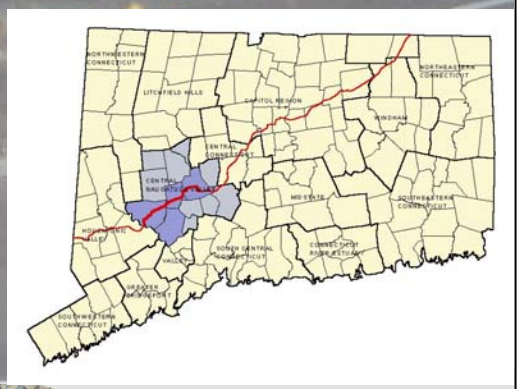
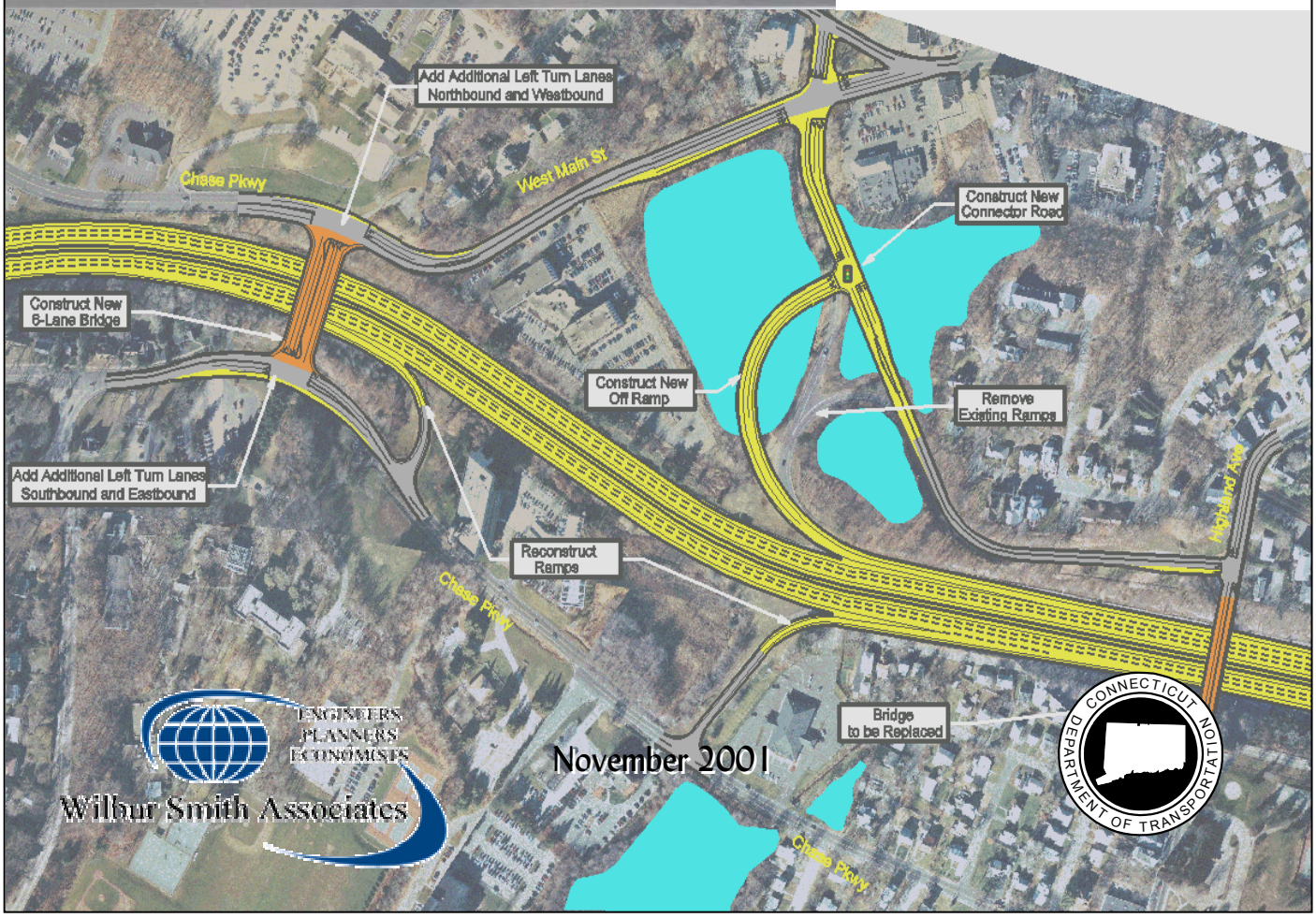
FINAL REPORT

I-84 WEST OF WATERBURY
NEEDS AND DEFICIENCIES STUDY

State Project #174-275





ENGINEERS
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November 2001

CONNECTICUT DEPARTMENT OF TRANSPORTATION

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Prepared For

CONNECTICUT DEPARTMENT
OF TRANSPORTATION

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EXECUTIVE SUMMARY

The Connecticut Department of Transportation (ConnDOT), and the Council of Governments of Central Naugatuck Valley (COGCNV) have identified peak hour traffic congestion and safety deficiencies along Interstate 84 (I-84) as major concerns for the West of Waterbury (WOW) corridor between the Housatonic River in Southbury and Interchange 23 in Waterbury. To address these concerns and to evaluate the effectiveness of different transportation improvement alternatives, these agencies are jointly undertaking a Needs and Deficiencies Study for the WOW corridor.

The mobility and economic vitality of the corridor is of critical importance to its communities, the Central Naugatuck Valley Region (CNVR), and the state as a whole. In addition, because the corridor includes I-84, all of New England will be impacted by the proposed transportation improvements. The ability to continue to move safely and efficiently through the corridor will influence the competitive position of businesses in the region.

This report identifies the existing and future needs and deficiencies in the WOW corridor and recommends modifications that will best meet the needs of the towns, the region, and the state. The recommendations were chosen from a set of alternatives developed as a result of input from the citizens and representatives of the study area communities. The suggested alternatives were evaluated on their ability to satisfy the study goals and objectives and to accommodate future mobility and land use projections. The selected improvements were identified by their overall effectiveness in contributing to safety, reducing congestion, and improving air quality and by their economic feasibility.

Study Area Definition

The study corridor limits can be described as: I-84 from the Housatonic River (Interchange 13) in Southbury to Interchange 23 in Waterbury, including the interchange of Route 8 and its associated ramps, the Oxford Airport, the intersection of Routes 63 and 64, and approximately 2000 feet of land on both the north and south sides of the Interstate. The physical transportation improvement recommended by this study focused on approximately 13 miles of this corridor from Interchange 18 in Waterbury to the Housatonic River.

Transportation Goals and Objectives

Transportation Goals and Objectives are the cornerstones for evaluating alternative transportation improvements. To evaluate the potential for success of these alternatives, an Advisory Committee (AC) was asked to define the goals and objectives for the study. The following four goals are supported by a comprehensive set of specific objectives and related performance measures:

- **Reduce Peak Hour Congestion -** The first goal is to reduce peak hour vehicular congestion, both in the A.M. and P.M. periods.

- **Public Health and Safety -** The second goal is to improve public health and safety associated with transportation.

- **Economic Development -** The third goal is to increase opportunities for local and region-wide economic development by improving transportation mobility.

- **Community Livability and Quality of Life -** The fourth goal is to enhance the livability and quality of life for corridor towns, neighborhoods and communities

Land Use

Land use is the force that drives the increase or decrease in traffic within a region. As land that is zoned commercial or industrial is developed, jobs and services are created that attract people. Residential properties are created in areas that allow those people to access their jobs, and population densities are created and moved as the economy dictates. With this dynamic demographic environment comes change in transportation, both in magnitude and orientation. Areas that are in stages of growth also see growth in traffic, while areas that experience losses in population and employment typically have reductions in traffic. The specific areas in which towns zone their developable land also plays an important role in traffic congestion. The trend toward suburban sprawl increases the average trip length and contributes to the utilization of roads that were not necessarily designed to accommodate high levels of traffic. With this in mind, towns and cities must plan carefully in order to best utilize the existing transportation infrastructure.

While various communities within the study corridor are forecasted to grow at differing rates, the underlying premise is that the region will experience modest growth over the next 25 years. This will mean growth in traffic that will need to use the existing transportation infrastructure, much of which is currently experiencing high levels of traffic.

Other Modes of Transportation

The WOW Study is mainly focused on the operations and performance of the interstate and its associated interchanges, with a primary goal to define opportunities that would reduce vehicular congestion. This does not explicitly imply that capacity must be added to the interstate to accommodate the growth in traffic. While this is certainly a potential transportation alternative, it must be supported by investments in other modes of transportation to provide a long term and user- friendly solution to the sustained mobility of the region. For this reason, several other modes of transportation were identified and inventoried to gain a perspective on their scope and effectiveness. They were as follows:

- Public Transit (bus and rail);
- Oxford Airport;
- Goods Movement (trucks);
- Pedestrian Facilities; and
- Bicyclist Facilities.

Environmental and Social Factors

The development patterns within the WOW corridor vary between densely developed urban and developed rural. This development has displaced much of the natural environment of the sub-region; however, that which remains is important to sustain the ecological and human quality of life. As a first step, from available sources of information, these natural resources have been identified and mapped. As improvement alternatives are refined, additional data will be gathered and potential impacts quantified.

Environmental resources, such as farmlands: environmental risk sites, wetlands, important fisheries and wildlife habitat, rare and endangered species, watercourses, wells, and aquifers, floodplains, public water supplies and surface water, public 4(f) and 6(f) lands, and air and noise impacts, were identified from secondary source data.

Cultural resources are an important part of Connecticut's heritage and cultural fabric. Significant historic and archaeological resources receive protection under Section 106 of the National Historic Preservation Act and Section 4(f) of the U.S. Department of Transportation Act.

Social factors and cultural resources, including historic sites, archeological sites, commercially important natural resources, visual/aesthetic resources, business activity and major employers, park-lands, management area and campgrounds, and museums and cultural resources were identified as part of this study.

"Environmental Justice" requires that no federally funded project should be implemented in such a way as to result in disproportionately high and adverse effects on disadvantaged, minority, and/or low-income populations. The 1990 U.S. Census data were reviewed as the primary means of evaluating potential environmental justice issues in the Study Area. With the exception of Waterbury, the communities within the Study Area have a lower percentage of low income and minority populations than the CNV Region overall and the State of Connecticut in general.

The recommended improvements have been conceptualized to avoid and/or minimize negative affects upon environmental resources, social and cultural factors, and populations considered under "Environmental Justice".

Study Purpose and Need

The mobility and economic vitality of the WOW Corridor is of critical importance to its communities, the CNV Region, and the state as a whole. In addition, because the corridor includes I-84, all of New England will be affected by the proposed transportation improvements. The ability to continue to move safely and efficiently through the corridor will influence the competitive position of businesses in the region.

The transportation improvements considered must respond to a variety of regional and local needs, including:

- Peak hour congestion of I-84 and parallel arterial roads;

- I-84 highway connectivity;
- Highway safety and directional signage;
- Assessing the future of the I-84/Route 8 viaduct; and,
- Public transit's role in the region.

In addition to these issues, other equally pressing matters are faced by municipalities and localized communities. For example, economic redevelopment initiatives in Waterbury, or highway spillover traffic on local town roads are important issues for local decision makers.

This Deficiencies and Needs Study for the I-84 corridor has been undertaken by the ConnDOT and COGCNV to define improvements that would address peak period traffic congestion and safety deficiencies along I-84 between Downtown Waterbury and the Housatonic River in Southbury.

Transportation Strategies

The identification and screening of potential alternative transportation improvements was performed in the Needs and Deficiencies process. The range of transportation improvements that were considered in this evaluation are listed below. They include No Build, Transportation Systems Management, Transportation Demand Management, Transit Operations, Intelligent Transportation Systems, Freeway Operations and Reconstruction Without Additional Capacity, and Freeway Reconstruction With Additional Capacity.

- No Build (Existing and Committed)

  The first strategy category is the No Build alternative. This Maintenance and Preservation Level of Improvement (LOI) would consider the implementation of improvements currently programmed and would contemplate no further increases to transport system capacity. The strategy assumes that facilities will be maintained effectively and safety improvements made where necessary.

- Transportation Systems Management

  Transportation System Management (TSM) is a name given to a broad range of strategy types whose purpose is to get the most out of existing transportation infrastructure without major capital investment. The performance of TSM related strategies is typically measured in terms of the movement of people and goods. TSM strategies are closely related to Transportation Demand Management (TDM) and Transit Operations (Bus Operations). A complementary package of TSM, TDM, and Bus Operations provides the potential for the most efficient system operation.

- Transportation Demand Management

  Transportation Demand Management (TDM) is a generic term that encompasses a wide range of strategies that have been employed by jurisdictions across the U.S. to reduce peak hour vehicular travel and increase overall mobility. There is a compelling relationship

between land use and transportation. The form and relationship among land uses dictates the type and level of travel demand generated. Travel demand is further influenced by the availability of alternative modes, travel time, and cost of trip - fare, parking, and other vehicle costs. The purpose of TDM strategies is to control these factors in a manner that direct travel demand to more efficient and productive modes.

- Transit Operations Service

  Bus system improvements could improve the ability of bus systems in the study corridor to attract riders and meet mobility needs. For example, an express service running the length of the WOW corridor and beyond that would serve local commuters.

- Freeway Operations/Intelligent Transportation Systems

  Intelligent Transportation Systems (ITS) means the application of modern information management processing, and communication technology to transportation systems. It includes a wide range of techniques capable of improving many different aspects of traffic and transportation systems

- Interchange Improvements

  The expressed purpose of these improvements is to increase the safety and useful life of current facilities, while improving the operation of traffic. This category of improvements included:

  - Improvement in roadway geometrics - horizontal and vertical curve;
  - Reconstruction of bridges and drainage structures;
  - Substitution of right-hand for left-hand ramps; and
  - Completion of interchanges from partial to full movements.

- Additional Capacity on Interstate 84

  This strategy evaluated the addition of a highway lane(s) for general-purpose traffic on I-84. Reconstruction of the facility would include the correction of ramps, completion of interchanges, reconstruction (and widening) of bridges, and modification of substandard geometrics.

Evaluation and Screening of Transportation Alternatives

Each of the conceptual alternatives identified in the study were evaluated based on their ability to address the deficiencies in the transportation system while avoiding or having minimal impact to environmental and social constraints.

The initial screening process used the stated Goals and Objectives as defined by the Advisory Committee as criteria to be evaluated against. Performance measures were used to quantify the transportation benefits, while environmental and social impacts were qualitatively identified

based on constraints mapping. From this process, a series of conceptual transportation improvements was developed to address each of the identified corridor deficiencies, and public comment was used to shape the alternatives into solutions that best served the needs of the communities.

The second phase of screening involved revising many of the conceptual improvement alternatives to consider physical geometry, construction constraints, cost estimates, property impacts, and additional environmental concerns. The suggested modifications that resulted, while still conceptual in nature, constitute the recommendations provided in this report.

Recommended Actions

The principle transportation improvement recommendation to result from this study process is the addition of a General Purpose Lane on I-84 in each direction with intermittent truck climbing lanes, from Interchange 13 to Interchange 18. This is approximately 13-miles of I-84 that today primarily has two travel lanes in each direction with intermittent truck climbing lanes. The cost for the construction of additional lanes on I-84 is approximately $267,600,000.

Additional improvements are also recommended at each interchange area west of, and including, Interchange 18 to address various deficiencies in the transportation system. These improvements consist of Transportation Systems and Demand Strategies as well as safety improvements to the corridor. The cost for the interchange improvements is approximately $15,000,000. Finally, the need for improvements for the I-84/Route 8 Interchange area in Waterbury has been identified, but need to be quantified by a future study.

Each of the recommended improvements has in the following text been tabulated by interchange area. Recommended improvements identified as short-term are projects that may be advanced within a schedule which is ahead of the long-term projects.

Interchange 13

Interchange 13 in Southbury is the westernmost interchange within the WOW study corridor. It forms a partial interchange just east of the Housatonic River, serving trips to and from the west. This interchange has two mainline lanes along I-84 in the eastbound and westbound directions. The on and off ramps to and from I-84 are single lane ramps. The short-term and long-term recommendations at this interchange area are listed in Table ES-1.

Table ES-1
Summary of Interchange 13 Recommendations

Project	Type	Preliminary Cost Estimate	Comments
Short-Term			
➢ Increase corner radius at WB entrance ramp and Oakdale Manor Road to 50 feet to accommodate trucks	TSM - Intersection	N/A	This deficiency will be addressed by DOT Safety Improvement Project No. 130-169
➢ Construct a new park and ride lot in interchange area	TDM - Parking	$320,000	
➢ Install a new sign for I-84 WB entrance ramp on Oakdale Manor Road	TSM - Signage	$2,500	
➢ Replace the faded route marker on Fish Rock Road	TSM - Signage	$500	Notify ConnDOT Maintenance
Long-Term			
➢ Provide 1400 feet of acceleration length for I-84 WB entrance ramp	Interstate Ramp	N/A	Will be completed as part of Interstate reconstruction
➢ Provide 500 feet of deceleration length for I-84 EB exit ramp	Interstate Ramp	N/A	Will be completed as part of Interstate reconstruction
➢ Provide an additional General Purpose Lane along I-84 EB	Interstate Mainline	N/A	Costs are broken out by contract (see Table 5.9)
➢ Provide Additional General Purpose Lane along I-84 WB	Interstate Mainline	N/A	Costs are broken out by contract (see Table 5.9)

NA – Not Applicable – will be completed by ConnDOT

The short-term recommendation for this interchange involves improving the corner radius of the westbound entrance ramp at Oakdale Manor Road. Increasing to a standard 50-foot radius will improve safety. This improvement has already been advanced by ConnDOT and will be constructed as part of their safety improvement program. This recommendation also has the potential for inclusion of a commuter parking facility and the improvement of signage in the area.

As a long-term solution, I-84 in the vicinity of this interchange requires an additional general-purpose lane in each direction to accommodate future year (2025) traffic volumes. In addition, adequate acceleration and deceleration distances need to be provided during the freeway reconstruction phase in coordination with the additional general-purpose lane.

Interchange 14

Interchange 14 in Southbury has full directional access to and from Route 172. This interchange has two mainline lanes and single lane entrance and exit ramps along I-84 in the eastbound and westbound directions. In the future year 2025, the eastbound entrance and exit ramp junctions with I-84 operate at LOS F during the weekday evening peak hour. The westbound entrance and exit ramp junctions with I-84 operate at LOS F during the weekday morning peak hours. During the weekday evening peak hour, the South Britain Road and I-84 westbound exit ramp junction operates at LOS F. It has been determined that the lack of storage space between the westbound off ramp and Main Street South along with the heavy right hand turn movement at this

intersection creates a queuing problem on this ramp. The short-term and long-term recommendations at this interchange area are listed in Table ES-2.

Table ES-2
Summary of Interchange 14 Recommendations

Project	Type	Preliminary Cost Estimate	Comments
Short-Term			
➢ Signalize the intersection with I-84 WB exit ramp and S. Britain Road to relieve queuing on ramp. ➢ Provide signal coordination and adequate lane geometry to improve traffic operations at intersection of S. Britain Road and Main Street South	TSM - Intersection	$550,000	
➢ Provide additional acceleration length for I-84 EB and WB entrance ramps	Interstate Ramp	N/A	This deficiency will be addressed by DOT Safety Improvement Project No. 130-169
➢ Eliminate the all-way STOP sign control at the intersection of Lakeside Road/Georges Hill Road/I-84 EB Off Ramp and provide a traffic signal	TSM - Intersection	$490,000	Intersection will require additional time between phases to clear vehicles
➢ Install a new I-84 directional sign on Main Street South	TSM - Signage	$500	
➢ Replace the damaged directional sign on I-84 WB exit ramp	TSM - Signage	$500	Notify ConnDOT Maintenance
Long-Term			
➢ Provide 600 feet of deceleration length for I-84 EB exit ramp	Interstate Ramp	N/A	Will be completed as part of Interstate reconstruction
➢ Provide additional General Purpose Lane along I-84 EB	Interstate Mainline	N/A	Costs are broken out by contract (see Table 5.9)
➢ Provide additional General Purpose Lane along I-84 WB	Interstate Mainline	N/A	Costs are broken out by contract (see Table 5.9)

NA – Not Applicable – will be completed by ConnDOT

To improve traffic operations, the intersection of Main Street South and South Britain Road requires widening and signal coordination with the South Britain Road and I-84 Westbound Off-Ramp intersection. Constraints at the intersection include a gas line that runs south of the intersection and parallel to Main Street South. There is also a commuter parking lot in the southeast quadrant of the intersection. In the northwest quadrant of the intersection, there are residential properties that should be considered prior to widening the intersection.

The intersection of Lakeside Road, Georges Hill Road, and the I-84 Eastbound Ramp is recommended to be signalized and widened to improve traffic operations. Widening on the east side of the intersection is constrained by rock ledge so widening may need to be performed on the west side of the intersection.

As a long-term solution, I-84 in the vicinity of this interchange requires an additional general-purpose lane in each direction to accommodate future year (2025) traffic volumes. ConnDOT is currently pursuing a Safety Improvement Project (No. 130-169) to improve acceleration

distances at this interchange. The deceleration distance along I-84 EB will be addressed during the freeway reconstruction phase of the project (long-term solution).

Other recommendations at this location involve improving highway and roadway signage (TSM).

Interchange 15

Interchange 15 is the primary access to the Town of Southbury. It provides full directional access to and from Route 6. Major commercial development in this area makes it the most heavily utilized interchange in Southbury. The configuration consists of two mainline lanes and single lane entrance and exit ramps along I-84 in the eastbound and westbound directions; however, in the westbound direction due to the presence of a climbing lane, there are three mainline lanes along I-84 just west of the on ramp from Route 6/Route 67 and the IBM driveway. In the future year 2025, the eastbound entrance and exit ramps from Route 67 operate at LOS F during the weekday evening peak hour, while the westbound entrance and exit ramps operate at LOS F during the weekday morning peak hour. The short-term and long-term recommendations at this interchange area are listed in Table ES-3.

Table ES-3
Summary of Interchange 15 Recommendations

Project	Type	Preliminary Cost Estimate	Comments
Short-Term			
➢ Provide additional turn lanes to improve traffic operations at intersection of Route 6/Main Street South/Southbury Plaza Driveway	TSM - Intersection	$150,000	
➢ Extend the EB truck climbing lane through the interchange to eliminate difficult weave	Interstate Mainline / Safety		Will involve expanding the I-84 structure over S. Britain Road
➢ Improve visibility of I-84 directional sign	TSM - Signage	N/A	Notify ConnDOT Maintenance
➢ Provide adequate signage along Route 6/67 to alert drivers in advance of the I-84 EB and WB On-Ramps	TSM - Signage	$2,000	
Long-Term			
➢ Provide 900 feet of acceleration length along I-84 EB entrance ramp	Interstate Ramp	N/A	Will be completed as part of Interstate reconstruction
➢ Provide additional 400 feet deceleration length to I-84 WB exit ramp to account for vehicle queue on ramp	Interstate Ramp	N/A	Will be completed as part of Interstate reconstruction
➢ Provide additional General Purpose Lane along I-84 EB	Interstate Mainline	N/A	Costs are broken out by contract (see Table 5.9)
➢ Provide additional General Purpose Lane along I-84 WB	Interstate Mainline	N/A	Costs are broken out by contract (see Table 5.9)

NA – Not Applicable – will be completed by ConnDOT

The intersection of Main Street, Route 6/67 and Southbury Plaza is recommended to be widened to provide an additional left turn lane in the northbound direction along Main Street. Due to this widening, Main Street would need to be widened in the westbound direction to provide adequate width for left turning vehicles. Also, the northbound right turn lane on Main Street would be shifted east of its present location due to the additional left turn lane. Based on field surveys, it appears feasible to provide the additional widening on the east side without impacting the parking lot in Southbury Plaza.

As a long-term solution, this interchange requires an additional general-purpose lane in each direction to accommodate future year (2025) traffic volumes. In addition, adequate acceleration and deceleration distances will be provided along I-84 in the eastbound and westbound directions during the freeway reconstruction phase of the project.

The extension of the existing truck climbing lane through the interchange area and improving highway signage will also be looked at as a short-term solution.

Interchange 16

Interchange 16 provides full directional access to and from Route 188 in Southbury. While these ramps are important to development in Southbury, they also serve development in Middlebury and Oxford. Interchange 16 also provides an important linkage to Oxford Airport. This interchange has two mainline lanes and single lane entrance and exit ramps along I-84 in the eastbound and westbound directions. In the future year 2025, the eastbound entrance and exit ramps from Route 188 operate at LOS F during the weekday evening peak hour, while the westbound entrance and exit ramps operate at LOS E and LOS F respectively during the weekday morning peak hour. The short-term and long-term recommendations at this interchange area are listed in Table ES-4.

Table ES-4
Summary of Interchange 16 Recommendations

Project	Type	Preliminary Cost Estimate	Comments
Short-Term			
➢ Provide signal coordination and additional lanes to improve traffic operations at the intersection of Old Waterbury Road and Route 188. ➢ Provide signal coordination and additional lanes to provide more storage and improve traffic operations at intersection of I-84 WB exit ramp and Route 188.	TSM - Intersection	$580,000	
➢ Provide additional acceleration length for I-84 WB entrance ramp	Interstate Ramp	N/A	This deficiency will be addressed by DOT Safety Improvement Project No. 130-169
➢ Install a new I-84 directional sign along Old Waterbury Road	TSM - Signage	$500	
➢ Install new route signage on I-84 WB exit ramp	TSM - Signage	$500	
➢ Straighten the I-84 EB entrance ramp sign	TSM - Signage	N/A	Notify ConnDOT Maintenance
Long-Term			
➢ Provide 1500 feet of acceleration length for I-84 WB entrance ramp	Interstate Ramp	N/A	Will be completed as part of Interstate reconstruction
➢ Provide 600 feet of deceleration length for I-84 EB exit ramp	Interstate Ramp	N/A	Will be completed as part of Interstate reconstruction
➢ Provide additional General Purpose Lane along I-84 EB	Interstate Mainline	N/A	Costs are broken out by contract (see Table 5.9)
➢ Provide additional General Purpose Lane along I-84 WB	Interstate Mainline	N/A	Costs are broken out by contract (see Table 5.9)
➢ Investigate the potential for truck rest areas – include shoulders on truck climbing lanes	TDM - Truck / TSM - Safety	N/A	

NA – Not Applicable – will be completed by ConnDOT

The recommendation for the intersection of Old Waterbury Road and Route 188 requires the provision of an exclusive right turn lane in the eastbound direction along Old Waterbury Road,

an exclusive left turn lane in the northbound direction, and an additional through lane in the southbound direction along Route 188. The intersection of I-84 WB Ramp and Route 188 will require additional left turn and through lanes in the northbound direction and an exclusive right turn lane in the southbound direction along Route 188 to accommodate future year traffic volume.

As a short-term solution, the two intersections should be widened as TSM improvements. In addition to the widening, the two signals should be coordinated to reduce queuing between intersections. Based on field surveys, widening along Route 188 seems achievable along the east side of the intersection due to the existence of wetlands west of the present alignment.

Other short-term improvements include providing highway and roadway signage in the vicinity of the interchange.

As a long-term solution, I-84 in the vicinity of this interchange requires an additional general-purpose lane in each direction to accommodate future year (2025) traffic volumes. In addition, adequate acceleration and deceleration distances will be provided along I-84 in the eastbound and westbound directions during the freeway reconstruction phase of the project. Providing adequate acceleration and deceleration distances will improve the sub-standard radii at the I-84 eastbound interchange**.** The need to investigate providing truck rest areas was also identified.

Interchange 17

Interchange 17 possesses some of the poorest operational conditions in the WOW corridor. Due to the physical layout of the interchange, the eastbound entrance and exit ramps are accessed from Route 64 while the westbound entrance and exit ramps are accessed via Route 63. This split interchange configuration creates heavy congestion at the intersection of these two routes. In the future year 2025, the eastbound entrance and exit ramps from Route 63/Route 64 operate at LOS F during the weekday evening peak hour, while the westbound entrance and exit ramps from Route 63/Route 64 operate at LOS F during the weekday morning peak hour. In addition, the westbound off-ramp to Route 64 operates at LOS F during the weekday evening peak hour. The short-term and long-term recommendations at this interchange area are listed in Table ES-5.

Table ES-5
Summary of Interchange 17 Recommendations

Project	Type	Preliminary Cost Estimate	Comments
Short-Term			
➢ Build a Connector Road between Route 64 and Route 63 along existing ROW to provide operational improvement	Arterial Road	$3,130,000	Develop along existing rail ROW
➢ Build a multi-use path along new Connector Road to provide bike/ped access between Middlebury and Waterbury	TDM – Bicycle/ Pedestrian	$210,000	
➢ Signalize the intersection of Chase Parkway/I-84 WB exit ramp/Connector Road and extend the exit ramp deceleration length an additional 525 feet	TSM – Intersection / Interstate Ramp	$1,240,000	Developing a tighter curve on WB exit ramp may help slow vehicles before the new signal
➢ Provide adequate signage to warn drivers of the end of truck-climbing lane on I-84 EB	TSM - Signage	$2,200	
➢ Provide Park and Ride Lot sign on Interstate	TSM - Signage	$2,200	
➢ Provide signage leading commuters to alternate Park and Ride lot at Maggie McFly's on Route 63	TDM – Parking / Signage	$2,000	Main lot at 100% utilization
➢ Replace the 'East' auxiliary sign mounting on I-84 Route marker	TSM - Signage	$100	Notify ConnDOT Maintenance
➢ Install a directional sign on Route 64 indicating Chase Parkway intersection	TSM - Signage	$600	
➢ Repair the bent sign on the I-84 EB entrance ramp	TSM - Signage	$100	Notify ConnDOT Maintenance
Long-Term			
➢ Provide 900 feet of acceleration length on I-84 WB entrance ramp	Interstate Ramp	N/A	Will be completed as part of Interstate reconstruction
➢ Widen the Route 63/64 intersection and provide additional lanes to accommodate future traffic volumes	TSM - Intersection	$1,050,000	May have property impacts
➢ Re-grade Route 64 to eliminate crest vertical curve and poor sight distance. ➢ Widen Route 64 (in conjunction with re-grade) to accommodate four lane cross section	Arterial Road	$2,150,000	Should not impact existing utilities. Should be done in conjunction with intersection improvements
➢ Provide additional General Purpose Lane along I-84 EB	Interstate Mainline	N/A	Costs are broken out by contract (see Table 5.9)
➢ Provide additional General Purpose Lane along I-84 WB	Interstate Mainline	N/A	Costs are broken out by contract (see Table 5.9)

NA – Not Applicable – will be completed by ConnDOT

The recommendations at this interchange would require a significant investment to complete. The biggest traffic operational concern is the intersection of Route 63 and Route 64. As a short-term improvement, a Connector Road constructed from Route 63 to Route 64 along existing rail ROW could provide relief to congestion at the intersection and also improve operations along Route 63 and Route 64. As traffic volumes in the corridor increase, the intersection would

require additional widening to operate efficiently. Other short-term improvements would include providing adequate highway and roadway signage at this interchange.

A recommended long-term improvement involves widening the intersection of Route 63 and Route 64 to handle the increasing level of traffic. Route 64 is recommended to be widened to four lanes and re-graded to reduce the crest vertical curve that is contributing to poor sight distance approaching the intersection from the east. In addition, the provision of a general-purpose lane through this interchange and increasing acceleration distances in the eastbound direction will be part of a freeway reconstruction phase at this location.

Interchange 18

Interchange 18 has two mainline lanes and single lane entrance and exit ramps along I-84 in the eastbound and westbound directions; however, in the westbound direction I-84 includes a truck-climbing lane at the Highland Avenue off ramp junction. Under the future year 2025, all freeway ramp junctions operate at LOS E or worse during the weekday morning and evening peak hours. The short-term and long-term recommendations at this interchange area are listed in Table ES-6.

Table ES-6
Summary of Interchange 18 Recommendations

Project	Type	Preliminary Cost Estimate	Comments
Short-Term			
➢ Build a Connector Road between Highland Avenue and W. Main Street to provide better connectivity. ➢ Reconstruct I-84 WB exit ramp to a standard 275 foot radius – install signal to intersection of ramp with connector road	Arterial Road / Interstate Ramp	$3,880,000	
➢ Widen the bridge over I-84 to provide an additional left turn lanes to Chase Parkway	Structural	$710,000	Structure needs to be widened as part of the additional lane improvement (cost included in add-a-lane)
➢ Provide overhead Route 8 directional signs on I-84 EB to reduce driver confusion	TSM - Signage	$100,000	
➢ Install a new I-84 directional sign on W. Main Street	TSM - Signage	$500	
➢ Install a new I-84 directional sign on Country Club Road	TSM - Signage	$500	
➢ Replace the deteriorated sign along Chase Parkway	TSM - Signage	$500	Notify ConnDOT Maintenance
➢ Provide adequate I-84 route signage along Chase Parkway to reduce driver confusion	TSM - Signage	$1,000	
➢ Move I-84 route sign away from fence on Highland Avenue to improve visibility	TSM - Signage	N/A	Notify ConnDOT Maintenance
Long-Term			
➢ Provide 500 feet of acceleration length to I-84 EB entrance ramp	Interstate Ramp	N/A	Will be completed as part of Interstate reconstruction
➢ Provide 500 feet of deceleration length to I-84 EB and WB exit ramps	Interstate Ramp	N/A	Will be completed as part of Interstate reconstruction
➢ Reconstruct I-84 EB to include an additional General Purpose Lane – lane will drop before entrance ramp but full pavement width will extend to Route 8 northbound entrance ramp	Interstate Mainline	N/A	Costs are broken out by contract (see Table 5.9)
➢ Provide additional General Purpose Lane along I-84 WB	Interstate Mainline	N/A	Costs are broken out by contract (see Table 5.9)

NA – Not Applicable – will be completed by ConnDOT

Like Interchange 17, Interchange 18 presents numerous operational and safety deficiencies while being constrained by the physical limits of the transportation infrastructure. While not all of the deficiencies can be addressed as part of this study, some improvement can be made to relieve the traffic pressure that is building in this area.

This interchange will require primarily traffic operations related improvements. The bridge over I-84 along Chase Parkway is recommended to be widened to provide six lanes to solve the

operational problems between West Main Street and Country Club Road. This widening could be pursued as a short-term improvement and would require bridge reconstruction.

The sub-standard curve radius at the I-84 WB Exit Ramp to Highland Avenue/W. Main Street could also be pursued as a short-term improvement. The realigned ramp would intersect with a newly constructed Connector Road between W. Main Street and Highland Avenue. Other improvements at this interchange are related to highway and roadway signage and will be pursued as short-term improvements.

The long-term improvement at this interchange is providing an additional I-84 general-purpose lane in each direction and providing adequate acceleration and deceleration distances in both directions during the freeway reconstruction phase. A key to the highway operations at this interchange is its connectivity to the Route 8 Interchange and will be investigated further when the Route 8 Interchange is evaluated in a separate concentrated future study.

Additional Recommendations

Interchanges 19, 20, and 21 constitute the series of ramps and interconnections that make up the 'Mixmaster' I-84/Route 8 Interchange structure in Downtown Waterbury. The bridge structures for the eastbound and westbound viaducts are stacked vertically, rather than in a more conventional arrangement where the opposing roadways are parallel to each other. This section of I-84 experiences numerous operational, structural, and safety deficiencies. Some of these are as follows:

- Left hand exit from I-84 eastbound to Route 8 northbound;
- Left hand entrance to I-84 eastbound from Route 8 southbound;
- Left hand entrance to I-84 westbound from Route 8 northbound;
- Left hand entrance to I-84 westbound from Bank Street;
- Substandard weave section between I-84 eastbound entrance from Route 8 south to Meadow Street Exit ramp;
- Substandard weave section between I-84 westbound entrance from Route 8 north to Highland Street Exit ramp;
- High accident location I-84 at Route 8, Meadow Street Interchange (Interchange 21);
- Two lane stretch of I-84 eastbound between exit to Route 8 northbound and entrance from Route 8 southbound; and
- Poor structural rating on main span over Naugatuck River (will be upgraded by ConnDOT).

While identifying these deficiencies, it became apparent that this interchange area would require a detailed analysis that is beyond the scope of this study. The level of complexity that this interchange area exhibits requires a focused effort that considers not only traffic operation, but structural analysis, maintenance and protection of traffic, environmental and social mitigation, property impacts, and a robust public involvement program. It is the recommendation of this study to conduct a follow-on study that will consider each of these elements in greater detail. For the purpose of this discussion, this future study will be referred to as the Waterbury Access Study.

In addition, inadequate Wayfinding (Tourism) and Directional signage has been identified as a deficiency in this study. While the intent of this study was not to develop a detailed signage plan or design the layout of special signage, it did take a conceptual look at the routing of traffic to and from I-84. It is the further recommendation of this study to develop a detailed signage plan for Downtown Waterbury. This may be a component of a Waterbury Access Study or a stand-alone investigation.

The recommended actions for the remainder of the corridor are listed in Table ES-7.

Table ES-7
Summary of Additional Recommendations

Project	Type	Preliminary Cost Estimate	Comments
Short-Term			
➢ Include Downtown Waterbury directional signage to Interstate and other destinations	Study	$10,000	Preliminary Cost - will need to study in greater detail to determine types and locations of signage
➢ Perform a study to evaluate the I-84/Route 8 interchange area	Study	TBN	This area will remain a 'choke point' in the interstate system until a solution is identified and pursued

TBN – To Be Negotiated
NA – Not Applicable – will be completed by ConnDOT

Next Steps

The recommendations from this study will need to satisfy state and federal approval and permitting requirements before they can be further developed and constructed. In order to receive federal funding for a highway project, ConnDOT and COGCNV must demonstrate to Federal Highway Administration (FHWA) that they have considered the environmental impacts of each proposed improvement that is being pursued. To accomplish this, a study must be performed in accordance with the National Environmental Policy Act (NEPA) as well as the Connecticut Environmental Policy Act (CEPA) to determine the level of impact to environmental resources. This study can take one of three forms:

- An Environmental Impact Statement (EIS), which is required for major projects anticipated to have extensive environmental impacts;
- An Environmental Assessment (EA), which is required for projects in which the environmental impacts are uncertain – which can lead to an EIS if impacts are determined to be significant; and
- A Categorical Exclusion (CE), which is required for minor projects that do not have any significant environmental impact.

If wetlands are to be impacted as a result of any of the proposed improvements, the U.S. Army Corps of Engineers (ACOE) requires a Section 404 (of the Clean Water Act) Permit. To apply for this permit, the project must seek to 1) avoid, 2) minimize, or 3) mitigate wetland impacts.

ACOE will review the environmental documents prepared under the NEPA process and decide on the level of the permitting that is required for the project.

Other permits that may be required by Connecticut Department of Environmental Protection (DEP) and U.S. Environmental Protection Agency (EPA) include:

- Connecticut Flood Management Certification;
- Connecticut Inland Wetlands and Watercourses Act Permit;
- Connecticut Indirect Source Permit; and
- National Pollutant Discharge Elimination System.

In addition to the environmental regulations that must be satisfied, FHWA will need to approve any alternative that requires a change in access on the Interstate. This includes ramps that have been relocated or modified to diverge or merge at a new location. Improvements at Interchanges 17 and 18 will need to be evaluated based on safety, design standards, and consistency with surrounding land uses.

Chapter 1
INTRODUCTION

The Connecticut Department of Transportation (ConnDOT), and the Council of Governments of Central Naugatuck Valley (COGCNV) have identified peak hour traffic congestion and safety deficiencies along Interstate 84 (I-84) as major concerns for the West of Waterbury (WOW) corridor between the Housatonic River in Southbury and Interchange 23 in Waterbury. To address these concerns and to evaluate the effectiveness of different transportation improvement alternatives, these agencies are jointly undertaking a Needs and Deficiencies Study for the WOW corridor.

The mobility and economic vitality of the corridor is of critical importance to its communities, the Central Naugatuck Valley Region (CNVR), and the state as a whole. In addition, because the corridor includes Interstate 84, all of New England will be impacted by the proposed transportation improvements. The ability to continue to move safely and efficiently through the corridor will influence the competitive position of businesses in the region.

This report identifies the existing and future needs and deficiencies in the WOW corridor and recommends alternatives that will best meet the needs of the towns, the region, and the state. The study alternatives were developed as a result of input from the citizens and representatives of the study area communities. The suggested alternatives were evaluated on their ability to satisfy the study goals and objectives and to accommodate future traffic and land use projections. The selected improvements were identified by their overall effectiveness in contributing to safety, reducing congestion, improving air quality, and by their economic feasibility.

1.1 Transportation Goals and Objectives

Transportation Goals and Objectives are the cornerstones for evaluating alternative transportation improvements. Goals are defined as:

- Aims or aspirations that direct the intent of implementing strategies. Broader than merely seeking to improve transportation, goals are expressions of "why" transportation strategies are implemented. They may represent changes in overall corridor conditions that will result from transportation improvements of all types. Goals are typically not quantifiable, but represent the expression of overriding societal values. Job creation, environmental protection, education, or recreation can be included into this category.

Objectives represent a separation of defined goals into component elements. They are defined as:

- Supporting components that enable the achievement of targeted goals. Objectives should lead to logical, quantifiable performance measures and focus on singular issues. Objectives may contribute to the achievement of more than one goal for the study.

Performance Measures (or Measures of Effectiveness) enable the quantification of the degree or achievement of defined objectives. They may be applicable for more than one objective.

An Advisory Committee (AC) was established which assisted in evaluating the potential for success of these alternatives. The AC members were asked to define the goals and objectives for the study. At the AC Meeting on the evening of January 26th, 2000, the members were assigned the task of developing a set of goals upon which the study would be asked to address. Each municipality was represented at the meeting and allowed the opportunity to define goals based on their needs and priorities. A uniform set of goals was developed that would govern the process by which the study would proceed.

In response to this exercise, the study team developed a set of corresponding objectives that would be used to satisfy the goals. Table 1.1 lists the goals and objectives that have been identified for this study. In addition, performance measures are listed that will allow the team to determine the relative anticipated ability of the alternatives to address the corridor needs and deficiencies, considering the study goals and objectives.

Table 1.1
Study Goals and Objectives

Goals	Objectives	Performance Measures
Reduce Peak Hour Congestion The goal is to reduce peak hour vehicular congestion, both in the A.M. and P.M. periods.	• Eliminate operational or physical constraints on I-84 and adjacent arterial roads • Reduce vehicle hours of travel (VHT) during peak travel periods • Utilize Intelligent Transportation Systems (ITS) strategies to more effectively manage transportation services and demand	• Vehicle delay • Level of service • Travel time savings • Transportation user benefit and cost • Hours of congestion • Traffic volume • Average speed
Public Health and Safety The goal is to improve public health and safety associated with transportation.	• Reduce the accident potential and hazard associated with the corridor. • Reduce the potential for truck related accidents and enhance overall truck safety in the state and region • Control traffic speed in conformance with legal limits. • Upgrade roadway to eliminate or reduce physical conditions contributing to unsafe movements. • Reduce emissions associated with mobile sources, especially those near sensitive receptors. • Reduce noise impacts to sensitive receptors.	• Number, type and severity of accidents • Median and 85th percentile speed • Truck parking in undesignated areas • Conformance of roadway segments with AASHTO and ConnDOT design standards • Number of sensitive air and noise receptors exposed • Automobile emissions

Table 1.1 continued

Goals	Objectives	Performance Measures
Economic Development The goal is to increase opportunities for local and region-wide economic development by improving transportation mobility.	• Facilitate truck movement through and within the corridor. • Enhance transportation access to areas designated for industrial and economic development. • Increase the economic viability of existing public infrastructure investments, such as roadways, parking facilities, and transit facilities. • Increase the potential for economic viability in terms of regional and state productivity, jobs, and property tax base.	• Number and location of major employment centers served • Number and type of underutilized infrastructure facilities • Economic benefits and costs of transportation improvements • Truck flows and facilities
Community Livability and Quality of Life The goal is to enhance the livability and quality of life for corridor towns, neighborhoods and communities	• Reduce air and noise impacts on neighborhoods and sensitive receptors. • Discourage traffic diversion from the interstate and maintain through traffic on I-84. • Improve traffic flow on arterial highways. • Preserve and enhance aesthetics. • Avoid or mitigate impacts to environmental resources. • Minimize impacts to low-income populations through Environmental Justice.	• Traffic volume on local roads and neighborhoods • Average travel speed on local roads • Watercourses crossed • Acres of wetlands impacted • Numbers of sensitive air and noise receptors impacted • Number of low income households impacted

Source: I-84 Advisory Committee, Wilbur Smith Associates

1.2 Study Area

The study corridor limits are illustrated in Figure 1.1. These limits can be described as: Interstate 84 from the Housatonic River (Interchange 13) in Southbury to Interchange 23 in Waterbury, including the interchange of Route 8 and its associated ramps, the Oxford Airport, the intersection of Routes 63 and 64, and approximately 2000 feet of land on both the north and south sides of the Interstate.

1.3 Study Process

The statement of Existing and Future Conditions (Technical Memorandum # 1) constituted the first step in the Needs and Deficiencies process. It documented transportation system performance, and it identified environmental and social conditions that would affect the viability of various improvement alternatives.

Transportation Alternatives (Technical Memorandum # 2) documented the preliminary alternative improvement strategies that have been put forward by ConnDOT for review by the Advisory Committee. These range from the 'No-Build' Scenario to the construction of an additional lane on each direction of I-84. This report also served as the preliminary screening of feasible alternatives.

This final report in the study process summarizes the documentation presented in Technical Memorandums #1 and #2, presents the results of the transportation alternatives refinement process, and recommends a corridor action plan based on comments from the public and the Advisory Committee.

1.4 Public Participation

A comprehensive public involvement program was developed for the study to bring local organizations and citizens up to date on specific issues and to listen to their concerns. The public involvement program incorporated the following elements:

- Six (6) public meetings of the AC held on January 26th 2000, March 21st 2000, June 26th 2000, October 11th 2000, May 22nd 2001, and November 7th 2001;
- Nine (9) Public Information Meeting held on March 29th 2000, July 19th 2000, January 24th 2000, January 25th 2001, June 6th 2001, June 7th 2001, October 4th 2001, October 9th 2001, and October 15th 2001;
- Twelve (12) presentations to the study area towns and their elected officials;
- Three (3) meetings with COGCNV;
- Four (4) meeting with the Greater Waterbury Chamber of Commerce;
- Several local meetings with private developers and local community groups; and,
- Compilation and maintenance of a mailing list.

The Appendix at the end of this report contains the public comments that were collected at the various Public Informational Meetings.

1.5 Study Team

Wilbur Smith Associates (WSA) was contracted by ConnDOT to perform the study and facilitate public outreach. WSA is a multi-disciplinary transportation engineering and planning firm with extensive experience in multi-modal transportation studies. WSA sub-contracted with two additional firms to aid in the analysis:

- Fitzgerald and Halliday (FHI), specializing in land use planning and environmental analysis.
- GM^2, specializing in structural analysis.

In addition to these firms, an important component of the study team was the Advisory Committee (AC). The AC consisted of representatives from each of the towns and cities within the study corridor and from state and federal public agencies. The group was responsible for assisting in the data collection, analysis review, and public outreach to their respective constituents. Participating agencies and municipalities included:

- Council of Governments of Central Naugatuck Valley (COGCNV)
- City of Waterbury
- Town of Middlebury
- Town of Southbury
- Town of Oxford
- North East Transportation Company
- Rideworks
- Greater Waterbury Transit District
- Country Club Neighborhood Association
- Housatonic Valley Association
- Greater Waterbury Chamber of Commerce
- Federal Transit Administration
- Federal Highway Administration
- U.S. Fish and Wildlife Service
- U.S. Army Corps of Engineers
- Office of Policy and Management
- Connecticut Department of Economic and Community Development
- U.S. EPA, Region I
- Department of Environmental Protection
- State Historic Preservation Office
- Connecticut Motor Transport Association

Chapter 2
EXISTING TRANSPORTATION

2.1 Study Area Demographics

There has been overall growth in both population and employment in the Study Area communities over the past 20 years. Tables 2.1 and 2.2 illustrate the changes. Population and employment levels were derived from the plans of conservation and development for each community, the *Central Naugatuck Valley Regional Plan* (CNV Regional Plan)(COGCNV, 1998), *A Profile of the COGCNVR: 1999* (COGCNV, 1999), projections provided by ConnDOT, and data provided through the state Office of Policy and Management.

Table 2.1
Population Change

Area	1980 Population	1990 Population	2000 Projected	% Change 1980-2000	2025 Projected	% Change 2000-2025
Southbury	14,156	15,818	18,200	29	21,200	16
Middlebury	5,995	6,145	6,499	8	6,600	2
Oxford	6,634	8,685	10,300	55	12,600	22
Waterbury	103,266	108,961	109,700	6	106,500	- 3
CNV Region	237,835	261,081	279,100	17	293,650	5
State of Connecticut	3,107,576	3,287,116	3,316,120	7	3,593,860	8

Source: U.S. Census, ConnDOT

Of the towns that make up the study area, Waterbury has the greatest population followed by Southbury, Oxford, and Middlebury. The greatest growth on a strict percentage basis occurs in Southbury and Oxford. In contrast, much of Waterbury experienced a decline in population. For 2025, Waterbury is projected to decrease in population from 109,700 to 106,500 people. Southbury and Oxford are expected grow significantly in population while Middlebury is projected to remain stable or increase slightly in size.

Employment is also expected to grow substantially in Oxford over the next 25 years. The First Selectman in Oxford anticipates that much of this growth will occur in the industrial area that surrounds the Waterbury-Oxford Airport. Levels of employment growth in the other three corridor communities are expected to be similar to that throughout the CNV Region. While much of Waterbury and Middlebury are expected to grow about 20% in employment, areas of Southbury and Oxford could see a very strong growth in excess of 50%. While this growth seems extraordinarily high, it should be noted that these towns have very low base numbers to begin with.

Table 2.2
Non-Agricultural Employment (persons employed) Change

Area	1980	1990	2000 Projected	% Change 1980-2000	2025 Projected	% Change 2000-2025
Southbury	4,250	6,440	9,130	115	10,530	15
Middlebury	4,170	3,660	3,600	-12	3,970	10
Oxford	850	1,320	1,780	101	3,090	74
Waterbury	49,230	48,510	46,530	5.5	52,180	12
CNV Region	89,980	99,600	106,340	18	122,320	15

Source: Connecticut Dept. of Labor, ConnDOT

The CNV Regional Plan estimates that there were 57,620 jobs in Study Area communities in 1995. This compares with 63,625 employed residents. This means that a great many of the Study Area residents traveled outside the Central Naugatuck Valley region to work. The towns of Middlebury, Oxford, and Southbury are anticipated to continue to have population growth, and will continue to serve as bedroom communities for employees commuting outside the Study Area. These trends suggest that the expected future growth of population and employment in the Study Area in general will result in increases in traffic volumes within the corridor, on local roads, and along I-84 for commuters traveling to and from the Study Area for work.

Trip Distribution. An analysis was performed to determine the origins and destinations of trips of vehicles on Interstate 84. To do this, a segment of I-84 in Waterbury was selected to determine which towns generated traffic that passed through this particular roadway link. From this analysis, a map was developed that illustrated the concentrations of origins and destination for each town in the state.

Figure 2.1 illustrates the distribution of trip ends throughout the state using the I-84 segment in Waterbury. A strong distribution of traffic along the entire WOW corridor and in downtown Waterbury is illustrated. There is also a heavy commuting pattern both north and south of Waterbury, along the Route 8 corridor south to New Haven and north to Litchfield County.

Over 10,000 trips traverse I-84 each day without an origin or destination in Connecticut. This reinforces the fact that I-84 carries a heavy proportion of long distance trips and is a vital economic link to the New England states.

2.2 Existing Land Use

The link between transportation access and land use is a critical relationship for any transportation system. Not only does transportation support the land use function by providing access and mobility, but the land use function also supports the transportation service by providing appropriate population and employment densities.

Land use within the I-84 corridor is mixed. In addition to developed land uses, there is a substantial amount of undeveloped land as well as preserved open space scattered throughout the corridor. The CNV Regional Plan estimates that there were 57,620 jobs in Study Area communities in 1995. This compares with 63,625 employed residents. This means that a great many of the Study Area residents traveled outside the Central Naugatuck Valley region to work.

The towns of Middlebury, Oxford, and Southbury are anticipated to continue to have population growth, and will continue to serve as bedroom communities for employees commuting outside the Study Area. These trends suggest that the expected future growth of population and employment in the Study Area in general will result in increases in traffic volumes within the corridor, on local roads, and along I-84 for commuters traveling to and from the Study Area for work.

Waterbury - Within Waterbury, land use is a mix of industrial and commercial activity from Interchange 19 east to Interchange 23. There is a concentration of residential neighborhoods west of Interchange 19 in Waterbury, on the south side of I-84, with pockets of commercial uses on lands immediately adjacent to the interstate. There are two small concentrations of institutional uses in Waterbury, including municipal offices located in downtown and two colleges (Naugatuck Valley Community Technical College, Teikyo Post College) located in the vicinity of Interchange 17. Land use west of Interchange 17 to Interchange 18 is commercial with several medical office buildings along Chase Parkway and Middlebury Rd. (Route 64).

For the City of Waterbury, the key transportation concerns are reducing congestion and improving safety on the interstate and local arterial roads, while improving local downtown circulation and economic development.

Middlebury - Land use in Middlebury within the I-84 corridor is generally low-density residential with concentrations of commercial uses along Routes 188, 63, and 64. There are also concentrations of commercial uses in the vicinity of Interchange 16 and along the Straits Turnpike/Route 63 corridor.

The key transportation issue for Middlebury is the congestion and reduced quality of life caused by through movement of traffic on local commercial and residential streets.

Southbury - A concentration of commercial uses in the vicinity of Interchanges 16 and 15 and along Route 6 and Main Street in Southbury exists. Another small commercial center in Southbury is located at the southwestern edge of the corridor around the intersection of Routes 172 and Main Street South.

The key transportation issue for Southbury is alleviating traffic congestion on I-84 and along Main Street South. The future development plans of neighboring communities has led local officials to believe that Interchange 16 will become overburdened by the year 2020.

Oxford - The Waterbury-Oxford Airport vicinity is the center of industrial land use in Oxford. Industrial land use in Southbury in the corridor is concentrated in the vicinity of Interchange 14 and along Route 172. The bulk of the industrial land in Middlebury is located in the southwestern portion of town along Route 188 and Benson Road.

The key transportation issue for the Town of Oxford is creating improved access from I-84 to the town's development parcels. Town officials would like to see a new interchange constructed in Middlebury to serve the airport and surrounding industrial uses.

2.3 Bicycle Facilities

Designated bicycle routes for the state have been developed by ConnDOT and published in their statewide bicycle map. Bicycle accommodation within Waterbury is limited, but several recommended routes exist in Southbury, Middlebury and Oxford.

Route 6 to Route 67 in Southbury and Oxford is part of a cross state route that heads south to the shoreline and north to the Massachusetts border. Southbury also has Route 172 and a portion of Route 67 as a recommended bike route. Middlebury has portions of Routes 188 and 63 as recommended routes, as well as South Road. Oxford has Routes 63 and 188 as recommended routes.

The COGCNV has proposed a regional bikeway network in their Plan of Conservation and Development. It includes provisions for bicycle facilities in the planning stages of projects. It is also meant to be a foundation upon which local projects can be built.

In addition to the on road bicycle routes, the Larkin State Bridle Trail is an off-road alternative for bicyclists. The trail is a multi-use path, allowing access to bicyclists, pedestrians, and equestrians. Additionally, the conversion of an abandoned trolley line adjacent to route 64 in Middlebury to a multi-use path has recently been completed. The trail is approximately 4.3 miles from end to end, and runs from just south of Lake Quassapaug to just west of route 63. It is a popular recreational facility for bicyclists and pedestrians. The COGCNV is currently working with municipalities along the Naugatuck River to create a bicycle path adjacent to the river.

2.4 Pedestrian Facilities

National travel surveys indicate that most pedestrian trips do not exceed two miles, however, a great deal of travel within urban centers such as Waterbury is actually made over much shorter distances. For these trips, walking is an efficient alternative to the automobile. It has been estimated that approximately 12% of all walking trips involve a journey to work, while 32% walk for other personal business purposes. While the remaining walkers typically do it for recreation or to get to school, it is the previous 44% that most likely have abandoned the car in favor of walking.

As development continues to grow in the suburban towns of Southbury, Middlebury, and Oxford, walking becomes less practical as the activity centers become more spread out. Still, amenities such as street lighting and safe sidewalks are important in encouraging walking. Many of the town centers provide good walking facilities that connect local shopping and commercial centers.

In Southbury, the major arterial routes within the town were inventoried for the availability of sidewalks. Main Street South, extending from Route 172 to Route 6, is the town's commercial center and has continuous, well-maintained sidewalks with wide green-space and street furniture (i.e. benches, lighting, gazebo).

It should be noted that river crossings are typically an impediment to pedestrian activity. This is not the case on the bridge spanning the Housatonic River. Sufficient walking space is provided on both sides of the structure.

Middlebury has few sidewalks, as much of the town is rural and development is not concentrated in any one area. While Middlebury has and requires minimal sidewalks throughout the town, it does have excellent pedestrian facilities in the form of multi-use paths. The Middlebury Multi-Use Trail and the Larkin State Bridle Trail are both heavily utilized by pedestrians. The Middlebury Multi-Use Path runs from Lake Quassapaug and parallels Route 64 to just east of Route 188. The Larkin State Bridle Trail runs through Southbury, Oxford, and Middlebury, but does not provide good access to local activity centers

In Waterbury, sidewalks exist throughout much of the city, though as in most urban centers, security and safety can act as a deterrent to pedestrian travel. Pedestrian amenities such as sidewalks, lighting, emergency phones, ped-signals, crosswalks, signage, benches, and planters provide a safe and comforting atmosphere for the pedestrian. There are currently several streetscape projects being designed in Waterbury. Improvements along Meadow Street, South Main Street, and Bank Street will include new sidewalks, landscaping, decorative lighting and signing.

2.5 Park and Ride Lots

Park and Ride Lots are designed to encourage carpooling and reduce the number of vehicles on the road during peak hours. The eight park and ride lots found within the study area are listed in Table 2.3.

Table 2.3
I-84 Park and Ride Lots

Park and Ride Lot	Features	Spaces	Usage
Southbury			
Route 172 @ Main Street South (Interchange 14)	P, L	84	60%
I-84 @ Route 67 (Interchange 15)	P, L	25	72%
I-84 @ Route 188 (Interchange 16)	P, L	43	72%
Middlebury			
Route 63 @ Maggie McFly's	P	44	10%
I-84 @ Route 63 (Interchange 17)	P, L, T	61	100%
Waterbury			
I-84 @ Chase Parkway (Interchange 17)	P, L, T, B	123	46%
Meadow & Grand Sts. @ Railroad Station	P, L, T, S, R	101	24%
I-84 @ Route 69 (Interchange 23)	P, L, T	178	60%

Source: ConnDOT
Features: P = paved, L = lighted, T = telephone, S = shelter, B = local bus service, R = rail service

The number of spaces being used for each park and ride lot was counted in May 2000 on a midweek morning. Two of the park and ride lots were not clearly designated as park and ride, including Route 63 at Maggie McFly's and Meadow and Grand St at the Railroad Station. The data also suggests the need to expand the park and ride lot at I-84 and Route 63, which is at capacity. Two other locations, I-84 at Route 67 and Route 188, could also benefit from the addition of parking spaces to accommodate future growth.

2.6 Public Transit

Public Transportation in the study area is focused on the greater Waterbury area. The Bonanza Bus Company operates routes through Waterbury and Southbury; the Northeast Transportation Company runs local fixed route service and provides American with Disabilities Act (ADA) paratransit service throughout greater Waterbury, as of July 1, 2000.

The Bonanza Bus Company operates 10 buses a day from Hartford to New York City and 10 buses a day from New York City to Hartford. The buses stop in Farmington, Waterbury, Southbury, Danbury and sometimes White Plains and Yonkers. Beyond the Hartford stop, four buses a day in each direction continue from Hartford to Manchester, Willimantic, Danielson and Providence. The service is provided every day of the week including Saturdays and Sundays. Buses leave Waterbury from 5:45 am to 9:15 pm and arrive in Waterbury from 8:15 am to 11:35 pm to make the 2 hour 20 minute journey into New York. The trip to Hartford is 45 minutes. The travel center, or bus terminal, is located on Bank Street where it meets Grand Street.

The Northeast Transportation Company (NET) provides fixed-route bus and paratransit service in Waterbury, Watertown, Naugatuck, Middlebury, Wallingford and Meriden with a fleet of 54 buses. Forty-six of these buses are owned by the state and NET leases eight.

In July 2000, ConnDOT produced a Statewide Bus System Study, in which recommended improvements were made for bus service throughout the state. Major changes were not recommended to the NET service, because the Waterbury system is well developed and has excellent coverage of the area. However, several NET routes were recommended for alteration in the route and one route, 31, was recommended for elimination. In addition, it was recommended that Saturday early morning service be discontinued and replaced with Sunday service from 9:00 am to 5:00 pm.

Metro North is a commuter rail system, which runs between New York City and points north in Connecticut and New York. The Metro North trains have five lines: Port Jervis, Pascack Valley, Hudson, Harlem and New Haven. The New Haven line has three branches, New Canaan, Danbury and Waterbury.

The New Haven line runs from Grand Central Terminal in New York City through the Bronx and into Connecticut along the coast of Long Island Sound. Once the line reaches Bridgeport, the Waterbury train branches off. The train stops in Derby-Shelton, Ansonia, Seymour, Beacon Falls and Naugatuck before heading into the downtown Waterbury station.

The Metro North Waterbury Station is located on Meadow Street in downtown Waterbury. The station is easily accessible from both I-84 and Route 8 using the downtown exits. Parking and connecting bus service is available.

2.7 Waterbury-Oxford Airport

The inclusion of the Waterbury-Oxford Airport into the study area was necessary due to its regional impact on traffic over the study period. The planned growth of the facility, along with projected industrial growth in the immediate vicinity, required a close look at the effect it would have on local trip generation. As it currently operates, airport traffic uses Christian Road to access the airport service road. This provides adequate service at today's traffic level, but could

create congestion if trips were to significantly increase over the next twenty-five years. The Town of Oxford, as well as the airport, could also benefit economically from a direct connection to the interstate. For these reasons, the airport and surrounding property was included in the analysis.

The Waterbury - Oxford Airport is a General Utility Airport with a designated service level of General Aviation. It is located on Christian Road, about 3 miles north of Oxford Center on Route 188. The airport has already surpassed development estimates that were projected by the 1994 Master Plan. New hangers, aprons, and a control tower have been added to the facility to increase capacity and improve safety.

Current Airport Operational Statistics include:

- Aircraft based on the field: 203
- Single engine airplanes: 160
- Multi engine airplanes: 29
- Jet airplanes: 13
- Helicopters: 1

- Aircraft operations: average 404/day
- 68% is local general aviation
- 30% is transient general aviation
- 1% is air taxi
- <1% is military

2.8 Goods Movement

The heavy use of I-84 by commercial vehicles requires the availability of rest areas and service stations that can accommodate the trucks and their operators over night. While a number of private truck stops exist throughout the state, they are not desirable by all truckers since they must leave the interstate and navigate local streets. Since commercial vehicle operators can only drive for 10 consecutive hours before they must stop to rest (by law), the need for inexpensive and convenient rest areas is important.

Due to the infrequency of interstate rest areas along I-84, trucks are routinely parking along the shoulders between Interchanges 16 and 15 and along the ramp shoulders at Interchange 15. This contributes to a safety issue in the region, as trucks must accelerate from a dead stop onto the mainline of I-84, which carries vehicles traveling over 60 mph. The results of a preliminary inventory of truck parking indicate that over ten trucks occupy the shoulder area near Interchange 16 in the westbound direction and over five in the eastbound direction in the later hours of the night.

2.9 Current and Projected Transportation System Performance

Twenty-four (24) hour count data indicated that the morning peak hour with the highest volume is between 7:00 and 8:00 A.M. In the afternoon, the highest volume peak hour is between 5:00 and 6:00 P.M. Figure 2.2 illustrates the morning and afternoon peak volumes for both 1999 and

2025 conditions. The truck percentage on the interstate fluctuates between 8% in Southbury and 5% in Waterbury of the peak volume at each of these areas. The truck percentage decreases as the interstate approaches Waterbury due to the fact that the overall volume of traffic increases, with a higher mix of automobiles.

The 2025 traffic volume is 'demand' volume. That is, it is the traffic that will utilize the interstate provided enough capacity exists. This is an important distinction because approximately 2100 vehicles could be accommodated by a single lane of traffic per hour. If a future peak hour volume is projected at 15,000 vehicles, and the highway is three-lanes in each direction, the theoretical capacity of the road would only be 12,600. Of course, at this volume of traffic the interstate would already be operating at a very poor level of service and would not likely be able to accommodate the additional 2,400 vehicles that are projected to use it. In this case traffic may leave the interstate and use local arterial roads to complete their trip. When the local arterials fill with traffic, vehicles may use local neighborhood roads.

I-84 westbound is the overall peak direction in the morning and eastbound is the overall peak direction in the afternoon. The split for each of these periods is roughly 55/45 and varies only slightly depending on the location along the corridor. This directional split is attributed to the high through traffic volume that uses this corridor. Destinations in New York, western and central Connecticut, and Massachusetts attract traffic that relies on this corridor for east-west connectivity.

In order to determine the existing and future transportation performance of I-84 and other local arterial roads, the CORSIM computer-based transportation simulation model was used in conjunction with traditional Highway Capacity Manual methodologies to quantify the level of congestion. In addition, ConnDOT's statewide travel demand model was used to relate current and future population and employment and projected future travel demand.

The results of the analyses for the existing and projected traffic volumes indicate the following:

Interstate 84

The future 2025 volumes were estimated to increase approximately 40% from their current level. On I-84, the future year Average Daily Traffic (ADT) on the Southbury end of the corridor is estimated to be about 40,500 in the eastbound direction and 42,000 in the westbound. In Middlebury between Interchanges 16 and 17, the eastbound ADT is 40,500 and the westbound is 42,300. In Waterbury, east of Interchange 23, the eastbound ADT is 62,400 while the westbound is 63,500.

I-84 in the westbound direction operates at poor Levels Of Service (LOS F) throughout much of the corridor in the year 2025 during the weekday morning peak hour condition. This is due to increase in traffic volumes within the corridor and the operation of left hand ramps to and from Route 8 and other interchanges. Figure 2.3 illustrates the comparison of LOS between year 2000 and 2025 for the westbound interstate during the A.M. peak hour.

In the afternoon peak hour, I-84 in the eastbound direction operates at poor levels of service (LOS F) in the year 2025 throughout the entire corridor. Similarly, I-84 in the westbound direction in the year 2025 operates at LOS F east of Interchange 18 in Waterbury during the

weekday evening peak hour. Figure 2.4 illustrates the comparison of LOS between year 2000 and 2025 for the eastbound interstate during the P.M. peak hour.

The results of the capacity analysis also indicated that I-84 would show poor levels of service throughout much of the corridor in the year 2025, and may require improvements to enhance traffic operations. The analysis demonstrated that some of the congestion is created by localized choke points – such as when a lane drop occurs or a truck-climbing lane ends.

Based on both sets of analysis it was determined that overall continuity in the number of lanes on the Interstate could potentially provide improved operations over the base condition.

Arterial Roadways

In summary, if no additional transportation improvements were to be implemented with the I-84 WOW corridor, during the next 25 years, I-84 WOW travelers would face:

- Significantly decreased travel speeds;
- Increased vehicle density (i.e., more vehicles per mile of highway);
- Decreased levels of service;
- Constrained capacity;
- Increased vehicle delays; and,
- Increased fuel consumption.

2.10 Safety Analysis

Accident records for I-84 from the most recent three-year period, 1996-1998, were collected from ConnDOT and analyzed. Accident record data is listed by date and includes information about the location, accident type, light, pavement and weather conditions, vehicles involved, direction of travel, severity of injuries and reason for the collision.

Five segments had accident rates high enough to be listed on ConnDOT's 1995-1997 SLOSS (Suggested List of Surveillance Sites). The SLOSS is a list of high accident sites, for which improvements may be appropriate. Locations are listed on the SLOSS when the ratio of the actual accident rate to the critical accident rate is greater than 1.0 and the number of accidents is greater than 15. The critical accident rate based on average accident rates for similar facilities statewide. The categories for which averages are prepared are defined in terms of the number of lanes, rural or urban characteristics, and whether the intersection is signalized or un-signalized. The accident rate is in terms of accidents per million vehicle miles. The segments of I-84 within the study area appearing on the SLOSS are shown in Table 2.4. Since the most recent SLOSS data is compiled a year behind the available accident data the number of accidents may not be comparable.

Table 2.4
1995-1997 SLOSS Locations on I-84

Location	From Milepoint	To Milepoint	Number of Accidents	Actual Accident Rate (RA)	Critical Accident Rate (RC)	RA/RC
I-84 between Route 188 & Route 63 (rural portion)	25.30	27.94	125	0.79	0.784	1.01
I-84 at Route 63 Interchange (Interchange 17)	29.66	30.04	66	3.01	2.970	1.01
I-84 at Chase Pkwy & Highland Avenue Interchange (Interchange 18)	30.87	31.76	171	2.66	2.646	1.01
I-84 at Route 8, Meadow Street Interchange (Interchange 21)	31.77	32.91	360	3.24	2.536	1.28
I-84 at Washington and Hamilton Interchange (Interchange 23)	32.92	33.71	225	3.00	2.613	1.15

Source: ConnDOT

To better understand contributing factors, traffic incidents were compiled by year, light conditions, pavement conditions, accident severity, and accident type. Observations from these analyses are reported in this section.

Light Conditions. The number of accidents that occurred in daylight conditions for the WOW corridor was 64%. The segment of I-84 between River Road and Route 172 shows a large percentage of accidents occurring under dark, dusk or dawn conditions. More accidents occurred at night (50%) than during daylight hours (39%). Almost twice as many accidents occurred during partially dark conditions or dark conditions (61%) than in daylight (39%). The portion of I-84 between Route 188 and Route 63 experienced almost as large a percentage of accidents occurring in dark (46%) as the percentage of accidents occurring in daylight (51%).

Pavement Surface Conditions. Interchange 13 (River Road), Interchange 14 (Route 172) and Interchange 18 (Route 845) all had about 20% of accidents occurring in snowy or icy conditions.

Accident Severity. The percentage of injury accidents for the corridor as a whole was 20%. Most segments along the corridor were close to 20% injury accidents. Three segments of I-84 had particularly high percentages of injury accidents, including the interchange area of Interchange 13 (40% injury), the segment between Route 172 and Route 6 (29% injury) and the interchange area of Interchange 17 (28% injury). From analysis of the accident records, most of these accidents resulted in only minor injuries.

Four fatal accidents occurred within the corridor. Each one is described in detail below:

- The first fatality, occurring on September 15, 1997 in the rural portion of the segment between Route 188 and Route 63 (mile 27.01), was a rear end accident. Under daylight dry conditions, a westbound automobile struck a westbound truck stopped on the shoulder. Two people were killed.

- The second fatality, occurring on April 3, 1997 in the rural portion of the segment between Route 188 and Route 63 (mile 27.83), was a fixed object accident. Under dark dry

conditions, an eastbound automobile struck an eastbound truck. The cause of the accident was an improper lane change. One person was killed.

- The third fatality, occurring on October 30, 1997 in the area of Interchange 21 (mile 32.62) was a sideswipe accident. Under daylight dry conditions, an eastbound automobile struck another eastbound automobile. The cause of the accident was loss of driver control. One person was killed.

- The fourth fatality, occurring on March 15, 1998 in the segment of I-84 between Route 830 (Hamilton Avenue) and Route 69 (mile 34.01), was a head-on collision. Under dark dry conditions, an eastbound automobile struck a westbound automobile. The cause of the accident was that the driver was under the influence of drugs or alcohol and went in the wrong direction on the highway. Two people were killed and one was injured.

Accident Type. Several segments if I-84 had unusually high percentages of a particular type of accident:

- Seven segments had significantly higher than average number of fixed object accidents, including I-84 from River Road to Route 172 (72%), near Interchange 14 (49%), Route 172 to Route 6 (50%), near Interchange 15 (53%), Route 6 to Route 188 (65%), Route 188 to Route 63 rural portion (47%), and near Interchange 17 (49%).

- Two segments at the eastern more congested half of the corridor, had a significantly higher than average number of rear end accidents. Interchange 22 had 45% rear end accidents and Route 830 (Hamilton Avenue) to Route 69 had 35% rear end accidents. The congestion in this area contributes to the high number of accidents, with vehicles stopping or slowing.

- The two segments at either end of the corridor, I-84 near Interchange 13 (60%) and near Interchange 23 (33%) had a significantly higher than average percentage of sideswipe accidents.

- Other segments had a slightly higher than average percentage of jack knife, overturn or moving object accidents.

Truck Related Accidents. The percentage of accidents involving trucks on I-84 is 27% for the corridor as a whole. This is significantly higher than the percentage of trucks (approximately 8%) compared to total vehicles. When compared with the average of 27%, all of the segments deviate within ± 9%. A few segments have slightly higher percentages, including the area near Interchange 16 (32% trucks) and the segments east of that (33% and 31% trucks). From observations in the field, trucks park on the shoulder in this area. In addition to this segment, the area west of Interchange 18 (36% trucks) and the Interchange 18 interchange area (36% trucks) both have a relatively high percentage of accidents involving trucks.

Other Contributing Factors. The top five typical contributing factors or causes for the accidents included:

- Driver following too close (23%)
- Driver changed lanes improperly (20%)

- Driving too fast for conditions (19%)
- Driver unable to cope with conditions and lost control (12%)
- Foreign object in road (7%)

Other factors such as driver falling asleep, slippery conditions, driver under the influence of alcohol or drugs, vehicle mechanical failure, and improper passing maneuver all contributed to less than 5% of the accidents.

2.11 Geometric Deficiencies

From the time of construction of I-84 in the early to mid-sixties, the traffic volume has increased dramatically. The highway was designed to carry approximately 35,000 vehicles daily, and has since exceeded 100,000 vehicles in some locations. This increase in traffic places a burden on the existing infrastructure and contributes to safety issues. The insufficient capacity at interchange ramps creates excessive queuing of vehicles that in some cases, affects the operation of the interstate mainline. Additionally, the changes in the practice of highway design have caused several interchanges to become sub-standard by today's criteria.

The purpose of this analysis was to identify any geometric deficiency at the interchanges within the study corridor. This included an assessment of acceleration and deceleration distances, queuing on interchange ramps, spacing between interchanges, and shoulder width.

Interchange Ramp Spacing

An analysis was performed to verify that the minimum distance between successive ramp terminals was satisfied, based on AASHTO spacing criteria. Successive ramp terminals are defined as the presence of two or more ramps (on or off) in close succession either upstream or downstream an urban freeway. A reasonable distance between successive terminals is required to provide adequate maneuvering and adequate spacing for signing. Based on this analysis, only the eastbound direction of I-84 demonstrated spacing deficiencies based on the AASHTO criteria. The locations are as follows:

- **Interchange 18** – This I-84 on ramp enters on the left hand side of the highway and has approximately 1690 feet of space to the left-hand Interchange 19 off ramp. The AASHTO minimum recommended spacing is 2000 feet.
- **Interchange 19** – The close succession of the off and on ramps to and from Route 8 have a distance of 445 feet. The requirement is that they should be at least 500 feet.
- **Interchange 19** – The on ramp from Route 8 is approximately 595 feet from the Interchange 20 on ramp. AASHTO recommends 1000 feet.
- **Interchange 20** – This interchange consists of two on ramps from downtown in close succession. They are spaced approximately 790 feet apart and the recommendation is for 1000 feet.
- **Interchange 20** – The on ramp from downtown is space 1415 feet from the off ramp at interchange 21. The recommendation is for 2000 feet.
- **Interchange 21** – The off ramp at this interchange is approximately 415 feet from the on ramp. AASHTO recommends a minimum of 500 feet.
- **Interchange 21** – The on ramp is spaced 740 feet from the off ramp at interchange 22. The recommendation is for 2000 feet.

Acceleration / Deceleration Length

Each of the 20 off ramps and 21 on ramps were evaluated to determine if the distance required to decelerate or to accelerate was available based on their current configuration. These ramps provide access to and from I-84 and local roadways and state highway systems.

To determine the acceleration distance of I-84 entrance ramps, the ramp design speed was first calculated. This was accomplished by measuring the radius of curvature of the ramp and applying methodology from A Policy on Geometric Design of Highways and Streets by the American Association of State Highway and Transportation Officials (AASHTO) – 1994 Edition, to determine design speed. Once the design speed of the ramp was determined, the distance required to accelerate from the ramp design speed to the interstate mainline speed was calculated. This distance was then compared to the actual distance that exists on the ramp today. If the calculated distance was greater than the actual ramp distance, the ramp was listed as geometrically deficient. Of the 21 on-ramps in the study corridor, 9 were determined to be geometrically deficient. Table 2.5 lists the results of the on-ramp analysis.

Similarly, the off-ramps were evaluated to verify whether existing deceleration length met current AASHTO requirements. Again, the radius of curvature of the ramp dictated the design speed. Once calculated, the speed was used to determine the length of deceleration distance that was required to decelerate from the mainline design speed. A secondary analysis was performed to determine the effect of queue lengths at signalized intersections at the ramp termini. If a vehicle queue was long enough to encroach on the minimum deceleration distance, then the ramp was noted to be deficient. Of the 20 off-ramps evaluated, 8 were determined to be geometrically deficient and one ramp was deficient based on the existence of vehicle queue. Table 2.6 lists the results of the off-ramp analysis.

Shoulder Width Analysis

A cursory examination of shoulder width was performed to gauge the existence of minimum shoulder requirements on the interstate mainline and its ramps. Aerial photographs were consulted and locations that appeared to violate AASHTO standards were noted. AASHTO criteria indicates that a 12-foot right hand shoulder (9 foot minimum) is desired on highway mainlines that are heavily traveled. The widths of shoulders on ramps vary; however, single lane ramps usually require a 10 to 12 foot breakdown lane to exist. The results of the analysis indicated that sufficient shoulders existed on all interchange ramps. Shoulder inventories for the mainline were separated by direction.

- **Eastbound -** The existing right shoulder width on I-84 eastbound measures approximately 12’ from Interchange 13 to the vicinity of the Peter Road overpass. The shoulder width then narrows from 12’ at Interchange 15 (east of the I.B.M. exit) to approximately 3’ wide. The full right shoulder reappears east of Exist 15 and maintains a 12’ width until it reaches a point approximately 350’east of Bucks Hill Road and drops back to 3’. East of Route 188, the right shoulder measures approximately 12’and then drops to approximately 3’ at a location 200’ east of South Road. The shoulder widens to 12’ on the east side of Shadduck Road and continues east to Interchange 18, where the right shoulder measures 3’ wide for the remainder of the corridor.

Table 2.5
On Ramp Assesment
I-84 West of Waterbury Needs and Deficiencies Study

Location	Direction	Curve Radius		Curve Design Speed[2]	Half Mainline Speed?[1]	Mainline Design Speed	Acceleration Length		AASHTO Min. Acceleration Length[1,3]		Comments
		(m)	*(ft)*	*(mph)*	(Y/N)	*(mph)*	(m)	*(ft)*	(m)	*(ft)*	
Interchange 13											
	WB	125	*410*	*40*	Yes	*70*	135	*430*	400	*1315*	inadequate acceleration length
Interchange 14											
	EB	80	*260*	*30*	No	*70*	140	*445*	445	*1460*	inadequate acceleration length
	WB	385	*1260*	*50*	Yes	*70*	140	*455*	245	*805*	inadequate acceleration length
Interchange 15											
	EB	820	*2690*	*50*	Yes	*70*	235	*760*	245	*805*	inadequate acceleration length
	WB	105	*340*	*40*	Yes	*70*	465	*1515*	445	*1460*	
Interchange 16											
	EB	80	*260*	*30*	No	*70*	165	*535*	445	*1460*	inadequate acceleration length
	WB	7330	*24050*	*50*	Yes	*70*	160	*520*	245	*805*	inadequate acceleration length
Interchange 17											
	EB	260	*850*	*50*	Yes	*70*	305	*990*	245	*805*	
	WB	740	*2430*	*50*	Yes	*70*	170	*550*	245	*805*	inadequate acceleration length
Interchange 18											
	EB	215	*710*	*50*	Yes	*65*	125	*410*	145	*480*	inadequate acceleration length
	WB	325	*1070*	*50*	Yes	*65*	195	*625*	55	*185*	
Interchange 19											
	EB	29725	*97520*	*50*	Yes	*65*	75	*235*	55	*185*	
	WB	665	*2180*	*50*	Yes	*65*	165	*530*	55	*185*	
Interchange 20											
	EB	75	*250*	*30*	No	*65*	115	*375*	265	*870*	inadequate acceleration length
	EB (Rte. 8)	235	*770*	*50*	Yes	*65*	55	*175*	55	*185*	
	WB	3340	*10960*	*50*	Yes	*65*	100	*325*	55	*185*	
Interchange 21											
	EB	400	*1310*	*50*	Yes	*65*	175	*570*	55	*185*	
	WB Left	290	*950*	*50*	Yes	*65*	90	*280*	55	*185*	
	WB Right	360	*1180*	*50*	Yes	*65*	125	*410*	55	*185*	
Interchange 22											
	WB	4730	*15520*	*50*	Yes	*65*	70	*220*	55	*185*	
Interchange 23											
	EB	565	*1850*	*50*	Yes	*65*	90	*280*	55	*185*	

(1) Assumed highway design speed of 70 mph Interchange 17 & west; 65 mph Interchange 18 & east
(2) AASHTO 1994, Fig. III-20, p 197
(3) AASHTO 1994, Table X-4, p 945

Table 2.6
Off Ramp Assesment
I-84 West of Waterbury Needs and Deficiencies Study

Location	Direction	Curve Radius		Curve Design Speed[2]	Half Mainline Speed?[1]	Mainline Design Speed	Deceleration Length		AASHTO Min. Deceleration Length[1, 4]		Signalized Intersection	Total Ramp Length	Est. Queue Length	Comments
		(m)	*(ft)*	*(mph)*	(Y/N)	*(mph)*	(m)	*(ft)*	(m)	*(ft)*	(Y/N)	*(ft)*	*(ft)*	
Interchange 13														
	EB	210	*690*	*50*	Yes	*70*	125	*395*	140	*460*	No	*N/A*	*N/A*	inadequate deceleration length
Interchange 14														
	EB	135	*440*	*40*	Yes	*70*	90	*290*	155	*510*	No	*N/A*	*N/A*	inadequate deceleration length
	WB	2670	*8760*	*50*	Yes	*70*	450	*1460*	120	*395*	No	*N/A*	*N/A*	
Interchange 15														
	EB	155	*510*	*45*	Yes	*70*	315	*1030*	155	*510*	Yes	*1030*	*385*	inadequate deceleration length
	WB	1270	*4170*	*50*	Yes	*70*	340	*1100*	120	*395*	Yes	*1100*	*1420*	with existence of queue
Interchange 16														
	EB	75	*250*	*30*	No	*70*	90	*285*	175	*575*	No	*N/A*	*N/A*	inadequate deceleration length
	WB	13060	*42850*	*65*	Yes	*70*	355	*1160*	120	*395*	Yes	*1190*	*490*	
Interchange 17														
	EB	275	*900*	*50*	Yes	*70*	165	*525*	120	*395*	Yes	*610*	*205*	
	WB	605	*1980*	*50*	Yes	*70*	340	*1115*	120	*395*	No	*N/A*	*N/A*	
Interchange 18														
	EB	75	*250*	*30*	No	*65*	120	*380*	145	*480*	Yes	*780*	*240*	inadequate deceleration length
	WB	65	*210*	*30*	No	*65*	120	*390*	145	*480*	Yes	*1790*	*175*	inadequate deceleration length
Interchange 19														
	EB	200	*660*	*50*	Yes	*65*	65	*210*	100	*330*	No	*N/A*	*N/A*	inadequate deceleration length
Interchange 20														
	EB	255	*840*	*50*	Yes	*65*	100	*325*	85	*280*	No	*N/A*	*N/A*	
	WB-A	780	*2560*	*50*	Yes	*65*	100	*325*	85	*280*	No	*N/A*	*N/A*	
	WB-B	265	*870*	*50*	Yes	*65*	55	*175*	85	*280*	No	*N/A*	*N/A*	inadequate deceleration length
Interchange 21														
	EB Meadow	170	*560*	*45*	Yes	*65*	65	*200*	120	*395*	Yes	*990*	*235*	inadequate deceleration length
	EB Market Sq	1905	*6250*	*50*	Yes	*65*	385	*1250*	85	*280*	Yes	*1390*	*440*	
	WB	400	*1310*	*50*	Yes	*65*	130	*415*	85	*280*	No	*N/A*	*N/A*	
Interchange 22														
	WB	325	*1070*	*50*	Yes	*65*	80	*250*	85	*280*	Yes	*1300*	*250*	
Interchange 23														
	WB	3055	*10020*	*50*	Yes	*65*	245	*800*	85	*280*	Yes	*885*	*195*	

(1) Assumed highway design speed of 70 mph Interchange 17 & west; 65 mph Interchange 18 & east
(2) AASHTO 1994, Fig. III-20, p 197
(4) AASHTO 1994, Table X-6, p 949

- **Westbound -** The existing right shoulder width on I-84 westbound measures approximately 12' at Interchange 13 to the vicinity of Peter Road and then narrows down to 3' for approximately 100'. The shoulder regains its full 12' width just east of Interchange 15 and then tapers down to approximately 3' at a location approximately 800' east of Rt.67 (Southford Road). The full 12' shoulder reappears at a location approximately 900' east of Bucks Hill Road until it reaches a point approximately 650' west of Long Meadow Road and narrows to 3'. The shoulder measures 12' wide again at a point 100' west of South Road and then tapers down to approximately 6-8' at a point about 600' west of Sandy Hill Road. Just east of Sandy Hill Road the shoulder drops to 3' wide to a point approximately 650' east of Route 63. The 12' shoulder reappears at the location 1000' east of Route 64 and continues west until it drops to about 6-8' between Interchanges 19 & 20. The shoulder remains at that width until it reaches Interchange 23.

2.12 Signage Deficiencies

The study team examined the current state of signage on and around I-84 and inventoried those that were missing, poorly located, or otherwise deficient. The task included field verification, photo documentation, and sign classification that was based on the following categories:

- Sign missing;
- Location;
- Legibility/Condition; and,
- Understanding.

Each sign in the corridor was evaluated against these basic criteria. Many of the signs encountered only require minor maintenance to correct their deficiency, while others involve full replacement. In all, 44 signs and locations to be signed were examined.

Figures 2.5 and 2.6 illustrate the locations of the signs that failed under the above conditions. Missing signs and poor signage condition were the predominant deficiencies in this analysis. Several fell into the category of improper or poor location while a few caused driver confusion. In many instances, signs were bent, falling over, or seriously damaged. In the vicinity of Interchange 19-20 in Waterbury, the overhead interstate signs in the eastbound direction have become faded due to exposure. In the westbound direction, the signs have become covered in road soot and require cleaning.

Signage deficiencies that pose a challenge to drivers are the missing or improperly located signs. Interchanges 17 and 18 in Waterbury, due to their complex configurations, are in need of clear directional signage to the Interstate. Downtown Waterbury, in general, is poorly signed to the Interstate ramps. Locations such as the City Green, Municipal Parking Garage, and St. Mary's Hospital offer no clearly defined routes to return to I-84. In some instances where signs do exist, the route is often circuitous and confusing.

2.13 Structural Evaluation

The I-84/Route 8 Interchange viaduct and other bridge structures were constructed in the mid-sixties, and have undergone a series of retrofits over the years. These bridges are mainly composed of steel girders and concrete deck slab supported on concrete substructure.

ConnDOT routinely inspects all structures every two years. The information contained in the latest inspection reports indicates that most of the bridges are in fair to satisfactory condition. On a scale of 1 to 10, the majority of the bridges are rated 5 and 6, indicating rehabilitation work will be needed in order to maintain their structural integrity to year 2025.

As part of this study, extra consideration is being given to the viaduct for several reasons. The poor operation of this interchange with respect to traffic and the safety issues that are associated with it constitute one set of deficiencies, while the overall condition of the structure represents another. It is important to identify each deficiency accordingly, and build a case for the need for a transportation improvement in this area. Certainly the capital investment that would have to be made would be substantial, but from an engineering standpoint, this interchange represents the most severe (and challenging) deficiency in the corridor. This study will begin to identify the needs and potential alternatives for this area. Because of the extreme complexity of the issues surrounding this interchange, a more detailed analysis will almost certainly be required as part of a subsequent study.

Many of bridge structures that make up Interchange 19/20 have geometric, structural, or operational deficiencies that do not meet the present ConnDOT standards. The structures evaluated have undergone a partial seismic retrofitting by ConnDOT, but they would need to be re-evaluated to determine if they comply with the present AASHTO Specifications. A fire suppression system has also been installed, but there is no clear indication as to which entity maintains and periodically tests the standpipes.

Based on the review, all of the bridges included in this interchange will require major rehabilitation consisting of:

- Concrete deck replacement;
- Construction of 'sloped curb' parapets;
- Elimination of numerous deck joints by making the deck slab continuous;
- Placing new membrane waterproofing and bituminous overlay;
- Cleaning and painting of structural steel;
- Rehabilitation or replacement of bridge bearings; and,
- Rehabilitation of concrete substructure.

Maintenance of traffic (MOT) on the existing bridges will be the major concern during replacement of the deck slab. Many of the turning roadways are one-lane facilities with narrow shoulders and a 6.71m (22') bridge width. Staging of construction on these bridges to maintain traffic will be difficult.

In addition to the evaluation of the Route 8 Interchange with I-84, bridge inspection reports were reviewed for each of the remaining structures in the I-84 corridor. The purpose of this task was to inventory the current condition of these structures and identify any relevant geometric information that could indicate whether or not the structure could accommodate an additional travel lane on I-84. Figure 2.7 illustrates the location of the I-84 structures on the base map, and gives their most recent condition rating.

2.14 Highway Capacity Analysis

A study of capacity is important in determining the ability of a specific roadway, intersection, or freeway to accommodate traffic under various levels of service. Level of service (LOS) is a qualitative measure describing driver satisfaction with a number of factors that influence the degree of traffic congestion. These factors include speed and travel time, traffic interruption, freedom of maneuverability, safety, driving comfort and convenience, and delay.

In general there are six levels of service describing flow conditions. The highest, Level of Service A, describes a condition of free flow, with low volumes and high speeds. Level of Service B represents a stable traffic flow with operating speeds beginning to be restricted somewhat by traffic conditions. Level of Service C, which is normally utilized for design purposes, describes a stable condition of traffic operation. It entails moderately restricted movements due to higher traffic volumes, but traffic conditions are not objectionable to motorists. Level of Service D reflects a condition of more restrictive movements for motorists and influence of congestion becomes more noticeable. Level of Service E is representative of the actual capacity of the roadway or intersection and involves delay to all motorists due to congestion. The lowest, Level of Service F, is described as force flow and is characterized by volumes greater than the theoretical roadway capacity. Complete congestion occurs, and in extreme cases, the volume passing a given point drops to zero. This is considered as an unacceptable traffic operating condition.

For this study, level of service was performed for mainline freeway segments, freeway ramp junctions, freeway weaving conditions, and intersections (both signalized and un-signalized). Traffic analyses for this study was based on the 1997 Highway Capacity Manual and conducted using the Highway Capacity Software (HCS).

Mainline Capacity Analysis

In order to assess the capacity along I-84, a freeway analysis was performed during the existing and future years for the weekday morning and evening peak hour conditions. The input to the freeway analysis was the freeway geometry, free-flow speed, number of lanes, and volumes during the weekday morning and evening peak hour conditions. The results of the analysis are listed in Table 2.7.

Table 2.7
Freeway Analysis Summary

SECTION ALONG I-84	Eastbound			Westbound		
	1999	2025	Need Additional Lane?	1999	2025	Need Additional Lane?
Between Int. 13 and Int. 14	C(E)	D(F)	Yes	E(D)	F(E)	Yes
Between Int. 14 and Int. 15	C(E)	D(F)	Yes	D(D)	F(F)	Yes
Between Int. 15 and Int. 16	C(D)	D(F)	Yes	D(D)	E(E)	Yes
Between Int. 16 and Int. 17	C(E)	D(F)	Yes	D(D)	F(E)	Yes
Between Int. 17 and Int. 17	C(D)	D(E)	Yes	D(C)	E(E)	Yes
Between Int. 17 and Int. 18	D(E)	E(F)	Yes	D(E)	F(F)	Yes
Between Int. 18 and Int. 19	D(E)	F(F)	Yes	C(D)	E(E)	Yes
Between Int. 19 and Int. 20	D(E)	E(F)	Yes	D(F)	F(F)	Yes
Between Int. 20 and Int. 21	E(E)	F(F)	Yes	C(D)	D(E)	Yes
Between Int. 21 and Int. 22	E(E)	F(F)	Yes	D(E)	F(F)	Yes
Between Int. 22 and Int. 23	E(F)	E(E)*	No	E(F)	E(E)*	No

X(X) Represents LOS for AM peak hour. PM Peak LOS shown in parenthesis.
* Assumes that an additional lane will be added by 2025.

Ramp Operations

Existing Year (1999) Analysis - A freeway-ramp junction analysis is performed along I-84 in both directions during the weekday morning and evening peak hour conditions to evaluate traffic operations along I-84 and connecting ramps. The inputs to the analysis are freeway and ramp geometry, speed, and traffic volumes. The results of the freeway-ramp analyses are presented in Table 2.8.

Table 2.8
Freeway Ramp Analysis Summary

INTERCHANGE	Eastbound		Westbound	
	1999	2025	1999	2025
Interchange 13				
Off Ramp to Fish Rock Road	B(D)	C(F)	-	-
On Ramp from Oakdale Road	-	-	D(C)	F(D)
Interchange 14				
Off Ramp to Lakeside Road	B(D)	C(F)	-	-
On Ramp from Georges Hill Road	C(D)	D(F)	-	-
Off Ramp to South Britain Road	-	-	D(C)	F(F)
On Ramp From South Britain Road	-	-	D(C)	F(D)
Interchange 15				
Off Ramp to Route 67	C(D)	D(F)	C(C)	F(D)
On Ramp from Route 67/I.B.M Drive	B(D)	C(F)	D(C)	F(D)
Interchange 16				
Off Ramp to Route 188	B(D)	C(F)	C(C)	F(D)
On Ramp from Route 188	C(D)	D(F)	C(C)	E(D)
Interchange 17				
Off Ramp to Route 63	C(D)	D(F)	-	-
On Ramp from Route 64	C(D)	D(F)	-	-
Off Ramp to Route 64	-	-	D(D)	F(F)
On Ramp from Route 63	-	-	C(C)	F(D)
Interchange 18				
Off Ramp to Chase Parkway	C(D)	E(F)	-	-
On Ramp from Chase Parkway	D(E)	F(F)	-	-
Off Ramp to Main St./Highland Ave.	-	-	C(D)	E(F)
On Ramp from Chase Parkway	-	-	D(D)	F(F)
Interchange 19				
Off Ramp to Sunnyside Ave./Route 8 SB	C(C)	C(D)	-	-
Off Ramp to Route 8 NB	C(D)	D(F)	-	-
On Ramp from Highland Ave.	C(D)	D(F)	-	-
On Ramp from Route 8 SB	-	-	C(D)	E(F)
Interchange 20				
Off Ramp to Route 8 SB	-	-	D(E)	F(F)
Off Ramp to Route 8 NB	-	-	C(D)	D(F)
On Ramp from Route 8 SB	F(F)	F(F)	-	-
On Ramp from Route 8 NB	D(E)	F(F)	C(F)	F(F)
Interchange 21				
Off Ramp to Meadow St.	D(E)	F(F)	D(D)	F(F)
Off Ramp to South Main St.	D(D)	F(F)	-	-
On Ramp from Meadow St.	C(D)	F(F)	-	-
On Ramp from Bank St. (Left)	-	-	C(D)	E(F)
On Ramp from Bank St. (Right)	-	-	C(D)	F(F)
Interchange 22				
Off Ramp to Frontage Road	D(D)	F(F)	-	-
Off Ramp to Union St.	-	-	C(C)	D(F)
On Ramp from Union St.	-	-	D(E)	F(F)
Interchange 23				
Off Ramp to Hamilton Ave.	-	-	F(F)	F(F)
On Ramp from Hamilton Ave.	F(F)	F(F)	-	-

Weaves

In order to evaluate traffic operations along the freeway, a weaving analysis is necessary where the freeway consists of on-ramps followed by off-ramps at close proximity to each other. In this study area, weaving analysis was performed in the Waterbury area where a number of such operations take place along I-84 in the eastbound and westbound directions. The following weaves were identified for evaluation:

- Route 8 NB On-Ramp to Meadow Street Off-Ramp (Eastbound Direction)
- Meadow Street On-Ramp to Route 8 NB (Westbound Direction)
- Meadow Street On-Ramp to Route 8 SB (Westbound Direction)
- Route 8 Southbound to Highland Avenue Interchange 18 Off-Ramp (Westbound Direction)

Additionally, peak hour surveillance of the Route 8/I-84 interchange was performed to assess the number of vehicles that attempt the weave from Route 8 southbound to the downtown Waterbury exit ramps at Interchanges 21 and 22. While this movement is prohibited, and signed as such, it was noted that only a couple vehicles actually performed this weave during each of the morning and afternoon peak periods. More vehicles may violate this maneuver during off-peak hours when the traffic volumes are not as high. This is a serious safety issue because the off-peak traffic is also traveling at a higher rate of speed, and a higher probability of serious accidents exists.

In order to evaluate weaving operations along I-84, freeway and ramp geometry, freeway and ramp speeds, and length of weaving section (distance between on and off ramps) were used as inputs. The results of the weaving analyses are summarized in Table 2.9.

Table 2.9
Weaving Analysis Summary

SECTION ALONG I-84	1999		2025	
	AM	PM	AM	PM
Eastbound Direction				
Route 8 NB to Meadow Street	E	E	F	F
Westbound Direction				
Meadow Street to Route 8 NB	C	E	E	F
Meadow Street to Route 8 SB	D	E	F	F
Route 8 Southbound to Highland Avenue	D	D	F	F

Signalized Intersection Analysis

Signalized intersection analyses were performed at study area intersections during the weekday morning and evening peak hour conditions for existing year conditions. The signal plans used for traffic analyses were provided by ConnDOT as well as the City of Waterbury. The results of the LOS analysis for existing and future conditions are shown in Table 2.10.

Table 2.10
Capacity Analysis Summary - Signalized Intersections

INTERSECTION	1999		2025	
	AM	PM	AM	PM
Interchange 14				
South Main St. and South Britain Rd.	C	D	E	F
Interchange 15				
I-84 EB Ramps and Route 6/Route 67	B	C	B	C
I-84 WB Ramps and Route 6/Route 67	D	C	E	D
N. Main St. and Heritage/Old Waterbury	C	C	F	E
Main Street and Southford/Shopping Plaza	F	F	F	F
Route 487/67 and Community House Rd.	C	C	C	D
Interchange 16				
I-84 WB Ramps and Route 188	C	C	D	D
Old Waterbury Road and Route 188	D	C	F	F
Interchange 17				
I-84 EB Off Ramp and Route 63	B	B	B	B
Route 63 and Route 188	B	E	E	F
Route 63 and Country Club Road	E	E	F	F
Route 63 and Route 64	F	F	F	F
Interchange 18				
I-84 EB Off Ramp and Chase Parkway	B	B	B	C
I-84 WB Off Ramp and W. Main St.	F	F	F	F
Chase Parkway and W. Main St.	B	C	F	F
Chase Parkway and Sunnyside/Highland	D	D	E	F
Chase Parkway and Country Club Road	C	C	F	E
Interchange 19-20				
Sunnyside Ave. and Riverside St.	C	B	F	C
Freight St. and Riverside NB	C	C	C	D
Freight St. and Riverside SB	E	C	F	C
W. Main St. and Riverside NB	C	C	D	F
W. Main St. and Riverside SB	E	E	F	F
Interchange 21				
I-84 EB On Ramp and Meadow St.	B	C	C	C
I-84 EB Off Ramp and Meadow St.	B	C	C	C
Willow Street and W. Main Street	C/E^	E/F^	F/F^	F/F^
Willow Street and Freight Street	D/D^	D/D^	F	E
Meadow Street and Grand Street	E	C	F	D
Grand Street and Bank Street	C/C^	C/D^	C/D^	D/F^
Grand Street and S. Main Street	C/D^	C/F^	C/F^	D/F^
Union Street and S. Elm Street	C/E^	D/F^	E/F^	F/F^
Meadow Street and Bank Street	C	C	C	C
Market Square/I-84 EB Off and Main St.	C	C	C	C
Meadow Street and Field Street	B	C	B	C
Interchange 22				
I-84 EB On Ramp and Baldwin St.	B	B	B	B
I-84 WB Off Ramp and Hamilton/Union	C	C	E	D
Union Street and Brass Mill Mall	A	B	A	B
Union Street and Mill Street	B	B	C	C
Mill Street and Baldwin Street	C	C	C	D
Interchange 23				
I-84 WB On Ramp and Hamilton Ave.	B	C	D	D
I-84 WB Off Ramp and Hamilton Ave.	B	C	B	C
I-84 EB On Ramp and Hamilton Ave.	C	C	C	F
Washington Street and Silver/Hamilton	E	F	F	F

^ With pedestrian phase

Un-signalized Intersections

Un-signalized intersection analysis was performed at stop sign controlled intersections in the study area. Roadway geometry and traffic volumes were used as input for the analysis. Table 2.11 summarizes the results of the LOS analyses for un-signalized intersections:

Table 2.11
Capacity Analysis Summary - Un-signalized Intersections

INTERSECTION	1999		2025	
	AM	PM	AM	PM
Interchange 13				
I-84 EB Off Ramp and Fish Rock Rd.	B	B	B	C
Fish Rock Rd. and Ichabod Rd.	A	A	A	B
Ichabod Rd. and Russian Village Rd.	B	B	B	B
Interchange 14				
I-84 WB Off Ramp and South Britain Rd.	C	D	D	F
I-84 EB Off Ramp and South Britain Rd.	A	C	B	F
Interchange 16				
I-84 EB Off Ramp and Route 188	C	B	E	C
Interchange 17				
I-84 WB Off Ramp and Chase Parkway	F	F	F	F
Interchange 18				
I-84 WB Off Ramp and Highland Avenue	C	F	F	F
Country Club Road and Oronoke Road	F	F	F	F
Interchange 19-20				
I-84 EB Off Ramp and Sunnyside Avenue	B	B	B	B
Interchange 21				
I-84 WB Off Ramp and Field Street	F	C	F	D

Source: Wilbur Smith Associates

Chapter 3
EXISTING ENVIRONMENTAL CONDITIONS

As part of this study, environmental resources we identified, such as farmlands, environmental risk sites, wetlands, important fisheries and wildlife habitat, rare and endangered species, watercourses, wells, and aquifers, floodplains, public water supplies and surface water, public 4(f) and 6(f) lands and air and noise impacts.

3.1 Wetland and Surface Water Resources

Much of the Study Area is characterized by palustrine forested wetlands, including riparian corridors of the major streams and rivers. Palustrine wetlands include most non-tidal wetlands and are dominated by trees, shrubs, persistent emergent plants, emergent mosses, and/or lichens. Wetlands of this type also include the small, shallow, permanent, or intermittent water bodies often called ponds. Palustrine wetlands may be situated shoreward of lakes, or river channels, on river floodplains, in isolated catchments, or on slopes. Numerous wet drainage ways and open stream channels are also common throughout the Study Area. These are primarily associated with highway drainage systems and other recently constructed developments.

The majority of wetlands in the Study Area, based on soil types, are considered to have poor to very poorly drained soils, excluding alluvial and floodplain wetlands associated with rivers and streams. Larger wetland systems occur within the town of Middlebury between Kissawaug Road and I-84. Another larger expanse of wetlands area is located south of Leonard Road in Middlebury. Actual wetland sizes and characteristics will be further evaluated following the development of project alternatives.

3.2 Floodplains

There are floodplain areas associated with the Eightmile Brook between Middlebury and Southbury and extending along the western border of Oxford. Within Southbury, floodplains are associated with the Pomperaug River, a tributary to the Housatonic River. In the southern portion of Middlebury, there are floodplains associated with Long Meadow Pond. To the east of Route 63, along the Middlebury/Waterbury border, there are floodplains associated with Hop Brook Lake and tributaries to Hop Brook Lake and Hop Brook. In the northern portion of the Study Area within Waterbury, there are floodplains associated with the Naugatuck River.

3.3 Groundwater Resources

A limited number of surface waters have been classified. The Pomperaug River is classified as Class B, suitable for recreation uses. Bullet Hill Brook, a tributary of the Pomperaug River in the vicinity of Interchange 15, has a surface water classification of B/A. Eightmile Brook in Middlebury is classified as A. Hop Brook and Long Meadow Brook, within Middlebury, are classified as Class A, meaning they are a potential drinking water supply, provide fish and wildlife habitat, and are suitable for recreational use.

3.4 Rare, Threatened, and Endangered Species

Within Southbury, four species of state Special concern were noted to potentially occur. Additionally, the CTDEP noted numerous state listed species (mostly plants) may be located just north of the Pomperaug River in Southbury. Alternatives developed within this area will require an additional review of the CTDEP Natural Diversity Database. The initial database query is not a substitute for comprehensive on-site survey that may be require when specific project alternatives are determined.

3.5 Farmland Soils

Lands that qualify as Prime Farmland or Additional Farmland of Statewide Importance occur as pockets throughout the I-84 corridor. Prime farmlands soils exist adjacent to I-84 within the central portion of Southbury and throughout Middlebury. The most common occurrences of important farmland soils adjacent to the highway corridor are in areas where soils are derived from glacial outwash sediments. However, within the Study Area, particularly within Waterbury, much of the Prime Farmlands mapped in 1965 has been developed, according to 1995 Connecticut Department of Environmental Protection (CTDEP) land use maps. Developed areas no longer qualify as important farmlands. These developed farmland areas were subsequently excluded from this analysis.

3.6 Noise Sensitive Areas

The potentially affected portions of Southbury generally are low-density single family residential areas with scattered homes on large lots. Some commercial land uses are found in the area, particularly around exit 15, may value visibility over noise abatement. An existing noise barrier shields Southbury Middle School, located on the north side of I-84 at Peter Road.

The portions of the town of Middlebury close to I-84 include a combination of very low-density single-family residential land uses and some corporate properties (office park) with pockets of commercial use.

The portions of the city of Waterbury proximate to I-84 include many single family and multiple-family properties in a higher concentration than the other communities, along with substantial areas of commercial use; institutions such as hospitals, schools and cemeteries are also found within this area. Much of the I-84 corridor is currently at a different grade than the surrounding areas (either high above the community on bridge structures, or else much lower than the surrounding terrain).

In the mid-eighties, the DOT monitored noise along segments of Interstate 84. The result of this analysis was an inventory of locations that were candidates for a noise abatement program. Several of these locations have been identified within the WOW corridor. Table 3.1 lists the eight retrofit locations identified by ConnDOT along I-84 within the project limits.

Table 3.1
Potential Noise Barrier Locations Along I-84

Town	Location
Southbury	Skyview Drive
Southbury	Stony Corner Road
Southbury	Church Street
Middlebury	Shaddock Road
Waterbury	Ponham Street
Waterbury	Plank Road
Waterbury	Country Club Road
Waterbury	Sidney Street

3.7 Air Quality

The findings from the air quality demonstrate that, in general, the emissions associated with traffic are estimated to decrease from 1999 to 2025. This reduction comes primarily from improvements in emissions reduction technology, inspection-maintenance programs, and alternative fuel vehicles.

For Carbon Monoxide (CO) and Volatile Organic Compounds (VOCs), total emissions for each year are somewhat higher during the PM peak than during the AM peak. This can be attributed to higher congestion in the PM peak hour; with resultant lower speeds, emission rates increase. However, with Nitrogen Oxides (NOx), emission rates increase with increased speeds, so the PM peak hour emissions are actually lower from the lower speeds caused by the congestion.

3.8 Environmental Risk Sites

Nine potential risk sites were identified to contain hazardous material and are listed in Table 3.2. The potential existence of other environmental risk sites within the Study Area will need to be further evaluated on a site-by-site basis once alternatives are identified.

Table 3.2
Potential Environmental Risk Sites in the I-84 Corridor

EPA ID	Type of Service	Location	City
CTD001839679	Industrial Cleaning Systems	Christian Road	Oxford
CTD049589294	Metal Finishers	Christian Road	Oxford
CTD001166008	Industrial	South Main Street	Waterbury
CTD018860551	Lighting and Electrical	Bank Street	Waterbury
CTD052710829	Screw Machine Products	South Main Street	Waterbury
CTD067072355	Flexible Metal Products	South Main Street	Waterbury
CTD067072371	Metal Wire and Tubing	Bank Street	Waterbury
CTD981898521	Electrical Utility Service	Jackson Street	Waterbury
CTD981063431	Chemical Supplier	East Aurora Street	Waterbury

Source: U. S. Environmental Protection Agency

3.9 Important Fisheries and Wildlife Habitat

Wildlife habitat in the Study Area occurs within the mosaic of urban, suburban, and rural/undeveloped lands. In urban areas, wildlife species likely to occur include squirrels and birds tolerant of urban conditions (e.g., pigeons, robins, blackbirds, grackles, house finches). In suburban areas, there is a greater diversity of birds (e.g., bluejays, sparrows, chickadees, turkey) and mammals (e.g., raccoon, moles, chipmunks, deer), and common amphibians and reptiles that occur in backyards and ponds (bullfrog, green frog, rat snake, garter snake, red-backed salamander). In rural areas, even more wildlife diversity included larger mammals (e.g., shrew, fox, coyote), birds (woodpeckers, hawks, bluebirds, and many other songbirds) and amphibians (salamanders and frogs) and reptiles (turtles and snakes) in suitable habitats.

3.10 Historic and Archaeological Resources

Approximately six historic sites are in close proximity to (within 500 feet) of I-84 or the arterial roads that provide access to the interstate. It is also notable that 17 of the historic sites listed are in the vicinity of downtown Waterbury. It can be anticipated that only three of those 17 sites have potential to be affected by project alternatives. Table 3.3 lists the historic sites in the study corridor.

Table 3.3
Historic Resources in the vicinity of I-84
West to East Along the Corridor

Site Name	Location
Southbury	
Southbury Historic District #1	Main Street from Old Waterbury Road north to the Woodbury town line
Russian Village Historic District	Kiev Drive and Russian Village Drive
South Britain Historic District	Bounded by East Flat Hill Road, Hawkins, Library, and Middle Roads
Hurley Road Historic District	Hurley Road
Bullet Hill School	Main Street and Seymour Road
Rueben Curtis House	1770 Bucks Hill Road
Middlebury	
Middlebury Center Historic District	Bounded by Library Road, North and South Streets, and Whitmore Road
Tranquility Farm	Route 64
Nathaniel Richardson House	Kelly Road
Waterbury	
Waterbury Brass Mill Site	Idylwood Avenue in Hamilton Park
Hamilton Park	Bounded by Silver Street, E. Main Street, Idylwood Avenue, Plank Road, and the Mad River
Overlook Historic District	Bounded by Helca Street, Farmington and Columbia Blvd., Cables Avenue and Clowes Terrace, Lincoln, and Fiske Streets
Hillside Historic District	Bounded by Woodlawn Terrace, West Main Street and Willow Street
Wilby High School	260 Grove Street
George S. Abbott Building	235 N. Main Street
Waterbury Clock Company	North Elm, Cherry Streets, and Cherry Avenue
Elton Hotel	16-30 W. Main Street
Matthews and Willard Factory	16 Cherry Avenue
John Kendrick House	119 W. Main Street
Downtown Waterbury Historic District	Bounded by East Main, West Main, Meadow, and Elm Streets
Palace Theater	86-110 East Main Street
Enoch Hibbard House and George Granniss House	33 & 41 Church Street
Waterbury Union Station	389 Meadow Street
Waterbury Municipal Center Complex	195 Grand Street
Bank Street Historic District	207-231 Bank Street
Riverside Cemetery	Riverside Street, between Sunnyside and Summit Streets

Source: CT Historical Commission, SHPO

There are numerous reported archeological sites within or adjacent to the study corridor. These are sites that have been documented with the Office of the State Archeologist for Connecticut and/or the Connecticut Historical Commission. Specific locations of these sites are not provided by these agencies, to protect the integrity of the site and avoid potential loss of artifacts. Of the sites identified, only one has been listed on the National Register of Historic Places. It is an archeological site associated with the Waterbury Brass Mill National Register historic site.

3.11 Section 4(f) and Section 6(f) Resources

Sites that qualify as Section 4(f) properties include a substantial number (26) of historic sites on the National Register of Historic Places and one archeological site within the study corridor. However, a limited number of those historic sites (about 6) are in immediate proximity (within 500 feet) of I-84 and the arterial roads that provide access to the interstate. Some of the 4(f) resources within the study corridor include municipal parks, state recreation areas, state parks, and the Larkin State Bridal Path

Section 6(f) of the Land and Water Conservation Fund Act (LWCF) states that any lands that were purchased or developed with LWCF funds cannot be "converted" to another use for purposes inconsistent with the Act, without being replaced with other land that is of equal value to the land proposed for conversion. There is one Section 6(f) property within the Study Area. This is the ice skating rink at Hamilton Park.

3.12 Environmental Justice

"Environmental Justice" requires that no federally funded project should be implemented in such a way as to result in disproportionately high and adverse effects on disadvantaged, minority, and/or low-income populations. The goal of Environmental Justice is expressed in Executive Order 12898 titled *Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations*. 1990 U.S. Census data was reviewed as the primary means of evaluating potential environmental justice issues in the Study Area. Table 3.4 compares the levels of low income, elderly, and minority populations in the communities that fall partially within the Study Area, as compared with the COGCNV region and the State of Connecticut.

With the exception of Waterbury, the communities within the Study Area have a lower percentage of low income and minority populations than the CNV region overall and the State of Connecticut in general as demonstrated in Table 3.4. In Waterbury there are some residential areas in close proximity (500 feet or less) to the south side of I-84, in the vicinity of Interchange 22. The housing in these neighborhoods predominantly consists of aging two and three family homes on small lots. Some of these neighborhoods are home to lower income residents. Although the other communities in the Study Area have a high percentage of elderly population, generally these residents are not low income. They are less likely to be disadvantaged and of concern in terms of Environmental Justice. However, the data does not reflect characteristics of individual census blocks (smaller geographic areas).

Table 3.4
Comparison of Environmental Justice Factors - I-84 Needs Deficiencies

Area	Total Pop. 1990	Median Household Income	% Age 65 Or Older	% Below Poverty Level	% Non-white
Southbury	15,818	$47,335	27%	1.9%	2%
Middlebury	6,145	$49,524	16%	3.5%	2%
Oxford	8,685	$54,448	1%	1.7%	2%
Waterbury	108,961	$30,553	16.5%	12.1%	21%
COGCNV Region	261,081	Not available	15%	6.5%	11%
Connecticut	3,287,116	$41,721	14%	6.8%	13%

Source: 1990 U.S. Census

3.13 Commercially Important Natural Resources

Commercially important natural resources include sand and gravel or other mined resources and forestry products. There are no mining operations or lumber harvesting operations within the study corridor.

3.14 Visual/Aesthetic Resources

Visual and aesthetic resources are generally considered to include natural areas, ridgelines, parks, historic sites and/or neighborhoods, and aesthetic streetscapes. Information on the locations of aesthetic visual resources within the study corridor was obtained from the plans of conservation and development for the communities, as well as a field review of the corridor.

While ridgelines of significance have not been documented within the communities, the plans of development note that scenic wooded hillsides are an important part of the character of the communities. The Town of Middlebury is characterized in the *Plan of Development* (May, 1990) by a series of ridges and valleys generally running north to south. The town of Southbury also has a series of wooded hillsides that provides vistas of the rural countryside. The plan of development notes, "the essential and desirable character of the town is founded on open space". Other aesthetic visual resources of note in the study corridor include the following:

- Scenic vista from Interstate 84 of the central Naugatuck valley from Interchange 17 west to Interchange 13.
- The Westover School campus in Middlebury.
- The Middlebury Town Hall complex, located on one of the ridgelines within the I-84 corridor in Middlebury.
- Scenic vistas that occur along Old Waterbury Road.
- Saint Anne's Church in Waterbury on East Clay Street.
- The monument and sculptures that adorn the Town Green in Waterbury on West Main Street.

- The tower, which rises from the Waterbury Republican American newspaper, that is visible throughout much of the City of Waterbury.

3.15 Business Activity and Major Employers

Major employers within the Study Area include retail centers, industrial centers, residential care facilities, schools, municipal governments, and corporate complexes. Some notable large employers (100 or more employees) in the corridor include the following:

- **Southbury**
  IBM
  Mediplex of Southbury
  Southbury Shopping Plaza

- **Middlebury**
  General Data Communications
  Timex
  Uniroyal Chemical

- **Oxford**
  Alternatives Inc.
  Oxford Industrial Park (surrounding airport)

- **Waterbury**
  Brass Mill Center Mall
  Cedar Lane Rehabilitation Care Center
  City of Waterbury
  Macdermid Inc.
  Northeast Utilities
  Romatic Manufacturing
  St. Mary's and Waterbury Hospitals

3.16 Park Lands, Management Areas and Campgrounds

Park lands within the study corridor include urban parks, recreation areas, community play fields, trails, and state recreation areas. These areas of preserved open space provide for passive recreation including walking, bicycling, hiking, horseback riding, field games, and picnicking. Information on open space was obtained from the *City of Waterbury Community Assessment* (1999), the *Central Naugatuck Valley Regional Plan* (COGCNV, 1998), and a database maintained by the COGCNV.

Table 3.5 lists the parks, recreation (management) areas, and campgrounds in the study corridor and notes their size and facilities. Of the resources listed, seven are in close proximity (within 500 feet) of Interstate 84 and/or the arterial roads that serve the interstate.

Table 3.5
Preserved Open Space in the I-84 Study Area

Open Space Area	Size in Acres	Facilities/Amenities
Southbury		
Community House Park	14.5	Play field, basketball, tennis, picnicking
Hidden Pond Park	58	Fishing, hiking
Platt Park	106	Hiking, nature trails
Ewald Town Park	8.5	Softball, walking track
Larkin State Bridal Path		Horseback riding, walking, bicycling
Middlebury		
Bristol Park	N/A	Picnicking, walking
Hop Brook Lake Recreation Area	N/A	Fishing, swimming, hiking, picnicking
Larkin State Bridal Path	N/A	Horseback riding, walking, bicycling
Middlebury Greenway	4.5 miles	Walking, bicycling, roller-blading
Meadowview Park	N/A	Softball, fishing, walking, playground, Greenway connector
Quassy Amusement Park	20	Rides, swimming, picnic area
Oxford		
Larkin State Bridal Path		Horseback riding, walking, bicycling
Kettletown State Park	488	Camping, fishing, swimming, hiking, picnicking
Southford Falls State Park	120	Fishing, swimming, hiking, picnicking
Waterbury		
City Mills	7.5	Basketball, softball, soccer, playgrounds
Chase Park	10.8	Basketball, softball, tennis, playground, gymnasium
The Town Green	2.2	Picnicking, walking
Hamilton Park	93	Basketball, baseball/soccer, tennis, ice skating
Waterbury Country Club		Golf
Washington Park	34	Baseball, soccer, tennis, gymnasium

Source: City of Waterbury, COGCNV

3.17 Museums and Cultural Resources

There are two museums in the corridor. One is the Mattatuck Museum located opposite the Town Green on West Main Street in Waterbury. It focuses on Connecticut artists. The other is Old Town Hall Historical Museum on Route 172 in Southbury. Other cultural resources in the include parks, historic resources, libraries, tourist destinations, and schools. Libraries, tourist destinations, cemeteries, and schools in the Study Area include the following (generally west to east):

- Pine Hill Cemetery;
- Southbury Public Library;
- Pomperaug Elementary School;
- Middlebury Public Library;
- Pomperaug High School;
- Long Meadow Elementary School;
- Rochambeau Elementary School;
- Westover School;

- Silas Bronson Public Library in Waterbury;
- Teikyo Post College;
- Naugatuck Valley Community College;
- The Holy Land (tourist destination); and,
- Riverside Cemetery.

Chapter 4
ALTERNATIVES EVALUATION

One goal of this Needs and Deficiencies Study is to compare a full range of transportation alternatives and evaluate their performance over a long range planning period. This evaluation is intended to consider the ability of these alternatives to accomplish defined transportation objectives, as well as their relative potential effects on the natural and social environment. Since transportation improvements usually have both positive and negative impacts, they must be weighed by decision makers and the public at-large to determine what combination of alternative strategies will provide the greatest benefit. A well-conceived transportation program for the study area could not only enhance the potential for regional economic development, but may also offer opportunities to improve the environment, and reinforce community linkages.

Because this Needs and Deficiencies Study considers a range of alternatives, the performance and impacts will vary over the evaluation period. This chapter presents a brief description of the level of improvement and the range of transportation improvements that is being considered in this evaluation. Subsequent chapters place these improvement alternatives in the context of the I-84 WOW corridor and evaluate their performance relative to the defined goals and objectives.

4.1 Level of Improvements

Level of Improvement (LOI) is intended to characterize the degree to which full construction or reconstruction is anticipated within the improvement alternative. Ranging from maintenance to "full build" alternatives, the LOI will dictate the type and degree of positive and negative impacts anticipated. The cost of even a "preservation of the mobility" approach can be quite substantial. Programs incorporating bridge or viaduct reconstruction often exceed $100 million. Costs of this magnitude must be carefully considered before alternatives to increase capacity are ruled out.

A first cut of defining Transportation Alternatives (TAs) involved generalizing improvements in to three broad categories. They are described and evaluated in the remainder of this chapter.

4.2 Screening Methodology

The Transportation Alternatives formulated for the initial evaluation within the I-84 WOW Needs and Deficiencies Study were intended to address transportation deficiencies identified early in the study process. They were not intended to represent the final solution or for that matter to limit future consideration of additional strategies. Each of the alternatives were screened based on the transportation benefit that they provided, their environmental and social impacts, and their preliminary cost. The alternatives that provided the greatest benefit with the least amount of impact and cost were selected and brought before the Advisory Committee and the public for concurrence.

Following the evaluation of these preliminary improvement strategies, elements from several of the TAs were selected for further environmental and engineering evaluation. The themes from which the alternatives were grouped included:

- TA 1- No Build (Existing And Committed)
- TA 2 - Transportation System Management, Transit Operations, & Transportation Demand Management Transit Operations
- TA 3 – Freeway and Interchange Reconstruction

4.3 TA 1- No Build (Existing And Committed)

The No Build package (TA 1) constitutes the base case condition for the evaluation of transportation improvements. No Build generally includes existing and committed projects, along with the normal maintenance and operation of the transportation system over the forecast period. The details of TA 1 were presented in Technical Report 1, the Existing and Future Conditions Report, which analyzed the future performance of this TA.

4.4 TA 2 - Transportation System Management, Transit Operations, & Transportation Demand Management Transit Operations

Figure 4.1 illustrates some of the strategies associated with TA 2, and Table 4.1 summarizes the improvement strategies that could be included in TA 2. Given the general nature of TSM, TDM, and Transit Operation Alternatives, these improvements are to be distributed throughout the corridor. TSM improvements would include traffic operations and safety improvements applicable in many areas of the corridor. TDM improvements will be focused on areas of internal travel demand such as Waterbury's downtown or shopping areas such as Main Street South in Southbury. Transit Operations improvements are suggested to make modifications within the context of the existing transit route system. Improvements such as the enhancement of express and local bus services are also included within this category.

Given the small-scale, localized nature of TA 2 improvements, a definitive list of improvement sites cannot be defined at this stage. Instead, typical locations and improvements have been identified for comparative evaluation. Final improvements may vary from those targeted in this analysis.

TSM, TDM and Transit Operations improvements are usually implemented within the right-of-way and are less capital intensive than other transportation improvement alternatives, but taken in aggregate, the cost associated with TA 2 would be significant. The success of the program especially the TDM segment depends in large measure on the voluntary cooperation of the public and private sector. The various potential alternatives are as follows:

Table 4.1
TA 2: TSM, TDM, and TO

Transportation System Management (TSM)
Directional / Wayfinding Signage
Safety Enhancements
Intersection Improvements
Arterial Signal System Coordination
Intelligent Transportation Systems (ITS)
Sidewalks
Pedestrian Crossings & Separation
Bicycle Shared Lanes
Multi-purpose Paths
Transit Operations
Express Service Expansion
Additional Local Service
Transportation Demand Management (TDM)
Employer Ridesharing Subsidy
Employer Flex Hours
Peak Hour Pricing
Transit Discounts
Land Use Regulation - Mixed Use
Land Use - Transit Friendly
Land Use - Access Management
On-Street Parking Control
CBD Parking Control
Park and Ride Lots
Maintenance and Operations

Safety Enhancements

Safety improvements are an important part of the overall approach to transportation systems management. Five segments of I-84 had accident rates high enough to be listed on ConnDOT's 1995-1997 SLOSS (Suggested List of Surveillance Sites).

Some of the potential alternative solutions for these segments are as follows:

- Extension of truck climbing lanes, providing shoulders at truck climbing lanes (part of an existing ConnDOT project), and consideration of a truck rest area could reduce accidents between Interchanges 15 and 17.

- Improve the directional signage at Interchange 17 (Route 63) help reduce driver confusion in this area. Also, improving the intersection at Chase Parkway and Route 64 could reduce serious accidents at this area.

- Further study of the reconstruction of I-84 at the Route 8 interchange to remove the left hand exits and complex weaving patterns. Additionally, the installation of overhead variable message signs would alert traffic to peak hour congestion.

Intersection Operational Improvements

Several intersections in the I-84 WOW study area have been identified as having severe operational deficiencies. As part of the TSM strategy each of these intersections will need to be upgraded to meet acceptable standards for handling traffic. Some of the potential improvement solutions may include adding exclusive left turn lanes and signal phases, improving signal timing and coordination, adding lanes, grade separation, updating of signal and improving stripping and signing. Some of the intersections that could benefit from additional lanes or signal timing include South Britain Road and Main Street South, Main Street South and Main Street North, Old Waterbury Road and Route 188, and Route 188 and I-84 Westbound Ramps.

Arterial Signal Coordination

This technique could improve travel times on principal arterial streets. Through coordinated traffic signal timing, vehicles will maintain a uniform speed and encounter as few red traffic signals as possible. The result is that motorists will experience fewer delays. In addition to the congestion between intersections, the possibility of queuing along the I-84 ramps could also be reduced. Some of the locations identified for arterial signal coordination are South Britain Road, Route 6/67, Route 188, and Route 63.

Intelligent Transportation Systems (ITS)

Possible ITS solutions in the I-84 West of Waterbury corridor include Advanced Traveler Information Systems (ATIS) and Incident Management. Through ATIS, information can be provided to motorists by means of Variable Message Signs (VMS) and Highway Advisory Radio (HAR), as well as before they start their trip, either through a phone number, or a website, or both. Incident management is the rapid detection and response to any incident with the potential to reduce traffic flow. Motorists and Closed Circuit Television (CCTV) cameras detect incidents and an operator at a Traffic Operations Center (TOC) can determine what action is needed and dispatch appropriate personnel. The operator can then use the Advanced Traveler Information Systems to quickly notify motorists of the incident, so that they can choose alternate routes.

One of the major causes of traffic delays is non-recurring congestion, caused by construction, accidents, or other unusual incidents. Information will be provided to motorists by means of VMS and HAR. Information can also be made available to motorists before they start their trip, either through a phone number, or a website, or both.

Typically, an incident will occur on one route, while parallel routes will be unaffected. Unless they have accurate, up-to-date information, motorists will be unable to avoid these incidents, and will incur unnecessary delays.

Incident management is the rapid detection and response to any incident with the potential to reduce traffic flow. A common means of incident detection is cellular phone calls from motorists who observe an incident. According to the *ITS Strategic Plan*, this system works well. However, in order to confirm these reports, and help determine the appropriate response, an additional system is proposed. The surveillance of I-84 by a set of CCTV cameras would fulfill this function. These cameras would be connected to monitors at a TOC, where an operator can confirm that an incident has taken place, determine what is needed to clear the incident, and dispatch appropriate personnel and equipment to deal with it. The operator can then use the Advanced Traveler Information Systems to quickly notify motorists of the incident, so that they can choose alternate routes.

Another Incident Management facet recommended by the *ITS Strategic Plan* is the Connecticut Highway Assistance Motorist Patrols, or CHAMP. These are light trucks, staffed by Department of Transportation employees, equipped to handle minor traffic incidents without the dispatch of additional equipment. They can provide a motorist with gasoline, a jump-start, a battery, push a stalled auto out of the traffic stream, or assist in changing a tire. They can remove debris from the right-of-way, and set up signs for accident and detour routes. Additionally, they observe traffic conditions and report to the operators at the TOC. CHAMP patrols already exist on I-95 and on I-91, and the *ITS Strategic Plan* urges their expansion to I-84. Nationwide, Highway Service Patrols have proven to be extremely popular in many urban areas, and have proven invaluable in building public support for ITS projects.

Transportation Demand Management

In most portions of the I-84 WOW study area, the existing pattern of land use and the relative availability of parking (in comparison with larger metropolitan areas) favor the use of single-occupant vehicles (SOVs). Even workers within the regional core - Downtown Waterbury - utilize an SOV more commonly than any other mode. The 1990 census reports that 76 percent of Waterbury residents drove alone, while only 15 percent utilized carpools, or vanpools and three percent used public transportation. The remaining six percent either walked or bicycled to work, or worked at home. For outlying employment centers, the proportion of commuters driving alone is even greater, reaching 85 percent in Southbury, Middlebury and Oxford combined. Of these communities, nine percent carpool, less than one percent use public transit, and the remaining five percent walk, bike, or work at home.

Market rate parking costs in Downtown Waterbury range from approximately $40-60 monthly for parking garages. Most metered lots have a cost of twenty-five cents for each 20 minutes, usually with a limit of three hours. However, many of the Downtown employees, including most State of Connecticut employees, have free parking provided to them. Elsewhere within the study area, almost all employee parking is provided for free.

Based on past regional and nationwide experience, the adoption of a high-profile TDM initiative at an individual employer can result in an increase in use of High Occupancy modes of up to 20 percent. Because HOV travel still represents a minority of travel in most work sites (especially for suburban and non-CBD locations), the total impact on congestion or modal split would be proportionately lower. A voluntary employer-based program implies that participation will be substantially less than 100 percent. Current corporate participation rates (the number of firms

participating versus the total number of area businesses) are in the range of one percent of all employers and ten percent of all employees.

Park and Ride Lots

Park and Ride Lots are designed to encourage carpooling and reduce the number of vehicles on the road during peak hours. The eight park and ride lots found within the study area are listed in Table 2.3 in Chapter 2 of this report.

In a memorandum entitled *Commuter Parking Lot Facilities in the Central Naugatuck Valley Region, Occupancy Analysis and Recommendations* by the COGCNV dated December 27th, 2000, recommendations were given on the potential expansion of commuter lots. The COGCNV study confirmed that the Route 63 lot in Middlebury exceeds its capacity on average. Since ConnDOT considers commuter parking lots at or above 75 percent of their capacity to be sites for potential expansion, this was the only lot that met that criterion.

In addition, the study concluded that driver awareness of commuter parking lots along Interstate 84 is needed. The installation of "Park & Ride" signage along I-84 and Route 8 could encourage the use of such facilities.

Congestion Management Strategy Report

Federal regulations require every state and metropolitan planning organization to establish a congestion management system (CMS) as part of its overall transportation planning program. The CMS proposed for the State of Connecticut and the Central Naugatuck Valley includes a requirement to prepare a special strategy report for each area or corridor with significant congestion. The purpose of the report is to identify and evaluate appropriate congestion mitigation strategies.

The I-84 WOW Needs and Deficiencies Study will serve the function of a CMS strategy report. As such, the Needs and Deficiencies will: (1) identify and thoroughly assess congestion in the corridor, and (2) identify and fully evaluate all appropriate congestion mitigation strategies. The study will use appropriate performance measures to both assess congestion and evaluate the effectiveness of mitigation strategies. Performance measures will be selected from the list of measures specified in Connecticut's CMS guidelines.

Transit Operations

Improvements to transit operations could include a new express bus service on I-84 with loops into major centers of population within the study area. A conceptual service was evaluated as a transportation alternative to evaluate its feasibility.

To survey the need for additional transit service in the corridor, several of the activity centers connected by the conceptual transit route were contacted to determine the current transit use or need. Heritage Village provides their own transportation for residents. Mini-bus shuttles are available for rides to local activities and appointments. For longer excursions, Heritage Village rents motor coaches approximately monthly to attend events throughout New England. The

towns of Southbury, Middlebury and Oxford all provide handicapped and senior shuttle, which run on various days of the week for shopping and doctors appointments. The Southbury Training School also utilizes their own buses to accommodate scheduled trips. In addition to these services, the Waterbury Hospital provides a B-well shuttle for patients who need a ride to doctors appointments. Based on the conversations with these organizations, it appears that the transit needs of these populations are being adequately served by the existing on-call shuttle services.

In order to attract riders that are not transit-dependant, the conceptual transit route must have a competitive travel time with the existing transportation facilities in the study area. If a bus service ran on existing I-84 mixed with other traffic, the travel time would be the same as the other vehicles plus the delays due to stops for passenger drop-off and pick-up. Therefore, in order to be competitive with I-84, an exclusive lane or facility would have to be constructed.

Based on the low numbers of transit-dependant households and the low population density in the study corridor, the conceptual transit route would have low ridership unless congestion on I-84 significantly increased and an exclusive facility could be constructed. For these reasons, providing additional transit service beyond Waterbury did not prove feasible.

4.5 TA 3 – Freeway and Interchange Reconstruction

Reconstruction improvements include adding a general-purpose lane to the freeway in each direction as well as reconstruction of left entrance and exit ramps, completion of partial interchanges and consolidation of split interchanges. Illustrated on Figures 4.2, 4.3, and 4.4 are the strategies associated with TA 3.

Additional General Purpose Lane Alternative

This improvement would consist of constructing an additional twelve-foot lane in each direction, and a twelve-foot inside shoulder. The additional lane would be continuous between the Housatonic River and Interchange 18. Segments where there is an existing climbing lane would consist of four lanes where the outer lane would remain a climbing lane. Every effort would be made to achieve and maintain a twelve-foot outside shoulder for safety reasons (ConnDOT is currently adding shoulders to climbing lanes between Interchanges 13 and 16). At some locations where the elevation differential between the eastbound and westbound alignment is great, retaining structures may need to be constructed. At the east end of the corridor near Interchange 18, right-of-way restrictions may require that inside and outside shoulders be reduced to minimize or eliminate impacts on adjoining property.

HOV Lanes

High Occupancy Vehicle (HOV) lanes were considered as a potential utilization of the additional lane alternative; however, they proved ineffective in reducing congestion on the interstate in the studies performed to the east and west of this corridor. Within the WOW corridor, development patterns are characterized by small pockets of commercial/industrial land uses that do not support the employment densities necessary for HOV facilities to be successful. In addition, connectivity to Downtown Waterbury would present considerable challenges due to the existing

structural constraints in the area as well as the left hand entrance and exit ramp configurations that exist on I-84.

Interchange Improvement Alternatives

Based on workshops with ConnDOT and the study team, and meetings with the region, towns and city; a set of interchange improvements were developed to address the deficiencies identified at various locations along the corridor. The following paragraphs describe the proposed alternatives at each interchange. Conceptual illustrations of these alternatives are included in Technical Memorandum # 2.

Interchange 13 in Southbury is the westernmost interchange within the WOW study corridor. It forms a partial interchange just east of the Housatonic River, serving trips to and from the west. This interchange has two mainline lanes along I-84 in the eastbound and westbound directions. The on and off ramps to and from I-84 are single lane ramps. In the future year 2025 with increase in traffic volumes, the off-ramp to Fish Rock Road and I-84 eastbound junction operates at LOS F during the weekday evening peak hour condition. In the westbound direction, the on-ramp from Oakdale Road and I-84 junction operates at LOS F during the weekday morning peak hour condition.

The preliminary alternatives for this interchange were as follows:

- Complete the interchange so that traffic to and from all directions is served. In the westbound direction, the existing westbound entrance ramp would be replaced by new westbound entrance ramps in a buttonhook configuration terminating at a realigned Oakdale Manor Road. In the eastbound direction, the existing eastbound exit ramp would remain in the same location while a new eastbound entrance ramp would be constructed at the same point on Fish Rock Road. This alternative would likely require the overpass structure for River Road to be modified. The new ramp configuration would also allow for the inclusion of a commuter parking lot on either the eastbound or westbound side.

- Increase the turning radius of the westbound entrance ramp at Oakdale Manor Road. As it exists today, truck traffic heading east on Oakdale Manor Road attempting to enter the westbound ramp must encroach upon the westbound lanes to make a wide enough turn to access the ramp. Increasing to a standard 50-foot radius at this skewed approach will prevent this from occurring and improve safety. This alternative also has the potential for inclusion of a commuter parking facility.

Interchange 14 in Southbury has full directional access to and from Route 172. This interchange has two mainline lanes and single lane entrance and exit ramps along I-84 in the eastbound and westbound directions. In the future year 2025 with an increase in traffic volume, the eastbound entrance and exit ramp junctions with I-84 operate at LOS F during the weekday evening peak hour condition. The westbound entrance and exit ramp junctions with I-84 operate at LOS F during the weekday morning peak hour conditions. During the weekday evening peak hour, the South Britain Road and I-84 westbound exit ramp junction operates at LOS F. It has been determined that the lack of storage space between the westbound off ramp and Main Street South

along with the heavy right hand turn movement at this intersection creates a queuing problem at this ramp terminus.

The potential alternatives at this interchange were as follows:

- Improve operations by realigning the westbound exit ramp with the westbound entrance ramp. This alteration provides additional space between the ramp and Main Street South and forms a single signalized intersection where two un-signalized intersections previously existed. The relocation of the westbound exit ramp terminus raised the issue of sight distance from the northbound approach of Route 172. Preliminary calculations and site investigation determined that sight and stopping distance is adequate based on the ramp relocation.

- Realign Lakeside Road to form a perpendicular intersection with Georges Hill Road. This would reinforce Georges Hill as the major movement through this intersection and improve operations. The use of Lakeside by traffic towing boats should be considered if this alternative is to be advanced. Since Lakeside Road starts at the bottom of a hill, some vehicles towing heavy loads may have difficulty climbing the grade if they are forced to stop at the new intersection.

Interchange 15 is the primary access to the Town of Southbury. It provides full directional access to and from Route 6. Major commercial development in this area makes it the most heavily utilized interchange in Southbury. The configuration consists of two mainline lanes and single lane entrance and exit ramps along I-84 in the eastbound and westbound directions; however, in the westbound direction due to the presence of a climbing lane, there are three mainline lanes along I-84 just west of the on ramp from Route 6/Route 67 and the IBM Drive. Under the future year 2025 condition, the eastbound entrance and exit ramps from Route 67 operate at LOS F during the weekday evening peak hour, while the westbound entrance and exit ramps operate at LOS F during the weekday morning peak hour condition.

The preliminary alternatives for this interchange were as follows:

- Provide a bypass lane that diverges from the existing westbound frontage road just west of the intersection with Route 6 to alleviate the congestion at the Route 6 and Main Street South intersection. The bypass road would terminate at Bullet Hill Road just opposite the IBM westbound entrance ramp. This road could provide some relief to the Route 6 and Main Street South intersection by allowing traffic destined for Main Street South to use the bypass instead of the congested intersection.

- Carry the truck-climbing lane through the interchange area so that trucks and automobiles are not forced into a difficult weave near the eastbound exit ramp. This modification would likely involve the reconstruction of the I-84 bridge over Route 6.

Interchange 16 provides full directional access to and from Route 188 in Southbury. While these ramps are important to development in Southbury, they also serve development in Middlebury and Oxford. Interchange 16 also provides an important linkage to Oxford Airport. This interchange has two mainline lanes and single lane entrance and exit ramps along I-84 in the

eastbound and westbound directions. With increase in traffic volumes in the future year 2025, the eastbound entrance and exit ramps from Route 188 operate at LOS F during the weekday evening peak hour under future year condition, while the westbound entrance and exit ramps operate at LOS E and LOS F respectively during the weekday morning peak hour condition.

The preliminary alternatives for this interchange were as follows:

- Relocate the westbound exit and entrance ramps further east onto Route 188 in Middlebury. While the exact location and configuration of these ramps have not been precisely determined, relocation could help alleviate the congestion problem at the existing location and provide better access to development in Middlebury. Of course, such a modification could have negative impacts on property as well as to the Pomperaug High School.

- Increase the sub-standard radius ramp for the eastbound exit. A typical DOT radius under current standards would be 275 feet. Such an improvement would be aimed at safety, since the tighter radius requires a more rapid deceleration for vehicles exiting the highway. The eastbound entrance ramp would merge with the interstate at the same location as it does today.

- Realign Old Waterbury Road and Route 188 to intersect at approximately 180 feet to the north of the existing intersection. The realignment would provide the benefits of increasing the storage space between the existing westbound exit ramps while also improving sight distance at the intersection.

- Extend the acceleration lane from the westbound entrance ramp to provide additional merge distance for vehicles entering the interstate. Currently, vehicles are forced into a truck-climbing lane with little distance to merge safely.

New Interchange Between 16 and 17 - The Town of Oxford could potentially benefit from a more direct linkage to Oxford Airport and its surrounding development. Currently, access to this area is served by Interchange 16 along Route 188 and finally by an airport access road. If development in Middlebury and Oxford exceeds the State's forecast for zones in these towns, a new interchange alternative should be revisited.

The potential interchange would serve the airport in Oxford, the industrial area in the northern portion of Oxford, and the Middlebury industrial area. According to the "Plan of Development for Oxford, Connecticut" adopted in April 1991, Oxford has 1500 acres of industrially zoned property available for immediate development. If all of this property were to be developed in the next 25 years, the traffic could potentially exceed the capacity of Interchange 16.

Interchange 17 possesses some of the worst operational deficiencies in the WOW corridor. Due to the physical layout of the interchange, the eastbound entrance and exit ramps are accessed from Route 64 while the westbound entrance and exit ramps are accessed via Route 63. This split interchange configuration creates heavy congestion at the intersection of these two routes. Under the future year 2025 condition, the eastbound entrance and exit ramps from Route 63/Route 64 operate at LOS F during the weekday evening peak hour, while the westbound

entrance and exit ramps from Route 63 operate at LOS F during the weekday morning peak hour condition. In addition, the westbound off-ramp to Route 64 operates at LOS F during the weekday evening peak hour condition.

The preliminary alternatives at this interchange were as follows:

- Construct a full diamond-type ramp configuration with full directional access at Route 63. To handle the increase in traffic on Route 63, the road would be widened and realigned to approach the 63/64 intersection from the east rather that from the south. The existing Route 63 leg of the intersection (with the steep grade) would be terminated along with the existing Route 64 leg. The new intersection would consist of three legs, the east and west being the predominant movement, and would receive the additional green time from the terminated southern leg. The traffic using Route 64 east of the intersection would now be diverted to Route 63 by a newly constructed connector road between the two routes. Access to the existing Route 63 would still be possible and the residences along that road would be protected under this alternative.

- Provide full directional access to and from the interstate by constructing a connector road to Route 63 from the existing eastbound entrance and westbound exit ramps. Route 63 along with the Route 63/64 intersection would need major upgrades to handle the increase in traffic. Chase Parkway would also be realigned to merge with Route 64 without the intersection at the existing ramps. This alternative would not eliminate any of the legs at the Route 63/64 intersection.

Interchange 18 has two mainline lanes and single lane entrance and exit ramps along I-84 in the eastbound and westbound directions. However, in the westbound direction I-84 includes a truck-climbing lane at the Highland Avenue off ramp junction. Under the future year condition, all freeway ramp junctions operate at LOS E or worse during the weekday morning and evening peak hours.

The preliminary alternatives at this interchange were as follows:

- Improve the radius of curvature of the westbound exit ramp to Highland Avenue and West Main Street. The existing ramp is less than the 275-foot radius that is required under current standards.

- Consolidate the eastbound exit and entrance ramps to Chase Parkway and remove the Highland entrance ramp to I-84 eastbound. The new relocated entrance ramp would likely become two lanes to handle the additional traffic diverted from the Highland Avenue ramp.

- Widen the bridge carrying Chase Parkway over the interstate to accommodate additional left turn lanes at both ends. This would help alleviate the congestion at these intersections.

- Construct a two-way connector road between West Main Street and Highland Avenue and improve the I-84 exit ramp to a standard radius. The new westbound exit ramp would tee into the connector road at a new signalized intersection. This would allow for the passage of traffic between Highland and West Main Street.

Interchanges 19 – 21 - The conceptual alternatives for Interchanges 19 through 21 are included for the purpose of exploring the potential for a major bridge reconstruction. The benefits of these improvements have not been quantified in this analysis, but are discussed qualitatively to begin the thinking process on the future of this facility.

Interchanges 19, 20, and 21 constitute the series of ramps and interconnections that make up the 'Mixmaster' structure in Downtown Waterbury. The bridge structures for the eastbound and westbound viaducts are stacked vertically, rather than in a more conventional arrangement where the opposing roadways are parallel to each other. This section of I-84 experiences numerous operational, structural, and safety deficiencies. Some of these are as follows:

- Left hand exit from I-84 eastbound to Route 8 northbound;
- Left hand entrance to I-84 eastbound from Route 8 southbound;
- Left hand entrance to I-84 westbound from Route 8 northbound;
- Left hand entrance to I-84 westbound from Bank Street;
- Substandard weave section between I-84 eastbound entrance from Route 8 south to Meadow Street Exit ramp;
- Substandard weave section between I-84 westbound entrance from Route 8 north to Highland Street Exit ramp;
- High accident location I-84 at Route 8, Meadow Street Interchange (Interchange 21);
- Two lane stretch of I-84 eastbound between exit to Route 8 northbound and entrance from Route 8 southbound; and
- Poor structural rating on main span over Naugatuck River (will be upgraded by ConnDOT).

This structure was completed in the mid-1960's and no longer has the capacity to support the growth in traffic over the past forty years. While it is possible to maintain the structure so that it meets federal safety standards, it provides a major constraint to traffic flow on I-84 west of Hartford. While the rest of I-84 is upgraded to three lanes in each direction, Waterbury will continue to see gridlock conditions (especially eastbound) if some of these operational deficiencies are not addressed. To help visualize the complexity of the situation, Figure 4.5 has been color coded to identify the various components of this interchange.

Figure 4.6 is a conceptual layout of some of the possibilities that might address the deficiencies. This illustration is not intended to be a recommendation for future improvements. It merely explores the potential for some changes that can provide some benefit to the transportation system and the City of Waterbury as well. No traffic impacts, environmental impacts, or capital costs have been quantified. The highlights of this plan are as follows:

- A new I-84 westbound structure would be constructed that runs parallel to, and at the same elevation of, the existing eastbound structure to carry I-84 through traffic – a short segment of existing I-84 westbound upstream of the entrance ramp from Route 8 southbound would be eliminated;
- The existing I-84 westbound structure would remain functional to handle traffic destined for Route 8 or Downtown Waterbury;

- A collector/distributor (CD) road would be constructed parallel to I-84 eastbound to handle traffic movement to Route 8 north and south and also to Downtown Waterbury – this road would eventually tie into the at-grade intersection at Bank Street and continue along Market Square to the entrance ramp at Interchange 22;
- Each of the left hand entrance and exit ramps would be replaced by right hand ramps; and
- I-84 eastbound would maintain three lanes throughout the interchange.

While no formal transportation improvement is to be evaluated in this study, the recommendation in this case would be to investigate the interchange area in greater detail in a future study.

4.6 Transportation Evaluation

Mainline Capacity Analysis

In order to assess the capacity along I-84 with the additional lane in each direction, a freeway analysis was performed during the weekday morning and evening peak hour conditions. The results of the analysis are shown in Tables 4.2 and 4.3. The following tables also indicate the number of lanes in each direction and the traffic volumes along I-84 for the weekday morning and evening peak hour conditions. East of Interchange 19, no additional lanes have been proposed, primarily due to the fact that the interchange with Route 8 is constrained to widening and three lanes currently exist east of the interchange. For this reason, the LOS does not improve for these segments for the Build scenario.

Table 4.2
Freeway Analysis Summary – Build Scenario (Eastbound Direction)

SECTION ALONG I-84	Number of Lanes		Traffic Volumes	Level of Service	
	No Build	Build		No-Build	Build
Between Int. 13 and Int. 14	2	3	2790(4730)	D(F)	C(E)
Between Int. 14 and Int. 15	2	3	2930(4390)	D(F)	C(D)
Between Int. 15 and Int. 16	2	3	2580(4180)	D(F)	C(D)
Between Int. 16 and Int. 17	2	3	2890(4300)	D(F)	C(D)
Between Int. 17 and Int. 17	2	3	2490(3670)	D(E)	C(D)
Between Int. 17 and Int. 18	2	3	3700(4940)	E(F)	D(E)
Between Int. 18 and Int. 19	2	3	4140(5350)	F(F)	D(E)
Between Int. 19 and Int. 20 *	2	2	3390(4460)	E(F)	E(F)
Between Int. 20 and Int. 21 *	4	4	7230(7990)	F(F)	F(F)
Between Int. 21 and Int. 22 *	3	3	6310(7720)	F(F)	F(F)
Between Int. 22 and Int. 23 *	3	3	5200(5940)	E(E)^	E(E)^

X(X) Represents LOS for AM peak hour. PM Peak LOS shown in parenthesis.
^ Analysis used a Peak Hour Factor (PHF) of 0.95 during the P.M. peak hour.
* No additional lanes have been proposed for these segments – need to analyze in separate study.

As indicated in the table, in the eastbound direction the additional lane along I-84 shows improvement in levels of service between Interchanges 13 and 19 from the no-build to build condition. The level of service does not change from the no-build condition east of Interchange 19 along I-84. It is important to note that wherever there is a climbing lane along I-84, the analysis was conducted for the worst-case scenario assuming that the climbing lane does not

exist along that section. The results of the capacity analysis are graphically represented in Figures 4.7 and 4.8.

In the eastbound direction, it was assumed for this analysis that the additional lane would be dropped at Interchange 19. Therefore, east of Interchange 19, the number of lanes along I-84 would be similar to existing conditions.

Table 4.3
Freeway Analysis Summary – Build Scenario (Westbound Direction)

SECTION ALONG I-84	Number of Lanes		Traffic Volumes	Level of Service	
	No Build	Build		No-Build	Build
Between Int. 13 and Int. 14	2	3	4420(3500)	F(E)	E(D)
Between Int. 14 and Int. 15	2	3	4170(3580)	F(F)	D(D)
Between Int. 15 and Int. 16	2	3	3850(3220)	E(E)	D(C)
Between Int. 16 and Int. 17	2	3	3940(3490)	F(E)	D(D)
Between Int. 17 and Int. 17	2	3	3340(3090)	E(E)	C(C)
Between Int. 17 and Int. 18	2	3	4210(4630)	F(F)	D(E)
Between Int. 18 and Int. 19 *	4	4	5530(6290)	E(E)	E(E)
Between Int. 19 and Int. 20 *	3	3	3300(4490)	D(E)	D(E)
Between Int. 20 and Int. 21 *	5	5	6150(8040)	D(E)	D(E)
Between Int. 21 and Int. 22 *	3	3	6310(7430)	F(F)	F(F)
Between Int. 22 and Int. 23 *	3	3	5160(6070)	E(E)^	E(E)^

X(X) Represents LOS for AM peak hour. PM Peak LOS shown in parenthesis.
^ Analysis used a Peak Hour Factor (PHF) of 0.95 during the P.M. peak hour.
* No additional lanes have been proposed for these segments – need to analyze in separate study.

As indicated in the table, all sections of I-84 between Interchanges 13 and 19 will operate at LOS E or better with the additional lane in the westbound direction for the weekday morning and evening peak hour conditions.

Weaving Analysis

For the purpose of this analysis, it was assumed that the additional lane in the eastbound and westbound directions along I-84 would begin in the vicinity of Interchange 18. Because the improvements east of Interchange 18 would need to be studied in greater detail and recommendations at this area are not presented as part of this study, the critical weaving movements identified in the Existing and Future Conditions Report remain unaffected.

Freeway-Ramp Analysis

A freeway-ramp analysis was conducted for the weekday morning and evening peak hour conditions to observe the effect of an adding a general-purpose lane in each direction along I-84. Additionally, the TA3 scenario consists of providing interchange improvements at several locations along the corridor. The following table provides freeway and ramp volumes at each interchange that were used for analysis purposes. The results of the freeway-ramp analysis are provided in Table 4.4.

Table 4.4
Freeway Ramp Analysis Summary

INTERCHANGE on I-84	Eastbound Direction				Westbound Direction			
	Traffic Volumes		Level of Service		Traffic Volumes		Level of Service	
	Freeway	Ramp	No Build	Build	Freeway	Ramp	No Build	Build
Interchange 13								
Off Ramp to Fish Rock Road	2800(4820)	80(170)	C(F)	B(D)	-	-	-	-
On Ramp from Fish Rock Road	2720(4650)	70(80)	-	B(C)	-	-	-	-
Off Ramp to Oakdale Road	-	-	-	-	4420(3500)	50(70)	-	C(C)
On Ramp from Oakdale Road	-	-	-	-	4370(3430)	100(60)	F(D)	C(C)
Interchange 14								
Off Ramp to Lakeside Road	2790(4730)	210(660)	C(F)	B(D)	-	-	-	-
On Ramp from Georges Hill Road	2580(4070)	350(320)	D(F)	C(C)	-	-	-	-
Off Ramp to South Britain Road	-	-	-	-	4170(3580)	400(330)	F(F)	C(C)
On Ramp From South Britain Road	-	-	-	-	3770(3250)	650(230)	F(D)	C(C)
Interchange 15								
Off Ramp to Route 67	2930(4390)	850(980)	D(F)	C(D)	3850(3220)	890(580)	F(D)	C(C)
On Ramp from Route 67/I.B.M Drive	2080(3410)	500(770)	C(F)	B(D)	2960(2640)	1210(940)	F(D)	D(C)
Interchange 16								
Off Ramp to Route 188	2580(4180)	180(350)	C(F)	B(C)	3940(3490)	480(540)	F(D)	C(C)
On Ramp from Route 188	2400(3830)	490(470)	D(F)	C(C)	3460(2950)	390(270)	E(D)	C(C)
Interchange 17								
Off Ramp to Route 63	2890(4300)	400(630)	D(F)	B(C)	-	-	-	-
On Ramp from Route 64	2490(3670)	1210(1270)	D(F)	C(D)	-	-	-	-
Off Ramp to Route 64	-	-	-	-	4210(4630)	870(1540)	F(F)	C(D)
On Ramp from Route 63	-	-	-	-	3340(3090)	600(400)	F(D)	C(C)
Interchange 18								
Consolidated Ramp Alternative								
Off Ramp to Chase Parkway	3700(4940)	400(540)	E(F)	C(D)	-	-	-	-
On Ramp from Chase Parkway	3300(4400)	1440(1620)	F(F)	C(F)	-	-	-	-
Off Ramp to Main St./Highland Ave.	-	-	-	-	5530(6290)	1660(1930)	E(F)	E(F)
On Ramp from Chase Parkway	-	-	-	-	3870(4360)	340(270)	F(F)	C(C)
Connector Road Alternative								
Off Ramp to Chase Parkway	3700(4940)	400(540)	E(F)	C(D)	-	-	-	-
On Ramp from Chase Parkway	3300(4400)	840(950)	F(F)	D(E)	-	-	-	-
Off Ramp to Main St./Highland Ave.	-	-	-	-	5530(6290)	1660(1930)	E(F)	E(F)
On Ramp from Chase Parkway	-	-	-	-	3870(4360)	340(270)	F(F)	C(C)

Table 4.4 - continued
Freeway Ramp Analysis Summary

INTERCHANGE on I-84	Eastbound Direction				Westbound Direction			
	Traffic Volumes		Level of Service		Traffic Volumes		Level of Service	
	Freeway	Ramp	No Build	Build	Freeway	Ramp	No Build	Build
Interchange 19 *								
Off Ramp to Sunnyside Ave./Route 8 SB	4140(5350)	610(550)	C(D)	C(C)	-	-	-	-
Off Ramp to Route 8 NB	3530(4800)	740(1010)	D(F)	C(D)	-	-	-	-
On Ramp from Highland Ave.	2790(3790)	600(670)	D(F)	D(F)	-	-	-	-
On Ramp from Route 8 SB	-	-	-	-	3980(5100)	1550(1190)	E(F)	E(F)
Interchange 20 *								
Off Ramp to Route 8 SB	-	-	-	-	6150(8040)	1300(1550)	F(F)	F(F)
Off Ramp to Route 8 NB	-	-	-	-	4850(6690)	1550(2200)	D(F)	D(F)
On Ramp from Route 8 SB	3390(4460)	2260(2050)	F(F)	F(F)	-	-	-	-
On Ramp from Route 8 NB	5650(6510)	1580(1480)	F(F)	F(F)	3300(4490)	680(610)	F(F)	F(F)
Interchange 21 *								
Off Ramp to Meadow St.	7230(7990)	600(410)	F(F)	F(F)	6310(7430)	800(530)	F(F)	F(F)
Off Ramp to South Main St.	6630(7580)	800(760)	F(F)	F(F)	-	-	-	-
On Ramp from Meadow St.	5830(6820)	480(900)	F(F)	F(F)	-	-	-	-
On Ramp from Bank St. (Left)	-	-	-	-	5510(6900)	200(340)	E(F)	E(F)
On Ramp from Bank St. (Right)	-	-	-	-	5710(7240)	440(800)	F(F)	F(F)
Interchange 22 *								
Off Ramp to Frontage Road	6310(7720)	1110(1780)	F(F)	F(F)	-	-	-	-
Off Ramp to Union St.	-	-	-	-	5160(6070)	500(500)	D(F)	D(F)
On Ramp from Union St.	-	-	-	-	4660(5570)	1650(1860)	F(F)	F(F)
Interchange 23 *								
Off Ramp to Hamilton Ave.	-	-	-	-	5410(6390)	250(320)	F(F)	F(F)
On Ramp from Hamilton Ave.	5200(5940)	700(970)	E(F)	E(F)	-	-	-	-

* Note: Interchanges 19 through 23 do not improve from the No Build condition since the additional lane ends at Interchange 18.
( ) Denotes PM data.

As indicated in the table above, with the additional general-purpose lane along I-84 in both directions, all freeway-ramp junctions between Interchanges 13 and 17 operate at LOS D or better during the weekday morning and evening peak hour conditions.

At Interchange 18, the eastbound off ramp junctions operate at LOS D or better during the weekday morning and evening peak hour directions. Under the Consolidated Ramp Alternative, the Highland Avenue on-ramp is removed, and therefore the on-ramp from Chase Parkway has a higher volume as compared to the Connector Road Alternative. The new eastbound on-ramp from Chase Parkway under the first Alternative would operate at LOS C and LOS F respectively for the weekday morning and evening peak hour conditions; however, under the second Alternative, the eastbound on-ramp from Chase Parkway would operate at LOS D and LOS E respectively. It is important to note that under the first Alternative, the eastbound on-ramp from Chase Parkway is assumed to be a two-lane ramp to handle the increase in traffic.

In the westbound direction at Interchange 18, the off-ramp junction will operate at LOS E and LOS F during the weekday morning and evening peak hour conditions respectively. This is due to the fact that an additional lane would be provided along I-84 in the westbound direction west of Interchange 18. For this reason, the westbound on-ramp junction will improve to LOS C when compared to the No-Build condition (LOS F).

In the eastbound direction, it is assumed that the additional lane will be dropped after the interchange and therefore, east of Interchange 18 will have no improvement in levels of service beyond the No-Build condition. In the westbound direction, all freeway-ramp junctions east of Interchange 18 will not show improvements in levels of service since the additional lane begins west of this interchange.

Intersection Analysis

Level of service analysis at intersections affected by these improvements was conducted for the weekday morning and evening peak hour conditions. For this analysis it was assumed that I-84 would consist of an additional lane in the eastbound and westbound directions from Interchange 13 to 18. Table 4.5 presents the results of the intersection analysis by interchange alternative.

Table 4.5
Intersection Analysis – Build Scenario

INTERSECTION	No Build		Build	
	AM	PM	AM	PM
Interchange 13				
I-84 WB Ramps and Oakdale Road	-	-	**A**	**A**
I-84 EB Ramps and Fish Rock Road	**B**	**C**	**B**	**C**
Interchange 14				
South Main St. and South Britain Rd.	E	F	E	F
South Britain Road and I-84 WB Ramps	D	**F**	B	B
S. Britain Rd. and I-84 EB Ramps	**B**	**F**	B	C
Lakeside Rd. and Georges Hill Road	-	-	B	B
Interchange 15				
I-84 EB Ramps and Rt. 6/Rt. 67	B	C	C	C
I-84 WB Ramps and Rt. 6/Rt. 67	E	D	E	E
N. Main St. and Old Waterbury Rd./Heritage Road	F	E	F	E
Main Street and Southford Rd./Shopping Plaza	F	F	F	F
Rt. 487/Rt. 67 and Community House Road	C	D	C	D
Interchange 16				
With Relocated Westbound Ramps				
I-84 EB Ramps and Route 188	E	C	E	C
I-84 WB Ramps and Route 188	D	D	B	B
Old Waterbury Road and Route 188	F	F	F	F
With Realigned Old Waterbury Road				
I-84 EB Ramps and Route 188	E	C	E	C
I-84 WB Ramps and Route 188	D	D	D	D
Old Waterbury Road and Route 188	F	F	F	F

Table 4.5 – continued
Intersection Analysis – Build Scenario

INTERSECTION	No Build		Build	
	AM	PM	AM	PM
Interchange 17				
With Full Interchange at Rt. 63, Realignment of Rt. 63, and new Connector Road				
I-84 EB Off Ramp and Rt. 63	B	B	B	C
I-84 WB Off Ramp and Chase Parkway/Route 63	F	F	C	C
Route 63 and Route 64	F	F	B	C
Route 63 and Connector Road	-	-	C	D
With Connector Road to Route 63				
I-84 EB Off Ramp and Route 63	B	B	B	B
Connector Road and Route 63	F	F	C	C
Route 63 and Route 64	F	F	C	D
Interchange 18				
With Consolidated Eastbound Ramps				
I-84 EB Off Ramp and Chase Parkway	B	C	C	D
Chase Parkway and W. Main Street	**F**	**F**	C	C
Chase Parkway and Country Club Road	F	E	C	C
With Connector Road				
I-84 EB Off Ramp and Chase Parkway	B	C	B	C
W. Main St. and Connector Rd.	**F**	**F**	C	D
I-84 WB Off Ramp and Connector Road	-	-	A	A
Highland Ave. and Connector Road	F	F	C	C

Bold-faced letters indicate un-signalized intersection.

4.7 Environmental Evaluation

A preliminary environmental evaluation was made of the alternatives under consideration for the I-84 WOW study area. This evaluation looked at environmental constraints that would need to be studied further for the selected action(s) during the environmental process for project implementation under the National Environmental Policy Act (NEPA), and the Connecticut Environmental Policy Act (CEPA). The analysis also took into consideration the social and historical impacts that were potential to any of the alternatives. Each of the alternatives evaluated in the study have been given a rating of either 'no significant impact', 'minor impact', or 'major impact' for each of the constraints.

At this stage of planning, a simple qualitative evaluation of anticipated environmental constraints has been made, using secondary-source data such as GIS data, aerial mapping, and USGS topographic mapping. Under the NEPA and CEPA processes, it would be expected that a more rigorous investigation would be made into existing conditions and anticipated impacts using field review and more intensive data collection.

As part of any environmental evaluation, the study considers both a "No-Build" alternative as well as "Build" alternatives. The No-Build Alternative would assume that no action is taken in the study area other than maintenance of existing facilities and implementation of currently programmed actions. For the five interchanges that are evaluated below, the No-Build Alternative would be expected to have a negligible effect, if any, on most environmental

constraints, since no action would be taken. The one exception is air quality, where the No-Build alternative could potentially have adverse effects on air quality due to increased congestion and delay, compared to build alternatives, which would improve traffic operations.

Table 4.6 shows a comparative representation of the potential environmental impacts associated with each alternative. Potential impacts were ranked into broad qualitative categories: "Minor Impact," "Major Impact," and "No/Insignificant Impact."

4.8 Preliminary Construction Cost Estimates

Costs for each construction element of TAs 2 and 3 were estimated based on unit costs derived from similar planning project assessments. Capital cost items such as pavement, earthwork, structures, drainage, and other miscellaneous improvements were estimated for each alternative and subtotaled. Costs for contingencies and incidentals were added to this to get order of magnitude cost estimates for each type of improvement. Items such as right of way acquisitions and environmental mitigation efforts were not included in the costs due to the preliminary nature of these estimates.

The costs developed for the screening process were based on general assumptions regarding topographical constraints and feasible constructability. Due to these assumptions, conservative factors were used to derive the costs. Since these costs were "order of magnitude" estimates, they were used as a rough guideline for comparing the relative investments of each preliminary alternative improvement. More detailed cost estimates were developed for the alternatives that resulted from the screening process, and are included in Chapter 5 of this document.

4.9 Preliminary Screening

Each of the alternative improvements was evaluated based on their ability to address the initial Goals and Objectives of the study. Issues such as congestion mitigation, environmental impact, and preliminary cost were considered by ConnDOT, COGCNV, the AC, and corridor communities and over the course of the project preferences for several of the alternatives became apparent. In many cases, it was requested that the study team refine select alternatives in order to mitigate some of these issues and improve the solution. That process constitutes the next chapter in this report.

The following text contains a qualitative review of how each TA addressed the stated goals of the project.

Goal 1: Congestion Reduction

Congestion reduction includes eliminating operational or physical constraints on I-84 and arterials, reducing vehicle hours of travel during peak periods, and utilizing ITS strategies to more efficiently manage transportation services and demand. TA 1 is neutral or strongly negative in meeting the objectives associated with congestion reduction. TA 2 is neutral or generally supportive. TA 3 (Interchange Improvements) and TA 3 (Additional Lane) are generally supportive or strongly supportive.

Table 4.6

Ranking of Potential Environmental Impacts

Alternatives	Prime or Statewide Important Farmland Soil Impacts	Environmental Risk Sites	State Wetland Soils	Threatened and Endangered Species	Wells, Aquifers and Public Water Supplies	Floodplains	Surface Waters	Parks and Recreations (4(f))	Archeological	Historic Locations and Areas	Air Quality Impacts	Sensitive Noise Receptors	Right of Way Acquisitions
Alternative 13	-	-	-	-	×	-	-	-	✓	-	-	✓	-
Alternative 14	✓	-	-	✓	×	-	-	-	✓	-	-	-	-
Alternative 15	✓	-	-	✓	×	×	-	-	-	-	-	✓	-
Alternative 16A	×	-	✓	-	✓	✓	×	-	-	-	-	✓	✓
Alternative 16B	-	-	✓	-	-	-	-	-	-	-	-	-	-
Alternative 17A	✓	-	×	-	-	×	×	-	-	-	-	✓	×
Alternative 17B	✓	-	✓	-	-	×	✓	-	-	-	-	-	×
Alternative 18A	✓	-	×	-	-	-	-	-	-	-	-	-	✓
Alternative 18B	✓	-	×	-	-	-	-	-	-	-	-	-	✓
No Build	-	-	-	-	-	-	-	-	-	-	✓	-	-
Add-a-lane	-	-	-	-	✓	✓	✓	-	-	-	-	✓	-

Ranking of Potential Impacts

✓ = Minor Impacts   × = Major Impacts   - = No/Insignificant Impacts

Goals 2: Public Health and Safety

The goal of enhancing public health and safety within the corridor comes in many forms. The objectives defined to support this goal focus principally on the reduction in accidents and potential hazards, the reduction of truck-related accidents, the control of traffic speeds, the elimination or reduction of unsafe physical conditions, the reduction of mobile source air quality emissions, and the reduction in noise impacts on sensitive receptors. The safety of the traveling public in both motorized and non-motorized vehicles and the health and safety of adjoining property owners is of paramount importance.

TA 1 is expected to generally result in deterioration in all categories evaluated. Continued increase in demand and congestion will increase accidents, emissions and noise. TA 2 will have a generally positive impact on controlling speed and reducing emissions, a strongly positive impact on reducing accidents and neutral impact on truck accidents, physical upgrades and noise. TA 3 (Interchange Improvements) will generally benefit public health and safety in almost all categories. TA 3 (Interchange Improvements) (Additional Lane) is strongly supportive of most of the objectives, such as accident reduction, control of speeds, and physical roadway conditions, but is expected to be neutral in terms of emissions.

Goal 3: Economic Development

There are four objectives that have been defined to support the goal of continued regional and statewide economic growth and development. TA 1 is generally negative for economic development, while TA 2 is completely neutral. TA 3 (Interchange Improvements) and TA 3 (Additional Lane) are supportive, with TA 3 (Interchange Improvements) being generally supportive and TA 3 (Additional Lane) being strongly supportive.

Goal 4: Community Livability and Quality of Life

There are six objectives defined as a means to measure transportation influence on community livability and quality of life. While TA 1 is supportive of avoiding most environmental impacts, it is neutral or negative for all the other community livability objectives, such as air and noise impacts and improving traffic flow. TA 2 provides generally supportive short-term action without the likelihood of impact on environmental resources. TA 3 (Interchange Improvements) and TA 3 (Additional Lane), because they focus on improved freeway operations, capacity, and management, would have a generally beneficial or neutral impact. The exception is in the avoidance of impacts to environmental resources, in which both would have a negative impact.

Chapter 5
REFINEMENT OF ALTERNATIVES

The previous chapter identified a broad range of TAs that addressed the needs and deficiencies of the corridor. Through the screening process, several of these alternatives failed to demonstrate feasible solutions due to poor transportation benefits, unacceptable environmental impacts, high capital costs, or negative public reaction. Since the publication of Technical Memorandum #2 (Alternatives Evaluation), the Study Team has investigated additional improvements as well as refined alternatives that survived the preliminary screening process. This chapter documents that process. The improvements that follow can be considered as preferred or recommended for project advancement.

5.1 Additional General Purpose Lane

An additional general-purpose lane in each direction along I-84 would provide additional capacity. With an additional lane from interchange 13 to Interchange 18, all freeway segments would operate at LOS E or better in the eastbound and westbound directions. All freeway-ramp junctions would operate at LOS D or better with the additional lane in both directions. It is important to note that the addition of a general-purpose lane in each direction is a long-term solution for the corridor. Also, with the projects currently in design both east and west of the study area, the additional lane would provide continuity with the design of those projects.

Based on the conceptual alignment of I-84 on aerial photography, it appeared feasible to include an additional general-purpose lane in each direction within the existing median. Several questions were left unanswered based on this evaluation. First, the median in the vicinity of Interchange 18 was narrow and it was uncertain whether a full lane with full shoulders could fit. Secondly, the composition of the original freeway remained uncertain – e.g. whether or not concrete slab construction was used for the entire corridor with asphalt overlaid on the surface. Thirdly, structural evaluations needed to be made to determine whether the bridges carrying and spanning I-84 needed to be replaced or expanded to accommodate the additional pavement. Lastly, limits of cut and fill of slopes, as well as locations and extents of retaining walls needed to be determined for construction and cost estimation purposes.

To answer these questions, additional field review was performed and visual inspections made to determine approximate cross sections, physical constraints, and structural condition along I-84. Cross sections and the segment limits that corresponded with them were noted based on four general conditions.

- I-84 Eastbound and Westbound at same elevation with relatively flat median with swales;
- I-84 Eastbound and Westbound at variable elevation with variable slope;
- I-84 Eastbound and Westbound at same elevation with variable height rock ledge in median; and
- I-84 Eastbound and Westbound at same elevation with variable depth valley in median.

The variability in verticality was approximated by visual inspection. The variability in horizontal median width was derived from the "As-Built" design files in the CAD base mapping. Based on this methodology, cut and fill limits were derived and locations for retaining walls calculated. This information was essential for reasonable cost estimation purposes.

Additionally, structures were evaluated based on their most recent biennial inspection rating, their ability to be expanded, and whether or not the piers were constraints to the widening of I-84. Figure 5.1 (11 sheets total) illustrates the results of the refined analysis for the additional lane alternative.

5.2 Intersection Operational Improvements

Several intersections in the I-84 WOW study area have been identified as having operational deficiencies. Most of these intersections have deteriorated due to the increased traffic volume that uses the interstate ramps, and in some cases these intersections are prohibiting the safe operation of the ramps themselves. These intersections have been analyzed as having a Level of Service F under the base (no-build) condition and are impeding the overall performance of the transportation system. From Interchange 13 to Interchange 16, intersection improvements have demonstrated to be low capital cost solutions to some of the deficiencies identified in the study. For this reason, and to avoid environmental impacts, TSM alternatives for these interchange areas were selected over the ramp reconstruction alternatives (discussed in the Chapter 4) for additional refinement and screening.

Table 5.1 lists the intersections that can be improved within the existing right of way or with minimal property taking. The table lists their location and their LOS before and after the proposed improvement.

Table 5.1
TSM Improvements

INTERSECTION	Base Condition		With Improvements	
	AM	PM	AM	PM
Interchange 14				
South Main St. and South Britain Rd.	E	F	C	C
South Britain Road and I-84 WB Ramps	**D**	**F**	B	D
S. Britain Rd. and I-84 EB Ramps/Lakeside Rd. and Georges Hill	**B**	**F**	C	C
Interchange 15				
Main Street and Main Street South /Shopping Plaza	F	F	D	D
Interchange 16				
I-84 WB Ramps and Route 188	D	D	C	C
Old Waterbury Road and Route 188	F	F	C	C

Bold-faced letters indicate un-signalized intersection.

The following section describes and evaluates the refined improvements at these interchanges areas. Improvements identified as short-term are projects that may be pursued at a relatively faster schedule, prior to the advancement of long term recommended improvements.

Interchange 13

Table 5.2 lists the deficiencies and the suggested improvements for Interchange 13.

Table 5.2
Interchange 13 Deficiencies/ Needs and Improvements

Deficiencies/Needs	Improvements
	Short-Term
♦ Inadequate turning radius for trucks entering I-84 WB On-Ramp from Oakdale Manor Road	➢ Increase corner radius to 50 ft. at the intersection to accommodate trucks
♦ I-84 WB Ramp entrance sign missing on Oakdale Manor Road	➢ Install a new sign
♦ Route marker sign faded on Fish Rock Road	➢ Replace the faded sign
	Long-Term
♦ Inadequate acceleration length on I-84 WB	➢ Provide 1400 ft. acceleration distance along I-84 WB
♦ Inadequate deceleration length on I-84 EB	➢ Provide 500 ft. deceleration distance along I-84 EB
♦ I-84 is expected to operate poorly in future (2025) in EB direction during P.M. Peak	➢ Provide Additional General Purpose Lane along I-84
♦ I-84 is expected to operate poorly in future (2025) in WB direction during A.M. Peak	➢ Provide Additional General Purpose Lane along I-84
	Additional Comments
♦ Potential for a full interchange	➢ Full interchange alternative did not provide benefit in highway operations

The modification for this interchange that may be accomplished in the short term would involve improving the corner radius of the westbound entrance ramp at Oakdale Manor Road. Increasing to a standard 50-foot radius would improve safety. This alternative modification has already been advanced by ConnDOT as a safety improvement that will be constructed as part of the safety improvement program. This proposal also has the potential for inclusion of a commuter parking facility and the improvement of signage in the area. Figure 5.2 illustrates the proposed modifications.

As a long-term solution, I-84 in the vicinity of this interchange requires an additional general-purpose lane in each direction to accommodate future year (2025) traffic volumes. In addition,

adequate acceleration and deceleration distances need to be provided during the freeway reconstruction phase in coordination with the additional general-purpose lane.

A full interchange alternative was evaluated at this location. The evaluation process indicated that there would not be a significant amount of traffic diverted from Interchange 14 to this interchange as result of the provision of a full directional access; therefore, this alternative is not recommended.

Interchange 14

Table 5.3 lists the deficiencies and the suggested improvements for Interchange 14.

Table 5.3
Interchange 14 Deficiencies/ Needs and Improvements

Deficiencies/Needs	Improvements
	Short-Term
♦ Excessive queue on I-84 WB Off-Ramp	➢ Signalize the intersection to relieve queuing (TSM)
♦ Closely spaced intersections of I-84 WB Off-Ramp/S. Britain Rd. and S. Britain Rd./Main. St. South	➢ Provide signal coordination and adequate lanes to improve traffic operations (TSM)
♦ Inadequate acceleration lengths on I-84 EB and WB	➢ This deficiency will be addressed by DOT Safety Improvement Project No. 130-169
♦ Confusing intersection at Lakeside Road	➢ Eliminate the all-way STOP sign control at the intersection of Lakeside Road/Georges Hill Road/I-84 EB Off Ramp to provide a traffic signal (TSM)
♦ I-84 directional sign missing on Main Street South	➢ Install a new directional sign
♦ Damaged directional sign on the I-84 WB Off-Ramp	➢ Replace the damaged directional sign
	Long-Term
♦ Inadequate deceleration length on I-84 EB	➢ Provide 600 ft. deceleration distance along I-84 EB
♦ I-84 is expected to operate poorly in future (2025) during P.M. Peak	➢ Provide Additional General Purpose Lane along I-84
♦ I-84 is expected to operate poorly in future (2025) in WB direction during A.M. Peak	➢ Provide Additional General Purpose Lane along I-84
	Additional Comments
♦ Offset Ramp alignment	➢ The offset ramp alignment will be maintained with TSM Improvements at this interchange

To improve traffic operations, the intersection of Main Street South and South Britain Road requires widening and signal coordination with the South Britain Road and I-84 Westbound Off-Ramp intersection. The South Britain Road and I-84 Westbound Off-Ramp intersection meets traffic signal warrants with 380 vehicles exiting the westbound off ramp and 1420 vehicles on South Britain Road during the P.M. peak hour. The suggested improvements at this intersection are illustrated in Figure 5.3.

Constraints at the intersection of South Main Street and South Britain Road include a gas line that runs south of the intersection and parallel to Main Street South. There is also a commuter parking lot in the southeast quadrant of the intersection. In the northwest quadrant of the intersection, there are residential properties that should be considered prior to widening the intersection. This intersection is photographed in Figure 5.4.

Figure 5.4

View of westbound approach on Main Street South at South Britain Road intersection

The intersection of Lakeside Road, Georges Hill Road, and the I-84 Eastbound Ramp is recommended to be signalized and widened to improve traffic operations. This intersection meets traffic signal warrants during the P.M. peak hour of operation with 660 vehicles exiting the eastbound ramp and 780 vehicles approaching the intersection from Lakeside and South Britain Roads.

The east side of the intersection is constrained by rock ledge and therefore widening may need to be performed on the west side of the intersection. As a result of this widening, the intersection can be re-aligned to provide wider turning radii for recreational and heavy vehicles. The improvements at this intersection are illustrated in Figure 5.4.

As a long-term solution, I-84 in the vicinity of this interchange requires an additional general-purpose lane in each direction to accommodate future year (2025) traffic volumes. ConnDOT is currently pursuing a Safety Improvement Project No. 130-169 to improve acceleration distances

at this interchange. The deceleration distance along I-84 EB will be addressed during the freeway reconstruction phase of the project (long-term solution). Other TSM improvements at this location require fixing highway and roadway signage.

Interchange 15

Table 5.4 lists the deficiencies and the suggested improvements for Interchange 15.

Table 5.4
Interchange 15 Deficiencies/ Needs and Improvements

Deficiencies/Needs	Improvements
	Short-Term
♦ Poor intersection operations at Main Street/Route 6/67/Southbury Plaza	➢ Provide additional lanes to improve traffic operations (TSM)
♦ Truck climbing lane ends prior to the I-84 EB Off-Ramp and resumes after I-84 EB On-Ramp	➢ Extend the truck climbing lane through the interchange
♦ Sign partially obscured by trees	➢ Improve visibility of sign to drivers
♦ Insufficient indication in advance of left turns to I-84 EB and WB On-Ramps on Route 6/67	➢ Provide adequate signage along Route 6/67 to alert drivers in advance of the I-84 EB and WB On-Ramps
	Long-Term
♦ Inadequate acceleration length on I-84 EB	➢ Provide 900 ft. acceleration distance along I-84 in the EB direction
♦ Inadequate deceleration length on I-84 WB	➢ Provide additional 400 ft. deceleration distance along I-84 in the WB direction
♦ I-84 is expected to operate poorly in future (2025) in EB direction during P.M. Peak	➢ Provide Additional General Purpose Lane along I-84
♦ I-84 is expected to operate poorly in future (2025) in WB direction during A.M. Peak	➢ Provide Additional General Purpose Lane along I-84
	Additional Comments
♦ Alternate access to Main Street South via Frontage Road from WB On-Ramp to Bullet Hill Road	➢ The alternate access to Main Street South from the I-84 WB Off-Ramp does not provide relief in traffic operations at the Main Street/Route 6/67/Southbury Plaza intersection

The intersection of Main Street South and Route 6/67 at Southbury Plaza is proposed to be widened to provide an additional left turn lane in the northbound direction along Route 6/67. Due to this widening, Main Street South would need to be widened in the westbound direction to provide adequate width for left turning vehicles. Also, the northbound right turn

lane on Route 6/67 would be shifted east of its present location due to the additional left turn lane. Based on field observations, it appears feasible to provide the additional widening on the east side without impacting the parking lot in Southbury Plaza. The improvements at this intersection are illustrated in Figure 5.5. The existing intersection is photographed in Figures 5.6 and 5.7.

Figure 5.6

View of the northbound approach on Main Street at the Main Street/Route 6/Southbury Plaza intersection

Figure 5.7

View of the Southbury Plaza driveway at the Main Street/Route 6/Southbury Plaza intersection

The extension of the truck climbing lane through the interchange area and improving highway signage will also be looked at as a short-term solution.

As a long-term solution, this interchange requires an additional general-purpose lane in each direction to accommodate future year (2025) traffic volumes. In addition, adequate acceleration and deceleration distances will be provided along I-84 in the eastbound and westbound directions during the freeway reconstruction phase of the project.

Interchange 16

This interchange primarily requires TSM improvements related to traffic operations and safety. Table 5.5 lists the deficiencies and the suggested improvements for Interchange 16

Table 5.5
Interchange 16 Deficiencies/ Needs and Improvements

Deficiencies/Needs	Improvements
	Short-Term
♦ Poor intersection operations at Old Waterbury Road and Route 188	➢ Provide additional lanes to improve traffic operations at this intersection (TSM)
♦ Closely spaced intersections of Old Waterbury Rd./Route 188 and I-84 WB Ramp/Route 188	➢ Provide signal coordination and additional lanes to provide more storage and improve traffic operations (TSM)
♦ Inadequate acceleration length on I-84 WB	➢ This deficiency will be addressed by DOT Safety Improvement Project No. 130-169
♦ I-84 directional sign missing on Old Waterbury Road	➢ Install a new sign along Old Waterbury Road
♦ Route indication sign is bent on I-84 WB Off-Ramp	➢ Install a new sign along I-84 WB Off-Ramp
♦ I-84 EB On-Ramp sign is leaning backward	➢ Straighten the I-84 EB On-Ramp sign
	Long-Term
♦ Inadequate acceleration length on I-84 EB and sub-standard radii on-ramp	➢ Provide 1500 ft. acceleration distance along I-84 WB
♦ Inadequate deceleration length on I-84 EB and sub-standard radii off-ramp	➢ Provide 600 ft. deceleration distance along I-84 in the EB direction
♦ I-84 is expected to operate poorly in future (2025) in EB direction during P.M. Peak	➢ Provide Additional General Purpose Lane along I-84
♦ I-84 is expected to operate poorly in future (2025) in WB direction during A.M. Peak	➢ Provide Additional General Purpose Lane along I-84
♦ Truckers stop along the shoulders of the highway and ramps	➢ Investigate the possibility of truck rest areas with ConnDOT and Municipalities

The recommendation for the intersection of Old Waterbury Road and Route 188 requires the provision of an exclusive right turn lane in the eastbound direction along Old Waterbury Road, an exclusive left turn lane in the northbound direction, and an additional through lane in the southbound direction along Route 188. The intersection of I-84 WB Ramp and Route 188 will

require additional left turn and through lanes in the northbound direction and an exclusive right turn lane in the southbound direction along Route 188 to accommodate future year traffic volume. The improvements at this intersection are illustrated in Figure 5.8.

As a short-term solution, the two intersections should be widened as TSM improvements. In addition to the widening, the two signals should be coordinated to reduce queuing between intersections. Based on field observations, widening along Route 188 seems achievable east of the intersection due to the existence of wetlands west of the present alignment. The existing intersection is photographed in Figure 5.9.

Figure 5.9

View of the Route 188 Northbound approach at the Route 188/Old Waterbury Road intersection

Other short-term improvements include providing highway and roadway signage in the vicinity of the interchange.

As a long-term solution, I-84 in the vicinity of this interchange requires an additional general-purpose lane in each direction to accommodate future year (2025) traffic volumes. In addition, adequate acceleration and deceleration distances will be provided along I-84 in the eastbound and westbound directions during the freeway reconstruction phase of the project. Providing adequate acceleration and deceleration distances will improve the sub-standard radii at the I-84 Eastbound interchange**.** Also, the possibility of providing truck rest areas will be investigated by ConnDOT in coordination with the municipalities.

5.3 Arterial Signal Coordination

This technique could improve travel times on principal arterial streets along the entire study corridor. Through coordinated traffic signal timing, vehicles will maintain a uniform speed and

encounter as few red traffic signals as possible. The result is that motorists will experience fewer delays in getting to their destinations. In addition to the congestion between intersections, the possibility of queuing along the I-84 ramps is also reduced. Some of the locations identified for arterial signal coordination are locations that are presently under signal control while some may require a traffic signal in the future (2025) condition due to the increase in traffic volumes. These are as follows:

- Interchange 14 – The possibility of signal coordination exists along South Britain Road. The intersections of South Britain Road with I-84 Eastbound and I-84 Westbound Ramps may require traffic signals in the future (2025) condition with increase in traffic volumes. A coordinated signal system can be designed along South Britain Road including the intersections of South Main Street, I-84 Westbound Ramps, and I-84 Eastbound Ramps.

- Interchange 15 – The possibility of signal coordination exists along Routes 6 and 67. The intersections of Route 6/Route 67 with North Main Street/Old Waterbury Road, Main Street/Southford Road, I-84 Westbound Ramps, I-84 Eastbound Ramps, and Community House Road are in close proximity to provide a coordinated signal system.

- Interchange 16 – The intersections of Route 188 with Old Waterbury Road and I-84 Westbound Ramps is currently operating under the same traffic controller due to its close proximity. The intersection of Route 188 and the I-84 Eastbound ramps is presently un-signalized and may require a traffic signal in the future (2025) with increase in traffic volumes. The possibility of extending the signal system along Route 188 to include the I-84 Eastbound ramps exists to obtain better progression of traffic.

- Interchange 17 – The possibility of signal coordination exists along Route 63. The intersections of Route 63 with Route 64, I-84 Eastbound Ramps, Route 188, and Country Club Road can be designed as part of the coordinated signal system. As part of the alternatives package, the possibility of providing a connection to the I-84 Westbound Ramps to Route 63 would add an intersection to the coordinated system.

5.4 Interchange Reconstruction Modifications

The recommended improvements for Interchanges 17 and 18 require a greater level of complexity and cost than the previous interchange area improvements. This is largely due to the severity of transportation deficiencies as well as the physical constraints that are present along this urban section of I-84.

Interchange 17

The biggest traffic operational concern at this interchange is the intersection of Route 63 and Route 64. As a short-term solution, a Connector Road from Route 64 to Route 63 along existing rail ROW could provide relief to congestion at the intersection and also improve operations along Route 63 and Route 64. As traffic volumes in the corridor increase, the intersection will require additional widening to accommodate these traffic volumes and therefore widening of this intersection is a long-term solution. The deficiencies and proposed improvements at this

interchange are listed in Table 5.6. The improvements proposed at this intersection are illustrated in Figure 5.10. The existing intersection is photographed in Figures 5.11 and 5.12.

Figure 5.11

View of the westbound approach on Route 64 at Route 63 and Route 64 intersection

Figure 5.12

View of Route 64 with limited sight distance and rock ledge on both sides of the roadway

Table 5.6
Interchange 17 Deficiencies/ Needs and Improvements

Deficiencies/Needs	Improvements
	Short-Term
♦ Poor intersection operations at Route 63 and Route 64	➢ Build a Connector Road between Route 64 and Route 63 to provide relief in traffic operations
♦ Poor intersection operations at Chase Parkway and I-84 Ramps	➢ Signalize the intersection with the addition of the Connector Road
♦ Poor arterial operations along Route 63	➢ Provide Connector Road to relieve congestion along Route 63
♦ No advance warning sign prior to the end of the truck climbing lane	➢ Provide adequate signage to warn drivers of the end of climbing lane
♦ No Park and Ride Lot sign at Maggie McFly's	➢ Provide Park and Ride Lot sign
♦ Commuter parking lot at capacity	➢ Expand Park and Ride Lot at this Interchange
♦ Loose East auxiliary sign mounting on I-84 Route marker	➢ Fix the East auxiliary sign mounting on I-84 Route marker
♦ Directional sign missing on Route 64 for Chase Parkway	➢ Install a directional sign on Route 64 for Chase Parkway
♦ A bent sign on the I-84 EB On-Ramp	➢ Fix the bent sign on the I-84 EB On-Ramp
	Long-Term
♦ Inadequate acceleration length on I-84 WB On-Ramp	➢ Provide 900 ft. acceleration distance along I-84 WB
♦ Poor intersection operations at Route 63 and Route 64	➢ Widen the intersection and provide additional lanes to accommodate future traffic volumes
♦ Poor sight distance along Route 64 east of intersection	➢ Re-grade Route 64 to eliminate crest vertical curve
♦ Vehicle queue at Route 63/64 intersection extends east along Route 64	➢ Widen Route 64 (in conjunction with re-grade) to accommodate four lanes
♦ I-84 is expected to operate poorly in future (2025) during P.M. Peak	➢ Provide Additional General Purpose Lane along I-84
♦ I-84 is expected to operate poorly in future (2025) in WB direction during A.M. Peak	➢ Provide Additional General Purpose Lane along I-84
	Additional Comments
♦ Split Interchange	➢ Alternative Concept A looked at providing a full interchange at Route 63, but turned out to be a high cost alternative with minimal benefit.

Other short-term improvements would include providing adequate highway and roadway signage at this interchange.

As identified earlier, a long-term improvement would be to widen the intersection of Route 63 and Route 64 to handle the increasing level of traffic. Route 64 is proposed to be widened to four lanes and re-graded to reduce the crest vertical curve that is contributing to poor sight distance approaching the intersection from the east. In addition, the provision of a general-purpose lane along I-84 through this interchange and increasing acceleration distances in the eastbound direction will be part of a freeway reconstruction phase at this location.

Interchange 18

Like Interchange 17, Interchange 18 presents operational and safety deficiencies while being constrained by the physical limits of the transportation infrastructure. While not all of the deficiencies can be addressed as part of this study, some improvement can be made to relieve the traffic pressure that is building in this area. Table 5.7 lists the deficiencies and proposed improvements for this interchange area.

Table 5.7
Interchange 18 Deficiencies/ Needs and Improvements

Deficiencies/Needs	Improvements
	Short-Term
♦ Poor intersection operations at I-84 WB Off-Ramp and W. Main Street	➢ Build a Connector Road between Highland Avenue and W. Main Street and improve operations at the intersection
♦ Poor intersection operations at Chase Parkway and W. Main Street	➢ Widen the bridge over I-84 to provide an additional left turn lane on Chase Parkway
♦ Poor intersection operations at Chase Parkway and Country Club Road	➢ Widen the bridge over I-84 to provide an additional left turn lane on Chase Parkway
♦ Sub-standard ramp radius at the I-84 WB Off-Ramp	➢ Provision of a Connector Road will eliminate this problem
♦ Sign has insufficient advance warning at the W. Main St. and Highland Avenue split	➢ Provide advance warning sign for drivers at the split to W. Main St. and Highland Avenue
♦ I-84 directional sign missing along W. Main Street	➢ Install a new directional sign at W. Main Street
♦ I-84 directional sign missing along Country Club Road	➢ Install a new directional sign at Country Club Road
♦ Part of sign marking deteriorated along Chase Parkway	➢ Fix the sign along Chase Parkway
♦ Directional sign unclear along Chase Parkway in the vicinity of the I-84 EB interchange	➢ Provide adequate signage along Chase Parkway to avoid driver confusion
♦ I-84 route markers obscured by trees along Chase Parkway	➢ Remove trees to improve visibility

Table 5.7 - Continued
Interchange 18 Deficiencies/ Needs and Improvements

Deficiencies/Needs	Improvements
♦ I-84 route markers obscured by fence along Highland Avenue	➢ Move sign away from fence to improve visibility
	Long-Term
♦ Connectivity to the Route 8 Interchange	➢ Initiate Waterbury Access Study
♦ Inadequate acceleration length in the eastbound direction along I-84	➢ Provide 500 ft. acceleration distance along I-84 EB
♦ Inadequate deceleration lengths in the EB and WB directions along I-84	➢ Provide 500 ft. deceleration distances along I-84 in the EB and WB directions
♦ Poor ramp spacing between the Interchange 18 EB On-Ramp and Interchange 19 Off-Ramp to Route 8	➢ Initiate Waterbury Access Study to address ramp spacing issues
♦ Poor weaving operation between Route 8 Northbound Off-Ramp and Highland Avenue Off-Ramp	➢ Initiate Waterbury Access Study to evaluate eliminating weaving problems
♦ I-84 is expected to operate poorly in future (2025) in EB and WB directions	➢ Provide Additional General Purpose Lane along I-84 in both directions and tie into the Route 8 Interchange
♦ I-84 is expected to operate poorly in future (2025) in WB direction	➢ Provide Additional General Purpose Lane along I-84 in both directions and tie into the Route 8 Interchange
	Additional Comments
♦ Proximity to Route 8 Interchange	➢ Due to its close proximity to the Route 8 Interchange, it is critical to study this interchange with the Route 8 Interchange in terms of highway operations

This interchange will require primarily traffic operations related improvements. The bridge over I-84 along Chase Parkway is proposed to be widened to provide six lanes to solve the operational problems between West Main Street and Country Club Road. This widening could be pursued as a short-term improvement and may require bridge reconstruction.

The sub-standard curve radius at the I-84 WB Exit Ramp to Highland Avenue/W. Main Street could also be pursued as a short-term improvement. The realigned ramp would intersect with a newly constructed Connector Road between W. Main Street and Highland Avenue. This proposed modification is illustrated in Figure 5.13.

Other improvements at this interchange are related to highway and roadway signage and may be pursued as short-term improvements. The existing intersections are photographed in Figures 5.14 and 5.15.

Figure 5.14

View of the Chase Parkway bridge over I-84

Figure 5.15

View of the Chase Parkway EB approach at Country Club Road and Chase Parkway intersection

The long-term improvement in the vicinity of this interchange would provide an additional general-purpose lane along I-84 in each direction and providing adequate acceleration and

deceleration distances in both directions during the freeway reconstruction phase. A key to the highway operations at this interchange is its connectivity to the Route 8 Interchange and will be investigated further when the Route 8 Interchange is evaluated in the Waterbury Access Study.

5.5 Directional and Wayfinding Signage Plan

As part of the existing conditions analysis, the signage in the corridor was inventoried and evaluated based on condition, location and understandability. A particular need was discovered in Downtown Waterbury concerning the lack of clear route signage to and from the interstate. This study recommends that a full signage evaluation and design take place before any action is taken, but a conceptual plan has been developed based on preliminary field reviews of the area. Essentially, this plan considers the placement of Interstate 84 directional signs at each critical juncture in the downtown street system. By installing these signs, driver confusion is minimized and the most direct routing to the freeway is marked out, preventing circuitous movements that can contribute to traffic congestion. The conceptual plan is illustrated in Figure 5.16.

5.6 Waterbury Access Study

The I-84 and Route 8 Interchange is a key component to the highway operations in Waterbury and its vicinity. Since this interchange is of a very complex nature, it will require a detailed study by itself to understand its impact on local traffic, Downtown Waterbury, and the state as a whole. As indicated in Table 5.8, there are a number of deficiencies that relate to the layout of the ramp geometry and ramp spacing at this interchange. As stated earlier, both Route 8 and I-84 serve the downtown Waterbury area and its vicinity, and therefore traffic operations in the downtown and at intersections served by this interchange are. Another issue related to the operation of the roadway system is the directional signage to the downtown areas and key locations in the vicinity of the downtown. Further evaluation and design of a comprehensive signage program can potentially be a component of the future Waterbury Access Study.

Table 5.8
Interchanges 19-21 Deficiencies/ Needs and Improvements

Deficiencies/Needs	Improvements
	Short-Term
♦ I-84 directional signs missing in the vicinity of Mount St. Mary's Hospital	➢ Install new signs directing to I-84 in the vicinity of Mount St. Mary's Hospital
	Long-Term
♦ High accident location interchange	➢ Initiate Waterbury Access Study to eliminate left hand On and Off ramps to reduce accidents
♦ A bottleneck in the EB direction on I-84 to two lanes	➢ Initiate Waterbury Access Study to provide additional capacity
♦ Left hand On and Off Ramps create weaving problems	➢ Initiate Waterbury Access Study to eliminate left hand On and Off Ramps
♦ Low travel speeds through the corridor	➢ Initiate Waterbury Access Study to provide additional capacity
♦ Inadequate acceleration and deceleration distances along I-84	➢ Initiate Waterbury Access Study
♦ Insufficient ramp spacing between interchanges in the eastbound direction	➢ Initiate Waterbury Access Study to investigate the possibility of eliminating ramps
♦ Poor signage to key downtown locations from I-84 like Mount St. Mary's Hospital, Municipal Parking Garage, etc.	➢ Study highway and street signage in detail as part of the Waterbury Access Study specifically to address signage deficiencies in downtown Waterbury
♦ I-84/Route 8 bridge structure has some deficiencies	➢ Study the I-84/Route 8 bridge structure in detail and carry rehabilitation work
♦ Number of intersections in the downtown Waterbury area operate poorly	➢ Study the downtown intersections in detail and provide mitigation solutions to relieve traffic congestion

5.7 Construction Cost Estimates

A preliminary engineering estimate was prepared for each of the current project proposals. In the case of the Additional Lane Alternative, the 13-mile proposal was broken into five (5) separate construction contracts of 2 to 3 miles each. All estimates were generated using a general format derived from the Department's preliminary estimating procedure, dated April 2001. As described by the estimating procedure, major construction items such as earthwork, pavement, structures, drainage, curbing are quantified and costed out. The summation of costs associated with the major items are then multiplied by a series of factors (percentages) which add additional cost for lump sum items such as clearing and grubbing, mobilization, and minor items. The major items and lump sum costs are added together and then a final set of factors are applied which account for incidentals, contingencies, engineering design costs, utility involvement and rights-of-way impacts.

Several key elements have been included in the preliminary cost estimating procedure. These items include signing and striping, stage construction, incident management system, health and safety support, and mitigation. Additionally, it was determined that there is a section of composite pavement that exists in an otherwise flexible pavement corridor. Costs associated with the repairing and widening of concrete base course (composite pavement) was included in the Contract A, Additional Lane estimate.

Engineering judgment was used when developing the preliminary quantities for earthwork, dimensions of pavement section and the scope of structural work. Assumptions made during the development the various estimates were clearly spelled out in the computational back up data (spreadsheets). Field observations, still photos and video documentation of the corridor provided valuable input for the estimating process.

For the Additional Lane Alternative, scaleable CADD cross sections were developed to more accurately detail the future median configuration. The cross sections were key to understanding the amount of earthwork required, the location and extent of proposed retaining walls, and the need for reconstruction of several local road overpasses. The costs for each of the five contracts are listed in Table 5.9. The total cost for the construction of additional lanes on I-84 is approximately $267,600,000. Details of the estimates can be found in the Technical Appendix.

Costs for each construction element of the I-84 interchange improvements were estimated based on a general format derived from the Department's preliminary estimating procedure, dated April 2001. Capital cost items such as pavement, earthwork, structures, retaining walls, drainage, signals and curb and barrier were estimated for each alternative and subtotaled. Costs for contingencies and incidentals were added to this to get order of magnitude cost estimates for each type of improvement. Items such as right of way acquisitions and environmental mitigation efforts were not included in the costs due to the preliminary nature of these estimates. All costs are in year 2001 dollars.

Table 5.10 lists the costs for each of the recommended interchange improvements. As noted previously, the interchange improvements at Interchange 13 to Interchange 16 are transportation system management type improvements. They are typically less costly, with the highest cost being Interchange 14 at a little over $1 million. Interchanges 13, 14 and 16 are significantly less costly at $340,000, $162,000 and $614,000, respectively. In contrast, improvements at Interchange 17 and Interchange 18 require more significant construction, including roadway segments on new alignment. The costs for these two interchanges are $7.9 million for Interchange 17 and $4.8 million for Interchange 18. Details of the cost estimates can be found in the Technical Appendix.

Table 5.9
Engineering Cost Estimate for Additional General Purpose Lane on I-84

ENTIRE PROJECT (5 CONTRACTS) - TOTAL LENGTH = 21.37 KM (13.3 MI)

SUMMARY

(2001 UNIT PRICES)

ITEM DESCRIPTION	CONTRACT A	CONTRACT B	CONTRACT C	CONTRACT D	CONTRACT E	TOTAL
SPECIFIC ITEMS						
EARTHWORK	$1,223,778	$515,260	$874,447	$1,930,117	$1,651,371	$6,194,972
DRAINAGE	$3,477,526	$2,247,260	$3,205,470	$3,463,749	$4,154,954	$16,548,959
PAVEMENT	$10,700,308	$6,392,044	$9,618,606	$10,014,180	$12,458,374	$49,183,512
STRUCTURES	$18,278,275	$9,609,100	$14,211,750	$13,672,600	$15,027,000	$70,798,725
MISCELLANEOUS	$6,600,848	$3,505,798	$4,620,122	$4,638,309	$5,373,592	$24,738,669
LUMP SUM ITEMS	$11,882,817	$6,569,491	$9,596,466	$9,947,092	$11,406,261	$49,402,127
SUBTOTAL	**$52,163,552**	**$28,838,953**	**$42,126,861**	**$43,666,046**	**$50,071,551**	**$216,866,964**
ADDITIONAL ITEMS						
INCIDENTALS (7% OF SUBTOTAL B)	$3,651,449	$2,018,727	$2,948,880	$3,056,623	$3,505,009	$15,180,687
CONTINGENCIES (5% OF SUBTOTAL B)	$2,608,178	$1,441,948	$2,106,343	$2,183,302	$2,503,578	$10,843,348
PRELIMINARY ENGINEERING (8%OF SUBTOTAL B)	$4,173,084	$2,307,116	$3,370,149	$3,493,284	$4,005,724	$17,349,357
UTILITY COST (3% OF SUBTOTAL B)	$1,564,907	$865,169	$1,263,806	$1,309,981	$1,502,147	$6,506,009
RIGHT-OF-WAY (ESTIMATED)	$80,000	$200,000	$200,000	$200,000	$200,000	$880,000
TOTAL	**$64,241,169**	**$35,671,913**	**$52,016,039**	**$53,909,237**	**$61,788,008**	**$267,626,366**
ROUNDED TOTAL	**$64,200,000**	**$35,700,000**	**$52,000,000**	**$53,900,000**	**$61,800,000**	**$267,600,000**

Table 5.10
Interchange Construction Costs

Interchange 13	$340,000
Interchange 14	$1,092,000
Interchange 15	$162,000
Interchange 16	$614,000
Interchange 17	$7,943,000
Interchange 18	$4,817,000
Total for All	**$14,968,000**

The Chase Parkway bridge over I-84 at Interchange 18 is recommended to be replaced to accommodate additional left turn lanes at both ends. This has not been included in the cost estimate for the interchange improvement since the bridge would need to be replaced as part of the Additional Lane Improvement. The widening of the approach lanes on Chase Parkway; however, have been included in the Interchange 18 cost.

Chapter 6
SUMMARY OF RECOMMENDATIONS AND ACTION PLAN

The initial alternative screening process applied the stated Goals and Objectives as defined by the Advisory Committee as criteria to be evaluated against. Performance measures were used to quantify the transportation benefits, while environmental and social impacts were qualitatively identified based on constraints mapping. From this process, a series of conceptual transportation improvements was developed to address each of the identified corridor deficiencies, and public comment was used to shape the alternatives into solutions that best served the needs of the communities.

The second phase of alternatives screening involved revising many of the conceptual improvement alternatives to consider physical geometry, construction constraints, cost estimates, property impacts, and additional environmental concerns. The suggested modifications that resulted from this step, while still conceptual in nature, constitute the recommendations presented in the remainder of this report.

6.1 Recommended Actions

The principle transportation improvement recommendation to result from this study process is the Additional General Purpose Lane on I-84 in each direction with intermittent truck climbing lanes from Interchange 13 to Interchange 18. This is approximately 13-miles of I-84 that today primarily has two travel lanes in each direction with intermittent truck climbing lanes. Additional improvements are also recommended at each interchange area west of, and including, Interchange 18 to address various deficiencies in the transportation system. These improvements consist of Transportation Systems and Demand Strategies as well as safety improvements to the corridor. Finally, the need for improvements for the I-84/Route 8 Interchange in Waterbury has been identified, but need to be quantified by a future study.

Each of the recommended improvements has in the following text been tabulated by interchange area.

Interchange 13

Interchange 13 in Southbury is the westernmost interchange within the WOW study corridor. It forms a partial interchange just east of the Housatonic River, serving trips to and from the west. This interchange has two mainline lanes along I-84 in the eastbound and westbound directions. The on and off ramps to and from I-84 are single lane ramps. The short-term and long-term recommendations at this interchange area are listed in Table 6.1.

Table 6.1
Summary of Interchange 13 Recommendations

Project	Type	Preliminary Cost Estimate	Comments
Short-Term			
➢ Increase corner radius at WB entrance ramp and Oakdale Manor Road to 50 feet to accommodate trucks	TSM - Intersection	N/A	This deficiency will be addressed by DOT Safety Improvement Project No. 130-169
➢ Construct a new park and ride lot in interchange area	TDM - Parking	$320,000	
➢ Install a new sign for I-84 WB entrance ramp on Oakdale Manor Road	TSM - Signage	$2,500	
➢ Replace the faded route marker on Fish Rock Road	TSM - Signage	$500	Notify ConnDOT Maintenance
Long-Term			
➢ Provide 1400 feet of acceleration length for I-84 WB entrance ramp	Interstate Ramp	N/A	Will be completed as part of Interstate reconstruction
➢ Provide 500 feet of deceleration length for I-84 EB exit ramp	Interstate Ramp	N/A	Will be completed as part of Interstate reconstruction
➢ Provide an additional General Purpose Lane along I-84 EB	Interstate Mainline	N/A	Costs are broken out by contract (see Table 5.9)
➢ Provide Additional General Purpose Lane along I-84 WB	Interstate Mainline	N/A	Costs are broken out by contract (see Table 5.9)

NA – Not Applicable – will be completed by ConnDOT

The short-term recommendation for this interchange involves improving the corner radius of the westbound entrance ramp at Oakdale Manor Road. Increasing to a standard 50-foot radius will improve safety. This alternative has already been advanced by ConnDOT and will be constructed as part of their safety improvement program. This recommendation also has the potential for inclusion of a commuter parking facility and the improvement of signage in the area.

As a long-term solution, I-84 in the vicinity of this interchange requires an additional general-purpose lane in each direction to accommodate future year (2025) traffic volumes. In addition, adequate acceleration and deceleration distances need to be provided during the freeway reconstruction phase in coordination with the additional general-purpose lane.

Interchange 14

Interchange 14 in Southbury has full directional access to and from Route 172. This interchange has two mainline lanes and single lane entrance and exit ramps along I-84 in the eastbound and westbound directions. In the future year 2025, the eastbound entrance and exit ramp junctions with I-84 operate at LOS F during the weekday evening peak hour. The westbound entrance and exit ramp junctions with I-84 operate at LOS F during the weekday morning peak hours. During the weekday evening peak hour, the South Britain Road and I-84 westbound exit ramp junction operates at LOS F. It has been determined that the lack of storage space between the westbound off ramp and Main Street South along with the heavy right hand turn movement at this

intersection creates a queuing problem on this ramp. The short-term and long-term recommendations at this interchange area are listed in Table 6.2.

Table 6.2
Summary of Interchange 14 Recommendations

Project	Type	Preliminary Cost Estimate	Comments
Short-Term			
➢ Signalize the intersection with I-84 WB exit ramp and S. Britain Road to relieve queuing on ramp. ➢ Provide signal coordination and adequate lane geometry to improve traffic operations at intersection of S. Britain Road and Main Street South	TSM - Intersection	$550,000	
➢ Provide additional acceleration length for I-84 EB and WB entrance ramps	Interstate Ramp	N/A	This deficiency will be addressed by DOT Safety Improvement Project No. 130-169
➢ Eliminate the all-way STOP sign control at the intersection of Lakeside Road/Georges Hill Road/I-84 EB Off Ramp and provide a traffic signal	TSM - Intersection	$490,000	Intersection will require additional time between phases to clear vehicles
➢ Install a new I-84 directional sign on Main Street South	TSM - Signage	$500	
➢ Replace the damaged directional sign on I-84 WB exit ramp	TSM - Signage	$500	Notify ConnDOT Maintenance
Long-Term			
➢ Provide 600 feet of deceleration length for I-84 EB exit ramp	Interstate Ramp	N/A	Will be completed as part of Interstate reconstruction
➢ Provide additional General Purpose Lane along I-84 EB	Interstate Mainline	N/A	Costs are broken out by contract (see Table 5.9)
➢ Provide additional General Purpose Lane along I-84 WB	Interstate Mainline	N/A	Costs are broken out by contract (see Table 5.9)

NA – Not Applicable – will be completed by ConnDOT

To improve traffic operations, the intersection of Main Street South and South Britain Road requires widening and signal coordination with the South Britain Road and I-84 Westbound Off-Ramp intersection. Constraints at the intersection include a gas line that runs south of the intersection and parallel to Main Street South. There is also a commuter parking lot in the southeast quadrant of the intersection. In the northwest quadrant of the intersection, there are residential properties that should be considered prior to widening the intersection.

The intersection of Lakeside Road, Georges Hill Road, and the I-84 Eastbound Ramp is recommended to be signalized and widened to improve traffic operations. Widening on the east side of the intersection is constrained by rock ledge so widening may need to be performed on the west side of the intersection.

As a long-term solution, I-84 in the vicinity of this interchange requires an additional general-purpose lane in each direction to accommodate future year (2025) traffic volumes. ConnDOT is currently pursuing a Safety Improvement Project (No. 130-169) to improve acceleration

distances at this interchange. The deceleration distance along I-84 EB will be addressed during the freeway reconstruction phase of the project (long-term solution).

Other recommendations at this location involve improving highway and roadway signage (TSM).

Interchange 15

Interchange 15 is the primary access to the Town of Southbury. It provides full directional access to and from Route 6. Major commercial development in this area makes it the most heavily utilized interchange in Southbury. The configuration consists of two mainline lanes and single lane entrance and exit ramps along I-84 in the eastbound and westbound directions; however, in the westbound direction due to the presence of a climbing lane, there are three mainline lanes along I-84 just west of the on ramp from Route 6/Route 67 and the IBM driveway. In the future year 2025, the eastbound entrance and exit ramps from Route 67 operate at LOS F during the weekday evening peak hour, while the westbound entrance and exit ramps operate at LOS F during the weekday morning peak hour. The short-term and long-term recommendations at this interchange area are listed in Table 6.3.

Table 6.3
Summary of Interchange 15 Recommendations

Project	Type	Preliminary Cost Estimate	Comments
Short-Term			
➢ Provide additional turn lanes to improve traffic operations at intersection of Route 6/Main Street South/Southbury Plaza Driveway	TSM - Intersection	$154,000	
➢ Extend the EB truck climbing lane through the interchange to eliminate difficult weave	Interstate Mainline / Safety		Will involve expanding the I-84 structure over S. Britain Road
➢ Improve visibility of I-84 directional sign	TSM - Signage	N/A	Notify ConnDOT Maintenance
➢ Provide adequate signage along Route 6/67 to alert drivers in advance of the I-84 EB and WB On-Ramps	TSM - Signage	$2,000	
Long-Term			
➢ Provide 900 feet of acceleration length along I-84 EB entrance ramp	Interstate Ramp	N/A	Will be completed as part of Interstate reconstruction
➢ Provide additional 400 feet deceleration length to I-84 WB exit ramp to account for vehicle queue on ramp	Interstate Ramp	N/A	Will be completed as part of Interstate reconstruction
➢ Provide additional General Purpose Lane along I-84 EB	Interstate Mainline	N/A	Costs are broken out by contract (see Table 5.9)
➢ Provide additional General Purpose Lane along I-84 WB	Interstate Mainline	N/A	Costs are broken out by contract (see Table 5.9)

NA – Not Applicable – will be completed by ConnDOT

The intersection of Main Street, Route 6/67 and Southbury Plaza is recommended to be widened to provide an additional left turn lane in the northbound direction along Main Street. Due to this widening, Main Street would need to be widened in the westbound direction to provide adequate width for left turning vehicles. Also, the northbound right turn lane on Main Street would be shifted east of its present location due to the additional left turn lane. Based on field observations, it appears feasible to provide the additional widening on the east side without impacting the parking lot in Southbury Plaza.

The extension of the truck climbing lane through the interchange area and improving highway signage will also be looked at as a short-term solution.

As a long-term solution, I-84 in the vicinity of this interchange requires an additional general-purpose lane in each direction to accommodate future year (2025) traffic volumes. In addition, adequate acceleration and deceleration distances will be provided along I-84 in the eastbound and westbound directions during the freeway reconstruction phase of the project.

Interchange 16

Interchange 16 provides full directional access to and from Route 188 in Southbury. While these ramps are important to development in Southbury, they also serve development in Middlebury and Oxford. Interchange 16 also provides an important linkage to Oxford Airport. This interchange has two mainline lanes and single lane entrance and exit ramps along I-84 in the eastbound and westbound directions. In the future year 2025, the eastbound entrance and exit ramps from Route 188 operate at LOS F during the weekday evening peak hour, while the westbound entrance and exit ramps operate at LOS E and LOS F respectively during the weekday morning peak hour. The short-term and long-term recommendations at this interchange area are listed in Table 6.4.

Table 6.4
Summary of Interchange 16 Recommendations

Project	Type	Preliminary Cost Estimate	Comments
Short-Term			
➢ Provide signal coordination and additional lanes to improve traffic operations at the intersection of Old Waterbury Road and Route 188. ➢ Provide signal coordination and additional lanes to provide more storage and improve traffic operations at intersection of I-84 WB exit ramp and Route 188.	TSM - Intersection	$580,000	
➢ Provide additional acceleration length for I-84 WB entrance ramp	Interstate Ramp	N/A	This deficiency will be addressed by DOT Safety Improvement Project No. 130-169
➢ Investigate the potential for truck rest areas – include shoulders on truck climbing lanes	TDM - Truck / TSM - Safety	N/A	
➢ Install a new I-84 directional sign along Old Waterbury Road	TSM - Signage	$500	
➢ Install new route signage on I-84 WB exit ramp	TSM - Signage	$500	
➢ Straighten the I-84 EB entrance ramp sign	TSM - Signage	N/A	Notify ConnDOT Maintenance
Long-Term			
➢ Provide 1500 feet of acceleration length for I-84 WB entrance ramp	Interstate Ramp	N/A	Will be completed as part of Interstate reconstruction
➢ Provide 600 feet of deceleration length for I-84 EB exit ramp	Interstate Ramp	N/A	Will be completed as part of Interstate reconstruction
➢ Provide additional General Purpose Lane along I-84 EB	Interstate Mainline	N/A	Costs are broken out by contract (see Table 5.9)
➢ Provide additional General Purpose Lane along I-84 WB	Interstate Mainline	N/A	Costs are broken out by contract (see Table 5.9)

NA – Not Applicable – will be completed by ConnDOT

The recommendation for the intersection of Old Waterbury Road and Route 188 requires the provision of an exclusive right turn lane in the eastbound direction along Old Waterbury Road, an exclusive left turn lane in the northbound direction, and an additional through lane in the southbound direction along Route 188. The intersection of I-84 WB Ramp and Route 188 will require additional left turn and through lanes in the northbound direction and an exclusive right turn lane in the southbound direction along Route 188 to accommodate future year traffic volume.

As a short-term solution, the two intersections should be widened as TSM improvements. In addition to the widening, the two signals should be coordinated to reduce queuing between intersections. Based on field observations, widening along Route 188 seems achievable along the east side of the intersection due to the existence of wetlands west of the present alignment.

Other short-term improvements include providing highway and roadway signage in the vicinity of the interchange.

As a long-term solution, this interchange requires an additional general-purpose lane in each direction to accommodate future year (2025) traffic volumes. In addition, adequate acceleration and deceleration distances will be provided along I-84 in the eastbound and westbound directions during the freeway reconstruction phase of the project. Providing adequate acceleration and deceleration distances will improve the sub-standard radii at the I-84 eastbound interchange.

The need to investigate providing truck rest areas was also identified.

Interchange 17

Interchange 17 possesses some of the worst operational deficiencies in the WOW corridor. Due to the physical layout of the interchange, the eastbound entrance and exit ramps are accessed from Route 64 while the westbound entrance and exit ramps are accessed via Route 63. This split interchange configuration creates heavy congestion at the intersection of these two routes. In the future year 2025, the eastbound entrance and exit ramps from Route 63/Route 64 operate at LOS F during the weekday evening peak hour, while the westbound entrance and exit ramps from Route 63/Route 64 operate at LOS F during the weekday morning peak hour. In addition, the westbound off-ramp to Route 64 operates at LOS F during the weekday evening peak hour. The short-term and long-term recommendations at this interchange area are listed in Table 6.5.

Table 6.5
Summary of Interchange 17 Recommendations

Project	Type	Preliminary Cost Estimate	Comments
Short-Term			
➢ Build a Connector Road between Route 64 and Route 63 along existing ROW to provide operational improvement	Arterial Road	$3,130,000	Develop along existing rail ROW
➢ Build a multi-use path along new Connector Road to provide bike/ped access between Middlebury and Waterbury	TDM – Bicycle/ Pedestrian	210,000	
➢ Signalize the intersection of Chase Parkway/I-84 WB exit ramp/Connector Road and extend the exit ramp deceleration length an additional 525 feet	TSM – Intersection / Interstate Ramp	$1,240,000	Developing a tighter curve on WB exit ramp may help slow vehicles before the new signal
➢ Provide adequate signage to warn drivers of the end of truck-climbing lane on I-84 EB	TSM - Signage	$2,200	
➢ Provide Park and Ride Lot sign on Interstate	TSM - Signage	$2,200	
➢ Provide signage leading commuters to alternate Park and Ride lot at Maggie McFly's on Route 63	TDM – Parking / Signage	$2,000	Main lot at 100% utilization
➢ Replace the 'East' auxiliary sign mounting on I-84 Route marker	TSM - Signage	$100	Notify ConnDOT Maintenance
➢ Install a directional sign on Route 64 indicating Chase Parkway intersection	TSM - Signage	$600	
➢ Repair the bent sign on the I-84 EB entrance ramp	TSM - Signage	$100	Notify ConnDOT Maintenance
Long-Term			
➢ Provide 900 feet of acceleration length on I-84 WB entrance ramp	Interstate Ramp	N/A	Will be completed as part of Interstate reconstruction
➢ Widen the Route 63/64 intersection and provide additional lanes to accommodate future traffic volumes	TSM - Intersection	$1,050,000	May have property impacts
➢ Re-grade Route 64 to eliminate crest vertical curve and poor sight distance. ➢ Widen Route 64 (in conjunction with re-grade) to accommodate four lane cross section	Arterial Road	$2,150,000	Should not impact existing utilities. Should be done in conjunction with intersection improvements
➢ Provide additional General Purpose Lane along I-84 EB	Interstate Mainline	N/A	Costs are broken out by contract (see Table 5.9)
➢ Provide additional General Purpose Lane along I-84 WB	Interstate Mainline	N/A	Costs are broken out by contract (see Table 5.9)

NA – Not Applicable – will be completed by ConnDOT

The modifications recommended at this interchange would require a significant financial investment to complete. The biggest traffic operational concern is the intersection of Route 63 and Route 64. As a short-term improvement, a Connector Road constructed from Route 63 to Route 64 along existing rail ROW could provide relief to congestion at the intersection and also improve operations along Route 63 and Route 64. As traffic volumes in the corridor increase,

the intersection would require additional widening to operate efficiently. Other short-term improvements would include providing adequate highway and roadway signage at this interchange.

A recommended long-term improvement involves widening the intersection of Route 63 and Route 64 to handle the increasing level of traffic. Route 64 is recommended to be widened to four lanes and re-graded to reduce the crest vertical curve that is contributing to poor sight distance approaching the intersection from the east. In addition, the provision of an additional general-purpose lane along I-84 through this interchange and increasing acceleration distances in the eastbound direction will be part of a freeway reconstruction phase at this location.

Interchange 18

Interchange 18 has two mainline lanes and single lane entrance and exit ramps along I-84 in the eastbound and westbound directions; however, in the westbound direction I-84 includes a truck-climbing lane at the Highland Avenue off ramp junction. Under the future year 2025, all freeway ramp junctions operate at LOS E or worse during the weekday morning and evening peak hours. The short-term and long-term recommendations at this interchange area are listed in Table 6.6.

Table 6.6
Summary of Interchange 18 Recommendations

Project	Type	Preliminary Cost Estimate	Comments
Short-Term			
➢ Build a Connector Road between Highland Avenue and W. Main Street to provide better connectivity. ➢ Reconstruct I-84 WB exit ramp to a standard 275 foot radius – install signal to intersection of ramp with connector road	Arterial Road / Interstate Ramp	$3,880,000	
➢ Widen the bridge over I-84 to provide an additional left turn lanes to Chase Parkway	Structural	$710,000	Structure needs to be widened as part of the additional lane improvement (cost included in add-a-lane)
➢ Provide overhead Route 8 directional signs on I-84 EB to reduce driver confusion	TSM - Signage	$100,000	
➢ Install a new I-84 directional sign on W. Main Street	TSM - Signage	$500	
➢ Install a new I-84 directional sign on Country Club Road	TSM - Signage	$500	
➢ Replace the deteriorated sign along Chase Parkway	TSM - Signage	$500	Notify ConnDOT Maintenance
➢ Provide adequate I-84 route signage along Chase Parkway to reduce driver confusion	TSM - Signage	$1,000	
➢ Move I-84 route sign away from fence on Highland Avenue to improve visibility	TSM - Signage	N/A	Notify ConnDOT Maintenance
Long-Term			
➢ Provide 500 feet of acceleration length to I-84 EB entrance ramp	Interstate Ramp	N/A	Will be completed as part of Interstate reconstruction
➢ Provide 500 feet of deceleration length to I-84 EB and WB exit ramps	Interstate Ramp	N/A	Will be completed as part of Interstate reconstruction
➢ Reconstruct I-84 EB to include an additional General Purpose Lane – lane will drop before entrance ramp but full pavement width will extend to Route 8 northbound entrance ramp	Interstate Mainline	N/A	Costs are broken out by contract (see Table 5.9)
➢ Provide additional General Purpose Lane along I-84 WB	Interstate Mainline	N/A	Costs are broken out by contract (see Table 5.9)

NA – Not Applicable – will be completed by ConnDOT

Like Interchange 17, Interchange 18 presents numerous operational and safety deficiencies while being constrained by the physical limits of the transportation infrastructure. While not all of the deficiencies can be addressed as part of this study, some improvement can be made to relieve the traffic pressure that is building in this area.

This interchange will require primarily traffic operations related improvements. The bridge over I-84 along Chase Parkway is recommended to be widened to provide six lanes to solve the

operational problems between West Main Street and Country Club Road. This widening could be pursued as a short-term improvement and would likely require bridge reconstruction.

The sub-standard curve radius at the I-84 WB Exit Ramp to Highland Avenue/W. Main Street could also be pursued as a short-term improvement. The realigned ramp would intersect with a newly constructed Connector Road between W. Main Street and Highland Avenue. Other improvements at this interchange are related to highway and roadway signage and will be pursued as short-term improvements.

The long-term improvement in the vicinity of this interchange is providing an additional general-purpose lane in each direction and providing adequate acceleration and deceleration distances in both directions during the freeway reconstruction phase. A key to the highway operations at this interchange is its connectivity to the Route 8 Interchange and will be investigated further when the Route 8 Interchange is evaluated in a separate concentrated future study.

Additional Recommendations

Interchanges 19, 20, and 21 constitute the series of ramps and interconnections that make up the 'Mixmaster' I-84/Route 8 Interchange structure in Downtown Waterbury. The bridge structures for the eastbound and westbound viaducts are stacked vertically, rather than in a more conventional arrangement where the opposing roadways are parallel to each other. This section of I-84 experiences numerous operational, structural, and safety deficiencies. Some of these are as follows:

- Left hand exit from I-84 eastbound to Route 8 northbound;
- Left hand entrance to I-84 eastbound from Route 8 southbound;
- Left hand entrance to I-84 westbound from Route 8 northbound;
- Left hand entrance to I-84 westbound from Bank Street;
- Substandard weave section between I-84 eastbound entrance from Route 8 south to Meadow Street Exit ramp;
- Substandard weave section between I-84 westbound entrance from Route 8 north to Highland Street Exit ramp;
- High accident location I-84 at Route 8, Meadow Street Interchange (Interchange 21);
- Two lane stretch of I-84 eastbound between exit to Route 8 northbound and entrance from Route 8 southbound; and
- Poor structural rating on main span over Naugatuck River (will be upgraded by ConnDOT).

While identifying these deficiencies, it became apparent that this interchange area would require a detailed analysis that is beyond the scope of this study. The level of complexity that this interchange area exhibits requires a focused effort that considers not only traffic operation, but structural analysis, maintenance and protection of traffic, environmental and social mitigation, property impacts, and a robust public involvement program. It is the recommendation of this study conduct a follow-on study that will consider each of these elements in greater detail. For the purpose of this discussion, this future study will be referred to as the Waterbury Access Study.

In addition, inadequate Wayfinding (Tourism) and Directional signage has been identified as a deficiency in this study. While the intent of this study was not to develop a detailed signage plan or design the layout of special signage, it did take a conceptual look at the routing of traffic to and from I-84. It is the further recommendation of this study to develop a detailed signage plan for Downtown Waterbury. This may be a component of a Waterbury Access Study or a stand-alone investigation.

The recommended actions for the remainder of the corridor are listed in Table 6.7.

Table 6.7
Summary of Additional Recommendations

Project	Type	Preliminary Cost Estimate	Comments
Short-Term			
➢ Include Downtown Waterbury directional signage to Interstate and other destinations	Study	$10,000	Preliminary Cost - will need to study in greater detail to determine types and locations of signage
➢ Perform a study to evaluate the I-84/Route 8 interchange area	Study	TBN	This area will remain a 'choke point' in the interstate system until a solution is identified and pursued.

TBN – To Be Negotiated
NA – Not Applicable – will be completed by ConnDOT

6.2 Next Steps

The recommendations from this study will need to satisfy state and federal approval and permitting requirements before they can be further developed and constructed. In order to receive federal funding for a highway project, ConnDOT and COGCNV must demonstrate to Federal Highway Administration (FHWA) that they have considered the environmental impacts of each proposed improvement that is being pursued. To accomplish this, a study must be performed in accordance with the National Environmental Policy Act (NEPA) as well as the Connecticut Environmental Policy Act (CEPA) to determine the level of impact to environmental resources. This study can take one of three forms:

- An Environmental Impact Statement (EIS), which is required for major projects anticipated to have extensive environmental impacts;
- An Environmental Assessment (EA), which is required for projects in which the environmental impacts are uncertain – which can lead to an EIS if impacts are determined to be significant; and
- A Categorical Exclusion (CE), which is required for minor projects that do not have any significant environmental impact.

If wetlands are to be impacted as a result of any of the proposed improvements, the U.S. Army Corps of Engineers (ACOE) requires a Section 404 (of the Clean Water Act) Permit. To apply for this permit, the project must seek to 1) avoid, 2) minimize, or 3) mitigate wetland impacts.

ACOE will review the environmental documents prepared under the NEPA process and decide on the level of the permitting that is required for the project.

Other permits that may be required by Connecticut Department of Environmental Protection (DEP) and U.S. Environmental Protection Agency (EPA) include:

- Connecticut Flood Management Certification;
- Connecticut Inland Wetlands and Watercourses Act Permit;
- Connecticut Indirect Source Permit; and
- National Pollutant Discharge Elimination System.

In addition to the environmental regulations that must be satisfied, FHWA will need to approve any modification that requires a change in access on the Interstate. This includes ramps that have been relocated or modified to diverge or merge at a new location. Improvements at Interchanges 17 and 18 will need to be evaluated based on safety, design standards, and consistency with surrounding land uses.