The Partnership Peer Exchange Committee set two objectives for the meeting:

1. Share experiences in partnering to develop environmental databases that meet the needs of multiple organizations and enable better, faster, and more cost-effective transportation decisions.
2. Highlight successful partnering strategies to balance goals, share resources, deal with opportunities and barriers affecting further improvements, and develop IT infrastructures that facilitate the sharing of environmental information.

ORGANIZATION OF THE REPORT

This peer exchange was convened under National Research Council procedures that limit the activity to sharing experiences and documenting that process. The Partnership Peer Exchange Committee served as the planning group for this activity. I served as the workshop rapporteur and, with the assistance of Thomas Palmerlee of the TRB staff, have prepared this report containing a factual summary of what occurred at the workshop. The report itself has three parts. "Meeting Summary and Key Themes" summarizes the themes that came out of the state team presentations and discussions. "Next Steps" is the short list of follow-on activities that could be pursued. "State Reports" contains the responses to 25 questions the committee believed would help summarize important dimensions of data sharing. Each question is cross-referenced to other state reports to facilitate comparisons. The appendices include the text of report questions, as well as questions to facilitate development of perspectives of the four groups participating. The groups were transportation professionals, resource agencies and regulators, NGOs, and information technology managers.

Meeting Summary and Key Themes

David R. Fletcher, *Geographic Paradigm Computing, Inc.*

INTRODUCTORY SESSION

All of the participants introduced themselves and highlighted individual concerns in the environmental information coordination arena. (A complete list of the participants is provided at the end of this document.)

Several themes that shaped the subsequent direction of the exchange emerged from this discussion:

1. How do you get the right data to the right people at the right time at the lowest cost? More to the point, how can better information be incorporated into improved project decision making?
2. How can you improve data quality (i.e., accuracy, timeliness, coverage) with limited resources?
3. How can you bridge the wide cultural differences between transportation and environmental specialists?
4. How do you institutionalize collaborative data relationships among groups who have historically not trusted or cooperated with each other?
5. How do you redefine data stewardship roles and responsibilities?

SUMMARY OF STATE TEAM PRESENTATIONS

Each of the four state teams presented detailed case studies of specific examples of innovative data partnerships. Even though each team's experience was unique, the descriptions of the data partnerships highlighted many similar characteristics.

Not surprisingly, their stories concerned several interrelated innovations including but not limited to cooperative data creation and sharing. It appeared that data partnerships do not exist in a vacuum but emerge out of the confluence of four dimensions of influence: policy, economic, technical, and cultural. Innovations in each of these areas provide the necessary critical mass enabling new data partnerships. Although it was not explicitly discussed by the participants, the overall impression was that their data partnerships might not have occurred in the absence of these related influences. Elements of each of these four areas are listed below.

Policy Innovations

1. High-priority business driver affecting the transportation agency's core mission or service requiring improved environmental data. This driver may be an executive or legislative mandate or regulatory requirement resulting in or affecting a significant state department of transportation (DOT) initiative or project.
2. Formal memoranda of understanding (MOUs) outlining roles, responsibilities, rights, and expectations for interorganizational policies, business processes, and data relationships.
3. Redesigned DOT planning or project development processes.

Economic Innovations

1. Willingness of DOTs to underwrite the cost of developing environmental data acquisition and upkeep.
2. Data programs perceived as public investments as opposed to agency overhead costs.

Technical Innovations

1. DOT and partner organization access to, and experience with, many technologies, including GIS, databases, and the Internet.
2. Well-understood metadata management processes.
3. Emerging national and state-level data standards.
4. Data packaged with applications, user-oriented tools, and technical support.
5. Easily accessible spatial data clearinghouses, repositories, warehouses, or libraries.

Cultural Innovations

1. Executive-level sponsorship, leadership, and commitment to ensure legitimacy and accountability.
2. Supportive and active professional and technical organizations such as the Urban and Regional Information Systems Association or extragovernmental arenas such as state geographic information councils for multidisciplinary practitioners to develop social capital and interpersonal trust.
3. One or more dynamic, trusted, and visible champions able to articulate clear visions, generate sustained enthusiasm, and enlist the cooperation and support of others.

In summary, the successful data-sharing partnerships presented were innovative strategies used by multiorganizational, multidisciplinary teams having common goals

and objectives, using integrated processes and interoperable data and technology, and pooling scarce resources. Although each team took advantage of different specific influences and each believed that it had much left to do to achieve its visions, each was effective in improving the data available to multiple agencies for environmental decision making.

An essential point is evident with each team. Meaningful data partnerships cannot be successful or sustained without the reinforcing influence of other, equally innovative business practices. DOTs wishing to derive benefits from environmental data sharing can benefit by candidly assessing the status of these related practices before proceeding.

PRACTICES THAT WORK

Assuming that the necessary preconditions for data partnerships exist, many different models are available for effective data partnerships and data sharing. The following points were highlighted by participants concerning what has worked for them.

1. Differing cultures within organizations create professional, social, and personal barriers impeding communication and subsequent data sharing. Conflicts between the GIS and surveying and mapping professions, between the scientific and engineering communities, and between the DOTs and the environmental resource agencies clearly exist and are characterized by a lack of understanding, respect, and trust of each other. Each affected group (engineers, scientists, technologists, elected officials) may be perceived as "encroaching" on the role, expertise, authority, or responsibility of the others. This can create resentment, defensiveness, and confusion.

As DOTs seek to address these issues proactively, the following are among the lessons learned:

- Communicate early and often with all affected stakeholders.
- Understand the needs of all potential partners before committing shared resources.
- Find ways to improve communication and trust at all levels—interpersonal, programmatic, and institutional.
- Accept that progress will be incremental—real breakthroughs are rare and require sustained effort by all partners.
- Identify and share even small successes with the larger community of interest.
- Be patient—genuine partnerships take time to reach acceptable agreements.
- Approach others instead of waiting for them to come to you.

2. Start small and build to something great. Each of the state teams recognized the importance of building momentum and credibility with many small successes as opposed to risking everything on a grand, revolutionary initiative. The following are among incremental strategies that have worked:

- Continue to invest in in-house staff, technology, and data. Be prepared to recognize and seize the moment.

– Recognize a champion to get the ball rolling in each potential partner agency. Respect that person's knowledge and progress and draw on his or her experiences from other related initiatives. Champions exhibit the universal characteristics of imagination, patience, persistence, courage, and vision.

– Build a small group of "true believers."

– Draw up short-term plan and resource requests. Deliver and document these successes.

– Approach funding agencies as a team.

– One size does not fit all. Accept the major organizational differences in placement and importance of environmental units; states have widely differing environmental workloads.

– Build on existing data-sharing resources (e.g., statewide geographic information councils). If they don't exist, establish them.

3. Remember that the ultimate goal is to improve the predictability and reliability of the transportation improvement process. Stay focused on the business mission:

– Have well-established goals and objectives.

– Obtain commitments to objectives at the executive level.

– Make sure you're solving real problems (data sharing is a potential solution and not the problem).

– Solve actual business problems.

COMMON PITFALLS

Just as there are many common strategies for what works, several common pitfalls are associated with environmental data partnerships.

1. Using interoperable GIS technology is an excellent data integration strategy and can help to facilitate data sharing by many organizations. However, a common pitfall is to expect technology to solve policy, business process, or cultural issues. Technology alone cannot solve interorganizational communication problems, and its introduction will often highlight underlying issues. For example, as of the present time, no clear public policy to address appropriate collaborative roles between regulator agencies and DOTs exists. Some participants and observers believe that data partnerships erode a "healthy" adversarial relationship between the two. Thus, having a regulated agency fund the development of regulator data could jeopardize the independence of the regulator. In addition, resource agencies are often in conflict with each other and with their stakeholders. Technology cannot resolve these underlying conflicts. Neither can data sharing.

2. Related to this is the unconscious assumption that data represent the entire factual basis necessary for project decision making. The political and public involvement process may reveal significant issues not reflected in the data. Some participants may interpret the data differently and use their analyses to recommend other approaches. Improving data access may also inadvertently increase the opportunities for data misunderstanding and misuse.

3. Data standards are like opinions—everybody has one. Although the teams highlighted the need for collaboratively developed, local data standards, they also recognized the need to address federal requirements as well as agency-specific legacy standards. In addition, various federal data standards may conflict with each other and with local standards. Many participants felt that his situation is exacerbated by the lack of coherent federal leadership from the Federal Geographic Data Committee, the U.S. Geological Survey (USGS), USDOT, the U.S. Environmental Protection Agency (EPA), and other agencies.

4. Because successful data partnership case studies are not well documented or distributed, many DOTs unfortunately have to "reinvent the wheel." Others may incorrectly believe that the concepts of data partnerships are too radical and untested to be pursued because they lack awareness of the state of the practice. Seeing successful innovator and early adopter approaches is critical to establishing widespread adoption of data partnerships.

5. Funding concerns of all types represent potential pitfalls to data sharing. Agencies have widely differing funding levels and priorities. Although environmental clearance funding is of paramount importance to DOTs, it may rank fairly low in an environmental agency's priorities.

6. The appropriate role of the environmental consultant community is not well understood by government agencies or NGOs. Consultants, even when working for public agencies, may consider the data resources proprietary and thus oppose the creation and sharing of comprehensive data resources. Better incentives could be developed to enlist consultant cooperation and redefine their deliverables.

CONCLUDING OBSERVATIONS

1. Legitimate differences exist between national, regional, and local environmental interests and perspectives. These differences reveal themselves as independent, generally uncoordinated federal, state, and municipal data programs conducted by many agencies across all levels of government. Many participants recognized that a national, one-size-fits-all approach is unrealistic. In other words, trying to develop a single nationwide environmental data repository that could be used for all environmental decisions by all affected interests is not achievable or desirable.

At the same time, many participants judged the current state of practice to be equally undesirable. Encouraging or supporting hundreds of contradictory, overlapping, inconsistent, and independent data programs spread across dozens of agencies is both inefficient and ineffective. However, the case histories did not provide any insight or guidance as to the "ideal" number or scope of high-quality data programs. Indeed, each data partnership presented is painstakingly forging its own local data visions, objectives, scopes, and activities.

It was noted that more federal leadership in this area would be useful. This leadership could take a number of forms. As an example, MOUs between USDOT and various environmental agencies such as EPA, USGS, and the U.S. Fish and Wildlife

Service could encourage collaborative data programs between state DOTs and regional environmental offices.

2. As a general principle, many participants firmly believed that the more often data are used, the more valuable they become. The nation possesses an enormous wealth of digital and analog environmental data that are not being exploited to the fullest. The combination of GIS and Internet technologies presents a revolutionary potential for realizing much benefit in the short term and provides a major stimulus for data improvement campaigns in the future. New models of data collaboration amply demonstrate this principle.

3. The ultimate reason for and big payoff of data-partnering initiatives is not to merely streamline existing processes but to redesign the national transportation planning, programming, and project development business practice. New tools provide new opportunities. Significant benefits will be gained when data sharing goes beyond the agencies directly involved to NGOs, academia, the private sector, and citizens. Providing access to data to those currently without access can help achieve a more effective, efficient, and equitable transportation improvement process.

4. Finding well-documented implementation case histories, useful advice, and deployment models is difficult. Often, even the participants in successful partnering initiatives are unclear about the root causes of their success. Consequently, the diffusion of data innovation is slowed by the limitations and idiosyncrasies of small group presentations, individual mentoring, and informal conversation. Many participants recognize the dilemma faced by states just beginning to explore these opportunities and note that new methods of packaging, marketing, and disseminating best practices are urgently needed.

Next Steps

David R. Fletcher, *Geographic Paradigm Computing, Inc.*

Although the specific charter of this peer exchange is limited to sharing experiences, the group concluded the workshop by discussing specific follow-on activities that could be pursued by individual participants. Each of these activities would facilitate continued knowledge transfer between the workshop participants and among new, interested groups. Several ideas were noted as possible action items:

1. Publish data-partnering case histories in a variety of outlets, including journals, websites, and specialty trade publications.
2. Include case histories in various environmental workshops and training courses.
3. Support and participate in peer-to-peer mentoring, presentations, site visits (scanning tours), and so forth. Sponsor local and regional meetings, conferences, webcasts, and so forth, to kick off specific interagency partnerships.
4. Develop environmental process primers, white papers, and brochures for DOTs, NGOs, and others. Explain what we do, how we do it, why DOTs need environmental data, and why resource agencies regulate projects.
5. Sponsor a follow-on federal resource agency peer exchange.
6. Develop a manual of best practices and methods for resource agencies.

Washington State

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Jeff Holm, *Washington Department of Information Services*
Jerry L. Harless, *Puget Sound Regional Council*
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GENERAL

1. What is your definition of environmental spatial data?

Environmental spatial data include data that describe the geophysical environment—the wild plants and animals; conditions such as water or air quality; and natural hazards such as flooding, landslides, mud slides, rock slides, earthquake faults, and liquefaction hazards.

Data commonly used to support environmental analysis include transportation systems, cadastral data, political boundaries (counties, cities, etc.), population and other demographic data, aerial imagery, environmental characterizations and conditions, land use, and other human use associations.

In addition, the Washington State Department of Transportation (WSDOT) considers data used to support environmental regulatory processes. This includes information on cultural and historic resources, noise, minority populations, and income.

2. Why does your state feel it is important to share environmental data?

Data sharing provides cost-efficiency in data collection and processing. Current resources are not adequate to cover the need for data management, and data sharing provides an opportunity to optimize the use of limited resources.

In general, data sharing helps organizations "work from the same page" and avoid conflict caused by the use of inconsistent data.

Environmental data are used in all phases of transportation project development:

- In the planning phase, environmental data are used to develop required air quality analysis and transportation corridor plans.
- During programming, environmental data are used to develop cost and schedule estimates.

- Environmental data are used during project development to analyze impacts and complete environmental requirements such as the National Environmental Policy Act (NEPA). Environmental data also provide fundamental information needed for design.
- During construction, environmental data may be used to evaluate contractor performance for consistency with the contract.
- Maintenance programs use environmental data to analyze impacts and comply with environmental regulations. In addition, environmental information can help identify potential maintenance needs (such as flood hazard management).

WSDOT does not collect or manage most environmental data despite its intensive use of such data. Instead, WSDOT imports data from the agencies responsible for managing natural resources.

3. What are the benefits of sharing data? Please include time savings, value-added products and outcomes, and cost–benefit information where possible.

- Promotion of trust. Sharing data helps state agencies use limited resources more efficiently and effectively and promotes the concept of common knowledge, in which data are not questioned with regard to veracity but rather are a point of commonality among diverse applications.
- Cost management. Data sharing can help reduce costs when data are planned to meet the needs of more than one customer. The following are examples:
  - Data collection efforts using aerial imagery enable multiple agencies to save on costs by collaborating on acquisitions.
  - Reduced cost can lead to higher quality through an increased resolution or more frequent update cycle.
- Outcomes that support more than one application. Within an agency, data sharing can result in cost savings and streamlined delivery. For example, project managers frequently request photogrammetric data for projects. These data can also add value for environmental analysis. Unfortunately, project managers often limit data collection to the proposed right-of-way for the construction project. Environmental analysis frequently looks at the watershed well beyond the right-of-way. Aligning these needs could reduce costs and time.
- Avoidance of redundant data collection. Coordination and sharing can reduce duplicative data collection and application development efforts. This results in savings in cost and time.
- Agreement among agencies on data protocols and, therefore, on data products. If data are commonly collected and shared, data quality and intended uses will be better understood, and the ability to evaluate data products more rapidly will be enhanced. This may help improve trust between regulators and the regulated community.

4. How useful are the environmental data layers that have been collected to transportation?

Usefulness varies depending on the data layer. Available environmental data are frequently not of an appropriate scale, scope, or time period to support analysis requested for NEPA, Endangered Species Act (ESA) consultation, and some permits. The scale is also not adequate to support engineering purposes. However, using available GIS data still provides a better foundation for discussion than not using such data.

5. How useful are the transportation data layers that have been collected to the natural resource community?

Data on transportation systems are a fundamental element of many environmental analyses. Currently, several transportation data layers are available. The transportation systems in data layers do not always match when displayed together to show a comprehensive view. The accuracy also varies, which can result in roadway features (such as culverts) being shown off the road system altogether. The Transportation Framework Project described below is working to improve transportation data.

DATA MANAGEMENT PROFILE

6. Who provides environmental spatial data in your state?

- Washington Department of Fish and Wildlife (WDFW)
- Washington State Department of Ecology
- Washington State Department of Natural Resources
- Washington State Department of Health
- WSDOT
- State Office of Archaeology and Historic Preservation
- County governments
- City governments
- Indian tribes
- USGS
- U.S. Fish and Wildlife Service
- U.S. Forest Service
- EPA
- U.S. Census Bureau
- National Oceanic and Atmospheric Administration
- Bureau of Land Management
- Bureau of Indian Affairs
- Private industry
- Environmental organizations

- Regional governments such as the Puget Sound Regional Council
- Bonneville Power Administration
- Local governments
- Tribal governments

7. Who are the primary users of environmental spatial data?

All the organizations listed above as well as nonprofit conservation organizations and neighborhood and watershed citizen advocacy groups are primary users.

8. Who are the primary supporters of statewide environmental data collection? How long have they been active supporters?

GIS has a strong advocacy among users in Washington. The Washington State Department of Natural Resources was the first state agency to use GIS in the 1970s and has remained an active supporter. Other primary advocates include the Washington State Department of Ecology, WDFW, and the Washington State Department of Information Services (DIS). Other agencies use and support GIS projects and coordination, as evidenced by the continued participation in the Washington State Geographic Information Council (WAGIC).

9. What are the user applications of the data?

User applications include the following:

- Managing natural resources, such as setting fishing and hunting limits, establishing species recovery plans, and monitoring species health;
- Developing transportation plans, conducting environmental assessments, and designing transportation projects;
- Developing local government land use plans;
- Monitoring hydrogeological changes and hazards such as floods, water quantity, and water quality; and
- Evaluating environmental impacts for regulatory decisions.

10. How are the data shared?

User agencies import data to their agency standard software and geographic coordinate system.

Within organizations, most have developed a user application in ArcView to improve access to data layers in the context of user needs. WSDOT has developed the Environmental GIS Workbench for this purpose (more information on this topic is given below in the section on digital government).

Limited data are available through online applications. Examples of Internet-based data in Washington are WDFW's SalmonScape and Washington State Department of Ecology's Environmental Information Management System, Public Permit Data System, and Billing and Revenue Tracking System. In addition, environmental data managed by the U.S. government are used to support decisions. An example is EPA's EnvironMap.

11. How are environmental spatial data collection, management, and distribution organized in your state?

Data collection, management, and distribution are carried out by each organization. Efforts are made to coordinate data collection and distribution. Organizations concerned with coordination include WAGIC and the Information Services Board (ISB).

WAGIC was formally established in 1990 by DIS. GIS managers and users created an informal coordination network in 1984 to improve information sharing and coordination; these tasks were absorbed by WAGIC in 1990. This organization remains strong today, despite the lack of legislative mandate or agency organization directives. WAGIC published a strategic plan in 1999. It has developed a clearinghouse and funding strategy in an effort to make the most of limited resources. WAGIC addresses more than environmental data and includes representation from federal, state, tribal, and local governments as well as from private industry and nonprofit organizations.

WAGIC implemented a voluntary, tiered membership structure that will partially offset council expenses. WAGIC committee processes were developed to minimize bureaucracy, maintain an effective level of accountability, and continue the informality and flexibility of current council structure. Additional information can be found at www.wa.gov/gic.

ISB is a 15-member board made up of leadership from the state legislature, state agencies, higher education, and the private sector. Membership includes the chief executive officers of state agencies. State law directs ISB to do the following:

- Develop standards to govern the acquisition and disposition of equipment, software, and purchased services;
- Approve IT acquisitions or set rules that delegate acquisition authority;
- Develop statement or interagency technical policies;
- Review and approve statewide IT strategic plans;
- Provide oversight on large projects; and
- Establish and monitor appeals processes.

In February 2003, ISB adopted standards for metadata, datum, and projects to facilitate improved data sharing.

ISB has established a subcommittee on Geographic Information Technology (GIT). The committee adopted a charter to

> represent the strategic interest of a coordinated, enterprise approach to utilizing geographic information technology and provide leadership for implementation of cost effective, collaboratively developed, spatial data management solutions . . . . [and to] develop policy and standards recommendations regarding geographic information technology for consideration and adoption by ISB as state policy.

12. How does your state fund environmental spatial data collection, management, and distribution? What are the major funding barriers and opportunities?

In 1999, the WAGIC chair estimated that $20 million was spent by state agencies on data management each year in Washington. Funds were provided through individual state agencies.

WAGIC looks for opportunities to cooperatively develop environmental data and develop data systems and applications. Coordination activities include the Washington Geospatial Framework Project, orthophotos, and the Landsat Consortium. For state agencies, this includes collaborating on funding requests proposed to the state legislature.

Individual agencies currently receive funding for data collection, management, and distribution.

Given tight revenues, agencies have less ability but greater need to use resources for collaborative activities.

13. What are the laws and policies that govern environmental spatial data collection, management, and distribution in your state?

State Laws

The Revised Code of Washington (RCW 43.105.041) delegates authority to ISB to "develop statewide or interagency technical policies, standards, and procedures." The relationship with the new ISB/GIT executive subcommittee provides an opportunity for WAGIC to formalize certain standards and guidelines that have been developed through various council initiatives. The adopted standards build on previous council efforts (www.wa.gov/gic/Techstds2/standards_index.htm).

Statewide IT Policies

The Policy and Planning Group of the Management and Oversight of Strategic Technologies (MOST) Division provides strategic IT policy leadership for the state and provides staff support to ISB and the Customer Advisory Board (CAB).

The legislation that created DIS, RCW 43.105, states that DIS will maintain and fund a planning component separate from its services component. Policy advisers from MOST serve ISB by helping formulate and maintain statewide IT policy, planning documents, and standards. MOST updates these IT policies and plans, as directed by ISB, and introduces new agency guidelines for emerging technologies to ensure effective and efficient use of IT resources.

Publications provided through the MOST Policy and Planning Group include

- *Managing the Digital State: The Washington State 2001 Information Technology Performance Report*;
- *Advancing the Digital State: The 1999 Washington State Information Technology Performance Report*;
- *Becoming Digital: Washington State's Performance in the Use of Information Technology: The 1995 Biennial Information Technology Performance Report*;
- *1996 Information Technology Strategic Plan*;
- *Building the Road Ahead: Telecommunications Infrastructure in Washington State: First Report of the Governor's Telecommunications Policy Coordination Task Force*; and
- *IT Portfolio Management: Policy, Standards, and Guidelines*.

Among the initiatives supported by the MOST Policy and Planning Group are the Telecommunications Oversight and Policy Committee, the Governor's Work Group on Commercial Access to Government Records, and the Governor's Telecommunications Policy Coordination Task Force.

The ISB website is www.wa.gov/DIS/ISB/policy.htm.

NUTS AND BOLTS

14. Do all agencies use the same software and projection for environmental spatial data?

Federal, tribal, state, and local governments and private institutions are largely using ESRI's Arc software for geospatial applications. However, datum has varied by user, and data exist in the following two formats: North American Datum (NAD) 1983 and NAD 1927.

Coordinate systems in use include

- Washington Coordinate System of 1983—north zone,
- Washington Coordinate System of 1983—south zone, and
- Geographic coordinates (decimal degrees).

ISB established standards and specifications for geospatial data collection by state agencies in March 2003. The new state policy provides 18 months for state agencies to migrate data to NAD 1983 and the Washington Coordinate System of 1983—north zone.

Federal agencies use the federal Universal Transverse Mercator (UTM) metric standard for geospatial data.

15. What are the standards and specifications for environmental data?

Conceptual guidelines for development of Washington GIT Technology Policy and Standards include (*a*) adopting national standards where appropriate, (*b*) maintaining consistency with and awareness of related RCW standards or rules, and (*c*) using implementations that both add value and reflect operating challenges.

Policy guidelines include the following:

- *ISB/WAGIC—Geographic Information Technology Policy and Standards Process* describes the iterative process for developing and maintaining GIT and GIS policy and standards.
- *ISB/WAGIC—Standard for Metadata* describes the standard for geodata set documentation.
- *ISB/WAGIC—Standard for Horizontal Datum and Coordinate System* describes the standard for datum and the coordinate system.

16. What are the overwhelming data gaps for environmental data?

A master list of environmental data sets was recently compiled and classified using the environmental issue categories of the Mid-Atlantic Transportation and Environment Framework Group Data Sources and subject area definitions of the WSDOT Environmental Activities Data Model. The combined list totaled more than 330 individual data elements. Despite this, there are several missing data elements.

For transportation agencies, the primary gaps in environmental data include consistent statewide soils; local government land use patterns and plans; agricultural origin and destination data; wetland trend data; ESA species and habitat mapping; local transportation networks including forest roads, elevation, and bathymetry; Usual and Accustomed Tribal areas; and land ownership. In addition to these data gaps, the information necessary to complete environmental impact analysis at project design scales is severely limited and inadequate to meet the needs of the many environmental regulatory programs. A recent report, *Information Technology Coordination Survey for the Transportation Permitting Efficiency and Accountability Committee* (draft prepared by CH2M Hill for the Environmental Affairs Office of WSDOT, June 2003), states:

> Data required for use in developing permit applications do not appear to be defined with any significant specificity. The resulting lack of consistency requires review activities that are likely more intensive than might otherwise be necessary with more clearly defined requirements resulting in predictable data quality.

Trend data are needed for all environmental parameters. In addition, models for data analysis and the data to support them are needed for analyses of land use change, cumulative and indirect effects, storm water runoff, and habitat connectivity.

17. What are some of the data confidentiality and data security issues encountered?

Privacy and security are issues in data management and distribution. Security issues for environmental geospatial data primarily concern the distribution of data on threatened and endangered species for plants and animals. WSDOT has addressed the issue by developing security tables that provide different levels of information detail to different users. Cultural resource information is also protected, and a very limited number of information managers have access to the data for purposes of project analysis.

Privacy issues for environmental spatial data include protection of landowner information on data systems that address restoration projects. Data needed for environmental justice issues may be at risk for collection because of privacy concerns. Data that are collected sometimes are limited in distribution to protect privacy. Examples are data on dams and water quality. Information sharing is managed by agreements, not on the basis of user rights.

18. How do you manage "rogue" data collection?

Note: For the purposes of this meeting, "rogue" data collection refers to data collected by individuals without corporate knowledge or authorization. The existence of these data sets is frequently unknown to other potential users, the data often lack explicit quality standards, and adequate documentation to facilitate data sharing is often missing.

The development of data and data systems by individuals does happen in Washington, and this is being addressed in various ways and to varying degrees by organizations in the state. Some of the reasons for rogue data collection are

- Lack of knowledge of data system development processes and resources,
- Frustration over the cost and time required for enterprise data systems,
- Lack of management directives to manage rogue data collection,
- Lack of adequate resources to fund and staff enterprise data collection in a timely fashion, and
- Lack of awareness of other users' needs.

WSDOT is moving toward enterprise data management to address rogue data collection. CAB will coordinate identification of technology and data needs and look for opportunities for collaboration on data between business functions. The Executive Information Technology Group will set priorities. Active participation in the WAGIC Geospatial Framework Program is another way WSDOT is increasing coordination.

19. Do you use project data to refresh databases? If so, how do you do it? How do you fund it?

Within WSDOT, as-built data are captured as image files but are not captured systematically to update GIS data layers. There is interest in this, but steps have not been taken to establish a process. This is primarily because the current business model provides little support for data activities once construction is complete.

In the 1990s, WDFW attempted to capture GIS data from permit applications, but the process proved to be cumbersome and was not implemented.

The Department of Ecology updates data for the Facility and Site Identification System from permit data received. This web-enabled system provides a central repository for information relating to facilities and sites of interest to the department. It provides critical information for each subject facility and site, such as physical location, ownership, and activities that occur at the location, as well as the reasons for the department's interest.

Local governments typically update environmental data from permits, particularly where environmentally critical areas such as wetlands and riparian buffers are delineated in the field as part of the permitting process.

20. How do you manage distribution and implementation of data systems?

Distribution and implementation of data systems are managed through individual agencies and coordinated through WAGIC or project-specific committees.

EXAMPLES OF SHARING ENVIRONMENTAL DATA

21. Please describe interagency coordination efforts for environmental spatial data in your state. Briefly summarize and compare past and current practice.

Washington Geographic Information Council

WAGIC is a good example of coordination efforts for geospatial data. The organization was created in 1984 through the proactive collaboration of several organizations that develop and manage geospatial data. It is not mandated by the state legislature

and does not receive direct funding. Agencies and other organizations have agreed to staff and support the organization through voluntary cash and in-kind contributions. Through WAGIC, Washington has developed the Washington State Geospatial Clearinghouse, the Washington Geospatial Framework, a state strategic plan, standard datum and coordinates, and a forum for coordination of Landsat imagery needs.

WAGIC meets bimonthly to discuss ongoing activities and emerging needs. A biannual workshop is held to review projects and priorities more intensively. An e-mail discussion list promotes coordinated communication between meetings.

Washington Geospatial Framework

The Washington Geospatial Framework is geospatial data that are collected and maintained by many Washington State organizations, that will be organized and managed cooperatively, and that will support the National Spatial Data Infrastructure. The framework will include georeferenced orthoimagery, elevation, transportation, hydrography, governmental units, and cadastral data. Framework participants work together to develop common data management protocols and to reduce duplication of effort. The framework is managed as a subcommittee of WAGIC.

The geospatial framework is envisioned as dynamic and as embodying the needs of the stakeholders, promoting enduring cooperation and partnerships to develop and maintain data, utilizing common standards, and facilitating the exchange of ideas and information.

Some benefits of framework participation include

- Sharing of the cost of data collection and maintenance over many organizations,
- Cross-jurisdictional or cross-organizational analysis capabilities,
- Better data access for decision making,
- Time and cost savings for GIS start-up,
- Opportunity to build new partnerships, and
- Involvement in a network of GIS users across the state.

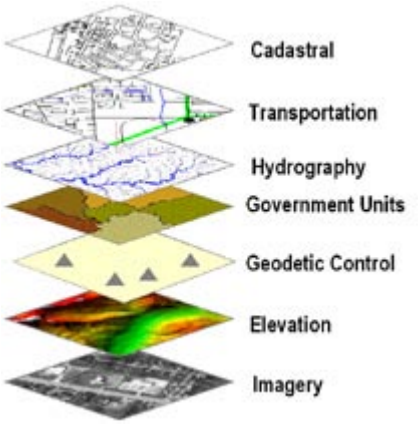
Framework layers will include cadastral data, hydrography data, transportation data, and orthoimagery.

Cadastral Data The Washington Cadastral Framework is an effort to develop and maintain commonly needed cadastral data in partnership with many organizations. Cadastral data include information about rights and interests in real property such as ownership, boundaries, and land survey information. Framework means the core data that provide a foundation on which to build more detail. The concept behind framework projects is to reduce duplication of effort and increase data-sharing capabilities. Project partners are developing new ways of doing digital data business in which partners share responsibilities, commitment, benefits, and control. wagic.wa.gov/Framework/cadastre/Default.htm.

Hydrography Data The Washington Hydrography Framework Project is the cooperative effort of many private and governmental organizations at the federal, state, local, and tribal levels to define, implement, and maintain a single high-resolution hydrography network for Washington State. Through a formal arrangement with the Interorganizational Resources Information Coordinating Council, the Washington Hydrography Framework Project has coordinated its efforts with those of the Oregon Hydrography Framework Project to facilitate a regional framework effort encompassing Washington, Oregon, and northern California.

The ultimate goal of the Washington Hydrography Framework Project is to establish a common core set of spatial and tabular hydrography information to which all organizations can attach their business-specific requirements. Requirements common to each framework partner have been identified and will reside in the framework database. The primary benefit of the project is the ability to effectively store, access, analyze, model, and trade hydrographic data among interested parties. This will be realized by the implementation of a single surface water information system for the region that will provide common ground for all organizations that use hydrography data.

Transportation Data The Washington Statewide Transportation Framework Project was organized to create an electronic map of transportation data for use in GIS across the state. The transportation data (called the transportation layer) will integrate with other statewide layers being developed or in existence, including hydrography (waterways), cadastral (property boundaries), and orthophotography.



Orthoimagery Orthoimagery is a georeferenced image, or picture, of Earth. It is generally produced from an aerial photograph or other remotely sensed data and is corrected for displacements caused by terrain and sensor orientation. This data set can be used to derive many vector data sets, such as land use and cover designations or transportation networks. It is often used as a backdrop to analyze, update, or reference other data on the basis of visible features.

Orthoimagery has been a complicated issue for years. The Washington Department of Natural Resources has produced licensed imagery and orthophotos (state plane projection) for its areas of interest, while the U.S. Forest Service has produced UTM

imagery and orthophotos over national forest lands in the state (public domain data). USGS has produced UTM imagery and orthophotos over the remaining areas of the state for consumption in the public domain. Statewide coverage has been a mix of public-domain and licensed data.

The Orthoimagery Framework seeks to improve coordination and coverage. The goals of this effort include expanding existing partnerships to implement a statewide, coordinated partnership to further reduce duplication and distribute costs among agencies; sustaining the collection of consistent orthoimagery data over time; and allowing partners to make these data available at low or no cost in the public domain. The effort will build on existing programs and partnerships.

Interagency Natural Resources Information Portal

The Washington Natural Resources Information Portal opened on June 1, 2003, via the World Wide Web. This portal is designed to help public stakeholders conduct quick and easy searches and access Washington State environmental and natural resource–related data sets from a single website. The public user can query by location, such as county, watershed, or salmon recovery region; agency; theme category; or file type. Keyword searches can be conducted, and there will be a variety of other search options. The project was designed collectively by a team of top state information managers who bring experience with and insight into their agency data sets to bear and who have been tasked to make such information accessible to the public as part of a larger ongoing salmon recovery effort (*The Washington Comprehensive Monitoring Strategy for Watershed Heath and Salmon Recovery*, Vol. 3 of 3, Dec. 2002). New data sets not previously available on the web will also be coming online.

Phase I of the web portal sends the user to the data set, which is stored on the respective state agency website (data sets are not stored in the portal website itself). The intent of Phase II and Phase III is to add local and federal government data sets. Additional options for the user to work with data sets within the portal application itself will be considered for future phases and will be contingent on the effectiveness, usage, and outcome of Phase I.

The actual construction work of the portal began on January 3, 2003. Each agency will be responsible for entering data set descriptions (formally known as "metadata," which means written narrative about the data set to help the user), an agency web URL address, and other data set information. We anticipate that the Natural Resources Information Portal will be fully populated with state agency data sets by the public opening date set for late June 2003. For additional information, please contact Nadine Romero at 360-902-2954 or by e-mail at NadineR@IAC.WA.GOV.

Digital Government

Digital government is more than just a buzzword for online government services. It is a fundamental shift in government culture, allowing those in public policy and government to respond much more quickly to citizens and making government services more accessible and understandable. Digital government means replacing old bureaucratic

service lines with accessible information and services, available 24 hours per day directly from the desktop, using powerful new technologies like digital signatures and electronic forms. It will offer a one-stop shop to many government services through the state's Internet portal, Access Washington.

The goals of the project are to

- Maximize the use of Washington's world-class IT infrastructure;
- Foster collaborative approaches for solving business problems;
- Encourage innovative uses of technology through vision, strategic planning, and policy;
- Build partnerships through first-class customer service;
- Provide cost-effective access to technology products and services by aggregating public-sector demand; and
- Strengthen public confidence through reliable services.

A Digital Government Readiness Assessment Tool was created to help agencies evaluate the four Cs of readiness: commitment, customer focus, coordination and collaboration, and capacity. Each of the four sections outlines the section's role in helping an agency deploy applications that will prosper within the digital Washington community.

Salmon and Steelhead Habitat Information and Assessment Project

In 1991, WDFW and the Western Washington Treaty Indian Tribes began the Wild Stock Restoration Initiative to catalog and inventory salmon and steelhead stocks to determine their population status and extinction risk. The first product of this partnership was the Salmon and Steelhead Stock Inventory (SASSI), which delineated stocks and identified their origin and status. The Salmon and Steelhead Habitat Inventory and Assessment Project (SSHIAP) began in 1995 as the natural complement to SASSI. SSHIAP is charged with providing watershed- and stock-level habitat information to assist tribal, state, and local planners in prioritizing habitat protection and restoration measures. This information must have resolution fine enough to be useful to local planners, and its format must be consistent to enable regional or stock-level comparisons of habitat conditions. With the recent listing of numerous salmon and steelhead stocks under ESA, the project has received renewed attention as a tool to help plan recovery activities.

Western Washington Treaty Indian Tribes and WDFW are comanagers of SSHIAP. The data needs of SSHIAP were incorporated into the design of the Washington Hydrography Framework data layer.

More information on SSHIAP can be found at www.nwifc.org/sshiap2/index.asp.

SalmonScape

WDFW has developed a tiered web client system that provides a web GIS interface to data mainly relating to hydrology and fish distribution, including the Salmonid Stock

Inventory and SSHIAP databases. The system has been designed to allow nontechnical personnel to view data and make reports. It is intended for use by all WDFW programs and eventually the public.

Watershed Characterization

The Washington State Legislature directed the Transportation Permitting Efficiency and Accountability Committee to undertake the following activities to develop a watershed approach to environmental mitigation:

- Develop methodologies for analyzing environmental impacts and applying compensatory mitigation consistent with a watershed-based approach before final design, including least-cost methodology and low-impact development methodology.
- Assess models to collate and access watershed data to support early agency involvement in transportation planning and review under NEPA.
- Use existing best available information from watershed planning efforts, lead entities, regional fisheries enhancement groups, and other recognized entities as deemed appropriate by the committee to determine potential mitigation requirements for projects within a watershed. Priority consideration should be given to the use of the state's alternative mitigation policy guidance to best link transportation mitigation needs with local watershed and lead entity project lists.

Watershed characterization methods seek to better understand project effects, assess the condition of surrounding natural resources, and identify potential mitigation options that have the greatest opportunity for maximizing environmental benefit while reducing mitigation cost. A set of principles is presented to guide and direct methods development. To maximize environmental benefit, the focus of recovery efforts is on ecosystem processes. In western Washington, key ecological processes are assumed to be the delivery and routing of water, sediment, pollutants, large wood, and heat.

For additional information, see www.wsdot.wa.gov/environment/streamlineact/watershed_docs/methods.pdf.

Puget Sound LIDAR Consortium

The Puget Sound LIDAR Consortium (PSLC) is an informal group of local agency staff and federal research scientists devoted to developing public-domain, high-resolution light-detecting and ranging (LIDAR) topography and derivative products for the Puget Sound region. PSLC began meeting in fall 1999. Participants in the consortium include the Kitsap Public Utility District; the city of Seattle; the Puget Sound Regional Council; the National Aeronautics and Space Administration; USGS; and Kitsap, Clallam, and Island Counties.

To date, PSLC has used LIDAR technology to collect 6-foot resolution digital elevation data over all or part of 11 Washington counties and placed the information in the public domain. A wide variety of public agencies, private corporations, and nonprofit groups have utilized the data for geologic mapping, geologic hazard analysis, flood hazard analysis, watershed and stream channel characterization, forest stand char-

acteristics, and groundwater analysis, as well as transportation and utility infrastructure planning. Earthquake fault hazard information, in part developed from PSLC LIDAR data, was made available just in time to be incorporated into the design of the Tacoma Narrows Bridge project. USGS fast-tracked the trenching of a fault scarp that was found by means of LIDAR and confirmed that a surface rupture occurred on that fault sometime around A.D. 800 to 1200. This fault zone is roughly parallel to and very near the Tacoma Narrows Bridge. The project engineers knew about the Tacoma fault zone and were trying to pin it down geographically. USGS got the LIDAR data to the engineers in time to have the data incorporated into the final bridge design.

PSLC has no rules or formal membership, but members work cooperatively on an ad hoc basis. For additional information, contact Jerry Harless, GIS Manager at the Puget Sound Regional Council, or the PSLC website at duff.geology.washington.edu/data/raster/lidar.

Environmental GIS Workbench

The Environmental GIS Workbench is a custom GIS application built to help WSDOT staff access more than 100 layers of environmental or natural resource management data. The Environmental Information Program works with appropriate federal, state, and other agencies to maintain a collection of the best available data for statewide environmental analysis. This application is an ArcView extension that provides WSDOT staff with tools for locating transportation projects and displaying a wealth of environmental data themes for that location. While the best available environmental GIS data often have considerable limitations, the data generally are a good flag for likely environmental issues affecting project planning.

The Environmental GIS Workbench includes data layers for air quality, groundwater, geology, soils, habitat, wetlands, cultural and socioeconomic data, hazardous waste, floods, major public lands, water quality and storm water, rivers and streams, visual quality, and land use and land cover.

The Environmental GIS Workbench has resulted in better distribution of information for decisions. One employee noted that using the workbench saved him approximately 6 hours of review time, reducing his review from 8 to 2 hours per project.

The Environmental GIS Workbench is being redeveloped for ArcGIS 8. This will provide the capability of adding data layers without the need for programming. The redevelopment is expected to be completed in October 2003.

For additional information, visit www.wsdot.wa.gov/environment/eao/envinfo/EGWbHome.htm.

22. Which project do you think exemplifies good coordination? Why was this project successful?

Washington Geospatial Framework

This project has sustained agency focus and staff resources over a long period of time.

Reasons for success include

- Common understanding and agreement on the goals and needs of the project,
- Advantages for all end users,
- National framework direction,
- Long-term dedication to project goals and objectives, and
- Personal leadership skills of the initiators.

The project would be more successful if it were predictably and adequately funded.

Natural Resource Data Portal

The Natural Resource Data Portal is just coming online, so the user perspective is not yet known. However, the project is considered a success because it is meeting its intended milestones, and early products are meeting expectations. Reasons for success include

- Successful test project called the Salmon CD, which brought together data layers most frequently requested by salmon restoration project managers and developers;
- Common vision;
- Focus on sharing data and not on resolving policy issues with the data;
- Legislative mandate; and
- Clearly defined leadership role.

Watershed Characterization

The Watershed Characterization Project has completed a pilot project that used watershed characterization methods to address the needs of environmental regulators. Among the reasons for success are the credibility of the project manager and technical skills of the GIS staff, the mandate from the state legislature, and a belief that the data would lead to a more informed result.

The project success could have been improved with more time to plan the project approach and more resources and dedicated staff time to develop the project with multiple agencies.

23. Which project did not lead to a coordinated outcome? Why do you feel this project was not successful?

Integrated Natural Resources Data System

The Integrated Natural Resources Data System (INRDS) was devised by Pacific Northwest National Laboratories in partnership with WSDOT, the Northwest Indian Fisheries Commission, and the Tulalip tribes. INRDS was intended to be a web-based system that integrates data and models and provides advanced visual analysis tools to help provide information to a wide user group that includes planners and other decision makers, public and tribal educators, and the general public.

The complete system was intended to combine Internet and intranet technologies for the secure access and sharing of data on topics such as salmon escapement, mitigation projects within a watershed, and pertinent water quality. The proposed system was to use and integrate commercial off-the-shelf software to the greatest extent possible to minimize development and maintenance costs. Components of INRDS included

- Data warehouse and model integration;
- Web-based technology;
- Security;
- Advanced visual analysis—GIS and data visualization;
- An education module focused on tribal cultural and heritage values; and
- Reporting, documenting, and tracking routines.

The concept for INRDS was valid, and the technology was functional. The project resulted in a proof-of-concept prototype that met the project's goals. However, the project did not lead to an implemented data system. Reasons for the lack of further development include lack of ownership by all contributing partners; not all potential end users understood the goals of the project or felt the outcome would be valuable; lack of resources for continued development; competition with other, higher-priority issues for staff time; and lack of a clear understanding of the user needs and benefits of the system.

Uniform Environmental Project Reporting System

The Uniform Environmental Project Reporting System was initiated by the Legislative Transportation Committee to identify potential mitigation sites and improve coordination of capital budget expenditures. WSDOT was directed to coordinate the project in its first year. The system was intended to collect information on completed and planned environmental protection and restoration projects. This information would help WSDOT to avoid impact on restoration sites, augment completed restoration projects, and partner with natural resource organizations to protect or restore projects that were of value. A prototype database was developed and tested through several interagency meetings. The Governor's Policy Office chaired the interagency committee in its second year. A report by the Joint Legislative Audit Review Committee supported the need for a database of this type to improve coordination and the investment in natural resource restoration. Despite this, the project failed to result in an implemented system. Reasons for the failure include lack of ownership by all contributing partners; lack of agreement with the goals of the project or lack of belief of all potential end users that the outcome would be valuable; lack of ready availability of information in an electronic format from most agencies; no authorization of funding to continue the project; concern among agencies about costs to develop and maintain the data for their agency; and competition with other, higher-priority issues for staff time.

HOW CAN WE DO THINGS BETTER?

24. What advice would you give others embarking on interorganizational data coordination efforts?

- Projects that require cooperative inputs or outcomes need to be planned cooperatively.
- Projects need adequate funding to do the expected work.
- Projects are most likely to succeed when they are viewed as a priority or important by managers.
- A clear vision of the product is required.
- Clear work plans and expectations for all participants (scope) are required.
- The project should be clearly integrated with required business tasks.
- Broad and dedicated participation is needed by staff knowledgeable and experienced in the business processes involved.
- Project champions should be in key policy and technical positions.
- Feasibility studies to understand the availability and format of existing information are very important.

The report *Information Technology Coordination Survey for the Transportation Permitting Efficiency and Accountability Committee (TPEAC)* identifies three actions to enhance IT coordination across permitting agencies:

- Provide guidance to applicants that leads them to good data.
- Provide easy access for the reviewer to good data.
- Implement systems that will enable both the applicant and the reviewer to monitor progress.

25. Please describe your vision of well-coordinated and functioning partnerships for environmental spatial information.

An effective partnership for data coordination is one in which organizations are able to clearly articulate their data needs and resources, collaboratively plan data improvements or systems to address needs, identify priorities for coordination, effectively participate in meetings for the duration of the project, and rely on a predictable and reasonable level of funding to develop and maintain the projects.

Information provided through the data systems should address the needs of the majority of critical business functions of all participants.

Information managers, content managers, and users should be included in developing a plan and conceptual model for new or enhanced databases.

Virginia

Steven Carter-Lovejoy, *Virginia Division of Natural Heritage*
Trent Park, *Virginia Department of Historic Resources*
Daniel K. Widner, *Virginia Department of Transportation*

GENERAL

1. What is your definition of environmental spatial data?

Environmental spatial data are defined as data that represent real-world information pertaining to ecosystems, geophysical systems, natural resources, and cultural and historic resources. They are in the form of georeferenced digital data that are readily usable by GIS tools and technologies.

2. Why does your state feel it is important to share environmental data?

It is important to share environmental data for two primary reasons:

1. Data sharing avoids a duplication of effort in developing and managing data, thus saving costs. Often multiple agencies are in need of environmental data.
2. Data are utilized by multiple parties or agencies but often managed and created by only one agency. The data are best managed by the data owners and then shared as appropriate (or not at all) by the responsible agency. Without such a consistent approach, there is a risk that the only data available could be inaccurate, outdated, and incomplete and that data could be inappropriately distributed to various parties.

The sharing of environmental data has also increased program efficiency by providing environmental review personnel with the tools needed to better plan for proposed projects and by providing documentation to support decision making for those projects. Agencies and partners are often unaware of what data sets are available in other agencies. In a climate of sharing, participants develop a much better understanding of what data resources may be available to them to improve their work.

3. What are the benefits of sharing data? Please include time savings, value-added products and outcomes, and cost–benefit information where possible.

Cost benefits are the most obvious benefit. Simply by removing duplication of effort, costs are reduced.

There is also the case of the "have" versus the "have not" agencies when it comes to resources. The Virginia Department of Transportation (VDOT) is in critical need of environmental spatial data for the regulatory process. In many cases these data are not available or are not available in digital format. The responsible agency does not have the resources to provide the data to VDOT. In such cases VDOT has decided to fund the development of some of the data. This benefits both the responsible agency and VDOT. Long-term plans for data maintenance and availability are part of the arrangement. Two Virginia agencies attending the TRB peer exchange, Natural Heritage and Historic Resources, have partnered with VDOT.

The sharing of data raises issues, such as data standards and formats, that must be dealt with by participating agencies. Previously, two agencies with relatively strong GIS programs—VDOT and the Virginia Economic Development Partnership—through their willingness to share data and other GIS resources, have helped to establish some de facto standards through practice rather than authority. The Virginia Geographic Information Network (VGIN) has established a list of available agency data and assisted in the procurement of a statewide high-resolution orthophotography base by leveraging the needs and money of Wireless 911. Local governments are encouraged to use this product, which is provided at no cost to them, and state agencies get the data at the cost of duplication. A consistent base map source available for future data development should help to standardize GIS data products, and needs for procuring separate products in various formats should be reduced.

4. How useful are the environmental data layers that have been collected to transportation?

This depends on the quality, currency, and accuracy of the data. It can vary in many cases. Generally speaking, environmental data are of a smaller map scale (usually derived from the USGS 1:24,000 standard) than what is required for engineering purposes (1:1,200 or better). For the environmental planning stages of VDOT, this smaller map scale is sufficient, but only for planning purposes. In many cases, environmental data are not current or comprehensive on a statewide basis.

A fundamental problem is putting the information in the hands of the staff that need it at the time that they need it. VDOT has developed an ArcIMS product that provides access to environmental data layers for all central and regional staff. However, the ultimate utility of these data will not be realized until procedures and practices are revised or established to ensure that this resource is effectively and efficiently incorporated into VDOT planning and decision making. Improvements are expected from a system now under development called CEDAR, the Comprehensive Data and Reporting System.

5. How useful are the transportation data layers that have been collected to the natural resource community?

Generally, the natural resource community needs to have a transportation layer for base map purposes. It is also important for them to know where existing and potential projects occur. This eases the process of evaluating the impact of a transportation project on their particular area of expertise.

DATA MANAGEMENT PROFILE

6. Who provides environmental spatial data in your state?

- Department of Conservation and Recreation
- Department of Historic Resources (DHR)
- Department of Game and Inland Fisheries
- Department of Environmental Quality
- Department of Forestry
- Virginia Institute of Marine Sciences
- Virginia Marine Resources Commission
- Department of Mines, Minerals, and Energy
- Virginia Outdoors Foundation
- Virginia Department of Health
- VDOT
- Various federal agencies including
  - EPA
  - U.S. Army Corps of Engineers
  - U.S. Fish and Wildlife Service
  - National Park Service
  - U.S. Forest Service
- Local governments and regional planning district commissions
- Private organizations such as the Nature Conservancy of Texas

7. Who are the primary users of environmental spatial data?

All of the above, but the ability to use GIS or create reasonably GIS-friendly data sets varies enormously among these agencies.

8. Who are the primary supporters of statewide environmental data collection? How long have they been active supporters?

State and federal agencies tasked with environmental regulation, review, or planning appear to be the most outspoken supporters of statewide environmental data collection. Those with the greatest need to use the data for their own business purposes are the most active. These include the groups listed in the answer to Question 6.

9. What are the user applications of the data?

VGIN, the Virginia GIS coordinating body, sponsored a natural resource work group that studied the use of natural resource spatial data. More than 60 applications were identified in 7 categories:

- Water quality assessment;
- Watershed management, protection, and assessment;
- Biodiversity and species protection;
- Regulatory review and assessment;
- Land management and planning;
- Applied research; and
- Other.

Cultural and historic resource management along with transportation should be added as well.

10. How are the data shared?

Data are shared primarily by duplication onto media such as CD-ROM and file transfer protocol (FTP). Owners of the data receive and process data requests and act accordingly.

11. How are environmental spatial data collection, management, and distribution organized in your state?

Environmental spatial data in Virginia are still managed by the individual agencies responsible for their particular business area. Plans have been discussed for a spatial data clearinghouse by VGIN but have not come to fruition.

The Internet is increasingly being used by state agencies to display and distribute their environmental spatial data, although these efforts are not coordinated. The following are examples:

- VDOT and DHR have a web-enabled application accessible by both agencies. DHR also makes this available to qualified users by request.
- The Virginia Department of Conservation and Recreation also has an ArcIMS site and is actively working to make new data sets available on it.
- VDOT makes its 6-year plan available through an ArcIMS site that is accessible via a web browser or an ArcGIS thick client.

12. How does your state fund environmental spatial data collection, management, and distribution? What are the major funding barriers and opportunities?

VDOT utilizes State Planning and Research funds from FHWA for spatial data creation and development activities.

Generally it is the responsibility of the data owners to provide the funds for collection, management, and distribution. This is accomplished through the use of state funds and federal grants.

Major barriers include the continual lack of funding for resource agencies that are responsible for these types of environmental data. In these times of reduced budgets, the unfortunate side effect is that state government staff is reduced, thus removing the manpower needed to create and maintain these important data.

Major opportunities include the sharing of resources from other larger state agencies and the federal government to supply the capital necessary to create and maintain the data. This is particularly true in the realm of environmental regulation at both the federal and state levels. If the information is important enough to halt or redirect road construction projects, for example, then it should be important to fund the creation and management of these data.

The statewide digital orthophotography base discussed in the answer to Question 3 is a creative funding opportunity. The Wireless 911 board oversees the collection of fees from cell phone users. This money was used to fund this project to provide a consistent base for Wireless 911 purposes. This has great benefit to state and local government developers of environmental and other spatial data.

13. What are the laws and policies that govern environmental spatial data collection, management, and distribution in your state?

The Freedom of Information Act (FOIA) is the driving law in Virginia. Certain environmental spatial data are exempt from FOIA, such as cultural and historic resources, threatened and endangered species, and natural heritage resources.

NUTS AND BOLTS

14. Do all agencies use the same software and projection for environmental spatial data?

Most agencies in Virginia use ESRI GIS software. Projections utilized in Virginia include

- UTM (derived from the source USGS quadrangles),
- State Plane North and South, and
- A customized Lambert conformal conic projection established with a Satellite Probatoire d'Observation de la Terre imagery base in 1994.

Datums are NAD 27 and NAD 83.

15. What are the standards and specifications for environmental data?

De facto standards include shapefiles, coverage, and geodatabase formats. Specifications for metadata can be viewed at www.vgin.virginia.gov. The Federal Geographic Data Committee (FGDC) metadata standard is the common format for metadata.

16. What are the overwhelming data gaps for environmental data?

Many data gaps are geographic in nature. For example, a statewide sinkhole data set is not available. With the presence of Karst topography in the Appalachian Mountains, this is a very serious issue in transportation engineering work as well as in the identification of threatened and endangered species.

17. What are some of the data confidentiality and data security issues encountered?

The answer to Question 13 addresses the associated legal issues. Data security issues related to IT need to be considered. In Virginia, we are interested in using web-based map services to provide data to those in need. To do this, we need to assure the data owners that their data are safe on the Internet and that access is restricted, when required.

18. How do you manage "rogue" data collection?

This issue needs to be looked after constantly. The best way to manage the problem is to make available as much information as possible and to promote and enforce data standards and usage. This might be best accomplished through a statewide coordinating body but is not really addressed on a state level at this time.

19. Do you use project data to refresh databases? If so, how do you do it? How do you fund it?

We are just beginning to do this at VDOT. Previously, there was much wasted information that sat on the shelf when it was collected for transportation projects. This was mostly due to the lack of technical ability to understand what to do with the information. Until mature spatially enabled systems are available for decision support in the environmental area, these data will not always be utilized.

20. How do you manage distribution and implementation of data systems?

At VDOT, data systems are implemented on the basis of established guidelines for IT project management principles, such as those espoused by the Project Management Body of Knowledge. Both the waterfall and spiral approaches to project implementation are used at VDOT. Guidelines are promulgated through the state's technology planning unit in the Virginia Information Technologies Agency.

While there is no formal distribution system for all state agencies combined, the vision (and practice in some cases) is to utilize a distributed network of data servers that use Internet protocols for sharing data. For environmental spatial data, this can be compared with ESRI's Geography Network, which uses published map services. The advantage of this approach is that data are not copied or physically distributed. When data change, the managing agency updates the data and then posts the current version through the map service. Agencies that use ArcGIS can connect to these published map services through the web URL. Within VDOT, a minigeography network exists for the sharing of spatial data. With a combination of Oracle databases with ESRI's Spatial Database Engine and ArcIMS web mapping servers, decision makers can access various spatial data needed to support their transportation-specific applications, such as asset management, environmental, and transportation planning.

EXAMPLES OF SHARING ENVIRONMENTAL DATA

21. Please describe interagency coordination efforts for environmental spatial data in your state. Briefly summarize and compare past and current practice.

Since about 1990 VDOT and the agencies of Virginia's Secretary of Natural Resources have operated under a successful MOU that establishes an Interagency Environmental Coordinating Committee (IECC) and a State Environmental Review Procedure (SERP). Through SERP, VDOT provides standard information about proposed projects to natural resource agencies, which have a prescribed period of time in which to review and respond. The results of the reviews are summarized in a Preliminary Environmental Inventory, which becomes part of the documentation for the project. IECC meets regularly to fine-tune the process (including determining which project categories should be submitted for review) and to share information about new priorities, new data sets, and other significant issues.

SERP has been a successful tool for giving environmental agencies access to VDOT projects and for calling VDOT attention to environmental concerns for specific projects. The process is labor-intensive both for VDOT and the agencies that conduct detailed review of each project. In the last few years project information has been distributed via electronic documents and images instead of reams of paper. VDOT plans for providing a website to facilitate reviewing agency access and response to VDOT projects should considerably streamline the workload. The SERP review occurs early in project development, which is good for planning, but environmental agencies do not usually have additional opportunities to review these projects, even though for some projects years may pass and scopes may change significantly before the projects are implemented. As VDOT facilitates access to and procedures for using environmental spatial data in-house, project planners will find it easier to keep informed with the most up-to-date environmental data.

Another key coordinating mechanism providing environmental agencies with review access for certain VDOT projects at a later stage in development is the Interagency Coordinating Meeting. As part of VDOT's process for securing wetland permits from the Virginia Department of Environmental Quality and the U.S. Army Corps of Engineers, projects are sent to interested environmental agencies for review. The projects are discussed at monthly meetings by VDOT environmental staff and key planners for specific projects and interested representatives from environmental agencies, including the regulatory agencies. Although it only applies to projects with wetland impacts, the mechanism is a useful way for environmental agencies to provide input at a later stage in project development than the SERP review. The presence of regulatory agencies that will be issuing permits provides additional impetus to VDOT's responses.

For projects that require environmental impact reviews, the Virginia Department of Environmental Quality coordinates distribution of environmental impact statements to state agencies and their responses back to VDOT.

22. Which project do you think exemplifies good coordination? Why was this project successful?

SERP is an exemplary tool that facilitates and succeeds because of good coordination. It is founded on the strong commitments by VDOT to hear the concerns of environmental agencies and by environmental agencies to spend time to review projects and, in effect, partner with VDOT in project development. It succeeds because of the continuing involvement of relatively high-level staff in IECC, where adjustments are made to keep the process as streamlined and relevant as possible. Its success should increase with the planned implementation of new technologies that will further improve data access and streamline processes.

23. Which project did not lead to a coordinated outcome? Why do you feel this project was not successful?

One project that never came to fruition was the establishment of a data center for geologic spatial data. VDOT was interested in gaining access to much-needed geologic data for the environmental review process. The responsible agency did not have many resources available, and VDOT was willing to contribute. A joint MOU was prepared and then processed up the chain of command at each agency. Because of organizational uncertainty and change in the geologic agency and a less-than-proactive push at VDOT, the proposal was never implemented.

HOW CAN WE DO THINGS BETTER?

24. What advice would you give others embarking on interorganizational data coordination efforts?

- Money is a great persuader.
- Think about the procedures that will put data in the right hands at the right time. The best data bank in the world is worthless if no one makes a withdrawal.
- Identify all the ways in which both sides can benefit from coordination. The most effective arrangements will provide benefits to all parties.
- Establish mechanisms to ensure ongoing communication—efforts can flounder if all parties are not meeting regularly to clarify expectations, correct misinformation, follow status, and provide encouragement and support.

- Expectations should be incorporated into procedures and practices whenever possible. Two people talking with the best of intentions will do nothing to change things until the scores of people implementing work—whether project development or project review—incorporate those changes into their daily practices.

25. Please describe your vision of well-coordinated and functioning partnerships for environmental spatial information.

We believe that the detailed critical components of a positive partnership for environmental spatial data have been outlined above. However, to reemphasize, a good communication structure and activity are important. It is important that all parties involved have a sense of ownership in the value of such a partnership. In that way the group can work together to overcome issues that will most certainly arise.

Good technical solutions need to be in place to facilitate the sharing of information as well as the protection and security of this information. The use of Internet technology to share information and provide a secure environment is important.

The management of data is another important factor. Data should not be duplicated many times so that there is a risk of using data that are out of date or inaccurate. The classic "data management nightmare" is one that is created when an agency like VDOT ends up managing other agencies' data because the data are needed by VDOT. The ideal partnership for sharing environmental data is one that allows access to data when needed, with the decision to allow access made by the owning agency.

Texas

Aaron Kim Ludeke, *Texas Parks and Wildlife Department and Texas Geographic Information Council*
Dominique Lueckenhoff, *U.S. Environmental Protection Agency, Region 6*
Jimmy Tyree, *Texas Department of Transportation*
Carter Smith, *Nature Conservancy of Texas*

GENERAL

1. What is your definition of environmental spatial data?

Environmental spatial data describe natural phenomena:

- Surface geology
- Soils
- Surface hydrology
- Aquifers
- Water quality
- Hypsography
- Air quality
- Habitat
- Biota
- Locations of lands and waters with existing or potential conservation values
  - Wetlands
  - Managed lands, such as parks, forests, and wildlife refuges
- Locations of threatened and endangered species

Environmental spatial data include geospatial data related to human health and used to support environmental justice analyses and exposure studies:

- Data pertaining to pollutant sources and impacts
  - Resource Conservation and Recovery Act data
  - Superfund sites under the Comprehensive Environmental Response Cooperation and Liability Act
  - Total maximum daily loads (TMDLs)
  - Wellhead protection areas
  - Radon
  - Lead
  - National air quality standards pollutants: ozone and particulates, toxic air emissions, nonpoint source pollutants

- Human receptor data
  - Population density
  - Minority
  - Age
  - Income
  - Housing

Data such as satellite imagery and digital orthophoto quads (DOQs), which can be used to map and analyze the above phenomena, are included.

2. Why does your state feel it is important to share environmental data?

Because these data are expensive to collect, archive, and keep up to date, it is important to identify custodial agencies and develop data-sharing protocols between agencies and the constituencies they serve. In addition, because some agencies are better funded than others, it is important that the data they develop be shared. It is often necessary to share resources so that there are enough resources to develop data. This lends itself to economies of scale, reduces duplication, and produces more consistent data, which provides for more consistent decision making.

3. What are the benefits of sharing data? Please include time savings, value-added products and outcomes, and cost–benefit information where possible.

Sharing data saves money because the data do not have to be re-created over and over. Also there is a strong advantage to having data that are developed by the most knowledgeable entities. The Texas Stratmap program is an example. With only $10 million of state money, $40 million worth of data was produced by leveraging partnership dollars from state and federal agencies, local government, and the private sector. Where feasible, the data were vertically integrated, which resulted in data layers that were easy to use and understand. For example, DOQs were used as a base to produce the soils, hydrology, and transportation layers. The horizontal control used to produce the digital elevation models has also been used to georeference subsequent Texas Landsat Enhanced Thematic Mapper imagery. This provides for seamless data integration within agencies and between agencies and other data users. Without this cooperation, it is unlikely that these data would have been developed in any reasonable time frame, if ever.

Sharing data also helps to provide better communication and coordination with other agencies. Understanding data (and any confidentiality issues) gives other agencies a greater awareness of the issues with which each agency deals.

4. How useful are the environmental data layers that have been collected to transportation?

A number of these layers provide direct inputs to transportation planning and project development. To reduce both impacts on natural resources and mitigation costs, it is important to know where the environmental constraints or concerns are in the landscape. This requires environmental data. For efficient construction, data on soils, hydrology, and slope are of critical importance.

Having the data managed and provided up front also produces significant cost savings compared with paying for collection of the same data over and over again with each new project or planning-related activity.

5. How useful are the transportation data layers that have been collected to the natural resource community?

Data on the transportation system are important for improving access for environmental surveys. Natural resource scientists and managers are often involved in fieldwork, which requires access to areas previously unvisited by the responsible parties. It is, therefore, critical to have an accurate, up-to-date transportation data layer, and even more critical in emergency response or law enforcement scenarios. Also, transportation layers provide an effective spatial reference in areas where other landmarks are unavailable. This can be especially important in finding landmarks for georeferencing historical photography.

It would be helpful, however, to have a clearer perspective of the full spectrum of transportation data that may be available. Data on existing or planned transportation corridors are important for conservation planning purposes. These data sets can be used in predictive modeling to show population growth and development potential and can allow a type of cost–benefit analysis in comparing different areas for conservation action. Such analyses of data provide information to be considered in natural resource threat assessments or related conservation planning techniques and can enable strategic decision making in weighing conservation area alternatives.

Having such transportation planning data can allow planners to avoid critical environmental areas up front rather than mitigating losses later. In cases where critical areas cannot be avoided, early information on project location within a potential alignment can help planners minimize impacts.

DATA MANAGEMENT PROFILE

6. Who provides environmental spatial data in your state?

In general, environmental spatial base data are provided by the Texas Natural Resources Information System (TNRIS), a division of the Texas Water Development

Board (TWDB). TNRIS serves as the state clearinghouse for natural resource and cultural resource data.

However, custodial data are also produced by state and federal agencies, including the Texas Parks and Wildlife Department (TPWD), the Texas Commission on Environmental Quality, the Texas General Land Office, TWDB, the Texas Railroad Commission (which regulates oil and gas), the Texas Historic Commission, the Texas Department of Agriculture, the Texas Department of Health, the Texas Department of Transportation (TxDOT), USGS, EPA, the U.S. Fish and Wildlife Service, the Natural Resource Conservation Service (NRCS), the U.S. Forest Service, the Federal Emergency Management Agency, the U.S. Bureau of the Census, the National Oceanic and Atmospheric Administration, the U.S. Army Corps of Engineers, the Centers for Disease Control and Prevention, the National Park Service, the National Aeronautics and Space Administration, the Agency for Toxic Substances and Disease Registry, the National Cancer Institute, FHWA, and the U.S. Department of Agriculture.

Other geospatial data generators include environmental consulting firms, towns and cities, environmental organizations, counties, river authorities, regional water planning groups, councils of governments, colleges and universities, research institutes, and a variety of other nongovernmental organizations, such as the Nature Conservancy (TNC) through its ecoregional conservation plans. These plans result in specific data themes developed by TNC for a specific purpose, but they are also of interest to others.

Many of the above-listed entities are custodians of data that TNRIS does not handle. Ideally in its clearinghouse role, TNRIS would have a file on each of these data sets and a seamless digital link to each one.

7. Who are the primary users of environmental spatial data?

Please see listings in answer to Question 6. Typically, geospatial data custodians—especially those with environmental resource concerns or responsibilities—are also primary users of environmental spatial data, hence the value of sharing.

8. Who are the primary supporters of statewide environmental data collection? How long have they been active supporters?

Primary supporters of statewide environmental data at the state level include TNRIS, the Department of Information Resources, the Texas Commission on Environmental Quality, the Texas General Land Office, and TPWD. In developing environmental base data layers, TNRIS work goes back to the 1970s. The big push came in the mid-1990s, after the Texas GIS Planning Council, the precursor to the Texas Geographic Information Council (TGIC), was formed to coordinate data development in Texas.

However, other governmental and nongovernmental organizations have and support statewide data sets geared toward particular environmental themes. An example is TNC's Conservation Data Center and its element occurrence records of rare, threat-

ened, and endemic species and natural communities. Such data sets are typically available on request but may be more limited in their distribution.

9. What are the user applications of the data?

Environmental spatial base data are used as a base on which to develop data specific to the needs of the users. For example, the DOQs often serve as a template on which to develop other data. They are also used to georeference other data, such as scanned historical photography. This provides for vertical integration of the resulting data. Specific uses of the great variety of digital spatial environmental data vary greatly.

TPWD has developed and is developing web applications so that users can easily access data for planning and management purposes. For example, TPWD is getting DOQs into the hands of our field staff so that, as they collect point or polygon data in the field, they can visualize how that collection relates to the landscape.

Environmental spatial data are also used for conservation planning, programmatic planning, environmental review and evaluation, and research. Specifically, the data are used for advanced identification of areas of concern, environmental review of projects, planning and avoidance, identification of potential mitigation sites, inputs to analysis tools, and possible future identification of cumulative effects.

10. How are the data shared?

In Texas, data are primarily shared through the TNRIS data clearinghouse. EPA, cities, councils of government, and other entities also have their own data archives and internal data-sharing capabilities. Data are also shared directly between agencies and organizations. Data are often provided to field staff in remote locations via CDs, e-mail attachments, FTP, FireWire drives, or accessible public drives through Internet connections, and more recently through secure access or password-protected Internet sites, using ArcIMS or map servers.

11. How are environmental spatial data collection, management, and distribution organized in your state?

TGIC works with TNRIS and other member agencies to plan for data development, acquisition, management, and distribution. TGIC also sets standards for digital data.

For non-TGIC members or entities not directly contributing to this centralized effort, there is no organization for collection, management, and distribution. TGIC is trying to embrace more entities around Texas, but it is primarily a voluntary governmental organization.

12. How does your state fund environmental spatial data collection, management, and distribution? What are the major funding barriers and opportunities?

The state legislature provided funding to TNRIS through TWDB to develop digital spatial base data through the Stratmap program. TWDB has provided funding for TNRIS to manage and distribute these data. The data were produced through cost sharing with the other state agencies, USGS, NRCS, and local partners from both the government and the private sectors. (Some of this support was in kind and not directly financial support.) Unfortunately, state funding has been severely affected by the current budget situation. Federal and other government funding is also being curtailed in the current economic climate. Private-sector and nongovernmental organization support has been adversely affected by the state of the economy as well. This is greatly affecting opportunities for cost sharing.

Homeland Security is providing funding for border and urban areas. Unfortunately, it appears to be taking funding away from other areas of the state; therefore, it is simply a redistribution of existing funding.

As for opportunities, there are untapped sources, which may best be accessed and tapped through better networking, partnering, and collaboration. These include

- The transportation sector (especially provisions in the reauthorization of the Safe, Accountable, Flexible, and Efficient Transportation Equity Act for the 21st Century);
- Government contracts (for example, federal dollars used for data collection are required to meet FGDC standards, but this is often ignored because of lack of awareness, expertise, or understanding and commitment); and
- More concerted outreach efforts to support data development and networking with cities, councils of governments, and other local and regional planning organizations, in addition to the private sector.

13. What are the laws and policies that govern environmental spatial data collection, management, and distribution in your state?

Restrictions on access to private property and sharing of data collected from that property have a major impact on the collection and sharing of environmental spatial data. Most of Texas is privately owned. Furthermore, there are legislatively mandated restrictions on access to this land by TPWD scientists. Scientists working for nongovernmental organizations, such as the Environmental Defense Fund or TNC, may have better access to private lands than government biologists, but they may be restricted by the landowner in how they can share or utilize the data they collect. It is, therefore, hard to compile a comprehensive survey of the specific locations of biological information in Texas. Data localities may have to be generalized to USGS quad maps or counties. This is especially the case for federally listed species. Even after data are collected on private lands, there are further restrictions on distribution.

NUTS AND BOLTS

14. Do all agencies use the same software and projection for environmental spatial data?

Most agencies and organizations in Texas use the ESRI suite of software products, which makes this aspect of data sharing relatively easy. There are TGIC map projection standards for statewide data sharing. However, for local applications, UTM, state plane, and unprojected decimal degrees are widely used. With modern GIS software's ability to project data or to change projections, this is a minor issue.

15. What are the standards and specifications for environmental data?

Environmental spatial base data have been produced by using USGS or other federal specifications. Individual agency data have been produced by using specifications for the particular agency.

16. What are the overwhelming data gaps for environmental data?

There is a need for the following:

- Completion of the 1:24,000 National Hydrology Data Set and the Soil Survey Geographic Database (1:24,000 soils data);
- Update of the DOQs statewide;
- Higher-resolution, more up-to-date elevation data;
- An up-to-date land cover and vegetation map;
- Completion of the 14-digit subwatersheds map;
- A flood hazards map;
- Completion of the digitizing and annotating of the polygons representing locations of species of conservation concern;
- Completion of the 1:24,000 surface geology mapping—both analog and digital (although this is a very unlikely near-term prospect given money and time constraints);
- Completion of the archaeology layer, as well as an understanding of the sensitivity of this data set;
- Better statewide wetlands map than in the National Wetlands Inventory;
- Point and nonpoint source data beyond TMDL and EPA collections;
- Digitization of the more than 100 years of the Audubon bird count records;
- County-scale land use and land use trends; and
- Complete, accurate USGS National Biological Service gap analysis for both terrestrial and aquatic systems.

17. What are some of the data confidentiality and data security issues encountered?

Most of these issues concern private property rights. Increasingly homeland security issues are becoming barriers to developing and sharing data. The Texas Council on Environmental Quality recently suggested that latitude and longitude should not be given out with its data. In addition, it may not be prudent to identify the exact locations of certain rare species because of the possibility of supporting illegal collection or intentional habitat destruction. Another example of restricted data access due to confidentiality is archaeological data. These data are provided by the Texas Historic Commission through a secure site on its Internet-based atlas of cultural and archaeological resources and locations. However, access to this information, while generally restricted to resource agencies (unless they have licensed archaeologists on staff who have obtained certified access), is not an issue for TxDOT because of the department's delegated authority for access, data collection, and protection of these resources.

18. How do you manage "rogue" data collection?

There is no real mechanism to handle this issue. The main deterrent is that such data would not be developed to standards and so would be of limited value to others. Ideally there would be metadata to inform potential users of the appropriateness of these data for their specific needs. All TGIC member agency data development with a value of $100,000 or more should be reported to the state cartographer.

19. Do you use project data to refresh databases? If so, how do you do it? How do you fund it?

Project data can be used to refresh or update databases. For example, for a potential I-69 mitigation bank, DOQs are being produced by TxDOT from 2003 photography. The DOQs will be added to the TNRIS clearinghouse. Since the source photography for East Texas DOQs is 8 years old, this will be a welcome addition to the East Texas data. The initial I-69 baseline data will also be updated and refined through field studies conducted by the section engineers. The data are also being shared (via a secure Internet site) with participating agencies in the I-69 Streamlining Pilot Project.
The biggest challenge is to recognize opportunities for project data to refresh databases and to have the ability to coordinate with that project to obtain the data. Ideally, the reporting of projects to the state cartographer will trigger these opportunities. Agencies have funding for internal projects. The major limitation, such as in the above example, is that they are often limited in aerial extent or scope.

20. How do you manage distribution and implementation of data systems?

We are working to share data through the Internet and with tools such as ArcIMS. The data will be managed in a geodatabase. Entities outside the TGIC and TNRIS axis will use a variety of ways to implement and distribute data systems.

EXAMPLES OF SHARING ENVIRONMENTAL DATA

21. Please describe interagency coordination efforts for environmental spatial data in your state. Briefly summarize and compare past and current practice.

The main interagency coordination has been the development of spatial environmental base data through TGIC. This council and its predecessor, the Texas GIS Planning Council, were established to coordinate and avoid duplication of data development.

Another important example is the work on I-69 and the efforts of the Texas Environmental Resource Stewards (TERS). These efforts include state and federal agencies working together to develop and share environmental spatial data for more efficient and economical transportation planning. TPWD is developing an ArcIMS website to share sensitive biological resource data on I-69.

TNC ecological and conservation planning efforts are good examples of coordination efforts among partners to collect, generate, and share resources, thus avoiding duplication of data development. This would include sharing of preserve boundaries and other parcel line work.

22. Which project do you think exemplifies good coordination? Why was this project successful?

The Stratmap project under TGIC is an excellent example of good coordination. It was successful because it had strong leadership and a clear objective. There was buy-in across the Texas state government. A successful argument was made to upper management and political leadership that this effort exemplified good government.

The I-69 and TERS projects discussed in the answer to Question 21 are other examples of good coordination. Excellent progress is being made on these projects, but there is still much work to do before their ultimate success can be assessed.

23. Which project did not lead to a coordinated outcome? Why do you feel this project was not successful?

So far the Water Information Integration Database, a project to use the Internet to seamlessly share water-related data among TWDB, the Texas Council on Environmental Quality, and TPWD for water resource planning, has been disappointing. This project was fully funded and supported by TWDB, but before this project was fully initiated there was a change in management at TWDB. The new management team decided it had other priorities for funding and staffing resources. To be fair, their decision was also affected by the current Texas budget crisis.

HOW CAN WE DO THINGS BETTER?

24. What advice would you give others embarking on interorganizational data coordination efforts?

We stress the following points:

1. Have clear goals.
2. Brief all potential agency-level leadership to address their concerns and build management support.
3. Find a champion (including key decision makers in cooperating organizations).
4. Address data confidentiality issues early.
5. Use already-established models and tools (if at all possible) but be able to adapt these to project-specific needs.
6. Show results as quickly as possible.
7. Maintain clear lines of communication among all partners and use them frequently.
8. Coordinate data sharing to produce cost savings and efficiencies and to gain support across agencies—this exemplifies good government.

25. Please describe your vision of well-coordinated and functioning partnerships for environmental spatial information.

These partnerships should be built on clear communication of goals, benefits, and responsibilities. Ideally, environmental entities should have common goals and a need for common data sets to help them efficiently achieve their goals. This is facilitated through organized problem-solving meetings involving dedicated staff representatives. Most agencies fill the roles of collector, developer, manager, and user of data. This allows them to see the need for partnerships from each of these perspectives. These relationships always come down to funding. There must be a way in these times of decreasing financial resources to emphasize the increasing need for coordination and pooling of resources to produce data once for the use of many.

Florida

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Jonathan Oetting, *Florida Natural Areas Inventory*
Paul Zwick, *University of Florida*
Robert J. Kawula, *Florida Fish and Wildlife Conservation Commission*
Richard Clarendon, *Hillsborough County Metropolitan Planning Organization*

GENERAL

1. What is your definition of environmental spatial data?

Environmental spatial data describe natural, physical, and human resources and include a location component, such as a physical address or geographic coordinate.

2. Why does your state feel it is important to share environmental data?

Information collection, management, and dissemination are costly endeavors. Sharing data enables organizations to leverage resources to cover the cost, reduce unnecessary spending by eliminating redundant data collection and processing, and provide a common information foundation on which to base decisions.

3. What are the benefits of sharing data? Please include time savings, value-added products and outcomes, and cost–benefit information where possible.

Sharing data saves money. For example, by using data collected by the Florida Department of Environmental Protection (FDEP) and the water management districts for the preliminary environmental review of transportation projects, the Florida Department of Transportation (FDOT) saves more than $50 million in data collection costs that would be incurred if it needed to collect those data on its own.

Sharing data improves data quality. Agencies can focus their time, expertise, and finances on gathering data about the resources they are responsible for managing. For example, FDOT gathers information about roadways, FDEP gathers information about natural resources, and the water management districts collect information about water permits. This focus allows each agency to provide the best possible data resource, which can then be made available to other organizations.

Sharing data saves time. Projects and programs can use existing information resources. Rather than starting from scratch, data sets can be updated to include current information.

Sharing data provides a basis for common understanding and decision making. For example, in Florida's Efficient Transportation Decision Making (ETDM) process, multiple agencies evaluate environmental effects of proposed transportation projects. The process brings together information from each agency into an integrated database, which provides a standard source of information for agency reviews. This encourages the reviews to be more consistent among agencies and across the state, with the ultimate outcome being more informed decision making. By also making the information available to the public, citizens are more aware of the basis for the decisions concerning these projects.

4. How useful are the environmental data layers that have been collected to transportation?

Data collected by the environmental resource agencies at the state and federal levels are useful early in the transportation planning process to help identify potential problems and project feasibility. In general, they are less useful for project-specific design and construction activities, for which more detailed information is required. For these activities, project-specific field studies are necessary.

5. How useful are the transportation data layers that have been collected to the natural resource community?

Transportation data layers provide critical base map information that natural resource organizations need to understand the current and future condition of the environment. Information about planned transportation projects helps identify potential effects on the natural resources. These effects may include both negative impacts (direct, secondary, and cumulative) and opportunities for enhancement and mitigation.

DATA MANAGEMENT PROFILE

6. Who provides environmental spatial data in your state?

The primary sources of statewide environmental spatial data in Florida are the state agencies, water management districts, and local government. The Florida Geographic Data Library (FGDL) gathers this information and makes it more widely available for public, private, and educational uses.

Additional sources of information include nongovernmental organizations, such as the Florida Natural Areas Inventory (FNAI), and private consultants working under contract with FDOT to conduct technical studies during project development.

7. Who are the primary users of environmental spatial data?

For transportation purposes, environmental spatial data are used primarily to evaluate effects of transportation projects on adjacent resources. For example, planners use the data to evaluate the feasibility of corridor alternatives. FDOT staff, consultants, and natural resource agencies also use the data to assist with environmental reviews. Permit applications include the data to document and quantify impacts. After construction, environmental spatial data are used to assist in monitoring compliance to permit standards. Members of the public can use the data to assess likely impacts of proposed projects on their homes, businesses, and neighborhoods.

8. Who are the primary supporters of statewide environmental data collection? How long have they been active supporters?

State agencies that need consistent information to manage their statewide resources are the primary supporters of statewide data acquisition. Some of the agencies with statewide programs are FDEP, the Florida Fish and Wildlife Conservation Commission, and the Department of Community Affairs. The five water management districts, although focusing on data acquisition in each of their geographic regions, have coordinated their efforts to permit consistent coverage of the state. FDOT, as a user of environmental data collected by multiple agencies, has been the primary financial supporter of FGDL, which was developed by the University of Florida. In Florida, statewide automation of environmental spatial data in a GIS form began in the late 1980s. Dissemination of that information through FGDL began in the mid-1990s.

9. What are the user applications of the data?

Users apply environmental spatial data throughout the transportation management process. Examples include identifying feasible corridor alternatives, evaluating the potential environmental effects of new projects, assessing likely mitigation strategies, producing maps for public workshops, providing information to regulatory agencies, planning fieldwork, and developing technical studies.

10. How are the data shared?

Florida's laws on public records, commonly referred to as the "Sunshine Law," require that information collected with public funds be provided on request at the actual cost of

duplication [Florida Statutes (F.S.) 119]. The phrase "actual cost of duplication" means the cost of the material and supplies used to duplicate the record but does not include the labor cost or overhead cost associated with such duplication [F.S. 119.07(1)(a)]. Therefore, a number of data-sharing mechanisms are in place for public-sector data sources. Many individual agencies exchange data directly via MOUs, which have established time frames, formats, and cost waivers. Most agencies also have procedures for responding to individual public information requests and providing access to the data via the Internet.

By far the most efficient mechanism for distributing GIS data is through FGDL. Each data provider has an MOU with the University of Florida to make information available for annual updates. FGDL staff put the data in a standard format and projection, include standard metadata files, and provide the information on CDs or for download on the Internet. FGDL also provides easy-to-use applications that allow non-GIS experts to use the data.

Environmental data gathered from the private sector for transportation purposes are usually acquired under contract on a project-specific basis. The data become the property of the contracting agency, after the contract is completed, and are shared as appropriate.

11. How are environmental spatial data collection, management, and distribution organized in your state?

The collection, management, and distribution of environmental spatial data are the responsibility of the organization generating the data. Standards and procedures usually follow the general information resource management policies in effect in that organization. In addition, there is a great deal of informal coordination and collaboration. The following examples describe these activities within the transportation agencies.

Because FDOT is an executive agency in Florida's state government, its information management resource policies fall under the umbrella of the State Technology Office (STO). The governor and legislature created STO through legislation in 2000 as a means of providing leadership and an integration path for state technology. It is the role of STO to support state agencies and departments with better models and solutions for IT. In the past, agencies had sole responsibility for their applications, data, and assets, with their own IT staff and budget. Without a unifying strategy, "silos" of IT assets multiplied across the state government. Currently, STO is working with IT teams in the state agencies to build an enterprise model for state information resources, focusing on strategic, enterprise-compliant technologies, standards, and processes. STO focuses on coordination across agency boundaries.

Within FDOT, a central information management office provides technical assistance and direction for strategic enterprise information resources that cross organizational boundaries in the department. This group maintains enterprise databases for the department. In addition, each district office and many program areas in the depart-

ment have information resource staff to support the technology needs specific to their programs. The central Environmental Management Office (EMO) recognized the need to bring together environmental resource data to support environmental evaluations of transportation projects. EMO funds FGDL to provide access to this information. There are currently more than 350 layers of GIS data in FGDL, including several types of remotely sensed images, such as Landsat Thematic Mapper and aerial photography. New data layers are continuously added to FGDL as they become available.

Florida's metropolitan planning organizations (MPOs) also collect, maintain, and disseminate data needed for long-range transportation planning in major metropolitan areas. Standards and practices vary widely according to the size and sophistication of the local government supporting each MPO. At a minimum, the MPOs typically compile data on existing and planned infrastructure for different transportation modes, service levels, and determinants of demand such as land use, population, housing units, and employment. These data are somewhat standardized, because they are utilized in the Florida Standard Urban Transportation Model Structure, or local variations thereof, to forecast traffic volumes and ridership. MPOs must periodically update these data, usually in conjunction with updates of their long-range plans every 3 to 5 years.

12. How does your state fund environmental spatial data collection, management, and distribution? What are the major funding barriers and opportunities?

Many funding sources support environmental spatial data collection, management, and distribution. Programs that need the data to operate usually include the cost in the program budget. In addition, cost-sharing programs are in effect among state, local, and federal agencies that collaborate on data acquisition, management, and distribution. Grant funds are also frequently sought to support new data acquisition projects. Many projects require additional project-specific data collection, which is included in the cost of the project.

The major funding barrier is the maintenance of the data sets to keep them up to date. It is easier to fund a one-time data collection effort than to fund ongoing updates of the data.

13. What are the laws and policies that govern environmental spatial data collection, management, and distribution in your state?

Environmental spatial data collection, management, and distribution in Florida fall under the laws and policies that apply to information resource management. The most pertinent to this discussion are the laws on public records (F.S. 119), which require that information gathered with public funds be made available to the public unless the data set is specifically exempt through legislation.

NUTS AND BOLTS

14. Do all agencies use the same software and projection for environmental spatial data?

There is no official requirement for agencies to use a specific software or projection. However, most agencies and FGDL use ESRI GIS software. Many state agencies use an Albers equal-area conic projection with parameters that have been customized for Florida. FGDL also uses the customized Albers projection. Regional and local agencies commonly use UTM or Florida State Plane coordinate systems.

15. What are the standards and specifications for environmental data?

Standards and specifications for environmental data are developed for specific data sets by the organization acquiring the data. For cooperative data acquisition activities, the participating organizations coordinate standards and specifications. For example, a common data set used with transportation projects is the existing land use and land cover data acquired by FDEP and the water management districts. This data set uses the Florida Land Use and Cover Classification System published by FDOT. FDEP and the water management districts collaborate to outline general minimum standards for acquiring the data, but the detailed specifications articulated within the data acquisition contracts are developed to meet specific agency needs and funding constraints.

16. What are the overwhelming data gaps for environmental data?

A comprehensive statewide archaeological survey has yet to be completed. Therefore, although a statewide data set of archaeological sites exists, geographic areas may not have sites in the database because no sites exist there or because the location has not been surveyed. The same is true of endangered species occurrences, historic structures, noise-sensitive sites, and smoke-sensitive areas.

FNAI's database essentially contains a complete picture of the occurrences of the rarest species. Data on the occurrences of less rare species that are more widely distributed and that may occur in hundreds if not thousands of locations around the state are incomplete. Examples of such widely distributed species include the eastern indigo snake (*Drymarchon corais couperi*) and the gopher tortoise (*Gopherus polyphemus*).

Detailed soil surveys still need to be completed for several counties.

Many counties collect more detailed and accurate environmental data than are available from the state agencies. These data need to be compiled statewide.

Although much of the natural and physical environment has been mapped and digitized, the data have not all been kept up to date. Therefore, there is a growing gap of data describing current conditions.

Other than census data, information about the social environment is not widely available. Property appraiser maps are still being converted to a digital format in many counties and need to be compiled for statewide coverage. An inventory of standard community characteristics is not well defined and is not available statewide.

17. What are some of the data confidentiality and data security issues encountered?

The most common data confidentiality issue that arises in transportation applications is the location of resources that are sensitive to exploitation, such as archaeological sites and endangered species occurrences. For example, at FNAI, approximately 5% of the rare species occurrences are considered data-sensitive for three possible reasons:

- The species is subject to collection (e.g., orchids) or destruction (e.g., venomous reptiles).
- The landowner stipulates that the occurrence be kept confidential.
- The data provider requests that the data not be distributed.

Property appraiser data also require a special request and processing fees because of confidentiality.

In some cases, demographic data collected by the Census Bureau are suppressed at the block group level to protect the confidentiality of individuals and households. Likewise, social service agencies collecting data that could be used to evaluate socio-cultural effects may resist divulging data for reasons of client confidentiality.

A major data security issue currently being addressed is the protection of information resources from intentional damage by hackers, as more information is made available and used on the Internet.

18. How do you manage "rogue" data collection?

This group identified two types of activities that might be characterized as rogue. First is the redundant acquisition of data that are already available or being gathered by another organization. This is best managed through communication and coordination. The second activity is when public data are gathered and sold at a profit without adding any value to the data. This activity has been prevented by making public data widely available at little or no cost. FGDL has helped manage both of these situations by making more information available to a wider audience.

19. Do you use project data to refresh databases? If so, how do you do it? How do you fund it?

Certain project data are used to update operational databases, such as the Roadways Characteristics Inventory. This is done with department procedures and operational

funds. Other environmental databases are usually not updated with project data unless the source organizations have mechanisms in place to receive these updates. For example, information about historic and archaeological sites collected for technical studies of environmental assessments is often transmitted to the State Historic Preservation Office as part of the study, using that office's published procedures for submitting updates to the Florida Site Files. Likewise, FNAI encourages users to submit updates from field surveys to its rare species occurrence database.

MPOs periodically update their inventories of roadway, transit, bicycle, and pedestrian facilities, typically using secondary data from implementing agencies, aerial photography, or if necessary, primary data collected via field surveys. MPOs receive state and federal formula grants for planning purposes, but for large data collection efforts, MPOs may have to tap resources such as FHWA Surface Transportation Program funds that would otherwise be spent on building projects.

20. How do you manage distribution and implementation of data systems?

FDOT follows the guidelines and procedures established by STO for the distribution and implementation of data systems. The development of the Environmental Screening Tool to support Florida's ETDM process provides an example.

When problems of the current environmental review process were first being addressed, the interagency working group recognized a need for an innovative technology application to create efficiencies and support improved decision making. The working group established the following objectives for the technology:

- Allowing agencies to easily access project planning information and other data about potentially affected community and natural resources;
- Maintaining a record of agency opinions and requirements, along with FDOT responses and commitments, throughout the life cycle of the project;
- Improving public access to data and to agency opinions and requirements; and
- Capitalizing on existing GIS resources.

A committee of IT experts was created to identify an approach that would meet these requirements. From the recommendations of the committee, an implementation plan was developed. The implementation plan identified the resource requirements, development approach, and deployment strategy for the Environmental Screening Tool application. Under general system requirements, the plan described the hardware, software functionality, and data needed by the ETDM GIS user community. It outlined the application development approach and standards that would be used to design, develop, and implement the application. The plan reported the results of alternative configurations that were evaluated for the application and included recommendations for the specific software, hardware, and physical server locations that best met the needs of

the project. In conclusion, the plan listed the application acceptance criteria, system limitations, installation plan, training strategy, and recommendations for a maintenance approach. Application development began after the plan was approved by the FDOT EMO.

Because an innovative technology solution was fundamental to the success of the new process, application development occurred in conjunction with process refinements. This created a flexible environment in which the process could be refined to take advantage of technology, and the technology could be easily adjusted as process details were defined. The technology team leader regularly attended the steering committee meetings and work group sessions to enable continual feedback about technology capabilities, process refinements, and development activities. The application and database were developed with the following general methodology:

1. Determine general system requirements for the conceptual process.
   - Establish technology goals consistent with the objectives of the ETDM process.
   - Review existing information systems used in the agencies.
   - Identify existing computer resource capabilities within the target user community.
   - Evaluate technology options.
2. Lay the database foundation.
   - Conduct a statewide data needs assessment with the cooperating agencies.
   - Identify and acquire existing sources of environmental resource data.
   - Design the ETDM database.
3. Design and develop the user interface in modules.
   - Develop prototypes on the basis of general system requirements.
   - Present prototypes for feedback from the steering committee and potential users.
   - Modify modules on the basis of feedback.
4. Update and add tools within the modules as the process details are refined.
   - Continue to meet with the steering committee, consultants, and users to help refine the process.
   - Develop system specifications for modifications and enhancements.
   - Implement modifications and enhancements after concurrence from the steering committee.
5. Provide public access through the Internet.
   - Build custom applications for the public to query and review maps and reports from the ETDM database.
   - Provide access to the public applications through the FDOT EMO website on the MyFlorida.com portal.
   - Distribute environmental data through FGDL.

EXAMPLES OF SHARING ENVIRONMENTAL DATA

21. Please describe interagency coordination efforts for environmental spatial data in your state. Briefly summarize and compare past and current practice.

Interagency coordination efforts for environmental spatial data have evolved in Florida as the focus of resources shifted from initially acquiring the data, to making existing data more accessible, and finally, to keeping the data current and relevant.

Statewide coordination of environmental spatial data began in Florida in the mid-1980s under the auspices of the Florida Growth Management Data Network Coordinating Council. This group successfully negotiated and implemented a joint cost-sharing agreement among USGS and several state agencies for the acquisition of a digital base map of Florida using the USGS 7.5-minute quadrangle maps. The data layers collected under this initiative included transportation, hydrography (water and wetlands features), administrative boundaries, public land survey lines, and digital orthophotography. Through coordination and cost sharing, the state saved approximately $12 million in data acquisition. After the project was well established, maintenance and coordination of future updates of this information were assigned to FDEP. Primarily because of the success of this project, the legislature expanded the membership and responsibility of the group by creating the Florida Geographic Information Board in 1996 to facilitate the identification, coordination, collection, and sharing of geographic information among state, regional, local, and federal agencies and the private sector. Unfortunately, the new board was never able to achieve the success of its predecessor and was eliminated in 2001.

By the mid-1990s it became apparent that a more effective way of coordinating data acquisition costs was through focused meetings of the data managers who were responsible for acquiring and maintaining specific data sets. The GIS managers from various agencies began meeting regularly to discuss coordination of data sets that each of their organizations needed, such as digital aerial photography, land use and land cover data, soil classifications, and satellite imagery. These groups developed standard data specifications, used cost-sharing opportunities, and exchanged data as they became available.

Meanwhile, more and more environmental spatial data layers were becoming available from many organizations in Florida. The GeoPlan Center at the University of Florida recognized the need to bring these data together in a standard, easy-to-use format that was accessible to the general public. With the cooperation of FDEP and FDOT, the GeoPlan Center developed FGDL, which compiles data and images collected from numerous state and federal governmental agencies and from some nonprofit organizations and private companies. The 2003 release of FGDL contains more than 350 data layers. FDGL's main benefits are its contributions to the availability, clarity, and uniformity of Florida's databases. Data are distributed on the Internet and on CD-ROM among state agencies and to the public and private sectors. Customized applications make the data easier for non-GIS experts to use. The data are provided in a standard

format, projection, and documentation; many users do not require any additional data processing to begin analyses.

Currently, Florida has a wealth of environmental spatial data. The challenge today is to maintain and improve the usefulness of the information so that it supports efficient decision making. Data sets need to be kept up to date. Data gaps need to be filled. Locational accuracy needs to be improved so that the data can be applied to more applications. All this takes funding, which in turn requires coordination to identify joint funding and data-sharing opportunities to reduce the cost. Coordination is also needed to develop standards to update statewide databases with data from project field surveys and from local agency data sets. The latter is particularly important given Florida's 25 MPOs, each of which maintains its inventory data in different formats, nomenclatures, and levels of detail. Florida's ETDM process provides an excellent opportunity for this coordination to occur through the FDOT district offices and their Environmental Technical Advisory Teams (ETATs).

22. Which project do you think exemplifies good coordination? Why was this project successful?

The development of Florida's ETDM process exemplifies good coordination. It promises to be successful because of the manner in which the new process was developed. Senior officials from participating agencies initially agreed to support the development of a new process for the environmental review and permitting of transportation projects. They assigned technical experts to represent their agencies in a working group. This working group identified problems and inefficiencies in the current process and jointly developed the new ETDM process. Key concepts within the new process include

- Early involvement by resource agencies in the transportation planning process through the use of ETATs,
- Ongoing community outreach,
- Use of GIS and Internet technology to assist in communication and support of environmental reviews, and
- Commitment to resolve disputes before placing projects in the FDOT work program.

After the concept was defined, the senior officials from each agency came back together to sign an MOU supporting the new process. An interdisciplinary team of consultants and FDOT staff developed initial details of the process. Concurrently, the team began developing an interactive database and mapping application to be used over the Internet. This application enables ETAT members to review project information, view maps, query results of GIS analyses, and record comments about project impacts on priority resources. The technology builds on existing environmental spatial data available through the FGDL. Before releasing the process guidelines and the application, the interagency working group was brought back together to test the process and

the Internet application. When these proved successful, agency operating agreements were developed to define ETAT responsibilities, and a statewide training program was deployed.

While the early indications are promising, the ETDM process is being phased in and is not yet in full operation.

23. Which project did not lead to a coordinated outcome? Why do you feel this project was not successful?

The Florida Geographic Information Board was created to coordinate the sharing of spatial data throughout the state. It was disbanded when it failed to produce quantifiable results. A number of factors led to this failure. First, it failed to pool expertise available throughout the state to identify priority problems that needed to be solved. Therefore, it did not focus time or resources on the issues most important to the state. The state experts found other mechanisms for coordinating on relevant spatial data issues. Second, although it garnered support of the state's senior managers, it did not delegate responsibility to technical experts within the agencies. Therefore, not only did it not have a focus, it did not have the expertise to accomplish the work. Finally, it got entangled in a political quagmire. Because it could not quantify successful results and did not have support of experts in the field, it lost support in the legislature and was eliminated.

HOW CAN WE DO THINGS BETTER?

24. What advice would you give others embarking on interorganizational data coordination efforts?

- Garner senior management support from all agencies involved.
- Establish clear goals, taking the opportunity to focus on and solve priority problems.
- Rely on a multidisciplinary team of experts to identify problems and solutions. Expertise should include information management specialists, data content specialists, and specialists in the fields for which the data will be used.
- Work in a spirit of cooperation. Participants should listen and respect different points of view even when they do not agree.
- Articulate project benefits.
- Evaluate and demonstrate progress.

25. Please describe your vision of well-coordinated and functioning partnerships for environmental spatial information.

Nongovernmental Organizations: FNAI

Organizations that create and distribute data often show reluctance to release their data if the distribution process is not under the organization's control. For data providers to share data freely, they need to have assurance that the data will not be misused or misinterpreted and that the widespread distribution of their data will not undermine the fundamental work of the organization. To reach that level of assurance, the following issues should be addressed.

Funding Data providers need adequate funding for data creation, compilation, quality control, maintenance, and distribution. Today's computer databases and GIS data are easily copied and transferred, and data users are often able to obtain vast quantities of data for little or no cost. This leads to a "disconnect" between data use and data creation, where the users are unaware of the costs required to create and maintain data and expect that data should be cheap and freely available. Data providers are then faced with the dilemma of meeting market demand and expectations, which undercuts funding, or curtailing distribution of the data by restricting access or imposing higher data fees, which damages their credibility and reputation as a cooperative data provider. Data providers need stable funding that covers all data creation and maintenance needs up front so they will not need to recover those costs through data distribution. They will then be able to meet market demand by providing their data at little or no cost. Free (or cheap) distribution also has the advantage of undercutting potential pirate sellers, that is, those who obtain and redistribute the data for profit.

Data Design and Interpretation Many of the data now widely available as GIS coverages were originally designed for internal use (or for very limited distribution) by the organization that creates and maintains the data. The data model (database design and mode of use) was therefore intended for users who would be highly trained in both database operation and interpretation of data content. Releasing these data for widespread distribution exposes the data model to naïve users who lack understanding of the underlying purpose of many features of the database as well as expertise in interpretation of content. Imagine purchasing a VCR with no manual and no labels on the front panel buttons. Users would know the basic purpose of the machine, and many could manage to operate it at some basic level, but important features would be ignored or misused. Misuse of data can often be worse than having no data at all. Metadata is generally an inadequate solution, as it is usually not designed to teach expertise in the data model and content. Data providers need the opportunity to create a data model designed for public consumption or at least to filter the existing data model through an interpretive interface.

Data Sensitivity As previously discussed, many GIS coverages contain data that are sensitive to exploitation and therefore not appropriate for widespread distribution. Data providers need the ability to restrict distribution of sensitive data or alternatively to mask sensitive data if they are to be widely distributed.

Data providers recognize the need for their data to be available for a wide range of uses and realize that their data are often an important piece of a larger assembly of information needed for the success of many programs. If the three issues discussed above are adequately addressed, data providers can become cooperative and even enthusiastic partners in a successful data-sharing effort.

Planning and Transportation Agencies

Planning and transportation agencies are users of a wide variety of environmental spatial information. Well-coordinated and functioning partnerships for environmental spatial information make these data available from multiple sources. FGDL is a good example. Organizations that generate the data are responsible for maintaining and documenting the data. They remain the experts for their specific data sets. Each data provider has an MOU with the University of Florida to make information available for annual updates. FGDL puts the data in a standard format and projection, includes standard metadata files, and provides the information on CDs or for download on the Internet. FGDL also provides easy-to-use applications that allow non-GIS experts to use the data. FDOT, as a primary user of FGDL, has been the major funding source for compiling and storing data in the library.

Through the ETDM process, planning agencies will be the earliest beneficiaries of environmental spatial data. When the process is fully operational as intended, MPO planners will be able to tap into a wealth of environmental data and online expertise to gain insight into their planned projects. This will enable them to quickly determine whether a proposed project will cause significant environmental impacts. Such information is invaluable in deciding whether to pursue the project; alter it to avoid, minimize, or mitigate impacts; or drop the project entirely before it becomes part of an adopted plan.

In a world of scarce financial resources, the constant challenge for MPOs is to establish the relative priority of candidate projects for funding. In other words, MPOs must be able to separate the "wheat from the chaff." ETDM is expected to become an important tool in allowing MPOs to make more informed decisions.

Once an MPO decides to include a project as part of an adopted long-range transportation plan, the documentation coming out of the ETDM process is expected to become part of the project record, incorporating issues for further study, identifying those that need no further analysis, and documenting project commitments to permitting and resource agencies and the public. These records will become increasingly important as a project moves from planning to implementation.

Environmental Agencies

Environmental agencies are the primary generators of environmental spatial data. To support this function, successful partnerships embark on joint funding agreements and data-sharing activities to reduce the cost of data acquisition and data updates. They work together to develop standards and specifications to create consistent data layers across the state. They also keep each other informed about data collection activities to eliminate duplicative data acquisition. This collaboration should be organized in multiagency working groups of experts for each data layer or data acquisition activity. The coordinated acquisition of statewide land use and land cover data interpreted from USGS aerial photography is an excellent example of this type of partnership. A multiagency group of GIS managers identified this layer as a priority data set used by each agency. These managers pulled experts together from their agencies to develop standards and format specifications. They entered into a joint funding agreement with USGS to acquire the aerial photography. Then, they each funded data automation contracts for separate geographic regions and exchanged data so that they all ended up with a consistent statewide data layer that met the needs of each agency. The data were subsequently made available to FGDL for distribution. The broad base of users who rely on the information helps justify funding for future updates.

Information Technology Specialists

IT specialists include information resource managers, data analysts, application developers, and system managers. From the perspective of these information resource professionals, good coordination results in low-cost alternatives for data acquisition, good database design that is flexible enough to meet a broad spectrum of user requirements, use of best practices for information management, and easy access to information by the private and public sectors. The data should be of the best quality that resources allow. They should be current, complete, consistent, and accurate. To meet these requirements, interagency partnerships that collaborate on issues related to environmental spatial data to support transportation decision making should be developed to do the following:

1. Seek senior management and legislative support for the funding of priority multiagency data acquisition projects. The funding should encompass the data management process, including creation, maintenance, and distribution of the data.
2. Identify gaps in priority data needs that support transportation decision making.
3. Provide forums for technical experts to identify the approach, standards, and specifications for filling these gaps. These forums should consider issues such as joint funding opportunities, incorporation of data from existing sources, automation specifications, data format specifications, database design, quality assurance, documentation, maintenance and updates, and data distribution.
4. Ensure that the data and information products are easily accessible by a wide spectrum of users.

APPENDIX A

Abbreviations and Acronyms

CAB	Customer Advisory Board
CEDAR	Comprehensive Data and Reporting System
DHR	Department of Historic Resources
DIS	Department of Information Services
DOQ	digital orthophoto quads
DOT	department of transportation
EMO	Environmental Management Office
EPA	Environmental Protection Agency
ESA	Endangered Species Act
ETAT	Environmental Technical Advisory Team
ETDM	Efficient Transportation Decision Making
FDEP	Florida Department of Environmental Protection
FDOT	Florida Department of Transportation
FGDC	Federal Geographic Data Committee
FGDL	Florida Geographic Data Library
FHWA	Federal Highway Administration
FNAI	Florida Natural Areas Inventory
FOIA	Freedom of Information Act
F.S.	Florida Statutes
FTP	File Transfer Protocol
GIS	geographic information systems
GIT	Geographic Information Technology
IECC	Interagency Environmental Coordinating Committee
INRDS	Integrated Natural Resources Data System

ISB	Information Services Board
IT	information technology
LIDAR	light detecting and ranging
MOST	Management and Oversight of Strategic Technologies
MPO	metropolitan planning organization
NAD	North American Datum
NEPA	National Environmental Policy Act
NGO	nongovernmental organization
NRCS	Natural Resource Conservation Service
PSLC	Puget Sound LIDAR Consortium
RCW	Revised Code of Washington
SASSI	Salmon and Steelhead Stock Inventory
SERP	State Environmental Review Procedure
SSHIAP	Salmon and Steelhead Habitat Inventory and Assessment Project
STO	State Technology Office
TERS	Texas Environmental Resource Stewards
TGIC	Texas Geographic Information Council
TMDL	total maximum daily load
TNC	The Nature Conservancy (of Texas)
TNRIS	Texas Natural Resources Information System
TPEAC	Transportation Permitting Efficiency and Accountability Committee
TPWD	Texas Parks and Wildlife Department
TRB	Transportation Research Board
TWDB	Texas Water Development Board
TxDOT	Texas Department of Transportation
URL	Uniform Resource Locator
USDOT	U.S. Department of Transportation

USGS	U.S. Geological Survey
UTM	Universal Transverse Mercator
VDOT	Virginia Department of Transportation
VGIN	Virginia Geographic Information Network
WAGIC	Washington State Geographic Information Council
WDFW	Washington Department of Fish and Wildlife
WSDOT	Washington State Department of Transportation

APPENDIX B

Questions for the State Reports

The following were the questions state teams used in preparing the advance reports on partnering for environmental data in their states.

GENERAL

1. What is your definition of environmental spatial data?
2. Why does your state feel it is important to share environmental data?
3. What are the benefits of sharing data? Please include time savings, value-added products and outcomes, and cost–benefit information where possible.
4. How useful are the environmental data layers that have been collected to transportation?
5. How useful are the transportation data layers that have been collected to the natural resource community?

DATA MANAGEMENT PROFILE

6. Who provides environmental spatial data in your state?
7. Who are the primary users of environmental spatial data?
8. Who are the primary supporters of statewide environmental data collection? How long have they been active supporters?
9. What are the user applications of the data?
10. How are the data shared?
11. How are environmental spatial data collection, management, and distribution organized in your state?
12. How does your state fund environmental spatial data collection, management, and distribution? What are the major funding barriers and opportunities?
13. What are the laws and policies that govern environmental spatial data collection, management, and distribution in your state?

NUTS AND BOLTS

14. Do all agencies use the same software and projection for environmental spatial data?
15. What are the standards and specifications for environmental data?
16. What are the overwhelming data gaps for environmental data?
17. What are some of the data confidentiality and data security issues encountered?

18. How do you manage "rogue" data collection? (Note: For the purposes of this meeting, "rogue" data collection refers to data collected by individuals without corporate knowledge or authorization. The existence of these data sets is frequently unknown to other potential users, the data often lack explicit quality standards, and adequate documentation to facilitate data sharing is often missing.)

19. Do you use project data to refresh databases? If so, how do you do it? How do you fund it?

20. How do you manage distribution and implementation of data systems?

EXAMPLES OF SHARING ENVIRONMENTAL DATA

21. Please describe interagency coordination efforts for environmental spatial data in your state. Briefly summarize and compare past and current practice.

22. Which project do you think exemplifies good coordination? Why was this project successful?

23. Which project did not lead to a coordinated outcome? Why do you feel this project was not successful?

HOW CAN WE DO THINGS BETTER?

24. What advice would you give others embarking on interorganizational data coordination efforts?

25. Please describe your vision of well-coordinated and functioning partnerships for environmental spatial information.

APPENDIX C

Agenda

Monday, June 23

8:00 a.m.	Introduction and Overview of the Peer Exchange
8:30 a.m.	Introduction of Participants
10:00 a.m.	Regional Presentation—Washington
10:45 a.m.	Discussion
11:15 a.m.	Regional Presentation—Virginia
Noon	Discussion
12:15 p.m.	Common Points from the Morning Sessions
1:30 p.m.	Regional Presentation—Texas
2:15 p.m.	Discussion
3:00 p.m.	Regional Presentation—Florida
3:45 p.m.	Discussion
4:30 p.m.	Common Points from the Afternoon Sessions
4:45 p.m.	NatureServe Perspectives
5:00 p.m.	Perspectives Presentations Working Session

Tuesday, June 24

8:00 a.m.	Goals of the Day
8:30 a.m.	Perspectives on Partnering for Environmental Data: Transportation
9:15 a.m.	Discussion
10:00 a.m.	Perspectives on Partnering for Environmental Data: Resource Agencies and Regulators
10:45 a.m.	Discussion
11:30 a.m.	Perspectives on Partnering for Environmental Data: Nongovernmental Organizations

12:15 p.m.	Discussion and Reflections from the Morning
1:30 p.m.	Perspectives on Partnering for Environmental Data: Information Technology Managers
2:15 p.m.	Discussion
3:00 p.m.	Discussion
	Common Points from the Perspective Presentations
	Uncommon Points and Why
4:30 p.m.	Discussion Continued
	Next Steps
	Messages for Other States
	Take-Home Messages from the Peer Exchange
	Advice for Other States
5:00 p.m.	Adjournment

APPENDIX D

Questions for the Perspectives Discussion

1. Do you believe the environmental information coordination that occurs now addresses the most pressing needs of your functional group?
2. What do you think are the issues that limit effective coordination on environmental information?
3. What are the top two issues that you can change within your own functional area to improve coordination on environmental information?
4. What are the top two things you would like each of the other functional groups to change to improve coordination?
   - Transportation
   - Environmental agencies
   - Nonprofit organizations
   - Information technologies
5. What messages do you think will help convince lawmakers and decision makers to fund and foster coordination on environmental information?
6. Do you have examples of cost savings? time savings? improved outcomes due to better information? If not, what are the barriers to developing these measures?
7. What are the key recommendations you would make to other states to improve coordination of environmental information?

Please be prepared to present your perspectives to the group on Tuesday morning. You will have 45 minutes and may have one or multiple presenters. Resources to use flip charts or PowerPoint presentations will be available.

Committee Member Biographical Information

Ellen Oman, *Chair,* is currently the Manager of Transportation Research with the Washington State Department of Transportation. In this position, she is responsible for managing the transportation research program. She has a diverse environmental background that includes experience in fisheries and wildlife management, geographic information system (GIS) application development, water quality, and watershed management. In those capacities, she has been active in collaborative efforts for development and use of environmental data. Before her recent selection as Manager of Transportation Research, she was responsible for environmental regulations, watershed management, environmental information management, and environmental cost–benefit analysis. Previously she was employed by a number of natural resource agencies. Ms. Oman has a master of science degree in veterinary sciences from the University of Idaho and a bachelor of arts degree in aquaculture from Goddard College. She served on the National Research Council's Committee on Remote Sensing and Spatial Information Technologies for Transportation from 2000 to 2003.

C. Leroy Irwin currently serves as the Manager of a newly created Environmental Management Office to oversee all environmental aspects of the Florida Department of Transportation (FDOT). He is responsible for program delivery, policy and procedure development, training, and quality assurance for all environmental programs. He is directing the Environmental Streamlining Effort for FDOT as a pilot state for the Federal Highway Administration and the American Association of State Highway and Transportation Officials. This initiative uses a web-based GIS program to integrate environmental considerations into the transportation planning and project development processes. The project involves FDOT, 23 state and federal agencies, and 25 metropolitan planning organizations. Mr. Irwin graduated from the University of Florida with a bachelor of science in agriculture, with a major in botany and a minor in bacteriology.

Robert J. Kawula currently works for the Florida Fish and Wildlife Conservation Commission's (FWC's) Office of Environmental Services (OES). His research interests include the use of GIS to determine habitat use patterns and the use of landscape metrics to assess wildlife habitats. In addition to species habitat modeling, his job responsibilities include maintenance and systems administration of OES's GIS system and databases, and providing technical assistance to FWC biologists, other agencies, and the public. He cooperates with FDOT. He brings the natural resource agency perspective to the committee. He received a Ph.D. from Southern Illinois University in zoology, with a major area of study in waterfowl ecology and biostatistics.

Aaron Kim Ludeke has served as the GIS Laboratory Manager at the Texas Parks and Wildlife Department since 1993 and as the Chairman of the Texas Geographic Information Council (TGIC) since 1999. TGIC is a cooperative association of state agencies, councils of government, state universities, and cities. TGIC has worked across agency lines at the local, state, and federal levels to develop statewide digital geospatial data and to set GIS standards for Texas. Under Ludeke's management, the laboratory works cooperatively on projects with federal and state agencies such as the Texas Department of Transportation and the U.S. Fish and Wildlife Service. He received a Ph.D. in recreation and resources development from the College of Agriculture at Texas A&M University.

Bruce A. Stein is Vice President for Programs for NatureServe, a provider of scientific information about rare and endangered species and ecosystems. As Vice President for Programs, Stein is involved in overseeing an array of activities related to making NatureServe's biodiversity information more accessible and useful to land managers, policy makers, and the general public. He was a senior scientist with the Nature Conservancy for more than a decade and was involved in the establishment of biological inventories throughout the Western Hemisphere. Dr. Stein's nongovernmental background and experience in providing ecosystem data to local and regional organizations brings important perspectives to the committee. He received a Ph.D. from Washington University, St. Louis, in a joint program with the Missouri Botanical Garden. He has served on the National Research Council's Committee on Future Roles, Challenges, and Opportunities for the U.S. Geological Survey.

Daniel K. Widner is the GIS Manager for the Virginia Department of Transportation's Information Technology Applications Division. His responsibilities include departmentwide GIS; geospatial data integration with environmental programs; geospatial data integration for asset management; road inventory information management; and geospatial coordination with local, state, and federal governments. He brings a strong information systems perspective to the committee. Mr. Widner has a bachelor of arts degree in geography from Indiana University.

Participants

FLORIDA TEAM

Richard Clarendon, *Hillsborough County Metropolitan Planning Organization*
C. Leroy Irwin, *Florida Department of Transportation*
Robert J. Kawula, *Florida Fish and Wildlife Conservation Commission*
Jonathan Oetting, *Florida Natural Areas Inventory*
Paul Zwick, *University of Florida*

TEXAS TEAM

Aaron Kim Ludeke, *Texas Parks and Wildlife Department*
Dominique Lueckenhoff, *U.S. Environmental Protection Agency, Region 6*
Carter Smith, *Nature Conservancy of Texas*
Jimmy Tyree, *Texas Department of Transportation*

VIRGINIA TEAM

Steven Carter-Lovejoy, *Virginia Division of Natural Heritage*
Trent Park, *Virginia Department of Historic Resources*
Daniel K. Widner, *Virginia Department of Transportation*

WASHINGTON STATE TEAM

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Elizabeth Lanzer, *Washington State Department of Transportation*
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OTHER PARTICIPANTS

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