2.0 INTRODUCTION

The 34th Street Transit Corridor Alternatives Analysis screening considers seven alternatives for high-capacity transit along 34th Street. The Federal Transit Administration (FTA) requires an examination of a No Build Alternative, in which current conditions are maintained, and a Transportation System Management (TSM) Alternative. The TSM Alternative includes minimal to modest investment to improve service without extensive capital improvements. In addition to the No Build and TSM Alternatives, the New York City Department of Transportation (NYCDOT), in collaboration with MTA New York City Transit (NYCT) and in cooperation with the MTA Bus Company, proposed to study five build alternatives that would implement fixed guideway (dedicated road or rail) operations with various transit modes. This chapter outlines how the alternatives were developed and presents detailed descriptions of the seven options evaluated in the screening process.

2.1 DEVELOPMENT OF ALTERNATIVES

Identifying the full range of possibilities for enhancing transit along 34th Street required consideration of three factors: alignment, logical termini, and mode. Each factor was examined in detail and then synthesized into distinct alternatives.

2.1.1 ALIGNMENT

The first step in developing alternatives was to identify the most suitable alignment for the proposed transit service. As the project intends to improve crosstown mobility in the 34th Street corridor, potential alignments included 34th Street; 32nd, 33rd, 35th, and 36th Streets; and 23rd and 42nd Streets.

34th Street: 34th Street is a two-way street with five to six lanes. Its curbside lanes are for dedicated bus use from 7:00 AM to 7:00 PM and used for standing and/or parked vehicles at other times. 34th Street is well served by transit, including north-south subway lines and local and express bus routes. The street is located one block north of Penn Station, a hub for commuter and intercity rail and local subway; there is an entrance to the station from 34th Street. In addition, ferry terminals are located at or near both ends of the street. High-capacity transit service along 34th Street would complement existing transit, and would provide convenient transfers to local and regional services while still accommodating most vehicular access.

34th Street is wider than most crosstown streets in Midtown. East of Third Avenue, the street is approximately 60 feet wide, and currently carries six travel lanes. Between Third and Ninth Avenues, the street is 50 to 54 feet wide, and currently carries four to five travel lanes. West of

Ninth Avenue, the street is 60 feet wide, and currently carries six travel lanes. The general street width and configuration is summarized in Table 2-1.

Table 2-1

34th Street: Width and Number of Lanes

Street Segment	Street Width (in feet)	Current Number of Lanes
FDR Drive-Third Avenue	60	6
Third Avenue-Ninth Avenue	50–54	4-5
Ninth Avenue-Twelfth Avenue	60	6

32nd, 33rd, 35th, & 36th Streets: The crosstown streets immediately north (35th and 36th Streets) and south (32nd and 33rd Streets) are one-way for all or most of their length and do not fully traverse Manhattan. 33rd and 35th Streets are the principal service routes for many commercial, institutional, and retail buildings that front 34th Street. To provide a transit alignment on these streets most likely would require either: 1) full closure of the street to vehicular traffic; or 2) a couplet of one-way transit guideways located two blocks apart. Since a two-way transit guideway can be provided on a wide street while maintaining partial vehicular access, these one-way streets are not preferred as the alignment for the Proposed Project.

23rd & 42nd Streets: 23rd Street to the south and 42nd Street to the north are two-way crosstown streets. Like 34th Street, both are important east-west corridors that serve a large travel market. While 23rd Street has subway and bus connections, it does not provide as many transfers to subway or express bus routes as 34th Street; it is also farther from Penn Station and the Midtown ferry terminals. 42nd Street already has high-capacity transit service for a portion of its length, including the 7 subway line and the 42nd Street S, which would be unnecessarily duplicated with additional fixed guideway service.

34th Street is the preferred alignment at this time for the reasons outlined above.

2.1.2 LOGICAL TERMINI

Following identification of the preferred alignment, the next step was to determine the most logical termini for new transit service along 34th Street. The Pier 79/West Midtown Ferry Terminal is located at 39th Street and the Hudson River; it provides ferry service between New Jersey and Midtown Manhattan. At 34th Street and the East River, the East 34th Street Ferry Terminal provides service between Midtown Manhattan and Lower Manhattan, Queens, the Bronx, and New Jersey. These ferry terminals are proximate to other major destinations, such as the Jacob K. Javits Center on the west side and New York University Langone Medical Center on the east side.

Since the ferry terminals are transportation destinations for people traveling along 34th Street and are located at either end of the corridor, they are the logical termini for the 34th Street transit corridor. Both terminals also provide the layover space needed for surface-based alternatives. As today, a single service would not necessarily need to service both terminals, but both terminals would be served by a 34th Street transit corridor improvement.

Depending on the mode, services could use all or part of the alignment to access other potential terminal points. Given the right-of-way discussion in 2.1.1, the fixed guideway improvements may be limited to 34th Street itself, depending on the mode; however, it is expected that there will be transit service from 34th Street to both termini.

2.1.3 MODE

NYCDOT, in collaboration with NYCT and in coordination with MTA Bus Company, and comments received through public feedback, has identified five potential high-capacity transit modes for 34th Street: Bus Rapid Transit (BRT), Streetcar, Light Rail Transit (LRT), Automated Guideway Transit (AGT), and Heavy Rail. Below is a general overview of the guideway, vehicles, propulsion/suspension, stops/stations, costs, and operations for each proposed mode. A summary of basic bus technology is included as a baseline comparison, as this would be the mode in the No-Build and TSM alternatives.

Section 2.2 will describe how these modes are developed into alternatives that can be analyzed for the 34th Street corridor. Section 3 presents the analysis.

2.1.3.1 BUS

Buses are rubber-tired vehicles that generally operate on roadways in mixed traffic, and are the most widely utilized transit mode.

- *Guideway:* Buses typically operate in mixed traffic, but in some instances may travel in exclusive rights-of-way.
- *Vehicle Types:* Bus transit encompasses a variety of vehicle types, ranging from vans to double-decker and articulated buses. In New York City, capacities of standard 40-foot and articulated buses range from 54 to 85 persons.
- *Propulsion/Suspension:* Diesel engines power the majority of buses currently in operation. The use of alternative fuel-powered vehicles, including compressed natural gas (CNG), and hybrid-electric, is becoming more common.
- *Stops/Stations:* Bus stop designs vary from simple signage to passenger shelters with minimal amenities for riders. Stops usually are closely spaced, ranging from one tenth of a mile to a quarter mile., Stops are typically every 600-1,000 feet apart; On 34th Street, stops occur every one to two blocks.
- *Cost:* Vehicles comprise the largest portion of capital expenses for new bus routes. Costs for buses can range from $350,000 to $1.2 million; expenses increase for newer, alternative fuel vehicles. In 2007, according to the National Transit Database (NTD), the average operating and maintenance cost per passenger mile for buses was $0.80.
- *Operation:* Buses provide occasional to frequent service. Operating speeds can reach 55 miles per hour (though typically not on city streets), but mixed traffic conditions often compromise reliability and average travel speeds.

New York City Passenger Shelter

New York City Articulated Bus (Flyer D60HF)

New York City Hybrid Bus (Orion 7)

Buses are the most flexible form of transit. They can operate in mixed traffic or in exclusive guideways and offer unparalleled routing flexibility. In addition, the vehicles are adaptable to a variety of fuels. New bus systems have lower capital costs than other modes. While systems are flexible, they have limited capacity and relatively slow travel times and speeds.

2.1.3.2 BUS RAPID TRANSIT

BRT is an enhanced bus system that blends the flexibility and relatively lower cost of buses with the efficiency of rail. BRT systems typically feature high-frequency, all-day service, exclusive right-of-way, level boarding, off-board fare payment, distinctive stations or stops, a quality image and unique identity, and application of Intelligent Technology Systems (ITS).

- *Guideway:* Conventional BRT operates along an exclusive busway that is access controlled. Busways can be at-grade, with pavement markings or physical barriers separating the BRT guideway from general traffic, or can be fully grade-separated. BRT vehicles can also operate in mixed traffic for some or all of their routes.
- V*ehicle Types:* BRT includes standard, articulated, and, to a lesser extent, double-articulated buses. Multiple, large doors used for both entry and exit in concert with low floors or high platforms facilitate faster passenger loading and unloading. Designs typically feature unique branding, large windows, enhanced wheelchair loading, and internal layouts that maximize passenger comfort and circulation.
- *Propulsion/Suspension:* Like traditional buses, BRT vehicles can be powered by either traditional diesel engines, or by other alternative fuels. Some clean fuel and propulsion systems include compressed natural gas (CNG), hybrid-electric, and biodiesel.
- *Stops/Stations:* BRT systems feature distinctive stops or stations that offer passenger protection, information, and fare collection equipment. Facilities can vary from simple bus shelters to full station buildings. Stops are typically spaced one half to one mile apart and can be located curbside, along the street median or a combination of both. In most systems, a combination of low-floor buses and station platforms is utilized to speed passenger boarding and unloading.
- *Cost:* The capital cost of new systems is between $7 million and $45 million per mile. The cost per vehicle ranges from $600,000 to $1.2 million. In 2007, according to the NTD, the operating and maintenance cost per passenger mile for bus systems in the United States

was $0.80. (This cost accounts for general bus service; BRT operating costs per passenger mile may be slightly higher due to additional amenities.)

- *Operation:* BRT offers frequent, reliable service during all hours of the day. Systems typically incorporate ITS elements, such as automatic vehicle location; priority or preemption at signalized intersections; and real-time passenger information systems, both on- and off-board.

Pittsburgh, PA Grade-Separated Busway

Bogotá, Colombia Median BRT Station

Interior of Beijing, China BRT bus

Orlando, FL Lymmo Real Time Information

Relative to rail modes, flexibility is a primary advantage of BRT systems. Vehicles can travel in both dedicated and non-dedicated rights-of-way and smoothly transition between the types of guideways. Other benefits include improved operating speeds and reliability due to elimination of various types of delay, as well as moderate to high vehicle capacities at a lower cost than rail. Compared with conventional bus, however, BRT yields higher capital costs and has somewhat less flexible routing. Operating in mixed traffic can compromise the travel times of BRT, thereby reducing the reliability benefits inherent in systems that run in exclusive guideways.

2.1.3.3 STREETCAR

Streetcar systems consist of electrically powered rail vehicles operated in one to three car sets. Vehicles usually share travel lanes with other traffic. Streetcars complement pedestrian-friendly development and activity and, in recent years, have reemerged as a high-quality transit alternative to support compact and higher-density development in cities that cannot afford, or do not have, sufficient demand for larger rail systems.

There are two classifications of streetcars: “heritage” and “modern.” The primary difference between the two is the vehicle design. Heritage streetcars preserve the look and feel of trolleys dating back to the early 1900s, while modern streetcars incorporate the advanced technology of light rail transit, enabling quieter and smoother running vehicles. The following discussion is limited to the modern streetcar since this type allows faster boarding due to its low-floor design; it also has a higher capacity.

- *Guideway:* Streetcars operate predominately in urban centers within mixed traffic. In few instances, vehicles can operate in exclusive rights-of-way.
- *Vehicle Types:* Modern streetcars often are articulated, varying in length from 60 to 115 feet. Vehicle bodies are usually narrower than standard buses and feature large windows, wide doors, and low floors.
- *Propulsion/Suspension:* Streetcars are electrically powered and the steel wheels travel along fixed, at-grade steel rails. Overhead wires typically supply power. Underground conduits are also possible if height clearance or aesthetics are of concern. The Bordeaux tramway (streetcar) in France is currently the only system powered via underground conduit. This technology, however, has not yet proven completely reliable[1].
- *Stops/Stations:* Streetcar stops are generally spaced close together, with an average distance of a quarter mile between stops. Stop designs can vary from simple signage to enhanced shelters.
- *Cost:* Capital costs of new streetcar systems are commensurate with the required level of utility relocations, roadway reconstruction, and streetscape enhancements. Costs are in the range of $25 million to $100 million per mile. The operating cost per passenger mile of U.S. light rail systems was $0.60 in 2007, according to the NTD. Streetcar and LRT costs in this document are equivalent because the FTA NTD aggregates the statistics of the two modes under one category, “light rail.”
- *Operations:* Streetcars typically provide frequent service with short headways. Modern systems primarily utilize off-board fare payment and incorporate such ITS features as automatic vehicle locators, signal preemption or prioritization, and passenger information displays at stops.

Seattle, WA Streetcar showing Overhead Wire

Pedestrian Activity Adjacent to Portland, OR Streetcar

[1] This refers to current technology use. Conduit streetcars were historically used in New York City.

Streetcars are best used in dense urban centers, particularly where parking is scarce; they are well suited to circulation and short trips. Vehicles can serve constrained station areas and streets, and negotiate sharp turns and narrow rights of way. Streetcars are not designed for long distances and corridors requiring high capacities or high speeds. Similar to buses, operating in mixed traffic can slow travel speeds and times.

2.1.3.4 LIGHT RAIL TRANSIT

LRT is typically an electrically powered, at-grade rail mode featuring high-capacity vehicles. LRT is suitable for medium-distance trips in suburbs and between central business districts and other major activity centers.

- *Guideway:* LRT operates predominately at-grade in an exclusive travel lane, but may include grade-separated guideways. In rare instances, LRT can operate in mixed traffic over short distances.
- *Vehicle Types:* Recent examples of LRT vehicles in the U.S. are those having two articulated sections, with a typical articulated car ranging from 90 to 95 feet in length. Operator cabs are located at both ends of the vehicles to allow bi-directional travel. Vehicle designs feature large windows, wide doors, and low floors.
- *Propulsion/Suspension:* LRT vehicles are almost exclusively electrically powered and the steel wheels travel along fixed, at-grade steel rails. Overhead wires typically supply power. Diesel LRT vehicles can be used when height clearance or aesthetics from overhead wires are of concern. NJ Transit employs diesel technology for the RiverLINE Light Rail system. Underground conduit can also power LRT vehicles; however, this technology is unproven, and raises additional cost issues.
- *Stops/Stations:* LRT stations are generally spaced one half to one mile apart. Station designs vary from enhanced shelters to full terminal buildings.
- *Cost:* Costs of new LRT systems depend largely on the guideway type, ranging from $25 million to $220 million per mile. The operating and maintenance cost per passenger mile of U.S. light rail systems was $0.60 in 2007, according to the NTD.
- *Operations:* LRT operates with short headways and can attain speeds of up to 65 miles per hour, depending on right-of-way exclusivity and the number of stops. Systems often incorporate off-board fare collection, automatic vehicle locators, signal preemption or prioritization, and passenger information displays at stops.

Hudson Bergen LRT
Underground Station

Phoenix, AZ
LRT interior view

Charlotte, NC LRT
Boarding Passengers

LRT technology offers flexibility in alignment. Vehicles may operate in mixed traffic or in an exclusive right-of-way, and in a variety of transit envelopes, including at-grade, elevated, or in a tunnel. LRT can accommodate moderate to high capacity and serve both low- and high-density land uses.

2.1.3.5 AUTOMATED GUIDEWAY TRANSIT

AGT encompasses fixed-guideway technologies that feature automatic train operation. AGT predominately serves as a distribution system in areas where there are high volumes of trips concentrated over short distances. Also known as "people movers," AGT is found commonly in airports, zoos, amusement parks, and, to a lesser extent, central business districts.

- *Guideway:* AGT must operate in exclusive, grade-separated, fixed guideways.
- *Vehicle Types:* AGT vehicles are small to medium-sized. The vehicles can accommodate 20 to 55 persons, typically with a high amount of standing room. Train sets can vary from one to six vehicles. Designs feature large windows at both ends and multiple doors, often on both sides of the vehicle.
- *Propulsion/Suspension:* AGT most often utilizes conventional third rail electric propulsion, but in some cases employs linear induction motors. Suspension can be either steel wheel on steel rail or rubber tires.
- *Stops/Stations:* AGT station spacing is comparable to light or heavy rail, ranging from one quarter to one third of a mile in activity centers to one-half to one mile in other areas. Designs of stations vary.
- *Cost:* Capital costs of AGT systems are between $70 million and $250 million per mile. In 2007, the operating and maintenance cost of AGT systems in the US was $6.20 per passenger mile, according to the NTD.
- *Operations:* Service characteristics of AGT, including operating speeds and headways, vary. Passenger capacities are generally less than on LRT or heavy rail systems, and, depending on the context of the AGT setting, operating speed ranges between 25 and 60 miles per hour. Fare collection for AGT is off-board; in many cases, the systems operate free of charge.

Miami, FL AGT


Detroit, MI AGT Station


Interior of JFK AGT (AirTrain)

Generally, AGT is suited for short distance travel in urban applications. The fully automated, centrally controlled operations allow many small units to run at short headways. While automated operations may reduce labor costs, AGT systems have high capital costs per mile;

these costs stem from the grade separation of the automated system and a limited pool of suppliers.

2.1.3.6 HEAVY RAIL

Urban heavy rail systems include electrically powered rail vehicles that operate in exclusive, grade-separated rights-of-way. The high-capacity system exhibits high performance in terms of speed and reliability.

- *Guideway:* Heavy rail may only operate in exclusive fixed guideways. Alignments are elevated or in underground tunnels and, in limited instances, may be at-grade. No grade crossings of the right-of-way are permitted.
- *Vehicle Types:* Heavy rail vehicle capacities range from between 100 and 200 persons. Operator cabs are usually located at both ends of the vehicle sets to allow for bi-directional travel. Vehicles typically designed with multiple sets of double doors along both sides; interior seating and standing configurations vary. Vehicles typically operate in multiple car trains.
- *Propulsion/Suspension:* Electrified third rail or overhead catenary wires powers heavy rail. Domestic vehicles have steel wheels and operate on steel rails.
- *Stops/Stations:* Heavy rail stations are generally spaced one-third of a mile to two miles apart. Station designs vary.
- *Cost:* Capital costs of heavy rail systems depend largely on the vertical alignment, with cost falling between $90 million and $3.1 billion per mile. According to the NTD, the operating cost and maintenance per passenger mile for heavy rail systems in 2007 was $0.40.
- *Operations:* Heavy rail systems can operate at short headways and obtain operating speeds of up to 60 miles per hour. In urban settings, passengers generally pay fares off-board, prior to entering the station platform.

The advantages of heavy rail systems include high capacities and frequent service over short and long distance travel. The exclusive rights-of-way with no crossings enable much higher speeds than the other modes discussed previously. However, the benefits of heavy rail come at very high capital costs. Further, the need to restrict all crossings of heavy rail right-of-way can present a challenge.

NYC Subway Train

Underground London Metro Station

2.2 DESCRIPTION OF ALTERNATIVES

The 34th Street Transit Corridor Alternatives Analysis Screening evaluates a No Build Alternative, a TSM Alternative, and five Build Alternatives. These alternatives are based on the differences in modes described above. In the section that follows, they are further discussed as they pertain to the Proposed Project. The alternatives are evaluated for the 34th Street corridor in Chapter 3, "Alternatives Screening Analysis."

2.2.1 NO BUILD ALTERNATIVE

Federal regulations require that a No Build Alternative be evaluated in an Alternatives Analysis and Environmental Impact Statement (EIS). For the purposes of the Proposed Project and to be compliant with requirements of the National Environmental Policy Act (NEPA), the No Build Alternative is the baseline against which the other alternatives are compared for the extent of environmental and community impacts. The No Build Alternative assumes that MTA NYCT, MTA Bus, and other transit operators would maintain their current express and local operations on 34th Street. Transit operators would adjust service levels based on ridership changes, as is their current practice.

NYCT operates four subway stations along 34th Street with north-south express and local service on 15 subway routes and provides north-south bus service on 16 routes. Vehicle type and schedule for the M16 and M34 bus routes and express bus operations would not change in the No Build conditions. Amtrak intercity train service and NJ TRANSIT and LIRR commuter service would continue to use Penn Station, in addition to the new station that will be constructed by ARC. **Figures 2-1** and **2-2** illustrate the existing 34th Street transit network.

The No Build Alternative assumes no new improvements to the transportation system in the study corridor, other than those currently in local and regional transportation plans and which have funds identified for implementation by 2035. Therefore, for purposes of this study, the baseline condition will reflect land use, social and demographic conditions, and transportation services in 2035, by which time it is reasonable to assume implementation of any of the build alternatives.

The following transportation projects outlined in the 2010-2035 Regional Transportation Plan of the New York Metropolitan Transportation Council1 are scheduled to occur in the project study area and will augment the existing transit network:

- *Second Avenue Subway:* The Second Avenue Subway is a two-track heavy rail line that will run along Second Avenue from 125th Street in Upper Manhattan to the Financial District in Lower Manhattan, and will include a new station at 34th Street and Second Avenue. The subway will include a connection from Second Avenue through the 63rd Street tunnel to existing tracks for service to West Midtown and Brooklyn, on which service will stop at the existing 34th Street/Herald Square station. Stations will be wheelchair-accessible and include escalators, stairs, and in compliance with the Americans with Disabilities Act (ADA), elevator connections from street-level to station mezzanine and from mezzanine to platforms.

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[1] New York Metropolitan Transportation Council (NYMTC): 2010-2035 Regional Transportation Plan - —A Shared Vision for a Shared Future; September 2009.

- *East Side Access:* The East Side Access project will connect LIRR's Main and Port Washington lines in Queens to a new LIRR terminal beneath Grand Central Terminal in Manhattan. The new connection will increase the LIRR's capacity into Manhattan and dramatically shorten travel time for Long Island and eastern Queens commuters traveling to the east side of Manhattan. This may reduce the number of passengers traveling from Penn Station to the East Side of Manhattan somewhat.
- *BRT:* NYCDOT and NYCT will implement BRT along First and Second Avenues, as well as along other routes in New York City. The First and Second Avenue corridor is approximately 8.5 miles long and will stretch from the South Ferry Station to 125th Street in Upper Manhattan. The M15 Limited bus currently serves this corridor. The proposed route will cross 34th St and will have stations within the corridor.
- *Extension of ❼ Subway Line:* In conjunction with the Hudson Yards rezoning, the MTA is extending the ❼ Subway line. The extension is from its existing terminus at West 41st Street and Seventh Avenue to a new terminus at West 34th Street and Eleventh Avenue.
- *Access to the Region's Core (ARC) Tunnel:* New Jersey Transit and the Port Authority of New York and New Jersey are constructing a new commuter rail tunnel between New Jersey and Manhattan. A new commuter rail station will be provided beneath 34th Street between Sixth and Eighth Avenues. ARC, which is planned for completion in 2017, will substantially increase the capacity of commuter rail service between Manhattan and areas west of the Hudson River.
- *Penn Station Access Study Update:* MTA Metro-North Railroad (Metro-North) has been preparing environmental analyses to examine the potential benefits and impacts associated with providing additional regional rail service within the New York Metropolitan Area from Metro-North's east-of-Hudson service territory to Penn Station, New York, and the west side of Manhattan. Proposed Penn Station Access service would be provided primarily by using existing infrastructure, with some capital improvements.

The proposed projects above would all occur in some part of the study area, and will be taken into consideration when evaluating all of the alternatives.

2.2.2 TRANSPORTATION SYSTEM MANAGEMENT ALTERNATIVE

The FTA describes TSM alternatives as relatively low-cost approaches to addressing transportation needs in a corridor. The TSM Alternative represents the "best that can be done" for mobility without constructing a new transit guideway. Generally, the TSM Alternative emphasizes upgrades in transit service through operational and relatively minor physical improvements, plus selected roadway upgrades through intersection improvements, minor widening, and other focused traffic engineering actions. A TSM Alternative normally includes such features as bus route restructuring, more frequent bus service, expanded use of articulated buses to increase capacity, bus lanes, special bus ramps on freeways, expanded park-and-ride facilities, express- and limited-stop service, signalization improvements, and improved transfer operations. While the scale of these improvements is generally modest, TSM alternatives may cost tens of millions of dollars while guideway alternatives range up to several hundreds of millions or billions of dollars. TSM alternatives are important components of transit studies because they provide a baseline against which all major investment alternatives can be evaluated. The most cost-effective TSM alternative generally serves as the baseline against which the selected Build Alternative is compared.1

For the 34th Street Transit Corridor the TSM Alternative will be based on Select Bus Service in New York City. It would include the following features between the FDR Drive and Twelfth Avenue:

- Low-floor, articulated buses that allow for near-level boarding and higher capacity;
- Existing signal timings with Transit Signal Priority (TSP) at limited locations;
- Increased enforcement of existing bus lanes; and
- Off-board or other fare collection to allow multiple door boarding.

These improvements should result in some reduction in travel time along the corridor and should provide a basis of comparison to for the alternatives discussed below. Projected end-to-end travel time for the TSM Alternative is 22 to 25 minutes based on current average travel times for buses (see Figure 1-10) and proposed improvements.

2.2.3 BUILD ALTERNATIVE 1—BUS RAPID TRANSIT

Build Alternative 1 would result in a new BRT line through the corridor. The following are the key characteristics of this alternative.

- *Technology:* Build Alternative 1 proposes BRT in the 34th Street corridor. The articulated bus proposed for the corridor will be low-floor to allow for level boarding.
- *Guideway:* Under this alternative, transit and non-transit traffic would be completely separated by a mountable physical barrier (e.g., raised curb, rumble strips, domes, etc) to reduce conflicts with vehicular traffic. Three alternative configurations for the guideway were considered, and are described below. Each configuration was evaluated for how it would fit in the existing curb-to-curb roadbed of 34th Street. It was assumed that a bus lane could be no narrower than 10 feet in width, a 12-foot-wide bus lane was preferred, and the physical barrier could be no narrower than 1.5 feet in width.
  - Curb-Running: BRT would run within the existing bus lane on 34th Street, which would be physically separated from the rest of the street. This change would have small effects on travel lanes: on some blocks one travel lane would need to be removed to accommodate the physical barriers due to the limited width of the road. Two-way traffic would be maintained for the entire corridor. Right turns along the corridor would be restricted through the use of separate signal phasing and turn prohibitions.

    Stations would be located on the existing sidewalks. Passengers would board westbound buses from the north curbside, and eastbound buses from the south curb. Both express and local buses, as well as emergency vehicles, would be able to use the bus lanes.

    Pedestrian space benefits would be limited due to the need for continuous bus lanes along the existing curb.

[1] This approach is also required for the FTA New Starts/Small Starts program.

Because of the presence of protected bus lanes along both curbs of 34th Street, parking and loading activity would be prohibited along the full length of 34th Street at all times.

- Median-Running: BRT would run in the center of 34th Street. A two-way transitway would be provided with treatments to separate the BRT lanes from general traffic lanes. Both express and local buses, as well as emergency vehicles, would be able to use the bus lanes. Two-way traffic would be maintained for the entire corridor; in some locations, the number of general travel lanes would need to be reduced by one.

  BRT stations would be constructed in the center of the 34th Street right-of-way near the intersections of north-south avenues. Pedestrians would then cross the general traffic lanes to reach the north or south sidewalks of 34th Street.

  Some sidewalk expansions would be possible depending on street width. Median stations would also serve as crossing refuges for pedestrians.

  Because of the width of the street, service deliveries/loading would not be allowed along 34th Street between Third and Ninth Avenues. East of Third Avenue and west of Ninth Avenue, service deliveries/loading and parking could be permitted along one curb of the street.

- Single Side Running: BRT would combine operate in a bi-directional busway oriented along the north curbside, south curbside, or combination of both curbsides along the corridor. Both express and local buses, as well as emergency vehicles, would be able to use the bus lanes. The remainder of the street would be used for up to two lanes of general traffic, as well as one lane of parking.

  One direction of bus riders would enter and exit vehicles from sidewalk stations while riders in the opposite direction would enter and exit from median stations.

  Sidewalk expansions could be added at most intersections where curbside parking space is available, as well as at other locations depending on street width. Median stations would also serve as crossing refuges for pedestrians.

  Under this configuration, one curb would be available at all times for parking or service delivery/loading activity on all blocks. On some blocks, loading could be available on both curbs for limited hours of the day, although doing so would require vehicles to use the bus lanes (such as by special permit).

For the Alternatives Analysis, the Single Side Running alignment will be used for the BRT mode option. While the benefits of the three options are similar, the parking impacts of the Curb-Running and Median-Running alternatives are considered to be unacceptable based on community needs, as shown by the significant amount of feedback received during the Alternatives Analysis outreach process. In addition, the Single Side Running alignment provides the most opportunities for creating additional pedestrian space. Therefore, this alignment best satisfies the goals and objectives of the project.

- *Stations:* Stations would be located at nearly every avenue crossing; a potential map of station locations is shown in **Figure 2-3**. However, the final station locations would be determined through the design process. These stations could be on the center median or on the sidewalk, depending on the configuration of the guideway and the direction of travel. BRT stations would be of high-quality design and have various amenities. These treatments would include large shelters, real-time information, and bicycle parking at key locations.

- *Fare Payment:* BRT would provide fare vending machines on station platforms, or similar payment systems. This would also facilitate all-door boarding, which allows patrons to board/exit the bus from the rear or the front, and would minimize dwell times.
- *Signal Operations:* TSP would be an integral component of this alternative by decreasing the frequency of delays at intersections. TSP will be at most signals through the corridor to allow for reduced end-to-end travel time.
- *Maintenance Facility:* Buses would be maintained at existing MTA depots.
- *Travel Time:* Projected end-to-end travel time for BRT is 18 to 20 minutes, based on current average travel times for buses (see Figure 1-10) and proposed improvements.

2.2.4 BUILD ALTERNATIVE 2—STREETCAR

Build Alternative 2 would result in a new streetcar line through the corridor. Following are the key characteristics of this alternative.

- *Technology:* Build Alternative 2 proposes streetcar service in the 34th Street corridor. Catenary wires (requiring a law change) or underground conduit would need to be installed in each direction along the corridor to supply power to the vehicles.
- *Guideway:* Under this alternative, transit and non-transit traffic would be operating in mixed traffic. Three alternative configurations for the guideway were considered, and are described below. This configuration was evaluated for how it would fit in the existing curb-to-curb roadbed of 34th Street. It was assumed that a streetcar lane could be no narrower than 11 feet, and that a 12-foot-wide streetcar lane was preferred.
  - Curb-Running: Streetcars would run within the existing bus lane on 34th Street, which would not be physically separated from the rest of the street. Vehicular traffic would be permitted to make right turns from the streetcar lane. Two-way traffic would be maintained for the entire corridor. Vehicles will only be permitted in the streetcar lane to make right turns.

    Stations would be located on the existing sidewalks. Passengers would board westbound streetcars from the north curbside, and eastbound streetcars from the south curb. Both express and local buses, as well as emergency vehicles, would be able to use the streetcar lanes.

    Pedestrian space benefits would be limited due to the need for continuous streetcar lanes along the existing curb.

    Due to the presence of streetcar lanes along both curbs of 34th Street, parking and loading activity would be prohibited along 34th Street at all times.
  - The Median-Running alignment for streetcar is very similar to the median alignment for the LRT Alternative; however, there will be no physical barrier between the streetcar and general traffic lanes. Vehicular traffic would only be permitted to enter the streetcar lane in order to make left turns.

Both express and local buses, as well as emergency vehicles, would be able to use the streetcar lanes. Two-way traffic would be maintained for the entire corridor; in some locations, the number of general travel lanes would need to be reduced by one.

Streetcar stations would be constructed in the center of the 34th Street right-of-way near the intersections of north-south avenues. Pedestrians would then cross the general traffic lanes to reach the north or south sidewalks of 34th Street.

Some sidewalk expansions would be possible depending on street width. Median stations would also serve as crossing refuges for pedestrians.

Because of the width of the street, service deliveries/loading would not be allowed along 34th Street between Third and Ninth Avenues. East of Third Avenue and west on Ninth Avenue, service deliveries/ loading and parking could be permitted along one curb of the street.

- Single Side Running: Streetcar would combine the above options with a bi-directional streetcar oriented along the north curbside, south curbside, or combination of both curbsides along the corridor. Because some streetcar stations will be located in the median, the benefits of streetcar, operating in mixed traffic, are negated.

  Both express and local buses, as well as emergency vehicles, would not be allowed to use the streetcar lanes. Two-way traffic would be maintained for the majority of the corridor however, the number of general travel lanes would need to be reduced by one through the majority of the corridor.

  One direction of streetcar riders would enter and exit vehicles from sidewalk stations while riders in the opposite direction would enter and exit from median stations.

  Sidewalk expansions could be added at most intersections where curbside parking space is available, as well as at other locations depending on street width. Median stations would also serve as crossing refuges for pedestrians.

  Because of the width of the street, service deliveries/loading would not be allowed along 34th Street between Third and Ninth Avenues. East of Third Avenue and west of Ninth Avenue, service deliveries/ loading and parking could be permitted along one curb of the street.

For the Alternatives Analysis, the Curb-Running alignment will be used for the Streetcar mode option. The Curb-Running alternative allows for a more efficient mixed traffic operation and will require less right-of-way because the alignment will not require platforms. It will also allow express and local buses as well as emergency vehicles to use the streetcar lanes.

- *Stations:* As with BRT, stations would be located at nearly every avenue crossing as shown in **Figure 2-4**, with the final station locations to be determined during the design process. These stations would be located on the sidewalk, as the guideway would be Curb-Running. The streetcar stations would be of high-quality design and have various amenities. These treatments would include large shelters, real-time information, and bicycle parking at key locations.
- *Fare Payment:* Streetcars would provide fare vending machines on station platforms, or similar payment systems. This would also facilitate all-door boarding, which allows patrons to board/exit the streetcar from the rear or the front, and would minimize dwell times.

- *Signal Operations:* TSP would be an integral component of this alternative by decreasing the frequency of stops at intersections. TSP would operate at most signals through the corridor to allow for reduced end-to-end travel time. Streetcar operations would encounter mixed traffic at intersections where vehicular traffic makes right turns.
- *Maintenance Facility:* A new storage and maintenance facility would need to be constructed on or near the corridor for this mode.
- *Travel Time:* Projected end-to-end travel time for streetcar is 21 to 23 minutes, based on current average travel times for buses (see Figure 1-10) and proposed improvements.

2.2.5 BUILD ALTERNATIVE 3—LIGHT RAIL TRANSIT

Under Build Alternative 3, an LRT line would be constructed along the proposed 34th Street alignment. The following are the key characteristics of Build Alternative 3.

- *Technology:* Build Alternative 3 proposes LRT service in the 34th Street corridor. Catenary wires (requiring a law change) or an underground conduit would need to be installed in each direction along the corridor to supply power to the vehicles. Diesel LRT vehicles could also be used, which would eliminate the need for overhead catenary.
- *Guideway:* Under this alternative, transit and non-transit traffic would be completely separated by a physical barrier (e.g., raised curb) to reduce conflicts with vehicular traffic. Three alternative configurations for the guideway were considered, and are described below. These configurations were evaluated for how they would fit in the existing curb-to-curb roadbed of 34th Street. It was assumed that an LRT lane could be no narrower than 11 feet wide, a 12-foot-wide guideway was preferred, and the physical barrier could be no narrower than 1.5 feet wide.
  - Curb-Running: LRT would run within the existing bus lane on 34th Street, which would be physically separated from the rest of the street by a mounted barrier except at designated intersections where right turns will be permitted. Two-way traffic would be maintained for the majority of the corridor.

    Stations would be located on the existing sidewalks. Passengers would board westbound LRT vehicles from the north curbside, and eastbound streetcars from the south curb. Both express and local buses, as well as emergency vehicles, would not be permitted into the guideway.

    Pedestrian space benefits would be limited due to the need for continuous LRT lanes along the existing curb.

    Due to the presence of LRT lanes along both curbs of 34th Street, parking and service deliveries/loading activity would be prohibited along 34th Street at all times.
  - Median-Running: LRT would run in the center of 34th Street, where a two-way guideway would physically separate from general travel lanes. Both express and local buses, as well as emergency vehicles, would not be allowed to use the guideway. Two-way traffic would be maintained for portions of the corridor; in some locations, the only one-way traffic will be permitted.

LRT stations would be constructed in the center of the 34th Street right-of-way near the intersections of relevant north-south avenues. Pedestrians would then cross the general traffic lanes to reach the north or south sidewalks of 34th Street.

Some sidewalk expansions would be possible depending on street width. Median stations would also serve as crossing refuges for pedestrians.

Because of the width of the street, service deliveries/loading would not be allowed along 34th Street between Third and Ninth Avenues. East of Third Avenue and west of Ninth Avenue, service deliveries/loading and parking could be permitted along one curb of the street.

– Single Side Running: LRT would combine the above options with a bi-directional streetcar oriented along the north curbside, south curbside, or combination of both curbsides along the corridor.

  Both express and local buses, as well as emergency vehicles, would not be allowed to use the LRT guideway. Two-way traffic would be maintained for the entire corridor, however, general traffic would be reduced to one lane in each direction between Third and Ninth Avenues.

  One direction of LRT riders would enter and exit vehicles from sidewalk stations while riders in the opposite direction would enter and exit from median stations.

  Sidewalk expansions could be added at most intersections where curbside parking space is available, as well as at other locations depending on street width. Median stations would also serve as crossing refuges for pedestrians.

  Because of the width of the street, service deliveries/loading would not be allowed along 34th Street between Third and Ninth Avenues. East of Third Avenue and west on Ninth Avenue, service deliveries/ loading and parking could be permitted along one curb of the street.

For the Alternatives Analysis, the Median-Running alignment will be used for the LRT mode option. Because the Curb-Running alignment is so similar to the Curb-Running alignment for streetcar this option was eliminated for LRT. The Curb and Singe Side Running alignments would require interrupting the mandatory physical barrier between the LRT guideway and travel lanes to get access to driveways. Therefore, safe and rapid operation of LRT can not be guaranteed with the Curb and Side Running Options.

- *Stations:* Stations would only be located at every other avenue crossing, as shown in **Figure 2-5,** with final station locations to be determined during the design process, especially taking into account transfer opportunities to other modes. These stations would be located in the median of the street with refuge areas near the crosswalks. The LRT stations would be of high-quality design and have various amenities. These treatments would include large shelters, real-time information, and bicycle parking at key stations.
- *Fare Payment:* LRT would provide fare vending machines on station platforms, or similar payment systems. This would also facilitate all-door boarding, which allows patrons to board/exit the light rail vehicle from the rear or the front, and would minimize dwell times.

- *Signal Operations:* TSP would be an integral component of this alternative by decreasing the frequency of stops at intersections. TSP would be at most signals through the corridor to allow for reduced end-to-end travel time.
- *Maintenance Facility:* A new storage and maintenance facility would need to be constructed on or near the corridor for this mode.
- *Travel Time:* Projected end-to-end travel time for LRT is 17 to 19 minutes, based on current average travel times for buses (see Figure 1-10) and proposed improvements.

2.2.6 BUILD ALTERNATIVE 4—AUTOMATED GUIDEWAY TRANSIT

Build Alternative 4 would result in AGT, such as a people mover, through the corridor. The following are the key characteristics of this alternative.

- *Technology:* Build Alternative 4 proposes a type of AGT. The system envisioned is an elevated and automated people mover that would use either monorail or third rail electric power.
- *Guideway:* Due to the general definition and characteristics of AGT (see section 2.1.3.5), the guideway would be elevated above a center median, which would need to be created for installation of the support structure. This configuration was evaluated for how it would fit in the existing curb-to-curb roadbed of 34th Street. It was assumed that the needed right-of-way for the AGT guideway structure is no narrower than 10 feet, and the existing bus lanes would be eliminated.
  - Median-Running: The AGT support structure would run in the center of 34th Street and be protected from general traffic lanes to minimize collisions against the structure. Both express and local buses, as well as emergency vehicles, would have to use general traffic lanes. Two-way traffic would be maintained for the entire corridor; in some locations, the number of general travel lanes would need to be reduced by one.

    AGT stations would be aerial at the same elevation as the AGT guideway in the center of the 34th Street right-of-way near the intersections of relevant north-south avenues. Pedestrians would cross the general traffic lanes from the north or south sidewalks of 34th Street to get to the median from where stairs, elevators, and/or escalators lead to the elevated station platform. These medians would also serve as a pedestrian refuge when crossing the 34th Street.

    Some sidewalk expansions would be possible depending on street width. Median stations would also serve as crossing refuges for pedestrians. Some sidewalk space would be required for staircases to stations.

    Because of the width of the street, service delivery / loading would not be allowed along 34th Street between Third and Ninth Avenues. East of Third Avenue and west on Ninth Avenue, service delivery / loading and parking could be permitted along one curb of the street. Alternatively, loading and parking could be allowed some hours of the day with reduced street travel capacity.
- *Stations:* Stations would be located at some of the avenue crossings (as shown in **Figure 2-6)** where transfers to other modes are possible, with final locations to be determined during the design process. All stations would be elevated and access would be located in

the median. The AGT stations would be of high-quality design and have various amenities. These treatments would include large shelters and real-time information.

- *Fare Payment:* Fare collection would be achieved off-board through the use of turnstiles at or before the station platforms.
- *Signal Operations*: The AGT vehicles would operate at set speeds along the guideway. Because the AGT is grade separated, operations would be seamless and separated from vehicular traffic. Therefore, no TSP would be required.
- *Maintenance Facility:* A new storage and maintenance facility would need to be constructed on or near the corridor for this mode.
- *Travel Time*: Projected end-to-end travel time for AGT is 13 to 19 minutes, based on current average travel times for buses (see Figure 1-10) and proposed improvements.

2.2.7 BUILD ALTERNATIVE 5—HEAVY-RAIL

Under Build Alternative 5, a new subway line would be constructed beneath 34th Street. The following are the key characteristics of Build Alternative 5.

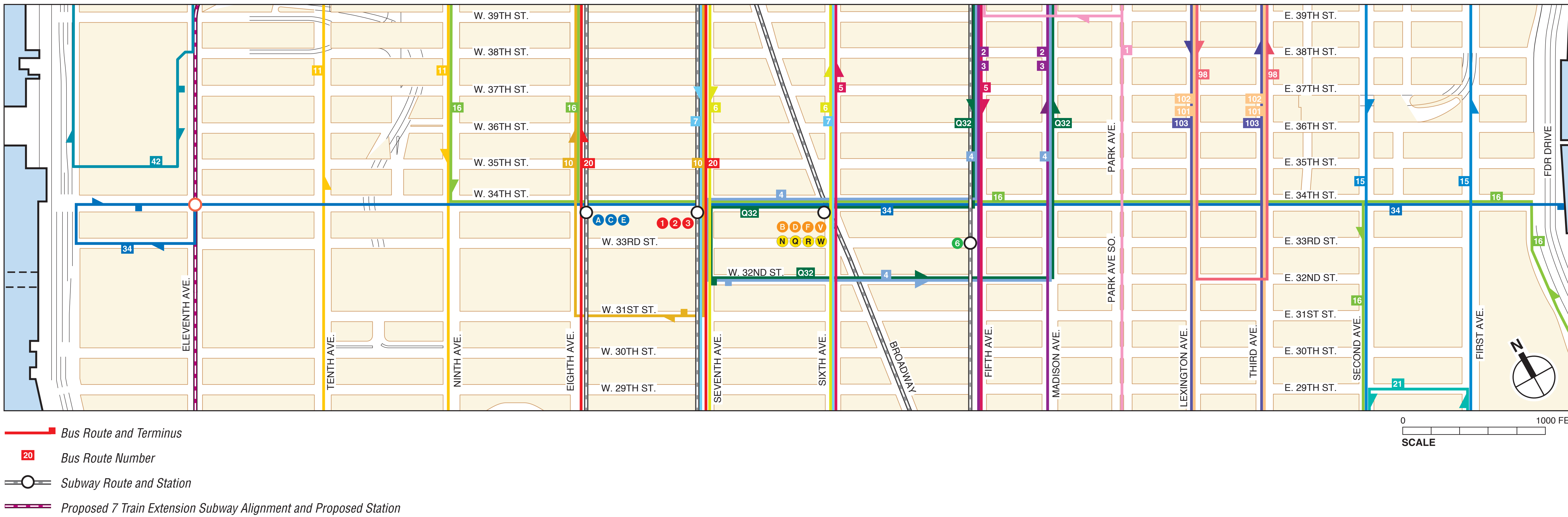
- *Technology:* Build Alternative 5 proposes heavy rail or subway for the 34th Street corridor. The subway system envisioned would be one that is similar to the systems on 14th Street (L) and 42nd Street (7).
- *Guideway:* The guideway would be underground and run between the ferry terminals at the East River and the Hudson River, using 34th Street and parts of the FDR Drive Service Road/Marginal Road and Twelfth Avenue, respectively. It is assumed that the existing bus lanes would be removed to allow various lane configurations for above-ground traffic. To be consistent with the other analyzed modes, emergency vehicles, as well as express and local buses would operate with general vehicular traffic.
- *Stations:* Like AGT, stations would be located only at some avenue crossings (as shown in **Figure 2-7)** where transfers to other modes are possible. The stations would be similar to the proposed subway stations being constructed for the Second Avenue subway, which include real-time information and additional amenities, such as elevators.
- *Fare Payment:* Fare control would be achieved through the use of turnstiles at existing subway stations.
- *Signal Operations:* Subway would operate at set speeds along the guideway. Because the subway operates below-grade, operations would be seamless and separate from vehicular traffic. Therefore, no TSP is required.
- *Maintenance Facility:* It is assumed that existing subway storage and maintenance facilities would be used for this mode, via a connection to an existing subway line.
- *Travel Time:* Projected end-to-end travel time for subway is 9 to 11 minutes, based on current average travel times for similar subway lines throughout the city.

2.2.8 OTHER TECHNOLOGIES

Recommended technologies to be included in the evaluation process were presented for comment during the first public meeting in November 2009, as well as on the NYCDOT website and through other public presentations. There was general public concurrence with the technologies described in this chapter. During the outreach, other technologies were also suggested for consideration in the Alternatives Analysis. It was determined that none of the alternative technologies suggested would be able to address the full purpose and need of the proposed project; however, some may be worth considering as supplemental measures or additions to other alternatives. A complete description of other suggested technologies received through the public outreach process is contained in Chapter 4.

2.2.9 RECOMMENDED TECHNOLOGIES

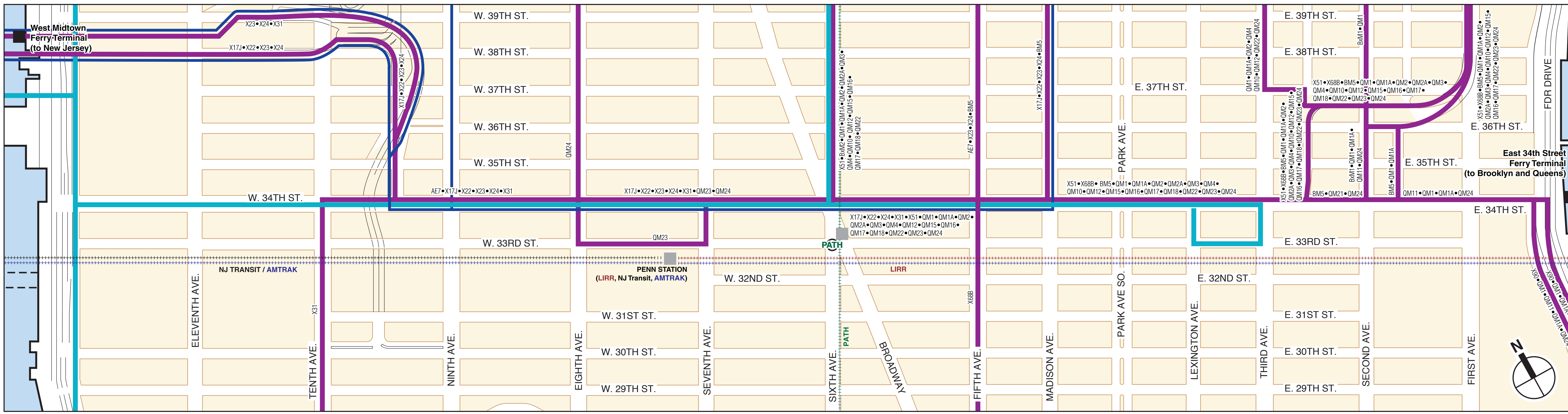
All five Build alternatives, as well as the No Build and TSM alternatives, will be evaluated and screened in a two-tiered process in Chapter 3, "Alternatives Screening Analysis."



NYCT Subway and Bus Service

Figure 2-1

12.23.09



QM23 Express Bus Routes (New York City Transit, MTA Bus Company, and Atlantic Express)

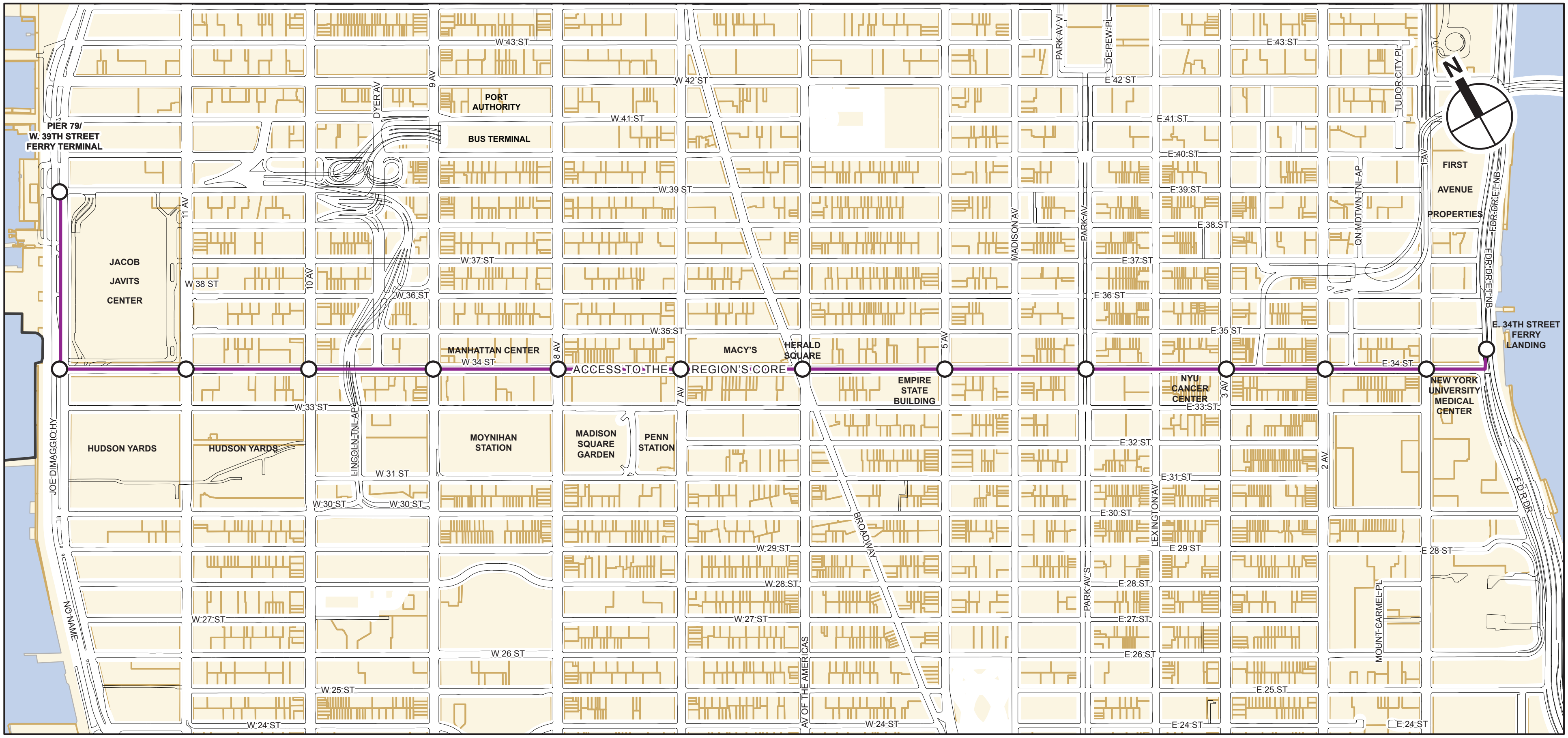
New York Waterway Bus Route

Academy Bus

0 1000 FEET
SCALE

Other Transit Service
Figure 2-2

12.23.09



34th Street Guideway

Station

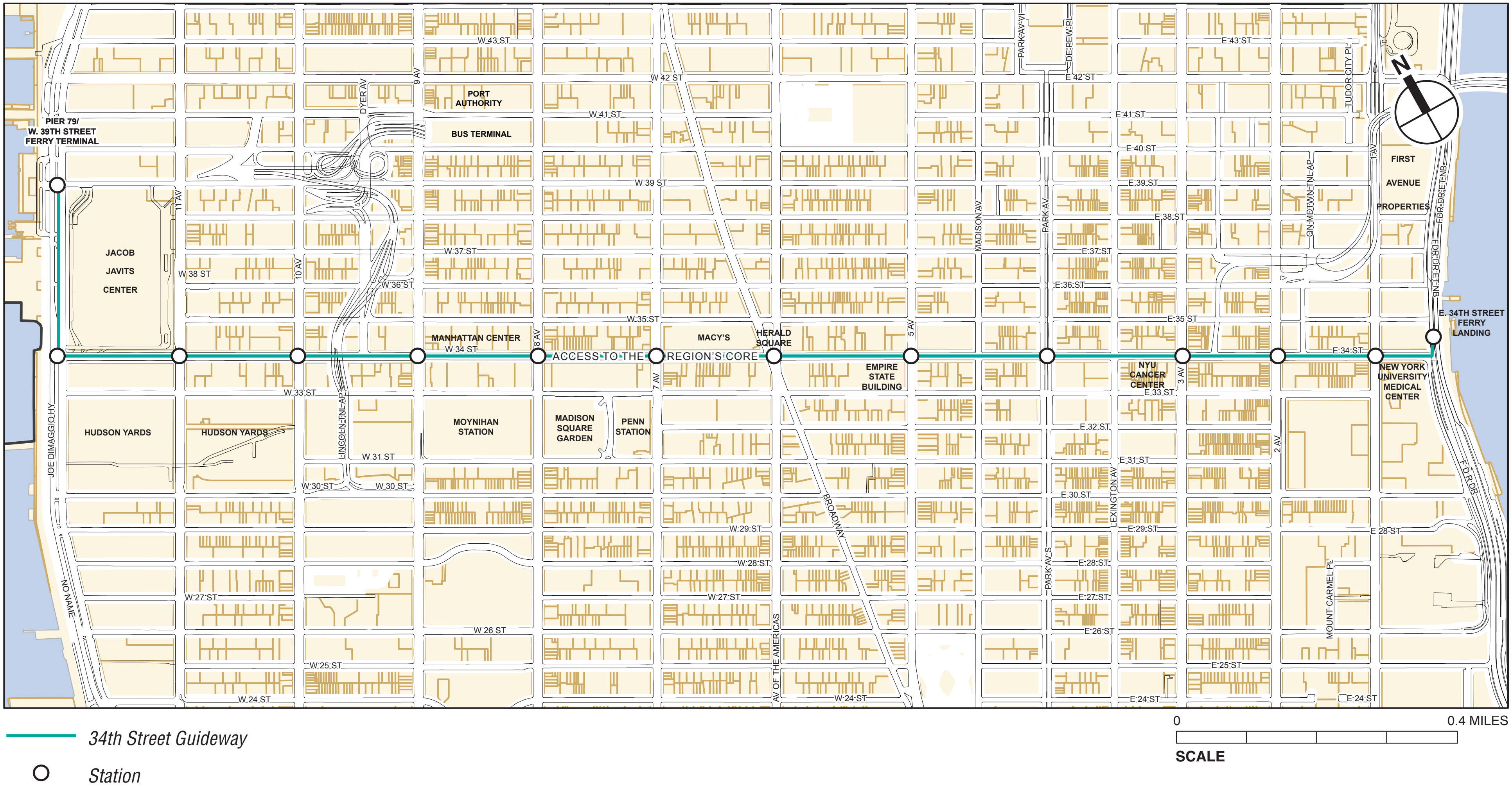
0 0.4 MILES

SCALE

Build Alternative 1 - BRT Station Map

Figure 2-3

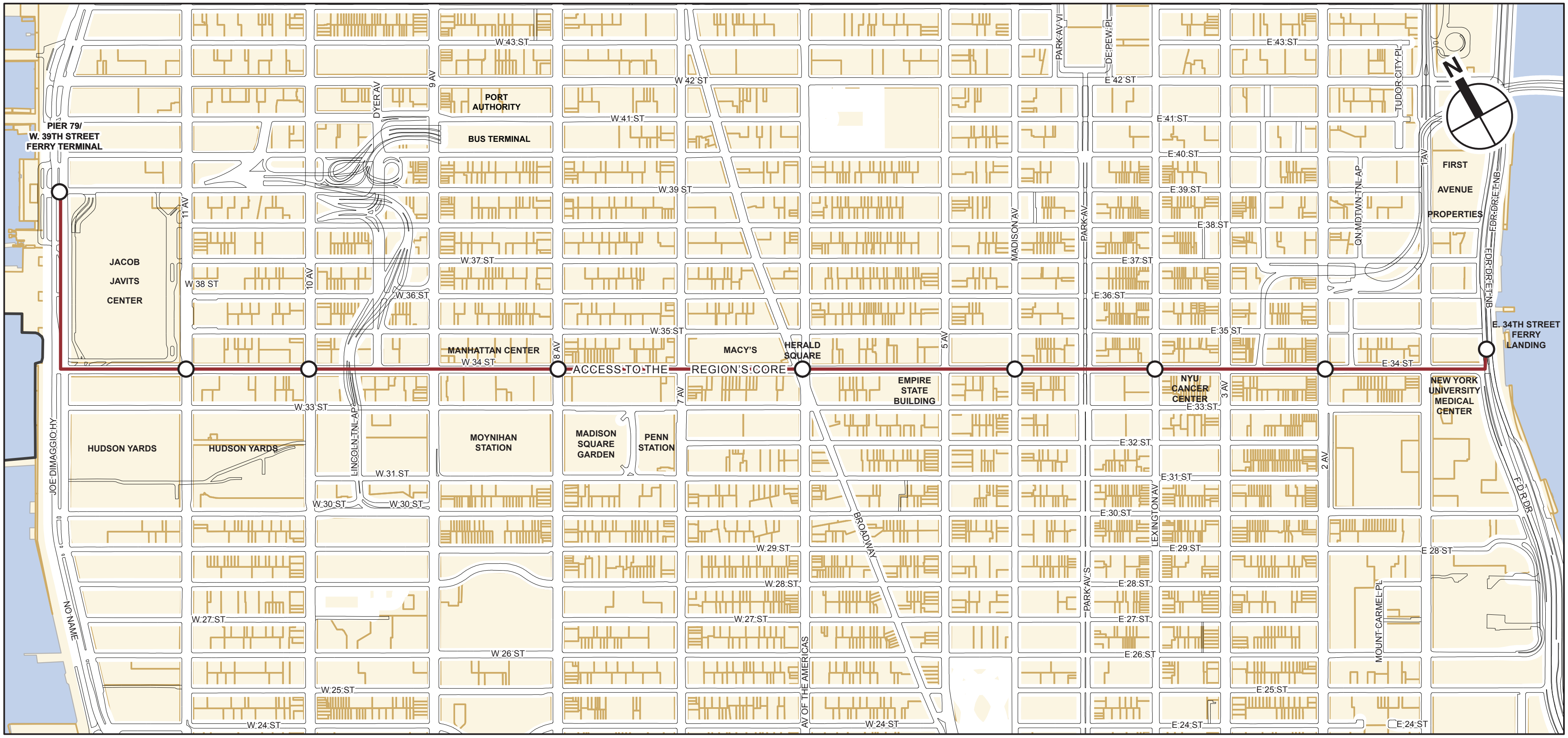
12.23.09



Build Alternative 2 - Streetcar Station Map

Figure 2-4

12.23.09



34th Street Guideway

Station

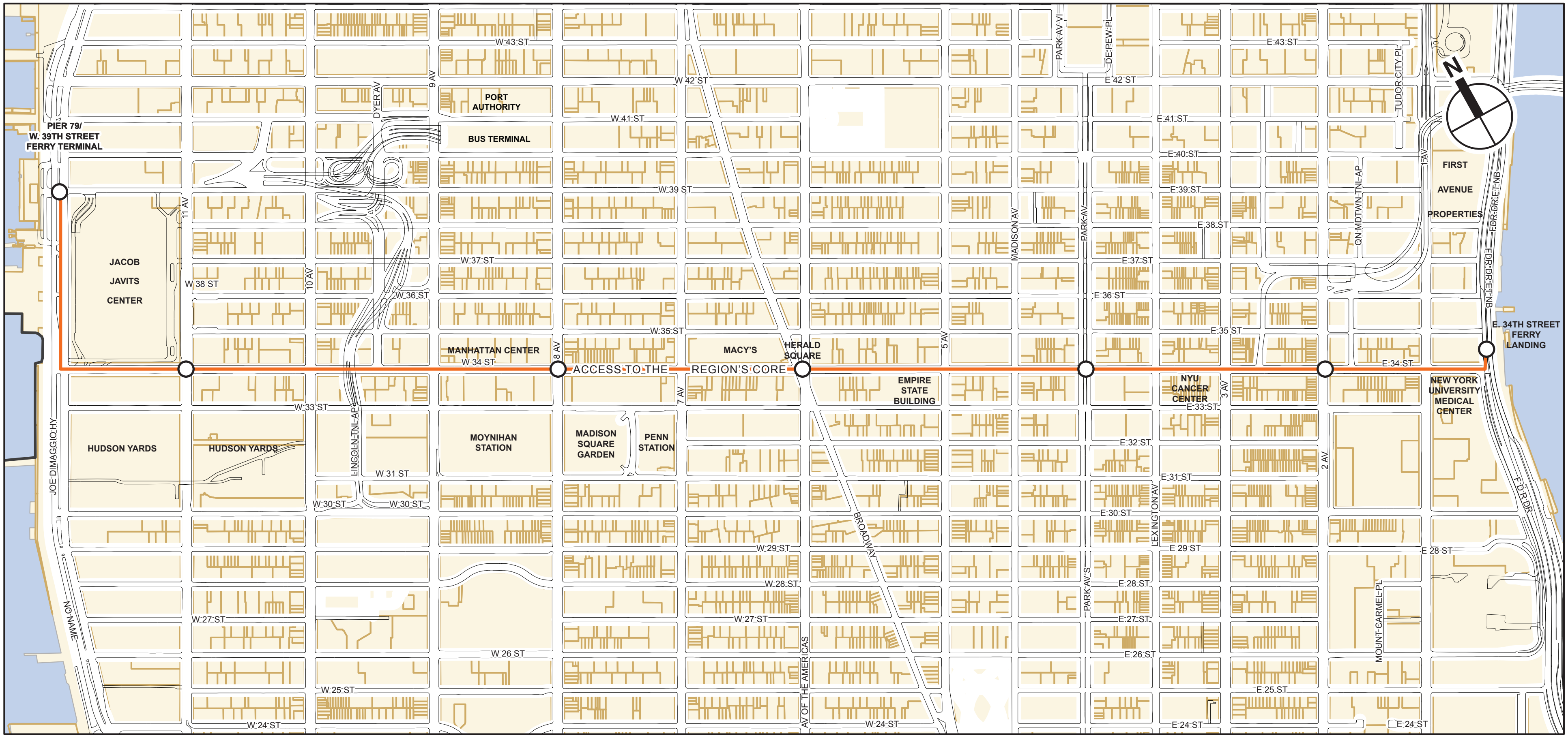
0 0.4 MILES

SCALE

Build Alternative 3 - Light Rail Potential Station Map

Figure 2-5

12.23.09



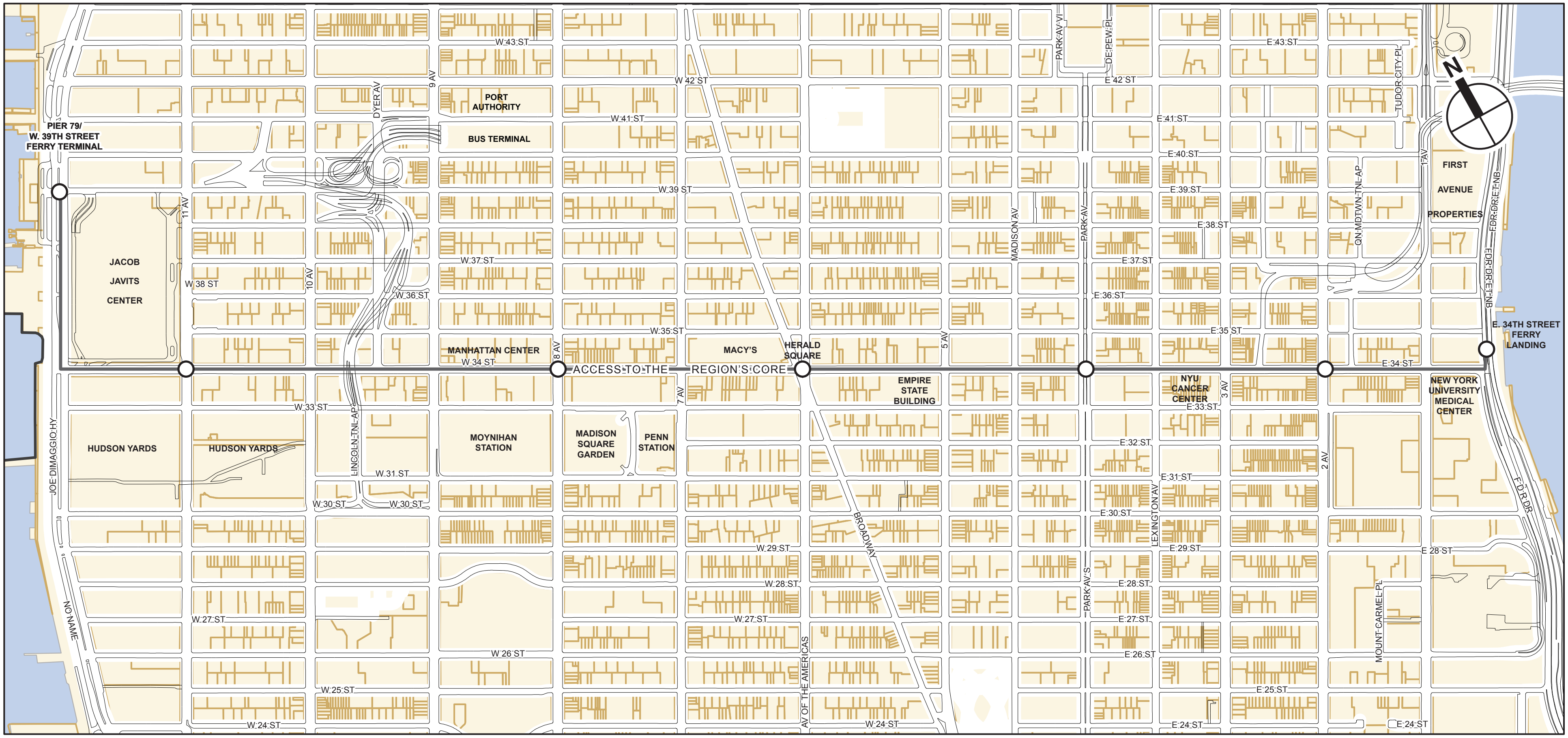
34th Street Guideway

Station

Build Alternative 4 - AGT Potential Station Map

Figure 2-6

12.23.09



34th Street Guideway

Station

0 0.4 MILES

SCALE

Build Alternative 5 - Subway Potential Station Map

Figure 2-7