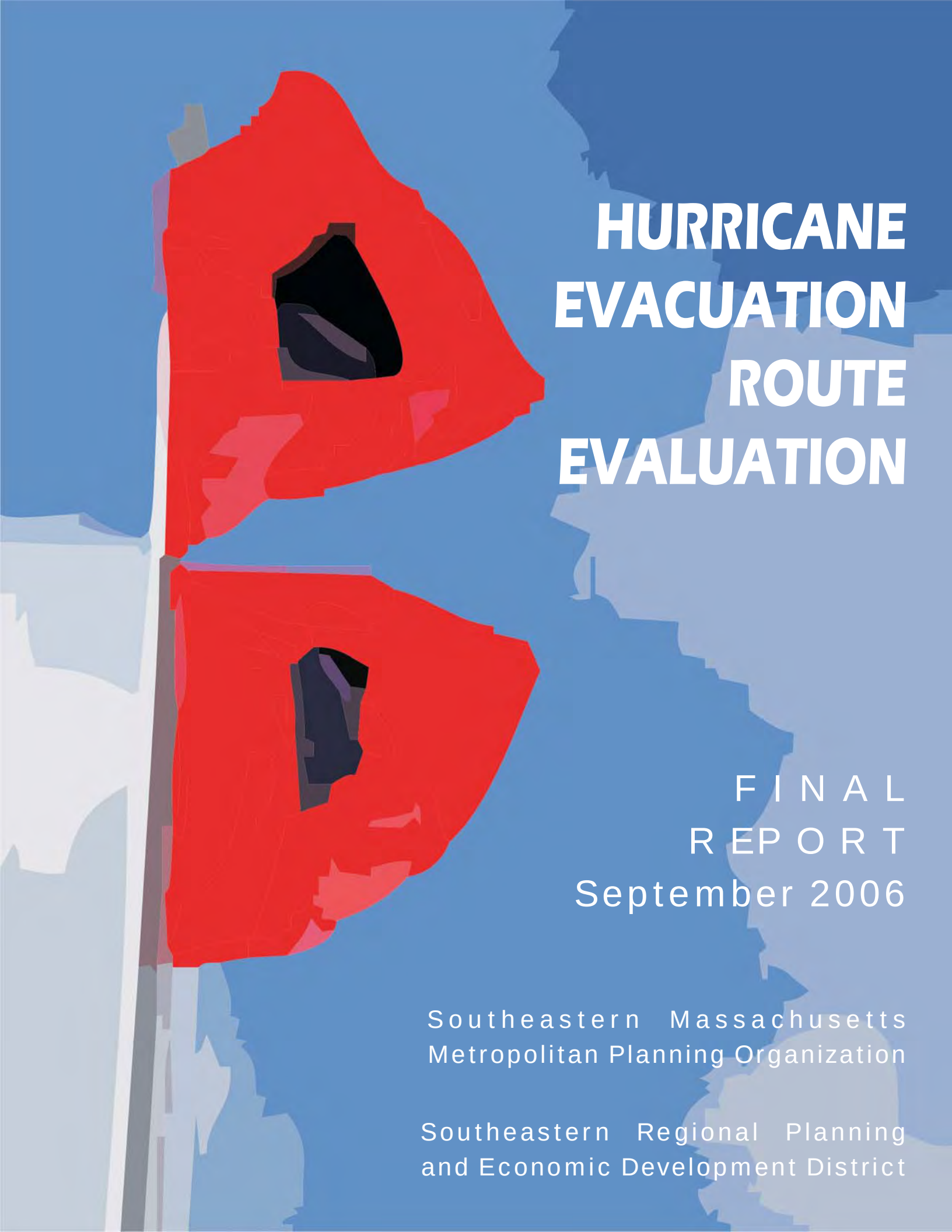

HURRICANE EVACUATION ROUTE EVALUATION

FINAL REPORT

September 2006

Southeastern Massachusetts Metropolitan Planning Organization

Southeastern Regional Planning and Economic Development District

SOUTHEASTERN MASSACHUSETTS METROPOLITAN PLANNING ORGANIZATION

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SRPEDD
HURRICANE EVACUATION ROUTE EVALUATION

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The Hurricane Evacuation Route Evaluation identified issues that may inhibit safe and effective traffic flow during an emergency. These issues include:

Evacuation Route Conflicts - Merging local evacuation routes for regional analysis found a lack of connectivity, gaps in designated routes, routes stopping at the community's borders or conflicting evacuation traffic flows.

Storm Surge Flooding - A worse case scenario, Marion and Wareham would experience the impact from a hurricane storm surge.

Community Issues - Wareham is the only community where total evacuees exceed the existing capacity of the town's emergency shelters. Wareham also has 4 shelters that could be flooded and one additional shelter would be isolated as a result of a storm surge.

Road System Impacts - Major roads impacted by a hurricane storm surge include I-195, Route 25, Route 6, and Route 28 in Buzzard's Bay coastal communities.

Major roads potentially impacted in Mount Hope Bay communities from a hurricane storm surge include I-195, Route 103, Route 136, Route 6, Route 138, and Route 79.

Evacuation Population and Traffic – In the SRPEDD area, nearly 58,000 people could be expected to seek shelter during a hurricane. Based on population projections, that number increases to 61,000 people by the year 2030.

Of the estimated 500,000 summer residents on Cape Cod, approximately 200,000 people could evacuate prior to a hurricane. This could equal 100,000 vehicles of which nearly 70,000 would travel northbound on Route 25 to I-495. This road normally carries 40,000 vehicles daily in both directions.

Based on the traffic estimates, it may require no less than 15 hours to evacuate Cape Cod and the Buzzard's Bay area via Route 25/I-495. The 1997 USACE Hurricane report recommends no less than 10 hours.

Several locations on the region's road network may inhibit safe and adequate evacuation traffic flow during an emergency situation. These locations include:

- I-495 north drops from 3 to 2 lanes between Rte. 25/I-195 and Rte. 24,
- Route 44 west drops from 2 to 1 lane from Rte. 58 & the Middleborough Rotary,
- Rte. 24/Rte. 140 interchange in Taunton, limited capacity and sub-standard ramps,
- Four of the 25 structurally deficient bridges on evacuation routes have no improvements planned for the immediate future.

Conclusions and Recommendations

- Establish a regional evacuation plan to assist emergency officials. This includes the identification of evacuation routes that are consistent across several communities and links to regional shelters.

- Enhance public awareness of shelter locations and evacuation routes through the distribution of promotional pamphlets, maps, cable television, local radio, community/state agency websites, etc.

- Continue to support the implementation of road improvements including:

    - Widening I-495 between I-195/Route 25 in Wareham to Route 24 in Raynham from two to three travel lanes in either direction,

    - Removal of the Middleborough Rotary and widening of Route 44 in Middleborough from one lane to two lanes in each direction.

    - Continued effort to expedite any and all repairs to structurally deficient bridges that are part of evacuation routes in the SRPEDD Region.

- Consider alternate locations or additional shelters outside of storm surge flood zone areas for the towns of Marion, Mattapoisett, and Wareham.

- Re-examination of Comprehensive Emergency Management plans with updated information is necessary by Cities and Towns. Communities need to be aware of what the neighboring city/town does during a regional emergency.

Introduction

2005 was a year of unprecedented storms including hurricane Katrina that devastated New Orleans, Louisiana and coastal Mississippi, This storm alone established the need for improved emergency management plans. Communities along the coastal areas of southeastern Massachusetts have been reviewing their Comprehensive Emergency Management Plans (CEM) to insure that a catastrophe like that of New Orleans would be better managed by Massachusetts communities and the state government.


AP / John Bazemore

Ironically, while these natural disasters occurred, the Southeastern Regional Planning and Economic Development District (SRPEDD) also began to examine evacuation routes designated by individual communities. These routes were merged together by the Massachusetts Emergency Management Agency (MEMA) for a regional network. SRPEDD examined traffic conditions on roads designated as evacuation routes and used Geographic Information Systems (GIS) to identify inconsistencies on evacuation routes between the communities.

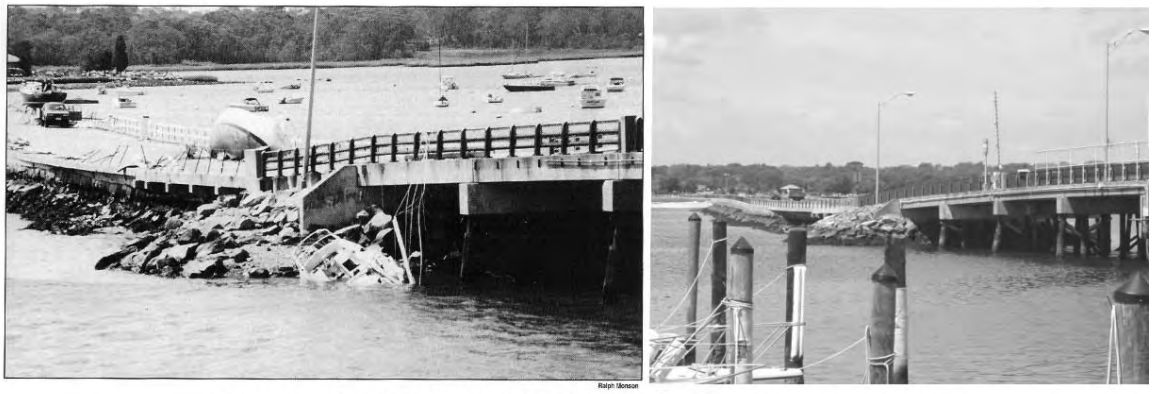
Inconsistencies were initially discovered while working on the Pre-Disaster Mitigation (PDM) plans and the Braga Bridge Disaster Route Evaluation Study for Fall River/Somerset, MA in 2004. SRPEDD received a grant for PDM to develop multi-jurisdiction hazard mitigation plans for all member communities. The focus of the PDM effort was to assist member communities in examining their existing evacuation plans and make appropriate changes for the update. Examination of the evacuation routes during this effort, along with our study of the Braga Bridge, discovered that there was a lack of logical connections between neighboring communities. Some evacuation routes either terminated at a town border or did not connect to the same road into the adjacent community.

This study will examine all evacuation routes within the SRPEDD region and take into account other potential road problems that would inhibit traffic flow in the event of a regional emergency. We will examine the potential impacts to the transportation network as a result of a hurricane threat to the SRPEDD Buzzards Bay and Mount Hope Bay communities. This effort will attempt to identify logical regional evacuation routes as well as identify problems that may inhibit safe and effective traffic flow during an emergency. These problems include:

- Evacuation route inconsistencies;
- Shelters in jeopardy of flooding;
- Congestion resulting from poor roadway layout or design;
- The locations of structurally deficient/functionally obsolete bridges on evacuation routes; and
- Any existing and future road construction that may hinder evacuation efforts.

Hurricanes

A hurricane is the most likely incident requiring a regional evacuation because of the regional impacts from wind and flooding. Areas along the coast including Cape Cod, southeastern Massachusetts and Rhode Island are all susceptible to damage caused by these storms. In the SRPEDD region, this includes two areas of concern: Mount Hope Bay and Buzzard's Bay areas. Mount Hope Bay includes the coastal communities of Fall River, Rehoboth, Seekonk, Somerset, and Swansea. Buzzard's Bay communities include Acushnet, Dartmouth, Fairhaven, Marion, Mattapoisett, New Bedford, Rochester, Wareham, and Westport.



Padanaram Bridge after Hurricane Bob (left) and as it is today (right).

Communities in Mount Hope Bay (greater Fall River area) would most likely see less of a storm surge than the Buzzard's Bay areas due to the fact that southern Rhode Island would absorb the brunt of the storm. Buzzards Bay, due in part to its geography, would act as a funnel and channel water inland pushed by the storm's winds. Population living along the waterfront of these communities could be forced to evacuate due to coastal flooding. Although wind is a concern for a larger area during a hurricane, the area most prone to flooding would require evacuation.[1]

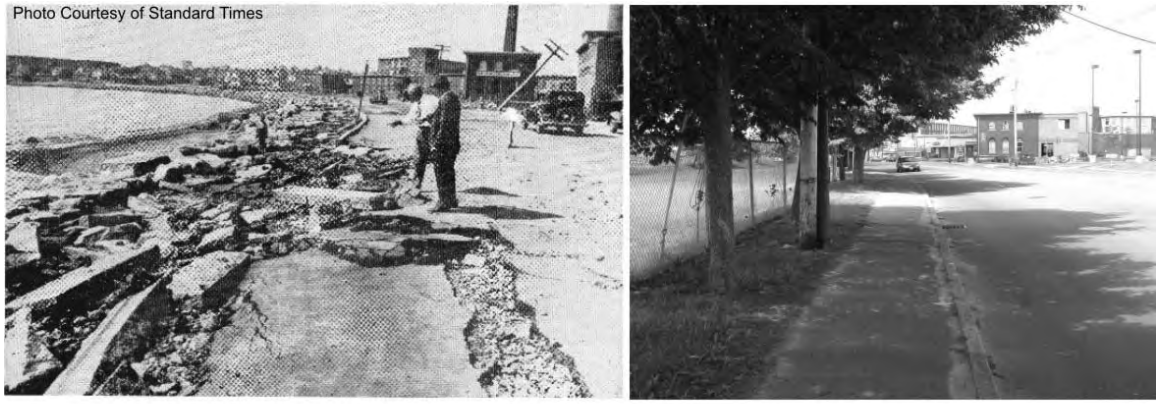
To help with the assessment of potential problems, many GIS data layers from a wide range of agencies were available to SRPEDD at the time of this study. Information used for the mapping included:

- Population Totals (*U.S. Census Bureau*)
- Road Inventory Files, Structurally Deficient, and Functionally Obsolete Bridges (*Executive Office of Transportation*)
- Evacuation Routes (*Massachusetts Emergency Management Agency*)
- Sea, Lake, and Overland Surges from Hurricanes (*United States Army Corps of Engineers*)
- Emergency Shelters (*Comprehensive Emergency Management Plans for each community*)

[1] Southern Massachusetts Hurricane Evacuation Study Technical Data Report, United States Army Corps of Engineers – New England District, May 1997, page 1-10.

- Police Department, Fire Department, and Town Hall Locations (*Southeastern Regional Planning & Economic Development District*)
- Existing and Future Road Projects (*Executive Office of Transportation and SRPEDD*)

Sea, Lake, and Overland Surges from Hurricanes (SLOSH) is a computerized model maintained by the National Hurricane Center to estimate storm surge heights and winds resulting from historical, hypothetical, or predicted hurricanes and by taking into account the storm's Pressure, Size, Forward speed, Track, and Winds. Graphical output from this model displays color-coded storm surge heights for a particular area in feet above the model's reference level, the National Geodetic Vertical Datum, which is the elevation reference for most maps. It is important to note the SLOSH model is accurate within a range of 20%, plus or minus. For example, if the model calculates a storm surges peak of 10 feet for the event, you can expect the observed peak to range from 8 to 12 feet.[2]



Cove Road after the Hurricane of 1938 (left) and as it is today (right).

The point of a hurricane's landfall is crucial in determining the areas that will be most impacted by the storm surge. If the hurricane's forecast track is inaccurate, the SLOSH model results will be inaccurate. The SLOSH model is best used for defining the potential maximum surge for a location, although emergency planners do not need information about storm surge heights in a real hurricane situation. They will only need to know the forecast of the storm's intensity at landfall and the tide at that time to be able to make an appropriate evacuation decision. Figure 1 shows the worse case scenario resulting from a category 3 storm of the SLOSH zones for each community in Buzzard's Bay.

Some general assumptions can immediately be made from this data. It is obvious that the entire coastline of the study area will be impacted by a hurricane. Looking at a worse case scenario, the towns that would experience the greatest impact would be the towns of Marion and Wareham. Although this requires the weather conditions during a hurricane event to peak simultaneously during high tide, it is still of some concern that a significant amount of flooding will occur over most of both towns.

[2] Southern Massachusetts Hurricane Evacuation Study Technical Data Report, United States Army Corps of Engineers – New England District, May 1997, page 2-5.

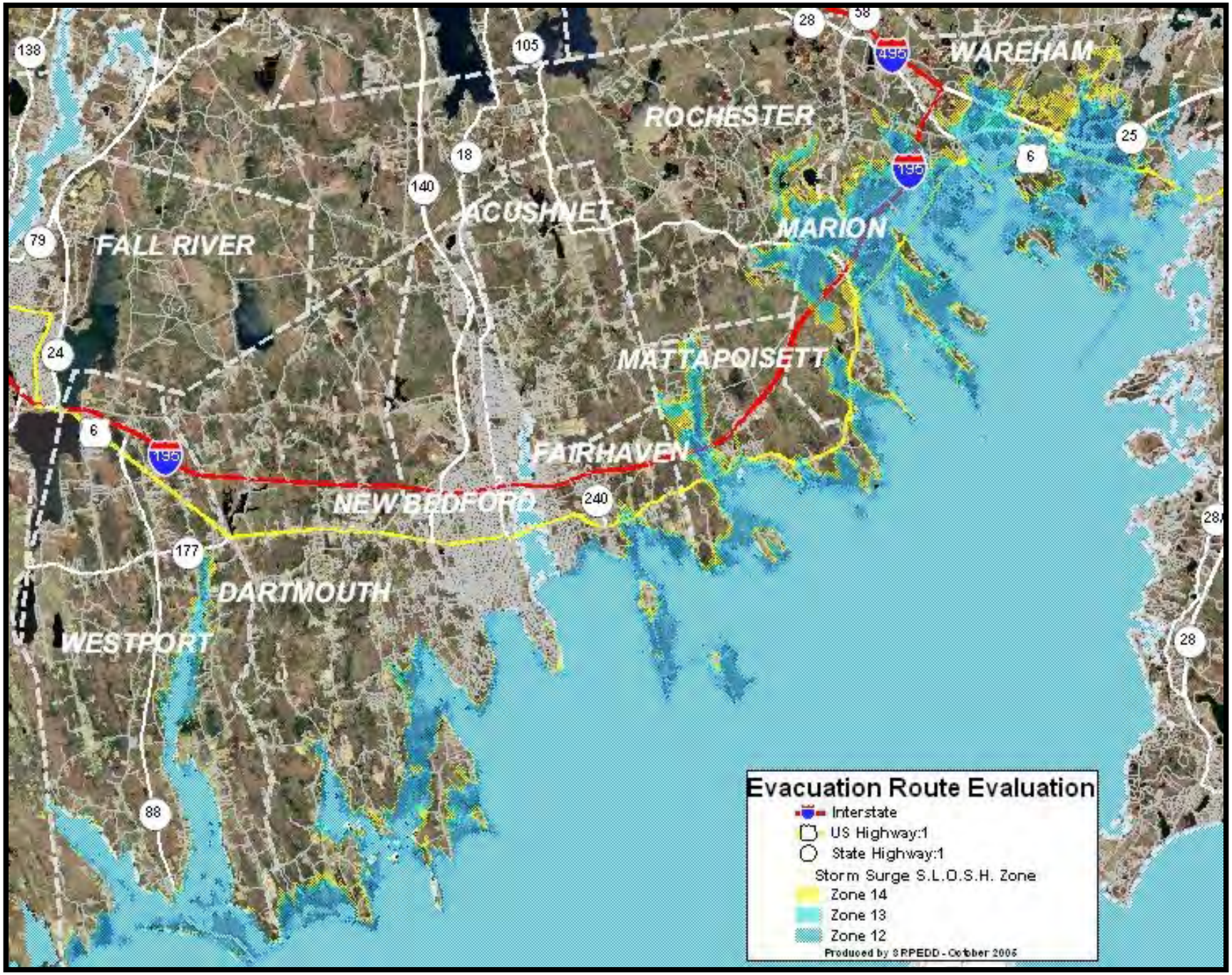


Figure 1 – SLOSH Zones for Buzzard's Bay

Along the Buzzards Bay region, roadways of all classifications would experience flooding and possible damage as a result of a severe storm surge. This includes I-195 in Marion and Wareham that falls within the central part of the SLOSH zone. Route 25, one of two major divided highways accessing Cape Cod, also falls within the SLOSH zone.

In Mount Hope Bay, shown in Figure 2, the most significant impact from flooding would take place along the banks of the Taunton River impacting Fall River and Somerset. The towns of Rehoboth, Seekonk, and Swansea could also see storm surge flooding in their southern sections due to their close proximity to water, marshes, and low lying wetland areas. As shown in Figure 2, portions of I-195, Route 103, Route 136, Route 6, Route 138, Route 79, and other important arterial and collector roads would be impacted. Descriptions of the potential impacts from extreme flooding to each community are listed in the appendix with maps displaying the storm surge potential.

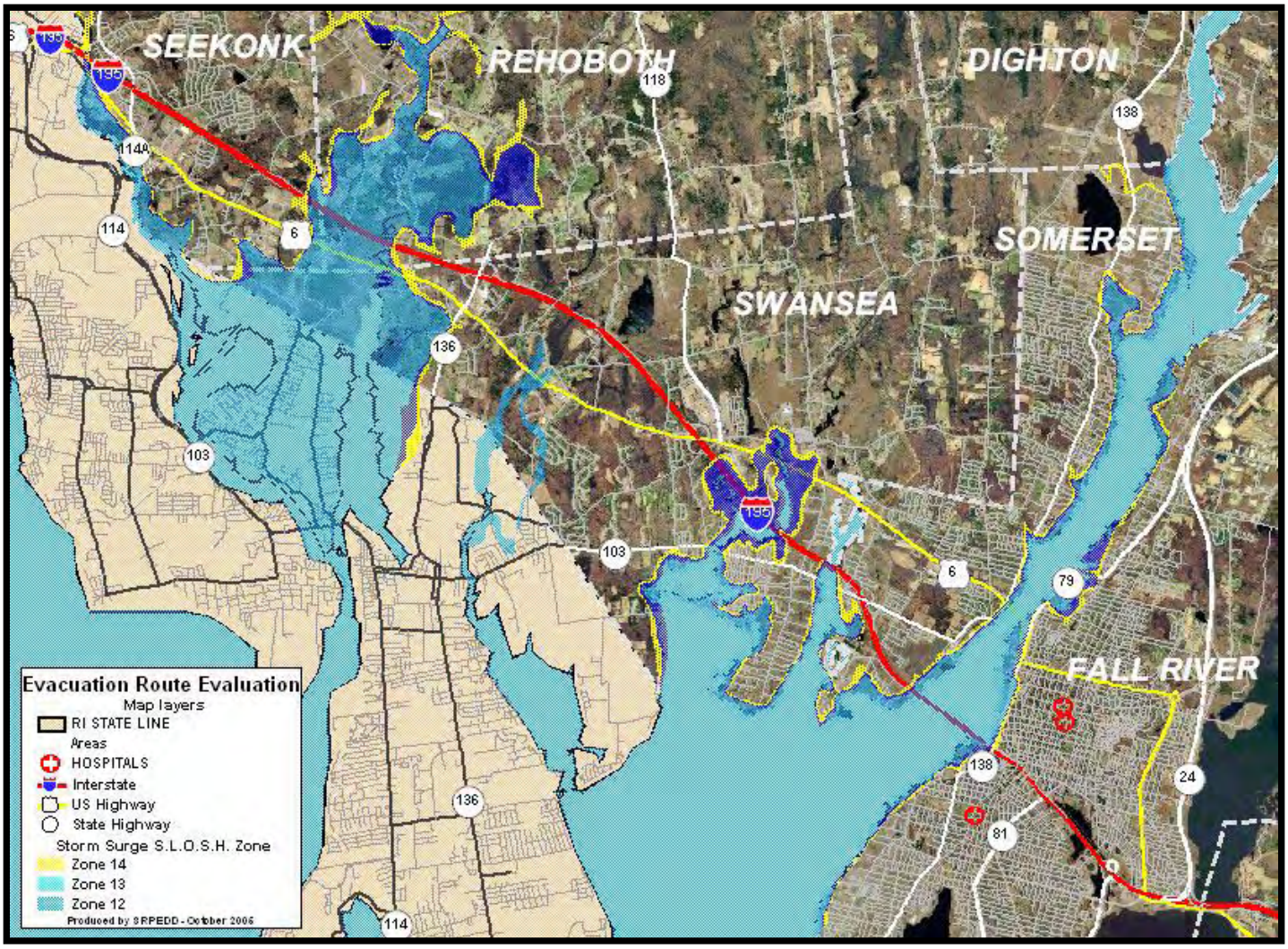


Figure 2 - SLOSH Zones for Mount Hope Bay

Evacuation Routes and Shelters

Communities within the Commonwealth of Massachusetts developed Comprehensive Emergency Management Plans (CEM) with the assistance of the Massachusetts Emergency Management Agency (MEMA). These plans are designed to provide an abundance of information in the event of any emergency situation associated with the community's surrounding geographic environment. This includes important state and local contact information, an inventory of shelters and their locations, evacuation route maps, potential flood areas, vulnerable damns, state and local emergency response agencies, and more.

Each community designated certain roads as part of their evacuation routes to assist with emergency management and evacuation during a crisis situation. These routes focus on the movement of people in the town with the intent of evacuees remaining within the town. Residents, who are asked to temporarily leave their home during an emergency, will relocate to a shelter in the community. A majority of the time, these routes and the designated shelters serve their purpose during an emergency that affects certain areas of one or even two communities. This was well demonstrated during the Taunton Mill River Dam crisis in November of 2005. Taunton City Officials, Police, Fire, and MEMA responded immediately. The police went door-to-door throughout the neighborhoods downstream from the dam warning residents of the pending disaster. The city shelter, Taunton High School, was opened to these residents until the situation was resolved. The city also alerted the media of the situation and various road detours were established in order to direct commuters around the affected area.

Evacuation Route Issues

Examining community evacuation routes on a regional scale identified flaws in the system. There appears to be no consideration to neighboring communities and their evacuation plans. Merging local evacuation routes for regional analysis highlighted a lack of connectivity, gaps, or routes stopping at the community's border as shown in Figure 3. Also, there are conflicts with evacuation flows. For example, town A sends its residents towards town B while town B sends its residents towards town A. If these maps were used verbatim on a regional scale, they could lead to some confusion.

Evacuation Shelter Issues

Examining the location of shelters shows that not all of these shelters are located on an evacuation route. In some cases, the designated shelter is usually the local high school. Although a majority of town residents are aware of the location of the school, it is important to include the adjacent road network as part of the evacuation routing so that all residents know where to go. Furthermore, residents and officials from outside the community will need to know where it is specifically located.

In certain cases, some shelters are located in potential SLOSH zones for the Buzzards Bay Communities. This is evident in Wareham where 4 shelters could be potentially flooded and one additional shelter would be isolated as a result of flooding.

Because these routes are based on local evacuation procedures, the intent is to show the regional problems in order to assist emergency planners on where changes can be made to minimize confusion during an evacuation event. Figure 3 shows the local evacuation routes and conflicts on a regional scale for the SRPEDD Communities. Individual maps showing each SRPEDD community are located in the appendix highlighting the issues regarding the evacuation routes and the emergency shelters. If no issues were found for a specific community, nothing was listed, but maps were included in the appendix.

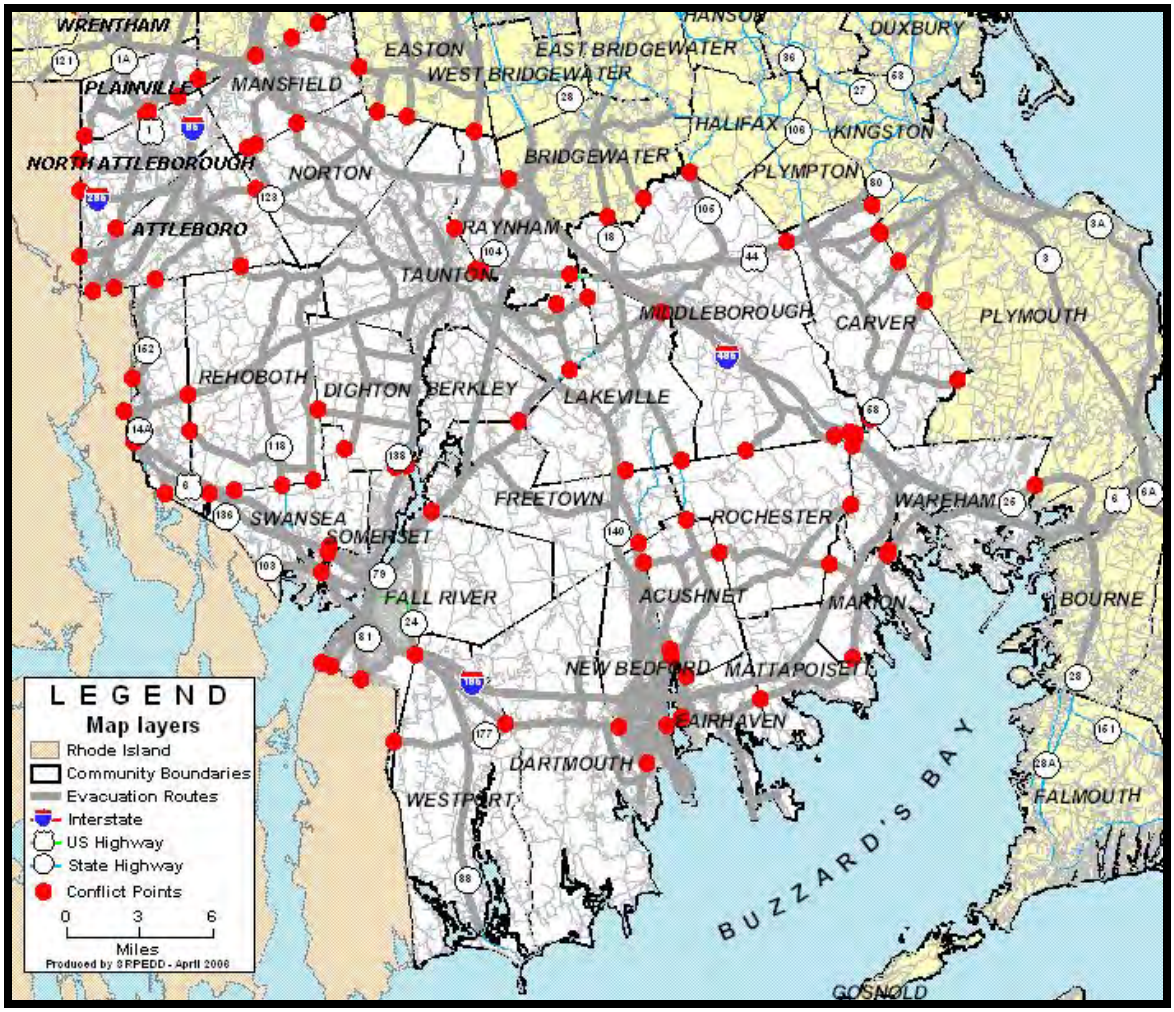


Figure 3 – Local Evacuation Routes on Regional Scale

The height of any evacuation takes place several hours or even days prior to a hurricane reaching land. During this time, the road network is not susceptible to physical damage, but may experience congestion problems that vastly differ from normal daily commuting problems. To evaluate the impact to the transportation network, we need to examine the evacuation process and the anticipated traffic. Communities need to understand how many people are evacuating, where will they go, and whether or not the shelters can handle the anticipated number of evacuees. From that, the focus will shift to address logistics such as the location of the shelters, as well as the potential inhibitors to safe and efficient traffic flow to these shelters and other areas further inland.

Transportation Problems

Population

The question for most Emergency Management Planners is how many people will evacuate an area during an emergency. Determining the size of the population will influence the amount of traffic emergency personnel can expect as well as testing the capacities of a community's emergency shelters. The 1997 Hurricane Report for Southeastern Massachusetts written by the United States Army Corps of Engineers (USACE) provides the most comprehensive report to-date highlighting the potential impacts to southeastern Massachusetts. Using more recent population information with the distribution methods USACE report will provide up-to-date estimates on what might occur if a regional evacuation was necessary.

Population forecasts by SRPEDD indicate that communities along Mount Hope and Buzzards Bay will increase in this area by as much as 19% over the next 25 years as shown in Table 1. Currently, nearly 58,000 people could be expected to seek shelter during a severe hurricane. Based on SRPEDD's population projections, that number increases to 61,000 people by the year 2030. Based on the available developable land in each of these communities, a majority of these new residents will live further inland away from the potential storm surge zones.

Table 1 – SRPEDD Population Projections

	2000	2010	2020	2030	Difference	
City/Town	Population	Projected	Projected	Projected	00-30	
Acushnet	10,161	11,581	13,001	14,421	4,260	*42%*
Dartmouth	30,666	34,166	37,666	41,166	10,500	*34%*
Fairhaven	16,159	16,939	17,719	18,499	2,340	*14%*
Fall River	91,938	94,508	97,078	99,648	7,710	*8%*
Marion	5,123	5,953	6,783	7,613	2,490	*49%*
Mattapoisett	6,268	6,848	7,428	8,008	1,740	*28%*
New Bedford	93,768	95,498	97,228	98,958	5,190	*6%*
Rehoboth	10,172	12,262	14,352	16,442	6,270	*62%*
Rochester	4,581	5,741	6,901	8,061	3,480	*76%*
Seekonk	13,425	14,225	15,025	15,825	2,400	*18%*
Somerset	18,234	19,084	19,934	20,784	2,550	*14%*
Swansea	15,901	16,991	18,081	19,171	3,270	*21%*
Wareham	20,335	22,395	24,455	26,515	6,180	*30%*
Westport	14,183	16,513	18,843	21,173	6,990	*49%*
Total	**350,914**	***372,704***	***394,494***	***416,284***	65,370	*19%*

Determining what residents will do during an emergency is very difficult to predict. A portion of the 1997 USACE Hurricane Study examined the human factors of evacuation. This behavioral analysis found many factors that influence what people do during a hurricane. For instance, residents may leave the area and stay with friends or family further inland in other communities. Some residents may choose to stay in a hotel further inland or choose to "ride out" the storm within their home. If there were seasonal or

vacationing residents in these communities, especially in Buzzard's Bay and Cape Cod, these residents would most likely cancel their vacation plans and leave for home. This is especially true for those who vacation with recreational vehicles and boats.

Evacuation Behavior

Similar to predicting what people will do during a hurricane evacuation, the amount of people that use shelters is also difficult to predict. Population estimates and distributions using shelters during a hurricane consider a number of variables including:

- Socio-economic characteristics of the evacuating population;
- the magnitude of the storm;
- the time when the storm will make landfall;
- public awareness of the shelters and their locations;
- influence of local officials encouraging use of the shelters; and
- location of evacuees' homes in relation to storm surge areas.

The evacuation totals are based on the 2000 U.S. Census year round and summer population for the Buzzard's Bay and Mount Hope Bay communities. Summer population is an estimate based on the number of housing units from the 2000 census that are considered a vacation home. The only significant jump in summer population is for the town of Wareham where a 29% increase occurs. The towns of Dartmouth, Fairhaven, Marion, Mattapoisett, and Westport will also have increases. In these communities, the increase is far less significant (less than 10%). In regard to Marion and Mattapoisett, the population base is relatively small and as the summer population increases, the shelters' capacity is more than adequate to accommodate evacuees. Campground population estimates were not available and are more difficult to estimate. Nevertheless, these sites would add to the evacuee totals due to the complete vulnerability of campers during a severe storm.

Another addition to the evacuee total includes the population from mobile homes. Complete mobile home evacuation is necessary regardless of the location because damaging winds pose a larger threat to these structures than flooding due to their vulnerable construction.

Based on the distribution percentages of the USACE report, Table 2 shows the breakdown of what the existing SRPEDD evacuating population would do during a hurricane emergency. Table 3 shows a conservative estimate of what the 2030 evacuating population would do during a hurricane emergency. This conservative estimate assumes that new residents will be located outside of the storm surge areas.

Table 2 – 2000 Evacuation Population Estimates

Year 2000			Severe Storm Scenario			Moderate Storm Scenario			
Community	Population	Summer Population	Total Evacuees	Evacuees Going Elsewhere	Evacuees to Shelter	Total Evacuees	Evacuees going elsewhere	Evacuees to Shelter	Shelter Capacity
ACUSHNET	10,161	10,191	1,254	377	877	971	150	820	2,800
DARTMOUTH	30,666	31,926	3,953	3,266	686	2,528	2,106	421	2,025
FAIRHAVEN	16,159	17,356	4,514	3,837	676	3,183	2,743	440	1,700
FALL RIVER	91,938	92,174	5,804	4,620	1,184	2,615	2,064	551	8,960
MARION	5,123	6,130	4,182	3,586	596	2,978	2,595	382	1,200
MATTAPOISETT	6,268	7,831	4,252	3,639	613	2,936	2,560	376	3,750
NEW BEDFORD	93,768	94,006	5,962	4,584	1,377	2,812	2,059	752	6,900
REHOBOTH	10,172	10,172	841	691	149	436	366	70	4,610
ROCHESTER	4,581	4,617	346	280	66	157	128	28	300
SEEKONK	13,425	13,458	864	705	158	417	346	70	Unknown
SOMERSET	18,234	18,278	2,806	2,342	464	1,642	1,400	242	4,500
SWANSEA	15,901	15,987	3,898	3,279	618	2,495	2,137	357	15,525
WAREHAM	20,335	26,204	17,491	13,141	**4,349**	14,276	10,441	**3,834**	**2,800**
WESTPORT	14,183	15,877	1,876	1,547	329	1,123	937	186	7,925
TOTAL	**350,914**	**364,207**	**58,043**	**45,894**	**12,142**	**38,569**	**30,032**	**8,529**	

Table 3 – 2030 Evacuation Population Estimates

Year 2030			Severe Storm Scenario			Moderate Storm Scenario			
Community	Population	Summer Population	Total Evacuees	Evacuees Going Elsewhere	Evacuees to Shelter	Total Evacuees	Evacuees Going Elsewhere	Evacuees to Shelter	Shelter Capacity
ACUSHNET	14,421	14,464	1,468	548	920	1,056	219	837	2,800
DARTMOUTH	41,166	42,857	4,500	3,704	795	2,747	2,282	465	2,025
FAIRHAVEN	18,499	19,869	4,640	3,939	701	3,233	2,783	450	1,700
FALL RIVER	99,648	99,904	6,190	4,929	1,261	2,770	2,188	582	8,960
MARION	7,613	9,109	4,331	3,705	626	3,038	2,644	394	1,200
MATTAPOISETT	8,008	10,005	4,361	3,726	635	2,979	2,595	385	3,750
NEW BEDFORD	98,958	99,209	6,222	4,793	1,429	2,916	2,143	773	6,900
REHOBOTH	16,442	16,442	1,155	943	212	561	466	95	4,610
ROCHESTER	8,061	8,124	521	420	101	227	185	42	300
SEEKONK	15,825	15,864	984	802	182	465	385	80	Unknown
SOMERSET	20,784	20,834	2,934	2,444	490	1,693	1,441	252	4,500
SWANSEA	19,171	19,275	4,062	3,412	651	2,561	2,191	370	15,525
WAREHAM	26,515	34,168	17,889	13,461	**4,429**	14,435	10,569	**3,866**	**2,800**
WESTPORT	21,173	23,702	2,267	1,860	407	1,279	1,062	217	7,925
TOTAL	**416,284**	**433,826**	**61,524**	**48,686**	**12,838**	**39,961**	**31,154**	**8,807**	

Examining the existing population totals and those of 2030, the town of Wareham is the only community in the study area unable to accommodate evacuees under their current shelter capacities. Furthermore, under a worse case scenario, the potential flooding compounds the problems in Wareham. All but one shelter would be impacted by flooding; rendering all of the shelters ineffective.

Potential Evacuation Traffic

By establishing the size of the population that would be impacted by a hurricane and subsequent evacuation, it is possible to determine the potential traffic a region may see on the roads during an evacuation. To analyze the effectiveness of the evacuation routes and the roads in general, staff used the Hitchcock Transportation Problem, which is part of SRPEDD's GIS software TransCAD. This involves identifying the most efficient way to service a set of destinations (evacuation shelters) from a set of origins (flood zones in coastal communities).

Information from the 2004 Natural Hazards Pre-Disaster Mitigation for Barnstable County written by the Cape Cod Commission was also used for this analysis. It is expected that a population of nearly 400,000 to 500,000 residents exist on Cape Cod during the summer months. Please note it is difficult to have an exact number due to the influx of seasonal people visiting the cape.

Based on the 1997 USACE distributions, 50% to 60% of the population would remain on Cape Cod, depending on their location and availability of shelter. The remaining population, approximately 200,000 people, could evacuate off Cape Cod.

To determine how many vehicles this would equal, we used an auto occupancy rate of 1.83 persons per vehicle for Cape Cod from the 1997 USACE report and applied to the 2000 U.S. Census. A higher rate of 2.01 was calculated for Buzzard's Bay and Mount Hope Bay Communities. These rates are based on numerous assumptions such as:

- Permanent population;
- The number of autos available per household for permanent and year round rental units; and
- 75% of the total vehicles available (some families may only use one vehicle in fear of separation during the evacuation process).

Therefore, it is likely that 100,000 vehicles would leave Cape Cod during the evacuation process. Although there are sufficient shelters on the cape to handle an emergency situation, many vacationers may choose to leave the cape during a storm for numerous reasons including:

- The vulnerability of recreational vehicles, camping vehicles, and boats during a hurricane;
- The concern of personal safety in an area prone to flooding and wind damage;
- The comfort and safety one feels in their own home further inland;
- The comfort and safety one feels at a hotel further inland versus a shelter (private rooms versus open floor gymnasium); and

- The idea of safety being further inland. Hurricanes tend to weaken significantly as they cross over land.

Using population totals from the 2000 U.S. Census and distribution formulas and calculations from the 1997 USACE report, we applied this data to our regional travel model network to determine where the population will evacuate and the volume of vehicles that might be expected.

With a majority of this traffic using Route 25 to I-495, the northbound direction of highway could see as much as 70,000 vehicles during an evacuation process. This road normally carries 40,000 vehicles per day in both directions. In addition to the traffic from Cape Cod, it is likely that Marion, Mattapoisett, and Wareham would have traffic leaving those communities totaling over 10,000 vehicles. As shown in Figure 4, analysis results indicate that the most favorable route for evacuation is I-495 north towards Taunton and the Worcester area.

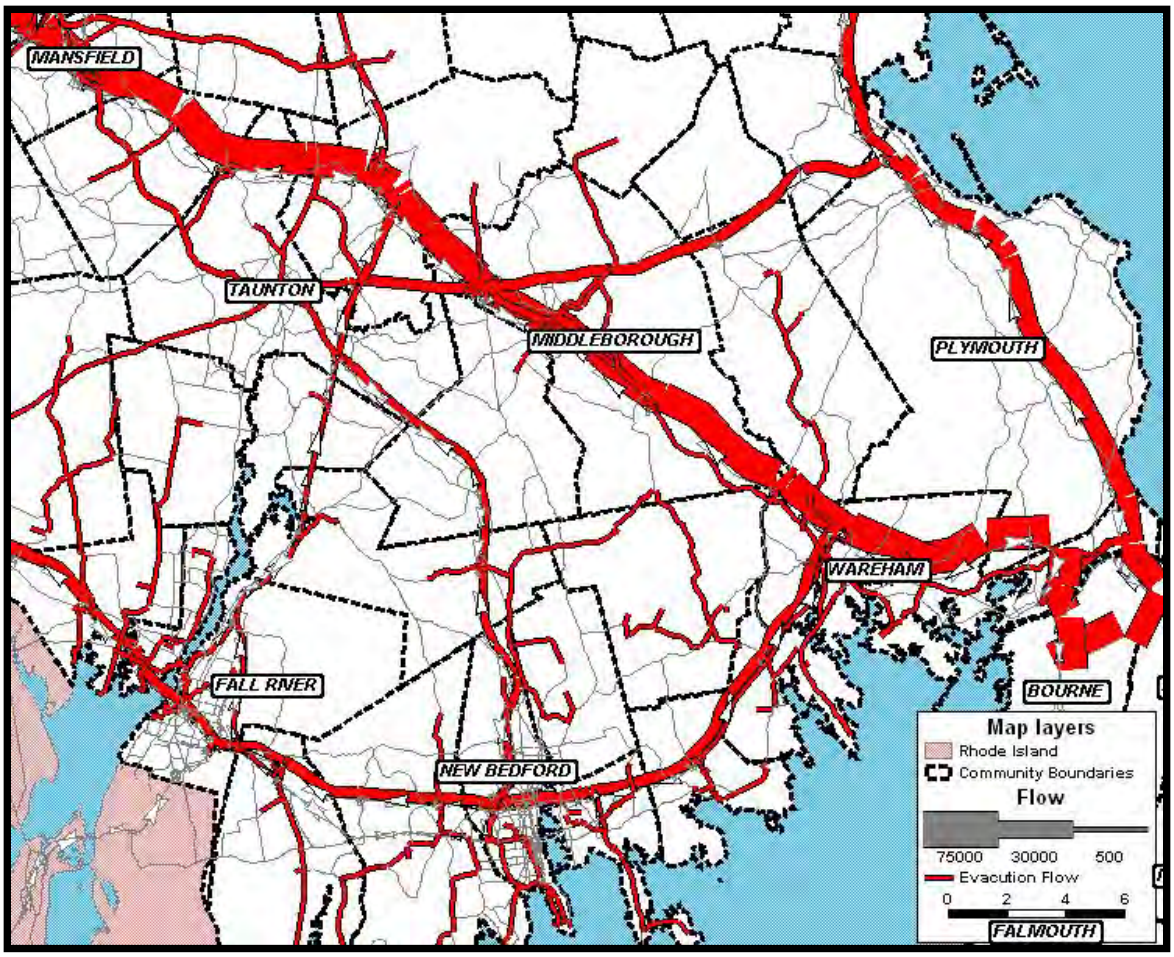


Figure 4 - Evacuation Flows from Cape Cod and Southeastern Massachusetts

Capacity analysis determines the operation of a roadway and uses a general Level of Service (LOS) to indicate how a facility operates in this case during peak hour traffic conditions; the highest hourly traffic volume in a 24-hour period. It is a comparison of the peak hour volume to the road's carrying capacity. The capacity is based on a number of factors, the most important being the number of travel lanes. The LOS is determined based on the volume to capacity calculation and placed within a range of A (representing ideal traffic flow operations) to F (representing delayed or congested flows).

In this particular instance, the normal calculations for capacity analysis are not applicable. The expected evacuation volume will far exceed (LOS F) the northbound carrying capacities of Route 25 and I-495. Route 25 will experience volumes nearly double than what it is capable of adequately handling during a normal day. The problem is compounded with the reduction in capacity at the interchange of Route 25, I-495 and I-195. As shown in Figure 5, the northbound direction of Route 25 into I-495 merges from 3 travel lanes to two, reducing the road's carrying capacity by 33%.

Figure 5 – Route 25 northbound merge from 3 to 2 travel lanes.

The 1997 USACE Hurricane report recommends a 10 to 11 hour time period would be necessary to evacuate the Cape Cod Region. "Off-cape" communities (Buzzard's Bay and Mount Hope Bay), require a 7-hour time frame for evacuation. Calculating these clearance times is extremely difficult due to the numerous variables that can occur during an emergency situation. These times can vary based on the day of the week a storm may occur. If a storm occurs during a weekday, traffic will consist of evacuees leaving the coast with traffic returning to their homes from work to make preparations for the pending storm and then deciding on their evacuation plans. During a weekend event, this work trip volume would obviously be lower.

Using the existing road capacities and the new traffic projections presented above, it can be expected that the 1997 USACE report's evacuation period estimate is not enough time with present population estimates. In order to clear Route 25 and I-495, it may require no less than 15 hours to evacuate. This assumes ideal traffic conditions such as adequate travel flows (near the speed limit), traffic made up of passenger vehicles, and no vehicle breakdowns or crashes. The presence of heavy trucks, recreational vehicles, boat trailers, and camper trailers adds delay to vehicle flow. These types of vehicles take up the space of 2 to 3 vehicles on a roadway and take more time to achieve the adequate speeds to stay with the flow of traffic on divided highways. A majority of these vehicles would be coming from the Cape Cod region due to the large population of seasonal residents and visitors.

The population from the Connecticut, New York, and New Jersey areas would use I-195 to head west towards Providence, Rhode Island. Furthermore, an evacuation would begin many hours before the storm immediately threatens landfall.

Other traffic on I-195 includes the Buzzard's Bay and Mount Hope Bay communities. The towns of Dartmouth, Fairhaven, Marion, Mattapoisett, and Westport have no direct access to a divided highway that travels north. Residents from these communities would likely use I-195 in order to travel inland on Route 24 or Route 140. It is important to have high capacity links connecting to these roads to expedite traffic flow in the event of a regional evacuation.

Compared to Route 25, it is expected that Routes 140 and 24 will experience far less evacuation traffic from the New Bedford and Fall River areas. These lower volumes are due in part to a lesser risk of flooding in these communities, less seasonal population, and the location of shelters away from flood prone areas.

Evacuation Issues

Along with the conflicts of evacuation routing, are the potential problems that could inhibit the evacuation process. Poor road design, road construction projects, structurally deficient and functionally obsolete bridges may not prevent people from evacuating, and may limit vehicle flow due to lane and weight restrictions or the narrowness and antiquated design of bridges.

Road Congestion from Inadequate Design

There are several locations that may inhibit safe and adequate traffic flow during an emergency situation. These areas could potentially add delay to an evacuation process depending on the volume of traffic. These locations are described below and shown in Figure 6.

- **I-495 between Route 25/I-195 and Route 24 –** Route 25 northbound merges from 3 travel lanes to 2 travel lanes at the interchange with I-195 and I-495. This reduces the carrying capacity of this road by 33% and would cause significant delay during the height of the evacuation of Cape Cod and the Buzzards Bay region. This particular road segment has also been identified as a future congestion problem based on normal traffic conditions in SRPEDD's Regional Transportation Plan.

- **Route 44 between Route 3 and Route 58 & Middleborough Rotary –** The newly relocated Route 44 that opened in December 2005 is a divided 4-lane highway providing an additional option for evacuation of the greater Plymouth area. Unfortunately, traffic traveling westbound towards Taunton will encounter two major congestion points along the way. The first is located west of Route 58 where the Route 44 merges from 2 travel lanes to one. The second is the Middleborough rotary, which is presently a congestion issue as identified in SRPEDD's transportation Plan. Currently, there is an on-going study of the Route 44 corridor from Raynham to Carver to recommend improvements and a possible widening to 4 lanes. Part of this study will include the removal of the rotary for more efficient traffic flows.

- **I-195 (Braga Bridge) on the Fall River / Somerset line –** Although this is not an issue hindering evacuation, this facility would be closed during a hurricane due to the high winds associated with the storm. Like the Bourne or Sagamore bridges, the Braga Bridge is closed to all traffic at a sustained wind speed of 80 mph. The problem occurs with lane closures on the bridge for road reconstruction or the necessary repairs being made to Government Center over the highway at the base of the bridge. It is important to expedite these repairs in order to maintain the existing capacity of this highway.

- **Interchange of Route 24 and Route 140 in Taunton –** This location is presently a congestion issue identified in the Regional Transportation Plan. Sub-standard interchange ramps with inadequate acceleration and deceleration lanes contribute to existing AM and PM peak hour traffic flow. Similar problems would be

experienced with traffic during an evacuation event. Route 24 is only 2 lanes northbound and therefore will constrict vehicle access from New Bedford as they attempt to merge with traffic from Fall River. The transportation plan has recommended a third travel lane on Route 24 north of Route 140.

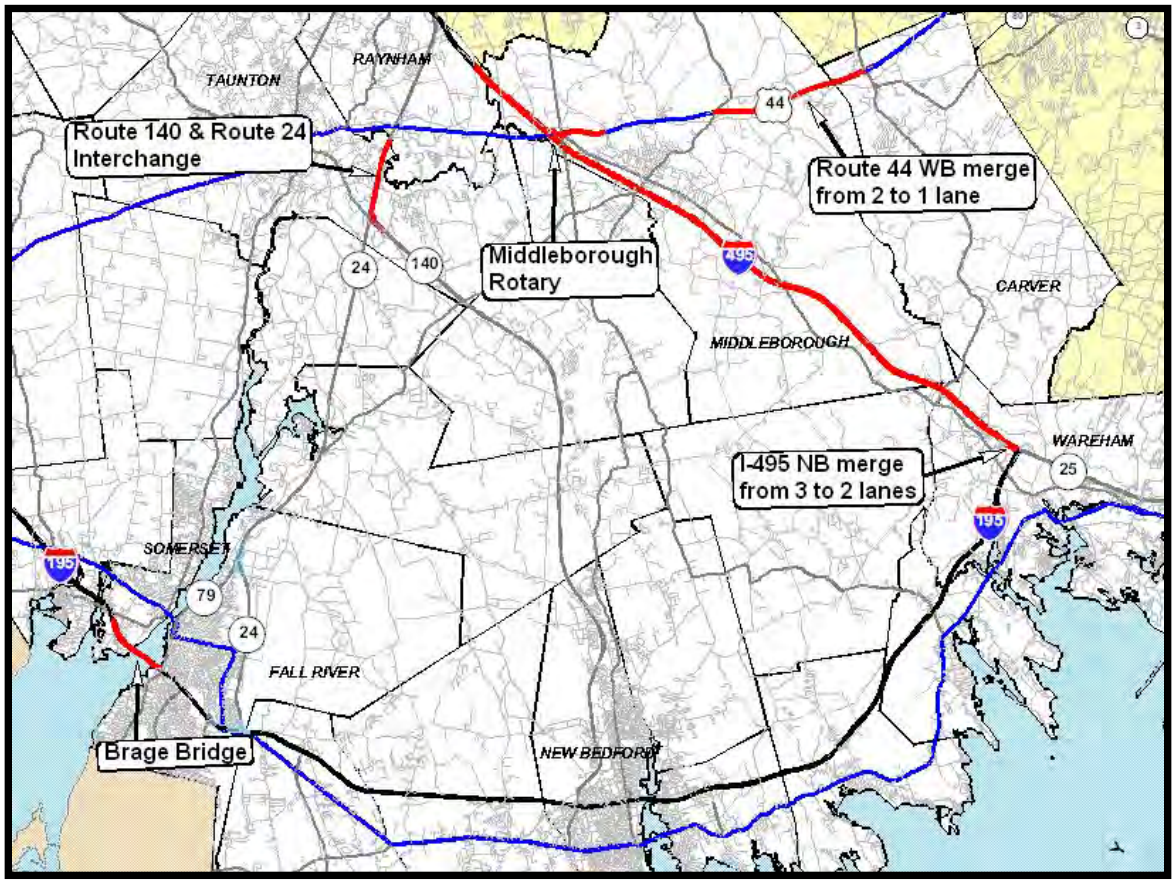


Figure 6 - Potential Congestion problems during evacuation

Road Construction

Road and bridge construction congestion is temporary. When the project is completed, lane restrictions and construction equipment associated with the project are removed. Although construction projects are necessary to maintain the roadways, the changes to roadway configurations and temporary detours may not be easily removed in the event of an emergency. It is important for state and community officials to know of these construction areas in the event of an evacuation.

Table 4 lists existing and future construction projects that are currently on SRPEDD's Transportation Improvement Program (TIP). These specific projects are on designated evacuation routes. Lane closures and traffic detours associated with the construction could be in place during an evacuation event. It is important to consider the need to expedite the construction time to ensure these facilities will be fully available if an emergency occurs.

Table 4 – Existing and Future Road Construction within SRPEDD Region

Project Description	City / Town	Total Cost	Expected Construction Years
2005 TIP Projects (Advertised for Construction)	-	-	
Resurface I-195	Fall River	$4,600,000	2006
Reconstruct Route 28 @ Route 105 Intersection	Middleborough	$540,000	2006
Resurfacing Route 140	New Bedford	$2,600,000	2006
Reconstruct Route 104	Raynham	$1,800,000	2005/2006
Reconstruct Route 24/140 Interchange, widen and extend acceleration and deceleration lanes	Taunton	$2,000,000	2006/2007
Rehabilitate 2 Bridges over Route 88 over Rail & over Route 6	Westport	$1,250,000	2006
2006 TIP Projects	-	-	
Replace Brightman Street Bridge over Taunton River	Fall River / Somerset	$131,850,000	2006 - 2012
Resurface I-495 - 12 miles	Middleborough / Raynham	$10,000,000	2007
Resurface I-295	North Attleborough	$3,000,000	2007
Replace Route 114A Bridge (Fall River Ave.) over I-195	Seekonk	$4,400,000	2006/2007
Rehab Route 44 Bridge (Winthrop St.) over Three Mile River	Taunton	$1,000,000	2006/2007
2007 TIP Projects	-	-	
Reconstruct Route 152, Phase 1 from Toner Boulevard to Holcott Drive	Attleboro	$2,300,000	2007
Reconstruct Route 1A Bridge (Newport Ave.) Bridge over AMTRAK / MBTA	Attleboro	$9,700,000	2007
Resurface I-95	Attleboro / North Attleborough	$6,000,000	2007
Replace Gulf Road Bridge over Apponagansett River	Dartmouth	$1,200,000	
Replace the Old Somerset Road Bridge over the Three Mile River	Dighton	$650,000	2007
Reconstruct Acushnet Avenue (Route 18) from Route 140 ramp to Braley Road	New Bedford	$5,000,000	2007
Replace Route 44 (Winthrop St.) Bridge over Palmer River	Rehoboth	$1,900,000	2007
Reconstruct Route 138 (Somerset Ave.)	Taunton	$9,100,000	2007/2008
Route 24/140 Interchange Construction of Interim Improvements	Taunton	$993,500	
Reconstruct Route 6 at Sanford Road	Westport	$1,700,000	
2008 TIP Projects	-	-	
Reconstruct Tiffany Street Phase 2 from Route 123 to new road	Attleboro	$1,500,000	
Resurface Dartmouth Street and Replace Three Traffic Signals	Dartmouth	$1,100,000	
Resurface I-195	Dartmouth / Westport	$5,000,000	2008
Replace Deck of Ramp A to Route 79 NB from I-195 EB	Fall River	$10,000,000	2008-2009
Replace Deck of Route 79 NB over Route 79 SB	Fall River	$10,000,000	2008-2009
Replace Deck of Route 79 SB over Route 138	Fall River	$10,000,000	2008-2009
Design and construction of Route 24 Interchange	Freetown/Fall River	$7,000,000	
Reconstruct Route 106 Underpass	Mansfield	$5,300,000	2009/2010
Reconstruct Chauncy St. (Route 106) @ Copeland Street	Mansfield	$500,000	
Construct Signals at I-495 Ramps with Route 105 Lakeville	Middleborough	$850,000	
Hawthorne Street Corridor Reconstruction (Historic Street)	New Bedford	$1,000,000	2008
Construct Improvements to the JFK Highway / Route 18	New Bedford	$13,000,000	
Install Signals at Interchange Ramps of I-495 with Route 138	Raynham	$600,000	
Replace Bay Street Bridge over Mill River	Taunton	$1,200,000	2008
Replace Holloway St. Bridge over Route 140	Taunton	$950,000	2008
Resurface I-195 and I-495 / Route 25 Ramps	Wareham	$5,000,000	2007

Project Description	City / Town	Total Cost	Expected Construction Years
2009 TIP Projects	-	-	
Reconstruct Route 152 Phase 2 from Holcott Drive to Holden Street	Attleboro	**$2,500,000**	
Rehab North Main Street Bridge over Bungay River	Attleboro	**$1,300,000**	
Construct New Ramp and Widen Bridge I-195 @ Faunce Corner Road	Dartmouth	**$12,000,000**	**2009**
Relocate Route 79 (Rhode Island Rd.)	Lakeville	**$2,000,000**	
Construct New Ramp from Route 140 to I-495 SB	Mansfield	**$2,000,000**	
Replace Balcom Street Bridge over Wading River	Mansfield	**$900,000**	
Resurface I-95	Mansfield / North Attleborough	**$6,500,000**	**2009**
Resurface I-195	Marion / Mattapoisett	**$5,000,000**	**2008**
Resurface Route 152 (Central Ave.) and Baker's Corner	Seekonk	**$2,000,000**	
Resurface I-195	Somerset / Swansea	**$6,000,000**	**2009**
Reconstruct Route 24/140 Interchange replace bridge ramps widen and extend acceleration and deceleration lanes	Taunton	**$21,250,000**	
Reconstruct Route 6/28	Wareham	**$5,000,000**	
Reconstruct Route 6/28 Bridge over Cohasset Narrows	Wareham	**$9,500,000**	
2010 TIP Projects	-	-	
Replace Olive Street Bridge over AMTRAK MBTA and CSX	Attleboro	**$6,000,000**	
Replace Berkley/Dighton Bridge over Taunton River	Berkley / Dighton	**$11,000,000**	
Construct New Ramp and Widen Bridge I-195 @ Faunce Corner Road	Dartmouth	**$9,600,000**	
Resurface I-195 from Rt. 24 to Braga Bridge	Fall River	**$8,000,000**	**2010**
TIP FUTURE ELEMENT			
Reconstruct Route 152 (South Main St) - Phase 3 from Downtown to Seekonk town line	Attleboro	**$4,500,000**	
Reconstruct Route 24 to interstate standards from I-495 to I-195	Berkley / Fall River / Freetown / Raynham / Taunton	**$84,000,000**	
Route 44 Widening from Route 24 to Route 58 - Remove Rotary and Double Barrel	Carver / Middleborough	**$136,000,000**	
Reconstruct Route 79 into a waterfront boulevard	Fall River	**$70,000,000**	
Route 81 Resurface and Replace Traffic Signals on Plymouth Ave	Fall River	**$2,000,000**	
Reconstruct Mill Street (Route 6) with traffic signals	New Bedford	**$2,000,000**	
Widen Route 24 to add Third Travel Lane in Both Directions from Route 140 north to I-495	Raynham/Taunton	**$50,000,000**	
Interchange Improvements at I-195 Route 6 and Route 118	Swansea	**$6,000,000**	
ROAD PROJECTS NOT INCLUDED IN TIP			
Resurface Route 240	Fairhaven	**$2,000,000**	
Resurface Route 18 from Middleborough T.L. to Route 105	Lakeville / Middleborough	**$2,400,000**	
Resurface South Main St. and Copeland Drive	Mansfield	**$1,500,000**	
Reconstruct Intersection of Route 138 at Center Street	Raynham	**$300,000**	
Reconstruct Route 79 (Myricks St.) from Lakeville to Berkley town lines	Taunton	**$100,000**	
BRIDGE PROJECTS			
Replace Route 18 Bridge (Bedford St.) over Taunton River	Middleborough	**$2,000,000**	
Rehab Route 140 Bridge (Tremont St.) over Three Mile River	Taunton	**$1,000,000**	

Bridges: Structurally Deficient and Functionally Obsolete

Bridges are classified as structurally deficient if the bridge deck, pavement, or supporting structure fails to meet standards. The 1998 edition of the Massachusetts Transportation Facts defines a structurally deficient bridge as "one that has experienced deterioration significant enough to potentially reduce its load-carrying capacity." Structurally deficient bridges are frequently regulated by weight restrictions and are sometimes closed due to severely deteriorated components. Weight restrictions or bridge closings severely impact the movement of traffic and are especially troublesome for buses and trucks.[3]

In 2005, a total of 25 bridges along designated evacuation routes were identified as structurally deficient. Since the publishing of the structurally deficient bridges list, several locations have since been repaired. Furthermore, additional locations on the list are presently under construction or in design for repairs as shown in Table 5. Only four bridges remain on the list that presently have no work planned for the future.

Such is the case with the Brightman Street Bridge and the Berkley/Dighton Bridge. Action to replace these facilities has begun with the Brightman Street Bridge expected to be completed sometime after 2010. Although the Berkley/Dighton Bridge is not part of an evacuation route, it is an important link between the two communities. An environmental study to replace the facility has begun and completion of the replacement is expected before 2020. Structurally Deficient bridges along designated evacuation routes should be considered for prioritization.

Table 5 – Structurally Deficient Bridges on Evacuation Routes in SRPEDD

Town	Bridge Name	Over/Under	Owner	Functional Class	Action	Project Status
Fall River	Brightman St	Taunton River	MHD	Arterial	REPLACE	UNDER CONST
Lakeville	Highland Rd	Rte 140 NB	MHD	Collector	REHAB	UNDER CONST
Swansea	US Rte 6	I 195	MHD	Min. Art.	REHAB	UNDER CONST
Swansea	Rte 136	I 195	MHD	Min. Art.	REPLACE	ADVERTISED
Dighton	Old Somerset Ave	Three Mile River	Town	Collector	REPLACE	100% DESIGN
Freetown	Rte 24	Rte 79 S MAIN ST	MHD	Freeway	REHAB	100% DESIGN
Fall River	RAMP A	Pocsset St & Ramps C&D	MHD	Arterial	REHAB	75% DESIGN
Fall River	Rte 79 NB	Rte 79 SB	MHD	Arterial	REHAB	75% DESIGN
Fall River	Rte 79 SB	Rte 138	MHD	Arterial	REHAB	IN DESIGN
Rehoboth	US Rte 44	Palmer River	MHD	Arterial	REPLACE	75% DESIGN
Seekonk	Rte 114A	I 195	MHD	Min. Art.	REPLACE	25% DESIGN
Taunton	Bay St	Mill River	City	Min. Art.	REPLACE	25% DESIGN
Taunton	US Rte 44	Three Mile River	MHD	Arterial	REHAB	25% DESIGN
Taunton	Bay St	RR MBTA (Abandoned)	Other	Collector		No Work Planned
Taunton	Rte 140 NB	Rte 79 Myricks St	MHD	Freeway		No Work Planned
Middleborough	I 495 NB	Taunton River	MHD	Interstate		No Work Planned
Wareham	US Rte 6	Weweantic River	MHD	Collector		No Work Planned

[3] 2003 Regional Transportation Plan, Southeastern Regional Planning and Economic Development District (SRPEDD), October 2003, page 7-1.

A functionally obsolete bridge is one that cannot accommodate the amount and type of traffic in use on that particular bridge. Functionally obsolete bridges usually have inadequate width or vertical clearance. In some cases, bridges are classified as functionally obsolete due to changes in adjacent roadway layout, such as road widening or lane additions. In other cases, bridges may be considered functionally obsolete because of changes in engineering standards.[4]

Table 6 lists the 24 functionally obsolete bridges in the region that are part of designated evacuation routes. These bridges, although functionally obsolete, are not considered to be a hindrance to an evacuation process. Maps located in the appendix show the locations of all of the bridges from these tables. Although construction is needed to correct these problems, it is unlikely that any corrective action will happen until the facility is considered to be structurally deficient.

Table 6 – Functionally Obsolete Bridges in SRPEDD Region

Town	Bridge	Over / Under	Owner	Functional Class.
Middleborough	US 44 HARDING ST	I 495	MHD	Arterial
Attleboro	US 1 WASHNGTON ST	RR AMTRAK/MBTA	MHD	Minor Arterial
New Bedford	US 6 WB	COMB ST18 & RELIEF	MHD	Arterial
New Bedford	US 6 WB	ST 18 RAMP B	MHD	Arterial
Fall River	I 195 & COLLECTOR	RR BCRR (ABANDONED)	MHD	Interstate
Middleborough	ST 28 W GROVE ST	RR MBTA/CSX	MHD	Minor Arterial
Middleborough	ST 28 W GROVE ST	RR MBTA/BCRR	MHD	Minor Arterial
Attleboro	ST152 MAIN ST	RR AMTRAK/MBTA	MHD	Minor Arterial
Freetown	ST 79 S MAIN ST	ASSONET RIVER	Town	Minor Arterial
Marion	US 6 WAREHAM ST	WEWEANTIC RIVER	MHD	Major Collector
Mattapoisett	US 6 FAIRHAVEN RD	MATTAPOISETT RIVER	MHD	Major Collector
Raynham	US 44 CAPE	ST 24	MHD	Arterial
Dighton	WILLIAMS ST	SEGREGANSET RIVER	Town	Minor Arterial
Fall River	I 195 RAMP A	RR BCRR SPURR (ABAND)	MHD	Arterial
Fall River	RAMP C	COMB I 195 & CITY STS	MHD	Interstate
Fall River	RAMP E	POCASSET ST	MHD	Interstate
Fall River	RAMP R	DAVOL ST	MHD	Interstate
Freetown	ST 79 ELM ST	ASSONET RIVER	Town	Minor Arterial
Middleborough	ST 18 BEDFORD ST	I 495	MHD	Arterial
Fairhaven	GOULART MEM	NASKETUCKET BAY	Town	Collector
New Bedford	HILLMAN ST	ST 18 & RAMP A	MHD	Collector
New Bedford	I 195 EB RAMP F	COMB WELD ST & RELIEF	MHD	Local
New Bedford	ST 18 RAMP A	ST 18	City	Minor Arterial
Taunton	HART ST	ST 24	MHD	Collector

[4] 2003 Regional Transportation Plan, Southeastern Regional Planning and Economic Development District (SRPEDD), October 2003, page 7-5.

Conclusions and Recommendations

Although it may seem that a regional evacuation of the coastal communities is less likely to occur as in other parts of the country, there are some issues that need to be addressed as not to hinder possible evacuation. Reviewing the current evacuation route system based on individual community plans suggests that change may be necessary to provide better regional connectivity. This in return will provide local and state officials with better information in the event of a regional evacuation.

On the local level, evacuation routes are designed to direct residents away from a dangerous situation and to temporary shelters (normally the high or junior high schools) that have the facilities to house people during an emergency. The designated routes should be made public to help reduce the confusion that an evacuation can bring because many of these shelters are not located on a designated route. Therefore, the community must inform the general public of these shelter locations through either the distribution of maps to residents, cable access programming, websites, or roadside signage for use during emergency situations. In some cases, maps can be distributed with town information and mailed out to every resident in the form of refrigerator magnets, calendars, or other useful novelties that are readily accessible during an emergency. This has been done for the town of Plymouth in regards to the nuclear power facility that is located within the town.

On a regional level, the roads most effective in moving people away from an emergency situation are those with the greatest carrying capacity. In these cases, two-lane minor arterial, collector, and local roads are not ideal for a regional evacuation effort unless they lead to a regionally designated emergency shelter. Multi-lane roads and divided highways have the ability to allow the greatest volume of traffic to move from an area at any given time. Therefore, interstate highways and divided state highways are the first choice for regional emergency evacuation. The second choice is the undivided multi-lane U.S. highways and state numbered arterials that would lead to the regional shelters. These road types are easier to describe in traffic reports during an emergency being that they are the most familiar to the general public. Figure 7 displays a regional evacuation route system based on these criteria.

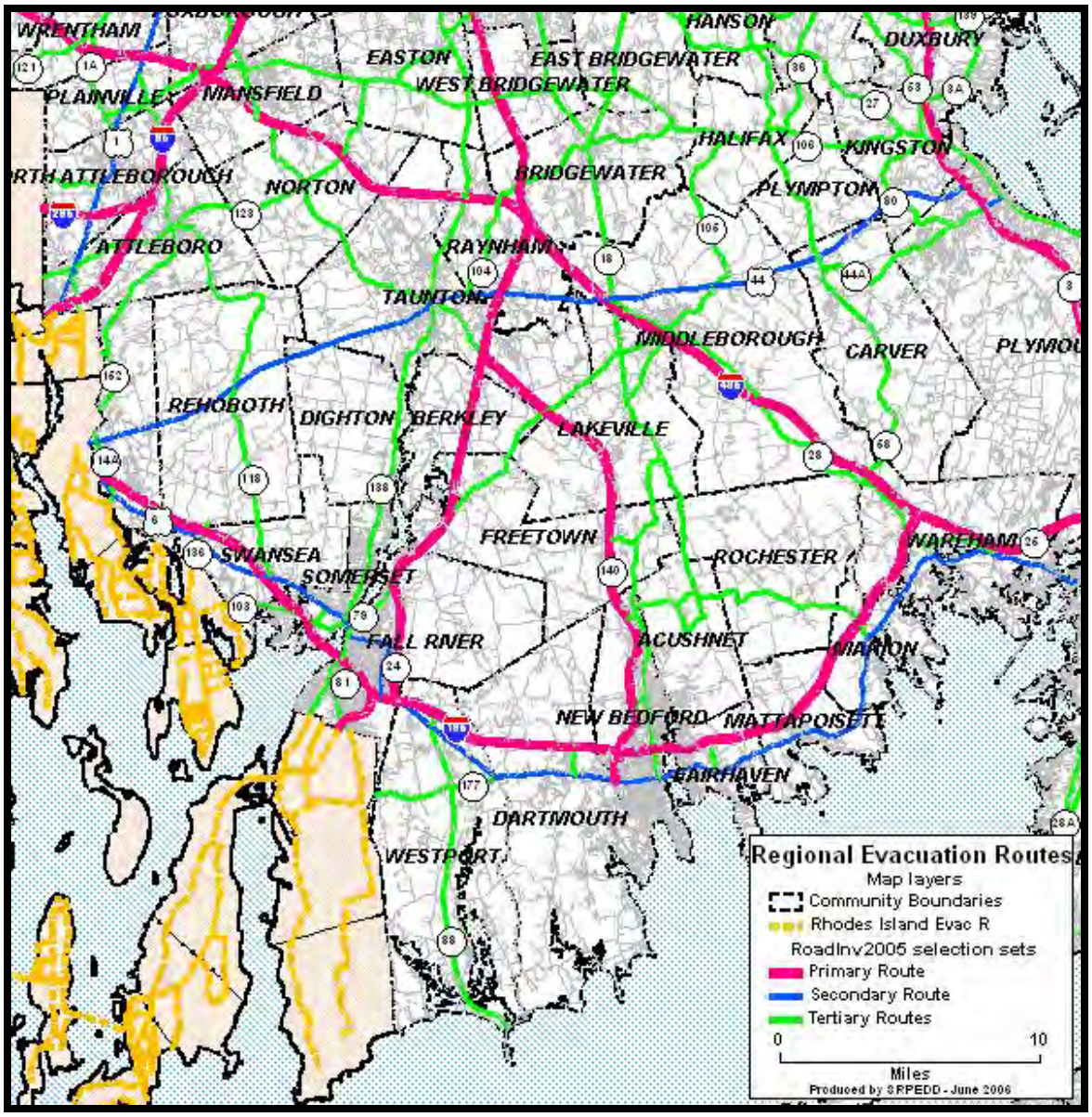


Figure 7 - Proposed Regional Evacuation Route System

A regional evacuation plan should also be established to assist emergency officials. This includes the identification of evacuation routes that are consistent across several communities and links to regional shelters. Regional shelter identification has begun with public outreach efforts by MEMA with the cooperation of the Red Cross. SRPEDD recommends that the map presented in this report be used as a start for an established regional evacuation route system.

The use of a regional evacuation route is dependant upon the type of incident likely to happen in southeastern Massachusetts. Established evacuation routes can be effective with certain natural disasters such as hurricanes, wildfires within state parks, or Pilgrim nuclear power plant. Other events including floods, tornados, earthquakes, or nor'easters/blizzards can happen anywhere which makes pre-determined evacuation routes more difficult or in some cases, unnecessary. In these cases, local evacuation

plans are appropriate in dealing with the emergency. The intent is to get communities and the state to think regionally about evacuation routing and identify shelters to assist more than the local population in the event of a major disaster.

As part of the route identification process, the potential congestion problems along I-495, Route 24, Route 44, and other areas should be identified as a hindering factor of evacuation until long-term solutions are implemented. In certain cases, costly long-term construction to remedy these problems just for regional evacuation may be considered fiscally irresponsible. Fortunately, these locations have already been identified as congestion problems under normal traffic circumstances and subsequent improvements will resolve multiple issues.

With the threat of potential flooding, the towns of Marion, Mattapoisett, and Wareham need to consider alternatives for sheltering their residents during a severe hurricane. This should be a warning for the town officials and emergency planners to identify additional shelters outside of the flood zones in the event of an emergency. Town officials must be aware that using these existing shelters with the threat of flooding may put many of their communities' residents in danger. This includes moving these residents inland to neighboring communities or regional shelters to be established by MEMA. Cooperative agreements, similar to the agreements established between communities for Police and Fire response, should be developed for emergency shelters.

Public outreach should be made by town officials to educate their citizens on emergency preparedness. This includes publications mailed to all residents with relevant information needed for an evacuation. This information should be added to the communities official Website or through the State's Website at www.mass.gov. Public access cable television is another avenue to distribute information and local radio stations should be aware of these plans to assist during emergency situations. Written plans and maps can be distributed as part of community calendars or information pamphlets.

It appears that structurally deficient bridges will not pose problems to a regional evacuation, but they may impact local efforts in Taunton, Middleborough, and Wareham. Community officials should pursue repairs to the bridges listed in Table 5 of this report through the MassHighway Department District 5 office and through the SRPEDD Joint Transportation Planning Group. In time, other bridges on evacuation routes will eventually fall into a state of structural deficiency. Local and state officials need to continue pursuing immediate repairs of these facilities to alleviate problems for normal or evacuation traffic flows. Bridge projects along designated evacuation routes should be a priority and should be done in an expeditious manner.

Another option is to use the business community as alternatives for shelters and be included with the comprehensive plan. An excellent example is the town of Westport that includes as a shelter alternative Whites Banquet Hall. This facility is considered an overflow site in the event of the number of Westport evacuees exceed their existing shelter capacities or if some shelters cannot be used. Larger structures located outside of flood zones with proper sheltering capabilities include hotels/motels, shopping malls, and industrial parks. Before any facility is designated as a shelter, it must meet the requirements established by the American Red Cross of Massachusetts Bay. These

specific guidelines include on site kitchen facilities, bathroom and shower facilities, sleeping space for a large number of residents, and other amenities.

Storm-surge damage on Buzzards Bay in Wareham, MA from Hurricane Bob (Photo Courtesy of Cape Cod Times-Photographer Steve Heaslip.)

Although New England has not recently had a severe storm, complacency is not an attitude people should take with any emergency situation. New England has not experienced a powerful storm since hurricane Bob, which struck in 1991. Bob was a small hurricane in size, but powerful with sustained winds of 95-100 miles per hour (Category 2) and a storm surge ranging from 6 to 8 feet above mean tide. The worst flooding from Bob occurred in Buzzard's Bay, southern Cape Cod and the Islands of Martha's Vineyard and Nantucket with damage estimated at $900 million, as well as a total of 17 fatalities.[5] Although this is significant damage as a result of the storm, the fifteen-year dormancy of hurricanes in New England may cause residents to be less responsive when faced with hurricane evacuation.

With the recent predictions (2006) from the National Hurricane Center of strong storms in the next few years, emergency preparedness is vital. Communities should re-visit their Comprehensive Emergency Management (CEM) plans to insure all information is up-to-date. Furthermore, evacuation routes between communities should be revised to eliminate gaps and conflicts while alternative shelters are considered.

We must learn from the lesson of Katrina and never believe that it can't happen here.

[5] The United States Hurricane Page (www.geocities.com/hurricanene.html), created by Michael A. Grammatico, 2002.

APPENDIX A

SLOSH Zone Issues for
Buzzard's Bay and Mount Hope Bay Communities

Color Key for Inundation (SLOSH) Zone Maps

Notes on Hurricane Inundation Zones:

1. Inundation Zones were derived from the National Hurricane's Center's application of the SLOSH (Sea, Lake, and Overland Surges from Hurricanes) model. Inundation zones reflect "WORST CASE" combinations of hurricane direction forward speed, landfall point, and high astronomical tide.

2. Hurricane categories 1 through 4 refer to the Saffir-Simpson scale of hurricane intensity.

3. Shaded land zones represent areas with coastal flooding potential from hurricanes of the categories and forward speeds referenced by the inundation matrix shown on this page. Inland areas that may only be subjected to freshwater flooding are not identified.

4. The New Bedford Hurricane Barrier is designed to provide complete flood protection during the vast majority of hurricanes that can be sustained in New England's meteorological climate. The SLOSH model indicates, however, that certain Category 3 and 4 hurricanes, which landfall on critical storm tracks coincident with high astronomical tide, may exceed the Barrier's minimum top elevation. Inundation Zone D (not shown) would result in flooding up the Acushnet River impacting New Bedford, Fairhaven and as far north as Acushnet.

Hurricane Inundation Zones shown are based on the 1994 Inundation Maps Atlas Mass Hurricane Evacuation Study Prepared by the Army Corp of Engineers and FEMA.

Dartmouth

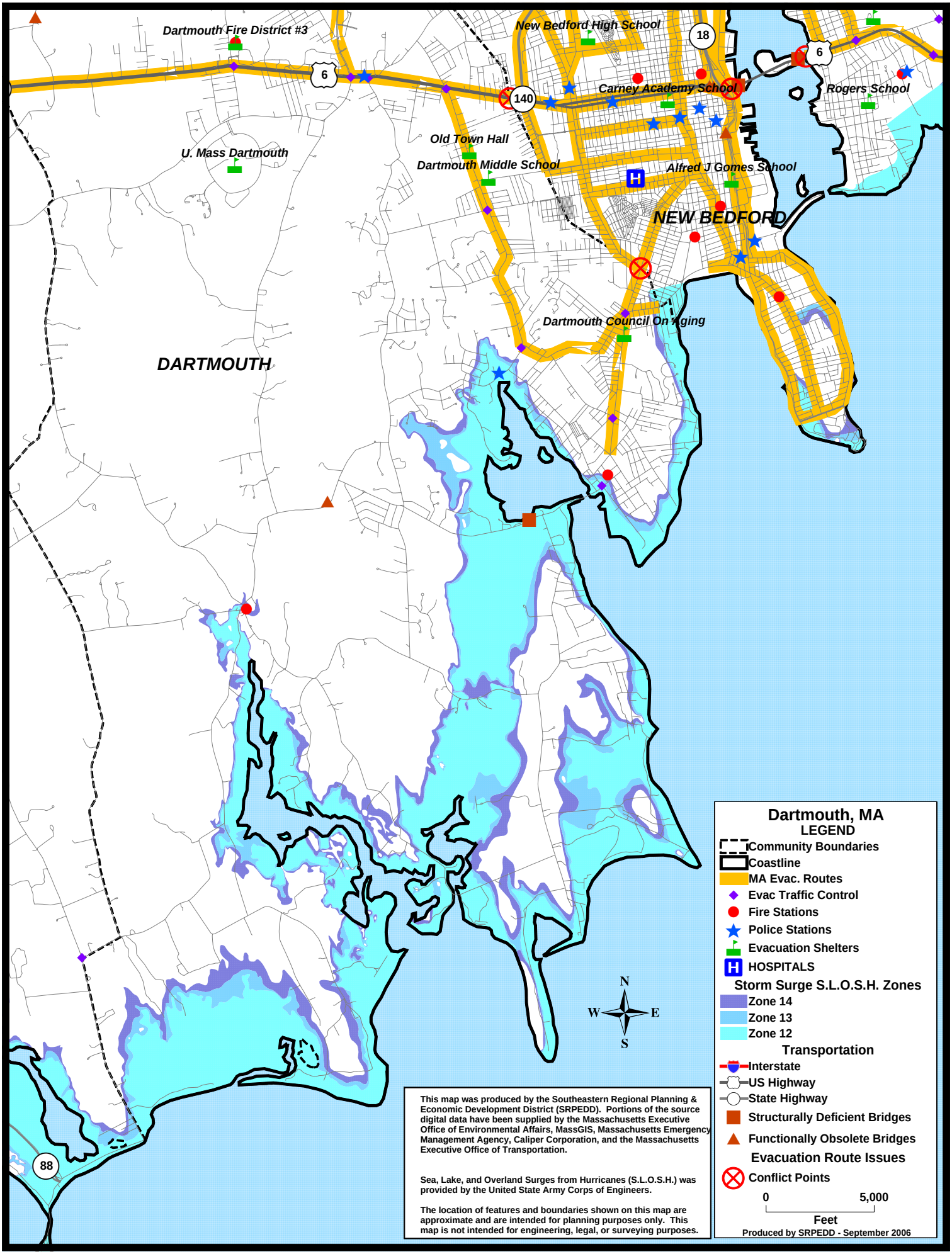
Dartmouth would have significant flooding along the shoreline and up the Westport River. Damage to roads caused by extreme flooding would be limited to the minor arterials, local roads, and bridges. Specific Issues Include:

- The Gulf Road Bridge over the Apponagansett River, presently structurally deficient, is on a minor arterial road leading into the Padanaram area of Dartmouth. Although this is a vital link to this particular area, it is not part of an evacuation route. During a severe storm such as the hurricane of 1938, the bridge was destroyed cutting the link to the Padanaram area. The reconstructed bridge was impacted in 1991 by Hurricane Bob.

- The Russells Mill Bridge over the Paskamansett River, listed as functionally obsolete, is not part of an evacuation route, but the road connects to other streets that lead into south Dartmouth and the coast. Russells Mill Road eventually connects Tucker Road and Slocum Road where town hall and other evacuation shelters are located.

Photo Courtesy of Standard Times

THIS WAS Smith's Neck Road, Dartmouth, after the storm blocked it.


Dartmouth Fire District #3
New Bedford High School
18
6
6
140
Carney Academy School
Rogers School
Old Town Hall
U. Mass Dartmouth
Dartmouth Middle School
Alfred J Gomes School
NEW BEDFORD
Dartmouth Council On Aging
DARTMOUTH
88
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Dartmouth, MA
LEGEND
Community Boundaries
Coastline
MA Evac. Routes
Evac Traffic Control
Fire Stations
Police Stations
Evacuation Shelters
HOSPITALS
Storm Surge S.L.O.S.H. Zones
Zone 14
Zone 13
Zone 12
Transportation
Interstate
US Highway
State Highway
Structurally Deficient Bridges
Functionally Obsolete Bridges
Evacuation Route Issues
Conflict Points
0
5,000
Feet
Produced by SRPEDD - September 2006
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Fairhaven

Nearly 37% (approximately 5 square miles) would be covered from a storm surge with most of Sconitcut Neck and West Island flooded.

Evacuation routes that would be impacted by a storm surge include:

- Causeway Road,
- Route 6,
- Sconticut Neck Road.

Photo Courtesy of Standard Times

LUMBERING on a big scale was done in Fairhaven Center.


ACUSHNET
FAIRHAVEN
MATTAPOISETT
195
240
6
Oxford School
Hastings Middle School
Rogers School
Wood School
E. Fairhaven School
Old Hammondtown School
J Gomes School
N
W
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S
Fairhaven, MA
LEGEND
Community Boundaries
Coastline
MA Evac. Routes
Evac Traffic Control
Fire Stations
Police Stations
Evacuation Shelters
HOSPITALS
Storm Surge S.L.O.S.H. Zones
Zone 14
Zone 13
Zone 12
Transportation
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US Highway
State Highway
Structurally Deficient Bridges
Functionally Obsolete Bridges
Evacuation Route Issues
Conflict Points
0
3,000
Feet
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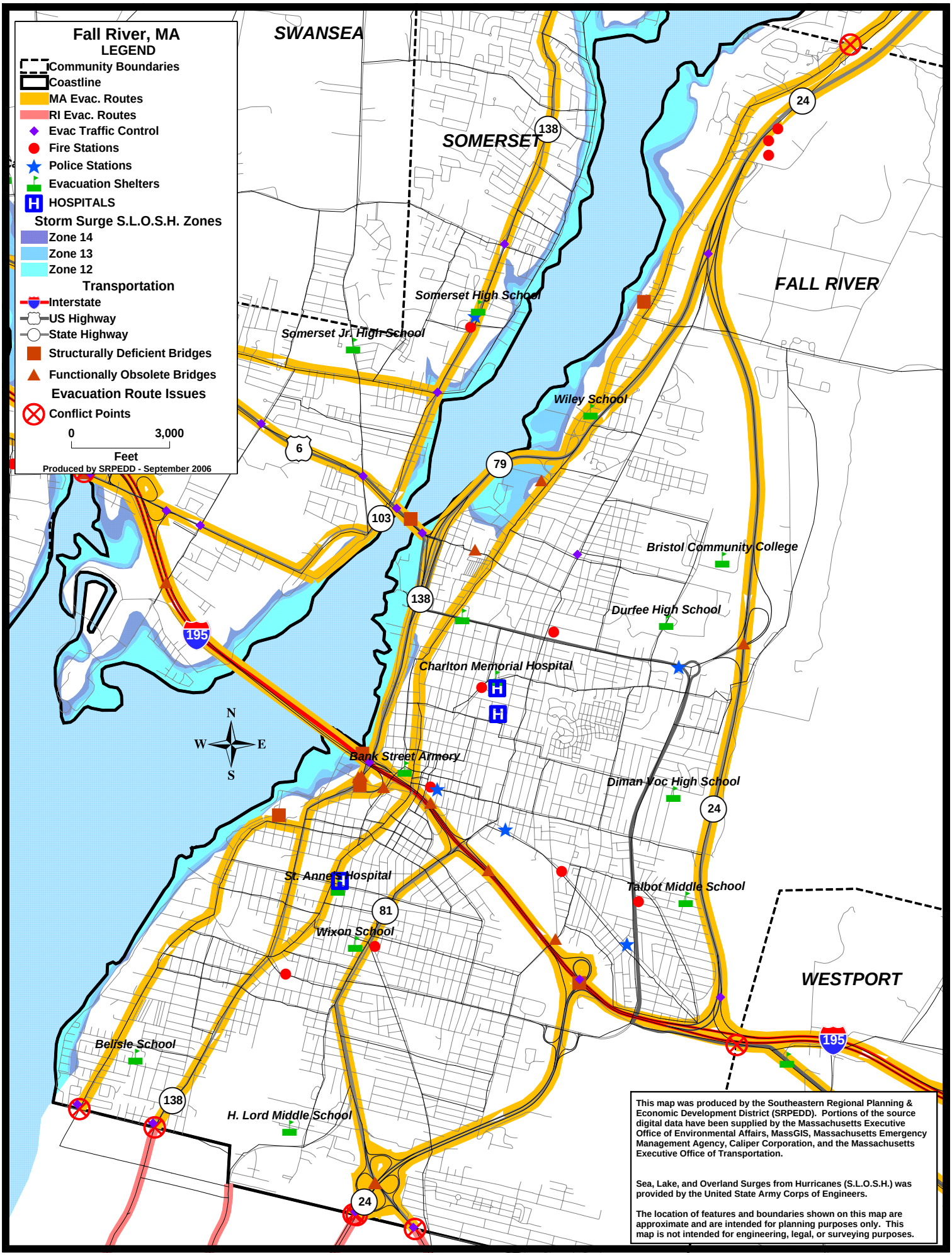
Fall River

The impact to the city would be reserved along the banks of the Taunton River.

Potential flooding would impact:

- Route 79,
- Davol Street (East and West),
- Route 138 in the area under the Braga Bridge.

Route 79 north of the Brightman Street Bridge may also experience significant flooding due to the close proximity to the Taunton River.


Fall River, MA
LEGEND
Community Boundaries
Coastline
MA Evac. Routes
RI Evac. Routes
Evac Traffic Control
Fire Stations
Police Stations
Evacuation Shelters
HOSPITALS
Storm Surge S.L.O.S.H. Zones
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Zone 13
Zone 12
Transportation
Interstate
US Highway
State Highway
Structurally Deficient Bridges
Functionally Obsolete Bridges
Evacuation Route Issues
Conflict Points
0
3,000
Feet
Produced by SRPEDD - September 2006
SWANSEA
SOMERSET
FALL RIVER
WESTPORT
Somerset High School
Somerset Jr. High School
Wiley School
Bristol Community College
Durfee High School
Charlton Memorial Hospital
Bank Street Armory
Diman Voc High School
St. Anne's Hospital
Wixon School
Talbot Middle School
Belisle School
H. Lord Middle School
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138
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79
103
195
81
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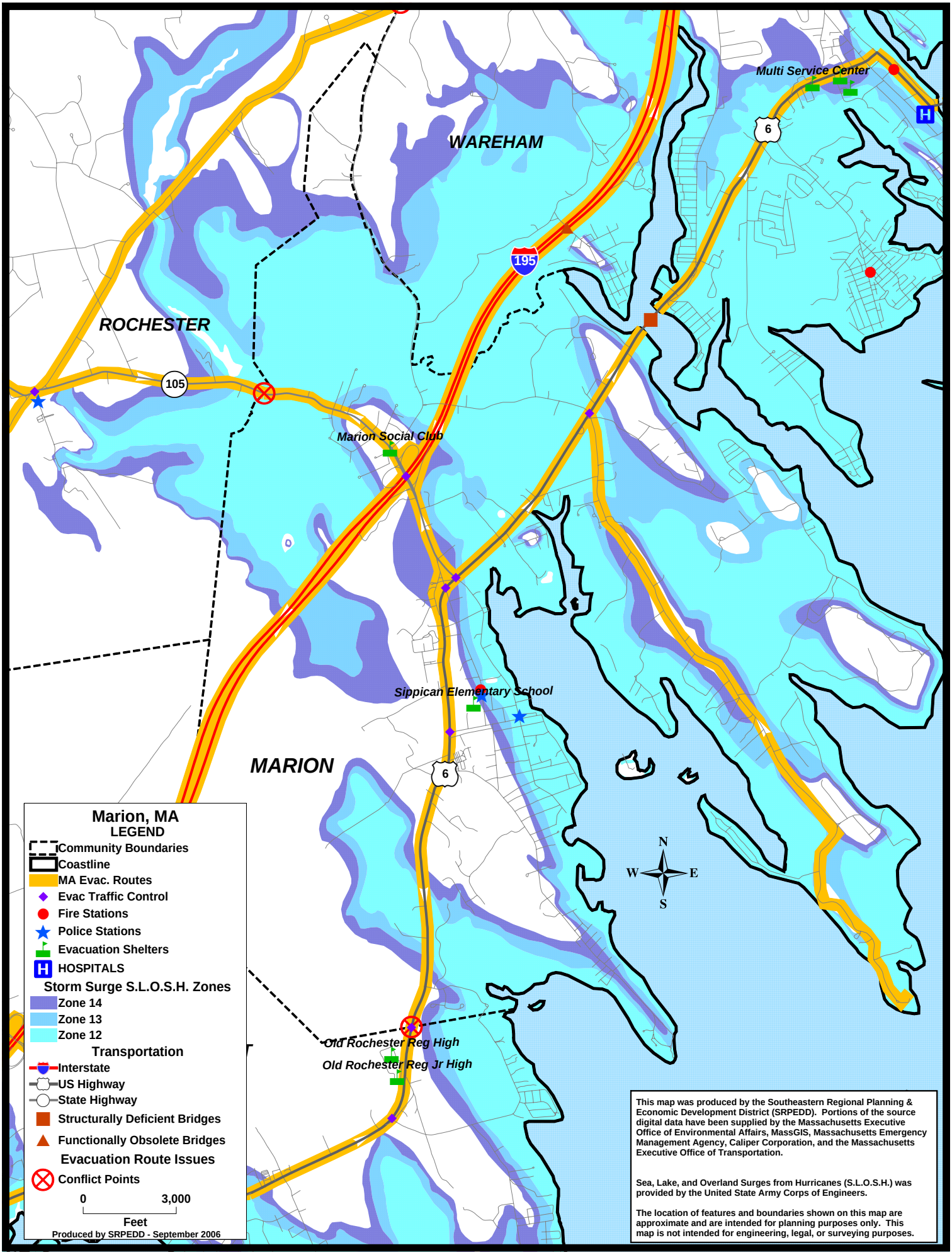
Marion

Nearly 71% (approximately 10 sq miles) would be flooded by a storm surge. Flooding caused by a severe storm would impact a majority of the town. Streets that are part of Marion's evacuation routes affected from a potential storm surge include:

- Point Street
- Front Street (Route 105)
- Interstate 195
- Mill Street (Route 6)
- Spring Street
- Wareham Street (Route 6)

The shelters in Marion include the Sippican Elementary School (1000 Capacity) and the Marion Social Club (200 Capacity). These shelters appear to be outside of the SLOSH flood zone, but the roads leading to these shelters areas (Route 6, Route 105, and I-195) would be flooded in the worst case scenario; isolating these locations. Town residents may need to seek shelter elsewhere, possibly to neighboring towns that are not located along the coast.

Tabor Academy after Hurricane Bob


WAREHAM
ROCHESTER
MARION
Multi Service Center
Marion Social Club
Sippican Elementary School
Old Rochester Reg High
Old Rochester Reg Jr High
195
105
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Marion, MA
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Community Boundaries
Coastline
MA Evac. Routes
Evac Traffic Control
Fire Stations
Police Stations
Evacuation Shelters
HOSPITALS
Storm Surge S.L.O.S.H. Zones
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US Highway
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Functionally Obsolete Bridges
Evacuation Route Issues
Conflict Points
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Feet
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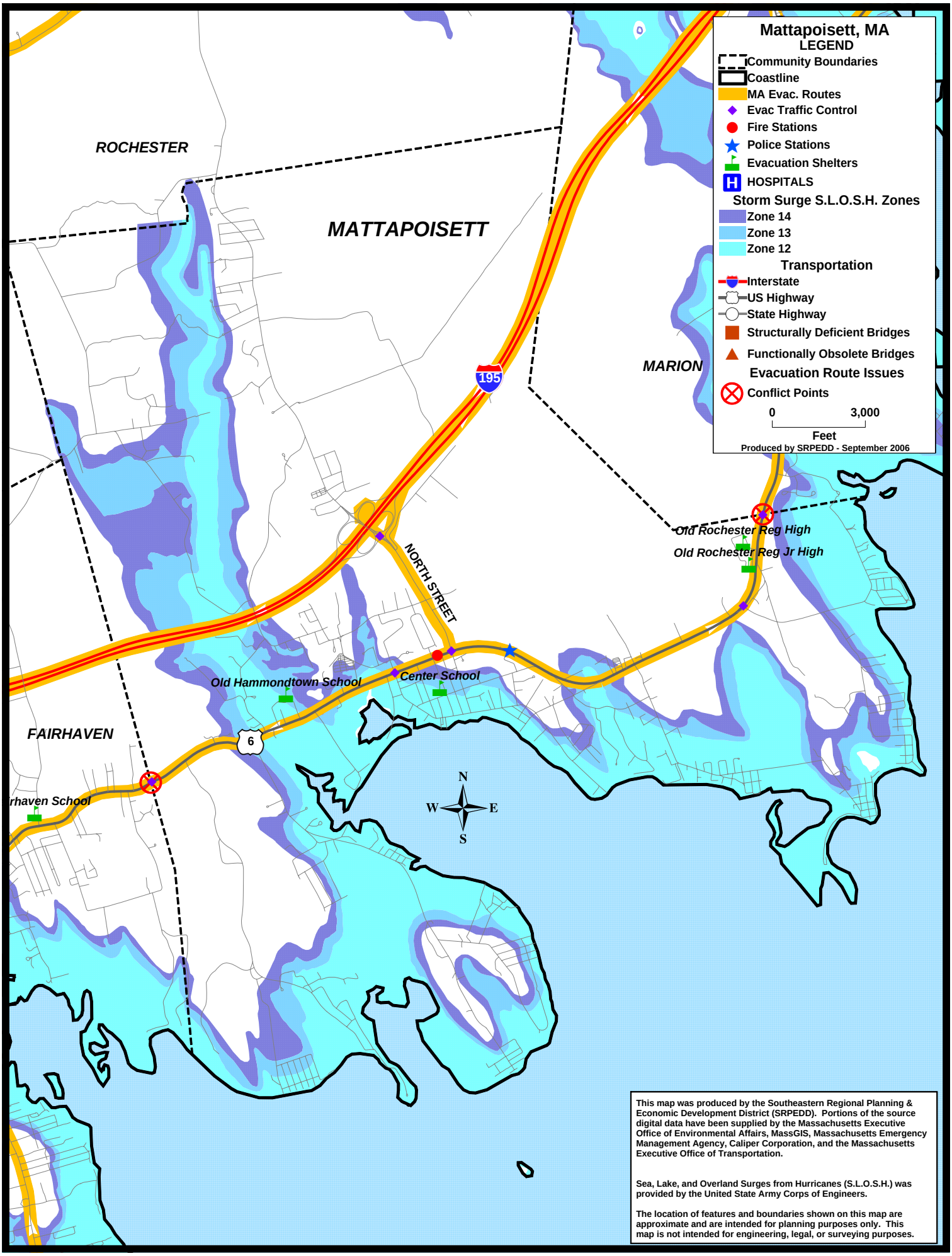
Mattapoisett

Nearly 41% (approximately 7 sq miles) would be flooded by a storm surge. In addition to the streets listed below, two shelters are located in the storm surge area. These shelters are the Old Hammondtown School (Capacity 750) and Center School (Capacity 900). Two additional shelters, Old Rochester Regional Junior High School (Capacity 600) and Old Rochester Regional High School (Capacity 1500) are not within a SLOSH flood zone. Route 6 that accesses these two facilities would be flooded in a worse case scenario, isolating the school.

Streets in the town impacted by a storm surge include:

- Fairhaven Road (Route 6)
- Interstate 195
- Marion Road (Route 6)
- North Street


Mattapoisett, MA
LEGEND
Community Boundaries
Coastline
MA Evac. Routes
Evac Traffic Control
Fire Stations
Police Stations
Evacuation Shelters
HOSPITALS
Storm Surge S.L.O.S.H. Zones
Zone 14
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Transportation
Interstate
US Highway
State Highway
Structurally Deficient Bridges
Functionally Obsolete Bridges
Evacuation Route Issues
Conflict Points
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Feet
Produced by SRPEDD - September 2006
ROCHESTER
MATTAPOISETT
MARION
FAIRHAVEN
195
6
NORTH STREET
Old Rochester Reg High
Old Rochester Reg Jr High
Old Hammondtown School
Center School
rhaven School
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S
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New Bedford

The city constructed a hurricane barrier in the 1960s to control the flooding brought on by a major storm. Located below the Route 6 Fairhaven/New Bedford Bridge at the mouth of the Acushnet River, the SLOSH zone model indicates that use of this barrier would significantly prohibit flooding to areas upstream from the barrier.

Although the installation of a Hurricane barrier may certainly minimize the impact from a storm surge, evacuation routes as well as major roads should be well maintained to handle evacuation of the south end. Streets that are part of evacuation routes impacted by a storm would be Cove Road and Rodney French Boulevard.

Figure 1 - Hurricane Dike along Cove Road, New Bedford


Hayden/Mcfadden School
195
FAIRHAVEN
Hastings Mid
New Bedford High School
18
140
NEW BEDFORD
6
6
Carney Academy School
Rogers Sc
th Middle School
Alfred J Gomes School
H
H
Dartmouth Council On Aging
N
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New Bedford, MA
LEGEND
Community Boundaries
Coastline
MA Evac. Routes
Evac Traffic Control
Fire Stations
Police Stations
Evacuation Shelters
HOSPITALS
Storm Surge S.L.O.S.H. Zones
Zone 14
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Zone 12
Transportation
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US Highway
State Highway
Structurally Deficient Bridges
Functionally Obsolete Bridges
Evacuation Route Issues
Conflict Points
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2,500
Feet
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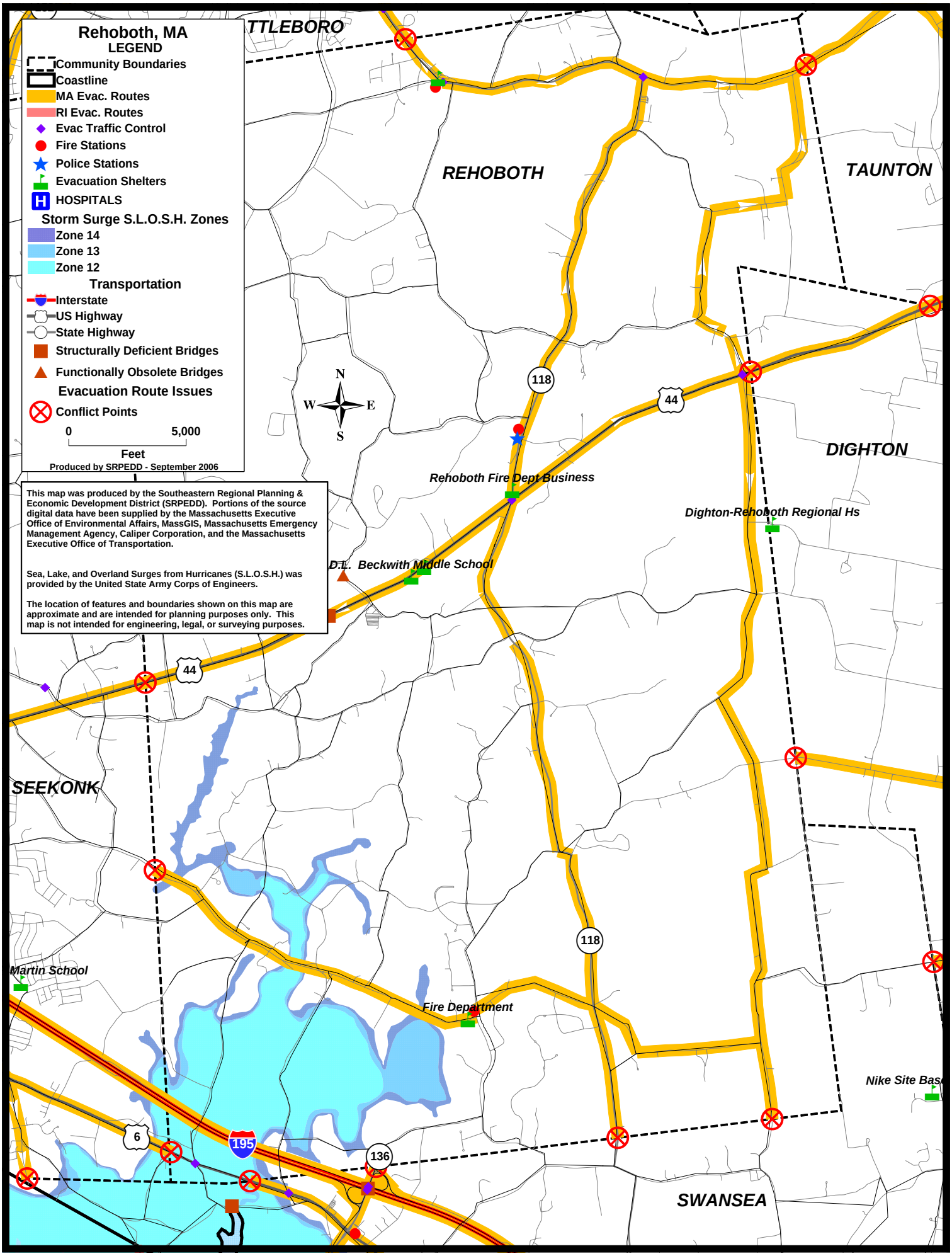
Rehoboth

A storm surge under the severe storm scenario would potentially impact roads in the southwest corner of town including:

- Routes I-195,
- Route 6,
- Providence Street.


Rehoboth, MA
LEGEND
Community Boundaries
Coastline
MA Evac. Routes
RI Evac. Routes
Evac Traffic Control
Fire Stations
Police Stations
Evacuation Shelters
HOSPITALS
Storm Surge S.L.O.S.H. Zones
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US Highway
State Highway
Structurally Deficient Bridges
Functionally Obsolete Bridges
Evacuation Route Issues
Conflict Points
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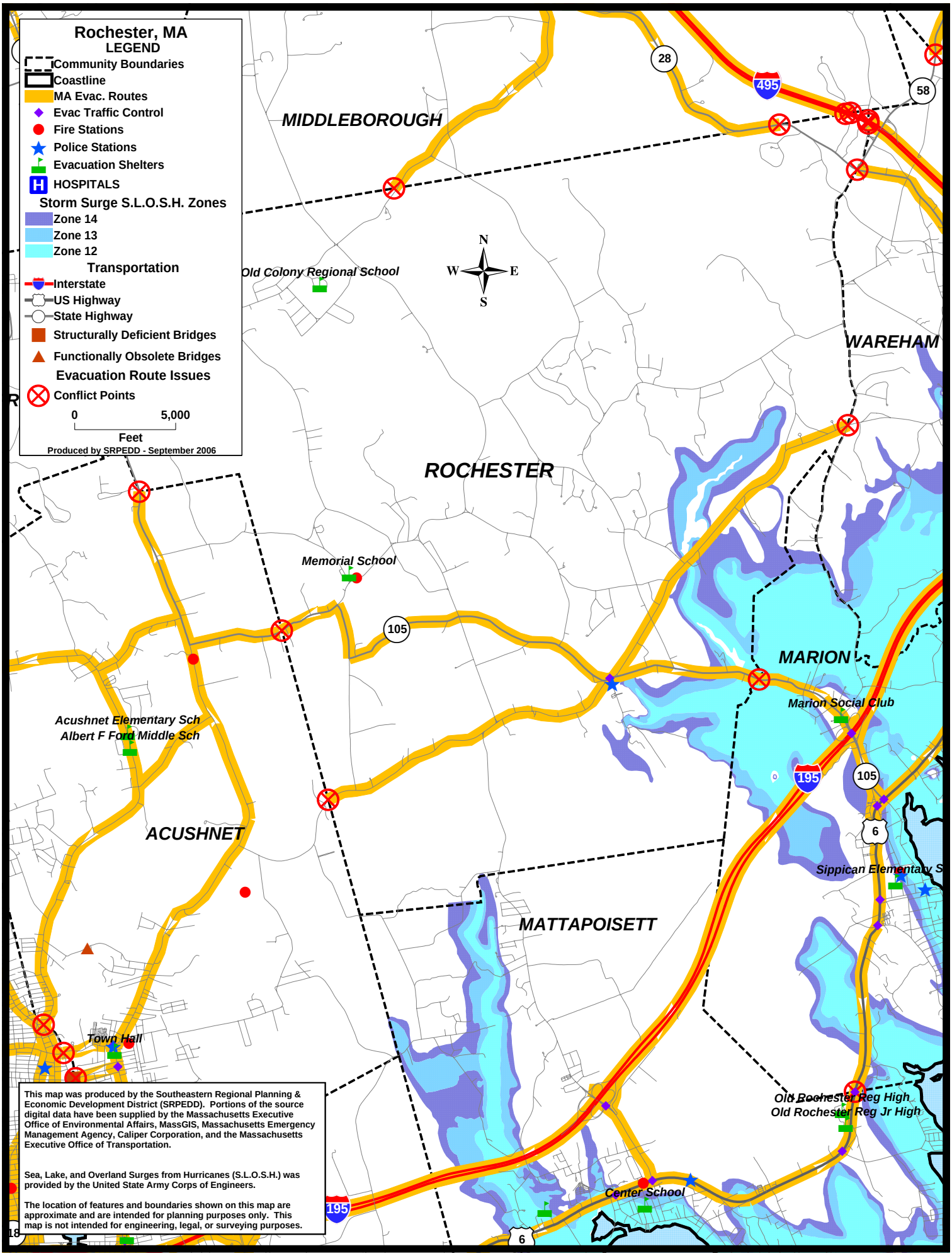
TTLEBORO
REHOBOTH
TAUNTON
DIGHTON
SEEKONK
SWANSEA
N
W
E
S
118
44
6
195
136
Rehoboth Fire Dept Business
Dighton-Rehoboth Regional Hs
D.L. Beckwith Middle School
Martin School
Fire Department
Nike Site Bas

Rochester

A storm surge under the severe storm scenario would potentially impact roads in the southeast corner of town including Mary’s Pond Road and Route 105.


Rochester, MA
LEGEND
Community Boundaries
Coastline
MA Evac. Routes
Evac Traffic Control
Fire Stations
Police Stations
Evacuation Shelters
HOSPITALS
Storm Surge S.L.O.S.H. Zones
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Zone 13
Zone 12
Transportation
Interstate
US Highway
State Highway
Structurally Deficient Bridges
Functionally Obsolete Bridges
Evacuation Route Issues
Conflict Points
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Feet
Produced by SRPEDD - September 2006
MIDDLEBOROUGH
ROCHESTER
WAREHAM
MARION
ACUSHNET
MATTAPOISETT
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Old Colony Regional School
Memorial School
Acushnet Elementary Sch
Albert F Ford Middle Sch
Marion Social Club
Sippican Elementary S
Town Hall
Old Rochester Reg High
Old Rochester Reg Jr High
Center School
28
495
58
105
195
6
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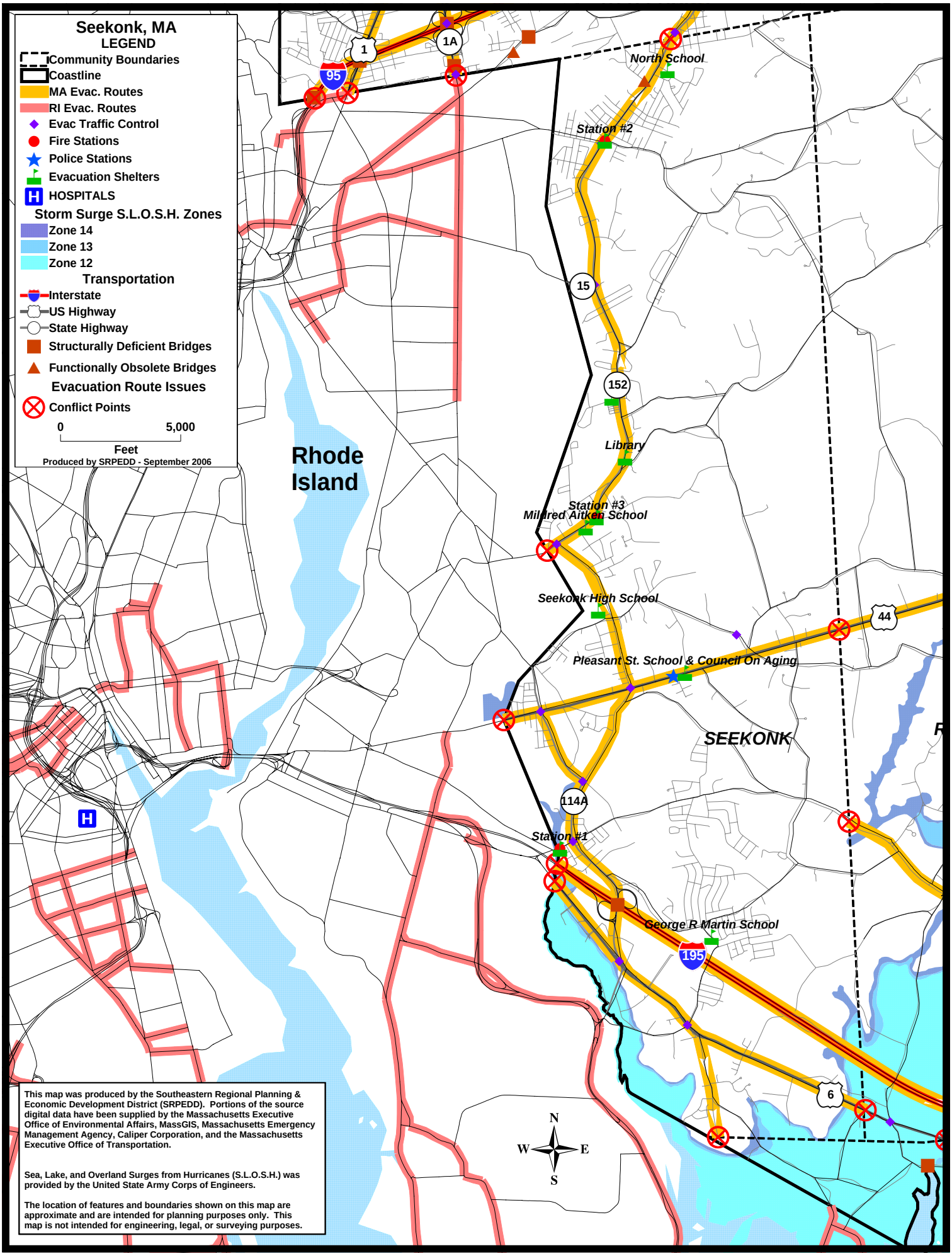
Seekonk

Since most of the flooding would happen in the southern portion of town, the following roads that are part of the evacuation route:

- I-195,
- Route 6,
- Route 114A (Mink Street).


Seekonk, MA
LEGEND
Community Boundaries
Coastline
MA Evac. Routes
RI Evac. Routes
Evac Traffic Control
Fire Stations
Police Stations
Evacuation Shelters
HOSPITALS
Storm Surge S.L.O.S.H. Zones
Zone 14
Zone 13
Zone 12
Transportation
Interstate
US Highway
State Highway
Structurally Deficient Bridges
Functionally Obsolete Bridges
Evacuation Route Issues
Conflict Points
0
5,000
Feet
Produced by SRPEDD - September 2006
Rhode Island
SEEKONK
North School
Station #2
Library
Station #3
Mildred Aitken School
Seekonk High School
Pleasant St. School & Council On Aging
Station #1
George R Martin School
1
1A
95
15
152
44
114A
195
6
N
W
E
S
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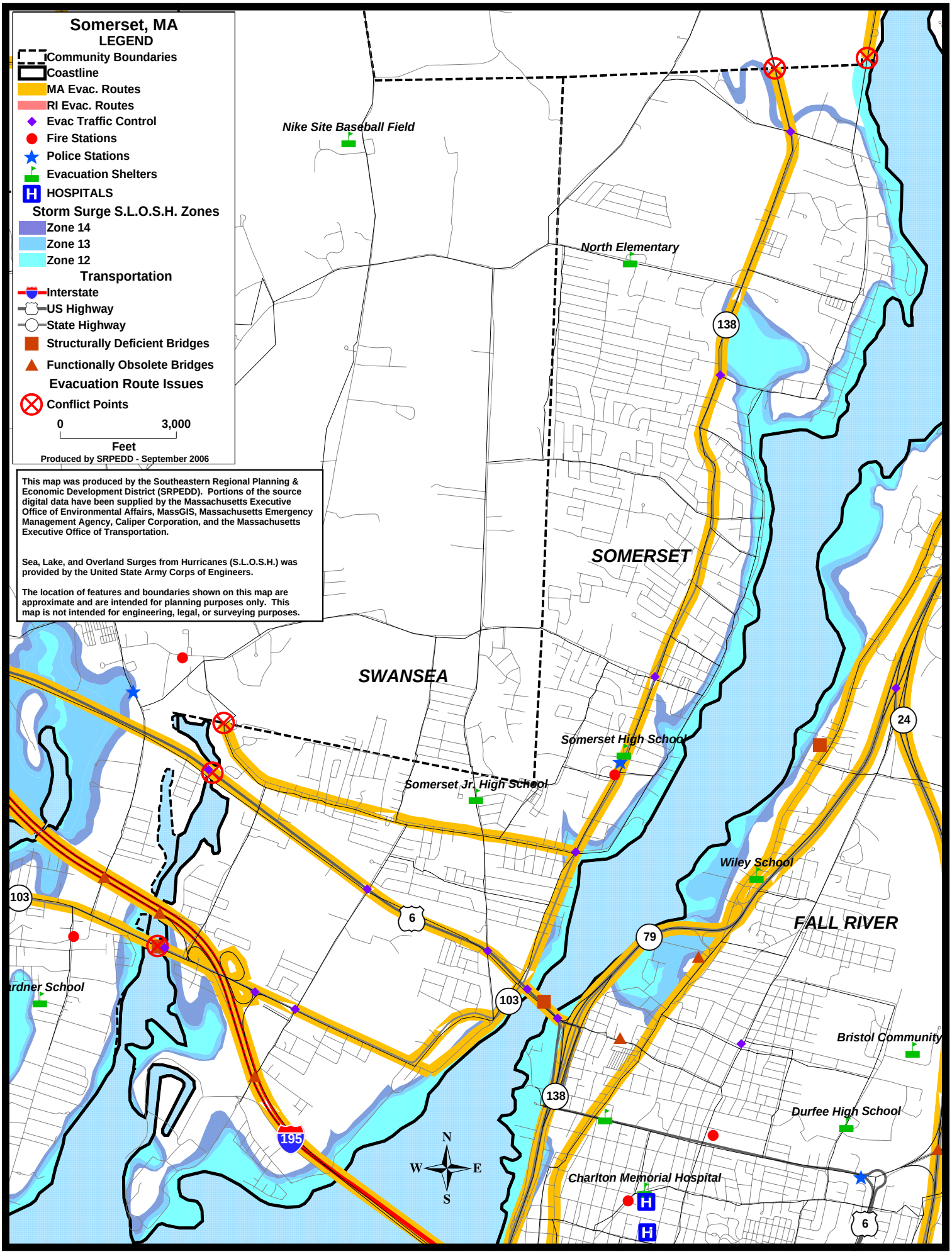
Somerset

Flooding in the southern portion of town and along the Taunton River would impact evacuation routes on:

- Route 138 (Riverside Ave),
- Route 103 (Wilbur Ave),
- I-195,
- Route 6.


Somerset, MA
LEGEND
Community Boundaries
Coastline
MA Evac. Routes
RI Evac. Routes
Evac Traffic Control
Fire Stations
Police Stations
Evacuation Shelters
HOSPITALS
Storm Surge S.L.O.S.H. Zones
Zone 14
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Transportation
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US Highway
State Highway
Structurally Deficient Bridges
Functionally Obsolete Bridges
Evacuation Route Issues
Conflict Points
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Feet
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Nike Site Baseball Field
North Elementary
SOMERSET
SWANSEA
Somerset High School
Somerset Jr. High School
Wiley School
FALL RIVER
Bristol Community
Durfee High School
Charlton Memorial Hospital
138
24
103
6
79
195
N
W
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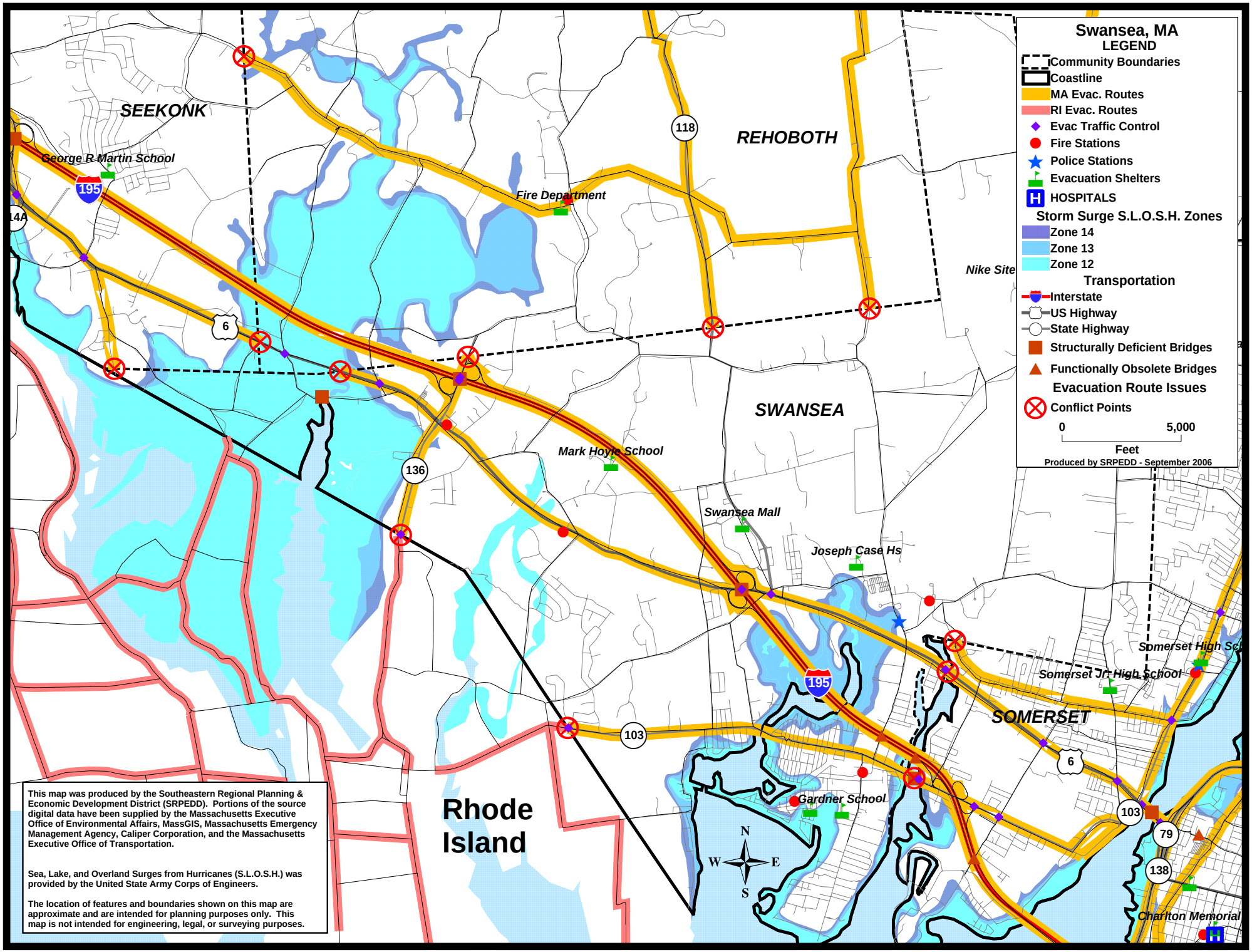
S

Swansea

All of Swansea’s evacuation routes at some particular locations would be impacted by the floodwaters of a severe storm including:

- I-195,
- Route 6,
- Route 103,
- Route 136.


Swansea, MA
LEGEND
Community Boundaries
Coastline
MA Evac. Routes
RI Evac. Routes
Evac Traffic Control
Fire Stations
Police Stations
Evacuation Shelters
HOSPITALS
Storm Surge S.L.O.S.H. Zones
Zone 14
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Interstate
US Highway
State Highway
Structurally Deficient Bridges
Functionally Obsolete Bridges
Evacuation Route Issues
Conflict Points
0
5,000
Feet
Produced by SRPEDD - September 2006
SEEKONK
REHOBOTH
SWANSEA
SOMERSET
Rhode Island
George R Martin School
Fire Department
Nike Site
Mark Hoyle School
Swansea Mall
Joseph Case Hs
Somerset High Sch
Somerset Jr High School
Gardner School
Charlton Memorial
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14A
136
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Wareham

With nearly 56 % (approximately 21 sq miles) covered by a severe storm surge, Wareham would most likely experience the greatest impact to a majority of its population that lives within the severe storm SLOSH zone. One alarming issue is there are four evacuation shelters located in the SLOSH zone. Under severe storm conditions, these shelters would experience flooding and possibly be rendered ineffective. This would force town residents to seek shelter elsewhere, possibly to neighboring towns that are not along the coast. The shelters impacted directly from flooding include:

Photo Courtesy of Standard Times

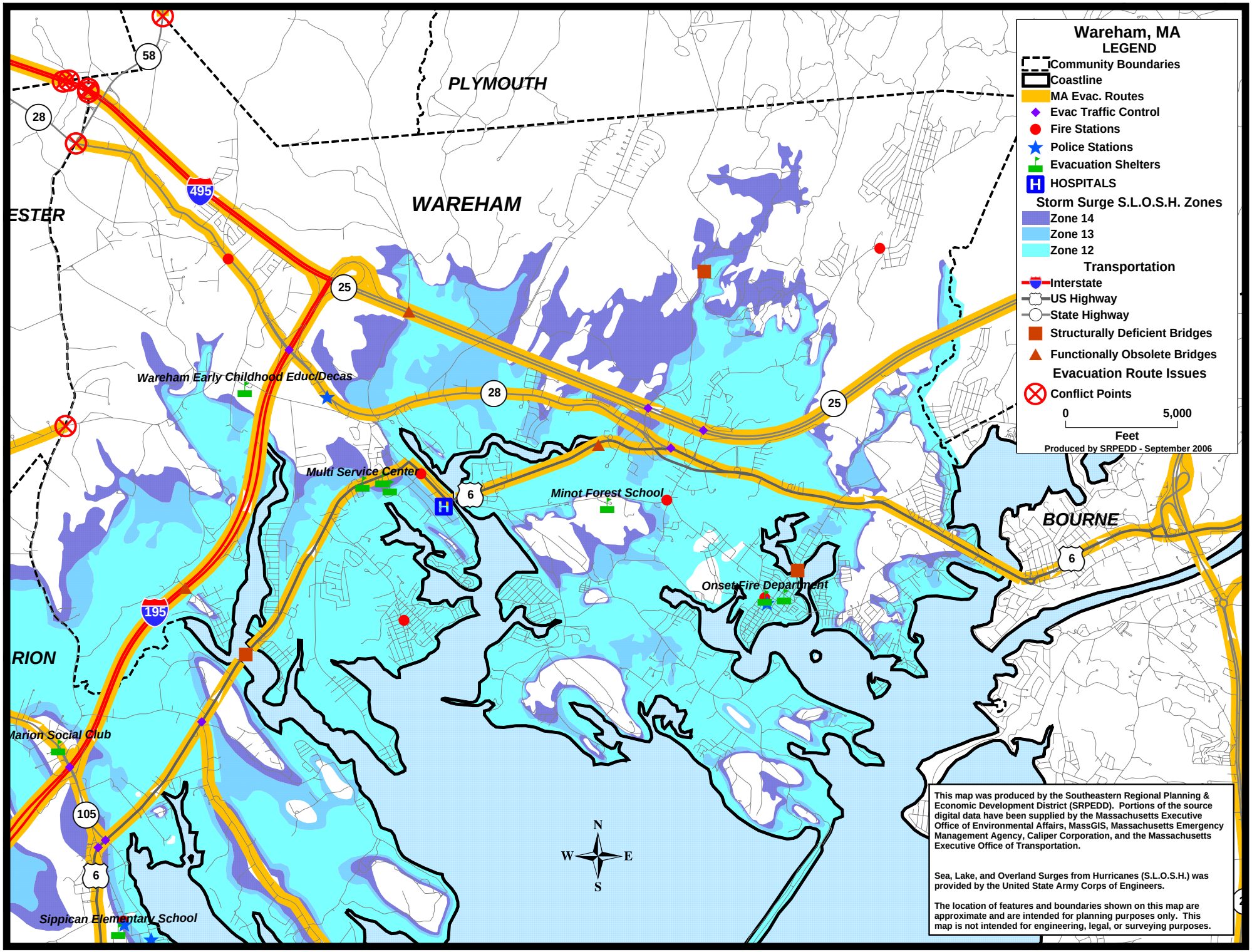
ONLY THE FOUNDATIONS remain at Swifts Beach site, Wareham.

- Town Hall (500 Capacity)
- Wareham High School (1000 Capacity)
- Onset Fire Dept (50 Capacity)
- Hammond School (Onset - 250 Capacity)

The Minot School (500 Capacity) located on Minot Avenue in the center of town does not sit within a SLOSH flood zone. However, the problem is that under the severe storm scenario, the area surrounding the school would be flooded including Minot Avenue; the only access road to the facility. The only school that appears to be safe, as well as accessible, is the Decas School (500 Capacity) located on Main Street near Tobey Road in West Wareham. As will be shown later in this report, this single school does not have the capacity to handle the projected evacuees that would use public shelters.

Roads that are part of evacuation routes impacted by the storm surge area include:

- Cranberry Highway (Route 6 And 28)
- Depot Street
- Interstate 195
- Main Street (Route 6)
- Marion Road (Route 6)
- Route 25
- Sandwich Road (Route 6)
- Sawyer Road


Wareham, MA
LEGEND
Community Boundaries
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MA Evac. Routes
Evac Traffic Control
Fire Stations
Police Stations
Evacuation Shelters
HOSPITALS
Storm Surge S.L.O.S.H. Zones
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Zone 12
Transportation
Interstate
US Highway
State Highway
Structurally Deficient Bridges
Functionally Obsolete Bridges
Evacuation Route Issues
Conflict Points
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Feet
Produced by SRPEDD - September 2006
PLYMOUTH
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RION
BOURNE
Wareham Early Childhood Educ/Decas
Multi Service Center
Minot Forest School
Onset Fire Department
Marion Social Club
Sippican Elementary School
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Westport

Westport would have significant flooding along the shoreline and up the Westport River. Two of the three roads that make up part of the evacuation routes Route 88 and Route 177, would be impacted by floodwater. Route 88 near Horseneck Beach in the southern end of the town would be impacted due to the close proximity to the Atlantic Ocean. Route 177 may see flooding as a result of the storm surge as it travels north along the Westport River.

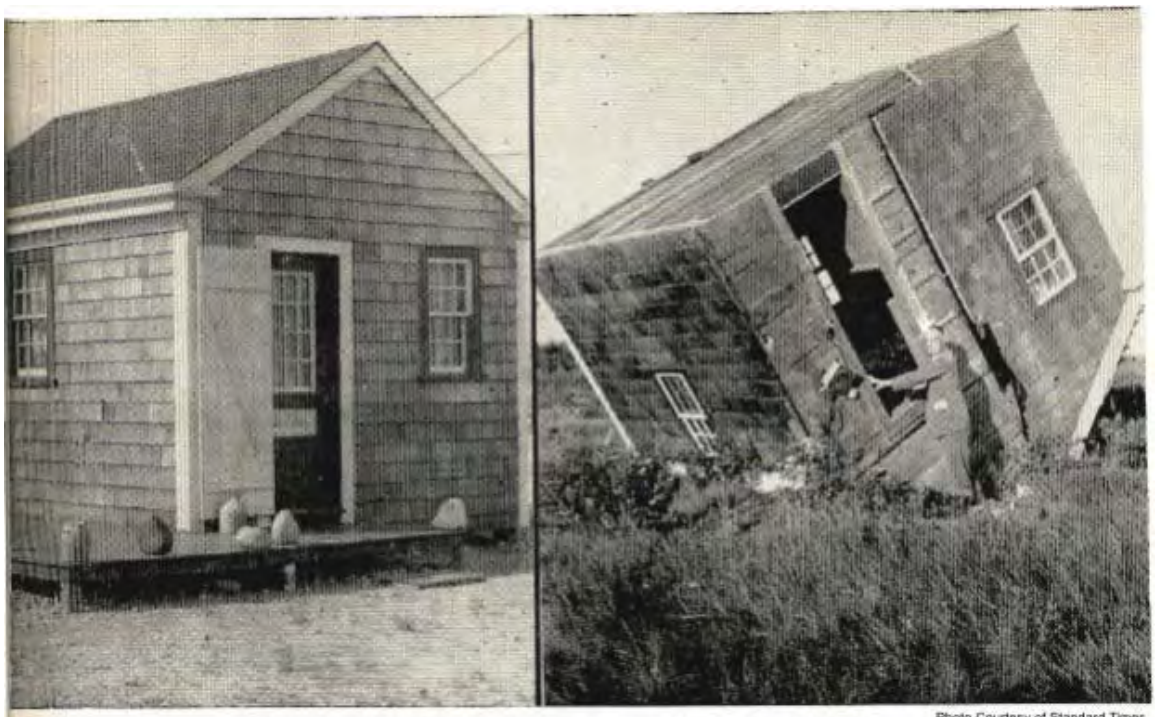
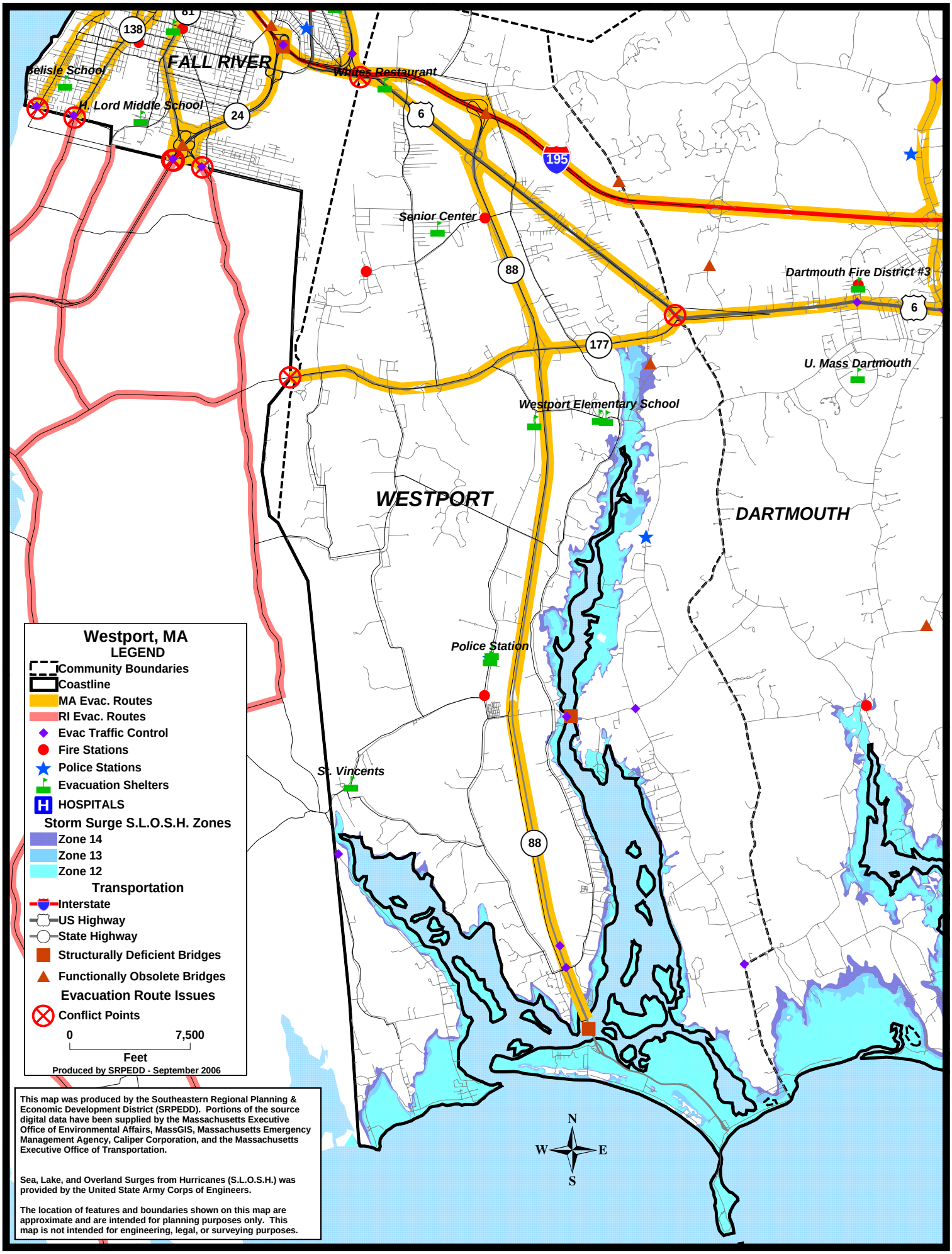


Photo Courtesy of Standard Times

BEFORE AND AFTER: A study in topsy-turvy at Horseneck East Beach.



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APPENDIX B

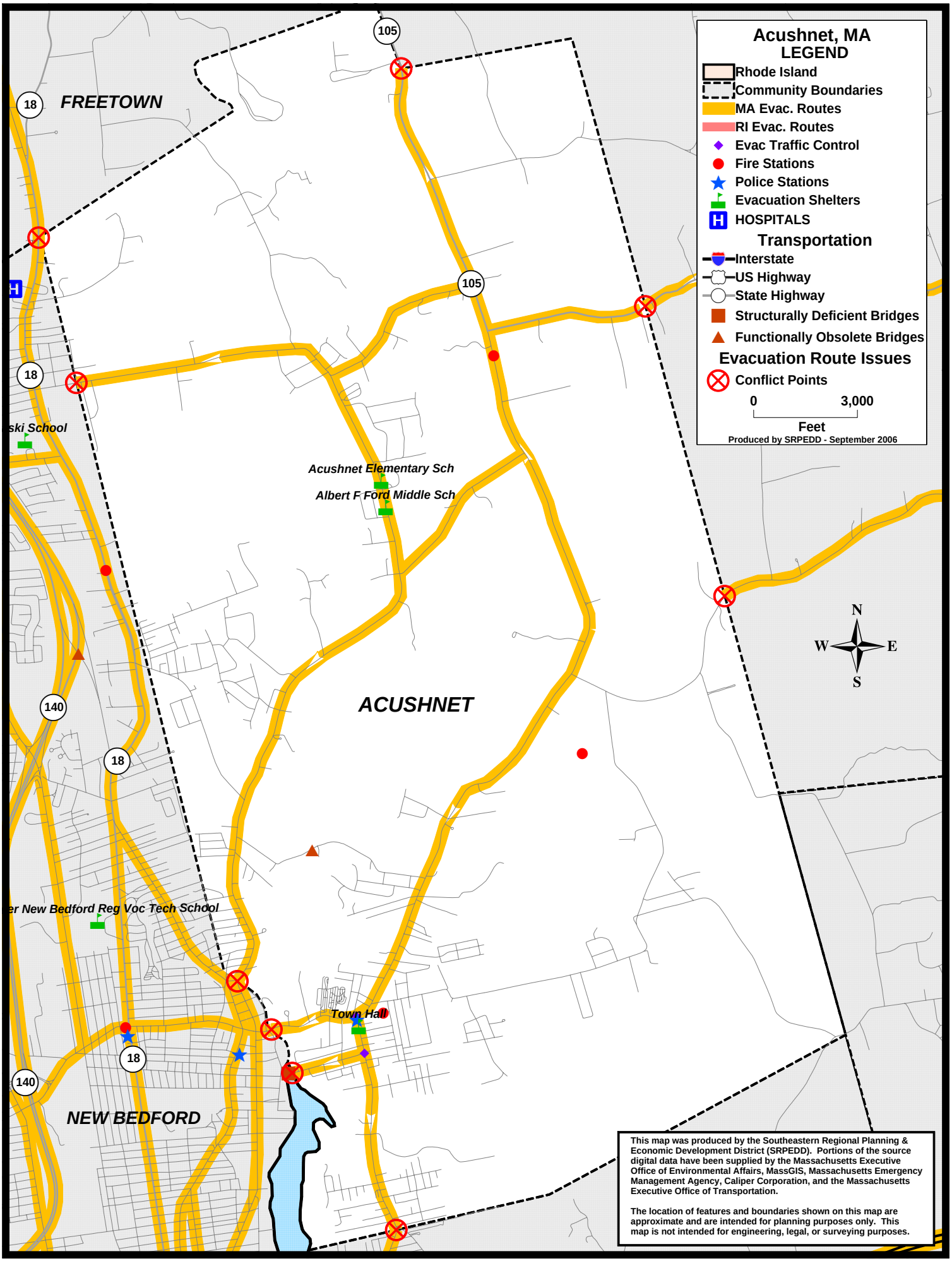
SRPEDD
Community Evacuation Route
Conflict Points

Acushnet

- Peckham Road evacuation route ends at the New Bedford City Line, nearly 1,200 feet from Route 18 in New Bedford, a city designated evacuation route.

- Main Street (Route 105) ends at the town line with Rochester.

- Slocum Street ends at the New Bedford City Line, but is nearly 1,000 feet away from Belleville Avenue, a city designated evacuation route.



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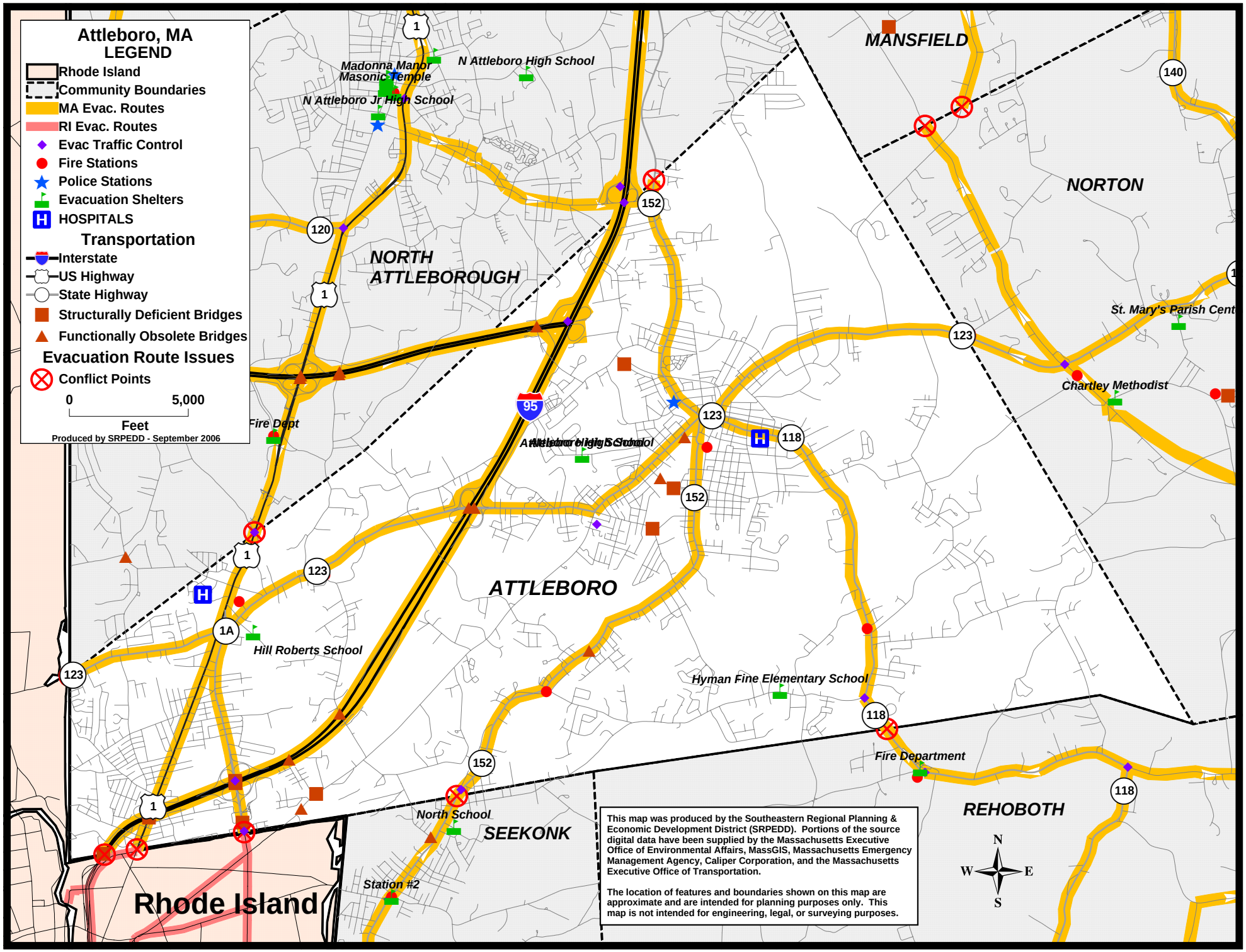
Attleboro

- North Main Street (Route 152) ends at the North Attleborough line.
- Attleboro High School and Hyman Fine Elementary School, designated shelters, are not on an evacuation route.


Attleboro, MA
LEGEND
Rhode Island
Community Boundaries
MA Evac. Routes
RI Evac. Routes
Evac Traffic Control
Fire Stations
Police Stations
Evacuation Shelters
HOSPITALS
Transportation
Interstate
US Highway
State Highway
Structurally Deficient Bridges
Functionally Obsolete Bridges
Evacuation Route Issues
Conflict Points
0
5,000
Feet
Produced by SRPEDD - September 2006
MANSFIELD
NORTON
NORTH ATTLEBOROUGH
ATTLEBORO
SEEKONK
REHOBOTH
Rhode Island
Madonna Manor
Masonic Temple
N Attleboro High School
N Attleboro Jr High School
St. Mary's Parish Cent
Chartley Methodist
Fire Dept
Hill Roberts School
Hyman Fine Elementary School
Fire Department
North School
Station #2
95
1
1A
120
123
140
152
118
N
S
E
W
This map was produced by the Southeastern Regional Planning & Economic Development District (SRPEDD). Portions of the source digital data have been supplied by the Massachusetts Executive Office of Environmental Affairs, MassGIS, Massachusetts Emergency Management Agency, Caliper Corporation, and the Massachusetts Executive Office of Transportation.
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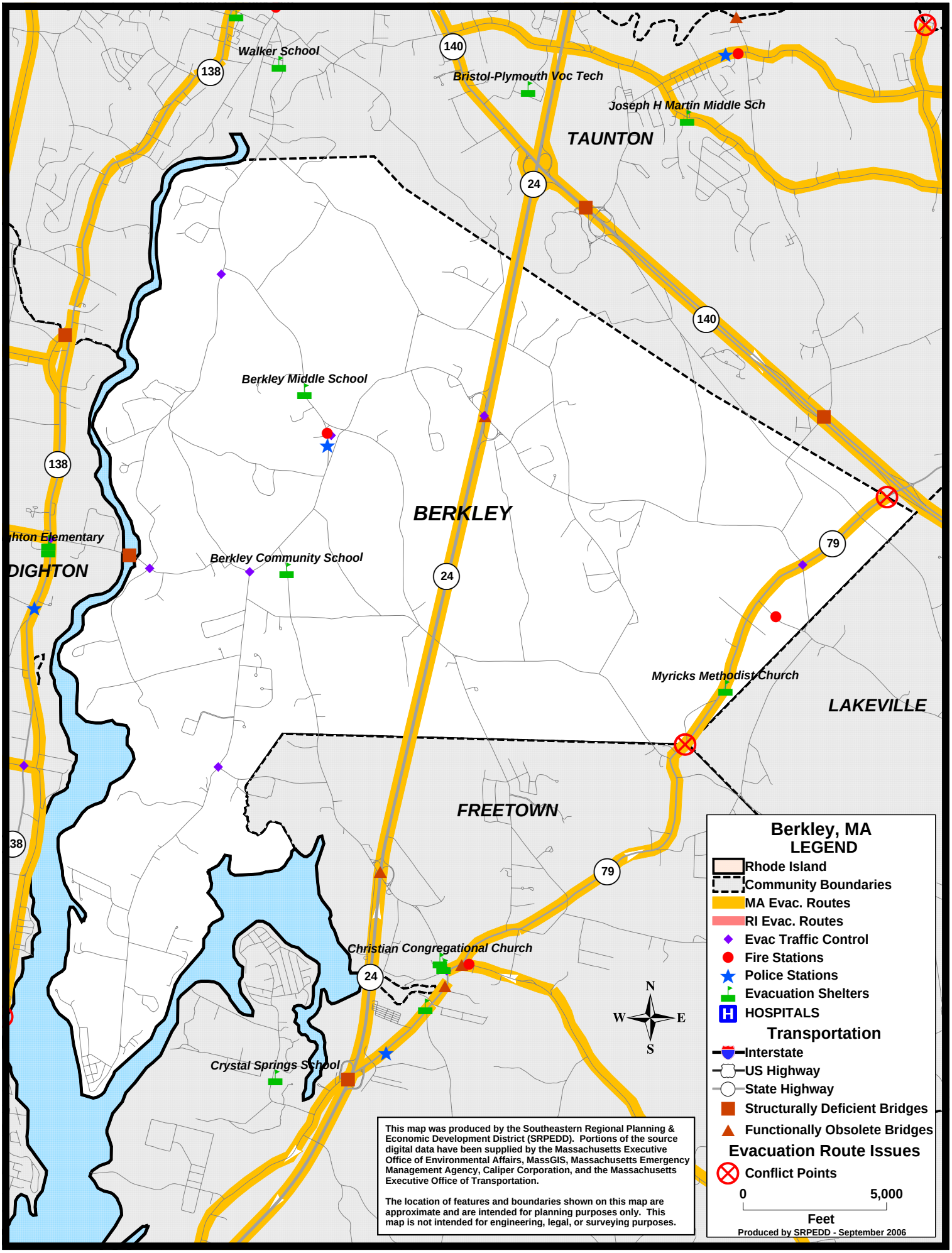
Berkley

- Myricks Street (Route 79) ends at the Taunton City Line.
- Berkley Middle and Community School shelters are not on an evacuation route.


Walker School
Bristol-Plymouth Voc Tech
Joseph H Martin Middle Sch
TAUNTON
Berkley Middle School
BERKLEY
Berkley Community School
DIGHTON
Myricks Methodist Church
LAKEVILLE
FREETOWN
Christian Congregational Church
Crystal Springs School
138
140
24
79
N
W
E
S
Berkley, MA
LEGEND
Rhode Island
Community Boundaries
MA Evac. Routes
RI Evac. Routes
Evac Traffic Control
Fire Stations
Police Stations
Evacuation Shelters
HOSPITALS
Transportation
Interstate
US Highway
State Highway
Structurally Deficient Bridges
Functionally Obsolete Bridges
Evacuation Route Issues
Conflict Points
0
5,000
Feet
Produced by SRPEDD - September 2006
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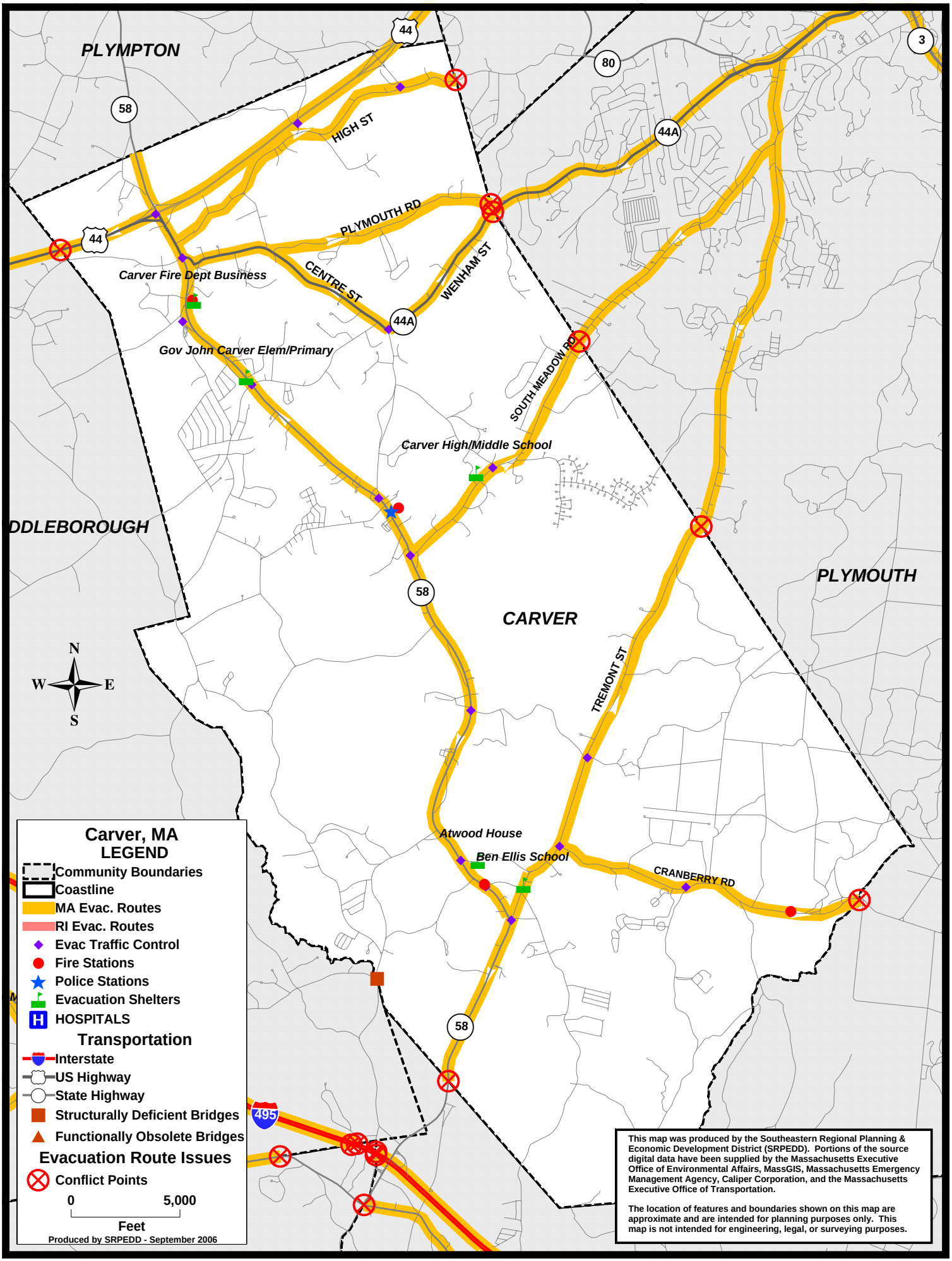
Carver

- High Street, East Head Road, North Main Street (Route 58), and Tremont Street (Route 58) all end at the town line.

- Wenham Road (Route 44A), South Meadow Road and Tremont Street send traffic into Plymouth while traffic is being sent into Carver.

- New Route 44 westbound merges from 2 lanes to 1 lane for traffic flow. Excessive traffic heading into this merge would cause delay and inhibit adequate traffic flow.


PLYMPTON
DDLEBOROUGH
CARVER
PLYMOUTH
44
58
80
3
44A
HIGH ST
PLYMOUTH RD
CENTRE ST
WENHAM ST
SOUTH MEADOW RD
TREMONT ST
CRANBERRY RD
495
Carver Fire Dept Business
Gov John Carver Elem/Primary
Carver High/Middle School
Atwood House
Ben Ellis School
N
W
E
S
Carver, MA
LEGEND
Community Boundaries
Coastline
MA Evac. Routes
RI Evac. Routes
Evac Traffic Control
Fire Stations
Police Stations
Evacuation Shelters
HOSPITALS
Transportation
Interstate
US Highway
State Highway
Structurally Deficient Bridges
Functionally Obsolete Bridges
Evacuation Route Issues
Conflict Points
0
5,000
Feet
Produced by SRPEDD - September 2006
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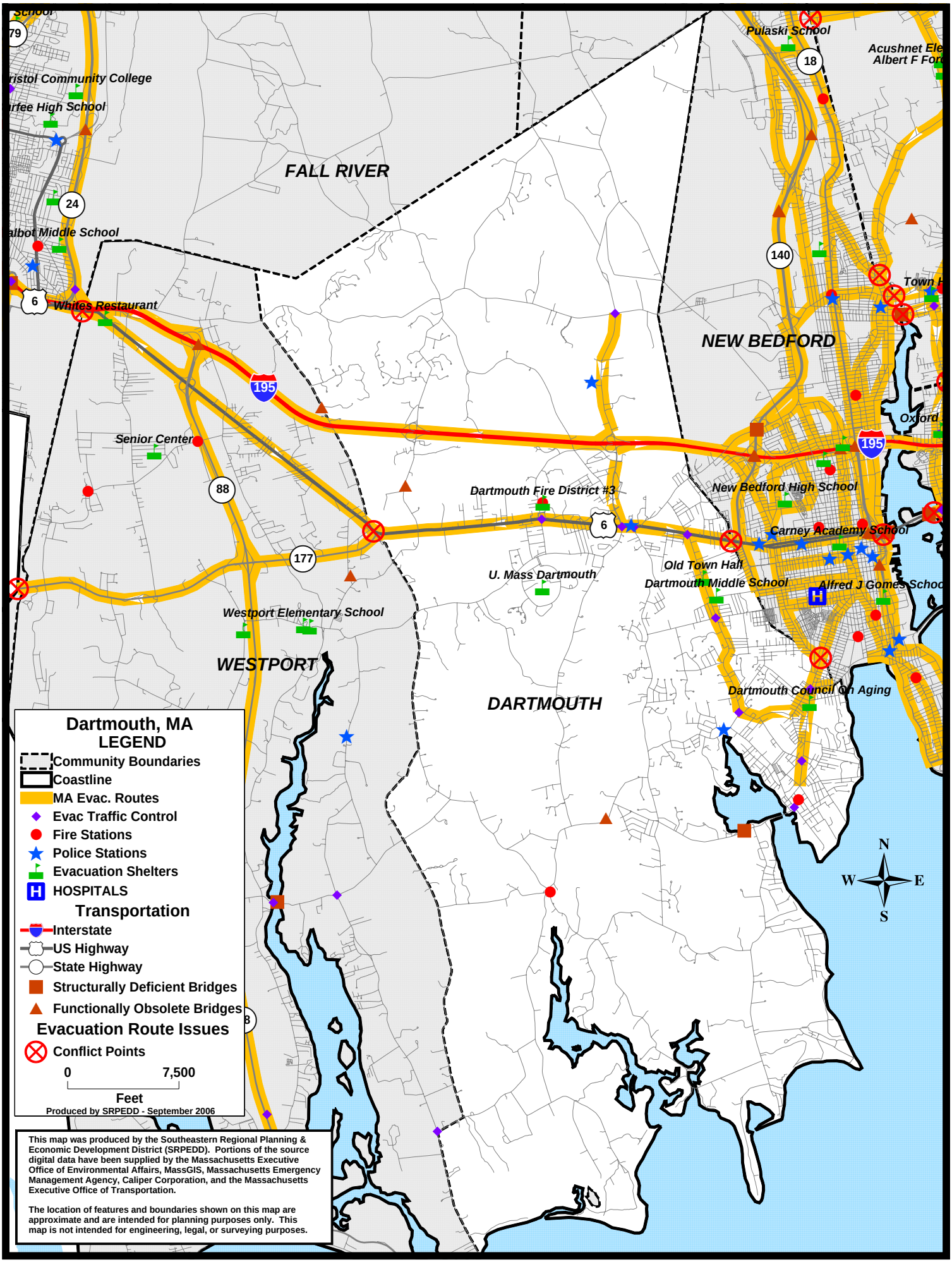
Dartmouth

- Sending traffic into New Bedford and Westport while they are sending traffic into Dartmouth.

- UMASS Dartmouth shelter is not on evacuation route.


Dartmouth, MA
LEGEND
Community Boundaries
Coastline
MA Evac. Routes
Evac Traffic Control
Fire Stations
Police Stations
Evacuation Shelters
HOSPITALS
Transportation
Interstate
US Highway
State Highway
Structurally Deficient Bridges
Functionally Obsolete Bridges
Evacuation Route Issues
Conflict Points
0
7,500
Feet
Produced by SRPEDD - September 2006
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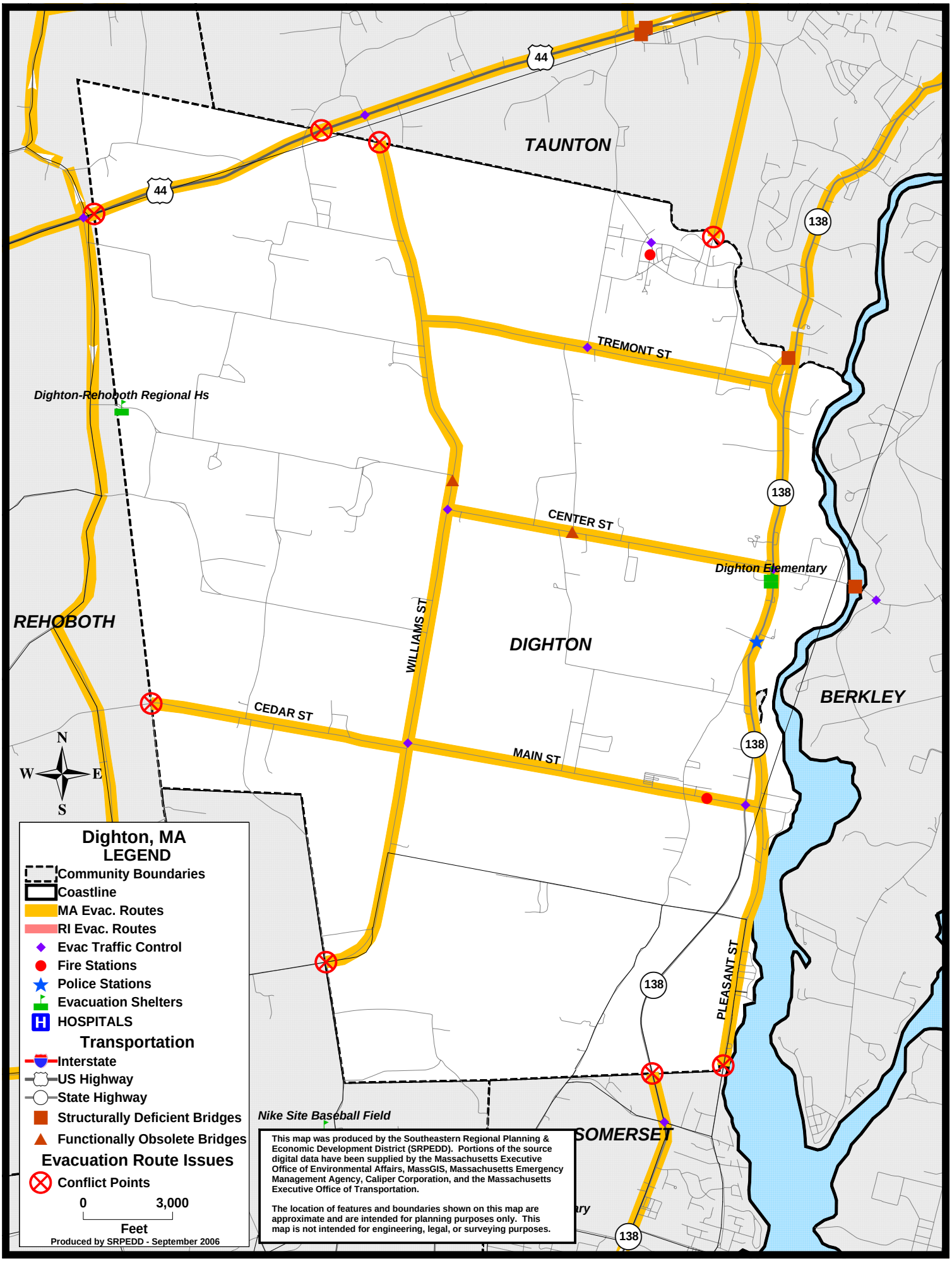
FALL RIVER
NEW BEDFORD
WESTPORT
DARTMOUTH
Pulaski School
Acushnet Ele
Albert F For
ristol Community College
irfee High School
albot Middle School
Whites Restaurant
Senior Center
Dartmouth Fire District #3
New Bedford High School
Carney Academy School
U. Mass Dartmouth
Old Town Hall
Dartmouth Middle School
Alfred J Gomes Schoo
Westport Elementary School
Dartmouth Council On Aging
Oxford
Town
N
W
E
S
195
6
24
88
177
140
18
79

Dighton

- Cedar Street, Pleasant Street, Somerset Avenue (Route 138) and Williams Street all end at the town line.

- Dighton/Rehoboth Regional High School is in close proximity to an evacuation route, but is not located on one.


TAUNTON
REHOBOTH
DIGHTON
BERKLEY
SOMERSET
44
138
TREMONT ST
CENTER ST
CEDAR ST
MAIN ST
WILLIAMS ST
PLEASANT ST
Dighton-Rehoboth Regional Hs
Dighton Elementary
Nike Site Baseball Field
N
W
E
S
Dighton, MA
LEGEND
Community Boundaries
Coastline
MA Evac. Routes
RI Evac. Routes
Evac Traffic Control
Fire Stations
Police Stations
Evacuation Shelters
HOSPITALS
Transportation
Interstate
US Highway
State Highway
Structurally Deficient Bridges
Functionally Obsolete Bridges
Evacuation Route Issues
Conflict Points
0
3,000
Feet
Produced by SRPEDD - September 2006
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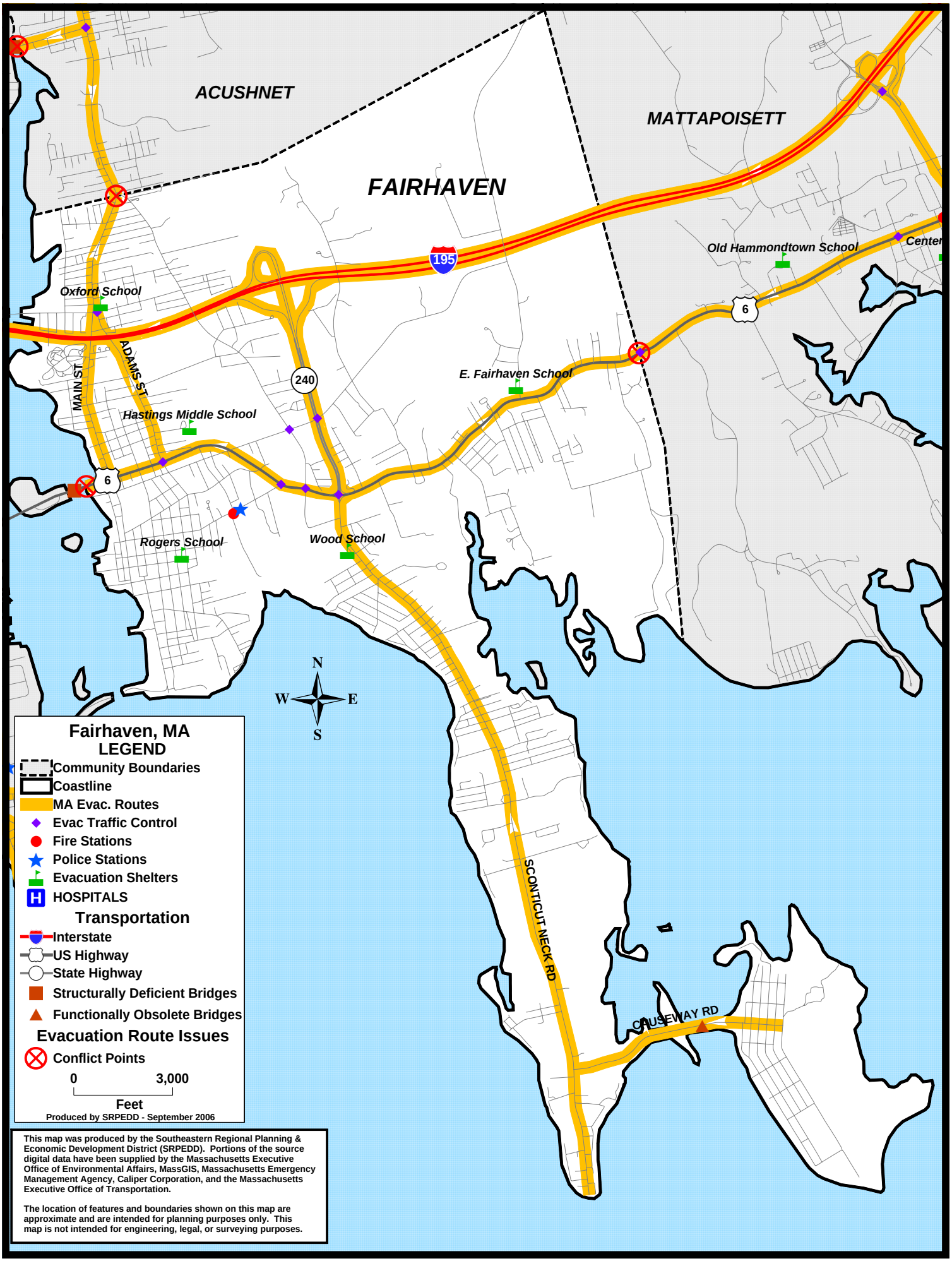
Fairhaven

- Sending traffic into Acushnet, Mattapoisett, and New Bedford while those communities send their traffic into Fairhaven.

- Rogers School Shelter is not on evacuation route.



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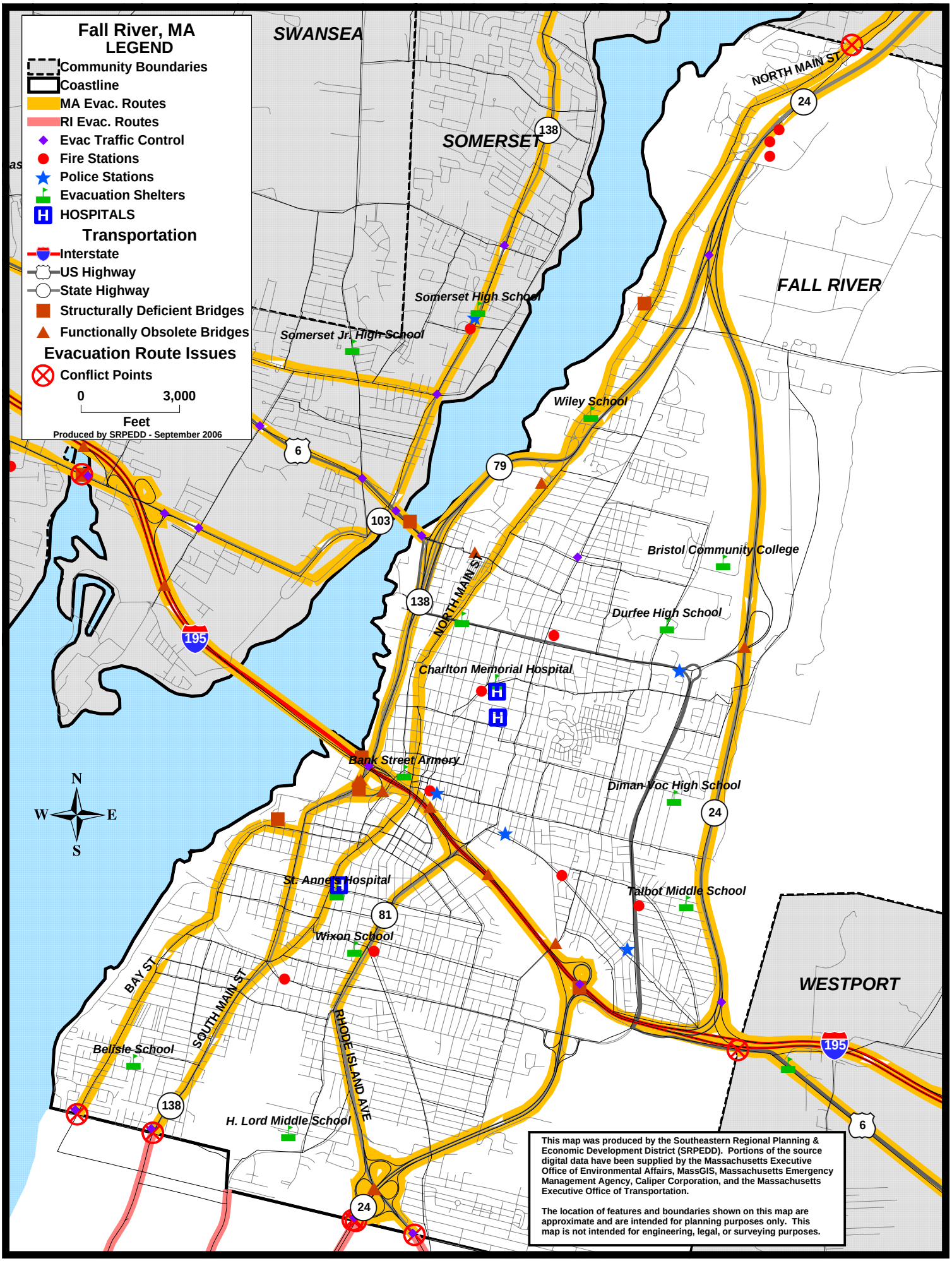
Fall River

- Fall River is sending traffic into Tiverton, RI from Route 138, Route 24, and Rhode Island Avenue. Rhode Island has designated these roads as evacuation routes, but directional flows are still in question. Since areas south of Fall River are in close proximity to water, one can assume that traffic would head north into Fall River during flooding brought on by a storm surge.

- Bay Road evacuation routes ends at the Tiverton Line.

- Durfee High School, Talbot Middle School, Diman Vocational School, Bristol Community College shelters are not on an evacuation route.


Fall River, MA
LEGEND
Community Boundaries
Coastline
MA Evac. Routes
RI Evac. Routes
Evac Traffic Control
Fire Stations
Police Stations
Evacuation Shelters
HOSPITALS
Transportation
Interstate
US Highway
State Highway
Structurally Deficient Bridges
Functionally Obsolete Bridges
Evacuation Route Issues
Conflict Points
0
3,000
Feet
Produced by SRPEDD - September 2006
SWANSEA
SOMERSET
FALL RIVER
WESTPORT
NORTH MAIN ST
SOUTH MAIN ST
BAY ST
RHODE ISLAND AVE
Somerset High School
Somerset Jr. High School
Wiley School
Bristol Community College
Durfee High School
Charlton Memorial Hospital
Bank Street Armory
Diman Voc High School
St. Anne's Hospital
Wixon School
Talbot Middle School
Belisle School
H. Lord Middle School
138
24
6
79
103
195
81
N
S
E
W
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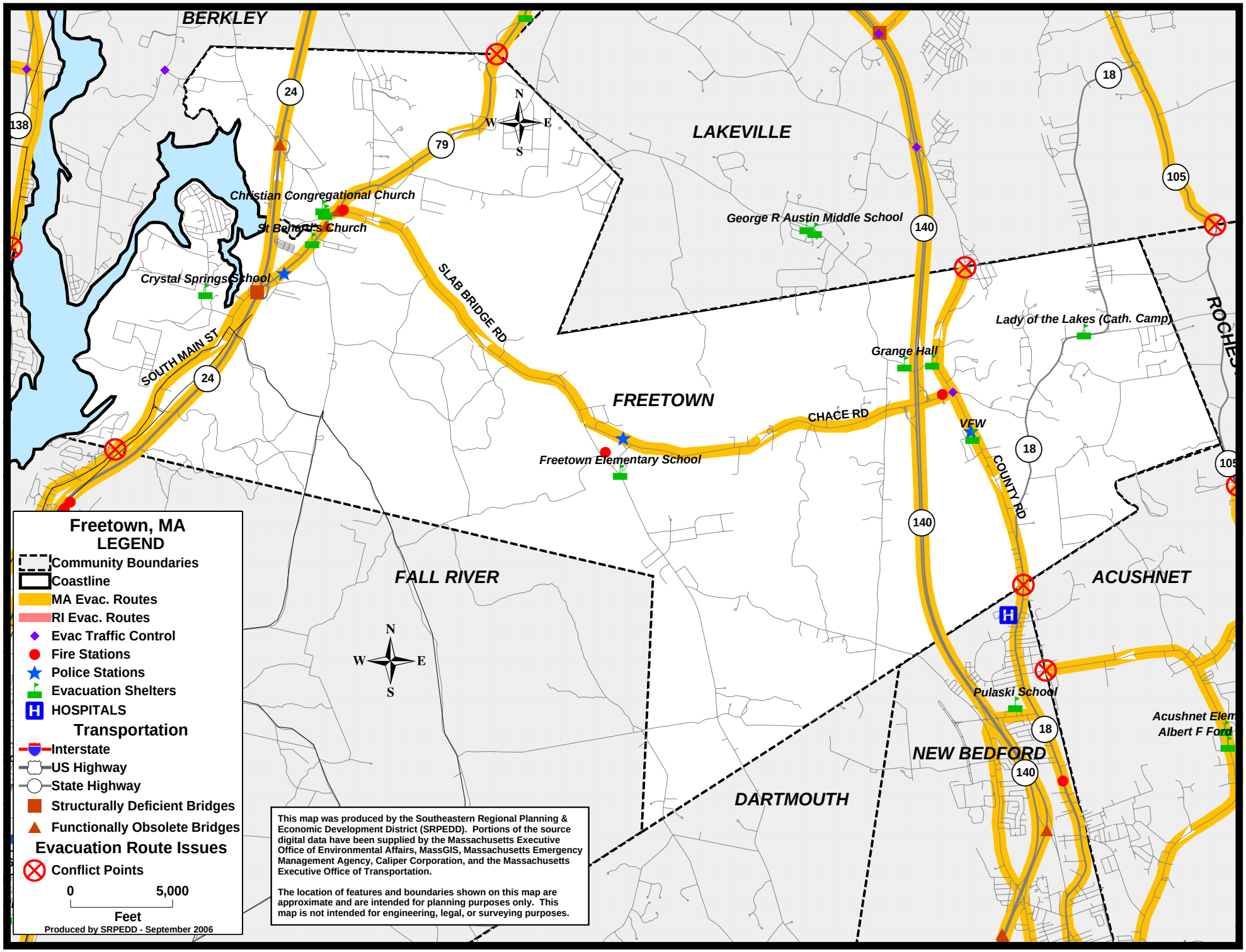
Freetown

- County Road route ends at Lakeville Line.
- Traffic is being sent into Fall River, New Bedford, Lakeville and Taunton while those communities are sending traffic into Freetown.
- Freetown Elementary Shelter is not on evacuation route.


BERKLEY
LAKEVILLE
FREETOWN
FALL RIVER
DARTMOUTH
NEW BEDFORD
ACUSHNET
ROCHES
Christian Congregational Church
St Bernard's Church
Crystal Springs School
George R Austin Middle School
Lady of the Lakes (Cath. Camp)
Grange Hall
VFW
Freetown Elementary School
Pulaski School
Acushnet Elem
Albert F Ford
SLAB BRIDGE RD
SOUTH MAIN ST
CHACE RD
COUNTY RD
138
24
79
140
18
105
N
S
E
W
Freetown, MA
LEGEND
Community Boundaries
Coastline
MA Evac. Routes
RI Evac. Routes
Evac Traffic Control
Fire Stations
Police Stations
Evacuation Shelters
HOSPITALS
Transportation
Interstate
US Highway
State Highway
Structurally Deficient Bridges
Functionally Obsolete Bridges
Evacuation Route Issues
Conflict Points
0
5,000
Feet
Produced by SRPEDD - September 2006
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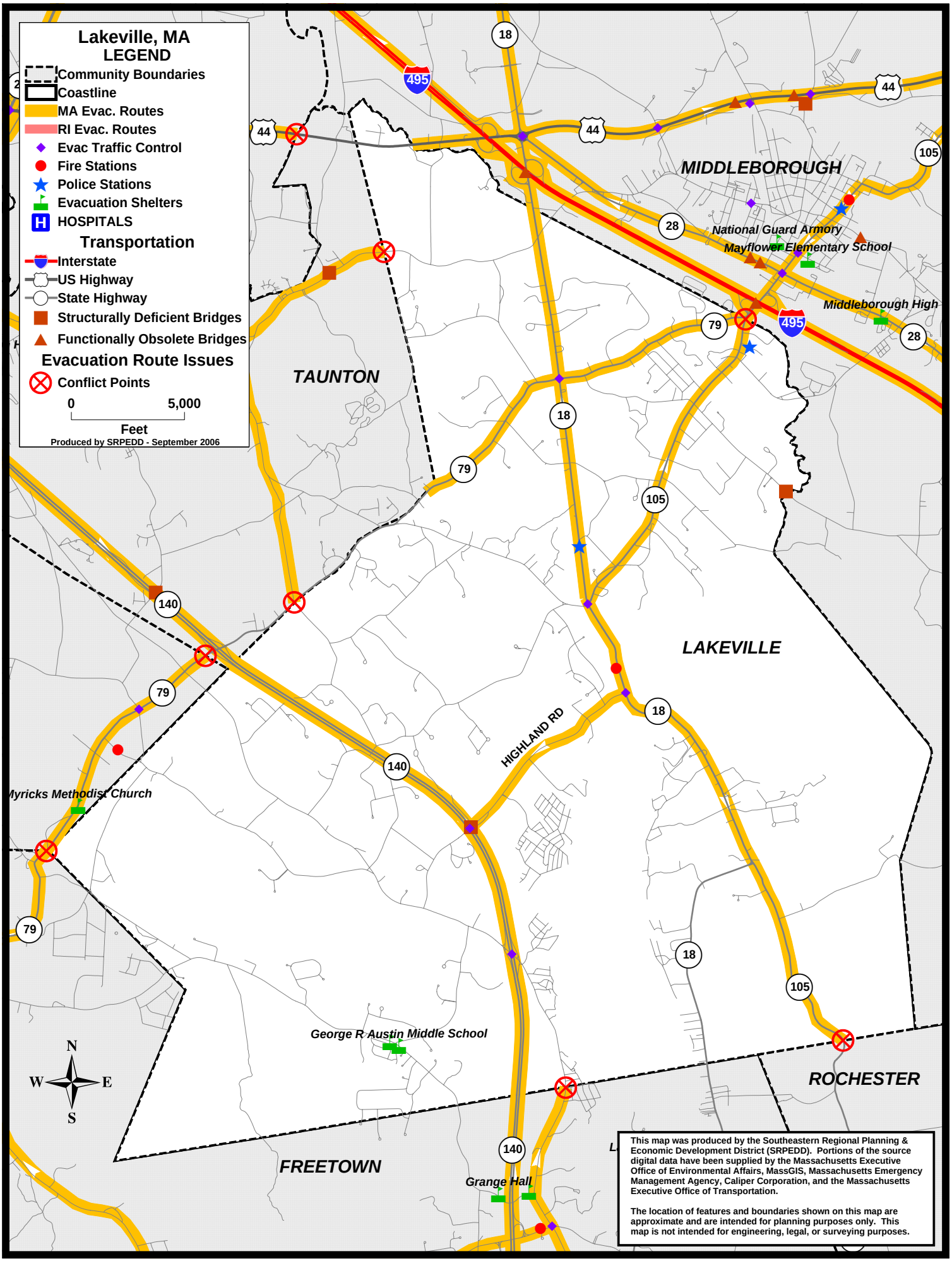
Lakeville

- Bedford Street (Route 105) and Rhode Island Road (Route 79) end at the town line.

- Apponequat Regional High School and George R. Austin Middle School shelters are not on an evacuation route.


Lakeville, MA
LEGEND
Community Boundaries
Coastline
MA Evac. Routes
RI Evac. Routes
Evac Traffic Control
Fire Stations
Police Stations
Evacuation Shelters
HOSPITALS
Transportation
Interstate
US Highway
State Highway
Structurally Deficient Bridges
Functionally Obsolete Bridges
Evacuation Route Issues
Conflict Points
0
5,000
Feet
Produced by SRPEDD - September 2006
MIDDLEBOROUGH
TAUNTON
LAKEVILLE
FREETOWN
ROCHESTER
HIGHLAND RD
National Guard Armory
Mayflower Elementary School
Middleborough High
Myricks Methodist Church
George R Austin Middle School
Grange Hall
495
18
44
105
28
79
140
N
S
E
W
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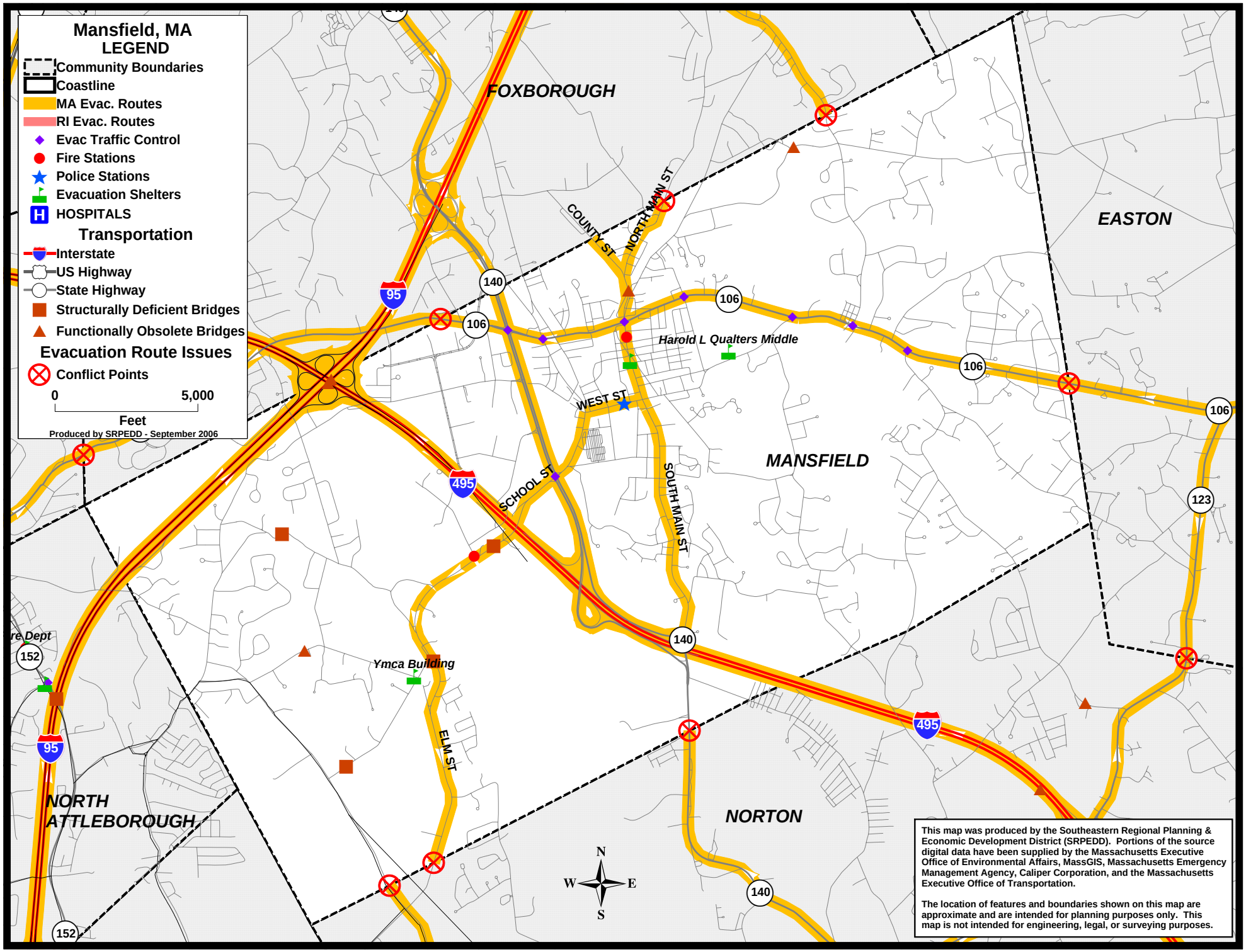
Mansfield

- Elm Street, North Main Street, County Street, and Chauncy St (Route 106) all end at the town Line.

- East Street (Route 106) sends traffic into Easton while they send traffic into Mansfield.

- The Harold Qualters Middle School is not located on an evacuation route.


Mansfield, MA
LEGEND
Community Boundaries
Coastline
MA Evac. Routes
RI Evac. Routes
Evac Traffic Control
Fire Stations
Police Stations
Evacuation Shelters
HOSPITALS
Transportation
Interstate
US Highway
State Highway
Structurally Deficient Bridges
Functionally Obsolete Bridges
Evacuation Route Issues
Conflict Points
0
5,000
Feet
Produced by SRPEDD - September 2006
FOXBOROUGH
EASTON
MANSFIELD
NORTH ATTLEBOROUGH
NORTON
COUNTY ST
NORTH MAIN ST
WEST ST
SCHOOL ST
SOUTH MAIN ST
ELM ST
Harold L Qualters Middle
Ymca Building
re Dept
95
495
140
106
123
152
N
S
E
W
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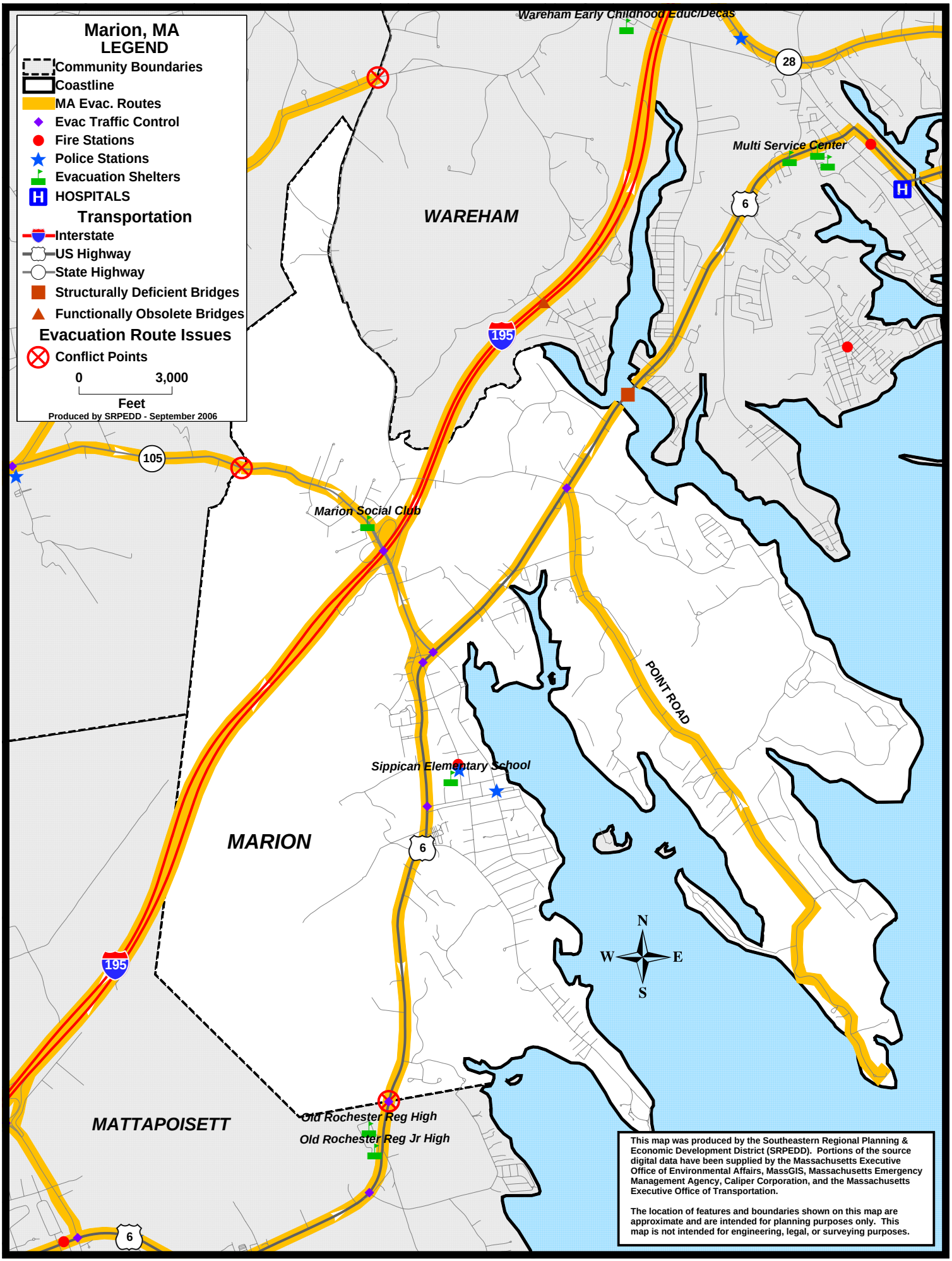
Marion

- Mill Street (Route 6) and Front Street (Route 105) send traffic into Mattapoisett and Rochester respectively while those towns are sending traffic into Marion.


Marion, MA
LEGEND
Community Boundaries
Coastline
MA Evac. Routes
Evac Traffic Control
Fire Stations
Police Stations
Evacuation Shelters
HOSPITALS
Transportation
Interstate
US Highway
State Highway
Structurally Deficient Bridges
Functionally Obsolete Bridges
Evacuation Route Issues
Conflict Points
0
3,000
Feet
Produced by SRPEDD - September 2006
Wareham Early Childhood Educ/Decas
28
Multi Service Center
6
WAREHAM
195
105
Marion Social Club
POINT ROAD
Sippican Elementary School
MARION
6
N
W
E
S
195
MATTAPOISETT
Old Rochester Reg High
Old Rochester Reg Jr High
6
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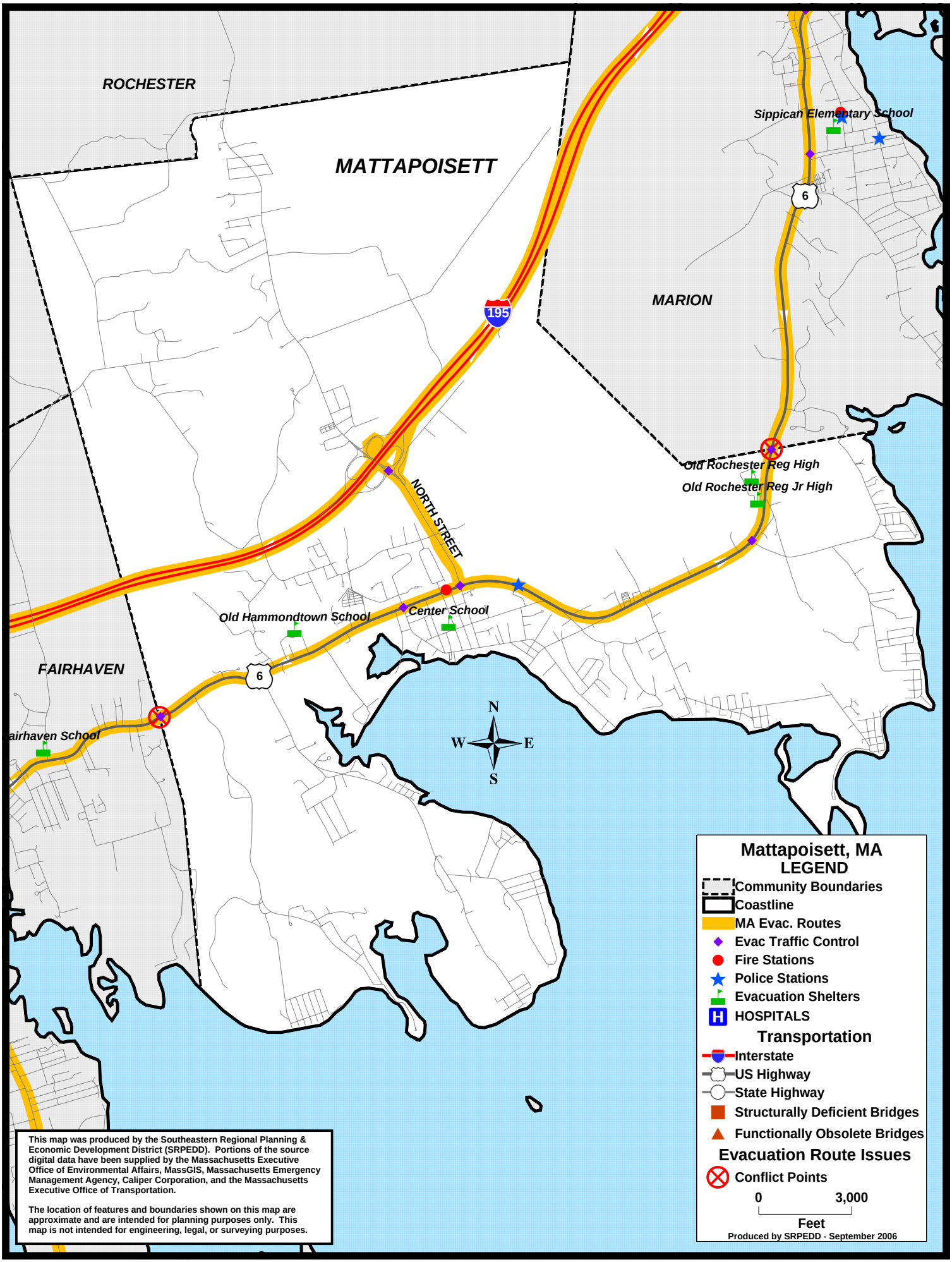
Mattapoisett

- Fairhaven Road and Marion Road (both Route 6) is sending traffic into Fairhaven and Marion while they are sending traffic in Mattapoisett.


ROCHESTER
MATTAPOISETT
MARION
FAIRHAVEN
Sippican Elementary School
Old Rochester Reg High
Old Rochester Reg Jr High
Old Hammondtown School
Center School
airhaven School
NORTH STREET
195
6
N
W
E
S
Mattapoisett, MA
LEGEND
Community Boundaries
Coastline
MA Evac. Routes
Evac Traffic Control
Fire Stations
Police Stations
Evacuation Shelters
HOSPITALS
Transportation
Interstate
US Highway
State Highway
Structurally Deficient Bridges
Functionally Obsolete Bridges
Evacuation Route Issues
Conflict Points
0
3,000
Feet
Produced by SRPEDD - September 2006
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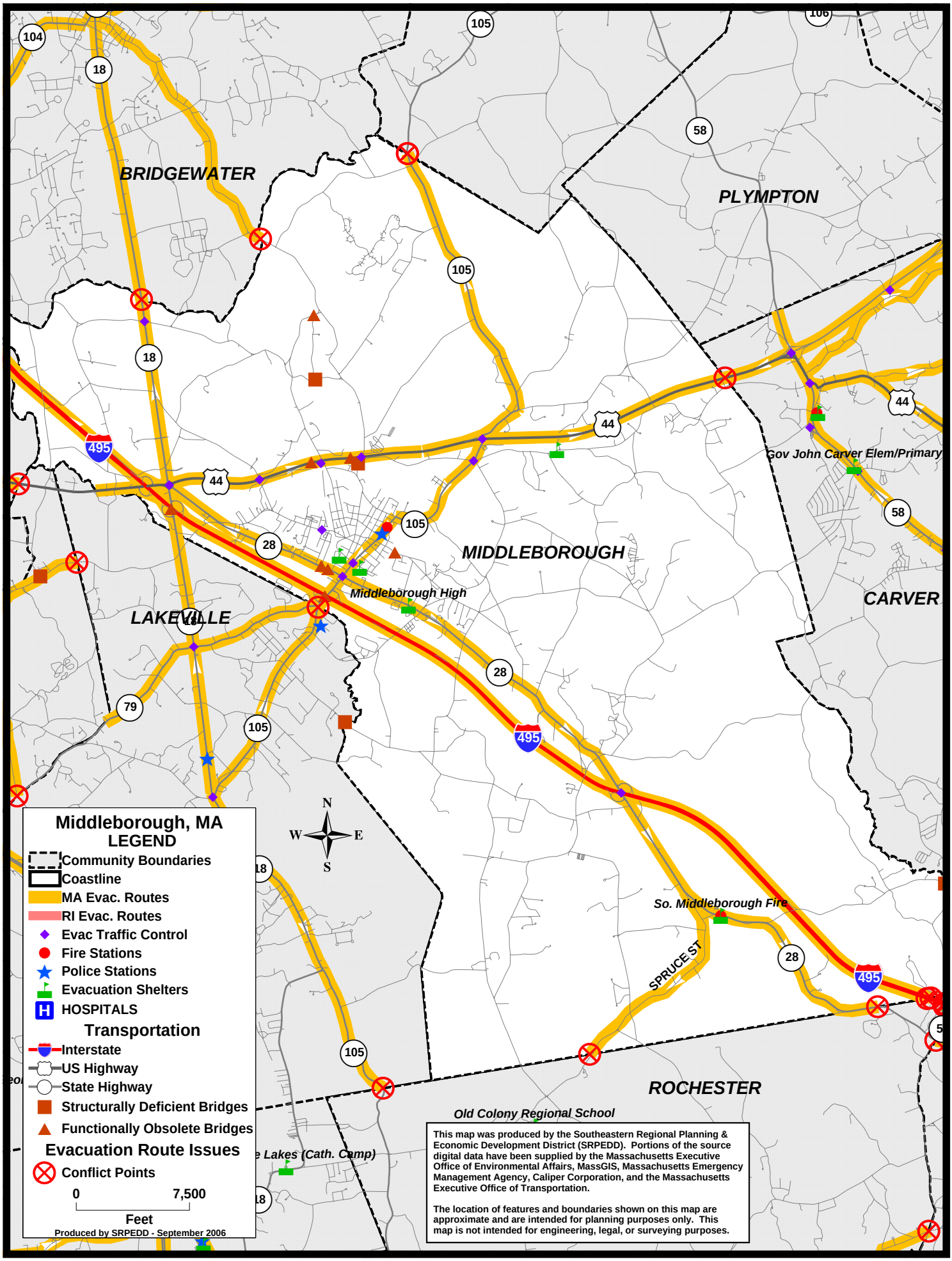
Middleborough

- Spruce Street and Wareham Street (Route 28) ends at the town line.
- Route 44 is sending traffic into Carver while they send traffic towards Middleborough.
- Middleborough Rotary, (as documented in SRPEDD studies as a congested area during normal peak hour traffic), would inhibit flow from Route 44 Westbound to I-495.
- Mayflower Elementary, National Guard Armory and Council on Aging shelters are not located on an evacuation route, but are in close proximity to one.


BRIDGEWATER
PLYMPTON
MIDDLEBOROUGH
LAKEVILLE
CARVER
ROCHESTER
Middleborough High
Gov John Carver Elem/Primary
So. Middleborough Fire
Old Colony Regional School
SPRUCE ST
104
18
105
106
58
44
28
79
495
N
W
E
S
Middleborough, MA
LEGEND
Community Boundaries
Coastline
MA Evac. Routes
RI Evac. Routes
Evac Traffic Control
Fire Stations
Police Stations
Evacuation Shelters
HOSPITALS
Transportation
Interstate
US Highway
State Highway
Structurally Deficient Bridges
Functionally Obsolete Bridges
Evacuation Route Issues
Conflict Points
0
7,500
Feet
Produced by SRPEDD - September 2006
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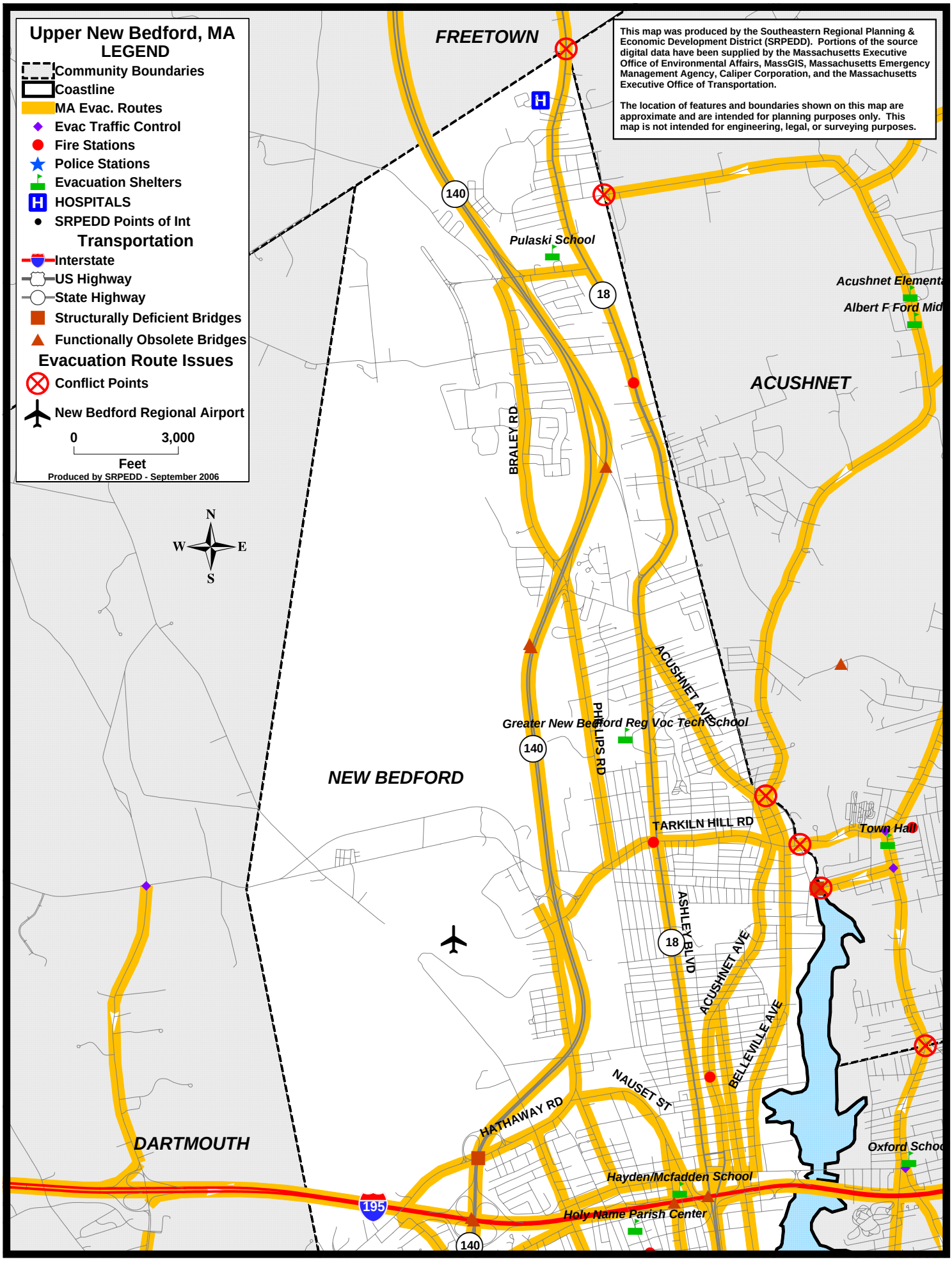
New Bedford

No apparent issues with the evacuation routes.


Upper New Bedford, MA
LEGEND
Community Boundaries
Coastline
MA Evac. Routes
Evac Traffic Control
Fire Stations
Police Stations
Evacuation Shelters
HOSPITALS
SRPEDD Points of Int
Transportation
Interstate
US Highway
State Highway
Structurally Deficient Bridges
Functionally Obsolete Bridges
Evacuation Route Issues
Conflict Points
New Bedford Regional Airport
0
3,000
Feet
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FREETOWN
ACUSHNET
NEW BEDFORD
DARTMOUTH
Pulaski School
Acushnet Element
Albert F Ford Mid
Greater New Bedford Reg Voc Tech School
Town Hall
Oxford Schoo
Hayden/Mcfadden School
Holy Name Parish Center
BRALEY RD
PHILLIPS RD
ACUSHNET AVE
TARKILN HILL RD
ASHLEY BLVD
BELLEVILLE AVE
NAUSET ST
HATHAWAY RD
140
18
195
N
S
E
W


Hayden/Mcfadden School
195
SHAWMUT AVE
HATHAWAY BLVD
COUNTY ST
New Bedford High School
NEW BEDFORD
140
18
6
FAIRHAVEN
Hastings Mi
Carney Academy School
Rogers Sc
UNION ST
BROWNELL AVE
ROCKDALE AVE
HAWTHORN ST
th Middle School
Alfred J Gomes School
ALLEN ST
DARTMOUTH ST
DARTMOUTH
Dartmouth Council On Aging
N
W
E
S
RODNEY FRENCH BLVD
BROCK AVE
RODNEY FRENCH BLVD
Lower New Bedford, MA
LEGEND
Community Boundaries
Coastline
MA Evac. Routes
Evac Traffic Control
Fire Stations
Police Stations
Evacuation Shelters
HOSPITALS
Transportation
Interstate
US Highway
State Highway
Structurally Deficient Bridges
Functionally Obsolete Bridges
Evacuation Route Issues
Conflict Points
0
2,500
Feet
Produced by SRPEDD - September 2006
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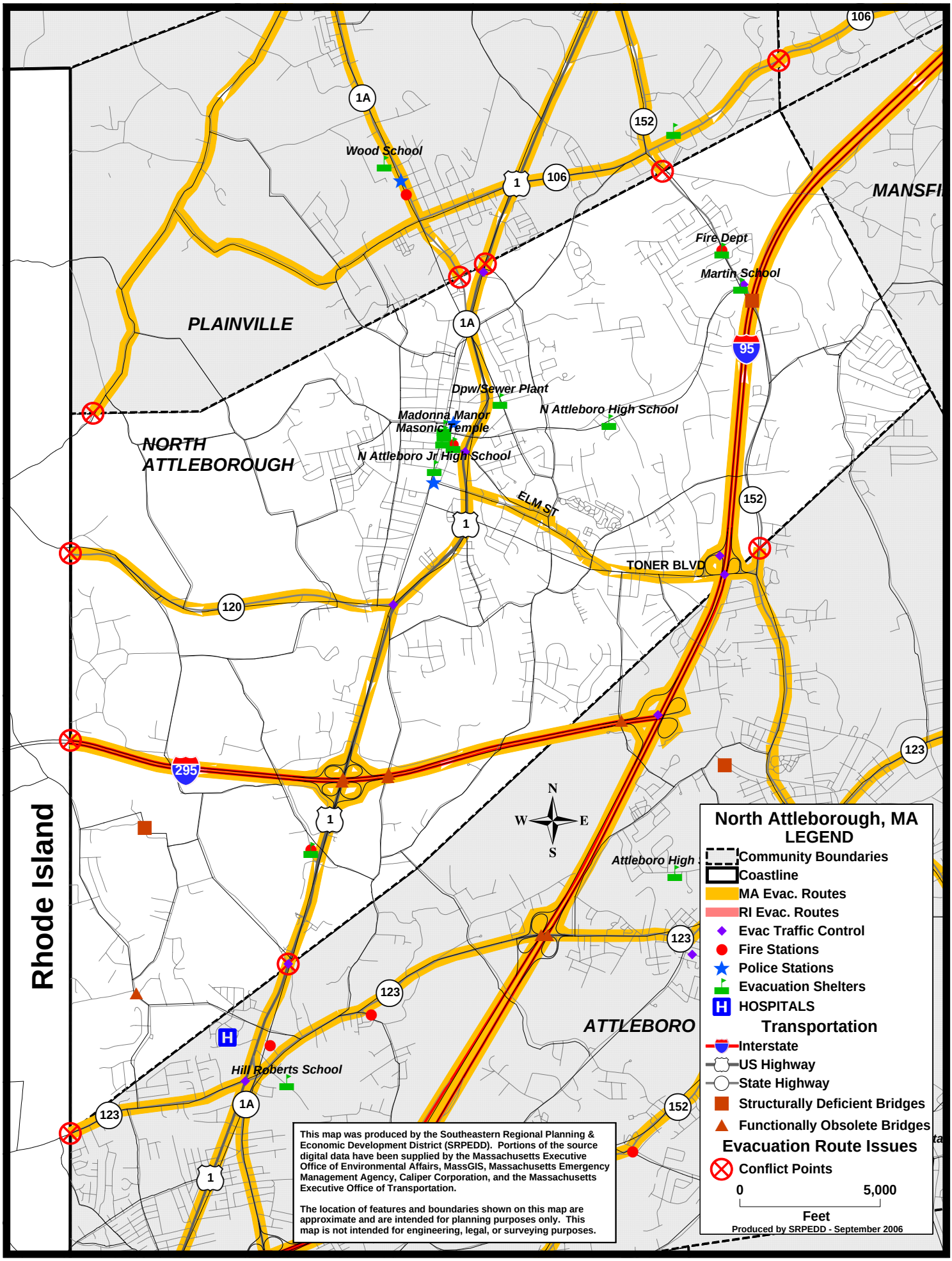
North Attleborough

- East Washington Street is sending traffic into Plainville while they are sending traffic back towards North Attleborough.

- North Attleborough High and Junior High School, the Martin School, Police Department, Fire Department, Madonna Manor, and the Sewer Department shelters are not part of an evacuation route.


North Attleborough, MA
LEGEND
Community Boundaries
Coastline
MA Evac. Routes
RI Evac. Routes
Evac Traffic Control
Fire Stations
Police Stations
Evacuation Shelters
HOSPITALS
Transportation
Interstate
US Highway
State Highway
Structurally Deficient Bridges
Functionally Obsolete Bridges
Evacuation Route Issues
Conflict Points
0
5,000
Feet
Produced by SRPEDD - September 2006
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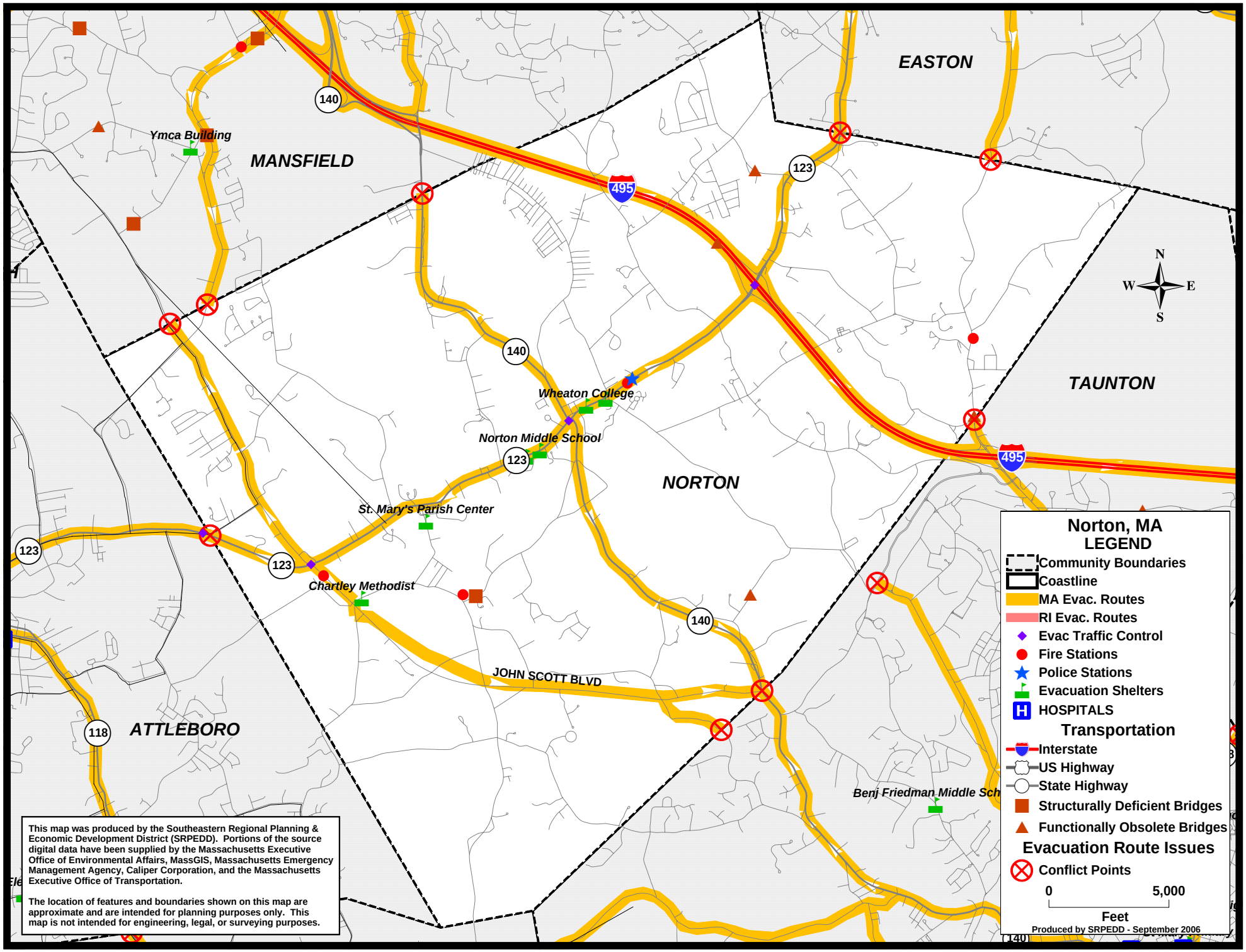
Rhode Island
PLAINVILLE
NORTH ATTLEBOROUGH
ATTLEBORO
MANSFI
Wood School
Fire Dept
Martin School
Dpw/Sewer Plant
N Attleboro High School
Madonna Manor
Masonic Temple
N Attleboro Jr High School
ELM ST
TONER BLVD
Attleboro High
Hill Roberts School
N
S
E
W
1A
1
106
152
95
120
295
123

Norton

- Mansfield Avenue (Route 140), North Worcester and South Worcester Streets end at the town line.

- Taunton Avenue (Route 140), Old Colony Road (Route 123) and East main Street (Route 123) send traffic into Taunton, Attleboro, and Easton while those communities are sending traffic towards Norton.


EASTON
MANSFIELD
TAUNTON
NORTON
ATTLEBORO
Ymca Building
Wheaton College
Norton Middle School
St. Mary's Parish Center
Chartley Methodist
Benj Friedman Middle Sch
JOHN SCOTT BLVD
140
123
495
118
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S
E
W
Norton, MA
LEGEND
Community Boundaries
Coastline
MA Evac. Routes
RI Evac. Routes
Evac Traffic Control
Fire Stations
Police Stations
Evacuation Shelters
HOSPITALS
Transportation
Interstate
US Highway
State Highway
Structurally Deficient Bridges
Functionally Obsolete Bridges
Evacuation Route Issues
Conflict Points
0
5,000
Feet
Produced by SRPEDD - September 2006
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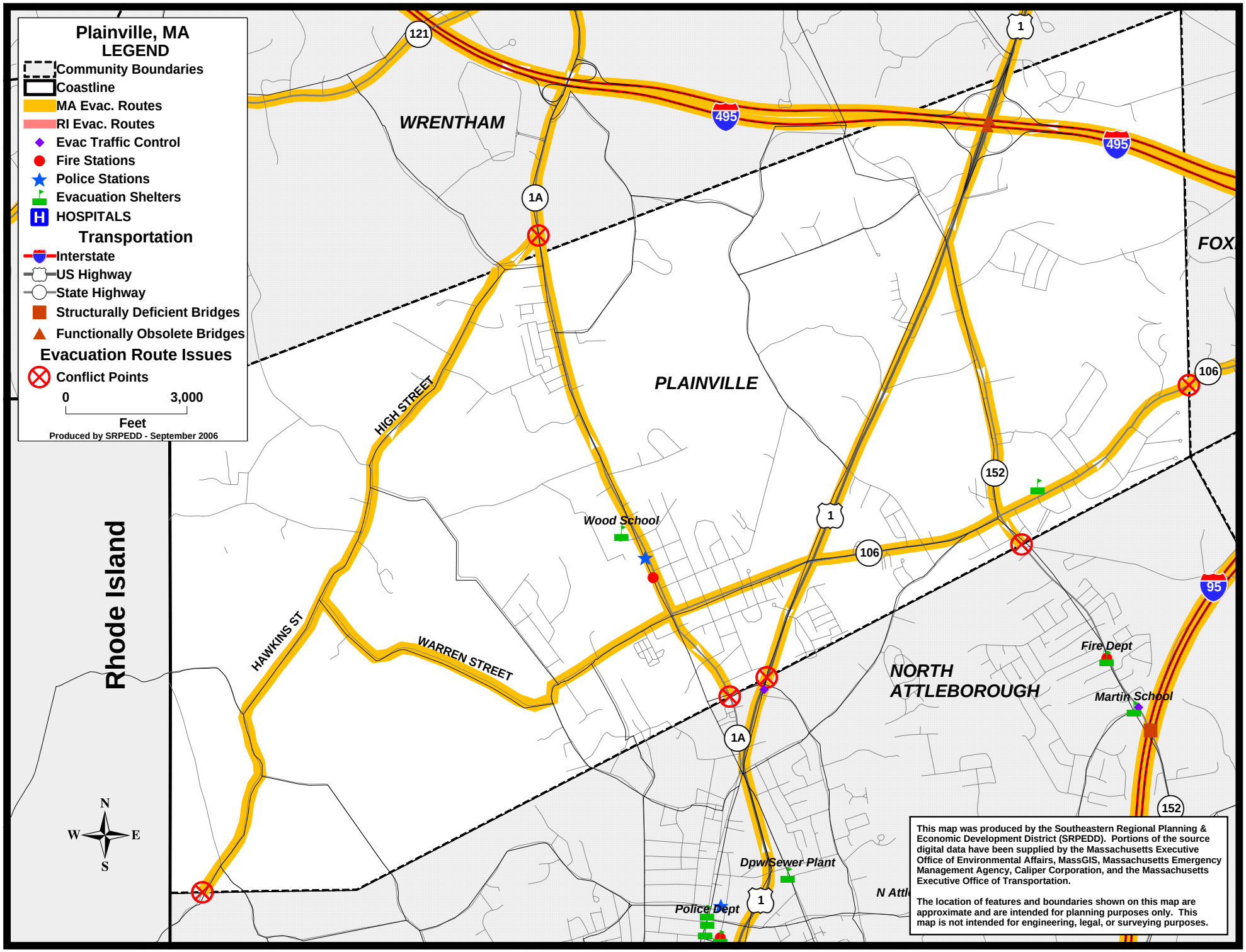
Plainville

- Messenger Street and South Avenue (Route 1A) end at the town line.

- Messenger Street (Route 106) and Washington Street (Route 1) sends traffic towards Foxboro and North Attleborough while those communities send traffic towards Plainville.


Plainville, MA
LEGEND
Community Boundaries
Coastline
MA Evac. Routes
RI Evac. Routes
Evac Traffic Control
Fire Stations
Police Stations
Evacuation Shelters
HOSPITALS
Transportation
Interstate
US Highway
State Highway
Structurally Deficient Bridges
Functionally Obsolete Bridges
Evacuation Route Issues
Conflict Points
0
3,000
Feet
Produced by SRPEDD - September 2006
WRENTHAM
PLAINVILLE
NORTH ATTLEBOROUGH
Rhode Island
HIGH STREET
HAWKINS ST
WARREN STREET
Wood School
Fire Dept
Martin School
Dpw/Sewer Plant
Police Dept
121
1
1A
495
106
152
95
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S
E
W
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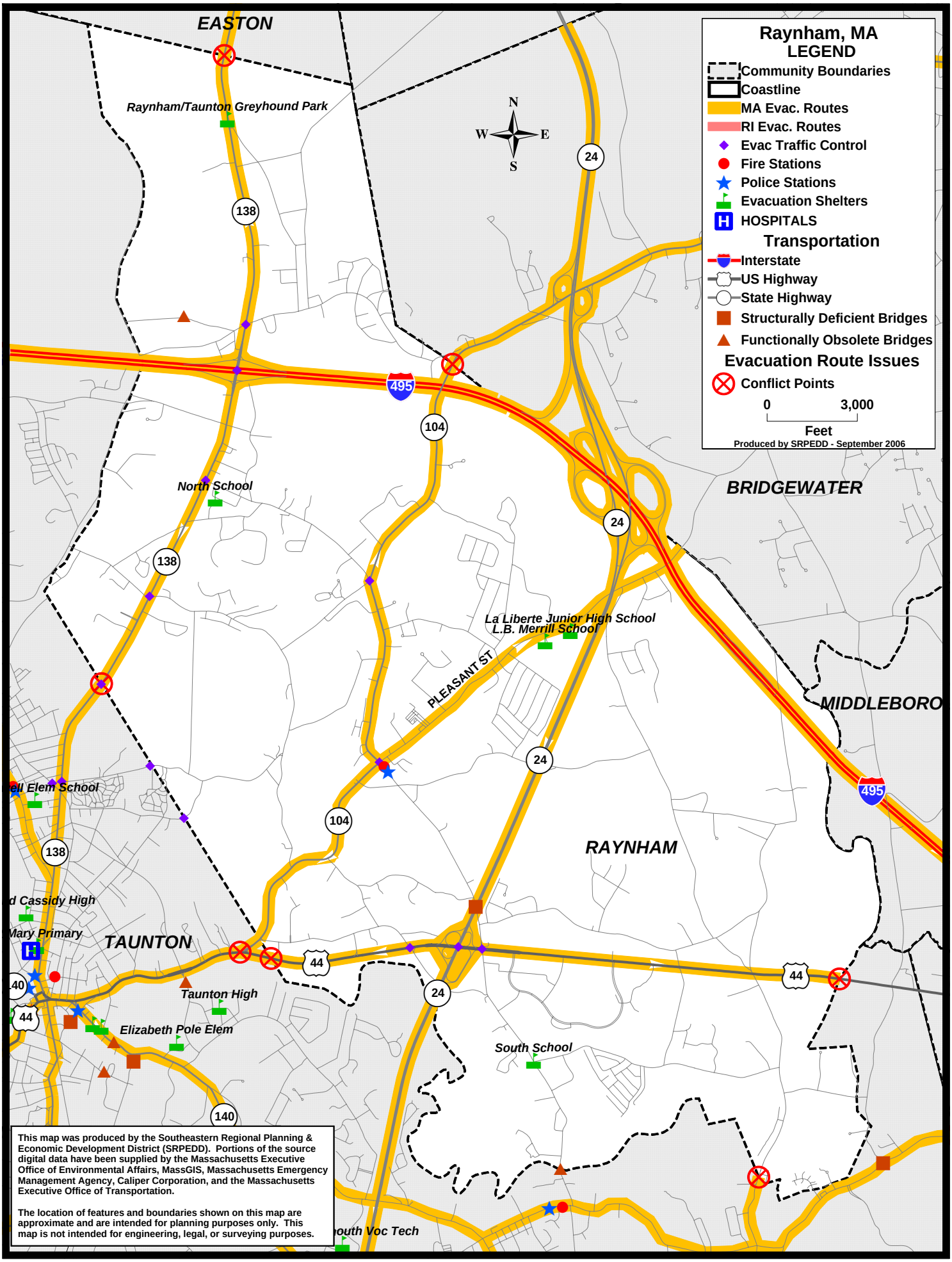
Raynham

- Route 44 ends at the town line with Taunton (to the east).
- Broadway (Route 138), North main Street (Route 104) send traffic into Easton and West Bridgewater while those communities send traffic towards Raynham.
- The South School is not located on an evacuation Route.



This map was produced by the Southeastern Regional Planning & Economic Development District (SRPEDD). Portions of the source digital data have been supplied by the Massachusetts Executive Office of Environmental Affairs, MassGIS, Massachusetts Emergency Management Agency, Caliper Corporation, and the Massachusetts Executive Office of Transportation.

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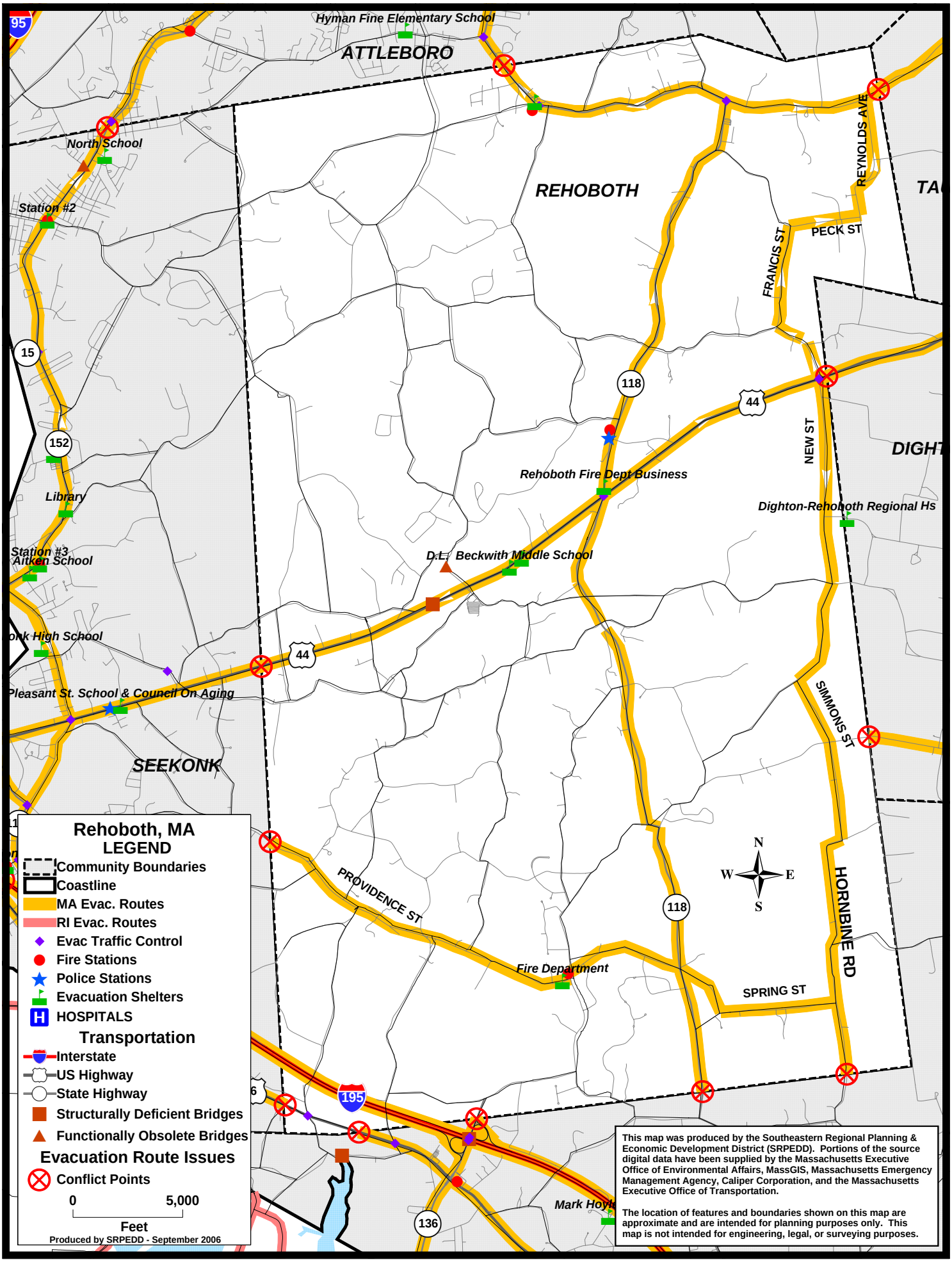
Rehoboth

- Horbine Road, Plain Street (Route 118), and Providence Street end at the town line.

- Dighton/Rehoboth Regional High School is in close proximity to an evacuation route, but is not located on one.


Hyman Fine Elementary School
ATTLEBORO
North School
Station #2
REHOBOTH
REYNOLDS AVE
PECK ST
FRANCIS ST
NEW ST
DIGHT
Rehoboth Fire Dept Business
Dighton-Rehoboth Regional Hs
Library
Station #3
Aitken School
D.L. Beckwith Middle School
ork High School
Pleasant St. School & Council On Aging
SEEKONK
SIMMONS ST
PROVIDENCE ST
Fire Department
SPRING ST
HORNBINE RD
Mark Hoyle
95
15
152
118
44
195
136
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E
S
Rehoboth, MA
LEGEND
Community Boundaries
Coastline
MA Evac. Routes
RI Evac. Routes
Evac Traffic Control
Fire Stations
Police Stations
Evacuation Shelters
HOSPITALS
Transportation
Interstate
US Highway
State Highway
Structurally Deficient Bridges
Functionally Obsolete Bridges
Evacuation Route Issues
Conflict Points
0
5,000
Feet
Produced by SRPEDD - September 2006
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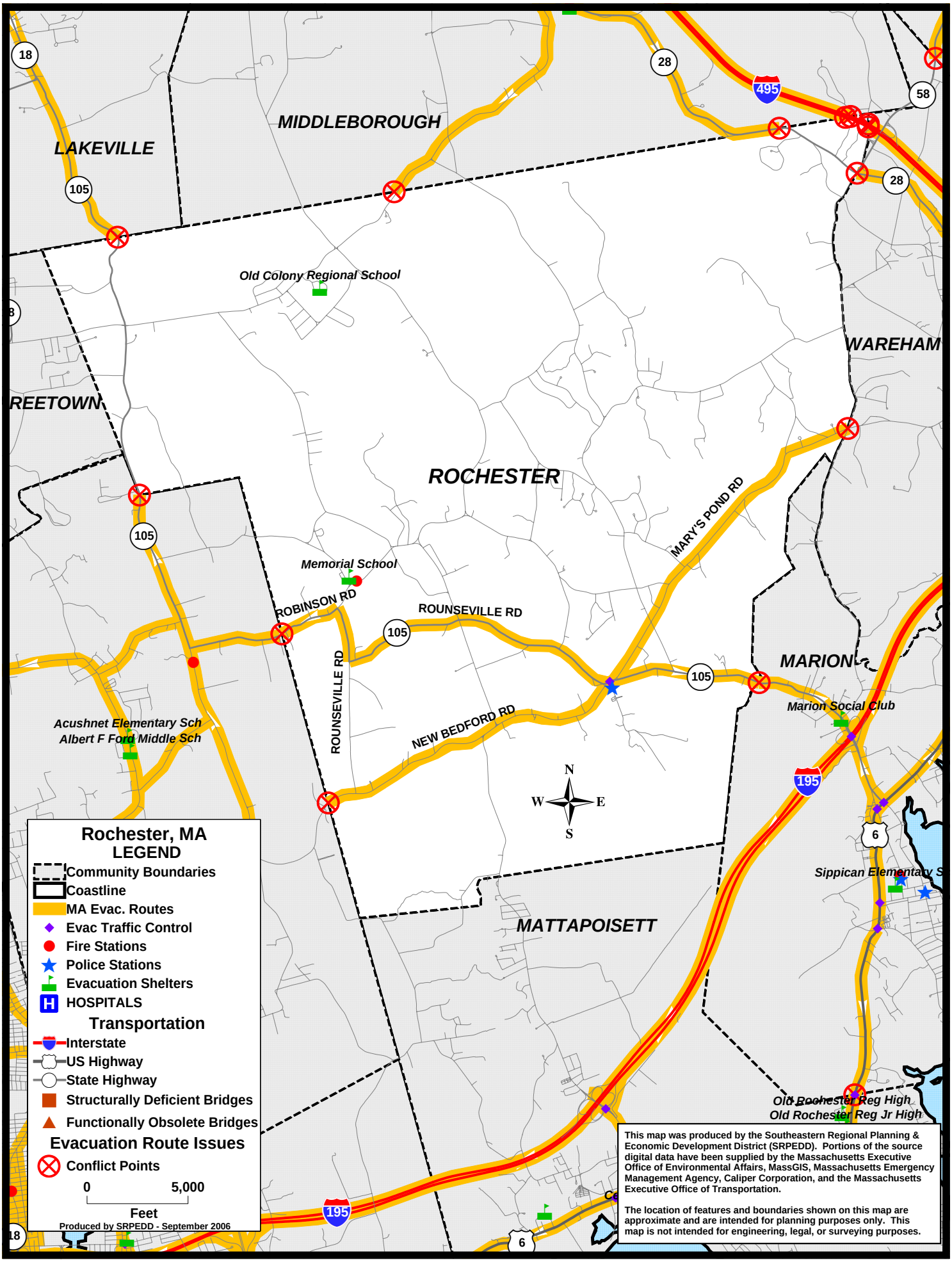
Rochester

- Mary’s Pond Road and New Bedford Road end at the town line.
- Marion Road (Route 105) is sending traffic into Marion while they are sending traffic towards Rochester.


MIDDLEBOROUGH
LAKEVILLE
REETOWN
WAREHAM
ROCHESTER
MARION
MATTAPOISETT
Old Colony Regional School
Memorial School
Acushnet Elementary Sch
Albert F Ford Middle Sch
Marion Social Club
Sippican Elementary S
Old Rochester Reg High
Old Rochester Reg Jr High
ROBINSON RD
ROUNSEVILLE RD
ROUNSEVILLE RD
MARY'S POND RD
NEW BEDFORD RD
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Rochester, MA
LEGEND
Community Boundaries
Coastline
MA Evac. Routes
Evac Traffic Control
Fire Stations
Police Stations
Evacuation Shelters
HOSPITALS
Transportation
Interstate
US Highway
State Highway
Structurally Deficient Bridges
Functionally Obsolete Bridges
Evacuation Route Issues
Conflict Points
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Feet
Produced by SRPEDD - September 2006
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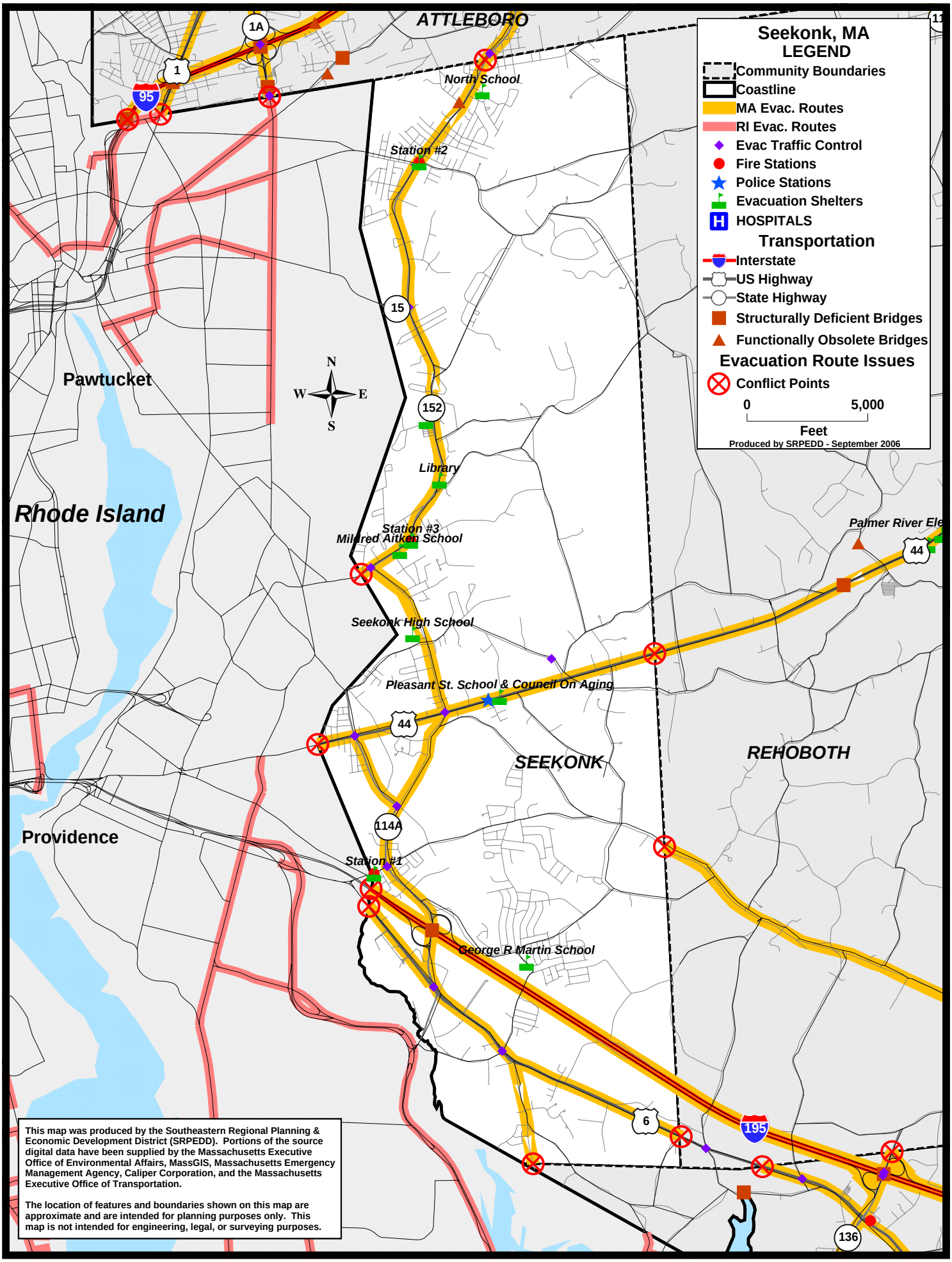
Seekonk

No apparent issues with the evacuation routes.


Seekonk, MA
LEGEND
Community Boundaries
Coastline
MA Evac. Routes
RI Evac. Routes
Evac Traffic Control
Fire Stations
Police Stations
Evacuation Shelters
HOSPITALS
Transportation
Interstate
US Highway
State Highway
Structurally Deficient Bridges
Functionally Obsolete Bridges
Evacuation Route Issues
Conflict Points
0
5,000
Feet
Produced by SRPEDD - September 2006
ATTLEBORO
REHOBOTH
SEEKONK
Pawtucket
Rhode Island
Providence
North School
Station #2
Library
Station #3
Mildred Aitken School
Seekonk High School
Pleasant St. School & Council On Aging
Station #1
George R Martin School
Palmer River Ele
N
S
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W
1A
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95
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114A
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195
136
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Somerset

- Read Street and County Street (Route 138) end at the town Line.

- Pleasant Street in Dighton is designated as an evacuation route stopping at the Somerset line. This should be changed to make Route 138 a designated route to line up with Somerset.

- North Elementary, the High and Junior High School shelters are not part of an evacuation Route.


Somerset, MA
LEGEND
Community Boundaries
Coastline
MA Evac. Routes
RI Evac. Routes
Evac Traffic Control
Fire Stations
Police Stations
Evacuation Shelters
HOSPITALS
Transportation
Interstate
US Highway
State Highway
Structurally Deficient Bridges
Functionally Obsolete Bridges
Evacuation Route Issues
Conflict Points
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Feet
Produced by SRPEDD - September 2006
N
W
E
S
Nike Site Baseball Field
North Elementary
SOMERSET
SWANSEA
Case Hs
Somerset Jr. High School
READ ST
Wiley School
FALL RIVER
WILBUR AVE
Bristol Community Colleg
Durfee High School
Charlton Memo
6
138
24
79
103
195
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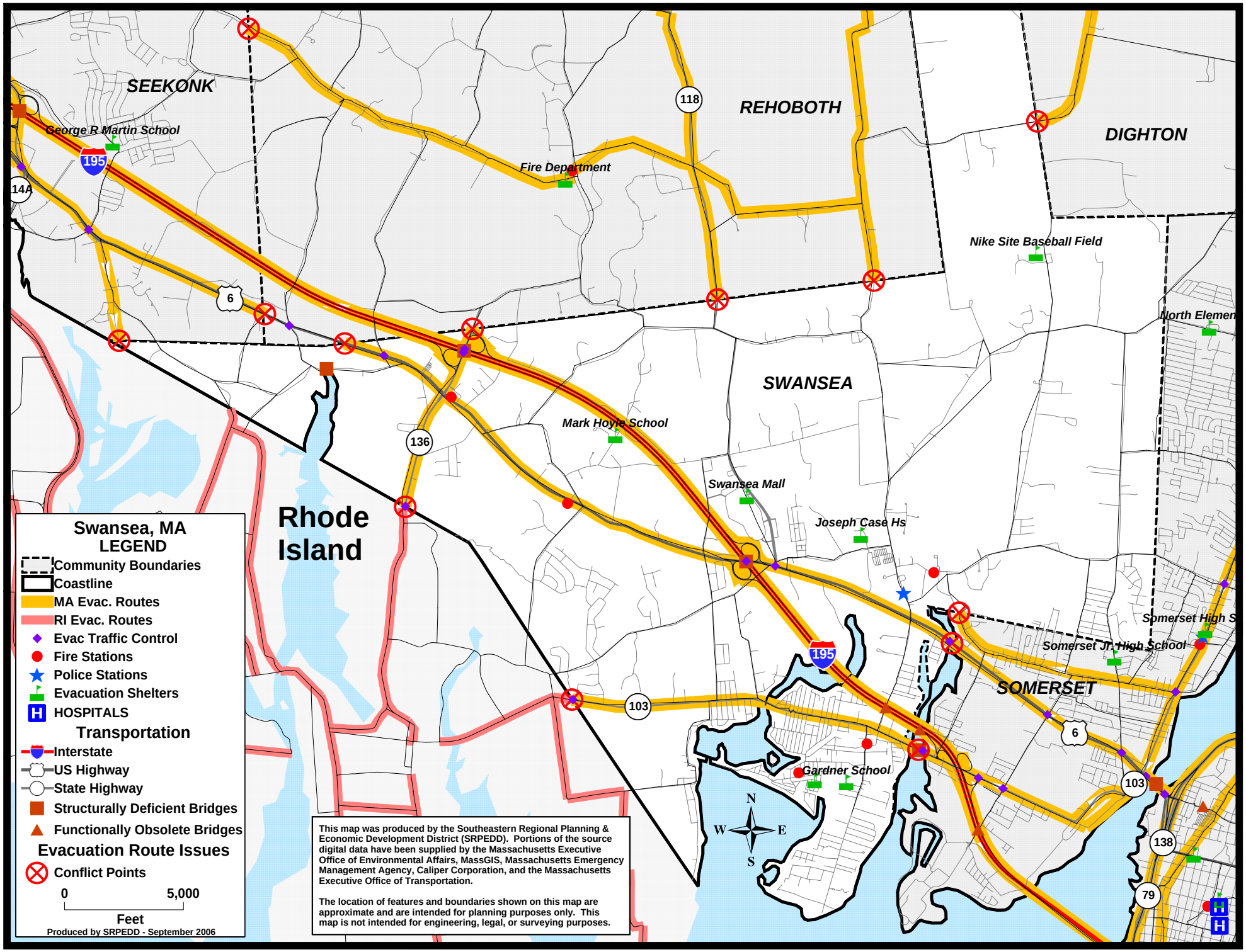
Swansea

- Route 6 ends at the town line with Rehoboth. Should consider Route 118 to link Route 6/I-195 with Rehoboth.

- The Nike Site baseball Field, Mark Hoyle School, Joseph Case High School, Gardner School and Elizabeth Brown School shelters are not on an evacuation route.


SEEKONK
REHOBOTH
DIGHTON
SWANSEA
SOMERSET
Rhode Island
George R Martin School
Fire Department
Nike Site Baseball Field
North Elemen
Mark Hoyle School
Swansea Mall
Joseph Case Hs
Somerset High S
Somerset Jr. High School
Gardner School
195
118
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Swansea, MA
LEGEND
Community Boundaries
Coastline
MA Evac. Routes
RI Evac. Routes
Evac Traffic Control
Fire Stations
Police Stations
Evacuation Shelters
HOSPITALS
Transportation
Interstate
US Highway
State Highway
Structurally Deficient Bridges
Functionally Obsolete Bridges
Evacuation Route Issues
Conflict Points
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Feet
Produced by SRPEDD - September 2006
N
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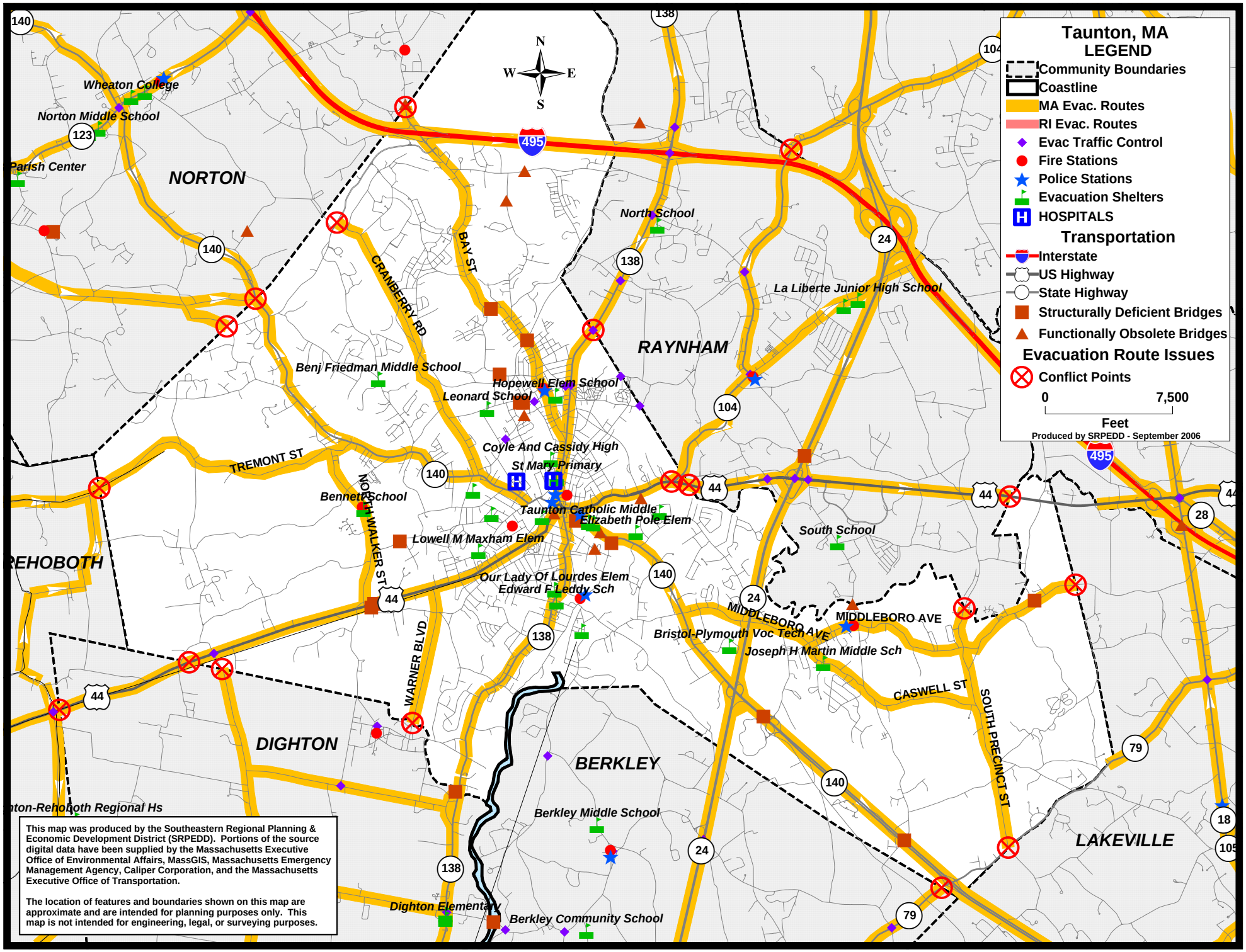
Taunton

- Warner Blvd, Bay Road, South Precinct Street, and Middleborough Avenue end at the city line.

- Kingman Street ends at Rhode Island Ave. Rhode Island Ave should be added as a route because it will connect the evac routes in Lakeville and Berkley Route 79.

- John Hancock Road ends in the middle of the Industrial Park.

- Friedman Middle School, Leonard School, Coyle Cassidy High School, Cohannet School, Galligan Elementary, Mulcahey Middle School, Taunton High School, Walker School, and Bristol Plymouth Vocational School Shelters are not on an evacuation route. It should be point out that many of these schools are 1 to 2 city blocks removed from these routes.



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Wareham

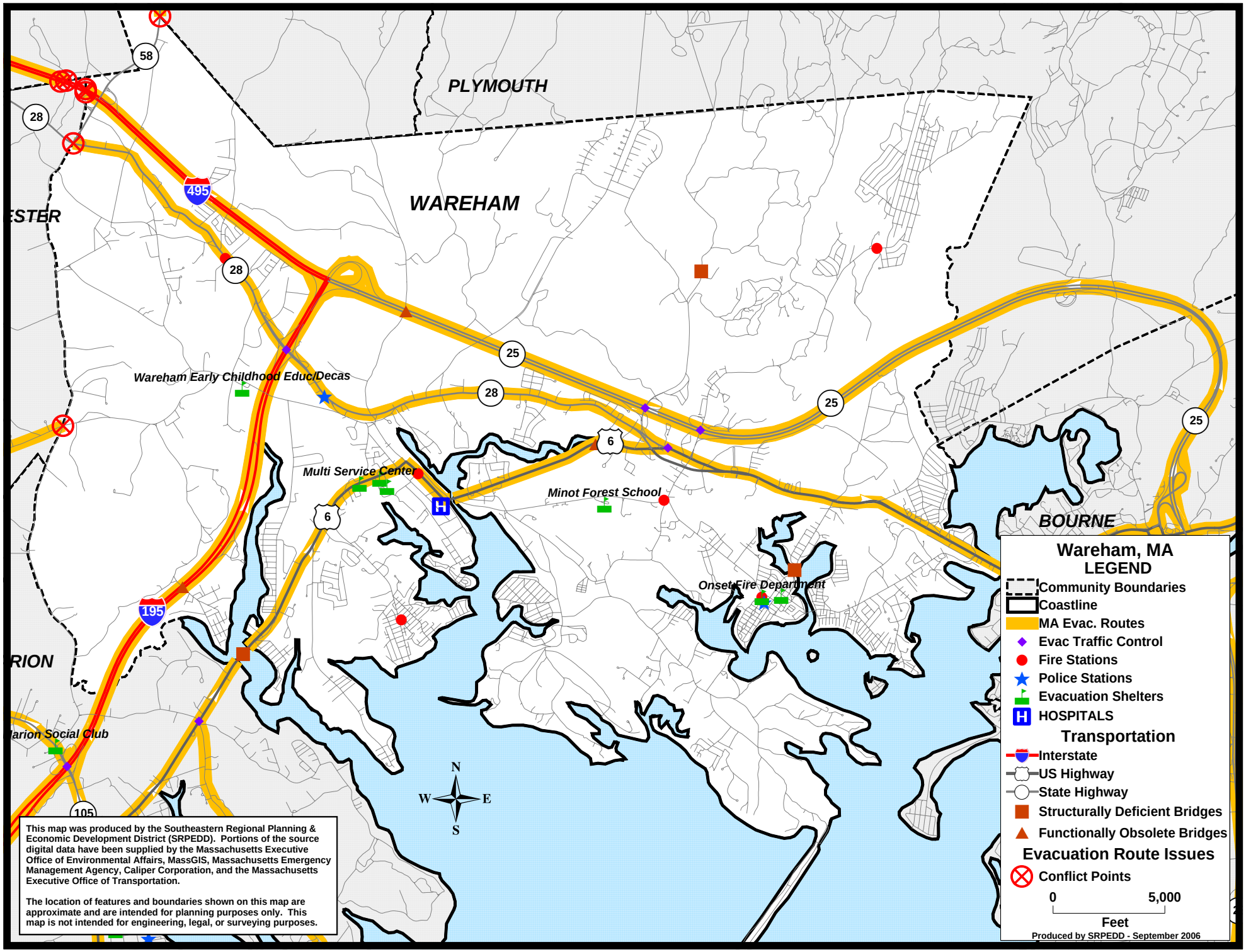
- Four shelters, Town Hall, High School, Onset Fire Department, and the Hammond School shelters are in water during a storm surge of a “worst case scenario” category 3 hurricane.

- The Minot School on Minot Avenue is not an evacuation route and would be isolated from the town in severe flooding.

- The Decas School is not on an evacuation Route.

- Route 28 ends at the town line.

- Route 25 northbound to I-495 north reduces from 3 travel lanes to 2 travel lanes. Excessive traffic flow from Cape Cod in addition to traffic from I-195 eastbound heading into this lane drop would cause delay and inhibit adequate traffic flow.



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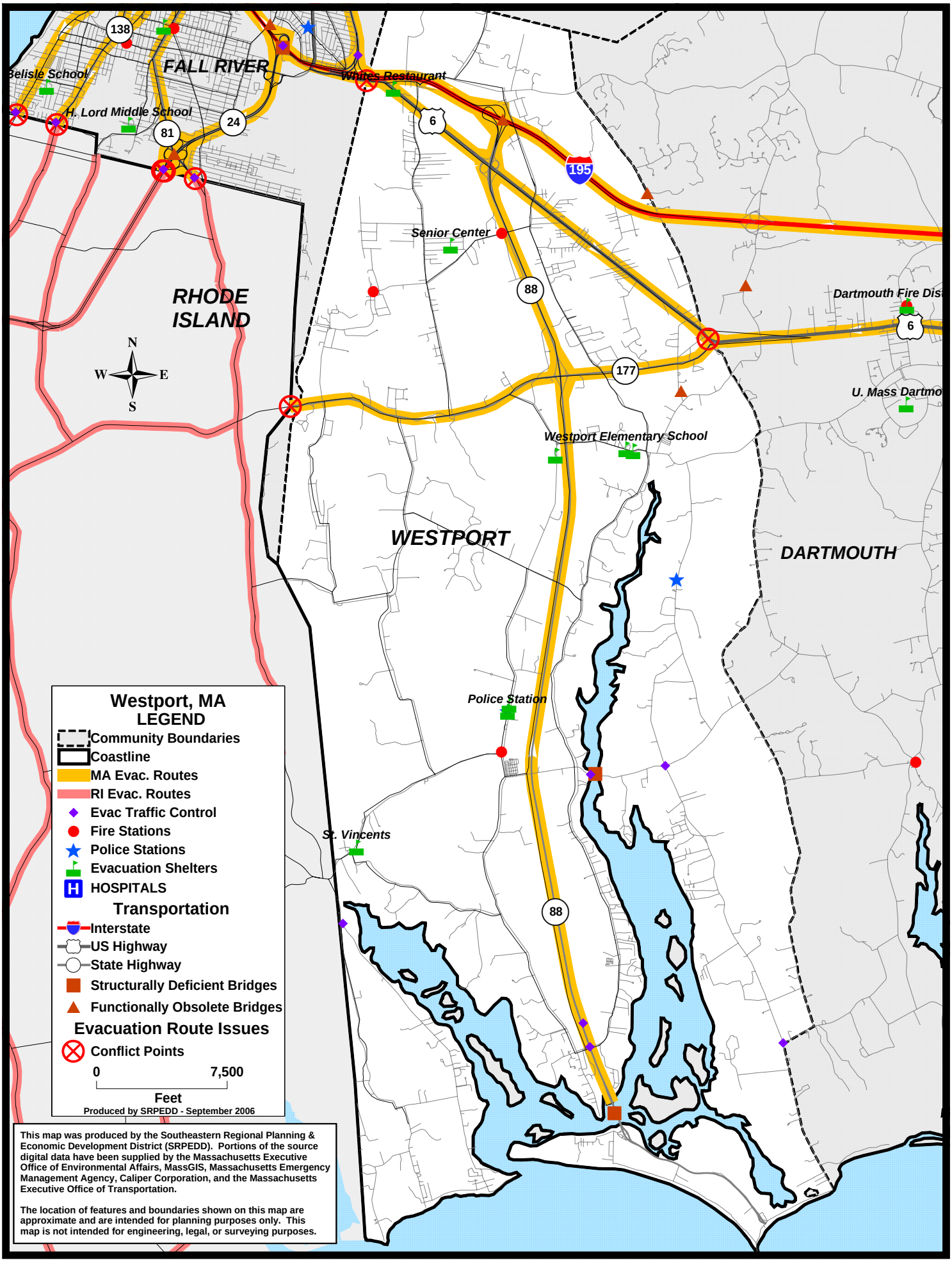
Westport

- Route 6 and 177 traffic is being sent towards Fall River and Dartmouth while both communities are sending traffic to Westport.

- All of their shelters with the exception of White's Restaurant are not on an evacuation route.

A regional evacuation route may consider the local road network, but it should be concerned with roads of higher carrying capacity to move as many vehicles away from danger as quickly as possible. This includes all Interstate and divided highway, U.S. Highways, and other multi-lane state numbered roads that lead to higher capacity roads. The routes should link to other evacuation routes in regions such as Cape Cod and other states. Figure 4 provides an initial attempt to establish a regional evacuation route.



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APPENDIX C

Letters, Related News Articles, and Public Meeting

Correspondence

THE COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF PUBLIC SAFETY

MASSACHUSETTS EMERGENCY MANAGEMENT AGENCY

400 Worcester Road
Framingham, MA 01702-5399
Tel: 508-820-2000 Fax: 508-820-2030
Website: www.mass.gov/mema

September 8, 2006

Steve Smith, Director
Southeastern Regional Planning & Economic Development District
88 Broadway
Taunton, MA 02780-2557

Dear Mr. Smith: STEVE

Thank you for providing the Massachusetts Emergency Management Agency your Hurricane Evacuation Route Evaluation report. Our Region II Manager, Robert Nadeau, and other staff members from MEMA also attended the SRPEDD presentation of the draft plan in August. MEMA is very interested in working with SRPEDD and the communities served by this plan. I have asked the regional office to be sure that the plan and the related recommendations are coordinated whenever possible with the organizations and available resources within the region. I have also asked the Homeland Security Coordinator for the Southeast Homeland Security Regional Advisory Council, Kerri-Ann Tirrell, to be sure that the council is aware of the contents and recommendations of the report.

I believe the collaborative work that is done in the interests of public safety in efforts such as these leads to a much safer and prepared Commonwealth of Massachusetts. Thank you again and we look forward to our continuing relationship with SRPEDD.

Sincerely,

Cristine McCombs
Director

RECEIVED
SEP 13 2006
By PM.

cc: Barry Wante
Robert Nadeau
Kerri-Ann Tirrell
Paul Mission

The Standard Times, New Bedford, MA

LOOKING AHEAD

STANDARD-TIMES FILE PHOTO

Boats and vehicles lie damaged at the Hathaway-Braley Wharf in Fairhaven following Hurricane Carol in 1954. Communities throughout SouthCoast are reviewing their emergency plans to be prepared for the next hurricane that hits the region.

Agency to air storm evacuation plans

By JOAO FERREIRA
Standard-Times staff writer

NEW BEDFORD — Following the wake-up call named Katrina, coastal communities in the region have been reviewing their emergency management plans to ensure the area is prepared for an overdue hurricane in the Northeast.

Those efforts resulted in a draft study that evaluated existing evacuation routes and the impacts to the transportation network in the event of a serious storm.

The results of that work are to be presented at 7 p.m. Wednesday at Buttonwood Park Zoo at a public information meeting of the Southeastern Regional Planning and Economic Development District.

New England has not experienced a powerful storm since Hurricane Bob, which struck in 1991.

The Category 2 storm had sustained winds of 95-100 mph and a storm surge ranging from 6 to 8 feet above mean tide.

The worst flooding from Bob occurred in Buzzards Bay, southern Cape Cod and Martha's Vineyard and Nantucket, resulting in 17 deaths and damage estimated at $900 million.

"Although this is significant damage as a result of the storm, the 15-year dormancy of hurricanes in New England may cause residents to be less responsive when faced with hurricane evacuation," the SRPEDD study warns. "We must learn from the lesson of Katrina and never believe that it can't happen here."

Even as Katrina struck, SRPEDD was examining each community's evacuation routes. Those routes were merged by the Massachusetts Emergency Management Agency to create a regional network.

In developing the study, SRPEDD looked at populations, current and future roads, evacuation routes, storm surges, emergency shelters and public safety.

This study examined all evacuation routes within the SRPEDD region and takes into account other potential road problems that would inhibit traffic flow in the event of a regional emergency.

The agency also examined the potential impacts to the transportation network as a result of a hurricane threat to the Buzzards Bay and Mount Hope Bay communities.

Some of the findings of the study include:

■ The examination of community evacuation routes on a regional scale identified flaws in the system. Each community's route apparently didn't take into account the neighboring communities. "Merging local evacuation routes for regional analysis highlighted a lack of connectivity, gaps, or routes stopping at the community's border," the study says.

■ Not all shelters, usually high schools, are located along an evacuation route. "It is important to include the adjacent road network as part of the evacuation routing so that all residents know where to go," the study says. In some cases, such as Wareham, shelters are located in flood zones.

■ Poor road design, road construction projects, structurally deficient and functionally obsolete bridges could limit vehicle flow during the evacuation process. The Braga Bridge in Fall River is one of the potential problem areas mentioned in the study.

The study makes several recommendations on those and other issues to address the problems. Those recommendations will be discussed during the Wednesday meeting.

The draft report is available on SRPEDD's web site at www.srpedd.org. Comments may be written by fax, mail, or e-mail; or presented verbally at the public meeting.

The Standard Times, New Bedford, MA

PAGE A4
The Standard-Times
SOUTHCOAST
THURSDAY, AUGUST 10, 2006
FREETOWN & LAKEVILLE A13

Study finds flaws in hurricane evacuation routes

By JOAO FERREIRA
Standard-Times staff writer

NEW BEDFORD — SouthCoast public safety officials gathered at Buttonwood Park Zoo last night to listen to the findings of the draft hurricane evacuation route evaluation for the region, but offered few comments on the proposal.

Paul Mission of the Southeastern Regional Planning and Economic Development District presented an overview of the results of the draft study that evaluated existing evacuation routes and the impacts on transportation in the event of a hurricane.

"We wanted to look at the evacuation routes," Mr. Mission said. "Some of our roads that were designated as evacuation routes didn't match up. We identified as many conflicts as we possibly could."

As an example of a conflict, Mr. Mission said, Middleboro evacuation routes lead to Plymouth, and Plymouth's lead to Middleboro.

He also questioned evacuating 200,000 people from Cape Cod, and 58,000 from the Buzzards Bay and Mount Hope Bay areas due to road deficiencies, construction and related factors.

For example, he said, it would take 15 hours to evacuate 70,000 cars on Route 25 from the Cape.

"If you don't have a good transportation system, your evacuation plans may not be totally effective. Communities need to know what their neighbors are doing."

The issue seems to be of special concern in SouthCoast.

Buzzards Bay is the most vulnerable area in the area in the case of a Category 3 hurricane, Mr. Mission said.

The towns most at risk are Fairhaven, Mattapoisett, Marion and Wareham. In the worst-case scenario, Mr. Mission said, Marion would be 71 percent under water, and Wareham would be 56 percent under water, including most of the town's emergency shelters.

The draft study recommends the creation of emergency shelters outside flood areas, and agreements between towns.

Mike Philbin of the Massachusetts Emergency Management Agency said the next step is for agencies to work together in developing better emergency plans.

"This is a continuing planning process. I don't see this ending," Mr. Mission said.

The Southeastern Massachusetts Metropolitan Planning Organization draft report is available on SRPEDD's Web site at www.srpedd.org. Comments can be sent by fax, mail or e-mail.

Mr. Mission said the final report is due in September.

The Sun Chronicle, Attleboro, MA

The Sun Chronicle, Attleboro - N. Attleboro, Mass. ■ Saturday, July 29, 2006 A7

★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★

SRPEDD Announces a Public Information Meeting on the Draft Hurricane Evacuation Route Evaluation for the Southeastern Massachusetts Metropolitan Planning Organization (SMMPO)

Wednesday, August 9, 2006 at 7:00PM
Buttonwood Park Zoo
New Bedford, MA

The Southeastern Regional Planning and Economic Development district (SRPEDD) will present an overview of the results of their draft study that evaluated existing evacuation routes and the impacts to the transportation network in the event of a serious hurricane.
The draft report is available on SRPEDD's web site at **www.srpedd.org**. Comments may be written by fax, mail, or email; or verbally in person at the public meeting.

SRPEDD, 88 Broadway, Taunton, MA 02780
Phone: 508-824-1367 • Fax: 508-823-1303
email: pmission@srpedd.org

The Standard Times Press Releases

The Standard-Times, New Bedford, MA Monday, July 31, 2006 Page A5

SRPEDD Announces a Public Information Meeting on the Draft Hurricane Evacuation Route Evaluation for the Southeastern Massachusetts Metropolitan Planning Organization (SMMPO)

Wednesday, August 9, 2006 at 7:00PM
Buttonwood Park Zoo
New Bedford, MA

The Southeastern Regional Planning and Economic Develpment District (SRPEDD) will present an overview of the results of their draft study that evaluated existing evacuation routes and the impacts to the transportation network in the event of a serious hurricane. The draft report is available on SRPEDD's web site at www.srpedd.org. Comments may be written by fax, mail, or email; or verbally in person at the public meeting.

SRPEDD, 88 Broadway, Taunton, MA 02780
Phone: 508-824-1367 Fax: 508-823-1303
email: pmission@srpedd.org

The Standard-Times, New Bedford, MA Thursday, August 3, 2006 Page A3

COMMUNITY UPDATE

Hurricane evacuation meeting scheduled

NEW BEDFORD — The Southeastern Regional Planning Economic Development District will hold a public information meeting on the draft Hurricane Evacuation route evaluation for the Southeastern Massachusetts Metropolitan Planning Organization (SMMPO) at 7 p.m. Wednesday at Buttonwood Park Zoo

SRPEDD will present an overview of the results of the draft study that evaluated existing evacuation routes and the impacts to the transportation network in the event of a serious hurricane.

The draft report is available on SRPEDD's web site at www.srpedd.org. Comments may be written by fax, mail, or email; or presented verbally at the public meeting.

Feast parade route, parking ban announced

NEW BEDFORD — The Traffic Division of the New Bedford Police Department released the Feast of the Blessed Sacrament parade route and a parking ban which will be in effect on Sunday.

The parade will form at Brooklawn Park and will step off sharply at 1 p.m. from Wood Street and Acushnet Avenue.

The route is as follows: south on Acushnet Avenue from Wood Street to Earle Street; then east on Earle Street to Madeira Avenue; then north on Madeira Avenue to the feast grounds.

A parking ban will be in effect along the entire route and will be strictly enforced, including the towing of vehicles if necessary, according to police. The ban will start from Wood Street and Acushnet Avenue south to Earle Street, easterly to Madeira Avenue and then north to the feast grounds.

The Wareham Courier

NEWS

Hurricane threat darkens Wareham's horizon

Swifts, Parkwood Beach areas most vulnerable

By JEREMY GANTZ
MPG Newspapers

WAREHAM/ONSET – Wareham's extensive coastline is potentially at "ground zero" if a major hurricane were to strike the Buzzards Bay region, a National Weather Service meteorologist said last week during a lecture at the Cape Cod Canal Visitor Center.

"Ultimately, when a major storm hits (upper Buzzards Bay), we're looking at something fairly catastrophic," Bob Thompson, Meteorologist-In-Charge of the National Weather Service Forecast Office in Taunton, said. He discussed the threat of hurricanes to the region at the Army Corps of Engineer's visitor center last Thursday (Aug. 3) as part of the facility's weekly evening program series.

"We think of Wareham as potentially at ground zero," Thompson said, adding that his study of the town's coastline indicates that the Swifts Beach and Parkwood Beach neighborhoods would be particularly vulnerable to destructive flooding caused by a major hurricane. Storm surges accompanying major hurricanes could be 20 to 25 feet high, with a worst-case scenario of 25-27 feet, according to Thompson.

Because Wareham, Marion and Bourne will bear the brunt of Buzzards Bay flooding, they are particularly vulnerable to storm surges caused by hurricanes, Thompson said. When a storm pushes water into the Bay, it will ultimately be constricted at the Bay's head – i.e., Wareham and Bourne. The last hurricane to make landfall in the region was Bob, in 1991. The highest surges in the region from that storm – 12-15 feet – were recorded in Onset, Bourne and Wareham. (The surges were only 6-10 feet along Rhode Island's shore.)

But Hurricane Bob was not a major – category 3 or higher – hurricane. The last major storm was 1954's Hurricane Carol; its surge in Wareham was 15 feet. Since then, no storm of that size has struck Wareham and Onset. But coastal development during the same period has been tremendous, leaving the town's 54 miles of coastline more vulnerable than ever.

"It's human nature to be complacent," he said. "They're not frequent phenomena. We don't have them every year. But it's a matter of time."

Year-round Swifts Beach resident Mary Reis, who recently moved into the new Cranberry Grove development three-quarters of a mile from the beach, echoed Thompson's notion of a complacent public.

"It's something we never think about," she said while walking around her neighborhood.

Of all the houses along Swifts Beach, only four are on stilts. Many ground-level homes directly abutting the beach would be the first victims of the powerful storm surges Thompson predicts. And the terrain stretching from the beach back to Route 6 is nearly flat, meaning flood waters could easily stretch inland for over a mile – as they did during the 2004 South Asian tsunami.

"The water doesn't just hit the beach and stop," Thompson said. "All of the roads leading to where you live could be flooded." (See related story for hurricane preparation information.)

Although the Atlantic hurricane season officially runs from June 1 to Nov. 30, the most threatening period is considered to be August and September, in part because sea temperatures are highest then. The 2005 hurricane season was the most active kept. There were 13 hurricanes, seven more than in the average season, according to the National Hurricane Center. Katrina was the most destructive hurricane to ever hit the United States.

This year, meteorologists are predicting another hyper-active Atlantic hurricane season – although they don't think it will be as severe as last year's. There's an 80 percent chance of an above-normal season, with 13 to 16 named storms and eight to 10 hurricanes – four to six of them major – predicted. Despite – or because of the fact that only four major hurricanes hit Wareham in the last century – Thompson believes the threat to the area is greater than ever.

"One of the things that people probably don't appreciate is that the next time we get a major hurricane, we'll probably be without power not for days, but for weeks," he warned.

> "We think of Wareham as potentially at ground zero."
> – Bob Thompson.

OBA, OPL offer hurricane program

The Onset Bay Association (OBA) and the Onset Protective League (OPL) will host a comprehensive hurricane emergency preparedness program at 7 p.m. Thursday, Aug. 24, at the Dudley L. Brown VFW Post on Ball Park Road off Onset Avenue in Onset. The program will include knowledgeable participants and be moderated by OBA and OPL member Lew Ferretti.

Representatives of the Wareham Fire Department, the Onset Fire Department, the Wareham Police Department, the Wareham harbormaster's office, EMS, the Board of Health and the Municipal Maintenance Department, the National Weather Service, the American Red Cross and U.S. Coast Guard will be present to furnish pertinent information and answer questions about how the citizens of Onset and Wareham can best prepare themselves for a potentially destructive hurricane striking our area.

Everyone is invited and encouraged to attend. Refreshments will be provided and served by members of both organizations.

For further information about this program, call (508) 295-0136.

Prepare for the destructive effects of major hurricanes

Unless you lived through the 1938 and 1954 hurricanes, its likely you've never experienced the destructive effects of a major hurricane. Experts recommend preparing for the worst.

- Have a family plan: Understand potential risks and know your evacuation plan.
- If you don't need to evacuate, know what protective actions are needed. If at home during the brunt of a hurricane, stay in small, interior rooms on the lowest level. Stay away from large rooms.
- Monitor weather reports by visiting www.weather.gov/boston or, if the power is out, listen to national weather radio (visit www.weather.gov/nwr for information about the Camp Edwards station)
- Consider the potential impacts of a hurricane: no power for weeks; no ATMs; no working gas pumps.
- Don't expect local, state or federal government officials to come to the rescue quickly. Take personal responsibility for hurricane responses.
- Visit the National Weather Service (www.nws.noaa.gov) and the National Hurricane Center (www.nhc.noaa.gov) for more help with hurricane preparation.
- The Town of Wareham's emergency plan is also available online at www.wareham.ma.us/Public_Documents/Wareham-MA_EMS/ems.
- National Weather Service meteorologist Bob Thompson can be reached by e-mail at robert.thompson@noaa.gov.

– Jeremy Gantz

Hurricane preparedness to be discussed

8/23

WAREHAM — A hurricane preparedness program will be held at 7 p.m. tomorrow at Dudley L. Brown VFW Post 2846 on Ball Park Road off Onset Avenue. The Onset Bay Association and Onset Protective League are sponsoring the event, which will be moderated by OBA and OPL member Lew Ferretti.

Representatives from the Wareham and Onset fire departments, the Wareham Police Department, the town's harbormaster, Emergency Medical Services, Board of Health, Municipal Maintenance Department, National Weather Service, American Red Cross, and the Coast Guard will provide information and answer questions about preparing for a potentially destructive hurricane.

All are invited. Refreshments will be provided. For more information, call (508) 295-0136.

The Herald News, Fall River, MA

LOCAL

The Herald News

The Herald News, Thursday, August 3, 2006 A3

Regional hurricane plans studied

WILL RICHMOND
HERALD NEWS STAFF REPORTER

FALL RIVER — Imagine a Category 3 hurricane is barreling toward southeastern Massachusetts.

You pack your family into the car and begin evacuating. At the same time a family in the neighboring town is doing the same. Along the way the two vehicles pass each other because each respective town has laid out an evacuation route that heads in passing directions.

To avoid this type of situation the Southeastern Massachusetts Metropolitan Planning Organization and the Southeastern Regional Planning and Economic Development District have recently completed a hurricane evacuation route evaluation.

"Examining community evacuation routes on a regional scale identified flaws in the system," the report said. "There appears to be no consideration to neighboring communities and their evacuation plans. Merging local evacuation routes for regional analysis highlighted a lack of connectivity, gaps, or routes stopping at the commu- conflicts with evacuation flows. For example, town A sends its residents towards town B while town B sends its residents towards town A. If these maps were used verbatim on a regional scale, they could lead to some confusion."

SRPEDD director of Highway Planning James Hadfield said the report was developed after the evacuation plans and routes of local towns was done, showing the potential for conflict.

"The local community plans and routing looked fine individually but side-by-side they didn't exactly match up," Hadfield said. "So we wanted to caution local communities so they can better define their routings."

Along with improving evacuation routes the report, which can be viewed on the SRPEDD Web site, the report also looked at the potential flooding sites, location of shelters and how highway repairs could effect evacuation routes in each of the region's towns.

"We wanted to highlight for organizations such as MassHighway where they should try to upgrade structurally defi- as the work gets done sometimes it can take a long time to get such a project finished," Hadfield said. "By highlighting the bad roads and bridges hopefully they can expedite the work so they will ready in case of an emergency."

As an example the report points to the work currently taking place on the Braga Bridge and under Government Center. "Although this is not an issue hindering evacuation, this facility (the Braga Bridge) would be closed during a hurricane due to the high winds associated with the storm," the report said. "Like the Bourne or Sagamore bridges, the Braga Bridge is closed to all traffic at a sustained wind speed of 80 mph. The problem occurs with lane closures on the bridge for road reconstruction or the necessary repairs being made to Government Center over the highway at the base of the bridge. It is important to expedite these repairs in order to maintain the existing capacity of this highway."

In Fall River, the report identified the impact to the city would be reserved along the banks of the Taunton River, with Route 79, Davol Street and Route 138 in the area under the Braga Bridge. Route 79 north of the Brightman Street Bridge may also experience significant flooding due to the close proximity to the Taunton River.

With the exception of the Braga Bridge issues, the report did not raise any concerns about Fall River's evacuation routes or shelter plans, as most of the problems were identified in the eastern part of the region.

Hadfield noted that a number of planned shelters in Wareham fall within a potential flood zone, while 70 percent of the town of Marion could be under water if such a storm were to strike at the right time.

Hadfield said the differences that do exist between services offered by neighboring towns is a good example of why such planning is effective on regional basis.

"It's very important to do this on a regional basis because sometimes neighboring communities need help," Hadfield said. "Hospitals tend to be regional in nature and when there are large fires neighboring communities help out so if there is going to be a major weather into that kind of category."

While the images of Hurricane Katrina and Rita are still fresh in the minds of many people, Hadfield said those two events had only a minor effect on the report's development.

Hadfield said the impetus for the report came after SRPEDD completed a study on how the region would be effected by the loss of the Braga Bridge. With that study finding that other bridges crossing the Taunton River and Narragansett Bay would face significant problems, a need to review all evacuation routes became needed.

"That study identified that there are issues with evacuation routes so we took the initiative to study these routes in the situation of a hurricane,' Hadfield said.

Before the evaluation becomes an official document, SRPEDD will hold a public hearing on Wednesday at 7 p.m. at Buttonwood Park Zoo in New Bedford.

"We'll give a presentation then turn it over to them (the public) to hear about what we missed," Hadfield said.

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the south coast
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Changing leaves Changing lives

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Preparing for 'the big one'

Hurricane evacuation route evaluation study

by Paul L. Mission

2005 was a year of unprecedented storms, including Hurricane Katrina, which devastated New Orleans, Louisiana and coastal Mississippi. This storm alone forced all coastal communities throughout the United States to review existing emergency management plans to insure that a catastrophe like that experienced in New Orleans would be better managed.

Ironically, while Dennis, Katrina, Rita, Wilma and their lesser but still formidable siblings created concern, the Southeastern Regional Planning and Economic Development District (SRPEDD) had already begun to examine evacuation routes for communities along Buzzard's Bay and Mount Hope Bay.

SRPEDD examined roads designated as evacuation routes and used Geographic Information Systems (GIS) to identify inconsistencies and conflicts on these routes between communities. The study also examined potential road problems that could inhibit traffic flow in the event of an evacuation as well as the impacts to major roads resulting from hurricane flooding.

Are we ready?

The results of the study identified several issues that may inhibit safe and effective evacuation traffic flow during a hurricane:

- Evacuation route conflicts

The routes between cities and towns don't always connect. There are gaps in designated routes, routes stop at the community borders, and there are conflicting evacuation traffic flows.

- Storm surge flooding

In a worse-case scenario, Marion and Wareham would almost be completey flooded from a hurricane storm surge. Floodwaters could cover as much as 71% of Marion and 56% of Wareham.

- Community issues

Wareham is the only community where the potential total of evacuees would exceed their existing emergency shelter capacity. Wareham also has four shelters that could be flooded and one additional shelter could be isolated as a result of a hurricane storm surge.

Because of the town's vulnerability during a hurricane, Science and Operations officer David R. Vallee of the National Weather Service in Taunton has labeled Wareham as "the Miami of the North."

- Road system impacts

Major roads impacted by a hurricane storm surge include I-195, Route 25, Route 6, and Route 28 in Buzzards Bay coastal communities. Major roads potentially impacted in Mount Hope Bay communities from a hurricane storm surge include I-195, Route 103, Route 136, Route 6, Route 138, and Route 79.

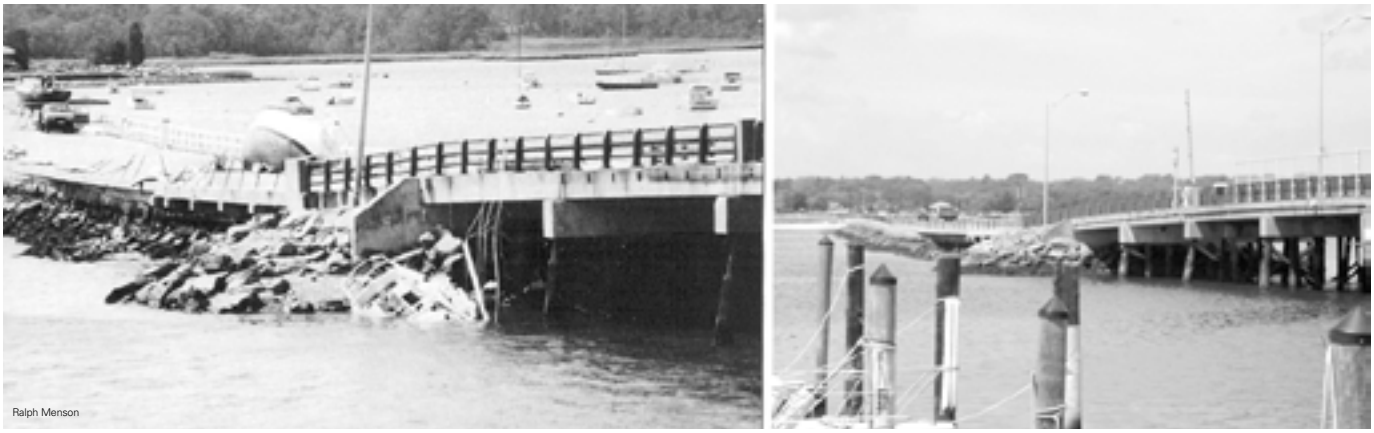
Evacuation population and traffic

In the SRPEDD area, nearly 58,000 people could be expected to seek shelter during a hurricane. Of the estimated 500,000 summer residents on Cape Cod, approximately 200,000 people could evacuate prior to a hurricane. This could result in nearly 70,000 vehicles using Route 25 northbound to I-495.

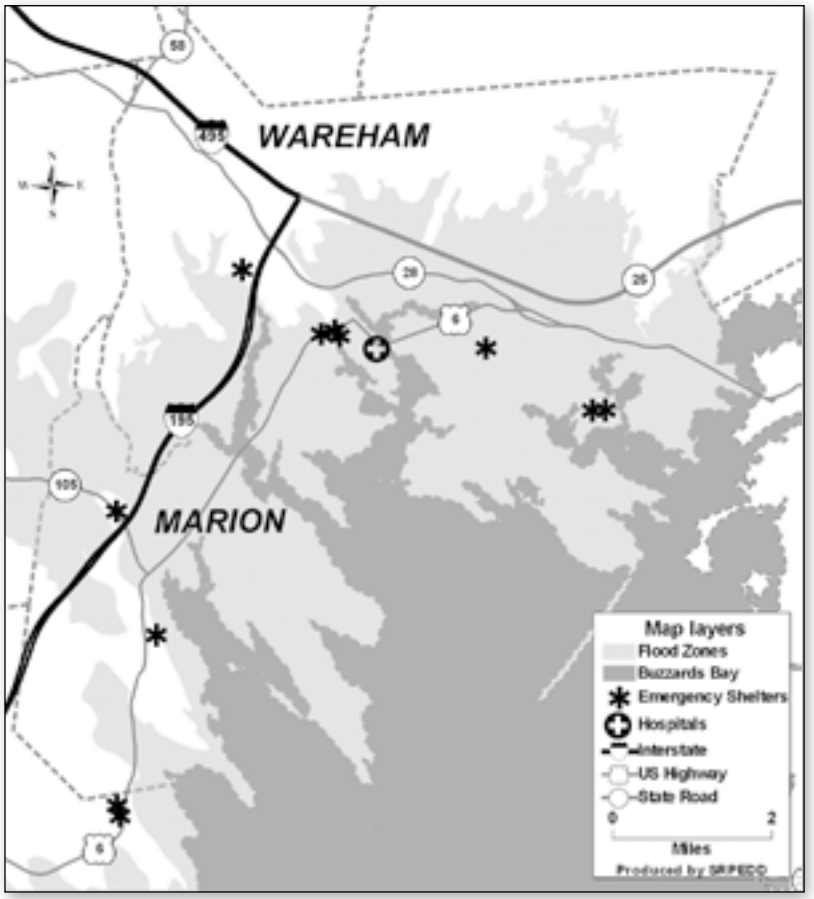
This road presently handles 40,000 vehicles daily in both directions. Based on this traffic potential, it may require no less than 15 hours to evacuate Cape Cod and the Buzzards Bay area along this roadway. A 1997 Hurricane report developed by the United State Army Corps of Engineers recommended no less than 10 hours.

Parts of our highway system will be a problem during evacuations because of existing limitations. These locations include:

- I-495 northbound, which drops from 3 to 2 lanes between Route 25/I-195 and Route 24;
- Route 44 westbound; it drops from 2 to 1 lane between Route 58 & the Middleborough Rotary;
- Route 24/Route 140 interchange has limited capacity and sub-standard ramps.



Padanaram Bridge after Hurricane Bob (left) and as it is today (right).



What needs to be done?

Several issues need to be addressed so that a regional evacuation would not be hindered. SRPEDD's study concludes and recommends the following:

- Establish a regional evacuation plan to assist emergency officials. This includes identifying evacuation routes that are consistent across several communities with links to regional shelters.
- Enhance public awareness of evacuation routes and shelter locations. This can be done though the distribution of promotional pamphlets and maps via US Mail, television, radio, and the Internet.
- Continue support for the the implementation of road improvements including:
- Widening I-495 between I-195/Route 25 in Wareham to Route 24 in Raynham;
- Removal of the Middleborough Rotary and widening of Route 44.
- A continued effort to expedite all repairs to structurally deficient bridges that are part of evacuation routes in the SRPEDD Region.
- Consider alternate locations or additional shelters outside of storm surge flood zone areas for the towns of Marion, Wareham, and other Buzzards Bay communities that might be vulnerable to damage from a severe hurricane.
- Communities need to continually update their Comprehensive Emergency Management plans as well as being aware of what their neighboring communities will do during a regional emergency.

Although New England has not recently had a severe storm, complacency is not an attitude people should take with any emergency situation. The fifteen-year dormancy of hurricanes in New England may cause residents to be less responsive when faced with hurricane evacuation.

With the recent predictions (2006) from the National Hurricane Center of strong storms in the next few years, emergency preparedness is vital. Communities should re-visit their emergency preparedness plans to insure all information is up-to-date. Furthermore, evacuation routes between communities should be revised to eliminate gaps and conflicts while alternative shelters are considered.

We must learn from the lesson of Katrina and never believe that it cannot happen here.

Paul L. Mission is a Transportation/GIS Specialist for the Southeastern Regional Planning & Economic Development District (SRPEDD.) He may be reached at pmission@srpedd.org

Public Meeting – Buttonwood Park Zoo, New Bedford, MA - August 9, 2006

Hurricane Evacuation Route Evaluation
Attendance Sheet

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Photos of the Public Meeting