Greater Hartford Mobility Study
Existing Conditions Report

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GREATER HARTFORD MOBILITY STUDY

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1 Introduction

The Connecticut Department of Transportation (CTDOT) is expanding its transportation vision for the Greater Hartford area by taking a holistic approach to improve mobility for all modes of travel spanning the Connecticut River from Hartford to East Hartford and throughout the region. The Greater Hartford Mobility Study (GHMS) will build upon the extensive planning and engineering work performed to date on multiple initiatives in the region, including the I-84 Hartford Project, CT*fastrak* East Expansion Study, Hartford Rail Alternatives Analysis, the I-84/I-91 Interchange Study, Bradley International Airport Master Plan, the East Coast Greenway and regional pedestrian and bicycle connectivity. These initiatives are illustrated in Figure 1-1, right.

Figure 1-1: Regional Planning Initiatives

GHMS is a comprehensive planning initiative that will assess the primary transportation deficiencies in the region and provide a mechanism to prioritize projects for further study and implementation. The study will consider all modes of transportation, including transit (rail and bus), freight (rail and truck), bicycles and pedestrians, and automobiles. A long-term, sustainable transportation system requires facilities to be brought to modern standards, prioritizing safety and efficiency, and providing mobility choices for all people in the region. The study will be executed by the study team, which is illustrated in Figure 1-2, right. The study team will be preparing a Project Management Plan (PMP) and Agency Coordination Plan (ACP) that will further elaborate on roles and responsibilities.

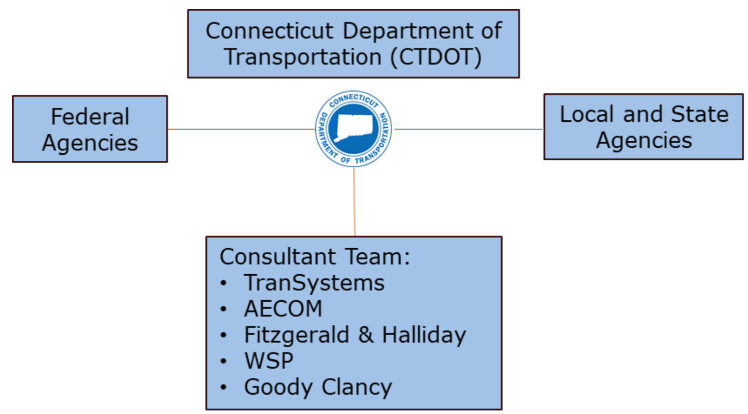


Figure 1-2: Study Team

1.1 Study Overview

GHMS is a *Planning and Environmental Linkage (PEL)* study that will facilitate simultaneous consideration of planning vision, economic goals, community goals and environmental goals by an early and ongoing coordination with the public, local stakeholders, and appropriate resource agencies. With multiple transportation initiatives currently in various phases of analysis and/or implementation in the Greater Hartford region, the GHMS PEL will provide a holistic approach to assess these initiatives and other potential multimodal mobility improvement opportunities with an integrated and overarching regional planning study.

The Study Area encompasses a broad geographic area that extends beyond Hartford and East Hartford. It was established to include major transportation facilities carrying people and goods within, through and around Hartford, as well as other regional travel hubs, such as Bradley International Airport, Hartford Line, and Hartford's Union Station. In Figure 1-3, following, this planning level study area is depicted in the boundary labeled Study Area. The Study Core of Hartford and East Hartford is the focus of several ongoing transportation initiatives with broader regional implications. However, it will be necessary to think beyond the core when defining project needs over the next several decades. Transportation to and from the core is as important as transportation within: therefore, six radial corridors have been defined based on the approximate travel sheds that feed into the Study Core. This study will identify mobility deficiencies both internal and external to the core. Potential transportation projects will be defined and studied based on logical endpoints to address those deficiencies.

> PEL represents a collaborative and integrated approach to transportation decision-making that considers benefits and impacts of proposed transportation system improvements to the environment, community, and economy during the transportation planning process.
> -FHWA
> (https://www.environment.fhwa.dot.gov/env_initiatives/PEL.aspx)

For analysis purposes, the study area was divided into seven (7) Corridors of Significance (COS) as shown . The COS form a primary multimodal transportation network that serve a vast number of people who move about the region. These corridors influence where people choose to live and work, where new development happens, the travel options that are available, and how the environment is impacted.

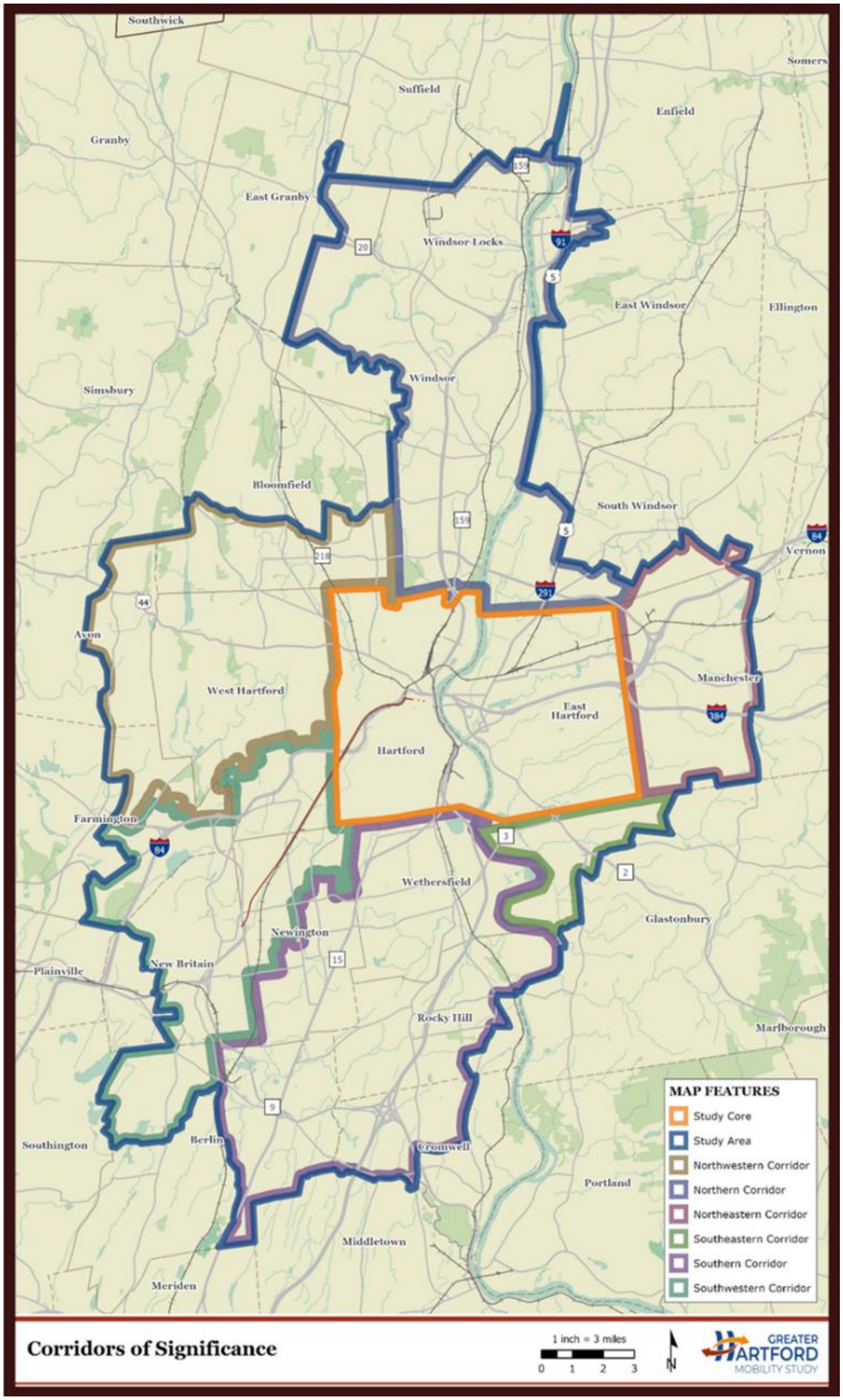


Figure 1-3: Study Area and Corridors of Significance

1.2 Vision and Goals

The GHMS will focus on identifying opportunities for successful implementation of a future transportation system that supports regional and state growth. A Vision Statement was developed for the purpose of creating a lens through which future transportation decision-making can be viewed. Projects that are defined by this study should be consistent with the Vision Statement, which is as follows:

> *The Greater Hartford Mobility Study's Vision is to improve mobility by planning an integrated, resilient, multi-modal transportation system in the Greater Hartford Region thereby enhancing the quality of life, economic vitality, and opportunity in the region.*

The Vision is a high-level expression that is further defined by a set of Study Goals. The following five goals have been established:

1. *Improve the movement of people and goods.* This is a core study goal. Efficiently moving people and goods is essential for a healthy economy.
2. *Increase transportation options, accessibility, reliability and safety.* Transportation can no longer rely only on a system of roads and highways to serve people's mobility needs. Sustainable transportation requires system redundancy and options for choosing how and when to make a trip. This includes making travel choices safe and reliable, as well as accessible to all people.
3. *Accommodate future needs and emerging technologies.* Just as important as addressing current system deficiencies, transportation improvements must consider the needs of future generations of users and upcoming innovative transportation technologies. Travel preferences are constantly in a state of change, as are decisions where people choose to live, work and play. Additionally, technology is an ever-evolving aspect continually impacting the status quo and the GHMS needs to consider the impacts of connected and autonomous vehicles, technology enabled transit, on-demand ride sharing, and alternative freight delivery technologies, among others.
4. *Prioritize social equity.* There has likely never been a time when social equity was a driving priority in so many areas of modern life. Public agencies are adapting to create a more inclusive and equitable future. Transportation should satisfy the needs of all users, regardless of race, color, gender, national origin, or economic status.
5. *Minimize environmental impacts.* CTDOT and partnering state agencies are committed to

addressing the deterioration of the natural and built environments. Transportation projects should avoid or minimize any further environmental impact, and should ideally improve conditions into the future.

The Vision Statement and Study Goals are the first steps towards establishing the means to identify and select potential transportation alternatives. During GHMS, the study team will identity mobility deficiencies and develop quantifiable performance measures. These will be combined with the Vision Statement and Study Goals to create the Study Purpose and Need Statement.

1.3 Existing Conditions Approach

The existing condition performance assessment of the study area was conducted by the following modes and/or focus areas:

- Traffic
- Highway and safety
- Bus
- Rail
- Environmental resources and conditions
- Land use
- Multimodal connectivity

The COVID-19 pandemic significantly impacted transportation services, travel patterns and choices throughout 2020. While the transportation services and travel patterns are on the road to recovery in 2021, it is still too early to determine whether the transportation industry will be back to the pre-pandemic levels or to a "new normal" with new travel patterns and choices. It is also unclear how quickly this full or partial recovery will happen.

Assuming that travel patterns and associated mobility considerations will be back to the pre-pandemic conditions, the GHMS team focused on pre-pandemic transportation data (mostly from 2019) to conduct multimodal existing conditions analysis. However, the team also recognizes significant and real potential for variations with travel behavior, travel choices, technological changes and policy implications that may impact transportation system performance and may alter transportation system improvement needs in upcoming years. As such, the team will be utilizing a Greater Hartford region-specific scenario planning tool for conducting future condition analysis.

As such, unless otherwise noted, the data used for conducting the existing conditions analysis is prior to COVID-19. At the time of publication, traffic volumes nationwide have mostly recovered to exceed pre-pandemic levels, but there are still lasting changes in the way people work and live. For example, the morning peak period has become less prominent, and mass transit ridership is still substantially below the pre-pandemic level.

2 Traffic Assessment

2.1 Introduction

This chapter focuses on summarizing existing traffic performance along key roadway corridors in the study area. Traffic performance is measured using various traffic variables such as overall traffic volumes, travel speed, traffic density, and delay. These variables have a direct connection with passenger and freight mobility within the study area. This chapter also outlines the findings of origin-destination (OD) patterns to better understand major traffic generators and attractors within the study area and overall accessibility.

Mobility is "how far you can go in given time" (a function of travel speed, traffic density/congestion, etc.)

Accessibility is "how much you can get to in that time" (a function of OD pairings, trip lengths, available travel options, etc.).

Both mobility and accessibility are important aspects for the Greater Hartford Mobility Study (GHMS).

2.2 Traffic Data Collection

The following section details the sources and post-processing used for traffic data. This data was compiled in early 2021 using information from before the COVID-19 epoch (2019 and prior traffic data). This included traffic volumes collected by CTDOT, travel speeds from the National Performance Management Research Data Set (NPMRDS), and travel patterns from StreetLight Data, a big data platform for mobility.

Key study area roadway corridors were divided into three categories. Roads in the first category, Priority Corridors, are the most heavily used routes in the GHMS study area. These routes experience significant recurring congestion and account for a large portion of regional delay costs. The second category, Contributing Corridors, includes other high-volume, regionally significant routes within the Study Area. Finally, the Corridors for Traffic Collection category covers lower-volume arterials that act as crucial links between local destinations and the freeway network. Although they carry less traffic than freeways, these corridors have at-grade intersections that result in significant delay costs. Table 2-1 and Figure 2-1, following, show the routes in each category.

Table 2-1: GHMS Traffic Corridors

Priority Corridors	Contributing Corridors	Corridors for Traffic Collection
I-84; I-91; Route 2	I-291; I-384; I-691; Route 3; Route 9; Route 15	U.S. Route 5; U.S. Route 44; Route 20; Route 159; Route 218; Silver Lane (SR 502); Asylum Avenue; Farmington Avenue

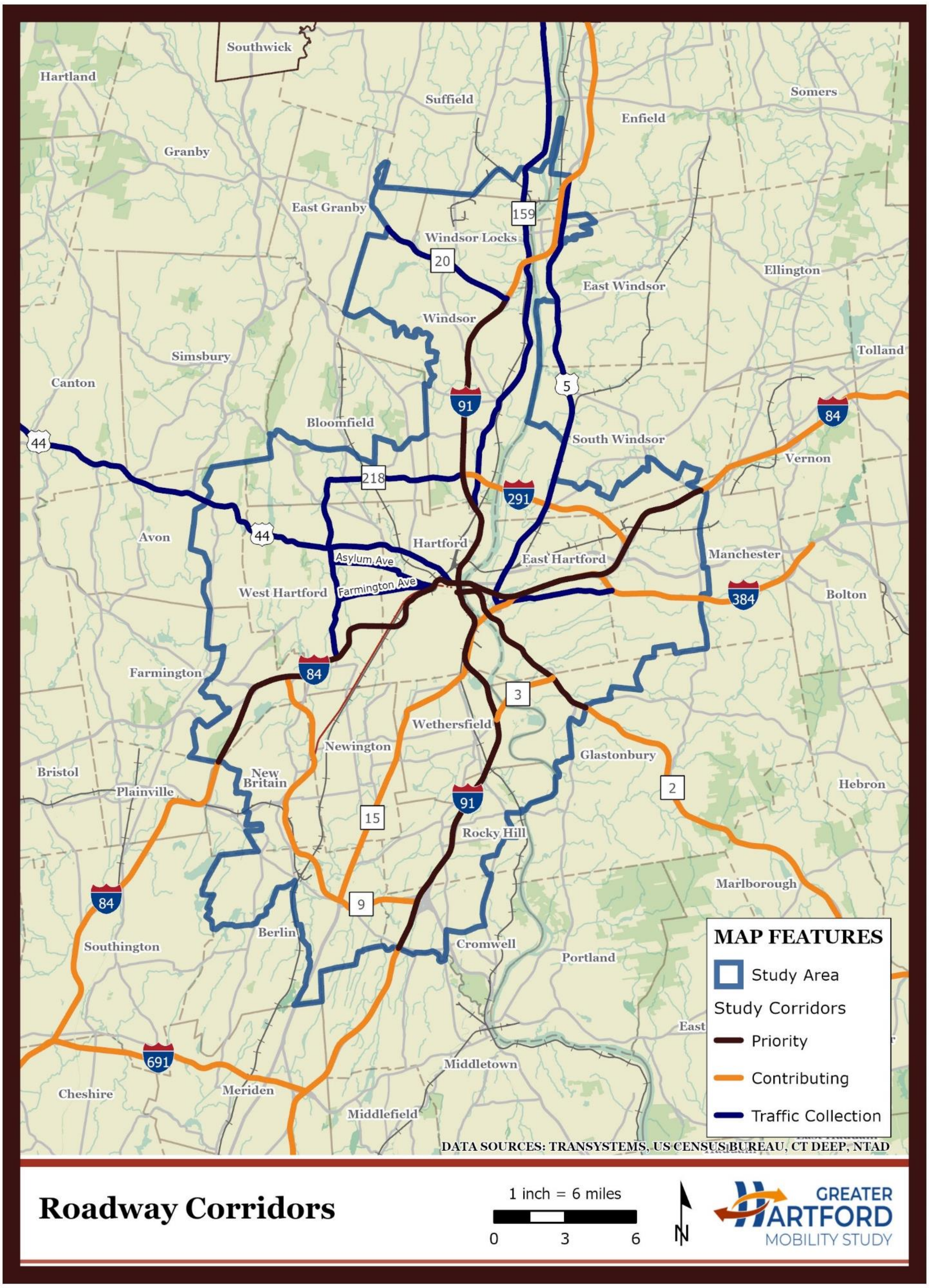
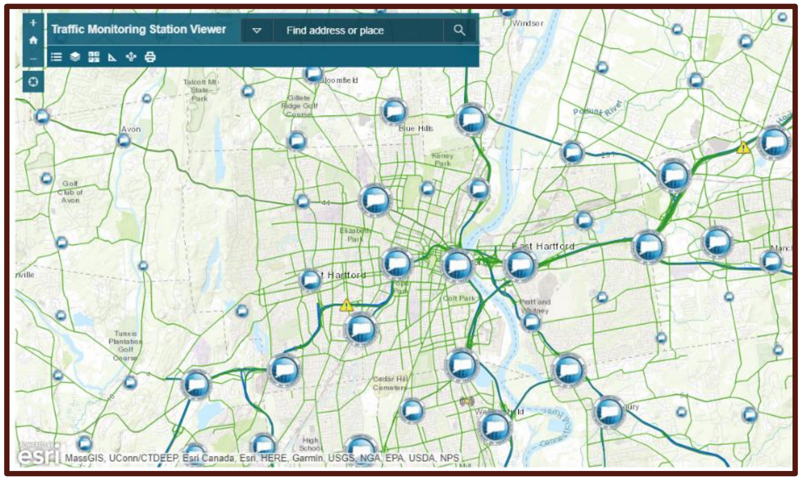


Figure 2-1: Roadway Types for Data Collection and Analysis

2.2.1 Traffic Volumes

Traffic volumes were collected from CTDOT count stations[1]. CTDOT collects traffic counts on a three-year cycle, with each freeway ramp and State-maintained route getting at least 24 hours of hourly traffic counts. These counts are normally taken on a weekday and avoid holidays or major construction. Since traffic volumes vary in a regular pattern, the CTDOT counts use a factor dependent on the month and day-of-week to turn a single day's counts into an estimate of annual average daily traffic (AADT). Some roads are counted more often, or have counts for several consecutive days, which allows a more thorough review of traffic patterns.



Data from over 800 individual CTDOT count stations was used for GHMS.

All recent (2015-2019) data was collected, along with older counts (especially where more recent information was not available), in order to provide at least 3 full days (72 hours) of counts at each location. 2020 counts were not considered due to COVID-19 related traffic anomalies. These counts were weighted based on how recently they were obtained. Counts were then adjusted using CTDOT's traffic adjustment factors to account for the month and day-of-week when they were taken.

The next step was to turn these isolated counts into a balanced count profile for each corridor. The balancing process seeks to establish a consistent set of counts along an entire route where, for a freeway, the total volume entering the road each hour equals the total volume exiting. The result was a 24-hour count profile for each corridor. An excerpt of one balanced count profile is shown in Figure 2-2.

[1] Available online at https://tminfo-dot.ct.gov/TMINFO/index.

Final NB Location	I-91 NB	To West St	I-91 NB	From West St	I-91 NB	To 99	I-91 NB	From 99	I-91 NB	To 3 & GMR	To GMR	To 3 NB	I-91 NB
		RKYH-117-North		RKYH-116-North		RKYH-120-North		RKYH0121-North		WETH-272-North	WETH-283-North	WETH-270-North	
12A	800	43	757	32	789	25	764	47	811	80	3	78	730
1A	533	29	504	18	522	12	510	29	539	52	3	48	488
2A	455	31	424	23	447	10	437	25	462	37	4	33	425
3A	508	46	462	28	490	10	479	25	505	41	1	40	464
4A	838	70	768	63	830	29	801	60	861	97	2	95	764
5A	1730	184	1547	82	1629	90	1539	115	1654	273	11	262	1381
6A	4489	610	3879	229	4108	251	3857	287	4144	817	43	774	3326
7A	6840	1041	5798	447	6245	533	5712	506	6218	1299	110	1188	4919
8A	6009	1066	4942	545	5487	561	4926	503	5429	1496	93	1402	3933
9A	4186	581	3604	407	4012	354	3658	427	4085	960	77	883	3125
10A	3633	434	3199	322	3521	299	3222	351	3573	744	57	687	2829
11A	3832	454	3378	346	3724	352	3371	367	3739	754	60	695	2984
12P	3860	466	3395	376	3771	401	3370	460	3830	844	85	760	2986
1P	3819	453	3366	354	3720	345	3375	441	3816	878	68	810	2938
2P	4236	501	3735	376	4111	352	3759	466	4225	1121	72	1048	3104
3P	5104	590	4514	536	5050	430	4620	486	5106	1615	88	1527	3491
4P	5562	754	4808	642	5450	503	4947	507	5454	1831	85	1746	3623
5P	5479	748	4731	603	5334	524	4810	502	5312	1738	78	1660	3573
6P	3686	469	3217	387	3605	311	3294	433	3726	1052	56	996	2675
7P	2450	335	2116	235	2351	225	2126	328	2454	587	33	555	1867
8P	2314	285	2029	177	2206	169	2036	256	2293	465	28	437	1828
9P	1807	214	1593	123	1716	158	1558	195	1753	316	14	302	1436
10P	1458	145	1313	88	1401	93	1307	160	1467	222	11	211	1245
11P	1292	89	1203	54	1257	50	1207	87	1294	184	8	177	1110
AM	17337	2718	14619	1220	15839	1345	14495	1296	15791	3612	247	3365	12179
MD	23565	2889	20677	2181	22858	2102	20756	2511	23267	5301	418	4883	17966
PM	16144	2092	14053	1782	15834	1458	14376	1496	15872	5185	251	4934	10687
NT	17871	1939	15932	1308	17241	1183	16058	1760	17818	3407	174	3232	14412
Daily	**74918**	**9637**	**65281**	**6492**	**71772**	**6088**	**65685**	**7063**	**72748**	**17504**	**1089**	**16415**	**55243**
CTDOT Est	**76100**	**8000**	**66800**	**6500**	**73300**	**5700**	**67200**	**7200**	**73900**	**16500**	**1100**	**17900**	**57400**

Figure 2-2: Example Balanced Count Profile

One important item to note is that, due to the CTDOT factors, these counts represent an average day of the year – traffic volumes during busy months, special events, or on Fridays are significantly higher than average. In addition, grouping traffic counts into one-hour bins results in an underestimate of actual peak volumes[2]. As a result, the volumes in the balanced count profile cannot be used alone to determine whether a road segment is congested. Travel speed data and densities discussed in the next section help with determining congestion hotspots within the study area.

[2] The Highway Capacity Manual recommends the use of a peak hour factor to account for this. On a freeway, the peak 15-minute flow is typically 5-10% higher than the average hourly flow.

2.2.2 Travel Speeds and Densities

Average travel speeds were obtained via the NPMRDS Congestion Scan. This data was originally collected by INRIX using location-based cell phone services, and can be queried via the NPMRDS website[3] in order to analyze congestion trends one hour at a time. Weekday speeds on each route were averaged over the three-year period from January 2017 through December 2019.

Travel speed is a useful indicator for congestion, and can be combined with traffic volume, segment length, number of lanes, and value of time to produce delay, delay cost, density, travel time, and travel time index. The density can, in turn, be used to estimate level of service. A heat map from NPMRDS, showing how average speeds change over time and location, is shown in Figure 2-3.

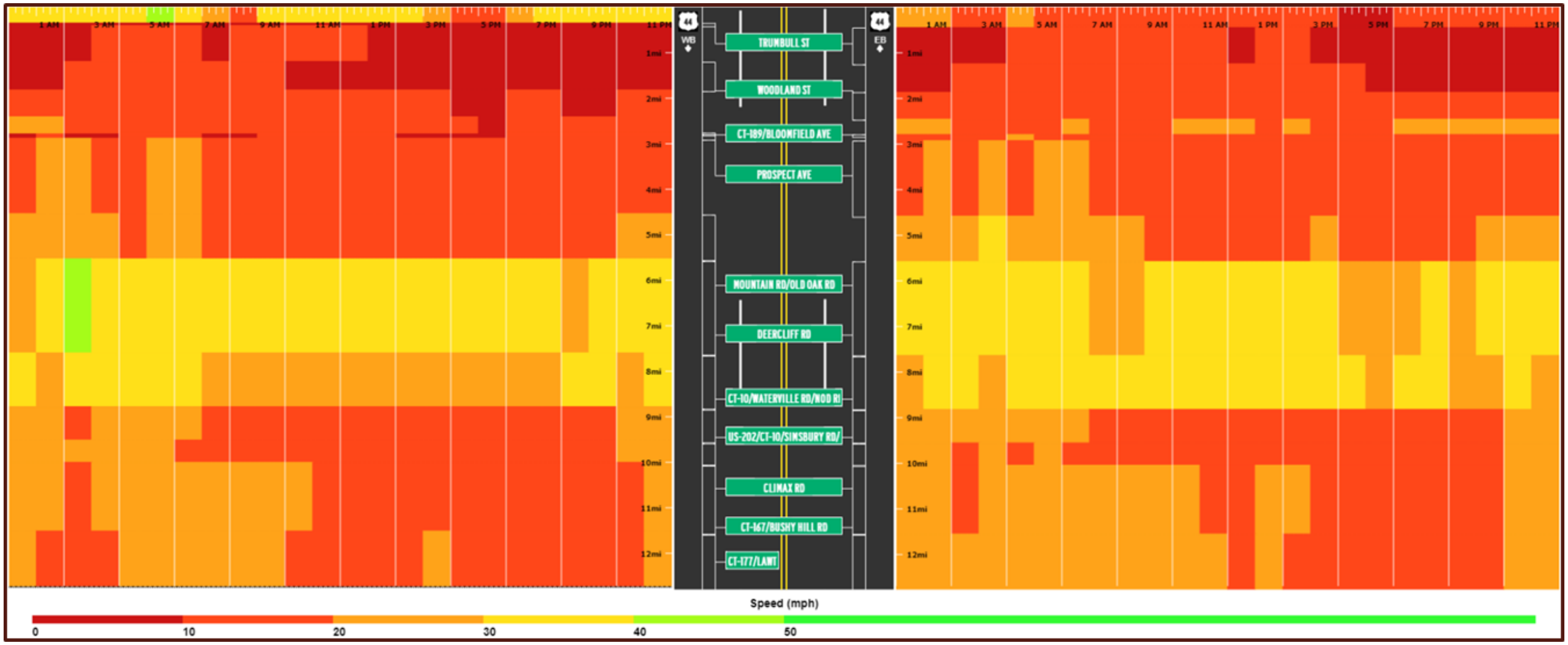


Figure 2-3: Example NPMRDS Heat Map

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3 Available online at https://npmrds.ritis.org/analytics/ (registration required).

Delay was calculated for each segment and hour based on the difference between the off-peak and peak travel speeds and the traffic volume. The value of time was taken from the Texas Transportation Institute: $17.91 per hour for passenger vehicles, and $100.49 per hour for commercial vehicles. All monetary values reflect current (2021 dollars).

2.3 Priority Corridors Traffic Assessment

The Priority Corridors are I-84 from New Britain to Vernon, I-91 from Cromwell to Windsor Locks, and Route 2 from Hartford to Glastonbury. Traffic volumes for each Priority Corridor are given in Appendix 1 - balanced count profile appendix. The highest daily volumes on I-84, I-91, and Route 2 are 175,400, 157,000, and 86,700 respectively.

2.3.1 I-84 Eastbound

Travel patterns on I-84 Eastbound are shown in Figure 2-5. In this diagram, traffic is moving from left to right. The thickness of the lines indicates the average hourly traffic volume during each period, with thicker lines representing more vehicles. I-84 Eastbound carries vehicles per day on its busiest segment.

Broadly speaking, traffic patterns on I-84 Eastbound can be summarized as heading into Hartford in the morning and leaving in the evening. West of Hartford (left side of Figure 2-5), traffic volumes are highest during the morning peak as commuters head into the city. Around the Broad Street on-ramp, the trend reverses, as evening traffic departing the city grows busier than morning and mid-day traffic. It is worth noting that despite this trend, traffic volumes remain high throughout the day all along I-84. It is only during the overnight hours that volumes subside.

I-84 has an eastbound high-occupancy vehicle (HOV) lane from East Hartford to Vernon. Traffic volumes in the HOV lane show a much more distinct peak, with nearly half of its daily traffic occurring during the three-hour evening peak.

> *Drivers are using HOV lanes primarily when speeds on I-84 decrease and avoid them otherwise.*

I-84 Eastbound experiences congestion throughout the day, but it is heaviest during peak periods. During the morning peak, when inbound traffic is at its highest, speeds drop from Farmington east through Hartford, with the lowest speeds (18 mph) in West Hartford around the Park Rd. exit. Speeds in Hartford remain below 50 mph, then drop again during the evening peak. Evening congestion is more severe, with speeds as low as 8 mph around the Sisson Avenue ramps. Though congestion is worst in Hartford, slowdowns extend east to Vernon, recovering around Route 30 (see Figure 2-4). The posted speed limit on I-84 ranges between 50-65 mph within the study area.

On an average day, I-84 Eastbound experiences 5,000 vehicle-hours of delay between I-691 in Southington and Route 31 in Vernon. With an approximate commercial vehicle percentage of 8%, the annual cost of delay on I-84 Eastbound is $45 million.

I-84 Eastbound Annual Cost of Delay:
Passenger Cars: Approx. $30 Million
Commercial Vehicles: Approx. $15 Million

2.3.2 I-84 Westbound

Travel patterns on I-84 Westbound are shown in Figure 2-6. In this diagram, traffic is moving from right to left.

A similar trend is apparent in this direction: morning volumes are heaviest entering Hartford, and evening volumes are heaviest leaving the city. For westbound traffic, the turning point appears to be around the Asylum Street off-ramp, but mid-day volumes in Hartford do not decrease much relative to peak volumes, indicating that the road is busy throughout the daylight hours. Once again, overnight volumes are much lower.

I-84 has a westbound HOV lane from Vernon to East Hartford. Traffic volumes in the HOV lane show a much more distinct peak, with nearly half of its daily traffic occurring during the three-hour morning peak. This indicates that drivers are using the HOV lane primarily when speeds on I-84 Westbound decrease and avoid it otherwise.

Like I-84 Eastbound, I-84 Westbound experiences congestion throughout the day, but it is heaviest during peak periods (see Figure 2-7). During the morning peak, when inbound traffic is at its highest, traffic slows down from the Governor Street exit in East Hartford to the Asylum Street exit in Hartford. The lowest speeds (15 mph) occur in East Hartford approaching the Bulkeley Bridge. Evening congestion is more severe, with speeds dropping to 13 mph in East Hartford and congested conditions extending to Route 9 in Farmington. The posted speed limit on I-84 ranges between 50-65 mph within the study area.

On an average day, I-84 Westbound experiences 4,600 vehicle-hours of delay between Route 31 in Vernon and I-691 in Southington. With an approximate commercial vehicle percentage of 8%, the annual cost of delay on I-84 Westbound is $41.1 million.

I-84 Westbound Annual Cost of Delay:
Passenger Cars: Approx. $27.5 Million
Commercial Vehicles: Approx. $13.5 Million

Figure 2-4: I-84 Speed Maps

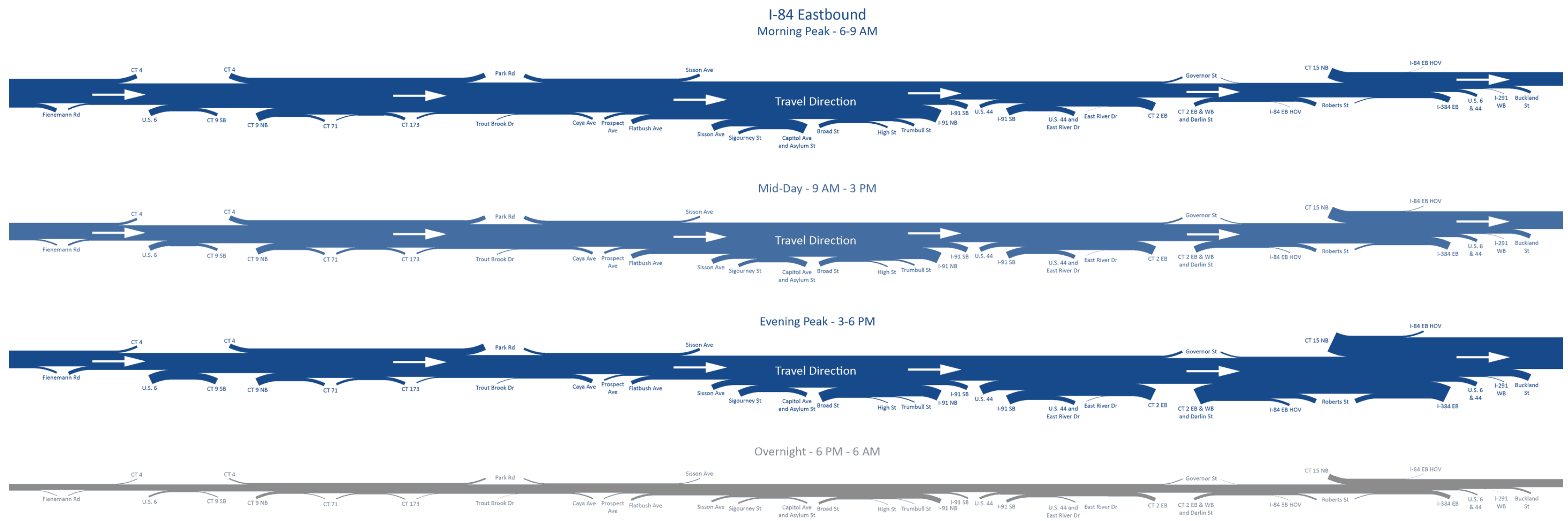

Figure 2-5: I-84 Eastbound Travel Patterns

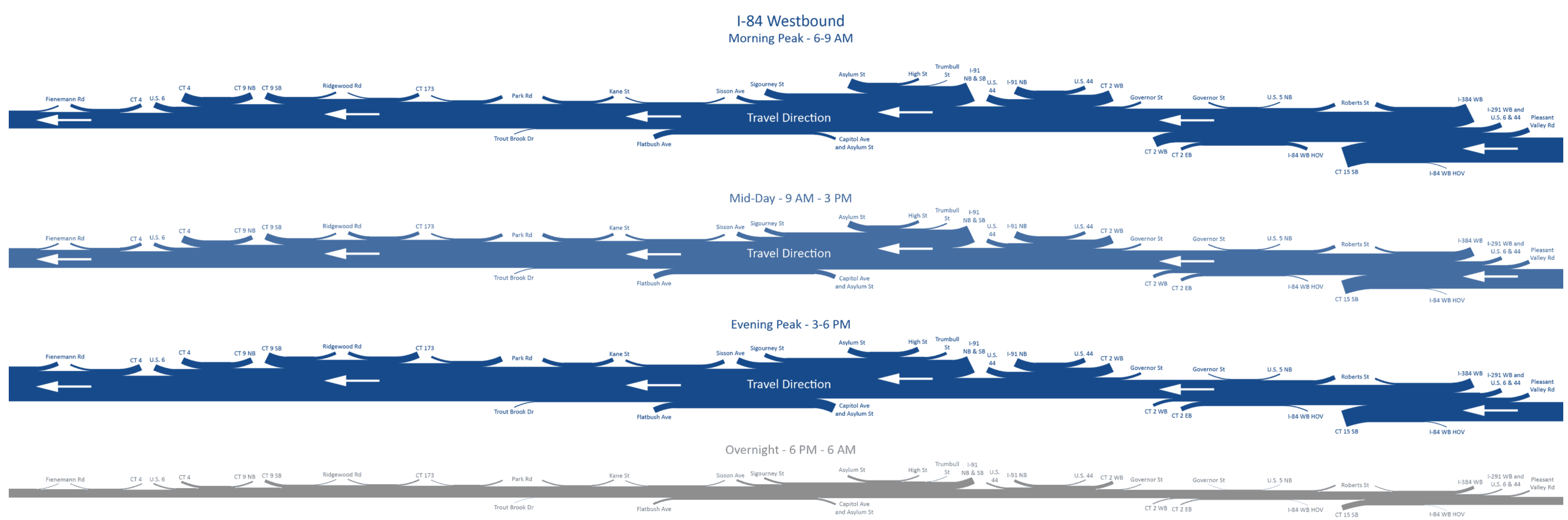

Figure 2-6: I-84 Westbound Travel Patterns

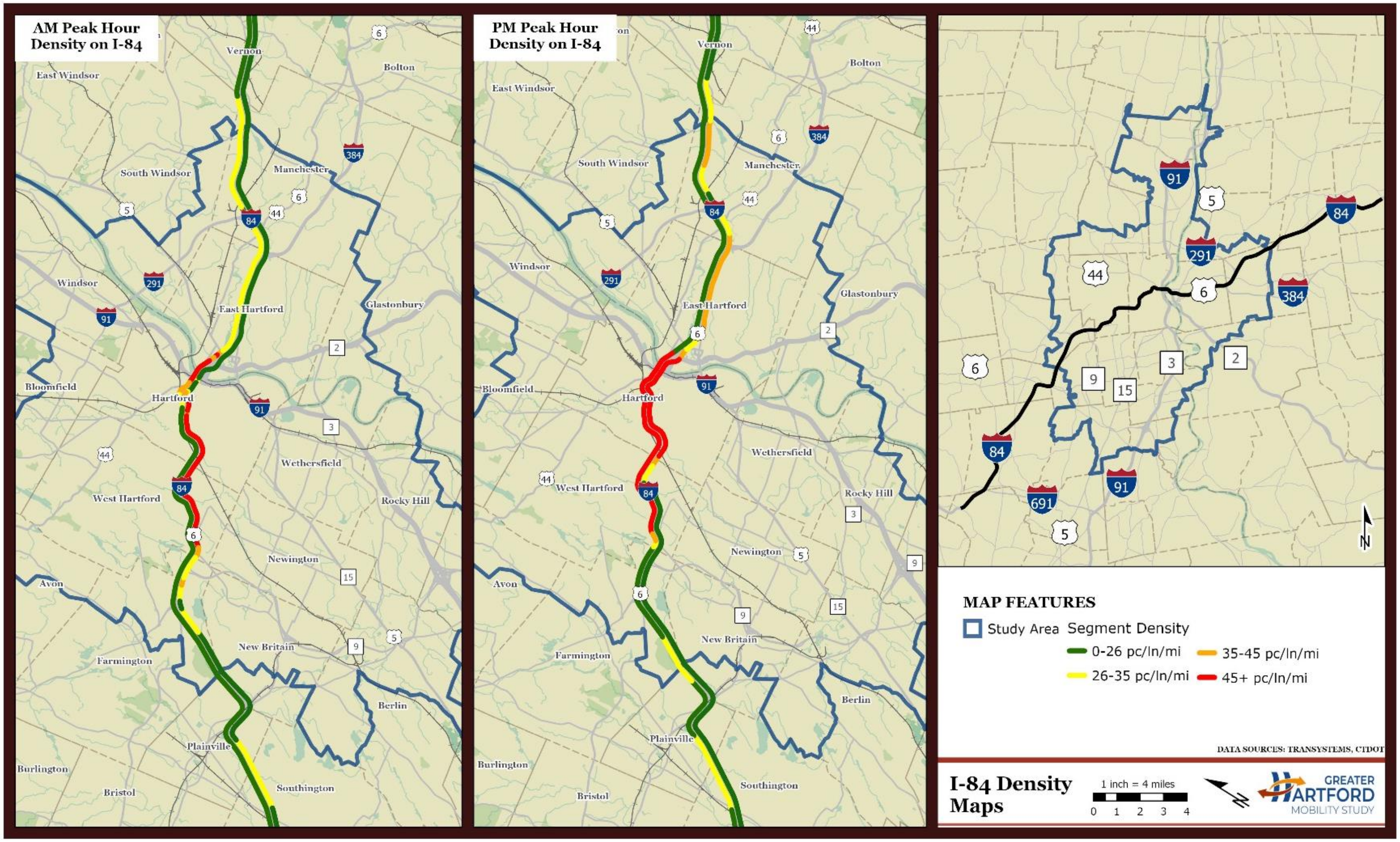

Figure 2-7: I-84 Density Maps
(at passenger lanes per mile)

Key Findings for I-84 Corridor

- Traffic volumes show predominant study core-centric (Hartford & East Hartford) directional flows – highest inbound volumes in AM peak and highest outbound volumes in PM peak.
- PM peak is more severe both in terms of increased congestion (higher traffic density) and corresponding reduced speeds (delay) dropping below 10 mph for some sections.
- HOV lanes are predominantly used during peak hours when I-84 mainline speeds are lower.
- Congested areas in the study core correlate with increased crash rates, especially around the Union Station curve and in weave areas.
- Annual cost of recurring delays is approximately $85 million, a third of which is incurred by commercial/freight operators.

2.3.3 I-91 Northbound

Travel patterns on I-91 Northbound are shown in Figure 2-9. In this diagram, traffic is moving from left to right.

I-91 shares some characteristics with I-84. Commuters from south of Hartford (left side of Figure 2-9) take I-91 to the city during the morning peak, and commuters from north of Hartford leave the city in the evening peak. This pattern is much less pronounced, though, than it is on I-84. For example, I-91 in Rocky Hill has high volumes throughout the daylight hours, with only a slight reduction mid-day. Interchanges with Route 3, Route 15, and I-84 are likewise busy from morning through evening. It is only after 6 PM that I-91 volumes drop off.

I-91 has a northbound HOV lane in Hartford and Windsor. Traffic volumes in the HOV lane show a distinct peak, with over 40% of its daily traffic occurring during the three-hour evening peak. This indicates that drivers are using the HOV lane primarily when speeds on I-91 Northbound decrease and avoid it otherwise.

I-91 Northbound experiences congestion mainly during peak periods. During the morning peak, there are intermittent slowdowns south of Route 9 in Cromwell and from Route 3 in Wethersfield to the Charter Oak Bridge in Hartford. Average speeds are as low as 37 mph in Hartford (see Figure 2-8).

> *In the evening peak, the ramp to the Charter Oak Bridge remains a pinch point, causing queues that frequently extend over a mile and average speeds of 24 mph.*

Farther north, another stretch of evening congestion extends from I-84 in Hartford to Route 178 in Windsor.

On an average day, I-91 Northbound experiences 3,400 vehicle-hours of delay between Route 15 in Meriden and Route 140 in East Windsor. With an approximate commercial vehicle percentage of 13%, the annual cost of delay on I-91 Northbound is $34.9 million.

2.3.4 I-91 Southbound

Travel patterns on I-91 Southbound are shown in Figure 2-10. In this diagram, traffic is moving from right to left. Similar to I-91 Northbound, there is a moderate inbound trend in the morning and outbound in the evening.

Mid-day volumes are also relatively high, especially within Hartford, where they are nearly as high as the peaks. Its interchanges with Route 3, Route 15, and I-84 are busy throughout the daylight hours. The volumes are much lower overnight.

I-91 has a southbound HOV lane in Windsor and Hartford. Unlike the other HOV lanes, the southbound lane is busy during both the morning and evening peaks. This is likely because I-91 Southbound experiences recurring congestion from I-291 to I-84 in both peaks, and drivers are using the HOV lane to get around that congestion.

I-91 Southbound experiences congestion mainly during peak periods (see Figure 2-11). During the morning peak, congestion begins at Route 75 in Windsor and extends south to I-84 in Hartford, with average speeds as low as 23 mph in Hartford's North Meadows. In the evening peak, congestion is more extensive and severe. Slowdowns extend from Route 305 in Windsor to Route 3 in Wethersfield, then from Route 9 in Rocky Hill to Route 15 in Meriden. Evening speeds are slowest (17 mph) around Jennings Road in Hartford. The posted speed limit on I-91 ranges between 55-65 mph within the study area.

On an average day, I-91 Southbound experiences 6,500 vehicle-hours of delay between Route 140 in East Windsor and Route 15 in Meriden. With an approximate 13 % commercial vehicle share, the annual cost of delay on I-91 Southbound is $67.7 million.

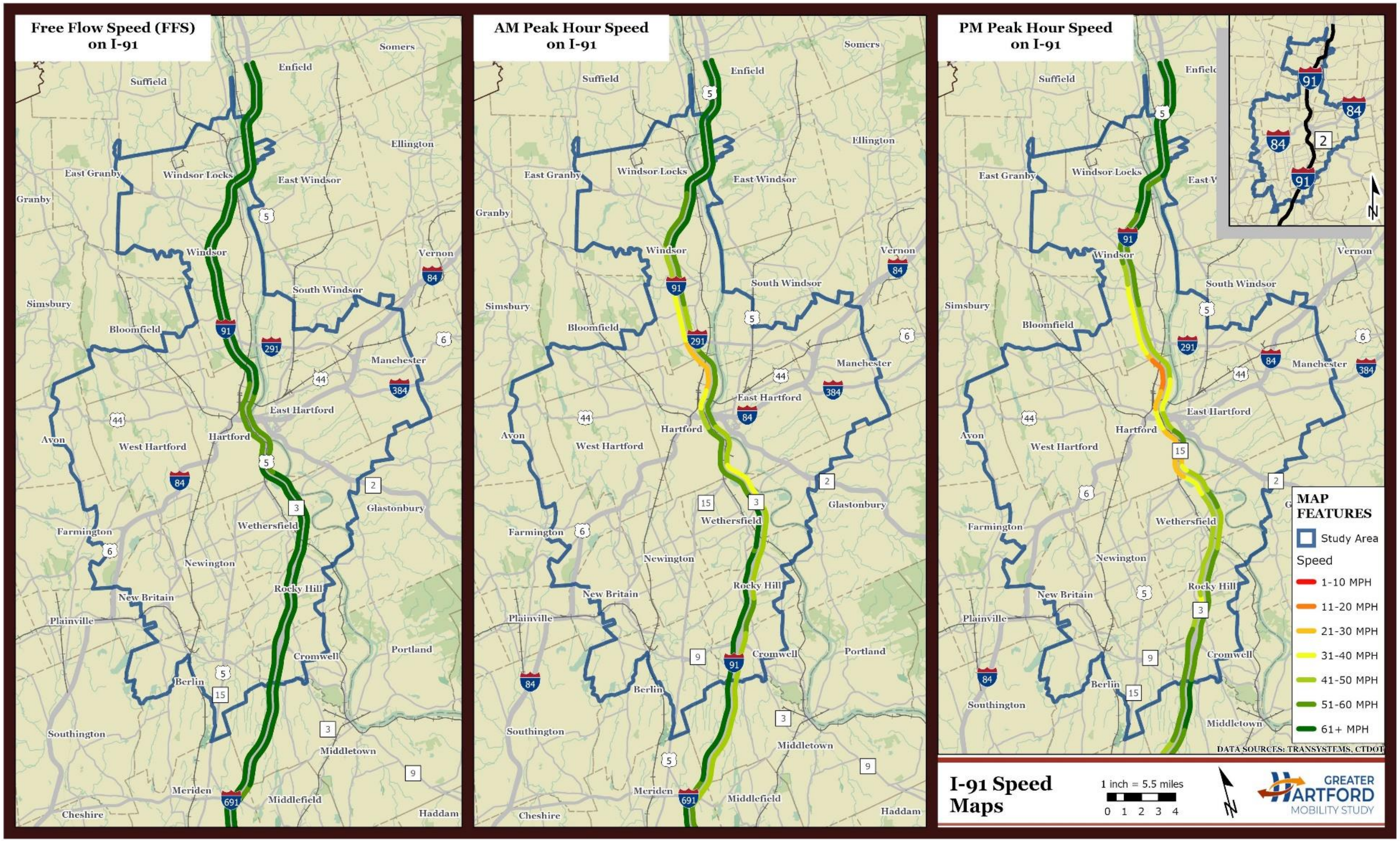

Figure 2-8: I-91 Speed Maps

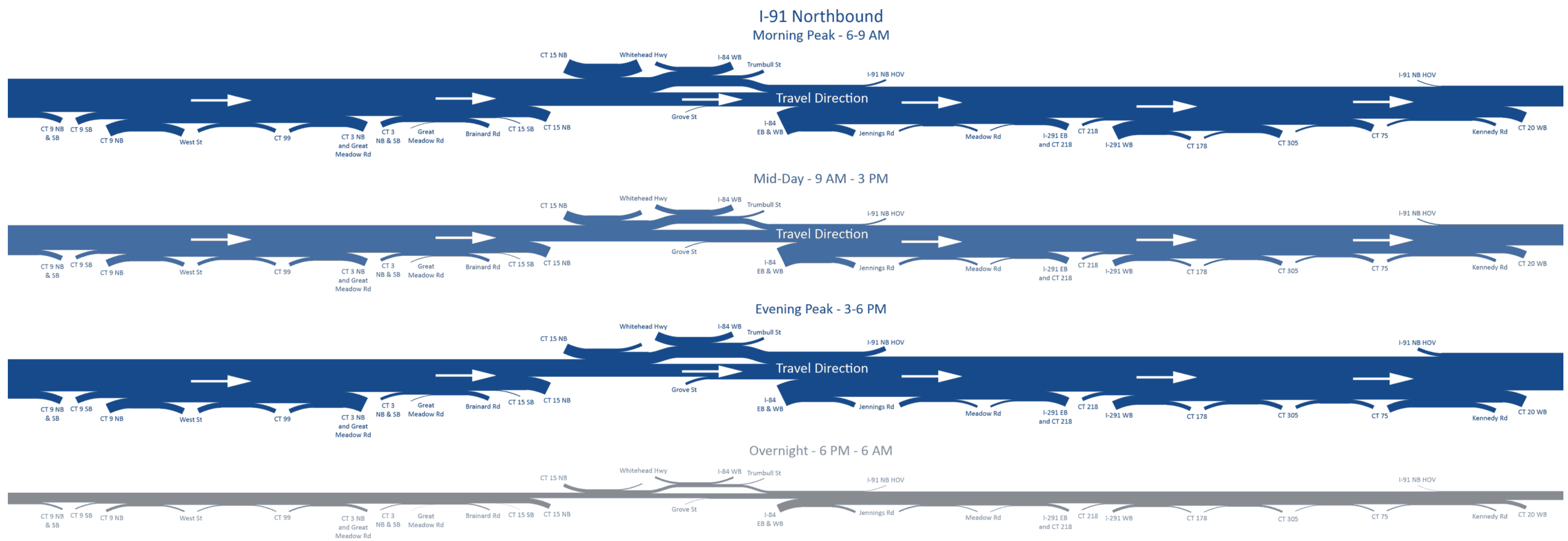

Figure 2-9: I-91 Northbound Travel Patterns

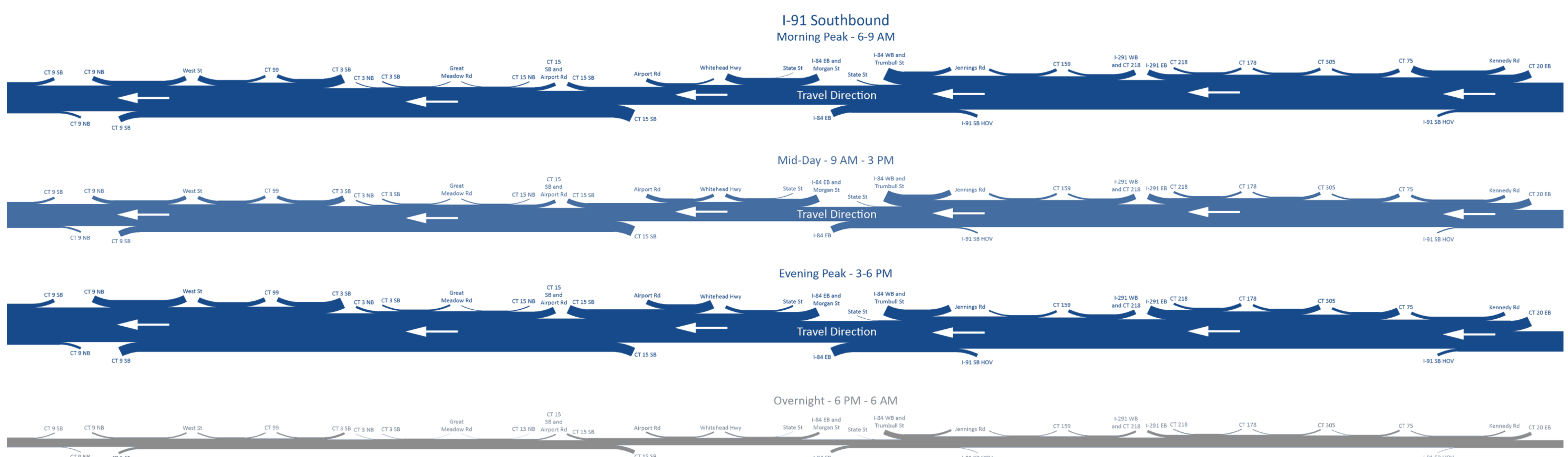

Figure 2-10: I-91 Southbound Travel Patterns

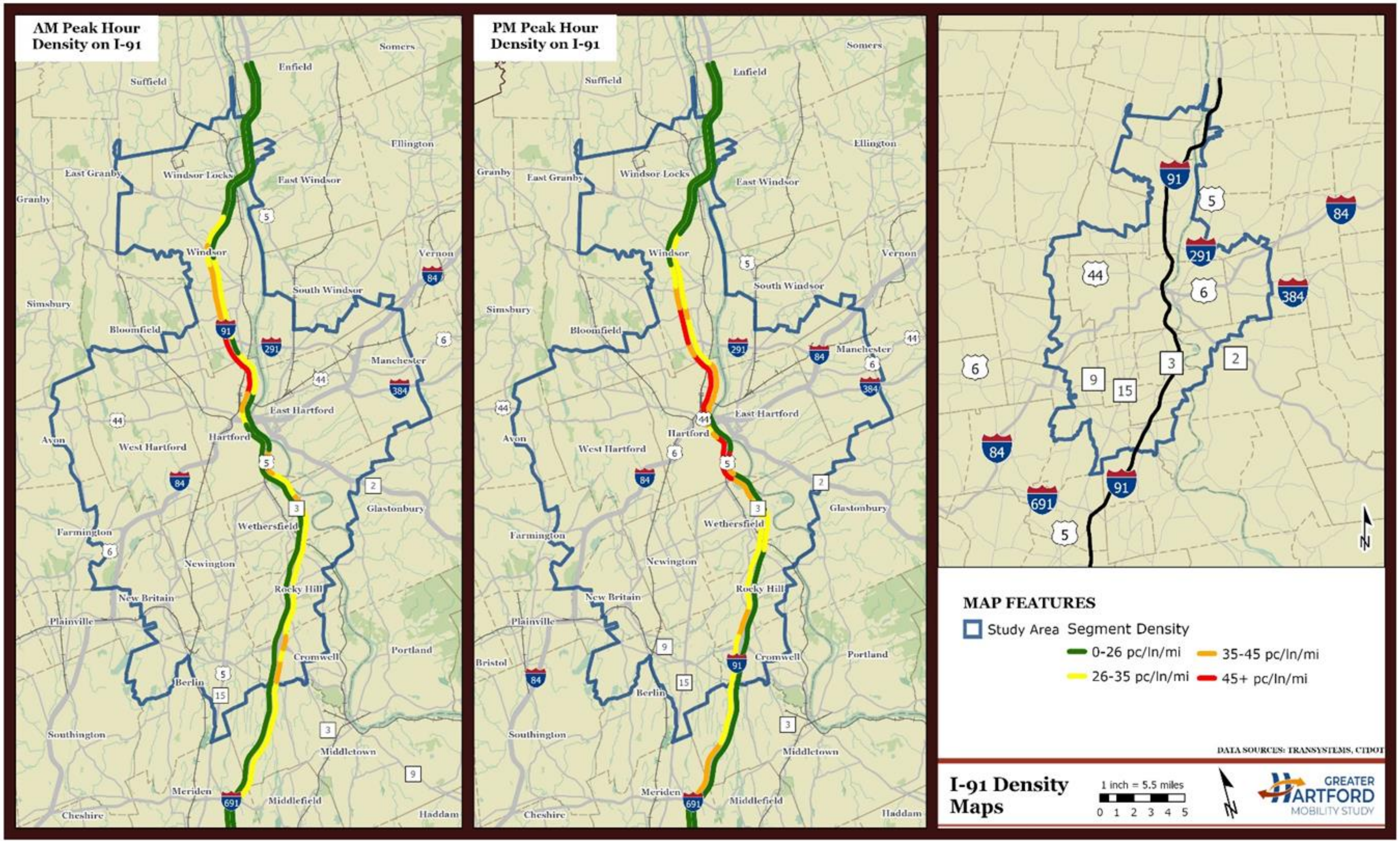

Figure 2-11: I-91 Density Maps
(at passenger lanes per mile)

Key Findings for I-91 Corridor

- Traffic volumes show less predominant study core-centric (Hartford & East Hartford) directional flow tendencies compared to I-84 – mid-day volumes are also relatively high.
- HOV lanes are predominantly used during peak hours when I-91 mainline speeds are lower.
- PM peak congestion is more severe compared to AM.
- Northbound congestion at the Route 15 interchange in Hartford is associated with a very high crash rate on I-91.
- Annual cost of recurring delays is approximately $102 million.

2.3.5 Route 2 Eastbound

Travel patterns on Route 2 Eastbound are shown in Figure 2-13. In this diagram, traffic is moving from left to right. Route 2 Eastbound displays a much higher disparity between peak hours than either I-84 or I-91. Eastbound volumes increase gradually throughout the day, peaking in the evening, when most commuters are heading out of Hartford. Of particular note is the leftmost portion of the diagram, which represents the Founders Bridge.

Most traffic using the Founders Bridge is continuing to I-84 Eastbound, not staying on Route 2. Similarly, much of the traffic on Route 2 Eastbound comes across the Bulkeley Bridge on I-84 Eastbound.

Like the other Priority Corridors, volumes drop overnight.

Route 2 Eastbound is only congested during the evening peak. This coincides with commuter traffic leaving Hartford. Speeds are slow between I-84 and Maple Street, both in East Hartford. The slowest speed, 23 mph, is beneath the Charter Oak Bridge where Route 2 Eastbound drops from three basic lanes to two.

On an average day, Route 2 Eastbound experiences 430 vehicle-hours of delay between State Street in Hartford and Route 83 in Glastonbury. With an approximate commercial vehicle percentage of 3%, the annual cost of delay on Route 2 Eastbound is $3.2 million.

2.3.6 Route 2 Westbound

Travel patterns on Route 2 Westbound are shown in Figure 2-13. In this diagram, traffic is moving from right to left. The time-of-day differences are less pronounced in the westbound direction. Though the morning peak is clearly the busiest, especially on the Founders Bridge at the left edge of the figure, evening volumes are similarly high in some locations.

There are many employment centers near Route 2 in East Hartford and Glastonbury, and the volumes indicate that employees at these locations use Route 2 to get to I-84. Like the other Priority Corridors, traffic decreases after 6 PM.

Route 2 Westbound experiences congestion during both peak periods (see Figure 2-13). In the morning, when traffic volumes are highest, Route 2 is congested from Route 17 in Glastonbury to the Founders Bridge in Hartford. Speeds on the bridge itself are relatively low throughout the day due to the traffic signal on its west end, but queues extend farther, and speeds are lower during peak periods. In East Hartford, the slowest morning peak speeds are 23 mph in the vicinity of Pitkin Street (see Figure 2-12). In the evening, congestion extends from Pitkin Street to I-84, with speeds as low as 22 mph around the I-84 interchange. The posted speed limit on Route 2 is 55 mph within the study area.

On an average day, Route 2 Westbound experiences 770 vehicle-hours of delay between Route 83 in Glastonbury and State Street in Hartford. With an approximate commercial vehicle percentage of 3%, the annual cost of delay on Route 2 Westbound is $5.7 million.

Key Findings for Route 2 Corridor

- Route 2 Eastbound displays much higher disparity between peak hours than I-84 and I-91. It is only congested during evening peak.
- Cost of recurring congestion related delay is approximately $10 million, which is significantly lower for Route 2 compared to I-84 and I-91.
- Speeds on the Founders Bridge itself are relatively low throughout the day due to the traffic signal on its west end, but queues extend farther, and speeds are lower during peak periods. Crash rates on the Founders Bridge are higher than elsewhere in the corridor.

Figure 2-12: Route 2 Speed Maps

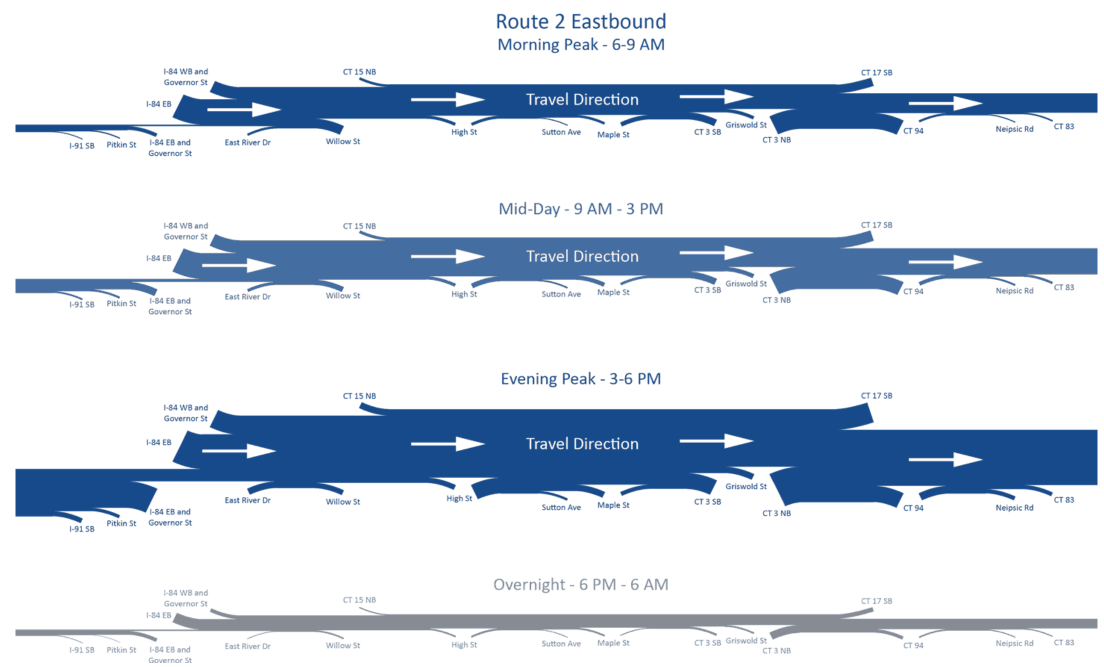

Figure 2-13: Route 2 Eastbound Travel Patterns

Figure 2-14: Route 2 Westbound Travel Patterns

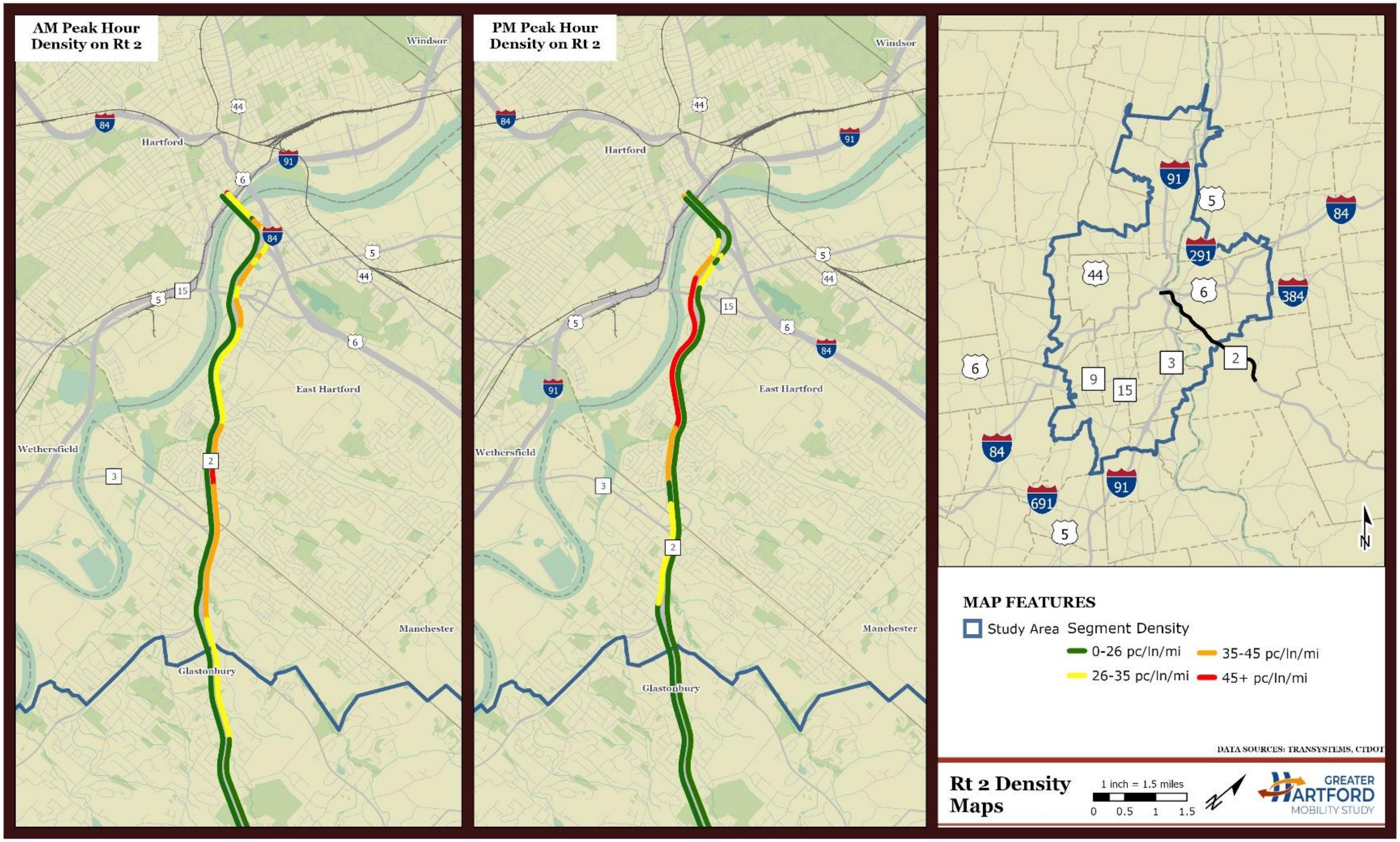

Figure 2-15: Route 2 Density Maps
(at passenger lanes per mile)

2.4 Contributing Corridors Traffic Assessment

Definition of Contributing Corridors: Contributing Corridors are the other high-volume, regionally significant routes within the study area that are not classified as Primary Corridors.

The Contributing Corridors for the GHMS are as follows:

- I-291
- I-384 (partially within the GHMS study area and partially outside)
- I-691 (fully outside the GHMS study area)
- Route 3 between I-91 and Route 2
- Route 9 between I-91 and I-84
- Route 15 between Route 9 and I-84

In addition, some portions of I-84, I-91, and Route 2 outside of the study area are considered to be Contributing Corridors.

Traffic volumes for each Contributing Corridor are given in Appendix 1 - balanced count profile appendix.

2.4.1 I-291

I-291 serves as a bypass around Hartford to the northeast, allowing tens of thousands of vehicles per day to avoid much of the recurring congestion on I-91 and I-84.

In addition, I-291 provides a way for traffic to access U.S. Route 5 in South Windsor without going through downtown East Hartford. Its busiest segment is the Bissell Bridge, where nearly 68,000 vehicles cross the Connecticut River each day, split roughly equally between eastbound and westbound traffic. I-291 has two basic lanes in each direction. Listed from west to east, the freeway has interchanges with:

- Route 218 (17,000 veh/day)
- I-91 (42,000 veh/day)
- Deerfield Road (9,000 veh/day)
- U.S. Route 5 (33,000 veh/day)
- Tolland Turnpike / Chapel Road (13,000 veh/day)
- I-384 (18,000 veh/day)
- I-84 (23,000 veh/day)

I-291 has a clear peaking pattern, with heavy westbound volumes in the morning and heavy eastbound volumes in the evening. In this way, its traffic pattern echoes that of I-84 east of Hartford. Unlike I-84, however, most of this peak period traffic is going to or from the north (via I-91) or west (via Route 218), with only a small portion going to or from downtown Hartford.

Congestion on I-291 occurs west of U.S. Route 5, and is confined to the peak periods (see Figure 2-17). In the morning, westbound traffic slows down to 39 mph approaching the ramp to I-91 Northbound. The traffic volume on this single-lane ramp exceeds 1,700 vehicles per hour during the morning peak, which is near the ramp's capacity. In the evening, congestion is more severe and occurs in the eastbound direction. Average speeds drop as low as 16 mph at the I-91 interchange (see Figure 2-16). The posted speed limit on I-291 (for sections considered as the Contributing Corridors) ranges between 40-65 mph within the study area.

On an average day, I-291 experiences 250 vehicle-hours of delay in the eastbound direction and 200 in the westbound direction. With an approximate commercial vehicle percentage of 6%, the annual cost of delay on I-291 Eastbound is $2.1 million, and the annual cost of delay on I-291 Westbound is $1.7 million.

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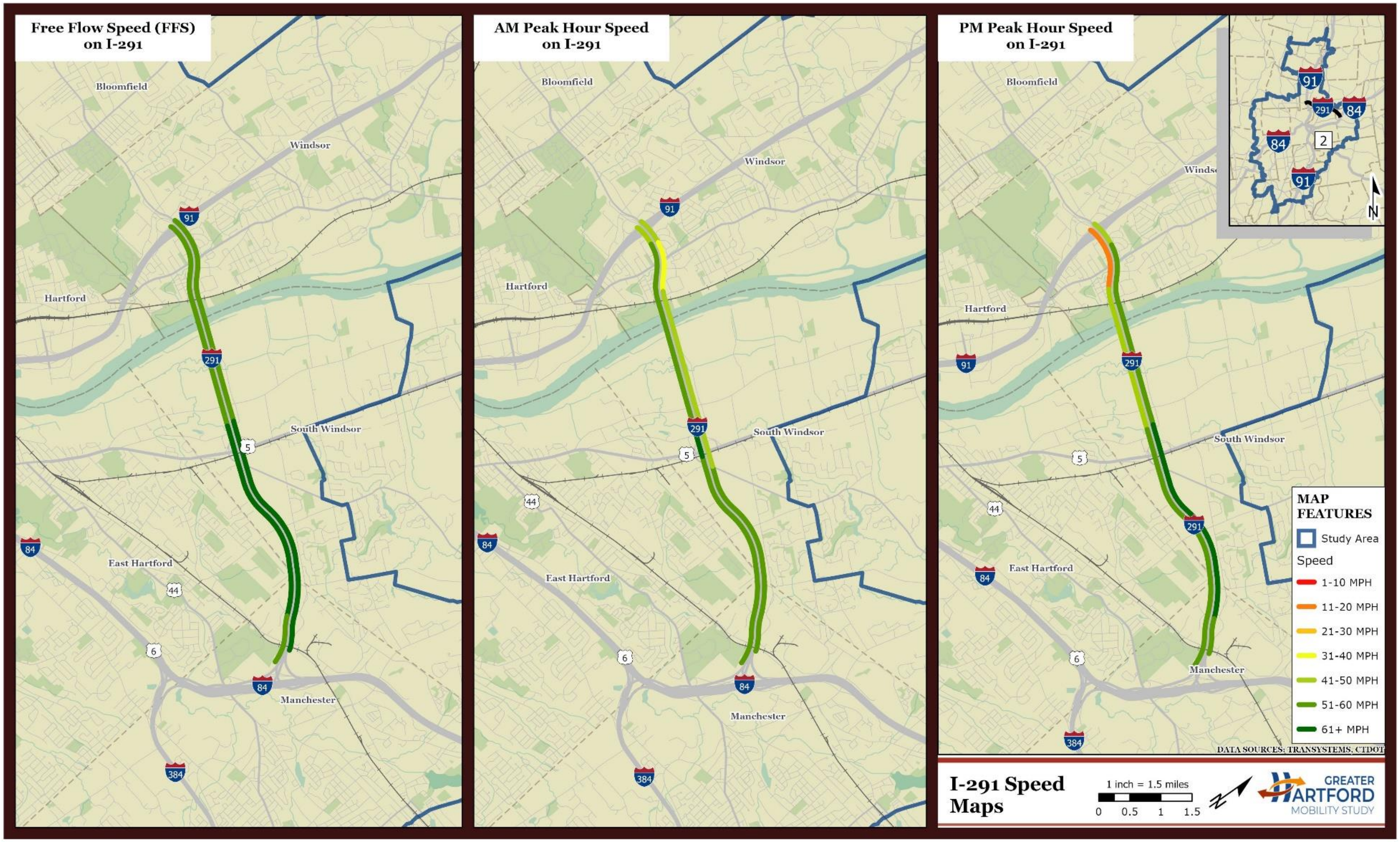


Figure 2-16: I-291 Speed Maps

Figure 2-17: I-291 Density Maps
(at passenger lanes per mile)

2.4.2 I-384

I-384 is a spur of I-84, running east-west through Manchester and Bolton. It serves both local traffic, which uses I-384 to access I-84 and I-291, and long-distance traffic, which continues east on U.S. Routes 6 and 44.

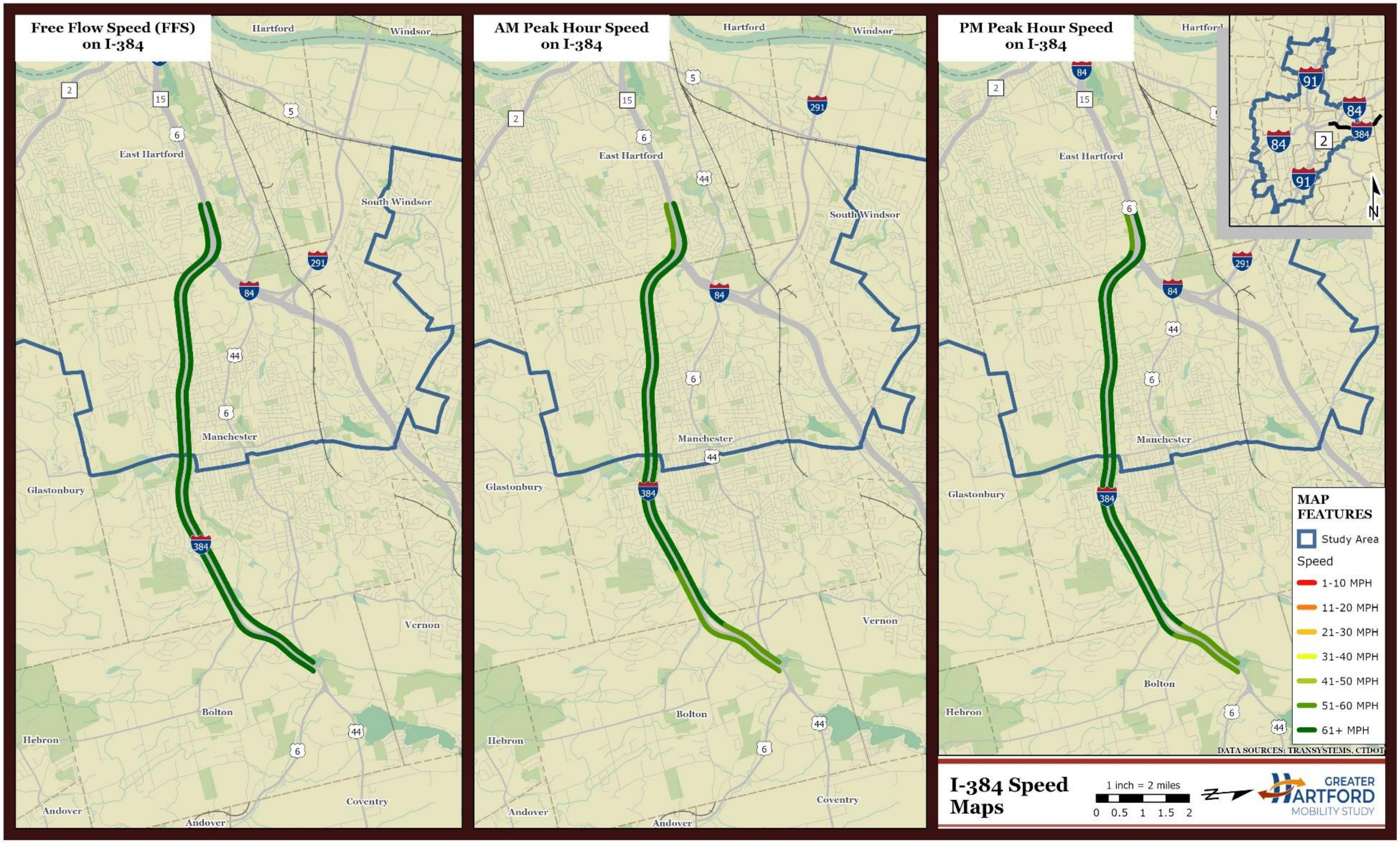
I-384 has two lanes in each direction at its eastern end, widening to four lanes in each direction at its junction with I-84, including one HOV lane. Its busiest segment is east of the Spencer Street interchange, with 65,000 vehicles per day. Traffic volumes are slightly higher westbound (53%) than eastbound (47%). Listed from west to east, the freeway has interchanges with:

- I-84 HOV Lane (3,000 veh/day)
- I-84 (52,000 veh/day)
- I-291 (18,000 veh/day)
- Buckland Street / Pleasant Valley Road (12,000 veh/day)
- Spencer Street / Cemetery Road (27,000 veh/day)
- Keeney Street (19,000 veh/day)
- Route 83 / Charter Oak Street (22,000 veh/day)
- Wyllys Street / Highland Street (10,000 veh/day)
- Route 85 (5,000 veh/day)
- U.S. Routes 6 & 44 (9,000 veh/day)

Much like the Priority Corridors, I-384 has its heaviest volumes heading into Hartford in the morning peak, and leaving Hartford in the evening. There are also several employment and retail centers around I-384, especially around the western half of the freeway, and many of the ramps in this area show high volumes throughout the day.

I-384's HOV lanes have a clear volume imbalance, with the westbound lane carrying 2,600 vehicles per day and the eastbound lane carrying only 700. As congestion on I-384 itself is minimal, these drivers could be attempting to avoid morning peak traffic on I-84. Surprisingly, though, HOV traffic on I-84 does not exhibit the same imbalance between morning and evening peaks. It is possible that I-384 Westbound traffic may use the HOV lane because it enters I-84 on the left-hand side, while I-384 itself enters on the right. This offers better access to the high-volume Route 2 and Route 15 interchanges, which are left-hand exits. The posted speed limit on I-384 is 65 mph for the study area Contributing Corridor section.

There is minimal congestion on I-384. Though speeds are reduced during peak periods, they mostly remain over 60 mph (see Figure 2-18), and densities (see Figure 2-19) are acceptably low as well. On an average day, I-384 experiences 90 vehicle-hours of delay in the eastbound direction and 60 in the westbound direction. With an approximate commercial vehicle percentage of 3%, the annual cost of delay on I-384 Eastbound is $0.7 million, and the annual cost of delay on I-384 Westbound is $0.4 million.



Chapter 1 Figure 2-18: I-384 Speed Maps

Figure 2-19: I-384 Density Map
(at passenger lanes per mile)

2.4.3 I-691

I-691 is a freeway connecting I-84 in Cheshire to I-91 and Route 15 in Meriden. In addition to serving long-distance traffic, the freeway also passes north of downtown Meriden and provides access to Midstate Medical Center and the Westfield Mall.

I-691 has two basic lanes in each direction, with a third lane provided in Meriden between Lewis Avenue and Route 15. Traffic volumes are highest west of the U.S. Route 5 interchange, with an average daily traffic above 86,000 vehicles, split evenly between eastbound and westbound directions. Listed from west to east, the freeway has interchanges with:

- I-84 (62,000 veh/day)
- Route 10 (22,000 veh/day)
- Route 322 (16,000 veh/day)
- Route 71 / Lewis Avenue (21,000 veh/day)
- Colony Street / State Street (11,000 veh/day)
- U.S. Route 5 (18,000 veh/day)
- Route 15 (39,000 veh/day)
- I-91 (37,000 veh/day)

Traffic volumes on I-691 are not heavily directional. Whether in the morning or evening peak, volumes are high in both directions. There is a slight trend towards eastbound traffic in the morning and westbound traffic in the evening, reflecting commuters heading to and from downtown Meriden, but this trend is much less pronounced than on the other interstates.

There is little recurring congestion on I-691. Speeds throughout the day are generally above 55 mph, dropping slightly during peak periods and, in the westbound direction, on the uphill grade between Route 71 and Route 322. This segment is the only location on I-691 that regularly operates above 35 pc/ln/mi; the rest of the freeway operates below that threshold. The lowest average speed, 46 mph, occurs during the morning peak at the U.S. Route 5 interchange and coincides with drivers facing directly into the rising sun (see Figure 2-20). Figure 2-21 shows traffic density along I-691 during peak hours.

The level of service of freeway segments is based on the density of vehicles, which is expressed in passenger cars per lane per mile (pc/ln/mi).

On an average day, I-691 experiences 290 vehicle-hours of delay in the eastbound direction and 190 in the westbound direction. Assuming a commercial vehicle percentage of 5%, the annual cost of delay on I-691 Eastbound is $2.3 million, and the annual cost of delay on I-691 Westbound is $1.5 million.

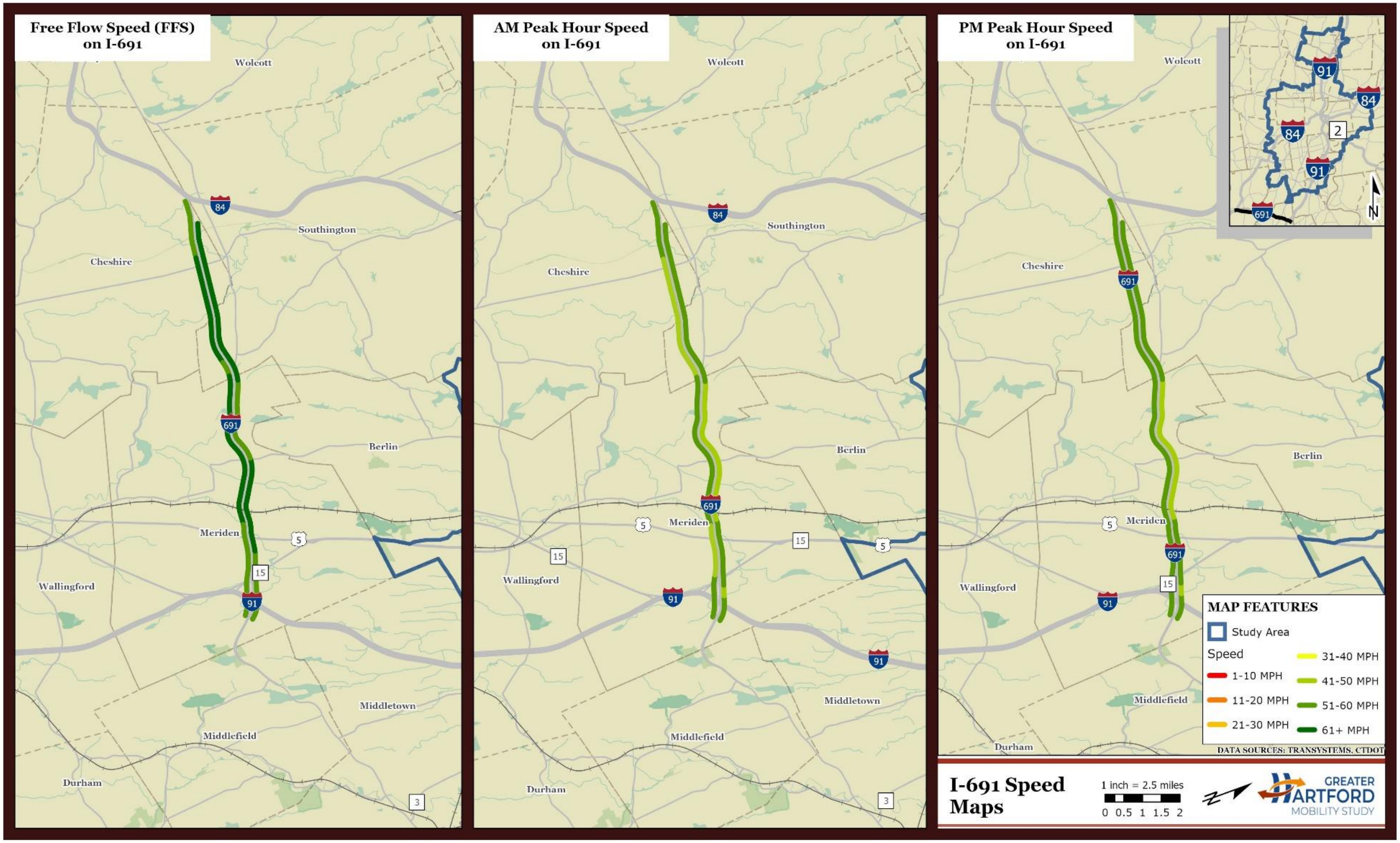


Figure 2-20: I-691 Speed Maps

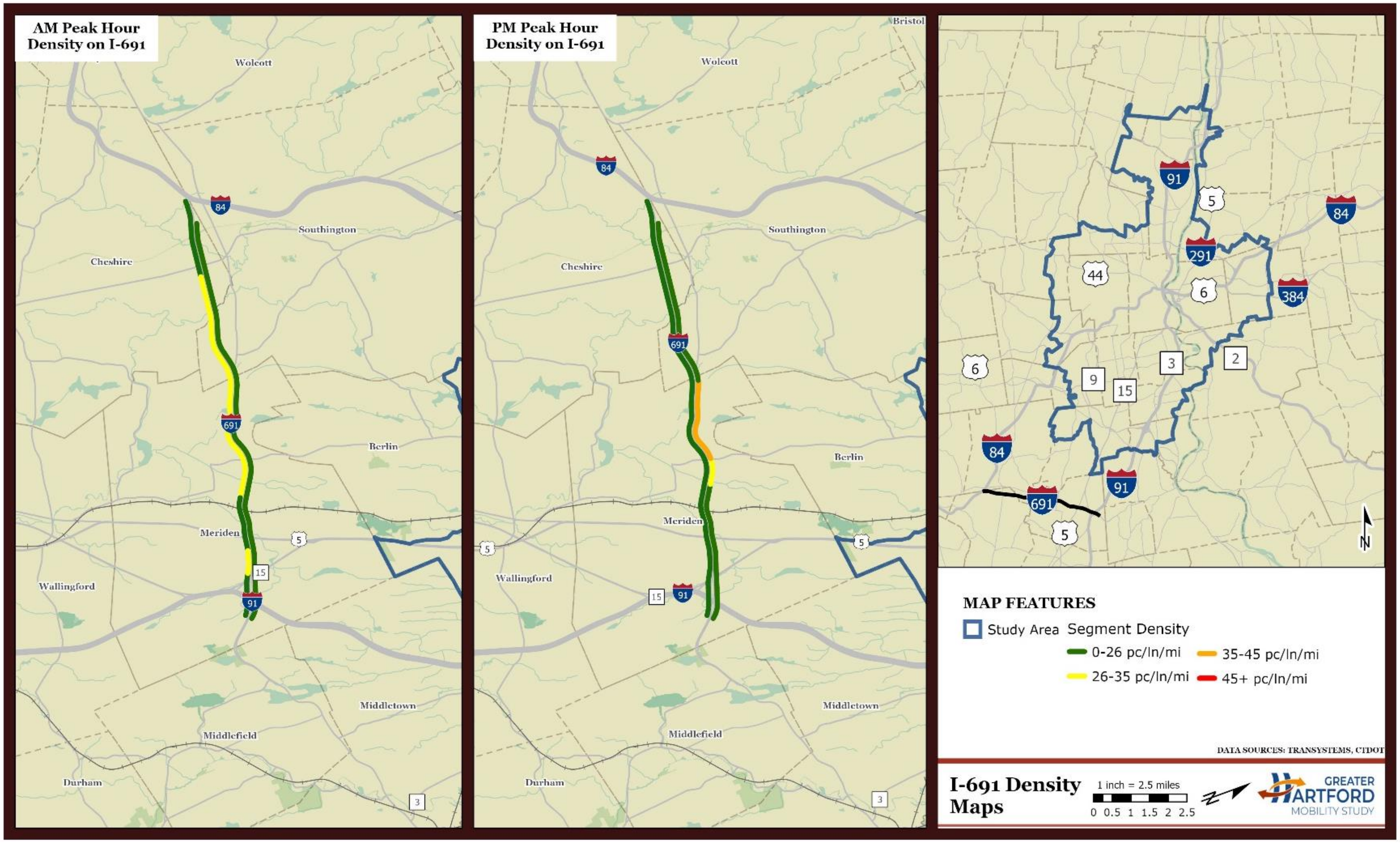


Figure 2-21: I-691 Density Map
(at passenger lanes per mile)

2.4.4 Route 3

Route 3 runs 14 miles from Middletown to East Hartford, but only the northernmost 3.5 miles are included as a Contributing Corridor.

This covers the portion between I-91 in Wethersfield and Route 2 in East Hartford. This segment is a freeway with one to two lanes in each direction and crosses over the Connecticut River via the Putnam Bridge. This bridge is the only freeway bridge over the Connecticut River between Hartford and Old Saybrook. It is frequently used as an alternative route for traffic bypassing congested segments of I-91 and Route 15. This section of Route 3 also provides local access to Wethersfield and Glastonbury. Route 3 carries 56,000 vehicles a day across the Putnam Bridge, with a nearly even directional split. Listed from south to north, the freeway has interchanges with:

- I-91 (44,000 veh/day)
- Glastonbury Boulevard / Putnam Boulevard (31,000 veh/day)
- Route 2 (50,000 veh/day)

Route 3 runs circumferentially to Hartford, so both peaks should have similar volumes. Southbound volumes are roughly identical in the morning and evening peaks, but northbound volumes are much higher in the evening. This is likely due to traffic bypassing the northbound direction of the Charter Oak Bridge during the congested evening peak.

There is very little congestion on Route 3 Southbound, with speeds above 45 mph throughout the day. In the northbound direction, the evening peak is marked by slow speeds north of I-91. Average speeds drop as low as 28 mph at the Glastonbury Boulevard interchange (see Figure 2-22). The posted speed limit on Route 3 ranges between 40-55 mph for the study area Contributing Corridor sections. Figure 2-23 shows traffic density along Route 3 during peak hours.

On an average day, Route 3 north of I-91 experiences 160 vehicle-hours of delay in the northbound direction and 70 in the southbound direction. With an approximate commercial vehicle percentage of 7%, the annual cost of delay on Route 3 Northbound is $1.4 million, and the annual cost of delay on Route 3 Southbound is $0.6 million.

Figure 2-22: Route 3 Speed Maps

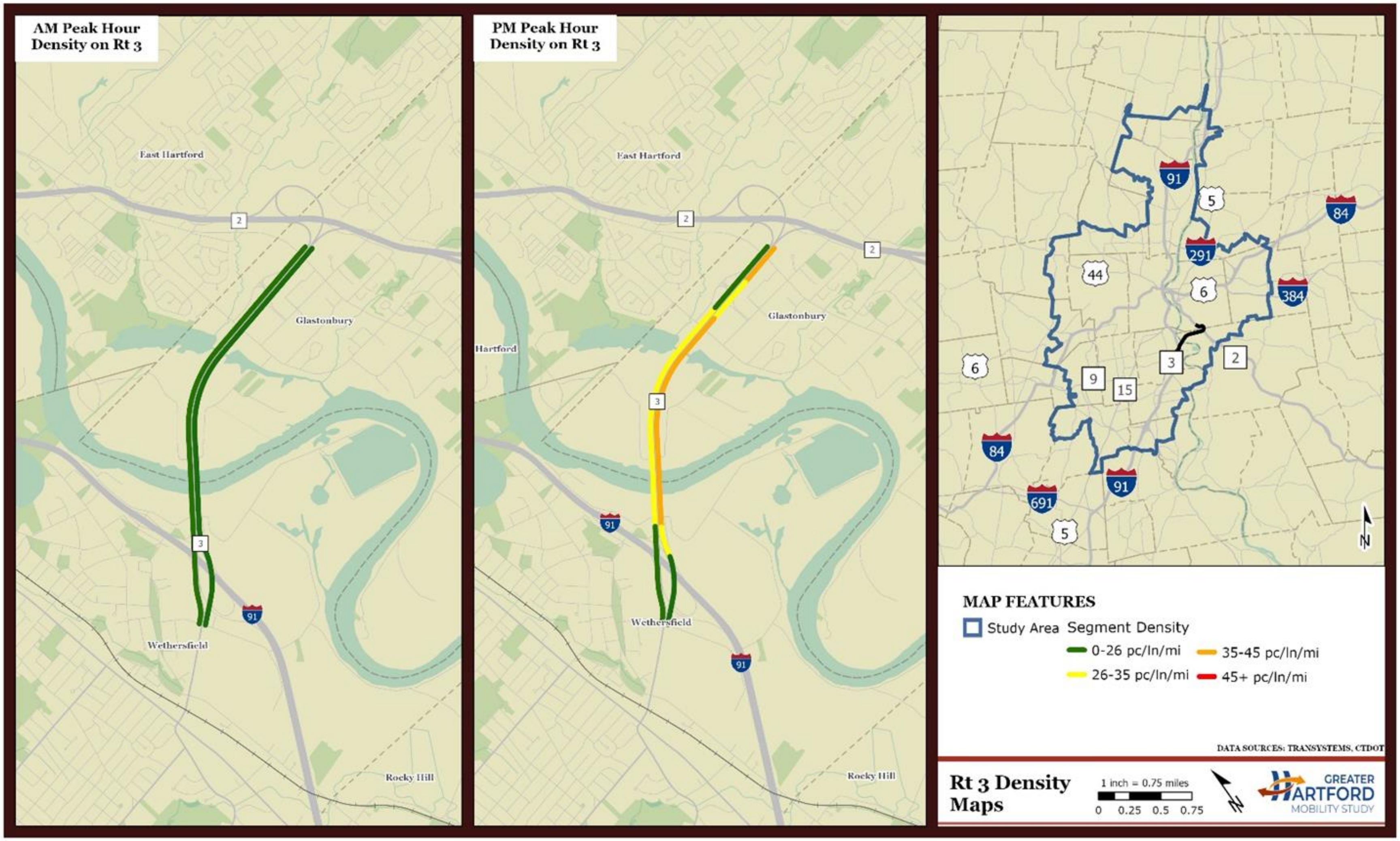


Figure 2-23: Route 3 Density Maps
(at passenger lanes per mile)

2.4.5 Route 9

Route 9 is 41 miles long, extending from I-95 in Old Saybrook to I-84 in Farmington. Eleven miles of Route 9 are considered to be a Contributing Corridor, from I-91 in Cromwell to its northern terminus.

This portion of Route 9 is a freeway with two basic lanes in each direction, and serves several trip purposes. It is an alternate route between I-91 and I-84, provides access to downtown New Britain, and connects several important destinations such as Central Connecticut State University, Westfarms Mall, and Kensington. The busiest portion of Route 9 within the study area, the segment west of Christian Lane, carries nearly 83,000 vehicles per day. The directional split varies by location. Listed from south to north, the freeway has interchanges with:

- I-91 (68,000 veh/day)
- Route 15 / Route 372 (37,000 veh/day)
- Christian Lane (15,000 veh/day)
- SR 571 (Kensington Bypass) (12,000 veh/day)
- Ellis Street (16,000 veh/day)
- Downtown New Britain / Chestnut Street (15,000 veh/day)
- Route 72 (52,000 veh/day)
- Route 174 / Smalley Street (8,000 veh/day)
- Route 175 / Ella Grasso Road (37,000 veh/day)
- Route 71 (25,000 veh/day)
- I-84 (48,000 veh/day)

Hourly traffic trends on Route 9 vary by location. North of Route 72, the freeway serves mainly traffic heading to or from Hartford. In the morning peak, northbound volumes are higher, while southbound volumes are heavier in the evening. South of Route 72, volumes are higher during the evening than the morning in both directions. This indicates a significant proportion of non-commuter traffic.

Congestion on Route 9 is limited to peak periods. Northbound, there is delay during the evening peak between Route 372 and Ellis Street, with average speeds dropping to 28 mph. There are also minor slowdowns (48 mph) approaching the off-ramp to Route 175 in the morning peak. On Route 9 Southbound, average speeds drop to 42 mph just south of Route 72 in the evening peak, but rebound south of Ellis Street (see Figure 2-24). The posted speed limit on Route 9 is 65 mph. On an average day, Route 9 north of I-91 experiences 410 vehicle-hours of delay in the northbound direction and 320 in the southbound direction. With an approximate commercial vehicle percentage of 4%, the annual cost of delay on Route 9 Northbound is $3.1 million, and the annual cost of delay on Route 9 Southbound is $2.5 million.

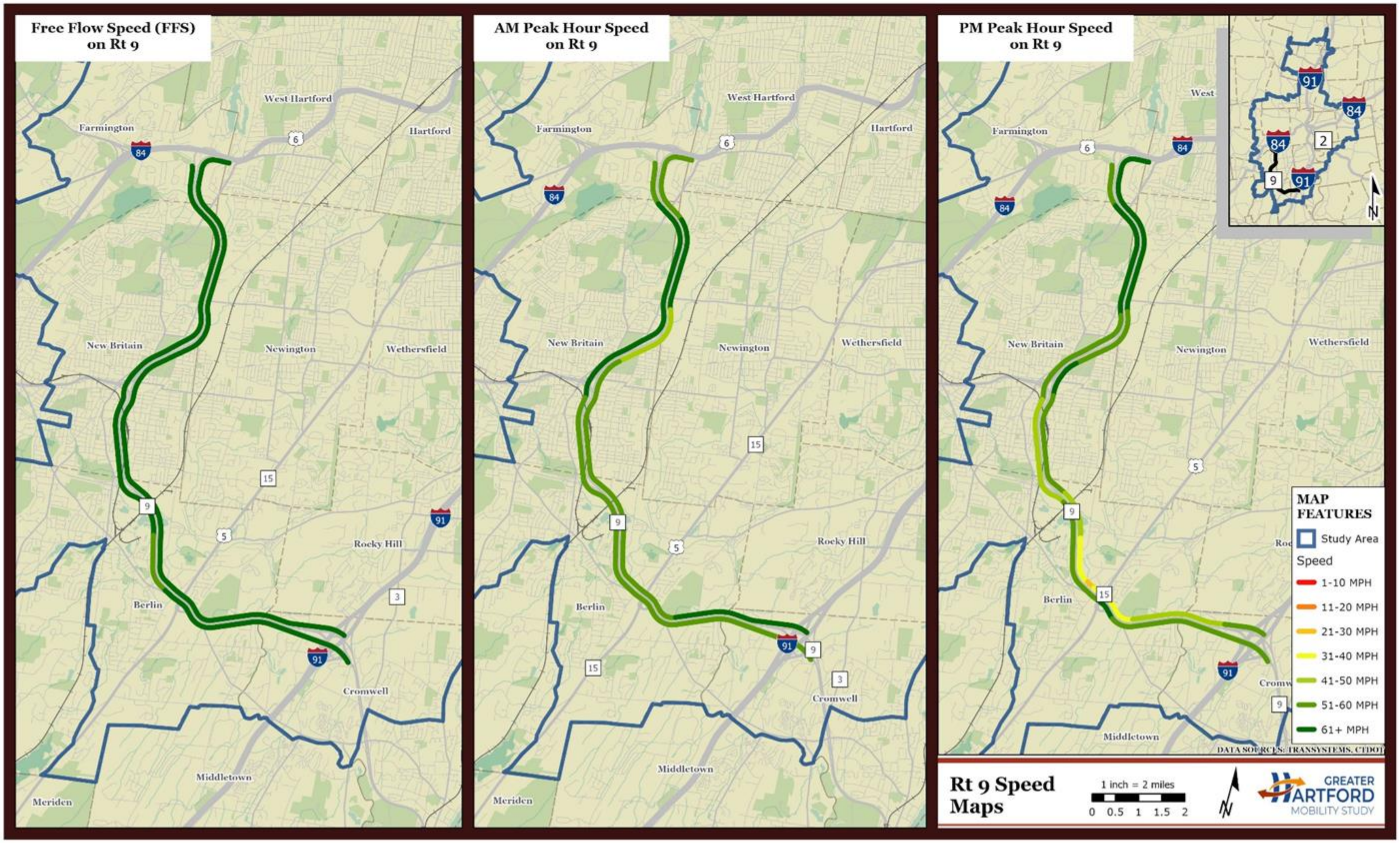


Figure 2-24: Route 9 Speed Maps

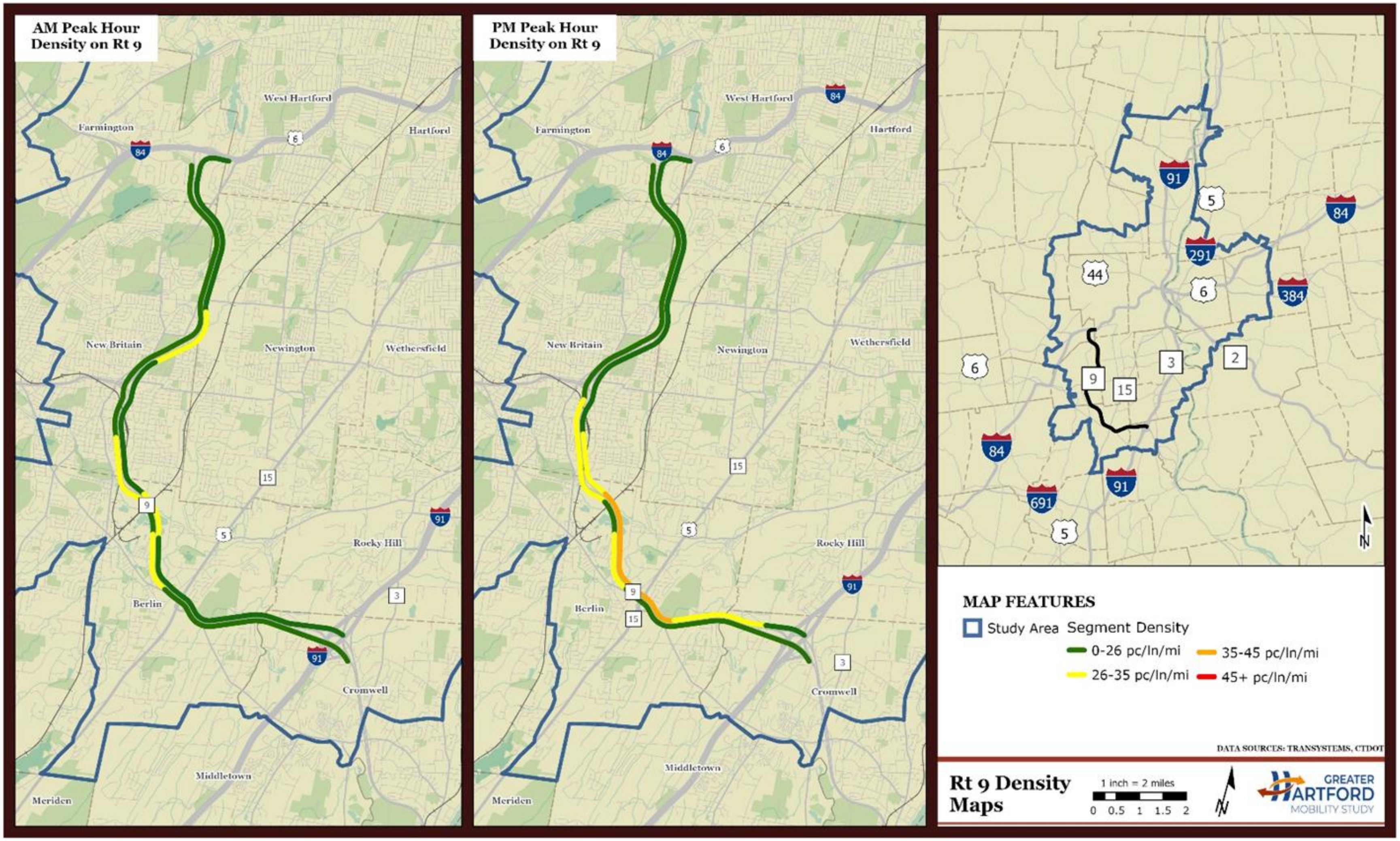


Figure 2-25: Route 9 Density Maps
(at passenger lanes per mile)

2.4.6 Route 15

Route 15 overlaps with U.S. Route 5 for nearly all of this distance. South of Wethersfield, Route 15 is designated the Berlin Turnpike, a two-to-three-lane divided arterial with some interchanges and many signalized intersections. Farther north, Route 15 becomes a freeway, the Wilbur Cross Highway, with one to three lanes in each direction. It crosses the Connecticut River on the Charter Oak Bridge and has interchanges with all three Priority Corridors.

The Berlin Turnpike is the core of a densely developed commercial swath, and provides access to businesses, neighborhoods, and intersecting arterials along its length. It serves as an alternate through route when I-91 is congested. The busiest portion of the Berlin Turnpike is in Wethersfield north of Route 175, where it carries 49,000 vehicles per day. The Wilbur Cross Highway, on the other hand, is a high-volume connection between the Berlin Turnpike, I-91, Route 2, and I-84. The busiest segment of Route 15 is the Charter Oak Bridge, with an average of 81,000 vehicles per day. Volumes are split relatively evenly between northbound and southbound. Listed from south to north, Route 15 has interchanges with:

- Route 9 / Route 372 (28,000 veh/day)
- Route 175 (23,000 veh/day)
- Route 99 (22,000 veh/day)
- I-91 (86,000 veh/day)
- Brainard Road / Airport Road (29,000 veh/day)
- Route 2 (5,000 veh/day)
- U.S. Route 5 / East River Drive (14,000 veh/day)
- Silver Lane (7,000 veh/day)
- I-84 (61,000 veh/day)

Traffic patterns on Route 15 vary by location. On the Berlin Turnpike in Berlin, there is a distinct northbound trend in the morning and southbound trend in the evening, indicating that Route 15 here is used as a commuter route. In Newington, where the Berlin Turnpike is a retail and restaurant hub, volumes are high throughout the day, and peaks are less pronounced, though southbound volumes are still highest in the evening. The southern portion of the Wilbur Cross Highway in Wethersfield once again shows distinct morning and evening peaks of roughly equal magnitude. Finally, between I-91 and I-84, Route 15 is strongly directional, with high southbound volumes in the morning and high northbound volumes in the evening.

The speeds shown in Figure 2-26 are average speeds along a road segment. On a freeway, slow speeds are indicative of congestion, but this is not necessarily the case for non-freeways. The Berlin Turnpike has numerous signalized intersections, and these signals introduce delay at all times of the day.

Rather than using absolute speed, this document considers congestion on signalized highways to occur when the average speed drops significantly below off-peak speeds. The posted speed limit for the corridor is 55 mph.

Traffic flow on the Berlin Turnpike is generally steady throughout the day. There is one location where speeds drop by more than 50% during the evening peak: Route 15 Southbound approaching the intersection with Route 287. The offset geometry and high volumes at this signalized intersection result in long southbound queues and average speeds of 17 mph.

On the Wilbur Cross Highway, there are some slowdowns during both peak periods, though densities do not rise above 35 pc/ln/mi. The slowest speeds occur on Route 15 Southbound across the Charter Oak Bridge, where they average 31 mph during the evening peak. This is not due to high volumes on Route 15 itself, however, but rather due to congestion on I-91 and the ramp from Route 15 Southbound to I-91 Southbound, situated at the south end of the bridge.

On an average day, Route 15 north of Route 9 experiences 1,030 vehicle-hours of delay in the northbound direction and 1,380 in the southbound direction. With an approximate commercial vehicle percentage of 5%, the annual cost of delay on Route 15 Northbound is $8.3 million, and the annual cost of delay on Route 15 Southbound is $11.1 million. 76% of this delay occurs on the Berlin Turnpike, with the remaining 24% on the Wilbur Cross Highway.

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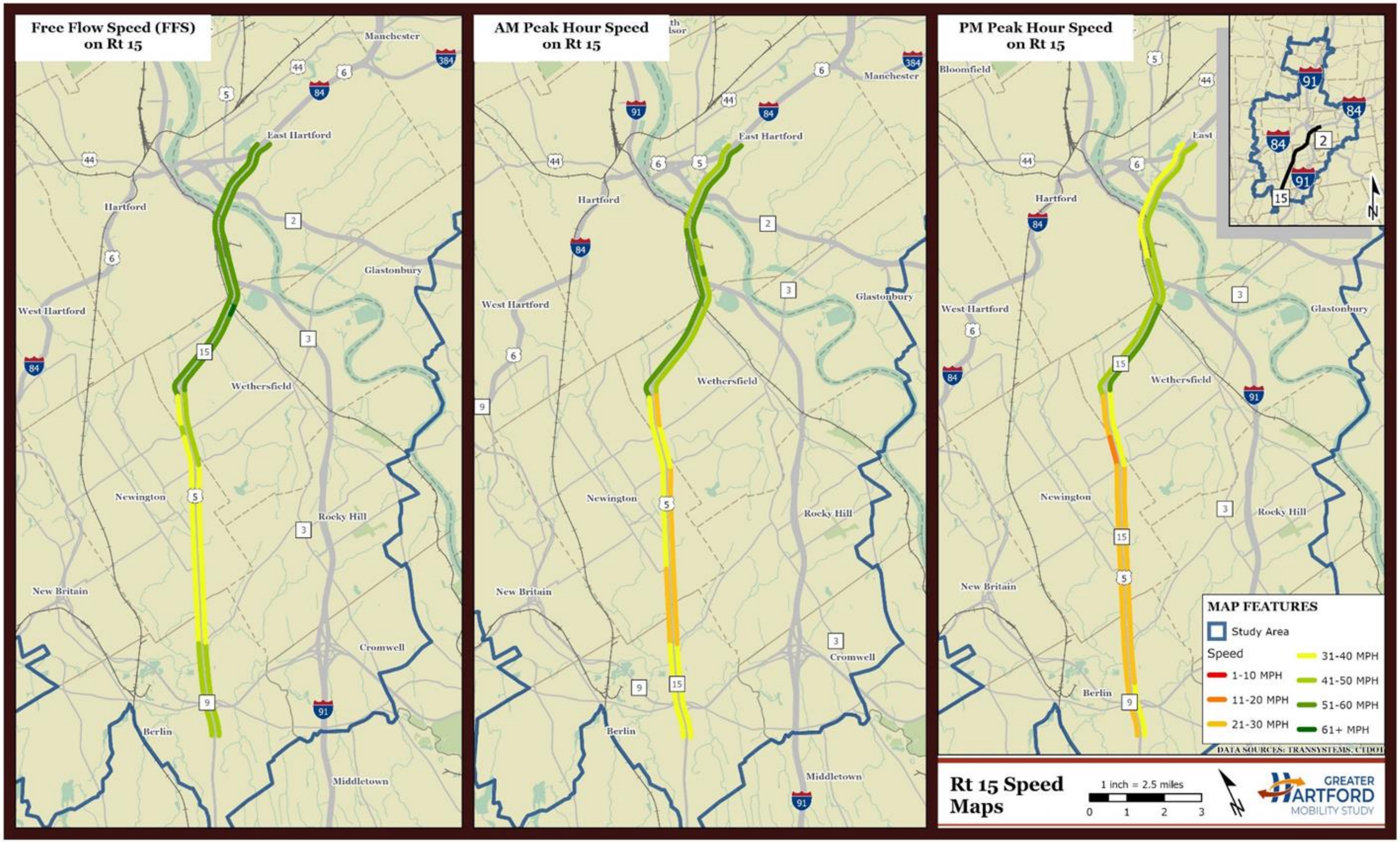

Figure 2-26: Route 15 Speed Maps

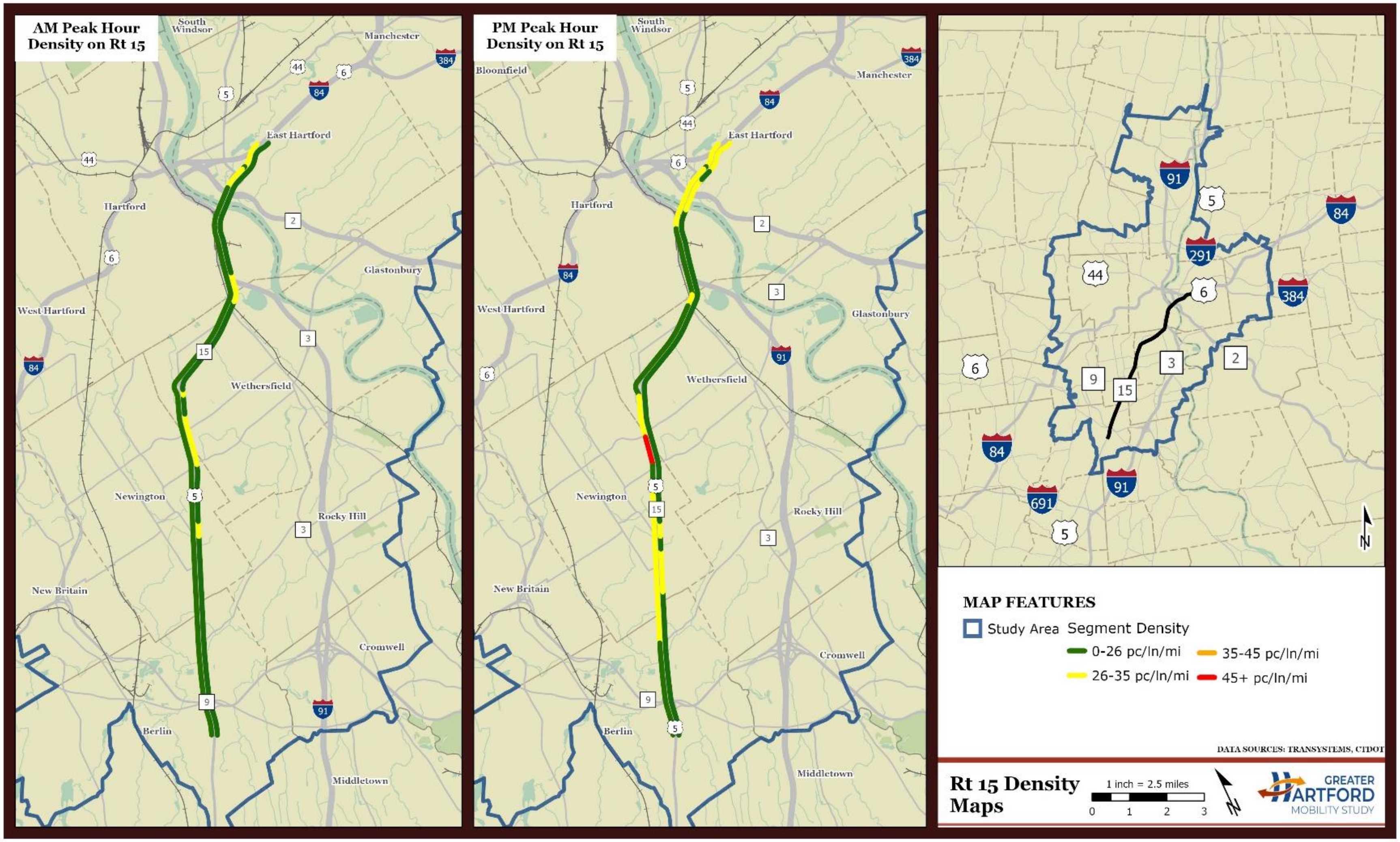

Figure 2-27: Route 15 Density Maps
(at passenger lanes per mile)

2.5 Corridors for Traffic Collection Traffic Assessment

The Corridors for Traffic Collection include:

- U.S. Route 5 from Route 15 in East Hartford to I-91 Exit 44 in East Windsor,
- U.S. Route 44 from Route 167 in Simsbury to I-84 in Hartford,
- Route 20 from Bradley International Airport to I-91,
- Route 159 from I-91 Exit 34 in Windsor to I-91 Exit 42 in Windsor Locks,
- The entirety of Route 218,
- SR 502 (East River Drive, Silver Lane, Spencer Street) from Route 2 in East Hartford to I-384 in Manchester,
- Asylum Avenue from South Main Street in West Hartford to I-84 in Hartford, and
- Farmington Avenue from South Main Street in West Hartford to Asylum Avenue in Hartford.

Traffic volumes for each Contributing Corridor are given in Appendix 1 - balanced count profile appendix.

2.5.1 U.S. Route 5

U.S. Route 5 runs parallel to I-91 throughout Connecticut. In East Hartford and South Windsor, the road is generally a divided highway with two lanes in each direction. In East Windsor, most of U.S. Route 5 is undivided, with one lane in each direction. It is the primary north-south route in these towns and serves both local and long-distance trips. When I-91 is heavily congested, U.S. Route 5 serves as a bypass.

Traffic volumes on U.S. Route 5 within the study area are generally around 10,000 vehicles per day in each direction. Southbound volumes are generally higher than northbound volumes. The busiest segment is between I-291 and Chapel Road in South Windsor, where northbound volumes are 12,000 vehicles per day, and southbound volumes are 14,000. Time-of-day traffic patterns vary, with U.S Route 5 in downtown East Hartford seeing high volumes throughout the day, and segments to the north showing distinct morning and evening peaks.

2.5.2 U.S. Route 44

U.S. Route 44 is the primary road connection between Hartford and the towns to its northwest. It provides the only crossing of the Metacomet Ridge in the seven-mile stretch between Route 4 in Farmington and Route 185 in Simsbury. West of Hartford, U.S. Route 44 has two lanes in each direction, along with a median as it passes over Avon Mountain. Its character is largely rural and commercial as it passes through Avon, with increasing density as the road enters West Hartford. Within Hartford, U.S Route 44's width varies from one to three through lanes in each direction. It passes through the dense Upper Albany and Clay Arsenal neighborhoods, then runs along Downtown North and Downtown before joining I-84 across the Bulkeley Bridge.

Traffic volumes on U.S. Route 44 are relatively high throughout the study area, with daily traffic of around 10,000 vehicles in each direction. They are highest in Avon, just east of U.S. Route 202, with 17,000 vehicles per day in the eastbound direction and 15,000 in the westbound. West of Hartford, U.S. Route 44 has a very strong directional pattern, with eastbound traffic much heavier in the morning and westbound traffic much heavier in the evening. Within Hartford, however, this trend becomes much less evident as U.S. Route 44 is busy throughout the day.

2.5.3 Route 20

Route 20 runs east-to-west through Connecticut's northern towns. The easternmost three miles are a freeway with two lanes in each direction, providing high-speed access between Bradley International Airport and I-91, as well as a number of industrial and logistics hubs near the airport. Route 20 also serves as a commuter route for residents of Granby and East Granby.

Route 20 carries traffic volumes ranging from 18,000 vehicles per day in each direction at the west end of the freeway to 28,000 vehicles per day in each direction at the east end. Eastbound volumes are modestly higher than westbound volumes throughout the corridor. Because of the many employment centers along Route 20, commute patterns tend to be inbound in the morning and outbound in the evening, but the airport produces trips throughout the day and well into the night. As a result, this corridor has a complex traffic pattern that varies by segment.

2.5.4 Route 159

Route 159 begins at the Hartford – Windsor town line and continues northward along the west bank of the Connecticut River. It goes through the Wilson, downtown Windsor, and Hayden neighborhoods within the study area, serving mainly residential areas. South of Route 75, Route 159 is divided and has one to two lanes in each direction. North of Route 75, it is mainly undivided, with one lane in each direction.

Traffic volumes on Route 159 are highest between Hartford and Route 75, with around 7,000 vehicles per day in each direction. Daily volumes decrease to 2,000 vehicles in each direction north of Route 75. There is a strong directional trend, with southbound traffic much heavier in the morning peak and northbound traffic in the evening peak. This is consistent with residents of Windsor using Route 159 as a way to get to jobs in Hartford.

2.5.5 Route 218

Route 218 is a primarily east-west road beginning at U.S. Route 44 in Bishop's Corner, West Hartford, then heading north and east to end at Route 159 in Windsor. The north-south portion has one lane in each direction, while the east-west portion has two, as well as a median for much of its length. It is the primary connection between major commercial centers in West Hartford and Bloomfield, as well as the main access route for the Cigna HealthCare campus.

Route 218 is one of the busiest non-freeway roads in Connecticut. Daily traffic volumes generally exceed 10,000 vehicles in each direction, and between Cigna and I-91, volumes can reach nearly twice that value. The busiest segment, just west of I-291, has a combined daily volume of 38,000 vehicles. Traffic volumes are heaviest during the evening peak, especially southbound and westbound, headed away from Cigna. There is a heavy morning peak in the opposite direction as well, indicating that Route 218 is a busy commuter corridor.

2.5.6 SR 502 (East River Drive, Silver Lane, Spencer Street)

SR 502 is an unsigned State-maintained route comprising East River Drive east of Route 2, Silver Lane, and Spencer Street in East Hartford and Manchester. It runs parallel to, and south of, I-84. SR 502 has interchanges with Route 2, Route 15, I-84's HOV lanes, and I-384, and thus serves as the primary connection between the freeway network and local destinations. East River Drive and Spencer Street have two lanes in each direction, while Silver Lane has one to two.

Traffic volumes on SR 502 vary from 1,800 to 14,000 daily vehicles in each direction, with the lowest volumes near the Route 2 interchange and the highest volumes in Manchester east of I-384. Traffic volumes are high throughout the day, without distinct morning and evening peaks, which reflects the mixed nature of development along the corridor. SR 502 serves local trips rather than through traffic. The major exception to this trend is when there is a special event at Rentschler Field, which has two access points on Silver Lane. Traffic heading to or from the stadium is directed down Silver Lane using special event traffic patterns and signal timing.

2.5.7 Asylum Avenue

Asylum Avenue is a locally maintained east-west road that runs from central West Hartford to Main Street in Hartford. Much of Asylum Avenue is one lane in each direction and undivided, but portions have more lanes or a median, and the easternmost 0.4 miles are one-way westbound. Asylum Avenue serves both local traffic and longer-distance trips between West Hartford and Hartford.

Traffic volumes on Asylum Avenue vary but are generally around 6,000 vehicles per day in each direction. West of Sigourney Street, there is a strong eastbound peak in the morning as commuters head into Hartford, and a strong westbound peak in the evening. East of Sigourney Street, Asylum Avenue serves commuters coming from the east as well, and there is less of a distinction between directions. There are also high volumes mid-day in this area.

2.5.8 Farmington Avenue

Farmington Avenue is an east-west road running from Farmington, where it is designated Route 4, to Asylum Avenue in Hartford. The road has one to two lanes in each direction with an intermittent median. Farmington Avenue is a major connection between employment centers in Hartford and the neighborhoods to the west. It is also the primary east-west road in West Hartford Center. As a result, it serves both short- and long-distance trips within the study area.

Traffic volumes on Farmington Avenue vary but are generally around 5,000 vehicles per day in each direction. Farmington Avenue serves mainly eastbound traffic in the morning peak, and mainly westbound traffic in the evening, but given the many uses along its length, its volumes are less directional during the mid-day.

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2.6 The Traffic Impact of COVID-19

As the country moves through the "Early Reaction, Coordinated Response and Long-term Recovery" phases of the pandemic, its impacts on the transportation industry in general and roadway traffic in particular are still being tracked and assessed.

At the time of writing, the COVID-19 pandemic is still in effect. It has been over a year since the pandemic's first traffic impacts were felt in mid-March of 2020. As CTDOT has numerous continuous count stations throughout the state, the agency has been able to track the evolution of traffic volumes throughout the pandemic[4]. Trends have also been tracked nationwide[5].

2.6.1 Decrease in Traffic Volume

Traffic volumes in Connecticut decreased by about half during the first weeks of the pandemic in March 2020. As Figure 2-28 shows, volumes dropped within a three-week period, then began to rise again. By mid-June, they reached 80% of pre-pandemic counts. Traffic counts initially dropped by more on weekends than weekdays, indicating a temporary decrease in non-essential travel, but the trend eventually inverted, with weekends showing a higher rebound than weekdays during the phased re-opening of restaurants and recreation. As of early 2021, volumes are generally within 10% of pre-pandemic levels.

Nationally, the change in traffic volumes has been heavily dependent on location. Traffic volumes in cities are still substantially lower than pre-pandemic, but volumes in rural areas have instead increased. The net effect is that overall volumes began to exceed pre-pandemic levels in February 2021 and continue to grow. As shown in Figure 2-29, while the initial decrease coincided with the beginning of the pandemic, the subsequent rise in cases had little impact on volumes.

2.6.2 Increase in Speeds

Along with the sharp decrease in traffic volumes in March and April of 2020, there was a decrease in congestion, and, simultaneously, apparent decrease in police enforcement. As a result of these two factors, travel speeds increased. In particular, the proportion of traffic going far above the speed limit rose severely, as shown in Figure 2-30. As of April, 2021, speeds are still moderately higher than pre-pandemic.

[4] A comparison of traffic counts throughout 2020 is available at https://portal.ct.gov/DOT/PP_SysInfo/Traffic-Monitoring, and CTDOT has prepared a full interactive presentation on the change in volumes, speeds, and safety, available at https://ctdot.maps.arcgis.com/apps/MapSeries/index.html?appid=4426084893454ae289e17c67f72433be.

[5] INRIX: COVID-19's Impact on Transportation Trends, https://inrix.com/covid-19-transportation-trends/.

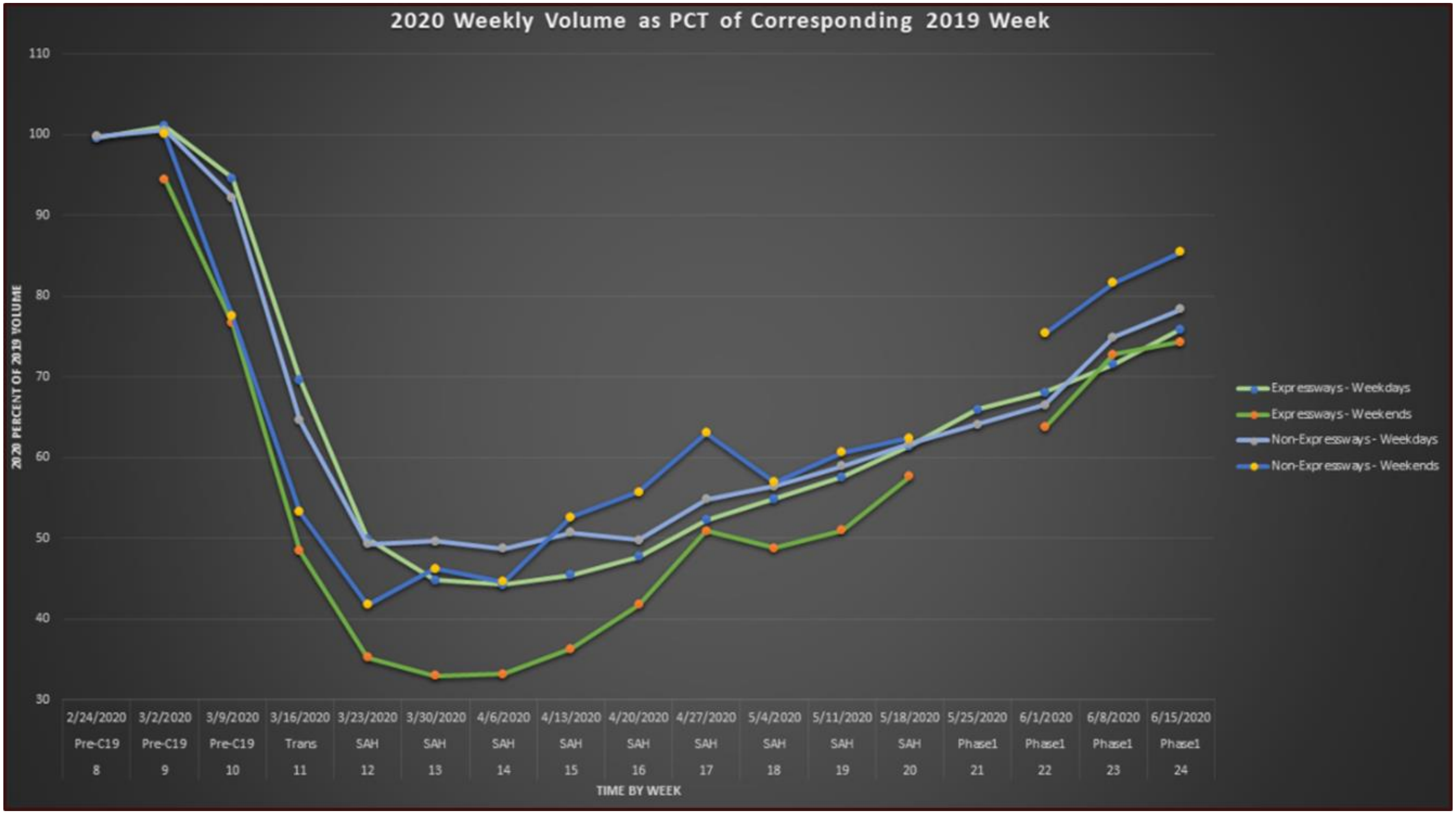

Figure 2-28: COVID-19-Era Traffic Volumes (CTDOT)

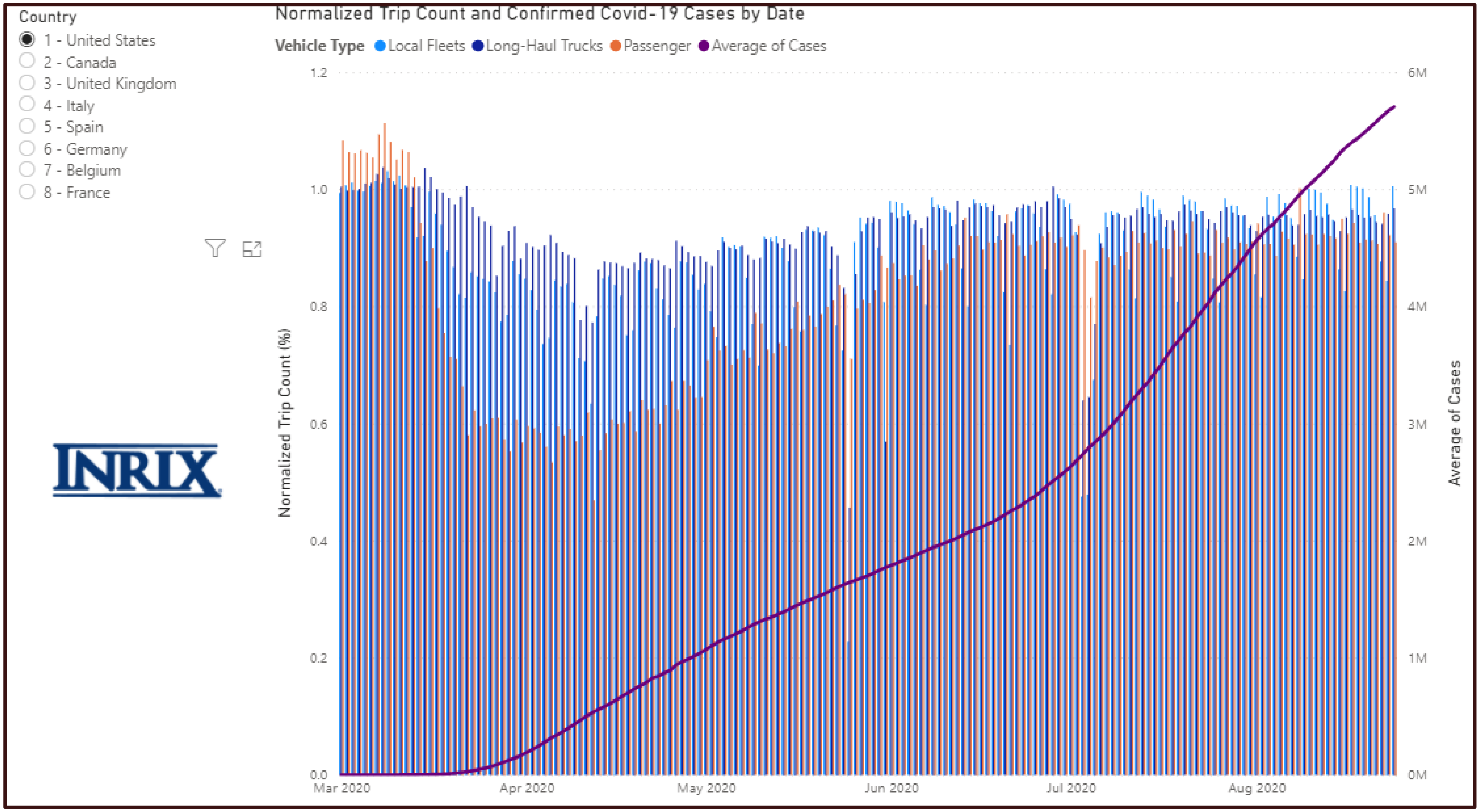

Figure 2-29: National Traffic Rebound (INRIX)

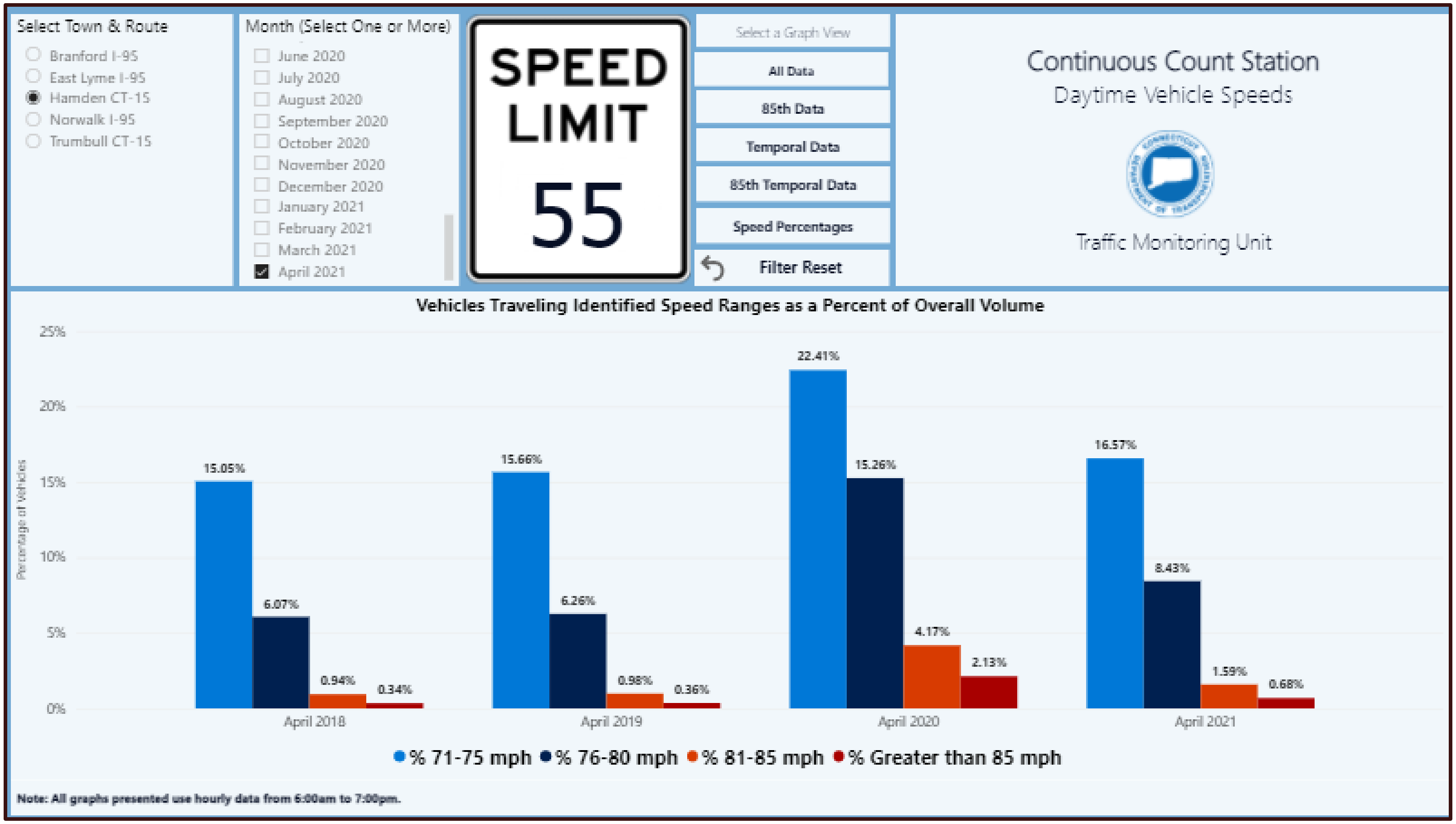

Figure 2-30: Speeding on Route 15 (CTDOT)

2.6.3 Increase in Crash Severity

The overall number of crashes on Connecticut's roads decreased proportionally to the decrease in volumes, so there was not a significant change in the crash rate per vehicle mile traveled. The same was true of serious crashes in 2020. However, there was an overall increase in the number of fatalities year-over-year, suggesting that the higher speeds on the state's roads may have resulted in increased proportion of fatal crashes.

2.6.4 Decrease in Transit Ridership

During the Stay-At-Home Order, vehicular travel decreased by about 50%. During the same period, Connecticut's bus ridership decreased by 50%, and passenger rail traffic decreased by 80-90%. Express bus lines saw an 85% decrease in ridership, while local bus lines were a more modest 40%[6]. Wary of being in enclosed, shared spaces, transit riders generally switched to private travel or worked from home, when the option was available. Transit operators quickly made changes to their procedures to increase sanitation, but transit reluctance may continue throughout the pandemic.

2.6.5 Increase in Telecommuting

Telecommuting has long been an important component of transportation demand management, but COVID-19 greatly increased its prominence and prevalence. Telecommuting decreases the amount of traffic traveling during peak hours. INRIX found that while overall traffic volumes now exceed those in pre-pandemic years, peak hour volumes in most major cities are still below pre-pandemic levels[7]. This is especially true of the morning peak period, which is affected by both telecommuting and remote learning.

2.7 Origin-Destination (OD) Assessment

An OD Study was prepared to support the development of the Greater Hartford Mobility Study (GHMS). The objective of the OD Study was to review and assess the origin-destination patterns associated with travel within the seven Corridors of Significance (COS) and commuter return trips.

The major input to the OD Study was travel data available through the StreetLight Data Insight platform. StreetLight's data metrics are currently derived from two types of locational "Big Data" sources: Navigation-GPS data and Location-Based Services (LBS) data. GPS data are from fleet management systems for trucks while LBS data are from personal smartphone devices for all vehicles. The data are collected, aggregated, and normalized to provide a data base of travel patterns useful for planning and travel analysis. A geographic context for analyzing these data was established using the traffic analysis zone (TAZ) system developed for the Capital Region Council of Governments (CRCOG) regional travel demand model.

[6] Hartford Courant: Responding to major drop in ridership, DOT proposes reducing service on Hartford commuter routes, free shuttles, https://www.courant.com/community/hartford/hc-news-hartford-bus-service-changes-20210513-ofhigpigcnaltm2y66ukz6sjyq-story.html

[7] INRIX: Morning Traffic Still Down in Major Metro Areas, https://inrix.com/blog/2021/04/morning-traffic-still-down-in-major-metro-areas/.

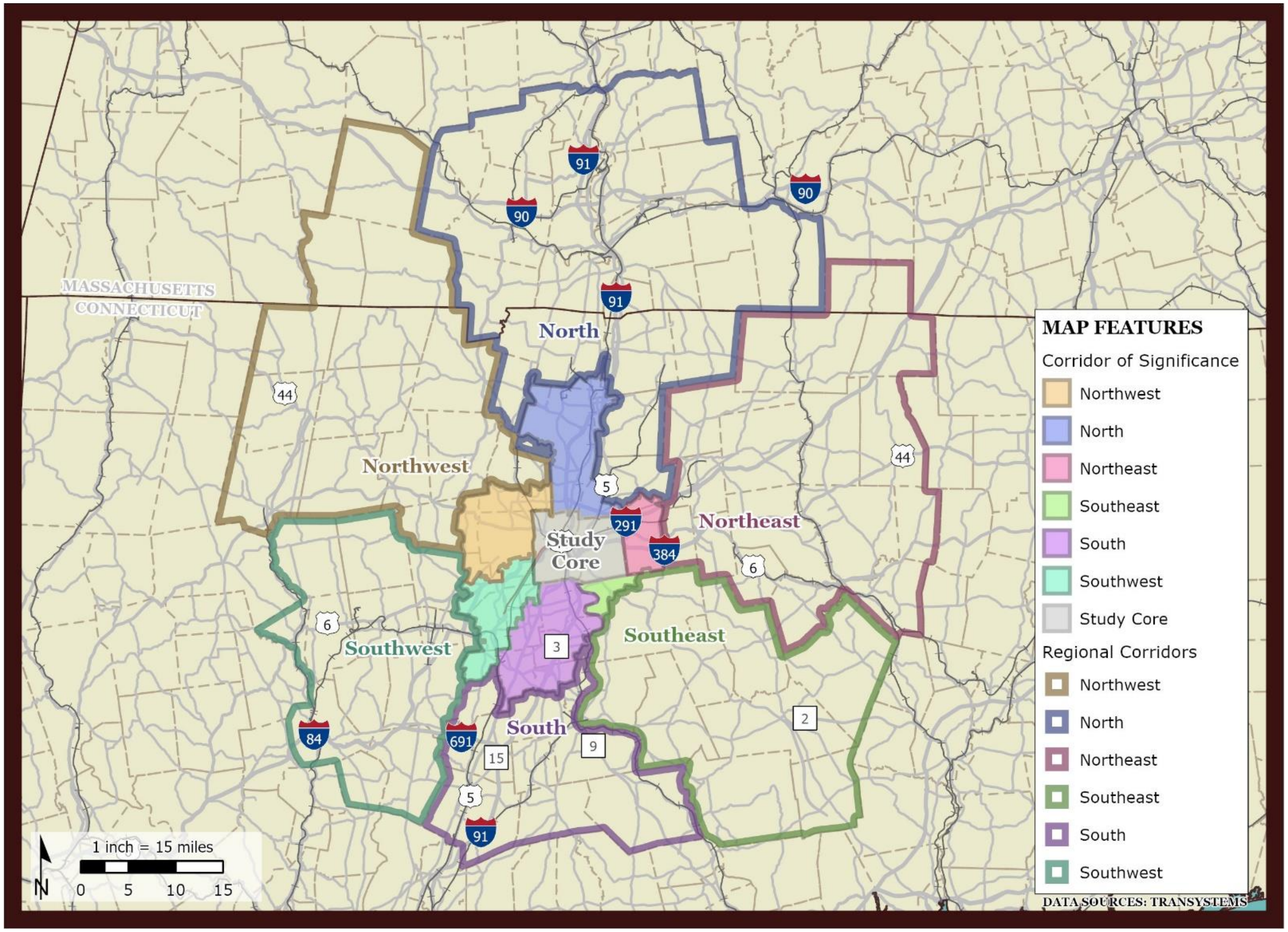

Figure 2-31: GHMS Study Corridors and Regional Corridors

Trips are analyzed starting from a regional perspective looking at regional trip movements within the context of their connection to the GHMS Study Area. Origin-destination patterns are evaluated using traditional origin-destination matrices as well as thematic maps used to depict the top origin and destination locations within each of the COS. The analysis uses StreetLight Volumes which represent an estimated number of vehicle trips traveling between origins and destinations.

2.7.1 CRCOG Model Area OD Patterns

The region, i.e., the CRCOG model area (see Figure 2-31 on the previous page), encompasses 64 towns in Connecticut extending as far west as Torrington, Harwinton, and Thomaston on the west; Ashford, Chaplin, and Windham on the east; and, Wallingford, Durham, and Haddam on the south. The model area extends north to include Springfield as well as Easthampton, South Hadley, and Granby in Massachusetts. For the purposes of this analysis, the model area outside of the GHMS Study Area was divided into six corridors (Northern, Northeastern, Southeastern, Southern, Southwestern, and Northwestern).

At the regional scale of analysis trips originate from or are destined to either external zones, the Regional Corridors, or the GHMS Study Area. Since the region cannot extend ad infinitum, external zones represent the points at which the region connects to the world around it. They facilitate the movement of trips into and out of the region. The Regional Corridors are areas within the region but outside of the GHMS Study Area.

Average daily trip making between these areas is summarized in Table 2-2. This exhibit illustrates that:

- The average number of trips originating in the GHMS Study Area on an average weekday (Tuesday – Thursday) is 1,906,662.
- Of this total, 1,434,328 (75 percent) are destined to locations within the GHMS Study Area.
- Conversely, on an average weekday, 1,901,841 trips are destined to the GHMS Study Area.
- Of this total, 77 percent (1,434,328) originate in the GHMS Study Area.

Internal trips (with both the origin and destination within the GHMS study area) are predominant (75-77%) among the overall GHMS study area related trips.

Table 2-2: Regional Daily OD Matrix (2019 Vehicle Trips)

		Destinations			
		Externals	Regional Corridors	GHMS Study Area	Total
Origins	Externals	63,092	266,930	49,368	379,390
	Regional Corridors	267,441	3,847,448	418,145	4,533,034
	GHMS Study Area	48,777	423,557	1,434,328	1,906,662
	Total	379,310	4,537,935	1,901,841	6,819,086

Source: StreetLight Data – 2019 Volumes

In similar fashion, Table 2-3 is the OD matrix for the AM Peak Period (6:00 AM – 9:00 AM). From the AM Peak Period OD Matrix it can be seen that:

- During the AM Peak Period on an average weekday the number of trips originating in the GHMS Study Area is 279,461.
- Of this total, 220,348 (79 percent) are destined to locations within the GHMS Study Area, i.e., they do not leave the study area.
- Of the remaining trips, 52,184 (19 percent) are destined for locations in one of the regional corridors while 6,929 (two percent) leave the region entirely.
- Destinations to the GHMS Study Area during the AM Peak Period on an average weekday total 354,495 trips.
- Of these trips, 62 percent (220,348) originate in the Study Area, 34 percent (121,484) originate in one of the Regional Corridors, and four percent (12,663) originate from the externals.

As was true on a daily basis, internal trips are the predominant OD pattern associated with the GHMS Study Area.

Table 2-3: Regional AM Peak Period OD Matrix (6:00 AM – 9:00 AM)

		Destinations			
		Externals	Regional Corridors	GHMS Study Area	Total
Origins	Externals	8,826	41,856	12,663	63,345
	Regional Corridors	62,224	607,709	121,484	791,417
	GHMS Study Area	6,929	52,184	220,348	279,461
	Total	77,979	701,749	354,495	1,134,223

Regional trip making during the PM Peak Period (3:00 PM – 6:00 PM) is illustrated in Table 2-4. During the PM Peak Period:

- The total number of trips during the PM Peak is 52 percent higher than the total number of trips during the AM Peak.
- 70 percent of the trips originating in the GHMS Study Area are destined to the locations in the GHMS Study Area. While this is a smaller percentage of internal trips than during the AM Peak it represents approximately 63 percent more trips.
- Of the remaining GHMS Study Area trip origins during the PM Peak, 27 percent travel to one of the regional orridors while three percent travel outside of the region. In total, this equates to nearly 153,000 trips leaving the Study Area during the PM Peak compared to approximately 61,000 during the AM Peak.
- There is also 28 percent more trips destined to the Study Area during the PM Peak Period than during the AM Peak Period.
- Of the trips destined to the Study Area during the PM Peak Period 79 percent originate in the Study Area. This is a higher percentage than the AM Peak.
- Conversely, there are a smaller number of trips destined to the Study Area from either the Regional Corridors or the Externals.

Table 2-4: Regional PM Peak Period OD Matrix (3:00 PM – 6:00 PM)

		Destinations			
		Externals	Regional Corridors	GHMS Study Area	Total
Origins	Externals	13,297	75,131	9,959	98,387
	Regional Corridors	59,939	966,831	85,399	1,112,169
	GHMS Study Area	13,485	140,194	359,776	513,455
	Total	86,721	1,182,156	455,134	1,724,011

Source: StreetLight Data – 2019 Volumes

2.7.2 Travel from the Regional Corridors (CRCOG Region Outside of GHMS Study Area) to the GHMS Study Area

The daily distribution of traffic from each of the Regional Corridors to the GHMS Corridors of Significance (COS) is shown in Table 2-5. From the Exhibit it can be seen that trips from the Regional Corridors tend to be destined to either the adjacent GHMS COS or Study Core.

- For example, 78 percent (60,782 / 78,599) of daily trips entering the GHMS Study Area from the Northeast Regional Corridor are destined to either the Northeast COS or the Study Core.
- While trips from the Regional Corridors may travel to any of the COS, however, the remaining OD pairs between the Regional Corridors and the COS typically account for less than six percent of entering traffic and range from a low of one percent (the North, Northwest, and Southwest Regional Corridors to the Southeast COS) to a high of 17 percent (the Northwest Regional Corridor to the North COS).

Table 2-5: Daily Trips from the Regional Corridors to the GHMS Study Area

Regional Corridors	GHMS CORRIDORS OF SIGNIFICANCE (Trips)							
	North	Northeast	Northwest	South	Southeast	Southwest	Study Core	Total
North	38,769	13,361	4,304	3,934	1,208	3,493	21,757	86,826
Northeast	5,943	38,916	2,354	4,455	2,140	2,925	21,866	78,599
Northwest	8,843	1,476	15,332	2,425	431	6,020	16,046	50,573
South	1,873	1,529	2,027	33,676	1,210	9,801	11,423	61,539
Southeast	1,796	4,791	1,643	7,502	14,685	2,703	13,308	46,428
Southwest	3,821	1,786	8,794	15,538	1,038	42,501	20,702	94,180
Total	61,045	61,859	34,454	67,530	20,712	67,443	105,102	418,145

Regional Corridors	GHMS CORRIDORS OF SIGNIFICANCE (Row percent)							
	North	Northeast	Northwest	South	Southeast	Southwest	Study Core	Total
North	45%	15%	5%	5%	1%	4%	25%	100%
Northeast	8%	50%	3%	6%	3%	4%	28%	100%
Northwest	17%	3%	30%	5%	1%	12%	32%	100%
South	3%	2%	3%	55%	2%	16%	19%	100%
Southeast	4%	10%	4%	16%	32%	6%	29%	100%
Southwest	4%	2%	9%	16%	1%	45%	22%	100%

The distribution of traffic from each of the Regional Corridors during the AM Peak Period to the GHMS COS is shown in Table 2-6. From the Exhibit it can be seen that:

- During the AM Peak Period the predominant pattern is again for traffic from a regional corridor to be destined for the COS to which it is immediately adjacent or the GHMS Study Core.

- While for daily trips this was most true for trips entering the GHMS Study Area from the Northeast Regional Corridor, during the AM Peak it is the South Regional Corridor where the highest proportion of trips (76 percent) are destined to either the South COS or the Study Core.
- The remaining OD pairs, i.e., those not involving the adjacent COS or the Study Core, typically see around five to seven percent of the entering traffic from a regional corridor. The percentage of traffic traveling between these OD can range from a low of one percent to a high of 16 percent.

Table 2-6: AM Trips from the Regional Corridors to the GHMS Study Area

Regional Corridors	GHMS CORRIDORS OF SIGNIFICANCE (Trips)							
	North	Northeast	Northwest	South	Southeast	Southwest	Study Core	Total
North	8,248	1,848	1,263	964	411	825	8,020	21,579
Northeast	1,951	7,056	867	1,616	676	1,009	9,908	23,083
Northwest	2,197	278	3,331	650	130	1,809	6,187	14,582
South	426	315	550	6,665	308	2,230	5,339	15,833
Southeast	725	1,273	803	2,229	3,404	1,145	7,455	17,034
Southwest	1,203	393	2,831	4,662	426	10,051	9,807	29,373
Total	14,750	11,163	9645	16,786	5,355	17,069	46,716	1,21,484
Regional Corridors	**GHMS CORRIDORS OF SIGNIFICANCE (Row percent)**							
	North	Northeast	Northwest	South	Southeast	Southwest	Study Core	Total
North	38%	9%	6%	4%	2%	4%	37%	100%
Northeast	8%	31%	4%	7%	3%	4%	43%	100%
Northwest	15%	2%	23%	4%	1%	12%	42%	100%
South	3%	2%	3%	42%	2%	14%	34%	100%
Southeast	4%	7%	5%	13%	20%	7%	44%	100%
Southwest	4%	1%	10%	16%	1%	34%	33%	100%

The distribution of traffic from each of the Regional Corridors during the PM Peak Period to the GHMS COS is shown in Table 2-7 and summarized below.

- Similar to the other time periods, during the PM Peak Period the predominant pattern is for traffic from a regional corridor to be destined for the COS to which it is immediately adjacent or the GHMS Study Core.
- In contrast to the AM Peak Period, however, when it was the South Regional Corridor with the highest proportion of trips exhibiting this pattern, during the PM Peak Period it is the Northeast Regional Corridor where 80 percent of trips are destined to either the Northeast COS or the Study Core.
- Also during the PM Peak, in contrast to the daily and AM Peak Period OD patterns, the number of trips from the Regional Corridors tends to more heavily favor the adjacent COS. The one exception to this pattern is the Northwest Regional Corridor. Trips from this regional corridor are almost evenly split between the adjacent COS and the Study Core.
- Finally, the remaining OD pairs, i.e., those not involving the adjacent COS or the Study Core, typically see around five to six percent of the entering traffic from a regional corridor. These OD pairs range from a low of one percent, e.g., the North Regional Corridor to the Southeast COS, to a high of 20 percent for trips between the Southeast Regional Corridor and the South COS.

Table 2-7: PM Trips from the Regional Corridors to the GHMS Study Area

Regional Corridors	GHMS CORRIDORS OF SIGNIFICANCE (Trips)							
	North	Northeast	Northwest	South	Southeast	Southwest	Study Core	Total
North	8,557	3,685	1,012	969	275	775	3,901	19,174
Northeast	942	8,808	424	830	394	518	3,269	15,185
Northwest	1,993	373	3,245	611	78	1,216	3,153	10,669
South	333	391	551	8,156	307	2,342	1,590	13,670
Southeast	294	1,060	223	1,678	3,097	421	1,731	8,504
Southwest	549	380	1,707	3,308	160	9,245	2,848	18,197
Total	12,668	14,697	7,162	15,552	4,311	14,517	16,492	85,399
Regional Corridors	GHMS CORRIDORS OF SIGNIFICANCE (Row percent)							
	North	Northeast	Northwest	South	Southeast	Southwest	Study Core	Total
North	45%	19%	5%	5%	1%	4%	20%	100%
Northeast	6%	58%	3%	5%	3%	3%	22%	100%
Northwest	19%	3%	30%	6%	1%	11%	30%	100%
South	2%	3%	4%	60%	2%	17%	12%	100%
Southeast	3%	12%	3%	20%	36%	5%	20%	100%
Southwest	3%	2%	9%	18%	1%	51%	16%	100%

In an attempt to get a better understanding of OD patterns associated with travel from the Regional Corridors to the GHMS COS a StreetLight OD analysis was conducted that used selected stations outside of the Study Area as entry points and TAZs within each of the Study Area COS as destinations. These stations, which were assumed to serve specific GHMS COS, are listed in Table 2-8.

Figure 2-32 through Figure 2-37 illustrate the distribution of daily traffic entering the GHMS Study Area from the stations listed in the above table. (Exhibits for AM and PM peak period traffic as well as well as weekend traffic appear in Appendix 2.) The exhibits present the data both as the number of trips and as a trip density. Trip density is defined as the number of trips divided by the area of the TAZ. TAZs are typically drawn such that in areas where there is less development, or development levels are less dense, TAZs are larger. In more densely developed areas TAZs are smaller. Thus, for the same number of trips a large TAZ will have a relatively low trip density while a small TAZ will have a relatively high trip density. It is anticipated that this measure may be helpful as an indicator of where strategies that promote travel by transit or non-motorized modes may be successful, i.e., have a high trip density. Following each map for GHMS COS, a series of observations have been noted. Overall, the maps reinforce the idea that travelers tend to be destined primarily to the corridor through which they enter the study area and then to a lesser extent the Study Core or a different GHMS Corridor.

Table 2-2-8: Regional Corridor Stations

GHMS Corridor	Station Location
North	Day Hill Rd
	I-91
	Route 75
	Seymour Rd
	US 5
Northeast	I-384
	I-84 HOV
	I-84
Northwest	Route 185
	Route 187
	Route 189
	US 44
South	I-91
	Route 5
	Route 99
	Route 9
Southeast	New London Turnpike
	Route 2
Southwest	I-84
	Route 6
	Route 72

Key Observations for Trips from North Corridor to GHMS Study Area (Figure 2-32)

- Destinations tend to be concentrated in the northern end of the North COS.
- The airport and surrounding employment sites are a major draw.
- Another concentration of trip destinations is seen at the south end of the North COS near the northern boundary of the Study Core along Route 5.
- Within the Study Core, trip destinations tend to be concentrated along the river and to the east especially at Pratt & Whitney.
- Trip density shows a concentration of activity around Bradley International Airport and to the north.
- Within the Study Core, trip density shows activity more to the west of the river and then along I-84 in the vicinity of the Shoppes at Buckland Hills. Pratt & Whitney as a destination is not evident.

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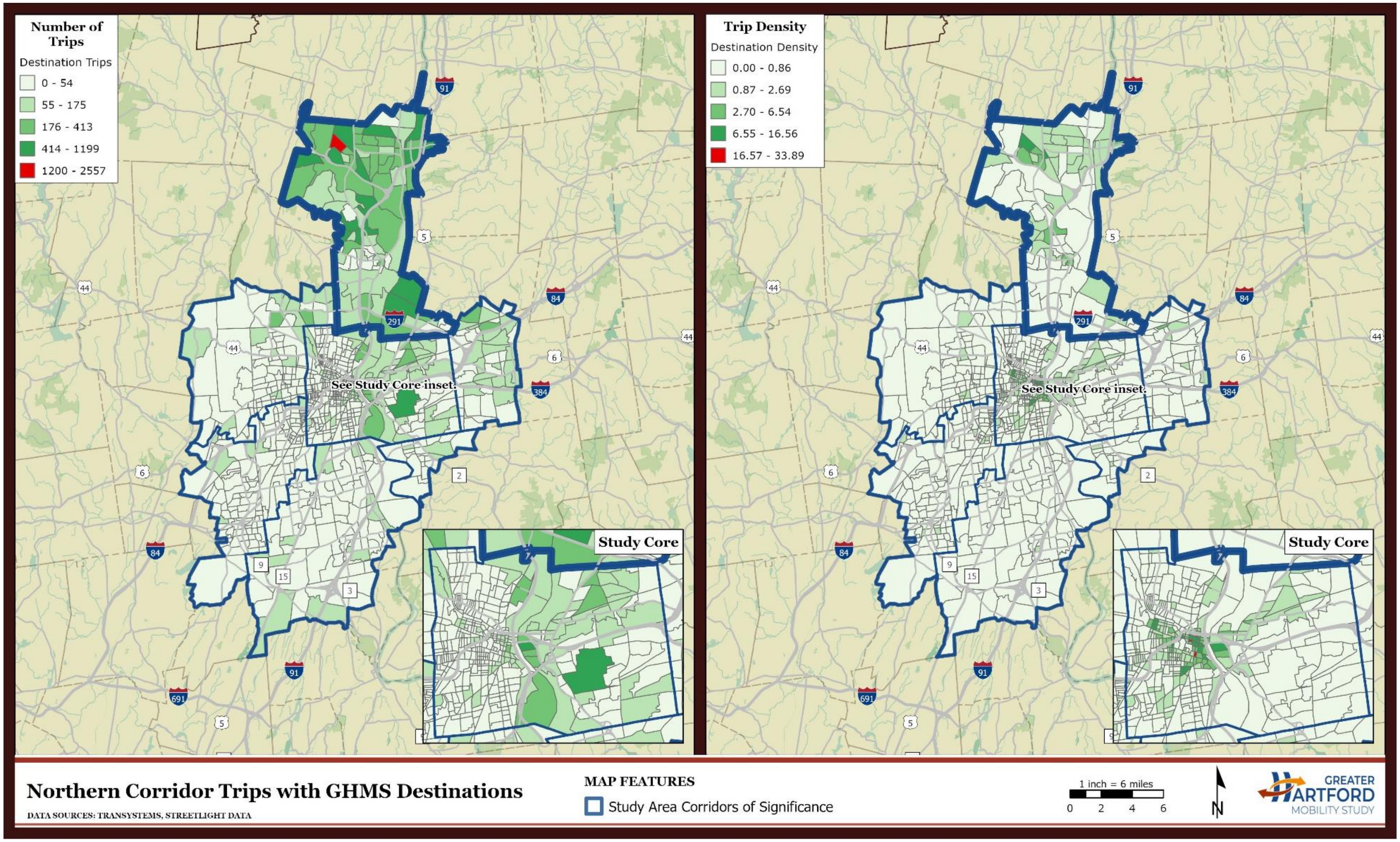

Figure 2-32: Northern Corridor Trips with GHMS Destinations

Key Observations for Trips from Northeastern Corridor to GHMS Study Area (Figure 2-33)

- Within the northeastern COS the heaviest concentration of trips is seen on the north along I-84 in South Windsor and Manchester.
- The airport is a relatively large destination for trips entering through the Northeast Corridor.
- Within the Study Core, destinations tend to be concentrated along the river and to the east especially at Pratt & Whitney.
- Trip density reinforces the activity at the north end of the corridor along I-84 in South Windsor and Manchester.
- Within the Study Core, trip density shifts the focus of activity from east of the river to west of the river south of I-84 and west of I-91. Pratt & Whitney shows relatively low trip density.

Key Observations for Trips from Southeastern Corridor to GHMS Study Area (Figure 2-34)

- Within the Southeastern COS itself major concentration of trips are destined for areas along CT 2 (Veterans of Foreign Wars Memorial Highway) and the New London Turnpike in the Town of Glastonbury.
- Pratt & Whitney again shows up as a major destination.
- The area including Hartford Brainard Airport, along the Connecticut River just north of the corridor, as well as areas further north along the river are also large attractors.
- Bradley International Airport again attracts a relatively large number of trips.
- Finally, and perhaps due to its small size, the pattern of destinations for trips entering the study area through this corridor appears more dispersed then the other corridors.
- As was the case with trips, trip density is relatively high within the Southeastern COS and areas along CT 2.

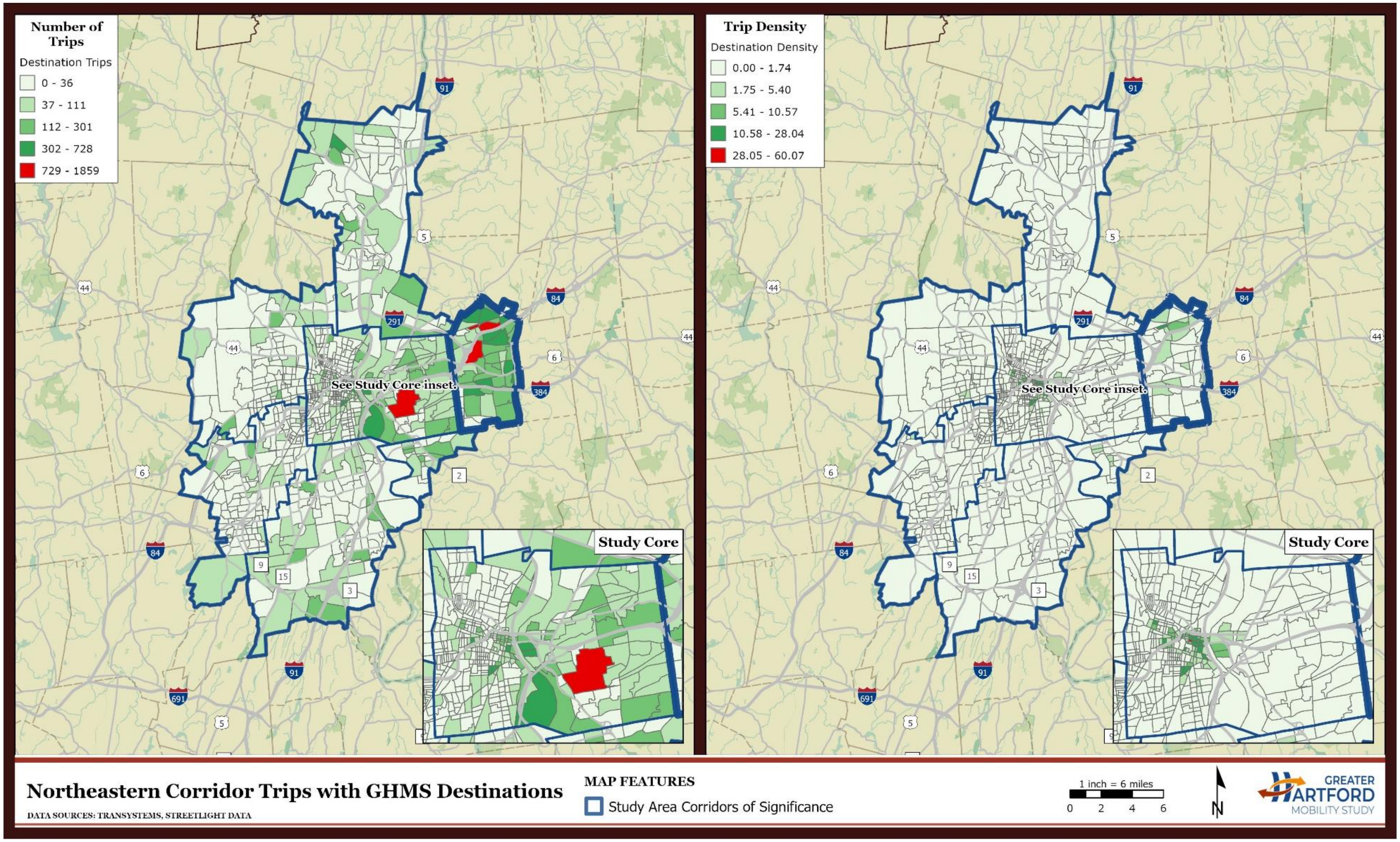

Figure 2-33: Northeastern Corridor Trips with GHMS Destinations

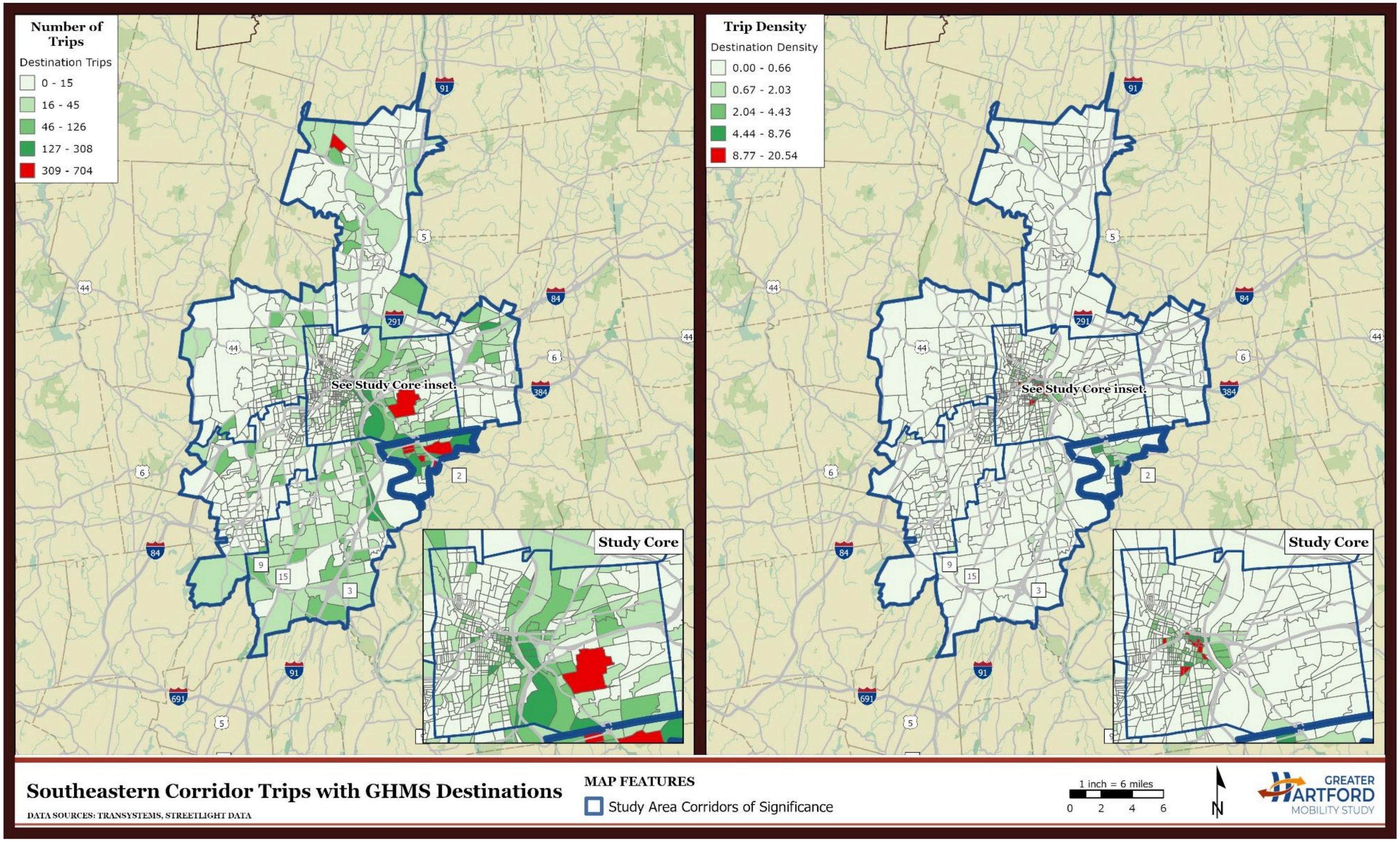

Figure 2-34: Southeastern Corridor Trips with GHMS Destinations

Key Observations for Trips from Southern Corridor to GHMS Study Area (Figure 2-35)

- There is a heavy concentration of trips entering through the South corridor destined for the towns of Berlin, Cromwell, and Rocky Hill. The pattern appears more pronounced than in the Northeast or Southeast COS.
- The most popular destination appears in the southern part of the Southern COS in the Town of Cromwell. This TAZ has a mix of residential and commercial development. The development is concentrated in the south and east of the TAZ along routes 3 and 372.
- Pratt & Whitney, in the Study Core, again shows up as a big destination.
- On the other end of the Study Area, Bradley International Airport is also a draw for trips entering via the South Corridor.
- Trip density again shows activity toward the west central part of the Study Core along the river as well as south of I-84 and west of I-91.

Key Observations for Trips from Southwestern Corridor to GHMS Study Area (Figure 2-36)

- The Town of Cromwell, in the Southern COS, shows as a relatively large destination for trips entering through the Southwestern Corridor.
- Downtown New Britain is a major destination along Route 72.
- Other relatively large destinations can be seen in the northern part of the Southwestern COS including Batterson Park (along I-84), Westfarms Shopping Mall (I-84 and Rte 9), and the University of Connecticut School of Medicine / UConn Health North (north of I-84 and partially in the Northwest Corridor).
- Pratt & Whitney as well as Bradley International Airport and the surrounding area show up as important destinations.
- Trip density reinforces the concentrated activity patterns seen along I-84, Route 72, and Route 9 through the Southwestern COS.
- Within the Study Core, trip density is concentrated along the river and to the west. There also appears to be more activity to the west of I-84.

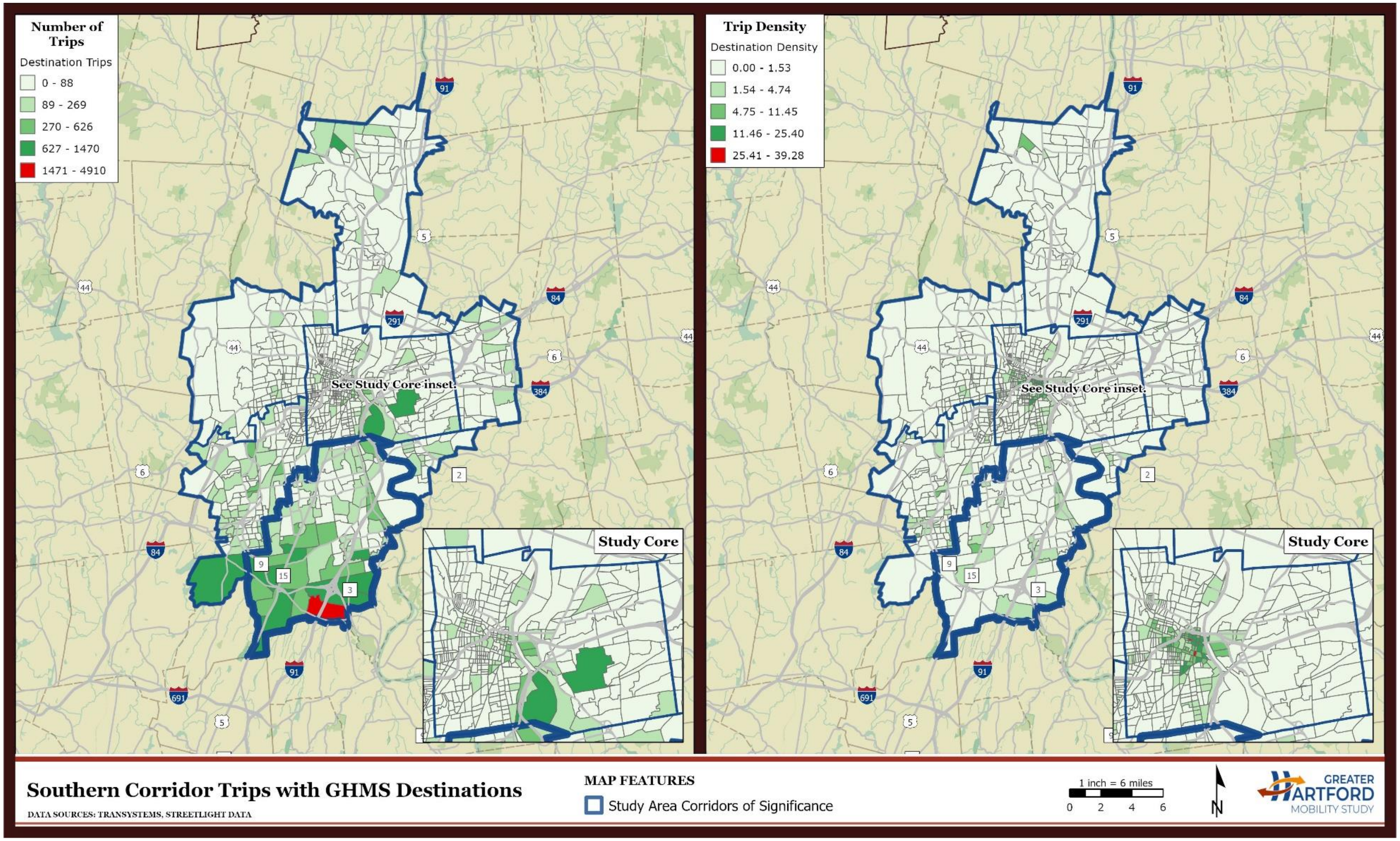

Figure 2-35: Southern Corridor Trips with GHMS Destinations

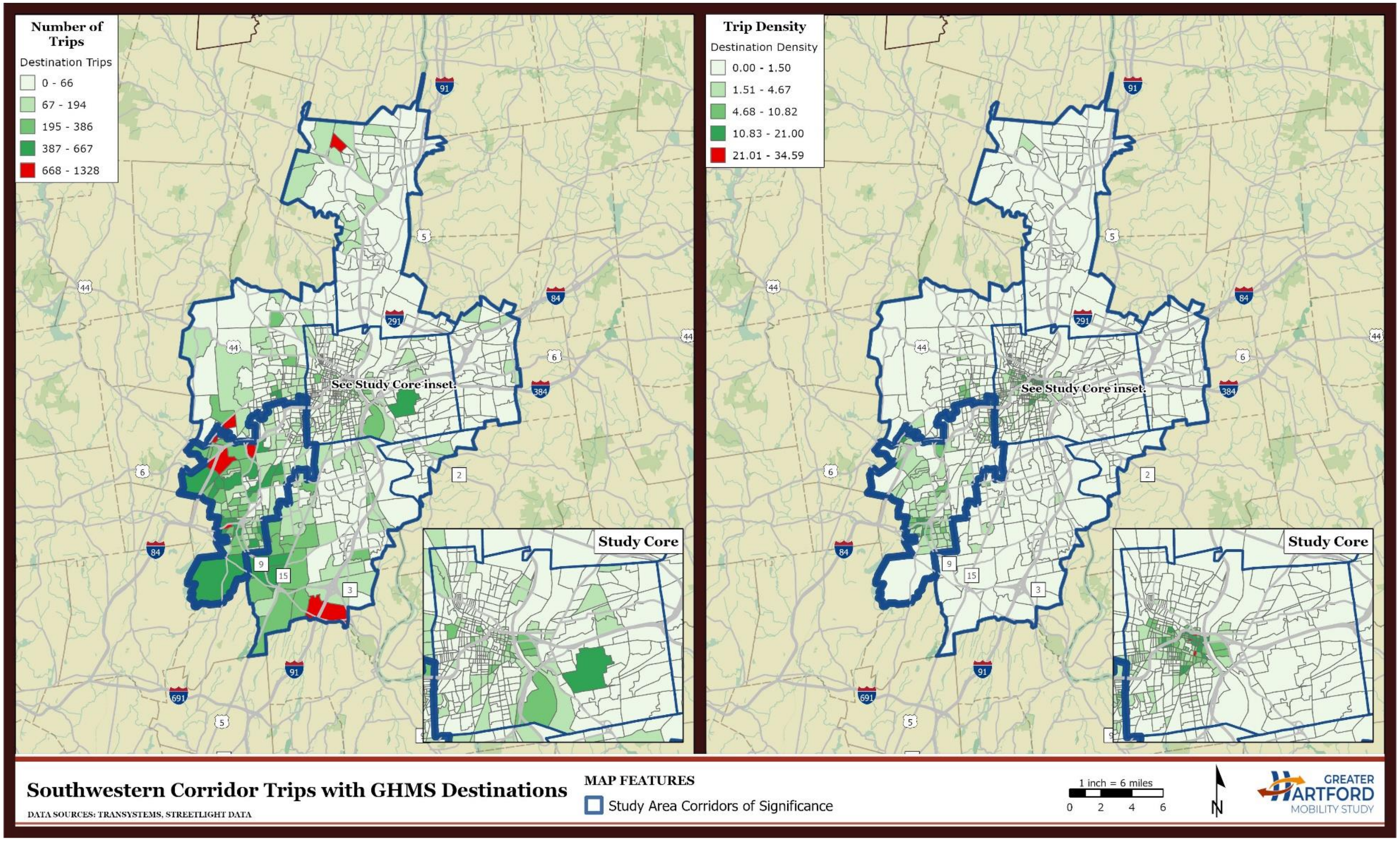

Figure 2-36: Southwestern Corridor Trips with GHMS Destinations

Key Observations for Trips from Northwestern Corridor to GHMS Study Area (Figure 2-37)

- As was evident in the Southwest and South corridors there is a heavy concentration of destinations immediately inside the border of the Northwestern COS to the west and north.
- A particularly heavy concentration of destinations can be seen in the Town of Avon along US 44 (Avon Mountain Road) and CT 10 (Waterville Road) as well as in the Town of Bloomfield along CT 218.
- Trip destinations from Northwest Corridor are more prominent in the North COS than in the Study Core.
- Study Core destinations tend to be concentrated on the west side and along the river.
- In contrast to the other corridors, neither Bradley International Airport nor Pratt & Whitney show up a major destination points.
- Trip density tends to shift the focus of activity closer to the study core and the Northwest COS boundary with the North COS.
- Trip density also shows a heavy concentration of trip making within the Study Core, west of the river, stretching along Route 44.

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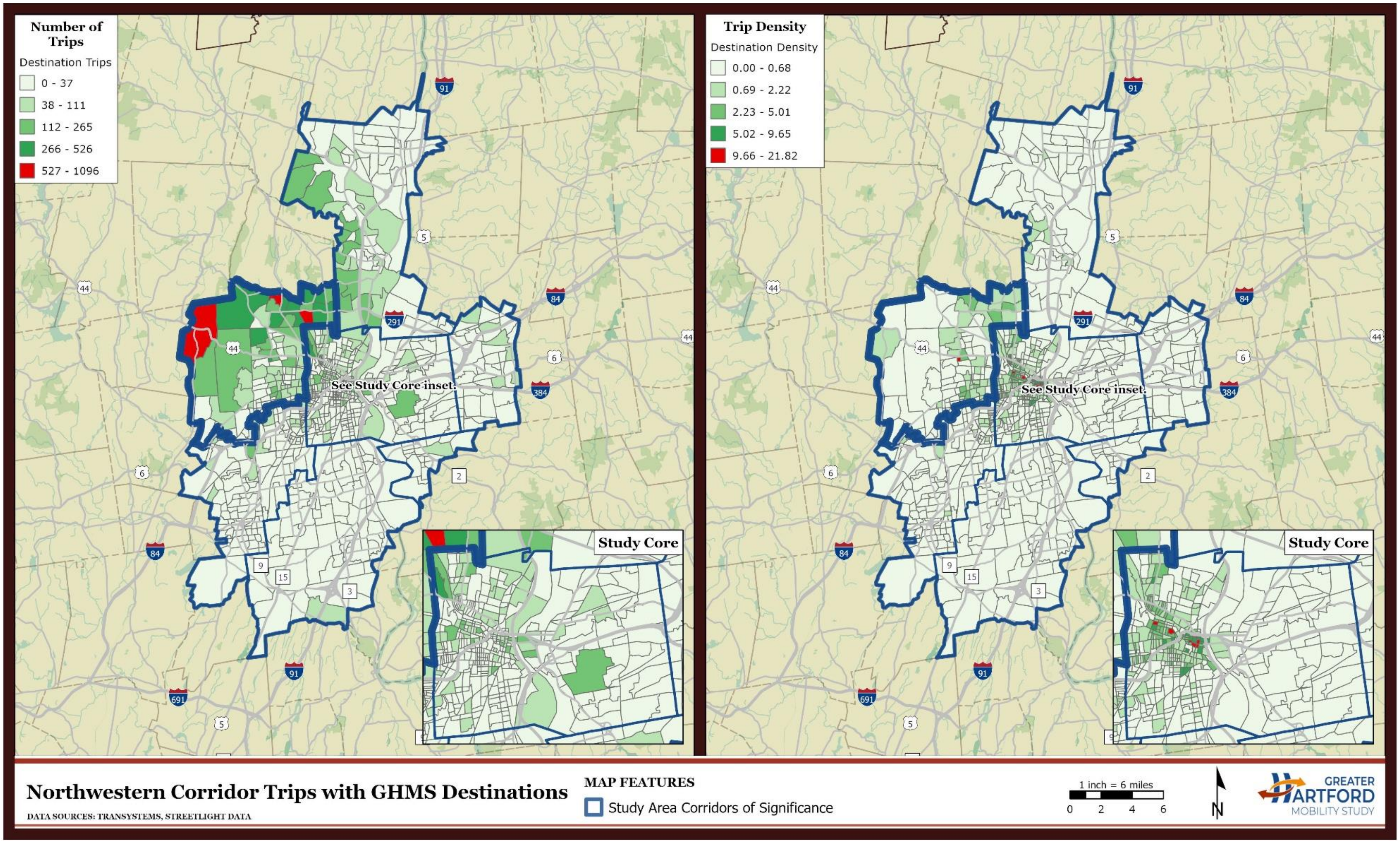

Figure 2-37: Northwestern Corridor Trips with GHMS Destinations

2.7.3 Travel within the GHMS Study Area

Table 2-9 illustrates the daily OD matrix for travel occurring within the GHMS Study Area.

For each COS, the predominant share of trips has both the origins and destinations within the same COS (intra-COS trips). As such, localized identification of needs and improvements may be essential for each COS.

For the seven COS, the percentage of intra-COS trips ranges from a low of 37 percent in the Southeast COS to a high of 71 percent in the Study Core. Further, as seen before, the second most likely destination is the Study Core. With few exceptions, other COS attract five percent or less of trips from a given origin COS

Nearly three out of every four trips destined for the Study Core originate within the Study Core. This offers an opportunity for strategic improvements focused on bike, pedestrian and transit infrastructure within the Study Core to encourage meaningful mode shift and reduced congestion on key Study Core corridors.

indicating a radial nature of trips with the study core (for the trips that leave individual COS).

Table 2-10 is the OD matrix for travel occurring during weekday AM Peak Period (6-9AM) within the GHMS Study Area. Here again, with the exception of the Southeast COS, the largest percentage of trips originating in each COS are destined for the same COS. For the remaining COS the percentage of intra-corridor trips ranges from a low of 41 percent in the Northwest COS to a high of 76 percent in the Study Core. Similar to the daily pattern, with the exception of the Southeast COS, the second most likely destination for each of the COS is the Study Core. With few exceptions, other COS attract six percent or less of trip from a given origin COS.

Table 2-11 is the OD matrix for travel occurring during PM Peak Period within the GHMS Study Area. The patterns are very similar to those seen previously with most trips originating in a COS being destined for the same COS or the Study Core. The percentage of intra-corridor trips ranges from a low of 34 percent in the Southeast COS to a high of 66 percent in the North COS and the Study Core. Continuing the pattern, second most likely destination for each of the COS is the Study Core. Finally, with few exceptions, other COS attract five percent or less of trips from a given origin COS.

Table 2-9: Daily OD Matrix for GHMS Study Area COS

Origins COS	Destination Corridors of Significance							
	North	Northeast	Northwest	South	Southeast	Southwest	Study Core	Total
North	85,698	5,252	5,660	3,428	729	2,771	23,508	127,046
Northeast	5,245	65,990	2,046	3,311	2,281	2,296	28,230	109,399
Northwest	5,930	2,167	59,397	4,880	810	19,496	34,821	127,501
South	3,456	3,453	4,553	156,321	4,105	32,927	35,513	240,328
Southeast	605	2,212	698	3,867	10,647	1,000	10,048	29,077
Southwest	2,846	2,419	19,258	32,951	1,117	103,874	37,498	199,963
Study Core	24,523	28,459	34,341	36,136	10,735	37,628	429,192	601,014
Total	128,303	109,952	125,953	240,894	30,424	199,992	598,810	1,434,328

Origin COS	Destination Corridors of Significance (row percent)							
	North	Northeast	Northwest	South	Southeast	Southwest	Study Core	Total
North	67%	4%	4%	3%	1%	2%	19%	100%
Northeast	5%	60%	2%	3%	2%	2%	26%	100%
Northwest	5%	2%	47%	4%	1%	15%	27%	100%
South	1%	1%	2%	65%	2%	14%	15%	100%
Southeast	2%	8%	2%	13%	37%	3%	35%	100%
Southwest	1%	1%	10%	16%	1%	52%	19%	100%
Study Core	4%	5%	6%	6%	2%	6%	71%	100%

Table 2-10: OD Matrix for GHMS Study Area COS – AM Peak Period (6:00 AM – 9:00 AM)

Origins COS	Destination Corridors of Significance							
	North	Northeast	Northwest	South	Southeast	Southwest	Study Core	Total
North	13,068	617	1,113	545	148	404	5,332	21,227
Northeast	775	6,010	448	553	327	405	5,560	14,078
Northwest	874	272	8,792	587	178	2,740	7,864	21,307
South	831	563	1,246	20,690	713	5,470	10,123	39,636
Southeast	102	205	74	401	1,008	157	1,503	3,450
Southwest	534	309	3,035	4,403	226	13,865	7,991	30,363
Study Core	3,982	3,185	4,460	4,053	1,332	4,588	68,687	90,287
Total	20,166	11,161	19,168	31,232	3,932	27,629	107,060	220,348

Origin COS	Destination Corridors of Significance (row percent)							
	North	Northeast	Northwest	South	Southeast	Southwest	Study Core	Total
North	62%	3%	5%	3%	1%	2%	25%	100%
Northeast	6%	43%	3%	4%	2%	3%	39%	100%
Northwest	4%	1%	41%	3%	1%	13%	37%	100%
South	2%	1%	3%	52%	2%	14%	26%	100%
Southeast	3%	6%	2%	12%	29%	5%	44%	100%
Southwest	2%	1%	10%	15%	1%	46%	26%	100%
Study Core	4%	4%	5%	4%	1%	5%	76%	100%

Table 2-11: OD Matrix for GHMS Study Area COS – PM Peak Period (3:00 PM – 6:00 PM)

Origins COS	Destination COS							
	North	Northeast	Northwest	South	Southeast	Southwest	Study Core	Total
North	19,673	1,602	1,458	976	182	702	5,111	29,704
Northeast	1,150	16,106	432	769	552	473	5,494	24,976
Northwest	1,616	655	14,880	1,561	188	5,084	7,339	31,323
South	780	1,042	1,027	39,597	1,051	8,463	6,943	58,903
Southeast	186	640	195	1,064	2,436	284	2,369	7,174
Southwest	640	707	4,750	9,067	294	25,222	7,817	48,497
Study Core	7,057	9,319	10,505	13,151	3,437	11,396	104,334	159,199
Total	31,102	30,071	33,247	66,185	8,140	51,624	139,407	359,776

Origin COS	Destination COS (row percent)							
	North	Northeast	Northwest	South	Southeast	Southwest	Study Core	Total
North	66%	5%	5%	3%	1%	2%	17%	100%
Northeast	5%	64%	2%	3%	2%	2%	22%	100%
Northwest	5%	2%	48%	5%	1%	16%	23%	100%
South	1%	2%	2%	67%	2%	14%	12%	100%
Southeast	3%	9%	3%	15%	34%	4%	33%	100%
Southwest	1%	1%	10%	19%	1%	52%	16%	100%
Study Core	4%	6%	7%	8%	2%	7%	66%	100%

Figure 2-38 through Figure 2-44 further explore these OD patterns. Each exhibit shows, by means of thematic plots, trips originating from the TAZ in a specific COS (green color) and the destination TAZ within the other study area COS (red color).

Key Observations for Trips from North COS to Other GHMS COS (Figure 2-38)

- High concentration of trips originates in the north end of the COS in the vicinity of Bradley International Airport and in the south end of the COS where the land use is largely residential.
- Destinations tend to be centered in the north end of the Northwest COS, in the Town of Bloomfield, where there is a mix of residential, commercial, and recreational land uses including the COPACO shopping center, an office /industrial park east of COPACO, and the CIGNA campus to the west.
- In the Study Core concentrations of destinations can be seen in the northwest, at the hospitals, along the river, and to the east including Pratt & Whitney and Hartford Brainard Airport.
- Northeast COS area in and around the Shoppes at Buckland Hills, in the Town of Manchester, is a big destination.

Key Observations for Trips from Northeast COS to Other GHMS COS (Figure 2-39)

- High concentration of trip origins in the northern and central parts of the COS near the Buckland Hills Mall and the area south of I-84. Origin trip density shows higher in the south and to a lesser extent in the north of the COS.
- Commuting patterns seems to focus more on Harford and the eastern part of the Hartford CBD.
- It appears that many shopping trips originating in East Hartford are utilizing the amenities in Manchester.
- Relatively high concentration of trips going to the Southeast COS (Glastonbury) and the North COS in the area between the river and US 5.

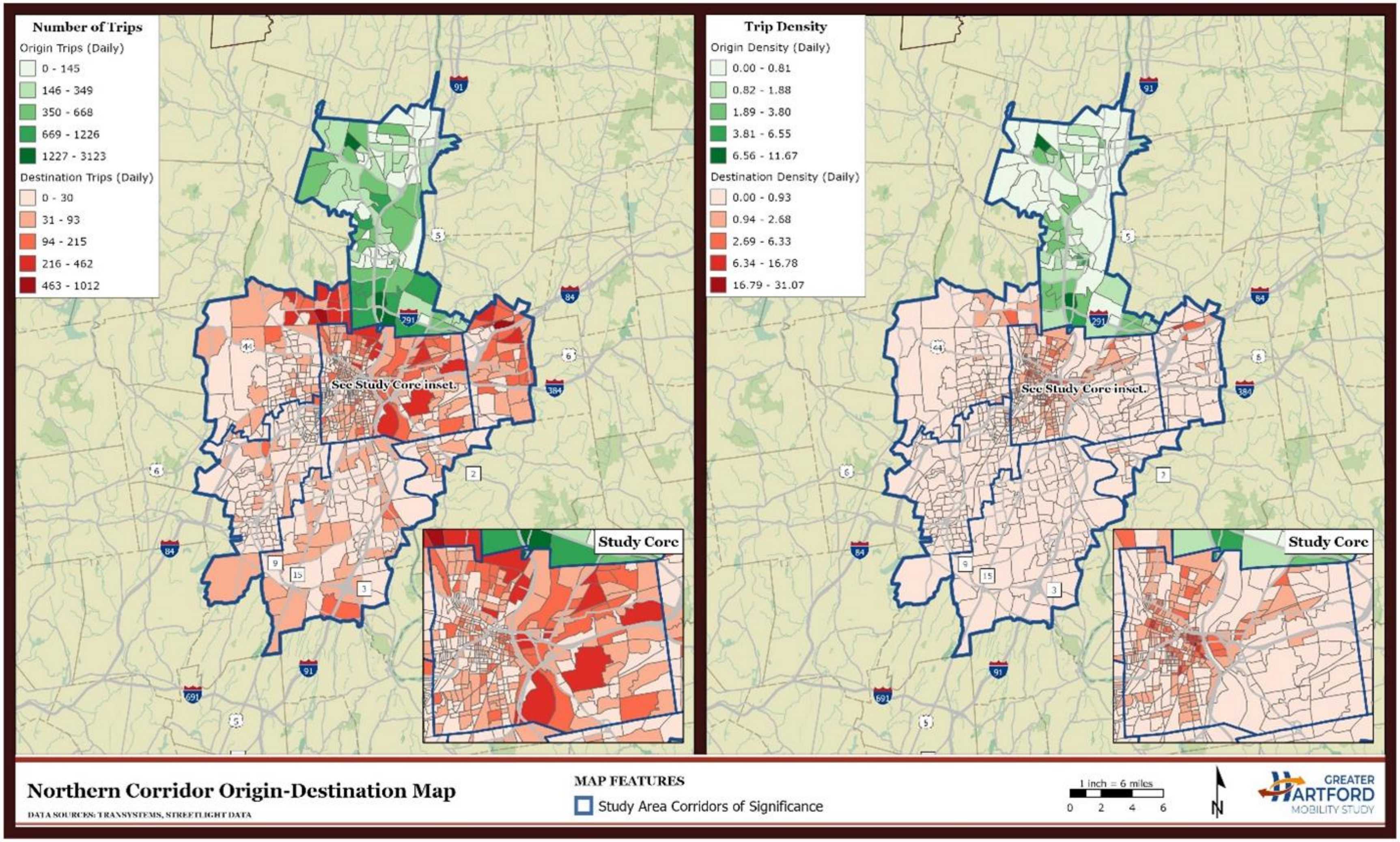

Figure 2-38: North COS OD Map

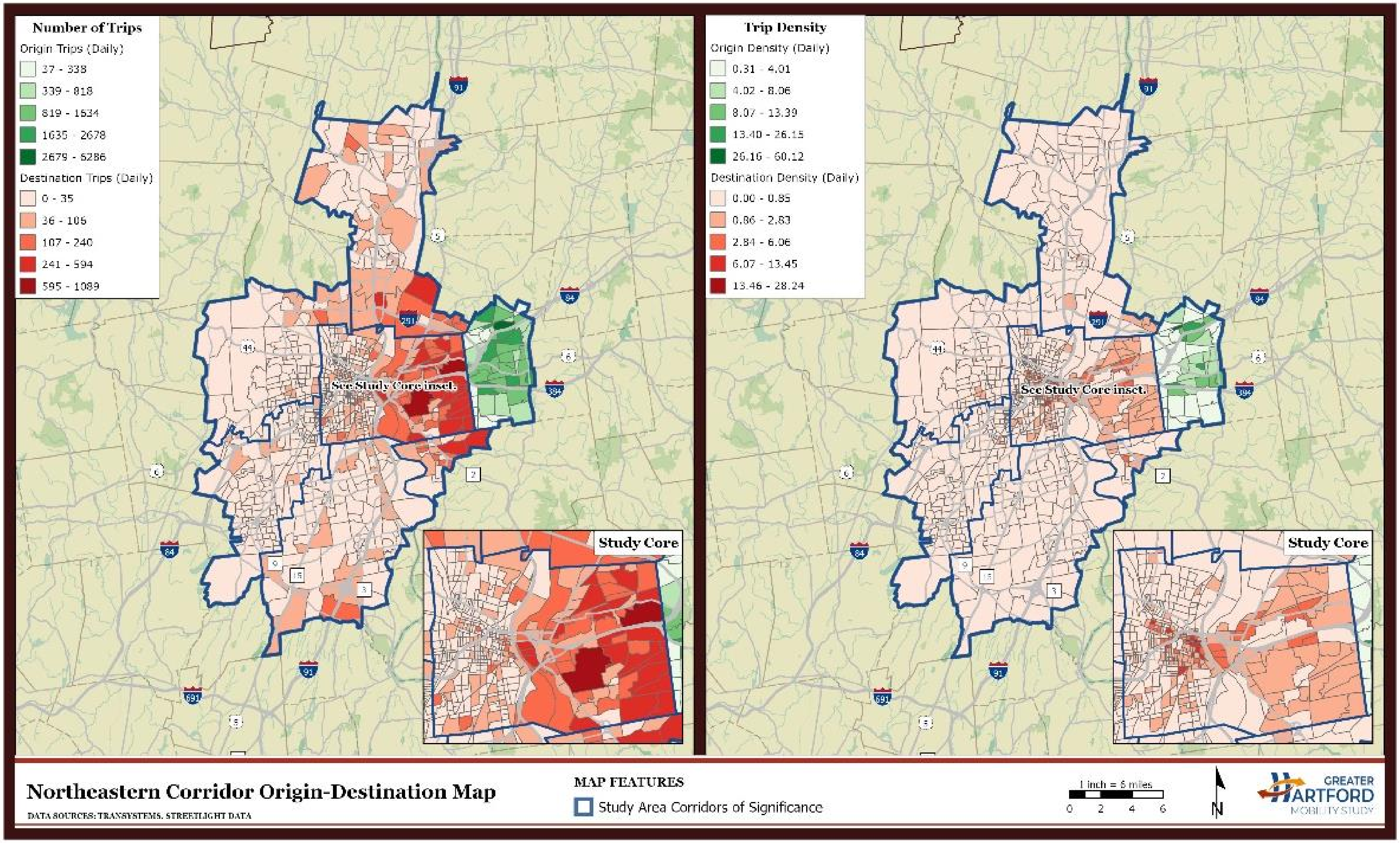

Figure 2-39: Northeast COS OD Map

Key Observations for Trips from Southeast COS to Other GHMS COS (Figure 2-40)

- A relatively large number and density of trips are commuting trips to Pratt & Whitney / Founders Plaza area in East Hartford.
- Trips into the Study Core tend to be concentrated in the east.
- The Day Hill Road TAZ, just south of CT 20 and west of I-91, is very large and shows a relatively high number of trip destinations but it drops off the density map. Most likely a lot of these trips are destined to the same location.
- There is a relatively high number of trips heading for the Northeast and South COS as well as in the Study Core west of the river.
- The origins look to be concentrated in a mixed residential commercial area east of CT 2 and then a commercial area south of CT 3 and west of CT 2. The office complexes on Hebron Ave do not show up as one might expect. Important destinations include Hartford Hospital again and Rocky Hill's Walmart.

Key Observations for Trips from South COS to Other GHMS COS (Figure 2-41)

- Higher concentration of trip origins at TAZs with apartment complexes vs TAZs with more single-family residences.
- Large number of trips going to New Britain.
- Significant trips destined to the Study Core, presumably commuters, in south Hartford, along the river, at Pratt & Whitney, the Hartford Brainard Airport, and the Buckland Hills Mall in Manchester.
- Most of the origin TAZs are heavily commercial areas on Route 15 and Route 99, along with the office/industrial park in Rocky Hill.
- The Walmarts in Rocky Hill and Newington are also key destinations. This may be due to either commuters going to/from New Britain or New Britain residents doing their shopping in Newington.

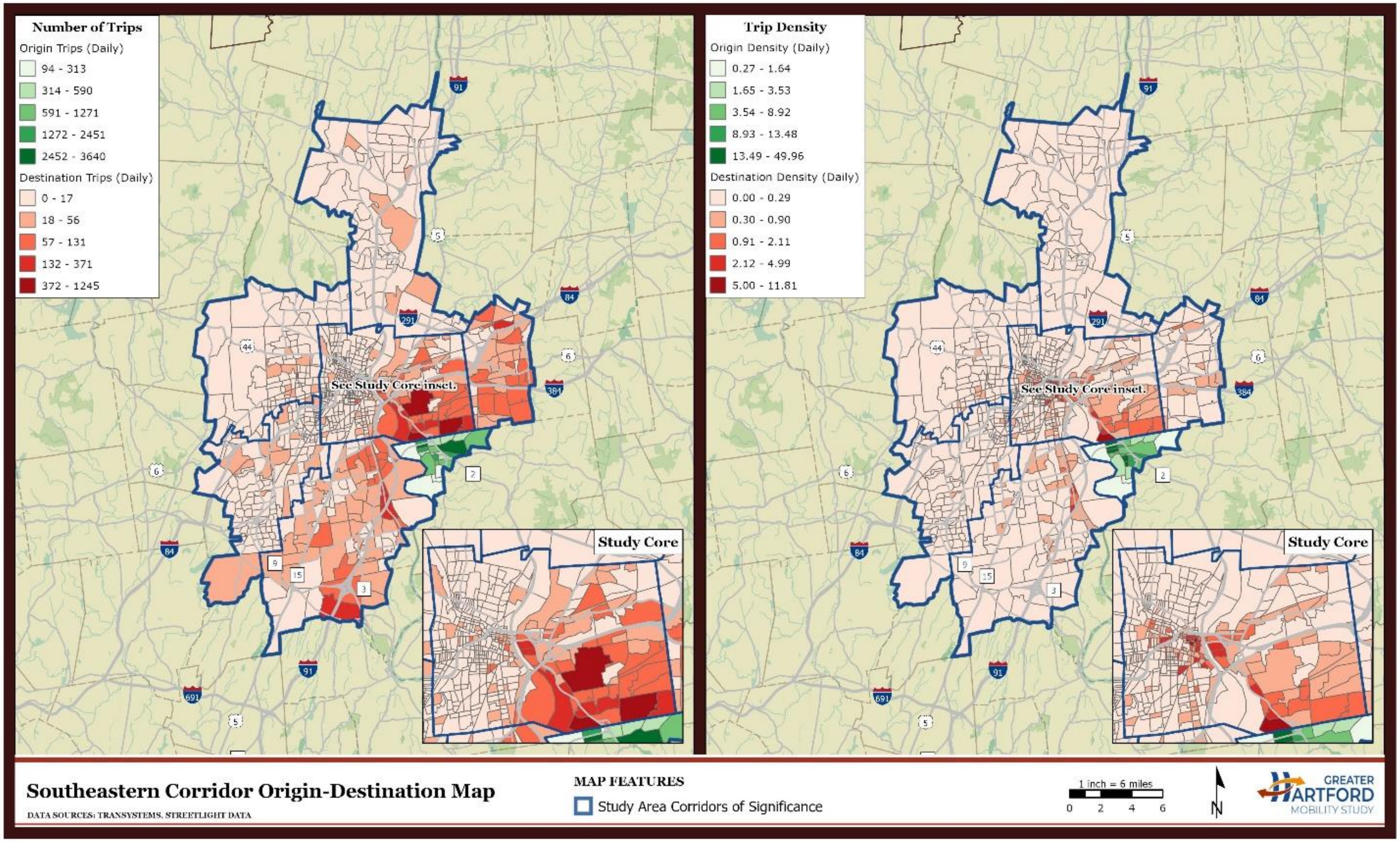

Figure 2-40: Southeast COS OD Map

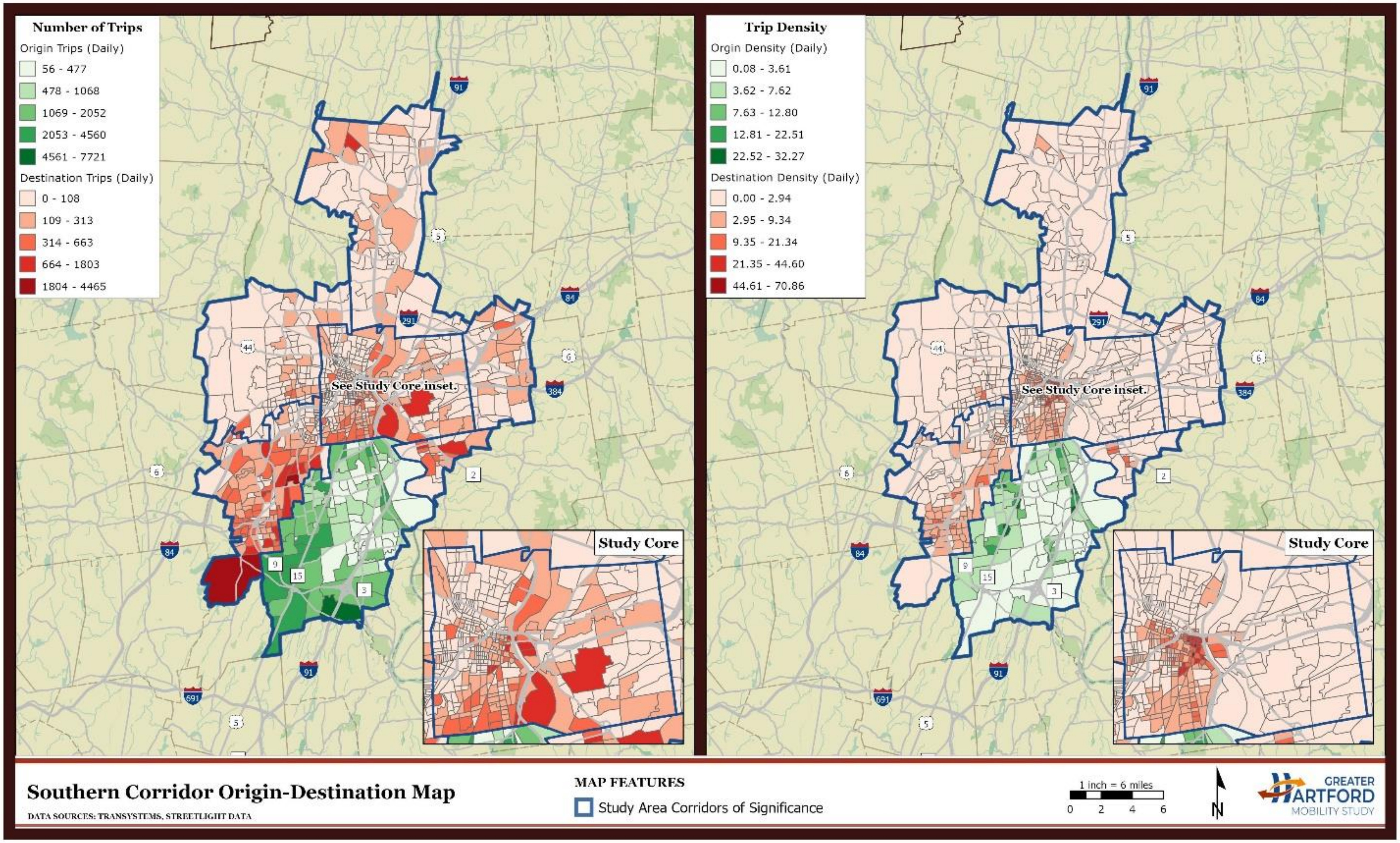

Figure 2-41: South COS OD Map

Key Observations for Trips from Southwest COS to Other GHMS COS (Figure 2-42)

- Relatively high number and density of trips destined right across the COS border into the South and Northwest COS as well as the Study Core.
- The river seems to present a barrier to trip making
- Appears to be many retail trips
- The Walmarts in Hartford and Newington stand out pretty strongly, as does BJs, Newington's downtown core, Blueback Square, and Westfarms Mall.
- Hartford Hospital is also a major destination.
- Relatively high trip destination density in the Northwest COS in the vicinity of the West Hartford town center.
- Relatively high number of trips and trip density in the South COS in New Britain.

Key Observations for Trips from Northwest COS to Other GHMS COS (Figure 2-43)

- Relatively high number of destinations across the COS border in the North and Southwest COS as well as the Study Core.
- In the North COS the destination is largely single family residential in the Town of Windsor.
- In the Southwest COS the destinations are largely residential but also include a golf course and high school (in the Town of West Hartford) as well as Westfarms Shopping Mall in the Town of Farmington.
- In the Study Core the destination includes the University of Hartford and a number of other schools.
- There are also a lot of shorter trips into the north end of Hartford and commuting into the CBD and insurance companies.
- The concentration of origins in the north end of the COS, in the Town of Bloomfield, is a mix of residential, commercial, and recreational land uses including the COPACO shopping center, an office /industrial park east of COPACO, and the CIGNA campus to the west.

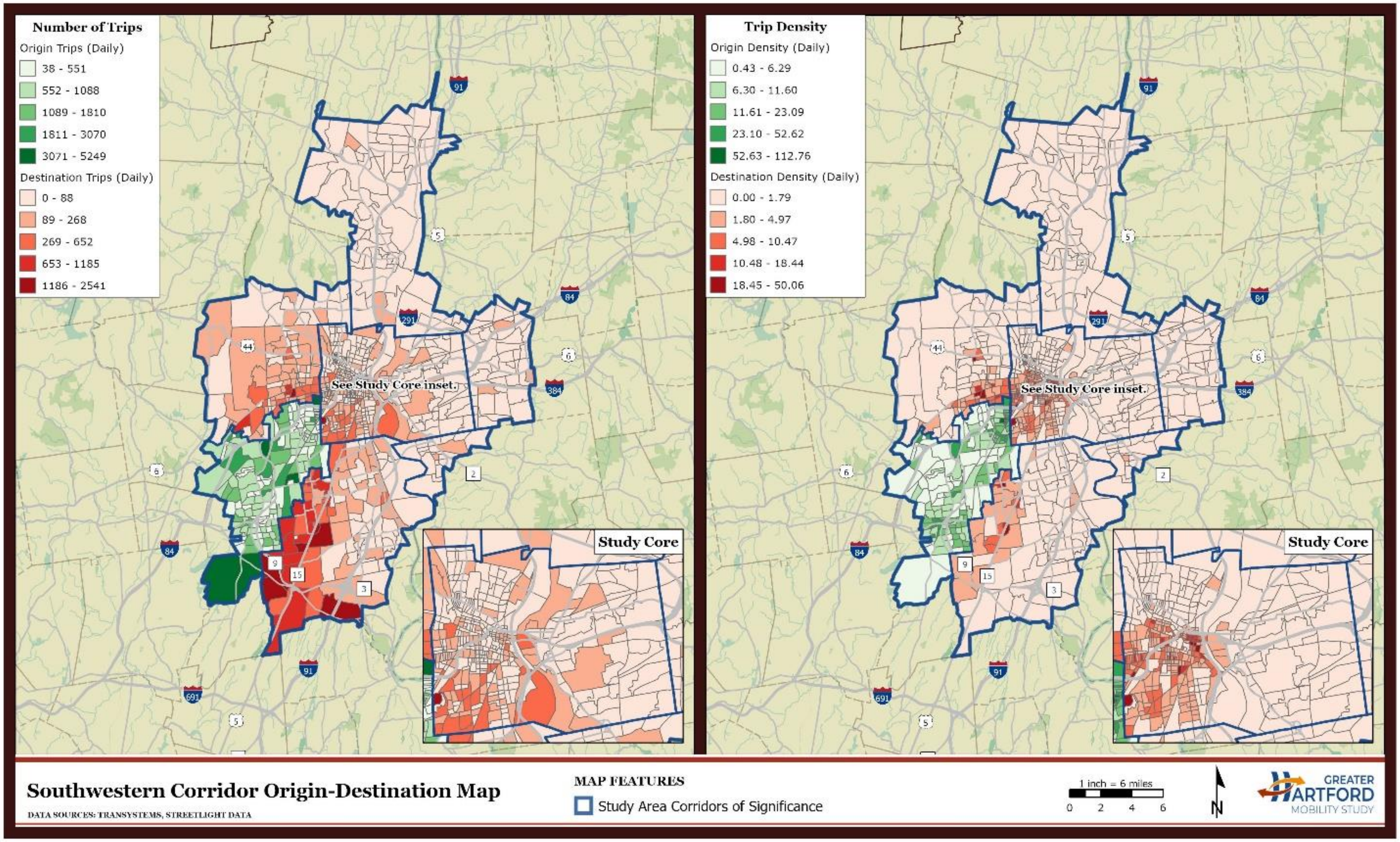

Figure 2-42: Southwest COS OD Map

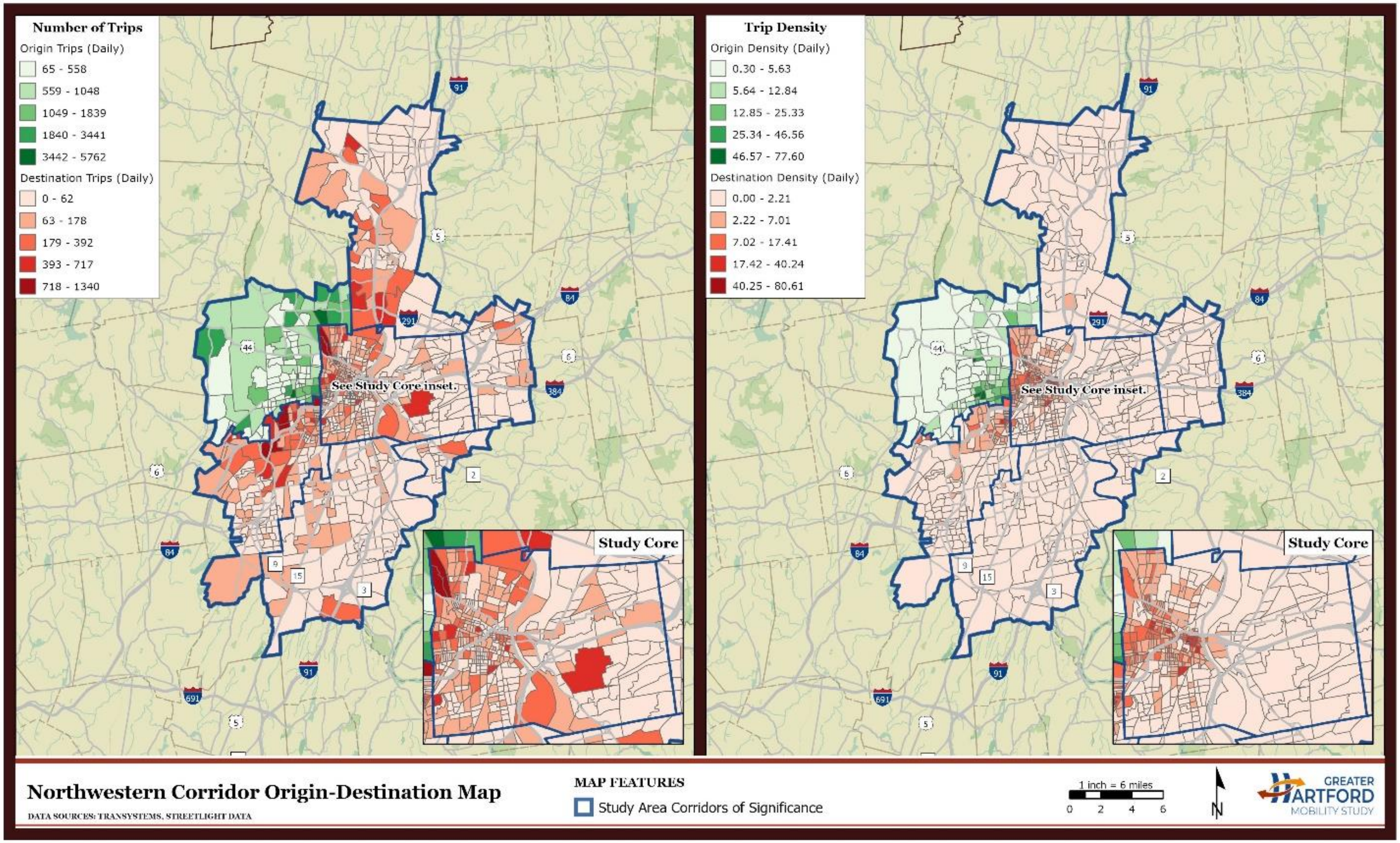

Figure 2-43: Northwest COS OD Map

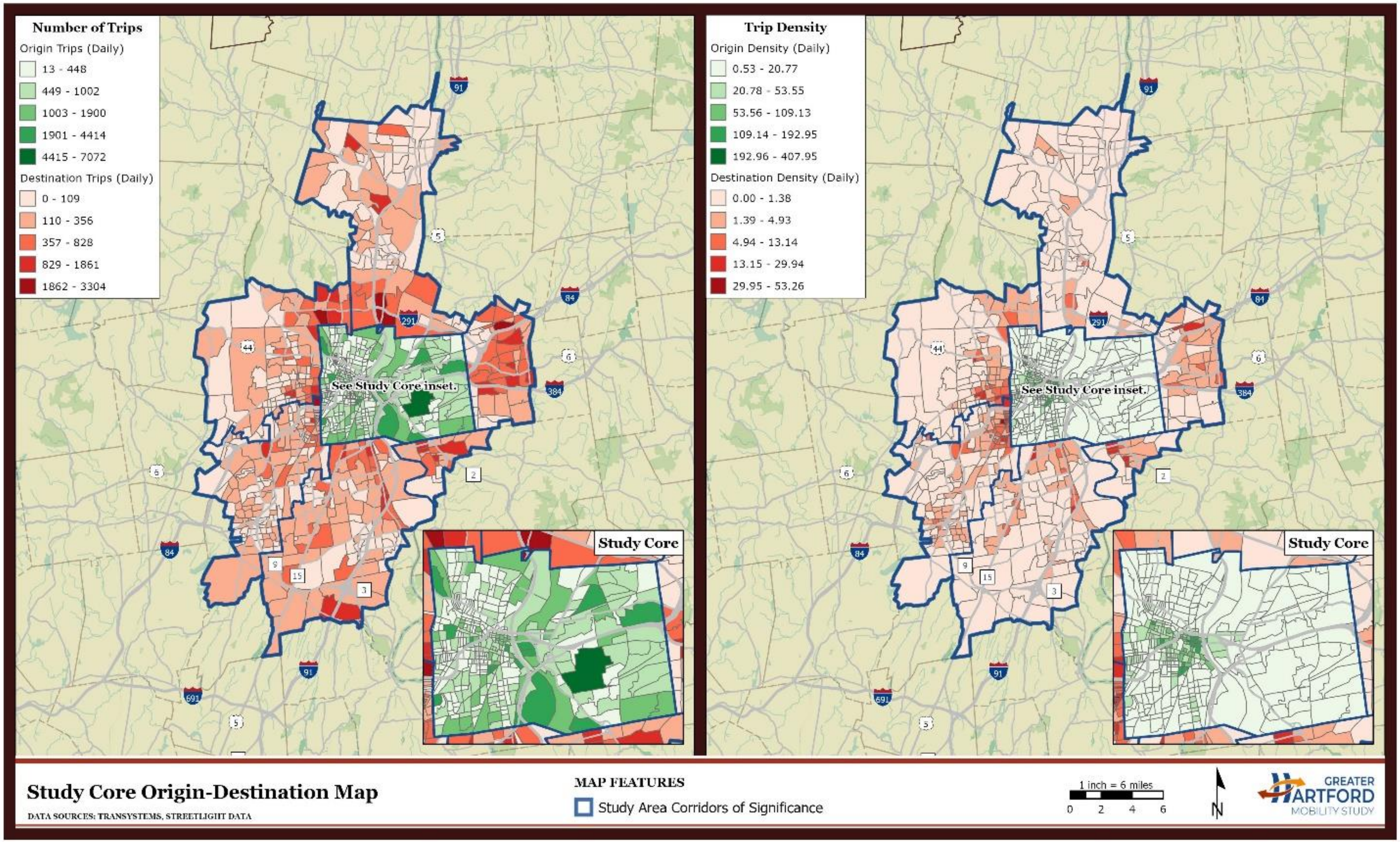

Figure 2-44: Study Core OD Map

Key Observations for Trips from Study Core to Other GHMS COS (Figure 2-44)

- Trip origins are concentrated west of the river especially in the vicinity of employment centers such as Pratt & Whitney and Hartford Brainard Airport as well as residential areas in East Hartford along Tolland and School Streets and in Mayberry Village.
- There appears to be a lot of relatively short trips with destinations just outside the Study Core
- These trips are likely focused on retail / service employment in those area.
- There is also a high level of trip making associated with Hartford Hospital, The Hospital of Saint Francis, and Connecticut Children's Medical Center west of the river in Hartford.

2.8 Existing Condition Traffic Assessment – Key Takeaways

- Traffic movement is primarily influenced by commuting-related directional traffic flows in (AM peak) and out (PM peak) of the study core.
- The annual cost of delay / congestion for the study area Primary Corridors (I-84, I-91 and Route 2) is approximately $200 million.
- Traffic density and congestion on Primary Corridors is concentrated mostly around the study core during peak periods. It will be important to understand COVID-19 pandemic's long-term impacts on traffic trends and congestion based on variables such as teleworking, off-peak traffic dispersion etc.
- While congestion is a function of volume to capacity (v/c) ratio, other factors such as geometric deficiencies, lane continuity and lane balance (discussed later in the Highway Assessment chapter) also contribute to the recurring congestion. The I-91 and I-84 interchange in the study core is a major congestion hotspot due to capacity, lane continuity, lane balance issues and contributes to significant congestion in the study core.

- The annual cost of delay / congestion for the study area Contributing Corridors is approximately $36 million.

- Nearly 3 out of every 4 trips destined for the Study Core originate within the Study Core. While predominant trips have both the trip ends within the Study Core, a significant portion of these trips rely on the Primary Corridors to access their destinations. This offers an opportunity for strategic improvements focused on bike, pedestrian and transit infrastructure within the Study Core to encourage meaningful mode shift and reduced congestion on key Study Core corridors.

- For each COS, the predominant share of trips has both the origins and destinations within the same COS (intra-COS trips). As such localized identification of needs and improvements may be essential for each COS.

- During the AM Peak Period, the largest OD pairs (excluding intra-COS trips) are from the South COS, the Southwest COS, and the Northwest COS to the Study Core. The same OD pairs show largest reverse trip pattern during the PM Peak Period.

- The pattern of destinations from the Northeast and Southeast COS tend to be more dispersed than the other COS with a higher concentration of trip destinations in East Hartford in the Study Core.

3 Highway Facilities Assessment

3.1 Introduction

This chapter focuses on summarizing existing conditions analysis of key geometric considerations such as existing horizontal and vertical alignments, stopping sight distances, interchange spacing, lane continuity and lane balance on the Priority Corridors within the GHMS Study Area (I-84, I-91, and Route 2). The analysis includes a review of roadway geometrics vs. posted speed limit, horizontal sight distance restrictions and interchange spacing. These highway design elements can have a significant impact on free flow speeds and mobility within the study area.

The existing conditions analysis also includes review and analysis of highway crash data along the Primary and Contributing Corridors (defined earlier in the Chapter 2) to assess crash rates along roadway segments, identify hotspot locations for safety improvement and understand potential correlation between crash hotspots and geometric deficiencies.

A high-level assessment of bridge structures with spans greater than 20 feet and that carry or cross over the Priority and Contributing Highway Corridors has been completed, especially for ongoing CTDOT bridge rehabilitation projects to identify opportunities for mobility enhancement in line with the GHMS vision and goals.

Analysis focused on identifying highway geometric deficiencies and crash hotspots, with a focus on understanding potential correlation between the two and their impact on traffic flow and mobility.

3.2 Roadway Geometric Review

Geometric criteria for the design of new highways is fundamentally based on anticipated 85th percentile running speeds. Since this is an existing conditions analysis, it is generally acceptable to use the posted speed limit to determine if any geometric features do not meet minimum requirements. The posted speed limit for I-84 and I-91 varies between 50 mph and 65 mph (see Figure 3-1). The posted speed limit will be used to obtain the minimum design criteria for horizontal curvature and stopping sight distance.

AASHTO recommends interchange spacing of 1 mile in urban areas. CTDOT recommends 2,000 feet between a on-ramp and an off-ramp. This minimum distance can vary if a traffic analysis requires a longer distance to provide better traffic operations. For the purposes of this study, interchanges where ramp spacing is under 2,000 feet will be identified as deficient.

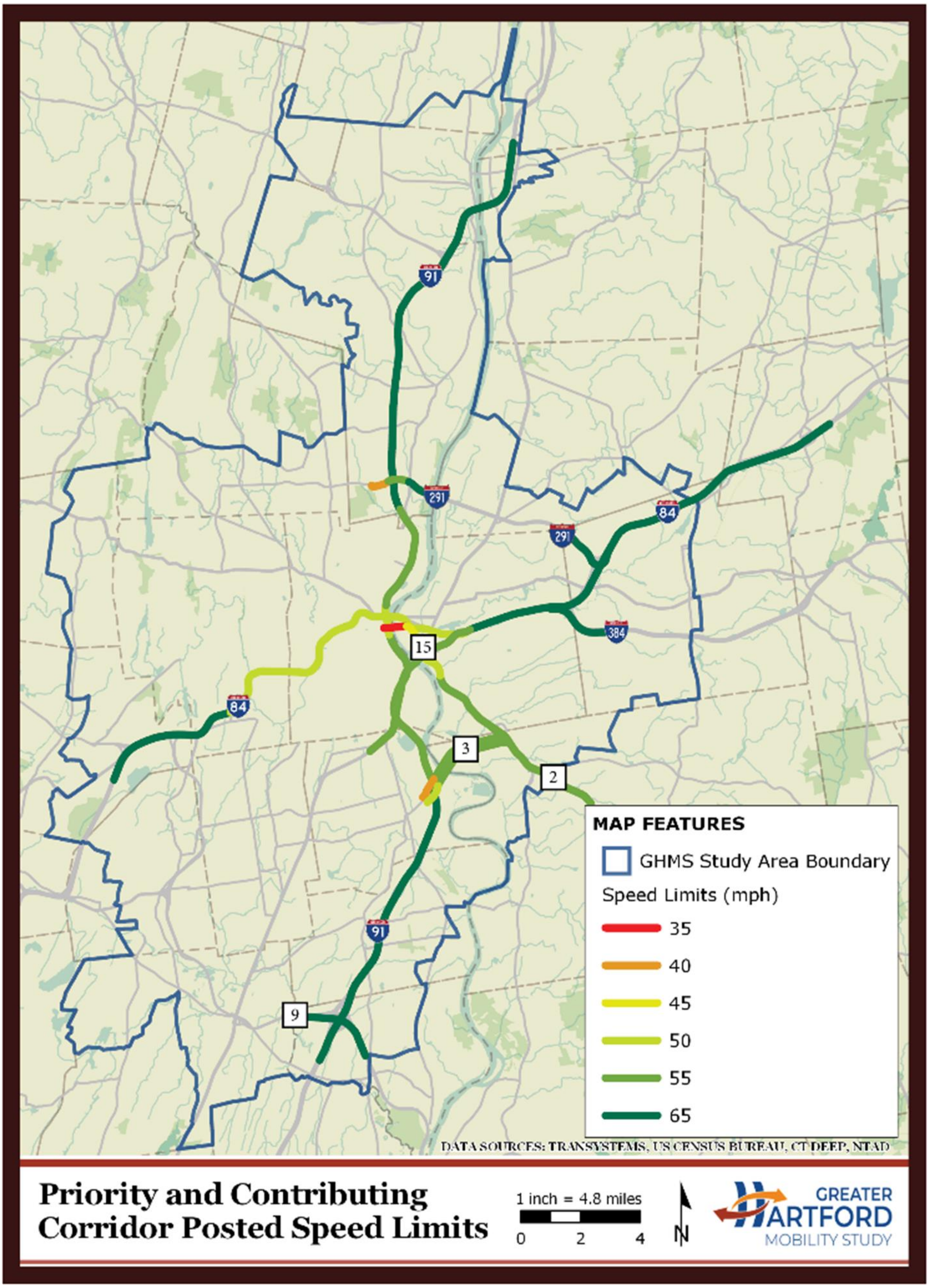

Figure 3-1: Priority and Contributing Corridors Posted Speed Limits

3.2.1 I-84

As shown in Figure 3-1, the study limits for I-84 begin in Farmington, just south of U.S. Route 6 (milepost 53.8), and end in Vernon, just east of Interchange 65 westbound ramps (M.P. 74.3). The posted speed limit varies between 50 mph (west of Hartford) and 65 mph (east of Hartford).

East of the U.S. Route 6 on-ramp in Farmington, the outside lane for I-84 eastbound drops at the Route 9 off-ramp. Two lanes continue eastbound for approximately 1,600-feet until they merge with the left-hand on-ramp from Route 4. The outside lane on I-84 eastbound also drops in Hartford approximately one mile west of the I-91 interchange. The third lane reemerges on the Bulkeley Bridge, east of the I-91 interchange. On I-84 westbound, the outside lane is dropped at Interchange 50 (I-91 South/U.S. Route 44). Two lanes continue on I-84 westbound for approximately 2,200-feet until the merge with the I-91 ramps. These three locations violate the basic principle of lane continuity as defined in AASHTO's "A Policy on Geometric Design of Highways and Streets".

> *The corridor has three basic lanes in each direction except for sections in Farmington and Hartford, which have two basic lanes in each direction.*

The horizontal alignment is considered curvilinear from the western study limit through the Route 15 interchange in East Hartford. This is likely due to the urban environment and minimizing adverse impacts during its construction. This section of I-84 also includes several closely spaced interchanges (see Table 3-1), some with left-hand ramps. The interchange types lack consistency and include split and half interchanges. Closely spaced interchanges combined with a curvilinear alignment create a highly complex corridor, which may be a contributing factor to higher than average crash rates.

I-84 between Interchange 46 (Sisson Avenue) and the Bulkeley Bridge was the subject of a recent E.I.S. study, which identified several roadway deficiencies including closely spaced interchanges, constrained weaves, stopping sight distance, and roadway geometry.

The I-84 horizontal alignment east of Route 15 is more typical of an interstate with long horizontal curves separated by long tangents. This type of alignment allows drivers to process directional signage and make decisions without constantly adjusting their vehicle to stay on alignment. This section of I-84 includes eastbound and westbound HOV lanes from Interchange 58 (East Hartford) to Interchange 64/65 (Vernon).

Table 3-1: I-84 Deficient Ramp Spacing

I-84 Closely-Spaced Interchange Ramps (Minimum Distance = 2,000')	
I-84 Eastbound Locations	**Available Distance (ft)**
Route 9 NB off-ramp to 84 to Interchange 40 off-ramp	1,485
Interchange 47 on-ramp to Interchange 48A off-ramp	1,000
Interchange 48 on-ramp to Interchange 49 off-ramp	1,180
I-91 SB off-ramp to 84 to Interchange 53 off-ramp	860
East River Drive on-ramp to Interchange 55 off-ramp	580
I-84 Westbound Locations	**Available Distance (ft)**
Interchange 40 on-ramp to Interchange 39A off-ramp	1,450
Interchange 48 on-ramp to Interchange 47 off-ramp	1,040
Interchange 49 on-ramp to Interchange 48 off-ramp	550
Route 44 on-ramp to Interchange 51 off-ramp	1,570
Route 5 on-ramp to Interchange 56 off-ramp	1,200

Sightline restrictions were evaluated for the mainline travel lanes. HOV and ramp lanes were excluded. The available sight distance in some areas was slightly below the required distance for the posted speed limit, however, they were not documented in this evaluation because mobility is likely not affected. The following locations are depicted in Table 3-2.

Table 3-2: I-84 Horizontal Sightline Restrictions

I-84 Eastbound Locations	Posted Speed Limit (mph)	Required SSD (ft)	Available SSD (ft)
Inside lane at Interchange 45 WB Ramp	50	425	375
Inside lane over Laurel Street	50	425	370
Inside lane east of Broad Street	50	425	260
Outside lane west of High Street	50	425	275
Inside lane at Downtown Tunnel	50	425	290
Outside lane at Roberts Street bridge	65	645	400
I-84 Westbound Locations			
Inside lane at EB on-ramp from Route 4	50	425	375
Inside lane at Interchange 43 ramps	50	425	360
Inside lane at Capitol Avenue bridge	50	425	340
Inside lane east of Interchange 48	50	425	310
Inside lane east of Bulkeley Bridge	50	425	310

Figure 3-2 through Figure 3-4 show the identified lane balance, lane continuity, ramp spacing and horizontal sight distance related deficiencies for the I-84 corridor within the GHMS study area.

Figure 3-2: Identified I-84 Deficiencies

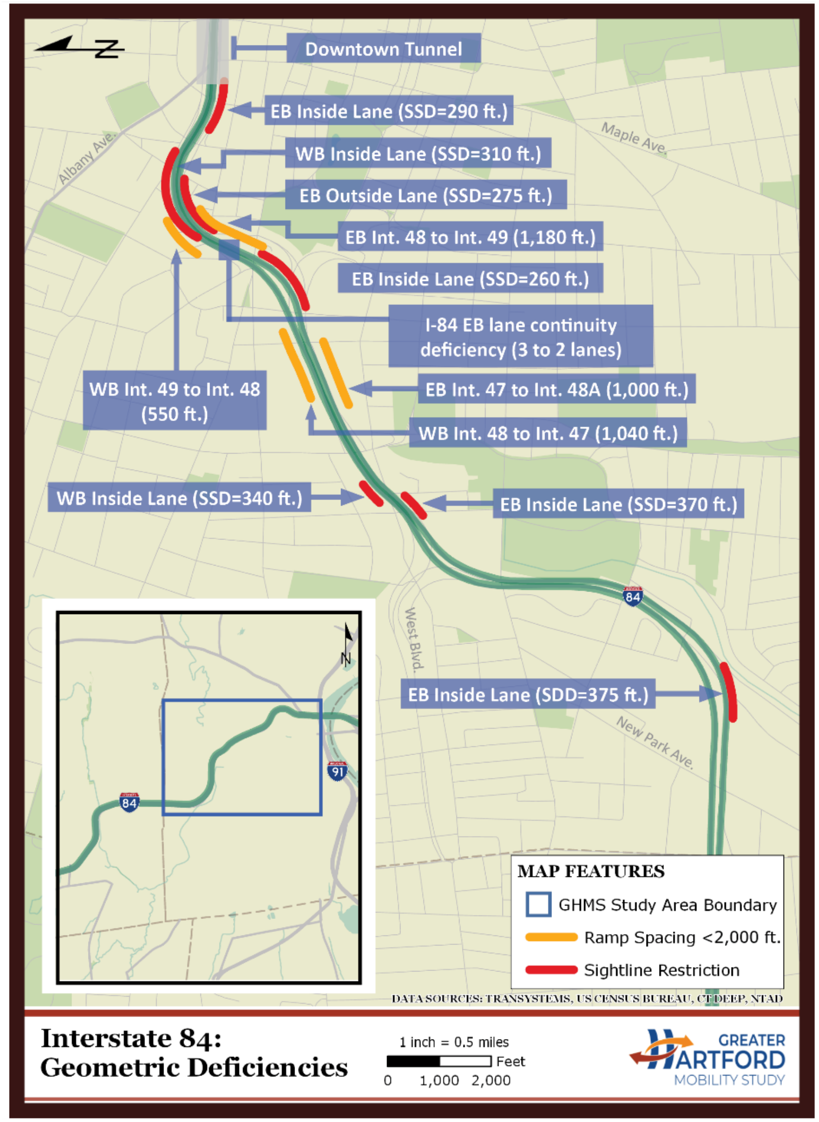

Figure 3-3: Identified I-84 Deficiencies

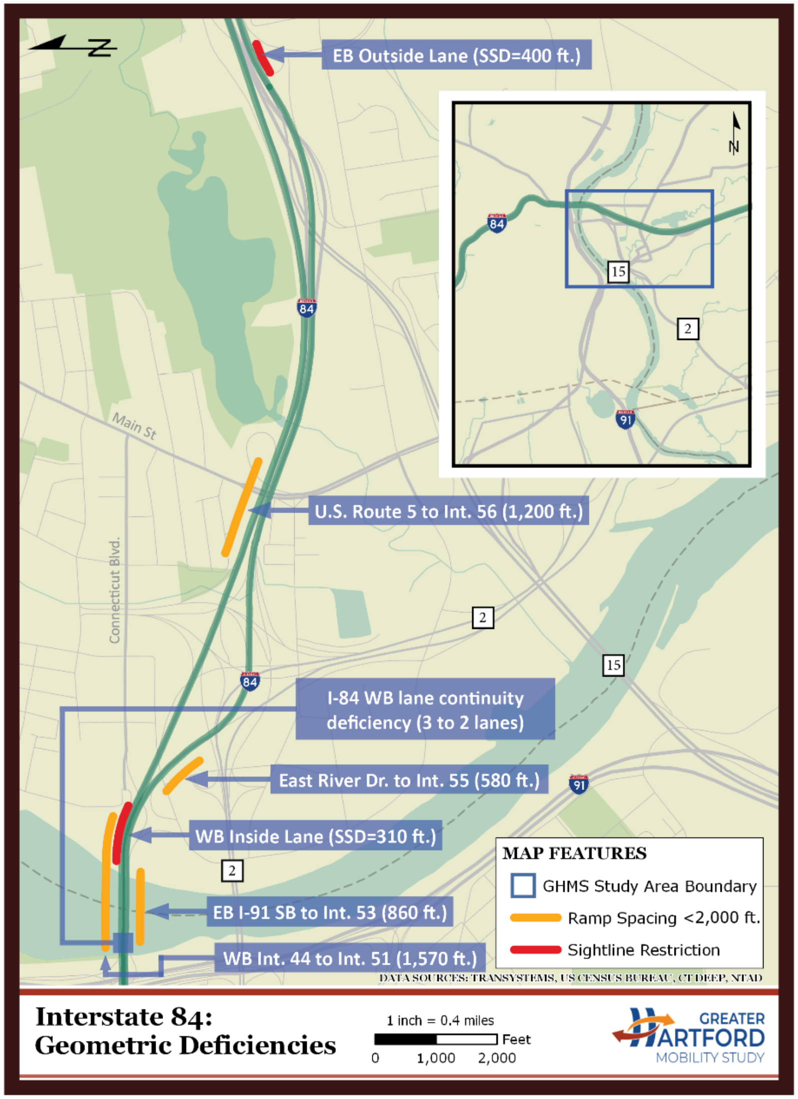

Figure 3-4: Identified I-84 Deficiencies

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3.2.2 I-91

As shown on Figure 3-1, the study limits for I-91 begin in Middletown, just south of Interchange 22 (Route 9) (M.P. 26.3), and end in East Windsor, just north of Interchange 45 (Route 140) (M.P. 51.4). There are three basic lanes in each direction and the posted speed limit varies between 65 mph (northern and southern sections) and 55 mph (Hartford area).

The corridor has three basic lanes except for a section in Hartford. I-91 northbound drops the inside lane approximately 1,000-feet south of Interchange 32A-32B (Trumbull Street/I-84 West). The inside lane drop becomes a collector-distributor road that provides an off-line weave with the Whitehead Highway northbound on-ramp. The 2-lane section of I-91 northbound continues to the downtown collector-distributor merge, approximately 0.8 miles. I-91 southbound approaches the downtown Hartford area with a 4-lane section. The outermost lane is an auxiliary lane that drops at Interchange 32A-32B (Trumbull Street/I-84 West). The third lane drops approximately 400-feet north of Interchange 31 (State Street) and continues south until the merge with the I-84 on-ramp, approximately 1,800-feet. These two locations violate the basic principle of lane continuity as defined in AASHTO's "A Policy on Geometric Design of Highways and Streets".

From the southern study limit to just south of Interchange 25-26 (Route 3), I-91 is a divided highway with a grass/wooded median of varying widths. Approximately 1,000-feet south of Interchange 25-26, the grass median is replaced with a concrete median.

The horizontal alignment is mostly tangential from the southern study limit to Interchange 25-26 (Route 3 - Putnam Bridge). Interchange spacing is consistent through this section, although the interchange types vary.

The horizontal alignment from Interchange 25-26 to Interchange 29 (Route 15 – Charter Oak Bridge) includes curves that meet the minimum design requirements for the posted speed limit. However, the I-91 southbound alignment just north of Interchange 29 includes a curve with a higher than average crash rate. This is likely due to the horizontal radius, which is less than the minimum required radius for the posted speed limit. The existing pavement markings for this simple horizontal curve are complex and abrupt, requiring a driver to make multiple unexpected adjustments.

The horizontal alignment from downtown Hartford to Interchange 45 (Route 140), meets or exceeds the minimum horizontal curve radius requirements for the posted speed limit. This section includes a concrete median with paved shoulders. There are northbound and southbound HOV lanes between the downtown area and Interchange 38. The interchange spacing is consistent, although most are less than the minimum recommended spacing of 1 mile in urban areas (see Table 3-3).

Sightline restrictions were evaluated for the mainline travel lanes. HOV and ramp lanes were excluded. The available sight distance in some areas was slightly below the required distance for the posted speed limit, however, they were not documented in this evaluation because mobility is likely not affected. These locations are depicted in Table 3-4.

Figure 3-5 and Figure 3-6 show the identified deficiencies for the I-91 corridor within the GHMS study area.

Table 3-3: I-91 Deficient Ramp Spacing

I-91 Closely-Spaced Interchange Ramps (Minimum Distance = 2,000’)	
I-91 Southbound Locations	Available Distance (ft)
Interchange 26 on-ramp to Interchange 25S off-ramp	690
Interchange 27 on-ramp to Interchange 28 off-ramp	1,540
Interchange 29 on-ramp to Interchange 29A off-ramp	420
Interchange 42 on-ramp to Interchange 41 off-ramp	1,470
Interchange 45 on-ramp to Interchange 44 off-ramp	800

Table 3-4: I-91 Horizontal Sightline Restrictions

I-91 Northbound Locations	Posted Speed Limit (mph)	Required SSD (ft)	Available SSD (ft)
Inside lane at Route 99	65	645	480
Inside lane at Wethersfield Cove Inlet	55	495	450
Inside lane north of Interchange 29	55	495	475
Inside lane at Interchange 40	65	645	560
Inside lane at Interchange 44	65	645	570
I-91 Southbound Locations			
Inside lane at Interchange 32	55	495	310
Inside lane west of Dexter Coffin Bridge	65	645	470

Figure 3-5: Identified I-91 Deficiencies

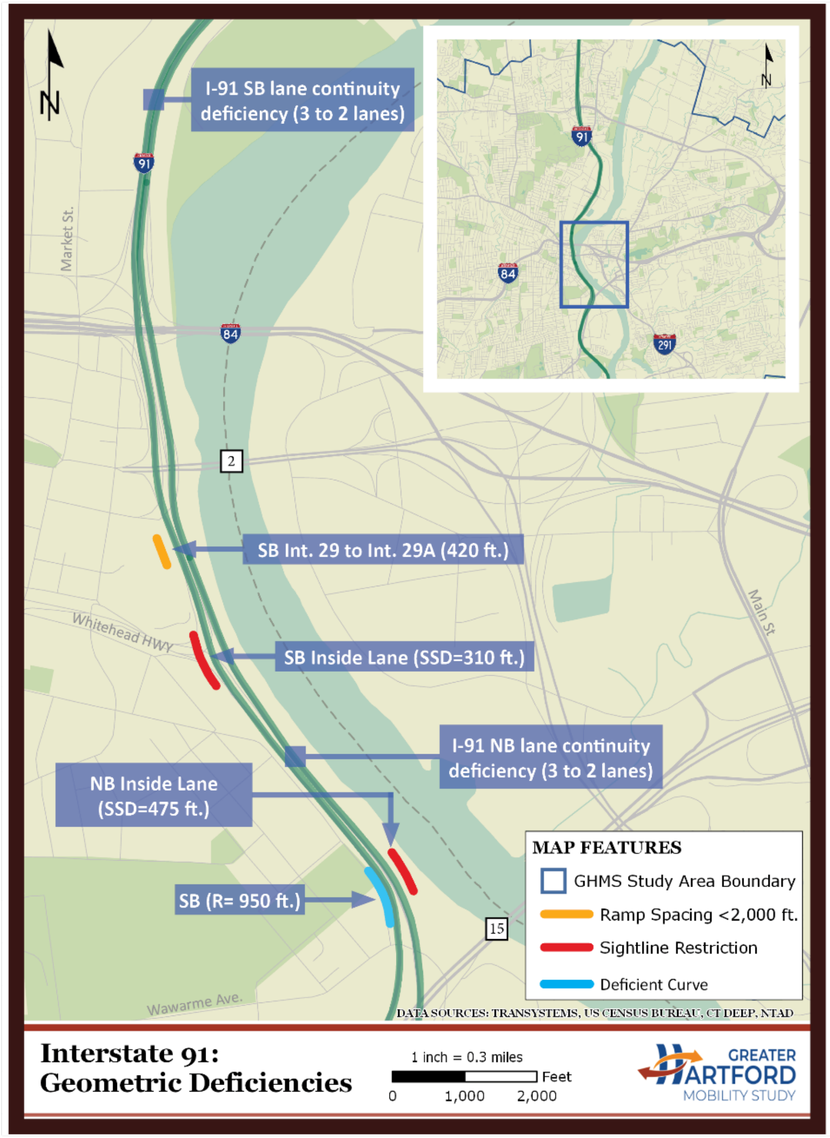

Figure 3-6: Identified I-91 Deficiencies

2

As shown on Figure 3-1, the study limits for Route 2 begin in East Hartford at the I-84 interchange (M.P. 0.0) and end in Glastonbury, east of Interchange 8 (Route 94) (M.P. 6.3). There are two basic lanes in each direction and the posted speed limit varies between 50 mph and 55 mph.

The Route 2 horizontal alignment generally includes long tangents between curves that meet or exceed the minimum design requirements for the posted speed limit. However, there is a reverse horizontal curve with a short tangent in the vicinity of Interchange 5B. This alignment is not indicative of the Route 2 corridor and, therefore, may not meet driver expectations. This portion of the Route 2 corridor also includes a very short westbound weave section (350'), which adds complexity and additional bits of information drivers need to process while negotiating the non-typical horizontal alignment (see Table 3-5).

The Route 2 alignment also includes a 'broken-back' horizontal curve (two successive curves in the same direction with a short tangent separating them) approximately 800-feet west of the eastbound split with Route 17. These curves are adjacent to a concrete median barrier with a narrow shoulder, which limits the horizontal stopping sight distance in the eastbound direction. Broken-back curves are not desirable because they are difficult to negotiate, especially when they are located within a decision-making area.

Route 2 includes several non-conventional and incomplete interchanges with half diamonds, three-quarter diamonds, and single ramps, which do not meet driver expectations. In general, full interchanges are preferred because it allows drivers to have full directional access.

CTDOT is expecting to start construction on State Project No. 0042-0317 (Resurfacing, Bridge, and Safety Improvements on Route 2 in the town of East Hartford) in January 2022. This project will permanently close the Exit 5B ramps, which include the Cambridge Street westbound on-ramp and the Sutton Avenue eastbound off-ramp. This section of Route 2 has been identified as an area that exhibits a higher-than-normal crash rate and would benefit from safety and traffic operational improvements.

State Project No. 0042-0317 will permanently close the Exit 5B ramps, which would help with safety and operational improvements.

The closure of the Sutton Avenue eastbound off-ramp allows for extension of the High Street acceleration lane to provide additional length for safe merging maneuvers. The closure of the Cambridge Street westbound on-ramp will allow for the extension of the Main Street deceleration lane and eliminates the unsafe weaving operation that exists currently.

The available sight distance in some areas was slightly below the required distance, however, they were not documented in this evaluation because mobility is likely not affected.

Table 3-5: Route 2 Deficient Ramp Spacing

Route 2 Closely-Spaced Interchange Ramps (Minimum Distance = 2,000')	
Route 2 Eastbound Locations	**Available Distance (ft)**
Interchange 5A on-ramp to Interchange 5B off-ramp	1,150
Interchange 5C on-ramp to Interchange 5D off-ramp	1,250
Route 2 Westbound Locations	
Interchange 5 on-ramp to Interchange 4 off-ramp	650
Interchange 5B on-ramp to Interchange 5A off-ramp	350
Interchange 49 on-ramp to Interchange 48 off-ramp	550
Route 44 on-ramp to Interchange 51 off-ramp	1,570
Route 5 on-ramp to Interchange 56 off-ramp	1,200

Table 3-6: Route 2 Horizontal Sightline Restrictions

Route 2 Eastbound Locations	Posted Speed Limit (mph)	Required SSD (ft)	Available SSD (ft)
Inside lane west of Route 17 split	55	495	380
Inside lane west of Route 17 split	55	495	260
Inside lane at Route 17 bridge parapet	55	495	400

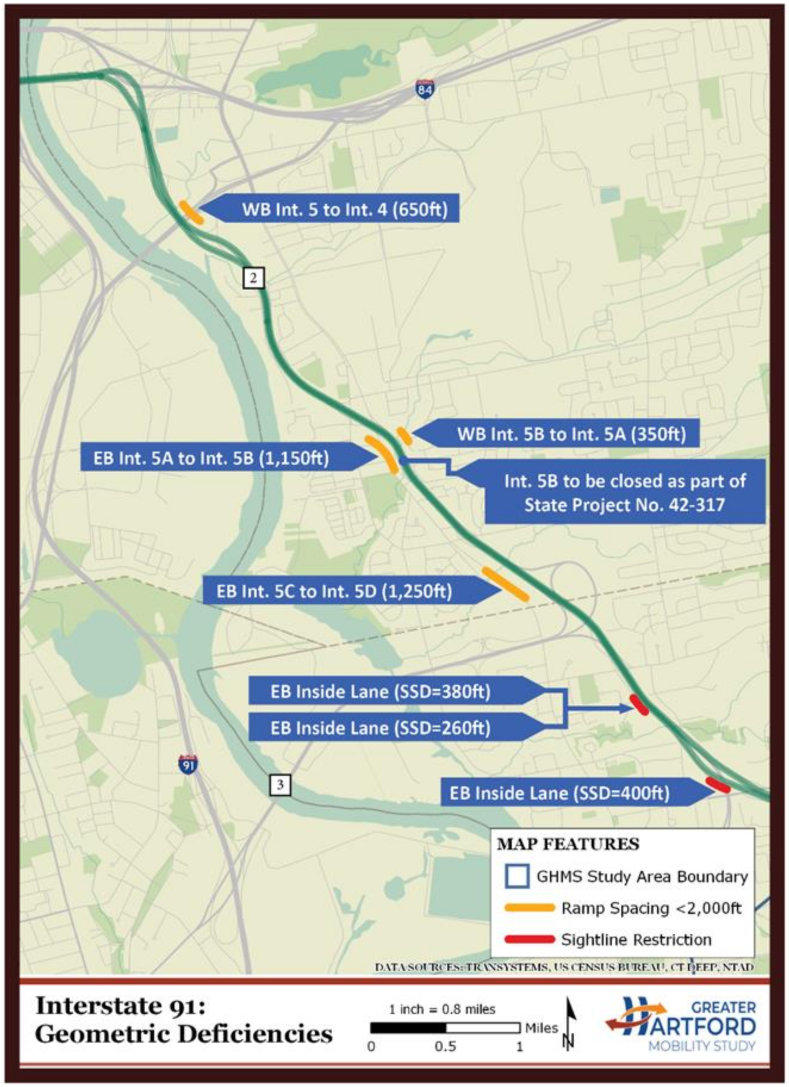

Figure 3-7: Identified Route 2 Deficiencies

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3.3 Highway Safety Analysis – Priority Corridors

Highway safety is sometimes perceived as a binary option – either a road meets design standards and is safe, or it does not meet standards and is unsafe. In reality, safety is the result of more than just road design: driver behavior, weather, congestion, distraction, and other factors influence the rate at which crashes occur. Crashes often have more than one root cause, making it difficult or impossible to determine why they occurred.

The highway safety analysis in this chapter uses statistical methods to look for locations with abnormally high crash rates and to identify the potential causes.

> *Rather than simply looking at the number of crashes on a road segment, the analysis considered length of the segment and amount of traffic using it. As a result, crash rates are reported in crashes per hundred million vehicle miles travelled (HMVMT).*

Crash data was collected from January 2015 through December 2019, a five-year period, in order to provide a large sample size and increase statistical significance.

3.3.1 I-84 Crash Rate

The crash rates on I-84 are shown on Figure 3-1. These rates are shown in more detail in bar charts on the following pages, where each bar represents a 0.1-mile segment of the freeway.

> *A high incidence of crashes on I-84 Eastbound correlate both with the areas of recurring congestion and known geometric deficiencies.*

Crash rates on I-84 Eastbound (see Figure 3-9) show a high incidence of crashes in areas where recurring congestion is frequent. In particular, the highest crash rates occur between Flatbush Avenue (MP 59.9) and the Route 2 interchange (MP 63.4). This section of I-84 has a number of geometric elements that may result in higher crash rates, including a left-hand off-ramp, narrow shoulders, sharp radii, and limited sight distance. In addition, the close spacing of ramps in this area, the weaving introduced by the lane configuration, and the reduction from three basic lanes to two all tend to contribute to higher crash rates. The highest crash rates coincide with the sharp curve north of Union Station (MP 61.8), where many of these contributing factors exist.

Outside of this central segment, crash rates above 500 per hundred million vehicle miles traveled (HMVMT) occur at the interchanges with South Main Street, Park Road, and Caya Avenue in West Hartford, as well as Buckland Street and Route 30 in Manchester. As the crash data includes crashes that occur on ramps, ramp queueing is a likely contributing factor. In the case of the Route 30 interchange, ramp queues sometimes extend onto I-84 itself, resulting in a high-speed differential between through and exiting traffic. For the segment in West Hartford, there are two-sided weaves due to the left-hand off- and on-ramps at the Park Road interchange. This area also has sharp curvature on I-84.

Crash rates on I-84 Westbound (see Figure 3-10) are dominated by a cluster of high-incident segments between U.S. Route 5 in East Hartford (MP 63.8) and Sisson Avenue (MP 60.8). This area is a focal point of congestion during both peak periods, and also contains a number of geometric deficiencies such as left-hand ramps, narrow shoulders, and sharp radii. In addition, the close spacing of ramps in this area, the weaving introduced by the lane configuration, and the reduction from three basic lanes to two all tend to contribute to higher crash rates. The highest frequency of crashes occurs around the weave between the High Street on-ramp and the Asylum Street off-ramp (MP 61.8). This area experiences frequent congestion and coincides with a sharp curve.

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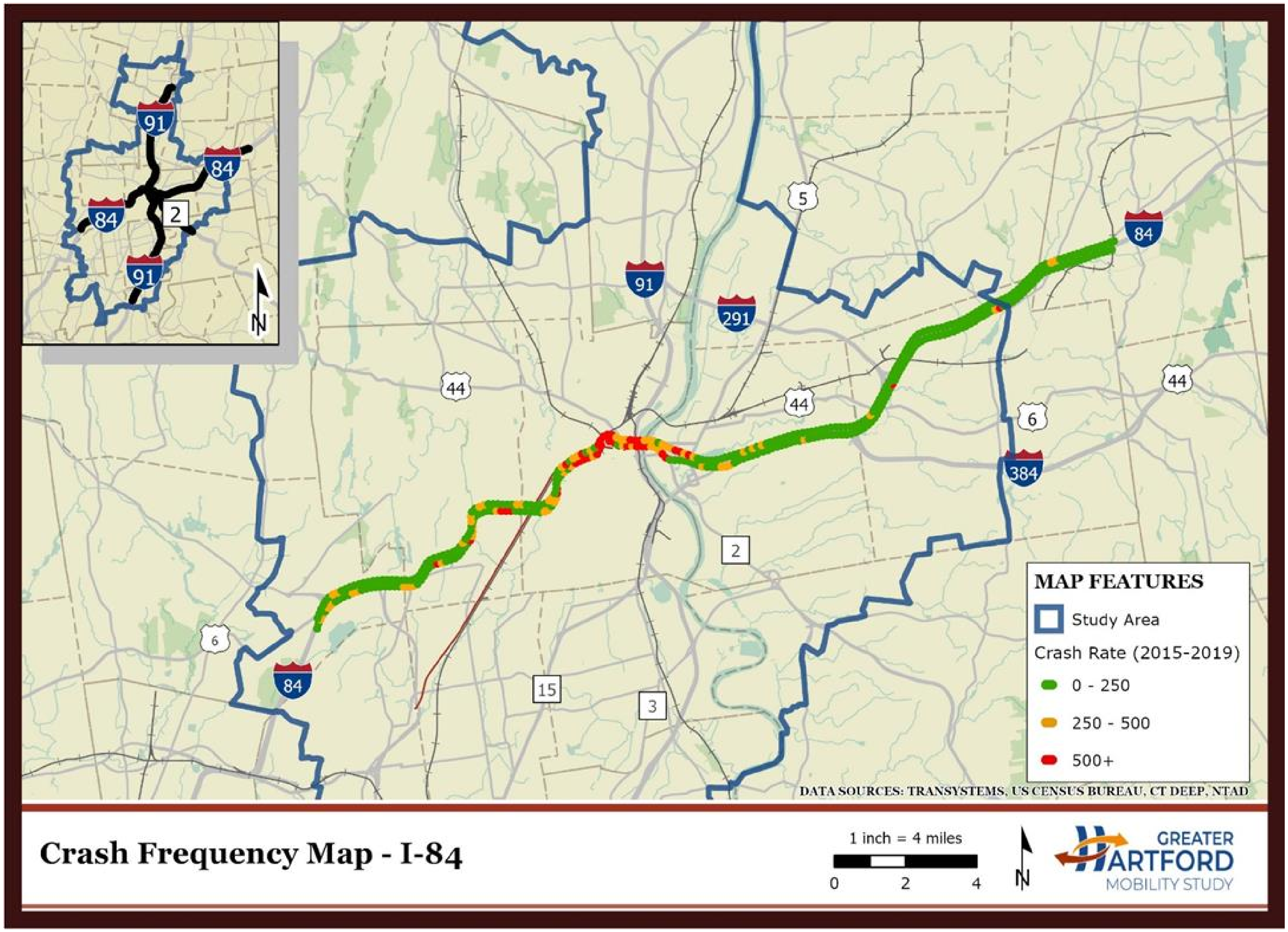

Figure 3-8: I-84 Crash Frequency Map

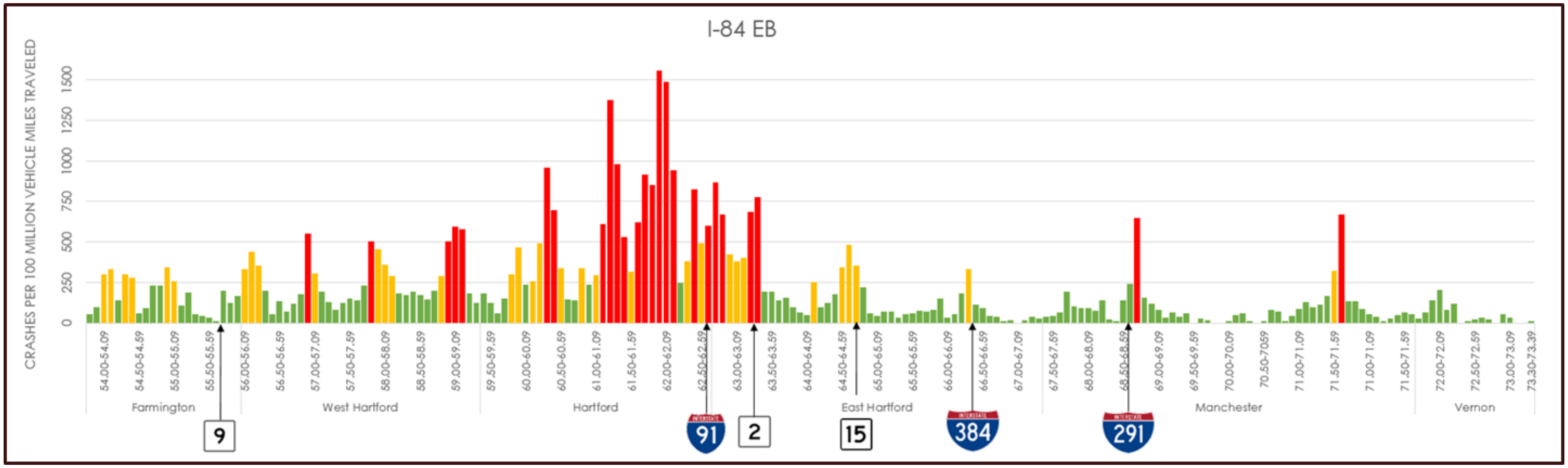

Figure 3-9: I-84 Eastbound Crash Rates

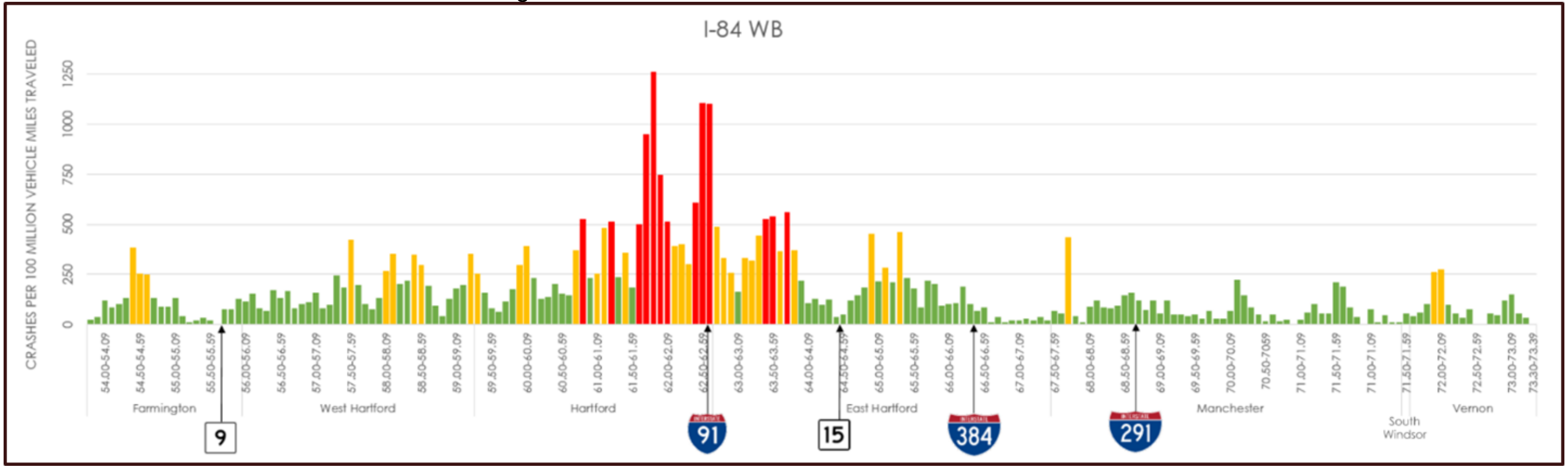

Figure 3-10: I-84 Westbound Crash Rates

3.3.2 I-91 Crash Rate

The crash rates on I-91 are shown on Figure 3-11. These rates are shown in more detail in bar charts on the following pages, where each bar represents a 0.1-mile segment of the freeway.

Crash rates on I-91 Northbound are generally low outside of Hartford, but there is a large spike in Hartford's South Meadows at the Route 15 interchange (see Figure 3-12). This is due to queues at the ramp to Route 15 Northbound (MP 36.8), which persist for hours each day and frequently extend a mile to the south. The speed differential between nearly stopped traffic in the right lane and moving traffic in the left two lanes, as well as aggressive driver behavior near the ramp, result in a high potential for crashes.

Other locations with high crash rates are at the Route 99 off-ramp in Rocky Hill, the Brainard Road lane drop in Hartford, and the three lane drops at the Whitehead Highway and I-91 Northbound Collector/Distributor Road in Hartford.

> *Crash rates on I-91 Northbound are generally low outside of Hartford, but there is a large spike in Hartford's South Meadows at the Route 15 interchange.*

Crash rates on I-91 Southbound are highest from I-291 (MP 42.2) to the Whitehead Highway (MP 37.9) – see Figure 3-13. This area corresponds with recurring congestion, including queues on the ramp to I-84 Westbound (MP 38.9), as well as a left-hand off-ramp to I--84 Eastbound (MP 38.5) and a left-hand on-ramp from the HOV lane (MP 40.1). I-91 Southbound is reduced from three to two basic lanes at the I-84 interchange, and ramp spacing is very close, with several weaves introduced by the lane configuration.

> *The I-91 Southbound section just north of the Route 15 interchange (MP 37.0) has a higher crash rate due to a complex right-hand curve, with severe crash damage evident on the median barrier.*

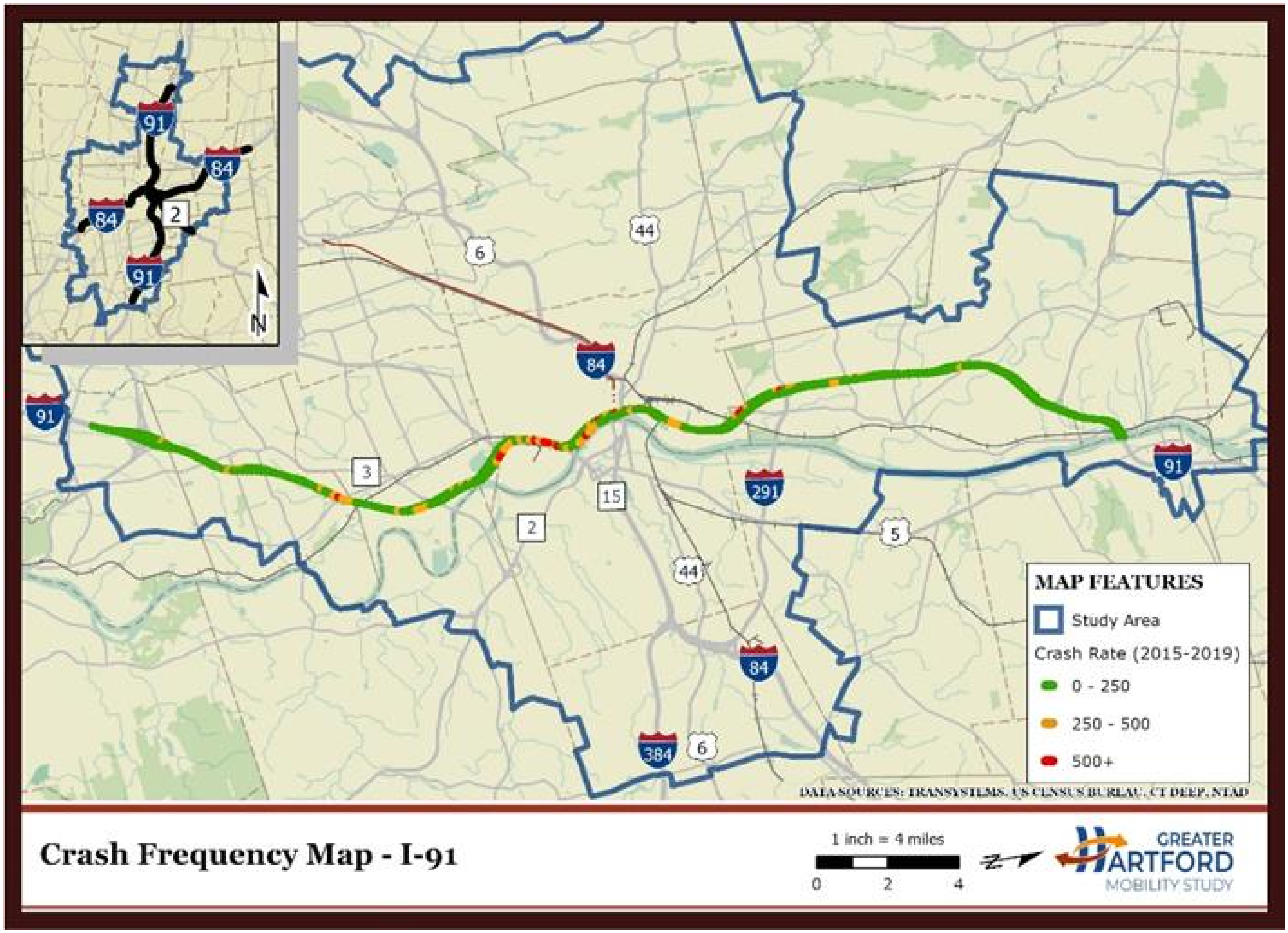

Figure 3-11: I-91 Crash Frequency Map

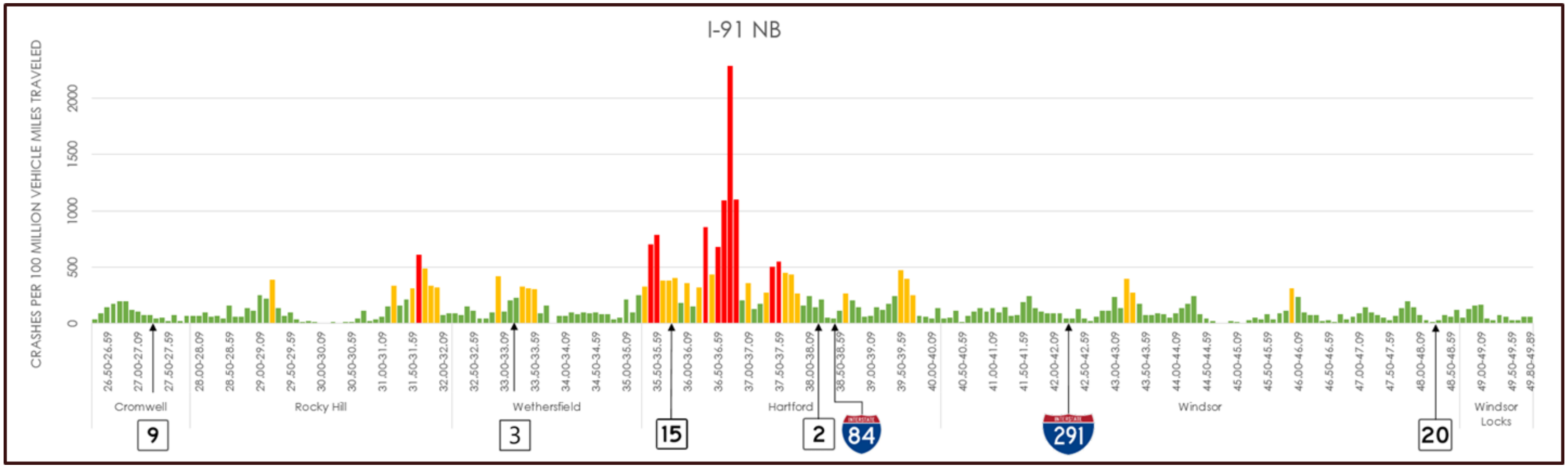

Figure 3-12: I-91 Northbound Crash Rates

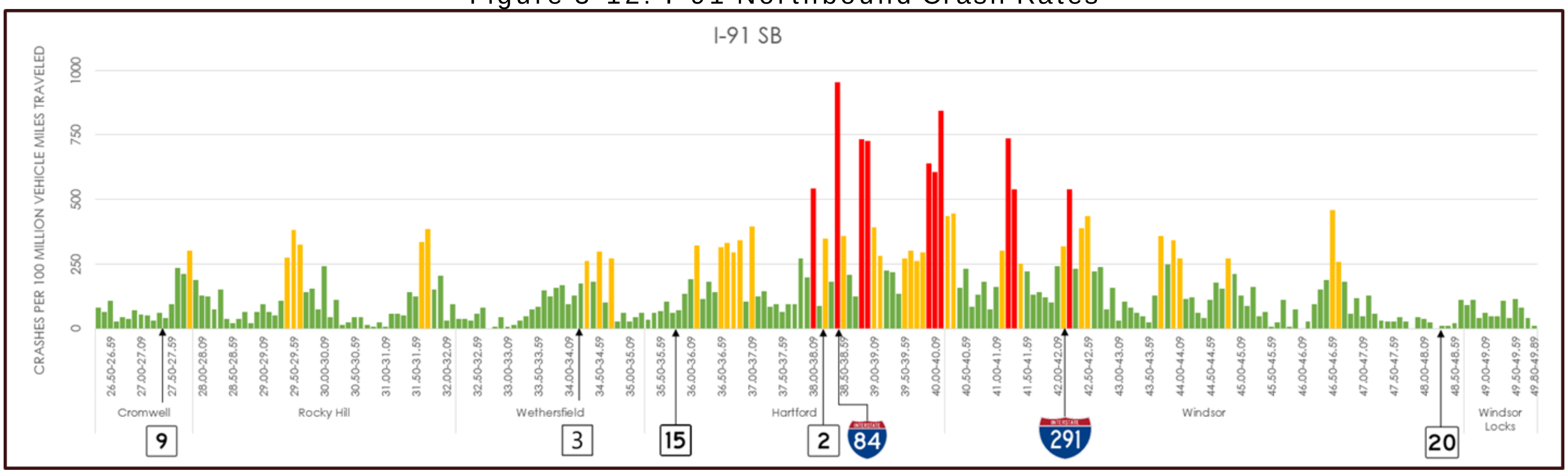

Figure 3-13: I-91 Southbound Crash Rates

3.3.3 Route 2 Crash Rate

The crash rates on Route 2 are shown on Figure 3-14. These rates are shown in more detail in bar charts on the following pages, where each bar represents a 0.1-mile segment of the freeway.

Crash rates on Route 2 Eastbound are highest between State Street (MP 0) and the I-84 interchange (MP 0.7) – see Figure 3-15. There are numerous eastbound off-ramps in this area, and it also serves as a transition between urban driving in downtown Hartford and freeway driving in East Hartford. Route 2 is reduced from three lanes to one at MP 0.5. This area was also under construction for several years as bridges at the I-84 interchange were replaced. Ramp closures and detours may have contributed to the high crash rate.

Eastbound Route 2 segments with higher crash rates have lane continuity, lane balance and geometric deficiencies such as closely spaced ramps with inadequate spacing.

Farther east, at MP 1.7, there is another segment with high crash rates. This is a complex area as well, with a left-hand lane reduction followed by a right-hand off-ramp and a left-hand on-ramp.

Crash rates on Route 2 Westbound are similar to the eastbound direction (see Figure 3-16). The highest crash rates are in a cluster around the west end of the freeway, including the I-84 interchange (MP 0.7) and the traffic signal at State Street (MP 0). A number of factors contribute to the high crash rate here: poor lane balance, numerous ramps close together, weaving, recurring congestion, and narrow shoulders. The recent construction activity also affects rates here.

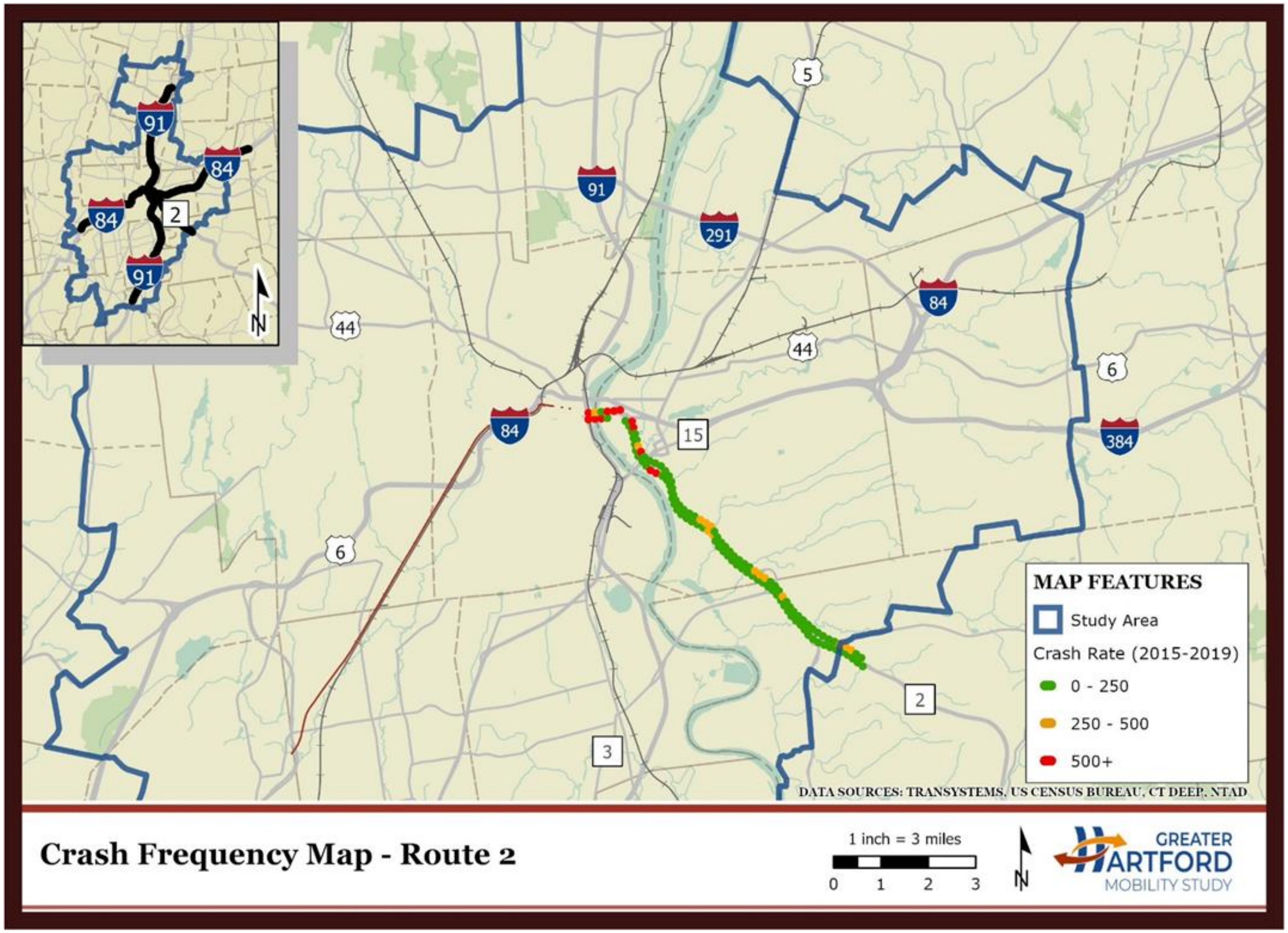

Figure 3-14: Route 2 Crash Frequency Map

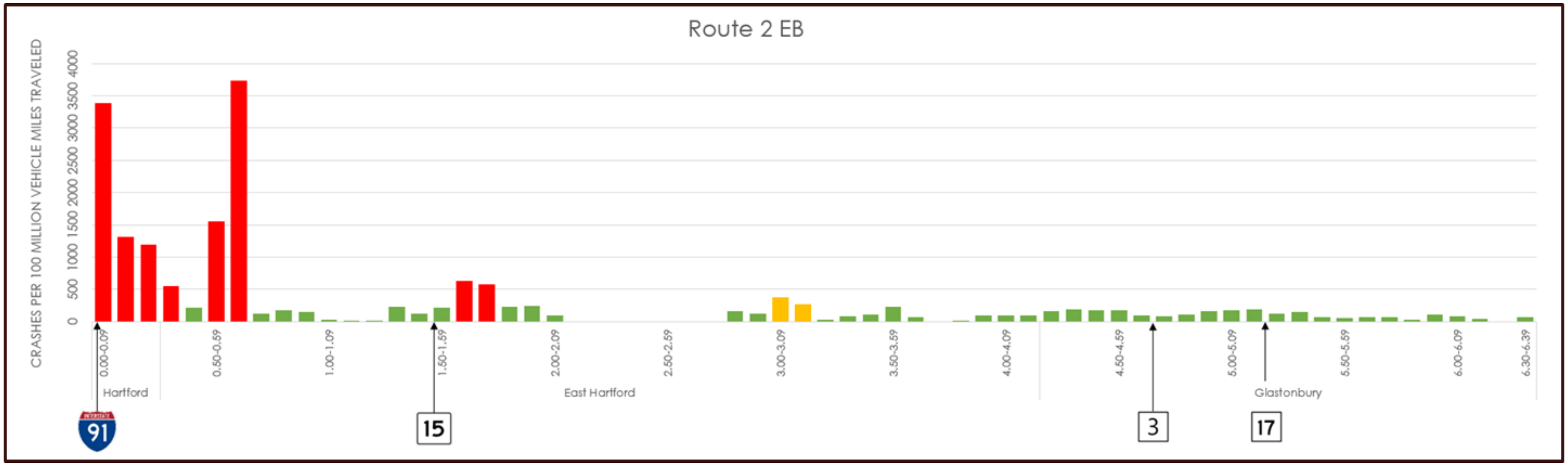

Figure 3-15: Route 2 Eastbound Crash Rates

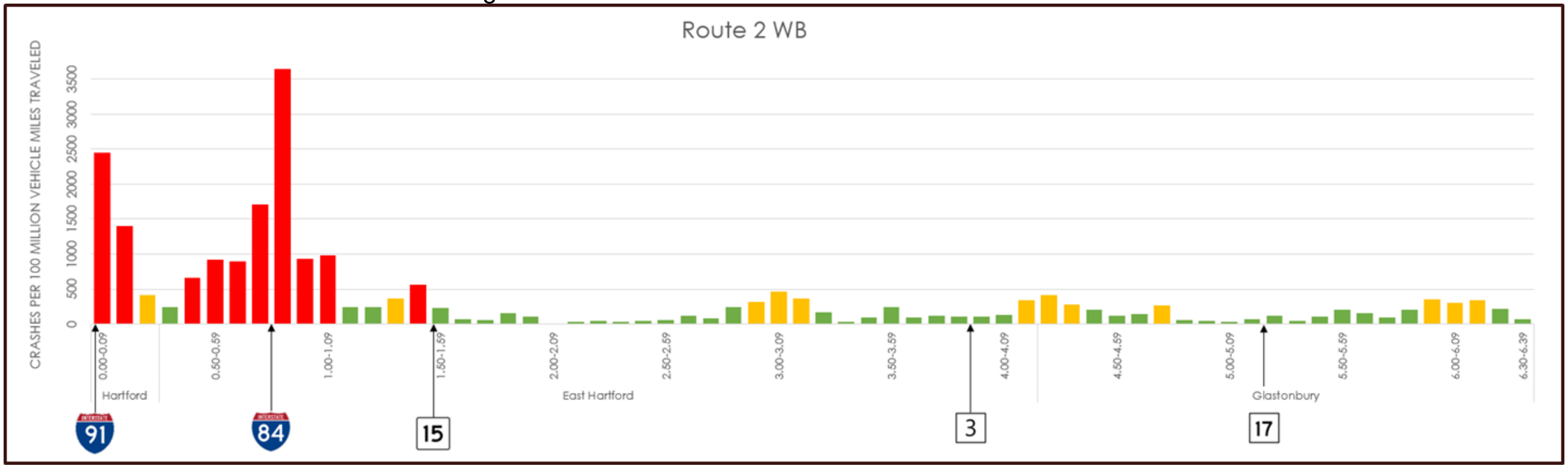

Figure 3-16: Route 2 Westbound Crash Rates

3.4 Safety Analysis – Other Corridors

The crash rates on Contributing Corridors within 1 mile of Priority Corridors are shown on Figure 3-17. Crash rates below 250 per HMVMT are shown in green, those between 250 and 500 per HMVMT are yellow, and rates above 500 per HMVMT are shown in red. These rates are shown in more detail in bar charts on the following pages, where each bar represents a 0.1-mile segment of the freeway.

3.4.1 I-291 at I-91 and I-84

Crash rates on I-291 Eastbound (Figure 3-18) are the highest at the two ends of the freeway. At the western end, this corresponds with an area of recurring congestion. At the eastern end, the I-291 ramp to I-84 Eastbound combines with the collector/distributor road containing traffic from I-384 and U.S. Route 6/44, then merges into I-84.

On I-291 Westbound (Figure 3-19), high crash rates correspond with the western end of the freeway, where I-291 drops from two basic lanes to one. There is recurring congestion here in the morning peak period, which may contribute to the increased crash rates.

3.4.2 I-384 at I-84

Crash rates on I-384 Eastbound are generally low (Figure 3-20). The only location where they exceed 500 per HMVMT is at the off-ramp to Spencer Street. As the crash rate includes crashes that occur on the ramp itself, these contribute to the high rate here, and do not necessarily indicate a safety concern on I-384 itself.

Crash rates on I-384 are below 500 per HMVMT (Figure 3-21). This segment of the freeway does not experience any recurring congestion, has full shoulders, and has a simple lane configuration with no weaving.

3.4.3 Route 3 at I-91 and Route 2

Crash rates on Route 3 Northbound show a high incidence of crashes on the westernmost portion of the corridor, west of I-91 (Figure 3-22). This segment of Route 3 is an undivided road with traffic signals. The potential for crashes is greatly increased here as there is no median to separate directional traffic, left-turning traffic must yield to opposing through traffic (potential for angled crashes), and rear-end crashes are more likely due to traffic stopping at signals.

The freeway portions of Route 3 have much lower crash rates. One segment above 500 crashes per HMVMT is at the I-91 interchange, corresponding with a left-hand off-ramp and a lane reduction from two basic lanes to one. The other location with an elevated crash rate is at the northern end of the freeway where Route 3 goes around a compound left-hand curve and merges with Route 2 Westbound.

Crash rates on Route 3 Southbound show a similar trend to the northbound direction, with few crashes on the freeway segments and higher rates on the undivided segments (Figure 3-23). The crash rates at MP 11.20-11.29 correspond to the left-hand off-ramp to I-91 SB. Other high-crash locations occur at traffic signals along Route 3.

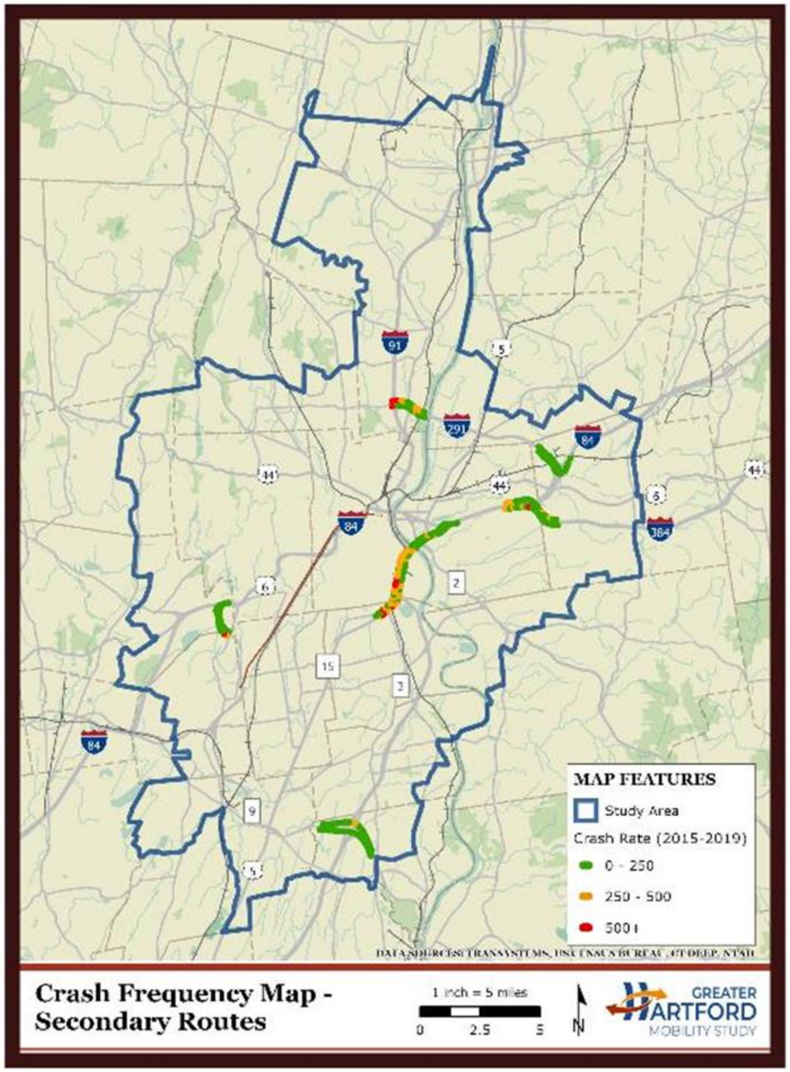

Figure 3-17: Secondary Route Crash Frequency Map

3.4.4 Route 9 at I-91 and I-84

Crash rates on Route 9 Northbound are all below 500 per HMVMT in the vicinity of I-91 and I-84 (Figure 3-24).

In the southbound direction (Figure 3-25), there is one location with an elevated crash rate: at the off-ramp to Route 71 in New Britain. There do not appear to be any geometric or operational deficiencies in this area, nor is there recurring congestion, so the cause of these crashes is unclear. It may be due to crashes on the off-ramp itself contributing to the overall crash rate.

3.4.5 Route 15 at I-91, Route 2, and I-84

Crash rates on Route 15 Northbound are generally below 500 per HMVMT, except at the Route 99 interchange in Wethersfield (Figure 3-26). Both in advance of the off-ramp and at the on-ramp, rates are slightly above 500, indicating potential operational issues at this interchange.

Crash data on Route 15 Southbound shows two locations with elevated crash rates (Figure 3-27). The first is at the I-91 interchange, where Route 15 is reduced from two lanes to one, with a lane dropping to Brainard Road. There is also a low-speed on-ramp from I-91 Northbound that enters in this area. Farther south, the stop-controlled on-ramp from Route 99 is another high-crash location. Average speeds here are 50 to 60 mph and entering traffic must accelerate to this speed in a short distance.

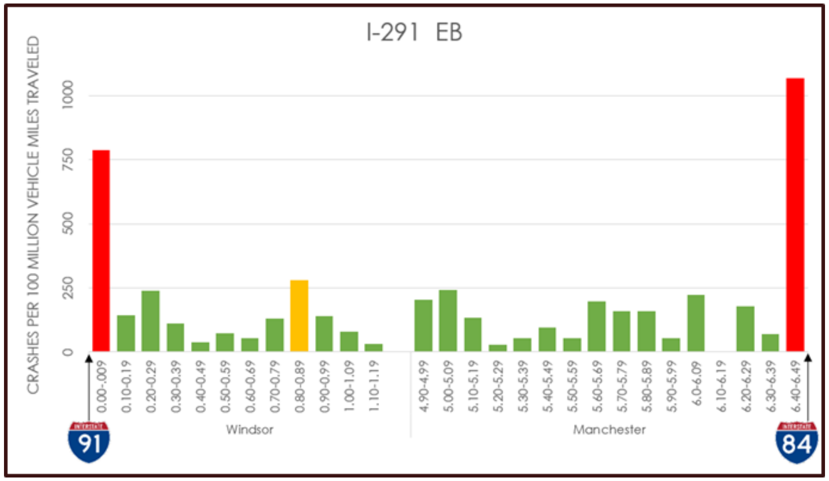

Figure 3-18: I-291 Eastbound Crash Rates

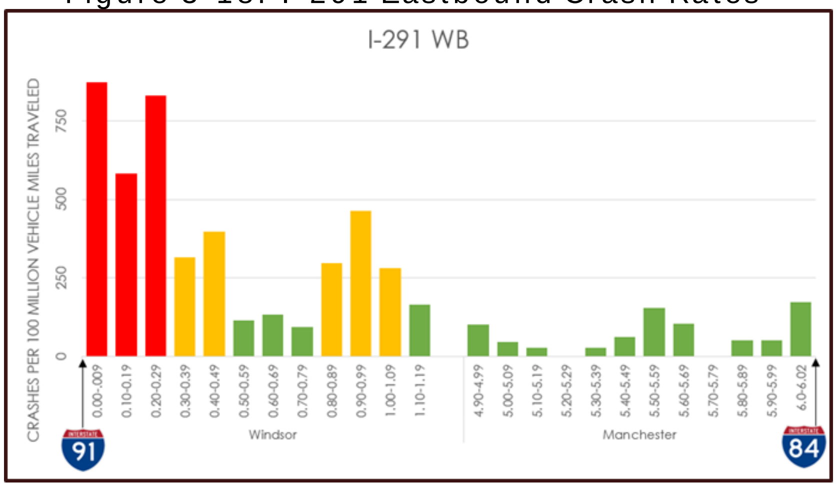

Figure 3-19: I-291 Westbound Crash Rates

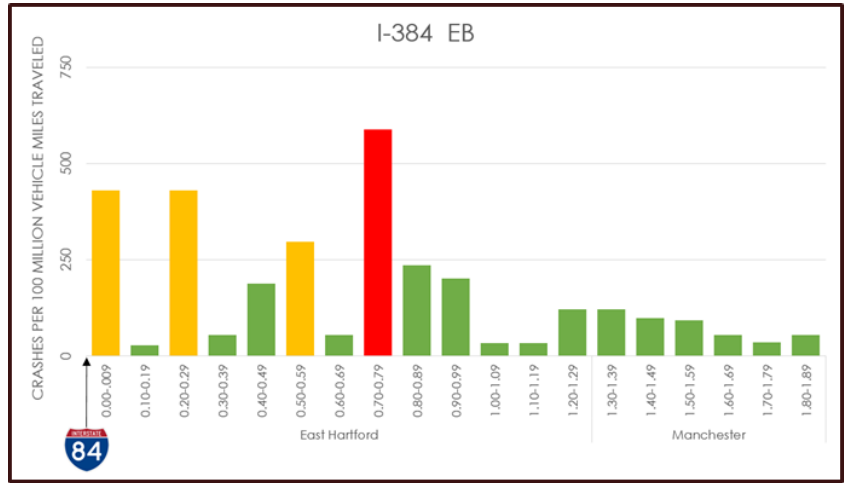

Figure 3-20: I-384 Eastbound Crash Rates

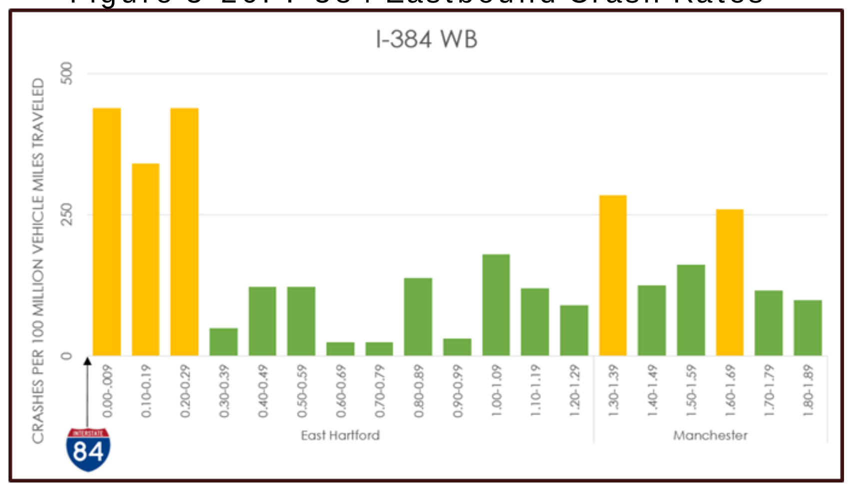

Figure 3-21: I-384 Westbound Crash Rates

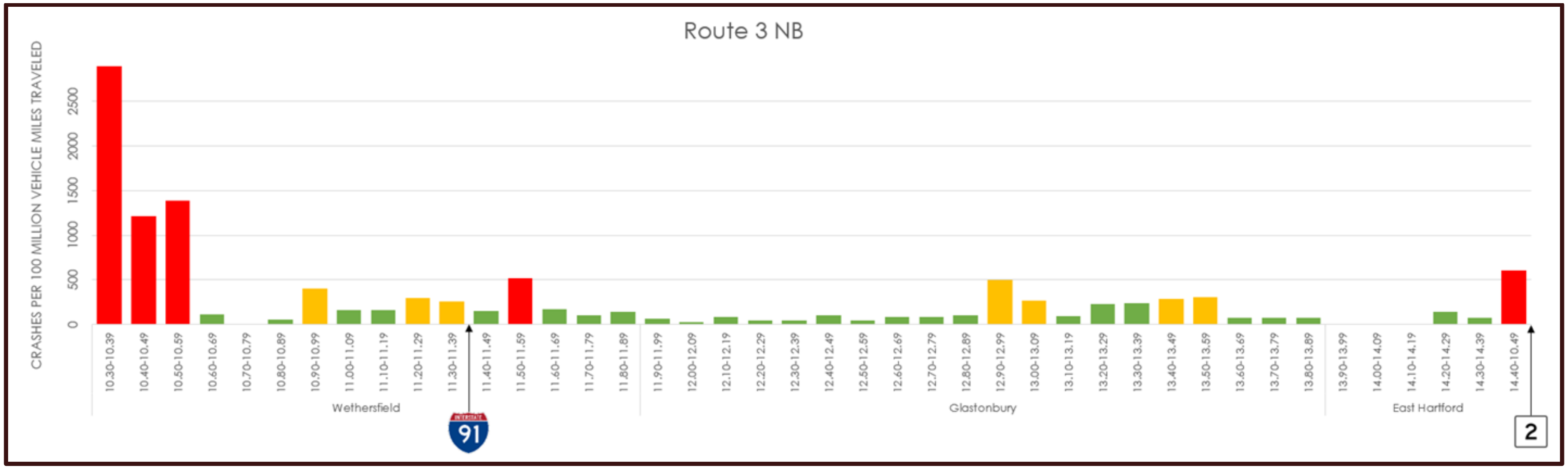

Figure 3-22: Route 3 Northbound Crash Rates

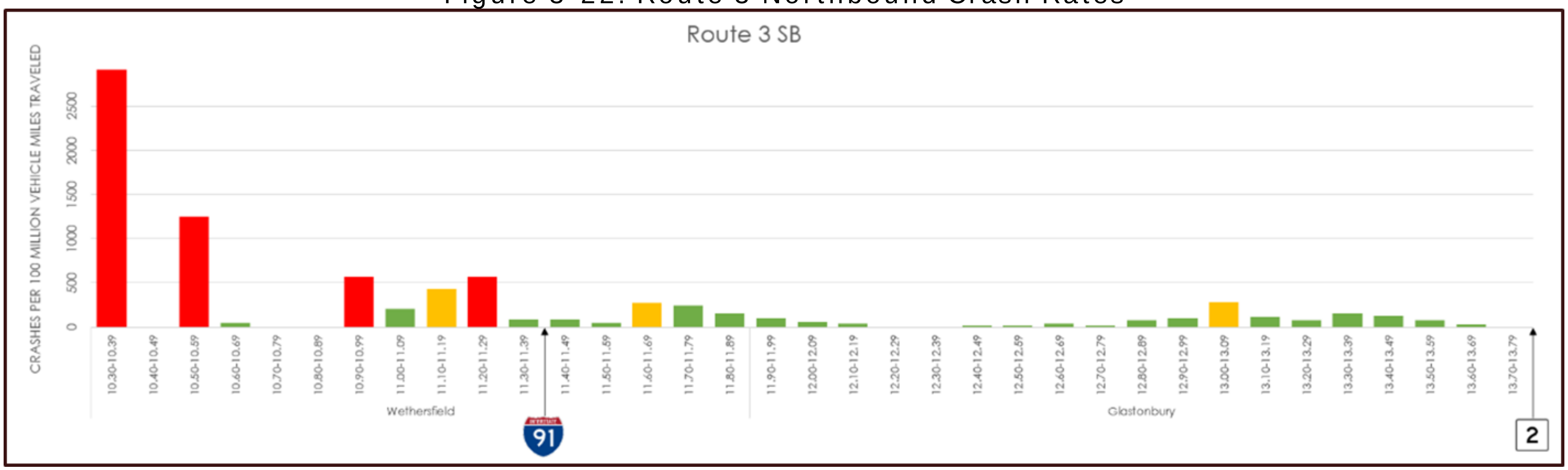

Figure 3-23: Route 3 Southbound Crash Rates

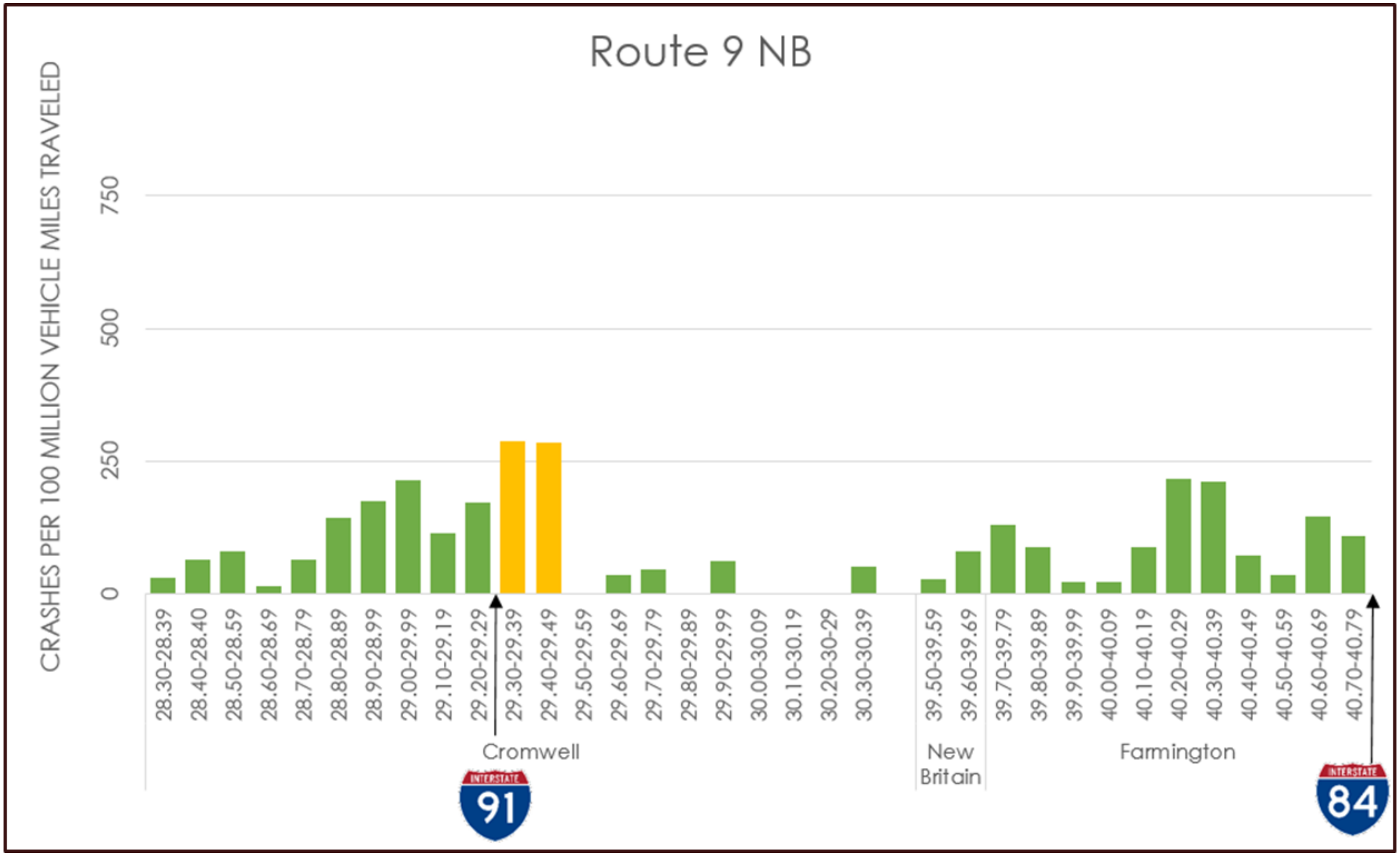

Figure 3-24: Route 9 Northbound Crash Rates

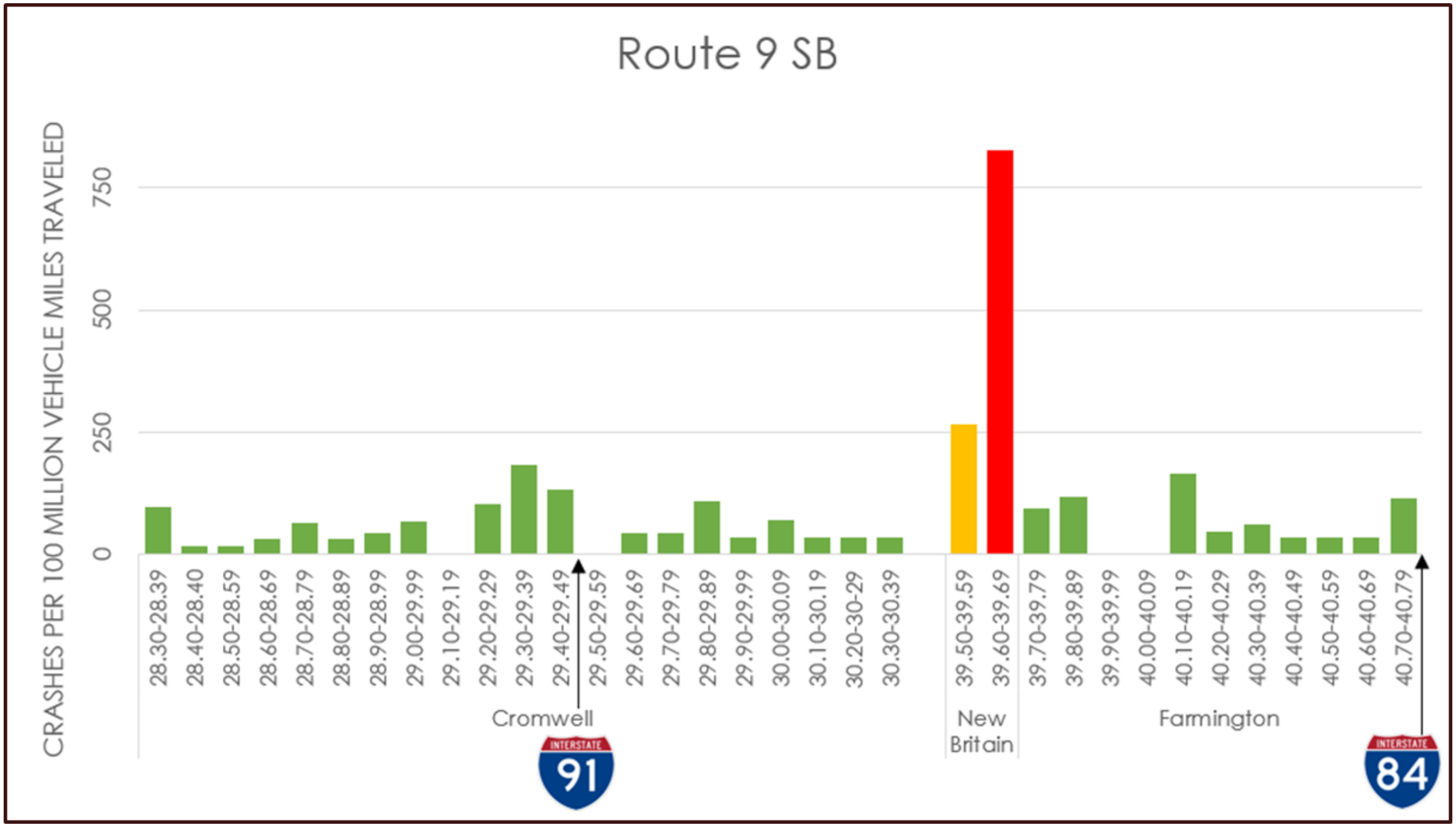

Figure 3-25: Route 9 Southbound Crash Rates

Crash data on Route 15 Southbound shows two locations with elevated crash rates (Figure 3-27). The first is at the I-91 interchange, where Route 15 is reduced from two lanes to one, with a lane dropping to Brainard Road. There is also a low-speed on-ramp from I-91 Northbound that enters in this area.

Farther south, the stop-controlled on-ramp from Route 99 is another high-crash location. Average speeds here are 50 to 60 mph and entering traffic must accelerate to this speed in a short distance.

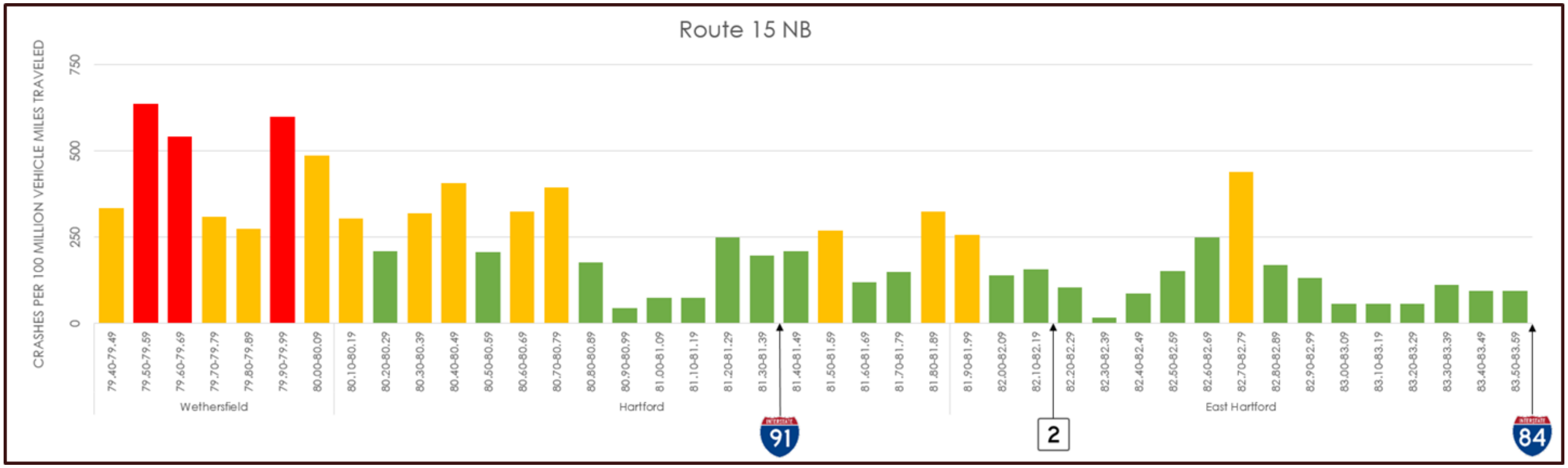

Figure 3-26: Route 15 Northbound Crash Rates

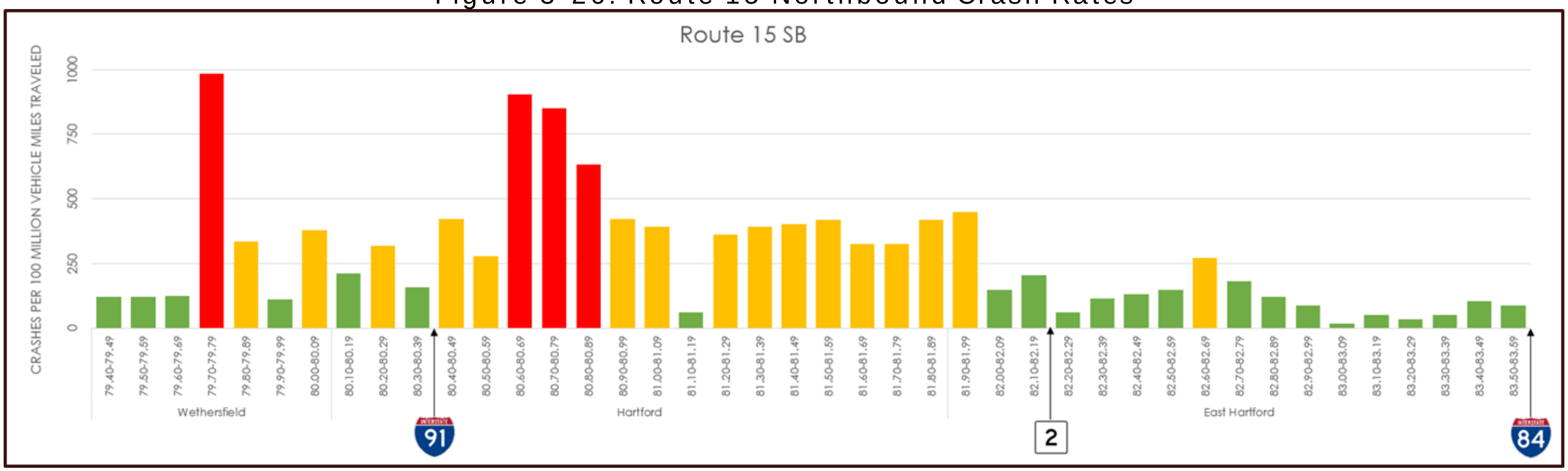

Figure 3-27: Route 15 Southbound Crash Rates

3.5 Bridge Structure Assessment – Priority Corridors

Due to the extensive area encompassed by the Greater Hartford Mobility Study limits, it was not practical to look at every bridge structure within this area. As a result, it was determined to just look at the bridges on the Priority Corridors. This includes all the bridges carrying or overpassing I-84, I-91 and Route 2 and their ramp systems at major interchanges within the study limits. In total, 240 bridges were assessed and documented utilizing the latest (2018 to 2020) bridge inspection reports.

3.5.1 General Description of Bridges

The majority of bridges within these priority corridors were constructed in the 1960's during the major expansion of the interstate and local highway system. They have all gone through one or more major rehabilitations during their 50 to 60 year life spans as is typical with these types of structures. At the time of construction, they were typically designed for a 50-year life span. The majority of these bridges can be classified as typical grade separation type structures, meaning they either carry the mainline highway over a local road or a local road is carried over the mainline highway on bridge structure. The exceptions are in the area of major interchanges where you can have longer multi-span bridges also referred to as viaduct structures. The crossing of I-84 over the Hartford Line rail corridor is another example of a very long multi-span structure required to separate the grades of these two shared corridor facilities.

A viaduct is an elevated bridge structure with multiple spans typically over land.

Typically, the highway bridges in the studied corridors have reinforced concrete bridge decks with multi steel stringer or girder superstructures simply supported on reinforced concrete piers and abutments. Almost all of the bridges have bituminous concrete overlay with membrane waterproofing, which were added during a bridge rehabilitation project. The old simply supported design of these bridges required deck joints at every substructure unit. It is important to note that these deck joints are located in the most vulnerable position on these bridges. Situated at surface level, these joints have been subjected to the impact and vibration of traffic and have been exposed not only to the effects of natural elements such as water, dirt and UV rays, but also to those of chemicals such as deicing salts and petroleum derivatives. All of the aforementioned external effects have contributed to deck joint leakages underneath these structures causing severe rust and section loss at steel beam ends. In addition to having deck joints at all substructure units, some of these bridges have other problematic details such as pin and hangers and steel pier caps, which also show severe rusting and section losses due to deck joint leakages.

The rehabilitation work that was completed on these grade separation structures over the years have generally consisted of deck repairs and patching, substructure repairs, addition of bituminous concrete wearing surface and membrane waterproofing, bearing repair or replacement, steel repairs primarily at beam ends, pin and hanger modifications, and structural steel painting. Many of these structures have undergone rehabilitation more than once to maintain their current fair condition.

There are several sections of the studied corridors that were reconstructed in the past as part of major highway improvement projects. As such, the bridges are newer as having been replaced during these projects. Some of the major highway projects are noted as follows:

- I-84/ I-91 Interchange Improvement Project – This project widened I-84 in downtown Hartford from High Street to the east through the I-91 Interchange and also made several ramp improvements This work was completed in the late 1980's to early 1990's. All impacted bridges were replaced to newer standards and all retaining walls were replaced in the trench section of I-84 in downtown Hartford.
- Widening and improvements to I-91 from the Hartford Interchange to Windsor Locks – This project occurred during the late 1980's to early 1990's and widened I-91 and added the HOV Lanes to I-91. Most of the bridges within this corridor were replaced during this project.
- Widening and improvements to I-84 in East Hartford and Manchester – This project was completed in the 1980's and resulted in many replaced bridges within this reach of highway. Of note is several of the replaced bridges were constructed of post-tensioned multi-span concrete boxes with integral concrete pier caps, a method not used much in Connecticut during that era.

Figure 3-28 through Figure 3-32 illustrate the location and identification numbers of the bridges in the study corridors. Table 3-7 through Table 3-9 show general information regarding the bridge location, year built and general description of each structure.

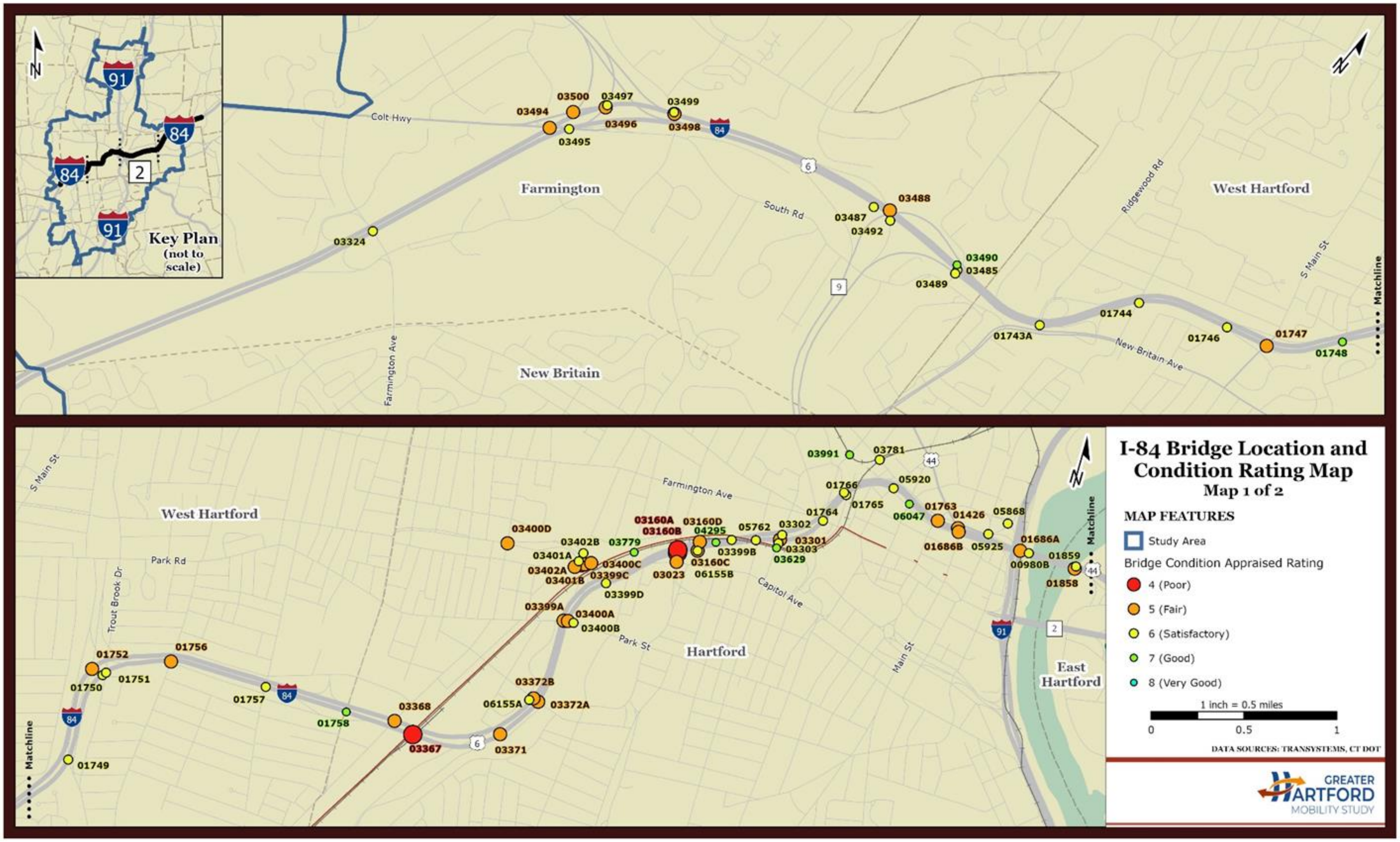

Figure 3-28: I-84 Map 1 Priority Bridge List Bridge Location / Number Data

Figure 3-29: I-84 Map 2 Priority Bridge List Bridge Location / Number Data

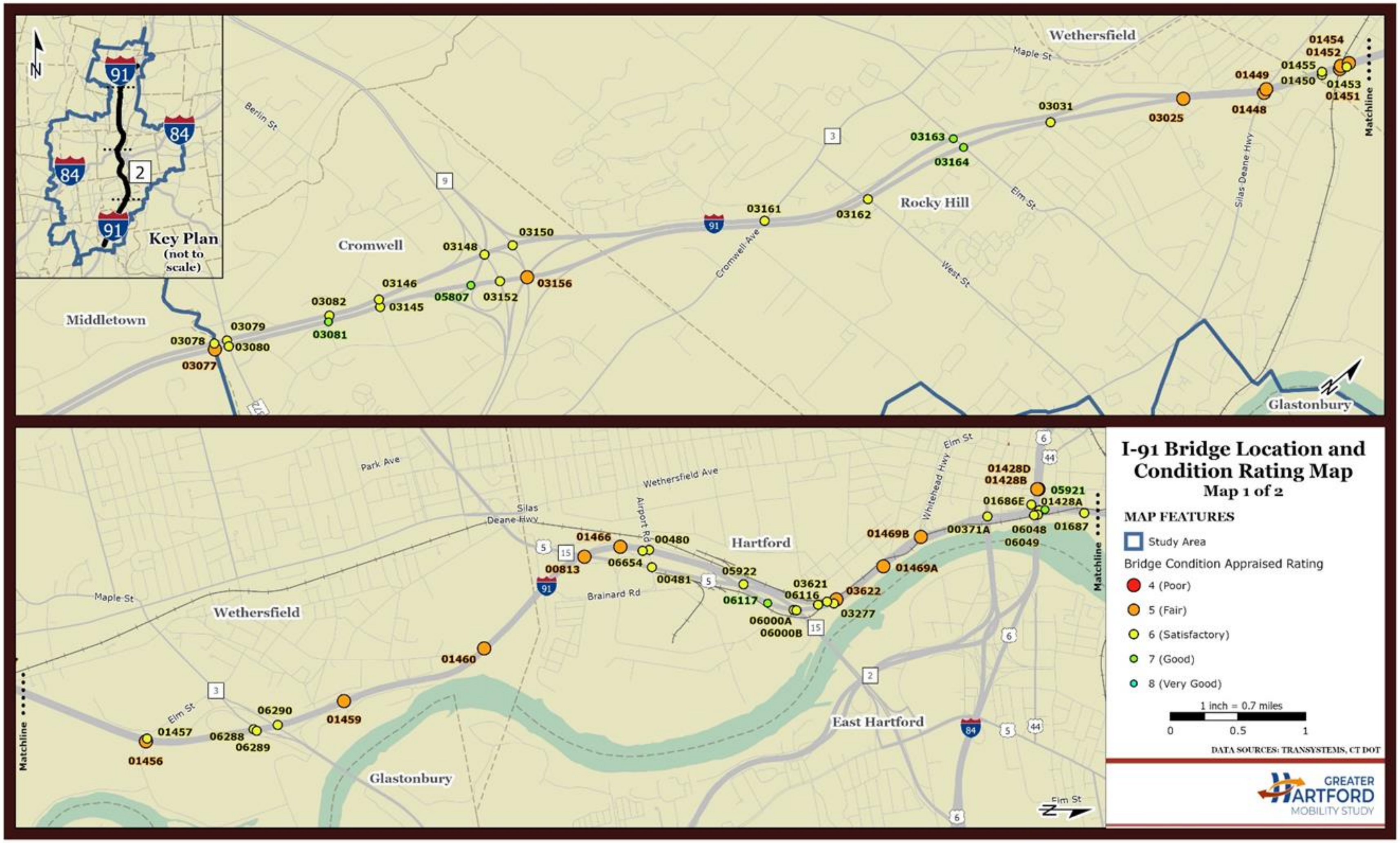

Figure 3-30: I-91 Map Priority Bridge List Bridge Location / Number Data

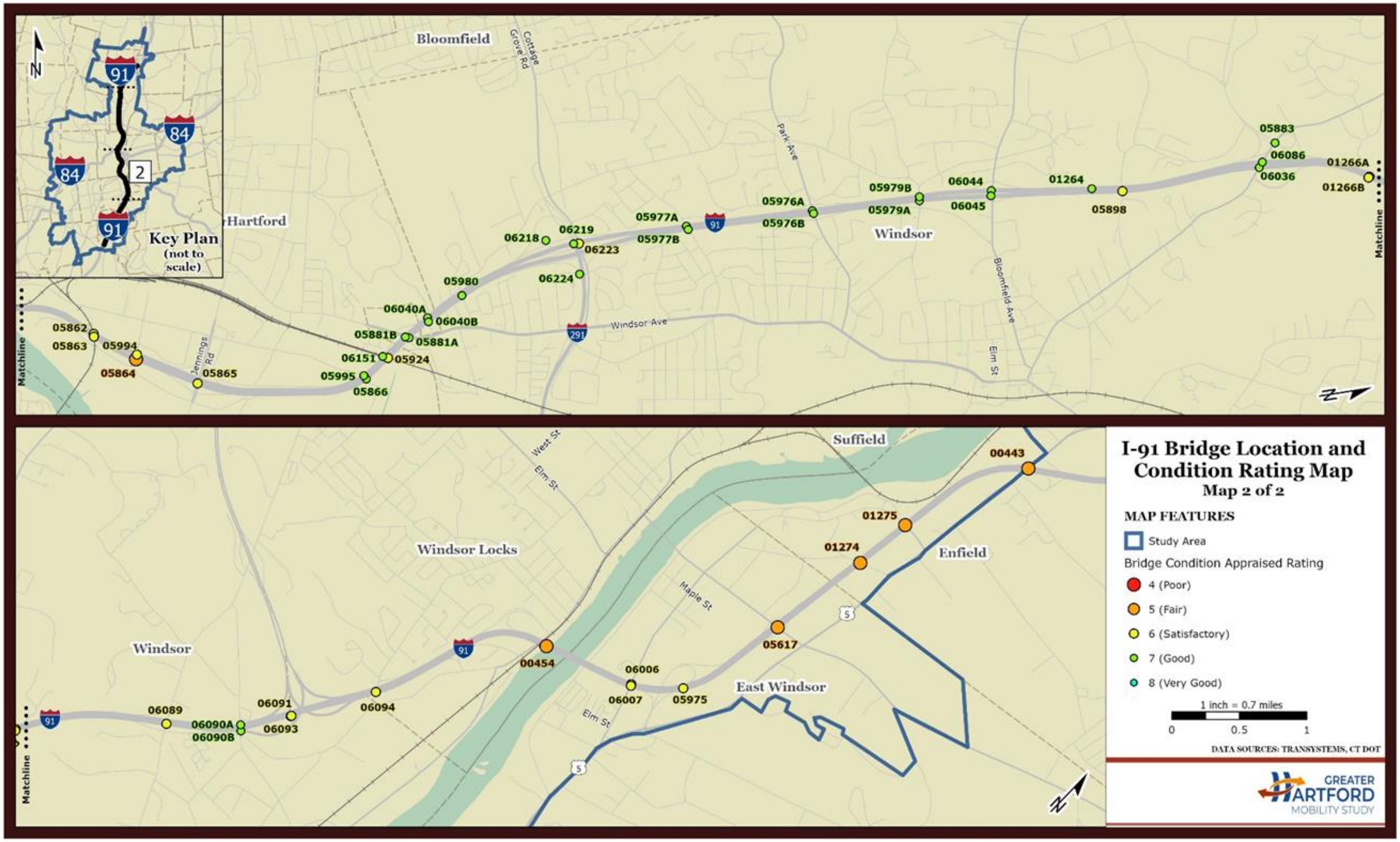

Figure 3-31: I-91 Map 2 Priority Bridge List Bridge Location / Number Data

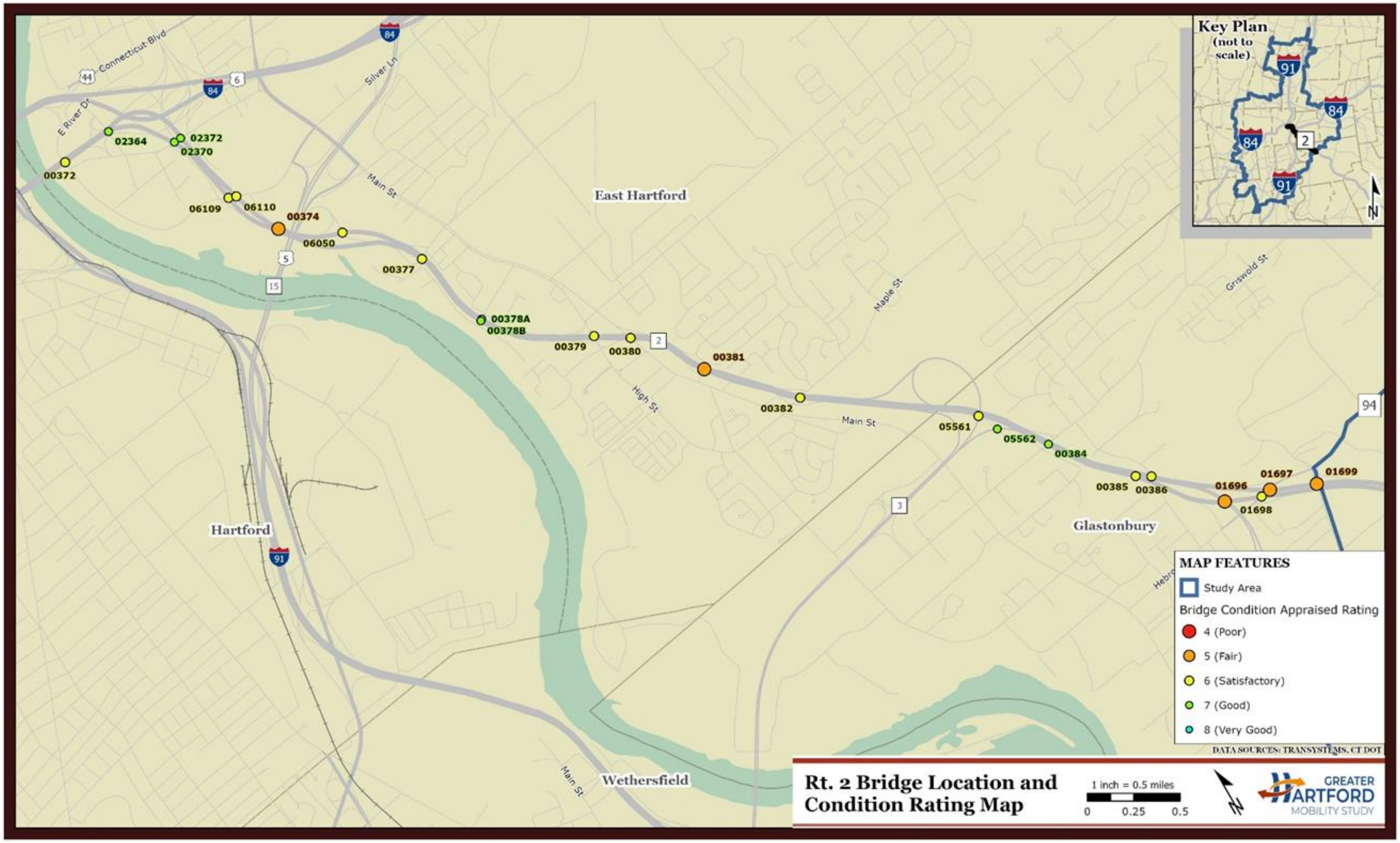

Figure 3-32: Route 2 Priority Bridge List Bridge Location / Number Data

Table 3-7: I-84 Priority Bridge List General Bridge Data

Town / City	Bridge No.	Year Built	Feature Carried / Crossed	General Desctiption
			I-84	
Farmington	03324	1967	Fienemann Road over I-84	2 Span Steel Stringer/Multi-beam or Girder
Farmington	03494	1969	I-84 WB over US RTE 6 EB & SR 531 WB	4 Span Steel Stringer/Multi-beam or Girder
Farmington	03495	1969	I-84 EB over US RTE 6 EB & SR 531 WB	4 Span Steel Stringer/Multi-beam or Girder
Farmington	03500	1966	I-84 TR 818 over SR 508 EB	3 Span Steel Stringer/Multi-beam or Girder
Farmington	03496	1969	I-84 WB over I-84 TR 818	3 Span Steel Stringer/Multi-beam or Girder
Farmington	03497	1969	I-84 WB over SR 508	3 Span Steel Stringer/Multi-beam or Girder
Farmington	03498	1969	SR 531 (South Road) over I-84 & SR 508	2 Span Steel Stringer/Multi-beam or Girder
Farmington	03499	1969	I-84 TR 817 over I-84 Ramp 207	3 Span Steel Stringer/Multi-beam or Girder
Farmington	03487	1969	Vacant Route 9 Ramp over I-84	5 Span Steel Stringer/Multi-beam or Girder
Farmington	03488	1969	RT 9 SB I-84 TR 820 over I-84	6 Span Steel Stringer/Multi-beam or Girder
Farmington	03492	1970	Vacant RTE 9 RAMP over I-84, I-84 TR 820,SR 506	7 Span Steel Stringer/Multi-beam or Girder
Farmington	03490	1966	I-84 TR 820 over Woodruff Road	3 Span Steel Stringer/Multi-beam or Girder
Farmington	03485	1969	I-84 EB over Woodruff Road	3 Span Steel Stringer/Multi-beam or Girder
Farmington	03489	1966	ROUTE 9 TR 806 over WOODRUFF ROAD	3 Span Steel Stringer/Multi-beam or Girder
West Hartford	01743A	1965	I-84 EB over SR 535 (Ridgewood Road)	2 Span Steel Stringer/Multi-beam or Girder
West Hartford	01744	1965	I-84 EB over Berkshire Road	3 Span Steel Stringer/Multi-beam or Girder
West Hartford	01746	1965	I-84 over Rockledge Brook	2 Span Concrete Continuous Culvert (includes frame culverts)
West Hartford	01747	1965	Route 173 over I-84	2 Span Steel Stringer/Multi-beam or Girder
West Hartford	01748	1965	Mayflower Street over I-84	2 Span Steel Stringer/Multi-beam or Girder
West Hartford	01749	1965	I-84 EB over I-84 WB Exit 42 Off Ramp	1 Span Steel Stringer/Multi-beam or Girder
West Hartford	01750	1965	I-84 Ramps 203, 204 over Trout Brook	2 Span Concrete Continuous Culvert (includes frame culverts)
West Hartford	01751	1965	I-84 EB over Trout Brook & Trout Brook Drive	5 Span Steel Stringer/Multi-beam or Girder
West Hartford	01752	1965	I-84 WB over SR 501 NB & I-84 TR 821	7 Span Steel Stringer/Multi-beam or Girder
West Hartford	01756	1965	South Quaker Lane over I-84	2 Span Steel Stringer/Multi-beam or Girder
West Hartford	01757	1965	Oakwood Avenue #2 over I-84	2 Span Steel Stringer/Multi-beam or Girder
West Hartford	01758	1965	Prospect Avenue over I-84	2 Span Steel Stringer/Multi-beam or Girder
Hartford	03368	1967	I-84 WB over New Park Avenue & AMTRAK	11 Span Steel Stringer/Multi-beam or Girder
Hartford	03367	1967	I-84 EB over New Park Avenue, AMTRAK, SR 504	18 Span Steel Stringer/Multi-beam or Girder
Hartford	03371	1967	I-84 EB over Olive Street (Abandoned)	3 Span Steel Stringer/Multi-beam or Girder
Hartford	06155A	1964	I-84, Amtrak, CTFastrak & Local over No. Branch of Park River	2 Span Culvert (includes frame culvert)
Hartford	03372A	1967	I-84 EB over Hamilton Street	3 Span Steel Stringer/Multi-beam or Girder
Hartford	03372B	1967	I-84 WB over Hamilton Street	3 Span Steel Stringer/Multi-beam or Girder
Hartford	03399A	1969	I-84 WB over Park Street	4 Span Steel Stringer/Multi-beam or Girder
Hartford	03400A	1969	I-84 EB over Park Street	3 Span Steel Stringer/Multi-beam or Girder
Hartford	03400B	1969	I-84 EB over Parking Lot	4 Span Steel Stringer/Multi-beam or Girder
Hartford	03400D	1969	I-84 TR 823 over Parking Lot	7 Span Steel Stringer/Multi-beam or Girder

Town / City	Bridge No.	Year Built	Feature Carried / Crossed	General Desctiption
			I-84	
Hartford	03402A	1969	SR 503 WB over Amtrak & Capitol Avenue	6 Span Steel Stringer/Multi-beam or Girder
Hartford	03401A	1969	SR 503 EB over Parking Lot	5 Span Steel Stringer/Multi-beam or Girder
Hartford	03401B	1969	SR 503 EB over I-84 & Amtrak & Local Roads	16 Span Steel Stringer/Multi-beam or Girder
Hartford	03402B	1969	SR 503 WB over Forest Street & Parking Lot	10 Span Steel Stringer/Multi-beam or Girder
Hartford	03399C	1966	I-84 TR 824 over Capitol Ave & Amtrak	14 Span Steel Stringer/Multi-beam or Girder
Hartford	03399D	1963	I-84 TR 824 over Capitol Ave & Amtrak	6 Span Steel Stringer/Multi-beam or Girder
Hartford	03400C	1969	I-84 TR 823 over I-84, 503, RR, Capitol Ave, Forest	15 Span Steel Stringer/Multi-beam or Girder
Hartford	03779	1962	Laurel Street over Amtrak, CNERR & CTFastrak	2 Span Steel Stringer/Multi-beam or Girder
Hartford	03023	1964	Sigourney Street over Capitol Ave & Amtrak	11 Span Steel Stringer/Multi-beam or Girder
Hartford	03160A	1965	I-84 EB over Amtrak; Local Roads; Parking	3 Span Steel Stringer/Multi-beam or Girder
Hartford	03160B	1965	I-84 WB over Amtrak; Local Roads; Parking	40 Span Steel Stringer/Multi-beam or Girder
Hartford	03160C	1965	I-84 Ramp 114 over Aetna Parking Lot	6 Span Steel Stringer/Multi-beam or Girder
Hartford	06155B	1964	I-84 Ramps & Local Roads over Park River Conduit	2 Span Culvert (includes frame culvert)
Hartford	03160D	1965	I-84 Ramp 115 over Aetna Parking Lot	4 Span Steel Stringer/Multi-beam or Girder
Hartford	04295	1979	I-84 EB On-Ramp 186 over I-84 WB Exit 48 On-Ramp	3 Span Steel Stringer/Multi-beam or Girder
Hartford	03399B	1969	I-84 WB over Parking Lot	4 Span Steel Stringer/Multi-beam or Girder
Hartford	05762	1987	I-84 Ramp 299 over I-84 Ramp I-91 & 06871T	5 Span Steel Stringer/Multi-beam or Girder
Hartford	03629	1975	Broad Street over Amtrak RR & Busway	3 Span Steel Stringer/Multi-beam or Girder
Hartford	03302	1966	Broad Street over I-84 WB & I-84 Ramp 191	1 Span Steel Stringer/Multi-beam or Girder
Hartford	03303	1966	I-84 Ramp 190 over Broad Street & Amtrak RR	15 Span Steel Stringer/Multi-beam or Girder
Hartford	03301	1966	I-84 EB over Broad Street, I-84 Ramp I-91	15 Span Steel Stringer/Multi-beam or Girder
Hartford	01764	1966	Asylum Street over I-84	1 Span Steel Stringer/Multi-beam or Girder
Hartford	01765	1966	I-84 EB over Amtrak RR & Local Roads	10 Span Steel Stringer/Multi-beam or Girder
Hartford	01766	1964	I-84 WB over Amtrak RR & Local Roads	6 Span Steel Stringer/Multi-beam or Girder
Hartford	03991	1912	Edwards Street over Central New England RR	1 Span Steel Stringer/Multi-beam or Girder
Hartford	03781	1907	Walnut Street over Amtrak & Central NE RR	1 Span Steel Stringer/Multi-beam or Girder
Hartford	05920	1988	High Street over I-84 & Ramps	2 Span Steel Stringer/Multi-beam or Girder
Hartford	06047	1991	Ann Uccelllo Street over I-84 & Ramps	2 Span Steel Stringer/Multi-beam or Girder
Hartford	01763	1964	Trumbull Street over I-84, TR 839 & TR 841	2 Span Steel Stringer/Multi-beam or Girder
Hartford	01426	1963	US RTE 44 & Main Street over I-84 & Morgan Street Ramp	2 Span Steel Stringer/Multi-beam or Girder
Hartford	01686B	1961	I-84 TR 825 over US RT 44 EB & Columbus Boulevard	8 Span Steel Stringer/Multi-beam or Girder
Hartford	05925	1990	I-84/I-91 TR 841/858 over US RTE 44 & Market Street	2 Span Steel Stringer/Multi-beam or Girder
Hartford	05868	1990	W-N Turning Rdwy over I-84/I-91 Ramps, CSO RR	9 Span Steel Box Beam or Girders - Single or Spread
Hartford	01686A	1961	I-84 over Market Street & I-91 NB	14 Span Steel Stringer Viaduct
Hartford	00980B	1964	I-84 TR 826 over Connecticut River	2 Span Steel Stringer/Multi-beam or Girder
East Hartford	01858	1964	I-84 EB over US Rte 44 EB	1 Span Steel Stringer/Multi-beam or Girder
East Hartford	01859	1964	I-84 WB over US Rte 44 EB	1 Span Steel Stringer/Multi-beam or Girder
East Hartford	02361	1964	I-84 EB & Ramp 196 over East River Drive	1 Span Steel Stringer/Multi-beam or Girder
East Hartford	02362	1964	I-84 WB & TR 827 over East River Drive	1 Span Steel Stringer/Multi-beam or Girder
East Hartford	02366	1964	Rte 2 WB & SR 500-806 over I-84 EB & TR 828	1 Span Steel Stringer/Multi-beam or Girder

Town / City	Bridge No.	Year Built	Feature Carried / Crossed	General Desctiption
			I-84	
East Hartford	02378	1964	I-84 830, SR 500-805 over I-84 EB & SR 500	1 Span Steel Stringer/Multi-beam or Girder
East Hartford	02367	1964	I-84 TR 829 over I-84 EB & I-84 TR 828	1 Span Steel Stringer/Multi-beam or Girder
East Hartford	02368C	1994	I-84 WB TR 827 over I-84, SR 500 and Ramps	10 Span Steel Box Beam or Girders - Single or Spread
East Hartford	02373	1964	SR 500 TR 801&802 over Pitkin Street	1 Span Steel Stringer/Multi-beam or Girder
East Hartford	02375	1964	SR 500 TR 801 over I-84 EB and I-84 TR 833	7 Span Steel Stringer/Multi-beam or Girder
East Hartford	02376	1964	I-84 TR 831 over I-84 EB	3 Span Steel Stringer/Multi-beam or Girder
East Hartford	02377	1964	SR 500 over I-84 WB and I-84 TR 10	3 Span Steel Stringer/Multi-beam or Girder
East Hartford	02380	1964	SR 500 TR 803 over SR 500 & TR 801, I-84 TR 831	4 Span Steel Stringer/Multi-beam or Girder
East Hartford	00818	1963	I-84 over Rte 5 & I-84 Ramp 116	2 Span Steel Stringer/Multi-beam or Girder
East Hartford	02381	1964	I-84 over Hockanum River	3 Span Concrete Continuous Culvert (includes rfame culverts)
East Hartford	05844B	1988	I-84 EB HOV Lane over Rte 15 & Silver Lane Off Ramp	12 Span Steel Stringer/Multi-beam or Girder
East Hartford	05844C	1988	I-84 WB HOV Lane over Rte 15	15 Span Steel Stringer/Multi-beam or Girder
East Hartford	05844D	1987	I-84 EB HOV & WB Ramp over I-84, Rte 15, Ramp A	5 Span Steel Stringer/Multi-beam or Girder
East Hartford	05843	1987	SR 518 - Roberts Street over I-84 and Exit 58 Ramps	4 Span Steel Stringer/Multi-beam or Girder
East Hartford	05555	1985	Simmons Road over I-84	2 Span Steel Box Beam or Girders - Single or Spread
East Hartford	05556	1985	Forbes Street over I-84	2 Span Steel Box Beam or Girders - Single or Spread
East Hartford	05685	1986	I-384 HOV over I-84 EB	3 Span Prestressed Concrete Continuous Box Beam or Girders - Multiple
East Hartford	05686	1986	I-384 WB over I-84	3 Span Prestressed Concrete Continuous Box Beam or Girders - Multiple
East Hartford	05557	1986	I-384 HOV Ramps over I-84 TR 836	1 Span Concrete Frame (except frame culverts)
Manchester	05581	1987	I-84 TR 836 & Bikeway over Hockanum River & Bikeway	3 Span Prestressed Concrete Continuous Stringer/Multi-beam or Girder
Manchester	05234	2017	I-84 Ramp 247 over Hockanum River	1 Span Prestressed Concrete Stringer/Multi-beam or Girder
Manchester	05687	1985	US Rte 44 over I-84 Ramps, Rte I-384 Ramp	4 Span Steel Box Beam or Girders - Single or Spread
Manchester	05845	1984	CD WB Roadway over I-84 Ramp J (Rte 44/I-84 WB)	3 Span Prestressed Concrete Continuous Box Beam or Girders - Multiple
Manchester	06283	1994	I-84 and I-84 Ramp 305	2 Span Steel Box Beam or Girders - Single or Spread
Manchester	06279	1993	I-291 EB over I-84 TR 836, I-84 RMP 304	2 Span Steel Box Beam or Girders - Single or Spread
Manchester	06282	1993	I-291 EB over I-84	2 Span Steel Box Beam or Girders - Single or Spread
Manchester	05846	1986	I-291 EB over I-84 Ramp 306	3 Span Prestressed Concrete Continuous Box Beam or Girders - Multiple
Manchester	05688	1984	Tolland Turnpike over I-84 & Ramps	4 Span Steel Box Beam or Girders - Multiple
Manchester	05441	1984	I-84 WB over Buckland Street	1 Span Steel Stringer/Multi-beam or Girder
Manchester	05442	1985	I-84 EB Off Ramp over Buckland Street	1 Span Steel Stringer/Multi-beam or Girder
Manchester	05440	1984	I-84 WB Off Ramp over Buckland Street	1 Span Steel Stringer/Multi-beam or Girder
Manchester	05443	1984	I-84 WB over Slater Street	1 Span Steel Stringer/Multi-beam or Girder
Manchester	05444	1984	I-84 EB over Slater Street	1 Span Steel Stringer/Multi-beam or Girder
Manchester	05226	1981	Route 30 over I-84 & I-84 Ramp 247	2 Span Steel Continuous Box Beam or Girders - Single or Spread
Manchester	05235	1981	I-84 Ramp 248 over Hockanum River	1 Span Prestressed Concrete Stringer/Multi-beam or Girder

Table 3-8: I-91 Priority Bridge List General Bridge Data

Town / City	Bridge No.	Year Built	Feature Carried / Crossed	General Desctiption
			I-91	
Middletown	03077	1965	I-91 NB over Mattabasset River	3 Span Steel Stringer/Multi-beam or Girder
Middletown	03078	1962	I-91 SB over Mattabasset River	1 Span Prestressed Concrete Box Beam or Girders - Multiple
Cromwell	03079	1965	I-91 SB over Route 372	1 Span Steel Stringer/Multi-beam or Girder
Cromwell	03080	1965	I-91 NB over Route 372	1 Span Steel Stringer/Multi-beam or Girder
Cromwell	03081	1965	I-91 NB over North Road	3 Span Steel Stringer/Multi-beam or Girder
Cromwell	03082	1965	I-91 SB over North Road	3 Span Steel Stringer/Multi-beam or Girder
Cromwell	03146	1965	I-91 SB over Evergreen Road	3 Span Steel Stringer/Multi-beam or Girder
Cromwell	03145	1965	I-91 NB over Evergreen Road	3 Span Steel Stringer/Multi-beam or Girder
Cromwell	05807	1988	I-91 NB TR 818 over I-91 NB	1 Span Steel Stringer/Multi-beam or Girder
Cromwell	03148	1965	I-91 SB over Route 9 SB & I-91 TR 818	3 Span Steel Stringer/Multi-beam or Girder
Cromwell	03152	1965	Route 9 SB over I-91 NB TR 818	3 Span Steel Stringer/Multi-beam or Girder
Cromwell	03150	1965	I-91 SB over Route 9 NB	3 Span Steel Stringer/Multi-beam or Girder
Cromwell	03156	1965	Route 9 NB & I-91 TR 821 over I-91 NB & I-91 TR 823	3 Span Steel Stringer/Multi-beam or Girder
Rocky Hill	03161	1965	Route 3 over I-91 & Dividend Brook	3 Span Steel Stringer/Multi-beam or Girder
Rocky Hill	03162	1965	SSR 411 (West Street) over I-91 & NB Ramp	5 Span Steel Stringer/Multi-beam or Girder
Rocky Hill	03163	2019	Route 160 over I-91 SB	1 Span Steel Stringer/Multi-beam or Girder
Rocky Hill	03164	2019	Route 160 over I-91 NB	1 Span Steel Stringer/Multi-beam or Girder
Rocky Hill	03031	1964	Gilbert Avenue over I-91	5 Span Steel Stringer/Multi-beam or Girder
Rocky Hill	03025	1964	Orchard Stret over I-91	2 Span Steel Stringer/Multi-beam or Girder
Rocky Hill	01449	1964	I-91 SB over Route 99	3 Span Steel Stringer/Multi-beam or Girder
Rocky Hill	01448	1964	I-91 NB over Route 99	3 Span Steel Stringer/Multi-beam or Girder
Wethersfield	01455	1964	I-91 over Beaver Brook	2 Span Concrete Continuous Culvert (includes frame culverts)
Wethersfield	01450	1964	I-91 over Goff Brook	2 Span Concrete Continuous Culvert (includes frame culverts)
Wethersfield	01451	1964	I-91 NB over Providence & Worcester RR	3 Span Steel Stringer/Multi-beam or Girder
Wethersfield	01452	1964	I-91 SB over Providence & Worcester RR	3 Span Steel Stringer/Multi-beam or Girder
Wethersfield	01453	1964	I-91 NB over Middletown Avenue	3 Span Steel Stringer/Multi-beam or Girder
Wethersfield	01454	1964	I-91 SB over Middletown Avenue	3 Span Steel Stringer/Multi-beam or Girder
Wethersfield	01457	1964	I-91 SB over Elm Street	3 Span Steel Stringer/Multi-beam or Girder
Wethersfield	01456	1964	I-91 NB over Elm Street	3 Span Steel Stringer/Multi-beam or Girder
Wethersfield	06288	1994	Route 3 NB over I-91 TR 802	1 Span Box Beam or Girders - Single or Spread
Wethersfield	06289	1994	Route 3 NB over I-91	1 Span Box Beam or Girders - Single or Spread
Wethersfield	06290	1994	Route 3 SB over I-91 & TR 804	3 Span Steel Box Beam or Girders - Single or Spread
Wethersfield	01459	1964	I-91 over Great Meadow Road	3 Span Steel Stringer/Multi-beam or Girder
Wethersfield	01460	1964	I-91 over Wethersfield Cove	3 Span Steel Stringer/Multi-beam or Girder

Town / City	Bridge No.	Year Built	Feature Carried / Crossed	General Desctiption
			I-91	
Hartford	00813	1964	I-91 over US Route 5 and Route 15	4 Span Steel Stringer/Multi-beam or Girder
Hartford	01466	1964	I-91 over I-91 TR 827	3 Span Steel Stringer/Multi-beam or Girder
Hartford	06654	1964	I-91 & SR 530 over Drainage	3 Span Concrete Culvert (includes frame culverts)
Hartford	00480	1964	I-91 over SR 530 (Airport Road)	1 Span Steel Stringer/Multi-beam or Girder
Hartford	00481	1964	SR 530-Airport Road over RTE 15	3 Span Steel Stringer/Multi-beam or Girder
Hartford	05922	1990	I-91 NB over US 5, RTE 15 & I-91 TR 861	2 Span Steel Stringer/Multi-beam or Girder
Hartford	06117	1991	I-91 NB over MDC Sewer Pipe	1 Span Steel Stringer/Multi-beam or Girder
Hartford	06000A	1991	Route 15 NB over I-91 NB, RTE 2, CT River, RR	15 Span Steel Stringer/Multi-beam or Girder
Hartford	06000B	1991	Route 15 SB over I-91 NB, RTE 2, CT River, RR	15 Span Steel Stringer/Multi-beam or Girder
Hartford	06116	1991	I-91 NB over CT Southern RR	1 Span Steel Box Beam or Girders - Single or Spread
Hartford	03621	1958	I-91 SB & I-91 TR 835 over Connectict SO. Rialroad	1 Span Concerte Frame (except frame culverts)
Hartford	03277	1958	I-91 over CT Southern Railroad	1 Span Cocnrete Frame (except frame culverts)
Hartford	03622	1958	I-91 SB & TR 835 over Connectict SO. Railroad	18 Span Steel Stringer/Multi-beam or Girder
Hartford	01469A	1964	I-91 NB over Park River & CSO RR	2 Span Steel Continuous Girder and Floorbeam System
Hartford	01469B	1964	I-91 SB over CSRR, SR 598WB & TR803	6 Span Steel Stringer/Multi-beam or Girder
Hartford	00371A	1958	RTE 2 over I-91 & Connecticut River CT SO. Railroad	6 Span Steel Stringer/Multi-beam or Girder
Hartford	01428D	1961	I-91 NB, US Rte 44 EB, RR, CT River	5 Span Steel Stringer/Multi-beam or Girder
Hartford	01428B	1961	I-91 TR 839 over I-91 - 153, I-84 - 825, US RTE 44 EB	11 Span Steel Stringer/Multi-beam or Girder
Hartford	01686E	1961	I-91 RP 153 over Parking Area	2 Span Steel Stringer/Multi-beam or Girder
Hartford	06049	1989	US Route 44 EB over I-91 NB, I-91 COL, SW Roadway	2 Span Steel Stringer/Multi-beam or Girder
Hartford	06048	1989	US Route 44 WB over I-91 NB, C-D Roadway & Ramp	2 Span Steel Stringer/Multi-beam or Girder
Hartford	01428A	1961	I-91 SB over Ramp D & F, I-84, US RTE 44	13 Span Steel Stringer/Multi-beam or Girder
Hartford	05921	1990	I-91 TR 841 over Ramp 186	1 Span Steel Stringer/Multi-beam or Girder
Hartford	01687	1950	I-91 & TR 841 over CT Southern Railroad	1 Span Cocnrete Frame (except frame culverts)
Hartford	05863	1990	I-91 NB over CT Southern Railroad	3 Span Steel Stringer/Multi-beam or Girder
Hartford	05862	1989	I-91 SB over Connecticut Southern Railroad	3 Span Steel Stringer/Multi-beam or Girder
Hartford	05994	1991	I-91 SB over Leibert Road	1 Span Prestressed Concrete Box Beam or Girders - Single or Spread
Hartford	05864	1991	I-91 NB over Leibert Road	1 Span Prestressed Concrete Box Beam or Girders - Single or Spread
Hartford	05865	1989	Jennings Road over I-91	2 Span Steel Continuous Box Beam or Girders - Single or Spread
Hartford	05995	1991	I-91 SB over Weston Street	1 Span Steel Stringer/Multi-beam or Girder
Hartford	05866	1990	I-91 NB over Weston Street	1 Span Steel Stringer/Multi-beam or Girder
Hartford	06151	1990	I-91 SB On Ramp over Amtrak Railroad	3 Span Steel Stringer/Multi-beam or Girder
Hartford	05924	1988	I-91 NB over AMTRAK Railroad	3 Span Steel Stringer/Multi-beam or Girder
Windsor	05881B	1991	I-91 SB over Route 159	1 Span Steel Stringer/Multi-beam or Girder
Windsor	05881A	1991	I-91 NB over Route 159	1 Span Steel Stringer/Multi-beam or Girder
Hartford	06040B	1988	I-91 NB over Keney Park Road & Meadow Brook	2 Span Steel Stringer/Multi-beam or Girder
Hartford	06040A	1991	I-91 SB over Keney Park Road & Meadow Brook	2 Span Steel Stringer/Multi-beam or Girder
Windsor	05980	1990	Bina Avenue or I-91 & HOV Lanes	2 Span Steel Continuous Box Beam or Girders - Single or Spread

Town / City	Bridge No.	Year Built	Feature Carried / Crossed	General Desctiption
			I-91	
Windsor	06218	1990	I-91 SB Ramp 204 over I-91 SB TR 855	1 Span Steel Box Beam or Girders - Single or Spread
Windsor	06224	1992	I-91 TR 860 over Briarwood Drive	1 Span Steel Stringer/Multi-beam or Girder
Windsor	06219	1992	I-91 TR 854 & 855 over I-291 Ramp 001	1 Span Steel Stringer/Multi-beam or Girder
Windsor	06223	1990	Route 218 over I-91 NB	1 Span Prestressed Concrete Frame (except frame culverts)
Windsor	05977A	1990	I-91 SB over Rood Avenue	1 Span Steel Stringer/Multi-beam or Girder
Windsor	05977B	1991	I-91 NB over Rood Avenue	1 Span Steel Stringer/Multi-beam or Girder
Windsor	05976B	1990	I-91 NB over RTE 178 (Park Avenue)	1 Span Steel Stringer/Multi-beam or Girder
Windsor	05976A	1991	I-91 SB over Route 178 (Park Avenue)	1 Span Steel Stringer/Multi-beam or Girder
Windsor	05979B	1991	I-91 SB over Capen Street	1 Span Steel Stringer/Multi-beam or Girder
Windsor	05979A	1990	I-91 NB over Capen Street	1 Span Steel Stringer/Multi-beam or Girder
Windsor	06045	1990	Route 305 over I-91 NB	1 Span Steel Stringer/Multi-beam or Girder
Windsor	06044	1990	Route 305 over I-91 SB	1 Span Steel Stringer/Multi-beam or Girder
Windsor	01264	1954	I-91 over Mill Brook	2 Span Concrete Continuous Culvert (includes frame culverts)
Windsor	05898	1989	Pigeon Hill Road over I-91	2 Span Steel Stringer/Multi-beam or Girder
Windsor	05883	1989	Day Hill Road WB over Route 75	2 Span Steel Stringer/Multi-beam or Girder
Windsor	06086	1991	I-91 SB over RTE 75 (Poquonock Avenue)	1 Span Steel Box Beam or Girders - Single or Spread
Windsor	06036	1991	I-91 NB over RTE 75 (Poquonock Avenue)	1 Span Steel Box Beam or Girders - Single or Spread
Windsor	01266B	1958	I-91 NB over Farmington River	5 Span Steel Stringer/Multi-beam or Girder
Windsor	01266A	1958	I-91 SB over Farmington River	5 Span Steel Stringer/Multi-beam or Girder
Windsor	06089	1992	Kennedy Road over I-91	2 Span Steel Stringer/Multi-beam or Girder
Windsor	06090B	1992	I-91 NB over Hayden Station Road	1 Span Steel Stringer/Multi-beam or Girder
Windsor	06090A	1992	I-91 SB over Hayden Station Road	1 Span Steel Stringer/Multi-beam or Girder
Windsor	06091	1992	Route 20 Westbound over I-91	5 Span Steel Stringer/Multi-beam or Girder
Windsor	06093	1992	I-91 NB over Route 20 Eastbound	1 Span Steel Stringer/Multi-beam or Girder
Windsor Locks	06094	1992	South Center Street over I-91	2 Span Steel Stringer/Multi-beam or Girder
Windsor Locks	00454	1959	I-91 over CT River, ,AMTRAK, RTE 159	8 Span Steel Stringer/Multi-beam or Girder
E Windsor	06006	1959	I-91 SB over SR 510 (Main Street)	3 Span Steel Stringer/Multi-beam or Girder
E Windsor	06007	1959	I-91 NB over SR 510 (Main Street)	3 Span Steel Stringer/Multi-beam or Girder
E Windsor	05975	1989	I-91 Ramps 101&103 over I-91	2 Span Steel Stringer/Multi-beam or Girder
E Windsor	05617	1959	I-91 over Route 140	3 Span Steel Stringer/Multi-beam or Girder
Enfield	01274	1959	Pleasant Road over I-91	4 Span Steel Stringer/Multi-beam or Girder
Enfield	01275	1959	SR 510 Depot HIll over I-91	4 Span Steel Stringer/Multi-beam or Girder
Enfield	00443	1959	US RTE 5-King Street over I-91	4 Span Steel Stringer/Multi-beam or Girder

Table 3-9: Route 2 Priority Bridge List General Bridge Data

Town / City	Bridge No.	Year Built	Feature Carried / Crossed	General Desctiption
			Route 2	
East Hartford	00372	1958	RTE 2 over East River Drive	1 Span Steel Stringer/Multi-beam or Girder
East Hartford	02364	1963	RTE 2 EB over Darlin Street	1 Span Steel Stringer/Multi-beam or Girder
East Hartford	02370	1964	RTE 2 Eastbound over Pitkin Street	1 Span Steel Stringer/Multi-beam or Girder
East Hartford	02372	1964	RTE 2 Westbound over Pitkin Street	1 Span Steel Stringer/Multi-beam or Girder
East Hartford	06109	1992	RTE 2 Westbound over East River Drive	1 Span Prestressed Concrete Box Beam or Girders - Multiple
East Hartford	06110	1992	RTE 2 Eastbound over East River Drive	1 Span Prestressed Concrete Box Beam or Girders - Multiple
East Hartford	00374	1962	RTE 2 over Hockanum River	5 Span Steel Stringer/Multi-beam or Girder
East Hartford	06050	1991	US RTE 5 TR 804 over Route 2 Westbound	1 Span Steel Box Beam or Girders - Single or Spread
East Hartford	00377	1962	RTE 2 over SR 516 - Willow Street Ext.	1 Span Steel Stringer/Multi-beam or Girder
East Hartford	00378A	1962	RTE 2 WB over Ensign Street	1 Span Steel Stringer/Multi-beam or Girder
East Hartford	00378B	1962	RTE 2 EB over Ensign Street	1 Span Steel Stringer/Multi-beam or Girder
East Hartford	00379	1962	RTE 2 over SR 517 SB	1 Span Prestressed Concrete Box Beam or Girders - Multiple
East Hartford	00380	1962	RTE 2 over Main Street	1 Span Steel Stringer/Multi-beam or Girder
East Hartford	00381	1951	RTE 2 over Sutton Avenue	1 Span Steel Stringer/Multi-beam or Girder
East Hartford	00382	1951	RTE 2 over Maple Street	1 Span Steel Stringer/Multi-beam or Girder
Glastonbury	05561	1987	Glastonbury RTE 3 over Route 2 & Ramp 080 EB	2 Span Steel Box Beam or Girders - Single or Spread
Glastonbury	05562	1987	RTE 3 TR 801 over RTE 2 Ramp 080	1 Span Steel Stringer/Multi-beam or Girder
Glastonbury	00384	1950	RTE 2 over Griswold Street	1 Span Steel Stringer/Multi-beam or Girder
Glastonbury	00385	1950	RTE 2 over Salmon Brook	2 Span Concrete Continuous Culvert (includes frame culverts)
Glastonbury	00386	1964	RTE 2 & RT 17 SB over House Street	1 Span Steel Stringer/Multi-beam or Girder
Glastonbury	01696	1964	RTE 2 EB over RTE 17	4 Span Steel Stringer/Multi-beam or Girder
Glastonbury	01698	1964	RTE 2 WB over RTE 94	1 Span Steel Stringer/Multi-beam or Girder
Glastonbury	01697	1964	RTE 2 EB over RTE 94	1 Span Steel Stringer/Multi-beam or Girder
Glastonbury	01699	1964	Oak Street over RTE 2	4 Span Steel Stringer/Multi-beam or Girder

3.6 Existing Structural Conditions and Overall Evaluations

In 1968 the Federal –Aid Highway Act directed the States to maintain an inventory of federal and highway bridges. According to National Bridge Inspection Standards (NBIS) today, condition ratings are used to describe an existing bridge compared with its condition if it was new. Each bridge component is assigned a condition rating based on inspection findings. These inspection ratings are based on the materials and physical condition of the deck, superstructure and the substructures. General condition ratings range from 0 (failed condition) to 9 (excellent). Bridge condition assessments are defined in Table 3-10, below.

In addition to the individual component ratings, an overall Structural Evaluation has been established for each bridge in NBIS. Structural Evaluation is an appraisal rating that describes an overall rating of the condition of the bridge structure. This is the summary of the separately rated conditions of the structural components of the bridge. This is the truest measure in the National Bridge Inventory (NBI) of the structural fitness of the bridge.

It should also be noted that the minimum threshold goal of the CTDOT is to maintain all bridge structures in a "State of Good Repair", which is defined as having a minimum structural condition rating of 5 (fair) or better.

Also noted for each bridge evaluated is whether or not the bridge is functionally obsolete. This is a parameter to assess if the bridges are up to current highway functional and safety standards. It has nothing to do with the actual structural material condition of the bridge. Reports indicate that a fairly high percentage of the bridges are functionally obsolete. This is largely due to lack of adequate shoulder width and substandard vertical clearances as compared to today's standards.

The term "section loss" is defined in the Bridge Inspector's Reference Manual (BIRM) Publication No. FHWA NHI 03-001 as the loss of a (bridge) members cross-sectional area usually by corrosion or decay. A "spall" is a depression in a concrete member resulting from the separation and removal of a volume of the surface concrete. Spalls can be caused by corroding reinforcement, friction from thermal movement, and overstress. The term "scour" refers to the erosion of streambed or bank material around bridge supports due to flowing water.

Table 3-11 through Table 3-13 below, shows Condition Ratings and Overall Evaluation for each bridge in the Priority Corridors within the GHMS limits.

Table 3-10: NBIS Condition Rating Scale

Code	Descriptions
9	Excellent Condition – No maintenance or rehabilitation concerns.
8	Very Good Condition – No maintenance or rehabilitation concerns. No problems noted.
7	Good Condition – Potential exist for minor maintenance. Some minor problems noted.
6	Satisfactory Condition – Potential exist for major maintenance. Structural elements shown minor deterioration.
5	Fair Condition – Potential exist for minor rehabilitation. All primary structural elements are sound but may have minor section loss*, cracking, spalling or scour.
4	Poor Condition – Potential exist for major rehabilitation. Advance section loss, deterioration, spalling, or scour.
3	Serious condition – Rehabilitation or repair required immediately. Loss of section, deterioration, spalling, or scour have seriously affected primary structural components. Local failures possible. Fatigue cracks in steel or shear cracks in concrete may be present.
2	Critical Condition – Need for immediate repairs or rehabilitation is urgent. Advance deterioration of primary structural elements. Fatigue cracks in steel or shear cracks in concrete may be present or scour may have removed substructure support. Unless closely monitored it may be necessary to close the bridge until corrective action is taken.
1	"Imminent" Failure Condition – Bridge is closed to traffic but corrective action may put back in light service. Major deterioration or section loss present in critical structural components or obvious vertical or horizontal movement affecting structure stability.
0	Failed Condition – Bridge is out of service and is beyond corrective action.

GREATER HARTFORD MOBILITY STUDY

Table 3-11: I-84 Priority Bridge List Conditions and Overall Evaluation

City / Town	Bridge No.	Feature Carried / Crossed	Year Inspected	# of Spans	Bridge Length (ft)	Deck Area (sq. ft.)	Condition Rating: Deck	Condition Rating: Superstructure	Condition Rating: Substructure	Condition Rating: Culvert	Overall Structural Evaluation	Sufficiency Rating	Functionally Obsolete	Planned or Recent Rehabilitation
				I-84										
Farmington	03324	Fienemann Road over I-84	2020	002	224	13776	6	6	6	N	6	74.2	N	
Farmington	03494	I-84 WB over US RTE 6 EB & SR 531 WB	2019	004	333	22477	6	5	6	N	5	77.0	N	
Farmington	03495	I-84 EB over US RTE 6 EB & SR 531 WB	2019	004	486	33777	5	6	6	N	6	84.4	N	2019
Farmington	03500	I-84 TR 818 over SR 508 EB	2020	003	230	7245	6	5	7	N	5	81.1	N	1990
Farmington	03496	I-84 WB over I-84 TR 818	2020	003	168	13020	6	5	6	N	5	71.7	N	
Farmington	03497	I-84 WB over SR 508	2020	003	199	11701	6	6	6	N	6	86.0	N	
Farmington	03498	SR 531 (South Road) over I-84 & SR 508	2020	002	355	17218	6	6	5	N	5	83.9	N	
Farmington	03499	I-84 TR 817 over I-84 Ramp 207	2019	003	232	7308	6	6	6	N	6	95.3	N	
Farmington	03487	Vacant Route 9 Ramp over I-84	2019	005	424	18444	6	6	6	N	6	90.0	Y	
Farmington	03488	RTE 9 SB I-84 TR 820 over I-84	2019	006	506	22011	6	6	5	N	5	84.3	N	
Farmington	03492	Vacant RTE 9 Ramp over I-84, I-84 TR 820, SR 506	2019	007	699	22018	7	6	6	N	6	93.0	Y	
Farmington	03490	I-84 TR 820 over Woodruff Road	2020	003	120	5220	7	7	7	N	7	91.0	N	
Farmington	03485	I-84 EB over Woodruff Road	2019	003	112	6227	6	6	6	N	6	81.5	N	
Farmington	03489	RTE 9 TR 806 over Woodruff Road	2020	003	142	7881	6	7	6	N	6	96.6	N	
West Hartford	01743A	I-84 EB over SR 535 (Ridgewood Road)	2019	002	152	10260	5	6	6	N	6	82.5	Y	
West Hartford	01744	I-84 EB over Berkshire Road	2018	003	151	9890	6	6	6	N	6	85.9	N	
West Hartford	01746	I-84 over Rockledge Brook	2019	002	32	8448	N	N	N	6	6	70.0	N	
West Hartford	01747	RTE 173 over I-84	2021	002	224	19645	6	5	6	N	5	81.0	Y	
West Hartford	01748	Mayflower Street over I-84	2019	002	260	13953	6	7	7	N	7	99.6	N	2017
West Hartford	01749	I-84 EB over I-84 WB Exit 42 Off Ramp	2019	001	96	6480	7	7	6	N	6	80.0	Y	1999
West Hartford	01750	I-84 Ramps 203, 204 over Trout Brook	2020	002	51	6225	N	N	N	6	6	96.7	N	
West Hartford	01751	I-84 EB over Trout Brook & Trout Brook Drive	2018	005	315	20947	6	6	6	N	6	88.6	N	
West Hartford	01752	I-84 WB over SR 501 NB & I-84 TR 821	2020	007	667	40354	5	5	6	N	5	75.5	Y	2002
West Hartford	01756	South Quaker Lane over I-84	2020	002	207	11115	5	5	6	N	5	73.1	Y	
West Hartford	01757	Oakwood Avenue #2 over I-84	2019	002	200	10740	7	7	6	N	6	94.6	Y	2013
West Hartford	01758	Prospect Avenue over I-84	2019	002	228	14250	7	7	7	N	7	75.8	Y	2015
Hartford	03368	I-84 WB over New Park Avenue & AMTRAK	2019	011	1043	57886	6	5	6	N	5	75.1	Y	1991
Hartford	03367	I-84 EB over New Park Avenue, AMTRAK, SR 504	2019	018	1852	102786	6	4	5	N	4	55.6	N	1991
Hartford	03371	I-84 EB over Olive Street (Abandoned)	2019	003	118	9381	6	5	6	N	5	79.6	N	
Hartford	06155A	I-84, Amtrak, CTFastrak & Local over No. Branch of Park River	2019	002	46	191268	N	N	N	6	6	85.0	N	1976
Hartford	03372A	I-84 EB over Hamilton Street	2019	003	121	9619	6	5	6	N	5	74.0	N	
Hartford	03372B	I-84 WB over Hamilton Street	2019	003	121	9377	6	5	6	N	5	74.0	N	
Hartford	03399A	I-84 WB over Park Street	2019	004	296	25130	6	5	6	N	5	78.9	N	
Hartford	03400A	I-84 EB over Park Street	2019	003	226	20254	5	5	7	N	5	60.5	N	
Hartford	03400B	I-84 EB over Parking Lot	2019	004	339	16136	6	6	6	N	6	69.5	N	
Hartford	03400D	I-84 TR 823 over Parking Lot	2020	007	599	16473	4	5	5	N	5	79.1	N	
Hartford	03402A	SR 503 WB over Amtrak & Capitol Avenue	2019	006	500	27075	5	5	6	N	5	78.2	Y	
Hartford	03401A	SR 503 EB over Parking Lot	2019	005	342	9405	5	6	6	N	6	94.0	Y	

							Condition Rating							
City / Town	Bridge No.	Feature Carried / Crossed	Year Inspected	# of Spans	Bridge Length (ft)	Deck Area (sq. ft.)	Deck	Superstructure	Substructure	Culvert	Overall Structural Evaluation	Sufficiency Rating	Functionally Obsolete	Planned or Recent Rehabilitation
				I-84										
Hartford	03401B	SR 503 EB over I-84 & Amtrak & Local Roads	2019	016	1337	56281	5	5	5	N	5	74.6	Y	2011
Hartford	03402B	SR 503 WB over Forest Street & Parking Lot	2019	010	756	20790	6	6	6	N	6	94.6	Y	1983
Hartford	03399C	I-84 TR 824 over Capitol Ave & Amtrak	2019	014	1187	54222	5	5	6	N	5	81.1	Y	
Hartford	03399D	I-84 TR 824 over Parking Lot	2019	006	458	12595	5	6	6	N	6	96.5	N	1983
Hartford	03400C	I-84 TR 823 over I-84, 503, RR, Capitol Ave, Forest	2019	015	1430	62908	5	6	5	N	5	81.4	Y	
Hartford	03779	Laurel Street over Amtrak, CNERR & CTFastrak	2019	002	59	4611	7	8	7	N	7	73.1	Y	1994
Hartford	03023	Sigourney Street over Capitol Ave & Amtrak	2019	011	654	70000	4	5	6	N	5	76.6	N	2007
Hartford	03160A	I-84 EB over Amtrak; Local Roads; Parking	2019	003	3252	236132	6	4	4	N	4	27.1	N	2009
Hartford	03160B	I-84 WB over Amtrak; Local Roads; Parking	2019	040	3177	209469	6	4	4	N	4	29.0	N	
Hartford	03160C	I-84 Ramp 114 over Aetna Parking Lot	2020	006	415	13860	6	6	5	N	5	81.1	N	
Hartford	06155B	I-84 Ramps & Local Roads over Park River Conduit	2019	002	74	528871	N	N	N	6	6	85.0	N	1976
Hartford	03160D	I-84 Ramp 115 over Aetna Parking Lot	2020	004	307	10910	6	5	5	N	5	86.0	N	
Hartford	04295	I-84 EB On-Ramp 186 over I-84 WB Exit 48 On-Ramp	2019	003	290	9232	6	7	7	N	7	90.0	Y	
Hartford	03399B	I-84 WB over Parking Lot	2019	004	296	14060	6	6	6	N	6	73.2	N	
Hartford	05762	I-84 Ramp 299 over I-84 Ramp I-91 & 06871T	2019	005	603	16824	7	7	6	N	6	92.4	Y	
Hartford	03629	Broad Street over Amtrak RR & Busway	2020	003	143	11297	7	7	7	N	7	92.4	Y	2013
Hartford	03302	Broad Street over I-84 WB & I-84 Ramp 191	2020	001	128	10560	6	6	6	N	6	88.1	Y	
Hartford	03303	I-84 Ramp 190 over Broad Street & Amtrak RR	2018	015	1131	39700	5	6	6	N	6	70.6	Y	1989
Hartford	03301	I-84 EB over Broad Street, I-84 Ramp I-91	2018	015	974	46265	6	5	5	N	5	58.5	N	
Hartford	01764	Asylum Street over I-84	2020	001	85	7692	7	6	6	N	6	82.1	Y	
Hartford	01765	I-84 EB over Amtrak RR & Local Roads	2020	010	1271	89605	5	6	6	N	6	65.6	N	1992
Hartford	01766	I-84 WB over Amtrak RR & Local Roads	2020	006	810	59670	5	6	7	N	6	77.6	Y	1992
Hartford	03991	Edwards Street over Central New England Railroad	2019	001	66	3979	7	7	7	N	7	93.6	Y	1995
Hartford	03781	Walnut Street over Amtrak & Central NE RR	2020	001	126	8064	6	7	6	N	6	74.6	Y	1994
Hartford	05920	High Street over I-84 & Ramps	2020	002	180	12510	6	7	6	N	6	76.3	Y	
Hartford	06047	Ann Uccelllo Street over I-84 & Ramps	2019	002	206	19879	7	7	7	N	7	93.5	N	
Hartford	01763	Trumbull Street over I-84, TR 839 & TR 841	2019	002	189	17483	6	5	6	N	5	58.2	Y	
Hartford	01426	US RTE 44 & Main Street over I-84 & Morgan Street Ramp	2019	002	205	22038	6	6	5	N	5	78.9	Y	1987
Hartford	01686B	I-84 TR 825 over US RTE 44 EB & Columbus Boulevard	2018	008	524	13452	4	5	5	N	5	69.6	N	
Hartford	05925	I-84/I-91 TR 841/858 over US RTE 44 & Market Street	2019	002	211	9242	7	6	6	N	6	92.0	Y	
Hartford	05868	W-N Turning Rdwy over I-84/I-91 Ramps, CSO RR	2020	009	223	58402	7	7	6	N	6	91.4	Y	
Hartford	01686A	I-84 over Market Street & I-91 NB	2020	014	870	74420	5	5	6	N	5	63.4	Y	1992
Hartford	00980B	I-84 TR 826 over Connecticut River	2020	002	263	6970	6	6	6	N	6	88.4	N	2020
East Hartford	01858	I-84 EB over US RTE 44 EB	2020	001	55	3113	6	5	6	N	5	79.0	N	
East Hartford	01859	I-84 WB over US RTE 44 EB	2020	001	59	3983	6	6	6	N	6	89.9	N	2000
East Hartford	02361	I-84 EB & Ramp 196 over East River Drive	2020	001	68	4454	7	6	7	N	6	85.6	N	
East Hartford	02362	I-84 WB & TR 827 over East River Drive	2020	001	126	9967	7	7	6	N	6	89.8	N	1996
East Hartford	02366	Rte 2 WB & SR 500-806 over I-84 EB & TR 828	2020	001	115	6133	8	8	8	N	8	95.4	Y	2019

City / Town	Bridge No.	Feature Carried / Crossed	Year Inspected	# of Spans	Bridge Length (ft)	Deck Area (sq. ft.)	Condition Rating				Overall Structural Evaluation	Sufficiency Rating	Functionally Obsolete	Planned or Recent Rehabilitation
							Deck	Superstructure	Substructure	Culvert				
				I-84										
East Hartford	02378	I-84 830, SR 500-805 over I-84 EB & SR 500	2019	001	73	4206	6	5	6	N	5	79.8	Y	
East Hartford	02367	I-84 TR 829 over I-84 EB & I-84 TR 828	2020	001	98	6501	8	8	8	N	8	95.2	N	2019
East Hartford	02368C	I-84 WB TR 827 over I-84, SR 500 and Ramps	2019	010	1592	47362	7	6	7	N	6	79.7	Y	
East Hartford	02373	SR 500 TR 801&802 over Pitkin Street	2019	001	76	4294	6	7	7	N	7	96.0	N	
East Hartford	02375	SR 500 TR 801 over I-84 EB and I-84 TR 833	2019	007	420	17997	8	8	7	N	7	95.5	Y	2017
East Hartford	02376	I-84 TR 831 over I-84 EB	2019	003	164	5163	7	8	7	N	7	92.3	Y	2017
East Hartford	02377	SR 500 over I-84 WB and I-84 TR 10	2019	003	146	10746	6	5	7	N	5	76.5	Y	
East Hartford	02380	SR 500 TR 803 over SR 500 & TR 801, I-84 TR 831	2019	004	461	14521	7	5	6	N	5	81.5	Y	1990
East Hartford	00818	I-84 over RTE 5 & I-84 Ramp 116	2019	002	190	33193	5	6	6	N	6	82.5	N	2004
East Hartford	02381	I-84 over Hockanum River	2020	003	64	13890	N	N	N	6	6	70.0	N	
East Hartford	05844B	I-84 EB HOV Lane over Rte 15 & Silver Lane Off Ramp	2018	012	1663	52947	7	6	6	N	6	91.0	N	
East Hartford	05844C	I-84 WB HOV Lane over Rte 15	2018	015	2047	65094	7	6	6	N	6	96.0	N	
East Hartford	05844D	I-84 EB HOV & WB Ramp over I-84, Rte 15, Ramp A	2018	005	803	62540	6	5	6	N	5	78.0	N	
East Hartford	05843	SR 518 - Roberts Street over I-84 and Exit 58 Ramps	2020	004	515	34917	6	6	7	N	6	93.5	Y	
East Hartford	05555	Simmons Road over I-84	2020	002	291	20225	7	6	6	N	6	80.5	Y	
East Hartford	05556	Forbes Street over I-84	2020	002	321	22310	6	6	7	N	6	93.6	Y	
East Hartford	05685	I-384 HOV over I-84 EB	2020	003	577	38855	6	5	6	N	5	84.0	N	
East Hartford	05686	I-384 WB over I-84	2020	003	770	47586	6	6	6	N	6	91.9	N	
East Hartford	05557	I-384 HOV Ramps over I-84 TR 836	2020	001	63	32763	N	6	7	N	6	83.0	N	
Manchester	05581	I-84 TR 836 & Bikeway over Hockanum River & Bikeway	2020	003	201	11397	7	6	7	N	6	90.8	N	
Manchester	05234	I-84 Ramp 247 over Hockanum River	2018	001	106	6943	8	8	8	N	8	96.8	N	
Manchester	05687	US RTE 44 over I-84 Ramps, Rte I-384 Ramp	2019	004	819	57945	6	6	7	N	6	91.9	N	
Manchester	05845	CD WB Roadway over I-84 Ramp J (Rte 44/I-84 WB)	2020	003	500	22900	6	5	7	N	5	83.5	N	
Manchester	06283	I-84 and I-84 Ramp 305	2020	002	606	26802	7	7	6	N	6	94.6	N	
Manchester	06279	I-291 EB over I-84 TR 836, I-84 RMP 304	2019	002	255	9651	7	7	7	N	7	91.8	N	
Manchester	06282	I-291 EB over I-84	2020	002	467	17690	7	7	7	N	7	95.7	N	
Manchester	05846	I-291 EB over I-84 Ramp 306	2020	003	375	17175	6	6	6	N	6	94.3	N	
Manchester	05688	Tolland Turnpike over I-84 & Ramps	2019	004	771	52813	7	6	6	N	6	78.0	N	
Manchester	05441	I-84 WB over Buckland Street	2019	001	151	14768	7	7	6	N	6	88.6	N	
Manchester	05442	I-84 EB Off Ramp over Buckland Street	2019	001	150	13823	7	6	7	N	6	94.0	N	
Manchester	05440	I-84 WB Off Ramp over Buckland Street	2019	001	150	6961	7	7	7	N	7	90.8	N	
Manchester	05443	I-84 WB over Slater Street	2019	001	140	12910	6	7	7	N	7	90.3	N	
Manchester	05444	I-84 EB over Slater Street	2019	001	141	12949	6	7	7	N	7	90.3	N	
Manchester	05226	Route 30 over I-84 & I-84 Ramp 247	2018	002	438	30003	7	6	6	N	6	64.0	N	
Manchester	05235	I-84 Ramp 248 over Hockanum River	2018	001	99	2780	7	6	7	N	6	94.9	N	

Table 3-12: I-91 Priority Bridge List Conditions Ratings and Overall Evaluation

City / Town	Bridge No.	Feature Carried / Crossed	Year Inspected	# of Spans	Bridge Length (ft)	Deck Area (sq. ft.)	Condition Rating: Deck	Condition Rating: Superstructure	Condition Rating: Substructure	Condition Rating: Culvert	Overall Structural Evaluation	Sufficiency Rating	Functionally Obsolete	Planned or Recent Rehabilitation
				I-91										
Middletown	03077	I-91 NB over Mattabasset River	2020	003	222	12325	7	5	7	N	5	79.7	N	1998
Middletown	03078	I-91 SB over Mattabasset River	2020	003	220	12214	6	6	6	N	6	88.8	N	1998
Cromwell	03079	I-91 SB over Route 372	2019	001	85	5567	6	6	6	N	6	85.2	Y	
Cromwell	03080	I-91 NB over Route 372	2019	001	84	5535	6	6	6	N	6	85.2	Y	
Cromwell	03081	I-91 NB over North Road	2020	011	130	57886	5	7	7	N	7	88.0	N	1991
Cromwell	03082	I-91 SB over North Road	2019	003	65	8117	5	6	6	N	6	89.0	N	1986
Cromwell	03146	I-91 SB over Evergreen Road	2020	003	127	7078	6	6	6	N	6	90.1	N	
Cromwell	03145	I-91 NB over Evergreen Road	2020	003	121	6716	5	6	6	N	6	89.0	N	
Cromwell	05807	I-91 NB TR 818 over I-91 NB	2020	001	175	6276	6	7	7	N	7	97.1	N	
Cromwell	03148	I-91 SB over Route 9 SB & I-91 TR 818	2018	003	237	159647	6	6	6	N	6	89.8	N	
Cromwell	03152	Route 9 SB over I-91 NB TR 818	2018	003	158	8714	7	6	7	N	6	93.6	N	
Cromwell	03150	I-91 SB over Route 9 NB	2019	003	165	9172	6	6	7	N	6	89.5	N	1996
Cromwell	03156	Route 9 NB & I-91 TR 821 over I-91 NB & I-91 TR 823	2018	003	305	14488	6	5	6	N	5	67.4	N	
Rocky Hill	03161	Route 3 over I-91 & Dividend Brook	2019	003	460	27907	6	6	7	N	6	79.4	N	1990
Rocky Hill	03162	SSR 411 (West Street) over I-91 & NB Ramp	2019	005	369	27195	6	6	6	N	6	93.2	N	1990
Rocky Hill	03163	Route 160 over I-91 SB	2020	001	140	5645	7	8	7	N	7	97.1	N	
Rocky Hill	03164	Route 160 over I-91 NB	2020	001	140	5645	7	8	7	N	7	96.1	N	
Rocky Hill	03031	Gilbert Avenue over I-91	2020	005	556	21962	5	6	7	N	6	91.0	N	1994
Rocky Hill	03025	Orchard Stret over I-91	2019	002	361	14259	6	5	6	N	5	79.2	Y	1992
Rocky Hill	01449	I-91 SB over Route 99	2019	003	217	17078	6	5	7	N	5	74.1	N	2000
Rocky Hill	01448	I-91 NB over Route 99	2019	003	200	15758	6	5	6	N	5	75.0	N	2000
Wethersfield	01455	I-91 over Beaver Brook	2017	002	25	6875	N	N	N	6	6	70.0	N	
Wethersfield	01450	I-91 over Goff Brook	2019	002	25	7420	N	N	N	6	6	70.0	N	
Wethersfield	01451	I-91 NB over Providence & Worcester Railroad	2019	003	134	9247	6	5	5	N	5	74.4	Y	
Wethersfield	01452	I-91 SB over Providence & Worcester Railroad	2019	003	136	9382	6	5	5	N	5	74.4	Y	
Wethersfield	01453	i-91 NB over Middletoen Avenue	2019	003	202	13877	6	6	6	N	6	89.0	N	
Wethersfield	01454	I-91 SB over Middletown Avenue	2019	003	192	13207	6	5	6	N	5	79.0	N	
Wethersfield	01457	I-91 SB over Elm Street	2020	003	103	7004	5	6	6	N	6	78.8	N	
Wethersfield	01456	I-91 NB over Elm Street	2020	003	113	7806	5	5	5	N	5	67.7	Y	
Wethersfield	06288	Route 3 NB over I-91 TR 802	2018	001	170	7445	7	7	6	N	6	96.6	N	
Wethersfield	06289	Route 3 NB over I-91	2019	002	423	30386	6	6	6	N	6	89.0	N	
Wethersfield	06290	Route 3 SB over I-91 & TR 804	2019	003	650	28492	7	7	6	N	6	92.2	N	
Wethersfield	01459	I-91 over Great Meadow Road	2019	003	106	13320	5	5	6	N	5	83.0	N	1995
Wethersfield	01460	I-91 over Wethersfield Cove	2018	003	338	39134	5	5	6	N	5	72.0	N	1997
Hartford	00813	I-91 over US RTE 5 and RTE 15	2019	004	87	38745	5	5	5	N	5	67.0	Y	
Hartford	01466	I-91 over I-91 TR 827	2020	003	174	20445	6	6	5	N	5	68.0	Y	
Hartford	06654	I-91 & SR 530 over Drainage	2020	003	23	12420	N	N	N	6	6	70.0	N	
Hartford	00480	I-91 over SR 530 (Airport Road)	2020	001	109	13771	6	6	6	N	6	79.0	Y	1995

City / Town	Bridge No.	Feature Carried / Crossed	Year Inspected	# of Spans	Bridge Length (ft)	Deck Area (sq. ft.)	Condition Rating: Deck	Condition Rating: Superstructure	Condition Rating: Substructure	Condition Rating: Culvert	Overall Structural Evaluation	Sufficiency Rating	Functionally Obsolete	Planned or Recent Rehabilitation
				I-91										
Hartford	00481	SR 530-Airport Road over RTE 15	2019	003	182	13923	6	6	6	N	6	89.3	Y	
Hartford	05922	I-91 NB over US 5, RTE 15 & I-91 TR 861	2019	002	483	28889	6	7	6	N	6	91.2	N	
Hartford	06117	I-91 NB over MDC Sewer Pipe	2020	002	220	19580	7	7	7	N	7	82.0	N	
Hartford	06000A	Route 15 NB over I-91 NB, RTE 2, Connecticut River, RR	2019	015	3372	256719	7	7	6	N	6	91.5	Y	
Hartford	06000B	Route 15 SB over I-91 NB, RTE 2, Connecticut River, RR	2019	015	3372	250091	6	7	6	N	6	89.9	Y	
Hartford	06116	I-91 NB over CSRR	2019	001	242	20328	7	7	6	N	6	89.8	N	
Hartford	03621	I-91 SB & I-91 TR 835 over CSRR	2019	001	65	5935	N	6	6	N	6	59.0	Y	
Hartford	03277	I-91 over CSRR	2019	001	78	8790	N	6	6	N	6	81.0	Y	
Hartford	03622	I-91 SB & TR 835 over CSRR	2019	018	150	9922	6	5	5	N	5	48.3	Y	1998
Hartford	01469A	I-91 NB over Park River & CSRR	2019	002	1350	64125	5	5	5	N	5	71.0	Y	2018
Hartford	01469B	I-91 SB over CSRR, SR 598WB & TR803	2019	006	1800	111575	4	5	5	N	5	54.7	N	2011
Hartford	00371A	RTE 2 over I-91 & Connecticut River, CSRR	2019	006	1175	127418	6	6	6	N	6	87.7	Y	1999
Hartford	01428D	I-91 NB, US RTE 44 EB, RR, Connecticut River	2018	005	408	12924	6	5	5	N	5	66.7	Y	1990
Hartford	01428B	I-91 TR 839 over I-91 - 153, I-84 - 825, US RTE 44 EB	2020	011	769	21147	7	5	7	N	5	79.9	Y	1991
Hartford	01686E	I-91 RP 153 over Parking Area	2021	004	289	10806	6	6	6	N	6	75.1	Y	1991
Hartford	06049	US Route 44 EB over I-91 NB, I-91 COL, SW Roadway	2019	002	132	5082	6	6	7	N	6	87.8	Y	
Hartford	06048	US Route 44 WB over I-91 NB, C-D Roadway & Ramp	2019	002	154	5364	7	6	6	N	6	87.8	Y	
Hartford	01428A	I-91 SB over Ramp D & F, I-84, US RTE 44	2019	013	951	40988	6	6	6	N	6	83.1	Y	1991
Hartford	05921	I-91 TR 841 over Ramp 186	2019	001	106	3583	7	7	7	N	7	95.0	N	
Hartford	01687	I-91 & TR 841 over CSRR	2019	001	40	25506	7	6	6	N	6	80.0	Y	1990
Hartford	05863	I-91 NB over CSRR	2021	003	201	14625	7	7	6	N	6	85.4	N	
Hartford	05862	I-91 SB over CSRR	2019	003	201	14628	6	7	6	N	6	90.8	N	
Hartford	05994	I-91 SB over Leibert Road	2020	001	140	10045	6	6	7	N	6	85.9	N	
Hartford	05864	I-91 NB over Leibert Road	2020	001	137	11465	6	5	6	N	5	72.9	N	
Hartford	05865	Jennings Road over I-91	2018	002	284	26862	6	6	7	N	6	98.9	N	
Hartford	05995	I-91 SB over Weston Street	2019	001	87	8918	7	7	7	N	7	86.8	N	
Hartford	05866	I-91 NB over Weston Street	2019	001	87	7801	7	7	7	N	7	98.0	N	
Hartford	06151	I-91 SB On Ramp over Amtrak Railroad	2019	003	150	4170	7	7	7	N	7	96.3	N	
Hartford	05924	I-91 NB over AMTRAK Railroad	2019	003	156	14451	6	7	6	N	6	86.7	N	
Windsor	05881B	I-91 SB over RTE 159	2020	001	163	12977	7	7	7	N	7	98.0	N	
Windsor	05881A	I-91 NB over RTE 159	2020	001	164	13067	7	7	7	N	7	90.3	N	
Hartford	06040B	I-91 NB over Keney Park Road & Meadow Brook	2019	002	222	20275	7	7	7	N	7	90.5	N	
Hartford	06040A	I-91 SB over Keney Park Road & Meadow Brook	2019	002	222	19000	7	7	7	N	7	90.5	N	
Windsor	05980	Bina Avenue or I-91 & HOV Lanes	2020	002	214	10058	7	7	7	N	7	87.9	Y	
Windsor	06218	I-91 SB Ramp 204 over I-91 SB TR 855	2020	001	176	4906	7	7	7	N	7	96.3	N	
Windsor	06224	I-91 TR 860 over Briarwood Drive	2020	001	113	3864	7	7	7	N	7	96.9	N	
Windsor	06219	I-91 TR 854 & 855 over I-291 Ramp 001	2020	001	127	10683	7	7	7	N	7	93.4	N	
Windsor	06223	Route 218 over I-91 NB	2020	001	135	10058	6	6	7	N	6	79.9	N	
Windsor	05977A	I-91 SB over Rood Avenue	2019	001	107	8517	6	7	7	N	7	86.3	N	
Windsor	05977B	I-91 NB over Rood Avenue	2019	001	107	9780	6	7	7	N	7	88.8	N	
Windsor	05976B	I-91 NB over RTE 178 (Park Avenue)	2019	001	126	10004	7	7	7	N	7	97.0	N	
Windsor	05976A	I-91 SB over RTE 178 (Park Avenue)	2019	001	126	10004	7	7	7	N	7	98.0	N	

City / Town	Bridge No.	Feature Carried / Crossed	Year Inspected	# of Spans	Bridge Length (ft)	Deck Area (sq. ft.)	Condition Rating					Sufficiency Rating	Functionally Obsolete	Planned or Recent Rehabilitation
							Deck	Superstructure	Substructure	Culvert	Overall Structural Evaluation			
		I-91												
Windsor	05979B	I-91 SB over Capen Street	2021	001	98	9286	7	7	7	N	7	89.9	N	
Windsor	05979A	I-91 NB over Capen Street	2019	001	98	8428	6	7	7	N	7	85.0	N	
Windsor	06045	RTE 305 over I-91 NB	2018	001	107	11074	7	7	7	N	7	85.8	Y	
Windsor	06044	RTE 305 over I-91 SB	2018	001	106	11013	7	7	7	N	7	74.2	Y	
Windsor	01264	I-91 over Mill Brook	2020	002	21	4046	N	N	N	7	7	70.0	N	1988
Windsor	05898	Pigeon Hill Road over I-91	2018	002	212	8204	7	6	7	N	6	77.0	Y	
Windsor	05883	Day Hill Road WB over RTE 75	2019	001	133	5293	7	7	7	N	7	94.4	Y	
Windsor	06086	I-91 SB over RTE 75 (Poquonock Avenue)	2020	001	186	14625	7	7	7	N	7	92.0	N	
Windsor	06036	I-91 NB over Route 75 (Poquonock Avenue)	2020	001	186	17261	7	7	7	N	7	92.0	N	
Windsor	01266B	I-91 NB over Farmington River	2019	005	504	36204	7	7	6	N	6	91.0	N	1992
Windsor	01266A	I-91 SB over Farmington River	2019	005	504	36204	6	7	6	N	6	91.0	N	1992
Windsor	06089	Kennedy Road over I-91	2018	002	203	15065	6	6	6	N	6	81.2	N	
Windsor	06090B	I-91 NB over Hayden Station Road	2020	001	117	13400	7	7	7	N	7	98.0	N	
Windsor	06090A	I-91 SB over Hayden Station Road	2020	001	117	11209	7	7	7	N	7	97.0	N	
Windsor	06091	Route 20 Westbound over I-91	2019	005	602	29980	7	7	6	N	6	92.5	N	
Windsor	06093	I-91 NB over RTE 20 Eastbound	2020	001	147	8825	7	6	6	N	6	85.0	N	
Windsor Locks	06094	South Center Street over I-91	2020	002	289	16631	7	6	6	N	6	98.5	N	
Windsor Locks	00454	I-91 over Connecticut River, AMTRAK, RTE 159	2019	008	1698	239207	6	5	6	N	5	70.0	Y	1991
East Windsor	06006	I-91 SB over SR 510 (Main Street)	2019	003	143	10146	7	6	6	N	6	89.2	N	1989
East Windsor	06007	I-91 NB over SR 510 (Main Street)	2019	003	143	10135	6	6	6	N	6	90.3	N	1989
East Windsor	05975	I-91 RAMPS 101 & 103 over I-91	2019	002	246	13505	7	6	7	N	6	94.8	N	
East Windsor	05617	I-91 over RTE 140	2020	003	139	16495	5	5	5	N	5	81.0	Y	1987
Enfield	01274	PLEASANT ROAD over INTERSTATE-91	2019	004	212	9065	6	5	6	N	5	77.0	Y	1995
Enfield	01275	SR 510 DEPOT HILL over INTERSTATE-91	2019	004	186	9430	6	5	6	N	5	81.5	Y	1990
Enfield	00443	US ROUTE 5-KING ST over INTERSTATE-91	2019	004	252	14490	7	5	6	N	5	80.6	Y	1992

Table 3-13: Route 2 Priority Bridge List Conditions Ratings and Overall Evaluation

City / Town	Bridge No.	Feature Carried / Crossed	Year Inspected	# of Spans	Bridge Length (ft)	Deck Area (sq. ft.)	Condition Rating				Overall Structural Evaluation	Sufficiency Rating	Functionally Obsolete	Planned or Recent Rehabilitation
							Deck	Superstructure	Substructure	Culvert				
Route 2														
East Hartford	00372	RTE 2 over East River Drive	2019	001	96	9965	6	7	6	N	6	83.6	Y	1997
East Hartford	02364	RTE 2 EB over Darlin Street	2019	001	57	1807	5	7	7	N	7	96.5	N	
East Hartford	02370	RTE 2 Eastbound over Pitkin Street	2019	001	65	2874	7	7	7	N	7	91.5	N	
East Hartford	02372	RTE 2 Westbound over Pitkin Street	2019	001	60	3120	5	7	7	N	7	90.4	N	
East Hartford	06109	RTE 2 Westbound over East River Drive	2019	001	159	11416	6	6	6	N	6	94.8	N	
East Hartford	06110	RTE 2 Eastbound over East River Drive	2019	001	150	10770	6	6	6	N	6	93.7	N	
East Hartford	00374	RTE 2 over Hockanum River	2019	005	444	51534	6	5	5	N	5	72.6	N	1996
East Hartford	06050	US RTE 5 TR 804 over Route 2 Westbound	2020	001	143	5155	7	7	6	N	6	97.8	N	
East Hartford	00377	RTE 2 over SR 516 - Willow Street Ext.	2020	001	69	6534	5	6	7	N	6	86.3	Y	
East Hartford	00378A	RTE 2 WB over Ensign Street	2020	001	58	2769	7	7	7	N	7	90.7	Y	1994
East Hartford	00378B	RTE 2 EB over Ensign Street	2020	001	58	2769	7	7	7	N	7	93.2	N	1993
East Hartford	00379	RTE 2 over SR 517 SB	2020	001	78	7230	7	7	6	N	6	92.2	N	1993
East Hartford	00380	RTE 2 over Main Street	2019	001	99	9900	7	6	7	N	6	91.5	N	1987
East Hartford	00381	RTE 2 over Sutton Avenue	2019	001	57	5078	5	6	7	N	5	74.1	N	
East Hartford	00382	RTE 2 over Maple Street	2019	001	77	6969	5	6	6	N	6	90.2	N	
Glastonbury	05561	Glastonbury RTE 3 over Route 2 & Ramp 080 EB	2019	002	278	18292	7	7	6	N	6	96.0	N	
Glastonbury	05562	RTE 3 TR 801 over Route 2 Ramp 080	2020	001	58	1844	7	7	7	N	7	94.9	N	
Glastonbury	00384	RTE 2 over Griswold Street	2019	001	52	4740	7	7	7	N	7	86.1	N	1988
Glastonbury	00385	RTE 2 over Salmon Brook	2019	002	33	9240	N	N	N	6	6	72.9	N	
Glastonbury	00386	RTE 2 & RT 17 SB over House Street	2019	001	73	11964	6	6	6	N	6	89.3	N	1986
Glastonbury	01696	RTE 2 EB over RTE 17	2020	004	278	12093	6	5	7	N	5	84.5	N	
Glastonbury	01698	RTE 2 WB over RTE 94	2019	001	96	4176	7	6	6	N	6	91.9	Y	
Glastonbury	01697	RTE 2 EB over RTE 94	2019	001	113	4915	7	5	6	N	5	80.4	Y	
Glastonbury	01699	Oak Street over RTE 2	2019	004	269	14459	6	5	6	N	5	64.0	Y	

The overall results of each corridor can be summarized as follows:

I-84 Corridor

Total Bridges Studied – 111
Functionally Obsolete – 42 Total (38%)

Overall Structural Evaluation

4 (poor) – 2% of bridges
5 (fair) – 31% of bridges
6 (satisfactory) – 49% of bridges
7 (good) – 15% of bridges
8 (very good) – 3% of bridges

I-91 Corridor

Total Bridges Studied – 105
Functionally Obsolete – 39 Total (32%)

Overall Structural Evaluation

4 (poor) – 0% of bridges
5 (fair) -23% of bridges
6 (satisfactory) – 47% of bridges
7 (good) – 30% of bridges
8 (very good) – 0% of bridges

Route 2 Corridor

Total Bridges Studied – 24
Functionally Obsolete – 8 Total (25%)

Overall Structural Evaluation

4 (Poor) – 0% of bridges
5 (fair) – 21%
6 (satisfactory) – 50%
7 (good) – 29%
8 (very good) – 0%

3.7 Existing Conditions Highway Assessment – Key Takeaways

- Although there were several locations with stopping sight distance deficiencies, the impact to mobility is likely minimal unless they can be attributed to a higher than average crash rate, which causes non-recurring delay.

- Many locations, such as Eastbound Route 2 sections, show a direct correlation between higher crash rates and geometric deficiencies.

- The section of I-84 between Interchange 41 (South Main Street) and the Bulkeley Bridge has extremely complex geometry, including several compound curves, 'broken-back' curves, and reverse curves with short tangents. The interchange frequency and inconsistent configurations make this section of I-84 the most challenging stretch of highway within the study area for motorists to traverse. Combining these two deficiencies with the highest vehicular volumes in the State leads to higher than average crash rates and vehicular delay.

- The deficient horizontal curve on I-91 southbound just north of the Charter Oak Bridge (U.S Route 5) is likely the cause of higher than average crash rates and should be studied for potential solutions.

- All of the original bridges remaining along the priority corridors are now 50 to 60 years old and have outlived their original design life of 50-years. Many of these structures have been rehabilitated more than once and will require additional rehabilitation to maintain a "state of good repair", as defined by a condition rating of 5 (fair) or better.

- For the bridges studied in the priority corridors 26% of them have an overall condition rating of 5 (fair), 48% have a rating of 6 (satisfactory) and 23% have a rating of 7 (good). The higher condition rated bridges are generally the structures that were replaced during latter highway modification projects.

- 37% of the bridges are noted as functionally obsolete. They essentially don't comply with the latest geometric and safety standards.

4 Bus Transit

4.1 Mobility

4.1.1 Purpose

The purpose of this analysis is to review CT*transit* route data with population and employment data to determine areas of high transit need. Maintaining connectivity between population centers and employment centers is critical to providing mobility in the region. Insight into key origins and destinations for commuters can inform planning decisions leading to a more effective transit system serving greater demand.

4.1.2 Data Sources

General transit feed specification (GTFS) data was provided by CT*transit* Hartford Division. This dataset includes information on the agency, routes, trips, stop times, stops, date, and day of the week (to determine service patterns).

> *GTFS is a common format for public transportation schedules and combines the schedule with geographic information about the transportation network.*

Demographic data was collected from the US Census Bureau American Community Survey for population and employment data, using the 2019 5-year estimates. Employment data was downloaded from the 2018 Longitudinal Employer-Household Dynamics Origin-Destination Employment Statistics data set. CRCOG's Comprehensive Service Analysis project's data was used to identify neighborhoods that were shown to exhibit high transit potential and/or high transit need.

4.1.3 Methodology

The demographic and employment data were reviewed and assessed to determine areas of transit need and key employment hubs. The areas of need were based on four indicators associated with transit need:

- People below poverty line
- Zero car households
- Population above 65
- Population under 18

These indicators were used to calculate a Transit Dependency Index (TDI) using the following formula:

> *TDI = Population Density x (% housing units without a vehicle + % senior citizens + % children ages 18 and under + % individuals below poverty).*

The TDI was then mapped by census tract in ArcGIS to identify the top six areas for transit need to align with the six employment hubs.

Employment data was aggregated from census block level data to census tracts. This data was also mapped using ArcGIS to identify the six key employment hubs.

The CT*transit* Hartford Division bus GTFS data combined with population data was used to assess the number and locations of residents by ten-minute increments of transit travel time to key employment destinations in the region. Travel times were derived from GTFS data from weekdays at 8 a.m. (sampled on Monday, March 23, 2020). Using the same bus network with employment data, a review and assessment of the number and locations of jobs by ten-minute increments of travel from selected neighborhoods that were shown to exhibit high transit potential and/or high transit need in CRCOG's Comprehensive Service Analysis project.

4.1.4 Analysis

As shown in Figure 4.1, the employment analysis determined six employment hubs:

1. Downtown Hartford
2. East Hartford
3. Northwest Windsor
4. East Farmington
5. Northwest Manchester
6. Glastonbury

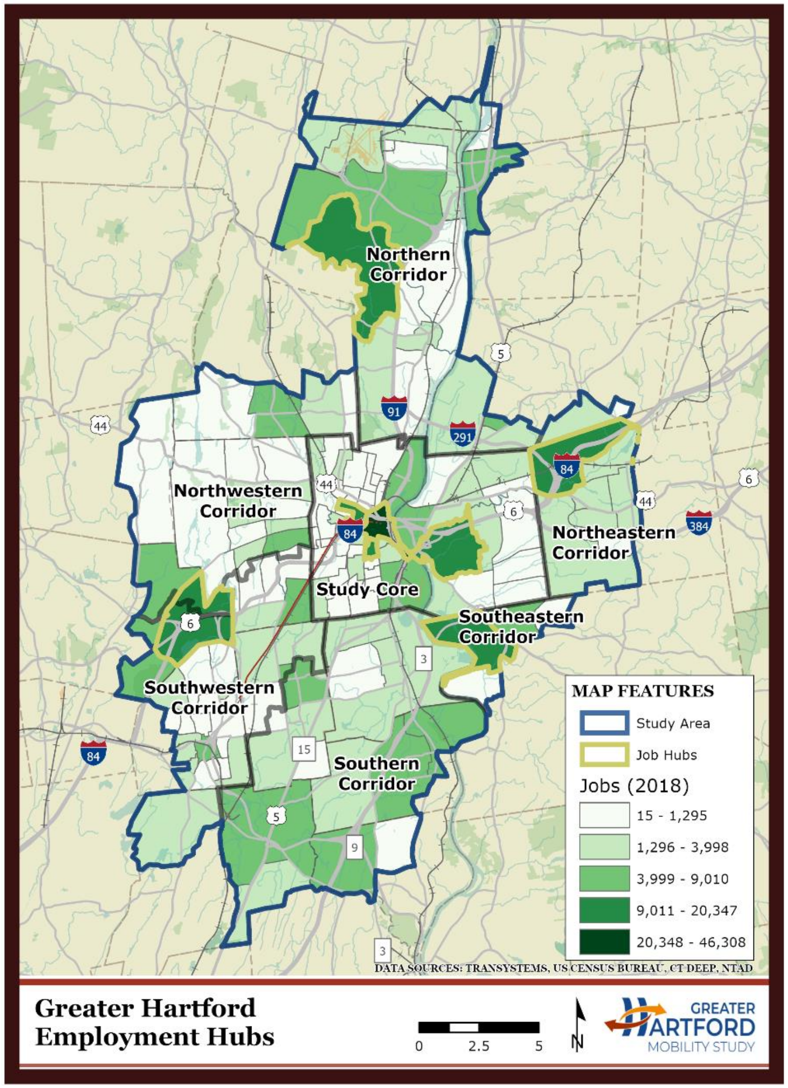

Figure 4.1: Greater Hartford Employment Hubs

As shown in Table 4-1, Downtown Hartford is by far the biggest employment hub with 18% of the jobs in Greater Hartford. The second and third employment centers, Northwest Windsor and East Farmington, are much smaller at 4% each of the region's jobs.

Table 4-1: Greater Hartford Employment Hubs

Employment 2018			
Location		Jobs	
Hub	Districts	Total	Percent
1	Downtown Hartford	79,112	18%
2	East Hartford	12,386	3%
3	Northwest Windsor	16,809	4%
4	East Farmington	16,419	4%
5	Northwest Manchester	10,797	2%
6	Glastonbury	11,008	2%

Demographic analysis calculated the TDI (Figure 4.2), which determined six areas of transit need:

1. Hartford North
2. Hartford West
3. Hartford South
4. East Hartford
5. Central Manchester
6. Central New Britain

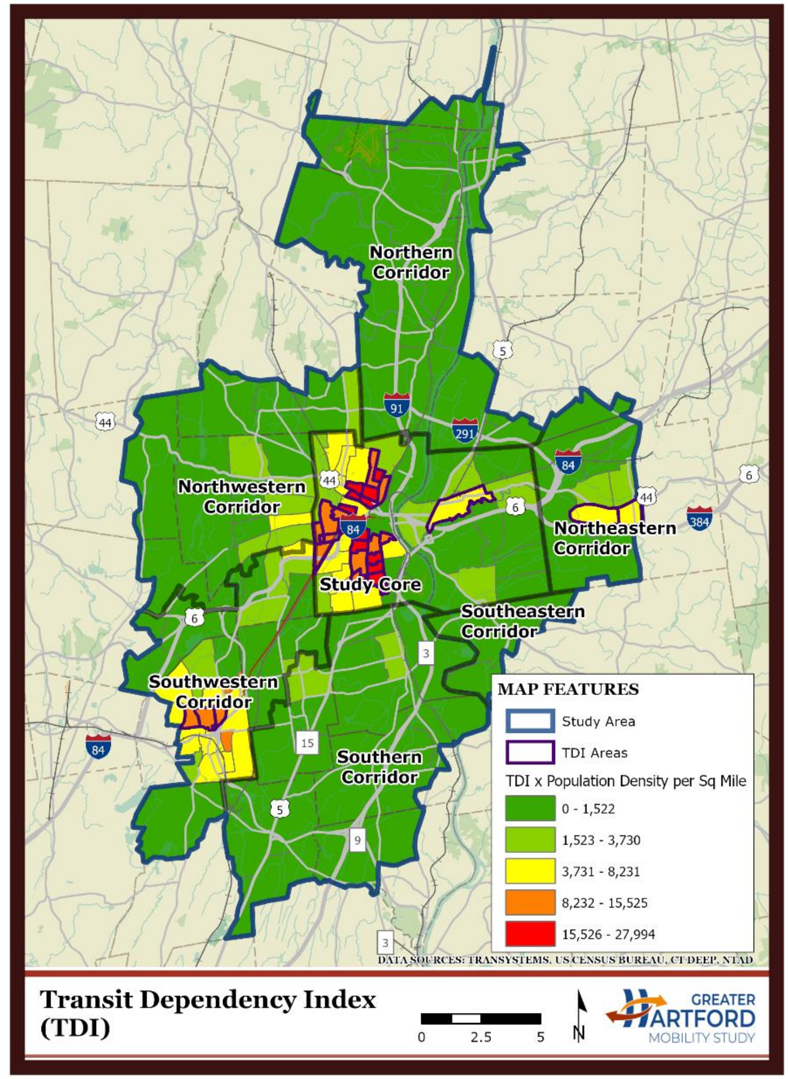

Figure 4.2: Greater Hartford Transit Dependency Index and Areas of Transit Need

As shown in Table 4-2, TDI area 3 has the largest population in need of transit followed by TDI area 2.

Table 4-2: Transit Need Locations

Transit Dependency Index			
Location		Population	
TDI	Districts	Total	Percent
1	Hartford North	15,619	17%
2	Hartford West	19,368	20%
3	Hartford South	30,898	33%
4	East Hartford	6,556	7%
5	Central Manchester	9,732	10%
6	Central New Britain	12,463	13%

Isochrone maps identified the population within 10-minute travel time increments (via bus or walking) of the six major employment hubs as shown in Table 4-3.

An isochrone map illustrates areas that can be reached from a common point within a defined range of time.

Table 4-3: Population within 10-minute Increments Transit Travel Time of Employment Hubs

GHMS Isochrone Analysis: Employment HUBs to Population 2020							
Location		Travel Time (minutes)					
Hub	District	10	20	30	40	50	60
1	Downtown Hartford	3,083	85,519	213,616	353,712	479,850	542,527
2	East Hartford	2,815	19,829	48,180	118,862	248,664	395,426
3	Northwest Windsor	1,532	9,236	37,806	105,736	116,580	121,330
4	East Farmington	205	8,351	48,387	110,407	116,872	116,917
5	Northwest Manchester	619	16,317	39,512	75,569	117,477	196,533
6	Glastonbury	1,356	16,935	44,179	118,893	243,952	368,282
	All	9,588	136,067	296,698	432,261	514,411	555,083

Figure 4.3 shows Employment Hub 1/Downtown Harford's high potential for transit to serve areas in need with TDI areas 1, 2, 3, and 4 all within its 30-minute isochrone network. All six areas of transit need are within Downtown Hartford's 60-minute isochrone.

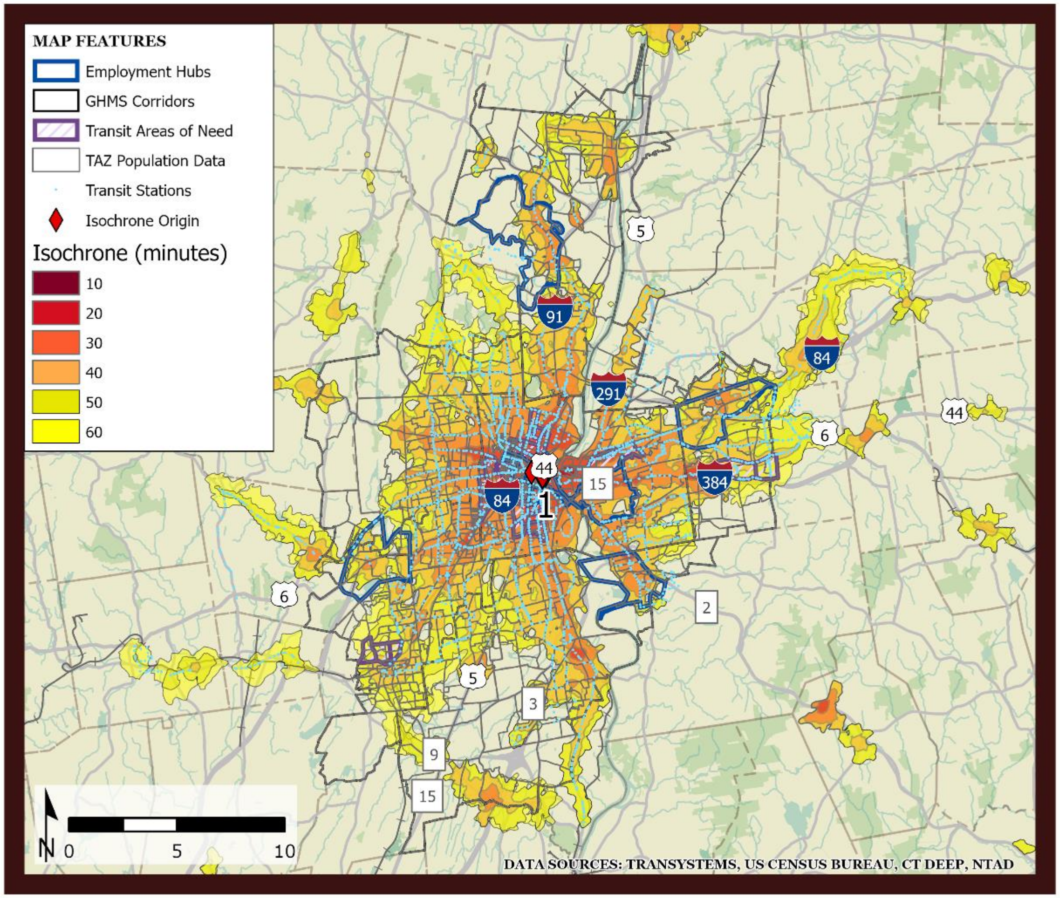

Figure 4.3: Hub 1 Downtown Hartford Isochrone Map

Employment Hub 2/East Hartford (Figure 4.4) shows a disconnect between transit need and employment with only TDI 4, East Hartford, covered within its 30-minute isochrone. Within its 60-minute isochrone all areas of transit need are covered except TDI 6, Central New Britain.

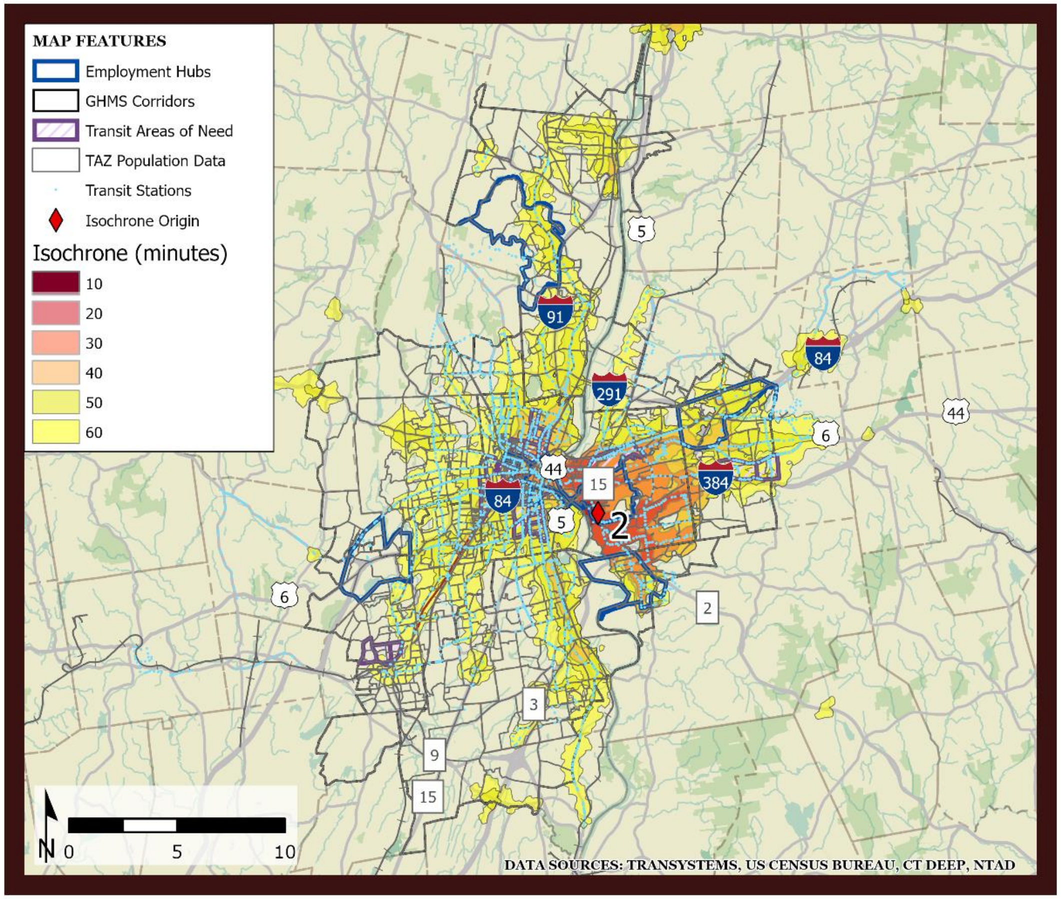

Figure 4.4: Hub 2 East Hartford Isochrone Map

Employment Hub 3/Northwest Windsor (Figure 4.5) is further disconnected between areas of transit need with only a portion of TDI 1, Hartford North, covered within its 30-minute isochrone. Within its 60-minute isochrone only TDI 1 is fully covered with TDI 2, 3, and 4 partially covered. TDI 5 (Manchester) and TDI 6 (New Britain) are completely outside of the 60-minute isochrone.

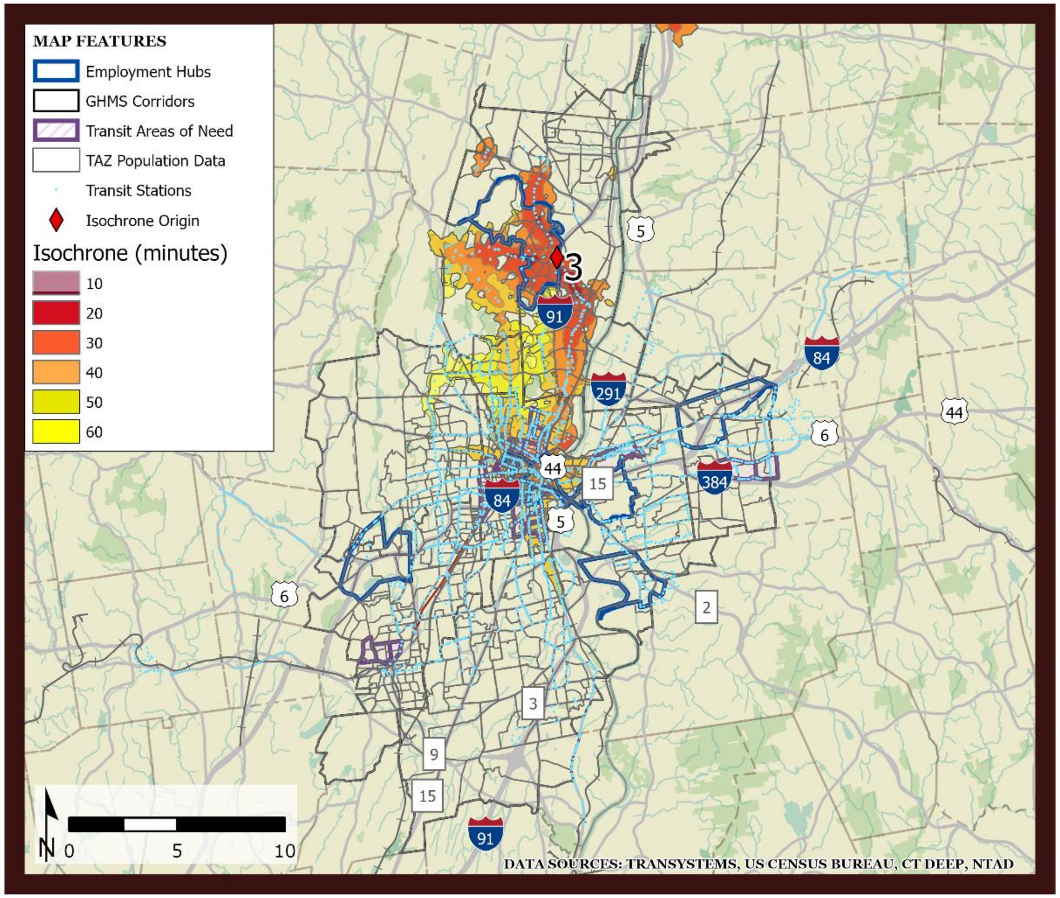

Figure 4.5: Hub 3 Northwest Windsor Isochrone Map

Employment Hub 4/East Farmington (Figure 4.6) is similarly isolated from areas of transit need with parts of TDI 6 (Central New Britain) and TDI 2 (West Hartford) within a 30-minute transit trip. No areas of transit need are completely covered within the Hub 4 60-minute isochrone. Parts with TDI 2, 3, and 6 are covered within a one-hour transit trip. TDI 1 (Hartford North) and TDI 5 (Manchester) are completely outside of the 60-minute isochrone.

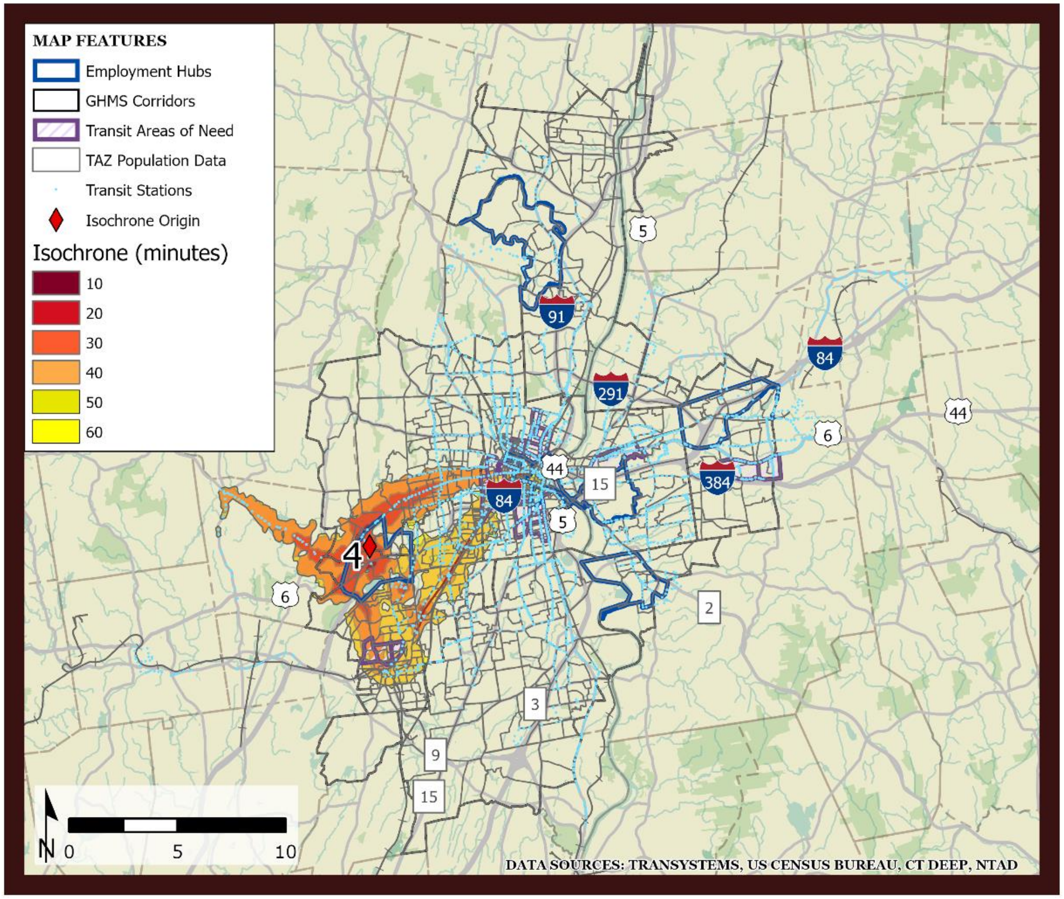

Figure 4.6: Hub 4 East Farmington Isochrone Map

Employment Hub 5/Northwest Manchester (Figure 4.7) shows most of TDI 4 (East Hartford) within a 30-minute transit trip. TDI 5 and TDI 2 are completely covered by the Hub 5 60-minute isochrone. Most of TDI 1 and TDI 3 are covered within a one-hour transit trip. TDI 6 (Central New Britain) is completely outside of the 60-minute isochrone.

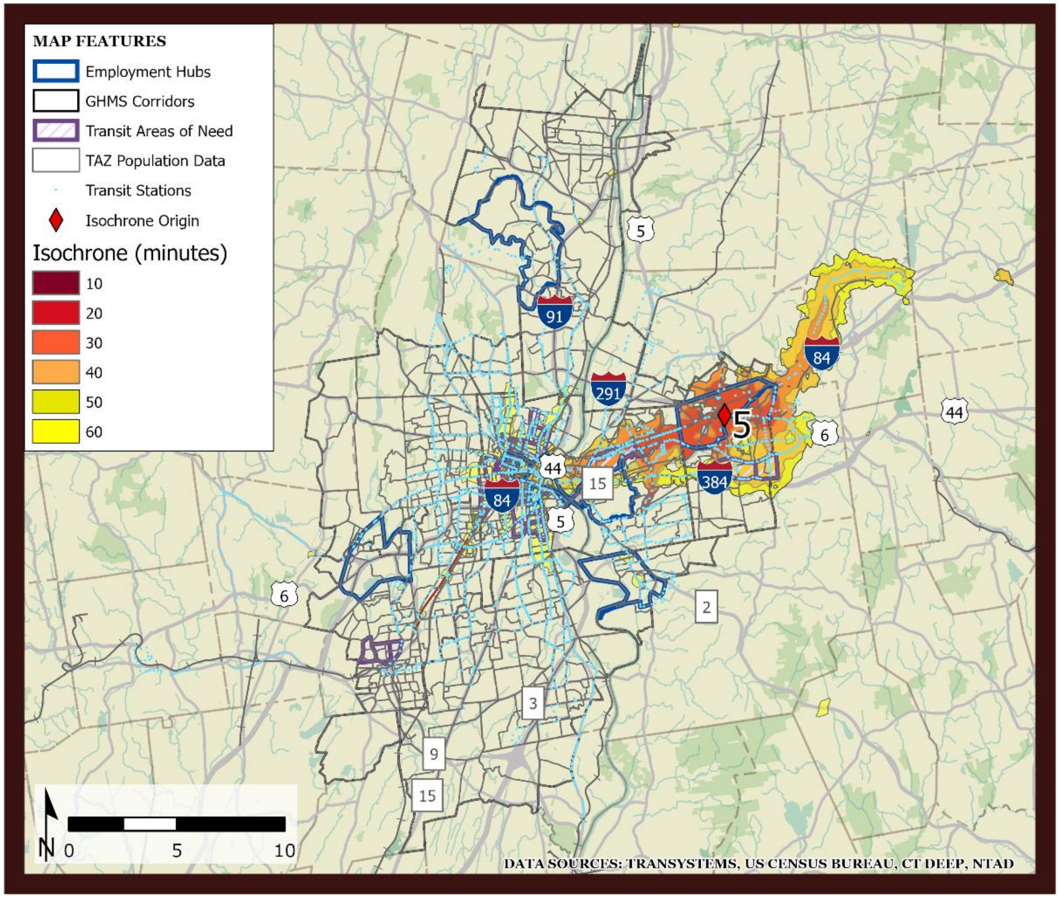

Figure 4.7: Hub 5 Northwest Manchester Isochrone Map

The employment Hub 6/Glastonbury isochrone map (Figure 4.8) shows most of TDI 4 (East Hartford) and part of TDI 1 (Hartford North) within a 30-minute transit trip. TDI 2, TDI 3, and TDI 5 are completely covered by the Hub 6 60-minute isochrone. TDI 6 (Central New Britain) is completely outside of the 60-minute isochrone.

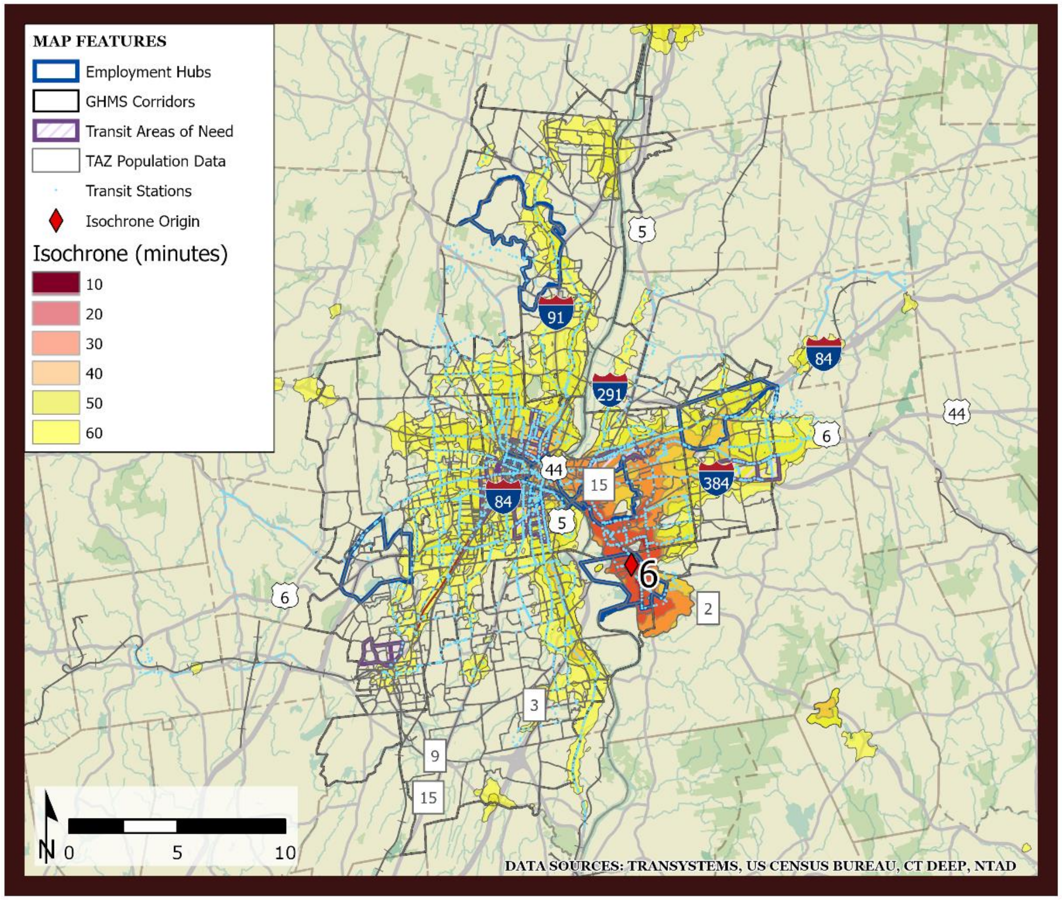

Figure 4.8: Hub 6 Glastonbury Isochrone Map

A second set of isochrones maps identified employment within 10-minute travel time increments (via bus or walking) of the six TDI areas of transit need as shown in Table 4-4. While the areas of transit need have varying degrees of access to employment hubs, TDI 1 through TDI 4 serve a similar number of jobs within a 60-minute isochrone.

Table 4-4: Employment within 10-minute Increments Transit Travel Time of Areas of Transit Need

GHMS Isochrone Analysis: Areas of Transit Need to Employment 2020							
Location		Travel Time (minutes)					
TDI Area	District	10	20	30	40	50	60
1	Hartford North	2,623	58,257	115,119	170,184	229,424	304,184
2	Hartford West	3,360	65,279	118,334	166,526	233,130	303,505
3	Hartford South	1,531	56,445	104,637	145,154	204,805	280,948
4	East Hartford	1,677	22,487	76,945	146,787	216,248	288,989
5	Manchester	2,091	10,302	24,937	44,554	94,010	116,698
6	New Britain	991	13,940	40,122	75,628	167,010	205,019
ALL		12,274	150,445	231,678	285,768	332,286	384,553

The TDI Area 1/Hartford North isochrone map (Figure 4.9) shows only Hub 1/Downtown Hartford within the 30-minute isochrone. All other employment hubs are partially within the 60-minute isochrone.

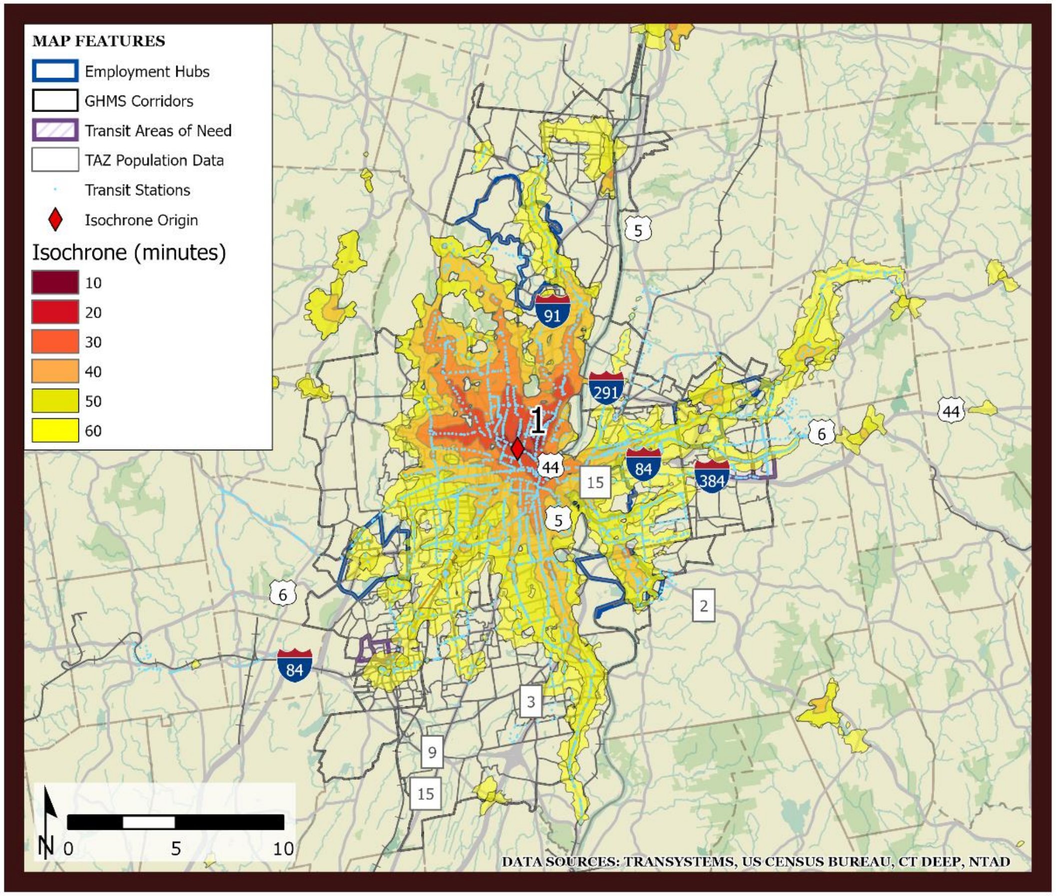

Figure 4.9: TDI Area 1 Hartford North Isochrone Map

The TDI Area 2/Hartford West isochrones map (Figure 4.10) also shows only Hub 1/Downtown Hartford within the 30-minute isochrone. All other employment hubs are partially within the 60-minute isochrone with most of Hub 4/East Farmington not covered by a one-hour commute.

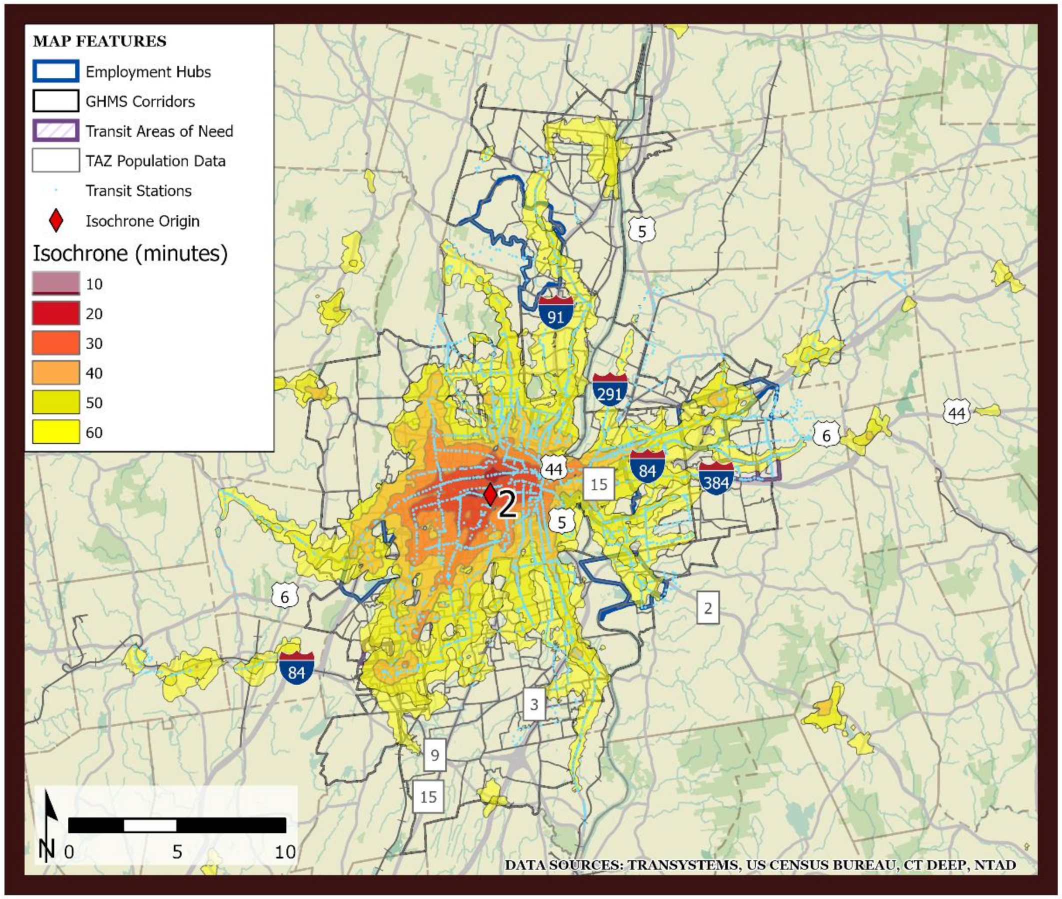

Figure 4.10: TDI Area 2 Hartford West Isochrone Map

The TDI Area 3/Hartford South isochrones map (Figure 4.11) also shows only Hub 1/Downtown Hartford within the 30-minute isochrone. All other employment hubs are partially within the 60-minute isochrone with most of Hub 4/East Farmington not covered by a one-hour commute.

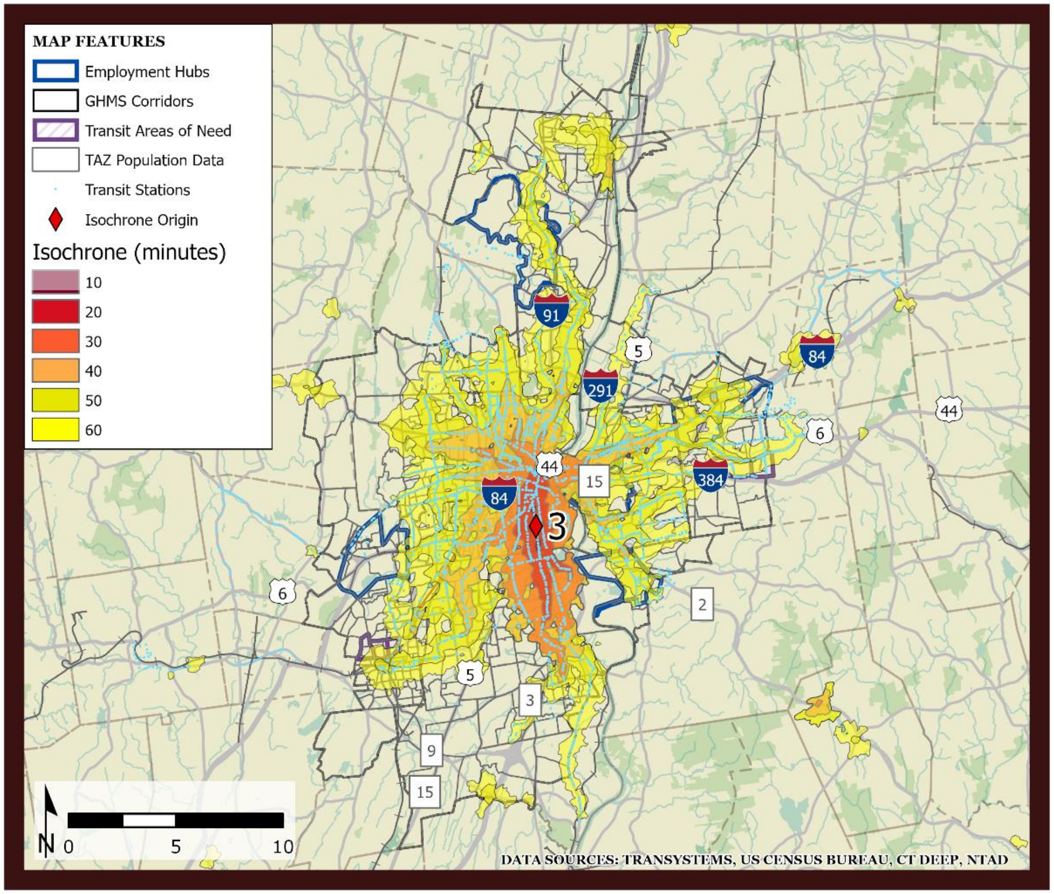

Figure 4.11: TDI Area 3 Hartford South Isochrone Map

The TDI Area/East Hartford map (Figure 4.12) shows most of Hub 1/Downtown Hartford and Hub 5/Northwest Manchester as well as part of Hub 2/East Hartford within the 30-minute isochrone. The three other employment hubs are partially within the 60-minute isochrone with most of Hub 4/East Farmington not covered by a one-hour commute.

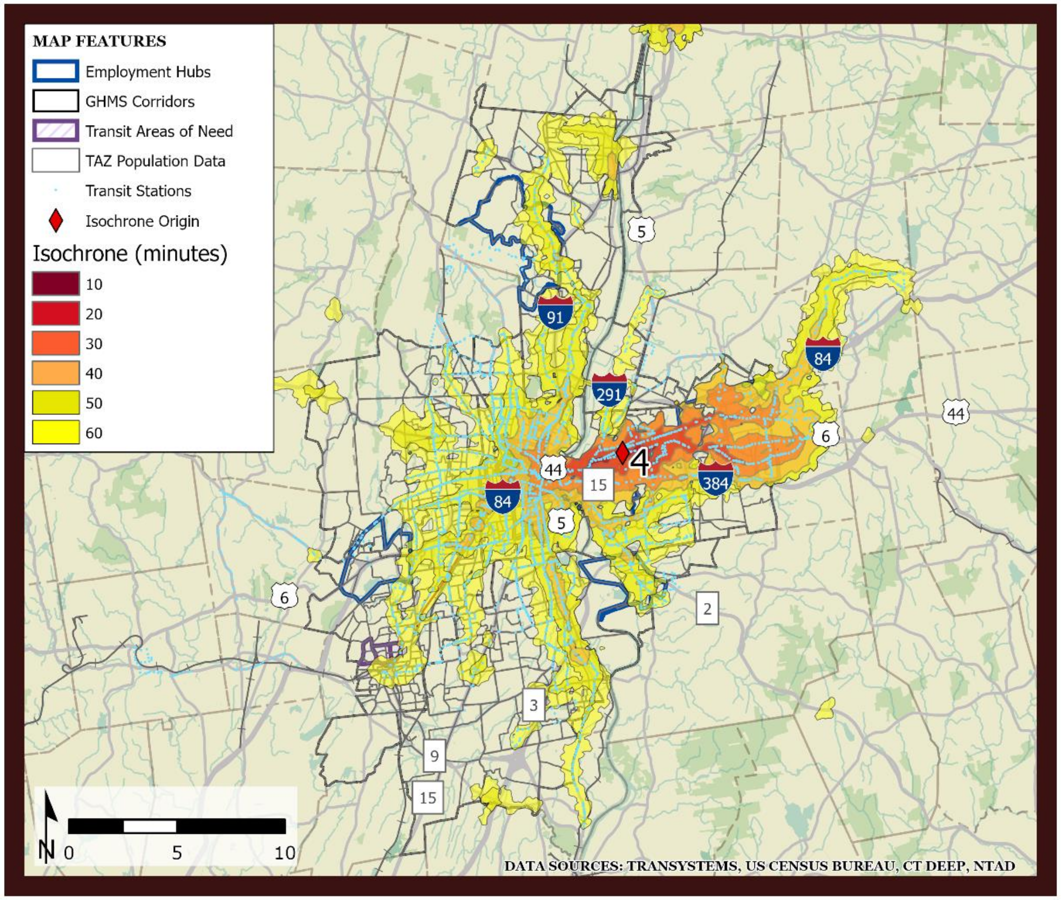

Figure 4.12: TDI Area 4 East Hartford Isochrone Map

The TDI Area 5/Central Manchester isochrone map (Figure 4.13) shows most of Hub 5/Northwest Manchester as well as part of Hub 2/East Hartford within the 30-minute isochrone. Hub 1/Downtown Hartford is within the 60-minute isochrone. Hub 3/Northwest Windsor, Hub 4/East Farmington, and Hub 6/Glastonbury are not accessible by a one-hour transit commute.

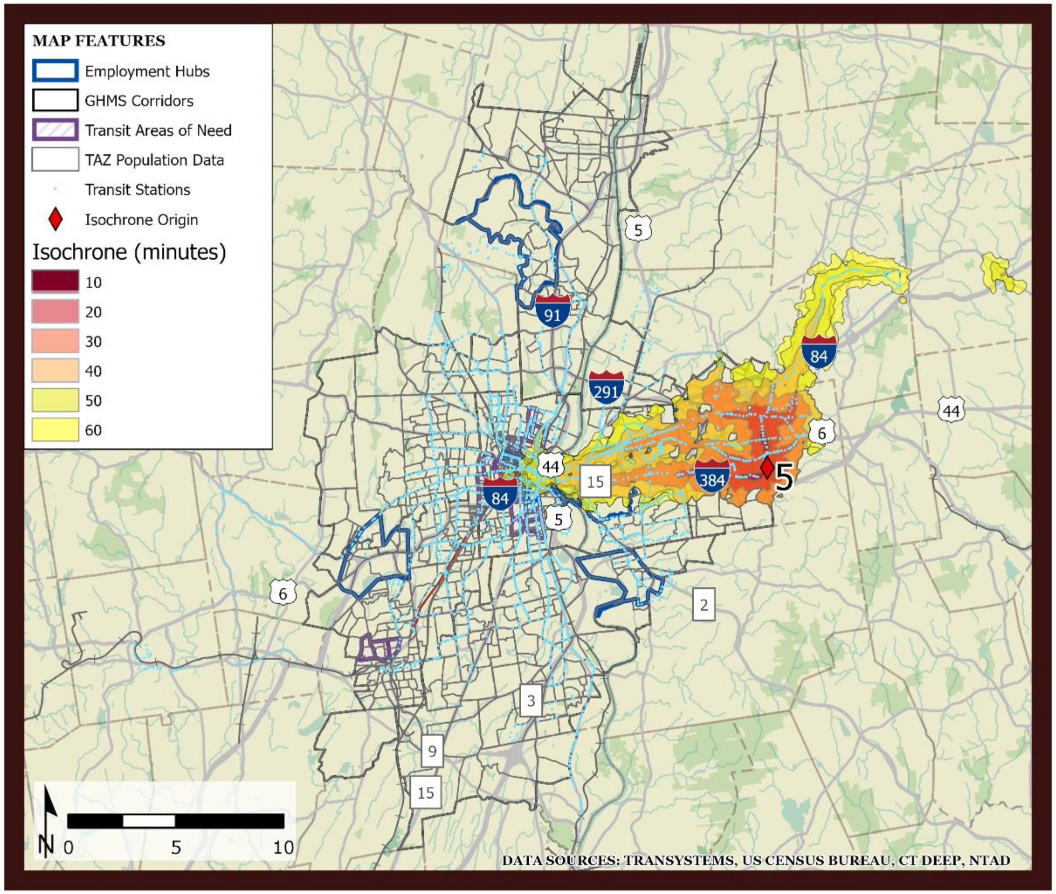

Figure 4.13: TDI Area 5 Central Manchester Isochrone Map

The TDI Area 6/Central New Britain isochrone map (Figure 4.14) shows most of Hub 4/East Farmington within the 30-minute isochrone. Hub 1/Downtown Hartford is within the 60-minute isochrone. The remaining three employment hubs are not accessible by a one-hour transit commute.

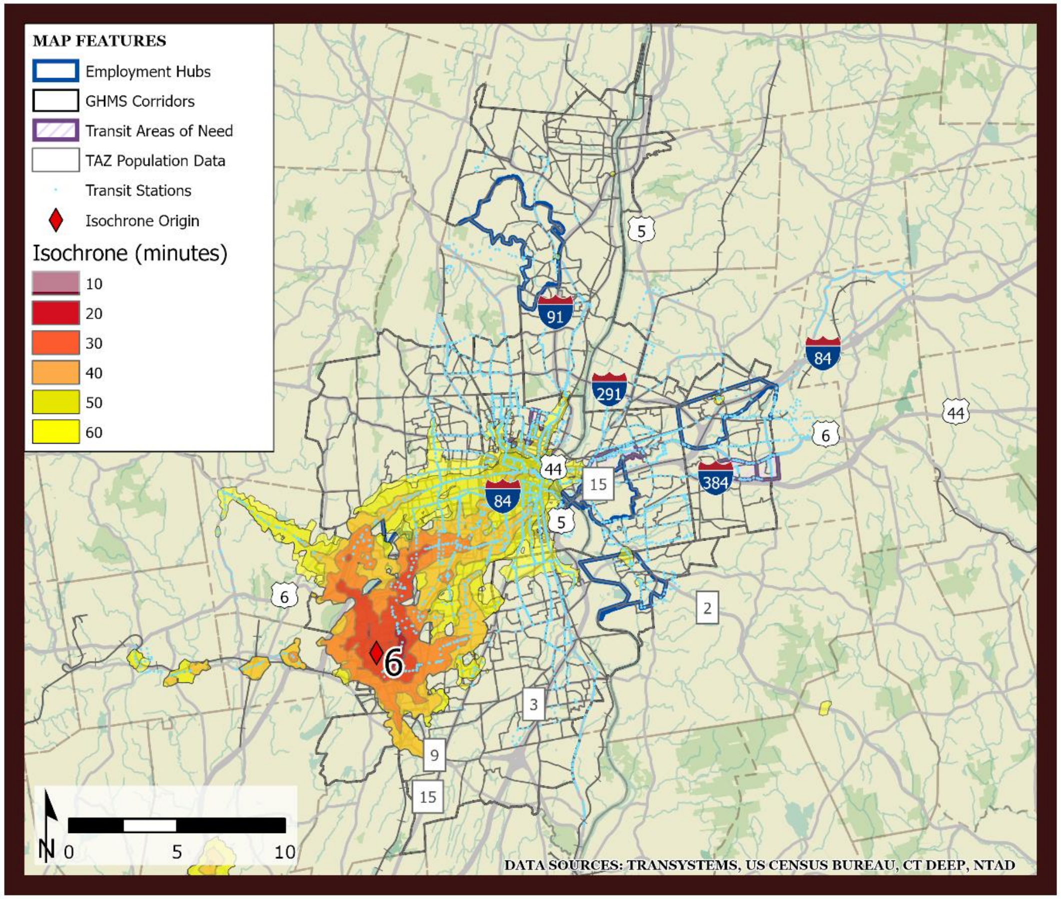

Figure 4.14: TDI Area 6 Central New Britain Isochrone Map

4.1.5 Summary

Downtown Hartford is well connected by the existing bus network which is based primarily on radial routes. However, suburban employment areas are not as well connected (Figure 4.15), limiting access to these jobs by people without cars (Figure 4.16). Even in suburban areas that have better access like East Hartford, East Farmington and Northwest Manchester more of the population is in the 60-minute isochrone, compared to most of the population within the 30-minute isochrones in downtown. This issue is due in large part to the low-density development and lack of walkability in these peripheral communities, while much of the central population within the 10-minute and 20-minute downtown isochrones having the option to walk or take transit to jobs. It should be noted that these isochrones represent transit service during traditional weekday peak commute hours. Many commuters in low-income communities in areas of transit need work in jobs with atypical work hours, such as many service jobs, and would experience even longer transit travel times in off-peak hours.

With many jobs located in downtown Hartford and four of the six residential areas of high transit need clustered around it, CT*transit* can continue to successfully serve the needs of many residents with its current network. For suburban communities of high transit need however, the low population and employment densities may require innovative new services to be financially sustainable in the long run.

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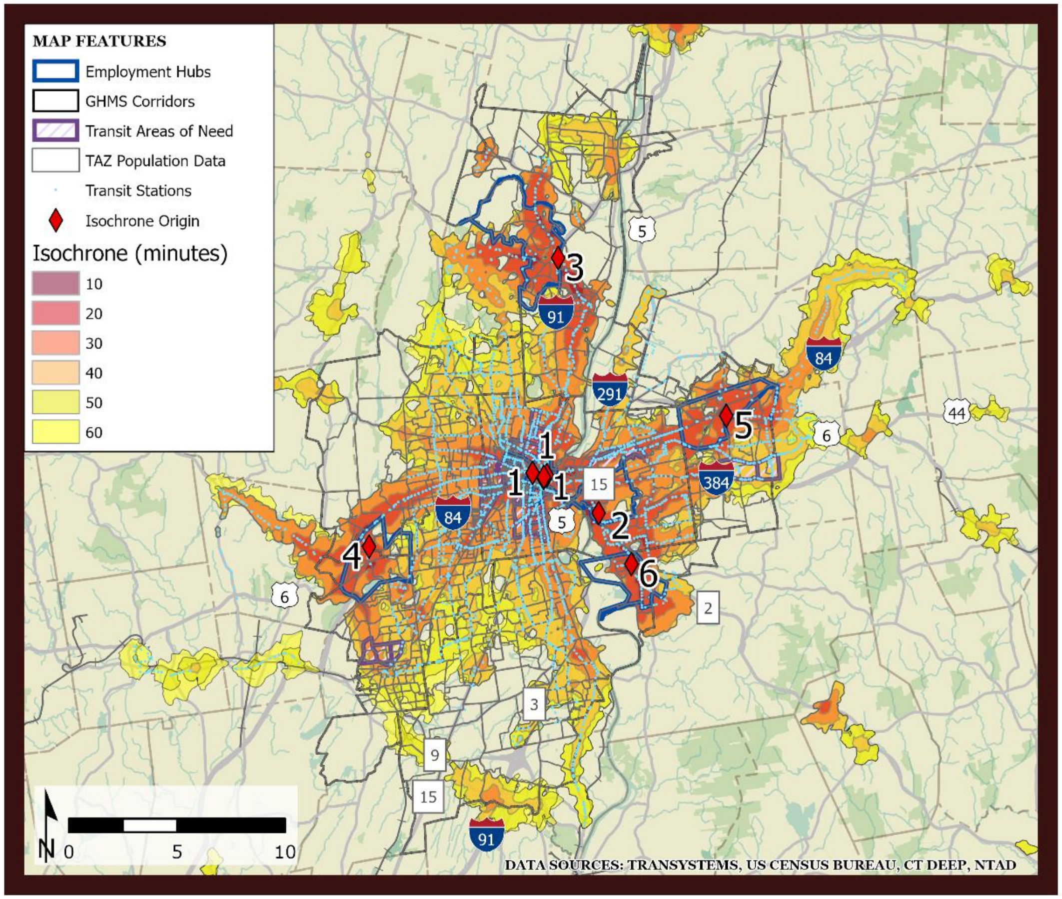

Figure 4.15: Greater Hartford Employment Hub Isochrones

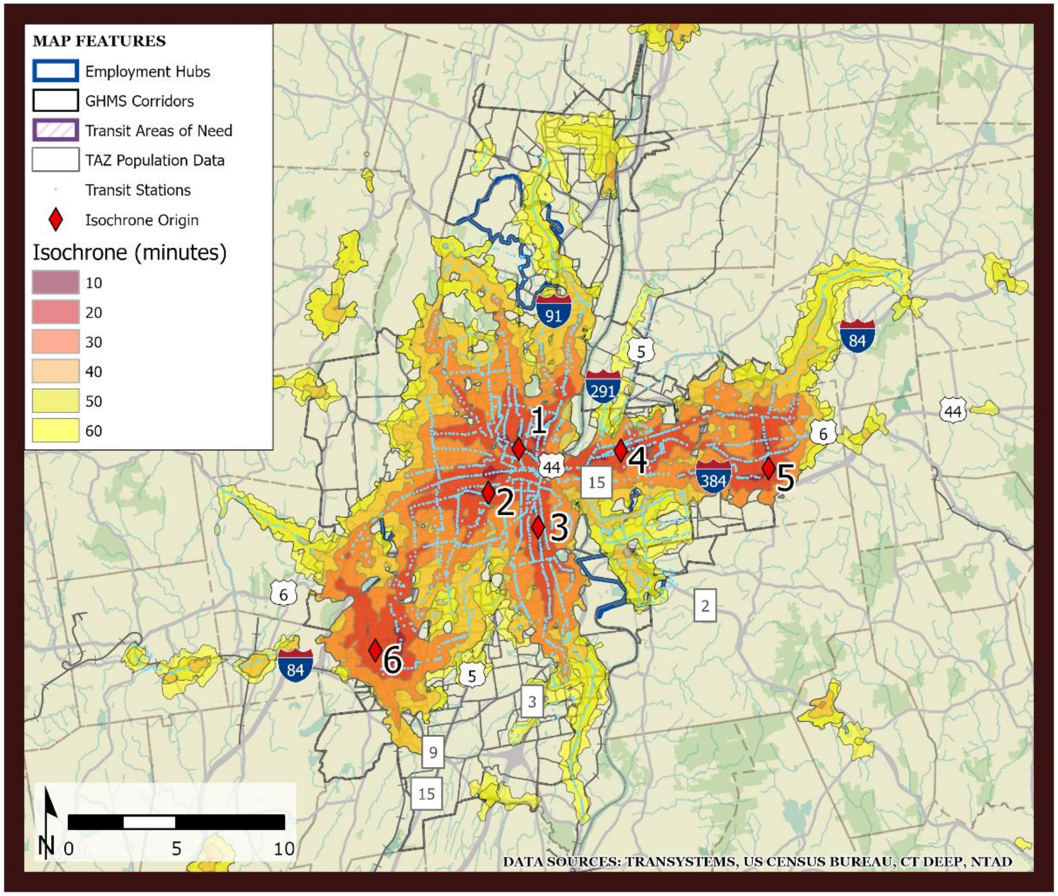

Figure 4.16: Greater Hartford Areas of Transit Need Isochrones

4.2 Transit Access

4.2.1 Purpose

The purpose of this analysis is to review the weekday frequency and span of service for each CT*transit* bus route serving the Greater Hartford region. The frequency of service in particular is a key determinant in the usefulness of a bus route to transit riders. Higher frequency routes will draw more riders to transit and make it easier to use by reducing wait times and providing more travel flexibility. Higher frequency service is also useful when transfers are required, helping to minimize wait times and simplify the trip planning process.

Span of service is also important, especially for riders using public transit outside of traditional AM/PM peak hour commute windows. Many jobs require shifts that start or end early in the morning or late at night. If transit service doesn't have a long enough service span, workers in those jobs won't be able to ride the bus, which may be their only transportation option.

4.2.2 Data Sources

The data source used to determine frequency and span was General Transit Feed Specification (GTFS) data for the CT*transit* bus system and the service schedules posted on the CT*transit* website. Ridership data provided by CT*transit* was also incorporated to provide context to the service data.

4.2.3 Methodology

Frequency was determined by running a script against the GTFS data that calculated the number of trips for a representative weekday, categorizing the trips into AM (6:00 AM — 8:59 AM), Midday (9:00 AM — 2:59 PM), PM (3:00 PM — 5:59), and Evening (6:00 PM — 8:59 PM) time periods. The number of trips was then used to calculate the average headway for each of these time periods. The span of service was calculated by determining the first time a bus departs the first station of a route in each direction and the last time a bus departs the first station in each direction.

Span is the length of the day that a bus route operates.
Frequency is the number of trips per hour on a given route.
Headway is the amount of time between vehicles on a given route.

Route level ridership was calculated by summing the stop level boardings for each route for weekdays during the month of October 2019, and then dividing that sum by the number of weekdays in the month to determine the average weekday ridership.

There are two caveats to note for this analysis. First, the time period for ridership data does not align with the schedule data used, so the ridership information provided is not for the representative day of service. Second, the GTFS data used to determine frequency only notes route direction as 0/1, while the ridership data notes route direction as east/west, north/south, or inbound/outbound. As a result, it is not possible to align the direction of travel for frequency with the direction of travel for ridership. Therefore, the route level ridership shown here is for both directions combined. The frequency shown for split routes in the tables below is for the trunk line section. As the route branches out the frequency is typically double that of the trunk portion of the route (or triple in the case of Routes 60-66).

Span was determined by the time of the first trip of the day at the first stop and the time of the last trip of the day at the first stop. Service hours shown are based on the schedules posted on the CT*transit* website. It is possible that these operations do not reflect the latest adjustments that may have occurred due to the ongoing COVID-19 pandemic.

4.2.4 Analysis

Local Routes with headways of 10 minutes or less at their peak frequency are the 60-66, 50-54, 31-33, 47, and 40-42. The 905 express route also has a peak frequency of 10 minute headways. The 101 is the only CT*fastrak* route with peak headways at or under 10 minutes, with service every 8 minutes on average during the peak hours. The AHS (Asylum Hill Shuttle) and CBS (Columbus Boulevard Shuttle) shuttle routes also have peak hour headways under 10 minutes.

Average frequency during the midday time period is a helpful gauge to understand consistently frequent service throughout the day. Several routes have midday headways of 15 minutes or less: 60-66, 50-54, 31-33, 47, 40-42, 101, and the DASH shuttle. Given this high level of service throughout the day it is not surprising these same routes also have some of the highest ridership numbers in the region. Of the local routes serving the Greater Hartford region (shown in Table 4-5), 26 of them have a peak headway of 30 minutes or less, while eight routes reach peak headways of 15 minutes or less. There are seven local routes whose peak average headway is 60 minutes or more.

Table 4-5: Local Route Frequency & Boardings[1,2]

Route	Direction	AM Headway	Midday Headway	PM Headway	Evening Headway	Avg Weekday Boardings
30	0	45	72	45	90	579
30	1	60	72	45	60	
31-33	0	10	10	10	30	2,975
31-33	1	10	10	11	22	
32	0	36	72	45	60	372
32	1	45	60	36	180	
34	0	60	360	60	0	296
34	1	45	0	60	180	
36	0	36	60	60	180	542
36	1	90	60	60	90	
37-39	0	13	19	11	45	1,699
37-39	1	11	19	14	30	
38	0	30	20	30	36	735
38	1	30	20	26	36	
40-42	0	10	10	10	18	2,113
40-42	1	10	10	10	18	
41	0	22	30	22	45	451
41	1	22	30	22	45	
43	0	22	33	22	180	395
43	1	22	28	30	0	
44	0	36	60	30	0	316

[1] All headway values are provided in minutes.
[2] Please use the following link for a map to the CT*transit's* Local Route Map: https://www.cttransit.com/sites/default/files/maps/division/hartfordsys_2021.pdf

Route	Direction	AM Headway	Midday Headway	PM Headway	Evening Headway	Avg Weekday Boardings
44	1	30	60	36	180	
45	0	45	0	0	180	55
45	1	0	0	36	180	
46	0	11	20	12	60	1,219
46	1	11	19	13	36	
47	0	10	10	10	36	2,300
47	1	11	10	10	30	
50-54	0	9	10	9	30	3,942
50-54	1	9	10	9	20	
53	0	22	60	20	180	704
53	1	26	60	22	60	
55	0	45	60	36	180	696
55	1	45	60	45	90	
56	0	30	60	30	180	555
56	1	30	60	36	60	
58	0	30	60	45	180	469
58	1	36	51	30	180	
59	0	30	60	36	180	336
59	1	30	60	30	180	
60-66	0	10	10	8	26	3,593
60-66	1	9	9	8	20	
61	0	22	30	20	60	686
61	1	20	28	22	36	
63	0	22	30	26	90	564
63	1	20	28	26	90	

Route	Direction	AM Headway	Midday Headway	PM Headway	Evening Headway	Avg Weekday Boardings
69	0	30	30	30	45	595
69	1	36	30	30	60	
72	0	20	40	15	60	528
72	1	20	40	16	45	
74	0	30	45	36	180	714
74	1	36	40	36	90	
76	0	20	30	20	36	1,144
76	1	20	30	20	36	
82-84	0	23	33	20	45	1,752
82-84	1	20	28	23	36	
83	0	30	30	22	60	1,684
83	1	22	33	26	45	
85	0	90	60	90	180	118
85	1	90	60	90	180	
86	0	36	120	30	180	243
86	1	36	120	36	90	
87	0	36	60	45	180	244
87	1	36	60	36	180	
88	0	18	30	16	60	1,683
88	1	16	30	18	30	
91	0	60	60	60	90	407
91	1	90	60	60	90	
92	0	60	60	60	90	227
92	1	60	60	60	90	
94	0	60	120	60	180	203

Route	Direction	AM Headway	Midday Headway	PM Headway	Evening Headway	Avg Weekday Boardings
94	1	45	180	45	180	
95	0	20	30	22	60	1,128
95	1	22	30	18	45	
96	0	36	120	45	180	292
96	1	45	120	60	90	
542	0	0	60	0	60	32
542	1	0	60	0	60	

Table 4-6 shows the average headway and average weekday boardings for the CT*fastrak* routes serving the Greater Hartford region. These routes show a significant range of peak headways, from 8 minutes to 60 minutes. Two CT*fastrak* routes have a peak headway of 15 minutes or less, while another two have a peak headway of only 60 minutes. While the most frequent route, the 101, has the highest average weekday boardings, ridership on the other routes does not appear to be directly correlated with frequency. This might be due to some of the frequent low ridership routes being short shuttle routes. The 140, with peak headways of 20 minutes, has lower average weekday boardings than the 144 or 153, with peak headways of 60 minutes. The three routes with highest ridership after the 101, the 128, 121, and 102, all operate at 20-30 minute peak headways and outperform the 161 with 15 minute peak headways.

Table 4-6: CT*fastrak* Route Frequency & Boardings[3,4]

Route	Direction	AM Headway	Midday Headway	PM Headway	Evening Headway	Avg Weekday Boardings
101	0	8	12	8	16	5,281

[3] All headway values are provided in minutes.
[4] Please use the following link for a map to the CT*transit's* CT*fastrak* Route Map: https://www.cttransit.com/sites/default/files/maps/division/ctfastrak_system_AUGUST2021.pdf

Route	Direction	AM Headway	Midday Headway	PM Headway	Evening Headway	Avg Weekday Boardings
101	1	8	12	8	14	
102	0	36	51	36	45	1,294
102	1	36	51	30	60	
121	0	30	33	30	45	1,334
121	1	30	30	30	36	
128	0	20	30	20	30	1,937
128	1	20	30	20	30	
140	0	20	20	20	26	151
140	1	22	20	20	26	
144	0	60	60	60	60	251
144	1	60	60	60	60	
153	0	60	60	60	60	305
153	1	60	60	60	60	
161	0	16	20	15	20	751
161	1	15	20	15	22	

Table 4-7 shows the average headway and average weekday boardings for the express routes serving the Greater Hartford region. The express routes are largely scheduled to serve traditional "nine to five" commuters and therefore have minimal to no service during the midday and evening periods. The 913 has the highest ridership of the express routes despite peak hour headways ranging between 45-60 minutes. The 905 has the second highest ridership and the most frequent service for express routes, with average headways of 10 minutes during AM and PM peak periods. With a few exceptions (such as the 902, 907, and 913) higher ridership is generally correlated with more frequent service.

Table 4-7: Express Route Frequency & Boardings[5,6]

Route	Direction	AM Headway	Midday Headway	PM Headway	Evening Headway	Avg Weekday Boardings
901	0	60	360	36	0	196
901	1	36	360	90	180	
902	0	90	0	36	0	23
902	1	36	0	60	0	
903	0	0	0	20	180	399
903	1	13	0	0	0	
904	0	60	0	30	0	153
904	1	30	0	90	180	
905	0	22	180	9	180	684
905	1	10	360	26	90	
906	0	45	360	36	0	136
906	1	30	360	60	180	
907	0	0	0	45	0	26
907	1	45	0	0	0	
909	0	180	0	90	0	46
909	1	90	0	180	0	
910	0	60	0	60	0	125
910	1	60	0	60	0	
912	0	60	180	26	180	228
912	1	30	360	90	180	
913	0	45	60	45	90	941

[5] All headway values are provided in minutes.
[6] Please use the following link for a map to the CT*transit's* CT*fastrak* Route Map: https://www.cttransit.com/sites/default/files/maps/division/expresssystem2021_0.pdf

Route	Direction	AM Headway	Midday Headway	PM Headway	Evening Headway	Avg Weekday Boardings
913	1	60	60	60	90	
914	0	45	360	22	180	252
914	1	22	360	60	180	
915	0	0	0	180	0	12
915	1	90	0	0	0	
926	0	0	0	90	0	26
926	1	90	0	0	0	
927	0	0	0	90	0	34
927	1	90	0	0	0	

Table 4-8 shows the average headway and average weekday boardings for the shuttle routes serving the Greater Hartford region. The AHS and CBS routes have the most frequent service during the peak periods but have very minimal service during the midday and evening periods. The DASH route is less frequent during the AM and PM peak periods but provides more consistent service frequency throughout the day. The DASH has the highest average weekday boardings, likely due in part its consistent service, though the AHS has more boardings per trip.

Table 4-8: Shuttle Route Frequency & Boardings[7]

Route	Direction	AM Headway	Midday Headway	PM Headway	Evening Headway	Avg Weekday Boardings
AHS	0	6	360	0	0	83
AHS	1	0	180	9	180	
CBS	0	9	0	0	0	20
CBS	1	0	120	9	180	
DASH	0	22	15	15	45	118

The span of service for local routes is shown in Table 4-9. The overall average span of service for local routes is 15 hours and 17 minutes. Fourteen routes provide a span of service 18 hours or greater, with the 50-54, 31-33, and the 40-42 providing the greatest hours of service. Nearly all local routes provide at least 12 hours of service between the first and last trip of the day.

[7] All headway values are provided in minutes.

Table 4-9: Local Route Span of Service

Route	Direction	First Trip	Last Trip	Hours of Service
30	0	4:05	23:40	19:35
30	1	4:45	0:10	19:25
31-33	0	5:05	0:45	19:40
31-33	1	4:31	1:04	20:33
32	0	6:35	19:15	12:40
32	1	5:48	18:04	12:16
34	0	5:25	21:25	16:00
34	1	6:23	22:37	16:14
36	0	6:20	22:45	16:25
36	1	5:11	18:38	13:27
37-39	0	5:00	23:45	18:45
37-39	1	4:29	0:13	19:44
38	0	5:00	20:20	15:20
38	1	5:41	20:03	14:22
40-42	0	4:15	0:45	20:30
40-42	1	4:34	0:00	19:26
41	0	5:00	23:45	18:45
41	1	4:33	0:30	19:57
43	0	6:35	18:20	11:45
43	1	5:38	17:56	12:18
44	0	6:35	17:55	11:20
44	1	6:15	18:15	12:00
45	0	6:20	21:25	15:05
45	1	16:28	22:07	5:39
46	0	5:10	21:25	16:15
46	1	5:31	21:45	16:14

Route	Direction	First Trip	Last Trip	Hours of Service
47	0	6:00	0:45	18:45
47	1	5:16	23:57	18:41
50-54	0	4:20	23:45	19:25
50-54	1	4:25	1:07	20:42
53	0	5:40	18:10	12:30
53	1	5:32	23:00	17:28
55	0	6:00	18:15	12:15
55	1	5:35	19:13	13:38
56	0	5:40	19:15	13:35
56	1	6:09	19:44	13:35
58	0	5:25	21:25	16:00
58	1	6:40	22:12	15:32
59	0	6:10	18:20	12:10
59	1	6:12	18:45	12:33
60-66	0	5:50	0:45	18:55
60-66	1	5:07	0:10	19:03
61	0	5:50	21:25	15:35
61	1	5:20	1:00	19:40
63	0	6:25	18:45	12:20
63	1	5:47	1:07	19:20
69	0	5:05	21:25	16:20
69	1	5:06	21:52	16:46
72	0	6:10	22:45	16:35
72	1	6:08	23:09	17:01
74	0	5:10	18:25	13:15
74	1	5:39	18:45	13:06
76	0	5:05	23:45	18:40

Route	Direction	First Trip	Last Trip	Hours of Service
76	1	5:03	23:15	18:12
82-84	0	4:53	22:40	17:47
82-84	1	4:45	22:16	17:31
83	0	5:03	22:40	17:37
83	1	5:00	22:39	17:39
85	0	7:30	18:15	10:45
85	1	7:45	21:10	13:25
86	0	6:05	18:15	12:10
86	1	5:56	18:41	12:45
87	0	5:50	18:10	12:20
87	1	6:27	18:05	11:38
88	0	5:00	0:46	19:46
88	1	4:25	23:13	18:48
91	0	5:38	23:09	17:31
91	1	5:18	23:06	17:48
92	0	6:23	19:39	13:16
92	1	7:10	19:32	12:22
94	0	5:40	18:00	12:20
94	1	6:00	18:23	12:23
95	0	5:05	23:45	18:40
95	1	5:28	0:15	18:47
96	0	5:15	18:10	12:55
96	1	5:45	18:41	12:56
542	0	5:45	23:50	18:05
542	1	5:53	23:58	18:05

The span of service for CT*fastrak* routes is shown in Table 4-10. The overall average span of service for CT*fastrak* routes is 18 hours and 35 minutes, which is the largest for all of the route types serving the Greater Hartford region. All of the CT*fastrak* routes provide service for a minimum of 17 hours and 40 minutes, with the 101 providing the greatest span at nearly 21 hours.

Table 4-10: CT*fastrak* Route Span of Service

Route	Direction	First Trip	Last Trip	Hours of Service
101	0	4:00	0:45	20:45
101	1	4:02	0:42	20:40
102	0	4:55	0:25	19:30
102	1	4:42	0:17	19:35
121	0	4:55	23:55	19:00
121	1	4:42	23:36	18:54
128	0	4:20	23:45	19:25
128	1	4:23	23:53	19:30
140	0	6:18	23:58	17:40
140	1	6:24	0:04	17:40
144	0	5:11	23:13	18:02
144	1	5:07	23:08	18:01
153	0	5:50	23:30	17:40
153	1	5:50	23:30	17:40
161	0	4:59	0:36	19:37
161	1	5:14	0:10	18:56

The span of service for Express routes is shown in Table 4-11. The overall average span of service for Express routes is 9 hours and 31 minutes, which is significantly shorter than for the Local and CT*fastrak* routes. This is largely due to the fact that the Express service is geared towards traditional “9 to 5” commuters, rather than midday or evening service. Therefore, even though some of the Express routes have a span of 10 or 11 hours they may have very little to zero midday service.

Some of the Express routes only provide service one direction at a time, such as inbound in the AM peak and outbound in the PM peak, resulting in spans of less than three hours.

Table 4-11: Express Route Span of Service

Route	Direction	First Trip	Last Trip	Hours of Service
901	0	5:30	17:50	12:20
901	1	5:56	18:24	12:28
902	0	7:30	17:40	10:10
902	1	6:31	17:03	10:32
903	0	15:40	18:00	2:20
903	1	6:15	8:50	2:35
904	0	6:15	17:40	11:25
904	1	6:38	18:12	11:34
905	0	5:57	18:28	12:31
905	1	6:06	18:20	12:14
906	0	5:55	17:40	11:45
906	1	6:13	18:05	11:52
907	0	15:55	17:25	1:30
907	1	6:38	8:03	1:25
909	0	6:10	17:15	11:05
909	1	6:41	17:48	11:07
910	0	6:15	17:10	10:55
910	1	6:55	17:45	10:50
912	0	5:50	18:30	12:40
912	1	5:50	18:09	12:19
913	0	6:15	23:05	16:50
913	1	5:56	22:41	16:45

Route	Direction	First Trip	Last Trip	Hours of Service
914	0	6:00	18:25	12:25
914	1	6:06	18:23	12:17
915	0	12:18	18:28	6:10
915	1	6:20	7:40	1:20
926	0	12:10	16:55	4:45
926	1	6:15	7:00	0:45
927	0	12:10	16:50	4:40
927	1	6:10	6:45	0:35

The span of service for Shuttle routes is shown in Table 4-12. The overall average span of service for the Shuttle routes is 6 hours and 43 minutes, which is smallest of all route types serving Greater Hartford. However, there are only three Shuttle routes, two of which only operate during the morning or afternoon and not all day. The DASH has a much longer span, at nearly 12 hours, and operates service throughout the time. DASH operations, however, are currently suspended in light of the COVID-19 pandemic.

Table 4-12: Shuttle Route Span of Service

Route	Direction	First Trip	Last Trip	Hours of Service
AHS	0	6:40	9:10	2:30
AHS	1	11:52	18:12	6:20
CBS	0	6:51	9:06	2:15
CBS	1	12:12	18:22	6:10
DASH	0	7:00	18:45	11:45

4.2.5 Summary

Overall, the majority of Greater Hartford routes that have high frequency service also provide service over a larger span of time. There are a few exceptions, however, particularly the Shuttle routes and a few Express routes, which provide frequent service during shorter periods of time oriented towards traditional commuting hours.

The same trend also generally holds when ridership is taken into account. Many of the frequent routes with a longer span have high ridership, but there are similar exceptions for the Shuttle and Express services, once again due to the market they are designed to serve. Looked at inversely, all of the routes with 1,000+ average boardings per day are either Local or CT*fastrak* routes, most of which have headways of 20 minutes or less during the AM/PM periods and 30 minutes or less during the midday period along with spans over 18 hours.

4.3 Travel Time Competitiveness and Transit Mode Share

4.3.1 Purpose

The purpose of these analyses is to review the travel time competitiveness and the transit mode share for selected zones with a high Transit Dependency Index (TDI – as defined in Section Task 3.4.1 - Mobility), within the Greater Hartford region. Understanding how transit travel times compare to other modes, and how these differences look for different origin-destination (O-D) pairs, will help to identify where long transit travel times may be suppressing potential transit ridership. Developing a mode share comparison will help to further understand the travel patterns already occurring in these O-D pairs and guide future mobility improvements.

4.3.2 Data

Data for this analysis was drawn from the CRCOG Travel Demand Model (TDM) using the 2020 base year scenario. The TDM provides mode choice trip tables and highway and transit travel time skims that were used in the analysis discussed below.

4.3.3 Methodology

Highway and transit travel time skims from the 2020 base year model were used in summarizing travel time data for the selected set of origin-destination zones that represent district pairs (see Table 4-13 and Figure 4.17). At least one TDI zone was selected for each study corridor as the origin zone, while the identified employment hubs were used as the destination zones. TDI areas are those with a higher proportion of populations that are more likely to rely on transit, based on income, car ownership, and age. It should be noted that these travel times were taken from the shortest path analysis of the regional travel demand model procedures. Highway travel times include two components: in-vehicle time and terminal times. In vehicle time represents actual drive time between origin-destination endpoints. Terminal time is an average walk access/egress time from/to a zone centroid to the vehicle. Terminal time is also called out of vehicle time and is a fixed input at both ends of a trip based on the origin/destination zone characteristics. Highway travel time data also shows distances between the origins and destinations.

Transit travel times summaries also show two components: in-vehicle time and out-of-vehicle time. Out of vehicle time represents walk time at the access/egress ends plus any walk time involved during a transfer. Non-motorized (walk and bike) travel times were calculated using the highway distances with fixed speeds. Walk and bike mode speeds were assumed to be 3 mph and 10 mph respectively.

Mode choice model trip tables from the 2020 base year scenario were used in calculating mode shares for the selected set of district pairs. Mode shares were calculated for three primary modes: auto, transit and non-motorized. Auto trips include drive alone, shared 2 and shared 3+. Transit trips include local bus, express bus, BRT, and commuter rail trips. Non-motorized trips include walk and bike trips. It should be noted that the mode choice model outputs are person trips and in production-attraction format.

Table 4-13: Distance (in miles) Between Origin Destination (O-D) Pairs

	Job Hub - Core Center	Job Hub - Core East	Job Hub - North Corridor	Job Hub - NE Corridor	Job Hub - SE Corridor	Job Hub - SW Corridor
TDI-Core South	1.5	4.1	11.2	9.9	6.9	7.6
TDI-Core West	2.3	5.2	11.6	11.0	7.5	6.4
TDI-Core North	1.1	4.0	9.0	9.0	6.3	9.2
TDI-Core East	2.5	2.1	10.4	4.6	5.7	10.9
TDI-NW Corridor	3.5	6.5	12.9	12.2	8.8	5.2
TDI-North Corridor	7.6	9.9	2.3	8.8	12.2	16.0
TDI-NE Corridor	8.1	7.5	14.4	3.5	7.6	16.6
TDI-SE Corridor	5.6	3.4	16.6	7.0	1.0	16.5
TDI-South Corridor	9.0	9.5	17.5	15.0	6.2	17.3
TDI-SW Corridor	11.5	11.0	20.8	17.7	10.7	5.4

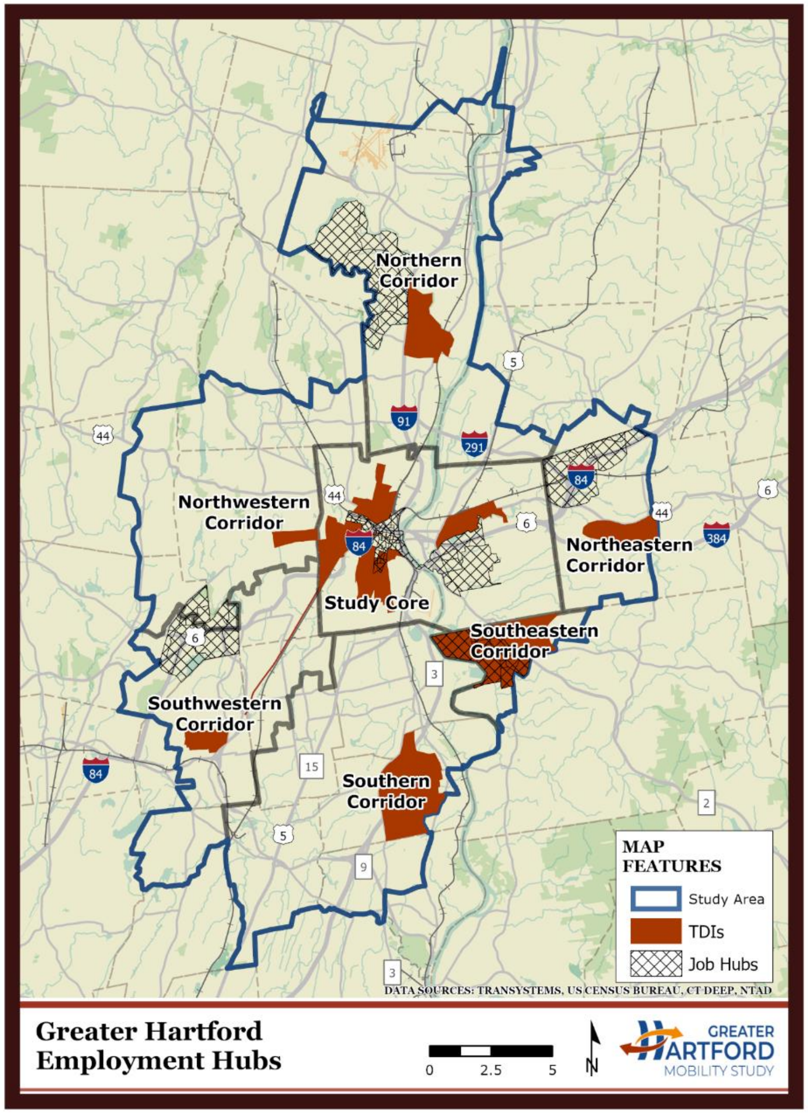

Figure 4.17 Map of TDI Area and Job Hubs

4.3.4 Analysis

As noted in the methodology travel times were developed for driving, transit, walking, and biking. The travel times for each O-D pair, mode, are shown in Table 4-14 through Table 4-17. Conditional formatting was applied individually to each table to help visualize the fastest (green) and slowest (red) travel times for that specific mode.

Table 4-14: Auto Travel Time (in minutes) Between O-D Pairs

	Job Hub - Core Center	Job Hub - Core East	Job Hub - North Corridor	Job Hub - NE Corridor	Job Hub - SE Corridor	Job Hub - SW Corridor
TDI-Core South	10.6	12.8	21.8	18.1	14.9	20.3
TDI-Core West	10.8	14.7	23.7	19.6	17.1	16.0
TDI-Core North	9.7	13.6	20.4	17.6	16.1	20.8
TDI-Core East	17.0	6.8	25.6	10.8	11.2	29.1
TDI-NW Corridor	13.6	17.4	26.4	22.3	19.8	13.8
TDI-North Corridor	17.2	19.4	6.7	14.2	21.8	29.3
TDI-NE Corridor	21.9	12.3	26.6	8.6	15.4	34.1
TDI-SE Corridor	20.3	8.2	30.7	14.7	4.0	32.5
TDI-South Corridor	19.9	17.5	30.0	24.8	12.8	28.9
TDI-SW Corridor	21.7	22.8	34.6	29.7	23.1	13.4

Table 4-15: Transit Travel Time (in minutes) Between O-D Pairs

	Job Hub - Core Center	Job Hub - Core East	Job Hub - North Corridor	Job Hub - NE Corridor	Job Hub - SE Corridor	Job Hub - SW Corridor
TDI-Core South	14.4	24.8	31.0	35.4	36.3	38.3
TDI-Core West	13.8	30.5	35.5	41.1	42.0	23.1
TDI-Core North	14.3	27.7	34.3	38.3	39.2	49.3
TDI-Core East	21.7	11.0	40.7	17.2	22.4	51.6
TDI-NW Corridor	15.5	32.2	37.1	42.8	43.7	20.1
TDI-North Corridor	28.5	42.0	13.4	52.6	53.5	63.5
TDI-NE Corridor	53.3	38.9	69.8	28.1	50.4	73.9
TDI-SE Corridor	35.1	17.4	53.6	34.9	10.5	64.9
TDI-South Corridor	33.4	42.2	50.0	52.8	53.7	57.3
TDI-SW Corridor	41.5	53.0	59.2	62.3	64.5	50.8

Table 4-16: Walk Travel Times (in minutes) Between O-D Pairs

	Job Hub - Core Center	Job Hub - Core East	Job Hub - North Corridor	Job Hub - NE Corridor	Job Hub - SE Corridor	Job Hub - SW Corridor
TDI-Core South	30.5	81.9	223.6	197.2	138.3	152.3
TDI-Core West	45.4	104.5	232.1	219.2	150.2	128.0
TDI-Core North	22.7	80.1	179.2	179.6	125.8	184.4
TDI-Core East	49.3	41.2	207.3	92.9	114.0	218.1
TDI-NW Corridor	70.8	130.0	257.5	244.6	175.7	103.6
TDI-North Corridor	152.4	199.0	45.4	176.9	244.7	320.6
TDI-NE Corridor	162.7	149.4	287.3	69.4	151.1	331.4
TDI-SE Corridor	111.6	67.8	332.9	139.6	20.3	329.8
TDI-South Corridor	180.8	189.3	350.3	300.6	124.1	346.3
TDI-SW Corridor	229.1	220.1	415.8	354.3	213.6	107.2

Table 4-17: Bike Travel Time (in minutes) Between O-D Pairs

	Job Hub - Core Center	Job Hub - Core East	Job Hub - North Corridor	Job Hub - NE Corridor	Job Hub - SE Corridor	Job Hub - SW Corridor
TDI-Core South	9.2	24.6	67.1	59.2	41.5	45.7
TDI-Core West	13.6	31.4	69.6	65.7	45.1	38.4
TDI-Core North	6.8	24.0	53.8	53.9	37.7	55.3
TDI-Core East	14.8	12.4	62.2	27.9	34.2	65.4
TDI-NW Corridor	21.2	39.0	77.3	73.4	52.7	31.1
TDI-North Corridor	45.7	59.7	13.6	53.1	73.4	96.2
TDI-NE Corridor	48.8	44.8	86.2	20.8	45.3	99.4
TDI-SE Corridor	33.5	20.3	99.9	41.9	6.1	99.0
TDI-South Corridor	54.2	56.8	105.1	90.2	37.2	103.9
TDI-SW Corridor	68.7	66.0	124.7	106.3	64.1	32.2

For a handful of closer O-D pairs bike travel is competitive with vehicular travel. However, for most of the trips personal automobiles are the quickest of the four modes. Nearly all walk trips are too long to be considered a reasonably viable option. A trend that carries across all modes is that trips to the Job Hub-Core Center, which is effectively downtown Hartford, are generally quicker than trips to the outlying job hubs. This is likely a result of the region's transportation infrastructure that was historically designed to get travelers into and out of downtown relatively efficiently regardless of mode.

Of particular interest when analyzing travel times at the regional level is the difference in travel time between public transit and private vehicles. Table 18 shows these differences for each of the O-D pairs analyzed, with conditional formatting that shows O-D pairs where transit is closer to auto travel time in green and longer in red. Travel time differences are negligible for the short trips in central Hartford, while longer trips start to show a larger difference in the travel times. However, as illustrated in Table 4-19 (which shows the O-D pair distance divided by the difference in travel time), the largest travel time differences are not necessarily a result of the longest distances. Here the O-D pairs in green indicate trips where the travel time differences are relatively small compared to travel distance while O-D pairs in red where the travel time differences are relatively high compared to the distance. For example, the greatest travel time difference is 43 minutes, between the North Corridor Job Hub and Northeast Corridor TDI area, but there are 9 other O-D pairs with a greater travel distance. The O-D pair between the SE Corridor Job Hub and South Corridor TDI area is only 6.2 miles apart but has a travel time difference of 41 minutes. Essentially, the travel time differences are not solely a function of distance, but also of the quality of transit network service and connections. These discrepancies in travel time and distance point to a transportation network outside the city core that is built largely for personal vehicle travel and lacks good transit options.

Table 4-18: Travel Time Comparison (in minutes) Between Auto and Transit

	Job Hub - Core Center	Job Hub - Core East	Job Hub - North Corridor	Job Hub - NE Corridor	Job Hub - SE Corridor	Job Hub - SW Corridor
TDI-Core South	3.9	12.0	9.2	17.4	21.4	17.9
TDI-Core West	3.0	15.9	11.7	21.5	24.9	7.1
TDI-Core North	4.5	14.1	13.9	20.7	23.2	28.5
TDI-Core East	4.8	4.1	15.2	6.4	11.3	22.5
TDI-NW Corridor	2.0	14.8	10.7	20.5	23.9	6.3
TDI-North Corridor	11.3	22.6	6.7	38.4	31.6	34.2
TDI-NE Corridor	31.3	26.6	43.2	19.5	35.0	39.8
TDI-SE Corridor	14.8	9.2	22.8	20.2	6.4	32.5
TDI-South Corridor	13.5	24.8	20.0	28.0	40.9	28.4
TDI-SW Corridor	19.8	30.2	24.6	32.6	41.4	37.4

Table 4-19: Ration of O-D Pair Distance to Auto-Transit Travel Time Difference (low number indicates large difference in travel time for a relatively shorter distance)

	Job Hub - Core Center	Job Hub - Core East	Job Hub - North Corridor	Job Hub - NE Corridor	Job Hub - SE Corridor	Job Hub - SW Corridor
TDI-Core South	0.4	0.3	1.2	0.6	0.3	0.4
TDI-Core West	0.8	0.3	1.0	0.5	0.3	0.9
TDI-Core North	0.2	0.3	0.6	0.4	0.3	0.3
TDI-Core East	0.5	0.5	0.7	0.7	0.5	0.5
TDI-NW Corridor	1.8	0.4	1.2	0.6	0.4	0.8
TDI-North Corridor	0.7	0.4	0.3	0.2	0.4	0.5
TDI-NE Corridor	0.3	0.3	0.3	0.2	0.2	0.4
TDI-SE Corridor	0.4	0.4	0.7	0.3	0.2	0.5
TDI-South Corridor	0.7	0.4	0.9	0.5	0.2	0.6
TDI-SW Corridor	0.6	0.4	0.8	0.5	0.3	0.1

In calculating the mode share of trips between each of the O-D pairs, the overall number of trips was determined both between each pair and for the Greater Hartford region as whole (see Table 4-20). As expected, the O-D pairs with the highest number of trips are connected to central Hartford. However, there is also a substantial number of trips in some outer parts of the region, such as the Southeast Corridor and the North Corridor.

Table 4-20: Total Trips

	Job Hub - Core Center	Job Hub - Core East	Job Hub - North Corridor	Job Hub - NE Corridor	Job Hub - SE Corridor	Job Hub - SW Corridor	Other	Total
TDI-Core South	32,541	871	95	199	335	445	48,204	82,691
TDI-Core West	20,395	488	70	122	192	425	40,808	62,500
TDI-Core North	13,726	448	82	106	152	137	20,312	34,964
TDI-Core East	1,905	1,403	43	367	175	74	13,797	17,764
TDI-NW Corridor	1,844	139	29	37	45	223	12,550	14,867
TDI-North Corridor	580	119	2,028	134	71	86	12,998	16,016
TDI-NE Corridor	934	607	82	1,763	247	116	29,289	33,037
TDI-SE Corridor	1,113	1,659	72	251	11,135	146	20,627	35,002
TDI-South Corridor	592	196	43	131	305	126	22,637	24,030
TDI-SW Corridor	456	126	28	58	80	967	29,792	31,507
Other	171,455	54,330	21,123	61,893	33,809	51,570	6,018,198	6,412,378
Total	245,541	60,384	23,695	65,062	46,547	54,314	6,269,211	6,764,754

Table 4-21 through Table 4-23 shows the mode share for personal vehicle, transit, and non-motorized modes, respectively. Outside of some of the O-D pairs connected to downtown Hartford nearly all trips are made via personal vehicles, with many pairs at 99% or even 100%. For the region overall, nearly 89% of trips are made by personal vehicles, 11% are by non-motorized modes, and just under 1% are by transit.

Out of 60 O-D pairs, only nine pairs have a personal vehicle mode share that is below the regional mode share of 89%. Regarding transit mode share, many of the O-D pairs tied to central Hartford have a higher share of transit trips than the region overall. Many of the trips that do not connect with the region's core have a very low rate of transit usage. The non-motorized mode share is quite high for the central, short-distance O-D pairs but drops off dramatically for pairs that have greater distance.

Table 4-21: Percent of Trips By Personal Vehicle

	Job Hub - Core Center	Job Hub - Core East	Job Hub - North Corridor	Job Hub - NE Corridor	Job Hub - SE Corridor	Job Hub - SW Corridor	Other	Total
TDI-Core South	36%	96%	97%	93%	94%	92%	70%	57%
TDI-Core West	42%	97%	98%	94%	95%	91%	68%	61%
TDI-Core North	37%	96%	97%	92%	95%	94%	73%	59%
TDI-Core East	69%	87%	99%	94%	97%	97%	82%	81%
TDI-NW Corridor	77%	99%	100%	99%	99%	98%	79%	79%
TDI-North Corridor	93%	100%	82%	99%	99%	99%	88%	88%
TDI-NE Corridor	83%	99%	99%	93%	98%	98%	79%	81%
TDI-SE Corridor	92%	97%	100%	99%	66%	100%	90%	83%

TDI-South Corridor	97%	100%	100%	100%	99%	100%	87%	87%
TDI-SW Corridor	97%	100%	100%	100%	99%	97%	79%	80%
Other	73%	91%	94%	89%	94%	92%	90%	90%
Total	64%	91%	93%	90%	88%	92%	89%	89%

Table 4-22: Percent of Trips by Transit

	Job Hub - Core Center	Job Hub - Core East	Job Hub - North Corridor	Job Hub - NE Corridor	Job Hub - SE Corridor	Job Hub - SW Corridor	Other	Total
TDI-Core South	9%	2%	3%	7%	5%	7%	6%	7%
TDI-Core West	11%	1%	2%	6%	5%	8%	5%	7%
TDI-Core North	11%	1%	3%	8%	5%	6%	5%	7%
TDI-Core East	7%	0%	1%	4%	2%	2%	2%	2%
TDI-NW Corridor	4%	0%	0%	1%	1%	1%	1%	2%
TDI-North Corridor	5%	0%	1%	1%	1%	1%	1%	1%
TDI-NE Corridor	15%	1%	1%	3%	2%	2%	2%	3%
TDI-SE Corridor	4%	0%	0%	1%	1%	0%	0%	1%
TDI-South Corridor	2%	0%	0%	0%	0%	0%	0%	0%
TDI-SW Corridor	2%	0%	0%	0%	1%	0%	0%	0%
Other	5%	0%	0%	2%	1%	1%	0%	0%
Total	7%	0%	0%	2%	1%	1%	0%	1%

Table 4-23: Percent of Trips by Non-Motorized

	Job Hub - Core Center	Job Hub - Core East	Job Hub - North Corridor	Job Hub - NE Corridor	Job Hub - SE Corridor	Job Hub - SW Corridor	Other	Total
TDI-Core South	55%	2%	0%	0%	1%	1%	25%	36%
TDI-Core West	47%	1%	0%	0%	0%	1%	26%	32%
TDI-Core North	53%	2%	0%	0%	1%	0%	22%	33%
TDI-Core East	24%	13%	0%	2%	1%	0%	16%	16%
TDI-NW Corridor	19%	1%	0%	0%	0%	1%	20%	19%
TDI-North Corridor	2%	0%	17%	0%	0%	0%	11%	11%
TDI-NE Corridor	2%	1%	0%	4%	0%	0%	18%	17%
TDI-SE Corridor	4%	3%	0%	0%	33%	0%	9%	16%
TDI-South Corridor	1%	0%	0%	0%	1%	0%	13%	12%
TDI-SW Corridor	0%	0%	0%	0%	0%	3%	20%	19%
Other	22%	9%	6%	9%	5%	7%	10%	10%
Total	29%	9%	7%	9%	11%	7%	10%	11%

4.3.5 Summary

- Mode share and travel time competitiveness varies dramatically between the different O-D pairs; however, transit mode share does not appear to correlate closely with the difference in travel times. As can be seen when the transit share and travel time difference tables are reviewed side-by-side (Table 4-24 and Table 4-25 below), there are several O-D pairs with minimal travel time difference but a still low transit mode share. Many of these, such as TDI Core

East to Job Hub Core East, TDI North Corridor to Job Hub North Corridor, TDI SE Corridor to Job Hub SE Corridor, are within the same corridor but outside the very center of the city. This may indicate transit service that is geared towards moving people downtown rather than serving more local trips outside of downtown. Part of the explanation is likely that some of the trips are of a short enough distance that non-motorized modes represent a higher share of trips, but it also points to other factors beyond travel time (such as service frequency or span) that are potentially influencing the decision of whether to drive or take transit for a given trip analysis looked at data from 2019, the last quarter in particular.

Table 4-24: Travel Time Comparison (in minutes) Between Auto and Transit

	Job Hub - Core Center	Job Hub - Core East	Job Hub - North Corridor	Job Hub - NE Corridor	Job Hub - SE Corridor	Job Hub - SW Corridor
TDI-Core South	3.9	12.0	9.2	17.4	21.4	17.9
TDI-Core West	3.0	15.9	11.7	21.5	24.9	7.1
TDI-Core North	4.5	14.1	13.9	20.7	23.2	28.5
TDI-Core East	4.8	4.1	15.2	6.4	11.3	22.5
TDI-NW Corridor	2.0	14.8	10.7	20.5	23.9	6.3
TDI-North Corridor	11.3	22.6	6.7	38.4	31.6	34.2
TDI-NE Corridor	31.3	26.6	43.2	19.5	35.0	39.8
TDI-SE Corridor	14.8	9.2	22.8	20.2	6.4	32.5
TDI-South Corridor	13.5	24.8	20.0	28.0	40.9	28.4
TDI-SW Corridor	19.8	30.2	24.6	32.6	41.4	37.4

Table 4-25: Percent of Trips by Transit

	Job Hub - Core Center	Job Hub - Core East	Job Hub - North Corridor	Job Hub - NE Corridor	Job Hub - SE Corridor	Job Hub - SW Corridor	Other	Total
TDI-Core South	9%	2%	3%	7%	5%	7%	6%	7%
TDI-Core West	11%	1%	2%	6%	5%	8%	5%	7%
TDI-Core North	11%	1%	3%	8%	5%	6%	5%	7%
TDI-Core East	7%	0%	1%	4%	2%	2%	2%	2%
TDI-NW Corridor	4%	0%	0%	1%	1%	1%	1%	2%
TDI-North Corridor	5%	0%	1%	1%	1%	1%	1%	1%
TDI-NE Corridor	15%	1%	1%	3%	2%	2%	2%	3%
TDI-SE Corridor	4%	0%	0%	1%	1%	0%	0%	1%
TDI-South Corridor	2%	0%	0%	0%	0%	0%	0%	0%
TDI-SW Corridor	2%	0%	0%	0%	1%	0%	0%	0%
Other	5%	0%	0%	2%	1%	1%	0%	0%
Total	7%	0%	0%	2%	1%	1%	0%	1%

4.4 Bus Reliability

4.4.1 Purpose

The purpose of this analysis is to review CT*transit* Hartford Division and CT*fastrak* on-time and other performance statistics. Unreliable transit operation can both delay rider's arrivals at their destinations and require them to start waiting at their origin bus stop sooner than they otherwise would. This in turn lengthens the average transit trip and makes it less competitive with other modes.

4.4.2 Data

The data used was provided by CT*transit* Hartford Division and the National Transit Database (NTD). CT*transit* provided on-time performance data by route by month for September, October, and November of 2019. This data is based on timepoints passed so it measures mid-route on-time performance as well as end point performance. On-time is considered zero minutes early to 5:29 minutes late. The NTD data includes the annual number of major failures and total failures for the CT*transit* Hartford system and for peer systems CDTA, PVTA, and RIPTA. To avoid the effects of the COVID pandemic on transit operations, the

4.4.3 Methodology

The on-time performance data collected was broken down by route ridership, type of route, and day of week to better understand its impact on riders. The raw data on failures received from the NTD was converted into distance between failure data to determine its impact relative to the overall size of CT*transit* Hartford's operation. Data on peer agencies was collected to provide a comparison of CT*transit*'s relative performance on this metric.

4.4.4 Analysis

On-time performance varies significantly by route with Route 101 Hartford New Britain via the busway operating 81.5% on-time and Route 927 Torrington operating at 37.7% on-time. Average on-time performance for all routes was 67.6%. See Table 4-26.

Table 4-26: Overall Weekday On-time Performance

Route	Early	Late	On-time
All Routes	9.2%	23.2%	67.6%
101 Hartford New Britain	6.6%	11.9%	81.5%
927 Torrington	22.6%	39.7%	37.7%

Looking at the 10 most heavily utilized routes, which together carry more than half of all riders in the 66 route Hartford Division, we see that those that operate via the busway, Routes 101 and 128, are among the most reliable in the system at 81.5% and 71.7% on time. On the other hand, the eight most heavily traveled routes that operate solely via local streets are in the bottom one half of routes in terms of on-time performance, averaging 60.1% on-time. Although this is to some extent to be expected given longer dwell times and dwell time variability on heavily traveled routes, it is still significant because it indicates that a large proportion of passengers are exposed to routes that tend to run early or late, increasing the impact on rider's lives. CRCOG is currently conducting a study to look at ways to improve speed and reliability on five major corridors in the region, a program that could have a major positive impact on transportation quality for a large number of people. See Table 4-27.

Table 4-27: Ten Busiest Route On-time Performance

Route	Early	Late	On-time
101- Hartford New Britain	6.6%	11.9%	81.5%
128 Hartford/West Farms/New Britain	9.2%	19.1%	71.7%
System Average	9.2%	23.2%	67.6%
40-42 North Main St.	9.5%	26.6%	63.9%
37-39 New Britain Ave.	10.1%	26.5%	63.4%
60-66 Farmington Ave.	8.7%	29.5%	61.8%
88 Burnside Ave.	8.3%	30.1%	61.6%
83 Silver Lane	8.7%	30.6%	60.7%
50-54 Blue Hills Ave.	11.5%	29.9%	58.6%
31-33 Park St.	8.5%	34.3%	57.2%
47 Franklin Ave.	12.6%	33.4%	54%

Different types of routes, CT*transit* Local, CT*transit* Express, CT*fastrak* BRT, and CT*fastrak* Local, have very different on-time performance levels. CT*fastrak* BRT routes are far more reliable than other types of routes achieving 83.1% on-time levels with 6.0% of buses running early and 10.9% operating late. This is followed by CT*fastrak* Local bus routes, which serve as feeders to the CT*fastrak* main line, sometimes traveling on the busway for part of their trip and other times just serving a CT*fastrak* station. These routes operate 72.3% on-time with 8% running early and 19.7% running late. CT*transit* Local service, which carries the largest proportion of system riders, operates 63.8% on-time with 9.6% operating early and 26.6% late. CT*transit* Express services are the least reliable, however this is partially due to a very high number of buses running early, not a significant problem where there is little or no intermediate ridership where passengers need to wait for buses at timepoints along the route. See Table 4-28.

Table 4-28: Weekday On-time Performance by Route Type

Route Type	Early	Late	On-time
CT*transit* Local	9.6%	26.6%	63.8%
CT*transit* Express	14.8%	23.9%	61.3%
CT*fastrak* BRT	6%	10.9%	83.1%
CT*fastrak* Local	8%	19.7%	72.3%

Weekend on-time performance was similar to weekday. During the three months studied Saturday on-time performance averaged 65.8% and Sunday 68.4%. The proportion of early and late buses was also similar. As on weekdays, CT*fastrak* reported the best on-time performance at 81.8% and 84.3% respectively. See Table 4-29.

Table 4-29: On-time Performance by Day of Week

Day	Early	Late	On-time
Weekday	9.2%	23.2%	67.6%

Saturday	9.3%	24.8%	65.8%
Sunday	8.3%	23.4%	68.4%

In terms of systemwide mechanical failures, CT*transit* Hartford Division had 520 major failures and 4,358 total failures in 2019. This represents 17,303 miles between major failures and 2,065 miles between any failure. Compared to peer agencies, this is comparable for major failures but below the peers in terms of all failures. See Table 4-30.

Table 4-30: Distance Between Failures, CT*transit* Hartford and Peers

Agency	Distance between major failures	Distance between all failures
CT*transit* Hartford Division	17,303	2,065
CDTA (Albany, NY)	15,801	4,045
RIPTA (Providence, RI)	17,093	4,451
PVTA (Springfield MA)	4,819	3,266

Compared to the other CT*transit* Divisions this is relatively low for major failures but comparable for all failures. See Table 4-31.

Table 4-31: Distance Between Failures, CT*transit* Divisions

Agency	Distance between major failures	Distance between all failures
CT*transit* Hartford Division	17,303	2,065
CT*transit* New Haven Div.	33,694	2,250
CT*transit* Stamford Div.	23,310	1,903

4.4.5 Summary

CT*transit* Hartford Division's on-time performance variety by type of route. CT*fastrak* routes, with the extensive transit priority provided by the busway, perform significantly better than CT*transit* Local routes which indicates that interaction with traffic is a major source of reliability problems. CRCOG is currently studying the potential for additional transit priority in the Hartford Region which could lead to major improvements to on-time performance especially for the busiest routes that carry the most people.

Miles between failures at CT*transit* Hartford are similar to peer agencies and other CT*transit* Divisions.

4.5 Safety Assessment

4.5.1 Purpose

The purpose of this analysis is to assess the overall safety of CT*transit* Hartford Division and CT*fastrak*. Public transit is critical in providing equitable safe mobility. Monitoring safety performance over time and compared to similar transit operators can provide insight into safety performance.

4.5.2 Data Sources

National Transit Database (NTD) data collected by the Bureau of Transportation Statistics was used for the CT*transit* and peer agency data analysis. The NTD data includes annual collision, fatality, injury, vehicle, ridership, and revenue mile data. The Bus Occupant Safety Data representing national averages of all transit is provided by the Bureau of Transportation Statistics. The data only includes crashes with a completed police report resulting in property damage, injury, or death. The records do not account for additional crashes that were not reported to the police.

4.5.3 Methodology

The assessment of safety performance metrics uses 2019 as the base year with 2014 as a 5-year historic comparison. Additional comparison was performed against national averages and peer agencies, the Capital District Transportation Authority, and Pioneer Valley Transit Authority. Relevant modes were aggregated and summarized for 2019 and 2014 for the CT*transit* Hartford Division, Capital District Transportation Authority, and Pioneer Valley Transit

Authority from the NTD dataset. Calculations were performed to ascertain rates of fatalities, injuries, and vehicles involved in crashes per 100 million vehicle-miles for comparison purposes with national rates as well as peer agencies.

4.5.4 Analysis

CT*transit safety 2019 existing conditions* - CT*transit* buses in the Hartford Division traveled approximately 10 million vehicle-miles in 2019 while experiencing 34 crashes resulting in a total of 68 injuries involving a total of 64 vehicles. There were no reported fatalities or serious injuries.

CT*transit safety historical comparison* – Service in the CT*transit* Hartford Division expanded significantly between 2014 and 2019, from approximately 6 million vehicle miles to approximately 10 million vehicle-miles in 2019, representing a 51% increase. Similarly, the region showed an increase in collision metrics in the same time period. A comparison of 2014 and 2019 CT*transit* Hartford Division as shown in Table 4-32, shows the rates of collisions and vehicles involved in crashes increased while injury rates declined.

Table 4-32: CT*transit* Hartford Division Bus Safety Data

	2014	2019	Change
Fatalities	**0**	**0**	
Injured persons	**52**	**68**	
Collisions	**15**	**34**	
Vehicles involved in crashes	**25**	**64**	
Vehicle-miles (millions)	**6.431**	**9.679**	**51%**
Rates per 100 million vehicle-miles			
Fatalities	0.00	0.00	n/a
Injured persons	809	703	-13%
Collisions	233	351	51%
Vehicles involved in crashes	389	661	70%

CT*transit 2019 existing conditions safety peer comparison* – Existing 2019 data was compared between the CT*transit* Hartford Division, the Capital District Transportation Authority (CDTA) in Albany, New York, and the Pioneer Valley Transit Authority (PVTA) in Springfield, Massachusetts as shown in Table 4-33. The data show that CT*transit* Hartford Division is underperforming in safety compared to peer agencies and the national average in collisions and injuries. However, CT*transit* Hartford Division did outperform the national fatality average with no deaths in 2019.

Table 4-33: 2019 Existing Bus Safety Data Peer Comparison

	CTtransit	CDTA	PVTA	National
Fatalities	**0**	**0**	**0**	**35**
Injured persons	**68**	**45**	**7**	**15,000**
Collisions	**34**	**20**	**3**	**0**
Vehicles involved in crashes	**64**	**36**	**5**	**74,000**
Vehicle-miles (millions)	**9.679**	**8.410**	**4.877**	**17,980**
Rates per 100 million vehicle-miles				
Fatalities	0.00	0.00	0.00	0.19
Injured persons	703	535	144	85
Collisions	351	238	62	-
Vehicles involved in crashes	661	428	103	411

It is important to note that CT*transit* Hartford Division has seen rapid expansion at 51% growth in vehicle-miles over the five-year period from 2014-2019 while the peer agencies saw more modest growth in the 10-12% range consistent with the national average. This surge in service may have been a contributing factor in the increase in collisions. As shown in Table 4-34, CT*transit* Hartford Division saw a smaller increase in safety related incidents than the CDTA.

Table 4-34: Capital District Transit Authority Bus Safety Data

	2014	2019	Change
Fatalities	**0**	**0**	**n/a**
Injured persons	**38**	**45**	**18%**
Collisions	**11**	**20**	**82%**
Vehicles involved in crashes	**18**	**36**	**100%**
Vehicle-miles (millions)	**7.504**	**8.410**	**12%**
Rates per 100 million vehicle-miles			
Fatalities	0.00	0.00	n/a
Injured persons	506	535	6%
Collisions	147	238	62%
Vehicles involved in crashes	240	428	78%

The PVTA, however, showed significant improvement in all safety metrics over the five-year period (Table 4-35) while nationally bus safety improved at a more modest pace (Table 4-36).

Table 4-35: Pioneer Valley Transit Authority Bus Safety Data

	2014	2019	Change
Fatalities	**0**	**0**	**n/a**
Injured persons	**32**	**7**	**-78%**
Collisions	**7**	**3**	**-57%**
Vehicles involved in crashes	**14**	**5**	**-64%**
Vehicle-miles (millions)	**4.451**	**4.877**	**10%**
Rates per 100 million vehicle-miles			
Fatalities	0.00	0.00	n/a
Injured persons	719	144	-80%
Collisions	157	62	-61%
Vehicles involved in crashes	315	103	-67%

Table 4-36: National Bus Safety Data

	2014	2019	Change
Fatalities	**44**	**35**	**-20%**
Injured persons	**14,000**	**15,000**	**7%**
Vehicles involved in crashes	**69,000**	**74,000**	**7%**
Vehicle-miles (millions)	**15,999**	**17,980**	**12%**
Rates per 100 million vehicle-miles			
Fatalities	0.28	0.19	-32%
Injured persons	86	85	-1%
Vehicles involved in crashes	434	411	-5%

4.5.5 Summary

CT*transit* Hartford Division has seen higher crashes and injuries compared to peer agencies and the national average. However, the rate of injuries has decreased while the system has expanded more quickly than the peer agencies as shown in Table 4-37.

Table 4-37: 2014 vs. 2019 Percent Change Bus Safety Data Comparison

	CT*transit*	CDTA	PVTA	National
Fatalities	n/a	n/a	n/a	-20%
Injured persons	31%	18%	-78%	7%
Collisions	127%	82%	-57%	
Vehicles involved in crashes	156%	100%	-64%	7%
Vehicle-miles (millions)	51%	12%	10%	12%
Rates per 100 million vehicle-miles				
Fatalities	n/a	n/a	n/a	-32%
Injured persons	-13%	6%	-80%	-1%
Collisions	51%	62%	-61%	-
Vehicles involved in crashes	70%	78%	-67%	-5%

4.6 State of Good Repair

4.6.1 Purpose

The purpose of this analysis is to review the CT*transit* bus fleet inventory to assess the average age of the fleet and the percentage of the fleet that exceeds the expected useful life. Maintaining the CT*transit* bus fleet is crucial to ensuring that safe and reliable service can be provided to customers. Understanding the overall state of the bus fleet will also aid in capital planning by identifying when and what rate fleet vehicles will need to be replaced.

4.6.2 Data Sources

The primary data source for this analysis is current fleet data provided by CT*transit*. This dataset included information on the year, make, and model of each bus, as well as the garage to which it is assigned. Supplemental data was also collected from the National Transit Database (NTD). NTD data provided historic fleet information and the data to compare to peer agencies, though the most recent year available was 2019. As a result, and due to reporting differences in the NTD data, data for the CT*transit* fleets differ between the CT*transit* fleet review and the peer agency review.

4.6.3 Methodology

The available fleet information was summarized by make and model for the Hartford and CT*fastrak* garages, as well as for the entire CT*transit* fleet overall to provide context within the agency. The data was used to determine how many buses are nearing retirement age and the number that are beyond retirement age. For this analysis, the retirement age was considered to be 12 years, per Useful Life of Transit Buses and Vans Final Report (dot.gov). The same analysis was also applied specifically to hybrid buses in the fleet. The average fleet age was calculated for the overall fleet as well as for the Hartford and CT*fastrak* garages, both for the overall fleet and by each make and model.

Additionally, a brief peer review was undertaken using NTD asset inventory time series data. The most recent year in this data set is 2019, so the Hartford data is older than the current 2021 data provided by CT*transit* that was used in the direct analysis of the CT*transit* fleet.

- The peer agencies included in the review:
  - Capital District Transportation Authority (CDTA) in Albany, NY
  - Pioneer Valley Transit Authority (PVTA) in Springfield, MA
  - Rhode Island Public Transit Authority (RIPTA) in Providence, RI
  - CT*transit* New Haven

4.6.4 Analysis

The current CT*fastrak* fleet consist of 337 buses, 292 of which are based in the Hartford garage and 45 in the CT*fastrak* garage. The overall CT*transit* fleet consists of 637 buses. As shown in Table 4-38, 15% (49 buses) of the Hartford/CT*fastrak* fleet is above the 12 year retirement age, with 9% (30 buses) nearing retirement (considered to be within two years of retirement age). This compares to 12% of the CT*transit* fleet over the retirement age and 22% nearing retirement. Table 4-39 shows that most of the buses nearing or above retirement age are assigned to the Hartford garage. Of the 45 CT*fastrak* buses, none are nearing retirement age and three are above retirement age.

Table 4-38: Hartford/CT*fastrak* Buses nearing or at Retirement Age, by Make and Model

Make	Model	Grand Total	Total Below 12 yrs	% Below 12 yrs	Total Near Retirement	% Near Retirement	Total Above 12 yrs	% Above 12 yrs
Gillig	30 FT Hybrid	12	12	100%	0	0%	0	0%
MCI	D4500	9	9	100%	6	67%	0	0%
New Flyer	35' Hybrid	3	3	100%	0	0%	0	0%
	40' LF	3	0	0%	0	0%	3	100%
	D40LF	41	0	0%	0	0%	41	100%
	D40LF-Commuter	5	0	0%	0	0%	5	100%
	XD 40	200	200	100%	0	0%	0	0%
	XDE40-Hybrid	39	39	100%	14	36%	0	0%
	No Model Listed	3	3	100%	0	0%	0	0%
Nova	LFS60-Hybrid	22	22	100%	10	45%	0	0%
Total	All Models	337	288	85%	30	9%	49	15%

Table 4-39: Buses nearing or at Retirement Age, by Garage

Garage	Grand Total	Total Below 12 yrs	% Below 12 yrs	Total Near Retirement	% Near Retirement	Total Above 12 yrs	% Above 12 yrs
CT*fastrak*	45	42	93%	0	0%	3	7%
Hartford	292	246	84%	30	10%	46	16%
Total	337	288	85%	30	9%	49	15%

No hybrid models are yet at retirement age in the CT*transit* fleet, but 32% (24 buses) of hybrid buses in the Hartford/CT*fastrak* fleet are nearing retirement (see Table 4-40). All 24 buses nearing retirement are part of the Hartford fleet. This compares to 44% (72 buses) in the overall CT*transit* hybrid fleet nearing retirement age.

Table 4-40: Hartford/CT*fastrak* Hybrid Buses nearing or at Retirement Age, by Make and Model

Make	Model	Grand Total	Total Below 12 yrs	% Below 12 yrs	Total Near Retirement	% Near Retirement	Total Above 12 yrs	% Above 12 yrs
Gillig	30 FT Hybrid	12	12	100%	0	0%	0	0%
New Flyer	35' Hybrid	3	3	100%	0	0%	0	0%
	XDE40-Hybrid	39	39	100%	14	36%	0	0%
Nova	LFS60-Hybrid	22	22	100%	10	45%	0	0%
Total	All Hybrid Models	76	76	100%	24	32%	0	0%

As seen in Table 4-41, the average age of the Hartford/CT*fastrak* fleet is 6.1 years, while the average age of the hybrid vehicles is over two years older, at 8.2 years.

The average age of the overall CT*transit* fleet is 6.8 years, while the average age of the full CT*transit* fleet of hybrid buses is nearly two years older, at 8.6 years.

Table 4-41: Average Age of Buses by Make and Model for the Hartford and CT*fastrak* Fleets

Make and Model	Average of Vehicle Age
Gillig	6.8
30 FT Hybrid	6.8
MCI	5.9
D4500	7.8
New Flyer	5.9
35' Hybrid	9.0
40' LF	14.0
D40LF	15.0
D40LF-Commuter	14.0
XD 40	3.2
XDE40-Hybrid	8.4
No Model Listed	1.0
Nova	8.4
LFS60-Hybrid	8.4
Overall Average	6.1

According to data downloaded from the NTD, the Hartford/CT*fastrak* fleet grew substantially in recent years, from 241 buses in 2014 to 295 buses in 2019. The average age of the Hartford/CT*fastrak* fleet decreased from 8.8 years in 2014 to 5.9 years today. However, the average age of the fleet without the younger CT*fastrak* buses is 7.1 years. Table 4-42 and Table 4-43 shows how the Hartford/CT*fastrak* fleet compares to several peer transit agencies. The Hartford/CT*fastrak* fleet has seen similar growth to the CT*transit* New Haven Division, PVTA, and CDTA. The average age of the Hartford bus fleet decreased by 1.7 years from 2014 to 2019, while peers at PVTA, CDTA, and RIPTA saw their average fleet age increase between 0.6 years to 6.2 years. CT*fastrak* service began in 2015 with 12 buses and increased to 30 buses in 2019.

Table 4-42: Fleet Comparison to Transit System Peers

Agency	Mode	2014 Buses	2019 Buses	Absolute Change	% Change
CT*transit* - Hartford Division	Standard Bus	241	265	24	10%
CT*transit* - Hartford CT*fastrak* Division	BRT Bus		30	30	-
CT*transit* New Haven Division	Standard Bus	125	137	12	10%
Pioneer Valley Transit Authority (PVTA)	Standard Bus	171	189	18	11%
Capital District Transportation Authority (CDTA)	Commuter Bus	14	16	2	14%
Capital District Transportation Authority (CDTA)	Standard Bus	222	252	30	14%
Rhode Island Public Transit Authority (RIPTA)	Standard Bus	232	232	0	0%

Table 4-43: Average Age of Buses Compared to Transit System Peers

Agency	Mode	2014 Average Age	2019 Average Age	Absolute Change	% Change
CT*transit* - Hartford Division	Standard Bus	8.8	7.1	-1.7	-19%
CT*transit* - Hartford CT*fastrak* Division	BRT Bus		5.0	5.0	-
CT*transit* New Haven Division	Standard Bus	9.7	3.5	-6.2	-64%
Pioneer Valley Transit Authority (PVTA)	Standard Bus	5.6	8.8	3.2	58%
Capital District Transportation Authority (CDTA)	Commuter Bus		0.0	0.0	-
Capital District Transportation Authority (CDTA)	Standard Bus	7.5	6.9	-0.6	-8%
Rhode Island Public Transit Authority (RIPTA)	Standard Bus	5.1	7.7	2.6	52%

4.6.5 Summary

Overall, the majority of CT*transit*'s Hartford/CT*fastrak* fleet is below retirement age, and both the proportion of the fleet and average vehicle age are younger than the overall CT*transit* fleet. However, there are 49 buses that are due to be replaced based on FTA standards, with another 30 buses due in the next two years. Of the 30 buses nearing retirement, 24 are hybrid models, though no hybrid models ae yet above the retirement age of 12 years. The average age of the Hartford fleet as reported in 2019 was similar to the average fleet age of the peer agencies.

4.7 Resiliency

Resiliency in the bus transit system is primarily related to the susceptibility of key facilities to flooding. The main physical facilities utilized by the CT*transit* and CT*fastrak* systems are the Hartford Maintenance Facility on Leibert Road just north of downtown and the CT*fastrak* busway extending to New Britain from downtown Hartford. The bus facility is on the Connecticut River and protected by a levee, although some small amount of flooding was recently experienced during a heavy rainfall. CT*transit* is monitoring this situation. The CT*fastrak* busway has not experienced any flooding since it was opened.

5 Rail Service Assessment

5.1 Introduction

This chapter includes existing conditions analysis of passenger and freight rail lines and operations within the study area. It highlights the role of Hartford passenger rail line in the overall Northeast Corridor rail operation and provides a context for linking study area rail service performance and opportunities with the regional rail system. The analysis includes summary of operation, station and parking facilities, level of service, and ridership data. The ridership assessment focuses on pre-COVID ridership information with discussion of pandemic impacts on ridership and passenger ridership recovery projections for post-COVID operations.

5.2 Passenger and Freight Operations Review

The following section details the passenger and freight rail operations within the GHMS study area. The section additionally addresses future infrastructure and service plans, and ongoing transit-oriented development (TOD) efforts in the study area. Passenger operations occur over the Hartford Line, which runs 62 miles north-south between New Haven, Connecticut, and Springfield, Massachusetts. Passenger service is operated by CT*rail* and Amtrak, with Amtrak service extending through Massachusetts and into Vermont as well as service to New York and along the Northeast Corridor to Washington, DC. Freight operation occurs over portions of the Hartford Line as well over the Suffield branch and numerous other rail lines in the region. Freight rail within the study area is operated by Genesee & Wyoming, under the subsidiary names of Connecticut Southern Railroad, New England Central Railroad and Providence and Worcester Railway Company; a small short line Central New England Railroad (CNZR) and by Canadian National Railway and CSX. Connecticut's freight rail network is connected to national freight rail networks and the ports in New London and New Haven.

5.3 Passenger Rail Service

5.3.1 Hartford Line Passenger Rail Service

CT*rail*-operated passenger rail service was reestablished in the corridor in the spring of 2018 following significant investments ($769.1 million over the life of the New Haven Hartford Springfield (NHHS) program) into infrastructure and equipment. The latter half of the 20th century saw significant disinvestment and loss of intercity rail service along the corridor in conjunction with economic recession. Prior to this, (the 1950s and 1960s) the region was well connected to the Northeast Corridor, as well as north into Massachusetts and Vermont.

Before 2018 Amtrak operated limited regional service over the line to all Hartford Line stations except New Haven / State Street. The new Hartford Line service is jointly operated by Amtrak and CT*rail* Service. Agreements between MassDOT and CTDOT allow for ticket reciprocity to facilitate these combined operations.

Figure 5-1 shows the Northeast Corridor passenger rail system depicting location of the Hartford Line and GHMS study area. The Hartford Line serves nine existing rail stations. The Berlin, Hartford, Windsor, and Windsor Locks stations are all within the GHMS study area.

An additional five stations are proposed on the Hartford Line as part of the overall New Haven-Hartford-Springfield Rail Program. Two of those stations (Newington and West Hartford) would be in the GHMS study area when constructed.

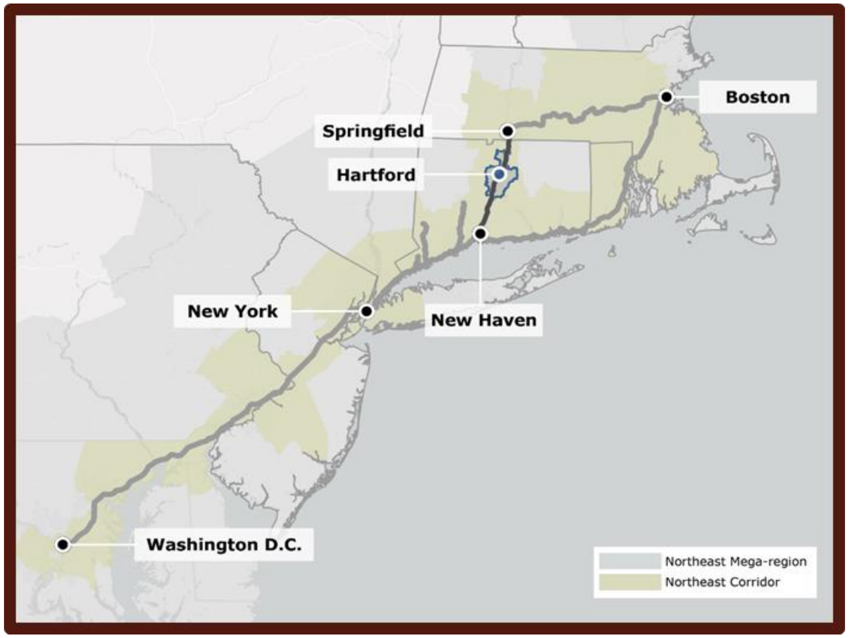

Figure 5-1: Regional Rail Overview

5.3.1.1 Infrastructure and equipment investment (general and highlighting GHMS area stations)

As noted earlier, significant investments in rail infrastructure and equipment were necessary to allow higher travel speeds and increase system reliability. The work included improvements to track, upgrades to bridges and grade crossings, as well as improvements to existing stations. While a majority of the work has been completed there are still additional track and station projects programmed for the near future. The following section summarizes the work completed to date.

Track Improvements: Historically the Hartford Line was double-tracked; however, in the mid-1980s Amtrak removed approximately 25 miles of one track to reduce the costs for upkeep and maintenance. In a single-track condition, Amtrak operations relied on sidings to facilitate train movements on the line. While managing train movements on a single-track system was possible prior to Hartford Line operations, the increased service density associated with the addition of Hartford Line service would limit speeds and make train movements over the line more difficult. As part of the New Haven Hartford Springfield (NHHS) rail program, CTDOT reinstalled approximately 27 miles of track (MP 7-17, MP 20-31, and MP 37-43) and installed two (2) miles of new passing sidings (MP 37-39) to replace lost double-tracking and accommodate increased service density from the Hartford Line operations. It should be noted that there are plans to complete additional double-tracking between Windsor and the Connecticut/ Massachusetts border where the alignment is still in a single-track configuration.

In addition to new double-tracking, the signal and control systems were upgraded/ replaced to facilitate the inclusion of Positive Train Control (PTC) to meet FRA regulations. A PTC system is designed to prevent train-to-train collisions, ensure that trains are not operated above allowable speeds, and improve the general safety of rail operations. The track upgrades and new signal system now allow for speeds on the line of up to 110 mph over certain sections.

Bridges and Grade Crossings: Beyond the track and signal improvements, work completed also included upgrades to grade crossings and rehabilitation or replacement of some bridges and culverts. The Hartford Line has 30 at-grade crossings over its alignment. Upgrades to existing grade crossings in Wallingford, West Hartford and Windsor helped allow for increases in maximum allowable speeds (MAS) and improved at-grade crossing safety.

Equipment: The Hartford Line operates a combination of CT*rail* diesel push-pull equipment and Amtrak push-pull equipment. The CT*rail* locomotives are GP40 and P40 diesel locomotives. The GP40s have received top-deck overhauls and complete overhauls to the P40 fleet are currently underway. The CT*rail* trips operate with leased coaches from the Massachusetts Bay Transportation Authority (MBTA), which are arranged in 4-car sets.

Drainage and Flooding: Effective drainage is key to the safe operation of the rail line. The ponding or flow of water over tracks may damage switches, lead to erosion, or generate premature wear to ties and tracks. Drainage and flooding concerns were heavily considered within the NHHS rail program and independently by corridor communities. Despite these recent efforts periodic flooding of tracks persists in certain locations and has led to recent train delays, including August 19, 2021 when five trains were delayed due to flooding.

Hartford Area Levee System: Rail lines in the GHMS area, including the Hartford Line, operate within and adjacent to flood hazard areas. In the vicinity of Hartford rail lines (the Hartford Line and six freight operators) and the roadway network are protected by a levee network on either side of the Connecticut River from Brainard Airport (south) to exit 34 of I-91 (north) where there is a flood control gate. The levee network was developed following catastrophic flooding in the mid-1930s, construction of the dikes began in 1938 and were completed in 1944, an additional two pumping stations and an auxiliary conduit were completed in 1981. There are five gates on the west side of the river and two on the east. Flood control gates exist where there is gap in the levee to allow either a roadway or rail line to pass through and can be closed to prevent flooding in protected areas.

Stations and Platforms: As previously mentioned, the Hartford Line currently serves nine stations between New Haven / Union Station and Springfield / Union Station as shown in Figure 5-2. This includes two stops on the New Haven Line, seven on the Hartford Line proper, and its northern terminus in Springfield MA. Five additional stations are proposed to be constructed in Connecticut as part of the New Haven-Hartford Springfield Rail Program, as well as potential service extension further north to Greenfield, Massachusetts, at the current northern terminus of Amtrak's Valley Flyer service.

Most stations along the Hartford Line have either been recently reconstructed or undergone extensive renovations to expand station amenities and improve access. The only existing stations which have not received upgrades are Windsor and Windsor Locks: however, reconstruction at both of these sites to include additional amenities and high-level platforms is programmed in the Capital Plan.

Table 5-1 highlights improvements by station.

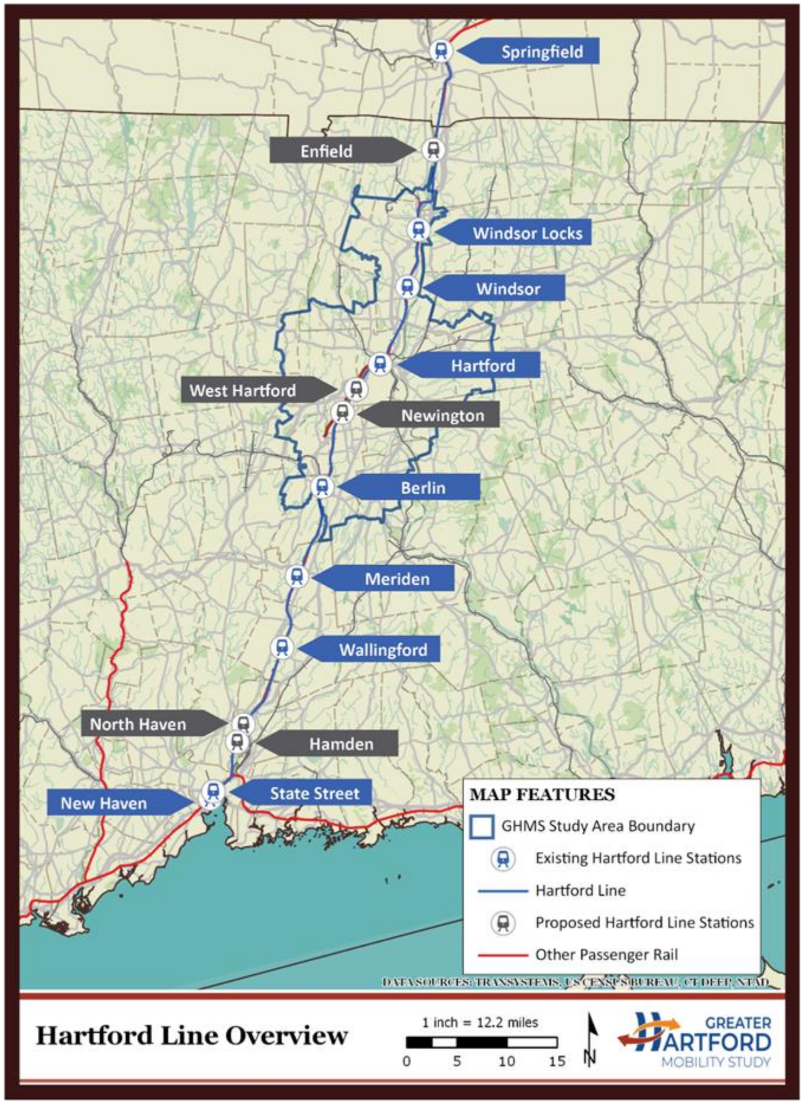

Figure 5-2: Hartford Line Overview

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Table 5-1: Summary of Station Improvements

Station	Improvements
Springfield	Springfield Union Station was reconstructed through a combination of federal and state contributions. The interior and exterior of the building were refurbished to bring the site into a SOGR while maintaining key historic features. The renovation also included the creation of an intermodal bus hub and a new parking garage.
Windsor Locks	Windsor Locks Station has not yet been reconstructed or improved. Funding for station reconstruction is available and final designs are in process. The new design includes additional parking, high-level platforms, and a dedicated bus transfer zone. An illustrative plan for the station can be seen in Figure 5-14.
Windsor	The construction of a new Windsor Station is currently in progress. The design includes additional parking and high-level platforms. The station renovations are integrated with the town's TOD plan (an overview of this plan can be found in Section 5.7.3.
Hartford	Prior to Hartford Line operations, the platform area received upgrades to its infrastructure that include high-level platform structures which can retract to facilitate oversized freight movement. The station also received upgrades to its amenities including a new passenger information system, benches, and security improvements.
Berlin	The Berlin station was reconstructed as part of the NHHS rail program and opened in October 2018. The station now includes significantly increased parking availability, high-level platforms, and a pedestrian overpass.
Meriden	The Meriden station was reconstructed as part of the NHHS rail program and opened in November 2017. The station includes parking for approximately 65 vehicles (below current CTDOT 200 vehicle standard), high-level platforms, and a pedestrian overpass.
Wallingford	The Wallingford station was reconstructed as part of the NHHS rail program and opened in November 2017. The station now includes increased parking availability, high-level platforms, and a pedestrian overpass with an elevator.
New Haven State Street	The State Street station received upgrades to its platforms and station facilities including a new 344-foot ADA compliant high-level platform for Track 1. The renovations to this station were completed in January 2019.
New Haven Union Station	There are currently no major improvements planned for the station as part of ongoing work on the Hartford Line.

Parking: This section provides a broad overview of parking at all stations along the Hartford Line as well as a more in-depth assessment of parking conditions in and around Hartford Union Station. Parking operations vary along the line with the more urban and higher demand stations having a pay-to-park model and the less urban stations providing free parking. To align with CTDOT policy, all renovated stations were upgraded to a minimum of 200 spaces, with only Windsor and Windsor Locks currently below this threshold. Table 5-2 provides an overview of parking availability by station.

Table 5-2: Parking Capacity and Fee Structure

Station	Capacity	Annual Permit Fee	Monthly Parking Fee	Daily Parking Fee
Springfield	377		$95.00	N/A[1]
Windsor Locks	30	N/A	N/A	N/A
Windsor	22	N/A	N/A	N/A
Hartford	200		$90.00	$15.00
Berlin	235		$20.00	$2.00
Meriden	65 (surface)		$20.00	$2.00
	225 (garage)		$20.00	$2.00
Wallingford	221		$20.00	$2.00
New Haven State Street	0[2]			
New Haven Union Station	1,135	N/A	$97.00	$14.00

Hartford Union Station Parking Availability[3]

A parking assessment for the study area was performed to determine the inventory of existing parking near Hartford Union Station. As part of the parking assessment, previous parking studies of the area were reviewed along with existing public parking within a quarter mile of Union Station.

The capacity of parking was determined based on access to public users, not including private or

[1] Springfield Union Station uses the Union Station Garage which does not offer daily rates, the garage offers hourly and monthly rates and a separate monthly commuter rate.
[2] There are no dedicated spaces for the State Street station and the location only offers a drop-off/pick-up zone. However, there are several proximal parking alternatives.
[3] For additional information on Hartford Union Station and its inter-modal connectivity please see chapter 9.

reserved parking areas. In addition, pricing information was obtained to provide a comprehensive assessment of parking near Union Station.

In the past 11 years, three parking studies were conducted to address parking near Union Station. These reports produced varying results across a variety of study areas. The major results of these studies are detailed below. In addition, a comprehensive city-wide parking study is currently underway in Hartford.

The Northwest Corridor Transit Planning Project Part 2 – Union Station Planning: Final Report, prepared by TranSystems in 2010, analyzed the parking capacity near Union Station with the purpose of comparing development alternatives in the area. The report determined there to be 1,484 parking spaces in lots/garages and 137 on-street spaces within 1/3 mile from Union Station accessible to patrons.

The Analysis, Needs, and Deficiencies Report, prepared by the I-84 Hartford Program Management Team in 2015, reviewed the amount of parking in a study area that included Union Station. According to the report, the Union Station/Spruce Street lot has 215 public spaces that are on average 95% utilized. It further indicated that lots on Church Street and High Street add 288 more public parking spaces. The Church Street lot recorded a low utilization (just 10%) during this survey and at the time of review the High Street lot was evening parking only and utilization wasn't calculated.

The I-84 Multimodal Station Parking Demand Memorandum, prepared by the I-84 Hartford Program Management Team in 2018, assessed the parking around Union Station as part of the planning for a new multimodal station. To that end, the memorandum reviewed parking needs and capacity for all modes of travel planned for the station. The memorandum reported 889 publicly accessible parking spaces within ¼ mile radius of Union Station but noted that some lots are only available to monthly or evening users.

5.3.1.2 Capacity

There are eight (8) publicly accessible parking areas within ¼ mile of Hartford Union Station, totaling 2,793 parking spaces. Table 5-3 provides a summary of the parking capacity and pricing information for these parking areas. Of these areas, two are garages with monthly rates, while the remaining six (6) lots are available for daily or monthly use.

The closest parking area to Union Station is the Spruce Street lot adjacent to the station. As summarized in Table 5-3, the Spruce Street lot has a capacity of 200 parking spaces and a maximum daily rate of $15. There are another 100 spaces across the street at the Church Street lot and an additional 80 parking spaces at the High Street lot behind the station. These lots are all within 150 yards of the station or less than a tenth of a mile.

There are approximately 232 metered spaces within a ¼ mile directly around the station. These spaces are part of the Pay to Park system in downtown Hartford. The rate for on-street parking is $0.25 per 15 minutes, with a two-hour time limit. On-street parking is free of charge after 6 PM and on weekends. While it is unlikely that metered on-street parking would be used by commuters these spaces could be used by individuals waiting for drop-off or pick-up.

The abundance of parking in the ¼ mile area, while shared with non-transit users, is more than sufficient for the current outbound usage of Hartford Union Station. Both an excess of parking or insufficient parking could negatively affect rail and transit use and the efficiency of the rail station. The negative influence of insufficient parking is particularly true for those users who generally live outside of what is considered walking distance (¼ mile to ½ mile) from the station and who are seeking longer distance intercity travel services at Union Station. On the other hand, an excess of parking encourages users to drive, rather than consider transit for their connecting trip, because parking is easily available and private automobiles are generally considered more convenient than transit. Finding the balance between excess and inadequate parking is key to accommodating riders and encouraging transit use at Union Station.

Table 5-3: Hartford Union Station Parking (1/4th mile)

Name	Address	Capacity	Daily Fee	Monthly Fee	Notes
Church St Lot	460 Church St	100			
Spruce St Lot	2 Spruce St	200	$15	$90	
High St Lot	409 Church St	80			
Allyn St Lot	180 Allyn St	280		$115.92	
Saints Lot	285 Church St	250		$116.60	
Capitol Lot	10 Ford St	288		$132.94	
Metro Garage	350 Church St	1215	-	$191.43	Monthly Only
Hartford 21 Garage	210 Asylum St	380	-	$242.92	Monthly Only

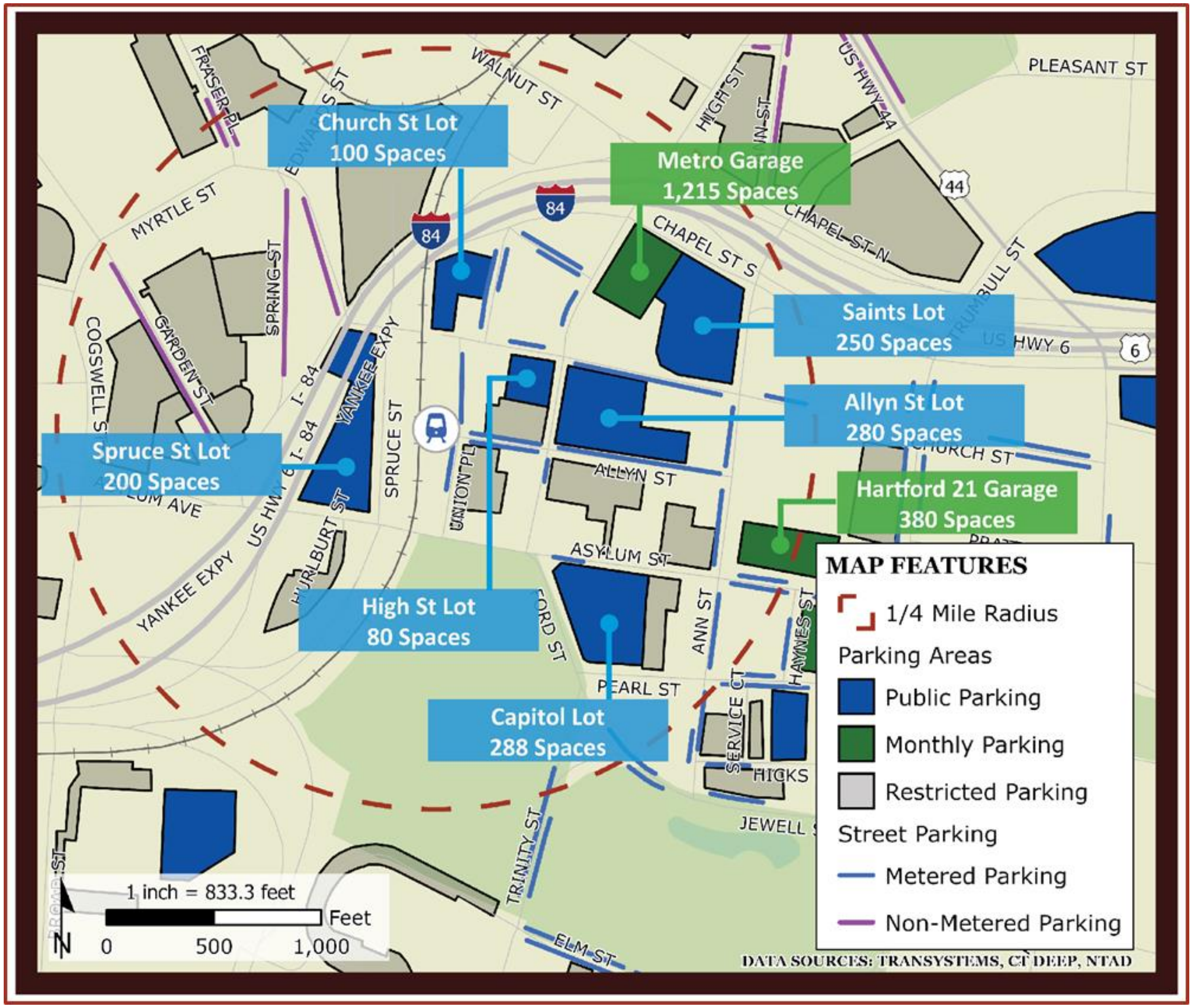


Figure 5-3: Hartford Union Station Parking Availability

5.3.1.3 Level of service (general and highlighting GHMS area stations)

> *The existing service on the Hartford Line is a result of the significant investments to improve the operating condition of the line which now allow for speeds up to 110mph and travel between New Haven and Springfield in as little as 81 minutes.*

However, the CT*rail* equipment and leased MBTA coaches are not permitted to reach the line's MAS (maximum allowable speed) and may only travel at up to 80mph, while Amtrak equipment is permitted to reach the line's 110mph MAS. The level of service varies along the line, with the New Haven to Hartford portion receiving a higher level of service than those stations north of Hartford. Most CT*rail* trips terminate/originate in Hartford and therefore do not continue to Windsor, Windsor Locks, or Springfield. All of the Amtrak trips continue to Springfield as part of Amtrak's regional services. In total 70% of Hartford Line trips continue to terminate in Springfield.

The information provided below presents the line's pre-pandemic operations and is based on a schedule published in November 2019.[4] The Hartford Line operates with 17 northbound trips servicing Hartford, with 12 of those continuing onto Springfield. There are 16 southbound trips with 11 originating in Springfield: the remaining trips originate from Hartford. This means that stations in the southern portion of the study area (Berlin and Hartford) receive a higher level of service than those in the northern portion (Windsor and Windsor Locks). Windsor and Windsor Locks each receive one additional trip in the southbound and northbound directions compared to Springfield. These trips were added to the November 2019 schedule and do not appear on previous schedules.

Headways for trips vary for both inbound and outbound trains given the service frequency noted above. Headways for outbound trains terminating in Hartford range between 40 minutes and 1 hour 26 minutes with a service gap of nearly four hours between 11:35 am and 3:26 pm.

Headways for Springfield-terminating trips are between 37 minutes and 1 hour 23 minutes. The first Springfield-terminating train does not depart New Haven until 8:15 am for a 9:47 am arrival in Springfield.

Trips between New Haven and Hartford average 52 minutes and trips between New Haven and Springfield are between 1 hour 23 minutes and 1 hour 32 minutes. The durations of equivalent southbound trips are similar. An automotive trip between New Haven

[4] Beginning in March of 2020 stay-at-home orders results from the COVID-19 pandemic led to significant decline in ridership leading to service modifications.

and Hartford during the peak AM period is estimated between 40 and 50 minutes depending on traffic, and an automotive trip between New Haven and Springfield during the same period is estimated at 1 hour to 1 hour 15 minutes.

> *The travel times between New Haven and Hartford are almost similar for rail and auto trip, making rail as a reliable and competitive alternative.*

5.3.1.4 Ridership

While the COVID-19 pandemic (beginning in March 2020) has significantly altered rail and transit ridership in the short-term, including on the Hartford Line, the Hartford Line had seen successive years of ridership growth since its inception. During the first year of operation, ridership exceeded pre-operation projections and served a monthly average of 50,000 riders. The following year (2019) the line averaged 60,882 riders per month and around 730,000 for the year. Moreover, January of 2020 saw the highest single-month ridership with more than 73,000 riders. Between June 2018 and January 2020 ridership grew by 114.65%.

The graph below (Figure 5-4) portrays Hartford Line ridership between January 2018 and December 2020. The logarithmic trend lines are the results of modeling pre-pandemic ridership, as well as the application of research from Virginia published in the summer of 2020. The Northern Virginia Transportation Authority engaged in a scenario planning exercise to explore possible futures resulting from the disruption caused by the COVID-19 pandemic. A key metric in their modeling was work-from-home trends and the role of a decreased commuter base on future transit ridership. Across their three modeled recovery scenarios, looking out to a 2025-time horizon, the projections indicated the possibility for 15%, 22%, and 37% reductions due to differing levels of continued work-from-home. These values for reduced future ridership were then used to forecast possible future ridership on the Hartford Line given the continued increase in work-from-home scenarios.

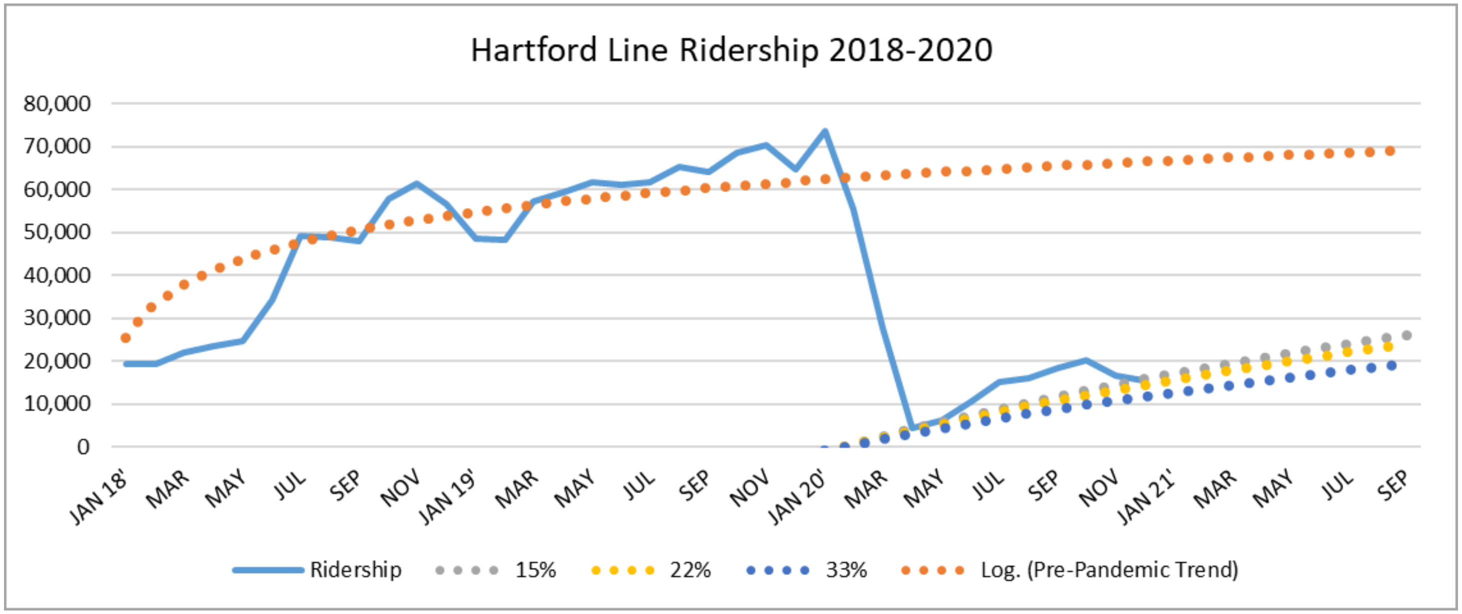


Figure 5-4: Hartford Line Monthly Ridership (2018-2021)

Data Source: CTDOT Office of Rail and AECOM Analysis

It is important to note that projections of this type are highly sensitive to the limited existing data and do not account for additional variables. The actual recovery of ridership will continue to evolve based on changes in infection rates and increasing vaccination levels, among other factors. Additionally, the work-from-home methodology only captures one type of rider, the daily commuter, and does not account for more regional use of the line. What should be understood about the Hartford Line is that before the onset of the COVID-19 pandemic the line was 1) doing well, 2) growing, and 3) had just seen its single highest ridership month. The pre-pandemic trend line attempts to approximate what current (2021) ridership may have been if there had been no dip associated with the pandemic. Additionally, the three recovery trend lines attempt to provide some insight as to how ridership levels may evolve over the short term (September 2021). Additional research around these trends is ongoing as the situation rapidly evolves. The state is actively working on creating new longer-term forecasts as they work to update the State Rail Plan and continue projects under CT*rail* Strategies.

5.3.2 Hartford Line Intercity Service

Beyond the joint services operated by CT*rail* and Amtrak between New Haven and Springfield, Amtrak also operates intercity service which connects the New York City market to Vermont, as well as eastern (Boston) and western (Pittsfield) Massachusetts. A majority of the Amtrak trips made over the line as part of Hartford Line service (northbound) are part of Amtrak's regional service. The corridor is part of a larger regional rail network, which affords connections throughout the Northeast and across the country over Amtrak's national service network.

5.3.2.1 Level of Service

Before operation of the Hartford Line, Amtrak services allowed for limited connections along the corridor through their Vermonter and Valley Flyer services. While not designed as a commuter system it was possible to commute via Amtrak's regional service. All of the original Hartford Line Stations (excluding State Street) were serviced daily by Amtrak trips along the corridor.

The map below (Figure 5-5) depicts Amtrak's regional rail network. Services that interface with the Hartford Line include Acela (Northeast Corridor), and Lake Shore Limited. Services that operate over the Hartford Line include Amtrak Hartford Line (trips included in the Hartford Line schedule), Northeast Regional, the Valley Flyer, and the Vermonter. These services provide connections throughout the Northeast and to Amtrak's national rail network.

Acela (NEC): The Acela is the primary Amtrak connection along the Northeast Corridor (NEC) and provides limited-stop service between Washington DC and Boston Massachusetts. The service includes a stop at Union Station in New Haven which facilitates connections to other Amtrak services and the Hartford Line.

Lake Shore Limited: The Lake Shore Limited provides daily service between Chicago Illinois and Boston Massachusetts and is currently the only rail connection between Springfield and Boston. One eastbound and one westbound trip are operated daily. Travel time between Chicago IL and Boston MA is 19 hours, while travel time on the service between Springfield MA and Boston MA is 2 hours 30 minutes.

Valley Flyer: The Valley Flyer operates as a regional connection along the Knowledge Corridor between New Haven, CT, and Greenfield, MA with trips seven-days per week. Travel time between New Haven and Greenfield is 2 hours 48 minutes.

Vermonter: The Vermonter is an intercity city service that operates daily between Washington DC and St. Albans Vermont. Travel time between the two termini is 13 hours 45 minutes.

Hartford Line (Amtrak trips): The Hartford Line service consists of CT*rail*-operated trains and Amtrak-operated trains with ticket reciprocity between the two providers over the line. Amtrak operates 8 northbound trips and 8 southbound trips, and unlike the CT*rail* trips, all of the Amtrak-operated trips continue to Springfield as opposed to terminating in Hartford or Windsor Locks. The Amtrak trips operated over the Hartford Line are part of Amtrak's Northeast Regional Service. Northeast Regional service provides intercity service across the northeast, traveling as far south as Virginia Beach and as far north as Boston MA.

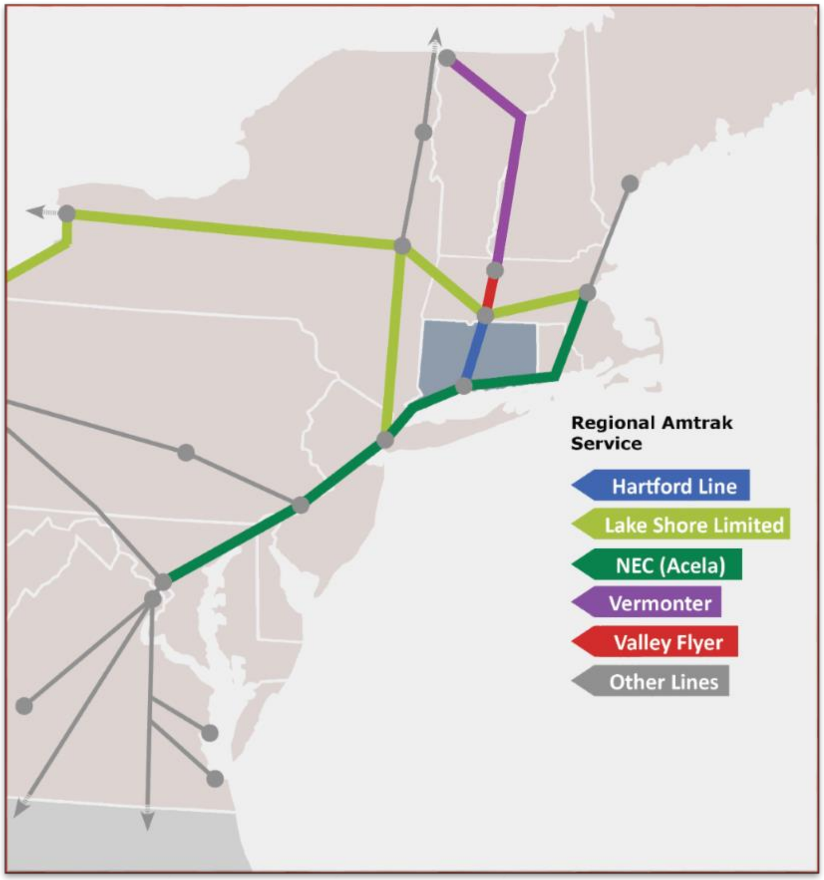


Figure 5-5: Amtrak Regional Rail Network

5.4 Freight Rail Operation

Freight rail is operated throughout the state and includes operations over passenger lines, including the Hartford Line and Northeast Corridor (NEC), as well as private branches. Freight rail is used as a more efficient alternative to truck freight to move large quantities of bulk goods. Within the GHMS study area, all of the freight lines connect to the Hartford Line with interconnections in Berlin, Hartford, and Windsor Locks.

Figure 5-6 provides an overview of freight rail operators within and adjacent to the GHMS study area.

There are currently five different freight rail providers operating in the GHMS study area.

- Canadian National Railway (CNR)
- Connecticut Southern Railroad (CSO)
- CSX
- Central New England Railroad (CNZR)
- Providence and Worcester Railroad Company (P&W)

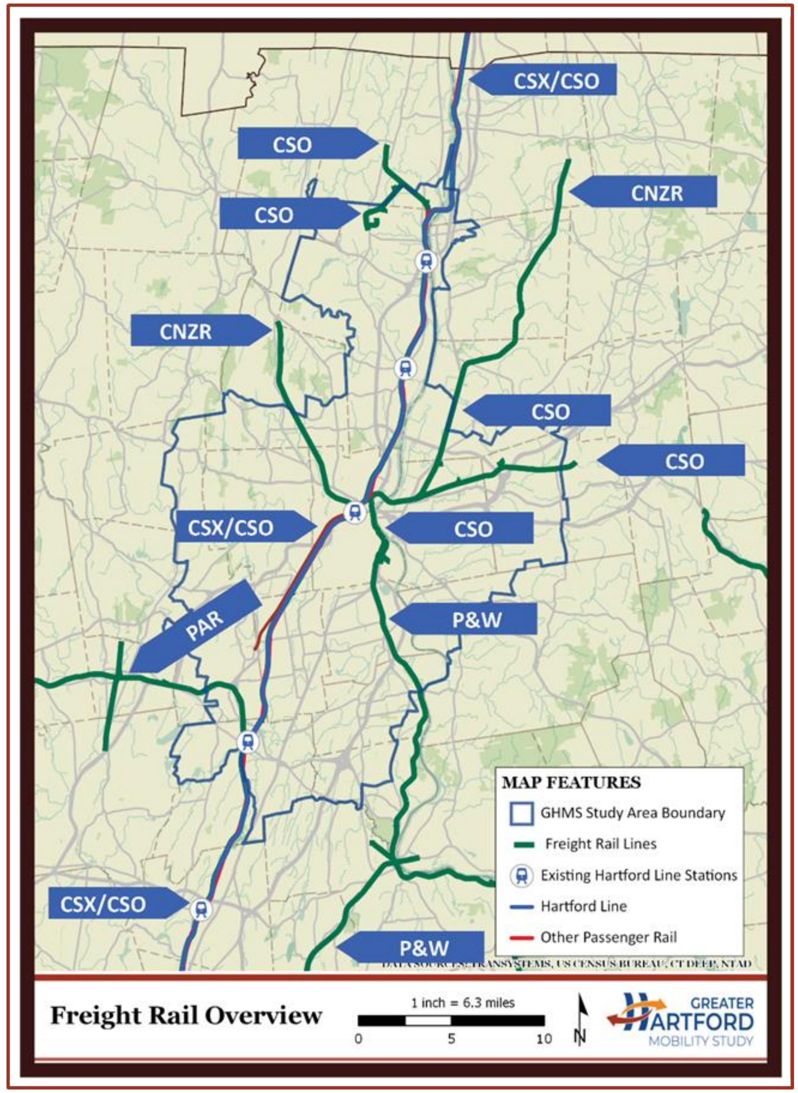


Figure 5-6: Freight Rail Overview

5.4.1 Goods Movement

Freight coming into Connecticut generally includes crushed stone (gravel and sand), primary metal products, grains and food products, lumber, pulp and paper products, chemicals, and petroleum. Outbound rail freight primarily consists of construction and demolition debris (wood debris, flooring, roofing, etc.), which is first processed for recyclables then transported to the Midwest where the non-recyclable content is disposed of in large landfills. The future matrix of inbound and outbound goods will be dependent on changing market conditions within the state as well the continuity between the state and national freight rail systems. Table 5-4 highlights forecasted growth for freight shipments throughout the region.

Table 5-4: Forecasted Growth in Rail Freight by Shipment Direction from 2019 to 2045

Direction	2019		2045		Growth (2019-2045)		
	Tons	Percent	Tons	Percent	Change	Percent Change	CAGR (%)
Inbound	1,112,928	26.9%	1,943,921	34.0%	830,993	74.7%	2.2%
Outbound	2,177,708	52.6%	2,689,338	47.0%	511,630	23.5%	0.8%
Intrastate	280,164	6.8%	406,669	7.1%	126,505	45.2%	1.4%
Through	573,148	13.8%	684,331	12.0%	111,183	19.4%	0.7%
Total	4,143,948	100.0%	5,724,259	100.0%	1,580,311	38.1%	1.3%

Source: 2019 Waybill Sample data and FAF4.5.1

Table 5-5 presents the tonnage moved, by direction, in 2019 .

Table 5-5: 2019 Rail Freight Tonnage and Value in Connecticut by Direction for Shipments of All Distances

Direction	Tons		Value (2019 $)	
	Amount	Percent	Amount	Percent
Inbound	1,112,928	26.9%	61,410,448	40.0%
Outbound	2,177,708	52.6%	57,246,360	37.3%
Intrastate	280,164	6.8%	1,823,692	1.2%
Through	573,148	13.8%	33,037,520	21.5%
Total	4,143,948	100.0%	153,518,020	100.0%

Source: 2019 Waybill Sample data

5.4.2 System Capacity

Recent rail plans emphasized the need to address the weight capacity of the system to allow the Connecticut rail system to better integrate with the national freight network. The current national standard for freight rail is 286,000 pounds per car (also known as 286k), and in some instances this is being increased to 315,000 pounds per rail car. Rail lines that do not meet this standard are economically disadvantaged because operators are not able to transport the same quantity of goods over the lower weight class territory, either making the shipping more expensive or unfeasible to use the system entirely. Under public ownership, both the Hartford Line and New Haven Line are not cleared for 286K capacity. While the track work undertaken as part of the NHHS Rail Program did lift certain sections up to the 286k standard there are still a significant number of structures over 100 years old which do not meet the standard, including the Connecticut River Bridge in Windsor Locks. Figure 5-7 provides a summary of freight rail weight classes statewide as well as investment prioritization from the previous State Rail Plan.

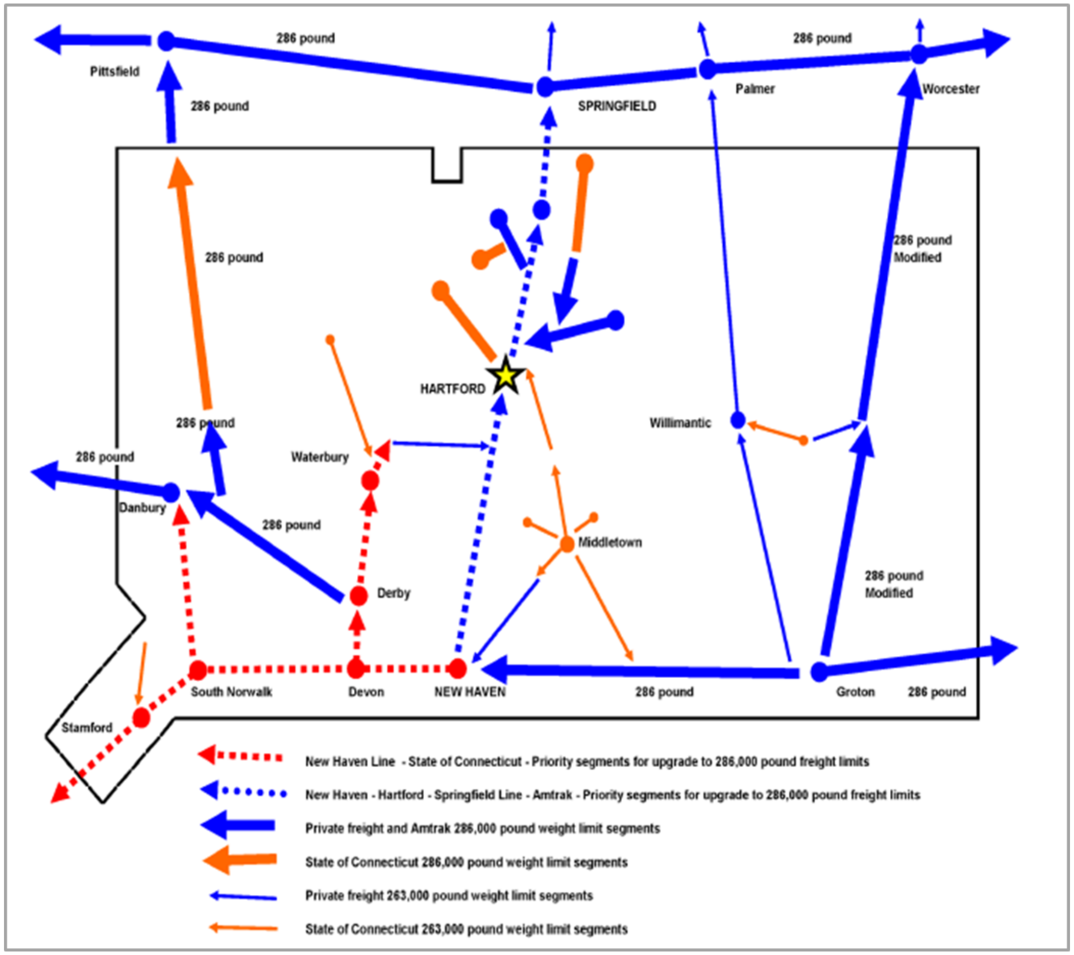


Figure 5-7: Freight Rail 286K Upgrade Prioritization (2012 State Rail Plan)

5.5 Hartford Union Station Ridership

The following section focuses on station boardings and alightings for the Hartford Union Station. The role of the station as a multimodal hub is discussed in Chapter 9. Boardings and alightings provide context for a given station's use against broader ridership data (i.e. highlighting which stations see the greatest traffic).

Existing pre-pandemic data indicates that approximately 318,000 people boarded and alighted at Hartford Union Station in 2019 accounting for 43.6% of total Hartford Line ridership. Estimated monthly boardings and alightings at Hartford Union Station are shown in Figure 5-8.

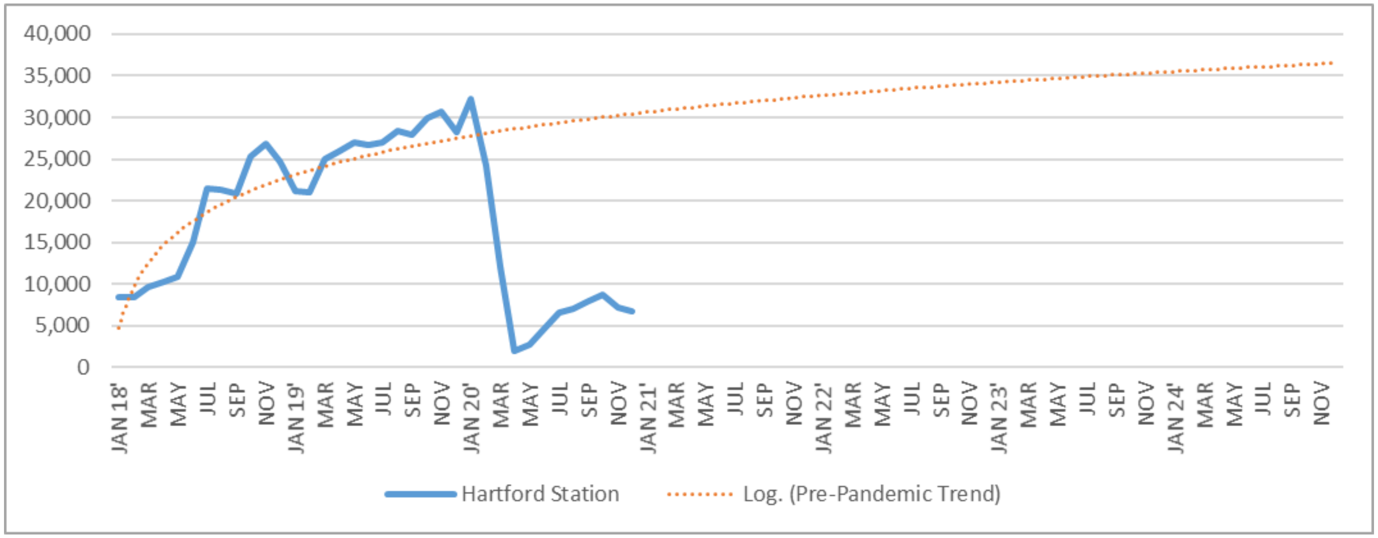


Figure 5-8: Estimated Hartford Union Station Boardings and Alightings (2018-2020)

5.6 CT*rail* Future Service Plans

The Greater Hartford Mobility Study (GHMS) will become part of the broader collection of work that guides Connecticut's investments and directions for its transportation system. The rail infrastructure within the GHMS study area will also be guided by the ongoing State Rail Plan Update, work completed under CT*rail* Strategies, as well as existing programmed investments. The following section summarizes future plans and investments as they relate to the Hartford Line to better understand how the GHMS can build on and support these efforts.

5.6.1 Review of Existing Programmed Investments

While the Hartford Line has recently undergone nearly $1 billion in improvements over the last decade, there are still additional investments planned or programmed to improve infrastructure, upgrade stations, and the possible construction of additional stations (Table 5-6).

5.6.2 Future Rail Plans

Beyond existing programmed investment there are broader visions for rail improvement both within the state and regionally. Connecticut's vision focusses on increasing the speed and density of rail service within the state network, while regional goals focus on the northeast as a single rail system with opportunities for modernization and improved efficiency.

Table 5-6: Estimated Capital Costs for Proposed Hartford Line Improvements

Project Name	Est. Cost
Connecticut River Bridge Replacement – Windsor Locks, CT	$300 Million
Hartford Line - 12 Miles of double-tracking (Windsor to MA line)	$120 Million
Hartford Rail Viaduct	$120 to $150 Million
CT*rail* New Rail Equipment (Initial 60 rail coaches followed by additional coaches)	$600 Million
New Rail Stations and Rail Station Improvements – Hartford Line (programmed)	$381 Million
Windsor Locks Station	*$67 Million*
Enfield Station	*$70 Million*
North Haven Station	*$52 Million*
Newington Station	*$52 Million*
West Hartford Station	*$70 Million*
Windsor Station	*$60 Million*

5.6.2.1 Local Plans

Recent State Rail Plans list many improvements, with passenger benefits focusing on improving speeds and on-time performance. The plan's proposed rail fleet and infrastructure upgrades will add an additional 30 trains per day throughout the rail system, including a 44 percent increase on the Hartford Line.

5.6.2.2 Regional Initiatives

The following regional initiatives are presented below because their proposals and visions either directly overlap the GHMS study area or affect operations on the Hartford Line corridor.

NEC FUTURE: The Northeast Corridor (NEC) is the general name for the rail alignment between Washington DC and Boston Massachusetts. Along this alignment, both regional and inter-city services are operated. NEC Future, the FRA sponsored Tier I EIS, has worked to establish a comprehensive vision for investment along the corridor to improve and modernize rail services. The selected alternative (see Figure 5-9) would allow for increased trips during peak hours, faster trip times, better job accessibility, reduced net pollutants and energy use, and better access to the region's airports.

Figure 5-9: NEC FUTURE Selected Alternative Overview

East West Rail: East West Rail is Massachusetts's rail initiative to strengthen the rail connection across the state between Pittsfield and Worcester with a particular emphasis on the Springfield to Worcester connection (Figure 5-10). The initiative brings with it the possibility for a viable inland route between New Haven and Boston and would reduce the current inland travel time from 3hrs 51min to 2hrs 58min(for the fastest alternative, ultimately travel times will vary based on the final selected alternative). Projected capital costs for the proposed alternatives range between $2.4 billion and $4.6 billion (depending on the final selected alternative).

The study presented a preliminary investigation of possible alternatives and concluded with a series of recommendations to further understand the impacts of an expanded East West rail connection. Recommendations for further work included: additional coordination with CSX (freight operator and ROW owner), a detailed economic and community benefits study to more accurately capture the regional impact of the proposals, and an investigation of governance options for the potential rail service since is outside of MBTA jurisdiction and MassDOT is not equipped to be a rail operator.

North Atlantic Rail Initiative: The North Atlantic Rail initiative (Figure 5-11) is a regional vision to increase the capacity and capabilities of the entire region's rail network and builds its argument on job creation, climate action, economic development, reduction of congestion, and travel efficiency, and public health and housing affordability. The North Atlantic Rail initiative has been developed out of Reboot New England and is led by a group of public and private-sector regional leaders and rail advocates.

The initiative proposes investments across 5 categories and would roll out in three phases.

- High-Speed Rail
- Infrastructure
- Equipment Acquisition
- Operational Improvements
- Service Expansion

Phase I: Early Action Projects ($35 billion) Early action projects are intended to focus on state of good repair concerns along the New Haven Line, finalizing working along the Hartford Line and establishing an East West regional rail connection.

Phase II: Completing High-Speed Rail ($50 billion) This phase would work to establish a truly highspeed rail connection between New York and Boston, including a tunnel under Long Island Sound and a new alignment between Hartford, CT, and Providence, RI. The improvements would generate an estimated travel time between 90 and 100 minutes (NYC to Boston), far surpassing the travel time currently available on the NEC.

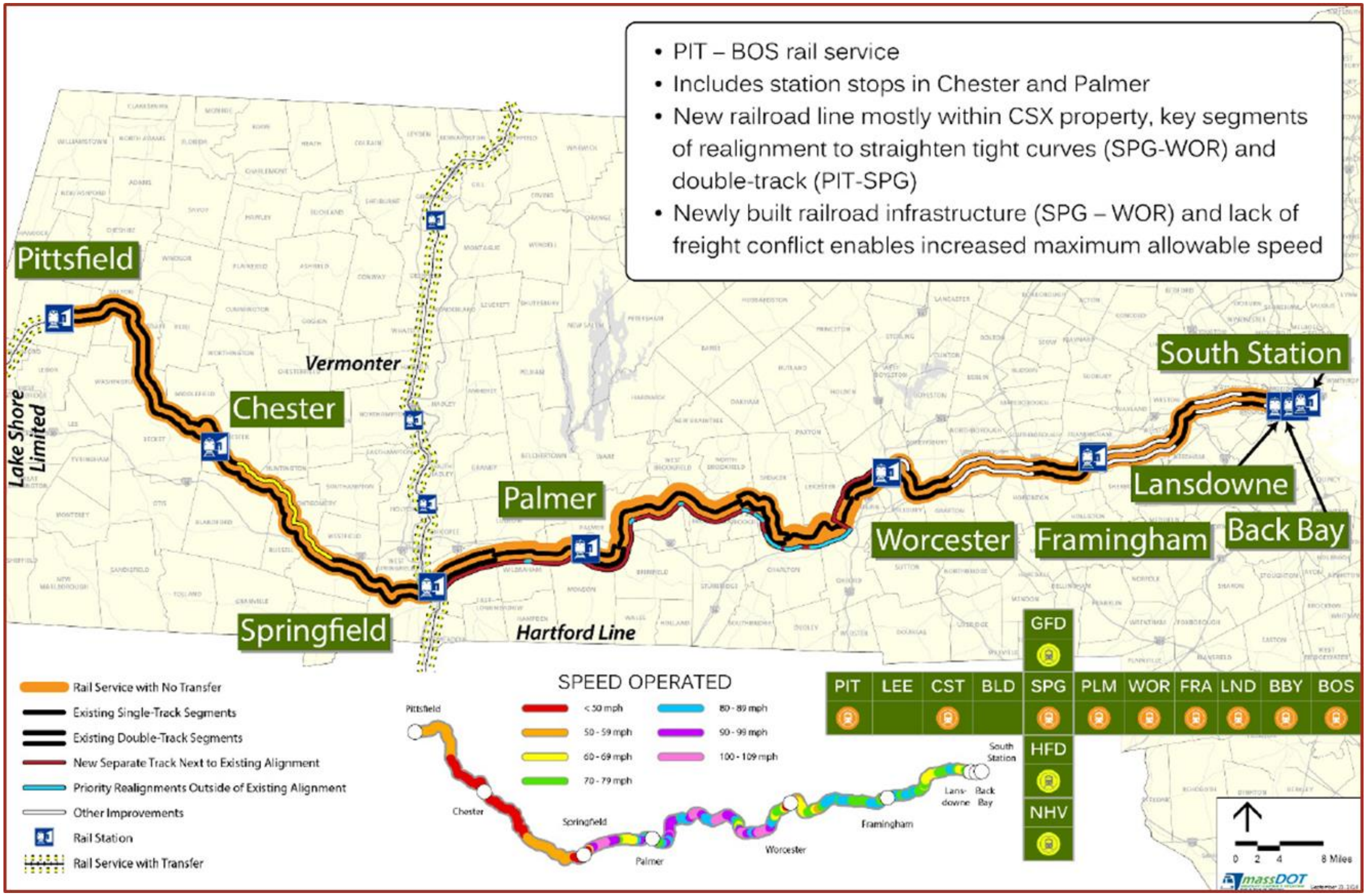


Figure 5-10: MassDOT East West Rail Alternative 4/5 Overview

Source: MassDOT East-West Passenger Rail Study

Phase III: Connecting the Dots ($20 billion) This phase focuses on building out beyond the core alignment, including connections from Danbury to Pittsfield and Springfield to Brattleboro. This phase would bring increased rail access to regional mid-size areas and create a more contiguous regional rail system.

The Economic Benefits of Regional Rail Investment in Metro Hartford-Springfield: This study, initiated by the Capital Region Council of Governments (CRCOG), presents a business case for completing Hartford Line improvements and the implementation of the Massachusetts East-West Rail project discussed above. The combination of completing Hartford Line improvements and the East-West rail initiative would reestablish a 21st century equivalent of the historic inland rail connection between New York City and Boson through Hartford, Springfield, and Worcester. These improvements are estimated to cost between $6 and $9 billion and would generate a projected $47 to $84 billion in new Regional Domestic Product (GDP) over a 30-year period. Additionally, the improvement would lead to significant growth in both housing units and commercial square footage.

Figure 5-11: North Atlantic Rail Initiative Phase 1 to 3

5.7 Transit Oriented Development (TOD) and Land-Use Impacts

Any changes to CT*rail* service or the location of stations would impact the surrounding land uses of communities. Often this means seeking ways to leverage the positive attributes of increased transit to encourage Transit Oriented Development (TOD). These developments are characterized by dense and mixed-use structures centered on the transit station and well connected to other modes (bicycle, pedestrian, and bus-transit). Historically, many communities in Connecticut would have met today's definitions of TOD. However, with development of the interstate system and penetration of cars, transit services were reduced, tracks were removed, and many moved away from the urban centers. With a renewed focus on transit accessibility, communities are working to reestablish the environment that had allowed dense and walkable communities to thrive.

Since 2018 many of the Hartford Line station communities and other towns in the corridor have made concerted efforts to plan for and facilitate the development of ancillary services, amenities, and developments that fit the model of TOD. Additionally, as part of the build-up to Hartford Line rail service, regional TOD planning efforts were undertaken to identify key areas for TOD and to help establish a framework for TOD Deployment. Below are overviews for the four stations within the GHMS study area addressed.

5.7.1 Berlin

The Berlin station was reconstructed as part of the NHHS rail program and received significant upgrades including new high-level platforms, an up-and-over, and increased parking capacity. In 2016 the town presented the results of a planning study arguing for TOD in Kensington Center (a subset of Berlin) within close proximity to the train station. More recently, (fall 2020) a developer broke ground on an $18 million mixed-use development (known as Steele Center) adjacent to the Berlin station. The resulting development will include 76 market-rate apartments, medical offices, restaurants, and additional retail space. Figure 5-12 below provides a rendering of the new development.

Figure 5-12: Rendering of Steele Center project, Berlin (QA+M Architecture)

Source: QA+M Architecture

5.7.2 Hartford

Hartford's Union Station received substantial upgrades to its platforms and the historic station building has been developed for office space. The station also serves as a multimodal transit hub and the northern terminus of the CT*fastrak* BRT service as well as other local and regional bus transit. The station is well-positioned in Hartford's downtown and is easy walking distance from the state capital, office buildings, Bushnell Park, the XL Center, and Dunkin Donuts Park (A minor league baseball stadium).

A major strategy for improving TOD in Hartford is to increase the number of housing units downtown through the reuse of existing structures and the development of new construction. Since 2013 more than 19 residential projects have been completed, adding more than 1,800 new residential units, most of which are within a half-mile of Union Station. Additional proposals focus on the opportunities for TOD along the *CTfastrak* corridor and the proposed West Hartford Rail station further out from downtown.

5.7.3 Windsor

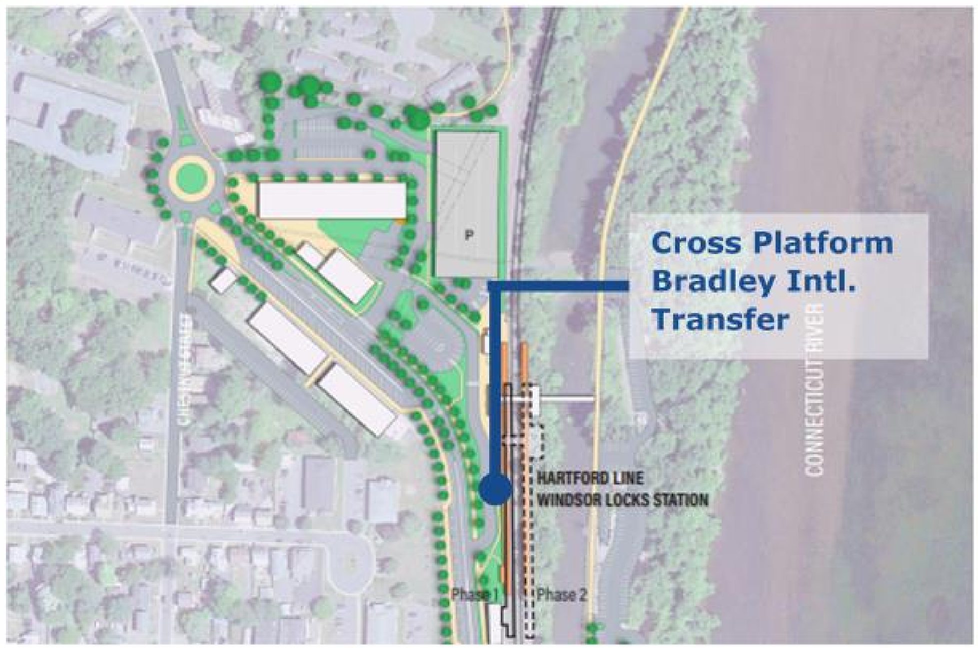
Windsor was one of the original stations along the Hartford Line which was part of Amtrak's initial inter-city services and is one of only two stations that has not been reconstructed. Plans and funding have been programmed for the station's reconstruction which includes additional parking and high-level platforms. In 2014 Windsor published a TOD strategy to create a town center that is: walkable and connected, vibrant and has diverse uses, accessible and safe, and attractive and distinctive. Figure 5-13 outlines the concept for the town's redevelopment strategy.

Figure 5-13: Windsor Center TOD Redevelopment

Source: Town of Windsor

5.7.4 Windsor Locks

In 2019 CTDOT published the Hartford Line TOD Action Plan, which included illustrative plans for the relocation of the Windsor Locks Station. The report noted that the Town of Windsor Locks is actively working to create a vibrant town center around the relocation of the Windsor Locks Station to its historic downtown location along Main Street, by supporting mixed-use, context-sensitive redevelopment, and pedestrian-oriented infrastructure improvements. The illustrated plan highlighted the potential full build-out of the station area based upon ongoing and planned improvements and the overall Town vision. The purpose of this illustrative plan is to demonstrate the transformative effect these improvements could have on downtown Windsor Locks (Figure 5-14).



Windsor Locks Station Area Build-Out Illustrative Plan.
Portion of an illustrative plan outlining the potential full build-out of the future Windsor Locks station area, including private redevelopment and infrastructure improvements.

Source: Hartford Line TOD Action Plan Part 2, 2019

Figure 5-14: Illustrative Station Layout for Windsor Locks Station

Due to its proximity to the future relocated station in Windsor Locks, the TOD Plan included the East Windsor Warehouse Point Connectivity Plan. The plan focuses on key corridors and gateways within Warehouse Point including Main Street, Bridge Street, Water Street, Bridge Street and Main Street, and Bridge Street and the Interstate I-91 access ramps. The recommendations developed for the Connectivity Plan were based upon an existing conditions analysis and findings from the 2018 Complete Streets and Development Concept Plan for Warehouse Point. Ultimately, the connectivity plan presents a framework for improving multi-modal connections both within Warehouse Point and to the relocated station in Windsor Locks (Figure 5-15).

The most recent plan for the Windsor Locks Station acknowledges the coordination with the Main Street improvement project and illustrates the cross-platform multimodal interconnectivity between the proposed rail platform and the adjacent bus drop-off/pickup area linking the station with the airport shuttle and other potential local and regional transit services.

Warehouse Point Connectivity Plan. A portion of a connectivity plan in Warehouse Point, connecting key gateways in the community with the future relocated station in Windsor Locks.

Source: Hartford Line TOD Action Plan Part 2, 2019

Figure 5-15: Warehouse Point Connectivity Plan

5.8 Existing Conditions Rail Assessment – Key Takeaways

- The GHMS Study Area covers four of the nine current stations on the Hartford Passenger Rail Line. Additionally, two of the five newly proposed stations will be located within the GHMS area. Thus, rail mode has significant potential to influence study area mobility if headways/frequency of service can be improved.

- The Hartford Line has 30 at-grade crossings over its alignment. Upgrades to existing grade crossings in Wallingford, West Hartford and Windsor helped allow for increases in maximum allowable speeds (MAS) and improved at-grade crossing safety.

- Between New Haven and Hartford, current travel time by rail mode is almost comparable to travel time by auto, making rail mode a viable and competitive option for long-distance trips.

- Significant infrastructure investment has resulted in operational improvements such as maximum allowable speed (MAS) of 110mph on the Hartford Line. However, due to equipment limitations the CT*rail* operation is restricted to a maximum speed of 80mph.

- The frequency/headways on the Hartford Rail Line are constrained by the infrastructure capacity (lack of double tracking between Windsor and the Connecticut/ Massachusetts border where the alignment is still in a single-track configuration).

- The abundance of parking in the ¼ mile area from the Hartford Union Station, while shared with non-transit users, is more than sufficient for the current outbound usage of Hartford Union Station.

- While the COVID-19 pandemic (beginning in March 2020) has significantly altered rail and transit ridership in the short-term, including on the Hartford Line, the Hartford Line had seen successive years of ridership growth since its inception. During the first year of operation, ridership exceeded pre-operation projections. January of 2020 (just prior to the beginning of COVID-10 pandemic in the United States) saw the highest single-month ridership with more than 73,000 riders.

6 Bicycle and Pedestrian Accommodations

6.1 Introduction

Bicycle and pedestrian mobility are core components of a multi-modal transportation system. Bicycle and pedestrian activity and demand is relatively high in urban areas, particularly in central business districts such as Downtown Hartford. The I-84/I-91 interchange area, located within Downtown Hartford, exhibits a strong influence on bicycle and pedestrian mobility in Downtown.

> *A full understanding of bicycle and pedestrian activity and demand within the study core is central to understanding barriers, issues and opportunities for bicycle and pedestrian travel between Downtown Hartford and surrounding areas.*

This bicycle and pedestrian assessment is concentrated on a five-town focus area consisting of the Towns of Windsor, East Hartford, Wethersfield, West Hartford, and City of Hartford as shown in Figure 6-1.

A performance-based assessment approach was undertaken to identify locations within the five-town focus area that exhibit the most substantial bicycle and pedestrian trip generation and/or demand.

Figure 6-1: Bicycle and Pedestrian Focus Area Map

This assessment was compared to existing facilities to identify potential areas of need for the expansion or improvement of bicycle and pedestrian facilities.

6.2 Demand Analysis Approach/Methodology

The bicycle and pedestrian activity and demand analysis is based on twelve categories of bicycle and pedestrian trip generators and attractors. The output of the analysis is a heatmap that shows “hotter” colors in locations where bicycle and pedestrian trips and trip demand are expected to be higher and “cooler” colors in locations where trips and trip demand are expected to be lower.

The land use categories used in the analysis are as follows:

- K-12 Schools
- Colleges and Universities
- Parks and Playgrounds
- Hospitals
- Other Points of Interests (Town Halls, Churches, Restaurants, etc.)
- Areas with High Concentration of Employment
- Neighborhood Retail Centers
- Entertainment Sporting Venues
- Transit Stations
- Bus Stops
- Regional Trails (East Coast Greenway, Charter Oak Greenway, Riverfront Paths)

The following process was used in the analysis and in development of the map:

6.2.1 Data Sourcing

The data was sourced from existing State and Regional GIS Datasets, U.S. Census data, and other sources as indicated in Table 6-1. In some instances, the project team supplemented existing data as noted in Table 6-1.

Table 6-1: Data Sources and Influences for Layers

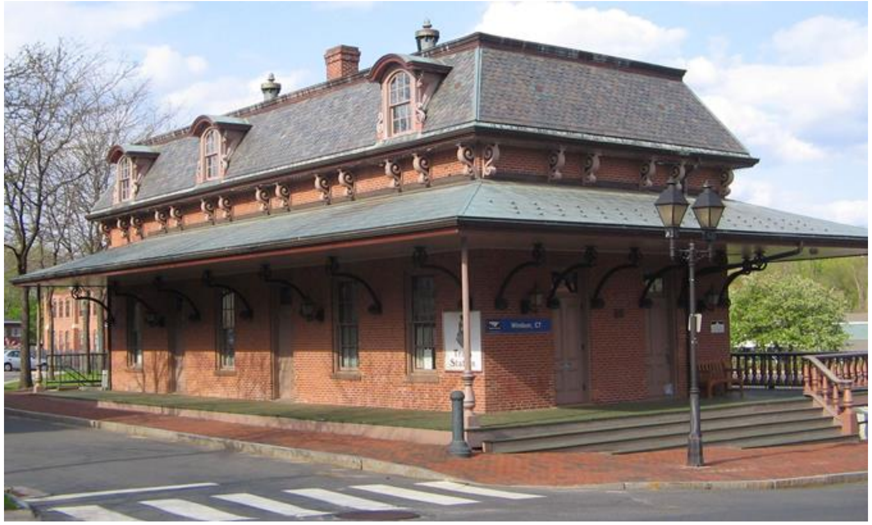
Data	Source	Influence Distance (miles)	Layer Scaling	Overall Weighting in Compiled Heatmap
K-12 Schools	Common Core Data – 2012 – 2013 School Year	0.5	Enrollment	15%
Colleges and Universities	FHI Studio Created with enrollment figures based on published data	0.5	Enrollment	5%
Parks and Playgrounds	CRCOG 2016 Land Use GIS layer	0.5	N/A	5%
Hospitals	FHI Studio Created – based on ArcGIS 2013 data	1.0	Number of beds	5%
Other Points of Interests (Town Halls, Churches, Restaurants etc.)	Open Street Maps POI data	1.0	N/A	5%
Employment Density	Longitudinal Employer-Household Dynamics (abbreviated “LEHD”, published by the US Census and available on the “OnTheMap” online platform). 2018 data utilized	1.0	Number of Employees	15%
Population Density	2010 US Census data (aggregated by census block)	0.5	Population	15%
Neighborhood Retail Centers	FHI Studio Created – based context zones found in the 2018 CRCOG Complete Street Plan showing commercial centers	1.0	N/A	10%

Data	Source	Influence Distance (miles)	Layer Scaling	Overall Weighting in Compiled Heatmap
Entertainment and Sporting Venues	FHI Studio Created	1.0	Capacity	5%
Bus Stops	CT transit – 2015 data	0.5	N/A	5%
Train Stations	FHI Studio Created – Based on existing and proposed Hartford Line stations	1	N/A	10%
Regional Trails (East Coast Greenway, Charter Oak Greenway, Riverfront Paths)	2019 CT Active Transportation Plan	0.5	N/A	5%

6.2.2 Mapping of Land Uses

Land uses described above were mapped in an ArcGIS database for the five-town focus area. Unique symbols are used for each land use type. Figure 6-2 reveals a dense concentration of bicycle and pedestrian attractor land uses in Downtown Hartford with clusters of attractors in surrounding neighborhoods and towns.

Windsor's Amtrak and Hartford Line train station is an example of a bicycle and pedestrian attractor. The station is served by a pedestrian network but lacks a connecting bicycle network.



6.2.3 Individual Attractor Heatmaps

Based on each of the data sources described above, heatmaps for each of the individual categories of attractors were generated. The heat maps were developed utilizing the Kernel Density tool within ArcGIS (Figure 6-3). These heatmaps were based on the *Influence Distance* and *Layer Scaling* properties noted in Table 6-1. These properties contribute as follows:

Influence Distance – This defines the distance any one point in one of the data layers will have on the heatmap. For example, K-12 schools have an influence distance of 0.5 miles. This means that for any given school, a distance outside of this area would have no impact on the resultant heatmap.

Layer Scaling – This defines the relative scale one feature may have over another in determining its contribution to the heatmap. For example, K-12 schools are scaled by enrollment. This means that a school with an enrollment of 1,000 students will be weighted 10-fold that of a school with an enrollment of 100 students. The scaling is utilized to account for differences in pedestrian and bicycle generation based on varying different sizes of individual attractor points.

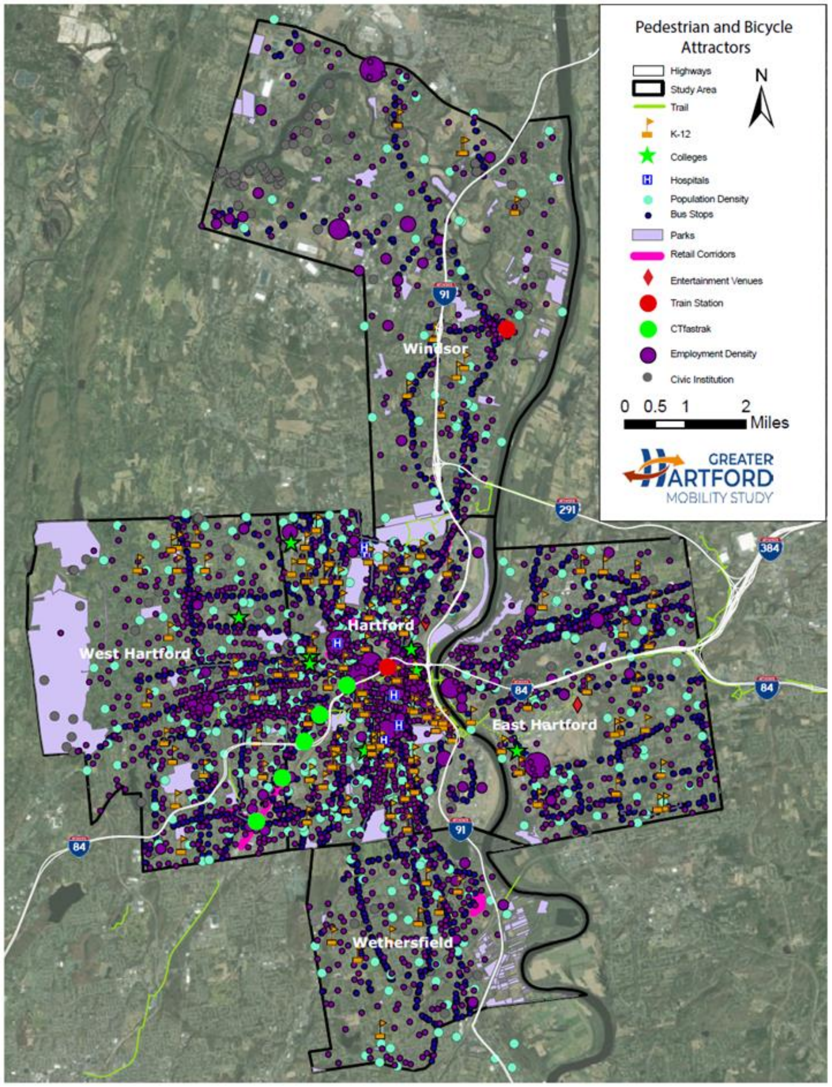


Figure 6-2: Bicycle and Pedestrian Attractors in Study Area

6.2.4 Overall Bicycle and Pedestrian Activity Heatmap Compilation

The twelve separate heatmaps (one for each land use category) were then merged in ArcGIS. The merger was conducted based on the *Overall Weighting in Compiled Heatmap* parameter provided in Table 6-1. This resulted in an overall heatmap which includes a maximum theoretical value of 100 with lower number indicating less expected bicycle and pedestrian activity (blue colors) and values above 40 representing the highest levels of expected bicycle and pedestrian activity (red colors).

Rentschler Field, the region's largest entertainment venue, is connected to points west including Downtown Hartford by Silver Lane (visible at bottom of the image). Silver Lane lacks bicycle facilities and lacks a sidewalk on the Rentschler Field side of the roadway. A shared-use pathway is currently planned.

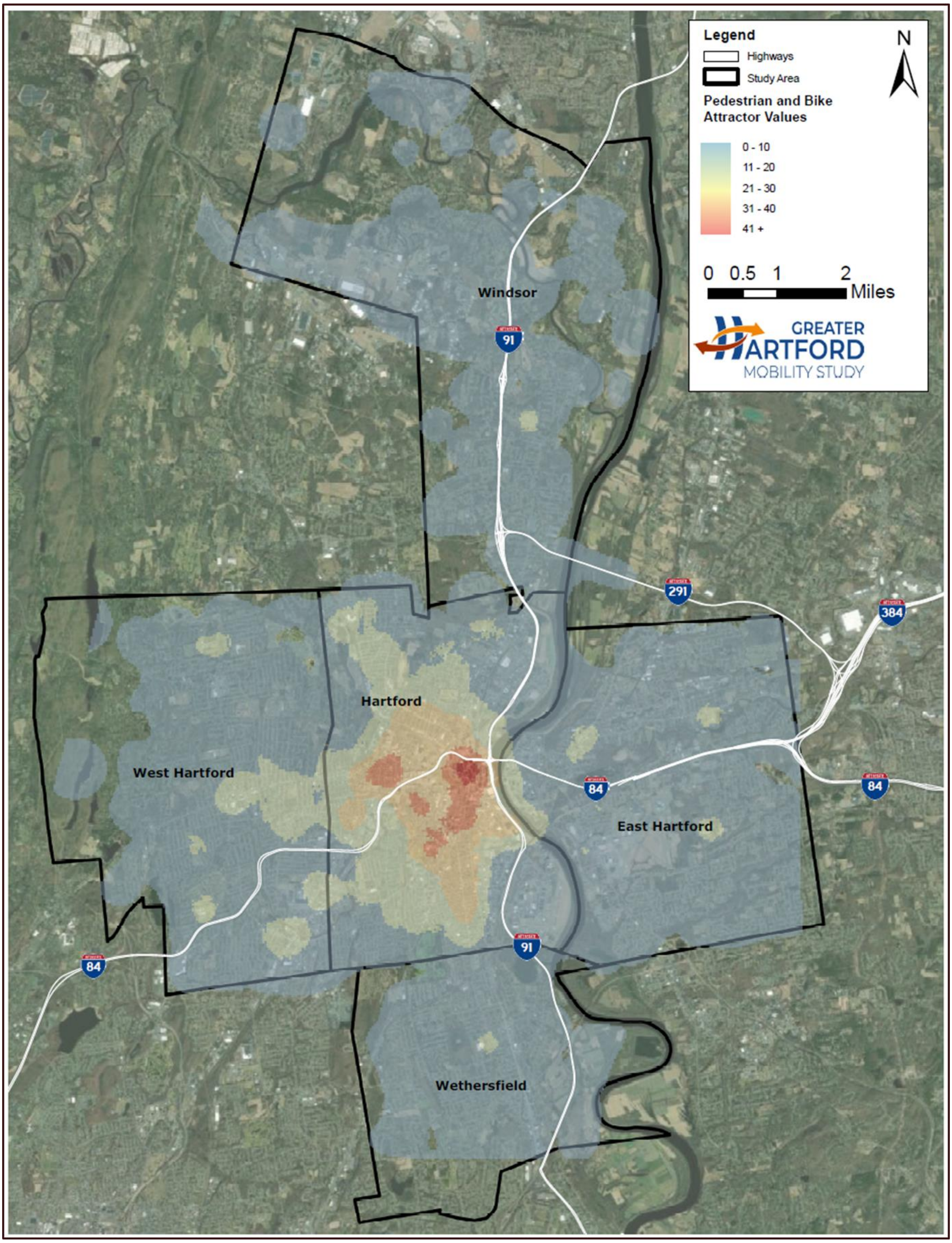


Figure 6-3: Heat Map of Bicycle and Pedestrian Potential of Generation and Attraction

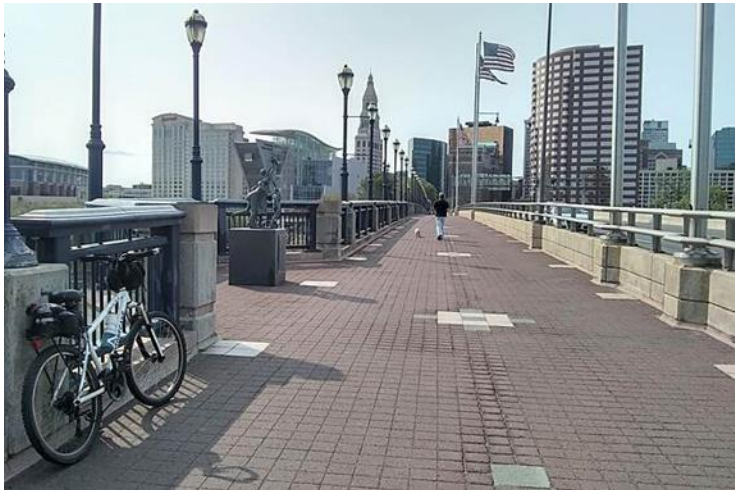
Source: FHI Studio

6.3 Demand Analysis – Key Findings

1. Downtown Hartford was found to have the highest level of bicycle and pedestrian generation and attraction (demand) within the study area (Figure 6-1 and Figure 6-3).
2. The highest levels of demand in the five-town study area are located in Hartford and are largely aligned with major corridors such as Albany Avenue, Farmington Avenue, and Franklin Avenue.
3. Areas of demand were also found through much of West Hartford and East Hartford and limited areas of Windsor and Wethersfield. Areas of higher demand in the towns surrounding Hartford are largely correlated with Town and commercial centers, schools, and major institutions.

Bicycle facilities are lacking in many of the highest demand areas and along corridors in high demand areas such as Hartford's Main Street, Albany Avenue, segments of Farmington Avenue, and Franklin Avenue.

4. Areas of high demand are generally well served by pedestrian facilities such as sidewalks although major barriers, primarily associated with I-84, I-91 and active and inactive rail corridors provide obstructions to bicycle and pedestrian connectivity.
5. Local greenways and pathways such as the East Coast Greenway, Charter Oak Greenway and Riverfront pathways, hold potential to provide regional connections between high demand areas such as Downtown Hartford and medium or lower demand areas in surrounding towns.



Route of East Coast Greenway on the Founders Bridge connecting East Hartford to Hartford.
Image Source: TrailLink.com

6.4 First/Last Mile Connectivity

Transit stations and stops are located throughout the five-town study area with the greatest density of those stops and stations located in Hartford. Transit stations shown in Figure 6-4 include CTfastrak stations and Hartford Line Rail stations. Bus stops are CT Transit bus stop locations.

Sidewalks are present at, or in proximity to, most of the study area's transit stations and stops although there are gaps in the network throughout the five towns.

> *The most significant sidewalk gaps in proximity of bus routes and stops are found in Windsor.*
>
> *Bicycle facilities are lacking in proximity of most of the transit stations and stops throughout the study area with the exception of limited facilities in Hartford, West Hartford, and East Hartford.*

West Hartford and East Hartford have comparable transit route, station, and stop density. Windsor has the lowest density of transit routes, stations, and stops and the lowest density of sidewalk and on-street bicycle facilities. Windsor's Hartford Line Rail station is well connected to a sidewalk network but there are no on-street bicycle facilities in proximity of the station or in the town.

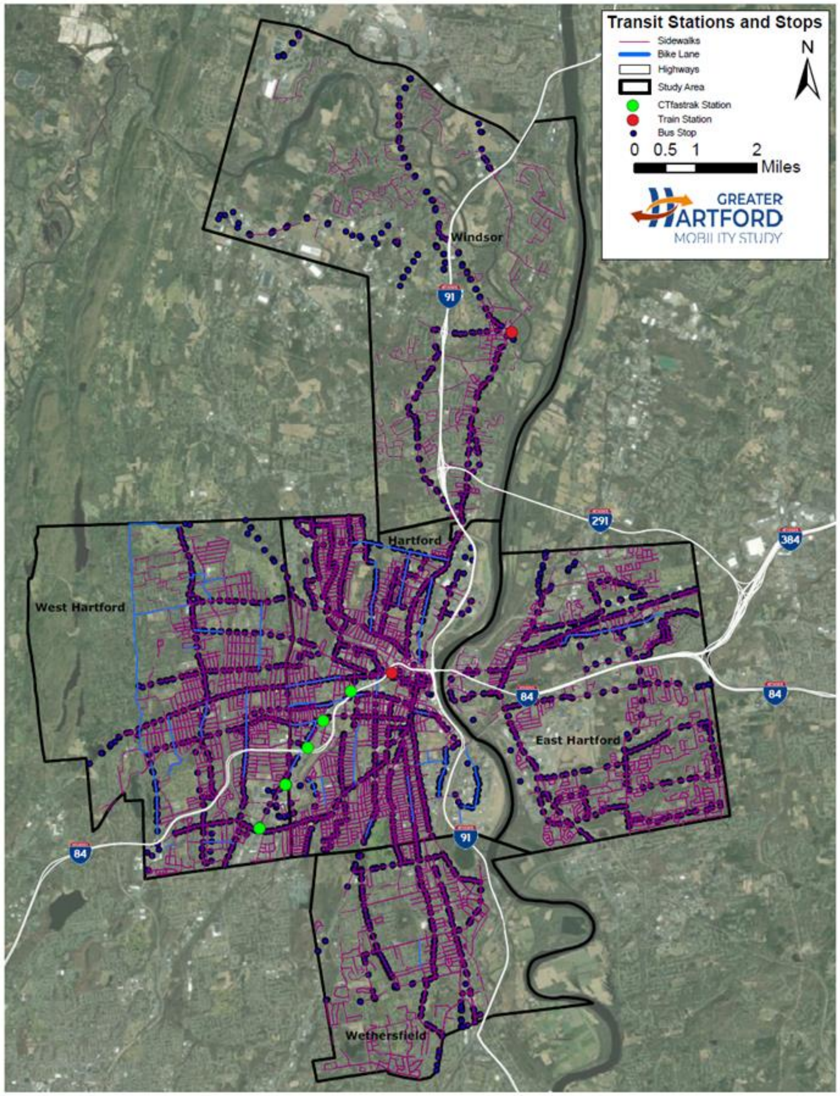
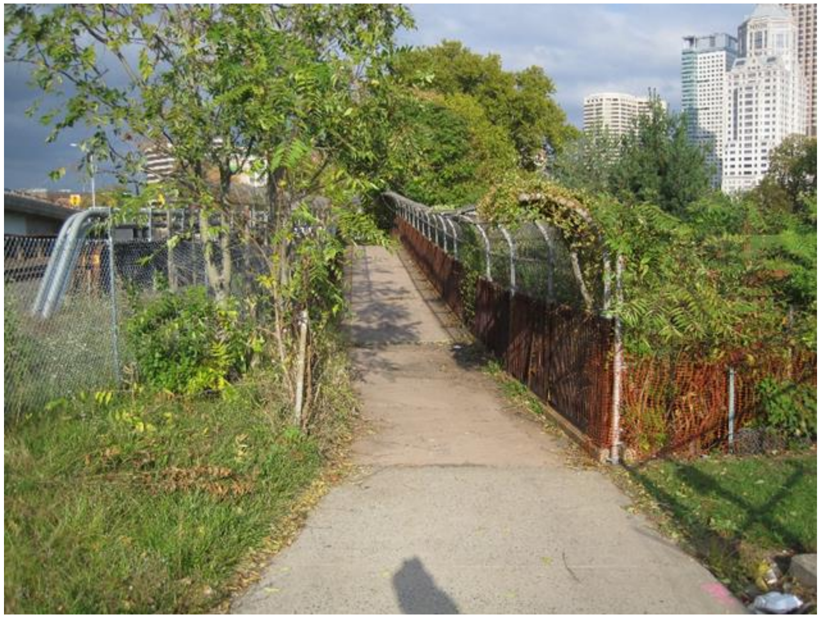


Figure 6-4: Transit Nodes/Stops in Bicycle Pedestrian Assessment Area

The I-84/I-91 interchange area is proximate to a dense cluster of bus stops and routes and a complete sidewalk network. On-street bicycle facilities in the interchange area are, however, lacking.

The pedestrian bridge shown in this photo is the route of the East Coast Greenway and connects to Hartford's Union Station.



6.5 Identified Major Gaps in Bicycle and Pedestrian Facilities

A gap analysis was conducted by comparing areas with existing sidewalk and bicycle facility infrastructure to potential demand as expressed in the heatmap. This was done by referencing the geographic areas associated with five levels of demand as presented in the bicycle and pedestrian demand heatmap. The total length (linear feet) of sidewalk and bicycle facilities was then summarized for each demand level area (Table 6-2). This value was then equalized by geographic area for each demand level.

Sidewalk facilities are most highly concentrated in the areas of the most intense demand as established by the demand level. The relative quantity of available bicycle facilities, whether bike lanes or pathways did not correspond with the highest area of demand. The highest demand level (41+) is found in Downtown Hartford where there are no designated bicycle lanes or established pathways designated for bicycle use. The East Coast Greenway route traverses this area but there are no established facilities dedicated for bicycle use along the route. The second highest demand level (31-40), which covers much of central Hartford, is also underrepresented by bicycle lanes in comparison to areas within other tiers of demand (Table 6-2).

Table 6-2: Extent of Bicycle and Pedestrian Facilities by Demand Level

Demand Level	Area (Acres)	Sidewalks (lf)	Sidewalks (lf/acre)	Bike Lanes (lf)	Bike Lanes (lf/acre)	Regional Paths or Greenways (lf)	Regional Paths or Greenways (lf/acre)
1-10	45,047	6,893,661	153	93,576	2	78,994	2
11-20	5,376	2,296,601	427	59,002	11	64,801	12
21-30	2,154	1,010,676	469	22,279	10	38,995	18
31-40	592	355,856	601	3,354	6	15,988	27
41+	59	45,543	776	0	0	0	0

6.6 Gap Analysis Key Findings

1. Areas of high bicycle and pedestrian demand are generally well served by sidewalks although major barriers, primarily associated with I-84, I-91 and active and inactive rail corridors obstruct bicycle and pedestrian connectivity. Bicycle facilities are lacking in many of the highest demand areas and along corridors in high demand areas such as Hartford's Main Street, Albany Avenue, segments of Farmington Avenue, and Franklin Avenue.
2. Sidewalk facilities are most highly concentrated in the areas of the highest bicycle and pedestrian demand. The relative quantity of available bicycle facilities, whether bike lanes or pathways did not correspond with the highest areas of demand. The highest bicycle and pedestrian demand level (41+) is found in Downtown Hartford where there are no designated bike lanes or established facilities designated for bicycle use. The East Coast Greenway route traverses this area but there are no established facilities dedicated for bicycle use along the route. The second highest demand level (31-40), which covers much of central Hartford, is also underrepresented by bicycle facilities in comparison to areas within other tiers of demand.

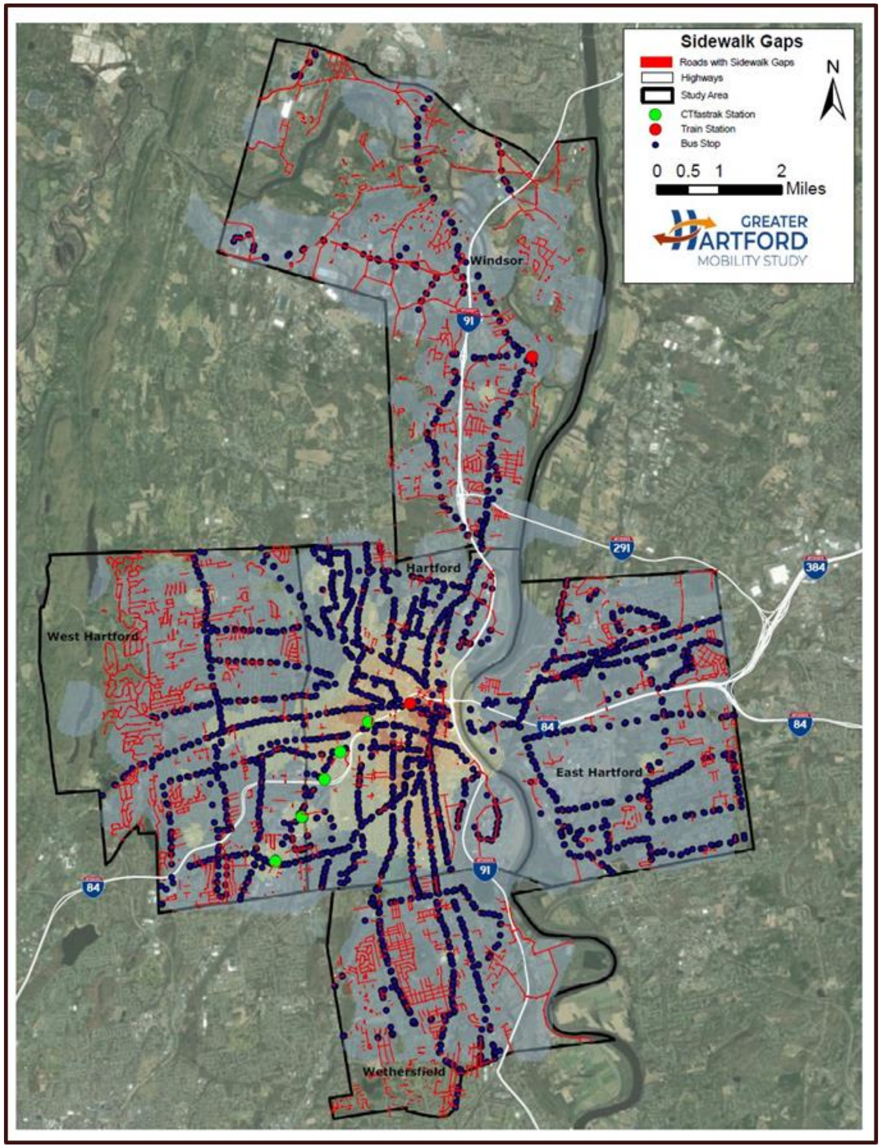


Figure 6-5: Gaps in Sidewalk Network

3. Local greenways and pathways hold potential to provide regional connections between high demand areas such as Downtown Hartford and medium or lower demand areas in surrounding towns. A contiguous north/south Connecticut Riverfront pathway holds potential to connect Wethersfield to Windsor, connecting through Hartford and the I-84/I-91 interchange. Similarly, a contiguous dedicated east/west greenway could accommodate the East Coast Greenway route and could provide a connection from West Hartford to East Hartford, passing through Downtown Hartford in proximity of the I-84/I-91 interchange.

This riverfront area along I-91 south of Downtown Hartford represents a gap in the Riverfront pathway system. The riverfront pathways have potential to provide bicycle and pedestrian connectivity from Wethersfield to Windsor.

7 Environmental Considerations

7.1 Introduction

The following section identifies key environmental constraints within the Study Area and Study Area sectors. This section is organized by resources (e.g. natural, cultural, socioeconomic and community-based). The presence of the following resources is illustrated on maps.

- Critical habitat
- Protected open space and DEEP property
- Prime farmland soils and soils of statewide importance
- Surface and groundwater resources
- Floodplains
- Wetlands
- Historic, architectural and archaeological resources
- Socioeconomic considerations – population and employment density, zero vehicle households, Environmental Justice and Title VI communities
- Institutional resources
- Land use and zoning
- Hazardous materials
- Noise sensitive land uses
- Air quality (areas of documented non-compliance)

This constraints-based mapping approach will aid in the identification of potential environmental and community issues and "fatal flaws" associated with the Universe of Alternatives.

The mapping will serve as a starting point for future, more detailed, alternatives analysis and resource field-verification to be conducted further along in the Study.

This space has been intentionally left blank.

7.2 Critical Habitat

Mapped habitat from CT DEEP was reviewed for its general presence within the study area and sectors and its potential to constrain future mobility improvements. Critical habitat within the study area is primarily associated with riverfront areas adjacent to the Connecticut River and its tributaries.

Grassland habitat is also identified in the vicinity of the Bradley Airport runways. The presence of these critical habitats is most likely to affect the siting of river crossings and widening or new alignments adjacent to the existing Hartford Line.

Table 7-1: Critical Habitat

Sector	Comments
Study Core	Habitat associated with the Hockanum River adjacent to I-84, Route 2, Route 15; Habitat associated with the Connecticut River between I-91 and I-291.
Northwest Sector	No mapped habitat noted
North Sector	Grassland habitat at Bradley Airport; Habitat associated with Waterworks Brook near Route 20 / I-91; Habitat associated with the Farmington River (Pierson Lane, Mill Brook, Farmington River Mouth) adjacent to the Hartford Line; Habitat associated with the Connecticut River between I-91 and I-291.
Northeast Sector	Habitat associated with the Hockanum River adjacent to the I-84 / I-291 interchange.
Southwest Sector	No mapped habitat noted
South Sector	Habitat associated with Wethersfield Meadows adjacent to the I-91 / Route 3 interchange; Habitat associated with Rocky Hill Meadows adjacent to I-91-Route 3 and the Connecticut Southern (G&W) rail line; Habitat associated with Folly Brook adjacent to I-91.
Southeast Sector	Habitat associated with Glastonbury Meadows and Keeney Cove adjacent to Route 3 between I-91 and Route 2.

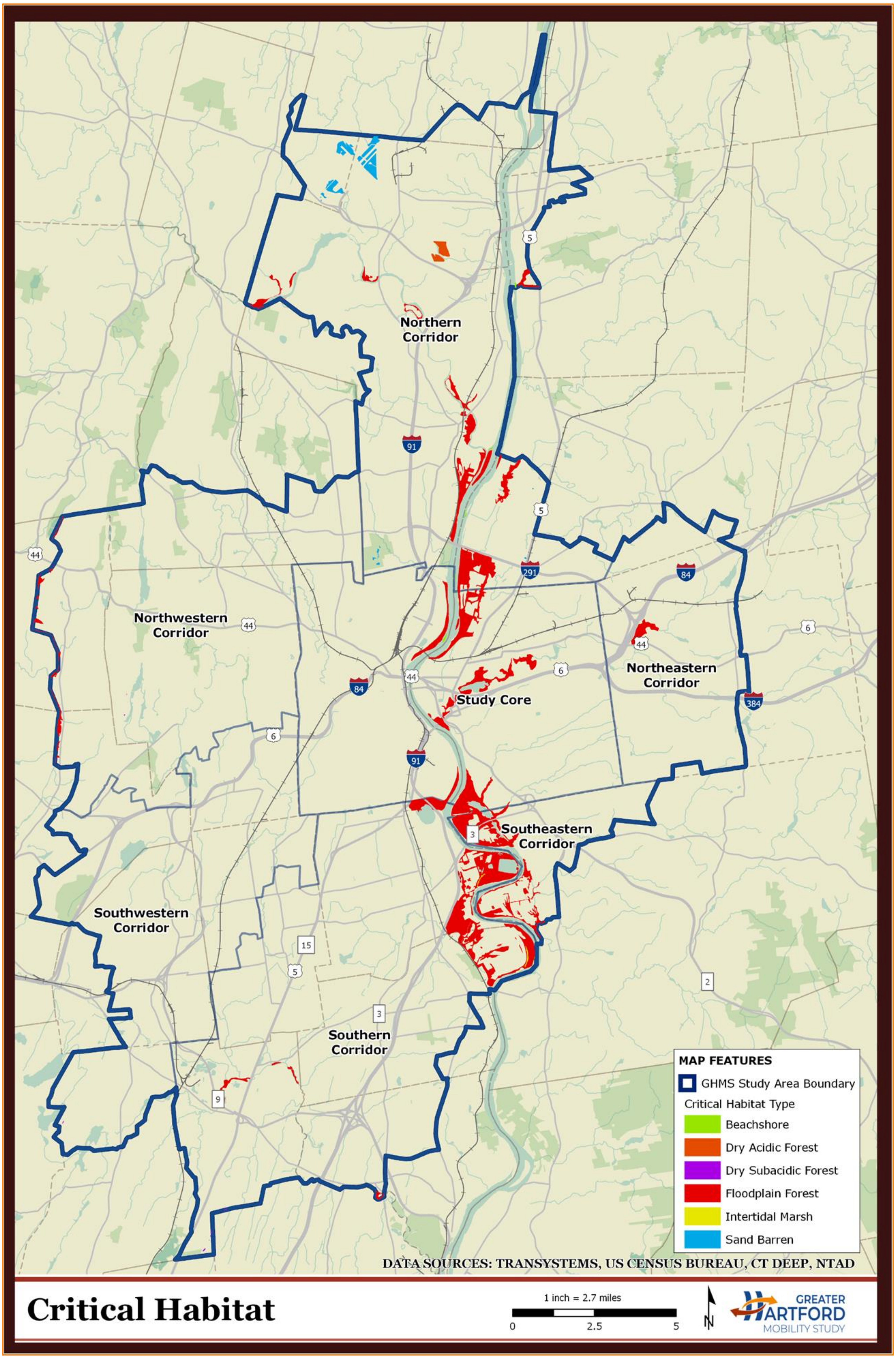


Figure 7-1: Critical Habitat

7.3 Protected Open Space and DEEP Property

Protected Open Space and DEEP Property were reviewed for their general presence within the study area and sectors and potential to constrain future mobility improvements. In cases where public funds have been expended for their purchase, there are often regulatory conditions that restrict the taking of any portion of these properties without legislative approval. It is possible that active transportation links may be compatible with these properties. In addition, there are municipal parks and open space areas with similar protections.

Private parcels with conservation easements are not included as part of this review.

It should also be noted that improved transit and active transportation networks that connect these facilities would improve the ability of all residents to access heathy recreational opportunities.

The presence of protected open space and DEEP properties is most likely to affect widenings, new alignments and extensions of active transportation networks (greenways, multi-use paths, etc.

Table 7-2: Protected Open Space and DEEP Property

Sector	Comments	
	DEEP Property	Municipal Property (Representative Sample)
Study Core	Connecticut River Wildlife Management Area (East Hartford).	Keney Park, Riverside Park, Pope Park, Colt Park, Bushnell Park, McAuliffe Park, Martin Park
Northwest Sector	Talcott Mountain State Park, North Branch Park River Flood Control site, South Branch Park River Flood Control sites, Auerfarm State Park Scenic Reserve.	Westmoor Park, Elizabeth Park, Fernridge Park
North Sector	Matianuck Sand Dunes Preserve, Windsor Meadows State Park, Rainbow Dam Fishway.	Washington Park, Northwest Park, Southwest Park, Spring Park
Northeast Sector	Hop River State Park Trail.	Wickham Park, Center Spring Park
Southwest Sector	South Branch Park River Flood Control site.	Ragged Mountain Preserve, Hungerford Park, Willow Brook Park, Martha Hart Park, Walnut Hill Park, Stanley Park
South Sector	Rocky Hill Quarry, Dinosaur State Park.	Mill Woods Park, Candlewyke Park, Maxwell Park, Clem Lemire Sports Complex, Churchill Park
Southeast Sector	Glastonbury Meadows Wildlife Management Area.	Addison Park, Gorman Park, Goodwin Playground Park

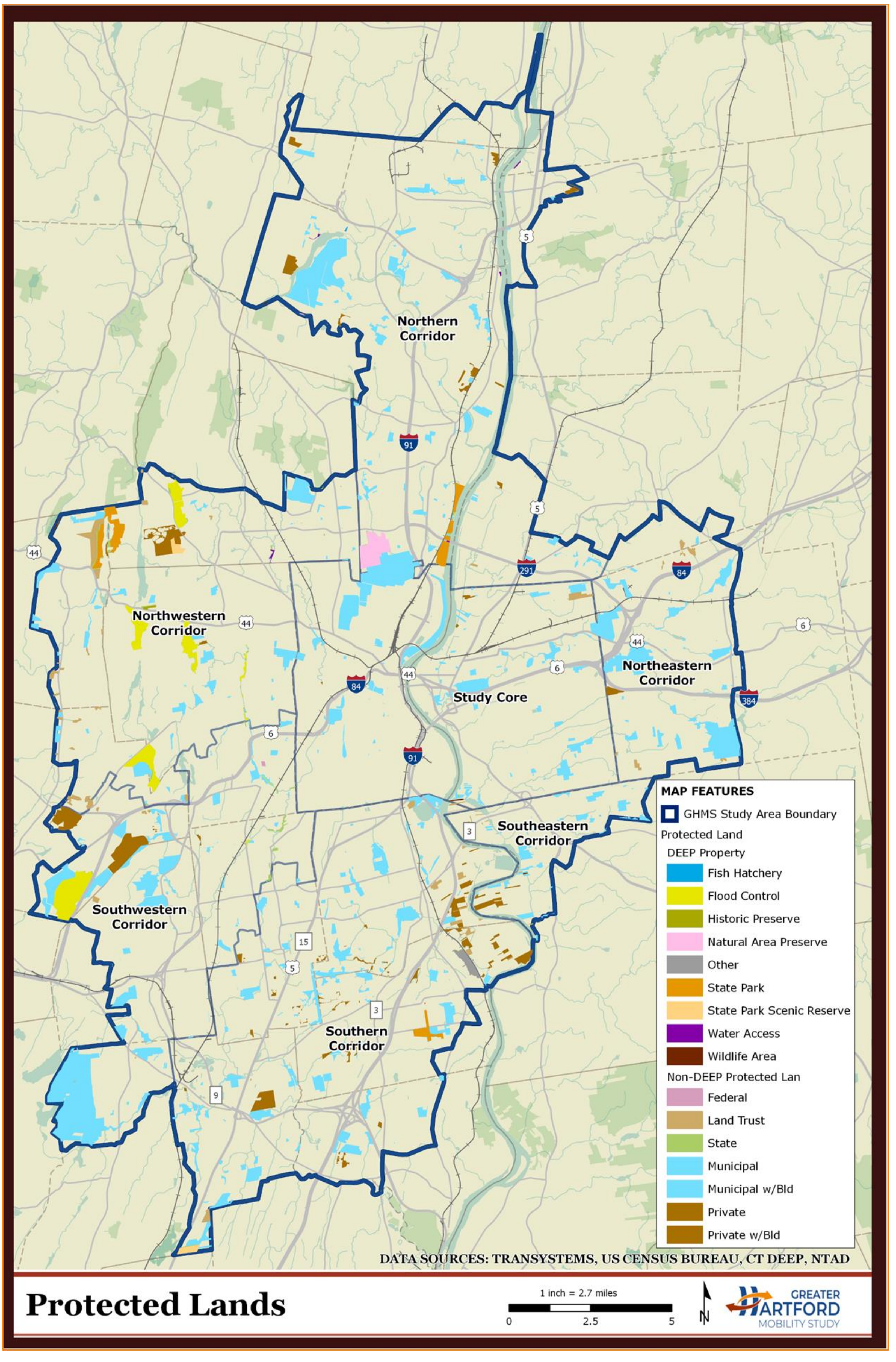


Figure 7-2: Protected Open Space and DEEP Property

Data Source: Connecticut Department of Energy and Environmental Protection (DEEP), CT State Historic Preservation Office (SHPO)

7.4 Prime Farmland Soils and Soils of Statewide Importance

Prime Farmland Soils and Soils of Statewide Importance were reviewed for their general presence within the study area and sectors and potential to constrain future mobility improvements.

Those lands may qualify to be protected in the Federal Farm and Ranch Lands Protection Program (FRPP) which is reauthorized in the Farm Security and Rural Investment Act of 2002 (Farm Bill) to protect working agricultural land from conversion to nonagricultural uses and the Connecticut Department of Agriculture, Farmland Preservation Program's goal of securing a food and fiber producing land resource base for the future of agriculture in Connecticut.

Prime Farmland Soils are those that have the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oil seed crops, and are also available for these uses (the land could be cropland, pastureland, range-land, forestland, or other land, but not urban built-up land or water). It has the soil quality, growing season and moisture supply needed to economically produce sustained high yields or crops when treated and managed, including water management, according to acceptable farming practices.

Soils of Statewide Importance are those that fail to meet one or more of the requirements of prime farmland, but are important for the production of food, feed, fiber, or forage crops. They include those soils that are nearly prime farmland and that economically produce high yields of crops when treated and managed according to acceptable farming methods.

This information does not necessarily portray land that is used currently for farming; it identifies productive soils that are suitable to be farmed. This data set is not designed for use as a primary regulatory tool in permitting or siting decisions but may be used as a reference source.

Prime Farmland Soils and Soils of Statewide Importance within the study area are widespread, although Prime Farmland Soils are more concentrated along riverfront areas. The presence of these soils is most likely to affect the siting of river crossings and planned actions adjacent to the Hartford Line in the North Sector. If impacts cannot be avoided, mitigation often includes removing topsoil and transporting to a receiving farm or other agricultural use.

Table 7-3: Prime Farmland Soils and Soils of Statewide Importance

Sector	Comments	
	Prime Farmland Soils	Soils of Statewide Importance
Study Core	Low prevalence	Low prevalence
Northwest Sector	Moderate prevalence	Moderate prevalence
North Sector	High prevalence	High prevalence
Northeast Sector	Moderate prevalence	Moderate prevalence
Southwest Sector	Low prevalence	Low prevalence
South Sector	High prevalence	High prevalence
Southeast Sector	High prevalence	High prevalence

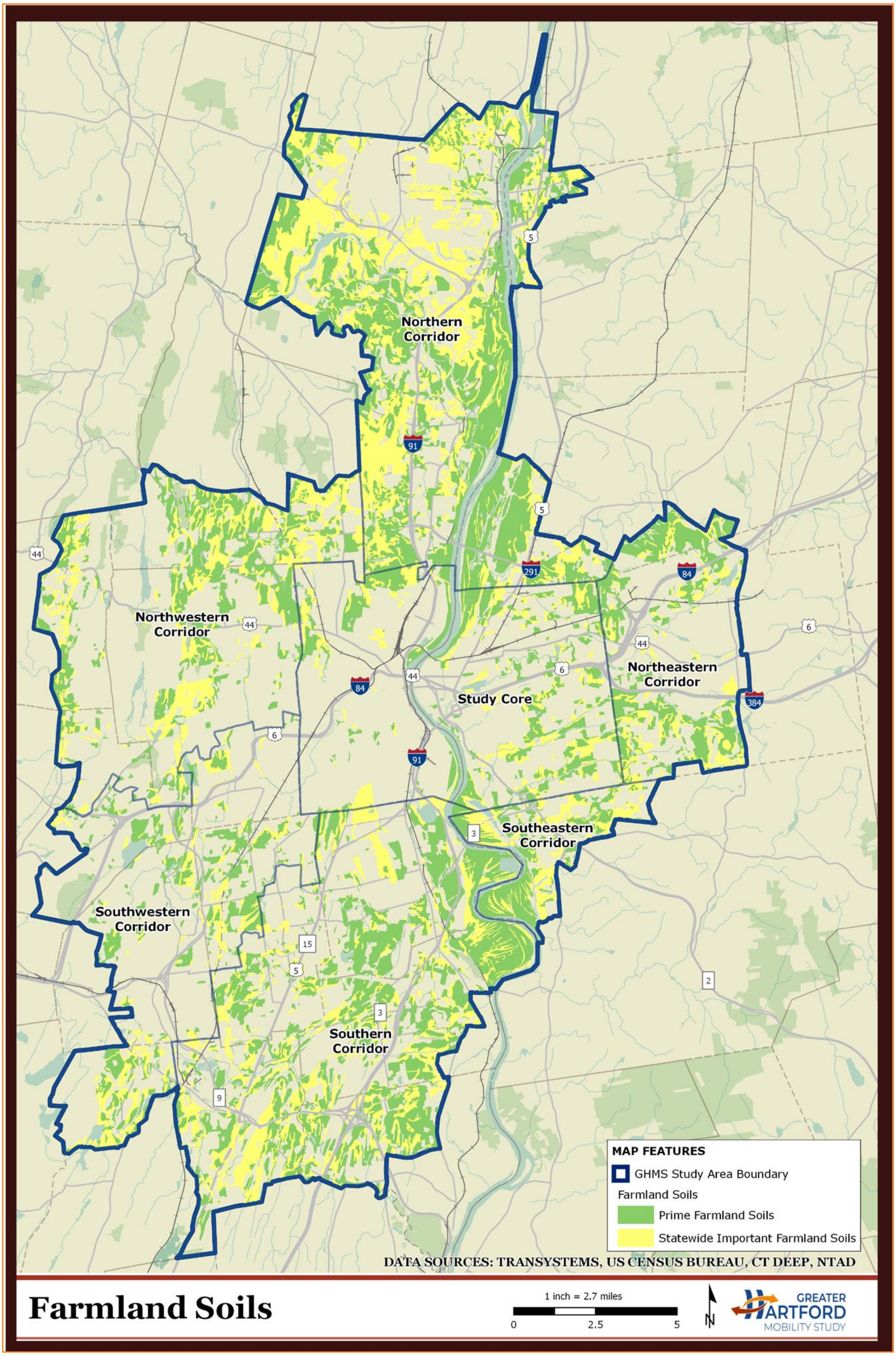


Figure 7-3: Prime Farmland Soils and Soils of Statewide Importance

7.5 Surface and Groundwater Resources

Surface and groundwater resources were reviewed for their general presence within the study area and sectors and potential to constrain future mobility improvements.

The presence of surface water resources is most likely to affect the siting of river and stream crossings, widenings or new alignments. These resources may have setbacks or protected zones and require additional levels of stormwater treatment.

Surface Water means the waters of Long Island Sound, its harbors, embayments, tidal wetlands and creeks; rivers and streams, brooks, waterways, lakes, ponds, marshes, swamps, bogs, federal jurisdictional wetlands, and other natural or artificial, public or private, vernal or intermittent bodies of water, excluding groundwater. The Surface Water Quality Classes are AA, A, B, SA and SB. All surface waters not otherwise classified are considered as Class A if they are in Class GA Ground Water Quality Classifications areas.

Class AA designated uses are: existing or proposed drinking water, fish and wildlife habitat, recreational use (maybe restricted), agricultural and industrial supply. Class A designated uses are: potential drinking water, fish and wildlife habitat, recreational use, agricultural and industrial supply. Class B designated uses are: fish and wildlife habitat, recreational use, agricultural and industrial supply and other legitimate uses including navigation. Class B* surface water is a subset of Class B waters and is identical in all ways to the designated uses, criteria and standards for Class B waters except for the restriction on direct discharges. Coastal water and marine classifications are SA and SB. Class SA designated uses are: marine fish, shellfish and wildlife habitat, shellfish harvesting for direct human consumption, recreation and other legitimate uses including navigation. Class SB designated uses are: marine fish, shellfish and wildlife habitat, shellfish harvesting for transfer to approved areas for purification prior to human consumption, recreation and other legitimate uses including navigation.

Table 7-4: Surface Water Resources

Sector	Comments
Study Core	Connecticut River, Hockanum River, Willow Brook, Park River, Keeney Cove, Porter Brook, Pewterpot Brook, Goodwin Brook, Burnham Brook
Northwest Sector	Hartford Reservoir 1,2,3,5,6, Dyke Pond, Hoe Pond, Ely Pond, Mead Pond, Willow Lake, Tumbledown Brook, Wash Brook, Indian Brook, Farmington River
North Sector	Connecticut River, Farmington River, Seymour Hollow, Strawberry Meadows Brook, Hathaway Hollow, Waterworks Brook, Adds Brook, Kettle Brook, Mundy Hollow, Phelps Brook, Goodwin Pond, Mill Brook, Meadow Brook, Deckers Brook, Podunk River, Newberry Brook,
Northeast Sector	Hockanum River, Hockanum River Reservoir, Union Pond, Lydall Brook, Bigelow Brook, Center Springs Pond, Porter Brook, Buckland Pond, Folly Brook, Hop Brook, Salmon Brook, Globe Hollow Reservoir
Southwest Sector	Woodridge Lake, Wood Pond, Batterson Park Pond, Bass Brook, Piper Brook, Trout Brook, Mattabesset River, Hart Pond
South Sector	Wethersfield Cove, Connecticut River, 1860 Reservoir, Goff Brook, Fairlane Brook, Valley Brook, Beaver Brook, Saw Mill Brook, Mattabesset River, Spruce Brook, Chestnut Brook,
Southeast Sector	Connecticut River, Salmon Brook, Porter Brook, Hubbard Brook, Keeney Cove

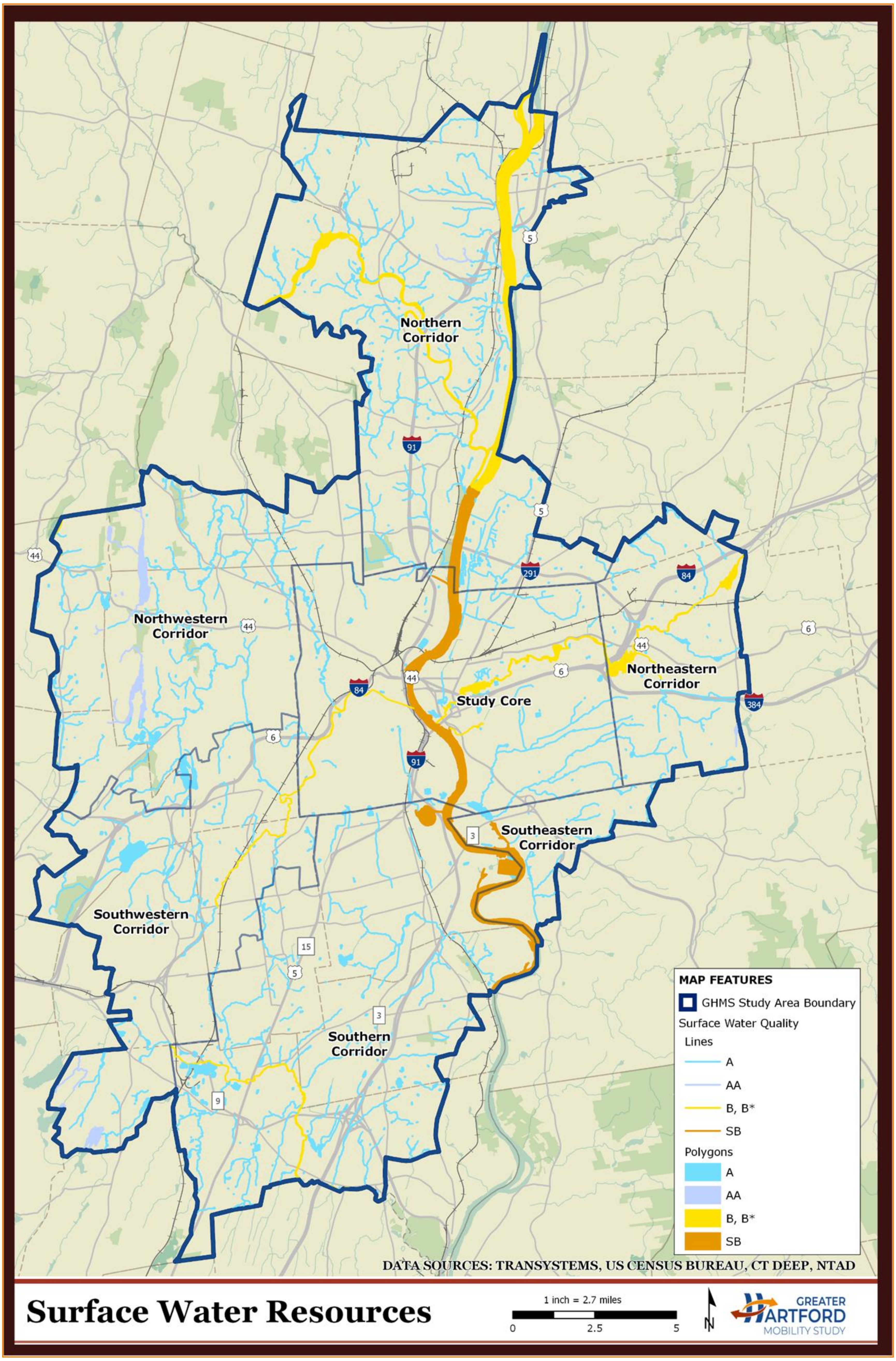


Figure 7-4: Surface Water Resources
Data Source: Connecticut Department of Energy and Environmental Protection (DEEP)

The CT DEEP Ground Water Quality Classes are GA, GAA, GAAs, GB and GC. Classes GAA and GA designate areas of existing or potential drinking water. All ground waters not otherwise classified are considered as Class GA. Class GAAs is for ground water that is tributary to a public water supply reservoir. Class GB is used where ground water is not suitable for drinking water. Class GC is used for assimilation of permitted discharges. Modified classes GA-Impaired, GAA-Impaired, GAA-Well-Impaired, GAA-Well and GA-NY are found in the data layer to categorize special cases of GA or GAA that may not be meeting the goal (impaired), surround public water supply wells (Well) or contribute to a public water supply watershed for another state (NY).

Similar to surface water resources, the presence of groundwater resources is most likely to affect the siting of river and stream crossings, widenings or new alignments. These resources may have setbacks or protected zones and require additional levels of stormwater treatment.

Table 7-5: Groundwater Resources

Sector	Comments
Study Core	Primarily GB (not suitable for drinking water) in central core of Hartford, East Hartford / GA outside central city (assumed suitable for drinking water)
Northwest Sector	Primarily GA (assumed suitable for drinking water) / GAA (near wells and tributaries contributing to the Hartford Reservoirs)
North Sector	Primarily GA (assumed suitable for drinking water) / GA-Impaired and GB near Bradley International Airport
Northeast Sector	Primarily GA (assumed suitable for drinking water) / GB (not suitable for drinking water) in central core of Manchester
Southwest Sector	Primarily GA (assumed suitable for drinking water) / GB (not suitable for drinking water) in central core of New Britain and adjacent to Hartford Line
South Sector	Primarily GA (assumed suitable for drinking water)
Southeast Sector	Primarily GA (assumed suitable for drinking water)

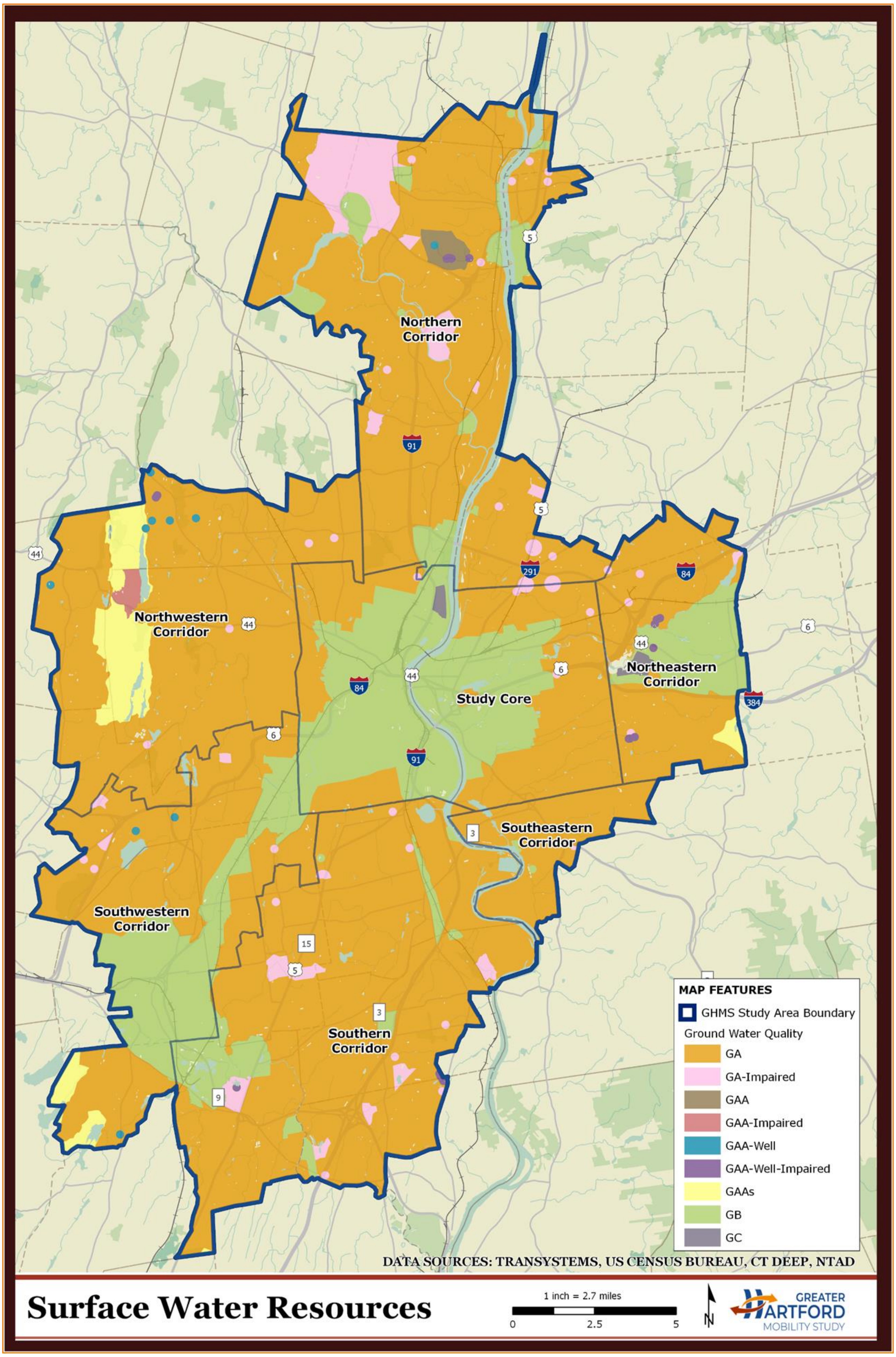


Figure 7-5: Groundwater Resources
Data Source: Connecticut Department of Energy and Environmental Protection (DEEP)

7.6 Floodplains

Floodplains (primarily the 100-year Flood Hazard) were reviewed for their general presence within the study area and sectors and potential to constrain future mobility improvements. Floodplains within the study area are primarily associated with riverfront areas adjacent to the Connecticut River and its tributaries. The presence of these floodplains is most likely to affect the siting of river crossings and widening or new alignments adjacent to the existing Hartford Line. Existing and proposed facilities within the vicinity of floodplain areas will also have to consider climate change and resiliency issues.

Table 7-6: Floodplains

Sector	Comments
Study Core	Moderate prevalence
Northwest Sector	Low prevalence
North Sector	Moderate prevalence
Northeast Sector	Low prevalence
Southwest Sector	Moderate prevalence
South Sector	Moderate prevalence
Southeast Sector	Low prevalence

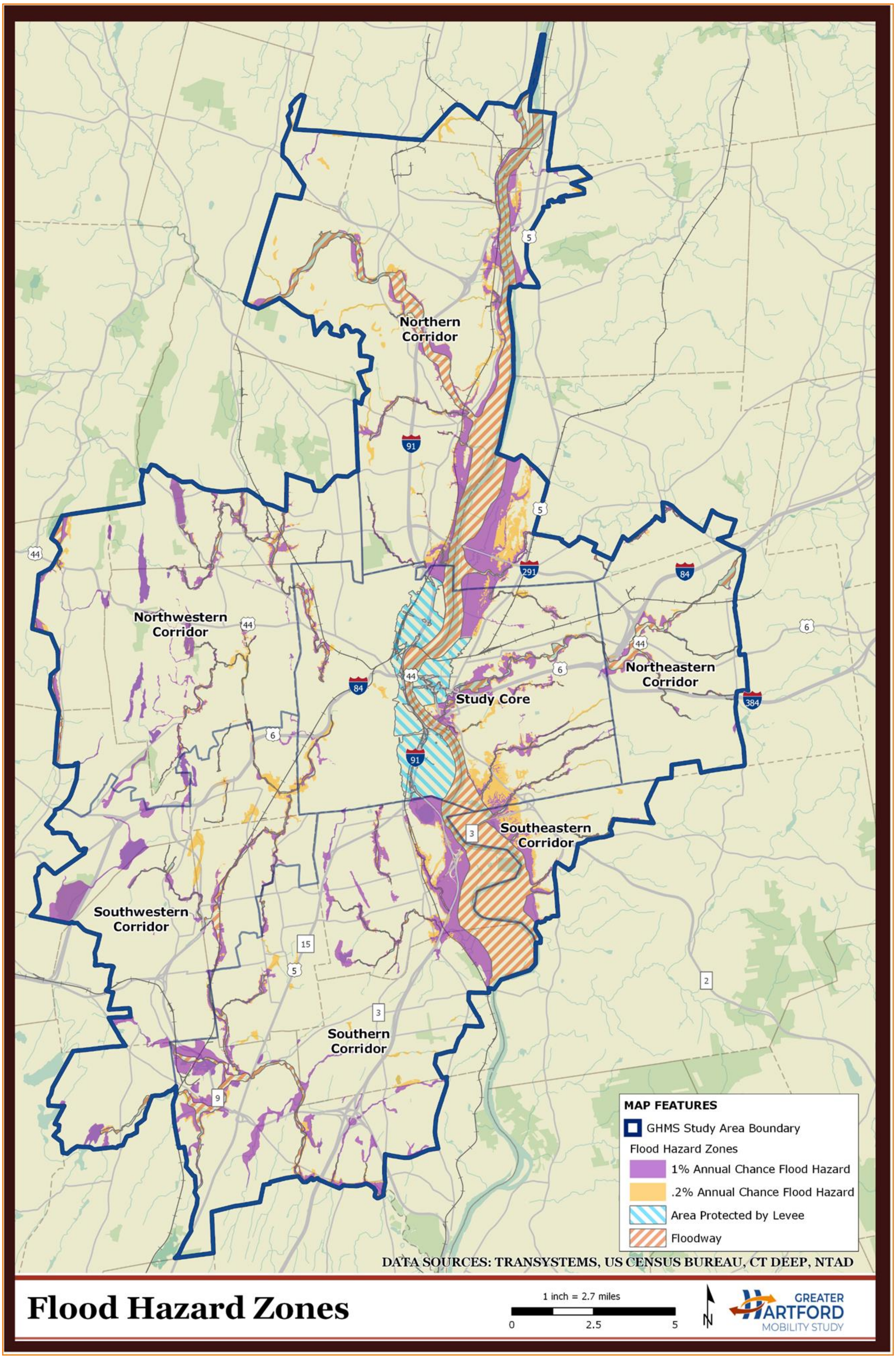


Figure 7-6: Floodplains
Data Source: Federal Emergency Management Agency (FEMA) National Flood Hazard Layer (NFHL)

7.7 Wetlands

Wetlands (characterized by DEEP as Inland Wetland Soils) were reviewed for their general presence within the study area and sectors and potential to constrain future mobility improvements. Wetlands within the study area are primarily associated with riverfront areas adjacent to the Connecticut River and its tributaries, as well as other streams and brooks. Isolated wetlands are present throughout the study area and may be associated with open space or surface water resources. The presence of these floodplains is most likely to affect the siting of river crossings and widening or new alignments. Existing and proposed facilities within the vicinity of wetland areas will also have to consider climate change and resiliency issues. Impacts to wetland resources will necessitate permitting at the local, state and federal levels.

Table 7-7: Wetlands

Sector	Comments
Study Core	Wetland areas adjacent to the Connecticut River, Park River, Hockanum River, Parker River and Pewterpot Brook. Isolated wetlands near Keney Park (Meadow Brook) and Rentschler Field (Willow Brook).
Northwest Sector	Wetland areas adjacent to Route 44 and Route 218 associated with Beman Brook and Wash Brook, North Branch of the Park River, Tumbledown Brook and Hart Meadow Brook.
North Sector	Wetland areas adjacent to I-91 and the Hartford Line associated with the Connecticut River, Farmington River and Mill Brook.
Northeast Sector	Wetland areas adjacent to I-84, I-384, Route 44, Route 6 associated with the Hockanum River, in Buckland Hills associated with Plum Gulley Brook and Farm Brook.
Southwest Sector	Wetland areas adjacent to I-84, Route 9 and the Hartford Line associated with the Dead Wood Swamp, Quinnipiac River, Mill Brook, Piper Brook, and Mattabesset River.
South Sector	Wetland areas adjacent to I-91, Route 9, Route 3 and the Hartford Line associated with the Connecticut River, Mattabesset River, Hatchery Brook and Spruce Brook.
Southeast Sector	Wetland areas adjacent to Route 3 and Route 2 associated with the Connecticut River and Salmon Brook.

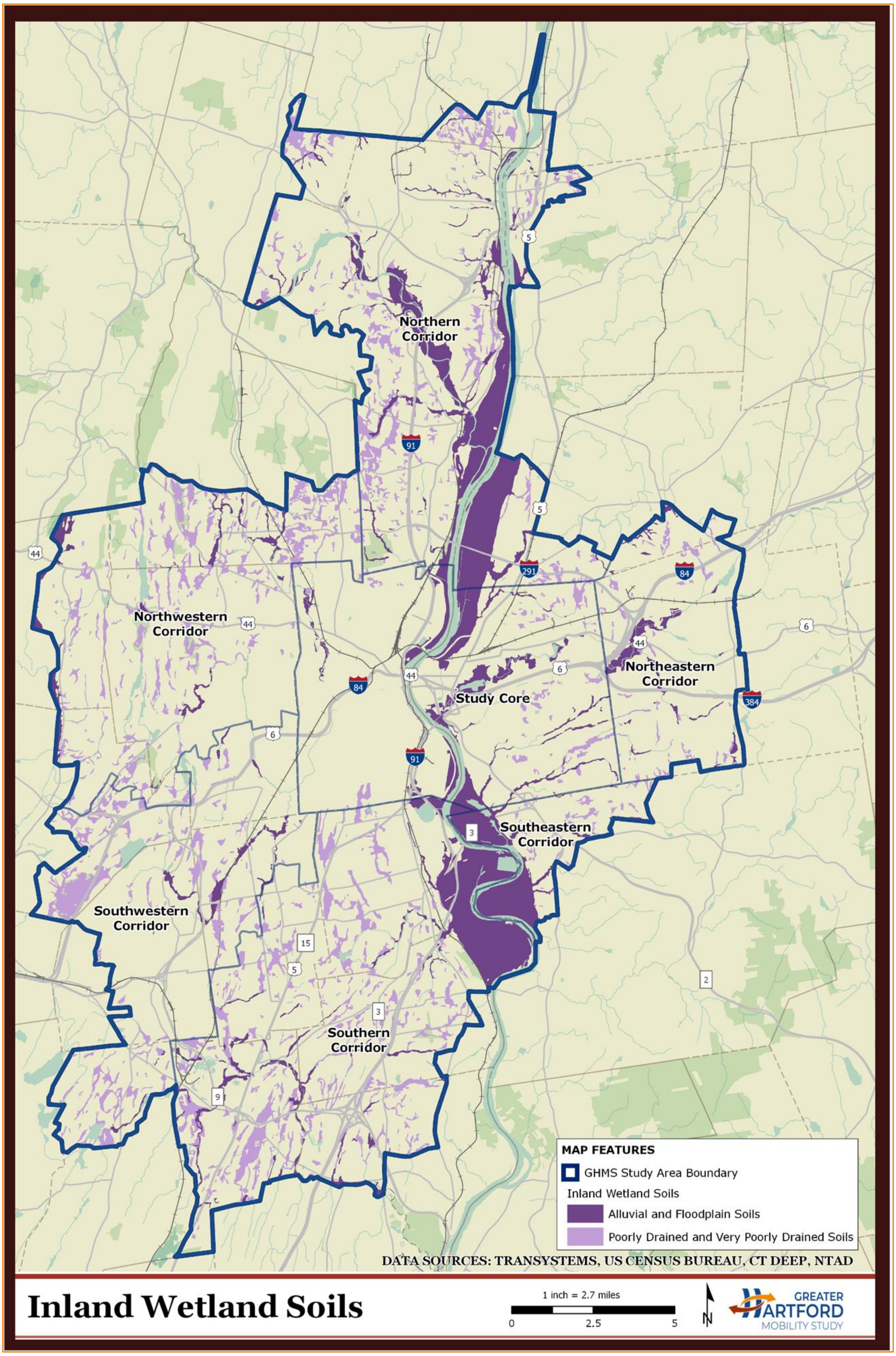


Figure 7-7: Wetlands

Data Source: Connecticut Department of Energy and Environmental Protection (DEEP)

7.8 Historic, Architectural and Archaeological Resources

Historic and Architectural Resources were reviewed for their general presence within the study area and sectors and potential to constrain future mobility improvements. It should be noted that concerns associated with archaeological resources are similar, but due to their sensitive nature are not provided in a publicly available searchable database.

There are over 400 historical and architectural properties within the study area that are listed in the National Register of Historic Places, including nearly 80 historic districts. The majority of these protected properties and districts are in Hartford within the Study Core.

In addition, there are countless properties and districts designated by local historical commissions as having local significance. The presence of these resources is most likely to affect widening, new alignments or placement of facilities that may alter the character or context of the property or district in question. A number of historic properties or transportation-related resources are located adjacent to the Hartford Line and may be integrated into potential solutions, such as railroad stations, depots and other support structures. If impacts to these properties cannot be avoided, context-sensitive solutions will be required, and an added layer of regulatory constraint must be addressed.

Table 7-8: Historic, Architectural and Archaeological Resources

Sector	Comments
Study Core	High prevalence: over 50 historic districts
Northwest Sector	Low prevalence: less than 5 historic districts
North Sector	Low prevalence: less than 5 historic districts
Northeast Sector	Moderate prevalence: less than 10 historic districts
Southwest Sector	Low prevalence: less than 5 historic districts
South Sector	Moderate prevalence: less than 10 historic districts
Southeast Sector	Moderate prevalence: less than 10 historic districts

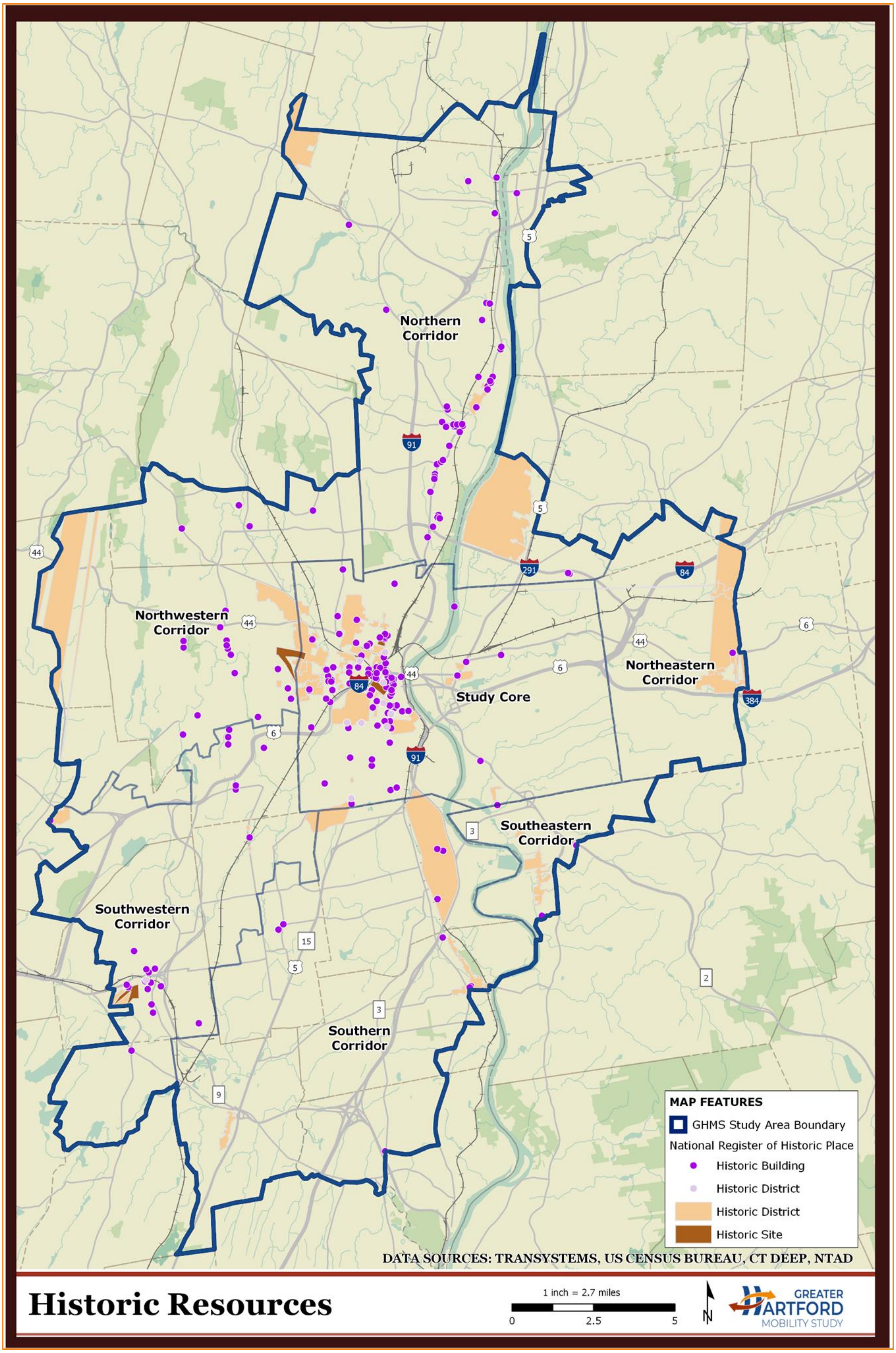


Figure 7-8: Historic, Architectural and Archaeological Resources

Data Source: National Park Service (NPS)

7.9 Socioeconomic Considerations – Population and Employment Density

Population density was reviewed for its general presence within the study area and sectors and its potential to constrain mobility improvements (due to impacts) or serve as a catalyst for mobility improvements (due to critical mass and ability to benefit greater numbers of citizens).

Population and employment trends within the study area have been the subject of analysis by CRCOG in two recent publications: the "Metropolitan Transportation Plan Long Range Transportation Plan for the Metro-Hartford Capitol Region – Connect 2045" adopted in April, 2019, and "METRO HARTFORD FUTURE ACCELERATING SHARED AND SUSTAINED ECONOMIC GROWTH A Comprehensive Economic Development Strategy for the Capitol Region," also published in 2019. Within the CRCOG region, population growth is expected to be 7.3% between 2010 and 2045. This growth is characterized as over three times the expected statewide growth during the same period. Both the Long Range Transportation Plan and the CEDS report reference an expected increase in the over-65 age cohort and stagnation or declines in other cohorts, which may inform the type of transportation and mobility improvements envisioned for the future.

Table 7-9: Population Density

Sector	Comments
Study Core	High density: many areas with over 11,000 people per square mile
Northwest Sector	Moderate density: some areas with over 10,000 people per square mile
North Sector	Low-to-moderate density: isolated areas with over 3,000 people per square mile
Northeast Sector	Moderate density: some areas with over 11,000 people per square mile
Southwest Sector	Moderate-to-high density: several areas with over 11,000 people per square mile
South Sector	Low-to-moderate density: isolated areas with over 3,000 people per square mile
Southeast Sector	Low density: few areas with over 3,000 people per square mile

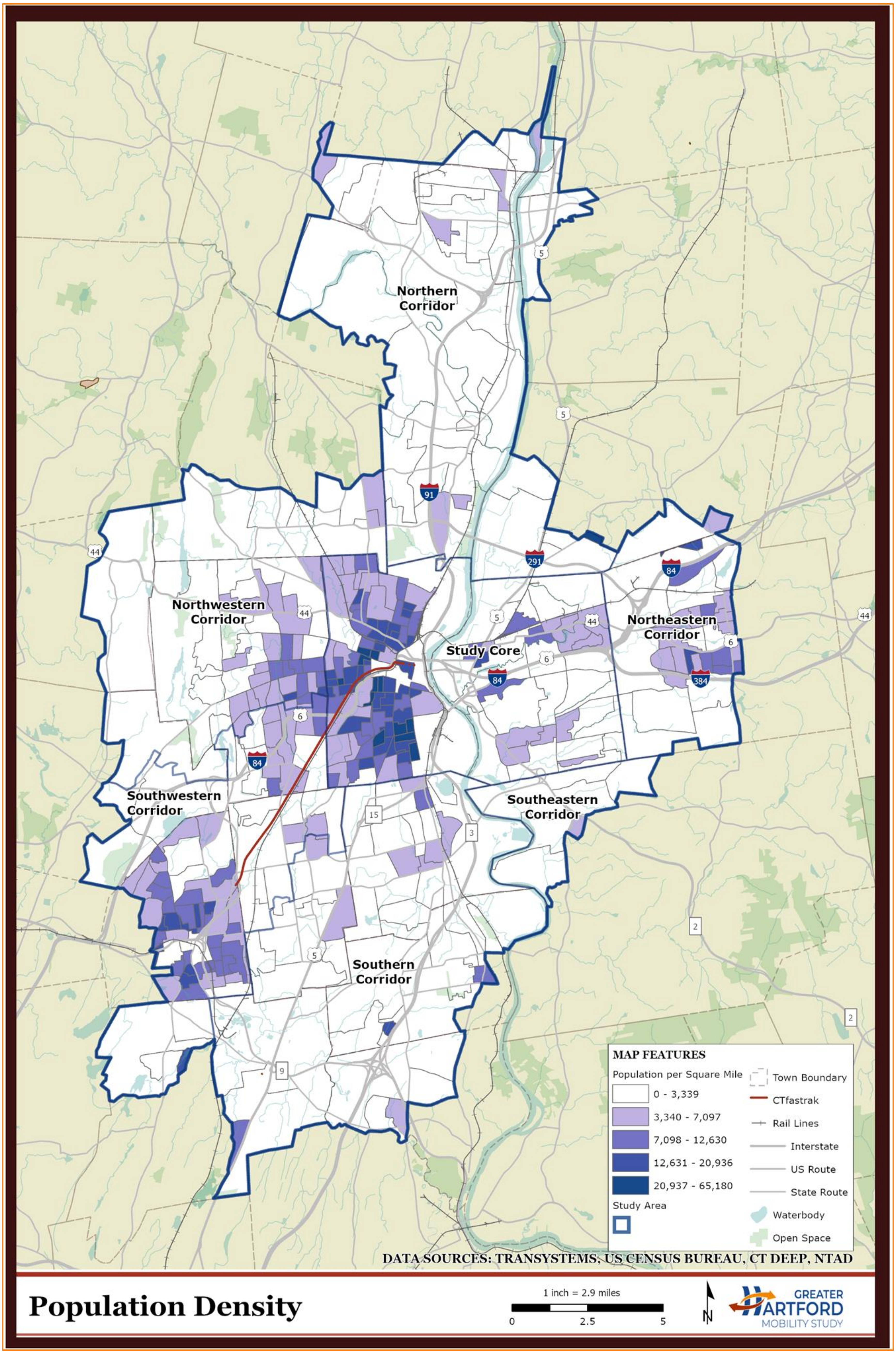


Figure 7-9: Population Density

Data Source: US Census Bureau

Regional employment projections show a 17% growth in the number of jobs between 2010 and 2045, or less than 1% per year. The Long Range Transportation Plan notes that this growth exceeds the projected population growth during the same period and will continue the region's status as a net importer of employees, requiring continued solutions to regional transportation issues.

A review of annual community population estimates from the Connecticut State Department of Public Health for the last five reporting years (2015-2019) indicate that population growth in Hartford County and the region as a whole is either flat or slightly (<1.5%) negative during that time period. The only recent population growth among the study area sectors during that time is in the Northern Sector.

Despite the decline in population over the last five years, data from the US Census American Community Survey indicates a slight growth in the number of households during the same five-year period. The number of households in Hartford County was estimated to increase by 2%, while the increase in the city of Hartford was nearly 8%. A corresponding drop in average household size is attributable to this finding.

Employment Centers

Employment centers were reviewed for their general presence within the study area and sectors and potential to constrain (due to potential property impacts) or support (due to socioeconomic benefits) future mobility improvements. The presence of employment centers is most likely to affect widenings or new alignments, transit routing and service, and active transportation connections. Potential benefits could include improved access to jobs and transit service that connects zero-vehicle households to employment centers outside the Study Core.

Using the US Census Longitudinal Employer-Household Dynamics dataset and the associated "On the Map" tool, employment center data was identified for Hartford County. Within the county, approximately 50% of workers live less than ten miles from their residence. Another 33% work between 10 and 24 miles from home and the balance work over 25 miles from home. Employment density (jobs per square mile) by sector is summarized below.

Table 7-10: Employment Density

Sector	Comments
Study Core	High density: some areas with over 50,000 jobs per square mile
Northwest Sector	Moderate density: some areas with 13,000-30,000 jobs per square mile
North Sector	Low-to-moderate density: isolated areas with 3,000-13,000 jobs per square mile
Northeast Sector	Low-to-moderate density: isolated areas with 3,000-13,000 jobs per square mile
Southwest Sector	Low-to-moderate density: isolated areas with 3,000-13,000 jobs per square mile
South Sector	Low-to-moderate density: isolated areas with 3,000-13,000 jobs per square mile
Southeast Sector	Low-to-moderate density: isolated areas with 3,000-13,000 jobs per square mile

It should be noted that the data summarized above is based upon pre-pandemic conditions and do not reflect an anticipated post-pandemic increase in work-from-home options. The data still provides a baseline for future scenario planning that is focused more on frequency (number of days at the workplace vs. number of days working from home) than on geography at this time. As mobility options are developed, further inquiries to specific large employers may be required to understand how post-pandemic working options may affect the role of employment centers and the workplace of the future.

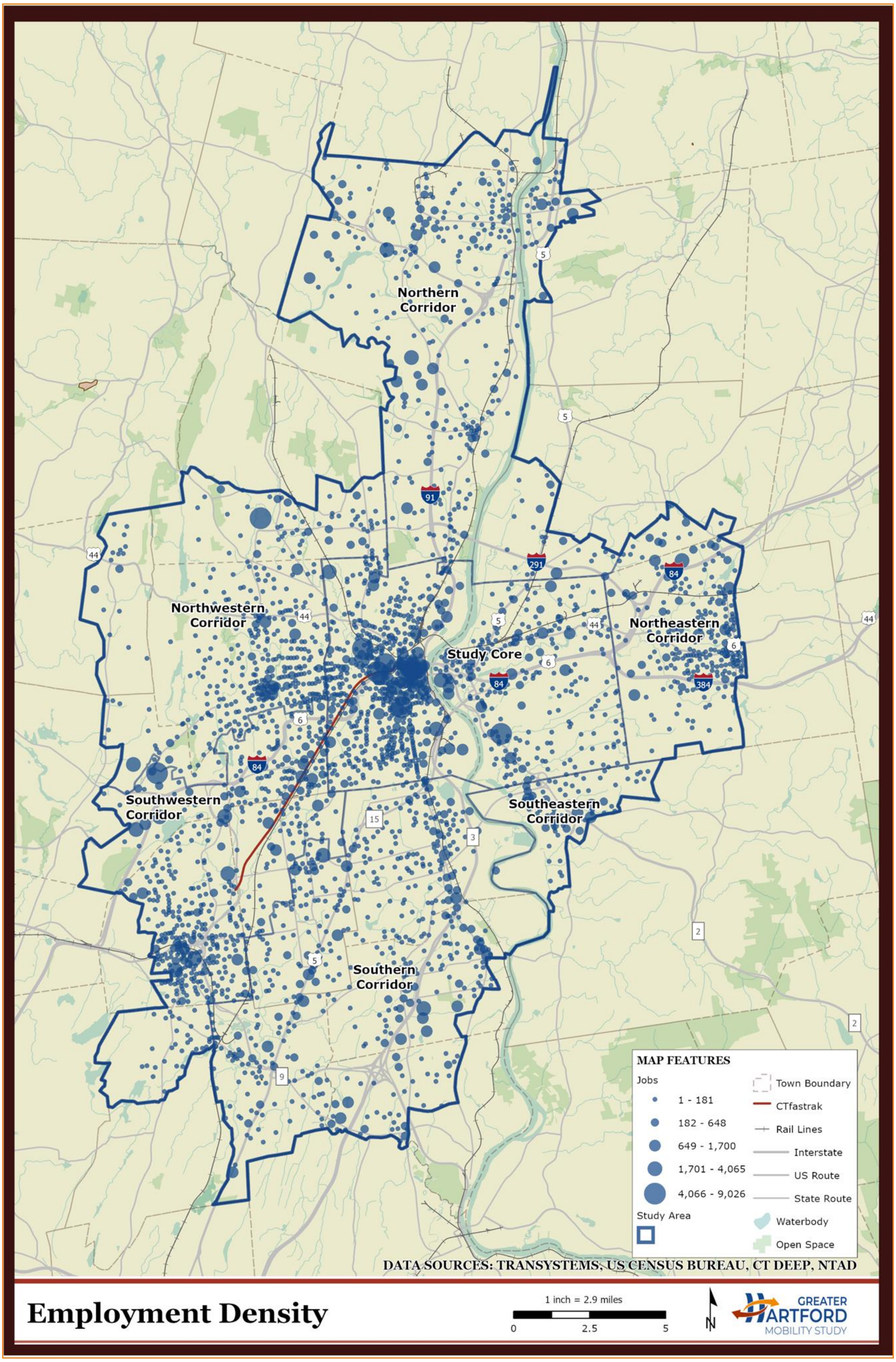


Figure 7-10: Employment Density

Data Source: US Census Bureau

7.10 Socioeconomic Considerations – Zero Vehicle Households

Zero-vehicle households represent a segment of the population that are either transit-dependent or must rely on bicycle travel, carpooling or walking to fulfill job responsibilities and obtain basic human services. These households are often part of low-income populations as well.

Demographic data on zero-vehicle households was reviewed for its general presence within the study area and sectors and potential to be positively or negatively affected by future mobility improvements. Hartford, East Hartford (Study Core) and New Britain (SW Sector) are all communities with concentrations of zero-vehicle households. The presence of these zero-vehicle households is most likely to affect the siting of new transit alignments or routes, stations or terminals, as well as consideration of transit links to regional employment centers. Improvements to access, mode choice, convenience and travel time savings will have to be balanced with potential noise and air quality impacts.

Table 7-11: Zero Vehicle Households

Sector	Comments
Study Core	High prevalence
Northwest Sector	Low prevalence
North Sector	Low prevalence
Northeast Sector	Moderate prevalence
Southwest Sector	High prevalence
South Sector	Low prevalence
Southeast Sector	Low prevalence

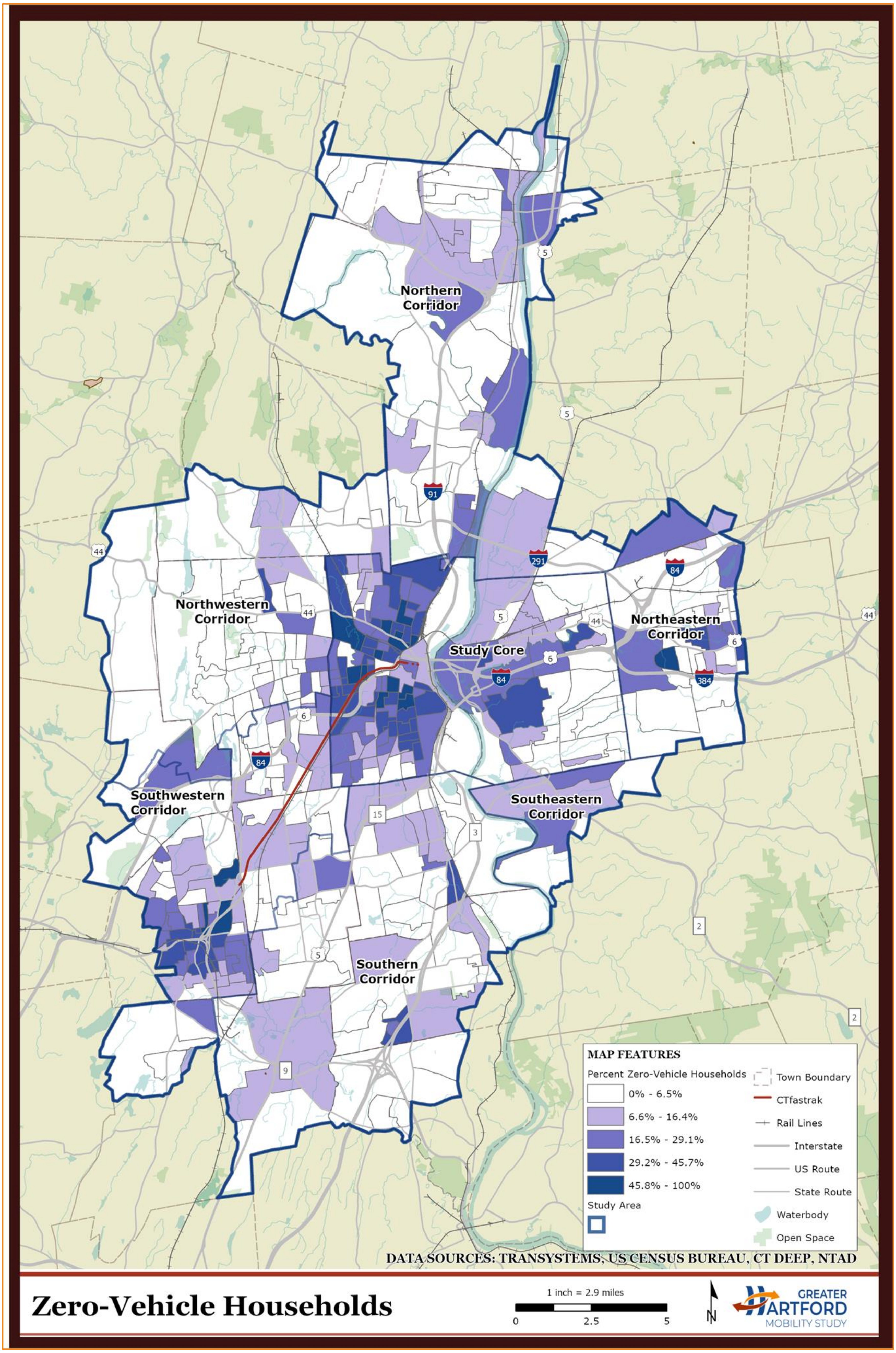


Figure 7-11: Zero Vehicle Households

Data Source: US Census Bureau

7.11 Socioeconomic Considerations – Environmental Justice / Title VI Communities

A primary purpose of Environmental Justice is to ensure that disadvantaged populations are not disproportionately affected by the impacts of transportation improvements. Similarly, Title VI regulations are in place to ensure that disadvantaged populations have equal access and opportunity to learn about and comment on proposed transportation improvements. The CRCOG 2019 Title VI / Environmental Justice Atlas was the data source for identification of Environmental Justice and Title VI communities within the study area.

Recipients of federal transportation funds for planning and other activities are required to comply with the provisions of Title VI of the Civil Rights Act of 1964 (42 U.S.C. Section 2000d). United Stated Department of Transportation (USDOT) guidance1 on the responsibilities to specific populations states that "Title VI of the Civil Rights Act of 1964, 42 U.S.C. 2000d, et seq., and its implementing regulations provide that no person shall be subjected to discrimination on the basis of race, color, or national origin under any program or activity that receives Federal financial assistance." The Federal Transit Administration's (FTA) guidance2 on Title VI responsibilities also has the following objectives:

a. Ensure that the level and quality of transportation service is provided without regard to race, color, or national origin;

b. Identify and address, as appropriate, disproportionately high and adverse human health and environmental effects, including social and economic effects of programs and activities on minority populations and low-income populations;

c. Promote the full and fair participation of all affected populations in transportation decision making;

d. Prevent the denial, reduction, or delay in benefits related to programs and activities that benefit minority populations or low-income populations;

e. Ensure meaningful access to programs and activities by persons with limited English proficiency.

Related to Title VI is Executive Order 12898 of 1994 (59 FR 7629), which focuses attention on the environmental and human health effects of federal actions on minority and low-income populations with the goal of achieving Environmental Justice (EJ) for all communities. This Executive Order directs federal agencies and their programs to avoid disproportionately high and adverse health or environmental effects on minority and low-income populations, to the greatest extent possible. The order is intended to promote nondiscrimination in federal programs as well as to provide minority and low-income communities access to public participation. The objectives of Title VI and EJ serve as a basis for a recipient of any federal transportation funds to adopt as the goals of its own program.

Minority Populations

As defined in the CRCOG documentation and the U.S. Census Bureau, minority populations are those groups who are members of the following racial or ethnic groups:

- Hispanic or Latino (of any race);
- African-American or Black;
- Asian, Native Hawaiian, other Pacific Islander;
- American Indian, Alaska Native;
- Some other race; or
- Two or more races.

Demographic data on minority populations was reviewed for their general presence within the study area and sectors and potential to be positively or negatively affected by future mobility improvements. Hartford, East Hartford (Study Core) and New Britain (SW Sector) are all majority-minority communities. The presence of these minority populations is most likely to affect the siting of new transit alignments or routes, as well as stations or terminals. Improvements to access, mode choice, convenience and travel time savings will have to be balanced with potential noise and air quality impacts.

Table 7-12: Minority Population

Sector	Comments
Study Core	High prevalence
Northwest Sector	Moderate prevalence
North Sector	Moderate prevalence
Northeast Sector	Moderate prevalence
Southwest Sector	High prevalence
South Sector	Low prevalence
Southeast Sector	Low prevalence

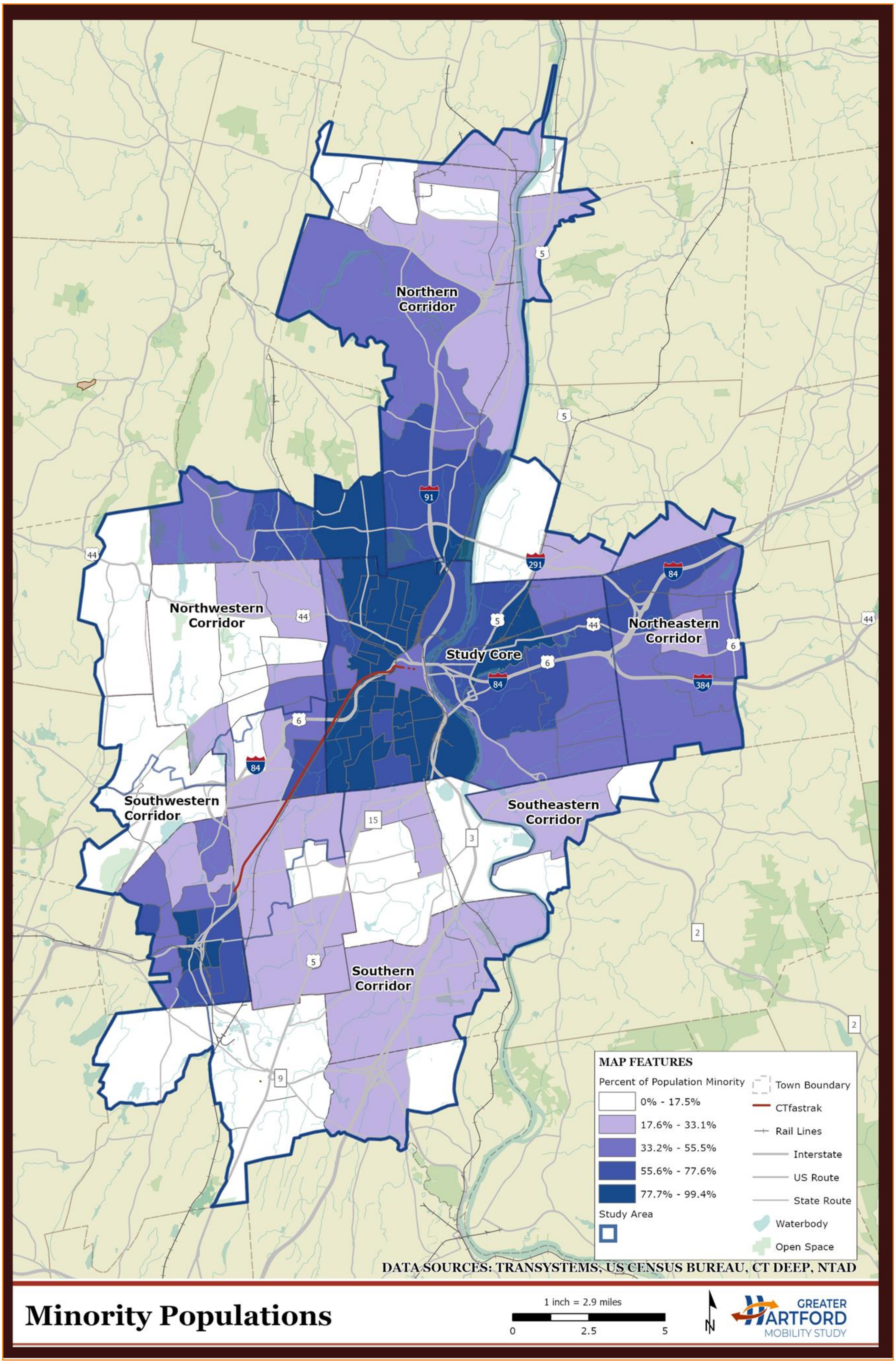


Figure 7-12: Minority Population

Data Source: US Census Bureau

Low-Income Populations

Low-income populations are typically those who are defined as being below the federal poverty level as defined by the US Department of Health and Human Services for purposes of calculating eligibility for certain federal assistance programs. The poverty level is calculated annually and is broken out by number of family members.

Demographic data on low-income populations was reviewed for their general presence within the study area and sectors and potential to be positively or negatively affected by future mobility improvements. The CRCOG Atlas uses the federally-defined Poverty Level as well as a second level of 150% of the federal poverty level. A total of 10.7% of residents in the CRCOG Region live below poverty level, and 17.0% at below 150% of the poverty level.

Hartford (Study Core) and New Britain (SW Sector) exhibit the highest incidence of persons below the poverty level. The presence of these low-income populations is most likely to affect the siting of new transit alignments or routes, stations or terminals, and transit fare structures. Improvements to access, mode choice, convenience and travel time savings will have to be balanced with potential noise and air quality impacts.

Table 7-13: Low-Income Populations

Sector	Comments
Study Core	High prevalence
Northwest Sector	Low prevalence
North Sector	Low prevalence
Northeast Sector	Moderate prevalence
Southwest Sector	High prevalence
South Sector	Low prevalence
Southeast Sector	Low prevalence

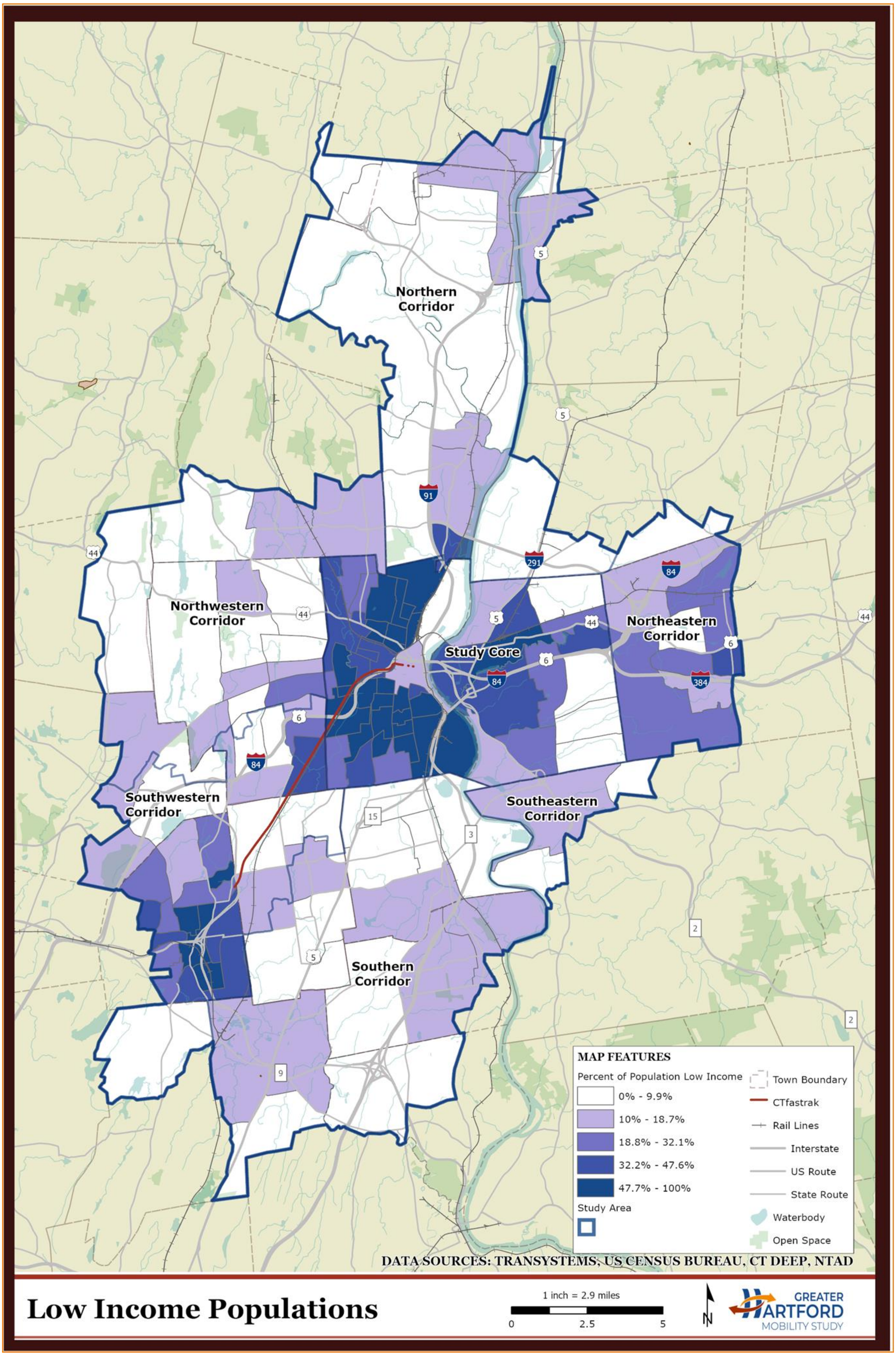


Figure 7-13: Low-Income Populations

Data Source: US Census Bureau

Limited English Proficiency

Limited English Proficiency (LEP) is the term used in federal regulations to define persons who have difficulty speaking English. LEP individuals are identified through the American Community Survey as persons who primarily speak a language other than English and speak English less than “very well.”.

Demographic data on LEP was reviewed for its general presence within the study area and sectors.

LEP is a Title VI concern regarding equal access and opportunity to learn about and comment on proposed transportation improvements. The CRCOG data is presented as an absolute number of residents: the LEP population in the Capitol Region represents over 8% of the total overall population. Nearly half of the LEP population is Spanish-speaking, followed by Polish and Chinese.

Table 7-14: Population with Limited English Proficiency

Sector	Comments
Study Core	High prevalence
Northwest Sector	High prevalence
North Sector	Moderate prevalence
Northeast Sector	High prevalence
Southwest Sector	High prevalence
South Sector	High prevalence
Southeast Sector	Moderate prevalence

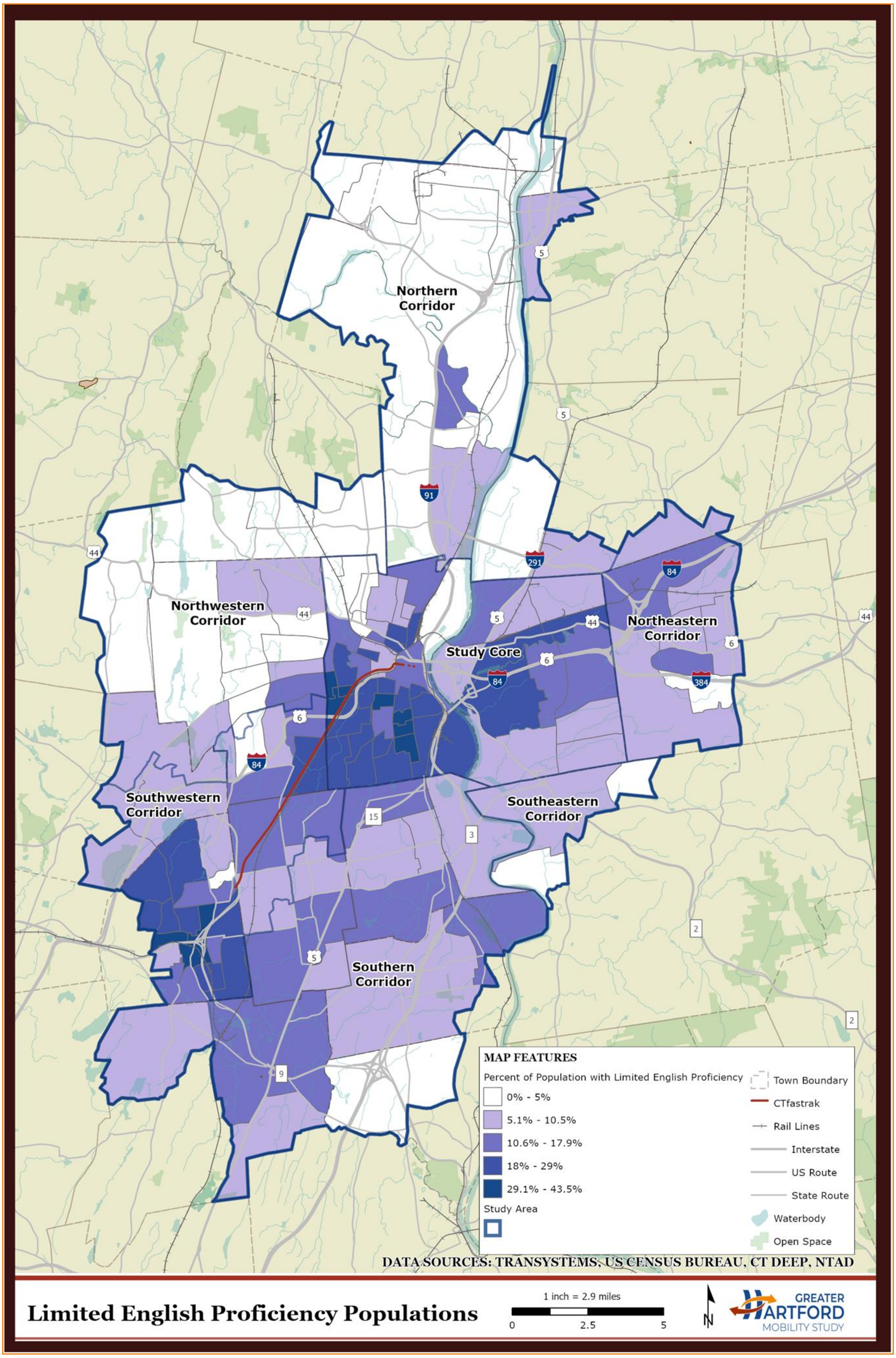


Figure 7-14: Population with Limited English Proficiency

Data Source: US Census Bureau

7.12 Socioeconomic Considerations –Institutional Resources

Institutional uses were reviewed for their general presence within the study area and sectors and potential to constrain (due to potential property impacts, noise, emissions) or support (due to socioeconomic and connectivity benefits) future mobility improvements. The presence of institutional uses is most likely to affect widenings or new alignments, transit routing and service, and active transportation connections. Institutional uses identified for this purpose are hospital / health care facilities and post-secondary educational facilities.

The location of hospitals and health care facilities are identified below. Access to these facilities is a key public health metric.

The locations of post-secondary educational facilities are also identified below. Unlike primary and secondary facilities that typically provide their own transportation services within the community, post-secondary educational facilities serve a regional population.

Table 7-15: Institutional Resources
Hospitals / Health Care Facilities

Sector	Comments
Study Core	Hartford Hospital, St. Francis Hospital and Medical Center, Connecticut Children's Medical Center, Institute of Living, Oak Hill School, Capitol Region Mental Health Center, Connecticut Institute for the Blind, Burgdorf Health Center, Northend Senior Center, Mount Sinai Hospital
Northwest Sector	Hospital at Hebrew Health Care, West Hartford; UConn Health Center, Farmington
North Sector	Hartford HealthCare, Windsor
Northeast Sector	Manchester Memorial Hospital, Manchester
Southwest Sector	UConn John Dempsey Hospital, Farmington; Hospital of Central Connecticut, New Britain;
South Sector	VA Connecticut Healthcare, Newington; Veterans Home and Hospital, Rocky Hill;
Southeast Sector	None

Post-Secondary Educational Facilities

Sector	Comments
Study Core	University of Hartford, Trinity College, UConn-Hartford, Capitol Community College, Rensselaer at Hartford, Goodwin College
Northwest Sector	University of St. Joseph, West Hartford
North Sector	None
Northeast Sector	Manchester Community College, Manchester
Southwest Sector	Central Connecticut State University, New Britain; UConn School of Medicine, Farmington
South Sector	None
Southeast Sector	None

7.13 Socioeconomic Considerations – Land Use and Zoning

Regional land use patterns were reviewed for their general presence within the study area and sectors and potential to influence future mobility improvements. Specific land use clusters may serve as nodes to be connected in a network as part of potential transit service or goods movement, such as employment centers, with the understanding that mobility is connected to where people reside. In other cases, land uses can be analyzed for the potential to be compatible with mobility improvements, whether from a physical, social or public health perspective. A summary of notable land use types within the individual sectors is provided below.

Table 7-16: Predominant Land Use

Sector	Comments
Study Core	Institutional, commercial and recreational uses
Northwest Sector	Institutional, industrial, commercial and mixed-use
North Sector	Institutional, industrial, commercial and agricultural uses
Northeast Sector	Industrial, institutional and commercial uses
Southwest Sector	Institutional, industrial and commercial uses
South Sector	Institutional, commercial and industrial
Southeast Sector	Institutional, agricultural and industrial uses

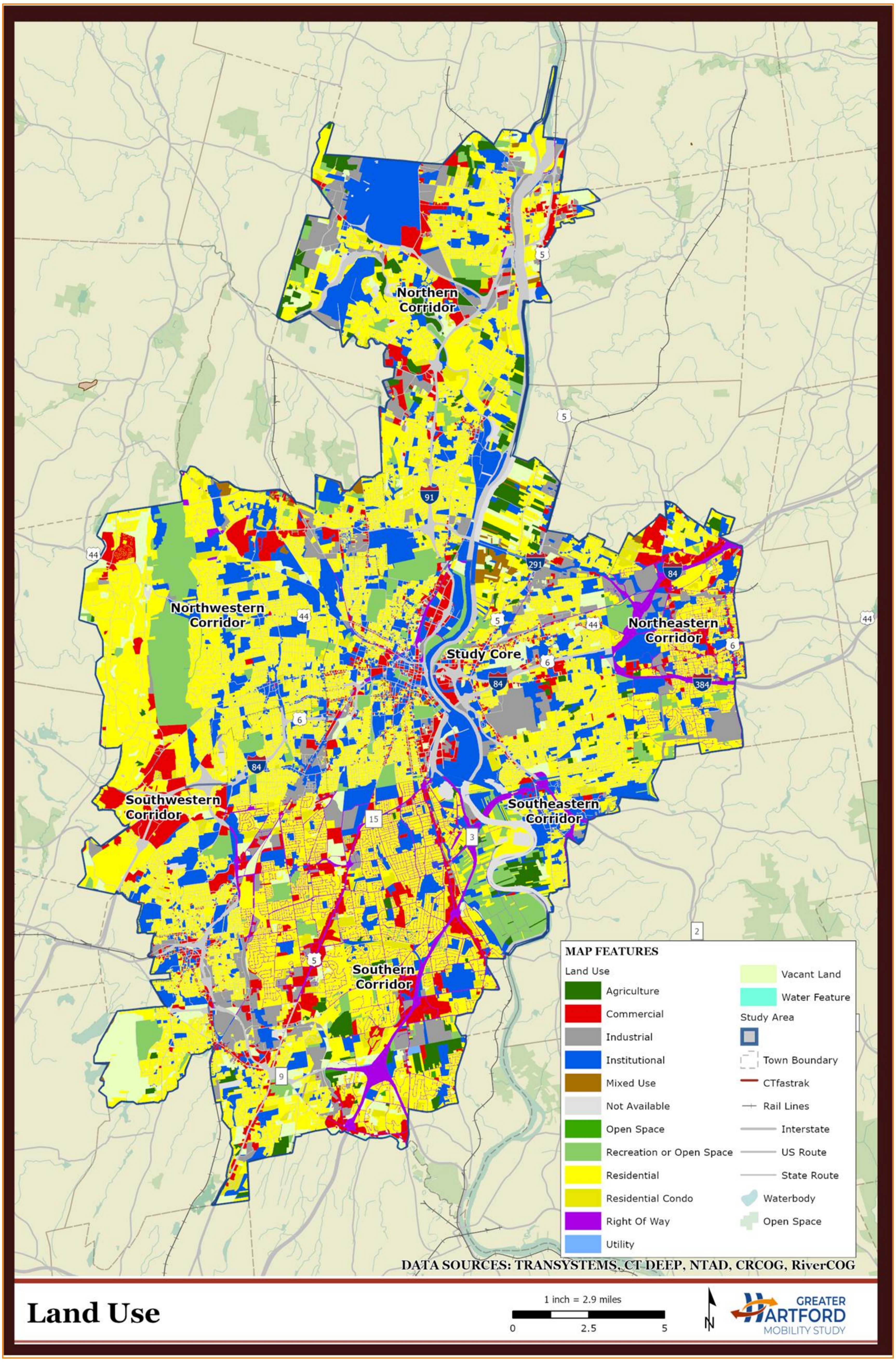


Figure 7-15: Land Use
Data Sources: Capitol Region Council of Governments, Lower Connecticut River Valley Council of Governments

Zoning regulations for each community were reviewed for their potential to promote Transit-Oriented Development (TOD) and take advantage of future mobility improvements.

Table 7-17: Zoning

Sector	Comments
Study Core	The city of Hartford has specific Transit-Oriented Development (TOD) zoning.
Northwest Sector	No communities with TOD-specific zoning.
North Sector	The town of Windsor allows increased residential density and building height in the redevelopment area of Windsor Center. In Windsor Locks, the Main Street Overlay Zone includes provisions to “take maximum advantage of the potential relocation of the Windsor Locks Train Station to its proper location back in the historic downtown setting and providing appropriate transit-oriented development land use and densities.”
Northeast Sector	The town of Manchester provides density incentives in its Comprehensive Urban Development Zone and General Business Zone for areas within one-half mile of mass transit.
Southwest Sector	No communities with TOD-specific zoning.
South Sector	The town of Newington has a TOD Overlay District.
Southeast Sector	The City of New Britain has a specific Incentive Housing Zone / Transit-Oriented Design District.

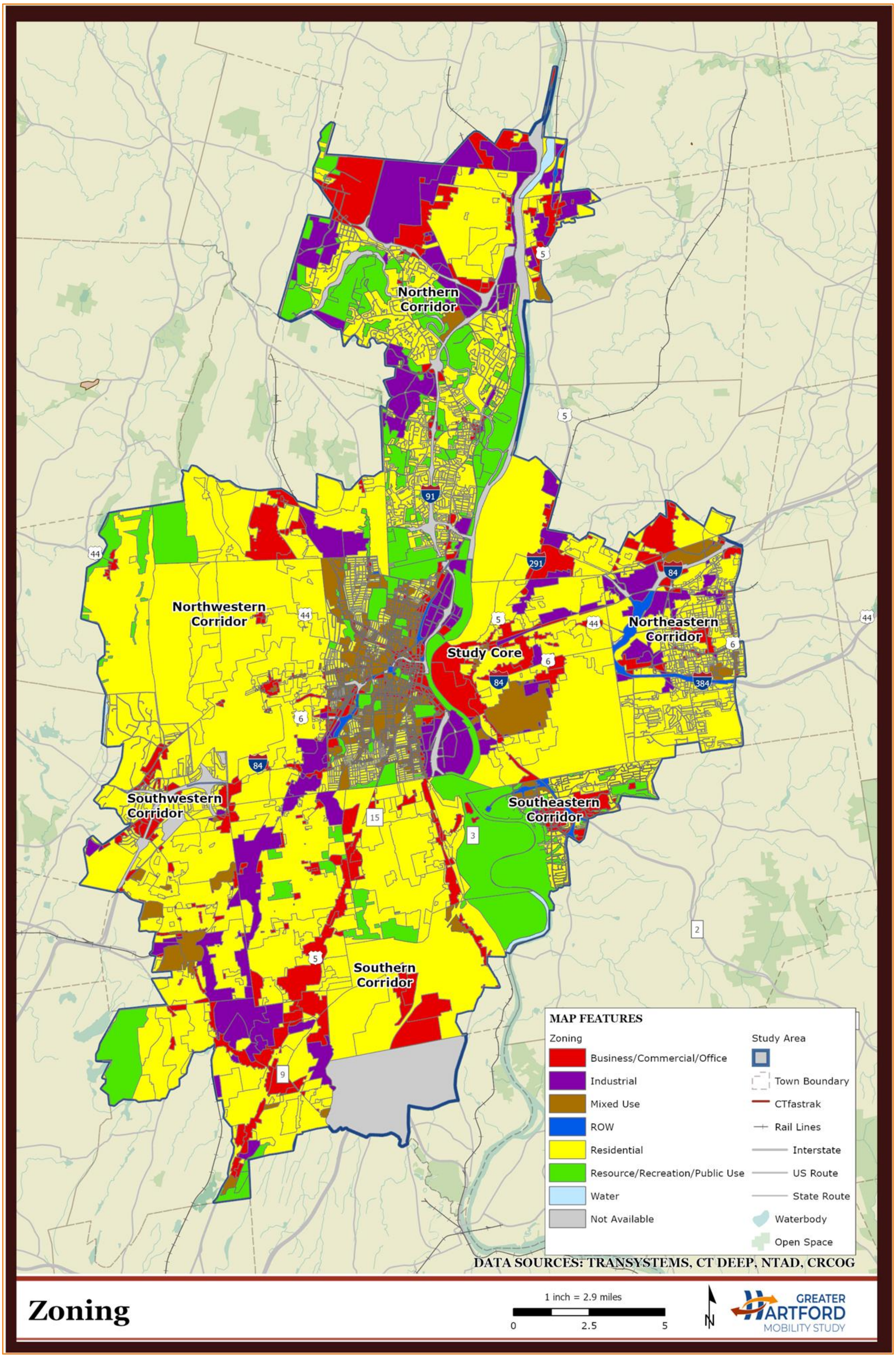


Figure 7-16: Zoning

Data Source: Capitol Region Council of Governments

7.14 Hazardous Materials

Hazardous materials records were reviewed for their general presence within the study area and sectors and potential to constrain future mobility improvements. The presence of hazardous materials is most likely to affect widenings or new alignments, transit routing and service, and active transportation connections.

CT DEEP maintains a "List of Contaminated or Potentially Contaminated Sites in Connecticut" (https://portal.ct.gov/DEEP/Remediation--Site-Clean-Up/List-of-Contaminated-or-Potentially-Contaminated-Sites-in-Connecticut). Sites are listed by community. The majority of sites in the CT DEEP database are spills or leaks associated with underground storage tanks (USTs) such as those at gas stations. Other sites include those subject to the Property Transfer Act, Federal Resource Conservation and Recovery Act (RCRA), sites included in the EPA Comprehensive Environmental Response Compensation and Liability Information System (CERCLIS) and sites with Environmental and Land Use Restrictions (ELUR), among others.

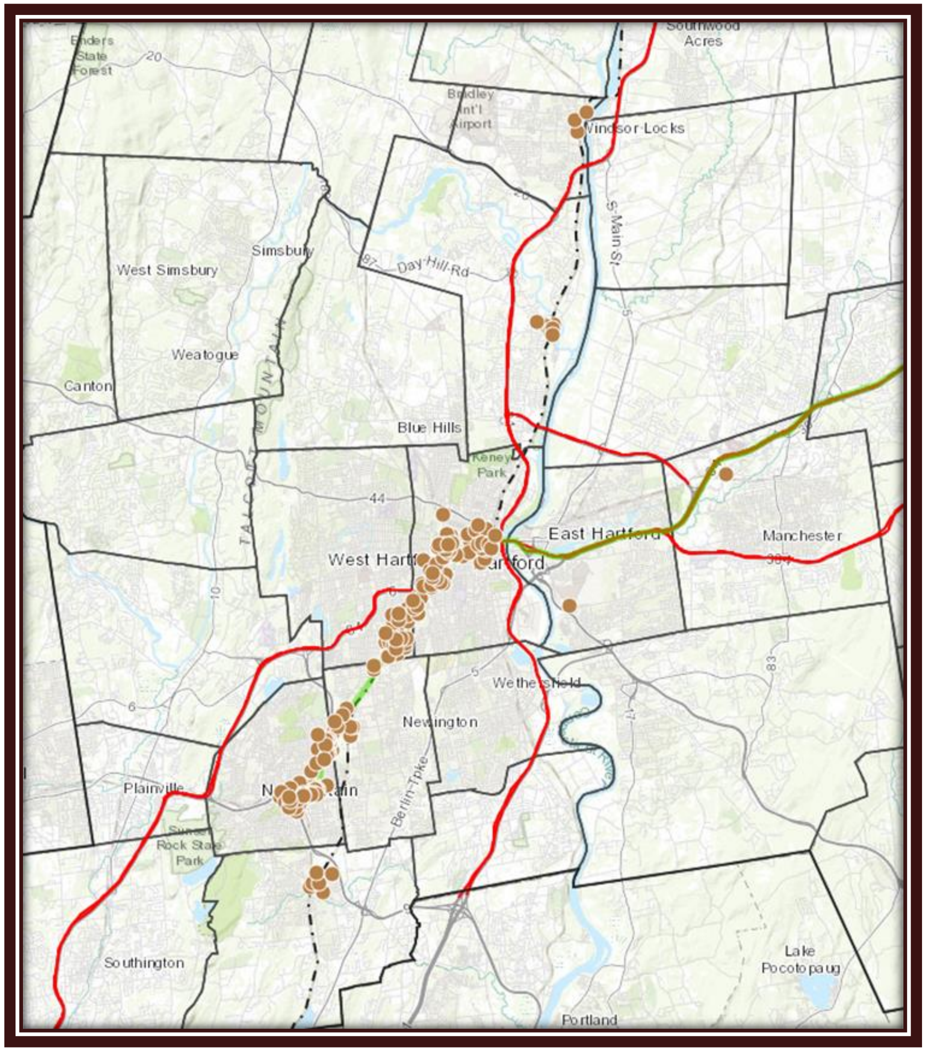
Table 18 summarizes the number of listings in each sector community, the number of sites that are not associated with USTs, the number of CERCLIS sites, and the number of ELUR sites. These summaries will provide an order-of-magnitude need for further consideration as sector-specific and site-specific future mobility improvements are proposed and potential barriers to these improvements.

CRCOG has developed a targeted inventory of sites within the CTfastrak and the CTrail-Hartford Line corridors to identify the need for brownfield assessment and remediation and to support transit-oriented development (TOD). Using a Geographic Information System (GIS) they are able to show parcels within a half-mile radius of the CTfastrak and the CTrail stations which have been identified through state or federal brownfields databases or by municipalities as brownfields sites. The goal of this work is to identify sites with TOD potential which need environmental assessment and/or remediation. The focus is on non-residential sites. Existing planning and environmental assessment reports can be linked to the inventory. The inventory currently includes 245 potential and known brownfields sites. CRCOG continues to expand this online inventory to include additional brownfield sites throughout the region.

Table 7-18: Hazardous Materials

Sector	Comments
Study Core	Hartford:621 total sites / 489 USTs / 0 CERCLIS sites / 0 ELUR sites / 130 other sites; East Hartford: 267 total sites / 185 USTs / 1 CERCLIS site / 0 ELUR sites / 81 other sites; West Hartford: 530 total sites / 471 USTs / 4 CERCLIS sites / 1 ELUR site / 54 other sites.
Northwest Sector	West Hartford: 530 total sites / 471 USTs / 4 CERCLIS sites / 1 ELUR site / 54 other sites; Bloomfield: 175 total sites / 120 USTs / 1 CERCLIS site / 1 ELUR site / 53 other sites; Farmington: 160 total sites / 117 USTs / 21 CERCLIS sites / 1 ELUR site / 21 other sites; Avon: 77 total sites / 53 USTs / 1 CERCLIS sites / 0 ELUR sites / 23 other sites.
North Sector	Windsor: 179 total sites / 102 USTs / 1 CERCLIS site / 0 ELUR sites / 76 other sites; Windsor Locks: 98 total sites / 68 USTs / 0 CERCLIS sites / 0 ELUR sites / 30 other sites; South Windsor: 132 total sites / 79 USTs / 3 CERCLIS sites / 1 ELUR site / 49 other sites; East Windsor: 87 total sites / 61 USTs / 5 CERCLIS sites / 0 ELUR sites / 21 other sites.
Northeast Sector	South Windsor: 132 total sites / 79 USTs / 3 CERCLIS sites / 1 ELUR site / 49 other sites; Manchester: 262 total sites / 175 USTs / 8 CERCLIS sites / 1 ELUR site / 78 other sites; Glastonbury: 115 total sites / 75 USTs / 3 CERCLIS sites / 0 ELUR sites / 37 other sites.
Southwest Sector	West Hartford: 530 total sites / 471 USTs / 4 CERCLIS sites / 1 ELUR site / 54 other sites; New Britain: 251 total sites / 167 USTs / 1 CERCLIS site / 2 ELUR sites / 81 other sites; Farmington: 160 total sites / 117 USTs / 21 CERCLIS sites / 1 ELUR site / 21 other sites; Newington: 179 total sites / 127 USTs / 3 CERCLIS sites / 2 ELUR sites / 47 other sites.
South Sector	Wethersfield: 93 total sites / 72 USTs / 0 CERCLIS sites / 0 ELUR sites / 21 other sites; Newington: 179 total sites / 127 USTs / 3 CERCLIS sites / 2 ELUR sites / 47 other sites; Rocky Hill: 83 total sites / 54 USTs / 5 CERCLIS sites / 0 ELUR sites / 24 other sites; Cromwell: 84 total sites / 57 USTs / 0 CERCLIS sites / 0 ELUR sites / 27 other sites.
Southeast Sector	Glastonbury: 115 total sites / 75 USTs / 3 CERCLIS sites / 0 ELUR sites / 37 other sites.

In addition, CRCOG works with the MetroHartford Alliance on the Capitol Region MetroHartford Brownfields program to inventory and assess properties contaminated by petroleum products and/or hazardous substances in communities throughout the combined CRCOG/MetroHartford Alliance region. Since 2004, the MetroHartford Brownfields Program has managed six US EPA assessment grants totaling $1,600,000 and a $200,000 grant from the State Department of Economic and Community Development (DECD). The MetroHartford Brownfields Program has conducted environmental site assessments and/or remediation planning on 40 sites in twelve municipalities with funds from six EPA and one CT DECD assessment grants. The MetroHartford Brownfields Program has undertaken 68 assessments: 25 Phase I, 31 Phase II and/or Phase III, 4 hazardous building materials assessments, and 8 remedial action/clean-up plans. A map of the locations included in the program is provided here.



Source: MetroHartford Brownfields Program

7.15 Noise Sensitive Land Uses

Noise-sensitive land uses are typically identified as health care facilities, schools and, to some degree, open space and recreational facilities. Noise-sensitive land uses were reviewed for their general presence within the study area and sectors and potential to constrain (due to potential noise impacts) or support future mobility improvements (due to network linkage or service benefits). The presence of noise-sensitive uses is most likely to affect facility widenings or new alignments, transit routing and service, and active transportation connections.

7.16 Air Quality (Areas of Documented Non-Compliance)

Air quality information from CT DEEP was reviewed for the general presence and characterization of emissions levels within the study area and sectors, and its relationship to future mobility improvements. Depending on specific modes and/or scale of improvements, projects may be required to be included in State Implementation Plan analysis. Transit and rail project impacts will need to reflect the difference between emissions reduced by mode shifts from passenger vehicle use (reduction in vehicle-miles travelled and vehicle-hours travelled) and emissions from transit vehicles and rail locomotives. The location of support facilities (storage yards, maintenance facilities, garages, etc.) may also be a consideration from a public health and environmental justice perspective.

Air quality standards are measured at a regional level: the overall study area is part of a single EPA-designated area, namely Hartford County. For ozone planning efforts, Hartford County (and all of Connecticut) is classified as nonattainment, although further classified as marginal rather than moderate. All other measured air quality pollutants are classified as unclassifiable or in attainment.

CT DEEP identifies major stationary sources of air pollution through its Title V operating permit program. The program is a means to ensure that sources are in compliance with Clean Air Act requirements for maximum achievable control technologies. Major stationary sources within the study area sectors are identified below.

Table 7-19: Major Stationary Sources of Air Pollution

Sector	Comments
Study Core	Capitol District Energy Center Cogeneration Associates, Capitol Avenue, Hartford; Metropolitan District Commission Incinerator, Brainard Road, Hartford; Materials Innovation and recycling Authority Resource Recovery Facility and South Meadow Station Energy Facility, Reserve Road, Hartford; Pratt & Whitney, Main Street, East Hartford.
Northwest Sector	None.
North Sector	Algonquin Power Energy Facility, Canal Bank Road, Windsor Locks; HSC/UTC, Hamilton Road, Windsor Locks.
Northeast Sector	Manchester Landfill, Landfill Way, Manchester.
Southwest Sector	None.
South Sector	Algonquin Gas Compressor Station, Shunpike Road, Cromwell; Mattabassett District Water Pollution Control Facility, Main Street, Cromwell.
Southeast Sector	None.

8 Land-Use Considerations

8.1 Introduction

The existing conditions land use assessment places special emphasis on those portions of the study area where current land use and/or desired or expected land use change will play an important role in economic development and quality of life for the Greater Hartford region. The location, type, and intensity of various land uses – particularly those serving employment, residence, shopping and services, education, and leisure – are intrinsically connected to structure and performance of the multi-modal transportation network. Greater mix and intensity of land use can reduce travel need and trip distance. Presence of multiple convenient transportation mode options in developed areas can serve the region's population, businesses, and institutions more inclusively by accommodating the unique travel needs and preferences of different people. It also makes economic activity and the overall transportation system more resilient in face of disruptions.

8.2 Land Use Priorities Serving Economic Development in the GHMS Area

The 2019 Metro Hartford Future plan by the Capitol Region Council of Governments (CRCOG) outlines an economic development strategy with important implications for regional land use and its interactions with the transportation system.

> *While the region has a relatively strong and varied job base, and rates highly in levels of education, young college graduates entering the workforce, and other criteria relative to peer regions, its stagnant population growth is a potential weakness threatening future prosperity.*

Important goals of the plan include helping current underemployed residents participate fully in the region's job opportunities and growing the population by retaining most of the people who move to the region each year for college or for jobs. This is relevant to the GHMS because it means encouraging development of additional housing, including formats that differ from current housing stock, and improving transportation connections between where people live, work, study, and obtain services. The Metro Hartford Future plan specifically calls for these strategies to counter current weaknesses:

- Invest in the region's downtowns as desirable places to live and important places serving overall quality of life – because downtowns offer the active mix of uses, good pedestrian network, and other transportation options that are valued by the talented workforce the region seeks to attract and retain.

- Expand new housing development near transit – because this expands transportation choices, reduces car dependence, can reduce household transportation costs, and makes more efficient use of the region's multi-modal infrastructure.
- Prepare sites for development through brownfields remediation and infrastructure projects – because many of the sites that are vacant and close to transit also face brownfields challenges from former industrial use, and require street and/or pedestrian infrastructure to connect across major rail and road corridors and into established neighborhood street networks.

Metro Hartford Future Plan Strategies for promoting region's growth:

1. *Invest in region's downtowns*
2. *Expand new housing near transit*
3. *Development through brownfields remediation and infrastructure projects*

These policy strategies are important because the past 20 years have demonstrated that the region will not retain and grow a talented workforce without active effort. Housing production has not occurred at significant levels on its own because of limited demand and because sites in the most desirable areas often have development cost premiums. A proactive approach to making development sites available in places with transportation choices and quality of life amenities is necessary to attract and retain the population needed for ongoing prosperity.[1]

A recent study by CRCOG, The Economic Benefits of Regional Rail Investment in Metro Hartford-Springfield, indicates that portions of the northeast with better access to transit service have outperformed the Hartford-Springfield region in economic development.

The GHMS study area includes a major portion of the Hartford-Springfield region's population and economy. Communities along the Northeast Corridor rail spine, excluding cities of Washington, New York and Boston as outliers, have seen average annual job growth of 1.1% since 1990 compared to 0.6% annual job growth for the Hartford-Springfield region, barely half as much.[2] The Information, Finance, and Professional Services industry sector, a foundation of the GHMS economy and strategic priority for growth,

[1] Capitol Region Council of Governments, Metro Hartford Alliance, and Hartford Foundation for Public Giving. *Metro Hartford Future: Accelerating Shared and Sustainable Economic Growth* (2019).

[2] Capitol Region Council of Governments. *The Economic Benefits of Regional Rail Investment in Metro Hartford-Springfield* (2021), p. 4.

especially gravitates toward places with high transit ridership. Travel associated with this sector in 2019 utilized transit for 29.4% of trips in the Northeast Corridor as a whole, but for only 2.7% of trips in the Hartford-Springfield region. While New York City's high transit use skews the Northeast Corridor figure, even the nationwide average of 7.7% transit trips by the Information, Finance, and Professional Services sector is nearly three times the Hartford region's rate.[3] A majority of workforce moving to the GHMS study area comes from metropolitan New York City, and thus is habituated to a greater opportunity to use transit, as well as to walk, than the GHMS area provides.[4]

Downtowns, transit station areas, and bus corridors therefore make sense as priority areas for development in the GHMS area. Other areas with significant retail and office use concentrations are also anticipated by CRCOG and GHMS municipalities as places where land use change may happen due to market factors that could increase or decrease viability of current uses. This could present a need to anticipate market-driven development in some places, and to proactively encourage redevelopment with alternate uses in others. These areas include commercial/retail corridors, office parks, and industrial sites where parcels are underutilized and offer potential for mixed-use redevelopment. Background trends for retail and office land use categories, significantly influenced by the COVID-19 pandemic, will shape the future of these areas.

8.3 Land Use Changes Accelerated by COVID-19 Pandemic

Nationwide, many large-format retail stores, including mall anchor stores, are downsizing or closing entirely due to changed retail buying patterns, particularly online shopping. The COVID-19 pandemic has tended to accelerate this established trend. As shown in Table 8-1, since 2014 three mall anchor stores closed at the two large malls within the GHMS study area, and five more closed at malls in Enfield and Meriden just outside the study area[5]. The cities and towns

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[3] Ibid., p. 5.

[4] Capitol Region Council of Governments, Metro Hartford Alliance, and Hartford Foundation for Public Giving. *Metro Hartford Future Executive Summary: Accelerating Shared and Sustained Economic Growth* (2019), p. 13.

[5] Information for this table came from multiple articles:

Gosselin, Kenneth (May 7, 2020). "Nordstrom will remain as key anchor tenant in Westfarms Mall amid closures elsewhere". Hartford Courant.

Schott, Paul (December 14, 2020). ["Lord + Taylor set to close CT stores within weeks"]. Stamford Advocate.

Rhatigan, Chris (January 7, 2020). "Meriden Mall Anchor Store to Close". Meriden Patch.

Journal Inquirer Staff (Jan 8, 2021). "Macy's to close 2 Conn. stores; Shoppes at Buckland Hills mall stores to stay open". Journal Inquirer.

where these malls and other large-format retail are located have already focused on the large sites as areas to seek alternative land use, to counter the economic loss from store closures. A mixed-use development approach is often sought, both to broaden market options and to capture the value benefit that can arise when employment, residential, education, and/or service uses are co-located. Many of these sites have the benefit of excellent roadway access and established bus service, though most are not adjacent to rail or BRT stations.

Storefront retail in traditional mixed-use urban settings has seen a decline over decades as many stores that sell goods gravitated first to large-format stores in auto-oriented shopping centers, and then to online sales. Today, food and drink establishments make up a large portion of local storefront retail, complemented by other retail that serves local populations such as pharmacies, banks, and convenience stores. The extent and prosperity of local retail is thus closely tied to local population density in many places. The presence of a safe, inviting pedestrian network, as well as transit and bike facilities, further increases economic opportunity for storefront retail by making it accessible to a larger immediate market and reducing the need to provide parking.

Nationwide, many large-format retail stores are downsizing or closing entirely due to changed retail buying patterns, particularly online shopping. In the past seven years, eight mall anchor stores have closed among the two large malls in the GHMS area and two nearby malls in Enfield and Meriden.

Table 8-1: Mall Anchor Store Closures

Mall	Anchor Store	Closure Year
Westfarms Mall, Farmington/West Hartford (GHMS SW Sector)	Lord & Taylor Sears (at adjacent Corbin's Corner shopping center)	2020 2017
Shoppes at Buckland Hills, Manchester (GHMS NE Sector)	Sears	2021

Dehnel, Chris (November 13, 2020). "Liquidation Sale Commences At Doomed Manchester Sears". Manchester Patch.

Wenzel IV, Joseph (December 28, 2016). "Sears in Enfield Square to close next year". Eyewitness News 3.

(November 3, 2016). "Sears in West Hartford to Close". NBC News Connecticut.

Westfield Meriden Mall, Meriden (approximately 4 miles south of GHMS South sector)	Macy's Sears JC Penney	2020 2019 2014
Enfield Square Mall, Enfield (approximately 6 miles north of GHMS North sector)	Sears Macy's	2017 2016

Office land use has been significantly impacted by the COVID-19 pandemic, as many employers and employees have grown accustomed to working from home using web connections. Even when public health conditions allow for full resumption of office space use, employers in many office-based industries anticipate that working from home will have a greater ongoing presence in work patterns. Some staff may commute to an office a few days per week and work from home on other days. Some firms may shift more permanently to a largely virtual workplace. While existing and newly constructed office space are expected to continue having important roles enabling the interpersonal collaboration that is important to productivity in many industries, and providing work facilities that can't be matched at home, demand for new office space is likely to slacken. Developers with older office space that struggles to be competitive sometimes convert it to residential or hotel use if the locations and buildings are suitable.

8.4 GHMS Study Area Integrated Land Use and Transportation Opportunities

Based on the factors above – recognizing downtowns and transit station areas previously designated as places to focus land use growth, as well as other places where trends may impact land use – Figures 8-1 through 8-3 highlight these anticipated places of land use growth and change. The circles and ovals represent places within about ½ mile or a 10-minute walk of transit stations, mixed-use district centers, or corridors with regular bus service. The actual amount and type of development appropriate in each area varies significantly depending on availability of development sites, market factors, and potential development density. It may be appropriate to designate some of these focus areas as having higher priority for development and supportive infrastructure than others. Land use scenario analysis in further phases of this study can identify priorities.

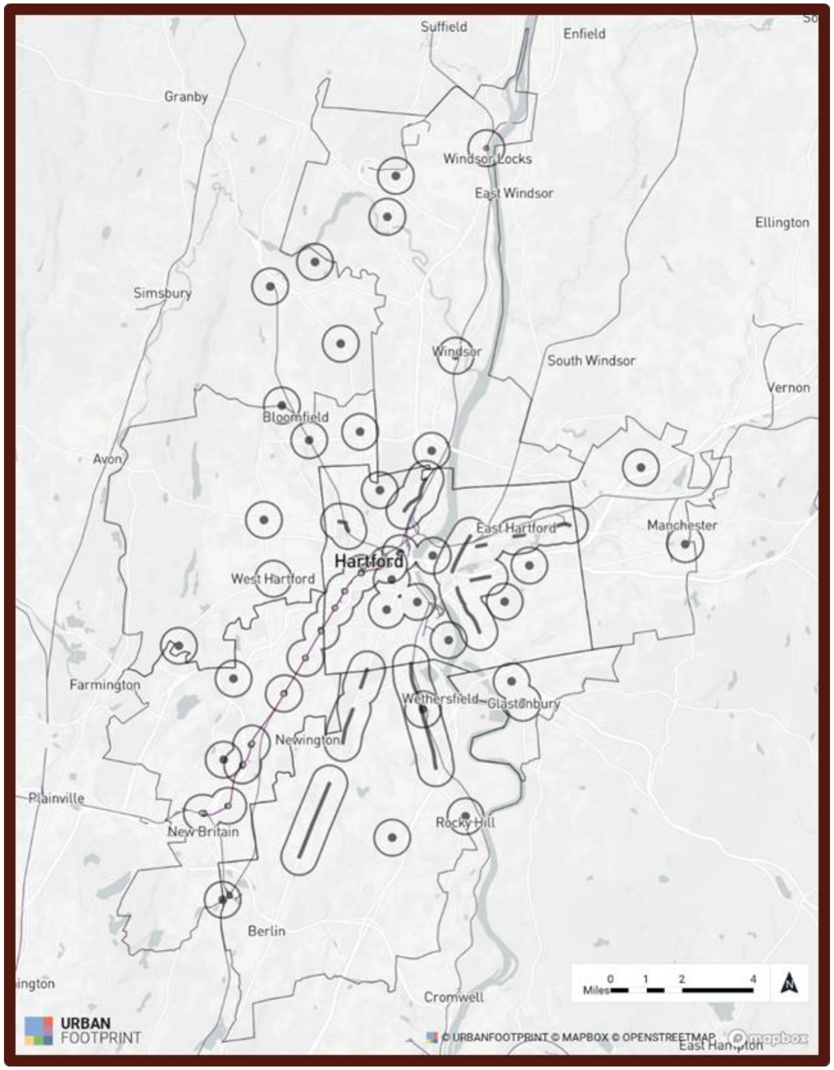


Figure 8-1: Land Use Growth & Change Focus Areas

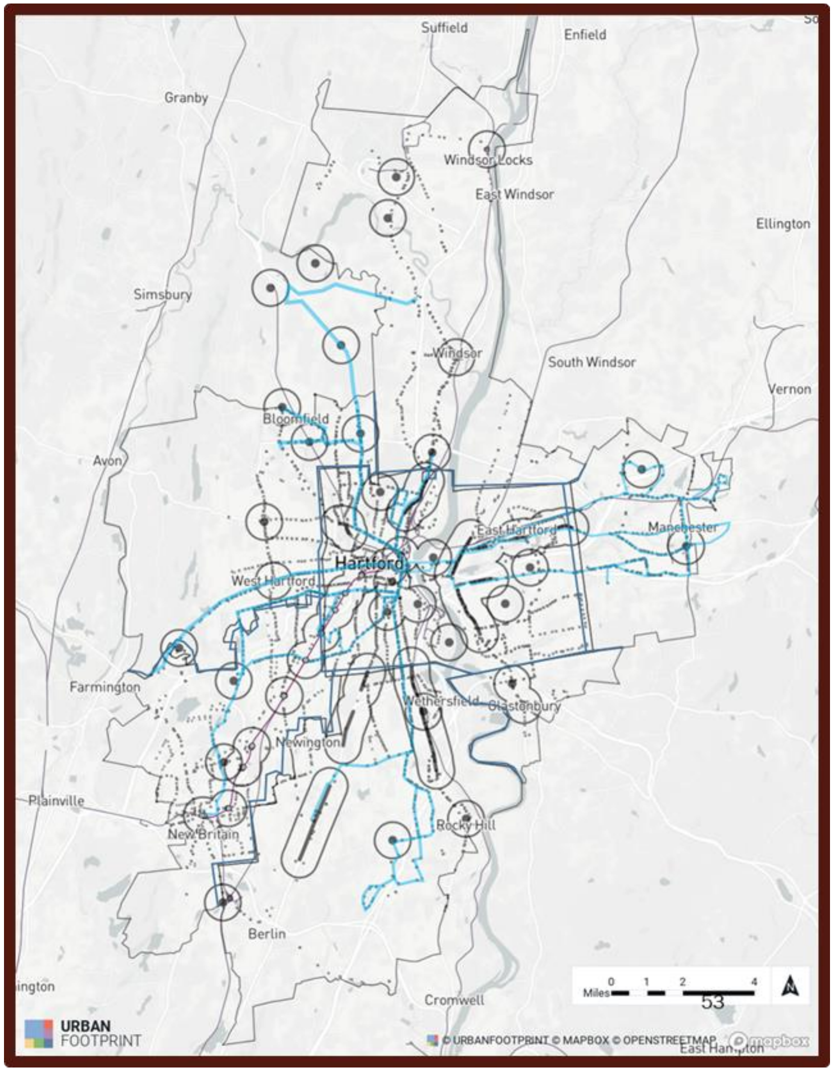
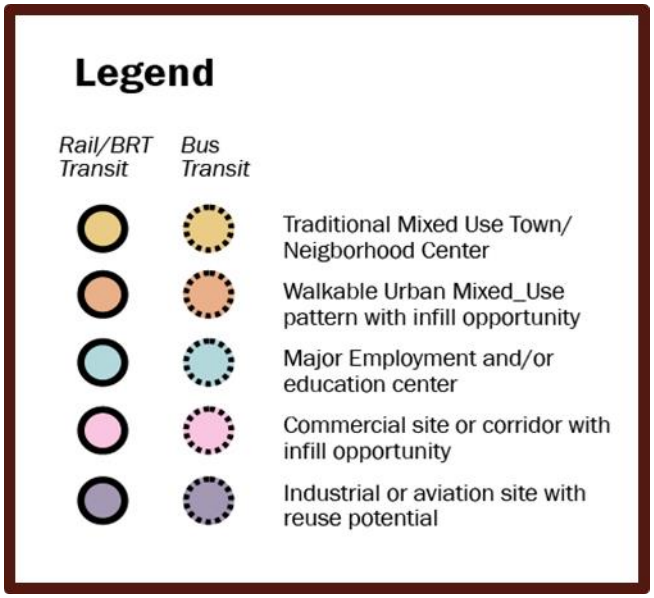


Figure 8-2: Land Use Growth & Change Focus Areas with Bus Services

Figure 8-1 shows a 1/2 mile (10-minute) walk distance around rail and BRT transit stations or other centers of growth. The actual extent of development opportunity varies widely between different areas according to site availability and potential density. See Figure 8-2 for overlay with bus services. Blue lines indicate the eleven bus routes with heaviest ridership. Figure 8-3 shows differentiation of these areas by land use patterns and transit access. All locations are priority areas not just for development, but for a mix of land uses that complement one another, like employment, housing, and/or education. Some locations have traditionally served a mix of uses while others would need to evolve to include more diverse land use.



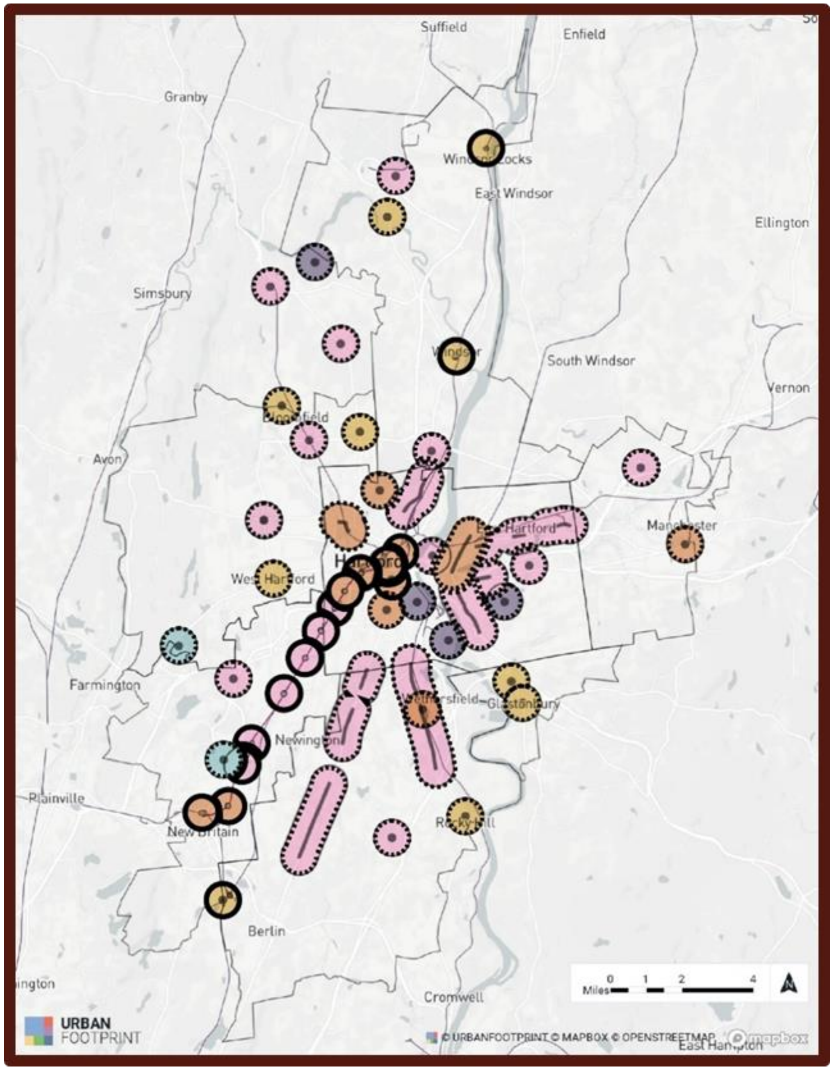


Figure 8-3: Land Use Growth & Change Focus Areas by Development Type

The focus area categorization shown in Figure 8-3 provides a general distinction of development patterns and level of transit access. Areas outlined with a solid line have (or are planned to have) rail or BRT (CTfastrak) transit service. Areas outlined with a dashed line have conventional bus service. Many of these are on or close to lines with especially high ridership (see Figure 8-2). Land use and development patterns are summarized in these categories:

- Traditional mixed-use town/neighborhood center. These are areas that have had a mix of residential, commercial, institutional, and/or civic uses for a century or more, reflecting early settlement patterns. Most have decent walkability thanks to sidewalk networks and relatively little traffic, though roadways are a barrier in some places like Rocky Hill. These areas generally have low to moderate density development; their development opportunities may be minor in the regional context but significant locally in terms of quality of place and economic development.

- Walkable urban mixed-use pattern with infill opportunity. These areas have a traditional pattern of blocks and were usually developed around transit services prior to widespread car ownership. Streets generally have sidewalks and are spaced 300 to 500 feet apart, making walking convenient. A mix of commercial, residential, institutional, and/or civic uses is present within walking distance. Development opportunities vary in scale; large development sites are relatively uncommon, but some significant opportunities are present.

- Major employment and/or education center. This category includes two large institutions, UCONN’s medical center in Farmington and Central Connecticut State University in New Britain. Both campuses have adjoining private sites with opportunity for complementary residential, commercial, or other development. While both institutional campuses are internally walkable, they both would benefit from more inviting and extensive pedestrian connections with their contexts.

- Commercial site or corridor with infill opportunity. This category characterizes a large proportion of land area identified for change. Some, particularly several CTfastrak station areas, have excellent transit service and have had zoning changes or other steps taken to encourage mixed-use redevelopment. Others line highly accessible auto corridors like the Berlin Turnpike. The Westfarms Mall and Shoppes at Buckland Hills are successful retail centers with good bus service and highway access and may be candidates for additional uses like housing or recreation. Sites vary significantly in terms of market potential, size, and redevelopment feasibility. Proactive efforts may be required to improve pedestrian facilities, street connections, or otherwise provide infrastructure needed for higher-value development.

- Industrial or aviation site with reuse potential. These sites – the Colt Factory, Brainard Airport, Rentschler Field, and Windsor's Great Pond area – contain large contiguous areas where new uses can replace obsolete ones. In each case, new multi-modal transportation infrastructure is needed to support significant levels of new development.

The focus areas generally avoid sensitive natural areas and historic resources identified in Chapter 7 and emphasize land that has already been developed. The following focus areas are examples of places where natural or historic context may pose greater limitations on development.

- Protected green space is present in some focus areas, particularly in the form of municipal parks (see section 7.3, Protected Open Space and DEEP protected areas). Examples include Pope and Keney Parks in Hartford, Manchester Center Springs Park near downtown Manchester, and Trout Brook Trail at the Elmwood CTfastrak station. Development is generally welcome near parks, and should leverage them as amenities, as long as it does not reduce the quality of these places.

- Prime farmland soils are especially present in some focus areas in Windsor and Bloomfield (see section 7.4, Prime Farmland Soils).

- Significant floodplain is present near Berlin's Kensington neighborhood and downtown Windsor (see section 7.6, Floodplain).

- Hartford and Glastonbury include significant historic district areas that overlap focus areas (see chapter 7.8, Historic, Architectural and Archaeological Resources). These historic districts do not necessarily constrain new development but require new development to demonstrate design approaches that are compatible with historic context. While this design attention may impose some cost premiums, it also commonly results in development that delivers higher and more enduring value to its owners, users and context.

Figure 8-4 shows CRCOG's designated growth centers in the region. This map shows planned land use across multiple communities as of 2014. Growth is typically prioritized in areas designated as mixed use, business/commercial/office, and underutilized. Focus areas for growth and change indicated in Figures 8-1 through 8-3 are consistent with this regional Plan. Figure 8-5 shows existing land use, for comparison with Figures 8-1 through 8-3.

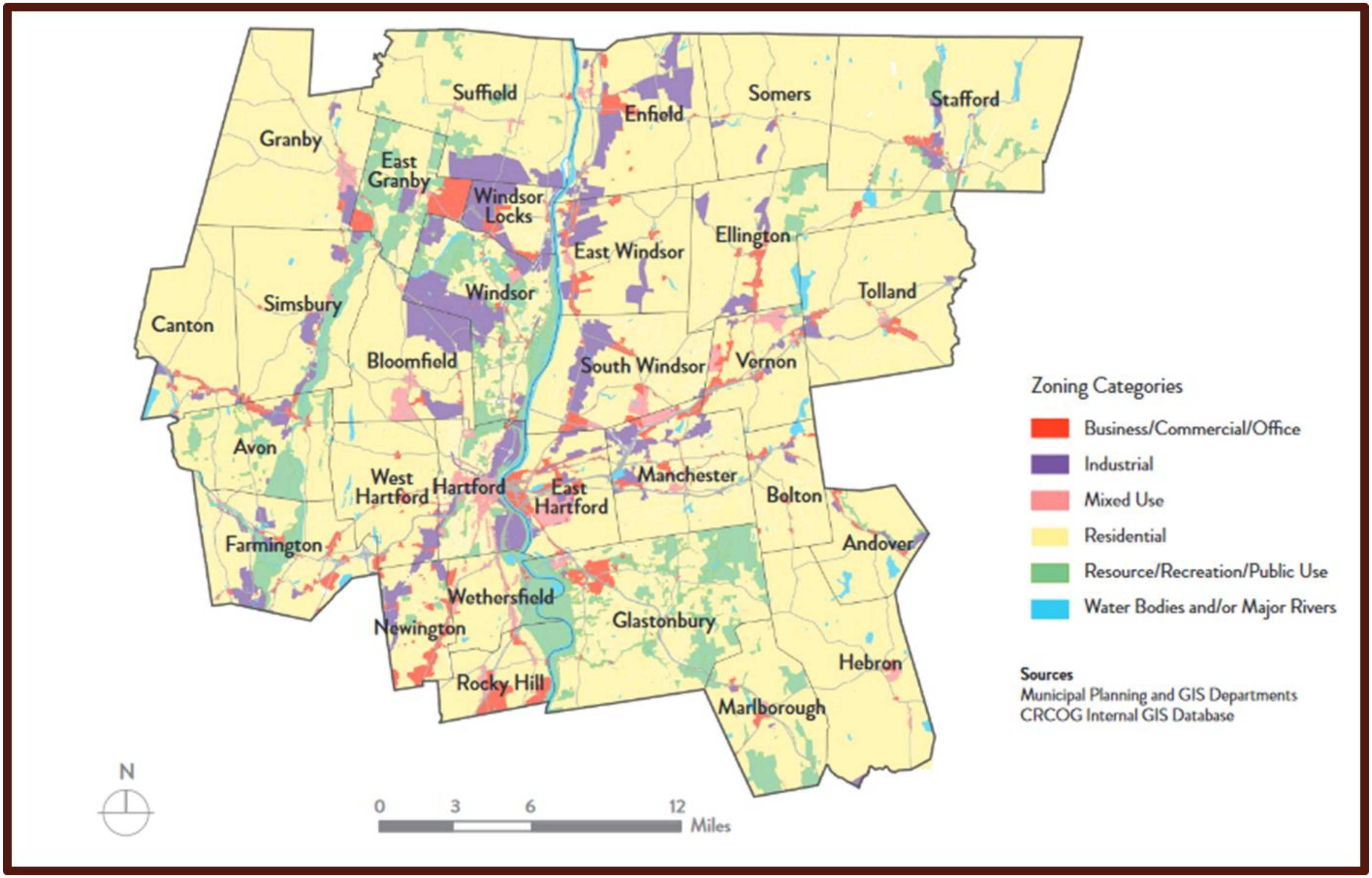


Figure 8-4: CRCOG Plan of Community Development (extends beyond GHMS study area)

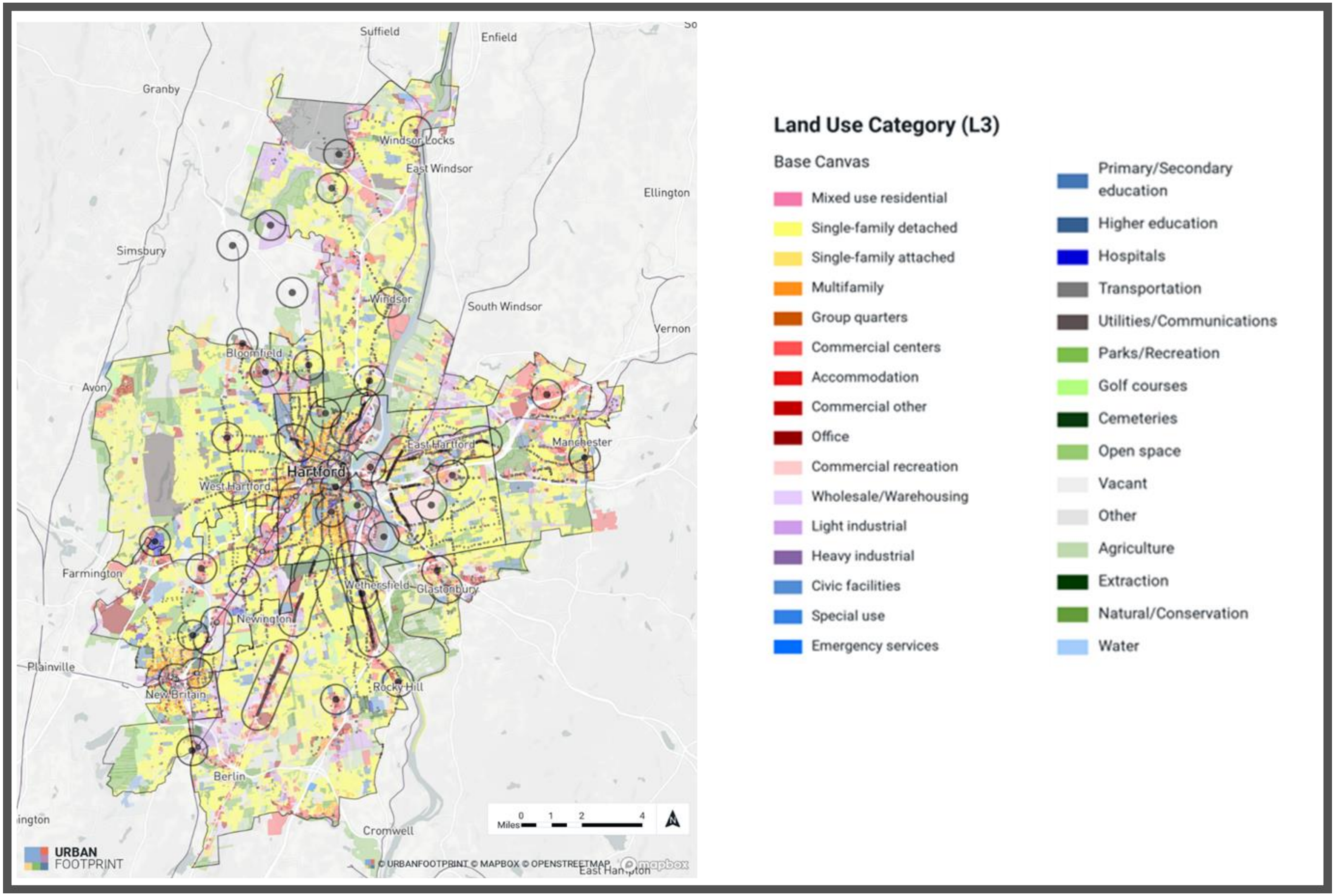


Figure 8-5: Current Land Use in the GHMS Study Area

Most of the focus areas for growth and change in Figure 8-5 are in red, pink, orange, or purple areas where there is current or potential flexibility for a variety of land uses and relatively greater development intensity. Yellow areas zoned for single family housing tend to lack opportunity for more intense or varied use due to community goals, development policy, and physical development patterns.

The focus areas include a number of areas with notable socioeconomic characteristics mapped in Chapter 7. Many of these are directly related to land use and related economic development goals. Examples include:

- Population and employment density (see section 7.9, Socioeconomic Considerations – Population & Employment Density). Focus areas tend to emphasize areas where higher densities are present or appropriate relative to other areas within the GHMS study area and within individual communities. Figures 8-6 and 8-7 below provide additional analysis of population and employment density relative to land use.

- Zero vehicle households (section 7.10, Socioeconomic Considerations – Zero Vehicle Households) are highly correlated with renter-occupied housing as shown in figure 13 below, and Environmental Justice/Title VI communities identified in section 7.11. Many focus areas are intentionally located amidst concentrations of low vehicle ownership, minority residents, low-income households, and limited-English households, because new development and improved multi-modal transportation options can provide especially significant economic development benefits for these communities. These benefits also translate to regional economic development benefit as more residents and employers gain access to each other.

- Focus areas are well aligned with established land use and zoning policies as shown in section 7.13, Socioeconomic Considerations – Land Use & Zoning, and multiple figures below.

- Some focus areas, particularly those along the New Haven-Hartford-Springfield rail corridor, include significant concentrations of brownfields sites (see section 7.14, Hazardous Materials). Remediation of these sites poses development cost premiums, but also offers significant benefits in return as underutilized land becomes useful again for economic and community use. Many of these sites are also well-located to take advantage of rail and CTfastrak transit service. Their redevelopment would provide the additional benefit of improving pedestrian connectivity and property value in their surrounding transit-served districts.

8.5 Density and Transportation Mode Share across the Study Area

The focus areas for growth and change reflect broader patterns of population and employment density, and of transportation mode choice, within the GHMS study area and its sectors. The Study Core – Hartford and East Hartford – retain significantly higher concentrations of population, jobs, and real estate development than the rest of the area, in spite of the gradual dispersal of population and jobs across the area in past decades. The Southwest and Northeast Sectors, dominated by New Britain and Manchester respectively, are also relatively denser than the remaining sectors, continuing historic settlement patterns.

Study Core of Hartford and East Hartford contains at least twice the density of residents and jobs as most other sectors.

Figure 8-6 shows that the study area core of Hartford and East Hartford contains at least twice the density of residents and jobs as most other sectors. It also has a relatively close match of residential and job density, indicating that residents may have access to a wide variety of jobs relatively close to home. The NW, NE and SW sectors jump out for having relatively higher population density than job density. This suggests these sectors have relatively high numbers of residents commuting out to jobs elsewhere. They may merit more transportation assets to serve this travel, and/or efforts to locate more jobs close to their residents to reduce commute distance and time.

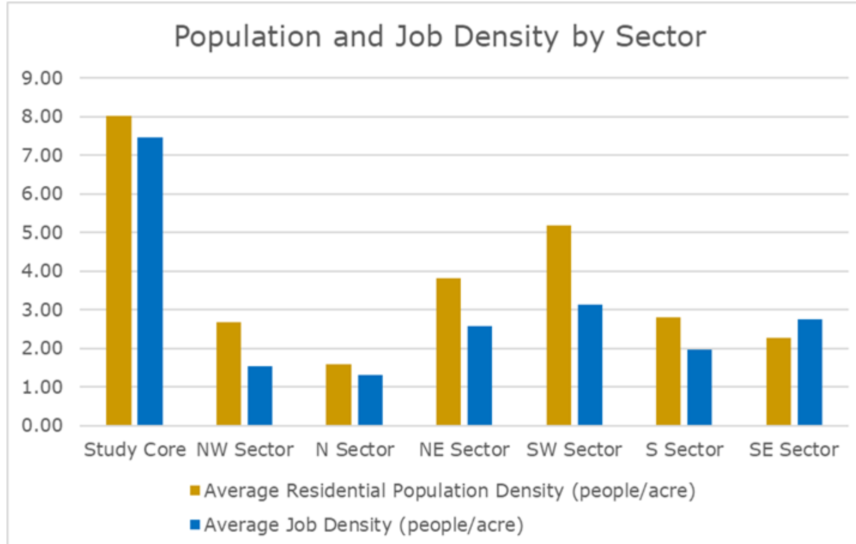


Figure 8-6: Population and Job Density by GHMS Study Area Sector

Figure 8-7 indicates that the amount of developed real estate floor area in each sector is highly proportional to residential and job density. Areas with relatively high existing density tend to also have more of the walkable downtown and urban districts that are priority growth areas. Thus, land use density may be most likely to increase where it is already high.

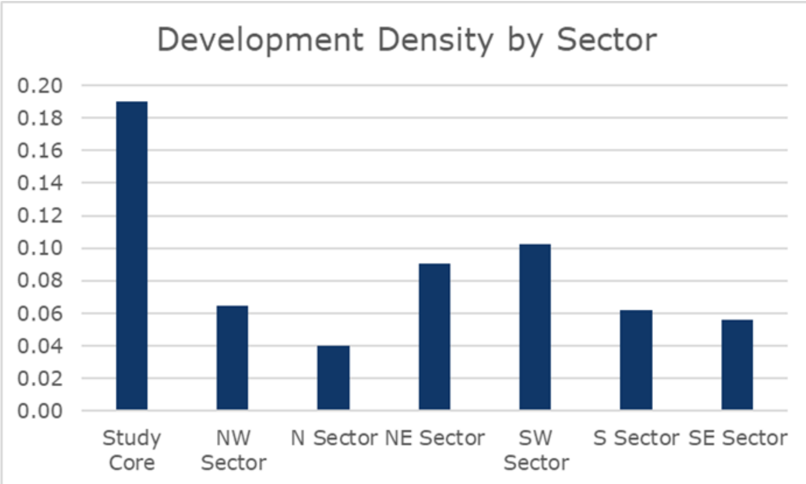


Figure 8-7: Development Density by GHMS Sector

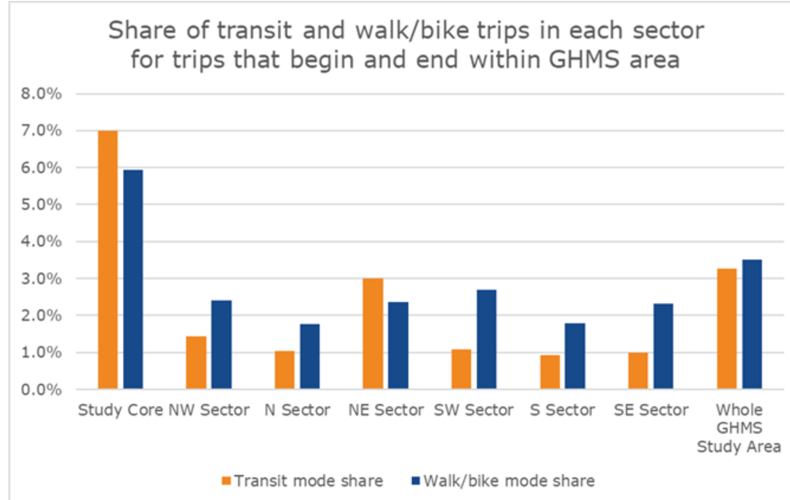


Figure 8-8: Transit and Non-Motorized Trip Mode Share within GHMS Study Area

Density and legacy urban development patterns correlate directly to choices in transportation mode. While driving is the dominant means of trips throughout the study area, sectors with relatively denser population and development see significantly higher shares of transit, walk, and bike trips than other sectors.

Figure 8-8 represents transit and non-motorized trip mode shares within GHMS as a whole. These represent trips that begin within individual sector and end anywhere in the GHMS area[6]. They do not include trips that begin or end outside of the GHMS area.

Figure 8-9 shows transit and non-motorized trips that have both the trip ends within the individual study sector. Walk shares are higher than in figure 8, as they are inherently local. Transit shares are lower than in figure 8, since many transit trips begin and end in different sectors.

[6] The mode choice model was developed with information from the 2016 Connecticut Household Travel Survey (CSTS), 2016 CRCOG On-Board Transit Survey (On-Board), U.S. Census American Community Survey (ACS) and Census Transportation Planning Program (CTPP). These data served as the foundation for the development of mode choice calibration targets. For the CRCOG mode choice calibration process, calibration targets were developed by mode, travel market segment, and trip purpose.

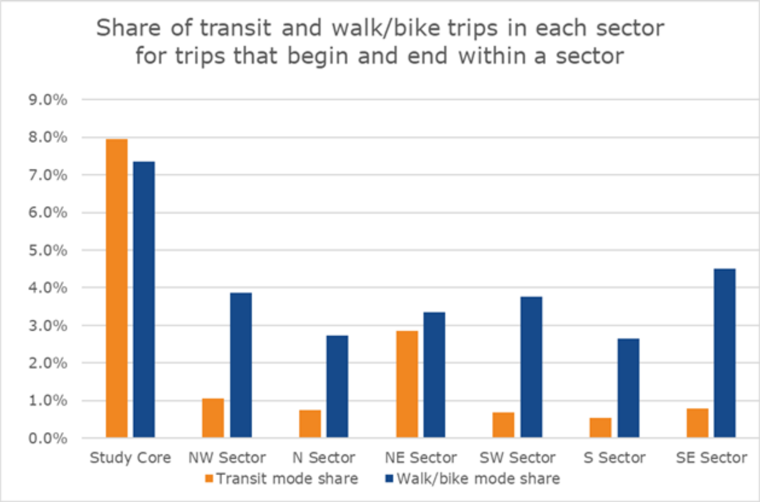


Figure 8-9: Transit and Non-Motorized Trip Mode Share Within Individual Sector

In the study core, the transit mode share is as high as 8% for local trips, well over twice the share in any other sector. While this demonstrates good availability of transit as a travel choice among homes, jobs, and other destinations, it is significantly lower than the 12% transit mode share common in other portions of the Northeast Corridor exclusive of New York City.[7]

The 8% transit mode share in the Study Core is significantly lower than the 12% transit mode share common in other portions of the Northeast Corridor exclusive of New York.

Transit mode share is relatively similar across the other sectors with the exception of the northeast sector, which is relatively high. This could possibly be explained by transit's convenience for making one of the few river crossings from the sector to Hartford, or significant clustering of jobs and homes around common transit routes. The chart may underrepresent current transit mode share in the southwest sector because data is from 2016, very shortly after inauguration of CTfastrak service.

Walk and bike mode share follows population and development density more closely than transit share. Walk trips typically comprise about 60 to 70% of the combined walk and bike trips, depending on sector. The northwest and southeast sectors show relatively high walk and bike mode shares for their density, possibly due to more complete sidewalk networks.

[7] Capitol Region Council of Governments. *The Economic Benefits of Regional Rail Investment in Metro Hartford-Springfield* (2021), p. 5.

In general, the Study Core offers the study area's most significant opportunities to locate development where it will benefit from the variety of transportation choices that attract and retain workforce and jobs important to the region's economy.

In general, the Study Core offers the study area's most significant opportunities to locate development where it will benefit from the variety of transportation choices that attract and retain workforce and jobs important to the region's economy. However, specific conditions in the land use growth & change focus areas will determine actual opportunities to leverage transportation choice for economic development. Certain focus areas in all sectors have the pedestrian, bike, and transit choices available to attract high-value development; others in all sectors may require more or better transportation choices to optimize development opportunity. Proactive efforts to co-locate mixed-use development concentrations with good transit service, sidewalks and bike facilities would help make the GHMS area more competitive with other regions.

Figures 8-10 through 8-14 show how the focus areas overlay selected characteristics of land use and demographics. Figure 8-10 highlights areas within 10-minute walking distance of bus, BRT or rail stops. Much of the study area, and especially the focus areas for growth and change, is within a ten-minute walk of a bus, BRT or rail stop (areas colored red and orange).

Figure 8-11 shows parcels designated as either vacant or with commercial parking. These parcels represent some that might be considered relatively easy attractive for development. Yet, focus areas for growth and change contain relatively few of these sites. Enlarged maps would show some as present in the focus areas, but these parcels still represent a relatively small share of land area. In many cases, development will need to take place on previously developed sites. This often entails a cost premium and/or greater complexity, but may be justified by proximity to transportation, complementary uses, amenities, or other assets.

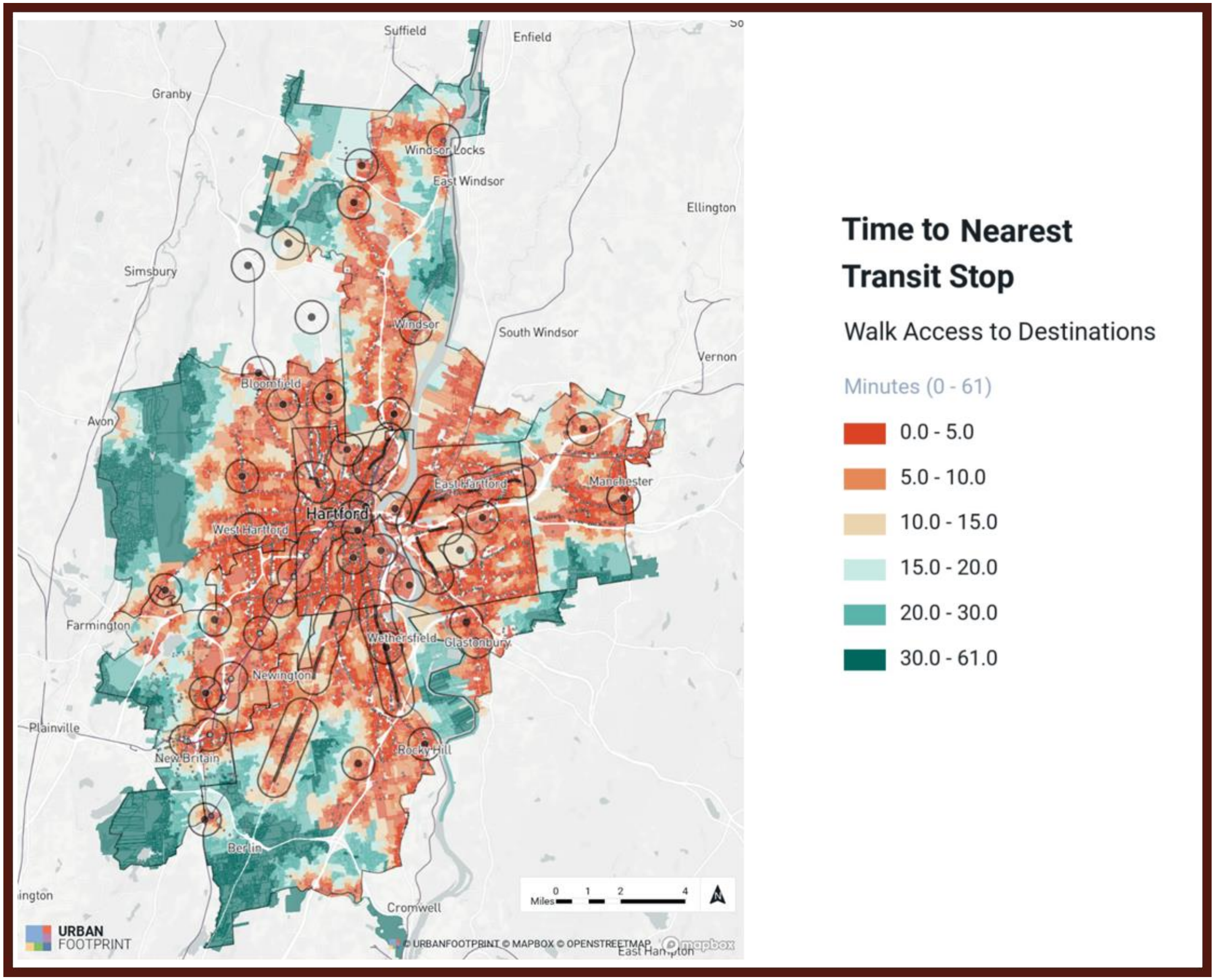


Figure 8-10: Walking distance to transit

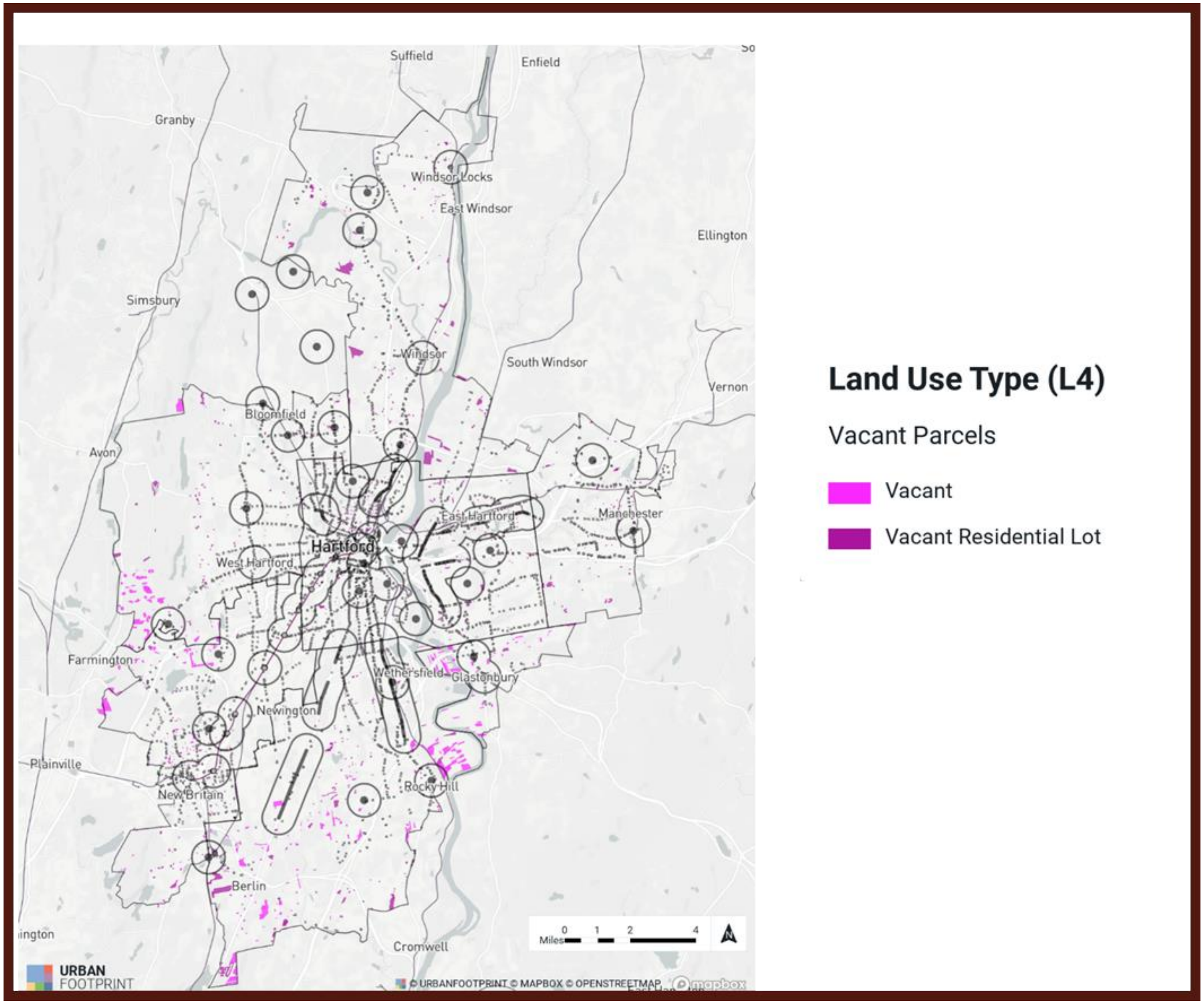
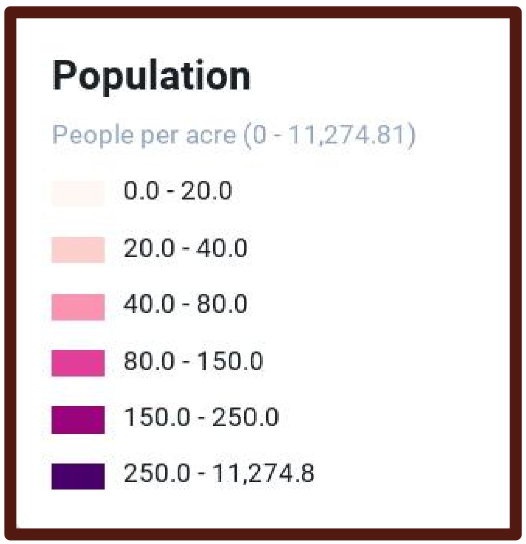


Figure 8-11: Parcels Designated Vacant or Providing Commercial Parking

Focus areas for growth and change represent a wide range of existing and potential residential population densities (see Figure 8-12). Many focus areas in Hartford and New Britain are among the most densely populated already; others have relatively lower populations. Areas with significant existing density may merit more effort to add transportation mode choice and capacity than less dense areas. Depending on a variety of market, social, and physical / environmental factors, some focus areas may be appropriate places to add significant residential density, while other land use may deserve priority in other areas.



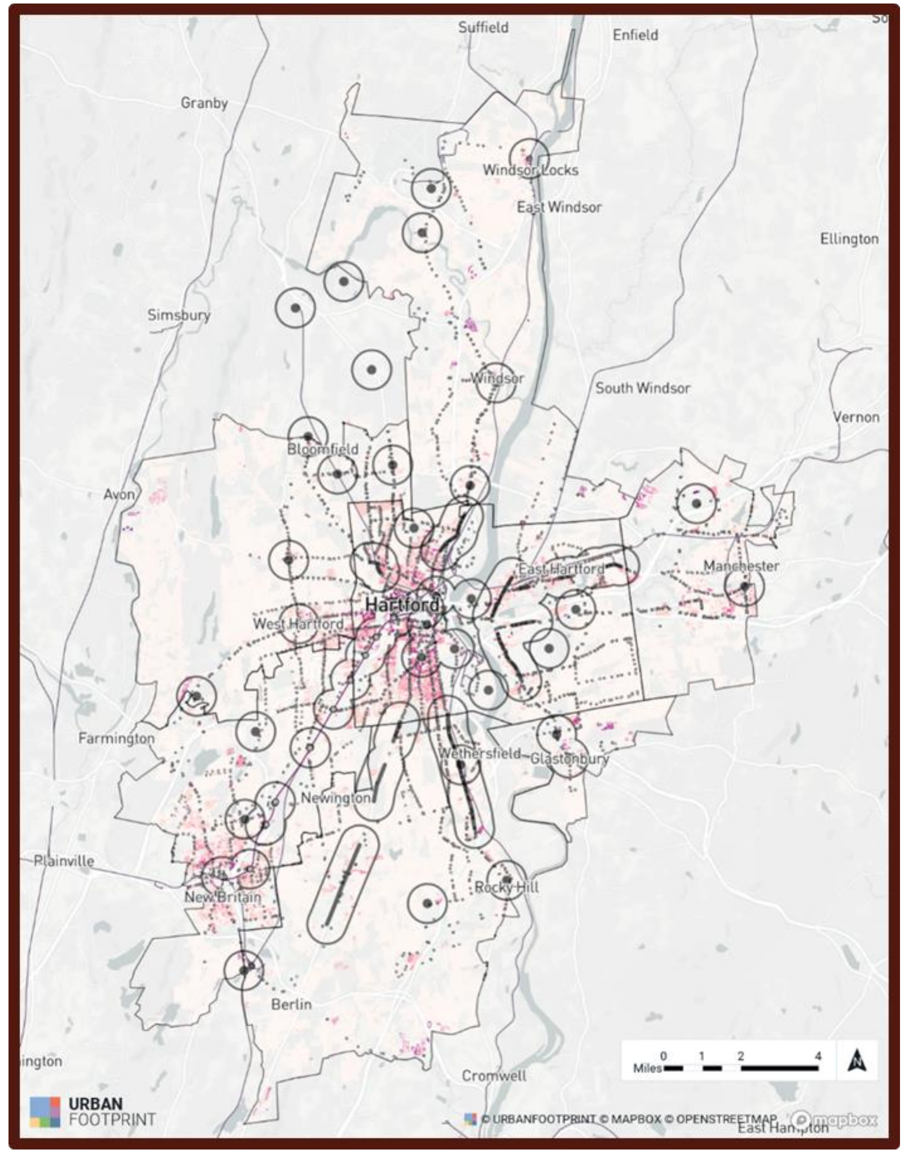


Figure 8-12: Population Density

Rental housing stock tends to be concentrated more in older cities with urban development patterns like Hartford, New Britain and Manchester. It is often associated with lower household income and lower car ownership. Therefore, presence of good transit and walking and biking infrastructure is especially important in areas with significant rental housing. The new growth intentionally targeted to many of these areas should be proactively guided to maximize benefit, and minimize displacement or other harm, to rental households.

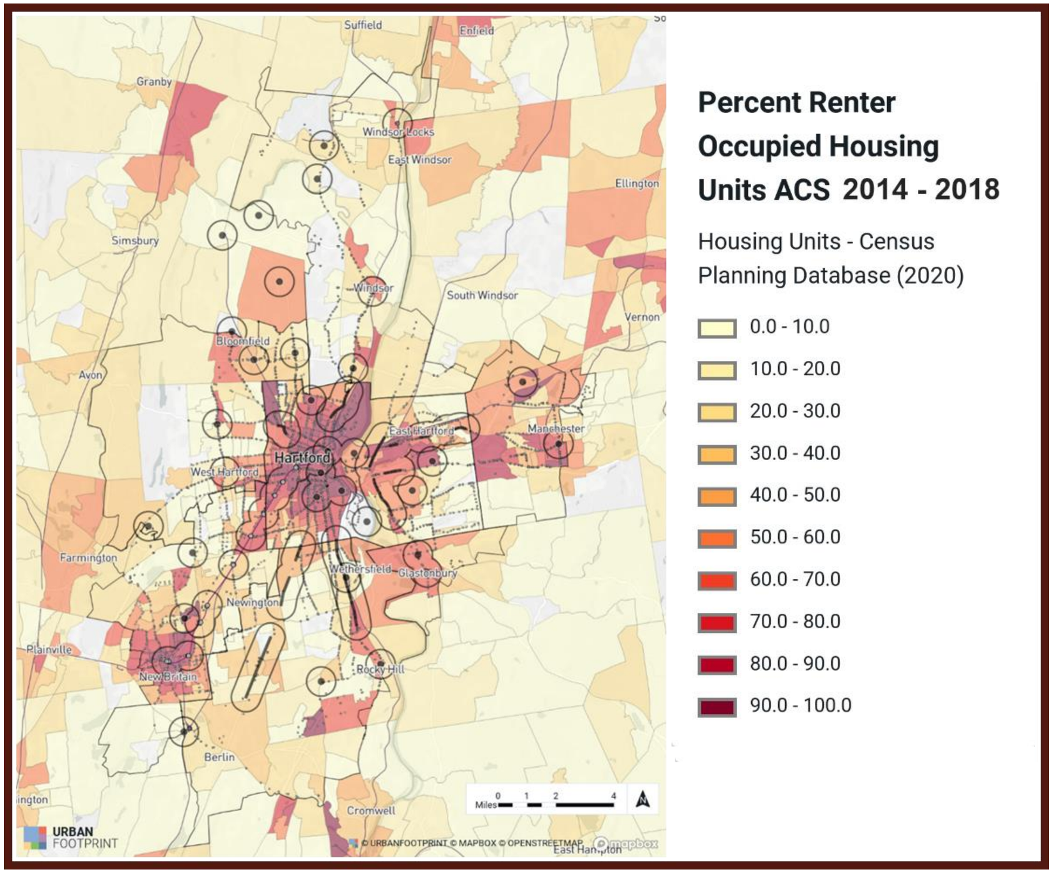


Figure 8-13: Share of Renter-Occupied Housing

Higher education institutions are important to the region’s economy as employers, ladders to economic opportunity for young residents, importers of potential new residents and workforce, and partners to industry in important economic growth areas. Their locations display a wide range of context types and relationships to focus areas. Some like Trinity College and UConn’s Hartford campus are in urban neighborhoods that help define campus character and that benefit from campus employment and market opportunities. Others like Manchester Community College and the University of Hartford are more isolated from intensity of use. In any case, higher education campuses are important long-term land use anchors due to their inherent mission-driven longevity.

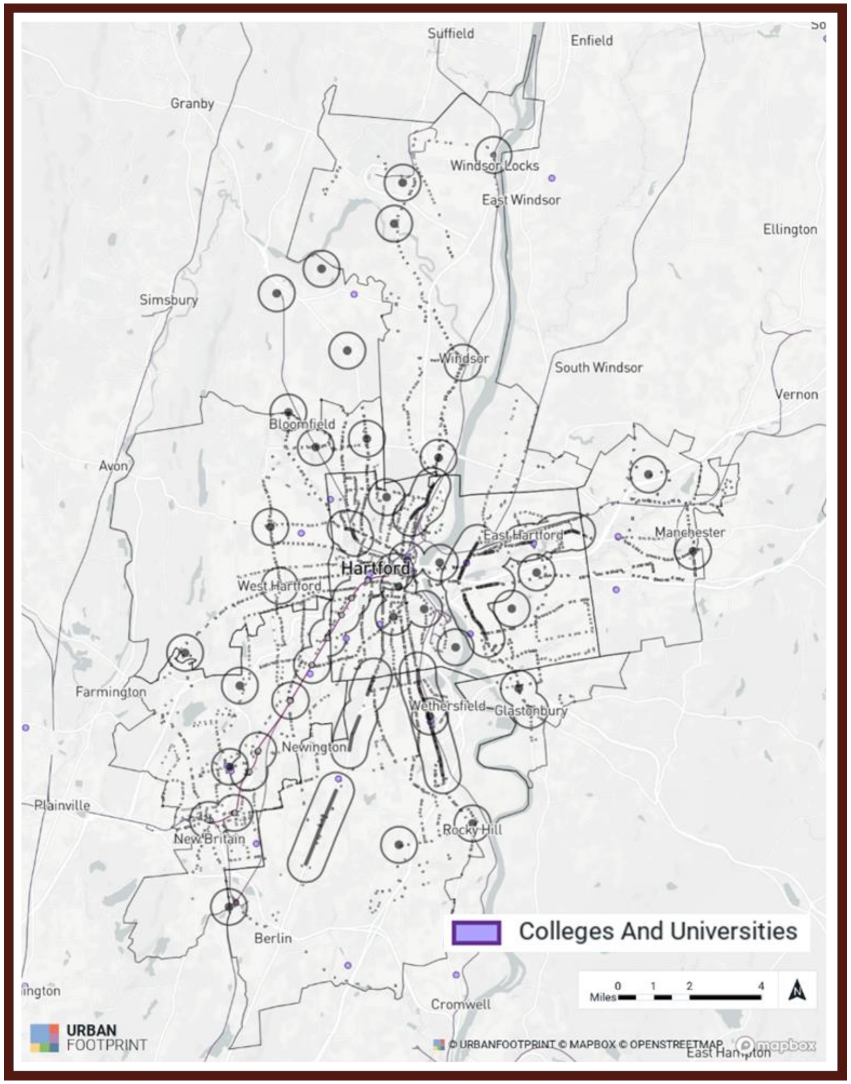


Figure 8-14: Colleges and Universities

8.5.1 Plans of Community Development for Study Area Municipalities

Figures 8-15 through 8-22 provide additional detail on priority development areas as designated by selected municipalities.

Adopted in 2020, Figure 8-15 identifies ten priority land use initiatives to prepare Hartford for the 400th anniversary of its founding in 2035.

Figure 8-15: Hartford City Plan 2035

This 2012 plan concentrates growth in the town core and transitions commercial development to mixed use in key nodes. Some of these nodes are outside the GHMS study area but are closely linked to it.

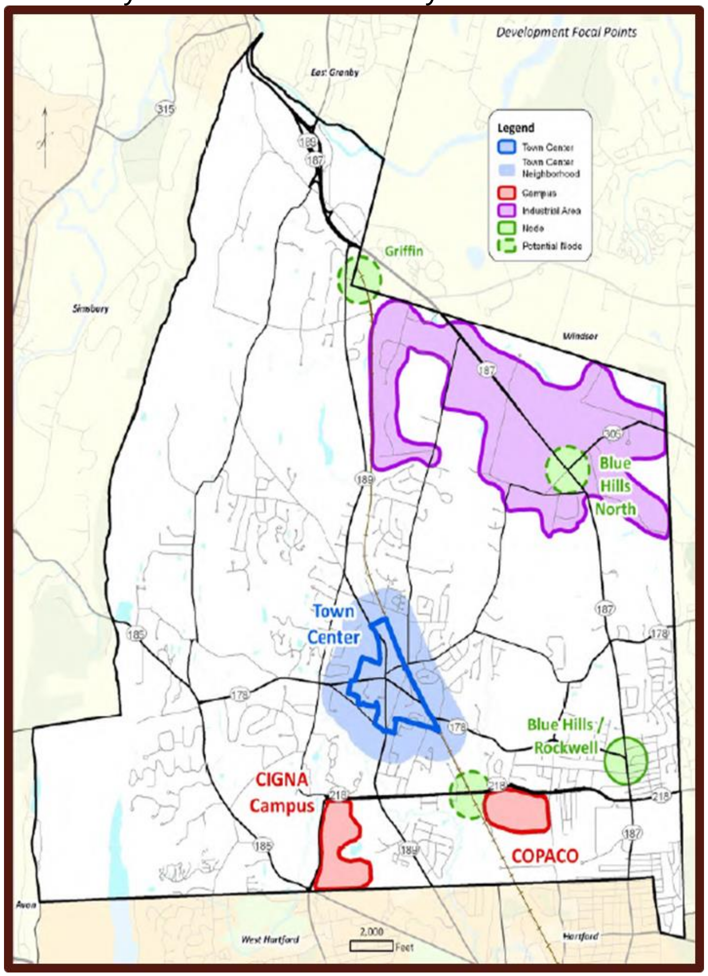


Figure 8-16: Bloomfield Plan of Community Development

This plan identifies many areas with potential for land use growth or change, including Founders Plaza (pink area along Connecticut River), Rentschler Field (pink area at center), and several commercial corridors outlined in black dots.

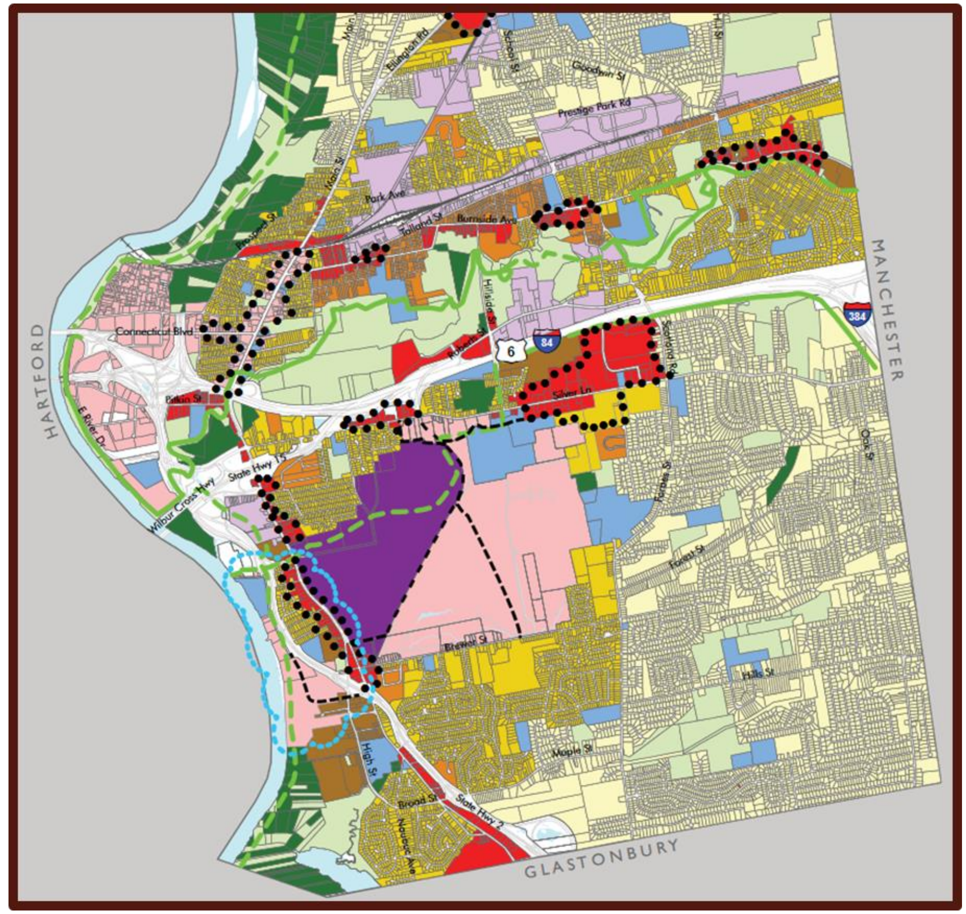


Figure 8-17: East Hartford Plan of Community Development

Glastonbury includes a wide variety of development conditions from town center to rural. The town intends to focus new development to the northwest, where a mix of concentrated historic and contemporary development is present, and where the street grid has potential to support a walkable mixed-use development approach.

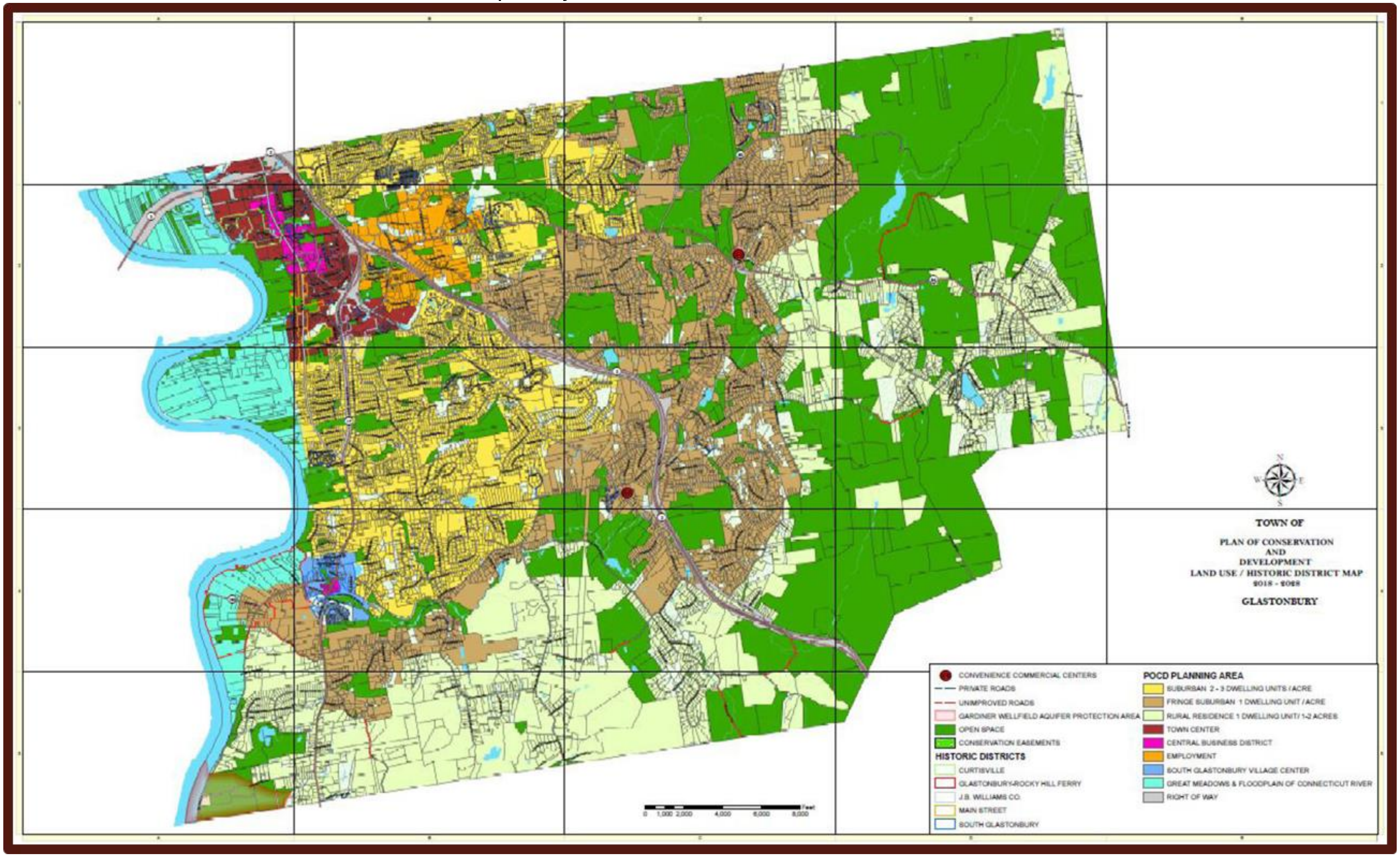


Figure 8-18: Glastonbury Plan of Community Development

Manchester's 2013 POCD shows how its town center area, at the geographic center of town, includes a combination of Mixed Use, Core Neighborhood, and Commercial Corridor uses. Other Mixed-Use Center and Mixed-Use Regional Center areas are largely commercial and could offer opportunity for more intensive and mixed uses over time.

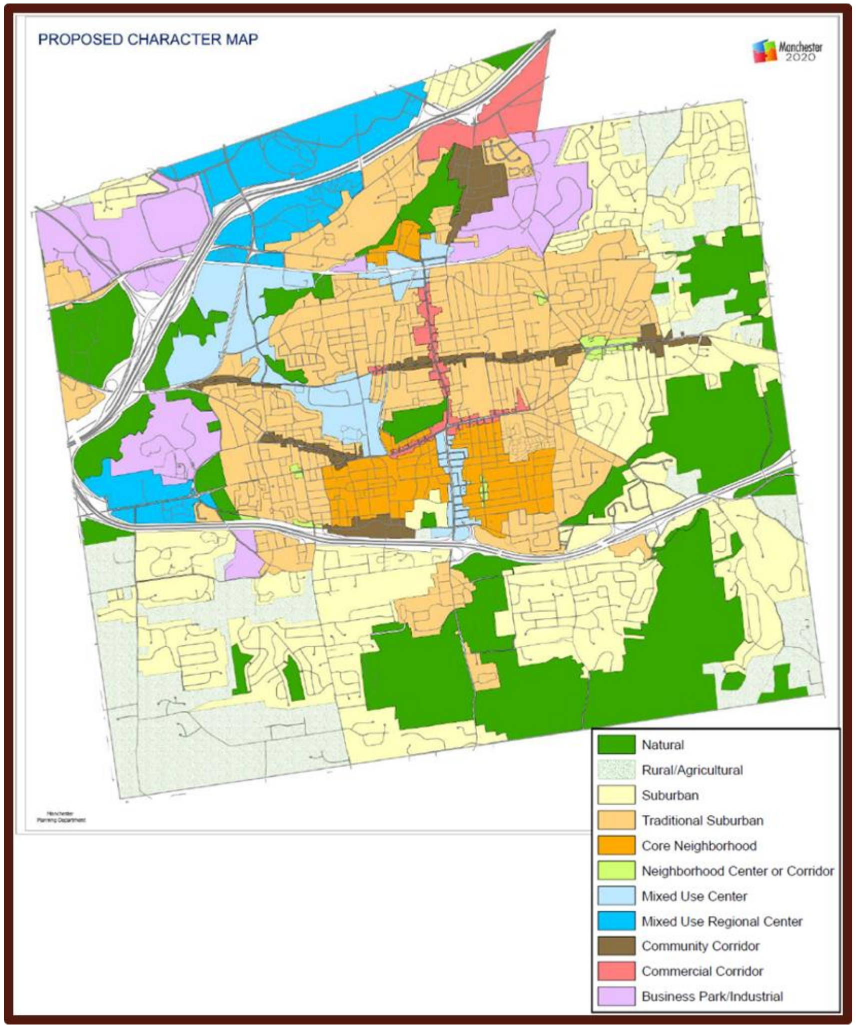


Figure 8-19: Manchester Plan of Community Development

Future Land Use and Economic Development Plans (2014). Windsor has designated four priority “village center” mixed-use growth areas – one its traditional town center, and the others emerging centers.

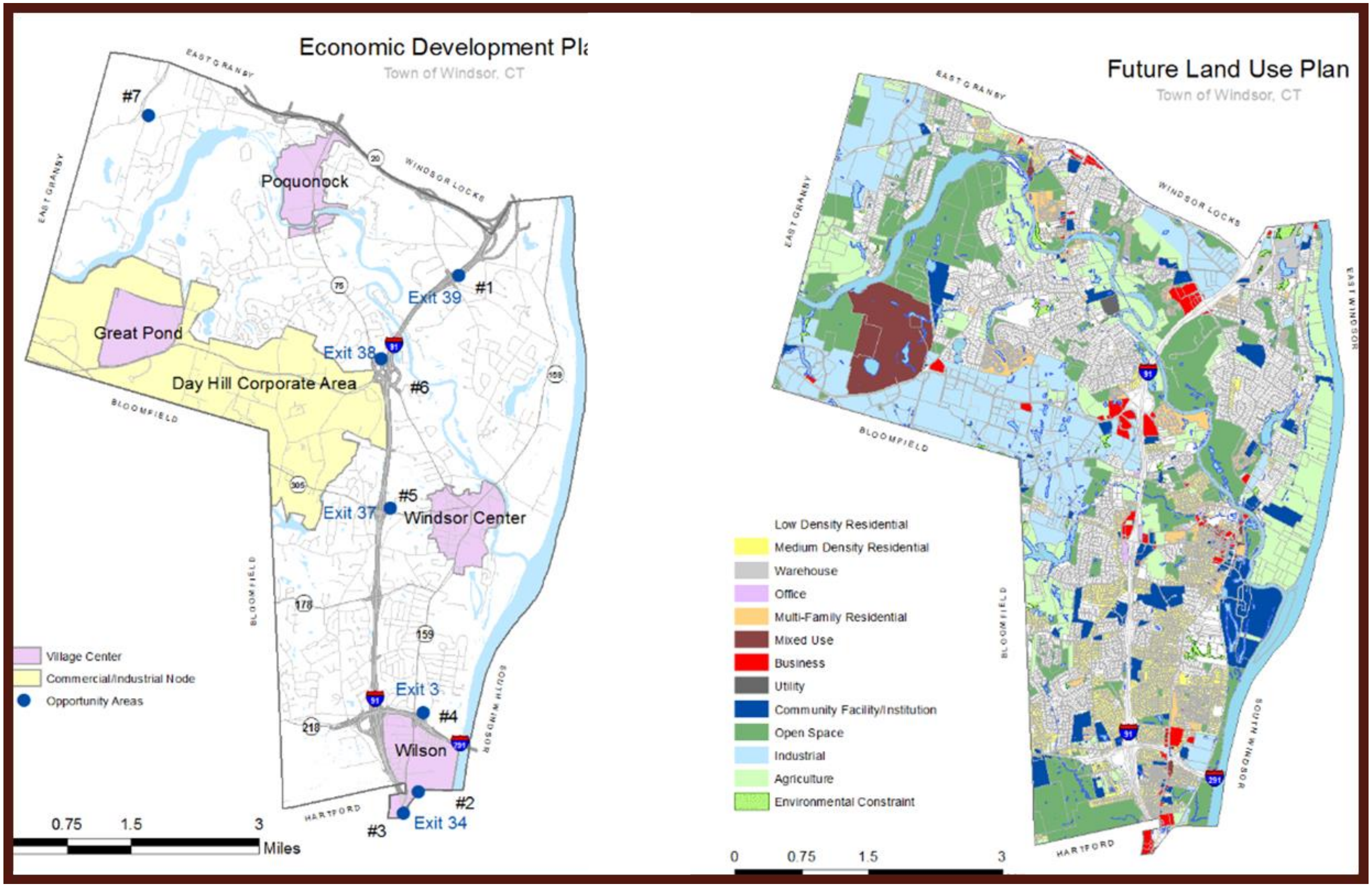


Figure 8-20: Windsor POCD

West Hartford's 2019 POCD designates mixed-use centers and transit station areas for priority growth. The town contains two CTfastrak stations.

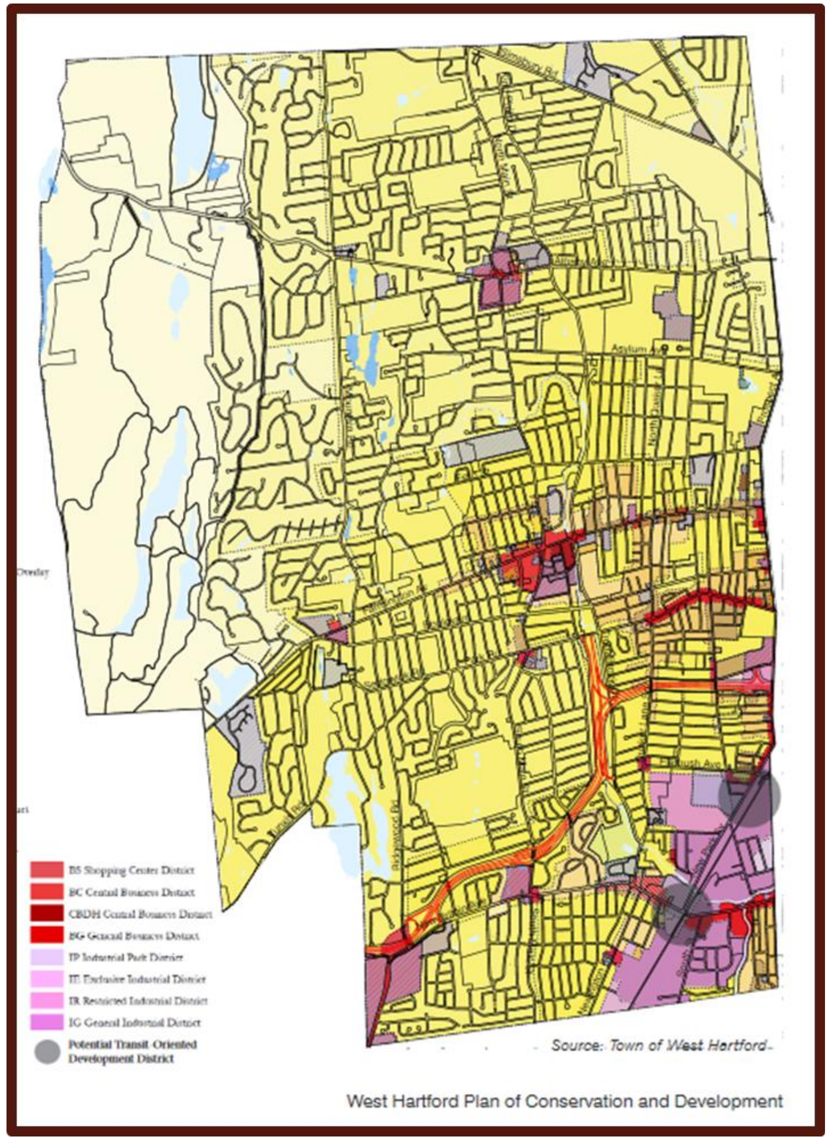


Figure 8-21: West Hartford POCD

With much of its land fully developed, Wethersfield has identified commercial corridors like the Silas Deane Highway as those most likely and appropriate for changes that intensify land use.

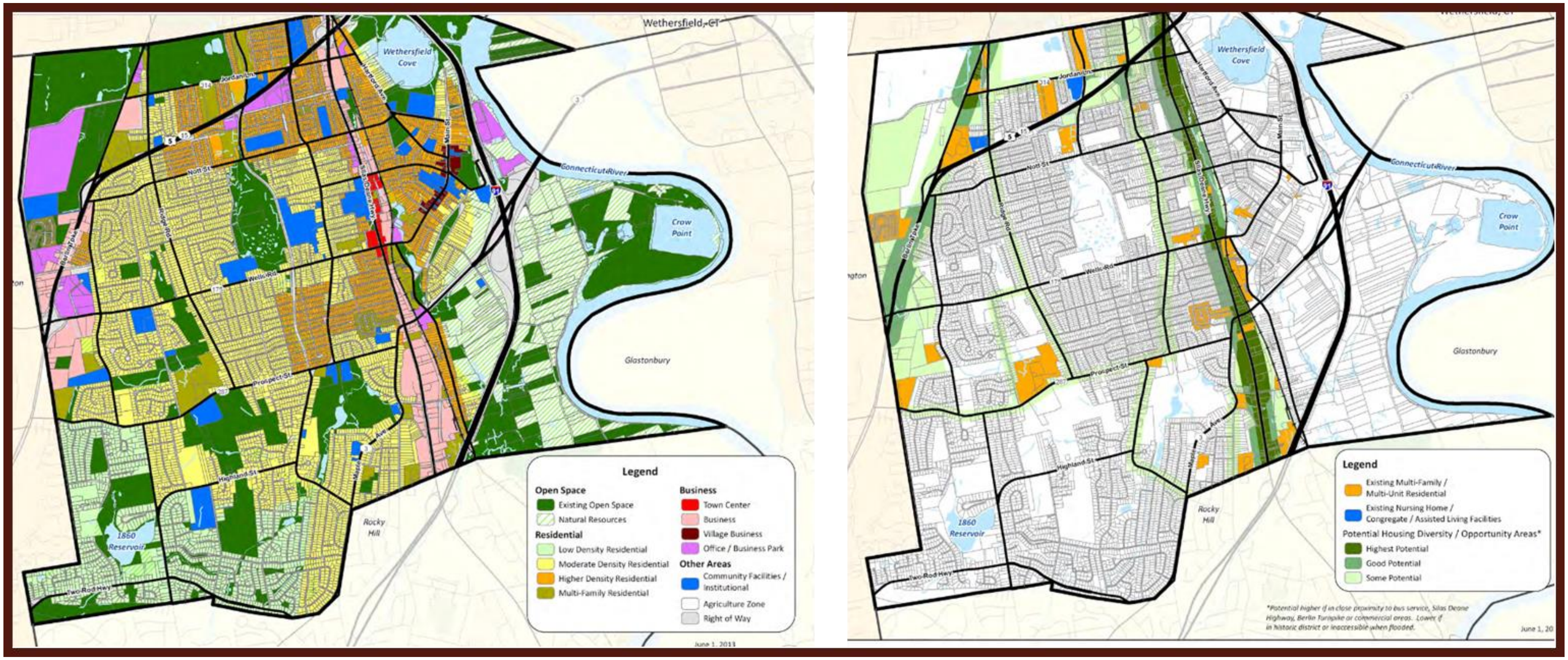


Figure 8-22: Wethersfield land use plan and target housing areas

8.6 Precedents of Land Use-Transportation Dynamics to Inform Further Study

To inform the scenario development phase, the following planning studies or initiatives may be worthwhile to highlight as case studies. Most of the study areas had prolonged periods without new real estate investment. Most of those have seen significant development take place in the past five years as a result of changes to zoning, multi-modal transportation infrastructure, public-private partnership, and/or other policy development updates. Some have seen little investment due to continued need for transportation investment, brownfields remediation, parcel assembly or other prerequisites. Lessons learned from these examples may suggest locations in the GHMS area most poised for growth and change. They may also suggest land use or transportation strategies that would be effective for overcoming challenges to economic development in other places.

i. New Haven Hill-to-Downtown Planning Study
ii. Fairfield TOD Planning Study
iii. Barnum TOD Planning Study, Bridgeport
iv. Stamford Glenbrook and Springdale Planning Studies
v. Warwick Station District, Warwick, RI
vi. Providence Innovation and Design District, Providence, RI
vii. Attleboro, MA Station Area Development
viii. Massachusetts Gateway Cities Report

The Bushnell South master planning process currently under way in Hartford also provides a useful window into development feasibility in dense, transit-served areas. The process seeks to establish a mixed-use neighborhood anchored by the Bushnell Theater on approximately 15 acres of parking lots formerly occupied by state employee parking. State investment in new parking structures, funded in part by the Capitol Region Development Authority (CRDA), has freed the parking lots for redevelopment. While there is a growing market for housing in the adjacent downtown, economic analysis has determined that much of the aspired development will require some form of subsidy from the state, city, and or other sources. Relatively less expensive four-story residential buildings do represent attractive opportunities for developers right now. Mixed-use buildings with concrete or steel first floor (“podium”) construction are inherently more costly to construct and thus would require some level of subsidy. Subsidies can take a variety of formats including city or state property tax abatement, a tax-increment financing district, or below-market land prices.

8.7 Land Use Considerations Key Takeaways

- While the region has a relatively strong and varied job base, and rates highly in levels of education, young college graduates entering the workforce, and other criteria relative to peer regions, its stagnant population growth is a potential weakness threatening future prosperity.

- Portions of the northeast with better access to transit service have outperformed the Hartford-Springfield region in economic development. Communities along the Northeast Corridor rail spine, excluding cities of Washington, New York and Boston as outliers, have seen average annual job growth of 1.1% since 1990 compared to 0.6% annual job growth for the Hartford-Springfield region, barely half as much.

- The Information, Finance, and Professional Services industry sector, a foundation of the GHMS economy and strategic priority for growth, especially gravitates toward places with high transit ridership. Travel associated with this sector in 2019 utilized transit for 29.4% of trips in the Northeast Corridor as a whole, but for only 2.7% of trips in the Hartford-Springfield region. While New York City's high transit use skews the Northeast Corridor figure, even the nationwide average of 7.7% transit trips by the Information, Finance, and Professional Services sector is nearly three times the Hartford region's rate.

- Real estate and business development should be focused in a relatively limited number of walkable focus areas within the GHMS area to maximize economic and community development (see figure 3). These areas offer the current or potential mix of land uses; relatively high concentrations of population, employment, and development; transportation choices; and amenity that will best support regional population growth and economic development moving forward. These areas also primarily consist of previously developed land, and generally avoid major wetlands and floodplains and other sensitive natural areas identified in Chapter 7. other Clustering new development in these areas will help Greater Hartford compete more successfully with other regions to which it has been losing ground since 1990.

- Real estate and business development will not inevitably flow to the designated focus areas, even though many have appropriate zoning and land use priorities in place. While some focus areas have recently gained benefit of improved transit services and other assets thanks to proactive regional effort, most areas will require additional proactive efforts to attract market-driven development. Examples include parcel aggregation, brownfields remediation, or investment in additional multi-modal transportation infrastructure.

- National-scale changes in land use, such as potential reduced office and retail space demand, are already forcing a rethinking of land uses in certain areas. This can present important new opportunities in some focus areas but may require updated approaches to multi-modal transportation, zoning, or other supportive elements, entailing additional study and resources.

9 Multimodal Connectivity

9.1 Introduction

With the emerging trends of Mobility-as-a-Service (MaaS), travelers have been increasingly relying on using multiple modes to reach their destinations in a seamless and efficient manner. Whether it's a connection between a ride-hailing service connecting to passenger rail or park and ride options to switch from autos to transit services, multimodal connectivity has been playing a significantly important role in efficient mobility solutions. The availability of well-planned first/last mile connection to major transit nodes using active transportation is also an example of how multimodal connectivity can support improved user experience and micro-mobil\ty.

This chapter includes discussion of multimodal connectivity in the GHMS study area focused on major transit nodes that facilitate mode transfers, such as the Hartford Union Station and Bradley Airport.

9.2 Connecting Hartford Union Station

Hartford Union Station is a historic transportation terminal originally built in 1889 and has been listed in the National Register of Historic Places since 1975. It acts as a hub of multimodal connectivity in the study area. Hartford Union Station is centrally located along the Hartford line and provides access to significant employment and residential destinations in Hartford and its surrounding communities. The following section reviews existing transit and rail connectivity at Union Station for bus-transit and BRT, bike, and pedestrian facilities, as well as other emerging services. Two types of primary trips will be addressed in this analysis: first and last-mile connections and regional connections. The former will focus on the multimodal connectivity afforded to those arriving at Hartford Union Station as a final destination within the surrounding two miles or those departing Union Station originating from the surrounding two miles. The latter examines those who are coming from further out and using the station for access to the broader regional rail network (i.e. connections south to the New Haven Line or north towards Vermont).

The Hartford area remains a significant employment destination in Connecticut with more than 115,430 jobs within two miles of Union Station.

The Hartford area remains a significant employment destination in Connecticut with more than 115,430 jobs within two miles of Union Station and roughly 9,200 originating from existing Hartford Line station communities.[1,2]

9.2.1 Fixed Route Bus

Hartford Union Station operates as a transit hub, bringing together Hartford Line rail service with local bus and regional services like CT*fastrak*. Beyond Union Station itself, there are five (5) bus stops in the immediate vicinity of Union Station (Figure 9-1), which are serviced by more than 30 CT*transit* bus routes. These routes provide connections between Union Station and most local and regional destinations, including the Greater Hartford area, New Haven, Waterbury, New Britain, and Storrs.

9.2.1.1 Local Service

There is a high density of local fixed-route bus service in Hartford, with 770 stops within a two-mile radius of Union Station serviced by 40 different routes. In addition to local bus service, the Asylum Hill, Columbus Boulevard, and Hartford Dash (currently suspended) shuttles provide free weekday service between Union Station and select areas of downtown Hartford.

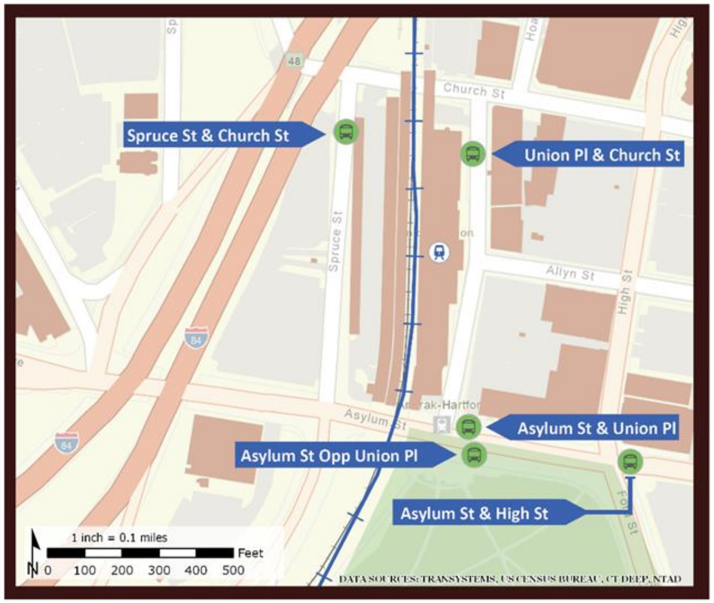


Figure 9-1: Union Station CT*transit* Stops

[1] The employment figures here are from the Census Bureau's LEHD OnTheMap Tool and present data on "All Jobs" for 2018 (the most recent data year).

[2] It is important to note that this figure is not arguing that these are trips that are currently made using the Hartford Line, rather it serves to the number of individuals employed in Hartford who have easy access to Hartford Line Stations.

There are local bus connections from Union Station to most major employers in the Greater Hartford area. These include Travelers, Aetna, Hartford Healthcare, and The Hartford, which can be reached with direct bus service from Union Station in approximately 10 minutes. Transfer between local buses is necessary to reach employment destinations such as the University of Hartford, Cigna, Hartford Hospital, Connecticut Children's Medical Center (CCMC), and Pratt & Whitney. These destinations are not serviced with direct routes from Union Station, therefore, the travel time from Union Station is longer, averaging 30 minutes by bus. Regardless, the system provides for strong connectivity between Union Station and surrounding major employers (see Figure 9-2).

9.2.1.2 Regional Service

Union Station also serves as the terminus for regional services, including CT*transit* express bus, CT*fastrak*, and the Bradley Flyer. There are 25 express bus routes providing connectivity to destinations around Connecticut, including Torrington, Old Saybrook, Middletown, Windsor Locks, Willimantic, and more. CT*fastrak* has 8 routes that use bus-only roadways for all or part of the trip, connecting Hartford Union Station and New Britain. The Bradley Flyer provides hourly service from Union Station and the Connecticut Convention Center to Bradley International Airport, seven days a week. See Figure 9-3.

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Figure 9-2: Hartford Union Station – Local Bus Service and Major Employers

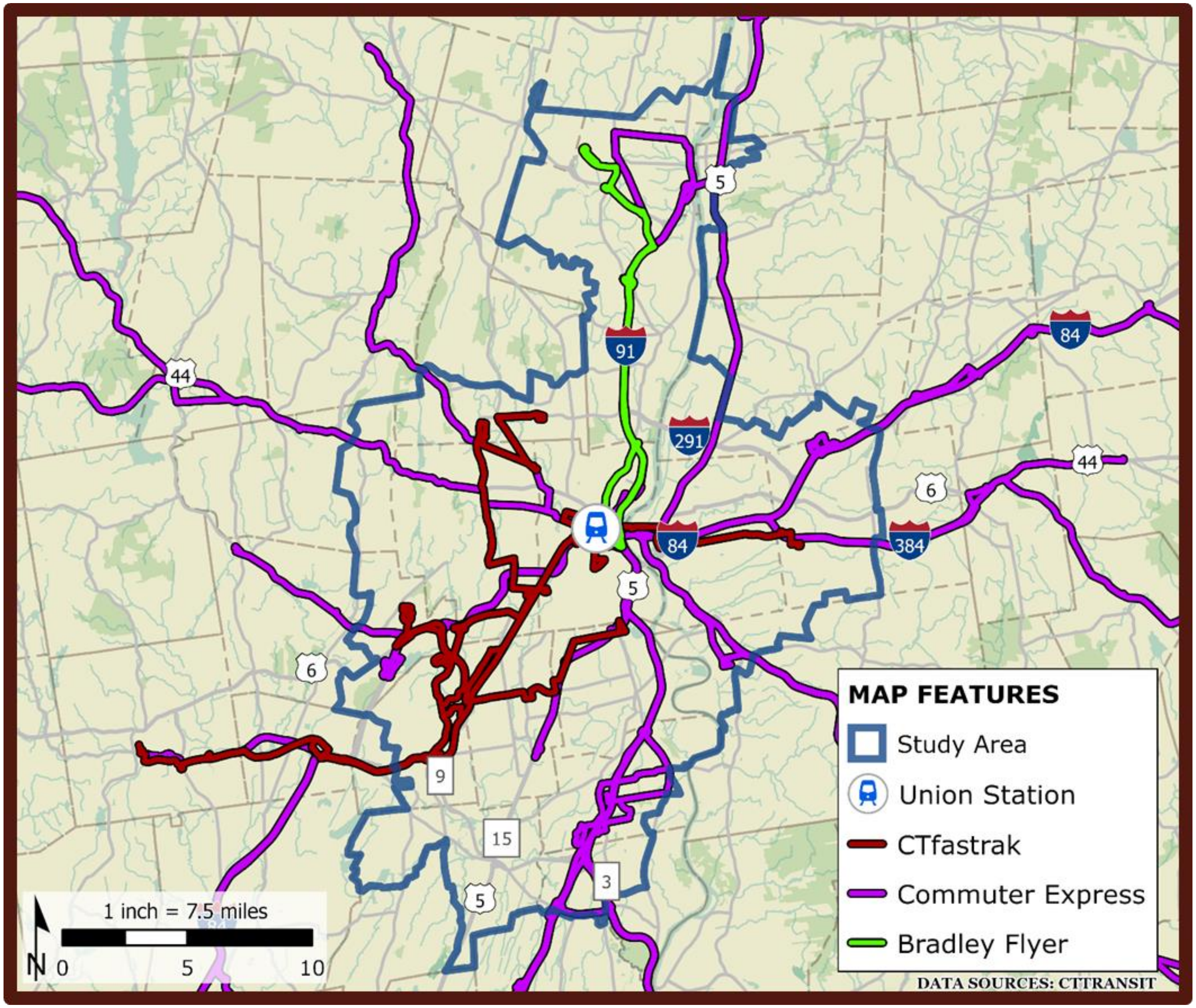

Figure 9-3: Hartford Union Station – Regional Bus Service Connection

9.2.1.3 Fixed Route Ridership

As part of the assessment of fixed route services directly accessible to Hartford Union Station, transit ridership to and from the five stops directly adjacent to the station was reviewed.[3] From these five stops 29 routes are directly accessible including the three downtown shuttles.

Three of 29 routes are part of the CTfastrak system, which services the corridor between Hartford and New Britain. Combined, the three CT*fastrak* routes (101, 102, and 128) receive the highest number of passengers across the five stops with more than 5,000 monthly boardings and 7,000 alightings.

DASH, one of the downtown shuttle services (currently suspended due to the COVID-19 pandemic), attract the most ridership of the shuttle services from this location. (See Table 9-1 here & Figure 9-2 earlier). The majority of daily ridership on the DASH come from boardings which is indicative of transfers from Hartford Line rail services to access other locations in downtown. Whether the dash has historically garnered ridership from the Hartford Line, the free downtown shuttle represents an ideal last mile commute.

Table 9-1: CT*transit* Ridership from Union Station

Route	Monthly Boardings	Monthly Alightings
101	3,702	5,281
60-66	1,900	1,956
913	1,227	2,132
128	953	1,220
82-84	1,248	845
30	1,302	619
83	927	734
DASH	777	607
76	523	735
102	542	505
72	488	344
74	324	350
905	309	63
AHS	62	236
903	164	107
All Others	543	288
Grand Total	14,991	16,022

[3] The five stops are: Asylum St opposite Union Pl, Asylum St and Union Pl, Union Place and Church St, Spruce St and Church St, and Asylum St and High St.

9.2.2 Active Transportation

Active transportation options continue to become a more viable, affordable means of transportation and is especially relevant as a first- or last-mile option. Active transportation extends the easily accessible range well beyond a comfortable walking distance. This section looks at various types of active transportation access including bicycling and bike share, scooters, and pedestrian (discussed below) infrastructure that are present in the Hartford Union Station vicinity.

Bikes on Buses and Trains: Ease of bringing a bicycle onto transit vehicles into Hartford and the level of infrastructure available once users arrive is a critical issue. CT*rail*-operated Hartford Line trains permit bikes on all trains (pending space availability), while Amtrak-operated Hartford Line trains limit bikes on board and require that tickets be purchased through Amtrak and a bike reservation be added to that ticket.

For bus connections into and out of Union Station, all CT*transit* buses are equipped with bike racks that allow for up to two bikes per bus. While CT*fastrak* buses are not equipped with external bike racks, passengers are permitted to bring bikes on board and use an internal rack system.

Union Station Area Bike Amenities: Hartford Union Station has provided two bike lockers located in the Spruce Street Lot; however, the limited capacity hurts the reliability of securing a space. While there are also traditional bike racks located at the bus terminal and near the front entrance of Union Station, they are significantly less secure and not protected from the weather.

On-road Facilities: The road network in and around Hartford Union station provides no dedicated bike facilities and users are required to ride with traffic. While this may not pose a barrier for more advanced users, the lack of dedicated amenities limits the viability of cycling as a first/last-mile connection. In Hartford's 2019 Bicycle Plan the deployment of bike lanes and other dedicated infrastructure was highlighted as a priority, with bike lanes (in multiple forms) being proposed across downtown (Figure 9-4). The deployment of the infrastructure outlined within the plan would go a long way towards improving user experience and safety.

Bikeshare and Scootershare: Bike- and scooter-share services can lower barriers to access and make it easier for commuters to use a bike as a first or last-mile option. Bikeshare is not currently available in Hartford, requiring bike users to bring a bike with them for a trip to Union Station or from it to their final destination. The Capital Region Council of Governments (CRCOG) recently signed a contract with Zagster that will allow the rollout of bikeshare and scooter share as early as spring 2021. The initial agreement will allow for rollout in Hartford, East Hartford, West Hartford, Newington, New Britain, and Manchester.

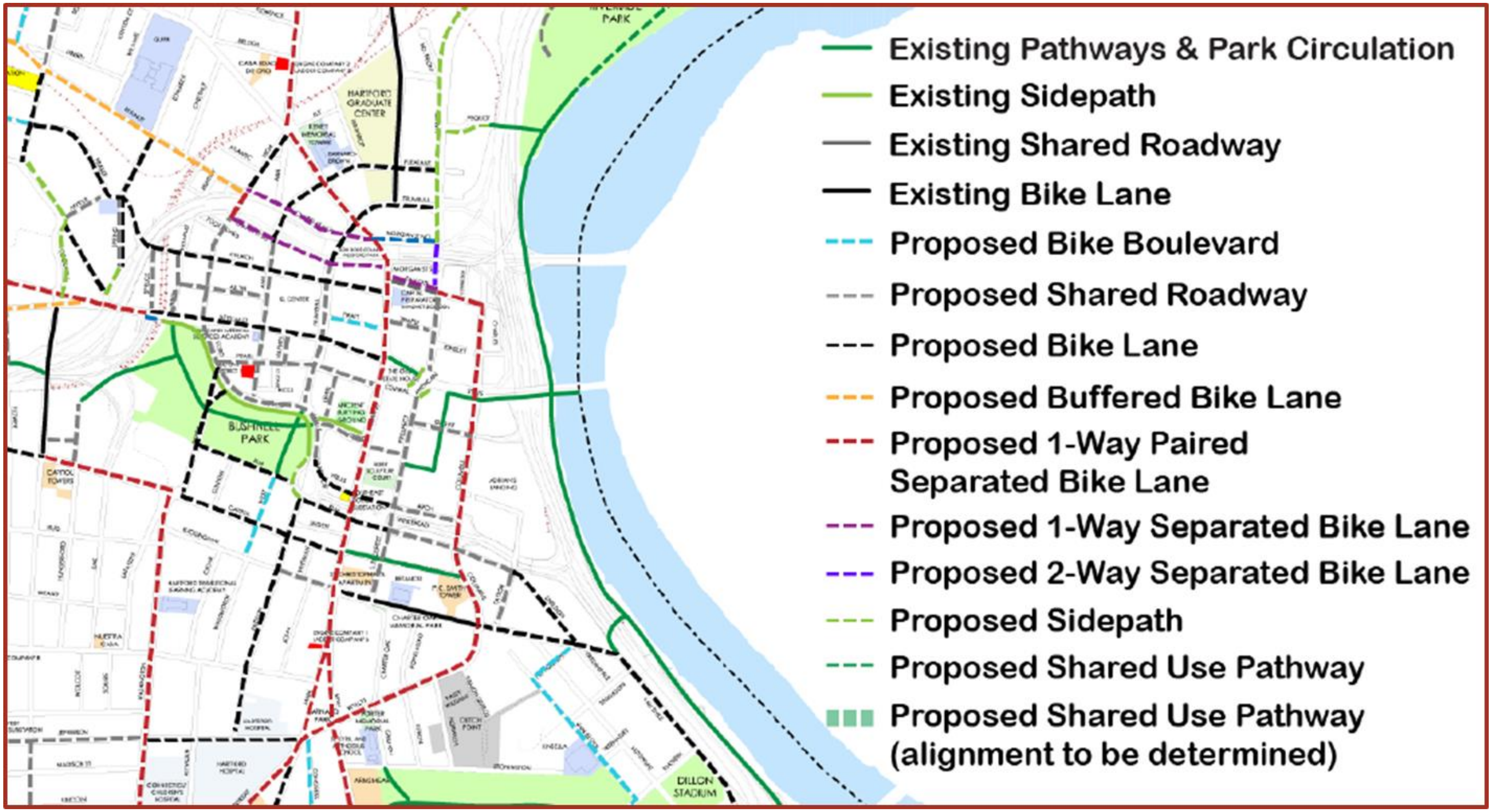

Figure 9-4: Hartford Bike Master Plan Proposed Bike Infrastructure

9.2.3 Pedestrian

The area in and around Hartford Union Station has a high degree of walkability due to the higher density of development and a contiguous network of sidewalks and crosswalks. Based on the Environmental Protection Agency (EPA) national walkability index, the areas just to the east of Union Station (towards downtown) have the highest degree of walkability, while areas to the west of the station are considered to be significantly less walkable. The lower walkability to the west of the station can be attributed to I-84 crossing through the zone and creating a less pedestrian friendly atmosphere. However, it is still possible for pedestrians to safely reach these areas.

9.3 Windsor Locks Station and Bradley Airport Connection

Bradley International Airport provides convenient access to and from Connecticut for those traveling nationally and abroad. It also provides connecting flights to major hubs throughout the United States, tying it to the regional market. Additionally, it is the second largest commercial airport in New England, servicing 6.75 million passengers in 2019. The airport is centrally located between the New York and Boston metropolitan areas and is interconnected with existing transit connections. Bradley International Airport has the capacity to expand services in the future as other major regional airports reach capacity and become increasingly vulnerable to sea level rise and flooding from severe storms.

9.3.1 Existing Conditions

Bradley International Airport is accessible across modes, including public transit, private automobile, and transportation network companies (TNCs). With future plans looking to further expand accessibility through either direct rail link or autonomous shuttle.

The most direct connection between Bradley and Hartford is the Bradley Flyer bus service, which provides hourly (20 trips total), semi-express service to all airport terminals in approximately 40 minutes from Hartford Union Station. This interconnection at Union station offers broad accessibility across modes including the Hartford Line, local fixed route bus, regional routes, and CT*fastrak*.

The following section summarizes proposals currently being considered for a direct rail connection from the Hartford Line, as well as additional transit connections from Windsor and Windsor Locks stations.

9.3.2 Potential Rail Connections and Future proposals

A 2014 study funded by the Bradley Development League (BDL) evaluated alternatives to determine the viability of a rail connection between Bradley Airport and the Windsor Locks rail station. The BDL is a consortium of four towns (East Granby, Suffield, Windsor, and Windsor Locks) surrounding Bradley International Airport that markets the airport and region for economic development purposes. The study into rail alternatives had three primary goals:

- Improve public transportation connectivity and accessibility between Bradley International Airport and the New Haven-Hartford-Springfield rail line;
- Provide cost-effective and efficient land transportation service to and from Bradley International Airport; and
- Support sustainable local and regional economic development.

Screening by the BDL Steering Committee identified a shortlist of four alternatives for further consideration (Figure 9-5):

- Alternative 1: Suffield Spur provides a potential rail connection to Bradley Airport utilizing the existing Connecticut Central Suffield Spur off of the Amtrak mainline. This alternative could use LHRC or DMU vehicles;
- Alternative 2: North Street provides a connection to Bradley Airport from Windsor Locks station via North Street and Route 75 using streetcar equipment;
- Alternative 3: Elm Street provides a connection to Bradley Airport from Windsor Locks station via Elm Street and Route 75 using streetcar equipment; and

Alternative 4: Route 20 provides a connection to Bradley Airport from Windsor Locks station via Route 159, Interstate 91, and Route 20 using LRT or DMU technology.

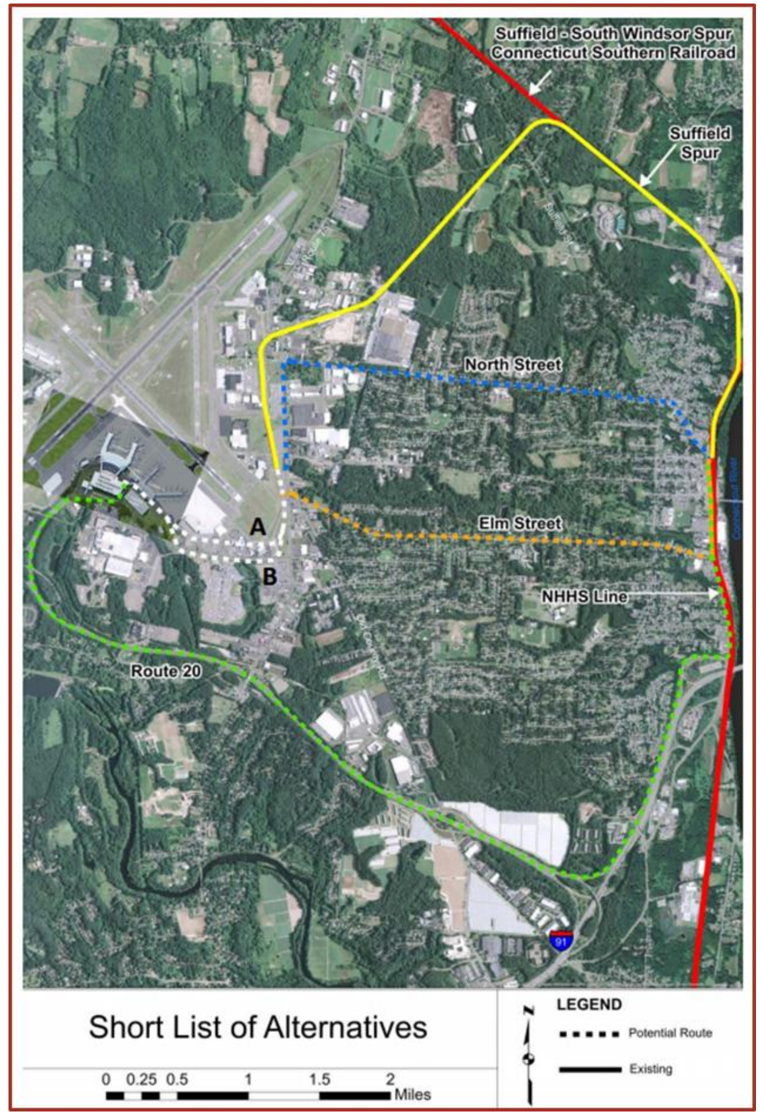

Figure 9-5: Rail Alternatives to Bradley International Airport

9.3.2.1 Suffield Spur Alternative Details

This alternative would utilize the existing Connecticut Central Railroad Suffield Spur from the Hartford Line to the airport via the Bradley Spur. This alternative could deploy diesel locomotive/commuter coaches, or Dual Mode Units (DMUs). The Windsor Locks station would be configured with a separate track for the Bradley Connector, and a two-sided platform to allow a cross-platform connection with Hartford line service.

This route follows the Suffield Spur as it leaves the Hartford line roughly 2,500 feet north of the Windsor Locks Station, and curves to the north-west, servicing several industrial/commercial properties. As seen on the map on the previous page (Figure 9-5) the existing alignment terminates adjacent to the “cell-phone” parking lot approximately 2,500 feet north of Schoephoester Road.

The existing line is currently maintained strictly for low-speed freight use only and would require significant upgrading for passenger service, including improvements to grade crossings and likely development of a signal system/PTC. All existing crossings (except Route 75) are protected only by static signage, and the Army National Guard property must be entered and exited by manually unlocking and re-locking gates. The Route 75 crossing is an unusual signalized crossing, using standard vehicular signals instead of crossing signals or gates. The crossing is actuated by a key-by, and it does not appear that track circuits are in place for automatic actuation.

Two routes have been identified for extending the line to the Ground Transportation Center (GTC). Both extend the existing track alignment to the south. This would impact the “cell phone” waiting lot and require some reconfiguration of that lot, or for that use to be shifted to some other location.

The Table 9-2 on the following page shows the two alignments along the Suffield Spur and a brief overview of the alignment length, the length of new construction or track renovation, the number of existing and proposed at-grade crossings, and the number of existing and proposed traffic signals.

Table 9-2: Suffield Spur Rail Alternative Options

	Suffield Spur A	Suffield Spur B
Corridor Length	6.24 miles	6.40 miles
New Construction		
At-Grade	0.78 miles	0.91 miles
Embedded	n/a	n/a
Elevated	0.57 miles	0.60 miles
Tunnel	n/a	n/a
Track Renovations		
At-Grade Crossings		
Existing	12	12
New	1	2
Traffic Signals		
Existing	1	2
New	0	0

Source: Bradley Airport Light Rail Feasibility Study, 2016

9.3.2.2 Windsor Locks Autonomous Bus Connection and Connecticut CAV Policy

On June 27, 2017, the Connecticut legislature enacted Public Act No. 17-69, establishing a pilot program for four municipalities to allow autonomous vehicle testers to operate fully autonomous vehicles on the highways of the municipalities. Windsor Locks applied to be one of the four communities to host an autonomous vehicle pilot program.

During a May 1, 2018 meeting, the Windsor Locks Board of Selectmen discussed a proposal for a Fully Autonomous Vehicle (FAV) Testing Pilot Program that was established by the State of Connecticut Office of Policy and Management (OPM). The goal for the pilot program is to allow a variety of FAV testing to occur in four municipalities throughout the state, bringing Connecticut to the forefront of the innovative and burgeoning autonomous vehicle industry. Following an application and written agreement, OPM will select four municipalities to participate in the pilot program. The autonomous vehicles would be fully tested on the highways of the chosen municipalities. Town officials agreed that the autonomous vehicles may be a useful and cost-effective alternative to a shuttle bus for transporting travelers between the new Windsor Locks Hartford Line Commuter Rail Station and the Bradley Airport Passenger Terminal. The selection of pilot communities is currently delayed.

Windsor Locks Station Area Build-Out Illustrative Plan.
Portion of an illustrative plan outlining the potential full build-out of the future Windsor Locks station area, including private redevelopment and infrastructure improvements.

Source: Hartford Line TOD Action Plan Part 2, 2019

In March, 2021, CTDOT announced its first-ever, statewide Strategic Plan for Connected and Automated Vehicles (CAV) to support emerging transportation technology and mobility trends. Specifically, the plan outlines strategies for advancing multimodal CAV-related services and infrastructure to address both current and evolving transportation needs. The strategic plan explores the ways CAV technologies could become a powerful tool in helping meet key CTDOT goals for improved safety; enhanced mobility, accessibility, and reliability; reduce congestion; support infrastructure state of good repair; provide efficiencies; reduce vehicle emissions; and support economic growth. Near-term (2021-2025) actions will include deploying pilot projects, early policy coordination and development, assessments of workforce and infrastructure readiness, and other activities.

According to the CTDOT webpage, "until sufficient national CAV standards are set, or a clearer consensus around the usage of CAV technologies, the CTDOT will focus its CAV technology and research investments towards conducting and supporting limited CAV field-testing and small pilot projects in Connecticut." These pilot programs and demonstration projects will allow the state and participating communities gather valuable insight as to the direction of the industry and the role that CAV can play in the states' transportation network. Additionally, participation in these programs will position state to become a leader in best practices and more proactively work to inform policy and regulatory decisions at the federal level.

The Plan identifies two near-term pilot programs: pilot testing CAV full size transit on the CTfastrak and pilot testing Vehicle-to-Infrastructure (V2I) and other emerging traffic signal technologies along a segment of the Berlin Turnpike. The Plan also notes that the CTDOT will also consider exploring additional options and ideas for advancing other types of CAV pilot tests and limited deployments in Connecticut as needs arise and as available funding/resources permit.

Among the components of the Plan that may be relevant to a Windsor Locks Pilot program are:

1. In the future, CAV technologies will likely provide increased mobility options for public transportation users. While fixed route bus and rail services are likely to remain the norm in highly populated urban areas, CAV may offer a better transportation solution for suburban and rural communities. CAV may also help to solve the last mile problem for public transportation. The need for CAV to be integrated at transit hubs should be a priority going forward; and

2. Addressing safety concerns will most likely be achieved via CAV pilot projects that are highly visible with positive community impacts. Providing the public with ways to experience CAVs, potentially via CAV public transit or low-speed shuttles, would clearly demonstrate that non-human driven vehicles are safe and efficient. It is

essential for the public to be able to experience the capabilities and limitations of the technology first-hand, so they can develop an informed perspective.

9.3.2.3 Expanded Bradley Airport Express

The latest (2019) Capital Region Council of Governments (CRCOG) Metropolitan Transportation Plan (MTP) provides a 25-year overview of the anticipated major transportation improvements and investments in the Capitol Region. The plan outlines recommendations for an expanded Bradley Flyer service.

Given the very limited transit service to the airport today, bus service improvements are needed. The Bradley Flyer is the only bus service between the airport and downtown Hartford, and it was designed to serve employees at the airport, not air travelers. For instance, the Bradley flyer does not provide dedicated luggage compartments or storage for passengers with large bags. The route's schedule and frequency should be adjusted to become more attractive to travelers. CRCOG's Hartford Comprehensive Transit Service Analysis recommends extending the Bradley Flyer to New Britain along the CT*fastrak* guideway but recognizes the concern of limited parking availability at the CT*fastrak* stations. Solutions to help alleviate these concerns could include encouraging long-term airport parking at the underutilized Szczesny Garage in New Britain, charging for parking at CT*fastrak* stations, and increasing parking capacity at CT*fastrak* stations.

The MTP includes the following specific recommendations:

1. Support the establishment of a transit connection between the airport and the CT*rail* Hartford Line, work with CTtransit to provide a connection to the CT*rail* Hartford Line service by instituting a direct shuttle service from the airport to the Windsor Locks rail station.

2. Support adjustments to Bradley Flyer Service to improve bus service to Hartford from Bradley; the route should operate more frequently and be re-routed to serve the Ground Transportation Center when completed. Extending the Bradley Flyer to New Britain along CT*fastrak* and rebranding the route could attract more choice riders coming from other stations.

3. Marketing and branding the Bradley Flyer Improved branding, user-friendly schedules, and better signage at the airport could help bolster ridership.

4. Support Bradley Master Plan's calls for improved designs for roadways surrounding the airport.

9.3.2.4 2021 CTDOT Transit SAFE Analysis

In accordance with Title VI of the Civil Rights Act of 1964 and Federal Transit Administration (FTA) Title VI Circular 4702.1B, Connecticut Department of Transportation (CTDOT) conducts a Service and Fare Equity (SAFE) Analysis any time fare changes or major service changes are proposed to ensure that changes do not unfairly impact minority and low-income populations. The onset of the COVID-19 pandemic initiated an extended emergency declaration and subsequent service modifications to bus and rail service.

The document also addresses proposed services changes to CTtransit bus service, minor fare changes on two CTtransit Express bus routes, and a proposal to eliminate the Metro-North Railroad Mail and Ride Program. Among the proposed service changes includes a new route that connects Windsor and Windsor Locks stations to Bradley International Airport. The proposed service improves upon existing transit connections to the airport by providing a direct connection to/from the Hartford Line.

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