FINAL DESIGN REPORT
FOR THE
PRELIMINARY DESIGN
OF

MAIN STREET MULTI-MODAL ACCESS AND REVITALIZATION PROJECT

(CARS SHARING MAIN STREET)

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NYSDOT P.I.N 5822.12
FTA No. NY-03-0428

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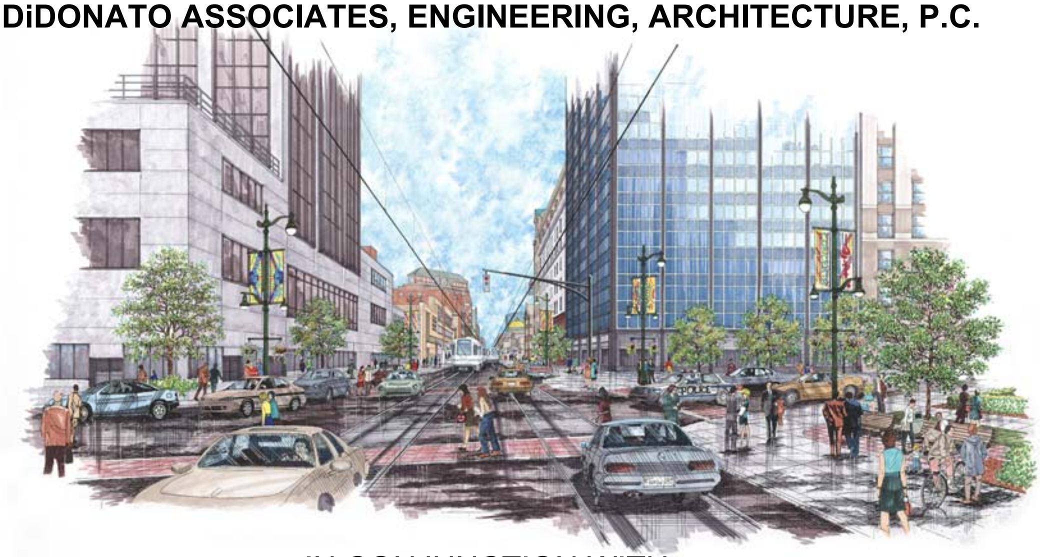

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AUGUST 24, 2006

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APPENDICES

MAIN STREET MULTI-MODAL ACCESS AND REVITALIZATION PROJECT

ABBREVIATIONS

AASHTO	American Association of State Highway and Transportation Officials
AC	Advisory Committee
ADA	Americans with Disability Act
AFC	Automatic Fare Collection
ANSI	American National Standard Institute
APTA	American Public Transportation Association
AREMA	American Railway Engineering and Maintenance Association
BP	Buffalo Place
CCTV	Closed Circuit TeleVision
COB	City of Buffalo
CS	Combined Sewer
DLP	Digital Light Projection
EA	Environmental Assessment
ECH	Erie Canal Harbor
EPA	Environmental Protection Agency
EPM	Environmental Procedures Manual
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
FT	Feet
Ft.-C	Foot Candle
GBNRTC	Greater Buffalo Niagara Transportation Council
HDM	Highway Design manual
HSBC	Hongkong Shanghai Bank Corporation
IEEE	Institute of Electric and Electronics Engineers
IN	Inches
ITE	Institute of Transportation Engineers
K	Thousand
LED	Light Emitting Diode
LOS	Level of Service
LRRT	Light Rail Rapid Transit
LRV	Light Rail Vehicle
M	Million
MOE	Measures of Effectiveness
MPH	Miles Per Hour
MAS	Maximum Authorized Speed
Mhz	Mega hertz
MUTCD	Manual of Uniform Traffic Control Devices
NEPA	National Environmental Policy Act
NFTA	Niagara Frontier Transportation Authority
NIMO	Niagara Mohawk
NYS	New York State
NYSDOT	New York State Department of Transportation
NYSDEC	New York State Department of Environmental Conservation
NITTEC	Niagara International Transportation Technology Coalition
NYCRR	New York Code of Rules and Regulations
OCC	Operations Control Center
OCS	Overhead Catenary System
PA	Public Announcement

PACE	Passenger Assistance Communication Equipment
PIDS	Public Information Displays
RTOR	Right Turn on Red
ROW	Right-Of-Way
RTU	Remote Terminal Units
SCADA	Supervisory Control Data Acquisition
SEQRA	New York State Environmental Quality Review Act
SF	Square Feet
TC	Train Control
TCC	Train Control Communication
TCS	Train Control System
TP	Traction Power
TSP	Transit Signal Priority
VDU	Video Display Units
VISSIM	**Vis**ual **Sim**ulation

SECTION 1 – EXECUTIVE SUMMARY

1.1 Background

Vehicular traffic was permitted on Main Street prior to being converted to a light rail rapid transit corridor with a shared pedestrian mall in the 1980's. Deteriorating economic conditions since the conversion have generated a movement to reintroduce vehicular traffic to Main Street. As such, the concept of returning vehicular traffic to Main Street has been studied for several years beginning with a feasibility study completed in 1998 by Erdman Anthony through the Environmental Assessment (EA) sponsored by the City of Buffalo, the Niagara Frontier Transportation Authority (NFTA), Erie County, the New York State Department of Transportation, and Buffalo Place. The Federal Transit Administration (FTA) is currently reviewing the final draft EA. Several options for improvements to Main Street were evaluated in the EA with the recommended option being the "*Share the Trackbed Alternative*". This involves the sharing of the travel lanes by vehicular and light rail traffic within the existing trackbed.

The scope of this project is to advance the "preferred alternative" to a preliminary design level. The preliminary design effort is being sponsored by the City of Buffalo in conjunction with the NFTA and Buffalo Place. The Design Team for the project is headed by DiDonato Associates, Engineering and Architecture, PC and includes URS Corporation, Foit-Albert Associates and Mathews Nielsen Landscape Architects. The Technical Committee responsible for the decision making process is comprised of members of the Client Team, Design Team, NYSDOT and the Greater Buffalo-Niagara Regional Transportation Council (GBNRTC). An Advisory Committee has been appointed by the Mayor of Buffalo to insure community involvement and help refine the scope and decision making process for the project.

1.2 Purpose

The primary objective of the project is to reopen Main Street to two-way vehicular traffic from Scott Street to Goodell Street through the implementation of the preferred alternative identified under the Environmental Assessment (EA), the "*Share the Trackbed Alternative",* (see Exhibit 1-Project Location Map). The proposed alternative will meet the needs and the revitalization objective outlined in the EA and help achieve the following:

- Increase Multi-Modal access options and Light Rail Rapid Transit ridership
- Simplify access to downtown
- Encourage public/private economic development
- Increase business visibility
- Provide vehicular access to adjacent land use
- Provide short-term parking
- Enhance aesthetics
- Provide a public friendly environment

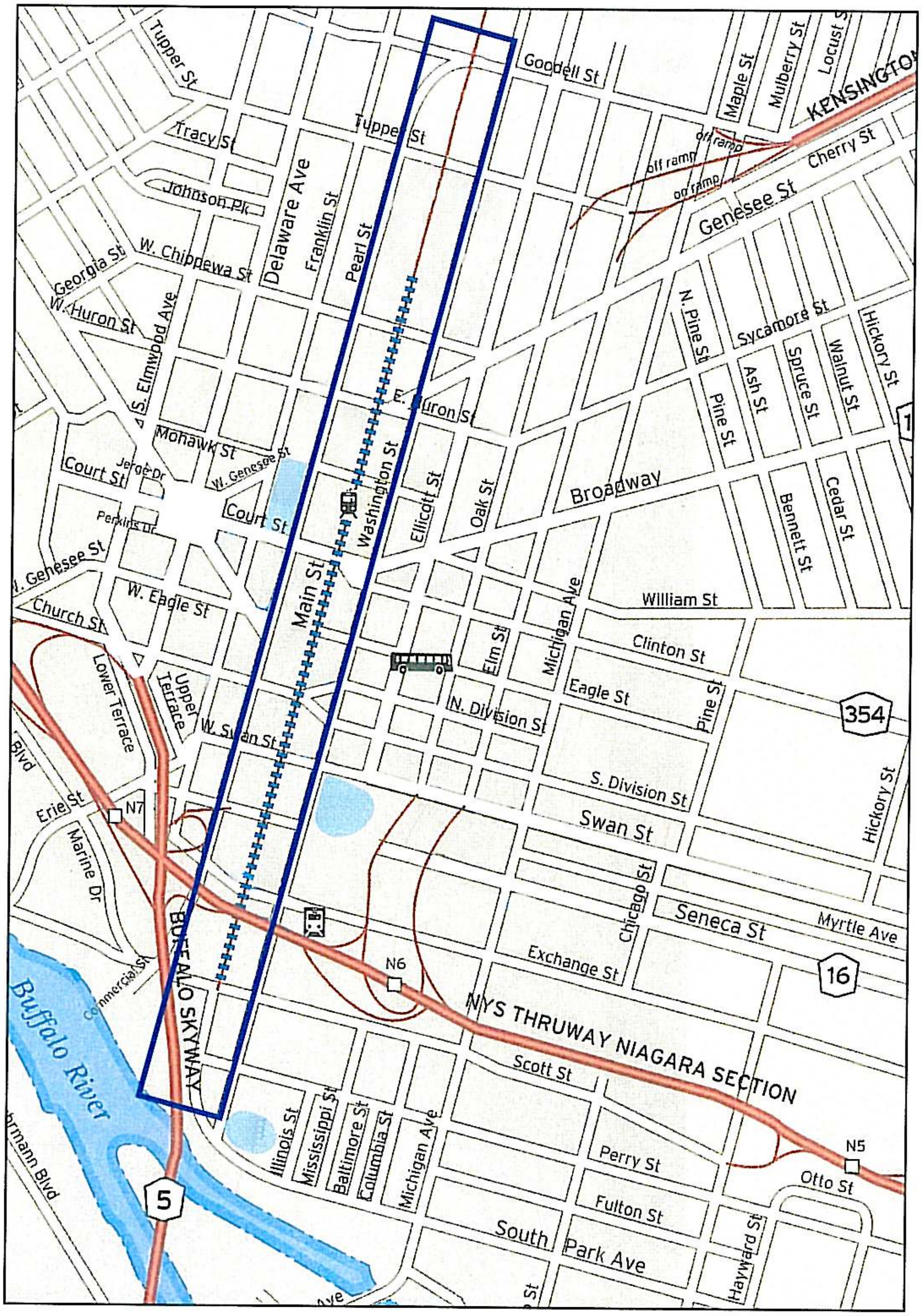

EXHIBIT 1
PROJECT LOCATION MAP

1.3 Design Options Considered

The overall project scope calls for the implementation of the "*Share the Trackbed Alternative"* recommended in the EA. As such, options to be considered for the project are related more to construction materials and streetscape elements than related to geometric and layout options. Trackbed rehabilitation, turn lanes, catenary pole relocations, curb alignment and station relocations are among the elements considered and discussed in the various sections of the report. Prioritizing the various scope elements considered in order to develop a fundable project was a key part in evaluating the various options.

1.4 Methodology

The goal of the preliminary design effort for the project is to establish concepts and design criteria that form the basis for the final design and construction for the entire project corridor. A primary component of the preliminary design is to evaluate projected vehicular traffic conditions and incorporate recommendations to insure that the vehicular, light rail and pedestrian traffic can coexist without sacrificing safety and not have a significant adverse impact on light rail operations. Streetscape improvements and design of intersections will play a key role in developing a safe and attractive environment for pedestrians. Redesign and placement of the LRRT stations is an important component, as well as the enhancement of visibility to properties while meeting the needs of transit accessibility and optimizing safety along the corridor. Establishing material selection criteria is essential for long-term durability and maintenance considerations. Developing estimates for the overall construction and determining the impacts of phasing on properties along the corridor and LRRT operations along with the establishment of funding will be key in determining the optimal approach to construction.

1.5 Summary

The initial overall project scope elements considered for the project were defined and summarized in the Scope Summary Memorandum. The determination of scope elements were based on preliminary studies, including the EA, as well as the early stages of the preliminary design with input from the Client Group, Technical Committee and the Advisory Committee. As part of the preliminary design effort to further shape the project scope, construction cost estimates have been developed for each of the scope elements to establish an overall project estimate. Based on the costs developed, direction was given to evaluate alternatives for minimizing work that is not essential to the primary project objective of opening Main Street to cars. The primary scope modifications considered are related to reducing work within the actual trackbed. Further discussion is contained in the following sections.

1.5.1 Roadway Design Elements

Implementation of the "Sharing the Trackbed" concept inherently imposes certain constraints on the geometric design options within the shared trackbed segments. A single travel lane in each direction will be shared by cars and light rail vehicles (LRV's). A 15-mile per hour speed limit will be established for the entire project corridor to maximize safety. The existing roadway/trackbed vertical alignment will be maintained, as the rail alignment will remain unchanged. The curb lines and station platforms in train boarding areas are currently located to properly interface with the train. The existence of the catenary poles to support the overhead wires create constraints or pinch points and fixed object hazards for vehicular traffic. As such, the decision was made to retain the existing curb alignment as well as to relocate the catenary poles, located between the inbound and outbound tracks and install new poles outside the trackbed to maximize the lane widths while maintaining the existing curb train interfaces for train boarding operations. The existing cantilevered, mini-high platforms at the stations currently project into the trackbed, which also creates a fixed object. Increasing the station platform offset to 2 feet and installing automated bridge plates mounted to the platforms will adequately address this clearance concern. Parking lanes are proposed along the shared trackbed sections, which are 9 feet in width and include a 3-foot wide buffer zone to the travel lanes.

Geometrically adequate lane transitions are proposed around the portal entrance to the subsurface rail section. The section between Goodell Street and Tupper Street will have two travel lanes, one in each direction, a center median and dedicated left turn lanes at the intersections. Dedicated bike lanes are proposed for bike access from the north project limit at Goodell Street to a future bike route on Pearl Street. The bike lanes will be constructed between Chippewa Street and the portal and from Tupper Street to Goodell Street. A wider travel lane around the portal will function as a shared vehicular and bike lane. Delineation of bike access along Chippewa Street will be performed to interface with the future Pearl Street improvements.

The connection of Eagle Street and Mohawk Street to Main Street is currently included in the project scope. This will be re-evaluated in the final design phases to determine if cost or operational considerations would require their elimination from the project. Each road segment would consist of a single travel lane in each direction and parking lanes. Eagle Street would extend from Washington Street to Main Street while Mohawk Street would extend from Washington Street to Pearl Street.

1.5.2 Traffic Modeling

Traffic modeling has been performed, which determined that the reintroduction of cars to Main Street could be accommodated without significant, negative impact to LRRT operations. The traffic analysis shows that the vehicular traffic and the train traffic can operate simultaneously with acceptable intersection level of service and with minimal delays to the train operations, less than one minute during peak hours in each direction. Analysis of the entire corridor shows that dedicated right turn lanes are not required provided that right turns on red are permitted. Also, the model shows that left turns can be made from the shared lane though certain intersections such as Church Street will require additional measures to insure safe conditions for vehicular and pedestrian traffic. New signals and controllers will be required at each intersection to accommodate the new traffic conditions. Additional cameras supported by the NFTA CCTV system are recommended for monitoring of traffic conditions. Supplemental measures are required to properly delineate the unique conditions that will exist at the portal interface.

1.5.3 Light Rail System Improvements

While the primary objective is to return two-way car traffic to Main Street, it is important for the LRRT system to continue to operate safely and efficiently. Traffic modeling has demonstrated that the shared trackbed concept could be implemented without significant adverse impact to train operations. Elements of the LRRT system that have been evaluated in the preliminary design include trackbed and rail components, overhead catenary system, train control system, signalization, wayside systems including communications, power, surveillance, emergency notification and utilities which share NFTA duct banks. Trackbed sections along the project corridor that are in poor condition will be rehabilitated as required.

Drainage of the trackbed is a significant factor that contributes to deteriorated trackbed areas, therefore, subsurface drainage is proposed adjacent to the existing curb just outside the trackbed to provide for some surface drainage. The existing curb will remain and will be cut flush to the pavement in parking areas.

The train traction power system consists of an overhead electrification system supported by poles located in the center of the trackbed. Sectionalizing switches within the trackbed as well as power feeds running through conduit under the trackbed control the power to the system. Removal of the catenary poles and switch components from the trackbed as mentioned under Section 1.5.1 is important to the lane configurations as well as to maximize accessibility under emergency conditions. New poles will be installed outside of the trackbed that would support cross-span wires and would support the electrification system. The poles would be installed at setbacks similar to the existing light poles and would serve a dual purpose as light poles. The catenary pole spacing of approximately 130 feet would not inhibit fire and emergency service access.

Adjustment to the station platform locations is required to provide adequate queue length in advance of intersections as well as to prevent backup of vehicles into preceding intersections. Combining the Theatre and Fountain Plaza Stations into one location between Huron and Chippewa Streets will accommodate the lane transitions around the portal as well as the anticipated traffic conditions. A station platform setback of 2 feet from the curb is important to comply with clear zone provisions. Accessibility to trains will be maintained from the platforms through the use of automated bridge plates that will interface with the train control system. The stations will be uniform in size and will be significantly smaller than the existing stations. The stations will include transparent wall panels to provide weather protection, to reduce viewing impact on building fronts and will be constructed of weather resistant materials to reduce long- term maintenance costs.

LRRT system components associated with the stations include Closed Circuit Television Vision (CCTV), Passenger Assistance Communication Equipment (PACE), Public Announcement (PA) system, Automatic Fare Collection (AFC), Passenger Information Displays (PIDS), and Train Control Communication (TCC). All of the components will be relocated or replaced and incorporated into the stations structures. Intersection traffic controllers will be replaced and will continue to interface with the train control system. Additional CCTV cameras will be installed to monitor intersections utilizing the existing NFTA cable infrastructure.

1.5.4 Urban Design Elements

A significant part of the project design effort is to develop an enhanced streetscape that will compliment the improved access to the area. Streetscape design includes strategic layout of short-term parking (over 250 spaces currently proposed, including proposed parking along Eagle and Mohawk Streets) and loading zones, effective use of station zones, establishing adequate pedestrian travel routes and integration of public spaces. Enhancements proposed include new sidewalk surfaces, enhanced crosswalks, improved lighting, new sustainable landscaping, seating, street furnishings, power outlets, removal of obsolete or conflicting features, new transparent screening for the portal, medians from the portal to Goodell Street and wind screening elements in localized problem areas. Additional considerations that will be evaluated further include the installation of drip irrigation systems, heated sidewalks (individually funded), artwork, display boards and informational signage. The preliminary design effort for the streetscape design has focused on the three blocks at the north end of the project, which is currently planned as the first construction phase. These blocks are generally representative of the conditions anticipated throughout the project corridor. Further design of the remaining blocks are reserved until the detailed design phases.

A key issue sponsored by the Advisory Committee is the utilization of parking within station boarding areas. Currently the NFTA operates with 2-car trains on a normal basis with a limited number of 3-car trains during peak hour operations. Four car trains are used during special events such as hockey games. NFTA has resolved that they will continue to utilize 4-car trains during special events in lieu of modifying train frequency. The Advisory Committee requested and the COB has agreed to implement provisions for parking in the third and the fourth car zone through the use of a traversable curb during the hours when the three and four cars are not in operation by the NFTA. A number of operational and safety concerns will be evaluated further as part of the final design effort before considering implementation of parking within these zones.

1.5.5 Construction Phasing

The COB has conveyed that the intent is to generally construct the project in a north to south direction with three distinct phasing segments determined to date. However, the timing of potential development near the foot of Main Street must be factored as well. The pending development projects directly impact the timing of the segment between Scott Street and Exchange Street. Therefore, an initial phasing approach has been established as follows:

- Phase 1A – Goodell Street to Chippewa Street
- Phase 1B – Exchange Street to Scott Street
- Phase 2 – Chippewa Street to Exchange Street
- Phase 3 – Improvements South of Scott Street

Initial funding has been secured to potentially begin the construction work in 2007 for Phase 1A pending resolution of the EA. Similarly, funding for phase IB has also been secured for the lower Main Street. Officials from the Erie Canal Harbor Development Corporation have conveyed that the timing of the proposed development at lower Main Street may require that Phase 1B be completed in 2008. No definitive time frame or sub-phasing has been established for the remaining segments at this point and further co-ordination will be required between the various agencies (involved in the developments) prior to setting the final phasing of construction.

A key element for staging of construction operations is, to structure the phasing so that all work to be performed within a given block is completed in one construction season. Noise restrictions within residential and hotel areas, maintenance of LRRT systems, maintenance of pedestrian traffic, and maintenance of access to businesses will also be considered.

1.5.6 Project Costs

The process of evaluating the various scope considerations included the development of construction cost estimates and impact on the overall cost of the project. The cost estimates were developed in 2006 construction dollars and are based on available data published by the NYSDOT as well as recent construction bid data from area projects of similar work elements. Design contingencies have been applied to each of the work elements to account for unknowns that will not be determined until the completion of the final design. A 15 percent contingency was used for the project as a whole with additional contingencies applied to certain items that have a greater potential for variation in cost. Estimates were then categorized under major work elements and divided into one-block segments in order to provide a means of evaluation for different phasing scenarios. Though a fixed budget was not established for the project, the EA listed an estimated cost of $53 million for the “Shared Trackbed” concept in 2003 dollars. A recent update to the EA projected the costs to $75 million, which was escalated to 2008 dollars and included the addition of the Church Street crossover, a new crossover south of Scott Street and the catenary pole relocation work. Subsequent to the EA cost update, direction was given to the design team from the COB to alter the scope as necessary to get the project scope more in line with the initial EA cost projections in order to be more fundable.

As such, estimates have been developed for each of the trackbed work alternatives. The lowest construction cost option is the minimal trackbed repair approach at just under $51 million (approximately $ 61 million total project cost), which is based on all work being completed by the end of 2009.

funding has been secured for Phase IA and IB. The rehabilitation (resurfacing) and reconstruction approaches would cost an additional $6 million and $16 million respectively for the same construction time period. The preferred approach recommended by the COB and Advisory Committee is the minimal trackbed work approach, which includes moving the catenary poles outside of the trackbed but does not include the Church Street crossover. This approach accomplishes the objective of returning vehicle traffic to Main Street in a cost effective manner.

SECTION 2 – ROADWAY GEOMETRY

Implementation of the preferred shared trackbed alternative, poses a unique challenge of creating lanes that will accommodate varied transportation modes consisting of light rail vehicles, cars, emergency vehicles and bicycles as well as pedestrians. Lane widths and configurations must be coordinated with the positioning of rail stations and loading areas as well as the catenary pole system. The curb location in the vicinity of stations is of particular concern in order to insure that adequate vehicular clearance is provided around the stations as well as maintaining the proper interface between the stations and rail cars. Turn lane size and configurations will be established as part of the traffic analysis. Other important geometry related issues include the transition and delineation of the vehicular lanes around the portal, crosswalk configurations, bike access at stations, turning radii at intersections to accommodate the selected design vehicle, maximizing the number of parallel parking spaces, providing for loading zones, clearing of obstacles to maximize sight distance and the protection of potential roadside hazards.

2.1 Lane Configurations, Widths and Alignment

This project will be designed in accordance with the requirements of the City of Buffalo *Standards and Specifications*, the New York State Department of Transportation (NYSDOT) *Highway Design Manual* (HDM), *Environmental Procedures Manual* (EPM), and *A Policy on Geometric Design of Highways and Streets, 2004* (AASHTO), for a functional classification of Urban Street. The project segment between Scott Street at the south limit and Goodell Street at the north limit will be designed as a two lane local urban street. A 15 mph speed limit will be established for the entire project corridor.

Trackbed Segments
The existing trackbed section is 23.5 feet wide and is currently used by Light Rail Vehicles (LRV's), emergency vehicles and delivery type vehicles with permits. The proposed shared trackbed segment between Scott Street and the end of the Light Rail Rapid Transit (LRRT) surface section at the portal entrance to the subsurface section of the LRRT system, just south of Tupper Street, will consist of two (2) 11.75 feet travel lanes for passenger vehicles with no curb offset. The lane widths are dictated in the LRRT station blocks by the train boarding interface requirement that are discussed further in Section 5. The 11.75 feet lane widths are maintained in the non-station blocks for consistency. Relocation of the Overhead Catenary System (OCS) poles outside of the roadway is necessary in order to utilize the full lane widths as discussed in Section 4. The station boarding areas and platforms are prohibitive in allowing space for a shared or dedicated bike lane. A 9 foot-wide parking lane and 3-foot wide buffer zone is proposed for each side of the trackbed in non-station areas. Consolidation of the Theatre and Fountain Plaza Stations provide the opportunity to incorporate a 5-foot wide bike lane from Chippewa Street to the portal area.

The horizontal alignment of the trackbed is generally straight with three deflections within the surface section. One deflection of approximately 0°10.5' is located near Seneca Street at approximately Sta.53+50. The other two deflections of approximately 0°28' and 0°17' are located north of Chippewa Street at approximately Sta.91+00 & Sta.94+00 respectively. The vertical alignment is generally uniform in nature ranging from 0.25% to 1% through most of the corridor with the exception of the lower portion of Main Street between Scott Street and Seneca Street and in the portal area. The longitudinal grade varies from 0.66% to 5.91% in the lower Main Street segment with the steepest grade just north of Exchange Street at HSBC Tower. The slope into the portal is approximately 6%. No changes to the horizontal or vertical alignments are proposed. The pavement surface condition at intersection approaches will be evaluated further in final design in areas where the grades exceed 5 percent.

Designated right turn lanes were initially considered on the Main Street approaches for each of the intersections. However, installing turn lanes nearly doubles the pedestrian crossing distance for the standard trackbed width. Also, maintaining narrow widths at intersections produces a beneficial calming effect on vehicular traffic, which is important for maintaining a low speed corridor as well as enhancing safety. No significant delays were observed in the traffic modeling for Main Street and its intersections due to the elimination of the dedicated right turn lanes (with permitted right turn on red). Traffic modeling was performed for inclusion and exclusion of right turn lanes and is discussed further under Section 3. Exclusive left turn lanes were not considered for this project for safety concerns over moving traffic in and out of the shared lane as well as the additional widening that would be required on the opposite side of the intersections.

Non-Trackbed Segments

A transition is required between the shared trackbed segments at the portal to the non-trackbed segments north of the portal. The distance over which the shifts shall occur is based on Table 262-2 from the 17 NYCRR also known as the New York State's *Manual of Uniform Traffic Control Devices* (MUTCD) for a design speed of 20 mph. It is desirable to minimize the transition distance for several reasons, which include minimizing of impact on existing properties, traffic calming benefits of having to maintain lower speeds to maneuver, and visual clarity in having an abrupt shift versus long transitions. Proper signage and delineation as well as physical measures to prevent vehicles from entering the portal are essential to the lane shift designs. The start of the shift is approximately two train car lengths south of the portal, which was selected to prevent a typical size train stopped at the portal from blocking northbound cars transitioning around the portal.

The section between portal and Tupper Street will consist of one (1) 14 feet wide travel lane on each side of the portal walls and 8-foot wide parking lanes. The travel lanes are adequate in size to accommodate bikes. A slight alignment shift across the Tupper Street intersection is required to align with the travel lanes between Tupper Street and Goodell Street. The travel lanes between Tupper Street and Goodell Street are proposed to be 11 feet in width separated by a 10-foot wide median. A raised, landscaped median is proposed for each end of the block to form a transition into dedicated left turn slots. A 5-foot wide bike lane and an 8-foot wide parking lane are proposed along each side for this block. No changes are proposed to horizontal and vertical alignments for the segment between the portal and Goodell Street.

The connection of Eagle Street and Mohawk Street to Main Street is currently included in the overall project scope. Each road segment would consist of (2)

12-foot wide travel lanes and 8-foot wide parking lanes. Eagle would extend from Washington Street to Main Street but not connect to Pearl Street due to the existence of the Main Place Mall. Mohawk would extend from Washington Street to Pearl Street. This option however will be re-evaluated in the final design phases of the project should cost or operational considerations require elimination from the project.

The overall Plans, Profiles and Typical Section drawings showing all geometric components, including parking and station layouts are shown in Appendix A of this report.

2.2 Intersections

There are a total of 11 existing side streets that intersect with Main Street within the project limits. Eagle Street and Mohawk Street right-of-way is connected with the Main Street right-of-way with no physical connection or crossing of the roadways. Both Eagle Street and Mohawk Street connections to Main Street are being considered under this project. A majority of the side streets intersect Main Street at right angles with a few exceptions. The intersection angles are as follows:

Side Street	Intersecting Angle
1. Scott Street/Marine Drive	70.6º±
2. Exchange Street (East & West)	90º±
3. Seneca Street (East & West)	90º±
4. Swan Street (East & West)	90º±
5. Cathedral Park	90º±
6. South Division/Church Street	80º±
6. North Division/Church Street	83º±
7. Eagle Street	90º±
8. Clinton/Court Street	56º±
8. Broadway/Court Street	53º±
9. Mohawk Street (East & West)	90º±
10. Huron Street (East & West)	90º±
11. Chippewa Street (East & West)	90º±
12. Tupper Street (East & West)	90º±
13. Goodell/Pearl Street (East & West)	68º±

Traffic calming is a key element of the design for this project, as the mixing of vehicular traffic with LRRT vehicles requires special safety considerations. The LRV's currently travel at speed limits of 15 mph during normal operating hours. Therefore, a 15 mph speed limit for vehicular traffic will be established throughout the project corridor. Narrowing of intersection widths is a proven traffic calming measure. Limiting the size of corner radii to the minimum required for a typical passenger vehicle using Main Street will help limit the size of vehicles attempting to use Main Street as well as minimize the crossing distance for pedestrians. A corner radius of 15 feet at a typical 90-degree intersection will accommodate passenger vehicles. Weight limits will be imposed to restrict the largest vehicles using Main Street to single unit type trucks (3 tons maximum).

2.3 Roadside Elements

Overhead Catenary System & Station Platforms

The existing overhead catenary system for the LRRT is supported by poles located in the center of the trackbed. As such, the poles create a fixed object hazard for vehicular traffic. The existing raised platforms at the LRRT stations extend approximately 6-inches into the trackbed along the curb line to meet the accessibility requirements for the light rail vehicles (LRV's). The cantilevered platforms are a fixed object hazard as they violate the City of Buffalo standard curb offset requirement of 2 feet. Both conditions will be addressed through design measures. The poles will be relocated outside of the roadway on each side with the catenary wires being supported by cross span wires. The poles will be moved to an offset on average of 18 feet from the existing curb line, except where it is possible to move closer at intersections. Movable bridge plates mounted to the raised station platforms are proposed to fill the gap between the rail car doors and the platforms.

Additional information regarding the Overhead Catenary System (OCS) is discussed in Section 4 and the Station Platforms and Bridge Plates are discussed in Section 5 of this report.

Portal Walls

The LRRT system is comprised of the surface segment of rail track's between Scott Street and Tupper Street and the subsurface segment of the rail track's between Tupper Street and the LRRT north terminus at University Station. Cars will share the trackbed between Scott Street and the portal south of the Tupper Street intersection. Approximately 600 feet south of the Tupper Street intersection, the rail tracks and the vehicular travel lanes will separate. The 42-inch high portal walls at the entrance to the subsurface segment of the LRRT system create a barrier separation from northbound and southbound vehicular travel lanes. A 2-foot minimum curb offset is proposed between the vehicular travel lanes and the portal wall to conform to the minimum offset for fixed objects. Replacement of the fencing extending above the portal walls is discussed further under section 7 of this report.

Signs & Traffic Signal Poles

The traffic and other informational signs will be located outside of the 2 foot clear zone as required by the City of Buffalo standards. Traffic signal poles will be located at all signalized intersections. The interface of the signal heads and overhead catenary wires must be carefully coordinated as clearances to the wires must be maintained while the signal heads must be properly aligned with the travel lanes. Additional signals and gates will be required at the portal area.

Lighting

The street light poles will generally be located within the sidewalk area and will be outside of the required minimum clear zone. Light fixtures for street and sidewalk lighting are proposed to be mounted on the new catenary support poles in the sidewalk areas as discussed in Section 4. Additional light poles will be required for sidewalk areas as needed to enhance security and to provide adequate lighting of the sidewalks during the night. The AASHTO guidelines require that the minimum illumination required for a local road should be 0.2 foot-candle (ft.-c) for residential use and 0.6 ft-c for commercial areas. The recommended uniformity ratio for a residential roadway is 10:1 and for commercial walkways is 4:1. The lighting requirements will be further evaluated in the final design phase to provide sufficient lighting and to minimize the shadow effects within the project corridor for vehicular and pedestrian traffic. Main Street within the corridor will be a combined residential and commercial street. Light poles located in the vicinity of the intersections will also be located at least 2 feet from the curb.

Medians

A raised median is proposed between the travel lanes near each end of the 700 block of Main Street with a flush median section between to facilitate access. This median will be 10 feet wide and will be landscaped. The section between the portal and Tupper Street will also have a landscaped median to separate the vehicular traffic.

Streetscape Amenities

Streetscape amenities will be provided along the entire Main Street corridor and will include benches, planters, and furnishings that will be developed as part of the detailed design of the project and remain out of the designated roadway clear zone. More detail regarding these amenities is provided in Section 7 of this report.

Utility Cabinets

There are aboveground utility cabinets (Green cabinets) located along Main Street in the vicinity of the LRRT stations. The cabinets primarily house train control, communications and power associated with the LRRT systems and are discussed further in Section 5.

The information drums located along the project corridor will be removed as part of this project.

Driveways

There are no driveways within the trackbed area along Main Street. The three existing driveways within the 700-block will be retained.

2.4 Bicycles

Bicycle access has been identified as a project objective. The limiting trackbed width, potential hazard presented by the track rails, position of the station mini-high platforms are among the elements that present challenges to incorporation of measures to accommodate bicycles. The current trackbed, curb to curb, width that will be maintained is 23.5 feet, resulting in 11.75 feet wide travel lanes, which is not desirable for a shared vehicle/bike lane. Typically, 14 feet is desirable for a shared lane, with 12 feet being the minimum for experienced bicyclists. The condition is exacerbated by the existence of the track rails, which are located approximately 2 feet from the curb line. The rail is a slipping hazard for bike tires and the rail flange creates a catch point for bike tires. Further discussion on the rail is included under Section 4.

Given the roadway limitations for bicycle access, the sidewalk area was considered for a bikeway. However, as with the roadway, there are a number of safety concerns for bicycles traveling in sidewalk areas. The primary concern is with mixing bicyclists and pedestrians in an urban setting. Having an exclusive bike lane would require pedestrians to cross the lane at numerous locations including intersections and train boarding areas. Furthermore, this would result in a net reduction of the useable sidewalk width and create pinch points at LRRT stations, sidewalk cafes and encroachment areas. It would also result in limitations in the placement of various streetscape elements including seating and plantings. As such, a revised approach has been proposed that would provide a connection for bicycles from the north project limit at Goodell Street to a future bike corridor along Pearl Street.

The access through the project for the Main-Pearl connection would be through a dedicated 5-foot wide bike lane on the segment from Goodell Street to Tupper Street, a shared 14-foot wide travel lane around the portal where space is limited and a dedicated 5-foot wide bike lane on the segment from Tupper Street to Chippewa Street. Improvements along Chippewa Street and Pearl Street to accommodate bicycles would be incorporated into a separate project.

2.5 Pedestrian Crossings

Reintroducing vehicular traffic to the shared pedestrian and light rail mall increases the importance of clearly defined pedestrian crossings at locations familiar to motorists. Clearly delineated crosswalks at intersections controlled by signalization will provide the safest interface for multi-modal use of the project corridor. Signed and marked mid-block crosswalks are not used on the City of Buffalo's downtown street network. The pedestrian movements at intersections are currently controlled by traffic signals. New pedestrian signals with count down timers will be installed at the new crosswalks at all intersections. Introducing mid-block crosswalks will pose increased risk along this corridor due to the mixed-use traffic. Further discussion on cross walks is included under Section 7.

2.6 Right-of-Way

The right-of-way on Main Street is generally 99 feet with the exception of a segment near the Hyatt Hotel where it reduces to approximately 79 feet. The right-of-way generally coincides with building fronts, with the exception of encroachment areas listed under Section 7. The intersecting side street right-of-ways vary in width but similarly to Main Street, generally coincide with the building lines. The right-of-way information below is based on the record plans and tax maps and is without the benefit of a boundary survey.

Side Street	Right-of-Way Width (Ft.)
1. Scott Street (East)	Varies
1. Marine Drive (West)	49.5
2. Exchange Street (East & West)	Varies
3. Seneca Street (East & West)	66
4. Swan Street (East & West)	66
5. Cathedral Park	99
6. North & South Division Streets	361±
7. Church Street	112±
8. Eagle Street	71±
9. Clinton & Broadway Streets	249±
10. Mohawk Street (East & West)	66±
11. Huron Street (East)	Varies
11. Huron Street (West)	66±
12. Chippewa Street (East & West)	66±
13. Tupper Street (East & West)	50±
14. Goodell Street	66±
15. Pearl Street	Varies

2.7 Summary

Key decisions related to the roadway geometry recommendations for the project include maintaining the roadway/trackbed width to facilitate ground level train boarding, removing the catenary poles from the roadway/trackbed and installing new poles in the sidewalk areas, setting the station platforms and all fixed objects a minimum of 2 feet from the travel lanes to maintain proper clear zones and establishing a 15 mph speed limit for the entire project segment to maximize safety. A summary of the geometric components for the project are listed as follows:

1. Travel Lane widths:
   Main Street: =11.75 ft. (Shared trackbed segment)
   =14 ft. (Portal to Tupper Street shared bicycle lane)
   = 11 ft. travel, 5 ft. bicycle (Tupper to Goodell)
   = 5 ft. bicycle lane (Chippewa Street to portal)

   Side Streets:
   Mohawk Street =12 feet
   Eagle Street =12 feet
   All other side streets to match existing lane widths
2. Parking Lane Widths:
   9 feet – trackbed segments; 8 Feet non-trackbed segments
   3 Foot buffer in shared trackbed areas
   Stall Lengths = 22 feet
3. Design Speed = 20 mph for 15 mph speed limit
4. Lateral clearance = 2 Feet Min.
5. Design Vehicle = Passenger Car with limited number single unit trucks (3 Tons)
6. Turning Radii for Design Vehicle = 15 ft. min.

SECTION 3 – TRAFFIC ENGINEERING AND SIGNALIZATION

The reintroduction of automobile traffic onto Main Street creates a unique challenge for maintaining the schedule of light rail vehicles in this corridor. Careful coordination of the station locations, consideration of turn lanes at intersections, designated on-street parking areas, and the traffic signal system will be required for this project. The traffic engineering modeling was used to determine the interaction between all of these factors and adjustments can then be made to the design parameters.

3.1 Forecasting

Traffic Volume Development

The purpose of this section is to document the development of year 2025 traffic forecasts for Main Street. The year 2025 peak hour traffic forecasts on Main Street were based on traffic volumes reported in the *City of Buffalo Main Street Multi-Modal Access and Revitalization Project Draft Final Environmental Assessment* (August 2005). Future year traffic volumes on other downtown Buffalo streets in the vicinity of Main Street were developed by applying projected traffic growth rates to the base year (2005) peak hour turning movement volumes.

Existing Traffic Volumes

The existing condition traffic volumes were developed from peak hour traffic volumes contained in Synchro files provided by the GBNRTC. The GBNRTC provided Synchro models for both the AM and PM peak hours that cover most intersections within downtown Buffalo. The GBNRTC also provided the intersection turning movement count sheets for several downtown City of Buffalo intersections. The majority of the intersection turning movement counts were conducted in 2005.

In some cases the traffic volumes between adjacent intersections varies significantly. This occurred in some cases because the traffic counts were conducted at different times of the year. In these instances, the base year traffic volumes were adjusted in a “smoothing” process so that traffic volumes between intersections were relatively consistent except in locations where parking facilities are likely significant sinks/sources of traffic. The parking garage on Pearl Street, south of Chippewa Street, is an example of a location where the smoothing process assumed traffic was destined during the AM peak and traffic originated during the PM peak hour. The 2005 AM, mid-day and PM peak hour volumes are illustrated in Figures 1 thru 3 of Appendix D.

Development of 2025 Peak Hour Forecasts

The design year for this project is assumed to be 2025, as documented in the *City of Buffalo Main Street Multi-Modal Access and Revitalization Project Draft Final Environmental Assessment (Final EA)*. The year 2025 PM peak segment traffic volumes provided in Table 3-13 of the Draft Final EA generally served as the starting point for development of the design year traffic forecasts. Additional assumptions used in the development of the design year traffic forecasts are summarized below:

- A background annual traffic growth factor of 0.5% was recommended in the Final EA and confirmed in a conversation with the GBNRTC.
- The PM peak hour segment volumes were available in the Final EA. These volumes were used with some modifications.
- Development of morning and midday traffic volumes on Main Street were developed based on existing study area morning and midday traffic patterns (i.e., directional and peak hour percentages) compared to afternoon traffic volumes.
- Approximately 25% of the Main Street traffic was assumed to be new traffic to the study area and the other 75% would be traffic diverted from adjacent corridors.
- In general, existing turn movement proportions by approach were maintained for intersections in adjacent corridors.
- The amount of circulating traffic for each block of Main Street varied depending on the availability and the number of on-street parking spaces.

As with the existing year traffic data, the future year traffic volumes needed to be smoothed between intersections taking into account parking facilities. The 2025 AM, mid day and PM peak hour volumes are shown in Figures 4 thru 6 of Appendix D.

Pedestrian Volumes

Downtown Buffalo and Main Street have a considerable amount of pedestrian activity throughout the day and especially during peak periods. Buffalo Place has been conducting pedestrian counts over lunch time hours along Main Street since the early 1980's. The most recent Main Street pedestrian count was conducted in 2005. The GBNRTC also provided pedestrian counts for other downtown intersections.

The development of Main Street pedestrian volumes for the AM and PM peak hours was based on a Buffalo Place *2000 Pedestrian Study* report that provided a comparison between midday volumes versus morning and afternoon volumes. A one percent annual growth was assumed for pedestrian volumes when developing 2025 pedestrian volumes.

Special Events Traffic Volumes

The special event traffic volumes were developed from traffic counts conducted by the consultant for both a single and dual special event. The single special event was a Buffalo Sabres hockey game held on January 12, 2006 with a starting time of 7:00 pm. The dual special event was a theater event at Sheas Theater combined with a Buffalo Sabres hockey game, both held in the evening of February 9, 2006.

The traffic counts showed vehicles arriving to the events throughout the period of sixty to ninety minutes prior to the event; however, most vehicles attempted to leave within a thirty-minute period of time immediately following the events. Vehicles start arriving for these special events towards the end of the PM peak hour and continued up until the event start times. The arrival travel patterns for inbound vehicles to the special events are normally different from outbound commuter travel patterns. For these reasons, the special event forecasts were developed for outbound traffic. In general, the streets not affected by special events typically have 25-35% of the traffic seen during peak periods. The single and dual special events traffic forecasts are shown in Figures 7 and 8 of Appendix D.

3.2 Signal Timing and Operation

The current traffic signal timings for downtown Buffalo intersections were obtained from sources including: GBNRTC Synchro models, City of Buffalo, NYSDOT, and NFTA. The signal timing data obtained from the agencies were supplemented by field investigations by the consultant. A majority of the intersections in the downtown area operate as fixed time traffic signals and use similar signal phasing during both the AM and PM peak periods. Traffic signals along Main Street also use fixed time operations, but preemption is allowed for LRRT operations.

The existing traffic signal system was installed in the early 1980's. The traffic signal system as stated earlier uses preemption as required by the LRRT movement along the tracks. The system works as any other intersection traffic signal system for the vehicular traffic at the signalized intersections. Inductance loops are placed within the train tracks that provide the necessary information for preempting the vehicular traffic signal system at intersections. Prior to moving the train from the station the train operator pushes a button on the control console of the LRV, which in return transmits a frequency signal into the interactive loop. The loop receives the transmission and determines the validity of the request, at which point a closed contact is made within the Train Control cabinet located at the stations which completes a circuit that is transmitted from the intersection controller located at the street. Once the signal controller has setup the preemption, a lamp located within the station area lights up indicating that the train operator can proceed.

The existing traffic signals are beyond their useful life. The hardware as well as the software being used for the intersection traffic control and the preemption system are now outdated and need to be replaced. The entire traffic control system within the Main Street corridor will be redesigned as part of this project.

A summary of the traffic signal timings for existing conditions is provided in Table 3-1.

Table 3-1 Existing Traffic Signal Timings

Intersection	Cycle Length	Signal Phasing [a]		
		1	2	3
Main / Scott [b]	88	32	33	23
Washington / Scott	54	30	24	
Main / Exchange	58	25	33	
Washington / Exchange	66	33	33	
Pearl / Seneca	64	31	33	
Main / Seneca	70	44	26	
Washington / Seneca	60	35	25	
Pearl / Swan	75	37	38	
Main / Swan	56	24	32	
Washington / Swan	75	37	38	
Pearl / Church	75 / 85	25 / 25	50 / 60	
Main / Church	83	39	44	
Washington / N. Division	75 / 85	30 / 30	45 / 55	
Washington / S. Division	75 / 85	30 / 30	45 / 55	
Pearl / Court [c]	70 / 70	28 / 28	42 / 30	- / 12
Main / Court	69	38	31	
Washington / Broadway	75	43	32	
Washington / Clinton	75	43	32	
Pearl / Huron	80	52	28	
Main / Huron	56	24	32	
Washington / Huron & Genesee [d]	88	40	26	22
Pearl / Chippewa	80	35	45	
Main / Chippewa	68	24	44	
Washington / Chippewa	75	45	30	
Pearl / Tupper	75	30	45	
Main / Tupper	75	30	45	
Washington / Tupper	75	30	45	
Main / Goodell	85	25	60	
Washington / Goodell	85	30	55	

Notes:

X / X = cycle or phase in the AM / PM peak periods
a – phase 1 = northbound/southbound; phase 2 = eastbound/westbound; phase 3 = other phase
b – phase 3 is northbound Main Street
c – phase 3 is a westbound left-turn
d – phase 2 = Huron Street and phase 3= Genesee Street

The traffic signal phasing for Main Street intersections appear to be based on pedestrian crossing times which results in several different cycle lengths along this street. LRRT vehicles operating along Main Street sometimes preempt the cross street signal phase. These preemption events result in either a shorter cross street phase or a longer Main Street phase. This decision is made by the control center using an algorithm that calculates minimum pedestrian times and releases LRRT vehicles from the station at the appropriate time. The traffic signal timing along Main Street is classified as preemption because there is no attempt to get the traffic signals back in 'synch' following a preemption event.

Intersection Traffic Controllers & Train Control Interfaces

Existing

The existing intersection traffic controller is a combination of standard City of Buffalo/NYSDOT traffic signal controllers with preemption capabilities. The special software required to preempt the traffic signal was installed in late 1979 and early 1980's by NFTA. The system is well beyond its useful life to the point that when parts are needed they are obtained from a spare parts supply that the LRRT staff has accumulated from NYSDOT when they retire or renew traffic controllers statewide.

Proposed

The proposed traffic signal system for the entire Main Street corridor intersections will be similar to the most updated City of Buffalo and NYSDOT recommended traffic signal controllers. The preemption system required for the operations of the LRRT will be integrated into the new signal controllers. The new software for the preemption will be as required by NFTA and will function similar to the existing traffic control system.

3.3 LRRT Operations (Existing)

The NFTA LRRT system operates at the street level along Main Street between the Portal (located south of Tupper Street) and Scott Street. The LRRT system operates from approximately 5:30 am to 1:00 am on weekdays. During the peak hours, the number of trains operating along Main Street is 8 to 9 per hour with approximately a seven-minute headway and a mix of two and three-car trains. The average dwell time at stations is approximately 45 seconds during the peak periods.

3.4 Parking and Loading Zones

The City of Buffalo and Buffalo Place recently conducted studies on downtown parking in Buffalo. These studies looked at both on-street parking and off-street parking facilities. An inventory of available parking spaces was included in these studies. The Buffalo Place study also looked at occupancy and duration of parking for on-street parking spaces. The average duration for on-street meter parking spots was approximately one hour.

The Main Street project will add approximately 160 on-street parking spaces along Main Street between Scott Street and Tupper Street with an additional 44 parking spaces between Tupper and Goodell Street. Loading zones will be provided in select locations along Main Street. Passenger drop-off zones will be provided in the 600 block of Main Street for Theater patrons. Further discussion of parking is contained in Section 7 of this report.

3.5 Traffic Modeling and Analysis

The evaluation of traffic and transit operations along Main Street was completed for existing and future year conditions. The future year traffic analysis includes automobiles on Main Street. The multi-modal characteristics (e.g., LRRT, autos, pedestrians) found along this street were analyzed using a micro-simulation program called VISSIM. The ability to model the activity at mid-block locations (e.g., transit stops, parking vehicles) is a primary reason for using a micro-simulation model. The primary goal of this analysis effort is to determine how the re-introduction of automobiles and on-street parking into the Main Street corridor affects intersection operations and LRRT operations along the corridor.

Microscopic traffic simulation models like VISSIM treat each vehicle as an individual entity and vehicle trajectories are altered at each time step by factors like car-following logic, other vehicles, and traffic control devices. Each vehicle in the simulation has a number assigned to it that is between 1 and 10 that determines how passive or aggressive that vehicle is when interacting with other vehicles. A more aggressive vehicle in the simulation will tend to travel faster, be more likely to change lanes to pass, and accept shorter gap times when completing a turn maneuver. For transit operations, the VISSIM model allows the user to input transit routes, transit stops, and dwell times for transit vehicles at the stops.

The output of the VISSIM model includes a variety of measures of effectiveness (MOE) for both automobile and transit operations. Examples of the types of MOEs available for automobiles from VISSIM include stop and total delay time at intersections, travel time and delay time along a corridor, queue length, and emissions data. Examples of MOEs for transit operations include travel time and delay along a corridor, delay at intersections, and average station dwell times.

Modeling Assumptions

A traffic model requires a considerable amount of data related to traffic and transit operations. Some of the required data inputs (e.g., traffic volumes) have been discussed in the previous sections. Additional information on modeling assumptions is provided below.

Street Network – The Main Street model includes the parallel streets of Pearl Street and Washington Street. This was done to gain a better understanding of how vehicle queues on the east-west cross street could affect Main Street intersection operations. New east west cross street connections at Eagle Street and Mohawk Street are included in the Main Street model.

Main Street Geometry – The proposed Main Street layout from the EA document suggested that right-turn lanes be provided for the northbound/southbound approaches to each Main Street intersection. The initial VISSIM model runs included these right-turn lanes, however, the final traffic analysis does not include any right-turn lanes based on the recommendations of the Technical and Advisory Committees.

Traffic Signal Timing – The existing Main Street traffic signal control is quite unique and would require a computer program to be written for each traffic signal controller along Main Street. For this analysis effort, a form of transit signal priority (TSP) timings was used to give preferential treatment to LRRT vehicles. The TSP timings will either extend Main Street green time to service an approaching LRRT vehicle or truncate the cross street green time to minimize the wait time for LRRT vehicles on Main Street. The same traffic signal control is used for all traffic analyses.

Main Street / Goodell Street – A northbound left-turn lane and a left-turn arrow was assumed for this modeling effort. This is due to the large area covered by the intersection and the amount of southbound traffic on Main Street.

Theater Station – This station is included in the existing conditions analysis, but is assumed to be removed for the future year conditions analysis based on the recommendations of the Technical and Advisory Committees.

On-Street Parking – The location of on-street parking areas were revised from the original layout contained in the EA document to reflect the current preferred design layouts proposed. The latest version of the VISSIM model includes the ability to model on-street parking areas. This capability was evaluated and found to be inadequate for this analysis effort because the actual parking maneuver causes little or no delay for Main Street traffic. An alternative solution was developed that involves a new 'parking' vehicle class and stop signs that only stops vehicles in this particular class. These stop signs are placed along Main Street where on-street parking zones are located and when a 'parking' class vehicle reaches these stop signs they stop and dwell there for 20 to 50 seconds. This dwell time stops traffic along Main Street and creates the corridor friction associated with on-street parking maneuvers. The percentage of 'parking' class vehicles and the number of 'parking' stop signs were calibrated to create approximately 125 to 150 parking maneuvers per hour.

Vehicle Mix – It is assumed that cars and delivery trucks (i.e., no large trucks) are the only vehicles allowed on Main Street.

Right-Turn on Red – The right-turn on red maneuver is allowed for vehicles turning from Main Street to the cross streets. No right-turn on reds are allowed for vehicles turning from the cross streets onto Main Street.

Speed Limits – The assumed speed for Main Street is 15 mph and speeds ranging from 25 to 30 mph were assumed for the other streets in the model.

Level of Service

The evaluation of intersections for this analysis results in a MOE called total delay. Total delay is computed by VISSIM for each vehicle by taking the difference between actual travel time and the theoretical (ideal) travel time. The total delay value reported by VISSIM is very similar to the "Control Delay" performance measure found in the *2000 Highway Capacity Manual*.

Observations of traffic flows provide an understanding of the general nature of traffic, but are insufficient to indicate either the ability of the street network to carry additional traffic or the quality of service provided by the street system. For this reason, the concept of level of service (LOS) has been developed to correlate numerical traffic volume data to subjective descriptions of traffic performance at intersections. LOS categories range from A (best) to F (worst), as shown in Table 3-2.

For the purposes of this study, a deficiency is defined as LOS E or worse. This threshold was developed based on conversations with City staff and a lower threshold is common in a downtown environment.

Table 3-2: Level of Service Performance Criteria for Signalized Intersections

Level of Service	Delay per Vehicle (seconds)	Description
A	≤10	Free flow, minimal delays
B	>10 and ≤20	Stable flow, occasional delays
C	>20 and ≤35	Stable flow, periodic delays
D	>35 and ≤55	Restricted flow, regular delays
E	>55 and ≤80	Maximum capacity, extended delays
F	>80	Forced flow, excessive delays

Source: Exhibit 16-2, *2000 Highway Capacity Manual*, Transportation Research Board

Traffic Analysis Results for Existing Conditions

The results of the signalized intersection capacity analyses and LRRT travel times for each peak period are summarized on Exhibits C-TF-1 thru C-TF-3 included in Appendix D. The results of the traffic analysis indicate that all of the Main Street intersections operate at LOS C or better during both peak periods.

Traffic Analysis Results for Future Conditions (Cars Sharing Main Street)

The results of the signalized intersection capacity analyses and LRRT travel times for each peak period are summarized on Exhibits included in Appendix D. The results of the traffic analysis indicate that all of the Main Street intersections operate at LOS D or better during both peak periods. There is some delay for both auto and LRRT vehicles on the Main Street approaches to the Church, Huron, and Chippewa Street intersections. Based on the traffic model, the travel time will increase by approximately one minute in each direction.

Most of the corridor delay along Main Street results from the LRRT vehicles stopped at stations while automobiles queue up behind the LRRT vehicle. Occasionally, it was observed that queued vehicles at an intersection would block a LRRT vehicle from reaching the station. The on-street parking maneuvers do result in some corridor delay, but do not typically result in impacts at intersections or LRRT stations.

In most cases, allowing left-turn vehicles does not appear to increase intersection delays significantly. The left-turn movements at the Main Street intersections with Court and Church Street seem to cause a little more delay due to the considerable number of pedestrians that reduce the capacity of the turning movements at these intersections.
The projected overall travel times for LRRT operations along Main Street increase by approximately one minute with cars sharing the roadway. The light-rail vehicles are projected to incur some delay at nearly every station due to the presence of automobiles on Main Street. The overall impact on the LRRT travel time along Main Street will be offset somewhat by the proposed consolidation of the Fountain Plaza and Theater District stations.

The following table summarizes the overall level of service for each of the Main Street intersections for the final layout conditions for the AM peak, PM peak and for the dual special events conditions.

Table 3-3 - LEVEL OF SERVICE			
YEAR 2025 CARS SHARING MAIN STREET			
INTERSECTION	OVERALL INTERSECTION LOS		
	AM PEAK	PM PEAK	DUAL SPECIAL EVENTS
Scott Street/Marine Drive	C	D	E
Exchange Street	B	C	B
Seneca Street	B	C	B
Swan Street	B	C	C
Church Street	C	C	C
Eagle Street	C	C	B
Court Street	C	C	B
Mohawk Street	C	C	B
Huron Street	C	C	B
Chippewa Street	B	C	B
Tupper Street	B	B	B
Goodell Street	B	B	B

Traffic Analysis Results for Special Event Conditions (Cars Sharing Main Street)

The traffic analysis results for conditions attributed to special events for Main Street intersection operations and light-rail travel time along Main Street are summarized in Appendix D of this report. The traffic analysis shows a poor level of service (LOS E) at the Main Street/Scott Street and Main Street/Church Street intersections and in particular the northbound approach to this intersection. The remaining intersections along Main Street are projected to operate at LOS C or better.

Field observations following a hockey event saw most of the congestion/delays experienced by motorists occurring within the parking facilities and accessing the street network at driveways. Once vehicles reach the street network they tend to experience some delay for the first few intersections and then traffic starts to disperse and intersection delays decrease as they move further away from the parking facilities. Similar observations following a theater event showed most of the delays occurring within parking lots.

The traffic analysis did not show significant delay to light-rail travel along Main Street. The Erie Canal Harbor northbound station is situated to allow for significant queuing at the Main Street/Exchange Street intersection and does not impact light-rail operations. The northbound station that indicates some potential delay for light-rail transit is the Church station due to its close proximity to the Eagle Street intersection. The Eagle Street intersection is a minor one and it is possible to incorporate some form of signal preemption as the northbound light-rail vehicle approaches the Church Street Station in order to clear the northbound queue at Eagle Street.

It is important to maintain a high quality of service for transit operations so that it is seen as a viable transportation alternative. Therefore, it is recommended that NFTA continue to use both the Event and Erie Canal Harbor stations and both tracks at each station for boarding passengers. This will require the segment of Main Street between Scott Street and Exchange Street to be closed to automobile traffic for a period of time immediately following an arena event. This period of time would be approximately 15-30 minutes following conclusion of the event. To enforce this roadway closure an additional police officer(s) would need to be stationed at the Main Street/Exchange Street intersection. The police officers at the Main Street intersections with Scott Street and Exchange Street could be supplemented with temporary cones or barricades to reinforce to automobile traffic that the roadway is closed.

3.6 LRRT Station Locations

The locations of LRRT stations along Main Street were driven by the traffic analysis, intersection safety and in some cases through the streetscape/urban design process as discussed in Section 7. The proposed station locations are based on the required queue lengths for the vehicular traffic at a particular intersection, the proposed parking along Main Street, the urban design within the block and space required for vehicles leading and trailing the LRV's, in order to remain clear of crosswalks and intersections. The station locations are discussed in detail in section 5.6 of this report. Station shifts that are proposed in order to minimize the potential for delays in trains pulling into stations include: The in-bound and outbound Church Street stations; the in-bound and out-bound Fountain Plaza stations; the in-bound Seneca Station.

The ability of a LRRT vehicle to travel from station-to-station with minimal delays is important to the reliability of this mode of transportation. A LRRT vehicle caught in a line of queued vehicles only a few feet short of the station is a frustrating occurrence for users of the LRRT system. It also results in additional delay for the vehicles following the LRRT vehicle once the LRRT vehicle reaches the station. Therefore, it is important to balance the needs of efficient transit operations versus the streetscape/urban design concepts for this corridor. The LRRT travel times for existing and future conditions and for special events are shown in Figures 9 and 10 in Appendix D of this report

3.7 Safety Recommendations

The re-introduction of automobiles and on-street parking into the Main Street corridor results in more interaction between cars, pedestrians and LRRT vehicles. The location of LRRT stations can be viewed as one safety issue. Other safety issues are discussed below:

- In general, right-turn pockets do not appear to be necessary for Main Street intersections. The corridor appears to function adequately without right-turn pockets as long as right-turn on red (RTOR) movements are allowed, without any adverse impact on the level of service. If the RTOR maneuvers are not allowed then the right-turn pocket/station location issue should both be revisited.
- In general, left-turn movements appear to function adequately without causing much additional delays. Restricting left turns at intersection during peak hours will also be studied further during the final design phase. These movements can be further evaluated once the system is opened and can be revised if a traffic operation problem arises.
- The Main Street intersections with Court and Church Street are quite large (i.e., significant travel distances to traverse the intersection for Main Street traffic) and this results in several potential problems. First, left-turn vehicles stop in the middle of the intersection to wait for their turn and this results in other stopped vehicles behind them being trapped in the intersection when the traffic signal turns red. Second, opposing left-turn vehicles (with queued vehicles behind them) can create a gridlock situation where neither left-turning vehicle can make the turn. Finally, if a left-turn vehicle is among the first few vehicles at the stop bar, this often results in only a couple of vehicles being served during a cycle. The high pedestrian volumes at these intersections reduces the capacity of these turn movements and further degrades traffic operations.
- A left-turn lane and left-turn arrow should be added at Main Street / Goodell Street for the northbound approach to the intersection. This is a

large intersection and it is difficult for the northbound left-turn drivers to judge opposing traffic.

- Closed Circuit Television cameras will be installed at major intersections to monitor the traffic conditions at these intersections. The system will be connected to the existing NITTEC system. The installation of these cameras will help in providing current traffic information and in an event of an accident the information could be relayed to the emergency crews as soon as it occurs.
- The unique conditions at the portal area and Scott Street intersection will be addressed by the installation of flashing signals, warning/guide signs and pavement markings. A flashing signal should be installed at the portal area where the vehicular traffic merges with LRV's. The gatearm would prevent the vehicular traffic to from moving forward when a train is exiting the portal. Traffic control barriers, signals and other safety measures, such as rumble strips would be installed to deter motorist from following LRV into the portal. These features will be studied further during the final design phase.
- Message display boards will be strategically located to inform the public of any accidents. The boards will help in redirecting vehicular traffic from an area of concern.
- Directing traffic away from lower Main Street for special events.

3.8 Summary

The evaluation of traffic and transit operations along Main Street was completed for existing and future year conditions. The future year traffic analysis includes automobiles on Main Street. The multi-modal characteristics (e.g., LRRT, autos, pedestrians) found along this street were analyzed using a micro-simulation program called VISSIM.

- The traffic analysis shows that the vehicular traffic and the train traffic can operate simultaneously with acceptable intersection level of service and without significant delays to the train operations. Turning movements will be evaluated further during the final design phase.
- New traffic signs will be installed along the Main Street corridor as required by the Federal MUTCD and the NYS MUTCD for vehicular as well as train traffic.
- The existing traffic signal system including the preemption system will be replaced with a new traffic signal system that will incorporate new software to interface with the LRRT system. The new traffic signal system will include new traffic signal heads and pedestrian traffic signal system with count down timers. The crosswalks at intersections will be made more visible using different surface materials.
- Additional traffic control measures will be installed along the portal area where the vehicular traffic will merge with the LRRT. The southbound lane between Tupper Street and the portal will have a signal with gatearm, to prevent vehicular traffic merging while the train is coming out of the portal. New left turn lanes for southbound traffic will be provided at

Tupper Street and a left turn lane for the northbound traffic at Goodell Street. The traffic control system at the Scott Street intersection will be reviewed with plans for Bass Pro and Erie Canal Harbor Development at the southern limits of the project as they become available.

SECTION 4 – TRACKBED, RAIL ELEMENTS AND PAVEMENT

In addition to the preliminary design of pavements outside of the trackbed, a number of issues related to the trackbed and rail system were identified in the Scope Summary Memorandum for consideration under this project. Issues to be evaluated include trackbed rehabilitation, modifications to rail flange, fixation of the rail, stray current isolation, train control system modifications, catenary pole protection or relocation and trackbed drainage. The primary focus of all improvements is what is required to accommodate the reintroduction of cars to share the trackbed with the LRV's. While the age and condition of the trackbed and rail components must be considered, anything that is not required to meet the objective of bringing cars back to Main Street can only be considered further if supported by funding. As such, each of the elements considered have been evaluated relative to scope and associated cost. In terms of trackbed rehabilitation, three options that were considered include full depth trackbed reconstruction, trackbed resurfacing and minimal trackbed repairs. Many of the rail system improvements could only be considered under the full depth trackbed reconstruction option due to their impact on the pavement structure. In order to fully explain the various work considered, the following paragraphs describe in detail work associated with pavement and rail system elements that were evaluated.

4.1 Existing Conditions

Background: As described earlier, since 1984, approximately 10 blocks of Main Street in the Buffalo Central Business District have been used as a transit-pedestrian mall. This 10-block segment between Scott Street and south of Tupper Street forms approximately 1.2 miles of street grade light rail transit operated by the Niagara Frontier Transportation Authority (NFTA). In addition to the transit vehicles, only delivery, emergency, and maintenance vehicles operate in this mall segment. Passenger car and other vehicular traffic cross the light rail transit tracks at several street intersections along the mall.

In this mall area, the two-track light rail route has six stations on each side. NFTA light rail vehicles are powered from an overhead catenary system supported on poles located generally 130 feet apart in the center of the trackbed. These two tracks are spaced 13 feet 6 inches apart from track centerline to track centerline. The track structure is 128 RE 7A girder groove rail embedded in the street pavement. Gauge rods connecting the rails are spaced approximately five feet apart. The rails are supported on a concrete slab, approximately 13 inches thick. Elastomeric bearing pads and epoxy grout leveling courses transfer rail loads to the slab.

Rail Condition: A visual inspection of the existing rail was performed. While only the railhead and flangeway guard are visible, these elements appear to be in good condition and are within standard specifications. Based on the observations that could be made and the discussions conducted with NFTA personnel, it is anticipated that the rail can continue to be used in the mall area. The continued use or reuse of the existing rail requires confirmation in subsequent design steps.

This type of track construction is typical of systems that were built in the 1980's. Toronto had a similar pavement maintenance problem with gauge rods with their streetcar system and developed a program in the 1990s to replace the gauge rod system with a direct fixation track system, similar to that described below. There has been a history of maintenance problems with the current embedded track design along the Main Street mall. Vibration, expansion and corrosion of the embedded gauge rods between the rails have caused breakage and cracking in the concrete pavement, creating an unsightly appearance and maintenance needs.

Possible approaches for addressing the above maintenance issues are described below.

4.2 Rail Components

The following considerations and improvements are relevant to the full depth trackbed reconstruction option and not to the other rehabilitation options considered:

As described above, an approach to providing a long-term solution for reducing pavement deterioration and its associated maintenance is to utilize a direct fixation track system. This direct fixation type of track structure is commonly used with in-street running light rail transit systems and uses direct fastening of the rail to an underlying support structure, such as a concrete slab.

A transit track system must be developed and designed with close consideration of the transit vehicle being used. Key factors include the wheel/rail interface, the wheel profile, the vehicle truck design, and the size of the flangeway required. These are considerations if a new rail section is to be used. (Flangeway is the opening along the head of the rail in which the wheel flange passes. The flangeway can be formed using girder groove rail, as currently used in Main Street, or by forming the opening in the embedment pavement.)

A common type of track structure used with in-street running light rail transit systems is direct fixation track. In this type of track, the rail is directly fastened to an underlying support structure, such as a concrete slab. There are various approaches to this design and many variables to consider. When adapting an existing system, there are additional unique factors to consider.

The following lists issues related to the track structure to be studied further:

- **Rail:** While, as described above, the existing rail appears to be in good condition, it is not known the condition that would result from construction needed to prepare for fixation. If new rail is to be used, the above design factors would need to be addressed. Girder groove rail is not manufactured in the United States, with girder groove rail used in LRRT systems generally being supplied from Europe. The 128 RE-7A girder groove rail is no longer manufactured. Should new rail be needed beyond that which NFTA currently has available, the rail selection is a very important element in the design.
- **Fasteners:** There are a variety of fasteners available. The fasteners generally use anchor bolts to attach the rail directly to an underlying support slab. The fastener to be utilized depends on the rail selected, the condition of the existing slab (below), and the approach to stray current control.

- **Support Slab:** From observations during maintenance work, NFTA reports the existing slab is in generally good condition. The actual design of the direct fixation system to be employed is a function of how much of the existing support slab can be reused.
- **Stray Current Control:** Stray current control is essential on light rail transit systems. Proper isolation of the track structure is needed. For the embedded track configuration in Main Street, a possible method of controlling the stray current is to employ an electrostatic "boot" that separates the rail from the surrounding concrete. In subsequent design steps, analysis is needed to determine whether the boot can accommodate the rather unorthodox existing rail section (if the existing track is to be used). A custom-shaped boot may be needed. Other approaches include isolating the entire track and slab structure or creating an isolated trough around the rail area.
- **Roadway Pavement:** Various pavements are used where light rail transit tracks are located in streets. The pavements are asphalt, poured-in-place Portland cement concrete, pre-cast concrete slabs, and decorative modular block. Often, the poured in place Portland cement concrete pavement section is used for in-street running light rail transit systems where relatively small strips of pavement exist outside of the track slab. Where the in-street section is wider, asphalt often provides an economic solution. However, frequently the over-riding factor in the pavement selection is that of urban design providing for an attractive appearance.
- **Drainage:** As with other types of track structure, surface track area drainage and drainage from the subsurface track support system are important for a direct fixation track installation.

At two locations along Main Street, at the HSBC tower and at the transition to the portal near Tupper Street, the track is constructed on a floating slab. In the past, repairs have been made as needed to the pavement near the rails. Broken concrete was removed and replaced by a fast-curing pavement mixture. Similar repairs have been under recent consideration.

Flangeway

Consideration has been given to the possible use of some type of flangeway filler as a safety measure if bicycles were to use the trackbed area. If available, the flangeway filler would need to be able to adequately resist the pressure of a bicycle tire, be sufficiently flexible to permit the rail vehicle wheel passage while staying in place, be able to withstand the general vehicular traffic, stay in place through the freezing and thawing cycles, and stay in place through snow removal operations. In contacting suppliers of products for the railroad and transit industries, no such flangeway filler material was identified that met all of the criteria. There is no known use of such a material by transit agencies in the United States for this type of application.

Further, bicycle tire contact with rail surfaces, especially when wet, at small skew angles, poses loss of friction problems for the bicyclist, which could also result in accidents. The flangeway opening can catch a narrow bicycle tire, resulting in steering and balancing problems for the bicyclist. In addition, conflicts result from the operation of transit vehicles, roadway traffic, and bicycles. Possible shared use by bicycles within the track area is a safety concern.

4.3 Pavement

Trackbed

The existing trackbed pavement was constructed as part of the track work installation project completed in 1983. The pavement generally consists of 5 ½ -inch concrete slabs supported by an underlying rubberized asphalt section of variable depth. The rubberized asphalt course bears directly on the concrete track slabs and select fill between the slabs. Other special pavement conditions which exist within the project corridor include continuous floating slab sections located at the HSBC tower and the portal approach, as well as a continuous track rail slabs at the Amtrak train tunnel and crossover slabs. The trackbed slab is supported by resilient pads, which bear on structural concrete decks in the floating slab and tunnel locations.

Overall, the slabs are showing signs of deterioration in the form of cracking, joint raveling and spalling. NFTA has performed maintenance over the years in the form of isolated slab replacements, joint sealant replacement and partial depth repairs. Rail vibration and poor subsurface drainage contribute to the deteriorated condition of the pavement. Surface repairs at crack joints and spalled areas are required to maintain the functional condition of the trackbed for vehicular use. Further investigation is necessary to determine actual remaining life based on the projected traffic.

Options considered for the trackbed pavement include full depth replacement of the concrete trackbed pavement; a 2" mill and resurfacing with epoxy resin bonded overlay; and minimal trackbed repairs to improve surface condition. A key component to the full depth and resurfacing options is the ability to work on at least one half of the trackbed at a time during normal daytime operating hours in order to minimize construction impacts on residences in various locations and overall construction costs. This would require NFTA to operate using a single track at a time. NFTA currently operates from 5:30 a.m. to 1:00 a.m. Monday through Friday and reduced hours on weekends. The current locations of the double crossover tracks that would have to be utilized for single-track operations are at the Erie Canal Harbor and Allen Street Stations. Utilizing these crossovers would more than double the operating time during peak hours. A crossover north of Church Street discussed under Section 4.4 would be required in order to maintain acceptable operating times during construction. The minimal trackbed repair work proposed would primarily consist of partial depth repairs that could be performed during reduced operating times on weekends and during nighttime shutdowns.

Direct fixation of the rail, which would directly benefit the proposed pavement structure by reducing the vibration and eliminating the need to provide a special joint to accommodate gauge rods, could only be addressed as part of the full depth pavement option. A 10-inch concrete pavement bearing directly on the rail support slabs would be the recommended pavement for the full depth option along with the installation of an underdrain system to maximize the life of the pavement.

Retaining the existing curb is necessary for the minimal trackbed option in order to prevent undermining of the trackbed slab adjacent to the curb. An underdrain system is recommended behind the curb line below the sidewalk in order to improve the subsurface conditions that presently contribute to the trackbed deterioration.

Non-Trackbed Pavements

Concrete and asphalt pavements were evaluated as pavement options in non-trackbed areas. While concrete may provide some aesthetic advantage, asphalt pavement is proposed for costs savings. A 10 inch, full depth asphalt concrete pavement section is proposed for the vehicular traffic lanes outside of the trackbed. The pavements include parking and bicycle lanes, the lanes around the portal and Eagle and Mohawk Streets. A surface mill and 2" overlay is proposed for the 700 block section from Tupper Street to Goodell Street as the pavement appears in good condition with the exception of isolated failures which require full depth repairs. Saw cutting of the existing curb between the trackbed and proposed parking areas is required for vehicular access. Underdrain is proposed for all new pavement areas. Patterned, full depth concrete pavement is proposed within the intersections from the edge of the trackbed to the work limits, inclusive of the crosswalks, to enhance visibility and durability.

4.4 Crossovers

A track crossover is a connection between two nearby and, normally parallel, tracks. This connection provides the means for trains to pass safely from one track to the other. A crossover provides operational flexibility: trains are able to operate in the reverse direction to the normal pattern for special purposes (such as performing maintenance functions). Crossovers are normally utilized at the ends of a rail transit line, to allow trains to perform a "turn-back" operation. Future crossover benefits include the maintenance of trackbed and pavement without any major interruption to the rail operations, though vehicular traffic impacts would have to be addressed.

There is currently only one existing crossover within the street running portion of the LRRT line. This crossover is located at the Erie Canal Harbor station and allows trains to reverse their direction or continue onto the NFTA rail yard. An additional crossover was originally planned as part of the LRRT system construction near Church Street; however, due to budget constraints the crossover was shelved. Certain infrastructure was installed including the base slab for the track, gapping of the catenary poles and the isolation switches.

NFTA has indicated that the installation of this originally planned crossover would provide additional operational capacity and flexibility. The crossover could facilitate single-track operations during the construction of this project and provide long-term benefits for NFTA during periods of high maintenance requirements. Decisions associated with phasing and cost are discussed further in Sections 9 and 10.

At various times, installation of the crossover at Church Street has been considered. It has been felt that having the crossover in place would aid greatly in conducting track and roadway maintenance and upgrading. An analysis conducted by NFTA in 1992-showed improvement in operating flexibility. Further, the analysis indicated cost savings after allowing for the construction cost of the

Church Street crossover. Also, the analysis projected further future savings in pavement and track repair costs.

The NFTA analysis conducted in 1992 projected the construction cost at $1,610,000, without construction management/administration costs. Subsequently, in 1997, NFTA projected a cost for the Church Street crossover of $2,600,000, plus $480,000 in costs for design and construction management/administration. Using Engineering News Record Cost Index information and other data, the probable construction cost estimate, in 2006 dollars, for the crossover would be approximately $3,500,000. This cost would include track materials, switches, track slab removal and replacement, subsurface drainage, fasteners, stray current provisions, catenary pole adjustments, train control and communication wiring, design, and construction management/administration.

Consideration for the Church Street crossover is evaluated as part of the overall project costs discussed in section 10.

The current Erie Canal Harbor crossover is located mid-block between Scott Street and Exchange Street. When this segment is reopened to traffic, the use of this crossover would be limited to times when the road is closed. Therefore, an additional crossover south of Scott Street is required to maintain LRRT operations. The actual position of the crossover will be evaluated further during the final design phase in coordination with other projects currently being planned for this area.

4.5 Overhead Catenary System

Overhead Catenary System (OCS) Pole Relocations

The existing OCS is supported by poles located in the center of the trackbed. The poles are up to 18-inches in diameter and are spaced between 130 and 150 feet apart. The poles are supported on 3'-6" diameter pier foundations, 14 to 21 feet deep, that extend to the trackbed surface with the anchor bolts projecting above the surface. The poles create a fixed object hazard in the center of the road for the proposed vehicular traffic as well as limit the useable width of the roadway. A study was performed comparing retaining the poles in the trackbed center versus removing the poles and installing new poles outside the trackbed.
The relocation of the catenary poles outside of the trackbed will provide travel lane widths of 11'- 9". If the poles are not relocated then the poles will have to be protected from the vehicular traffic. This would be done by providing a 3-foot wide median (6 inches high) between the catenary poles. The provision of this median would reduce the lane widths to 10'-3". Comparison of these alternatives is discussed further in Appendix H. There is a cost saving of approximately $2.5 million by retaining the poles; however, the safety concerns and aesthetics must be considered.

Given the overriding improvement in safety to the roadway and train boarding requirements, removing the poles from the trackbed is the preferred alternative. The poles would generally be in locations similar to the existing light poles in the sidewalks. Underground utilities and vaults will impact the final placement of the poles. The poles will serve a dual purpose as both catenary support and lighting.

Given the location of the poles, cross-span wires are proposed to support the existing contact and messenger wires in the trackbed, in lieu of bracket arms. The cross-span wires will connect directly to the poles to maximize accessibility for emergency responders by not having additional longitudinal wires outside of the trackbed. Aesthetics will not be adversely affected, as the number of poles down the corridor will actually be reduced by the removal of the center poles. The catenary poles will be designed to look consistent with lighting for the project area.

The supporting hardware consisting of isolation switched and anchor poles will also be required.

4.6 Utilities (Trackbed)

When the LRRT was installed in the 1980's, utilities were generally relocated outside of the trackbed. The relocations were performed to provide room for the train control and traction power duct banks and structures located between the rail support slabs as well as avoid future impact on rail operations to access utilities. The duct banks generally run the entire length of the LRRT surface section and consist of one 6-way, 4-inch concrete encased duct for rail system traction power elements and one 8-way, 4 inch concrete encased duct for train control and communication elements. The duct banks are connected throughout the surface section with 8' wide by 8' long by 6' deep manholes, which also serve as splice points for 2-way, 2-inch concrete encased duct banks which feed existing catenary poles along the rail system. The LRRT system ducts are used by a number of tenants, which include Time Warner Cable (formerly Adelphia Communications), AT&T and MCI Communications. Utility crossings as well as some abandoned sewer and waterlines are known to exist within the trackbed. Major utility crossings include a 48-inch and 20-inch diameter water transmission main south of the HSBC building as well as 36 inch diameter transmission mains at Court Street and Huron Street. Numerous smaller diameter water mains cross at various intervals throughout the project corridor. Additionally, Electrical, Sewer and Telephone facilities cross at various locations within the project limits. No utilities will be installed within the trackbed under this project with the exception of additional conduits as needed for train operations.

4.7 Drainage

The existing drainage along Main Street is provided by a closed drainage system. Trench drains are located within the curbed section of the trackbed and run perpendicular to the tracks at regular intervals. These trench drains were installed as part of the trackbed construction in the 1980's and have been upgraded/retrofitted as part of the maintenance program. Trench drains along the trackbed are connected to catch basins along the sidewalks. These catch basins carry the stormwater to the main combined sewer trunk lines. There are various outfalls located along Main Street for the combined system.

As part of the project, rehabilitation or replacement of the trench drains and installation of new underdrain is proposed subject to the trackbed rehabilitation approach. Additional drainage inlets will be placed based within the trackbed as needed. Overall, the drainage patterns along the Main Street corridor will not change, as the roadway/trackbed profile will be retained.

4.8 Train Control

Within the street running portion of the LRRT service, the train control consists of the following apparatuses:

1. Inductive Loop (AVI also located at Scott St.)
2. Station Start Light
3. Traffic Intersection Controller (TPS System)
4. Alstom's Datatran (Train Location Indications)
5. Onboard Transponder activated through operator push
6. Train Control Signal/Track Circuit/Power Switch (Erie Canal Only)
7. Supporting Hardware (Control Cases, Power, Cabling)

On the street portion of the system, the on-board or Car borne portion of the Train Control System is switched to the off position by the operator selecting the street running mode on the control console of the LRV. The operator is then restricted by operating rules to 15 MPH Maximum Authorized Speed (MAS) until 8 PM at which time the operator can run at 20 MPH MAS. The system safety is within the hands of the highly skilled control of the LRRT operators. The carborne "Over-speed" protection while in the surface mode is set to trip at 28 MPH.

In this type of operation, the train operator becomes the critical portion of the Train Control system in two ways. When operators receive an indication via the "Ready to Depart" light, to leave the station, they push a button on the control console of the LRV, which in return transmits a frequency signal into an inductive loop that is located within the concrete portion of the track bed near the mini-high portion of the station. The loop receives this transmission and determines the validity of the request, at which point a closed contact is made within the Train Control cabinet located at the stations which completes a circuit that is transmitted from the intersection controller located at the cross street. When the signal is received, two things occur: First the system returns an acknowledgement that the signal has been received by the traffic controller and illuminates a starter light located just in advance of the mini-high portion of the station. This acknowledgement tells the operator that the traffic controller has received the request and that they can proceed toward the intersection. In addition, the traffic controller acts upon the request in several ways. The controller determines at what point the controller is in, in the normal timing sequence and depending upon those conditions initiates a request to change the traffic light signals to allow the LRV to proceed through the intersection unobstructed.

The second critical area is at the Erie Canal Harbor Station where the operator is the completion part of the routing selection process. Depending upon which platform is currently occupied at the Erie Canal Harbor Station, the operator may need to change tracks and enter into the Erie Canal Harbor Station platform on the outbound side. For this to occur several things need to occur, one the vital train detection circuits must make the determination that it is safe to throw the power switch machine from the normal (straight track operation) to the reverse side (crossover rail operation). With these circuits satisfied the LRV dispatcher back at the Operations Control Center makes a request for the switch to operate to the reverse position. No action occurs until the operator selects the switch to also go to the reverse position on the LRV control console, at which time an agreement or a hand-shake occurs between the wayside portion of the Train Control System and the OCC the system then moves the switch points to the reverse position and a wayside authorizing movement into the station displays a proceed aspect.

The OCC monitors the street running operation remotely based upon a station check-in, check out system that is a subset of the train starter signals. The dispatcher cannot determine the exact location of the LRV but rather can only determine the last station that the LRV was at and waits until an arrival at the next station is sent. Should no signal be sent from the next station the OCC will continue to display the location of the LRV at the last known station. Should the dispatcher wish to hold an LRV at a particular station location either in response to an emergency or to re-establish a correct headway, the dispatcher must contact the LRV operator over the LRRT dedicated radio frequency.

The intersection traffic controller that receives the LRT station request and determines the signal sequence is the original equipment that was installed in the early 1980's. The system is well beyond its useful life to the point that when parts are needed they are obtained from a spare parts supply that the LRRT staff has accumulated from NYSDOT when they retire or renew traffic controllers statewide.

The traffic controller logic was designed by an independent contractor who assembled the parts and performed the programming required for the LRT traffic preemption logic. This contractor is no longer available and the supporting logic documentation is obsolete. Replacement of the controller is necessary to maintain the existing system as well as to interface with the proposed traffic signal system discussed under Section 3.

Train Control (CTC Communication)

This subsystem of the Train Control system provides the communication device between the wayside TC system and the OCC. The system is responsible for transmitting non-vital controls and indications required by the Train Control System. This subsystem is based upon General Railway Signal (GRS) (Now Alstom) Datatran (8) communication system. This subsystem is obsolete and only minimal support for replacement and/or repair can be obtained from Alstom.

External Communications

From conversations with NFTA staff, it was noted that HSBC has installed underneath the LRRT track infrastructure an essential Fiber Optic cable separate from the NFTA duct system. Interruption and/or damage to this cable could result in severe legal penalties to NFTA. Work in and around the HSBC area will need to be closely monitored and staged with NFTA and HSBC staff to assure protection of this cable during the construction phase of this project.

There are fiber optic cables for 6 outside utilities running through the LRRT Cable infrastructure conduit duct banks within the street running section. Below are the current names of these six organizations. Prior to beginning design, each organization should be contacted. Currently, these six organizations are:

University of Buffalo
AT & T
Time Warner Cable (formerly Adelphia Communications)
Metropolitan Fiber Systems
QWEST Communications
MCI

These leased lines (conduits) will need to be treated in the same manner as the LRRT communication systems. Fiber Optic Cables as well as communications and train control cables loop in and out of each "Green Cabinet" (discussed in Section 5), and associated with each surface station will have to be relocated prior to their removal or relocation to maintain service.

4.9 Summary

A primary consideration in determining the extent of improvements related to the trackbed and rail is cost. The trackbed can be utilized by car traffic for the next 5 to 10 years with limited work being performed on the pavement. Ultimately reconstruction of the trackbed, including installation of subsurface drainage, will be required. Due to the cost limitations as discussed in Section 10, the following improvements are proposed:

- Minimal trackbed pavement repairs.
- Rehabilitation of existing trench drains.
- Removal of catenary poles within the trackbed and installation of new catenary poles in the sidewalks to support the OCS with cross-span wires.
- Relocation of OCS switch housing.
- Cable relocations associated with station shifts.
- Replacement of traffic signal controllers and software to interface with the Train Control System.

SECTION 5 – STATION REHABILITATION AND LOCATION

There are 6 sets of stations, in-bound (west side) and out-bound (east side), on the surface section of the LRRT system. The stations are identified as Erie Canal Harbor Station, Seneca Street Station, Church Street Station, Lafayette Square Station, Fountain Plaza Station and Theatre District Station. The stations are generally located on every other block with the exception of the Fountain Plaza and Theatre Stations, which are located on adjacent blocks. The goals of the preliminary station design effort are to develop station design concepts that do not dominate the landscape or architecture, while providing for weather protection as well as maintaining accessibility to the LRRT system. Evaluation of the existing station locations and strategic placement of the redesigned stations is a significant component of the preliminary design effort. Exhibits, which relate to the text for this Section, are included in Appendix B of this report.

5.1 Architecture

A number of concerns have been identified over the condition of the existing stations. The size of the stations has been identified as a concern as they tend to block exposure of the existing buildings. The existing stations range in length from 60 feet for the Church Street Station, to over 170 feet for the Fountain Plaza Station. The existing Erie Canal Harbor Stations are over 240 feet in length, which include dual platforms required for the current LRRT switchover operations. The existing station area includes platforms, ramps and covered areas within the train boarding area. The existing station structures are dark, non-transparent and create hidden spaces. Pealing paint and corrosion are some of the maintenance problems that exist on the structures.

The proposed station design concepts will incorporate strategies, which will create a greater sense of transparency including clear glass wall panels and translucent roof panels. The architectural theme is one of compact transparency. The streetscape behind and beyond each station will be more visible than currently accommodated by the existing stations. Storefront visibility along Main Street is of primary importance encouraging public interface and reducing blind corners, which currently exist along the transit corridor. The construction of stations, which do not compete with the existing architectural vocabulary on Main Street, is an additional programmatic requirement. Use of stainless steel materials where possible will help in reducing the overall maintenance of the structures. Improved lighting within the station areas will enhance security.

A uniform station length is proposed in order to standardize components, facilitate maintenance and future rehabilitation of the structures while minimizing their size. A station area length of approximately 42 feet is proposed for each station, which is approximately 2/3 of the length of the Church Street station and is similar in size to the Events Station located south of the Erie Canal Harbor Station. The depth of the station area is approximately 14 feet, which will allow for a sidewalk width of over 20 feet between the stations and building fronts.

5.2 Boarding Area

The boarding areas within each station are separated into two waiting areas. The elevated platform at approximately 30" above the sidewalk grade level and 36" above the rail is intended for passengers with accessibility requirements or those with limitations which will not permit at grade boarding via the foldout train steps. Accessible by a ramp with a 1:12 slope and a stairway, the elevated platform is designed to accommodate 2 wheel chairs and 3 ambulatory passengers. The grade level boarding area is sized to accommodate approximately 20 ambulatory passengers at 7 sf per person within the sheltered enclosure. Benches are provided for both boarding areas with the ticket machines accessible in the at-grade boarding area. Proper lighting of the boarding areas will enhance security as well as improve the overall look of the stations.

In addition to the sheltered boarding area, non-sheltered boarding areas will be provided as part of the streetscape design. These areas are discussed in Section 7 of this report.

5.3 Weather Protection

Each station is protected to the fullest extent possible to create a shelter, which will provide protection during inclement weather. Shelter overhangs on all sides provide additional protection for station occupants. The selection of a roofing panel which is translucent and which does not telegraph surface debris accumulated between periods of regular maintenance would be an optimal material choice. Either tinted glazing or prefabricated translucent panels would meet this objective. The selection of stainless steel for structural components is a logical choice for a highly durable and attractive finish. Transparent wall panels with minimized openings of 5 feet will provide wind protection, which is a concern within the project corridor. The wall panels in the ground level area would be setback from the curb a minimum of 4 feet to allow for maneuverability of transit users.

5.4 Accessibility

Currently, train accessibility is provided for those in need of assistance via ramps to the raised platform areas, which extend to the door opening. The existing platforms overhang the curb line by approximately 6-inches. The timber boards which are mounted to the face of the platforms to fill the gap between the platforms and train doors have been dislodged numerous times by emergency and delivery type vehicles that drive along the trackbed. As described under Section 2, there is a need to create a 2-foot clear zone adjacent to the curb line to prevent future incurrences. Several considerations were evaluated to accomplish this, which include elimination of raised platforms through train mounted or wayside lifts, as well as setting back the raised platform and installing train mounted or platform mounted bridge plates. Shifting of the curb line was also evaluated which would require modifications to the foldout train steps. The high cost of the train step modifications, over $12 million, along with implementation, maintenance and operational concerns eliminated this option from further consideration. Train mounted lifts at a cost of almost $6 million for the LRRT fleet, implementation time constraints relative to the current mid-life project for the LRV's and operational impacts that would likely increase station dwell times anywhere from 2 to 6 minutes depending on the user's abilities, when lifts are required were key considerations for eliminating the train mounted lift option by the Technical and Advisory Committees. Wayside lifts pose significant operational and maintenance concerns as other systems which have wayside lifts have experienced dwell times up to 8 minutes, breakdowns due to weather exposure and require the train operator's assistance. Therefore, wayside lifts were eliminated from further consideration.

The preferred option selected by the Technical and Advisory Committees is to continue to use raised platforms accessed by a sloped ramp with the platform setback 2 feet from the curb. The two remaining considerations relative to using the raised platforms are whether to use train mounted or platform mounted bridge plates. While train mounted bridge plates have benefits of weather protection allowing for flexibility in aligning with the platform, the primary concerns are the $2 million to $3 million price tag to retrofit the fleet, implementation constraints with the train mid-life rebuild project and operational concerns should there be a mechanical failure with the plate extended as the train would be shutdown until the problem is corrected. As such, the Technical and Advisory Committees prefer the implementation of a folddown type, platform mounted bridge plate. The folddown plate option would be incorporated into each phase of construction unlike the train-mounted option, which would have to be completed prior to the completion of the initial construction phase.

The fold down plate would create a physical barrier at the edge of the platform to protect the edge. The fold down option will facilitate a manual override operation in the event of mechanical failure to mitigate impacts on rail service, as exposure to the weather creates an operational concern for platform-mounted plates. The plate design will include an edge barrier at least 2-inches high to prevent mobility aids from slipping off the edge, interface with the train control system for automated use to minimize operational impacts, a slip resistance surface, and visual and/or sound delineation to alert the public of its operation. A minimum length of 8 feet for the bridge plate was specified by NFTA in order for the train operators to properly align the door with the plate. The cost for implementation for all of the bridge plates is estimated at approximately $1.0 million in 2006 dollars.

The raised platforms are generally designed for persons in need of assistance to board the train at a level plane (such as handicapped persons, elderly people or people with strollers). The ground level station boarding areas will be provided for those able to use the train steps. The train stations will be designed to provide improved weather protection to all train users.

5.5 Equipment and Furnishings

Benches incorporated into the boarding areas must be low maintenance and durable similar in material to those chosen for the shelter. Ticket machines provided either at the stations or another location must be accessible and sheltered for user facility. Additional components for each station include station location maps, message boards and signage. As themes for the design of landscaping and other urban design elements including lighting continue to develop, the equipment and furnishings should reflect these themes incorporating them into a comprehensive environment. Further incorporation of large-scale elements like the panel boxes is of primary importance and can be addressed when the ability to downsize or relocate them has been further determined in the design process. Provisions will be made for keeping the ramp areas free of snow and ice during the winter weather through heating elements in the ramps.

5.6 Station Locations

Existing station platforms and shelters are located approximately 1000 feet apart on average with the exception of the Fountain Plaza and Theatre District Stations, which are approximately 800 feet apart. The Erie Canal Harbor Station has dual platforms in each direction to accommodate the current staging operations employed by the LRRT system as it functions as the start and end station for the system. The Events Station is located just south of Scott Street and is used only for Arena events and not during normal system operations.

Generally, the intent of the design is to maintain stations within the general vicinity of their current locations in order to minimize disruption to current LRRT system operations and maintain convenience for the transit users. Other factors that influence the decision for station placement include vehicular traffic interfaces, lane transitions and required operational changes.

- The Erie Canal Harbor Station is currently able to function as the start and end station for both the in-bound (west) and out-bound (east) tracks by utilizing the double crossover north of the station and the train control system. However, post construction operations will not be able to continue in this manner once vehicular traffic is sharing the trackbed. Therefore, there is no longer the need to maintain dual platforms on each, allowing single platform and shelters to be placed on each side. The proposed location for the Erie Canal Harbor Station platforms would align with the existing platforms at the far end of each approach. Coordination with the Bass Pro project may ultimately effect the final location of the station platforms in this block. Shifting of the Events Station will have to be coordinated with the proposed development projects at the lower end of Main Street, and will require further evaluation during the final design phase.

- Slight shifts of the Seneca Street Station platforms are proposed to allow for the addition of parking on each end of the block as well as to provide the recommended vehicle storage lengths identified by the traffic model. The resulting shifts away from the Seneca and Swan Street intersections are approximately 35 feet for both the in-bound and out-bound platforms respectively.

- Parking and vehicle storage lengths are key reasons for the approximate 100-foot shift to the north for the in-bound Church Street station platform. The out-bound station platform requires a shift to the south of just over 10 feet in order to accommodate the proposed Eagle Street connection.

- The in-bound Lafayette Square Station platform will remain in approximately the same location as currently exists, while the out-bound station platform is proposed to shift approximately 40 feet to the south to accommodate parking.

  The Theatre District and Fountain Plaza stations were evaluated collectively due to the closer proximity of the two stations than any other stations on the surface section of the LRRT system. Generally, the surface stations are located on every other block except for the Fountain Plaza and Theatre Stations, which are on consecutive blocks. The out-bound Theatre Station is within 700 feet of the Chippewa Street intersection. In order to accommodate the necessary travel lane transitions around the portal along with associated delineation and warning measures, the distance between the station and Chippewa Street would be reduced by approximately one half. The existing out-bound Fountain Plaza Station is located just south of the Chippewa Street intersection. Input was sought from property owners in both the Theatre District block as well as the 700 block on placement of the Theatre District Stations. The general consensus from stakeholders and the Advisory Committee was:

  - The resulting close proximity of the Theatre and Fountain Plaza Stations minimizes any benefit for having both stations.
  - Drop-off zones are important in vicinity of the theatres for patron access.
  - Stations in the Theatre block severely limit parking.
  - Shifting the Theatre Stations to south end of Theatre block would negatively impact residential and hotel properties due to noise concerns.

  Based on the above issues and concerns, the consensus is to combine the Theatre and Fountain Plaza Stations and locate them in the Fountain Plaza block similar to the current Fountain Plaza Station locations. The recommendation to place them in the Fountain Plaza block is supported by the larger daily LRRT system ridership in the Fountain Plaza block than the Theatre District block. Additionally, the proposed locations of the Fountain/Theatre Station platforms are strategically placed to attempt to balance the open views of Fountain Plaza as an important public space while accommodating parking at the north end of the block. A shift of approximately 50 feet to the south is proposed for the in-bound station, which will address vehicle storage requirements identified in the traffic modeling analysis. A 25-foot shift to the south is proposed for the out-bound station platform in order to provide adequate vehicle storage length while keeping the platform close to the Theatre District.

5.7 Communications, Power and Monitoring

The communication system of the LRRT is the backbone of the operation. The system supports Closed Circuit Television Vision (CCTV), PACE Emergency Communication at station platforms, Public Announcement (PA) system, and

Automatic Fare Collection (AFC), NFTA Police, Maintenance and LRRT Radio frequencies. In addition to these systems, the Power/Catenary remote Supervisory Control and Data Acquisition (SCADA) system and the Train Control System both in the tunnel and for the street running operation are supported by the LRRT communication system. At the core of this system is a 48-Fiber Optic cable, which provides the vehicles for all of these systems to successfully communicate between the field operations and the Operation Control Center (OCC).

The system has two distinct parts that are based upon varying technology. The fiber optic cable provides the "express" portion of the system, while a 50 pair communications cable picks up and supports the wayside functions at particular locations. This type of system architecture is common and reduces the amount of splices and possible level losses along the wayside system. At specific locations, the fiber optic cable is terminated and the 50 pair communication cable breaks out or provides input into the Fiber optic cable. The combination of the fiber and the traditional copper communication cable provide the cable infrastructure for the entire communication system.

CCTV

Unlike the train control, some portions of the communication system have been upgraded. In particular, the CCTV portion of the system is state of the art and provides excellent quality video resolution along with a new control and monitoring system back at the OCC. The system was installed in 2002 and with the exception of several problems with the overall Digital Light Projection (DLP), display the system has been extremely reliable. The cameras are PELCO an excellent manufacturer of security cameras and should provide the LRRT years of successful operation.

The CCTV does however use up quite a few of the fibers within the fiber optic cable as each station along the line has a dedicated fiber that provides the digital based signal from the cameras mounted on the mini-high portion of the station back to the control and monitoring station. The system is manned and operated by the NFTA Police force dedicated to the LRRT operations, who work closely with other law enforcement agencies, fire departments, and the LRRT Power and Train Dispatchers. The officer that monitors the camera system reported that the current system meets their needs exceptionally well. The system has built in intelligence to the point where if a passenger at a station pushed the emergency control phone at the station the camera for that particular station is immediately displayed and the emergency phone is connected to a phone located right on the officers console. He can then from the same console determine a method in which to react and at the officers finger tips has connection ability to any of the emergency response teams or organizations that could/would be required.

Public Announcement

The PA portion of the system is a traditional system found on many properties in the late 1970's and early 1980's. The system has performed and been maintained extremely well but has also reached the end of its useful life. The Aztec-Lansing system is a fairly simple system, which allows the dispatcher

within the OCC to broadcast system wide announcements or target an individual station. The systems at the station consists of a local power supply, the field end of the Aztec Lansing communication package and two PA type speakers mounted under the roof of the mini-high platforms in the surface stations.
Passenger Assistance Communication Equipment (PACE)

At each mini-high platform along the street running portion of the system a device allows passengers to either select information or call NFTA police in an emergency. Back at the OCC the system is interfaced into the CCTV system, which when activated a dedicated Video Display Unit (VDU) on the NFTA Police surveillance system pops up showing the location from where the call is being initiated. The system consists of a basic speaker/phone device with the built in functionality described above. This system will need to be replaced or relocated depending upon the project phasing selected in accordance with the new station location and mini-high platform.

Passenger Information Displays (PIDS)

The PIDS are relatively new, installed during the late 1990's and possess the capabilities of most modern day digital displays. The signs were manufacturer by Daktronics one of the premiere manufacturer of addressable LED text message signs. The signs can be addressed from NFTA's OCC when necessary, however under normal conditions the signs re-play a pre-determined message usually relating to the station and passenger security. Given the age and capabilities of this system it should be maintained under this project and re-located along with the station.

Automatic Fare Collection (AFC)

The AFC has been renewed since the original operations of the line. The system is based upon current technology with video display units (VDU) that perform the interface between the patrons and the system. A money collection system intakes the funds and places them within a secure box within the AFC housing. The system is sophisticated enough to perform remote reporting to the LRRT staff at the NFTA yard and shop facilities. The money or funds are collected by LRRT staff (Police and Communications) on a daily or as needed basis. Newer AFC equipment is also starting to make its way to the LRRT stations, which offer patrons additional ways to pay (debit/credit cards) as well a more user-friendly VDU display. Each station has multiple AFC interface units more than supporting the need of the patrons at times along the street running service.

Wayside Radio

The wayside radio portion of the system consists of three talk-groups and has been recently upgraded to add the Buffalo Fire Department. This system is an 800 Mhz "trunked" system and is based upon Ericsson equipment. The LRRT surface radio system is supported by three Microwave Sites at:

- HSBC Tower
- Boston
- Lancaster

This core system provides excellent service with a coverage rate of approximately 95% system wide. Wayside Radio equipment does not exist along the wayside in the street running portion of the system, so from a station standpoint will not require re-location or modification.

The tunnel portion of the radio system is support by bi-directional amplifiers at each station along with Omni - Antenna's mounted on each roof. Through the tunnel portion, a slotted Radiax (leaky) cable runs the entire way.

Supervisory Control And Data Acquisition (SCADA)

Along the street running area of the system, only certain areas contain SCADA equipment. The SCADA system provides the OCC Dispatchers the ability to control and monitor the conditions of the Catenary Traction Power System. Monitoring and control of the system is accomplished by the SCADA system. Dispatchers wishing to isolate or turn off portions of the traction power system can perform this task back at the OCC. The office system was provided by QEI Electronics, which has been involved in the electric traction power field for many years. The current wayside systems that support the LRRT operation today are nearing the end of its useful life and will require replacement in the near future.

The system AC & DC circuit breakers and isolations switches that can remove or return power to the traction power system. Through the use of Remote Terminal Units (RTU) located in several locations along the LRRT, system messages are transmitted and received from the OCC.

The communication system has been updated in some areas and these subsystems should be retained and relocated where possible, this includes:

1. CCTV
2. PIDS
3. AFC
4. PACE

Other portions of the communications system will need to be renewed or installed new to bring the technology up-to-date. These subsystems are:

1. PA
2. Emergency Call Box Phones
3. Wayside Phone
4. Conduit Duct Bank and Communications Cabling

Factors affecting potential modifications or replacement of system components include:

- Proximity of equipment with relationship to station location.
- Age and condition of the existing system.
- The need for improved technology

Power and communications are routed through control panels at each of the stations. The existing “Green Cabinets” are large and create a visual barrier. It is anticipated that the panels can be reduced in size by at least one third and incorporated into the station structures. The “Green Cabinet” in the vicinity existing out-bound Theatre Station houses the interphase to the tunnel ATC and will have to be relocated to outside of pavement areas with the proposed consolidation of the Fountain Plaza and Theatre Stations.

5.8 Summary

The proposed concept design for the stations call for a significant reduction in size from the existing stations, at 2/3 the size of the smallest station, and about ¼ of the size of the existing Fountain Plaza Station. A station area approximately 14 feet by 42 feet, including a raised platform is proposed throughout. Transparent, translucent, stainless steel are the types of materials that will be incorporated. The platforms will be setback 2 feet from the curb line to meet the clear zone requirements. Automated, platform mounted bridge plates; 8 feet in length are proposed to bridge the gap. Consolidation of the Theatre District and Fountain Plaza Stations are proposed in order to accommodate a safe and viable design for the 600-block segment, which has to contend with the train portal interface. Incorporation of the power and communication control panels into the station structures will further reduce the visual impact of the stations on the environment. Relocation of the CCTV, PACE, PIDS and AFC system components is planned for the new stations. Replacement of the PA system, emergency phones and a wayside phone is required due to their age and condition. Relocation of communication lines through the new control panels would require close coordination with the cable owners.

SECTION 6 – ACCESSIBILITY/ADA COMPLIANCE

Maintaining accessibility for transit riders as well as insure accessibility for all throughout the project corridor is an important objective for the project. Compliance with all applicable code requirements set forth by ADA, ANSI, NYS and FTA must be achieved. Specific elements of the preliminary design effort are discussed below.

6.1 Sidewalks

The generally wide nature of the sidewalks throughout the project corridor will insure adequate maneuverability space. The streetscape components will be placed in a manner to maintain and enhance accessibility. Discussion of the design of these elements is included under Section 7. The sidewalk cross-slopes will be designed to comply with the ADA requirements. Specific grading will be developed as part of the final design effort.

6.2 Crosswalks

Accessible ramps (1 on 12 or flatter) will be provided at each intersection crosswalk. All ramps will include detectable warning fields. The width of the ramps will be sufficient to meet current ADA requirements. Wide, enhanced crosswalks, 16 feet with a 2-foot border on each side, are being proposed as part of the overall streetscape design.

Options being considered for reducing the excessive crosswalk lengths at the Church Street/Division Street and Goodell Street intersections are being discussed under Section 7. All proposed changes to these intersections are subject to the approval by NYSDOT.

6.3 Station Areas

The train accessibility requirement is currently met at the stations. Raised platforms with accessible ramps are provided at all stations for access to the first car of each train. The proposed stations will retain the raised platform and ramp features, as discussed under Section 5, in order to accommodate persons requiring assistance. Automated, station mounted bridge plates are proposed to fill the gap between the station platform and accessible train door. Warning surfaces will be provided at the station boarding areas behind the curb and at the edge of the raised platform for ADA compliance.

6.4 Parking

Designation accessible parking spaces will be evaluated for incorporation at various locations throughout the project area. The spaces will be located with consideration of the public spaces and various land uses.

6.5 Summary

All elements of the project design will be developed to comply with all current regulations for accessibility for persons with disabilities.

SECTION 7 – SIDEWALKS, STREETSCAPE AND URBAN DESIGN

Main Street is a major civic corridor through the heart of downtown Buffalo. The present form of downtown echoes the importance of the street as the early development of the city was largely born at the foot of Main Street in the present Erie Canal Harbor District. Major commercial, retail, and entertainment facilities developed along Main Street as downtown grew in a relatively linear fashion. As a result Main Street today functions as a connective thread that integrates downtown districts and venues and conveys much of the identity of the downtown area.

The redesign of Main Street offers the opportunity for the street to contribute positively to the image of Buffalo by improving the quality of the streetscape. The re-introduction of vehicular traffic will add vibrancy to the street with greater visibility and increased access to businesses and at the same time the physical design of the streetscape will express the significance of the street as a civic space. There is a great opportunity to create a leafy corridor with high quality furnishings that becomes a major public amenity to the growing downtown residential population, the existing downtown office workers, and visitors alike who will be encouraged to linger longer and explore further.

This section outlines the parameters by which the streetscape component of the project will be designed.

7.1 Existing Conditions

The existing character of Main Street is defined by wide sidewalks, limited landscape elements, variable pavement conditions, and extensive architectural treatment of the streetscape. Visually the street is interrupted by structures that were intended to be lively additions to downtown that unfortunately are now dated and maintenance intensive. Paving is problematic as unit pavers were set on an inadequate base material causing differential settlement. Overall concrete slabs are sound however cracking and heaving has occurred in areas characterized by different sub-grade conditions. In many places planting is restricted to raised planters that are too small to support mature trees and do not offer pedestrians a place to sit. Seating options include small benches placed in variable locations adjacent to planters and beneath transit shelters. Streetscape elements such as lighting and trash receptacles are painted green, which if combined with the red painted asphalt draw attention to these features. The broad sidewalks offer the opportunity for street programs to occur such as the Country Market. Areas that are used for outdoor seating for restaurants help liven the street in summer months.

7.2 Districts and Street Typologies

At the onset of the project, the Design Team and Client Group identified four districts within the Main Street Corridor that describe the streetscape character and existing land uses today. These were:

District	*Boundaries*
Entertainment District	*Goodell to Chippewa*
Retail / Office District	*Chippewa to Church*
Traditional Office District	*Church to Exchange*
Erie Canal Harbor District	*Exchange to Scott*

Recognizing that changes in land use patterns will occur within the Main Street Corridor in the future, the Design Team identified four Street Typologies as a framework for design decisions. The four typologies are:

Typology	*Typical location*
Station Areas	253 feet length of a station zone
Parking Areas	On street parking, loading and drop off areas
Intersections	Intersections including pedestrian crossing features and required sight lines
Unique Spatial Conditions	View corridors and open space (contributing); portal and overhead structures (challenges)

(See Appendix C, Exhibit 1)

Each typology is further defined and expressed through criteria that:

- Address pedestrian and vehicular safety
- Maximize on-street parking
- Create memorable streetscapes
- Address existing district character while planning for the future

7.2.1 Station Areas

Within the 11 block long Main Street project area there are a total of six stations representing the at grade portion of the LRRT System, the special events station is located south of Scott Street which is used during events at the HSBC Arena. One station, the Theater District Station, has been consolidated with the Fountain Plaza station. The remaining stations are located in the approximate location of the existing stations and therefore occur at an interval of nearly one every other block. Station locations are discussed in Sections 3 and 5 of this report.

The existing station boarding areas are delineated by a wider (21") curb that is 6-inches high to properly interface with the train steps. A narrower, lower (4" high) curb exists in all other areas. The higher curb will be retained in all proposed station areas. The length of the station boarding area is determined by the maximum number of LRV's that may be used at any one time. A total of four cars has been established and a minimum length of 253' for the station platform, inclusive of the station shelter.

The width of each station area from the face of building to the curb is 37'-9" and is comprised of three zones. From the curb, the first six feet is required clearance that both accommodate station patrons and snow clearing machinery. The next area, at a minimum of 16'-9", is the station planting zone that accommodates large planters with seating. These planters create a distinctive Main Street environment that is comfortable and green. These areas serve not only light rail patrons but also provides a respite for visitors, residents, and workers in the downtown area. The final width established at each station area is the remaining distance from the edge of the planting zone to the building face, typically fifteen feet. Fifteen feet provides ample pedestrian circulation and the opportunity for outdoor seating associated with a restaurant or café. Without seating, the width of these areas may be reduced to twelve feet. (See Appendix C, Exhibit 2 and 3)

Design goals for the station areas are two-fold and include:
- Pedestrian safety boarding, disembarking, and waiting for the trains
- An aesthetically pleasing environment that provides comfortable shaded seating within a distinctive setting on Main Street

The following criteria is recommended for pedestrian safety:
- A minimum offset from the vehicular travel lane of eight feet to any permanent obstruction is suggested. This provides the ability of the station patron to step back an adequate distance from moving traffic while waiting for the train. This area should be kept free of all obstructions to allow the station patron to view an approaching train without stepping forward onto the curb. This is especially important with the use of the light rail system by children and students.
- An unobstructed view for the pedestrian of any potential hazard including moving vehicles or a suspicious person is suggested. The unobstructed view should be maintained between the heights of 3 and 8 feet from the surface of the sidewalk. Minor obstructions such as tree trunks and signposts are acceptable as well as any required element of the light rail station such as ticket vending machines. This view shed also provides visibility of pedestrians from the vantage of automobiles on Main Street which increases their awareness of the proximity of pedestrians to the roadway curb.

The client group has requested the design team to explore the option of constructing a traversable (mountable) curb in the station boarding area in order to allow for additional parking. The idea was initially proposed as a compromise to the decision by NFTA to retain the ability to operate with four car trains during special events such as hockey games. Subsequently, the advisory committee requested that the concept be implemented throughout the station-boarding zone for the 2nd, 3rd and 4th train cars. NFTA currently operates with 2 car trains at all times and with 3 car trains during peak operating hours on a daily basis.

At the direction of the City of Buffalo, traversable curb type parking is proposed only along the 3rd and 4th rail car zone and will not be considered for the 2nd car zone. The parking in the 3rd car zone will be effective only during the non-peak hours when only 2 rail cars are being used by NFTA. Similarly, the 4th car zone would be used for parking daily, except for when NFTA operates with 4 rail cars, which is during special events at the HSBC area. Proper signs would be posted with the imposed restrictions for parking along in the 3rd and the 4th rail car zones.

Implementation of the traversable curb concept for parking within the station boarding zones presents a number of challenges related to safety for LRRT passengers, pedestrians and motorists. Additional study is required to determine how these challenges can be adequately addressed. Safety and operational concerns include:

- Interaction between motorists and passengers in waiting areas as passengers tend to wait close to the curb.
- Establishing adequate clear zones between parking areas and LRV's to provide passenger access and prevent view obstructions.

- Balancing of the clear zone with vehicle maneuvering for parallel parking. Too great an offset from the trackbed to parking spots will encourage motorists to perform parking maneuvers entirely within the passenger waiting areas.
- Establishment of adequate safety barriers at edge of parking for pedestrian protection as vehicles must travel over a curb to park. This is of particular concern during winter months when snow and ice are present.
- Sloped curb within train step area.
- Establishment of vehicle restrictions to allow for safe LRRT operations.

These issues will be properly addressed for all station-boarding zones and therefore will be studied further as part of the final design.

7.2.2 Parking Areas

The primary objective of the 'Cars Sharing Main Street' project is to provide vehicular access to Main Street. This is accomplished by providing travel lane (light rail track bed shared with cars) and new parking located parallel to the curb. The amount of parking is maximized between intersections on non-station blocks, with additional parking on station blocks either beyond the leading or trailing end of the station area.

The width of the new parking bays, along the trackbed segments where wider sidewalks exist, has been established at nine feet with an additional three foot buffer between the parking bay and shared track bed. This additional three-foot area provides safe access to a vehicle during the operation of light rail trains. In the 600 block of Main Street, this dimension is increased to five feet, thereby serving a dual purpose as a bike lane and buffer between parked cars and the train. The length of each parking bay has been established as twenty-two feet. In areas where the sidewalks are narrower such as around the portal, the 700 block, Eagle Street and Mohawk Street, eight-foot wide parking slots are provided. The approximate number of short-term parking spaces proposed along the project are 166 spaces between Scott Street and Tupper Street, 43 spaces between Tupper Street and Goodell Street, 16 spaces along Eagle Street and 32 spaces along Mohawk Street. Approximately 250 parking spaces are proposed within the project corridor. These however, do not include the parking in the station zone areas.

Loading zones have been identified along the length of Main Street at each block where a number of businesses do not have alternative off-Main Street access to their building. There are a total of nine loading zones. They are typically comprised of one or two parking spaces (22 or 44 feet) each in length with a width of nine feet plus a three feet buffer. In the theater district, a zone has been established that may be used for either vehicular passenger drop-off for Theater District venues or loading and unloading during non-event hours. The length of this zone is approximately 110 feet with a width of nine feet plus a three foot buffer.

The sidewalk adjacent to parking will have the following dimensional criteria. To allow for the clearance of snow at the curb, a six-foot zone without vertical obstructions will be provided. For general pedestrian circulation a minimum 10-

foot clear zone from the face of the building is accommodated which will increase to a minimum of 12 feet where café seating might occur. The remaining area at a dimension of either 9'-9" or 7'-9" will become the planting and amenity zone. (See Appendix C, Exhibit 4).

7.2.3 Intersections

The highest priority at each intersection along Main Street is safety. Clearly marked pedestrian crosswalks and un-obstructed views for pedestrians and automobile drivers define the design objectives. Each intersection zone along the length of Main Street is established as 50 feet beyond the curb of the intersecting street. The exceptions are the smaller streets of Mohawk and Eagle where 30 feet is established. Within these zones, no parking is permitted and planting is kept at a minimum. Crosswalks are 20 feet wide and composed of a simple stamped or scored concrete with a color variation that is distinct from the remainder of the street pavement. Crosswalks on intersecting streets are located such that the pedestrian path on Main Street is as straight as possible without jogging toward the center of the street at each intersection. The stop bar is therefore kept flush to the building face, which prevents vehicles from stopping within the sight line of a pedestrian approaching the intersection on Main Street. Curb ramps are located at the end of each crosswalk and comply with ADA regulations dictating slope and the use of a tactile warning surface.

7.2.4 Unique Spatial Conditions

The Ellicott Plan for Buffalo as designed by Joseph Ellicott, is modeled on the layout of Washington, D.C. Downtown has several public squares defined by the intersection of radial streets with an orthogonal street grid. Three of these public spaces occur along the length of Main Street and include Lafayette Square, Roosevelt Square, and the open space at Division and Church Streets. The design of the Main Street streetscape will respect these important public spaces by the placement of planting, seating, and pavement scoring that reinforces the original Ellicott layout. These areas are design opportunities that will serve to enhance the public spaces. Design challenges characterize the remaining unique spatial conditions, the 600-block portal and the HSBC and highway underpasses, where the surrounding streetscape is not conducive to pedestrian movement. The portal area will be addressed by replacing the existing fence on the portal wall with a new, more transparent screening. Providing continuity to the streetscape and aesthetic improvements that will enliven these environments will improve the character and help unify Main Street.

7.3 Sidewalks & Materials

The design goal of the Main Street sidewalks is to improve pedestrian circulation while accommodating various amenities that enhance the experience and viability of Main Street. The width of the new sidewalks will generally range from approximately 22 to 38 feet. Sidewalks will be wider in station zones and at intersections, and narrower where on-street parking is provided. The minimum proposed clear width for pedestrian circulation along any sidewalk on Main Street is ten feet.

Sidewalk materials will typically be poured-in-place concrete. Finishes may include exposed aggregate, other textured finishes and distinctive scoring patterns as well as stamped concrete, in limited areas. Colored concrete will be considered and stone unit pavers will be reviewed for special use at historic facades.

The layout of sidewalk amenities whether planters, street trees, signage, or other vertical elements, will provide a minimum width of six feet clear at the curb to allow the passage of snow removal machinery. This dimension of six feet, as recommended by Buffalo Place, will be respected elsewhere to maximize the ability to remove snow from the sidewalk. Additionally, snow storage areas will be provided to allow for short-term storage before the removal of snow from the Main Street district. (See Appendix C, Exhibit 5)

7.4 Pedestrian Amenities

The sidewalk amenities in the Main Street corridor should contribute to the overall character of the districts and provide places for people to safely interact. Pedestrian amenities should be distinctive in style and well-built. The following list of amenities is a preliminary outline of those under consideration:

Item	Material	Size
Benches	Wood seating with metal arms and legs	6 feet to 8 feet in length
Trash Receptacles	Metal with powder coated finish	30-40 gallon capacity
Planters	Concrete with Granite	400-500 CF of soil should be provide for each tree

7.5 Landscaping

New landscape elements will include deciduous shade trees, flowering trees, a limited number of evergreen trees, deciduous and evergreen shrubs, perennial and seasonal plantings. Due to the required street and curb reconstruction, all of the existing street trees will need to be removed. New plantings will be used to create distinctive zones within the corridor and provide seasonal interest. Plants will be selected based on streetscape typology, amount of available sunlight, sight line requirements, adjacent uses, maintenance requirements and planting conditions.

An important goal of the project is to improve horticultural standards, including use of continuous tree planting trenches for improved tree health. Current research shows that an 8” caliper tree requires 500 cubic feet of soil for healthy growth while a 16” caliper tree requires 1000 cubic feet of soil. A key consideration in evaluating planting conditions on Main Street is whether in-ground locations are available or if the required soil volume will need to be planned for above-ground planters. Above ground planters will be considered at some locations because of the high number of sidewalk vaults in the project area, particularly between Huron and Seneca Streets.

Trees to be used on Main Street will be selected from the City of Buffalo Forest list.

7.6 Light Fixtures

A distinctive, but standard City of Buffalo approved luminaries will be used along Main Street to ensure that replacements are timely and cost effective. The lighting levels will be safe but not excessive. Location of light fixtures will, in part, be determined by the required spacing of the catenary poles which are being relocated from the center of the roadway to the sidewalks. These 30 foot high poles will include street light luminaries with a lower level, pedestrian height fixture on the same pole. The intermediate street and pedestrian light fixtures will be in the same family of fixtures, located on lower height poles (typically 12 feet high). The poles may include custom arms for banners and hanging baskets.

Other specialty light fixtures may be incorporated within the unique spatial zones, particularly near the portal in the Theater District and beneath the elevated I-90 expressway. In addition, outlets may be provided at select trees to allow for electrical power that may be used for seasonal lighting

7.7 Events Spaces

The majority of downtown events occur at locations along Main Street. The streetscape design should accommodate the event by providing adequate space for the physical elements associated with each event. Designs should also provide enough room and unobstructed views for the crowds in attendance. The following chart identifies current events and location:

Name of event	Location
Curtain-up	Theater District
Tree Lighting	Fountain Plaza
Thursday at the Square	Lafayette Square
Country Market	Main Street between Lafayette Square and Eagle Street
M&T Events Series	M&T Plaza

7.8 Art Work

The incorporation of artwork into the project should be accomplished through the development of an Art Master Plan for Main Street. This document could be developed by the design team and would identify opportunities for the inclusion of permanent and/or temporary art, coupled with the consideration of budget, design requirements, and project schedule. The goal of the Master Plan would be to identify the best opportunities and a thematic concept that would make art a meaningful and exciting addition to the streetscape. Art objects may either be incorporated as stand alone features such as a freestanding sculptural element, or may be integrated into required elements such as benches, lighting, pavement, or planters.

7.9 Encroachments

Six buildings have sidewalk encroachments along Main Street.

Name of establishment ***Use of encroachment area***	**Address**	**Encroachment area (Length x width)**
Hyatt *Atrium*	532 Main Street	88' x 19'
'B' District Police Station	695 Main Street	(2)4' x 4' columns encroaching 8' into walk
Bijou Grill *Addition*	643 Main Street	63' x 10.5'
Market Arcade *Cinema Signage*	639 Main Street	14' x 14' four post sign
Main Place *Columns for Pedestrian bridge to former AM&A's*	377 Main Street	4 columns, 2 paired each side of street 13' from face of building
City Grill *Wood Patio Deck*	256 Main Street	32' x 20'

Verification of the permits for the use in the City of Buffalo right-of-way will be performed during the final design. The encroachment issue will be resolved by the City of Buffalo prior to the start of construction, since the reconstruction of the sidewalks will impact these encroachments.

7.10 Utilities

As noted under Section 4, utility lines, with the exception of those required for the LRRT system, were generally relocated outside of the trackbed prior to or as part of the LRRT system construction. Therefore, there are numerous utilities located under the sidewalk areas between the curb lines and building faces. A description of the various utilities are listed as follows:

Sanitary Sewers

The sanitary sewer system along the project corridor, owned and maintained by the Buffalo Sewer Authority, consists of a combined sewer system located on the east and west sides of the trackbed running parallel to the project corridor. The combined sewers throughout the project corridor are generally comprised of brick and range in size from 12 to 36 inches in diameter. The sanitary sewer system generally consists of five distinct segments, with sanitary sewer system outfalls characterizing the segments. The combined sewers running south from the project limits at Goodell Street and the combined sewers running north from Court Street to the previously removed Genesee Street intersection just south of Huron comprise the first two segments, with all flows from Main Street being picked up by a seven foot outfall crossing the project corridor. The combined sewers running south from Court Street to Swan Street comprise the third segment, with all flows from Main Street being picked up be an eight-foot outfall crossing the project corridor. The fourth segment runs from Swan to Seneca Streets with all flows from Main Street being picked up by the outfall that crossed the project corridor at Seneca Street. The final segment consists of all sewer systems south of Exchange Street, with all flows being picked up by the Hamburg Drain outfall.

The current EPA and NYSDEC rules and regulations require that the combined storm and sewer systems should be separated as part of the new construction. No utility work is proposed under the preferred alternative and therefore the separation of the combined system will not be a part of this project.

Waterlines

The water distribution system along the project corridor consists of 10 to 12 inch diameter mains, located on the east and west side of the trackbed with several crossings and hydrant branches located throughout the project. Waterlines along Main Street were installed between 1980 and 1985; a majority of the waterline section was installed during the LRRT construction period.

The waterlines are generally located in the sidewalk area between the trackbed and R.O.W. and run parallel with the trackbed. The west side waterline terminates at the intersection of Main and Tupper, while the east side waterline converges back into the roadway pavement beyond Tupper and continues along Main Street. No improvements or relocation of the waterline is proposed under this project.

Communications

Telephone and fiber optic lines owned by Verizon, World Com Telecommunications, Adesta Communications, Fibertech Networks and MCI Telecommunications are located at various locations throughout the project corridor. The majority of the communication systems in the project corridor consist of shared facilities, with single conduit and duct bank branches to provide specific building feeds. Verizon owns several duct banks and manholes, which are generally concentrated at the intersecting side streets, with minor branches onto Main Street. Communications is further discussed in Section 5.6 in detail.

Electric

Electrical distribution systems along the project corridor are owned by National Grid and generally consist of underground concrete encased duct banks and manholes running throughout the project corridor. The majority of the electrical distribution system was relocated outside the trackbed during the construction of the LRRT system. The primary electrical duct bank runs parallel with the trackbed and is comprised of 4-inch conduits, ranging from twenty to twenty four in number. Feeder ducts branch off the primary duct bank at numerous locations within the project limits to provide power feeds to rails stations, street lighting and building services. Electrical transformers are located within the sidewalk vaults throughout the length project corridor. The primary electrical duct bank is shared by other utilities including MCI telecommunications and Adesta Communications at various locations within the project limits. National Grid also owns and maintains street lighting located within the project corridor. The street light poles, luminaries and the cable are owned by the City of Buffalo. National Grid supplies power on a demand meter system basis.

Gas

Natural gas lines, owned by National Fuel Corporation are interspersed throughout the project corridor. Medium and low-pressure lines, 3 inches to 16 inches diameter in size, cross the project at various locations from the project limits at Scott Street to Chippewa Street with minor branches onto Main Street. Low-pressure gas mains run parallel on both the east and west side of the trackbed from Chippewa Street to the project limits at Goodell Street.

General Approach/Coordination

No major utility related work is anticipated at this time; however, due to the nature of the project minor utility location work in certain areas may be required. As part of the construction process all utility companies will be notified of the construction and a pre-construction meeting with the various utility companies will be scheduled.

7.11 Drainage

The existing drainage along Main Street is a closed system. A network of pipes and catch basins collect the stormwater and drain into various combined sewer trunk line outfalls along the Main Street corridor and side streets. The drainage along the corridor is working as designed except for isolated locations where low points have been created due to poor surface and sub-surface conditions. Inlets, manholes and separated storm piping, generally 12” to 18” in diameter, were installed throughout the project corridor as part of the station site work contracts in the 1980’s.

The section between Goodell Street and Court Street consists of 16-inch to 30-inch storm pipes, with catch basins, drainage manholes and inlets located at regular intervals. The trench drains within the trackbed are also connected to this system. This section of Main Street between Goodell and Huron Street drains into a 7-foot combined sewer under Genesee Street. The section of Main Street between Court Street and Swan Street drains into an 8-foot combined sewer running along Swan Street. However, a section of Main Street between Church and Mohawk Street drains into a combined system along Mohawk Street. The section between Swan Street and Seneca Street drains into a combined system under Seneca Street. Similarly, the area south of Swan drains into an 11-foot combined system located under Exchange Street. The Hamburg drain is the outfall for the area between Exchange Street and Scott Street.

Replacements of drainage system components will be performed as needed to accommodate proposed grading conditions, station components and streetscape elements established as part of the final design effort.

7.12 Special Wind Conditions

HSBC Underpass / Seneca Street Station block / Main Place Block

Severe wind conditions occur in the vicinity of the HSBC center. Various wind calming features have been installed near the underpass of the HSBC center and along the Seneca Street station block. These range from a metal passage structure with curved roof between Seneca Street and the LRRT station to simple metal structures. Wind calming techniques are being studied for this project, a technique that best suits the purpose will be installed to provide wind calming effects in the HSBC center and Seneca Street station areas. The pedestrian bridge at the Main Place block includes a wind screen that slows the wind effects in this block.

7.13 Feature Removals

Existing decorative art features are located at various locations within the project corridor, specifically steel “gateway” arches located north of Scott Street and north of Chippewa Street and decorative steel art features located at Mohawk Street. Additional features at Eagle Street and between Huron and Chippewa will also be removed. Feature removal is necessary to meet the objectives of this project and to accommodate the new streetscape and urban design themes being developed for this project. These features will be removed in their entirety, including structural steel, electrical components and foundations.

7.14 Heated Sidewalks

Snow and ice accumulation along the sidewalks during the winter season can cause problems if not maintained properly. Heated sidewalks are an option along the Main Street corridor to reduce the maintenance costs related to snow removal and deicing of the sidewalks. However, there are costs associated with maintaining the heated sidewalks as well. Heated sidewalks will also require replacement or repairs every few years on average. At present there are heated sidewalks located in the downtown Buffalo area. The installation of heated sidewalks was raised in the survey distributed in 2005. Responses were limited but favorable by those who were willing to pay for the installation, up-charges and the regular utility costs. Implementation of the heated sidewalks would have to be performed under betterment agreements with property owners.

7.15 Summary

A successful redesign of Main Street is dependent upon providing convenient vehicular access, a safe and comfortable experience for light rail patrons, and a dynamic and attractive setting for pedestrians. The extensive length of Main Street in downtown Buffalo requires both variety and consistency. Design variation will occur by responding to distinct downtown districts while consistency is derived from the dimensional standards inherent in the streetscape typologies. Major design objectives include creating high horticultural standards that insures the growth of healthy street trees and a distinctive yet simple strategy for the inclusion of streetscape elements that reduces visual clutter while at the same time provides a unique character to the street. The redesign of the streetscape is intended to help facilitate the economic rebirth of Main Street.

SECTION 8 – SAFETY AND SECURITY MEASURES

In addition to traffic safety measures being evaluated for the reintroduction of vehicular traffic to the shared trackbed roadway, various other safety and security measures will be addressed along the project corridor. Currently, the stations are monitored through closed circuit television and NFTA police patrols the mall area. Expansion of the monitoring system will be evaluated to enhance security along the entire corridor. Areas that present unique safety challenges are the portal opening and the roadway segment under One HSBC Center. Lighting improvements will be evaluated to help create a safe feeling for pedestrians. The interface with cars, trains, bicyclists and pedestrians will be addressed in the project design.

8.1 Lighting

The proposed lighting for the project must provide for safe levels along the roadway/trackbed as well as address the needs of the wide sidewalk areas and monitoring system. The existing light fixtures are spaced at approximately 100 feet on center. Combining the OCS and light poles will require that intermediate poles be added to maintain the desired intensities. The required intensities for Main Street are discussed under Section 2 and will be further evaluated in the final design phase to provide sufficient lighting and to minimize the shadow effects within the project corridor. A reasonable spacing of light poles similar to the existing poles and fixtures (metal halide) is 75 feet.

8.2 Monitoring

As discussed in Section 5, NFTA police monitoring of station areas is performed through the CCTV system that is routed through the OCC. Consolidation of the Fountain Plaza and Theatre District Stations will require the existing Theatre District cameras to be mounted on poles to monitor the portal area. This is of particular importance given that the portal area will become the interface between the shared and separated lanes. Additional cameras are recommended at each of the intersections throughout the shared trackbed areas in order to monitor and react to traffic conditions. Two adjustable cameras are proposed at each of the intersection that would connect to the existing fiber optic system that is routed to the OCC. Ultimately, the monitoring system could be interfaced with NITTEC to assist in the management of traffic operations.

8.3 Special Conditions

8.3.1 Portal Entrance

Of significant importance is proper identification and control of the interface at the portal. In the southbound direction, cars will be merging from a separated lane into a shared lane with the LRV's. A traffic signal and automated gate arm is proposed that would interface with the train control system to insure that vehicles cannot merge into the shared lane when the train is approaching from the tunnel portion. Also, the divergence of vehicular traffic from the shared to separated lanes in the northbound direction is a concern for the potential driver confusion that could result in vehicles entering the portal and tunnel area. Delineation in the form of flashing warning lights, signage and markings is necessary to identify this area. Consideration of a positive barrier system is necessary to insure that vehicles are prohibited from entering the portal from both a safety and security standpoint. Various types of barriers have been evaluated as discussed in Appendix I. The fabricated type of barrier recommended is an automated horizontal beam barrier interfaced with the train control system. Another consideration would be the removal of trackbed slabs at the portal entrance. Maintenance of the open section of the portal is a concern that would have to be addressed further should slab removal be implemented.

8.3.2 HSBC Underpass

Security at the HSBC Tower has been identified as a concern with the returning of vehicular traffic to Main Street. Representatives of HSBC have expressed concern over vehicles stopped beneath the building structure within the roadway. Measures considered to address these concerns include installation of positive barriers similar to the portal area, side barriers to restrict lane widths and discourage motorists from stopping and exiting vehicles, coordination of signals each side of the building to minimize occurrences of standing vehicles, additional security cameras to assist in monitoring and height restricting barriers to limit the vehicle size utilizing this segment. Positive barriers would only be utilized during High Threat Levels (based on the Terror Alert Color) as this would close the road under HSBC. Assessment of barrier types and implementation will be studied further during the final design phase. Further coordination with One HSBC Center and familiarization with the building structure will be required to finalize measures considered for this location.

8.3.3 LRV Modifications

LRV improvements directly related to the project discussed during the preliminary design process include the installation of brake lights and possible variable signage at the rear of the vehicles. NFTA determined that the brake lighting system on the vehicles is in need of upgrades to adequately notify trailing vehicles of the LRV’s intent to stop. Variable signage was considered as a supplemental measure to aid in the delineation at the portal interface, LRV signage is not considered further at this stage due to cost considerations.

8.4 Summary

Safety and security measures proposed for the project include:

- Improved lighting
- The addition of cameras at intersections to expand monitoring capabilities
- Positive barriers at the portal and potentially at HSBC Tower
- Signal and arm/gate for merging lanes at the portal
- Brake light improvements on the LRV’s

Further study is needed to determine the extent of additional measures to be considered at One HSBC Center. LRV signage is not considered further at this time due to cost considerations.

SECTION 9 – CONSTRUCTION PHASING

A primary objective of the project is economic revitalization. As such, the construction must occur in a manner that maintains access to existing properties along the corridor to minimize disturbances. A balance must be established between disturbances and construction duration, limiting the duration on any block to one construction season. Work hours, rail operations and funding are all factors in the phasing of construction. Nighttime construction is a primary concern for residences along Main Street, which are predominately located north of Court Street. Rail operations create limitations for trackbed improvements during daytime hours. Considerations of single tracking and alternate modes of transporting passengers such as shuttle service will be evaluated. The installation of a crossover at Church Street is a consideration for mitigating service impacts during single-track operations.

9.1 General Approach

In order to minimize disruption to properties along the Main Street corridor as well as on transit operations, minimizing the number of phases is preferable. Additionally, overall project costs are historically higher the more a project is segmented. The additional costs relate to transitions between segments, mobilization or other measures to address train/car interfaces at the project limits as well as additional traffic control measures to name a few. However, funding limitations, interfaces with other projects and construction durations on each block weigh heavily into the construction phasing decisions.

At this point, it is understood that the project will be constructed in multiple phases starting at the north project limit and working south. The first phase (1A) would include the section between Goodell Street and Chippewa Street. In order to coincide with the anticipated completion of the projects along the lower Mains Street, it is anticipated that the construction work will then shift to the southern limits, with Phase 1B construction of the project happening between Scott Street and Exchange Street. Phase 2 of the construction will incorporate the remainder of the Main Street section between Chippewa Street and Exchange Street. The final construction under Phase 3 will include work South of Scott Street. The initial phasing concept is shown in Exhibit 9-1.

The construction work performed in each phase will be staged. Each stage would involve the reconstruction of sidewalk area on one side. The second stage will involve the reconstruction of the opposite sidewalk area. Given the proposed option of performing minimal trackbed repairs in lieu of major rehabilitation or reconstruction, the trackbed work would be performed either at night during operational shutdowns or during times of reduced operations when single tracking could be accommodated. Work will have to be staged to maintain access to properties at all times during the construction period. The exact phasing and staging will be developed during the detailed design. Closure of station platforms within the block being constructed would be necessary to facilitate construction of the new station areas.

It is proposed that the reconstructed sections of Main Street will be fully functional with the reintroduction of cars on Main Street. The sections that remain to be reconstructed or under construction will have proper traffic signs to guide the traveling public.

9.2 LRRT Operations

Maintaining rail service throughout the course of construction is integral to the success of the project as well as the long-term success of the downtown area. Interruption of rail service would limit accessibility to the downtown area for many riders as well as potentially impacting the long-term ridership. A concern raised by NFTA Metro Rail is that the current crossover locations result in headways increasing from the current 7-minute time to over 20 minutes during single-track operations. The installation of the Church Street crossover is said to reduce the time by an estimated 50 percent to 10 minutes for single-track operations. These durations are significant to rail operations. However, based upon the proposed alternative of minimal trackbed repairs, the crossover has been eliminated from consideration (further discussion can be found in Section 4).

Other considerations include closure of stations located within the blocks under construction and rail operations during later project phases. Closures will likely be required to accommodate the construction of the new stations as well as modifications to train control components within each work area. Safety considerations related to de-boarding passengers within a work zone are another concern. Other operational considerations and short-term measures will have to be evaluated further once the phasing is finalized.

9.3 Work Hours and Duration

The proposed construction work will progress mainly during normal daytime construction hours, particularly within blocks with residences and hotels. Nighttime work would be limited to low noise generating type work such as concrete placement and electrical work related to the catenary system. Coordination with stakeholders throughout the construction process will be key in minimizing problems and disturbances. Short-term construction impacts are anticipated to be consistent with the scale and scope of the proposed improvements. It is anticipated that standard construction mitigation procedures will be utilized by this project.

Work requiring LRRT system shutdowns such as catenary system modifications and train control modifications would have to be performed during nighttime system shutdowns, between 1:00 a.m. and 5:30 a.m. Other shutdown periods would have to be coordinated with NFTA to coincide with light usage, non-event periods such as Sunday afternoons.

9.4 Schedule

The following is a preliminary schedule for the project. The schedule for the project will may vary due to the funding of the project.

Design Approval	Summer 2006
Begin Phase 1A Final Design	Fall 2006
Project Bid Phase 1A	Spring 2007
Contract Award	Spring 2007
Phase 1A Construction Begins	Summer 2007
Phase 1A Construction Completed	Winter 2007

The schedule for the other phases of work would depend on the progress of Phase 1A operations and funding for the rest of the phases.

9.5 Summary

The proposed project to bring back Cars on Main Street is anticipated to be completed in three phases with two stages in each phase. A majority of the work will be located outside of the trackbed and can be completed during the daytime hours. Repair work within the trackbed and switchover of LRRT system components would be performed when singe-tracking LRRT operations are acceptable or during the nighttime when the LRRT is not in operation. Access to residences, businesses and offices will be provided at all times. Pedestrian facilities will be maintained during the construction period. Construction mitigation measures will be in place to minimize any impacts (such as noise, dust etc.) due to the project. Each construction work phase will be completed in one construction season.

SECTION 10 – COST ESTIMATING

An initial construction cost estimate of $ 53 million in 2003 dollars was developed in the EA for the overall project for the Shared the Trackbed alternative. This included roughly $30 million to rebuild the deteriorating trainway and Metro Rail Stations. This figure was recently updated in the EA to reflect projected costs in 2008 dollars as well as to incorporate elements such as new crossovers at Church and Scott Streets and the relocation of catenary poles outside of the trackbed. As such, the project estimate escalated to approximately $75 million. Subsequently preliminary design estimates have been developed which evaluated the various scope elements identified in the Scope Summary Memorandum. Upon development of scope element costs, work elements have been prioritized in order to achieve a fundable project that achieves the goal of returning cars to Main Street.

10.1 Cost Analysis

Throughout the course of the preliminary design development, costs have been developed for various scope elements evaluated for consideration under the project. Elements similar in nature or integral to each other have been grouped together when formulating costs. Categories established include:

- Roadway Pavement (including trackbed and rail related work)
- Parking Area Pavement
- Sidewalk Pavements
- Signalization, Signage and Markings (traffic control measures)
- Catenary Work (relocation or protection)
- LRRT Systems (includes all train control and station related systems)
- Stations (includes demolition, new structures and amenities)
- Bridge Plates (at station platforms)
- Streetscape/Landscaping (including all planters, plantings, furnishings and amenities)
- Safety and Security Measures (specific to portal interface and HSBC Tower)
- Drainage, Utilities and Vaults (in non-trackbed areas)

Costs for the above groupings were developed for the entire project on a block to block basis. Understanding the segmental costs was critical in the evaluation of funding related to the proposed phasing which was key to shaping the scope. Additional elements that apply to the overall project were evaluated for their impact on the project construction costs. These elements include:

- Crossovers at Church Street and Scott Street
- Drip Irrigation System
- LRV Brake Light Improvements
- LRV Signage
- Intersection Monitoring System (cameras added at intersections)
- Wind Screening (allowance carried for lower Main Street with scope to be developed as part of the detailed streetscape design for this area)

Additional elements discussed as part of the preliminary design but not incorporated into the estimate at this time include heated sidewalks and parking meters as they are not eligible for funding under this project. Allocation for funding of artwork will be evaluated further as the design progresses.

As a result of the cost escalation presented in the updated EA, alternatives were evaluated as discussed in earlier chapters. The primary alternatives considered were focused on the trackbed work discussed in Section 4. The alternative work approaches considered full trackbed pavement reconstruction, trackbed rehabilitation (resurfacing) and minimal trackbed repair work. Relocation of all catenary poles was compared with protecting the poles and relocating poles within intersections. The minimal trackbed at a construction cost of approximately $51 million (the total project cost being $ 61 million) with all work being completed by the end of 2009, is the most cost effective approach. The trackbed rehabilitation and reconstruction approaches add approximately $ 6 million and $ 16 million to construction costs respectively. The significant difference in cost resulted in the recommendation for advancing the minimal trackbed alternative. A summary of costs associated with the minimal trackbed alternative is included in Appendix E.

10.2 Phasing Considerations

Estimated project construction costs without regard to phasing are developed initially as a baseline for the project as the phasing is ultimately a function of the availability of funds and can be variable. At this point in time, a three-phase project is being considered for implementation. Additional costs associated with transitions, time constraints, LRRT operations, inflation projections, among other phasing related issues will ultimately impact the overall project costs.

10.3 Funding

The project will be primarily funded through FHWA with an 80 percent, 10 percent and 10 percent proportion shared between FHWA, the City of Buffalo and NFTA respectively. To date, approximately $6.0 million has been allocated under the FHWA funding to begin the first phase of construction, Phase 1A. Additional funds in the amount of approximately $2.0 million through a Transportation Enhancement Program grant is being applied for with a matching grant from the City in the amount of $500 K for landscaping improvements. The approximately $8.5 million figure is key in shaping the scope for Phase 1A. Similarly $ 8 million funding has been secured for the lower Main Street. Additional funding will be established for the remaining project segments as the project design progresses.

10.4 Summary

In order to make the project viable for funding, decisions had to be made for the selection of scope elements that are vital to the successful completion of the project. As such, important but not vital elements such as trackbed reconstruction and rail fixation work have been eliminated from the project scope along with the Church Street crossover and LRV signage. Removal of the catenary poles within the trackbed with new combined catenary and light poles outside the trackbed has been determined to be a key element to the project and has been included in the scope. Other items will continue to be evaluated, as the project progresses are drip irrigation and wind screening elements.

SECTION 11 – ADDITIONAL CONSIDERATIONS

11. 1 Maintenance Jurisdiction

The City of Buffalo, Niagara Frontier Transportation Authority and Buffalo Place are the main agencies having maintenance and jurisdiction over the different elements along the Main Street corridor. Negotiations in developing maintenance agreements for the roadway/trackbed, sidewalks, landscaping, traffic signals and controls amongst other concerns are on-going between the agencies. NYSDOT has jurisdiction on North and South Division Streets as well as Goodell Street.

11.2 Snow Removal

Snow removal will be a priority in order to maintain the trackbed for LRRT and motor vehicles during winter months. Removal of the catenary poles from the trackbed will facilitate snowplow operations. Placement of landscaping and streetscape elements will be coordinated to allow for snow storage adjacent to the trackbed in non-station areas. Other locations in the project area that do not impact traffic or pedestrian movements will continue to be evaluated as the project progresses.

11.3 Vault Abandonment

There are numerous basements and building vaults throughout the project corridor. Modifications and abandonment's were performed at various locations as part of the reconstruction work completed in the 1980's. Maintaining access and coordination with streetscape components and sidewalk construction will be integral with the design effort. Further investigation will be performed during the detailed design phases to determine if additional abandonment's can be performed to facilitate construction.

11.4 Environmental Assessment

An Draft Final Environmental Assessment sponsored by the City of Buffalo, the Niagara Frontier Transportation Authority (NFTA), Erie County, the New York State Department of Transportation, and Buffalo Place has been developed to address all environmental related issues for the project. NFTA is the lead agency and is currently facilitating the review process with the Federal Transit Administration (FTA). A final determination is required before the final design phase can be advanced beyond fifteen percent completion.

11.5 Public Input

A survey questionnaire was developed at the start of the preliminary design process in order to gain an understanding of local conditions and needs individuals and businesses located along Main Street. A summary of the information was made available to the public at a first public information meeting. The first public information meeting was held on February 1, 2006 for the project. Concepts for station designs and potential streetscape elements and approaches were presented to the public. A second public meeting was held on August 8, 2006, that presented a 3D traffic model depicting the interaction of vehicles, pedestrians and the rail cars along Main Street. Preliminary station and urban design concepts were also presented to the public. The public was asked to provide their input on the design of this project. The comments received are included in Appendix G of this report with responses to the comments.

11.6 Coordination with Other Projects

There are other projects sponsored by various other agencies that are under design or planning phase for the improvements in downtown Buffalo at this time. Coordination will be required with these agencies at various stages of this project. Some of the projects include:

- Bass Pro/Buffalo Erie Canal Harbor Area Design
- Church Street Median Improvements
- Implementation of projects contained within The Queen City Hub Plan; i.e. Pearl Street conversion to two-way traffic
- Erie Street Improvements

Planning and interfacing with these and any other projects identified will be an on-going process. Much of the coordination effort will be performed during the final design of each phase of this project.

APPENDICES

Appendix A

Exhibits – Roads and Trackbed Plans

Profiles, Sections & Details

Appendix B

Exhibits – Station Concept Plans,

Elevations & Details

Appendix C

Exhibits – Streetscape Concept

Plans & Details

Appendix D

Traffic Engineering

And

Analysis Data

Appendix E

Construction Cost Estimates

Appendix F

Reference Standards

Appendix G

Public Information Meeting

Comment Summary & Responses

Appendix H

Catenary Pole Study

Appendix I

Safety and Security Measures

Appendix J

APTA PEER REVIEW