I-84 Danbury PEL Study

August 2025

Prepared for:

The Connecticut Department of Transportation

The use of PEL is encouraged by the Federal Highway Administration as it considers environmental, community, and economic goals early in the transportation planning process. The CTDOT may adopt or incorporate Planning Products from this PEL Study into a federal or state environmental review process, pursuant to Title 2 3 U.S.C. § 168(d)(4).

I-84 Danbury

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Acronyms and Abbreviations

Acronym/Abbreviation	Definition
AADT	Average Annual Daily Traffic
ATSPM	Automated Traffic Signal Performance Measures
CC	Concept Combination
CD	Collector Distributor
CEPA	Connecticut Environmental Policy Act
City	City of Danbury
CT DEEP	Connecticut Department of Energy & Environmental Protection
CTDOT	Connecticut Department of Transportation
DLU	Dynamic Lane Use
DOJ	U.S. Department of Justice
EB	Eastbound
EIS	Environmental Impact Statement
ESA	Endangered Species Act
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
GIS	Geographic Information System
HARTransit	Housatonic Area Regional Transit
HESA	Human Environment Study Area
IPaC	Information for Planning and Consultation
LEP	Limited English Proficiency
NDDB	Natural Diversity Data Base
NEPA	National Environmental Policy Act
NGPL	Natural Gas Pipeline
NRCS	Natural Resources Conservation Service
NWI	National Wetland Inventory
NYSDOT	New York State Department of Transportation
PAC	Project Advisory Committee
PEL	Planning and Environment Linkages
PIP	Public Involvement Plan
SHPO	State Historic Preservation Office
SR	State Route
TDM	Travel Demand Management

Acronym/Abbreviation	Definition
TSMO	Transportation Systems Management and Operations
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
WestCOG	Western Connecticut Council of Governments
WB	Westbound
WCSU	Western Connecticut State University

ES. Executive Summary

Introduction

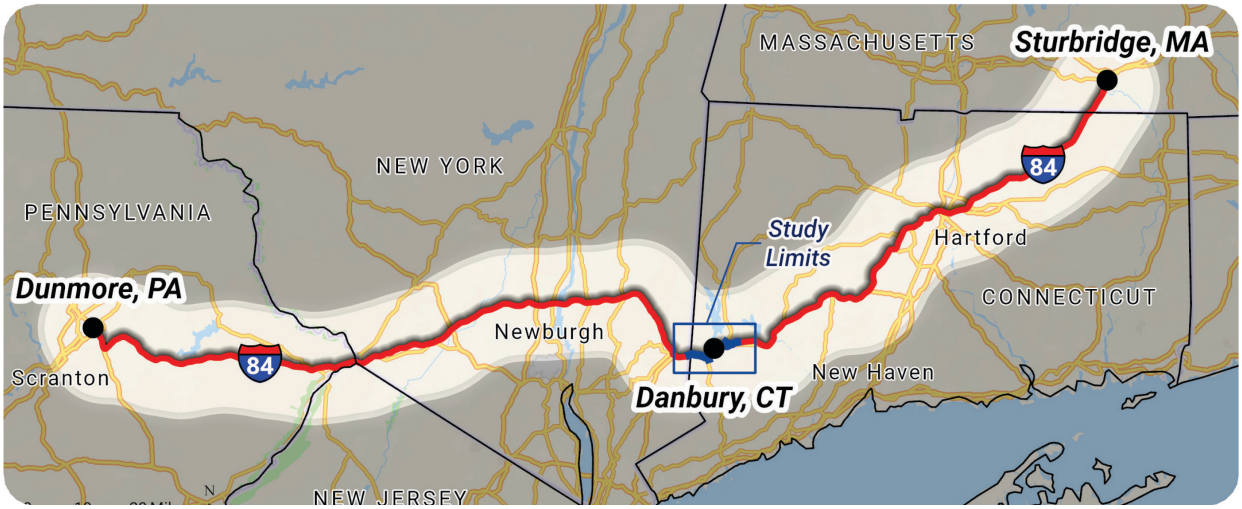
The Connecticut Department of Transportation (CTDOT) has undertaken an analysis of the Interstate 84 (I-84) corridor around Danbury, Connecticut through the Planning and Environment Linkages (PEL) process. PEL is a collaborative, integrated approach to transportation decision-making that considers environmental, community, and economic goals early in the transportation planning process. The I-84 Danbury PEL Study has examined specific transportation needs and deficiencies through the Danbury portion of the I-84 corridor and evaluated numerous potential solutions, which could foster efficient travel and mobility for all users in the corridor.

The subject PEL Study has allowed CTDOT to engage with local communities, businesses, regulators, I-84 corridor travelers, and other interested stakeholders throughout the Danbury area, to understand their concerns and ideas for immediate and long-term improvements. This PEL Study will inform future projects.

Study Area

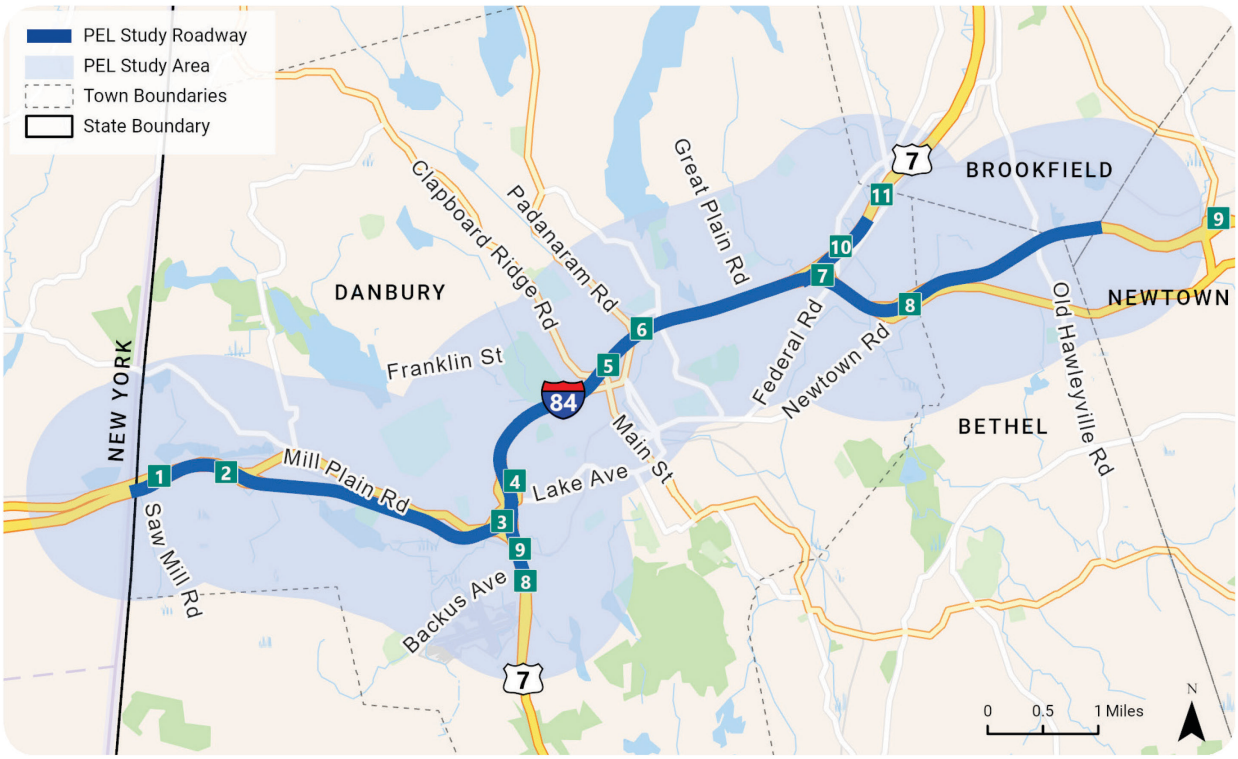
I-84 extends from I-81 in Dunmore, Pennsylvania, to I-90 in Sturbridge, Massachusetts, as depicted on Figure ES-1, below, crossing through the states of Pennsylvania, New York, Connecticut, and Massachusetts. I-84 plays an important economic role in connecting the cities of Danbury, Waterbury, and Hartford to the New York and Boston metropolitan areas.

Figure ES-1
I-84 Regional Extent



An approximately 10-mile portion of the I-84 corridor was analyzed in this PEL Study, extending slightly beyond the New York State border to the west and slightly beyond Interchange 8 to the east, including portions of Route 7 to the north near Interchange 7 and to the south near Interchange 3, as depicted in Figure ES-2. This portion of I-84 serves as one of the principal east-west routes in Connecticut, as well as providing local access to key destinations.

Figure ES-2
PEL Study Area

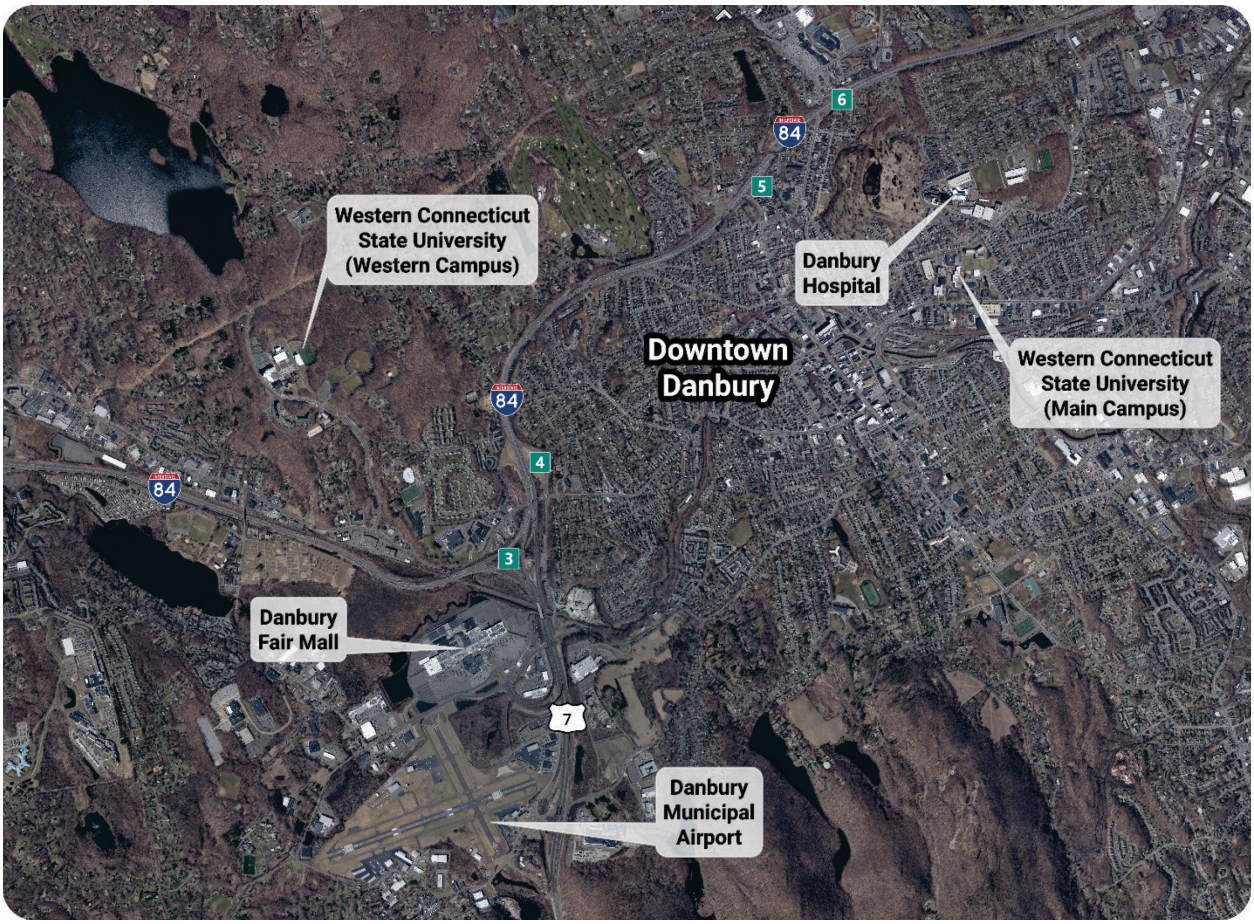


Study Area Characteristics

The PEL Study Area is primarily composed of heavily developed residential, commercial, institutional, and industrial land uses, as well as airfields, railroads, interstates, local road infrastructure, managed open space, cemeteries, and golf courses. Limited areas of natural habitats for plants and animals are found throughout the PEL Study Area.

Central Danbury is the most densely developed section of the city, defined as the surrounding area between highway Interchanges 3 and 7 (see Figure ES-3). Many neighborhoods, major employers, recreation areas, and cemeteries are located close to, or directly abut, the highway. This includes downtown Danbury, located one-half mile south of the highway, and the center of Danbury, surrounded by dense, older residential neighborhoods.

Figure ES-3
Aerial Overview of I-84 Near Downtown Danbury



Needs and Deficiencies

I-84 through the PEL Study Area suffers from heavy congestion which is characterized by lower speeds, longer delays, and queuing. Travel along the I-84 corridor from New York to the west and from Boston to the east, through the City of Danbury (City), has historically been one of the most congested roadway segments in the region. A steady increase in traffic volumes over past years has contributed to congestion and delays. Population growth in Danbury through 2040 is projected to increase by over 14%, the highest projected growth rate in Western Connecticut. These predicted population changes are anticipated to compound congestion and mobility issues throughout the I-84 corridor.

The heaviest congestion on I-84 during the morning peak hours occurs in the westbound direction, towards New York between Interchanges 4 and 9 and southbound on Route 7 between Interchanges 10 and 11. The heaviest congestion in the afternoon peak hours occurs on I-84 eastbound, heading towards Massachusetts from the New York state line through Danbury to Interchange 7 and further east of Interchange 8 where the highway contracts from three lanes to two.

Adjacent to I-84, the City is characterized by an inefficient layout of the local street network. A lack of capacity on local roads, as well as gaps in transit options within the City translate into increased local trip volume on I-84 and Route 7. In addition, low levels of transit use, bicycling, and walking results in a high

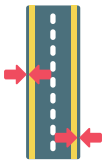
reliance on automobiles using the highway network for day-to-day travel. Without an alternate direct local east-west route, during periods of highway congestion, motorists detour onto local streets, causing congestion on local roads.

Mobility is the ability of a transportation system to move people and goods efficiently. The lack of an east/west local roadway network combined with an overall lack of alternate travel modes in the greater Danbury area (e.g., lack of freight, passenger rail, pedestrian and bicycle routes) results in poor mobility.

I-84 has numerous design deficiencies that lead to heavy congestion and lack of mobility characterized by lower traffic speeds, unreliable travel times, and increased risk of crashes. These include:

Short acceleration and deceleration lane lengths, where there is a limited distance in which to either increase speed before merging with traffic or to decrease speed to a rate at which a vehicle can safely leave the main traffic flow and slow down before exiting. These conditions can slow down the flow of traffic along the interstate and lead to congestion.

Sharp curves and hills along I-84 through the PEL Study Area result in substandard stopping sight distances (i.e., the required distance for a driver to recognize, react, and safely stop their vehicle). Curves and hills restrict visibility, and crashes are more likely to occur when there is insufficient sight distance, potentially resulting in a rear-end or sideswipe type crash.



Insufficient shoulders widths along I-84 result in less room for vehicles to react during unforeseen conditions, such as a crash on the highway. Other shoulder functions include providing space for disabled vehicles, enforcement and maintenance activities, maneuvering, and temporary storage of stormwater, all of which are diminished when shoulder widths are insufficient.

Incomplete interchanges occur where at least one connection is missing (e.g., where there is not an on- and off-ramp in both directions of the interstate, leading to congestion and inefficient traffic flow. Interchange 6 within the PEL Study Area is an incomplete interchange.

Left-hand interchanges that do not meet driver expectations and can confuse drivers attempting to exit the highway, with a potential to cause crashes and associated congestion. Within the PEL Study Area, Interchanges 3 and 7 are left-hand interchanges.

Close interchange spacing, often a root cause of speed change and weaving issues, resulting in safety concerns. Within the PEL Study Area, this condition occurs on I-84 between Interchanges 3 and 4, 5 and 6, and 7 and 8, and on US 7 between Interchanges 8 and 9, and from Interchange 9 to I-84 Interchange 4.

Lack of lane continuity that can induce unexpected lane changes, slower speeds, congestion, and crashes. I-84 through the PEL Study Area transitions from two to three lanes in numerous locations, with a lack in continuity, leading to driver confusion, merging, and slowing down of traffic.

Short weaving distances where on-ramps and off-ramps are closely spaced, resulting in entering traffic crossing paths with exiting traffic within a very short distance. This most notably occurs where I-84 and US 7 are co-located on the same alignment for approximately 3.5 miles between Interchanges 3 and 7, concurrent with numerous other conditions (i.e., left-hand exits, incomplete interchanges, close interchange spacing, and lane continuity) that create weaving conditions.

Agency Coordination and Public Involvement

CTDOT has engaged with federal, state, regional, and local agencies during the PEL process. Additionally, concerns and input were obtained from members of a Public Advisory Committee (PAC), representing key stakeholders. PAC members identified how the PEL Study aligned with their interests and long-term goals and included:

Local Transportation Industry Groups

Economic Development Groups

Municipal and Regional Government Staff

Neighborhood Groups

Area Industry

Special Interest Groups

Public engagement, and Information and announcements about public involvement opportunities were distributed using a variety of tools, including the following:

Project Website

Social Media

E-Bulletins

Open Houses

Surveys

Workshops

The public participation process has been implemented in a manner that enabled interested parties to have the opportunity to provide input, comment on the process, and be made aware of PEL Study developments.

Alternatives Development and Analysis

Considering the identified deficiencies in the PEL Study Area, the purpose of the PEL Study is to identify, develop, and advance solutions aimed at reducing congestion and improving the mobility of people and goods in the I-84 corridor and throughout greater Danbury. These solutions were focused on the following outcomes:

Reduce Congestion: By correcting deficiencies and improving the travel experience, efficiency, and reliability.

Improve Mobility and Accessibility: By expanding travel options, including more efficient vehicular travel as well as the accessibility and ease of use of rail, bus, bike and pedestrian travel modes.

Foster Safe Travel: By improving conditions that contribute to crashes in the corridor.

Support a Strong Economy: By supporting local businesses through efficient access on and off I-84 through Danbury by decreasing travel time and providing access to users.

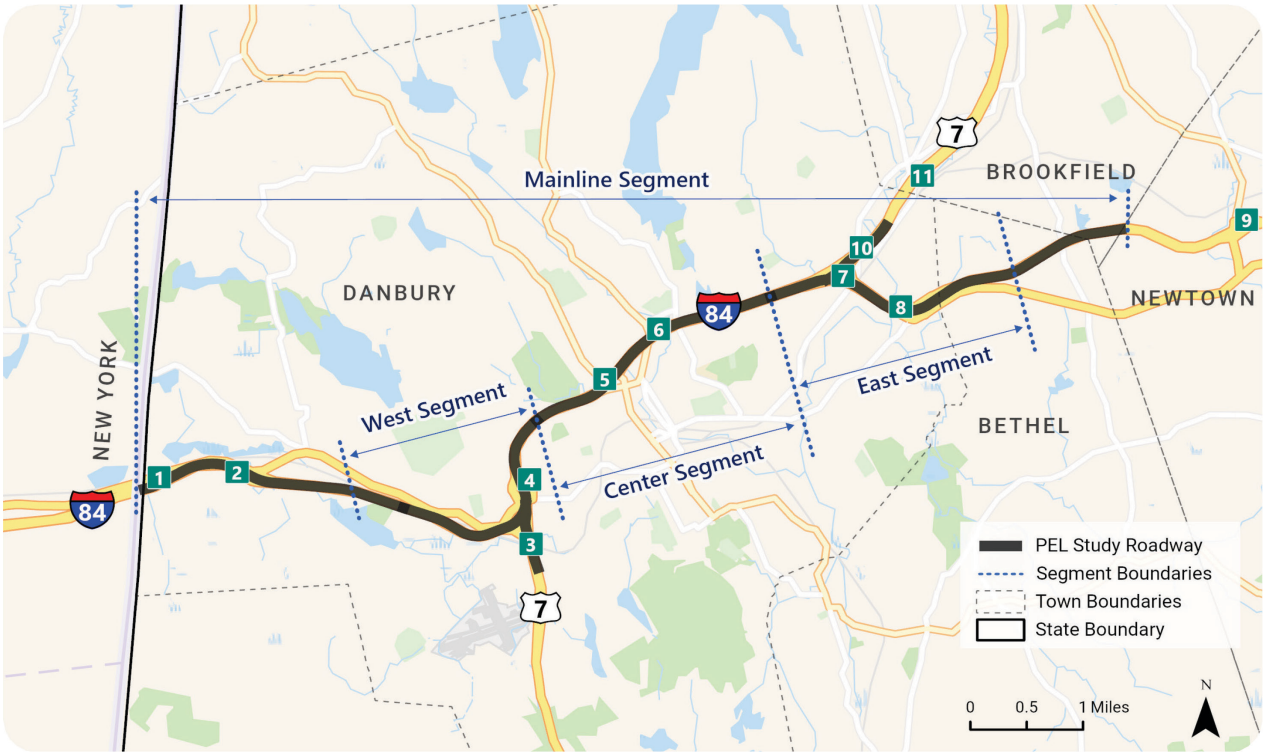
Protect Resources: By avoiding and/or minimizing the potential for environmental and community impacts.

Promote Livable Communities: By providing travel options that improve local community mobility (rail, transit, bike and pedestrian) along with reduction of congestion on the interstate and local roads to foster a more livable, safe and healthy community.

The above focus areas align with the City's transportation planning efforts as reflected in their 2023 Plan of Conservation and Development, including movement of people and goods throughout and adjacent to the City with an emphasis on reducing congestion, providing equitable choices in transportation modes, and enhancing quality of life.

Individual improvements, or concepts, were identified within the I-84 corridor. To aid in developing and evaluating these concepts, the PEL Study Area was divided into four segments: Mainline, West, Center, and East, each having unique concerns. This enabled an assessment of how individual concepts can address the unique segment needs within the ten-mile the corridor. Segments are described below and depicted graphically in Figure ES-4.

Figure ES-4
PEL Study Area Segments



Mainline Segment

The Mainline Segment runs the entire length of the PEL Study Area, including the East, Center, and West segments. It is characterized by congestion, emphasized during the morning and afternoon peak travel periods, as well as a lack of lane continuity.

West Segment

The West Segment runs from just east of Interchange 2 to Interchange 4. In addition to the challenges associated with left-hand exit ramps, the merging of Route 7 also contributes to congestion and mobility issues in this segment. Local roads, including Segar Street and Lake Avenue, become congested during the higher traffic volume periods as queues form with drivers entering and exiting I-84/Route 7.

Center Segment

The Center Segment runs through the downtown portion of the City and includes Interchanges 5 and 6. This section is characterized by the incomplete interchange 6, which affects access to the downtown, Danbury business district and Danbury Hospital. Consequently, drivers are forced to use a combination of interstate and poorly connected local roads to complete their local trips.

East Segment

The East Segment includes Interchanges 7 and 8, as well as the complex intersection where I-84 continues eastbound and Route 7 splits off to the northeast. Weaving movements through this section of I-84 are common in both eastbound and westbound directions due to the left-hand exit ramps. During the morning commute, traffic volumes and weaving movements contribute to congestion and mobility

issues on westbound I-84, with eastbound traffic being affected during the late afternoon and evening commute.

Concept Development

Twenty-six concepts were developed as part of this PEL Study to address congestion and mobility issues that are unique to one of the four geographic segments. These concepts included interchange and ramp improvements, highway modifications to create continuous or express lanes, transit options, strategies focused on Transportation Systems Management and Operations (TSMO, or a wide range of strategies that focus on operational improvements and travel management solutions), and development of collector-distributor roads. A collector-distributor (CD) road is a roadway that "collects" traffic from the exit ramp and "distributes" it to local roadways. It parallels the freeway mainline and is used in dense urban environments where traffic weaving is a concern. Table ES-1 presents a summary of these concepts and denotes the geographic segment in which they are located.

Table ES-1
Summary of PEL Concepts

Concept Number	Concept Name	Segment
C1	Lane Continuity	Mainline
C2	Collector Distributor Road	Center
C3	Hospital Access – Tamarack Avenue	Center
C4	Transit Option	Mainline
C5	Left to Right Hand Ramps	Mainline
C6	Interchanges 3 and 4 – Segar Street Eastbound	West
C7	Tunnel	West
C8	I-84 under Collector Distributor Road	Mainline
C9	US-7 Median	Mainline
C10	US-7 Ramp – Westbound	East
C11	CD Road Grade Separated	Center
C12	Interchanges 3 and 4 Collector Distributor Road	West
C13	Great Plain Road	Center
C14	Collector Distributor Road Eastbound	East
C15	Collector Distributor Road	East
C16	Interchange 6 – Collector Distributor Road	Center
C17	I-84 Realigned with Collector Distributor Road	Center
C18	I-84 Realigned with Collector Distributor Road Eastbound	East
C19	I-84 Realigned with Collector Distributor Road	East
C20	Interchange 8 with White Turkey Road Connection	East
C21	I-84 with Collector Distributor Road to Great Plain Road	East
C22	I-84 Expressway	Mainline
C23	Transportation Systems Management and Operations (TSMO)	Mainline
C24	Starr Avenue – Interchange 5	Center
C25	Three Lane Collector Distributor Road	Center
C26	North Street On-Ramp Interchange 6	Center

Concept Screening Process

Each concept was screened in a three-tier process as follows:

- Tier 1 was a fatal flaw analysis to determine if the concept was consistent with the purpose of reducing congestion and improving mobility; if it was feasible from a construction and/or cost perspective; and if it had the potential for excessive or disproportional environmental or community impact.
- Tier 2 was a redundancy analysis to determine if the concept achieved a similar function as another concept, but without a clear advantage and/or with greater construction, operational, or environmental disadvantages.
- Tier 3 consisted of a screening matrix that evaluated engineering and environmental aspects of each concept to evaluate performance and potential impact.

Following the initial screening process, 8 of the 26 originally proposed concepts moved forward and were combined for further analysis. The advancing concepts are described in Table ES-2 below.

Table ES-2
Advancing Concepts Summary

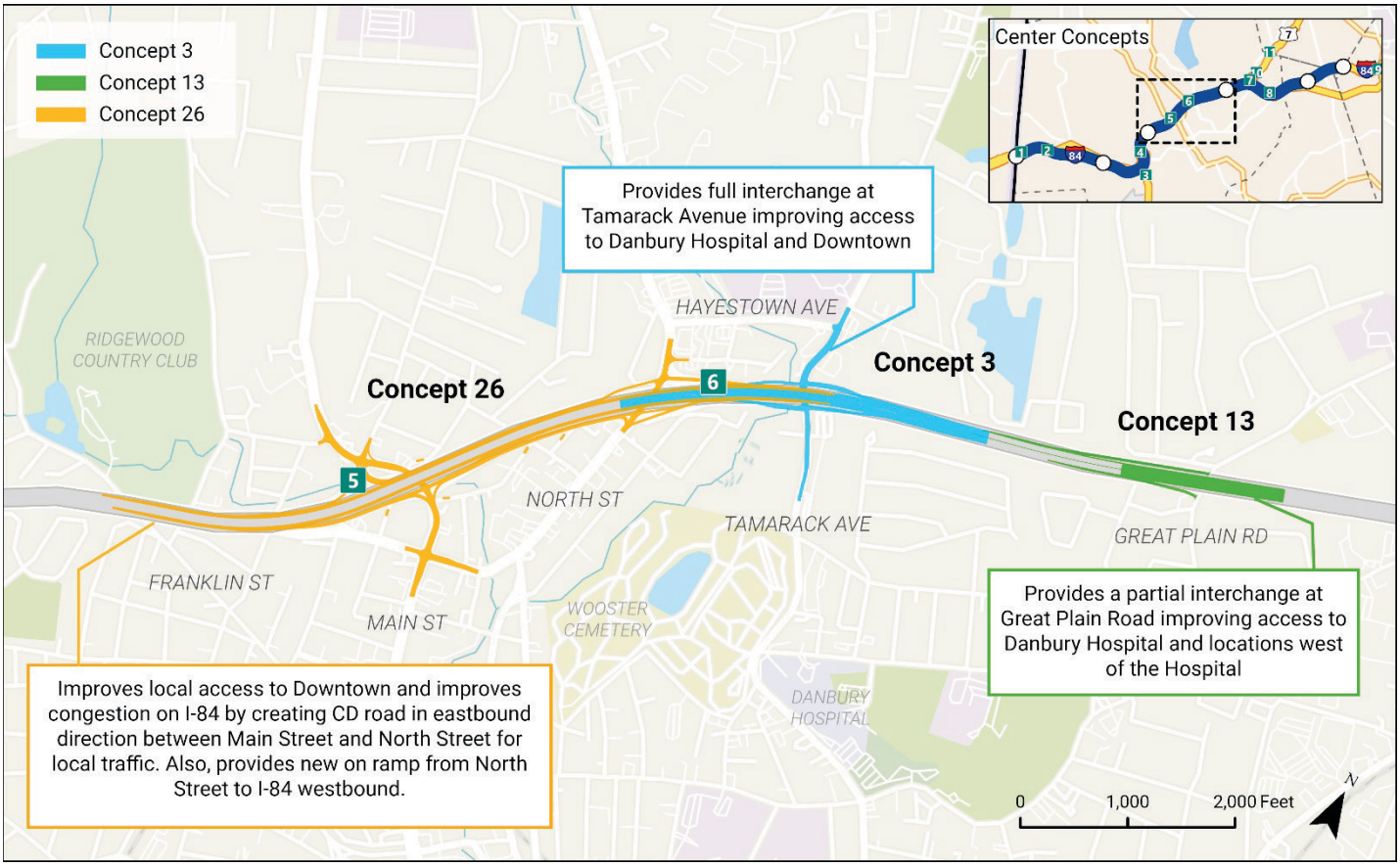
<table>
<tr><th>Mainline Concept</th><th>West Concepts</th><th>Center Concepts</th><th>East Concepts</th></tr>
<tr><td rowspan="3">C1 – I-84 lane continuity in both the EB and WB directions of the Mainline</td><td>C6 – Interchanges 3 and 4: off-ramp from EB I-84 to Segar Street</td><td>C3 –Full interchange at Tamarack Avenue</td><td>C14 –EB only CD road between Interchanges 7 & 8</td></tr>
<tr><td rowspan="2">C12 – Interchanges 3 and 4: Collector distributor road along EB I-84 between Lake Avenue and US-7</td><td>C13 –Partial interchange at Great Plain Road</td><td rowspan="2">C15 –EB and WB CD roads between Interchanges 7 & 8</td></tr>
<tr><td>C26 – EB collector distributor road between Main Street (Int 5) and North Street (Int 6)</td></tr>
</table>

The above eight segment-specific concepts were joined into 12 concept combinations that present as complete concepts and serve as solutions spanning all four segments.

Concept Combinations

Each of the 12 Concept Combinations were subject to the same screening process that was used for the 26 individual concepts (i.e., fatal flaw, redundancy, and screening matrix analyses). In the west, the screening advanced only those combinations containing Concept 6, as it removes a weave that is retained in Concept 12. Similarly in the east, the screening advanced only those combinations with Concept 15, as it removes a weave that is retained by Concept 14. The center concepts each have a unique way to better connect I-84 with downtown Danbury and the hospital area, as shown in Figure ES-5.

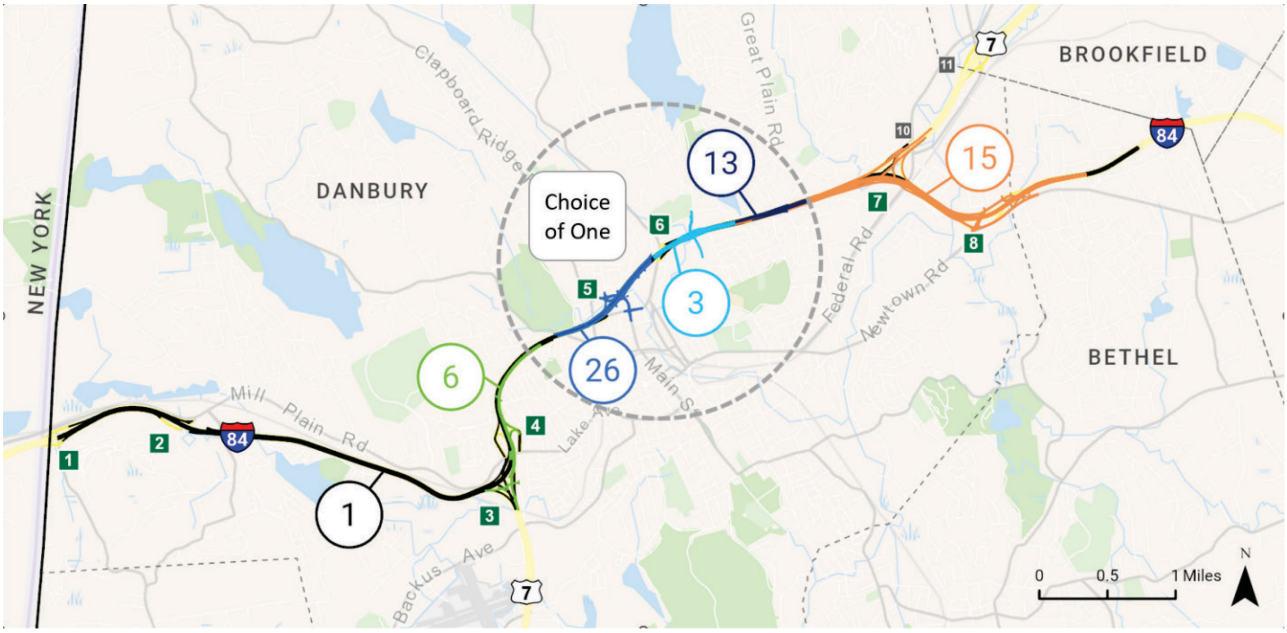
Figure ES-5
Center Segment Improvements



Screening Results and Recommendations

The three resulting combinations from the screening are recommended to be carried forward from the PEL Study as alternatives as part of the "Reasonable Range of Alternatives" for further consideration. Each alternative would provide lane continuity on I-84 (**Concept 1**), eliminate weaving at the Lake Avenue exit by providing a new exit at Segar Street (**Concept 6**), provide CD roads in both directions between Interchanges 7 and 8 (**Concept 15**), and bring a choice of three concepts in the Center Segment, each having a unique way to better connect I-84 with downtown Danbury and the hospital area (**Concepts 3, 13, and 26**). These are presented in Figure ES-6.

Figure ES-6
Recommended Concept Combinations



Potential Breakout Projects

Breakout projects were identified that could be completed independently and would complement the PEL Study purpose of reducing congestion and improving mobility without precluding other solutions. Breakout projects have the following characteristics:

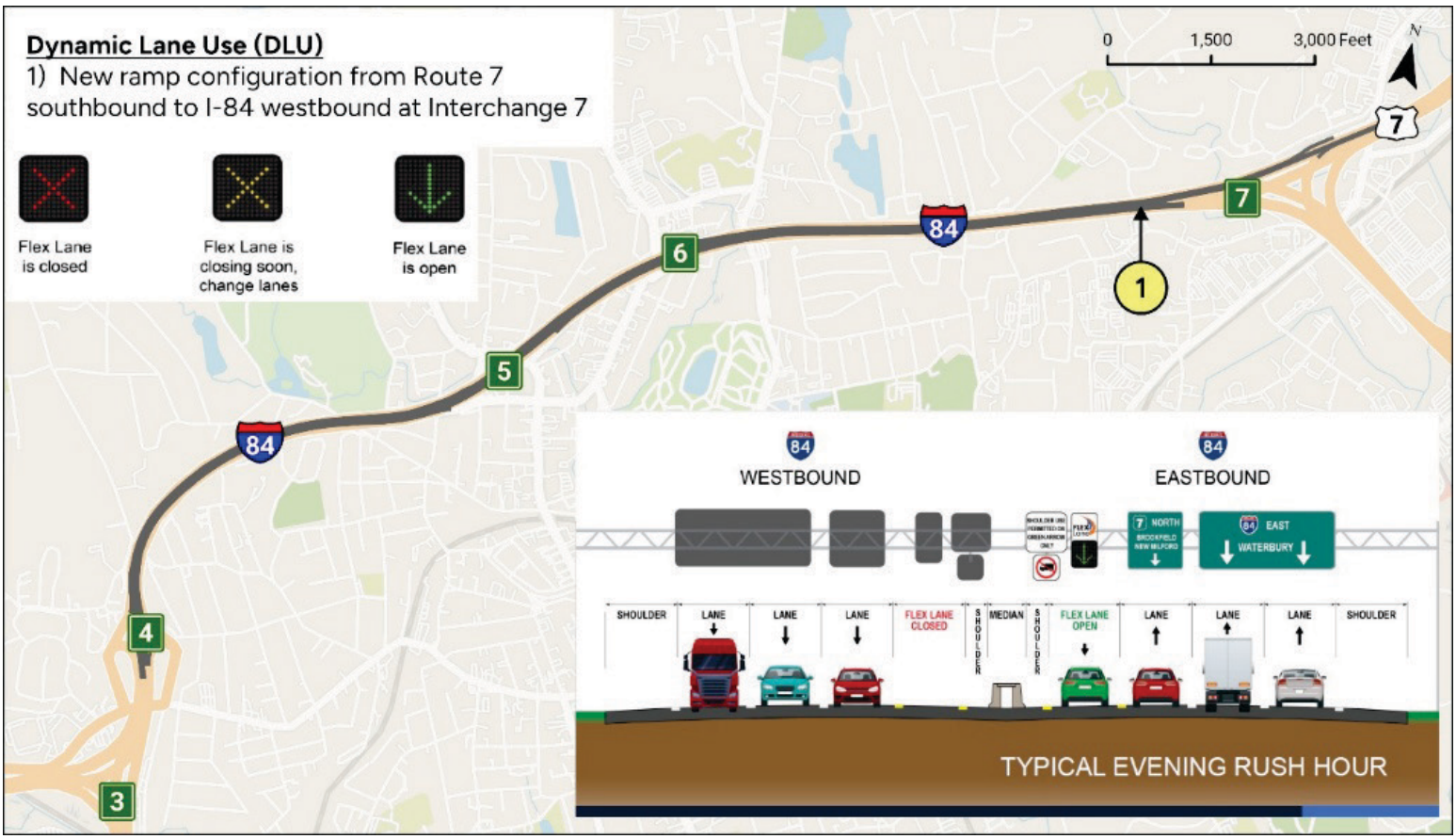
- Independent Utility (*i.e., do not rely on the completion of future projects*)
- Logical Termini (*i.e., functionality within established limits*)
- No Connected Actions (*i.e., would not restrict or influence other reasonably foreseeable transportation improvements*)

Breakout projects identified during the PEL Study are summarized below.

Dynamic Lane Use (DLU)

DLU (Figure ES-7) uses the median shoulder of I-84 as a temporary travel lane only during high-congestion periods between Interchange 4 and Interchange 7. DLU can reduce congestion and improve mobility on the highway. Such a strategy could also reduce the diversion of highway traffic to the local road network, thereby reducing congestion and improving mobility on those local roads, benefiting other modes of travel adjacent to the highway, such as pedestrian, bicycle, or public transit travel modes. Although being considered as a breakout project, DLU could also be combined with the west, center, and east concepts in future projects and be part of an expanded reasonable range of alternatives.

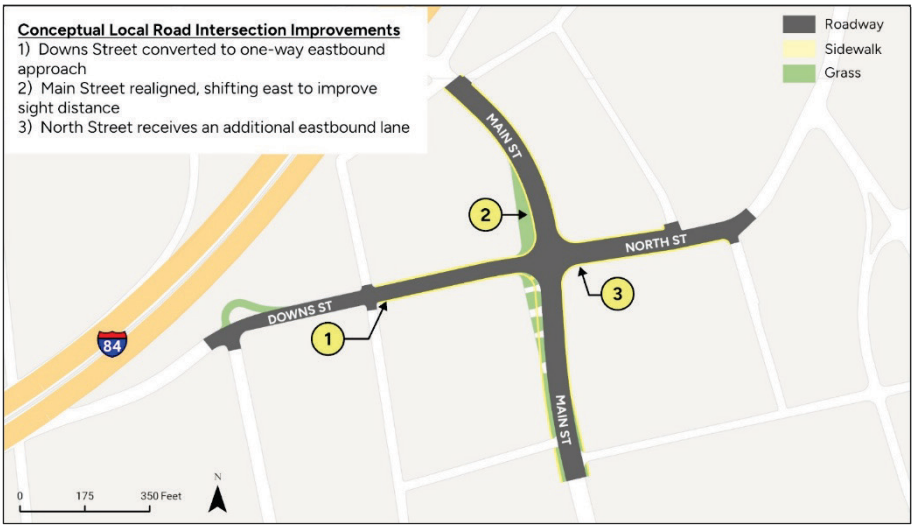
Figure ES-7
DLU Conceptual Arrangement



Intersection Improvement at Main Street and Downs Street

This improvement (Figure ES-8) potentially realigns the intersection at Main and Downs to increase operational efficiency. This breakout project would provide transportation benefits for local travel in Danbury, without the need for implementation of any other project. Specifically, the project would improve mobility and congestion on the local road network. The terminus for this project would be the intersection of Main Street with North Street (going west) and Downs Street (going east).

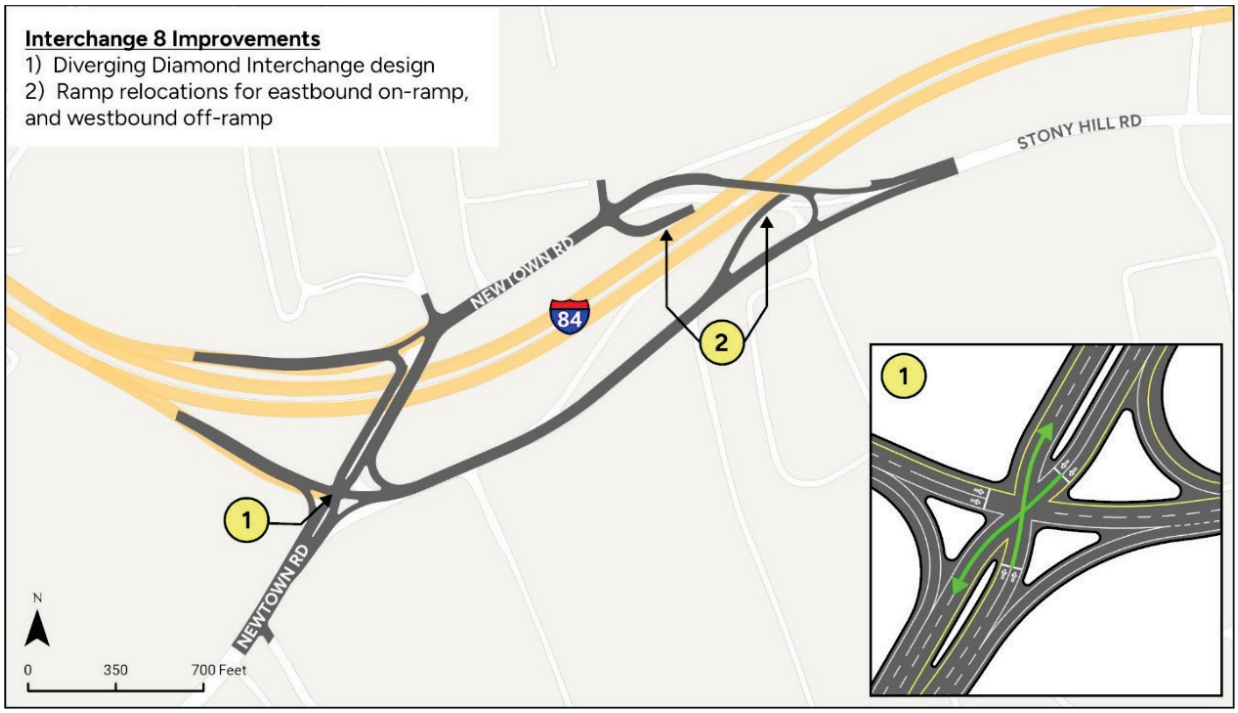
Figure ES-8
Main Street – Downs Street Conceptual Arrangement



Interchange 8 Improvements – US Route 6/Newtown Road

This improvement (Figure ES-9) reconfigures the US-6/Newtown Road interchange and relocates ramps to increase mobility through this area and reduce congestion.

Figure ES-9
Interchange 8 Conceptual Arrangement



Regional/Local Transit Improvements

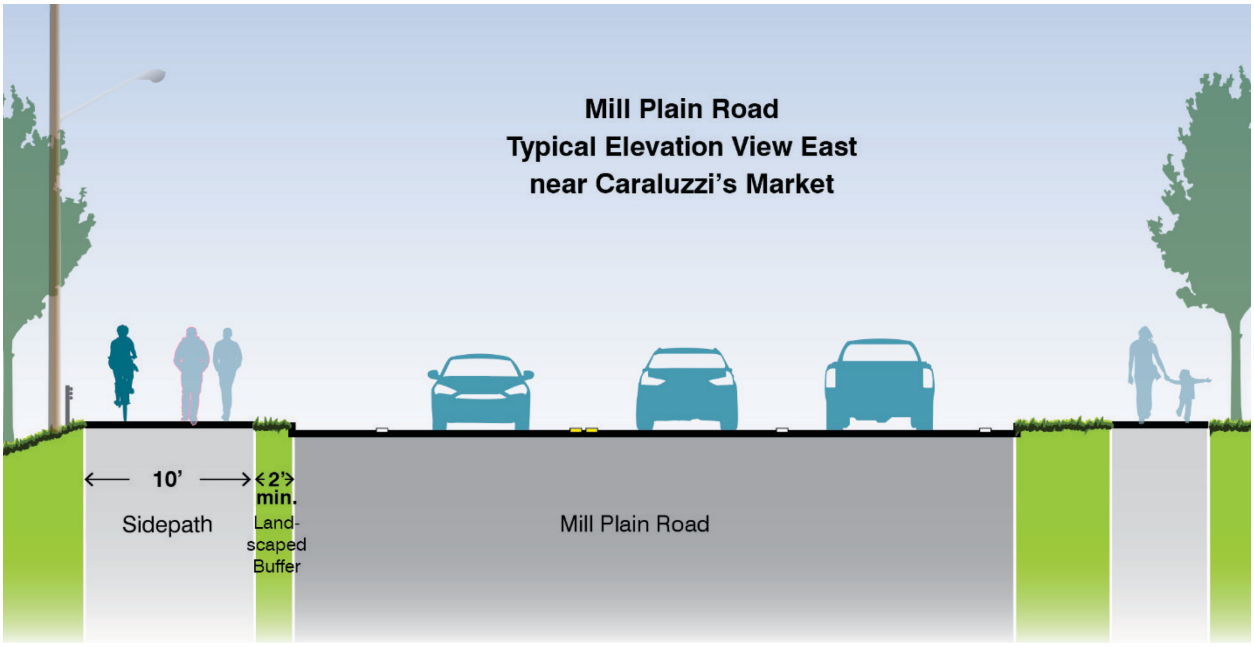
Transit improvements can potentially increase regional and local mobility in the I-84/US-7 corridor, particularly for the residents of Danbury. These include adding express bus routes surrounding communities and a local circulator route. A comprehensive bus transit analysis is recommended to further evaluate potential breakout transit projects that could improve congestion and mobility in the I-84 corridor. The analysis should consider the following to help inform potential transit improvements that could be moved forward as independent projects:

1. Review of proposed bus transit routes identified earlier to determine how they are complementary to and can be incorporated with the existing HARTransit routes
2. Service frequency and stops as part of the service planning
3. Ridership estimates for the new routes
4. Analysis of fleet needs including impacts of electrification of bus fleet

Bicycle Plan Improvements

A bicycle gap analysis identified a lack of east-west connectivity for bicycle travel, especially for short-distance trips. Potential improvements could include on-street bicycle lanes and side paths on state roads and city streets. An example of a conceptual bicycle lane featuring a side path to improve mobility is depicted in Figure ES-10.

Figure ES-10
Conceptual Cross-Section



Bicycle plan improvements, as a potential breakout project, would require further detailed study by CTDOT and coordination/discussion with the City. The study would need to consider what types of bicycle lanes/paths were viable as on-street and off-street solutions along with physical constraints, such as bus routes and street parking, which could impede development along state routes and city streets.

Pedestrian Facility Improvements

A sidewalk gap analysis conducted on state-owned roadways within the study limits identified missing sidewalk connections and specific areas. Improvements would enhance mobility around the City and could be implemented using typical construction methods. This potential breakout project would require further coordination and discussion with the City. A more detailed engineering and feasibility analysis has been conducted on Mill Plain Road to explore opportunities such as potentially combining bicycle and pedestrian accommodations via the use of shared use paths due to right-of-way and utility constraints.

Next Steps

Environmental Review

Every project initiated by CTDOT must comply with state and federal statutes and regulations, including the Connecticut Environmental Policy Act (CEPA); the National Environmental Policy Act (NEPA), if there is a federal 'nexus' (federal funding, federal properties, or issuance of a federal permit required); and regulatory permitting. Environmental reviews typically occur early in the design process once project footprints are identified, and potential impacts can be evaluated.

Schedule and Implementation

I-84 Improvement Alternatives: The PEL screening process identified three alternatives to be carried forward into the environmental review phase. The typical schedule for an environmental review for a large and complex corridor project such as this is generally a function of the project's scope and magnitude. It is anticipated that an expanded range of alternatives could be included depending on the development of breakout projects such as DLU. Given the length of the planned corridor improvements, it is likely that an extensive environmental review phase would be required. The environmental review process would be followed by design, permitting, right of way acquisition and construction.

Breakout Projects:

The goal of the breakout projects is to provide congestion relief and mobility improvements at specific locations within the study area in a shorter time frame. Some of the breakout projects (DLU, Main and Downs Streets) have begun preliminary design and conceptual layouts along with stakeholder and public outreach. Other breakout projects (Interchange 8, Transit, Bicycle, Pedestrian improvements) will require further feasibility analysis and coordination efforts (HARTransit, City) to determine the viability of specific improvements. It is anticipated that breakout projects will complete environmental review, design, permitting and rights of way acquisitions within 3 to 5 years and have the potential to complete construction by early 2030's

1.0 Introduction and PEL Study Background

1.1 Introduction

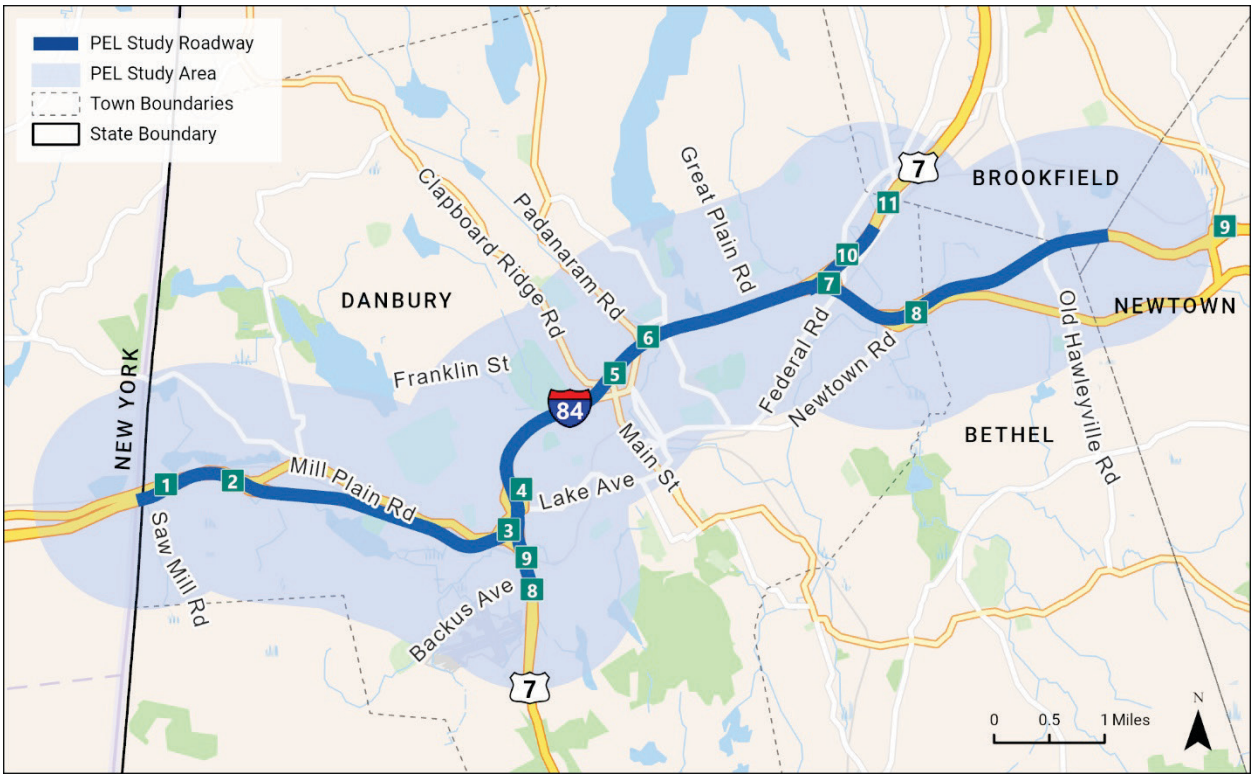
Interstate 84 (I-84) is a highway in the northeastern United States that extends from I-81 in Dunmore, Pennsylvania, to I-90 in Sturbridge, Massachusetts, crossing through the states of Pennsylvania, New York, Connecticut, and Massachusetts. Figure 1-1 (Regional Extent of I-84 Corridor) depicts the extent of I-84 from Dunmore to Sturbridge. The Connecticut portion of I-84 serves as one of the principal east-west routes in the state. It plays an important economic role in connecting the cities of Danbury, Waterbury, and Hartford to the New York and Boston metropolitan areas. The highway also provides local access to key destinations in greater Danbury, including Danbury Hospital, downtown Danbury, and numerous retail districts.

Figure 1-1
Regional Extent of I-84 Corridor

In 2015, the Federal Highway Administration (FHWA) determined that improvements along I-84 through Danbury have merit and could be pursued independently of other sections in the I-84 corridor. In the same year, Connecticut initiated the "Let's GO CT Plan" (CTDOT, 2015), which also identified the portion of I-84 through Danbury as a high priority for improvement.

In 2016, the Connecticut Department of Transportation (CTDOT) initiated a study to evaluate transportation issues along I-84 through the greater Danbury area, primarily focused on the City of Danbury (the City) in Fairfield County, Connecticut. Following initial baseline data collection and a needs and deficiencies assessment completed early in 2019, CTDOT initiated FHWA's Planning and Environment Linkages (PEL) approach to address needs and deficiencies in the I-84 corridor through greater Danbury. Figure 1-2 depicts the PEL Study Area.

Figure 1-2
I-84 PEL Study Area



Initially, the study area extended from Interchanges 3 to 8 along I-84. However, as the New York State Department of Transportation (NYSDOT) began to consider changes to I-84 in eastern New York close to the Connecticut border, the I-84 PEL Study Area was expanded slightly beyond the New York State border on the west to understand the traffic conditions contributing to the issues along I-84 through the Danbury area. The PEL Study Area was also extended to just beyond Interchange 8 to the east and includes portions of U.S. Route 7 (US-7) at Interchange 3 and Interchange 7, as shown in Figure 1-2.

CTDOT and their consultant team have developed the following specific objectives for this PEL Study:

1. Develop the PEL Study purpose.
2. Validate the physical limits of the PEL Study Area.
3. Engage planning organizations, resource and regulatory agencies, and the public (facility users, residents, and interested parties).

4. Provide a 'roadmap' that links local, state, and regional planning efforts to the project-level National Environmental Policy Act (NEPA) and Connecticut Environmental Policy Act (CEPA) processes.
5. Identify solutions (concepts) that can potentially address transportation issues and are aligned with the purpose of the PEL Study.
6. Identify environmental resources (built and natural) and the potential for impact on these resources by various concepts.
7. Document and dismiss unreasonable concepts from further consideration. (Unreasonable concepts are those that are not aligned with the intended PEL Study purpose, would cause significant or irreparable harm to the natural or human environment, or are technically infeasible or cost-prohibitive to construct.)
8. Recommend a reasonable number of concepts (i.e., the reasonable range of alternatives) for further study under NEPA and CEPA.
9. Identify potential "breakout projects" that may proceed independently.
10. Identify the required environmental analysis for any recommended projects.
11. Identify potential funding sources for any recommended projects.

Appendix A provides a completed FHWA PEL Questionnaire. The questionnaire contains information that will inform any future projects reviewed under NEPA and CEPA. It summarizes the study background, methodologies, agency and public coordination, resources reviewed, identified projects, and funding sources.

1.2 Overview

I-84 is a vital transportation corridor that is a main route for people, goods, and services to travel between the greater New York and Boston metropolitan areas through Connecticut. Regional and state-wide studies have identified numerous congestion points along I-84. Specifically, I-84 through greater Danbury experiences frequent congestion, especially during morning and afternoon peak travel periods. Congestion is characterized by lower speeds, longer delays, and queuing. Causes of congestion in the corridor include heavy traffic volumes (including those generated by local trips), highway geometric deficiencies, weaving movements caused by left-hand entrances and exits, and frequent crashes.

The I-84 corridor also suffers from poor mobility. Mobility is the ability of a transportation system to move people and goods efficiently. A primary cause of poor mobility is the lack of roads in the local network capable of efficiently moving traffic in the east/west directions. As such, many residents use I-84 for local trips exclusively within Danbury.

This PEL Study has allowed CTDOT to analyze the I-84 corridor holistically, garner input from the traveling and local public, and engage regulatory and resource agencies while studying different segments of I-84 within the PEL Study Area to understand how potential solutions (concepts) address issues unique to each segment of the interstate within the PEL Study Area. A key outcome of this process is formulating project recommendations for further potential study and future implementation.

As an essential component of the PEL process, a Public Involvement Plan (PIP, 2021) was developed and implemented to guide the public involvement process, create meaningful

engagement between stakeholders and CTDOT, and gain input on the components and entirety of this PEL Study. Stakeholders included members of the public (including users of the highway; area businesses, residents, and adjacent landowners, as well as interested individuals, municipalities, and organizations), regulatory and resource agencies with regulatory authority, and local, state, and regional planning entities.

The public involvement process has allowed the public and agencies to participate throughout the PEL Study, beginning in the early stages. A thorough public involvement process is paramount to thoughtful and inclusive planning. This process has thus afforded timely information exchange with those interested in or affected by the current and future conditions in the PEL Study Area by providing sufficient notice and time for review and comment at key study milestones.

2.0 PEL Study Purpose

2.1 Background

This PEL Study examines specific needs and deficiencies through the Danbury portion of the I-84 corridor to develop concepts that may be considered in a reasonable range of alternatives in future planning decisions. The information in the PEL Study can inform future analyses for those projects that move forward for further consideration.

The existing conditions in the PEL Study Area were analyzed to better understand the needs and deficiencies at a regional and local level and to set the stage for consideration of transportation improvements through the PEL Study Area.

The current highway design of I-84 through the PEL Study Area has inherent issues resulting from the growth of Danbury around this transportation corridor as it historically developed from a local route into its current role as part of the interstate system. As detailed in subsequent sections of this chapter, highway and interchange geometric deficiencies contribute to decreased mobility, increased congestion, and increased risk of crashes.

While the current highway design contributes significantly to many of the issues experienced on I-84, the steady increase in traffic volumes over the years resulting from the rapidly expanding population along the corridor also contributes to congestion and delays, a trend projected to continue in the coming decades. Two distinct population groups have contributed to this increase in traffic volume. The first group is the increased local population using the highway for local trips. The second group consists of commuters traveling to and from the Danbury area and those throughout the Massachusetts-Connecticut-New York region utilizing this portion of the corridor for work-related and personal trips.

Given the complex issues of geometric deficiencies, increasing congestion, and inhibited mobility, coupled with population growth on both a regional and local scale, CTDOT chose to initiate this corridor-based PEL Study to develop and advance concepts for consideration. A detailed PEL Study allows sufficient time to identify and develop concepts, seek stakeholder input, and make recommendations for a path forward in the planning process. The study also facilitates CTDOT's consideration of future projects for implementation.

2.2 Needs and Deficiencies

CTDOT initiated a comprehensive needs and deficiencies analysis in 2017. The analysis identified numerous deficiencies in the PEL Study Area, particularly those related to congestion and poor mobility. These deficiencies are discussed more fully in the documents entitled "*I-84 Danbury Project Needs and Deficiencies Report, Technical Memorandum No. 1*" and "*I-84 Danbury Project Supplemental Needs and Deficiencies Study, Technical Memorandum No. 2*" (see Appendix B) and are summarized in the subsections below.

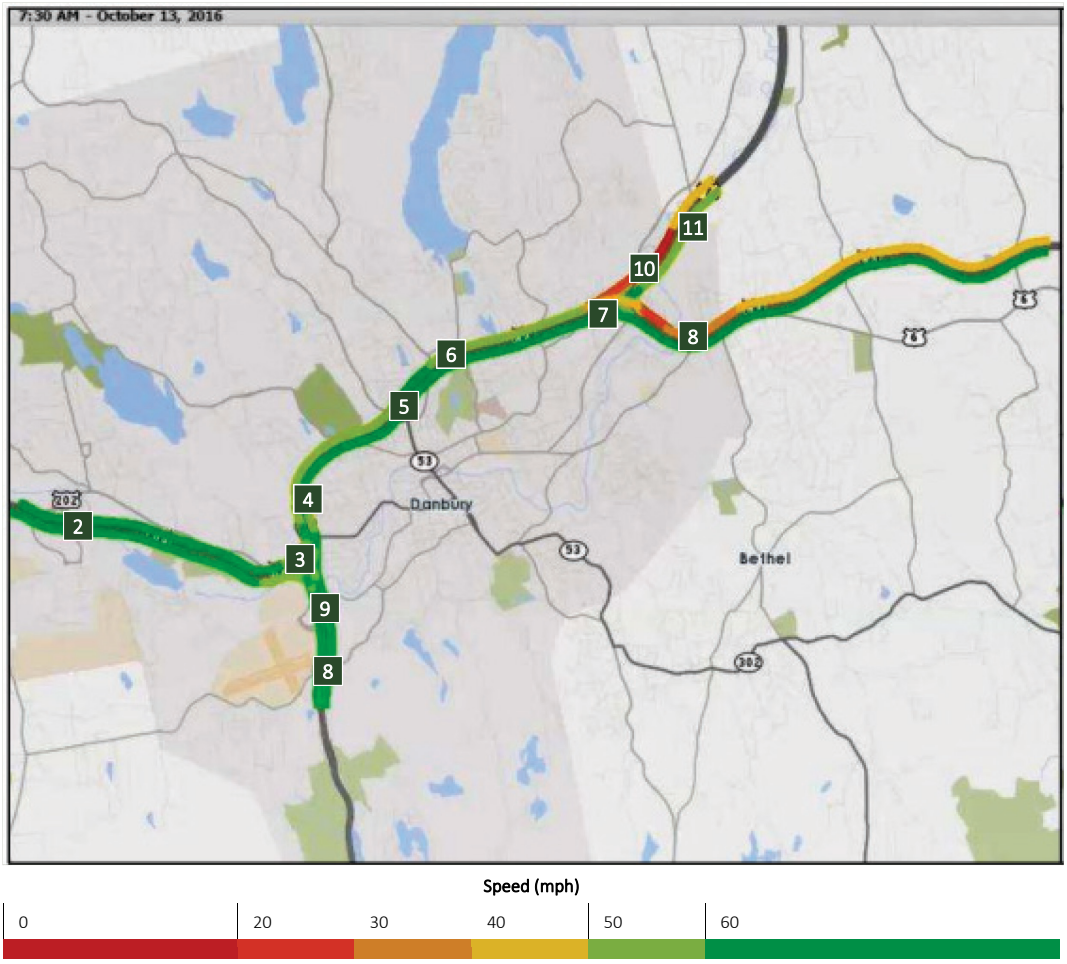
2.2.1 Traffic Volumes

Before initiating the PEL Study, CTDOT commissioned an assessment of traffic patterns in the I-84 corridor. The analysis showed that heavy traffic volumes, particularly during the morning and afternoon peak periods, contribute to congestion in the PEL Study Area. As of 2016, I-84 between Interchanges 3 and 7, where I-84 and US-7 are co-located, had an average annual

daily traffic (AADT) volume of 110,000 vehicles per day. Volumes decreased to 80,000 vehicles per day west of Interchange 3 and 85,000 vehicles per day east of Interchange 7. US-7 traffic volumes ranged from 60,000 to 65,000 vehicles per day. Updated traffic volumes, based on CTDOT 2021 count data, indicate that traffic between Interchanges 3 and 7 is about 110,000 to 120,000 vehicles per day; traffic volume west of Interchange 3 is about 72,000 to 82,000 vehicles per day, and east of Interchange 7 is 79,000 vehicles per day. This updated data along with additional traffic counts from 2024 is slightly higher but consistent with the prior analysis.

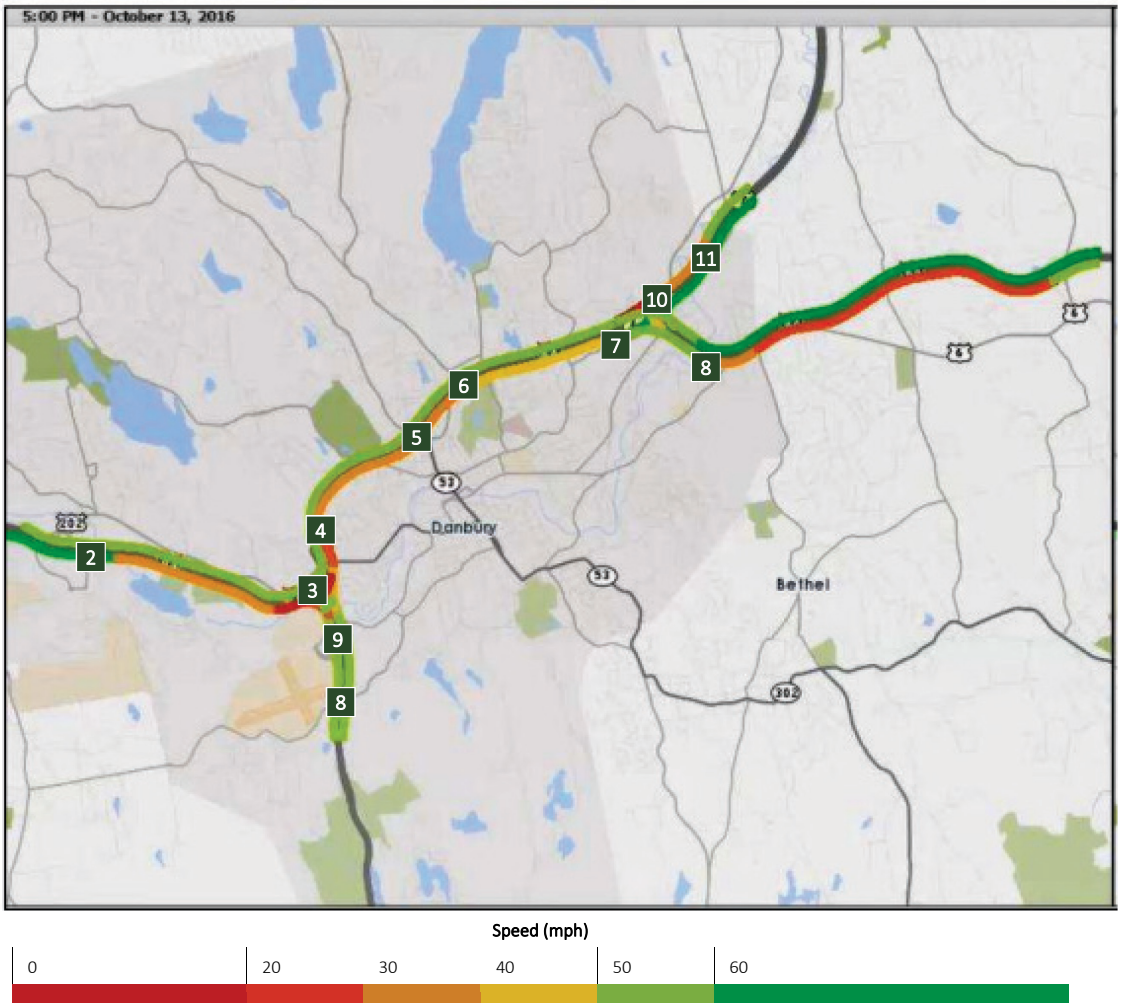
During the morning peak hours, congestion occurs primarily in the westbound direction, heading towards New York State. The segments with the heaviest congestion during the morning peak hours occur on I-84 westbound, between Interchanges 7 through 9, and US-7 southbound between Interchanges 10 and 11. This is illustrated in Figure 2-1, where speed data was captured on a typical morning (7:30 a.m. on October 13, 2016) and color coded into bands. This clearly shows the speed reduction due to congestion well under the posted speed limits of 50 mph on US-7 and 55 mph on I-84 as traffic approaches their merge from both legs.

Figure 2-1
I-84 A.M. Congestion Map



During the afternoon peak hours, congestion occurs primarily in the eastbound direction, coming from New York State. The segments with the heaviest congestion during the afternoon peak hours are I-84 eastbound between the New York State line and Interchange 7, particularly in the vicinity of interchange 3 where I-84 merges with US-7 at a tight curve, and east of Interchange 8, where the highway narrows from three lanes to two. This is illustrated in Figure 2-2, where speed data was captured on a typical afternoon (5:00 p.m. on October 13, 2016) and color coded into bands. This clearly shows the speed reduction due to congestion well under the posted speed limit of 55 mph in these segments.

Figure 2-2
I-84 P.M. Congestion Map



2.2.2 Physical Conditions

Highway geometric deficiencies can contribute to congestion and higher-than-expected crash rates. CTDOT identified the following deficiencies on certain highway segments within the PEL Study Area:

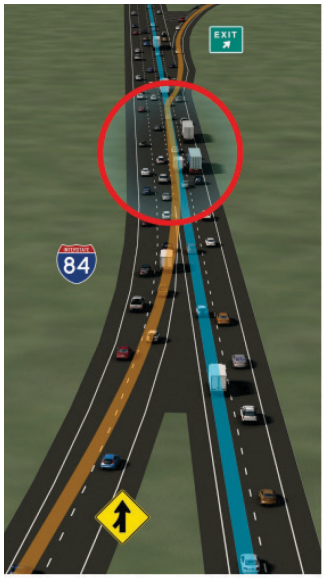
1. **Short deceleration and acceleration lane lengths (Interchanges 4 and 8).** An acceleration lane is a highway section that allows vehicles to increase their speed before merging with through traffic. A deceleration lane is a section of a highway that provides space for vehicles to decrease speed to a rate at which they can safely leave the main traffic flow and slow down before exiting. Shorter acceleration lengths at interchanges 4 and 8 make it more difficult to merge into interstate traffic and a short deceleration length makes it more difficult to safely exit the interstate.
2. **Sharp curves and hills, resulting in substandard stopping sight distances.** Stopping sight distance is the required distance for a driver to recognize, react, and safely stop their vehicle. Curves and hills restrict visibility when too sharp. Crashes are more likely to occur when there is insufficient sight distance and drivers have less time to react resulting in a rear-end or sideswipe type crash. Insufficient stopping sight distance was noted between Interchanges 3 and 4 and Interchanges 7 and 8 where sharp curves exist.
3. **Shoulders on either the left or right side of the highway that do not meet current highway design standards.** Insufficient shoulder widths provide less room for vehicles to react during an unforeseen condition such as a crash on the highway. This results in a lack of recovery area for vehicles to remain on the highway without potentially going off the road under certain circumstances. Other shoulder functions include providing space for disabled vehicles, enforcement and maintenance activities, maneuvering, and temporary storage of stormwater.
4. **Incomplete interchanges (Interchange 6).** An incomplete interchange is where at least one connection is missing between highways (e.g., where there is not an on- and off-ramp in both directions or there is either an on- or off-ramp in a single direction). An incomplete highway interchange can lead to congestion and inefficient traffic flow, as vehicles may have to navigate through at-grade intersections instead of using grade-separated routes, resulting in delays and frustration for drivers.
5. **Left-hand interchanges (Interchanges 3 and 7).** Interchanges that exit to the left (Figure 2-3) do not meet driver expectations and can confuse drivers attempting to exit the highway. Some research indicates a higher likelihood of crashes with left hand ramps than other ramps. Often, drivers tend to weave over to the left side of the highway within a short distance of the ramp, not recognizing that the exit is on the left. This creates a safety concern with moving traffic on the highway.
6. **Short weaving distances.** When on-ramps and off-ramps are closely spaced, entering traffic crosses paths with exiting traffic within a very short distance, and weaving in this short distance is undesirable and results in a potential safety concern.

Figure 2-3
Left-hand Interchanges

Ramps on the left mean traffic must cross lanes to exit

7. **Close interchange spacing (I-84 Interchanges 3 to 4; Interchanges 5 to 6; Interchanges 7 to 8; US-7 Interchanges 8 to 9; and US-7 Interchange 9 to I-84 Interchange 4).** Like short weaving distances, close interchange spacing (Figure 2-4) is often a root cause of speed change and weaving issues, which results in a potential safety concern.
8. **Lack of lane continuity.** Freeways work best with continuous through lanes throughout long stretches. A lack of lane continuity can induce lane changes compounded by the presence of interchange entrance and exit ramps.

Figure 2-4
Close Interchange Spacing



Closely spaced ramps create weaving movements

2.2.3 Weaving Movements

Weaving movements occur when one motorist must cross the path of another motorist in the same lane such as when traffic is entering and exiting the highway at closely spaced ramps.

I-84 and US-7 are co-located on the same alignment for approximately 3.5 miles between Interchange 3 and Interchange 7. In this corridor, left-hand entrances and exits, close interchange spacing, short deceleration/acceleration lane lengths, and a lack of lane continuity cause significant weaving activity and contribute to congestion and crashes.

In the eastbound direction, US-7 enters I-84 on the right-hand side at Interchange 3 and exits on the left-hand side at Interchange 7. In the westbound direction, US-7 enters I-84 on the right-hand side at Interchange 7 and exits on the left-hand side at Interchange 3. This configuration causes significant weaving movements. In addition, I-84 traffic must merge right to exit the highway between Interchanges 4 and 6.

2.2.4 Crash Data

The most recent crash data available when the needs and deficiencies analysis was performed was from 2014 to 2016. This data indicated that I-84 between Interchanges 3 and 8 experienced 1,299 crashes, which is an average of approximately one crash per day. Based on the most recent crash data (2021-2023) for I-84 between Interchanges 3 and 8, there were a total of 1,176 crashes, which is a reduction of 123 crashes, or 9 percent, from the previous three-year period; however, still averaging approximately one crash per day. This reduction correlates well with AADT volumes reported for 2016 (109,000 vehicles) and 2021 (99,000 vehicles), which also shows a 9% reduction.

The segments of I-84 between Interchanges 3 and 6 in the eastbound direction and between Interchanges 3 and 4 in the westbound direction had higher than expected crash rates. Some of this is attributable to the weaving action described in Section 2.2.3. The crashes between Interchanges 3 and 6 in the eastbound direction are primarily rear-end crashes attributable to peak-hour congestion. A portion of these crashes, specifically between Interchanges 3 and 4 in the eastbound direction, is associated with the weaving condition similar to that of the westbound travel in this section of the highway, resulting in sideswipe-type crashes. The crashes between Interchanges 3 and 4 in the westbound direction are also typically sideswipe crashes attributable to the roadway geometry (i.e., roadway curve approaching Interchange 3 and the left-hand exit to Route 7). Section 2.6 of the Needs and Deficiencies Report, dated

October 2018, provides a more detailed explanation of the types and concentration of crashes.

US-7 between Interchanges 10 and 11 in the southbound direction and in the vicinity of Interchange 8 in the northbound direction also have higher than expected crash rates. This applies to nine additional entrance or exit ramps within the PEL Study Area. Analysis indicates that most mainline crashes are either rear-end or sideswipe types located within segments that experience congestion or have geometric design deficiencies.

2.2.5 Local Traffic Patterns

I-84 and US-7 move as many as 120,000 vehicles daily through the PEL Study Area. About one-third of these vehicles represent "local" trips that begin and end in the PEL Study Area. Danbury's local street network developed during the 19th and early 20th centuries. While some improvements have been made to increase capacity and improve the efficiency of local street intersections, the overall structure of this network has largely remained unchanged. The inefficient layout of the local street network and lack of capacity on local roads contribute to the frequent use of I-84 and US-7 for local trips. Additionally, motorists may detour onto local streets during peak travel times and detour around highway crashes to avoid congestion. The lack of an alternate local east-west route and inadequate capacity of the existing local street network means that I-84 and US-7 congestion spills over onto city streets when the highway is congested.

The location of interchanges and an inefficient local street network make it difficult to access key destinations from the highway, including downtown Danbury and major employers. Additionally, there is no direct route between Danbury Hospital and the highway, which limits emergency and routine access to the hospital. Interchange 6 is the closest highway access to Danbury Hospital; however, this incomplete interchange only has an off-ramp in the westbound direction and an on-ramp in the eastbound direction. As such, motorists must use Interchange 5 and travel on local streets to access Danbury Hospital, which causes delays for emergency vehicles, particularly those accessing the hospital from the north and west.

2.2.6 Travel Demand

As noted, Greater Danbury is one of the fastest-growing regions in Connecticut, resulting in increased demand for moving goods and people through the I-84 corridor. Between 2010 and 2022, Danbury is estimated to have grown by over 7,000 residents (an increase of approximately 8.9%). Also, among the fastest-growing towns in Connecticut during this period were neighboring Bethel (11.0% increase) and Brookfield (7.7% increase) to the southeast and northeast of Danbury, respectively. Continued population growth in the region will exacerbate congestion and mobility issues. Traffic forecasts for 2040 indicate that peak average daily traffic volumes will increase to 130,000 vehicles per day (approximately 18%) on I-84 between Interchanges 3 and 7. Traffic volumes are also projected to increase on US-7 and local roadways connecting to the highway.

2.2.7 Multi-Modal Mobility and Connectivity

Danbury has lower transit use, bicycling, and walking levels than other Connecticut cities. As a result, Danbury is more reliant on the automobile and the highway network for day-to-day travel. As of 2017, over 90% of Danbury commuters drove to work. Just 4.4% of Danbury commuters utilized transit to commute to work, which is lower than all other major cities in Connecticut and less than the state average of 4.9%. According to 2022 American Community

Survey estimates, 2,444 or 7.7% of occupied housing units in Danbury are zero-car households.

Bus transit in the Danbury area is operated by Housatonic Area Regional Transit (HARTransit). This system provides service on seven routes, some extending into neighboring towns like Bethel, Brookfield, and New Milford. The system also serves major employers, shopping centers, medical centers, schools, the downtown Danbury area, and elderly and low-income housing areas. Most major arterials within the city are well-served by the HARTransit fixed-route system.

The HARTransit system is comprised of seven city bus routes, three shuttles, four loop routes, and one regional bus route. HARTransit also operates shuttles from local park and ride lots within the Danbury, Ridgefield, and New Fairfield areas to the New York Harlem Line Stations in Brewster, Katonah, and Southeast respectively. Rail transit is served by Metro North's Danbury Branch Line and Harlem Line in New York.

There is a lack of bicycling infrastructure in Danbury. This is evident at many underpasses, overpasses, and ramp termini that lack sidewalks and crosswalks. Additionally, many city streets are characterized by narrow, public rights-of-way and steep road gradients, discouraging bicycle and pedestrian travel. Improvements to infrastructure that encourage multimodal use could reduce single-occupant vehicles from traveling within and through the PEL Study Area and thus reduce congestion. Additionally, such improvements provide modal choices that serve the surrounding community, which includes minority and low-income populations. Multi-modal options can alleviate the disparity of transportation choices and improve accessibility to reliable transportation for all populations. The study's multi-modal recommendations are discussed in Chapter 6.

2.3 Purpose of the PEL Study

Recognizing the needs and deficiencies of the I-84 corridor, the purpose of the PEL Study is to identify, develop, and advance concepts aimed at reducing congestion and improving the mobility of people and goods. Chapters 4 and 5 present the concepts that could reduce congestion and/or improve mobility, in alignment of the PEL study purpose. These concepts incorporate a variety of approaches that address the identified needs and deficiencies. These include solutions that, in part,

- Reduce or eliminate problematic weaving and merging.
- Eliminate left-hand exits.
- Improve roadway geometry.
- Improve ramp placement, spacing, configuration, and length.
- Improve connections to alternate modes of transportation.
- Improve mobility.
- Improve connections between highway and local road network.
- Improve access to critical facilities such as Danbury Hospital, major employers, and retail centers.
- Improve alternative non-vehicular transportation options that serve the greater Danbury population.
- Incorporate travel demand management (i.e., strategies to maximize traveler choices, such as ride-sharing).

3.0 Existing Environmental Conditions

This Chapter summarizes the existing environmental conditions throughout the PEL Study Area, including brief discussions of the Physical Environment (e.g., utilities and physical features), Human Environment (e.g., land uses, population, cultural resources and historic architecture), and Natural Environment (e.g., watercourses and waterbodies, wetlands, critical environmental areas, and threatened and endangered species). The Built Environment includes both the Physical Environment and the Human Environment. Understanding existing conditions provides context for the concepts analyzed and presented in Chapters 4 through 6.

CTDOT undertook the following studies to inform the PEL process and subsequent environmental reviews:

1. Inventory and Analysis of the Physical Environment: Utilities (6/01/2019) (included as Appendix C)
2. Inventory and Analysis of the Existing Human Environment (6/18/2019) (included as Appendix D)
3. Inventory and Analysis of Existing Cultural Resources and Section 4(f) Resources (8/13/2019) (included as Appendix E)
4. Inventory and Analysis of the Existing Transportation Environment (08/13/2019) (included as Appendix F)
5. Inventory and Analysis of the Existing Natural Environment (1/17/2020) (included as Appendix G)
6. Supplemental Existing Conditions Analysis (7/21/2022) (included as Appendix H)

These reports serve as the basis for the information presented in this Chapter. Note that these existing condition reports use their report-specific study areas due to the type of data and its available form. For instance, the Human Environment Study Area relied on U.S. government-established census blocks as a data source, which included areas outside the PEL Study Area. That said, the analyses of the existing conditions documented in these reports include and reflect the PEL Study Area.

3.1 Existing Physical Environment: Utilities

I-84 is a limited-access roadway, and utilities typical of urban and suburban settings serve the surrounding area. Utilities in the PEL Study Area include water, sewer, stormwater, electricity, natural gas, and communications. A location map for these utility facilities is presented in Appendix C, Figure 1.

The City of Danbury provides drinking water service through the PEL Study Area through one of its two water treatment plants. The City's wastewater treatment plant is located approximately three quarters of a mile south of exit 8 off I-84. It provides sanitary sewer services near the I-84 Study Area. The City also oversees the operation and maintenance of an extensive sewer system located approximately three-quarters of a mile south of I-84 at Interchange 8.

Electric service near I-84 is provided by Eversource Energy. Eversource's facilities in Danbury include the Plumtree Substation, Brookfield Junction and Stony Hill Substation. The transmission lines that connect the Brookfield Junction and the Plumtree substation cross over I-84 near the westbound exit 8 off-ramp. Eversource also has numerous utility ducts that cross over or under I-84, carried by the bridge superstructure of the crossing street. Underground utility ducts also carry electric service beneath I-84.

Local natural gas service is also provided by Eversource, with numerous utility ducts that cross over and under I-84, either by bridge superstructure or underground. Two natural gas pipelines occur within the right-of-way that runs along the north side of I-84; one crosses I-84 near Interchange 2 to the west, and the other crosses under US-7 just north of the I-84 Interchange 7.

3.2 Existing Human Environment

3.2.1 Existing Land Use and Development Patterns

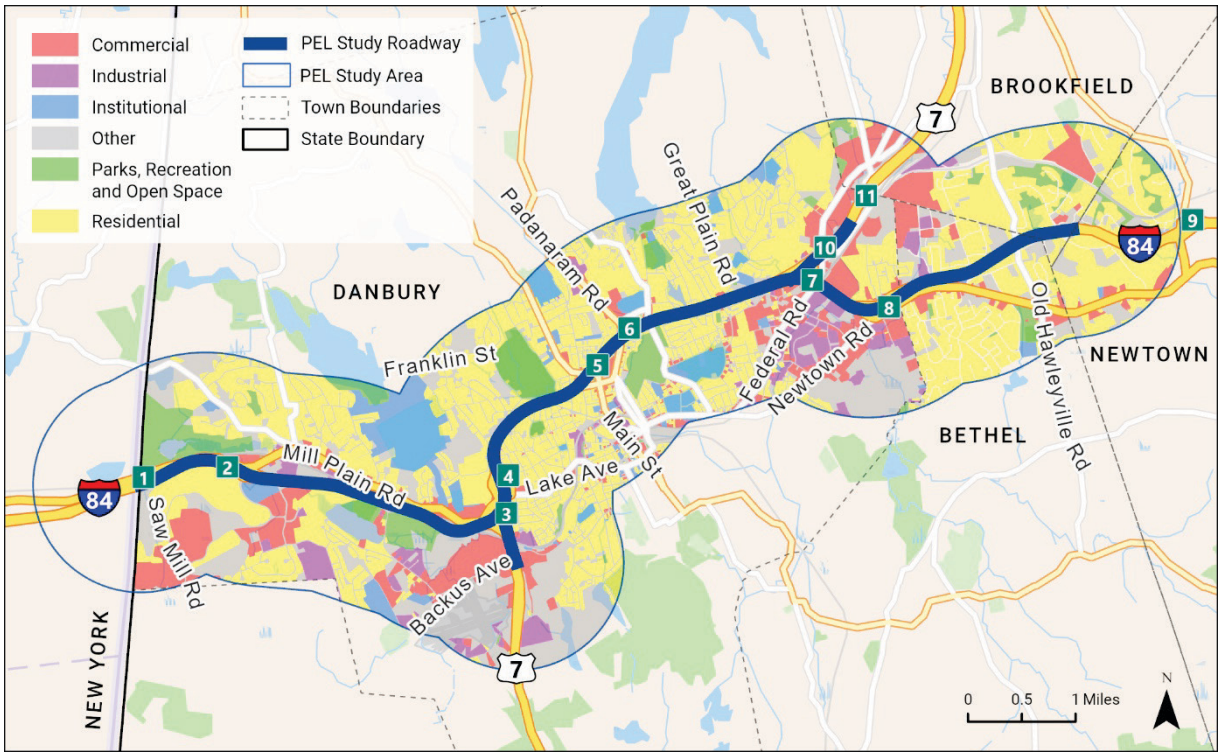
Land use within the PEL Study Area provides context for the concepts analyzed and presented in Chapter 4, particularly with respect to land use constraints, density, and potential impacts on properties.

The PEL Study Area is comprised of approximately 69% residential, 10% commercial or industrial land uses, and 6% occupied by parks, recreational facilities, and open space. Utilities, transportation facilities, rights-of-way, and vacant land occupy the remainder (15%).

Western Danbury, also known as the West Side District, surrounds I-84 between Interchanges 1 and 3. The West Side District is primarily residential, with multifamily residentially zoned land generally to the south of I-84 and single-family-zoned land typically to the north of I-84. The greatest housing and associated population density is located close to the highway. As this district previously had large areas of undeveloped parcels, recent years have seen significant new developments, including sizeable multifamily growth with associated non-residential uses (i.e., parks, commercial uses, etc.). The West Side District is a major retail and employment center, serving much of Greater Danbury. Retail, commercial, and institutional areas include the Danbury Fair Mall, various corporate centers, the Danbury Airport, and the Western Connecticut State University (WCSU) campus.

Central Danbury is the city's most densely developed section, defined as the area surrounding Interchanges 3 and 7 (Figure 3-1). Many neighborhoods, recreation areas, and cemeteries are close to or abut the highway. The downtown area, where various mills and other manufacturing were once located, is now surrounded by dense, older residential neighborhoods. When I-84 was built in the early 1960s, it was routed to the north of downtown, and those neighborhoods to the north of the highway now tend to be newer, more suburban communities. Although the various mills and manufacturing jobs have since disappeared, downtown is still a major employment center, as it contains WCSU, Danbury Hospital, City municipal functions, other institutions, and government employers.

Figure 3-1
Existing Land Use



Eastern Danbury includes the area near Interchanges 7 and 8, where US-7 separates from I-84 and continues north through Brookfield. At this separation point, I-84 continues east into Bethel, Brookfield, and Newtown. The area surrounding Interchanges 7 and 8 supports retail, commercial, and industrial regional employers, with some residential areas north of Interchange 8.

3.2.2 Population

Population trends are briefly discussed to provide context for the local commuting population within the greater Danbury region that could be affected by future activities near and along I-84. Between 2010 and 2022, Danbury's population grew by 8.9%, which was higher than the increase for the greater Danbury region (Danbury's surrounding towns) of 6.7% and the State of Connecticut of 1.8% during the same timeframe.

As the population of the greater Danbury area continues to grow, so do the miles traveled on its highways. Commuting patterns are an important factor when considering highway use and congestion. Approximately 67% of the workforce commutes into, and roughly 60% of residents commute out of the PEL Study Area. Most of these commuters travel by car (90.5%), and over 77% travel alone. The remainder of the commuters are split between public transit, walking, and biking. While public transit ridership in the area is roughly evenly split between bus and rail, the rail use percentage is lower here than in all of Fairfield County.

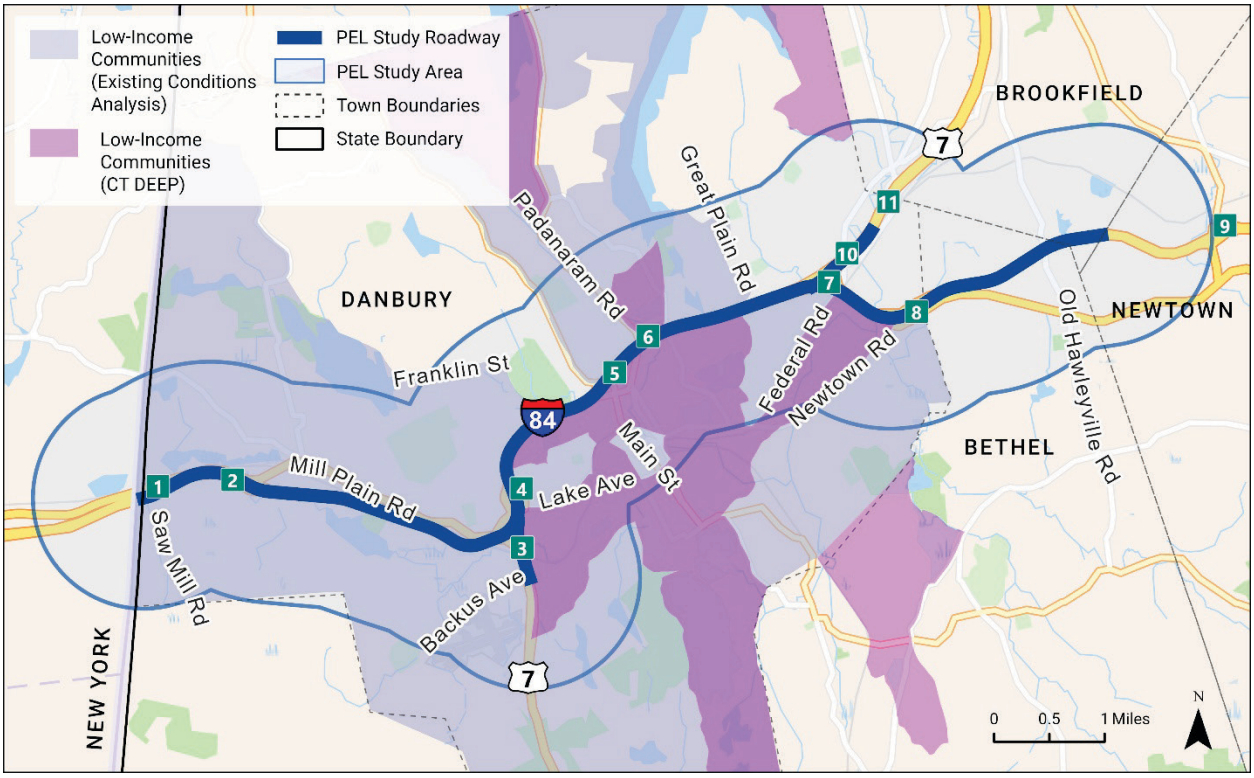
The PEL Study identified and analyzed how proposed transportation improvements might have a disproportionate adverse impact on minority and low-income populations. Minority and low-income populations, termed sensitive populations for the purposes of this study, include Limited English Proficiency (LEP) and low-mobility populations. LEP populations are defined as anyone who is five years old or older who speaks English less than "very well." The U.S. Census Bureau publishes LEP data in 5-year estimates, and the data used in this study was from 2011 to 2015. U.S. Department of Justice (DOJ) "Safe Harbor" provision requires that written translations of vital documents be provided if 5% or more of the total population of persons eligible to be served, or 1,000 individuals, whichever is less, are identified as LEP. Vital documents for the PEL Study were translated into Spanish and Portuguese to accommodate the large LEP population of these language speakers in the PEL Study Area, mainly within the City of Danbury.

Low-mobility populations are defined as those who lack access to a vehicle and must rely on other modes of transportation for their daily travel needs, such as public transit, walking, or biking. Therefore, public events associated with the PEL study were held in areas close to or accessible by public transit connected to low-mobility communities. Out of the 18 census tracts studied, 11 were identified as low mobility (5.2% or more households without access to a vehicle), and most were within the City of Danbury.

For the existing conditions analysis, potentially sensitive populations were identified from census tracts that met the definition of either a minority community or a low-income community.[1] Figure 3-2 presents those census tracts at the time of the analysis intersecting the PEL Study Area. Overlaid on the census tract data are low-income communities designated by the Connecticut Department of Energy & Environmental Protection (CT DEEP). The census tracts in central Danbury, south of I-84 between Interchanges 3 and 8, had the highest concentrations of minority and low-income populations.

[1] See Appendix D for details how populations were identified and analyzed.

Figure 3-2
Sensitive Communities



CT DEEP Income Threshold – A US Census block group, as determined by the most recent US census for which 30% or more of the population consists of low-income persons and have an income below 200% of the federal poverty level, or a distressed municipality.

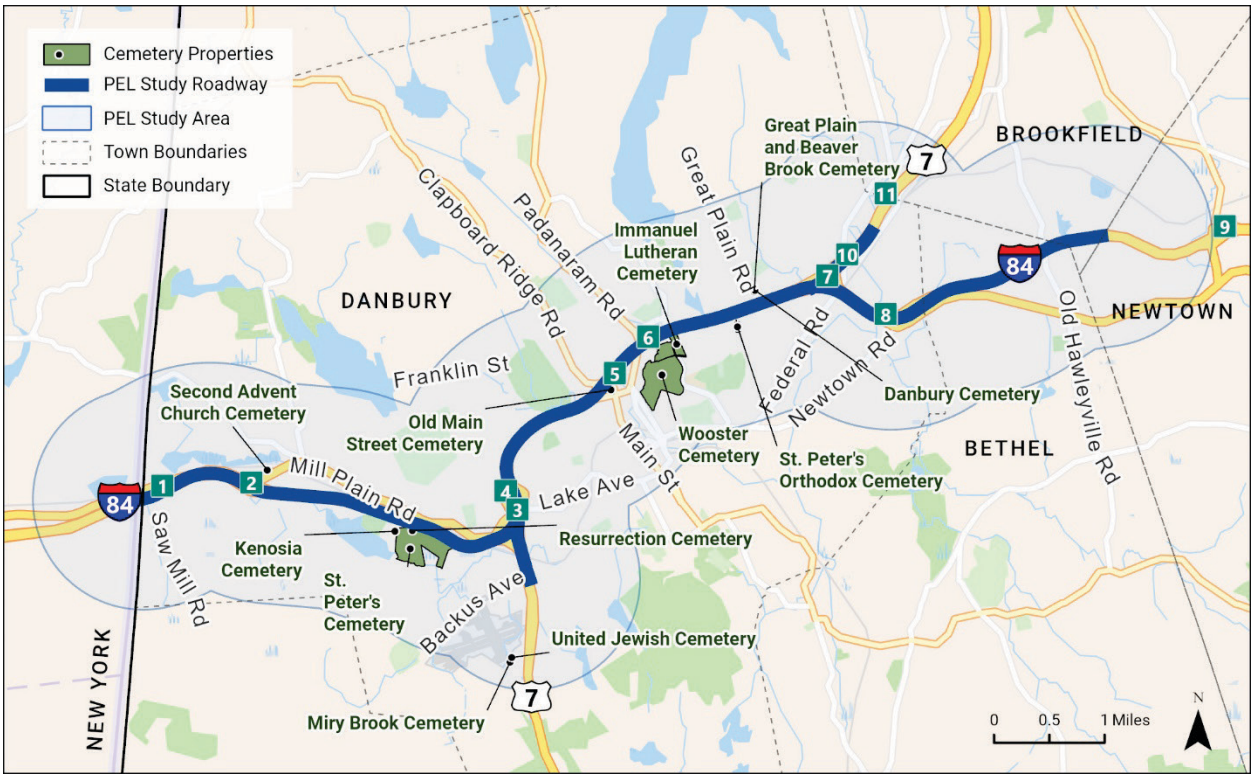
3.2.3 Cultural Resources

An initial Cultural Resources Investigation was performed to evaluate potential cultural resource constraints when evaluating the concepts presented in Chapter 4. These investigations were comprised of a Phase IA Archaeological Assessment and an Architectural Reconnaissance Survey. No subsurface testing was conducted in association with these studies.

3.2.4 Historic Architecture

A preliminary historic architectural survey identified several locations with the potential for previously unidentified historic properties. These potential historic properties include various nineteenth-century dwellings, a potential historic district along Fairview Avenue, a potential early twentieth-century streetscape along Ridge Road, historic cemeteries (Figure 3-3), and historic railroad corridors.

Figure 3-3
Cemetery Properties Near PEL Study Roadway



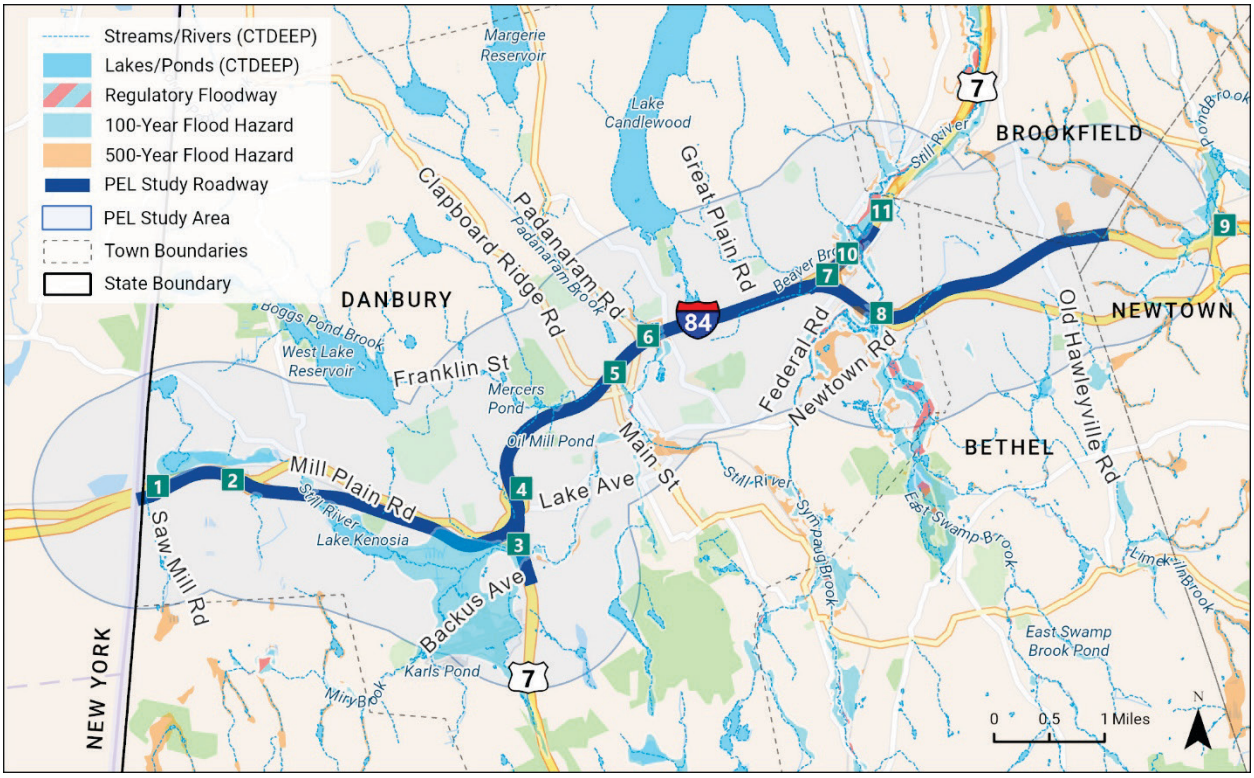
3.3 Existing Natural Environment

3.3.1 Watercourses and Waterbodies

Figure 3-4 presents the major watercourses and waterbodies within the PEL Study Area. The Still River roughly parallels the roadway corridor, and numerous smaller streams, riparian wetlands, and catchments (ponds and lakes) also exist within or near the PEL Study Area. I-84 crosses many of these watercourses via bridges and culverts.

The largest watercourse within the PEL Study Area is the Still River, a tributary to the Housatonic River. The river meanders through the wetlands of Mill Plain Swamp and into Oil Mill Pond. Smaller tributaries, such as Boggs Pond Brook and Padanaram Brook, drain into the Still River, with an associated complex network of streams, brooks, wetlands, and catchments. Wetland types within the PEL Study Area vary, including emergent wetlands, riparian wetlands, forested wetlands, and ponds.

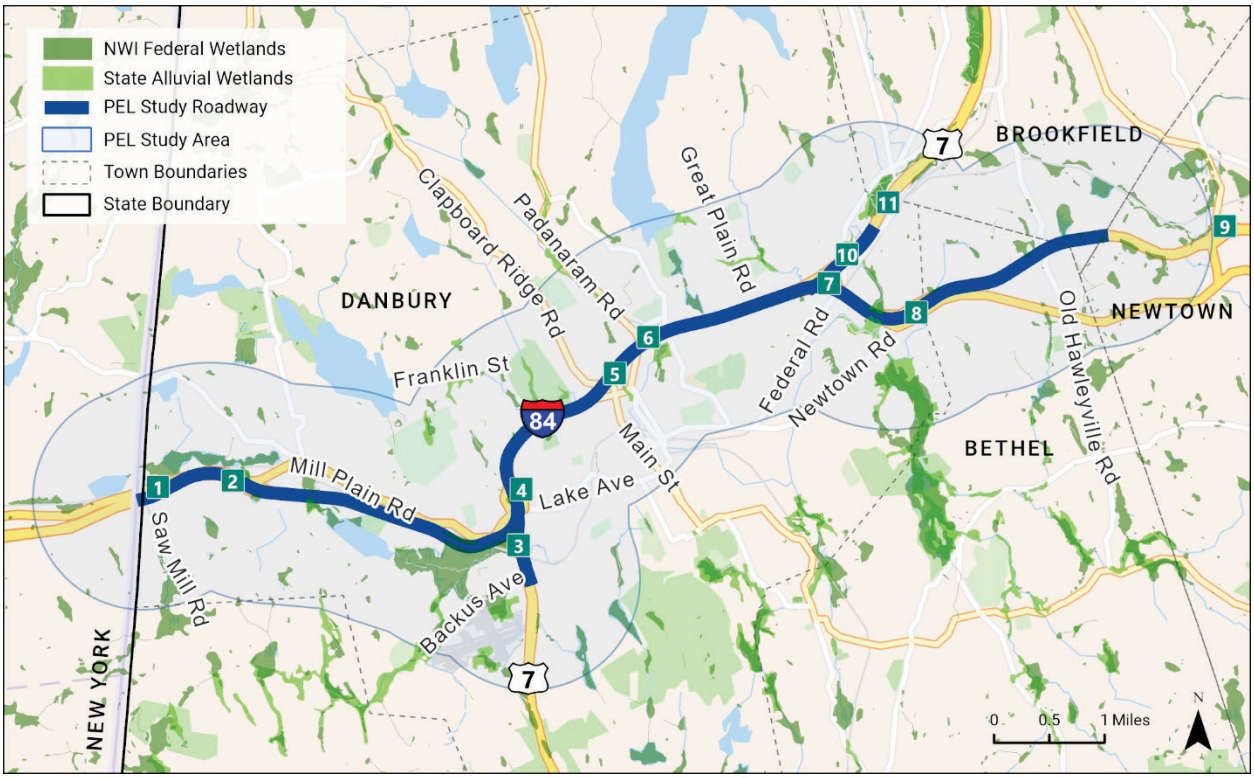
Figure 3-4
Watercourses and Waterbodies



3.3.2 Wetlands

Wetlands are regulated by the State of Connecticut and the U.S. Army Corps of Engineers (USACE). Wetland resources are considered in the evaluation of concepts presented in Chapter 4. Wetland systems within the PEL Study Area were identified using data from the Natural Resources Conservation Service (NRCS) soil mapping and the National Wetland Inventory (NWI). The mapping tools may be used for generalized locations of wetland systems but would not supplant site-specific assessment to verify wetland resource boundaries. These mapping tools identified wetlands and watercourses present throughout the PEL Study Area (Figure 3-5). Most wetlands identified with these mapping tools comprise areas of poorly drained soils with limited additional wetlands mapped by the NWI.

Figure 3-5
Wetlands

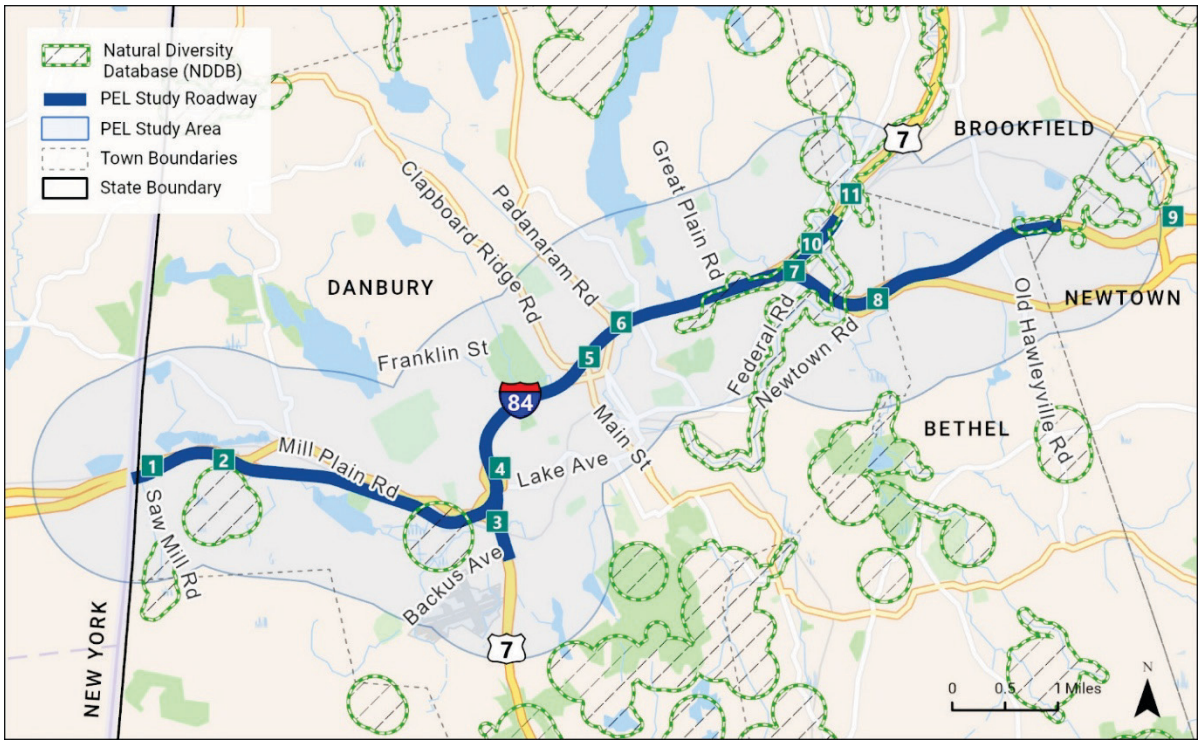


3.3.3 Critical Environmental Areas and Threatened and Endangered Species

State and federal entities regulate critical habitats and threatened and endangered species. These ecological resources are considered in evaluating the concepts presented in Chapter 4.

A review of the U.S. Fish and Wildlife Service (USFWS) Information for Planning and Consultation (IPaC) determined that there are no federally designated critical habitats within the PEL Study Area. CT DEEP maintains a Natural Diversity Data Base (NDDB) of the approximate locations of endangered, threatened, and special concern species and significant natural communities in Connecticut. Mapping from this database can be used as a pre-screening tool to identify potential impacts on state-listed species on a site. Several locations are mapped by CT DEEP, which generally consist of wetland and watercourse corridors associated with Mill Plain Swamp and the Still River (Figure 3-6).

Figure 3-6
Listed Species



The USFWS IPaC returned a list of two animal species listed as "threatened" under the Endangered Species Act (ESA) (16 U.S.C. 1531 et seq.) that may occur in the PEL Study Area and/or may be affected by any future projects. These are the northern long-eared bat (*Myotis septentrionalis*) and the bog turtle (*Clemmys muhlenbergii*). Both species are listed as "endangered" at the state level under the Connecticut ESA (CGSs, Chapter 495).

The USFWS proposed listing the tri-colored bat as endangered under the ESA in 2022 with a target date of September 2024 to finalize the listing. However, on April 1, 2024, the USFWS issued a series of guidance documents covering the tri-colored bat, suggesting that the endangered listing may be accelerated. As of this report, a final listing has not been issued by the USFWS.

The USFWS has also reopened the public comment period for a proposed rule, published on December 12, 2024, to list the monarch butterfly as a threatened species under the ESA. The proposed rule includes species-specific protections and flexibilities to encourage conservation of the butterfly under section 4(d) of the ESA. The comment period will be reopened until May 19, 2025. Tracking federal listings for the tri-colored bat and the monarch butterfly are warranted, as they may need to be further considered for impacts once projects enter a more detailed environmental review phase.

Additionally, four plant species listed as "special concern" under the Connecticut ESA have the potential to occur in the PEL Study Area and/or may be affected by any future project. These are the hairy fruitsedge (*Carex trichocarpa*), Tuckerman's sedge (*Carex tuckermanii*), purple cress (*Cardamine douglassii*), and purple milkweed (*Asclepias purpurascens*).

4.0 Concept Development, Screening, and Evaluation

4.1 Introduction

This chapter describes how the PEL Study Area was divided into four study segments, discusses how concepts were developed, and describes the screening methodology applied to these concepts. Finally, this chapter presents the results of the screening analysis, which helped to:

- Identify viable concepts that are aligned with the PEL Study purpose.
- Eliminate unreasonable concepts from further detailed consideration.
- Understand how a concept potentially impacts the built and natural environments.

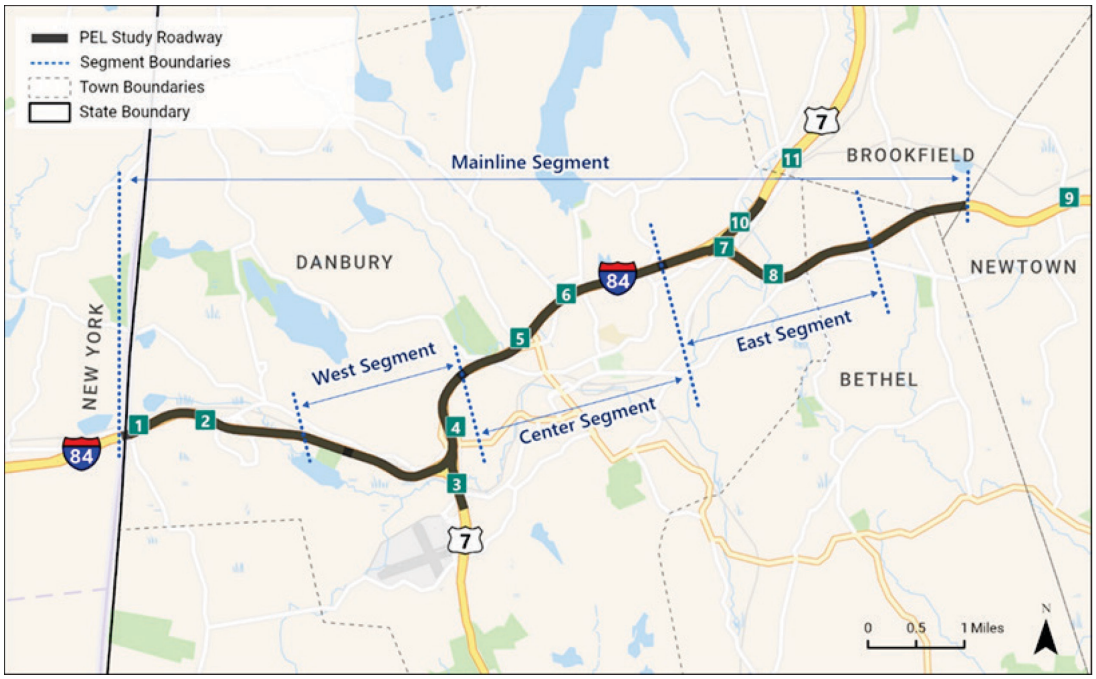
Those concepts that remained after screening and were not otherwise identified as potential breakout projects were combined and further analyzed, as discussed in Chapter 5. Breakout projects, which are analyzed in Chapter 6, must have:

1. Independent utility, meaning the project should be able to be constructed and have a reasonable expenditure even if no other transportation improvements are made in the area.
2. Logical termini, meaning the project has rational endpoints for the improvement.
3. No connected action, meaning the project would not restrict or influence consideration of other reasonably foreseeable transportation improvements in the PEL Study Area.

4.2 Segment Descriptions

Due to the varying conditions along the I-84 corridor, the PEL Study Area was divided into four segments, referred to as the Mainline, West, Center, and East Segments, shown in Figure 4-1. Each segment has unique characteristics, described below, that affect congestion and mobility differently and provide unique challenges and environmental constraints considered in developing feasible solutions.

Figure 4-1
Segment Identification



Mainline Segment – The Mainline Segment runs from the New York State Line to the eastern extent of the PEL Study Area. This segment is characterized in part by two locations where I-84 and US-7 merge, causing substantial congestion and mobility issues along westbound I-84 during the morning commute period, typically 7:00 a.m. to 9:00 a.m., and eastbound I-84 during the evening commute period, typically 4:00 p.m. to 7:00 p.m. Interchanges 3 and 7 contain left-hand exit ramps that are a source of congestion as vehicles maneuver from left-hand off ramps into through lanes (and the opposite movement), causing significant weaving issues. The middle of this segment provides the main east/west movement for local traffic within Danbury, adding to the congestion on I-84. Crashes in the Mainline Segment are primarily rear-end type and are most often attributed to congestion during peak periods.

West Segment – The West Segment runs from just east of Interchange 2 to Interchange 4 on I-84. In addition to the challenges associated with left-hand exit ramps as described above, inconsistent design speeds through this segment of I-84 and the merging of US-7 contribute to congestion and mobility issues. Traffic on local roads, including Segar Street and Lake Avenue, becomes congested during the higher traffic volume periods as queues form from traffic accessing and exiting from I-84/US-7. Most of the crashes in the West Segment are rear-end type, attributed to congestion, but fixed-object and sideswipe crashes also occur, attributed to ramp geometry.

Center Segment – The Center Segment runs through downtown Danbury and includes Interchanges 5 and 6. Due to the segment's proximity to the downtown business district and Danbury Hospital, drivers use this portion of the highway for local trips. The additional trips contribute to congestion and mobility issues on I-84 during the higher traffic volume periods. This segment is also characterized by incomplete interchanges that affect access to downtown

Danbury. Partial interchanges, such as Interchange 6, force drivers to use a combination of the interstate and poorly connected local roads to complete their trips. Residential communities, including neighborhoods immediately adjacent to I-84/US-7 in this portion of the corridor, are impacted by traffic using local neighborhood roads during peak travel hours. Most crashes in the Center Segment are rear-end type, attributed to congestion, but fixed-object and sideswipe crashes attributed to ramp geometry also occur.

East Segment – The East Segment includes Interchanges 7 and 8, and the intersection where I-84 from the southwest (eastbound) continues east and US-7 splits off to the northeast. Weaving movements through this section of I-84 are common in both eastbound and westbound directions due to left-hand exit ramps. During the morning commute, traffic volumes and weaving movements contribute to congestion and mobility issues on I-84 westbound, affecting eastbound traffic during the late afternoon and evening commute. The east segment (including Interchanges 7 and 8) is characterized by ramp and ramp-termini crashes. Most crashes in this segment are rear-end type attributed to congestion, with sideswipe crashes attributed to ramp geometry being prevalent as well.

4.3 Concept Development

The design team, with engagement with community members, developed twenty-six separate concepts based on their potential to address congestion and mobility issues within each segment. Specifically, during concept development, the following items were considered:

- Alignment with the PEL Study purpose.
- Input from public and agency participants. This included the needs and perspectives of the local community and transportation system users regarding the problems and issues within the PEL Study Area.
- Consistency with existing long-range state, regional, and local transportation planning goals, trends, studies, and plans.
- Existing conditions based on available environmental information and the corresponding needs and deficiencies in the I-84 corridor.

Seven concepts were identified for the Mainline Segment, nine for the Center Segment, three for the West Segment, and seven for the East Segment. Table 4-1 presents a summary identifying the concept name, number, and the segment where it is located. Concepts were sequentially numbered as they were developed. Detailed concept descriptions and drawings are provided in Appendix I.

Table 4-1
PEL Concepts

Concept Number	Concept Name	Segment
C1	Lane Continuity	Mainline
C2	Collector Distributor Road	Center
C3	Hospital Access – Tamarack Avenue	Center
C4	Transit Option	Mainline
C5	Left to Right Hand Ramps	Mainline
C6	Interchanges 3 and 4 – Segar Street Eastbound	West
C7	Tunnel	West
C8	I-84 under Collector Distributor Road	Mainline
C9	US-7 Median	Mainline
C10	US-7 Ramp – Westbound	East
C11	CD Road Grade Separated	Center
C12	Interchanges 3 and 4 Collector Distributor Road	West
C13	Great Plain Road	Center
C14	Collector Distributor Road Eastbound	East
C15	Collector Distributor Road	East
C16	Interchange 6 – Collector Distributor Road	Center
C17	I-84 Realigned with Collector Distributor Road	Center
C18	I-84 Realigned with Collector Distributor Road Eastbound	East
C19	I-84 Realigned with Collector Distributor Road	East
C20	Interchange 8 with White Turkey Road Connection	East
C21	I-84 with Collector Distributor Road to Great Plain Road	East
C22	I-84 Expressway	Mainline
C23	Transportation Systems Management and Operations (TSMO)	Mainline
C24	Starr Avenue – Interchange 5	Center
C25	Three Lane Collector Distributor Road	Center
C26	North Street On-Ramp Interchange 6	Center

Notes:
1. Blue denotes the Mainline Segment; peach denotes the West Segment; green denotes the Center Segment; and yellow denotes the East Segment
2. Collector-Distributor Road is a roadway that "collects" traffic from the exit ramp and "distributes" it to local roadways. It parallels the freeway mainline and is used in dense urban environments where traffic weaving is a concern.
3. Detailed descriptions of each concept are contained in Appendix I.

4.4 Concept Screening

Each concept was evaluated through a three-tier screening process. The first tier of the screening process was designed to identify and eliminate concepts with fatal flaws. The second tier of screening was designed to identify and eliminate concepts that were redundant to and less advantageous to others within a geographic segment. The third tier was designed to identify the best-performing concepts based on a matrix of environmental and engineering factors. Sections 4.5, 4.6, and 4.7 further describe these screening tiers.

4.5 Fatal Flaw Analysis

The first tier in the screening process evaluated each of the twenty-six concepts for a fatal flaw. Concepts were initially analyzed to determine if they had potential to improve mobility or reduce congestion.

A concept was determined to be fatally flawed and dismissed from further analysis if it possessed any of the following:

1. Highly complex construction methods outside the range of techniques typical for a large roadway project.
2. Construction costs not commensurate with the improvement achieved.
3. Potential for excessive or disproportional environmental or community impacts.

Once it was clear that a concept did not have a fatal flaw, as defined above, it was examined for its ability to progress independently of other concepts as a breakout project. Concepts identified as breakout projects were removed from the tiered analysis for further study and project review. Concepts that were not found to have a fatal flaw and did not meet the criteria for a breakout project were advanced to the redundancy analysis.

4.5.1 Fatal Flaw Data Analysis and Methodology

Concepts were individually analyzed using the methodology described below to identify if they possessed any of the fatal flaws identified above.

Meeting PEL Purpose

The results of a traffic demand modeling analysis determined whether a concept had the potential to reduce congestion and improve mobility. The traffic simulation model was used to analyze the traffic conditions and predict whether the concept would likely improve mobility and/or reduce congestion in the design year 2040. If the analysis determined that the concept failed to improve mobility or reduce congestion, it was eliminated from further consideration.

Feasibility (Constructability)

This criterion evaluated the construction techniques and the potential for disproportionately high environmental and community impacts that would be likely for each concept. The constructability was evaluated for its cost/benefit in terms of:

1. Construction duration for its complexity (typical vs specialized construction method).
2. Short-term effects during construction (such as temporary property acquisitions and disruption to the community) and long-term effects after construction (such as property acquisition or excessive operation and maintenance costs).

Feasibility (Costs)

This criterion evaluated the estimated construction cost relative to the concept's functionality in reducing congestion and improving mobility. A concept with a cost far exceeding the value of its functional benefit or one that surpassed a reasonable expectation of securing funding from any potential source was eliminated from further consideration. At the conceptual evaluation level performed for the PEL, the feasibility of project funding was not based on detailed construction estimates; rather, budgetary estimates were based on industry knowledge of highway construction of similar scope and magnitude.

Potential for Environmental Impacts

This criterion evaluated the potential for excessive environmental impacts beyond what might be expected compared to the actions and impacts of other highway projects of similar size and scope. Also analyzed at this screening stage was potential for disproportionate impacts on low-income communities. The existing environmental information presented in Chapter 3 was used to qualitatively evaluate each concept at a high level for potential excessive impacts on the human, natural, and physical environments. The degree of impact was classified qualitatively on a scale ranging from Substantial (the most) to Moderate to Low to Minimal (the least).

The opportunity to mitigate impacts was identified at this screening stage; however, specific details on mitigation measures will be explored outside of this PEL Study when a defined project and design details are available.

4.6 Redundancy Analysis

This analysis checks for redundancies in function and eliminates similar concepts with more functional disadvantages or greater potential for environmental impacts. Redundant concepts have the following characteristics:

1. Align with the PEL Purpose in a similar fashion to one or more other concepts and, therefore, serves a similar function.
2. Does not have a clear advantage over similar concepts.
3. Has greater construction, operational, or environmental disadvantages than similarly functioning concepts.

4.7 Screening Matrix Analysis

The screening analysis evaluated concepts in each segment, examining engineering and environmental considerations. Specific engineering and environmental metrics measuring congestion, mobility, and the potential for environmental impacts were evaluated for each concept using a screening matrix. Concepts were then compared within their respective segments (i.e., Mainline, Center, West, and East) to determine the reasonable concepts that would advance.

Engineering considerations included those factors that measure the ability of the concepts to reduce congestion, improve mobility, or limit the ability to construct the concept (i.e., cost and impact during construction). Environmental considerations included those factors with the potential to impact the built and/or natural environment, including community impacts.

Engineering and Environmental considerations were further separated into 'Key' and 'Additional' considerations. Whether a consideration was designated as Key or Additional depended on its impact and whether it was a differentiator in the analysis. An engineering consideration was key if it had a direct, positive impact on congestion or mobility and aligned with the PEL Study purpose. An environmental consideration was key if it had a direct, negative impact on the built or natural environment. Additional engineering or environmental considerations are secondary and carry less weight, as they had no differentiation among the concepts being evaluated, were not likely to have the same degree of impact as key considerations, had a lesser regulatory focus, or were not closely aligned with the PEL purpose.

Table 4-2 presents the metrics used in the Screening Matrix Analysis. Information on where the metric was analyzed (i.e., applicable segment), why it was being analyzed, and how it is linked to congestion and mobility is included in the table. Not all metrics in Table 4-2 were applicable to all four segments because each segment has different design deficiencies and environmental resource conditions to be considered.

Table 4-2
Metrics Used in Screening Matrix Analysis

Engineering Considerations			
Metric	Key/Additional [1,2]	Applicable Segment	Notes
Corrections of weaving	Key	Mainline, West, East	Design improvement that contributes to a decrease in congestion
Addresses lane continuity	Key	All	Design deficiency that contributes to congestion
Addresses left-hand ramps on I-84	Key	Mainline, West, East	Elimination of left-hand ramps reduces congestion
Reduction in travel time	Key	All	The most direct measure of congestion improvement in a segment
Meets driver expectations	Additional	West, Center, East	Design deficiency that contributes to congestion and affects local and highway mobility at interchanges
Distance between adjacent ramps	Additional	Center, East	Design deficiency that contributes to congestion
Maintains direct access to businesses on North Street	Additional	Center	Increasing direct access results in mobility improvements for commuters and local communities
Number of changes to local movements	Additional	West, East	The number of changes to local movements is associated with additional movements a motorist or citizen must take because of changes to the roadway network. Mobility decreases as the number of local movements increases.
Scope of improvements to local network	Additional	West, Center, East	The number and scope of improvements are tied to improving mobility in the local road network.
Construction complexity and staging	Additional	All	The higher the complexity, the higher the impact

Engineering Considerations			
Metric	Key/Additional [1 2]	Applicable Segment	Notes
Construction cost	Additional	All	The higher the cost, the higher the impact
Horizontal curve and sight distance	Additional	Mainline, East	A lower sight distance around a horizontal curve increases congestion
Acceleration/deceleration lane lengths improved on all interchanges	Additional	Mainline	Design improvement that reduces congestion
Vertical geometry improvements	Additional	Mainline, West, East	Design improvement that reduces congestion
Maintain I-84 traffic during construction	Additional	All	Minimize construction impacts to commuters and local communities
Improves connection to Danbury Hospital	Additional	Center	Improves access to Hospital
Improves connection to downtown	Additional	Center	Improves mobility in local road network
Consistent design speed within the segment	Additional	Mainline, West, East	A less consistent speed contributes to increased congestion.
Enhance pedestrian, bicycle, and transit for local streets	Additional	West, Center, East	Improves mobility for commuters and citizens in the local road network

Environmental Considerations			
Built Considerations			
Metric	Key/Additional [1 2]	Applicable Segment	Notes
Full property acquisitions	Key	All	Direct measure of concept impacts
Dead-end streets - community cohesion	Key	All	Related to local mobility
Neighborhood impacts	Key	All	Direct measure of concept impacts
Cemetery property impacts	Key	All	Contributes to the overall assessment of concept impacts
Partial property acquisitions	Additional	All	Contributes to the overall assessment of concept impacts.
Community facility impacts	Additional	All	Contributes to the overall assessment of concept impacts
Section 4(f) property impacts	Additional	All	Contributes to the overall assessment of concept impacts and may warrant a detailed alternatives analysis at the project stage.
Visual/aesthetic impacts	Additional	All	Considered an impact on the highway corridor as well as views from local properties
Impact on natural gas pipeline (NGPL)	Additional	All	Contributes to the overall assessment of concept impacts
Historic property impacts	Additional	All	Contributes to the overall assessment of concept impacts

Natural Environment Considerations			
Metric	Key/Additional [1 2]	Applicable Segment	Notes
Wetland impacts	Key	All	Contributes to the overall assessment of concept impacts and permitting complexity
Stream impacts	Key	All	Contributes to the overall assessment of concept impacts and permitting complexity
Potential for floodplain impacts	Key	All	Contributes to the overall assessment of concept impacts and permitting complexity
Listed species impacts	Key	All	Contributes to the overall assessment of concept impacts
Impacts on habitat for sensitive plants and wildlife	Additional	All	Contributes to the overall assessment of concept impacts

Notes:
1 – Key Considerations were those issues that were differentiators between concepts during the screening process.
2 – Additional Considerations were those issues that were not differentiators between concepts during the screening process.

4.7.1 Screening Matrix Analysis Data Collection and Methodology

The detailed screening matrices presented in Appendix J were the basis for whether a concept was advanced or eliminated in the study. How a specific engineering or environmental metric was applied and measured for a concept is detailed in Appendix J, Table J-1.

The screening process used rating criteria and assigned a level of benefit or impact to the application of these criteria for each concept. Engineering considerations were rated on a three-level scale of best, average, and worst performance against the metric. Environmental considerations were rated on a three-level scale of minimal, moderate, and major impact.

Much of the data available was of a qualitative nature, however, when data was available and appropriate, quantitative data was used for engineering analyses, including metrics such as distance between adjacent ramps, construction cost, reduction in travel time, and acceleration/deceleration lane lengths. Qualitative assessment was applied for other metrics in the Screening Matrix Analysis.

The data used in the Screening Matrix Analysis was determined by superimposing each concept layout footprint over the various environmental resources in a Geographic Information System (GIS) database. Impacts on the built and natural environment were approximated based on early conceptual layouts; as such, potential impact levels were compared to determine differences in severity levels.

Within each segment, criteria within the engineering and environmental considerations category impacted by the concept to the same degree were not used as a 'differentiating' factor. Any 'non-differentiating' factors are listed at the end of each screening matrix table (see Appendix J, Tables J-2 to J-5). Non-differentiating factors varied between segments due

to unique segment geographies and concept configurations addressing functionality and impacting resources differently.

Following the application of the rating criteria for each metric to each concept in the geographic segment, an overall rating was assigned for each category. These overall ratings for each concept within a geographic segment were used to determine if the concept was advancing or eliminated. Key considerations identified concepts most closely aligned with the PEL Study purpose and those with greater potential to impact human and/or natural environmental resources and therefore weigh more heavily in this comparison. Concepts with similar benefits but greater impacts compared to other concepts in a segment were eliminated from further consideration.

Although the Screening Matrix Analysis considered potential impacts and similarities in function when comparing concepts, it differed from the Redundancy Analysis based on the number of considerations and more detailed qualitative and quantitative rating criteria when determining which concepts would be eliminated from further consideration or advanced to the next screening level.

4.8 Segment Screening Results

The following narrative describes each concept by segment, summarizes the analysis, and indicates whether the concept advanced for additional consideration.

Mainline Segment Concepts

Concept 1 – Lane Continuity

Description: Concept 1 (C1, Figure I-1, Appendix I): This concept's primary component would be adding non-interrupted eastbound and westbound travel lanes to provide at least three continuous travel lanes in each direction. This concept proposes maintaining the current alignment of I-84 and staying within the existing right-of-way to the greatest extent possible. Improvements are proposed at Interchanges 3, 4, and 7 on I-84.
Purpose: To improve mainline congestion and mobility.
Feasibility: Typical construction methods and reasonable expectation of being funded.
Benefits: Would improve lane continuity, eliminate left-hand ramps, and, where possible, improve horizontal curvature and vertical geometry.
Impacts: Low probability of significant or irreparable harm. Potential impacts to water resources due to bridge modifications and replacements, but low impacts to community cohesiveness, local communities and neighborhoods, and the built environment.
Advancing: Yes

Concept 5 – Left to Right Hand Ramps

Description: Concept 5 (C5, Figure I-5, Appendix I) would replace left-hand ramps with right-hand ramps at the I-84 and US-7 interchanges. This concept maintains the current alignment of I-84 and stays within the existing right-of-way to the greatest extent possible.
Purpose: To eliminate left-hand ramps and the ensuing weaving that occurs.
Feasibility: Not evaluated due to failure to meet purpose.
Benefits: Would eliminate left-hand ramps.
Impacts: Not evaluated due to failure to meet purpose.

Advancing: No. This concept was eliminated from further screening because it failed to reduce congestion or improve mobility.

Concept 8 – I-84 Under Collector Distributor Road

Description: Concept 8 (C8, Figure I-8, Appendix I) would lower I-84 below grade between Interchanges 2 and 8. I-84 would have no local access between Interchanges 3 and 7. All local traffic traveling towards Interchanges 4, 5, and 6 would use a collector distributor (CD) Road. I-84, US-7, and the CD Road would connect at Interchanges 3 and 7. The feasibility of lowering I-84 was explored using the following methods of construction: open cut, cut and cover, mined tunnel, and bored tunnel.
Purpose: To improve mainline congestion and mobility.
Feasibility: This concept had numerous constructability issues due to complex construction methods, which resulted in very high costs. The connection with US-7 was especially problematic.
Benefits: Would eliminate left-hand ramps and reduce the weaving areas between through and local movements.
Impacts: Potential for substantial impacts to community and housing. Construction complexity would have severe adverse impacts to local communities and roads during construction, then increased local congestion on CD road after construction.
Advancing: No. This concept was eliminated from further screening due to infeasibility and impact to local communities.

Concept 9 – US-7 Median

Description: Concept 9 (C9, Figure I-9, Appendix I) would maintain the current alignment of I-84 and separate US-7 vehicles from those on I-84. The primary component of this concept is that US-7 would be shifted into the median section of I-84 and would be an express facility with no local connections between Interchanges 3 and 7. Improvements would only occur at I-84 Interchanges 3, 4, 7, and 8.
Purpose: To improve mainline congestion and mobility.
Feasibility: Typical construction methods and reasonable expectation of being funded.
Benefits: Would create lane continuity, eliminate left-hand ramps, and, where possible, improve horizontal curvature in the mainline section of I-84 within the PEL Study Area.
Impacts: Potential for moderate property impacts and the disruption in community cohesion between north and south caused by a wider interstate that results in longer highway crossing distances beneath it, potential disturbance to the natural gas transmission pipeline, and potential disturbance to streams and drainage features.
Advancing: Yes.

Concept 22 – I-84 Expressway

Description: Concept 22 (C22, Figure I-22, Appendix I) proposes express lanes in both directions in the median section between Interchanges 3 and 8. A barrier would separate the median express lanes of I-84 from US-7 to its right, therefore prohibiting direct access between these roadways and between I-84 and the local interchanges along the express segment. This concept provides access from I-84 to US-7 by introducing two exit ramps: one in the eastbound direction, located on I-84 west of Interchange 3 and the other in the westbound direction, located east of Interchange 8. US-7 would then provide connections to the local interchanges.
Purpose: To improve mainline congestion and mobility.
Feasibility: Typical construction methods and reasonable expectation of being funded.
Benefits: Would create lane continuity, eliminate left-hand ramps, and, where possible, improve horizontal curvature in the mainline section of I-84 within the PEL Study Area, while maintaining current alignment.
Impacts: Potential for moderate property impacts, disruption in community cohesion between north and south caused by a wider interstate that results in longer highway crossing distances, potential disturbance to the natural gas transmission pipeline, and potential disturbance to streams and drainage features. Changes in roadway configuration may create mitigation opportunities.
Advancing: Yes.

Concepts 4 and 23 – Transit and TSMO Options

Description: Concept 4 (C4, Figure I-4, Appendix I) introduces potential transit options for transportation in the I-84/US-7 corridor. Concept 23 (C23, Figure I-23, Appendix I) identifies strategies focused on operational improvements with minimal modifications to the existing roadway.
Purpose: Both concepts would increase mobility and reduce congestion while providing options for both local and regional travel.
Analysis: Mainline Concepts 4 and 23 are both technically and financially feasible concepts that, in part, could have positive impacts by reducing congestion and improving mobility in the I-84 PEL Study Area. Each of these concepts is independent of the Mainline improvements and not dependent on other Mainline improvements to be built for them to be feasible. Due to this independent utility, it was determined that these concepts would not advance to further concept or concept combination screening, as they can be advanced as breakout projects. Since Concept 4 has identified multiple options, further study will be needed outside of this PEL Study, to determine which options should be pursued as independent breakout projects. At the time of this study, the DLU option within Concept 23 will also be advanced; however, other TSMO strategies may be considered later. More information on both Concept 4 and Concept 23 is provided in Chapter 6.

Summary of Fatal Flaw Analysis for the Mainline Segment

Concept 5 was eliminated due to not meeting the PEL Study purpose and Concept 8 was eliminated due to construction infeasibility.

Summary of Redundancy Analysis for the Mainline Segment

No concept was eliminated due to redundancy.

Summary of Screening Matrix Analysis for the Mainline Segment

Appendix J, Table J-2, provides detailed screening matrices analyzing the key and additional engineering and environmental considerations, along with other engineering and environmental criteria that were considered.

Concept 1 performed the best in reducing travel time on both I-84 and US-7, a key measure of congestion relief. Both Concept 9 and Concept 22 had considerably higher impacts on the environmental metrics as compared to Concept 1. Notable impacts estimated from the analysis were property takes and sensitive neighborhood impacts. Table 4-3 below provides a summary of ratings for engineering and environmental considerations for the mainline concepts.

Table 4-3
Screening Matrix Analysis Summary – Mainline Segment

Considerations	Concept 1 Lane Continuity	Concept 9 US-7 Express Median	Concept 22 I-84 Express Median
Key Engineering	△	○	○
Key Environmental	△	▽	▽
Additional Engineering	△	○	○
Additional Environmental	△	○	○
Concept Advancing	✓	✗	✗

Symbols are defined as follows:

Symbol	Engineering Metrics	Environmental Metrics
△	Best performance	Minimal impacts
○	Average performance	Moderate impacts
▽	Worst performance	Major impacts

Since Concept 1 performed similarly to or better than Concepts 9 and 22 in terms of the congestion and mobility metrics but with far fewer impacts, Concept 1 is the only mainline concept that was carried forward into the next stage of the PEL screening process.

West Segment Concepts

Concept 6 – Interchanges 3 & 4 - Segar Street Eastbound

Description: Concept 6 (C6, Figure I-6, Appendix I) proposes a new off-ramp from eastbound I-84 to Segar Street. In this concept, a median barrier would be installed to prohibit I-84 eastbound traffic from using the Lake Avenue exit (Interchange 4). This eliminates the current weaving condition between I-84 eastbound traffic using the Lake Avenue exit ramp and US-7 northbound traffic merging onto I-84 eastbound.
Purpose: To improve eastbound, I-84 congestion and mobility at Interchanges 3 and 4.

Feasibility: Typical construction methods and reasonable expectation of being funded.
Benefits: Would eliminate weaving condition between Interchanges 3 and 4, which would reduce congestion and congestion related crashes, and improves mobility.
Impacts: Low potential for impacts to the natural environment (wetlands and listed species habitat) and minimal potential for impacts to the built environment and the surrounding community.
Advancing: Yes.

Concept 7 -Tunnel

Description: Concept 7, (C7, Figure I-7, Appendix I), proposes a tunnel and open-cut section on the west side of the PEL Study Area within the vicinity of Interchanges 2 and 4. This concept would straighten the current horizontal alignment on I-84. The proposed new alignment of I-84 would have two lanes of travel in each direction. The existing portion of I-84 (referred to as the I-84 spur) would remain to serve US-7 and Lake Avenue.
Purpose: To improve traffic flow and design speed in the western part of the I-84 PEL Study Area only.
Feasibility: High degree of construction complexity resulting in extraordinary costs, in addition to continued costs for maintaining the remaining I-84 spur road.
Benefits: Would achieve a consistent travel speed in the corridor, involve off-line construction, and reduce the slowdowns caused by sharp curves.
Impacts: Potential for substantial impacts to housing, local communities, and local infrastructure. Significant rights-of-way and property impacts, relocation of the West Lake Treatment Facility and displacement of the firehouse; majority of the full property acquisitions located within low-income communities; impacts to the community due to visible and audible highway where there was none prior; disruption of community cohesion with a physical separation of a neighborhood.
Advancing: No, eliminated from further screening due to the potential for substantial impacts along with the limited benefit realized only in the west segment at high construction and maintenance costs.

Concept 12 – Interchanges 3 & 4 – Collector Distributor Road

Description: Concept 12 (C12, Figure I-12, Appendix I) proposes a CD Road along I-84 eastbound, starting at the merge of the Lake Avenue off-ramp and the US-7 northbound on-ramp at Interchange 3 and ending at the merge with I-84 eastbound at Interchange 4 (about 1,200 feet in length). In this concept, the off-ramp to Lake Avenue would be on the CD Road and a median barrier (about 1,500 feet in length) would be installed to prohibit I-84 eastbound traffic from using the Lake Avenue exit ramp. This would eliminate the current weaving condition between I-84 eastbound traffic with the US-7 northbound traffic that merges onto I-84 eastbound.
Purpose: To improve eastbound, I-84 congestion and mobility at Interchanges 3 and 4.
Feasibility: Typical construction methods and reasonable expectation of being funded.
Benefits: Would eliminate weaving condition between Interchanges 3 and 4 which reduces congestion and congestion related crashes and improves mobility.
Impacts: Low potential for impact to natural resources (wetlands and streams), minimal potential for impacts to the built environment. Changes in roadway configuration may create mitigation opportunities.
Advancing: Yes.

Summary of Fatal Flaw Analysis for the West Segment

Concept 7 was eliminated from consideration due to the potential for substantial impacts to the surrounding community, housing, and infrastructure, along with a high degree of constructability complexity resulting in extraordinary costs.

Summary of Redundancy Analysis for the West Segment

No concepts were eliminated due to redundancy analysis.

Summary of Screening Matrix Analysis for the West Segment

Appendix J, Table J-3, provides detailed screening matrices analyzing the key and additional engineering and environmental considerations for these concepts, along with other engineering and environmental matrices considered.

While Concepts 6 and 12 are similar in reducing congestion and congestion related crashes and improving mobility, each has a unique way of delivering those solutions. The unique feature of Concept 6 is the proposed Segar Street ramp, whereas it is a CD road for Concept 12. Both remove existing weaves due to left-hand ramps. The most significant difference between these concepts is that Concept 12 has a higher potential for wetland and stream impacts and associated permitting effort, but not to the degree that avoidance, minimization, or mitigation would be unattainable. Table 4-4 below summarizes ratings for engineering and environmental considerations.

Table 4-4
Screening Matrix Analysis Summary – West Segment

Considerations	Concept 6 Interchanges 3 & 4 – Segar Steet Ramp	Concept 12 Interchanges 3 & 4 – CD Road
Key Engineering	△	○
Key Environmental	△	▽
Additional Engineering	▽	△
Additional Environmental	○	△
Concept Advancing	✓	✓

Symbols are defined as follows:

Symbol	Engineering Metrics	Environmental Metrics
△	Best performance	Minimal impacts
○	Average performance	Moderate impacts
▽	Worst performance	Major impacts

Concepts 6 and 12 were carried forward from the Screening Matrix Analysis into the next stage of the PEL screening process.

Center Segment Concepts

Concept 2 – Collector Distributor Road

Description: Concept 2 (C2, Figure I-2, Appendix I) proposes eastbound and westbound collector-distributor (CD) roads in the center section of I-84 within the PEL Study Area. This concept also provides access to other local roadways, such as Tamarack Avenue and Madison Avenue, which currently do not have direct access to the highway mainline. This concept eliminates the existing interchanges at Main Street and North Street, with the CD Road connecting to Main Street, North Street, Madison Avenue, and Tamarack Avenue.
Purpose: To reduce congestion and improve mobility on I-84 between Interchanges 5 and 6 and better connect to downtown Danbury.
Feasibility: Typical construction methods and reasonable expectation of being funded
Benefits: The CD roads would improve local access to downtown and the Danbury Hospital and remove local traffic from I-84, thus reducing congestion on the mainline. The introduction of a CD Road eliminates the weaving of traffic between existing interchanges at Main Street and North Street.
Impacts: Potential for moderate impacts including right-of-way impacts, disruption of community cohesion, potential to affect natural gas transmission pipelines, and potential impacts to water resources. Changes in roadway configuration may create mitigation opportunities.
Advancing: Yes

Concept 3 – Hospital Access - Tamarack Avenue

Description: Concept 3 (C3, Figure I-3, Appendix I) would provide a full interchange at Tamarack Avenue (i.e., ramps connect to and from I-84 in both directions with Tamarack Avenue).
Purpose: To improve connection to downtown and the hospital.
Feasibility: Typical construction methods and reasonable expectation of being funded.
Benefits: This interchange would improve access to Danbury Hospital and Downtown in the center section of the PEL Study Area.
Impacts: Potential for low to moderate impacts. There is minimal potential for impacts to the natural environment, but impacts are possible to the built environment, given the occurrence of cemeteries, neighborhoods, and Section 4(f) properties. FHWA regulations defines Section 4(f) properties to include publicly owned parks, recreation areas, and wildlife/waterfowl refuges or historic sites of national or state significance. Changes in roadway configuration may create mitigation opportunities.
Advancing: Yes

Concept 11 – CD Road Grade Separated

Description: Concept 11 (C11, Figure I-11, Appendix I) proposes a CD road, similar to C2. The existing interchanges at Main Street and North Street would be eliminated and the CD Road would provide connection to Main Street, North Street, and Tamarack Avenue.
Purpose: To improve I-84 congestion and mobility between Interchanges 5 and 6, and connection to downtown Danbury.
Feasibility: Specialized and multi-staged construction methods but reasonable expectation of being funded.
Benefits: Would improve local connectivity and reduce mainline congestion.

Impacts: This concept would have substantial potential to impact neighborhoods, including low-income communities, dead ending several local streets, with likely impacts to local cemeteries including burial sites, streams, and wetlands.
Advancing: No, this concept was eliminated from further screening due to potential for substantial community impacts.

Concept 13 – Great Plain Road

Description: Concept 13 (C13, Figure I-13, Appendix I) proposes a new partial interchange on I-84 at Great Plain Road in the center section of the corridor.
Purpose: To improve connection to downtown and hospital.
Feasibility: Typical construction methods and reasonable expectation of being funded.
Benefits: The interchange would improve access between I-84, the Danbury Hospital, and points west of the Hospital.
Impacts: Low potential for impacts to natural environment, and low potential for impacts to the built environment. Changes in roadway configuration may create mitigation opportunities.
Advancing: Yes

Concept 16 – Interchange 6 – Collector Distributor Road

Description: Concept 16 (C16, Figure I-16, Appendix I) proposes CD roads between North Street and Tamarack Avenue on the north and south sides of I-84. This concept eliminates the existing North Street interchange (Interchange 6) and replaces it with ramps from I-84 connected to CD roads using J-shaped ramps in each direction.
Purpose: To improve connection to downtown and hospital with a full interchange.
Feasibility: Typical construction methods and reasonable expectation of being funded.
Benefits: Would improve access to Downtown Danbury and Danbury Hospital.
Impacts: Moderate potential for impacts to the built environment including property acquisitions, dead-end streets, neighborhoods, and cemetery properties. Potential for moderate impacts to wetlands and streams. Changes in roadway configuration may create mitigation opportunities.
Advancing: Yes

Concept 17 – I-84 Realigned with Collector Distributor Road

Description: Concept 17 (C17, Figure I-17, Appendix I) proposes CD roads in each direction between west of Franklin Street Extension and east of Tamarack Avenue. This concept realigns I-84 to reduce highway curvature. The Main Street interchange (Interchange 5) would be shifted north to meet the new I-84 alignment. The existing North Street interchange (Interchange 6) would be eliminated and replaced with a new interchange at Tamarack Avenue.
Purpose: To improve I-84 congestion and mobility between Interchanges 5 and 6, and connection to downtown Danbury.
Feasibility: Complex and multi-stage construction methods with a reasonable expectation of being funded.
Benefits: Would improve horizontal curvature on I-84, which would maintain a more consistent design speed in the corridor and improves connection to Downtown and the Danbury Hospital.
Impacts: Substantial potential for impacts to housing, low-income communities, and recreation with few roadway configuration opportunities possible. This concept would have substantial potential for impacts to neighborhoods, dead ending several local streets, and disrupting several established neighborhoods including recreational resources and cemetery burial plots.

Advancing: No. This concept was eliminated from further screening due to potential for substantial impacts.

Concept 24 – Starr Avenue – Interchange 5

Description: Concept 24 (C24, Figure I-24, Appendix I) proposes a CD road in the eastbound direction between Main Street (existing Interchange 5) and North Street (existing Interchange 6). In the westbound direction, the existing westbound ramps at Interchange 5 (Main Street) would be eliminated and a new, full Interchange 5 would be constructed on Starr Avenue. Additionally, a new on-ramp would be introduced at North Street in the westbound direction, which would convert Interchange 6 on North Street to a full interchange.
Purpose: To improve connection to downtown and hospital with full interchanges at Starr Avenue and North Street.
Feasibility: Typical construction methods but with several stages, and reasonable expectation of being funded.
Benefits: Would improve local access to downtown and reduce congestion on I-84 by providing an alternative for local traffic use instead of the interstate.
Impacts: Moderate to substantial potential for impacts to housing and low-income communities, especially to the Starr Avenue neighborhood, with minor potential for impacts to streams and wetlands. Changes in roadway configuration may create mitigation opportunities.
Advancing: Yes

Concept 25 – Three Lane Collector Distributor Road

Description: Concept 25 (C25, Figure I-25, Appendix I) proposes a 3-lane CD road that would provide connection to Main Street, North Street, Madison Avenue, and Tamarack Avenue. This concept would eliminate the existing interchanges at Main Street and North Street.
Purpose: To improve I-84 congestion and mobility on I-84 between Interchanges 5 and 6, and connection to downtown Danbury and the hospital.
Feasibility: Specialized and multi-staged construction methods but reasonable expectation of being funded.
Benefits: Would improve local access to both downtown and the Danbury Hospital and reduce congestion on I-84 by providing an alternative for local traffic use instead of the interstate.
Impacts: This concept has the potential to impact a substantial number of residential units, including potential acquisition of a large, 100-unit nursing home facility and disproportionately affecting other low-income communities. Additionally, this concept could potentially impact burial sites at a local cemetery, with minor potential for impacts to the natural environment.
Advancing: No. This concept was eliminated from further screening due to potential for substantial impacts.

Concept 26 –North Street On-Ramp Interchange 6

Description: Concept 26 (C26, Figure I-26, Appendix I) would create a one-way, two-travel lane CD Road in the eastbound direction between Main Street (Interchange 5) and North Street (Interchange 6). This concept would add an auxiliary lane on I-84 westbound between the North Street on-ramp and Main Street off-ramp. The existing westbound ramps at Interchange 5 (Main Street) would remain and a new on-ramp would be introduced to North Street, providing full access to I-84.
Purpose: To improve connection to downtown and hospital with a full interchange.
Feasibility: Typical construction methods but with several stages, and reasonable expectation of being funded.

Benefits: Would improve local access to downtown and improve congestion on I-84 by providing an alternative for local traffic use instead of the interstate. Also, would provide westbound access from North Street to I-84.
Impacts: Moderate to substantial potential for impacts to housing communities and cemeteries, but minimal potential for natural environment impacts. Changes in roadway configuration may create mitigation opportunities.
Advancing: Yes

Summary of Fatal Flaw Analysis for the Center Segment

Concepts 11, 17, and 25 were eliminated from consideration due to identified fatal flaws from substantial property impacts.

Summary of Redundancy Analysis for the Center Segment

Concepts 3, 13, 16, and 26 were advanced as not redundant compared to other concepts within the Center Segment.

Concepts 2 and 16 are similar in function, as both add a two-lane CD road through a densely populated area of central Danbury and have similar benefits in reducing congestion and improving mobility. Traffic modeling does not indicate a clear advantage in congestion or mobility improvements for either concept. Concept 2 was eliminated due to redundancy as it has greater impacts to neighborhoods, community facilities, and a natural gas transmission pipeline.

Concepts 24 and 26 are similar in function, as both add an eastbound-only two-lane CD road through a densely populated area of central Danbury and have similar benefits in reducing congestion and improving mobility. Concept 24 was eliminated due to redundancy as the interchange relocation requires more property acquisitions and would have a greater permanent impact on the community.

Summary of Screening Matrix Analysis for the Center Segment

Appendix J, Table J-4, provides detailed screening matrices analyzing the key and additional engineering and environmental considerations for these concepts, along with other engineering and environmental matrices that were considered.

Concepts 3 and 13 advanced for further consideration, as they generally performed well with mostly minimal impacts to the natural environment and some moderate impacts to the built environment.

Concept 16 was eliminated from consideration, as it underperformed compared to the other three concepts in function, especially regarding congestion reduction. It had generally higher impacts, mainly focused on property acquisitions, community mobility, dead-end streets, and sensitive neighborhoods.

Concept 26 also advanced, despite having a higher potential for impact relating to key environmental considerations, it functions better than Concept 16 and It also provides full access to North Street, which is highly desirable for area residents.

Table 4-5 provides a graphic summary of ratings for engineering and environmental considerations.

Table 4-5
Screening Matrix Analysis Summary – Center Segment

Considerations	Concept 3 Tamarack Avenue	Concept 13 Great Plain Road	Concept 16 Interchange 6 – CD Road	Concept 26 Interchange 6 – North Street Full Access
Key Engineering	○	○	▽	○
Key Environmental	△	△	▽	▽
Additional Engineering	△	△	○	○
Additional Environmental	△	○	△	△
Concept Advancing	✓	✓	✗	✓

Symbols are defined as follows:

Symbol	Engineering Metrics	Environmental Metrics
△	Best performance	Minimal impacts
○	Average performance	Moderate impacts
▽	Worst performance	Major impacts

East Segment Concepts

Concept 10 – US-7 Ramp - Westbound

Description: Concept 10 (C10, Figure I-10, Appendix I), proposes a new two-lane on-ramp from US-7 southbound to I-84 westbound at the vicinity of Interchange 7, replacing the current single lane on-ramp. The improvement would result in changing the ramp configuration for the US-7 southbound on-ramp to I-84 eastbound from an exit-only ramp to an exit ramp.
Purpose: To improve lane continuity.
Feasibility: Typical construction methods and reasonable expectation of being funded.
Benefits: Would improve access to I-84 westbound, which would reduce congestion.
Impacts: Minimal potential for impacts. Changes in roadway configuration may create mitigation opportunities as all work would be within the right-of-way.
Advancing: Yes.

Concept 14 – Collector Distributor Road Eastbound

Description: Concept 14 (C14, Figure I-14, Appendix I) proposes a CD Road in the eastbound direction between Interchanges 7 and 8 to eliminate the weaving condition.
Purpose: To improve I-84 congestion and mobility modestly between Interchanges 7 and 8.
Feasibility: Typical construction methods and reasonable expectation of being funded.
Benefits: Would create lane continuity, eliminate left-hand ramps, and, where possible, improve horizontal curvature.

Impacts: Moderate potential for impacts to surrounding communities, commercial property, natural gas pipeline, streams, wetlands, and floodplains. Changes in roadway configuration may create mitigation opportunities.
Advancing: Yes.

Concept 15 – Collector Distributor Road

Description: Concept 15 (C15, Figure I-15, Appendix I) proposes CD roads in each direction between Interchanges 7 and 8. Improvements are only proposed at I-84 Interchanges 7 and 8.
Purpose: To improve I-84 congestion and mobility between Interchanges 7 and 8.
Feasibility: Typical construction methods and reasonable expectation of being funded.
Benefits: Would create lane continuity, eliminate left-hand ramps, and, where possible, improve horizontal curvature.
Impacts: Moderate potential for impacts to surrounding communities, commercial property, natural gas pipeline, streams, wetlands, and floodplains. Changes in roadway configuration may create mitigation opportunities.
Advancing: Yes.

Concept 18 – I-84 Realigned with Collector Distributor Road Eastbound

Description: Concept 18, (C18, Figure I-18, Appendix I) proposes a CD road in the eastbound direction between Interchanges 7 and 8 to eliminate the weaving condition. Existing left-hand ramps between I-84 and US-7 at Interchange 7 would be replaced with right-hand ramps. This concept realigns I-84 in the east section. The US-7 interchange (Interchange 7) would be shifted to the south and the US-6/Newtown Road interchange (Interchange 8) would be shifted north to meet design standards for horizontal curvature.
Purpose: To improve I-84 congestion between Interchanges 7 and 8.
Feasibility: Constructability would be complex, as the roadway would have to traverse a steep, rocky hill, cut through a neighborhood north of I-84, and integrate with a railroad corridor. The use of typical construction methods, with multiple stages, is still considered to have a reasonable expectation of being funded despite having a higher cost than other options.
Benefits: Would eliminate weaving conditions, which would reduce congestion and improve safety and mobility, and would improve horizontal curvature of the mainline, maintaining more consistent traffic operations and avoiding propagating congestion caused by a sudden change in conditions not meeting driver expectations.
Impacts: The interstate realignment would likely cause substantial property impacts including a multi-family apartment complex, community cohesion impacts, and extensive impacts to floodplains and a railroad corridor.
Advancing: No. This concept was eliminated from further screening due to constructability considerations and potential for substantial community impacts.

Concept 19 – I-84 Realigned with Collector Distributor Road

Description: Concept 19 (C19, Figure I-19, Appendix I) proposes CD roads in each direction between Interchanges 7 and 8 to eliminate the weaving condition. Existing left-hand ramps between I-84 and US-7 at Interchange 7 would be replaced with right-hand ramps. This concept realigns I-84 in the east section. The US-7 interchange (Interchange 7) would be shifted slightly to the south and the US-6/Newtown Road interchange (Interchange 8) would be shifted farther north to meet design standards for horizontal curvature.
Purpose: To improve I-84 congestion and mobility between Interchanges 7 and 8.

Feasibility: Constructability would be complex, as the roadway would have to traverse a steep, rocky hill, cut through a neighborhood north of I-84, and integrate with a railroad corridor. The use of typical construction methods, with multiple stages, is still considered to have a reasonable expectation of being funded despite having a higher cost than other options.
Benefits: Would eliminate weaving condition which would reduce congestion and congestion related crashes and improve mobility. This concept would also improve horizontal curvature of the mainline, maintaining more consistent traffic operations and avoiding propagating congestion caused by a sudden change in conditions not meeting driver expectations.
Impacts: The potential for impacts to the built and natural environment with this concept would be similar to Concept 18; however, with greater potential for impacts due to the addition of a CD road.
Advancing: No. This concept was eliminated from further screening due to constructability considerations and potential for substantial impacts.

Concept 20 – Interchange 8 with White Turkey Road Connection

Description: Concept 20, (C20, Figure I-20, Appendix I), proposes a new Interchange 8 with a north-south connection to White Turkey Road Extension. This concept provides access to US-7 via White Turkey Connector for automobile traffic on Newtown Road and US-6 without getting on I-84. Traffic heading to US-7 northbound would be routed up and over a local hill to separate it from the congestion and weaving issues associated with the current Interchange 7 configuration.
Purpose: To improve options for light vehicle traffic accessing US-7 northbound from I-84 westbound.
Feasibility: Typical construction methods with significant rock excavation, but still reasonable expectation of being funded.
Benefits: Would remove local traffic from I-84 and improve access to US-7.
Impacts: Moderate potential for property impacts. The road would be restricted to cars or light trucks only, due to the resulting incline over the local hill (10% or greater grade), further reducing its function, and not fully addressing the PEL purpose of moving goods and services through the area. Additionally, it appears to cross the existing natural gas pipeline, which is a potentially significant impact.
Advancing: No.

Concept 21 – I-84 with Collector Distributor Road to Great Plain Road

Description: Concept 21 (C21, Figure I-21, Appendix I) proposes a CD road in both directions between Great Plain Road and Newtown Road (Interchange 8). This concept would shift I-84 slightly to the south. Existing left-hand ramps between I-84 and US-7 at Interchange 7 would be replaced with right-hand ramps.
Purpose: To improve I-84 congestion and mobility between Interchanges 7 and 8.
Feasibility: Typical construction methods and reasonable expectation of being funded.
Benefits: I-84 realignment would be possible in the corridor. CD road would reduce highway congestion and improve local mobility.
Impacts: Moderate potential for impacts to properties. Changes in roadway configuration may create mitigation opportunities.
Advancing: Yes.

Summary of Fatal Flaw Analysis for the East Segment

Concepts 18 and 19 identified fatal flaws in constructability and environmental impacts. These two concepts were eliminated from consideration. Concept 20 had high constructability issues and moderate impacts through a planned industrial/business park, thus, Concept 20 was also eliminated from consideration.

Summary of Redundancy Analysis for the East Segment

Concept 10 would entail restriping and widening the ramps from southbound US-7 to I-84 east and westbound to improve the merging of traffic and reduce delays of traffic onto I-84 from southbound US-7. Similar to Concepts 14 and 15, Concept 10 would reduce travel time and delays within the limits of the proposed improvement. However, unlike Concepts 14 and 15, Concept 10 would push the congestion from one end of the project corridor to the other, such that it would not provide a long-term solution and therefore did not merit advancement. However, specific features of Concept 10 were then integrated into Concepts 14 and 15.

Concept 21 was eliminated as redundant, as it has the same function as Concepts 15 and 13 (Center segment) combined, but far greater impacts to the built and natural environments than those combined concepts.

Concepts 14 and 15 were advanced. Both eliminate weaves to varying degrees, and there were no clear disadvantages when considering impacts to the built and natural environments, that warranted elimination of either concept.

Summary of Screening Matrix Analysis for the East Segment

Appendix J, Table J-5, provides detailed screening matrices analyzing the key and additional engineering and environmental considerations for these concepts, along with other engineering and environmental matrices that were considered.

Table 4-6 below provides a summary of ratings for engineering and environmental considerations. Both concepts were advanced, as they have a similar degree of impact given their comparable footprints but function differently due to the number of CD roads.

Table 4-6
Screening Matrix Analysis Summary – East Segment

Considerations	Concept 14 – CD Road Eastbound	Concept 15 – CD Road
Key Engineering	○	△
Key Environmental	△	△
Additional Engineering	○	○
Additional Environmental	○	○
Concept Advancing	✓	✓

Symbols are defined as follows:

Symbol	Engineering Metrics	Environmental Metrics
△	Best performance	Minimal impacts
○	Average performance	Moderate impacts
▽	Worst performance	Major impacts

4.9 Concepts Advancing to Concept Combination Screening

Based on the detailed concept screening presented above, the following concepts moved into the next stage of the screening process:

1. Mainline Segment – Concept 1
2. West Segment – Concept 6 and Concept 12
3. Center Segment – Concept 3, Concept 13, and Concept 26
4. East Segment – Concept 14 and Concept 15

The next stage involved combining these concepts into Concept Combinations which underwent further screening analyses, as presented in Chapter 5.

5.0 Concept Combination Screening and Recommendations

5.1 Introduction

As discussed in Chapter 4, dividing the PEL Study Area into four segments was critical to addressing the needs, deficiencies, and environmental conditions unique to each segment. This allowed for the development of solutions to address the problems within each segment. The three-tier screening process applied to the 26 individual concepts presented in Chapter 4 identified the ten concepts that performed best within each segment.

Two concepts (Concepts 4 and 23) are evaluated separately in Chapter 6 as potential breakout projects. The remaining eight concepts from the three-tier screening process fall into one of the four segments (mainline, east, center, and west). They include Concept 1 in the mainline; Concepts 6 and 12 in the west; Concepts 3, 13 and 26 in the center; and Concepts 14 and 15 in the east. These concepts were combined into twelve concept combinations, each with one element from each segment for the entire length of the Study area (Table 5-1). These combinations of concepts were then evaluated relative to how they perform together to solve the congestion and mobility problems within and around the entire I-84 Danbury PEL Study Area. This chapter presents how the effectiveness of the concept combinations was evaluated to solve the problems within the corridor.

Concept combinations represent the unique combinations that can be configured by joining the eight individual concepts. Each concept combination (CC) has been given a unique identifier (CC-A through CC-L). Table 5-1 identifies the concept combinations and provides a brief description of the mainline improvements for each combination. Detailed descriptions of the individual concepts can be found in Chapter 4.

Table 5-1
Concept Combinations Summary

CC No.	Component Concepts	Mainline Concept	West Concepts	Center Concepts	East Concepts
CC-A	1-6-3-14	**C1**- All concept combinations include the addition of a lane in both the EB and WB directions of the mainline	**C6**-Interchanges 3 and 4: New off-ramp from EB I-84 to Segar Street	**C3-**Reconfigured Full interchange at Tamarack Avenue	**C14** – New EB only CD road between Int 7 & 8
CC-B	1-6-3-15				**C15** – New EB and WB CD roads between Int 7 & 8
CC-C	1-6-13-14			**C13**–New Partial interchange at Great Plain Road	**C14** – New EB only CD road between Int 7 & 8
CC-D	1-6-13-15				**C15** – New EB and WB CD roads between Int 7 & 8
CC-E	1-6-26-14			**C26-**EB collector distributor road between Main St (Int 5) and North St. (Int 6)	**C14** – New EB only CD road between Int 7 & 8
CC-F	1-6-26-15				**C15** – New EB and WB CD roads between Int 7 & 8
CC-G	1-12-3-14		**C12**-Interchanges 3 and 4: Collector distributor road along EB I-84 between Lake Avenue and US-7	**C3-**Reconfigured Full interchange at Tamarack Avenue	**C14** – New EB only CD road between Int 7 & 8
CC-H	1-12-3-15				**C15** – New EB and WB CD roads between Int 7 & 8
CC-I	1-12-13-14			**C13-**New Partial interchange at Great Plain Road	**C14** – New EB only CD road between Int 7 & 8
CC-J	1-12-13-15				**C15** – New EB and WB CD roads between Int 7 & 8
CC-K	1-12-26-14			**C26-**EB collector distributor road between Main St. (Int 5) and North St. (Int 6)	**C14** – New EB only CD road between Int 7 & 8
CC-L	1-12-26-14				**C15** – New EB and WB CD roads between Int 7 & 8

5.2 Screening of Concept Combinations

The twelve concept combinations were analyzed using a three-tier screening process similar to the process that was used to screen the initial 26 individual concepts as described in Chapter 4, with the difference being that the concept combinations are compared to each other as a complete combination over the entire PEL Study Area instead of individual segment concepts.

The screening process eliminated combinations that were not feasible, were redundant to better-performing combinations, or had greater environmental issues than other combinations in order to produce a reasonable range of alternatives.

5.3 Fatal Flaw Analysis

The 12 concept combinations were assessed through the Fatal Flaw process using the same definitions applied to concept screening in Chapter 4. This analysis was conducted for each concept combination to verify that no fatal flaws were introduced in the process of combining discrete segment concepts. As such, each concept combination was evaluated to determine if combining individual concepts could result in a fatal flaw. For example, if one concept widened a highway segment to the north and another concept widened a highway segment to the south, then the resulting roadway would not align properly once these components were combined. This non-alignment could have created a fatal flaw.

None of the concept combinations exhibited characteristics that had fatal flaws, as defined. Therefore, all 12 concept combinations moved on to the Redundancy Analysis.

5.4 Redundancy Analysis

All twelve concept combinations were analyzed to determine whether they might be redundant with one or more of the other concept combinations. For the purposes of this screening analysis, redundancy has the following characteristics:

- Addresses the PEL Purpose in a similar fashion to one or more of the other concept combinations.
- Serves a similar function as one or more of the other concept combinations.
- Does not have a clear advantage over other concept combinations.
- Has more disadvantages than other similarly functioning concept combinations.

The above characteristics were established as criteria for the Redundancy Analysis in Chapter 4 and were similarly applied to the concept combinations. Once a concept combination was shown to be redundant without a clear advantage compared to one or more of the other, it was eliminated from further consideration. As this analysis focuses on concept combinations, the entire 10-mile corridor was considered.

5.4.1 Addressing PEL Purpose

One of the primary elements of the PEL purpose is improving congestion. To analyze comparative improvements in congestion, several travel time reliability measures were analyzed. Three travel time reliability measures relate to drive-time conditions.[1] The most effective methods of measuring travel time reliability are:

1. The 95th percentile travel time, which indicates how significant delays will be on specific routes during the heaviest travel days.
2. Buffer time, which is the time cushion that most travelers add to their average travel time to ensure an on-time arrival.
3. Planning time, which is the sum of the travel and buffer times and represents the total travel time that should be planned to arrive on time approximately 95% of the time.

[1] https://ops.fhwa.dot.gov/publications/tt_reliability/ttr_report.htm

Planning time is of significant interest to the public who are trying to arrive at their destination on time. Therefore, planning time is the focus for this portion of the Redundancy Analysis. The percent change in planning time over the no-build condition was used to represent the potential improvement associated with each concept combination. The percent change was calculated by comparing the 2040 no-build planning time to each of the individual concept combination's 2040 planning time. Table 5-2 shows that for all peak hour roadway movements along I-84 and US-7 in both the a.m. and p.m. periods, all the percent changes were positive, which are indicative of a travel reliability improvement.

Table 5-2
Percent Improvement of Planning Time by Concept Combination

Planning Time Index	CC-A	CC-B	CC-C	CC-D	CC-E	CC-F	CC-G	CC-H	CC-I	CC-J	CC-K	CC-L
I-84 West (A.M.)	35%	32%	30%	24%	34%	34%	35%	32%	30%	24%	34%	34%
I-84 East (P.M.)	61%	60%	66%	66%	66%	66%	61%	60%	66%	66%	66%	66%
US-7 South (A.M.)	72%	72%	72%	72%	76%	77%	72%	72%	73%	72%	77%	77%
US-7 North (P.M.)	69%	72%	57%	53%	75%	76%	71%	73%	59%	61%	76%	77%
Average	**59%**	**59%**	**56%**	**54%**	**63%**	**63%**	**60%**	**59%**	**57%**	**56%**	**63%**	**64%**

The common element of the mainline segment (i.e., C1) has the biggest contribution to the improvement. This is due to its extensive geographic and traffic volume influence compared to the other three segments (West, Center, and East). Due to the magnitude of the common mainline concept contribution, all concept combinations improved the overall planning time to a similar degree when comparing each concept combination across any one planning time index category. Therefore, all concept combinations meet the first redundancy requirement of addressing the PEL purpose in a similar fashion.

5.4.2 Serving Similar Function

Evaluating the characteristic of similar functionality helps to focus on the individual elements of the concept combinations. As the mainline segment is a common element for all combinations, it is not a factor in this evaluation. The two components from the western segment (C6 and C12, shown in Figure 5-3) are similar, as they both attempt to address a weaving issue between I-84 mainline and the exit ramp to Lake Avenue. The two components from the eastern segment (C14 and C15, shown in Figure 5-4) are very similar, as they both rely on a CD road, and attempt to address weaving issues between Interchanges 7 and 8 and where US-7 diverges from I-84 to the northeast. The three components from the center segment (C3, C13, and C26, shown in Figure 5-5) feature solutions that contribute a different functionality in connecting mainline I-84 to different locations of the Danbury downtown and hospital areas. To further differentiate concept combinations containing these elements, the similarities and differences created by these elements are examined further in Section 5.4.3.

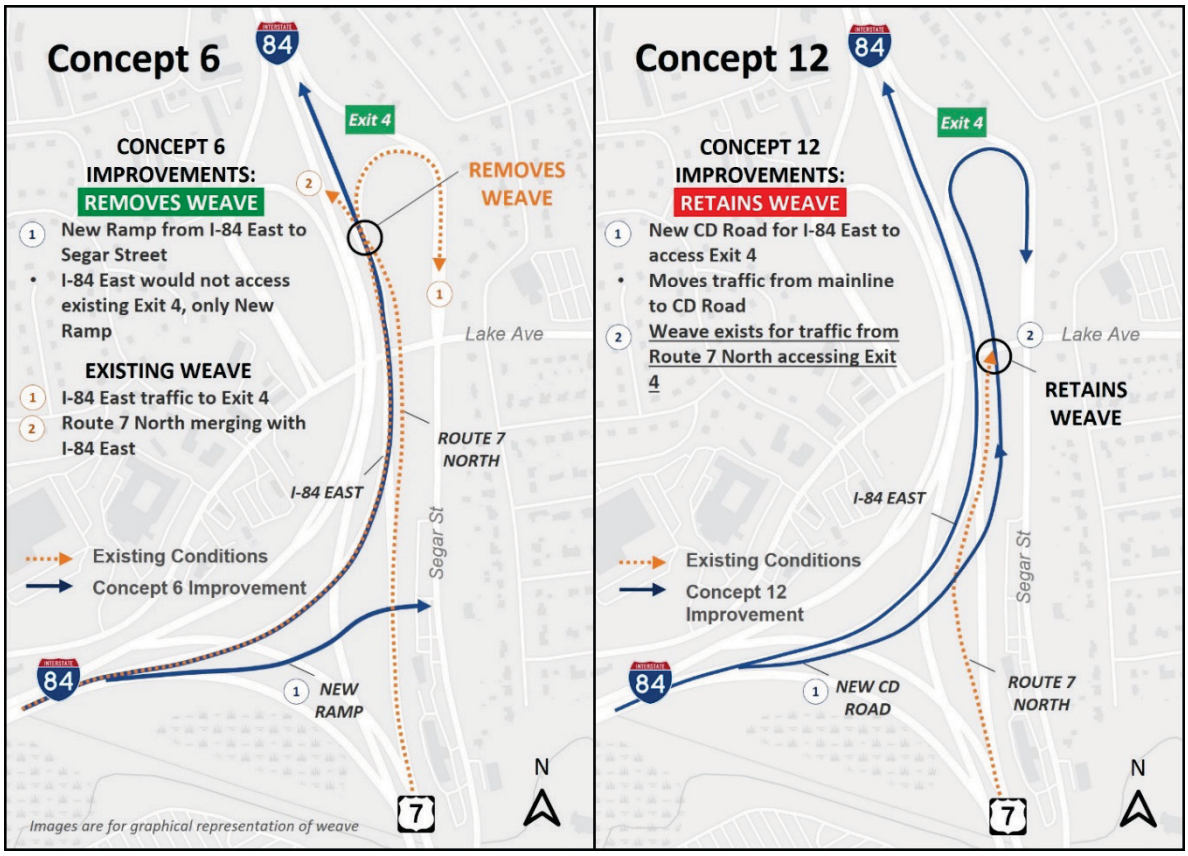
5.4.3 Advantages/Disadvantages

The remaining components of the Redundancy Analysis evaluate whether a concept combination has advantages or disadvantages compared to other concept combinations that address the PEL purpose in similar fashion and are similarly functioning. Corrections of weaving, which is considered a key engineering consideration having a direct association with the PEL purpose, was the basis for this analysis.

Weaving conditions are a contributing cause of congestion on I-84 through the PEL Study Area. They interfere with driver expectations, and cause conflicts as drivers negotiate frequent lane changes. Weaving is primarily an artifact of close proximity of on-ramps and off-ramps, making it difficult to maintain one lane of travel along I-84 through this section. Weaving can result in congestion, slowdowns, and an increase in crashes when different paths of traffic come into conflict with one another.

While all concept combinations eliminate the left-hand ramp weaving issues, other design decisions can retain or introduce weaves. The weaves for the west segment are shown in Figure 5-1. C6 eliminates the existing weave where northbound US-7 traffic merges with eastbound I-84 traffic exiting to Interchange 4 by introducing a new ramp from eastbound I-84 to Segar Street and thus eliminating access from eastbound I-84 to Interchange 4. C12 retains this weave between these movements on a new eastbound CD Road. Therefore, each of the six concept combinations that contain C6 are more advantageous relative to weaving as compared to each of the similar concept combinations with C12.

Figure 5-1
West Segment Weave



The weaves for the east segment are shown in Figure 5-2. C15 removes the weaves for eastbound and westbound I-84, where I-84 traffic mixes with traffic exiting at interchanges 8 and 7 respectively, by adding a CD road in each direction. C14 retains the westbound weave, as it only has a CD road in the eastbound direction. Therefore, each of the six concept combinations that contain C15 are more advantageous relative to weaving as compared to each of the similar concept combinations with C14.

Figure 5-2
East Segment Weave

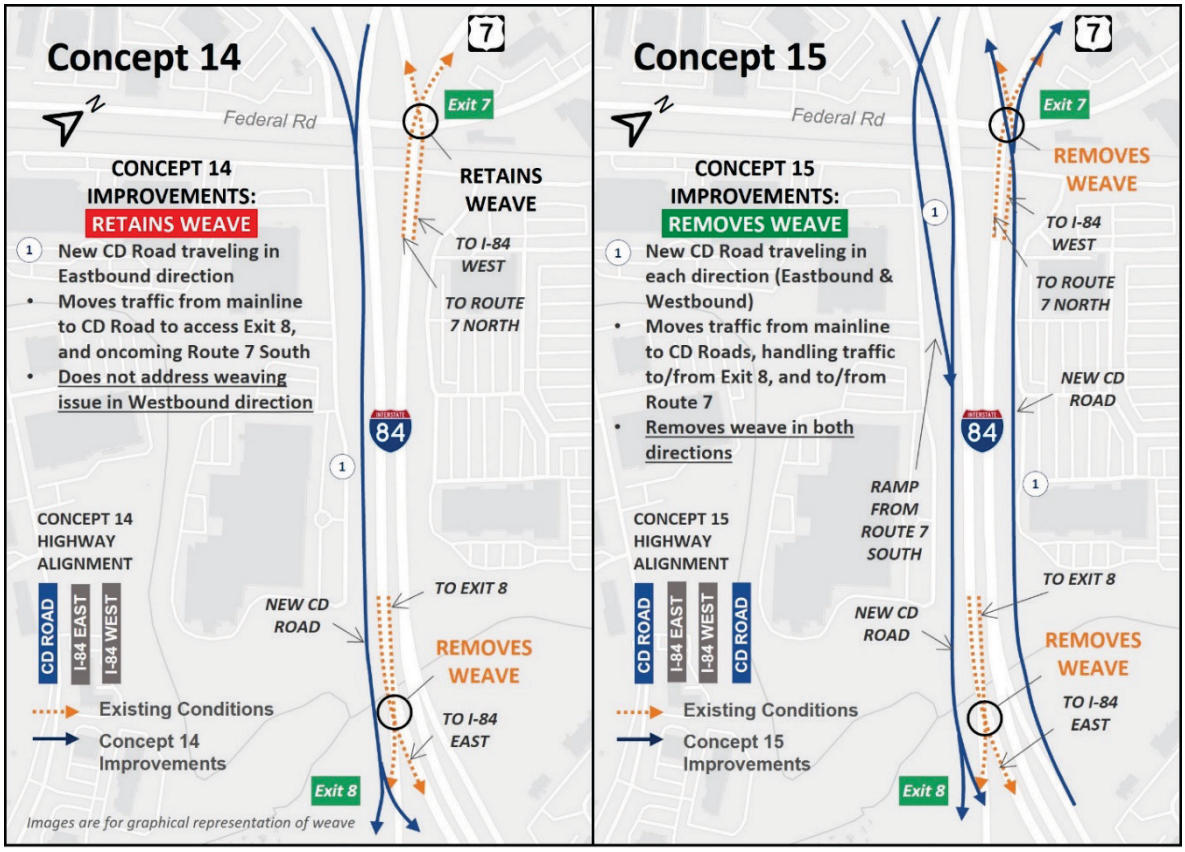


Table 5-3 presents the differences among the concept combinations in corrections of weaving. A full range of performance conditions is evident, with combinations CC-B, CC-D, and CC-F having the best performance (green), and CC-G, CC-I, and CC-K having the worst performance (red). The remaining concept combinations have average performance (yellow). The differences among the three performance levels are based on the number of weaving movements that would remain as compared to the existing condition.

Table 5-3
Corrections of Weaving Consideration

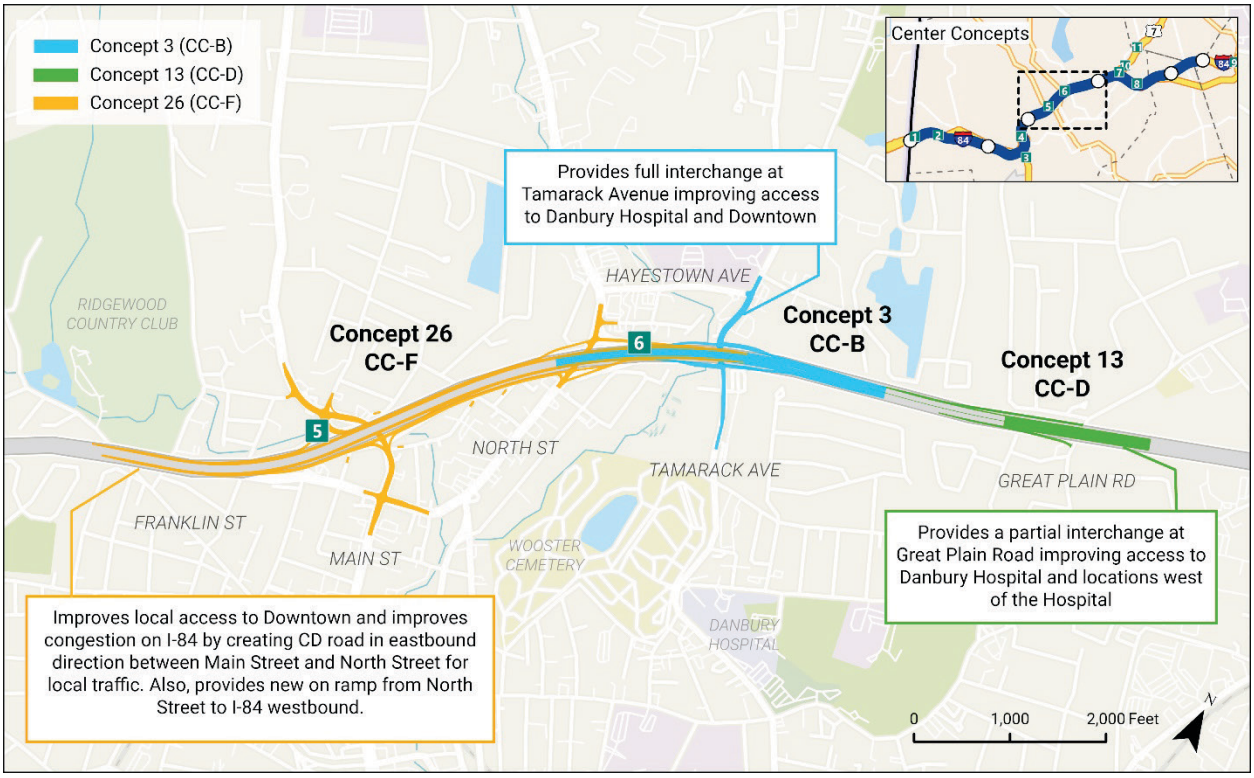
Engineering Consideration	CC-A	CC-B	CC-C	CC-D	CC-E	CC-F	CC-G	CC-H	CC-I	CC-J	CC-K	CC-L
Corrections of Weaving	○	△	○	△	○	△	▽	○	▽	○	▽	○

Symbols Defined as Follows: △ Best Performance ○ Average Performance ▽ Worst Performance

Given that the concept combinations serve a similar function, combinations having either average or worst performance when considering corrections of weaving, have a clear disadvantage when compared with the remaining concept combinations and are therefore considered to be redundant.

The Center Segment concepts (C3, C13, and C26) provide different approaches in connecting mainline I-84 to different locations of the Danbury downtown and the hospital. C26 focuses its modifications near the Main Street and North Street interchanges; C3 is primarily centered around the Tamarack Avenue full interchange; and C13 is focused on the Great Plain Road partial interchange. As indicated in 5.4.2 and shown in Figure 5-3, these concepts contribute different functionality to mobility improvements in the center segment. Furthermore, none of the concept combinations appear to have clear advantages or greater disadvantages when compared with the other center treatments.

Figure 5-3
Concept Combinations with Center Treatments



5.4.4 Redundancy Conclusion

All concept combinations meet the requirement of addressing the PEL purpose in a similar fashion. There is similar functionality in the eastern (C6 and C12) and western (C14 and C15) elements of the concept combinations. In both the east and west segments, those similar elements have one element (C14 and C12 respectively) that has no clear advantage while carrying greater disadvantages (more weaves). Eliminating concept combinations that contain these two redundant elements removes nine of the twelve combinations (CC-A, -C, -E, -G, -H, -I, -J, -K, and -L). The remaining concept combinations are those that include Concept 15 in the East Segment, Concept 6 in the West Segment, and Concept 1 in the Mainline. These three remaining concept combinations (CC-B, CC-D, and CC-F) thus move forward into the Screening Matrix Analysis (Table 5-4).

Table 5-4
Redundancy Analysis by Concept Combination

CC No.	Screening Category		
	Fatal Flaw	Redundancy	Screening Matrix
CC-A	→	X	
CC-B	→	→	
CC-C	→	X	
CC-D	→	→	
CC-E	→	X	
CC-F	→	→	
CC-G	→	X	
CC-H	→	X	
CC-I	→	X	
CC-J	→	X	
CC-K	→	X	
CC-L	→	X	

Colors Defined as Follows: → Combination Advancing X Combination Eliminated

5.5 Screening Matrix Analysis

The remaining concept combinations (CC-B, CC-D, and CC-F) were analyzed and compared to determine if there were differences in relation to their potential for environmental impact. All three concept combinations share the same segment concept for the mainline, west, and east segments (C1, C6, and C15, respectively), with the only difference in these combinations being the options for the Center Segment (C3, C13, and C26).

When reviewing the potential for environmental impacts among the remaining concept combinations, while there is some small degree of variability (Table 5-5), none stand out as having disproportionate potential for impact. As the potential for environmental impact is insufficient to eliminate any of the three remaining concept combinations, all three were advanced for further consideration.

Table 5-5
Potential for Environmental Impact – Final Concept Combinations

Environmental Consideration | Concept Combination	CC-B	CC-D	CC-F
Built			
Full Property Acquisitions	●	●	●
Partial Property Acquisitions	●	●	●
Sensitive Neighborhood Impacts - Full	●	●	●
Dead-End Streets-Community Cohesion	▲	▲	●
Potential cemetery property impacts	▼	▼	▼
Section 4(f) Property Impacts	●	▲	▲
Proximity to NGPL Right-of-Way	●	●	●
Historic Property Impacts	▲	▲	▲
Environmental Consideration | Concept Combination	**CC-B**	**CC-D**	**CC-F**
Natural			
Wetland Impacts	●	●	●
Stream Impacts	●	●	●
Potential for Floodplain Impacts	●	●	●
Listed Species Impacts	▲	▲	▲
Critical Environmental Area Impacts	▲	▲	▲
Impacts on Habitat for Sensitive Plants and Wildlife	▼	▼	▼

Symbols Defined as Follows: ▲ No Impacts ● Potential for Impacts ▼ High Potential for Impacts

5.6 Concept Combinations Recommended for the Reasonable Range of Alternatives

The remaining concept combinations all include one mainline concept (C1), one west concept (C6), and one east concept (C15), and differ only in the center section, combined with one of the three remaining center concepts (C3, C13, and C26). These concept combinations (CC-B, CC-D, and CC-F) are recommended to be carried forward into the Reasonable Range of Alternatives for further project-based environmental reviews. Next steps are described in Chapter 7.

The logical western terminus of the three concept combinations is between Interchanges 1 and 3, and the logical eastern terminus is east of Interchange 8 on I-84. These endpoints represent the western and eastern extents of the transportation improvements reflected in the remaining concept combinations. More detailed analysis during the Class of Action determination will establish the specific location of these termini. Since all three alternatives (CC-B, CC-D, and CC-F) for a proposed future project contain the mainline C1 concept (Lane Continuity) and no other component extends further east or west, the same logical termini apply to each one.

Connected actions must be analyzed as part of NEPA. Actions are connected if they: (i) Automatically trigger other actions which may require environmental impact statements (EIS) (ii) Can not or will not proceed unless other actions are taken previously or simultaneously (iii) Are interdependent parts of a larger action and depend upon the larger action for their justification.

Benefits of any of the concept combinations include reducing congestion along the I-84 corridor and local roadways and increasing mobility by improving access to the local roadway network. Chapter 7 provides additional analysis on how these mainline alternatives are independent of a future connected action in the I-84 corridor.

6.0 Potential Breakout Projects

6.1 Introduction

Breakout projects are independent projects that could be initiated and completed separately and would either address or complement the objectives of the PEL Study and align with the PEL Study purpose. Breakout projects must meet the criteria for a stand-alone transportation project under the Code of Federal Regulations (see 40 CFR part 93.101 for the definition of a Highway Project). They require further study and analysis before being implemented. Breakout projects must have:

1. A project has independent utility if it is usable and is a reasonable expenditure of federal and state funds, even if no additional transportation improvements in the area are made.
2. Logical termini identified to establish the project and study limits for both transportation improvements and environmental impact review. Logical termini ensure that a project can function and that environmental impacts can be evaluated.
3. No connected action, meaning it would not restrict or influence consideration of other reasonably foreseeable transportation improvements in the PEL Study Area.

Several potential breakout projects have been identified as meeting the above criteria and are potentially viable to move forward independently. Some of these could be initiated by CTDOT and some would be appropriate for implementation by others. In all cases, these potential breakout projects would complement the solutions recommended in Chapter 5. The purpose of this chapter is to discuss these potential breakout projects in greater detail and provide further information for their consideration.

6.2 Concept 4 – Transit

Concept 4 (C4, Figure I-4, Appendix I) identifies potential transit options that would improve mobility and increase transportation options for the traveling public in the I-84/US-7 corridor in Danbury and neighboring towns. These options would potentially reduce congestion on the highway and local roads, improve mobility along the corridor and in the region, provide better access for transit-dependent communities, complement existing transit services, and support economic and transit-oriented development opportunities. Having these transit options is particularly important for Danbury residents who represent zero-car households.

A transit assessment in the I-84/-7 corridor was conducted to identify and review these transit options and provide a foundation for a future comprehensive transit study. Additional details on the approach, analysis, and findings are available in the I-84 Danbury Transit Assessment Technical Report in Appendix K. A summary discussion follows.

6.2.1 Existing Travel Conditions and Services

An analysis of weekday peak period travel based on the U.S. Census and regional travel model data found the following:

Most trips in the Danbury region are local trips, meaning they begin and end within an eight-town region.

- Approximately 10% of the existing trips are made to/from New York State.
- Approximately 3% of the existing trips are made to/from New York City.
- I-84 and Route 7 are the primary roadways used for both local and regional travel.
- Local traffic is the main contributor to the congestion levels on I-84 and Route 7 during the A.M. and P.M. peak periods.
- Danbury has the most zero/one-car households in the study area.

The ownership of the various transport resources is noted below. Collaborative discussions with the CTDOT Bureau of Public Transportation along with the Housatonic Area Regional Transit (HARTransit) would allow for these improvements to be further defined and potentially moved forward as potential projects if funding is secured.

The Danbury region has the following transit services:

- Bus service is operated by HARTransit with seven routes.
- The bus system is focused within Danbury; however, some routes extend into neighboring towns such as Bethel, Brookfield, and New Milford.
- HARTransit bus routes also serve major employers, shopping centers, medical centers, schools, elderly populations, and low-income housing areas.
- Metro-North Railroad operates a commuter rail service on the Danbury Branch Line, which connects to the New Haven Line and Harlem Line in New York State.

6.2.2 Transit Option Development

Transit options were explored and evaluated for their ability to:

- Reduce vehicular congestion on highways and local roads.
- Improve mobility along the corridor and in the region.
- Provide better access for transit-dependent communities.
- Complement existing transit services.
- Support economic and transit-oriented development opportunities.

The evaluation process included the following:

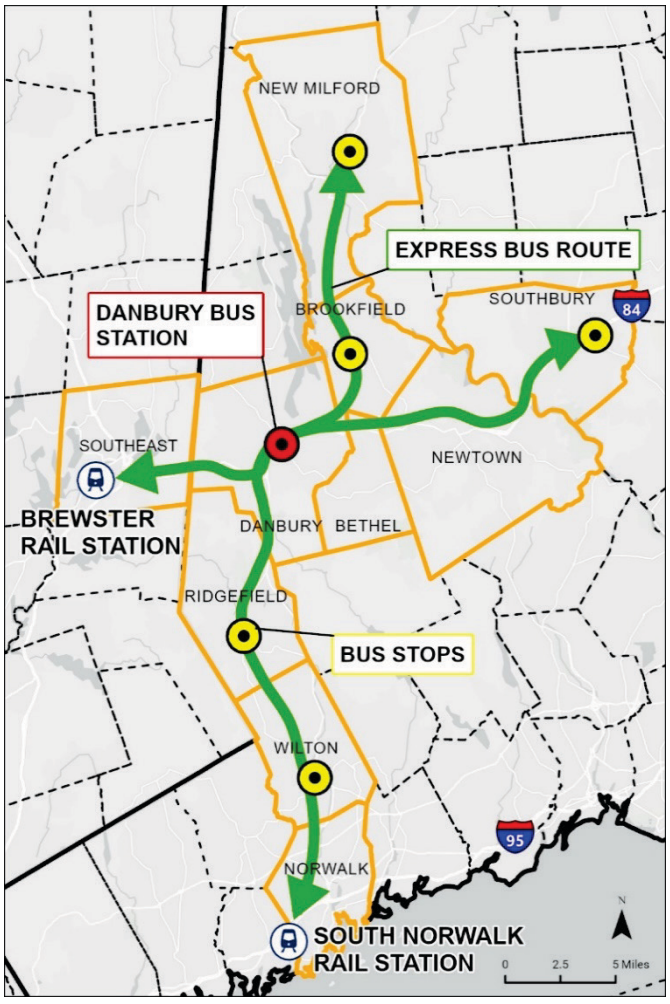
- Identifying potential transit improvements after studying regional demand.
- Defining modes, routes, and other service factors (i.e., service frequency, one-way trip time, vehicle type/capacity, number of stops, etc.).
- Assessing potential ridership levels and impact on traffic.
- Conducting a high-level assessment of benefits (i.e., potential to divert automobile users to transit, level of congestion relief on I-84 and Route 7).
- Developing high-level capital and operations and maintenance costs.

6.2.3 Potential Transit Options

The following regional and local transit options through Danbury were identified during the PEL Study, with opportunities for connections between them.

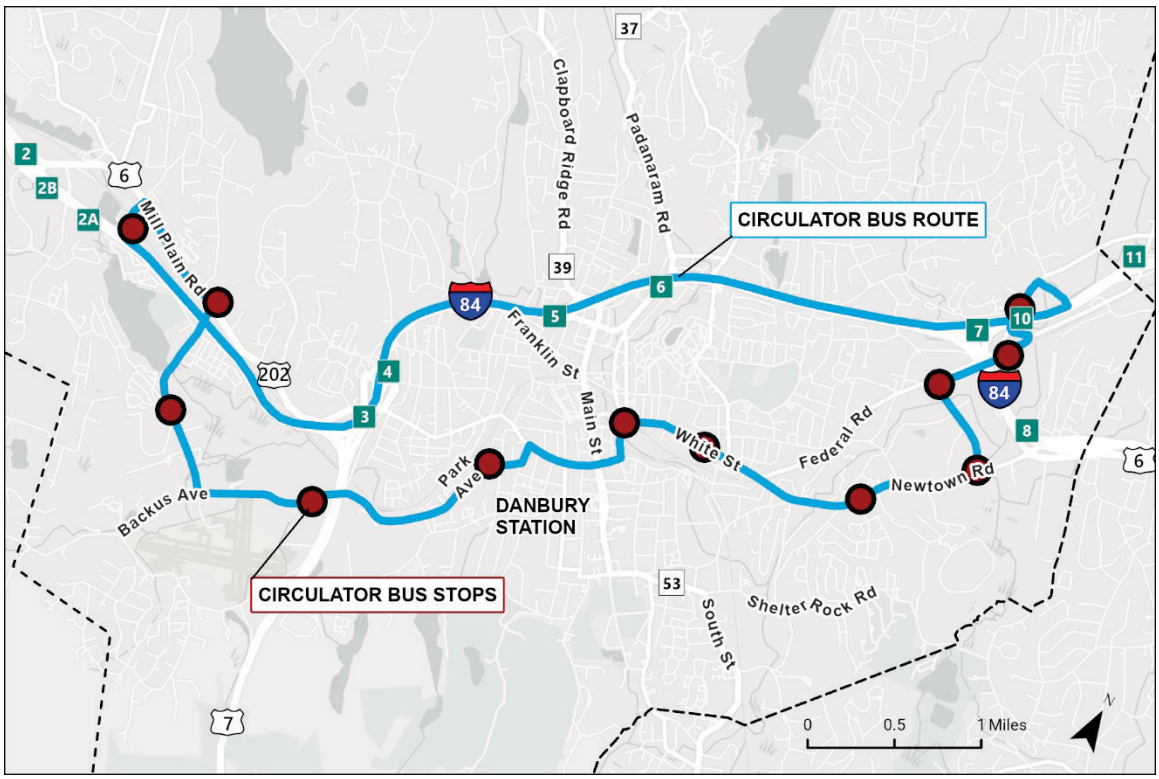
- New Milford – Danbury Park-and-Ride (P&R) – Addition of a Norwalk Express Bus (Figure 6-1, Express Bus Option): This would provide a north-south regional peak express service.
- Southbury – Danbury P&R: Addition of a Brewster Rail Station Shuttle Bus (Figure 6-1, Express Bus Option): This would provide an east-west inter-town express service and access to the Metro North Harlem Line.

Figure 6-1
Express Bus Option – Conceptual Layout



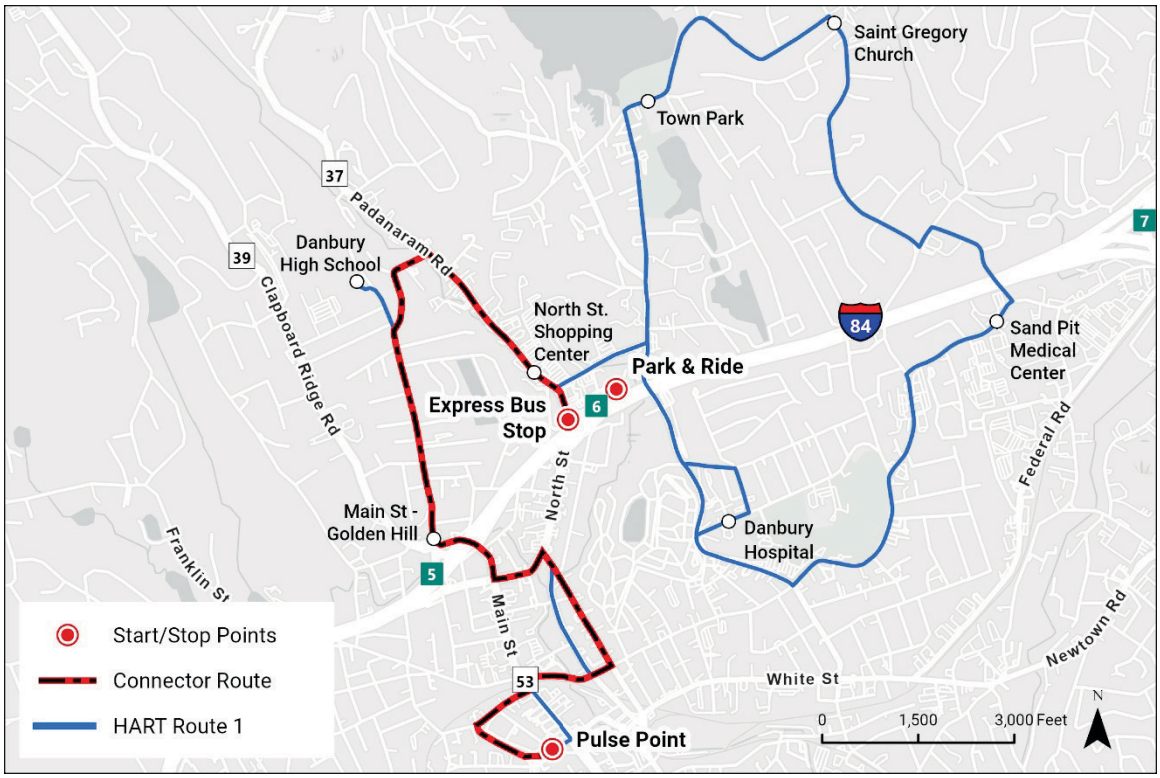
- Addition of a Danbury Circulator Shuttle Bus (Figure 6-2, Circulator Bus Option): This would provide a local circulator shuttle route offering regional bus/shuttle riders access to major attractions in Danbury, including Danbury Fair Mall, Danbury Municipal Airport, Danbury Hospital and the WCSU campus.

Figure 6-2
Circulator Bus Option – Conceptual Layout



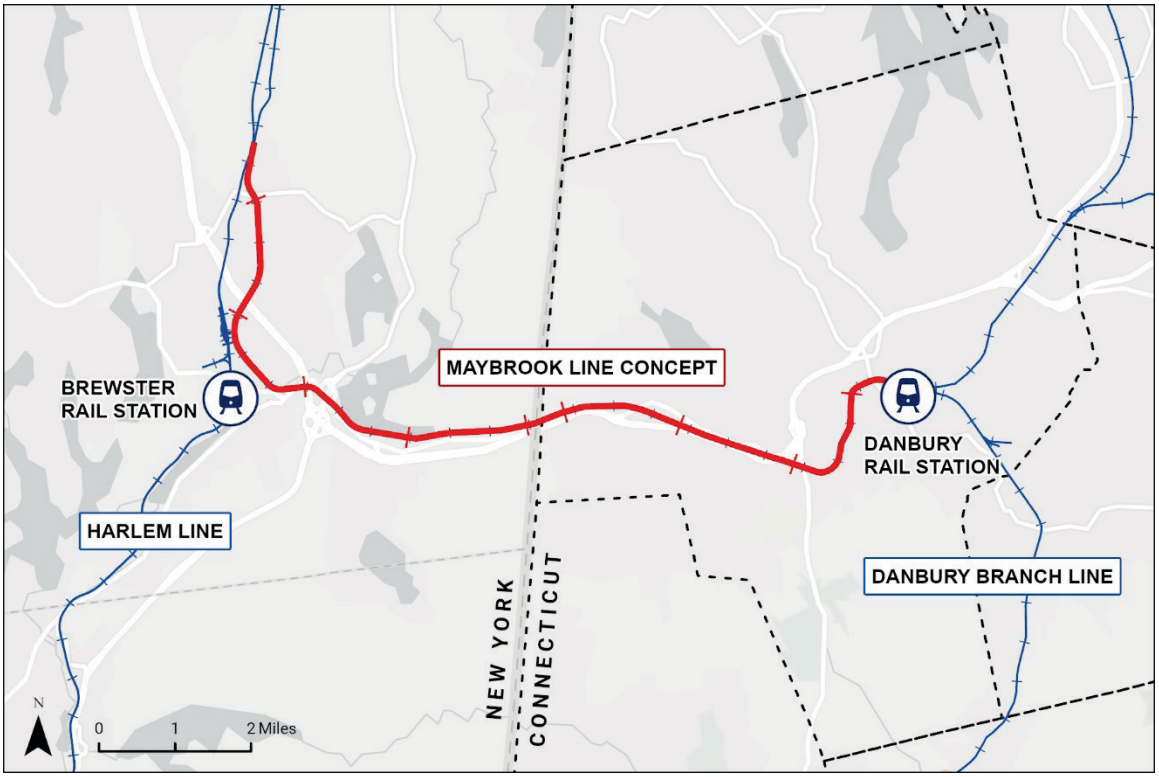
- Addition of a Danbury P&R/Express Connector (Figure 6-3, P&R/Express Connector Option): This service would require a new bus stop at North Street and Walnut Street serving the Danbury Park & Ride/ Express Connector and an adjusted Route 1 service. Connecting the Express Connector to HARTransit's existing Route 1 service will provide riders more access to local Danbury locations.

Figure 6-3
P&R/Express Connector Option – Conceptual Layout



- Addition of a Maybrook Line Rail Shuttle (Figure 6-4, Maybrook Line Option): The Maybrook Line is an unutilized railroad right-of-way between Danbury and Metro-North's Southeast Station in Brewster, NY. The Housatonic Railroad owns and has freight rights over the Maybrook Line. Currently, the line is used for occasional Metro-North Railroad equipment moves. A proposed Rail-Link Project, defined by The Southeast to Danbury Rail Link Feasibility Study (2022), would provide an improved passenger rail transit option between Southeast New York and Danbury. This option could connect a new rail station in Danbury with the Metro-North Southeast Station in Brewster, NY. The proposed rail service would operate alongside sections of the almost complete Maybrook Bikeway and generally parallel to Interstate I-84.

Figure 6-4
Maybrook Line Option – Conceptual Layout



6.2.4 Evaluation of Concept

During the projected 2040 peak traffic hour, I-84 will carry approximately 7,000 auto trips in the peak travel direction. Based on a high-level transit ridership analysis and an approximate estimate of potential traffic diversion to transit, if all the potential transit options stated above were implemented, approximately 410 auto trips (or about 6 percent of the 7,000 auto trips) on I-84 could be shifted to transit during peak hour.

Minimal right-of-way would be required at existing park and ride lots and bus stops. New transit options have the potential to offer regional and local mobility choices within the community. Although they could be implemented individually, the benefits are maximized if implemented together as a system.

Bus transit options could complement any highway concepts. These improvements are anticipated to require minimal infrastructure improvements and could be implemented before any highway construction commences while providing long-term alternative options.

Implementation of transit concepts would improve regional and local mobility, address the needs of transit-dependent users, and may attract additional ridership. While these changes also would not significantly reduce congestion on I-84, they have the potential to improve mobility in the corridor.

6.2.5 Transit Recommendations

The transit analysis discussed in Section 6.2.4, did not indicate a significant amount of mode shift from vehicular to transit use for people driving to New York and points west. This finding is relevant to the Maybrook Line Rail Shuttle option which was specifically reviewed by the Bureau of Public Transportation at CTDOT. This review determined that a large capital investment would be necessary to upgrade the line for passenger use. The Housatonic Railroad Company, who owns this line, would also be required to partner in making the necessary improvements or selling the line. Furthermore, even if this line was available, CTDOT would need to review the potential purpose and need, to include a cost benefit analysis, to justify the corresponding rail investment.

It is recommended that the remaining breakout transit projects, described in Section 6.2.3, be further studied via a comprehensive bus transit service analysis independent of the alternatives recommended in Chapter 5.

6.3 Concept 23 – Transportation Systems Management and Operations

Concept 23 (C23, Figure I-23, Appendix I) is comprised of strategies focused on operational improvements to increase mobility and reduce congestion with minimal modifications to the existing roadway. These strategies have the potential to reduce congestion and improve mobility on I-84.

The Transportation Systems Management and Operations (TSMO) concept represents a series of potential strategies in several program areas developed by the FHWA and the Federal Transit Administration (FTA) to integrate operations into the planning and programming of projects. These operational improvements can maintain and even restore the performance of the existing transportation system before extra capacity is needed. The goal is to get the most performance from the existing transportation facilities. TSMO also helps agencies balance supply and demand and provide flexible solutions to match changing conditions.

The strategies, presented in Table 6-1 and described in the ensuing narrative, all have the potential to reduce congestion and improve mobility on I-84 and the surrounding local roadways. All can likely be implemented within the existing right-of-way. Some of these strategies may be part of a future build project; however, they may also pose an opportunity for application as separate independent breakout projects that would not interfere with the future construction of any alternatives recommended for advancement. If pursued as breakout projects, they could be implemented quickly using typical construction methods.

Table 6-1
Transportation Systems Management and Operations Program Areas and Strategies

Program Areas	Strategies
Active Transportation Demand and Management	Dynamic Lane Use Temporary or Hard Shoulder Running
Freeway Management	Freeway Ramp Metering
Traffic Incident Management	Variable Message Signs and Cameras
Arterial Management	Traffic Signal Retiming and Optimization
Travel Demand Management	Telecommuting, Rideshare, Bus, and Rail Transit
Public Transportation Management	Bus and Rail Transit Operations
Corridor Traffic Management	Safety Applications, Access Management, and Others
Real-time Traveler Information	Connected and Automated Vehicle Deployment

TSMO strategies are described below in Section 6.3.1. Additionally, they are discussed in detail in Appendix L. Several strategies that had the potential to address the PEL Study purpose to "*reduce congestion and improve mobility of people and goods in the I-84 corridor in greater Danbury*" were examined.

6.3.1 Description of Strategies

TSMO program areas and strategies are summarized below. This is not intended to be a rigorous analysis. To advance any of these strategies, either as potential breakout projects or added to complement a mainline alternative, additional feasibility, cost assessment, and environmental impact analysis would be required.

Active Transportation Demand and Management

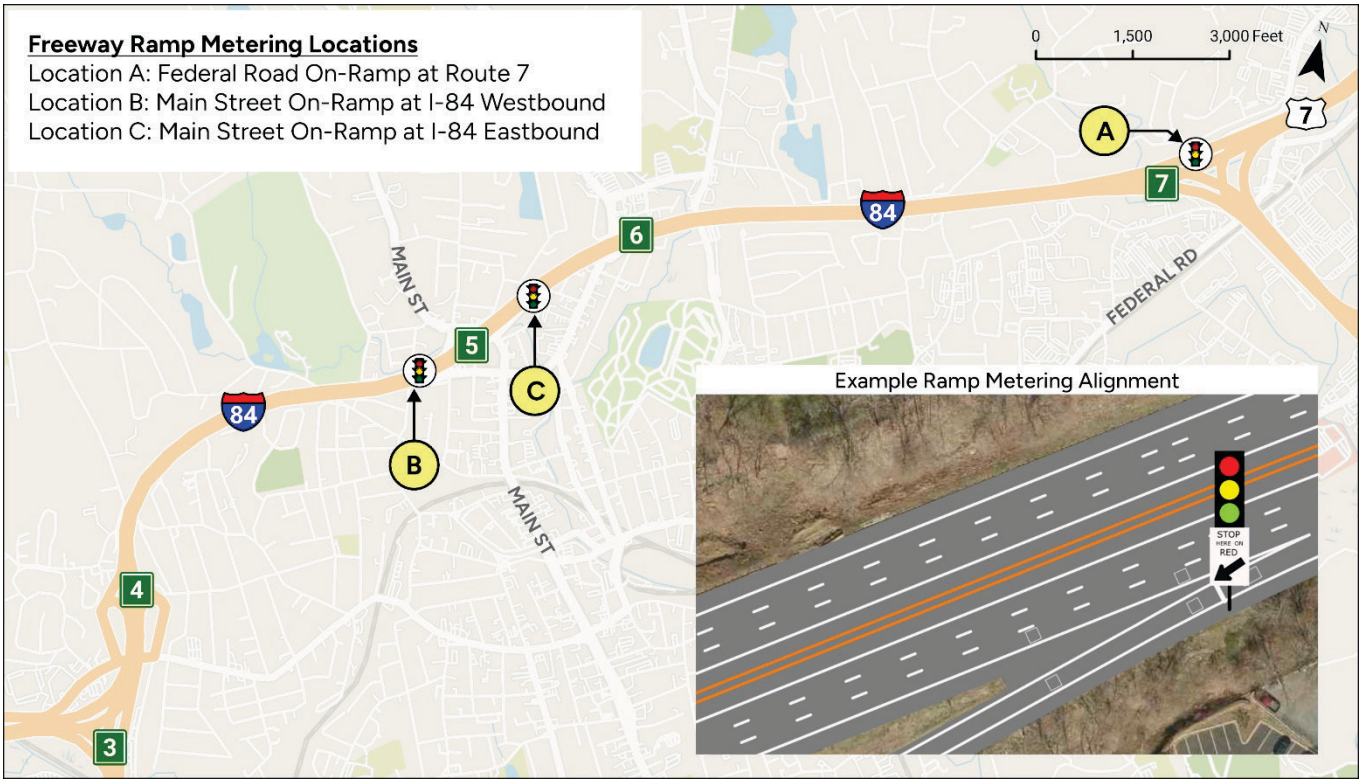
Dynamic Lane Use – DLU involves closing or opening individual traffic lanes to improve traffic flow in the peak direction by time of day. This strategy involves reallocating road space in response to changes in demand to use existing infrastructure more efficiently.

Temporary or Hard Shoulder Running – Shoulder running would utilize the mainline right shoulder for I-84 westbound and I-84 eastbound during peak hours between Interchange 3 and Interchange 7.

Freeway Ramp Metering – Freeway ramp metering (Figure 6-5) involves managing the amount of traffic entering a freeway by installing traffic signals on the entry ramps to control the frequency at which vehicles enter the highway, usually during peak periods. Three locations would be considered for installation based on current high traffic volumes:

- Federal Road on-ramp at Route 7 southbound
- Main Street on-ramp at I-84 westbound
- Main Street on-ramp at I-84 eastbound

Figure 6-5
Freeway Ramp Metering – Conceptual Alignment



Traffic Incident Management – Traffic incident management is a strategy that employs roadside devices such as cameras and variable message signs to notify motorists of incidents and delays in the area. This enables them to make informed travel choices. No permanent roadside devices are deployed in the study limits. Devices presently in this area are limited to portable cameras and variable message signs using cellular to communicate with the Newington Operations Center.

Arterial Management – Arterial management is associated with improving the operations on arterials with the use of traffic signal technologies such as signal retiming and optimization, signal modernization and upgrades, use of adaptive systems, and extracting performance measures using the Automated Traffic Signal Performance Measures (ATSPM). For I-84 in greater Danbury, there are opportunities to work with the City of Danbury to evaluate and implement arterial management strategies on key corridors such as Mill Plain Road, Lake Avenue, Main Street, North Street, Federal Road, Newtown Road, and others.

Travel Demand Management – The Travel Demand Strategy (TDM) looks at opportunities to reduce the number of single-occupant vehicles using the transportation network. FHWA defines TDM as managing both the growth of traffic and the periodic shifts in traffic demand on a given network or system to better manage traffic congestion and improve the performance of the transportation system. Managing travel demand involves using various tools and strategies that provide travelers, regardless of whether they drive alone, with travel choices - such as work location, route, time, and mode.

TDM strategies, or solutions that re-distribute or reduce travel demand, can be implemented by both the public and private sectors. The goal can be accomplished through a variety of approaches. In the public sector, various TDM services are available in the Greater Danbury area, including park-and-ride lots, carpool/vanpool services through CTRides, and bike/transit integration. The private sector can contribute to TDM by allowing their employees to work flexible hours and telecommute.

Public Transportation Management – This strategy is associated with improving public transportation operations. For this study, Concept 4 (Transit) looks at opportunities to enhance bus and rail transit in the Greater Danbury area. These options are discussed earlier in this chapter with most being recommended for a more comprehensive study.

Corridor Traffic Management – Corridor traffic management includes installing highway curve signage and pavement markings to caution drivers of upcoming roadway conditions.

Connected and Automated Vehicle Systems – Connected and automated vehicle deployment is considered part of integrated corridor management that could, in the future, become a viable way for vehicles to communicate and possibly coordinate with each other using artificial intelligence and automated vehicles. This strategy could be deployed in the I-84 Danbury corridor once the infrastructure and testing are completed in Connecticut.

6.3.2 Evaluation of Strategies

Table 6-2 presents the pros and cons of each strategy, indicating with a "✓" which strategies that apply. These items are included in relation to how the strategies align or fail to align with the PEL Study purpose and their impact on implementation, operations, or maintenance.

Table 6-2
Pros and Cons of TSMO Strategies

Description	Dynamic Lane Use	Hard Shoulder Running	Freeway Ramp Metering	Traffic Incident Mgmt.	Arterial Mgmt.	Travel Demand Mgmt.	Public Transp. Mgmt.	Corridor Traffic Mgmt.	CV and AV Vehicle Deployment
Pros									
+ Peak-hour delay is reduced	✓	✓		✓[1]	✓[1]	✓[1]	✓[1]	✓[1]	✓[1]
+ Improve mobility on highway	✓	✓		✓[1]		✓[1]	✓	✓[1]	✓[1]
+ Improve mobility on local streets					✓[1]	✓[1]	✓	✓[1]	
+ Does address other modes of travel such as pedestrian, bicycle, or public transit travel modes					✓[1]	✓[1]	✓	✓[1]	
Cons									
- Unfamiliar to drivers and may create confusion	✓	✓	✓						
- Divert traffic to adjacent local streets			✓	✓[2]					
- Unable to use shoulder for emergency use during peak hour	✓	✓							

Summary of Pros (applies to all strategies):

+ Typical construction methods could be used.
+ Does not require additional rights of way.

Summary of Cons (applies to all strategies):

– Does not address lane continuity on I-84.
– Does not address left hand ramps in the I-84 corridor.
– Lack consistent design speed throughout the I-84 corridor.
– Interchange 6 remains a partial interchange.
– Does not improve access to the Danbury Hospital.
– Does not propose changes to the existing interfaces to local streets.

[1] This is based on a qualitative assessment, as a detailed quantitative analysis was not performed.

[2] This is true only in the event of incidents.

6.3.3 Recommendations

Dynamic Lane Use

DLU can reduce congestion and improve mobility on the highway. Such a strategy could also reduce the diversion of highway traffic to the local road network, thereby reducing congestion and improving mobility on those local roads, benefiting other modes of travel adjacent to the highway, such as pedestrian, bicycle, or public transit travel modes.
Recommendation: DLU is recommended to be advanced for further consideration by DOT. DLU is explored further in Chapter 7.

Freeway Ramp Metering

Freeway ramp metering does not reduce congestion or improve mobility on the local roads. This option could potentially improve traffic flow on I-84, but at the expense of traffic impacts on local roads. Due to the traffic congestion on the crossroads adjacent to the I-84 and Route 7 ramp locations, motorists would divert to other local roads adding traffic congestion in other areas of the City. This would create a gridlock type condition in the local street network.
Recommendation: This strategy was dismissed from further consideration.

Traffic Incident Management

Traffic incident management could reduce congestion and improve highway mobility with the help of roadside devices such as permanent variable message signs and cameras replacing and expanding upon the portable locations. These devices can help motorists get notifications of incidents and delays in the area, enabling them to make travel choices. This strategy does not require additional right-of-way. It does not address other modes of travel adjacent to the highway, such as pedestrian, bicycle, or public transit travel modes.
Recommendation: This strategy could be considered as part of a future project or on its own merits.

Arterial Management

Arterial management could reduce congestion and improve mobility on local streets with the help of traffic signal technologies. This strategy does not require additional right-of-way and could be implemented quickly. It addresses other modes of travel adjacent to the highway, such as pedestrian, bicycle, or public transit travel modes.
Recommendation: This strategy could be considered as part of a future project or on its own merits.

Travel Demand Management

TDM could help reduce the use of single-occupant vehicles on the highway. Therefore, it has the potential to reduce congestion and improve mobility on the highway and on the local roads. It also addresses other modes of travel adjacent to the highway, such as pedestrian, bicycle, or public transit travel modes. This strategy does not require additional right-of-way.
Recommendation: TDM could be considered as part of a future project or on its own merits.

Public Transportation Management

Public transportation management addresses other modes of travel adjacent to the highway, such as bus and rail transit. Under Concept 4 (Transit Options), a high-level evaluation of bus and rail transit was undertaken, and it was determined that bus and rail transit provide mobility options in the corridor. This evaluation is documented in the Transit Assessment report. This strategy does not require additional right-of-way.

Recommendation: Public transportation management could be considered as part of a future project or on its own merits.

Corridor Traffic Management

Corridor traffic management includes installation of highway curve signage and pavement markings on the highway to caution drivers of upcoming roadway conditions. This strategy does not require additional right-of-way.

Recommendation: Corridor traffic management could be considered as part of a future project or on its own merits.

Connected and Automated Vehicle Systems

Connected automatic vehicle systems could be deployed in the I-84 Danbury corridor once the infrastructure and testing are completed in Connecticut.

Recommendation: Connected and automatic vehicle systems could be considered as part of a future project or on its own merits.

6.3.4 Other Potential Breakout Projects

The following potential improvement projects have been identified as those that provide localized congestion and mobility improvements and are considered as independent of the long-term concepts in the reasonable range.

1. Intersection Improvement at Main Street and Downs Street
2. Interchange 8 Improvements – US-6/Newtown Road
3. Bicycle Plan Improvements
4. Pedestrian Facilities Improvements

Below are conceptual descriptions of these potential projects. Each would require separate analysis, environmental review, design, and implementation to proceed.

Intersection improvement at Main Street and Downs Street

The Main Street/Downs Street intersection improvement was proposed by CTDOT in collaboration with the City of Danbury. It is viewed as an independent project that would enhance local mobility and be complementary to the PEL objectives. Currently, the intersection of Routes 39 and 53 (Main Street), Route 37 (North Street), and State Route (SR) 841 (Downs Street) is a four-legged signalized intersection. In the eastbound direction on I-84, Interchange 5 is the only access to downtown Danbury and the Danbury Hospital from points to the west. The lack of alternate access to downtown Danbury from I-84 eastbound is the main cause of congestion and delay at the Main Street, North Street, and Downs Street intersection. As traffic volumes grow in the project area, this intersection is anticipated to experience increased levels of congestion and delay.

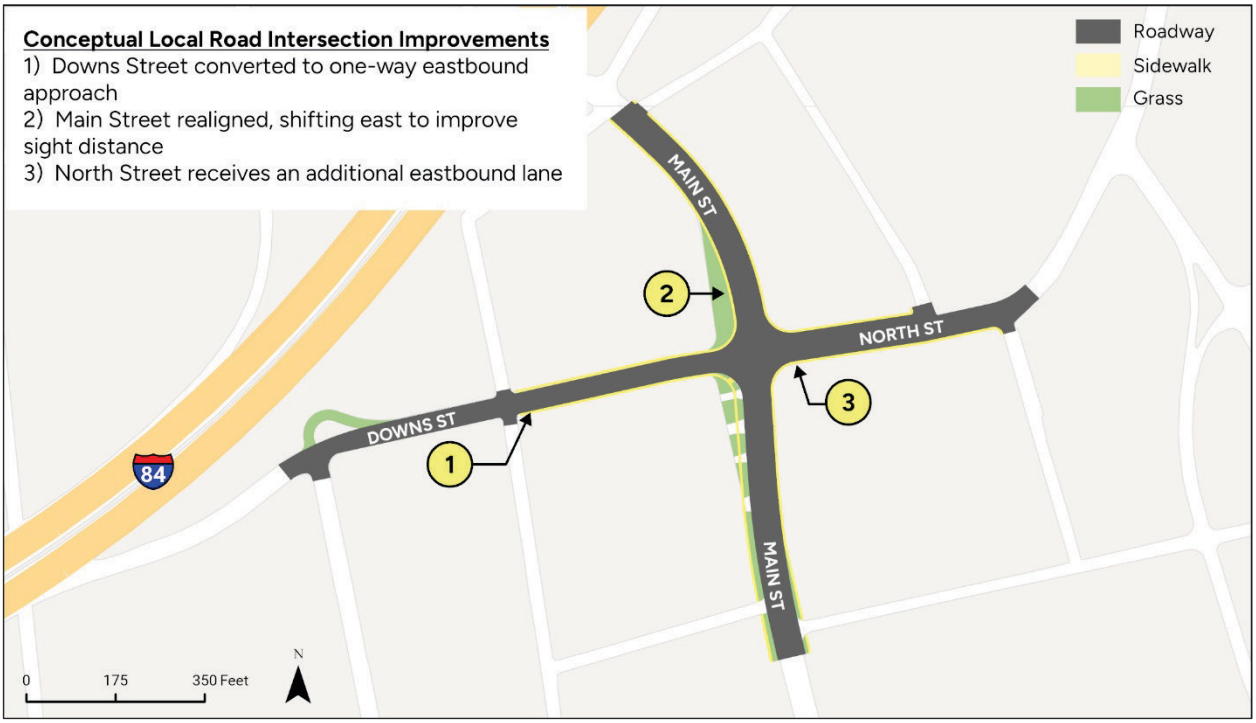
To improve operation at the traffic signal, specifically to reduce delay and congestion, several improvements are under consideration for this intersection (Figure 6-6). Downs Street could be converted to a one-way street with lanes that accommodate left-turn, through and right-turn movements. A new alignment along Main Street could improve the sight distance for vehicles traveling southbound. North Street would have an additional receiving lane for vehicles traveling east.

Improvements to pedestrian and bicycle facilities, such as new sidewalks and bike lanes, could also be considered to improve mobility and provide a safe, comfortable, and integrated intersection for its users. It is recommended that existing traffic operations be further evaluated to consider conversion of two-way traffic to one-way, potential lane arrangements and whether there could be adequate receiving lanes to accommodate future traffic.

This breakout project would provide transportation benefits for local travel in Danbury, without the need for implementation of any other project. Specifically, the project would improve mobility and congestion on the local road network.

The terminus for this project would be the intersection of Main Street with North Street (going west) and Downs Street (going east). CTDOT is looking to initiate this project.

Figure 6-6
Main Street – Downs Street Conceptual Arrangement

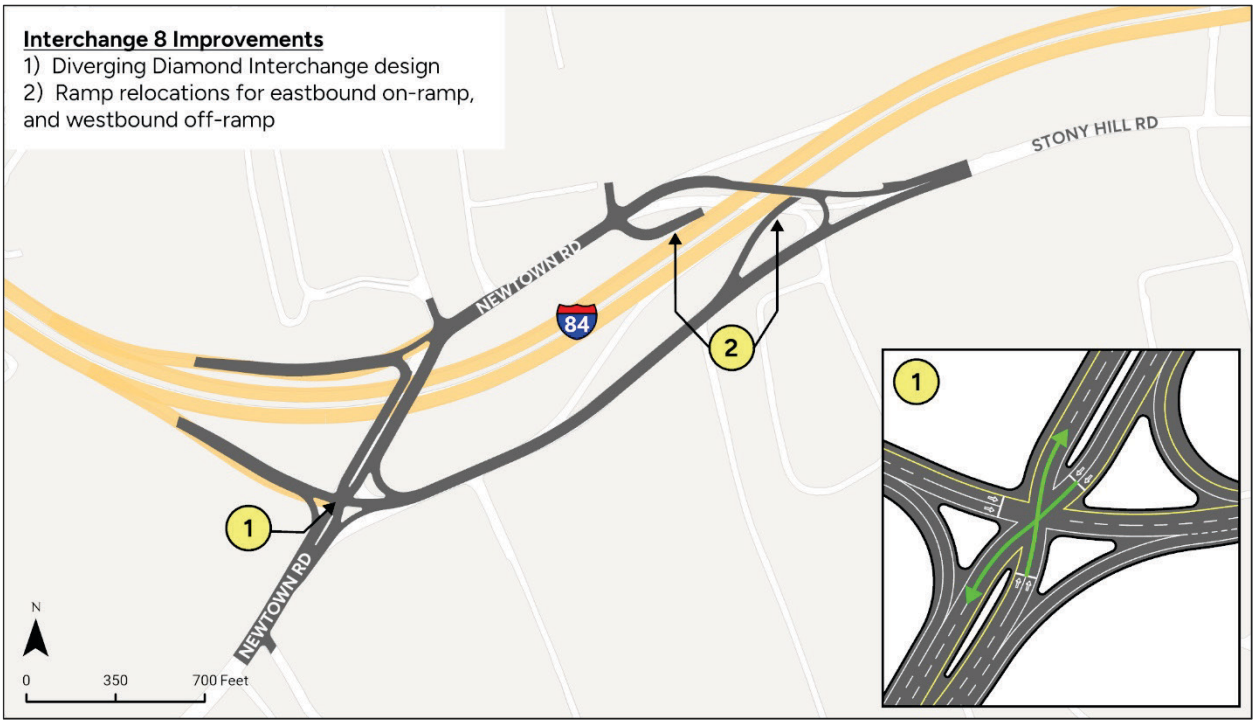


Interchange 8 Improvements – U.S. Route 6/Newtown Road

Currently at Interchange 8, Newtown Road (SR 806), US-6, and the I-84 ramps form an interchange with various circuitous movements. An improvement option near this interchange involves the reconfiguration of the interchange at US-6 and Newtown Road. A new diverging diamond interchange could potentially reduce the amount of traffic circulating around the one-way street network on US-6. In addition, ramp relocations could be implemented on the I-84 eastbound on-ramp and the westbound off-ramp. This would involve reconstruction of US-6 and Newtown Road (SR 806) within the interchange limits, replacement of two existing bridges over I-84, and replacement of three existing traffic signals.

This breakout project (Figure 6-7) would provide transportation benefits for both local travel and travel on I-84 through the corridor, without the need for implementation of any other project. Specifically, the project would improve mobility and congestion on the local road network and improve interstate access.

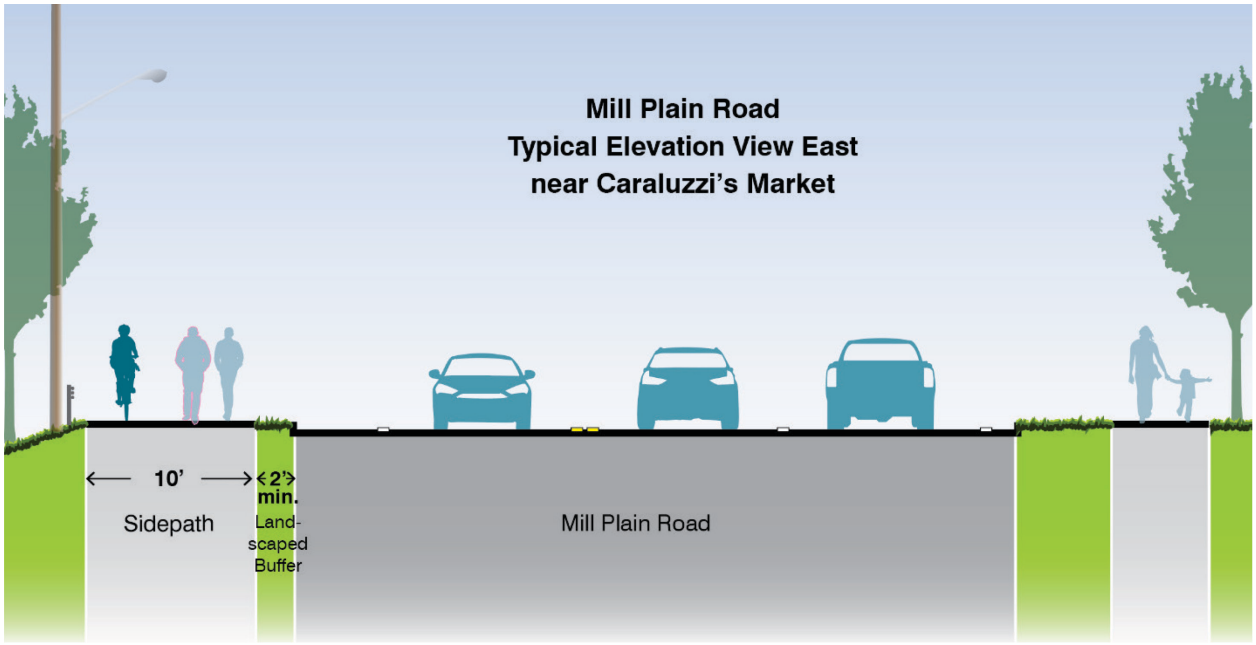
Figure 6-7
Interchange 8 Conceptual Arrangement



Bicycle Plan Improvements

A conceptual bicycle plan was prepared to address the mobility needs of the I-84 Danbury corridor. The plan was based on a gap analysis and a review of feasible routes where bicycle accommodation could be provided. The gap analysis identified a current lack of east-west connectivity for bicycle travel, especially for short-distance trips. The conceptual bicycle plan identified several options within the City via state routes and city streets. Options to improve mobility around the City include on-street bicycle lanes, off-street bicycle paths, and bicycle-only roadways. An example typical cross-section of how a bicycle lane could be arranged is shown in Figure 6-8.

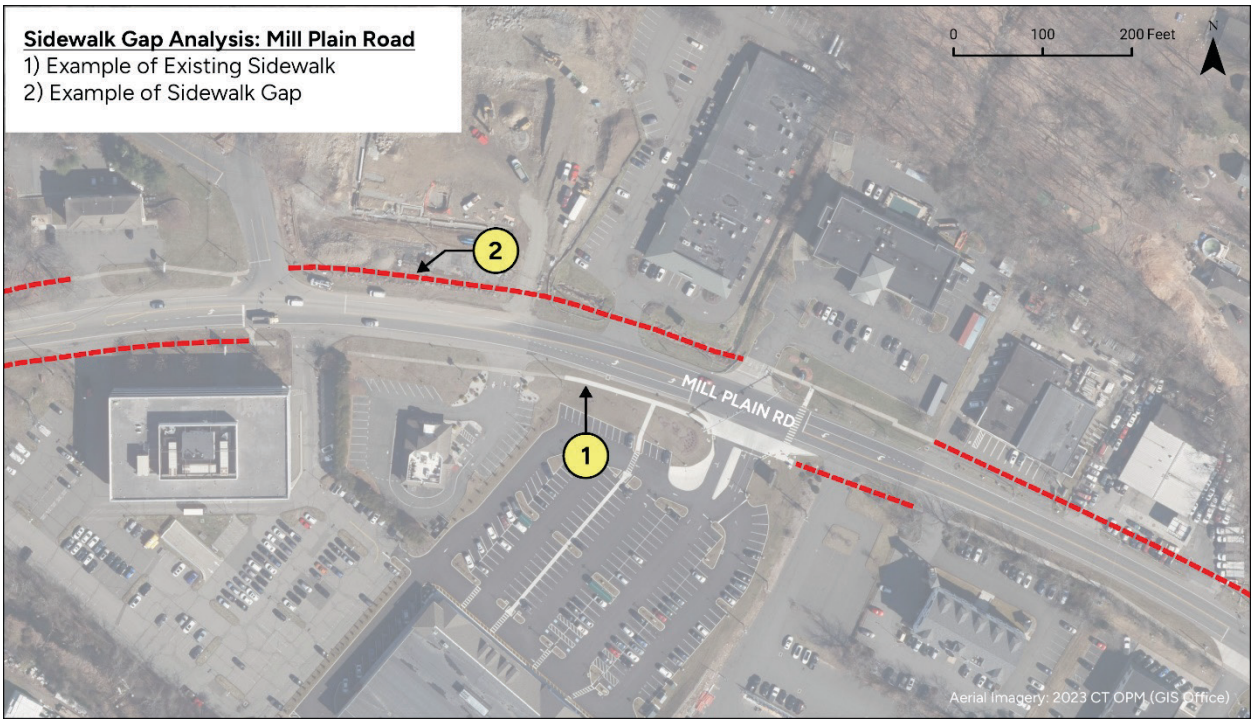
Figure 6-8
Conceptual Cross-Section



Pedestrian Facility Improvements

A sidewalk gap analysis was conducted on state owned roadways within the study limits. Based on this assessment, missing sidewalk connections were identified along the state roadways, such as the example shown in Figure 6-9. In addition, discussions with the City have explored specific areas where pedestrian infrastructure can be improved in the study corridor such as Mill Plain Road. Improvements would enhance mobility around the City and could be implemented using typical construction methods.

Figure 6-9
Sidewalk Gap Analysis



7.0 Next Steps

7.1 Introduction

Based on the results of the PEL Study, a reasonable range of alternatives for I-84 Improvements has been identified. Additionally, potential breakout projects have also been developed and are recommended to move forward for further evaluation.

This chapter provides a high-level overview of the advancement and implementation of the I-84 improvements and breakout projects, identification of potential funding sources for design and construction, the environmental review process, and general timelines for execution.

7.2 I-84 Improvement Alternatives

The screening process identified three potential alternatives by combining six concepts across four geographic segments of the PEL Study Area. These are summarized in Table 7-1. Each includes improvements through lane continuity in both the eastbound and westbound directions of I-84, primarily between Interchanges 3 and 8, interchange modifications in the west, center, and east segments of the corridor including elimination of left-hand exit ramps, and construction of several CD roads to reduce congestion and improve mobility and accessibility to multimodal travel for the citizens of Danbury as well as regional travelers and interstate commerce. Further analysis during the subsequent environmental review may identify additional concepts or combinations to add to the reasonable range of alternatives.

Table 7-1
I-84 Improvement Alternatives

Project Alternatives	Combination Components	Mainline Concept	West Concept	Center Concept	East Concept
CC-B	1-6-3-15	**C1**-I-84 lane continuity each direction	**C6**-Interchanges 3 and 4: New off-ramp from eastbound I-84 to Segar Street	**C3** – Full interchange at Tamarack Avenue	**C15**-CD roads between Interchanges 7 & 8
CC-D	1-6-13-15			**C13** – Partial interchange at Great Plain Road	
CC-F	1-6-26-15			**C26** – CD road eastbound between Main and North Streets	

DLU, identified in Concept 23 – TSMO and independently being considered as a breakout project along a portion of I-84, could also be combined with the west, center, and east concepts in future projects and be part of an expanded reasonable range of alternatives. DLU may be combined with interchange improvements or could be modified to address additional highway design deficiencies, such as left-hand exits.

High-level budgetary estimates were developed for I-84 Improvement Alternatives based on CTDOT Cost Estimating Guidelines. The cost ranges were developed based on the preliminary risk-based analysis using 2035 dollars and included escalation and inflation. The cost range for alternatives CC-B, CC-D, and CC-F was estimated to be between $2.8 and $4.9 billion. Cost ranges are provided to account for variability in project complexity and construction costs. These are considered planning level costs as there is no specific project identified and there has

been no engineering design to assess specific impacts that would include right-of-way acquisition or environmental costs.

The typical schedule for an environmental review for a large and complex corridor project such as this is generally a function of the project's scope and magnitude. It is anticipated that an expanded range of alternatives could be included depending on the development of breakout projects such as DLU. Given the length of the corridor improvements, it is likely an extensive environmental review phase would be required, followed by design, permitting, right of way acquisition and construction.

7.3 Breakout Projects

Three breakout projects were initially identified as concept solutions during the preparation of this PEL study: DLU; Interchange 8 Improvements; and Main Street/Downs Street Intersection Improvements. Each would be subject to NEPA and CEPA requirements. If breakout projects are completed, they would become part of the existing conditions for the environmental analysis of any future project.

Similar to the I-84 Improvement Alternatives. high-level budgetary estimates were developed for each breakout project based on CTDOT Cost Estimating Guidelines. These are considered planning-level costs in 2025 dollars which are reflective of inflation and escalation; however, do not include right-of-way acquisition and environmental costs. A cost range is provided to account for variability in project complexity and construction costs. Cost ranges for potential future transit, bicycle and pedestrian breakout projects could not be determined as these improvements have not been defined to a degree that allows for cost estimation.

The goal of the breakout projects is to provide congestion relief and mobility improvements at specific locations within the study area in a shorter time frame. Some of the breakout projects (DLU, Main and Downs Streets) have begun preliminary design and conceptual layouts along with stakeholder and public outreach. Other breakout projects (Interchange 8, Transit, Bicycle, Pedestrian improvements) will require further feasibility analysis and coordination efforts (HARTransit, City) to determine the viability of specific improvements. It is anticipated that breakout projects will complete environmental review, design, permitting and rights of way acquisitions within 3 to 5 years and have the potential to complete construction by the early 2030's.

7.3.1 Dynamic Lane Use

The I-84 corridor between Interchanges 3 and 7 is characterized by significant congestion and limited mobility that affects both local and regional travel. The purpose of the DLU Project would be to modify the mainline inside the existing right-of-way to reduce congestion and improve mobility during peak use, which is needed both locally and regionally.

DLU would reconfigure the existing inside shoulder next to the median on I-84 between Interchanges 3 and 7 as a temporary travel lane for use when warranted during high peak usage. CTDOT operations would open or close the shoulder as a travel lane based on traffic conditions on the highway. As this peak demand is directional, the westbound dynamic lane would typically only be open in the morning, while the eastbound dynamic lane would typically only be open in the afternoon. See Figure 7-1, depicting the general DLU arrangement.

Other components to accommodate DLU would include expanding the existing one-lane on-ramp to two lanes from US-7 southbound to I-84 westbound located in the eastern end (Figure 7-2) to alleviate congestion and excessive queuing on US-7 southbound. The two-lane on-ramp would merge into I-84 westbound.

Figure 7-1
DLU Conceptual Arrangement

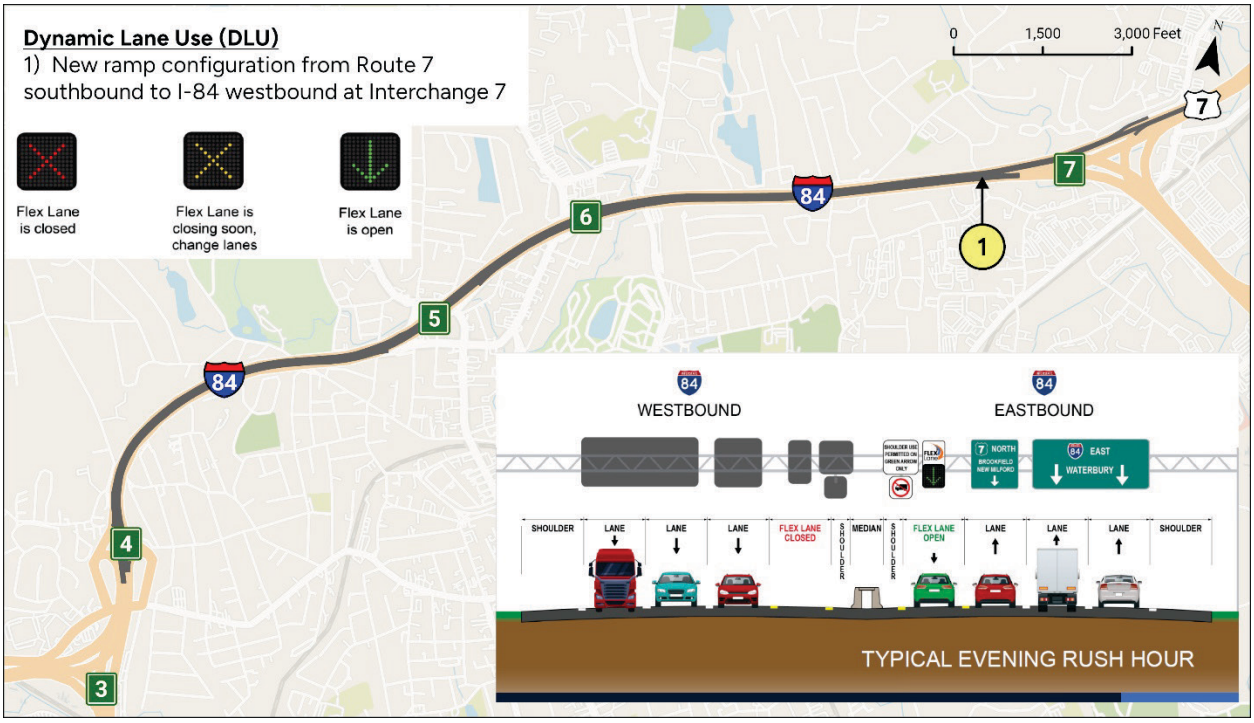
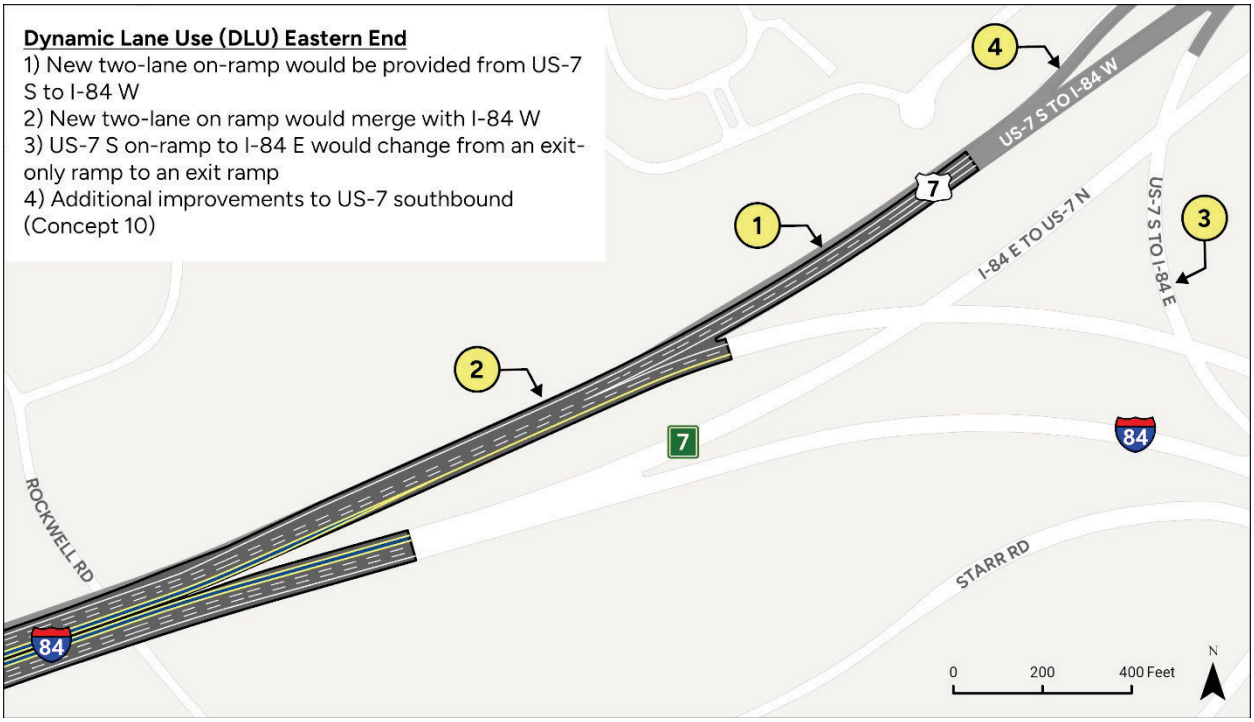


Figure 7-2
DLU – East End Conceptual Arrangement



The overall goal of the DLU strategy is to restore or maintain the performance of the existing transportation system before adding extra capacity. It is anticipated that a DLU project can be designed, existing lanes can be modified, and the project can be implemented within the existing right-of-way. The DLU is moving forward as an independent project, as it is not connected with or a connected action of any other improvement, nor does its implementation preclude future improvements. DLU can be integrated with other identified alternatives in this PEL Study. The projected cost range for DLU is $250 Million to $350 Million.

7.3.2 Interchange 8 Improvements

Proposed Interchange 8 improvements have been identified that would modify traffic flow along the adjacent local road network and I-84 on- and off-ramps (Figure 6-8). At Interchange 8, Newtown Road (SR 806), US-6, and I -84 ramps form an interchange with various circuitous movements.

The purpose of these improvements would be to improve highway access and traffic flow and circulation as well as reduce congestion. Improving traffic circulation within the Interchange 8 area would also provide more direct access to destinations for motorists and would eliminate unnecessary vehicular trips on the I-84 mainline through this area. Having these more direct and efficient routes for drivers would positively enhance the traffic experience for residents and motorists visiting the Danbury area.

Alternatives for improving Interchange 8 include a new diverging diamond interchange and on-ramp and off-ramp relocations. Other options may also be considered. Concepts are being evaluated for feasibility and project initiation. The projected cost range for Interchange 8 Improvements is $90 Million to $115 Million.

7.3.3 Main Street/Downs Street Intersection Improvements

Routes 39 and 53 (Main Street), Route 37 (North Street), and SR 841 (Downs Street) converge to form a four-legged signalized intersection. The intersection is the subject of a potential breakout project that would modify the intersection configuration and alignment. The intersection of Main Street, Downs Street and North Street in Danbury is characterized by poor traffic operations, poor sight lines on Main Street (from the north), and congestion. The purpose of intersection improvements at Main Street and Downs Street (Figure 6-6) would be to modify the intersection configuration and alignment to reduce congestion and improve traffic flow. The downstream impact of these improvements would be an increase in mobility access to existing businesses and residential areas in this part of Danbury while providing increased pedestrian safety. Given this intersection is within a low-income community, similar positive benefits to those populations are also anticipated. The City has provided concurrence to initiate this project. The projected cost range for the Main Street & Downs Street Intersection Improvements is $10 Million to $15 Million.

7.3.4 Transit Improvements

As concluded in Section 6.2.5, a comprehensive bus transit analysis is recommended to further evaluate potential breakout transit projects that could improve congestion and mobility in the I-84 corridor. The analysis should consider the following to help inform potential transit improvements that could be moved forward as independent projects:

1. Review of proposed bus transit routes identified earlier to determine how they are complementary to and can be incorporated with the existing HARTransit routes
2. Service frequency and stops as part of the service planning
3. Ridership estimates for the new routes
4. Analysis of fleet needs including impacts of electrification of bus fleet

7.3.5 Bicycle Plan Improvements

Bicycle plan improvements, as a potential breakout project, would require further detailed study by CTDOT and coordination/discussion with the City. The study would need to consider what types of bicycle lanes/paths were viable as on-street and off-street solutions along with physical constraints, such as bus routes and street parking, that impede development along state routes and city streets.

7.3.6 Pedestrian Facilities Improvements

This potential breakout project would require further coordination and discussion with the City. A more detailed engineering and feasibility analysis will be required on Mill Plain Road to explore opportunities such as potentially combining bicycle and pedestrian accommodations via the use of shared use paths due to right-of-way and utility constraints.

8.0 PEL Study – Agency Coordination and Public Involvement

8.1 Introduction

This chapter provides a summary of agency coordination efforts, and public involvement activities that have taken place during the PEL Study. It is CTDOT's intent to foster communications that will disseminate information about the PEL Study as well as solicit and consider input from the public, local interest groups, stakeholders and from local, state, and federal agencies.

PEL Study communications and facilitation of stakeholder input was guided by a PIP, known as the I-84 Danbury Project Public Involvement Plan (Danbury PIP). The Danbury PIP was developed following the guidance in the State of Connecticut Department of Transportation Public Involvement Procedures (2020). This guidance recommended the establishment of and communication through a Project Advisory Committee (PAC) and encouraged public information meetings, both of which were held during this PEL Study.

8.2 Federal and State Agency Coordination

Throughout the PEL process, State and Federal agencies have been invited to periodic interagency project presentations and have been specifically engaged in the PEL process based on their jurisdiction over resources that could potentially be affected. For projects resultant from this PEL Study, public and agency coordination, as well as public outreach will continue through the environmental, design and construction phases.

State and Federal Agencies invited to project presentations have included the FHWA, United States Army Corps of Engineers (USACE), the CT DEEP, the U.S. Environmental Protection Agency (US EPA), the USFWS, and the State Historic Preservation Office (SHPO). Meeting opportunities were provided to discuss specific subjects of interest, concerns, and recommendations at key milestones in the PEL process and to allow agency personnel to provide input on compliance for their respective jurisdictions. An initial agency meeting was held in 2017. A second occurred in the June of 2023. A summary of meeting topics and attendees are provided in Table 8-1.

Table 8-1
Agency Meeting Summary

Meeting Date	Meeting Name	Purpose/Key Themes	Meeting Attendees
May 18, 2017	PEL Agency Coordination Meeting	Study goals & considerations, study approach, existing resources, next steps	CT DEEP, USACE, US EPA
January 5, 2022	Interagency Meeting	Access Modification	FHWA
January 19, 2022	Interagency Meeting	Screening process & methodology	FHWA
November 22, 2022	Interagency Meeting	PEL Chapter Reviews, Agency coordination meetings, PEL Risk Analysis	FHWA
March 27, 2023	Interagency Meeting	PEL Chapter 4 Review, TSMO and Access Modification	FHWA
June 12, 2023	PEL Agency Coordination Meeting	PEL Study - background information, study updates	CT DEEP, USACE
May 1, 2024	Interagency Meeting	PEL Study updates	FHWA

8.3 Public Involvement

Public involvement activities during the PEL Study were based on the Danbury PIP, which is provided on the project website and describes the objectives, methods, and expectations for public engagement. The document has been used and revisited periodically to ensure effective engagement with the many stakeholders and diverse members of the public. The purpose of the plan is to provide the tools and strategies for engagement and to:

1. Identify deficiencies and needs.
2. Contribute to the understanding of PEL Study Purpose.
3. Identify, develop, and evaluate alternative solutions.
4. Assist the project team in identifying potential impacts and possible mitigation measures; and
5. Inform stakeholders about progress on the PEL Study.

Public input provides the opportunity to share and address community concerns, goals, and priorities. The Danbury PIP describes how the project team reached out to seek input from stakeholders and the public throughout the study. The public involvement program, guided by the PIP, has utilized a range of strategies and techniques to engage members of the public throughout greater Danbury. In addition to outreach to the public, special strategies were used to ensure meaningful participation for under-represented populations, including:

- Low-income and minority communities.
- Persons with limited English proficiency.
- Persons with disabilities.

The goals of public outreach in the PEL Study process have been to:

1. Promote public input into the process.
2. Maintain a fluid and consistent communication process that provides information and receives public feedback.
3. Engage a diverse range of the public population; and,

The objectives of public outreach in the PEL process have been to:

1. Conduct public interactions that are accessible and inclusive to all to encourage participation.
2. Develop outreach and presentation materials that are transparent and convey a clear understanding of the PEL Study.
3. Be responsive to public inquiries; and,
4. Continue to build public understanding of the PEL Study.

8.3.1 General Methodology and Tools

Table 8-2 displays public engagement methodologies that the project team has employed to fulfill stakeholder engagement and objectives of the I-84 Danbury PEL Study. Public engagement activities are identified for the following general categories of stakeholders and includes: (1) the public; (2) the PAC; and (3) key stakeholders such as municipalities, community and faith-based organizations, special interest groups, and elected officials. Events have been conducted over the course of the study and have been used to both inform and obtain input. Appendix N.1 details communication methods used during the study.

Table 8-2
Summary of Public Engagement Methodologies

Stakeholder Category	Engagement Events	Engagement Tools
Public	▪ Informal, pop-up events (14) ▪ Public meetings / workshops (4) ▪ Formal public meeting (2)	▪ Project website (1) ▪ Social media accounts (4) / posts ▪ Newsletters and fact sheets (12) ▪ Press advisories (3) ▪ E-Bulletins (16) ▪ Comment cards ▪ Survey, 3 languages (1)
Project Advisory Committee (PAC)	▪ PAC meetings (15)	▪ Presentations (15) ▪ Newsletters and fact sheets (13) ▪ PAC notebooks (25+)
Low-income Communities, Community Based Organizations, and Special Interest Groups	▪ Informal, pop-up events (14) ▪ Stakeholder interviews or small group meetings (43)	▪ School / church letters (100) ▪ Project website (1) ▪ Project video in 3 languages (1) ▪ Social media accounts (3) / posts ▪ Newsletters / fact sheets (12) ▪ Press advisories (3) ▪ Tribuna articles and ads (3) ▪ Social media ads in 3 languages (3) ▪ Survey, 3 languages (1) ▪ E-Bulletins (16)
Elected Officials	▪ Informal public official meetings and listening sessions (11) ▪ Invite legislators to public informational meetings or workshops (3)	▪ Newsletters and fact sheets (13) ▪ E-bulletins (16) ▪ Direct emails (4-6)
Other Targeted Stakeholders	▪ Stakeholder meetings (53) ▪ Focus group meeting (1)	▪ Newsletters / fact sheets (12) ▪ E-Bulletins (16)
Media		▪ News articles (20) ▪ News ads (multiple ads for 3 occurrences) ▪ Social media ads in 3 languages (3) ▪ Press advisories (3) ▪ E-Bulletins (16)

8.3.2 Project Advisory Committee and Project Stakeholders

The PAC is comprised of individuals from a diverse range of stakeholder groups. CTDOT, with assistance from the Study team, invited the PAC members to participate in the group. The PAC first met in 2019 and averaged two to four subsequent meetings per year, except in 2020, when only one PAC meeting occurred because of COVID-19 public health concerns. The purpose of the PAC meetings was to ensure that a wide variety of interests were considered during the study and that local experts were provided an opportunity to share their knowledge of specific transportation issues and opportunities. In addition, the PAC members were encouraged to share Study information with their respective groups.

Table 8-3 on the following page summarizes PAC members who were invited to or participated in PAC meetings.

PAC meeting input was incorporated into the final study. Appendix N.2, Table N-1, provides a summary of each PAC meeting, including dates, purpose and key themes, and the number of PAC Members in attendance. Some of the key concerns raised by PAC attendees included the following:

- Congestion mitigation efforts
- Traffic signals on local road network
- Lack of bicycle and pedestrian infrastructure
- Improved access to rail and bus transit service
- Poorly lit underpasses
- Traffic congestion impacts on local economy
- Desire for non-highway solutions to be identified and evaluated
- Danbury Hospital access

The Project Team considered these concerns to facilitate concept development and potential breakout projects. During the PAC meetings, the project team presented various concepts to address transportation issues in alignment with the PEL Study purpose, detailed the concept screening process, presented screening results, and highlighted those concepts that would be used to develop alternatives for future projects. Potential breakout projects were also presented for feedback. Meetings with PAC members generated support for Study recommendations and solutions that were advancing.

Concerns and input were also gathered from one-on-one meetings with various representatives of local transportation industry groups, elected officials, focus groups, economic development groups, and various advocacy groups, some of whom were also PAC members. The purpose of these meetings/interviews was to gather input and facilitated targeted and/or one-on-one conversations that may not easily have been possible in other settings.

Table 8-3 displays a list of the stakeholder groups identified and coordinated with during the study process. For purposes of this study, a stakeholder is any person or group that 1) expressed interest in, 2) was involved in or affected by, and/or 3) had the potential to influence others' opinions or decisions on this project. Those stakeholder groups that are also represented on the PAC are identified with a check mark in the appropriate column.

Table 8-3
Stakeholder Groups/Organizations

Category	Entity	PAC Member
Municipal Representatives	City of Danbury/Danbury Airport	✓
	City of Danbury Business Advocacy	✓
	City of Danbury Engineering	✓
	City of Danbury, Family, School and Community Partnerships	✓
	City of Danbury Health & Human Services	✓
	City of Danbury Housing Authority	✓
	City of Danbury Library	✓
	City of Danbury Planning	✓
	City of Danbury Public Schools	✓
	City of Danbury Public Works	✓
	City of Danbury Traffic	✓
	City of Danbury City Council	
	City of Stamford	✓
	Putnam County	✓
	Town of Newtown	✓
	Town of Bethel	✓
	Town of Brookfield	✓
	Town of Redding	✓
	Town of Ridgefield	✓
	Town of New Fairfield	✓
	Town of New Milford	✓
Transportation Agencies	Housatonic Area Regional Transit	✓
	New York Metropolitan Transportation Council	✓
	Housatonic Railroad	✓
	New York State DOT	
	Mid-Hudson South Transportation Coordinating Committee	
Government Agencies	Connecticut State Police, Troop A, Southbury, CT	✓
	Danbury Commission for Persons with Disabilities	✓
	Juniper Ridge Tax District, Danbury, CT	✓
	Western Connecticut Council of Governments (WestCOG)	✓
Local Neighborhoods	Old Brookfield Road Neighborhood	✓
	Spring Street Neighborhood, Danbury, CT	✓
	West Terrace Neighborhood, Danbury, CT	✓
Business Groups	AAA Northeast	✓
	Boehringer-Ingelheim Ridgefield, CT	✓
	Cartus, Danbury, CT	✓
	Danbury Hospital	✓
	Greater Danbury Chamber of Commerce	✓
	Danbury Museum and Historical Society	✓
	Motor Transport Association of Connecticut	✓
	Sterling Woods, Danbury, CT	✓
	Western Connecticut State University	✓
	St. Peter Cemetery – Diocese of Bridgeport	✓
	CT Weather	✓
	Danbury Fair Mall	
	Wooster Cemetery	
	Immanual Lutheran Cemetery	
	Kenosia Cemetery	

Category	Entity	PAC Member
Other Targeted Stakeholders	CityCenter Danbury	✓
	CTrides	✓
	Get Downtown, Danbury, CT	✓
	League of Women Voters of Northern Fairfield County	✓
	Sierra Club, Connecticut Chapter	✓
	Connecticut Association for Community Transportation	
	NO2MOREI84	
	NY Communities	

Interviews with various stakeholders were conducted by the project team to understand "hot button" issues and to elicit concerns from groups that may be most affected by the project. In addition, one-on-one or small group meetings helped the Study team learn how the Study aligned with these stakeholders' short- and long-term goals.

Appendix N.3, Table N-2 presents a summary of key stakeholder meetings including date, stakeholder name, number of participants and key concerns discussed.

8.3.3 Public Meetings and Outreach

Public outreach included various types of public meetings regarding the PEL process and concept development. Public interactions included pop-up events, focus groups, open houses, listening sessions, and surveys. Descriptions and results of these outreach efforts are detailed below.

Pop-Ups – Fourteen (14) pop up events were held across the Danbury area to engage with people at local events and places with large foot traffic, such as the Danbury Mall. During pop-up engagements, the Study team members provided general background and introductions to the I-84 Danbury Study as well as having conversations on concepts and solutions. Common concerns received relates to their frustration about congestion on I-84 in Danbury, especially during peak hours.

During the pop-up events, the community raised concerns related to left hand exits and the effect the different concepts might have on surrounding neighborhoods. Community members also expressed concerns with future growth in Danbury causing more traffic and congestion, closures of Interchange 6 eastbound, autonomous vehicles, and increased emissions from population growth.

A common theme from engaging with the community was frustration about congestion on I-84 in Danbury, with many residents relating that they do everything they can to avoid driving on I-84, especially during peak hours. Residents also expressed safety concerns along I-684 in New York, including weaving of traffic and trucks traveling at dangerous speeds. Highway users attributed a significant element of congestion to the drop from 3 lanes to 2. Danbury residents expressed worries about the impact adding lanes would have to their homes and properties along the corridor.

Focus Group – A focus group was convened on May 10, 2017, in Danbury, and brought 30 selected participants that represent a sample of Danbury-area residents in terms of race/ethnicity, income levels, employment, commuting patterns, age, and gender. The purpose of this focus group session was to gather input from the general public to: (1) identify Study goals and objectives, as well as expectations for the Study as a whole; (2) understand critical issues and opportunities on various topics related to potential changes to I-84 (e.g., economics and community, environmental topics and, commuter travel); and, (3) inform the development of alternatives by considering the viewpoints of those who frequently use the highway or those who will be more directly affected by any future improvements. A full report including topics discussed and recommendations for improvements is provided in Appendix N.4.

Open Houses – The Study team hosted an Open House on the campus of WCSU, on June 13, 2017, from noon until 8:00 p.m. The purpose of the event was to introduce the public to the study with videos, presentations, poster boards and fact sheets. Members of the public were encouraged to provide comments and ask questions of the Study Team members. Forty-three members of the public attended.

A second Open House and Public Information Meeting were held in succession on December 14, 2022, from 5:30 p.m. to 6:30 p.m. at the WCSU Student Center. The Open House occurred

prior to the Public Information Meeting to answer specific questions about the study and included a short loop video. The video is available at www.i84danbury.com/course_cat/past-events/. Poster boards provided background information on the project and the PEL study process –including potential concepts under consideration for the mainline, west, center, and east segments as well as the concepts that had been eliminated from further consideration. Meeting Reports for each Open House are provided in Appendices N.5 and N.6.

Public Information Meetings – The Study Team held a Public Information Meeting (PIM) on December 14, 2022, between 6:30 p.m. and 8:00 p.m., immediately after the Open House. The meeting discussion included study limits, PEL Study process, and study segments for the segments of the corridor, as well as non-highway options. Nine community members attended. Audience members were encouraged to complete a survey after the meeting at this link https://portal.ct.gov/ctdotsurvey to help the CTDOT improve future community engagement.

The Study Team held another PIM on June 26, 2025, from 5:00 p.m. to 7:00 pm. The meeting provided an opportunity for Danbury community residents, leaders, and business owners to learn about the I-84 Danbury PEL Study and share their feedback with the CTDOT study team. In addition to the general PEL process, the team shared information on the recommended range of alternatives and potential breakout projects. A virtual PIM was held on July 8, 2025, from 12:00 p.m. to 2:00 p.m. The same information presented at the June 26th PIM was provided to attendees during this virtual meeting. Meeting reports for each PIM are provided in Appendices N.7 and N.8.

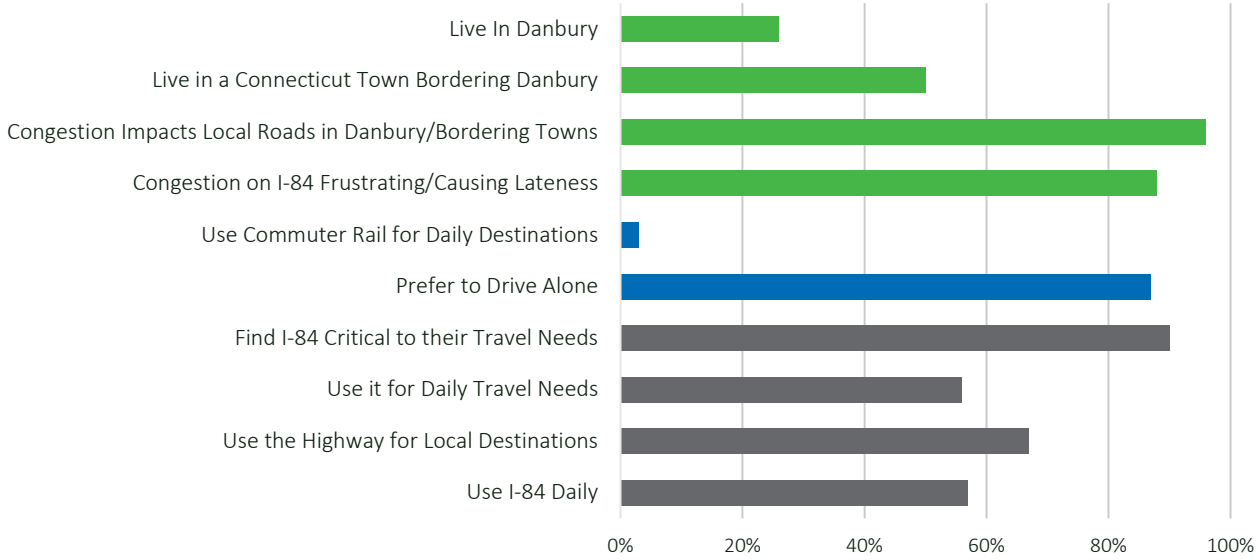
Listening Sessions – Two virtual listening sessions were held in June of 2022 on the Microsoft Teams video meeting platform. The listening sessions included a 10 to 15-minute presentation by the Study Team to explain the study limits, why improvements are needed, the study's purpose, concepts, screening, and next steps, followed by open comments and questions from the attendees. At the virtual listening session held on June 9, 2022, from 12:00 p.m. (noon) to 1:00 p.m., no members of the public attended. At the second listening session, held on June 14, 2022, from 4:00 p.m. to 5:00 p.m., four members of the public were in attendance. A Meeting Report for the second public listening session can be found in Appendix N.9.

Survey – A public survey was launched in conjunction with the June 2017 Open House for meeting attendees to share how they perceive and travel in and along the Study area. It was an informal inquiry that sought to better engage the public during the initial stages of the planning of the I-84 PEL Study. Digital online versions of the survey were available on the study website in English, Spanish, and Portuguese after the Open House. Survey results from the 178 respondents (Figure 8-1) concluded that a significant percentage of those polled had the following perspectives:

- 90% indicated that I-84 is critical to their travel needs.
- 87% answered that they prefer to drive alone.
- Over 88% responded that congestion on I-84 is frustrating or causes lateness.
- Nearly 96% indicated that congestion on I-84 impacts local roads in Danbury or in bordering towns.

These results strongly support that the public is seeking solutions to reduce congestion and improve mobility in the corridor. The full summary of results can be found on the study's website under the Library, Other Documents menu tab.

Figure 8-1
Survey Results



8.3.4 Summary of Public Comments Received

Public comments were submitted through a variety of methods, including live meetings, open houses, and pop-up events, electronic comments through the project website, PAC meetings and stakeholder meetings. A total of 978 comments were logged during the PEL Study and categorized based on the following common themes:

1. Access, Congestion
2. Highway Design
3. Environmental Impacts
4. Lack of Multimodal Access
5. Community Impacts, Trucks
6. Intelligent Transportation Systems
7. Project Planning Process, Safety, Study Concepts

Key common concerns brought to the Study team through these public comments and considered in making PEL Study recommendations were as follows:

1. Congestion at Danbury interchanges
2. Improve interchanges/remove left-hand ramps
3. Improve roadway geometry and slopes
4. Multimodal solutions
5. Project costs and available funding

This input helped to inform the PEL Study process, more specifically, the following components, that were principal elements or considerations of the Study:

- PEL Study Purpose
- Concepts/Alternatives Development
- Screening Matrix Evaluation Criteria

Congestion is a central focus of the PEL Study and was integrated into the PEL Study Purpose statement. It also was a key engineering consideration which led to development of the screening matrix criterion, reduction in travel times on I-84 and Rt. 7. Interchange improvements were considered during concept development for the west and center segments. Left-hand ramp removal and improvements to roadway geometry were used in the screening matrix evaluations for the mainline, west, and east segments, while construction costs were a criterion used for all segments, all of which contributed to the reduction of congestion within the PEL Study Area.

A tabular summary of public comments is provided in Appendix N.10, Table N-3 along with a graph showing the percentage breakdown of comments by theme.

8.3.5 Public Notification Process

Following internal review and comment by CTDOT, a Final PEL Study Report will be issued. Notice of the availability of the Final PEL Study document and a public informational meeting will be distributed within the greater Danbury area through publication in local newspapers, posting on the project website, and direct electronic mailing to identified project stakeholders and PAC members. Individual meetings with agencies and organizations identified in Section 8.3 will be held prior to the public informational meeting and with the PAC membership at a special PAC meeting.

9.0 References

CDM Smith, 2018. I-84 Danbury Project, Needs and Deficiencies Report, Technical Memorandum No. 1, State Project Number 34-349.

CDM Smith, 2020. I-84 Danbury Project, Supplemental Needs and Deficiencies Study, Technical Memorandum No. 2, State Project Number 34-349.

CDM Smith, 2021. I-84 Danbury Project Public Involvement Plan, State Project Number 34-349.

CDM Smith, 2022. I-84 Danbury Project, Concept Study 23: Transportation Systems Management and Operations (TSMO) Strategies, Engineering White Paper.

CDM Smith, 2025. Concept Study 4: Transit Assessment Study, Engineering White Paper.

CTDOT, 2015. Let's GO CT: Connecticut's 5 Year Transportation Ramp-Up Plan.

Milone & MacBroom, 2019. I-84 Danbury Project, Inventory and Analysis of Existing Cultural Resources and Section 4f Resources, State Project Number 34-349.

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Milone & MacBroom, 2019. I-84 Danbury Project, Inventory and Analysis of the Physical Environment: Utilities, State Project Number 34-349.

Milone & MacBroom, 2020. I-84 Danbury Project, Inventory and Analysis of the Existing Natural Environment, State Project Number 34-349.

SLR International Corporation. 2022. I-84 Danbury Project, Supplemental Existing Conditions Analysis, State Project Number 34-349.

N.8 July 2025 Virtual Public Information Report

I-84 Danbury PEL Study

Prepared for: The Connecticut Department of Transportation

August 2025

I-84 Danbury

N.9 Public Listening Session Report

I-84 Danbury PEL Study

Prepared for: The Connecticut Department of Transportation

August 2025

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N.10 Public Comments Summary

I-84 Danbury PEL Study

Prepared for: The Connecticut Department of Transportation

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