DEVELOPING AND APPLYING A TRANSPORTATION MODEL FOR AQUIDNECK ISLAND, RHODE ISLAND

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16. Abstract

This research project focuses on Aquidneck Island in the State of Rhode Island. The research project has two primary objectives. First, the project builds the foundation for coordinated transportation and land use planning on Aquidneck Island using TransCAD 4.5. Specifically, the project focuses on two case studies on the island to demonstrate and test the application of TransCAD travel demand forecasting model and its effectiveness in addressing the impacts of land use changes and new development on the transportation network. Second, the project expanded the capabilities of the University of Rhode Island in the areas of transportation planning and modeling using TransCAD.

The report is divided into several sections. First, the report presents a profile of the island and its three municipalities of Newport, Middletown and Portsmouth. This is followed by an overview of the Aquidneck Island travel demand forecasting model developed by the Louis Berger Group. Next, the report presents the application of the TransCAD travel demand model in the two case studies on the island. The report ends with conclusions from the analyses of the case studies and a list of recommendations for the future use of the Aquidneck Island travel demand model, including suggestions for the refinement of the model.

It is concluded that TransCAD was more applicable for regional use and analysis. A comprehensive traffic problem-solving approach should also utilize a micro-level intersection analysis software package. The connection between the model and the land uses was primarily based on employment and population projections. Therefore, additional models would be needed to estimate future employment and population in the study area. The model does not include seasonal traffic information. This has major impact on resort areas such as the City of Newport. The model does not include information on alternative modes of transportation in addition to driving. Lastly, the calibration of the model performed prior to the model's use by this study needed additional verification; for example one-way streets in Newport were not included. Based on the findings of this study, the model will be corrected and refined in the future. The application of TransCAD and the model will require support from the three municipalities on the island. Long term, the application of the travel demand model will provide a unique opportunity to address the impacts of land use changes and new development on the transportation network of the island. The model can improve the patterns of development throughout the island by educating the decision makers on the impacts proposed developments have on the land and the road network.

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1. INTRODUCTION

The orientation of public policy on land use and transportation planning in the U.S. has changed significantly in the past. Until the 1930s, land development and urban transportation were integrated for the purpose of creating compact communities that were pedestrian and transit oriented. Since then, and specifically since 1945, planning for land use and development has often been done apart and separate from planning for transportation. Land use planning has generally been done at the local level while planning for transportation has mostly been done at the regional and state levels. Transportation planning based on the automobile means there is little reason to have coordinated land use as automobile linkages can be assumed to any development anywhere. This has promoted a low-density, sprawl pattern of development in the urban and suburban areas. Automobile-dependent development is directly responsible for the mobility and air quality problems that currently beset many large urban and suburban areas in the U.S.

Urban and suburban sprawl has caused numerous problems. These include jobs and housing imbalances; rising land and housing costs; diminishing open space; air, water and land pollution; overburdened infrastructure; severe traffic congestion along with long commutes; and absence of community life. Moreover, sprawl has hindered the development of other modes of transportation such as walking, biking, ridesharing and public transit as it is designed for automobiles. This is one of the fundamental causes of the exponential growth in traffic and the resulting air pollution in urban and suburban areas over time. It is argued that the public policy on land use and transportation planning must be reoriented and linked to manage growth and promote a balanced pattern of development if it is to deal with the above problems.

There is a widening recognition that land and transportation are complex, highly interrelated systems. "Transportation exists to overcome geographic discrepancies in resources, goods and services by moving material, people or information between where things are and where things are wanted. By overcoming these geographic discrepancies for certain locations and regions, transportation systems dramatically alter accessibility. This in turn influences travel demands and eventually land-use patterns, creating new and sometimes unintended outcomes" (1). Geographic Information Systems for transportation (GIS-T) such as TransCAD provide an important technical tool for public land-use and transportation planning and decision-making. "By allowing a wide range of information to be integrated based on location, GIS-T fosters a holistic perspective on complex land-use and transportation problems. GIS-T allows analytical and computational tools to be used in conjunction with detailed representations of the local geography, allowing analysis and problem-solving to be tailored to the local context. GIS-T can also greatly reduce the gulf between analysis and communication, allowing greater public input into analytical decisions such as choice of data, modeling assumptions and scenario development. This could lead to greater public acceptance of transportation decisions. GIS-T can also make transportation information more accessible, potentially enhancing location and transportation decision-making by the public-at-large and encouraging wider participation in the transportation planning process" (1).

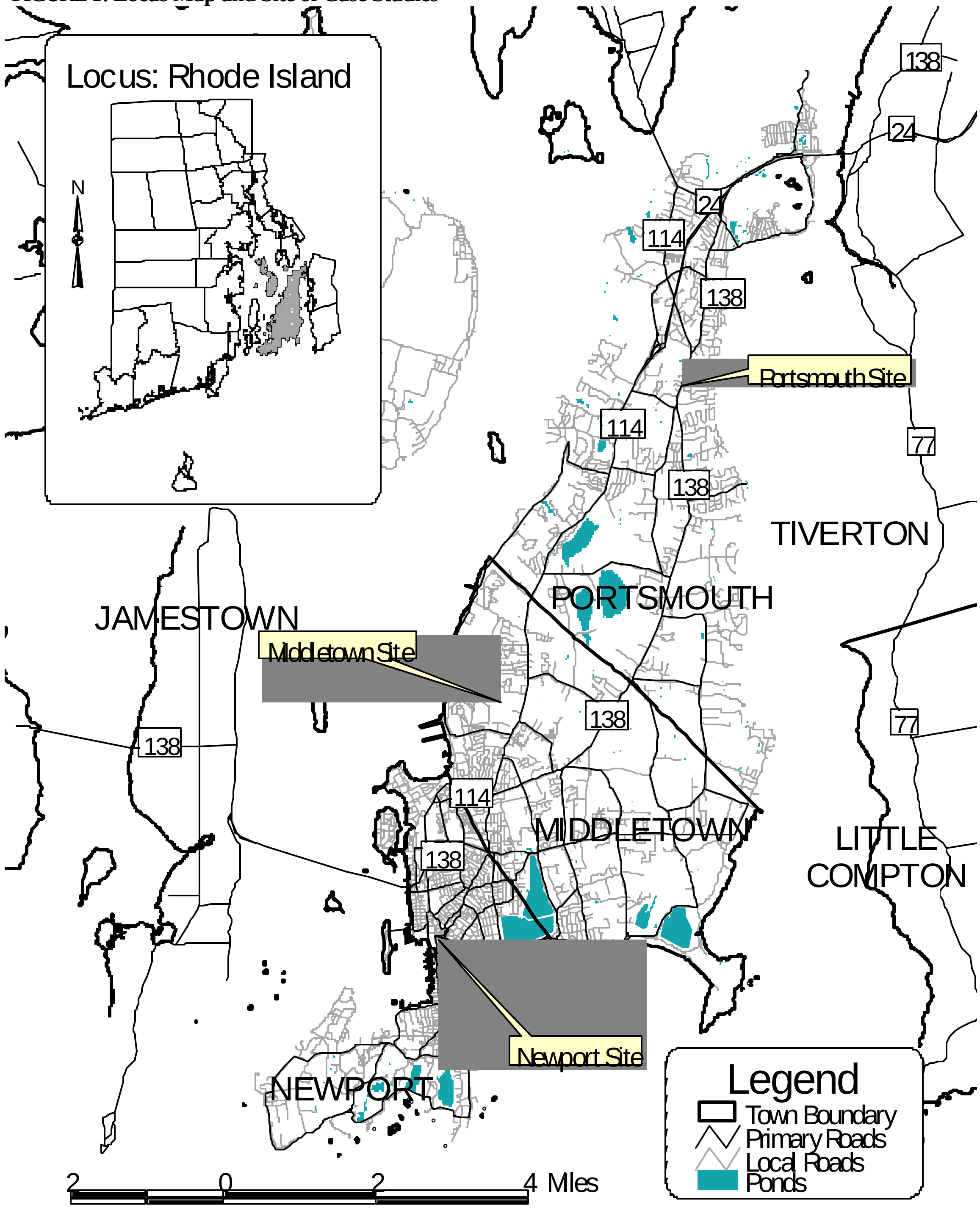
This research project focuses on Aquidneck Island in the State of Rhode Island (see Figure 1). Using TransCAD, the study applies the travel demand forecasting model developed for the island to demonstrate its potential applications in transportation planning. TransCAD is the one of the Geographic Information Systems designed specifically for use by transportation professionals to store, display, manage, and analyze transportation data (see Appendix I). TransCAD combines GIS and transportation modeling capabilities in a single integrated platform. TransCAD can be used for all modes of transportation, at any geographic scale or level of detail. Also, it has applications for all types of transportation data and is ideal for building transportation information and decision support systems. TransCAD runs on readily available hardware and embraces virtually all desktop-computing standards. Therefore, it can be purchased and installed at a much lower cost than any other integrated GIS and transportation modeling solution (2).

Aquidneck Island's marine environment is unique to Rhode Island because of its dependence on tourism and defense economy, its reliance on access to the West Bay from three bridges and ferry services, and its level of impact on Narragansett Bay when making land use decisions. Aquidneck Island is home to the communities of Newport, Middletown, Portsmouth and Naval Station Newport. Past development patterns and population growth have contributed to a congested road network, costly road maintenance projects and inconsistent land use decisions based on limited knowledge of the regional transportation network.

During the past four years Aquidneck Island has invested time and resources into supporting island-wide cooperation with the staffing and promotion of the Aquidneck Island Planning Commission (AIPC), a nonprofit municipal planning commission. The development of a TransCAD travel demand forecasting model by Louis Berger Group (LBG) is the first tangible product the AIPC has delivered to the island communities. As a continuation of this effort, the AIPC in partnership with the URI Department of Community Planning and Landscape Architecture (CPLA) utilized the Aquidneck Island TransCAD-based travel demand model to measure the impacts of alternative proposed developments on the island's existing transportation network. Specifically, the AIPC and CPLA, referred to here on after as "the team" selected three case studies on the island, where proposed developments will include complex land use decisions and transportation improvements, to demonstrate and test the application of the travel demand model and its effectiveness in addressing the impacts of new development and land use changes on the transportation network (see Figure 1). Also, the team provided the communities with realistic examples of how and why TransCAD and the travel demand forecasting model can improve the patterns of development and growth along the island's travel corridors.

The findings of this research project will be important for the promotion of the travel demand model as a tool for Aquidneck Island to use as part of the daily decision-

FIGURE 1. Locus Map and Site of Case Studies



making processes regarding transportation and land use. Also, the findings of the project will provide the support and commitment for adopting land use and zoning regulations that will help to reduce the impact of development on the transportation network, encourage development patterns that support "smart growth" planning strategies and protect the marine environment that is the foundation for the quality of life on Aquidneck

Island. By creating a team of professionals with the capability of researching data, testing case studies and reporting findings to the communities, the AIPC will be in a unique position to promote further municipal support for applying the travel demand model in the future.

Rhode Island Statewide Planning Program (RISPP) and the Rhode Island Department of Transportation (RIDOT) have played a key role in promoting travel demand modeling statewide. In 1997, Louis Berger Group prepared the Rhode Island Statewide Travel Demand Forecasting Model under contract to the Rhode Island Department of Transportation. The Rhode Island State Model facilitates the State of Rhode Island's compliance with air quality and congestion management requirements set forth by the 1990 Clean Air Act Amendments (CAAA) and the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991. The initial use of the RI State Model was to evaluate Rhode Island's Transportation Improvement Program (TIP) to determine project conformity to requirements of the CAAA. Later the model was used in different studies such as corridor planning, traffic management, strategic planning, high occupancy vehicle (HOV) studies, testing of travel demand management (TDM), transportation system management (TSM) strategies, project level modeling, testing land-use scenarios and other congestion management system (CMS) strategies.

RISPP and the van Beuren Charitable Foundation funded the development of the Aquidneck Island travel demand model in order to provide a tool for planners and engineers to promote and enhance regional coordination of transportation and land use planning. RISPP and RIDOT are monitoring the progress of the Aquidneck Island travel demand model project and applying the findings of it to a statewide planning strategy for travel corridors. As part of the AIPC's three-year work plan, the three island communities would like to foster an ongoing relationship with RISPP and RIDOT to become the pilot area for testing many of the planning concepts for travel corridors. Having the TransCAD travel demand forecasting model in place, case studies tested and analyzed, and published findings on the use and refinement of the Aquidneck Island travel demand model; Aquidneck Island will promote the usefulness and importance of continued coordination of land use and transportation planning in the State of Rhode Island in the future.

The partnership between the University of Rhode Island, the RISPP and RIDOT and three Rhode Island communities will encourage continued support for integrated systems management within a regional framework that includes multiple modes of transportation. Without the experience and financial resources the University offered, the Aquidneck Island Planning Commission did not have the opportunity to promote an extensive analysis of the TransCAD application and the usefulness of the travel demand forecasting model for land use decisions because of limited funding and staff resources.

Lastly, this research project will expand the capacity of the University of Rhode Island in the area of transportation by providing a living classroom for faculty and students to test the application and usefulness of the TransCAD software. Specifically, the team used the funding support from the URI Transportation Center to purchase and install TransCAD for the use of students and faculty at URI Department of Community Planning and Landscape Architecture. The research results will expand the University's expertise and capacity in transportation modeling programs and the use of TransCAD to link transportation and land use planning at the regional level.

2. RESEARCH PROJECT OBJECTIVES AND SIGNIFICANCE

This research project has two primary objectives. First, the project builds the foundation for coordinated transportation and land use planning on Aquidneck Island using TransCAD 4.5. Specifically, the team selected three case studies on the island to demonstrate and test the application of the TransCAD travel demand forecasting model and its effectiveness in addressing the impacts of land use changes and new development on the transportation network. Also, the team provided the communities with realistic examples of how and why the travel demand model can improve the patterns of development and growth along the island's travel corridors. Second, the project expanded the capabilities of the University of Rhode Island in the areas of transportation planning and modeling using TransCAD.

The findings of this project will be useful to promote the continued support for regional transportation planning on Aquidneck Island and throughout the state. Also, the project will foster a partnership between the AIPC, he URI Department of Community Planning and Landscape Architecture, and the URI Transportation Center to promote transportation planning and modeling at the University in the future.

3. RESEARCH PROJECT METHODOLOGY AND OUTLINE

The team conducted the following tasks to accomplish its two primary objectives. Graduate research assistant involvement was incorporated into every task. All tasks relied heavily on the graduate students' knowledge of GIS systems, research experience, and presentation skills. The tasks were also designed to enhance the capabilities of the Department of Community Planning and Landscape Architecture with the TransCAD, to promote the AIPC's travel demand modeling project, and to build the foundation for a continuing partnership between the University, Rhode Island municipalities and Rhode Island state agencies.

Task One: TransCAD Training

The TransCAD training was conducted in two phases. First, the CO-PIs and two graduate research assistants participated in the TransCAD training sessions on October 16 and 17, 2002. The Louis Berger Group (LBG), the consultant that developed the Aquidneck Island travel demand forecasting model, conducted the two-day training sessions in their offices in Massachusetts. The training covered transportation modeling theory, demonstration of Aquidneck Travel Demand Model, and the application of the TransCAD. Second, on July 16, 2003, the LBG provided another training session for the Aquidneck Island municipal planners at the University of Rhode Island to cover

TransCAD basics and advanced functions of the program using the island's travel demand model and the case studies identified for this project.

Task Two: Review Current Literature

The literature review was conducted at two levels. First, the team collected and reviewed the literature on the application of TransCAD at local and regional levels. Second, the team reviewed the related reports on Aquidneck Island and its three municipalities.

Task Three: Identify Case Studies

The team interviewed municipal planners to identify the major upcoming development projects for the island. The team then reviewed these projects and assessed their land use and transportation complexity and the number of people that are impacted by them. Based on this assessment, the team chose one case study in each community in order to demonstrate the application of the TransCAD travel demand model.

Task Four: Inventory and Data Input

The team inventoried existing land use, transportation facilities and services at the site of each case study. The type of information that were collected included but were not limited to traffic counts, survey data, applicable zoning and subdivision regulations, public facilities available at each site, sensitive environmental resources in the area, and detailed information about each proposed project.

Task Five: Analysis and Findings

The team analyzed the data using the travel demand model and the local regulatory framework in which each case study must conform to (i.e. zoning and subdivision regulations). TransCAD fully integrates GIS and planning tools for trip generation, trip distribution, mode split modeling, and traffic assignment. The findings of the analysis documented the impact of the proposed case studies on the transportation network in Aquidneck Island.

Outline of the Report

The report is divided into several sections. Following this introduction, the report presents a profile of the island and its three municipalities. Next, the report provides an overview of the Aquidneck Island travel demand forecasting model developed by LBG. Then the report presents the application of the TransCAD travel demand model in the case studies on the island. The report ends with conclusions drawn from the analyses of the case studies and a list of recommendations for the future use of the Aquidneck Island travel demand model, including suggestions for the refinement of the model. Appendix I summarizes the capabilities of TransCAD and its application in transportation planning using the current literature.

4. A PROFILE OF AQUIDNECK ISLAND

Aquidneck Island is located in the state of Rhode Island and is about 45 square miles. It is approximately 70 miles south of Boston and 180 miles northeast of New York City. It is connected to the state by three bridges, two of which are located at its north end and one at its southwest end and a commuter ferry service operating from Providence to Newport. The island has three political jurisdictions: the City of Newport and the towns of Middletown and Portsmouth. It is also a part of Newport County, which also includes the towns of Jamestown, Little Compton and Tiverton.

The history of the island is oriented to maritime and farming uses, which continue to this day, although many farms have been converted to subdivisions. The Navy maintains a large presence on the island and is the state's second largest employer. While farming provided subsistence, the maritime trades brought much wealth and national attention to the island, including the City of Newport. The towns of Middletown, in the mid-section, and Portsmouth, to the north, comprise the balance of the Aquidneck Island geography. Portsmouth is mostly a bedroom community with a steadily growing population while Middletown has the bulk of the larger commercial properties on the island, such as office parks and shopping centers.

4.1 Population

Aquidneck Island's resident population peaked in 1970 with 76,883 people. In 1973, reorganization by the U.S. Navy reduced the number of employees at Newport Naval Base by more than 14,000. This reorganization led to a 21 percent decrease in the island's population by 1980, meaning the population dropped to 60,811 by 1980. The population of the island slowly increased during the 1980s for a growth rate of 6.1 percent for the decade to reach to 64,544 by 1990. Population growth on the island between 1980 and 1990 was significantly higher than the statewide growth rate of 5.9 percent (3). In the early 1990s, a regional and state recession was accompanied by job and population losses on Aquidneck Island. Overall, there was a 5.5 percent population decrease during the decade. The total population reached to 60,958 in 2000.

Newport lost 15.3 percent of its population during the Navy reorganization in the early 1970s. By 1980s, the population was 29,258. After 1980, Newport's population continued to decline to 28,227 in 1990, a 3.5 percent loss during the 1980s. The 2000 census accounted the population of Newport at 26,475.

Among the three Aquidneck Island communities, the 1973 Navy reorganization had the largest impact on Middletown, which lost more than 12,500 people or 42.1 percent of its population between 1970 and 1980. The town's population declined from 29,800 in 1970 to 17,251 in 1980. The population grew by 12.8 percent during the 1980s to reach to 19,460 in 1990. By 2000, the population of Middletown was 17,334.

Portsmouth is the only island community that did not lose population when the Navy reorganized. The town actually grew by 14.2 percent in the 1970s as population increased from 12,521 in 1970 to 14,302 in 1980. The population continued to grow with an increase of 17.9 percent in the 1980s as the population reached to 16,857 by 1990. By 2000, the population of the town had reached to 17,149.

Aquidneck Island has a significant transient population consisting of tourists, vacationers, boaters, and people on business. Accurate data on seasonal population changes does not exist. Seasonal population growth is most significant in Newport.

4.2 Land Use

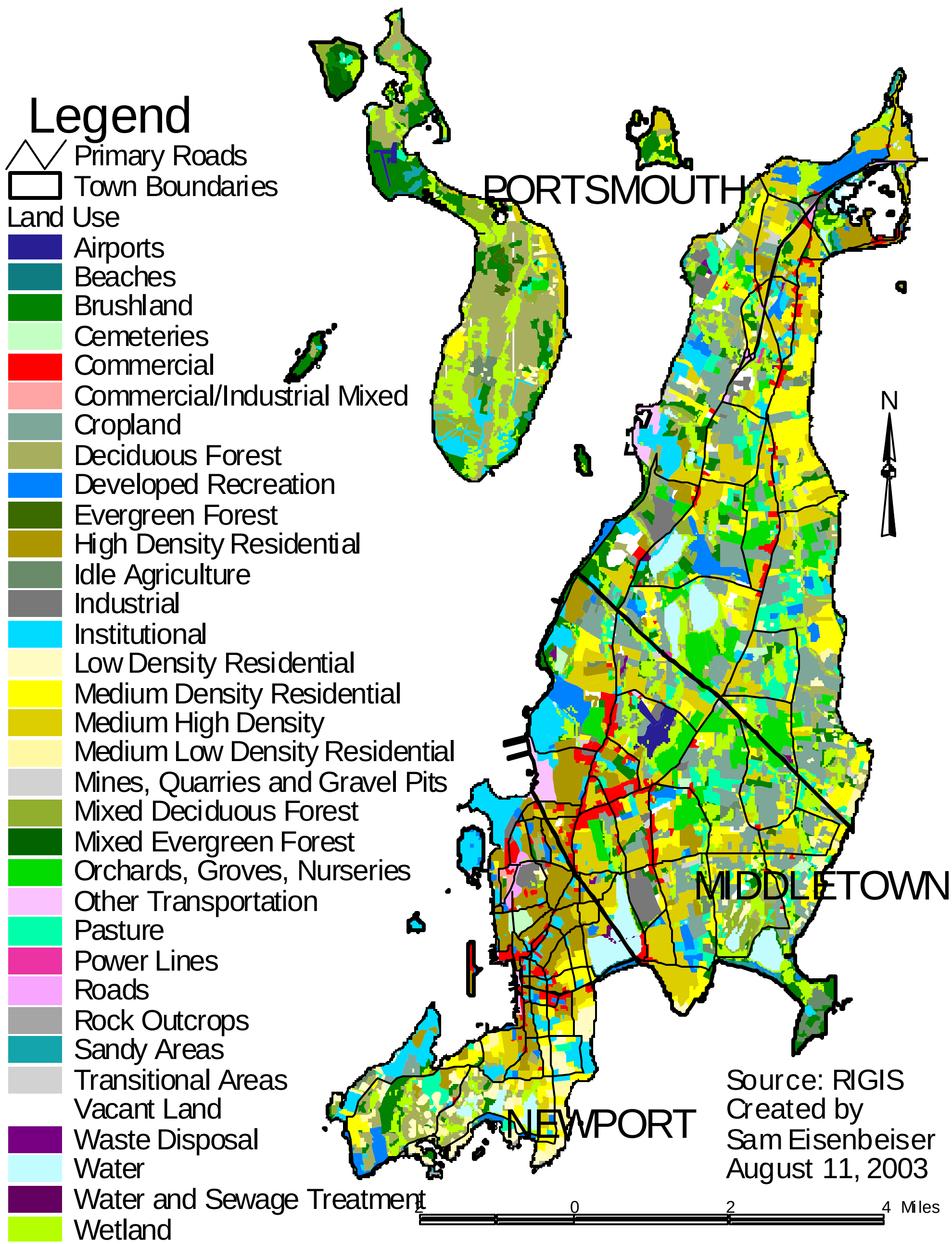
Aquidneck Island is 28,605 acres or about 45 square miles, which is four percent of the total area of the State of Rhode Island. Newport contains 18 percent (5,095 acres or about 8 square miles) of the island's area. Middletown contains 29 percent (8,427 acres or about 13 square miles) of the island's area. Portsmouth contains the largest extent of acreage at 15,083 acres or about 24 square miles, meaning 53 percent of the total area of the island. Figure 2 shows the land use pattern of the island. Of the entire island area, only 561 acres, or 2 percent, is surface water in the form of lakes, ponds, and reservoirs (3).

Based on the 1995 Rhode Island Geographical Information System data, 46 percent of the total area of Aquidneck Island, 13,041 acres, could be considered already developed. This left 54 percent of the total land area, or 15,564 acres, in an undeveloped state. Of the undeveloped land, 33 percent (5,073 acres; 18 percent of total island area) was in agricultural use and 32 percent (5,022 acres; 18 percent of total island area) was in a wooded state. Of the undeveloped lands, 4,179 acres (27 percent of the undeveloped acres and 15 percent of total acres) could be considered to be constrained to further development due to the presence of surface water, wetlands, rocky areas, beaches, or sandy areas. As a further constraint to future development, 3,613 acres (23 percent of undeveloped area and 14.7 percent of total area) was under some form of protection (e.g. held in federal, state or municipal or private conservation easement or trust) for conservation purposes in perpetuity.

In 1995, Newport had 3,690 acres, or 72 percent of its total area, in some form of development. This left 28 percent of the town area, or 1,405 acres, in an undeveloped state. Middletown had 4,124 acres, or 49 percent of its total area, in some form of development. The remaining 51 percent of the town area, 4,303 acres, was in an undeveloped state. Portsmouth had 5,227 acres, or 35 percent of its total area, in some form of development. This left 65 percent of town area, or 9,856 acres, in an undeveloped state.

Overall, 32 percent of Aquidneck Island was developed for residential uses. Of the 9,253 acres of residential land on the island, 69 percent were 1/8 to one-acre lot sizes, 17 percent were less than 1/8-acre lot sizes and 14 percent were greater than one-acre lot sizes. Over the period of 1988 to 1997, residential land use area increased by 11.3 percent.

Figure 2. Aquidneck Island Land Use Pattern



Aquidneck Island was 3 percent commercially developed (887 acres). From 1988 to 1997, commercial land use area increased by 1.5 percent. Newport had 5 percent (242 acres) of commercial development, which made up 27 percent of all commercial development on the island. Middletown had 5 percent (436 acres) of commercial development, which made up 49 percent of all commercial development on Aquidneck Island. Portsmouth had 1 percent (209 acres) of commercial development, which made up 24 percent of all commercial development on the island.

Aquidneck Island was 2 percent industrially developed (469 acres). Over time, from 1988 to 1997, industrial land use area increased by 8.5 percent. Newport had 5 percent (73 acres) of industrial development, which made up 16 percent of all industrial development on the island. Newport also contained 22 acres of mixed commercial/industrial land use, which was 100 percent of this mixed use on the island. Middletown had 2 percent (174 acres) of industrial development, which made up 37 percent of all industrial development on the island. Portsmouth had 1 percent (222 acres) of industrial development, which made up 47 percent of all industrial development on Aquidneck Island (3).

4.3 Economy

In 1998, there were 37,174 people working on Aquidneck Island including Navy personnel. This was a 9.6 percent decline from 1990, when the U.S. Census Bureau reported more than 41,120 people working in the island municipalities. The number of people working on the island peaked in 1988 and declined during the regional recession in the early 1990s.

In 1998, there were 11,975 private sector jobs in Newport. Peak employment in 1988 was reduced 15 percent by 1995. Newport's recovery from the early 1990s recession lagged behind the region and the state. By 1998, Newport still had 12.5 percent fewer jobs than it had during its peak in 1988.

In 1998, there were 7,791 private sector jobs in Middletown. Employment in Middletown peaked in 1988. Between 1988 and 1990, Middletown lost more than 22 percent of its private sector jobs. By 1998, most of those jobs had been replaced so that employment was only 1.9 percent below the 1988 peak.

There were 4,108 private sector jobs in Portsmouth in 1998. Portsmouth lost more than 40 percent of its private-sector jobs between 1988 and 1995. This decrease was due almost entirely to cutbacks at Raytheon. Although the number of private sector jobs has increased since 1995, the 1998 employment levels were still 32 percent below peak employment in 1988.

Between 1980 and 1998, Newport and Middletown experienced higher rates of private sector job growth than Rhode Island did. The total number of private sector jobs in Portsmouth declined during this period.

The U.S. Navy was the largest employer on Aquidneck Island with 7,885 employees in 1999. Other key employment centers include Melville Marine Industries, Raytheon, and commercial development along West Main Road. Since 1975, several major shifts have occurred in the private sector employment on the island. Employment in the service sector has increased from 29 percent to 48 percent, while manufacturing has decreased from 26 percent to 11 percent. Services, retail trade, and manufacturing dominate private sector employment on Aquidneck Island. Other industries have less than 1,000 jobs island wide.

Aquidneck Island is a small employment center with more jobs (33,000) than resident labor force (30,810) in 2000. This gives the island 7 percent of all Rhode Island jobs and payroll and 90 percent of the payroll in Newport County. Newport County is the most educated county in Rhode Island, according to the 2000 Census, with 38 percent of adults aged 25 or more holding at least a Bachelor's degree compared to 26 percent of Rhode Island adults. The Aquidneck Island population in particular has high college attainment at 41 percent. Aquidneck Island gained college graduates faster than the state in the 1990s. These demographics will help the island continue to be a favorable location for high technology industry (4).

4.4 Transportation

The transportation infrastructure on the island consists of roadways (with two major north-south arterials near capacity), a Rhode Island Public Transit Authority (RIPTA) bus line and several boat ramps. The two primary arterials are West Main Road (Route 114) and East Main Road (Route 138). Traffic volumes on Route 138 range from an AADT of approximately 15,000 at the Newport/Middletown line to approximately 27,000 at its intersection with Route 24 in Portsmouth. Route 114 carries substantial traffic volumes, ranging from an AADT of approximately 28,000 in Newport to 33,000 at the Middletown/Portsmouth line (5).

Three bridges connect the island with adjacent islands and the mainland:

- The Sakonnet River Bridge (Route 24) currently carrying about 40,000 vehicles daily (AADT) connects Portsmouth to Tiverton at the northeast end of the island.

- The Mount Hope Bridge (Route 114) carries 17,000 vehicles daily between Portsmouth and Bristol at the northwest end of the island. This is the only bridge that allows bicycle traffic.

- The Pell Bridge (Route 138), a toll bridge with 23,000 AADT, connects Newport with Jamestown on the west side of the island (5).

RIPTA bus service is provided on four routes. Route 60 provides service between downtown Newport and Providence. Route 62 serves the Thames-Spring-Towne Center area. Route 63 is a local route connecting Middletown shopping centers with the Gateway Center in Newport. Route 64 serves Newport and URI.

RIPTA implemented Newport-Providence passenger-only ferry service in June 2000. Although originally proposed to serve commuter traffic, ferry service has expanded to attract tourists as well. The Defense Highway Commuter Bike Lane, constructed in 1998 and funded by the U.S. Navy and RIDOT, is the only designated bike path on the island (5).

The Newport Chamber of Commerce estimates that between 3 and 3.5 million people visit Newport annually between May and October. Eighty-seven percent of visitors arrive in Newport via automobile. Although Middletown and Portsmouth do not attract as many visitors, they do bear the burden of carrying much of the traffic to Newport and providing many of the services required by tourists (5).

To deal with increasing transportation pressures, municipalities are implementing measures to maintain roadways, calm traffic, and encourage use of alternative modes of transportation. At the same time, they are starting to search for long-term methods to accommodate travel demands while respecting pedestrian and biker safety, heritage preservation, shoreline vistas, and other quality-of-life issues.

5. AQUIDNECK TRAVEL DEMAND FORECASTING MODEL

The Louis Berger Group, Inc. (LBG) was contracted to develop the Aquidneck Island travel demand forecasting model for Aquidneck Island Planning Commission (AIPC) using the TransCAD software package. The model includes the three municipalities of Portsmouth, Middletown and Newport (6). This part of the report provides an overview of the travel demand modeling process and its key components using the Louis Berger Group Reports titled "***Aquidneck Island Travel Demand Model***" (6) and "***Aquidneck Island Travel Demand Model Workshop: Introduction to Modeling and User Manual***" (7).

The approach to the development of the model was to extract the island communities from the Rhode Island Statewide Model (RISM) as a beginning and to upgrade and update model components and parameters as necessary to create the new model. LBG used the 2000 Census geography and data as a base to reconfigure and update traffic analysis zones (TAZ) on the island. The RISM roadway network on the island was limited to major arterials and expanded significantly for the new model (6).

The AIPC worked in partnership with the Newport County Chamber of Commerce to develop and distribute a business survey for Aquidneck Island. This survey provided information regarding employer locations as well as the categories and types of businesses on the island. The AIPC also worked with LBG to develop and distribute a small sample household survey to provide information concerning household-generated trip origins and destinations. The AIPC identified and allocated Aquidneck Island employment data to the Census Block geography (6).

5.1 Travel Demand Modeling Process

LBG utilized the standard three-step structure consisting of trip generation, trip distribution, and trip assignment modules. Prior to the development of the basic model components, several other tasks had to be accomplished: Extract a network from the Rhode Island Statewide Model (RISM); create traffic analysis zones (TAZ) from the 2000 Block Group Census geography; conduct a household characteristics and travel survey; conduct a business survey; and compile traffic count data. (6). After the data were analyzed and properly formatted, an estimate of the trips within the island and by island residents (internal-internal) was calculated through the trip generation process. A similar process was followed to estimate trips made by residents that had destinations off-island (internal-external). Lastly, trips to the island from non-residents (external-internal) and trips passing through the island (external-external) were estimated (6).

The trip distribution step estimated trip interchanges between TAZs on the island and to destinations off-island. The trip interchanges were then loaded onto the network with the trip assignment module. The final step involved the calibration of the model by comparing model assigned volumes to traffic counts and making adjustments to model components as indicated by the analysis (6). The model offers base-year data and the capability to conduct future-year forecasts for area-wide and project-specific transportation analyses.

5.2 Traffic Analysis Zones (TAZ)

Traffic analysis zones (TAZs) are the backbone of travel demand models. TAZs in Aquidneck Island coincide with the 2000 U.S. Census block groups. TAZs represent geographical areas in the model from which and to which trips are allocated. Each dwelling unit in the study area produces and attracts trips. Because of computational limitations, dwellings (or households) are aggregated into TAZs. Trips are assumed to be produced and attracted in each TAZ by a point within called a centroid. The centroid is connected to the network to allow the trips to be distributed to other TAZ centroids .

Centroid connectors must be attached to the network at points that will result in a logical distribution. Each centroid will typically have two-to-four connections to the network. Connections to the network must not be made at intersections. This would distort network loadings and cause problems if turning movements are subsequently required (7).

5.3 TAZ Selection Guidelines and Issues

Census geography typically used in the modeling process are: Blocks, Block Groups, Tracts, and Counties. The definition of TAZs is best accomplished through the application of census geography as defined in the Census Transportation Planning Package (CTPP). The CTTP data enables the user to assemble Block Groups into equivalent TAZs or to aggregate them into larger units. Splitting of census units were avoided. Natural or constructed boundaries, such as watercourses or railroad beds respectively, were considered in defining TAZs. Other considerations were homogenous land use activities, similar population densities, and special generators, such as large commercial retail or institutional land uses (7).

Key issues associated with the development of TAZs were: number of TAZs, size of each TAZ, and centroid connections. The number and size of zones generally are dependent upon the level of detail in the network to be served and the population of the study area. An important consideration is the relationship between the center of activity in the zone (centroid) and connections to the network (centroid connectors).

5.4 Network Issues

The network-building approach began with an identification of the roadways that were to be included in the system. Networks were simulated by defining segments (links) and intersections (nodes) and attaching physical and operational attributes to them. Typical attributes were link length, speed (posted limit), capacity, direction (one or two way), functional classification, traffic counts (base year), number of lanes, and area type. These data were recorded in a format consistent with the requirements of TransCAD travel demand software package. The existing network, as it is represented for the base year, was used in the calibration phase of network development. The network database was created using the databases provided by RIGIS (Rhode Island Geographic Information System) (6 and 7).

5.5 Data Requirements

Several general categories of data were needed for developing the travel demand model. Household and travel characteristics data (i.e., age, gender, income, occupation, auto availability, purpose of the trip, time of the trip, origin of the trip, destination of the trip, mode of travel) were collected using a household survey. These data were instrumental in the development of the trip production component of the trip generation step of the process. Land use activity data, generally stated in terms of employment, were required to estimate the trip attraction component of the trip generation process. The next category of data dealt with roadway system physical attributes. These data were required to construct the network. Traffic count data were collected from several sources: permanent count stations; 2000 traffic flow map from RIDOT; and special count stations throughout Aquidneck Island (6).

5.6 Model Calibration

Calibration of the model was performed to achieve an acceptable replication of ground counts. During the calibration process, LBG observed that assigned trips throughout the system were reasonable and within acceptable tolerances. In some areas of the island, total system-wide volumes were higher than ground counts. An overall reduction in trip generation rates varying between 10 percent and 15 percent was initially undertaken. Table 1 summarizes comparisons based on assigned volumes and traffic counts by facility type (6).

TABLE 1. Volume Comparison by Facility Type

Functional Class	Count Volume	Model Volume	Percent Difference	Major Arterial
Major Arterial	426,800	421,326	1.3%	10%
Minor Arterial	94,100	85,352	9.3%	15.0%
Collector	83,800	91,850	-9.6%	25.0%

Source: The Louis Berger Group, Aquidneck Island Travel Demand Model, 2002.

6. CASE STUDIES: APPLICATION AND FINDINGS

This part of the report presents the application of the travel demand model using the case studies on Aquidneck Island. The case study in Portsmouth evaluates the effects of possible roadway changes and improvements on the transportation network. The case study in Middletown evaluates the transportation effects of alternative development scenarios for a large tract of land. The case study in Newport focused on the introduction of automobile access to Long Wharf Pedestrian Mall. The Long Wharf Pedestrian Mall is located in a General Business Zone and is currently configured to allow pedestrian access only within the business area with parking lots located at the outside of the development. During the analysis, it was discovered that many of the one-way streets in Newport were designated as two-way streets in the model. Due to this problem, the analysis of the third case study could not have been completed. Therefore, the analysis and its results are not presented in the report. In order to change the direction of each road in the model to reflect the correct traffic flow in Newport, the AIPC will be continuing the development of the model beyond the end date of this research project.

6.1 Portsmouth

The town of Portsmouth is currently planning to redevelop its existing Business District into a defined Town Center near the intersection of Routes 138 and 114 to Route 24, which leads north to the Sakonnet River Bridge. The town was interested in knowing how the development of the proposed Town Center will impact traffic movement on Route 138 and what can be done to mitigate congestion. The purpose of this case study is to explore how changes in the model might impact the traffic through this congested area. The present business activities located at the site of the Town Center include two banks, a large grocery store (Clements Market), a gas station, CVS, a computer ink shop and the

Portsmouth Public Library. There is a large assisted living complex within walking distance to the area as well as three residential neighborhoods. The area captures a high volume of traffic from Route 24 that causes congestion and safety concerns during the commuting hours. The town has designated this area as the future site of the Town Center because it has the type of businesses present to encourage a community gathering area and is located in the heart of the town. In order to revitalize the area the town needs to improve traffic flow and to make changes to the roadway that would encourage pedestrian use and safety.

The following scenarios are based on the assumption that the town will need to: decrease the volume of traffic that passes through the Town Center location; provide an alternate route for traffic destined for Route 24; and reduce automobile speed as it approaches the Town Center. A Base Year 2000 scenario was provided for comparison purposes. The remaining scenarios exhibit the impact no modifications, roadway improvements and a new connector highway could have on the Town Center location if implemented.

Baseline Scenario – Year 2000

This scenario evaluates the baseline or existing conditions in the Portsmouth Business District as shown in the current model provided by Louis Berger Group. The resultant daily traffic volumes are shown in Figure 3.

No Modification Scenario – Year 2010

For comparison purposes, this scenario assumes no modifications or improvements to roadways in the study area. Population growth/decline factors for the three towns on the island are applied to reflect change in population between 2000 and 2010. Following the adjustment of the population figures of the three municipalities, the model was run. The resultant daily traffic volumes are shown in Figure 4 and represent an increase in overall traffic volume.

Gridlock Scenario – Year 2010

This scenario simulates gridlock in the study area in 2010 by lowering the travel speed on East Main Road from 50 to 25 mph. The speed limit was reduced to represent the actual travel speed in the Town Center location, which is already posted at 25 mph. During peak travel periods and commuting hours the traffic backs up for approximately ½ mile north and south from commuters trying to access Route 24 and from commuters exiting Route 24 to get on the island. It is expected that traffic not destined for the town center would circumvent the resultant congestion using Hedly Street as an alternate route. The key intersections of interest for this case study are Hedly and Route 114 (West Main Road), Hedly and 138 (East Main Road), and Turnpike Road and East Main Road. The resultant daily traffic volumes at each of these intersections are shown in Figure 5.

FIGURE 3
Baseline Scenario
Year 2000

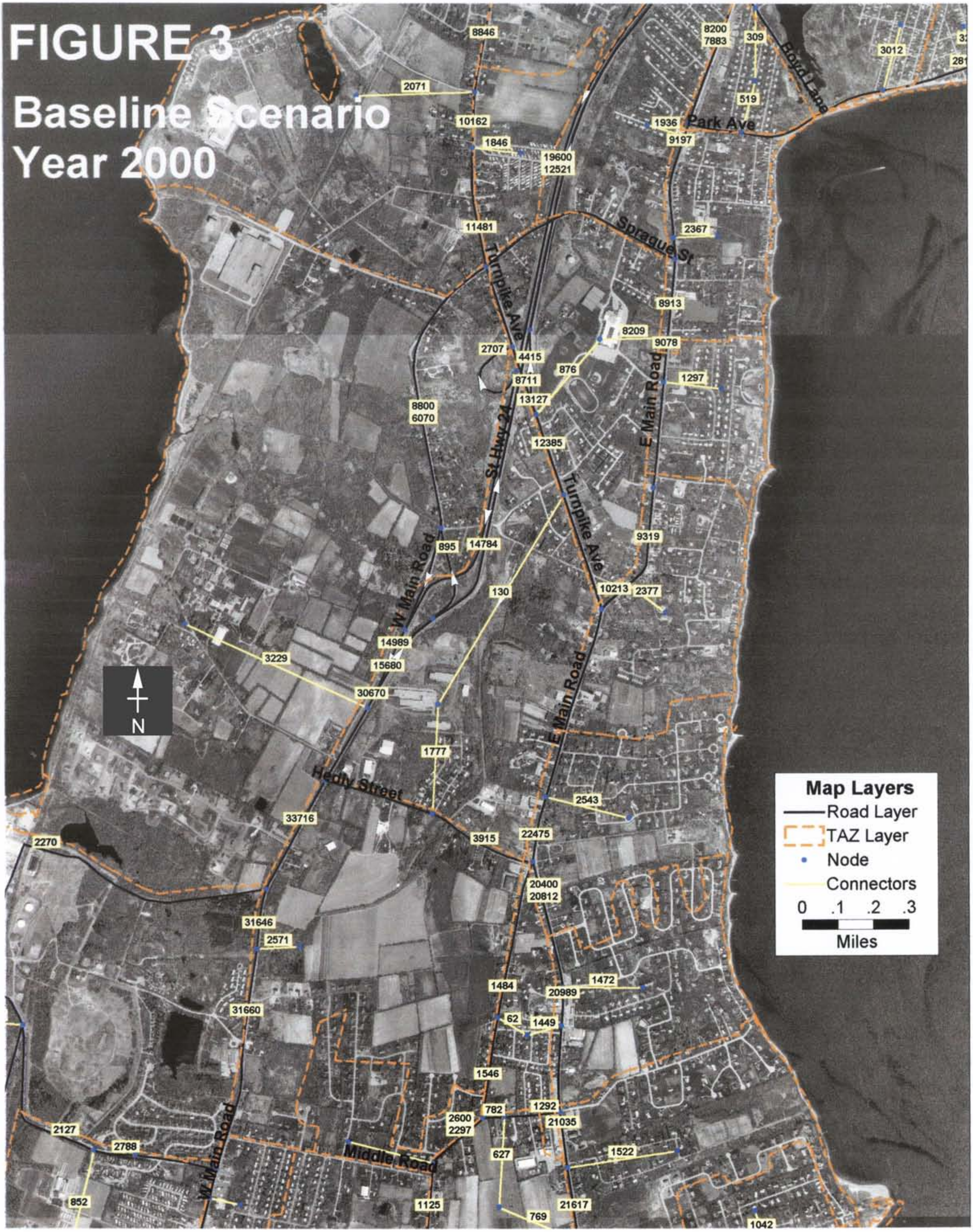


FIGURE 4
No Modification Scenario Year 2010

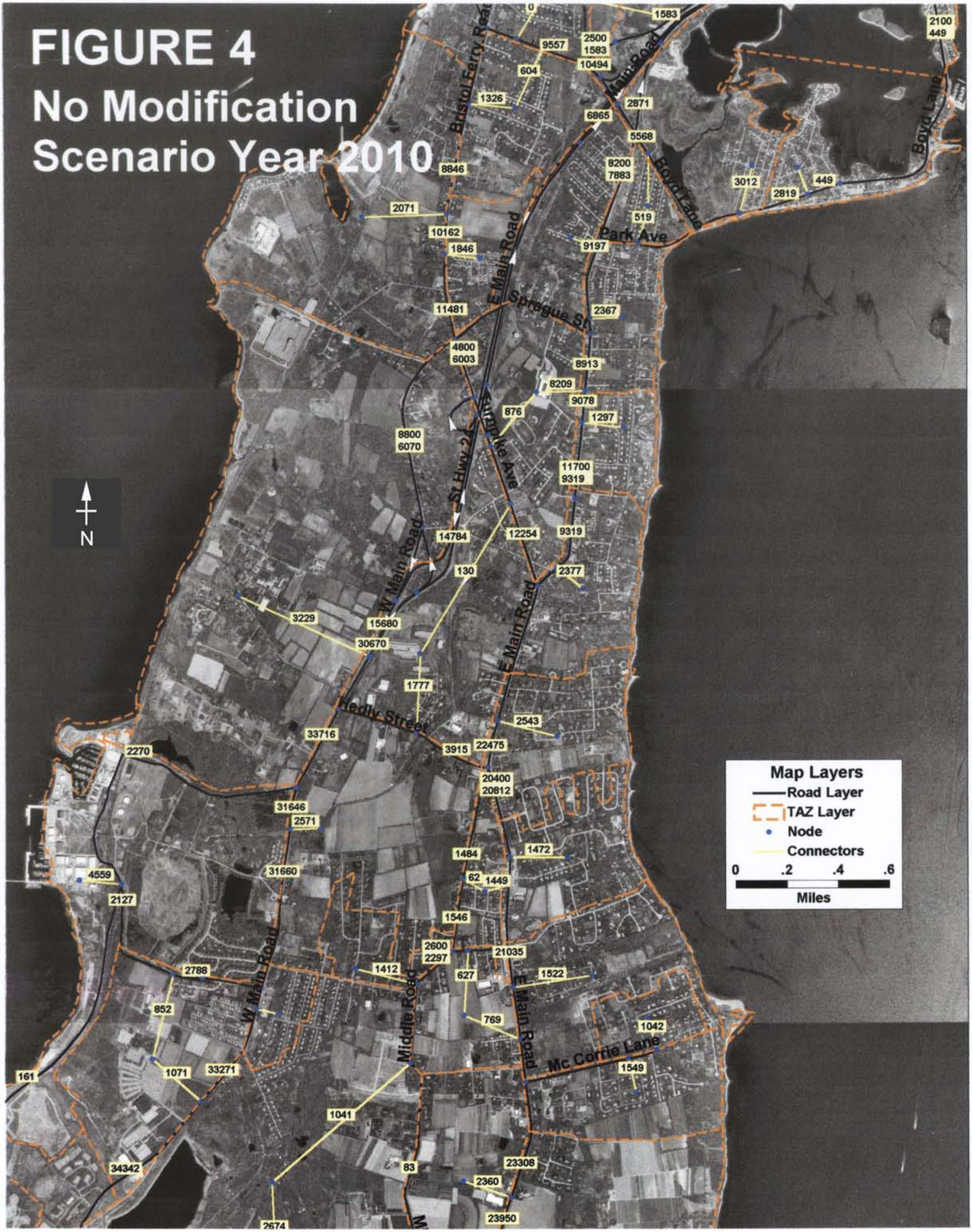
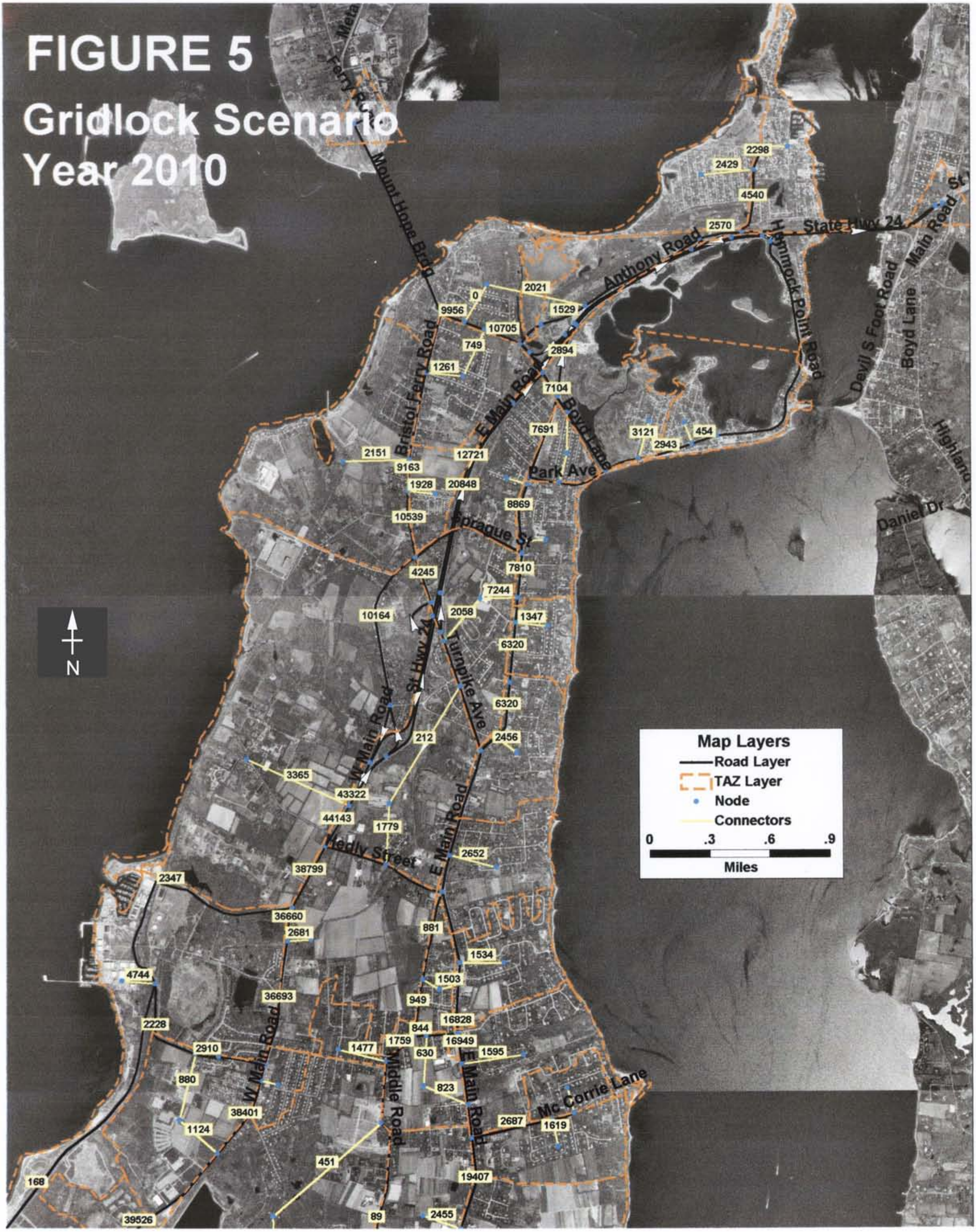


FIGURE 5
Gridlock Scenario Year 2010



In order to improve the traffic and pedestrian conditions in the Town Center area a large volume of the Year 2010 traffic would have to be re-routed to West Main Road. To re-route portions of northbound East Main Road traffic to West Main Road via Hedly Street, a number of approaches might be considered by the Town Planning Department. Some possibilities are summarized below, listed by intersection.

<u>Hedly Street at East Main Road:</u>

- Gather Community consensus
- Add a traffic signal
- Add a fifth lane to East Main Road for turning
- Or add a "P" or jughandle turn (such as those on Route 1 in South Kingstown)
- Or consider a rotary
- Change existing road signage to acknowledge the option
- Simplify this intersection by eliminating the 'triangle'

<u>Hedly Street at West Main Road:</u>

- Add a turn lane for northbound traffic with a stacking length
- Possible relocation of the Portsmouth Transfer Station
- Change in signalization (green arrow, etc.)

Southbound traffic potentially headed toward the Portsmouth Town Center is given the option, after merging with West Main Road (Route 114), of making a left turn at the Hedly Street traffic signal, and continuing their southbound journey via East Main Road. In order to facilitate this alternate route, the following approaches might be considered:

- Add a fifth lane for turning at West Main Road onto Hedly Street
- Or a "P" loop at Cory's Lane realignment for southbound turns
- Change existing road signage on Route 24, and add sign on Route 114
- Could be done in conjunction with Cory's Lane intersection realignment

Connector Scenario – Year 2010

This scenario assumes a new road (highway extension) connects Route 24 with 138 in the vicinity of Town Hall, at a point located south of the town center location. This proposed connector would serve two main purposes. First, it would divert traffic from entering the Town Center area by offering a faster more direct route to the Route 24 entrance. Second, the connector would avoid West Main Road as an alternate Route because of increasing traffic volumes created as a result of population and development growth on that roadway. It is expected that traffic not destined for the town center would choose the speedier connector as an alternate route. The key intersections of interest for this case study are the new intersections created by the connectors, and Turnpike Road (Route 24 entrance) and East Main Road. The resultant daily traffic volumes are shown in Figure 6.

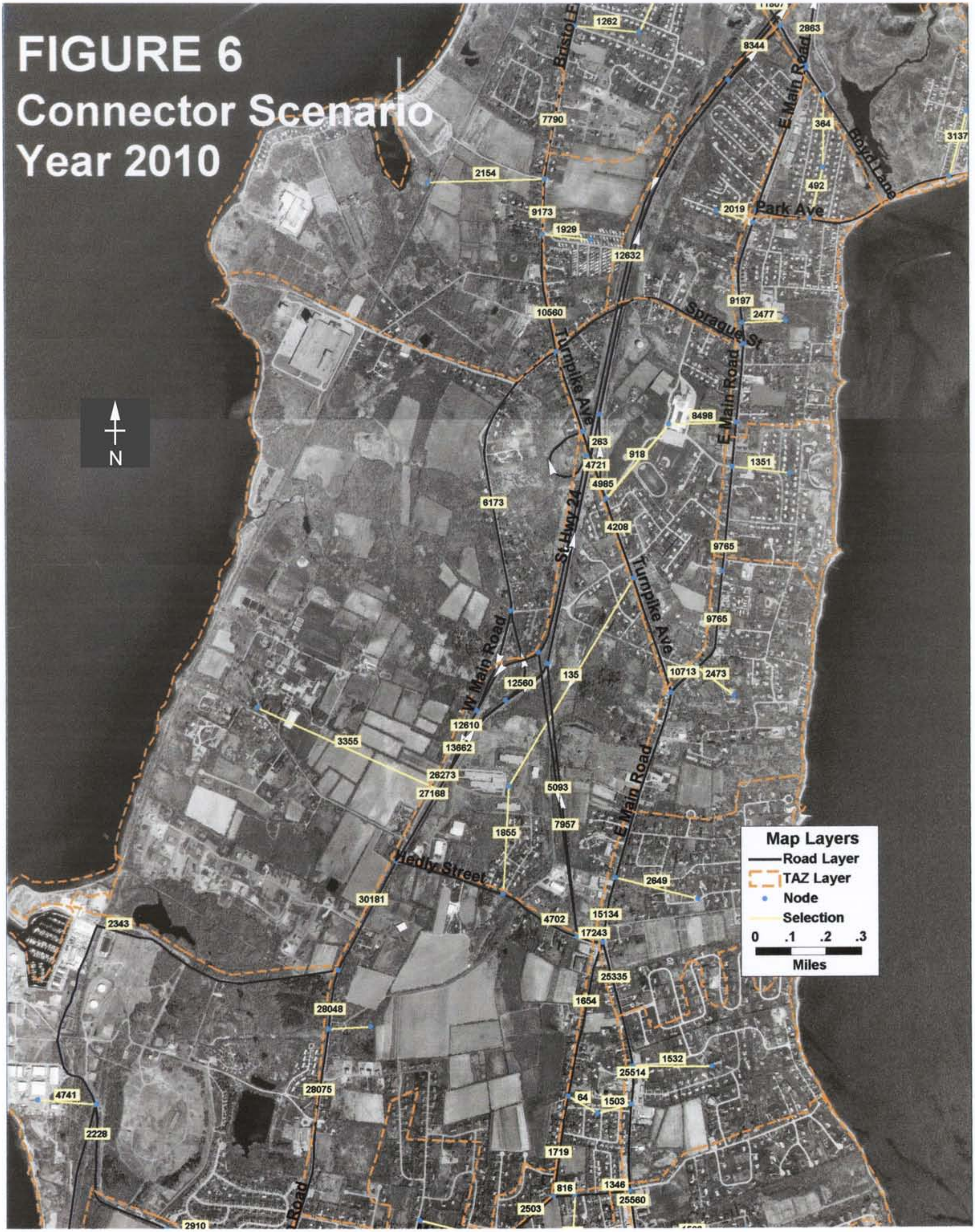


FIGURE 6
Connector Scenario
Year 2010

Connector Gridlock Scenario – Year 2010

This scenario assumes gridlock conditions in the Town Center location and that a connector highway is available for northbound traffic to avoid this gridlock. The gridlock conditions were used to measure the impact a connector could have as a release valve for traffic not destined for the Town Center location but destined for Route 24 off Turnpike Avenue. By creating gridlock conditions the effects of a connector can be measured more clearly to evaluate the prevalence of people choosing to use the connector instead of East Main Road. The resultant traffic volumes are shown in Figure 7.

Results

Two key intersections in the study area were chosen as a means of comparing the results of the scenarios. These two intersections are: East Main Road at Hedly Street and West Main Road at Hedly Street. Daily traffic volumes resulting from running the model for each scenario are summarized in the following two tables. The baseline scenario counts for the year 2000 are shown in Table 2. East Main Road handles an average daily volume of about 20,000 vehicles per day, and Hedly shows a few thousand. By the year 2010, population has been projected to increase on Aquidneck Island, with a slight corresponding increase in volumes on East Main Road and Hedly Street.

In order to simulate a 'gridlock' type scenario on East Main Road near the Town Center, model traffic speed was decreased from 50 to 25 miles per hour (the actual posted speed limit). This simultaneously diverted northbound traffic from East Main Road onto Hedly Street, the desired effect. It also diverted southbound traffic onto West Main Road, as evidenced in Table 3. About 3,000 vehicles per day are diverted from West Main Road via Hedly Street to a point on East Main Road south of the Portsmouth Town Center.

The figures and tables for these scenarios provide a comprehensive summary of the information produced by the travel demand model. The maps highlight the potential traffic volumes at key intersections as a result of various roadway improvements. The tables provide a comparison of each scenario and the ability to evaluate the results each scenario would potentially create for the Town Center location. By comparing the scenarios the town could determine the desired outcome and then analyze which scenario would be most likely to achieve this outcome.

The addition of a new high speed connector from Hedly Street to Interstate Route 24 relieves some traffic traveling northbound on East Main Road, but does little to relieve the pressure on southbound traffic, thereby negating any potential overall positive impact. The connector does not capture traffic traveling on West Main Road in either the northbound or southbound directions, therefore decreasing the overall potential of relieving traffic congestion on either West Main or East Main Roads. As a result of the travel demand model's forecast, the town must evaluate the improvements that can be made at the intersections of East Main Road with both Hedly Street and Turnpike Road.

FIGURE 7
Connector Gridlock Scenario
Year 2010

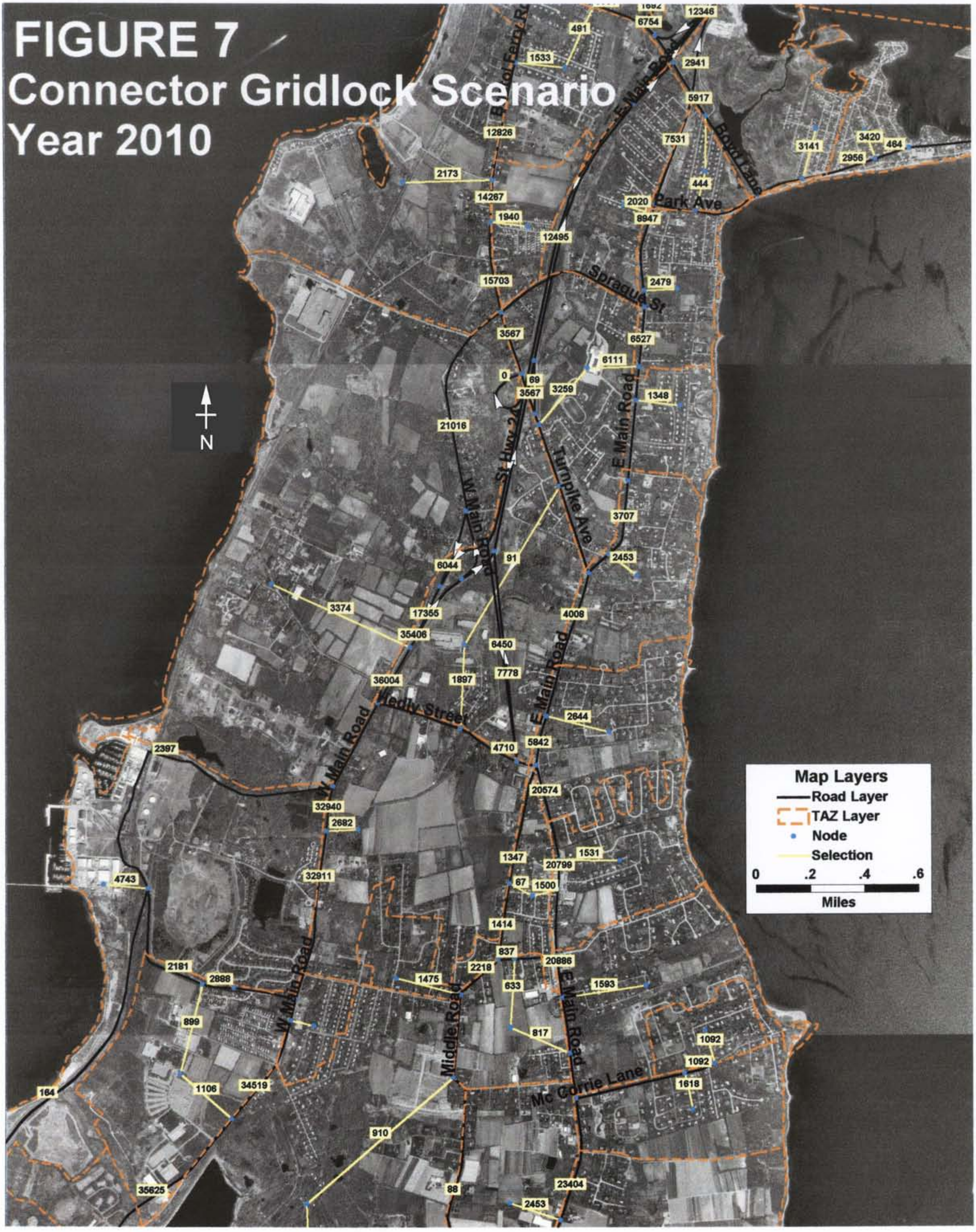


TABLE 2. Daily Traffic Volumes by Scenario, East Main Road at Hedly Street, Portsmouth, RI

Street	E. Main	E. Main	E. Main	E. Main	Hedly	Hedly
(Direction Before Intersection)	North	South	North	South	East	East
(Direction After Intersection)	Through	Through	Left	Right	Right	Left
Baseline Scenario 2000	8,788	10,251	1,195	1,287	454	1,679
No Modification Scenario 2010	8,997	10,523	1,252	1,348	477	1,757
Gridlock Scenario 2010	3,051	5,129	4,797	481	3,157	753
Connector Scenario 2010	4,025	11,131	8,440	2,838	4,877	2,371
Connector Gridlock Scenario 2010	3,091	10,231	8,814	2,635	5,157	1,863

TABLE 3. Daily Traffic Volumes by Scenario, West Main Road at Hedly Street, Portsmouth, RI

Street	W. Main	W. Main	W. Main	W. Main	Hedly	Hedly
(Direction Before Intersection)	North	South	North	South	West	West
(Direction After Intersection)	Through	Through	Right	Left	Right	Left
Baseline Scenario 2000	15,646	14,068	1,492	645	287	2,388
No Modification Scenario	15,823	14,176	1,566	670	298	2,501
Gridlock Scenario 2010	19,171	17,472	430	3,567	3,930	1,727
Connector Scenario 2010	15,425	12,552	2,406	507	204	2,203
Connector Gridlock Scenario 2010	16,948	16,227	863	2,122	706	1,100

These improvements must eliminate the existing safety hazards as well as encourage pedestrian activity in the area surrounding the Town Center. Without these improvements the traffic congestion coupled with the safety hazards for pedestrians will not facilitate the use or success of a new Town Center.

6.2 Middletown

The case study in Middletown focused on a large undeveloped parcel. Known locally as the Vanicek property, it is located to the west of West Main Road across from the intersection of West Main Road and Forest Avenue. Primary access to the parcel, when developed, is expected to be located at this intersection. The parcel also has frontage on Browns Lane, which intersects West Main Road to the north. The parcel is 71 acres in size. Based on a conversation with Ron Wolanski, the Middletown Town Planner, development of the parcel will be contingent on preserving 40 percent of the site as open space.

The site is currently zoned for general business use, making it a candidate for a shopping center. However, developing the parcel as a mixed-use village is considered a possibility. Based on these parameters, the two scenarios that are being modeled for the purposes of this case study simulate the development of the parcel as a shopping center and a mixed-use village. This type of use would include development of office space, retail stores, convenient stores and residential property. Most of the trips generated in the area would be from both shopping and work related trips as the residential development will be limited.

Baseline Scenario – Year 2000

The calibrated model provided by the Louis Berger Group is based on 2000 population figures and employment estimates for the three towns of Aquidneck Island. The model predates the opening of the Barnes & Noble plaza located to the east of West Main Road north of Forest Avenue. Because this plaza is so close to the subject undeveloped parcel, accounting for the activity generated by this plaza is necessary as part of establishing the baseline scenario.

The Barnes & Noble plaza consists of 107,000 SF of retail space. Using an industry standard ratio of 400 SF/employee (8), the estimated additional retail employees at that location equals 269. This amount was added to the existing 160 retail employees assigned to the plaza's traffic analysis zone (TAZ) to reflect the operation of the new plaza. Following this alteration, the model was run. The resultant daily traffic volumes are shown in Figure 8.

No Build Scenario – Year 2010

For comparison purposes, this scenario assumes no development on the Vanicek parcel. Population growth/decline factors for the three towns on Aquidneck Island are applied to reflect change in population between 2000-2010. Following the adjustment of the populations of the three towns, the model was run. The resultant daily traffic volumes are shown in Figure 9.

Shopping Center Scenario – Year 2010

This scenario involves the development of a shopping center on the Vanicek parcel. A one-story building was assumed, along with the preservation of 40 percent of the parcel as open space. To estimate the retail employment generated by this operation, the total floor area of the hypothetical shopping center was calculated using the existing floor-to-area ratio (FAR) of the newly constructed Barnes & Noble Plaza, which is 0.16. This results in a total floor area of over 293,000 SF for the hypothetical shopping center. Using an industry standard ratio for a shopping center of this size of 500 SF/employee (8), the number of retail employees at the site is estimated to be 587. This total was added to the retail employment of the subject parcel's TAZ. Following this adjustment, the model was run. The resultant daily traffic volumes are shown in Figure 10.

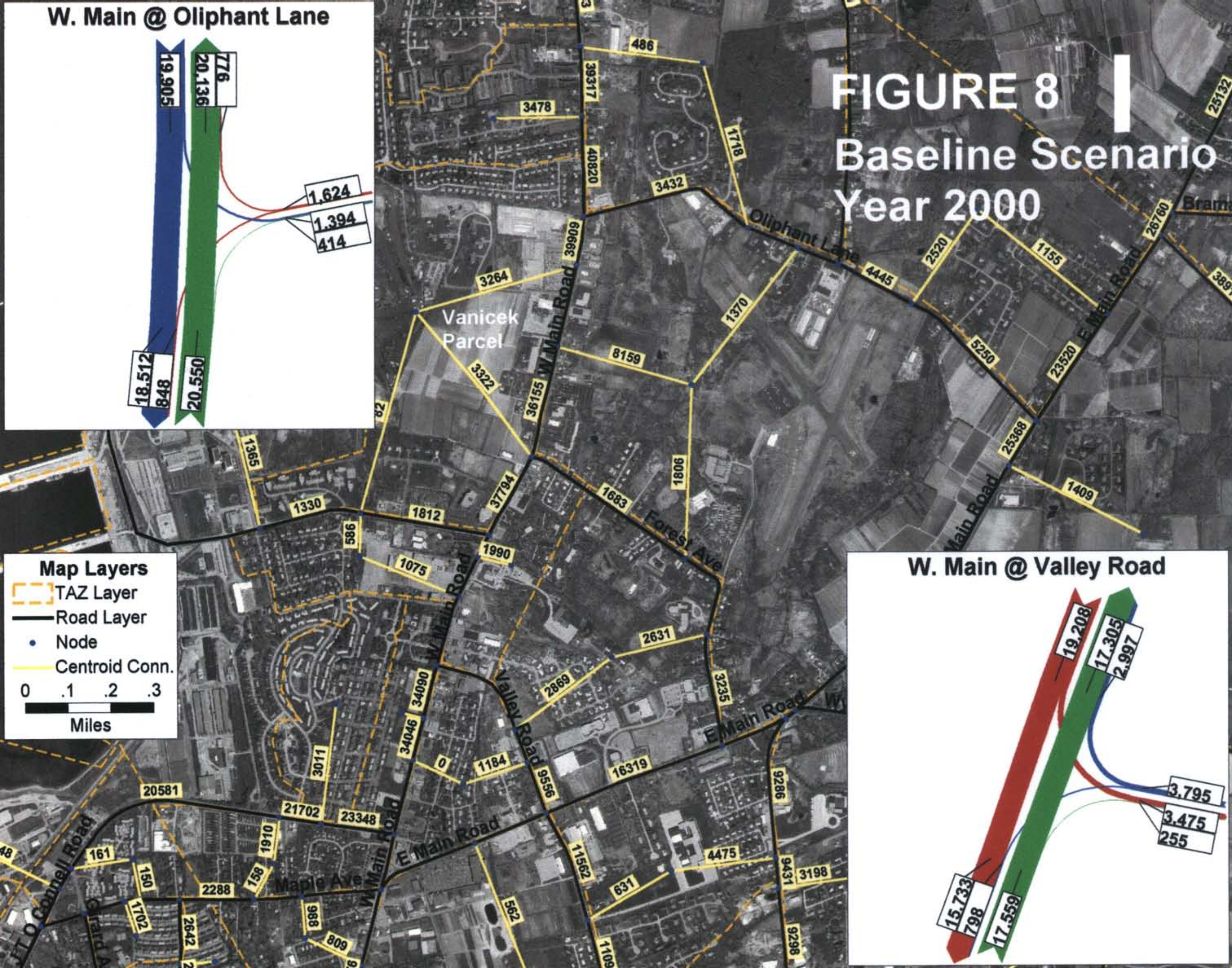


FIGURE 8
Baseline Scenario
Year 2000
W. Main @ Oliphant Lane
19,905
20,136
776
1,624
1,394
414
18,512
848
20,550
W. Main @ Valley Road
19,208
17,305
2,997
3,795
3,475
255
15,733
798
17,559
Map Layers
TAZ Layer
Road Layer
Node
Centroid Conn.
0 .1 .2 .3
Miles
Vanicek Parcel
W Main Road
E Main Road
Oliphant Lane
Forest Ave
Valley Road
Maple Ave
O Connell Road
486
39317
3478
40820
1718
3432
39909
3264
2520
1155
4445
26760
25132
1370
8159
5250
23520
36155
3322
25368
1806
1683
1409
37794
1365
1330
1812
586
1990
1075
2631
3235
2869
34090
34046
0
1184
16319
3011
9556
9286
20581
21702
23348
1910
11562
4475
161
150
158
2288
631
9431
3198
1702
2642
886
809
562
9298

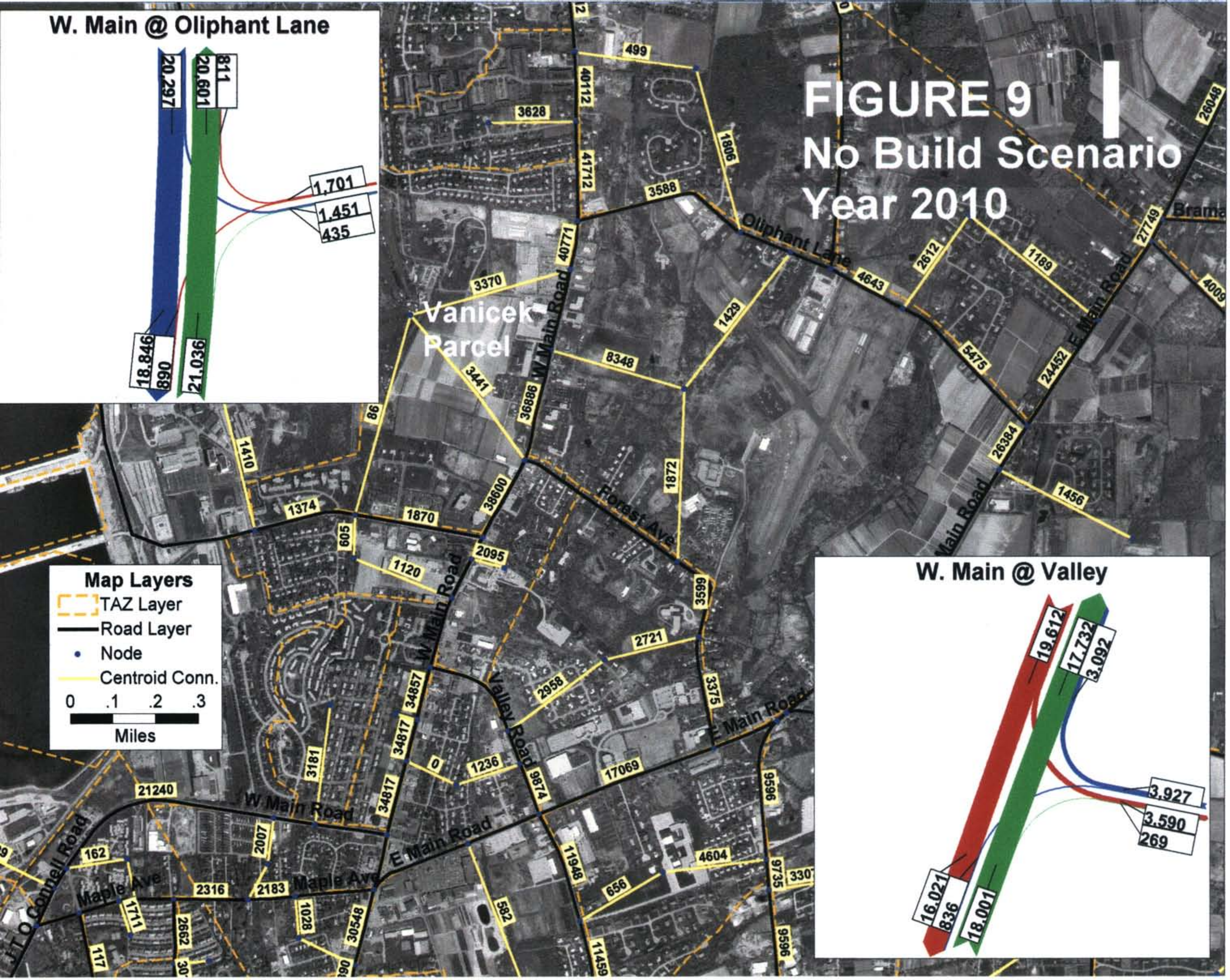


FIGURE 9
No Build Scenario
Year 2010
W. Main @ Oliphant Lane
20,297
20,601
811
1,701
1,451
435
18,846
890
21,036
W. Main @ Valley
19,612
17,732
3,092
3,927
3,590
269
16,021
836
18,001
Map Layers
TAZ Layer
Road Layer
Node
Centroid Conn.
0 .1 .2 .3
Miles
Vanicek Parcel
W Main Road
E Main Road
Oliphant Lane
Forest Ave
Valley Road
Maple Ave
J T O Connell Road
40771
36886
38600
2095
34857
34817
30548
21240
41712
40112
3588
4643
5475
24452
26384
27749
26048
9874
11948
17069
3375
3599
1872
8348
1429
3441
3370
1374
1870
605
1120
1410
86
499
3628
1806
2612
1189
1456
2721
2958
1236
0
3181
2007
2183
2316
1028
1711
162
117
2662
582
656
4604
9735
9596
11459
4009


FIGURE 10
Shopping Center
Year 2010
W. Main @ Oliphant Lane
21,562
21,790
667
1,941
1,345
692
20,217
1,274
22,482
W. Main @ Valley Road
20,409
18,074
3,242
4,036
3,731
248
16,678
795
18,321
Map Layers
TAZ Layer
Road Layer
Node
Centroid Conn.
0 .1 .2 .3
Miles
Vanicek Parcel
W Main Road
E Main Road
Oliphant Lane
Valley Road
Forest Ave
Maple Ave
J T O Connell Road
465
3592
42326
44021
1810
3978
43971
9579
8105
1336
2486
1206
4828
5597
23816
26940
25184
3864
207
8323
1773
25230
1417
1378
1344
637
1752
2384
2065
1048
41727
2704
2817
3817
35793
35679
0
1215
9966
16350
9409
3156
22068
23850
15276
11948
4487
3228
9488
9298
166
1972
156
2422
1689
2697
1023
30631
550
622
53
96

Mixed Use Village Scenario – Year 2010

This scenario entails developing a mixed-use village on the subject parcel. Since current zoning regulations for the town of Middletown do not address such developments, the population and retail and non-retail employment of a mixed-use village was estimated based on a number of assumptions.

The *Land Development Calculations* (9) was consulted to estimate commercial floor area and housing units in the hypothetical development. Similar to the other scenarios, the preservation of 40 percent of the total parcel was assumed. In addition, the buildings are limited to two stories, with an even division between residential and commercial space. Half of the commercial space is dedicated to retail and the other half to office space. The few remaining assumptions are detailed in the model output (see the appendix).

The development calculation model estimates a total of 440,889 square feet of commercial space in the hypothetical development. Dividing this space between retail and office space and using industry standard floor area/employee ratios (8), the resultant employee estimates are 490 in retail and 745 in non-retail. The model also estimates a total of 435 dwelling units on the site. Based on an average of 2.25 residents per unit, the total estimated additional population of the site equals 979. The total retail and non-retail employment and population estimates were added to the TAZ containing the subject parcel before running the model. The resultant daily traffic volumes are shown in Figure 11.

Results

Two key intersections surrounding the site were chosen as a means of comparing the results of the four scenarios. The intersection of West Main Road and Oliphant Lane is located to the north of the access points of the Vanicek parcel. Oliphant Lane is one of the few connecting roads between West Main Road and East Main Road on Aquidneck Island. The intersection of West Main Road and Valley Road lies to the south of the subject parcel. Valley Road is an alternate route used to avoid the intersection of West Main Road and East Main Road.

Daily traffic volumes resulting from running the model for each scenario are summarized in the Tables 4 and 5. Overall traffic increases with the addition of either development scheme as compared to the No Build scenario, with a larger increase associated with the Mixed Use Village. At West Main Road and Oliphant Lane, overall traffic increases by 6.9 percent with the addition of the Shopping Center and by 7.4 percent with the Mixed Use Village. At West Main Road and Valley Road, overall daily traffic increases by 3.0 percent in the Shopping Center scenario and by 3.6 percent with the addition of the Mixed Use Village.

FIGURE 11
Mixed Use 2010

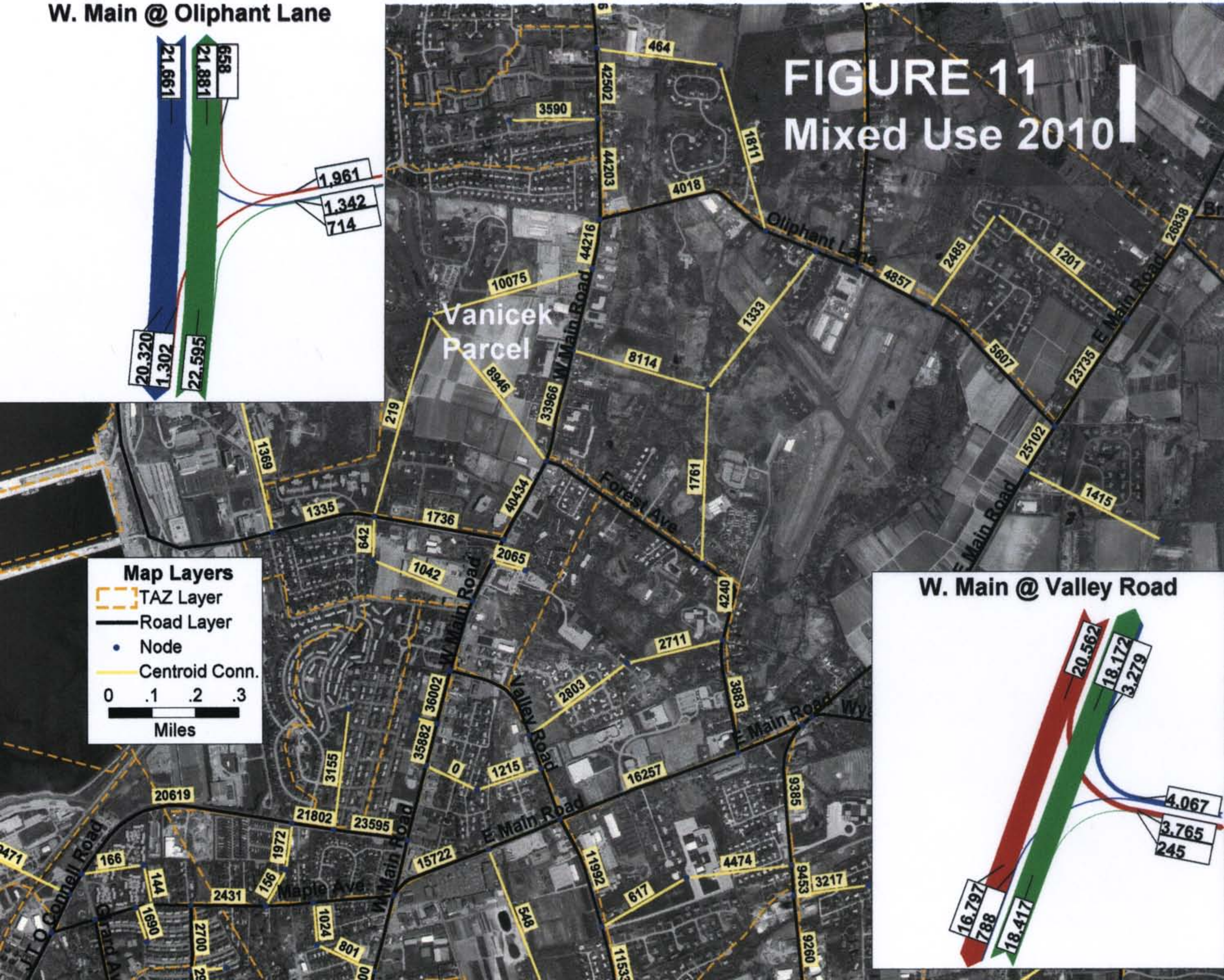


TABLE 4. Daily Traffic Volumes by Scenario, West Main Road at Oliphant Lane, Middletown, RI

Direction	Northbound		Westbound		Southbound		
Movement	Through	Right	Left	Right	Left	Through	Total
Baseline 2000	20,136	414	848	776	1,394	18,512	42,080
No Build 2010	20,601	435	890	811	1,451	18,846	43,034
Shopping Center 2010	21,790	692	1,274	667	1,345	20,217	45,985
Mixed Use Village 2010	21,881	714	1,302	658	1,342	20,320	46,217

TABLE 5. Daily Traffic Volumes by Scenario, West Main Road at Valley Road, Middletown, RI

Direction	Northbound		Westbound		Southbound		
Movement	Through	Right	Left	Right	Left	Through	Total
Baseline 2000	17,305	254	798	2,997	3475	15,733	40,562
No Build 2010	17,732	269	836	3,092	3590	16,021	41,540
Shopping Center 2010	18,074	248	795	3,242	3731	16,678	42,768
Mixed Use Village 2010	18,172	245	788	3,279	3765	16,797	43,046

7. CONCLUSIONS AND RECOMMENDATIONS

The following conclusions have been drawn from the application of TransCAD travel demand model in Aquidneck Island:

1. TransCAD was more applicable for regional use and analysis. A comprehensive traffic problem-solving approach should also utilize a micro-level intersection analysis software package.

2. The connection between the model and the land uses was primarily based on employment and population projections. Therefore, additional models would be needed to estimate future employment and population in the study area.

3. The model does not include seasonal traffic information. This has major impact on resort areas such as the City of Newport.

4. The model does not include information on alternative modes of transportation in addition to driving.

5. Calibration of the model performed prior to the model's use by this study needed additional verification; for example one-way streets in Newport were not included and some overlap among files for street names for other towns was apparent.

6. The interpretation of the results of each case study requires further investigation by appropriate professionals (i.e. whether Hedly Street could actually handle more traffic).

7. One way of manipulating the model result is through changing speed limits to redistribute volumes. This may yield inaccurate results and/or not be reality based.

8. Some proposals, for instance the Route 24 connector, were purely hypothetical. Attention should be given to the interpretation of the results and their impact on any future changes in the transportation network in the study area.

The following recommendations are proposed for the refinement and the future application of the model for Aquidneck Island:

1. Based on the findings of this study, the AIPC and LBG will continue the refinement of the travel demand model. Specifically, the model will be amended in order to include seasonal traffic and multimodal transportation information. Also, the model will be corrected to reflect the correct traffic flow in Newport.

2. The application of TransCAD and the travel demand forecasting model will require support from the three municipalities on the island. It is recommended that the three municipalities consider sharing financial resources to have a transportation professional administer the use of TransCAD and the travel demand model on an island-wide basis.

3. Long term, the application of the travel demand model will provide a unique opportunity to address the impacts of land use changes and new development on the transportation network of the island. The travel demand model can improve the patterns of development throughout the island by educating decision makers on the impacts proposed developments have on the land and the road network.

4. The findings of this study would help in refining the Statewide Travel Demand Forecasting Model developed by Rhode Island Statewide Planning Program and the Rhode Island Department of Transportation.

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APPENDIX I

TransCAD and Transportation Planning

"The objective of transportation planning is to guide development of a land-use/transportation system to achieve beneficial economic, social and environmental outcomes. Spatial analysis and GIS offer much to the transportation planning process, including spatial database management, geographic visualizations of possible scenarios and tools for processing geographic data into geographic information. GIS can also greatly enhance the quantity and quality of information flows among all components of transportation planning process, influencing decision making within this process" (1). This part of the report reviews TransCAD and its applications and compares it to other software packages.

TransCAD and Its Applications

TransCAD, developed by Caliper Corporation, is a GIS-based software package for planning, management, operation and analysis of transportation systems and facilities. TransCAD helps transportation professionals store, display, manage, and analyze transportation data. Information on transportation networks, freight flows, routes, schedules, traffic analysis zones, and transportation system performance can be stored, displayed, and analyzed at any spatial scale. TransCAD is capable of directly reading many data files thus allowing the street database, area database, and much of the demographic data to be imported directly from these sources (2). The travel demand modeling software is based primarily on a traditional four-step demand model. Advanced disaggregate demand models are also included. Trip production can be accomplished through cross-classification, regression models, or discrete choice models.

The GIS context gives TransCAD some important advantages. Accurate mapping helps make the models more effective. Also, the mapping and visualization functions of TransCAD help communicate data. In addition, the spatial analysis functions interface seamlessly with the travel demand model.

According to Caliper Corporation, TransCAD use has grown rapidly during the past few years. Since January 1999 more than 125 Metropolitan Planning Organizations (MPOs) have acquired TransCAD for travel forecasting applications, and more than 25 MPOs use it for other planning applications. TransCAD can conduct network analysis, such as shortest path routines, as well as transit analysis and facility location modeling (2). For example, in Rhode Island, TransCAD Statewide Travel Demand Model was applied in several projects in a regional as well as statewide level to test and demonstrate its potential use (10). These included:

- Air quality analysis (Conformity Analysis)

  This case study evaluated projects on Rhode Island's Transportation Improvement Plan (TIP) for conformity with the 1990 Clean Air Act

Amendments (CAAA) and the ISTEA. This case study examined the entire State of Rhode Island.

- East Providence Case Study (Corridor Planning)

  This case study used the RI State Model to evaluate the effects within a municipality due to proposed roadway improvements. The two projects under consideration were Waterfront Drive and the Henderson Bridge Connector.

- Washington Bridge Case Study (Traffic Management)

  The RI State Model was used to test the effect of lane restrictions on an interstate highway and the resulting traffic diversion during peak periods of travel.

- Combination of projects (Strategic Planning)

  This project evaluated a combination of several projects on a statewide level for strategic planning and policy-making purposes.

- Moshassuck Valley Industrial Highway Case Study (Test Land Use Scenarios)

  This case study evaluated the effect that completion of an industrial highway and the resulting land use changes would have on traffic volumes and travel patterns in the immediate area.

- Route 10 Upgrade Project (HOV Modeling)

  The RI State Model was used to model alternatives involving HOV lanes on Route 10.

- Apponaug Circulator Project (Project Level Modeling)

  This case study involved the using of the RI State Model for project level analysis. A small sub-area was extracted from the statewide model to build a new model for the Apponaug Circulator study area in the City of Warwick.

According to Caliper Corporation, the vast majority of transportation planning programs in the United States teach TransCAD as a part of their program. Many institutions use the TransCAD manuals as textbooks for their coursework. In addition, Caliper offers additional tutorial modules for training purposes upon request. In the past four years, approximately 1200 transportation professionals have attended TransCAD training courses taught by Caliper staff (2).

The following table lists names of courses that include TransCAD training as part of their syllabus. The list was compiled from an Internet search, and the results demonstrate the range of programs that have incorporated TransCAD into their curriculum.

Selected List of Courses with TransCAD Training

Institution	Course
Illinois Institute of Technology	Demand Models for Urban Transportation
Iowa State University	CE451/551: Trip Distribution with TransCAD
University of California Los Angeles	UP249: Advanced GIS
University of Texas	CE394: GIS in Water Resources
University of California Berkley	TransCAD short course
University of Tennessee-Knoxville	Geography 549: Topics in Geography of Transportation
The City College of New York	CEG4200: GIS Transportation Modeling
University of North Carolina	PL128: Urban Transportation Policy and Planning
Pennsylvania State University	CE521: Transportation Networks/System Analysis
Cornell University	CEE361
University of Toledo	GEPL6190: Advanced Geographic Systems Seminar
CUNY	Geography 383: Transportation Geography and Planning
University of Colorado at Denver	URP6674: Transportation Planning II
UMT	GEOG482: Community and Regional Analysis
University of Illinois at Urbana-Champaign	UP318: Fundamentals of GIS for Planners
University of Iowa	Geography Department courses
University of Georgia	Geography Department courses
University of Tennessee	Geography Department courses

Software Comparison

There are a number of commercial software packages available on the market for transportation network planning and modeling. These include TRANPLAN, EMME/2, TRIPS, QRSII and TransCAD. A key characteristic of TransCAD is that it is fully integrated with GIS. This distinguishes it from many early transportation-modeling applications. In comparing TransCAD with other software packages, integration with GIS is a key consideration. Fully integrated applications have the GIS software embedded within them, making interface with the mapping and spatial analysis functions seamless. Partially integrated packages work in conjunction with other software to achieve GIS capabilities. Most software developers are providing this service currently. Some models remain isolated from GIS software, with no opportunity for mapping or visual or spatial analysis functions (1).

The applications are also categorized by their primary function. Some of the applications are chiefly travel models with some land-use integration. These travel models use socioeconomic data and road networks as their inputs, calculating the resultant trip allocation. While these models are fully functional in terms of network analysis, they are not capable of accounting for the effects of transportation infrastructure improvements on land use (11).

The other category of applications consists of chiefly urban models with some transportation analysis functions and outputs. These applications typically offer fewer functions related to network or transit analysis (12). However, these models may be considered 'integrated' if a feedback mechanism is embedded within that reflects the impact of transportation on the land use system, and vice versa (13,14).

The characteristics of a number of transportation-modeling software packages are summarized below.

Name: TransCAD
Source/Developer: Caliper Corporation
Resource/Website: www.caliper.com
Associated Software: Caliper Maptitude
GIS Integration: Full
Category: Travel model

Name: California Urban Futures Model
Source/Developer: Institute of Urban and Regional Development, University of California at Berkeley
Resource/Website: www.dcrp.ced.berkeley.edu
GIS Integration: Full
Category: Integrated model
Reference: (13,15)

Name: Cube Voyager
Source/Developer: Citilabs
Resource/Website: http://www.citilabs.com/
Associated Software: Cube ME, Voyager, TP+, Trips, Tranplan, Accmap, MinUTP
GIS Integration: Full
Category: Travel model

Name: EMME/2
Source/Developer: INRO
Resource/Website: http://www.inro.ca/products/e2_products.html
Associated Software: Enif (Graphical User Interface)
GIS Integration: Partial – Enif provides graphics capability
Category: Travel model
Reference: (16)

Name: GeoMedia Transportation Manager
Source/Developer: Intergraph
Resource/Website: http://www.intergraph.com/gis/industries/transportation/gmt.asp
Associated Software: GeoMedia Transportation Analyst

GIS Integration: Partial – Integraph provides GIS software
Category: Travel model

Name: ITLUP (Integrated Transportation and Land Use Package)
Source/Developer: Dr. Stephen H. Putman, University of Pennsylvania
Resource/Website: http://dolphin.upenn.edu/~yongmin/usl/intro.htm
Associated Software: DRAM (Disaggregated Residential Allocation Model); EMPAL (Employment Allocation Model)
GIS Integration: Partial – can be used with an ArcView Shell
Category: Integrated model
Reference: (17,13,15,12)

Name: MEPLAN
Source/Developer: Marcial Echenique & Ian Williams
Resource/Website: www.meap.co.uk/meap/me&p.htm
Associated Software: MENTOR
GIS Integration: Partial
Category: Integrated model
Reference: (13,17,15,12)

Name: METROSIM (NYMTC-LUM)
Source/Developer: Alex Anas & Associates
Resource/Website: www.acsu.buffalo.edu/~alexanas
GIS Integration: Partial
Category: Integrated model
Reference: (17,15,12)

Name: MUSSA
Source/Developer: Dr. Francisco Martinez
Resource/Website: http://www.mussa.cl/E_index.html
Associated Software: none
GIS Integration: Partial, with some visualization capabilities
Category: Travel model
Reference: (17,12)

Name: Place3s
Source/Developer: California Energy Commission
Resource/Website: www.energy.ca.gov/places
Associated Software: Criterion's Index, Smart Places
GIS Integration: Partial – both Index and Smart Places interface with ESRI ArcView
Category: Integrated model
Reference: (15)

Name: QRSII (Quick Response System)
Source/Developer: AJH Associates – Alan J. Horowitz, Professor of Civil Engineering, University of Wisconsin, Milwaukee

Resource/Website: http://my.execpc.com/~ajh/intro.htm
Associated Software: GNE (General Network Editor)
GIS Integration: None
Category: Travel model
Reference: (16)

Name: UrbanSim
Source/Developer: University of Washington
Resource/Website: http://www.urbansim.org/
GIS Integration: Partial
Category: Integrated model
Reference: (18,17,15,12)

Name: TRANUS
Source/Developer: modelistica
Resource/Website: http://www.modelistica.com/
Associated Software: TUS (TRANUS User Shell)
GIS Integration: Partial using TRANUS User Shell
Category: Integrated model
Reference: (13,17,15,12)

Land Use and Transportation Integration

A thorough understanding of the connection between land use and transportation is widely recognized as critical for accurate travel demand forecasting (17). However, the achievement of an integrated land use/transportation model remains an elusive goal (11,19).

In 1991, interest in transportation modeling was renewed by creation of the Intermodal Surface Transportation Efficiency Act (18). The regulation calls for increased linkage between transportation and land use as a justification for funding of transportation projects (11,17). Following this increased interest in transportation modeling, new approaches to linking land use and transportation are now emerging. In 1993, the Travel Model Improvement Program (TMIP) was established by the U.S. Department of Transportation and the Environmental Protection Agency (17). This program recognizes the need to better integrate land-use into the travel demand forecasting process, as well as the limitations of the traditional four-step model in accomplishing this feat (17).

One reason that the integration of land use and transportation is so difficult may be related to the evolution of the practice of modeling. Urban modeling as a technology experienced a setback due to skepticism and criticism surrounding the concept of modeling itself (19). Today, while some of the lost ground is being made up, most models continue to rely on the four-step methodology, which was originally conceived in the early years of the modeling practice.

Another difficulty in integrating land use and transportation is that they tend to be mutually reinforcing (11). Land uses that generate travel demand often lead to investments in transportation infrastructure. At the same time, improvements in transportation systems have effects on land use. However, the four-step model assumes a one-way relationship between land use and transportation, limiting the utility of this type of model (1).

Activity-based modeling has demonstrated some advantages over the four-step model, especially in the area of estimating air quality (20). The traditional modeling process is less capable than activity-based modeling at accounting for multi-purpose, multi-stop trips (11,12). The realm of microsimulation appears to be an evolutionary advance from the four-step methodology (19). Micro simulation avoids the need to disaggregate models by representing persons, trips, or choices individually, creating a more dynamic model (14). Already being used to simulate traffic dynamics, this agent-based approach might be used to "represent the agents that compose the land-use – transportation system—migrating households, firms, or individuals; socioeconomic groups; commuters; pedestrians; developers; etc" (19). The chief disadvantage to this type of system to date is that it consumes a great deal of computing power, as well as processing time. However, the popularity of this type of model is expected to increase as computing power decreases in cost over time (14).

APPENDIX II

Model Output using MG1L model from *Land Development Calculations*, Walter M. Hosack, 2001

Development capacity forecast for ***MIXED USE*** *based on an adjacent* ***GRADE PARKING LOT*** *located on the same premises.* ***Given:*** *Gross land area.* ***To Find:*** *Maximum commercial building area and apartment dwelling unit capacity of the land area given when the residential land use allocation varies.* ***Premise:*** *all building floors considered equal in area.*

DESIGN SPECIFICATION

Enter values in boxed areas where text is bold and blue. Express all fractions as decimals.

Given:	**Gross Land Area**	**GLA=**	**71.000**	acres	3,092,760	SF
Land Variables:	Public/ private right-of-way & paved easements	W=	**0.100**	fraction of GLA	4,356	SF
	Net Land Area	NLA=	63.900	acres	2,783,484	SF
	Unbuildable and/or future expansion areas	U=	**0.000**	fraction of GLA	0	SF
	Gross Land Area Reduction	X=	0.100	fraction of GLA	4,356	SF
	Buildable Land Area Remaining	**BLA=**	**63.900**	acres	2,783,484	SF
Parking Variables:	Est. gross pkg. lot area per pkg. space in SF	s =	**400**			
	Parking lot spaces planned or required per dwelling unit	u=	**2**			
	Garage parking spaces planned or required per dwelling unit	Gn=	**1.00**			
	Gross building area per garage space	Ga=	**350**			
	Non-residential building SF permitted per parking space	a=	**333**			
	No. of loading spaces	l =	**2**			
	Gross area per loading space	b =	**350**	SF	700	SF
Site Variables:	**Project Open Space as fraction of BLA**	S=	**0.400**		1,113,394	SF
	Private Driveways as fraction of BLA	R=	**0.005**		13,917	SF
	Misc. Pavement as fraction of BLA	M=	**0.005**		13,917	SF
	Loading area as fraction of BLA	L=	0.000		700	SF
	Total Site Support Areas as a fraction of BLA	Su=	0.410		1,141,858	SF
Core:	**Core development area as fraction of BLA**	**C=**	0.590	C=Su must = 1	1,641,626	SF
Building Variables:	Res. bldg. efficiency as percentage of GBA	Be=	**0.700**			
	Bldg. support as fraction of GBA	Bu=	0.300	Be + Bu must = 1		

Dwelling Unit Mix Table: NOTE: The Dwelling Unit Mix table requires that (Be) above contain a value greater than zero.

DU dwelling unit type	GDA gross du area	CDA=GDA/Be comprehensive du area	MIX du mix	PDA = (CDA)MIX Pro-rated du area
EFF	**950**	1,357	**15%**	204
1 BR	**1,050**	1,500	**25%**	375

2 BR	1,500	2,143	35%		750
3 BR	1,750	2,500	15%		375
4 BR	2,000	2,857	10%		286
				Aggregate Avg. Dwelling Unit Area (AGG) =	1,989
				GBA sf per parking space a=	995
				Enter zero in the adjacent box unless you wish to override the AGG value calculated above	0

MIXED USE PLANNING FORECAST

40.00 % =(RAP): residential land use allocation percentage

60.00 % =(CAP): non-residential land use allocation percentage

total floors FLR	CGBA non-res GBA	RGBA res GBA	total bldg MBCA cover area	non-res CFLR floors	total parking MPLA lot area	total parking MNPS spaces	total dwelling MNDU units	density per dBA bldable acre
1.00	447,453	416,198	863,651	0.5	704,857	1,762	209.2	3.3
2.00	578,963	609,223	594,093	1.0	940,453	2,351	306.3	4.8
2.50	615,122	671,510	514,652	1.2	1,008,935	2,522	337.6	5.3
3.00	641,845	720,627	454,157	1.4	1,060,788	2,652	362.3	5.7
5.00	702,921	844,113	309,407	2.3	1,183,813	2,960	424.3	6.6
6.00	720,050	881,892	266,990	2.7	1,219,582	3,049	443.3	6.9
7.00	732,805	911,017	234,832	3.1	1,246,616	3,117	458.0	7.2
8.00	742,673	934,155	209,603	3.5	1,267,774	3,169	469.6	7.3
9.00	750,533	952,980	189,279	4.0	1,284,786	3,212	479.1	7.5
10.00	756,942	968,595	172,554	4.4	1,298,764	3,247	486.9	7.6
11.00	762,267	981,757	158,548	4.8	1,310,454	3,276	493.5	7.7
12.00	766,763	993,002	146,647	5.2	1,320,376	3,301	499.2	7.8
13.00	770,608	1,002,720	136,410	5.6	1,328,904	3,322	504.1	7.9
14.00	773,935	1,011,202	127,510	6.1	1,336,312	3,341	508.3	8.0
15.00	776,842	1,018,670	119,701	6.5	1,342,807	3,357	512.1	8.0

WARNING: These are preliminary forecasts that must not be used to make final decisions.

1) These forecasts are not a substitute for the "due diligence" research that must be conducted to support the final definition of "unbuildable areas" above and the final decision to purchase land. This research includes, but is not limited to, verification of adequate subsurface soil, zoning, environmental clearance, access, title, utilities and water pressure, clearance from deed restriction, easement and right-of-way encumbrances, clearance from existing above and below ground facility conflicts, etc.

2) The most promising forecast(s) made on the basis of data entered in the design specification from "due diligence" research must be verified at the drawing board before funds are committed and land purchase decisions are made. Actual land shape ratios, dimensions and irregularities encountered may require adjustments to the general forecasts above.

3) The software licensee shall take responsibility for the design specification values entered and any advice given that is based on the forecast produced.