Appendix 4.1-J

May 17, 2010 Memorandum from CTPS to the Inter Agency Coordinating Group

MEMORANDUM

TO: **Inter-Agency Coordinating Group Files** **May 17, 2010**

FROM: **Scott Peterson**

RE: **South Coast Rail Zipper Lane Analysis – Response to Questions**

BACKGROUND

In supporting the development of the Draft Environmental Impact Report/Statement (DEIR/DEIS), the Central Transportation Planning Staff (CTPS) analyzed several alternatives using the travel demand model set. The service plans for these alternatives were developed by the project team and evolved over time as more information about each alternative was developed. This memo describes how the Rapid Bus alternative operation plan evolved over time and examines how different policy assumptions on the South East Expressway Zipper Lane affect the operations plan and the resulting demand. This memo is in response to EPA comments that were submitted in September of 2009 to the Interagency Group.

ZIPPER LANE

The Southeast Expressway HOV Lane "Zipper Lane" extends about six miles north from Furnace Brook Parkway in Quincy to Freeport Street in Dorchester. It is open Monday through Friday (except some holidays) to northbound HOV traffic between 6:00 a.m. and 10:00 a.m. and to southbound HOV traffic between 3:00 p.m. and 7:00 p.m.

A special "Zipper Truck" drives over a six mile, flexible barrier wall, lifting it away from the median and setting it down a lane's width away, creating a protected carpool lane on the opposite side of the highway. After the commuting period is over, the Zipper Truck again drives over the barrier wall, lifting it up and setting it down next to the median.

By borrowing a lane from the off-peak side of the Expressway, the "zipper truck" creates five lanes for northbound traffic and three lanes for southbound traffic in the morning. During the afternoon commuting period, there are five lanes for southbound traffic and three for northbound traffic. In 1996, the MassHighway Department opened the Zipper Lane and experimented with different operating policies in order to determine which one provided the optimal flow of traffic in peak period conditions. They started with a 3+ occupancy rule, which resulted in its underutilization, which coined the term "empty lane syndrome'. This is a situation when 500 or fewer vehicles use the HOV lane and users of the competing routes see what appears to be an underutilized facility, causing people to

exert political pressure on government to open it up for more vehicles. After testing several other operating policies, MassHighway decided on using the 2+ occupancy rule, which we have today.

The Boston Region MPO staff maintains historical travel times from 2002 to 2008 for the northbound Southeast Expressway HOV and general-purpose lanes. As shown in the Table 1 below, during 2007, the HOV lane processed an average 1,130 vehicles per hour per lane during the four hours of operation, only 150 vehicles less than the general-purpose lane, which processed 1,280. The number of persons per hour per lane carried by the HOV lane is more than twice that carried by the general-purpose lanes, 3,010 versus 1,370. The HOV lane is more efficient than the general-purpose lanes, as it carries more persons per lane when the hourly volume is below 1,500. However since the HOV lane is narrower than the general-purpose lane, it is more sensitive to congestion, resulting in slower speeds. When the HOV lane starts to carry more than 1,500 vehicles per hour, it experiences congestion and long queues at the point the HOV lane merges with the general purpose lane, just south of Columbia Road. This increases the travel time of the users of this facility. In 2008, the HOV lane was carrying 1,370 vehicles per lane per hour or 91% of its carrying capacity. By 2030, there will demand for the HOV lane in excess of 1,600 vehicles per hour, well over the HOV lane carrying capacity, assuming the area south of Boston continues to grow as anticipated.

TABLE 1:
Southeast Expressway, Northbound Vehicle Occupancy
6:00 AM to 10:00 AM

Year	Facility	Lanes	Total Vehicles	Total Persons	Average Vehicles per Hour per Lane	Persons per Hour per Lane	Persons per Vehicle
2008	HOV	1	4,500	12,000	1,130	3,010	2.67
	General	4	20,500	22,020	1,280	1,370	1.07
	All	5	25,000	34,020	1,250	4,380	1.36

*Source 2008 CTPS Southeast Expressway travel time runs, vehicle counts, and occupancy counts

Table 2 contains information on average travel times and speeds for both the HOV and the general-purpose lanes during the AM period of operation. In 2004, the average HOV travel time from start of the HOV lane to Columbia Rd On-ramp in Dorchester took 13.3 minutes, seven minutes faster than the general-purpose lane. The HOV travel time increases to about 17 minutes in 2007 based on fieldwork and this is expected to increase to 19 minutes in 2030 based on the demand forecasts. The general-purpose travel time is expected to increase from 24 minutes in 2007 to 32 in 2030.

TABLE 2:
Southeast Expressway (I-93) Northbound
Peak Hour Travel Times and Speeds: HOV Lane and General Purpose Lanes
From Start of HOV Lane in Quincy to Columbia Road On-Ramp in Dorchester

Year	AM Peak Hour HOV Lane (2+ Occupancy Rule)		AM Peak Hour General Purpose Lanes	
	Avg. Travel Time (Min)	Avg. Travel Speed (Mph)	Avg. Travel Time (Min)	Avg. Travel Speed (Mph)
Free flow	6.0	55.0	na	na
2004	13.3	24.8	20.3	16.3
2005	14.3	23.1	23.8	13.9
2006	15.3	21.6	24.3	13.6
2007	16.8	19.6	24.3	13.6

In 2030, more vehicles are using the HOV lane as well as the general-purpose lanes, which diminish the effectiveness of the HOV lane to provide travel timesavings. As more vehicles get funneled through the HOV lane, queue lengths play a significant role in increasing overall traffic times. Some of the key points about the traffic queues are:

1. HOV (2+) traffic queues would form in the HOV lane and degrade its operation.
2. HOV (3+) should not significantly increase queues if the volumes are below 750 vph, but it would shift traffic into the general-purpose lane degrading its operation and making it more difficult for the HOV traffic to merge north of Columbia Road.
3. Under an HOV (3+) scenario, the general-purpose lanes traffic queues would extend about 4 to 5 miles on I-93 northbound into the Route 24/I-93 interchange area. Also, traffic queues would extend about 2 miles onto Route 3 northbound and add to the recurring traffic queue on Route 3 northbound between interchange 17 (Union Street) and interchange 14 (Route 228). Currently, those queues extend just beyond the Braintree Split, approximately one-half mile from the zipper lane entrance.

Figure 1 shows information about the relationship between the average travel time between from start of HOV Lane in Quincy to Columbia Road on-ramp in Dorchester and the maximum number of vehicles per hour that can traverse in 2030 for four different policy scenarios:

- **Bus Only**: The bus only operating policy would permit only bus access within the zipper lane. This would exclude all HOV commuters who are not traveling by bus.

- **Three-Plus Occupancy**: The three-plus operating policy would allow access to the zipper lane only to vehicles with three or more passengers. All other commuters would be forced to use the general-purpose lane.
- **Three-Plus Occupancy with Permit**: The three-plus with permit operating policy would allow access to the zipper lane only to vehicles with three or more passengers or those that hold a permit to access the zipper lane. Vehicles that hold a permit could access the zipper lane regardless of number of passengers in the vehicle. The permits could be purchased and would not require any other special provisions.
- **Two-Plus**: The two-plus policy would maintain the existing zipper lane operation, which allows access to all vehicles with two of more passengers.

As shown in Figure 1, the travel times for each of these policy scenarios range from 11 minutes with the "Bus Only Policy" to just under 20 minutes using the current "HOV 2-Plus Rule." In free flow conditions, the HOV lane can be traveled in about 6 minutes, but because of traffic queues that develop due to the merge with the general-purpose lane just off of Columbia Road, an additional 5 to 13 minutes of travel time is produced to go from the terminus of the Zipper Lane to South Station. A "Bus Only Policy" would produce the lowest volumes on the HOV lane, resulting in the best travel time of 6 minutes but the lowest HOV volume. A "Three-plus Occupancy Policy" produces the second lowest estimate of vehicles using the HOV lane, between 600 and 800, but has a travel time of 12 to 15 minutes. A "Three-plus Occupancy and Permit Policy could increase the throughput to between 1,000 and 1,200 and results in a travel time of 15 to 18 minutes. The current "HOV 2-Plus Policy" results in travel times of between 18 and 21 minutes, but also accommodates the greatest number of vehicles, in excess of 1,200.

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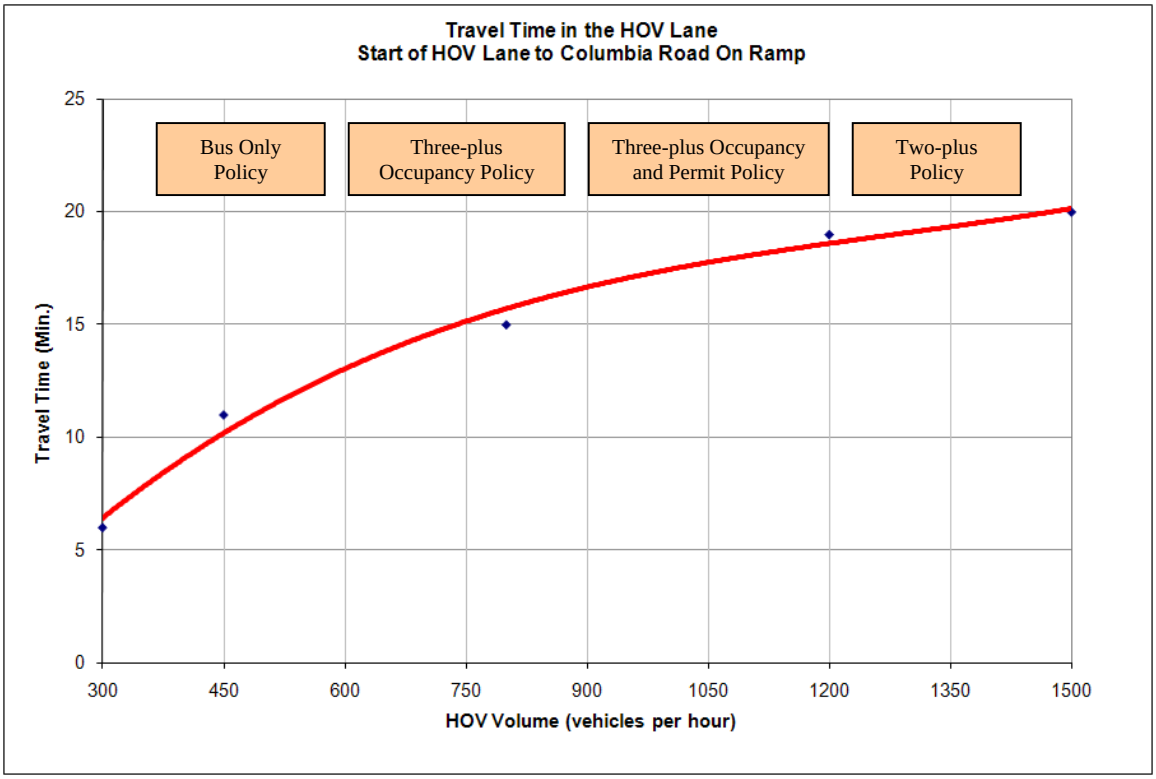
FIGURE 1:
ZIPPER LANE TRAVEL TIMES
USING DIFFERENT OPERATING STRATEGIES

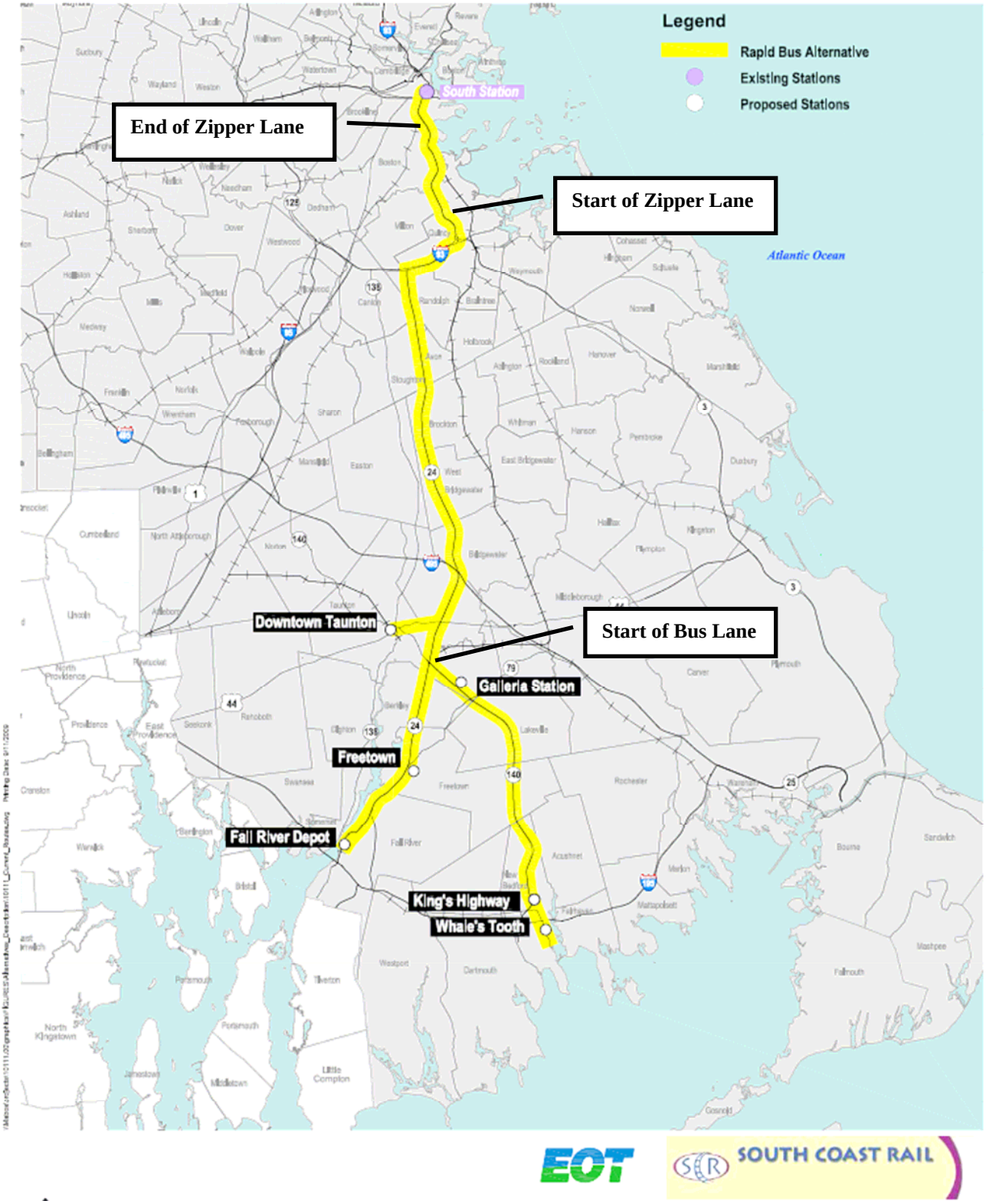


Source: 2009 CTPS Regional Travel Demand Model - Note: The range of vehicles for each occupancy rule has been approximated and would overlap one another to some degree in reality.

RAPID BUS ALTERNATIVE

The Rapid Bus Alternative would provide commuter bus service to South Station via I-93, Route 140 and Route 24. North of I-495, buses would use a combination of new zipper bus lanes, new reversible bus lanes, two-way bus lanes, existing zipper HOV lanes, and existing HOV lanes, along with a short section in mixed traffic. South of the I-495 interchange in Raynham, buses would travel in the general-purpose lanes with mixed traffic. The New Bedford route would be 56.4 miles long and the Fall River route would be 51.5 miles long. Figure 2 shows the Rapid Bus Alternative. This alternative requires improvements to highway infrastructure along Route 24 (construct third lane from Route

FIGURE 2:
RAPID BUS ALTERNATIVE



140 to I-495, a distance of 5.8 miles; widen Route 24 to accommodate movable barriers; construct a zipper bus lane from I-495 to Harrison Boulevard, a distance of 15.4 miles); and Route 128/I-93 (construct reversible bus lane from Harrison Boulevard on Route 24 to the Braintree Logan Express Lot, a distance of 4.2 miles; and construct a two-lane bus roadway from Braintree Logan Express Lot to existing HOV zipper lane on the Southeast Expressway, a distance of 1.6 miles). Infrastructure improvements also include constructing, reconstructing, or widening 20 bridges and reconstructing 11 highway interchanges. This alternative would include six new rapid bus stations (Downtown Taunton, Galleria Station, King's Highway, Whale's Tooth, Freetown and Fall River Depot) and major expansion of the bus terminal at South Station. The expansion of South Station has been studied separately as part of a larger private development and would be constructed prior to being used by the Rapid Bus Alternative.

RAPID BUS SERVICE PLAN

In supporting the South Coast Rail DEIR, CTPS has examined two service-operating plans for the Rapid Bus Alternative. The first was presented in the February, 2008 Environmental Notification form and the second was included in the September 2009 Technical Report. The headways of 15 minutes in the peak and 1 hour in the off-peaks were the same in both scenarios. The stations, fares, and parking availability were the same as well for both scenarios. The only difference between these two service plans was the run-time assumption. In the first operating plan, the project team assumed free flow speeds on the roadways, which produced very fast run-times. In the second operating plan, CTPS ran the 2030 travel demand model and identified the level of congestion in the corridor, including the Zipper Lane. The alternative is shown in Figure 2.

Table 3 shows, the run times increased from New Bedford and from Fall River to South Station based on the change from free flow speeds to 2030 congested speeds. Run times increased from New Bedford as an example, from 68 to 103 minutes, a 35-minute increase. The increase from Fall River was slightly less, going from 61.5 to 91 minutes, a 29-minute increase. As Table 2 showed, the Zipper Lane in the free flow condition took only 6 minutes to traverse, but under congested conditions in 2030, the travel time is expected to increase to 19 minutes. A comparison of the scenarios shows a 35-minute increase in overall travel time, of which 13 minutes is due to the Zipper Lane and 22 minutes is due to congestion occurring in either in the mixed traffic ROW south of I-495 or north of the Zipper Lane in Boston. It should be noted that as the number of vehicles that are able to use the zipper lane decreases, the travel time to South Station from the end of the zipper lane increases. This increase in delay is due to the merge and congestion with the general-purpose lane between the northern end of the Zipper Lane and South Station. The assumption of free flow speeds in the February 2009 scenario represents the best possible travel time the Zipper Lane could ever achieve, while the 2030 congested speeds in the September 2009 scenario used a two-plus occupancy rule on the HOV lane, which represents one of the worst-case scenarios for travel time assumptions in the Zipper Lane

TABLE 3:
Rapid Bus Travel Time Estimates

South Coast Rail Rapid Bus Alternative		2030 Horizon Year AM Peak Hr Northbound HOV Lane Travel Time Estimates			
Zipper Lane Operating Policy		**2+**	**2+**	**3+ (no permit)**	**Bus Only**
South Coast Rail Assumptions		**Rapid Bus**	**Rapid Bus**	**Rapid Bus**	**Rapid Bus**
Traffic Assumption		**Free flow**	**Congested**	**Congested**	**Congested**
Travel Time from New Bedford		**68.0**	**103.0**	**100.5**	**92.0**
	Distance	55	56	56.4	56.4
	Speed	49	33	33.7	36.8
Terminal times		**5.0**	**5.0**	**5.0**	**5.0**
Travel Time from End of Zipper Lane to S.Station		**4.0**	**9.5**	**10.0**	**10.5**
	Distance	2.5	2.5	2.5	2.5
	Speed	38	16	15	14
Travel Time from Start to End of Zipper Lane		**6.0**	**19.0**	**16.0**	**7.0**
	Distance	5.5	5.5	5.5	5.5
	Speed	55	17	21	47
Travel Time for Rte 24 from I-495 to Zipper Lane		**22.0**	**22.0**	**22.0**	**22.0**
	Distance	22	22	22	22
	Speed	60	60	60	60
Travel Time from New Bedford to I-495 via Rte 24		**31.0**	**47.5**	**47.5**	**47.5**
	Distance	25	25	25	25
	Speed	48	32	32	32

RAPID BUS DEMAND

The two service plans described above produce results that can be broken down into two performance measures that can help compare them, daily boarding and auto diversions. Table 4 shows that the first scenario with the best run times, assumed free flow speeds on the Zipper Lane as well as local roads. This resulted in the greatest number of 2030 daily boardings on that mode with 6,800, 3,500 of which were auto diversions. As the service plans were refined, this scenario was considered unrealistic so the travel times were re-examined based on the horizon year 2030 mix traffic congestion levels and the Zipper Lane operation with a 2+ HOV policy rule and this resulted in scenario 4. Scenario 4 assumed the worst travel times on the Zipper lane and this resulted in the lowest number of 2030 daily boardings of the 4 scenarios considered with 4,200, of which only 1,700 came from auto diversions.

Scenarios 2 and 3 in Table 4 show the possible daily boardings and auto diversions that may be achieved with different operating plans on the Zipper Lane. The Zipper Lane travel times range from 6 minutes in Scenario 1 to 19 minutes in Scenario 4 depending on the Zipper Lane policy rule being considered. Scenario 2, the bus only rule, could generate 5,200 daily boardings on the Rapid Bus service, of which 2,300 are auto diversions. This is an increase of 1,000 daily boardings more than Scenario 4 and 600 more auto diversions, Scenario 3, the 3-plus rule, could generate 200 additional daily boardings, of which 100 are auto diversions.

TABLE 4:
Rapid Bus Alternative Travel Times and Demand Estimates
Relative to the No-build

Scenario	AM Peak Run Time from New Bedford	Zipper Lane Policy	Zipper Lane Time	Non-Zipper Lane Travel Times	2030 Daily Rapid Bus Boardings	2030 Auto Diversions
1. Rapid Bus (Feb-09)	**68.0**	**Free flow**	**6**	**62**	**6,800**	**3,500**
2. Rapid Bus (Dec-09)	92.0	Bus Only	7	85	5,200	2,300
3. Rapid Bus (Dec-09)	100.5	3 plus	16	84	4,400	1,800
4. Rapid Bus (Sep-09)	**103.0**	**2 plus**	**19**	**84**	**4,200**	**1,700**

1) The scenarios in bold were examined previously using the travel demand model.
2) The ones unbolded were interpolated from the previous Rapid Bus analysis based on changes in Zipper Lane travel times.
3) Representative travel times are shown for trips from New Bedford to South Station in the AM peak period.

By ways of comparison, Table 5 presents the travel times and demand estimates of the rail alternatives relative to the No-Build.

TABLE 5:
Travel Times and Demand Estimates of the Rail Alternatives Relative to the No-build

Alternative	AM Peak Run Time from New Bedford	2030 Daily Boardings	2030 Auto Diversions
Attleboro Electric	75	9,360	5,300
Attleboro Diesel	84	8,040	4,500
Stoughton Electric	76	9,580	5,900
Stoughton Diesel	85	8,140	5,000
Whittenton Electric	87	9,640	5,500
Whittenton Diesel	96	8,040	4,600

The resulting changes in the performance measures described above are due to changes in the operating polices on the Zipper Lane, but do not necessarily change the relative performance of this alternative when compared to the other South Coast Rail alternatives. There are five major factors contributing to why the rapid bus alternatives produces lower performance measures, than the commuter rail alternatives. These factors are:

- Run times are longer to South Station, with the exception of bus only versus Whittenton Diesel, in which the rail alternative is three minutes slower than the Rapid Bus Alternative.
- The commuter rail alternatives serve several more stations
- Lack of connectivity with the Orange Line Station
- Transfer times between the rapid bus and the rapid transit lines are a little longer than with the commuter rail lines
- Fewer new stations being provided in areas of proposed growth
- Lack of intra-regional connectivity / no intermediate stations

Together these factors produce between 52% and 65% of the daily boardings and 35% to 50% of the auto diversions that, for instance, the Stoughton Diesel rail alternatives produce.

CONCLUSION

The Rapid Bus Alternative would be affected by highway congestion levels, which impacts the alternative's travel time and estimated ridership, regardless of changes to the zipper lane policy. This memo summaries the projected Rapid Bus travel time and ridership in four zipper lane policy scenarios: 1) the zipper lane under existing operation with free-flow condition, a scenario that cannot be achieved, 2) a bus only operation, 3) a three plus operation, and 4) a two plus operation. The relative demand for each one of these scenarios is shown in Figure 3.

The Rapid Bus Alternative performs optimally in the hypothetical free-flow travel condition, which would require no peak period congestion. This condition cannot reasonably be anticipated. The next best performing scenario limits HOV lane access to buses only. This enables an AM peak travel time estimate of 92 minutes and 5,200 daily boardings. This scenario outperforms the Rapid Bus Alternative presented in the Alternatives Description Technical Report (September 2009) with an 11% decrease in travel time and a 19% increase in riders.

This analysis did not model the effects of how the change in zipper lane policy would impact the congestion on the general-purpose lanes. However, it should be noted that with any reduction in zipper lane access from the current two plus policy, general-purpose lane congestion is expected to increase. This congestion would result in decreased mobility for drivers and an increased in air pollutants generated in the corridor. As the general-purpose lane traffic congestion increases, more traffic spills over to competing roadways such as Morrissey Blvd, which experience more congestion as well. Regional vehicle miles travelled (VMT) would also increase as commuters lose the incentive to carpool.

Changing the HOV occupancy to bus only cannot be reasonably anticipated for several reasons, including:

- The negative impact on congestion levels in the general purpose lanes;
- The negative impact on air quality as a result of the increased congestion; and
- The Highway Division's past experience with "empty lane syndrome" that exerts public pressure to return the lane to car commuters.

Even if these obstacles and issues could be addresses, the best case Rapid Bus scenario only produces half the auto diversions of the best-performing rail alternatives.

The current and reasonably anticipated Zipper Lane operation permits vehicles with two or more passengers (two plus). This is the operation that was presented in the September 2009 Technical Report. The estimated two plus operation is comparable to the estimated 3+ operation; its AM peak travel time is 2.5 minutes longer (103.0), it attracts 200 fewer boardings (4,200), and it diverts 100 fewer auto users to passenger transportation (1,700).

As a point of comparison, the Rapid Bus Alternative attracts approximately 55% fewer riders than the worst-performing rail alternative. The Rapid Bus Alternative under this scenario also diverts approximately 95% fewer drivers to passenger transportation than the worst-performing rail alternative.

FIGURE 3:
Demand Estimates by Alternative and Travel Time to South Station