Transportation Emergency Preparedness Plan for the Nashua Region

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1.0 INTRODUCTION

A. OVERVIEW OF TRANSPORTATION PLANNING AND EMERGENCY PREPAREDNESS

Events such as the New York City black out of 2003, and Hurricane Katrina in 2005 brought renewed focus on the role of transportation in emergencies. Several programs have been instituted related specifically to transportation emergency preparedness. Passage of the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) in August 2005, established new and revised requirements for statewide and metropolitan transportation plans and programs, as well as the underlying planning processes. One of the requirements of SAFETEA-LU is that Metropolitan Transportation Plans include “…(as appropriate) emergency relief and disaster preparedness plans and strategies and policies that support homeland security (as appropriate) and safeguard the personal security of all motorized and non-motorized users.” (Title 23 § 450.322 (h))

Transportation planning plays a fundamental role in the state, region, and community’s vision for its future. It helps shape an area’s economic health and quality of life. It influences patterns of growth and economic activity by providing access to land and it provides for the mobility of people and goods. The performance of the system affects public policy concerns like air quality, environmental resource consumption, social equity, land use, urban growth, economic development, safety and security.

Transportation planning recognizes the link between transportation and other societal goals. It requires developing strategies for operating, managing, maintaining, and financing the area’s transportation system in such a way as to advance the area’s long-term goals. One of these strategies is emergency preparedness.

Emergency preparedness is about preparing for and mitigating risks. It involves preparing for emergencies before they occur, responding when they do, and rebuilding after man-made or natural disasters have occurred.

With respect to transportation, emergency preparedness deals with identifying vulnerabilities, in the transportation system; analyzing the transportation network for redundancies that would provide rerouting capabilities so that the system could continue functioning if a critical link in the network were to fail; defining strategies for dealing with “choke” points such as toll booths; and analyzing the capacity of the transportation network for effective emergency route planning.

The Nashua Regional Planning Commission (NRPC) developed this document to address transportation emergency preparedness in the Nashua region. The first step in the development process was to determine what role the NRPC, as the Metropolitan Planning Organization (MPO) for the Nashua region, plays in transportation emergency preparedness and planning. One key role is that of convener, and to that end, the NRCP gathered a group of experts from various fields involved with emergency management and response to form an advisory panel to help guide the plan’s development process.

As there have been many articles, white papers, reports and plans written on preparing for emergencies, an extensive literature review was conducted for insight and guidance on how to develop an effective plan. Key points related to transportation planning that were made in the various documents reviewed are included in this study.
As suggested by the literature, a Transportation Network Vulnerability Analysis for the Nashua region was conducted. That analysis identified critical transportation linkages both within the region and to the neighboring areas. Vehicle flows were modeled with selected critical links removed, and alternate routes that would likely be taken in selected scenarios were identified and discussed. Also analyzed was the theoretical capacity of the transportation network in order to facilitate evacuation and evacuation planning in the region. Due to the size of the transportation network in the entire region, the capacity analysis focused on the City of Nashua.

Finally, the effects of pandemics, such as the 2009 H1N1 flu, were also researched to determine potential impacts to the transportation system. That research determined that the key disruptions to the system would be primarily due to personnel shortages and potential interruptions in the supply chain rather than failures of the transportation network itself.

B. THE ROLE OF THE METROPOLITAN PLANNING ORGANIZATION

The Nashua Regional Planning Commission (NRPC) is the designated Metropolitan Planning Organization (MPO) for the City of Nashua and the Towns of Amherst, Brookline, Hollis, Hudson, Litchfield, Lyndeborough, Mason, Merrimack, Milford, Mont Vernon, Pelham and Wilton, New Hampshire. MPOs are transportation policy-making organization made up of representatives from local government and transportation authorities; with respect to the Nashua MPO, those authorities include the NH Department of Transportation (NHDOT), Federal Transit Administration (FTA), Federal Highway Administration (FHWA), and the Nashua Transit System.

Federal Legislation requires an MPO for any urbanized area with a population greater than 50,000. The purpose is to administer the federal transportation process and ensure that investments in transportation projects and programs are based on a continuing, cooperative, and comprehensive (“3-C”) planning process. In accordance with federal regulations, the MPO is required to carry out metropolitan transportation planning in cooperation with the state and with operators of publicly-owned transit services. The MPO must successfully administer this process in order to acquire and spend Federal money on transportation improvements in the region. The core functions of the MPO include providing a forum for effective regional decision making, evaluating transportation alternatives for the region, maintaining a Long Range Transportation Plan (LRTP) for a 20 year horizon, developing a Transportation Improvement Program (TIP) for a four year period, ensuring that the TIP and LRTP comply with air quality requirements, and involving the public.

While many activities related to emergency planning and response are the responsibility of public safety and emergency response agencies, MPOs can also play an important role in promoting coordinated planning in anticipation of unexpected events or natural disasters. Michael D. Meyer, Ph.D., P.E., Georgia Institute of Technology, discusses how MPOs can be involved in emergency planning in “The Role of the Metropolitan Planning Organization (MPO) In Preparing for Security Incidents and Transportation System Response”. One of the principal roles that Mr. Meyers discusses is that of “convener” for the activities that relate to prevention, response, recovery and post-incident knowledge sharing. In this role, MPOs are not responsible for developing a regional emergency plan, but rather they bring the appropriate parties together to coordinate the planning process.

together who would be responsible for developing a coordinated plan. As a convener, the MPO also acts as a champion, encouraging key agencies to come together on a regular basis to discuss existing emergency operations plans and coordinate those plans with other plans that exist in the region. Conveners provide forums for agencies to:

- Develop a common set of goals and objectives for effective emergency operations;
- Develop coordinated surveillance and prevention strategies;
- Discuss coordinated emergency response;
- Map out local and regional emergency routes;
- Foster agreements on local and regional emergency shelter locations;
- Develop appropriate recovery strategies;
- Coordinate public information dissemination strategies; and
- Assess organizational and transportation systems response across the region before, during and after an incident.

NRPC is positioned to provide data and mapping services to the communities of the region in support of emergency preparedness planning using extensive GIS capabilities and regional data sets combined with the Travel Demand Modeling capability. In a traditional role NRPC acting in its capacity as an MPO can provide valuable information and planning support to public officials and first responders. In addition, NRPC can plan the role of a convener, providing a forum where operations plans could be discussed and coordinated with other plans in the region. Regular meetings on operations issues could be held, but the MPO would not be responsible for developing a regional operations plan.

C. ADVISORY PANEL DISCUSSION
The NRPC gathered a group of experts in emergency management for a workshop to get their assistance in identifying the demands placed on the transportation system in the event of an emergency or disaster and solutions on how to meet those demands. Workshop attendees consisted of municipal officials including staff from Public Works and Traffic Departments and the Nashua Transit System, the City of Nashua Fire Marshal, directors of the Emergency Management team for the City of Nashua, members of the Nashua and Merrimack police departments, the Executive Director of the NH National Guard, the Director of Emergency Services for the Department of Health and Human Services, senior staff from the NH Department of Homeland Security and Emergency Management, and the Planning and Development team leader for the Federal Highways Administration New Hampshire Division.

The workshop was held early in the process to discuss the approach the MPO and region could take towards assessing the role of the transportation system in emergency preparedness. Attendees discussed a several potential hazards or incidents that could impact transportation network in the region. The initial approach to this planning process was to develop several hazard scenarios or disasters and predict how the transportation network would function under the stresses brought on by each scenario. After extensive discussion with emergency operations experts and first responders the approach to the development of this plan was modified to take an all hazards approach when analyzing the performance of the transportation network under the stress of an emergency. Rather than predicting a set of impacts from a flood, earthquake or other natural or manmade disaster, NRPC focused on the transportation system itself and identified vulnerabilities within the existing network.
On a regional level there has been little coordination specific to the transportation system and emergency preparedness issues such as evacuation. Therefore the workshop attendees recommended focusing on individual communities to begin the planning process. With this in mind NRPC focused the evacuation portion of this document on the City Nashua infrastructure. Nashua was chosen for its population density and complexity of the road network.
2.0  LITERATURE REVIEW (SECTION 1)

Existing evacuation and emergency plans were reviewed for this analysis, including review of the following:

A. NATIONAL INCIDENT MANAGEMENT SYSTEM (NIMS) (DECEMBER 2008)
   http://www.fema.gov/emergency/nims/

The National Incident Management System (NIMS) is a standardized approach to incident management and response designed to improve preparation, coordination and incident management in the event of a crisis. Developed by the Department of Homeland Security and released in 2004, it establishes a uniform set of processes and procedures that emergency responders at all levels of government will use to conduct response operations.

   i. Components of the NIMS:

      Command and Management:

      o The Incident Command System (ICS): The ICS defines the operating characteristics, management, structure components incident management, and emergency response characteristics of organizations throughout the entire span of an emergency situation.

      o Multiagency Coordination Systems: The definition of a multiagency coordination system is a combination of facilities, equipment, personnel, procedures, and communications provided with the responsibility to coordinate a plan of action and support for an incident through adequate management and proper use of command.

      o Public Information Systems: During an incident or disaster, information systems established in the event of an emergency will pass valuable communication to the public. This information is vital to help save lives.

Preparedness:

Preparedness in NIMS requires a never-ending cycle of planning, training, exercise simulation, and equipment checking.

      o Planning: Plans are essentially created in the NIMS system as a system of setting priorities, integrating a variety of functions for each person or thing involved in a system, and an integrated support spectrum.

      o Training: Involves education, including coursework for procedures and protocols, multiagency command and communication, incident management, and organizational structure.

      o Exercises: Exercises include the use of simulations that are realistic enough so that personnel will be knowledgeable of what to expect if a disaster does occur. This includes multidisciplinary and multijurisdictional exercises that attempt to coordinate the efforts of all individuals who would aid in every aspect of an emergency situation. The exercises improve integration, interoperability, and optimize coordination efforts and utilization.

      o Equipment Standards: Emergency response agencies always rely on equipment to carry out important tasks in an emergency situation. Preparedness involves the readily available equipment that meet general standards for optimal use and effectiveness. They are sometimes designed to be interoperable with similar equipment used by other jurisdictions.
Resource Management:

There are four primary tasks in resource management that are vital in an NIMS effort:
- Creating a system of describing, recording, requesting, and keeping tabs on resources;
- Implementing this system in the event of a disaster;
- Providing resources to those who need it during an incident;
- Recalling resources during an incident.

Communications and Information Management:

The NIMS system was designed with the need for a standard communication network in mind so that information management and sharing can be more useful and conducted properly.

Supporting Technologies:

The National Incident Management System constantly updates with technological advances for implementation and refinement of all aspects of NIMS systems. This includes voice and communication system technology, information storing, retrieval and management systems, and display systems. The main concern is that all technologies used in all jurisdictions in the event of a crisis are compatible with each other and do not interfere with one another.

Continued Management and Maintenance:

This aspect of the NIMS system refers to the direction the incident management system takes in the future, including system checks to meet standards of effectiveness and reliability, as well as the consistent refinement of the NIMS and its components over the course of many years.

B. STATE OF NEW HAMPSHIRE EMERGENCY OPERATIONS PLAN (MARCH 2005)


The State of New Hampshire Emergency Operations Plan (EOP) represents a collaborative effort on the part of State government to provide a mechanism for effectively responding to and recovering from the impact of natural or human-caused disasters or emergencies, such as earthquakes, hurricanes, civil disturbances, terrorism, and nuclear power plant incidents.

The purpose of the State EOP is to initiate, coordinate and sustain an effective State response to disasters and emergency situations. The Plan is designed to:

1. Identify planning assumptions, assess hazard potentials and develop policies.
2. Establish a concept of operations built upon an interagency coordination in order to facilitate a timely and effective State response.
3. Assign specific functional responsibilities to appropriate State departments and agencies.
4. Coordinate actions necessary to respond to an emergency and coordinate the links between local governments, neighboring States, Federal response and the Maritime Provinces of Canada.
5. Unify the efforts of government, volunteers and the private sector for a comprehensive approach to reducing the impacts of emergencies/disasters.
The State EOP describes basic procedures to be used in responding to potential and/or actual emergency situations. The types of assistance to be provided are grouped into sixteen functional Emergency Support Functions (ESFs) to facilitate effective response operations. Each ESF is assigned a primary or co-primary agency, which has been selected based upon statutory authority, current roles and responsibilities or resources and capabilities within the particular functional area. Other agencies have been designated as support agencies for one or more of the ESF(s) based upon their expertise, resources and capabilities to support the functional areas. The primary agency is responsible for developing and maintaining the ESF documents and for coordinating related tasks during emergency operations. The sixteen functional ESFs are:

1. Transportation
2. Communications and Alerting
3. Public Works and Engineering
4. Fire Fighting
5. Information and Planning
6. Mass Care and Shelter
7. Resource Support
8. Health and Medical Services
9. Search and Rescue
10. Hazardous Materials
11. Food and Water
12. Energy
13. Law Enforcement and Security
14. Public Information
15. Volunteers and Donations
16. Animal Health

The Transportation ESF was reviewed as part of this study. The purpose of this ESF is to “provide a coordinated response in the management of transportation needs.” The NH Department of Transportation is listed as the primary agency. Responsibilities of the NH DOT outlined in the ESF include:

1. Staff the State Emergency Operations Center (EOC) for coordinating transportation activities in support of the State EOP.
2. Develop and maintain a State Evacuation Plan.
3. Coordinate and control emergency highway traffic regulations in conjunction with the NH State Police, NH National Guard, and the Federal Highway Administration.
4. Identify transportation capabilities and needs to facilitate evacuation.
5. Assess the damage to transportation resources, analyzing the effects of the disaster on the regional and State transportation system, monitoring the accessibility of transportation capacity and congestion in the transportation system, and implementing management controls as required.
6. Assist in the design and implementation of alternate transportation services, such as mass transit systems, to temporarily replace system capacity lost to disaster damage.
7. Manage and coordinate transportation resources and activities to facilitate the efficient evacuation of at risk residents resulting from actual or impending emergencies beyond the capabilities of local jurisdictions.

Organizational roles filled by the primary agency include an Evacuation Unit Leader, who is charged with planning for and facilitating the movement of evacuees from an impacted area, and a Route Security Unit Leader, who coordinates with Public Works and Engineering to ensure the safety and security of routes utilized following an incident.

In addition, the State of New Hampshire Public Health Emergency Preparedness and Response Plan - Attachment to ESF-8 of the New Hampshire Emergency Operations Plan, dated March 8, 2006, was also reviewed for this assessment. The purpose of this plan is to establish methods and procedures to be used by the Department of Health and Human Services (DHHS), Division of Public Health Services (DHHS) and other emergency planning agencies to respond to public health emergencies. A public health emergency is broadly defined as the occurrence of a sudden event that affects the public's health. A public health emergency can be caused by natural disasters, biological terrorism, chemical terrorism/accidents, radiological terrorism/accidents, or naturally occurring communicable disease outbreaks.

As the Public Health Emergency Preparedness and Response Plan states, mass transportation is a vital component to public health emergencies. The transportation system needs to be capable of transporting mass dispensing clinic clients, patients, casualties, or fatalities. The Transportation ESF maintains a master list of transportation assets in the State of New Hampshire. The State Department of Safety maintains a map of the locations of all of the school buses in the state, and ESF-7 (Resource Support) maintains a separate resource list for transportation assets.

C. MUNICIPAL HAZARD MITIGATION PLANS (DATES VARY BY MUNICIPALITY)

http://www.nashuarpc.org/publications/landuse.htm#hazard

Local Hazard Mitigation Plans serve as tools for municipalities and emergency personnel. These plans identify hazards to citizens, public and private property. They also assess the frequency, intensity and potential damage anticipated from these local and regional hazards, and they identify actions and strategies that are intended to protect citizens and reduce or prevent damage to property. The plans identify natural hazards such as floods, earthquakes and hurricanes, and man made hazards such as hazardous materials, biological hazards and terrorism. The plans also identify critical facilities such as water supply, fire stations, and transportation routes.

The Risk Assessment section of these plans identifies evacuation routes and bridges that are located on those routes. In addition, the plans identify the locations of emergency services such as fire and police departments, hospitals and emergency shelters as well as facilities with potentially vulnerable populations such as schools, child care facilities and nursing homes.

D. NORTHERN MIDDLESEX PRE-DISASTER MITIGATION PLAN (JULY 2006)


This plan encompasses municipalities in northern Massachusetts that are near the NRPC region. It is similar in nature to the Hazard Mitigation plans that have been developed for NRPC municipalities. This pre-disaster hazard mitigation plan contains and assessment and inventory of natural hazard risks, a vulnerability analysis based on the geographic location of critical
infrastructure and facilities, and an existing protection matrix. The regional nature of the plan helps to ensure that mitigation initiatives, measures and strategies are coordinated across municipal boundaries.

E. NH DEPARTMENT OF SAFETY – HOMELAND SECURITY AND EMERGENCY MANAGEMENT
SEABROOK STATION NUCLEAR POWER PLANT - EMERGENCY PLANS FOR YOUR PROTECTION AND
2009 EMERGENCY PUBLIC INFORMATION CALENDAR FOR NEIGHBORS OF SEABROOK STATION IN NEW HAMPSHIRE

Nuclear power plants, like many sorts of industrial facilities, involve the use of hazardous materials. But unlike other facilities, the nation’s 103 nuclear power plants are required to have detailed emergency plans to protect the public in the event of an accident that could result in the release of radioactivity.

Emergency plans for nuclear power plants are regulated by the Nuclear Regulatory Commission and the Federal Emergency Management Agency, which supervise graded exercises of those plans. The Bureau of Emergency Management is responsible for maintaining New Hampshire’s nuclear plant emergency plans. Those plans are reviewed and updated annually.

The evacuation plans for Seabrook Station Nuclear Power Plant reviewed for this analysis could be used to provide guidance to regions as they develop their own plans. The evacuation processes can easily be adapted to other regions and other (non-nuclear) types of emergencies. For example, for each community within the emergency planning zone, a map is provided showing established pick-up points or established pick-up routes where those needing a ride in an emergency can walk to and be picked up by an emergency bus, which will then take them to the reception center for their region. This straight-forward concept could be used by any region as they develop their evacuation plans and routes.

F. TRANSPORTATION RESEARCH BOARD SPECIAL REPORT 294: THE ROLE OF TRANSIT IN EMERGENCY EVACUATION (2008)

At the request of Congress, the Transportation Research Board (TRB) studied the capacity of transit systems serving the nation’s 38 largest urbanized areas to accommodate the evacuation and/or movement of people from or to critical locations in an emergency. This request came after several significant emergencies required the evacuation of large numbers of people – namely, the terrorist attacks on September 11, 2001 and Hurricane Katrina in 2005 – causing renewed focus on the adequacies of existing emergency response plans.

The potential for transit to play a significant role in emergency response and evacuation is just beginning to be realized. One of the findings of the TRB study is that the majority of Emergency Operations Plans in large urban areas are not sufficiently specific in describing how a major evacuation could be conducted successfully, “and few focus on the role of transit”.

The study discusses the role of transit in the four major elements of emergency response and evacuation plans: mitigation, preparedness, response and recovery.
“Transit agencies should be part of all four planning elements. Transit has a role to play in mitigation by protecting its own assets (e.g., moving vehicles to higher ground during severe flooding incidents) and establishing redundant communications systems to help ensure continuity of service. Transit agencies should be part of preparedness plans and represented in the emergency command structure. They can also play a vital role during the response phase in both helping to evacuate those without access to a private vehicle and bringing emergency responders and equipment to the incident site. Finally, they can be involved in the recovery phase, reestablishing normal transit operations and bringing evacuees back to the area, if needed.”

There are several factors that can affect the role that transit plays in an evacuation scenario. Clearly, the nature of the incident and its location in a region is one of the key factors. If the incident results in catastrophic failure of the transportation system, or occurs in an area not served by transit, then use of emergency buses, for example, may not be feasible. Also, the availability of transit operators and equipment at the time of the incident is critical. New Orleans did include transit in its evacuation plans, however, during Hurricane Katrina, those plans failed because most drivers did not report to work and there were significant inadequacies in the equipment planned for use in the evacuation. And, obviously, if the incident caused damage to transit equipment or facilities, then the ability of transit to play a significant role in the evacuation of a region’s citizens will be greatly diminished.

The study also points out the unique role that transit can play in evacuating those without access to a vehicle and special needs populations, such as the disabled, the elderly, and those who require the assistance of service animals. These groups have historically been inadequately addressed in most local emergency evacuation plans.
3.0 NETWORK VULNERABILITY ANALYSIS (SECTION 2)

A. THE TRANSPORTATION NETWORK IN THE NASHUA REGION

The transportation network in the Nashua region is greatly influenced by two factors: the geography of the region and the region’s proximity to the economic engines of Boston to the south and Manchester and Concord to the north. It is the combination of these two factors that have resulted in the relative ease of north-south travel through the region and limited east-west travel.

The geographic features that have the greatest impact on travel are the rivers and brooks crossing the region. The Merrimack River effectively splits the transportation system and limits east-west travel within the region to two bridges. The transportation network developed around the river with parallel north-south routes. The Nashua River, Souhegan River and Pennichuck Brook generally flow from west to east and divide the transportation network in several locations, impacting both east-west and north-south travel. Rivers play a significant role in emergency preparedness planning as they are an impediment to motorized travel in the region. They are also a focal point in transportation emergency preparedness and security as the loss of a bridge will likely have an impact on mobility and travel time throughout the region.

The second factor that has influenced the development of the transportation network in the region is the proximity to economic engines of Boston to the south and Manchester and Concord to the north. The influence of these major cities has focused the development of the transportation network towards providing north-south capacity.

North-south travel through the region is provided on several routes including the F.E. Everett (FEE) Turnpike, US 3, NH 3A, and NH 13. The major east-west travel routes in the region are NH 101, NH 101A, NH 111 and NH 130. In the Nashua region, these east-west routes have virtually no limited-access segments and pass through dense neighborhoods, making travel through the region congested and time-consuming. Beyond these arterial roads, east-west travel is limited to the secondary road network. Figure 1 shows the major road network within the Nashua region.

The current layout of the transportation network and associated land uses help define which links are critical to the system and which links will become stressed during an emergency that disrupts a portion of the transportation system.
FIGURE 1: NASHUA REGION ROAD NETWORK
B. **DEFINING A CRITICAL LINK**

There are no set criteria to define a roadway as critical to a region’s transportation system. Critical transportation infrastructure assets such as bridges, tunnels, and major corridors have long been recognized as vital components that contribute substantially to public safety and national economic activity. Characteristics of the road such as functional classification, average daily traffic volume, capacity and design speed in conjunction with physical characteristics such as geography, bridges and culverts and the population that is served by the road will play a role in determining if it is critical to a transportation system. Roads that provide direct access to emergency facilities, services or shelters may be considered critical to public safety and thus play an important role in the transportation network. Roadways with structures such as bridges or culverts are likely to be critical to the system, particularly when a road does not have convenient alternate routes with similar capacity.

Based on these criteria, a critical link in the Nashua Region may be defined as:

- Carrying 20,000 Vehicles per Day (VPD) or more
- Includes a bridge, culvert or overpass
- Equivalent parallel routes are not available or convenient
- The road provides direct access to emergency facilities
- Loss of the link will have an adverse impact on mobility or emergency response
- Loss of the link results in significantly increased travel time or response time

C. **IDENTIFYING CRITICAL LINKS**

A stated goal of this planning process and analysis is to identify how the transportation system functions under stress. One potential stress of the transportation system is the loss of one or more critical links in the network. This section of the plan outlines the process used by Nashua Regional Planning Commission (NRPC) to identify critical links in the region’s road network.

An examination of the Nashua region’s roadway network yields several roadways that contain potentially critical links. These links play an important role in mobility, public safety and economic vitality of the region. As a starting point for the analysis NRPC selected links with 20,000 or more vehicles per day. Of these links, NRPC staff then considered if there was sufficient redundancy in the network near each link such that mobility would not be significantly impacted if a link was lost for an extended period of time. Consideration was also given to the population served by the road (i.e., is it the only access point to a large population). The presence of structures such as bridges, culverts and over-passes was also considered in the identification of critical links. Bridges, culverts and over-passes are, by their nature, inherently critical pieces of the transportation system. There are nearly 200 bridges and an unknown number of culverts (estimated to be at least double the number of bridges) in the Nashua region. Several bridges in the region carry well over 20,000 vehicles per day. Some of the more significant bridges include the two crossings of the Merrimack River between Hudson and Nashua (the Sagamore Bridge and the Taylor Falls Bridge), the Main Street Bridge in Downtown Nashua and the FEE Turnpike over the Nashua River, the FEE Turnpike (Merrill’s Marauders Bridge) over the Souhegan River, and NH 101A over Pennichuck Brook. These bridges and several others are considered critical links in the transportation system.

Based on the criteria outlined above NRPC selected the following critical links in the Region for analysis.
D. ANALYSIS METHODOLOGY

The NRPC used the 2007 Regional Travel Demand Model to determine how the transportation system is likely to respond under the stress of losing critical links in the road network. An initial, “existing conditions” scenario was run in the model to establish a baseline. Critical links identified in the previous section were then “broken” and traffic flow was simulated along the network. Impacts to the network were analyzed for changes in traffic volumes and volume to capacity ratios as compared to the baseline scenario.

Spatial bridge data were obtained from the New Hampshire Department of Transportation (NH DOT) in June 2009 for use in this analysis. Attributes attached to the bridge dataset provide an indicator as to whether a particular bridge is on the NH DOT “Red List” or “Yellow List”. A bridge is considered to be “structurally deficient” and is placed on the Red List if one or more of its structural elements (girder, stringer, deck, pier, abutment, etc.) have an inspection rating of 4 or less, with 9 being a “perfect” bridge and 0 being a “closed” bridge. All bridges (state and municipal) are inspected at least once every two years in accordance with the Federal Highway Administration (FHWA) National Bridge Inspection Standards (NBIS), and the inspection data is maintained by the FHWA in their National Bridge Inventory (NBI) database. State-owned Red List bridges are inspected every six months, and municipal-owned Red List bridges are inspected every twelve months. A red-listed bridge is not likely to collapse or unsafe; the hands-on inspections identify unsafe conditions and, if the bridge is determined to be unsafe, the structure is closed. Bridges on the Yellow List are those that have a NBI rating of “structurally deficient” or “functionally obsolete”, but do not meet the criteria for Red List status. Functionally obsolete bridges are those that were built to older design standards no longer used today, and generally do not have adequate lane widths, shoulder widths, or vertical clearances to meet current traffic demands.

<table>
<thead>
<tr>
<th>Link</th>
<th>Municipality</th>
<th>≥ 20,000 VPD</th>
<th>Bridge or Culvert</th>
<th>Lack of Redundancy</th>
<th>Impact to Mobility</th>
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</thead>
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<tr>
<td>FEE Turnpike Between Exits 5 and 6</td>
<td>Nashua</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Sagamore Bridge</td>
<td>Nashua/Hudson</td>
<td>X</td>
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<td>X</td>
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<tr>
<td>Taylor Falls Bridge</td>
<td>Nashua/Hudson</td>
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<td>Main Street Bridge</td>
<td>Nashua</td>
<td>X</td>
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<tr>
<td>NH 101A at Pennichuck Brook</td>
<td>Merrimack/Nashua</td>
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<td>Milford Bypass (NH 101)</td>
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<td>NH 3A</td>
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<td>NH 38</td>
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<td>Turkey Hill Road</td>
<td>Merrimack</td>
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</tbody>
</table>
In addition to the spatial data, the “Municipal Redlist 2009 (revised April 2009)” and “State Redlist Summary 2009 (revised April 2009)” tables, which are publicly available on the NH DOT Bridge Design website http://www.nh.gov/dot/org/projectdevelopment/bridgedesign/documents.htm, were also reviewed as part of this assessment. Both the spatial and tabular data were used to determine if there were any red- or yellow-listed bridges located along routes that the model predicted would have significant increases in traffic volumes as a result of the removal or breaking of a critical link.

E. ANALYSIS RESULTS

i. F. E. Everett Turnpike Nashua River Crossing Between Exits 5 and 6

The F. E. Everett (FEE) Turnpike is a major limited access facility that serves as the primary north-south travel corridor through the Nashua Region. The FEE Turnpike carries approximately 80,000 vehicles per day through the region. Between exits 5 and 6, the FEE Turnpike has a 10-lane cross section and carries over 125,000 vehicles per day over the Nashua River (NH DOT Bridge IDs Nashua 100/118 (southbound) and Nashua 101/118 (northbound)). NRPC identified this link as critical to the region due to the high volume of traffic and lack of equivalent redundant capacity across the Nashua River.

Using the methodology described above, a comparison of existing conditions to a scenario with the Nashua River crossing on the FEE Turnpike removed revealed that the loss of the Nashua River crossing on the FEE Turnpike for an extended period of time would have significant impacts to the transportation network in downtown Nashua and areas to the west. There would also be impacts to areas north and east of the river crossing. A summary of these impacts is listed below, followed by Figure 2, a map highlighting the primary alternate routes the model predicts would be taken by drivers if traffic were not allowed to flow between Exits 5 and 6 as a result of a closure of the Nashua River Bridge.

Impacts to Downtown Nashua

- Downtown Nashua would experience significant increases in traffic, mostly from drivers using the Main Street Bridge to cross the Nashua River. The travel demand model predicts traffic on the Main Street Bridge to increase from 33,000 to 90,000 – over 3 times the capacity of the 4 lane urban arterial bridge.
- With Main Street heavily congested due to its being well over capacity, side streets would be significantly impacted by cut-through traffic. Nearly every side street in the downtown area would see at least a 50% increase in traffic volume. As a result, Concord and Kinsley Streets, as well as the majority of segments on Manchester, West Hollis, Broad, Water, and Ledge Streets, would exceed their capacity.
- Traffic would likely divert off the FEE Turnpike at Exits 4 and 5 to access Main Street. The southern end of Main Street at Kinsley Street and East Hollis Street show daily traffic volumes increasing from 20,000 to 35,000.

Impacts to the West and South

- The model shows trips from the western part of the region choosing to divert well in advance of the effected part of the FEE Turnpike, going through Hollis or southern Merrimack instead. This would cause several segments of NH 101A in Nashua and
Amherst normally over capacity under baseline conditions to be under capacity due to the diversion of traffic.

- The paths from the center of Hollis into Nashua using Depot Road and NH 111 (West Hollis Street) would be over capacity.
- Traffic through the center of Hollis would be up to approximately 15,000 - 20,000 cars per day.
- The model also shows a large increase in traffic in southwest Nashua, a mostly-residential area, from trips traveling to or from the west. For example, traffic triples on NH 111A (Groton Road).
- Traffic on the FEE Turnpike south of the Exit 4 and north of Exit 7 would decrease between 10% and 20%.

**Impacts to the North and East**

- Some of the traffic from Manchester and other points northeast of the region would avoid the FEE Turnpike completely and drive through Litchfield and Hudson.
  - Small to moderate increases in traffic through central and south Hudson would occur as more cars choose to cross the Merrimack River using Taylor Falls Bridge instead of the Sagamore Bridge.
  - Overall, however, Taylor Falls and Sagamore Bridges would not see much change in traffic volume. Both barrels of the Taylor Falls Bridge would see a slight increase by about 2,500 vehicles, or 6%, and eastbound traffic over Sagamore Bridge would decrease by less than 1%, while westbound traffic would increase by 3%.

There were no NH DOT red- or yellow-listed bridges along the routes identified in this scenario.
FIGURE 2: TRAVEL DEMAND MODEL RESULTS WITH THE REMOVAL OF THE NASHUA RIVER CROSSING BETWEEN FEE TURNPIKE EXITS 5 AND 6
ii. Sagamore Bridge

The Sagamore Bridge was originally constructed in 1973; the westbound span (the original structure, Bridge ID Nashua 157/059) was reconstructed in 1999 and the eastbound span (Bridge ID Nashua 157/058) was constructed in 2000 as part of the original Circumferential Highway project. It carries approximately 45,000 vehicles per day across the Merrimack River between Nashua and Hudson and provides direct access to the FEE Turnpike and Daniel Webster (DW) Highway in Nashua. It is critical to east-west travel because it is one of only two crossings of the Merrimack River in the region. If the Sagamore Bridge were lost or closed to traffic for an extended period of time, traffic would instead cross the River using the Taylor Falls Bridge to the north or the Tyngsboro, Massachusetts bridge to the south, as shown on Figure 3. Downtown Nashua would see a large increase in traffic and congestion as would sections of Hudson; Tyngsboro would also likely see large increases in traffic volume (model for Tyngsboro not available). When running this scenario in the model, the following impacts result:

**Impacts to Nashua:**
- An additional 18,000 cars per day would be using Taylor Falls Bridge to cross the Merrimack River.
  - On the west side of the bridge, the primary approach routes of Allds, Temple, Pearl, East Hollis, and Canal/Bridge Streets would experience increases in traffic volume ranging from 20% to 50%. With the exception of Allds Street, all these routes are already over capacity in the baseline scenario, and therefore, even higher levels of congestion and lower levels of service would be experienced. And while Allds Street is not over capacity in the baseline scenario, it would become over capacity as the preferred route for traffic coming from South Nashua.
  - On the east side of the river, Ferry St (NH 111) and most secondary streets in the center of Hudson would experience a sizable increase as all traffic trying to get to Nashua would funnel across the Taylor Falls Bridge.
- Taylor Falls Bridge is on NH DOT’s Yellow List due to its NBI rating as a functionally obsolete bridge. Additional information is included in the Taylor Falls Bridge scenario.
  - Increases in traffic volume also occur on the southern end of the FEE Turnpike, South Main Street, and the DW Highway as vehicles from South Nashua have to travel farther north to cross the river at Taylor Falls. The southern end of Main Street would become over capacity as a result.

**Impacts to the South and East:**
- The model predicts that traffic not choosing to use Taylor Falls Bridge to cross the Merrimack River would head south to the Tyngsboro Bridge in Massachusetts, then proceed north through Hudson using River Road (NH 3A) or continue driving south towards Lowell/Boston. Traffic volume would increase over the Tyngsboro Bridge by approximately 20,000 vehicles.
- Local roads in Hudson typically used to get to the Sagamore Bridge would see a decrease in traffic: Wason Road would be down 75%, while other cut-through routes, such as Musquash Road, Bush Hill Road, and Spear Road, would be down more than 50%.
• Normally over capacity under baseline conditions, Dracut Road in Hudson would see enough of a decrease in traffic to drop it back to under capacity as drivers from Pelham and the Lowell, Massachusetts area would use Massachusetts roads to access the Turnpike and points west of the Merrimack River.
FIGURE 3: TRAVEL DEMAND MODEL RESULTS WITH THE REMOVAL OF THE SAGAMORE BRIDGE
iii. Taylor Falls Bridge

The Taylor Falls Bridge is a 4 lane facility that crosses the Merrimack River and connects Downtown Nashua with Hudson Center. It is the older of the two crossings of the river in the region, and serves as a commuting route for residents living east of the Merrimack River who are looking to access the northbound lanes of the FEE Turnpike. The Taylor Falls Bridge currently carries 38,000 vehicles per day over the Merrimack River, making it and the connecting road network amongst the most congested in the Nashua region. The westbound span of the bridge was constructed in 1970 (Bridge ID Hudson 109/068) and the eastbound in 1973 (Hudson 110/068), according to NH DOT records. This municipality-owned yellow-listed bridge is classified as functionally obsolete in the NBI database, and has a weight limit posting of E-2, which means Certified Vehicles, both Single Unit and Combination Vehicles, are excluded from crossing the bridge. More information regarding the E-2 designation and weight limit restrictions is available at: http://www.nh.gov/dot/org/projectdevelopment/bridgedesign/documents.htm

If the Taylor Falls Bridge were closed to traffic, the majority of traffic would cross the River using the Sagamore Bridge to the south. As a result, traffic volumes would increase on the north-south routes in Hudson and the FEE Turnpike. Some Litchfield drivers would choose to drive north to Manchester. The model predicts the following impacts:

Impacts to Nashua:

- Nearly 30,000 of the 38,000 vehicles normally using the Taylor Falls Bridge would use the Sagamore Bridge instead, increasing its traffic volume to over 74,000.
- Traffic originating downtown would travel south on Main Street to the Sagamore Bridge, causing some sections to become over capacity.
- Traffic not originating from downtown that would typically use the Taylor Falls Bridge would take the FEE Turnpike, increasing traffic between Exits 2 and 8. The increase in traffic between Exits 2 and 5 causes that stretch of the turnpike to be over capacity.
  - FEE Turnpike Northbound at Exit 3B carries a yellow-listed bridge (ID Nashua 134/073) over the southbound off-ramp. The functionally obsolete bridge was built in 1997.
  - There are also two functionally obsolete bridges between Exits 5 and 6 on the FEE Turnpike south of the Nashua River, over a canal/service road. These bridges were built in 1955 (northbound, Bridge ID Nashua 101/112) and 1959 (southbound, ID Nashua 100/112), and both were reconstructed in 1996.
- Nearly every major route heading into and out of downtown Nashua shows a decrease in traffic volume.
  - East-west traffic on Amherst Street and, obviously, the two approach streets to the bridge, East Hollis and Canal, would decrease significantly. All three of these streets which are over capacity under normal conditions would become under capacity.
  - North-south traffic using Concord and Manchester Streets would also decrease, bringing typically over-capacity volumes on Concord Street to below capacity levels.
Impacts to Hudson:

- In Hudson, roads leading to and away from the Sagamore Bridge would see large increases in traffic volume. For example, the model indicates Wason Road would increase from 8,200 to almost 13,000 vehicles.
- NH 111 from Windham would see a marked decrease in traffic volume, indicating that travelers select another route at the beginning of their trip, most likely driving through Pelham, where the model shows increased volumes on Marsh Road and Sherburne Road, or taking I-93.
- Model results also suggest the capacity of Library Street would be exceeded as, similar to Main Street in Nashua, it would be used as a through-route for north-south travel.

Impacts to the North:

- In Litchfield, the majority of drivers wanting to be west of the River would travel north to the I-293 crossing in Manchester and then south on the Turnpike to their destination.

Figure 4 highlights these potential impacts and resulting travel patterns.
FIGURE 4: TRAVEL DEMAND MODEL RESULTS WITH THE REMOVAL OF THE TAYLOR FALLS BRIDGE
iv. Main Street Bridge

The Main Street Bridge (Bridge ID Nashua 127/115) over the Nashua River is a four-lane facility with left and right turn lanes in Nashua that was built in 1925. In addition, there are parking spaces parallel to the travel lanes on both sides of the bridge. Approximately 33,000 vehicles use the bridge daily for north-south travel through downtown Nashua. This bridge is posted with an E-2 designation. Traffic from Amherst Street (NH 101A), Manchester Street, and Concord Street to the north and northwest as well as from Canal Street to the east converges just north of the Main Street Bridge, then funnels down Main Street towards South Nashua’s heavily commercialized shopping district. While other crossings over the Nashua River exist on Canal Street and the FEE Turnpike, the Main Street crossing is important for direct access to the historic and vital downtown area, with its unique blend of commercial and retail businesses. The model predicts that without the Main Street Bridge, much of the diverted traffic would use the FEE Turnpike. Many of the roads that lead to the Turnpike exits would see an increase in volume, as shown on Figure 5. Other drivers would use Canal Street to cross over the Nashua River. Below is a summary of the impacts to the road network if the Main Street Bridge was taken out of service:

- Traffic between Exits 5 and 6 on the FEE Turnpike increases by over 22,000 vehicles – more than half of the 33,000 vehicles diverted.
  - Routes between Exit 5 and Main Street, such as Ledge, West Hollis, Kinsley and Lake Streets, would see increases in traffic, with portions of West Hollis and Kinsley Streets exceeding capacity.
  - Broad Street and Henri Burque Highway would be used to access Exits 6 and 7, respectively, and would experience around a 20% increase in traffic. While these increases would not result in capacity being exceeded, Henri Burque Highway would be near capacity with a vehicle to capacity ratio of 0.92.
  - As previously discussed in the Taylor Falls Bridge scenario, there are two functionally obsolete bridges between Exits 5 and 6 on the FEE Turnpike south of the Nashua River, over a canal/service road.

- The rest of the diversions appear to take place primarily east of Main Street, where traffic would take a circuitous route using several local roads including Sargents Avenue, Courtland Street, Chandler Street, Canal Street (crossing over the Nashua River), Armory Street, Temple Street and East Pearl Street (one-way westbound).
  - Capacity on Canal Street is exceeded under normal conditions, so the increase in traffic would only make it more congested. Armory Street would be well over capacity, and the remaining streets would not exceed capacity even though they would see significant increases in traffic volume. Capacity on these 2-lane local roads is typically 16,600.
FIGURE 5: TRAVEL DEMAND MODEL RESULTS WITH THE REMOVAL OF THE MAIN STREET BRIDGE OVER THE NASHUA RIVER
v. NH 101A (Amherst Street) over Pennichuck Brook

NH 101A is an east-west route approximately 14 miles in length that extends through Milford, Amherst, Hollis, Merrimack, and Nashua. The western terminus is at its intersection with the western end of the Milford Bypass (NH 101) and it eastern terminus is at the intersection of Main, Concord and Lowell Streets in Nashua. Traffic volumes range from 9,000 vehicles per day in Milford to just over 50,000 in Nashua. The section of Route 101A that crosses over the Pennichuck Brook on the Merrimack/Nashua boundary is known as Amherst Street, a commercially developed stretch with many stores, restaurants and other service-oriented businesses. This route provides for direct travel between points to the northwest, such as Amherst and Milford, and downtown Nashua, and also provides access to the FEE Turnpike. The bridge (NH DOT Bridge ID Merrimack 062/043) carries two travel lanes in each direction plus a westbound left-turn lane and is used by approximately 35,000 vehicles per day. According to NH DOT records, the bridge was constructed in 2001. Without this bridge, drivers from the north and west would divert onto alternate routes in Merrimack, such as Continental Boulevard and Tinker Road, exceeding their capacity. Both the FEE Turnpike and DW Highway would see increases in traffic volume, while NH 101A east and west of the bridge would see significant decreases. The model predicts the following impacts, shown on Figure 6, may occur if the Pennichuck Brook Bridge were removed from the road network:

- The model shows local trips originating in Merrimack with destinations east of the Pennichuck Brook bridge on Amherst Street would take Continental Boulevard to either Industrial Drive or Tinker Road, then use Thornton Road, Manchester Street or the DW Highway to Concord Street in Nashua.
  - Traffic would exceed capacity on:
    - Continental Boulevard south of Industrial Drive;
    - Tinker Road between Continental Boulevard and Thornton Road; and
    - Concord Street between Manchester and Main Streets in Nashua.
- Trips originating west of the bridge would divert onto County Road and Spring Road if coming from Amherst Village and Pine Hill Road if coming from Hollis.
- FEE Turnpike traffic between Exits 8 and 10 would increase to nearly 67,000 as vehicles divert from Amherst Street to Industrial Drive and Continental Boulevard (Exit 10).
- A decrease in traffic volume along most of NH 101A from Main Street in Nashua to the eastern end of the Milford Bypass would occur.
- Amherst Street which is often over-capacity under normal conditions would be under capacity in this scenario.

No NH DOT red- or yellow-listed bridges are along the predicted alternate routes.
FIGURE 6: TRAVEL DEMAND MODEL RESULTS WITH THE REMOVAL OF THE PENNICHUCK BROOK BRIDGE ON NH 101A
vi. Milford Bypass – NH 101

The Milford Bypass (NH 101) is a two-lane limited access facility located between Amherst and Wilton. The five mile long Bypass carries approximately 28,000 vehicles per day and serves as a major east-west corridor in the region. In addition to providing direct east-west travel, the Bypass removes vehicles from more congested portions on NH 101A in downtown Milford. While NH 101A is a redundant route in this scenario, it passes through a densely developed downtown area that has a mix of commercial, residential and public (e.g., school, recreational) property uses. Speed limits on 101A are predominantly low (less than 35 miles per hour), driveway entrances and exits are in abundance, and there are many signalized and non-signalized intersections, all which contribute congestion problems that make its use as a commuter route inefficient and unattractive. The Bypass, on the other hand, is limited-access with a 55 mile per hour speed limit and other than its termini (intersections with NH 101A), the only intersections are a diamond interchange with NH Route 13 and a signalized intersection with Old Wilton Road/Phelan Road.

The roadway extent that was analyzed for this scenario includes a 3 mile long section of 101 that extends westerly from its intersection with Baboosic Lake Road to the 5 mile long Bypass, as shown on Figure 7. There are two NH DOT yellow-listed bridges along this extent – one over Boston Post Road and Beaver Brook between the intersection with Baboosic Lake Road and the beginning of the Bypass (Bridge ID Amherst 159/107), and one over Perry Road at the western end of the Bypass (Milford 083/124). Both bridges are state-owned and are classified as functionally obsolete.

For analysis purposes NRPC assumed the entire section was closed to traffic for an extended period of time. A comparison of the baseline network to the network with this section of NH 101 closed shows significant impacts to parallel routes in Amherst, Brookline and Milford as described below:

- Nearly all through-traffic traveling between Amherst and Milford that would normally take NH 101 would instead use Amherst Street, going through Amherst Village and the Milford Oval. Traffic would exceed capacity along Amherst Street in Amherst Village and along the entire stretch of NH 101A through Milford.
- North River Road and Lyndeborough Road become the predominant northerly commuter routes from Wilton.
- In Milford, NH 101A (Elm Street/Nashua Street) becomes the primary central through-route, increasing traffic significantly, as shown on Figure 7.
- From Brookline, traffic uses Emerson Road to Ponemah Road to go east, NH 13 to go northeast, and Armory Road to Mason Road to go west.
  - There is one NH DOT yellow-listed bridge on Ponemah Road: Bridge ID Amherst 186/107, over the Souhegan River. This bridge, constructed in 1956 and reconstructed in 1996, is classified as functionally obsolete.
- NH 101 east of the Baboosic Lake Road intersection and west of the Bypass shows little change in volume, indicating that most traffic appears to be normal until the affected links are reached, then it diverts onto the alternate routes.
- While traffic volume on most of the alternate routes does not exceed capacity, it does approach capacity limits.
FIGURE 7: TRAVEL DEMAND MODEL RESULTS WITH THE REMOVAL OF THE MILFORD BYPASS (BEGINNING AT THE BABOOSIC LAKE ROAD INTERSECTION)
vii. NH 3A (Lowell Road) in Hudson

NH 3A is a north-south route that runs along the Merrimack River from the Massachusetts state line to Concord, crossing from the east side of the river to the west side of the River in Manchester. (A second, more northerly segment of NH 3A traverses through Franklin, Bristol and Plymouth). The section defined as a critical link for this analysis is in Hudson and provides access to several shopping centers, including Walmart and Sam’s Club, as well as the Sagamore Bridge. For the scenario run through the model, the NH 3A link just south of Sagamore Bridge, between Rena Street and the driveways to Walmart (east side of NH 3A) and Sam’s Club (west side of 3A), and known as the Lowell Road was removed from the network (see Figure 8). Approximately 30,000 vehicles per day travel along this section of road, which is commonly used by commuters from Pelham and Massachusetts heading to Nashua and other points west of the Merrimack River via the Sagamore Bridge. This section of NH 3A is a divided highway with two travel lanes in each direction plus turning lanes at the signalized intersections at Rena Street and at “Walmart Boulevard”. With this link removed from the network, the model predicts many drivers in Hudson would take a north-south route using local roads in Hudson, while drivers originating in the Pelham area would take an east-west route across Keyes Hill Road in Pelham and Kimball Hill Road in Hudson. Drivers to the south would likely cross the River in Massachusetts, taking the FEE Turnpike or DW Highway to their destination.

Impacts in Hudson:

- Local roads in Hudson used to bypass the broken link would see significant increases in traffic. For example, traffic on Burns Hill and Wason Road would nearly double and Musquash Road would see close to a 200 percent increase in traffic volume.
- The increase in traffic volume on the short segment of Lowell Road between Wason Road and the Sagamore Bridge which is normally well over capacity would worsen the already congested conditions.
- Dracut Road, which is typically near capacity levels, would carry half its normal volume.
- The Sagamore Bridge would only see a 20 percent decrease in volume, as it would still be accessible if approached from Lowell Road north of the bridge.

Impacts to the East:

- Drivers from the Pelham area divert closer to their origin and take the alternate route along Keyes Hill Road and Kimball Hill Road. Depending on their destination, they would continue west to the Taylor Falls Bridge or head south along Burns Hill Road to Pelham or Wason Roads.

Impacts to the West:

- DW Highway between the two river crossings would see a decrease in traffic similar to that on Sagamore Bridge.
- Bridge and Canal Streets in Nashua would see a slight increase in traffic from additional drivers using the Taylor Falls Bridge.
Impacts to the South:

- Drivers from southern origins would either cross the Merrimack River in Tyngsboro and use routes on the west side of the river or divert off NH 3A south of the Dracut Road intersection, using Winslow Farm/Pine Road to navigate easterly to Musquash Road.
- Likewise, drivers heading north on Dracut road divert at the Musquash Road intersection.
FIGURE 8: TRAVEL DEMAND MODEL RESULTS WITH A LINK ON NH 3A REMOVED FROM THE ROAD NETWORK
viii. **NH 38, Pelham**

NH 38 is a north-south route approximately nine miles in length that extends from the Massachusetts state line through Pelham, where it is known as Bridge Street, and into Salem. It was analyzed as a local critical link to assess the level of impact to a single town. While this route does not carry the same levels of traffic as the previously discussed links, it is an important route for residents of Pelham and for traffic moving from Lowell, Massachusetts to the shopping district in Salem. Traffic volumes range from a high of 14,400 north of Hobbs Road to a low of 8,670 between Old Bridge Street and Main Street. For this analysis, links along Route 38 were removed from the network in two locations: south of Old Bridge Street near the Hannaford Shopping Center and at a culvert located south of Hobbs Road (see Figure 9). With these links removed from the system, traffic primarily diverts using several east-west routes to access other north-south routes such as NH 128 (Mammoth Road) or NH 111A (Windham Road) to circumvent the broken links. The model predicts the following impacts may occur if traffic was impeded in the two locations on NH 38:

- Trips south of the broken link by Old Bridge Street would divert to the west on Willow Street, then either use Marsh Road (NH 111A) to head north, or continue west on Burns Road to Mammoth Road.
  - Traffic volumes on Burns Road would nearly triple, while Willow Street traffic would increase by about 50%, and Mammoth Road by about 70%.
- Alternately, some drivers would divert to the east on Highland Avenue, and then use Livingston Road to Old Bridge Street.
- Currier Road, which connects to Highland Avenue, would also see an increase in traffic from southeast Pelham and Massachusetts drivers diverting farther south.
- Trips north of the broken link by Hobbs Road would divert onto Hobbs Road, then travel south on Windham Road.
  - Both Hobbs and Windham Roads would see increases in traffic volumes that would exceed their capacity.
  - For southerly destinations, drivers would continue on Marsh Road, or take Old Bridge Street to Livingston Road. Livingston Road would potentially see a ten-fold increase in traffic volumes.
  - Drivers with westerly destinations would use Brookview Drive to Mammoth Road.
- There would be small decreases in or no changes to volumes on the north and south ends of NH 38, which may be because alternate routes through Windham and Methuen, Massachusetts are too far out of the way to use as detours.

There is a municipality-owned red-listed bridge on Old Bridge Street (Bridge ID Pelham 109/081), which as a weight restriction of 10 tons, and a municipality-owned yellow-listed, functionally obsolete bridge with an E-2 designation on Willow Street (Pelham 105/069). Both of these bridges are located on likely alternate routes that would be taken if NH 38 were closed to traffic at the locations shown on Figure 9.
FIGURE 9: TRAVEL DEMAND MODEL RESULTS WITH LINKS ON NH 38 REMOVED FROM THE ROAD NETWORK
ix. Turkey Hill Road, Merrimack

Another local critical link that was analyzed was the Souhegan River crossing on Turkey Hill Road in Merrimack. Approximately 10,750 vehicles a day cross over this municipality-owned bridge, according to counts conducted in 2008. Turkey Hill Road is part of a popular commuter route that connects the FEE Turnpike and DW Highway in Merrimack with NH 101 in Bedford. The Turkey Hill Road area is densely populated with residential neighborhoods, which contributes to the traffic volume as residents travel between their homes and destinations in Merrimack and Bedford. There are three other crossings of the Souhegan River in Merrimack: two to the east, Merrill’s Marauders Bridge on the FEE Turnpike and Chamberlain Bridge on DW Highway, and one to the west on Amherst Road, near the Merrimack/Amherst town line. Both the bridge on Turkey Hill Road and Merrill’s Marauders Bridge are on the NH DOT Red List, however Merrill’s Marauders Bridge was rehabilitated in 2009 as part of improvements being made to the Turnpike, and rehabilitation and widening of the Turkey Hill bridge is on a July 24, 2009 NH DOT list of municipal projects selected for funding through the American Recovery and Reinvestment Act (ARRA). The municipality-owned DW Highway crossing is on the NH DOT Yellow List, with an NBI rating of functionally obsolete; records show the bridge was built in 1921 and rebuilt in 1934. Without the Turkey Hill crossing, significant detours would have to be made to cross the river, as shown on the following Figure 10, and detailed below.

- Drivers north or east of the Souhegan River bridge on Turkey Hill Road would either take Baboosic Lake Road to DW Highway and cross the River using Chamberlain Bridge, or take the Bedford Road to the FEE Turnpike and Merrill’s Marauders Bridge. Traffic volumes on eastern end of Baboosic Lake Road would approach capacity level, but would not exceed it. Capacity is exceeded on DW Highway under baseline conditions, and the additional traffic would obviously add to the congestion.

- Drivers to the south and west of Turkey Hill Road would likely use the River crossing on County Road.
  - Traffic on Amherst Road would increase between 15% and 30% between Turkey Hill Road and the County Road bridge.
  - Wilson Hill Road (which becomes Spring Road in Amherst) would experience increases in traffic approaching 40% as it nears the Thornton’s Ferry Road intersection.
  - Thornton’s Ferry Road, which connects Spring Road to County Road, would see a dramatic increase in volume ranging from 60% – 100%. South of the County Road intersection, there would still be an increase in traffic, but the level would be lower, at 20% – 25%. The southern section of this road intersects with Boston Post Road, which also has a bridge over the Souhegan River approximately ¼ of a mile southeast of the intersection (Bridge ID Amherst 193/130, a functionally obsolete, yellow-listed, E-2 posted, municipality-owned bridge.)
  - In Amherst, traffic volumes on Baboosic Lake Road and Pond Parish Road would increase between 20% and 30% by diverted drivers using either the County Road or the Boston Post Road crossing.

In addition to the DOT “listed” bridges previously discussed, there are also two yellow-listed bridges located along the potential alternate routes. The first is a municipality-
owned, functionally obsolete bridge on Bedford Road over Baboosic Brook. This bridge was built in 1984, and carries an E-2 weight restriction. The second yellow-listed bridge is located on Baboosic Lake Road and carries traffic over the FEE Turnpike. This bridge, built in 1954, is classified as functionally obsolete.
FIGURE 10: TRAVEL DEMAND MODEL RESULTS WITH THE SOUHEGAN RIVER BRIDGE ON TURKEY HILL ROAD REMOVED FROM THE ROAD NETWORK
4.0  EVACUATION PLANNING

The previous section discussed the network vulnerability analysis conducted for the Nashua region. The next step the NRPC took in the emergency preparedness plan development process is an evacuation analysis. Evacuation of a region, city, town or neighborhood can be extremely complex and requires coordination at multiple levels of government. In a primer on evacuation and preparedness as they relate to transportation, the Federal Highway Administration (FHWA) states that specific evacuation routes can not be finalized “until the geographic scope of a natural or man-made disaster is determined”. However, the primer does describe how evacuation routes can be planned in advance of an emergency, by identifying potential evacuation routes based on several factors, including functional service and strategic location. An important factor to consider in that process is roadway capacity, commonly defined as the number of vehicles that can pass a certain point on the road in a specified period of time under prevailing road and traffic conditions. In addition to capacity, routes should also be analyzed for where there may be potential bottlenecks, barriers or other impediments.2

One reason that knowing roadway capacities is important is that the primary mode of transportation that would likely be used during evacuation efforts will be the private automobile. However, the availability of transit vehicles that could be used to assist in evacuating those with special need or those with no access to a vehicle also needs to be assessed. Memorandums of Understanding/Agreement with public and private transportation agencies and mutual aid agreements with municipalities and emergency response agencies within the region to obtain, coordinate and provide adequate means of transportation for those without vehicles or with limited transportation options should be part of the evacuation plan.3

One factor that is especially hard to plan for is human behavior, which is considered one of the more difficult tasks that emergency management and response personnel have to face. People evacuating an area are likely to use routes familiar to them, and feel they know how long it should take to negotiate those routes, not necessarily considering that those times will be seriously impacted by crisis conditions. Because of this, it is essential that real-time information about road conditions, evacuation routes, shelter availability and other vital information be conveyed to evacuees en-route during an evacuation.

The NRPC approached the evacuation portion of the Transportation Emergency Preparedness Plan for the Nashua Region by taking the recommendations put forth in the FHWA primer and identifying for the City of Nashua potential evacuation routes and potential problems along those routes. The City was chosen primarily for its population density and complexity of the road network. This document can then provide guidance to communities as they develop their local plans by showing the resources and considerations that go into assessing the transportation network as part of developing emergency evacuation plans.

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A. **DATA SOURCES**

Geographic Information Systems (GIS) can be a very useful tool when planning for the evacuation of an area. For this part of the evacuation planning process, a variety of spatial data sources were reviewed and incorporated into maps that highlight where resources and needs were distributed across the study area, and that show the theoretical road capacities, based on data stored in the NRPC travel demand model. Table 1 below lists data sources for the different elements spatially analyzed for this study. This table is intended to be a resource guide for the types of data that might be considered when developing an emergency evacuation plan. The data sources reviewed are not specific to the City of Nashua, and could be used by all the communities in the region to support a local plan.
<table>
<thead>
<tr>
<th>ELEMENT</th>
<th>PURPOSE</th>
<th>SOURCE</th>
<th>FORMAT (DATE)</th>
<th>ONLINE LINK (IF AVAILABLE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road Capacity</td>
<td>Identify high capacity routes</td>
<td>NRPC Travel Demand Model</td>
<td>ESRI shapefile (2002)</td>
<td>NRPC: <a href="http://nashuarpc.org/index.htm">http://nashuarpc.org/index.htm</a></td>
</tr>
<tr>
<td>Access Control</td>
<td>Identify segments of highway with access control in place</td>
<td></td>
<td></td>
<td>NRPC traffic count information: <a href="http://nashuarpc.org/trafficcount/index.htm">http://nashuarpc.org/trafficcount/index.htm</a></td>
</tr>
<tr>
<td>Number of lanes</td>
<td>Locate where number of through lanes decrease (potential choke points)</td>
<td></td>
<td></td>
<td>NRPC traffic count information: <a href="http://nashuarpc.org/trafficcount/index.htm">http://nashuarpc.org/trafficcount/index.htm</a></td>
</tr>
<tr>
<td>Major Intersections</td>
<td>Locate potential choke points</td>
<td>NRPC Traffic count records</td>
<td>ESRI shapefile (1991 – present)</td>
<td></td>
</tr>
<tr>
<td>Bridges</td>
<td>Bridge locations and status (i.e., red-listed, yellow-listed, historic)</td>
<td>NH DOT Railroads</td>
<td>ESRI Shapefile (1992)</td>
<td>NH GRANIT GIS Clearinghouse: (listed above)</td>
</tr>
<tr>
<td>Emergency Resources</td>
<td>Locations of: Fire department, police department, emergency operations, hospital and emergency shelter locations</td>
<td>NRPC Municipal Hazard Mitigation Reports</td>
<td>Written reports and associated ESRI shapefile (various dates)</td>
<td>NRPC Publications: <a href="http://nashuarpc.org/publications/enviro.htm#hazard">http://nashuarpc.org/publications/enviro.htm#hazard</a></td>
</tr>
<tr>
<td>ELEMENT</td>
<td>PURPOSE</td>
<td>SOURCE</td>
<td>FORMAT (DATE)</td>
<td>ONLINE LINK (IF AVAILABLE)</td>
</tr>
<tr>
<td>-----------------------</td>
<td>-------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------</td>
<td>---------------------------------------------------------</td>
</tr>
<tr>
<td>Critical Facilities</td>
<td>Licensed day care/child care facility locations</td>
<td>NH Dep’t of Health and Human Services (DHHS), Bureau of Child Care Licensing (BCCL)</td>
<td>Web-based Child Care Search (no date provided)</td>
<td>DHHS BCCL: <a href="http://www.dhhs.state.nh.us/DHHS/BCCL/default.htm">http://www.dhhs.state.nh.us/DHHS/BCCL/default.htm</a></td>
</tr>
<tr>
<td>Critical Facilities</td>
<td>Homeless shelter locations</td>
<td>NH Coalition to End Homelessness</td>
<td>Web-based Emergency Shelter Listing (no date listed)</td>
<td>NH Coalition to End Homelessness: <a href="http://www.home4hope.com/index.cfm">http://www.home4hope.com/index.cfm</a></td>
</tr>
<tr>
<td>Housing Units with No Vehicle</td>
<td>Locate block groups more likely to need transportation assistance</td>
<td>US Census Bureau American Community Survey (ACS)</td>
<td>ESRI Shapefile and Summary File 3 table (09/04/02)</td>
<td>US Census Bureau ACS: <a href="http://www.census.gov/acs/www/Products/">http://www.census.gov/acs/www/Products/</a></td>
</tr>
</tbody>
</table>
B. **Roadway Capacity Analysis**

During the preliminary research phase of this project, the NRPC learned that additional work and planning is necessary at the local level before a regional effort to coordinate evacuation planning can be completed. At this time, those local level planning efforts have not been completed. Since a region-wide evacuation plan is not feasible at this time, the NRPC took an alternative approach by selecting the City of Nashua as the primary example for developing a sample set of considerations and recommendations to be used when establishing effective evacuation routes. The road network in Nashua was analyzed to identify the theoretical capacities along primary routes, potential choke points, shelter locations and the location of vulnerable populations such as elderly and disabled citizens.
FIGURE 11: CITY OF NASHUA
The emergency scenario considered for the City was the evacuation of people to the primary emergency shelters identified by emergency management personnel during meetings with NRPC staff. As shown on Figure 11, there are two shelters in Nashua. The shelters are at Nashua High School North and Nashua High School South, which have amenities such as kitchen facilities, showers and large spaces to set up sleeping accommodations that would be required if housing evacuees for an extended period of time. This scenario assumes evacuees north of the Nashua River would be directed to Nashua High School North and evacuees south of the Nashua River would be directed to Nashua High School South.

As previously stated, the likely mode of transportation for many evacuees would be their private automobile. Major routes leading to these shelters were evaluated for their ability to handle the potential volume of traffic that could occur in an emergency and to identify any potential problems along the routes that could impede traffic flow. Table 2 shows theoretical capacities of different types of roads, which are used in the NRPC Travel Demand Model that was used for this analysis.

<table>
<thead>
<tr>
<th>TABLE 2 - THEORETICAL CAPACITIES (VPD)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Access Controlled</strong></td>
</tr>
<tr>
<td>Rural</td>
</tr>
<tr>
<td>Two Lane (no median)</td>
</tr>
<tr>
<td>Two Lane (median)</td>
</tr>
<tr>
<td>Four Lane</td>
</tr>
<tr>
<td>Six Lane</td>
</tr>
<tr>
<td>Eight Lane</td>
</tr>
<tr>
<td>Ramp (one lane)</td>
</tr>
<tr>
<td>Ramp (two lane)</td>
</tr>
<tr>
<td><strong>Non-Access Controlled (median)</strong></td>
</tr>
<tr>
<td>Rural</td>
</tr>
<tr>
<td>Six Lane</td>
</tr>
<tr>
<td>Four Lane</td>
</tr>
<tr>
<td>Two Lane</td>
</tr>
<tr>
<td><strong>Non-Access Controlled (no median)</strong></td>
</tr>
<tr>
<td>Rural</td>
</tr>
<tr>
<td>Six Lane</td>
</tr>
<tr>
<td>Four Lane</td>
</tr>
<tr>
<td>Two Lane</td>
</tr>
<tr>
<td><strong>Non-Access Controlled (center lane)</strong></td>
</tr>
<tr>
<td>Rural</td>
</tr>
<tr>
<td>Six Lane</td>
</tr>
<tr>
<td>Four Lane</td>
</tr>
<tr>
<td>Two Lane</td>
</tr>
<tr>
<td><strong>One Way</strong></td>
</tr>
<tr>
<td>Rural</td>
</tr>
<tr>
<td>Three Lanes</td>
</tr>
<tr>
<td>Two Lanes</td>
</tr>
<tr>
<td>One Lane</td>
</tr>
<tr>
<td><strong>Unbalanced</strong></td>
</tr>
<tr>
<td>Rural</td>
</tr>
<tr>
<td>Three lanes</td>
</tr>
</tbody>
</table>
C. **Evacuation to Emergency Shelter at Nashua High School North**

Nashua High School North is located on the north side of the Nashua River, on Chuck Druding Drive, as shown on Figure 2. Chuck Druding Drive, a dead-end street, is one leg of a four-legged roundabout; across the circle from that leg is Coburn Avenue, and the remaining two legs carry Broad Street (NH 130). This roundabout is approximately 1.5 miles west of F.E. Everett (FEE) Turnpike Exit 6.

Chuck Druding Drive is a two-lane local road that essentially turns into the driveway and parking area for the high school and can carry approximately 16,600 vpd. There is one dead-end residential street, Souhegan Drive, located off of the Chuck Druding Drive.

Evacuation traffic originating from the east side of Nashua north of the Nashua River could access the emergency shelter at Nashua High School North by navigating to Amherst Street then to Broad Street. Major routes along this path include Canal Street, which has a capacity of approximately 12,500 vehicles per day (vpd). Main Street would also be used along this route to Broad Street; the one-tenth of a mile of Main Street between Canal and Amherst Streets can carry approximately 25,800 vpd, as can Amherst Street for its extent to the Broad Street intersection. The intersection of Broad Street and Amherst Street is high-volume under normal conditions and would likely need a police presence in an emergency situation.

At its eastern terminus, Broad Street can carry approximately 15,000 vpd. This capacity level increases about one-half mile west of the Amherst Street intersection to 31,600 vehicles per day (vpd) and maintains this level to just west of FEE Turnpike Exit 6. However, that capacity is reduced by 50% to 15,800 vpd as Broad Street goes from a 4-lane urban road to a two-lane urban road just west of the interchange, in the direction of travel to the emergency shelter at the High School from the Turnpike. The capacity drops again to 15,000 vpd as the geometry of the road changes to no longer include a center turning lane/median, and it remains at this level until Broad Street crosses the Nashua/Hollis boundary, approximately 1 mile west of High School. These drops in capacity would result in potential bottlenecks as large numbers of evacuees drive west towards the shelter.

Coburn Avenue could also be used as a route to the shelter at the High School by the residents in the neighborhoods north-northwest of Broad Street. Coburn Avenue can potentially carry 16,600 vpd, as can the other suburban, two-lane roads connected to it.

Evacuees originating northwest and northeast of the Nashua River could be transported via the Turnpike south to Exit 6 then drive west on Broad Street to the shelter at Nashua High School North. The capacity of the Turnpike southbound is 35,000 vpd from the Nashua/Merrimack boundary south to Exit 8, and 54,500 south of Exit 8. If the northbound lane were reversed to allow southbound travel, that would increase southbound capacity by 35,000 vpd north of Exit 8 (where there are 2 northbound lanes) and 54,500 vpd south of Exit 8 (where there are 3 northbound lanes).

Amherst Street (NH 101A) would play a significant role for evacuees from the northwest side of Nashua, as residents head to Exits 7 and 8 to access the Turnpike. The western end of Amherst Street can potentially carry 47,500 vpd to the Somerset Parkway, the eastbound lanes of which could then be taken by approximately 35,000 vpd to Exit 8. In an evacuation situation, the
Westbound lanes of the Parkway could be reversed and also carry an additional 35,000 vehicles per day to Exit 8.

Approximately one-third of a mile east the Somerset Parkway, the capacity of Amherst Street drops to 31,600 vpd due to a decrease in the number of lanes. The capacity drops again to 16,600 vpd east of Exit 7, at the intersection of Amherst Street and the Henri Burque Highway (US 3). The intersection of Henri Burque Highway with Amherst Street is another significant intersection that would likely require a police presence to manage traffic efficiently in an emergency situation. This intersection could become problematic if Henri Burque Highway, with a capacity of 17,400 vpd, is used to get to Exit 7 by evacuees leaving the densely populated neighborhoods of north Nashua around Manchester Street and Concord Street. Both of these streets can carry 16,600 vehicles per day, and have a traffic signal at their respective intersections with the Henri Burque Highway. South of those intersections, Manchester Street converges with Concord Street just north of the Main Street/Amherst Street/Concord Street/Lowell Street signalized intersection.

There are many signalized and unsignalized intersections along the potential routes to the emergency shelter at Nashua High School North. Figure 12 displays several but not all of the major signalized and unsignalized intersections. Many of the streets in the densely populated residential neighborhoods that intersect with Manchester and Concord Streets do so without a traffic signal. There is great potential for several smaller roads to be used as cut through roads to Amherst Street.

There is a gated driveway to Nashua High School North off of Cheyanne Drive, near the southeast corner of the school grounds, which could also provide access to the emergency shelter. To get to this access point, vehicles would have to navigate along densely populated residential streets.

Table 3 summarizes the capacities and potential choke points discussed above.
FIGURE 12: POTENTIAL EVACUATION ROUTES TO EMERGENCY SHELTER AT NASHUA HIGH SCHOOL NORTH
<table>
<thead>
<tr>
<th>Route/Road</th>
<th>From</th>
<th>To</th>
<th>Capacity (vpd)</th>
<th>Description</th>
<th>Distance (mi)</th>
<th>Potential Problems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chuck Druding Dr</td>
<td>Roundabout/ Broad St</td>
<td>Emergency Shelter/ Nashua HS North</td>
<td>16,600</td>
<td>2 lanes; suburban; private road</td>
<td>0.4</td>
<td></td>
</tr>
<tr>
<td>Bridge St</td>
<td>Taylor Falls Bridge (Nashua/Hudson Line)</td>
<td>Canal St</td>
<td>15,000</td>
<td>2 lanes; urban</td>
<td>0.4</td>
<td></td>
</tr>
<tr>
<td>Canal St</td>
<td>Bridge St</td>
<td>Main St</td>
<td>12,500</td>
<td>2 lanes; Central Business District (CBD)</td>
<td>0.6</td>
<td>Unsignalized intersections with residential streets</td>
</tr>
<tr>
<td>Main St</td>
<td>Canal St</td>
<td>Amherst St</td>
<td>25,800</td>
<td>4 lanes; CBD</td>
<td>0.1</td>
<td>Major signalized intersection at Main/Amherst/Concord/ Lowell Streets</td>
</tr>
<tr>
<td>Amherst St</td>
<td>east of Broad Street</td>
<td>Main St</td>
<td>25,800</td>
<td>4 lanes; CBD</td>
<td>0.3</td>
<td>Major signalized with Broad St</td>
</tr>
<tr>
<td></td>
<td>Fairmount St</td>
<td>Broad St</td>
<td>25,000</td>
<td>3 lanes; suburban</td>
<td>0.4</td>
<td>Unsignalized intersections with potential cut through roads (eg, with Sargent Av)</td>
</tr>
<tr>
<td>Broad St</td>
<td>east of Chuck Druding Dr</td>
<td>Amherst St</td>
<td>15,000</td>
<td>2 lanes; urban</td>
<td>0.2</td>
<td>Decrease in capacity from Amherst St</td>
</tr>
<tr>
<td></td>
<td>Pine Hill Av</td>
<td>Gusabel Av</td>
<td>31,600</td>
<td>4 lanes; median; urban</td>
<td>0.7</td>
<td>Major signalized intersections (Tpke off-ramps)</td>
</tr>
<tr>
<td></td>
<td>Gusabel Av</td>
<td>Dublin Av</td>
<td>15,800</td>
<td>2 lanes; median; urban</td>
<td>0.6</td>
<td>Reduction in number of lanes (4 to 2)</td>
</tr>
<tr>
<td></td>
<td>Dublin Av</td>
<td>Roundabout/Chuck Druding Dr</td>
<td>15,000</td>
<td>2 lanes; urban</td>
<td>0.7</td>
<td>Unsignalized intersection with Dublin Av</td>
</tr>
<tr>
<td></td>
<td>(west of Chuck Druding Dr)</td>
<td>Nashua/Hollis Line</td>
<td>15,000</td>
<td>2 lanes; urban</td>
<td>0.9</td>
<td></td>
</tr>
<tr>
<td>Coburn Av</td>
<td>Roundabout/ Broad St</td>
<td>Pine Hill Rd</td>
<td>16,600</td>
<td>2 lanes; suburban</td>
<td>1.4</td>
<td>Unsignalized intersections with residential streets</td>
</tr>
<tr>
<td>FE Everett Tpke SB</td>
<td>Exit 8</td>
<td>Exit 7</td>
<td>54,500</td>
<td>one-way; 3 lanes; access controlled</td>
<td>0.8</td>
<td>On-ramp merging</td>
</tr>
</tbody>
</table>
### Route/Road

<table>
<thead>
<tr>
<th>Route/Road (which could be reversed for a mass evacuation)</th>
<th>From</th>
<th>To</th>
<th>Capacity (vpd)</th>
<th>Description</th>
<th>Distance (mi)</th>
<th>Potential Problems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amherst St (west of Broad Street)</td>
<td>Exit 7</td>
<td>Exit 6</td>
<td>72,125</td>
<td>one-way; 4 lanes; access controlled</td>
<td>0.4</td>
<td>Exit 6 off-ramp to Broad St</td>
</tr>
<tr>
<td>Nashua/Merrimack Line</td>
<td>Wallingford Dr</td>
<td>Trafalgar Sq/Airport Rd</td>
<td>39,550</td>
<td>5 lanes; median; urban</td>
<td>1.7</td>
<td>Signalized intersection with Thornton Rd</td>
</tr>
<tr>
<td>Wallingford Dr</td>
<td>Trafalgar Sq/Airport Rd</td>
<td>Henri Burque Hwy (US 3)</td>
<td>47,500</td>
<td>6 lanes; median; urban</td>
<td>0.8</td>
<td>Major signalized intersection with Somerset Pkwy</td>
</tr>
<tr>
<td>Trafalgar Sq/Airport Rd</td>
<td>Henri Burque Hwy (US 3)</td>
<td>Broad St</td>
<td>31,600</td>
<td>4 lanes; median; urban</td>
<td>0.9</td>
<td>Reduction in number of lanes (6 to 4); Major signalized intersection with Henri Burque Hwy</td>
</tr>
<tr>
<td>Henri Burque Hwy (US 3)</td>
<td>Broad St</td>
<td>Amherst St</td>
<td>16,600</td>
<td>2 lanes; suburban</td>
<td>0.7</td>
<td>Reduction in number of lanes (4 to 2); Various signalized and unsignalized intersections</td>
</tr>
<tr>
<td>Somerset Pkwy EB*</td>
<td>Amherst St</td>
<td>Exit 8</td>
<td>35,000</td>
<td>one-way; 2 lanes; access controlled</td>
<td>0.6</td>
<td>*WB could also carry 35,000 in a contraflow scenario</td>
</tr>
<tr>
<td>Henri Burque Hwy</td>
<td>Amherst St</td>
<td>Concord St</td>
<td>17,400</td>
<td>2 lanes; access controlled</td>
<td>1.4</td>
<td>Signalized intersections (see streets below)</td>
</tr>
<tr>
<td>Manchester St</td>
<td>Nashua/Merrimack Line</td>
<td>Concord St</td>
<td>16,600</td>
<td>2 lanes; suburban</td>
<td>2.1</td>
<td>Major signalized intersection with Henri Burque Hwy and various unsignalized intersections</td>
</tr>
<tr>
<td>Concord St</td>
<td>Nashua/Merrimack Line</td>
<td>Main St/Amherst St/Lowell St</td>
<td>16,600</td>
<td>2 lanes; suburban</td>
<td>2.0</td>
<td>Major signalized intersection with Henri Burque Hwy and Main St; various unsignalized intersections</td>
</tr>
</tbody>
</table>

### FEE Turnpike Ramps

<table>
<thead>
<tr>
<th>FEE Turnpike Ramps</th>
<th>Capacity (vpd)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exit 8 SB On-Ramp</td>
<td>From Somerset Pkwy</td>
<td>26,000</td>
</tr>
<tr>
<td>Exit 7 SB On-Ramp</td>
<td>From Circumferential Hwy</td>
<td>26,000</td>
</tr>
<tr>
<td>Exit 6 SB Off-Ramp</td>
<td>To Broad St</td>
<td>26,000</td>
</tr>
</tbody>
</table>
D. **Evacuation to Emergency Shelter at Nashua High School South**

Nashua High School South is located on the south side of the Nashua River, on Riverside Street. Riverside Street is a dead-end road located off of West Hollis Street (NH 111). The West Hollis Street intersection with Riverside Street is signalized and located approximately one-half mile west of F.E. Everett (FEE) Turnpike Exit 5W. The capacity of Riverside Street is approximately 16,600 vpd.

Riverside Street may also be accessed via Panther Drive, a one-way two lane street that acts as a connector between West Hollis Street and Riverside Street. Panther Drive is approximately one-tenth of a mile east of the West Hollis Street/Riverside Street intersection (see Figure 13). At West Hollis Street, the access to Panther Lane for west bound traffic is via a slip lane; east bound traffic would need to make a left-hand turn at the unsignalized intersection. Both lanes of Panther Drive must yield to traffic already on Riverside Street heading towards the high school.

Traffic from the east side of Nashua could use several routes to get to the emergency shelter at Nashua High School South. Starting at the Merrimack River crossing at Taylor Falls Bridge and moving easterly, East Hollis Street has a theoretical capacity of approximately 15,000 vpd from to Marshall Street, where the capacity drops to 12,500 as vehicles enter the downtown area of Nashua. There are several signalized and unsignalized intersections along East Hollis Street; major signalized intersections include East Hollis and Allds Street, and East Hollis and Main Street.

Continuing west, East Hollis Street becomes West Hollis Street, which is a one-way, two lane urban street with a theoretical capacity of 14,000 vpd. As the road leaves the downtown area around Pine Street and becomes a more suburban road, the capacity increases to 16,000 vpd. At Twelfth Street, the number of lanes increases to three, with a capacity increase to 24,600 vpd until Simon Street, where the number of lanes goes back to two. Between Twelfth and Simon Streets, there are several intersections with primarily residential streets, several of which are also one-way and act as cut through streets between West Hollis Street and Kinsley Street (which is also one-way in an easterly direction). There is a signal at Liberty Street, which allows one-way traffic to move from Kinsley to West Hollis Street. If the flow of traffic were reversed on Kinsley Street, it could be use to move about 16,600 vpd westerly toward the shelter.

At Simon Street, the capacity decreases to 16,600 vpd as West Hollis Street approaches the FEE Turnpike Exit 5 ramps. At the ramps, the road changes from one-way with two lanes to two-way with four lanes, and its capacity increases to 33,300 vpd until just west of Riverside Drive. Within this extent are the unsignalized intersection with Panther Drive and the signalized intersection with Riverside Drive.

With two lanes in a suburban area, Allds Street on the east side of Nashua has a capacity of 16,600 vpd and could be used by evacuees in the surrounding neighborhoods. There are signalized intersections with East Hollis Street at the northern end of Allds Street and with Main Street at the southern end.

Lake Street could also play a significant role in evacuating traffic from east of the turnpike and south of West Hollis Street, where there are very densely populated residential neighborhoods. Lake Street can theoretically carry 16,600 vpd as a two lane suburban road and has numerous unsignalized intersections with the many residential streets in this area of Nashua. However, as there is no direct way to get to West Hollis Street or Riverside Drive from the west end of Lake
Street, traffic would have to use one of the “cut through” roads between Kinsley and West Hollis Streets (unless flow were reversed on Kinsley St). One road that would be likely used to cut across to West Hollis Street is Pine Street, which extends from Lake Street northerly across Kinsley and West Hollis Streets to Ledge Street. There are signalized intersections with Kinsley and West Hollis Streets, as well as several unsignalized intersections. Traffic on the east end of Lake Street could navigate to Main Street, then go either south to East Dunstable Road to access the FEE Turnpike at Exit 4, or north to West Hollis Street.

East of the turnpike and south of Lake Street, Daniel Webster Highway (DW Highway) and Main Street are the primary north/south roads, with east/west connections to the Turnpike. Starting at the Massachusetts/New Hampshire border, DW Highway is a four lane, non-access controlled urban road, with a median separating the opposing lanes of travel and a capacity of approximately 31,600 vpd until its intersection with Graham Drive. There are many signalized and unsignalized intersections along this stretch of highway, which has two opportunities for motorists to access the FEE Turnpike: via Spit Brook Road to the Exit 1 northbound on-ramp, and via the Circumferential Highway to the Exit 2 northbound on-ramp. The intersection with Spit Brook Road is signalized, and from the DW Highway to the ramps, Spit Brook Road can carry approximately 30,000 vpd on 4 lanes. Traffic can access Exit 2 via a slip lane off DW Highway to a one lane ramp (capacity = 26,000 vpd) to the Circumferential Highway, which can carry approximately 32,900 vpd on two access controlled one-way lanes.

About a tenth of a mile north of the Exit 2 access point discussed above is a signalized intersection with Veteran’s Drive, which connects to the southern end of Main Street. Both of these two lane streets have a capacity of 16,600 vpd and would be used by the many residents living east of DW Highway in this area of Nashua. Therefore, the intersection could be problematic as evacuees attempt left hand turns out of Veteran’s Drive onto DW Highway as they head toward the Circumferential Highway and Exit 2; for southbound traffic on DW Highway, the left-hand turn onto the ramp to the Circumferential Highway is at a signalized intersection.

At Graham Drive, DW Highway becomes access controlled with divided northbound and southbound lanes of travel for approximately one-half mile to Robinson road, which is just north of the FEE Turnpike Exit 3 northbound on-ramp. The on-ramp is two lanes, and can carry 26,000 vehicles to the turnpike. At Robinson Road, the opposing lanes of travel are no longer divided, and DW Highway intersects with Main Street at a three-leg rotary, with Main Street making up two of the legs and continuing northerly to the five-way intersection just north of the Nashua River in the downtown area. Between the rotary and East Dunstable Road, Main Street is a two-lane road with a capacity of 16,600 vpd. At East Dunstable Road intersection, a second southbound lane increases the total number of lanes to three and the road capacity to 22,500 vpd. At Allds Street, approximately one-half mile north of East Dunstable Road, a second northbound lane increases the total number of lanes to four and the road’s capacity to about 30,000 vpd. This capacity drops slightly to 25,800 vpd around Otterson Street as Main Street enters the downtown business district, and remains at that value to the end of Main Street, past the West Hollis Street intersection. There are many signalized and unsignalized intersections along Main Street (see Table 4).

East Dunstable Road provides direct access to FEE Turnpike Exit 4 for the many residential properties in South Nashua. East Dunstable Road is a two lane suburban road with a capacity of 16,600 vpd. There are many unsignalized intersections with residential streets along East
Dunstable Road. The capacity increases to 34,100 vpd between Harris Road and Lund Road due to an increase in the number of lanes to four to accommodate traffic entering and exiting the Turnpike at Exit 4. Within this extent, there are four signalized intersections: at Harris Road, at the Exit 4 southbound ramps, at the Exit 4 northbound ramps, and at Lund Road. As the road changes from a four lane road with a median to a two lane road with no median, the capacity drops back down to 16,600 vpd from Lund Road to the signalized intersection at Main Street.

Main Dunstable Road would also likely be utilized by evacuees originating in the southern part of Nashua as it intersects directly with West Hollis Street, approximately two-tenths of a mile east of Panther Drive. Main Dunstable Road is a two-lane road with a theoretical capacity of 16,600 vpd from its intersection with Groton Road to Sagamore Road. At Sagamore Road, the area around Main Dunstable Road become more urban in nature, so the capacity decreases to 15,000 vpd. At Northeastern Boulevard, the capacity increases back to 16,600 vpd as the area reverts back to suburbia.

Traffic west/southwest of the emergency shelter at Nashua High School South would use West Hollis Street to navigate directly to Riverside Street. The theoretical capacity of West Hollis Street from the Nashua/Hollis municipal boundary easterly to Landsdown Drive is 16,600 vpd and along that extent, there are several unsignalized intersections with residential streets. At Landsdown Drive, the capacity increases to 33,300 vpd with the addition of two additional travel lanes in each direction. There is approximately one-tenth of a mile between Landsdown Drive and the signalized intersection at Riverside Street.

There is also a gated driveway to Nashua High School South directly off of FEE Turnpike South, just north of the Exit 5 off-ramp. The number of vehicles this one-lane paved road could carry would be relatively low but it would provide an additional access point to the emergency shelter.

Figure 13 displays and Table 4 summarizes the capacities and potential choke points discussed above.
FIGURE 13: POTENTIAL EVACUATION ROUTES TO EMERGENCY SHELTER AT NASHUA HIGH SCHOOL SOUTH
### Table 4 - Summary of Capacities Along Major Routes to Nashua High School South

<table>
<thead>
<tr>
<th>Route/Road</th>
<th>From</th>
<th>To</th>
<th>Capacity (vpd)</th>
<th>Description</th>
<th>Distance (mi)</th>
<th>Potential Problems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Riverside Dr</td>
<td>West Hollis St</td>
<td>Nashua HS South</td>
<td>16,600</td>
<td>2 lanes; suburban</td>
<td>0.7</td>
<td>Unsignalized intersection with Panther Drive</td>
</tr>
<tr>
<td>Panther Dr</td>
<td>West Hollis St</td>
<td>Riverside Dr</td>
<td>16,600</td>
<td>2 lanes; suburban</td>
<td>0.2</td>
<td>Unsignalized intersection with Riverside Drive</td>
</tr>
<tr>
<td>East Hollis St</td>
<td>Taylor Falls Bridge (Nashua/Hudson line)</td>
<td>Marshall St</td>
<td>15,000</td>
<td>2 lanes; urban</td>
<td>0.5</td>
<td>Major signalized intersection with Allds St</td>
</tr>
<tr>
<td></td>
<td>Marshall St</td>
<td>Main St</td>
<td>12,500</td>
<td>2 lanes; CBD</td>
<td>0.4</td>
<td>Major signalized intersection with Main St</td>
</tr>
<tr>
<td>West Hollis St (east of Riverside Dr)</td>
<td>Main St</td>
<td>Pine St</td>
<td>14,000</td>
<td>one-way; 2 lanes; CBD</td>
<td>0.4</td>
<td>Major signalized intersection with Main St</td>
</tr>
<tr>
<td></td>
<td>Pine St</td>
<td>Twelfth St</td>
<td>16,600</td>
<td>one-way; 2 lanes; CBD</td>
<td>0.7</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Twelfth St</td>
<td>Simon St</td>
<td>24,600</td>
<td>one-way; 3 lanes; suburban</td>
<td>0.3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Simon St</td>
<td>FEE Tpke SB on-ramp</td>
<td>16,600</td>
<td>one-way; 2 lanes; suburban</td>
<td>0.4</td>
<td>Unsignalized intersection with Exit 5 off-ramp (has own lane)/Main Dunstable Rd</td>
</tr>
<tr>
<td></td>
<td>FEE Tpke Exit 5 SB on-ramp</td>
<td>Landsdown Dr</td>
<td>33,300</td>
<td>two-way; 4 lanes; suburban</td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td>(west of Riverside Dr)</td>
<td>Landsdown Dr</td>
<td>Nashua/Hollis line</td>
<td>16,600</td>
<td>2 lanes; suburban</td>
<td>2.7</td>
<td>Unsignalized intersections with residential streets</td>
</tr>
<tr>
<td>Allds St</td>
<td>East Hollis St</td>
<td>Main St</td>
<td>16,600</td>
<td>2 lanes; suburban</td>
<td>1.0</td>
<td>Signalized intersections at both ends; unsignalized intersections with residential streets</td>
</tr>
<tr>
<td>Route/Road</td>
<td>From</td>
<td>To</td>
<td>Capacity (vpd)</td>
<td>Description</td>
<td>Distance (mi)</td>
<td>Potential Problems</td>
</tr>
<tr>
<td>------------------------------------</td>
<td>-----------------------</td>
<td>------------------------</td>
<td>----------------</td>
<td>------------------------------------</td>
<td>---------------</td>
<td>-------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Lake St</td>
<td>Main St</td>
<td>Exit 5 NB off-ramp</td>
<td>16,600</td>
<td>2 lanes; suburban</td>
<td>1.5</td>
<td>Many unsignalized intersections with residential streets</td>
</tr>
<tr>
<td>Pine St</td>
<td>Lake Street</td>
<td>West Hollis St</td>
<td>12,500</td>
<td>2 lanes; CBD</td>
<td>0.5</td>
<td>Many unsignalized intersections with residential streets</td>
</tr>
<tr>
<td>FE Everett Tpke NB</td>
<td>Exit 1</td>
<td>Exit 5</td>
<td>54,500</td>
<td>one-way; 3 lanes; access controlled</td>
<td>4.0</td>
<td>Merging traffic at on-ramps; Exit 5W off-ramp to West Hollis St</td>
</tr>
<tr>
<td>FE Everett Tpke NB</td>
<td>Massachusetts/New Hampshire State Line</td>
<td>Graham Dr</td>
<td>31,600</td>
<td>4 lanes; median; urban</td>
<td>2.1</td>
<td>Major signalized intersections with Spit Brook Road and Exit 2 ramps; signalized intersection with Veterans Dr; various unsignalized intersections and driveway entrances</td>
</tr>
<tr>
<td>DW Hwy</td>
<td>Graham Dr</td>
<td>Exit 3 NB on-ramp</td>
<td>35,000</td>
<td>one-way; 2 lanes; access controlled</td>
<td>0.6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Exit 3 NB on-ramp</td>
<td>Robinson Rd</td>
<td>26,000</td>
<td>1 lane ramp; access controlled</td>
<td>0.2</td>
<td>Roundabout at South Main St; Signalized intersection with East Dunstable Rd</td>
</tr>
<tr>
<td>Main Street</td>
<td>Robinson Rd</td>
<td>East Dunstable Rd</td>
<td>16,600</td>
<td>2 lanes; suburban</td>
<td>0.3</td>
<td>Roundabout at South Main St; Signalized intersection with East Dunstable Rd</td>
</tr>
<tr>
<td>East Dunstable Rd</td>
<td>Allds St</td>
<td></td>
<td>22,500</td>
<td>3 lanes; urban</td>
<td>0.5</td>
<td>Signalized intersection with Allds St</td>
</tr>
<tr>
<td>Allds St</td>
<td>Otterson St</td>
<td></td>
<td>30,000</td>
<td>4 lanes; urban</td>
<td>0.3</td>
<td>Signalized intersection with Lake St</td>
</tr>
<tr>
<td>Otterson St</td>
<td>West Hollis St</td>
<td></td>
<td>25,800</td>
<td>4 lanes; CBD</td>
<td>0.3</td>
<td>Signalized intersection with West Hollis St</td>
</tr>
<tr>
<td>Route/Road</td>
<td>From</td>
<td>To</td>
<td>Capacity (vpd)</td>
<td>Description</td>
<td>Distance (mi)</td>
<td>Potential Problems</td>
</tr>
<tr>
<td>-------------------</td>
<td>-----------------</td>
<td>------------------</td>
<td>----------------</td>
<td>---------------------------</td>
<td>---------------</td>
<td>-------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Spit Brook Rd</td>
<td>DW Hwy</td>
<td>Exit 1 ramps</td>
<td>30,000</td>
<td>4 lanes; urban</td>
<td>0.4</td>
<td>Signalized intersection with ramps</td>
</tr>
<tr>
<td>East Dunstable Rd</td>
<td>Spit Brook Rd</td>
<td>Harris Rd</td>
<td>16,600</td>
<td>2 lanes; suburban</td>
<td>1.4</td>
<td>Signalized intersection with Harris Road; Unsignalized intersections with residential streets</td>
</tr>
<tr>
<td></td>
<td>Harris Rd</td>
<td>Lund Rd</td>
<td>34,100</td>
<td>4 lanes; median; suburban</td>
<td>0.2</td>
<td>Signalized intersections with Exit 4 ramps and Lund Road</td>
</tr>
<tr>
<td>Lund Rd</td>
<td>Main St</td>
<td>16,600</td>
<td></td>
<td></td>
<td>0.7</td>
<td>Signalized intersection with Main St</td>
</tr>
<tr>
<td>Main Dunstable Rd</td>
<td>Groton Rd</td>
<td>Sagamore Rd</td>
<td>16,600</td>
<td>2 lanes; suburban</td>
<td>1.7</td>
<td>Unsignalized intersections with residential streets</td>
</tr>
<tr>
<td></td>
<td>Sagamore Rd</td>
<td>Northeastern Blvd</td>
<td>15,000</td>
<td>2 lanes; urban</td>
<td>1.2</td>
<td>Several signalized intersections (Conant Rd, Northeastern Blvd) and unsignalized intersections with residential streets</td>
</tr>
<tr>
<td>Northeastern Blvd</td>
<td>West Hollis St</td>
<td>16,600</td>
<td></td>
<td></td>
<td>0.3</td>
<td>Major signalized intersection with West Hollis St</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FEE Turnpike Ramps</th>
<th>Capacity (vpd)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exit 1 NB On-Ramp</td>
<td>26,000</td>
<td>1 lane</td>
</tr>
<tr>
<td>Exit 2 NB On-Ramp</td>
<td>32,900</td>
<td>2 lanes</td>
</tr>
<tr>
<td>Exit 3 NB On-Ramp</td>
<td>32,900</td>
<td>2 lanes</td>
</tr>
<tr>
<td>Exit 4 NB On-Ramp</td>
<td>26,000</td>
<td>1 lane</td>
</tr>
<tr>
<td>Exit 5W NB Off-Ramp</td>
<td>26,000</td>
<td>1 lane</td>
</tr>
</tbody>
</table>
E. Pandemic Planning

In response to the 2009 H1N1 influenza pandemic, much attention was focused on preparing for and mitigating the effects of large scale public health emergencies. The potential for impacts to the transportation system exist during a pandemic, primarily in the form of decreased personnel to manage the system and supply chain. The US Department of Homeland Security’s Highway and Motor Carrier Sub-Sector Pandemic Influenza Planning Guideline states:

“Whether transporting passengers by bus, taxi, or paratransit vehicle; shipping goods and services by commercial trucks around town or across the country; maintaining the nation’s highway infrastructure (i.e., highways bridges, tunnels and operations centers); working in a transportation-related job; or shipping or receiving transported goods, the Sub-Sector’s impact on the nation’s economy and social stability is significant. Any disruption to these key highway transportation services and infrastructure may cause significant local, regional and even national challenges potentially putting the delivery of critical food, fuel, and medical supplies, as well as emergency response equipment, supplies, and personnel at risk.”

Workforce numbers may be significantly reduced due to illness, parents/guardians having to stay home with sick children, employees refusing to go to work out of fear and fatigue in staff that are working extraordinary hours. The Homeland Security Council’s 2005 publication “Implementation Plan for the National Strategy for Pandemic Influenza” recommends that the public and private sectors plan for an absenteeism rate of approximately 40 percent for about two weeks at the height of a pandemic wave, with lower levels of staff absent for a few weeks on either side of the peak.

Because of the reduced workforce numbers, much of the planning guidance focuses on prioritizing essential services, functions, supplies and personnel, and developing continuity of operations plans to maintain delivery of those essential services, functions and supplies given potentially significant and sustained personnel shortages. It’s also suggested that “non-essential” services and functions be identified so that any available resources can be shifted to more essential uses. For example, buses may be rerouted from places such as shopping centers to locations offering health and medical services.

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5.0 Recommendations

This Emergency Preparedness Plan for the Nashua Region contains both general and specific information about how transportation systems may be affected by disasters and how to respond to those effects. General information includes how the MPO can play a role in regional emergency preparedness; summarized results of a literature review of key documents used within the region, state and nation; and a brief discussion on planning for pandemics. Specific information includes an analysis of the vulnerability of the transportation system in the Nashua Region, and data on the transportation network within the City of Nashua that could support evacuation route planning.

In looking at both the specific and the general information laid out in this document, the following recommendations are suggested for municipalities that are developing Emergency Preparedness plans:

A. **NETWORK VULNERABILITY:**
The network vulnerability analysis provided insight into how vehicular traffic may respond when certain bridges or road links are taken out of the transportation system. The analysis shows there is a need for additional capacity across the rivers in the region. Should a major bridge such as the Taylor Falls Bridge over the Merrimack River or the Nashua River crossing on the FEE Turnpike be closed to traffic, many of the alternative routes would exceed their capacity, potentially leading to gridlock. **Alternate routes** and **traffic control plans** need to be developed and evaluated so that when an emergency closure does occur, responders will have a set of clearly defined options and processes in place and can respond rapidly. **Intelligent Transportation Systems (ITS)** should be a part of the traffic control plans, including the use of Dynamic/Changeable Message Signs to direct rerouted traffic to the designated alternate routes and traffic signal coordination to manage traffic flow through signalized intersections most efficiently. As there are a limited number of river crossings in the region, the procurement and deployment of **temporary bridges/structures** should also be considered.

B. **EVACUATION PLANNING:**
Evacuation planning can be a very complex task involving many different agencies at the local, regional, state (including neighboring states) and federal levels. **Resources, communications, and operations must be coordinated** between agencies in advance of an emergency situation. The NRPC is equipped to assist with those coordination efforts by providing a forum where those involved in emergency response could discuss and coordinate existing resources and plans, form multi-agency task forces, evaluate potential evacuation routes using the NRPC travel demand model and GIS data, and develop strategies for moving large numbers of vehicles efficiently. Once evacuation routes are established, they need to be periodically reevaluated and refined. Should an evacuation event occur, the forum should be reconvened for a regional assessment of the organizational and transportation systems response so that any identified deficiencies can be corrected and to develop new strategies to better prepare the region for the next event.

It can be beneficial to involve the public in the emergency planning process, since most of those people affected by an emergency have no background in response and they may bring up issues that were not considered and provide insight into typical driver behavior. **Educating the public** once a plan is in place is also critical to effective evacuations. Running drills and providing
written materials such as the Emergency Public Information Calendar for Neighbors of Seabrook Station are great ways to keep the public involved and informed.

As previously mentioned, the NRPC travel demand model can be a very useful tool in establishing effective evacuation routes at a regional level. The model contains roadway data such as type of roadway (i.e., arterial, collector), number of lanes and lane widths, and theoretical capacities. The model can be used to develop time bands around an evacuation point, such as an emergency shelter, that give an estimation of drive time along the transportation system to that point.

The NRPC also has the data and expertise to assist municipalities to determine hourly roadway capacities, which can then be used to estimate the length of time it would take to evacuate an area. The formula for evacuation time is:

\[
\frac{\text{Evacuation Population}}{\text{Average Vehicle Occupancy}} = \frac{\text{Evacuation Time}}{\text{Hourly Roadway Capacity}}
\]

Using the data from the US Census to estimate the population of a municipality (or smaller areas using Census blocks), estimated roadway capacity from the NRPC model, and an average vehicle occupancy of 1.1 persons per vehicle, the formula can be used to estimate evacuation times.

One effective method for moving people is with the use of transit vehicles. An effort to quantify and coordinate the use of public and private buses should be conducted as part of evacuation plan development. The Nashua Transit System, First Student School Bus Transportation Services, local school districts (not using First Student) and other transit services should be part of the planning process. While this is important for putting a system in place that would reduce the number of private vehicles on congested roadways, it is especially critical for evacuating people without access to a vehicle. Table 5 below provides an estimate of the number of housing units in each municipality within the NRPC region that could potentially require transportation assistance.

**Table 5 - Housing Units with No Vehicle Available**

<table>
<thead>
<tr>
<th>Municipality</th>
<th>Total Population</th>
<th>Occupied Housing Units</th>
<th>Housing Units with No Vehicle Available</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amherst</td>
<td>10,769</td>
<td>3,590</td>
<td>82</td>
</tr>
<tr>
<td>Brookline</td>
<td>4,181</td>
<td>1,343</td>
<td>9</td>
</tr>
<tr>
<td>Hollis</td>
<td>7,015</td>
<td>2,440</td>
<td>105</td>
</tr>
<tr>
<td>Hudson</td>
<td>22,928</td>
<td>8,034</td>
<td>282</td>
</tr>
<tr>
<td>Litchfield</td>
<td>7,360</td>
<td>2,357</td>
<td>81</td>
</tr>
<tr>
<td>Lyndeborough</td>
<td>1,585</td>
<td>5,60</td>
<td>11</td>
</tr>
<tr>
<td>Mason</td>
<td>1,147</td>
<td>4,33</td>
<td>7</td>
</tr>
<tr>
<td>Merrimack</td>
<td>25,119</td>
<td>8,832</td>
<td>128</td>
</tr>
<tr>
<td>Milford</td>
<td>13,535</td>
<td>5,201</td>
<td>236</td>
</tr>
<tr>
<td>Municipality</td>
<td>Total Population</td>
<td>Occupied Housing Units</td>
<td>Housing Units with No Vehicle Available</td>
</tr>
<tr>
<td>---------------</td>
<td>------------------</td>
<td>------------------------</td>
<td>----------------------------------------</td>
</tr>
<tr>
<td>Mont Vernon</td>
<td>6,215</td>
<td>2,036</td>
<td>28</td>
</tr>
<tr>
<td>Nashua</td>
<td>86,605</td>
<td>34,614</td>
<td>2,877</td>
</tr>
<tr>
<td>Pelham</td>
<td>10,914</td>
<td>3,606</td>
<td>112</td>
</tr>
<tr>
<td>Wilton</td>
<td>3,743</td>
<td>1,410</td>
<td>48</td>
</tr>
</tbody>
</table>

Source: US Census 2000 Summary File 3 - Tenure by Vehicles Available (Universe: Occupied housing units)

Table 6 provides an estimate of the population in the region living in group quarters (all people not living in housing units), broken out into two categories: institutionalized population, which include those living in correctional facilities, nursing homes, psychiatric hospitals, hospitals for the chronically ill, and juvenile institutions, and non-institutionalized population, which includes those living in group or community homes, college dormitories, military quarters and emergency shelters.

<table>
<thead>
<tr>
<th>Municipality</th>
<th>Total Population</th>
<th>Institutionalized Population</th>
<th>Non-Institutionalized Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amherst</td>
<td>10,769</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Brookline</td>
<td>4,181</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Hollis</td>
<td>7,015</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Hudson</td>
<td>22,928</td>
<td>112</td>
<td>75</td>
</tr>
<tr>
<td>Litchfield</td>
<td>7,360</td>
<td>0</td>
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Source: US Census 2000 Summary File 3 - Household Type (including living alone) by Relationship (Universe: Total Population)

Transportation points where people without transportation resources can be picked up and taken to evacuation points (emergency shelters) should be identified and established. These locations should be large, well-known sites such as shopping centers, schools or town halls that people can reach by foot. Accommodations need to be pre-planned for the populations that are not mobile and who may require specialized transportation services such as paratransit vehicles equipped with wheelchair lifts or ramps. And transportation for people who are assisted by service animals should also be considered.
During an evacuation event, there are several strategies that can be implemented to enhance traffic flow and potentially reduce evacuation times:

- **Contra Flow Operations:** One strategy for conducting a large-scale evacuation is to use “reverse lane” or contra-flow tactics, where all travel lanes on a designated roadway proceed in one direction, generally towards an evacuation point (or away from the cause of the evacuation). This is typically done during daylight hours only on interstates or other divided and access-controlled highways such as the FE Everett Turnpike or Somerset Parkway. The benefit of contra-flow is that all available lanes on a highway can be used for evacuation purposes. Congestion at the entrance and exit points can significantly reduce the effectiveness of contra-flow operations and therefore, those points must be well planned. Effective placement of signage, barriers and law enforcement personnel is also critical to a successful implementation of this strategy.

- **Closure of Turnpike on and off-ramps:** To reduce congestion along evacuation routes such as the FE Everett Turnpike, it may be necessary to close some on-ramps that are between evacuation origins and destinations. Closure of off-ramps may also be necessary to ensure that evacuees stay on the designated evacuation routes.

- **Traffic Signal Coordination and Timing:** Traffic signal coordination and timing plans should be in place to maximize traffic control in an evacuation scenario. Depending on the extent of the evacuation, coordination may be required between municipalities or even regionally. Signals which can not be coordinated should be identified and alternate plans need to be made, such as setting those lights to flashing yellow or red.

- **Intelligent Transportation Systems (ITS):** As previously discussed, the use of ITS technologies should also be part of evacuation plans. One of the most common and available ITS tools is Dynamic or Changeable Message Signs that can provide valuable guidance and information to evacuees, directing them to evacuation routes and destinations as well as providing real-time information. Highway Advisory Radios can also be used to provide information to evacuees. Another ITS tool is traffic signal preemption; several NRPC communities already have these systems, which are activated via strobe emitters on emergency vehicles.

- **Phased Evacuation:** Roadway capacity may be maintained and congestion reduced by controlling access to evacuation routes in stages and geographical section. Phase evacuations can also be used to prioritize the evacuation of certain areas that are in immediate danger.

- **Road barriers:** When used in conjunction with other transportation strategies, road barriers can help keep evacuees on the designated routes, and block them from entering closed areas.

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