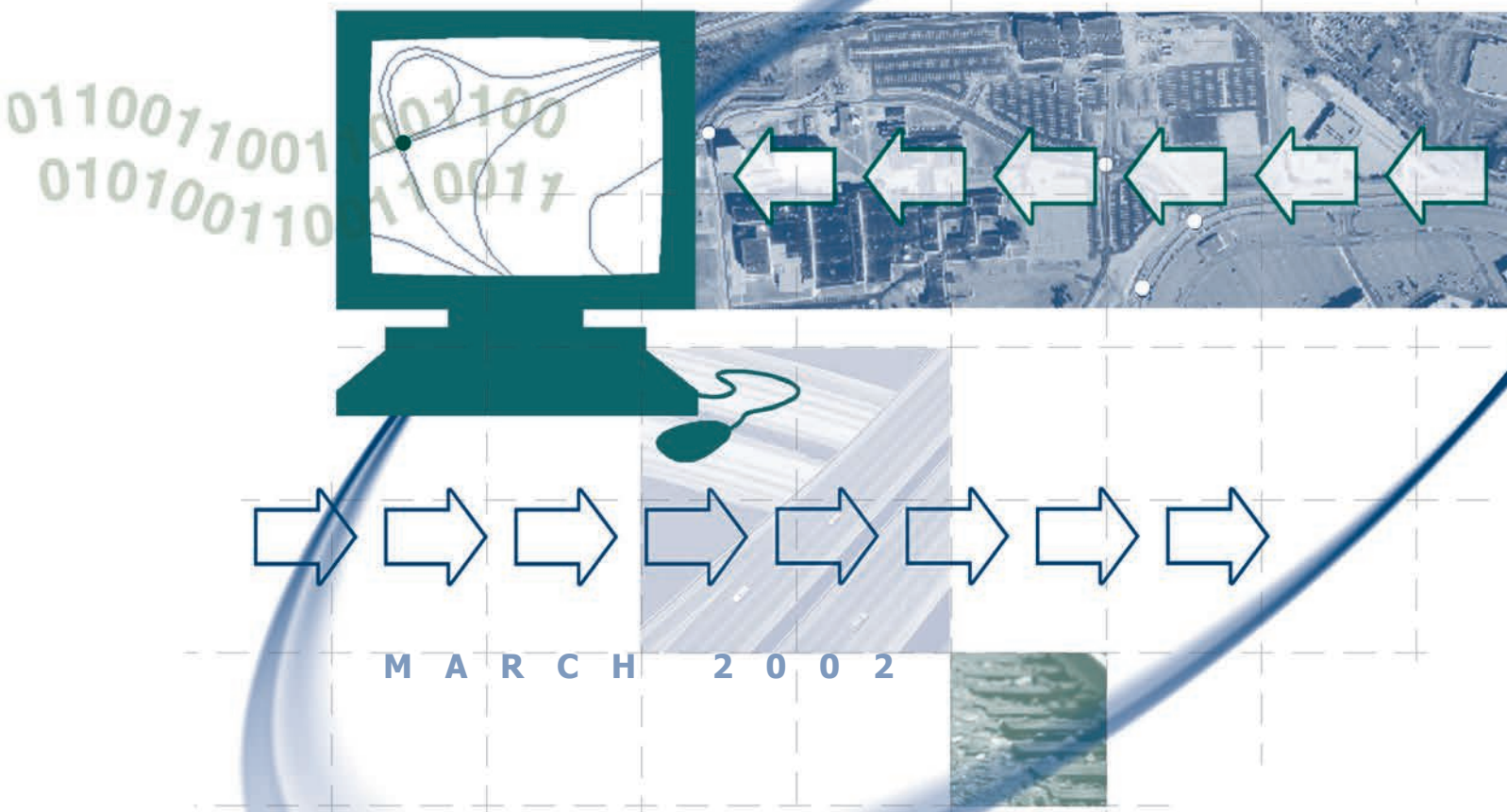
VOLUME I - NEEDS ASSESSMENT SUMMARY

Region-wide Transportation GIS Project Design and File Architecture



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The Delaware Valley Regional Planning Commission By:

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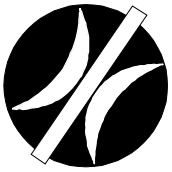
A Joint Venture

In Association With: TransDecisions, Inc.

DELAWARE VALLEY REGIONAL PLANNING COMMISSION

Created in 1965, the Delaware Valley Regional Planning Commission (DVRPC) is an interstate, intercounty and intercity agency that provides continuing, comprehensive and coordinated planning to shape a vision for the future growth of the Delaware Valley region. The region includes Bucks, Chester, Delaware, and Montgomery counties, as well as the City of Philadelphia, in Pennsylvania; and Burlington, Camden, Gloucester and Mercer counties in New Jersey. DVRPC provides technical assistance and services; conducts high priority studies that respond to the requests and demands of member state and local governments; fosters cooperation among various constituents to forge a consensus on diverse regional issues; determines and meets the needs of the private sector; and practices public outreach efforts to promote two-way communication and public awareness of regional issues and the Commission.



Our logo is adapted from the official DVRPC seal, and is designed as a stylized image of the Delaware Valley. The outer ring symbolizes the region as a whole, while the diagonal bar signifies the Delaware River. The two adjoining crescents represent the Commonwealth of Pennsylvania and the State of New Jersey.

DVRPC is funded by a variety of funding sources including federal grants from the U.S. Department of Transportation's Federal Highway Administration (FHWA) and Federal Transit Administration (FTA), the Pennsylvania and New Jersey departments of transportation, as well as by DVRPC's state and local member governments. The preparation of this document was funded by grants from the Federal Highway Administration and the Pennsylvania Department of Transportation. The authors, however, are solely responsible for its findings and conclusions, which may not represent the official views or policies of the funding agencies.

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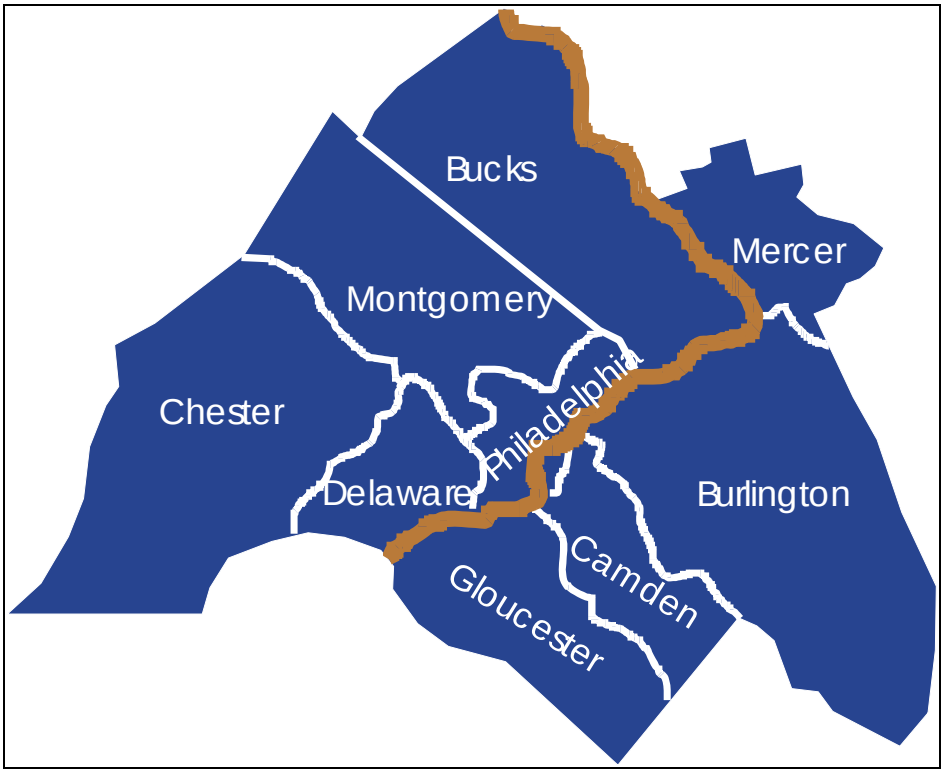

PREFACE

As the federally designated Metropolitan Planning Organization (MPO) for the Philadelphia Metropolitan Area, the Delaware Valley Regional Planning Commission (DVRPC) is responsible for working on a variety of issues with the Commonwealth of Pennsylvania, the State of New Jersey, the City of Philadelphia, four suburban Southeastern Pennsylvania and four suburban Southern New Jersey Counties that comprise the Region. Among the most critical of these issues are those pertaining to transportation and transportation planning.

In order to support required activities and functions related to the agency's core responsibilities, DVRPC has adopted a number of advanced technologies including a geographic information system (GIS). By implementing a GIS, DVRPC has been able to enhance and extend the analytical capabilities of its technical staff, while also providing a framework for creating and maintaining regional-scale digital mapping.

Coincidentally, with DVRPC's development of a GIS, a number of local and state government entities and transportation operating agencies throughout the region have implemented similar systems and databases of their own. In most cases, these systems have been developed independently, with limited consideration given to regional cooperation and coordination. In order for DVRPC, its member organizations, transportation operating agencies, and other local and state entities holding a stake in the region's transportation infrastructure to fully realize the benefits of GIS, it is necessary for there to be region-wide continuity in the transportation GIS process. This continuity is far more achievable when a common technical basis is established and maintained.

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Chapter I - Project Overview

I-1 Project Purpose

The primary purpose of this project is to "assure that each of these entities (DVRPC, its member city and county governments, and transportation operating agencies) has a GIS and data files that can be developed and seamlessly shared with each other to facilitate better transportation planning analysis and decision-making among the counties, the regions, and the states." It is the anticipation of DVRPC that accomplishing this purpose will require efforts on the part of all participants to supplement whatever data systems may be available from state, regional or federal sources. The purpose of the work to be performed for this project is to lay the foundation and establish the basic systemic and operational framework for these efforts.

I-2 Project Goals

In formulating the requirements of this project, DVRPC has focused on four major project goals. These goals are stated below.

Goal No.1: "Expand the use of GIS among all transportation planning partners and assist all members to improve their capacity as needed to reach a common operational level."

DVRPC recognizes that in order to expand and support the use of GIS by its members and others within the region, it is first essential to fully understand the needs for GIS among those entities. A primary stumbling block for most failed GIS implementations has been a fundamental failure to identify and define the basic needs for GIS of the organization for which the implementation has failed. Before GIS use can be expanded and enhanced within the region, it will be paramount for true needs of the end user organizations to be determined and documented. This project is designed to accomplish this.

Goal No. 2: "Evaluate the transportation GIS files developed and maintained by federal and state agencies, DVRPC member governments and transit operators to determine how they can be used in an accurate and regionally consistent manner."

DVRPC recognizes that there exists a large amount of GIS data among its members, in a variety of base scales, resolutions and formats. This applies to federal and state agencies, as well. It is critical that DVRPC does not waste substantial resources in "reinventing wheels" in its efforts to implement a region-wide transportation GIS. For this reason, DVRPC has established a goal for optimizing the considerable investments that have been made in developing and refining these various data sets. Through a process of careful needs assessment and relevant data gathering, DVRPC is promoting the concept.

Goal No.3: "Provide for the seamless exchange of GIS data files and the integration of planning infrastructure among all member governments and operating agencies."

A substantial amount of effort that is expended on this project will have been wasted if an ineffective implementation strategy is designed and implemented. Part of a successful implementation strategy for this project must include provisions for data sharing among the participating members. Along with this data sharing will come enhanced capabilities for intergovernmental cooperation for transportation planning. DVRPC has applied this basic premise to structuring and delivering implementation strategies to its member organizations. This project presents the opportunity to consider new, state-of-the-art approaches to GIS data management that may change the way DVRPC and its members do business, creating new and improved opportunities for working cooperatively towards common goals.

Goal No. 4: "Structure the region-wide GIS design so that it can be expanded and enhanced by individual partners, while maintaining its consistency and exchangeability."

The approach taken by DVRPC introduces technology tools that will significantly enhance it's own capabilities and those of its member entities for creating and maintaining a truly dynamic transportation GIS. This approach is focused on the database and not any specific proprietary software solution. This solution introduces substantial flexibility with regard to the database maintenance options that can be applied. The concept of using a database engine that supports multiple software platforms is a truly unique, yet proven, effective means for achieving this goal.

I-3 Project Approach

This project has been conducted in several phases. The first of these is the Needs Assessment phase. Its primary purpose has been to address the first two goals described above. By establishing the existing systems, data models and applications of GIS for transportation planning of the State DOT 's, regional transit agencies, turnpike authorities, member county and city governments, and DVRPC, itself, it becomes feasible to identify the relative levels of accuracy and detail that are required to support GIS-based transportation planning activities. This is the first step towards developing an implementation strategy and designing a practical data model that can be applied on a regional scale. The principle data collection technique that was employed consisted of interviews conducted with responsible representatives of each of the organizations listed in the following table.

New Jersey (State):
New Jersey Department of Transportation
New Jersey Transit Corporation
New Jersey Turnpike Authority
New Jersey (Local):
Burlington County Engineer's Office
Burlington County Office of Information Processing
Camden City Department of Development and Planning
Camden County Division of Engineering
Camden County Division of Planning
Camden County Improvement Authority
Gloucester County Planning Division
Mercer County Planning Division
Trenton City Department of Development and Planning
Trenton City Department of Housing
Pennsylvania (State):
Pennsylvania Department of Transportation – Bureau of Planning and Research
Pennsylvania Department of Transportation – District 6 Office

Pennsylvania Turnpike Commission
Pennsylvania (Local):
Bucks County Planning Commission
Chester County Department of Computing and Information Services
Chester County Planning Commission
Delaware County Planning Department
Montgomery County Planning Commission
Philadelphia City Planning Commission
Philadelphia City Mayor's Office of Information Services
Philadelphia City Police Department
Philadelphia City Streets Department
Regional:
Delaware River Port Authority
Delaware Valley Regional Planning Commission
Port Authority Transit Corporation
Southeastern Pennsylvania Transportation Authority

Table I-1 - List of Participating Organizations

The Needs Assessment phase also included the collection and analysis of information regarding the geography files (GIS digital line-work) and the database files (attributes and events) that are currently used and maintained by each of the participating organizations. The purpose of this exercise was to compile and record details of these files to support further analysis aimed at addressing a number of parameters including:

- Line-work quality
- Attribute/event database quality
- Data elements available from DOT and other files
- Data elements available from transit agencies
- Other transportation GIS elements and their availability

The results of the Needs Assessment Phase have been tabulated in both a graphic matrix and database and are summarized in the concluding section of this Needs Assessment report.

Data that has been collected and compiled through the Needs Assessment phase will be used as input to a process that will result in a series of additional reports. These subsequent reports are as follows:

- Linework Recommendations Report
- Feature Standards Report
- Symbology Standards Report
- GIS Data Elements Recommendations Report
- Database Design Recommendations Report
- Metadata Report
- Street Addressing Recommendations Report

Each of these reports will be developed as a separate volume of an overall project document. Volume I starts with this needs report. Subsequent volumes will be added in sequential order. Taken together, the findings that are detailed in these volumes will serve as the foundation for the transportation GIS "concept" that is to be proved through the next phase—the Prototyping and Implementation Planning phase.

The Prototyping and Implementation Planning phase will follow the Needs Assessment phase. During this phase of the project, sample data sets obtained from the participants during the Needs Assessment phase are used to test various scenarios for developing and maintaining a region-wide transportation GIS framework. This prototyping effort will focus on a "proof of concept" approach, whereby a conceptual model arising from the Needs Assessment phase is tested for validity. It may be the case that several such concepts will be tested.

Following the prototyping effort, an analysis will be performed on the results and implementation strategies will be developed for each participating organization.

I-4 Needs Assessment Overview Structure

This Needs Assessment report is organized into chapters. Due to the fact that the street centerline data model and the methods used to link event data to theses centerlines are generally considered to be the most critical GIS elements for transportation planning, Chapter II describes various data models that are employed for street centerlines. The intent here is to provide a background in the technical and technological issues pertaining to a street centerline file that can effectively support transportation planning applications. The major types of centerline data models relevant to the Region that are discussed include:

- Pennsylvania DOT - County – State Route – Segment
- New Jersey DOT - Standard Route Identifier (SRI)

Chapter III summarizes an analysis of the linework that currently exists within the region that serves to represent road centerlines and support transportation planning efforts. In performing this analysis, a number of parameters characterizing GIS linework were considered including:

- Extent, Scale and Coverage
- Directional Representations
- Map Resolution and Accuracy
- Current maintenance policies and procedures
- LRS method (if applicable)
- Current utilization of the data by the subject entity
- Topological connectivity and consistency

In Chapter IV, current event databases that exist in the region to support transportation are summarized and reviewed. Included in this review are databases maintained by Departments of Transportation, Turnpike Authorities and Commissions, Transit Agencies and local governments.

Chapter V concludes the report with a summary and analysis of several related issues. Included are:

- Standards for Street Addressing
- Considerations for Database Design
- The Need for Metadata
- Symbology
- Project Prototypes

This report includes, in Appendix A, a summary assessment for each participating organization. Each summary consists of three sections. The first section provides summary information from the interview process. Included are actual responses to survey questions provided by the interviewees for each organization. The second section comprises a summary of the interview discussions. A third section provides an evaluation of each organization on several parameters. These parameters include linework

quality, database quality, overall status of transportation GIS within the organization, and potential for contributing data to a region-wide model.

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Chapter II - Linear Referencing Systems Currently In Use In The Region

II-1 Centerline Identification Standards

A key piece in creating a region-wide standard for geospatial data representing transportation networks is the development, implementation, and general acceptance of a centerline identification standard. The function of such a data standard is to enable database developers to transact updates and to exchange information by defining unique and relatively stable transportation reference points and segments that can be assigned permanent feature identifiers.

A useful transportation identification standard must successfully address several issues without causing unreasonable extra burden to either database developers or users. First, the standard must be useful in representing the physical or real-world domain of transportation features. Secondly, the standard must be useful in fulfilling the wide variety of mapping requirements of potential users. Thirdly, the standard must support a large number of different network applications (for example address geo-coding, network routing, vehicle and incident location, and highway facility management). Each of these applications typically segments the network in different ways.

A key point in developing a Centerline Identification Standard is to ensure that the standard does not attempt to reconcile the differences that exist among multiple cartographic representations of the same real-world features. The standard should propose a method for specifying real-world features, so that users of different cartographic representations can more easily exchange updates to both geometric and tabular information.

Network objects consist of links and nodes, which together form the network. These objects are inherently topological. Transportation networks provide information on the feasible paths between specific locations, and on decision points along those paths. Once a network has been created, other transportation application layers can be built upon it, including identified routes, linear referencing methods, linearly referenced points and linear events. Construction of routes and linear referencing methods is accomplished through an ordered listing of the links (or parts of links) that comprise each route.

II-2 Methods Used Currently to Link Attribute Data to Road Centerlines

The methods used today to link attribute information to road centerlines within the geographic area served by this DVRPC study are detailed and described below as well as the new NSDI Transportation Identification Standard:

- Pennsylvania DOT - County – State Route – Segment
- New Jersey DOT - Standard Route Identifier (SRI)

There are other methods being employed, most notably geocoding by street address. While these methods to support the placement of point event data along a centerline, they will not support the use of linear event data nor do they support the multi-variant analysis of linear data that is so critical to transportation planning.

II-3 Pennsylvania Department of Transportation RMS Location Reference System (County-Route-Segment-Offset Method)

A single Linear Referencing System (LRS) is used throughout PennDOT to link their corporate databases to the road centerline basemaps. The base map development and maintenance activities are a coordinated effort between the Geographic Information and the Cartographic Information Sections. Both GIS and cartographic activities use a single set of digital road centerline base maps first developed during the mid–1980's from USGS 1:24,000 scale quadrangle maps. The map projection is Polyconic; the map datum is NAD 1983.

The LRS is defined in the Department's Roadway Management System (RMS) as a County-Route-Segment-Offset address. Each segment is roughly one-half mile in length. All state and federal-aid eligible roads are addressed in this manner. The Bureau of Maintenance and Operations (BOMO) in the Deputate for Highway Administration maintains both the RMS and LRS. Additionally, turnpike routes, ramps, ferries, and toll bridges are linked.

GIS development in the Department is concerned not only with state highways, but also with other roads that are also part of the National Highway System (NHS) in Pennsylvania. In addition to state routes, the NHS includes roadways in three non-state jurisdictions: certain locally owned roads on or off the Federal aid system, Pennsylvania Turnpike, and toll bridges (maintained by port authorities or other agencies). Furthermore, the Department has initiated the development of all other local roads in GIS.

The linear referencing method used in the GIS was designed to integrate all the types of roads, and produce a single LRS that is fully compatible with the requirements of the Intergraph Modular GIS Environment (MGE) Segment Manager software tools.

All RMS road segments occur in one of the 67 Pennsylvania counties. Bridge segments that straddle the border of 2 or more counties are assigned administratively to one of the counties. Inventory data for each jurisdiction are organized with county code as the first qualifier.

RMS inventories each state road according to its 4-digit state route number. Route numbers are unique within a county. If the road carries one or more traffic routes, the state route number is usually the same as the lowest numbered traffic route number. State route (SR) numbers from 0001 to 0999 are traffic routes; SR's numbered between 1000 and 4999 are routes that are fully contained within the county. Routes in the 6000 to 6999 range are usually temporary records for roads under construction. SR's in the 8000 to 8999 range are ramps at interchanges of access-controlled highways. SR's with 9000 to 9999 numbers are special facilities (rest areas, wyes and truck escape ramps). There are no state routes numbered 5000 to 5999, nor 7000 to 7999, and no plans exist to use these series of numbers.

A route can be divided into any number of segments. Segments are sequentially numbered (4 digits), usually in increments of 10, starting with the southern-most or western-most (depending on the overall direction of the route) segment in the county. Divided highways have separately inventoried segments for each direction of travel. Northbound and eastbound segments have even-numbered segments; their southbound or westbound companion segments have odd-numbered segments. Undivided roads have segment records that contain data for all lanes in both directions of travel. The state route number and segment number are displayed on the segment markers posted along the road. Attributes that occur within the segment are referenced by their 4-digit offset (number of feet from the beginning of the segment).

Non-state roads on the Federal Aid system do not have official route numbers. The common reference to these roads is by street name. For control purposes in federal reporting, a federal identification number

has been established for each road. The 4-character federal I.D. number is the reference number under which the road is inventoried. It is purely administrative in function; it is not posted on the road, nor is it published on maps used by the public.

Most federal I.D. numbers contain an alphabetic character. This convention was established mainly to indicate the federal aid urbanized area in which the road lies. The other components of the RMS location referencing system are the same for these routes as they are for the state roads, though the controls are not as stringent.

The roads are divided into any number of separately inventoried segments. The segments are generally numbered sequentially (4 digits) in increments of 10. A segment generally represents a contiguous section of road, bounded on each end by an intersection with some other road. There is no limit to the length of a segment. No attribute data is stored at a level of detail greater than the segment.

Although PennDOT currently uses the RMS County/Route/Segment/Offset method in its business databases, within the GIS architecture this reference is converted to County/Route/Cumulative Offset. This simplified reference system is truly linear and can be used more directly by GIS products. It also is more similar to systems used by the Federal government and other states, such as New Jersey. See Figure II-1 for a graphical depiction of this segmentation scheme.

II-4 New Jersey Department of Transportation Standard Route Identifier (SRI) Linear Referencing System

The New Jersey Department of Transportation (NJDOT) has implemented internally a unique centerline identifier termed the Standard Route Identifier (SRI). The SRI, in conjunction with milepost, is a standard, consistent and uniform way of identifying every state, county, municipal, and authority roadway within the State. The SRI can be used to locate any linear and/or point attributes along any roadway.

The Standard Route Identification System (SRI) is a 10 digit unique numbering system defined the following way:

CC|MM|RRRR|S|D

CC = County (00-21) 00 for State, Interstate and 500 Routes
MM = Municipality (00-99) 00 for State, Interstate, 500,600, and 700 County Routes
RRRR = Route Number
S = Suffix
D = Direction

NJDOT currently maintains in its GIS approximately 2700 miles out of New Jersey's statewide total of approximately 35,000 miles of public road. These routes cover the Interstates, US Routes and NJ Numbered roads down to the 500 level county roads. The Cartography Section at NJDOT also maintains individual cartographic county maps of every road in the state.

Basically, the 500/ 600/ 700 routes are all County Jurisdiction roadways. The 500 system is an inter-county system - meaning that one particular 500 route (i.e.: 501) can theoretically run from the southern most county (Cape May) all the way to the northern most county (Sussex). The 500 level system was originally designed as a secondary defense network.

New Jersey's Public Road Mileage by Jurisdiction – 1998

NJDOT	2,331
Authority	399
County	7,520
Municipal	25,024
Park	647

Table II-1 – New Jersey's Public Road Mileage by Jurisdiction – 1998

The 600 and 700 series are intra-county systems - meaning that each county can have the same 600 numbered route (i.e.: Cape May has a 601 and Sussex has a 601). The 700 series is a continuation of the 600 series.

As described in Chapter IV, "Attribute and Database Identification", a significant number of event database tables currently maintained by NJDOT include the SRI number and milepost reference as fields. This database design promotes the capability of relating the database records to the geography files, resulting in the mapping of the event data on the road centerlines using GIS software.

Figure II-1 graphically depicts the manner in which event data can be mapped to the respective centerlines of PennDOT and NJDOT based on each agencies' LRS and LRM. In the PennDOT example, a cumulative distance is calculated and the event is geocoded to that location. In the NJDOT example, the SRI and milepost are used to locate the event on the road .

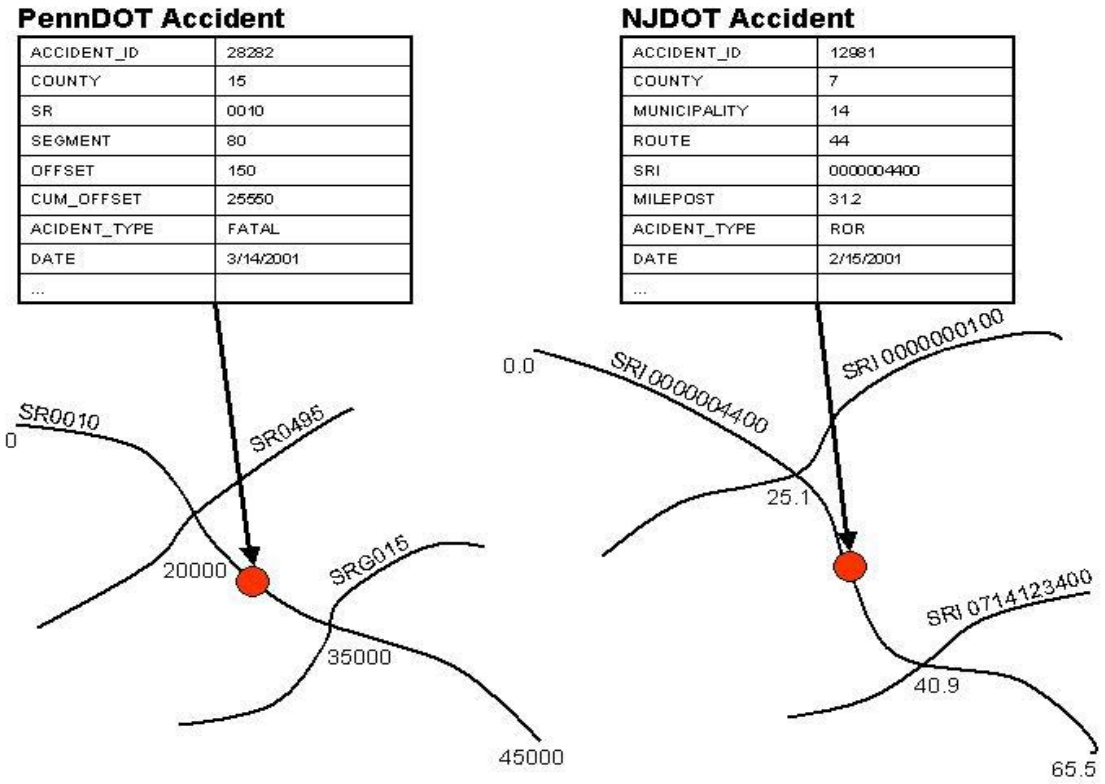

Figure II-1 – Comparison of Department of Transportation Linear Referencing Systems

Chapter III - Existing Linework Deficiency

III-1 Problem Definition

Geography files comprise the most critical aspect to a successful Linear Referencing System (LRS) implementation. If the graphics which comprise the LRS are not to a scale that is acceptable to the users, are not complete, and are not topologically clean, the chances of success for the whole project lay in doubt.

There is considerable confusion within both the transportation and GIS communities on the relationships among transportation features such as roads, their representation as geo-spatial objects in geographic information systems (GIS), and their representation in analytical networks. Much of this confusion results from the inconsistent use of terminology to describe transportation features and their representations. It is also perpetuated by current versions of GIS software, which fail to adequately address the differences between lines used for cartographic displays and those used for network analysis. The importance of geo-spatial data depicting transportation features – especially road networks – extends well beyond their cartographic value. Road networks provide the basis for several indirect location referencing systems, including street addresses and various linear referencing methods commonly used to locate features like bridges, signs, pavement conditions and traffic accidents. Integration of the "best available" transportation databases into a regional framework layer must provide for region-wide connectivity in order to support network applications. This means that there can be no "gaps" in the data. Further, the transportation data for each regional entity must be produced so that it can be connected topologically to transportation data for adjacent areas.

The existing transportation layers have been developed at different scales, with different levels of positional accuracy, at different levels of currency and using different linear referencing schemes. These databases will either have to be stitched together in order to provide the network connectivity required or a completely new layer will need to be created. If a new layer is to be created, the process of conflation (transferring the information from one spatial dataset to another) will most likely be required to move attributes from existing networks to the newly created network so that a common LRS scheme can be created.

Currently within the region serviced by DVRPC, there is a considerable variance among the government entities in terms of the geography files that are used for transportation GIS applications. In some cases, there is no centerline database being used or maintained at all. In other cases, files purchased from third-party vendors are being used, typically with varying degrees of accuracy and currency. Some agencies have developed and are maintaining centerline files internally, while others have used the services of outside contractors. Obviously, this situation has not fostered any significant levels of region-wide linework development or data sharing.

III-2 Purpose

During the agency interviews, detailed information was collected and compiled regarding the current transportation related GIS data being maintained by the various participating entities. Using this information, JMT/EnterInfo performed a detailed analysis to determine the appropriateness and applicability of the graphic features for inclusion into the region-wide GIS transportation database. This chapter will function to summarize the analysis and provide an overall representation of the region-wide linework. Some of the issues to be addressed through this analysis include:

- Extent, Roadway Systems and Scale
- Directional Representations
- Map Resolution and Accuracy
- Current maintenance policies and procedures
- LRS method (if applicable)
- Current utilization of the data by the subject entity
- Topological connectivity and consistency

III-3 Extent, Roadway Systems and Scale

III-3.1 Background

Extent refers to the scope and depth of the area covered by the agency's centerline dataset. This is an important determining factor when analyzing the region's linework because there needs to be an overall extent large enough to cover the entire DVRPC region.

Roadway systems refer to the various classes of roads that are included in the database. For example, a state transportation agency may limit its linework to state-maintained roads only. A local government, on the other hand, may include only local streets in its database, excluding state roads.

Scale refers to the scale at which the centerlines were created. This is also an important determining factor when analyzing the region's linework because it greatly affects the accuracy of the dataset.

Extent :
The aerial extent of a map is the area on the Earth's surface represented on the map. It is the limit of the area covered, usually defined by a rectangle just large enough to include all mapped features, but could also be the limit of a political jurisdiction such as a municipality, county, or state.

Roadway Systems:
Typically, segments within a road centerline file are classified based upon some criteria, such as levels of usage, ownership and maintenance

Scale:
To show a portion of the Earth's surface on a map, the area must be reduced. Map scale, or the extent of reduction, is expressed as a ratio. The number on the left indicates distance on the map; the number on the right indicates distance on the ground. The following three statements show the same scale:
1 inch = 2,000 feet
1 inch = 24,000 inches
1:24,000

The last is known as a representative fraction (RF) because the amounts on either side of the colon are equivalent; that is, '1:24,000' means '1 inch equals 24,000 inches' or '1 foot equals 24,000 feet' or '1 meter equals 24,000 meters', and so on. Map scale indicates how much the given area was reduced. For the same size map, features on a small-scale map (1:1,000,000) will be smaller than those on a large-scale map (1:1,200).

Each scale represents a different trade-off. With a small-scale map, you'll be able to show a large area without much detail. With a large-scale map, you'll be able to show a lot of detail but not as much area. The small-scale map can show a large area because it greatly reduces the area; the large-scale map can only show a portion of one street, but in such detail that the shapes of the houses can be seen.

III-3.2 Assessment

In general, the scale and extent of the datasets that encompass the region are adequate for region-wide transportation planning. These datasets are summarized in Table III-1. The smallest scale available in the region is 1:24,000 (1 inch = 2,000 feet). This scale is large enough to obtain the details necessary for transportation planning. County centerline datasets reflect a spatial resolution anywhere from 1 inch = 2,000 feet to sub-meter accuracy created by GPS. Although the overall extent of coverage for the region is adequate, there are a few specific cases where deficiencies exist that will need to be addressed in order to make region-wide transportation planning as accurate and efficient as possible.

III-3.3 Deficiencies

As stated before, the scales and extents of the centerline datasets that encompass the DVRPC region are adequate for transportation planning, however, there are deficiencies that should be addressed. For instance, the New Jersey Department of Transportation centerline dataset has the greatest extent of coverage, the entire state, but it does not contain every road in the state. The NJDOT centerline dataset only contains down to "500 level" roads at this point. They will be finished adding the "600 level" and "700 level" county roads by 2003. Of the total of 35,921 miles of public roads in the state, 11,000 miles of road were complete at the time of the interview. This leaves a gap when planning for county and municipal transportation scenarios. A similar deficiency exists in relation to the Pennsylvania Department of Transportation centerline dataset. PennDOT's dataset only covers state maintained roads. Again, deficiencies stem from the exclusion of county and township-owned roads.

ORGANIZATION	***SCALE***	***EXTENT***	***ROADWAY SYSTEM***
New Jersey DOT	*1" = 2,000'*	*New Jersey*	*500, 600, 700 Level Roads*
New Jersey Transit Corporation	*GPS Grade (NavTech)*	*Service Territory*	*Interstate, State*
New Jersey Turnpike Authority	*1" = 2,000'*	*NJ Turnpike Only*	*NJ Turnpike*
Burlington County Engineers	*1" = 100'*	*Burlington County, NJ*	*Local, State, Interstate*
Burlington County Data Processing (GIS)	*GPS Grade*	*Burlington County, NJ*	*Local, State, Interstate*
Camden County	*GPS Grade*	*Camden County, NJ*	*Local, State*
City of Trenton	*1" = 50'*	*Trenton, NJ*	*To be developed*
City of Camden	*1" = 200'*	*Camden, NJ*	*Local, State*
Mercer County	*1" = 1,000' (GDT)*	*Mercer County, NJ*	*Local, State, Interstate*
Gloucester County	*1" = 2,000'*	*Gloucester County, NJ*	*Local, State*
Pennsylvania DOT	*1" = 2,000'*	*Pennsylvania*	*State, Interstate*
Montgomery County	*1" = 2,000'*	*Montgomery County, PA*	*Local*
Bucks County	*1" = 2,000'*	*Bucks County, PA*	*Local*
Delaware County	*n/a*	*None*	
Chester County	*1" = 200'*	*Chester County, PA*	*Local, State, Interstate*
City of Philadelphia	*1" = 200'*	*Philadelphia, PA*	*Local, State, Interstate*
SEPTA	*n/a*	*None*	
Pennsylvania Turnpike	*1"= 2,000'*	*Turnpike only*	*PA Turnpike*

Commission			
Delaware River Port Authority (DRPA)	*n/a*	*None*	
Port Authority Transit Corp.(PATCO	*n/a*	*None*	
DVRPC	*1" = 2,000'*	*Entire Region*	*Local, State, Interstate*

Table III-1 Summary of Scales and Extents

III-4 Directional Representations

Directional Representation refers to the method in which Northbound/Southbound and Eastbound/ Westbound lanes are represented in the centerline dataset.

III-4.1 Background

Several different models are employed throughout the DVRPC region. This is an important determining factor when analyzing the region's linework because it will affect the metrics of regional transportation planning adversely if the incorrect number of centerlines is assumed. The different models include the following:

Single Centerline:
This model represents both directions as a single centerline. Both North and Southbound or East and Westbound are represented as a single combined centerline in the dataset. Usually, when this model is employed, the different directional lanes are represented as offsets or just in displays. This model is a logical model of the real world.

Dual Centerline:
This model represents both directions as their own separate centerlines. The North and Southbound or East and Westbound lanes are represented as separate centerlines in the dataset. This model is more recently a physical representation of the real world due to the multiple centerlines for different directions.

Combination:
This model represents both directions as a single centerline where the actual road is not separated by a median, or represents both directions as separate centerlines where the actual road is separated by a median. This model logically represents the real world in some cases, and physically represents the real world in others, in terms of directional representation.

III-4.2 Assessment

Most agencies in the region employ the combination model. This is a semi-physical way of representing the real world. In general, the combination model allows the region to be represented in a way that is adequate for region-wide transportation planning. Provided that the attributes of the single directional centerlines differentiate between actual single centerlines and those which are multi-directional centerlines, transportation planning should be unaffected.

ORGANIZATION	***DIRECTIONAL REPRESENTATION***
New Jersey DOT	*Combination*
New Jersey Transit Corporation	*n/a (Navtech)*
New Jersey Turnpike Authority	*Dual*
Burlington County Engineers	*Dual*
Burlington County Data Processing (GIS)	*Dual*
Camden County	*Single*
City of Trenton	*Combination*
City of Camden	*Combination*
Mercer County	*n/a (ETAK)*
Gloucester County	*Combination*
Pennsylvania DOT	*Combination*
Montgomery County	*n/a (GDT)*
Bucks County	*n/a (GDT & ETAK)*
Delaware County	*n/a (no centerlines)*
Chester County	*Dual*
City of Philadelphia	*Dual*
SEPTA	*n/a (no centerlines)*
Pennsylvania Turnpike Commission	*Dual*
Delaware River Port Authority (DRPA)	*n/a (no centerlines)*
Port Authority Transit Corp.(PATCO	*n/a (no centerlines)*
DVRPC	*Combination*

Table III-2 Summary of Directional Representations

III-4.3 Deficiencies

As stated before, the directional representation models employed for the centerline datasets that encompass the DVRPC region are adequate for transportation planning. Deficiencies include regional interoperability and consistent definitions for lane representation. Since only some of the agencies employ the same model, interoperability issues may arise when performing regional transportation planning. This may leave a gap for specific planning scenarios that utilize centerline datasets from multiple agencies where the directional representation models do not match. In addition, the definitions for these directional representations may differ slightly or greatly between agencies. One agency may define a divided centerline as having a certain distance between the lanes while another may simply define a divided centerline as having a median separating the lanes. In order for accurate transportation planning to take place throughout the region, the models employed and definitions utilized must be consistent.

III-5 Map Resolution and Accuracy

Map resolution refers to how accurately the location and shape of map features can be depicted for a given map scale. Scale affects resolution. In a larger-scale map, the resolution of features more closely matches real-world features because the extent of reduction from ground to map is less. As map scale decreases, the map resolution diminishes because features must be smoothed and simplified, or not shown at all.

As scale decreases, long narrow features such as streams and roads must be represented as lines and smaller area features as points. The minimum sizes and dimensions are sometimes called minimum mapping units. When maps are being compiled, the minimum mapping units might be stated as a series of rules to follow.

III-5.1 Background

Many factors besides resolution influence the accuracy of depicted features, including the quality of source data, the map scale and the method in which features are represented. Any number of factors can cause error. Note that these sources can have a cumulative effect. The following equation, while not empirical, illustrates the relationship:

E = f(f) + f(l) + f(c) + f(d) + f(a) + f(m) + f(p) + f(rms) + f(mp) + u where,

f = flattening the round Earth onto a two-dimensional surface (transformation from spherical to planar geometry)
l = accurately measuring location on Earth (correct projection and datum information)
c = cartographic interpretation (correct interpretation of features)
d = drafting error (accuracy in tracing of features and width of drafting pen)
a = analog to digital conversion (digitizing board calibration)
m = media stability (warping and stretching, folding, wrinkling of map)
p= digitizing processor error (accuracy of cursor placement)
rms = registration accuracy of tics
mp = machine precision (coordinate rounding by computer in storing and transforming)
u = additional unexplained source error

National Map Accuracy Standards:
The National Map Accuracy Standards were established for the U.S. in 1941 by what is now the Office of Management and Budget (OMB). These standards state that: (1) No more than 10 percent of features shall be more than 1/30th of an inch from their intended location on maps of scale larger than 1:20,000; and (2) No more than 10 percent of features shall be more than 1/50th of an inch from their intended location on maps of scale smaller than 1:20,000.

For purposes of this region-wide linework assessment, we have established three levels of accuracy. Each agency will be assigned to one of the following accuracy levels.

- Superior – A high level of accuracy that allows for precise regional transportation planning. The source for this data is at least 1” = 200’ scale data but more often it was created using GPS data.
- Adequate – A medium level of accuracy that is adequate for regional transportation planning. The source of this data is usually 1” = 2,000’ or 1:24,000.

- Poor – A low level of accuracy that is not adequate for regional transportation planning. The source of this data is a much smaller scale than 1" = 2,000' or 1:24,000.

III-5.2 Assessment

In assessing the relative accuracy of the various centerline data sets currently in use throughout the region, consideration was given to a number of factors including:

- original scale
- source data
- maintenance processes
- update procedures

ORGANIZATION	***ACCURACY***
New Jersey DOT	*Adequate*
New Jersey Transit Corporation	*Superior*
New Jersey Turnpike Authority	*Adequate*
Burlington County Engineers	*Superior*
Burlington County Data Processing (GIS)	*Superior*
Camden County	*Superior*
City of Trenton	*n/a*
City of Camden	*n/a*
Mercer County	*Adequate*
Gloucester County	*Adequate*
Pennsylvania DOT	*Adequate*
Montgomery County	*Adequate*
Bucks County	*Adequate*
Delaware County	*n/a*
Chester County	*Superior*
City of Philadelphia	*Superior*
SEPTA	*n/a*
Pennsylvania Turnpike Commission	*Adequate*
Delaware River Port Authority (DRPA)	*n/a*
Port Authority Transit Corp.(PATCO)	*n/a*
DVRPC	*Adequate*

Table III-3 Summary of Accuracy Assessment

III-5.3 Deficiencies

The accuracy level throughout the DVRPC region is adequate for transportation planning. Since no agencies have received the "Poor" designation, we find that there are no deficiencies in relation to map resolution and accuracy in the region. The only deficiencies that may exist relate to the local use of the

DOT centerline datasets. Each of these datasets were captured at 1" = 2,000'. Although they have been corrected to a higher accuracy, they still may be inaccurate for local level use.

III-6 Current Maintenance Policies and Procedures

Maintenance is the process of preserving the centerline dataset as changes are made in the real world. These changes must be tracked and incorporated into the production centerline dataset within a pre-determined period of time. In order for maintenance to function efficiently, the process and parameters must be strictly defined.

III-6.1 Background

A maintenance plan defines a context or methodology, including formal procedures for requesting, evaluating, and implementing changes to a database. The objective is to identify and document the data that must be modified, the likely impact of the change on normal operations, and the time, cost and other resources required to implement the change. Next, the change is analyzed, designed and tested. It is important that all changes be made in a consistent manner. Some maintenance problems require an immediate response. Situations that threaten integrity, release of new government regulations or others require a quick fix, and formal procedures must wait. However, these emergency data patches should be formally incorporated into the database. Maintenance plans take many forms: corrective, adaptive, perfective and preventative.

Corrective maintenance activities include both emergency corrections and preventative repairs. These maintenance procedures include improving the integrity and the reliability of the data, streamlining and tightening data validation routines and correcting invalid data. This maintenance procedure involves cleaning and quality checking the data prior to inclusion in the overall database.

Adaptive maintenance is to enhance the system by adding data features in response to new requirements or new problems. Adaptive maintenance is reactive; fix the data only when it is necessary. This type of maintenance should be completed when additional fields need to be included in the database, or changing the data to reflect a change in focus of the project or the organization.

Perfective maintenance is to enhance the data by improving efficiency, reliability or maintainability often in response to user requests. Here, the idea is to fix the data before it breaks. Restructuring efforts are aimed at enhancing performance without changing how the database works or what it does. Perfective maintenance may include such things as: data normalization (if the data is not currently normalized), on-going fixes and updates that allow the data and associated systems to operate more efficiently.

Ongoing preventative maintenance is an important part of any database's standard operating procedure. The objective of preventative maintenance is to anticipate problems and correct them before they occur. Files and databases must be updated, periodically reorganized and regularly backed up.

III-6.2 Assessment

For purposes of this region-wide linework assessment, we have established three levels of maintenance. Each agency will be assigned to one of the following maintenance levels:

- Standard Operating Procedure – The maintenance plan is established and rigorously applied to in a timely manner.
- Established Plan – The maintenance plan has been established, but is not applied in a timely manner.

- No Plan – There is no established maintenance plan.

III-6.3 Deficiencies

Major deficiencies arise when no maintenance plan is in place or the pre-defined maintenance plan is not followed properly. The maintenance plan is a very important part of any enterprise GIS. Without a maintenance plan, the centerline dataset is obsolete immediately. All of the resources spent developing the dataset are squandered; the dataset becomes a snapshot in time rather then an up-to-date real world interpretation. Several maintenance gaps exist in regards to regional transportation planning. As shown in Table III-4, a majority of the agencies in the DVRPC region do not have a maintenance plan in place. Of those agencies that do employ a maintenance plan, most do not perform maintenance procedures in a timely manner.

ORGANIZATION	***MAINTENANCE POLICY***
New Jersey DOT	*Established*
New Jersey Transit Corporation	** purchased from NavTech*
New Jersey Turnpike Authority	*No Plan*
Burlington County Engineers	*Established*
Burlington County Data Processing (GIS)	*SOP*
Camden County	*No Plan*
City of Trenton	*No Plan*
City of Camden	*No Plan*
Mercer County	*No Plan*
Gloucester County	*No Plan*
Pennsylvania DOT	*SOP*
Montgomery County	*Established*
Bucks County	*No Plan*
Delaware County	*n/a*
Chester County	*SOP*
City of Philadelphia	*SOP*
SEPTA	*n/a*
Pennsylvania Turnpike Commission	*Established*
Delaware River Port Authority (DRPA)	*n/a*
Port Authority Transit Corporation	*n/a*
DVRPC	*n/a*

Table III- 4 Summary of Data Maintenance Policies

Regionally, only the Pennsylvania Department of Transportation, Chester County GIS, City of Philadelphia and the Burlington County GIS Section employ maintenance plans that operate under strict time constraints. In order for accurate regional transportation planning, the foundation data must remain real time, requiring a timely maintenance plan.

III-7 Linear Referencing System/Method

III-7.1 Background

Refer to Chapter 2 for background information on Linear Referencing Systems currently being used within the region.

III-7.2 Assessment

For purposes of this region-wide linework assessment, the two types of linear referencing systems that are currently in use are as follows:

- Route-Milepoint
- Route-Segment-Offset

ORGANIZATION	***Linear Referencing System***
New Jersey DOT	*Route-Milepost*
New Jersey Transit Corporation	*None*
New Jersey Turnpike Authority	*None*
Burlington County Engineers	*None*
Burlington County Data Processing (GIS)	*None*
Camden County	*None*
City of Trenton	*None*
City of Camden	*None*
Mercer County	*None*
Gloucester County	*None*
Pennsylvania DOT	*Route-Segment-Offset*
Montgomery County	*None*
Bucks County	*None*
Delaware County	*None*
Chester County	*None*
City of Philadelphia	*None*
SEPTA	*None*
Pennsylvania Turnpike Commission	*Route-Milepost*
Delaware River Port Authority (DRPA)	*None*
Port Authority Transit Corp. (PATCO)	*None*
DVRPC	*None*

Table III-5 . Summary of LRS/LRM

III-7.3 Deficiencies

For the most part, there are currently no true Linear Referencing Systems for roads and highways being used by the member organizations of DVRPC. In fact, the only agencies operating within the region that utilize LRS in the their transportation GIS databases are the DOTs and the Pennsylvania Turnpike Commission. This is a major deficiency in regards to regional transportation planning; some form of LRS utilization is critical to the successful application of GIS for transportation planning. Standardizing on a common LRS to be applied on a region-wide basis is one feasible approach. However, standardization of the LRS and sharing of the data is a delicate process. Standardization will only be beneficial if the costs associated with allowing the data to be shared are less than the costs associated with collecting and maintaining redundant data.

III-8 Current Utilization

Regional transportation planning should establish transportation policies for all forms of travel - motor vehicle, transit, pedestrian, bicycle and freight - and lay out the priority projects for roads and freight movement as well as bicycling, walking and transit. Regional transportation planning should also consider planned capital projects, as well. Regional transportation planning is based on forecasts of growth in population, households and jobs as well as future travel patterns and analysis of travel conditions. It considers estimates of federal, state and local funding which will be available for transportation improvements.

III-8.1 Background

In this document, current utilization refers to how each agency utilizes their centerline dataset for transportation planning activities. These activities can include anything from the mapping of accidents, road re-surfacing projects, commuter parking, bridge rehabilitation/ reconstruction and traffic control improvements to performing traffic counts or various other activities related to forecasting of traffic and road utilization as it relates to population growth in the area. All of the aforementioned types of activities should be coordinated on a regional level. The local municipality should be aware of the state's plans for road improvements in their area. Uncoordinated transportation activities resulting from a lack of regional transportation planning can result in misallocation of funds and general confusion in regards to transportation activities. Region-wide data sharing will serve to clear this confusion by synchronizing road improvements and coordinating the transportation plans from the local municipality to the regional level.

III-8.2 Assessment

For purposes of this region-wide linework assessment, we have established three levels of utilization. Each agency will be assigned to one of the following utilization levels.

- Active – The centerline dataset is actively being utilized for transportation planning.
- Moderate – The centerline dataset is utilized moderately for transportation planning.
- None – The centerline dataset is not used

III-8.3 Deficiencies

Those agencies that are not currently utilizing their centerline dataset for transportation planning activities represent a deficiency in relation to a regional model. If they are not using the dataset for regional

planning, they are less likely to actively maintain the type of data that is necessary for planning. Even if this data is actively maintained, if the specific agency does not utilize the centerline dataset for transportation planning, it is not as valuable for regional planning due to accuracy concerns. In addition, the transportation planning related data may not be as accurate if the agency is not currently using the data daily for transportation planning activities. In most cases, if there is not a maintenance plan in place, errors are detected during utilization. The lack of utilization will lead to a less accurate dataset.

ORGANIZATION	***CURRENT UTILIZATION***	***TYPE OF UTLIZATION***
New Jersey DOT	*Active*	*Project planning*
New Jersey Transit Corporation	*Active*	*Transit operations, system planning*
New Jersey Turnpike Authority	*None*	
Burlington County Engineers	*Active*	*Engineering*
Burlington County Data Processing (GIS)	*None*	
Camden County	*None*	
City of Trenton	*None*	
City of Camden	*None*	
Mercer County	*None*	
Gloucester County	*Moderate*	*Land use planning*
Pennsylvania DOT	*Active*	*Project planning, mapping, program management*
Montgomery County	*None*	
Bucks County	*None*	
Delaware County	*None*	
Chester County	*Active*	*Economic development, E911*
City of Philadelphia	*Active*	*Public safety, document management, vehicle routing*
SEPTA	*None*	
Pennsylvania Turnpike Commission	*Active*	*Project planning, executive support system*
Delaware River Port Authority (DRPA)	*None*	
Port Authority Transit Corp. (PATCO)	*None*	
DVRPC	*None*	

Table III-6 Current Utilization of Centerline for Transportation Planning

III-9 Network Topology

Topology explicitly defines spatial relationships. The principle in practice is quite simple; spatial relationships are expressed as lists (e.g., a polygon is defined by the list of arcs comprising its border).

III-9.1 Background

Creating and storing topological relationships has a number of advantages. Data is stored efficiently; so large data sets can be processed quickly. Topology facilitates analytical functions, such as modeling flow through the connecting lines in a network, combining adjacent polygons with similar characteristics, identifying adjacent features and overlaying geographic features. The arc-node data structure supports five major topological concepts:

- Connectivity - Arcs connect to each other at nodes
- Area definition - Arcs that connect to surround an area define a polygon
- Contiguity - Arcs have direction, left, and right sides
- Routes
- Events

III-9.2 Connectivity

Connectivity allows for the identification of a route to the airport, connect streams to rivers, or follow a path from the water treatment plant to a house. Arc-node topology defines connectivity - arcs are connected to each other if they share a common node.

Arcs represent linear features and the borders of area features. Every arc has a from-node, which is the first vertex in the arc, and a to-node, which is the last vertex. Together, they define the direction of the arc. Arcs are made up of vertices, including the two endpoint vertices, to define the shape of linear features.

Nodes indicate the endpoints and intersections of arcs. They do not exist as independent features. That is, they cannot be added or deleted except by adding and deleting arcs. Nodes can, however, be used to represent point features which connect segments of a linear feature (e.g., intersections connecting street segments, valves connecting pipe segments).

III-9.3 Area Definition

Geographic features wished to be represented cover a distinguishable area on the surface of the earth, such as lakes, parcels of land and census tracts. An area is represented in the vector model by one or more boundaries defining a polygon. The polygon is simply a list of arcs defining its boundary. Arc coordinates are stored only once, thereby reducing the amount of data and ensuring that the boundaries of adjacent polygons do not overlap.

III-9.4 Contiguity

Two geographic features, which share a boundary, are called adjacent. Contiguity is the topological concept, which allows the vector data model to determine adjacency.

The arc's direction is defined by the from and to node; this allows polygons to be on the left or right side. Left-right topology refers to the polygons on the left and right sides of an arc.

III-9.5 Routes

Routes define paths along an existing set of linear features, such as a path through the street network from a house to the airport. Routes are based on arcs. They can extend from one point to another, as in the

home to airport example; be a circuit, starting and ending at the same point, as in a bus route; or be disconnected, as in a street split by a river.

Sometimes routes begin at a point along an arc, which means that for the beginning or ending arc in the route, only part of the arc is used. A change in the description is required so that it is possible to describe where along the arc the route begins. This requires additional information describing measurements along the arc.

III-9.6 Events

Events describe occurrences of features located on a route. Two types of events occur along routes, point events and linear events. A point event describes the location of a point feature along a route, such as signage or a traffic accident. They are located as a measure along a route. A linear event describes the location of a linear feature along a route, such as pavement condition or toll charges.

III-9.7 Assessment

In assessing deficiencies in centerline topology, the principle criteria from those listed above are connectivity, contiguity, routes and events. A centerline data set that meets these criteria will most likely be useful as base data for transportation planning applications.

III-9.8 Deficiencies

The majority of the centerline datasets throughout the DVRPC region are not routable. The only agencies that maintain a routable network are New Jersey Transit Corporation, the Pennsylvania Turnpike Commission and the City of Philadelphia. For the remainder of the region, there are major deficiencies regarding network topology and routable networks. In order to perform network routing activities, there is a significant amount of data that needs to be added to the centerline dataset to enable it to become routable. This includes data such as one–way streets, overpass/underpass intersection locations, and turn-tables. A summary of the findings with regard to network topology is shown in table III-7, below.

ORGANIZATION	***TOPOLOGICAL CONNECTIVITY***
New Jersey DOT	*No*
New Jersey Transit Corporation	*Routable*
New Jersey Turnpike Authority	*No*
Burlington County Engineers	*No*
Burlington County Data Processing (GIS)	*No*
Camden County	*No*
City of Trenton	*No*
City of Camden	*No*
Mercer County	*No*
Gloucester County	*No*
Pennsylvania DOT	*No*
Montgomery County	*No*
Bucks County	*No*

Delaware County	*No*
Chester County	*No*
City of Philadelphia	*Routable*
SEPTA	*No*
Pennsylvania Turnpike Commission	*Routable*
Delaware River Port Authority (DRPA	*No*
Port Authority Transit Corp. (PATCO)	*No*
DVRPC	*No*

Table III-7 . Summary of Network Topology

III-10 Linework Deficiency Conclusion

The information that follows serves to summarize the conclusions that have been reached regarding the status of GIS street centerline linework as it currently exists throughout the region.

III-10.1 Regional Assessment

The most fundamental issue faced by DVRPC for Regional Transportation Planning is the establishment of a road centerline file that has the following aspects:

1. Owned and maintained by each local entity
2. Maintenance is performed on an on-going basis
3. Data is freely available to all member DVRPC agencies
4. Basic fundamental attribute information tied to each centerline and coverage is complete for the organizational needs.

In assessing centerlines as they exist today in the DVRPC region, JMT/EnterInfo believes it is clear that only four organizations have centerline information that meets items 1,2 and 4 above. These entities are: The City of Philadelphia, Chester County Pennsylvania, Burlington County New Jersey and Pennsylvania DOT.

Another grouping of organizations have some combinations of the above requirements. For example, NJDOT and DVPRC have maintenance procedures on their linework but it is not performed on an on-going basis, while other agencies have, for all practical purposes, no linework at all. Based on the aspects defined above, JMT/EnterInfo has developed an evaluation detailing the potential function of a regional data model. Again, the evaluation details the potential for each agency contributing to the regional data model and categorizes potential based on the following issues:

- Extent, Roadway Systems, and Scale
- Directional Representations
- Map Resolution and Accuracy
- Current maintenance policies and procedures
- LRS method (if applicable)
- Attribute data structure
- Current utilization of the data by the subject entity
- Topological connectivity and consistency

III-11 Potential Linework Contributors

New Jersey Department of Transportation has a high potential for contributing relevant centerline data to a regional transportation planning model because the centerline dataset is accurate, maintained and utilized for transportation planning activities, making it very valuable to a regional model. However, this centerline dataset is lacking in local streets and has poor spatial resolution for local government use.

Burlington County, New Jersey Engineering Department And GIS Section have a relatively high potential for contributing relevant centerline data to a regional transportation planning model because the centerline data is highly accurate, actively maintained and utilized for transportation planning activities, though limited to the county. Better cooperation between these two agencies would make Burlington County a model for transportation GIS at the county level.

Pennsylvania Department of Transportation has a high potential for contributing relevant data to a regional transportation planning model because the centerline dataset is accurate, actively maintained (2-week cycle) and utilized for transportation planning activities, making it very valuable to a regional model. However, this centerline dataset is virtually none, and has poor spatial resolution for local government use.

Chester County, Pennsylvania has a high potential for contributing relevant centerline data to a regional transportation planning model because the centerline dataset is extremely accurate, maintained daily and utilized for various transportation planning activities, making it very valuable to a regional model.

City of Philadelphia, Pennsylvania has a high potential for contributing relevant centerline data to a regional transportation planning model because the centerline dataset is extremely accurate, maintained monthly and utilized for various transportation planning activities, making it very valuable to a regional model. The only deficiency is their data sharing policy may prevent the city from contributing to the regional model.

Delaware Valley Regional Planning Commission (DVRPC) has a high potential for contributing relevant centerline data to a regional transportation planning model. While DVRPC serves as the principle agency for transportation planning throughout the region, there is a gap between the GIS operations and Transportation Planning operations. In spite of this, DVRPC still has a high potential for contributing data to a regional transportation planning model. In fact, it is essential that DVRPC's contribution be facilitated due to the large number of DVRPC customers throughout the region.

III-12 Unlikely Linework Contributors

New Jersey Transit Corporation has a moderate potential for contributing relevant centerline data to a regional transportation planning model because the centerline dataset is highly accurate. However, the dataset is not owned or maintained by *NJTransit*, which does not allow the data to be shared.

New Jersey Turnpike Authority has a limited potential for contributing relevant centerline data to a regional transportation planning model. Although the centerline dataset is accurate, NJ Turnpike does not employ a LRS, nor do they actively utilize the data for transportation planning activities.

Camden County, New Jersey has a limited potential for contributing relevant data to a regional transportation planning model. Although the centerline dataset is accurate, Camden County does not employ a LRS, nor do they actively utilize the data for transportation planning activities.

City of Camden, New Jersey has a limited potential for contributing relevant centerline data to a regional transportation planning model. Although the centerline dataset is accurate, it is maintained sporadically and the city does not employ a LRS, nor do they actively utilize the data for transportation planning activities.

Mercer County, New Jersey has a limited potential for contributing relevant centerline data to a regional transportation planning model, because, at this time, they do not own a centerline dataset. The County recently initiated its participation in GDT's community update program.

Gloucester County, New Jersey has a limited potential for contributing relevant centerline data to a regional transportation planning model. Although the centerline dataset is accurate, it is not maintained and the county does not employ a LRS, nor do they actively utilize the data for transportation planning activities.

Montgomery County, Pennsylvania has a limited potential for contributing relevant data to a regional transportation planning model. Although the centerline dataset is reasonably accurate, it is not owned or maintained by the county. The centerline dataset was purchased from GDT. In addition, the county does not employ a LRS, nor do they actively utilize the data for transportation planning activities.

Bucks County, Pennsylvania has a limited potential for contributing relevant centerline data to a regional transportation planning model. Although the centerline dataset is reasonably accurate, it is not owned or maintained by the county. The centerline dataset was purchased from GDT and ETAK. In addition, the county does not employ a LRS, nor do they actively utilize the data for transportation planning activities. The County has recently contracted with DVRPC's orthophoto production contractor for the development of a centerline file based on the recently acquired digital orthophotography.

City of Trenton, New Jersey has a limited potential for contributing relevant centerline data to a regional transportation planning model. The city is just beginning to develop a GIS database and the ability to share data with other regional entities lies sometime in the future.

At this time, *Delaware County, Pennsylvania* has a limited potential for contributing relevant centerline data to a regional transportation planning model since it has no centerline dataset.

At this time, *South Eastern Pennsylvania Transportation Authority (SEPTA)* has a limited potential for contributing relevant centerline data to a regional transportation planning model since it has no centerline dataset.

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Chapter IV - Attribute and Database Identification

IV-1 Executive Summary

The information that follows summarizes the information that was collected and analyzed regarding the current status of transportation-related GIS attribute databases currently in use throughout the region.

IV-1.1 Definition

Database files or Events/Distributed Attributes are phenomena that are located in linear space and their spatial components are described in the context of a Linear Referencing Scheme. Each record in an event table contains a location reference component and a set of attributes that describe and classify the event. Event data cannot be displayed or analyzed using traditional mapping and GIS methods, as they require special software that can convert the linear reference to standard geometric features. The process of converting the linear reference to cartographic reference is termed Dynamic Segmentation. Once an event has been dynamically segmented, it can be used in spatial analysis to generate maps and reports and is compatible with other more typical GIS data types.

The management of event data in a GIS is simply a large data warehousing project. Pavement data, accident data, construction data and other event data are being collected by some government entities connected with DVRPC. Different LRS's are being used, data is being code listed differently, data is being stored in multiple formats from paper to small databases to large Relational Database Management Systems to mainframe databases. Some of the data is current and some is out of date. By utilizing mainstream data warehousing techniques and software packages most of the operational data stores will need to undergo a process of extraction and transformation so that it can be cleaned and utilized in a region-wide application.

DVRPC desires to employ a distributed database model for accessing and sharing transportation GIS data throughout the region. It is not DVRPC's intent to become a centralized data repository. Rather, the primary goal here is to allow the member entities to maintain their current GIS hardware and software platforms for GIS while facilitating methods and procedures for easily sharing data. This principle guides all efforts while analyzing the current database files.

IV-1.2 Purpose

Detailed information was collected and compiled during the agency interviews regarding the current transportation-related attribute data being maintained by the various participating agencies. Using this information, detailed research was performed to determine the appropriateness and applicability of the data elements for inclusion into the regional GIS transportation database. Some of the items to be identified through this research include:

- Data elements available from state DOT's,
- Data elements available from transit agencies and
- Other transportation GIS elements, their structure, availability, consistency, accuracy and currency.

IV-2 Data Elements Available From State DOT's

Research was conducted into the GIS database design and data structures currently employed by the DOT's. In performing this research, the information systems and technologies currently being used were considered. This research effort focuses on the application and utility of the data within the context of a regional transportation GIS. Compatibility with existing systems and the level of effort required for data translation, manipulation and reformatting are also carefully considered.

IV-2.1 Pennsylvania Department of Transportation

This assessment will introduce PennDOT's roadway inventory, bridges, highway maintenance, transportation projects, traffic accident, traffic monitoring, airports and intermodal facilities and railroads attribute data. For internal GIS utilization, two components of the agency business process are important to note:

1. The internal LRS that is utilized is a Route/Network Linear Feature (NLF) model that is derived from the agency's RMS model.
2. Attribute data is transferred from a variety of databases to the agency's Oracle GIS database for use within the GIS.

Roadway Inventory

PennDOT utilizes its centralized Roadway Management System (RMS) for managing state highway assets. All attributes of any state road are stored in RMS by their location. All functions integrated in RMS use the same location referencing scheme: county code, route number, segment number and offset. The location data in each record mark the range (beginning and ending points) of its attributes.

Although PennDOT does not have primary responsibility for non-state roads, the organization does include limited information for the Pennsylvania Turnpike and Non-State Federal Aid roads. For the Turnpike, only data required for federal reporting such as administrative and traffic volume data is maintained. In addition, location referencing on the Turnpike is based on milepoint rather than the RMS standard segment/offset method. Similar to the Turnpike, non-state roads qualifying for federal funding only have data required for federal reporting by PennDOT. For these roads, location referencing is slightly different because they do not have a legislated route number physically posted on the road that can be used as a database key. Instead, an administrative route code has been established for internal processing.

DATABASE	***ATTRIBUTE DESCRIPTIONS***
Roadway Management System	➢ *Road segment inventory; location and physical characteristics of road segment* ➢ *Classification of the road segment for administrative and reporting purposes* ➢ *Traffic volumes; measured and calculated amounts of vehicle traffic that travel the section of road* ➢ *Traffic volume history; vehicle traffic amount from previous years' measurements* ➢ *Type of pavement surface* ➢ *Drainage pipe survey data* ➢ *Type and condition of shoulder*

	➢ *Location and description of guard rails* ➢ *Location on a traffic route where a ramp enters or exits the traffic route* ➢ *Locations of Highway Performance Monitoring System sample sections* ➢ *Point locations of all roads that intersect at-grade with a state route* ➢ *Municipality in which the section of road lies* ➢ *Traffic route number(s) associated with a section of road* ➢ *Railroad crossing* ➢ *Legislative route number associated with a section of road* ➢ *Street name associated with a single section of road between 2 intersections* ➢ *Names of intersecting streets at each intersection on a state road* ➢ *Network linear feature control table; provides linkage to graphic elements in centerline files to produce road network for GIS operations* ➢ *Posted roads* ➢ *Pavement roughness summaries from tests taken each year*

Table IV-1 PennDOT RMS Attributes

Bridges

The Bridge Management System (BMS) includes data for location, dimensions, physical and administrative characteristics and condition of each bridge greater than eight feet in length. These attributes also include features both on and under the bridge. BMS stores the state route location (county, SR number, segment number and offset) at the begin point of the bridge. The end point is calculated by adding the length of the bridge to the begin point. Those bridges that do not carry a state route are represented with coordinate values. Coordinates are stored in BMS for most bridges.

DATABASE	***ATTRIBUTE DESCRIPTIONS***
Bridge Management System	➢ *Inventory of bridges and their physical characteristics* ➢ *Information about the condition of the bridge, as recorded in the most recent bridge inspection* ➢ *Vertical and horizontal clearance dimensions for the road running under a bridge* ➢ *Information about the waterway under a bridge* ➢ *Identifies the railroad tracks passing either on or under a bridge*

Table IV-2 PennDOT BMS Attributes

Highway Maintenance

The Maintenance Operations and Resources Information System (MORIS) records include planned and actual maintenance activities, as well as completed maintenance activities and expenses.

MORIS is also used by field personnel to record observed road deficiencies and by managers to schedule activities, equipment and other resources. Only records related to highway maintenance are utilized by the GIS for the most recent five years.

DATABASE	***ATTRIBUTE DESCRIPTIONS***
Maintenance Operations and Resources Information System (MORIS)	➢ *Planned surface treatment work activity* ➢ *Quantity and costs of commodity materials related to the activity* ➢ *Completed highway maintenance activities*

Table IV-3 PennDOT MORIS Attributes

Transportation Projects

Planning and managing major construction and restoration projects on highways and bridges are planned, programmed and reported using the Multi-Modal Project Management Systems (MPMS). Two sets of project data are stored in the GIS. They are projects that are on the current approved Twelve Year Program (either active, programmed or candidate) and projects that have advanced to construction. Similar to other databases, the location of the project is recorded according to the standard county, SR, segment and offset referencing scheme. For those projects not on state routes there is the RMS reference is not used. Project locations may also be stored according to their geographic coordinates.

DATABASE	***ATTRIBUTE DESCRIPTIONS***
Multi-Modal Project Management Systems (MPMS)	➢ *Project information: type of project, milestone dates, total project costs, and location* ➢ *Project phase-related data, including status, type of work, funding appropriation, and total phase costs* ➢ *Funding sources and amounts for a project phase* ➢ *Construction project status information*

Table IV-4 PennDOT MPMS Attributes

Traffic Accident Records

The Accident Records System (ARS) stores traffic accident data for the past five years where there was personal injury or damage to a vehicle that requires towing. This information is utilized in the development of transportation improvement projects. Crash locations are recorded according to the standard RMS location referencing scheme. Crashes on the Pennsylvania Turnpike are included and their locations are converted to the GIS linear referencing scheme. Crashes on local roads in Bucks, Chester, Delaware, Montgomery or Philadelphia are also included. The GIS database contains only a summary of the time and place, physical and environmental conditions, the presence or absence of certain types of vehicles, classifications of drivers and types of events involved. This information is used to determine priority locations for crash analysis.

DATABASE	***ATTRIBUTE DESCRIPTIONS***
Accident Records System	➢ *Circumstances and characteristics of a crash* ➢ *Location of the crash on the road network* ➢ *Intersections having certain levels of accident concentrations*

Table IV-5 – PennDOT ARS Attributes

Traffic Monitoring

Various statistics are calculated that approximate the vehicle traffic volumes at any road segment by collecting measurements at control and sample locations. A traffic limits database has been developed that depicts the segmentation of the state highway system according to the pattern of computed traffic volumes. Beginning and ending points are recorded as the "limits" and between those limits, all points are assigned the same computed traffic volumes. These methods are used to detect regional changes in traffic patterns. The Traffic Monitoring Sites (TMS) Maintenance System was designed to support planning, scheduling and managing traffic counting.

DATABASE	***ATTRIBUTE DESCRIPTIONS***
Traffic Monitoring Sites Maintenance System (TMS)	➢ *Raw traffic counts* ➢ *Traffic extrapolation limit sets* ➢ *Range(s) of segments that make up a limit set* ➢ *Traffic monitoring sites (administrative control to group count locations into a "site")* ➢ *Traffic counting stations – location, scheduling, and control information about each point on the road network where counts are planned to be taken* ➢ *Function, or usage, associated with a station* ➢ *In-pavement traffic monitoring equipment at a station*

Table IV-6 PennDOT TMS Attributes

Airports and Intermodal Facilities

Various GIS databases contain information relative to airports, railroads and other intermodal facilities. Each of the public use airports has identifying information, numbers of various types of aircraft, ownership and selected runway information associated with a point feature. Intermodal facilities such as rail and truck terminals, ports, etc., are identified based on ISTEA guidelines. Identifying information, the types of modes serviced and responsible planning agency are stored based on data maintained by the Bureau of Rail Freight, Ports and Waterways. Both data sets are located by latitude/longitude coordinates and also as a distributed attribute on the nearest state highway.

DATABASE	***ATTRIBUTE DESCRIPTIONS***
Intermodal Systems (IMS)	➢ *Licensing information, such as name, location, registered aircraft, and maximum runway, for all public use airports* ➢ *Intermodal facilities' management information, like name, location, type of services*

Table IV-7 PennDOT IMS Attributes

Railroads

The railroad database contains information such as owner, number of tracks, trackage rights, and length of rail line segment. This database consists mainly of freight railroads and approximately 300 miles of passenger service lines owned by Amtrak and SEPTA.

DATABASE	***ATTRIBUTE DESCRIPTIONS***
Railroad	➢ *Freight railroad lines' ownership, class, and traffic data*

Table IV-8 PennDOT Railroad Attributes

IV-2.2 New Jersey Department of Transportation

The tables and attributes identified introduce NJDOT's Oracle-based RDBMS, which is utilized for a variety of transportation planning activities. Documentation is limited to that provided by NJDOT.

Accident Records

NJDOT' accident records are maintained in tables that are organized on an annual basis. The update cycle is annual. For more information, contact Mr. George Kuziw of NJDOT.

TABLES	***ATTRIBUTE DESCRIPTIONS***
Accident_master_xx *(Accident data for 1988, 1989, 1991, 1992, 1993, 1994, 1995)*	➢ *Attribute Descriptions not provided*
Vehicle_master_xx *(Data for 1988, 1989, 1991, 1992, 1993, 1994, 1995)*	➢ *Record Code, Control Sequence, Sequence Number, Vehicle Unit Number, Vehicle Type, Direction of Travel, traffic Controls, Contributing Circumstances, Pre Accident vehicle Action, Hazardous Material, License Plate Number, Vehicle State*
Occ_master_xx *(occupancy data for 1988, 1989, 1991, 1992, 1993, 1994, 1995)*	➢ *Control Number, Sequence Number, Vehicle Unit Number, Occupant Age, Occupant Age, Class of Injured or Killed, Victim's Physical Condition, Position in/on Vehicle, Safety Equipment Used, Ejection from vehicle, Location of Complaint, Type of Most Severe Physical Injury, Ambulance License Number, Hospital Code, Pedestrian Maneuver, Pedestrian Physical Status, Pedestrian Alcohol Test Given and Type, Traffic Controls, Apparent Contributing Circumstances, Direction, Pre-Accident Vehicle Action*
Driver_master_xx	➢ *Record Code, Control Number, Sequence Number, Vehicle Unit Number, Driver Age, Driver Sex, Residence, Driver Physical Status, Driver State, Birth place, Drive Alcohol Test, Day of Birth*

Table IV-9 NJDOT Accident Tables

Construction & Maintenance

The construction management database tables are maintained by the NJDOT Construction and Maintenance Division. These records are continually updated, with the most recent being June, 2001. For more information, contact Rob Sholink of NJDOT.

TABLES	***ATTRIBUTE DESCRIPTIONS***
Active_const (*Active construction project information)*	➢ *Project Number, Region, Route, Section Number, Project Name, Local Projects, Description 3, Cities, towns, boroughs and municipalities, Townships, region name, Names, Federal Project Number, 2nd Federal Project Number, Type of Work, Status Code, Resident's Last name, First name, Title of Engineer, Name of Consultant Inspection Firm, Last name of Project Manager, Last name of Supervisor, Name of Primary Contractor, Project field comments, Project rejection date, Funding codes, CE job numbers, Field office telephone number, Number of structures on project, Field survey code, Inspected by code, Legislative district, Date of project advertisement, Date of project bid, Date of project award, Date of project estimated completion, Estimated completion date code, Date of adjusted completion date, Adjusted completion date code, Date of project fully open to traffic, Project fully open to traffic code, Date of project acceptance, Project acceptance code, Date the database is updated, DC 114 updated as of date, Date the current record was deleted, Total liquidated damages occurred on project, Total reductions occurred on project, Resident engineer's percent complete, Percentage of manpower, Percentage of manpower that should be used, Percentage of as-builts completed on project, Length of project in miles, Latitude, Longitude, Structure number, Beginning milepost, Ending milepost, FWWA Federal project category, FHWA Involvement, Final certificate date, Region name, Construction/maintenance inspection code, Original contract cost, Adjusted contract cost, Amount paid to contractor, Actual project start date, GIS Route Identification*
Adopt_hwy (*Companies in the adopt-a-highway program)*	➢ *Record Number, Company, Address, Route/Milepost, Region Contact Data, Miles, GIS Route Identification, From Milepost, To Milepost, Map Number*
Inmate (*Inmate work locations on the state highway system)*	➢ *Correctional Institution, Route Number, Start Milepost, End Milepost, Type of Work, GIS Route Identification*

Table IV-10 NJDOT Construction and Maintenance Tables

Statewide Planning

The statewide planning tables listed below are maintained by NJDOT's Mobility Strategies Section. They are updated periodically. For more information, contact Lance Weight of NJDOT.

TABLES	***ATTRIBUTE DESCRIPTIONS***
Coas_ev_res (*Coastal evacuation resource information)*	➢ *Location, Milepost, Direction, Latitude, Longitude, County, Municipal name, Intersecting road, GIS route identification*
Coastal_evac (*Coastal evacuation information)*	➢ *Route, Direction, Milepost, Municipality, County, GIS Route Identification*

Hurricane_evac *(Hurricane and radiological evacuation routes for the state)*	➢ *Attribute information not provided*
Emer_priority_rte *(Created in February 1995 for the Bureau of Statewide Planning)*	➢ *Route Number, From Milepost, To Milepost, Priority, GIS Route Identification*
Njdot_facility *(statewide planning maintenance facilities (created 12/97))*	➢ *Facility Name and Address, Route, Crew Number, Milepost, latitude, Longitude, Region, Maintenance Facility, Winter Facility, Domar Sand Facility, Electrical Facility, Landscape Facility, Bridge Facility, Construction Facility, Garage Facility, Signs/Lines Facility*

Table IV-11 NJDOT Statewide Planning Tables

Bridges

The Bridges Section, under Structural Engineering, within NJDOT maintains and updates bridge information on a periodic basis as the section receives new information. In the future, NJDOT's intranet capabilities may be used to update the bridge information on an annual or semi-annual basis.

TABLES	***ATTRIBUTE DESCRIPTIONS***
Bridge_n (*New bridge structures)*	➢ *FIPS code for states, Structure number, Record type, Route signing prefix, Designated level of service, Route number, Directional suffix, State highway department district, County code, Place code, Features intersected, facility carried by structure, Location, Inventory route, minimum vertical clearance, Milepoint, Latitude, Longitude, Bypass, detour length, Toll, Maintenance responsibility, Owner, Functional classification of inventory route, Year built, Lanes on the structure, Lanes over the structure, Average daily traffic, Year of average daily traffic, Design load, Approach roadway width, Bridge median, Skew, Structure flared, Traffic safety features, Historical significance, Navigation control, Navigation vertical clearance, Navigation horizontal clearance, Structure open, posted, or closed to traffic, Type of service, Structure type, main, Structure type, approach spans, Number of spans in main unit, Number of approach spans, Inventory route, total horizontal clearance, Length of maximum span, Structure length, Bridge roadway width, curb-to-curb, Deck width, out-to-out, Minimum vertical clearance over bridge roadway, Minimum vertical underclearance, Minimum lateral underclearance on right, Minimum lateral underclearance on left, GIS route identification, Milepoint with decimal point, Standard route identification, Historic bridge code, Description*
Co_bridges_d (*Data for Mercer County bridges)*	➢ *Number, Road over, Road under, Culvert, Height, Length, Structure, Over, Over stream, Structure type, Year built, Right of way, Road width, Span feet, Clearance under, Capacity tons, Upstream invert, Downstream invert, Center line elevation*

Table IV-12 NJDOT Bridges Tables

Capital Programming

The Capital Program Management Division in NJDOT maintains various information related to capital improvements and programs. The data is update periodically. For more information, contact Rich Stoolman.

TABLES	***ATTRIBUTE DESCRIPTIONS***
Cap04 (*2000-2004 Capital Plan data)*	➢ *Database number, Route, Route_2, Section, Limits, Description, Jurisdiction, Who is sponsoring project, Lead unit, Program category, program category, Legislative districts, Congressional districts, MPO, County, Municipality, Latitude, Longitude, Detailed information if there is a break in mileposts or if there is more than one route involved, From milepost, To milepost, Structure number of bridge, Field coded by job type, GIS route identification, NHS bridge, Region, MPO financing, Id number used by CPM*
Cpm_all_proj (*Project Managers and projects for all Capital Programs and others)*	➢ *Route Number, GIS Route ID, DB number, UPC number, Milepost data, Latitude, Longitude, Bridge Structure Number, Map ID, Section, Type of Work, Total Dollars, Current Status, Construction Start Date, Construction Completion Date, Program Manager, Project Manager, cap9701, cap9802, Record Active/Inactive Status, Construction Complete, Gov/Comm Tour Inclusion, Project Sensitivity, Char Flag Field, Integer Flag Field, Project Description, County, Hot Topic, More than one location with same number*
Pipeline (*Capital Program pipeline projects not in the Capital Program (created 6/97))*	➢ *DB Number, UPC Number, Route, Section, Fiscal Year 9802, Project Sponsor, Lead Unit, Program manager, Project Manager, Project Category, New Program, Congressional District, Legislative District, Metropolitan Planning Organization, County, Municipality, Latitude, Longitude, Milepost data, Bridge data, Rte_Gis_Field, Character Flag Field, Numeric Flag Field*
Mpo_pave (*Pavement data related to MPOs (created 7/95))*	➢ *MPO, Route, Direction, Start Milepost, End Milepost, Length, Control Section, County, Region, Pavement Type, Number of Lanes, Shoulder Condition, Average Ride Quality Index, Surface Distress Index, Final Pavement Rating, GIS Route Identification*
Stdev99 (*Latest Study and Development data as of 5/99)*	➢ *Database Number, Route, Section, County, Municipality, Latitude, Longitude, From Milepost, To Milepost, Structure*

Table IV-13 NJDOT Capital Programming Tables

Traffic/Congestion Management Data

The Technical Analysis Section, under Structural Engineering, maintains and updates congestion and traffic information. The section updates the data periodically as new information is received. In the future, NJDOT's intranet capabilities may be used to update the traffic and congestion information on an annual or semi-annual basis. For more information, contact Ira Levinton of NJDOT.

TABLES	***ATTRIBUTE DESCRIPTIONS***
Cms_data (*Data from*	➢ *CMS Link ID, GIS Route Identifier, Route Description Number,*

the Congestion Management System)	*Beginning Milepost, End Milepost, First Route Number, Second Route Number, MPO, County, County Number, NHS System Route, Toll Barrier, Toll Road, Jurisdiction, A Node-XY coordinates, B Node-XY coordinates, A-B Hourly Capacity, B-A Hourly Capacity, A-B Speed Limit, B-A Speed Limit, Detection Management, One-way ADT, Year of ADT, A-B AM Peak Hour Volume, B-A AM Peak Hour Volume, A-B PM Peak Hour Volume, B-A PM Peak Hour Volume, Functional Classification, Distance/Miles, A-B Number of Lanes, B-A Number of Lanes, A-B Roadway Width, B-A Roadway Width, A-B Shoulder Width, B-A Shoulder Width, Parking, Median Width, Median Type, Facility Type, A-B HOV Type, B-A HOV Type, Number of Signals, Peak Period Buses, Peak Direction Hour Buses, Peak Period Bus Passengers, Average Bus Passengers per Bus, Peak Direction Hour Bus Passengers, Vehicle Miles of Travel, A-B 24 Hour Volume, B-A 24 hour Volume, A-B AM Peak Hour Volume, B-A AM Peak Hour Volume, A-B PM Peak Hour Volume, B-A PM Peak Hour Volume, A-B Hour Truck Volume, B-A Hour Truck Volume, A-B AM Peak Hour Trucks, B-A AM Peak Hour Trucks, A-B PM Peak Hour Trucks, B-A PM Peak Hour Trucks, A-B AM Peak Hour V/C Ratio, B-A AM Peak Hour V/C Ratio, A-B PM Peak Hour V/C Ratio, B-A PM Peak Hour V/C Ratio, Maximum Peak Hour V/C Ratio, A-B V/C Hours .9-1.1, A-B V/C Hours 1.1-1.3, A-B V/C Hours 1.3+, B-A V/C Hours .9-1.1, B-A V/C Hours 1.1-1.3, B-A V/C Hours 1.3+, Max A-B B-A V/C hours .9+, Total Daily 2-Way Delay, AM Peak Period 2-Way Delay, PM Peak Period 2-Way Delay, Midday Period 2-Way Delay, Night Period 2-Way Delay, Minimum AM Peak Speed, Minimum PM Peak Speed, Peak Period Incidents 2-Way, Off-peak Period Incidents 2-Way, Total 2-Way Incidents, Total 2-Way Accidents, Total 2-Way Other Incidents, Peak per Incident Delay 2-Way, Off-peak per Incident Delay 2-Way, Total Incident Delay 2-Way, 2-Way Incident Delay per VMT*
Traff_count (*1998-1997 traffic county data)*	➢ *ID Number, road Class, Highway Number, GIS Route Identification Milepost, Description, Year, Annual Average Daily Traffic, County Code, Municipal Code, Rte Miscellaneous, Location, Street Name*
Average_veh_occ (*Average vehicle occupancy data)*	➢ *Standard Route Identifier, GIS Route Identification, Milepost, Date, Day of Week, AM Begin Time, AM End Time, AM Direction, PM Begin Time, PM End Time, PM Direction, AM General Purpose Lanes/Number of Vehicles, AM General Purpose Lanes/Number of Occupants, AM General Purpose Lanes/AVO Rate, AM HOV Lanes/Number of Vehicles, AM HOV Lanes/Number of Occupants, AM HOV Lanes/AVO Rate, AM Total Number of Vehicles, AM Total Number of Occupants, AM Total AVO Rate, PM General Purpose Lanes/Number of Vehicles, PM General Purpose Lanes/Number of Occupants, PM General Purpose Lanes/AVO Rate, PM HOV Lanes/Number of Vehicles, PM HOV Lanes/Number of Occupants, PM HOV Lanes/AVO Rate, PM Total Number of Vehicles, PM Total Number of Occupants, PM Total AVO Rate, AM HOV Violators, PM HOV Violators*
Avc_wim (Automatic Vehicle Classification/Weigh	➢ *GIS Route Identification, Milepost, Direction, Functional Classification, Number of Lanes, County, Municipality, station, Type, Equipment, Model, Sensors, Status*

in Motion Data)	
Trkmap (*Routes that 102" trucks cannot travel on (created June 1995))*	➢ *GIS Route Identification, Begin milepost, End Milepost, Standard Route Identifier, Section Length, Level of Access, GIS Route Identifier*
Urban_area (*Data from the current Functional Class project)*	➢ *Name, Area, Perimeter, Number, Large or Small*

Table IV-14 NJDOT Traffic/Congestion Management Tables

Pavement Data

The Bureau of Pavement Management maintains and updates pavement information in-house on a periodic basis as they receive new data. In the future, DOT's intranet capabilities will be used to update pavement information on an annual or semi-annual basis. For more information, contact Rich Cary of NJDOT.

TABLES	***ATTRIBUTE DESCRIPTIONS***
Pavement_xx (*pavement data for 1991, 1993, 1995, 1997)*	➢ *Route, Direction, From Milepost, To Milepost, Pavement Type, Speed Limit, One Way ADT, Equivalent Single Axle Load, Cumulative Single Axle Load, Percent Truck, Construction Year, Rehabilitation Year, Number of Lanes, Region, Control Section, Functional Class, County, Municipality, Legislative District, Shoulder, Median, Bridge, Type of Mix in Surface, Raised Pavement Marker, HPMS Section Number, Traffic Signal, Terminal Section, Construction Cost Index, Maintenance Cost Section, Cumulative Maintenance Cost, Life Cycle Cost Index, Environmental Region, Accident Year, Total Accidents, Wet Weather Accidents, Between Intersection Accidents, Between Int Wet Accidents, Fatal Accidents, Injury Accidents, Property Damage Accidents, Skid Number, Skid Date, Aran Date, Aran Ride Quality Index, Traffic Factor, Distress Index, Pavement Index, Average Rut Depth, Multiple Cracks Levels, Transverse Cracks Levels, Longitudinal Cracks Levels, Patching Levels, Shoulder Drop Levels, Cracking Levels, Faulting Levels, Longitudinal Joint Levels, Spare Fields*
Weather_sta (*Created 9/98 for pavement management)*	➢ *Station Name, Index Number, Division Number, County, Latitude, Longitude, Elevation, Temperature, Precipitation, Evaporation, Special Conditions, Observer, Route Number, Milepost*

Table IV-15 NJDOT Pavement Data Tables

Roadway Inventory Data

The roadway inventory data tables are maintained periodically by the Bureau of Transportation Data Development (BTDD). For more information, contact Jim Carl of NJDOT.

TABLES	***ATTRIBUTE DESCRIPTIONS***

Div_hwy (*Created on 8/9/99 containing records for divided highways with 4 or more lanes)*	➢ *Standard Route Identifier, Begin Milepost, End Milepost, Length of Section, Type of Divided Highway, National network, GIS Route Identifier, Unique Identifier, Map Identifier*
Fed_aid_sys (*Created in February 1998 showing routes by nhs, stp or non federal aid)*	➢ *Standard Route Identification, Milepost Start, Milepost End, System, Straight Line Diagram Name, GIS Route Identifier*
Func_class (*Current Functional Classification Data)*	➢ *State FIPS Code, Rural/Urban Designation Code, Urbanized Area Code, Functional System Code, Route Signing, Signed Route number, Route, Street Name, A node, B node, Route Segment Number, Length, Route Status, Access Control, Median Type, Number of Though Lanes, 1991 AADT, Truck Network Route*
Hwy_inventory (*State highway inventory table created in 10/94)*	➢ *Route Number, Route Letter, MP Begin, MP End, Distance, Roadway Width A-B Direction, Roadway Width B-A Direction, Number of Lanes A-B Direction, Number of Lanes B-A Direction, Shoulder Width A-B Direction, Shoulder Width B-A Direction, Parking, Exclusive Turn A, Exclusive Turn B, Median Width in Feet, Median Type, One-Way ADT, Peak Hour Percentage, Peak Hour Truck Percentage, Urban/Rural, Access, Facility type, Grade, Jurisdiction, County, No Passing, Signals, Green Percent, Capacity A-B Direction, Capacity B-A Direction, Volume to Capacity Ratio A-B Direction, Volume to Capacity Ratio B-A Direction, Federal Aid System, Functional Class, Speed Limit A-B Direction, Speed Limit B-A Direction, Vehicle Miles of Travel, Lane Miles, GIS Route Identification*
Nhs (*National Highway System (new nhs info is in fed_aid_sys table))*	➢ *Functional Class, Route Number, GIS Route Number, Number for Classification Purposes, Begin Milepost, End Milepost, County Number*
Rt_inven (*Rt_inven - Route inventory data (created 1996))*	➢ *Route Number, Route Suffix, Beginning Milepost, Ending Milepost, Section Length, Coincident Route, Control Section, Municipality, Numbered Route System, Duplicate Mileage, Supplemental Mileage, Jurisdiction, Federal Rural/Urban Code, Roadway Class, Number of Lanes, Federal Aid Route Number, Strahnet Route Code, Travel Route Category, Travel Route ID, Governmental Control, Federal Aid Route System, Toll, Functional Classification, AADT, Parkway Trucks, Access Control, Primary Direction Shoulder, Other Direction Shoulder, Federal Median Type, SRI Route Number, Year on System, Year Constructed, Median Width, Median Type, Primary and Secondary Direction Left Side Parking Shoulder Width Shoulder Type, Primary and Secondary Direction Right Side Parking Shoulder Width Shoulder Type, Primary and Secondary Direction Surface Type and Width, GIS Route ID*

Table IV-16 NJDOT Roadway Inventory Tables

Other Relevant Database Tables

For park and ride, and ride sharing information, the Technical Analysis Section under the Planning Division manages and updates these databases. Traffic Management Association (TMA) groups collect new information and feed it to the section for in-house update and maintenance. In the future, NJDOT's intranet capabilities may be used to update this information on an annual or semi-annual basis.

TABLES	***ATTRIBUTE DESCRIPTIONS***
Cult_sign (*Created on 3-6-96 and contains the route and milepost locations of cultural signs in Newark****)***	➢ *GIS Route Identification, From Milepost, To Milepost, From Kilometers, To Kilometers, Flag*
Drain_tmp (*Poor drainage roads)*	➢ *Database Number, Route, Section, Drain Value, Drain Rank, From milepost, To Milepost, GIS Route Identification, Flag*
Njdot_dam	➢ *Dam Name, Mile Post, GIS Route Identification*
Park_ride (*park and ride sites (created 5/98))*	➢ *Park and Ride Name, Route, Milepost, Location, County, Municipality, GIS Route Identification, Flag*
Ride_sign (*Ride sharing sign locations (last updated 5/98))*	➢ *Route Direction, Milepost, County, Municipality, Sign Size, Sign Type, Engineer, Sign Status, Date, GIS Route Identification*
Sld_fclass *Created from the Straight Line Diagram Files)*	➢ *Identification Number, Standard Route Identification, Milepost Beginning, Milepost Ending, Functional Class System Code, Route GIS*
Sld_juris (*Created from the Straight Line Diagram Files)*	➢ *Identification Number, Standard Route Identification, Milepost Beginning, Milepost Ending, Functional Class System Code, Route GIS*
Sld_lanes (*Created from the Straight Line Diagram Files)*	➢ *Standard Route Identification, Milepost Beginning, Milepost Ending, Number of Lanes, Route GIS Identifier*
Sld_links (*Created from the Straight Line Diagram Files)*	➢ *Standard Route Identification, Straight Line Diagram Name, Milepost Beginning, Milepost Ending, SRI Section Length, SRI Length Minus Map Length, GIS Route Identification, Kilometerpost Start, Kilometerpost End*
Speed_limit_d (*Updated in 1998)*	➢ *Highway, From Milepost, To Milepost, Speed Limit, Opposite Direction Speed Limit*
Urb_com_trends (*Created 7/92)*	➢ *Municipal Code, Zip Code, Number of Employees*
Wire_comm (*Wireless communication carriers sites (created 12/97))*	➢ *Route, Milepost, Direction, City, County, Tower or Antenna Carrier, Latitude, Longitude, Comments, Fee, Date Received, GIS Route Identification, Flag*
Access_permits	➢ *Type of Permit, Route, Region, Identification number, Year, Milepost, Direction, Team Leader, Case Manager, Development Type, Section Id, End Milepost, Unique Identifier, GIS Route Identification, Standard Route Identification, Kilometerpost*

Table IV-17 NJDOT Other Tables

IV-3 Data Elements Available From Transit Agencies

Research into data elements available from major transit agencies operating within the region was also conducted. As with the DOT's, this research effort focuses on all relevant databases and information systems and considers the region-wide applicability and utilization as primary factors.

IV-3.1 Southeastern Pennsylvania Transit Authority (SEPTA)

SEPTA currently maintains databases to support their ongoing system operations and service planning.

Stops and Pattern Stops

DATABASE	***ATTRIBUTE DESCRIPTIONS***
Stops	➢ *StopId (Uniquely identifies each stop, used regardless of how many routes are passing it)* ➢ *RefStopId (parent stop to StopId, used in determining stop areas)* ➢ *Type (bus stop, station, timepoint)* ➢ *Description (description of the stop location)* ➢ *Longitude* ➢ *Latitude* ➢ *OnStreet (street the bus is driving along when it passes this stop)* ➢ *AtStreet (nearest cross street or street intersecting the OnStreet)* ➢ *NSFS (NS – near side of the AtStreet when travelling along the OnStreet, FS – other side or across the AtStreet when travelling along the OnStreet, MB – mid block for stops that are along a block and not an intersection)* ➢ *FareZoneId (fare zone where the stop resides)* ➢ *Restroom (Y,N)* ➢ *Shelter (Y,N)* ➢ *Parking (Y,N)* ➢ *TaxiStand (Y,N)* ➢ *FlagStop (Y,N)* ➢ *StopDirection (direction of travel of the bus when it passes the stop)* ➢ *CurbCutout (Y,N – wheelchair access)*
Pattern Stops	➢ *Division (City, Frontier, Victory, Rail)* ➢ *Route (must match Trapeze route)* ➢ *ADA (Y,N – wheel chair accessibility or ability of a vehicle to accept someone in a wheelchair)* ➢ *Direction (must match Trapeze direction)* ➢ *Pattern (must match Trapeze direction)* ➢ *Sequence (position of stop in the sequence of stops along a route, direction and pattern in the direction of travel of the vehicle* ➢ *StopId (Uniquely identifies each stop, used regardless of how many routes are passing it, same as StopId in Stops table)* ➢ *Timepoint (node abbreviation field as found in Trapeze, key link between stops data collection and Trapeze scheduling data)* ➢ *StopNumber (phone number used by callers of the STAR system)* ➢ *DistToPrev (distance from current stop to previous one in the sequence of stops along a pattern)*

Table IV-18 SEPTA Tables

IV-3.2 New Jersey Transit

New Jersey Transit Corporation, providing various transit services in the Delaware Valley, records and maintains various databases and attribute information related to these services. Despite this wealth of information, data licensing agreements prohibit the ability for NJ Transit to share road data throughout the region. Spatial data sets developed by NJ TRANSIT, including bus and rail routes, stations, and other data, are available subject to NJ TRANSIT's data provision policy.

According to company officials, New Jersey Transit uses GIS to support the various functions of the corporation. At this time, the following functional areas being emphasized include:

- Operations Support
- Customer Information
- Automatic Passenger Counting
- Service Planning

The goal is to build a system that supports the agency's mission and is maintainable.

The primary database tables maintained by New Jersey Transit at this time include:

- Commuter and Light Rail Lines
- New Jersey Transit Operated Bus Lines
- Contracted Bus Lines
- Ordinanced Bus Stops

IV-4 Other Transportation GIS Elements

In addition to the DOT's and the Transit Agencies, there are other agencies and facilities operating within the region that have data available for consideration as part of a regional transportation GIS. A list of potential sources was developed and pursued for availability of data from these sources. The following agencies are identified as having attribute/database information that can contribute to the regional transportation GIS architecture.

IV-4.1 Camden County, New Jersey

Camden County Sign and Signal Inventory Databases

The Camden County Department of Public Works has collected sign and signal information with the intent of implementing a sign management system for Camden County. Data was collected for approximately 24,000 traffic signs and GPS data along approximately 400 miles of County roads. The County completed an inventory of all warning, regulatory and guide signs. Guide signs on overhead structures were inventoried, but it was not possible to directly measure some sign attributes. Sign attributes collected include the following:

DATABASE	***ATTRIBUTE DESCRIPTIONS***
SIGNview	➢ *Unique sign identifier* ➢ *Municipality that the sign is located*

	➢ *Jurisdiction to which the sign belongs* ➢ *Retroreflectivity readings of the sign* ➢ *Digital image of each sign* ➢ *GPS coordinate of the sign (latitude, longitude and elevation)* ➢ *Crew that collected the data* ➢ *MUTCD sign designation (includes sign size, sign description, sign color, sign shape, type of sign, action to be taken)* ➢ *Height of sign* ➢ *Offset of the sign from roadway* ➢ *Verify the presence of curb* ➢ *Verify the presence of striping* ➢ *Roadway ID (County route number)* ➢ *Roadway name according to present street sign* ➢ *In what type of area is the sign located* ➢ *Travel direction of motorist viewing the sign* ➢ *Direction the sign is facing* ➢ *Position of the sign on the roadway* ➢ *Rating of the sign* ➢ *Sheeting type of the sign face* ➢ *Support type to which the sign is mounted* ➢ *Material of the support* ➢ *Number of signs mounted to the support* ➢ *Rating of the support* ➢ *If the support has a breakway construction* ➢ *Inventory date*

Table IV-19 Camden County Sign Database

During the collection of sign data, approximately 200 signalized intersections were noted for later collection. Categories of data collected for these signalized intersections include Auxiliary, Controllers, Faces and Supports. For a signalized intersection, the key attribute is a uniquely coded 'Node ID', which is used to relate data to other features at a particular intersection. Traffic signal attributes collected include the following:

DATABASE	***ATTRIBUTE DESCRIPTIONS***
SIGNALview	➢ *Unique intersection ID* ➢ *Number of Pull boxes per intersection approach* ➢ *Number of detectors per intersection approach* ➢ *Municipality that the Pull boxes are located* ➢ *Rating of the Pull boxes* ➢ *Unique signal controller identifier* ➢ *Municipality that the signal controller is located* ➢ *How the controller is mounted* ➢ *In what type of area the signal is located* ➢ *Rating of the signal controller* ➢ *GPS coordinate of the signal controller* ➢ *Code type of the signal head* ➢ *Municipality that the signal head is located* ➢ *Position on the support that the signal head is located*

	➢ *Direction that the signal head is facing* ➢ *Obstructions to viewing the signal head* ➢ *Rating of the signal head* ➢ *Municipality that the support is located* ➢ *Presence of signs mounted to the support* ➢ *Presence of lights mounted to the support* ➢ *Material of the arm* ➢ *Material of the base* ➢ *Material of the pole* ➢ *Length of the arm and length of multiple arms where applicable* ➢ *Rating of the arm* ➢ *Rating of the base* ➢ *Rating of the pole* ➢ *GPS coordinate of the support*

Table IV-20 Camden County Signal Database

IV-4.2 Gloucester County, New Jersey

Street Centerline

In the area of transportation, the Gloucester County Planning Department is responsible for a number of local and regional transit planning activities, as well as providing services for highway planning of improvements. The following attribute information is contained within the County's street centerline data:

DATABASE	***ATTRIBUTE DESCRIPTIONS***
Street Centerline	➢ *Feature type (highway, arterial, primary, road, etc.), Section type (bridge, etc.), Class, Feature name, Left from address, left to address, Right from address, right to address, Left state, right state, Left county, right county, Left place, right place, Left msa, right msa, Left mcd, right mcd, Left zip, right zip, Oneway, Interpolated, Reserved*

Table IV-21 Gloucester County Centerline Attributes

IV-4.3 Chester County, Pennsylvania

Street Centerline

Chester County's 1" = 200' scale street centerline was captured from photo-identifiable features on aerial photography, dated 1993. Road name information was taken from tax maps. The County is currently undergoing a conflation process to merge these positionally accurate lines with the accurate attributes maintained in the E-911 road centerline coverage. Attributes contained in each file are as follows:

DATABASE	***ATTRIBUTE DESCRIPTIONS***
Street Centerline	➢ *Feature Code, Directional Prefix, Street Name, Thoroughfare type, Post Directional, State Route Number, From Left Address, To Left Address, From Right Address, To Right Address*
E911 Street	➢ *Road Class Designator, Complete Street Name, True Compass*

Centerline	*Directional, Street Pre-Directional, Street Name, Street Thoroughfare Type, Street Post-Directional, Development Name, Lower Left Address, Upper Left Address, Lower Right Address, Upper Right Address, Low Theoretical Address, High Theoretical Address, Street Name Alias 1, Street Directional Alias 1, Street Name Alias 2, Street Directional Alias 2, Street Name Alias 3, Street Directional Alias 3, Municipal Code Number, Date Stamp*

Table IV-22 Chester County Centerline Attributes

Bridges

In addition to the street centerline data, bridge features were captured from the 1993 aerial photography and contains the following information where available:

DATABASE	***ATTRIBUTE DESCRIPTIONS***
Bridges	➢ *Length of bridge span, Outside width of bridge span, Weight limit of bridge in tons, Owner of bridge - County necessity, Type of bridge - County necessity, Age of bridge in years - County necessity, Height of bridge in feet i.e. 17.50, PennDOT Station Marker on bridge*

Table IV-23 Chester County Bridge Attributes

IV-4.4 City of Philadelphia

Street Centerline

The City of Philadelphia has established a street centerline containing unique segment identifiers for the operation of Sanitation's routing program, RouteSmart. This unique identifier (BD#) is used to relate the centerline to all of the RouteSmart data files and is also used to identify which customers are associated with each arc. The City recognizes that other applications and related tables could also be based upon the BD#. The attribute descriptions for the City's street centerline file are as follows:

DATABASE	***ATTRIBUTE DESCRIPTIONS***
Street Centerline (LINE)	➢ *Directional prefix of street, Name of the street, Street type (i.e.ST,AVE,etc), Directional suffix of street, Beginning address on left side, Ending address on left side, Beginning address on right side, Ending address on right side, Five digit unique street code, Hundred block on left side, Hundred block on right side, Unique identifier of each arc (**BD#**), The direction of traffic flow, Street type classification, Date of most recent update, Date that a new BD# was added*
Street Centerline (NODE)	➢ *Unique value for each intersection, Street code of connected streets first in alphabetical order, Street code of connected streets second in alphabetical order, Street code of connected streets third in alphabetical order, Street code of connected streets fourth in alphabetical order, Street code of connected streets fifth in alphabetical order, Streets Names of first two streets connecting at node, Date of last update*

Table IV-24 Philadelphia Centerline Attributes

IV-4.5 Delaware Valley Regional Planning Commission (DVRPC)

DATABASE	***ATTRIBUTE DESCRIPTIONS***
Aadtxxx (1985-1995 Traffic Counts)	➢ *Latitude, Longitude, Project number, Road name, TR#, Milepost segment, From Street, To Street, Functional Class, Distance, Municipal Name, Municipal Code, County Code, Aadt for 1985-1995*
Commuter Rail Stations	➢ *Station name*
RASP Airports	➢ *Airport name*
Bicycle Facilities	➢ *Existing or Proposed, Facility Name*
Rail Lines	➢ *Passenger Rail, Freight Rail or Rapid Transit/Light Rail*
Grxing (provided by (Federal Rail Administration)	➢ *ID, Latitude, Longitude, Acc*

Table IV-25 DVRPC Database Tables

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Chapter V - Related Issues

V-1 Need For Street Addressing Standards

Street Name/Addresses are one of the most commonly used Centerline Identification schemes used for locating geographic information along a street centerline. Many agencies and organizations in both the public and private sector maintain databases in which the street name/address is the primary key used to link the information to a map. The geocoded records are used with GIS software to assist in problem solving.

It is clear that anyone currently storing information on their street centerlines which will or is currently used for address matching should adopt elements of the United States Postal Service's addressing standard. The primary reason for DVRPC member organizations to adopt standardized addressing is that the use of addressing standards enhances the ability to use a geographic centerline file to determine the coordinate location of an address record in a database file. In this manner, a wide variety of data relevant to transportation planning that is address-based becomes increasingly useable with GIS software. This enhances the value of the data by (1.) adding a spatial component that is missing from the data in its native form and (2.) making the data available for mapping and spatial analysis with other forms of relevant information.

V-2 How does Address Matching Work?

Simply put, address matching or geocoding is the process by which the address fields in the database are assigned an x,y coordinate location (typically latitude/longitude or State Plane Coordinate System). The geocoding software compares the address of each record in the database with a geographic file that references the address to its location on a digital street centerline map. When a match is found the x,y coordinates are assigned to the address of the database record. Additionally, if the street centerlines in the geographic file have been assigned their census geographic area (i.e. Census Tract, Block Group or Block) they will also be assigned to the database record.

Most GIS software products that are available on the market today offer tools for automating the address matching, or geocoding process. Information that was obtained through the Needs Assessment interview process shows that virtually all member organizations that are using GIS software are using products that support this functionality.

V-3 The Regional Perspective

During the Needs Assessment interview, each organization was asked if they currently maintain any transportation-related data that is address-based or contains address ranges. Over half of the respondents reported that they do have data of this nature in their GIS database. For the most part, this encompassed centerline files with address ranges as an attribute. There are varying degrees of accuracy, currency and applications of this data.

V-4 Conclusion

It is generally agreed that the ability to use street address-based information in conjunction with a centerline file to which the data can be geocoded is required for a GIS that is used for transportation

planning. Most of the spatial databases that are currently being maintained by the DVRPC member organizations currently support some form of geocoding address-based data. This is a positive situation that provides a reasonable foundation for building a regional framework.

Part of the prototype effort to follow will focus on this issue. Various scenarios for creating, maintaining and applying a "geocodable" centerline will be evaluated. Existing standards for street addressing along with emerging standards such as the NSDI Address Content Standard will be researched and recommendations will be presented in a future document. Further efforts of this project will work towards validating this concept for DVRPC and its member organizations.

V-5 Considerations For Database Design

When designing a database, decisions must be made regarding how best to take some system in the real world and model it in a database. This consists of deciding which tables to create, what columns they will contain, as well as the relationships between the tables. While it would be convenient if this process was totally intuitive and obvious, or even better, an automated process, this is simply not the case. A well-designed database takes time and effort to conceive, build and refine.

V-5.1 Overview

A GIS adds a layer of complexity to the process. Spatial data and the real world systems that they model present a number of challenges to the database designer that other, more traditional information technologies do not. Topological relationships that exist among geographic features in a database must be accurate and consistent if they are to realistically model real world conditions. Relationships among the features as they are represented spatially in the database and associated records in attribute databases must maintain their integrity through constant updates.

V-5.2 GIS-T Databases

The unique complexities of GIS data are particularly relevant to databases that support transportation planning applications. Requirements for supporting spatial functions such as geocoding and network modeling place fairly rigorous demands on the design of the database. GIS-T databases typically have specific requirements for data elements to support the required applications.

V-5.3 Data Sharing

The need to create opportunities and mechanisms for the sharing of data is another critical consideration for GIS database design. In order for DVRPC and its member organizations to be able to effectively share GIS data, there will need to be some coordination and cooperation in the design and maintenance of GIS databases.

V-6 Need For Metadata

The term "metadata" is commonly described as "data about data". Metadata typically describe the content, quality, condition, and other characteristics of data. Put simply, metadata helps a user to locate and understand data. The use of metadata is not unique to GIS data. Most information systems that store and manage large volumes of diverse types of data utilize some form of metadata to provide users with the descriptive information that they need to understand the data.

The primary uses of metadata are:

- To organize and maintain an organization's investment in its databases
- To provide information to data catalogs and clearinghouses
- To provide information to aid in the transfer of data
- To provide information to enable data users to select fields and create queries

V-6.1 Relevance to GIS

A primary characteristic of most spatial databases is the fact that they are dynamic and constantly changing. These databases are models of spatial and temporal landscapes that undergo continual change. In order for the various information systems that rely upon these databases to maintain their validity and utility, processes need to be in place that ensure that the databases are consistently updated to reflect spatial and temporal changes.

Equally important is the need for mechanisms, procedures and standards for maintaining current records of these changes. In order for end users to make effective and meaningful use of GIS databases, it is essential that they fully understand the content, quality and condition of the data they are using. Due to the extremely dynamic nature of GIS data, the need for accurate and meaningful metadata is critical.

V-6.2 Mechanisms, Procedures and Standards

As stated previously, the need for mechanisms, procedures and standards for maintaining current records of changes to spatial databases are vital to ensure their usefulness. Mechanism refers to the software tools that are required to integrate the maintenance of metadata into an overall program of database maintenance and management. Procedures refer to the prescribed operational steps that form an orderly process for employing the mechanisms to create and maintain the metadata. Standards refer to the common terminology and definitions that are required to ensure that the metadata is useful and meaningful to a widespread, diverse user community. These standards also typically include the format and content requirements for metadata documentation.

Mechanisms - At the present time, there exist a number of mechanisms, or tools for creating and maintaining metadata for GIS databases. There are several software tools that have been developed and are available free of charge. Most of these tools support the Federal Geographic Data Committee (FGDC) Metadata Standard that is described briefly below, or some form of a modified version of this standard. Examples include:

- *Pennsylvania Spatial Data Access (PASDA) Data Interview Form* – online tool for creating metadata by completing a relatively easy to use interactive form. (http://www.pasda.psu.edu/metadata/metamaker-ez.shtml)

- *NJMetaLite* - This software application, which runs on Windows 95/98 and Windows NT (Service Pack 5 or above), is a modification of MetaLite, a metadata tool developed by the USGS and the United Nations Environmental Program. The New Jersey Department of Environmental Protection has modified the program to include data fields and features relevant to GIS work being done in New Jersey. (*http://www.state.nj.us/dep/gis/endex/njml.htm*)

- *ArcView® Metadata Collector* – Developed by NOAA, this is an easy-to- use application that can be utilized by any ArcView 3.x user for creating Federal Geographic Data Committee (FGDC)–

compliant metadata. The tool can create metadata for any data type supported by ArcView, including ARC/INFO coverages, ArcView shapefiles, as well as any supported image formats. (http://www.csc.noaa.gov/ metadata/text/download.html)

- *CORPSMET95* – Developed by the U.S. Army Corps of Engineers, this is a Windows-based desktop application that leads the end user through the process of developing FGDC compliant metadata. (*http://corpsgeo1.usace.army.mil/*)

- *Metamaker 2.30* - produced to support the National Biological Information Infrastructure (NBII), this product supports the FGDC Content Standard for Geospatial Metadata (CSDGM) as well as additional fields recording biological related information as required by the NBII. This is a standalone database based on Microsoft Access Version 2.0 for Windows 3.1. It is a 16-bit program that stores metadata elements in a relational database. Output can be produced using cns & mp which are integrated into the program. (http://www.umesc.usgs.gov/metamaker/nbiimker.html)

These are just a few of the many tools that are currently available as mechanisms for creating and maintaining metadata. An excellent summary of metadata tools can be found at the following URL: (http://badger.state.wi.us/agencies/wlib/sco/metatool/mtools.htm)

Procedures – The procedures that are applied to the creation and maintenance of metadata for a particular organization are typically dictated by the internal structure and business processes of the organization. In most cases where metadata is actively used and maintained, the use of a metadata management software tool is employed as a part of the database maintenance workflow. This helps to ensure that information describing changes to the database is consistently updated and remains synchronized with the database.

Standards – Standards for metadata are useful for ensuring its consistency and to support its widespread utility. They provide a common set of terminology and definitions for the documentation of GIS databases. The most common standard in use is the FGDC CSDGM. This standard is quite comprehensive and is designed to be applied to a broad range of GIS data types. For this reason, it is often regarded as being too complex for compliance by most organizations.

Few organizations maintain GIS metadata of the complexity required for total compliance with the FGDC Standard. In most cases, a “hybrid” standard is developed which embodies the “spirit" of the Federal standard, if not completely its “letter”.

One example of a hybrid standard is actually a subset of the prescribed FGDC Content Standard for Geospatial Metadata. This subset is often referred to as Metadata-Lite. FGDC hosts a web based Metadata Entry System (MES) which utilizes the Metadata-Lite elements to stimulate the creation of basic FGDC-compliant metadata records for the cataloging of spatial data sets.

If an agency is compelled to create specifications for metadata or minimal metadata, a few guidelines should be followed.

1. Do not invent a standard. There already is one. Try to stay within its constructs. Subtle changes from the CSDGM such as collapse of compound elements will be costly in the long run - you will not be able to use standard metadata tools and your metadata may not be exchangeable. Do not confuse the metadata presentation (view) with the metadata itself.

2. Consider data granularity. Can you document many of your data sets (or tiles) under an umbrella parent? Prepare the general information and use it as the master component to your metadata document.

3. Prioritize your data. Begin by documenting those data sets which have current or anticipated future use, data sets which form the framework upon which others are based, and data sets which represent your organization's largest commitment in terms of effort or cost.

4. Document at a level that preserves the value of the data within *your* organization. Consider how much you would like to know about your data sets if the GIS staff most familiar with the data is no longer available.

V-7 The Regional Perspective

One of the questions that was asked of the various DVRPC member organizations was whether or not they actively maintain metadata for their GIS data and, if so, what mechanisms, procedures and standards are employed. Most organizations reported that they maintain either no metadata or a minimal amount. A few reported that they maintain metadata based upon their own standard or a "hybrid" FGDC standard. One member organization reported that they maintain a fully FGDC compliant set of metadata.

V-7.1 Conclusion

Two of the primary goals of this project are to (1) provide for the seamless exchange of GIS data files and the integration of planning infrastructure among all member governments and operating agencies and (2) structure the region-wide GIS design so that it can be expanded and enhanced by individual partners, while maintaining its consistency and exchangeability. Two of the primary roles of metadata with regard to GIS databases are (1) to provide information to aid in the transfer and sharing of data and (2) to provide information to data catalogs and clearinghouses. It is apparent the goals of this project and the uses of metadata are consistent and complementary. For this reason, DVRPC has included the consideration of the establishment of a regional GIS-T metadata standard as part of this project.

Part of the prototype effort to follow will focus on this issue. It is generally recognized that metadata, when properly designed and implemented can be a vital component of an operational GIS. Further efforts of this project will work towards validating this concept for DVRPC and its member organizations. The end result will be recommendations for potential mechanisms, procedures and standards that might be applied on a regional basis.

V-8 Need For Data Dictionary

A data dictionary is a repository of information in a GIS in which information is stored on all the objects within the database and their relationships. The data dictionary serves as a reference source suited for many purposes in an operational GIS environment, including: training, metadata, quality control, and data development. By specifying the exact GIS data structure (layer names, table layouts, valid values, and annotation information), this information can be used by the GIS end users to better understand the data that they are using.

If DVRPC and its member agencies are to establish any type of effective mechanism to share GIS data related to transportation planning, it will be absolutely essential that all data generators design, develop and deploy a data dictionary to support the use of their data on a region-wide basis.

V-9 Need For Symbology Standards

Cartographic design uses symbology to convey geographical information in a manner that is both appealing to the eye and easily understood. A map symbol is a graphic design, which represents a map feature and its characteristics. Symbology has a number of characteristics, such as pattern, color, and size. For example, an Interstate Highway is recognized on a map because it is typically drawn using a thick, red line, while other roads are drawn with thin, black lines. It is advisable to develop a regional standard symbology set that would be employed when graphically representing all geographic features. The standard will provide the region's producers and users of map information with a single, easy to understand standard for the cartographic production of GIS data. The objective is to develop a region-wide standard for cartographic map symbols, colors, and patterns to aid in the production of maps and to help provide maps that have a consistent appearance and meaning. This symbology set would function to standardize the way in which geographic features are represented, fostering universal understanding. A variety of symbol types allow data to be viewed and represented in a way that best describes and communicates the current application.

V-9.1 Overview

Creating a standard transportation planning symbol set throughout the region will allow the multiple agencies and audiences to view the maps or graphic representations and universally understand their meaning. A fundamental requirement of data sharing is that both the supplier and the recipient of the data understand what the data represents in terms of real-world features. This is relatively straightforward for features having well defined boundaries such as a building or an airport. However, many transportation features are characterized by extensive linear networks, with no universally agreed upon standards for displaying or otherwise graphically representing these features. Each developer of a graphic representation generally utilizes symbology that meets his or her application needs. A map or graphic representation from Buck's County and Montgomery County Pennsylvania could have the same features symbolized in a completely different way, creating confusion when attempting to understand the meaning of the representation. Standard symbology will allow the maps or graphic representations to be overlaid or displayed together without confusion, creating a more seamless representation of the region.

V-9.2 Standard Symbology Elements

Prior to defining a standard symbology set, standard definitions should be developed for the elements that are to be symbolized. In order to take advantage of a standard symbology set it is important that all agencies are using the same criteria when defining a road, intersection or boundary. One potential standard feature definition schema is the U.S. Census Bureau's Feature Class Codes (CFCC). All elements that can be graphically represented on a map should have a standard symbology defined. This included features directly related to transportation such as road, intersections, and rail types as well as features not directly related to transportation such as jurisdictional boundaries and other geographic features. Standard symbology should also be defined for non-geographic features such as text and symbols. Below is a list of CFCCs that may be used as a basis for defining a standard symbology set. This list outlines minimum inclusion requirements.

V-9.3 Road Types

Different types of roads should have standard symbologies defined by type in order for universal understanding. These types can by defined by who owns or maintains the road such as state, county, and municipality roads. Road types can also be defined by their access type such as limited access highways, highways, or toll roads. Roads can also be defined by other attributes such as being stacked, divided, ramp or a frontage road.

Feature Class A Road

Primary Highway with Limited Access – Interstate highways and some toll highways are in this category and are distinguished by the presence of interchanges. The highways are accessed by way of ramps and have multiple lanes of traffic. The opposing traffic lanes are divided by a median strip.

Primary Road without Limited Access – This category (A2) includes nationally and regionally important highways that do not have limited access as required by the previous category (A1). It consists mainly of US Highways, but may include some state highways and county highways that connect cities and larger towns. A road in this category must be hard-surface (concrete or asphalt). It has intersections with other roads, may be divided or undivided, and may have multi-lane or single lane characteristics.

Secondary and Connecting Road – This category (A3) included mostly state highways, but may include some county highways that connect smaller towns, subdivisions, and neighborhoods. The roads in this category generally are smaller than roads in A2, must be hard-surface, and usually have a local name along with a route number and intersect with many other roads and driveways.

Local, Neighborhood, and Rural Road – This category (A4) is used for local traffic and usually has a single lane of traffic in each direction. In an urban area, this is a neighborhood road and street that is not a thoroughfare belonging to A2 or A3. In a rural area, this is the short-distance road connecting the smallest towns: the road may or may not have a county route number. Scenic park roads, unimproved or unpaved roads, and industrial roads are included in this category.

Vehicular Trail – This category (A5) is usable only by four-wheel drive vehicles, is usually a one-lane dirt trail, and is found almost exclusively in very rural areas. Sometimes the road is called a fire road or a logging road and may include an abandoned railroad grade where tracks have been removed. Minor, unpaved roads usable by ordinary cars and trucks belong in category A4.

Road with Special Characteristics – This category (A6) includes roads, portions of road, intersections of road, or the ends of a road that are parts of a vehicular highway system and have identifiable characteristics.

Roads as Other Thoroughfare – This category (A7) is not part of the vehicular highway system. It is used by bicyclists or pedestrians, and is typically inaccessible to mainstream motor traffic except for private-owner and service vehicles. This category includes foot and hiking trails located on park and forest land, as well as stairs or walkways that follow a road right-of-way and names similar to roads.

Depending on the degree of control and standard symbology that is desired, all, none or a portion of these attributes could be used to define a region-wide standard. The idea is to foster familiarity, and not to exert control, so the minimum standards that are necessary for ease of understanding would be most practical. To define the standard symbology set for roads, the agencies throughout the region should strive to agree upon the graphic elements (i.e., colors and patterns) for the aforementioned types and other attributes.

V-9.4 Jurisdictional Boundaries

Standard jurisdictional boundary symbology should also be defined for ease of communication via graphical representation. Jurisdictional boundaries can include countries, states, counties, townships, municipalities and other regions such as the DVRPC region. Again, the agencies throughout the region should work towards defining the specific colors, outlines and patterns for displaying each of these type of boundaries.

Types:

- National
- State
- County
- City
- Military Installation
- Neighborhood
- Township
- Town
- City
- Other non-political jurisdictions

V-9.5 Intersections

Intersection symbology can also be standardized. Intersection types can be defined as simple, complex (cloverleaf, diamond, traffic circle, etc…), offset, overpasses/underpasses, grade-separated interchanges, or entrance/exit ramps.

Type

- Simple
- Complex
- Offset
- Overpass
- Underpass
- Entrance Ramp
- Exit Ramp

V-9.6 Other Geographic Features9

Other geographic features that are not necessarily transportation related should also be standardized. These features can include any of the following: parks, recreation areas, various landmark features, hydrologic features, railways, topography and other planimetric features.

V-9.7 Other non-geographic features

In addition to all of the geographic features, non-geographic features should also have a standard symbology defined. These features can include road labels and other text or annotation, as well as road shields and other symbols.

V-10 The Regional Perspective

Part of the needs assessment interview process included discussions regarding existing symbology standards that may be in place. For the most part, DVRPC member organizations that maintain and use GIS for transportation applications have established some form of standards for cartographic symbolization of features. The two state Departments of Transportation that operate within the region (New Jersey and Pennsylvania), have established standards using their GIS software, Intergraph and its companion plotting software product, IPLOT. Other examples include DVRPC and the Burlington County Engineering Department's use of pen table definitions inside of Microstation CADD software. A few others use either custom-defined or vendor-supplied symbol definitions within the ESRI software environment. The remaining organizations either do not have standard symbology definitions within their GIS or are not currently using GIS for transportation-related applications.

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Chapter VI -Stages of Road Centerline, Attribute, and LRS/LRM Development Within the Region

VI-1 Four Stages Of Road Centerline Development

As a basis for quantifying and analyzing the transportation GIS needs of the various participants, a series of Stages of Road Centerline Development have been derived. The following information provides details as to the characteristics of each stage and the grouping of participants among the various stages, based upon the results of the needs assessment phase.

In defining the characteristics of each stage, consideration was given to the most critical components of a transportation GIS as determined through the Needs Assessment interview phase and current technical standards for GIS applications for transportation planning. On the basis of this determination, the following components were identified:

- A base road centerline geometry that is topologically accurate and is updated and maintained on a regular basis
- An attribute database that is related to the graphic components of the centerline and includes a unique identification attribute (unique identifier) for each road segment
- A road centerline and related attribute database that supports a Linear Referencing System (LRS) accompanied by a GIS that applies a Linear Referencing Method (LRM) for dynamically locating events along road segments

Based on these components, a series of four stages of road centerline development have been defined. These stages lie on a scale from Stage 1 through Stage 4, with Stage 1 being the least supportive of GIS for transportation planning and Stage 4 being the most supportive of these types of applications.

Figure A-1 depicts the distribution of the various participants across the range of centerline development stages. It must be understood that the rating of each participant is based solely on the suitability of their centerline data for supporting transportation planning applications. This is by no means intended to reflect an overall assessment of the utility and value of the centerline data within the context of a comprehensive, multi-functional GIS. Street centerlines support numerous GIS applications, such as E911, vehicle routing and pavement management. The focus of this project is transportation planning.

VI-1.1 Stage 1 – No Road Centerline

Agencies, which fall into this stage, have either no road centerlines or have road centerlines that were either purchased or collected but have fallen out of date with no maintenance plans in place to update them.

VI-1.2 Stage 2 – Road Centerline with No LRS Measure

Agencies, which fall into this stage, have digital road centerlines that have been either purchased or collected and have an established maintenance procedure in place to maintain them at regular or periodic intervals. These files may or may not include feature attribution. In most cases, they are not being utilized for transportation planning applications of GIS. In some cases, there has been a standard unique identifier established for each road segment, but there is no route number. The Coordinate/Route model

described in the Chapter VI cannot be supported in these cases. An example of this is the City of Philadelphia, which has established BD# for each street segment in the City, but no route number. Also, Chester County currently uses geocoding by street address as means of locating event data along street centerlines. While this is useful and support of transportation planning is feasible given a supportive database design, this approach does not conform to DVRPC's concept of a Common Linear Referencing System.

VI-1.3 Stage 3 – Road Centerline with Attribution and Unique Centerline ID and Route Number but no LRS Measure

Agencies, which fall into this stage, have road centerlines with various degrees of database attribution attached to the centerline but also have established a unique Centerline ID and a route number to facilitate the application of the Coordinate/Route model.

VI-1.4 Stage 4 – Road Centerline with Attribution, Unique ID and LRS Measure

Agencies, which fall into this stage, have all of the information included in Stage 3 but also have incorporated an LRS that includes a route number and LRS measure, into their database design. Additionally, the agency's GIS software supports the use of an LRM to place both point and linear events along the road network.

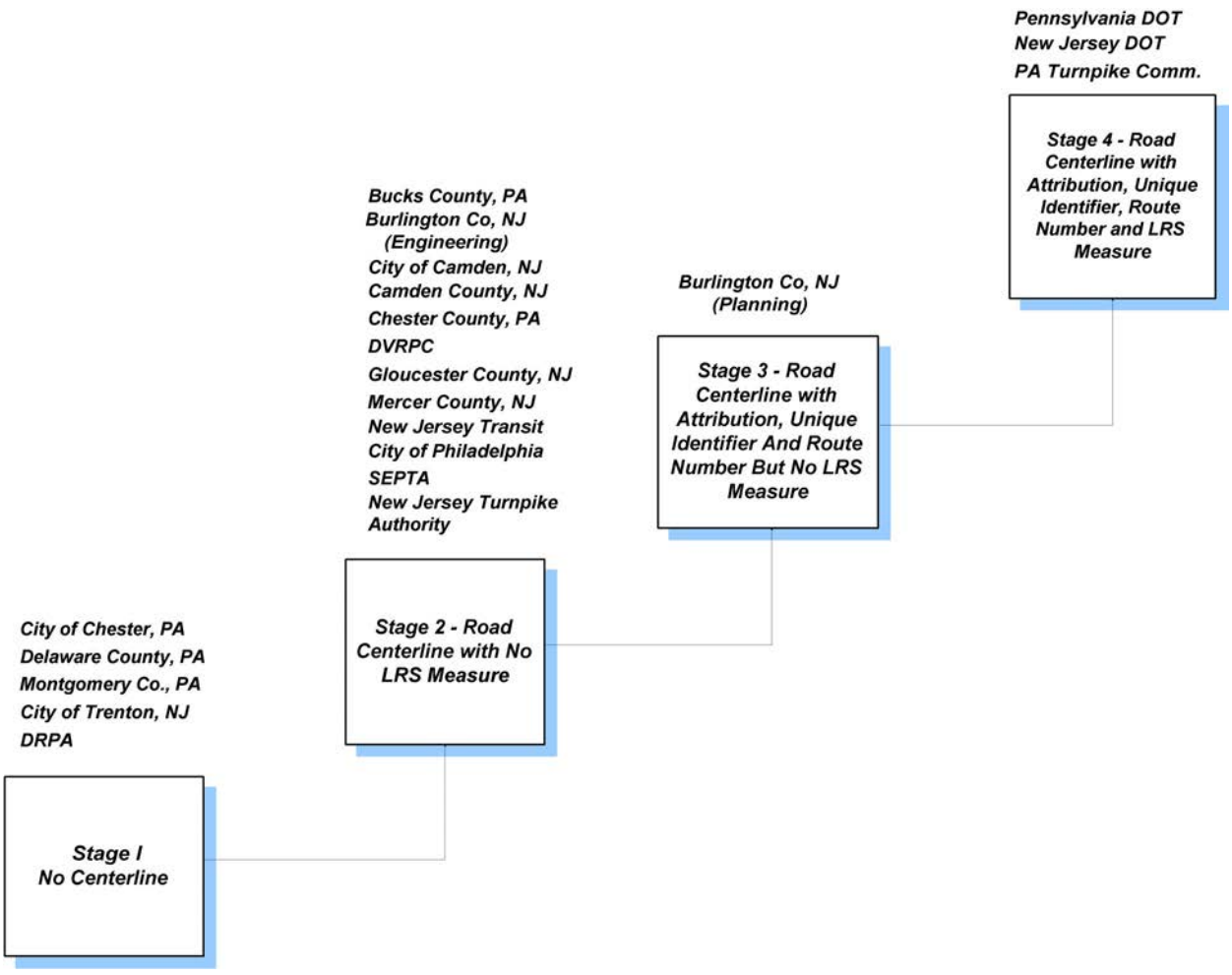

Figure VI-1 Distribution of Participating Agencies by Stage

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Appendix A - Individual Summary Reports Pennsylvania Municipalities

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City of Philadelphia

Interview Summary

General Information

1. Responsible Agency for GIS – Streets, Water, Police, Planning, Mayor's Office of Information Services
2. Responsible Agency for GIS-T – Streets
3. GIS Software Vendor – ESRI, occasional MapInfo
4. Computer Hardware/Networking – Windows NT, AIX UNIX, Novell Netware, TCP/IP
5. Metadata – Yes; Consistent format accessed through one system
6. GIS Strategic Plan – In last phase of completion

Centerline Information

1. Road Centerlines – Yes
2. Level of Detail – Every street
3. Approximate Centerline Scale – 1" = 200'
4. Map Projection – PA State Plane, South Zone, units in Feet
5. Creator of Centerlines – Existing data rectified to orthophotography
6. Unique Road Identifier – Yes, BD#
7. Maintenance – Yes, monthly
8. Routable Network – Yes
9. Standard symbology – No
10. Related data – poles, stop signs, accidents, traffic counts, signalized intersections

Database Information

1. Current GIS Database – MS Access, Oracle, SQLServer, INFO, Sybase
2. Enterprise-wide Information Processing Environment – IBM Mainframe
3. Centerline Road Attribution – Directional prefix, Street name, Street type, Directional suffix, Address ranges, Unique street code, Unique identifier for each arc and node, Direction of traffic flow, Street type classification, Update dates
4. Attribute Data Entry Validation – Yes
5. Events/Distributed Attributes Placed on Centerline – Under development; speed limits, number of lanes, cartway width
6. Linear Referencing Method – No; Offset mentioned in some tabular attributes
7. Address Ranges – Yes
8. Parcels - Yes

Interoperability/Data Sharing

1. Conflation – Yes (Census)
2. Cooperation With Other Government Organizations – PennDOT, Surrounding counties
3. Cooperation With Utilities – No; conceptual phase with PGW and PECO and telecoms.
4. Current GIS Data Users – City agencies, SEPTA
5. Data Distribution Policy – Select distribution to the following: contractors with the City of Philadelphia; government agencies; law enforcement agencies.
6. GIS Wish List – PennDOT segment offset, bridge data
7. Transportation Modeling – No

Interview Discussion

The City of Philadelphia utilizes GIS in many departments and supporting agencies including Department of Streets, Water, Police Department, Planning Commission and the Mayor's Office of Information Services. The Department of Streets assumes primary management responsibilities for GIS for transportation initiatives and maintains street centerline information for use by other City agencies. The City is in the last phase to complete its GIS strategic plan with an expected completion date of the third quarter of 2001.

The City's primary software vendor for GIS is ESRI with occasional utilization of MapInfo software by the Board of Revision of Taxes (BRT). The current desktop environment is a combination of AIX, Windows NT and Windows 98 operating systems. The City's servers utilize UNIX and Windows NT operating systems with Novell Netware.

The Department of Streets maintains the City's street centerline file at a scale of 1" = 200' in the State Plane Coordinate System, South Zone with units in feet. The centerline file includes every street within the City. It originally came from the Philadelphia City Planning Commission. They started with the TIGER file, which was edited so that each of the arcs was within the cartway of City Planning's parcel maps, which were scanned and digitized in the early 1990's. The centerline was edited by the Streets Department to include an attribute for one-way streets, missing street names, and the five-digit street codes for each of the street segments. Every effort was made to add and delete arcs as needed with the goal of representing all the streets in the city, both private and public, plus a few walkways that have street addressed properties. Common driveways were also added to accommodate Sanitation collection. These driveways are programmatically removed to create the coverage described here. In 1998, the arcs were again rectified to the visual center (center 1/3) of the curb lines coverage generated from the Philadelphia Water Department's orthophotography flown in March of 1996. The centerline is constantly updated from information from the Streets Department City Plan unit, feedback from the Police Department, and field observations (Streets Department GIS Centerline Database Design – June 1999).

The City of Philadelphia also maintains many transportation-related data sets such as poles, stop signs (as part of the pole layer), accidents from PennDOT and the Police Department, traffic count information and signalized intersections. Information placed along roads is performed using theoretical address ranges, and in some cases offsets are mentioned in the attributes. The City is currently developing event data from existing line-based information for speed limits, number of lanes and cartway widths. Efforts have also been made to conflate census data to the street centerline file for a specified project area.

Several database software solutions are being used to support the City's GIS. These products include MS Access, Oracle, MS SQL Server, INFO and Sybase. Line feature attribute information directly tied to the centerline file include the directional prefix of a street; street name; street type; directional suffix of a street; beginning and ending addresses on left and right side; unique street code; right and left side hundred blocks; a unique identifier for each arc; direction of traffic flow; street type classification; and relevant update dates. Node feature attributes include a unique value for each intersection; street codes for connected streets; intersection name; and update dates. The street centerline file is updated on a monthly basis using automated tools to promote data standardization.

The City of Philadelphia utilizes data from other organizations such as PennDOT and surrounding counties but does not distribute GIS data to organizations outside of City agencies. The only exception to this policy has been street centerline distribution to SEPTA. In addition, the City is coordinating with local utility service providers to allow the providers access to the City's GIS data via direct access in order to minimize street openings and better coordinate those that do occur.

Evaluation

On the basis of the interview session with the City of Philadelphia, the following evaluation has been developed regarding various parameters related to GIS applications for transportation planning.

Linework Quality – Based on documentation provided, the City of Philadelphia utilizes a highly accurate and well-maintained street centerline data set at a scale of 1" = 200'. The continued maintenance and adjusting of data reflects the City's commitment to GIS and its transportation applications.

Database Quality – The City maintains a database that provides potential for various routing and transportation applications. The City continues to enhance database information allowing for growth of the GIS throughout various City agencies.

Overall Status of Transportation GIS – The City has shown a strong commitment to transportation GIS, which is reflected through the many years of development and integration into the processes of many City agencies. The City could benefit from continued enhancement of its transportation-related database to continue serving City agencies and the regional efforts.

Potential for Contributing Data to a Regional Model – The City of Philadelphia has significant potential for contributing data to a regional model, having the most sophisticated centerline in the region of any municipality. However, current data distribution policies may prevent the City from contributing to this region-wide effort.

Nevertheless, the City, recognizing this distribution policy, is willing to share its experience and data model via a needs assessment without distributing its entire data model. Moreover, should it be determined that the resulting program is successful, the City would be willing to share its data model.

Stage Designation

Based on the foregoing summary information, the City of Philadelphia's road centerline development has been designated as a "Phase 2" implementation. This designation is based on the existence of a road network that can be used for network routing, has a unique centerline ID, various degrees of database attribution and an established maintenance plan. However, the City currently lacks an LRS measure.

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Appendix B - Individual Summary Reports Pennsylvania Counties

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Bucks County, Pennsylvania

Interview Summary

General Information

1. Responsible Agency for GIS – Responsible Agency for GIS – Bucks County Planning Commission
2. GIS Software Vendor – ESRI
3. GIS Software – ArcInfo 7.2, ArcView 3.2 (Network Analyst and Spatial Analyst)
4. Computer Hardware – UNIX (Sun Solaris), Migrating to Windows NT server-based system
5. Metadata – No
6. GIS Strategic Plan – No

Centerline Information

1. Road Centerlines – Yes, GDT and ETAK; county road map; PennDOT centerline for surrounding counties
2. Level of Detail – Every road in the County
3. Approximate Centerline Scale – GDT/ETAK scale
4. Map Projection – PA State Plane 83 Feet
5. Creator of Centerlines – GDT/ETAK
6. Unique Road Identifier – No
7. Maintenance – GDT updated on ad hoc basis; last update 1995
8. Routable Network – No
9. Standard symbology – No

Database Information

1. Current GIS Database – INFO, MS Access
2. Enterprise-wide Information Processing Environment – IBM Mainframe & VAX (Payroll & Auditing)
3. Centerline Road Attribution – Address ranges, street names
4. Attribute Data Entry Validation – No
5. Events/Distributed Attributes Placed on Centerline – No
6. Linear Referencing Method – No
7. Address Ranges – Yes
8. Parcel Layer – In development (complete for 6 out of 50 townships)

Interoperability/Data Sharing

1. Conflation – No
2. Cooperation With Other Government Organizations – PennDOT, PASDA, NRCS, DVRPC, Municipalities, NJ Transit, SEPTA, TMA
3. Cooperation With Utilities – PECO, Verizon, PP&L, GP, North Penn, Bucks County Water & Sewer
4. Current GIS Data Users – County agencies, Municipalities
5. Data Distribution Policy – No formal policy (usually based on time and materials)
6. GIS Wish List – None provided; would like to know what is available
7. Transportation Modeling – No

Interview Discussion

The Bucks County Planning Commission is currently the responsible agency for street centerline data to be utilized for planning initiatives. The County currently utilizes ESRI software, including ArcInfo 7.2 and ArcView 3.2 with the Network Analyst and Spatial Analyst extensions. The County is currently working in a UNIX environment with ongoing efforts to migrate to a Windows NT platform. With this operating system migration and hardware upgrades, the County intends to move to an ArcInfo 8 environment.

The County does not maintain metadata for any of its data sets and has no formal strategic plan for GIS. The Planning Commission has presented a conceptual plan to the County Commissioners as a result of developing an RFP for developing planimetric data, creating three new staff positions and performing in-house parcel data conversion. At the time of this interview, the Bucks County Planning Commission was nearing the release of the RFP for planimetric data development, to include a street centerline data set.

The current road centerline file utilized by the County was purchased from GDT and is primarily used for its address matching capabilities. The County maintains the GDT data on an ad hoc basis with the last update in 1995. The GDT data contains address ranges and street name information and is compiled at 1" = 2000' in Pennsylvania State Plane, North American Datum 1983 with units in feet.

In addition to the GDT data, ETAK data is also available. The County also maintains a County Road Map for publishing and distribution to the public. This data is used only for its cartographic representation of data and contains no attribute information.

The Planning Commission utilizes Microsoft Excel, Microsoft Access and INFO to store GIS attribute information and transportation planning data. The County's Information Technology Department continues to utilize and IBM mainframe and VAX to store tax assessment, payroll and auditing data. No other database technologies are currently in place.

The BCPC receives data from many different organizations to be utilized for planning activities. These organizations include PennDOT, PASDA, NRCS, DVRPC, local municipalities, New Jersey Transit, SEPTA and TMA. Most data requests to the County originate from the local municipalities. Fees for this data is assessed on a time and materials basis with no other formal distribution policy. The BCPC also shares information with local utility organization such as PECO, Verizon, PP&L, GP, North Penn and Bucks County Water and Sewer.

Evaluation

On the basis of the interview session with Bucks County, the following evaluation has been developed regarding various parameters related to GIS applications for transportation planning.

Linework Quality – The Planning Commission possesses the GDT centerline data, but does not actively use or update it. The centerline file created by the County is utilized only for publishing maps. The Planning Commission and DVRPC could benefit greatly from a more geographically accurate street centerline file.

Database Quality – There currently are no extensive databases for transportation planning being used and maintained by Bucks County. Transportation planners use databases of transportation-related projects throughout the County on a minimal basis.

Overall Status of Transportation GIS – At this time, there is no substantial transportation GIS in operation in Delaware County. There is a great deal of interest on the part of the Planning Department staff in making better use of GIS for transportation planning.

Potential for Contributing Data to a Regional Model – Based on current conditions, it appears that Bucks County lacks significant potential for contributing data to a regional model.

Stage Designation

Based on the foregoing summary information, Bucks County's road centerline development has been designated as a "Stage 2" implementation. This designation is based on the fact that since the interview, the County has hired a contractor to perform the photogrammetric mapping with a road centerline.

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Chester County, Pennsylvania

Interview Summary

General Information

1. Responsible Agency for GIS – County Dept. of Computing and Information Services
2. GIS Software Vendor – ESRI
3. GIS Software – ArcInfo 7x/8x, ArcView, ArcIMS
4. Computer Hardware – Intel Windows NT (Desktop), UNIX, Windows NT (Server)
5. Metadata – Conforms to PASDA (Not FGDC compliant)
6. GIS Strategic Plan – Yes

Centerline Information

1. Road Centerlines – Yes, single centerline for each direction
2. Level of Detail – Every road in the County
3. Approximate Centerline Scale – 1"=200'
4. Map Projection – PA State Plane 83 Meters
5. Creator of Centerlines – County GIS Department
6. Unique Road Identifier – Street Names and address ranges
7. Maintenance – Daily updates; weekly updates for E911
8. Routable Network – No
9. Standard symbology – Yes, all roads have standard feature definition

Database Information

1. Current GIS Database – Oracle 7.3 (8i for web development), MS Access
2. Enterprise-wide Information Processing Environment – Oracle 8.1.6
3. Centerline Road Attribution – Street names, address ranges, planning on adding TIGER
4. Attribute Data Entry Validation – Strict controls on basic street information
5. Events/Distributed Attributes Placed on Centerline – PennDOT attributes on PennDOT centerlines (CCPC)
6. Linear Referencing Method – PennDOT NLF_ID (CCPC)
7. Address Ranges – Yes, accurate for E911 process
8. Parcel Layer – Street addressing only

Interoperability/Data Sharing

1. Conflation – Yes. Address ranges from E911 centerline to 200-scale landbase. Planning to conflate TIGER information onto road centerlines.
2. Cooperation With Other Government Organizations – PennDOT, SEPTA, DVRPC, PA State Police, Municipalities
3. Cooperation With Utilities – Philadelphia Suburban Water, PECO, Norfolk Southern RR
4. Current GIS Data Users – County agencies, Municipalities
5. Data Distribution Policy – Yes
6. GIS Wish List – SEPTA Bus Routes, DVRPC transportation planning data, public transportation generators, bikeway networks
7. Transportation Modeling – No

Interview Discussion

The Chester County, Department of Computing Information Services, GIS Section maintains a geographically accurate road centerline file for the County. The GIS Section is responsible for the maintenance of geographic and attribute data related to the landbase and E911 road centerlines. Attribute Information such as address ranges and unique road names are maintained. Current efforts to conflate the landbase and E911 road centerlines are nearing completion, with the intended result that only one road centerline file will be utilized by all agencies within the County.

The Chester County Planning Commission (CCPC) utilizes PennDOT's road centerline file for transportation planning initiatives. Attribute and database information such as volume estimates, traffic data and level of service are acquired from PennDOT, DVRPC and local municipalities. This information is displayed using PennDOT's road centerline file and corresponding unique segment identifier, the NLF_ID.

Chester County continues to interact with various government and private entities. The County desires future coordination with organizations to acquire data such as bus routes, private and public transportation routes, bikeway networks, accident data, local road details related to pavement conditions and speed limits. The organizations identified from which to acquire this information include SEPTA, PennDOT, DVRPC, local municipalities and public and private transportation groups. The acquisition of this data would be utilized for future modeling efforts, traffic simulation and related transportation planning efforts.

Evaluation

On the basis of the interview session and subsequent data samples that were obtained from Chester County, the following evaluation has been developed regarding various parameters related to GIS application for transportation planning:

Linework Quality – There are two types of centerline data currently in use in Chester County. The GIS Section maintains a geographically accurate centerline file with a variety of attributes primarily associated with the land base and E911 services. The Planning Commission uses PennDOT's road centerline file. Attribute data obtained from PennDOT, DVRPC and other sources are related to the centerline graphics and mapped. In light of the fact that the GIS Section has, in place, a process for regularly updating the County's centerline file, it is recommended that this file be adopted as the County's official centerline file and that it's adoption and utilization by the Planning Commission be encouraged.

Database Quality – Both the GIS Section and the Planning Commission have developed and continue to maintain GIS attribute databases that are well suited for transportation planning application. The GIS Section's centerline database lacks a unique identifier that would facilitate the use of a broader range of attribute information. The Planning Commission's PennDOT-based centerline has the requisite unique identifier but lacks the spatial accuracy and completeness of that which is maintained by the GIS Section.

Overall Status of Transportation GIS – In general, it is apparent that the Planning Commission is taking good advantage of GIS data that is readily available to support various transportation planning activities. This functionality could most likely be broadened and enhanced through a more cooperative effort with the GIS Section.

Potential for Contributing Data to a Regional Model – The assessment of the information gathered for Chester County indicates a relatively high potential for contributing relevant data to a regional transportation planning database. This conclusion is based upon the following factors:

- The GIS Section has developed and is actively maintaining a geographically accurate and relatively attribute-rich centerline file
- The Planning Commission is actively utilizing available spatial and attribute data to support transportation planning activities and processes.
- Overall there is an enthusiastic, positive and proactive attitude among management and staff for both County agencies towards the productive utilization of GIS and the maintenance of the data that are required to support it.

Stage Designation

Based on the foregoing summary information, Chester County's road centerline development has been designated as a "Stage 2" implementation. This designation is based on the existence of a countywide road centerline file containing address matching capabilities. The road centerline file does not contain a unique, user-defined segment ID, but rather a software-generated identifier, and it lacks an LRS measure.

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Delaware County, Pennsylvania

Interview Summary

General Information

1. Responsible Agency for GIS – County Data Processing Dept. (hardware/software), Bd. Of Assessments manages parcels
2. GIS Software Vendor – ESRI
3. GIS Software – ArcInfo 8x, ArcView, ArcExplorer
4. Computer Hardware – Intel Windows NT (Desktop), UNIX, Windows NT (Server)
5. Metadata – None (No original data)
6. GIS Strategic Plan – No

Centerline Information

1. Road Centerlines – No – would like to use PennDOT's centerlines; Emergency Services uses TIGER
2. Level of Detail – n/a
3. Approximate Centerline Scale – n/a
4. Map Projection – UTM Zone 18 (data from DVRPC)
5. Creator of Centerlines – n/a
6. Unique Road Identifier – n/a
7. Maintenance – n/a
8. Routable Network – n/a
9. Standard symbology – n/a

Database Information

1. Current GIS Database – ArcView dbf/INFO – personal geodatabase (ESRI)
2. Enterprise-wide Information Processing Environment – Oracle
3. Centerline Road Attribution – none
4. Attribute Data Entry Validation – none
5. Events/Distributed Attributes Placed on Centerline – none
6. Linear Referencing Method – none
7. Address Ranges – Emergency Services uses TIGER address range
8. Parcel Layer – Board of Assessments maintains a county-wide parcel layer

Interoperability/Data Sharing

1. Conflation – No.
2. Cooperation With Other Government Organizations – PennDOT, SEPTA, DVRPC
3. Cooperation With Utilities – Chester Water Authority (Water Service Areas)
4. Current GIS Data Users – County agencies, Municipalities
5. Data Distribution Policy – No. Board of Assessments has a fee structure.
6. GIS Wish List – PECO, Philadelphia Suburban Water, Delaware County Commerce Center, PennDOT data, asset locations, traffic signal locations, SEPTA information
7. Transportation Modeling – No; typically done by DVRPC

Interview Discussion

The GIS for Delaware County is currently being used by the Planning Department and the County Board of Assessments. The County Data Processing Department is responsible for maintaining and supporting hardware and software. The Planning Department is running ESRI's ArcInfo version 8.0.1 and ArcView 3.2. The two principal GIS users on the Department staff have done some work with ArcExplorer. The Board of Assessments uses ArcInfo for maintaining a parcel layer and for generating plots.

Coordination and cooperation in the use of GIS at the County level is not very well organized. There is no strategic plan for GIS and there generally exists a lack of communication. The Planning Department staff feels that the County should have a GIS expert on staff to provide a higher level of support. There exists a potential for some cooperative and coordinated actions with the County Emergency Services Department.

The County government has recognized the importance of technology in improving the levels of service that are provided to the general public. This is evidenced through the development of an online "Virtual Courthouse" which is currently underway. Planning Department staff indicated that ESRI is involved in this process, developing applications using ArcIMS software. This project may help provide some impetus for improving the use of GIS throughout the County government.

The County has received a price quote from ADR for the development of road centerlines from the DVRPC orthophotography. At this time, there has been no action taken in regard to this option. The Planning Department indicated that they would be interested in partnering with other County agencies in acquiring this data.

The County Transportation Planners are using a substantial amount of data from a variety of sources, both online and "offline". There is recognition on their part of the value that could be added to their work through the ability to map this information thematically.

PennDOT is building a system of detector loops throughout the County that will report traffic volumes in real time. This system may have some potential for providing current and accurate data to some sort of future transportation planning GIS.

Evaluation

On the basis of the interview session and subsequent data samples that were obtained from Delaware County, the following evaluation has been developed regarding various parameters related to GIS application for transportation planning.

Linework Quality – There currently is no centerline data currently in use in Delaware County. The Planning Department possesses the PennDOT centerline files, but does not actively use them. If the Planning Department can secure a partner of partners, the ADR centerline option may be feasible.

Database Quality – There currently are no extensive databases for transportation planning being used and maintained by Delaware County. Transportation planners maintain and use databases of transportation-related projects throughout the County. They are extremely interested in being able to integrate the DVRPC TIP database with this database. They are also extremely interested in being able to map the information contained in their database.

Overall Status of Transportation GIS – At this time, there is no substantial transportation GIS in operation in Delaware County. There is a great deal of interest on the part of the Planning Department staff in making better use of GIS for transportation planning.

Potential for Contributing Data to a Regional Model – Based on current conditions, it appears that Delaware County lacks significant potential for contributing data to a regional model.

Stage Designation

Based on the foregoing summary information, Delaware County's road centerline development has been designated as a "Stage 1" implementation. This designation is based on the current non-existence of a countywide road centerline file.

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Montgomery County, Pennsylvania

Interview Summary

General Information

1. Responsible Agency for GIS – Montgomery County Planning Commission
2. GIS Software Vendor – ESRI
3. GIS Software – ArcView 3.2, ArcCad, AutoCAD
4. Computer Hardware – Windows98, Windows NT (Desktop)
5. Metadata – No
6. GIS Strategic Plan – Yes

Centerline Information

1. Road Centerlines – Yes, GDT; county road map
2. Level of Detail – Every road in the County
3. Approximate Centerline Scale – 1" = 2000'
4. Map Projection – PA State Plane 83 Feet
5. Creator of Centerlines – GDT
6. Unique Road Identifier – No
7. Maintenance – GDT updated in 1999; county road map updated on ad hoc basis based on subdivision plans
8. Routable Network – No
9. Standard symbology – No

Database Information

1. Current GIS Database – MS Access
2. Enterprise-wide Information Processing Environment – Oracle, SQL Server, Honeywell mainframe
3. Centerline Road Attribution – Street names, address ranges
4. Attribute Data Entry Validation – No
5. Events/Distributed Attributes Placed on Centerline – No
6. Linear Referencing Method – No
7. Address Ranges – Yes
8. Parcel Layer – No

Interoperability/Data Sharing

1. Conflation – No
2. Cooperation With Other Organizations – DVRPC
3. Cooperation With Utilities – No
4. Current GIS Data Users – County agencies, developers
5. Data Distribution Policy – No
6. GIS Wish List – Sign and signal data, road width, traffic count locations, SEPTA loadings, PA Turnpike in/out counts, freight information from Norfolk Southern (economic activity by cargo type,
7. Frequency, trains per day), airport data from DVRPC, parking, highway occupancy permitting files, bicycle/pedestrian trail use

8. Transportation Modeling – No

Interview Discussion

The Montgomery County Planning Commission is the responsible agency for data related to transportation planning initiatives. The County utilizes ESRI's ArcView and ArcCad GIS software in addition to AutoCad for data maintenance. A strategic plan for GIS was performed in 1997. No action items have been performed as a result of this plan due to budget constraints.

Currently, County staff operates in a Windows 98 desktop environment with planned migration to a Windows NT environment. Land records data is maintained in a Honeywell mainframe system and is provided to the Planning Commission for import into MS Access. Oracle and SQL Server are also used on a countywide basis.

The Planning Commission utilizes two street centerline files. GDT data was purchased in 1999 and has been used on a temporary basis for addressing and Health Department disease studies. The second source is a countywide street centerline file maintained by the Planning Commission that is updated according to subdivision plans. This file is used primarily for cartographic purposes and contains no attribute information.

The Montgomery County Planning Commission does not currently distribute data other than traffic information to local developers and the published county road map and receives the majority of its transportation-related data from DVRPC. However, the County has identified several types of data that would greatly improve its processes and planning efforts. These items include sign and signalization data; road widths; traffic count locations; SEPTA stops and loadings; PA Turnpike in/out traffic count data; Norfolk Southern Railroad freight information, economic activity by cargo type and frequency of trains per day; DVRPC airport information; parking; highway occupancy permitting files; and pedestrian/bicycle trail use.

Evaluation

On the basis of the interview session and subsequent data samples that were obtained from Montgomery County, the following evaluation has been developed regarding various parameters related to GIS applications for transportation planning.

Linework Quality – The most current data set utilized by Montgomery County is the centerline file used for distributing cartographic road maps. However, this data set is not currently geographically referenced. The GDT data being utilized is not being updated, and therefore lacks currency. The County and DVRPC could benefit from referencing the existing cartographic centerline to an orthophoto basemap or creating a new centerline file from DVRPC orthophotography.

Database Quality – There currently are no extensive databases for transportation planning being used and maintained by Montgomery County.

Overall Status of Transportation GIS – At this time, there is no substantial transportation GIS in operation in Montgomery County. There is a great deal of interest on the part of the Planning Commission staff in making better use of GIS for transportation planning and they have provided many examples as to how they could improve operations and planning efforts.

Potential for Contributing Data to a Regional Model – Based on current conditions, it appears that Montgomery County lacks significant potential for contributing data to a regional model.

Stage Designation

Based on the foregoing summary information, Montgomery County's road centerline development has been designated as a "Stage 1" implementation. This designation is based on the non-existence of a countywide road centerline file that is maintained and used on a regular basis.

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Appendix C - Individual Summary Reports
New Jersey Municipalities

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City of Camden, New Jersey

Interview Summary

General Information

1. City Department in Charge of GIS – Department of Development and Planning.
2. GIS Software Vendor – ESRI
3. GIS Software – ArcView 3.0
4. Computer Hardware – Intel Windows 95/98 (Desktop) Windows NT (Server)
5. Metadata – None at this time
6. GIS Strategic Plan – Yes

Centerline Information

1. Road Centerlines – Yes both in shapefile and coverage format
2. Level of Detail – Every road in the City – dual lines where separated by a median.
3. Approximate Centerline Scale – 1"=200'
4. Map Projection – NJ State Plane 27 Feet
5. Creator of Centerlines – Based on 1992 airphotos. Created by ADR and PSE&G
6. Unique Road Identifier – None but have Street Names and address ranges in 15 of 20 census tracts.
7. Maintenance – No formal procedure. Centerlines are maintained on an ad hoc basis when changes are noticed
8. Routable Network – No
9. Standard symbology – No

Database Information

1. Current GIS Database – ArcView .dbf
2. Enterprise-wide Information Processing Environment – Yes but no ties to GIS
3. Centerline Road Attribution – Street Addresses
4. Attribute Data Entry Validation – None
5. Events/Distributed Attributes Placed on Centerline – Address matching
6. Linear Referencing Method – Address Matching
7. Address Ranges – Yes, completed in 15 of the City's 20 Census Tracts.
8. Parcel Layer – Work in process. Will link to Tax Assessor database in the future. Approximately 1/3 of the City is complete.

Interoperability/Data Sharing

1. Integration of Different Map Scale Data – No
2. Conflation – None
3. Cooperation With Other Government Organizations – Yes - limited data from NJDEP
4. Cooperation With Utilities – Work with City's DPW and have worked getting ADR/PSE&G data in the past.
5. Current GIS Data Users – Parks Bureau and Planning Division
6. Data Distribution Policy – A rough policy is in place – would like to see what other jurisdictions are doing.

7. GIS Data Wish List – DVRPC, NJDOT Transportation Data.
8. Transportation Modeling – No

Interview Discussion

The City of Camden GIS is operated out of the Department of Development and Data Planning. Currently the City does not have a full time staff person dedicated to GIS. GIS development is being undertaken by staff with other primary responsibilities.

The street centerline layer was created in 1992 and was generated from orthophotography so the spatial accuracy of the linework at that point in time was quite good. The linework has had ad-hoc maintenance performed on it since then and address ranges have been added to the centerline in 15 out of the 20 City's Census Tracts.

In the opinion of the staff, the City is essentially "slowly moving ahead with GIS with the best of its abilities when faced with limited staffing and budget constraints". Student interns are being used to help create the parcel maps.

The City of Camden is very interested in working with Camden County and NJDOT to begin to utilize GIS for Transportation purposes.

The City is currently using ArcView 3.0 and its license of ArcInfo has expired.

Evaluation

From the basis of the interview session and subsequent data samples that were obtained from The City of Camden, The following evaluation has been developed regarding various parameters related to GIS application for transportation planning:

Linework Quality – At the present time, The City's centerline file has attribution and most of the address ranges have been completed. The maintenance on the road centerlines is currently done using ad hoc methods. With a limited amount of work, the centerline file could become suitable to support GIS applications for transportation planning.

Database Quality – Currently, there is no database being maintained by The City of Camden that will adequately support transportation planning but with the map updating and completion of the addressing potential exists for such a database to be developed.

Overall Status of Transportation GIS – The City of Camden is currently not using GIS for transportation planning.

Potential for Contributing Data to a Regional Model – At this time, the City of Camden has moderate potential for contributing data to a regional transportation GIS data model.

Stage Designation

Based on the foregoing summary information, The City of Camden's road centerline development has been designated as a "Stage 2" implementation based upon the criteria described above.

The most critical need that the City of Camden has at this time for Transportation GIS is a regular process maintaining and updating its centerline file. There exists a need for internal coordination of data development and maintenance issues. The City should seek out Camden County and explore the possibility of working cooperatively in the development of a transportation GIS database. The City should also investigate the potential for cooperative efforts with Emergency Management. This may help to generate support for funding the maintenance of the data and the expansion of the GIS.

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City of Trenton, New Jersey

Interview Summary

General Information

1. Responsible Agency for GIS – City MIS Department. DPW and Planning both manage aspects of GIS-T within the City.
2. GIS Software Vendor – ESRI
3. GIS Software – ArcInfo 8x, ArcView, ArcIMS
4. Computer Hardware – Intel Windows NT (Desktop), Windows NT (Server)
5. Metadata – Not currently. Will use ArcCatalog to create FGDC compliant metadata
6. GIS-T Strategic Plan – No

Centerline Information

1. Road Centerlines – Under development. Will be a single line unless separated by a median.
2. Level of Detail – Every road in the City
3. Approximate Centerline Scale – 1"=50'
4. Map Projection – NJ State Plane 83 Feet
5. Creator of Centerlines – being created by consultant from aerial photography.
6. Unique Road Identifier – None. However will have street name and ROW width on each street segment.
7. Maintenance – DPW and Planning – exact procedures still under discussion
8. Routable Network – No
9. Standard symbology – No

Database Information

1. Current GIS Database – None. Plan on using ESRI's personal geodatabase, which is based on Microsoft JET database.
2. Enterprise-wide Information Processing Environment – Yes in MIS department
3. Centerline Road Attribution – Street names (all in a single field) and ROW width.
4. Attribute Data Entry Validation – Will be handled in the geodatabase.
5. Events/Distributed Attributes Placed on Centerline – None currently
6. Linear Referencing Method – Police want addressing for incident mapping and Engineering may want GPS.
7. Address Ranges – Not yet
8. Parcel Layer – Yes currently under development. Property addresses will be included.

Interoperability/Data Sharing

1. Conflation – No
2. Cooperation With Other Government Organizations – DVRPC, NJDEP, and Mercer County.
3. Cooperation With Utilities – No
4. Current GIS Data Users – None currently but discussing Pavement Management System and Crime Analysis
5. Data Distribution Policy – No. Would like to see other agencies data sharing agreements.
6. GIS Wish List – Anything from surrounding jurisdictions NJDOT, DVRPC, TMA
7. Transportation Modeling – No

Interview Discussion

The City of Trenton MIS Department is in the process of building the City-wide GIS. The City has hired GIS consultants, developed a GIS plan, flown new aerial photography, purchased GIS software and begun to receive GIS data. The road centerlines for the City will be captured off of the new 1": 50' scale digital orthophotograpy. The road centerlines will be a single line unless the road is separated by a median strip. The attribution on the road centerline in the first phase will be very rudimentary. It will consist of the street name (all stored in a single column – not parsed according to TIGER addressing standards) and Right-of-Way (ROW) width. Maintenance of the road centerline and additional future attribution is now being discussed between the Department of Public Works (DPW) and The Department of Planning. Currently two potential uses of the road centerline are currently being discussed. First is the addition of address ranges to the street segments so that the Police Department can perform incident mapping. Second, the Engineering Department is looking at a Pavement Management System (PMS) and perhaps adding other attribution such as signs and signals using GPS technology.

The City of Trenton continues to interact with various government and private entities. The City desires future coordination with organizations to acquire data transportation and other GIS data. The organizations identified include NJDOT, NJDEP, DVRPC, Mercer County and public and private transportation groups. The acquisition of this data would enhance the future of the City's Transportation planning activities.

Evaluation

On the basis of the interview session the following evaluation has been developed regarding various parameters related to GIS application for transportation planning:

Linework Quality – The spatial quality of the linework when completed should be excellent. With proper planning the City should be able to keep the centerline layer of the GIS up to date. The only issue with the centerline and linework quality at this point in time is the lack of attribution tied to the centerline and the way current attribution is being stored. The City needs to not only add address ranges (which they plan on doing) but also parse the street name field in a manner similar to or meeting TIGER standards.

Database Quality – Once again the attribution should be updated and corrected as planned and a maintenance procedure established. The use of the functionality in ESRI's geodatabase if used properly should ensure that database integrity is maintained. The database lacks a unique identifier that would facilitate the use of a broader range of attribute information and hopefully some of the recommendations established by this study will be implemented.

Overall Status of Transportation GIS – The City is in the beginning stages. Accurate data is being collected and with the proper database design, it should be feasible to build numerous successful GIS-T applications.

Potential for Contributing Data to a Regional Model – The assessment of the information gathered for The City of Trenton indicates a relatively low potential for contributing relevant data to a regional transportation planning database. However, the accurate centerline file and future database additions will eventually make the City data more attractive.

Stage Designation

Based on the foregoing summary information, the City of Trenton's road centerline development has been designated as a "Stage 2" implementation. This designation is based on the current development of a citywide road centerline file. The road centerline file will not contain a unique, user-defined segment ID, but rather a software-generated identifier and is currently will not be ready for address matching or LRS.

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Appendix D - Individual Summary Reports
New Jersey Counties

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Burlington County, NJ – Department of Data Processing GIS Section

Interview Summary

General Information

1. County Department in Charge of GIS – Data Processing – GIS is under this group
2. GIS Software Vendor – ESRI
3. GIS Software – ArcInfo 8x, ArcView 3.2
4. Computer Hardware – Intel Windows NT/Windows98 (Desktop) Windows NT (Server)
5. Metadata – Yes complete FGDC compliance.
6. GIS Strategic Plan – Old GIS Strategic plan. Would like to work with the State Office of GIS to create a new plan. None for GIS-T

Centerline Information

1. Road Centerlines – Yes, just finished collecting every road via GPS. Funded via a FGDC grant.
2. Level of Detail – Every road in the County. Centerline for each direction
3. Approximate Centerline Scale – Sub-Meter accuracy
4. Map Projection – NJ State Plane 83 Feet
5. Creator of Centerlines – County. Roads where driven using GPS (accuracy was differentially corrected) then used digital orthos for final QA/QC.
6. Unique Road Identifier – Street Names and address ranges as well as NJDOT SRI numbers where they could ascertain them for NJDOT Straight Line Diagram application.
7. Maintenance – They maintain through a maintenance process that starts with the County Clerk. When new drawing is submitted, they wait a couple of months and then go drive and GPS the new centerlines.
8. Routable Network – No
9. Standard symbology – No left up to individual users.

Database Information

1. Current GIS Database – INFO. May convert to Geodatabase with Oracle or SQL Server.
2. Enterprise-wide Information Processing Environment – Client Server no mainframe.
3. Centerline Road Attribution – Fully described in metadata/data dictionary. 32 fields of information.
4. Attribute Data Entry Validation – No check during QA/QC.
5. Events/Distributed Attributes Placed on Centerline – Address matching
6. Linear Referencing Method – Address Matching, Node-to-Node, Intersection-to-Intersection
7. Address Ranges – Yes – TIGER compliant
8. Parcel Layer – Work in process. Will link to Tax Assessor database

Interoperability/Data Sharing

1. Integration of Different Map Scale Data – None. All collected via GPS
2. Conflation – No Conflation
3. Cooperation With Other Government Organizations – Townships, NJDEP, Feds, DVPRC, nothing with NJDOT
4. Cooperation With Utilities – None at current time.

5. Current GIS Data Users – County users, townships
6. Data Distribution Policy – Yes, agreement similar to NJDEP for reproduction and accuracy
7. GIS Data Wish List – DVRPC, NJ Transit, trails
8. Transportation Modeling – No

Interview Discussion

The Burlington County Department of Data Processing (GIS Section) currently serves as the responsible County agency for GIS. The GIS Section maintains a geographically accurate road centerline file for the County. The GIS Section is responsible for the maintenance of geographic and attribute data related to the landbase and road centerlines. Attribute Information such as address ranges and unique road names are maintained. FGDC funded efforts to GPS all of the County's road centerlines are complete and contain 32 fields of attribution including TIGER like addressing and NJDOT's SRI number where it could be derived from NJDOT's Straight Line Diagram application.

Burlington County continues to interact with various government and private entities. The County desires future coordination with organizations to acquire data such as bus routes, private and public transportation routes, bikeway networks, accident data, local road details related to pavement conditions and speed limits.

The GIS Section maintains a geographically accurate centerline file with a variety of attributes primarily associated with the land base and E911 services. The work undertaken and completed to map road centerlines using GPS is of very high quality and the GIS Section should be commended in providing quality metadata and foresight to add NJDOT's SRI number.

The one issue dealing with road centerlines in Burlington County is the fact that the Engineering Department uses it's own road centerline file which it derives from orthophotography. The Engineering Department continues to maintain and add very valuable attribute data, which it uses internally but is not being utilized by the Counties GIS efforts. The GIS Section and the Engineering Department have in place, processes for regularly updating their respective centerline files. It is recommended that the two groups work towards a solution for developing and maintaining a common, accurate centerline with strong attribution.

Evaluation

On the basis of the interview session and subsequent data samples that were obtained from Burlington County, The following evaluation has been developed regarding various parameters related to GIS application for transportation planning:

Linework Quality – There are two types of centerline data currently in use in Burlington County. The GIS Section maintains a geographically accurate centerline file with a variety of attributes primarily associated with the land base and E911 services. The Engineering Department uses it's own road centerline file which it derives from orthophotography. The Engineering Department continues to maintain and add very valuable attribute data, which it uses internally but is not being shared with GIS section.

Database Quality – Both the GIS Section and the Engineering Department have developed and continue to maintain GIS attribute databases that are well suited for transportation planning application. The GIS Section's centerline has both TIGER addressing and NJDOT's SRI unique identifier that would facilitate

the use of a broader range of attribute information. The Engineering Department's combination of centerline and business databases makes for unlimited possibilities and a real opportunity to make Burlington County a model for Transportation GIS at the County level both in the State of New Jersey and in the US.

Overall Status of Transportation GIS – In general, it is apparent that the GIS Section is taking good advantage of GIS data that is readily available to support various transportation planning activities. This functionality could be broadened and enhanced through a more cooperative effort with the Engineering Department.

Potential for Contributing Data to a Regional Model – The assessment of the information gathered for Burlington County indicates a relatively high potential for contributing relevant data to a regional transportation-planning database. This conclusion is based upon the following factors:

- The GIS Section has developed and is actively maintaining a geographically accurate and relatively attribute-rich centerline file
- The Engineering Department is actively building attribute data to support Engineering activities and processes.
- Overall there is an enthusiastic, positive and proactive attitude among management and staff for both County agencies towards the productive utilization of GIS and the maintenance of the data that are required to support it. The mitigating issue is a lack of
- Communication.

Stage Designation

Based on the foregoing summary information, Burlington County GIS Section's road centerline development has been designated as a "Stage 3" implementation. This designation is based on the existence of a countywide road centerline file containing address matching capabilities and NJDOT's SRI numbering system. There is no LRS measure.

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Burlington County, NJ – Engineering Department

Interview Summary

General Information

1. Responsible Agency for GIS – Burlington County Data Processing Dept. (GIS Section) Engineering Department is not currently using GIS but would like to.
2. GIS Software Vendor – County has ESRI but no GIS software in Engineering – Using Microstation J for CADD work.
3. GIS Software – ArcInfo 8x, ArcView, ArcView
4. Computer Hardware – Intel Windows NT (Desktop), Windows NT (Server) –Would need to add a workstation for GIS
5. Metadata – None on Engineering Data but they do have CAD Standards including Level Lists
6. GIS Strategic Plan – No

Centerline Information

1. Road Centerlines – Yes, single centerline for each direction
2. Level of Detail – Every road in the County
3. Approximate Centerline Scale – 100 scale topo with full planimetric data (3.3 ft accuracy)
4. Map Projection – NJ Stateplane NAD83 ft
5. Creator of Centerlines – Engineering Department. Planning has also created centerlines
6. Unique Road Identifier – Road Name/Route Number
7. Maintenance – Maintained via new orthos. Flown in sections-entire county updated every five years
8. Routable Network – No
9. Standard symbology – Yes, all roads have standard feature definition via pen tables

Database Information

1. Current GIS Database – MS Access linked to Microstation J
2. Enterprise-wide Information Processing Environment – None that affects Engineering
3. Centerline Road Attribution – pavement characteristics (length, width etc.)
4. Attribute Data Entry Validation – Data is validated upon entering data into the Access database
5. Events/Distributed Attributes Placed on Centerline – None
6. Linear Referencing Method – None, roads are pre-segmented via attribute changes
7. Address Ranges – None

Interoperability/Data Sharing

1. Conflation – No.
2. Cooperation With Other Government Organizations – NJDOT for sign Mgmt system , DVRPC, Municipalities, NJDEP
3. Cooperation With Utilities – None
4. Current GIS Data Users – None
5. Data Distribution Policy – Yes
6. GIS Wish List – DVRPC Air photos, NJTransit – bus routes, stops, light rail location
7. Transportation Modeling – No

Interview Discussion

The Burlington County – Engineering Department maintains a geographically accurate road centerline file for the County for engineering purposes. Along with the road centerline the Engineering Department maintains a database of traffic signals and signing, traffic maintenance, road striping, manholes, culverts and basic pavement attributes. The Engineering Department contracts out for continual orthophoto flights so that it can keep its full planimetric layer up to date over a five-year revision cycle. All this being said the Engineering Department currently uses no GIS at all and the valuable information it collects is not utilized in the Counties GIS efforts. There is a real desire within the Engineering Department to start to utilize GIS. The fact that the GIS Section within the County has just completed a GPS road centerline data collection effort with extensive attribution including TIGER like addressing and NJDOT's SRI numbering begs for the integration of the two separate transportation layers that the County is collecting and maintaining. While the GIS Section in Planning has solid road centerline attribution, the Engineering Department has solid attribute information about the roads that needs to be available to other Sections within Burlington County.

The Engineering Department has extensive scanning and plotting capabilities and a strong background in utilizing software applications and hardware resulting from their extensive use of CADD. At the current time there is no network capabilities between the Engineering Department and the County IT environment so any GIS data sharing would need to be done without the use of a network.

The Engineering Department has expressed a strong desire to start to overcome some of the issues that have held up the inclusion of Engineering into the County's GIS infrastructure. The main area of contention seems to be over the ownership, re-sale and dissemination of Engineering's data outside of the County. The current GIS Section takes a liberal approach to data sharing while last year alone the Engineering Department sold it's data in a cost recovery effort.

Evaluation

On the basis of the interview session and subsequent data samples that were obtained from Burlington County, The following evaluation has been developed regarding various parameters related to GIS application for transportation planning:

Linework Quality – There are two types of centerline data currently in use in Burlington County. The GIS Section maintains a geographically accurate centerline file with a variety of attributes primarily associated with the land base and E911 services. The Engineering Department uses it's own road centerline file which it derives from orthophotography. The Engineering Department continues to maintain and add very valuable attribute data, which it uses internally but is not being utilized by the Counties GIS efforts. In light of the fact that the GIS Section has, in place, a process for regularly updating the County's centerline file, as does the Engineering Department, it is recommended that the two groups work towards a solution for developing and maintaining a common, accurate centerline with strong attribution.

Database Quality – Both the GIS Section and the Engineering Department have developed and continue to maintain GIS attribute databases that are well suited for transportation planning application. The GIS Section's centerline has both TIGER addressing and NJDOT's SRI unique identifier that would facilitate the use of a broader range of attribute information. The Engineering Department's combination of centerline and business databases makes for unlimited possibilities and a real opportunity to make Burlington County a model for Transportation GIS at the County level both in the State of New Jersey and in the US.

Overall Status of Transportation GIS – In general, it is apparent that the GIS Section is taking good advantage of GIS data that is readily available to support various transportation planning activities. This functionality could be broadened and enhanced through a more cooperative effort with the Engineering Department.

Potential for Contributing Data to a Regional Model – The assessment of the information gathered for Burlington County indicates a relatively high potential for contributing relevant data to a regional transportation planning database. This conclusion is based upon the following factors:

- The GIS Section has developed and is actively maintaining a geographically accurate and relatively attribute-rich centerline file
- The Engineering Department is actively building attribute data to support Engineering activities and processes.
- Overall there is an enthusiastic, positive and proactive attitude among management and staff for both County agencies towards the productive utilization of GIS and the maintenance of the data that are required to support it. The mitigating issue is a lack of communication.

Stage Designation

Based on the foregoing summary information, Burlington County Engineering's road centerline development has been designated as a "Stage 4" implementation.

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Camden County, New Jersey

Interview Summary

General Information

1. Responsible Agency for GIS – No single county-wide department for GIS. They do have a GIS steering committee (DPW, Improvement Authority and Health Department)
2. GIS Software Vendor – ESRI
3. GIS Software – ArcInfo 8x, ArcView
4. Computer Hardware – Intel Windows NT&95/98 (Desktop), Windows NT (Server). However there is no network within the County so data sharing between agencies is via sneaker net.
5. Metadata – None at this point
6. GIS Strategic Plan – No.

Centerline Information

1. Road Centerlines – Yes, single centerline.
2. Level of Detail – 400+ miles of road. 500,600, and 700 level roads
3. Approximate Centerline Scale – GPS to 2 meter accuracy
4. Map Projection – NJ State Plane 83 Feet
5. Creator of Centerlines – Roads were created with GPS for the Department of Public Works by a contactor. The Improvement Authority uses GDT and TIGER for address matching.
6. Unique Road Identifier – None on GPS centerlines. GDT/TIGER have standard information for each type.
7. Maintenance – No staff or plan for maintenance.
8. Routable Network – No
9. Standard symbology – No use ESRI State Route Symbols

Database Information

1. Current GIS Database – INFO, MS Access, ArcView .dbf files
2. Enterprise-wide Information Processing Environment – MIS uses AS400 system for Tax Records
3. Centerline Road Attribution – None for GPS data. GDT/TIGER have their information for address matching
4. Attribute Data Entry Validation – DPW Cartograph system has attribute validation as part of the application.
5. Events/Distributed Attributes Placed on Centerline – Utilizing GPS coordinates DPW places coordinates for sign location, traffic signals, controllers and supports.
6. Linear Referencing Method – Improvement Authority uses Address Ranges. DPW eventually would like to see a Route/Milepost system.
7. Address Ranges – Yes, using the GDT or TIGER data only.
8. Parcel Layer – Improvement Authority is building a County-Owned parcel layer.

Interoperability/Data Sharing

1. Conflation – No
2. Cooperation With Other Government Organizations – NJDOT, DVRPC, NJDEP, Vendors – GDT, Municipalities

3. Cooperation With Utilities – None really have worked with PSE&G in the past.
4. Current GIS Data Users – Improvement Authority, DPW, Health Department
5. Data Distribution Policy – None
6. GIS Wish List – NJDOT Transportation Data, Air photos from DVRPC, NJTransit bus routes, surrounding jurisdictional data.
7. Transportation Modeling – No - performed by DVRPC for the County.

Interview Discussion

Camden County is in the very early stages of considering the utilization of GIS for transportation planning and could benefit immensely from the work being done on this project. The Department of Public Works has begun to introduce GIS technology into their business processes and is implementing a Sign Management System using a commercial, off-the-shelf (COTS) asset management software product. The process of selecting the COTS system, loading the data into the system, and having to manage and maintain the data in the system has taught some very valuable lessons and prepared the Department somewhat for the amount of work that a County-Wide Transportation GIS would entail.

The County has three basic users of GIS currently: the Department of Public Works, the County Improvement Authority and the Department of Health. Outside of performing address matching on GDT and TIGER centerlines neither the Improvement Authority nor Department of Health is actually utilizing GIS for transportation planning. DPW has in the past paid a consultant to GPS all of the 500-600-700 level roads in the county. Outside of the road geometries no attribution was attached to the road centerlines so other County agencies such as the Health Department or Improvement Authority must purchase GDT or rely on TIGER data to solve their address matching problems. There is no central County department or agency responsible for the development and maintenance of County-wide GIS. Neither funding nor resources to develop and maintain GIS are earmarked in the budget.

Evaluation

On the basis of the interview session and subsequent data samples that were obtained from Camden County, the following evaluation has been developed regarding various parameters related to GIS application for transportation planning:

Linework Quality – There are two types of centerline data currently in use in Camden County. The DPW has centerlines of the 500-600-700 level roads with no attribution and no maintenance plan. However, they were spatially very accurate when they were collected by a consultant. The Improvement Authority and the Department of Health rely on either TIGER or GDT data to perform their required address matching.

Database Quality – Currently, there is no database being maintained by Camden County that will adequately support transportation planning. The sign management system does have some valuable information stored in it including GPS locations for sign locations, traffic signals, controllers and supports.

Overall Status of Transportation GIS – Camden County is currently not using GIS for transportation planning.

Potential for Contributing Data to a Regional Model – At this time, Camden County has a low potential for contributing data to a regional transportation GIS data model. However, that being said, they are in a great position to benefit by the work being done on this DVRPC funded project.

The most critical need that Camden County has at this time is a more accurate, and current centerline file and a willingness by the County to maintain what ever is built in the future.. There are a number of possibilities including NJDOT data, conversion of existing files, DVRPC, etc. Emphasis needs to be placed on constructing this file to support the use of external distributed attribute data with the centerline file.

Stage Designation

Based on the foregoing summary information, Camden County's road centerline development has been designated as a "Stage 2" implementation based upon the criteria described above.

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Gloucester County, New Jersey

Interview Summary

General Information

1. Responsible Agency for GIS – Gloucester County Planning Department
2. GIS Software Vendor – ESRI
3. GIS Software – ArcInfo 8x, ArcView 3.2 and ArcExplorer. Looking at ArcIMS for a public website and street map.
4. Computer Hardware – Intel Windows NT (Desktop), Windows NT (Server)
5. Metadata – Some at this point but still really needs to be addressed.
6. GIS Strategic Plan – Not at this point.

Centerline Information

1. Road Centerlines – Yes - single line except for divided roads – no attributes. Also have ETAK roads which have address ranges.
2. Level of Detail – Every road in the County
3. Approximate Centerline Scale – 1"=2000'
4. Map Projection – NJ State Plane 83 Feet
5. Creator of Centerlines – County – Digitized from 1990 air photos – no attributes
6. Unique Road Identifier – ETAK has street names and address ranges. County centerlines have no attribution
7. Maintenance – Only way to update the centerlines is to wait for the new aerials every five years. Subdivision approval process is confusing.
8. Routable Network – No
9. Standard symbology – No

Database Information

1. Current GIS Database – INFO, .dbf and MS Access.
2. Enterprise-wide Information Processing Environment – Only for Tax Assessment
3. Centerline Road Attribution – Store type and route numbers for their centerlines.
4. Attribute Data Entry Validation – None
5. Events/Distributed Attributes Placed on Centerline – Currently no attribution is placed on to the road centerlines
6. Linear Referencing Method – None at this point. ETAK has address ranges but since ETAK data is old some of the address ranges are not correct. Would like to take accurate address ranges and put them on their road centerlines.
7. Address Ranges – Out of date ETAK address ranges on the ETAK file.
8. Parcel Layer – They have funding to create countywide parcel database.

Interoperability/Data Sharing

1. Conflation – No, but would like somehow to conflate some accurate address ranges onto their centerline file.
2. Cooperation With Other Government Organizations – DVRPC, NJDEP and various local Municipalities
3. Cooperation With Utilities – None
4. Current GIS Data Users – Various groups within the county

5. Data Distribution Policy – Yes
6. GIS Wish List – Traffic Counts, TIP Projects, Scope Projects, ROW, PMS, Straight Line Diagrams, Video Logging, Traffic Impact Studies and whatever else is available.
7. Transportation Modeling – No handled by DVRPC

Interview Discussion

The GIS for Gloucester County New Jersey is maintained out of the County's Planning Department. The County has standardized on ESRI tools and has received money to begin a countywide parcel mapping activity.

The County has currently has two sets of road centerlines. The first was purchased from ETAK Corporation and has not only street names but address ranges so that data can be placed using standard address geocoding tools. The second centerline file was digitized by the County off of 1992 digital orthophotography. Roads have been digitized as a single centerline except where the road is divided. The only attribution attached to those road centerlines is the road type and route number. The County would be interested in getting address ranges onto the road centerline.

The only method the County uses to update their road centerline layer is to wait for the next five year set of digital orthophotos from DVRPC. The sub-division process is too cumbersome to serve as a valid method to update this road layer.

The County is very interested in ways to acquire various types of transportation data that other agencies in the State or in the Region might be collecting such as Straight Line Diagrams, TIP projects, construction projects, asset management, pavement management, video logs, traffic impact studies, etc.

The County desires future coordination with organizations to acquire data transportation and other GIS data. The organizations identified from which to acquire this information include NJDOT, NJDEP, DVRPC, and public and private transportation groups. The acquisition of this data would enhance the future of the County's Transportation planning activities.

Evaluation

On the basis of the interview session and subsequent data samples that were obtained from Gloucester County, the following evaluation has been developed regarding various parameters related to GIS application for transportation planning:

Linework Quality – There are two types of centerline data currently in use in Gloucester County. The County's GIS group maintains a geographically accurate centerline only a couple of basic pieces of attribute information. The County in the past also purchased ETAK data so that they could use it for address matching. This data has fallen out of date.

Database Quality – The County's centerline database lacks a unique identifier that would facilitate the use of a broader range of attribute information. It also lacks any street address matching attribution

Overall Status of Transportation GIS – In general, it is apparent that the County is taking good advantage of GIS data that is readily available to it. However, for Transportation GIS, the County can benefit from this DVRPC project

Potential for Contributing Data to a Regional Model – The assessment of the information gathered for Gloucester County indicates a relatively low potential for contributing relevant data to a regional transportation planning database.

Stage Designation

Based on the foregoing summary information, Chester County's road centerline development has been designated as a "Stage 2" implementation. This designation is based on the existence of a countywide road centerline file. However the road centerline file does not contain a unique ID, nor does it have street addressing information, or an LRS measure.

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Mercer County, New Jersey

Interview Summary

General Information

1. County Department in Charge of GIS – County Planning Dept.
2. GIS Software Vendor – ESRI
3. GIS Software – ArcInfo 8x, ArcView 3.2
4. Computer Hardware – Intel Windows NT (Desktop) Windows NT (Server)
5. Metadata – NJ State Metadata Using Metalite
6. GIS Strategic Plan – Old GIS plan, none for GIS-T

Centerline Information

1. Road Centerlines – Yes, ETAK roads file purchased by County prosecutor
2. Level of Detail – Every road in the County
3. Approximate Centerline Scale – 1"=1,000'
4. Map Projection – NJ State Plane 83 Feet
5. Creator of Centerlines – ETAK Corporation
6. Unique Road Identifier – Street Names and address ranges
7. Maintenance – One time purchase of commercial product (Etak)
8. Routable Network – No
9. Standard symbology – No

Database Information

1. Current GIS Database – Lotus .DBF(dBase)
2. Enterprise-wide Information Processing Environment – Tax assessment data only
3. Centerline Road Attribution – Etak
4. Attribute Data Entry Validation – None
5. Events/Distributed Attributes Placed on Centerline – Address matching
6. Linear Referencing Method – Address Matching
7. Address Ranges – Yes, but not maintained
8. Parcel Layer – Ad hoc for Open Space Initiative

Interoperability/Data Sharing

1. Integration of Different Map Scale Data – From municipalities, CAD-based data
2. Conflation – No
3. Cooperation With Other Government Organizations – Townships, NJDEP, Etak
4. Cooperation With Utilities – None
5. Current GIS Data Users – None
6. Data Distribution Policy – Yes, agreement similar to NJDEP for reproduction and accuracy
7. GIS Data Wish List – DVRPC, NJ Transit, trails
8. Transportation Modeling – No

Interview Discussion

The Mercer County Planning Department currently serves as the responsible County agency for GIS. At the current time, most of the County's GIS efforts are focused on issues other than transportation. For example, open space planning and farmland preservation are two areas where GIS is currently being applied. The County is also working on incorporating parcel data into the GIS. Again, this is primarily in response to needs for planning efforts outside the realm of transportation.

There is an organization known as the Regional Transportation Partnership (previously known as MSM Regional Council) that exists within the County. A non-profit agency, they are funded largely through corporate contributions and memberships. Their primary mission is to promote wise land use planning policies, smart growth and other issues. One application of GIS that the RTP has been developing is known as "GOZ" or Goal Oriented Zoning. The RTP is involved with DVRPC directly on the "Central Jersey Transportation Forum" which is dealing with issues pertaining to the Route 1 corridor.

In the opinion of the Planning Department staff, the County is essentially "starting from nothing" with GIS. The concept of regional coordination and cooperation is of great interest. The staff cited a lack of awareness of existing data sources as a critical issue.

Internally, the Planning Department is attempting to determine potential ways to share files with the Engineering Department, which uses CADD software. Related to this is the Engineering Department's concern that a large volume of their information (pre-1995) remains paper-based.

The County is in the process of upgrading their GIS resources. At the time of the interview, orders had been placed for a variety of ESRI® software products and some additional workstations.

The County is also applying for State funding to update their metadata to current standards. They are also planning to work with the State GIS Office to create a new GIS strategic plan.

The Etak file that the Planning Department has was obtained through the County Prosecutor's Office. The acquisition of this file was a "one time" process circa 1995. Updates are done through manual digitizing "in house". NJDEP orthophotos are used as source data for new roads.

The Engineering Department has 13 Township maps digitized in CADD format. These maps are created and maintained at the Township level. The County has "stitched" these maps together to form a Countywide base. There is no maintenance performed on these maps at the County level.

The Planning Department is in the process of developing a road database that they would eventually like to "relate" to a centerline file using GIS. This data is being maintained in a spreadsheet file.

Evaluation

On the basis of the interview session and subsequent data samples that were obtained from Mercer County, The following evaluation has been developed regarding various parameters related to GIS application for transportation planning:

Linework Quality – At the time of the interview, Mercer County did not possess a road centerline file that would be suitable to support GIS applications for transportation planning. However, in the time since the interview, the County has been implementing a street centerline by joining GDT's "Community Update" program.

Database Quality – Currently, there is no database being maintained by Mercer County that will adequately support transportation planning.

Overall Status of Transportation GIS – Mercer County is currently not using GIS for transportation planning.

Potential for Contributing Data to a Regional Model – At this time, Mercer County has a low potential for contributing data to a regional transportation GIS data model.

Stage Designation

Based on the foregoing summary information, Mercer County's road centerline development has been designated as a "Stage 2" implementation based upon the criteria described above and the fact that the County has joined GDT's "Community Update" program.

Another area of need exists with internal coordination of data development and maintenance issues. The County Planning and Engineering Departments will need to work cooperatively in the development of a transportation GIS database that works. The County should also investigate the potential for cooperative efforts with Emergency Management. This may help to generate support for funding the maintenance of the data and the expansion of the GIS.

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Appendix E - Individual Summary Reports State Agencies

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New Jersey Department of Transportation

Interview Summary

General Information

7. Responsible Agency for GIS – GIS at NJDOT falls with in the Information Systems Group
8. GIS Software Vendor – Intergraph
9. GIS Software – MGE/MGSM - GeoMedia
10. Computer Hardware – Intel Windows NT (Desktop), Windows NT (Server)
11. Metadata – Not federally compliant metadata but do provide basic metadata for all of the GIS information they provide. The GIS unit is working with the IT group to decide on a metadata that meets FGDC standards. Metadata will be included in the OIT statewide clearinghouse.
12. GIS Strategic Plan – None at this point

Centerline Information

11. Road Centerlines – Yes, single centerline for each road. The single centerline represents both the north/east and south/west bound directions unless in some cases where there is a large separation between the lanes and then there are actually two centerlines.
12. Level of Detail – Currently just the State/Federal highway network and the County 500 level. Four Counties have the 600 level completed by Baker Engineering with the remaining Counties to be completed by 2002.
13. Approximate Centerline Scale – Roads were originally captured off of 1:24,000 USGS quad sheets. However they have been spatially adjusted to fit digital orthophotos that have produced by the State.
14. Map Projection – New Jersey State Plane 83 Meters
15. Creator of Centerlines – Done in-house at New Jersey DOT
16. Unique Road Identifier – Currently each road in the State has been given a unique State Route Identifier (SRI) number. Also NJDOT maintains a Network Linear Feature ID (NLF_ID) which allows them to place their business data (via dynamic segmentation) out onto the road network.
17. Maintenance – The GIS group is in charge of maintaining this information for GIS. The revision process is basically continual with a five-year updating policy based on the State gathering a new set of digital orthophotography.
18. Routable Network – No
19. Standard symbology – Yes, all roads have standard feature definition and it is from this representation that at plot time that roads are re-symbolized. Heavy use of I/PLOT pen tables.

Database Information

9. Current GIS Database – Oracle 8.0.3
10. Enterprise-wide Information Processing Environment – None at the DOT. The GIS group receives information from the various departments within the DOT in numerous formats (Oracle, MS Access, FoxPro, MS Excel and flat files)
11. Centerline Road Attribution – Route Number, NLF_ID, Milepost information, SRI number and Straight Line Diagram identifier number
12. Attribute Data Entry Validation – No validation checks outside of adjusting the route numbers so that they match the NLF_ID that NJDOT needs. The operational users entering the data do not validate data and the operational data is just uploaded into the GIS groups Oracle database. The data is then

only checked when a query returns an up-expected result and then a select distinct command is run against that column in the database and updates/corrections are made at that point in time.
13. Events/Distributed Attributes Placed on Centerline – Currently over 40 different tables are placed dynamically along the road centerlines. These tables include Capital Projects, Traffic Information, Pavement Information, Crash data etc.
14. Linear Referencing Method – Currently NJDOT uses a Route (NLF_ID) and milepoint LRM. NJDOT is also capable of using a SRI number and a milepoint
15. Address Ranges – No Address Information
16. Parcel Layer – No

Interoperability/Data Sharing

1. Conflation – No but since NJDOT is the keeper of the road centerline information for the State of New Jersey there are other agencies who wish that street name/address ranges could be attributed on all roads. However, NJDOT does not know of a way to efficiently do this and they are concerned that if they conflate something like GDT or NavTech data that they will run into copyright issues and this is something that they want to avoid.
2. Cooperation With Other Government Organizations – PennDOT, New Jersey Transit MPO's and limited contract with Counties and Municipalities.
3. Cooperation With Utilities – None
4. Current GIS Data Users – Used by numerous groups within the DOT
5. Data Distribution Policy – Yes
6. GIS Wish List – None at this point. But if an easy method of getting information from the Counties were developed some useful information certainly exists at that level.
7. Transportation Modeling – No

Interview Discussion

The GIS Section at NJDOT has developed a mature stable GIS-T environment. The GIS Section maintains a geographically accurate road centerline file for the roads it must manage and maintain. The GIS Section is responsible for the maintenance of geographic and attribute data related to the road centerlines. Attribute information such as the Route Number (NLF_ID) and SRI number, as well as milepost information, is maintained by the GIS Section. Current efforts to extend the road coverage is nearing completion on the 600 series routes for the remaining 17 Counties scheduled for completion by 2002.

The DOT, through the use of dynamic segmentation, is able to link a tremendous amount of the DOT's operational data to the road centerline network. Accidents, Pavement Information, Construction Project Data, Traffic Count Information, Functional Class Code are just a few of the more than 40 tables of information currently being utilized. The one issue that NJDOT has with this information is that there have been institutional barriers that the GIS Section has been trying to overcome. None of the other departments/sections within the DOT are "required" to give their data to GIS so the GIS Section must continually seek out new information so that it can be added to GIS. The lack of a central DOT database or data warehouse and established business processes are key factors in this lack of institutional data sharing. These issues are currently being addressed by the DOT on an enterprise level.

NJDOT continues to interact with various government and private entities. The DOT desires future coordination with organizations to acquire data such as bus routes, private and public transportation routes, bikeway networks, accident data, local road details related to pavement conditions and speed

limits. Certainly there is a great need to facilitate the exchange of the vast information collected and maintained by the DOT with local governments and the information that they collect and maintain.

Evaluation

On the basis of the interview session and subsequent data samples that were obtained from NJDOT, The following evaluation has been developed regarding various parameters related to GIS application for transportation planning:

Linework Quality – There are two types of centerline data currently in use in NJDOT. The GIS Section maintains a geographically accurate centerline file with a variety of attributes primarily associated with just the State and Federal highways system. The DOT also maintains a county road series while these cover every road in the county and are maintained using the State's digital orthophotos they are simply CAD files with no attribution

Database Quality – The DOT, through the use of dynamic segmentation, is able to link a tremendous amount of its operational data to the road centerline network. Accidents, Pavement Information, Construction Project Data, Traffic Count Information, Functional Class Code are just a few of the over 40 tables of information currently being utilized. As mentioned previously, there exist institutional barriers that hinder the timely updating and enhancing of the database with new information.

Overall Status of Transportation GIS – In general, it is apparent that the DOT is taking good advantage of GIS data that is readily available to support various transportation planning activities. This functionality could most likely be broadened and enhanced through a more cooperative effort with the local governments and the addition of the remaining 600 level road network.

Potential for Contributing Data to a Regional Model – The assessment of the information gathered for NJDOT indicates a high potential for contributing relevant data to a regional transportation planning database. This conclusion is based upon the following factors:

- The GIS Section has developed and is actively maintaining a geographically accurate and relatively attribute-rich centerline file
- The NJDOT is actively utilizing available spatial and attribute data to support transportation planning activities and processes.
- Overall there is an enthusiastic, positive and proactive attitude among management and staff in NJDOT towards the productive utilization of GIS and the maintenance of the data that are required to support it.

Stage Designation

Based on the foregoing summary information, NJDOT's road centerline development has been designated as a "Stage 5" implementation. This is primarily based upon the fact that the DOT maintains a highly accurate centerline file with a rich attribute database that includes a unique identifier and an LRS measure.

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New Jersey Turnpike Authority

Interview Summary

General Information

1. Responsible Agency for GIS – GIS at New Jersey Turnpike is being led by the Engineering Group
2. GIS Software Vendor – ESRI
3. GIS Software – ArcView 3.2
4. Computer Hardware – Intel Windows NT (Desktop), Windows NT (Server)
5. Metadata – No metadata at this point
6. GIS Strategic Plan – None at this point

Centerline Information

1. Road Centerlines – Yes, paid a consultant to GPS the road centerline. Have one centerline for each direction of the Turnpike
2. Level of Detail – Turnpike Only
3. Approximate Centerline Scale – 1"=1200'
4. Map Projection – New Jersey State Plane 83 Feet
5. Creator of Centerlines – New Jersey Turnpike paid a consultant to perform GPS collection
6. Unique Road Identifier – None
7. Maintenance – No real maintenance procedures since the centerline of New Jersey Turnpike does not change often.
8. Routable Network – No
9. Standard symbology – No

Database Information

1. Current GIS Database – ArcView .dbf files. Some event data is in paper some in other PC databases
2. Enterprise-wide Information Processing Environment – Mainframe
3. Centerline Road Attribution – None currently. Eventually they need to place a lot of information but currently don't have any. They are currently working on all parcels within 200' of NJT ROW. They have also mapped all bridges (x,y) and utilities that cross the ROW as a point feature with milepost as an attribute.
4. Attribute Data Entry Validation – None
5. Events/Distributed Attributes Placed on Centerline – None at this point. Utilities and Bridges could become events if NJT moves towards LRS
6. Linear Referencing Method – None
7. Address Ranges – No
8. Parcel Layer – Mapping all parcels within 200 feet of the Turnpike right-of-way.

Interoperability/Data Sharing

1. Conflation – No
2. Cooperation With Other Government Organizations – Currently getting data from NJDEP. They believe in the past that they have received information from NJDOT.
3. Cooperation With Utilities – No
4. Current GIS Data Users – Engineering Department

5. Data Distribution Policy – No but would like to see what is available
6. GIS Wish List – Ability to get more information from NJDOT
7. Transportation Modeling – No

Interview Discussion

The New Jersey Turnpike Authority's Engineering Department has collected via a consultant, a GPS accurate road centerline file of the Turnpike. The Engineering Department is responsible for the maintenance of geographic and attribute data related to the Turnpike but the information directly linked to the Turnpike and its spatial geometry changes little over time. Currently no attribute information is being placed along the road centerline although it is realized that a substantial amount of information could be placed along the road in the future. At this point in time New Jersey Turnpike is mapping all parcels within 200 feet of the ROW and has bridge and utility locations both as x,y point features.

The New Jersey Turnpike Authority continues to interact with various government and private entities including New Jersey DEP for GIS data. The New Jersey Turnpike Authority desires future coordination with NJDOT because not only do they have attribute information about the Turnpike but they also have expertise in linear referencing systems (LRS). A mitigating issue in this regard is that NJDOT uses Intergraph and New Jersey Turnpike uses ESRI. With today's technology this should be relatively simple to overcome not like it has been in the past.

Evaluation

On the basis of the interview session the following evaluation has been developed regarding various parameters related to GIS application for transportation planning:

Linework Quality – The linework collected and maintained by New Jersey Turnpike is spatially accurate and due to its limited nature does not require much overall maintenance.

Database Quality – Currently there is no attribution directly linked to the New Jersey Turnpike centerline. The New Jersey Turnpike Authority needs to establish a linear referencing system (LRS) so that multiple linear referencing methods (LRM's) could be used in the future to place information along the centerline. Examples would be to use a route_id and x,y to place bridges and perhaps route_id/milepost to place some of their other information

Overall Status of Transportation GIS – In general, it is apparent that the New Jersey Turnpike Authority is just beginning to take advantage of what GIS-T can offer to them. This functionality could most likely be broadened and enhanced through a more cooperative effort with NJDOT's GIS Section.

Potential for Contributing Data to a Regional Model – The assessment of the information gathered for NJ Turnpike indicates a relatively limited potential for contributing relevant data to a regional transportation planning database at this point in their GIS development process.

Stage Designation

Based on the foregoing summary information, New Jersey Turnpike's, road centerline development has been designated as a "Stage 2" implementation.

New Jersey Transit Corporation

Interview Summary

General Information

1. Responsible Agency for GIS – GIS Unit of Planning Dept.
2. GIS Software Vendor – Intergraph
3. GIS Software – MGE/MGSM - GeoMedia
4. Computer Hardware – Intel Windows NT (Desktop), Windows NT (Server)
5. Metadata – No
6. GIS Strategic Plan – Yes

Centerline Information

1. Road Centerlines – Yes, licensed from NavTech Corporation
2. Level of Detail – Every road in the New Jersey TRANSIT service territory
3. Approximate Centerline Scale – Centerlines are generated by NavTech, which uses a variety of compilation methods.
4. Map Projection – NAD 1983 New Jersey State Plane
5. Creator of Centerlines – Navigation Technologies
6. Unique Road Identifier – Street Names and address ranges
7. Maintenance – New Jersey TRANSIT purchases quarterly updates from NavTech
8. Routable Network – Yes
9. Standard symbology – Yes, all roads have standard feature definition.

Database Information

1. Current GIS Database – Oracle 8.1.6
2. Enterprise-wide Information Processing Environment – Oracle 8.1.6
3. Centerline Road Attribution – Street names, address ranges, as well as routing information like one-way, turns and overpass/underpass
4. Attribute Data Entry Validation – NavTech has strict controls on street information
5. Events/Distributed Attributes Placed on Centerline – New Jersey TRANSIT is using GIS to manage their bus routes and bus route patterns
6. Linear Referencing Method – Street name and addresses
7. Address Ranges – Yes
8. Parcel Layer – N/A

Interoperability/Data Sharing

1. Conflation – No
2. Cooperation With Other Government Organizations – New Jersey TRANSIT regularly shares data with other agencies
3. Cooperation With Utilities – N/A
4. Current GIS Data Users – Numerous groups within New Jersey TRANSIT
5. Data Distribution Policy – Cannot share licensed road information but could share bus routes and patterns.
6. GIS Wish List – None at this time
7. Transportation Modeling – No

Interview Discussion

An accurate and maintained source of road centerline data is critical for GIS applications at New Jersey TRANSIT. Instead of trying to maintain the data in-house or to gather the centerlines from the vast number of jurisdictions that make up the New Jersey TRANSIT bus route system, they have instead opted to license a commercial centerline product. This product, developed by Navigation Technologies (NavTech), helps to ensure that New Jersey TRANSIT's centerlines and address ranges are accurate and up to date. New Jersey TRANSIT receives centerline and attribution updates four times a year. Their licensing agreement prohibits New Jersey TRANSIT from sharing NavTech's data.

New Jersey TRANSIT is currently engaged in significant data development programs that include geocoding and maintaining agency bus routes, and mapping bus stop locations using GPS. Major applications supported by bus route GIS data include the agency's paratransit system and Automatic Passenger Counter application.

New Jersey TRANSIT regularly participates in New Jersey's State Mapping Advisory Committee as well as New Jersey state government GIS coordination efforts spearheaded by the state's CIO.

Evaluation

On the basis of the interview session the following evaluation has been developed regarding various parameters related to GIS application for transportation planning:

Linework Quality – The New Jersey TRANSIT centerline data is of very high quality, but it is not owned by New Jersey TRANSIT. It is licensed from Navigation Technologies (NavTech)

Database Quality – The GIS Section has developed and continues to maintain GIS attribute databases that are designed for their bus route planning application.

Overall Status of Transportation GIS – The GIS Section's data development efforts are nearing completion, They are focusing their efforts on supporting operations and service planning, customer information and vehicle locating applications and ongoing maintenance of the database.

Potential for Contributing Data to a Regional Model – The assessment of the information gathered for New Jersey TRANSIT indicates a moderate potential for contributing relevant data to a regional transportation planning database. The company is little interested in participating in an "open" exchange of data throughout the DVRPC region. New Jersey Transit acknowledges that there would likely be significant limitations to the effectiveness of data exchange caused primarily by the proliferation of independently developed commercial and governmentally sponsored spatial data. New Jersey TRANSIT advocates the advancement of data interoperability standards and techniques to effectively relate and exchange data between data sets.

Stage Designation

Based on the foregoing summary information, New Jersey Transit's road centerline development has been designated as a "Stage 2" implementation.

Pennsylvania Department of Transportation

Interview Summary

General Information

1. Responsible Agency for GIS – GIS at PennDOT Geographic Information Section within the Bureau of Planning and Research.
2. GIS Software Vendor – Intergraph
3. GIS Software – MGE/MGSM – GeoMedia, GeoMedia Professional, GeoMedia Web Map.
4. Computer Hardware – Intel Windows NT (Desktop), Windows NT (Server)
5. Metadata – Not federally compliant metadata but they do provide basic metadata for all of the GIS information that they provide to the PASDA site. Currently they are awaiting a metadata tool from Penn State/PASDA. Internally, PennDOT has comprehensive and complete data dictionaries with a web-based HTML interface to access the data dictionary information.
6. GIS Strategic Plan – Yes, it is in its second version.

Centerline Information

1. Road Centerlines – Yes, all State- Maintained roads are represented as a single road centerline except on divided highways. PennDOT manages the parallel segments of divided highways as though they are separate roadways.
2. Level of Detail – The State- Maintained Highway Network and other roads that are part of the National Highway System (NHS) in Pennsylvania
3. Approximate Centerline Scale – Nominally 1:24,00 scale. The original road centerlines were digitized about 10 years ago from USGS quad sheets. There are some efforts underway to increase the spatial accuracy of the road centerlines by visually adjusting the linework to some existing digital orthophotos.
4. Map Projection – polyconic, NAD83 units in decimal degrees
5. Creator of Centerlines –Completed in-house at PennDOT
6. Unique Road Identifier – Contiguous segments of state routes have the same unique and arbitrary NLF_ID. Discontinuous portions of a route will have distinct NLD_ID's. When new road segments are added they are assigned an existing or a new NLF_ID depending upon the route and location on the route. Occasionally, a new NLF_ID is assigned by a GIS Technician.
7. Maintenance – The GIS Section is responsible for maintaining this information. The actual changes to the road network (new road segments, modifications to existing segments or deletions to old segments) are made on the mainframe in the Roadway Maintenance System (RMS). Once the changes are made in RMS they are downloaded from the mainframe to the GIS Oracle database. At this point, a unique NLF_ID is assigned or deleted, if required, and the GIS staff makes the required changes to PennDOT graphics files. New LRS coordinate files are created for the appropriate county, district and State. All changes are completed within 10 working days.
8. Routable Network – No
9. Standard symbology – Yes, all roads have standard feature definition. For plotting, these standard feature definitions are modified via the use of an I/Plot Pen Table. This is all controlled by the use of the pen tables that PennDOT distributes to all of its GIS users.

Database Information

1. Current GIS Database – Oracle 8.0.4
2. Enterprise-wide Information Processing Environment – Most attribute information or operational information is still on the mainframe and is collected and entered into the mainframe DB2 or ISAM database files. The GIS Section, acting as a data warehouse, extracts and transforms the data in the Oracle 8.0.4 database for GIS.
3. Centerline Road Attribution – NLF_ID, County, SR, Segment, Segment Length information
4. Attribute Data Entry Validation – Data validation occurs when data is entered into the operational mainframe database.
5. Events/Distributed Attributes Placed on Centerline – Currently over 40 different tables are placed dynamically along the road centerlines. These tables include Capital Projects, Traffic Information, Pavement Information, Crash data etc.
6. Linear Referencing Method – Currently PennDOT uses a Route (NLF_ID) and the combination of County, State Route, Segment and Offset.
7. Address Ranges – No Address Information
8. Parcel Layer – No

Interoperability/Data Sharing

1. Conflation – No
2. Cooperation With Other Government Organizations – PennDOT data is available through PASDA and shares data with numerous State and Local government agencies.
3. Cooperation With Utilities – None
4. Current GIS Data Users – Used by numerous groups within the DOT. GIS is now available in each of PennDOT's District Offices and they are now moving GIS down to the county level
5. Data Distribution Policy – Yes
6. GIS Wish List – Updated Municipal Boundaries and local road accident data.
7. Transportation Modeling – No

Interview Discussion

The GIS Section at PennDOT has developed a mature and stable GIS-T environment. The GIS Section maintains a geographically accurate road centerline file at 1:24,000 scale for the roads that it needs to report and maintain. The GIS Section is responsible for the maintenance of geographic and attribute data related to the road centerlines. Current efforts to increase the spatial accuracy of the road centerline is underway at PennDOT.

The DOT through the use of dynamic segmentation is able to link a tremendous amount of the DOT's operational data to the road centerline network. Accidents, Pavement Information, Construction Project Data, Traffic Count Information and Functional Class Code are just a few of the over 40 tables of information currently being utilized within PennDOT. PennDOT also allows the individual Districts to add dynamic segmentation distributed attribute (event) tables into the system at the local level.

PennDOT continues to interact with various government and private entities. The DOT desires future coordination with organizations to acquire data such as bus routes, local accidents and updates to municipal boundaries. There is a great need to take some of the vast information that the DOT has and be able to easily transfer that information to local governments.

Evaluation

On the basis of the interview session and subsequent data samples that were obtained from PennDOT, the following evaluation has been developed regarding various parameters related to GIS applications for transportation planning:

Linework Quality – This is PennDOT's weakest link. The spatial accuracy of PennDOT's centerline, while adequate for PennDOT, is of limited value to local governments.. It would be useful to DVRPC to help PennDOT increase the spatial accuracy of their linework for District 6.

Database Quality – The DOT, through the use of dynamic segmentation, is able to link a tremendous amount of the DOT's operational data to the road centerline network. Accidents, Pavement Information, Construction Project Data, Traffic Count Information and Functional Class Code are just a few of the over 40 tables of information currently being utilized. The extraction and transformation of data from the operational databases on the mainframe to the GIS Oracle database is a well- designed approach. Data validation and data entry occurs on the mainframe relieving the GIS Section from these tasks.

Overall Status of Transportation GIS –Current and well-defined data maintenance and update procedures. The quality and quantity of attribute information is well prepared the most significant issue with PennDOT data is the poor spatial resolution of the centerline file for local government use.

Potential for Contributing Data to a Regional Model – The assessment of the information gathered for PennDOT indicates great potential for contributing relevant data to a regional transportation planning database. This conclusion is based upon the following factors:

- The GIS Section has developed and is actively maintaining a geographically accurate and relatively attribute-rich centerline file.
- PennDOT is actively utilizing available spatial and attribute data to support transportation planning activities and processes.
- Overall there is an enthusiastic, positive and proactive attitude among management and staff in PennDOT towards the productive utilization of GIS and the maintenance of the data that are required to support it.

Stage Designation

Based on the foregoing summary information, PennDOT's road centerline development has been designated as a "Stage 4" implementation. This is primarily due to the existence of an LRS measure.

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Pennsylvania Turnpike Commission

Interview Summary

General Information

1. Responsible Agency for GIS – GIS at PA Turnpike is being led by the Engineering Department
2. GIS Software Vendor – ESRI
3. GIS Software – ArcView 3.2, ArcInfo 8.1
4. Computer Hardware – Intel Windows NT (Desktop), Windows NT (Server); some Windows 2000 systems
5. Metadata – No metadata at this point
6. GIS Strategic Plan – None at this point

Centerline Information

1. Road Centerlines – Yes, developed by a consultant, using CADD files and aerial photo mosaic. Have one centerline for each direction of the Turnpike
2. Level of Detail – Turnpike Only
3. Approximate Centerline Scale – 1"=2,000'
4. Map Projection – PA State Plane South Zone 83 Feet
5. Creator of Centerlines – Consultant
6. Unique Road Identifier – Route, milepost
7. Maintenance – Centerline is maintained by the Engineering Department using CADD software. ArcInfo route structure is built by IT group. Revisions are rare due to minor changes.
8. Routable Network – Yes. ESRI ArcInfo route structure
9. Standard symbology – No

Database Information

1. Current GIS Database – Oracle, SQL Server and FoxPro.
2. Enterprise-wide Information Processing Environment – None
3. Centerline Road Attribution – Route and milepost.
4. Attribute Data Entry Validation – None
5. Events/Distributed Attributes Placed on Centerline – Bridges, capital planning, collision analysis, facilities, U-turn locations, interchanges and service plazas. Placed dynamically along the centerline using route and milepost.
6. Linear Referencing Method – Route and milepost
7. Address Ranges – No
8. Parcel Layer – No.

Interoperability/Data Sharing

1. Conflation – No
2. Cooperation With Other Government Organizations – Currently sharing data with local agencies, and PennDOT.
3. Cooperation With Utilities – No
4. Current GIS Data Users – Engineering Department
5. Data Distribution Policy – No
6. GIS Wish List – Ability to get more information from PennDOT

7. Transportation Modeling – No

Interview Discussion

The Pennsylvania Turnpike Commission's Engineering Department has collected via a consultant, an accurate road centerline file of the Turnpike. The Engineering Department is responsible for the maintenance of geographic and attribute data related to the Turnpike. Currently significant attribute information is being placed along the road centerline.

The Pennsylvania Turnpike commission is in the process of developing GIS as a management tool. A highly accurate centerline has been developed with an LRS measure (route-milepost) incorporated into it. The commission utilizes consultants to provide assistance in developing and utilizing the system and the database. They have developed an Executive Decision Support System that uses the GIS data and software to provide managers with up-to-date information and map displays.

Evaluation

On the basis of the interview session the following evaluation has been developed regarding various parameters related to GIS application for transportation planning:

Linework Quality – The linework collected and maintained by The Pennsylvania Turnpike Commission is spatially accurate and due to its limited nature does not require much overall maintenance. The Commission uses a route-milepost LRS.

Database Quality – Currently there is significant attribution directly linked to the Pennsylvania Turnpike centerline. Specific information regarding these attributes can be found in the foregoing Interview Summary section.

Overall Status of Transportation GIS – In general, it is apparent that the Pennsylvania Turnpike Commission is taking advantage of what GIS-T can offer to them.

Potential for Contributing Data to a Regional Model – The assessment of the information gathered for NJ Turnpike indicates a relatively high potential for contributing relevant data to a regional transportation planning database at this point in their GIS development process.

Stage Designation

Based on the foregoing summary information, NJ Turnpike's, road centerline development has been designated as a "Stage 4" implementation. This is due to the fact that they maintain an accurate centerline with and LRS measure.

Appendix F - Individual Summary Reports Regional Agencies

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Delaware Valley Regional Planning Commission (DVRPC)

Interview Summary
General Information

1. Responsible Agency for GIS – GIS Section of Regional Planning Department
2. GIS Software Vendors and Software – ESRI, ArcInfo 8.1, ArcView and ArcIMS. Intergraph MGE modules. Bentley Microstation is used for cartography and I/plot for plotting.
3. Computer Hardware – Intel based PCs and NT servers. Web server (2 separate boxes) running ArcIMS; GIS file server running Oracle, enterprise server running corporate database in Oracle; Output devices include plotters, CD writers, etc.
4. Metadata – Yes. It is not FGDC compliant, but follows PASDA requirements
5. GIS Strategic Plan – No. Looking to this project to produce information that can be used in a plan.
6. Network Operating System – Windows NT

Centerline Information

1. Road Centerlines – Yes. The single centerline represents both the north/east bound and south/west bound directions unless in some cases where there is a large separation between the north/east bound and south/west bound lanes and then there are actually two centerlines.
2. Level of Detail – All roads in the region.
3. Approximate Centerline Scale – The road centerlines are digitized off of USGS Quad Sheets 1:24000 scale (1985-1995). Every five years roads are added. There currently is a need for an update for Year 2000. These are CAD files with no attribution. Microstation levels are used to distinguish features. DVPRC is looking for perhaps a way to update without having to actually create a whole new set of year 2000 files. DVRPC would like to make their centerline files compatible with their new imagery base possibly by obtaining their member government centerline files.
4. Map Projection – NJ State Plane NAD27; NAD83 for orthophotos; also UTM for regionwide data
5. Creator of Centerlines – DVRPC started 15 years ago by digitizing centerlines off of USGS Quad Sheets.
6. Maintenance – The GIS group is in charge of maintaining this information for GIS. The revision process is basically a five-year updating policy but if data sharing could be implemented the data could be kept up to date easier and more often.
7. Topology on Centerline – Not on GIS data. Transportation modelers use schematic network.
8. Routable Network – No. (Schematic only)
9. Standard symbology – Yes all roads do have a standard feature definition. At plot time these standard feature definitions are modified via the use of an I/Plot Pen Table. For example an Interstate road could be a solid red line on level 4 of the CAD file but at plot time the line could be plotted out as a dotted line that is heavy green. This is all controlled by the use of the pen tables created by the GIS group.
10. Linear Referencing System (LRS) – DOT data only. DVRPC does not have one for own data.
11. Point, Polygon Data – Traffic counts, Census data, land use

Database Information

1. Current GIS Database – The GIS section is using INFO as part of the ESRI software suite Oracle for MGE. This group is working towards the eventual migration of all INFO data to Oracle. Other groups are using Microsoft ACCESS.
2. Enterprise-wide Information Processing Environment – Agency-wide data is maintained in Oracle 8.1.6 (demographics, traffic counts, etc.)
3. Attribute Data Entry Validation – no
4. Events/Distributed Attributes Stored in Database – PennDOT, NJDOT, some data sets from local governments.
5. Linear Referencing Method – none
6. Unique identifier – No
7. Data dictionary - No

Interoperability/Data Sharing

1. Integration of different scaled data – No. Tried it, but it gave erroneous results.
2. Conflation – See Number 1, above.
3. Cooperation With Other Government Organizations – Yes. NJDOT CMS, pavement and bridge data; Data dumps from PennDOT District 6; various data from municipalities and counties.
4. Current GIS Data Users – Counties request and use traffic data, land use information. Produces custom maps for public and private customers; distributes coordinate files that can be imported for use in other programs.
5. Data Distribution Policy – Fees are charged, depending upon the requestor. Consultants may obtain data for free as long as it is part of their contract agreement.
6. GIS Wish List – Traffic signal data, more DOT data, City of Philadelphia, transit routes, etc.
7. Cooperation With Utilities – Nothing currently. Some activity in the past.
8. Transportation Modeling – Modeling currently done with schematic network model that is not a GIS layer. Planners see advantage to using a model that is integral part of GIS database.
9. Applications/Customers Reliant on GIS Data – None at this time
10. Map Production – Map production required to support annual work plan. Produced Type 10 maps previously produced.
11. Required Maps That Cannot Currently be Produced – None
12. How is DOT Data Received – PennDOT- Oracle dump files; NJDOT – variety of formats
13. Any Requirements for Data Delivery to Federal Government – Traffic counts and HPMS data.
14. Future Access to GIS via Internet/Intranet/Extranet – Yes. Some is available now, view only via ArcIMS. DVRPC is considering eCommerce options.
15. Development/Maintenance of Web-based System – Map server is separate from Web server. APIs – Java 2.3, Oracle 8I, Homesite 4.5, Photoshop.

Interview Discussion

The Delaware Valley Regional Planning Commission (DVRPC) serves as the Metropolitan Planning Organization (MPO) for the Philadelphia Metropolitan Area. In order to support required activities and functions related to the agency's core responsibilities, DVRPC has adopted a number of advanced technologies including a geographic information system (GIS). By implementing a GIS, DVRPC has been able to enhance and extend the analytical capabilities of its technical staff, while also providing a framework for creating and maintaining regional-scale digital mapping.

Representatives from several DVRPC departments participated in the interview process. As the interview progressed, it became quite obvious that DVRPC has a wide variety of functions and responsibilities for conducting transportation planning throughout the region and supporting planning efforts that occur at the local government level.

DVRPC has been developing, maintaining and using GIS for over 15 years. The initial GIS was developed using Intergraph Modular GIS Environment (MGE) software. Beginning in 1965, DVRPC has captured aerial photography for the entire region on a five-year cycle. Subsequent flights were done in 1990 and 1995. In 2000, this project was upgraded to black and white digital orthophotgraphy.

Also beginning in 1990, in conjunction with the aerial photography, DVRPC developed and has been updating a regional land use layer. In 1985, DVRPC digitized a street centerline file using USGS quadrangle maps. In 1990, this data was updated using the 1990 uncorrected aerial photography. This update process was carried out again in 1995, using the uncorrected photography that was captured that year. This is the current centerline file being used by DVRPC. This file was created as a CAD file with no attribution relevant to transportation planning.

DVRPC is in the process of scaling back their Intergraph GIS while phasing in ESRI Software. The host software is ArcInfo 8x, with most end users using ArcView 3.2 on their desktops. ESRI ArcIMS software is being used to develop a public access web site. Some initial uses for this site include the dissemination of information such as traffic count data and project information for the Transportation Improvement Program (TIP).

DVRPC's computer hardware resources include Intel-based desktop computers running the Windows NT operating system. The current servers are also running Windows NT. The GIS server stores the geography files as MicroStation design files, Oracle for MGE attributes, ArcInfo coverages and the attribute data is stored in INFO. In the near future, the INFO data will be migrated to Oracle. The DVRPC corporate database is maintained in Oracle and is about to be moved to a new enterprise class server. There is a web server to support the web site and there is a separate map server on which the ArcIMS applications are being developed. Graphic output is produced with two Hewlett Packard DesignJet plotters. DVRPC has purchased a high-capacity CD writer.

At this time, DVRPC's GIS is managed by the GIS Section of Regional Planning Department. This group manages the primary data files including the land use layer, the road centerline and other types of geography files used to support planning efforts, such as Census geography. Other entities within DVRPC create data and this data typically remains with the user, but, in some instances, it may be added to the DVRPC database.

As mentioned previously, the primary datasets produced and maintained by DVRPC are the land use and centerline layers. In 2001, the black and white digital orthophotography is being added. Other spatial and attribute data used by DVRPC are obtained from external sources. PennDOT's District 6 office provides data dumps of the Department's Intergraph MGE ands Oracle data.

Primary users of GIS outside of the GIS Department include the Transportation Section. This group makes significant use of data provided by the Departments of Transportation of Pennsylvania and New Jersey. Most of the end users in this Section use ArcView to analyze and map the DOT data. Their available tools include custom ArcView software extensions developed specifically for use with the DOT data.

There are other potential users of GIS within DVRPC who do not currently use the technology for a variety of reasons. Most notable among these are the engineers and planners who perform the traffic modeling that supports transportation planning throughout the region. This modeling effort utilizes specialized software (TRANPLAN) and a regional transportation network model. This model is a schematic representation of the region's road network that lacks the geographic and geometric accuracy of the street centerline file. A program known as VIPER is used to maintain the network model.

In addition to its internal operations, DVRPC also exchanges data with a variety of entities throughout the region. Most of the local government organizations that were interviewed for this project cited DVRPC as their primary source of transportation and traffic related data such as traffic counts, demographic data and travel survey information. In turn, DVRPC staff cited a number of local entities from which they obtain data including the DOT's , Burlington and Camden Counties in New Jersey, and regional transit agencies. There has been limited success in exchanging data with the City of Philadelphia.

DVRPC management and staff have cited a number of critical needs with regard to the use of GIS for transportation planning. Among these are:

- For its internal users, there is a need to integrate the modeling functions with the GIS.
- The current centerline file needs to be updated and attributed. DVRPC needs a plan for accomplishing this.
- There is a critical need for more detailed information about what its member local governments are doing with GIS.
- A higher level of cooperation for data sharing needs to be established with the City of Philadelphia. Most attempts to exchange data have been unsuccessful, due in part to the City's lack of a clear distribution policy.
- DVRPC needs to take greater advantage of current and emerging technologies, such as the Internet and web-enabled GIS to more effectively disseminate information to its customers.

All of the characteristics of this agency point to a critical need to take advantage of all appropriate technologies that may be available. There also exists an acute need for sharing resources—such as data—across a broad spectrum of both suppliers and end users. By developing business processes and data models that are supported by technology-driven tools and resources, significantly improved levels of delivery of both products and services will be attainable.

Evaluation

On the basis of the interview session with DVRPC and a review of sample data provided by the agency, the following evaluation has been developed regarding various parameters related to GIS application for transportation planning:

Linework Quality – While DVRPC has developed and maintains an accurate regional road centerline file, the file has no significant attribution, and, as such, provides little support for transportation planning applications. The agency does maintain a schematic regional network that is used with specialized software for transportation modeling and forecasting. The integration of the GIS centerline file into the modeling and forecasting environment is a critical need. Future database design of the road centerline file will need to take this fact into careful consideration.

Database Quality – As revealed through the interview process, DVRPC maintains and utilizes a wide variety of data. A large percentage of this information is spatial in nature and its value and usefulness

could be greatly enhanced through GIS applications. Establishing effective ways to share this information throughout the region by using GIS and related technologies is critical.

Overall Status of Transportation GIS – While DVRPC serves as the principle agency for transportation planning for the Philadelphia region and is the primary source for transportation-related data, there remains a gap between the GIS operations and the transportation planning operations. One desired goal for this project will be to bridge this gap through greater involvement in GIS development and utilization throughout the region.

Potential for Contributing Data to a Regional Model – DVRPC has a relatively high potential for contributing data to a regional transportation planning model. As a major generator and consumer of these types of data, it is absolutely essential that DVRPC's contribution be facilitated. This fact is further emphasized by the fact that there are a large number of DVRPC data customers throughout the region. Any model that is developed that does not include DVRPC-generated data will be meaningless.

Stage Designation

Based on the foregoing summary information, DVRPC's road centerline development has been designated as a "Stage 2" implementation. This designation is based on the existence of a road centerline file with no LRS measure. By creating a centerline with appropriate attribution to establish relationships to existing databases and an LRS measure, DVRPC can considerably expand the potential use of GIS for transportation planning throughout the region.

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Southeastern Pennsylvania Transportation Authority (SEPTA)

Interview Summary

General Information

7. Responsible Agency for GIS – Service Planning Department; used by Service Planning, and other departments within Customer Service, Paratransit, Division of Capital Design and Construction, Operations Support, and Operations
8. GIS Software Vendor – ESRI, Caliper
9. GIS Software – ArcView 3.2 and TransCAD
10. Computer Hardware – Intel based workstations
11. Metadata – None
12. GIS Strategic Plan – No

Centerline Information

1. Road Centerlines – No
2. Level of Detail – n/a
3. Approximate Centerline Scale – n/a
4. Map Projection – n/a
5. Creator of Centerlines – n/a
6. Unique Road Identifier – n/a
7. Maintenance – n/a
8. Routable Network – n/a
9. Standard symbology – n/a

Database Information

9. Current GIS Database – none
10. Enterprise-wide Information Processing Environment – Oracle
11. Plans for Migrating GIS Data to Enterprise Database - Possibly
12. Attribute Data Entry Validation – no
13. Events/Distributed Attributes Stored in Database – Transit stop info, survey and Census data
14. Linear Referencing Method – none
15. Unique identifier – No
16. Data dictionary - No

Interoperability/Data Sharing

8. Conflation – No.
9. Cooperation With Other Government Organizations – No
10. Cooperation With Utilities – No
11. Current GIS Data Users – None
12. Data Distribution Policy – No
13. GIS Wish List – Base map, all relevant PennDOT data; needs to know what is available
14. Transportation Modeling – Uses TransCAD (more for data maintenance instead of actual modeling)

Interview Discussion

The Southeastern Pennsylvania Transportation Authority (SEPTA) is a major public transportation service provider operating primarily in the Pennsylvania portion of DVRPC's service area. This agency operates a variety of transit systems.

Up to this point, SEPTA has not significantly utilized GIS for transportation planning. They are in the initial stages of a process aimed at more effective use of the technology, so this DVRPC effort is timely. Staff members within the Service Planning Division possess experience and capabilities in GIS and are leading this effort. Their knowledge base is solid and the support they appear to be receiving from management should help in this effort.

SEPTA has some requirements for a transportation planning GIS that are unique from most of the other participating agencies and government organizations. Given the variety of services that they provide and the types of facilities and modes of transportation that they operate, their data requirements are quite diverse. SEPTA's data requirements include ridership information, transit stop locations, transit routes, construction project locations, vehicle weight restrictions, level of service on transit routes etc. While much of this data is available in various formats, the ability to maintain and utilize it within an operational, enterprise GIS would significantly enhance the agency's services and capabilities to provide services.

SEPTA's requirements for transportation geography are equally unique. While an accurate and complete road centerline is essential, SEPTA also requires rail features as part of its GIS database. Attribute data would need to include traffic impedance factors, expressway/local road designations, overpass/underpass indicators, and vehicle weight restrictions. The staff feels that a street centerline file would need to be structured so that there is a single centerline for each direction or, at least, the system would need to provide the capability to dynamically create directionality on a single centerline base.

SEPTA is very interested in the prospect of being able to share data among other government agencies within the region and at the State level. They also see a critical need to possess the capability for integrating their GIS with legacy databases and systems, including TransCAD and Trapeze, their scheduling software.

Evaluation

On the basis of the interview session with SEPTA, the following evaluation has been developed regarding various parameters related to GIS application for transportation planning:

Linework Quality – SEPTA does not presently maintain or utilize a comprehensive linear GIS database. There exists some isolated applications, using ETAK and other types of data, but these typically have no significant potential as a foundation for the development of a transportation planning GIS.

Database Quality – Aside from some TransCAD data and the Trapeze scheduling software database, here currently are no extensive databases for transportation planning being used and maintained by SEPTA.

Overall Status of Transportation GIS – At this time, there is no substantial transportation GIS in operation within the SEPTA organization.

Potential for Contributing Data to a Regional Model – While not being able to contribute significant GIS information to a regional model, many of the other organizations that were interviewed expressed interest in obtaining whatever data that SEPTA has to offer.

Stage Designation

Based on the foregoing summary information, SEPTA's road centerline development has been designated as a "Stage 1" implementation. This designation is based on the non-existence of a road/rail centerline file.

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Delaware River Port Authority of Pennsylvania and New Jersey and Port Authority Transit Corporation

Interview Summary

General Information

1. Responsible Agency for GIS – Engineering
2. GIS Software Vendor – ESRI
3. GIS Software – ArcView 3.2
4. Computer Hardware – Compaq DeskPRO (Desktop), Compaq Prolinear, Sun, HP (Server), HP, Oce Plotters, CDOM and Zip Drives
5. Metadata – No
6. GIS Strategic Plan – No

Centerline Information

1. Road Centerlines – No. Data is primarily land parcel based
2. Level of Detail – n/a
3. Approximate Centerline Scale – n/a.
4. Map Projection – Unknown
5. Creator of Centerlines – n/a
6. Unique Road Identifier – n/a
7. Maintenance – Maintained by the Engineering Department
8. Routable Network – n/a
9. Standard symbology – Used for parcel data.

Database Information

1. Current GIS Database – Engineering uses .dbf files in ArcView; IS uses NT SQL
2. Enterprise-wide Information Processing Environment – Solaris OS, Oracle RDBMS
3. Centerline Road Attribution – n/a
4. Attribute Data Entry Validation – Yes. This is being done in the engineering Department
5. Events/Distributed Attributes Placed on Centerline – n/a
6. Linear Referencing Method – n/a
7. Address Ranges – n/a
8. Parcel Layer – Yes. This is the primary GIS database.

Interoperability/Data Sharing

1. Conflation – No
2. Cooperation With Other Government Organizations – No
3. Cooperation With Utilities – No
4. Current GIS Data Users – Staff assigned to Gateway Project from the Engineering or Regional Development Divisions
5. Data Distribution Policy – No.
6. GIS Wish List – None at this time
7. Transportation Modeling – No

Interview Discussion

Due to scheduling conflicts, an actual onsite interview was not held with the Delaware River Port Authority (DRPA) and Port Authority Transit Corporation (PATCO). However, there were a few telephone conversations and the agency did respond via email with written responses to the interview questionnaire. The following discussion is based upon that response and some follow-up telephone conversations.

The DRPA is a regional transportation and economic development agency serving the people of Southeastern Pennsylvania and southern New Jersey. DRPA owns and operates the Benjamin Franklin, Walt Whitman, Commodore Barry, and Betsy Ross bridges. Through a subsidiary, PATCO, DRPA runs the PATCO Speedline, a 14.2 mile rail line operating between Lindenwold, New Jersey and Center City Philadelphia. The Speedline has 9 stations in New Jersey and 4 stations in Philadelphia. Train service began February 15, 1969.

The limited GIS activity that has occurred with DRPA and PATCO is coordinated for both agencies through a single entity, the DRPA Engineering Division. Personnel from that Division provided most of the information contained in this report. Based on the information provided, it is apparent that while DRPA does use GIS technology, this utilization is focused more on land management applications associated with specific projects such as "The Gateway to New Jersey" along Admiral Wilson Boulevard., than on agency-wide transportation applications. The primary database is composed of vector polygons of land parcels located within the project area with attributes relating primarily to various characteristics of those parcels. There is no road centerline file being used either for the special project or the agencies' overall operations and no apparent requirement for one. It is conceivable that DRPA may wish to incorporate road and rail centerline data in the future to assist in managing their bridges and the PATCO line. Also, there may, at some time, be a need for obtaining and using event data such as crash locations in a GIS.

Evaluation

On the basis of the interview session the following evaluation has been developed regarding various parameters related to GIS application for transportation planning:

Linework Quality – DRPA/PATCO does not currently use or maintain a road centerline file.

Database Quality – The GIS database currently in use is related primarily to parcels of land that are located within the project area of "The Gateway to New Jersey" project.

Overall Status of Transportation GIS – There is no general Transportation GIS being developed, maintained or used by DRPA/PATCO.

Potential for Contributing Data to a Regional Model – The assessment of the information gathered for DRPA/PATCO indicates no existing files for contributing to a regional transportation planning database.

Stage Designation

Based on the foregoing summary information, DRPA/PATCO's road centerline development has been designated as a "Stage 1" implementation. This is primarily due to the lack of a road centerline file.

Region-wide Transportation GIS Project Design and File Architecture
Volume I – Needs Assessment Summary

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ABSTRACT
The primary purpose of this project is to assure that DVRPC, it's member city and county governments, and transportation operating agencies have a GIS and data files that can be developed and shared with each other to facilitate better transportation planning analysis and decision-making. This report, divided into five volumes, serves as the foundation to establish the operational framework for these efforts.

Volume I – Needs Assessment Summary takes an in-depth look at street centerline data models, existing centerline files, and existing transportation databases currently in use in the region. Also addressed are database design, metadata, street addressing, and symbology issues. This information was gathered by interviewing each participating organization and a summary for each is included in an appendix.

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