CENTRAL MASSACHUSETTS

METROPOLITAN PLANNING ORGANIZATION

Sturbridge
Route 20 Corridor Profile

December 2019

Document Prepared by:
Staff of the Central Massachusetts Metropolitan Planning Organization
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One Ashburton Place, 6th floor
Boston, MA 02109
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1.0 Introduction

1.1 Transportation Management Systems Integration: "Corridor Profile"

A Corridor Profile combines the information produced by the transportation Management Systems along a particular highway corridor, at times in multiple host communities, and analyzes performance-based data, suggests both operational and physical improvements, and often identifies candidate projects for further study.

Utilizing the range of data and analyses produced by the ongoing transportation Management Systems maintained by the staff of the Central Massachusetts Regional Planning Commission (CMRPC) and overseen by the Central Massachusetts Metropolitan Planning Organization (CMMPO), Corridor Profile efforts allow for comprehensive integration through the consideration of a broad range of key transportation planning factors.

Ultimately, a range of suggested improvement options are compiled for the consideration of the host communities and the Massachusetts Department of Transportation (MassDOT), Highway Division. When local consensus is reached, proposed improvement projects accepted by the community eligible for federal-aid funding have the potential to be selected by the CMMPO for programming in the annual Transportation Improvement Program (TIP) document. At this time, the highly competitive TIP is essentially fully proscribed for the fiscal years 2020 to 2024.

As the Corridor Profile study series has evolved, it has become increasingly multi-modal and intermodal. The Management Systems have also served as the basis for the transition to performance-based planning. Performance-based planning seeks to measure the value of investments made in the region's transportation infrastructure. US DOT's national focus areas include reducing congestion, improving pavement, reducing vehicle crashes and, in the spirit of the state's Complete Streets Program, increasing the use of other modes such as transit, bicycling, and walking.

The Route 20 Corridor Profile includes the analysis and interpretation of Management System data, including the following:

Traffic Counting: Daily Automatic Traffic Recorder (ATR) counts and MassDOT Highway Division count data.

Congestion Management Process (CMP): Current Travel Time & Delay studies along Route 20; current and future projected peak-hour Turning Movement Counts (TMC) at focus intersections and associated Level-of-Service (LOS) analyses for intersections and segments.

Freight Planning: Peak hour percentages of heavy vehicles utilizing Route 20 focus intersections.

Transportation Safety Planning Program: In-depth vehicle crash research using crash data received from the MassDOT, utilizing a three-year history of reported crashes and subsequent analysis.

Pavement Management System (PMS): Observation of pavement surface distress and extent in the field along with subsequent analysis and calculated Overall Condition Index (OCI).

Bridge Management System (BMS): Bridge condition data available through MassDOT Highway Division; GIS-based inventory of major roadway drainage structures, if any, as well as staff observations in the field.

Depending on local sentiment and available funding, the technical work necessary to compile a Corridor Profile is supplemented by customized public outreach efforts. This can range from basic meetings with local officials to the formation of a Technical Advisory Group to guide the effort. As determined necessary, special meetings can also be held with various stakeholder groups.

1.2 Performance Management

Reaffirmed by the Fixing America's Infrastructure (FAST) Act, the CMMPO is continuing the evolution of the development of performance-driven, multimodal TIP projects. Performance Based Planning & Programming (PBP&P) is intended to improve public transparency, fiscal accountability, and investment decisions affecting the condition and performance of the transportation system.

The CMMPO's evolving Performance Management program includes both federal transportation performance management requirements and the MPO's established goals and objectives. These goals and objectives are then integrated through each of the Ten Federal Transportation Planning Emphasis Areas. The areas are safety, security, state of good repair, congestion, multimodality, GHG/sustainability, equity, economic vitality, stormwater management & resiliency, and travel & tourism. Each goal and objective has corresponding performance metrics that are monitored and progress towards these established goals is reported annually. A Performance Measures Scoresheet was created to assess current and candidate future year TIP projects to determine to what extent they address regional goals. TIP projects that rank high are often projects that can provide substantive measurable outcomes for each goal, thus having increased regional impact.

The findings from this Corridor Profile Report include a list of suggested improvements. Ideally, these suggested improvements will encourage a TIP project that can influence regional

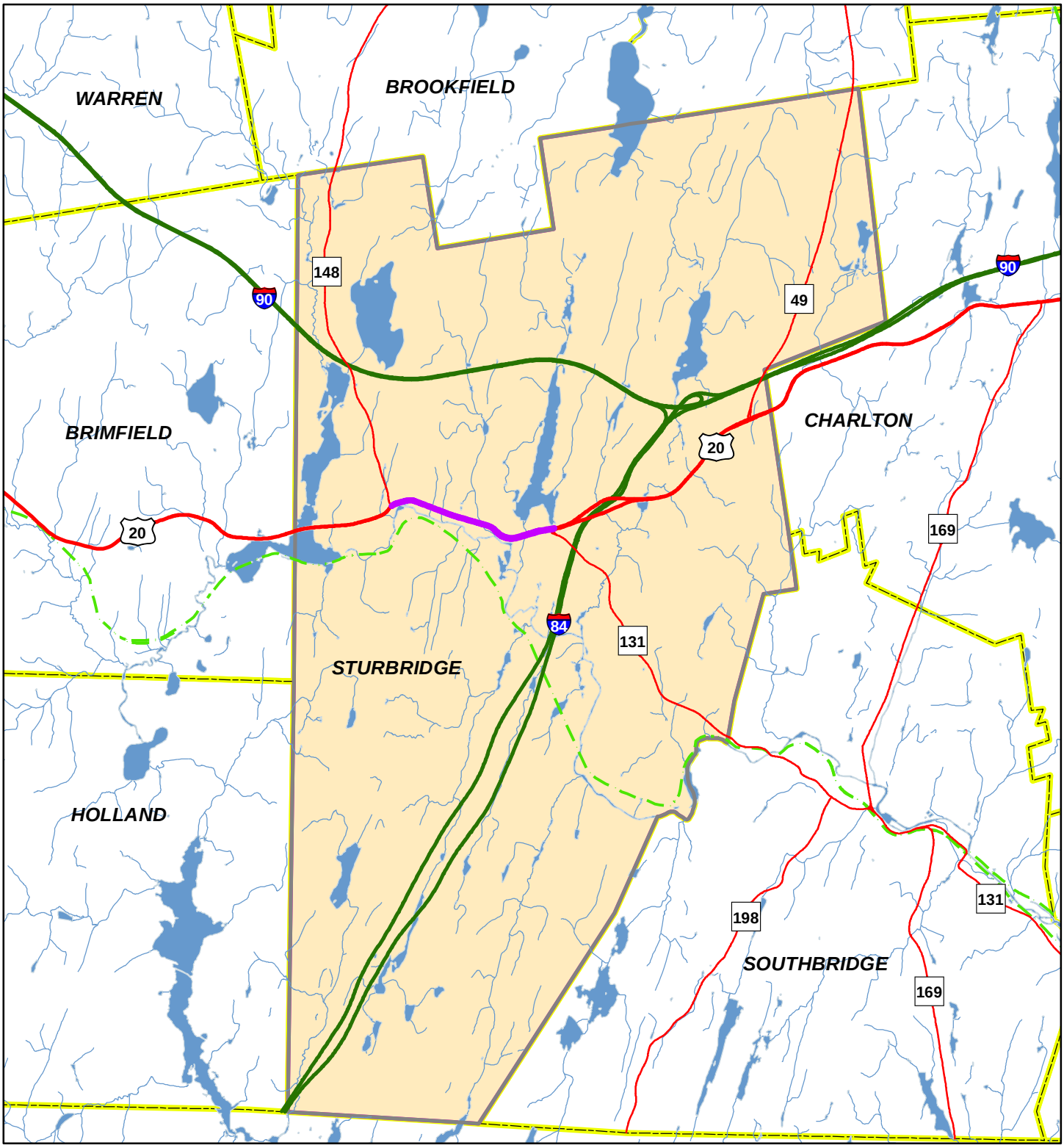
performance. A table integrating the suggested improvements and how they can support the goals and objectives for each federal emphasis area is included in the Overall Findings chapter of this report.

1.3 Route 20 Corridor Profile: Sturbridge

The Route 20 Corridor Profile was competitively selected by the CMMPO as a worthy candidate to analyze and study. Route 20 is a federal-aid roadway that is eligible for US DOT funding for improvements. Since the corridor is heavily traveled, the goals of this Corridor Profile include improving roadway safety, reducing congestion, preserving and improving roadway pavement, maintaining drainage structures as well as determining how to improve the roadway for bicycle and pedestrian accommodations. The Route 20 study corridor is shown in **Figure 1** along with other major aspects of the region's multi-modal transportation network including long distance trails.

The study limits of this Corridor Profile are between Route 148 and Route 131. Route 148 is a north/south roadway that travels through Brookfield and North Brookfield then ending in the town of Oakham at Route 122. Route 131 is also a north/south roadway which travels through Southbridge and Dudley until continuing into Connecticut. Within the study area Route 20 is a four-lane roadway separated by a median to the east of Cedar Street and, to the west, a two-lane roadway. Route 20 has a mixture of commercial, industrial, and residential land uses. Old Sturbridge Village, a popular tourist attraction, is located along Stallion Hill Road on the southern side of Route 20. In addition, the MassPike (I-90)/I-84 interchange is located just to the east of the Route 131 intersection.

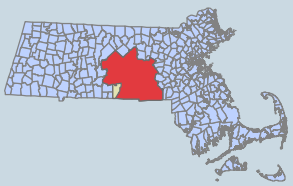
The roadway study segment of Route 20 in Sturbridge is 1.6 miles and the entire length of the study area is state maintained. The MassDOT Roadway Inventory File (RIF) indicates that the right-of-way for the entire Route 20 study area is 60 feet.

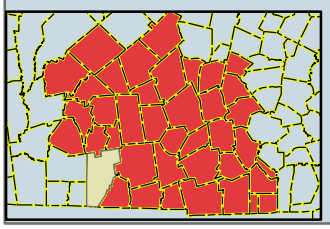


ROUTE 20 CORRIDOR PROFILE

Host Community of Sturbridge

Figure 1





Legend

- Route 20 Corridor Profile
- Interstate
- U.S. Route
- State Route
- Water
- Potential Rail Trail

Miles

0 0.475 0.95 1.9 2.85 3.8

CMRPC

Central Massachusetts Regional Planning Commission

Source: Data provided by the US Census Bureau, Central Massachsuetts Regional Planning Commission (CMRPC), massDOT Office Of Transportation Planning Geospatial Resources Section and the Office of Geographic Information MassGIS), Commonwealth of Massachusetts, Information Technology Division.

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1.4 Corridor Profile Work Activities Defined in UPWP

This Corridor Profile effort has been completed as part of a previously CMMPO Endorsed Unified Planning Work Program (UPWP). The following provides an overview of the major tasks that were included within the defined scope of the Route 20 Corridor Profile effort:

- CMRPC coordination on an entire range of Corridor Profile aspects including data collection and analysis.
- Vehicle crash analyses completed using MassDOT-maintained vehicle crash data.
- Completion of an "Environmental Profile" for the entire Route 20 study corridor in Sturbridge. Consists of GIS-based maps highlighting overlays developed by Department of Conservation & Recreation (DCR), Department of Environmental Protection (DEP), and National Heritage & Endangered Species Program (NHESP).
- Range of suggested improvement options compiled for host community consideration.
- Preparation of report document, complete with color graphics and maps, along with accompanying Technical Appendix.
- Attend meetings with host community involved in study.

1.5 Town of Sturbridge Route 20 Observations & Existing Deficiencies

The following observations and existing deficiencies, also shown in **Figure 2**, were observed in Sturbridge along the Route 20 study corridor:

Route 20/Route 148/Holland Road Intersection

- Heavy congestion during school times in the AM and PM, especially on Route 148 from Tantasqua schools.
- There is a crosswalk across Route 148, but no pedestrian walk signals.
- Limited shoulder on Route 20 and no sidewalk on the south side.

Route 20/Arnold Road Intersection

- Difficulty exiting Arnold Road during peak travel periods, especially left turns onto Route 20.
- There is a crosswalk across Route 20, but there is no sidewalk on the south side in this area. There is also a flashing pedestrian sign at this location.

Route 20/Cedar Street Intersection

- Short merge lane heading westbound due to lane drop.
- Difficult for westbound vehicles to make allowable U-turns due to no protected left turn phase with dedicated green time.

- The ADA ramps at the crosswalks need to be updated to current standards.
- U-turning vehicle can cause delays for through vehicles that use the inside lane.

Route 20/Stallion Hill Road Intersection

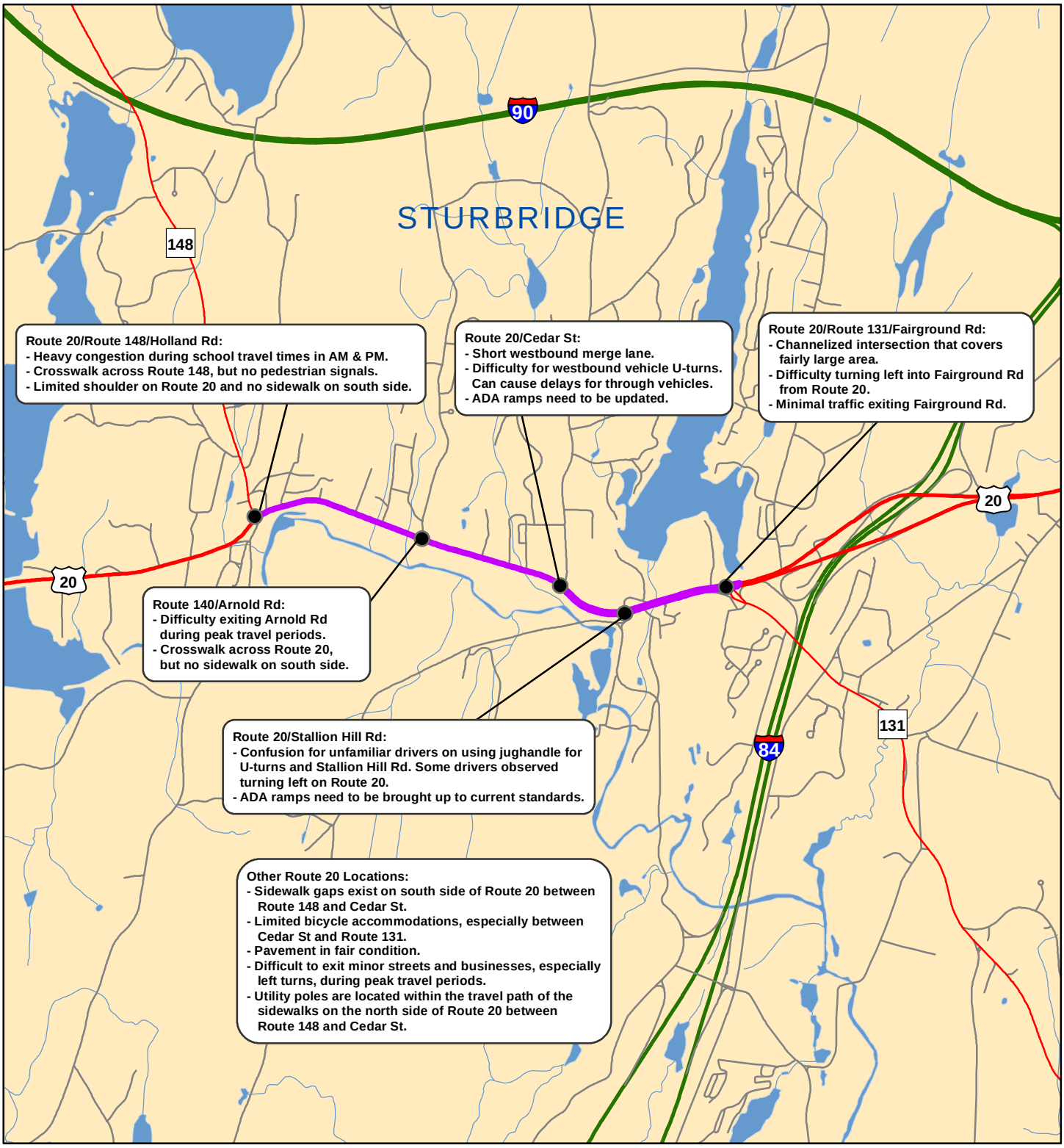
- Some confusion for unfamiliar drivers to use jughandle for U-turns and Stallion Hill Road. Still, some people have been observed to turn left on Route 20 even though it is restricted.
- The ADA ramps at the crosswalks need to be brought up to current standards.

Route 20/Fairground Road/Route 131 Intersection

- Difficult for eastbound vehicles to make a left turn into Fairground Road.
- Minimal traffic exiting Fairground Road.
- Channelized intersection that covers fairly large area.

Other Route 20 Locations

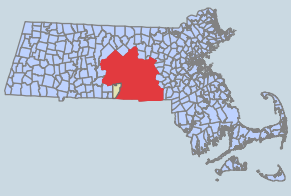
- Sidewalk gaps exist along the south side of Route 20 between Route 148 and Cedar Street.
- Limited bicycle accommodations, especially between Cedar Street and Route 131.
- Pavement is in fair condition throughout the entire study corridor.
- Difficult to exit minor streets and businesses, especially left turns, during peak travel periods.
- Between Route 148 and Cedar Street the utility poles are located within the travel path of the sidewalks on the north side of Route 20. This causes difficulties for wheelchairs attempting to maneuver along this section of sidewalk.

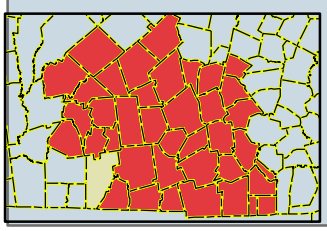


ROUTE 20 CORRIDOR PROFILE

Sturbridge Observations & Deficiencies

Figure 2





Legend

- Route 20 CP
- Interstate
- State Route
- U.S. Route
- Roads
- Streams
- Water Bodies

0 0.15 0.3 0.6 0.9 1.2 Miles

CMRPC
Central Massachusetts Regional Planning Commission

Source: Data provided by the US Census Bureau, Central Massachsuetts Regional Planning Commission (CMRPC), massDOT Office Of Transportation Planning Geospatial Resources Section and the Office of Geographic Information MassGIS), Commonwealth of Massachusetts, Information Technology Division.

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2.0 Route 20 Environs

2.1 Natural Environment

Major features of the natural environment were also identified as part of the Route 20 Corridor Profile effort and were used to create Environmental Profile maps for the study area. Such maps are included in previous Corridor Profile Reports and allow the user to view major environmental systems beyond the corridor study area that have impacts on such things as drainage, water quality and wildlife migration.

The following Environmental Profile Maps for the Route 20 Corridor Profile study include environmental features such as vernal pools, wetlands, impaired waters and wellhead protection areas. Vernal pools are small, shallow ponds characterized by lack of fish and by periods of dryness. Wetlands are areas where water covers the soil, or is present either at or near the surface of the soil all year or for varying periods of time during the year. Under the Clean Water Act, states, territories, and authorized tribes are required to develop lists of impaired waterways. These are waters that are too polluted or otherwise degraded to meet the water quality standards set by states, territories, or authorized tribes. The law requires that these jurisdictions establish priority rankings for waters on the lists and develop a Total Maximum Daily Load (TMDL) for these waters. A TMDL is a calculation of the maximum amount of pollutant that a waterbody can receive and still safely meet water quality standards. A wellhead protection area is that area of an aquifer which contributes water to a well under the most severe pumping and recharge conditions that can be realistically anticipated.

These maps of the study area showing major environmental features were compiled from the following key resources.

<u>Department of Conservation and Recreation (DCR)</u>

The mission of DCR is to protect, promote and enhance our wealth of natural, cultural and recreational resources. Geographic Data layers are managed by divisions within DCR.

- **Division of State Parks and Recreation -**This division protects land and resources on privately and municipally held land through technical assistance, grant and planning programs, policy development, and other services.
- **Forest Stewardship Program -** This non-regulatory program is designed to help landowners protect the inherent ecosystem values of their forest.
- **Division of Water Supply Protection -** Manages and protects the drinking water supply watersheds for Greater Boston.

Department of Environmental Protection (DEP)

MassDEP is responsible for ensuring clean air and water, safe management and recycling of solid and hazardous wastes, timely cleanup of hazardous waste sites and spills, and the preservation of wetlands and coastal resources. It includes:

- **Division of Watershed Management (DWM)**
- **Watershed Planning Program (WPP) -** Contaminated water adversely impacts drinking water supplies, degrades our recreational water resources and destroys wildlife habitat. Water that does not soak into the ground is called runoff. Proper manure management and runoff management will protect or improve water quality in any community and watershed. Geographic data layers are from an integrated list from DWM and WPP and include:
    - **Impaired Waterways (typically due to phosphorous, metals, and pathogens from sewage and farming's use of manure as well as other contaminants)**
    - **Impaired Waterbodies**
    - **Monitored Waterways**
    - **Zone II (Wellhead Protection Areas)**
- **Bureau of Resource Protection (BRP) -** The Wetlands Protection Act protects wetlands and the public interests they serve, including flood control, prevention of pollution and storm damage, and protection of public and private water supplies, groundwater supply, fisheries, land containing shellfish, and wildlife habitat. These public interests are protected by requiring a careful review of proposed work that may alter wetlands or buffer zones.

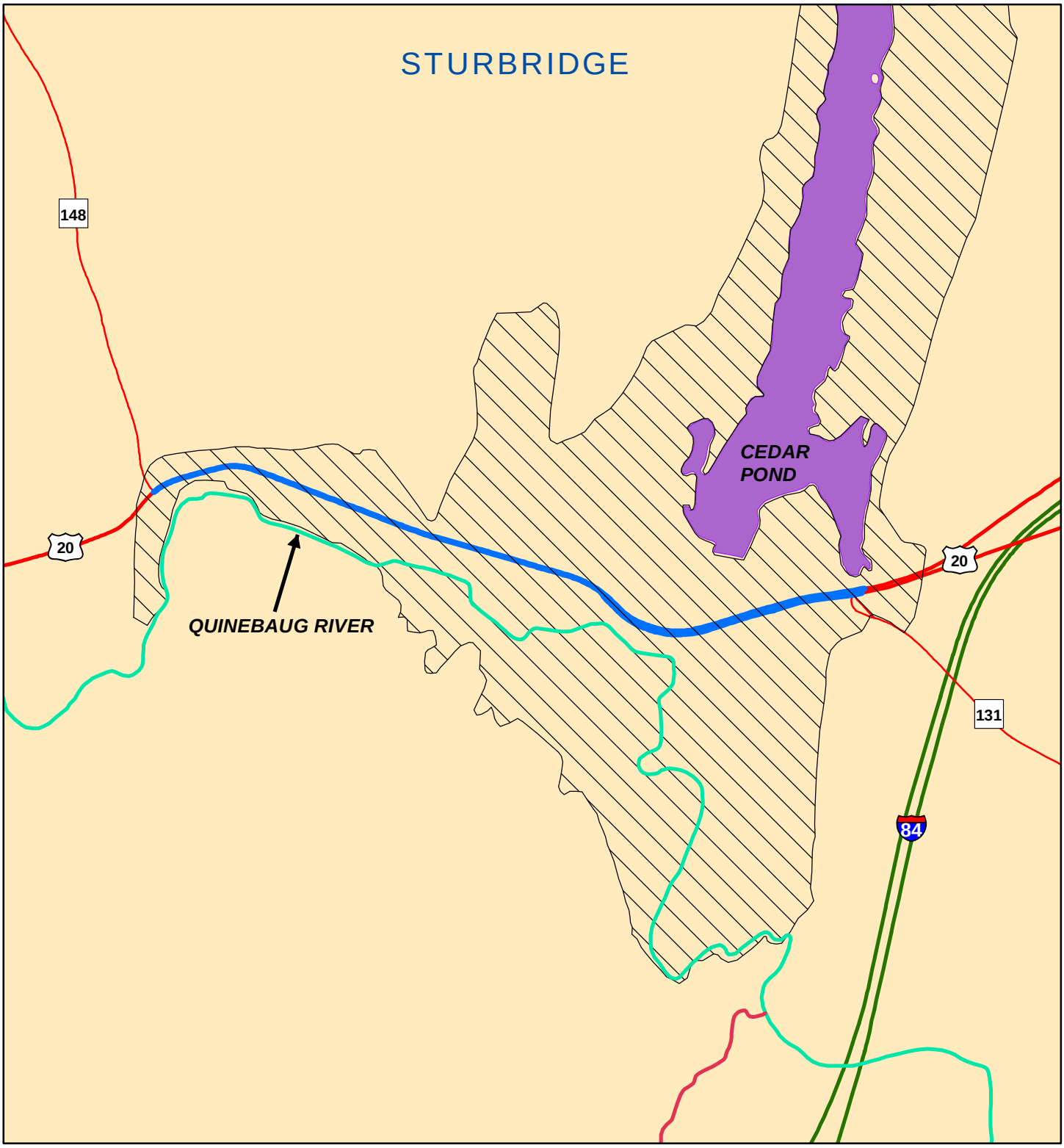
National Heritage & Endangered Species Program (NHESP)

The overall goal of the NHESP is the protection of the state's wide range of native biological diversity. NHESP is responsible for the conservation and protection of hundreds of species that are not hunted, fished, trapped, or commercially harvested in the state. Available geographic data layers include:

- **Certified Vernal Pools**
- **Potential Vernal Pools**
- **BioMap Core Habitat** - This depicts the most viable habitats for rare species in Massachusetts.
- **BioMap Supporting Natural Landscape**
- **Priority Habitats of Rare Species** – These are the geographical extents of habitat for all state-listed rare species, both plants and animals. Priority habitats are officially used under the Massachusetts Endangered Species Act (MESA).

Impaired Waterways and Wellhead Protection Areas

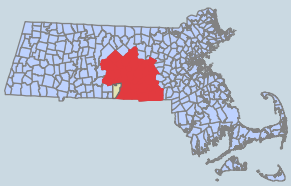
Figure 3 shows impaired waterways and wellhead protection areas in the study area. In Sturbridge, the entire Route 20 study corridor is within a wellhead protection area. Just south of Route 20 is the Quinebaug River, which requires a TMDL. Cedar Pond, located just north of Route 20, has an impairment, but it is not caused by a pollutant. The impairment is actually a non-native aquatic plant species.

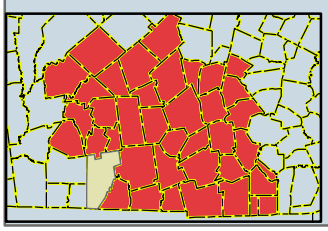


ROUTE 20 CORRIDOR PROFILE

Sturbridge Impaired Waters & Wellhead Protection Areas

Figure 3





Legend

- Route 20 CP
- Interstate
- State Route
- DEP Aproved Zone II's

Water Body (Rivers, Lakes and Ponds) Category

- 2 Attaining Some Uses
- 3 No Uses Assessed
- 4A TMDL is Completed
- 4C Impairment not Caused by a Pollutant
- 5 Waters Requiring a TMDL

0 0.1 0.2 0.4 0.6 0.8 Miles

CMRPC

Source: Data provided by the US Census Bureau, Central Massachsuetts Regional Planning Commission (CMRPC), massDOT Office Of Transportation Planning Geospatial Resources Section and the Office of Geographic Information MassGIS), Commonwealth of Massachusetts, Information Technology Division.

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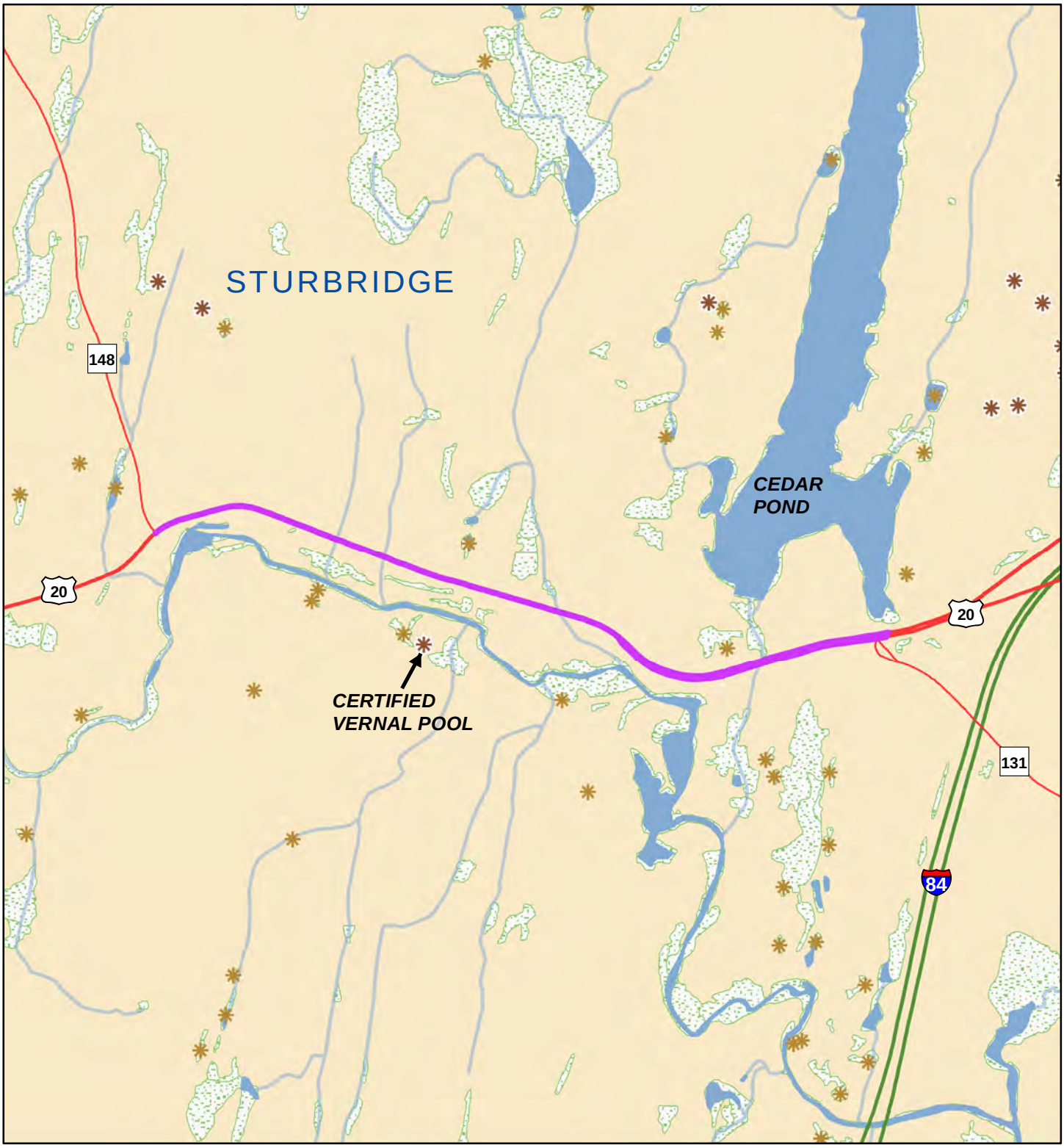
Major Watershed Areas, Vernal Pools, and Wetlands

Figure 4 shows major watershed areas, vernal pools, and wetlands within the Route 20 study area. The entire Route 20 study corridor and surrounding area falls within the Quinebaug River Watershed. There are also numerous wetlands located north and south of Route 20, mainly near the Quinebaug River and Cedar Pond. In addition, there are some potential vernal pools nearby as well as one certified vernal pool. The majority of these certified and potential vernal pools are located on the southern side of Route 20, south of the Quinebaug River. Further study would be needed to investigate the types of species that inhabit the wetlands and vernal pools within the study area, and if any potential improvements would be detrimental to their existence.

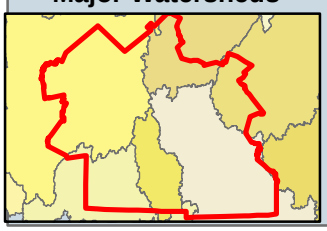


ROUTE 20 CORRIDOR PROFILE

Sturbridge Major Watersheds, Vernal Pools & Wetlands

Figure 4

Major Watersheds



Legend

- Route 20 CP
- NHESP Certified Vernal Pools
- Potential Vernal Pools
- Quinebaug River Watershed
- DEP Wetlands (Jan. 2009)
- Water Bodies
- Streams

0 0.1 0.2 0.4 0.6 0.8 Miles

C M R P C
Central Massachusetts Regional Planning Commission

Source: Data provided by the US Census Bureau, Central Massachsuetts Regional Planning Commission (CMRPC), massDOT Office Of Transportation Planning Geospatial Resources Section and the Office of Geographic Information MassGIS), Commonwealth of Massachusetts, Information Technology Division.

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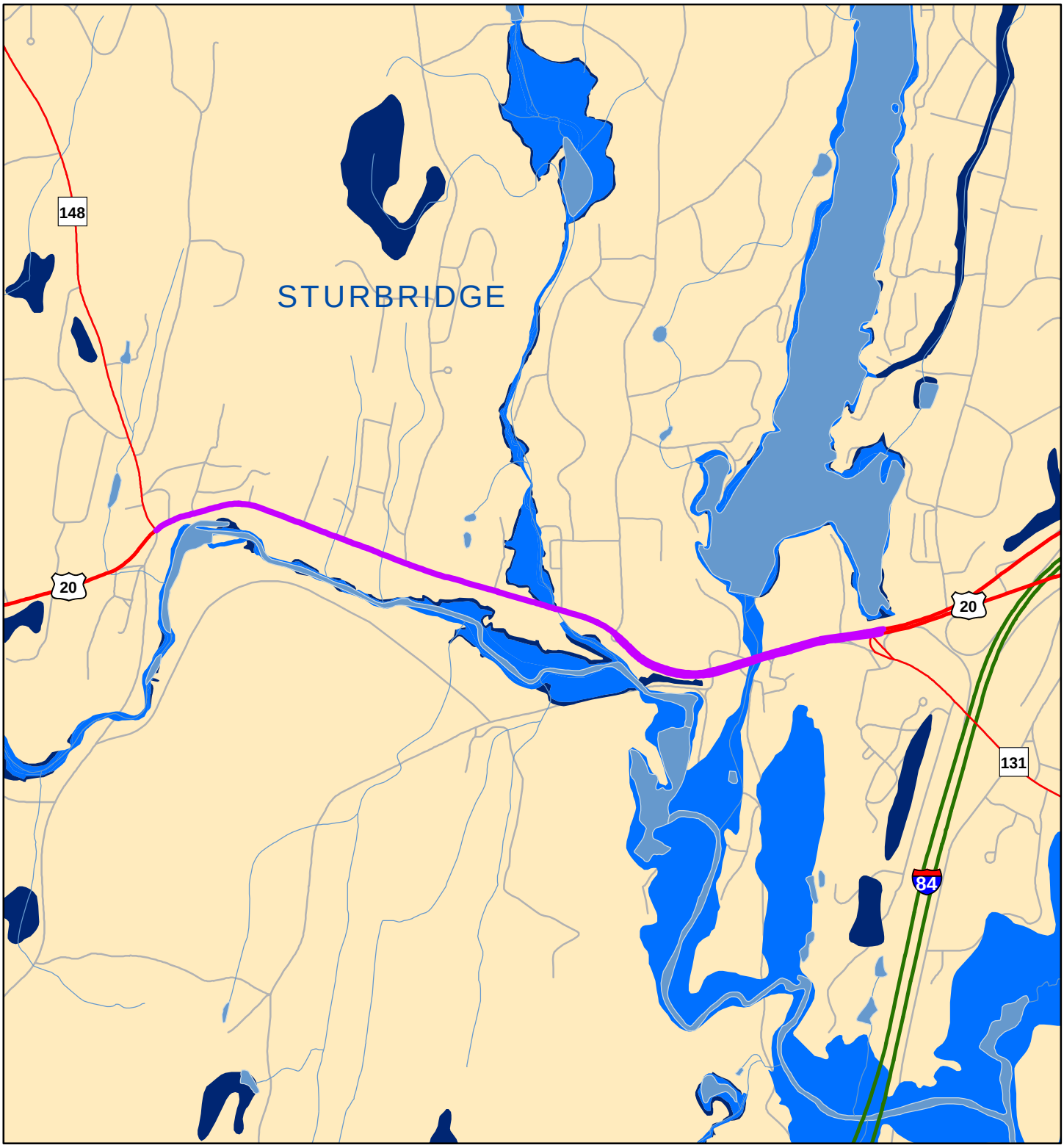
2.2 Flood Zones

Created by the Federal Emergency Management Agency (FEMA) in regards to National Flood Insurance Rates, **Figure 5** shows the 100 and 500 year flood zones near the study area. The 100 year flood zone means that there is a one percent annual chance of a flood within that defined area. The 500 year flood zone means that there is a 0.2 percent annual chance for a flood. The closer something is to the flooding source (e.g. river, stream, pond, etc.) the greater the risk of flooding. Flood zones are also used to calculate flood insurance rates for homes and businesses.

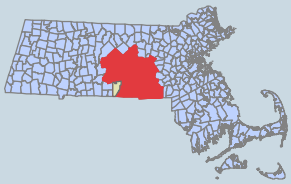
Along the Route 20 study corridor, the majority of the flood zones are 100 years. These 100 year flood zones are located along the Quinebaug River and Cedar Pond. Another area is located north of Route 20 between Arnold Road and Cedar Street. There are minimal 500 year flood zones located on some of the outer edges of the 100 year zones around the Quinebaug River.

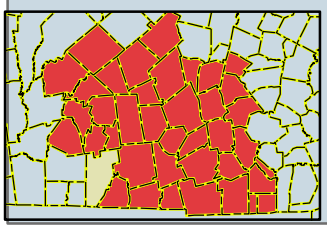


ROUTE 20 CORRIDOR PROFILE

Sturbridge Flood Zones

Figure 5





Legend

- Route 20 CP
- Interstate
- State Route
- Local Roads
- Streams
- Water Bodies
- 100 Year Flood Zone
- 500 Year Flood Zone

0 0.1 0.2 0.4 0.6 0.8 Miles

C M R P C
Central Massachusetts Regional Planning Commission

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2.3 Route 20 Major Drainage Structures

Using the previously described Environmental Profile maps compiled for this study using DCR, DEP, NHESP and FEMA data, the major water features intersecting Route 20 were identified through a GIS analysis. This mapping exercise allowed for the identification of major stream crossings along the study area of Route 20 in the town of Sturbridge. **Figure 6** shows the location of each identified major water crossing, denoted by a red pentagon symbol. Inside each pentagon is a number corresponding to the major drainage structures observed along Route 20.

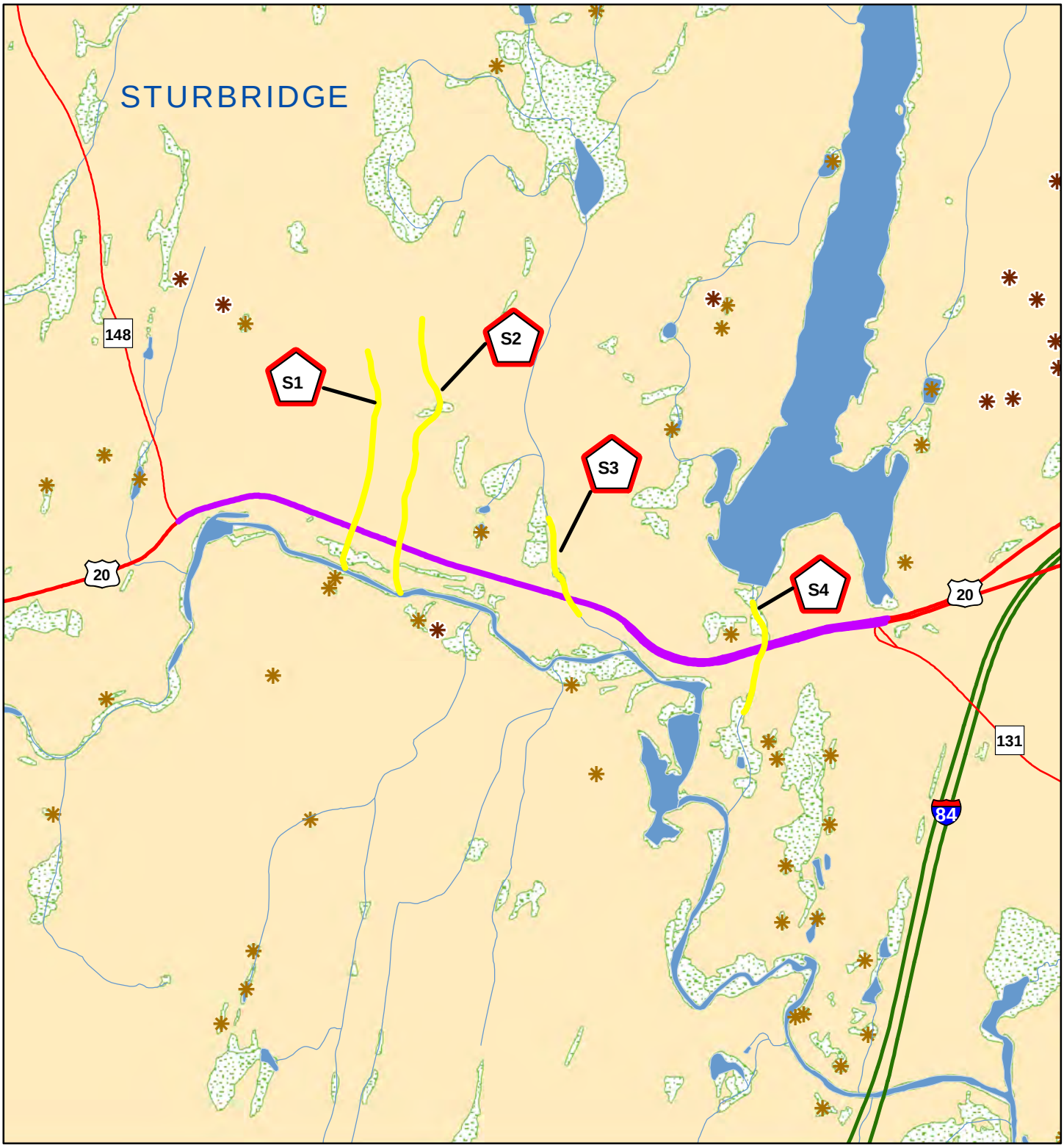
Staff then conducted a field visit to locate and observe the various drainage structures along Route 20. In total, four distinct structures were reviewed within the study area. Accompanying the graphic, **Table 1** summarizes key information about each of the major drainage structures surveyed in the field. This information includes: pipe material and diameter, general condition, estimated pipe length, field observations, and any additional notes.

All observed structures appear to be in good to excellent condition and all structures were made of concrete. Two of the structures (S3 & S4) are considered short span bridges. One of the structures flowed under the Yankee Peddlar (433 Main Street) so the condition of the southern portion could not be analyzed. As for the two culverts (S1 & S2), one could not be found during the site visit (S1) while the other (S2) only had an inlet structure on the north side of Route 20. Field observations noted heavy vegetation at all locations. Following the table, **Figure 7** shows photos taken in the field of various major drainage structures along Route 20.

Based on the observations made in the field, the following provides a brief listing of specific maintenance and improvement options that target the Route 20 drainage structures observed in the field:

- Regularly inspect & clean.
- Clear trash, vegetation, branches and other blockages.
- Inspect for adverse wildlife activity, ex. animal nests, beaver dams.
- As appropriate, maintain passage for aquatic & land animals.
- Install safety fencing where needed.
- As necessary, institute a planned, prioritized reconstruction program for improved or replaced structures.
- Consider participation in UMass-Amherst “River and Stream Continuity Project”. This project surveys, assesses, and prioritizes road-stream crossing structures for replacement.

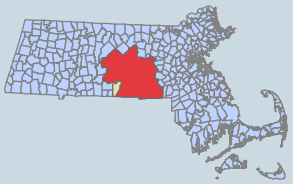
In addition, MassDEP has a Culvert Replacement Municipal Assistance Grant Program for communities. Information about this program can be found on the MassDEP Website. Currently, this year's deadline for project submittal has past, as the deadline was March 2019. Through this program a community can only apply for one culvert project as there are limited funds available. The total anticipated funding for this year was $750,000. Awarded funds may range from $25,000 to $200,000, depending on phase and work proposed. Eligible projects must be a culvert replacement on a public way, owned and maintained by the applying municipality, and must cross a natural freshwater, non-tidal river or stream channel. The project must meet the Massachusetts Stream Crossing Standards.

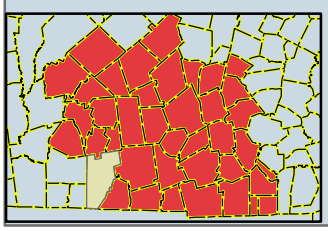


ROUTE 20 CORRIDOR PROFILE

Sturbridge Major Drainage Structures

Figure 6





Legend

- Route 20 Corridor Profile
- Interstate
- State Route
- Streams
- Streams Intersecting Rt 20
- Drainage structures
- NHESP Certified Vernal Pools
- Potential Vernal Pools
- Water Bodies
- DEP Wetlands (Jan. 2009)

CMRPC

Source: Data provided by the US Census Bureau, Central Massachsuetts Regional Planning Commission (CMRPC), massDOT Office Of Transportation Planning Geospatial Resources Section and the Office of Geographic Information MassGIS), Commonwealth of Massachusetts, Information Technology Division.

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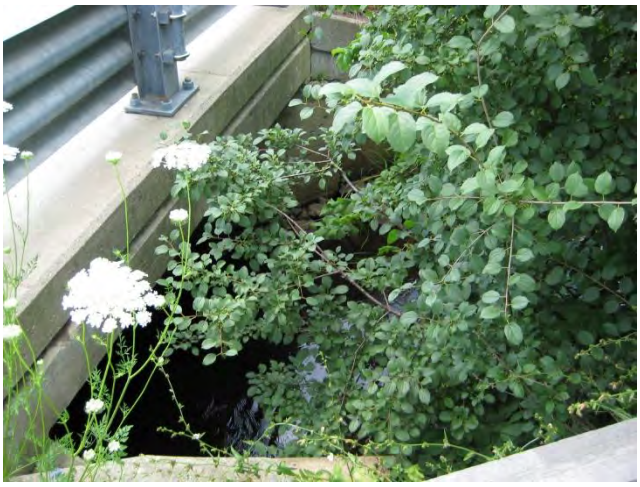
0 0.1 0.2 0.4 0.6 0.8 Miles

Table 1
Sturbridge Route 20
Inventory of Major Drainage Structures

Assigned Map #	Host Community	Primary Materials	General Condition	Approx. Pipe Size	Approx. Length	Field Observations	Additional Notes
Major Culverts							
S1	Sturbridge			This Culvert Could Not be Located During Field Investigations			
S2	Sturbridge	Concrete	North Side - Fair/Good South Side - Unknown	3'	Unknown	North side has lots of vegetation. Noticed very little water.	No culvert outlet located on south side of road. There are two storm drains on south side, but not sure if they are connected to culvert.
Bridge Structures							
S3	Sturbridge	Concrete	North Side - Good South Side - Unknown	12'	85'	Guardrail on north side looks new. Lots of vegetation on north side and fallen dead branch in water near opening. South side is under the Yankee Peddlar building and very little is visible.	Bridge #S-30-022 and is considered a short span bridge (10-20 ft). Built in 1850 and rebuilt in 1900. It is not Structurally Deficient.
S4	Sturbridge	Concrete	Good/Excellent	14'	70'	There is a beaver dam and lots of vegetation on the north side. Also, steep slopes and marshes. South side also has lots of vegetation. Guardrails on both side and extra protective fencing on south side.	Bridge #S-30-033 and is a short span bridge (10-20 ft). Built in 1956. It is not Structurally Deficient.

Figure 7
Sturbridge
Route 20 Major Drainage Structures Photos

Culvert #S2 North Side



Bridge #S3 North Side

Bridge #S3 North Side

Bridge #S3 South Side

Bridge #S4 North Side

Bridge #S4 South Side

2.4 Performance Management

The regional Performance Measure of Stormwater Management & Resiliency pertains to this chapter. The goal is to create a transportation network that is resilient to the impacts of stormwater. For any new TIP projects it is important to consider the use of Green Infrastructure or Nature Based Solutions to help manage stormwater. Also, older culverts should be upgraded to new modern structures that can handle the heavy water flows from the stronger and the increasing frequency of storms in the region. A higher priority should be given to areas that are within a 100 or 500 year flood zone. By using these approaches, the goal of a stormwater resilient transportation network can be obtained. It should be mentioned that there is a proposed project to replace the culvert, which is also known as a short span bridge (S-30-022), located just west of Snell Street. By replacing this structure it will increase the resiliency of the transportation network.

3.0 Congestion Management Process (CMP)

3.1 Overview of the Central Massachusetts CMP

Congestion management is the application of strategies to improve transportation system performance and reliability by reducing the adverse impacts of congestion on the movement of people and goods. A Congestion Management Process (CMP) is a systematic and regionally-accepted approach for managing congestion that provides accurate, up-to-date information on transportation system performance and assesses alternative strategies for congestion management that meet both state and local needs. The CMP is intended to move these congestion management strategies into the funding and implementation stages.

The CMP, as defined in federal regulation, is intended to serve as a systematic process that provides for safe and effective integrated management and operation of the multimodal transportation system. The process includes:

- Development of congestion management objectives
- Establishment of measures of multimodal transportation system performance
- Collection of data and system performance monitoring to define the extent and duration of congestion and determine the causes of congestion
- Identification of congestion management strategies
- Implementation activities, including identification of an implementation schedule and possible funding sources for each strategy
- Evaluation of the effectiveness of implemented strategies

The Congestion Management System (CMS) was first introduced by the **Intermodal Surface Transportation Efficiency Act** (ISTEA) of 1991 and continued under the successor law, the **Transportation Equity Act for the 21st Century** (TEA-21). The CMS was intended to augment and support effective decision making as part of the overall metropolitan planning process. In 2006, the **Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users** (SAFETEA-LU) called for the CMS to evolve into a Congestion Management Process (CMP), with a greater focus on the implementation of operational improvements to the highway system to mitigate congestion. In 2012, the **Moving Ahead for Progress in the 21st Century Act** (MAP-21) called for the continuation of the CMP program while also requiring a transition to performance based planning. This was reaffirmed by 2015's successor national legislation **Fixing America's Surface Transportation** (FAST) **Act**.

3.2 Daily Traffic Volumes

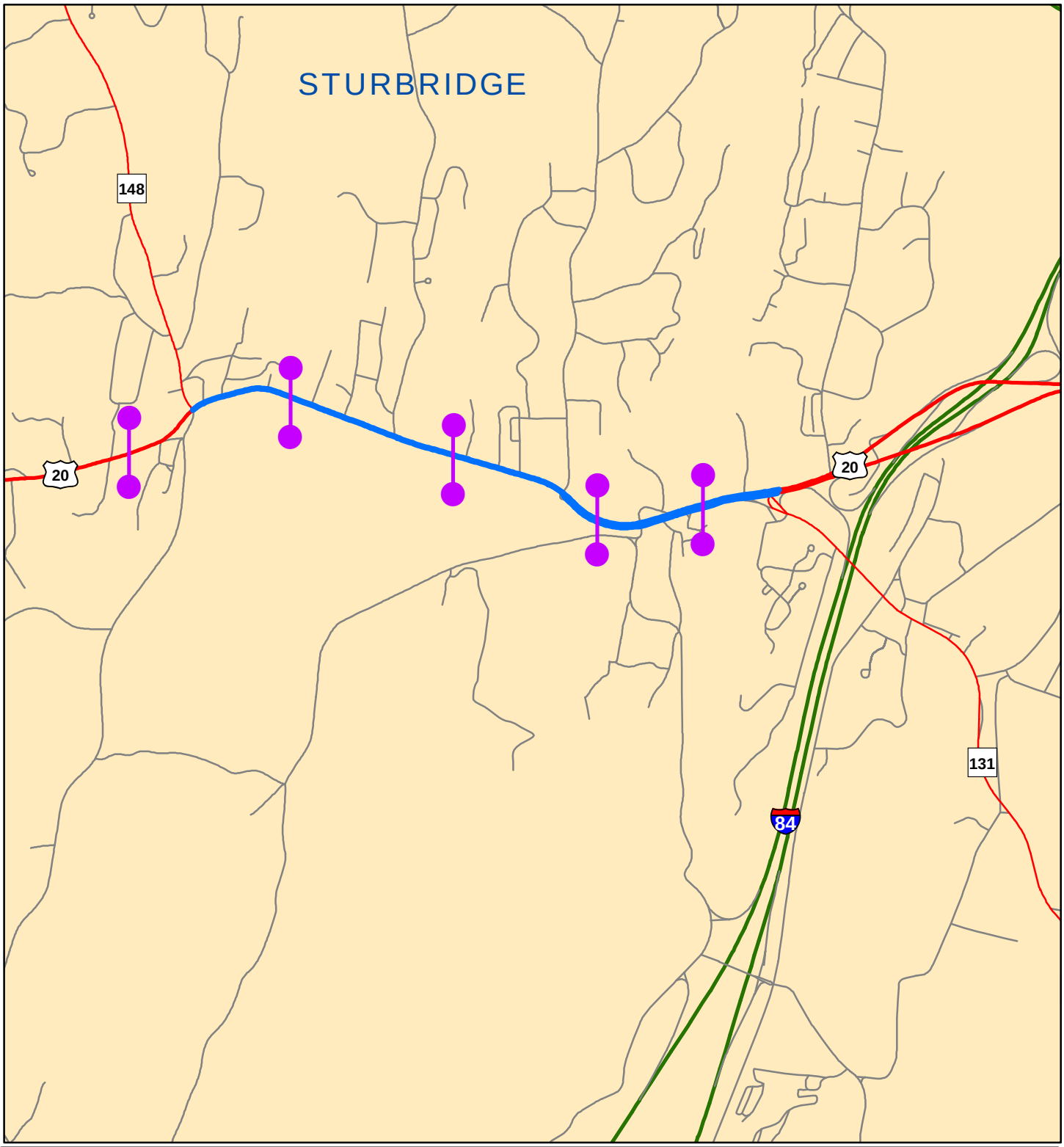
Figure 8 shows locations along Route 20 in the town of Sturbridge where CMRPC placed Automatic Traffic Recorders (ATRs) to determine the volume of traffic. All counts were

completed in October or December 2018. The ATRs were installed along the roadway and left in place for nearly 48 hours. There were five count locations completed for this Corridor Profile. **Table 2** shows the volume results from the Route 20 ATR locations. As the data shows, the highest traffic volumes are closest to Route 131. Although the count to the west of Route 148 is beyond the study limits, it does indicate that volumes drop dramatically to the west of Route 148. The entirety of Route 20 through the study corridor carries over 16,000 vehicles per day.

Table 2
Sturbridge Route 20 Daily Traffic Volumes

ATR Location	Date	Volume*
Route 20 West of Route 148	10/2/2018	8,850
Route 20 Between Route 148 & Arnold Road	10/2/2018	16,525
Route 20 Between Arnold Road & Cedar Street	10/30/2018	22,150
Route 20 Between Cedar Street & Stallion Hill Road	10/24/2018	25,200
Route 20 Between Stallion Hill Road & Route 131	12/5/2018	27,750

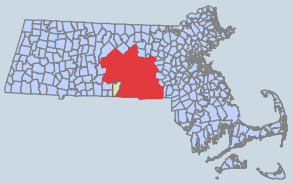
*Vehicles Per Day (VPD)

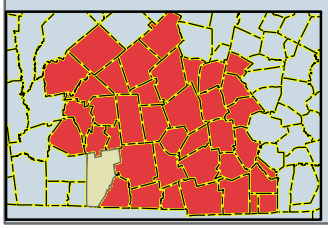


ROUTE 20 CORRIDOR PROFILE

SturbridgeTraffic Count Locations

Figure 8





Legend

- Route 20 Corridor Profile
- Interstate
- State Route
- US Route
- Local Roads
- ATR Locations

0 0.125 0.25 0.5 0.75 1 Miles

CMRPC Central Massachusetts Regional Planning Commission

Source: Data provided by the US Census Bureau, Central Massachsuetts Regional Planning Commission (CMRPC), massDOT Office Of Transportation Planning Geospatial Resources Section and the Office of Geographic Information MassGIS), Commonwealth of Massachusetts, Information Technology Division.

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3.3 Route 20 Travel Time and Delay Study

CMRPC staff conducted one travel time and delay study for this Corridor Profile effort. The travel time data was collected by CMRPC using a Global Positioning System (GPS) unit. The study occurred between 7am – 9am and 4pm – 6pm. After the field data was collected, it was downloaded into *TravTime* software (developed by Geo Stats) in order to analyze the data. As indicated in **Table 3**, it takes about four minutes to travel on Route 20 from Route 148 to Route 131. In the PM, traveling in the westbound direction took more than a minute longer, slightly over five minutes.

Table 3
Route 20 Travel Time and Delay Study Results

Peak Period	Direction	Study Year	Distance	Travel Time (average minutes)
AM-Sturbridge	Eastbound	2018	1.6 miles	3.7
AM-Sturbridge	Westbound	2018	1.6 miles	3.6
PM-Sturbridge	Eastbound	2018	1.6 miles	3.8
PM-Sturbridge	Westbound	2018	1.6 miles	5.1

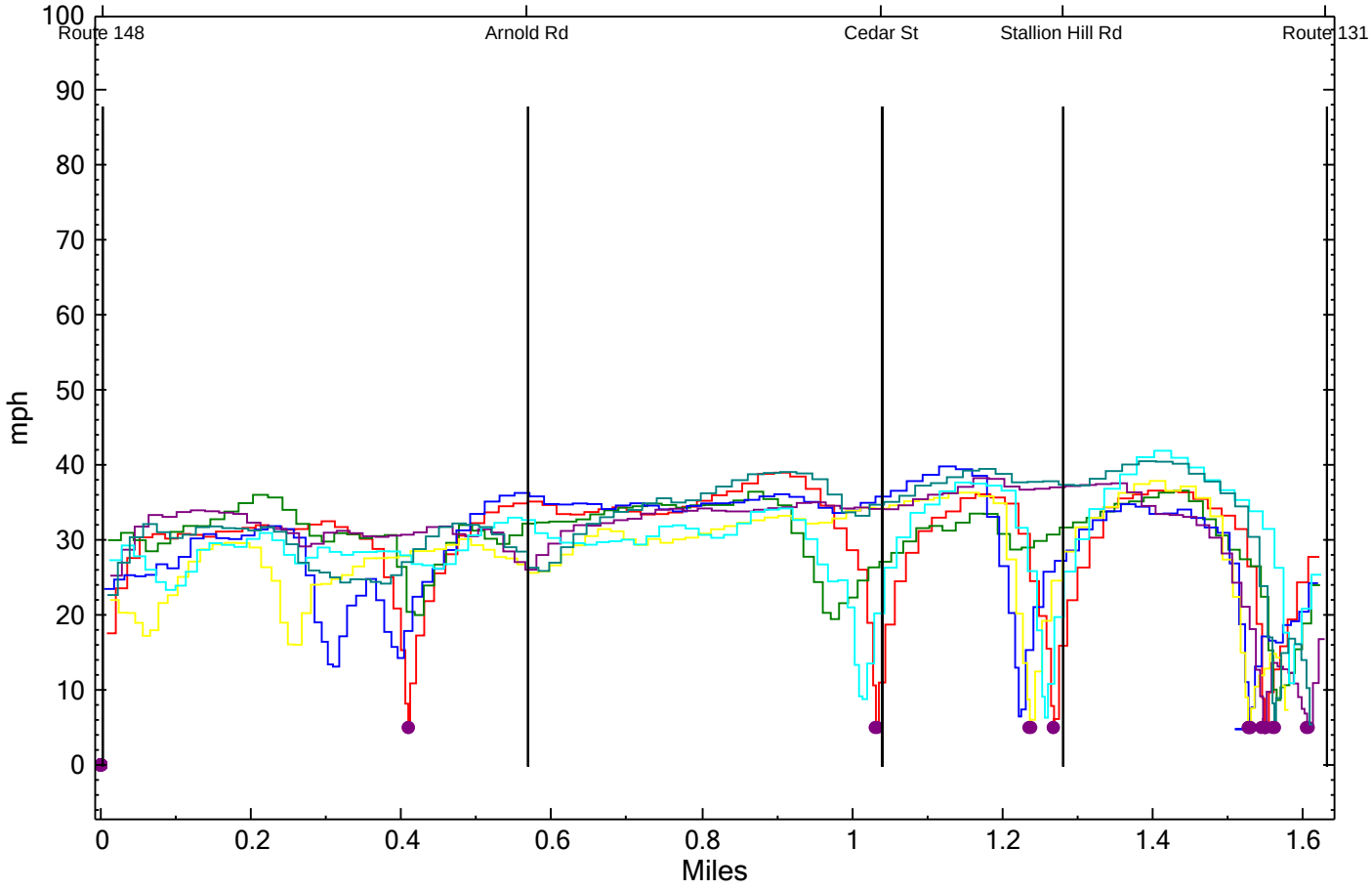
Figures 9 through 12 show vehicle speeds for each run of the travel time and delay study that was completed in 2018. Average travel speeds were consistently around 25 mph for both the AM and PM time periods, but dropped below 20 mph for vehicles traveling westbound in the PM. In the AM, vehicles needed to stop at most traffic lights as well as for school buses picking up students. The study vehicle also had to stop for pedestrians on a few occasions. During the PM, traffic was much more congested, especially traveling in the westbound direction on Route 20. Traffic is sometimes backed up to Cedar Street from the Route 148 intersection. There is a short lane drop just after Cedar Street that also was observed to slow traffic. Between Cedar Street and Route 148, Route 20 is a single lane in each direction. Many vehicles are turning on/off Route 20 during this time period and Route 20 is not sufficiently wide enough for following vehicles to go around the turning vehicles.

Figure 9

Speed Profile - Route 20 EB

2018 - AM

ScaleX: 1 in = 0.25 Miles
ScaleY: 1 in = 25 mph



1

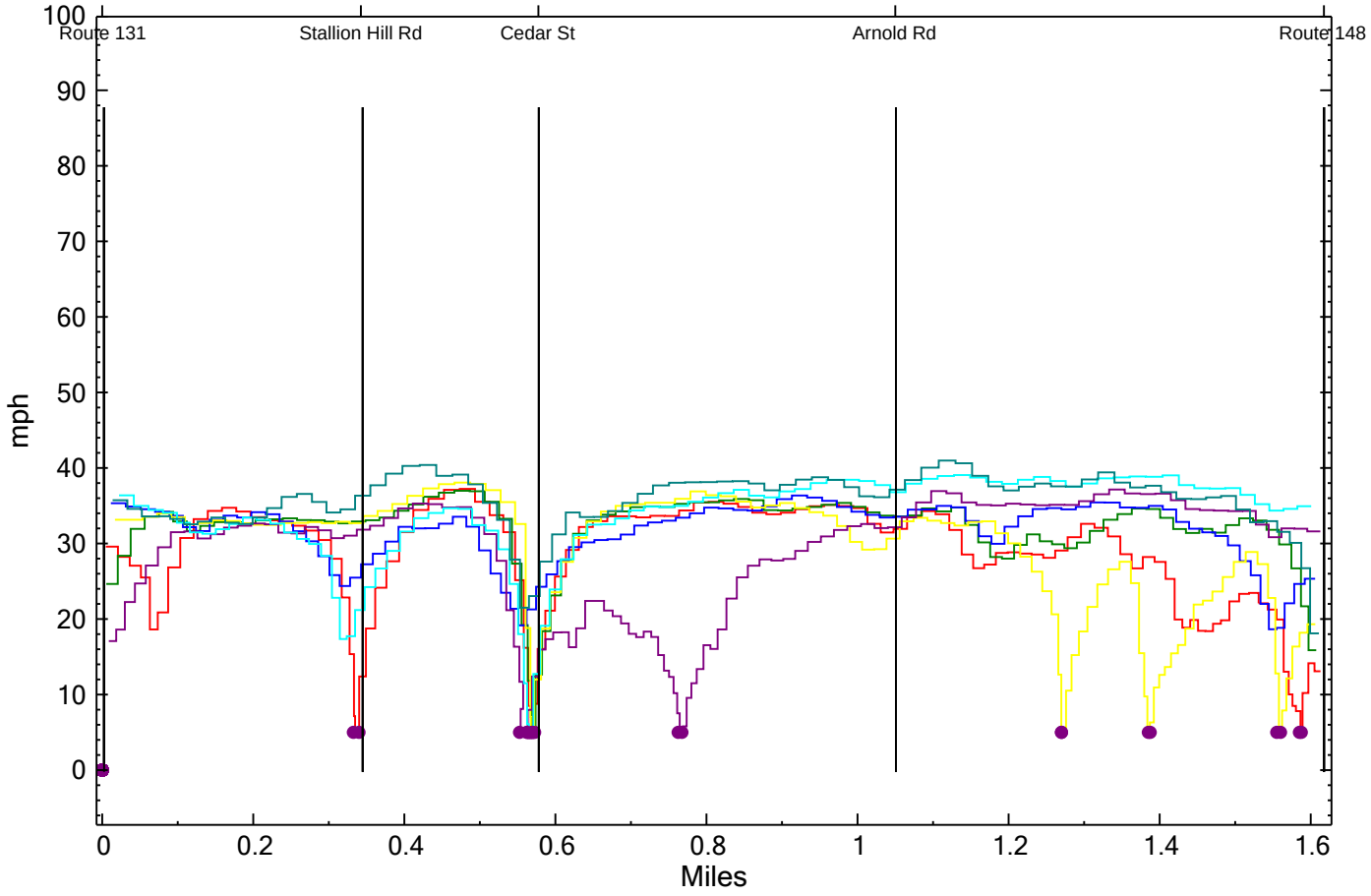
Generated 11/5/2018 10:00 AM

Figure 10

Speed Profile - Route 20 WB

2018 - AM

ScaleX: 1 in = 0.25 Miles
ScaleY: 1 in = 25 mph



1

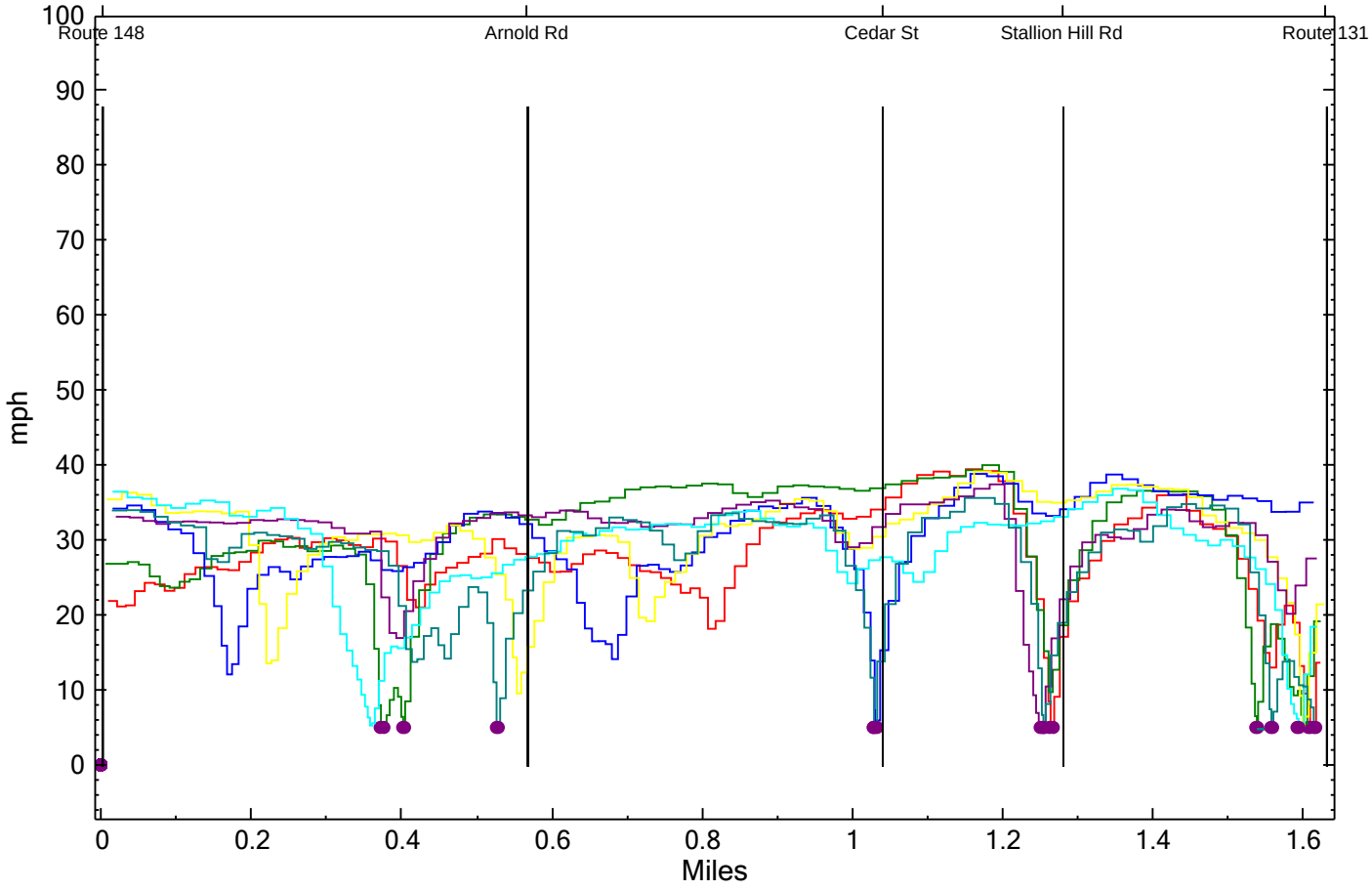
Generated 11/5/2018 10:02 AM

Figure 11

Speed Profile - Route 20 EB

2018 - PM

ScaleX: 1 in = 0.25 Miles
ScaleY: 1 in = 25 mph



1

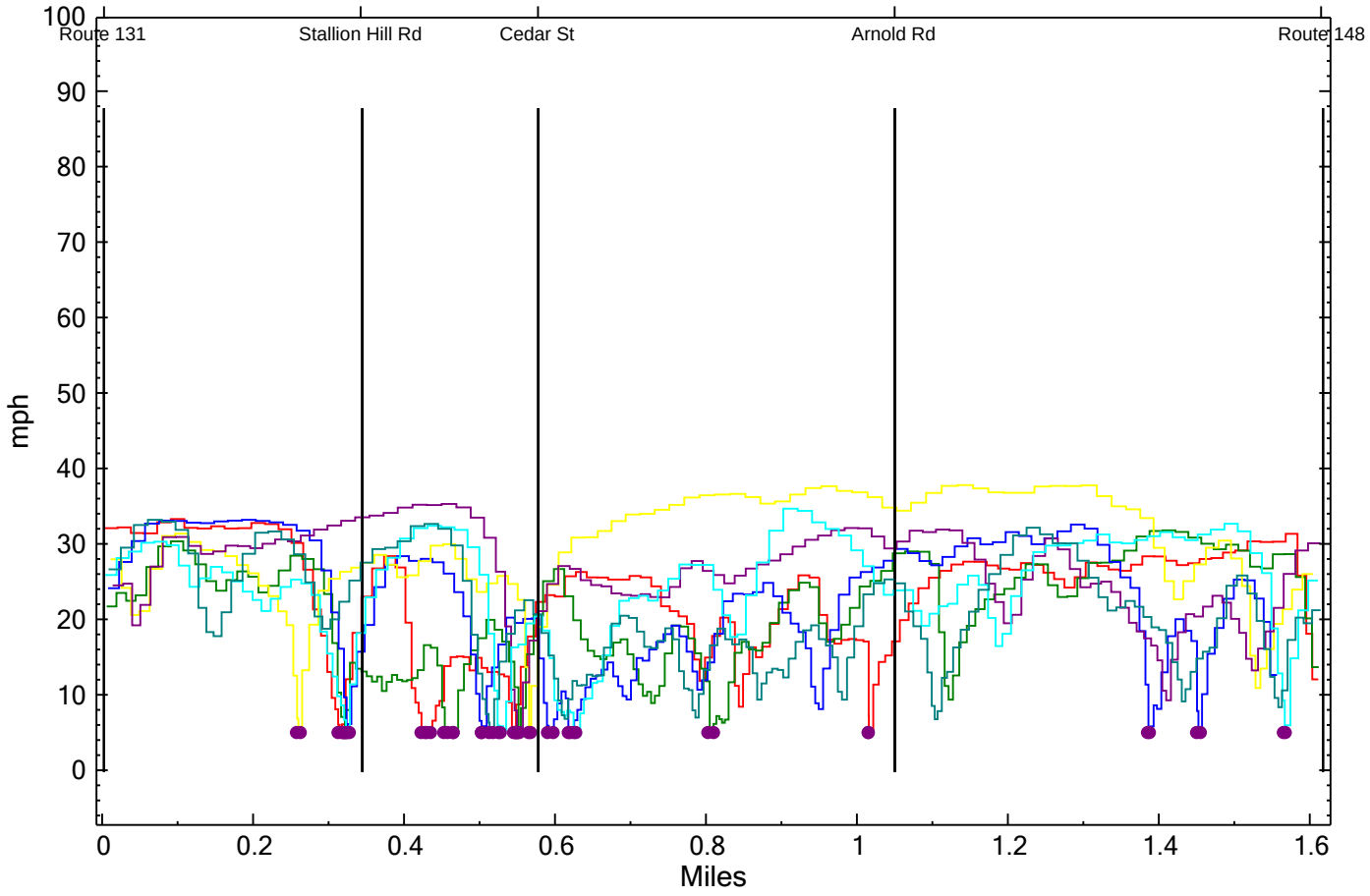
Generated 11/5/2018 10:51 AM

Figure 12

Speed Profile - Route 20 WB

2018 - PM

ScaleX: 1 in = 0.25 Miles
ScaleY: 1 in = 25 mph

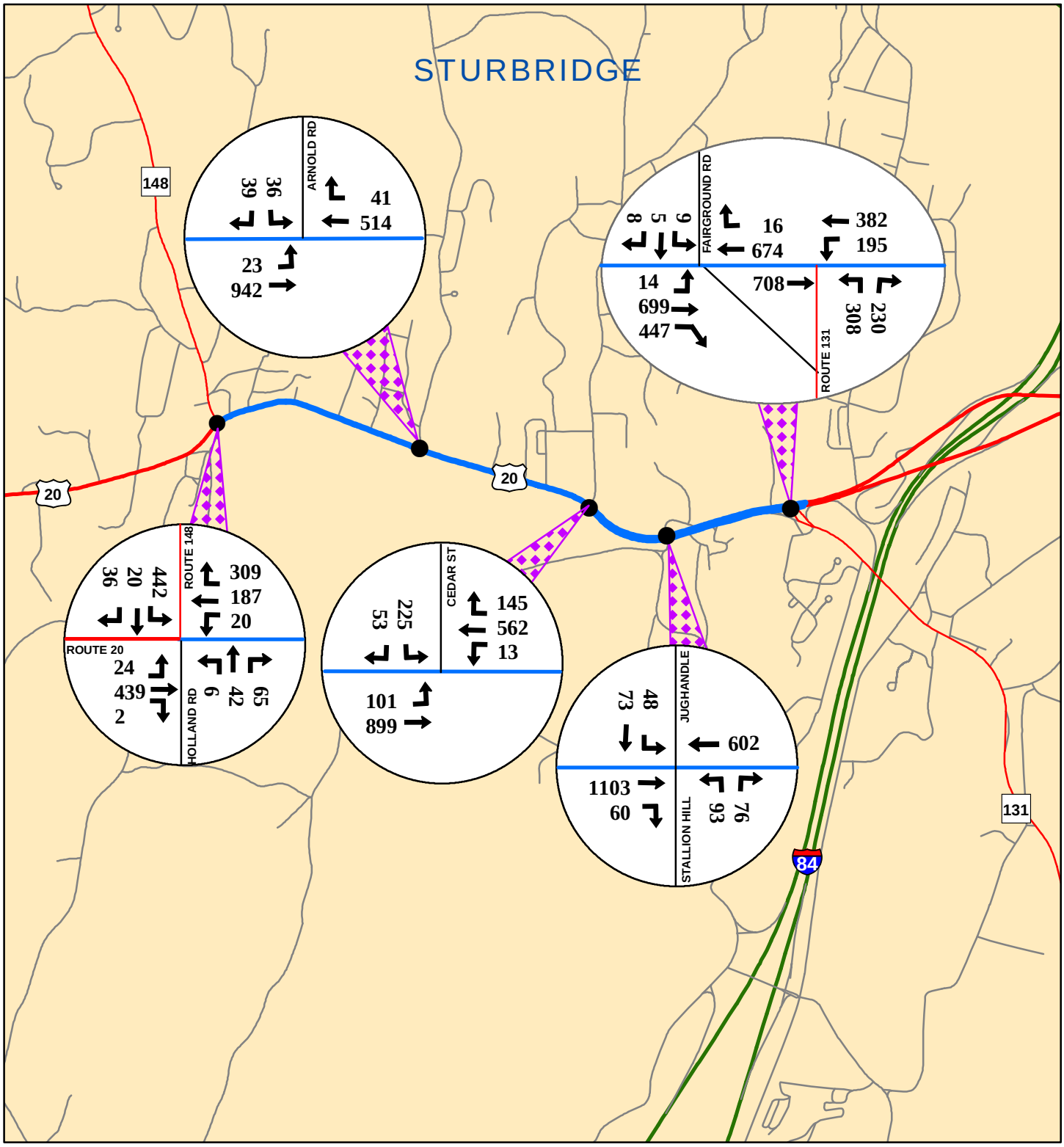


1

Generated 11/5/2018 10:51 AM

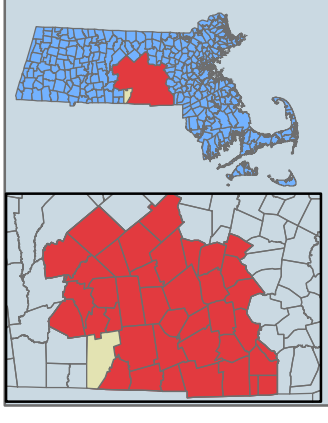
3.4 Route 20 Intersections Existing Peak Hour Traffic Volumes

CMRPC conducted Turning Movement Counts (TMCs) at six focus intersections for this Corridor Study. All counts were completed in 2018 and during peak flow months while local schools were in session. In displaying these counts as a network, a "balancing" exercise was conducted to account for the typical addition and loss of traffic between adjacent study intersections (due to local streets, site drives serving major land uses, and other private driveways) as well as natural statistical variations encountered when TMCs are conducted on different weekdays. These adjusted volumes are shown in **Figure 13** and **Figure 14** as existing AM and PM peak hour traffic flows. (All TMC datasheets are provided in the document's Technical Appendix).



ROUTE 20 CORRIDOR PROFILE

Sturbridge Existing Traffic Flows
AM Peak Hour Period
Figure 13



Legend

- Route 20 Corridor Profile
- Interstate
- State Numbered Routes
- Local Roads

Miles
0 0.1 0.2 0.4 0.6 0.8

C M R P C
Central Massachusetts Regional Planning Commission

Source: Data provided by the US Census Bureau, Central Massachsuetts Regional Planning Commission (CMRPC), massDOT Office Of Transportation Planning Geospatial Resources Section and the Office of Geographic Information MassGIS), Commonwealth of Massachusetts, Information Technology Division.

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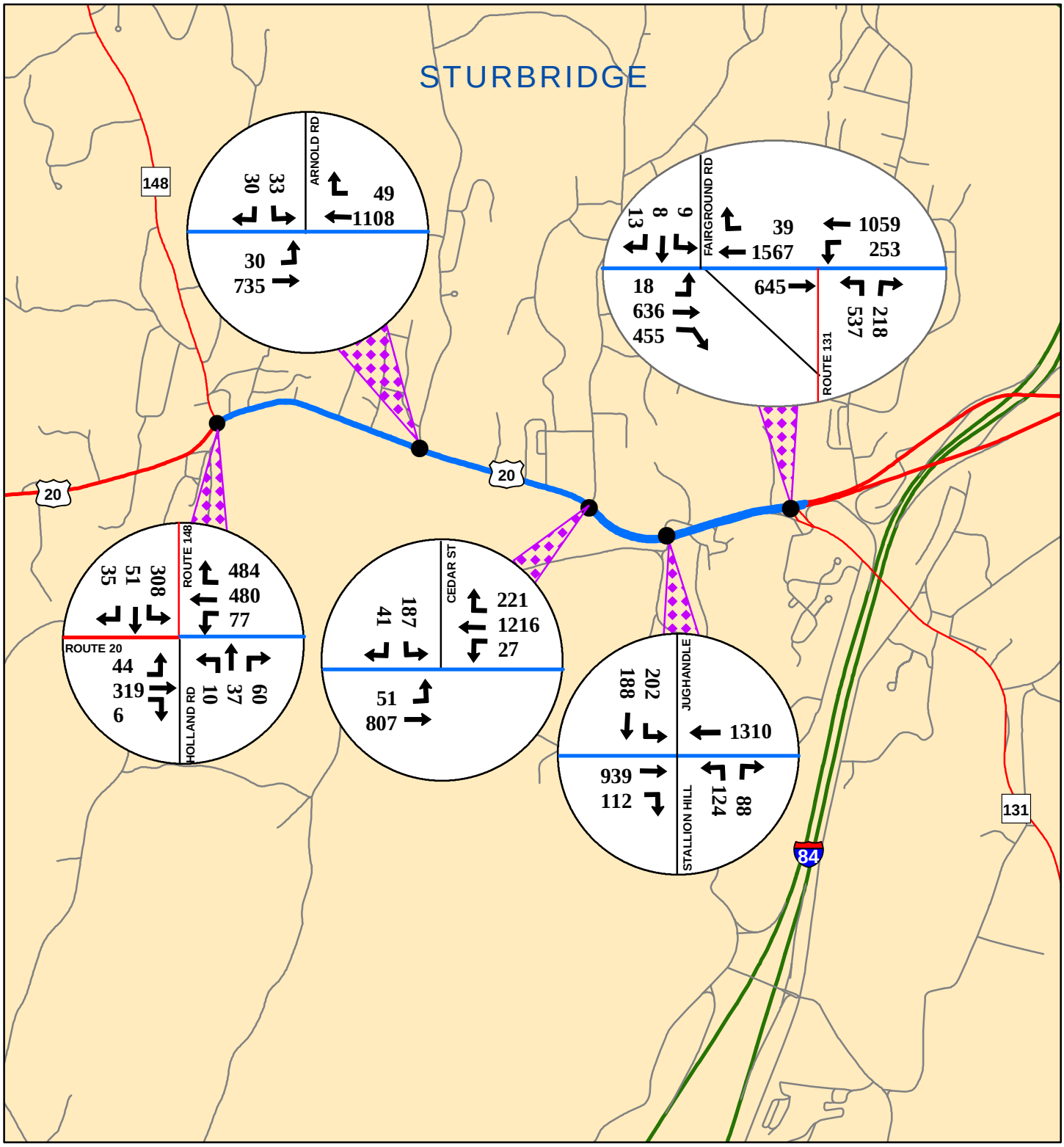
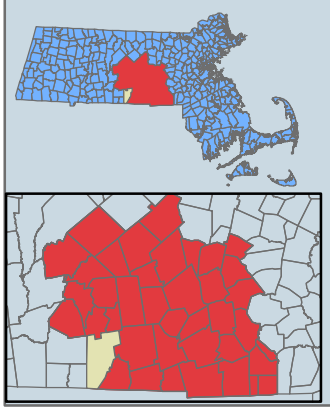


ROUTE 20 CORRIDOR PROFILE

Sturbridge Existing Traffic Flows
PM Peak Hour Period
Figure 14



Legend

- Route 20 Corridor Profile
- Interstate
- State Numbered Routes
- Local Roads

Miles
0 0.1 0.2 0.4 0.6 0.8

C M R P C
Central Massachusetts Regional Planning Commission

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3.5 Percentage of Heavy Vehicles Utilizing Route 20 Focus Intersections

According to the Highway Capacity Manual (HCM), heavy vehicles are vehicles that have more than four tires touching the pavement. Trucks, buses, and recreational vehicles (RVs) are the three primary groups of heavy vehicles. Heavy vehicles often adversely affect traffic flows in two ways: 1) they are larger than passenger cars and occupy more roadway space and 2) they have inferior operating capabilities when compared to passenger cars, particularly with respect to acceleration, deceleration, and the ability to maintain speed on upgrades.

Table 4 lists the percentage of heavy vehicles that was observed at each of the focus intersections. The Route 20 focus intersections in Sturbridge average 6.0% in the morning peak hour and 2% during the evening peak hour. In the AM, the highest heavy vehicle percentage was at Route 131 with 7.5% and the lowest was at Stallion Hill Road with 4.7%. In the PM, the highest percentage was at Route 148/Holland Road with 2.5% and the lowest was at Cedar Street with 1.4%. Observers in the field noted that school buses accounted for some of the heavy vehicle traffic as well.

It should be noted that the heavy vehicle percentages shown in the table were observed on one random weekday. The numbers are, by nature, subject to variation due to sample size and temporary or permanent local conditions as well as other factors, such as prevailing weather. As such, the figures in the table should be used as a general indicator of trends and conditions only, as opposed to absolute statements of prevailing circumstance.

Table 4
Percentage of Heavy Vehicles Utilizing Route 20 Focus Intersection

Study Intersection	Date of Count	Morning Peak Hour %	Evening Peak Hour %
Route 20/Route 148/Holland Rd	October 2018	5.9%	2.5%
Route 20/Arnold Rd	October 2018	6.6%	1.9%
Route 20/Cedar St	October 2018	5.4%	1.4%
Route 20/Stallion Hill Rd	October 2018	4.7%	2.4%
Route 20/Fairground Rd	November 2018	5.8%	1.7%
Route 20/Route 131	November 2018	7.5%	2.1%
Peak Hour Averages:		**6.0%**	**2.0%**

3.6 Route 20 Intersections Projected 2028 Peak Hour Traffic Volumes

As this is a planning document, meant to be used to suggest and help design improvements that may not be built or implemented for several years, it is typical to estimate or "project" future traffic conditions in the study area. Transportation changes and solutions are rarely made instantly, and pertinent area circumstances can change. More specifically, here is an attempt to modify current levels of traffic volume to reflect what might be anticipated in ten years – reasonable lead time for planning purposes.

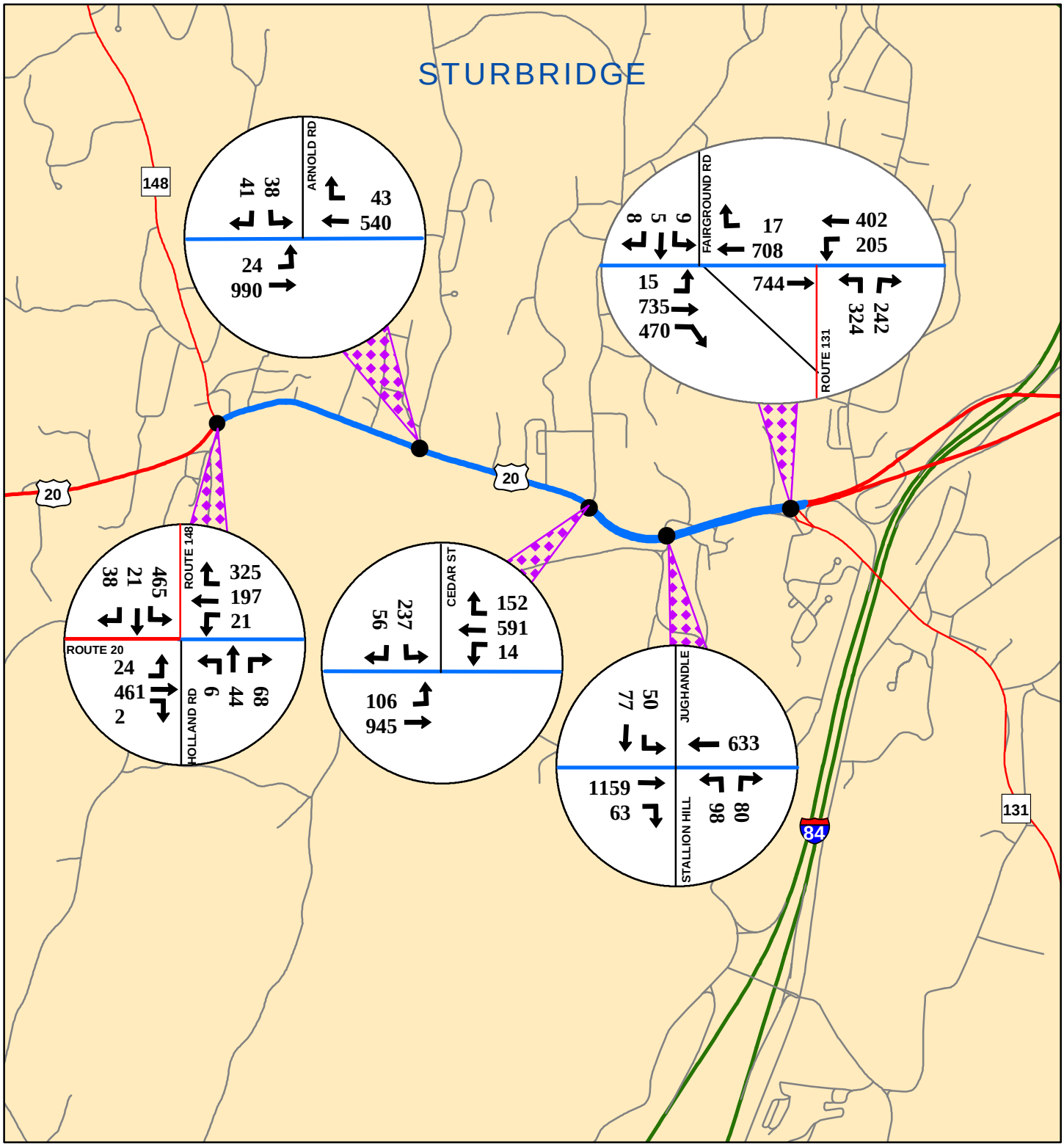
Regional Travel Demand Model

The Regional Travel Demand Model is an advanced computer simulation of the region's network of major highways that is maintained by the CMRPC transportation staff. It considers the greater region's population, housing stock, and employment. For this Corridor Profile effort, anticipated overall growth in traffic volumes was examined.

This study looks to the future with estimated year 2028 projected traffic increases. This allows for an assessment of potential future year operational conditions and, if necessary, the suggestion of potential improvement options for host community consideration.

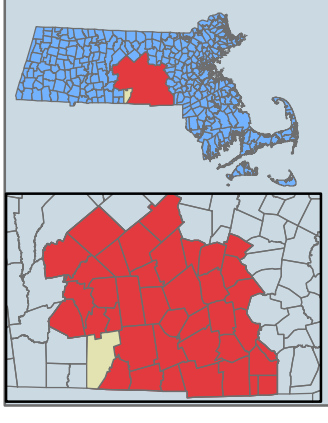
The model currently projects approximately 0.5% per year growth over the next decade in the general Corridor Profile study area, resulting in about an overall 5% increase in Route 20 traffic volumes in the 10 year period between 2018 and 2028. This percentage increase was applied in order to assess potential future year conditions.

The resulting 2028 traffic flow networks for the AM and PM peak hours were then analyzed to characterize likely future operating conditions. **Figure 15** and **Figure 16** illustrate 10-year projections of the existing volumes, assuming an annual growth rate of 0.5% for the entire length of Route 20 in the town of Sturbridge.



ROUTE 20 CORRIDOR PROFILE

Sturbridge Projected 2028 Traffic Flows
AM Peak Hour Period
Figure 15



Legend

- Route 20 Corridor Profile
- Interstate
- State Numbered Routes
- Local Roads

Miles
0 0.1 0.2 0.4 0.6 0.8

C M R P C
Central Massachusetts Regional Planning Commission

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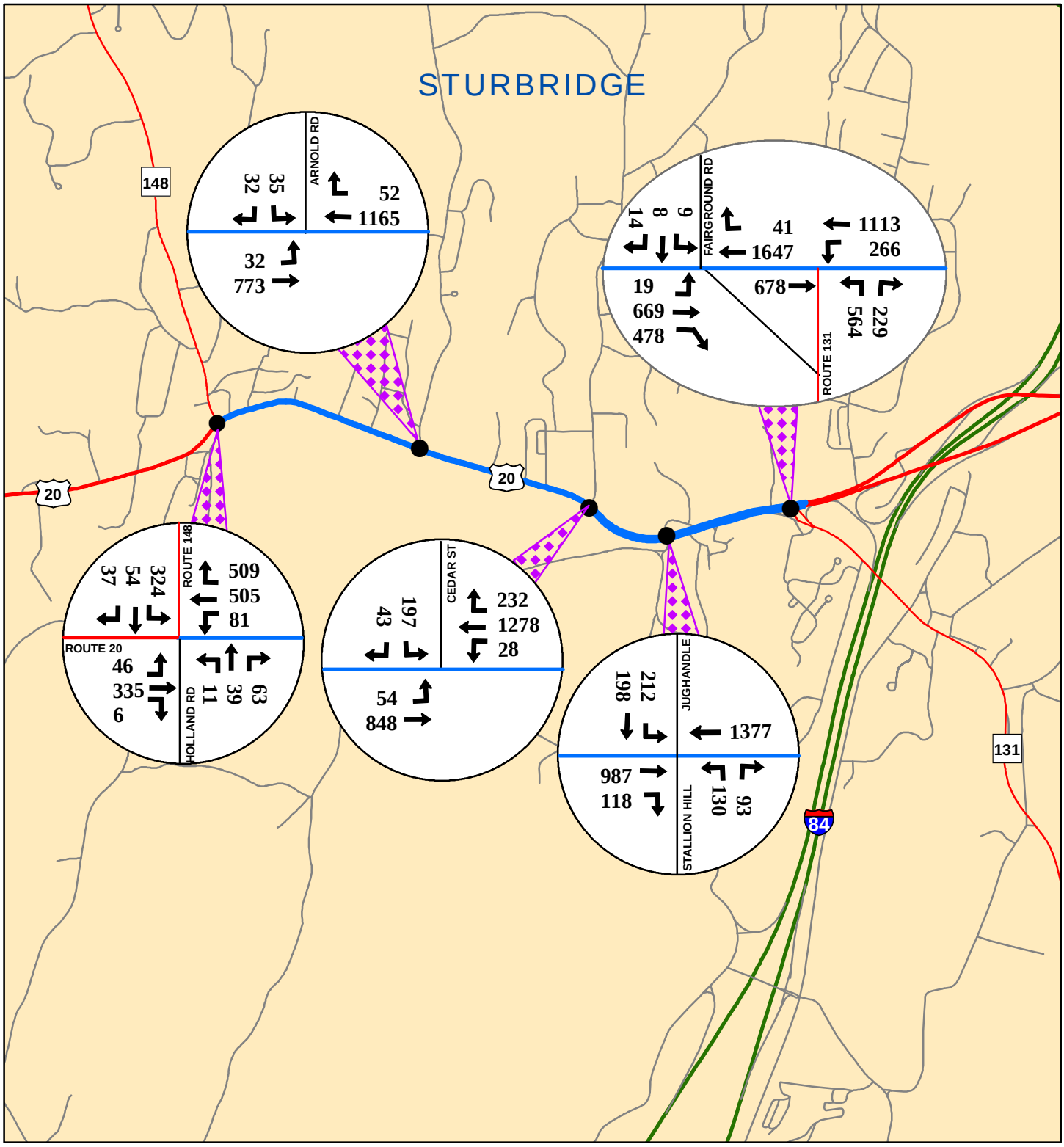
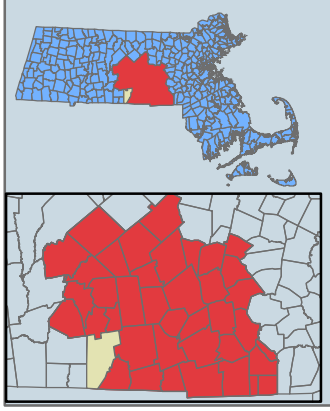


ROUTE 20 CORRIDOR PROFILE

Sturbridge Projected 2028 Traffic Flows
PM Peak Hour Period
Figure 16



Legend

- Route 20 Corridor Profile
- Interstate
- State Numbered Routes
- Local Roads

Miles
0 0.1 0.2 0.4 0.6 0.8

CMRPC
Central Massachusetts Regional Planning Commission

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3.7 Route 20 Intersections Peak Hour Level of Service (LOS) Analyses

Using the existing and projected 2028 traffic increases for Route 20, a Level of Service (LOS) grade was calculated for the intersections. The LOS is calculated by using the *Highway Capacity Software* (HCS). The software calculates the amount of delay (in seconds) for each approach and the intersection as a whole. Using the estimated length of delay in seconds, a LOS grade between "A" and "F" is assigned. LOS "A" is indicative of free flow conditions while LOS "F" indicates highly congested conditions. **Table 5** lists both the existing and projected LOS for the Route 20 focus intersections. (The complete LOS worksheets are provided in the document's Technical Appendix). The following notable trends were observed:

- There are six study intersections in the Route 20 Corridor Profile. One is Stop sign controlled and the other five are signalized.
- Arnold Road is the lone Stop-sign controlled intersection and it has an LOS "E" for the AM and "F" in the PM under existing conditions. The LOS grade is for the minor street approach, Arnold Road, as Route 20 vehicles encounter very minimal delays through the intersection.
- The Route 148/Holland Road intersection has a LOS "C" for both the AM & PM time periods as well as existing and project 2028 conditions. This intersection can be very congested, especially in the AM, due to the Tantasqua regional schools on Route 148 near the Brookfield town line.
- Cedar Street and Stallion Hill Road intersections are operating at an LOS "A" or "B" during both time periods for existing and projected 2028 conditions.
- Although Fairground Road and Route 131 intersections were analyzed separately, the traffic signals are synched together as the intersections are very closely spaced. Fairground Road operates at an LOS "A" for both time periods for existing and future conditions. However, Route 131 operates at a LOS "C" or worse. During the PM time period, the overall intersection averaged in excess of 50 seconds of delay.

TABLE 5
Intersection Level Of Service (LOS) Analyses Results:
Existing Conditions & Projected 2028 Conditions

		NETWORK											
		Existing Balanced						2028 Projected					
	ROUTE 20	AM			PM			AM			PM		
COMMUNITY	INTERSECTION	V/C[1]	Delay[2]	LOS	V/C[1]	Delay[2]	LOS	V/C[1]	Delay[2]	LOS	V/C[1]	Delay[2]	LOS
	SIGNALIZED	**Overall Intersection Operations**											
Sturbridge	Route 20/Route 148/Holland Road	0.98	30	C	0.81	27	C	1.04	35	C	0.95	32	C
	Route 20/Cedar Street	0.84	11	B	0.67	9	A	0.88	12	B	0.70	10	A
	Route 20/Stallion Hill Road	0.60	9	A	0.85	15	B	0.63	10	A	0.97	18	B
	Route 20/Fairground Road	0.59	5	A	0.62	4	A	0.62	5	A	0.65	5	A
	Route 20/Route 131	0.82	23	C	1.32	53	D	0.87	24	C	1.38	59	E
	UNSIGNALIZED[3]	**Minor Street Approaches under "Stop" Sign Control**											
Sturbridge	Route 20/Arnold Road	0.49	45	E	0.73	114	F	0.58	58	F	0.90	170	F

1) V(volume)/C(capacity) is for worst lane group; C is maximum flow under prevailing conditions

2) Delay in seconds

3) Delay and LOS are for minor street approach

3.8 Route 20 Roadway Segments Peak Hour Level of Service (LOS) Analyses

Using the existing and projected 2028 traffic increases for Route 20, a Level of Service (LOS) grade was calculated for each of the roadway segments between the focus intersections. The LOS for roadway segments is calculated by using a *Highway Capacity Software* (HCS). The software calculates segment LOS differently depending on whether the roadway has two lanes or multiple lanes. **Table 6** lists both the existing and projected LOS for the Route 20 segments in the host community. (The complete LOS worksheets are provided in the document's Technical Appendix.)

Table 6
Roadway Segment Level of Service (LOS) Analyses Results:
Existing Conditions & Projected 2028 Conditions

Route 20 Segments	Segment Length (Miles)	# of Travel Lanes	Existing Conditions		Projected 2028 Conditions	
			AM	PM	AM	PM
Route 148 to Arnold Road	0.52	2	E	E	E	E
Arnold Road to Cedar Street	0.48	2	E	E	E	E
Cedar Street to Stallion Hill Road	0.22	4	B/A	B/C	B/A	B/C
Stallion Hill Road to Route 131	0.38	4	B/A	B/C	C/A	C/C

For two-lane roadways, the "Follower Density" calculations (followers per mile) are used for the LOS. The LOS thresholds differ slightly based on the posted speed limit of the roadway. The LOS is greater for lower-speed roadways (<50 MPH) as compared to higher-speed roadways (>50 MPH). The number of curb cuts and passing zones are also considered in the LOS analysis. As shown in the above table, the segments between Route 148 and Cedar Street have two lanes and a LOS "E". The chart below shows the LOS criteria for two-lane roadways.

Level of Service	Follower Density >50 MPH Speed Limit	Follower Density <50 MPH Speed Limit
A	<2.0	<2.5
B	2.0 – 4.0	2.5 – 5.0
C	4.0 – 8.0	5.0 – 10.0
D	8.0 – 12.0	10.0 – 15.0
E	>12.0	>15.0
F	LOS F exists when demand exceeds capacity	

Similar to two-lane roadways, the "Density" calculations (passenger cars/per mile/per lane) defines the LOS for multi-lane roadways. Density describes the motorist's proximity to other vehicles and is related to a motorist's freedom to maneuver within the traffic stream. As previously shown in **Table 6**, the two roadway segments with four lanes are between Cedar Street and Route 131. The LOS is calculated for each travel direction in a multi-lane analysis. The score of the left side is for the eastbound direction of travel while the score of the right side is for the westbound direction. The chart below shows the LOS criteria used for multi-lane roadways.

Level of Service	Density (pc/mi/ln)
A	<11
B	11 - 18
C	18 - 26
D	26 - 35
E	35 - 45
F	>45

3.9 Performance Management

The performance measures related to the Congestion Management Process (CMP) is the federal rule of System Performance & Air Quality (PM3). The goal is to achieve a significant reduction in congestion on the National Highway System (NHS). This rule has five measures that are linked to reliability, congestion and emissions. The CMMPO has in fact voted to support the five statewide targets in regards to 1) Level of Travel Time Reliability (LOTTR), 2) Level of Truck Travel Time Reliability (TTTR), 3) Percentage of Non-Single Occupancy Vehicle (SOV) Travel, 4) Peak Hour Excessive Delay (PHED), and 5) Total Reduction of On-Road Mobile Source Emissions.

1. As for the measure of LOTTR, improvements on Route 20 could potentially help towards this measure. One option would be to check the timing and phasing of all the traffic signals along the Route 20 study corridor to be certain all are working correctly. If needed, the timings could be adjusted for improved traffic flow. By making these signalized intersections more efficient, it will potentially reduce travel delays and improve Level of Service at the focus intersections.
2. The TTTR target only pertains to the Interstate system so improvements on Route 20 will not help towards this measure, but could improve truck travel times on Route 20. The TTTR measure is also considered part of the MPO customized regional performance measure of Economic Vitality.

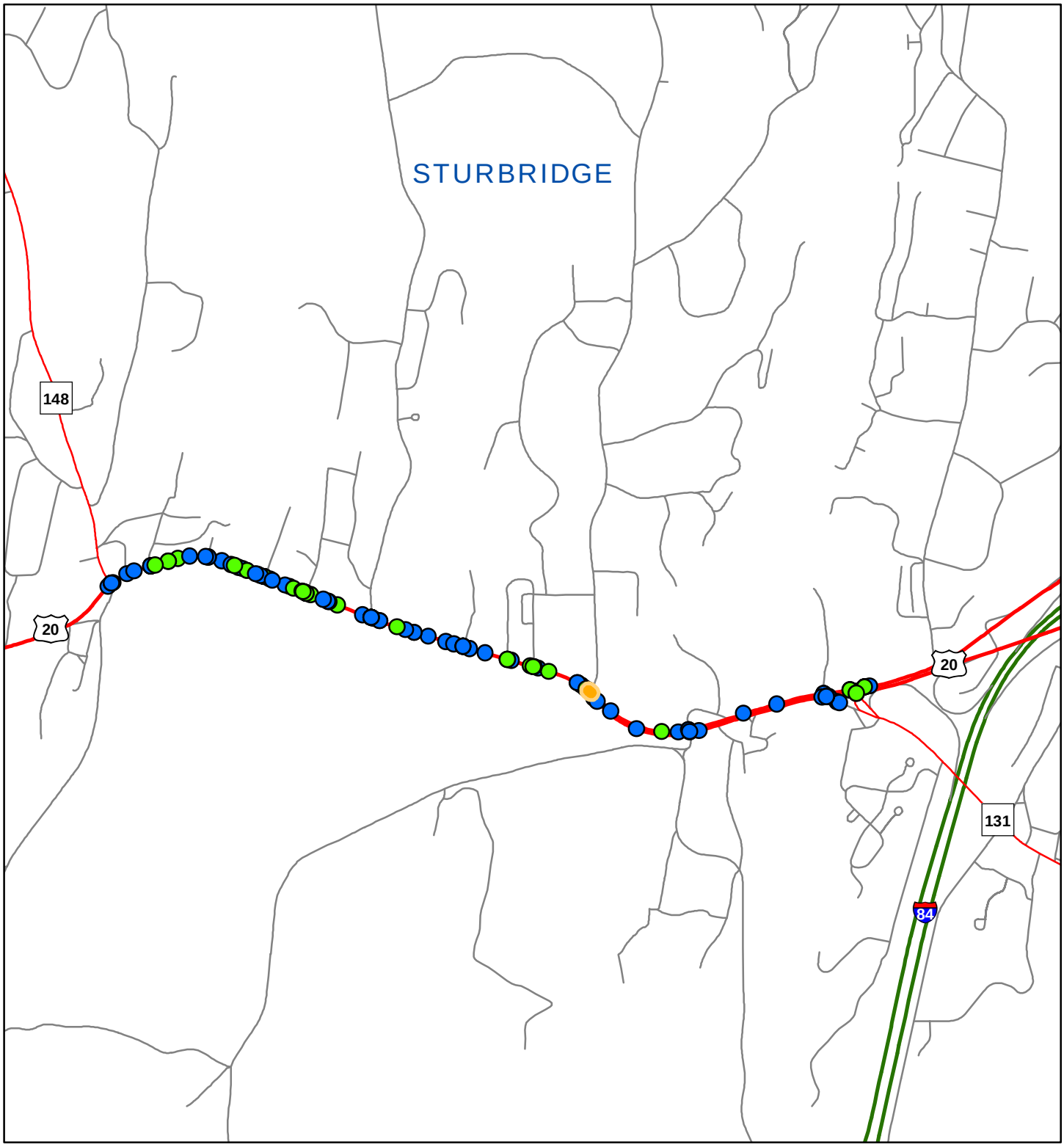
3. For the non-SOV travel measure, creating other travel options (e.g. carpool, public transit, walking or bicycling) through the Complete Streets program or public outreach and awareness would help contribute towards reaching the target. This measure is also considered part of the regional performance measure of Multimodal in which the goal is to expand the bicycle, pedestrian, and transit networks in the region.
4. For the PHED measure, any improvements to Route 20 made in regards to the above measures that would help reduce delays would also contribute positively towards this statewide target.
5. Lastly, the Reduction of Emissions measure is related to Congestion Mitigation & Air Quality (CMAQ) projects where such projects are intended to reduce emissions. Examples of these types of projects include intersection improvements, bicycle & pedestrian improvements, and new transit services or buses. This measure is also related to the MPO customized regional performance measure of GHG/Sustainability. With the reduction of travel delays and fewer idling vehicles, Green House Gas (GHG) emissions could potentially be reduced.

4.0 Safety Management System (SMS)

For this Corridor Profile, CMRPC staff obtained crash data from the Massachusetts Department of Transportation (MassDOT). On a yearly basis MassDOT receives crash data from the Registry of Motor Vehicles (RMV) branch of MassDOT. Before the data is released to the public, a quality control analysis is conducted on the crash records. MassDOT then releases the three most recent years of data. The crash information used for this Corridor Profile is from the three-year period from 2014 to 2016. This chapter will discuss the results of this data analysis for the town of Sturbridge.

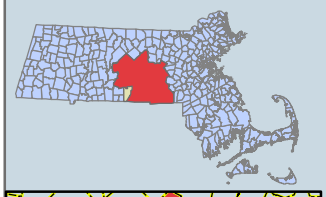
Figure 17 shows the location of the crashes that occurred on Route 20 in Sturbridge between 2014 and 2016. The colored dots on the map indicate whether an incident was a fatal injury, non-fatal injury, or property damage-only type crash. Also included are bicycle and pedestrian incidents. The total count of each crash type is shown in the legend. In addition, the locations of Highway Safety Improvement Program (HSIP) eligible crash clusters are shown on the map. To be HSIP eligible, the clusters need to be within the top 5% statewide. These clusters are defined based on the number of crashes adjacent to one another within a defined radius that has a high incidence of crash severity. MassDOT has developed an automated procedure for processing, standardizing, matching and aggregating the crash data collected by the RMV branch by geographical location using Geographic Information System (GIS) tools and procedures resulting in vehicle crash clusters, bicycle clusters and pedestrian clusters.

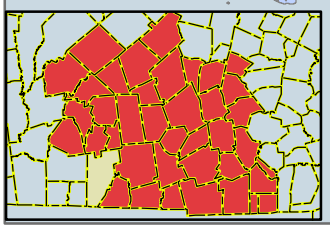
For the three-year period that was analyzed for this Corridor Profile, the intersection of Route 20 and Cedar Street was the only HSIP-eligible intersection. At this location there were eight crashes with non-fatal injuries and nine crashes that were property damage only. Of the 17 reported crashes, there were four angle, eight rear-ends, four sideswipes and one single vehicle crash.



ROUTE 20 CORRIDOR PROFILE

Sturbridge Crash Data
Figure 17





Legend

- HSIP Eligible Crash Clusters (Auto)
- Non-Fatal Injury (38)
- Property Damage (115)
- Unknown (1)

Miles
0 0.075 0.15 0.3 0.45 0.6

CMRPC
Central Massachusetts Regional Planning Commission

Source: Data provided by the US Census Bureau, Central Massachsuetts Regional Planning Commission (CMRPC), massDOT Office Of Transportation Planning Geospatial Resources Section and the Office of Geographic Information MassGIS), Commonwealth of Massachusetts, Information Technology Division.

Information depicted on this map is for planning purposes only. This information is not adequate for legal boundary definition, regulatory interpretation, or parcel-level analysis. Use caution intrepreting positional accuracy.

4.1 Town of Sturbridge Crash Analysis

For the town of Sturbridge, MassDOT vehicle crash records were analyzed for the three-year period 2014 - 2016. All crashes along Route 20 from the Route 148 to Route 131 were tabulated. Also, incidents on minor streets that were close to or at Route 20 were also included. All important information from the crash reports was summarized and included in the various tables that follow.

There were a total of 154 reported study area crashes in the town of Sturbridge for the three-year analysis period. **Table 7** shows a summary of the crashes in which the details are shown in a variety of ways. Property damage-only crashes accounted for 75% of the total, while non-fatal injuries accounted for 25%. Rear-end crashes were the most prevalent with a total of 78. Angle crashes were second with 47. The two intersections with the most crashes were at Route 131 and Cedar Street. Often the case, most crashes occurred on dry road conditions, in daylight, and in clear weather. The highest number of crashes (43) occurred between 12 PM and 4 PM. The most crashes occurred during the month of June, with the month of May close behind.

Table 7
Summary of Reported Crashes
On Route 20 Corridor in the Town of Sturbridge
January 1, 2014 - December 31, 2016

Crash Severity

	Number	Percent
Property Damage Only	115	74.7%
Non-Fatal Injury	38	24.7%
Fatal Injury	0	0.0%
Not Reported	1	0.6%
Total	**154**	**100.0%**

Manner of Collision

	Number	Percent
Angle	47	30.5%
Rear-end	78	50.6%
Head-on	4	2.6%
Sideswipe, same direction	11	7.1%
Single vehicle crash	13	8.4%
Unknown/not reported	1	0.6%
Total	**154**	**100.0%**

Type of Collision

	Number	Percent
Collision with a motor vehicle in traffic	135	87.7%
Collision with animal	1	0.6%
Collision with curb, embankment or guardrail	3	1.9%
Collision with fixed object	12	7.8%
Collision with Bicyclist or Pedestrian	2	1.3%
Other / Unknown	1	0.6%
Total	**154**	**100.0%**

Locations with the highest number of crashes

	Number
ROUTE 20 / ROUTE 131	24
ROUTE 20 / CEDAR STREET	17
ROUTE 20 /ARNOLD ROAD	13
ROUTE 20 / HINMAN STREET	10

Road Surface Condition

	Number	Percent
Dry	126	81.8%
Wet	20	13.0%
Snow	7	4.5%
Unknown	1	0.6%
Total	**154**	**100.0%**

Time of Day

	Number	Percent
Before 7 AM	4	2.6%
7 AM - 10 AM	21	13.6%
10 AM - 12 PM	20	13.0%
12 PM - 4 PM	43	27.9%
4 PM - 6 PM	37	24.0%
6 PM - 9 PM	19	12.3%
After 9 PM	10	6.5%
Total	**154**	**100.0%**

Light Conditions

	Number	Percent
Daylight	126	81.8%
Dark	23	14.9%
Dusk	5	3.2%
Total	**154**	**100.0%**

Weather Conditions

	Number	Percent
Clear	107	69.5%
Snow	7	4.5%
Rain	10	6.5%
Cloudy	28	18.2%
Fog	1	0.6%
Not Reported	1	0.6%
Total	**154**	**100.0%**

Month of the Year

	Number	Percent
January	9	5.8%
February	13	8.4%
March	7	4.5%
April	13	8.4%
May	19	12.3%
June	23	14.9%
July	10	6.5%
August	7	4.5%
September	13	8.4%
October	15	9.7%
November	13	8.4%
December	12	7.8%
Total	**154**	**100.0%**

Table 8 shows the collision type by study area location in the town of Sturbridge. The table lists the total crashes at each intersection and at other Route 20 locations (non-intersection crashes) and what type of crash occurred. There were 44 non-intersection crashes and 110 intersection crashes. There were 47 angle crashes along the study corridor. Hinman Street had the most angle crashes for an intersection with a total of 7 while other non-intersection locations had 12. One reason for the number of angle crashes along Route 20 is the high volume of left turning vehicles, whether turning in/out of a business at the intersection or turning in/out of a minor street or driveway. Drivers often underestimate the speed and distance of oncoming vehicles (or become impatient when insufficient safe gaps occur) and turn in front of the oncoming vehicles, leaving them very little time to stop. Rear ends were the most prevalent type of crash with a total of 78. Non-intersection locations had the most with a total of 23 while the top two intersections were Route 131 and Cedar Street. Rear ends often occur during congested roadway conditions and from driver inattention. Roadway surface conditions can also be a factor. Additionally, there were also 11 sideswipe crashes in which the majority occurred on the multi-lane section of road between Cedar Street and Route 131. Lastly, there were 13 single vehicle crashes and four head-on collisions.

Table 8
Collision Type by Location in Sturbridge, 2014-2016

Location	Total	Type					
		Angle	Rear-End	Head-On	Sideswipe, Same Direction	Single Vehicle Crash	Unknown
Route 20 / Route 148 / Holland Road	**9**	3	6				
Route 20 / School Street	**1**		1				
Route 20 / Church Street	**6**	3	3				
Route 20 / Bates Court	**3**	1	2				
Route 20 / Bates Hill Road	**7**	1	5			1	
Route 20 / Hinman Street	**10**	7	1		1	1	
Route 20 / Arnold Road	**13**	5	5	1		2	
Route 20 / Crescent Way	**6**	1	3		1	1	
Route 20 / Snell Street	**5**	3	2				
Route 20 / Cedar Street	**17**	4	8		4	1	
Route 20/ Stallion Hill Road	**5**		1		2	2	
Route 20 / Fairground Road	**4**	1	2			1	
Route 20 / Route 131	**24**	6	16			2	
Other Route 20 Locations	**44**	12	23	3	3	2	1
Total	**154**	**47**	**78**	**4**	**11**	**13**	**1**

Table 9 below shows the types of collisions that occurred and the severity. Over two thirds of the crashes caused property damage only. Rear-end crashes caused the most property damage with a total of 53 and angle crashes were second with a total of 39. Of the 38 crashes that caused a non-fatal injury, rear-end crashes were again the most prevalent with a total of 25. There was also one unknown severity for an angle crash and one unknown crash type that caused property damage only.

Table 9
Sturbridge Crashes by Severity and Type of Collision, 2014-2016

Type of Collision	Severity			
	Fatal Injury	Non-Fatal Injury	Property Damage Only	Unknown
Angle		7	39	1
Head-on		1	3	
Rear-end		25	53	
Sideswipe, same direction		2	9	
Single vehicle crash		3	10	
Unknown			1	
Total Number of Crashes		**38**	**115**	**1**

Also included in the crash analysis were bicycles and pedestrians. According to the crash data, this section of Route 20 does not appear to be an area where bicycle and pedestrian crashes occur frequently. During the three years of crash data, there were only two crashes that involved either a bicyclist or pedestrian. The bicyclist crash occurred at the intersection of Hinman Street and was classified as a sideswipe crash that resulted in a non-fatal injury. The pedestrian crash occurred at the intersection of Cedar Street and was classified as a single vehicle crash that resulted in a non-fatal injury. A vehicle was turning left onto Cedar Street and struck the pedestrian.

4.2 Performance Management

The first performance measure to consider is Safety. In 2019, the CMMPO chose to adopt the statewide safety performance measure targets set by MassDOT for calendar year 2019. The objectives of the safety performance measures are to reduce the total number of fatalities, rate of fatalities per 100 million vehicles miles traveled (VMT), total number of serious injuries, rate of serious injuries per 100 million VMT, and the total number of combined serious injuries and fatalities for non-motorized modes. Currently, the first four listed safety measures are showing a decrease in statewide trends. However, the last safety measure is showing an increase in the statewide data. In all safety categories, MassDOT has established a long-term target towards "Zero Deaths" and will establish safety targets for the MPO to consider for

adoption each calendar year. In regards to the Route 20 study corridor, any suggested safety improvements to reduce crashes would potentially help reach the safety targets set forth by MassDOT.

In addition to the Safety performance measures above, two other objectives are to reduce heavy truck crashes and all crashes on freight routes and reduce the rate of fatalities and serious injuries per 100 million VMT along freight routes. To complete these objectives the number and rate of injuries and fatalities along roadways and freight routes need to be reduced. Since Route 20 is considered a primary freight route, suggested safety improvements along the study corridor would potentially help both of these objectives.

Another performance measure is Security. The objective of this measure is to enhance transportation security coordination and preparedness regionwide. One way to measure this is to establish evacuation routes in the region. In a previous joint effort between the CMRPC and the MRPC, a Central Region Homeland Security Evacuation Plan was completed in 2013. In this evacuation plan, numerous roadways within the central region were designated as either "primary" or "secondary" evacuation routes. Route 20 was designated a primary evacuation route so it is critical for this roadway to be both safe and secure. Another goal is for all communities in the CMRPC region to have a Hazard Mitigation Plan. Staff has worked with the town of Sturbridge to develop their plan and it was submitted to MEMA/FEMA in June 2019 and is expected to be approved in August 2019. The Sturbridge Board of Selectmen would likely adopt the plan in September 2019.

5.0 Pavement Management System (PMS)

5.1 Pavement Management Concepts

Pavement management is an asset management system designed to assist decision-makers in determining the most cost-effective strategies to address poor or failing roadway conditions. In general, a successful Pavement Management System (PMS) defines a roadway network, identifies the condition of each segment of the network, develops a list of needed improvements, and balances those needs with the available resources of the party responsible for maintaining the defined roadway network. *Cartegraph*, a software package developed and supported by Cartegraph Systems Incorporated, is used by CMRPC in its pavement management program to assess overall pavement condition and to assist in developing a cost effective strategy for addressing observed pavement distress.

For this Corridor Profile, pavement distress information was collected for Route 20 in the town of Sturbridge between Route 148 and Route 131. The pavement data was collected by conducting "windshield surveys." A team of two CMRPC representatives inspected Route 20, taking note of the severity and extent of the following pavement distresses:

- Potholes
- Distortions
- Alligator Cracking
- Transverse and Longitudinal Cracking
- Block Cracking
- Rutting
- Bleeding/Polished Aggregate
- Surface Wear and Raveling
- Corrugations, Shoving, and Slippage

Based on the observed distresses, an Overall Condition Index (OCI) was calculated for each surveyed roadway segment. The OCI is used to rate each segment on a scale of 0 to 100. An OCI of 100 indicates optimal pavement conditions, usually a newly paved roadway segment. Conversely, a score of 0 indicates a roadway that has failed entirely and is likely impassable for an average passenger vehicle. Starting at a top index rating of 100, the OCI is calculated by subtracting a series of deduct values, each associated with the severity and extent of the various pavement distresses described above. *Cartegraph's* deduct values are determined through a series of deduct curves, which were developed by pavement engineers using years of research on pavement performance. The resulting OCI is a quantified rating of pavement condition.

Cartegraph's Recommended Action category definitions are as follows:

- Do Nothing (OCI 100 – 88) – used when a road is in relatively perfect condition and prescribes no maintenance.
- Routine Maintenance (OCI 88 – 68) – used on roads in reasonably good condition to prevent deterioration from the normal effects of traffic and pavement age. This treatment category would include either crack sealing or local repair (pothole, depression, poorly constructed utility patch, etc.), or minor localized leveling.
- Preventative Maintenance (OCI 68 – 48) – slightly greater response to more pronounced signs of age and wear. This includes crack sealing, full-depth patching, and minor leveling, as well as surface treatments such as chip seals, micro-surfacing, and thin overlays.
- Structural Improvement (OCI 48 – 24) – when the pavement deteriorates beyond the need for surface maintenance applications, but the road base appears to be sound. These include structural overlays, shim and overlay, cold planing and overlay, and hot in-place recycling.
- Base Rehabilitation (OCI 24 – 0) – represents roads that exhibit weakened pavement foundation base layers. Complete reconstruction and full depth reclamation are indicated.

Each Recommended Action category has an associated cost, which includes the design, materials, and labor to complete such action. *Cartegraph* produced OCI Recommended Action categories suggest the type of remedial improvements necessary to bring a road segment to "Excellent" condition. As a roadway's OCI drops, the associated Recommended Action becomes more demanding, and the cost of repair increases. Therefore, the cost of "Routine Maintenance," which categorically falls under "Do Nothing," is only a fraction of the cost of "Base Rehabilitation," the most financially demanding Recommended Action category. For a practical example, the cost of applying crack seal to alligator cracking over a half mile segment of road is significantly less than the cost to fully reconstruct a half mile of impassable roadway. Therefore, it is better to do "Routine Maintenance" on a roadway in order to prevent the deterioration of the pavement.

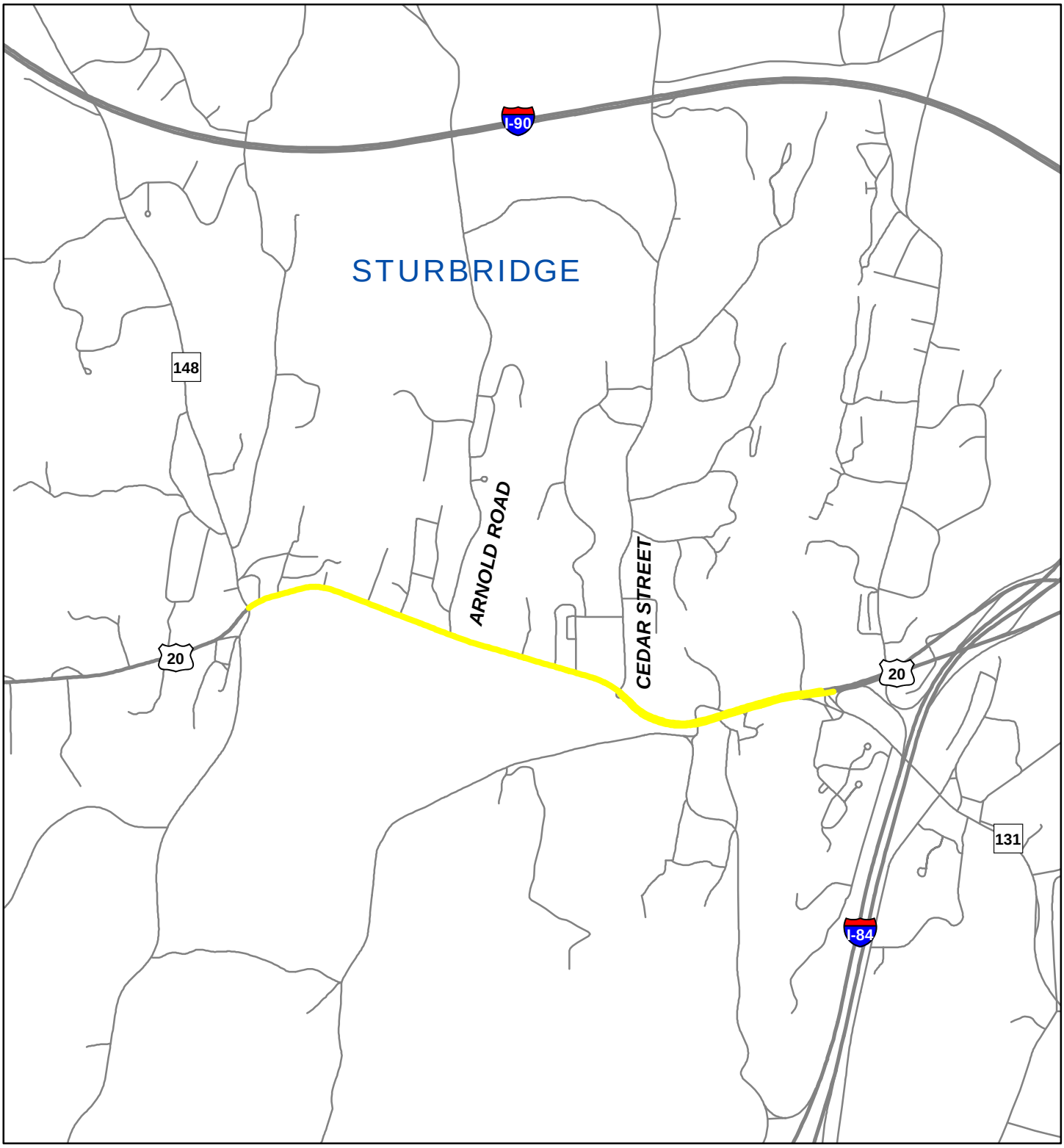
5.2 Town of Sturbridge Overall Condition Index (OCI)

The most recent pavement data for Route 20 in Sturbridge was collected in 2019. **Figure 18** shows Route 20 is in fair condition for the entire study segment. **Table 10** shows the roadway segments having an OCI ranging between 57 and 62 with a recommended action of "Preventative Maintenance". Since the roadway segment between Cedar Street and Route 131 is separated by a raised median, the segment has been analyzed by direction. The eastbound

direction of this segment contains localized medium transverse & longitudinal cracking, low severity surface wear, low severity rutting, low severity bleeding, medium severity alligator cracking, low severity block cracking, and low severity distortions and potholes. As for the westbound direction, it contains similar distresses, but had a higher severity of transverse & longitudinal cracking, surface wear, and block cracking. The roadway segment between Cedar Street and Route 148 contains medium severity surface wear, low severity rutting, medium severity bleeding, medium severity alligator cracking, medium severity block cracking, and low severity potholes and distortions.

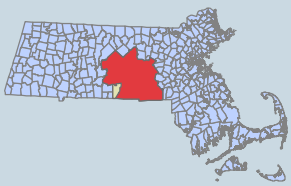
Table 10
Sturbridge Route 20 Pavement Analysis Recommendations

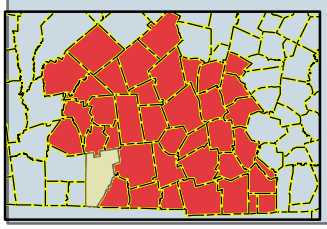
Street	From	To	Length	Plan Activity	OCI
Route 20	Route 148	Cedar St	1.05 mi	Preventative Maintenance	57.4
Route 20 (EB)	Cedar St	Route 131	0.55 mi	Preventative Maintenance	61.4
Route 20 (WB)	Route 131	Cedar St	0.55 mi	Preventative Maintenance	64.0



ROUTE 20 CORRIDOR PROFILE

Pavement Condition
Figure 18





Legend

- Excellent
- Good
- Fair
- Poor
- Very Poor

0 0.125 0.25 0.5 0.75 1 Miles

CMRPC Central Massachusetts Regional Planning Commission

Source: Data provided by the US Census Bureau, Central Massachsuetts Regional Planning Commission (CMRPC), massDOT Office Of Transportation Planning Geospatial Resources Section and the Office of Geographic Information MassGIS), Commonwealth of Massachusetts, Information Technology Division.

Information depicted on this map is for planning purposes only. This information is not adequate for legal boundary definition, regulatory interpretation, or parcel-level analysis. Use caution intrepreting positional accuracy.

5.3 Performance Management

In regards to pavement, the target from the Federal Highway Administration (FHWA) rule PM2 is to increase the percentage of non-Interstate NHS roadways in good condition greater than 30% and decrease the percentage of roadways in poor condition to less than 30%. PM2 also pertains to Interstate roadways, but for this Corridor Profile the non-Interstate performance targets are only considered since Route 20 is a non-Interstate roadway. Currently, the entire length of Route 20 within the study area is in "Fair" condition. By repaving any section of Route 20, it would help to reach the pavement goal of having greater than 30% of non-Interstate roadways in good condition. Further, by repaving Route 20, it will prevent the roadway from degrading over time, eventually resulting in a poor condition rating.

6.0 Bridges

6.1 Statewide Bridge Management System

MassDOT collects bridge condition data on an ongoing basis using consistent federal standards in various structural categories including bridge deck, superstructures (the physical condition of the bridge), substructures (condition of the piers, abutments, piles, girders, footings, or other related components), retaining walls, deck geometry, and roadway approach alignment. According to MassDOT, in order to be defined as a bridge, the structure must be at least 20 feet or greater in length. The resulting inventory is used to calculate a condition rating, which is used to classify substandard bridges as either Structurally Deficient or Functionally Obsolete. Bridges that do not fall into one of those categories are ineligible for the Highway Bridge Replacement and Rehabilitation Program funded by the Federal Highway Administration (FHWA).

A "Structurally Deficient" (SD) bridge is defined as a bridge whose condition has been rated no better than poor in any of these five areas: bridge deck, superstructures, substructures, culverts, and retaining walls. A "Functionally Obsolete" (FO) bridge is defined as a bridge that is considered in serious condition in any of these three categories: deck geometry, underclearances, or approach roadway alignment. Additionally, if the structural condition or waterway adequacy is in serious condition (but better than that for a structurally deficient bridge), the bridge would be identified as being functionally obsolete. Essentially, a functionally obsolete bridge is one that is not built in accordance with or does not meet currently accepted design standards.

6.2 MassDOT Municipal Small Bridge Program

This program provides financial support to cities and towns for small bridge replacement, preservation and rehabilitation projects. It is five year program to assist cities and towns to replace or preserve bridges with spans between 10 feet and 20 feet. Each municipality may qualify for up to $500,000 per year. These small bridges are not eligible for federal-aid under existing programs. The town must complete an application with a preliminary cost estimate that includes design costs and an amount for contingencies (suggested 15%). Additional items needed include photographs, a description of the structure which includes date of construction/reconstruction and structure type, repair history, summary of known problems, and a discussion of proposed work.

6.3 Route 20 Corridor Profile Bridges

Within the study area there are two short span bridges owned by MassDOT. These types of bridges have a span between 10 to 20 feet and are categorized as a "BRI" structure which means it is a highway bridge structure that meets the Massachusetts General Laws (MGL) but not the federal definition of a bridge. Federal regulations define a bridge as a structure having a span greater than 20 feet. **Table 11** provides some details about these two bridges. Currently, there is a proposed project to replace the existing culvert (S-30-022). The Plans, Specifications & Estimates (PS&E) were submitted in January 2019 and construction is estimated to begin sometime in the spring of 2020. State funds will be used for this project.

Table 11
Route 20 Bridges

Host Community	MassDOT Bridge #	Facility Name (Over)	Facility Name (Under)	Year Built/ or Rebuilt	Structurally Deficient
Sturbridge	S-30-022	Route 20	Cedar Meadow Brook	1850 / 1900	No
Sturbridge	S-30-033	Route 20	Cedar Pond Outlet	1956	No

6.4 Performance Management

The Performance Measure related to this chapter is within the State of Good Repair national planning factor. The objectives, which are part of PM2, are to maintain at least 16% of NHS bridges by deck area in good condition and have less than 12% of NHS bridges by deck area in poor condition. Since both of the above bridges are not considered part of the National Bridge Inventory (NBI) they do not count towards this federal performance measure.

7.0 Public Transit (Public and Private Transportation)

7.1 Regional and Profile Area Services

Worcester Regional Transit Authority

The Worcester Regional Transit Authority (WRTA) provides transit service for the City of Worcester and 36 additional communities within the Central Massachusetts area. Fixed-route service is provided within thirteen communities, and flexible Community Shuttle service is available in three communities.

Paratransit service is available to eligible individuals, including Americans with Disabilities Act (ADA) complementary paratransit service. ADA paratransit services operate within a 3/4 mile "buffer" surrounding the fixed-route service and is available during the corresponding fixed-route schedule. Non-ADA paratransit service is available for elders and people with disabilities, with service hours varying by community or eligibility. These services are generally provided by local Councils on Aging or other contractors, and are subsidized by the WRTA.

Ridesharing/Transportation Network Companies (TNCs)

In Massachusetts, rideshare companies such as Uber and Lyft are referred to as Transportation Network Companies (TNCs). Generally, ridesharing is commonly provided as a curb-to-curb on-demand ride service. Customers can order a ride through various providers using either a smartphone application, or other online service, and the operator provides the trip in a privately-owned vehicle. In Central Massachusetts, TNC services are available as Uber or Lyft.

Taxicab and Other Providers

Additionally, Yellow Cab and Red Cab taxicab companies also provide public transportation opportunities within the area. Other specialized transportation services are available to eligible individuals within the area.

7.2 Town of Sturbridge

Existing WRTA Services

There is no fixed-route service available in Sturbridge, but fixed-route service is available in neighboring Southbridge. WRTA Route 29 begins at the WRTA Hub at Union Station in downtown Worcester, and ends at the Big Bunny Market plaza on Main Street (Route 131) in Southbridge. From the Sturbridge town line to the WRTA bus stop within the Big Bunny plaza, is approximately one-quarter mile.

On weekdays, Route 29 begins at 5:35 AM and ends at 7:35 PM, providing seven round trips between Worcester and Southbridge. This route also has Saturday service, with six round trips from 8:00 AM to 8:00 PM. Currently, there is no Sunday service on Route 29.

ADA complementary paratransit service is available in a section of Sturbridge, within the ¾ mile buffer surrounding WRTA Route 29. The service is available to individuals determined eligible under the Americans with Disabilities Act guidelines. The schedule mirrors the existing Route 29 fixed-route schedule. ADA paratransit services are provided by a combination of the WRTA, and SCM Elderbus.

Additional non-ADA paratransit services are offered to all Sturbridge elders (aged 60 and over) and people with disabilities on weekdays between 8:30 AM and 4:30 PM. Non-ADA paratransit services are operated by SCM Elderbus, through a contract to the WRTA. The WRTA provides a handicapped-accessible van, and reimburses SCM Elderbus for operating expenses. In Fiscal Year 2019, SCM Elderbus provided nearly 7,000 passenger trips[1] to Sturbridge clients. In terms of FY 2019 annual ridership totals, Sturbridge ranked second, behind Southbridge, out of the twenty-one communities within the SCM Elderbus service area[2].

ReadyBus, operated by SCM Elderbus, is an on-demand transportation service that is available in Sturbridge, and three other communities. The service is focused on providing transportation for non-elder, and non-disabled individuals who need the service to work and other destinations within their community. ReadyBus operates in conjunction with SCM Elderbus services and is funded through the MassDOT Community Transit Grant Program. In Fiscal Year 2019, approximately 550 passenger trips were provided via ReadyBus within Sturbridge, about 20% of the total ReadyBus passenger activity[3].

Existing TNC Services

In 2018, the Massachusetts Department of Public Utilities (DPU) released trip count data provided by Uber, Lyft, and other TNC providers. 4,155 TNC trips originated within Sturbridge, and 4,505 TNC trips had Sturbridge as its destination[4]. Compared to TNC trip count data from 2017[5], origin trips grew by 106% (2,192), and destination trips grew by 107% (2,177). The data shows that TNC providers are gaining traction in more rural, and suburban communities. The average miles travelled from origin and destination were between 15.9 and 16.5 miles, suggesting that a traveler originating from Sturbridge would travel on average 15.9 miles to their destination, and that a traveler heading to Sturbridge would travel on average 16.5 miles on the return trip. When compared to six peer communities within Massachusetts between

[1] Source: SCM Elderbus
[2] Source: CMRPC
[3] Source: SCM Elderbus, CMRPC
[4] Source: 2018 Data Report: Rideshare in Massachusetts, Massachusetts DPU
[5] Source: 2017 Data Report: Rideshare in Massachusetts, Massachusetts DPU

9,000 and 10,000 residents, Sturbridge ranked third in terms of highest number of origin and destination trips for 2018.

Future Outlook

The WRTA underwent a Comprehensive Service Analysis (CSA)/Regional Transit Plan of its entire fixed-route system by consultant URS Corporation/AECOM in 2015. In the CSA, individual route recommendations were proposed with implementation into a three-phase approach based on availability of resources and funding. None of the service recommendations in the report included Sturbridge.

In December 2018, CMRPC Transit staff met with Sturbridge officials to discuss the potential interest in WRTA fixed-route service in town. CMRPC offered to conduct a 'Transportation Needs' survey to Sturbridge residents to gather feedback on the need for either WRTA, or other services. It is not known at this time the level of interest from Sturbridge officials in distributing the survey.

7.3 Performance Management

The Performance Measure related to this chapter is Multimodality. The objective is to expand the transit network in the region. As the town of Sturbridge does not currently have any WRTA fixed-route services available, it is a good candidate to help reach this goal, if feasible. As previously mentioned there have been no service recommendations for Sturbridge at this time.

8.0 Other Modes

8.1 Introduction

Traffic jams and congestion occur when demand for the highway infrastructure exceeds supply. Because of this, various state initiatives, design criteria revisions, funding opportunities and compacts have guided the design of the region's transportation and physical infrastructure so that alternatives to driving alone are highly encouraged. These other modes include bicycling, public transit (detailed in another chapter of this CP), and walking. This chapter includes examples of the aforementioned statewide initiatives and their applicability to the Route 20 Corridor Profile.

8.2 MassDOT Healthy Transportation Compact

The Transportation Reform Law (2009) established the Healthy Transportation Compact (HTC) which promotes improved public health through active transportation. Active transportation refers to bicycling, transit, and walking. The HTC is an interagency initiative co-chaired by the commonwealth's Secretary of Transportation and Secretary of Health and Human Services, including the Secretary of Energy and Environmental Affairs, MassDOT Highway Administrator, MassDOT Transit Administrator, the Commissioner of Public Health and the Secretary of Housing and Economic Development. The HTC goals are to facilitate transportation decisions that balance the needs of all users, expand mobility, improve public health, support a cleaner environment and create stronger communities. The intent is to adopt best practices to increase efficiency in achieving positive health outcomes through the coordination of land use, transportation and public health policy.

Some of the programs and/or initiatives promoted by MassDOT and its partners that are currently in place, making the connection between health and transportation, are:

- Mass in Motion
- Safe Routes to School
- Healthy Transportation Policy Directive
- Healthy Transportation Engineering Directive

8.3 Healthy Transportation Policy Directive

MassDOT's Healthy Transportation Policy Directive requires all state transportation projects to increase bicycling, transit, and walking options. This Directive is intended to promote multimodal access for all transportation customers. MassDOT has indicated that everyone in Massachusetts must be provided the opportunity to bike, take transit, or walk instead of driving alone in a motor vehicle.

All MassDOT facilities will consider adjacent land uses and, as applicable, be designed to include sidewalks of sufficient width, landscaping, street crossing opportunities and other features to enhance healthy transportation options. Safety audits will be conducted at crash cluster sites where incidents have occurred with healthy-mode transportation users. MassDOT has also developed a Shared Use Path Planning and Design Guide to assist communities proposing shared use paths on or along rail beds in order to accelerate the path design process. To view the guide, click on the following link Shared Use Path Planning and Design Guide.

8.4 Complete Streets

What is widely known as the "Complete Streets" approach was first included in MassDOT's 2006 *Project Development and Design Guide*. Multimodal design guidelines are part of MassDOT's current policy for Context Sensitive Design. In a Complete Streets approach, roadway projects accommodate all users, not only auto traffic. All highway projects shall, from the earliest design stages, provide safe access and connectivity for pedestrians and bicyclists. The Healthy Transportation Policy Directive expands on how, when and where these accommodations should be provided, including ADA design compliance. The *Complete Streets Initiative*, which requires roadway designs that accommodate all users, calls for bicycle & pedestrian accommodation as part of most highway projects, a major exception being limited access highways.

The state's 2014 Transportation Bond Bill authorized $50 million dollars for the creation of Complete Streets Funding Program. It offers Massachusetts municipalities incentives to adopt complete streets policies and practices. To aid in the program MassDOT launched an interactive web portal to assist municipalities through the policy development, prioritization planning, and project approval steps of the application process. To view the website click on the following link Complete Streets Program

For a community to be eligible for funding from this program it must meet three primary requirements as follows:

1. Attendance of a municipal employee at a Complete Streets training and develop a Complete Streets Policy that scores 80 or above out of a possible 100 points.
2. Development of a Complete Streets Prioritization Plan.
3. Application for available funding to construct projects in the communities with a completed Prioritization Plan.

Once these primary requirements are met, the host communities are eligible for up to $38,000 in technical assistance and up to $400,000 in construction funding. The Transportation Bond Bill stated that 33% of the funds will go to municipalities that are at or below the median household income. According to the 2018 Annual Report, the first two years of the program

disbursed $27.8 million for technical assistance and construction grants. Over 40% of the disbursements went to municipalities that are below median household income. Future funding is based on the availability of funds and the interest and success of the program. Also, through the Capital Investment Plan (CIP) additional funding could be directed towards the program.

In 2018, the town of Sturbridge contracted with CMRPC to assist with the community's Complete Streets policy and to develop a prioritization plan. The prioritization plan was approved by MassDOT on 3/29/19. The next step for the town would be to apply for funding for their projects listed on the prioritization plan. The next submission deadline for project funding is May 2020.

8.5 Bicycling in the Corridor

Paved shoulders reduce passing conflicts between motor vehicles, bicyclists and pedestrians while also making the crossing pedestrian more visible. They also provide for storm water discharge from outside the travel lanes, reducing hydroplaning, along with splash and spray to following vehicles, bicyclists and pedestrians. In rural areas, roadway shoulders provide space for bicyclists to ride at their own pace.

There are no dedicated bicycle lanes along Route 20 in Sturbridge within the study area. There are, however, sufficiently wide shoulders between Cedar Street and Route 148 that are acceptable to safely ride a bicycle for the majority of this section of Route 20. In the eastern portion of the Route 20 study area, between Cedar Street and Route 131, shoulders do not exist.

In 2018, CMRPC staff completed the Regional Bicycle Plan. This plan is intended to identify opportunities for encouraging and enhancing bicycle travel within the CMRPC region. The recommendations contained in the plan should be used as a guide for local jurisdictions in taking advantage of these opportunities. The implementation of the recommendations will eventually provide for a comprehensive bicycle transportation network in the region that is focused on accessibility, mobility, and safety. For more information, follow this link to the Bicycle Plan on the CMRPC website 2018 Regional Bicycle Plan.

Through the public input process, related meetings, and stakeholder outreach, a number of intersections, bridges, interchanges, and other barriers to bicycle travel were identified in the Bicycle Plan. As a result of this earlier process, the entire Route 20 Corridor Profile study area is considered a problem corridor. Per the plan, Route 20 is a regional priority as it connects various centers of activity within and beyond the CMRPC region to one another. In the longer term, it is envisioned to provide connectivity between jurisdictions across an even larger geographic area.

8.6 Pedestrian Facilities and Activity in the Corridor

As observed in the field, there are sidewalks on the north side of Route 20 for the entire length of the study area. These sidewalks are either in excellent or good condition. The majority of the southern side of Route 20 also has sidewalks which are similarly in excellent or good condition, with one area being in fair condition. However, there are a number of gaps in the sidewalks on the south side, mainly between Route 148 and Cedar Street. As for ADA ramps, all were observed to be in good condition between Cedar Street and Route 131. From Cedar Street to Route 148, the ramps are mostly in poor condition or do not exist. Additionally, there are numerous cross walks within the study corridor for pedestrians to cross Route 20.

In 2018, CMRPC staff completed the Regional Pedestrian Plan. This plan was intended to facilitate the expansion and upgrade of the pedestrian network in the region in order to encourage more walking trips and safely link important destinations to where people live. The plan also intended to document the extensive pedestrian-related planning and project development work being conducted in the CMRPC communities. The recommendations within the plan should be used as a guide for local jurisdictions in taking advantage of the opportunities. For more information, the plan can be found on the CMRPC website at 2018 Regional Pedestrian Plan.

Through the public input process, related meetings, and stakeholder outreach, some overall recommendations included connecting emerging residential development with traditional village centers and improving crosstown connectivity such as connecting segments of already existing pathways and trails. Some priority recommendations for Sturbridge included continuing Complete Streets development, partnering with eligible K-8 grade schools with the MassDOT Safe Routes to School (SRTS) Program to increase safe biking and walking among students, and also to work with MassDOT and DCR to ensure that regional multi-use trails and pathways are advanced to meet the needs of subregional and regional travel via other non-motorized modes.

8.7 Regional Trails in the Corridor

Besides on-road facilities like sidewalks and marked bicycle lanes, regional trails are also used by hikers and bicyclists. In the winter time trails can also be used by cross-country skiers. These trails are often built on old former rail lines as well as through forests, recreational areas, and parks. **Figure 19** features the current and potential envisioned Grand Trunk Trail, local trails, and open space areas in the town of Sturbridge. The open space layer is basically public and private-owned recreational and conservation lands. These lands include, but are not limited to, town parks, commons, playing fields, school fields, golf courses, bike paths, scout camps, cemeteries, and fish & game clubs.

As shown, the Grand Trunk Trail (GTT) travels through the towns of Southbridge, Sturbridge, and Brimfield. The GTT is also part of an effort to create a larger 66-mile regional trail known as the Titanic Rail Trail that will eventually run from Palmer to Franklin. Currently, only the Westville Lake and Brimfield sections are complete. In Fiscal Year 2020 of the 2020 – 2024 Transportation Improvement Program (TIP), a section of the trail between Ed Calcutt bridge and the intersection of River Road & Farquhar Road is scheduled to be built. The central section would be the only remaining piece of the GTT that is left to be built in Sturbridge.

In the town of Sturbridge there is a Trails Committee that was appointed by the Board of Selectmen to provide for the development, maintenance, coordination and promotion of the Sturbridge trail system. The committee also monitors and acts in an advisory capacity in regard to public lands and for those that care for them. This committee currently consists of four members and four associate members. For more information about the Sturbridge Trails Committee see their website at Sturbridge Trails Committee.

In 2019, the Sturbridge Trails Committee was awarded a MassTrails Grant for $12,865, with a town match of $5,637, to conduct a feasibility design study in regards to the central section of the Grand Trunk Trail.

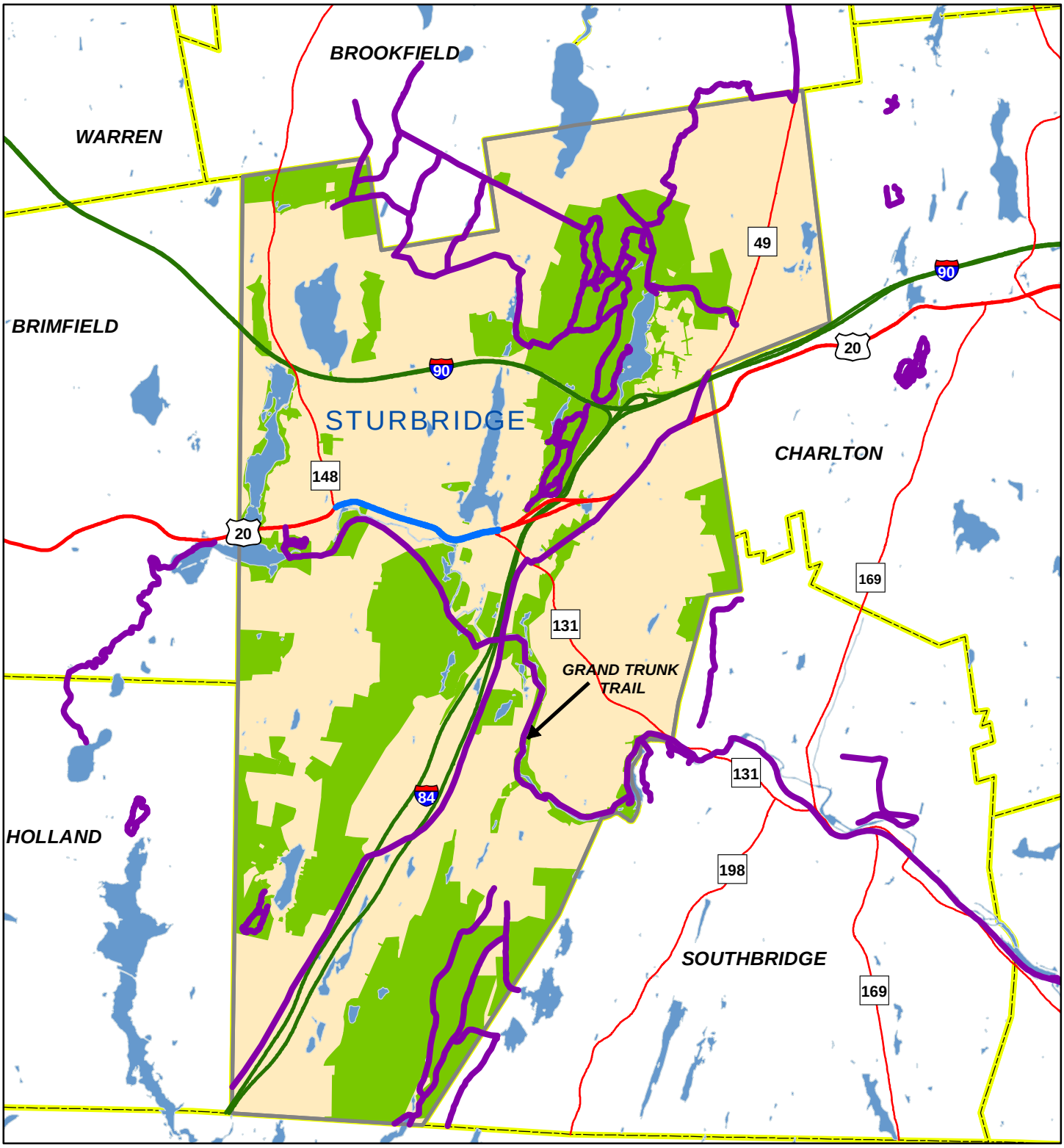
In addition to the grant mentioned above, the Committee also received a second grant for $44,390, with a town match of $29,480, for construction of the Riverlands Phase 1 of the Grand Trunk Trail. The work includes building a car parking lot and about 2,300 feet of trail. This area is near the Brimfield town line.

In early 2017, the CMRPC received a grant through the District Local Technical Assistance (DLTA) program to update the existing inventory and maps of the region's trail system. The CMRPC held three public meetings with host communities, land trusts, and various trail groups to identify what resources, maps, and information are currently available. Through this process it was found that participants wanted a clickable online regional map of the existing trails to use as a resource. To do this work, the CMRPC applied for an Efficiency & Regionalization grant through the Community Compact Program in November 2017, however it was not awarded to the CMRPC. The grant was for $50,000 and would have been used to continue the ongoing trail work.

Staff will again look to apply for funding through the DLTA program at a later date. To assist in this trail system mapping effort, a trails group for Southern Worcester County was established to discuss trails and help make updates to the map. In addition, the CMRPC communities would be responsible for mapping incomplete or missing trails within their communities. The town of Sturbridge was an active participant in the mentioned public meetings.

Also, in 2019, the CMRPC was awarded a MassTrails Grant for $26,648 to create a comprehensive web-based regional trails guide and app. The CMRPC will also add an additional

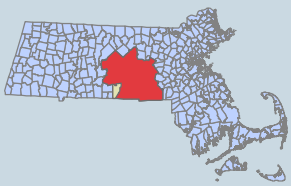
$6,662 in funds for this project. This online guide and app will serve as a central and standardized repository for trail features and locations throughout southern Worcester County. As of October 2019, CMRPC staff is still awaiting final approval from the Federal Highway Administration (FHWA) in regards to the awarded grant funds. Once staff receives the contract, work can begin.

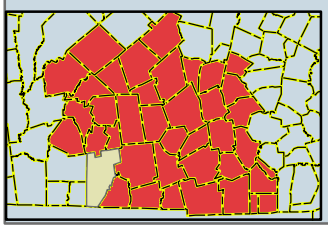


ROUTE 20 CORRIDOR PROFILE

Regional Trails & Open Space

Figure 19





Legend

- Route 20 Corridor Profile
- Interstate
- U.S. Route
- State Route
- Regional Trails
- Water Bodies
- Open Space

Miles

0 0.45 0.9 1.8 2.7 3.6

CMRPC
Central Massachusetts Regional Planning Commission

Source: Data provided by the US Census Bureau, Central Massachsuetts Regional Planning Commission (CMRPC), massDOT Office Of Transportation Planning Geospatial Resources Section and the Office of Geographic Information MassGIS), Commonwealth of Massachusetts, Information Technology Division.

Information depicted on this map is for planning purposes only. This information is not adequate for legal boundary definition, regulatory interpretation, or parcel-level analysis. Use caution intrepreting positional accuracy.

8.8 Performance Management

There are multiple regional Performance Measures that are related to this chapter. Each one is summarized below.

1. The first objectives are under the State of Good Repair category and include improving accessibility for all modes by increasing ADA-compliant ramps as well as improving sidewalks in poor condition. To help reach the first target, current non ADA-compliant ramps should be upgraded. In the Route 20 study area, there are a number of non-compliant ramps due for upgrades. These improvements could potentially be completed through the town's yearly roadway maintenance program or included within a larger roadway project. Basically, any new ADA-compliant ramps will help reach this performance target. In regards to sidewalks, the majority are in good to excellent condition with a small section in fair condition. Although improvements to the existing sidewalks won't reduce the cumulative number of sidewalks in poor condition, maintaining the current sidewalks would help prevent them from degrading over time.
2. The second Performance Measure is in regards to Multimodality. The first objective is to expand bicycle, pedestrian, and transit networks in the region. The second objective is to increase the number of communities with Complete Street policies by working with communities to encourage increased participation. To reach the first objective, sidewalks could be built where gaps exist and the width of Route 20 could potentially be widened to increase accommodations for bicycles, especially between Cedar Street and Route 131. Additionally, dedicated bicycle lanes could be marked along Route 20 in an attempt to increase drive awareness. For the second objective, the town of Sturbridge already has a Complete Streets policy. As such, nothing can be done in regards to this measure.
3. The third Performance Measure is in the Economic Vitality category. The objective is to make employment opportunities accessible and available allowing for job expansion by improving bicycle, pedestrian, and transit networks near major employment centers. There is a number of major employment centers located along Route 20 within the study area. These places all employ between 100 – 249 people. Any new roadway improvements should consider bicycle and pedestrian modes when being constructed. Currently, there is no public transit along this corridor so any potential transit improvements are unknown at this point.
4. The fourth Performance Measure is in regards to Travel and Tourism. The objective is to enhance the access, safety, and effectiveness of the region's transportation network that serves places of touristic value. Completing the Grand Trunk Trail or connections to the trail from Route 20 would help to meet this objective. Also, Old Sturbridge Village is

a major tourist attraction for Sturbridge. By improving the surrounding roadways with various bicycle & pedestrian amenities, this goal would also be reached.

9.0 Overall Corridor Profile Findings

This Corridor Profile effort considers the results of all Management System and environmental analyses and, in conjunction with the public process, selects those improvement options viewed as acceptable to the host community. Based on all the analysis completed and discussed previously, this section of the study summarizes the Corridor Profile findings for both intersections and roadway segments as well Performance Measures related to the Route 20 corridor.

9.1 Route 20 Intersections

Table 12 summarizes the findings for intersections. It includes study intersection locations, environmental considerations adjacent to Route 20, calculated intersection Level of Service (LOS), the percentage of heavy vehicles during the morning and evening peak hour periods, number of documented vehicle crashes, the availability of public transit and other considerations. These include obstructed lines of sight or the need for bicycle and pedestrian accommodations.

The following are Route 20 observations based on the table:

- All focus intersections are either near the Quinebaug River or Cedar Pond. The Quinebaug River requires a Total Maximum Daily Load (TMDL) and Cedar Pond contains an impairment that is not caused by a pollutant. The entire study section of Route 20 is within a wellhead protection area. In addition, most of the study intersections have wetlands or a flood zone nearby.
- The Stop-sign controlled Route 20 and Arnold Road intersection has the worst LOS currently and in the future. The intersections that operate the best are Cedar Street, Stallion Hill Road, and Fairground Road with an LOS “A” or “B” for existing and projected conditions in the AM & PM. The Route 20/Route 148/Holland Road intersection operates fairly well with a LOS of “C” for both time periods. This intersection can, at times, experience congested conditions due to heavy school traffic. The signalized intersection with the longest delay is Route 131. During the AM it has a LOS of “C” and worsens for the PM with a LOS of “D” for existing and “E” for projected conditions.
- Normally, heavy vehicles travel at slower speeds than passenger cars. As such, the more heavy vehicles on the roadway, the more likely travel times are slower. The percentage of heavy vehicles using the Route 20 intersections, as is typically the case in the region, was higher during the morning peak hour than in the evening peak. Often trucking activities follow a 7AM to 3PM shift, leading to a drop in activity in the evening.

Morning percentages were as high as 7.5% (Route 131) and evening percentages were as high as 2.5% (Route 148/Holland Road).

- MassDOT crash data from 2014-2016 was used for this Corridor Profile. There were a total of 72 crashes at the six study intersections in the town of Sturbridge. The intersection that had the highest amount of crashes was Route 131, with a total of 24. The next highest crash locations are Cedar Street with 17 and Arnold Road with 13. Using the 2014-2016 crash data, the Cedar Street intersection is eligible for Highway Safety Improvement Program (HSIP) funding.
- Currently, the WRTA does not provide fixed route public transit service along the Route 20 study corridor in the town Sturbridge. However, Elderbus does provide service to the elderly and disabled population.
- The Route 20 intersection with Route 148 and Holland Road has heavy congestion during school travel times in the AM & PM. It is difficult to exit Arnold Road during peak travel periods, especially left turns. Westbound vehicles making a U-turn at the Cedar Street intersection can cause delays for vehicle heading straight. At the Stallion Hill Road intersection, Route 20 westbound volumes use a jughandle for U-turns and also to access Stallion Hill Road as left turns are prohibited for westbound vehicles. Fairground Road and Route 131 intersections are in close proximity to each other and the traffic signals are synched together.

Table 12

Town of Sturbridge
Route 20 Focus Intersections:
Overall Corridor Profile Findings

Study Intersection Location	Environmental Consultation Analysis	Level-of-Service (LOS)**	Freight Movement Heavy Vehicle %	Safety Analysis***	Public Transit	Other Considerations
Route 20/Route 148/ Holland Road	Nearby water (Quinebaug River) requiring a TMDL*. Wellhead protection area.	AM = C (C) PM = C (C)	AM = 5.9% PM = 2.5%	9	No Fixed Route Service Elderbus provides service to the elderly and disabled	Heavy congestion during school travel times (AM & PM).
Route 20/Arnold Road	Nearby water (Quinebaug River) requiring a TMDL. Wellhead protection area. Nearby wetlands.	AM = E (F) PM = F (F)	AM = 6.6% PM = 1.9%	13	No Fixed Route Service Elderbus provides service to the elderly and disabled	Difficult exiting during peak travel periods, especially left turns.
Route 20/Cedar Street	Nearby water (Quinebaug River) requiring a TMDL. Wellhead protection area. Nearby flood zone. Nearby wetlands.	AM = B (B) PM = A (A)	AM = 5.4% PM = 1.4%	17	No Fixed Route Service Elderbus provides service to the elderly and disabled	U-turns for WB vehicles can cause delays during peak travel periods.
Route 20/Stallion Hill Road	Nearby water (Quinebaug River) requiring a TMDL. Wellhead protection area. Nearby flood zone. Nearby wetlands.	AM = A (A) PM = B (B)	AM = 4.7% PM = 2.4%	5	No Fixed Route Service Elderbus provides service to the elderly and disabled	Jughandle used for U-turns and left turns onto Stallion Hill Road.
Route 20/Fairground Road	Nearby water (Cedar Pond) contains impairment. Wellhead protection area. Nearby flood zone. Nearby wetlands.	AM = A (A) PM = A (A)	AM = 5.8% PM = 1.7%	4	No Fixed Route Service Elderbus provides service to the elderly and disabled	Close proximity to Route 131, traffic signals are synched together.
Route 20/Route 131	Nearby water (Cedar Pond) contains impairment. Wellhead protection area. Nearby flood zone. Nearby wetlands.	AM = C (C) PM = D (E)	AM = 7.5% PM = 2.1%	24	No Fixed Route Service Elderbus provides service to the elderly and disabled	Spacious intersection.

*Total Maximum Daily Load (TMDL)
**Intersection Level-of-Service Existing (Projected 2028)
***Total number of crashes (2014-2016)

9.2 Route 20 Roadway Segments

The Corridor Profile findings for Route 20 roadway segments are summarized in **Table 13**. Similar to the previous table, the roadway segment table lists each Route 20 study segment, environmental considerations adjacent to Route 20 and beyond, calculated roadway segment Level of Service (LOS), the daily percentage of heavy vehicles, number of documented vehicle crashes, the field-observed condition of the paved roadway surface, any highway or railroad bridges, the availability of public transit and other considerations, including the need to accommodate both bicycles and pedestrians.

Based on the information summarized in the table, the following observations are provided:

- All four Route 20 segments are either near the Quinebaug River or Cedar Pond. The Quinebaug River requires a Total Maximum Daily Load (TMDL) and Cedar Pond contains an impairment that is not caused by a pollutant. The entire study section of Route 20 is within a wellhead protection area. In addition, all segments have wetlands and a flood zone nearby.
- Unlike the intersections, the roadway segments LOS is calculated based on the density of the roadway. The two-lane segments of Route 20 between Route 148 and Cedar Street have a LOS of "E". The multi-lane segments between Cedar Street and Route 131 have a LOS between "A" and "C". Also, each direction of travel has its own LOS grade.
- Using data obtained through the ongoing traffic count program maintained by CMRPC, staff is able to determine heavy vehicle percentages along Route 20 for a 24-hour period. The data listed in the table is the daily percentage of heavy vehicles traveling along the focus segments. The entire study corridor averages about 11% heavy vehicles.
- From 2014 to 2016 there were 82 reported roadway segment crashes on Route 20 within the study area. The majority of the crashes (50) occurred between Route 148 and Arnold Road. The next highest number of crashes (25) happened between Arnold Road and Cedar Street. The two remaining segments of the Route 20 study corridor had a total of only seven crashes.
- Roadway pavement condition along Route 20 in Sturbridge is based on a calculated "Overall Condition Index" (OCI) which is derived from the pavement distresses (cracking, distortions, etc) observed in the field. The OCI scale ranges from 100, indicative of a new roadway, down to zero, where total failure of the paved surface is evident. The entire length of the Route 20 study segment is in "fair" condition and requires "Preventative Maintenance". The OCI scores range from 57 to 64. The segment between Cedar Street and Route 131 is separated by a raised median so each direction was rated separately.

- Route 20 has two bridges within the study area. One bridge (S-30-033) is located between Stallion Hill Road and Route 131 and the second bridge (S-30-022) is between Arnold Road and Cedar Street. Both of these structures are considered short span bridges. These types of bridges have a span between 10 to 20 feet and are categorized as a "BRI" structure which means it is a highway bridge that meets Massachusetts General Laws but not the federal definition of a bridge.
- Similar to that indicated in the intersection findings, there is no fixed-route public transit service along the entire length of the Route20 study corridor. However, Elderbus does provide service for the elderly and disabled in Sturbridge.
- Between Route 148 and Arnold Road there are gaps in the sidewalk on the south side of Route 20. Similar, most of the roadway segment between Arnold Road and Cedar Street has no sidewalk on the south side of Route 20. The multilane section of Route 20 between Cedar Street and Route 131 does not have an adequate shoulder on both sides of the roadway to fully accommodate bicyclists.

Table 13

Town of Sturbridge
Route 20 Roadway Segments:
Overall Corridor Profile Findings

Route 20 Roadway Segments	Environmental Consultation Analysis	Level-of-Service** (LOS)	Freight Movement Daily % of Heavy Vehicles	Safety Analysis***	Pavement Condition****	Bridges	Public Transit	Other Considerations
Route 148 to Arnold Road	Nearby water (Quinebaug River) requiring a TMDL*. Wellhead protection area. Nearby wetlands and flood zone.	AM = E (E) PM = E (E)	11.0%	50	OCI = 57.4 Preventative Maintenance	None	No Fixed Route Service Elderbus provides service to the elderly and disabled	Sidewalk gaps on south side of Route 20.
Arnold Road to Cedar Street	Nearby water (Quinebaug River) requiring a TMDL. Wellhead protection area. Nearby wetlands and flood zone.	AM = E (E) PM = E (E)	11.0%	25	OCI = 57.4 Preventative Maintenance	S-30-022	No Fixed Route Service Elderbus provides service to the elderly and disabled	No sidewalk on south side for majority of segment.
Cedar Street to Stallion Hill Road	Nearby water (Quinebaug River) requiring a TMDL. Wellhead protection area. Nearby wetlands and flood zone.	AM = B/A (B/A) PM = B/C (B/C)	11.0%	4	OCI (EB) = 61.4 OCI (WB) = 64.0 Preventative Maintenance	None	No Fixed Route Service Elderbus provides service to the elderly and disabled	No shoulder to fully accommodate a bicycle.
Stallion Hill Road to Route 131/ Fairgound Road	Nearby water (Cedar Pond) contains impairment. Wellhead protection area. Nearby wetlands and flood zone.	AM = B/A (C/A) PM = B/C (C/C)	11.0%	3	OCI (EB) = 61.4 OCI (WB) = 64.0 Preventative Maintenance	S-30-033	No Fixed Route Service Elderbus provides service to the elderly and disabled	No shoulder to fully accommodate a bicycle.

*Total Maximum Daily Load (TMDL)
**Segment Level-of-Service Existing (Projected 2028), EB LOS/WB LOS
***Total number of crashes (2014-2016)
****OCI = Overal Condition Index, Ranging From 0 - 100

9.3 Performance Management

Table 14 shows the integration of the Route 20 Corridor Profile findings as they relate to performance management. This table lists each of the ten federal transportation planning emphasis areas and the associated report chapter in which they are discussed. The performance objectives for each of the emphasis areas are also listed in the table. There are multiple performance areas that are included in more than one chapter while the State of Good Repair category is actually associated with three chapters. The corridor context column describes how the Route 20 corridor relates to each of the performance areas and its objective. Further, the last two columns list the observed deficiencies on Route 20 and what suggested improvements could perhaps help obtain the planning region's performance objectives.

Table 14 - Integrating Corridor Profile Findings with Performance Management

Associated Chapter	Performance Area	Performance Objective	Corridor Context	Observed Deficiencies	Suggested Improvement and Regional Impact
Chapter 4	SAFETY	Reduce the number and rate of fatal & serious injury crashes in the region on all roadways and freight routes. Also includes non-motorized fatalities and serious injuries. (PM1)	Route 20 is a primary freight route and a heavily traveled route for passenger cars. Safety improvements could reduce vehicle crashes that involve injuries and fatalities along the roadway/freight routes.	A total of 154 crashes occurred in the host community along the Route 20 study segment between 2014 and 2016. Of those crashes, 38 caused a non-fatal injury. Also, there is one HSIP crash cluster located at Cedar Street.	Improve Cedar Street intersection and other high crash locations along Route 20. Improve roadway geometry, pavement markings, signage, and add signalized traffic control, if needed, to reduce the number of crashes.
Chapter 4	SECURITY	Enhance the transportation security coordination and preparedness regionwide.	Route 20 is considered a primary evacuation route and it is important for the roadway to be safe and secure.	See the observed deficiences from the other performance areas.	See the suggested improvement options from the other performance areas.
Chapters 5, 6, 8	STATE OF GOOD REPAIR	Maintain the highway infrastructure asset system in a state of good repair (PM2): **5)** Increase % of pavement in good condition and reduce % of pavement in poor condition. **6)** Increase % of bridges by deck area in good condition and reduce % of bridge by deck area in poor condition. **8)** Increase number of ADA compliant ramps and reduce % of sidewalks in poor condition.	**5)** Route 20 is currently in fair condition throughout the study area. **6)** There are two short span bridges along the Route 20 corridor study area. **8)** Limited ADA compliant ramps along Route 20. Most sidewalks in good condition with a limited amount in fair condition.	**5)** None of the Route 20 segments are in poor condition, but if not maintained they could become poor in a few years. **6)** Short span bridges are not considered part of the National Bridge Inventory (NBI) so fixing them will not count towards the Performance Measure. **8)** Limited ADA compliant ramps. Some sidewalks in fair condition.	**5)** At the very least Preventative Maintenance such as crack sealing, patching and surface treatments should be scheduled along the entire study area so the roadway will not degrade to a poor condition. **6)** One of the short span bridges along Route 20 is expected to be reconstructed in the next two years. **8)** Upgrade existing non-ADA compliant ramps or install new ones. There are no sidewalks in poor condtion. Maintain all sidewalks to avoid deterioration.
Chapter 3	CONGESTION	To achieve a significant reduction in congestion on the National Highway System (NHS). Travel time reliability, non-SOV travel, peak hour excessive delay, and emissions reduction are the focus of this Performance Measure (PM3).	Route 20 is a major travel route for the host communities and surrounding towns. The MassPike (I-90)/I-84 interchange is located to the east of Route 131.	At times, heavy congestion exists along the Route 20 study segment. Half of the roadway is two lanes and the other half is four lanes. The two lane portions tend to be more congested. A few intersections have a LOS "C" or worse.	Periodically check timing and phasing of all traffic signals in the study corridor to be certain they are working efficiently. Create other travel options through the Complete Streets program.
Chapters 7 & 8	MULTIMODALITY	**7 & 8)** Expand the bicycle, pedestrian, and transit network in the region and work with member communities to implement Complete Streets policies.	**7 & 8)** The current bicycle, pedestrian and transit networks along Route 20 are inconsistant or non-existent. Working with the host community through Complete Streets can help lessen this inconsistency.	**8)** There are sidewalk gaps on the south side of Route 20. There are no shoulders for bicyclists along the multilane section of Route 20. **7)** Fixed-route transit does not exist along Route 20.	**8)** Construct new sidewalks where none currently exist. Widen sections of Route 20 where there are no shoulders. Sturbridge already has a Complete Streets policy and improvement plan. **7)** Potentially study the feasibility of fixed-route transit on Route 20.
Chapter 3	REDUCE GHG / SUSTAINABILITY	Reduce on-road mobile source emissions (PM3).	With reduction of vehicle delays GHGs could potentially be reduced.	An average of 20,000 vehicle per day travel Route 20. No fixed-route buses along Route 20. The roadway is not consistently suitable for all roadway users.	Encourage use of other modes along Route 20. Consider Complete Streets improvements.
None	EQUITY	Assure that improvements are made throughout the entire region and provide access to essential services for Enviornmental Justice (EJ) populations.	The town of Sturbridge does not have any EJ populations along Route 20, but does have a vulnerable population of head of household 75+ age. There is no fixed route bus access along this corridor. Route 20 is eligible for federal-aid monies through the TIP.	See the observed deficiences from the other performance areas.	Ensure that vulnerable populations have access to transportation services. Proposed projects should consider benefits and burdens of all populations in the project area.
Chapters 3 & 8	ECONOMIC VITALITY	**3)** Improve truck travel time reliability (PM3). **8)** Make employment opportunities accessible and available allowing for job expansion by improving bicycle, pedestrian, and transit networks near major employment centers.	**3)** Route 20 is a primary freight route, nearby MassPike (I-90)/I-84 Interchange. **8)** Multiple major employment centers witin or close to the Route 20 study area.	**3)** At times, heavy congestion exists along Route 20 in the host community. There are multiple intersections with a LOS "C" or worse. **8)** Limited shoulders for bicyclists, some gaps in sidewalks, and no fixed-route transit service.	**3)** Periodically check timing and phasing of all traffic signals in the study corridor to be certain they are working efficiently. **8)** Consider bicycle and pedestrian improvements around major employers to create safe and reliable travel for all modes. Look into the possibility of transit services along the roadway.
Chapter 2	STORMWATER MGMT & RESILIENCY	Create a transportation network that is resilient to the impacts of stormwater.	There are 4 drainage structures located under Route 20 within the study area. Two structures are considered short-span bridges and the other two are culverts. Making sure these culverts are working well could help reduce the impacts of storms.	One of the culverts could not be found during the field inspection visit. In addition, the south side of the second culvert could not be found. The bridge to the west of Cedar Street is scheduled to be reconstructed within the next two years.	Make sure the current drainage structures are sufficient according to todays standards. Attempt to locate the culverts that could not be found during the field visit.
Chapter 8	TRAVEL & TOURISM	To enhance the access, safety and effectiveness of the region's transportation network that serves places of touristic value.	There are regional and local trails in the host community of Sturbridge. Old Sturbridge Village is located off of Stallion Hill Road, south of Route 20.	See the observed deficiences from the other performance areas.	Install or improve wayfinding signs to recreation areas and tourist locations. Improve roadways near and around local tourist attractions.

10.0 Suggested Improvement Options

CMRPC summarizes a broad range of suggested improvement options within each completed Corridor Profile effort. Depending on host community needs, some suggestions can be specific to a certain corridor location or can be applied in all areas. Staff will typically meet with each community included in the Corridor Profile scope to discuss and incorporate their ideas for suggested improvements into the study report. Some improvements can be implemented on a short-term basis while others are aimed at the future, perhaps 5 to 10 years from the present.

As a reference, below are some of the short-term improvement options that were suggested in previous Corridor Profiles which can be used at specific intersections or along an entire corridor. These suggestions include:

- Check the traffic signal timing & phasing of signalized intersections.
- Maintain all traffic signals, signs, and pavement markings.
- Trim any overgrown vegetation that is obstructing sight lines of vehicles, signs, or traffic signals.
- Maintain good pavement surfaces.
- Maintain bridges, culverts, and other roadside drainage facilities and features.
- Consider access management techniques.
- Incorporate additional signage for safety purposes, such as warning signs.
- Consider enhancing pedestrian and bicyclist safety where needed.
- Reconfigure the travel lanes at an intersection where appropriate and feasible.
- Use streetscaping for beautification purposes.

Additionally, the following suggested improvements incorporated into prior Corridor Profile efforts were more for mid-term/long-term time frames. These types of improvements will likely cost more and will take longer to implement or construct. They have been mostly suggested on a community-by-community basis, but can generally be used for more than one location. They include:

- Realignment of intersection approaches.
- Consider the installation of a modern roundabout instead of a traffic signal where appropriate and feasible.
- Widen roadways where additional travel or turning lanes are needed.
- Incorporate Intelligent Transportation Systems (ITS) components into the roadway network, such as dynamic messaging signs.
- Install overhead highway lighting where necessary.
- Utilize a “Complete Streets” approach, designing for all roadway users.

- Coordinate traffic signals where appropriate and feasible.
- Install new traffic signals where warranted or modernize/update existing signal equipment.
- Install new or improve current guide signs for sites of touristic value.
- Utilize traffic calming measures along densely settled sections of a roadway, as appropriate and feasible.

Reaffirmed by the Fixing America's Infrastructure (FAST) Act, the CMMPO is continuing the evolution of the development of performance-driven, multimodal TIP projects. Performance Based Planning & Programming (PBP&P) is intended to improve public transparency, fiscal accountability, and investment decisions affecting the condition and performance of the transportation system.

The CMMPO's Performance Management program includes numerous goals and objectives across ten federal transportation planning emphasis areas. Each goal and objective has corresponding performance metrics that are monitored and progress towards the established goals is reported annually. A Performance Measures Scoresheet was created to assess current and candidate future year TIP projects and to what extent they address regional goals. TIP projects that rank high are often projects that can provide substantive measurable outcomes for each goal, thus having increased regional impact.

This Corridor Profile report includes a range of suggested improvement options for MassDOT and host community consideration. Maintained by MassDOT, Route 20 is federal-aid eligible, therefore many of the suggested improvement options could be included in future candidate TIP projects that have the potential to produce higher Performance Management scores. Higher scores increase the likelihood of CMMPO programming. Besides the TIP, the MassWorks Infrastructure Program could also be a funding option for some of the improvements on Route 20. For more information on the MassWorks program, click here MassWorks Program.

10.1 Route 20 Suggested Improvement Options

The following suggested improvement options, meant to address general overall deficiencies observed along the Route 20 study corridor, have been compiled for the consideration of both MassDOT and Sturbridge. These improvement options are also shown in **Figure 20**. Projected future year Level of Service results for intersections with proposed operational improvements are shown in **Table 15**.

Some improvement options included in this Corridor Profile were also suggested in a "2014 Commercial Tourist District Improvement Plan" conducted by the Pare Corporation, hired by the Town of Sturbridge. In addition, town officials have recently met with MassDOT District #3 staff in June of 2019 about moving forward with some of the proposed improvements from the

2014 plan. This effort in fact reaffirms some of the suggested improvement options while also considering up-to-date data and the current requirements for Performance Management.

Route 20/Route 148/Holland Road

- Check/adjust signal timing during peak hours.
- Add pedestrian walk signal for current crosswalk.
- Consider potential for a modern roundabout at this location. Analyzing this intersection as a roundabout showed an improvement in delays in both the AM and PM time periods. Future delays showed 13 seconds (LOS B) in the AM and 28 seconds (LOS D) in the PM.

Route 20/Arnold Road

- Consider installation of flashing beacon.
- Define lanes on Arnold Road approach to mark left and right turn lanes. Current striping on Arnold Road does appear sufficiently wide enough to provide for two lanes.

Route 20/Cedar Street

- Consider the feasibility of adding a left turn lane on the Route 20 westbound approach for vehicles making a U-turn.
- Update/improve lane drop warning signs for vehicles heading west. Consider lengthening lane drop transition area.

Route 20/Stallion Hill Road

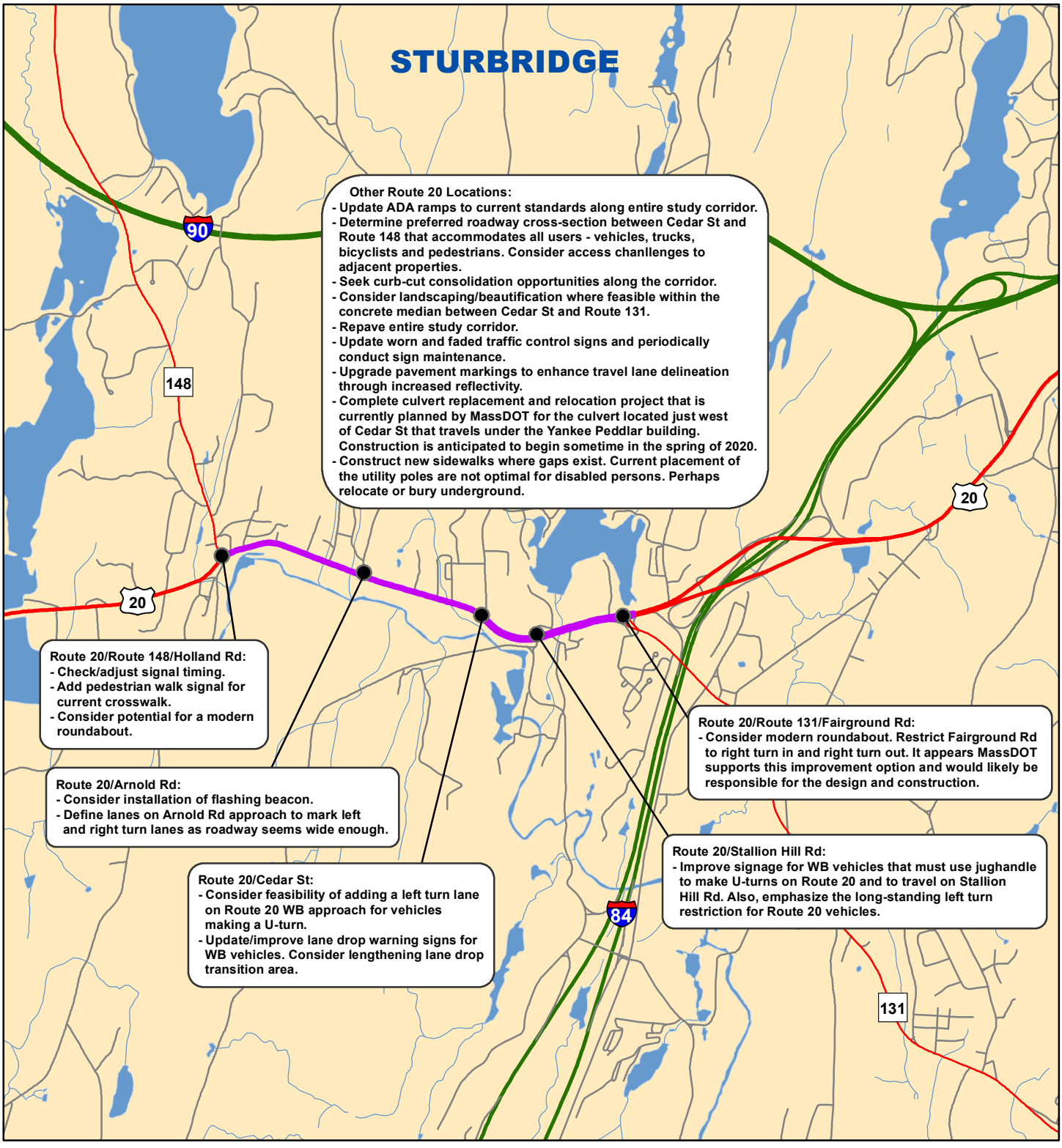
- Improve signage for westbound vehicles that must use jughandle to make U-turns on Route 20 and to travel on Stallion Hill Road. Also, emphasize the long-standing left-turn restriction for Route 20 vehicles.

Route 20/Route 131/Fairground Road

- Consider modern roundabout at this location. Restrict Fairground Road to right turn in and right turn out. It appears that MassDOT supports this improvement option and would likely be responsible for the design and construction of this project. (Staff is aware that to the east, MassDOT/Sturbridge are considering short term improvements to Route 20/New Boston Road intersection.) Future roundabout analysis showed improvement in the AM with 13 seconds of delay (LOS B), but delays would be worse in the PM with 93 seconds of delay (LOS F). MassDOT may need to explore additional design options associated with potential roundabout geometry in order to reduce the projected delay in the PM.

Other Route 20 Locations

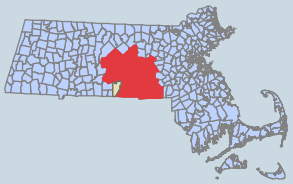
- Update ADA ramps to current standards along the entire study corridor.
- Determine a preferred roadway cross-section for Route 20 between Cedar Street and Route 148 that accommodates all users – vehicles, trucks, bicyclists and pedestrians. Consider access challenges to adjacent properties, especially on south side of Route 20.
- Construct new sidewalks where current gaps exist. Anticipated future MassDOT engineering directive could require improvement projects to consider a separated shared-use path for bicycle and pedestrians. If so, the north side of Route 20 would be a candidate location. Perhaps current utilities would need to be relocated or buried underground. The current placement of the utility poles are not optimal for disabled persons.
- Seek curb-cut consolidation opportunities along the entire study corridor.
- Consider landscaping/beautification where feasible within the concrete median between Cedar Street and Route 131.
- Repave entire study corridor.
- Update worn and faded traffic control signs and periodically conduct sign maintenance throughout the entire study corridor.
- Upgrade pavement markings to enhance travel lane delineation through increased reflectivity throughout the entire study corridor.
- A culvert replacement and relocation project is currently planned by MassDOT for the culvert located just west of Cedar Street that travels under the Yankee Peddlar building. Construction is anticipated to begin sometime in the spring of 2020 with an estimated cost of $3.9 million. New sidewalks and ADA ramps are also included within the project scope.

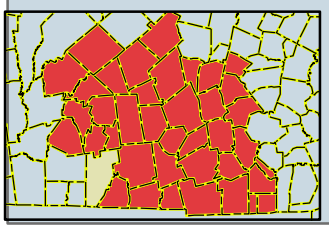


ROUTE 20 CORRIDOR PROFILE

Sturbridge Suggested Improvements

Figure 20





Legend

- Route 140 CP
- Interstate
- U.S. Route
- State Route
- Roads
- Streams
- Water Bodies

0 0.2 0.4 0.8 1.2 1.6 Miles

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Source: Data provided by the US Census Bureau, Central Massachsuetts Regional Planning Commission (CMRPC), massDOT Office Of Transportation Planning Geospatial Resources Section and the Office of Geographic Information MassGIS), Commonwealth of Massachusetts, Information Technology Division.

Information depicted on this map is for planning purposes only. This information is not adequate for legal boundary definition, regulatory interpretation, or parcel-level analysis. Use caution intrepreting positional accuracy.

TABLE 15
Intersection Level Of Service (LOS) Analyses Results:
Projected 2028 Conditions and Potential Future Year Improvements

COMMUNITY	ROUTE 20 INTERSECTION	NETWORK 2028 Projected AM V/C[1]	AM Delay[2]	AM LOS	NETWORK 2028 Projected PM V/C[1]	PM Delay[2]	PM LOS	Potential Future Year Improvements
	SIGNALIZED	**Overall Intersection Operations**						
Sturbridge	Route 20/Route 148/Holland Road	1.04	35	C	0.95	32	C	Consider modern roundabout: Future projected delay of 13 seconds in AM and 28 seconds in PM.
	Route 20/Cedar Street	0.88	12	B	0.70	10	A	Install potential westbound left turn lane.
	Route 20/Stallion Hill Road	0.63	10	A	0.97	18	B	Improve guide signage for jughandle and regulatory signage for no left turns.
	Route 20/Fairground Road	0.62	5	A	0.65	5	A	Consider modern roundabout: Future delay of 13 seconds in AM however 93 seconds in PM - due to heavy projected Route 20 westbound flows.
	Route 20/Route 131	0.87	24	C	1.38	59	E	
	UNSIGNALIZED[3]	**Minor Street Approaches under "Stop" Sign Control**						
Sturbridge	Route 20/Arnold Road	0.58	58	F	0.90	170	F	Consider installation of flashing beacon. Better define Arnold Rd approach lanes through minor widening and pavement markings.

1) V(volume)/C(capacity) is for worst lane group; C is maximum flow under prevailing conditions
2) Delay in seconds
3) Delay and LOS are for minor street approach

Central Massachusetts Regional Planning Commission

Member Communities

Auburn	Northborough
Barre	Northbridge
Berlin	Oakham
Blackstone	Oxford
Boylston	Paxton
Brookfield	Princeton
Charlton	Rutland
Douglas	Shrewsbury
Dudley	Southbridge
East Brookfield	Spencer
Grafton	Sturbridge
Hardwick	Sutton
Holden	Upton
Hopedale	Uxbridge
Leicester	Warren
Mendon	Webster
Millbury	West Boylston
Millville	West Brookfield
New Braintree	Westborough
North Brookfield	Worcester

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