Industrial Avenue Corridor Study
Williston, Vermont

April 15, 2013

Final Report

Prepared by:
Stantec
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This study is the result of the support and strong interest of the Project Committee Members. Much of the background, history, local input, existing conditions, and consensus documented in the study is attributed to the Committee member's involvement. The study's quality and success is due to their contributions.
Executive Summary

The Industrial Avenue Corridor Study was prepared at the request of the Town of Williston and the Chittenden County Regional Planning Commission (CCRPC) to anticipate future travel demands along Industrial Avenue and to define multi-modal strategies to accommodate these demands. Future traffic forecasts were made based on assumed changes in land use patterns within the corridor as well as historical regional traffic growth patterns. A number of alternative strategies to safely and efficiently accommodate those travel demands were defined and evaluated. After considering public comment on the alternatives a recommended plan has been proposed. The recommended plan provides guidance for future infrastructure improvements in the corridor and a basis for the Town to negotiate development related traffic mitigation measures.

The Recommended Plan

The recommended plan retains the existing roadway infrastructure to move vehicular traffic and adds new facilities to accommodate alternative travel modes. The existing two-lane roadway cross section will be maintained throughout the mile-long study corridor however, narrower travel lanes will be provided in some sections to allow for the striping of bicycle lanes on the existing paved shoulder. Bicycle lanes would be provided in each direction for the entire length of the corridor from US Route 2 to VT Route 2A. Only at the very eastern end of the corridor, on the south side of Industrial Avenue approaching VT 2A where two eastbound lanes are provided, will any roadway widening be required to provide the bike lanes. The existing sidewalk on the north side of Industrial Avenue between Rossignol Park and VT 2A and passing through a residential zone will be maintained. New sidewalks will be constructed on both sides of Industrial Avenue between Route 2 and Rossignol Park to facilitate circulation among commercial properties and access to public transportation (Chittenden County Transportation Authority bus stops). The south side sidewalk will be constructed first as recent redevelopment of properties on the south side of the roadway for office use has created new pedestrian travel demands. Traffic signalization at intersections in the corridor is not presently recommended but traffic delay conditions will be monitored at the North Brownell Road and Wintersport Lane intersections as these locations are most likely to experience long side street delays as travel demands increase. Further study of the VT 2A/Mountain View Road/Industrial Avenue intersection is recommended to define a strategy to relieve existing traffic congestion at this location.

Existing Transportation Facilities

Industrial Avenue is a two-lane, two-way roadway with a paved width of 34 to 38 feet located within a 49.5 feet wide right-of-way. Signal control is provided at each end of the corridor where it meets US Route 2 (to the west) and VT 2A (to the east). Side streets entering the corridor including Avenue A, Avenue B, Avenue C, Avenue D and North Brownell Road are all under STOP sign control. There are no designated bike lanes in the corridor. A five-feet wide sidewalk located on the north side of Industrial Avenue links VT 2A with Rossignol Park, located just west North Brownell Road and south of Industrial Avenue, and is the only sidewalk in the corridor. The Chittenden County Transit Authority provides commuter peak period bus service along Industrial Avenue and more regular service along Route 2.
Existing Land Use and Zoning Conditions

Existing land use conditions in the Industrial Avenue corridor generally comply with the existing zoning districts. Land east of North Brownell Road is primarily zoned for residential uses and is made up of smaller parcels. Some small, home-based businesses exist at some of the residential properties fronting on Industrial Avenue. West of North Brownell zoning supports industrial and commercial uses. Parcels abutting Industrial Avenue and the “Avenues” in this area comprise approximately 1.5 million square feet of commercial building floor space.

Existing Travel Demands

Industrial Avenue presently carries approximately 8400 vehicles per day. In comparison, Route 2 and VT 2A, also two-lane roadways located at either end of Industrial Avenue, carry 16,600 and 12,600 vehicles per day, respectively. Traffic volumes vary by location with Industrial Avenue carrying 935 PM peak hour vehicles just west of North Brownell Road and 1300 PM peak hour vehicles east of its junction with North Brownell Road. Pedestrian and bicycle traffic is very limited amounting to fewer than ten pedestrians or bicyclists passing through the corridor in any one hour. Parcels abutting Industrial Avenue and the “Avenues” in this area generate approximately 800 PM peak hour vehicle trips.

Future Land Use Conditions

Recent development proposals within the Industrial Avenue industrial district, including parcels with frontage on Avenues A through D, have resulted in the conversion of industrial properties to office or commercial uses. Parcels with frontage along Industrial Avenue have seen the most activity. For analysis purposes it was assumed that all land located within approximately 300 feet of Industrial Avenue is redeveloped as office space and that existing building floor areas on these parcels increase by 25 percent. Approximately 520,000 square feet of new development is assumed in the traffic forecasts.

Future Traffic Volumes

The assumed new land uses in the corridor will generate more vehicle trips per square foot of building floor area than the existing industrial uses. Assumed changes in land use conditions in the industrial area will generate 300 new PM peak hour vehicle trips. Background traffic growth, estimated at 1.0 percent per year will add another 120 PM peak hour trips by the 2035 design year assumed in the study.

Future Traffic Operations

An evaluation of intersection operations under projected future AM and PM peak hour conditions indicates that there will be some change in “end-to-end” travel times along Industrial Avenue during the PM commuter peak hour. Added turning conflicts at the intersecting side streets will cause PM peak hour travel times to increase by 40 to 70 seconds. Existing travel times are on the order of two and one-half minutes ignoring delays encountered on the Industrial Avenue eastbound approach to VT 2A. (Travel delays on this approach are highly variable due to the limited capacity of the VT 2A/Mountain View Road/Industrial Avenue intersection. Delays as high as nine minutes were measured in the field during the PM peak commuter hour.) Virtually no change in AM peak hour travel times between Route 2 and VT 2A are anticipated. Under the projected future PM peak hour traffic conditions delays are expected to increase for traffic entering Industrial Avenue from North Brownell Road and Wintersport Lane to the point where traffic signalization may be worth consideration.
Alternatives

A variety of cross section treatments were considered for reconfiguration of Industrial Avenue and evaluated with respect to impacts on right-of-way and traffic operations. Various elements considered individually and in combination included:

- Adding sidewalks to one or both sides of the road with and without ‘greenbelts’;
- Adding bicycle lanes to both sides of the road;
- Adding a shared-use path to the north side of the road;
- Providing a two-way left-turn lane from Route 2 to North Brownell Road; and,
- Installing traffic signals at Avenue B/Wintersport Lane and at North Brownell Road.

Depending on location the additional right-of-way required to implement these alternatives ranged from zero to eight feet. Only the two-way left-turn lane and signal elements have any impact on traffic operations. The two-way left-turn lane offered some minor decreases in through traffic delays which were offset by minor increases in delays associated with new traffic signals. The proposed signals did significantly reduce projected side street delays where proposed.

Recommended Alternative

The roadway alternatives analysis was reviewed with the project steering committee, (made up of Town Public Works staff, Town Planning staff and CCRPC staff), and with the public at a Williston Planning Commission meeting. The preferred alternative based on these discussions includes the addition of bike lanes to both sides of the road, accomplished primarily by restriping the existing pavement, and the construction of sidewalks on both sides of the road between Route 2 and Rossignol Park. Two-way left-turn lanes were considered unnecessary based on the travel time analysis and signalization was rejected based on concerns that a new signal at North Brownell Road would attract more cut-through traffic past residential properties on North Brownell Road. The recommended alternative was selected by the Williston Selectboard on February 25, 2013.

Future Actions

The Town has already completed a Scoping Study relative to providing pedestrian accommodations between Route 2 and Rossignol Park along Industrial Avenue. Based on the scoping study findings, design of the south side sidewalk can begin as soon as funding is available. There is no urgent need to construct the north side sidewalk however, sections of this sidewalk can and should be built or funded if and when parcels fronting on the north side of Industrial Avenue are redeveloped. An impediment to the striping of continuous bike lanes throughout the corridor is a right-of-way constraint on the south side of Industrial Avenue at VT 2A. The proposed bike lanes could be striped as soon as funding is available with the eastbound bike lane terminating just west of VT 2A. Alternatively, the striping could be postponed until land takings can be accomplished or easements acquired to allow the very eastern end of the eastbound bike lane to be constructed.
VT 2A/Mountain View Road/Industrial Avenue

The VT 2A/Mountain View Road/Industrial Avenue intersection presently operates at capacity during peak hours. During the afternoon peak hour in particular congestion at this intersection affects operations along Industrial Avenue as far west as Avenue C. The study identifies several alternative treatments that would relieve this congestion and recommends that a more detailed scoping study be completed to define an improvement plan for this intersection.
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1.0 Introduction

Land use conditions along Industrial Avenue are in a state of transition. Some light manufacturing and warehouse uses have recently been replaced with office space and a day care center. The office uses and day care center generate more traffic per square foot of building area than the prior industrial uses. Consequently, the recent conversions to higher value land uses have increased travel demands by all modes in the corridor. The Town of Williston and the Chittenden County Regional Planning Commission (CCRPC), in anticipation of a continuation of this building reuse and land redevelopment trend, commissioned this study to define future transportation infrastructure requirements in the corridor. This corridor study forecasts expected future travel demands associated with a possible future land use scenario and defines the transportation infrastructure needed to safely and efficiently accommodate those demands. The final plan provides a basis for the Town to negotiate traffic mitigation with developers of future projects in the corridor.

1.1 Project Background

Two recent redevelopment projects in the Industrial Avenue corridor have highlighted transportation concerns. First, the former Rossignol ski manufacturing facility located on the south side of Industrial Avenue opposite Avenue C was converted into 113,000 square feet of office space, a 13,000 square-foot fitness center and a café. Certain tenants in the building, now known as the White Cap Business Park, serve a public transit dependent clientele. With the major bus route serving the area located on Route 2, a need for a sidewalk on Industrial Avenue between Route 2 and the new White Cap Business Park has been identified. The recently completed EJ’s Kids Klub day-care center on the corner of Avenue D and Industrial Avenue has proven to be a relatively high traffic generator such that Avenue D now carries more peak hour traffic than the other three avenues (A, B and C) serving the industrial area combined. Existing vacancies at industrial buildings in the area and a shrinking supply of buildable land in Williston could drive future conversions creating increased travel demands.

1.2 Project Area

The project study area includes Industrial Avenue from Route 2 (Williston Road) to VT 2A (Essex Road). Figure 1 shows the location of Industrial Avenue within the Town of Williston. Intersections considered in the study are listed below.

- Williston Road (Route 2)/Industrial Avenue
- Avenue A/Industrial Avenue
- Avenue B/Winter Sports Lane/Industrial Avenue
- Avenue C/White Cap Driveway/Industrial Avenue
- Avenue D/Industrial Avenue
- North Brownell Road/Industrial Avenue
For the study intersections a multi-step planning process has been completed as described below.

Figure 1: Project Location Plan
1.3 Study Process

This study generally follows the recommended process outlined in the Vermont Corridor Management Handbook. The major steps in the preparation of corridor studies are listed below.

1. Getting Organized
2. Analyze Current and Future Conditions
3. Develop Vision, Goals and Objectives
4. Develop and Evaluate Preferred Strategies
5. Develop the Corridor Implementation Plan
6. Finalize the Corridor Plan.

Data, methods, and findings for the various element of the study are described in greater detail herein.
2.0 Existing Conditions

Land use and transportation inventories for the study area were developed through the assemblage of existing data and through the collection of new data. Compiled information includes:

- Current land use and zoning conditions for parcels having access by way of Industrial Avenue.
- Roadway conditions including roadway cross sections, right-of-way, sidewalks, bike lanes or shoulders, driveways, and traffic controls.
- Travel demands including AM and PM commuter peak hour vehicular traffic volumes, daily traffic volumes, and pedestrian and bicycle volumes.
- Public transit facilities, services and usage.
- Recent crash experience.
- Peak hour roadway performance based on capacity analyses for corridor sections and intersections.

The existing conditions data collection efforts and findings are presented below.

2.1 Existing Land Use and Zoning

The project study area includes two separate zoning districts as shown on the official Town zoning map. A portion of the map is provided in Figure 2. The western end of the corridor, west of Allen Brook, is located within the Industrial Zoning District West (IZDW). East of Allen Brook, land abutting Industrial Avenue is zoned for residential use. The Residential Zoning District (RZD) is very restrictive. The only non-residential uses permitted in this district are child care centers, churches, elementary and middle schools and parks. Home businesses are permitted but are still considered residential uses. The industrial zone however allows for a broad range of industrial uses and some limited commercial uses. Permitted commercial uses include retail uses that are space intensive, that is, uses that would not fit well in a pedestrian-oriented retail environment. Office uses are generally not permitted except as business incubators and as adaptive reuse of existing industrial buildings. All development in this district requires a discretionary permit from the Town’s Development Review Board (DRB). The DRB may impose conditions on a project to mitigate project related transportation impacts.

Current land use conditions in the corridor are generally consistent with the underlying zoning districts. Within the industrial zone, parcels with direct frontage on the north side of Industrial Avenue include a mix of retail and industrial uses. A day care center is also provided along this segment. Parcels located further north and accessed by Avenues A, B, C and D exhibit more industrial uses and very few retail operations. Parcels fronting on the south side of Industrial Avenue generally reflect the “adaptive reuse” of industrial buildings allowed under zoning. The White Cap
Business Park located opposite Avenue C is a prime example. This is a former ski manufacturing facility that now provides 113,000 square feet of office space, a 13,000 square-foot fitness center and a café. Single family homes, at least one of which includes a home business, have frontage on Industrial Avenue at the eastern end of the corridor. Several parcels on the south side of Industrial Avenue just east of North Brownell Road are used for commercial purposes even though they are located within the residential zone.

The Town of Williston compiled data regarding current (as of July 2012) land use conditions in the industrial zone by parcel. This information is fully documented in Appendix A. Table 1 summarizes the existing land use conditions. As shown, the 63 industrial zoned parcels located in the corridor comprise 223 acres and 1,489,212 square feet of building floor area. Industrial uses are the dominant use by acreage. Office use is the second largest component. Retail use, including retailers with significant outdoor sales areas, is the third most significant component by acreage.

Figure 3 shows the existing land use conditions by location and access conditions. Parcels that share access by way of the same side street or driveway are grouped together. Five groupings are shown. Groups A, B, C and D have primary access by way of Avenues A, B, C and D, respectively. Parcels in Group WS have primary access by way of Wintersport Lane and by way of the White Cap driveway. Parcels having their own direct access to Industrial Avenue are included in the “Other” column in Table 1.

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*Table 1: Existing Land Use Conditions*

In addition to noting existing land use conditions, estimates of vacant floor space were developed by Stantec based on a “drive by” survey. Visibly vacant floor spaces and/or vacant parking lots were used as indicators of building occupancy. Assumed conditions by parcel are included in the appendix. The overall occupancy in the corridor is estimated at 90 percent.
FIGURE 2 - ZONING MAP

WILLISTON, VT
INDUSTRIAL AVE. CORRIDOR STUDY

SCALE

INDUSTRIAL ZONE (IDZW)

RESIDENTIAL ZONE (RZD)
2.2 Existing Roadway Conditions

The project study area includes the entirety of Industrial Avenue, intersecting side streets and the two “gateway” intersections at each end of corridor. Existing roadway conditions in the corridor are described below.

2.2.1 Industrial Avenue

Industrial Avenue is a two-lane, two-way major collector connecting Routes 2 and 2A in Williston. Existing conditions are illustrated in Figures 4 A, B, C and D. The travel lanes are 13 feet to 14 feet wide and the shoulders are 4 feet to 5 feet wide as shown. The overall width of the roadway varies from 34 feet to 38 feet wide. The posted speed limit is 30 miles per hour (mph). Much of the roadway through the industrial area offers a straight and level alignment. However, the roadway climbs slightly and curves to the east headed north from Route 2. Heading east from North Brownell Road the roadway slopes downhill to the Allen Brook crossing and begins climbing again to VT 2A. There is generally no curbing along the roadway however, certain side streets; Avenues B and C and Winter Sport Lane, have curbing that extends to Industrial Avenue. A sidewalk is provided on the north side of Industrial Avenue linking Rossignol Park (located in the southwest quadrant of the Industrial Avenue/North Brownell Road intersection) with VT 2A and residential areas to the east. Some curbing is also provided along Industrial Avenue where the sidewalk is located close to the roadway. There is a crosswalk provided on Industrial Avenue just west of North Brownell Road at the Park.

2.2.2 Route 2

Route 2 at Industrial Avenue is classified as an urban, principal arterial. It generally provides one travel lane in each direction however, turning lanes are provided at driveways and intersections. In the vicinity of its intersection with Industrial Avenue the speed limit is 40 miles per hour. Commercial land uses abut the intersection.

2.2.3 Route 2A

Route 2A is classified as an urban, minor arterial. It passes through the project study area in a north-south direction at the east end of Industrial Avenue. Locally it links Interstate Route 89 with Essex Junction by way of the Taft Corners commercial area. A mix of commercial and residential land uses are present along the roadway. Similar to Route 2, it is primarily a two-lane roadway with additional turning lanes added at intersections.

2.2.4 Intersections

The state-owned intersections at either end of Industrial Avenue are controlled by traffic signals while all other intersections along the corridor are under STOP sign control. Signal control is provided at the intersection of Route 2A with Industrial Avenue, which enters from the west, and Mountain View Road which enters from the east. Southbound Route 2A provides separate turn lanes for left, through and right-turn movements. Eastbound Industrial Avenue and northbound Route 2A each provide a dedicated left-turn lane and shared through-right turn lane. Mountain View Road provides a single lane approach. Cross walks and pedestrian actuated signal heads allow pedestrians to cross the west and south legs of the intersection.
The Route 2/Industrial Avenue intersection is also under traffic signal control. Two lanes are provided on the Route 2 eastbound approach with a separate left-turn and through lanes. Similarly, the southbound Industrial Avenue approach includes separate left and right turn lanes. The westbound Route 2 traffic is accommodated in a single lane. There is a bus stop on Industrial Avenue northbound just north of the intersection. There are no pedestrian accommodations at the intersection.

As noted, the side streets entering Industrial Avenue are all under STOP sign control. Given the need to accommodate large trucks associated with the industrial uses in the study area, most of these side streets, Avenues A through D and Winter Sports Lane, are generally quite wide with widths ranging from 24 to 36 feet. (Gail Terrace, a residential street entering the corridor from the north near VT 2A, is only 22 feet wide.) All side streets afford two-way operation with a single travel lane in each direction. Parking is not restricted on the side streets entering from the north however, no on-street parking was observed in the vicinity of Industrial Avenue during the conduct of the peak period traffic surveys described below. All side streets enter Industrial Avenue at a 90-degree angle except for North Brownell Road. North Brownell Road, a local street owned by the Town of Williston enters Industrial Avenue from the south at an acute angle and at the beginning of an eastbound downgrade as noted above. Due to the grade conditions sight distances are limited on Industrial Avenue westbound in advance of North Brownell Road. However, at the location where left turns would be made into North Brownell Road, the sight distance is more than adequate as Industrial Avenue has a straight and level alignment to the west of this location.

2.3 Traffic Volumes

Traffic volume data for the study area were collected from various sources. Daily traffic counts for Industrial Avenue, Route 2 and Route 2A were available from VTrans. The CCRPC was able to provide peak period vehicle turning movement counts collected during its annual summer count program at the three higher volume intersections in the study area. These are the Industrial Avenue intersections with Route 2, with North Brownell Road and with Route 2A. The most recent counts taken at these intersections occurred in June 2008, July 2007 and June 2010, respectively. Vehicle turning movement and classification counts were taken by Stantec at the remaining intersections during April 2012. The collected traffic data are included in Appendix B.

Figures 5 and 6 provide existing traffic flow networks for AM and PM commuter peak hours. The peaks generally occurred from 7:30 to 8:30 AM and from 4:30 to 5:30 PM.

As shown, the peak direction flows on Industrial Avenue are westbound (towards Burlington) during the morning peak hour and eastbound during the evening peak hour. The AM peak hour volume on Industrial Avenue just east of Avenue C is 649 vehicles per hour (vph). During the PM peak hour the volume at this location is 451 vph. Higher volumes were recorded on Industrial Avenue east of North Brownell Road. East of North Brownell Road Industrial Avenue carries 935 AM peak hour vehicles and 520 PM peak hour vehicles.

Side street volumes are illustrated in Figure 7. As shown, North Brownell Road, a through street, carries the highest peak hour volumes entering and exiting Industrial Avenue and the lowest volumes were measured at Gail Terrace, a local residential street. Of the remaining locations counted Avenue C carries the greatest volumes.
Daily traffic volumes for the study area roadways were obtained from CCRPC and VTrans records as well. As noted in Table 2, Route 2 is the highest volume roadway in the project area carrying 16,600 vehicles per day (vpd). VT 2A carries significantly lower volumes, 12,600 vpd. Industrial Avenue carries approximately 8400 vpd east of North Brownell Road.

<table>
<thead>
<tr>
<th>Location</th>
<th>Daily Traffic Volume</th>
<th>Count Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Route 2-East of Industrial Avenue</td>
<td>10900</td>
<td>2010</td>
</tr>
<tr>
<td>Route 2-West of Industrial Avenue</td>
<td>16600</td>
<td>2011</td>
</tr>
<tr>
<td>VT 2A-South of Industrial Avenue</td>
<td>12600</td>
<td>2010</td>
</tr>
<tr>
<td>Industrial Ave –East of Avenue B</td>
<td>8000</td>
<td>2009</td>
</tr>
<tr>
<td>Industrial Ave –East of North Brownell Road</td>
<td>8400</td>
<td>2009</td>
</tr>
</tbody>
</table>

Table 2: Existing Daily Traffic Volumes

As suggested by the street name, Industrial Avenue carries a higher percentage of truck traffic than other area roadways. For example, data for the Route 2/Industrial Avenue intersection indicates that trucks comprise 16 percent of the total volume on Industrial Avenue and only eight percent of the through volume on Route 2 during the AM peak hour. Truck volumes are also relatively high on the “Avenues”. The percentages of truck traffic carried by each of the side streets are also documented in Figure 7. As shown, truck traffic accounts for as much as 25 percent of the side street volumes.

Pedestrian and bicycle volumes along Industrial Avenue were also recorded as part of the April traffic count program. Generally, volumes were very light with fewer than 6 pedestrians or bicycles passing through any one intersection during any peak hour.

Travel time runs were conducted along Industrial Avenue as described below to determine existing operating levels of service for the roadway. During the conduct of the travel time runs several people were observed waiting for the Chittenden County Transportation Authority buses that operate along the corridor. Based on these observations it is estimated that fewer than ten people presently board CCTA buses during the afternoon commuter peak period along Industrial Avenue.

The data shown in Figures 5 and 6 reflect “balanced” traffic flow networks. The raw traffic count volumes were adjusted up or down to achieve balanced flows between intersections where appropriate. (The traffic volume leaving one intersection in a given direction should equal the volume arriving at the next intersection from the same direction assuming that there are no driveways/traffic generators in between the two intersections.) Given the presence of many driveways along the corridor that were not counted, volumes were not balanced exactly. However, where adjustments were made they were generally made in the upward direction to create a more conservative (higher) traffic flow condition. Given the magnitude of some of these adjustments, the balanced volumes were not increased further to reflect 30th highest hour or Design Hour Volume (DHV) conditions on the roadway. The reported traffic flow conditions are assumed to approximate DHV’s.
FIGURE 6 - PM PEAK HOUR VOLUMES
INDUSTRIAL AVE. CORRIDOR STUDY
WILLISTON, VT
7/17/2012
Figure 7 - Industrial Ave Peak Hour
Side Street Volumes

- Avenue A
- Avenue B
- Wintersport LN
- Avenue C
- White Cap
- Avenue D
- N. Brownell
- Gail Terrace

Vehicles Per Hour (VPH)

- Trucks
- Cars
### 2.4 Traffic Operations

Intersection and roadway operating levels of service (LOS) are calculated for the study area intersections based on the traffic volume, geometry and traffic control data provided above.

#### 2.4.1 Level of Service Criteria

Level of service (LOS) is a term used to describe the quality of the traffic flow on a roadway facility at a particular point in time. It is an aggregate measure of travel delay, travel speed, congestion, driver discomfort, convenience, and safety based on a comparison of roadway system capacity to roadway system travel demand. Operating levels of service are reported on a scale of A to F, with A representing the best operating conditions with little or no delay to motorists, and F representing the worst operating conditions with long delays and traffic demands sometimes exceeding roadway capacity.

Intersection operating levels of service are calculated following procedures defined in the *Highway Capacity Manual*, published by the Transportation Research Board. For unsignalized and signalized intersections the operating level of service is based on travel delays. Delays can be measured in the field but generally are calculated as a function of traffic volume; peaking characteristic of traffic flow; percentage of heavy vehicles in the traffic stream; type of traffic control; number of travel lanes and lane use; intersection approach grades; and, pedestrian activity. Through this analysis volume-to-capacity ratios can be calculated for individual movements or for the intersection as a whole. A volume-to-capacity ratio of 1.0 indicates that a movement or intersection is operating at its theoretical capacity. The specific delay criteria applied per the *2000 Highway Capacity Manual* to determine operating levels of service are summarized in Table 3.

<table>
<thead>
<tr>
<th>Level of Service</th>
<th>Signalized Intersections</th>
<th>Unsignalized Intersections</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>≤10.0</td>
<td>≤10.0</td>
</tr>
<tr>
<td>B</td>
<td>10.1 to 20.0</td>
<td>10.1 to 15.0</td>
</tr>
<tr>
<td>C</td>
<td>20.1 to 35.0</td>
<td>15.1 to 25.0</td>
</tr>
<tr>
<td>D</td>
<td>35.1 to 55.0</td>
<td>25.1 to 35.0</td>
</tr>
<tr>
<td>E</td>
<td>55.1 to 80.0</td>
<td>35.1 to 50.0</td>
</tr>
<tr>
<td>F(^1)</td>
<td>&gt;80.0</td>
<td>&gt;50.0</td>
</tr>
</tbody>
</table>

*Table 3: Intersection Level of Service Criteria*

\(^1\) Level of Service F is also assigned if the volume-to-capacity ratio exceeds 1.0.


For unsignalized intersections, it is assumed that through movements on the main street have the right-of-way and are not delayed by side street traffic. Main street traffic may be exposed to delays from traffic turning left from the main street. Generally, and in the case of this study, the longest delays at unsignalized intersections are experienced on the side streets by traffic waiting to enter or cross the main street (Industrial Avenue).
The *Highway Capacity Manual* also includes procedures to determine operating levels of service on roadway segments. The level of service gradations from A to F reflect deviations in the actual travel time or travel speed along a roadway relative the assumed free flow speed on the roadway. Actual running speeds are influenced by a number of factors including traffic volume levels and driveway/side street interference. Delays incurred by through vehicles at the “boundary” intersections or the end points of the corridor being studied can also determine level of service results. Applicable level of service criteria are shown in Table 4.

<table>
<thead>
<tr>
<th>Level of Service</th>
<th>Free Flow Travel Time Percentage of Actual Travel Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>&gt; 85 -100%</td>
</tr>
<tr>
<td>B</td>
<td>&gt; 67 – 85%</td>
</tr>
<tr>
<td>C</td>
<td>&gt; 50 – 67 %</td>
</tr>
<tr>
<td>D</td>
<td>&gt; 40 – 50 %</td>
</tr>
<tr>
<td>E</td>
<td>&gt; 30 – 40 %</td>
</tr>
<tr>
<td>F(^1)</td>
<td>&lt;= 30</td>
</tr>
</tbody>
</table>

\(^1\) Level of Service F is also assigned if the volume-to-capacity ratio exceeds 1.0 at a boundary intersection.


*Table 4: Travel Time Level of Service Criteria*

### 2.4.2 Calculated Operating Levels of Service

Capacity analysis results for the study area intersections are presented in Table 5 below. At the side streets calculated operating levels of service are generally LOS C or better. This is true for even the highest volume locations, Avenue D and North Brownell Road. Wintersport Lane and the White Cap driveway are exceptions operating at LOS D or E. The lower level of service is attributable to the relatively high percentage of left-turns made from the side streets and the four-way configuration of the intersections. A four-way intersection has a greater number of turning conflicts than a three-way intersection. The added complexity can add to side street delays.

The procedures for calculating operating levels of service at unsignalized intersections often yield very conservative results. Actual delays may be much shorter than calculated delays. Queuing conditions observed in the field and described below suggest that is the case along the Industrial Avenue corridor.

The unsignalized intersection analysis results are also often considered in the context of the side street volumes. VTrans, for example, has a policy of prioritizing improvements for unsignalized intersections operating at LOS E or F only when the side street demands exceed 100 vehicles per hour. North Brownell Road and Avenue D each carry more than 100 vehicles per hour during the PM peak and Winter Sport Lane carries approximately 100 vehicles per hour during the PM peak. At North Brownell Road the approach volume is 300 vph during the PM peak hour (the busier of the two peak hours studied) however, 90 percent of this traffic is turning right. The right turning volumes generally experience much shorter delays than traffic turning left.
## Table 5: Existing Intersection Capacity Analysis Results

<table>
<thead>
<tr>
<th></th>
<th>Existing (2012)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Peak Hour</td>
</tr>
<tr>
<td><strong>Unsignalized Intersections</strong></td>
<td></td>
</tr>
<tr>
<td>Avenue A/Industrial Ave</td>
<td>AM</td>
</tr>
<tr>
<td></td>
<td>PM</td>
</tr>
<tr>
<td>Wintersport Ln /Avenue B/ Industrial Ave</td>
<td>AM</td>
</tr>
<tr>
<td></td>
<td>PM</td>
</tr>
<tr>
<td>White Cap/Avenue C/Industrial Ave</td>
<td>AM</td>
</tr>
<tr>
<td></td>
<td>PM</td>
</tr>
<tr>
<td>Avenue D/Industrial Ave</td>
<td>AM</td>
</tr>
<tr>
<td></td>
<td>PM</td>
</tr>
<tr>
<td>North Brownell/Industrial Ave</td>
<td>AM</td>
</tr>
<tr>
<td></td>
<td>PM</td>
</tr>
<tr>
<td>Gail Terrace/Industrial Ave</td>
<td>AM</td>
</tr>
<tr>
<td></td>
<td>PM</td>
</tr>
<tr>
<td><strong>Signalized Intersections</strong></td>
<td></td>
</tr>
<tr>
<td>Williston Road (Route 2)/Industrial Ave</td>
<td>AM</td>
</tr>
<tr>
<td></td>
<td>PM</td>
</tr>
<tr>
<td>Essex Rd (Route 2A)/Mountain View Dr /Industrial Ave</td>
<td>AM</td>
</tr>
<tr>
<td></td>
<td>PM</td>
</tr>
</tbody>
</table>

Notes: Results shown are for the worst operating minor street approach for unsignalized conditions.

\(^1\) LOS = Level of Service
\(^2\) Delay = Average delay expressed in seconds per vehicle
\(^3\) V/C = Volume-to-capacity ratio for critical movements

The two signalized intersections in the study area were both found to be operating at LOS C or D during the commuter peak hours as also shown in Table 5. Intersection volume-to-capacity ratios, a comparison of the maximum number of vehicles that an intersection can process to the actual demand, however; are at 0.79 (79 percent of capacity) or higher. High volume-to-capacity ratios often represent relatively unstable conditions where individual intersection approaches may operate over capacity with long queues building for short durations. A 0.94 volume-to-capacity ratio calculated for the VT 2A intersection is indicative of the unstable traffic operations observed in the field as noted below.

The travel time level of service concept was applied to the corridor for the commuter peak traffic hours. Travel time surveys were conducted in the corridor to establish existing operating conditions. The travel time data are shown in Figures 8 through 11 with results presented by direction and time period. Data are also broken down by...
roadway segment. The “West” segment consists of Industrial Avenue between Route 2 and Avenue C. The “Middle” segment consists of Industrial Avenue from Avenue C to North Brownell Road. North Brownell Road to VT 2A is the east segment. As shown, traffic generally flows in the corridor with few interruptions except for eastbound flows during the PM peak hour. Trip times ranged from just under two minutes to just under three minutes except for the PM peak period eastbound trips. During this time period, the first trip made beginning at 4:27 PM was typical of trips for other time periods/directions. The trip time was just under three minutes. However, as the afternoon progressed, long queues spilled back from the VT 2A intersection such that travel times grew to more than ten minutes. Delays were even experienced on the west segment due to congestion at VT 2A. As Figure 8 shows travel times started to improve after 5 PM. However, an incident on VT 2A north of Industrial Avenue drew emergency vehicles which impeded the northbound flow on VT 2A and in turn the eastbound left-turn movement from Industrial Avenue at VT 2A. The incident resulted in a trip time exceeding ten minutes during the final run of the study.

Level of service calculations based on the observed speeds and free flow speeds were determined. The posted speed limit on Industrial Avenue is 30 miles per hour. The length of the study corridor is 5320 feet. Using a free-flow speed of 30 miles per hour the free flow travel time is 2:02 minutes. Levels of service for the roadway segment are presented Table 6 based on the longest travel time measured in each of the peak periods. As shown, the segment operates at Level of Service B or better except during the PM peak hour westbound when delays at the VT 2A intersection influence travel speeds throughout the corridor.

<table>
<thead>
<tr>
<th>Time Period/Direction</th>
<th>Observed Travel Time (min:sec)</th>
<th>Free Flow Travel Time Percentage of Observed Travel Time (min: sec)</th>
<th>Level of Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>AM Peak Hour</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eastbound</td>
<td>2:20</td>
<td>87%</td>
<td>A</td>
</tr>
<tr>
<td>Westbound</td>
<td>2:23</td>
<td>85%</td>
<td>A</td>
</tr>
<tr>
<td>PM Peak Hour</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eastbound</td>
<td>11:45</td>
<td>17%</td>
<td>F</td>
</tr>
<tr>
<td>Westbound</td>
<td>2:39</td>
<td>77%</td>
<td>B</td>
</tr>
</tbody>
</table>

*Table 6: Industrial Avenue Segment Level of Service*

### 2.4.3 Field Observations

During the traffic counting program and during the travel time surveys referenced above, Stantec staff made observations of existing traffic operations. These observations help to validate and/or qualify findings based on the analytical methods presented above. Some key observations follow:

- For all but the evening, eastbound traffic condition, traffic in the corridor travels at or near the posted speed limit. Delays encountered by through traffic waiting for other vehicles to turn into driveways or side streets were rare and very limited in duration.
- Evening, eastbound traffic flow conditions were significantly impeded by traffic operations at the Industrial Avenue/VT 2A/Mountain View Road intersection. Generally, the eastbound left-turn movement at this location experiences demands that exceed capacity forming long queues. The queues
for the left-turn movement block access to the through lane on the Industrial Avenue eastbound approach causing queues to build up even faster.

- During the evening peak hour at the Industrial Avenue/VT 2A/Mountain View Road intersection, long queues on the eastbound approach were not simultaneously accompanied by long queues on all of the other intersection approaches suggesting that signal timing adjustments could be made to shorten the eastbound queues.

- Long queues developed on the eastbound and westbound Route 2 approaches to the Route 2/Industrial Avenue intersection. These queues however, generally cleared each signal cycle.

- Side street queues rarely exceeded one or two vehicles. (Most often there were no queues present.) Longer queues formed on Avenue D and North Brownell Road during the PM peak period when a rolling queue on Industrial Avenue eastbound limited the ability of traffic from these side streets to enter Industrial Avenue.

- Several motorists were observed making U-turns on Industrial Avenue at Avenue C during the PM peak commuter period to avoid getting caught in the long eastbound queue.

### 2.5 Trip Generation Rates

The traffic volume data collected for the study area were combined with the collected land use data to develop vehicle trip generation rates for the existing land uses. The observed trip generation rates were compared to trip rates published by the Institute of Transportation Engineers that reflect average trip rates by land use for properties surveyed nationwide.

The locally observed trip generation rates for the study area are summarized in Table 7. As noted above, land use data was combined for parcels that share the same point or points of access. The calculated rates show that there is considerable variation in the trip rates (vehicle trips per 1000 square feet of building floor space) among the five sectors studied. AM peak hour trip rates range from 0.17 trips per ksf (Avenue A) to 1.08 trips per ksf (Avenue B). Likewise, for the PM peak hour the low rate of 0.11 trips per ksf was again observed for Avenue A and the high rate of 1.16 was again observed for Avenue B. These variations are likely due to the wide variety of businesses operating in the corridor. Consequently, data for the “Avenues” was combined to reflect all industrial/mining floor space. (Land uses along each of the Avenues include at least 86 percent industrial/mining floor space.) Collectively, they show AM and PM peak hour trip rates of 0.46 and 0.53 trips per ksf. On the south side of Industrial Avenue, the land uses sharing access by way of Winter Sports Lane and the White Cap driveway contain only 39 percent industrial space. The trip generation rates here are notably higher with 0.79 trips per ksf generated during the AM peak hour and 0.85 trips per ksf generated during the PM peak hour. The data suggests that the recent land use changes occurring on the south side of Industrial Avenue have elevated peak hour trip rates by 50 to 60 percent. For all uses where traffic volumes were monitored, the Combined Total rates are 0.54 and 0.61 trips per ksf for the AM and PM peak hours, respectively.
<table>
<thead>
<tr>
<th>Item</th>
<th>Avenue A</th>
<th>Avenue B</th>
<th>Avenue C</th>
<th>Avenue D</th>
<th>All Avenues Combined</th>
<th>Wintersport Ln &amp; White Cap Drive</th>
<th>Combined Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building Floor Area (ft²)</td>
<td>222,880</td>
<td>68,250</td>
<td>351,254</td>
<td>349,004</td>
<td>991,388</td>
<td>323,810</td>
<td>1,315,198</td>
</tr>
<tr>
<td>Occupied Floor Area (ft²)</td>
<td>222,880</td>
<td>68,250</td>
<td>330,285</td>
<td>294,774</td>
<td>916,188</td>
<td>269,150</td>
<td>1,185,339</td>
</tr>
<tr>
<td>Industrial Floor Space (%)</td>
<td>95%</td>
<td>90%</td>
<td>96%</td>
<td>86%</td>
<td>92%</td>
<td>39%</td>
<td>78%</td>
</tr>
<tr>
<td>AM Peak Hour</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vehicle Trips</td>
<td>38</td>
<td>74</td>
<td>123</td>
<td>221</td>
<td>456</td>
<td>257</td>
<td>713</td>
</tr>
<tr>
<td>Trips / 1000 (ft²)</td>
<td>0.17</td>
<td>1.08</td>
<td>0.35</td>
<td>0.63</td>
<td>0.46</td>
<td>0.79</td>
<td>0.54</td>
</tr>
<tr>
<td>PM Peak Hour</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vehicle Trips</td>
<td>25</td>
<td>79</td>
<td>107</td>
<td>315</td>
<td>526</td>
<td>274</td>
<td>800</td>
</tr>
<tr>
<td>Trips / 1000 (ft²)</td>
<td>0.11</td>
<td>1.16</td>
<td>0.30</td>
<td>0.90</td>
<td>0.53</td>
<td>0.85</td>
<td>0.61</td>
</tr>
</tbody>
</table>

Note: Trip rates based on total floor space.

Table 7: Observed Trip Generation Rates by Zone

Table 8 provides a comparison of the locally observed rates to national average trip rates for comparable uses. ITE rates are provided for industrial park, warehousing and office uses, uses that are found along Industrial Avenue. Also provided is a calculated “Blended Rate” assuming a mix of 78 percent industrial space and 22 percent office space reflecting conditions observed along Industrial Avenue. As shown, office uses are associated with the highest trip generation rates. Peak hour vehicle trip generation is approximately 1.5 trips per ksf for office space. Industrial uses generate trips at slightly more than one-half of this rate and warehousing uses generate trips at approximately one-third of the office rate. The blended or expected rate for the Industrial Avenue area is 1.00 trips per ksf during both peak hours. The observed rates, 0.54 trips per ksf in the AM and 0.61 trips per ksf in the PM, are well below the expected rates. The lower rates may simply reflect regional variation in trip rates and the nature of businesses operating in the corridor.

### ITE Trip Generation Rates

<table>
<thead>
<tr>
<th>Peak Hour</th>
<th>Industrial Park (LUC 130)</th>
<th>Warehousing (LUC 150)</th>
<th>Office (LUC 710)</th>
<th>Blended Rate¹</th>
<th>Observed Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>AM</td>
<td>0.84</td>
<td>0.45</td>
<td>1.55</td>
<td>1.00</td>
<td>0.54</td>
</tr>
<tr>
<td>PM</td>
<td>0.86</td>
<td>0.47</td>
<td>1.49</td>
<td>1.00</td>
<td>0.61</td>
</tr>
</tbody>
</table>


LUC = Institute of Transportation Engineers Land Use Code

¹Weighted average of the Office and Industrial Park rates assuming 78% industrial uses and 22 percent office uses.

Table 8: Trip Rate Comparison
2.6 Safety

The crash history for the study area was investigated using the VTrans crash database. VTrans keeps records of crashes by roadway link or segment. VTrans reports for 2006 through 2010 were reviewed. VTrans reported 55 crashes at intersections in the study area over the five-year period. The greatest numbers occurred at the two high-volume intersections at either end of the corridor. Table 9 provides a summary of the number of crashes by type, time of day, weather and location and Figure 8 identifies the crashes by location and observed crash rate. Using the peak hour traffic volume data presented above crash rates for each intersection are also calculated and shown in Table 7. As noted, none of the crashes involved fatalities and observed crash rates are lower than statewide average crash rates for comparable intersections.

VTrans also maintains a High Crash Location (HCL) list for roadways statewide. This list was most recently updated to include crash experience from 2006 through 2010. None of the study area intersections are included on the HCL list. Also, there are no roadway segments along Industrial Avenue listed as high crash locations. Crash rates for the study area intersections were determined based on the 2006-2010 data. This analysis, see Appendix B, indicates that the crash rates for these intersections (reported in number of crashes per 1 million entering vehicles) are lower than the statewide critical crash rates for similar intersections.

<table>
<thead>
<tr>
<th>Item</th>
<th>Route 2</th>
<th>Avenue A</th>
<th>Avenue B</th>
<th>Avenue C</th>
<th>Avenue D</th>
<th>North Brownell Rd.</th>
<th>Gail Terrace</th>
<th>Route 2A</th>
<th>TOTAL</th>
<th>Non-Intersection Crashes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>8</td>
<td>3</td>
</tr>
<tr>
<td>2007</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>2</td>
<td>12</td>
<td>3</td>
</tr>
<tr>
<td>2008</td>
<td>3</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>2009</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>3</td>
<td>8</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>3</td>
<td>9</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>9</td>
<td>4</td>
<td>4</td>
<td>7</td>
<td>0</td>
<td>8</td>
<td>3</td>
<td>11</td>
<td>46</td>
<td>9</td>
</tr>
</tbody>
</table>

| Type |         |          |          |          |          |                   |             |         |       |                         |
|------|---------|----------|----------|----------|----------|-------------------|-------------|---------|       |                         |
| Angle| 0       | 1        | 2        | 4        | 0        | 3                 | 0           | 1       | 3     | 0                       |
| Rear-end| 0   | 3        | 2        | 1        | 0        | 2                 | 2           | 8       | 12    | 3                       |
| Head-on| 1     | 0        | 0        | 0        | 0        | 2                 | 0           | 0       | 0     | 1                       |
| Unknown-other| 8  | 0        | 0        | 2        | 0        | 1                 | 1           | 2       | 3     | 5                       |
| Total| 9       | 4        | 4        | 7        | 0        | 8                 | 3           | 11      | 46    | 9                       |

| Severity |         |          |          |          |          |                   |             |         |       |                         |
|-----------|---------|----------|----------|----------|----------|-------------------|-------------|---------|       |                         |
| Property Damage| 9   | 4        | 4        | 6        | 0        | 5                 | 2           | 10      | 40    | 9                       |
| Personal Injury| 0   | 0        | 0        | 1        | 0        | 3                 | 1           | 1       | 6     | 0                       |
| Fatality| 0       | 0        | 0        | 0        | 0        | 0                 | 0           | 0       | 0     | 0                       |
| Other    | 0       | 0        | 0        | 0        | 0        | 0                 | 0           | 0       | 0     | 0                       |
| Total    | 9       | 4        | 4        | 7        | 0        | 8                 | 3           | 11      | 46    | 9                       |
## Industrial Avenue Intersection Crashes by Cross Street

<table>
<thead>
<tr>
<th>Item</th>
<th>Route 2</th>
<th>Avenue A</th>
<th>Avenue B</th>
<th>Avenue C</th>
<th>Avenue D</th>
<th>North Brownell Rd.</th>
<th>Gail Terrace</th>
<th>Route 2A</th>
<th>TOTAL</th>
<th>Non-Intersection Crashes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clear</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>5</td>
<td>0</td>
<td>2</td>
<td>3</td>
<td>7</td>
<td>24</td>
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<tr>
<td>Cloudy</td>
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<td>1</td>
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<td>2</td>
<td>0</td>
<td>1</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>Rain</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Snow/Ice</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>2</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>Fog</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>9</td>
<td>4</td>
<td>4</td>
<td>7</td>
<td>0</td>
<td>8</td>
<td>3</td>
<td>11</td>
<td>46</td>
<td>9</td>
</tr>
</tbody>
</table>

### Time

<table>
<thead>
<tr>
<th>Time</th>
<th>Route 2</th>
<th>Avenue A</th>
<th>Avenue B</th>
<th>Avenue C</th>
<th>Avenue D</th>
<th>North Brownell Rd.</th>
<th>Gail Terrace</th>
<th>Route 2A</th>
<th>TOTAL</th>
<th>Non-Intersection Crashes</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:00AM to 9:00AM</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>9:00AM to 4:00PM</td>
<td>4</td>
<td>4</td>
<td>1</td>
<td>4</td>
<td>0</td>
<td>3</td>
<td>1</td>
<td>5</td>
<td>6</td>
<td>0</td>
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<tr>
<td>4:00PM to 6:00PM</td>
<td>0</td>
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<td>2</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>6:00PM to 7:00AM</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>2</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>9</td>
<td>4</td>
<td>4</td>
<td>7</td>
<td>0</td>
<td>8</td>
<td>3</td>
<td>11</td>
<td>46</td>
<td>9</td>
</tr>
</tbody>
</table>

Statewide Average Crash Rate\(^1\): 0.428 0.415 0.415 0.415 0.415 0.415 0.415 1.153

Observed Crash Rate\(^1\): 0.231 0.193 0.185 0.366 0.000 0.339 0.137 0.502


\(^1\) Accidents per million entering vehicles

*Table 9: Reported Crashes by Location/Intersection (2006 - 2010)*
FIGURE 12 - CRASH LOCATIONS
INDUSTRIAL AVE. CORRIDOR STUDY
WILLISTON, VT
7/17/2012
The Chittenden County Transit Authority provides regularly scheduled bus service to the project area by way of Route 1, the "Williston" route. There are several variations of Route 1 however, all buses pass through the Route 2/Industrial Avenue intersection offering service at approximately 15-minute intervals at this location during commuter peak periods. The Williston-Essex variation of the route has buses on Route 2A passing through Industrial Avenue intersection on one-hour headways. Buses on the Williston Village variation travel the length of Industrial Avenue. Two buses make this trip during the AM commuter peak period and again during the PM commuter peak period. Route maps are shown in Figures 9 and 10 below. There are no bus shelters provided at any of the posted bus stops along Industrial Avenue.
3.0 Future Vision, Goals and Objectives

The project steering committee, based on a review of the existing conditions data and based on consultation with other Town officials, has established a future vision for the Industrial Avenue corridor.

*Industrial Avenue shall safely and efficiently (with reasonable levels of peak hour congestion and delay) accommodate the multimodal travel demands generated by a changing mix of land uses in the corridor and by future regional development.*

More specifically, Industrial Avenue shall be designed as a complete street and constructed to:

- Operate at LOS D or better (segment operating level of service) during peak hours under projected 2035 traffic conditions;
- Serve side street traffic demands at peak hour volume-to-capacity ratios less than or equal to 1.0 under projected 2035 traffic conditions;
- Include no more than two new traffic signal installations to facilitate side street access;
- Provide space for enhanced bus stop facilities (shelters) at key locations;
- Provide a continuous pedestrian connection (sidewalk and/or shared-use path) between Route 2 and Route 2A;
- Provide a continuous bike accommodation (on-street bike lane and/or shared-use path) between Route 2 and Route 2A;
- Provide well-defined cross walks at convenient intervals along the roadway (generally at intersections and/or bus stops);
- Maintain and preferably reduce the number of existing private driveways entering the roadway; and,
- Meet applicable VTrans and AASHTO design standards to ensure safety.

This corridor study forecasts expected future travel demands associated with possible future land use changes and regional traffic growth. It also proposes and evaluates alternative transportation infrastructure improvements to safely and efficiently accommodate those demands. The final, recommended plan provides a basis for the Town to negotiate traffic mitigation with developers of future projects in the corridor. It is also the basis for securing future funding for its implementation from available local and state sources.
4.0 Future Conditions

Traffic conditions in the project study area are likely to change over time due to redevelopment in the Industrial Avenue corridor and regional traffic growth. Projected traffic conditions for a 2035 design-year are defined below based on consideration of these factors. Also considered are proposed roadway improvements for the project area that would impact future performance of the roadway system.

Future traffic forecasts were developed for No Build and Build conditions. The No Build traffic condition assumes all existing commercial floor space in the corridor becomes fully occupied. (There are a number of vacant buildings in the project area that are not presently fully leased or occupied.) Assumed new uses are consistent with current uses in these buildings. Also, through traffic volumes in the corridor are increased to account for regional traffic growth. For the Build scenario it is assumed that a number of properties within the corridor are redeveloped with more intensive land uses. Details of the analysis assumptions are described below as are the expected future peak hour traffic operations under No Build and Build conditions.

4.1 Trip Generation Rates

Forecasts of future traffic volumes generated by land uses in the corridor are dependent upon assumed trip generation rates for those land uses. As noted above, existing trip generation rates were derived based on existing traffic counts and land use conditions in the corridor. Rates were developed to reflect industrial uses (primarily located on the north side of the road) and office uses (primarily located on the south side of the road). For analysis purposes, these rates were increased by approximately ten percent to account for the fact that ten percent of the building floor space considered in the analysis is presently vacant. The resulting trip rates used for the future traffic forecasts are shown in Table 10.

<table>
<thead>
<tr>
<th></th>
<th>Industrial</th>
<th>Office</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AM Peak Hour</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In</td>
<td>0.32</td>
<td>0.73</td>
</tr>
<tr>
<td>Out</td>
<td>0.18</td>
<td>0.22</td>
</tr>
<tr>
<td>Total</td>
<td>0.50</td>
<td>0.95</td>
</tr>
<tr>
<td><strong>PM Peak Hour</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In</td>
<td>0.20</td>
<td>0.37</td>
</tr>
<tr>
<td>Out</td>
<td>0.37</td>
<td>0.65</td>
</tr>
<tr>
<td>Total</td>
<td>0.57</td>
<td>1.02</td>
</tr>
</tbody>
</table>

Note: Trip rates based on locally observed conditions.

*Table 10: Assumed Trip Generation Rates*
4.2 Local “No Build” Traffic Increases

Unoccupied commercial space in the Industrial Avenue corridor represents a potential source of future traffic growth. As noted above, an estimated ten percent of the floor space in the corridor is presently unoccupied. Approximately 106,000 square feet of the unoccupied space is industrial/warehouse space and 23,000 square feet is office space. Vehicle trips associated with this space were calculated using the local trip generation rates reported above. The resulting trip estimates are summarized in Table 11.

<table>
<thead>
<tr>
<th>Item</th>
<th>Avenue A</th>
<th>Avenue B</th>
<th>Avenue C</th>
<th>Avenue D</th>
<th>Wintersport Ln &amp; White Cap Drive</th>
<th>Combined Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Currently Vacant Building Floor Area (ft²)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Industrial</td>
<td>0</td>
<td>0</td>
<td>20,969</td>
<td>54,230</td>
<td>31,210</td>
<td>106,409</td>
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<tr>
<td>Office</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>23,450</td>
<td>23,450</td>
</tr>
<tr>
<td>Total</td>
<td>0</td>
<td>0</td>
<td>20,969</td>
<td>54,230</td>
<td>54,660</td>
<td>129,859</td>
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<tr>
<td>AM Peak Hour Trips</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In</td>
<td>0</td>
<td>0</td>
<td>7</td>
<td>17</td>
<td>27</td>
<td>51</td>
</tr>
<tr>
<td>Out</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>10</td>
<td>11</td>
<td>25</td>
</tr>
<tr>
<td>Total</td>
<td>0</td>
<td>0</td>
<td>11</td>
<td>27</td>
<td>38</td>
<td>76</td>
</tr>
<tr>
<td>PM Peak Hour Trips</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>11</td>
<td>15</td>
<td>30</td>
</tr>
<tr>
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<td>8</td>
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<tr>
<td>Total</td>
<td>0</td>
<td>0</td>
<td>12</td>
<td>31</td>
<td>42</td>
<td>85</td>
</tr>
</tbody>
</table>

Note: Trip estimates based on locally observed trip rates (See Table 10).

Table 11: Projected Corridor Trip Generation Increases for No Build Condition

The above vehicle trips were assigned to the roadway system in accordance with existing traffic patterns. The assumed patterns are reflected in Figure 11. As shown, 55 percent of the traffic destined to Industrial Avenue is assumed to originate from the west and 45 percent is oriented to the east. Route 2 West and Route 2A North are expected to carry the largest shares of traffic destined to the Industrial Avenue corridor.
Historic Traffic Volumes

- VT2A - South of Industrial Ave
- US2 - West of Industrial Ave
- Industrial Ave
4.3 Background Traffic Growth

Historic traffic volumes for the project area roadways were examined to determine expected future traffic growth trends. Reference was also made to the VTrans “Red Book” (Continuous Traffic Counter Grouping Study and Regression Analysis Based on 2011 Traffic Data, Vermont Agency of Transportation - Policy, Planning, & Intermodal Development Division, Traffic Research Unit, March 2012) which summarizes traffic volume data collected by the state and projects future traffic growth trends. Average daily traffic volume data for area roadways is illustrated in Figure 12. Traffic volumes are provided from 1977 to present for Industrial Avenue, Route 2 and Route 2A. As shown, there was a period of traffic growth on Route 2 from 1977 to 1996 when traffic volumes peaked. Volumes have been in decline since then. A similar, albeit somewhat delayed, growth pattern occurred on Route 2A and Industrial Avenue. Volumes on these roads grew until approximately 2005 when daily volumes began to show some decline. A continuation of the recent trend data would suggest a decline in future traffic volumes.

![Figure 12: Historic Traffic Volumes](image)

The Red Book data and analysis reflect comparable results. The Red Book defines growth factors for various roadway types based on a sample of roadways from around the state. Count data from seven continuous count stations are used to define growth factors for urban roads. One of the seven stations is on Route 2A in Williston. Regression analyses look back five years to project near-term growth rates and twenty years to project longer range growth rates. The short-term (five-year) growth factors for Route 2A and for all urban roads are 0.93 and 0.96, respectively. Growth factor values less than 1.0 indicate a decline in future volumes over the next five
years. The longer-term (20-year) growth factors suggest little or no growth. For Route 2A the 20-year growth factor is 1.03 (three percent total growth over the next 20 years). For the urban road group the factor is 1.0, no growth. The other two major road groups studied by VTrans include interstate highways and rural roads. The rural roads group also has a 1.0 growth factor. Interstate highways are expected to experience traffic growth of 21 percent, approximately one percent per year, over the next 20 years.

In order to present a conservative analysis condition, a ten percent increase in through traffic volumes on Industrial Avenue was assumed in creating the 2035 peak hour traffic flow networks. This ten percent factor was only applied to through volumes with the understanding that non-through traffic volume levels will be dependent on future land use conditions. Volume increases associated with assumed land use changes are discussed below. Through volumes in the corridor were determined by deducting measured side street and driveway volumes from the total peak hour volumes on Industrial Avenue. The calculations indicate through volumes of approximately 630 and 590 vehicles during the AM and PM peak hours, respectively, on Industrial Avenue west of North Brownell Road. East of North Brownell Road, the estimated through volumes include 1010 AM peak hour vehicles and 1020 PM peak hour vehicles.

4.4 2035 No Build Traffic Volumes

Peak hour traffic volume networks were developed for 2035 No Build conditions based on the assumptions described above. Existing volumes were combined with new traffic associated with full occupancy of all commercial space in the corridor and with new through traffic in the corridor associated with an assumed 20 percent “background growth” increase. The 2035 AM and PM peak hour traffic flow networks are presented in Figures 13 and 14. Comparisons with the existing conditions traffic flow networks presented above show the total volumes entering the Avenue B/Winter Sports Lane/Industrial Avenue intersection increasing by nine percent during both the AM and PM peak hours. Peak hour volumes at the two gateway intersections with Route 2 and with Route 2A grow by approximately six percent.

4.5 Industrial Avenue Redevelopment

Redevelopment and reuse of parcels within the Industrial Zoning District West abutting Industrial Avenue will influence future traffic volumes entering and exiting the roadway. Projections of future land use conditions were developed in consultation with the Town’s planning staff. For this analysis it was assumed that parcels located within approximately 300 feet of Industrial Avenue would be redeveloped as office/incubator space similar to the conversion that recently occurred at the White Cap site. (It is assumed that these sites are the most likely to be redeveloped due to their visibility from Industrial Avenue. However, any site in the district could be redeveloped and this assumption is not meant to imply that parcels in close proximity to Industrial Avenue would receive different treatment under zoning.) Also, it is assumed that the existing building floor areas on the redeveloped parcels would increase by approximately 25 percent. This may occur by adding mezzanine space in existing warehouse areas with high ceilings or by constructing new buildings. Larger increases were not assumed since more intensive building uses will require more surface parking. It would be difficult in most cases to significantly expand building footprints and surface parking at the same time.
Table 12 presents a summary of the assumed future land use conditions and the expected increases in peak hour traffic volumes associated with these changes. Traffic increases are calculated based on the locally observed trip rates for office uses presented above. As shown, the future traffic forecasts assume a total increase of 104,464 square feet of building floor area and an increase of 297 to 304 peak hour vehicle trips. Assumptions regarding land use and traffic changes by parcel are included in Appendix A.

<table>
<thead>
<tr>
<th>Item</th>
<th>Avenue A</th>
<th>Avenue B</th>
<th>Avenue C</th>
<th>Avenue D</th>
<th>Wintersport Ln &amp; White Cap Drive</th>
<th>Combined Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assumed Change in Building Floor Area (ft²)</td>
<td></td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>Industrial</td>
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<td>-209,769</td>
<td>-43,581</td>
<td>-124,841</td>
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<tr>
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<td>54,476</td>
<td>156,051</td>
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<td>0</td>
<td>52,443</td>
<td>10,895</td>
<td>31,210</td>
<td>104,464</td>
</tr>
<tr>
<td>AM Peak Hour Trips</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In</td>
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<td>0</td>
<td>124</td>
<td>26</td>
<td>74</td>
<td>256</td>
</tr>
<tr>
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<td>4</td>
<td>0</td>
<td>20</td>
<td>4</td>
<td>12</td>
<td>41</td>
</tr>
<tr>
<td>Total</td>
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<td>0</td>
<td>144</td>
<td>30</td>
<td>86</td>
<td>297</td>
</tr>
<tr>
<td>PM Peak Hour Trips</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In</td>
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<td>0</td>
<td>148</td>
<td>30</td>
<td>88</td>
<td>304</td>
</tr>
</tbody>
</table>

Note: Trip estimates based on locally observed trip rates (See Table 10).

Table 12: Projected Corridor Trip Generation Increases for Build Condition

4.6 2035 Build Traffic Volumes

Peak hour traffic volume networks were developed for 2035 Build conditions based on the assumed land use changes described above. New trips associated with these land use changes were assigned to the roadway network in accordance with the trip distribution patterns presented in Figure 9. The assigned traffic volumes were then combined with the No Build volumes to create the Build traffic networks. The 2035 Build traffic volumes are shown in Figures 15 and 16 for the AM and PM peak hours, respectively. Comparisons with the No Build traffic flow networks show the total peak hour volumes entering the two gateway intersections with Route 2 and with Route 2A growing by five to eight percent.
WILLISTON, VT
INDUSTRIAL AVE. CORRIDOR STUDY
WILLISTON, VT
11/30/2012

AM BUILD PEAK HOUR VOLUMES
4.7 Proposed Transportation System Improvements

Two transportation system improvements are proposed in the study area which should be constructed well in advance of the 2035 design year. VTrans is developing plans to reconstruct the Industrial Avenue/Route 2 intersection. The current conceptual plan shown in Figure 17 shows the addition of a second eastbound left-turn lane on Route 2 to Industrial Avenue. A crosswalk is also proposed on the east leg of the intersection. The CCRPC and the Town of Williston are also pursuing a plan to construct a sidewalk along the south side of Industrial Avenue from Route 2 to Rossignol Park. Implementation of these improvements is assumed in the analysis of future traffic operations.

4.8 Future Traffic Operations

Future traffic operations analyses were completed for Industrial Avenue and for the study area intersections following the procedures used to assess existing operating conditions. Capacity analysis results for the study area intersections are compared in Table 13 for existing, 2035 No Build and 2035 Build conditions.

As shown, the side street calculated operating levels of service generally decline by at least one letter grade progressing from Existing to Build conditions. The two exceptions are the Avenue A and Gail Terrace intersections with Industrial Avenue where the side street volumes are relatively light. Operations are consistently worse during the PM peak hour relative to the AM peak hour as volumes exiting the side streets are highest during the PM peak hour when area employees are leaving work. The very worst condition is expected at the Wintersport Lane/Avenue B intersection where Build volumes are expected to exceed the capacity of the Wintersport Lane approach by seven percent during the PM peak hour. (The predicted volume-to-capacity ratio is 1.07.) The second most congested condition is during the PM peak hour at the North Brownell Road intersection. Here the Build PM peak hour volume-to-capacity is 0.91.

Conditions at one of the two signalized intersections in the study area will worsen measurably assuming the traffic increases occur as described above by 2035. The Route 2A/Mountain View Drive intersection with Industrial Avenue will experience traffic demands approximately equal to the intersection capacity under Build, AM peak hour conditions. Demands will exceed capacity, with volume-to-capacity ratios of 1.03 and 1.09 under PM No Build and Build conditions respectively. At the Route 2 intersection with Industrial Avenue, the currently proposed improvements, adding a second left-turn lane to the Route 2 eastbound approach, preclude operations from worsening relative to existing conditions.
### Table 13: Future Capacity Analysis Results

The travel time level of service concept was again applied to the corridor for the commuter peak traffic hours. For existing conditions, actual travel time measurements were taken in the field. The measurement demonstrated that travel times on all three roadway segments, (West, Middle and East as described earlier), are influenced by long queues on the Industrial Avenue eastbound approach to Route 2A during the PM peak hour. These delays were not reflected in the Synchro model used to analyze existing operations. However, since “field observations” cannot be used to predict delays under future conditions, the Synchro model was employed to assess the relative travel times under existing and future conditions. The Synchro model accumulates calculated delays for through traffic on Industrial Avenue at each intersection to provide the total delay encountered on a trip between Route 2 and Route 2A. The calculated delays were combined with the base or unimpeded travel times to determine the relative conditions to determine the roadway segment travel

<table>
<thead>
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<th>Unsignalized Intersections</th>
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</thead>
<tbody>
<tr>
<td><strong>Avenue A/Industrial Ave</strong></td>
<td></td>
</tr>
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</tr>
<tr>
<td>PM</td>
<td>C</td>
</tr>
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<td><strong>Wintersport Ln/Avenue B/Industrial Ave</strong></td>
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<tr>
<td>AM</td>
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<tr>
<td>PM</td>
<td>E</td>
</tr>
<tr>
<td><strong>White Cap/Avenue C/Industrial Ave</strong></td>
<td></td>
</tr>
<tr>
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<td>D</td>
</tr>
<tr>
<td>PM</td>
<td>D</td>
</tr>
<tr>
<td><strong>Avenue D/Industrial Ave</strong></td>
<td></td>
</tr>
<tr>
<td>AM</td>
<td>C</td>
</tr>
<tr>
<td>PM</td>
<td>C</td>
</tr>
<tr>
<td><strong>North Brownell/Industrial Ave</strong></td>
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</tr>
<tr>
<td>AM</td>
<td>C</td>
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<tr>
<td>PM</td>
<td>C</td>
</tr>
<tr>
<td><strong>Gail Terrace/Industrial Ave</strong></td>
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<tr>
<td>AM</td>
<td>C</td>
</tr>
<tr>
<td>PM</td>
<td>B</td>
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<tr>
<td><strong>Signalized Intersections</strong></td>
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<td><strong>Williston Road (Route 2)/Industrial Ave</strong></td>
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<tr>
<td>AM</td>
<td>C</td>
</tr>
<tr>
<td>PM</td>
<td>D</td>
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<tr>
<td><strong>Essex Rd (Route 2A)/Mountain View Dr/Industrial Ave</strong></td>
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<tr>
<td>AM</td>
<td>D</td>
</tr>
<tr>
<td>PM</td>
<td>D</td>
</tr>
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</table>

1 LOS = Level of Service  
2 Delay = Average delay expressed in seconds per vehicle  
3 V/C = Volume-to-Capacity ratio
times and operating levels of service for Industrial Avenue between Route 2 and
Industrial Avenue presented in Table 14.

As shown, calculated travel times are essentially unchanged during the AM peak
hour progressing from Existing to Build conditions. A noticeable increase in delay is
realized between No Build and Build conditions during the PM peak hour. However,
a closer examination of the intersection capacity analysis worksheets indicates that
the longer delays are associated with congestion at the two gateway intersections.
Travel times for through traffic along Industrial Avenue past the “Avenues” are not
significantly impacted by the projected increases in turning traffic volumes at the
Avenues.

<p>| Time Period/ | Calculated | Free Flow | Observed | Free Flow |</p>
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<td>(min:sec)</td>
<td>Percentage of</td>
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<td>Westbound</td>
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<td>93%</td>
<td>A</td>
<td>3:02</td>
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Note: Travel times and level of service calculated using the Synchro traffic model for Industrial Avenue
between Route 2 and Route 2A..

Table 14: Future Segment Level of Service

4.9 Findings

Based on the all of the information presented above, the following key findings are
repeated to help define corridor needs.

4.9.1 Existing Conditions

Land Use

- There is approximately 1.5 million square feet of commercial building floor
  space which has either direct or indirect access to Industrial Avenue. Much
  of the development on the south side of the road is used as office space while
  north side uses are primarily, but not exclusively, industrial in nature.

- Approximately ten percent of the current commercial building floor space is
  vacant.

Infrastructure

- Industrial Avenue provides one travel lane in each direction to accommodate
  vehicular traffic except on its approaches to Route 2 and Route 2A where a
  total of three lanes are provided.

- A sidewalk is provided on the north side of Industrial between Rossignol
  Park and Route 2A. Sidewalks are absent west of Rossignol Park.
The only striped crosswalk in the corridor is located where the sidewalk crosses from the north side of Industrial Avenue to the south side at Rossignol Park.

Wide paved shoulders on Industrial Avenue can accommodate bikes between Route 2 and North Brownell Road. East of North Brownell Road little or no shoulder is provided requiring cyclists to share lanes with vehicles.

There are no bus shelters at the designated bus stops in the corridor.

**Safety**

- There are no high-crash locations within the Industrial Avenue corridor.
- Sight lines on Industrial Avenue looking west at North Brownell Road are adequate to allow safe turning into North Brownell Road. Sight lines looking west are limited due to roadway grades just east of the location where left turns are made.

**Traffic Volumes**

- Industrial Avenue presently carries approximately 1000 vehicles west of North Brownell Road during each of the two commuter peak hours. Approximately 16 percent of this traffic is comprised of trucks during the AM peak hour.
- Side street volumes, except on North Brownell Road, are well below 100 vehicles per hour, a threshold volume for consideration of traffic signal control. At North Brownell Road 93 percent of the side street traffic turns right during the PM peak hour, the busier of the two.
- Based on the side street volumes, the commercial uses in the corridor generate at least 713 peak hour vehicle trips. (Private driveways with direct access to Industrial Avenue were not included in the traffic counts.)
- Pedestrian and bicycle volumes are minimal at fewer than ten per hour.
- Transit volumes are also light with fewer than ten transit riders per hour alighting from or boarding buses in the corridor.

**Traffic Operations**

- With the exception of extremely long delays approaching Route 2A from the west during the PM peak traffic hour, through traffic along Industrial Avenue experiences little or no delay.
- Side street traffic entering Industrial Avenue generally experiences only minor delays. Calculated delays, which often are less than measured delays on Stop-sign controlled intersection approaches, are only significant at one location: Wintersport Lane during the PM peak traffic hour.
- The North Brownell Road intersection approach, the highest volume side street in the corridor, operates with average delays (LOS C) during peak hours.
- The Route 2A/Mountain View Road/Industrial Avenue intersection experiences peak hour traffic demands approximately equal to the capacity of the intersection. Inefficient allocation of the intersection capacity, that is, non-optimal signal timing, results in extreme peak hour delays and queues on the Industrial Avenue approach during the PM peak hour.
The Route 2/Industrial Avenue intersection operates with moderate delays during peak hours with traffic demands of up to 86 percent of the intersection capacity.

### 4.9.2 Future Conditions

**Land Use**

- If redevelopment trends observed on the south side of Industrial Avenue (conversion of industrial space to office space) expand to the north side of the road, approximately 522,000 square feet of new office space could become available in the corridor.

**Infrastructure**

- Capacity and safety improvements will be provided at the Route 2/Industrial Avenue intersection consisting primarily of the addition of a second eastbound left-turn lane into Industrial Avenue from Route 2.
- A sidewalk will be provided on the south side of Industrial Avenue between Route 2 and Rossignol Park.

**Traffic Volumes**

- Full occupancy of existing vacant commercial space in the Industrial Avenue corridor would add 76 to 85 new peak hour vehicle trips to the roadway system.
- Continuation of historic traffic growth trends experienced in the corridor indicate no change in through traffic volumes over the next 20 years. However, application of a 0.5 percent per year growth rate would add approximately 60 peak hour vehicles to the corridor west of North Brownell Road and 100 peak hour vehicles east of North Brownell Road over the next 20 years.
- Conversions of industrial space to 522,000 square feet of new office space would add approximately 300 net new vehicle trips to the roadway system.

**Traffic Operations**

- Under 2035 No Build conditions, which assumes full occupancy of existing commercial space and a one-percent per annum growth rate in through traffic volumes, several of the side street approaches to Industrial Avenue will be operating at capacity experiencing long delays (LOS E of F conditions). These include: Wintersport Lane, the White Cap driveway and North Brownell Road.
- Under 2035 No Build conditions through traffic volumes along Industrial Avenue will experience very little change in delay and travel times. Travel times will increase by only a few seconds relative to existing conditions and the calculated operating levels of service will remain unchanged in the LOS A to B range.
- Under 2035 Build conditions, which includes all No Build traffic and the assumed redevelopment of certain parcels in the industrial zone, further decline in side street operating levels of service relative to No Build conditions is expected. Side street traffic delays will be most critical at Wintersport Lane and at North Brownell Road where LOS F operations are expected and where volume-to-capacity ratios will approach or exceed 1.0.
• Under 2035 Build conditions through traffic volumes along Industrial Avenue will experience very little change in delay and travel times relative to No Build conditions except at the two signalized gateway intersections at either end of the corridor. Calculated travel times however will be in the LOS B to C range.

• Proposed improvements to the Route 2/Industrial Avenue intersection will allow it to continue to operate below capacity and with only moderate delays under future No Build and Build conditions.

• The Route 2A/Mountain View Road/Industrial Avenue intersection will experience increased peak hour traffic demands, delays and queues under future Build conditions.

The future areas of concern described are identified by location in Figure 18.
5.0 Alternatives

Five alternative plans for the Industrial Avenue corridor were developed and analyzed. These include the No Build alternative, (simply maintaining the existing transportation infrastructure), and four Build alternatives. The four Build alternatives were developed by combining possible linear and spot improvement elements into comprehensive corridor plans. The linear treatments include actions that would change the roadway cross section for an extended distance and have potential right-of-way impacts. The spot improvements generally include traffic control treatments impacting specific intersections. Provided below is a description of individual linear and spot improvements considered followed by a discussion of the Build alternatives for the entire corridor.

5.1 Linear Treatments

Possible linear treatments for the study corridor are presented individually and in combination below to better understand their right-of-way impacts. Linear treatments considered include:

- On-street bike lanes;
- Sidewalks;
- Two-way left-turn lane; and,
- Multi-use path.

The right-of-way impacts of these strategies are evaluated at three points along the corridor. The first point, Location A, is representative of the corridor west of North Brownell Road. Here and throughout the entire corridor the right-of-way is 49.5 feet wide. The existing paved roadway width is approximately 36 feet. Location B is just east of North Brownell Road where the roadway width is also 36 feet and where a sidewalk is present on the north side of Industrial Avenue. Location C is at the extreme eastern end of the corridor where Industrial Avenue includes three travel lanes and a sidewalk on the north side of the roadway. The existing pavement width is 39 feet in this area. The existing roadway cross sections at these three locations are shown in Figure 19.
Figure 19: Existing Roadway Cross Section
5.1.1 Bike Lanes

The provision of bike lanes will help address the project goal of accommodating all travel modes. Presently there are no formal bike accommodations in the corridor. Cyclists use the paved shoulder which varies in width from five feet at the western end of the corridor to no shoulder at Route 2A.

The preferred bike accommodation includes a minimum 15 feet of pavement for cyclists and the adjacent vehicular travel lane per VTrans standards. Pavement striping typically would include an 11-foot travel lane and a four-foot shoulder/bike lane. Given the high percentage of truck traffic in the corridor, a total width of 16 feet may be preferred with a 12-foot lane and four-foot shoulder. Figure 20 illustrates typical roadway cross sections at three points in the corridor assuming that bike lanes are provided. As noted, in the western end of the corridor, bike lanes could be designated with no change to the existing pavement width. On the approach to Route 2A a pavement widening of three feet, from 39 feet to 42 feet, would be required to fit in the minimum bike accommodation. The total 47 feet of paved area, including the existing sidewalk, could fit within the 49.5 feet wide layout. However, if the widening were to occur entirely on the south side of the road it would extend 1.5 feet beyond the existing roadway right-of-way.

5.1.2 Sidewalks

Preliminary designs have been prepared to add a sidewalk to the south side of Industrial Avenue in the western end of the corridor. The proposed sidewalk would be five feet wide and offset from the roadway by a five-foot wide greenbelt. A five foot wide sidewalk is already present in the eastern end of the corridor on the north side of the road. On the approach to Route 2A there is no separation from the traveled way with the sidewalk located at the back of the existing curb. Further west a greenbelt of variable width is present. Implementation of the currently proposed plan would provide a continuous sidewalk for the entire length of Industrial Avenue with a crossing at Rossignol Park.

In order to eliminate the need to cross Industrial Avenue at Rossignol Park and provide continuous pedestrian connections on both sides of the roadway, additional sidewalks would need to be added. Assuming no change in existing travel lane and shoulder widths, the addition of a second sidewalk would extend the cross section for the roadway and sidewalks to 54 feet, 4.5 feet beyond the current right-of-way width in the western end of the corridor. To the east where the north side sidewalk already abuts the roadway edge the right-of-way requirements are 51 feet and 55 feet as shown in Figure 21.
Figure 20: Cross Section with Bike Lanes

Industrial Avenue Corridor Study
Looking East

SECTION A-A

5' sidewalk
6' shoulder
11' travel lane
6' shoulder
5' sidewalk

SECTION B-B

5' sidewalk
5' shoulder
11' travel lane
5' shoulder
5' sidewalk

SECTION C-C

4' sidewalk
5' shoulder
11' travel lane
11' travel lane
4' bike lane
5' sidewalk

Cross Section with Sidewalks

LEGEND

shld. = SHOULDER
row = RIGHT OF WAY
width = 49.50'

Figure 21: Cross Section with Sidewalks
5.1.3 **Multi-Use Path**

A multi-use path can accommodate bicyclists and pedestrians. Such a facility is typically constructed on only one side of the road. Provision of a multi-use path may eliminate the desire to provide on-street bike lanes. According to VTrans standards, a multi-use path should have a minimum width of ten feet. Separation from the traveled way with a greenbelt is also preferred. Figure 22 illustrates, again at three locations along Industrial Avenue, the right-of-way impacts associated with provision of a multi-use path in lieu of the existing and proposed sidewalks in the corridor. Assuming that the travel lanes and shoulder are narrowed to 12 feet and four feet, respectively, at the western end of the corridor the proposed treatment requires a 45 foot right-of-way. This is less than the existing right-of-way width however, the roadway centerline would have to shift to avoid any takings in building this improvement. The 52-foot width required to accommodate this treatment at the eastern end of the corridor would extend beyond the available right-of-way.

5.1.4 **Two-way Left-turn Lane**

A two-way left-turn lane is an effective means of reducing through traffic delays on a roadway by allowing vehicles waiting to turn left to clear the through travel lanes. They may also allow for safer traffic operations as a motorist waiting to turn left may feel less pressured to turn into a marginal gap in the oncoming traffic stream if there is no queue of vehicles waiting behind him or her. Two-way left-turn lanes, if they are wide enough, can also aid traffic turning left from side streets or driveways by allowing for a ‘staged’ left turn. In the first stage a motorist may turn left into the left-turn lane. In the second stage, perhaps after waiting some time for a suitable gap, the vehicle would merge into the through traffic stream. A lane width of ten to 12 feet is adequate for a two-way, left-turn lane that is not designed to facilitate staged left turns. A width of 14 to 16 feet is desirable where staged turns will be encouraged.

Only the impacts of a narrow, 11-foot wide, turn lane are considered in Figure 23. As shown in Figure 21, adding a two-way, left-turn lane centered on the existing roadway fits within the existing right-of-way on the western roadway segments. The eastern end of the corridor already includes a dedicated eastbound left-turn lane.

5.1.5 **Combination-Bike Lanes and Two Sidewalks**

Providing sidewalks on both sides of Industrial Avenue and bike lanes would require a wider cross section than providing only one of the two treatments. As shown in Figure 24, providing both treatments would create a 44 feet to 52 feet wide cross section at the western end of the corridor assuming that existing travel lanes and shoulders are narrowed. With the existing three-lane section at the eastern end of the corridor a 57 feet wide section is needed extending well beyond the available 49.5 foot right-of-way width.
Figure 22: Cross Sections with Multi-Use Path
Figure 23: Cross Sections with Two-way Left Turn Lane

工业大道走廊研究
Looking East

Cross Section with Bike Lanes and Sidewalks

Figure 24: Cross Sections with Bike Lanes and Sidewalks
5.1.6 Combination-Bike Lanes and Two-way, Left-turn Lane

Required pavement widths are maximized when combining on-street bike lanes with a two-way, left-turn lane. As shown in Figure 25, the paved surface is 43 feet across with 12-foot through lanes, four-foot bike lanes and an 11-foot left-turn lane. Providing this cross section with the proposed sidewalk and green belt on the south side of Industrial Avenue would add ten feet to the cross section and extend beyond the available right-of-way. (Elimination of the proposed green belt between the roadway and sidewalk would lessen these impacts however; curbing would need to be installed along the pavement edge changing drainage patterns and increasing construction costs.) East of North Brownell Road this treatment requires less than the 49.5 feet of right-of-way but would require takings on the south side of the road if the existing road remains in its present location.

5.1.7 Combination-Multi-use Path and Two-way, Left-turn Lane

Providing a multi-use path and two-way, left-turn lanes requires a 54 foot wide right-of-way assuming that minimum four foot wide shoulders are maintained where shoulders are present today. This width exceeds the right-of-way width and requires takings to the south side of the roadway if the existing roadway alignment is maintained in the western end of the corridor. At the eastern end where the existing sidewalk is located on the north side of the road takings would also occur on the north side. Roadway cross sections for this alternative are shown in Figure 26.

5.2 Corridor Treatments

Four alternative corridor plans were developed for more detailed evaluation. The plans offer increasing degrees of accommodation for pedestrians, cyclists and vehicles as follows:

- Alternatives 1A and 1B (Level 1) - Accommodate all modes “end to end” (Route 2 to Route 2A) on at least one side of the roadway. Maintain existing vehicular traffic controls/accommodations.

- Alternative 2 (Level 2) - Accommodate all modes “end to end” on both sides of the roadway. Add signal control to reduce side street delays.

- Alternative 3 (Level 3) - Accommodate all modes “end to end” on both sides of the roadway. Add signal control to reduce side street delays. Add left-turn lanes to Industrial Avenue to reduce through traffic delays.

Any of the four plans could be adopted by the Town as the “preferred alternative” however, it is also possible that the final preferred plan includes a combination of the various elements shown in the four plans. Phased implementation of the preferred plan is also possible. Each of the alternatives is discussed below.
Figure 25: Cross Sections with Bike Lanes and Two-way Left-turn Lanes
Figure 26: Cross Sections with Multi-Use Path and Two-way Left-turn Lanes
5.2.1 Alternatives 1A and 1B

Two variations of the low-level improvement plan were developed. Both alternatives are identical within the western section of the corridor. Between Route 2 and Rossignol Park a sidewalk is added on the south side of Industrial Avenue and the existing shoulders are striped and designated as bike lanes. East of Rossignol Park to Route 2A the plans differ. Alternative 1A shown in Figure 27 (attached) assumes a widening of the existing sidewalk on the north side of Industrial Avenue to create a ten-feet wide multi-use path. The path would accommodate both pedestrians and bicyclists on this segment. No changes would be made to the existing roadway in this section. For Alternative 1B Industrial Avenue would be restriped east of Rossignol Park to designate on-street bike lanes in both directions. A widening of Industrial Avenue would also be required, most likely to the south side, in the immediate vicinity of Route 2A. The existing five-feet wide sidewalk on the north side of the road would remain as is. Alternative 1B is illustrated in Figure 28, also attached.

5.2.2 Alternative 2

The mid-level improvement plan, Alternative 2, builds upon the pedestrian and bicycle improvements shown for Alternative 1B. The available paved shoulders are designated as bike lanes for the entire length of the Industrial Avenue corridor as shown for Alternative 1B. However, sidewalks are shown on both sides of the road for the entire corridor with a new sidewalk constructed on the north side of the road between Route 2 and Rossignol Park and on the south side of the road east of Rossignol Park to Route 2A. Traffic signal control is also proposed at the two intersections expected to experience the worst operating conditions of all the unsignalized intersections in the corridor. These include the Wintersport Lane/Avenue B/Industrial Avenue intersection and the North Brownell Road/Industrial Avenue intersection. Alternative 2 is illustrated in the attached Figure 29.

5.2.3 Alternative 3

For the highest-level improvement alternative, enhancements are proposed to Alternative 2. Specifically, Industrial Avenue from just west of Avenue A to just east of North Brownell Road would be widened to a three-lane cross section. On-street bike lanes and sidewalks would also be provided in this segment. The added center lane would function as a dedicated left-turn lane at each of the intersections along this segment and potentially as a two-way, left-turn lane between intersections. North Brownell Road would also be realigned to meet Industrial Avenue directly opposite Avenue D so that a proposed traffic signal at this location would aid traffic entering Industrial Avenue from both side streets. The roadway treatment east of North Brownell Road would be the same as proposed under Alternative 2. The Alternative 3 plan is illustrated in the attached Figure 30.

5.3 Impact Analysis

The impacts of the three corridor alternatives with respect to traffic operations (intersection operating levels of service and travel time along Industrial Avenue) and right-of-way requirements were quantified and compared. These analyses are described below.
5.3.1 Intersection Operations

Intersection peak hour traffic operations were analyzed for the Industrial Avenue corridor following the procedures described above to quantify existing and future intersection operations. The future or 2035 Baseline conditions analyzed above assumed that no changes are made to the transportation infrastructure within the corridor. The results for the 2035 Baseline conditions are compared to results for conditions assuming implementation of each of the three alternative corridor plans in Table 15. As shown, Alternative 1 (A or B) is not expected to have any significant impact on vehicular traffic operations as it makes no changes to the roadway infrastructure that would affect the roadway’s
traffic carrying capacity. Side street traffic which must now enter Industrial Avenue under Stop control conditions will continue to do so. For Alternative 2, traffic signal control proposed at the Wintersport Lane/Avenue B/Industrial Avenue intersection and the North Brownell Road/Industrial Avenue intersection will reduce delays for traffic entering from the side streets resulting in overall peak hour operating Levels of Service (LOS) C or better. No significant changes are anticipated at other study area intersections. For Alternative 3, the addition of left-turn lanes to Industrial Avenue offers some minor improvements in intersection operations at Wintersport Lane/Avenue B relative to Alternative 2 conditions. At the other proposed signalized intersection, the realignment of North Brownell Road opposite Avenue D complicates the intersection offsetting any benefit associated with adding left-turn lanes to Industrial Avenue. However, the intersection would still operate at LOS B during both AM and PM commuter peak hours with projected 2035 traffic volumes.

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<td>47.6</td>
<td>0.76</td>
<td>E</td>
<td>47.6</td>
</tr>
<tr>
<td>North Brownell/Industrial Ave</td>
<td>AM F</td>
<td>72.0</td>
<td>0.84</td>
<td>F</td>
<td>72.0</td>
</tr>
<tr>
<td></td>
<td>PM F</td>
<td>61.0</td>
<td>0.91</td>
<td>F</td>
<td>61.0</td>
</tr>
<tr>
<td>North Brownell/Industrial Ave/Avenue D (Realigned)</td>
<td>AM B</td>
<td>14.0</td>
<td>0.64</td>
<td>B</td>
<td>14.0</td>
</tr>
</tbody>
</table>

1 LOS = Level of Service  
2 Delay = Average delay expressed in seconds per vehicle  
3 V/C = Volume-to-Capacity ratio  
Results for signalized conditions are shown in italics.

Table 15: Future Intersection Operations with Improvements

### 5.3.2 Travel Times

The intersection peak hour traffic operations analyses were used to quantify expected impacts to vehicular travel times along Industrial Avenue for each of the alternative roadway improvement scenarios. The intersection operations analyses provide delay estimates for each intersection approach. The changes in calculated delay for the Industrial Avenue eastbound and westbound intersection approaches relative to delays calculated for the existing conditions were determined. These delays were added to the existing travel times reported above to represent expected future travel times in the corridor. For this analysis, delays associated with eastbound passage through the Route 2A/Mountain View Road/Industrial Avenue intersection were omitted. These delays were observed to be in excess of several minutes under
existing PM peak hour conditions and, if included, would overshadow any calculated changes in delay associated with the suggested corridor treatments.

As shown in Table 16, even the most substantial of the proposed corridor alternatives will have a very limited impact on travel times. As with the operations analysis, implementation of Alternative 1A or 1B will not change expected travel times for through traffic on Industrial Avenue. The introduction of traffic signals under Alternative 2 does add some delay to through travel. As shown, peak hour delays increase by approximately 11 to 30 seconds (7% to 23% percent of free flow travel time) relative to the baseline condition under Alternative 2. Alternative 3 adds left-turn lanes which will help reduce delays to through vehicles however, the calculations show that the realignment of North Brownell Road opposite Avenue D will add some delay to through traffic flow on Industrial Avenue such that there is little net change in travel time relative to Alternative 2.

<table>
<thead>
<tr>
<th>Direction</th>
<th>Peak Hour</th>
<th>Future 2035</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Industrial Avenue Travel Time (minutes:seconds)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Do Nothing</td>
</tr>
<tr>
<td>Traveling Eastbound</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AM</td>
<td>2:31</td>
<td>2:31</td>
</tr>
<tr>
<td>PM</td>
<td>3:30</td>
<td>3:30</td>
</tr>
<tr>
<td>Traveling Westbound</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AM</td>
<td>2:11</td>
<td>2:11</td>
</tr>
<tr>
<td>PM</td>
<td>3:02</td>
<td>3:02</td>
</tr>
</tbody>
</table>

Table 16: Future Corridor Travel Times with Improvements

5.3.3 Right-of-Way Requirements

Each of the alternative plans have different right-of-way requirements and these requirements vary by location along Industrial Avenue. The proposed roadway cross sections and right-of-way requirements are illustrated in Figures 20 through 26 and summarized in Table 17. Consistent with analyses presented above, right-of-way impacts are reported at three locations. The first point, Section A, is representative of the corridor west of North Brownell Road. Here and throughout the entire corridor the right-of-way is 49.5 feet wide. The existing paved roadway width is approximately 36 feet along Section A. Section B is just east of North Brownell Road where the roadway width is also 36 feet and where a sidewalk is present on the north side of Industrial Avenue. Section C is at the extreme eastern end of the corridor where Industrial Avenue includes three travel lanes and a sidewalk on the north side of the roadway. The existing pavement width is 39 feet in this area.

As noted in Table 17, the proposed 44 feet wide cross section for Alternative 1A and 1B can fit within the available 49.5 feet right-of-way for Section A, the west end of the corridor. However, there may be an encroachment of approximately 1.5 feet to the south side of the roadway if the existing roadway centerline location is maintained. This could be mitigated by reducing the width of the proposed green strip from five feet to four feet and by narrowing the proposed eastbound bike lane from six feet to five feet. In Section B, widening is associated with conversion of the 5-foot sidewalk to a 12-foot multi-use path on the north side of the road for
Alternative 1A. This widening can also be accomplished generally within the existing right-of-way. Alternative 1B does not require any widening in Section B. In Section C, the space available on the north side of the road for multi-use path construction is more limited with a two-feet wide encroachment anticipated under Alternative 1A. Alternative 1B includes a widening of approximately 1.5 feet to the south side of the road, assuming that the roadway centerline location is maintained, to accommodate a four-feet wide eastbound bike lane. This bike lane could be accommodated with no encroachment if the entire roadway were to shift to the north.

More substantial right of way requirements are associated with Alternative 2 as the basic cross section is 52 feet wide. Again, the available right-of-way is only 49.5 feet. On roadway Section A where a five-feet wide green strip is proposed separating the sidewalks from the roadway another 2.5 feet of right-of-way is required to fit in the proposed treatments. Curbing could be installed to eliminate the green strip requirement; however, installing curbing at the edge of the travelway will generally incur costly drainage improvements. (Catch basins, drainage pipes and detention basins may need to be installed to remove stormwater from the paved roadway.) For most of Section B, the existing north side sidewalk is located immediately adjacent to the roadway behind a raised curb lessening the right-of-way requirements. Assuming that curbing is used for Alternative 2 on both sides of the roadway here, the required cross section is only 42 feet. Without curbing on the south side, the right-of-way requirement is 47 feet, slightly less than the 49.5 feet available. Either variation of Alternative 2 however, could not be built without some encroachment on the south side of Industrial Avenue unless the entire roadway were reconstructed and the centerline shifted to the north. In Section C right-of-way impacts would again be minimized if the roadway were shifted to the north. The total space requirement, assuming a curbed section, is 51 feet, slightly more than 49.5 feet available.

Right-of-way impacts for Alternative 3 are the same as for Alternative 2 except within Section A and the very western portion of Section B. In these areas inclusion of an 11-feet wide left-turn lane in the roadway cross section is accommodated in part by assuming that the bike lanes in this area are reduced in width from six feet (Alternatives 1 and 2) to four feet (Alternative 3). The total right-of-way requirement, 61 feet, greatly exceeds the existing right-of-way width of 49.5 feet.

The above right-of-way discussion only considers accommodation of roadways, bike lanes and sidewalks within the public roadway right-of-way. Additional right-of-way may be required to accommodate snow storage, utilities, traffic control equipment and bus shelters.

<table>
<thead>
<tr>
<th>Roadway Segment</th>
<th>Roadway Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Do Nothing</td>
</tr>
<tr>
<td>Location A – West of N. Brownell</td>
<td></td>
</tr>
<tr>
<td>Total Paved Width (ft)$^1$</td>
<td>34’</td>
</tr>
<tr>
<td>Additional Paved Width Relative to Existing Conditions (ft)$^1$</td>
<td>-</td>
</tr>
<tr>
<td>Paved Area Outside of Existing Right of Way (ft)$^1$</td>
<td>0’</td>
</tr>
</tbody>
</table>
## Table 17: Approximate Right-of-Way Impacts for Alternative Designs

<table>
<thead>
<tr>
<th>Location B – East of N. Brownell</th>
<th>Roadway Segment</th>
<th>Roadway Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total Paved Width (ft)</td>
<td>34’</td>
</tr>
<tr>
<td></td>
<td>Additional Paved Width Relative to Existing Conditions (ft)</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Paved Area Outside of Existing Right of Way (ft)</td>
<td>0’</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Location C – Just West of Route 2A</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Paved Width (ft)</td>
<td>34’</td>
<td>44’</td>
</tr>
<tr>
<td>Additional Paved Width Relative to Existing Conditions (ft)</td>
<td>-</td>
<td>10’</td>
</tr>
<tr>
<td>Paved Area Outside of Existing Right of Way (ft)</td>
<td>0’</td>
<td>0’</td>
</tr>
</tbody>
</table>

Includes ‘green belt’ if provided.
Note: Existing Right-of-Way is 49.5 feet. The roadway may not be centered within the roadway for all locations/scenarios, as such, actual right-of-way impacts may be greater than noted.

### 5.4 Route 2A

The Industrial Avenue Corridor Study is being conducted concurrent with the Williston-Essex Network Transportation Study (WENTS). The WENTS is considering a range of potential roadway network changes that could significantly impact traffic volume levels on Route 2A. Accordingly, the WENTS has primary responsibility for proposing and evaluating roadway improvement alternatives for the Route 2A/Mountain View Road/Industrial Avenue intersection. However, since the Route 2A/Mountain View Road/Industrial Avenue intersection operates so poorly under existing and projected future traffic conditions, an evaluation was conducted of alternative intersection improvement plans that were proposed in prior studies. Four primary alternatives were considered as described below.

- Intersection Alternative 1- Add westbound left-turn lane.
- Intersection Alternative 2A- Add westbound left-turn lane; eastbound left-turn lane; and, northbound through lane.
- Intersection Alternative 2B- Add westbound left-turn lane and northbound through lane. Convert eastbound through/right-turn lane to an all-purpose lane.

Conceptual plans for these alternatives are on the following pages.
Intersection Alternative 1 - Add westbound left-turn lane.
Intersection Alternative 2A- Add westbound left-turn lane; eastbound left-turn lane; and, northbound through lane.

Figure 32: Route 2A Alternative 2A
Intersection Alternative 2B- Add westbound left-turn lane and northbound through lane. Convert eastbound through/right-turn lane to an all-purpose lane.

Figure 33: Route 2A Alternative 2B
Intersection Alternative 3 – Reconstruct as a modern roundabout.

Figure 34: Route 2A Alternative 3
Projected 2035 peak hour intersection operating levels of service for the Route 2A/Mountain View Road/Industrial Avenue intersection were determined for each of the alternative improvement plans using the projected 2035 traffic demands presented in this study. As shown in Table 18, each of the alternative intersection treatments will provide significant levels of improvement relative to conditions assuming no change in the existing intersection configuration. Two of these alternatives, intersection Alternative 2A and Alternative 2B, result in expected 2035 peak hour traffic operations that are below capacity. Projected operations for the single-lane roundabout are very close to capacity, 97 percent of capacity, under future PM peak hour conditions. Consequently, using the traffic forecasts provided in this study, the two variations of Alternative 2 and Alternative 3 would provide meaningful improvements in peak hour intersection operations relative to existing geometric and traffic control conditions.

<table>
<thead>
<tr>
<th></th>
<th>Future 2035 Peak Hour Operations</th>
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<tr>
<td></td>
<td>Do Nothing</td>
<td>Alt 1</td>
<td>Alt 2A</td>
<td>Alt 2B</td>
<td>Alt 3</td>
<td></td>
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<tr>
<td></td>
<td>LOS1</td>
<td>V/C2</td>
<td>LOS</td>
<td>V/C</td>
<td>LOS</td>
<td>V/C</td>
</tr>
<tr>
<td>Route 2A/Mountain View Road/Industrial Ave</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AM</td>
<td>E 0.93</td>
<td>D 0.92</td>
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<td>PM</td>
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<td>D 1.02</td>
<td>D 0.83</td>
<td>C 0.87</td>
<td>- 0.97</td>
<td></td>
</tr>
</tbody>
</table>

1 LOS = Level of Service  
2 V/C = Volume-to-Capacity ratio

Table 18: Future Route 2A/Mountain View Road/Industrial Avenue Intersection Operations with Improvements
6.0 Recommendations

The alternative improvement plans for Industrial Avenue were presented to Town officials and residents at a series of public meetings. During the public review process a consensus of opinion was reached among Town officials with the Town supporting implementation of a hybrid plan in a phased manner. The recommended infrastructure plan and other study recommendations are described below.

6.1 Recommended Infrastructure Plan

The recommended plan includes elements of two of the alternative plans presented above. Within the more commercially developed western section of the corridor, between Route 2 and Rossignol Park, sidewalks would be constructed on both the north and south sides of the roadway. Each sidewalk would be five feet wide with a green belt, a grass strip separating the sidewalk from the roadway, ranging in width from four to five feet. The existing 34 feet wide paved travelway would be restriped to include an 11 feet wide travel lane and six feet wide bike lane in each direction. As shown in Figure 35 (attached), east of Rossignol Park there would be no new sidewalk construction; however, the existing 32 feet wide pavement section would be restriped to include an 11 feet wide travel lane and five feet wide bike lane in each direction. Just west Route 2A where Industrial Avenue widens to three lanes, a minor widening of Industrial Avenue would be provided to allow the five feet wide bike lanes to continue east to Route 2A. A widening of approximately 1.5 feet to the south is recommended in this area. This would maintain the existing lane alignments through the signalized Route 2A/Mountain View Road/Industrial Avenue intersection and maintain sufficient depth to park two vehicles end to end in the residential driveways that intersect the south side of the road.

Throughout the corridor new crosswalks would be provided at intersections to meet with the proposed new sidewalks. Bus shelters may also be provided at designated bus stops if and when transit travel demand increase.

6.2 Phasing

It is anticipated that funding limitations will dictate that the proposed corridor improvements will be implemented in a phased manner. Whereas a Scoping Report has already been completed for the proposed sidewalk on the south side of Industrial Avenue, it is recommended that this sidewalk be constructed first. Existing land uses on the south side of the roadway are likely to generate more pedestrian trips than the existing industrial land uses on the north side of the road. The transition from industrial uses to office uses is happening more slowly on the north side of the road. However, sidewalk segments on the north side of the roadway could be constructed at any time as mitigation for development and redevelopment projects occurring on parcels with frontage on Industrial Avenue. The Town should consider opportunities to advance the sidewalk plan as it evaluates permit applications for development in the corridor.

Proposed roadway striping to create bike lanes could occur at any time. As noted above this is a relatively low cost action and can be implemented without takings throughout much of the corridor. The exception occurs at the east end of the corridor where Industrial Avenue includes a two-lane
approach to Route 2A. Here a narrow land taking and roadway widening would be necessary to provide a bike lane on the south side of the roadway. Should bike lanes be provided in advance of any roadway widening at this location, the eastbound (south side) bike lane would need to end in advance of this the Route 2A intersection and appropriate warning signs would need to be provided.

6.3 Improvement Costs

Approximate implementation costs for the proposed improvement plan have been determined. Costs are presented for design and construction components.

Sidewalks-A scoping study has already been prepared for the recommended sidewalk on the south side of Industrial Avenue. This study, Industrial Avenue Sidewalk Scoping Study prepared by Stantec dated February 23, 2012, estimated the cost to construct a sidewalk along the south side of Industrial Avenue for a distance of 3206 feet at $170,000. This translates to $53.00 per linear foot. The design fee was estimated at 15% percent of the construction cost or $25,500. These cost estimates remain valid and can be applied to the proposed sidewalk to the north side of the road as well. The north side sidewalk would be approximately the same length of the south side sidewalk.

Crosswalks-There are presently no crosswalks present in the corridor west of Rossignol Park. With sidewalks in place it is recommended that crosswalks be provided at each major side street/driveway intersection with Industrial Avenue. Crosswalks would be striped crossing Industrial Avenue and crossing the side streets. With three four-way intersections on this segment and three three-way intersections, 12 new crosswalks would be provided. Applying a standard VTrans unit cost of $400 each the cost of crosswalk striping is estimated at $4800.

Roadway Widening-At the very eastern end of the corridor a 1.5 foot roadway widening is proposed for a distance of approximately 500 feet. Applying standard VTrans unit costs of $17 per square foot, the widening would cost $12,750 to construct. However, given the relatively small size of the project, unit costs could be much higher. A $25,000 construction cost should be assumed with approximately $5000 in design services.

Bike Lanes-New pavement markings are proposed to designate bike lanes in the corridor. A new edge line should be provided on each side of the road for a distance of 10,531 feet to designate the bike lanes. At the standard VTrans unit cost of one dollar per linear foot, the edge lines could be provided at a cost of approximately $11,000. Signage would also be provided in the corridor to identify the bike lanes. Installation of four post-mounted signs is proposed at an unit cost of $250 per sign.

Bus Shelters-Bus shelters are not an integral component of the proposed plan but may be worth providing in the future at key locations if and when transit travel demands grow. The CCTA typically spends $20,000 for installation of a basic bus shelter.

Traffic Signals-Traffic signals are not proposed as part of the current plan but may become warranted at a future point in time. VTrans estimates typical signal installation costs at $180,000 per intersection not including any related geometric improvements to the intersection. Design fees typically amount to $20,000 per location. The alternatives analysis in this study included two new signal installations which would represent a total cost of $400,000.

As described above, the required elements of the recommended plan, (sidewalks, crosswalks, roadway widening and bike lanes), could be provided at an estimated total cost of $565,000. Additional elements that may be considered at a future point in time, (bus shelters and traffic signals), would add to this budget.
6.4  Right of Way

The conceptual improvement plan identifies locations where land takings may be required to accommodate the proposed new pedestrian and bicycle facilities. As shown, the impacts are limited to a very few locations and there may be opportunities to partially or fully mitigate these impacts during the design process.

At the very eastern end of the corridor, a one to five foot taking is anticipated on the south side of the road assuming that all new roadway widening occurs to that side of the road. The roadway could be shifted slightly to the north in order keep the proposed new bike lane entirely within the roadway right-of-way but this would add cost to the construction project and could negatively impact lane alignments for traffic passing through the Route 2A/Mountain View Road/Industrial Avenue intersection. Of course, the implementation of capacity improvements at this intersection either as identified in this study or in the WENTS could require additional right-of-way on the Industrial Avenue approach.

At the western end the corridor the recommended plan places the southern edge of the proposed sidewalk 1.5 feet outside the roadway layout. This impact could be mitigated by narrowing the proposed six feet wide bike lane and/or narrowing the proposed five feet wide greenbelt. However, the taking areas abut commercial properties with significant front yard setbacks. Obtaining right-of-way from these property owners may be not be problematic and preferable in terms of maintaining a uniform cross section within the travel corridor. Acquisition of additional right-of-way beyond the minimum 1.5 feet required might also be desirable and provide room for snow storage, utilities and/or bus shelters.

6.5  Plan Benefits

The recommended plan achieves the principal goals outlined in the Purpose and Need Statement.

- It manages peak hour traffic demands under future “build out” conditions in an efficient manner with only nominal delays to through traffic on Industrial Avenue and with significant side street delays limited to only two locations and to the evening peak hour.
- It provides continuous, end-to-end (Route 2 to Route 2A) bicycle accommodations for cyclists.
- It provides end-to-end accommodations for pedestrians and a robust sidewalk network within the commercial segment of the corridor facilitating circulation among the various businesses and access to transit services.
- It requires very limited right-of-way takings.
- It minimizes new construction thereby limiting construction costs.
6.6 Access Management

Existing vehicular access to developed parcels along Industrial Avenue generally occurs by way of intersecting side streets. The few private driveways entering directly onto Industrial Avenue are located on the north side of the roadway east of Avenue C. The driveway volumes are relatively low and driveway activity has very limited impacts on traffic operations along Industrial Avenue as evidenced by the existing conditions travel time surveys conducted in the corridor. Consequently, there is little urgent need to close, consolidate or relocate driveways under existing conditions. However, fewer driveways will enhance pedestrian safety along the proposed sidewalks and result in fewer traffic conflict points if and when parcels are redeveloped. Consequently, as parcels fronting on Industrial Avenue are redeveloped closing and/or consolidation of driveways should be considered as part of the permit process to reduce the number of driveways on Industrial Avenue. Where possible, alternative access would be provided by way of existing side streets.

Roadway connections between the Avenues should also be pursued as part the development review process for future land use proposals. Presently there is a roadway connection between Avenue C and Avenue D. There are no such public connections between Avenue C and Avenue B or between Avenue B and Avenue A. These connections, if provided, would allow traffic to flow between the Avenues without entering onto Industrial Avenue. Reducing the volume of traffic turning on and off of Industrial Avenue will help smooth traffic flow and limit pedestrian vehicle conflicts where the Avenues enter Industrial Avenue. Also, should traffic signals ever be installed along Industrial Avenue at just one or two of the side street intersections, the recommended connections would allow traffic leaving all businesses along the Avenues access to a traffic signal installation. Such access may be important should long delays be experienced entering Industrial Avenue at unsignalized locations.

6.7 Traffic Monitoring

As noted, the installation of two new traffic signals in the corridor was considered and rejected by the Town. The potential need for the signals is dependent upon growth in future traffic demands through and within the corridor. Signals are not warranted under existing conditions. Consequently, it is recommended that peak period traffic monitoring be conducted periodically within the corridor, particularly at the Wintersport Lane, Avenue D and North Brownell Road intersections with Industrial Avenue as these three are the most likely to experience significant side street delays.

Monitoring should also be conducted at the North Brownell Road intersection if and when improvements are made to the Route 2A/Mountain View Road/Industrial Avenue intersection. Existing congestion at the Route 2A/Mountain View Road/Industrial Avenue intersection causes vehicle queues to spill back to North Brownell Road during the PM peak hour. When queues are present the intersection operates more like an all-way STOP controlled intersection with vehicles from Industrial Avenue west of the intersection and North Brownell Road taking turns entering Industrial Avenue eastbound. If the Route 2A/Mountain View Road/Industrial Avenue intersection congestion is relieved and queues are eliminated then more normal operations would resume at the North Brownell Road intersection. North Brownell Road traffic would need to yield to Industrial Avenue traffic and thereby may experience longer delays than experienced today.

6.8 Next Steps

The Town of Williston formally adopted the recommended plan by vote of the Williston Selectboard on February 25, 2013 (See attached meeting minutes). The adopted plan would guide future public investment along the roadway and inform the permitting process for future development and redevelopment in the corridor. New public investment may include sidewalk construction, roadway widening, new bus shelters, pavement resurfacing and pavement restriping. Similar investments could be required of developers as conditions of permits for new development or redevelopment to mitigate
project-related transportation impacts. The plan may also inform the permitting process with respect to access management.

To the extent that the Town seeks to construct elements of the plan, next steps would include:

- Approach VTrans and/or the CCRPC to discuss the necessity for an additional scoping study to evaluate impacts to historical, archeological, and environmental resources resulting from this corridor study’s recommended alternative.

- After the appropriate level of scoping is complete, coordinate with VTrans and apply for state funding under the Local Transportation Facilities (LTF) program.

- Allocate Town funds (local match to State funds) for project construction.
TAKE ON SOUTH SIDE OF ROAD FOR ABOUT 3200')

ADD 5' SIDEWALK WITH 5' GREEN STRIP (+/- 1.5' IN R S P O D IB P 3 1 0 9 16 5 4 A A-A C 24.75' lane bike side 5' row 6'

INCLUDE 11' TRAVEL LANES AND 5' BIKE LANES

RE-STRIPE EXISTING 32' ROADWAY TO

WIDEN ROADWAY TO ADD

4' EB BIKE LANE (+/- 1.5' W D I B P 15 9 3 3 1 11 11')

4' C M P S H R U B B E R Y  A N D  A L R A  C O M P A N Y (P A R K E R  B R O S.)


INCLUDE 11' TRAVEL LANES AND 5' BIKE LANES

TAKE FOR ABOUT 250')