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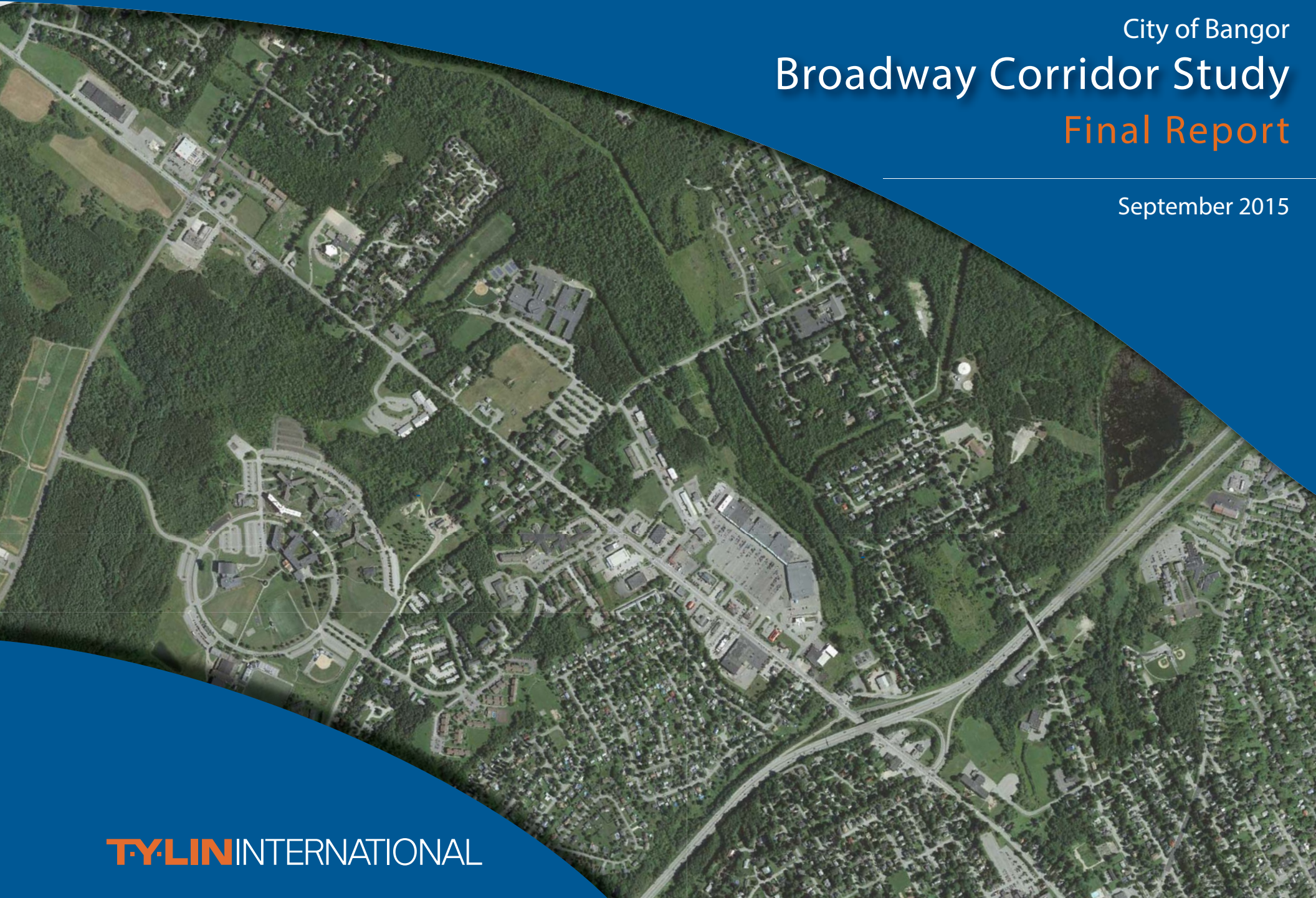
Bangor Area Comprehensive Transportation System

City of Bangor

Broadway Corridor Study

Final Report

September 2015



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EXECUTIVE SUMMARY

The following recommendations were developed from a comprehensive evaluation of existing data, traffic and land use analyses, and input from the Study Steering Committee. The improvement strategies meet the Study Purpose and Need statement. The strategies range from low cost short-term improvements to long-term visionary recommendations. The following briefly summarizes each improvement strategy.

General Corridor Recommendations

- Retime, Coordinate and Upgrade Traffic Signal Equipment.
- Restripe Broadway for a wider curb lane for better bicycle conditions.
- Implement corridor-wide ADA Improvements.
- Add/enhance existing sidewalk and crosswalks.
- Implement access management/driveway improvements on Broadway.
- Revise site plan review standards to include consideration of inter-parcel connections, shared parking, and either shared driveways or a minimum of one curb cut fronting Broadway.
- Meet City Complete Streets Policy.

Intersection Improvement Recommendations

- Broadway/Center Street/I-95 Northbound Ramps - Change Broadway southbound lane assignment at Center Street to one left, one through, one right lane. Eliminate the channelized right lane to Center Street. Install Roundabout as a long-term option.
- Broadway/Earle Street - A raised channelization island shall be installed on the Earle Street approach to restrict movements to right turn entry and exit movements only.
- Broadway/Alden Street/I-95 Southbound Ramps - Restrict movements at Alden Street to Right in/out. Install Roundabout as a long-term option.

- Broadway/Falvey Street - Restrict movements at Falvey Street intersection and remove traffic signal. The implementation of this improvement should occur in conjunction with construction of a new roadway connection between the Bangor Gardens Neighborhood and Husson Avenue.
- Broadway/Broadway Shopping Center/McDonald's Restaurant - Reconfigure McDonald's and Shopping Center entrances. It is recommended that the traffic signal be relocated to the Shopping Center Driveway opposite Bangor Savings Bank.
- Broadway/School Street - No capacity enhancements are recommended. It is suggested that sidewalks be constructed on School Street between Broadway and Hillside Drive. Additionally, a fourth crosswalk should be provided on the northerly leg of the intersection
- Broadway/Husson Avenue - The long-term recommendation – when re-development occurs – is to relocate the existing commercial driveway to be opposite Husson Avenue.
- Broadway/Grandview Avenue - It is suggested that the Grandview Avenue approach be widened to accommodate a shared left/through lane and a right lane. A crosswalk on the southerly leg of the intersection (after the sidewalk connection to Husson Avenue is constructed) should be provided. Signage and pavement markings that warn motorists that the Broadway northbound through lane transitions to a dedicated right-turn lane onto Grandview Avenue shall be installed.
- Grandview Avenue/Hillside Drive/High School Drive - Reconstruct the intersection such that Hillside Drive and the High School Drive are aligned.

Broadway Streetscape / Cross-Section Improvements

- Restripe Broadway for a wider curb lane for better bicycle conditions under short-term conditions. In an effort to gain some shoulder space, it is suggested that the travel lanes be narrowed to 11-feet and the center lane be narrowed to 12-feet. This change will allow for 3-foot shoulders (not wide enough to be formal bicycle lanes). In conjunction with this change, it is recommended that all catch basins be converted to curb-inlet type basins such that the shoulder surface is not disturbed by a grate and pavement deterioration. The City will review other long-term cross-section improvement options presented in this report in the future.

New Transportation Connections Recommendations

- Provide a Pedestrian Connection (Dairy Queen) to Bangor Gardens Neighborhood.

- Provide New Connection between Husson Avenue and Bangor Gardens Neighborhood.
- Provide a New Entrance to Husson University – In an effort to provide improved connectivity to Husson University and relieve traffic pressure on Husson Avenue it is recommended that a new entrance be provided at Chapin Street.
- New Inter-Parcel Connections – To improve safety along Broadway by minimizing unnecessary turn movements and provide circulation options, the following connections are recommended. It should be noted that some on-site parking and circulation modifications will be required with these changes.
 - A connection between the China Light Restaurant and the Broadway Shopping Center.
 - In conjunction with the McDonald’s Restaurant recommendation providing a connection through the rear of Moe’s Restaurant to Bangor Savings Bank
 - A rear connection between CITGO and the Broadway Shopping Center.
 - A connection between Walgreens and the Apartment Complex to the south.
- Provide a formalized parallel road in the Broadway Shopping Center to relieve traffic pressure on Broadway and to provide a high-level alternative multi-modal parallel facility to Broadway.

1.0 INTRODUCTION

T.Y. Lin International (TYLI) was contracted by Bangor Area Comprehensive Transportation System (BACTS) to perform a study of the Broadway Corridor in Bangor, Maine (see **Figure 1**) from the southerly intersection of the Interstate 95 Northbound On-Ramp approximately 0.8 miles north to the intersection of Broadway and Grandview Avenue. From I-95 to the intersection with Alden Street, Broadway is categorized by the Maine Department of Transportation (MaineDOT) as an Other Principal Arterial; from Alden Street north, Broadway is a Minor Arterial. I-95 is a principal arterial interstate and both Center Street and Grandview Avenue are Major/Urban Collectors.

Broadway serves as a main link between I-95 and major towns including Glenburn and Brewer. In the City of Bangor, Broadway is also an important internal link between major commercial, residential, educational and recreational land uses within the community.

The two primary study goals established at the beginning of the process included the following:

- To preserve existing roadway capacity over the long term (2035 design year) to facilitate through traffic movement and minimize congestion while providing safe vehicular access to new and existing development along Broadway; and
- To maintain the functional integrity and safety of the corridor, while accommodating the public and private needs for access and adjacent land parcels.

2.0 PURPOSE AND NEED STATEMENT

The following Purpose and Need Statement was crafted by the Steering Committee for use in guiding the Study. The objective of this study is to develop a Traffic System Management Plan to ensure that the following will allow Broadway to operate at an acceptable level of multi-modal service through 2035.

(1) Preserve existing roadway capacity over the long term to facilitate through traffic movements and minimize congestion, while at the same time providing safe means of access for all modes of travel to new and existing developments along Broadway; and

2) Optimize the multi-modal functional integrity and safety of the corridor, while accommodating the public and private needs for access to adjacent land parcels. In developing the plan, the consultant will utilize accepted engineering standards to address such items as:

- The location, spacing, timing and coordination (for progressive two-way traffic flow) of existing and future traffic signals; the location and design of turning lanes;
- The frequency and spacing of intersecting streets and private driveways;
- Channelization, or other turning movement controls;
- Identification of current levels of service and development of access management standards (which may include minimum sight distance requirements, corner clearance requirements, separation standards, etc.)
- The identification of short-term and long-term solutions for inter-parcel connections to improve circulation for all modes of travel, while improving connectivity to surrounding neighborhoods;
- The integration, where feasible, of low impact development and green infrastructures to both improve the aesthetics of the corridor and mitigate the impacts of stormwater runoff.

3.0 EXISTING CONDITIONS

A comprehensive evaluation of existing conditions was performed within the study area for both Transportation and Land Use and is discussed as follows.

Transportation Conditions

In respect to transportation conditions, an Existing Conditions Technical Memorandum was prepared and is a standalone document (see **Appendix**). That document covered the following items in detail with a brief summary presented as follows.

- Existing Average Annual Daily Traffic Volumes - Annual Average Daily Traffic (AADT) volumes on Broadway range from 13,650 vehicles south of Center Street to 24,930 vehicles north of Falvey Street. Refer to **Figure 2** for AADT information within the study area.
- Existing Monthly Traffic Volume Variation - Permanent count stations provide information regarding seasonal and weekday variations as well as a daily traffic variation. While there are no permanent count stations in the study corridor, there is a permanent count station located on Union Street, southeast of Jackson Street. This count station provides insight into travel patterns within the community due to its proximity to the study area, however it should be cautioned that Broadway has more than double the traffic volume than Union Street and has more commercial land uses. Average monthly traffic variation was derived from data collected at the Union Street Permanent Count Station as illustrated on **Figure 3**. The month of May shows the greatest volume of vehicles, followed by April and June. While this chart does illustrate some seasonal variation during the summer months, this variation is minimal.
- Existing Daily Traffic Volume Variation - Volume variation by day of the week was also documented from the Union Street Permanent Count Station. The average total volume variation for each day of the week is shown on **Figure 4** and indicates that Friday has the greatest volume through the corridor and Sunday the least.
- Existing Intersection Turning Movement Volumes - Twelve hour intersection turning movement counts were collected by BACTS in September 2014. The counts were conducted from Tuesday to Thursday between 6:00AM and 6:00PM at each of the signalized intersections noted below. **Figure 5** presents the existing turning movement volumes.
 - Broadway/I-95 NB/Center Street

- Broadway/I-95 SB/Alden Street
 - Broadway/Falvey Street
 - Broadway/Broadway Shopping Center/McDonald's
 - Broadway/School Street/Walgreens
 - Broadway/Husson Avenue
 - Broadway/Grandview Avenue
- Existing Hourly Traffic Volume Variation – According to the 12-hour turning movement counts Broadway has a significant morning peak, with most intersection volumes increasing steadily throughout the afternoon, peaking during the evening commute time period (**See Figure 6**).
 - Existing Vehicle Classification - Heavy truck percentages were recorded as part of turning movement counts in the corridor. For the 6:00AM to 6:00PM count period, the major intersections do not see an unusually high volume of trucks (1 to 5%). Minor streets carry similarly low heavy truck percentages as the mainline.
 - Existing Pedestrian Volumes - Relatively low pedestrian volumes were recorded between 6:00AM and 6:00PM at the study intersections. The number of pedestrians crossing at each intersection for the noted 12-hour period is noted as follows:
 - Broadway/Center Street/I-95 NB Ramps – 34 pedestrians
 - Broadway/Alden Street/I-95 SB Ramps – 81 pedestrians
 - Broadway/Falvey Street – 20 pedestrians
 - Broadway/Shopping Center Entrance/McDonald's Exit – 63 pedestrians
 - Broadway/School Street/Walgreens – 61 pedestrians
 - Broadway/Husson Avenue – 61 pedestrians
 - Broadway/Grandview Avenue – 46 pedestrians

- **Crash History** - The term High Crash Location (HCL) has been created in order to indicate an intersection with safety concerns. To be classified as an HCL, MaineDOT has established two criteria: there must be 8 or more crashes during a three year study period and the location must have a critical rate factor (CRF) greater than or equal to 1.0. The CRF is a statistical comparison of the frequency of crashes at the study location with other comparable locations in the state. Several locations within the study area are HCL's as presented on **Figures 7 and 8**.
- **Existing Intersection Level of Service** - The standard used to evaluate traffic operating conditions of the transportation system is referred to as Level of Service (LOS). This is a qualitative assessment of the quantitative effect of factors such as speed, volume of traffic, geometric features, traffic interruptions, delays, and freedom to maneuver. LOS analysis was based upon procedures detailed in the 2010 Highway Capacity Manual, Transportation Research Board. **Figure 9** presents intersection LOS during the AM and PM peak hours. While LOS grades tend to indicate acceptable mobility, inadequate intersection spacing and vehicles queues that block through lanes create poor traffic conditions along Broadway. Most intersections operate at acceptable levels of service overall, but tend to have turn movements that operate poorly. The closely spaced signalized intersections and poor traffic signal detection equipment contribute to traffic congestion and is not totally represented in the LOS analysis.
- **Existing Transportation Infrastructure Inventory** – An existing conditions inventory was conducted that included review of intersection conditions, sidewalks, crosswalks, traffic control, and bicycle provisions. Refer to the Existing Conditions Technical Memorandum for specific inventory information.
- **MaineDOT Customer Service Levels** - MaineDOT has developed a process for prioritizing highway and bridge candidate projects for the biennial work plan according to Customer Service Levels (CSL). MaineDOT has provided CSL ratings regarding Safety, Condition, and Service. Facilities are rated on an A-B-C-D-E-F scale. The Condition CSL includes consideration of Pavement Condition, Roadway Strength, Bridge Condition, and Ride Quality. Broadway has a level of service of B due to ride quality and narrow shoulders between I-95 NB Ramps to School Street. Broadway from School Street to Grandview Avenue has a level of service C with some lane markings and pavement conditions deteriorating. The Service CSL includes consideration of posted roads and congestion. The study portion of Broadway between I-95 NB and SB Ramps has a level of service B with some minor congestion and narrow shoulders. From I-95 SB to the north, Broadway experiences a service level of C due to the increased congestion. The Safety CSL includes consideration of Crash History, Paved Roadway Width, Pavement Rutting, and Bridge Reliability. From the I-95 NB Ramps to Husson Avenue, Broadway has a safety rating of B. Broadway from Husson Avenue to Grandview Avenue has a safety rating C.

- Access Management - Existing access management deficiencies within the study corridor were identified following a review of MaineDOT and City standards. An assessment of existing driveway conditions was performed and consisted of reviewing the number of driveways provided for each property; the width of driveways; the spacing of driveways; and how close driveways are to intersections (corner clearance). There are a number of development parcels that have non-compliant driveway conditions and specific locations are noted in the Existing Conditions Technical Memorandum.

Land Use/Zoning/Urban Design

Zoning - As shown on **Figure 10** the zoning for the 98 acre +/- Focus Study Area is mainly comprised of the Shopping and Personal District, but also includes portions of the High Residential Density District, Low Density Residential District, and the Urban Service District. These Districts have frontage on the length of Broadway running from Grandview Avenue to Center Street – the primary focus of the corridor. It is important to note that while this is primarily a commercial district that is currently not very inviting for pedestrians, the core 98 acres is surrounded by dense and walkable residential neighborhoods. The relationship between these neighborhoods and the commercial core is not strong, and ideally the recommendation of this Study will improve connectivity throughout the area and encourage residents to walk and bike to the many services that are in most cases just a few minutes from home. Developing synergies between the surrounding residential neighborhoods and the commercial core will make the area more vibrant, safe, and more attractive for investment.

Figure / Ground - As shown on **Figure 11** the commercial core is comprised of buildings with large footprints that are not part of a discernible urban form, such as the residential neighborhood, Bangor Gardens. Broadway is clearly the central spine for the commercial core, with buildings addressing the street in an ad hoc manner. Figure/Ground graphics are useful for not only revealing the scale of development, but the pattern of development. In looking at patterns, one can begin to understand the disconnect between land use and mobility. Ideally, one might look at a figure/ground graphic of this area and see a distribution of buildings that suggests a stronger link between mobility between the street network and land use – in other terms, a higher level of connectivity and sense of place.

Asphalt / Impervious Surface - The study area is in the watershed for Arctic Brook, which actually passes beneath the shopping plaza and Broadway in a large culvert. Arctic Brook is an Urban Impaired Stream as defined by the MaineDEP. **Figures 12 and 13** show the extent of impervious surface of the core 98-acre study area. Total impervious surface is approximately 75% of this area. As a rule of thumb, a watershed (or sub watershed) should not exceed 50% impervious surface. Since 2005, projects requiring Site Plan Review must not only treat water for quantity, but quality. Some communities have day lighted streams such as Arctic Brook as part of long-term restoration efforts. That is not called for in this Study, but it should not be ruled out as a way to make the area more integrated with natural environment, improving both aesthetics and habitat.

Pedestrian Shed - As shown on **Figure 14**, from the center of the study area, it is about a five to ten minute walk to the northern and southern extents of Broadway that have been reviewed in this Study. Furthermore, many neighborhoods and land uses – such as the high school – are within this radius, however there is not optimum connectivity for either vehicles or pedestrians, making travel times much greater, in some cases twice the distance. Thus while there are a healthy range of uses in close proximity to each other, the lack of connectivity within the pedestrian shed discourages a walkable environment and contributes to congestion on Broadway.

Streets / Connectivity - As noted above, a lack of vehicular and pedestrian connectivity throughout the study area promotes congestion and does not encourage walking and biking. **Figure 15** demonstrates how all the major streets in the area such as Center Street, Alden Street, Falvey Street, School Street, Husson Avenue, and Grandview Avenue intersect primarily with Broadway, providing few alternative routes to disperse traffic and reduce congestion on Broadway. This lack of connectivity – on both an area wide scale as well as a parcel-to-parcel scale – is typical of corridor / strip type development patterns, but can be remedied through incremental planning for vehicular and pedestrian connections.

4.0 STUDY PROCESS / PUBLIC INVOLVEMENT

In addition to regular meetings with the Steering Committee and City Staff, the Study included two Public Meetings, a Business Owner / Property Owner Meeting, individual meetings with property owners, and a presentation to the Infrastructure Committee. Meetings notes are located in the **Appendix**.

The initial RFP defined the scope of work, but the consultant team refined and expanded the scope as needed with input from the Steering Committee and Staff. Minutes of Meeting from the Steering Committee Meetings and other meetings were regularly posted to the City website to maintain project transparency and provide a clearinghouse for project progress for the general public. All project recommendations went through multiple reviews and have been vetted by different constituents of the community, City Staff, MaineDOT, BACTS, and other agencies.

A Purpose and Need Statement was drafted at the beginning of the process and further refined to address all users of the corridor. The Purpose and Need Statement was used as a metric to review the recommendations developed during the course of the Study and ultimately included with the Final Report.

5.0 RECOMMENDATIONS

Several Improvement Strategies were identified for consideration for the study corridor that meet the Study Purpose and Need statement. The strategies range from low cost short-term improvements to long-term visionary recommendations. A detailed alternatives analysis was performed in the development of recommendations and included future traffic volumes and use of the SimTraffic traffic simulation model. Refer to the **Appendix** for details on the alternatives analysis. The following details each improvement strategy as well as improvements that were eliminated from consideration.

5.1 Improvement Strategies that were eliminated from Consideration

- Convert Broadway to a three-lane roadway – A capacity analysis was conducted that evaluated the level of service implication of reducing through-put capacity on Broadway such that one through lane in each direction is provided with a center turn lane. Results of that analysis indicate unacceptable congestion would occur and therefore this option was eliminated from consideration.
- Provide two left lanes on inbound Broadway to I-95 Northbound – This change did not result in improved traffic conditions due to the need for additional signal phases and thus was dropped from consideration.
- Close Alden Street at Broadway – The full closure of Alden Street would completely disconnect the neighborhood from Broadway and thus was eliminated from consideration.
- Combine Alden Street and I-95 Southbound Off-Ramp – While the concept of combining the I-95 Southbound Ramp and Alden Street has benefit, the impact to I-95 at the mainline diverge and the complexities of permitting the change with FHWA was deemed to be problematic and thus this option was eliminated from consideration.

5.2 Recommended Improvements

5.2.1 General Corridor Recommendations

- Retime, Coordinate and Upgrade Traffic Signal Equipment – Specific recommendations include:
 - Provide the coordination of signals between Falvey Street and the I-95 Southbound Ramp in the short-term. Mid-term improvements shall include consideration of a fully coordinated system that can be linked to a Regional Transportation Management System.

- The Grandview Avenue and Falvey Street signals shall be upgraded with Video Detection in the short-term. All other intersections should be upgraded within the Video detection within a mid-term horizon.
- Short-term improvements shall include elimination of poor wire splices and crimps instead of silicone wire nuts.
- Restripe Broadway for a wider curb lane for better bicycle conditions – **Figure 16** presents the existing cross-section of Broadway. Broadway has a 72-foot right-of-way which comprises of approximately two 5-foot sidewalks, four 12-foot travel lanes, and a 14-foot center lane. In an effort to gain some shoulder space, it is suggested that the travel lanes be narrowed to 11-feet and the center lane be narrowed to 12-feet. This change will allow for 3-foot shoulders (not wide enough to be formal bicycle lanes) as depicted on **Figure 17**. In conjunction with this change, it is recommended that all catch basins be converted to curb-inlet type basins such that the shoulder surface is not disturbed by a grate and pavement deterioration.
- Corridor-wide ADA Improvements – Upgrade all intersections and driveways with handicap accessible ramps. The Existing Conditions Technical Memorandum notes the inventory of existing sidewalk elements for upgrade.
- Add/enhance existing sidewalk and crosswalks – The following is recommended and in many cases are noted on the improvement plan.
 - Center Street/I-95 Northbound: Improve sidewalks around Tri-City Pizza and south of Center Street; add crosswalk in front of Poplar Street and on northerly side of the intersection; and add detectible warning panels and pedestrian countdown heads.
 - Earle Street to I-95 Bridge: Rebuild sidewalks with back curbing to separate pedestrians from parking lots and implement access management improvements.
 - Alden Street/I-95 SB: Add a northerly approach crosswalk; construct a pedestrian refuge island; and rebuild the existing sidewalks to account for the realigned intersection improvements.
 - Falvey Street: Rebuild the existing sidewalk at intersection; relocate crosswalk on Broadway; and construct a raised island to restrict turn movements and function as a pedestrian refuge island.
 - Between Falvey Street and the new Shopping Center: Rebuild existing sidewalks.
 - New Shopping Center Driveway: Add new sidewalks; detectible warning panels; pedestrian countdown heads and crosswalks.
 - Between Shopping Center and School Street: Rebuild existing sidewalks for access management at car dealership.

- School Street: Add a crosswalk on the southerly leg of intersection; add detectible warning panels and pedestrian countdown heads.
 - Between School Street and Husson Avenue: Rebuild the sidewalk at the entrance to Benjamin Moore for access management improvements.
 - Husson Avenue: Add a sidewalk on northerly side of Husson Avenue to the first residential development driveway and along southerly side of the commercial drive; add a crosswalk to the northerly side of the Husson Avenue intersection; add detectible warning panels and pedestrian countdown heads.
 - Between Husson Avenue and Grandview Avenue: Add sidewalk to the westerly side of Broadway to Grandview Avenue; add a crosswalk across Grandview Avenue; add detectible warning panels and pedestrian countdown heads.
 - School Street: Construct sidewalks on sides of School Street between Broadway and Hillside Drive
 - North side of the Broadway Shopping Center southernmost driveway: Construct new sidewalk.
 - North side of Alden Street between Broadway and North French Street: Construct new sidewalk.
-
- Driveway improvements on Broadway – It is recommended that several driveways along Broadway be improved by narrowing width, closing, or sharing. **Figures 18 through 22** illustrate the locations where driveway adjustments are recommended.
 - Revise site plan review standards to include consideration of inter-parcel connections, shared parking, and either shared driveways or a minimum of one curb cut fronting Broadway. Many improvements to Broadway will be incremental, but if each site is planned and designed as part of the larger context, not parcel-by-parcel, then positive change will happen and in a more cost efficient manner.
 - Meet City Complete Streets Policy – The City adopted a Complete Streets Policy in the most recent Comprehensive Plan. Leverage this policy to ensure that new improvements in the Broadway corridor serve as many different users as feasible. As the Comprehensive Plan is updated, look to the most recent Maine and National Complete Street policies to amend the Bangor policy as needed.

5.2.2 Intersection Improvement Recommendations

Broadway/Center Street/I-95 Northbound Ramps

- Change Broadway southbound lane assignment at Center Street to one left, one through, one right lane – **Figure 18** illustrates the recommended improvement with key conclusions/elements noted as follows:
 - Southbound or inbound Broadway will have only one through lane and thus eliminates the merge area south of the intersection.
 - The alignment of Center Street is improved to “calm” traffic and provide improved pedestrian crossings.
 - A fourth crosswalk is proposed on the northerly leg of the intersection.
 - Changes at Earle Street and access/egress impacts to Tri-City Pizza may require the need for an egress driveway to Center Street.
- Install Roundabout – A long-term option for this location is installation of a roundabout configuration intersection as depicted on **Figure 23**. Based upon capacity analysis results a two-lane roundabout would be required. This requirement will likely necessitate right-of-way acquisition, although that would be determined during preliminary engineering evaluations. The roundabout, in concert with a roundabout at Alden Street/I-95 Southbound Ramps intersection, could allow for construction of a median island on Broadway and thus would provide optimal access management and would be expected to provide the safest type of design. In addition a dual roundabout scenario would allow for U-Turn movements (e.g. Irving vehicles could turn right and use the Alden Street roundabout to reverse direction to travel inbound).

Broadway/Earle Street

- Restrict Turn Movements – A raised channelization island shall be installed on the Earle Street approach to restrict movements to right turn entry and exit movements only. This recommendation is based upon the fact that this location is a High Crash Location with Earle Street movements be the primary contributing factor. Based upon concerns expressed by Tri-City Pizza, a direct egress connection to Center Street should be considered (**Figure 24**).

Broadway/Alden Street/I-95 Southbound Ramps

- Restrict Movements at Alden Street to Right in/out – A raised channelization island shall be installed on the Alden Street approach to restrict movements to right turn entry and exit movements only. This change will eliminate a traffic signal phase and significantly improve traffic congestion (**See Figure 19**).
- Reconfigure I95 SB on-ramp for improve alignment – Relocate the I-95 Southbound On-Ramp to the south from improved alignment such that traffic signal clearance timings are reduced.
- A fourth crosswalk is proposed on the northerly leg of the intersection.
- Install Roundabout - A long-term option for this location is installation of a roundabout configuration intersection as depicted on **Figure 25**. Based upon capacity analysis results a two-lane roundabout would be required. This requirement will likely necessitate right-of-way acquisition, although that would be determined during preliminary engineering evaluations. The roundabout, in concert with a roundabout at Center Street/I-95 Northbound Ramps intersection could allow for construction of a median island and thus would provide optimal access management and would be expected to provide the safest type of design.

Broadway/Falvey Street

- Restrict Movements at Falvey Street Intersection and Remove Traffic Signal – The removal of a traffic signal at this location will have significant positive impacts to corridor mobility. To accomplish this change in traffic control, left turn movements from Falvey Street will need to be prohibited. It is recommended that a raised island be constructed in Broadway that will control the allowed turning movements (see **Figure 19**). The following should be noted:
 - The implementation of this improvement should occur in conjunction with construction of a new roadway connection between the Bangor Gardens Neighborhood and Husson Avenue. This would provide an alternative routing option for travel to the north.
 - Under this recommendation, pedestrians would no longer have a signalized crossing. Given that alternative crossing options are far away, it is suggested that this crossing remain and include a raised refuge island and a rectangle rapid flash beacon warning light.
 - Access to the businesses opposite Falvey Street will be impacted by this change. The plan suggests that movements on Broadway be restricted and an inter-parcel connection to the Broadway Shopping Center be provided.

Broadway/Broadway Shopping Center/McDonald's Restaurant

- Reconfigure McDonald's and Shopping Center Entrances – It is recommended that the traffic signal be relocated to the Shopping Center Driveway opposite Bangor Savings Bank as illustrated on **Figure 20**. The following should be noted:
 - The new signalized Broadway Shopping Center Driveway will require capacity enhancements and will have three approach lanes.
 - Left-turns from McDonald's Restaurant will operate with long delays without traffic signal control. It is suggested that an inter-parcel connection be provided that permits traffic to access the new traffic signal at Bangor Savings Bank.
 - Two options are suggested for the former signalized Broadway Shopping Center entrance. The entrance could be eliminated and the space used for a development pad; or the driveway could remain as a STOP controlled location.

Broadway/School Street

- No capacity enhancements are recommended. It is suggested that sidewalks be constructed on School Street between Broadway and Hillside Drive. Additionally, a fourth crosswalk should be provided on the northerly leg of the intersection. **Figure 21**

Broadway/Husson Avenue

- Reconfigure Husson Avenue intersection – The alignment of Husson Avenue and the Commercial Driveway create traffic signal phasing inefficiencies that contribute to congestion problems. The long-term recommendation – when re-development occurs – is to relocate the existing driveway to be opposite Husson Avenue (see **Figure 21**). Other improvements shall consist of the following:
 - A short-term recommendation is to change the traffic signal phasing for left-turns onto Husson Avenue from its current protected only phasing to a protected/permissive phasing scheme.
 - A fourth crosswalk shall be installed on the northerly leg of the intersection.

Broadway/Grandview Avenue

- Improve capacity at Grandview Avenue (**See Figure 22**) – To address congestion issues during peak time periods, it is suggested that the Grandview Avenue approach be widened to accommodate a shared left/through lane and a right lane. Other suggested improvements include:

- Provide a crosswalk on the southerly leg of the intersection (after the sidewalk connection to Husson Avenue is constructed).
- Install signage and pavement markings that warn motorists that the Broadway northbound through lane transitions to a dedicated right-turn lane onto Grandview Avenue.

Grandview Avenue/Hillside Drive/High School Drive

- Improvement Alignment – Reconstruct the intersection such that Hillside Drive and the High School Drive are aligned.

5.2.3 Broadway Streetscape / Cross-Section Improvements

As noted previously, Broadway has a right-of-way width of 72 feet that currently comprises of four 12-foot travel lane, one 14-foot center turn lane and two 5-foot sidewalks. Three options are possible for consideration:

- Option 1: Proposed Cross-Section with Shoulders (see **Figure 16**) – This consists of providing four 11-foot travel lanes, one 12-foot center turn lane, two 3-foot shoulders and two 5-foot sidewalks.
 - Pro - This section allows for minimal improvement to on-road bicycle accommodations.
 - Con - No improvement to the pedestrian walking experience.
- Option 2: Proposed Cross-Section with Easterly Wide Sidewalk (see **Figure 26**) – This consists of providing four 11-foot travel lanes, one 12-foot center turn lane, a 5-foot sidewalk on the west side of Broadway and a 11-foot shared use path on the east side. No shoulders are provided and would require a design exception from MaineDOT.
 - Pro – An improved pedestrian and aesthetic environment is provided on the east side. The share use path could be used for bicycles, but it is cautioned that this design has safety concerns as it relates to the significant number of driveway conflict points. Access management improvements and warning devices (green paint and signage) would be required. Termination of the path would have to be carefully planned, particularly on the southern end of the project area.

By placing the shared use path on the east side of Broadway, as the proposed parallel road in the shopping plaza is developed, the businesses fronting the eastern side of Broadway can be accessed in a more controlled manner from this parallel road. This will allow for additional curb cut closures and consolidations along the eastern side of Broadway, minimizing conflict points with the shared use path and vehicles accessing properties.

- Con – Poor on-road bicycle accommodations will be provided.

Overhead utilities are located on the eastern side Broadway and any improvements would have to be carefully coordinated with CMP to ensure the relocated poles are located in optimal locations to avoid street trees and to maintain ADA clearances around poles.

- Option 3: Proposed Cross-Section with Westerly Wide Sidewalk (see **Figure 27**) - This consists of providing four 11-foot travel lanes, one 12-foot center turn lane, a 5-foot sidewalk on the east side of Broadway and a 11-foot shared use path on the west side. No shoulders are provided and would require a design exception from MaineDOT.

- Pro – An improved pedestrian and aesthetic environment is provided on the west side. The share use path could be used for bicycles, but it is cautioned that this design has safety concerns as it relates to the significant number of driveway conflict points. Access management improvements and warning devices (green paint and signage) would be required. Termination of the path would have to be carefully planned, particularly on the southern end of the project area.
- Con – Poor on-road bicycle accommodations will be provided.

As compared with the eastern side of Broadway, the western side of the corridor does not provide the opportunity to for a parallel road to serve the back of the parcels. There are opportunities for inter-parcel connections, but not the space for a complete street. By placing the shared use path on the western side of Broadway, the number of potential conflict points between pedestrians and vehicles is not reduced as much as on the eastern side.

5.2.4 New Transportation Connections Recommendations

- Provide a Pedestrian Connection (Dairy Queen) to Bangor Gardens Neighborhood (see **Figure 28**) – There are no convenient connections between the Bangor Gardens Neighborhood and the commercial land uses on Broadway (pedestrians must walk to Falvey Street). Although a public right-of-way does not exist, the City should work with property owners and businesses to identify a location with public use easements for pedestrians.
- Provide New Connection between Husson Avenue and Bangor Gardens Neighborhood (see **Figure 28**) – The Bangor Gardens Neighborhood is not very accessible and the noted connection will serve several purposes. It will allow residents to access Husson Avenue and thus reduce traffic demand at Falvey Street (which will eliminate the traffic signal as noted previously). It will also improve pedestrian and bicycle connectivity to northerly destinations such as Husson University and Bangor High School.

- Provide a New Entrance to Husson University (See **Figure 28**)– In an effort to provide improved connectivity to Husson University and relieve traffic pressure on Husson Avenue it is recommended that a new entrance be provided with the following options:
 - Option 1: New Entrance at Grandview Avenue – This location would provide a direction connection via the dead-end Grandview Avenue and would require some traffic signal and intersection improvements to accommodate the added traffic. The key concern on this location is impact to the residential properties and therefore is not recommended.
 - Option 2: New Entrance at Chapin Street – This option is preferred and would required creation of a new intersection and could function as the primary or “gateway” entrance to Husson University. Improvements to Broadway would be required under a STOP sign or signal control and would require a left-turn lane on Broadway. A roundabout intersection was investigated and a single-lane roundabout would function adequately at this new intersection.
- New Inter-Parcel Connections (See **Figures 18-22**) – To improve safety along Broadway by minimizing unnecessary turn movements and provide circulation options, the following connections are recommended. It should be noted that some on-site parking and circulation modifications will be required with these changes.
 - A connection between the China Light Restaurant and the Broadway Shopping Center.
 - In conjunction with the McDonald’s Restaurant recommendation providing a connection through the rear of Moe’s Restaurant to Bangor Savings Bank
 - A rear connection between CITGO and the Broadway Shopping Center.
 - A connection between Walgreens and the Apartment Complex to the south.
- Provide Formalized Parallel road in Broadway Shopping Center (See **Figure 29**) – To relieve traffic pressure on Broadway and to provide a high-level alternative multi-modal parallel facility to Broadway it is suggested that a continuous formalized roadway be planned. Key elements are noted as follows:
 - **Figure 30** presents the proposed roadway cross-section for the roadway which will have two 11-foot travel lanes, two 6-foot bicycle lanes, two 8.5-foot esplanade/landscape areas, and two 8-foot sidewalks.

- It is envisioned that the above cross-section would begin at Grandview Avenue and follow Hillside Avenue, create a four-way intersection with School Street and continue to the southerly entrance to the Shopping Center. It is suggested that some type of connection to North French Street be pursued. The topography presents constructability challenges, but at a minimum a pedestrian/bicycle connection is recommended.

6.0 IMPLEMENTATION / COST

The following tables present the estimated cost to construct the recommended improvements and the implementation schedule.

Concept Level Costs for Broadway Recommended Improvements			
Location	Improvement	Cost	
Broadway/ I-95 Northbound /Center Street Intersection	Option 1: Separate Left, Through, and Right Turn Lanes SB Broadway	Includes sidewalks, ADA ramps, streetscape improvements south of I-95 NB, Center Street improvements; and pedestrian and traffic signal improvements	\$230,000
	Option 2: Roundabout	Includes sidewalk and roadwork but does not include ROW acquisition	\$1,300,000
Broadway between I-95 Southbound and I-95 Northbound	Add lights under the bridge and rebuild sidewalk, create a right-in/right-out at Earle Street, and access management improvements	\$270,000	
Broadway/I-95 Southbound/Alden Street Intersection	Option 1: Create right-in/right-out at Alden Street	Includes traffic signal upgrades, right turn restriction island, ADA ramps, and relocating I-95 SB ramp	\$520,000
	Option 2: Roundabout	Includes sidewalk and roadwork but does not include ROW acquisition	\$1,800,000
Broadway between I-95 Southbound and Falvey Street	Rebuild sidewalk	\$45,000	
Broadway/Falvey Street Intersection	Includes removal of traffic signal, pedestrian crossing warning lights, new median island, and ADA Improvements	\$70,000	
Broadway between Falvey Street and Shopping Center Signal	Rebuild existing sidewalk and access management improvements	\$160,000	
Relocating Traffic Signals from McDonald’s to Bangor Savings Bank	Includes removing and replacing existing traffic signal, rebuilding the sidewalk, access management improvements, pedestrian and signal improvements. Costs do not include inter-parcel connections.	\$405,000	
Broadway between the Shopping Center and School Street	Rebuild existing sidewalk	\$155,000	

Concept Level Costs for Broadway Recommended Improvements		
Location	Improvement	Cost
Broadway/School Street Intersection	Includes building sidewalks on School Street between Broadway and Hillside Drive and pedestrian improvements at the Broadway/School Street intersection	\$345,000
Broadway between School Street and Husson Avenue	Rebuild sidewalk and access management improvements	\$140,000
Broadway/Husson Avenue Intersection	Includes rebuilding the sidewalk, new sidewalks along the commercial drive and Husson Avenue, ADA Improvements, and traffic signal upgrades	\$150,000
Between Husson Avenue and Grandview Avenue	Relocate obstacles in sidewalk, reconstruct existing sidewalk and construct new sidewalk	\$240,000
Broadway/Grandview Avenue Intersection	Includes upgrading the pedestrian and traffic signal system, new crosswalk and ADA improvements and widening Grandview Avenue westbound approach	\$135,000
Change Traffic Signal Phasing at Husson Avenue	Upgrade traffic signal heads and revised timing	\$5,000

<u>IMPLEMENTATION PHASING FOR IMPROVEMENT STRATEGIES</u>	
<u>IMPROVEMENT TYPE</u>	<u>IMPLEMENTATION</u>
	Short-Term: 0-5 years Mid-Term: 5-10 years Long-Term: 10+ years
Overall Improvements	
Retime/Coordination Traffic Signals	Short
Upgrade traffic signal equipment	Short/Mid
Restripe Broadway for wider curb lane for better bicycle conditions	Short (as part of MaineDOT paving project)
Corridor-wide ADA Improvements	Short/Mid

<u>IMPLEMENTATION PHASING FOR IMPROVEMENT STRATEGIES</u>	
<u>IMPROVEMENT TYPE</u>	<u>IMPLEMENTATION</u>
	Short-Term: 0-5 years Mid-Term: 5-10 years Long-Term: 10+ years
Add/enhance existing crosswalks	Short
Upgrade existing sidewalks due to width constraints and general condition	Short/Mid
Add sidewalks to eliminate gaps in system <ul style="list-style-type: none"> • Broadway between Husson and Grandview • School Street • Husson Avenue • Alden Street • Broadway Shopping Center Connections 	Short Mid Mid Mid Mid/Long
Access Management /Driveway improvements on Broadway	Short/Mid/Long
Revise site plan review standards to include consideration of inter parcel connections, shared parking and minimum of one curb cut fronting Broadway	Short/Mid/Long
Streetscape Improvement Opportunities within Broadway Cross-section	Short/Mid/Long
Meet City Complete Streets Policy	Short/Mid/Long
Intersection Improvements	
Change Broadway EB Lane Assignment at Center Street to one left, one through, one right lane	Short/Mid
Install Roundabout at I95/Center Street	Long

<u>IMPLEMENTATION PHASING FOR IMPROVEMENT STRATEGIES</u>	
<u>IMPROVEMENT TYPE</u>	<u>IMPLEMENTATION</u>
	Short-Term: 0-5 years Mid-Term: 5-10 years Long-Term: 10+ years
Restrict Movements at Alden Street to Right in/out	Short/Mid
Reconfigure I95 SB on-ramp for improve alignment	Mid
Install Roundabout at I95 SB Ramps	Long
Restrict Movements and Remove Signal at Falvey Street Intersection	Mid/Long
Reconfigure McDonald's and Shopping Center Entrances	Short/Mid
Reconfigure Husson Avenue intersection	Long
Change Traffic Signal Phasing at Husson Avenue	Short
Improve alignment at Hillside Drive/High School/Grandview Avenue	Long
Improve capacity at Grandview Avenue	Mid
New Transportation Connections	
Provide pedestrian connection (Dairy Queen) to Bangor Gardens Neighborhood	Short/Mid
Provide new connection (pedestrian and/or vehicle) between Husson Avenue and Bangor Gardens	Mid/Long
Provide new roadway connection to Husson University	Long
New inter-parcel connections	Short/Mid/Long

<u>IMPLEMENTATION PHASING FOR IMPROVEMENT STRATEGIES</u>	
<u>IMPROVEMENT TYPE</u>	<u>IMPLEMENTATION</u>
	Short-Term: 0-5 years Mid-Term: 5-10 years Long-Term: 10+ years
Provide formalized parallel road in Broadway Shopping Center	Long

APPENDIX

FIGURES

EXISTING CONDITIONS TRANSPORTATION TECHNICAL MEMORANDUM

MEETING NOTES

ALTERNATIVES ANALYSIS