Expanding Regional Freight Information Resources for the Upper Midwest: The Great Lakes Maritime Information Delivery System

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Executive Summary

This project marked the beginning of a long-term endeavor to develop and manage a comprehensive data repository and information clearinghouse for the maritime industry in the Great Lakes. The system is envisioned to facilitate the acquisition, storage, management, analysis and exchange of data between analysts and decisionmakers within the industry. This system will thus serve as a resource for public policy decisions and for drawing the necessary link between maritime freight movements, economic viability, and environmental quality throughout the Great Lakes and St. Lawrence Seaway. As such, the system will serve as a central focus for diverse interests within the industry to support the promotion of sustainable maritime transportation in the region.

This project was originally proposed to focus on expanding an existing detailed GIS-based multimodal regional freight data reporting system named ***Midwest FreightView*** (MWFV). However, this approach was modified significantly over the course of the project based on interactions with representatives of the maritime industry in the Great Lakes Region. Stakeholders in the region attending the June 9 Great Lakes Data Workshop in Detroit rejected MWFV as the only component of the information delivery system in favor of a more diversified approach that incorporated web-based dissemination of prepared information in the form of maps, reports, tables and graphics. While the core of the data repository would still reside in the comprehensive MWFV GIS, the main user interface and information delivery system would be located on a more "user friendly" web page. The project team thus responded by amending the design of the system to meet the needs of our partners in the industry and will be unveiling the new web page for the system in November, 2006.

The main objective originally envisioned for MWFV was to generate and maintain a long-term database and data distribution system that would be available for state transportation agencies, regional planning agencies, port authorities and economic development organizations, as well as other interested decisionmakers and stakeholders within the region. This objective still remains as an important component of the work completed in the first phase of this project. Much of the data acquired in the first phase of this project came from existing sources—both commercial and government. The data are currently being stored on designated server space in the central repository at the GISAG Center at The University of Toledo and are undergoing incorporation into MWFV. Specific data assembled into this centralized data repository currently include the following:

1. Intrastate Employment patterns for each commodity type by SIC, NAICS, (Demographics Plus, Inc. *Business Counts Database*);
2. Population and Socioeconomic data representing Market Demand within the region
3. Port Locations—U.S. (BTS National Transportation Atlas);
4. Dock Locations (Army Corps of Engineers) and attributes:
5. Waterway Network—Great Lakes and Inland Waterways (Army Corps of Engineers)

6. Port Operations Data such as Tonnages, Commodities transshipped (Lake Carriers Assn.), Vessels Serviced, Equipment, *etc*.
7. Baseline 2002 commodity flows through the Saint Lawrence Seaway and Great Lakes System obtained from the FHWA Freight Analysis Framework estimated from 2002 Commodity Flow Survey Data. This data set provided the research team with a skeleton framework upon which to add subsequent flow data.

Other data dealing with dock locations and related operational attributes were manually entered into the database. This process was the most labor intensive and time consuming of the data assembly tasks. Most of this information has been compiled for docks on the American side of the Great Lakes. The corresponding information for the Canadian side of the Great Lakes is in its final stages of compilation. Dock identification codes were standardized within the database and documented.

The data listed above will reside in the data reporting system built on a ***Citrix Metraframe*** installation. Currently a specialized ***ArcView GIS*** application provides the user interface. Users can access MWFV with a web browser and Internet connection; all operations are carried out on the Toledo Server—the user's computers simply act as a terminal. The site is thus able to accommodate a wide range of users that extends between casual browsers and "basic mappers" to more experience GIS and database users.

The most recent activities undertaken have been to start compiling information on the various types of commodities transported on the Great Lakes, with an emphasis on observing the origins and destinations of these commodities, flow routes, tonnages, *etc*. In addition, the project team will investigate the acquisition of AIS data to track vessel movements. Implementation of this technology will be actively pursued in the next phase of the project.

In addition to the data assembly operations, the project team set about to design a more generalized information delivery system following our discussions with industry representatives at the June 9 Great Lakes Maritime Data Workshop in Detroit. Workshop participants readily agreed that the data delivery system must serve as an accurate, current, comprehensive and user-driven data resource that will be used to inform public policy decisionmakers as to the value and utility of the Great Lakes Maritime Transportation System (GL MTS). Of particular importance in reporting to public officials are:

- Jobs
- Economic impact of Great Lakes shipping
- Safety issues associated with diverting freight traffic to GL MTS
- Environmental impacts/benefits compared to other modes
- Shipper savings associated with GL MTS
- Congestion effects of other modes in comparison to GL MTS
- Competition effects of Maritime Transportation and rate increases in other modes
- Shift in intermodal connections and transshipment costs (*e.g.*, "full cost" studies – pavement damage, fuel savings, crashes, *etc.,*
- The value of shipping to states, cities regions, *etc*.

Workshop participants discussed additional data needs for regional stakeholders that require data to facilitate projections and forecasts for freight movements under alternative scenarios involving alternative modes or intermodal movements. Regulatory impacts were also emphasized in the discussion along with improved coordination of public investments over the entire system to benefit all stakeholders within the region despite their location or jurisdiction.

Workshop participants also effectively argued that any system that requires a significant amount of training and practice would not be used as heavily as a more "user friendly" system consisting of prepared graphs, maps, bullet points, tables, and other features such as prepackaged reports in basic standard formats such as Annual Reports, Executive Summaries, and reports of studies completed by analysts who used data from the repository. The project team responded to this point by proposing to develop a system that offers a variety of products and functions among varying degrees of expertise required by users. These include:

- A detailed data repository for vessel movements, port functions, commodity flows, economic activities and environmental impacts, etc.
- A GIS data viewer for advanced users to view and analyze a variety of data
- An information delivery site for maps, tables, graphics, text and other features
- A data exchange to support user inquiries and furnish information on demand.
- Assemble data and report information among different Geographic areas of impacts and jurisdictions (*e.g.*, states and provinces, congressional districts, cities, counties, ports, *etc.*)
- Establish a communication link within the system (*e.g.*, email access) for regional stakeholders to request specific information to be posted on the site. This function was agreed upon as essential if the information delivery was to be successful
- Establish a system for data exchange to analysts in maritime industry agencies and organizations; also develop a site in the system for analysts within the region to publish the results of their analysis—particularly with regard to public policy issues of interest to the Great Lakes Maritime Industry
- Begin to develop a library function in the form of a data clearinghouse that reviews and summarizes data from diverse sources--both public and commercial--and provide links for users to branch to from the site. The result of which is to provide the Great Lakes Maritime Industry with a comprehensive centralized resource for data and information. An example of such a link would be for taxes, fees, and other costs; however, this component would not represent a core function of the data resource. It was further suggested that the site become a gateway to maritime agencies (*e.g.*, Coast Guard, USACE, *etc.*)

All of these functions have been adopted into the design of the prototype information delivery site to be opened in November, 2006.

One of the objectives of this project that was discussed at the June 9 meeting concerns the long-term viability of this information delivery resource. Eventually this data repository and delivery system must be able to sustain itself financially as other members of the maritime industry in this region. To this end, the project team has begun to explore the establishment of a ***Great Lakes Maritime Exchange*** (GLMX) in the form of a non-profit ***501(c)(6)*** organization that would be financed through subscription fees by its partners in the industry. This exchange could partner with MISNA (Maritime Information Services of North America), an umbrella organization of maritime exchanges in the United States and British Columbia. The principal investigator on the project team was invited to the MISNA National Meeting in Portland, Oregon in September, 2006 to gather more information on maritime exchange activities in North America. This approach shows significant promise.

The vision for the Great Lakes Maritime Information Delivery System Project evolved over the course of the project to produce a multidimensional system that will support a wider array of functions that include data storage, delivery of prepared documents, GIS functionality, and a clearinghouse for information over the entire industry. The project team will solicit feedback and suggestions for continuous improvement of the information delivery system; communication with the industry will be a major objective as this resource evolves in the coming years.

Expanding Regional Freight Information Resources for the Upper Midwest: The Great Lakes Maritime Information Delivery System

Introduction

This project marked the beginning of a long-term endeavor to develop and manage a comprehensive data repository and information clearinghouse for the maritime industry in the Great Lakes. The system is envisioned to facilitate the acquisition, storage, management, analysis and exchange of data between analysts and decision makers within the industry. This system will thus serve as a resource for public policy decisions and for drawing the necessary linkages between maritime freight movements, economic viability, and environmental quality throughout the Great Lakes and St. Lawrence Seaway. As such, the system will serve as a central focus for diverse interests within the industry to support the promotion of sustainable maritime transportation in the region.

This project was originally proposed to focus on expanding an existing detailed multimodal regional freight data reporting system named ***Midwest FreightView*** (MWFV) by incorporating maritime transportation data. It was argued that significant increases in highway freight traffic volumes have produced increasing pressures on this system, resulting in the necessity to examine every transportation alternative to relieve this pressure--especially by maritime transportation. This system would also serve as an effective tool for evaluating intermodal transportation opportunities in the Great Lakes Region; it can be used to model flows between modes to improve the flow of commodities within the region and to minimize environmental impacts. Finally, it was envisioned that expanding MWFV would enable stakeholders in the region to relate maritime traffic flows to the regional economy of the Midwest and adjacent Canadian provinces.

While the original objective of this project to develop a detailed maritime database that would be added to the existing MWFV system, the project team began to see the necessity for an expanded effort in the delivery of information from this resource. The scope of this project thus evolved over time as the project team interacted with stakeholders in the region. The watershed event in this change of focus took place at the June 9 Great Lakes Data Workshop in Detroit. A significant number of the participants at the Workshop expressed greater interest in having access to a wider array of prepared maps, reports, tables and graphics on the project web site than a comprehensive GIS as the core of the information delivery system. The project team responded by revising the design of the system to meet the needs of our partners in the industry. This resulted in fewer deliverables in terms of raw data in the database, but a clearer picture of what an effective information delivery system will be for this industry. This revised vision for the regional information delivery system therefore forms the basis for a significant portion of this report.

While the project team will not abandon our development of the GIS database as the core element of the database management portion of the project, our emphasis in the delivery of data will shift to the development of a user interface that distributes the wider a variety of resources requested by users.

The project team gathered additional insight as work progressed in this effort. In particular, it became clear that the data currently stored and managed in the database needed to be enhanced through real-time acquisition of vessel locations using AIS technology, compilation of detailed regional employment data by sector, and collection of detailed commodity flows by vessel. Data from these sources will be essential if stakeholders desire an up-to-date, reliable and effective resource that truly reflects the level of activity currently working in the lakes. Our stakeholders emphasized the importance of accurate and current

information to share with government officials in the area of public policy. It can also be argued that such data would facilitate intermodal connectivity at ports if short sea shipping is to be a viable alternative in diverting freight off of congested highways. Such data would also be useful in our expanded efforts with the Upper Midwest Freight Coalition to draw the link between transportation and the regional economy and in gaining a clearer understanding of patterns of freight flows within the region.

Finally, this project report ends with a proposal for the establishment of a Great Lakes Maritime Exchange using the model developed by MISNA (Maritime Information Services of North America). Such an exchange would provide the foundation for continued data collection, management and exchange in the Great Lakes to support long-term sustainable maritime transportation.

Project Background. As stated above, the original intent of this project was to expand MWFV to include maritime transportation. This System was well positioned to carry out the task of assembling, storing and managing maritime data for the Great Lakes system. A major effort had already been undertaken in the development of MWFV. At present, MWFV is a distributed GIS developed to track patterns of intermodal freight movements within a seven state area of the upper Midwest and two provinces of Canada. The principal objectives of MWFV were threefold: 1) to provide a means to spatially relate existing and projected freight flows to the regulatory environment and the physical capacity of the infrastructure, 2) to track trends in freight movement over time and space, and 3) to link freight movement to population characteristics and economic activity within the region. Users can take advantage of the GIS location-based query and selection capabilities as well as mapping functions to illustrate these relationships. In addition, the system was designed to expand into providing advanced analysis capabilities such as vehicle routing and travel time computations to evaluate the effectiveness of the network to support freight movement. As a result, the system has begun to develop into an effective tool for economic development planning as a means to measure accessibility to markets, identify bottlenecks in the network that hinder freight flows, and for identifying feasible locations for warehousing, manufacturing, retail and intermodal connection facilities. The system displays data on highways, railroads, intermodal connections, and air transportation. However, little data are currently assembled for maritime transportation. The structure of the MWFV database is presented in Appendix A.

The system was developed as part of the ***Upper Midwest Freight Corridor Study***, a cooperative venture between seven Midwestern state departments of transportation and the Midwest Region University Transportation Center (MRUTC) at the University of Wisconsin, The University of Illinois-Chicago, and The University of Toledo. The data reside entirely in The GISAG Center at The University of Toledo and are accessed as part of a distributed GIS.

One of the main objectives originally envisioned for MWFV was to generate and maintain a long-term database and data distribution system that would be available for state transportation agencies, regional planning agencies, port authorities and economic development organizations, as well as other interested decisionmakers and stakeholders within the region. This requires ongoing efforts to furnish the most up-to-date data available *from all modes* in the transportation system. These data collection efforts are discussed in detail in the next chapter.

Data Acquisition

Much of the data acquired in the first phase of this project came from existing sources—both commercial and government. The data are currently being stored on designated server space at the GISAG Center at The University of Toledo. These data will be added to MWFV in the Fall of 2006 when the project web page is posted. The challenge to the project team at this stage was to organize the data in such a way that all elements of the database were spatially compatible with respect to data structure format, geo-referencing, scale, segmentation, and compatibility with widely-used GIS software. Specific data assembled into the centralized data repository currently include the following:

1. Intrastate Employment patterns for each commodity type by SIC, NAICS, (Demographics Plus, Inc. *Business Counts Database*);
2. Population and Socioeconomic data representing market demand within the region
3. Port locations—U.S. (BTS National Transportation Atlas);
4. Dock locations (Army Corps of Engineers) and attributes:
5. Waterway Nenwork—Great Lakes and inland waterways (Army Corps of Engineers)
6. Port operations data such as tonnages, commodities transshipped (Lake Carriers Assn.), vessels serviced, equipment, *etc*.
7. Baseline 2002 commodity flows through the Saint Lawrence Seaway and Great Lakes System obtained from the FHWA Freight Analysis Framework estimated from 2002 Commodity Flow Survey Data. This data set provided the research team with a skeleton framework upon which to add subsequent flow data as we obtain it.

Please refer to Appendix B for a set of maps prepared on MWFV that display a sample of the data listed above. Appendix B also provides an illustration of the user interface for MWFV and some of its analytical capabilities.

While most of the data listed above have been obtained from existing digital data sources, other data dealing with dock locations and related operational attributes were manually entered into the database. This process was the most labor intensive and time consuming of the data assembly tasks. These efforts however, yielded a data layer that displays the location of commercial docks with their associated dock data available to be viewed. No such database exists to our knowledge. We are currently seeking permissions to display the following characteristics for each of the docks:

1. I.D. code number (please see Appendix C)
2. Name
3. Location
4. Address
5. Phone number
6. County
7. State/Province
8. Waterway
9. Port
10. Mile (if located on a river)
11. Latitude
12. Longitude
13. Operator
14. Owner
15. Purpose
16. Slip length
17. Slip width
18. Slip depth
19. Vessel loading equipment
20. Vessel loading speed
21. Vessel unloading equipment
22. Vessel unloading speed
23. Railway connections
24. Notes of interest

Most of this information has been compiled for docks on the United States side of the Great Lakes. The corresponding information for the Canadian side of the Great Lakes is still in the final stages of compilation. An identification code system has been developed by the project team to uniquely identify the commercial docks in this database. This code was developed because of a lack of standardization in identification codes among agencies and firms. As this project is looking at the Great Lakes system as a whole, our ID code was designed to work for all docks on both the Canadian and US sides of the Lakes. The code is an eight-digit number system where each digit, or set of digits, represents a specific category (please see Appendix C for a detailed explanation of code numbers). The advantage of this ID system is that each number represents something real, it is not a mere arbitrary number used for administrative functions. Users who understand this code system will be able to easily locate a dock and know what types of commodities it handles.

- **X**0000000 First Digit – Country Code
- 0**XX**00000 Second & Third Digits – State/Province Code
- 000**XX**000 Fourth & Fifth Digits – Port Code
- 00000**X**00 Sixth Digit – Commodity Code
- 000000**XX** Seventh & Eight Digits – Specific Dock Code

The data listed above are in the final stages of being merged into the MWFV data reporting site for viewing. The reporting site is best described as a file sharing data library consisting of geospatial data and non-spatial data in a usable format. Users of the site will have secured access to this repository. Technical System Specifications for the data repository are described as follows. The repository is situated on aa ***Apple® G4 Xserve®*** file server with ***ATAboy2® RAID*** (Redundant Array of Inexpensive Disks) system connected to the World Wide Web (WWW) in the GISAG (Geographic Information Science and Applied Geography Lab) at The University of Toledo. RAID LEVEL 5 is implemented for maximizing "High data reliability and Highest Transfer capacity" along with frequent data backups.

The user interface for this data reporting system is built on a ***Citrix Metraframe*** installation of a specialized ***ArcView GIS*** application. Users can access MWFV with a web browser and Internet connection; all operations are carried out on the Toledo Server—the users' computers simply act as a terminal. The site is thus able to accommodate a wide range of users that extends between casual browsers and "basic mappers" to more experienced GIS and database users.

The original proposal submitted for this project asserted the following: "It is expected that the initial assembly, storage and delivery of the maritime component of MWFV will be completed by August 2006. However, it should be emphasized here that the long-term objective of this system is to provide a *long-term* regional freight observatory for the Upper Midwest. This project represents only the beginning of this venture." It was expected that the assembly of the data would be an ongoing process and that the initial stages of the project would involve the design and structuring of the database. These tasks are completed. We are now in the process of gathering a wider array of data. The data assembled listed in this report represents the progress *so far* in this project.

The most recent activities undertaken have been to start compiling information on the various types of commodities transported on the Great Lakes, with an emphasis on observing the origins and destinations of these commodities, flow routes, tonnages, *etc*. This segment of the project is in its very preliminary stage and will include an emphasis on acquiring the following data:

1. Commodity type (SIC, NAICS) of existing freight shipped through the Great Lakes (by weight and declared value)—1999-2005;
2. Ports of origin and destination for each commodity type—1999-2004;
3. Establishment locations and employment by sector associated with each commodity type shipped on the Great Lakes, (ES-202 Database, Bureau of Labor Statistics (BLS), US Department of Labor).

The major limitation in the acquisition of the data listed above is confidentiality. For example, the BLS requires a signed waiver of any right to disclose ES-202 data in disaggregate form; all data must be reported in aggregate or in derived form to avoid disclosing employment figures for any individual firm or establishment. The same problems are going to occur when we propose to track commodity flows within vessel movements—or even tracking individual vessels. If we are to acquire, store and manage these data, we must do so under confidentiality agreements with carriers, ports and shipping companies. We intend to pursue this in the coming months. These agreements can greatly assist in the acquisition of AIS data to track vessel movements. Implementation of this technology will be accompanied by discussions with members of the industry in the next phase of the project (Additional discussion of the incorporation of AIS data is included in later sections of this report).

So far, the discussion in this report has been devoted to the assembly of data into a central data repository within MWFV. However, the project team was also charged with the task of developing a more generalized information delivery system that requires very little technical training and GIS expertise on the part of users. Representatives of the Great Lakes Maritime Industry emphasized the importance of providing useful information in a more generalized format that could be taken directly off of the web-based delivery system. In addition, industry representatives acknowledged the importance of storing and managing data that could be accessed and exchanged with other analysts in the industry. The results of studies conducted with data from the data repository could then be posted on this centralized delivery site. To date, the prototype delivery site is still in the final stages of development and will be unveiled in November 2006. These recommendations marked a significant departure from the approach originally adopted by the project team. The details of this new approach are outlined in the following chapter.

A New Perspective on Information Delivery

As stated above, the emphasis on a purely GIS-based information resource changed significantly after discussions with stakeholders within the region pertaining to their data and information needs. The objectives for this initiative thus changed midway through the project. On June 9, 2006, The Great Lakes Maritime Research Institute hosted the Great Lakes Maritime Data Workshop in Detroit. This meeting marked the beginning of an initiative to assemble an internet-based data resource for Great Lakes Carriers, Ports and regional economic development organizations. Participants included:

- US Army Corps of Engineers
- American Great Lakes Ports Association
- Canadian Chamber of Maritime Commerce
- US Maritime Administration
- NOAA
- University of Wisconsin-Superior (GLMRI)
- University of Minnesota Duluth (GLMRI)
- Lake Carriers Association
- Transport Canada
- Great Lakes Commission
- St. Lawrence Seaway
- Port of Duluth
- Detroit Port Authority
- University of Toledo

A detailed list of attendees is provided in Appendix D. This meeting was the first of several meetings in a multiyear project sponsored by The Great Lakes Maritime Research Institute. Workshop participants discussed in detail the purpose, goals and content of the data delivery system. This served to define the scope of the remainder of the first phase of this project and provided a clear direction for long-term efforts in this initiative. The recommendations are discussed in detail below.

Purpose and Goals of the Information Delivery System. Workshop participants readily agreed that the data delivery system must serve as an accurate, current, comprehensive and user-driven data resource. In terms of its purpose, a critical objective of the system must be to provide data and information to inform public policy decisionmakers as to the value and utility of the Great Lakes Maritime Transportation System (GL MTS). Of particular importance in reporting to public officials are:

- Jobs
- Economic impact of Great Lakes shipping
- Safety issues associated with diverting freight traffic to GL MTS
- Environmental impacts/benefits compared to other modes
- Shipper savings associated with GL MTS
- Congestion effects of other modes in comparison to GL MTS
- Competition effects of Maritime Transportation and rate increases in other modes
- Shift in intermodal connections and transshipment costs (*e.g.*, "full cost" studies – pavement damage, fuel savings, crashes, *etc.,*
- The value of shipping to states, cities regions, *etc*. (economic impact)

Workshop participants discussed additional data needs for regional stakeholders that require data to facilitate projections and forecasts for freight movements under alternative scenarios involving alternative modes or intermodal movements. Regulatory impacts were also emphasized in the discussion along with improved coordination of public investments over the entire system to benefit all stakeholders within the region despite their location or jurisdiction.

One additional concern dealing with the purpose of the data delivery system dealt with the question of "Where does the reach of the Marine Industry begin or end"? Does it begin and end at the ports or should it extend all the way from the origin to the destination? Participants argued for the scope of the database to

"follow the cargo" to consider ripple effects, regional impacts and locational patterns in the supply chain (*e.g.*, steelworkers and farmers in the region both depend on the maritime industry). This perspective certainly coincides with one of the original objectives of this project in linking marine freight movements to the regional economy. These questions however, require detailed data that are not readily available without the acquisition of ES-202, vessel commodity flows, and vessel movements.

Information Delivery Priorities for System Users. The most important outcome of the meeting dealt with the form that the information delivery should take. The original design of the data delivery system was for a GIS format where users would query the database, perform simple analysis functions and prepare graphics, tables, text and maps as output. The challenge in implementing such a system however, concerns the extent to which the system should support the query, manipulation and analysis of data (*e.g.*, vehicle routing, OD flow modeling, intermodal transfer simulation, *etc.*). In turn, developers of the system are further challenged by the need for users to gain the necessary expertise to operate the system.

In response, meeting participants effectively argued that any system that requires a significant amount of training and practice would not be used as heavily as a more "user friendly" system consisting of prepared graphs, maps, bullet points, tables, and other features such as prepackaged reports in basic standard formats such as Annual Reports, Executive Summaries, and reports of studies completed by analysts who used data from the repository. The project team responded to this point by proposing to develop a system that offers a variety of products and functions among varying degrees of expertise required by users. These include:

- Basic prepared maps for viewing and download,
- Prepared tables and graphs for viewing and download,
- Simple mapping functions in the data viewer,
- Query functions for more advanced users, and
- Analysis functions and specialized functions in the database for advanced users.

In addition, the project team noted that help functions could be furnished to assist users such as:

- **Technical manuals** available in *.pdf* format in downloadable form for detailed directions on use
- **Web-based documentation / tutorials for instruction** on the Toledo web site for specific functions such as basic mapping, query functions, and more advanced analysis functions. Additional tutorials can be posted documenting the contents of the database.
- **On-line help functions** to solve routine problems that are encountered as users operate the system.
- **Technical support via telephone and email** using staff at the Toledo site at specified times to help users with more complex problems not available at the on-line help functions.

The discussion concluded with the following recommended tasks for the project team in the next phase of the project:

- Assemble, store, and manage raw data in the data set
- Begin to develop data reporting standards with regard to data reconciliation among diverse sources, standardization of reported units, "currentness" of reported statistics, establishment of data acquisition protocols, quality control and accuracy checking, and to develop mechanisms to check for redundancy and duplication of efforts among contributors to the database. It was strongly recommended that this system "level the playing field" in data reporting by using the same units as other modes and regions—this resource must reflect the metrics used in the industry. Data reporting standards should be discussed and reviewed on an ongoing basis (revisited every three years)

- Assemble data and report information among different geographic areas of impacts and jurisdictions:
  - States and Provinces
  - Congressional districts
  - Cities
  - Counties
  - Ports
- Begin to prepare information in the form of maps, tables, text and graphics for stakeholders pertaining to public policy interests
- Establish a communication link within the system (*e.g.*, email access) for regional stakeholders to request specific information to be posted on the site. This function was agreed upon as essential if the information delivery was to be successful
- Establish a system for data exchange to analysts in maritime industry agencies and organizations
- Develop a site in the system for analysts within the region to publish the results of their analysis—particularly with regard to public policy issues of interest to the Great Lakes Maritime Industry
- Begin to develop a library function in the form of a data clearinghouse that reviews and summarizes data from diverse sources--both public and commercial--and provide links for users to branch to from the site. The result of which is to provide the Great Lakes Maritime Industry with a comprehensive centralized resource for data and information. An example of such a link would be for taxes, fees, and other costs; however, this component would not represent a core function of the data resource. It was further suggested that the site become a gateway to maritime agencies (*e.g.*, Coast Guard, USACE, *etc.*)

One final charge to the project team resulting from the discussion was to begin thinking about how to implement expedited data collection through technological innovations (*e.g.*, AIS, informatics, electronic forms, *etc.*). It was suggested that a pilot project for automated data acquisition would be extremely useful in later phases of the project. This recommendation in particular is to be actively pursued in the next phase of the project.

Recommendations for Data Acquisition. One final topic covered in the June 9 meeting dealt with data requests for the site. It was recognized early in the discussion that data acquisition efforts must be prioritized given constraints in time, staffing and budget. Data priorities were highest for the following in the initial phase of the project:

- **Cargo flows**—vessel types, vessel size, types of commodities, origins, destinations
- **Facilities** including docks, terminals, locks, equipment, and navigation facilities
- **Linking Great Lakes maritime freight movements and the economy of the Great Lakes Region** (*e.g.*, evaluating impacts of GL MTS freight movements on regional employment)
- **Environmental Data** dealing with air and water emissions from Great Lakes vessels, including a baseline inventory of emissions data from great lakes vessels and a baseline ballast inventory
- **Data to support air and water pollution reductions based on diverting traffic** from highway and rail modes to marine transport modes
- **Data to support comparative analysis of Great Lakes Fleet vs. Railroads and Trucks** in terms of fuel consumption per ton-mile along with effects of fuel costs on transport economics of great lakes vessels vs. rail vs. truck over time
- **Compiled lists of current sources of data** as part of the data library and clearinghouse function of the site.

Meeting participants contributed a number of additional recommendations related to long-term issues associated with the assembly, storage and management of the database. Of great importance was the establishment of both baseline information and projected trends among a wide range of factors in the industry. Specific recommendations included:

- Consider the utility of data for projections into the future and tracking trends.
- Data pertaining to investments in the infrastructure are critical. The system should account for current costs, projected costs, investments (over different planning horizons) and the benefits of investments; include the costs of making no investments
- Include data that have been developed jointly between government and private interests—these data have considerable utility and credibility
- Seek permissions in acquiring, storing and disseminating data. Acquire MOUs before including data in the system
- Check for gaps in the data and additional needs for data that may not yet be available
- Document caveats in working with the data—prepare a metadata reference page.

The data collection efforts and recommendations for the project site obtained from the June 9 Meeting thus set the direction for the remainder of Phase I of this project and formed the basis for the approach to be followed in subsequent phases of the project. Given the continuing nature of this project, the contents of this report should not only contain the progress of the project and work completed to date, but also a serious discussion of the direction of our data management and delivery efforts in the upcoming months and years. The following section covers the direction that the project team plans to take in our next steps.

Looking Ahead: Next Steps

The main objective of this resource is to maintain a long-term database and data distribution system built on a strong relationship with the political jurisdictions and stakeholders listed above. This data resource will serve as a central focus for these various interests to come together to focus on optimizing freight movements within the region. With the addition of other interests such as firms, shippers, carriers, regional planning agencies, port authorities and economic development organizations, this resource can have a direct positive impact on the regional economy. Furthermore, this system was originally developed as part of the ***Upper Midwest Freight Corridor Study*** conducted as a cooperative venture between seven Midwestern state departments of transportation and the Midwest Region University Transportation Center (MRUTC) at the University of Wisconsin, The University of Illinois-Chicago, and The University of Toledo. The added input of the regional maritime industry stakeholders within the region during the June 9 meeting further reinforces the relevance and utility of this resource for the region.

Specific Tasks. It was made clear that the next phase of the project must carry out parallel tasks of providing a generalized information delivery system while still expanding data collection efforts in the direction of acquiring flow data in greater detail with respect to commodities, origins and destinations, and vessel characteristics (including fuel consumption and emissions). The project team must link the maritime transportation "network" to the highway and rail networks, which in turn can be linked to the regional economy. These efforts also include detailed data library system and information clearinghouse functions. As a result, the next steps to be completed by the project team will involve the following distinct tasks:

- Continue to assemble data in the centralized repository to include the following:
  - **Cargo flows**—vessel types, vessel size, types of commodities, origins, destinations
  - **Baseline data for vessel movements** including size, horsepower, emissions, fuel consumption, ballast inventories, *etc*.
  - **Port Facilities** including docks, terminals, etc. and relevant attributes dealing with capacity, tonnages, *etc*.
  - **Linking Great Lakes maritime freight movements between origins, routes, ports and destinations** as a means to link maritime freight flows to the regional economy
  - **Acquisition of additional economic data** dealing with employment by sector, establishments, *etc*.
  - **Lock data** including relevant attributes dealing with size, capacity, tolls, *etc*.
  - **Navigation facilities**.
- Documentation of data standards derived from data sources in the region (including consultation with data source agencies, Maritime Exchanges, Ports and other related organizations) and reporting data in units consistent with the maritime industry and related transportation modes
- Begin a dialog with regional stakeholders with respect to their information needs in order to prepare maps, graphics, tables and text in a user friendly format
- The development of an internet-based data reporting site for data resources and organizations within the region including links to related sites
- Documentation of the data resources on the site.

Given the inherent spatial nature of the transportation infrastructure, the organization of the data in this study has been assembled within a geographic information system and will be stored in that format. However, the data will be made available outside of that format as well in tabular and other database management formats.

Partnerships. This proposed project represents a partnership between the Great Lakes Maritime Research Institute, the Intermodal Transportation Institute at The University of Toledo, and The Geographic Information Science and Applied Geographics (GISAG) Center at the University of Toledo. The GISAG Center will provide all server space and data management services for this project. Access to the Toledo Site will be linked from the GLMRI Web Page. The Toledo Project team will work closely with Dr. Xiubin Wang of GLMRI to identify data for the system and to design the database and data dissemination system. Additional partnerships will be maintained with participants from the June 9 meeting:

- US Army Corps of Engineers
- American Great Lakes Ports Association
- Canadian Chamber of Maritime Commerce
- US Maritime Administration
- NOAA
- University of Wisconsin-Superior (GLMRI)
- University of Minnesota Duluth (GLMRI)
- Lake Carriers Association
- Transport Canada
- Great Lakes Commission
- St. Lawrence Seaway
- Port of Duluth
- Detroit Port Authority
- University of Toledo

The meeting participants suggested participation from additional industry stakeholders including Canadian Shipowners, the St. Lawrence Seaway Development Corporation, Green Marine, AIS System, and interested private shippers. One additional partnership that would yield long-term sustained viability for this information delivery endeavor is with MISNA (Maritime Information Services of North America). The following section represents a proposal to join MISNA as their maritime exchange in the Great Lakes.

A Great Lakes Maritime Exchange. One of the objectives of this project is to develop a long-term sustained information delivery resource for the Great Lakes Region. Eventually this data repository and delivery system must be able to sustain itself financially as a member of the maritime industry in this region. To this end, it is proposed here that GLMRI and its partners in the industry consider the establishment of a ***Great Lakes Maritime Exchange*** (GLMX) in the form of a non-profit organization that would be financed through subscription fees by its partners in the industry. There are a number of such exchanges in the coastal regions of the United States and in British Columbia. These exchanges partner with one another through MISNA, an umbrella organization of non-profit *501(c)(6)* maritime exchanges in the United States and British Columbia. According to MISNA:

> [these maritime exchanges] represent a broad cross section of maritime interests in their respective regions -- vessel owners and agents, ports, pilots, towboat companies, stevedores and terminal operators, admiralty lawyers, customs brokers and freight forwarders, ship repair firms, employer associations, insurance agencies, marine surveyors, maritime unions and oil spill response organizations, just to name a few. [1].

Again, according to MISNA, the marine exchanges comprising this organization carry out a range of tasks that include:

- Advance Vessel Schedule Information, including ETAs and ETDs
- Advance and real-time vessel movement monitoring (AIS)
- Actual Arrival and Departure Data
- Vessel Traffic Analysis
- Historical Vessel Movement
- Port and Terminal Utilization Studies
- Promote Maritime Interests [1].

The principal investigator on the project team was contacted by MISNA in June, 2006 with the proposal to begin a maritime exchange in the Great Lakes. To date, none exist in this region. Subsequently the principal investigator was invited to a MISNA National Meeting in Portland, Oregon in September, 2006. MISNA has established standards and protocols for data reporting that could be adopted in the Great Lakes without developing a new set independently. A sample of data obtained from vessel tracking includes the following fields:

- Ship Name
- Lloyd's Number
- Ship Flag
- Ship Type
- Local Agent
- Estimated Date of Arrival
- Estimated Time of Arrival
- Actual Date of Arrival
- Actual Time of Arrival
- Arrival Port
- Arrival Berth
- Actual Date of Departure
- Actual Time of Departure
- Last Port of Call
- Next Port of Call

One of the main functions for many of the maritime exchanges is real-time vessel tracking using the AIS System as implemented in the Great Lakes/St. Lawrence Seaway system [2]. Continuous tracking enhances safety, optimizes transit times through better traffic management, optimizes scheduling of lock passages, improves fleet management for ship owners and assists in navigation through the system, provides faster response times following accidents/incidents, provides data to support homeland security efforts, and assists in tracking hazardous cargoes [2].

It is further argued here that continuous tracking of vessels can provide a means for effective coordination of intermodal connections in short sea shipping. The system can also provide input functions for long-term vessel tracking such as with the Automated Secure Vessel Tracking System [3]. Long-term vessel tracking can provide useful data to track total vessel traffic over the entire system—including specific channels where dredging is needed or other navigation improvements are required. Continuous vessel tracking can also provide needed data to track vessel emissions and to demonstrate savings in overall emissions by diverting freight traffic from rail and highway to the lakes.

It should be emphasized that maritime exchanges maintain strict confidentiality with their client organizations and do not disclose data among organizations without authorization. As discussed previously in this report, the same approach would be adopted in the Great Lakes. Thus a great lakes maritime exchange could serve as another partner with GLMRI and the maritime industry as a commercial resource and merits consideration.

Conclusion

The initial phase of the Great Lakes Maritime Information Delivery System Project began with an initial assumption that it would simply serve as an extension to the ***Midwest FreightView*** system developed for the Upper Midwest Freight Corridor Study. The end of the first phase of the project yielded significantly different results from what was originally envisioned. The new product will be a multidimensional system that will support the following functions:

- A detailed data repository for vessel movements, port functions, commodity flows, economic activities and environmental impacts, etc.
- A GIS data viewer for advanced users to view and analyze a variety of data
- An information delivery site for maps, tables, graphics, text and other features
- An information clearinghouse and centralized data facility to furnish links to other information resources, private vendors furnishing commercial products, and government agencies
- A data exchange to support user inquiries and furnish information on demand.

The project team anticipates that the initial prototype of the web-based information delivery resource will be introduced to the Great Lakes maritime community in November, 2006. The project team will solicit feedback and suggestions for improvements at that time. Continuous improvement of the information delivery system will also be a major objective as this resource evolves in the coming years. We will strive to maintain an open dialog with the members of the industry to assure our success in this endeavor.

References Cited

[1] Maritime Information Service of North America (MISNA), (2004) (Internet), *History of MISNA*, (cited September, 2006), http://www.misnadata.org/content/history.php?m=15.

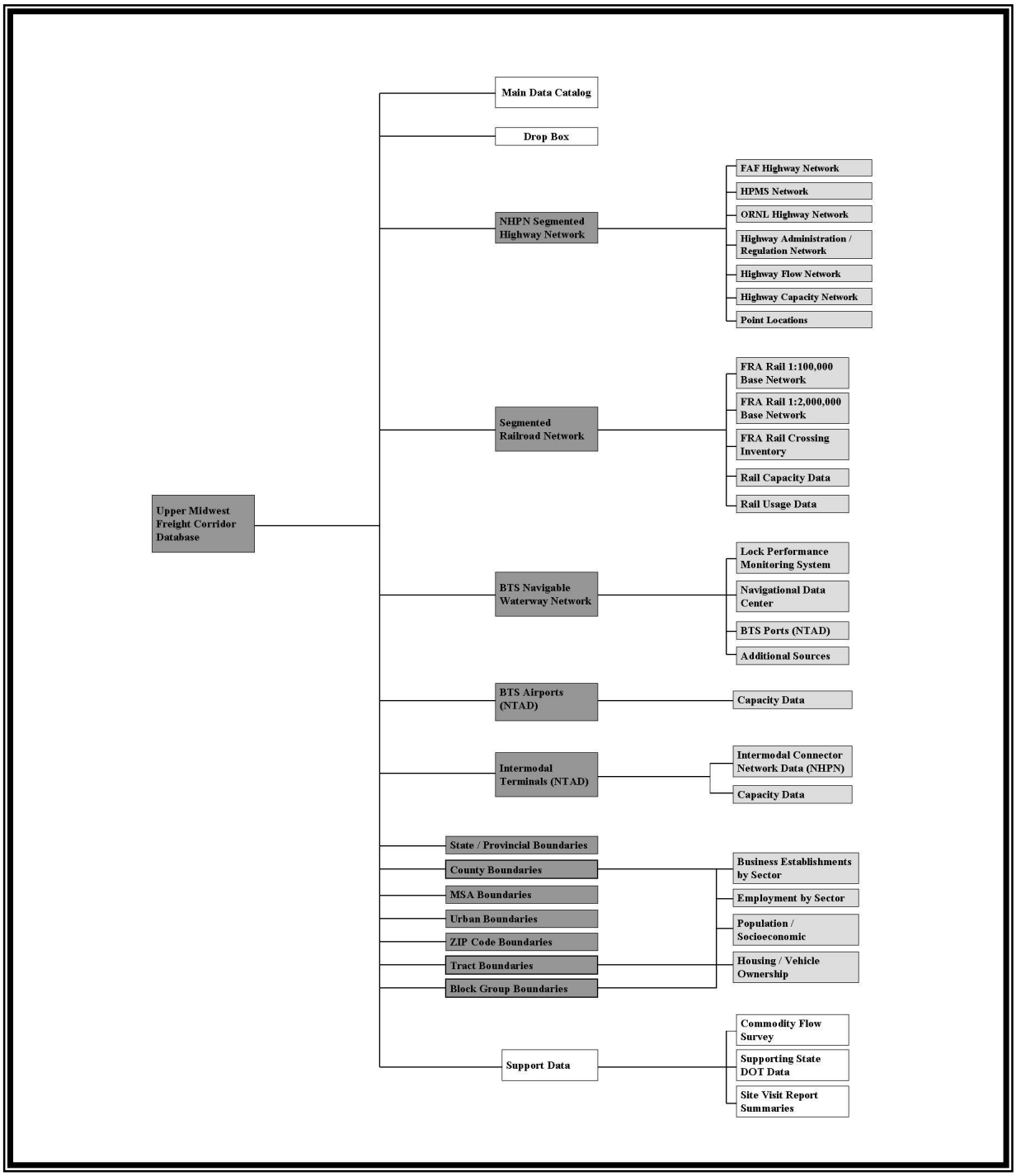
[2] Great Lakes/St. Lawrence Seaway System (SLSDC and SLSMC), (2006) (Internet), *AIS Project* (cited September, 2006), http://www.greatlakes-seaway.com/en/navigation/ais_project.html.

[3] Maritime Information Service of North America (MISNA), (2006) (Internet), *Automated Secure Vessel Tracking System (ASVTS)*, (cited September, 2006), http://www.asvts.org

APPENDIX A

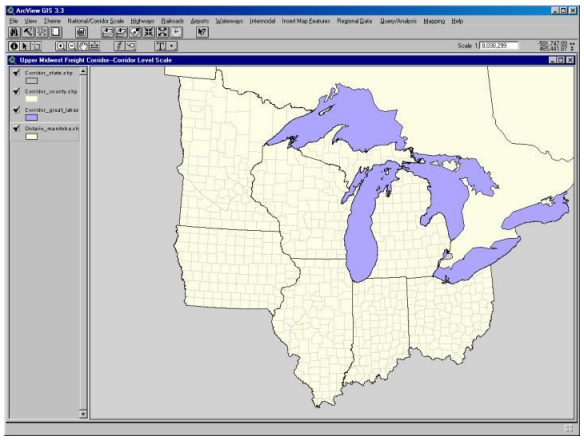
Schematic Diagram of the Structure of the Current *Midwest FreightView* Database

Schematic Diagram of the Structure of the Current MWFV Database



APPENDIX B

Sample of Map Output from *Midwest FreightView* Great Lakes Maritime Database



Example 1: Basic Mapping Functions

Figure B.1
Initial display for the user Interface
in ***Midwest FreightView***

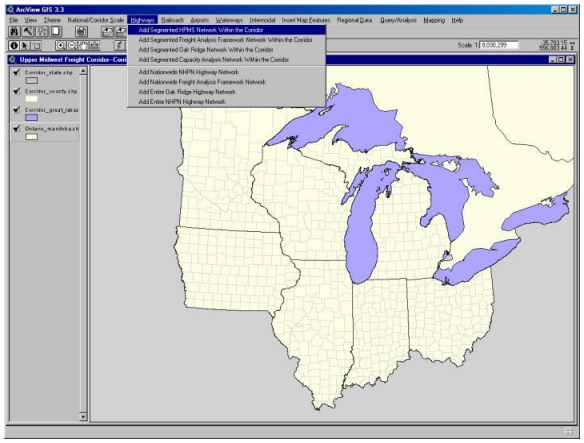


Figure B.2
User activates pull down menu to open the highway network in the Great Lakes Region.

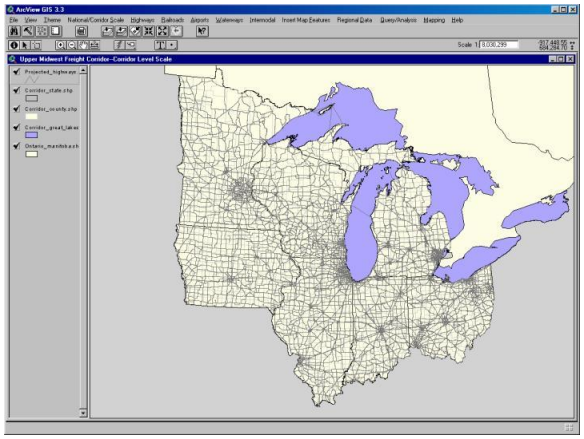


Figure B.3
MWFV displays highway network in the view window.

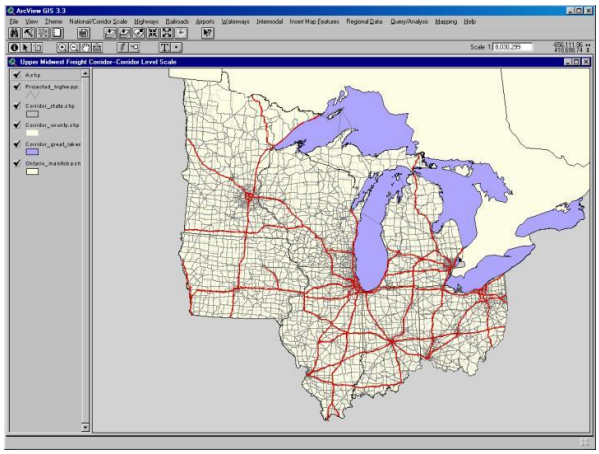


Figure B.4
MWFV provides users with the ability to highlight specific features in the display. In this case, major highways are highlighted.

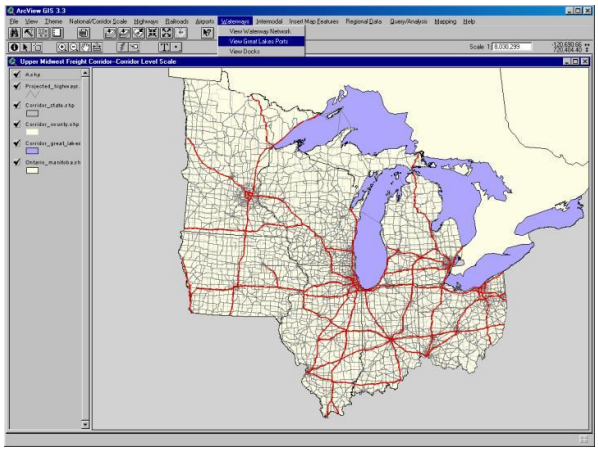


Figure B.5
User activates pull down menu to display the Great Lakes Port locations in the system.

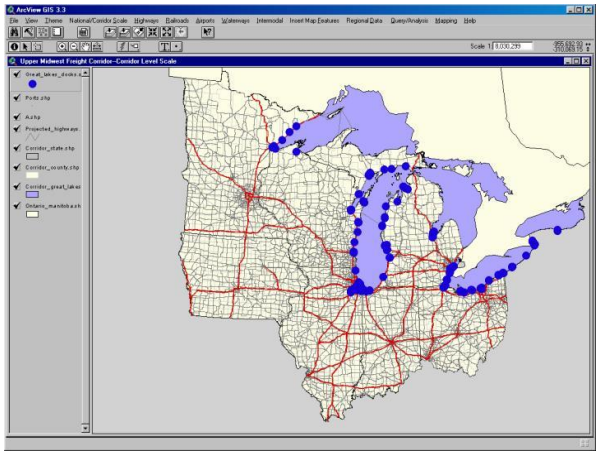


Figure B.6
MWFV displays port locations in the view window.

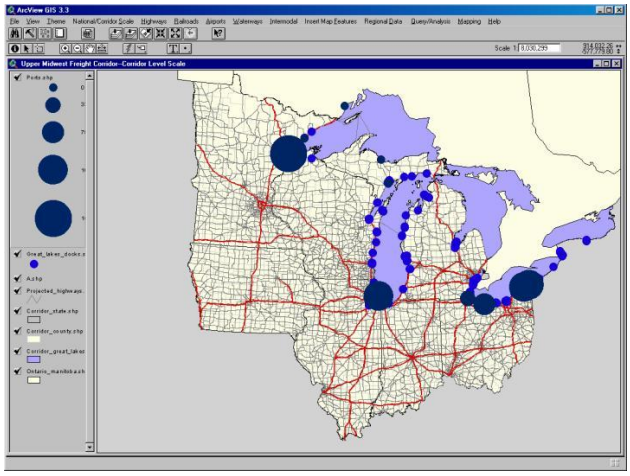
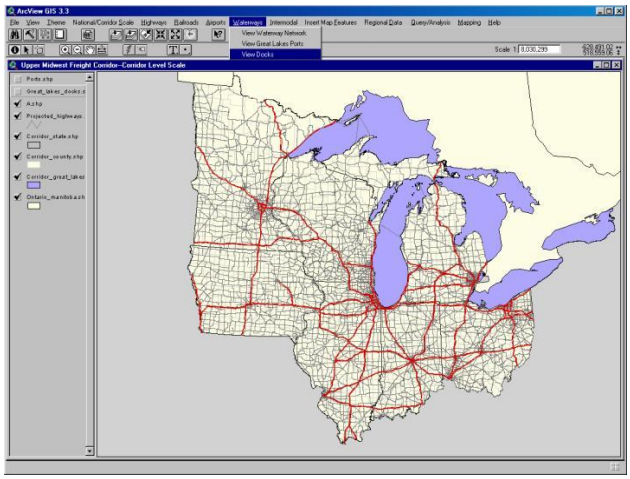


Figure B.7
User now queries the port data points for map display. In this case, the user opened the database to query ports for coal tonnages. The graduated symbols in the map thus provide a graphic comparison among Great Lakes Ports for coal tonnage in 1995 (provided by Lake Carriers Association).



Example 2: Display of Attributes for Features in the System

Figure B.8
User activates pull down menu to display the Great Lakes dock locations in the system.

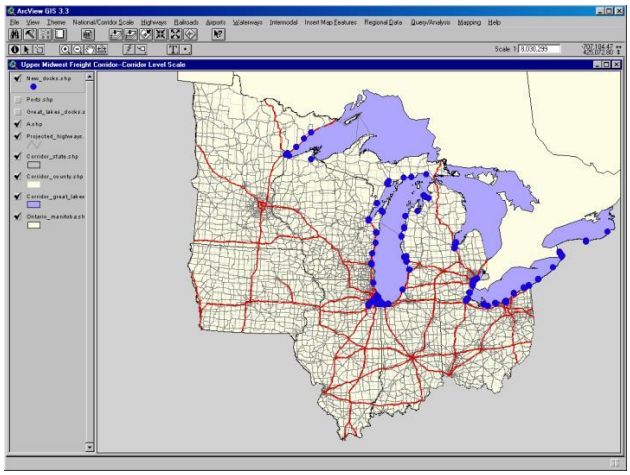


Figure B.9
MWFV displays dock locations in the view window. Note that at this scale, dock locations are distributed in the same locations as ports; however there are more points in this map than in the map in Figure II.6.

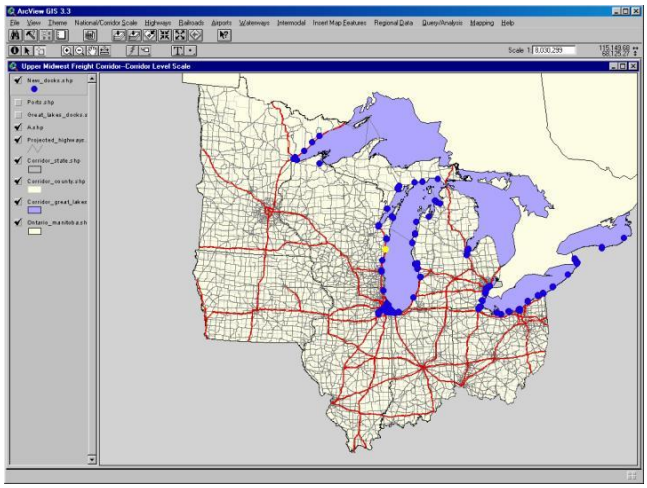


Figure B.10
User points to a single dock and highlights it with the cursor. (See yellow dot located at Sheboygan, Wisconsin)

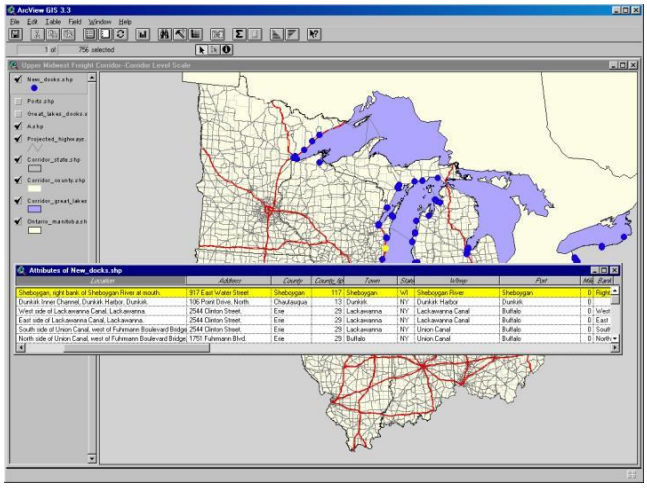
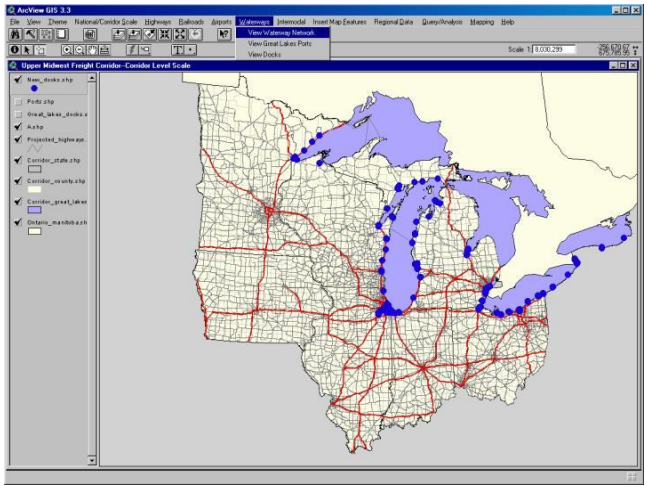


Figure B.11
User opens attribute table and examines highlighted record in the table corresponding to the dock location (note only a portion of the table is shown in the display).



Example 3: Mapping the Network

Figure B.12
User activates pull down menu to open the waterway network.

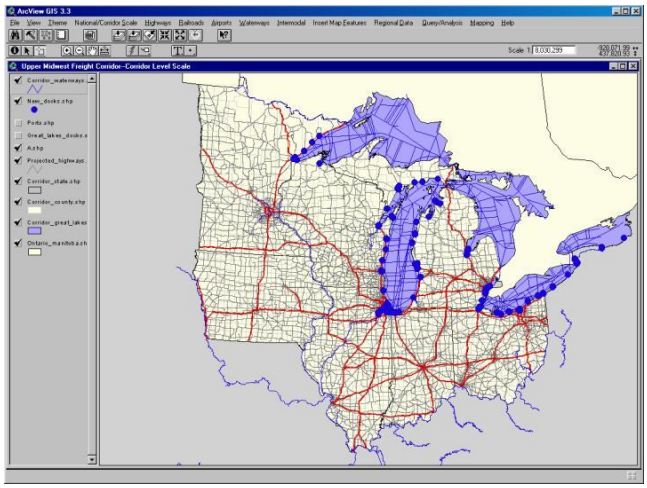


Figure B.13
MWFV displays USACE waterway network for both the Great Lakes and the Inland Waterway system. Given that MWFV was developed as an intermodal transportation display system for the Upper Midwest Freight Corridor Study, more than one waterway system is displayed.

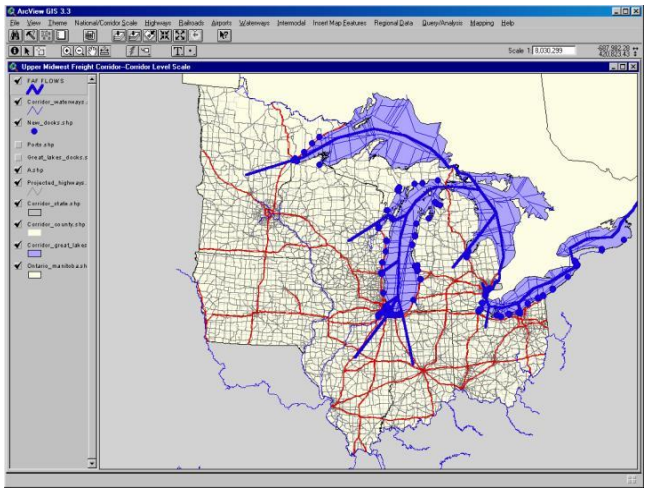
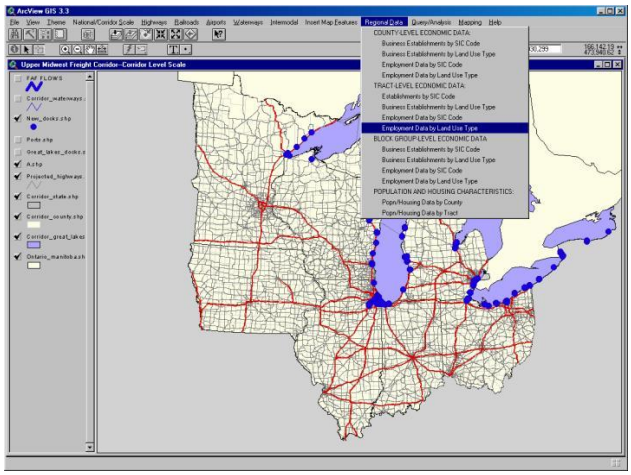


Figure B.14
User highlights shortest path links on the Great Lakes/St. Lawrence Seaway Network that were developed to contain baseline commodity flows from the 2002 Freight Analysis Framework. Flow data were based on 2002 Commodity Flow Survey. Note that additional links are inserted to state centroids as a means to capture state-based flows that originate or terminate away from the major ports in the region.



Example 4: Linking the Great Lakes Maritime Transportation System to the Regional Economy.

Figure B.15
User activates pull down menu to open the regional employment database. In this case, the user is opening employment data by census tract.

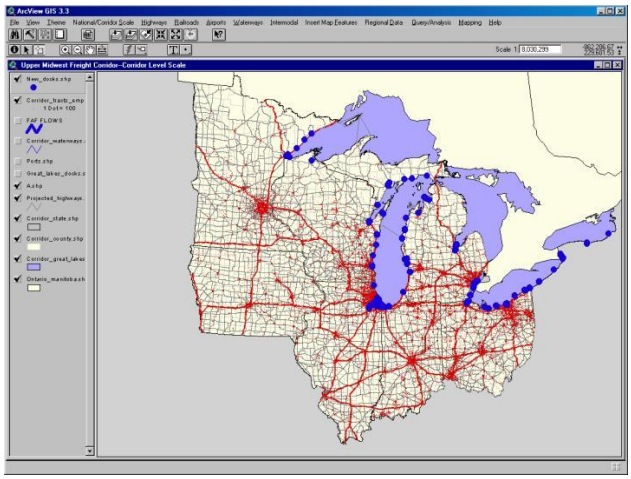


Figure II.16
MWFV displays a dot distribution map of manufacturing employment alongside Great Lakes dock locations. MWFV was developed as an intermodal transportation display system for the Upper Midwest Freight Corridor Study, more than one waterway system is displayed. The map appears cluttered, prompting the user to "turn off" some of the map elements in the display to produce the map in Figure B.17.

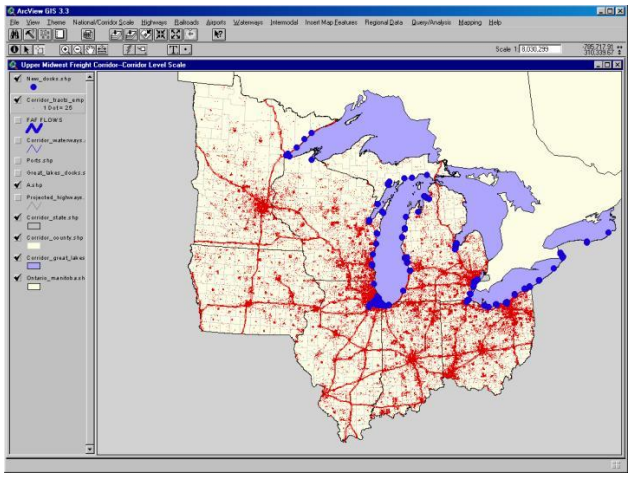


Figure B.17
MWFV displays an uncluttered dot distribution map of manufacturing employment superimposed over Great Lakes dock locations. Not only will users be able to cartographically display these relationships, but the data are also stored in a convenient format for a wide variety of statistical and spatial analyses.

APPENDIX C

Code Specifications for Great Lakes Commercial Docks

Code Specifications for Great Lakes Commercial Docks

An identification code system has been developed by the project team to uniquely identify the commercial docks in this database. This code was developed because of a lack of standardization in identification codes among agencies and firms. As this project is looking at the Great Lakes system as a whole, our ID code was designed to work for all docks on both the Canadian and American sides of the Lakes. The code is an eight-digit number system where each digit, or set of digits, represents a specific category. The advantage of this I.D. system is that each number represents something real, it is not a mere arbitrary number used for administrative functions. This code system enables individuals to easily identify and locate a dock and determine the types of commodities it handles.

Code Key

- **X**0000000 First Digit – Country Code
- 0**XX**00000 Second & Third Digits – State/Province Code
- 000**XX**000 Fourth & Fifth Digits – Port Code
- 00000**X**00 Sixth Digit – Commodity Code
- 000000**XX** Seventh & Eight Digits – Specific Dock Code

The advantage of this I.D. system is that each number represents an actual characteristic of the dock; it is not an arbitrary number used for administrative functions.

Identification System Code Index

- **X**0000000 First Digit – Country Code
  - 1 Canada
  - 2 United States

- 0**XX**00000 Second & Third Digits – State/Province Code
  - 01 Illinois
  - 02 Indiana
  - 03 Michigan
  - 04 Minnesota
  - 05 New York
  - 06 Ohio
  - 07 Ontario
  - 08 Pennsylvania
  - 09 Quebec
  - 10 Wisconsin

- 000**XX**000 Fourth & Fifth Digits – Port Code

  Illinois:
  - 01 Chicago
  - 02 Waukegan

  Indiana:
  - 01 Buffington
  - 02 Burns International Harbor
  - 03 Gary
  - 04 Indiana Harbor

Michigan:

- 01	Alpena	-19	Marine City
- 02	Brevort	-20	Menominee-Marinette
- 03	Calcite	-21	Marquette
- 04	Charlevoix	-22	Marysville
- 05	Cheboygan	-23	Monroe
- 06	Detroit	-24	Munising
- 07	Escanaba	-25	Muskegon
- 08	Filer City	-26	Ontanagon
- 09	Frankfort Harbor	-27	Port Dolomite
- 10	Gladstone	-28	Port Gypsum
- 11	Grand Haven	-29	Port Huron
- 12	Gulliver	-30	Port Inland
- 13	Harbor Beach	-31	Portage Canal
- 14	Holland	-32	Saginaw River
- 15	Ludington	-33	Sault Ste. Marie
- 16	Macinac Island	-34	St. Joseph
- 17	Manistee Harbor	-35	Stoneport
- 18	Manistique	-36	Traverse City

Minnesota:

- 01 Duluth – Superior
- 02 Silver Bay
- 03 Taconite Harbor
- 04 Two Harbors

New York:

- 01 Buffalo
- 02 Dunkirk
- 03 Ogdensburg
- 04 Oswego
- 05 Rochester

Ohio:

- 01 Ashtabula
- 02 Cleveland
- 03 Conneaut
- 04 Fairport Harbor
- 05 Huron
- 06 Kelly's Island
- 07 Lorain
- 08 Marblehead
- 09 Sandusky
- 10 Toledo

Ontario:

- 01	Amherstburg	-13	Morrisburg
- 02	Bath	-14	Nanticoke
- 03	Bowmanville	-15	Oshawa
- 04	Britt	-16	Owen Sound
- 05	Bruce Mines	-17	Pelee Island
- 06	Cornwall	-18	Port Colborne
- 07	Goderich	-19	Port Stanley
- 08	Hamilton	-20	Sarnia
- 09	Little Current	-21	Thunder Bay
- 10	Marathon	-22	Toronto
- 11	Millhaven	-23	Windsor
- 12	Mississauga		

Pennsylvania:

- 01 Erie

Quebec:

- 01	Baie Comeau	-11	Port Alfred
- 02	Becancour	-12	Port Cartier
- 03	Contrecoeur	-13	Quebec City
- 04	Cote Ste. Catherine	-14	Rimouski
- 05	Gros-Cacouna	-15	Sept Iles
- 06	La Baie	-16	Sorel
- 07	Lauzon Levis	-17	St. Romuald
- 08	Mataine	-18	Tracy
- 09	Montreal	-19	Trois Riveres
- 10	Pointe Naire	-20	Valleyfield

Wisconsin:

- 01 Ashland
- 02 Duluth – Superior
- 03 Green Bay
- 04 Manitowoc
- 05 Menominee – Marinette
- 06 Milwaukee
- 07 Sheboygan
- 08 Sturgeon Bay
- 09 Washburn

- 00000**X**00 Sixth Digit – Commodity Code

- 1 Aggregate
- 2 Coal
- 3 General Cargo
- 4 Government
- 5 Grain
- 6 Iron Ore
- 7 Liquid
- 8 Passenger
- 9 Shipyard / Lay-Up

- 000000**XX** Seventh & Eight Digits – Specific Dock Code

The Specific Dock Code is a two-digit number used to differentiate between docks in a particular port that handle the same type of commodity. It is possible that there will be multiple docks with identical code numbers up until these last two digits, which will always show the difference between specific docks in a port.

APPENDIX D

Meeting Participants in the Great Lakes Data Workshop
Detroit, Michigan
June 9, 2006

ATTENDEES

Name	Organization	Title
Jeff Ahlgren	Coast Guard Sector Detroit	Chief
Dick Ash	Army Corps of Engineers	Operations Research Analyst
Helen Brohl	US Great Lakes Shipping Assn.	Executive Director
Jonathan Brown	Army Corps of Engineers	Regional Economist
Steve Fisher	American Great Lakes Ports Assn.	Director
David Grier	Army Corps of Engineers	Navigation Analyst
Tonya Harrington	Army Corps of Engineers	Regional Economist
Ray Johnston	Chamber of Maritime Commerce	President
Dave Knight	Great Lakes Commission	Program Manager
Jatinder (Paul) Kochhar	Transport Canada	Economist
Patrick Lawrence	University of Toledo	Professor
Peter Lindquist	University of Toledo	Professor
Brian Link	USCOC, NOAA, OCS	G.L. Nav. Advisor
Douglas McDonald	Army Corps of Engineers	Washington Liaison
Glen Nekvasil	Lakes Carriers Association	Vice President
Adolph Ojard	Duluth Seaway Port Authority	Executive Director
Steven Olinek	Detroit/Wayne County Port Authority	Deputy Director
Richard Stewart	University of Wisconsin-Superior	Co-Director
Kevin Tunks	Maritime Administration	Enterprise Architect
Mark Vonderembse	University of Toledo	Director
Xiubin Wang	University of Wisconsin-Superior	Professor
Carol Wolosz	University of Minnesota Duluth	Program Coordinator