

Springfield, Massachusetts

McKnight Community Trail

MassDOT Project File # 608157

July 2021

FUNCTIONAL DESIGN REPORT



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Prepared for: City of Springfield

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1.0 INTRODUCTION

BETA Group, Inc. (BETA) has prepared this Functional Design Report (FDR) to fulfill the Massachusetts Department of Transportation Highway Division (MassDOT) 25 percent design phase requirements for the proposed McKnight Community Trail Project (Project File No. 608157).

1.1 PROJECT BACKGROUND AND SUMMARY

The McKnight Community Trail Project (the Project) proposes to construct a ±1.5-mile multi-use path between Armory Street and the Rebecca M. Johnson School (Hayden Avenue) in the McKnight neighborhood of the City of Springfield, Massachusetts. The Project limits are shown in **Figure 1**.

The Project is representative of a December 2014 *Feasibility Study for the McKnight Community Trail*, conducted by Weston & Sampson. As specified in the Feasibility Study, the Project primarily utilizes a section of the former Highland Division of the New York, New Haven, and Hartford Railroad layout. The Feasibility Study referenced a 1997 *Master Plan* for a larger 12.5-mile trail along the railroad layout that was never completed. As of 1993, any previous railroad track infrastructure has been removed within the Project limits. The Project Site accommodates an underground oil pipeline owned by Buckeye Pipe Line Company LP which will be retained. The Project Site is currently owned by Buckeye Pipe Line Company LP, True Vine Church of God Pentecostal Inc, and the City of Springfield.

The Project will generally be comprised of a paved (bituminous concrete) 12-foot wide pathway with a footbridge structure (1,500 feet). The Project will provide structural improvements to the existing Glen Road Bridge (BR# S-24-027). The proposed trail will pass underneath the St James Avenue Bridge (BR# S-24-028). No proposed changes or impacts are expected by constructing the path underneath the bridge. It is noted that several amenities and trailhead connections to adjacent roadways were explored in the *Feasibility Study* are not included as part of the Project but may be added at a later date.

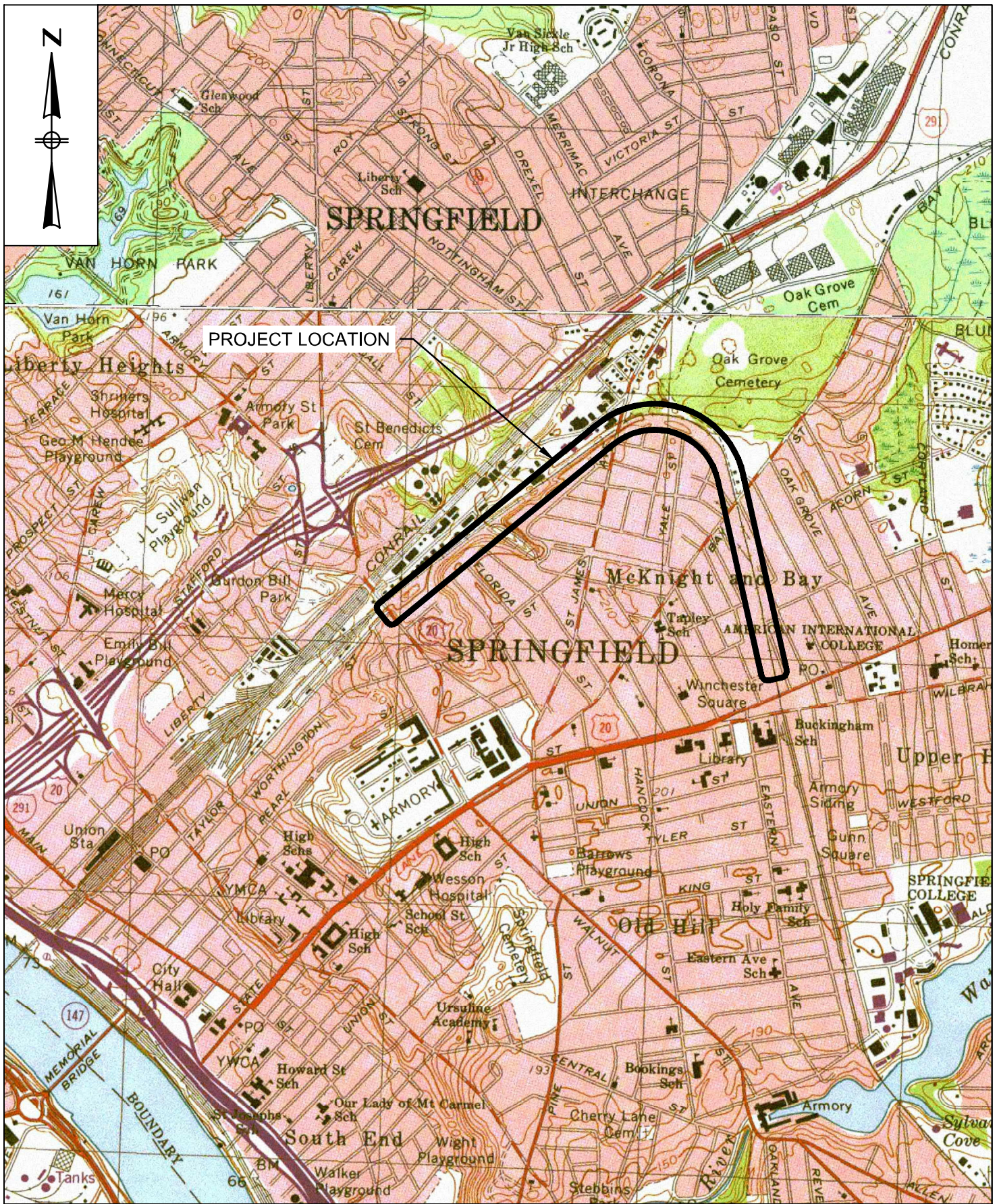
1.2 PROJECT DESCRIPTION

The proposed trail begins at the existing signalized intersection of Armory Street at Taylor Street and Agnew Street (the western trailhead) and travels northeast along what is known locally as Gasoline Alley, owned by Buckeye Pipe Line LP. The trail will pass over a reconfigured Glen Road Bridge, which spans an unnamed stream. The McKnight Trail will intersect north of the Glen Road Bridge to formalize an existing spur trail, "Glen Road Connector Trail," which provides access to Clarendon Street. A secondary spur providing access Cornell Street will be retained. Due to safety concerns, a connection to Albany Street via Glen Road (west of the trail) is not proposed as part of the Project. Glen Road currently functions as a driveway for industrial (fuel tank) uses.

What safety concerns?

Continuing northward, the paved (bituminous concrete) trail will become a footbridge over an area of wetland. The 1,500-foot-long footbridge will end near the St. James Avenue Bridge, returning to an at-grade paved (bituminous concrete) trail, traversing underneath St. James Avenue south of Albany Street. The existing St. James Avenue bridge will be retained. Existing vehicle, pedestrian, and bicycle accommodations will be retained along St. James Avenue.

East of St. James Avenue, the trail makes a sweeping right turn southward towards Bay Street. One at-grade crossing is proposed for the Project to be located on Bay Street between Clifford Street and Dawes Street. The Project intends to formalize the crossing with a marked crosswalk and a Pedestrian Hybrid Beacon.



Continuing southward, the trail will terminate at the Rebecca M. Johnson School along Hayden Avenue, which provides playgrounds, a splash pad, ball fields, and a parking facility. Further connection to State Street was evaluated in the *Feasibility Study* but is not intended for the Project.

2.0 EXISTING CONDITIONS

2.1 LAND USE

Land uses surrounding the Project consist of forested wetlands, industrial (energy), residential, and educational/institutional. Much of the Project will be located along right-of-way currently serving an underground oil pipeline.

It is noted that the Project is located within approximately one mile of Springfield Technical Community College, Springfield College, American International College, the Roger Putnam Vocational Technical School, and the Science and Technology School (Sci Tech).

2.2 TRAILHEADS AND GRADE CROSSINGS

Three study area locations were evaluated for this study including the western trailhead at Armory Street, Taylor Street, and Agnew Street; the at-grade crossing of Bay Street at Clifford Street and Dawes Street; and the eastern trailhead at Hayden Avenue.

2.2.1 ARMORY STREET AT TAYLOR STREET AND AGNEW STREET

Armory Street is an urban principal arterial under City jurisdiction that generally provides north-south travel between Springfield Technical Community College and the Chicopee City Line. North of the Project, Armory Street interchanges with Interstate 291 and Route 20 which both provide access between Interstate 91, the Springfield Metro Center, and Interstate 90 (Massachusetts Turnpike). Armory Street generally provides one travel lane in each direction, separated by double yellow center line. At the study area intersection, Armory Street provides a dedicated right turn lane to Taylor Street. Sidewalks are provided on both sides of Armory Street. Street lighting is provided on both sides of the roadway. Other utilities are generally located underground.

Taylor Street is an urban collector under City jurisdiction that provides east-west connections between the Springfield Metro Center and Armory Street. The roadway generally serves one lane in each direction separated by double yellow center line. Sidewalks are provided along the southern side of the roadway with guardrail and vegetation flanking the northern side of the roadway. At its intersection with Armory Street, Taylor Street provides one wide general purpose travel lane in each direction. It is noted that the eastbound travel lane is wide enough to stack two vehicles side-by-side, though a formal right turn lane is not marked. "No Turn on Red" signs are posted for Taylor Street vehicles.

Agnew Street is a private road serving as a driveway to industrial tenants. The roadway generally serves two-way east-west travel and vehicle parking. At the intersection with Armory Street, Agnew Street provides one travel lane in each direction separated by double yellow center line. "No Turn on Red" signs are posted for Agnew Street vehicles. Sidewalk is not provided on either side of Agnew Street given the narrow roadway width and parking areas.

The traffic signal accommodates signalized crossings on the western, northern, and eastern legs. Taylor Street and Agnew Street operate with split phasing. The Armory Street southbound right turn lane operates as an overlap with the Taylor Street phase. It is understood that this intersection is under evaluation as part of another project. While the proposed McKnight Community Trail is intended to terminate at Armory Street, no changes to the existing traffic signal and its operations are proposed.

2.2.2 BAY STREET AT CLIFFORD STREET AND DAWES STREET

Bay Street is an urban minor arterial under City jurisdiction that generally serves north-south traffic between St. James Street and Boston Road. Land use is generally residential and commercial. Bay Street generally provides one travel lane in each direction separated by double yellow center line. Bicycles are generally accommodated with ± 4 -foot-wide shoulders along both sides of the roadway. Shoulders are not defined as bike lanes. Sidewalks are provided along both sides of Bay Street, separated from the roadway by grass buffer and granite curbing. Bus turnouts are provided sporadically along both sides of the roadway. Street lighting is generally provided on the east side of Bay Street.

Clifford Street and Dawes Street intersect Bay Street from the west and east to form two offset unsignalized intersections. Both roadways are local roadways under City jurisdiction, accommodating two-way traffic with no striping. On-street parking is accommodated on both sides each roadway, primarily for residential use. Sidewalks are provided on both sides of the two roadways, separated by grass buffer. Clifford Street and Dawes Street are controlled with STOP signs and stop lines.

The existing intersection accommodates pedestrians north and south along Bay Street, though no existing crosswalk is provided for pedestrians crossing Bay Street. The nearest Bay Street crosswalk is approximately 1,300 feet south of Clifford Street at an existing traffic signal at Catherine Street.

A bus turnout is provided on the northbound side of Bay Street, south of Dawes Street and opposite Clifford Street. Public transportation and school buses generally travel along Bay Street in both directions throughout the day. The intersection serves as a school bus stop in the morning and afternoon. Southbound buses stop within the roadway between Clifford Street and Dawes Street, blocking all traffic. Northbound buses partially utilize the existing bus turnout, though all traffic must stop for the school bus. Students were generally observed congregating on the northwest corner of the intersection and cross the roadway as required depending on the direction of the bus. As noted, there is no existing crosswalk at this location. Additional students were observed waiting in parked vehicles along both sides of Clifford Street.



2.2.3 HAYDEN AVENUE

Hayden Avenue is a narrow local roadway under City jurisdiction that generally provides one-way southbound travel between Andrew Street and State Street. The largest land use is the Rebecca M. Johnson School along the western side of Hayden Avenue, though no direct vehicular access is provided via Hayden Avenue. On-street parking is prohibited on the western side of the road, fronting a large play field, playgrounds, a splash pad, and other amenities. On-street parking is accommodated on the eastern side of the roadway, which serves several residential structures and a cement concrete sidewalk. A pedestrian connection is provided between the sidewalk and the opposite field, though adequate signage is not provided for the crossing.

2.3 PUBLIC TRANSPORTATION

The Pioneer Valley Transit Authority (PVTA) provides local bus service throughout the City of Springfield and the surrounding region. Three PVTA buses were noted traveling through the Study Area.

Bus T3 utilizes Armory Street and State Street, providing service to local high schools during arrival and dismissal peak periods. Stops within the study area are located on Armory Street between Hannon Street and Agnew Street. Documentation suggests the bus makes one trip in the morning and afternoon.

Bus X90 – Inner Crosstown serves intercity connections to shopping centers and residential areas for East Longmeadow, Springfield, Chicopee, and Holyoke. Within the study area, Bus X90 travels along Armory Street and provides stops between Hannon Street and Agnew Street. Weekday and Saturday headways are generally 30 minutes with service between 7:00 AM and 9:00 PM. Sunday headways are generally 60 minutes with service between 9:00 AM and 5:00 PM.

Bus B6 – Ludlow via Bay Street serves intercity connections to Ludlow and Springfield Union Station (Amtrak regional rail). Within the study area, Bus B6 travels along Bay Street with stops opposite Clifford Street (northbound) and at Princeton Street (southbound). Weekday headways are generally 20 minutes, with service between 5:00 AM and 10:00 PM. Saturday headways are approximately 30 minutes with service between 7:00 AM and 9:00 PM. Sunday headways are generally 45 minutes, with service between 8:30 AM and 7:00 PM.

2.4 TRAFFIC VOLUMES

In accordance with MassDOT Engineering Directive E-20-005, the traffic data utilized as part of this study were obtained from various sources. Given the current global COVID-19 Pandemic, the traffic engineering profession has found varied travel patterns including but not limited to increased or decreased travel volumes throughout the day. Within the study area, historical traffic data was obtained in January 2019 along Armory Street, State Street, and Bay Street.

In addition, this study evaluated new traffic data collected in May 2021 for locations that did not have historical data. Automatic Traffic Recorders (ATR) collected traffic volume, speed, and classification for 48 hours on Tuesday, May 18th and Wednesday, May 19th in 2021 along Bay Street and Hayden Avenue. Turning Movement Counts (TMC) were collected for the intersection of Bay Street at Clifford Street and Dawes Street on Tuesday, May 18, 2021 from 7:00 AM to 6:00 PM. Complete traffic data is included in the Appendix.

2.4.1 ADJUSTMENT

Traffic volumes were evaluated for seasonal adjustment based on current MassDOT directives. Traffic data for Armory Street, obtained in January 2019, was seasonally adjusted by a factor of 1.06 to represent average month conditions for similar urban principal arterials. Agnew Street and Taylor Street volumes were adjusted by a factor of 1.01 to represent average month conditions for other roadways.

As the Bay Street data collection occurred during the COVID-19 Pandemic, these data were compared with historical data at Bay Street and Tapley Street collected in July 2019. MassDOT data suggests July volumes are higher than the average month. For the purposes of this study, no adjustment was made. A summary of the comparison exercise is provided in **Table 1** and graphically in the chart below.

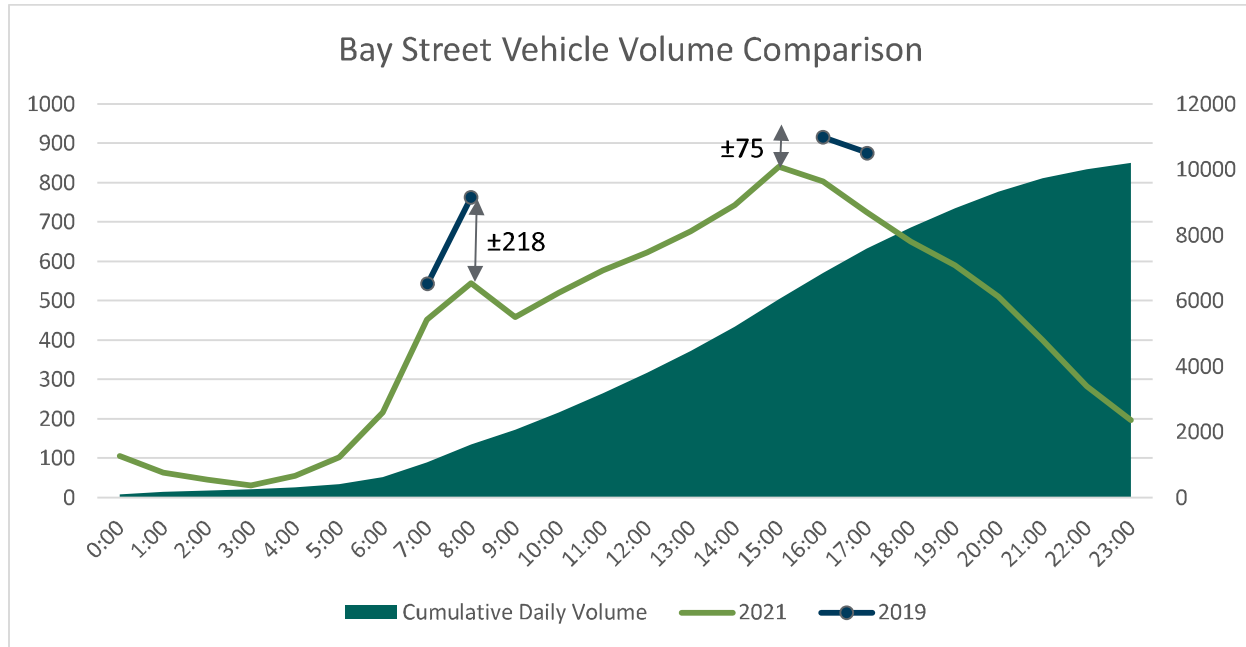


Table 1: Bay Street Traffic Volume Adjustment for COVID-19

TIME	May 2021	July 2019	Diff	Adjustment	SAY
7:00	451	544			
8:00	544	762	218	1.401	1.40
15:00	840*	--	75*	1.089	1.10
16:00	802	915*			
17:00	725	875			
4-Hour	2522	3096	574	1.228	1.25

* PM Peak Hour was found to be earlier in 2021. Used to provide a conservative analysis.
4-Hour exercise includes volumes from 7:00-9:00 and 16:00-18:00
Data summary based on 2021 ATR Volume and 2019 Turning Counts at Tapley Street

As shown in the table, adjustment factors were rounded for ease of comparison. As daily volumes were not available based on historical turning counts, the daily adjustment (1.25) was approximated based on the four available hours obtained in 2019. Peak hour comparisons revealed higher volumes in the afternoon and lower volumes in the morning, resulting in a larger (1.4) adjustment in the AM Peak Hour and a smaller (1.1) adjustment for the PM Peak Hour. It is noted that the afternoon (PM) peak hour observed in 2021 was earlier than those observed in 2019. To be conservative, the earlier peak hour was utilized and adjusted for this study.

While no historical data was available for Hayden Avenue, the existing roadway characteristics support the small volumes obtained in 2021. Nevertheless, this study assumes the adjustments developed via Bay Street are generally applicable for Hayden Avenue. **Table 2** provides a summary of the adjusted daily and peak hour volumes for Armory Street, Bay Street, and Hayden Avenue.

Table 2: Average Daily Traffic Volumes

Location	Daily	Weekday AM Peak Hour			Weekday PM Peak Hour		
	Weekday	Volume	K Factor	Dir. Dist.	Volume	K Factor	Dir. Dist.
Armory Street N of Napier Street	18,500	1,240	6.7	56% NB	1,430	7.8	50/50
Bay Street N of Dawes Street	12,750	765	6.0	50/50	1,020	8.0	54% NB
Hayden Avenue N of State Street	200	15	7.5	--	20	10.0	--

Note: Bay Street and Hayden Avenue volumes adjusted for COVID-19 based on Historical 2019 Volumes

Adjustment Factors: Daily = 1.25 AM Peak = 1.4 PM Peak = 1.1

Armory Street volumes seasonally adjusted by a factor of 1.06 to represent average month conditions

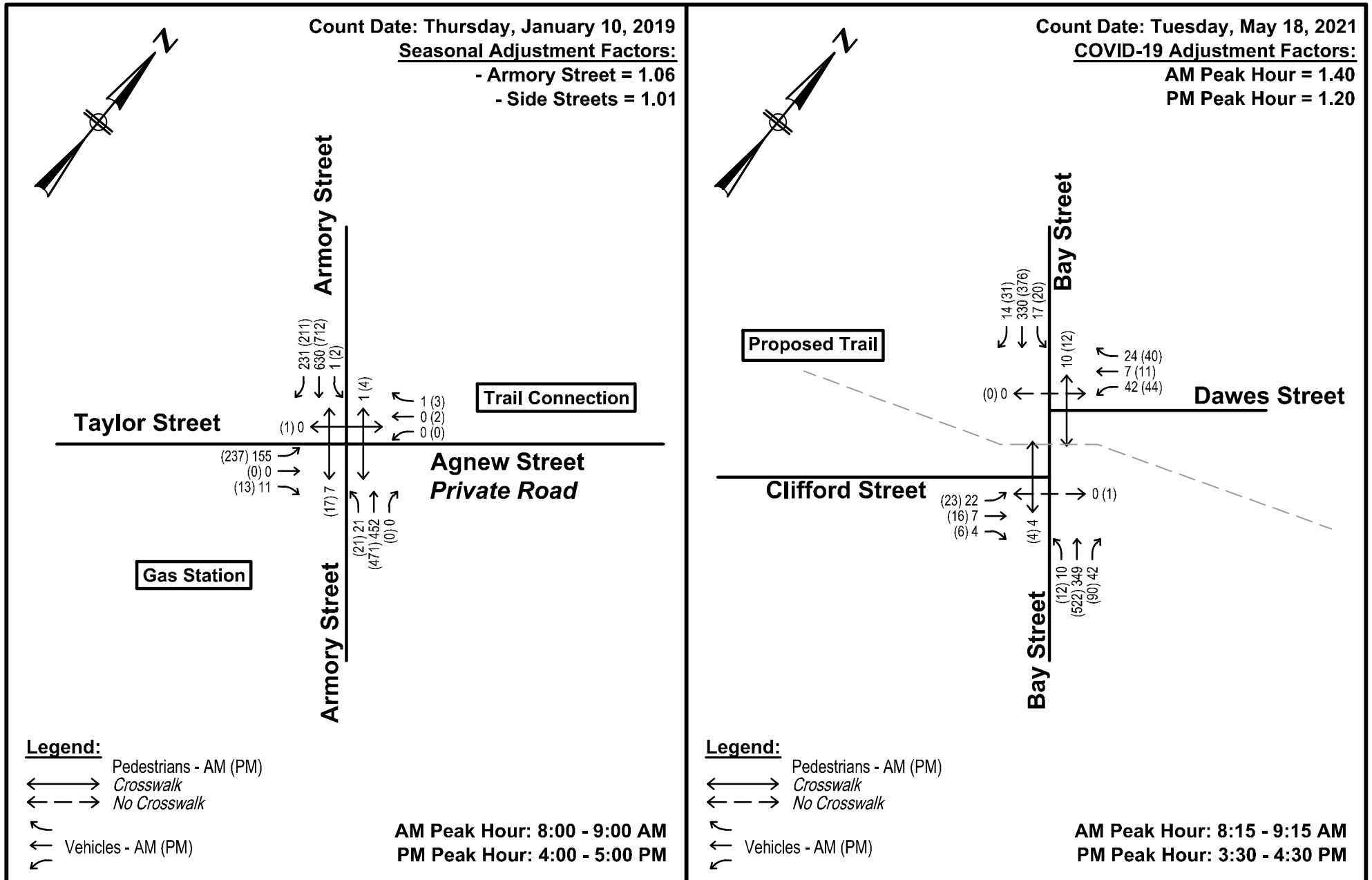
As shown in the table, Armory Street was found to carry approximately 18,500 vehicles per day with slightly higher northbound travel in the morning and relatively split travel in the afternoon. Bay Street was found to carry approximately 12,750 vehicles per day with higher northbound travel in the afternoon. Hayden Avenue was found to carry approximately 200 vehicles per day. All three roadways were found to have higher afternoon (PM peak hour) volumes than those in the morning (AM peak hour).

A summary of the adjusted peak hour vehicle and pedestrian turning volumes are provided in **Figure 2**. Armory Street was found to have peak hours between 8:00-9:00 AM and 4:00-5:00 PM. In general, Taylor Street traffic is more heavily oriented to/from the north via Armory Street, likely due to the Interstate 291 connection. Agnew Street was found to have negligible volumes in the peak hour. Armory Street traffic was heavier in the southbound direction for both peak hours. Pedestrians were generally found to have higher volumes walking along the west side of Armory Street and crossing Taylor Street. A negligible number of pedestrians were observed crossing Armory Street at this intersection in the peak hour.

Bay Street peak hours were found to occur between 8:15-9:15 AM and 3:30-4:30 PM. Data suggests Dawes Street is more heavily utilized than Clifford Street in both peak hours. Dawes Street provides a connection to State Street via Andrew Street. Bay Street volume is generally split evenly northbound and southbound in the morning, with slightly higher northbound volume in the PM Peak Hour. Pedestrian traffic was higher along the eastern side of Bay Street, crossing Dawes Street. A negligible number of pedestrians were observed crossing Bay Street at this intersection in the peak hour, though it is noted that no existing crosswalk is provided for such a movement.

2.5 TRAFFIC SPEEDS

Vehicle travel speeds were measured via Automatic Traffic Recorder (ATR) in May 2021 for Bay Street and Hayden Avenue. A comparison of posted (or prima facie) speed limits and the measured 85th percentile speeds are provided in **Table 3**. Historical speed data for Armory Street was not available.



McKnight Community Trail
 Springfield, MA

Figure 2
 Existing Peak Hour Traffic Volumes
Not to Scale

Table 3: Existing Travel Speed Summary

Location	Direction	Speed Limit (Posted)	85th Percentile Speed (Measured)
Bay Street	NB	30 mph	35 mph
N of Dawes Street	SB	30 mph	35 mph
Hayden Avenue	NB	--	--
N of State Street (One Way)	SB	25 mph*	22 mph

* Advisory School Zone

The table shows 85th percentile speeds on Bay Street were approximately 35 miles per hour (mph) in both directions which is slightly higher than the prima facie/posted speed of 30 mph. Hayden Avenue was found to have 85th percentile speeds of 22 mph, which is consistent with the posted 25 mph school advisory.

2.6 VEHICLE CLASSIFICATION

Vehicle classification was obtained via Automatic Traffic Recorder (ATR) in May 2021 for Bay Street and Hayden Avenue. A summary is provided in **Table 4**. Based on the information, Bay Street was found to have a truck percentage of approximately 6.2% northbound and 0.8% southbound. The narrow roadway of Hayden Avenue included approximately 0.9% trucks. Buses represented approximately 1% of total Bay Street traffic.

Table 4: Existing Vehicle Classification

Location	Direction	Bus	Heavy Vehicle*
Bay Street	NB	0.8%	6.2%
N of Dawes Street	SB	1.3%	0.8%
Hayden Avenue	NB	--	--
N of State Street (One Way)	SB	0.0%	0.9%

*Heavy vehicle defined as "2 Axle 6 Tires" and larger

3.0 SAFETY ANALYSIS

3.1 CRASH DATA

Crash data were obtained from IMPACT¹, MassDOT Highway Division's crash data repository, for the most recent five available years (2014-2018). Crash data were reviewed for at-grade trailheads or crossings within the study area including:

- Armory Street at Taylor Street and Agnew Street
- Clarendon Street at Glen Road Trail
- Bay Street at Clifford Street and Dawes Street
- Hayden Avenue at Rebecca M. Johnson School

Intersection crash rates were calculated based on the collected turning movement counts and compared to the MassDOT Statewide and District 2 average crash rates for signalized and unsignalized intersections. Crash rates represent the average number of reported crashes per million entering vehicles.

A summary of crash data is provided in **Table 5**.

As can be seen in the table, the signalized intersection of Armory Street at Taylor Street and Agnew Street had the largest number of reported crashes (26) over the five-year period. These were predominantly rear-end type crashes (50%) and angle type crashes (35%). There were zero reported crashes involving a pedestrian or bicycle. Three crashes were reported involving at least one bus and one crash was reported involving at least one tractor trailer. Crashes were generally found to result in property damage with nine (35%) listed as an injury. It is noted that zero crashes resulted in serious (incapacitating) injuries or fatalities. Based on the data, crash frequency increased in 2018 and are generally more likely to occur in the fall (September-November) or spring (March-May). This may be a correlation to the nearby colleges/universities. Interestingly, approximately 10 crashes (38%) were reported with "Inattention" as a contributing factor for the crash. The intersection was calculated to have a crash rate of 0.66 crashes per million entering vehicles, which is lower than the statewide and District 2 averages for signalized intersections.

The unsignalized intersection of Bay Street at Clifford Street and Dawes Street experienced 13 reported crashes in five years. Crashes were typically angle type (54%), generally consistent with turning maneuvers and the offset unsignalized intersection configuration. Zero crashes were reported involving a pedestrian or a bicycle, though one crash was reported involving a moped. Six crashes (46%) were reported involving an injury, though zero were reported with serious (incapacitating) injuries or fatalities. Seven of the 13 crashes (54%) were reported in the spring (March-May) months. The intersection was calculated to have a crash rate of 0.48 crashes per million entering vehicles, which is lower than the statewide and District 2 averages for unsignalized intersections.

The trailheads at Clarendon Street and Hayden Avenue were both found to have minimal crash activity. The Clarendon Street crash was noted as a sideswipe likely associated with the curvature of the roadway. The Hayden Avenue crash was reported as a speed related single vehicle crash in the late evening/overnight hours.

¹ <https://apps.impact.dot.state.ma.us/cdp/home>

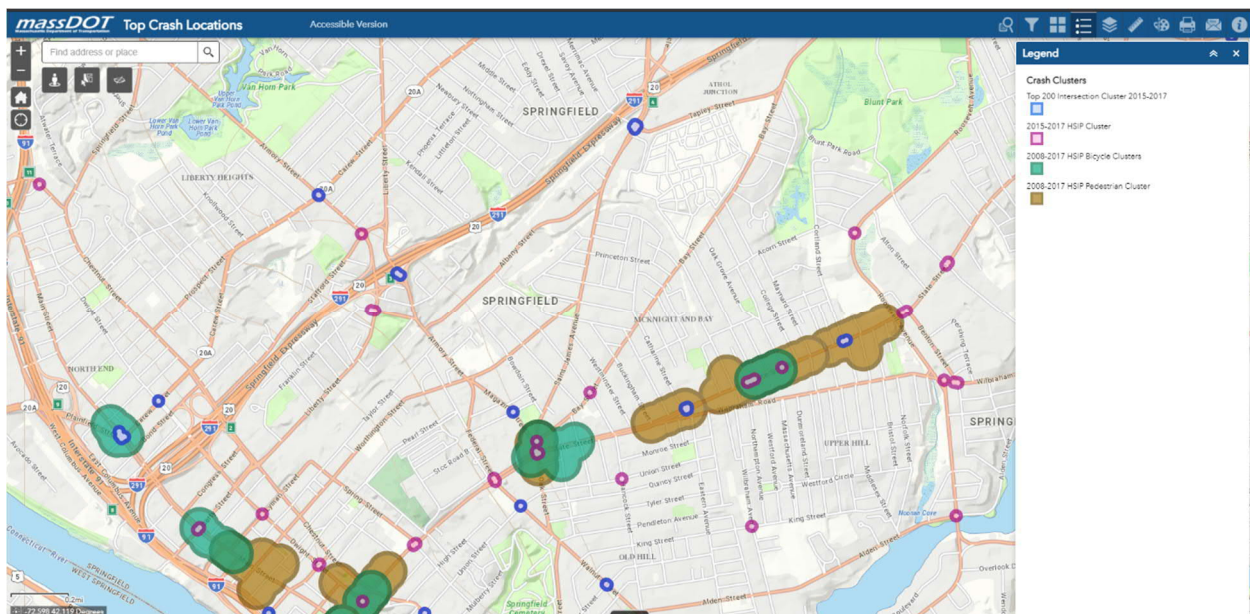
Table 5: Crash Data Summary

	Armory St at Taylor St & Agnew St	Clarendon St at Glen Road Trail	Bay St at Clifford St & Dawes St	Hayden Ave at Rebecca M. Johnson School
<u>Collision Type</u>				
Angle	9	0	7	0
Rear-End	13	0	2	0
Sideswipe	2	1	3	0
Pedestrian / Bicycle	0	0	0	0
Single Vehicle Crash	2	0	1	1
<u>Crash Severity</u>				
Property Damage	15	1	7	1
Non-Fatal Injury	9	0	6	0
Not Reported	2	0	0	0
<u>Ambient Light</u>				
Daylight	19	1	12	0
Dusk	0	0	1	0
Dark - Lighted Roadway	7	0	0	1
<u>Weather Condition</u>				
Clear	17	1	6	1
Cloudy	4	0	7	0
Rain	5	0	0	0
<u>Time of Year</u>				
December - February	3	0	1	0
March - May	7	0	7	0
June - August	5	1	3	1
September - November	11	0	2	0
<u>Year</u>				
2014	3	0	2	0
2015	7	0	2	0
2016	4	0	4	1
2017	2	1	2	0
2018	10	0	3	0
<u>Summary</u>				
Total crashes 2014 – 2018	26	1	13	1
Average crashes per year	5.2	0.2	2.6	0.2
Crash Rate*	0.66	--	0.48	--
<i>District 2 Crash Rate*</i>	<i>0.80</i>	--	<i>0.62</i>	--
<i>Statewide Crash Rate*</i>	<i>0.78</i>	--	<i>0.57</i>	--

*per million entering vehicles

3.1.1 HIGHWAY SAFETY IMPROVEMENT PROGRAM (HSIP)

The MassDOT Highway Safety Improvement Program (HSIP)² was evaluated to determine if the study area falls within a known high crash cluster. As shown in the image below, State Street has been defined as a pedestrian cluster (2008-2017). This section of State Street is adjacent to several commercial properties, high density residential, and fronts the American International College. The proposed terminus of the McKnight Community Trail is located outside (to the north) of this existing high crash cluster.



While other clusters exist in the region, none of the reported clusters are located at existing or proposed at-grade crossings for the trail.

3.2 TRAFFIC SIGNAL WARRANT ANALYSIS

To justify the installation or continued use of a traffic signal at an intersection, one or more of the traffic signal warrants in the Manual on Uniform Traffic Control Devices (MUTCD) must be met. Nine warrants are included in the MUTCD for traffic signals. A traffic signal warrant analysis was performed for the existing traffic signal at the Armory Street, Taylor Street, and Agnew Street intersection, and the unsignalized intersection of Bay Street at Clifford Street and Dawes Street.

As part of this evaluation, the following traffic signal warrants were evaluated based on procedure outlined in the MUTCD:

- Warrant 1, Eight Hour Vehicular Volume
- Warrant 2, Four Hour Vehicular Volume
- Warrant 3, Peak Hour Vehicular Volume
- Warrant 4, Pedestrian Volume

Warrants 5 through 9 were not deemed applicable for this Project and were not evaluated. A summary of the traffic signal warrant evaluation is provided in **Table 6**. Backup calculations are provided in the **Appendix**.

² <https://gis.massdot.state.ma.us/topcrashlocations/>

Table 6: Traffic Signal Warrant Summary

Location	Warrant 1	Warrant 2	Warrant 3	Warrant 4
Armory Street at Taylor Street & Agnew Street	YES	YES	YES	NO
Bay Street at Clifford Street & Dawes Street	NO	NO	NO	NO

As can be seen in the table, the continued operation of the existing traffic signal at Armory Street, Taylor Street, and Agnew Street is warranted. While Agnew Street volume is negligible under existing conditions, the seasonally adjusted Taylor Street volumes well exceed the required thresholds the three vehicular volume-based warrants. Pedestrian volume was found to be too low to satisfy the Pedestrian Volume warrant. No signal related changes are intended as part of the McKnight Trail Project.

The intersection of Bay Street at Clifford Street and Dawes Street was evaluated based on the observed May 2021 turning movement volumes. Under the existing conditions, side street (Clifford Street and Dawes Street) volume are significantly lower than the required thresholds for Warrant 1, 2, and 3. Similarly, pedestrian volumes were observed to be significantly lower than the Warrant 4 threshold. Adjusting the existing volumes, discussed in **Section 2.4.1**, does not increase the observed volumes enough to satisfy any of the warrants. Based on this analysis, the installation of a full traffic signal is not recommended.

3.3 PEDESTRIAN CONTROL DEVICE ANALYSIS

As part of this evaluation, the following pedestrian safety devices were considered for installation at the crossing location.

3.3.1 PEDESTRIAN HYBRID BEACON

The next level down from a full traffic signal control is a Pedestrian Hybrid Beacon. These beacons, also called a HAWK Signal, include standard Walk/Flashing Don't Walk/Don't Walk pedestrian signals and vehicular signal heads in a "T" shape configuration (RED, RED, YELLOW). Under normal operation, vehicular signal heads are off (dark). When a pedestrian pushes the button, the yellow signal head begins flashing to alert drivers of the upcoming signal change. The flashing yellow turns to steady yellow, then steady double red (side-by-side). At this time, the solid WALK signal activates allowing the pedestrians to cross. When the pedestrian signal switches to Flashing Don't Walk, the vehicular red signals begin flashing in a wig-wag pattern. This allows vehicles to proceed with caution if no pedestrians are present. When the Flashing Don't Walk ends, the signal turns dark again for regular travel. It is noted that a Pedestrian Hybrid Beacon does not control the side streets, which would continue to operate as STOP signs.

Section 4F.01 of the MUTCD outlines the recommended guidance for installation of a Pedestrian Hybrid Beacon. The guidance is based on the 85th percentile speed and volume of major road vehicles, the crossing distance, and the pedestrian volume. Based on an 85th percentile speed of 35 miles per hour, a crossing distance of approximately 30 feet, and a two-way peak hour vehicular volume of approximately 825 vehicles, the required pedestrian volume for the crosswalk is 400-500 pedestrians per hour. The existing intersection was observed to accommodate approximately 10 pedestrians per hour (in the peak period) in May 2021. It is noted that no existing crosswalk is provided for the intersection. The existing

school bus and PVTA bus stops likely represent a significant portion of the peak period pedestrian crossings.

BETA evaluated Table 1 of the Federal Highway Administration (FHWA) *Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations*. The table outlines various crossing treatments to improve safety based on vehicle speed, volume, and roadway lane configuration. For this crossing location, Table 1 recommends the installation of High Visibility Crosswalk Markings, Parking Restrictions, Adequate Lighting Levels, and Crossing Warning Lights. Further, the table suggests the consideration of a Pedestrian Hybrid Beacon.

The proposed trail is expected to significantly increase pedestrian and bicycle activity, especially given the proximity to nearby colleges and universities. The trail would likely be utilized for recreational activity, athletic training, and as a non-motorized route for school commuting. While the induced demand is not realized at the time of writing, it is expected that the installation of a pedestrian hybrid beacon would adequately and safely accommodate pedestrian crossings given increased vehicular and non-motorized volumes in future years.

3.3.2 RECTANGULAR RAPID FLASHING BEACON

As discussed in Table 1 of the Federal Highway Administration (FHWA) *Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations*, the installation of a Rectangular Rapid Flashing Beacon (RRFB) was considered for the proposed trail crossing. The RRFB is a flashing warning beacon that supplements existing pedestrian warning signage in accordance with FHWA Interim Approval 21, dated March 20, 2018 and have been utilized throughout the Commonwealth of Massachusetts over the last several years. As an RRFB is a supplementary warning device, it does not regulate traffic or require vehicles to STOP in the way that a full traffic signal or Pedestrian Hybrid Beacon does. As such, they are an adequate safety countermeasure for crosswalks where pedestrian and vehicle volumes do not justify the installation of other measures.

For the purposes of this Study, the installation of an RRFB is an acceptable safety measure. However, given the urban nature of the area and the high potential for a significant increase in pedestrian and cycling traffic, a Pedestrian Hybrid Beacon is recommended. This conclusion is generally in accordance with the December 2014 *Feasibility Study* discussed in **Section 1.0**.

4.0 PROPOSED IMPROVEMENTS

The proposed Project along the former railroad corridor will be designed for a vehicle³ design speed of 18 mph and connect Armory Street via Agnew Street to the Rebecca M. Johnson School at Hayden Avenue. The following improvements are proposed:

4.1 SHARED USE PATH ALIGNMENT AND MARKINGS

The trail will generally consist of a 12-foot wide hot mix asphalt (bituminous concrete) surface with parallel unpaved graded shoulders varying two to five feet in width. The path will narrow from 12-feet to 8-feet approaching/departing Agnew Street given the constrained driveway-like nature of the roadway and abutting properties. The project will maintain a 21.5-foot wide Agnew Street to accommodate the existing industrial uses. The eight-foot wide path will connect to an existing five-foot wide cement concrete sidewalk along Armory Street. This is intended to provide pedestrian and bicycle

³ The proposed multi-use path is not intended to serve motorized vehicles but will accommodate authorized snow removal, maintenance, and/or emergency response vehicles where necessary.

access to the existing traffic signal, which will be retained. North of Agnew Street the 12-foot path continues, crossing over the Glen Road Bridge and intersects with the Glen Road Trail Connector at a T-intersection. Portions of the Glen Road Trail Connector will narrow from 12-feet to 8-feet in width to minimize the impacts to area wetlands. It is noted that segments of 8-foot width is an accepted minimum width for two-way pedestrian and bicycle travel based on the *MassDOT Project Development Design Guide* and the *MassDOT Separated Bike Lane Planning and Design Guide*. Approximately 400 feet north of the Glen Road Connector, the paved 12-foot wide path will be raised footbridge over an area of wetland. The footbridge will extend for approximately 1,500 feet, ending near the St. James Avenue Bridge. The remainder of the trail will return to the 12-foot wide paved surface.

Centerline markings are not proposed for the trail. The proposed at-grade crossing will provide a Pedestrian Hybrid Beacon, relevant signage, updated roadway striping, a new crosswalk, and updated signage for the two side streets.

The eastern terminus at Hayden Avenue will provide updated roadway striping, reconfigurations to on-street parking, a pedestrian plaza, and other amenities where appropriate.

5.0 OTHER PROJECT CONSIDERATIONS

5.1 MAINTENANCE OF TRAFFIC DURING CONSTRUCTION

All roadways will remain open to traffic through construction. Pedestrian and vehicular access to abutting properties will be maintained at all times, except for brief periods when abutters will be notified in advance. As the existing site is undeveloped, no impact is expected to pedestrian and bicycle activity during construction.

5.2 PROJECT SCHEDULE

The project is scheduled on the 2023 Transportation Improvement Plan (TIP) for the Pioneer Valley Planning Commission (PVPC). It is anticipated that construction can begin in the Spring of 2023 and be substantially completed with 18 months.