

Interagency Leadership Team  
Enhancing and Managing a Shared GIS Database

## **Summary Report**

### ***What Is the Problem?***

The quality of life for the citizens of North Carolina, both urban and rural, is heavily dependent on transportation. There is consensus among the Interagency Leadership Team that the transportation system should be planned hand-in-hand with economic development and the protection and enhancement of our State's cultural and natural resources. To facilitate the effective and efficient development and management of our transportation systems, we need a tool that provides reliable, up-to-date, and complete data necessary for planning transportation projects and identifying and assessing their impacts on the economy and natural and human resources. Geographic information systems (GIS) is just that tool. Unfortunately, the GIS data necessary for transportation and environmental decision-making is either out of date or does not exist at all statewide.

GIS is a decision-support tool that allows the user to combine many types of data onto a digital map and then analyze that information in an efficient manner. The multitudes of data that are necessary for the complex analysis and synthesis inherent in transportation development are available on a computer, literally at a person's finger tips, and can reduce the need to spend time and money visiting sites and doing extensive hands-on surveys and research. Some GIS data layers do exist in North Carolina, but the full benefits of GIS are not being realized in terms of productivity and efficiency because data layers are either incomplete, out of date or completely non-existent for some resources. This situation is a result of a lack of financial and human resources at the local, state, and federal government levels to create and maintain GIS information that is instrumental for good decision-making.

### ***What Is the Solution?***

The Interagency Leadership Team, comprised of ten state and federal agencies that are involved in the transportation planning and environmental decision-making process, believes that enhancing the shared GIS database is a critical step toward more effective and efficient transportation planning while recognizing the value of North Carolina's natural and cultural resources. Further, the development and maintenance of electronic data sharing using GIS was identified by the North Carolina General Assembly "NCDOT Project Delivery Study Final Report" (a study commissioned by the Joint Legislative Transportation Oversight Committee) as a means of providing an analytical and visualization tool to synthesize and communicate information for planning and project development.

The Interagency Leadership Team proposes:

1. North Carolina will establish a major, focused effort to create or update 171 GIS data layers and then maintain them on a specified basis depending on the type of data. With this concentrated effort, the majority of these data can be updated within one year after funding is made available. A few other data layers require a three to five-year development period due to the finite number of private sector companies that are qualified to perform certain specialized work to create those data layers. Some examples of these data layers that require a longer development period are Terrestrial Archaeological Sites and Historic Properties and Districts.
2. The Center for Geographic Information and Analysis (CGIA), in cooperation with the North Carolina Department of Transportation, will manage the proposed multi-year data development effort. CGIA is the lead state agency in North Carolina for GIS.
3. The updated and maintained GIS database will be available over the Internet through NC OneMap. NC OneMap is a statewide, internet-accessible GIS data resource that now includes data from over 90 city, county, regional, state, and federal government agencies. For those data layers that are protected by provisions in the General Statutes, those data will only be accessible by agency staff and others on a restricted access basis.

### ***How Much Does It Cost?***

The cost of this initiative consists of development, maintenance and project management costs, as described below:

1. Data development, primarily performed by private sector contractors
2. Maintenance of the data layers by a combination of private contractors and state government staff
3. Project management that is focused on ensuring that data is developed consistently using best practices and that dependencies between data layers are handled efficiently early in the process and consistently throughout the duration of the project and across all 171 GIS data layers. CGIA will serve as project manager for this effort.

The project costs:

- **\$38.2 Million** - data development/enhancement for this multi-year initiative. Approximately \$ 26.3 million will go to the private sector to perform data development for certain data layers in cooperation with the responsible state agencies.
- **\$4.7 Million** - recurring annual maintenance cost to keep the data layers current on an ongoing basis. Approximately \$4.0 million will go to the private sector.

The largest cost drivers within the total estimated cost are data development tasks associated with 17 data layers. These are shown in Attachment 1 and include (in order of highest cost): Stream Mapping, Surveyed Historic Properties, Terrestrial Archaeological Sites, Parcel Boundaries, Digital Aerial Imagery (Orthophotography), Wetlands Inventory, and Water Distribution Systems-Pipes.

## **What Are the Benefits?**

In order to determine the quantitative and qualitative benefits, a questionnaire (see Attachment 3) was developed and sent to the agencies that comprise the ILT:

- North Carolina Department of Transportation
- North Carolina Department of the Environment and Natural Resources
- North Carolina Department of Commerce
- North Carolina Department of Cultural Resources
- North Carolina Wildlife Resources Commission
- United States Army Corps of Engineers
- Federal Highway Administration
- United States Fish and Wildlife Service
- Environmental Protection Agency
- National Marine Fisheries Service

Generally, the benefits to be realized from implementing this project and sustaining the enhanced, shared GIS database are:

- **Cost savings** can be realized through decreasing the amount of overall time for project delivery through better screening of projects for the Merger process and use of GIS to reduce the number of alternatives that need to be carried forward for detailed studies. The largest cost savings are derived from the increased construction costs due to inflation and direct labor savings.
- **Current and reliable data for decision-making:** Each agency that is a stakeholder in the transportation planning and environmental/cultural resource review process can be assured that it is accessing the most current data supplied by the source agency. The stakeholders will be able to be confident of the accuracy, currency, and completeness of the GIS data since it has been updated and maintained specifically to improve those key aspects of the data.
- **Improved decision making** will occur with current, reliable information. The early identification and avoidance of key environmental resources will result in greater efficiencies in the delivery of transportation projects and better predictability of project costs and schedules. These reductions of impacts to these resources will also improve the overall quality of life for North Carolina's residents. Secondary benefits will come from non-transportation related programs and activities at the local, state and federal levels. One example is the use of GIS in local planning and development efforts.
- **Productivity gains:** A savings in staff resources will be realized in the review agencies in the long term once the GIS database is up to date, available, and routinely used by the stakeholders in the transportation planning process. The time and resources spent researching and studying transportation alternatives, many of which are eventually deemed unviable because of the impact to resources, will be greatly reduced.

The following summarizes the potential cost savings:

1. The greatest savings for using GIS in the transportation and environmental decision-making process relates to the cost savings that can be realized from developing projects faster. For every year projects are delayed, an estimated 4 % inflation rate can be applied to the construction cost of transportation projects. If GIS had been in place for 2006, an estimated **\$34 million** could have been saved in conjunction with the \$850 million of projects that are underway in the project development process (currently between Concurrence Points 1 and 2 of the Merger process). Cost savings due to road user benefits could also be realized sooner, but these savings have not been calculated nor are included into this analysis.
2. If GIS were used as an effective screening tool to determine which projects should go into the Merger process, a cost avoidance of **\$3,050,000** could be realized. This is attributed to the fact that roughly 10 projects (medium complexity and cost) are put into the Merger process only to determine at Concurrence Point 2 that they should be removed from the Merger process. The reason is that there is not enough “good” information to make the determination of which projects should go into the Merger process and, in the absence of that information (which could be provided by GIS data layers), project engineers are on the side of caution and place these projects into the Merger process. The availability of complete, accurate and up-to-date GIS data layers would enable projects to be screened more effectively to eliminate the direct labor costs associated with meetings and preparation for those meetings, as well as the increase in construction costs due to inflation associated with ineffective use of time (e.g., projects being in the Merger process when they could have proceeded in a more traditional manner).
3. In the long-range transportation systems planning process, benefits include increased staff productivity and efficiency, improved public perception through transparency of information, reduced number of corridors/alternatives studied in detail, reduced number of meetings, and improved quality of decisions.
4. In the project development process, most of the cost and time savings are realized in the reduction of the number of alternatives carried forward for detailed study if GIS information plus field truthing could be used to make a corridor decision for new location projects. Generally, the availability of complete, accurate and up-to-date GIS information will improve the quality of decisions made, especially at the beginning of the project development process. The annual estimated time savings for the Merger 01 (project development process) is 7,132 man-days and results in an annual cost savings of **\$3,082,000**. This is largely attributed to the following activities: preliminary design and minimization of impacts, environmental screening and analysis, collection of background information for projects, and land suitability/environmental features mapping.

5. NCDOT's NPDES Compliance Program, which is managed by the Highway Stormwater Program, could not cost-effectively meet compliance requirements without the use of GIS. The importance of having reliable, maintained GIS layers is paramount to the sustainability of NCDOT's compliance with the Clean Water Act NPDES regulations. The annual savings as a result of having complete, accurate and up-to-date GIS data layers is estimated to be **\$640,000**. In addition, NCDOT's Total Maximum Daily Loading Program would cost an additional **\$2.5 million annually** without the use of GIS and its supporting data layers.
6. GIS can be used in a wide spectrum of transportation and environmental-related programs and activities, including a variety of modes (including rail), and from long-range transportation planning, through project development and design, to operations and maintenance activities. For example, the NCDOT Rail Division has estimated an annual cost savings of **\$154,000** for their project development activities.
7. A time savings of 2,810 man-days per year and an estimated cost savings of **\$964,415** per year can be realized for transportation-related (non-Merger) programs and activities, which includes division-design-construct projects, NCDOT's Secondary Road Program, NPDES field compliance activities, rail projects, the comprehensive transportation planning process, and the preparation of feasibility studies.
8. More than 28 non-transportation-related programs and activities were identified within 12 agencies that could benefit from the availability of GIS information. The benefits identified included time and cost savings, increased productivity and "better" decision-making. For example, the NC Department of Cultural Resources estimates that within their agency alone, they could realize a cost savings of approximately **\$425,675** annually for the non-transportation-related programs and activities they manage.
9. The North Carolina Stream Mapping Program will provide a comprehensive digital map of stream locations useful to an array of federal, state, and local governments, as well as the private sector and general public. The projected cost for the remainder of Stream Mapping Project is \$3,135,375 per year for the next four years. State agencies and local governments have developed cost-to-benefit numbers that accumulate an annual benefit of **\$5,559,632** per year. Details on these savings are provided below:
  - a. *Department of Transportation and Ecosystem Enhancement Fund*: Improved estimation and efficiency for mitigation and stream restoration will generate \$2,050,000 in additional stream mitigation credits.
  - b. *Local Government Savings*: Improved data will result in increased efficiency for site plan reviews. The City of Durham projects a savings of \$215,730 per year. Expanded to other local governments, this will create \$3,059,632 in savings for local governments.
  - c. *Department of Environment and Natural Resources, Division of Water Quality*: Efficiencies provided to applicants and environmental consultants in the development of plans and applications for submission to DWQ will benefit through reduced field work. This savings is projected to provide \$450,000 in annual savings to this community.

10. The benefits that could be derived from other agencies (non-ILT agencies), organizations, the private sector and the public at-large have not been evaluated as part of this analysis. However, those potential benefits likely outweigh the quantitative and qualitative benefits presented in this analysis. Examples include: regional planning organizations (such as Metropolitan Planning Organizations and Rural Planning Organizations), county and municipal programs and activities, USFWS endangered species recovery planning and implementation, Crime Control and Public Safety emergency planning and response, and US Army Corps of Engineers Civil Works projects.

The use of these complete, accurate and up-to-date GIS data layers can support good land use planning at the local level across the state. Land use plans ultimately drive growth patterns, infrastructure development (including new and improved transportation facilities) and are integral to economic development. Comprehensive land use planning that considers the natural and cultural resources of the area is likely to yield development and infrastructure improvements that can be facilitated in a manner that avoids and minimizes impacts to important resources. For example, transportation improvements can be facilitated with greater efficiency and higher predictability of cost and schedule if land use planning and the associated long-range comprehensive transportation planning take into account key natural and cultural resources using the proposed GIS data information.

11. Of the 17 highest cost data layers, the following data layers were identified as being of high benefit to the agencies who responded:
- Digital Aerial Imagery (Orthophotography) (17 out of 17 respondents)
  - Stream Mapping (16 out of 19 respondents)
  - Transportation: System and Non-System Road Network (15 out of 18 respondents)
  - Wetland Types (Coastal North Carolina) (13 out of 19 respondents)
  - Designated Historic Properties and Districts (12 out of 17 respondents)

Ultimately, GIS can facilitate our collective efforts to deliver transportation solutions in a timely manner while enhancing the natural and human environment and economic development potential in North Carolina. In addition, GIS will support and enhance analysis and decision-making for non-transportation related programs and activities at the local, state and federal levels.

**Attachment 1**  
**Largest GIS Data Layer Costs**

<b>Layer</b>	<b>Agency</b>	<b>Cost to Create/Update</b>	<b>Annual Cost to Maintain</b>
Designated Historic Properties and Districts	Dept. of Cultural Resources	\$ 755,000	\$ 20,000
Digital Aerial Imagery (Orthophotography)	CGIA, NC Counties	\$2,259,000	\$574,000
Land Cover	CGIA	\$ 349,000	\$ 0
Parcel Boundaries	CGIA, NC Counties	\$3,129,000	\$ 0
Sanitary Sewer Systems-Pipes	CGIA	\$ 992,000	\$359,000
Sanitary Sewer Systems-Service Areas	CGIA	\$ 338,000	\$270,000
Stormwater Systems-Service Areas	CGIA	\$ 237,000	\$237,000
Surveyed Historic Properties	Dept. of Cultural Resources	\$6,140,000	\$115,000
Terrestrial Archaeology Sites	Dept. of Cultural Resources	\$4,500,000	\$ 90,000
Terrestrial Archaeology Surveyed Areas	Dept. of Cultural Resources	\$ 500,000	\$ 19,000
Transportation: System and Non-System Road Network	Dept. of Transportation	\$ 281,000	\$148,000
Underwater Archaeology Sites	Dept. of Cultural Resources	\$ 750,000	\$ 50,000
Water Distribution Systems-Pipes	CGIA	\$1,677,000	\$405,000
Water Distribution Systems-Service Areas	CGIA	\$ 432,000	\$347,000
Wetland Types (Coastal North Carolina)	Dept. of Environment and Natural Resources	\$ 575,000	\$ 44,000
Wetlands Inventory	US Fish and Wildlife Service	\$2,000,000	\$ 0
Stream Mapping	Dept. of Environment and Natural Resources	\$12,541,500	\$1,010,000
<b>Total of Largest Cost Items</b>		<b>\$37,455,500</b>	<b>\$3,688,000</b>

**Attachment 2**  
**Summary of Costs Savings**

<b>Reference # in Report</b>	<b>Item</b>	<b>Cost Savings (annual)</b>	<b>Comments</b>
1	Cost savings due to time savings (inflation) for use of GIS in early project development – cost of inflation	\$34,000,000	Based on 2006 projects
9	Stream Mapping (includes benefits from Ecosystem Enhancement Program)	\$5,559,632	Includes benefits to the NC Ecosystem Enhancement Program
4	Cost savings (labor) related to the project development process – use of GIS and ground truthing to determine LEDPA between CP 2 and CP3. (See Question #1)	\$3,082,000	
2	Cost savings (labor and inflation) for use of GIS in early project development – cost of labor	\$3,050,000	Based on 2006 projects
5	NCDOT's Total Maximum Daily Loading Program	\$2,500,000	
7	NCDOT Division Programs and Activities	\$964,415	
5	NCDOT's NPDES Compliance Program	\$640,000	
8	Department of Cultural Resources Non-Transportation Related Programs and Activities	\$425,675	Example of non-transportation related benefits
6	NCDOT Rail Division Planning Activities	\$154,000	
	<b>TOTAL</b>	<b>\$50,375,722</b>	

## Attachment 3

### GIS Business Case Questionnaire

1. Which steps in the Merger process does your agency participate in where GIS would be of benefit? List these in the activity column below; some activities have already been listed and reflect the activities in the Merger process where GIS information may be useful. Please think about the Wilmington Bypass project as an example of a complex project on new location when answering the following questions:
  - a. For each activity, how much “hands-on” time (in man-days) would be saved on an annual basis? (“Hands-on” time refers to actual time spent working on a task.)
  - b. What are the estimated annual cost savings for that activity (salary, equipment, travel, etc.)? (Keep calculations and assumptions available for future reference, but do not submit them at this time.)
  - c. Would the use of these GIS data layers, assuming they are complete, accurate and maintained over time, increase the quality of analyses and associated decisions? If so, describe how? Include your comments in the “Quality of Decision(s)” column for that particular activity.
  - d. Add any other comments for each of the activities, as appropriate.
2. What other transportation activities (non-Merger projects) does your agency participate in where GIS would be of benefit? Please add these in the activity column below to the examples of activities and programs already listed.
  - a. For each activity, how much “hands-on” time (in man-days) would be saved on an annual basis? (“Hands-on” time refers to actual time spent working on a task.)
  - b. What are the estimated annual cost savings for that activity (salary, equipment, travel, etc.)? (Keep calculations and assumptions available for future reference, but do not submit them at this time.)
  - c. Would the use of these GIS data layers, assuming they are complete, accurate and maintained over time, increase the quality of analyses and associated decisions? If so, how? Include your comments in the “Quality of Decision(s)” column for that particular activity.
3. Other than transportation-related projects and programs, what other programs in your agency could benefit from the availability and use of accurate, complete and maintained GIS data layers? List each activity or program in the “Activities/Programs” column. Then, identify the benefits by checking in the appropriate column. If you need to add another benefit that is not listed in the table, please add it for the particular activity in the “Other” column.

4. Of the following data layers (the 17 highest cost data layers), how would you rate their benefit to your agency's activities and programs if these data layers were accurate, complete and regularly maintained? Please put an "X" in the appropriate column for each data layer to reflect the degree to which it would benefit your agency's programs and decision-making. Please add comment(s) for each data layer, especially if there are certain assumptions associated with your ranking.

- Designated Historic Properties and Districts
- Digital Aerial Imagery (Orthophotography)
- Land Cover
- Parcel Boundaries
- Sanitary Sewer Systems-Pipes
- Sanitary Sewer Systems-Service Areas
- Stormwater Systems-Service Areas
- Surveyed Historic Properties
- Terrestrial Archaeology Sites
- Terrestrial Archaeology Surveyed Areas
- Transportation: System and Non-System Road Network
- Underwater Archaeology Sites
- Water Distribution Systems-Pipes
- Water Distribution Systems-Service Areas
- Wetland Types (Coastal North Carolina)
- NWI Wetlands Inventory
- Stream Mapping