

**TOWN OF WINTHROP**

**BICYCLE NETWORK CONNECTIVITY USING**

**LOW STRESS BICYCLING MODEL**

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# Winthrop Bicycle Connectivity Study



## INTRODUCTION

Town of Winthrop is a coastal community with a population of 17,497 (Census 2010) that lies adjacent to the neighborhoods of East-Boston and Cities of Revere and the Boston Logan Airport. Figure 1 shows the location and network of streets and paths in Winthrop.



Figure 1 – Town of Winthrop Road Network

The Town of Winthrop is served by about 42 miles of travel network. Table 1 shows the functional classification of the roadway according to the Federal Highway Authority seven levels of designation. About 85% is owned by the town, while 10% is private (unaccepted road) and 5% under state jurisdiction (Department Conservation and Recreation or DCR) and designated as recreational. The

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portion of the roadway network that is designated local is 60%, while another 27% makes up the main arterial and collector network. There is a proposed multi-use path with about 3 miles of travel network on the north-west boundary of the Town.

Table 1: Roadway Miles by Functional Class and Jurisdiction

Road Mileage	Jurisdiction				
Functional Class	Unaccepted	Town	DCR	Proposed	Grand Total
Multipurpose Path				2.94	
Minor Arterial		6.90	0.16		7.06
Major Collector		6.14	1.03		7.17
Local	4.29	22.92	0.09		27.30
Grand Total	4.29	35.95	1.28		41.53

The Town streets have speeds ranging from 15 to 30 miles, with only 8% of the mileage above 25 miles per hour. This is a very convenient state to be in since raw speed and speed differential between non-motorized travel (bicycle and pedestrian) and automobile travel is an important factor that discourages use of shared roadway network. Table 2 shows the travel network speed limit (Mass DOT Road Inventory 2018) within the Town of Winthrop street network.

Table 2: Roadway Miles by Speed Limit & Jurisdiction

Road Miles	Jurisdiction				
Speed Limit	Unaccepted	Town	DCR	Proposed	Grand Total
15		0.16			0.16
20		2.35			2.35
25	4.29	29.77	1.12	2.94	35.18
30		3.68	0.16		3.84
Grand Total	4.29	35.95	1.28		41.53

According to the US Census transportation data (2012-2016), greater Boston has a Bicycle Travel mode share of less than 1%. The Town of Winthrop by virtue of its location and its proximity to Boston, would have about the same travel characteristics. Table 3 shows the mode share in the Boston area.

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Table 3: Mode share in the Boston area

Mode	% Commute
Car, truck, or van -- Drove alone	71.32%
Car, truck, or van – 2 or more-person carpool	7.60%
Bus or trolley bus	9.79%
Ferryboat	0.09%
Bicycle	0.78%
Walked	4.76%
Motorcycle	0.10%

## I. CURRENT STRESS LEVEL STATUS IN WINTHROP

Town of Winthrop is a coastal community with limited travel access to outside destinations. Its proximity to Boston in the south-west, and Revere and Lynn in the north makes it a much-desired residential community. The population has been relatively stable around 18,000 persons for the last 10 years with slight decline since the last census. Figure 2 shows the population density of the Town using census 2010 data.

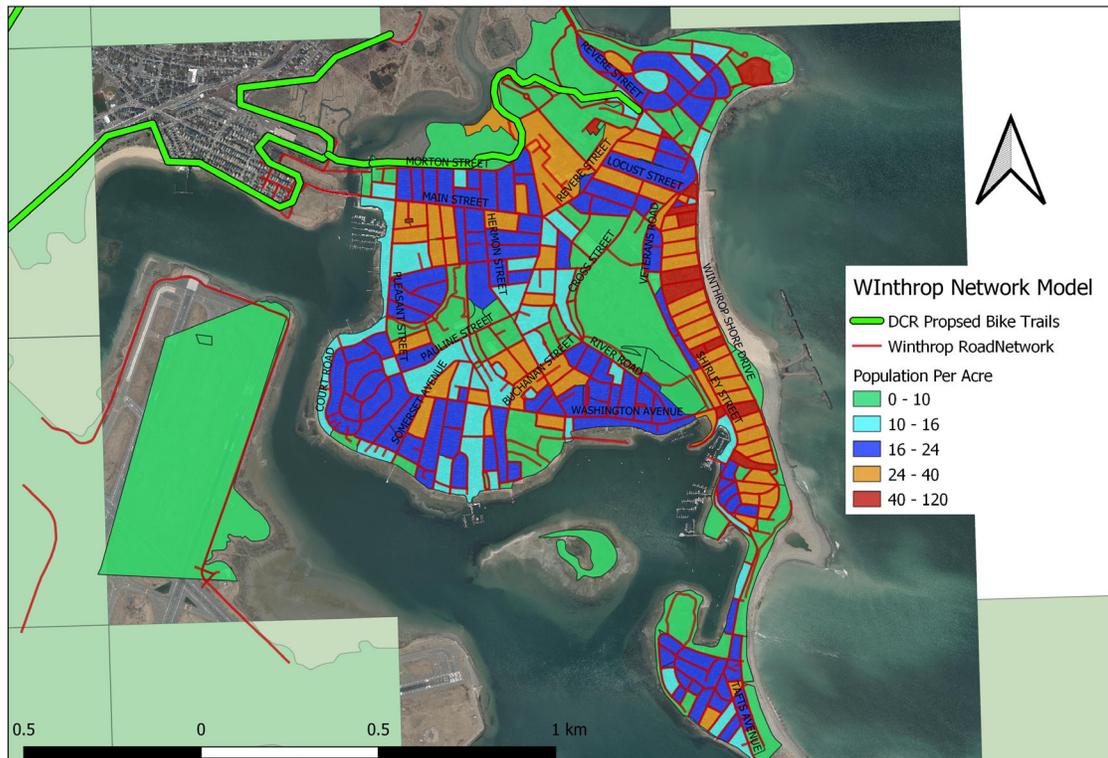


Figure 2: Population Density Persons Per Acre, Winthrop, MA (Census 2010)

The Town’s highest density area is on its eastern side and is primarily a long the beach front. The area is served by two collector streets, Winthrop Shore Drive

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and Veterans Road (Rte 145). Figure 3 shows the traffic volume map (Source: Mass DOT Roadway Inventory 2018) overlaid onto the population density.



Figure 3: Traffic Volume, Winthrop, MA (Src: Mass DOT Road Inventory 2018)

The arterial network is primarily composed of Pleasant Street, Main Street, Revere St, Washington St, and Veterans Road, which is designated as County Route 145. Those arterial streets carry the bulk of the traffic. From the point of view of non-motorized travel, the presence of higher volume is not always a deterrent to travel, yet careful mitigation efforts would be needed as the number of conflicts increase and allowing safe and efficient interaction is paramount.

The same can be said of Speed, where 30 miles per hour speed is set for the arterial network that also carries the most traffic. Figure 4 shows the speed limit for the routes (Source: Mass DOT Roadway Inventory 2018). It is commonly known that the prevailing speeds are higher than the posted speed limits. And efforts at mitigating speed impacts are worthwhile. Since most municipalities and states are adopting Vision Zero as a target in their bid to eliminate travel related serious injuries and fatalities, Winthrop would be in the forefront by performing critical analysis of all the factors contributing to crashes.

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Figure 4: Speed Limit, Winthrop, MA (Src: MassDOT Road Inventory 2018)

The combination of higher volume and high speed make the arterial network a danger zone for the safe travel of both pedestrians and bicycles. For the risk averse traveler, the situation poses an unwelcome combination and would hinder use by the 15-year-old and younger, and the 65 years and older persons in the community. This may pose a limit to the adoption of such important travel initiatives such as Safe Route to School and biking to transit stations. Since Winthrop also has welcomed Bike Share, the main gateway and access for travel to both internal and external travel connections should be available for all town residents.

Mass DOT Crash Statistics indicates that there is a pedestrian crash cluster for the 2017-2018 data that is located on the geographic center of the Town of Winthrop. The area of concern is where most of the shopping activity takes place. It is also the area with one of the highest traffic volumes with speed limit varying between 25 to 30 mph. This mix of higher speed travel, large auto movement, and even larger non-motorized (pedestrian, bicycle) activity is a major concern and a contributor to travel hazard, either in the form of crashes clusters as shown in Figure 5, or restriction of access and overall frustration for all modes of travel.

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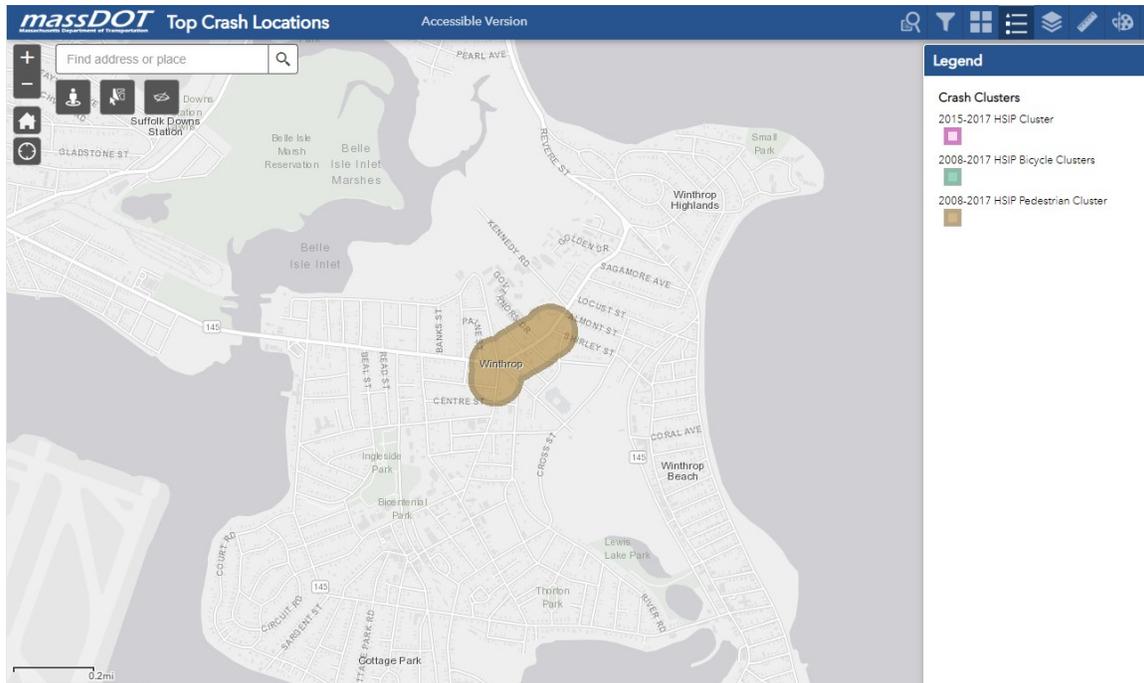


Figure 5: Pedestrian Crash Cluster, Winthrop, MA (Source: Mass DOT)

Bicycle travel on the street network is primarily connected through low stress local streets and the recreational routes primarily along the eastern shoreline. The network data is obtained from Massachusetts road inventory with limited enhancements through geographic and attribute data updates. The data was used to generate stress level maps based on the Low Stress Level model built by Mekuria et.al. (1).

**Table 4: Levels of Traffic Stress (LTS) General Definition**

LTS 1	Presenting little traffic stress and demanding little attention from cyclists. Suitable for almost all cyclists, including children trained at safely crossing intersections, and attractive for a relaxing bike ride. On links, cyclists are either physically separated from traffic, or in an exclusive bicycling zone next to a slow traffic stream with no more than one lane per direction, or on a shared road where they interact with only occasional motor vehicles (as opposed to a stream of traffic) with a low speed differential. Bike lanes do not run along a parking lane or next to a right turn lane. Intersections are easy to approach and cross.
LTS 2	Presenting little traffic stress and therefore suitable to most adult cyclists but demanding more attention than might be expected from children. On links, cyclists are either physically separated from traffic, or in an exclusive bicycling zone next to a moderate speed traffic stream with no more than one lane per direction and with adequate clearance from a parking lane, or on a shared road where they interact with only occasional motor vehicles (as opposed to a stream of traffic) with a low speed differential. Where a bike lane lies between a through lane and a right turn lane, it is configured to give cyclists unambiguous priority where cars cross the bike lane, and to keep car speed in the right turn lane comparable to bicycling speeds. Crossings are not difficult for most adults.
LTS 3	More traffic stress than LTS 2, yet markedly less than the stress of integrating with multilane traffic, and therefore welcome to many people currently riding bikes in American cities. Offering cyclists either an exclusive riding zone (lane) next to moderate speed traffic, or shared lanes on streets that are not multilane and have moderately low speed. Crossings may be longer or across higher speed roads than allowed by LTS 2 but are still considered acceptably safe to most adult pedestrians.
LTS 4	A level of stress beyond LTS3.

Source: Mekuria, Furth, Nixon, 2012 (1)

## II. STRESS MAPPING

There are two levels of network complexity when performing traffic stress mapping. The first being the roadway segment characteristics along which a traveler uses. The second is at intersections where crossing and turning movements are made.

Figure 6 shows the Traffic Stress Level (LTS) map for the Town of Winthrop using the LTS model in (1) for segment level assignment.



Figure 6: Level of Traffic Stress (LTS), Winthrop, MA

Except the primary arterial and collector routes shown in Figure 6 with purple color as LTS 3, the rest of the Town's network is at or below LTS 2. The Town network is completely connected under LTS 2 despite a longer circuitry that comes due to the barrier formed by Route 145 (Main St, Pleasant St, Washington Ave, Veterans Road and Revere St).

The stress level map shows that there maybe a need to look more closely into the network connections at key intersections where crossing improvements need to be made. The arterial network carrying the most auto traffic is also the one most needed for the safe connectivity across the town. Winthrop arterial streets are the widest in town and with the greatest potential for improvement into shared streets.

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Figure 7: Revere St & Highland Ave Junction, Winthrop (Courtesy: Google Map)

The majority of the intersections are stop controlled with less than 7 traffic signal-controlled junctions. Figure 2 shows one signalized intersection at Revere St (Route 145), Crest Ave and Highland Ave. Winthrop street network is about 60% local roads, which makes it suitable for low stress travel. Figure 3 shows the stress classification map of the Town.



**Figure 8 - Shortest Path Tree for Level of Traffic Stress 2**

The LTS 2 map shown in Figure 8, reveals areas where intersection improvements could increase the connectivity through out the network. Intersections such as Pauline St and Pleasant Street are already signalized and benefit the pedestrian and cyclist to have a safe crossing. Other locations such as school access locations at Walden and Pauline St., Metcalf Sq., at Main St, Winthrop St., and Revere St. (Five-legged intersection) may need to be carefully studied for safe accessibility by non-motorized traffic. With the introduction of electronic bicycles, the mix of bicycle users may increase, and safe accommodation requires thoughtful planning and design. Signalization of an intersection may not always be sufficient to secure crossing for pedestrians and bicycles.



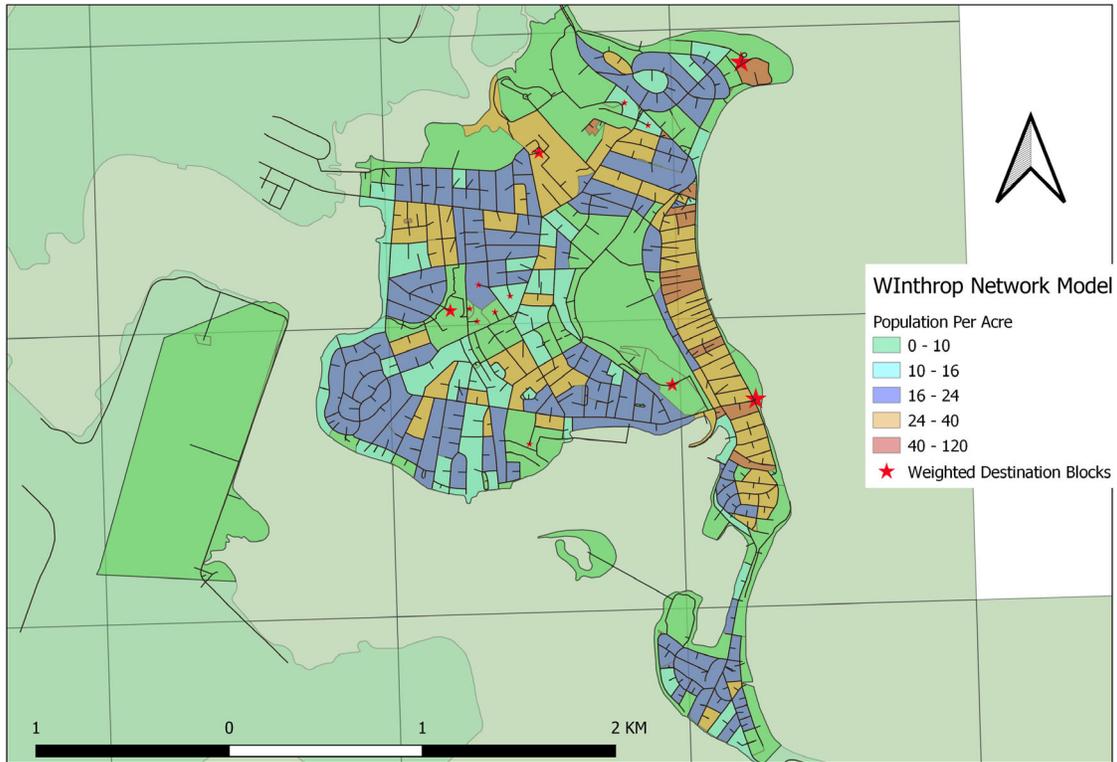
**Figure 9 – Pleasant Street at Buchanan St / Sunnyside St**

Street intersections such as Pleasant Street at Buchanan Street (Figure 9) may be excellent candidates for safety audits and shared use accommodations through the introductions of traffic calming measures such as raised crossings and mini roundabouts.

### **III. FLOW PROPENSITY MAPPING**

Person Flow Estimates were generated by assigning each census block as an origin and a total of fourteen (14) internal destination points that were identified as destination within Winthrop according to their land use. The destinations were given propensity weight values from 1 to 20 in proportion to their desirability. Figure 10 shows the geographic locations of these select destinations with the relative weights as the star symbol size.

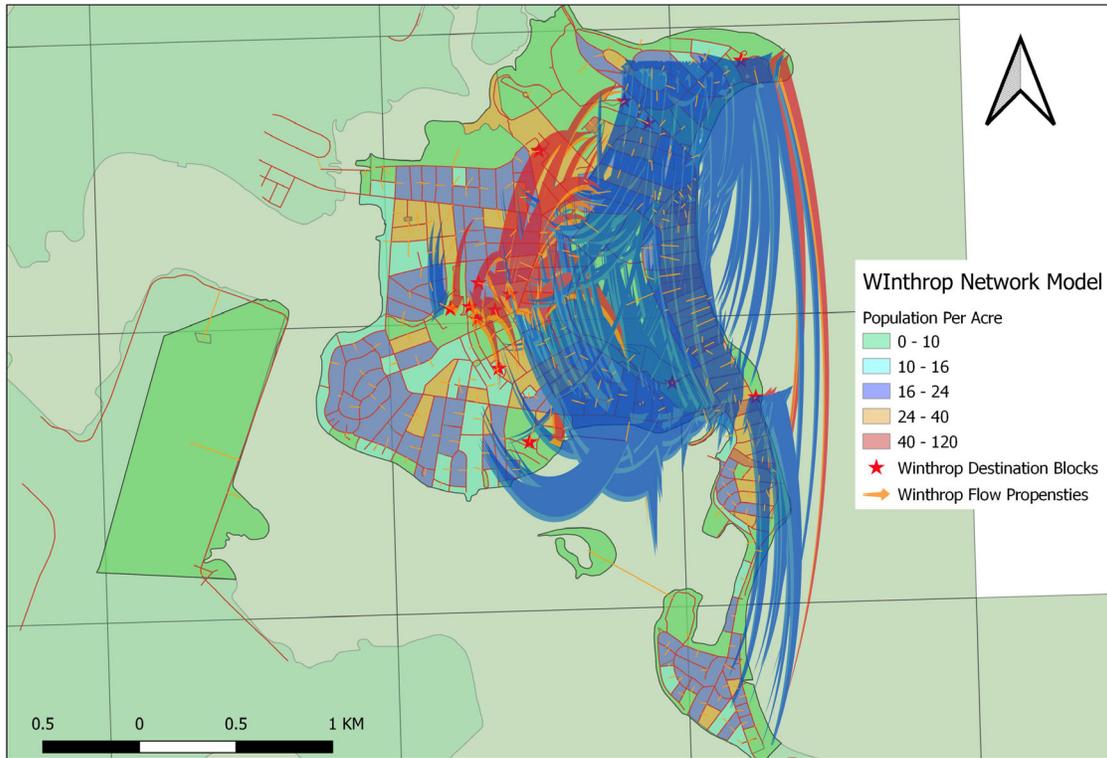
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**Figure 10 – Weighted Travel Destinations**

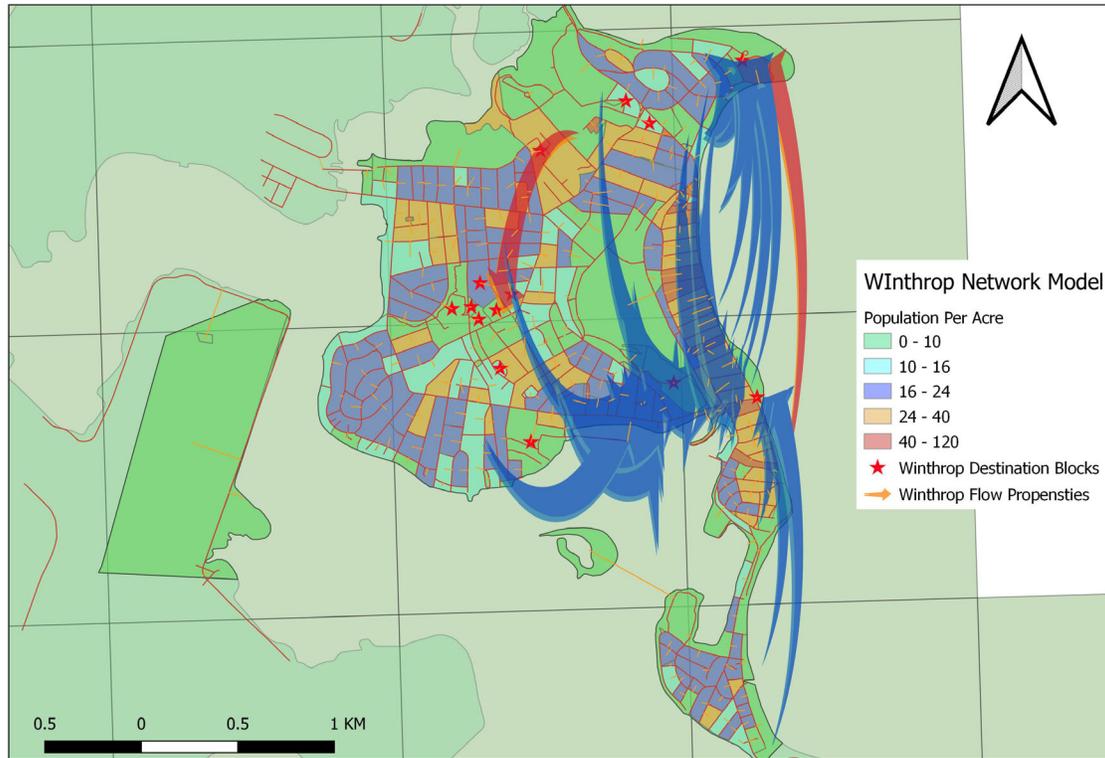
A simple network travel model was used to show travel patterns and determine the general flow patterns, thereby designating critical travel corridors. Following the travel gravity type modeling, a flow path network was generated as shown in Figure 11.

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**Figure 11 – General Flow Propensity Model**

Critical flow paths were identified to select corridors in Winthrop that would increase overall connectivity using the weight threshold from these flow maps. Figure 12 shows the major flow maps from high density locations to selected destinations.



**Figure 12 - Critical Flow Paths**

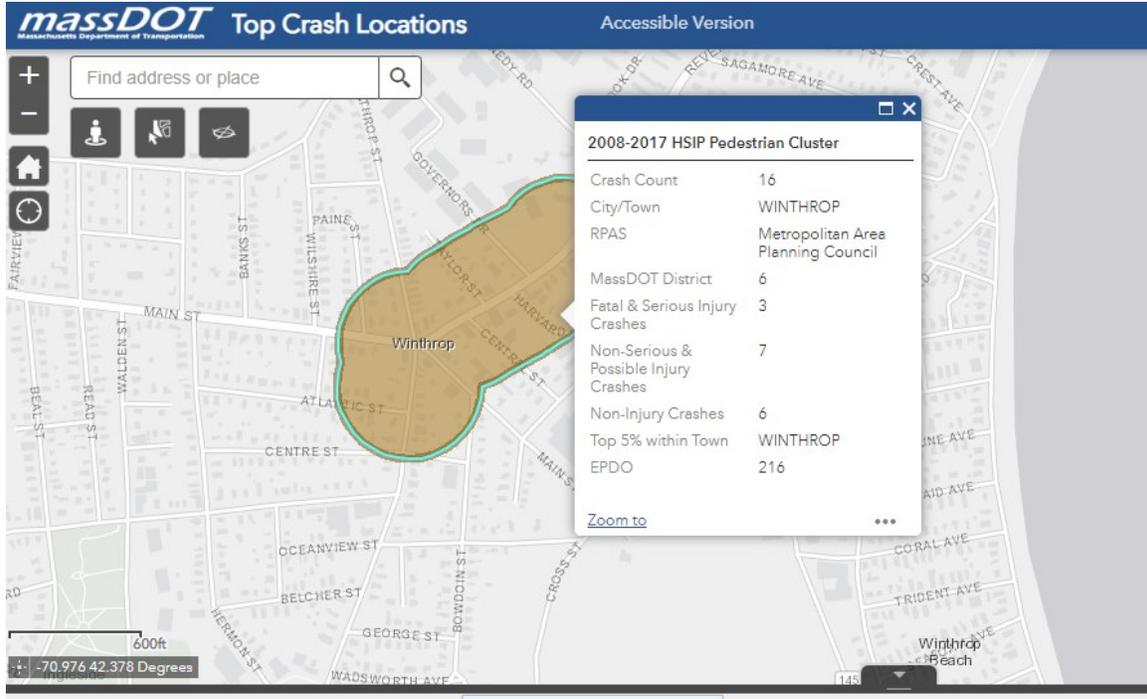
The blue and maroon color flow paths are used to distinguish travel flow paths from origins to destination that have an eastern and western travel directions respectively and are not necessarily different from each other. The arrow widths show the flow propensities. Based on a simple analysis travel corridors were identified that would give Winthrop a suitable shared connectivity travel network. This flow pattern was used to point to travel network that is suitable for detailed investigation.

#### **IV. CRASH CLUSTER MAPPING**

The crash cluster map referred to earlier in Figure 6, also indicates where the safety focused improvement should happen in the shared use network. Winthrop safety considerations highlight the intersections at Main Street, Winthrop Street, Revere Street. The safety records of the area at that location was highlighted by MassDOT (Figure 13 a zoomed

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in version of Figure 5) as one of the top cluster crash locations for the years between 2008-2017. Calming the network before and after this intersection would contribute to a reduction in overall crashes in the area.



**Figure 13 – Top Crash Cluster Location in Winthrop**

## V. SUMMARY MEASURES OF NETWORK CONNECTIVITY

Figure 14 shows this primary network that is designated to accommodate travel by all modes. The network is composed of a combination of streets (three given routes, SR145, N1323, N1325) from the State Road Inventory data (RInv). The selected streets that comprise these routes are (Pleasant Street, Washington Avenue, Veterans Road, Winthrop Shore Drive, Revere Street identified as SR145), (Portion of Main Street identified as N1323 ) and portions of Winthrop Street and Revere Street (identified as N1325). These three RInv routes are part of the primary travel network that has the capacity to serve all the desired origin and destinations and would make the rest of Winthrop’s network accessible and shareable by all modes. By designating these routes as the primary shared use travel facilities will lower the stress on the rest of the network. These routes have sufficient right-of-way that can be improved to suit the vision what shared use travel with access to all users. Winthrop is primarily a residential and tourist destination and hence making the primary network to be shared by all modes is the main object of any planning endeavor.

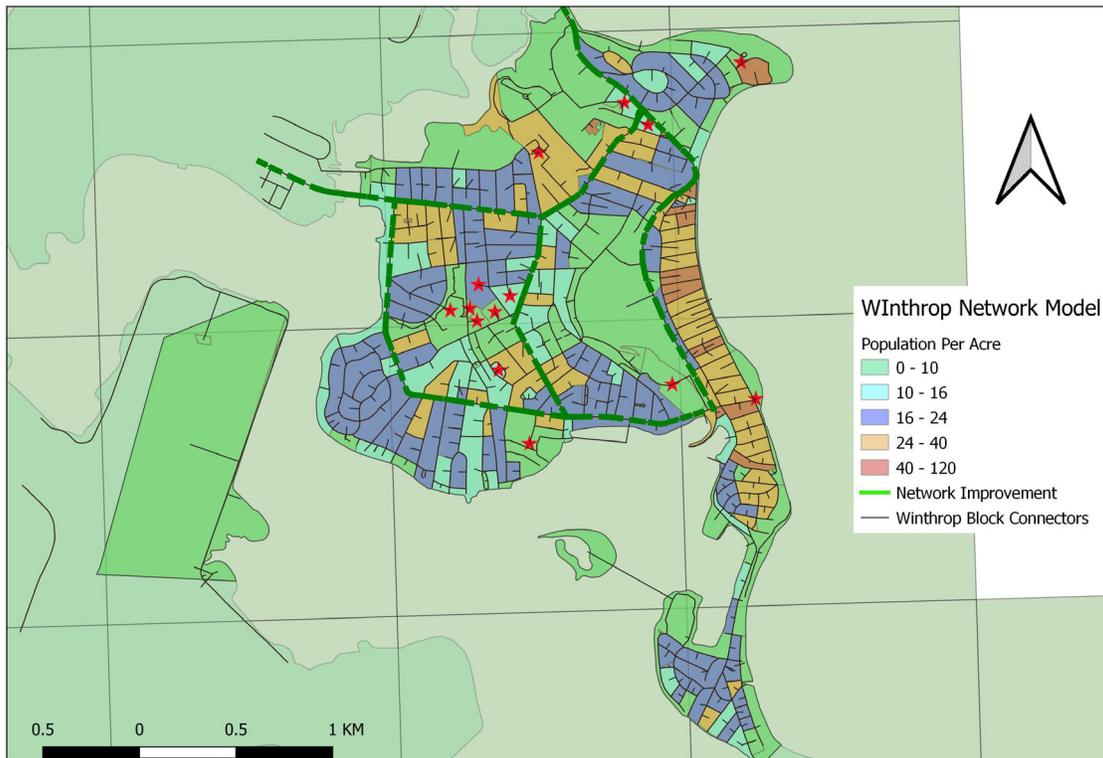


Figure 14 – Recommended Critical Shared Use Travel Network

The designated network is what maybe termed as the high-speed network within the Town of Winthrop. The overall focus of the mitigation is to reduce crash,

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increase accommodation of all users and in keeping with the character of the town as residential and tourist destination. The safe connected network is useful to serve all the desired travel patterns. A pedestrian connectivity survey maybe made along all the same network to ensure sidewalk access, safe street crossing by providing visibility and speed reduction of automobile travel.

We are recommending traffic calming measures on the critical travel networks with raised crossings and roundabouts at several intersections along the identified primary road. An example of such intersections are recommended for raised crossing are Pleasant Street and Cottage Park Road, and a mini-roundabout at Buchanan St/Sunnyside Ave at Pleasant Street and a roundabout at Main Street, Revere Street and Winthrop Street (which is currently served by a signalized intersection).

## **VI. CONCLUSIONS**

The Town of Winthrop has an exciting opportunity to make its street network become available and useful for a variety of modes. Making street safer for persons 8 years old to 80 years old, with walking, and biking, being one more option for students and elderly persons to travel is a very worthy endeavor. Making non-motorized travel be a valid choice requires thoughtful planning and design of existing and proposed facilities. Since Winthrop is also a tourist destination, it is very important to make it accessible through a combination of auto, transit, bicycle, and pedestrian modes. This study has been done with a view to perform a more comprehensive network analysis at the intersection level.

## **ABBREVIATIONS AND ACRONYMS**

LTS – Level of Traffic Stress

DCR – Department of Conservation and Recreation

MassDOT – Massachusetts Department of Transportation

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