

I-95 Interchange 74 Concept Design Report

Prepared for:

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June 27, 2017

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Executive Summary Report

This report describes proposed improvements that will address safety/traffic operational concerns on I-95 at Interchange 74 and between Interchanges 74 and 75 and will address vehicular safety/traffic operational concerns on Route 161 along with bicyclist and pedestrian safety and access concerns. In addition, this report includes an evaluation of three improvement alternatives that will address safety/traffic operational concerns on Route 161 at the northbound access ramps. The results of this Concept Design Report will be used to assist in the alternative selection as part of the NEPA/CEPA process.



Project Area (A larger scale plan is included in [Appendix 00 on page 60](#)).

Project Purpose and Need - The purpose of this project is to improve vehicular safety on I-95 at Interchange 74 and address traffic operational concerns between Interchanges 74 and 75. In addition, these improvements will address traffic operational concerns and improve safety for all roadway users (motorists, pedestrians and bicyclists) on Route 161 near interchange ramps.

Current deficiencies include substandard geometry on the I-95 freeway, substandard geometric features on Interchange 74 access ramps, poor condition and features of Bridge No. 00250 (I-95 over Route 161) and a lack of auxiliary turn lanes/shoulders on Route 161, which restricts bicycle and pedestrian access.

Development of Alternatives - As a result of meeting on August 2nd 2016 with CTDOT representatives, the three improvement alternatives (2, 6C and 8) and a no-build alternative were selected for further consideration.

All improvement alternatives include I-95 improvements that provide a 70 MPH Design Speed, adequate acceleration and deceleration lengths, relocation of the southbound access ramps to a frontage road, auxiliary lanes between Interchanges 74 & 75 and a widened cross-section to accommodate a future 6-lane expressway. In addition, all improvement alternatives widen Route 161 to provide auxiliary left-turn lanes, 5-foot shoulders and sidewalks to address safety, traffic operations and pedestrian/cyclist safety and accessibility.

Design challenges to provide safe and efficient traffic operations on Route 161 at the northbound access ramps for Interchange 74 include:

- Providing access to I-95 North from Route 161 South.
- Addressing capacity concerns on Route 161 at King Arthur Drive/NB exit ramp.
- Addressing crash patterns on Route 161.

To assess the effectiveness of the alternatives, criteria such as: safety; traffic operations; pedestrian/cyclist safety & mobility; environmental & property impacts and construction costs, was established. Each alternative was assessed and graded 1 (poor or higher impacts/costs) to 5 (well or lower impacts/costs).

A brief overview of the alternatives are as follows:

- Alternative 1 No-build - The Developer of the Gateway Commons Development is required to make roadway modifications to Interchange 74 access ramps to accommodate a significant development adjacent to I-95. As a result, the “no-build” alternative has incorporated these roadway modifications as noted in the report.
- Alternative 2 - This alternative eliminates left-turns for Route 161 southbound vehicles destined for NB I-95 and significantly reduces left-turn volumes at the King Arthur Drive intersection. A flyover ramp would cross over the southbound exit ramp, the I-95 freeway and Route 161 then merge with the northbound entrance ramp in the vicinity of the existing commuter lots then merge again to one lane prior to forming an auxiliary lane between Interchanges 74 and 75.
- Alternative 6C - Route 161 SB vehicles destined for I-95 NB would be accommodated by a “loop” type entrance ramp south of Bridge No. 00250. The section of Route 161 south of the expressway would be realigned approximately 15 feet to the east and the northbound exit ramp would be relocated approximately 200 feet further south along Route 161 to allow for the 114’- radius loop ramp. The loop ramp would traverse over a widened Bridge No. 00250, merge with vehicles on the slip ramp from Route 161 NB prior to forming an auxiliary lane between Interchanges 74 and 75.
- Alternative 8 – Although similar to Alternative 6C, the northbound exit ramp was realigned to terminate approximately 500 feet to the south of its current location on Route 161 to enlarge the radius of the “loop” ramp to 170 feet. This realignment of the NB exit ramp resulted in two “T” type intersections with improved level of service.

Comparison of Alternatives - The following chart is a comparison of all alternatives regarding the effectiveness of addressing the evaluation criteria noted from 1 (poor or higher impacts/costs) to 5 (well or lower impacts/costs).

Criteria		No Build	Alt 2	Alt 6C	Alt 8
Safety	I-95	N/A	5	5	5
	Route 161	3	4	4	5
Design Criteria		2	4	2	4
Traffic operations	I-95	N/A	4	4	4
	Route 161	2	3	3	4
Pedestrian/Cyclist safety and mobility		1	4	4	4
Environmental Impacts	I-95	N/A	2	2	2
	Route 161	5	4	4	4
Right of Way Impacts		N/A	4	2	3
Construction Costs		N/A	2	3	3
Other Considerations: potential development; aesthetics; mitigation etc.		N/A	2	3	4

Meeting with Town Officials – On September 14th, a meeting with representatives from the Town of East Lyme, CTDOT and HW Lochner was held to update town officials with interchange alternatives that are currently under consideration. Town representatives noted their concern with Alternative 2 due to aesthetics and Alternative 6C due to the realignment of King Arthur Drive and expressed their support for Alternative 8.

Concerns: As part of this study, potential impacts resulting from the improvements were studied at locations adjacent to the project limits. The intersection of Route 1 and Route 161 will operate at a LOS of “E” in the 2020 PM peak period and at a “F” in the 2045 PM peak period. Although traffic operations and the LOS at this intersection are not affected by the various interchange alternatives, there will be significant traffic queues on all approaches to this intersection, especially on the Route 1 approaches. *NB traffic queues will impact traffic operations on Route 161 at the frontage road soon after the probable constuction completion date of late 2023.*

In addition, CTDOT provided future peak turning counts for traffic analyses at Interchange 74, assuming the southbound entrance ramp at Interchange 75 would be closed. The possible closure of the southbound entrance ramp at Interchange 75 as part of a future Interchange 75 and 76 (I95/I-395/Route1) improvement project would increase the volume at the Route 1/161 intersection thereby creating significant engineering challenges to address the delay and queue lengths at this intersection.

Recommendation:

After review of the three alternatives, Alternative 8 has been recommended as the preferred alternative, since this alternative addresses safety and traffic operations more comprehensively, improves access to adjacent businesses as compared to the other alternatives, maintains the existing character of the area, and has with less disruption to the adjacent properties in the vicinity of King Arthur Drive.

Project Purpose and Need

The purpose of this project is to improve vehicular safety on I-95 at Interchange 74 and address traffic operational concerns between Interchanges 74 and 75. In addition, these improvements will address traffic operational concerns and improve safety for all roadway users (motorists, pedestrians and bicyclists) on Route 161 in the vicinity of interchange ramps.

Current deficiencies on I-95 at Interchange 74 include insufficient acceleration and deceleration lengths on both north and southbound access ramps, substandard ramp geometry, congestion and delay on both exit ramps. Both northbound and southbound access ramps were on the 2012-2014 Surveillance List of Suggested Safety Sites (SLOSSS) with Sequence Nos. 911 and 1093, respectively. In addition, safety and traffic operational concerns on I-95 are further exacerbated by the minimal distance between Interchanges 74 and 75.

Based on a 2015 inspection, Bridge No. 00250 (I-95 over Route 161) has a Sufficiency Rating of 59; the deck, superstructure and substructure were rated as a 4, 5 and 5, respectively. Deck geometry and under-clearances (vertical and horizontal) were rated as 4 and 3, respectively. The bridge span length limits the width of the roadway section of Route 161 to four 10-foot travel lanes, no left-turn lanes, no usable shoulder for bicycle access and restricts pedestrian use to one four-foot sidewalk.

Current deficiencies on Route 161 in the vicinity of the access ramps include:

- Severe congestion during peak periods,
- Lack of auxiliary turn lanes at ramp entrances, side streets and high volume commercial driveways
 - South of King Arthur Drive, the section of Route 161 from Industrial Park Road to Starbucks is on the CTDOT SLOSSS List at Sequence No. 1378.
- Poor pedestrian and bicyclist access, especially in the vicinity of Bridge No. 00250 (I-95 over Route 161).

Existing Transportation Conditions

I-95 Freeway

This section of Interstate 95 has a design speed of 60 MPH. The 2014 average daily traffic (ADT) on I-95 varies from 67,400 to 72,300 vehicles per day (VPD). This section of freeway frequently suffers from congestion during AM, PM and weekend peak periods.

Its cross-section includes two 12-foot travel lanes with 10-foot right-side shoulders in each direction. The width of the left-side shoulder varies from 2 to 6 feet in the southbound direction and 3.5 to 13 feet in the northbound direction. The median width varies from 12 feet to 20 feet and has a concrete median barrier throughout the project limits.

There are minimal distances between Interchanges 74, 75 (I-95 under Route 1) and 76 (I-95 at I-395).

Regarding Interchanges 74 and 75, the distance between the gores of the entrance and exit ramps is approximately 2,700 feet in both directions. Considering the proposed improvements at Interchange 74 will extend the acceleration and deceleration distances in both directions, the distance between these gore areas will be significantly reduced.

The existing distances between the gore areas on Interchanges 73 and 74 in the northbound and southbound directions are 5,070 and 7,450 feet, respectively.

I-95 - Safety concerns

Both northbound and southbound access ramps were on the 2012-2014 Surveillance List of Suggested Safety Sites (SLOSS) with Sequence Nos. 911 and 1093, respectively ([Appendix 08 - page 222](#)).

At Interchange 74, the northbound and southbound exit ramps have insufficient deceleration distances of 100 and 400 feet, respectively. Since traffic queues frequently extend to both gore areas during the PM peak periods, the deceleration distance should be 615 feet at both exit ramps. During off peak periods, the deceleration distances should be 390 feet in the northbound direction and 550 feet in the southbound direction, based on the first governing geometric control.

Due to the 135' radius of the southbound exit ramp, the posted speed limit is 20 MPH.

Based on the design speed of the entrance curves, both northbound and southbound entrance ramps should have acceleration distance of 1,230 feet. However, the existing acceleration distances for the northbound and southbound ramps are 1,150 feet and 160 feet, respectively.

Insufficient acceleration and deceleration distances may have been a factor in the number of crashes at Interchange 74. Crash Data (M.P. 85.40 to 88.40) is included in [Appendix 02 - page 64](#) and [Appendix 03 - page 145](#).

I-95 Structural Condition Review

Bridge No. 00250, I-95 over Route 161

Originally built in 1948 and then widened to the south in 1958 (to separate the northbound lanes), Bridge No. 00250 has a single 97-foot span consisting of steel multi-girders with a composite cast-in-place reinforced concrete deck supported by reinforced concrete abutments. The overall bridge length is 103 feet with out-to-out deck width of 93'-8". The bridge has an AASHTO HS-20 Inventory Rating of 57.5 tons based on a calculation performed in 2000, although this capacity is well in excess of the 36 ton minimum. The bridge is skewed to I-95 by approximately 57 degrees, and its abutments run roughly parallel to Route 161.

Based on a September 9, 2015 inspection, Bridge No. 00250 has a Sufficiency Rating of 59.0. The deck, superstructure and substructure were rated as a 4, 5 and 5, respectively. Deck geometry and under-clearances (vertical and horizontal) were rated as 4 and 3, respectively. The vertical clearance is 14'-2" at the southbound curblin, and is posted at

a 13'-11" clearance for the right lane. Due to the bridge span length and skew angle, the cross-section of Route 161 is restricted to four 10-foot travel lanes, 2-foot shoulders and a 4.5-foot concrete sidewalk (west side only), which restricts pedestrian and bicyclist access.

The reinforced concrete deck is in poor condition with map cracking, efflorescence and isolated spalls with exposed rebar resulting in a total calculated deterioration on the bottom of 4.4%. The top of the deck was not observed during recent inspections due to the overlay; however, the pavement is noted to be raveling and cracking. Thirty eight percent of chloride samples from the deck exceeded threshold values, which resulted in the lowering of the deck condition from 6 (satisfactory) to 4 (poor).

The original metal railings and concrete curb were supplemented by metal beam guiderail and then more recently by the placement of pinned concrete barrier. The original raised concrete median has been removed and pinned concrete barrier has been placed along the structure. By drilling through the structural deck to install the pinned barrier, a significant number of pop-outs were created.

The welded steel plate girders have a condition rating of 5 (fair), with large areas of peeling paint, light surface rust and section loss at two girders. Up to 19% section loss is noted in a non-critical area and up to 3% section loss was observed in a critical area. Bearings are lightly deteriorated, with some past observations that they were locked up and could not properly function.

The reinforced concrete abutments and wingwalls exhibit vertical and map cracking throughout with isolated heavy efflorescence. There are hollow areas on the north abutment and concrete pedestals, but no undermining noted.

Bridge No. 02585, I-95 over Pattagansett River

Initially constructed in 1948 then extended in 1956, this cast-in-place 10' wide by 8' high reinforced concrete box culvert received a 74.6 Sufficiency Rating with a Structural Evaluation of 7 as a result of its most recent inspection on June 3, 2015.

A hydrologic study and hydraulic analysis will be necessary to confirm the adequacy of this structure's opening. The inspection report notes water bands on the concrete walls at about 30 inches above the invert.

The 2015 inspection notes only minor undermining and scour and no major structural deficiencies.

Bridge No. 00251, I-95 over Latimer Brook

This cast-in-place reinforced concrete box culvert has two, 12' wide by 10' high, barrels and was constructed in 1948. The structure received a 74.6 Sufficiency Rating with a Structural Evaluation of 6 as a result of its most recent inspection on June 3, 2015.

A hydrologic study and hydraulic analysis will be necessary to determine hydraulic adequacy of this structure. FEMA flood mapping indicates that there is no overtopping of this structure during the 100 or 500 year flood event. There is a small spillway just upstream of the structure.

There is significant scour and erosion at the outlet, and some scour and erosion at the inlet. The western barrel has a timber baffle system installed into the floor of the culvert to facilitate fish passage. The eastern barrel has a timber installed at its inlet to ensure that the western barrel is the low flow passage. The inlet is at a significant skew to the channel that was introduced when the culvert was constructed and the brook was diverted. The banks of the channel at the outlet continue to be washed out by the heavy energy of the flow and riprap has been placed along wingwalls and in front of the cutoff wall.

There is fish ladder just upstream of the culvert to allow passage around the spillway, which is maintained and operated by the Connecticut DEEP, Inland Fisheries Division.

Route 161- Capacity & Safety Concerns

Route 161 (Flanders Road) is functionally classified as an urban minor arterial roadway. Within the project limits, Route 161 is generally tangent with a uniform minimal vertical grade of approximately .5%. Within the project area, this section of Route 161 has four travel lanes with no auxiliary turn lanes at the freeway ramp termini or commercial driveways. Traffic volumes on Route 161 vary from 16,500 vehicles per day (VPD) just north of the southbound ramps to 25,400 VPD just north of King Arthur Drive.

Topography on the westerly side of Route 161 is fairly flat and uniform. On the easterly side of Route 161, the topography is elevated, which creates significant grades on King Arthur Drive (8.75%) and commercial driveways (up to 12%).

The terminus of the northbound exit ramp opposes King Arthur Drive on Route 161 and is signal controlled. The exit ramp has a 2-lane approach that includes a combined left/thru lane and an exclusive right-turn lane. King Arthur Drive has a one-lane approach to Route 161.

The northbound entrance ramp is located approximately 300 feet north of the exit ramp terminus. Due to the 57 degree skew angle between the freeway and Route 161, the



configuration of northbound entrance ramp results in southbound drivers making a much slower “U” type turn to enter the entrance ramp. Those southbound left-turning vehicles that are awaiting for a gap in opposing traffic, store in the inner thru-lane creating a de facto left-turn lane, which restricts southbound thru vehicles to one lane.

The southbound ramps intersect Route 161 to form a “T” type configuration approximately 80 feet north of I-95 overpass. The exit ramp is side-street stop controlled. As with the northbound ramp, the northbound left-turning vehicles that are waiting for a gap in opposing traffic to enter the southbound entrance ramp, store in the inner thru-lane, which creates a de facto left-turn lane restricting northbound thru vehicles to one lane.



At the southbound entrance ramp, the proximity of the bi-directional commercial driveway for Pools Etc. at 280 Flanders Road creates additional conflict points and raises safety concerns. In addition, it creates poor delineation between the ramp and the driveway. The guide sign for the entrance

ramp is located north of the driveway, which further causes driver confusion. The width of the entrance ramp when coupled with the width of the commercial driveway, results in an excessively long pedestrian crossing and an extended exposure to vehicles.

Route 161 Crash Data - Based on the most recent crash data (2012 – 2014), there were 108 crashes with 16 injury crashes reported on Route 161 from Industrial Park Road to Route 1. There was one crash that involved a pedestrian in the vicinity of the Mobil Gas Station. The section of Route 161 from Burger King to Starbucks is on the CTDOT SLOSS List at Sequence No. 1378 ([Appendix 08 - page 222](#)). The most prevalent crash types were “Rear-end” (32%) followed by “Turning-intersecting Paths” (30%), “Sideswipe – Same Direction” (18%) and “Turning-opposite Direction” (12%). Predominate crash locations were at commercial driveways (48%) followed by intersecting public roadways (19%). The most cited contributing factors were “Failed to Grant Right of Way” (38%), “Following Too Closely” (29%) and “Improper Lane Change (16%). The crash data is attached in ([Appendix 06 - page 181](#) and [Appendix 07 - page 210](#)).

Route 161 Crash Analysis - Considering the crash data and traffic volumes, it appears that a signification proportion of crashes involved left-turning vehicles either exiting from or entering onto Route 161. Left-turning vehicles on Route 161 that are waiting for a gap in the opposing two lanes of traffic, creates a de facto left-turn lane at busy intersections or commercial driveways, which results in the high percentage of “turning-type” and “sideswipe type” crashes. Drivers trying to make a left-turn onto Route 161 have difficulty finding an adequate gap to cross two lanes of traffic from the left and one lane of traffic from the right. A crash diagram is attached in ([Appendix 1 - page 62](#)).

Pedestrian Access – Pedestrian access is limited on this section of Route 161. Under Bridge No.00250, there is 4-foot concrete sidewalk on the west side of Route 161. As redevelopment occurred on Route 161, developers have provided concrete sidewalks along their frontage. As a result, there are sections of 4' to 5' wide concrete sidewalks along the frontage of Stop & Shop Plaza, Mobil Gas Station and Starbucks but not elsewhere within the project limits.

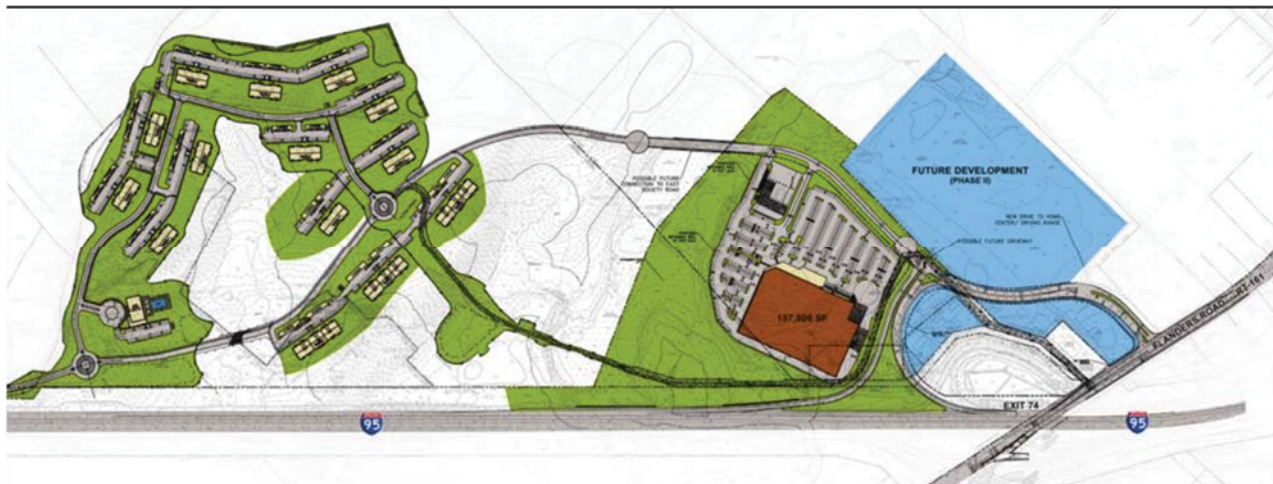
There is one cross-walk within the project limits, which is located at the signal-controlled Route 161/King Arthur Drive intersection. The nearest crosswalk to the south is at the signal-controlled intersection of Industrial Park Road and to the north is at the signal-controlled intersection of Route 1.

Bicycle Access – Considering the existing shoulder width varies from 0 to 2 feet and traffic volumes vary from 16,500 to 25,400 vehicles per day, bicycle access is rated as poor on the subject section of Route 161. However, it should be noted that this assessment is in conflict with the 2009 State of Connecticut Bicycle Map, which rates this section of Route 161 as most suitable for bicycling.

Public Transportation –

- **Bus Service** – Fixed route service is provided Monday through Saturday by Southeast Area Transit District (SEAT) with stops at the Park & Ride facility noted below and at the Stop & Shop Plaza.
- **Park & Ride Facilities** – There are a Park & Ride facility located on a state-owned maintenance road off of King Arthur Drive.

The Gateway Development



Gateway Commons Development

The Simon Konover Development Corporation and KGI Properties are developing Gateway Commons, a mixed use community, on approximately 40 acres adjacent to I-95 and Route 161 to the north and west, respectively.

The State of Connecticut, Office of State Traffic Authority(OSTA) has approved roadway modifications under Phase 1 of this development (OSTA# 044-1505-01). It is anticipated that Phase 1 roadway modifications will be completed in 2017.

Existing Environmental Conditions

The following data has been compiled from the Connecticut Environmental Conditions Online site in an effort to identify environmental resources that are within the project area and may be impacted by potential improvement alternatives. The following data represent some of the more significant environmental concerns within the project area:

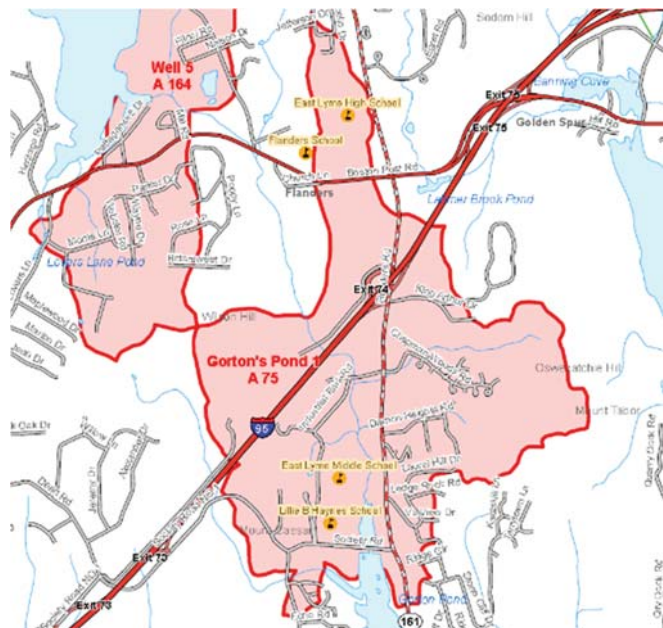
- Aquifer Protection Areas
- Flood Zone Areas
- Inland Wetland Areas

Upon completion of the Concept Design Phase, an environmental review of the proposed improvements will be conducted to fully comply with the NEPA and CEPA processes.

Aquifer Protection Areas

The shaded area represents a Level A Aquifer Protection Area. The Aquifer Protection Program is administered by the Connecticut Department of Energy & Environmental Protection (DEEP) and provides primary protection for high-yield public water supply well fields. The intent of the program is to protect water supplies by identifying land areas that contribute ground water to the water supply well fields.

Most of the project area is within the Aquifer Protection Area.



Aquifer Protection Areas

Flood Zone Areas

FEMA flood data was utilized to show 100 year (light blue area) and 500 flood (red area) zones, respectively.

The two areas of concern are along the Pattagansett River and Latimer Brook. After a hydrologic study of both watersheds is completed, the design for the I-95 widening will incorporate features to avoid impacts to the flood plane elevation in these areas.

A Flood Plain Management permit will be required in all of the proposed improvement alternatives.



FEMA Flood Zone at Pattagansett River



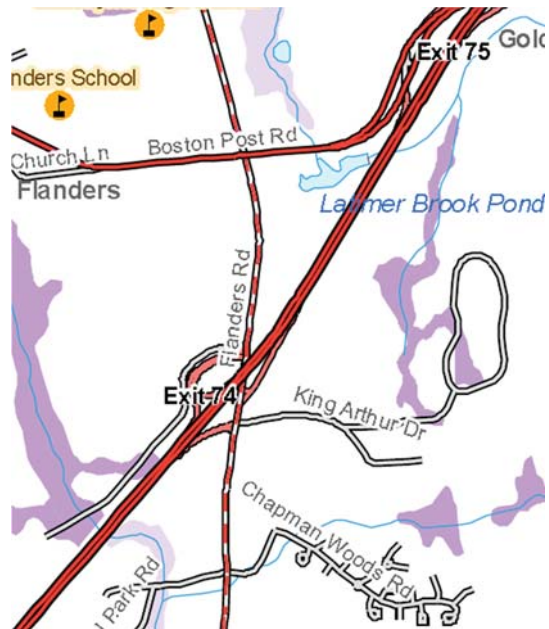
FEMA Flood Zone at Latimer Brook

Inland Wetland Soil Areas

This expanded section of map is a general guide in identifying the general location of areas that may be designated as Inland Wetland Soils within the project limits as defined in the Inland Wetlands and Watercourses Act, Connecticut General Statutes. The minimum size delineation is approximately 3 acres.

As Inland Wetlands are determined by soil type, an on-site examination by a certified Soil Scientist will be necessary to confirm the presence or absence of soils designated as Inland Wetlands.

An Inland Wetland permit will likely be required with this project regardless of the alternative selected.



Inland Wetland Soil Areas

Fisheries



Fishway located 80' upstream of inlet

Outfall of Bridge No. 00251

CT. DEEP, Inland Fisheries Division has designated Latimer Brook as a sea-run trout stream. Due to an upstream barrier dam (upstream from Bridge No. 00251), a fishway was constructed in 1960 to allow passage of trout and salmon and has been updated several times to allow for passage of other fish stocks. The Latimer Brook Fishway is owned, operated and maintained by the Diadromous Fisheries Program, which is a unit of the Inland Fisheries Division and is located at the Maring Fisheries Headquarters in Old Lyme.

Future Traffic Demand Considerations

CTDOT has determined that a 2045 horizon year for traffic growth will be utilized to ensure that interchange improvements on I-95 at Interchange 74 will provide long-term benefits and will address future needs.

CTDOT Office of Planning supplied both 2020 and 2045 traffic projections including both partial and full build for the Gateway Development (Appendices 76 thru 81 – pages 725 thru 735) that were utilized in analyzing capacity and queue lengths at all intersections within the project limits along with the two adjacent intersections to the north and the south of the project limits for all 3 improvement alternatives including the no-build alternative. In addition, these projected volumes were utilized to analyze the level of service of the merge/diverge area between Interchanges 74 and 75 in both directions.

CTDOT Office of Planning incorporated future full-build traffic volumes from The Gateway Development into both 2020 and 2045 traffic projections. Presently, the Developer has received approval for a partial build of his development from OSTA.

CTDOT has initiated a project that has studied interchange improvements at Interchange 76 on I-95 at I-395. Some interchange alternatives in this study addressed the inadequate distance between Interchange 75 and 76 by the elimination of access to I-95 South and from I-95 North at Interchange 75.

As a result, CTDOT Office of Planning supplied both 2020 and 2045 traffic projections that were based on Interchange 75 fully open **and** Interchange 75 with no access for SB entering and NB exit vehicles. However, for this report, the traffic analyses were based on Interchange 75 maintaining its existing configuration.

Design Considerations

Design Constraints

The following factors and constraints have been considered and have found to reduce flexibility in the development of alternatives:

- I-95 and Route 161 intersection skew angle
- Profile grade of King Arthur Drive (8.75%)
- The Gateway Development and access roads
- Location of the Eversource substation

Alternative Evaluation Criteria

The following criteria was used to assess the effectiveness of the alternatives:

- Safety – effectiveness of addressing pattern crashes on I-95 & Route 161
- Design criteria – CTDOT Highway Design Manual, 2003 – adherence to standards
- Traffic capacity/operational improvements – Methodology
 - I-95 – Highway Capacity Manual (HCM 2010)
 - Route 161 – Synchro/SimTraffic 9 Package
 - Follows analysis methodologies outlined in the HCM 2010
- Pedestrian and bicyclist mobility/safety accommodations
- Environmental impacts
- Right of Way impacts
- Construction costs
- Other considerations (examples)
 - Mitigation potential
 - Wetland, Water detention or commuter parking
 - Aesthetic considerations
 - Future maintenance costs
 - Future development potential

Development of Alternatives

As noted earlier in this report, the improvement alternatives will address the following concerns:

- Safety and capacity issues on I-95 at Interchange 74 and its access ramps
- Safety and capacity issues between Interchanges 74 and 75
- Safety, capacity and traffic operational issues on Route 161 in coordination with OSTA and the Gateway Development, which is located adjacent to the southbound access ramps.

Initially, ten interchange alternatives were developed to address these concerns. As a result of meeting on August 2nd 2016 with CTDOT representatives, the number of alternatives were reduced to three with a no-build alternative. Two of the alternatives were not considered feasible due the skew angle between the I-95 freeway and Route 161. The other alternatives were not advanced since they included a very steep section (8.75%) of a municipally owned roadway as part of the interchange improvements.

The alternatives that have been selected for further consideration are:

- **Alternative 1 - No build**, which maintains existing conditions except for the modifications to Route 161 and the southbound ramps that were required for Phase 1 of the Gateway Development.
- **Alternative 2**, which includes a flyover ramp for southbound Route 161 vehicles to access I-95 northbound.
- **Alternative 6C**, which relocates the intersection of King Arthur Drive and the Northbound exit ramp terminus on Route 161 further south, to allow for a “loop” style entrance ramp for southbound Route 161 vehicles to access I-95 northbound.
- **Alternative 8**, which relocates the northbound exit ramp terminus on Route 161 further south to allow a larger radius “loop” style entrance ramp for southbound Route 161 vehicles to access I-95 northbound.

It should be noted that common design improvements included in Alternatives 2, 6C and 8 have been *italicized* and are fully described in Alternative 2. In the descriptions for Alternatives 6C and 8, the common design improvements are referred to Alternative 2, Common Improvements.

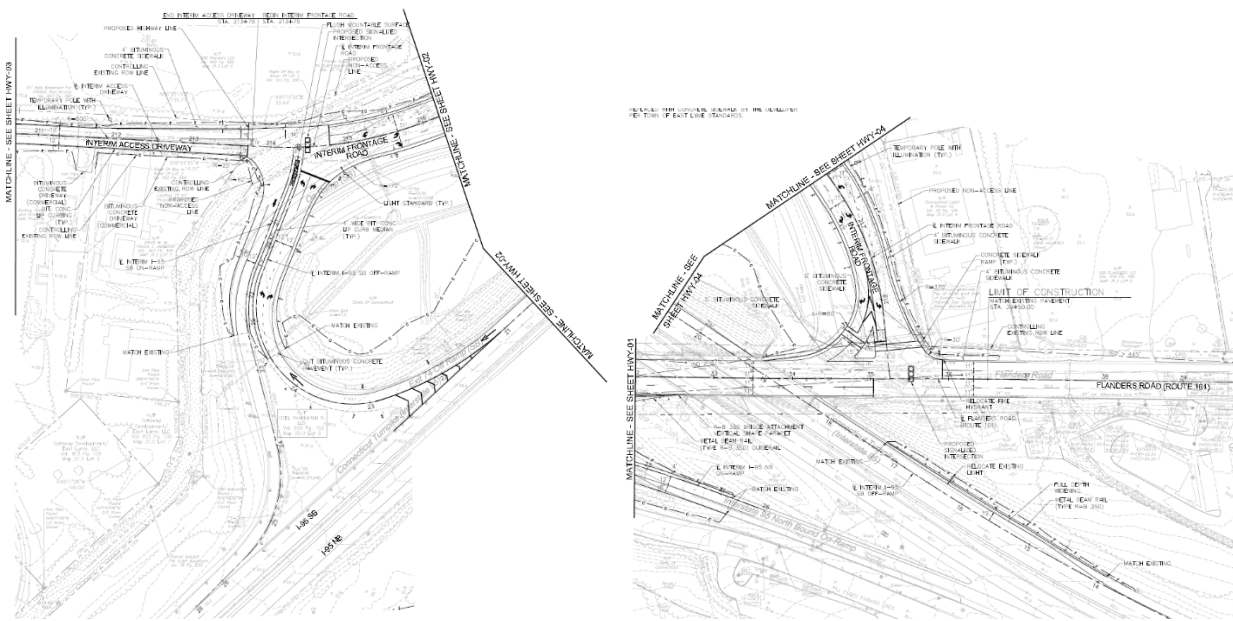
Alternative 1 - No Build

No Build alternatives typically represent the existing roadway network condition. However, OSTA has required that the Developer of the Gateway Commons Development make the roadway modifications (noted and illustrated below) prior to the opening of

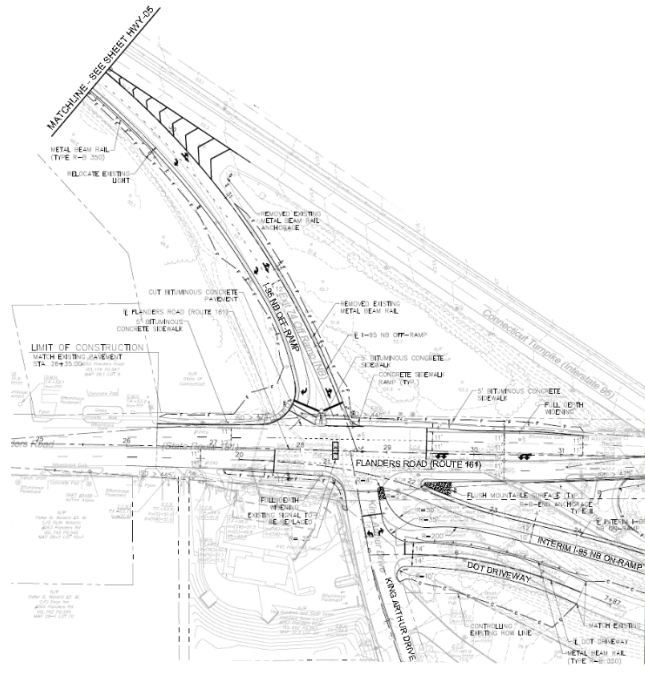
Phase 1 (Costco). Since these roadway modifications are expected to be completed in 2017, it was determined that the “no-build” alternative will incorporate the roadway modifications required by OSTA for Phase 1.

The Developer will modify the roadway network as follows:

- A temporary frontage road will be constructed in the vicinity of the commercial driveway for Pools Etc. at 280 Flanders Road.
- The existing southbound ramps will be realigned to terminate on the temporary frontage road to form a “T” type configuration. The driveway for Pools Etc. will also be realigned to connect to the frontage road.
- The intersections of Route 161/new frontage road and the realigned southbound ramps/new frontage road will be signal-controlled.
- The northbound entrance ramp will be relocated further south along Route 161 to form a 5-legged intersection with King Arthur Drive and the northbound exit ramp. Southbound Route 161 vehicles will be required to make a “U-turn” at the signal to access the NB entrance ramp. The existing two lane approach on the northbound exit ramp will be extended.
- Deceleration distances for both north and southbound exit ramps will be extended to address the additional queue length from the development’s generated traffic volumes.



Developer's Phase 1 Modifications at Southbound Ramps w New Frontage Road



Developer's Phase 1 Modifications at Northbound Ramps

The following chart is an assessment of how the “No-Build” alternative addresses the evaluation criteria noted from 1 (poor or higher impacts/costs) to 5 (well or lower impacts/costs).

Criteria		1	2	3	4	5
Safety	I-95	N/A				
	Route 161			X		
Design Criteria			X			
Traffic capacity/operations			X			
Pedestrian/Cyclist safety and mobility		X				
Environmental Impacts				X		
Right of Way Impacts		N/A				
Construction Costs		N/A				
Other Considerations: Commercial Development		N/A				

Alternative 2 – Flyover Ramp



Alternative 2 (A larger scale plan is included in [Appendix 09 – page 226](#)).

Flyover Ramp - This alternative eliminates left-turns for Route 161 southbound vehicles destined for NB I-95 and significantly reduces left-turn volumes at the King Arthur Drive intersection as compared to Phase 1 road modifications for the Gateway Commons Development.

The flyover ramp would have a maximum vertical grade of 5% and a horizontal radius of approximately 266 feet (approximately 29 MPH @ $e=6\%$). The flyover ramp would cross over the southbound exit ramp, the I-95 freeway and Route 161 then merge with the northbound entrance ramp in the vicinity of the existing commuter lots then merge again to one lane prior to forming an auxiliary lane between Interchanges 74 and 75.

Route 161 at Northbound Exit Ramp and King Arthur Drive – Route 161 would be widened to allow an exclusive southbound left-turn lane. Due to projected traffic volumes, the northbound exit ramp would be widened to provide a 3-lane approach, an exclusive left-turn lane, a combined left-turn and through lane and an exclusive right-turn lane. As a result, the exit ramp and King Arthur Drive would be split phased, which would require an additional signal phase and thereby increasing delay. Southbound traffic would be given an advance for SB left-turning vehicles.

This intersection would operate at a “C” LOS during the 2020 PM peak and “D” during the 2045 PM peak. It should be noted that during the 2045 PM Peak, the left and left/thru vehicles from the I-91 northbound exit ramp would operate at an “F” LOS and create longer queue lengths on the ramp.

Route 161 at the new frontage road – This intersection would be signal-controlled with two exclusive left-turn lanes northbound and an exclusive right-turn lane southbound on Route 161. On the frontage road approach to Route 161, there would be two left-turn and two right-turn lanes.

This intersection would operate at a “C” LOS during the 2020 and 2045 PM peak periods. It is anticipated that this intersection and the King Arthur Drive intersection would be

coordinated to maximize traffic flows and improve traffic operations. Traffic analyses are included in (Appendices 27 thru 34 pages 282 – 349 for partial build) and (Appendices 51 thru 58 pages 502 – 569 for full build).

With the exception of the “No Build” Alternative, all alternatives share the following improvements:

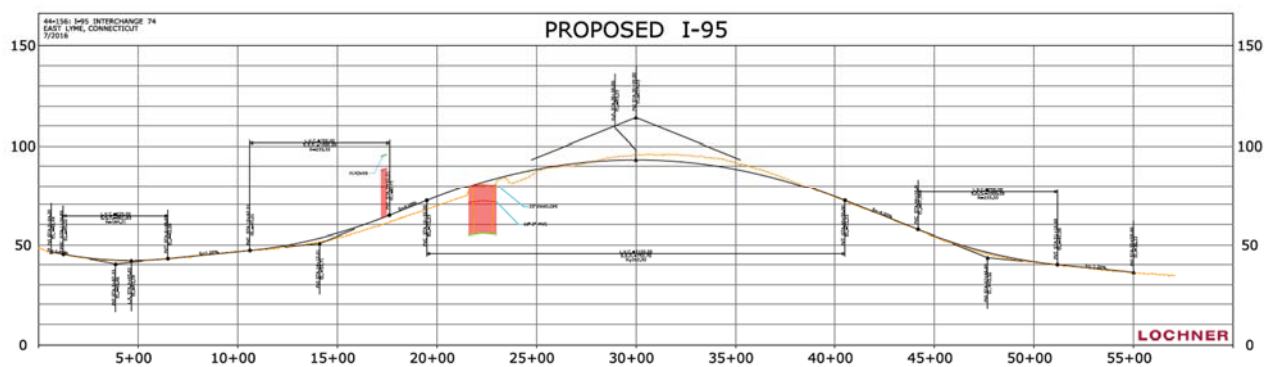
- Interstate 95 Improvements
 - Auxiliary Lanes
 - Bridge Modifications and Replacements on I-95
- Interchange 74 SB Ramps and new frontage road
- Route 161 Improvements in the vicinity of the new frontage road

The following improvements are also included in Alternatives 6C and 8 and are italicized for easy reference.

I-95 Improvements – As part of the *Let’s Go CT Ramp Up Plan*, the Department has identified the need to widen I-95 to three travel lanes in each direction from the Baldwin Bridge in Old Saybrook to the Gold Star Bridge in New London. This initiative is currently listed on the DOT 5-year Ramp-up Plan.

To lower future construction costs and avoid future disruptions to traffic, the subject section of I-95 will be reconstructed approximately from M.P. 86.67 to M.P. 88.05 to accommodate a cross-section of 126 feet including Bridge 00250, I-95 over Route 161. Bridge Nos. 02585 and 00251 will be extended (or replaced depending on the hydrologic study and hydraulic analysis) to accommodate the 126-foot cross-section and to avoid future additional permitting and disturbance of adjacent wetland areas or waterways. The hydrologic study and hydraulic analysis should be conducted early in the next phase of this project, even in preliminary form, to better understand project constraints.

Due to the change in profile grade and the new cross-section, the section of I-95 within the project limits will be reconstructed. I-95 will be reconstructed to meet a 70 MPH Design Speed. The profile of the freeway will be modified to provide a 2,100-foot crest vertical curve with maximum vertical grades of 4%.



Proposed Profile Improvements on I-95 (see Appendix .0015 page 162)

The existing width (approximately 88 feet) on this section of I-95 accommodates 2 travel lanes in each direction. The future typical cross-section of I-95 will be 126 feet wide to accommodate a 6' raised concrete median, 2-12' left shoulders, 6-12' travel lanes & 2-12' right shoulders. However, since a 4-lane expressway will be maintained until the completion of the larger I-95 future widening project, a determination on the pavement markings for the widened section will be made during the preliminary design phase.

Auxiliary Lanes - *Auxiliary lanes between Interchanges 74 and 75 will be included to improve the LOS on this section of I-95 and minimize turbulence in the flow of through traffic. Without auxiliary lanes, the distance between the end of the improved acceleration lane for northbound entrance ramp on Interchange 74 and the improved deceleration lane for the exit ramp on Interchange 75 would be approximately 800 feet. The distance between the end of the improved acceleration lane for southbound entrance ramp on Interchange 75 and the improved deceleration lane for the exit ramp on Interchange 74 is approximately 400 feet. Weave analyses (2020 and 2045), which justify the need for auxiliary lanes, are included in the supplemental attachments, pages 442 thru 445.*

Bridge No. 02585, I-95 over Pattagansett River

The existing culvert is in good condition based on the most recent inspection report with only minimal repairs required. Assuming the structure is hydraulically adequate, the existing 10' X 8' cast-in-place box culvert will be extended approximately 30 feet on both its inlet and outlet to accommodate the future widening of I-95. The Rehabilitation Study Report will consider options further; however, both cast-in-place and precast extensions could be considered. The existing river channel may be accommodated better at the outlet by skewing the culvert extension counterclockwise from the existing culvert's alignment.

It is anticipated that approximately 880 feet of retaining wall will be required to minimize the roadway footprint in the adjacent wetland areas. It is anticipated that the extension of the box culvert and the retaining walls would be constructed early in the contractor's sequence of operations plan with minimal disruption in traffic flow.

Should a replacement be required, it is assumed that a new bridge would be constructed to the north of the existing structure and would likely require 3 phases. Based on an initial review, construction can occur wholly within the existing right-of-way.

Bridge No. 00250, I-95 over Route 161

With the widening of Route 161, the widening and geometric improvements on I-95 and the deterioration of the existing bridge, a replacement bridge will be required for this project.

The new superstructure type will need to consider impacts to the I-95 profile while increasing the vertical clearance by 2'-4" from the existing minimum of 14'-2" to at least 16'-6". A span length on the order of 160 feet will be required to accommodate the widened Route 161. Based on a rule of thumb for span to depth ratios, the superstructure depth will be roughly 6'-6", which is 1'-6" greater than the existing. The proposed profile improvements on I-95 will be designed to allow an under clearance of 16' 6" to Route 161.

Route 161 is significantly skewed to I-95 by nearly 57 degrees. Ideally, structures will have a skew angle of 30 degrees or less for improved performance and maintainability. It is unlikely that a joint-less abutment system will be feasible at the current skew, which would be preferred to better protect the girder ends and minimize long-term maintenance. The skew will cause performance issues for the joints as shear forces from longitudinal thermal movements, will require more frequent maintenance and replacements.

The width of the new structure will accommodate a future widened freeway with a 126-foot typical cross-section (3 travel lanes in each direction) and the taper style southbound exit ramp. With Alternatives 6 and 8, an additional widening of 26 feet will be required on the southerly side of the bridge to accommodate the proposed loop-style entrance ramp.

A significant opportunity exists at this project site to develop a replacement concept that will minimize the duration of construction and reduce traffic impacts. While the skew creates some complications, particularly in the northeast and southwest quadrants, the MP&T scheme could replace each barrel in two stages by working from the outside towards the median. Other options will be explored during the Type Study.

Bridge No. 0251 – I-95 over Latimer Brook

With the widening of I-95, the existing cast-in-place twin 12' x 10' culverts will need to be extended (approximately 40 feet at the inlet and 60 feet at the outlet) or replaced with a bridge. A hydrologic study and hydraulic analysis may show that the existing waterway opening is inadequate, although all physical signs at the site show otherwise.

With the presence of the upstream fish ladder and the fish baffles in the one barrel, the environmental impacts may be considered greater if the structure needs to be replaced. A culvert extension or bridge replacement will need to be timed appropriately to avoid risk of impact to the fish and perhaps other species.

The existing structure is in satisfactory condition based on the most recent inspection report. Although more repairs will be required at this culvert than at the Pattagansett River culvert, this work is achievable and reasonable to extend the lifespan of the structure by decades.

Significant in-channel work will be required at both the inlet and outlet, and especially the latter given scour and erosion. The original channel of the brook was further to the north

and so the angle of attack at the inlet is not preferable. At the outlet, the outside bank is being eroded as the brook tries to curve back towards the north to meet up with the original channel.

The Rehabilitation Study Report will fully consider options after the initial hydraulic analysis. However, both cast-in-place and precast options for the culvert extensions should be considered. The inlet extension would need to be skewed to the existing culvert alignment to minimize the angle of attack from the brook channel. Although more costly, a single span bridge could be constructed over the existing culvert in stages. The culvert top slab and some of the walls would be removed as needed to provide clearance to the new superstructure, leaving the remainder of the culvert in place. This alternate would minimize in-stream work in comparison to the culvert extension, and should be strongly considered especially if the hydraulic analysis shows a need for a larger opening.

The southern wing-wall at the inlet will need to be extended as a retaining wall to support the widened I-95 Southbound roadway. The proximity of this wall to the highly skewed channel will be best accommodated by a mechanically stabilized earth (MSE) wall, precast concrete retaining wall (t-wall) or the like in order to avoid additional excavation and the need to construct a footing with a toe.

To accommodate the expressway widening, additional Right of Way may be required on the inlet end of the structure.

Southbound Ramps and Frontage Road



Southbound Ramps & new frontage road

The southbound exit and entrance ramps will realigned to terminate on the new frontage road to the Gateway Commons Development.

Exit Ramp - The taper-style ramp will diverge from I-95 initially as a one lane exit, then widen to two lanes and then to three lanes. The design speed for the exit ramp will vary from 35 MPH at the first horizontal curve to 30 MPH near its terminus. The deceleration distance to the controlling curve on exit ramp will be 590 feet. Due to the horizontal curvature of the exit ramp, lane widths will be 14 feet to address off-tracking of WB-62 and WB-67 vehicles.

Entrance Ramp - The entrance ramp will initially start as two lanes to accept the two westbound left-turn lanes on the frontage road then merge to one lane prior to the 385-foot horizontal curve (35 MPH design speed). The entrance ramp will have an acceleration length of 1,230 feet prior to entering onto southbound I-95.

Intersection of Frontage Road, southbound ramp termini – the four-legged intersection of the frontage Road, southbound ramp termini and the commercial driveway will be signalized. The signal phasing will allow the exit ramp to have a green indication during rest periods. The lane configuration addresses future commercial driveways across and to the west of the ramp terminus. The approach lanes at the intersection of the southbound ramps and the frontage road include:

- Exit ramp – 1 exclusive left-turn lane, 1 exclusive through lane and 1 exclusive right-turn lane.
- Westbound frontage road – 2 exclusive left-turn lanes and 1 combined thru/right-turn lane.
- Eastbound frontage road – 1 combined left/thru-lane, 1 exclusive through lane and 1 exclusive right-turn lane

This intersection would operate at a “C” LOS during the 2020 PM peak period and a LOS “C” during the 2045 PM peak period.

Intersection of Route 161 at the Frontage Road – The frontage road will connect the terminus of the southbound ramps to Route 161, north of the Eversource substation. The temporary frontage road south of the substation will be removed. This “T” type intersection will be signalized and have the following approach lanes:

- Northbound Route 161 will have a four-lane approach with two exclusive left-turn lanes and two through lanes
- Southbound Route 161 will have a three lane approach with two through lanes and an exclusive right-turn lane.
- Eastbound Frontage Road will have a four-lane approach with two left-turn lanes and two right-turn lanes.

The level of service for this intersection varies from a “C” to a “B” depending on the alternative due to coordination with the adjacent intersection to the south.

Property Impacts For Alternative 2, the following property impacts will likely be required:

- total property acquisitions
 - Five Guys Restaurant
 - Pools Etc. at 280 Flanders Road
- partial property acquisitions
 - Barry’s Cleaners & Launderers, 308 Flanders Road
 - Smokey O’Grady’s Restaurant, 306 Flanders Road
 - Steven Carpenteri (several businesses), 301 Flanders Road
 - True Value Hardware/Shetucket Cash Lumber Co. Inc., 300 Flanders Road
 - Golf Range, 296 Flanders Road

- Mobil Gas Station, 262 Flanders Road
- Corey's Gas Station, 263 Flanders Road
- Niantic Motel, 265 Flanders Road
- America's Best Value Inn, 256 Flanders Road
- Motel 6, 269 Flanders Road

Estimated construction cost range: \$160 to \$170 Million - Appendices 21 & 22 - pages 252 thru 257.

Evaluation Summary

Benefits:

- Addresses safety concerns at the signalized intersections and eliminates southbound left-turning vehicles on Route 161 destined for I-95 North.
- Meets Design Criteria
- Adequately addresses capacity concerns at the signalized intersections. Analyses show that the intersection of Route 161 at the frontage road will operate at a "C" LOS during the 2020 and 2045 PM peak periods. The Route 161/King Arthur Drive/NB exit ramp intersection will operate at a "C" and "D" LOS during the 2020 and 2045 PM peak periods, respectively.
- Improves access and safety for both pedestrian and cyclists
- Less property impacts than the other alternatives
- Avoids impacts to King Arthur Drive

Concerns

- Additional cost to construct and maintain three additional bridges along with more retaining walls compared to the other alternatives.
- Lacks mitigation area for the loss of commuter parking areas.
- Traffic queues - It should be noted that during the 2045 PM Peak, left and left/thru vehicles from the NB exit ramp operates at an "F" LOS, which does create longer queue lengths on the NB ramp.
- The aesthetics of the flyover is not consistent with the surrounding environment.

The following chart is an assessment of how Alternative 2 addresses the evaluation criteria noted from 1 (poor or higher impacts/costs) to 5 (well or lower impacts/costs).

Criteria		1	2	3	4	5
Safety	I-95					X
	Route 161				X	
Design Criteria					X	
Traffic Operations	I-95				X	
	Route 161			X		
Pedestrian/Cyclist Safety and Mobility					X	

Environmental Impacts	I-95		X			
	Route 161				X	
Right of Way Impacts					X	
Construction Costs			X			
Other Considerations- Mitigation potential for drainage, wetlands Displaced Commuter Lot; Future Maintenance Costs; aesthetics			X			

Alternative 6C



Alternative 6C (A larger scale plan is included in [Appendix 10 page 228](#)).

“Loop” Type Entrance Ramp - In Alternative 6C, Route 161 SB vehicles destined for I-95 NB would be accommodated by a “loop” type entrance ramp south of Bridge No. 00250 to reduce SB left turn volumes at the signalized terminus of the NB ramp, as compared to Phase 1 road modifications for the Gateway Commons Development. The profile grade of this ramp is approximately 4.75%. To provide a 114’ radius on the loop ramp, Route 161 would be realigned approximately 14 feet to the east and the northbound exit ramp would be realigned approximately 200 feet to the south.

The loop ramp would traverse over a widened Bridge No. 00250, merge with vehicles on the ramp from northbound Route 161 then merge again to one lane prior to forming an auxiliary lane between Interchanges 74 and 75. Entering NB vehicles onto the auxiliary lane would meet or/exceed the 53 MPH entering speed threshold.

This realignment of Route 161 would necessitate significant realignment of King Arthur Drive and the driveway to Niantic Motel at 265 Flanders Road along with a retaining wall to accommodate the elevation difference. Access to the motel driveway for SB vehicles would be more difficult due to its proximity to the stop bar. The access road to the maintenance facility would be realigned with the potential for a relocated commuter parking area.

Route 161 at Northbound Exit Ramp and King Arthur Drive – Route 161 would be widened to allow an exclusive southbound left-turn lane onto King Arthur Drive. Due to projected traffic volumes, the northbound exit ramp would be widened to provide a 3-lane approach, an exclusive left-turn lane, a combined left-turn and through lane and an exclusive right-turn lane. As a result, the exit ramp and King Arthur Drive would be split phased, which would require an additional signal phase and increase delay. Southbound traffic would be given an advance for SB left-turning vehicles.

This intersection would operate at a “C” LOS during the 2020 PM peak and “D” during the 2045 PM peak. It should be noted that during the 2045 PM Peak, left and left/thru vehicles from the northbound exit ramp would operate at an “F” LOS and create longer queue lengths on the northbound exit ramp.

Route 161 at the new frontage road – This intersection would be signal-controlled with two exclusive left-turn lanes northbound and an exclusive right-turn lane southbound on Route 161. On the frontage road approach to Route 161, there would be two left-turn and two right-turn lanes.

This intersection would operate at a “C” LOS during the 2020 and 2045 PM peak periods. It is anticipated that this intersection and the King Arthur Drive intersection would be coordinated to maximize traffic flows and improve traffic operations on Route 161. Traffic analyses are included in (Appendices 35 thru 42, pages 354 – 417 for partial build) and (Appendices 59 thru 66, pages 575 – 638 for final build).

Common improvements – Improvements that are common to all improvement alternatives are noted *in italics* in the previous section describing Alternative 2 but were not reiterated in this section for brevity purposes.

Property Impacts - The additional property impacts associated with Alternative 6 C include the following:

- Total acquisitions
 - Five Guys Restaurant
 - Starbucks, 267 Flanders Road
 - Mobil Gas Station, 262 Flanders Road
 - Corey’s Gas Station, 263 Flanders Road
- Partial acquisitions
 - Barry’s Cleaners & Launderers, 308 Flanders Road
 - Smokey O’Grady’s Restaurant, 306 Flanders Road

- Steven Carpenteri (several businesses), 301 Flanders Road
- True Value Hardware/Shetucket Cash Lumber Co. Inc., 300 Flanders Road
- Golf Range, 296 Flanders Road
- Pools Etc. at 280 Flanders Road
- Niantic Motel, 265 Flanders Road
- Motel 6, 269 Flanders Road
- AMPAT Associates, Burger King, 257 Flanders Road
- America's Best Value Inn, 256 Flanders Road

Estimated construction cost range: \$125 to \$135 Million – (Appendix 23 – page 262 & Appendix 24 – page 267)

Evaluation Summary

Benefits:

- Addresses safety concerns at the signalized intersections and eliminates southbound left-turning vehicles on Route 161 destined for I-95 North.
- Adequately addresses capacity concerns at the signalized intersections. Analyses show that the intersection of Route 161 at the frontage road will operate at a “C” LOS during the 2020 and 2045 PM peak periods. The Route 161/King Arthur Drive/NB exit ramp intersection will operate at a “C” and “D” LOS during the 2020 and 2045 PM peak periods, respectively.
- Improves access and safety for both pedestrian and cyclists
- Provides possible mitigation area for the loss of commuter parking areas.

Concerns

- Property impacts are higher than other alternatives
- Does not meet Design Criteria for minimum Design Speed (25 MPH) on the “loop” ramp.
- Traffic queues - It should be noted that during the 2045 PM Peak, the left and left/thru vehicles from the northbound exit ramp operates at an “F” LOS, which does create longer queue lengths on the northbound exit ramp.
- The proposed combination of the horizontal and vertical alignment on King Arthur Drive is less desirable than its current geometric configuration.
- The combination of the horizontal and vertical realignments on the commercial driveway for the Niantic Motel is less than desirable.

The following chart is an assessment of how Alternative 6C addresses the evaluation criteria noted from 1 (poor or higher impacts/costs) to 5 (well or lower impacts/costs).

Criteria		1	2	3	4	5
Safety	I-95					X
	Route 161				X	
Design Criteria			X			
Traffic Operations	I-95				X	
	Route 161			X		
Pedestrian/Cyclist Safety and Mobility					X	
Environmental Impacts	I-95		X			
	Route 161				X	
Right of Way Impacts			X			
Construction Costs				X		
Other Considerations- Mitigation potential for drainage, wetlands Displaced Commuter Lot; Future Maintenance Costs; aesthetics				X		

Alternative 8



Alternative 8 (A larger scale plan is included in [Appendix 11 - page 230](#)).

Alternative 8 – In this alternative, the design goal was to improve the Design Speed of the “loop” ramp while minimizing impacts to roadways and businesses on the east side of Route 161, and improving traffic operations and capacity on northbound exit ramp.

“Loop” type Entrance Ramp - In an effort to enlarge the radius of the ‘loop’ ramp for southbound Route 161 vehicles bound for I-95 North, the northbound exit ramp was realigned to terminate approximately 500 feet to the south of its current location on Route 161. This realignment further south provides a longer right-turn lane for the loop ramp and moves its gore location approximately 270 feet further south than Alternative 6C, which allows a larger radius curve.

Route 161/Northbound Exit Ramp Intersection - The realignment of the exit ramp creates a new “T” type intersection with Route 161, which will require one less signal phase than Alternatives 2 and 6C, allows for more efficient traffic operations and improved LOS. The lane arrangement of the exit ramp approach to Route 161 would have two exclusive left-turn lanes and an exclusive right-turn lane.

This intersection would operate at a “B” LOS during the 2020 and 2045 PM peak periods.

Route 161/King Arthur Drive Intersection - The intersection of Route 161 and King Arthur Drive may also become a “T” type or maintain a four-way intersection depending on the land use opposite King Arthur Drive. Southbound traffic would be given an advance for SB left-turning vehicles. This intersection will also operate at an improved level of service since split phasing of the side streets will not be required. This intersection would operate at a “A” LOS during the 2020 and 2045 PM peak periods.

Route 161 at the new frontage road – This intersection would be signal-controlled with two exclusive left-turn lanes northbound and an exclusive right-turn lane southbound on Route 161. On the frontage road approach to Route 161, there would be two left-turn and two right-turn lanes. This intersection would operate at a “B” LOS during the 2020 and at a “C” LOS during the 2045 PM peak periods. It is anticipated that the Route 161 intersections at the new frontage road, King Arthur Drive and the northbound exit ramp would be coordinated to maximize traffic flows and improve traffic operations on Route 161. Traffic analyses are included in (Appendices 43 thru 50, pages 422 – 497 for partial build) and (Appendices 67 thru 74, pages 643 – 718 for final build).

Exclusive southbound left-turn lane – Since the property impacts required for the relocated northbound exit ramp and southbound “loop” ramp on the west side of Route 161 allows for more flexibility, this alternative includes a southbound left-turn lane for the commercial businesses on the east side of Route 161.

The left-turn lane will allow “safe harbor” for left-turning vehicles, which will allow drivers to comfortably wait for a gap in opposing traffic to make their maneuver. The combination of the southbound left-turn lane along with the lack competing turning vehicles for businesses on the west side of Route 161 will address most pattern crashes on this

section of Route 161, including “rear-end”, “sideswipe – same direction”, “turning – intersecting paths” and “turning – opposite direction”.

Common improvements – Improvements that are common to all improvement alternatives are noted *in italics* in the previous section describing Alternative 2 but were not reiterated in this section for brevity purposes.

Property Impacts - The property impacts associated with Alternative 8 include the following:

- Total acquisitions
 - Five Guys Restaurant
 - Mobil Gas Station, 262 Flanders Road
 - America’s Best Value Inn, 256 Flanders Road
- Partial acquisitions
 - Barry’s Cleaners & Launderers, 308 Flanders Road
 - Smokey O’Grady’s Restaurant, 306 Flanders Road
 - Steven Carpenteri (several businesses), 301 Flanders Road
 - True Value Hardware/Shetucket Cash Lumber Co. Inc., 300 Flanders Road
 - Golf Range, 296 Flanders Road
 - Pools Etc. at 280 Flanders Road
 - Corey’s Gas Station, 263 Flanders Road
 - Niantic Motel, 265 Flanders Road
 - Motel 6, 269 Flanders Road
 - AMPAT Associates, Burger King, 257 Flanders Road

Estimated construction cost range: \$125 to \$130 Million – (Appendix 25 – page 272 and Appendix 26 - page 277)

Evaluation Summary

Benefits:

- Addresses safety concerns at the signalized intersections and eliminates southbound left-turning vehicles on Route 161 destined for I-95 North.
- Addresses safety concerns at the commercial driveways for Starbuck’s, The Niantic Motel and Corey’s Gas Station.
- Minimizes impacts to Starbuck’s, The Niantic Motel and Corey’s Gas Station on the eastside of Route 161 south of the expressway.
- Avoids impacts to King Arthur Drive
- Addresses capacity concerns at the signalized intersections.
 - Analyses show that the intersection of Route 161 at the frontage road will operate at a “B” LOS during the 2020 PM peak period and at a “C” LOS during 2045 PM peak periods.
 - The Route 161/King Arthur Drive intersection will operate at an “A” LOS during the 2020 and 2045 PM peak periods.
 - The Route 161/NB exit ramp intersection will operate at a “B” LOS during the 2020 and 2045 PM peak periods.

- Improves access and safety for both pedestrian and cyclists
- Provides possible mitigation area for the loss of commuter parking areas or wetland areas or to provide an area for storm water detention.

Concerns

- Requires 3 total property acquisitions & 10 partial property acquisitions
- Requires an additional traffic signal on Route 161.

The following chart is an assessment of how Alternative 8 addresses the evaluation criteria noted from 1 (poor or higher impacts/costs) to 5 (well or lower impacts/costs).

Criteria		1	2	3	4	5
Safety	I-95					X
	Route 161					X
Design Criteria					X	
Traffic Operations	I-95				X	
	Route 161				X	
Pedestrian/Cyclist Safety and Mobility					X	
Environmental Impacts	I-95		X			
	Route 161				X	
Right of Way Impacts				X		
Construction Costs				X		
Other Considerations- Mitigation potential for drainage, wetlands Displaced Commuter Lot; Future Maintenance Costs; aesthetics					X	

Comparison of Alternatives

The design challenges to provide safe and efficient traffic operations on Route 161 at the northbound access ramps for Interchange 74 include:

- Providing access to I-95 North from Route 161 South.
- Addressing capacity concerns on Route 161 at King Arthur Drive/NB exit ramp.
- Addressing crash patterns on Route 161.

Access to I-95 North from Route 161 South - The three alternatives propose similar approaches to this challenge by including right-handed slip ramps for southbound vehicles. Alternatives 6C and 8 include “loop” type ramps that start south of the expressway, crosses over Route 161 via a widened Bridge No. 250 then merges with the northbound slip ramp from Route 161. Alternative 2 includes a “flyover” ramp that starts in the vicinity of the existing entrance ramp, crosses over the southbound exit ramp, the expressway mainline and Route 161, then merges with the northbound slip ramp from Route 161.

Capacity concerns on Route 161 at King Arthur Drive/NB exit ramp – In Alternatives 2 and 6C, the NB exit ramp requires an exclusive signal phase, due to projected traffic volumes. Although the intersection operates at a “D” LOS during the 2045 PM peak, the left and left/thru lanes will operate at a “F” LOS which will result in longer queue lengths on the exit ramp. In Alternative 8, the NB exit ramp is relocated further south forming a “T” type configuration and would operate at “B” LOS during the 2020 & 2045 PM peaks.

Safety concerns on Route 161 south of King Arthur Drive –

- In Alternative 2, Route 161 will maintain its current lane use with little impacts to traffic operations on commercial driveways south of King Arthur Drive.
- In Alternative 6C, the realignment of the NB exit ramp and entrance ramp requires total acquisitions of Starbuck’s and both gas stations, which will address a percentage of the crashes. The commercial driveways for both motels will benefit from the minor widening of Route 161 for the southbound left-turn lane onto King Arthur Drive by allowing some “safe-haven” for southbound vehicles
- In Alternative 8, the realignment of the NB exit ramp and entrance ramp further south requires total acquisitions of the Mobil gas station and America’s Best Value Inn on the west side of Route 161. The NB ramp relocation allows for a southbound left-turn lane to provide “safe harbor” prior to entering commercial driveways on the east side of Route 161.

The following chart is a comparison of all alternatives regarding the effectiveness of addressing the evaluation criteria noted from 1 (poor or higher impacts/costs) to 5 (well or lower impacts/costs).

Criteria		No Build	Alt 2	Alt 6C	Alt 8
Safety	I-95	N/A	5	5	5
	Route 161	3	4	4	5
Design Criteria		2	4	2	4
Traffic operations	I-95	N/A	4	4	4
	Route 161	2	3	3	4
Pedestrian/Cyclist safety and mobility		1	4	4	4
Environmental Impacts	I-95	N/A	2	2	2
	Route 161	5	4	4	4
Right of Way Impacts		N/A	4	2	3
Construction Costs		N/A	2	3	3
Other Considerations: potential development; aesthetics; mitigation etc.		N/A	2	3	4

Project Termini at Existing Facilities

Southerly terminus on I-95 – As a result of the improvements on I-95, the distance between the northbound entrance ramp on Interchange 73 and the northbound exit ramp at Interchange 74 is approximately 4,220 feet. In the southbound direction, the distance is 6,600 feet between the entrance ramp at Interchange 74 and the exit ramp at Interchange 73.

It should be noted that the existing acceleration and deceleration distances at Interchange 73 are insufficient in both north and southbound directions.

Our freeway analysis of the merge of NB entrance ramp at Interchange 73 shows the freeway segment operates at a LOS “D” in 2020 and at a LOS “E” in 2045 during the AM peak period and a LOS “F” in both 2020 and 2045 during the PM peak period. With a future third northbound travel lane, the merge of NB entrance ramp at Interchange 73 will operate at a LOS “C” in both 2020 and 2045 AM peak periods and at “C” and “D” in 2020 and 2045 PM peak periods, respectively. The current 2-lane southbound freeway segment between Interchange 74 and 73 operates at a LOS “D” in both 2020 and 2045 AM peak periods and at a LOS “F” in both 2020 and 2045 PM peaks. With a future third southbound travel lane, the freeway segment will operate at a LOS B and C in 2020 and 2045 AM peak, respectively and at a LOS C and D in 2020 and 2045 PM peak periods, respectively. (See Appendices 82 thru 85 - pages 737 - 743).

Northerly terminus on I-95 – Auxiliary lanes will improve safety and address some operational concerns on this section of I-95 between Interchanges 74 and 75.

There are concerns with safety and traffic operations at Interchange 76 that does affect safety and traffic operations at Interchange 75 NB entrance ramp to I-395 and SB exit ramp onto Route 1.

Southerly terminus on Route 161 – The location of the southerly terminus changes depending on the selected alternative. The traffic operations and the LOS at adjacent southbound intersection of Route 161 at Industrial Park Road and Chapman Woods remains unaffected by any of the interchange alternatives.

Northerly terminus on Route 161 – The intersection of Route 1 and Route 161 will operate at a LOS of “E” in the 2020 PM peak period and at a “F” in the 2045 PM peak period.

Traffic operations and the LOS at this intersection are not affected by the various interchange alternatives.

Concerns:

- Traffic queues will be significant, especially on the Route 1 approaches, during both 2020 and 2045 PM peak periods. Traffic operations at Interchange 75 will be negatively impacted by westbound traffic queues from this intersection.
- NB traffic queues will impact traffic operations on Route 161 at the frontage road.

- The possible closure of the southbound entrance ramp at Interchange 75 as part of a future Interchange 75 and 76 improvement project would increase the volume of westbound left-turning vehicles and create significant engineering challenges to address the delay and queue lengths at this intersection.

Recommendation

After review of the three alternatives, Alternative 8 has been recommended as the preferred alternative, since this alternative addresses safety and traffic operations more comprehensively, improves access to adjacent businesses as compared to the other alternatives, maintains the existing character of the area and has less disruption to the adjacent properties in the vicinity of King Arthur Drive.

Future Design Milestones

Upon completion of the Concept Design Phase, it is anticipated that the Preliminary Design Phase will be initiated for this project. As part of the NEPA/CEPA process, Alternative 8 will be assessed further in coordination with related federal and state agencies, municipal officials, stakeholders and the public.

The following milestones will be established to complete the design process and begin the construction phase of the project:

- Initiation of Preliminary Design Phase
- Start NEPA/CEPA process
- Meet with stakeholders and hold a public informational meeting
- Preliminary Design Submittal
- Public Hearing
- FHWA Access Modification Approval
- Preliminary Design Approval
- Environmental Permitting Applications
- Initiation of Final Design and ROW Phases
- Completion of the NEPA/CEPA process
- Final Design Plans
- Design Completion Date
- Advertising
- Award of Construction Contract
- Start of Construct Phase

It should be noted that there will be coordination with related federal and state agencies, municipal officials, stakeholders and the public throughout this process. In addition, coordination will continue with future planning efforts at Interchanges 75 (I-95 at Route 1) and 76(I-95 at I-395).

Design criteria

I-95 - Urban Freeway (Figure 5A) – Alternatives 2, 6C & 8

Design Element	Design Criteria	Proposed Design	Achieved
Design Speed	70 MPH	70 MPH	Yes
Lane Width	12'	12'	Yes
Right Shoulder Width	12'	12'	Yes
Left Shoulder Width	12'	12'	Yes
Median Width (includes left shoulders)	26.5' minimum	30'	Yes
Cross Slope – Travel Lanes	1.5 – 2.0%	1.5 – 2.0%	Yes
Cross Slope – Shoulder Lanes	4%	4%	Yes
Bridge Width/Cross Slope	Meet approach width/cross slope	Meet approach width/cross slope	Yes
Roadside Clear Zones	30'	30'	Yes
Stopping Sight Distance	730'	730'	Yes
Minimum Radius (e=6.0%)	2,050'	2,050'	Yes
Maximum Grade	4%	4%	Yes
Minimum Vertical Clearance - Under	16'-3"	16'-6"	Yes

I-95 - Urban Freeway (Figure 12-4A, 12-4B & 12-4C) – Ramps

Design Element	Design Criteria	Proposed	Achieved
Design Speed Alt 2, 6C & 8	SB Exit	35 MPH	Yes
	SB Entrance	35 MPH	Yes
Design Speed - Alternative 2	NB Exit	35 MPH	Yes
	NB Entrance	25 MPH* Loop (Flyover) Ramp	Yes
Design Speed – Alt. 6C	NB Exit	35 MPH	Yes
	NB Entrance	25 MPH* Loop Ramp	No
Design Speed - Alternative 8	NB Exit	35 MPH	Yes
	NB Entrance	25 MPH* Loop Ramp	Yes
Lane Width	12'	12'	Yes
Right Shoulder Width	10'	10'	Yes
Left Shoulder Width	4'	4'	Yes
Cross Slope – Travel Lanes	1.5 – 2.0%	1.5 – 2.0%	Yes
Cross Slope – Shoulder Lanes	4%	4%	Yes

Bridge Width/Cross Slope		Meet approach width/cross slope	Meet approach width/cross slope	Yes
Roadside Clear Zones		30'	5'	No
Stopping Sight Distance – Alt 2, 6C & 8	SB exit ramp	260'	360'	Yes
	SB Entrance	250'	360'	Yes
Stopping Sight Distance – Alt 2, 6C & 8	NB Exit Ramp	315'	320'	Yes
SSD Alt 2	NB Entrance	250'	290'	Yes
SSD Alt 6C	NB Entrance	155'	250'	Yes
SSD Alt 8	NB Entrance	155'	345'	Yes
Min. Radius – Alt 2	NB Exit	385' (e=6.0%)	>385' (e=6.0%)	
	NB Entrance	170' (e=2.0%)	266' (e=2.0%)	Yes
Min. Radius – Alt 6C	NB Exit	385' (e=6.0%)	>385' (e=6.0%)	Yes
Min. Radius – Alt 6C	NB Entrance	145' (e=6.0%) Figure 11-4D	114' (e=6.0%)	No
Min. Radius – Alt 8	NB Exit	385' (e=6.0%)	>385' (e=6.0%)	Yes
Min. Radius – Alt 8	NB Entrance	154' (e=4.0%) Figure 11-4D	167' (e=4.0%)	Yes
Maximum Grade – Alts 2, 6C & 8		5%	5%	Yes

* Criteria for Turning Roadway Figure 11-4D

Route 161 - Urban Minor Arterial-Intermediate Area – Non NHS - (Fig. 5D) – Alternatives 2, 6 & 8

Design Element	Design Criteria	Proposed Design	Achieved
Design Speed	30 - 45 MPH	45 MPH	Yes
Lane Width	11' - 12'	11'	Yes
Right Shoulder Width	4' - 8'	5'	Yes
Left Shoulder Width (Alt 8 Only)	2' - 4'	2'	Yes
Cross Slope – Travel Lanes	1.5% – 2.0%	1.5% – 2.0%	Yes
Cross Slope – Shoulder Lanes ($w \geq 4'$)	4% – 6%	4%	Yes
Turn Lane Width	11'	11'	Yes
Turn Lane Shoulder Width	2' - 4'	2' left – 5' Right	Yes
Sidewalk Width	5'	5'	Yes
Bridge Width/Cross Slope	Meet approach width/cross slope	Meet approach width/cross slope	Yes
Roadside Clear Zones	20'	15'*	No

Stopping Sight Distance	360'	>360'	Yes
Minimum Radius (e=6.0%)	711' @ 6%	3,980' @ N. C.	Yes
Maximum Grade	7%	2%	Yes
Minimum Grade	0.5%	0.23%	No
Minimum Vertical Clearance	16'-3"	16'-6"	yes

*Due to the underpass width of Bridge No. 250. The proposed length of span is 160 feet due to the skew angle. Additional span length would be needed to meet clear zone requirements.

King Arthur Drive-Urban Local Street-Intermediate Area (Figure 5F) – Alt 6C only

<u>Design Element</u>	<u>Design Criteria</u>	<u>Proposed Design</u>	<u>Achieved</u>
Design Speed	25- 30 MPH	25 MPH	Yes
Lane Width	10' - 11'	11'	Yes
Shoulder Width	2' - 4'	5'	Yes
Cross Slope – Travel Lanes	1.5% – 3.0% with curbing	1.5% – 3.0% with curbing	Yes
Cross Slope – Shoulder Lanes $W \geq 4'$	4% – 6%	4%	Yes
Turn Lane Width	10' - 11'	11'	Yes
Turn Lane Shoulder Width	2' – 4'	5' Right	Yes
Sidewalk Width	5'	5'	Yes
Roadside Clear Zones	14'	14'	Yes
Stopping Sight Distance	155'	215'	Yes
Minimum Radius (e=4%)	145'	115'	No
Maximum Grade	11%	7.5%	Yes

Signal Warrant Analysis

Project No. 44-156, Interchange 74 Improvements, I-95

Town of East Lyme

Signal Warrant for new intersection on Route 161 at relocated NB exit ramp

Warrant 1, Eight-Hour Vehicular Volume - (MUTCD Table 4C-1)

Condition A – Minimum Vehicular Volume									
No. of lanes for moving traffic on each approach		Veh/hour on major street (total of both approaches)				Veh/hour on higher-volume minor street approach			
Route 161	NB Exit Ramp	100%	80%	70%	60%	100%	80%	70%	60%
2 or more	2 or more	600	480	420	336	200	160	140	112
2	2	1219				(182-25%) 136			

Approximately 50% of vehicles on the minor street are right-turning vehicles. Due to the volume on the major street (Route 161) and the numerous commercial driveways proximate to the intersection, it was assumed that 50% of the right-turning vehicles would be able to advance during the red phase. As a result of this reduction in the minimum hourly traffic volume, **it was determined that Warrant 1, Condition A is not satisfied.**

Condition B – Interruption of Continuous Traffic									
No. of lanes for moving traffic on each approach		2012 Veh/hour on major street (total of both approaches)				2014 Veh/hour on higher-volume minor street approach			
Route 161	NB Exit Ramp	100%	80%	70%	60%	100%	80%	70%	60%
2 or more	2 or more	900	720	630	504	100	80	70	56
2	2	1219				(182-25%) 136			

As noted above, approximately 50% of vehicles on the minor street are right-turning vehicles. Due to the volume on the major street (Route 161) and the numerous commercial driveways proximate to the intersection, it was assumed that 50% of the right-turning vehicles would be able to advance during the red phase. As a result of this reduction in the minimum hourly traffic volume, **it was determined that Warrant 1, Condition B is satisfied.**

It should be noted that under the build conditions, the ADT on this minor street (NB exit ramp at Interchange 74) is projected to increase from 3,100 VPD (2013) to 7,000 VPD (2020) with left-turning AM peak hour volumes increasing from 120 to 220 vehicles and PM peak hour volumes increasing from 120 to 430 vehicles.

Developer's Phase 1 – Traffic Summary

Table 4-2024
Peak Hour Traffic Operations Summary
 2024 Phase 1 Retail with Interim Ramps

	Background		Build	
	PM	SAT	PM	SAT
Route 161 at Route 1¹	D(49" delay)	C(24" delay)	E(58" delay)	C(28" delay)
Rte 161 NB Left (200')	C/0.68/180	C/0.55/130	C/0.74/210	C/0.68/170
Rte 161 NB Through	E/0.91/545	D/0.69/250	E/0.94/635	D/0.82/375
Rte 161 NB Right	A/0.30/55	A/0.31/45	A/0.34/70	A/0.38/55
Rte 161 SB Left (200')	E/0.93/305	B/0.55/135	E/0.97/315	C/0.65/140
Rte 161 SB Through	C/0.51/215	C/0.64/200	C/0.53/240	C/0.72/235
Rte 1 EB Left (100')	C/0.65/120	B/0.25/55	C/0.67/125	B/0.26/55
Rte 1 EB Through	D/0.87/310	C/0.68/185	D/0.89/315	C/0.72/180
Rte 1 WB Left (300')	F/1.07/605	C/0.75/185	F/1.19/675	C/0.84/280
Rte 1 WB Through	E/0.94/730	C/0.46/200	E/0.97/725	C/0.45/200
Rte 1 WB Right (200')	B/0.45/150	A/0.17/35	B/0.46/150	A/0.16/30
Route 161 at Frontage Road¹	C(22" delay)	B(14" delay)	C(28" delay)	B(17" delay)
Rte 161 NB	A/0.71/405	A/0.53/70	C/0.97/370	A/0.67/25
Rte 161 SB	D/0.91/420	C/0.73/235	D/0.88/395	C/0.69/220
Rte 161 SB Right turn	A/0.10/25	A/0.11/25	A/0.20/25	A/0.27/25
Frontage Left	C/0.06/25	B/0.07/25	B/0.25/90	C/0.48/115
Frontage Right	B/0.59/275	B/0.54/185	C/0.80/520	C/0.87/385
Route 161 at I-95 NB off ramp/King Arthur Drive¹	C(22" delay)	B(13" delay)	C(33" delay)	C(22" delay)
Rte 161 NB	C/0.85/595	B/0.68/345	D/0.99/605	C/0.89/385
Rte 161 SB	B/0.55/400	A/0.47/30	B/0.58/355	A/0.51/115
Rte 161 SB Left (150')	D/0.74/130	C/0.63/65	D/0.93/240	D/0.90/230
Off Ramp Left/Through	D/0.66/150	D/0.49/90	E/0.87/270	D/0.82/205
Off Ramp Right	C/0.59/110	B/0.59/80	C/0.54/115	B/0.54/85
King Arthur Left	D/0.59/80	C/0.30/50	F/0.86/120	D/0.46/60
King Arthur Right	D/0.68/140	D/0.53/90	D/0.59/150	C/0.42/85
Route 161 at Industrial Park and Chapman Woods Rd.¹	B(13" delay)	B(12" delay)	B(15" delay)	B(12" delay)
Rte 161 NB Left (200')	B/0.39/35	A/0.36/35	B/0.41/35	A/0.38/30
Rte 161 NB Through	B/0.53/305	A/0.37/170	B/0.55/315	A/0.39/180
Rte 161 SB Left (100')	A/0.14/25	A/0.03/25	A/0.15/25	A/0.04/25
Rte 161 SB Through	A/0.66/150	B/0.59/300	B/0.68/185	B/0.62/315
Industrial Park Left (2 @ 120')	D/0.64/115	C/0.55/85	D/0.64/115	C/0.56/85
Industrial Park Through/Right	A/0.32/45	A/0.30/35	A/0.32/45	A/0.30/35
Chapman Woods Rd	B/0.27/35	C/0.15/25	B/0.27/35	C/0.15/25
Frontage Road at Temporary I-95 SB ramps²	N/A	N/A	B(15" delay)	C(23" delay)
Frontage EB Through	N/A	N/A	C/0.65/300	D/0.91/445
Frontage WB Left (175')	N/A	N/A	A/0.31/25	B/0.44/135
Frontage WB Through	N/A	N/A	A/0.20/25	A/0.30/115
Ramp Left	N/A	N/A	D/0.63/130	D/0.77/175
Ramp Right	N/A	N/A	A/0.55/145	A/0.50/125

Notes: X/0.0/00 - Level of Service/V/C ratio/95% Q length

¹ - Signalized intersection² - Unsignalized; signalized as Frontage Road under build

Table from Developer's OSTA Submittal

Alternative Comparison – Traffic Summary - Partial Build 2020 AM

2020 AM Partial Build Traffic Operations Summary						
	Alt 2		Alt 6 C		Alt 8	
	LOS	v/c -95%Q	LOS	v/c -95%Q	LOS	v/c -95%Q
RTE 1 at RTE 161	C	0.87	C	0.87	C	0.87
Rte 1EB Left	D	0.84/153 ft	D	0.84/150 ft	D	0.84/153 ft
Rte 1EB Thru/RT	C	0.73/256 ft	C	0.73/255 ft	C	0.73/333 ft
Rte 1WB Left	C	0.80/243 ft	C	0.80/208 ft	C	0.80/221 ft
Rte 1WB Thru	D	0.87/469 ft	D	0.87/380 ft	D	0.87/339 ft
Rte 1WB Right	A	0.14/166 ft	A	0.14/171 ft	A	0.14/132 ft
Rte 161NB Left	C	0.80/193 ft	C	0.80/205 ft	C	0.80/206 ft
Rte 161NB Thru	C	0.64/205 ft	C	0.64/254 ft	C	0.64/231 ft
Rte 161NB Right	A	0.15/65 ft	A	0.15/106 ft	A	0.15/56 ft
Rte 161SB Left	C	0.59/114 ft	C	0.59/114 ft	C	0.59/126 ft
Rte 161SB Thru/RT	C	0.63/166 ft	C	0.63/160 ft	C	0.63/164 ft
RTE 161 at Gateway Rd	A	0.62	A	0.62	A	0.53
Frontage Rd Left	D	0.14/41 ft	D	0.14/39 ft	C	0.11/45 ft
Frontage Rd Right	B	0.62/81 ft	B	0.62/77 ft	B	0.53/87 ft
Rte 161NB Left	C	0.35/72 ft	C	0.35/75 ft	B	0.29/63 ft
Rte 161NB Thru	A	0.26/96 ft	A	0.26/63 ft	A	0.29/95 ft
Rte 161SB Thru	A	0.41/122 ft	A	0.41/136 ft	A	0.50/144 ft
Rte 161SB Right	A	0.10/30 ft	A	0.10/62 ft	A	0.21/62 ft
RTE 161 at King Art/NB Exit R	B	0.65	B	0.65		
Ramp EB Left	D	0.37/71 ft	D	0.37/69 ft		
Ramp EB Left/Thru	D	0.36/85 ft	D	0.36/80 ft		
Ramp EB Right	A	0.39/66 ft	A	0.39/66 ft		
King Art WB Left	D	0.47/88 ft	D	0.47/96 ft		
King Art WB Right	A	0.30/143 ft	A	0.30/130 ft		
Rte 161NB Thru	C	0.65/239 ft	C	0.65/227 ft		
Rte 161NB Right	A	0.03/16 ft	A	0.03/19 ft		
Rte 161SB Left	A	0.27/55 ft	A	0.27/52 ft		
Rte 161SB Thru	A	0.51/169 ft	A	0.51/159 ft		
RTE 161 at King Arthur					A	0.47
King Art WB Left					C	0.29/76 ft
King Art WB Right					B	0.32/109 ft
Rte 161NB Thru/Right					A	0.41/154 ft
Rte 161SB Left					A	0.20/58 ft
Rte 161SB Thru					A	0.47/145 ft
RTE 161 at NB Exit Ramp					A	0.45
Ramp EB Left					C	0.25/65 ft
Ramp EB Right					B	0.42/69 ft
Rte 161NB Thru					A	0.43/133 ft
Rte 161SB Thru					A	0.45/111 ft
Rte 161 at Indust Park/Chapman	B	0.62	B	0.62	B	0.62
Ind Park EB Left	C	0.29/73 ft	C	0.29/73 ft	C	0.29/79 ft
Ind Park EB Thru/RT	A	0.07/51 ft	A	0.07/48 ft	A	0.07/53 ft
Chapman WB	B	0.25/63 ft	B	0.25/62 ft	B	0.25/59 ft
Rte 161NB Left	A	0.20/52 ft	A	0.20/58 ft	A	0.20/52 ft
Rte 161NB Thru/Rte	B	0.45/131 ft	B	0.45/137 ft	B	0.45/121 ft
Rte 161SB Left	A	0.12/58 ft	A	0.12/75 ft	A	0.12/52 ft
Rte 161SB Thru/Right	B	0.62/178 ft	B	0.62/194 ft	B	0.60/190 ft
Frontage Rd at SB Ramps	A	0.31	A	0.31	A	0.31
Front Rd EB Thru	B	0.06/52 ft	B	0.06/48 ft	B	0.06/50 ft
Front Rd EB Right	B	0.04/26 ft	B	0.04/32 ft	B	0.04/26 ft
Front Rd WB Left	B	0.28/126 ft	B	0.28/131 ft	B	0.28/87 ft
Front Rd WB Thru	A	0.06/38 ft	A	0.06/46 ft	A	0.06/40 ft
Ramp NB Left	A	0.03/24 ft	A	0.03/31 ft	A	0.03/28 ft
Ramp NB Right	A	0.31/47 ft	A	0.31/53 ft	A	0.31/66 ft

Alternative Comparison - Traffic Summary - Partial Build 2020 PM

Alternative Comparison						
2020 PM Partial-Build Traffic Operations Summary						
	Alt 2		Alt 6C		Alt 8	
	LOS	v/c -95%Q	LOS	v/c -95%Q	LOS	v/c -95%Q
RTE 1 at RTE 161	E	1.15	E	1.15	E	1.15
Rte 1EB Left	E	0.87/153 ft	E	0.87/148 ft	E	0.87/154 ft
Rte 1EB Thru/RT	D	0.89/458 ft	D	0.89/428 ft	D	0.89/469 ft
Rte 1WB Left	F	1.15/368 ft	F	1.15/353 ft	F	1.15/371 ft
Rte 1WB Thru	D	0.89/3190 ft	D	0.89/2215 ft	D	0.89/3644 ft
Rte 1WB Right	A	0.36/228 ft	A	0.36/243 ft	A	0.36/225 ft
Rte 161NB Left	D	0.84/281 ft	D	0.84/276 ft	D	0.84/280 ft
Rte 161NB Thru	F	1.10/593 ft	F	1.10/547 ft	F	1.10/1005 ft
Rte 161NB Right	A	0.24/290 ft	A	0.24/206 ft	A	0.24/591 ft
Rte 161SB Left	F	1.07/368 ft	F	1.07/309 ft	F	1.07/335 ft
Rte 161SB Thru/RT	C	0.76/2137 ft	C	0.76/216 ft	C	0.76/388 ft
RTE 161 at Gateway Rd	B	0.71	B	0.72	B	0.76
Frontage Rd Left	D	0.39/70 ft	D	0.42/80 ft	C	0.33/72 ft
Frontage Rd Right	C	0.71/134 ft	C	0.72/151 ft	B	0.67/144 ft
Rte 161NB Left	B	0.42/103 ft	C	0.42/121 ft	B	0.44/107 ft
Rte 161NB Thru	A	0.37/145 ft	A	0.36/127 ft	A	0.40/138 ft
Rte 161SB Thru	B	0.67/201 ft	B	0.64/222 ft	B	0.76/180 ft
Rte 161SB Right	A	0.22/131 ft	A	0.22/122 ft	A	0.24/102 ft
RTE 161 at King Art/NB Exit R	C	0.99	C	0.88		
Ramp EB Left	D	0.56/102 ft	D	0.60/117 ft		
Ramp EB Thru/Left	D	0.55/132 ft	D	0.59/128 ft		
Ramp EB Right	A	0.46/111 ft	B	0.48/107 ft		
King Art WB Left	D	0.49/89 ft	D	0.52/91 ft		
King Art WB Right	B	0.33/143 ft	B	0.37/148 ft		
Rte 161NB Thru	D	0.99/389 ft	C	0.88/384 ft		
Rte 161NB Right	A	0.04/142 ft	A	0.04/95 ft		
Rte 161SB Left	B	0.42/82 ft	C	0.49/71 ft		
Rte 161SB Thru	B	0.74/215 ft	B	0.70/220 ft		
RTE 161 at King Arthur					A	0.65
King Art WB Left					C	0.28/87 ft
King Art WB Right					B	0.31/119 ft
Rte 161NB Thru/Right					A	0.59/179 ft
Rte 161SB Left					A	0.26/66 ft
Rte 161SB Thru					B	0.65/182 ft
RTE 161 at NB Exit Ramp					A	0.65
Ramp EB Left					C	0.39/115 ft
Ramp EB Right					C	0.56/93 ft
Rte 161NB Thru					A	0.65/181 ft
Rte 161SB Thru					A	0.65/124 ft
Rte 161 at Indust Park/Chapm	B	0.77	B	0.77	B	0.77
Ind Park EB Left	C	0.50/113 ft	C	0.50/108 ft	C	0.50/136 ft
Ind Park EB Thru/RT	B	0.39/82 ft	B	0.39/85 ft	B	0.39/79 ft
Chapman WB	A	0.19/57 ft	A	0.19/54 ft	A	0.19/54 ft
Rte 161NB Left	B	0.50/79 ft	B	0.50/70 ft	B	0.50/73 ft
Rte 161NB Thru/Rte	B	0.59/187 ft	B	0.59/184 ft	B	0.59/168 ft
Rte 161SB Left	A	0.21/96 ft	A	0.21/105 ft	A	0.21/83 ft
Rte 161SB Thru/Right	B	0.77/259 ft	B	0.77/271 ft	B	0.77/219 ft
Gateway Rd at SB Ramps	B	0.52	B	0.52	B	0.52
Front Rd EB Left/Thru	B	0.40/96 ft	B	0.40/103 ft	B	0.40/94 ft
Front Rd EB Right	A	0.26/57 ft	A	0.26/56 ft	A	0.26/56 ft
Front Rd WB Left	B	0.38/136 ft	B	0.38/146 ft	B	0.38/127 ft
Front Rd WB Thru/RT	A	0.27/103 ft	A	0.27/108 ft	A	0.27/98 ft
Ramp NB Left	B	0.21/83 ft	B	0.21/78 ft	B	0.21/74 ft
Ramp NB Right	B	0.64/103 ft	A	0.52/111 ft	A	0.52/109 ft

Alternative Comparison – Traffic Summary - Partial Build 2045 AM

Alternative Comparison						
2045 AM Full-Build Traffic Operations Summary						
	Alt 2		Alt 6 C		Alt 8	
	LOS	v/c -95%Q	LOS	v/c -95%Q	LOS	v/c -95%Q
RTE 1 at RTE 161	D	1.08	D	1.08	D	1.08
Rte 1EB Left	F	1.02/143 ft	F	1.02/130 ft	F	1.02/136 ft
Rte 1EB Thru/RT	C	0.88/472 ft	C	0.88/473 ft	C	0.88/464 ft
Rte 1WB Left	E	1.02/350 ft	E	1.02/357 ft	E	1.02/349 ft
Rte 1WB Thru	D	0.97/746 ft	D	0.97/775 ft	D	0.97/1094 ft
Rte 1WB Right	A	0.17/242 ft	A	0.23/233 ft	A	0.23/236 ft
Rte 161NB Left	F	1.08/266 ft	F	1.08/279 ft	F	1.08/274 ft
Rte 161NB Thru	D	0.89/1132 ft	D	0.89/1408 ft	D	0.89/1432 ft
Rte 161NB Right	A	0.24/608 ft	A	0.35/1045 ft	A	0.35/1031 ft
Rte 161SB Left	F	1.05/245 ft	F	1.05/230 ft	F	1.05/272 ft
Rte 161SB Thru/RT	D	0.98/222 ft	D	0.98/251 ft	D	0.98/262 ft
RTE 161 at Gateway Rd	B	0.72	B	0.72	B	0.76
Frontage Rd Left	D	0.46/85 ft	D	0.46/90 ft	C	0.37/69 ft
Frontage Rd Right	C	0.72/133 ft	C	0.72/135 ft	B	0.63/138 ft
Rte 161NB Left	D	0.58/157 ft	C	0.58/146 ft	B	0.52/113 ft
Rte 161NB Thru	A	0.33/147 ft	A	0.33/142 ft	A	0.37/168 ft
Rte 161SB Thru	B	0.60/223 ft	B	0.60/212 ft	C	0.76/206 ft
Rte 161SB Right	A	0.24/154 ft	A	0.24/154 ft	A	0.27/143 ft
RTE 161 at King Art/NB Exit R	C	0.87	C	0.83		
Ramp EB Left	D	0.61/123 ft	D	0.61/132 ft		
Ramp EB Left/Thru	D	0.61/148 ft	D	0.61/148 ft		
Ramp EB Right	A	0.42/91 ft	A	0.42/93 ft		
King Art WB Left	D	0.61/105 ft	D	0.61/113 ft		
King Art WB Right	C	0.69/199 ft	C	0.47/173 ft		
Rte 161NB Thru	C	0.83/371 ft	C	0.87/403 ft		
Rte 161NB Right	A	0.04/88 ft	A	0.04/110 ft		
Rte 161SB Left	C	0.45/84 ft	C	0.46/77 ft		
Rte 161SB Thru	B	0.68/225 ft	B	0.71/228 ft		
RTE 161 at King Arthur					B	0.69
King Art WB Left					C	0.31/81 ft
King Art WB Right					B	0.36/127 ft
Rte 161NB Thru/Right					A	0.68/204 ft
Rte 161SB Left					A	0.29/85 ft
Rte 161SB Thru					B	0.69/208 ft
RTE 161 at NB Exit Ramp					A	0.64
Ramp EB Left					C	0.46/97 ft
Ramp EB Right					C	0.48/82 ft
Rte 161NB Thru					A	0.61/200 ft
Rte 161SB Thru					A	0.64/117 ft
Rte 161 at Indust Park/Chapm	B	0.76	B	0.76	B	0.75
Ind Park EB Left	C	0.35/94 ft	C	0.35/80 ft	D	0.42/64 ft
Ind Park EB Thru/RT	A	0.11/48 ft	A	0.11/56 ft	A	0.11/51 ft
Chapman WB	C	0.29/62 ft	C	0.29/60 ft	C	0.35/84 ft
Rte 161NB Left	B	0.33/59 ft	B	0.33/59 ft	A	0.30/64 ft
Rte 161NB Thru/Rte	B	0.57/182 ft	B	0.57/148 ft	B	0.54/177 ft
Rte 161SB Left	A	0.15/65 ft	A	0.15/57 ft	A	0.14/91 ft
Rte 161SB Thru/Right	B	0.76/241 ft	B	0.76/194 ft	B	0.75/259 ft
Gateway Rd at SB Ramps	B	0.49	B	0.49	B	0.49
Front Rd EB Left/Thru	C	0.31/62 ft	C	0.31/57 ft	C	0.31/64 ft
Front Rd EB Right	A	0.21/51 ft	A	0.21/56 ft	A	0.21/57 ft
Front Rd WB Left	C	0.49/138 ft	C	0.49/154 ft	C	0.49/122 ft
Front Rd WB Thru/RT	A	0.29/94 ft	A	0.29/103 ft	A	0.29/95 ft
Ramp NB Left	A	0.07/39 ft	A	0.07/43 ft	A	0.07/55 ft
Ramp NB Thru	B	0.07/41 ft	B	0.07/39 ft	B	0.07/43 ft
Ramp NB Right	A	0.46/110 ft	A	0.46/110 ft	A	0.46/118 ft
Driveway SB Left	A	0.11/64 ft	A	0.11/55 ft	A	0.11/67 ft
Driveway SB Thru	B	0.03/37 ft	B	0.03/30 ft	B	0.03/34 ft

Alternative Comparison - Traffic Summary - Partial Build 2045 PM

Alternative Comparison						
2045 PM Partial-Build Traffic Operations Summary						
	Alt 2		Alt 6 C		Alt 8	
	LOS	v/c -95%Q	LOS	v/c -95%Q	LOS	v/c -95%Q
RTE 1 at RTE 161	F	1.43	F	1.43	F	1.43
Rte 1EB Left	F	1.19/159 ft	F	1.19/157 ft	F	1.19/165 ft
Rte 1EB Through/RT	F	1.23/3521 ft	F	1.23/3780 ft	F	1.23/3782 ft
Rte 1WB Left	F	1.37/329 ft	F	1.37/344 ft	F	1.37/331 ft
Rte 1WB Through	F	1.09/5288 ft	F	1.09/5304 ft	F	1.09/5759 ft
Rte 1WB Right	B	0.45/253 ft	B	0.45/267 ft	B	0.45/244 ft
Rte 161NB Left	E	0.98/270 ft	E	0.98/280 ft	E	0.98/280 ft
Rte 161NB Through	F	1.20/1600 ft	F	1.20/1580 ft	F	1.20/1629 ft
Rte 161NB Right	A	0.27/1505 ft	A	0.27/1630 ft	A	0.27/1541 ft
Rte 161SB Left	F	1.43/360 ft	F	1.43/351 ft	F	1.43/358 ft
Rte 161SB Thru/RT	D	0.87/2925 ft	D	0.87/3087 ft	D	0.87/560 ft
RTE 161 at Gateway Rd	C	0.83	C	0.83	B	0.89
Frontage Rd Left	D	0.49/104 ft	D	0.49/114 ft	C	0.38/80 ft
Frontage Rd Right	D	0.83/175 ft	D	0.83/163 ft	C	0.82/166 ft
Rte 161NB Left	C	0.40/243 ft	C	0.40/244 ft	C	0.47/283 ft
Rte 161NB Through	A	0.44/285 ft	A	0.44/364 ft	A	0.48/433 ft
Rte 161SB Through	C	0.81/237 ft	C	0.81/207 ft	C	0.89/201 ft
Rte 161SB Right	A	0.26/138 ft	A	0.26/129 ft	A	0.27/136 ft
RTE 161 at King Art/NB Exit F	C	0.99	C	0.99		
Ramp EB Left	E	0.75/151 ft	E	0.75/150 ft		
Ramp EB Left/Thru	E	0.73/155 ft	E	0.73/180 ft		
Ramp EB Right	D	0.74/165 ft	D	0.74/148 ft		
King Art WB Left	E	0.69/116 ft	E	0.69/118 ft		
King Art WB Right	C	0.53/245 ft	C	0.53/177 ft		
Rte 161NB Through	D	0.99/509 ft	D	0.99/479 ft		
Rte 161NB Right	A	0.05/114 ft	A	0.05/87 ft		
Rte 161SB Left	D	0.72/140 ft	D	0.72/177 ft		
Rte 161SB Through	B	0.82/281 ft	B	0.82/253 ft		
RTE 161 at King Arthur					B	0.83
King Art WB Left					C	0.33/87 ft
King Art WB Right					C	0.40/132 ft
Rte 161NB Through					B	0.79/264 ft
Rte 161SB Left					B	0.47/85 ft
Rte 161SB Through					B	0.83/187 ft
RTE 161 at NB Exit Ramp					B	0.79
Ramp EB Left					C	0.50/175 ft
Ramp EB Right					D	0.70/118 ft
Rte 161NB Through					B	0.79/263 ft
Rte 161SB Through					A	0.79/153 ft
Rte 161 at Indust Park/Chapman	C	0.89	C	0.89	C	0.89
Ind Park EB Left	D	0.63/146 ft	D	0.63/148 ft	D	0.63/174 ft
Ind Park EB Thru/RT	B	0.47/111 ft	B	0.47/124 ft	B	0.47/110 ft
Chapman WB	A	0.22/59 ft	A	0.22/63 ft	A	0.22/56 ft
Rte 161NB Left	C	0.66/86 ft	C	0.66/72 ft	C	0.66/91 ft
Rte 161NB Thru/Rte	B	0.66/245 ft	B	0.66/203 ft	B	0.66/235 ft
Rte 161SB Left	A	0.26/96 ft	A	0.26/94 ft	A	0.26/98 ft
Rte 161SB Thru/Right	C	0.89/300 ft	C	0.89/291 ft	C	0.89/289 ft
Gateway Rd at SB Ramps	B	0.64	B	0.64	B	0.64
Front Rd EB Left/Thru	B	0.40/102 ft	B	0.40/92 ft	B	0.41/89 ft
Front Rd EB Right	A	0.26/54 ft	A	0.26/53 ft	A	0.26/60 ft
Front Rd WB Left	B	0.47/173 ft	B	0.47/166 ft	B	0.43/129 ft
Front Rd WB Thru/RT	A	0.27/135 ft	A	0.27/134 ft	A	0.26/94 ft
Ramp NB Left	B	0.21/75 ft	B	0.21/70 ft	B	0.21/63 ft
Ramp NB Right	A	0.64/177 ft	A	0.64/133 ft	A	0.64/140 ft

Alternative Comparison – Traffic Summary - Full Build 2020 AM

Alternative Comparison						
2020 AM Full-Build Traffic Operations Summary						
	Alt 2		Alt 6 C		Alt 8	
	LOS	v/c -95%Q	LOS	v/c -95%Q	LOS	v/c -95%Q
RTE 1 at RTE 161	C	0.92	C	0.92	C	0.92
Rte 1 EB Left	D	0.84/150 ft	D	0.84/151 ft	D	0.84/155 ft
Rte 1 EB Through/RT	C	0.74/295 ft	C	0.74/327 ft	C	0.74/387 ft
Rte 1 WB Left	D	0.92/249 ft	D	0.92/228 ft	D	0.92/311 ft
Rte 1 WB Through	D	0.87/285 ft	D	0.87/319 ft	D	0.87/381 ft
Rte 1 WB Right	A	0.14/171 ft	A	0.14/143 ft	A	0.14/177 ft
Rte 161 NB Left	D	0.92/184 ft	D	0.92/194 ft	D	0.92/255 ft
Rte 161 NB Through	C	0.70/217 ft	C	0.70/228 ft	C	0.70/367 ft
Rte 161 NB Right	A	0.20/62 ft	A	0.20/86 ft	A	0.20/62 ft
Rte 161 SB Left	C	0.63/131 ft	C	0.63/138 ft	C	0.63/144 ft
Rte 161 SB Thru/RT	C	0.69/190 ft	C	0.69/170 ft	C	0.69/177 ft
RTE 161 at Gateway Rd	B	0.60	B	0.60	B	0.59
Frontage Rd Left	D	0.39/70 ft	D	0.39/68 ft	C	0.33/70 ft
Frontage Rd Right	B	0.60/100 ft	B	0.60/91 ft	B	0.54/116 ft
Rte 161 NB Left	C	0.56/143 ft	C	0.56/111 ft	C	0.49/112 ft
Rte 161 NB Through	A	0.28/126 ft	A	0.28/104 ft	A	0.30/111 ft
Rte 161 SB Through	B	0.49/172 ft	B	0.49/184 ft	B	0.59/166 ft
Rte 161 SB Right	A	0.22/86 ft	A	0.22/112 ft	A	0.24/109 ft
RTE 161 at King Art/NB Exit	B	0.76	B	0.76		
Ramp EB Left	D	0.54/103 ft	D	0.54/110 ft		
Ramp EB Left/Through	D	0.55/130 ft	D	0.55/120 ft		
Ramp EB Right	A	0.33/76 ft	A	0.33/66 ft		
King Art WB Left	D	0.49/88 ft	D	0.49/86 ft		
King Art WB Right	B	0.33/139 ft	B	0.33/127 ft		
Rte 161 NB Through	C	0.76/292 ft	C	0.76/247 ft		
Rte 161 NB Right	A	0.03/59 ft	A	0.03/71 ft		
Rte 161 SB Left	B	0.33/65 ft	B	0.33/52 ft		
Rte 161 SB Through	B	0.59/176 ft	B	0.59/176 ft		
RTE 161 at King Arthur					A	0.51
King Art WB Left					C	0.28/81 ft
King Art WB Right					B	0.30/109 ft
Rte 161 NB Through/Right					A	0.47/137 ft
Rte 161 SB Left					A	0.23/56 ft
Rte 161 SB Through					A	0.51/176 ft
RTE 161 at NB Exit Ramp					A	0.49
Ramp EB Left					C	0.45/112 ft
Ramp EB Right					B	0.35/89 ft
Rte 161 NB Through					A	0.49/139 ft
Rte 161 SB Through					A	0.48/109 ft
Rte 161 at Indust Park/Chap	B	0.63	B	0.63	B	0.63
Ind Park EB Left	C	0.29/42 ft	C	0.29/71 ft	C	0.29/73 ft
Ind Park EB Thru/RT	A	0.07/85 ft	A	0.07/47 ft	A	0.07/47 ft
Chapman WB	B	0.25/60 ft	B	0.25/61 ft	B	0.25/61 ft
Rte 161 NB Left	A	0.21/56 ft	A	0.21/55 ft	A	0.21/62 ft
Rte 161 NB Thru/Rte	B	0.46/137 ft	B	0.46/117 ft	B	0.46/116 ft
Rte 161 SB Left	A	0.12/64 ft	A	0.12/58 ft	A	0.12/52 ft
Rte 161 SB Thru/Right	B	0.63/207 ft	B	0.63/183 ft	B	0.63/168 ft
Frontage Rd at SB Ramps	B	0.40	B	0.40	B	0.40
Front Rd EB Left/Thru	C	0.29/75 ft	C	0.29/79 ft	C	0.29/77 ft
Front Rd EB Right	A	0.22/53 ft	A	0.22/52 ft	A	0.22/47 ft
Front Rd WB Left	C	0.40/131 ft	C	0.40/132 ft	C	0.40/120 ft
Front Rd WB Thru/RT	A	0.30/91 ft	A	0.30/87 ft	A	0.30/86 ft
Ramp NB Left	A	0.08/41 ft	A	0.07/44 ft	A	0.07/39 ft
Ramp NB Through	B	0.07/32 ft	B	0.07/33 ft	B	0.07/39 ft
Ramp NB Right	A	0.38/90 ft	A	0.38/89 ft	A	0.38/87 ft
Driveway SB left	A	0.11/58 ft	A	0.11/61 ft	A	0.11/52 ft
Driveway SB Through	B	0.09/51 ft	B	0.03/32 ft	B	0.03/34 ft

Alternative Comparison – Traffic Summary - Full build 2020 PM

Alternative Comparison						
2020 PM Full-Build Traffic Operations Summary						
	Alt 2		Alt 6C		Alt 8	
	LOS	v/c -95%Q	LOS	v/c -95%Q	LOS	v/c -95%Q
RTE 1 at RTE 161	E	1.18	E	1.18	E	1.18
Rte 1 EB Left	E	0.89/154 ft	E	0.89/152 ft	E	0.89/151 ft
Rte 1 EB Through/RT	F	1.07/2289 ft	F	1.07/2063 ft	F	1.07/2348 ft
Rte 1 WB Left	F	1.18/351 ft	F	1.18/354 ft	F	1.18/351 ft
Rte 1 WB Through	D	0.88/3993 ft	D	0.88/3500 ft	D	0.88/3409 ft
Rte 1 WB Right	A	0.36/237 ft	A	0.36/243 ft	A	0.36/246 ft
Rte 161 NB Left	E	0.93/273 ft	E	0.93/258 ft	E	0.93/270 ft
Rte 161 NB Through	F	1.07/1013 ft	F	1.07/1055 ft	F	1.07/1322 ft
Rte 161 NB Right	A	0.28/674 ft	A	0.28/653 ft	A	0.28/848 ft
Rte 161 SB Left	F	1.17/344 ft	F	1.17/360 ft	F	1.17/363 ft
Rte 161 SB Thru/RT	D	0.78/1135 ft	D	0.78/11839 ft	D	0.78/1152 ft
RTE 161 at Gateway Rd	C	0.82	C	0.82	C	0.90
Frontage Rd Left	D	0.67/137 ft	D	0.67/130 ft	C	0.55/138 ft
Frontage Rd Right	C	0.77/184 ft	C	0.77/194 ft	B	0.70/162 ft
Rte 161 NB Left	D	0.82/178 ft	C	0.82/202 ft	C	0.80/142 ft
Rte 161 NB Through	A	0.37/170 ft	A	0.37/137 ft	A	0.41/145 ft
Rte 161 SB Through	C	0.72/244 ft	C	0.72/264 ft	C	0.90/209 ft
Rte 161 SB Right	A	0.48/206 ft	A	0.48/201 ft	A	0.51/167 ft
RTE 161 at King Art/NB Exit	D	1.00	D	1.00		
Ramp EB Left	E	0.89/178 ft	E	0.89/198 ft		
Ramp EB Through/Left	E	0.89/214 ft	E	0.89/210 ft		
Ramp EB Right	A	0.43/110 ft	A	0.43/102 ft		
King Art WB Left	D	0.56/97 ft	D	0.56/102 ft		
King Art WB Right	B	0.37/141 ft	B	0.37/158 ft		
Rte 161 NB Through	D	1.00/405 ft	D	1.00/383 ft		
Rte 161 NB Right	A	0.04/138 ft	A	0.04/99 ft		
Rte 161 SB Left	C	0.49/142 ft	C	0.49/86 ft		
Rte 161 SB Through	B	0.77/273 ft	B	0.77/245 ft		
RTE 161 at King Arthur					B	0.69
King Art WB Left					C	0.28/76 ft
King Art WB Right					B	0.33/119 ft
Rte 161 NB Through/Right					A	0.66/192 ft
Rte 161 SB Left					A	0.37/73 ft
Rte 161 SB Through					B	0.69/212 ft
RTE 161 at NB Exit Ramp					B	0.70
Ramp EB Left					C	0.66/191 ft
Ramp EB Right					C	0.49/143 ft
Rte 161 NB Through					A	0.70/241 ft
Rte 161 SB Through					A	0.69/118 ft
Rte 161 at Indust Park/Chapman	B	0.77	B	0.77	B	0.77
Ind Park EB Left	C	0.54/128 ft	C	0.54/119 ft	C	0.54/132 ft
Ind Park EB Thru/RT	A	0.42/105 ft	A	0.42/83 ft	A	0.42/86 ft
Chapman WB	A	0.19/62 ft	A	0.19/54 ft	A	0.19/60 ft
Rte 161 NB Left	C	0.56/82 ft	C	0.56/72 ft	C	0.56/69 ft
Rte 161 NB Thru/Rte	B	0.63/212 ft	B	0.63/175 ft	B	0.63/192 ft
Rte 161 SB Left	A	0.18/91 ft	A	0.18/88 ft	A	0.18/75 ft
Rte 161 SB Thru/Right	B	0.77/266 ft	B	0.77/262 ft	B	0.77/238 ft
Gateway Rd at SB Ramps	B	0.69	B	0.69	B	0.69
Front Rd EB Left/Thru	C	0.61/148 ft	C	0.61/134 ft	C	0.61/132 ft
Front Rd EB Right	A	0.40/80 ft	A	0.40/78 ft	A	0.40/66 ft
Front Rd WB Left	C	0.67/335 ft	C	0.67/205 ft	C	0.67/203 ft
Front Rd WB Thru/RT	B	0.69/241 ft	B	0.69/238 ft	B	0.69/224 ft
Ramp NB Left	B	0.23/87 ft	B	0.23/72 ft	B	0.23/71 ft
Ramp NB Through	B	0.28/94 ft	B	0.28/84 ft	B	0.28/88 ft
Ramp NB Right	B	0.64/150 ft	B	0.64/177 ft	B	0.64/138 ft
Driveway SB left	B	0.41/120 ft	B	0.41/122 ft	B	0.41/127 ft
Driveway SB Through	B	0.12/61 ft	B	0.12/63 ft	B	0.12/59 ft

Alternative Comparison with full build - LOS 2045 AM

Alternative Comparison						
2045 AM Full-Build Traffic Operations Summary						
	Alt 2		Alt 6 C		Alt 8	
	LOS	v/c -95%Q	LOS	v/c -95%Q	LOS	v/c -95%Q
RTE 1 at RTE 161	D	1.08	D	1.08	D	1.08
Rte 1 EB Left	F	1.02/143 ft	F	1.02/130 ft	F	1.02/136 ft
Rte 1 EB Through/RT	C	0.88/2387 ft	C	0.88/1735 ft	C	0.88/1560 ft
Rte 1 WB Left	E	1.02/350 ft	E	1.02/357 ft	E	1.02/349 ft
Rte 1 WB Through	D	0.97/746 ft	D	0.97/1775 ft	D	0.97/1094 ft
Rte 1 WB Right	A	0.17/242 ft	A	0.23/233 ft	A	0.23/236 ft
Rte 161 NB Left	F	1.08/266 ft	F	1.08/279 ft	F	1.08/274 ft
Rte 161 NB Through	D	0.89/1132 ft	D	0.89/1408 ft	D	0.89/1432 ft
Rte 161 NB Right	A	0.24/608 ft	A	0.35/1045 ft	A	0.35/1031 ft
Rte 161 SB Left	F	1.05/245 ft	F	1.05/230 ft	F	1.05/272 ft
Rte 161 SB Thru/RT	D	0.98/239 ft	D	0.98/268 ft	D	0.98/262 ft
RTE 161 at Gateway Rd	B	0.72	B	0.72	B	0.76
Frontage Rd Left	D	0.46/85 ft	D	0.46/90 ft	C	0.37/69 ft
Frontage Rd Right	C	0.72/133 ft	C	0.72/135 ft	B	0.63/138 ft
Rte 161 NB Left	D	0.58/157 ft	C	0.58/146 ft	B	0.52/113 ft
Rte 161 NB Through	A	0.33/147 ft	A	0.33/142 ft	A	0.37/168 ft
Rte 161 SB Through	B	0.60/223 ft	B	0.60/212 ft	C	0.76/206 ft
Rte 161 SB Right	A	0.24/154 ft	A	0.24/154 ft	A	0.27/143 ft
RTE 161 at King Art/NB Exit	C	0.87	C	0.87		
Ramp EB Left	D	0.61/123 ft	D	0.61/132 ft		
Ramp EB Left/Through	D	0.61/148 ft	D	0.61/148 ft		
Ramp EB Right	A	0.42/91 ft	A	0.42/93 ft		
King Art WB Left	D	0.61/105 ft	D	0.61/113 ft		
King Art WB Right	C	0.69/199 ft	C	0.47/173 ft		
Rte 161 NB Through	C	0.83/371 ft	C	0.87/403 ft		
Rte 161 NB Right	A	0.04/88 ft	A	0.04/110 ft		
Rte 161 SB Left	C	0.45/84 ft	C	0.46/77 ft		
Rte 161 SB Through	B	0.68/225 ft	B	0.71/228 ft		
RTE 161 at King Arthur					B	0.69
King Art WB Left					C	0.31/81 ft
King Art WB Right					B	0.36/127 ft
Rte 161 NB Through/Right					A	0.68/204 ft
Rte 161 SB Left					A	0.29/85 ft
Rte 161 SB Through					B	0.69/208 ft
RTE 161 at NB Exit Ramp					A	0.64
Ramp EB Left					C	0.46/97 ft
Ramp EB Right					C	0.48/82 ft
Rte 161 NB Through					A	0.61/200 ft
Rte 161 SB Through					A	0.64/117 ft
Rte 161 at Indust Park/Chap	B	0.76	B	0.76	B	0.75
Ind Park EB Left	C	0.35/94 ft	C	0.35/80 ft	D	0.42/64 ft
Ind Park EB Thru/RT	A	0.11/49 ft	A	0.11/56 ft	A	0.11/51 ft
Chapman WB	C	0.29/62 ft	C	0.29/60 ft	C	0.35/84 ft
Rte 161 NB Left	B	0.33/59 ft	B	0.33/59 ft	A	0.30/64 ft
Rte 161 NB Thru/Rte	B	0.57/182 ft	B	0.57/148 ft	B	0.54/177 ft
Rte 161 SB Left	A	0.15/65 ft	A	0.15/57 ft	A	0.14/91 ft
Rte 161 SB Thru/Right	B	0.76/241 ft	B	0.76/194 ft	B	0.75/259 ft
Gateway Rd at SB Ramps	B	0.49	B	0.49	B	0.49
Front Rd EB Left/Thru	C	0.31/73 ft	C	0.31/81 ft	C	0.31/75 ft
Front Rd EB Right	A	0.21/51 ft	A	0.21/56 ft	A	0.21/57 ft
Front Rd WB Left	C	0.49/138 ft	C	0.49/154 ft	C	0.49/122 ft
Front Rd WB Thru/RT	A	0.29/94 ft	A	0.29/103 ft	A	0.29/95 ft
Ramp NB Left	A	0.07/39 ft	A	0.07/43 ft	A	0.07/55 ft
Ramp NB Through	B	0.07/41 ft	B	0.07/39 ft	B	0.07/43 ft
Ramp NB Right	A	0.46/110 ft	A	0.46/110 ft	A	0.46/118 ft
Driveway SB left	A	0.11/64 ft	A	0.11/55 ft	A	0.11/67 ft
Driveway SB Through	B	0.03/37 ft	B	0.03/30 ft	B	0.03/34 ft

Alternative Comparison with full build - LOS 2045 PM

Alternative Comparison						
2045 PM Full-Build Traffic Operations Summary						
	Alt 2		Alt 6 C		Alt 8	
	LOS	v/c -95%Q	LOS	v/c -95%Q	LOS	v/c -95%Q
RTE 1 at RTE 161	F	1.54	F	1.54	F	1.54
Rte 1 EB Left	F	1.34/152 ft	F	1.34/151 ft	F	1.34/140 ft
Rte 1 EB Thru/RT	F	1.26/3959 ft	F	1.26/2132 ft	F	1.26/4180 ft
Rte 1 WB Left	F	1.54/333 ft	F	1.54/334 ft	F	1.54/324 ft
Rte 1 WB Thru	F	1.10/5352 ft	F	1.10/4335 ft	F	1.10/5924 ft
Rte 1 WB Right	B	0.45/241 ft	A	0.50/234 ft	A	0.50/236 ft
Rte 161 NB Left	F	0.98/263 ft	F	1.07/261 ft	F	1.07/275 ft
Rte 161 NB Thru	F	1.20/1609 ft	F	1.26/1213 ft	F	1.26/1647 ft
Rte 161 NB Right	A	0.27/1582 ft	A	0.46/918 ft	A	0.46/1581 ft
Rte 161 SB Left	F	1.43/349 ft	F	1.48/356 ft	F	1.48/345 ft
Rte 161 SB Thru/RT	D	0.87/2999 ft	D	0.93/1850 ft	D	0.93/3022 ft
RTE 161 at Gateway Rd	C	0.91	C	0.91	C	0.91
Frontage Rd Left	E	0.83/341 ft	E	0.83/208 ft	D	0.68/504 ft
Frontage Rd Right	D	0.91/240 ft	D	0.91/266 ft	D	0.91/434 ft
Rte 161 NB Left	D	0.78/222 ft	D	0.78/262 ft	D	0.89/251 ft
Rte 161 NB Thru	A	0.44/297 ft	A	0.44/167 ft	A	0.47/343 ft
Rte 161 SB Thru	D	0.84/440 ft	D	0.84/339 ft	C	0.89/252 ft
Rte 161 SB Right	B	0.51/223 ft	B	0.51/211 ft	A	0.51/174 ft
RTE 161 at King Art/NB Exit	D	1.08	D	1.08		
Ramp EB Left	F	1.08/313 ft	F	1.08/254 ft		
Ramp EB Left/Thru	F	1.08/293 ft	F	1.08/253 ft		
Ramp EB Right	D	0.68/178 ft	D	0.68/169 ft		
King Art WB Left	F	0.68/110 ft	F	0.68/110 ft		
King Art WB Right	D	0.53/194 ft	D	0.53/181 ft		
Rte 161 NB Thru	D	1.01/561 ft	D	1.01/673 ft		
Rte 161 NB Right	A	0.05/106 ft	A	0.05/132 ft		
Rte 161 SB Left	D	0.79/178 ft	D	0.79/181 ft		
Rte 161 SB Thru	B	0.83/305 ft	B	0.83/298 ft		
RTE 161 at King Arthur					B	0.83
King Art WB Left					D	0.31/88 ft
King Art WB Right					C	0.42/147 ft
Rte 161 NB Thru					B	0.79/212 ft
Rte 161 SB Left					B	0.56/83 ft
Rte 161 SB Thru					A	0.83/168 ft
RTE 161 at NB Exit Ramp					B	0.81
Ramp EB Left					D	0.78/243 ft
Ramp EB Right					D	0.68/229 ft
Rte 161 NB Thru					B	0.81/289 ft
Rte 161 SB Thru					A	0.79/156 ft
Rte 161 at Indust Park/Chapman	C	0.88	C	0.88	C	0.88
Ind Park EB Left	D	0.68/137 ft	D	0.68/159 ft	D	0.68/165 ft
Ind Park EB Thru/RT	B	0.49/131 ft	B	0.49/133 ft	B	0.49/142 ft
Chapman WB	A	0.25/60 ft	A	0.25/69 ft	A	0.25/55 ft
Rte 161 NB Left	D	0.73/111 ft	D	0.73/129 ft	D	0.73/80 ft
Rte 161 NB Thru/Rte	B	0.71/227 ft	B	0.71/277 ft	B	0.71/216 ft
Rte 161 SB Left	A	0.25/95 ft	A	0.25/84 ft	A	0.25/61 ft
Rte 161 SB Thru/Right	C	0.88/330 ft	C	0.88/359 ft	C	0.88/269 ft
Gateway Rd at SB Ramps	C	0.81	C	0.81	C	0.81
Front Rd EB Left/Thru	C	0.61/147 ft	C	0.61/162 ft	C	0.61/138 ft
Front Rd EB Right	A	0.40/88 ft	A	0.40/101 ft	A	0.40/87 ft
Front Rd WB Left	D	0.81/498 ft	D	0.81/318 ft	D	0.81/279 ft
Front Rd WB Thru/RT	B	0.68/331 ft	B	0.68/260 ft	B	0.68/217 ft
Ramp NB Left	B	0.23/76 ft	B	0.23/76 ft	B	0.23/75 ft
Ramp NB Thru	B	0.28/96 ft	B	0.28/96 ft	B	0.28/84 ft
Ramp NB Right	C	0.81/251 ft	C	0.81/494 ft	C	0.81/307 ft
Driveway SB left	B	0.41/128 ft	B	0.41/110 ft	B	0.41/124 ft
Driveway SB Thru	B	0.12/64 ft	B	0.12/73 ft	B	0.12/75 ft

Construction Staging Supplemental

GENERAL OVERVIEW

Construction staging for improvements on I-95 will be controlled by the replacement of Bridge No. 00250 and the change of profile grade on I-95 (refer to PDF of profile).

To address the elevation differences due to the proposed profile change, the contractor will be required to build a temporary earth retaining system or install temporary sheeting depending on the depth of bedrock in fill areas. In cut areas, it is assumed that the contractor will be utilizing a temporary lateral support system due to the anticipated depth of bedrock.

Since the ramp configurations for Alternatives 6C and 8 are similar, construction staging on I-95 will essentially be the same. The proposed "Loop" ramp necessitates additional widening of Bridge No. 00250 which allows for the bridge to be reconstructed in 3 basic construction stages. There will be minor construction stages required prior to the disruption of traffic on I-95 and after completion of the bridge to complete the median area. It is envisioned that no overbuild would be required. The removal of the existing superstructure and the placement of new girders for Bridge No 00250 will require periodic closures of Route 161.

Construction staging would differ for Alternative 2 due to the construction of the flyover bridge and the construction of a narrower Bridge No. 00250. The narrower bridge would require 4 basic construction stages to complete the bridge while maintaining adequate deceleration length for the southbound exit ramp. It is envisioned that no overbuild would be required. The placement of the beams for the flyover bridge would require short duration periodic closures of I-95 (not more than 10 minutes). The removal of the existing superstructure and the placement of new girders for Bridge No 00250 will require periodic closures of Route 161.

Potential detour routes during the removal and placement of superstructure will be identified during the preliminary design phase with input from DOT traffic and local emergency response representatives.

ALTERNATIVE 2 – FLYOVER RAMP

STAGE 1

- Build permanent frontage road and widen Route 161 in the vicinity of the frontage road terminus.
 - Install temporary signalization
 - Provide one northbound left-turn lane (two if possible) onto the frontage road.
- Place temporary barrier curb as necessary in the vicinity of Bridge No. 00250 to maintain the existing median and provide two 11-foot lanes with 2-foot inside and outside shoulders in both directions.
- Extend both ends of Bridge 2585.
- Build temporary southbound exit ramp and permanent entrance ramp to frontage road. The exit ramps terminus can be constructed in its permanent location (horizontally & vertically).
- Construct new access road to state maintenance facility.
- Construct the permanent northbound entrance ramp outside the existing northbound entrance ramp area.
- Construct the widened section of the northbound exit ramp.

STAGE 2

- Open SB ramps onto new frontage road including temporary SB exit ramp and permanent SB entrance ramp.
- Place temporary barrier curb along northbound right shoulder.
- To address the elevation differences due to the proposed profile change, the contractor will be required to build a temporary earth retaining system or install temporary sheeting depending on the depth of bedrock in fill areas. In cut areas, it is assumed that the contractor will be utilizing a temporary lateral support system due to the anticipated depth of bedrock.
- Remove section of Bridge No. 00250 superstructure along northbound I-95 (fascia girder and deck to next girder, which must remain).
- Construct available outside section of northbound I-95 including Bridge No. 250. (Provide 26' for two 11-foot travel lanes and two 2-foot shoulders on bridge. This may require a slight shifting of the new centerline to the southeast.)
- Lengthen Bridge No. 00251 (to the right of the northbound lanes).

STAGE 3

- To address the elevation differences due to the proposed profile change, the contractor will be required to build a temporary earth retaining system or install temporary sheeting depending on the depth of bedrock in fill areas. In cut areas, it is assumed that the contractor will be utilizing a temporary lateral support system due to the anticipated depth of bedrock.
- Place temporary barrier curb where required
- Construct embankment for entrance to flyover ramp
- Shift northbound traffic to the right onto newly constructed section (Stage 2).
- Remove/reconstruct section of I-95/bridge vacated by Phase 2 NB lanes
- Construct abutments, wingwalls, retaining walls and embankments for northbound entrance ramp (flyover).

STAGE 4

- Shift SB travel lanes onto newly constructed section (Stage 3).
 - Access to SB exit ramp maintained on the existing outside lane.
- To address the elevation differences due to the proposed profile change, the contractor will be required to build a temporary earth retaining system or install temporary sheeting depending on the depth of bedrock in fill areas. In cut areas, it is assumed that the contractor will be utilizing a temporary lateral support system due to the anticipated depth of bedrock.
- Place temporary barrier curb where required
- Remove/reconstruct section of I-95/bridge vacated by Stage 3 SB lanes

STAGE 5

- Shift SB deceleration lane for the exit ramp onto newly constructed section (Stage 4)
- Construct remaining section of I-95, Bridge No. 250 and permanent SB exit ramp

STAGE 6

- Shift SB travel lanes and deceleration lane onto outside area of completed stages 4 & 5.
- Place temporary barrier along both sides the permanent median area.
- Construct pier for flyover ramp and permanent barrier curb

- Construct superstructure for flyover bridge

STAGE 7

- Complete the following
 - widening of Route 161
 - signalization
 - Sidewalks & driveways
 - widening of I-95
 - illumination
 - guiderail systems

ALTERNATIVES 6C & 8

STAGE 1

- Build permanent frontage road and widen Route 161 in the vicinity of the frontage road terminus and other available areas.
 - Install temporary signalization
 - Provide one (two if possible) northbound left-turn lane(s).
- Place temporary barrier curb in the vicinity of Bridge No. 00250 as necessary to maintain the existing median and provide two 11-foot lanes with 2-foot inside and outside shoulders in both directions.
- To address the elevation differences due to the proposed profile change, the contractor will be required to build a temporary earth retaining system or install temporary sheeting depending on the depth of bedrock in fill areas. In cut areas, it is assumed that the contractor will be utilizing a temporary lateral support system due to the anticipated depth of bedrock.
- Extend both ends of Bridge 2585
- Excavate and form embankments in available areas.
- Build temporary southbound exit ramp and permanent entrance ramp to frontage road. The exit ramps terminus can be constructed in its permanent location (horizontally & vertically).
- Construct new access road to state maintenance facility.
- Construct available realigned section of the northbound entrance ramp (Alt 6C only).
- Construct realigned section of the northbound exit ramp (Alt 8 only).

STAGE 2

- To address the elevation differences due to the proposed profile change, the contractor will be required to build a temporary earth retaining system or install temporary sheeting depending on the depth of bedrock in fill areas. In cut areas, it is assumed that the contractor will be utilizing a temporary lateral support system due to the anticipated depth of bedrock.
- Construct available outside section of northbound I-95 including Bridge No. 250 and lengthen Bridge No. 00251 (to the right of the northbound lanes).
- Construct the available section of the permanent NB entrance “slip” ramp.
- Construct the available section of embankment for NB entrance “loop” ramp.
- Install temporary signalization at terminus of NB exit ramp.

STAGE 3

- To address the elevation differences due to the proposed profile change, the contractor will be required to build a temporary earth retaining system or install temporary sheeting depending on the depth of bedrock in fill areas. In cut areas, it is assumed that the contractor will be utilizing a temporary lateral support system due to the anticipated depth of bedrock.
- Place temporary barrier curb where required
- Shift northbound traffic to the east onto newly constructed section (Stage 2) and new NB exit ramp.
- Remove existing northbound superstructure and complete the new northbound superstructure and available roadway sections vacated by Phase 2 NB lanes.

STAGE 4

- To address the elevation differences due to the proposed profile change, the contractor will be required to build a temporary earth retaining system or install temporary sheeting depending on the depth of bedrock in fill areas. In cut areas, it is assumed that the contractor will be utilizing a temporary lateral support system due to the anticipated depth of bedrock.
- Place temporary barrier curb where required
- Shift southbound through traffic onto newly constructed section (Stage 3)
- Maintain existing temporary SB exit ramp until new temporary SB ramp is completed.

STAGE 5

- Complete the widening of I-95 along with Bridge Nos. 250 and 251
- Place temporary barrier along both sides the permanent median area
- Complete the following on I-95:
 - Permanent center median barrier curb
 - illumination
 - guiderail systems
- Complete widening of Route 161
 - signalization
 - Sidewalks
 - Driveways