I. INTRODUCTION

This technical memorandum analyzes proposed design modifications for East Side Access to determine whether additional environmental impacts would result that were not identified in the Final Environmental Impact Statement (FEIS) prepared for the project, dated March 2001, and the Record of Decision (ROD) issued by the Federal Transit Administration (FTA) on May 21, 2001. The proposed modifications are changes to the design of the non-public (back-of-house) spaces within the LIRR Concourse and the number and location of proposed entrances to the new LIRR Concourse.

This memorandum describes the FEIS design, subsequent NEPA reviews, and the proposed design modifications, and then discusses the impacts of the modified design during construction and operation, in comparison to the impacts that were previously disclosed. As discussed in this memorandum, the proposed change would not introduce any new significant adverse impacts or require any change to mitigation commitments.

Since the ROD was issued in May 2001, several Project design changes were proposed and evaluated for their potential environmental impacts. The assessments, described below, examined the proposed modifications with respect to the analyses presented in the FEIS to determine if any additional significant adverse impacts, which were not previously disclosed, would result from the changes.

- In February 2002, FTA concurred with an assessment that found no new adverse environmental impacts would result from tail tracks that will extend to 38th Street.
- In April 2006, FTA concurred with an environmental analysis of Design Changes in Queens Revision 14-4M that stated no new significant adverse environmental impacts would result when compared to what was presented in the 2001 FEIS and that no further environmental review was needed.
- In July 2006, FTA issued a Finding of No Significant Impact (FONSI) based on a Revised Supplemental Environmental Assessment to the FEIS (the EA) that was prepared to address community concerns regarding the new design for the 50th Street ventilation facility, which also included a loading dock and cooling towers.
- In July 2008, FTA concurred with an assessment of the 37th Street sidewalk grates and ventilation plenum that stated no significant adverse impacts would result from its construction or operation.

The current design modifications do not affect the Queens alignment, the tail tracks, or the 37th Street ventilation plenum/sidewalk grates. As a result, only the FEIS and the 50th Street Facility EA are discussed in this technical memorandum.

The last section of this Technical Memorandum includes proposed language for the Amended Programmatic Agreement between FTA, MTA and the State Historic Preservation Office (SHPO) dated July 2006. Under the new language, the stipulations of the Programmatic Agreement would apply to any new historic property or archaeologically sensitive area that is identified within a revised Area of Potential Effect (APE) that results from a future design change. Currently, the historic properties and archaeologically sensitive areas are specifically identified in the Programmatic Agreement. The proposed language allows for ongoing Section 106 consultation with SHPO, while limiting the number of amendments to the Programmatic Agreement that could be required during final design and construction.

Sections II and III below address the proposed changes to the LIRR Concourse and entrance scheme, respectively. Section IV addresses a GCT operating policy decision and Section V, the proposed language for the Programmatic Agreement amendment.

II. PROPOSED CHANGES TO LIRR CONCOURSE

Two proposed changes affect the concourse level of the new LIRR terminal. A description of the changes, their need, and the potential beneficial and adverse effects that could result from their implementation are described below.

Description of Proposed Change

One-Track Push Back

A minor modification to the 350,000-square-foot LIRR Concourse, which does not affect the planned public circulation or retail space, is proposed. In order to provide Metro-North Railroad (MNR) with additional train storage space on the lower level of GCT, the proposed modification (known as the One-Track Push Back) would reduce the footprint of the LIRR Concourse along Track 161. This One-Track Push Back would occupy about 4,900 square feet of space in the northeastern section of the LIRR Concourse. The non-public space in the service corridor and along the northeastern perimeter of the Concourse would be reconfigured and redesigned to accommodate the rooms that would be displaced by the Push-Back.

The FEIS design left almost 30,000 square feet of unassigned space in the Concourse. In conjunction with re-allocations of space for LIRR operations, MTA police, retail etc., the current design includes an additional 20,000 square feet of public circulation space and 8,000 square feet of retail space compared to the FEIS design. Under the current design, only 625 square feet of unassigned space remains. It was anticipated that as design progressed, the level of unassigned space would be reduced.

The table below shows how the space allocation in the proposed LIRR Concourse has changed over time.

Space Allocation in LIRR Concourse

PROGRAM CATEGORY		2005 (Design SF)	2009 (Design SF)
LIRR Terminal Management	LIRR Passenger Services	22,638	18623
	LIRR System Safety		433
	LIRR Information Technology		1267
	LIRR Controllers		283
LIRR Transportation	LIRR Transportation	9,121	7,941
LIRR Engineering	LIRR Engineering	12,055	20,232
	Third Party Communication Vendors		899
MTA Police	MTA Police	5,396	11,075
Building Infrastructure	Building Infrastructure	92,913	92,946
Retail	Retail	18,463	26,515
Public Spaces (Circulating, waiting, queuing)	Public Spaces (Circulating, waiting, queuing)	79,636	89,694
Vertical Circulation	Vertical Circulation	11,360	11,014
Service	Service	58,989	59,530
MNR Access Corridor	MNR Access Corridor	825	573
Commissary	Commissary	8,705	8,705
Unassigned	Unassigned	29,233	625
CONCOURSE (TOTAL SQUARE FEET)		**349,334**	**350,355**

Staging Area for the Unified Trash and Recycling Facility

A Unified Trash and Recycling Facility is proposed jointly by MNR and LIRR, to be funded separately from East Side Access. The facility will have independent utility from ESA and would occupy tracks 186, 187, and 188 to the north of the proposed LIRR service corridor in the approach tunnels to GCT.

Neither the design nor function of the 50th Street Facility would change as a result of the Recycling Facility. The 50th Street Facility would still include a loading dock for deliveries of materials and equipment for the LIRR Terminal, and as a fall back facility for trash and recyclables in the event that normal operations of the Unified Trash and Recycling Facility are interrupted. Approximately 2,000 square feet of space would be allocated within the LIRR service corridor (back-of-house space) for use as a staging area for this facility.

FEIS Design

The concept design for the proposed LIRR Concourse under the Preferred Alternative that was presented in the FEIS was a schematic (see Figure 2-8). The concept design did not provide the level of detail needed to describe the proposed changes associated with either the One-Track Push Back or the staging area for the Unified Trash and Recycling Facility.

The description presented in the FEIS for the LIRR Concourse is as follows:

> *The Preferred Alternative would bring trains to a new level beneath the existing lower level at GCT, and would create a new passenger concourse on the west side of the existing lower level of GCT. The new passenger concourse would occupy the westernmost track area of GCT's lower level (the area that would be used for LIRR's new tracks and platforms under Option 1). That area is currently occupied by four tracks used for MNR service (tracks 114-117) and the tracks of MNR's Madison Yard. The new finished concourse space would be separated from MNR's track area to the east, and would be well lit and climate controlled. It would include passenger amenities, such as ticketing booths, information booths, waiting room seating, retail elements (newsstands, etc.), and required LIRR administrative and operational support services. (see page S-12)*

50th Street Facility EA

The EA prepared for the 50th Street Facility did not provide any details on the service corridor leading to the Facility.

Assessment of Effects of Proposed Concourse Changes

Neither the One-Track Push Back nor the staging area for the Unified Trash and Recycling Facility would result in significant adverse impacts in any of the NEPA impact areas or change the conclusions presented in either the FEIS or the 50th Street EA. The One-Track Push Back would benefit public transportation by providing an additional revenue track for MNR's service. Allowing for a staging area within the LIRR service corridor would facilitate the operations of the new Recycling Facility, which will have many benefits, including a reduction of a few truck trips per day at the 50th Street Facility.

III. PROPOSED CHANGES TO ESA ENTRANCE SCHEME

The proposed changes affecting entrances to the new LIRR Terminal include deferring one street entrance (at 45th Street) until plans for the host building are finalized and eliminating one street entrance (at 44th Street) due to constructability issues. Figure 1 shows the street entrance scheme presented in the FEIS and indicates the current plans for entrances.

FEIS Design Description

New entrance locations were chosen from an initial list of 27 sites (developed during the Major Investment phase of the project) based on a set of objective siting criteria. While a review of structural and architectural drawings for affected buildings was part of the screening process, for some buildings these drawings were not up-to-date or even available. The FEIS (pg. 2-14) states that "as info becomes available through surveys performed during P.E., the locations chosen will continue to be reviewed and assessed... any change in the location of an entrance to GCT is likely to a minor one, with potential shifts within the same building or block, or to a nearby street, which would not significantly affect the environmental analyses presented in this document." The sites listed for the Preferred Alternative include:

- 44th Street (the Bank of America building at 335 Madison Avenue);
- 45th Street (the MTA Building at 347 Madison Avenue);
- 47th Street (the American Brands Building at 245 Park Avenue on the south side of the street between Park and Lexington avenues);
- 48th Street (outside of the Chase building at 270 Park Avenue on the southwest corner);
- 48th or 49th Street (the Bankers Trust building at 280 Park Avenue between Madison and Park avenues).

It is important to note that the number of entrances selected was based on criteria related to customer convenience and was not a result of projected demand. It is also important to note that the five street entrances were initially selected for Option 1 of the Manhattan Alignment. Option 1 would require the use of the lower level of GCT for a new LIRR terminal instead of constructing the platforms and mezzanine beneath the lower level (and using only Madison Yard in the lower level for a new Concourse), as in the Preferred Alternative (Option 2). Option 1 would rely on the Biltmore Room, new space created adjacent to the Dining Concourse, and three cross passageways for passenger circulation, whereas Option 2 provides for a large 350,000 square foot concourse that offers direct exit to streets and significantly better passenger circulation for both LIRR and MNR customers.

The Preferred Alternative would also use three of the access points constructed as part of the Grand Central North Project (including the 383 Madison Avenue building) by constructing an escalator bank between MNR Tracks 34/35 and 36/37 from the 47th Street cross passage to the LIRR Concourse, and two stairwells at the far west end of the 47th Street Crosspassage.

The FEIS states that the Biltmore Room would be "considered" for the Preferred Alternative; however, it was included in the design for Option 1. *In Option 1, pedestrians entering GCT would use one of two vertical circulation elements that carry people up directly into the Biltmore Room under 43rd Street. Pedestrians would also be able to enter GCT's Dining Concourse near and just west of track 116 walking through a small waiting area at the south end of LIRR tracks. In Option 2, all pedestrians would first enter the Dining Concourse near track 116 to make their way upward using a number of vertical circulation elements available such as the Oyster Bar ramps and the new escalator bank bringing people up near the New York Transit Museum store.* (see page 9C-61 and Figure 9C-2, attached)

Based on 2020 demand and beyond (analyses assumed that the LIRR system would operate at full capacity i.e., 24 twelve-car trains per hour, 95 percent full); a significant amount of excess capacity would be provided under the Preferred Alternative.

Description and Justification for the Change

The 45th Street Entrance (MTA building at 347 Madison) would be deferred until a later date and the 44th Street Entrance (the Bank of America building at 335 Madison Avenue) would be eliminated. The current design includes an ADA elevator within the new ventilation structure on 44th Street, and while the 44th Street Entrance would not be built as part of East Side Access, the concourse design would not preclude its construction at some later date, should future passenger flow demand justify such expenditure.

The entrances at 47th Street (245 Park Avenue) and 48th Street (280 Park Avenue) are common to both the EIS and the proposed design.

The 44th and 45th street entrances, in general, were shown to process small pedestrian flows when examining the ridership model's zonal end destinations, likely, in part, because land uses served by those entrances are almost fully built out today and destinations to the southwest are also served by Penn Station for LIRR customers. These entrances would each process about five to six percent of all egressing flows; by comparison, other individual entrances would process ten or more percent of egressing flows.

Two modest-sized (similar to the recently constructed MNR North End Access entrances) 48th Street entrances were identified in the FEIS – one at 280 Park Avenue and the other, across the street on the same block, at 270 Park Avenue. This entrance at 270 Park Avenue was planned with one stairway and one escalator daylighting in the large open plaza area at 270 Park Avenue (west side of Park Avenue). The entrance was mandated under Option 1 (shallow tunnel option in the FEIS) to correct a dead-end condition in a proposed 48th Street cross passage. Since there is no 48th Street cross passage under the Preferred Alternative, the need for this entrance is not critical. The current design includes a large entrance at 280 Park Avenue (four escalators and a staircase on 48th Street), eliminating the redundancy of the two FEIS entrances while providing ample capacity for those destined to 48th Street and north.

Constructability constraints related to the 45th and 44th Street entrances are described below.

45th Street (MTA building at 347 Madison Avenue)

The 45th Street entrance would be located between Vanderbilt and Madison avenues beneath 45th Street coming up into the MTA building at 347 Madison Avenue. Three escalators and a stairway would be constructed. MTA's building at 347 Madison Avenue is a relatively antiquated building, making construction of the entrance difficult. The construction would require relocation of the ground-floor tenants, and removal and relocation of the building's mechanical systems including: steam rigs and the steam line from the street; compressed-air service; ground-floor duct work and air handling units; storm and sanitary lines; and water heaters.

In addition, several existing building columns would require underpinning, increasing construction risk and costs. Construction would also require penetration of the exterior

UA wall of GCT and relocation of an Empire City Duct Line containing 35 occupied conduits (constituting two years of work).

A proposal to demolish 347 Madison Avenue to permit as-of-right high-rise development at the site is under consideration by MTA. Given the difficulties associated with the entrance construction, and the possibility of site redevelopment, MTA proposes to defer the design of this entrance until plans for the building are finalized. Redevelopment of the site would facilitate the integration of a street entrance on 45th Street and eliminate the problems associated with maintaining the entrance during construction.

In order to meet New York State Building Code requirements, an emergency fire exit consisting of a stairway would be constructed leading to 347 Madison Avenue in the interim. The Code requires that travel distance to an exit from any public space within the Concourse cannot exceed 250 feet, and as a result, this stairway would be required to meet code.

44th Street Entrance (Bank of America Building at 335 Madison Avenue)

The entrance on 44th was planned to be constructed within the Bank of America building. At the Concourse level beneath 44th Street, a large opening would be created in the UA wall, entering a vestibule for two escalators and a stair that would convey passengers southerly to a landing constructed within the parking level of the MTA garage. From that landing, two escalators and stair would lead to an entry lobby at Madison Avenue. In addition, for the parking level landing, a wide staircase would be built leading to the passageway adjacent to the Biltmore Room. This would require relocation of a retail tenant at the street, lower lobby and basement levels, and permanent taking of those spaces, within the Bank of America building. It would significantly reduce the quantity of MTA garage parking, and would reduce basement tenant space currently occupied by a health club, requiring permanent taking of that area. In addition, it would require relocation of existing building services, an existing emergency egress stair, and a building exhaust air shaft. Two existing perimeter building columns would be removed, requiring reframing of the basement and sub-basement floors.

FEIS Analyses Related to the Proposed Changes

Pedestrian Conditions Within GCT

The FEIS analyzed conditions within GCT with and without the introduction of new LIRR service. During the four-hour AM peak period, about 65,000 new LIRR riders would pass through GCT in 2020, with about 44 percent of this new ridership concentrated in the 8-9 AM peak hour (29,000).

Most of the LIRR riders would be destined to points north of the terminal (areas that are difficult to access through Penn Station subway connections) and would not enter GCT at all. About 65 percent or about 42,200 would be destined to 45th through 49th Streets or above during the 6-10 AM peak period. Some 15,300 people (23.5 percent) would be destined to 45th Street or south. The remaining 11.5 percent or 7,450 would be leaving

GCT via the subway (see Figure 9C-7, attached). Pedestrians destined to areas south of 42nd Street would walk through GCT as a link in their travel.

To assign LIRR riders to their final Midtown destination, exiting LIRR patrons were assumed to use one or more of the nearest exits closest to their end location. Once on the street, people were assumed to follow as direct a path as possible into their Manhattan destination zone.

The pedestrian analysis examined the five new entrances proposed under the Preferred Alternative, and the existing GCT entrances including the three recently constructed (two within Grand Central North, and one within the 383 Madison building) entrances to the 47th Street cross passageway (pgs 9C-43 and 9C-60).

Vertical Circulation Elements (VCEs)

The FEIS identified significant adverse impacts at several locations within GCT, using methodology found in the New York City Office of Environmental's Coordination's *CEQR Technical Manual* (the guidebook in the conduct of all traffic and environmental studies in the City). The methodology for determining a significant impact on an escalator (which is not included in the CEQR Technical Manual), was developed as follows:

- If capacity is exceeded when comparing future No Action with Preferred Alternative demand; and
- If the v/c ratio is already greater than 1.00 in the No Action, if it increases by 5 percent with the addition of incremental pedestrian flows. This is roughly equivalent to a one-inch widening (associated with stairway LOS F) based on the similar processing rates of a standard 24-inch-wide stair exit lane or a single 20-inch lane of a dual-lane, 40-inch wide escalator.

The most significant pedestrian flow impacts in GCT that were identified in the FEIS, are the IRT subway stairs and escalators, which would be unaffected by the proposed design changes, and so are not discussed in this technical memorandum. The number of people going to the subway would be unaffected by the change to the street entrance scheme.

Of 28 pedestrian circulation elements analyzed in the FEIS (see Table 9C-29, attached), not including the IRT subway stairs and escalators, the following elements were found to be adversely affected for the 15-minute AM or PM peak periods:

- Escalators facing the NY Transit Museum – predicted to operated under capacity in the No Build, would operate over capacity in the Build Condition. Operating both escalators in the same direction during peak hours would mitigate this impact.
- West Stairs (north set) from Dining Concourse – predicted to operate at LOS B in the No Build, would operate at LOS D in the Build condition. The south set of the West Stairs would be underutilized (since the model assigns customers to the nearest VCE).

All other locations would operate at acceptable levels of service under the FEIS design, primarily LOS A or B, with three locations operating at LOS C.

In addition to impacts in the 15-minute peak period, one location would be adversely affected during the five-minute peak period. The 43rd Street Stairs from the Biltmore Room would deteriorate from LOS B to LOS D during the AM 5-minute peak.

Please note that these FEIS impacts were overstated for the Preferred Alternative (Option 2). At the time of the pedestrian flow analysis, the design of Option 2 had not advanced far enough to identify where the escalators from the LIRR concourse would daylight in the Dining Concourse. The pedestrian flow analysis assumed that the LIRR escalators would be located near Track 116 (where customers would enter the Dining Concourse under Option 1), which is between the West Stairs (north set) and the NY Transit Museum escalators. Since the pedestrian flow model assigns pedestrians to the nearest VCE, LIRR customers were assigned to the Museum escalators and the north set of the West Stairs. The LIRR escalators would, in fact, daylight in the Dining Concourse in front of the West Stairs, in between the north and south sets. So customers would use both the north and south set of the West Stairs, which has ample capacity under Build conditions. The museum escalators, behind the West Stairs, would operate under capacity since most customers would choose the stairs.

47th Street Crosspassage
Time-space analyses (which examine useful spaces occupied by people for selected critical time durations) under the FEIS design indicate that no significant adverse impacts would occur in the corridor with the addition of LIRR customers, assuming reasonable worst-case pedestrian flows and normal operating conditions. In addition, the VCEs to the 47th Street cross passage from the street were found to operate with ample capacity for future projected volumes of both MNR and LIRR customers.

Sidewalks
Finally, the FEIS identified significant impacts on sidewalks and at crosswalks due to the increase in pedestrian activity in the GCT area. Mitigation measures included the widening of crosswalks in some locations and aimed at clearing the sidewalks of a variety of street impediments (private vendors and/or street furniture such as newspaper kiosks and flower boxes) to create more sidewalk capacity. These measures would be implemented if the NYC Department of Transportation deems them warranted upon project completion (pg 9C-64).

Assessment of Effects of Proposed Changes

The street entrance locations presented in the FEIS were based on design objectives for passenger convenience, which included the desire to span the length of the public circulation space within the LIRR Concourse. In addition, their locations were chosen so that each passenger entrance could also function as an emergency exit to meet New York State Building Code requirements. The Code requires that an emergency exit be within 250 feet of all public spaces within the Concourse. To meet this requirement the Project would need to construct emergency exits at 45th, 46th, 47th, and 48th streets.

The current design would meet the Code requirements since an emergency stair would be provided at 45th Street in lieu of the passenger entrance. As in the FEIS design, an emergency staircase would be provided at 46th Street in the Roosevelt Hotel, and the 47th Street at 245 Park Avenue, and 48th Street at 280 Park Avenue entrances would also serve as emergency exits meeting Code requirements.

The latest planning assumptions and modeling techniques were used to assess potential impacts in the GCT area that could result from the proposed design changes. The updates include:

- A 2006 origin-destination survey of LIRR customers used to assign passengers to their final destinations. In the FEIS, 1990 U.S. Census data was used;
- Projects that will be implemented by 2020 were included in the No Action alternative including Second Avenue Subway and the No. 7 Extension;
- The latest 2020 NYMTC socioeconomic forecasts for Metro-North and NYCT growth rates;
- New pedestrian counts in the GCT area that were recorded in October 2008; and
- Use of STEPS (Simulation of Transient Evacuation and Pedestrian movementS), a dynamic model that provides real-time 3D simulations of pedestrian movements, level of service and usage, in lieu of the manually calculating pedestrian movements as was done in the FEIS.

The characterization of significant adverse impacts within GCT and on sidewalks and crosswalks near the entrances followed the same methodology used the FEIS identified above.

As indicated below, the revised entrance scheme would not result in significant adverse impacts in any of the NEPA impact areas nor change the conclusions presented in the FEIS or any of the other NEPA reviews.

Pedestrian Conditions Within GCT and the 47th Street Crosspassage

Currently approximately 77,700 Metro-North Customers either enter or leave the GCT Upper Concourse to/from the street during the PM peak hour (which is slightly higher than the morning peak hour). By 2020, that number is expected to grow to approximately 90,800 Metro-North Customers (and 101,200 MNR customers in year 2030). Only about 10,530 LIRR customers are expected to traverse GCT's Upper Concourse en route to the escalators in the Dining Concourse to the new LIRR Concourse. This is a worst-case number based on the LIRR operating at full capacity – 24 fully loaded trains per peak hour. Hence, LIRR customers will comprise only about 10 to 12 percent of railroad customers in GCT proper (i.e., not including the 47th Street cross passage) in future years.

Using up-to-date assumptions and assigning the new pedestrian overlay onto GCT without the 44th and 45th Street entrances, the findings of the FEIS did not change appreciably and no new significant pedestrian impacts were identified at likely potential impact locations (primarily areas in and around the 47th and 48th Street entrances).

Two previously cited significant impact locations, the Museum escalators and the West Stairs (north set) from the Dining Concourse would *not* experience impacts because of the current design configuration of the LIRR escalators into the Dining Concourse. In the case of the Museum escalators, the current design significantly reduces the reliance of this particular element, and pedestrians would primarily use the center areas of the Dining Concourse to ascend up and out of the new LIRR Concourse and GCT. In the case of the West Stairs (north set) from the Dining Concourse, the new LIRR escalators would connect to the Dining Concourse in between the north and south sets of stairs, so both stairwells would likely be used fairly equally and the combined stair capacity would be sufficient to result in LOS C operations. Pedestrian simulation modeling of these areas mentioned indicates that these spaces and elements would operate acceptably.

For areas of concern within the 47th Street Crosspassage, time-space analyses indicate that acceptable levels of service would prevail. Pedestrian simulation modeling of this area indicates that while there would be small areas of congestion for short time durations, the overall space would operate acceptably. The VCEs connecting to the street would continue to function, as reported within the FEIS, with volume-to-capacity ratios indicative of conditions under capacity and no queuing.

Person Trips at 47th and 48th Street Entrances in 2020 Build Conditions

Location	FEIS MNR	FEIS LIRR	Current Design LIRR
48th Street (280 Park/270 Park/415 Madison)	na	1500	1800
NE corner of Park/48th (@ Westvaco Building)	900	725	1,150
47th Street btw Park and Lex (245 Park Avenue Bldg)	560	245	720
47th Street btw Mad. and Vand. (northside of 47th)	680	275	120
Madison / 47th (inside Bear Stearns Bldg)	635	220	720

Volume to Capacity (V/C) Ratio at 47th and 48th Street Entrances in Year 2020

Location	FEIS No Build	FEIS Build	Current Design Build
48th Street (280 Park/270 Park)	na	0.35	0.53
NE corner of Park/48th (@ Westvaco Building)	0.38	0.68	0.90
47th Street btw Park and Lex (245 Park Avenue Bldg)	0.22	0.32	0.52
47th Street btw Mad. and Vand. (northside of 47th)	0.32	0.55	0.49
Madison / 47th (inside Bear Stearns Bldg)	0.28	0.37	0.63

These volume-to-capacity ratios indicate that all VCEs would operate under capacity in the current design.

Pedestrian Conditions on Sidewalk Corners and Crosswalks

The northeast and southeast corners of the Madison Avenue /47th Street and Park Avenue/48th Street intersections would operate similar to those cited in the FEIS (Tables 9C-34 and 9C-35). These conditions are summarized below.

Location	Corner	PM FEIS (from Table 9C-34)	PM Current Design
Madison Avenue at 47th Street	Northeast	C	C
	Southeast	D	D
Park Avenue at 48th Street	Northeast	C	D

Location	Crosswalk	PM FEIS (from Table 9C-35)	PM Current Design
Madison Avenue at 47th Street	North	D	C
	East	E	E
	South	C	D
Park Avenue at 48th Street	North	B	B
	East	D	D

Other Environmental Impact Areas

No changes would result to the conclusions found in the FEIS with regard to the proposed modifications in the following impact categories:

- Land Use, Zoning, and Public Policy
- Social Conditions
- Economic Conditions
- Visual and Aesthetic Considerations

- Historic Resources
- Archaeological Resources
- Transportation – subways, vehicular traffic, parking
- Air Quality
- Noise and Vibration
- Utilities
- Energy
- Contaminated Materials
- Natural Resources
- Coastal Zone Management
- Construction Impacts
- Environmental Justice
- Secondary and Cumulative Effects
- Safety and Security
- Commitment of Resources

IV. GCT OPERATING POLICY

MTA has decided that LIRR operations in GCT will be consistent with MNR's operations, which currently do not provide 24 hour service, seven days per week. This decision has no impact on the conclusions or mitigation measures presented in the FEIS, since the FEIS focuses on worst-case analyses during peak hours and makes no mention of a nighttime operating policy. This decision will not adversely affect LIRR service; Penn Station will continue to provide nighttime service.

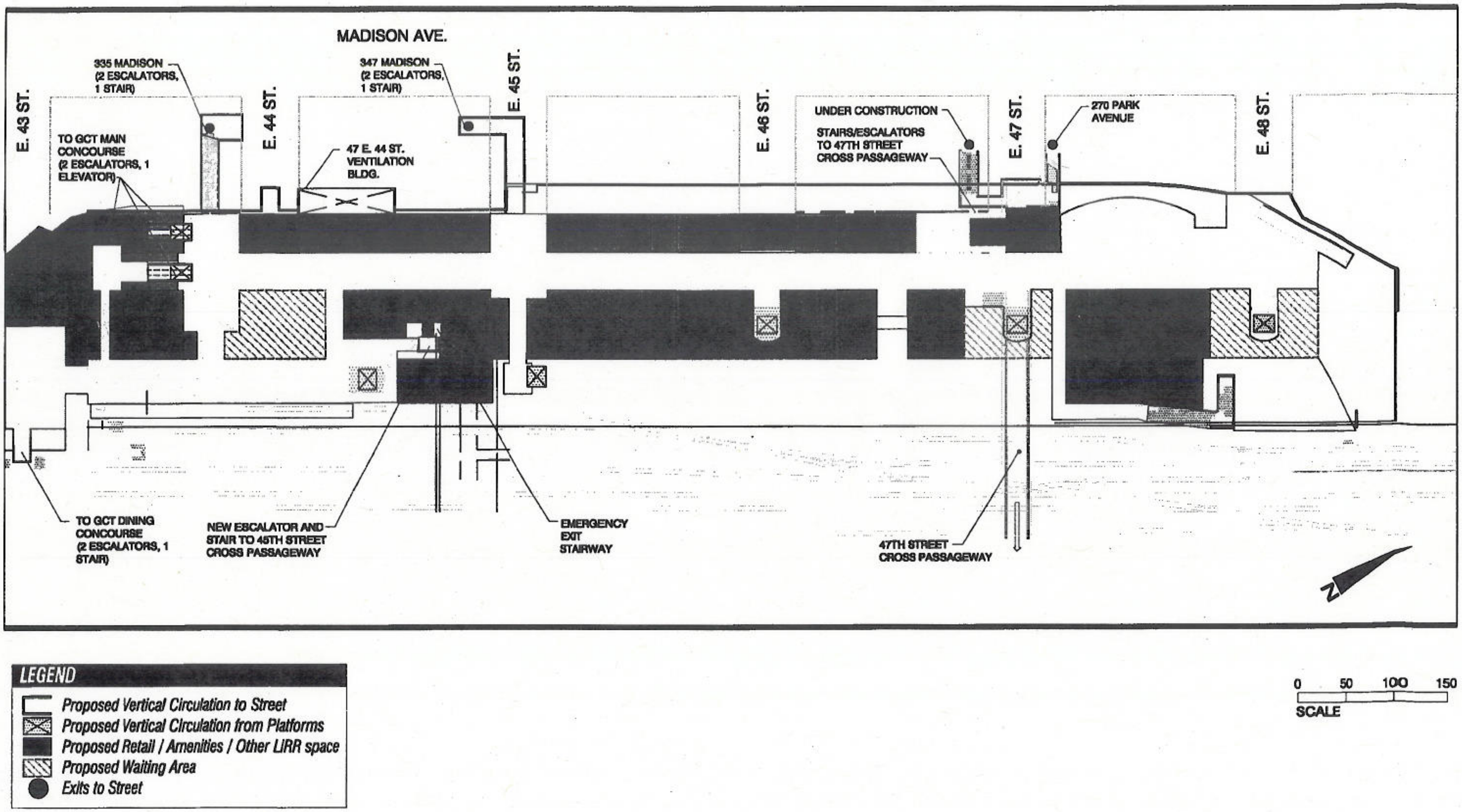
IV. PROGRAMMATIC AGREEMENT AMENDMENT

The following language is proposed to be added to the Programmatic Agreement:

Additional Built Historic Properties and archaeologically sensitive areas (collectively historic resources) not referenced in this PA may be identified by MTA CC with FTA, NYSHPO, NYCLPC and other appropriate New York agencies as project engineering proceeds and if new project elements are added to the design. If additional historic resources are identified within the existing APE that could potentially be affected (via either direct or indirect effects) by the design change, the stipulations of this PA will apply. For any change of design that affects the project's horizontal alignment, the APE will be expanded consistent with how the APE is defined in this document. Any previously unevaluated historic resource identified in newly affected areas will be identified and evaluated by MTA CC for listing in the National/State Register of Historic Places or as a New York City Historic Landmark in consultation with NYSHPO and the NYCLPC. The associated documentation will be comprised of an inventory form, a physical description, a statement of significance, and photographs of the resources in question for Historic Built Properties and a Stage 1A Archaeological Assessment for archaeological resources. The potential effects on those additional historic resources will be assessed prior to construction by FTA and MTA CC, in consultation with

NYSHPO, in accordance with the Section 106 process (36 CFR 800). If additional historic resources that could potentially be affected (via either direct or indirect effects) are identified within the expanded APE, the stipulations of this PA will apply.

MTA CC will consult with FTA, NYSHPO and NYCLPC annually to ensure that FTA and MTA CC maintain up-to-date lists of historic resources within the existing and expanded APEs as the design and construction of East Side Access proceeds.

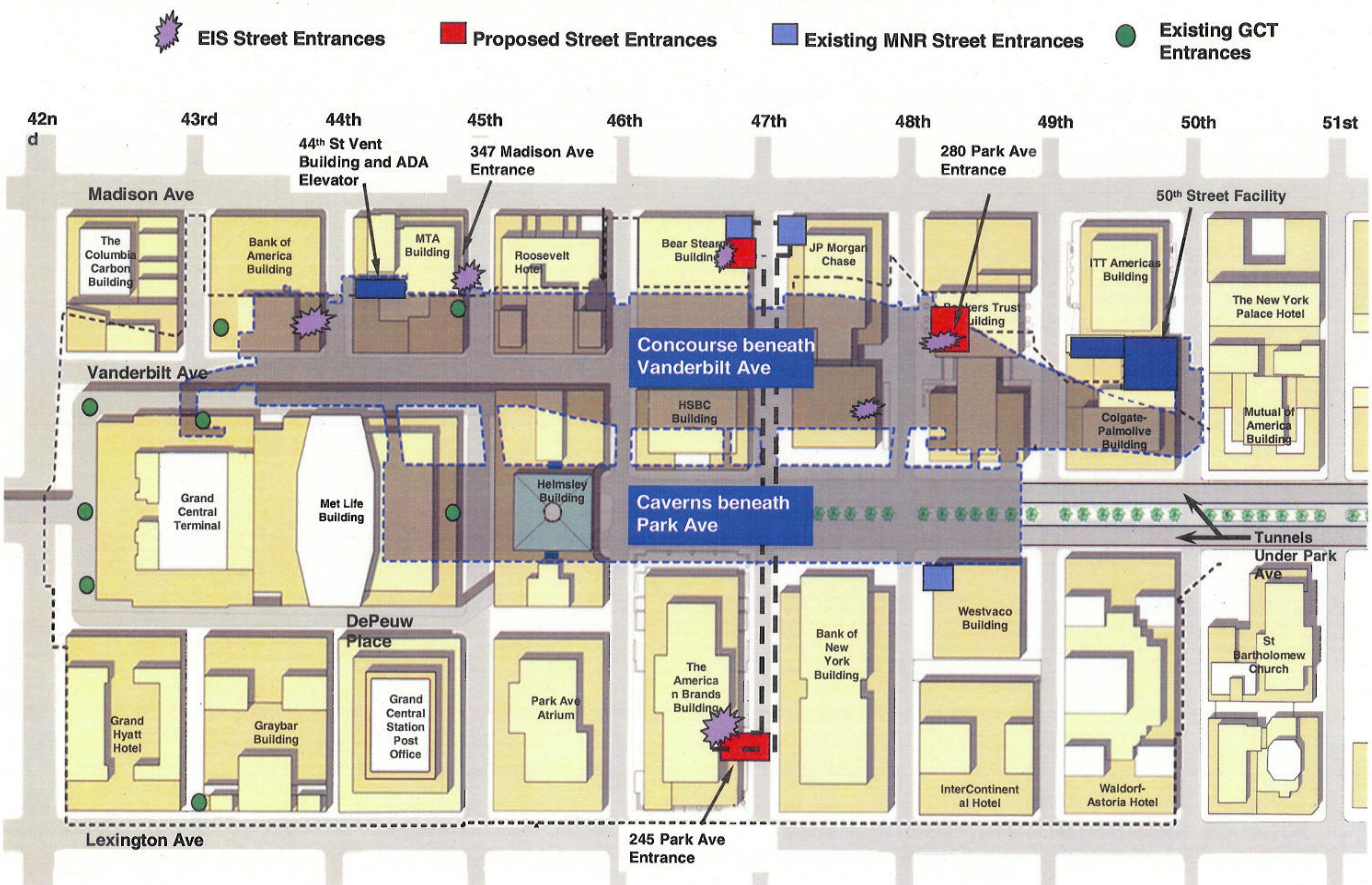


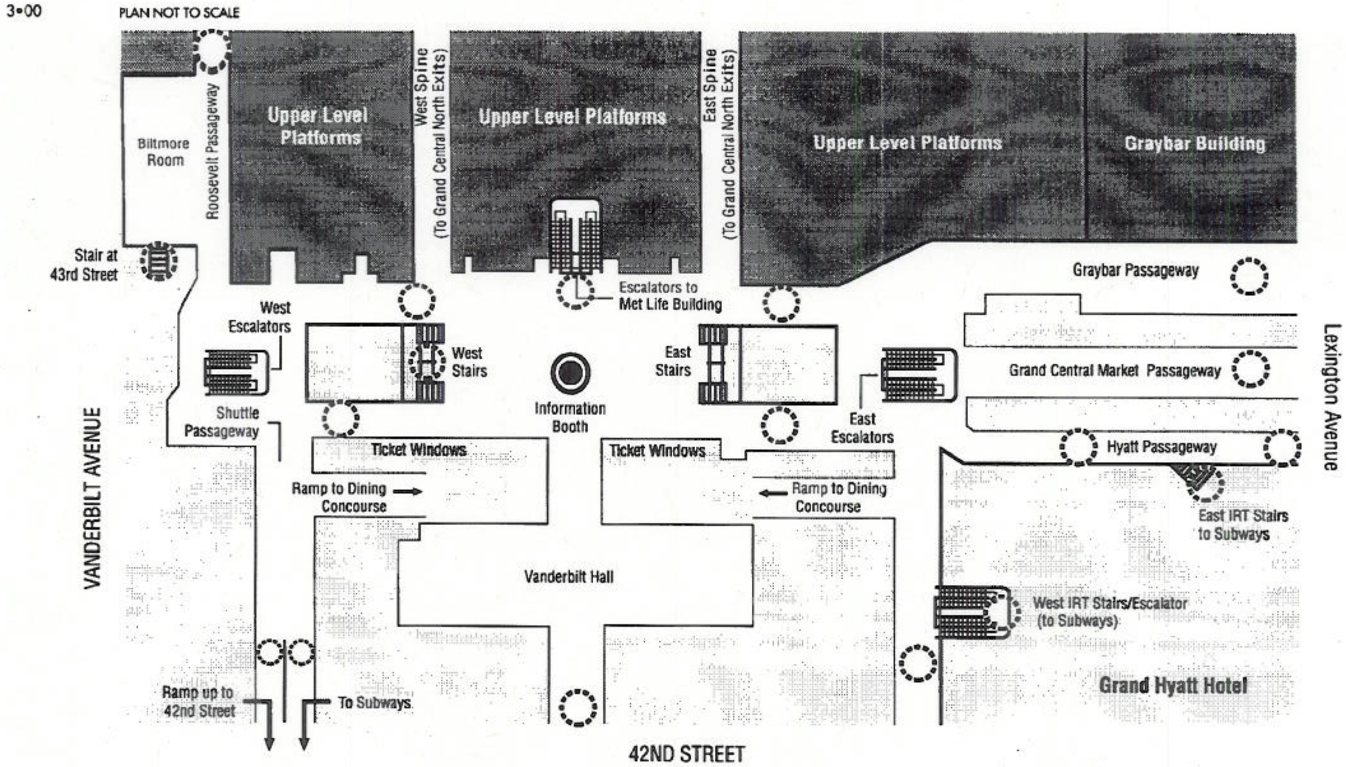
MTA/LIRR
East Side Access

Figure 2-8

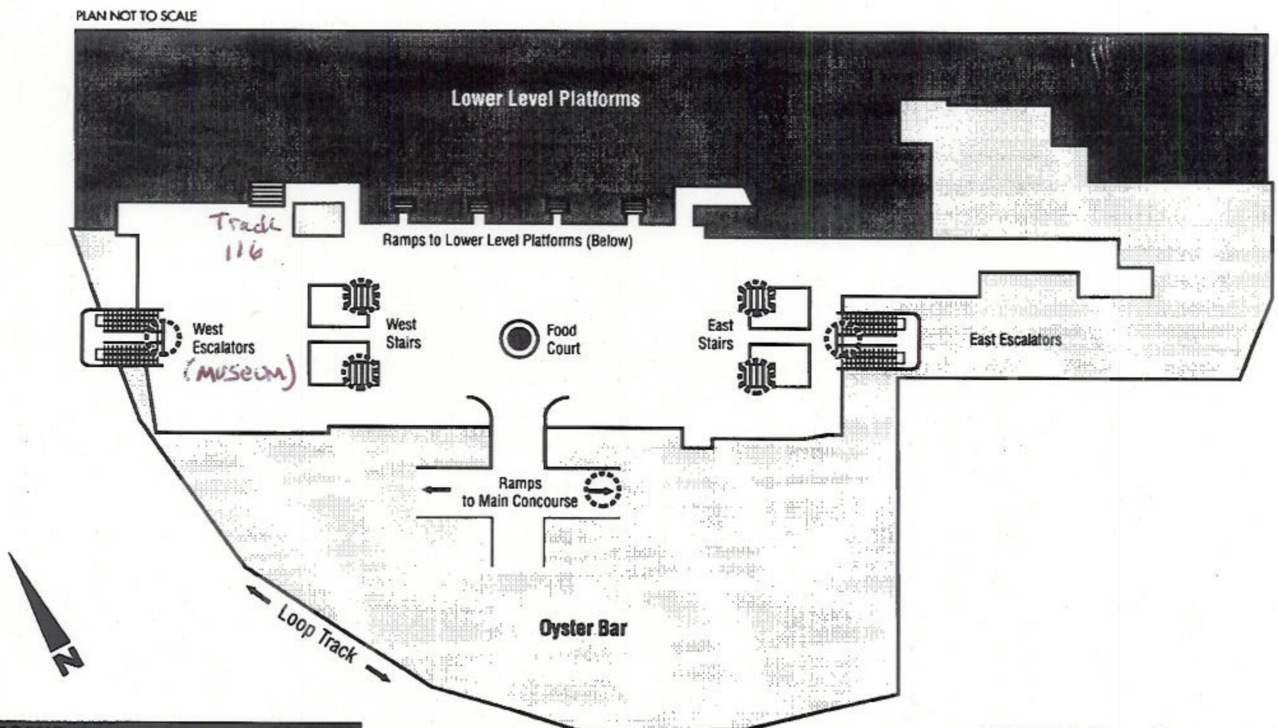
Proposed Concourse at Lower Level: Option 2

East Side Access Entrance Locations





GCT Main Concourse



GCT Dining Concourse

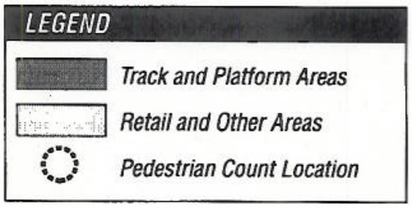


Figure 9C-2

Pedestrian Count Locations: Grand Central Terminal

MTA / LIRR

East Side Access

Figure 9C-7

Projected Distribution of LIRR Ridership at Grand Central Terminal

Table 9C-29
2020 PREFERRED ALTERNATIVE PEAK PERIOD LEVEL-OF-SERVICE (LOS) ANALYSIS OF PEDESTRIAN CIRCULATION ELEMENTS WITHIN GRAND CENTRAL TERMINAL

Pedestrian Element		Peak 5 Minutes within Peak 15 - Minute Period		Peak 15 - Minute Period	
Location	Section	AM	PM	AM	PM
1. Met Life Building Escalators	3 Up Escalators	under capacity	under capacity	under capacity	under capacity
	1 Down Escalator	under capacity	under capacity	under capacity	under capacity
2. Graybar Passageway	Corridor	A	A	A	A
3. East Stairs / Escalators	North Stairs from Dining Concourse	B	A	A	A
	South Stairs from Dining Concourse	A	A	A	A
	Up Esc. Facing Hudson News	under capacity	under capacity	under capacity	under capacity
	Down Esc. Facing Hudson News	under capacity	under capacity	under capacity	under capacity
	North Corridor	B	B	A	A
	South Corridor	C	C	C	C
3A. 43rd Street Passageway	Corridor	A	A	A	A
4. Hyatt Passageway	Corridor	B	B	B	A
5. Eastern IRT Subway Stairs	Stairs	D	D	C	C
6. Western IRT Subway Stairs / Escalators	Stairs	F*	F*	E*	E*
	Up Escalator	over capacity	under capacity	near capacity	under capacity
	Down Escalator	over capacity*	under capacity	over capacity*	under capacity
7. East Passageway to 42nd St. (Park-Lex)	Corridor	C	B	B	B
8. Lower Concourse East Ramp	Ramp	A	B	A	A
9. 42nd St. Main Entrance	Corridor	A	B	A	A
10. Shuttle Passageway	Corridor	C	B	B	B
11. Ramp to Vanderbilt Ave. / 42nd St. Corner	Ramp	C	C	C	C
12. West Stairs / Escalators	North Stairs from Dining Concourse	E*	D*	D*	D*
	South Stairs from Dining Concourse	A	A	A	A
	Up Esc. Facing NYC Transit Museum Store	over capacity*	under capacity	over capacity*	under capacity
	Down Esc. Facing NYC Transit Museum Store	under capacity	over capacity*	under capacity	over capacity*
	North Corridor	B	B	B	B
	South Corridor	B	B	B	B
13. 43rd St. Stairs in Biltmore Room	Stairs	D*	C	C	C
14. Roosevelt Passageway	Corridor	B	A	B	A

* SIGNIFICANT IMPACTS

Grand Central Terminal Recycling and Waste Management Facility

Categorical Exclusion Documentation

December 2009

Prepared by:

MTA Capital Construction Company
2 Broadway
New York, NY 10004

1.0 Introduction

This environmental documentation is being submitted in support of a Categorical Exclusion (CE) under the National Environmental Policy Act of 1969 (NEPA), for the proposed construction of the Grand Central Terminal Recycling and Waste Management Facility (the Project). MTA Capital Construction has prepared this documentation for the Federal Transit Administration (FTA), in accordance with the Council on Environmental Quality (CEQ) regulations implementing NEPA (40 CFR 1500) and U.S. Department of Transportation regulations which includes the following:

> *"construction of rail storage and maintenance facilities in areas used predominantly for industrial or transportation purposes where such construction is not inconsistent with existing zoning and where there is no significant noise impact on the surrounding community" may qualify as a CE if appropriately documented.* [23 CFR 771.117 (d)(11)]

The Project would provide an efficient, consolidated trash management operation in Grand Central Terminal (GCT) for MTA Metro-North Railroad (Metro-North) and MTA Long Island Rail Road (LIRR). The project would reduce the number of truck trips needed for refuse removal from GCT, greatly expand the MTA's recycling program, and restore an unused track needed for service storage in order to improve Metro-North operational efficiency. The Project location is shown on Figure 1.

The new recycling facility would be constructed concurrent with, and largely within, the MTA East Side Access (ESA) Concourse, which will be built in a portion of the lower level of GCT. Its construction would be below ground and entirely within the GCT trainshed area (which is not part of any historic designation). Trash and recyclables would be taken out by train to Bronx North (BN) Yard where it would be loaded onto truck for disposal, consistent with the current Metro-North operation to remove recyclables from GCT. No improvement to BN Yard would be necessary.

The GCT Recycling and Waste Management Facility is not part of the East Side Access project – a separate funding source is being sought (e.g. a TIGER application was submitted in September 2009) and the project has independent utility.

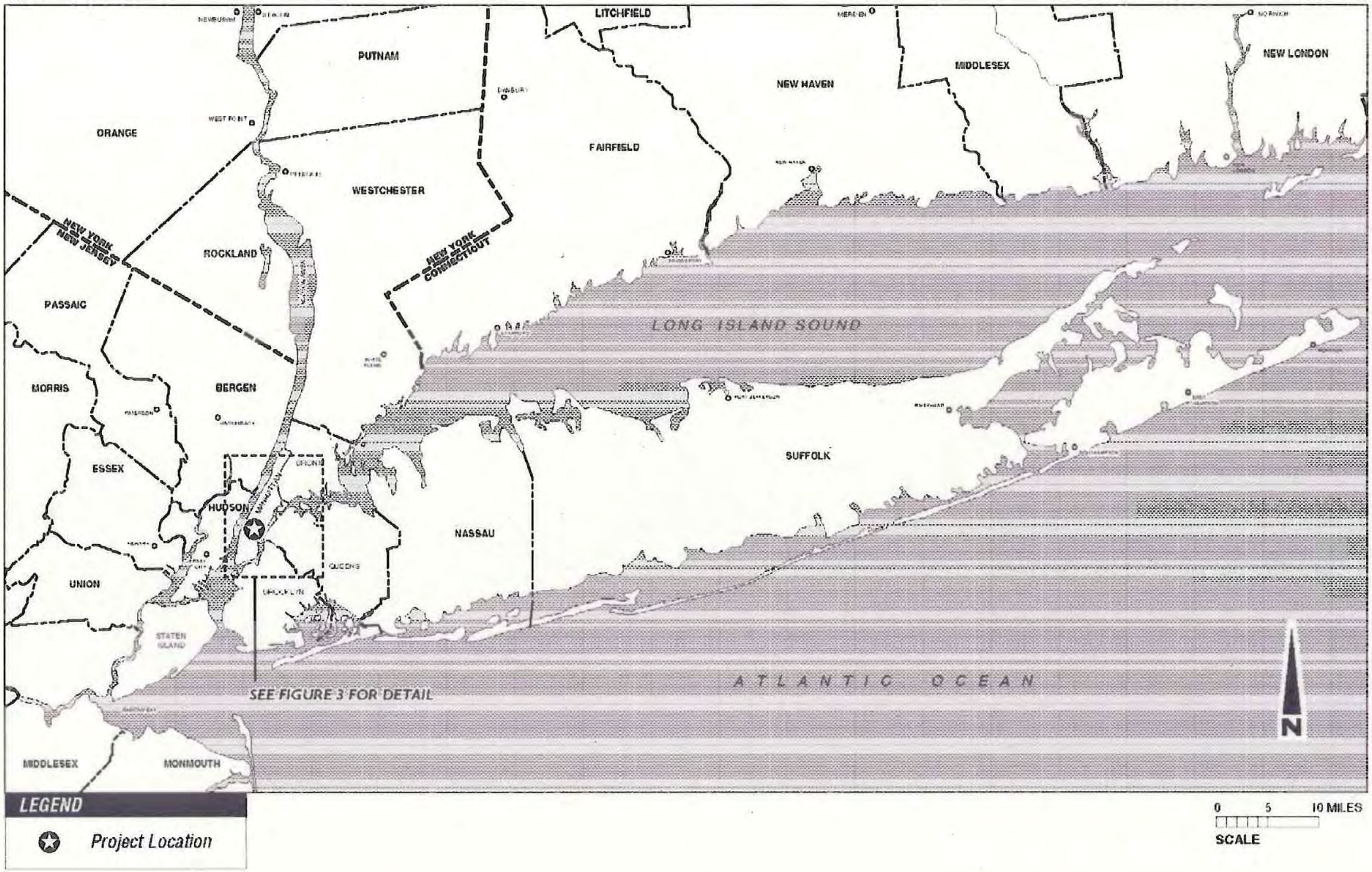
A number of environmental benefits would result from the Project. Recycling saves energy, water, and resources such as trees and metal ores; reduces global warming pollution from manufacturing, land filling, incinerating, and the transport of goods; and protects habitat and biodiversity.

The Project would not require acquisition of property; would not induce significant impacts to planned growth or land use for the areas affected; or require the relocation of people. The Project would not have significant localized adverse impact on natural, cultural, recreational, historic or other resource; would not involve significant air, noise, or water quality adverse impacts; would not have significant adverse impacts on travel patterns; and would not otherwise, either individually or cumulatively, have any significant adverse environmental impacts.

The Project is covered by an exemption from SEQRA contained in Section 1266(11) of the Public Authorities law, which states in pertinent part:

> No project to be constructed upon real property theretofore used for a transportation purpose, or on an insubstantial addition to such property contiguous thereto, which will not change in a material respect the general character of such prior transportation use, nor any acts or activities in connection with such project, shall be subject to the provisions of article eight, nineteen, twenty-

9.10.09



MTA / LIRR
East Side Access

Project Location

Figure 1
Project Location

> four or twenty-five of the environmental conservation law, or to any local law or ordinance adopted pursuant to any such article. Nor shall any acts or activities taken or proposed to be taken by the authority or by any other person or entity, public or private, in connection with the planning, design, acquisition, improvement, construction, reconstruction or rehabilitation of a transportation facility, other than a marine or aviation facility, be subject to the provisions of article eight of the environmental conservation law, or to any local law or ordinance adopted pursuant to any such article if such acts or activities require the preparation of a statement under or pursuant to any federal law or regulation as to the environmental impact thereof. (emphasis added.)

The "article eight" referred to above is Article 8 of the NYS Environmental Conservation Law, which is SEQRA. The Project continues an existing essential support activity integral to the carrying out of a transportation purpose in locations already in use for this transportation purpose. Consequently, the Project is exempt from SEQRA pursuant to the above provision in the PAL.

2.0 Purpose and Need

Existing, planned and proposed waste management facilities for Metro-North and LIRR at GCT are shown on Figure 2. The purpose and need for the new facility is outlined below.

GCT and Current Practices

The current recycling program at GCT is inefficient and limited due to space constraints for staging and separation of waste at Track 14. Currently, metals, glass and plastics are mixed with the trash that is sent to a landfill due to the lack of space to separate and stage these items for recycling. In addition, at Depew Place, each trash container must be loaded directly onto a truck, requiring a second truck trip to provide the empty replacement container for use on the platform at Track 14, since there is no space for staging at Depew Place.

East Side Access and Future LIRR Service

MTA's ESA will soon bring LIRR trains into a new terminal beneath Grand Central, with a large 350,000 square foot concourse occupying space within a portion of GCT's lower level. Under the current planned operating scheme for GCT, waste from the new LIRR terminal, trains, and operations would be handled through a new facility built on East 50^{th} Street between Park and Madison Avenues, which would contain a freight elevator and loading dock, in addition to ventilation fans, ducts, substation and other equipment for operation of the terminal. Compactable waste (wet trash) would be collected in a 30 cubic yard (CY) self-contained compactor. When the compactor is full, a night-time truck pick-up would be scheduled and a second truck would deliver an empty replacement compactor to this facility (again due to space constraints). Non-compactable waste would be stored in a 30 CY open container located in the LIRR service corridor until full, then loaded on the freight elevator to the loading dock for truck pick-up. Newspaper and cardboard would also be collected in the service corridor and transferred to the loading dock for nightly pickup. Metro-North's wet trash and non-compactable waste would continue to be handled as described above.

Proposed Action

The Project would provide an efficient, consolidated trash management operation in GCT for Metro-North and LIRR. The project would reduce the number of truck trips needed for refuse removal from GCT, greatly expand the MTA's recycling program, and restore a currently unused track needed for service storage in order to improve Metro-North operational efficiency.

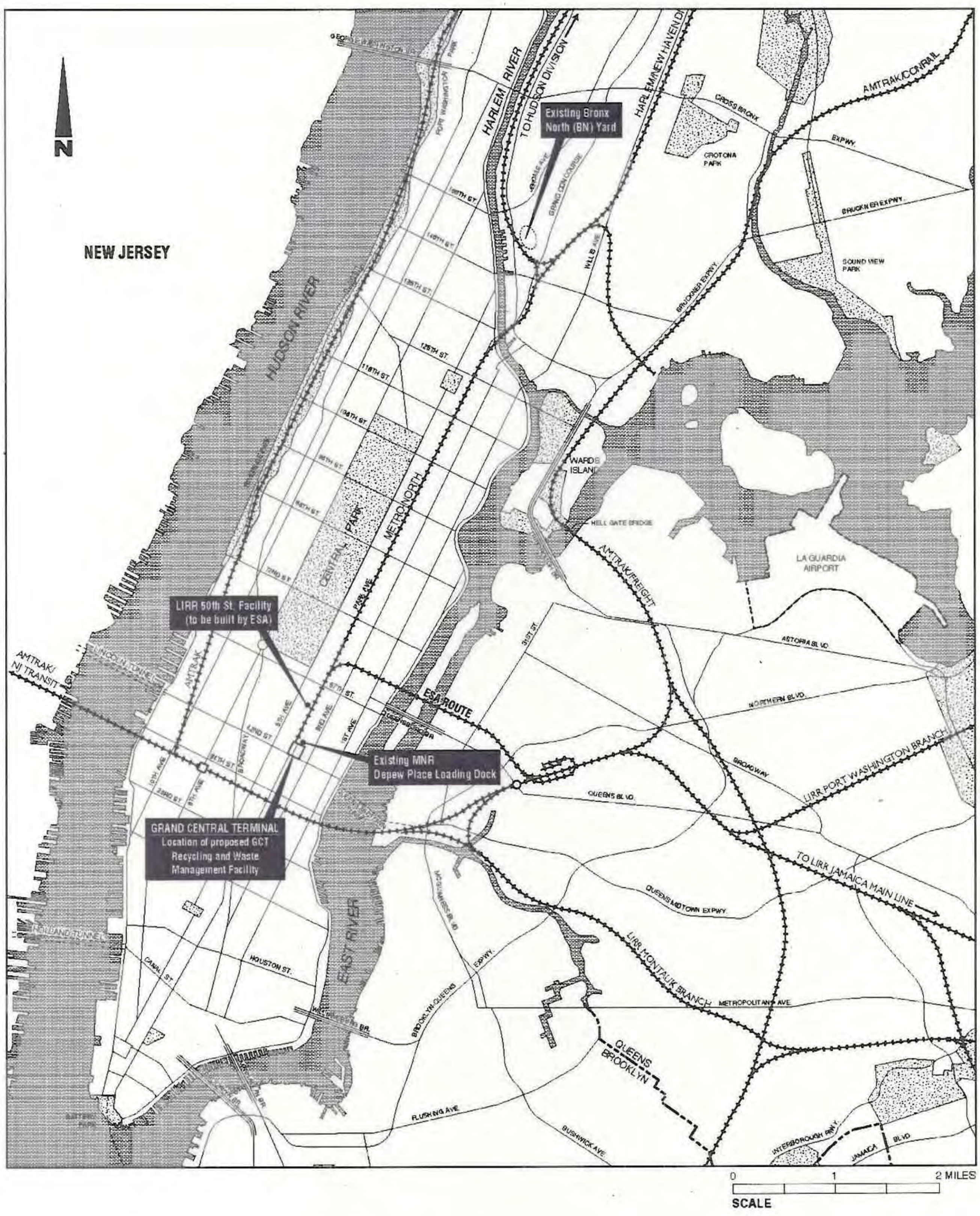


Figure 2
Existing and Planned Waste Management Facilities

3.0 Detailed Project Description

Three waste transfer stations – South, Mid and North- would be constructed, as shown on the conceptual layout (see Figure 3 for a key plan and Figures 3A, 3B and 3C for details). The South and Mid Transfer stations would be constructed within the ESA Concourse, serving as collection points for GCT Metro-North waste and ESA-LIRR waste, respectively. Trash shuttles would operate at regular intervals in the Concourse, "shuttling" the trash to the North-Transfer Station for flatcar loading. The North Transfer Station would be located on currently unused stub tracks 186 through 188, just north of the ESA Concourse. A new central loading platform would be constructed at Track 187. This area would be partially enclosed on three sides to provide environmental controls, such as those described below.

A ventilation system with a minimum of 20 air changes per hour would be installed to control odor and maintain temperatures of 85 degrees F in the summer and 65 degrees F in the winter. The existing ballasted track areas would be replaced with slab-on-grade track with trench drains located in between the rails to facilitate track clean-up of any trash overflow and the pressure washing of the area. Overhead cranes would pick up the trash shuttle containers from the shuttle trailers and deposit the contents into the appropriate flatcar containers. During this operation, the containers would be weighed to record amounts of trash and recyclables collected from the particular transfer station. The containers would be bar-coded to allow optical scanning and tracking of the waste streams for cost and revenue distributions from the trash and recycling operations. Each of the three transfer stations would be operated 24-7 and equipped with CCTV monitoring for security.

Metro-North's Track 14 would be restored for revenue service storage as soon as the new facility is operational, since it would no longer be needed for trash hauling.

The Project is scheduled to be complete by February of 2012. Use of the facility would be phased in; immediately upon completion, it would be used by Metro-North for recycling and wet trash, and by ESA for removal of construction debris (about 5,000 tons per week). When the ESA project is complete and LIRR passenger service commences in 2016, the new facility would be used jointly by Metro-North and LIRR as a recycling and waste management facility serving all of GCT and the new LIRR terminal.

Use of the GCT tunnels and potentially the BN Yard was anticipated in the FEIS for removal of construction & demolition debris during construction of the ESA Project (see FEIS page 17-18). The added capacity for debris removal resulting from the Project would facilitate this effort and reduce potential conflicts with Metro-North operations.

Construction costs are estimated at $20,695,000. Construction cost savings (about $5 million[1]) would be realized by "piggybacking" on the construction and program management services already in place for ESA.

4.0 Existing and Proposed Waste Management Operations

Existing Operations

Waste is collected throughout the Terminal, on the platforms, in the concourses (upper and lower), from the restaurants and retail establishments, the trains, and Metro-North operations. Currently, trash management operations at GCT include two main collection points for exiting non-hazardous waste streams:

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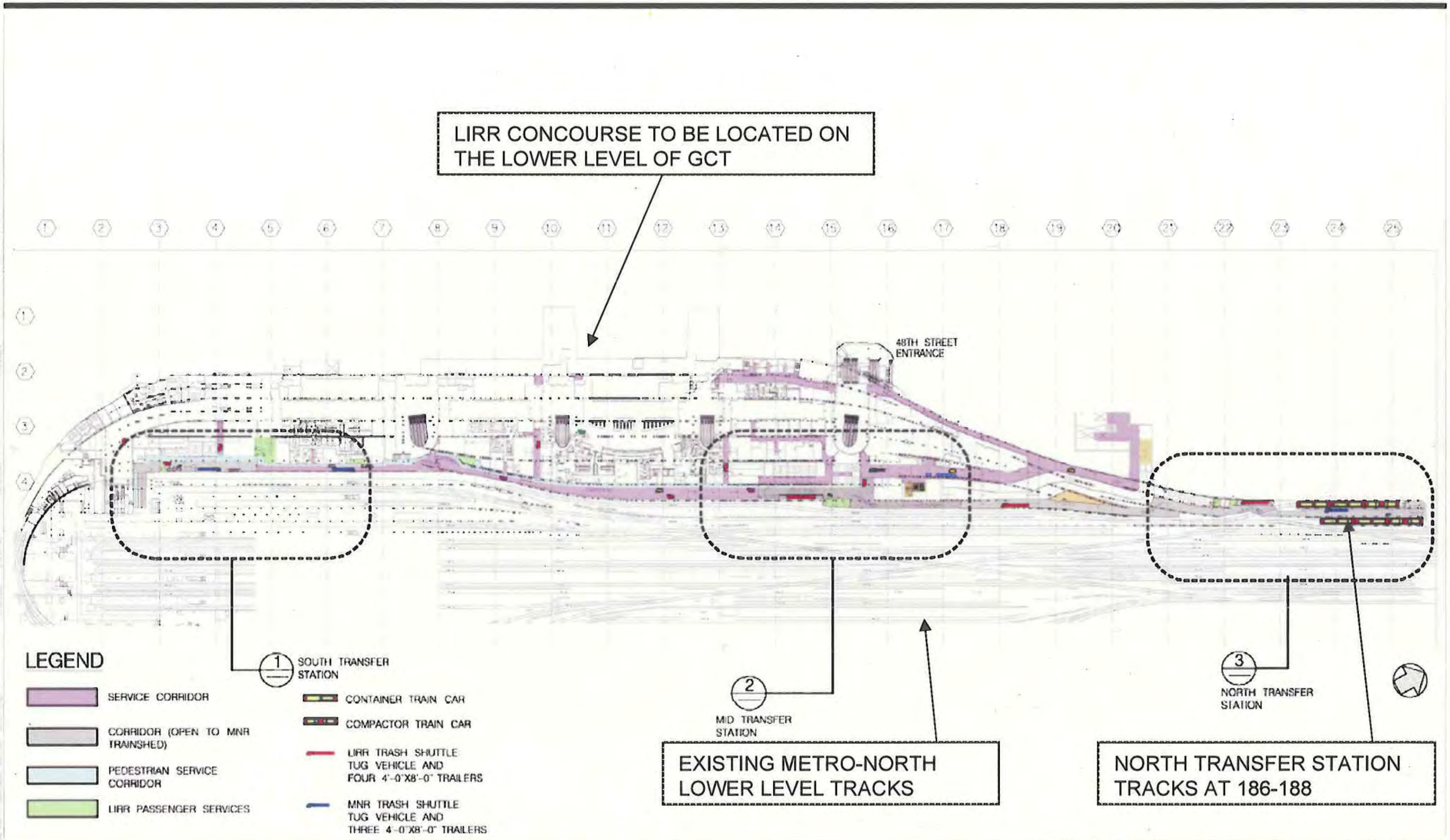
[1] Savings are on the order of 10 percent of the construction cost for union supervision of trade workers and 12 percent for construction and program management services.



Metropolitan Transportation Authority
Capital Construction Company

Long Island Rail Road
East Side Access

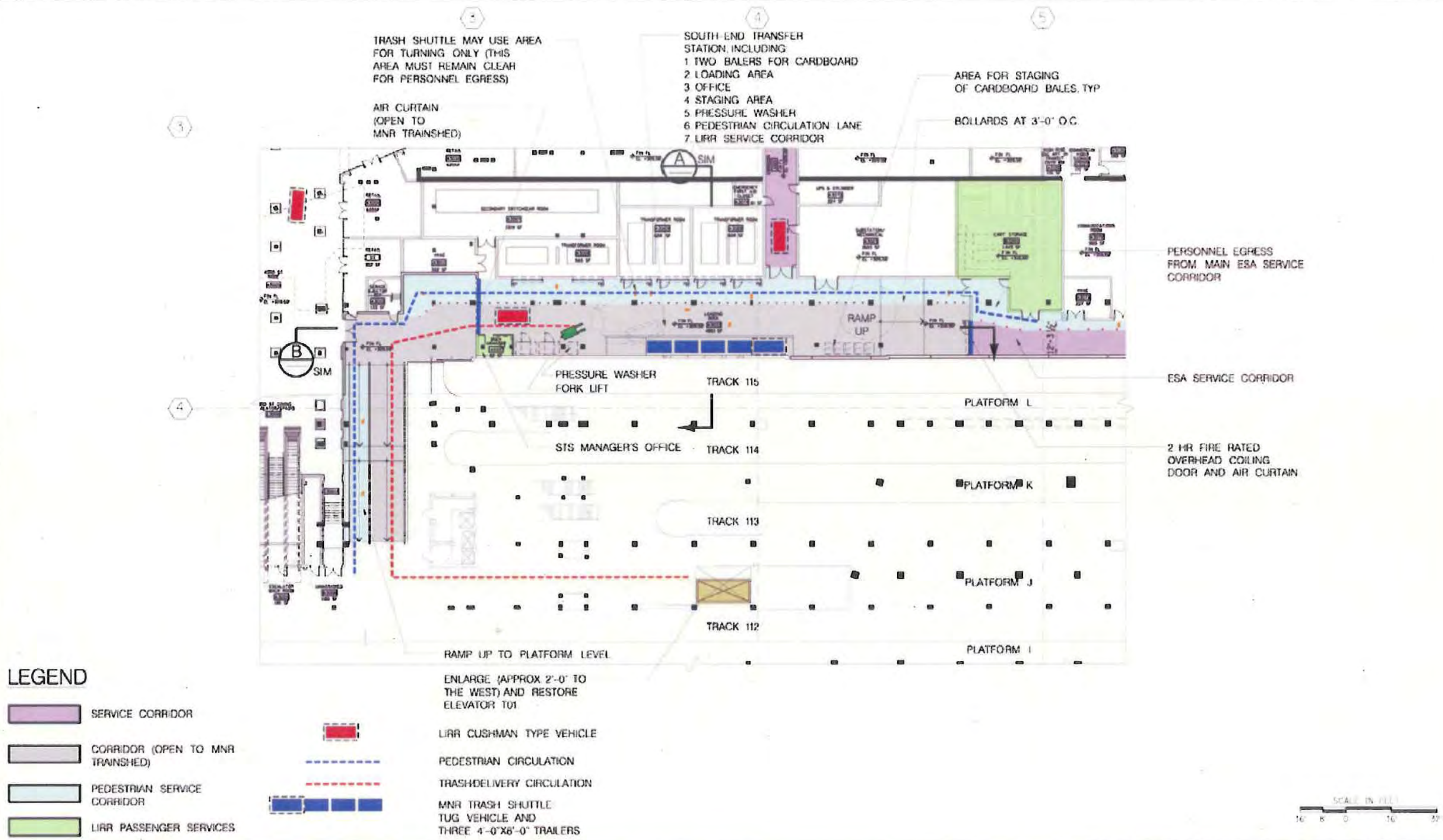
Figure 3

GCT Recycling & Waste Management Facility Key Plan

South, Mid & North Transfer Stations

GEC
PB
STV
PARSONS
General Engineering Consultant

PARSONS BRINCKERHOFF
STV INCORPORATED
PARSONS TRANSPORTATION GROUP OF NEW YORK
469 Seventh Avenue • New York, NY • 10018



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Long Island Rail Road
East Side Access

Figure 3.A

Detail 1

South Transfer Station

GEC PB STV PARSONS
General Engineering Consultant

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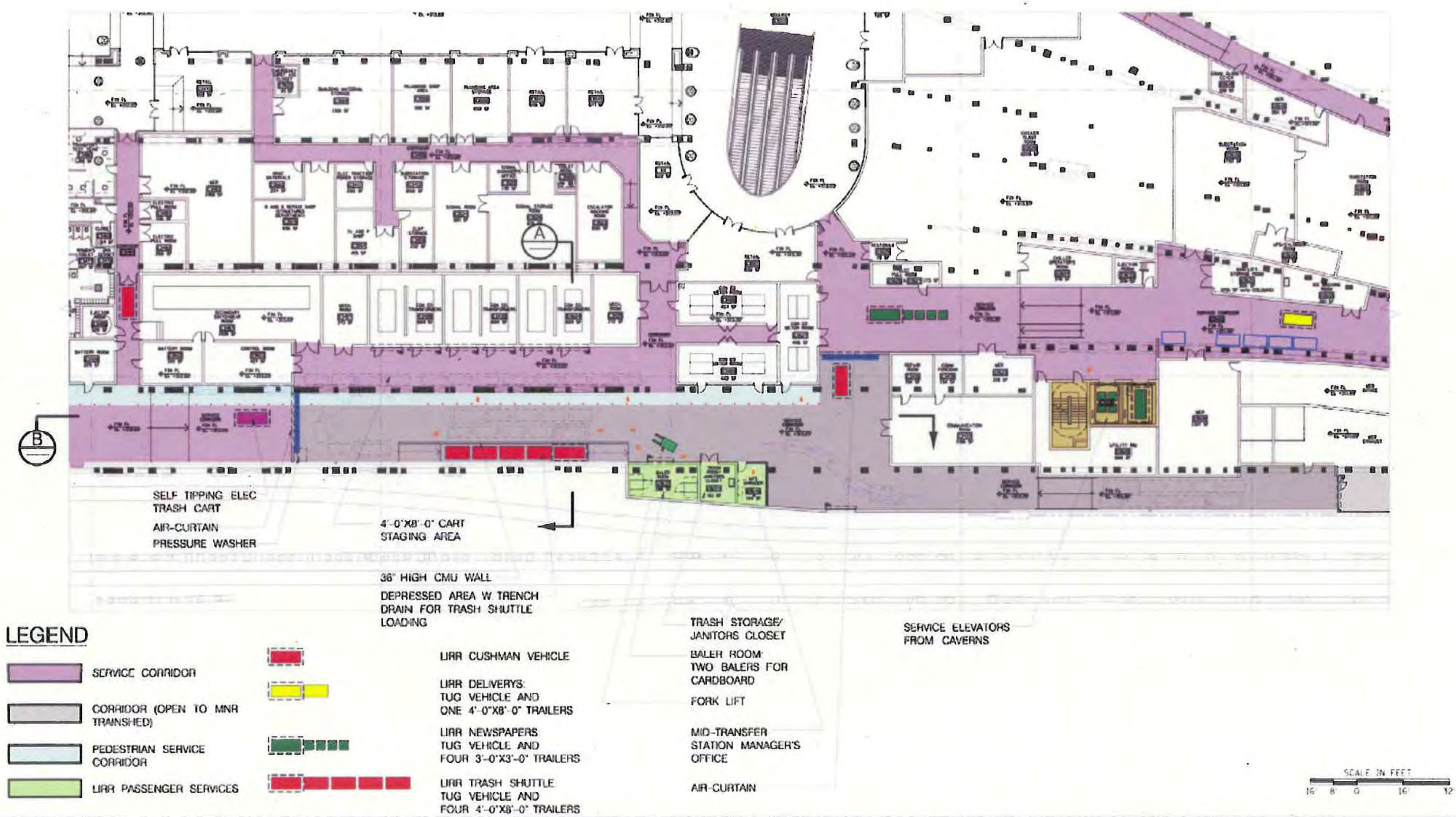

Metropolitan Transportation Authority
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Long Island Rail Road
East Side Access

Figure 3.B

Detail 2

Mid Transfer Station

GEC PB STV PARSONS
General Engineering Consultant
PARSONS BRINCKERHOFF
STV INCORPORATED
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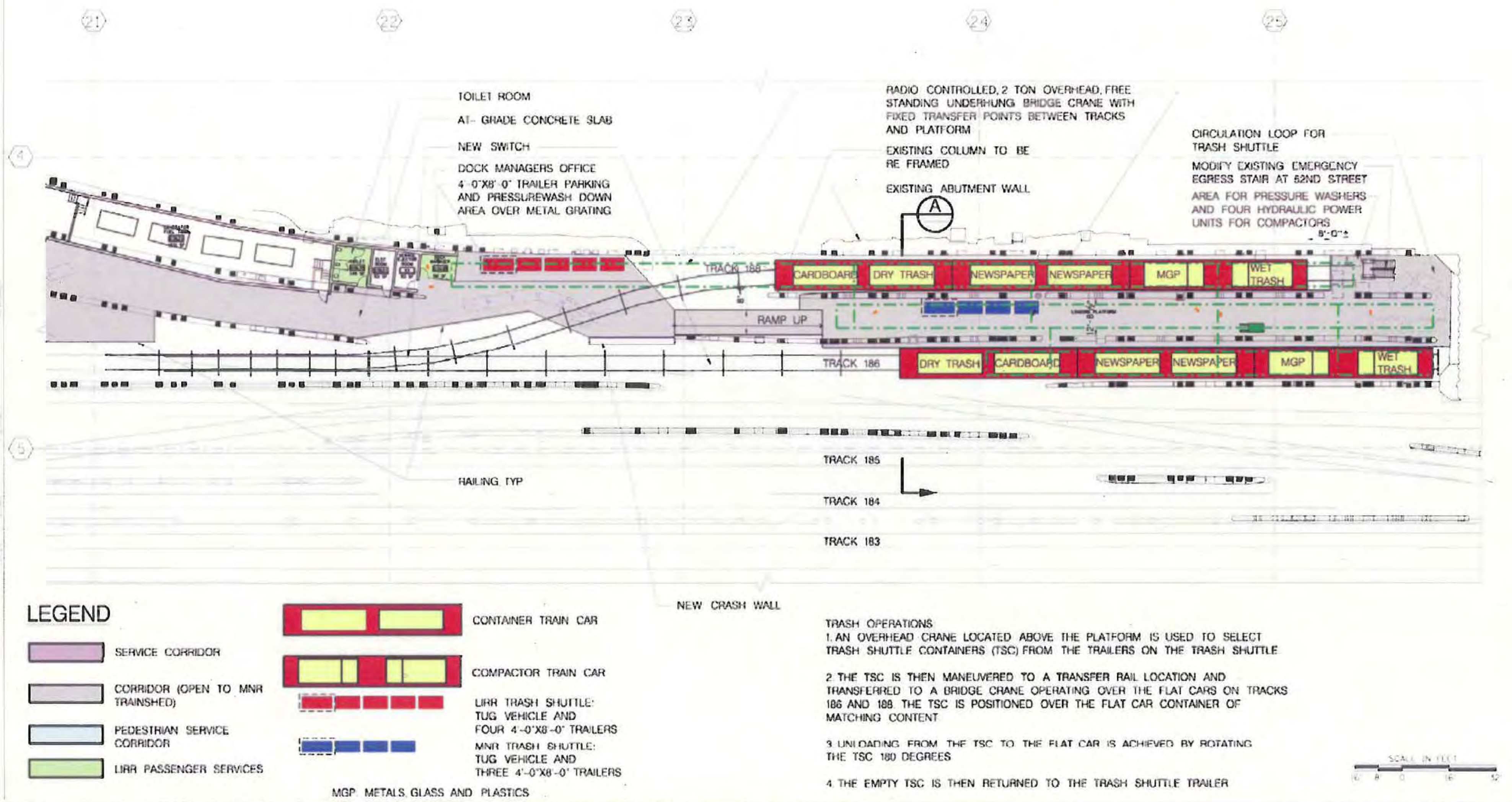
469 Seventh Avenue • New York, NY • 10018



Metropolitan Transportation Authority
Capital Construction Company

Long Island Rail Road
East Side Access

Figure 3.C

Detail 3

North Transfer Station

GEC
PB
STV
PARSONS
General Engineering Consultant

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- The Depew Place Loading Dock handles all compactable waste (wet trash) and deliveries via five bays, two 35-cubic yard compactor units (in a refrigerated room), a loading dock office, a ramp to street level, and two freight elevators. None of the bays have dock lifts or levelers. Space is severely constrained and the dock is expected to operate at capacity in the near future.
- Track 14 (Platform F) serves as a collection point for non-compactable waste generated by the Metro-North (e.g., 3rd rail sections, track fasteners, and miscellaneous track and power hardware) and Construction &Demolition (C&D) debris; as well as cardboard and newspaper, the only recyclables currently collected at GCT. The space is outfitted with a cardboard baler and electric charging stations for forklifts.

Off-site processing from the Depew Place Loading Dock in Midtown Manhattan is via truck to a landfill. Off-site processing from Track 14 is via flatcar to the BN Yard, an existing operational yard in the Bronx, where contracted truck haulers remove and replace the containers that are off-loaded from the flatcars.

Currently a trash train with three flatcars makes a trip to the BN Yard three nights per week for the existing Metro-North newspaper recycling effort. One truck at a time picks up one of two 30 CY containers on a flatcar. As a result, up to six trucks per day (for three days out of the work week) travel to and from the BN Yard, typically between the hours of 10 AM and 5 PM. Currently, the newspaper is recycled at a New Jersey recycling facility (via the Major Deegan Expressway to the George Washington Bridge).

Future Operations with the Project

The proposed facility would handle about 12,600 tons of waste per year, of which about 70 percent would be recycled, an increase of about 20 percent over No Action conditions. In the No Action condition, an estimated 2,567 tons per year of metals, glass and plastic (MGP) waste would be disposed of in landfills rather than recycled. The proposed facility would combine three crowded and inefficient recycling and waste management operations serving GCT into one efficient operation, with state-of-the-art equipment and design, and an ability to recycle all MGP waste in GCT for the first time. The Project includes the provision of MGP containers that would be placed throughout GCT and the new LIRR terminal. This high visibility recycling effort at GCT would promote sustainable practices to the 750,000 people who pass through GCT each day and to an additional 160,000 daily LIRR customers once ESA is operational.

The trash train would need to make five trips per week (at night), carrying four flatcars and eight 30 CY containers. Hence, up to eight trucks per day would travel to and from the BN Yard to haul the MGP waste. The hauler/recycling facility is unknown at this time. The new recycling contract would go through the MTA bidding process and the lowest competent bidder would be selected. Processing costs, which include waste hauling, would be minimized for haulers using recycling centers in the Bronx, thus giving Bronx processing centers a competitive edge in any bidding process.

5.0 Environmental Consequences of the Project

The environmental benefits of recycling have been well documented. Recycling saves energy, water, and resources such as trees and metal ores; reduces global warming pollution from manufacturing, and filling and incinerating; and protects habitat and biodiversity. Recycled goods replace materials mined and manufactured outside of the region with materials collected and processed within the region. As a result, significant energy and transportation benefits accrue due to the avoidance of the transport or goods in addition to the mining and processing of virgin materials. Recycling increases the longevity of existing landfills and prevents the costly process of siting new landfills.

The potential localized impacts of recycling are described below.

Land Use, Zoning and Socioeconomic Conditions

The operation of the new facility within GCT would have no significant adverse impacts on land use, zoning or socioeconomic conditions in Manhattan. As described above, truck trips in Manhattan would decrease. Transporting trash by train is consistent with Mayor Bloomberg's initiatives and the New York Metropolitan Transportation Council's (NYMTCs) Plan to increase rail hauling and decrease truck trips in Manhattan. NYMTC supports this project and NYMTC's Transportation Improvement Plan (TIP) will be amended to add this project, should it proceed.

The BN Yard (44 West 225th Street) is owned by the MTA and zoned M1-1 as a manufacturing district. The site borders other areas zoned as manufacturing, commercial, and residential (see Figure 4). The BN Yard is immediately adjacent to a Target Store at 40 West 225th Street, and bounded by the Major Degan Expressway to the east, live railroad tracks to the southwest, and 225th Street to the north (see Figure 5). Just north of 225th Street is the Marble Hill Housing project. The Marble Hill Houses complex in the Bronx has eleven buildings, 14 and 15-stories high with 1,682 apartments housing an estimated 3,433 people. The 16.64-acre complex was completed March 3, 1952 and is bordered by Broadway, Exterior, West 225th and West 230th Streets.

The year 2000 U.S. Census population and income characteristics of the study area are shown below. Those in the Marble Hill Census Tract and the BN Yard Study Area (which includes all census tracts adjacent to BN Yard) contain similar percentages of minority populations and those with incomes below the poverty level when compared to the Bronx as a whole. When compared to the City and State statistics, the study area has a high percentage of minority residents and those with incomes below the poverty level.

U.S. Census Year 2000 Population Characteristics

	Marble Hill Census Tract	BN Yard Study Area	Bronx	New York City	New York State
Total Population	7,820	22,454	1,332,650	8,008,278	18,976,457
% Non White	76.29%	74.29%	70.13%	55.34%	32.05%
Median Household Income (1999 Dollars)	$25,754	$27,209	$27,611	$38,293	$43,393
% of Individuals Below Poverty Level	29.92%	30.38%	30.70%	21.20%	14.60%

While the Project would increase truck trips at BN Yard by up to 16 per day (i.e., worst- case, eight trucks in and out), as described below, significant adverse impacts are not expected to result. Because of its distance from 225th Street and location between an expressway and live railroad tracks, operations in the Yard (which consist only of transferring enclosed

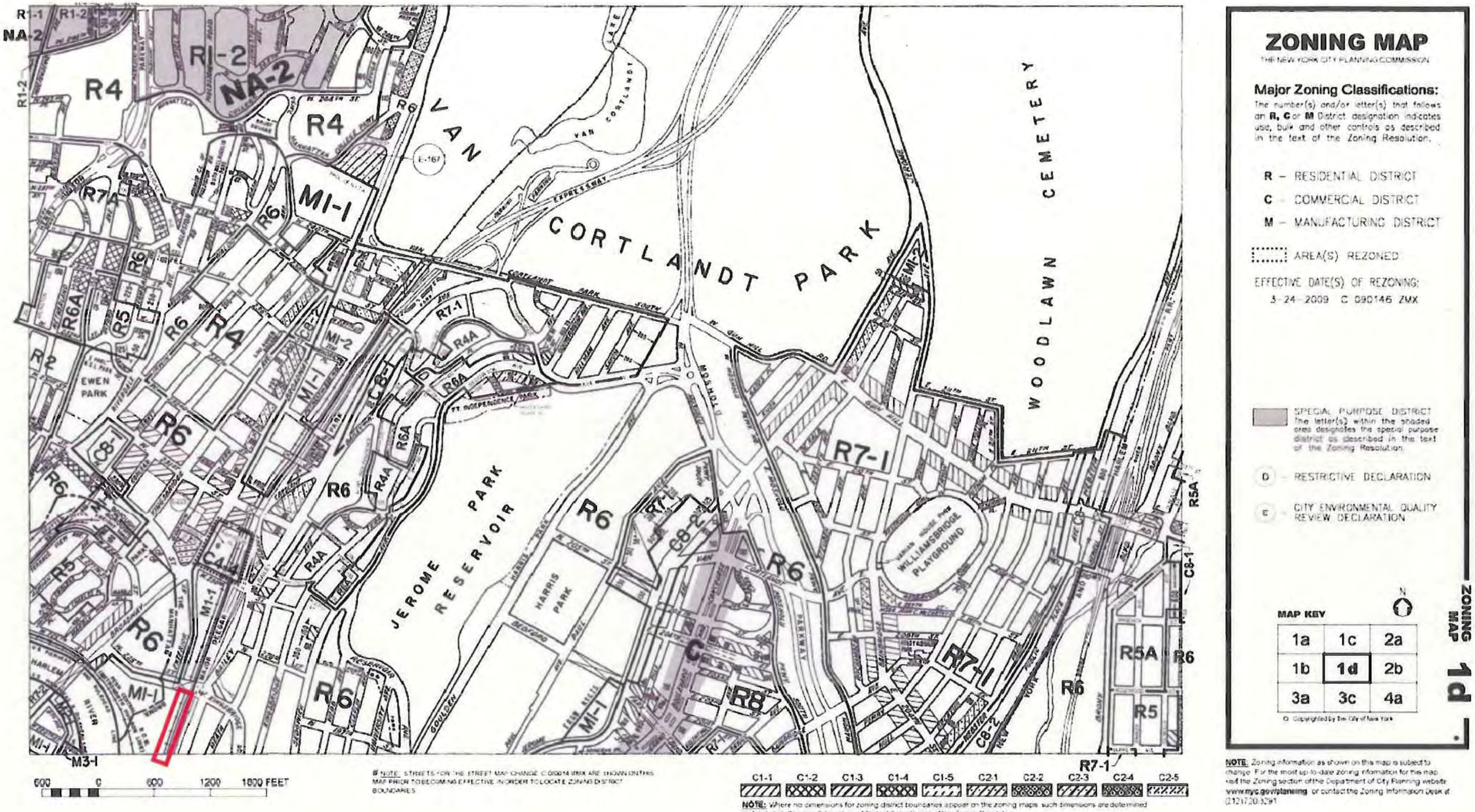

Figure 4
Bronx North Yard and Environs
Zoning Map

Figure 5
Bronx North Yard and Environs
Satellite Map

containers from flatcar to truck), are well buffered from the zoned residential area North of 225th Street. The easy access to the Major Deegan Expressway (see Figure 6), makes BN Yard an ideal location for such an operation. Furthermore, all future contracts with haulers/recyclers operating at the BN Yard will be required to use Ultra Low Sulfur Diesel Fuel, which significantly reduces PM_{10} and $PM_{2.5}$ emissions from trucks.

The new GCT facility would directly employ 47 people, and create a total of 87 jobs when indirect and induced impacts are considered, potentially in the Bronx, an Economically Depressed Area.

Cultural Resources

Operation of the project would have no direct or indirect effects on historic built properties, parkland, or archaeological resources. Improvements within GCT only affect the new LIRR Concourse and an area in the trainshed that has no historic designation. There is no parkland in the project area and since construction would occur only within GCT, in a previously disturbed area, there is no potential to unearth archaeological resources.

Transportation

One train trip per night would replace nine nightly trucks for garbage pick-up and nine nightly trucks for delivery of empty containers (or a total of 36 truck trips) that travel in Midtown Manhattan, where highway access is limited and trucks must travel on local roads to leave the island (e.g., trucks traveling from/to the Bronx must use 2nd and 3rd Avenues and traverse East Harlem and other neighborhoods where high asthma rates are found).

The restoration of Track 14 to revenue storage would contribute to more efficient Metro-North operations. Track 14, if not needed to transport recyclables, would add capacity to platform an additional eight-car passenger train and store it during the day. Without this capacity, the train would need to deadhead (travel without customers) in the morning peak period seven miles to Highbridge Yard in the Bronx and back again to pick up customers during the PM Peak. While the new facility would add two nightly train roundtrips per week to handle the increase in recycling materials, the restoration of Track 14 to passenger use would reduce five daily train roundtrips. Thus, an overall reduction in the number of train trips to and from the Bronx would result from the Project.

The operations analysis performed for the Project concludes that the maximum increase in the number of trucks that would report to the BN Yard in order to pick up the collected trash and recyclables from the Project is eight (8) per day or sixteen (16) truck trips. The New York City Environmental Quality Review Act ("CEQR") threshold for preparing a detailed analysis of intersection Levels of Service ("LOS") is 50 passenger car equivalents (trips) in the peak hour, with each truck being considered as equivalent to two (2) cars. This places the Project well below the threshold requiring the preparation of a LOS analysis.

While truck vehicle miles traveled (VMT) would decrease in Manhattan as a result of this program, overall changes in truck VMT are dependent on the final destination of the recycling processing center, which is unknown at this time. As a result, overall truck VMT reductions were not quantified.

Air Quality and Odor

As a result of the new facility, truck traffic would increase in the vicinity of the BN Yard. Currently up to six (6) trucks per day (for three (3) days out of the work week) travel to and from BN Yard for Metro-North's waste management operation. The number of trucks with the Project would increase to eight (8) per day (for five (5) days of the work week). The New York City Department of Environmental Protection Interim Guidance on the need for $PM_{2.5}$ analyses includes the following thresholds for heavy

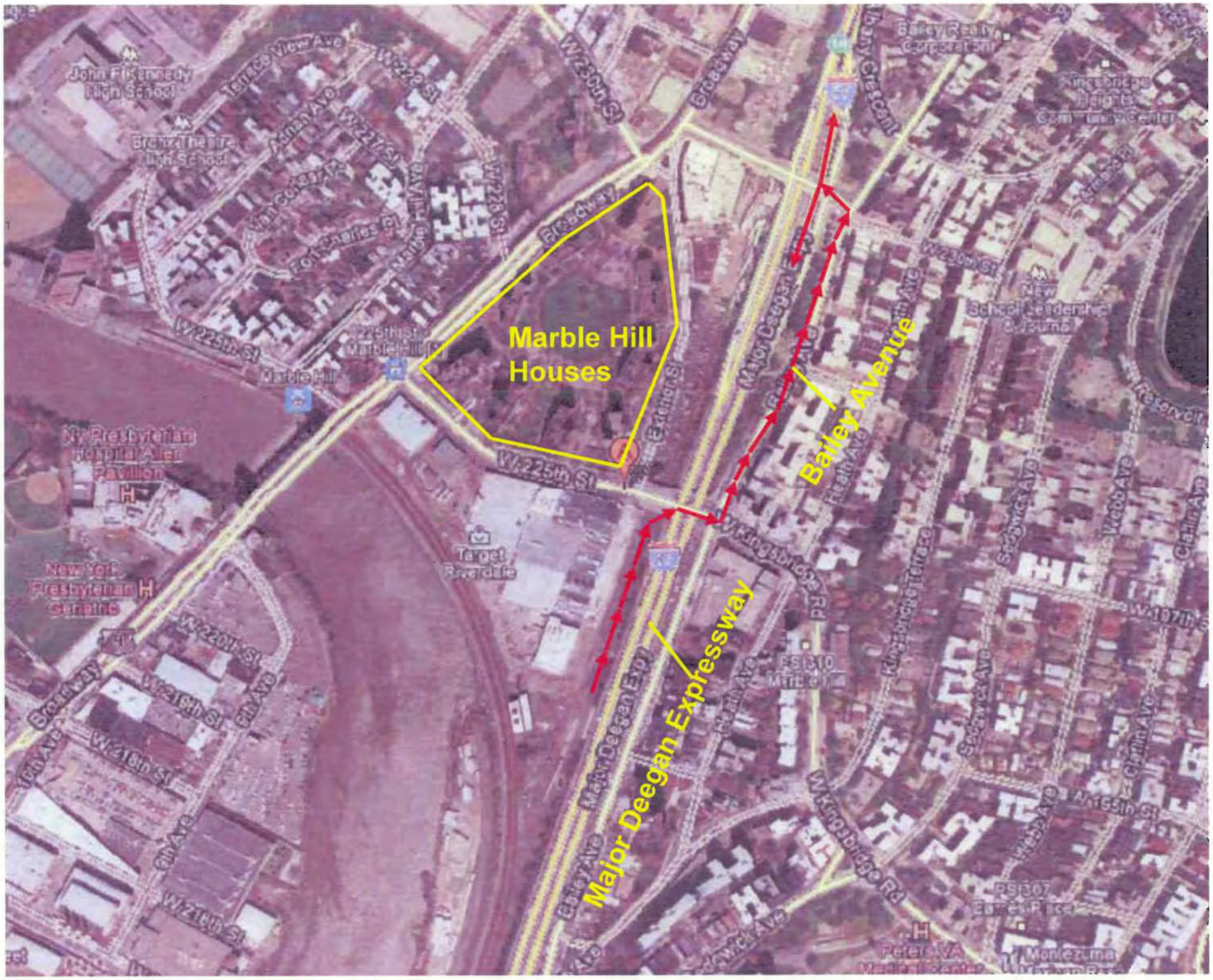

Figure 6
Truck Routes from Bronx North Yard

duty diesel vehicles (HDDV):

> If the proposed action would generate fewer than the below incremental traffic per hour or its equivalent in vehicular emissions, a need for the detailed $PM_{2.5}$ analysis would be unlikely:
>
> - 12 HDDV: for paved roads with < 5000 veh/day
> - 19 HDDV: for collector type roads
> - 23 HDDV: for principal and minor arterials
> - 23 HDDV: for expressways and limited access roads

With only eight (8) HDDV's per day, the Project is well below the threshold requiring preparation of a $PM_{2.5}$ analysis. Furthermore, the trucks operating at the BN Yard would be required to use Ultra Low Sulfur Diesel (ULSD), which significantly reduces sulfur dioxide, PM2.5 and other particulates.

Trash would not be stored at the BN Yard, nor would there be open containers of wet trash at the site when it was not in use. The 30 CY wet trash containers delivered to and from the BN Yard each day would be lined and sealed. The containers would be loaded onto trucks the same day as they were delivered to the BN Yard, so that the trash train could return for nightly pickup at GCT. As a result, no significant odor impacts are expected.

Noise and Vibration

A noise analysis was performed using the latest modeling techniques endorsed by FHWA to assess the increase of truck trips that would be generated by the proposed facility. The results of the analysis demonstrate that the increase in truck traffic would cause no more than a one dBA increase in noise levels at sensitive receptors in the area. The methodology used and a summary of the results of the assessment are included in Appendix A. A one dBA increase in noise levels would not be noticeable to the human ear and is below the CEQR impact threshold. Vibration levels at sensitive receptors are unlikely to increase since no new source of vibration would be introduced by the proposed project.

Energy

Overall energy savings would likely be realized since the number of train trips to BN Yard would be reduced and truck VMT (which is dependent on the recycling contractor) is not likely to increase significantly, and may also decrease (if a local hauler/processor of waste is selected as the MTA contractor).

Natural and Water Resources

No direct or indirect significant adverse impacts on natural or water resources would result from operation of the Project. There are no wetlands or other natural or water resources in the Project area and the Project would not trigger a Coastal Zone assessment or interfere with local Waterfront Revitalization Plans.

Hazardous Materials

The GCT Recycling and Waste Management Facility would not be used to collect or transport hazardous materials. Hazardous materials from Metro-North are currently securely stored in Alley 3 and taken out via track 100, as needed. Hazardous waste generated by LIRR operations is planned to be securely stored in the service corridor portion of the new Concourse and hauled via truck at the 50^{th} Street facility. The Project would not change the current or planned practices.

Safety and Security

Each of the three transfer stations would be operated 24-7, equipped with CCTV monitoring for security, and benefit from safety and security provisions that will be put in place by East Side Access.

Infrastructure and Utilities

Operation of the Project would have no significant adverse effect on infrastructure or utilities in the Project area because no utilities or active infrastructure would be disturbed or utilized.

Construction Impacts

The Project would be constructed below ground, entirely within the GCT trainshed area (which is not part of any historic designation). No improvement to the BN Yard would be necessary. The Project would not require acquisition of property and would not induce significant impacts to planned growth or land use for the areas affected; would not require the relocation of people. Construction of the Project would be concurrent with the construction of the concourse for the East Side Access Project. Hence, no significant adverse impacts would result from the construction of the Project. Specifically, no significant adverse impacts would occur in the following categories:

- Land Use, Zoning, Socioeconomic Impacts
- Cultural Resources
- Transportation
- Air Quality and Odor
- Noise and Vibration
- Hazardous Materials
- Natural, Water Resources/Coastal Zone/Waterfront Revitalization
- Safety and Security

Environmental Justice

No significant adverse impacts are expected to occur from construction or operation of the Project. Therefore, the Project would not disproportionately adversely affect low-income or minority populations in the Bronx or Manhattan or businesses or social services in the area. The Project could potentially provide new jobs at an existing recycling center in the Bronx, or a new one created to handle the MGP waste from the facility, and it is chosen as the competent low-bidder for this work.

Appendix A

GCT Recycling and Waste Management Facility Noise Analysis Memo

AKRF

Environmental and Planning Consultants

440 Park Avenue South
7th Floor
New York, NY 10016
tel: 212 696-0670
fax: 212 213-3191
www.akrf.com

Memorandum

To:	Audrey Heffernan
From:	Benjamin H. Sachwald
Date:	December 15, 2009
Re:	Bronx North Yard Acoustical Study - DRAFT
cc:	Stephen S. Rosen, Ph.D. Julie Cowing, AICP

A. INTRODUCTION

An increase in truck traffic would result as part of the planned Grand Central Terminal (GCT) Trash Management program. This program would use trash trains to haul GCT- LIRR and MNR waste from GCT to the Bronx North (BN) Yard. The purpose of the this study was to determine whether the additional truck trips to and from the BN Yard would result in a perceptible change in noise levels at locations located along the routes that trucks would use to access/egress the Bronx BN Yard. Due to the volume of vehicular traffic on the Major Deegan Expressway, noise emissions from train activity in the BN yard would not have any appreciable effect at nearby noise-sensitive locations. The assessment included monitoring to determine existing noise levels at noise-sensitive locations along the anticipated truck routes, noise levels due to trucks travelling to and from the BN Yard were calculated using the Federal Highway Administration (FHWA) Traffic Noise Model (TNM) Version 2.5, and the results of the assessment were compared to the noise impact criteria outlined in the New York City Environmental Quality Review (CEQR) Technical Manual.

B. ACOUSTICAL FUNDAMENTALS

Quantitative information on the effects of airborne noise on people is well documented. If sufficiently loud, noise may interfere with human activities such as sleep, speech, communication, and tasks requiring concentration or coordination. It may also cause annoyance, hearing damage, and other physiological problems. Several noise scales and rating methods are used to quantify the effects of noise on people, taking into consideration such factors as loudness, duration, time of occurrence, and changes in noise level with time. However, it must be noted that all the stated effects of noise on people vary greatly with each individual.

"A"-WEIGHTED SOUND LEVEL (dBA)

Noise is typically measured in units called decibels (dB), which are 10 times the logarithm of the ratio of the sound pressure squared to a standard reference presence squared. Because loudness is important in the assessment of the effects of noise on people, the dependence of loudness on frequency must be taken into account in the noise scale used in environmental assessments. One of the simplified scales that accounts for the dependence of perceived loudness on frequency is the use of a weighting network, known as "A"-weighting, in the measurement system to simulate the response of the human ear. For most noise assessments, the A-weighted sound pressure level in units of dBA is used in view of its widespread recognition and its close correlation with perception. In this study, all measured noise levels are reported in A-weighted decibels (dBA). Common noise levels in dBA are shown in **Table 1**.

ABILITY TO PERCEIVE CHANGES IN NOISE LEVELS

The average ability of an individual to perceive changes in noise levels is well documented (see **Table 2**). Generally, changes in noise levels of less than 3 dBA are barely perceptible to most listeners, whereas changes in noise levels of 10 dBA are normally perceived as doubling (or halving) of noise loudness. These guidelines permit direct estimation of an individual's probable perception of changes in noise levels.

Table 1
Common Noise Levels

Sound Source	(dBA)
Military jet, air raid siren	130
Amplified rock music	110
Jet takeoff at 500 meters	100
Freight train at 30 meters	95
Train horn at 30 meters	90
Heavy truck at 15 meters	80-90
Busy city street, loud shout	80
Busy traffic intersection	70-80
Highway traffic at 15 meters, train	70
Predominantly industrial area	60
Light car traffic at 15 meters, city or commercial areas, or residential areas close to industry	50-60
Background noise in an office	50
Suburban areas with medium-density transportation	40-50
Public Library	40
Soft whisper at 5 meters	30
Threshold of hearing	0

Notes: A 10 dBA increase in level appears to double the loudness, and a 10 dBA decrease halves the apparent loudness.

Sources: Cowan, James P., *Handbook of Environmental Acoustics*, Van Nostrand Reinhold, New York, 1994.
Egan, M. David, *Architectural Acoustics*, McGraw-Hill Book Company, 1988.

Table 2
Average Ability to Perceive Changes in Noise Levels

Change (dBA)	Human Perception of Sound
2-3	Barely perceptible
5	Readily noticeable
10	A doubling or halving of the loudness of sound
20	A "dramatic change"
40	Difference between a faintly audible sound and a very loud sound
Sources: Bolt Beranek and Newman, Inc., *Fundamentals and Abatement of Highway traffic Noise*, Report No. PB-222-703. Prepared for Federal Highway Administration, June 1973.	

NOISE DESCRIPTORS USED IN IMPACT ASSESSMENT

Because the sound pressure level unit of dBA describes a noise level at just one moment, and because very few noises are constant, other ways of describing noise over more extended periods have been developed. One way is to describe the fluctuating noise heard over a specific period as if it had been a steady, unchanging sound. For this condition, a descriptor called the "equivalent sound level," L_{eq}, can be computed. L_{eq} is the constant sound level that, in a given situation and period (e.g., 1 hour, denoted by $L_{eq(1)}$, or 24 hours, denoted by $L_{eq(24)}$), conveys the same sound energy as the actual time-varying sound. Statistical sound level descriptors, such as L_1, L_{10}, L_{50}, L_{90}, and L_x, are used to indicate noise levels that are exceeded 1, 10, 50, 90, and x percent of the time, respectively. Discrete event peak levels are given as L_{01} levels.

For this assessment, the maximum 1-hour equivalent sound level ($L_{eq(1)}$) has been selected as the noise descriptor to be used for this noise impact evaluation. $L_{eq(1)}$ is the noise descriptor recommended for use in the *CEQR Technical Manual* for vehicular traffic noise impact evaluation, and is used to provide an indication of highest expected sound levels.

C. ASSESSMENT IMPACT DEFINITION

Based on the criteria outlined in the *CEQR Technical Manual*, this study uses the following criteria to define a significant noise impact:

- An increase of 5 dBA or more in noise levels at sensitive receptors (including residences, play areas, parks, schools, libraries, and houses of worship) over those measured for the Existing condition, if the Existing levels are less than 60 dBA $L_{eq(1)}$ and the analysis period is not a nighttime period.
- An increase of 4 dBA or more in noise levels at sensitive receptors over those measured for the Existing condition, if the Existing levels are 61 dBA $L_{eq(1)}$ and the analysis period is not a nighttime period.
- An increase of 3 dBA or more in noise levels at sensitive receptors over those measured for the Existing condition, if the Existing levels are greater than 62 dBA $L_{eq(1)}$ and the analysis period is not a nighttime period.

D. ASSESSMENT METHODOLOGY

VEHICULAR TRUCK TRAFFIC NOISE

The planned GCT Trash Management scheme of using trash trains to haul GCT-LIRR and MNR waste from GCT to the BN Yard would generate a small number of truck trips above existing conditions. Due to access constraints at the BN Yard, only one truck is permitted in the BN Yard at a time. This information was used to develop the assessment's reasonable worst case scenario. Since there may be two different trucking operators handling the GCT-LIRR and MNR waste, the maximum expected number of additional trucks would be two trucks in one hour. The TNM Version 2.5 software was used to calculate the noise generated by the additional truck traffic on roadways near the BN Yard and these levels were added to existing (measured) noise levels to determine the reasonable worst case scenario's one-hour L_{eq} noise levels.

Traffic Noise Model

The TNM is a computerized model developed for the FHWA that calculates the noise contribution of each roadway segment to a given noise receptor. The noise from each vehicle type is determined as a function of the reference energy-mean emission level, corrected for vehicle volume, speed, roadway grade, roadway segment length, and source-receptor distance. Further considerations included in modeling the propagation path include identifying the shielding provided by rows of buildings, analyzing the effects of different ground types, identifying source and receptor elevations, and analyzing the effects of any intervening noise barriers.

The analysis consisted of the following five step procedure:

1. Street level noise measurements were made at noise-sensitive locations along the anticipated routes that trucks would use to access/egress the BN Yard;
2. The existing building, roadway, and ground elevation geometry was coded into the TNM software;
3. The TNM was used to calculate noise levels produced by trucks that are part of the planned GCT waste trucking operations;
4. The quietest measured existing $L_{eq(1)}$ values were added to the TNM results obtained in step 3 to obtain the total noise levels with the planned GCT Trash Management program; and
5. The total noise levels obtained in step 4 were compared to the quietest measured existing noise levels and the differences were compared to the impact criteria outlined above.

E. EXISTING CONDITIONS

SITE DESCRIPTION

The BN yard is located to the west of the Major Deegan Expressway, to the east of the Harlem River and south of West 225th Street. There is an access road leading from West 225th Street behind the existing commercial spaces. The neighborhood surrounding the project site is predominantly characterized by residential, parking and commercial uses.

SELECTION OF NOISE RECEPTOR LOCATIONS

Four locations around the project site were selected for noise monitoring. All receptor sites were chosen due to their location along the anticipated routes that trucks would use to access/egress the BN Yard. Sites 1 and 2 were located on West 225th Street between Broadway and Bailey Avenue, with Site 1 located further west along West 225th Street and Site 2 located further east along West 225th Street. Site 3 was located on Bailey Avenue between West 229th Street and West 230th Street and Site 4 was located on Bailey Avenue between West 193rd Street and West 225th Street (see **Table 3** and **Figure 1**). These receptor sites are representative of other locations in the immediate area and are generally the locations where maximum potential increases would be expected.

NOISE MONITORING

It is anticipated that additional trucks associated with the planned GCT Trash Management scheme would access/egress the BN Yard during the weekday daytime. The potential for a noise impact would be greatest when the existing noise levels are lowest (i.e., not during the weekday AM and PM rush hour). Consequently, noise monitoring was performed from approximately 9:30 AM to 4:30 PM. During this time, twenty minute measurements were taken throughout the day. Noise monitoring occurred on December 1 and 2, 2009.

Table 3
Noise Receptor Locations

Receptor Site	Location	Associated Land Use
1	West 225th St between Broadway and Exterior Street (Near Broadway)	Residential
2	West 225th St between Broadway and Exterior Street (Near Exterior Street)	Residential
3	Bailey Avenue between West 230th and West 229th Streets (At 2860 Bailey Avenue)	Residential
4	Bailey Avenue between West 225th and West 193rd Streets (At 2686 Bailey Avenue)	Residential/School

EQUIPMENT USED DURING NOISE MONITORING

Measurements were performed using Brüel & Kjær Sound Level Meters (SLM) Type 2260, Brüel & Kjær Sound Level Calibrators Type 4231, and Brüel & Kjær ½-inch microphones Type 4189. The Brüel & Kjær SLMs are Type 1 instruments. The meters used (S/N 2384814 and 2385602) were calibrated on August 7, 2009 and August 14, 2009, respectively and are valid through August of 2010. The calibrators used (S/N 2412436 and 2688762) were calibrated on August 7, 2009 and July 23, 2009, respectively and are valid through August and July of 2010, also respectively. The instruments were mounted on a tripod at a height of approximately 5 feet above the ground. The SLMs were calibrated before and after readings using Brüel & Kjær Type 4231 sound level calibrators with the appropriate adaptors. The data were digitally recorded by the SLMs and displayed at the end of the measurement period in units of dBA. Measured quantities included L_{eq}, L_1, L_{10}, L_{50}, and L_{90}. Windscreens were used during all sound measurements except for calibration. All measurement procedures were based on the requirements of ANSI Standard S1.13-2005.

RESULTS OF BASELINE MEASUREMENTS

Table 4 summarizes the noise monitoring results for the weekday analysis hours. Values are shown for specific monitored weekday time periods. In general, noise levels are relatively high and reflect the level of vehicular activity on adjacent streets and, at Sites 1 and 2, elevated subway activity. At Site 1, measured noise levels consist of a combination of vehicular traffic on West 225th Street/Broadway and the elevated MTA No. 1 train. At Site 2, measured noise levels consist primarily of vehicular traffic on West 225th/Exterior Street; the elevated MTA No. 1 train also contributes to the overall noise level at Site 2. At Sites 3 and 4, measured noise levels are primarily a function of vehicular traffic on Bailey Avenue and the Major Deegan Expressway.

F. ASSESSMENT RESULTS

Table 5 summarizes the results of the assessment. Predicted increases in noise level values are shown for the quietest measured time period to assume a worst case scenario. The increase in $L_{eq(1)}$, as a result of the additional trucks that would access/egress the BN Yard associated with the planned GCT Trash Management scheme, would be less than 1 dBA at all four receptor sites. An increase in noise levels of this magnitude would not be considered perceptible and would be below the CEQR threshold for an impact.

Table 4
Measured Existing Noise Levels (in dBA)

Receptor Site	Location	Measurement Start Time	$L_{eq(1)}$	L_1	L_{10}	L_{50}	L_{90}
1	West 225th St between Broadway and Exterior Street (Near Broadway)	9:40 AM	70.7	79.7	72.9	68.4	64.1
		10:37 AM	71.6	82.7	72.2	66.6	62.5
		11:48 AM	69.3	79.1	71.9	66.5	62.0
		1:56 PM*	69.1	78.5	72.1	66.3	61.5
		2:53 PM	70.3	80.2	74.3	66.8	62.0
		3:46 PM	71.8	81.2	73.8	68.1	62.8
2	West 225th St between Broadway and Exterior Street (Near Exterior Street)	10:09 AM	71.0	80.3	74.3	67.3	63.0
		11:04 AM	69.7	78.2	72.8	67.1	62.0
		12:17 PM	69.3	77.9	72.3	66.6	60.8
		2:26 PM*	69.2	77.6	72.8	66.1	60.9
		3:19 PM	69.4	77.9	72.1	67.6	62.9
		4:11 PM	71.1	81.2	73.2	67.6	63.0
3	Bailey Avenue between West 230th and West 229th Streets (At 2860 Bailey Avenue)	9:58 AM	69.9	74.3	71.5	69.5	67.6
		10:55 AM	69.4	73.4	71.1	69.1	67.2
		12:08 PM	69.9	73.5	71.3	69.4	68.1
		1:03 PM	70.1	74.0	71.6	69.9	68.1
		3:19 PM	68.6	73.4	70.4	68.1	66.3
		4:11 PM*	68.4	73.5	69.6	67.7	66.4
4	Bailey Avenue between West 225th and West 193rd Streets (At 2686 Bailey Avenue)	9:29 AM	70.3	73.9	71.8	69.9	68.5
		10:27 AM	69.9	74.9	71.3	69.4	67.8
		12:35 PM	70.0	73.8	71.4	69.7	68.1
		1:31 PM	70.2	76.0	71.7	69.5	68.0
		2:51 PM	70.0	75.9	71.9	69.4	67.2
		3:47 PM*	69.4	75.9	71.6	68.3	66.2

Notes: Field measurements were performed by AKRF, Inc. on December 1 and 2, 2009
* Lowest measured value

Table 5
Acoustical Analysis Results (in dBA)

Receptor Site	Location	Existing $L_{eq(1)}$	TNM $L_{eq(1)}$	Total $L_{eq(1)}$	Increase $L_{eq(1)}$
1	West 225th St between Broadway and Exterior Street (Near Broadway)	69.1	55.2	69.3	0.2
2	West 225th St between Broadway and Exterior Street (Near Exterior Street)	69.2	57.8	69.5	0.3
3	Bailey Avenue between West 230th and West 229th Streets (At 2860 Bailey Avenue)	68.4	53.5	68.5	0.1
4	Bailey Avenue between West 225th and West 193rd Streets (At 2686 Bailey Avenue)	69.4	54.3	69.5	0.1

G. CONCLUSIONS

As shown in Table 5, the results of the assessment demonstrate that predicted increases in $L_{eq(1)}$, as a result of the additional trucks that would access/egress the BN Yard associated with the planned GCT Trash Management program, a would be less than 1 dBA at all four receptor sites. An increase in noise levels of this magnitude would not be considered perceptible and would be below the CEQR threshold for an impact.

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Pedestrian Simulation of East Side Access and Grand Central Terminal

November 2009

Prepared for:

MTA Capital Construction

Prepared by:

STV Incorporated

LIRR EAST SIDE ACCESS

TABLE OF CONTENTS

APPENDICES

LIRR EAST SIDE ACCESS

LIST OF TABLES

LIST OF FIGURES

I. Introduction and Project Scope Overview

A comprehensive pedestrian flow modeling analysis of Grand Central Terminal (GCT) and the new LIRR Terminal was undertaken to determine the effects of East Side Access (ESA) at GCT without the construction of the 44th and 45th street entrances, which were assumed in the design analyzed in the 2001 Final Environmental Impact Statement (FEIS) that was prepared for the project. A number of changes have occurred since the FEIS analyses were prepared, including: higher than anticipated Metro-North Railroad (MNR) growth; the opening of the North End Access entrances; and the commitment to build both Phase 1 of the Second Avenue Subway and the No. 7 Line Extension. The modeling analysis incorporates the latest planning assumptions and relevant survey data to determine whether additional pedestrian flow impacts that were not identified in the FEIS would result under the proposed design. The modeling analysis was also undertaken to verify that the design of the new ESA caverns and concourse will meet the level of service criteria (i.e., LOS C/D) established for the project.

Data collection involved weekday peak-period pedestrian counts at stairs, escalators, and passageway areas in GCT for input into the model to simulate existing conditions. These counts were collected over a series of typical midweek days (i.e., Tuesday, Wednesday, Thursday) in October 2008. Counts of pedestrian queues during end/beginning-of-month days at the GCT ticket window area in the Upper Concourse were made to capture the worst-case queuing. Pedestrians exiting and entering each MNR track were counted on both levels within GCT. Pedestrian tracings of groups of people from each track and from key vertical circulation elements (VCEs) were developed to establish a base origin/destination pattern within GCT.

To analyze pedestrian conditions under the design change (no street connections to either 44th or 45th streets), the study focused on the PM peak period for model development after data indicated the late afternoon hours process more people through GCT than during any other period of a typical weekday. There are a number of reasons for this pattern, including the concentration of flows that occur in the PM given that the terminal is an end destination, and ticket buying and general person queuing within the terminal is much more pronounced later in the day. Model runs included Existing Conditions, 2020 No Build, and 2020 Build assuming that the 44th and 45th street entrances would not be built. As in the FEIS, the analysis of potential impacts within GCT and the LIRR Concourse focused on key representative corridors, passageways, and stairwells that would be affected by design change. The affected locations include vertical connections and areas in GCT's Dining and Upper concourses, the Oyster Bar ramps, passageway elements within GCT including the 47th Street crosspassage, and Grand Central North (formerly referred to as North End Access) entrances.

In addition to analyzing the proposed design changes, problematic areas at the south end of the 105 East 42nd Street corridor and the IRT Fare Control Area (FCA) 238 were re-examined to assess the effects of the latest planning information (i.e., higher than anticipated MNR growth, and the effects of SAS and the No.7 Line Extension). These areas would not be affected by the proposed design changes since the same number of LIRR customers would use the subway whether or not the street entrances are constructed. FCA 238 was identified in the FEIS as a location where significant adverse impacts would occur under Build conditions. This area of concern was analyzed for both the AM and PM peak hours and years 2020 and 2030. The

“Kenneth Cole Stairs”, a new VCE that is in the NYCT 2010-2014 Capital Plan connecting the 105 East 42nd Street corridor and FCA 238, was included in the model.

Lastly, two other configurations were modeled to inform future MTA planning projects in GCT. The additional runs included a lower level loop track connection to the NYCT FCA 238 and an escalator between the ESA concourse and the Biltmore Room

One complete united LIRR ESA / MNR GCT terminal was modeled, including the LIRR Concourse; 47th Street Crosspassage; GCT Dining Concourse (DC) and Upper Concourse; Oyster Bar ramps; passageway to Roosevelt hotel; incoming train room; passageways to 42nd Street to Vanderbilt/42nd corner, Park/42nd corner and to the 105 East 42nd (midblock between Park and Lexington), Graybar and Lexington passageways, and the connection to Vanderbilt Avenue from the Upper Concourse. Vertical circulation elements that connect these areas were included; for vertical connections leading to areas not being studied herein (such as VCEs into the Met Life building or down to and beyond NYCT FCAs turnstile lines), the model “assumed” that sufficient downstream capacity existed to accept pedestrian loads leaving the terminal.

There are many areas typically unaffected during peak hours by normal pedestrian commuter flows. As such (and because schedule constraints limit the extent of the modeling effort), the following areas were not included within the simulation model:

- GCT Central Market corridor (commuters typically do not walk through this space to reach their destination).
- The seating and dining areas within the Dining Concourse (the dining areas beneath the east and west stairs to the Main Concourse and the circular dining areas east and west of the information booth; commuters do not walk through these spaces).
- Vanderbilt Hall (space dedicated for holiday vendors and special events).
- Restaurant areas just inside the Vanderbilt Avenue side entrance.
- MNR platforms (space not to be used by LIRR passengers).
- ESA LIRR mezzanine and platforms (space not to be used by MNR passengers).
- Passages within the Met Life building (not anticipated to be used by LIRR passengers).
- Outside sidewalks (beyond the main influence area of LIRR passengers).
- Connections above the Roosevelt passageway into the 347 Madison building (not anticipated to be used by LIRR passengers).
- 45th Street crosspassage (LIRR passengers will not use this deep connection because there are no connections to the LIRR Concourse).
- NYCT paid-area subway mezzanines and platforms.

As is typical for the conduct of pedestrian analyses, the peak 15-minute period was modeled using the STEPS pedestrian simulation model. The existing conditions model was created to calibrate and validate existing pedestrian flows within GCT, and thus serve as the basis of future-conditions model runs.

The new LIRR service was assumed to operate at capacity to simulate reasonable worst-case conditions. Twenty-four fully loaded (95 percent full) trains per hour would operate during the peak period. This assumption is consistent with the analyses performed for the FEIS.

This report represents the third in a series of three documents, and was prepared to summarize the development of the future condition pedestrian flow volumes and findings from the future condition pedestrian simulation model. The first two memoranda focused on data collection results and model development, and are included in attached technical appendices.

II. STEPS Model Development

The development of the STEPS model can be organized into two categories, the building of the physical background elements and the creation of pedestrian movements. The physical background elements of the model consist of floor levels, walls, escalators, stairs and turnstiles, elevators, and train movements into and out of the terminal – in essence, all the physical elements that compose a "working structure." The pedestrian events identify the characteristics of the people who will be modeled in the simulation; specifically, the number of people, their origins, and destinations, walking speeds, assigned routes, and patience levels. A more detailed discussion about the model inputs for the physical background and pedestrian events elements is provided in Appendix C.

III. Model Validation

An important and standard step within modeling processes is the validation of the results in order to determine the accuracy of the inputs/outputs. The validation was achieved through visual and quantitative assessment of the model outputs. Specifically, the methods used to review the model include: a visual assessment of the simulation, quantitative evaluation of the population within the model, and comparison of model analysis findings with results obtained from field observations and calculations.

A. Visual Assessment

The model simulation was visually examined to verify that pedestrian movements closely represent pedestrian circulation patterns within GCT. Special attention was paid to highly congested areas, such as the 105 East 42nd Street corridor that connects to NYCT FCA 238, to ensure that they represent the conditions observed during the peak periods. The size of the queues at the vertical circulation elements (VCEs), and number of people on the VCEs and their processing rate were checked. In addition, levels of service (LOSs) from the model and in the existing terminal were compared to match.

In STEPS, pedestrians are assigned to the shortest (straight-line) path. In addition, travel time is calculated in segments and not from the origin to final destination as a whole. The model does not have the ability to recognize that a shorter travel time can be achieved by detouring pedestrians to take "non-straight-line" paths to avoid crowds; even though the walking distance would be longer, faster walking speed could be attained to achieve shorter traveling time. Through observations of the model, checkpoints were strategically placed at highly populated areas to guide pedestrians through congestion. These checkpoints serve as "stepping stones" to break up the route into short travel segments, creating many decision (guiding) points, allowing the model to calculate the next action at each checkpoint to accommodate unexpected interferences. Checkpoints were also used to recreate, in the model, the existing walking patterns of the people in GCT.

B. Population and Operation Validation

Due to the many possible path combinations existing in GCT, there was no feasible way to track the exact origins and destinations of the many thousands of people in the terminal during the peak periods during the data collection efforts. Therefore, main decision points, locations where noticeable amounts of people from different origins would cross paths and then disperse into different directions, were identified throughout the terminal. This was done in STEPS by sub-routes, when people approach a main decision point, the percentages defined within the sub-route, assigned to that point, would divide them once again into different directions. Each main route is made up of a combination of sub-routes. To verify that the model was accurately populated, the volume of pedestrians exiting the model and the amount of pedestrians crossing each main decision point were checked. The pedestrian volumes in the model were not accepted until they were within five percentage of accuracy.

During the AM peak hour, about 29,000 new LIRR riders would use ESA in 2020, which would not change appreciably in future years given that trains would be fully loaded. Detailed volume information during the PM peak hour and PM peak 15-minute is presented in Table 1 and Table 2.

A 2006 LIRR origin-destination survey was used to assign LIRR customers through the terminal and out to the street. The FEIS relied on 1990 census data for these assignments. As in the FEIS, most LIRR customers would be headed to points north of the terminal, using the entrances/exits at the 47th Street crosspassage and 48th Street entrance, and not enter the main GCT concourse (see Figures 1 and 2).

Table 1: PM Peak Hour Passenger Volumes in GCT Proper

Location	Existing	2020 No Build	2020 Build	% Total	2030 No Build	2030 Build	% Total
MNR Customers entering GCT Upper Concourse from street	41,700	48,800	na	82%	54,300	na	84%
LIRR Customers entering GCT to LIRR Concourse **	na	na	10,530 *	18%	na	10,530 *	16%

* without short subway loop from LIRR Concourse to FCA 238 (about 36.5% of all LIRRers); short subway loop would reduce LIRR customers entering GCT Proper by about 2330, to 8,200.
** based on 24 trains per hour @ 1,202 pax/train

Table 2: Peak 15-minute Passenger Volumes in FCA 238

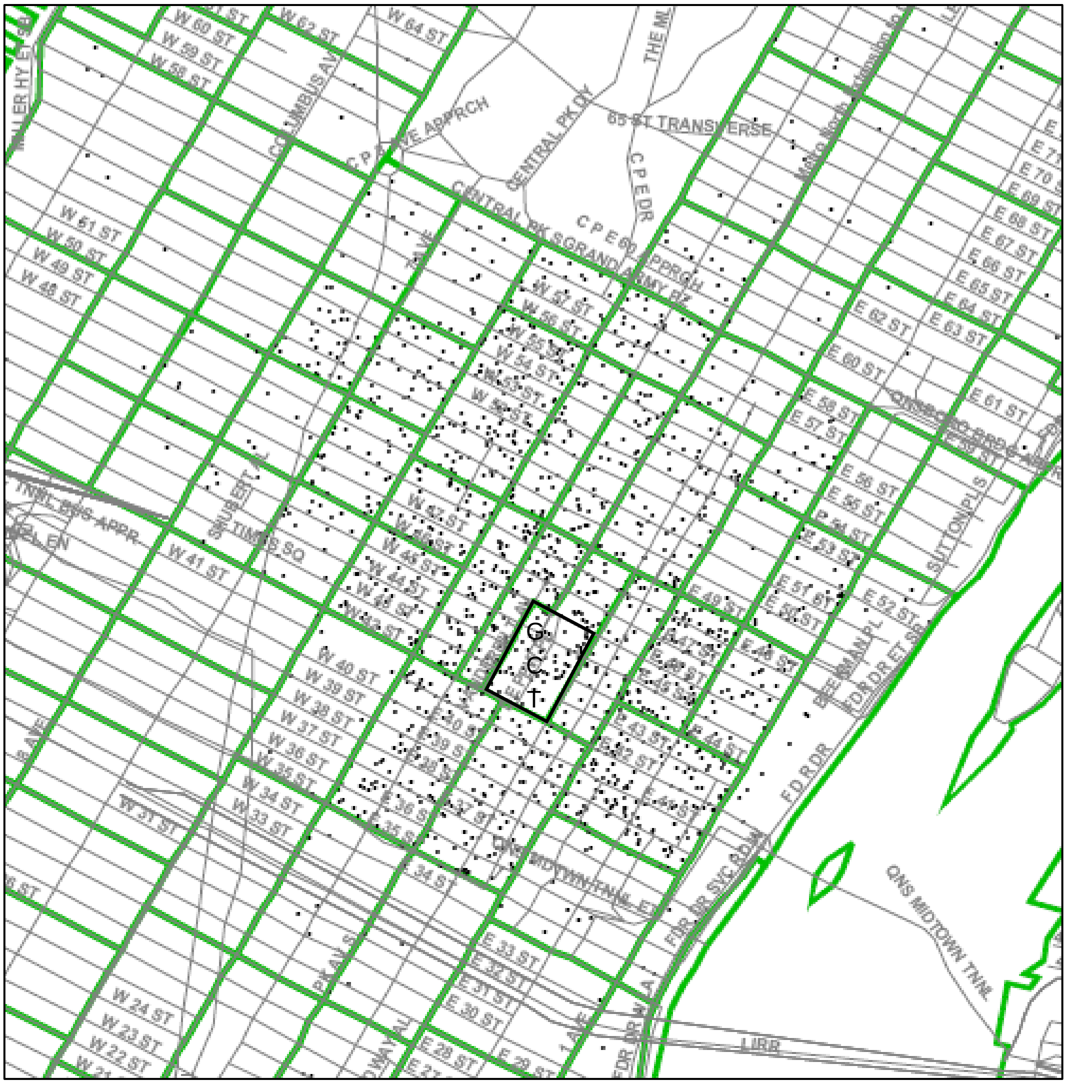
	Existing	2020 No Build	% Total	2020 Build	% Total	2030 No Build	% Total	2030 Build	% Total
LIRR	na	na	na	2,630	40%	na	na	2,630	38%
MNR	1,230	1,490	39%	1,490	23%	1,710	40%	1,710	25%
NYCT	2,070	2,370	61%	2,370	37%	2,580	60%	2,580	37%
Total	3,300	3,860	na	6,490	na	4,290	na	6,920	na

It is important to note that the growth in pedestrians between 2020 and 2030 is all due to MNR and NYCT growth as the ESA service is assumed to be at capacity in 2020.

In a similar manner to the EIS, LIRR riders were assigned to/from their final Midtown destination, LIRR patrons were assume to use one or more of the nearest exits closest to their end location. (From the four main escalator banks connecting the LIRR mezzanine to the LIRR Concourse, LIRR passengers would be ascending each bank by "favoring" the southern ends of the LIRR platforms given that platform VCEs are positioned toward the north end. Thus, more train cars would be processed by the southern VCEs as follows: 33 percent to the southmost VCE, 25 percent to the south middle VCE, 21 percent to the north middle VCE, and 21 percent to the northmost VCE). Once on the street, people were assumed to follow as direct a path as possible into that Midtown destination zone.

Those pedestrians who would have used the 44th or 45th street entrances in the FEIS design were assigned to the nearest exit, primarily through the 47th Street Crosspassage to an existing escalator on the south side of 47th Street at Madison Avenue (the closest and most direct to 44th and 45th streets.

Figure 1: Distribution of LIRR Ridership at GCT (Based on 2006 LIRR O/D Survey)



Each dot represents a destination cluster, not an individual person trip, within the MTA RTFM zone system

Figure 2: Distribution of LIRR Ridership at GCT

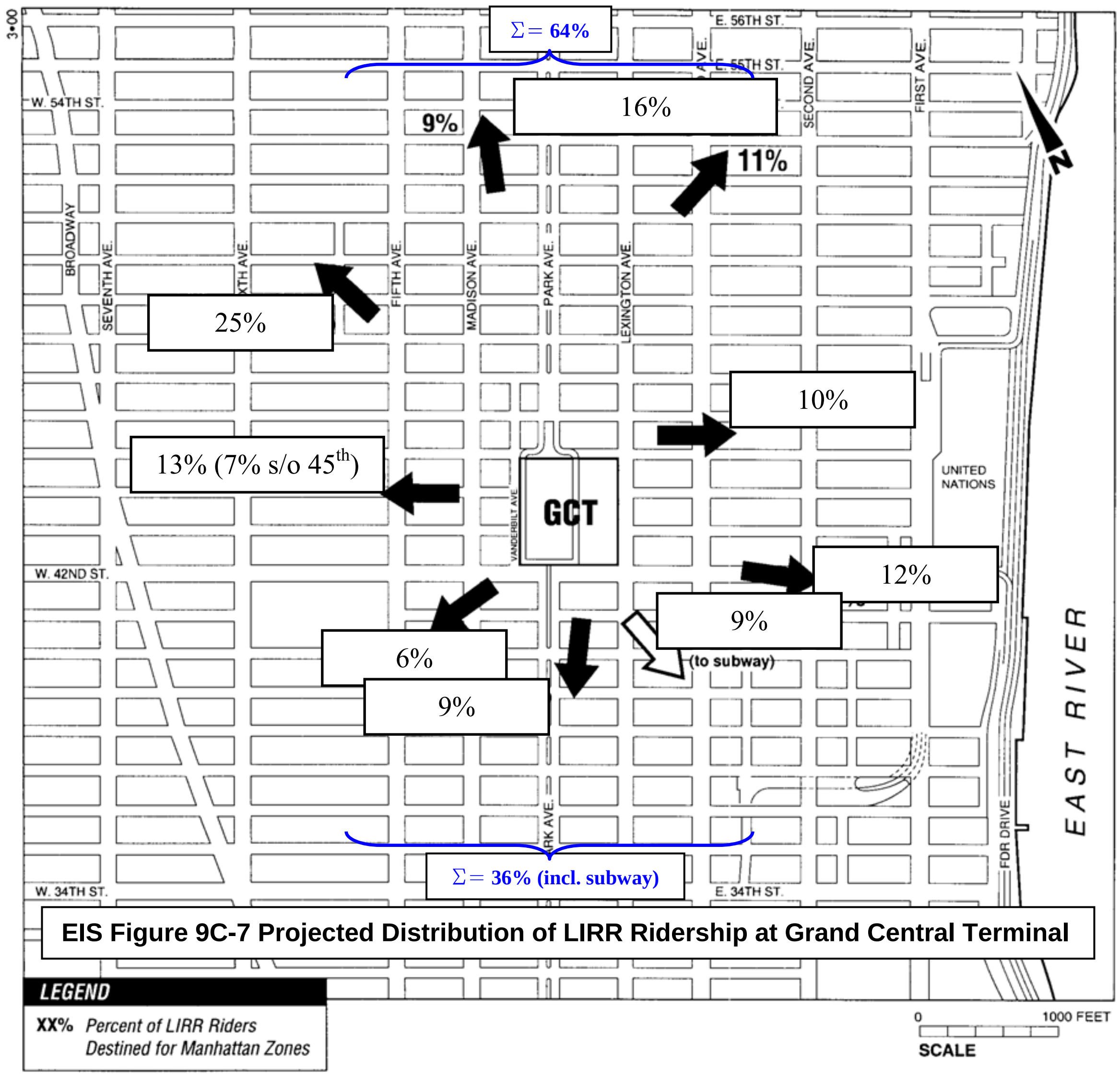


Table 3 lists the LIRR pedestrian flow conditions in GCT PM peak 15 minute period.

Table 3: LIRR Pedestrian Flow Conditions in GCT PM Peak 15-minute Period (highest terminal passenger volume; output from model)

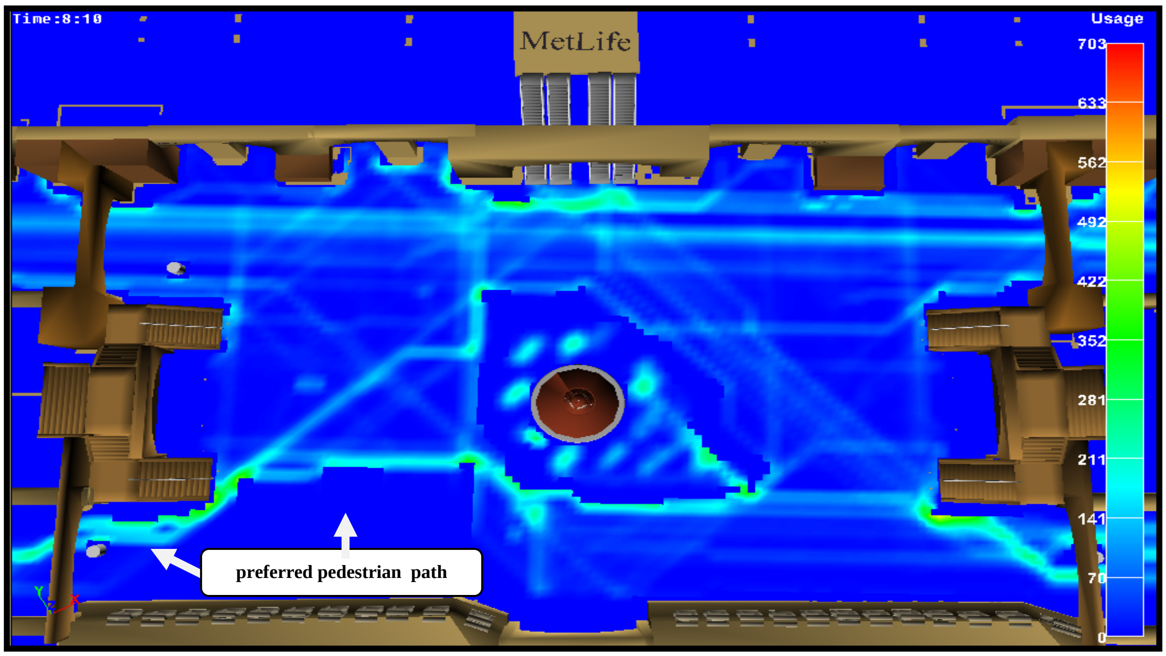
Location	Existing	2020 w/o ESA	2020 w/ESA
NYCT IRT Fare Control Area 238	1,580 up / 1,640 down	1,800 up / 2,230 down	2,400 up / 2,150 down
ESA Escalators in GCT Dining Concourse	--	--	2,340
Transit Museum Escalator to Dining Concourse (down)	220	260	560
LIRR Concourse bet. 44th and 48th Streets	--	--	4,020
LIRR Concourse bet. 44th Street and Escalators to GCT Dining Concourse	--	--	1,760
Passageway bet. NYCT Transit Museum and NYCT Shuttle	1,910	2,040	2,040
in 47th Street Crosspassage			
VCE to LIRR Concourse	--	--	2,770
VCE to Westvaco (NE corner of 48th/Park)	430	530	1,440
VCE to 245 Park Avenue	--	--	820
VCE to Chase (NE corner of 47th/Madison)	970	1,200	1,300
VCE to Bear Stearns (SE corner of 47th/Madison) (w/o Biltmore Room stairs)	70	90	870
Crosspassage near LIRR Escalator	850	1,060	3,040
Crosspassage East End e/o GCT East Spine	90	100	810

IV. Model Results

The STEPS model provides three useful simulation outputs that assist the analyst in examining the terminal. First, a real-time simulation output of pedestrians walking and queuing within corridors, ascending/descending VCEs, and traversing through turnstiles is provided to give the viewer a sense of scale for the project in terms of the sizes of the facility and the volume of people. For example, a stakeholder can visually understand the difference between 500 versus 5,000 people per hour walking through a ten-foot-wide corridor.

Second, the simulation can highlight high-usage walking paths through the terminal. The easy identification of desired pedestrian routes can guide designers to properly locate way-finding signage, VCEs, and retail kiosks so as not to obstruct preferred pedestrian paths (see Figure 3). Obstructions within these desire lines would create pedestrian turbulence, a reduction in pedestrian walking speeds, and a deterioration in pedestrian LOS.

Figure 3: PM Peak Period Usage Paths in Main Concourse



Third, the simulation identifies "hot spot" locations that exhibit high pedestrian densities and possibly operate at poor levels of service. The hot spots are sensitive areas that at times even a slight increase in volume can result in disruption to the flows and deteriorated conditions. The images from the model are similar to Doppler radar pictures, which identify locations of intense precipitation; in STEPS, the deep red color signifies dense pedestrian activity operating at a poor level of service.

The following list identifies GCT hot spots that exist today:

1) NYCT FCA 238 after trains unload (see Figure 4). These conditions, while certainly problematic, occur nearly every day as commuters queue in dense interpersonal spacing, and tolerate poorer levels of service (in part, because this remains the shortest travel path) in order to clear the area sooner.

2) The junctions/main decision points, such as where the Lexington Passage crosses the 105 East 42nd Street corridor, where dense pedestrian paths intersect each other, which result in slower traveling speeds (see Figure 5).

3) 105 East 42nd Street corridor, which has a number of obstructions within and lining it, such as an information kiosk, refuse cans, a police desk, retail store information board etc., and its effective width is significantly narrowed (the north end of this corridor is shown in Figure 5).

4) The ticketing windows on the south side of GCT's Upper Concourse, where there are a significant number of stationary people narrowing the available walking space (see Figure 6).

The hot spots, however, do not endure for the entire peak period (e.g., 6-10 AM), but can occur briefly throughout the peak period. Small isolated hot spots usually occur for less than one minute at a time. These brief times of congestion would not constitute a significant pedestrian impact, per CEQR, since they do not endure for the entire 15-minute period. Nevertheless, such conditions are indicative of potential longer-duration problems that may occur in the future. Hot spots at VCE banks can last longer because they are usually based on train arrivals. The effects of ESA on these locations are discussed in the next section.

Figure 4: PM Level of Service at NYCT FCA 238 during Subway Alighting Surge

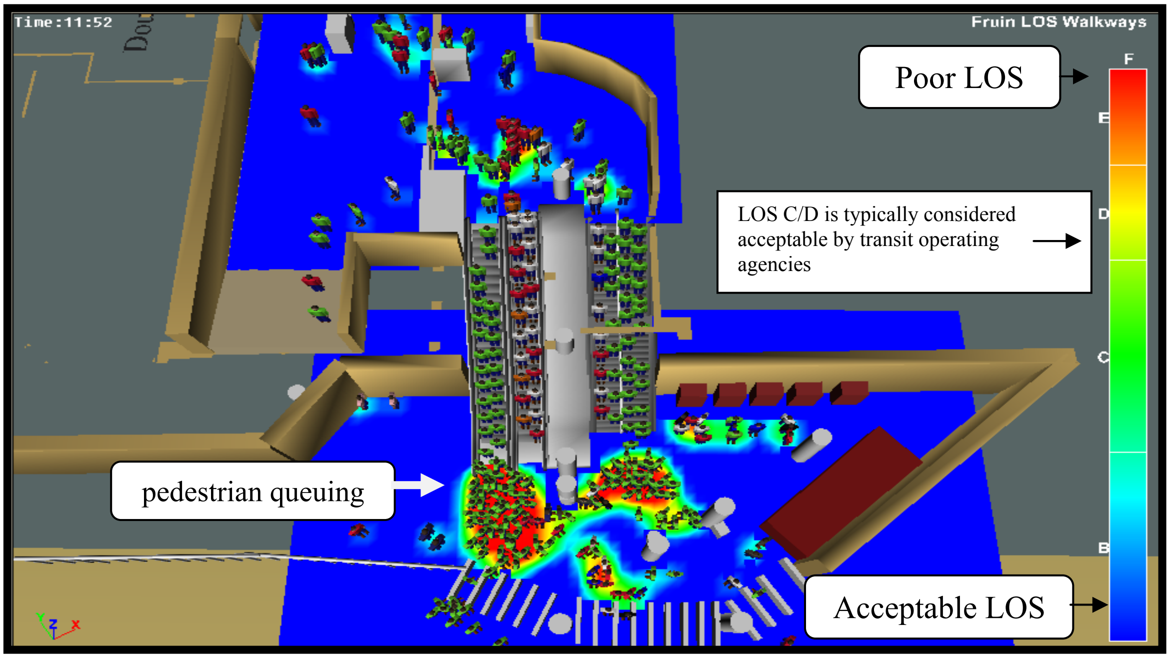


Figure 5: **PM Momentary Hot Spots at Pedestrian Intersection (GCT Upper Concourse)**

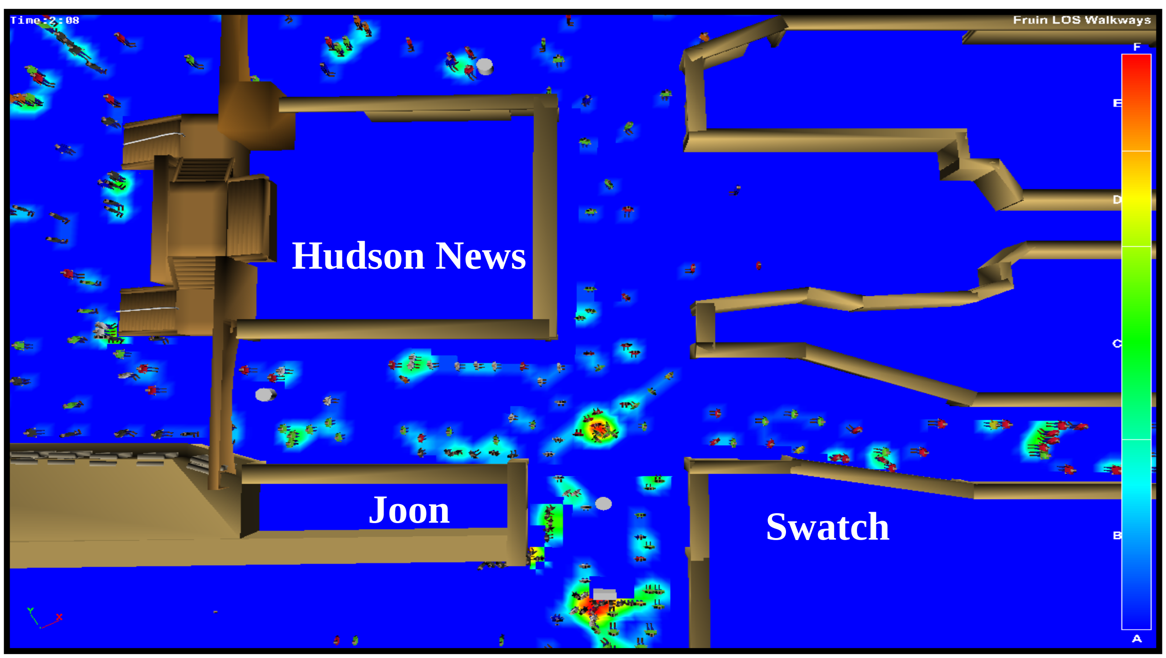
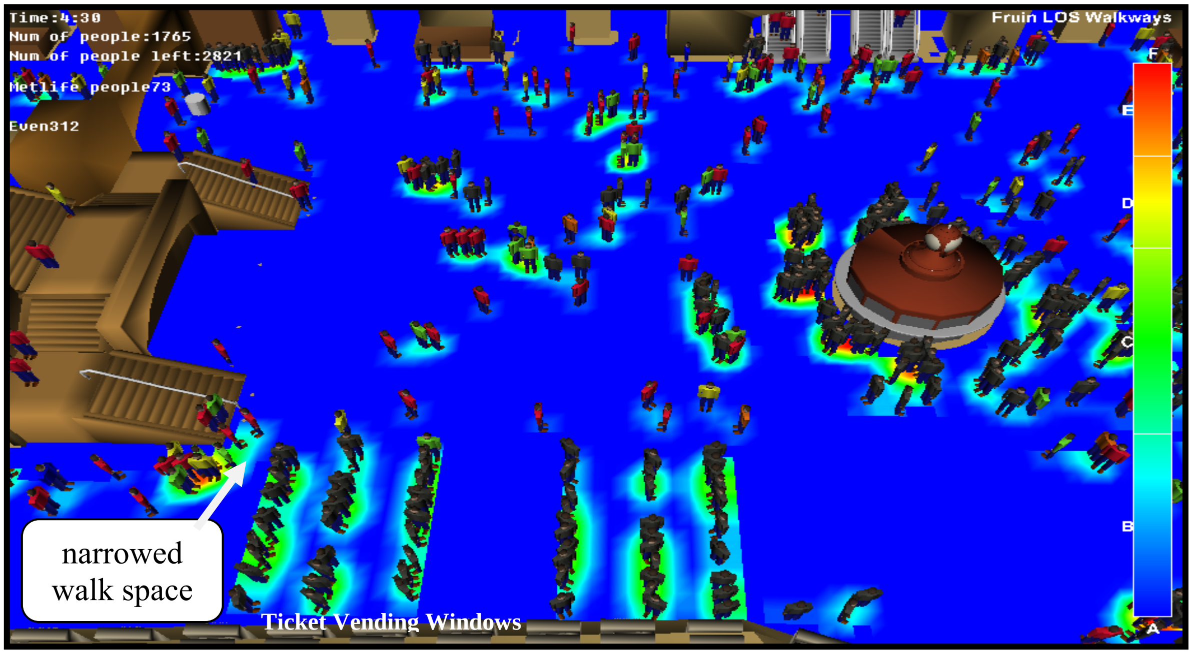


Figure 6: PM Poor Walkway LOS by Lines at Ticket Vending Windows (GCT Upper Concourse)



A. Level-of-Service Assessment

When a simulation is running, STEPS constantly calculates analytical values of the model such as the number of people occupying a location, the usage of an exit, the amount of people that have left the model, etc. The modeler can specify these values to be recorded for display on screen or saved to a separate file. Even though LOS can be visually observed in real time while the model is running, outputs from the model would be needed to accurately compare LOS among the different scenarios.

For this study, the first step was to select representative locations to monitor. For some areas, AM and PM locations are different from each other to capture the main pedestrian flows. For example, at FCA 238, the studied locations were placed at the top of the stairs for the morning where people tend to amass in large clusters, whereas in the evening, the most critical areas for queuing occur in the turnstiles areas. Tables 4 and 5 list summarized levels of service for the locations in each scenario and the volumes of pedestrians passing through the locations during the recorded 15 minutes. For each location, the 15-minute LOS was calculated via a weighted average to describe the general operational condition of the location. In essence, this weighted average is similar to a static spreadsheet analysis that yields an average LOS as defined in the *CEQR Technical Manual*. For procedures on how LOS was recorded and calculated, please refer to the Appendix D. The tables showing percentage values for each recorded minute can be found in Appendix E.

The Build scenarios were evaluated for future years 2020 and 2030. As indicated above, the growth in pedestrians in GCT between 2020 and 2030 is entirely due to MNR and NYCT growth, as the ESA service is assumed to be at capacity in 2020. For each Build year, the model architecture was based on the Proposed Design, and modified for several design alternatives as described above for assessing AM conditions at critical locations.

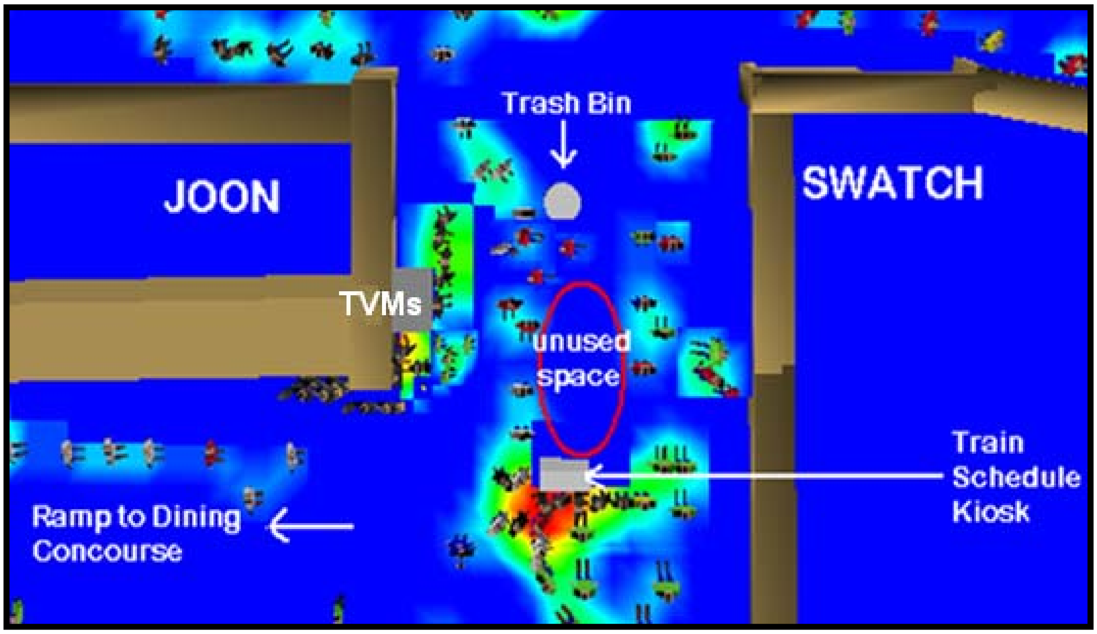
In terms of current operations in GCT, many of the evaluated VCEs are operating at LOS C or better, with the exception of the elements at FCA 238. In the AM peak 15 minutes, the stairs leading to FCA 238 function at LOS C or better, while the escalators are operating at LOS D. Conditions are worse in the PM peak period, where all of the vertical circulation elements operate at an average LOS E, with approximately a quarter of that time in LOS F. These conditions are attributed to the pedestrian surges from the subway when multiple trains unload at once.

The 105 East 42nd Street corridor connected to FCA 238 is also influenced by these subway surges, especially around the location of the information kiosk and the ticket vending machines (TVMs). The commuters that gather around the TVMs to check the train schedule utilize almost half of the corridor's width. The placement of the information kiosk and trash bin at the center of the corridor splits the corridor into half, creating a pocket of unused space between them (see Figure 7). (For better utilization of the corridor at this location, these obstructing items can be relocated along the wall.)

Cross movements of people on the Oyster Bar east ramp going to the Dining Concourse further contribute to the congestion. Shopper movements were not specifically included since field observations indicated that these flows are not significant and thus do not influence overall levels of service and congestion. Instead, the width of the walking corridor was artificially made narrower in the model to account for stationary people who tend to wait out of the main moving flows and for people entering a store. The model was then calibrated to match existing, observed conditions.

The 47th Street Crosspassage is currently operating at LOS C or better. The majority of commuters utilize the VCEs to Chase Bank and at the Westvaco Building. Even though, the beer carts along the north wall of the passageway take up one third of its width, this segment is still operating at acceptable LOSs in the PM peak period.

Figure 7: Corridor Congestion in the PM Peak Period of Existing Scenario



A1. Alternatives Modeled

Proposed Design

When compared to the FEIS design, the proposed design includes minor modifications to the new LIRR Concourse, no street connections to 44th or 45th street, and the inclusion of the Kenneth Cole Stairs. The Kenneth Cole stairs will provide a new twelve-foot-wide stair, offering much-needed additional capacity between the 105 East 42nd Street corridor and FCA 238. It will be constructed in the location of the Kenneth Cole store on the west side of the 105 East 42nd Street corridor.

Proposed Design with Biltmore Room VCEs

The first alternative to the Proposed Design includes vertical connections to the Biltmore Room, which would house two escalators, linking the LIRR Concourse to the former incoming train room in GCT.

Proposed Design with Biltmore Room VCEs + Short Loop Connection

In the second alternative, in addition to the Biltmore Room escalators, a short subway loop was added, providing direct connection between the south end of the LIRR Concourse and FCA 238.

A2. Model Results – Proposed Design

Tables 4 and 5 summarized AM and PM LOS results under the Proposed Design. To facilitate referencing to text below, table cells will be colored.

LIRR Concourse: LOS analyses were conducted for several locations in the new LIRR Concourse and for the LIRR VCE connecting the GCT Dinning and LIRR concourses, which would be composed of one stair and two escalators (Location #1). Analyses indicate that LOS C or better would characterize conditions on this VCE as well as the entire concourse, as it was designed for.

Transit Museum Escalators: This VCE would operate at acceptable LOS C or better, although the number of people using this element (Location #5 in the LIRR Concourse figures) by the Transit Museum to reach the Dinning Concourse almost doubled in the Build conditions.

47th Street Crosspassage: Directly connected to LIRR Concourse, the 47th Street Crosspassage would also be affected by new LIRR service. Although it was assumed that the same number of LIRR passengers arrived in the AM peak period would return in the PM peak period to the LIRR Concourse, there would be a more noticeable effect on LOS in the crosspassage in the morning due to the surges of passengers alighting from trains. Consequently, the condition of the escalator at the Westvaco building (Location #3, see green cells) leading up to 48th Street would slightly worsen from existing LOS C or better to LOS D in the morning.

Given the sizeable capacity of the VCEs in the former Bear Stearns building, even though the usage in the Build conditions more than tripled from existing demands, these elements would still operate at acceptable levels of service. Significantly underutilized today, these VCEs will provide valuable capacity relief to the escalator at Chase Bank in the future by creating a more balanced split of vertical circulation demand to keep both VCE banks operating at LOS C to D or better. (Location #2; see tan cells)

The addition of LIRR passengers would not have considerable influence on the remaining locations in the crosspassage, which would all continue to operate at LOS C or better.

FCA 238: The Proposed Design would not alter the conclusions of the FEIS or significantly change the analyses at the VCEs at FCA 238 because virtually the same number of LIRR customers is proposed to transfer to the subway. Currently, about 36 and 43 percent of the respective AM and PM peak 15-minute would be characterized by LOS E-F (see grey cells). The Kenneth Cole VCE (which is included in the NYCT 2010-2014 Capital Program) would provide enough capacity relief for the existing escalators to operate with less incidence of LOS E and F (see blue cells) for the 2020 No Build (PM Peak), 2030 No Build (PM Peak), 2020 Build (AM Peak) and 2030 Build (AM Peak) scenarios as compared to Existing Conditions. The LOS for the double escalator bank (Location #1) in PM Build conditions, with the provision of Kenneth Cole stairs, would not worsen significantly, and even compared to the existing conditions (LOS E-F increases by less than 15% of the time; see purple cells)

In the AM, the existing stairs (Location #2) would remain operating at acceptable LOS C or better in the year 2020, and deteriorate slightly to LOS D by the year 2030 without the short loop and improve to LOS C or better with a short loop connection (see red cells). For the PM peak period, the operating condition of these stairs would be relieved from LOS E to D with the introduction of Kenneth Cole stairs in the year 2020 (No Build, Build) and 2030 (No Build), but return to LOS E in 2030 Build Condition (see orange cells).

The Kenneth Cole stairs would continue to operate at LOS C or better for the AM peak periods, but worsen to LOS D and E for the respective 2020 and 2030 PM Build cases (see pink cells).

The condition of 105 East 42nd Street Corridor is also worth noting. Because of the 2020/2030 background growth and the introduction of LIRR riders (a volume increase of 16 percent in total or 690 in 15 minutes), this corridor would operate at a much more congested condition (see Figure 8). As shown in Figure 8, more hot spots (LOS E-F) would occur along the corridor, compared to existing conditions (Figure 7). To relieve the congestion, the TVMs, arrival board kiosk, refuse containers, and rolling information board in this corridor could be relocated along the walls or completely out of the corridor. The LOS analyses were not performed for this corridor due to the continuously changing and random hot spots along the whole corridor.

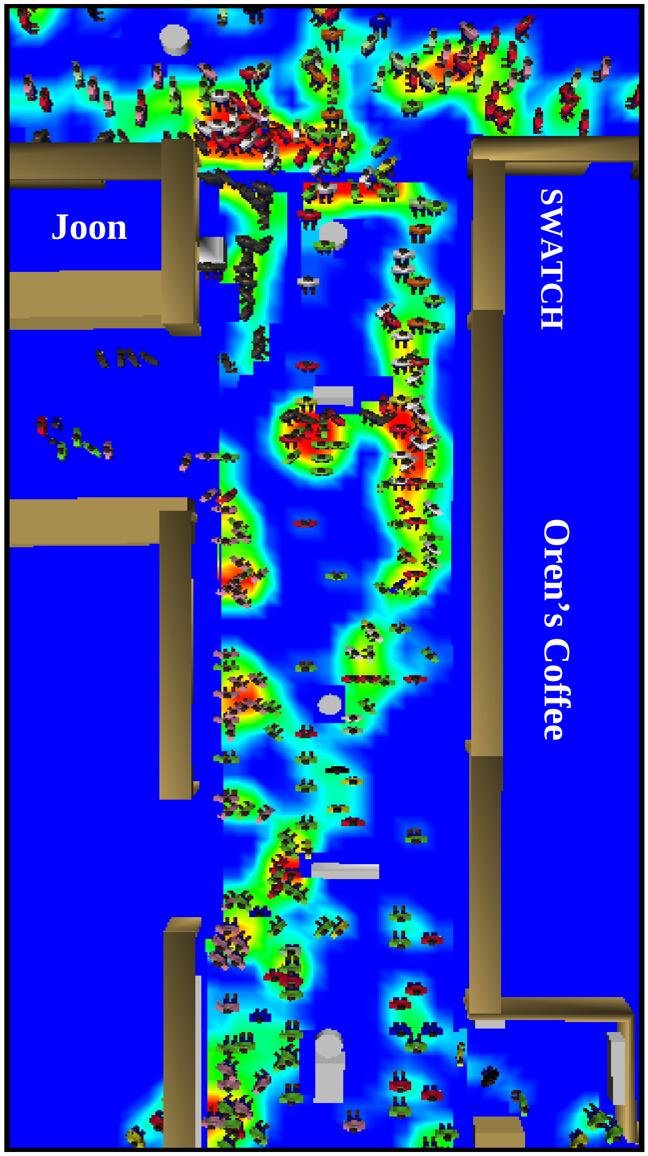
A2. Model Results – Proposed Design and Biltmore Room Escalators

The Biltmore escalators would attract some of the passengers from the VCEs that lead up to the former Bear Stearns building, at 47th Street Crosspassage. However, since the VCEs in the former Bear Stearns building are already operating at LOS C or better, the addition of these escalators (and the draw of people to these Biltmore Room elements) would not affect the operating condition there. The main purpose of the Biltmore escalators would be to provide another connection between LIRR Concourse and the main terminal, to help balance out the usage of the LIRR Concourse by attracting more people to the south end of the corridor.

A3. Model Results – Proposed Design and Short Loop Connection to the Subway

This subway loop is projected to offer some relief at FCA 238 by navigating passengers directly into the subway's paid zone within the passageway to the Shuttle, avoiding the crowds at the unpaid area by the existing VCEs. The short loop would improve the LOS D condition, in the AM in year 2030, of the existing stairs (Location #2) to a LOS C or better (red cells).

Figure 8: Corridor Congestion in the PM Peak Period in 2020 Build Scenario



B. Other Assessments

In addition to level of service, other outputs from the model have been summarized and assessed, including:

1) Number of pedestrians per one minute increment through major entrance/exit points, connections between corridors and vertical circulation egresses (Appendix F)
2) Total number of people in the model for the entire LIRR Concourse, GCT, and FCA 238 areas over time (Appendix G)
3) Journey time for major routes between the LIRR Concourse and GCT Upper Concourse or 47th Street Crosspassage (Appendix H)

The procedures on how the above outputs were recorded and analyzed as well as the results summary can be found in Appendices F, G, and H.

V. Conclusions

The pedestrian model analysis findings have presented an updated look at how GCT would function in future years without street connections in the LIRR Concourse to 44th and 45th streets.

From this update, there are some important differences to note.

1. This Proposed Design would not significantly impact the NYCT Museum escalators given that the main connection from the LIRR Concourse is a VCE that would channel people further into the Dining Concourse to the immediate west of the center information booth. The EIS showed the Museum escalators to be an area of congestion (since it was assumed that these escalators would be the first VCE seen by LIRR customers, which was only the case under EIS Option 1). The core of the Dining Concourse (DC) itself is spacious enough to process both MNR and LIRR sets of volumes (typically, the DC processes only about ⅓ of MNR's riders, and ESA would add about ⅓ of its passengers through it). GCT processes 500,000 MNR customers today and another 250,000 visitors. Of LIRR's 160,000 daily customers, only about 36 percent (about 58,000 people) would use GCT proper. The percent of LIRR passengers would decrease to about 45,000 (about 28 percent) if the Short Loop connection is constructed (which would be used by about 13,000 people, or just over eight percent). MNR expressed concern that the path that would carry people down the Oyster Bar ramps, west past Junior's in the Dining Concourse, and into the main VCE that would connect the LIRR Concourse to the Dining Concourse would be congested. The model indicated that people are typically metered as they enter GCT, whether from the street or from subway connections, and as such, do not arrive in the Dining Concourse en masse, and thus would not experience any significant queuing in the Dining Concourse level.

   The path that would involve use of the 105 East 42nd Street corridor and IRT FCA 238 has been well established as being congested today, and would certainly worsen to points of extreme congestion without the application of any new vertical capacity. The EIS indicated this to be an impact that could only be addressed with additional stairs and/or escalators and a reconfiguration of the FCA. The "Kenneth Cole Stairs" are included in NYCT's next Capital Plan, and will provide a significant capacity increase in the ability for people to move up/down between GCT and the FCA. This stair will also allow people along the corridor to sort themselves on each side (e.g., down volumes on the west side, up volumes to the east side) to some degree so not everyone would have to congregate at the existing stair/escalator near former Oren's coffee shop.

2. The model demonstrated that the "short loop" alternative, with a new fare control line, would allow the majority of LIRR riders destined to the IRT to avoid using GCT at all and simply connect into the existing "paid" crosspassage that connects the Shuttle and IRT trains. Table 4 indicates that the time spent in LOS A-C increased by ten percent and LOS E-F reduced from four to zero percent with provision of the short-loop corridor, compared to the Proposed Design. The analysis results indicated that the short-loop addition, in combination with the new KC stair and reconfigured FCA 238, would allow the FCA area to function without the extreme congestion that is currently occurring.

There are some important similarities between results presented in the EIS and the modeling effort.

1. All areas in GCT affected by the changes in the Proposed Design as compared with the FEIS design would operate at acceptable LOSs. No significant adverse impacts would result from the design changes.

2. The 47th Street crosspassage was shown to operate in the future without any significant congestion except at the LIRR Concourse portal up from ESA (connecting on the south side between MNR Tracks 35 and 36) where minor congestion would prevail as MNR riders traveling further east would mix with LIRR riders. The model indicated that this small mixing area would not create significant queuing elsewhere in the crosspassage.

3. The upper concourse of GCT was shown to operate acceptably in the EIS and in the model, with the exception of minor pockets of friction where crossing paths would occur. One area at the foot of the Vanderbilt Avenue stairs (the south stair) would be slightly congested during times when the ticket-window queues are lengthy. This congestion can be lessened if other ticket windows are opened on the east side of the upper concourse and additional TVMs are added (as is expected in space occupied by the former Joon pen store).

The level of congestion described above, does not constitute significant pedestrian impacts, per CEQR, since they do not endure for the entire 15-minute period.

Table 4: AM Levels of Service

Location		Existing						2020 with Kenneth Cole Stairs at Fare Control Area 238																							
								2020 No Build (without ESA)						2020 Build (with ESA Current Design[2])						2020 Build (with ESA Alternative 1[3])						2020 Build (with ESA Alternative 2[4])					
		Volume[1]	Level of Service				Wt. Avg	Volume	Level of Service				Wt. Avg	Volume	Level of Service				Wt. Avg	Volume	Level of Service				Wt. Avg	Volume	Level of Service				Wt. Avg
			A-C	D	E	F			A-C	D	E	F			A-C	D	E	F			A-C	D	E	F			A-C	D	E	F	
FCA 238	Existing Escalator in FCA 238 **(Loc #1)**	1,510 up	60%	4%	11%	25%	D	1,110 up	73%	6%	11%	10%	D	1,330 up	67%	7%	14%	12%	D	1,330 up	67%	7%	14%	12%	D	1,330 up	70%	7%	11%	12%	D
	Existing Stair in NYCT IRT FCA 238 **(Loc #2)**	460 up / 1,700 down	100%				A-C	340 up / 1,000 down	100%				A-C	250 up / 1,280 down	89%	7%	4%		A-C	250 up / 1,280 down	89%	7%	4%		A-C	240 up / 1,020 down	99%	1%			A-C
	Proposed Kenneth Cole Stairs in FCA 238 (Loc #3)	--						840 up / 900 down	100%				A-C	700 up / 1,430 down	97%	3%			A-C	700 up / 1,430 down	97%	3%			A-C	710 up / 1,050 down	99%	1%			A-C
Madison Coucourse	ESA Escalators connected to GCT Dining Conc. **(Loc #1)**	--						--						2,600	98%	2%			A-C	2,600	98%	2%			A-C	2,010	100%				A-C
	Madison Conc. bet. 44th St. and ESC to GCT (Loc #2)	--						--						2,600	100%				A-C	2,600	100%				A-C	2,010	100%				A-C
	Madison Conc. Under 47th St Xpass (Loc #3)	--						--						1,800	100%				A-C	1,600	100%				A-C	1,600	100%				A-C
	48th Street VCE leading to Mad Conc. (Loc #4)	--						--						1,500	100%				A-C	1,500	100%				A-C	1,500	100%				A-C
	Biltmore Room Escalator (Loc #5)	--						--						--						470	100%				A-C	470	100%				A-C
47th Street Cross-passage	VCE to Bear Stearns (Loc #1)	170	100%				A-C	330	100%				A-C	1,060	100%				A-C	680	100%				A-C	680	100%				A-C
	VCE to Chase (Loc #2)	1,300	100%				A-C	1,490	99%	1%			A-C	1,620	87%	10%	3%		A-C	1,620	87%	10%	3%		A-C	1,620	87%	10%	3%		A-C
	VCE @ Westvaco **(Loc #3)**	880	100%				A-C	1,060	99%	1%			A-C	1,830	69%	10%	18%	3%	D	1,830	69%	10%	18%	3%	D	1,830	69%	10%	18%	3%	D
	Crosspassage east end e/o GCT East Spine (Loc #4)	330	100%				A-C	400	100%				A-C	1,200	100%				A-C	1,200	100%				A-C	1,200	100%				A-C
	VCE @ 245 Park Avenue (Loc #5)	--						--						1,180	94%	5%	1%		A-C	1,180	94%	5%	1%		A-C	1,180	94%	5%	1%		A-C
	Crosspassage near LIRR Escalator (Loc #6)	860	100%				A-C	1,250	100%				A-C	3,200	100%				A-C	3,200	100%				A-C	3,200	100%				A-C
	VCE vestibule to Madison Conc. (Loc #7)	--						--						2,015	98%	2%			A-C	2,020	98%	2%			A-C	2,020	98%	2%			A-C

Notes:
1. Volumes without specified direction of flow refer to the main directional flow only
2. Current Design: without Biltmore escalators, without subway short loop
3. Alternative 1: with Biltmore escalators, without subway short loop
4. Alternative 2: with Biltmore escalators, with subway short loop

Table 4 (con't): AM Levels of Service

Location		2030 with Kenneth Cole Stairs at Fare Control Area 238																							
		2030 No Build (without ESA)						2030 Build (with ESA Current Design[2])						2030 Build (with ESA Alternative 1[3])						2030 Build (with ESA Alternative 2[4])					
		Volume[1]	Level of Service				Wt. Avg	Volume	Level of Service				Wt. Avg	Volume	Level of Service				Wt. Avg	Volume	Level of Service				Wt. Avg
			A-C	D	E	F			A-C	D	E	F			A-C	D	E	F			A-C	D	E	F	
FCA 238	Existing Escalator in FCA 238 **(Loc #1)**	1,270 up	66%	4%	17%	13%	D	1,460 up	59%	9%	14%	18%	D	1,460 up	59%	9%	14%	18%	D	1,420 up	65%	7%	13%	15%	D
	Existing Stair in NYCT IRT FCA 238 **(Loc #2)**	350 up / 1,150 down	100%				A-C	280 up / 1,400 down	54%	25%	21%		D	280 up / 1,400 down	54%	25%	21%		D	300 up / 1,140 down	97%	2%	1%		A-C
	Proposed Kenneth Cole Stairs in FCA 238 (Loc #3)	940 up / 1,000 down	100%				A-C	790 up / 1,520 down	97%	3%			A-C	790 up / 1,520 down	97%	3%			A-C	800 up / 1,180 down	97%	3%			A-C
Madison Coucourse	ESA Escalators connected to GCT Dining Conc. **(Loc #1)**	--						2,600	98%	2%			A-C	2,600	98%	2%			A-C	2,010	99%	1%			A-C
	Madison Conc. bet. 44th St. and ESC to GCT (Loc #2)	--						2,600	100%				A-C	2,600	100%				A-C	2,010	100%				A-C
	Madison Conc. Under 47th St Xpass (Loc #3)	--						1,800	100%				A-C	1,600	100%				A-C	1,600	100%				A-C
	48th Street VCE leading to Mad Conc. (Loc #4)	--						1,500	100%				A-C	1,500	100%				A-C	1,500	100%				A-C
	Biltmore Room Escalator (Loc #5)	--						--						470	100%				A-C	470	100%				A-C
47th Street Cross-passage	VCE to Bear Stearns (Loc #1)	540	100%				A-C	1,630	100%				A-C	1,150	100%				A-C	1,150	100%				A-C
	VCE to Chase **(Loc #2)**	1,550	98%	2%			A-C	1,180	56%	25%	19%		D	1,180	56%	25%	19%		D	1,180	56%	25%	19%		D
	VCE @ Westvaco **(Loc #3)**	1,140	98%	2%			A-C	1,920	47%	16%	21%	16%	D	1,920	47%	16%	21%	16%	D	1,920	47%	16%	21%	16%	D
	Crosspassage east end e/o GCT East Spine (Loc #4)	460	100%				A-C	1,270	100%				A-C	1,270	100%				A-C	1,270	100%				A-C
	VCE @ 245 Park Avenue (Loc #5)	--						1,230	93%	6%	1%		A-C	1,230	93%	6%	1%		A-C	1,230	93%	6%	1%		A-C
	Crosspassage near LIRR Escalator (Loc #6)	1,450	100%				A-C	3,390	99%	1%			A-C	3,390	99%	1%			A-C	3,390	99%	1%			A-C
	VCE vestibule to Madison Conc. (Loc #7)	--						2,015	98%	2%			A-C	2,015	98%	2%			A-C	2,015	98%	2%			A-C

Notes:
1. Volumes without specified direction of flow refer to the main directional flow only
2. Current Design: without Biltmore escalators, without subway short loop
3. Alternative 1: with Biltmore escalators, without subway short loop
4. Alternative 2: with Biltmore escalators, with subway short loop

Table 5: PM Levels of Service

Location		Existing						2020 with Kenneth Cole Stairs Built at Fare Control Area 238												2030 with Kenneth Cole Stairs Built at Fare Control Area 238											
								2020 No Build (without ESA)						2020 Build (with ESA Current Design[2])						2030 No Build (without ESA)						2030 Build (with ESA Current Design)					
		Volume[1]	Level of Service				Wt. Avg	Volume	Level of Service				Wt. Avg	Volume	Level of Service				Wt. Avg	Volume	Level of Service				Wt. Avg	Volume	Level of Service				Wt. Avg
			A-C	D	E	F			A-C	D	E	F			A-C	D	E	F			A-C	D	E	F			A-C	D	E	F	
FCA 238	Existing Escalator in FCA 238 **(Loc #1)**	1,000 up / 850 down	49%	8%	14%	29%	E	880 up / 850 down	61%	11%	13%	15%	D	950 up / 720 down	39%	13%	22%	26%	E	900 up / 910 down	61%	11%	11%	17%	D	1,050 up / 800 down	35%	17%	20%	28%	E
	Existing Stair in NYCT IRT FCA 238 **(Loc #2)**	600 up / 800 down	48%	14%	17%	21%	E	330 up / 480 down	69%	13%	12%	6%	D	630 up / 520 down	59%	12%	13%	16%	D	350 up / 570 down	67%	12%	10%	11%	D	580 up / 600 down	45%	10%	16%	29%	E
	Proposed Kenneth Cole Stairs in FCA 238 (Loc #3)	--						550 up / 800 down	87%	4%	7%	2%	A-C	830 up / 900 down	64%	8%	13%	15%	D	610 up / 910 down	80%	6%	10%	4%	A-C	820 up / 1,020 down	47%	15%	18%	20%	E
Madison Coucourse	ESA Escalators connected to GCT Dining Conc. **(Loc #1)**	--						--						2,570	99%	1%			A-C	--						2,570	99%	1%			A-C
	Madison Conc. bet. 44th St. and ESC to GCT (Loc #2)	--						--						2,565	100%				A-C	--						2,565	100%				A-C
	LIRR Madison Conc. Under 47th St Xpass (Loc #3)	--						--						4,020	100%				A-C	--						4,020	100%				A-C
	48th Street VCE leading to Mad Conc. (Loc #4)	--						--						1,800	100%				A-C	--						1,800	100%				A-C
Transit Museum	Transit Museum Escalator to Dining Conc. **(Loc #5)**	220	100%				A-C	260	100%				A-C	560	98%	1%	1%		A-C	300	100%				A-C	600	97%	2%	1%		A-C
47th Street Cross-passage	VCE to Bear Stearns (Loc #1)	70	100%				A-C	90	100%				A-C	870	100%				A-C	105	100%				A-C	880	100%				A-C
	VCE to Chase (Loc #2)	970	100%				A-C	1,200	100%				A-C	1,320	98%	2%			A-C	1,380	100%				A-C	1,500	97%	3%			A-C
	VCE @ Westvaco (Loc #3)	430	100%				A-C	530	99%	1%			A-C	1,670	73%	12%	15%		A-C	610	99%	1%			A-C	1,750	61%	15%	23%	1%	D
	Crosspassage east end e/o GCT East Spine (Loc #4)	90	100%				A-C	100	100%				A-C	825	100%				A-C	115	100%				A-C	840	100%				A-C
	VCE @ 245 Park Avenue (Loc #5)	--						--						730	99%	1%			A-C	--						730	99%	1%			A-C
	Crosspassage near LIRR Escalator (Loc #6)	850	100%				A-C	1,060	100%				A-C	3,040	98%	2%			A-C	1,220	100%				A-C	3,200	98%	2%			A-C
	VCE vestibule to Madison Conc. (Loc #7)	--						--						1,850	94%	6%			A-C	--						1,850	94%	6%			A-C

Note:

1. Volumes without specified direction of flow refer to the main directional flow only
2. Current Design: without Biltmore escalators, without subway short loop

APPENDIX A: Pedestrian Conditions within Grand Central Terminal

The analysis of potential impacts within Grand Central Terminal (GCT) focuses on critical representative corridors, passageways, and stairwells that could be affected by the addition of LIRR service into GCT. A new concourse under the terminal's west edge on the Dining Concourse would be utilized by LIRR service, resulting in new pedestrian flows within the terminal. These affected areas could include corridors and stairwells through the Dining and Main Concourse levels of GCT, as well as to the surrounding streets and sidewalks which border the terminal.

Pedestrian volumes are typically peaked in the outbound direction of GCT in the morning as commuters are traveling to work, while the reverse is true for the evening peak period. The AM peak pedestrian activity in the Dining Concourse experiences nominal congestion, due in part to single train arrivals dispersed among all tracks. The Dining Concourse area is not subjected to simultaneous train alightings, involving high cross-flow conflicts, as experienced by the Main Concourse. Although the presence of restaurants and seating areas has significantly reduced free circulation space for pedestrians, no significant increases in congestion has resulted.

The objective of STV's pedestrian count program and analysis is to identify circulation patterns that would closely simulate future LIRR patterns throughout GCT, and observe the current utilization of all the terminal's critical elements that could be affected by ESA passenger overlays. This would allow the verification of both AM and PM 15-minute peak periods, the determination of existing and future pedestrian LOSs with the introduction of LIRR service into GCT, and impact determination.

Overall Terminal Pedestrian Volumes

New pedestrian volume data were collected at each entry point into GCT during October 2008. These new pedestrian counts were performed within the Main Concourse, Dining Concourse, and 47th Street Crosspassage during the weekday 7:30 to 9:30 AM and 4:30 to 6:30 PM peak periods.

The total volume of pedestrians entering GCT is approximately 45,800 during the 8:10 to 9:10 AM peak hour and 48,400 during the 5:15 to 6:15 PM peak hour. Pedestrian volumes during the peak hours are fairly balanced as the peak 15-minute pedestrian volumes represent between 26 and 29 percent of the peak hour volume.

Pedestrian Volumes at Selected Key Locations

The highest levels of pedestrian activity in the Dining Concourse occur at the Oyster Bar ramps leading to the Main Concourse, which processes about 320 people traveling up to the Main Concourse during the AM peak 15-minute period and approximately 650 people traveling down to the Dining Concourse during the PM peak (see Figure 1). The northern staircases above the east and west Dining Concourse stairs process between 160 to 180 ascending pedestrians and 270 to 350 descending pedestrians during the AM and PM 15-minute peak period, respectively. These volumes are not particularly high.

In the Main Concourse, the escalators serving the Met Life Building and the two stair/escalator elements leading to the IRT subway station are among the most highly utilized throughout GCT (see Figure 2). The Met Life escalators process around 2,000 pedestrians ascending out of the terminal during the AM 15-minute peak and about 1,350 people descending into entering during the PM 15-minute peak.

The stair/escalator bank leading toward the subway adjacent to the 42nd Street passage processes approximately 1,960 pedestrians ascending into GCT during the AM 15-minute peak and about 1,640 pedestrians descending to the subway level during the PM 15-minute peak. The eastern subway stairwell along the Lexington Passage processes approximately 1,040 people ascending into GCT and about 720 people descending to the subway level during the AM and PM 15-minute peak periods, respectively.
Another high-volume corridor is the passageway leading to the IRT shuttle train, which processes two-way pedestrian volumes ranging between 1,820 and 1,950 during the AM and PM peak 15-minute periods.

Within the 47th Street Passageway, the pedestrian volumes to/from the access points at Madison Avenue and at Park Avenue/48th Street are fairly even. During the AM peak 15-minute period, these element process between 1,200 and 1,380 pedestrians ascending to street level during the AM peak 15-minute period and between 710 and 970 pedestrian descending to the 47th Street Passage during the PM peak 15-minute period.

Figure 1: Dining Concourse Volumes during AM / PM 15-Minute Peak Period

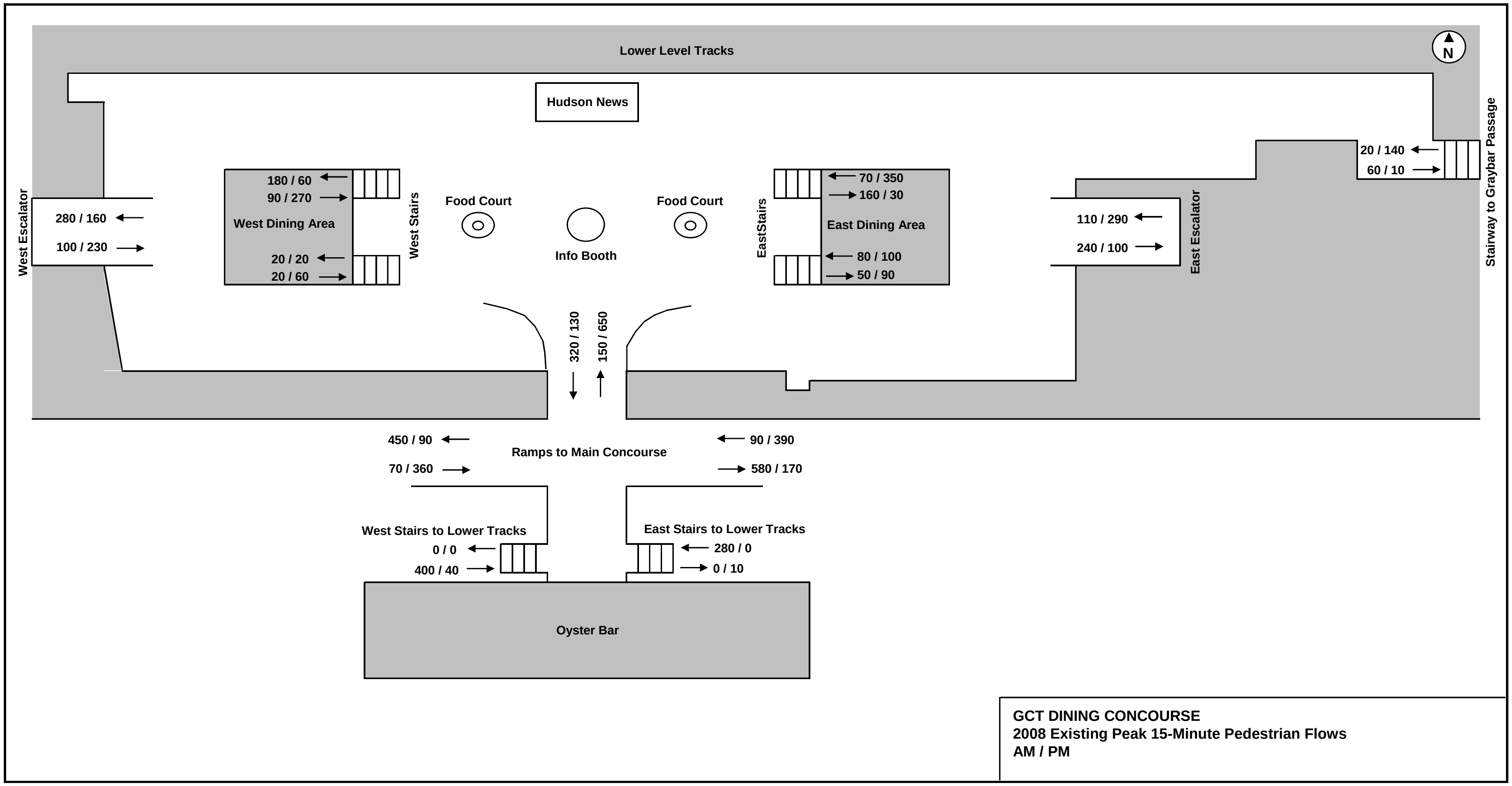


Figure 2: Main Concourse Volumes during AM / PM 15-Minute Peak Period

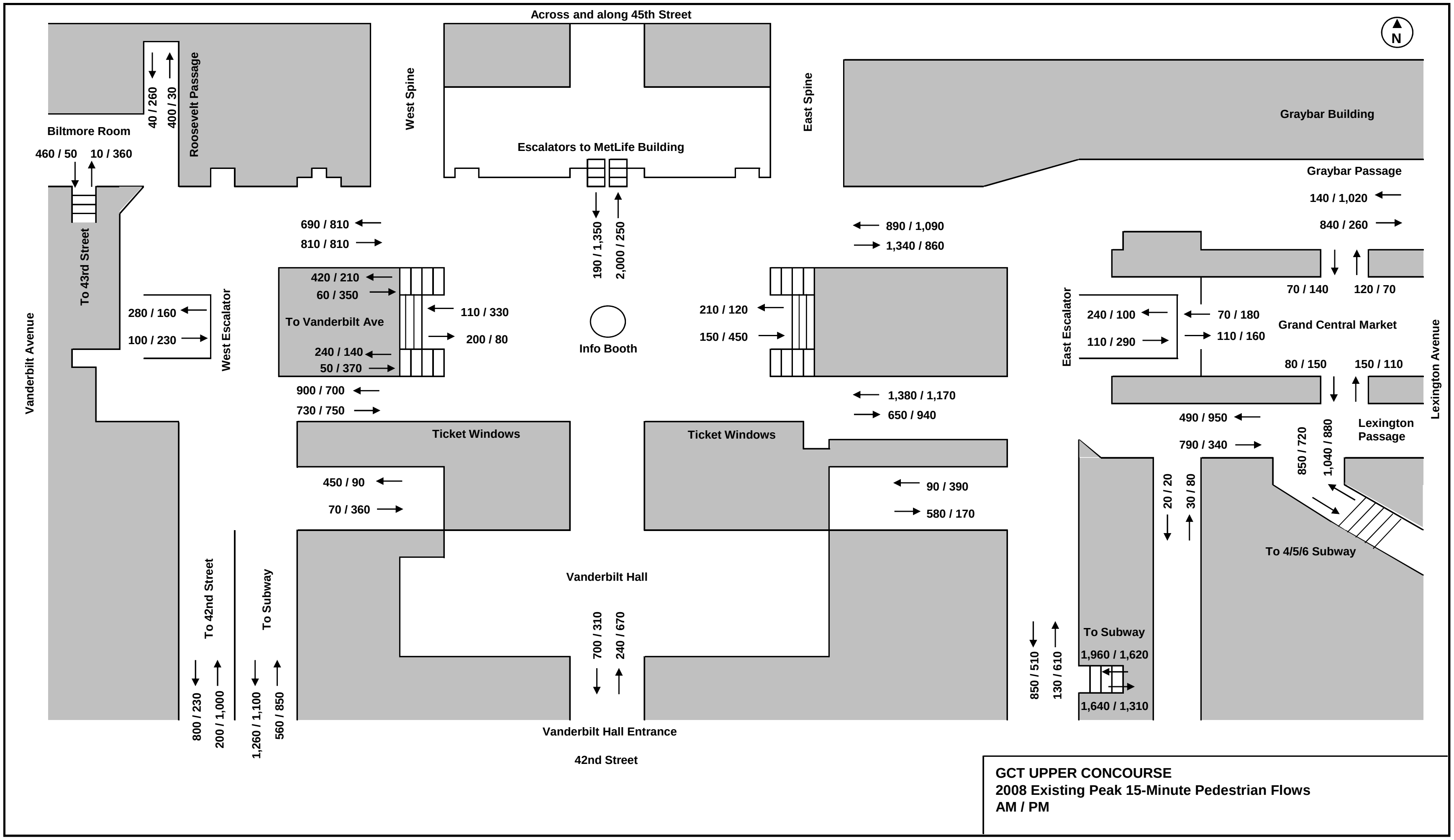


Figure 3: 47th Street Passageway Volumes during AM / PM 15-Minute Peak Period

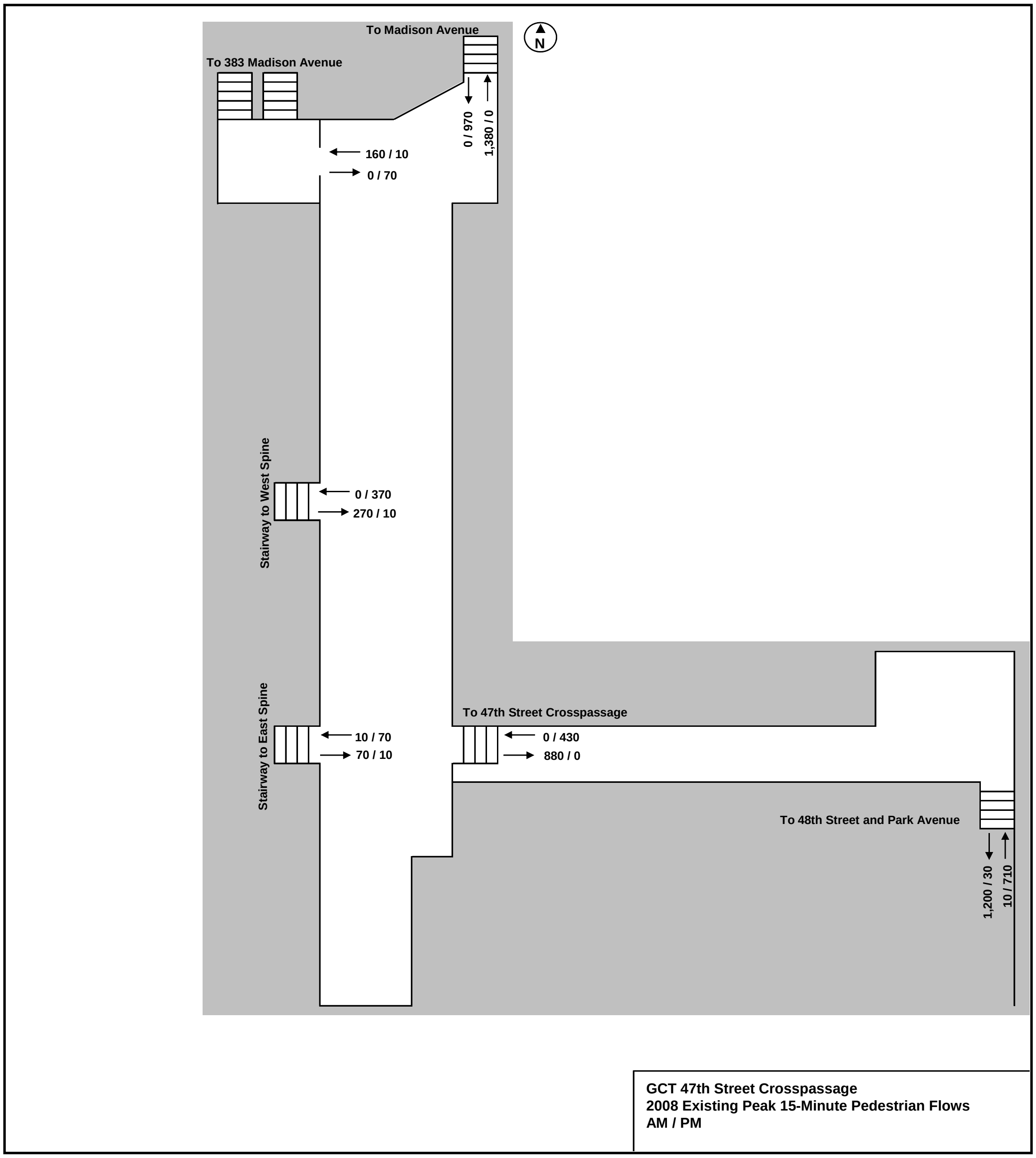


Figure 4: Main Concourse 2020 No Build Volumes during PM 15-Minute Peak Period

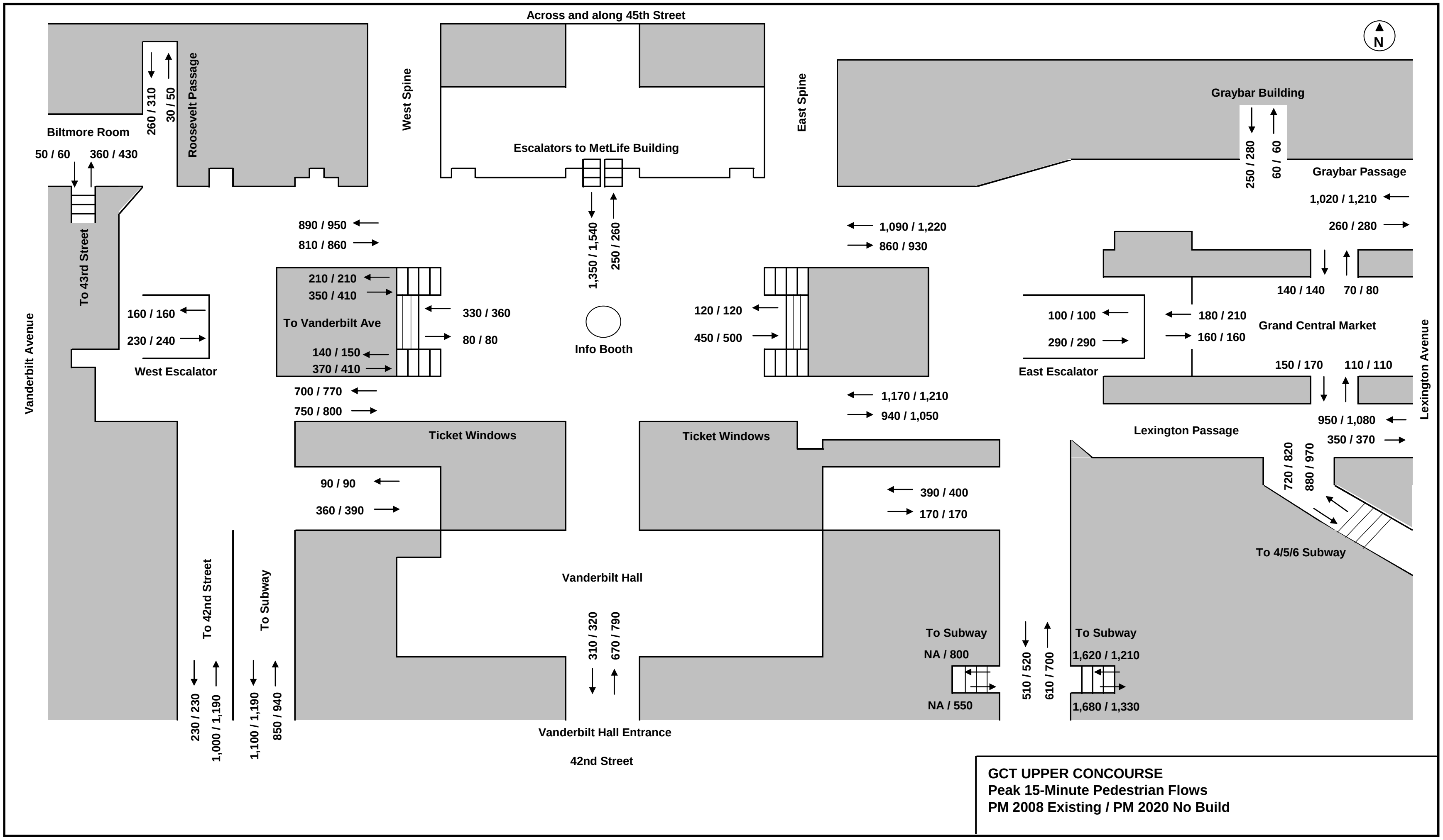


Figure 5: 47th Street Passaeway 2020 No Build Volumes during PM 15-Minute Peak Period

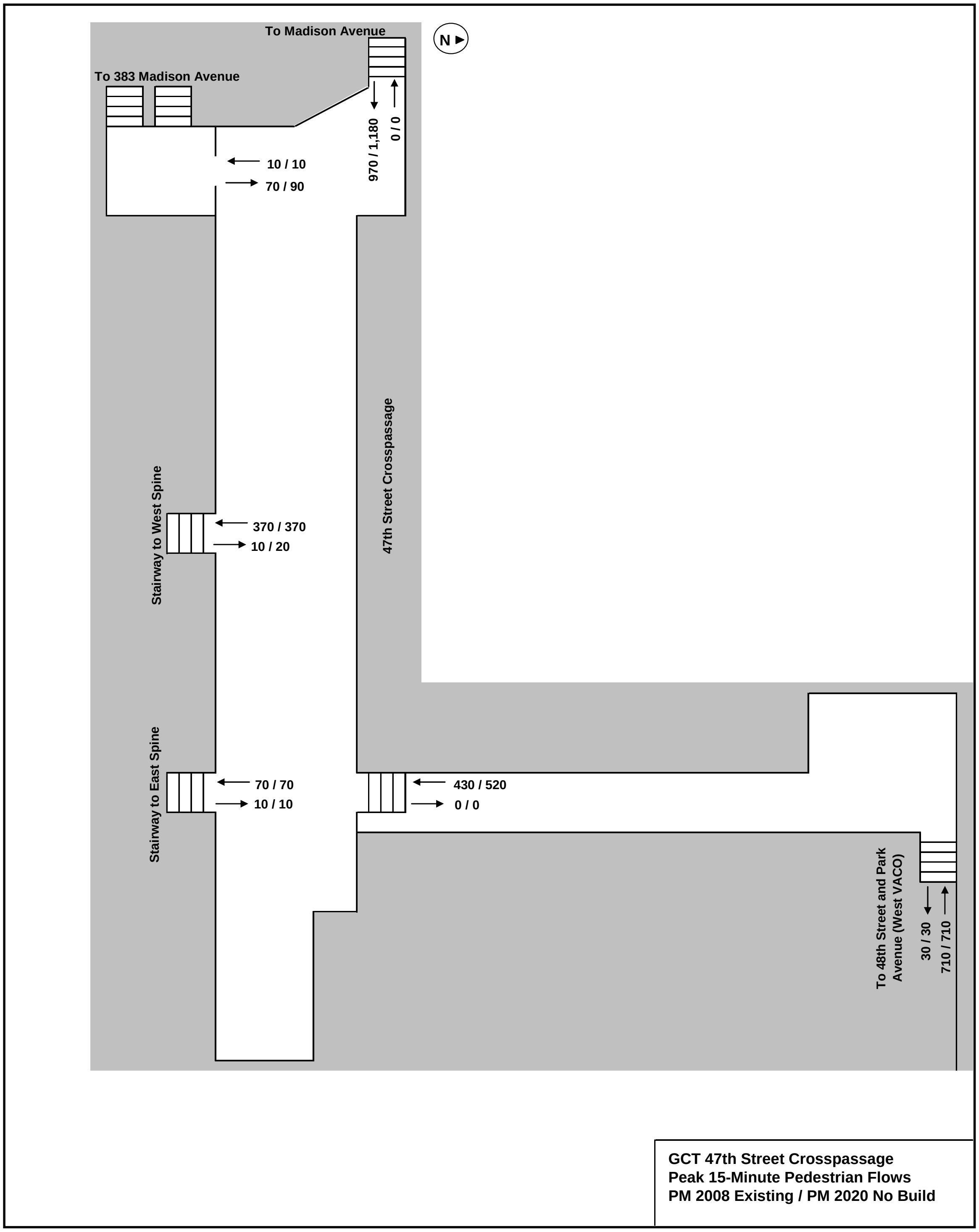


Figure 6: Main Concourse 2020 Build Volumes during PM 15-Minute Peak Period

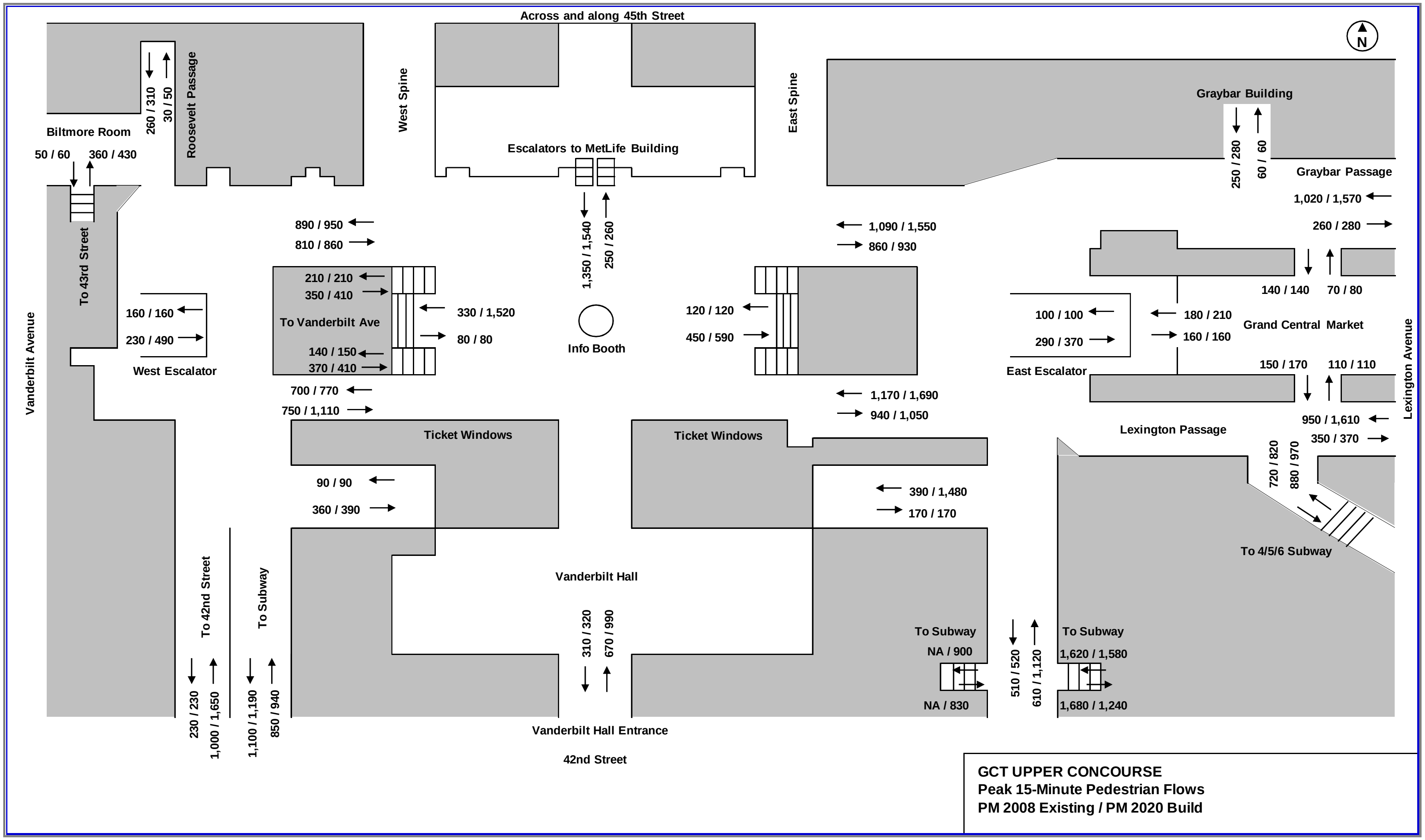


Figure 7: 47th Street Passageway 2020 Build Volumes during PM 15-Minute Peak Period

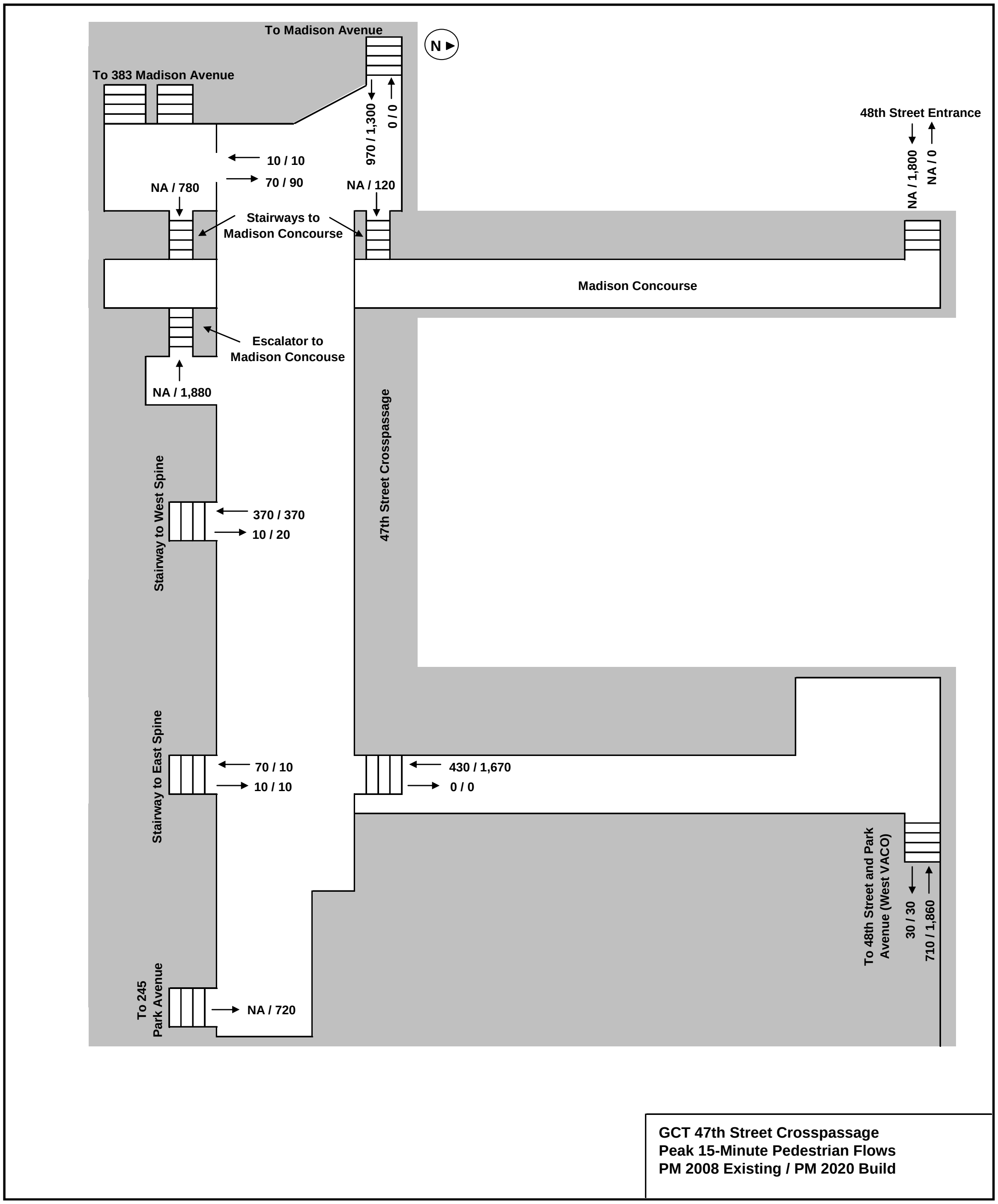


Figure 8: Main Concourse 2030 No Build Volumes during PM 15-Minute Peak Period

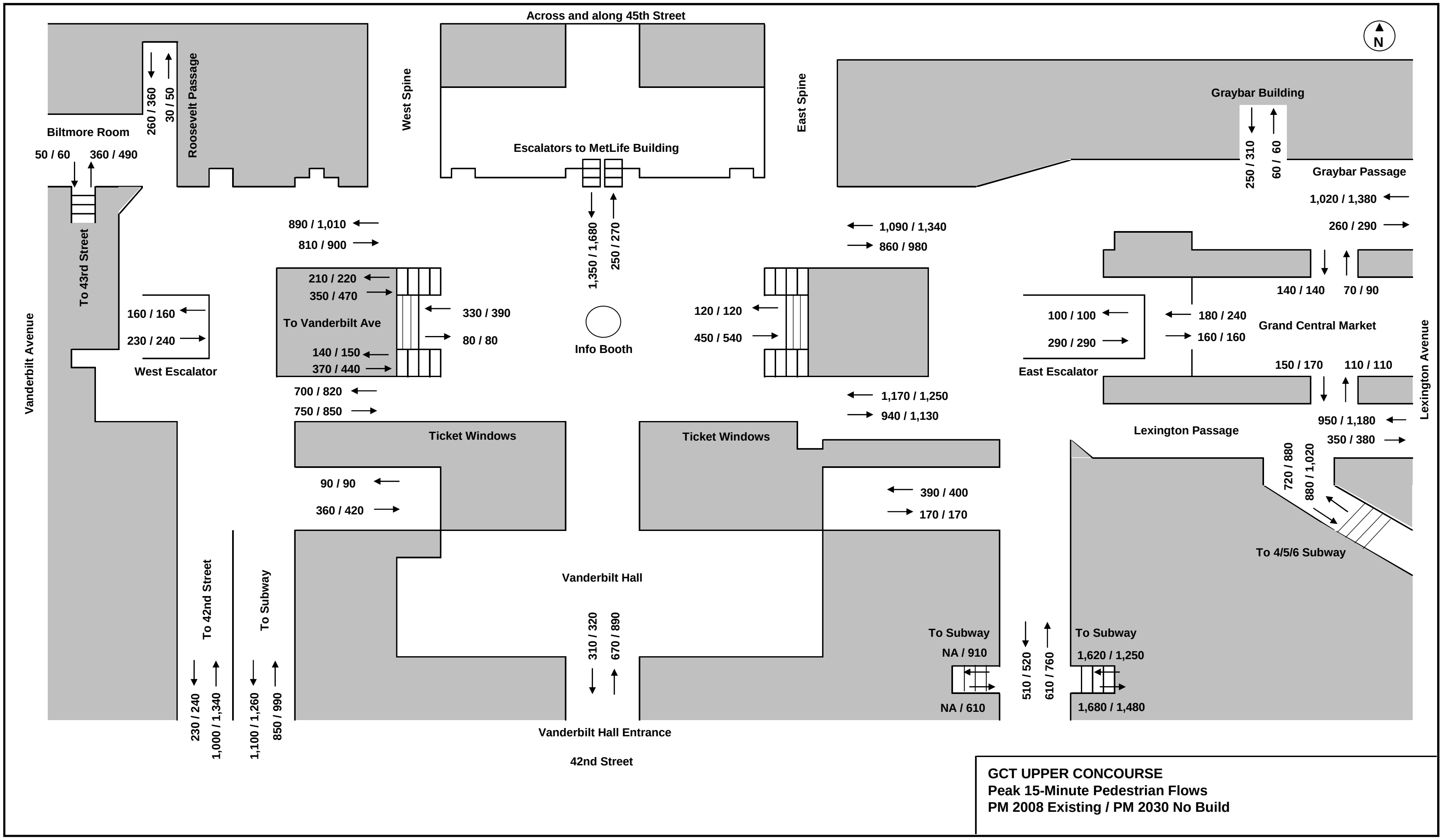


Figure 9: 47th Street Passageway 2030 No Build Volumes during PM 15-Minute Peak Period

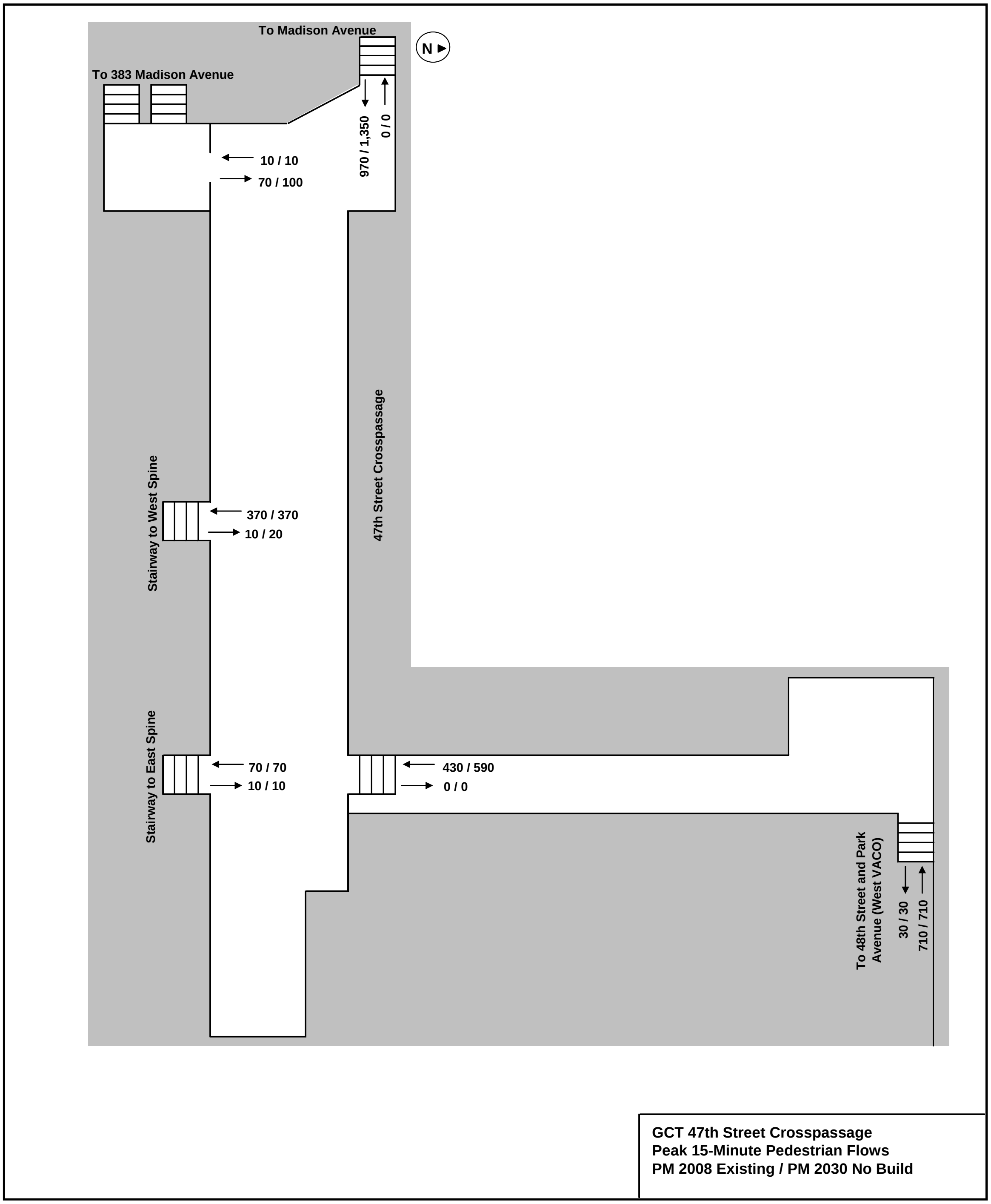


Figure 10: Main Concourse 2030 Build Volumes during PM 15-Minute Peak Period

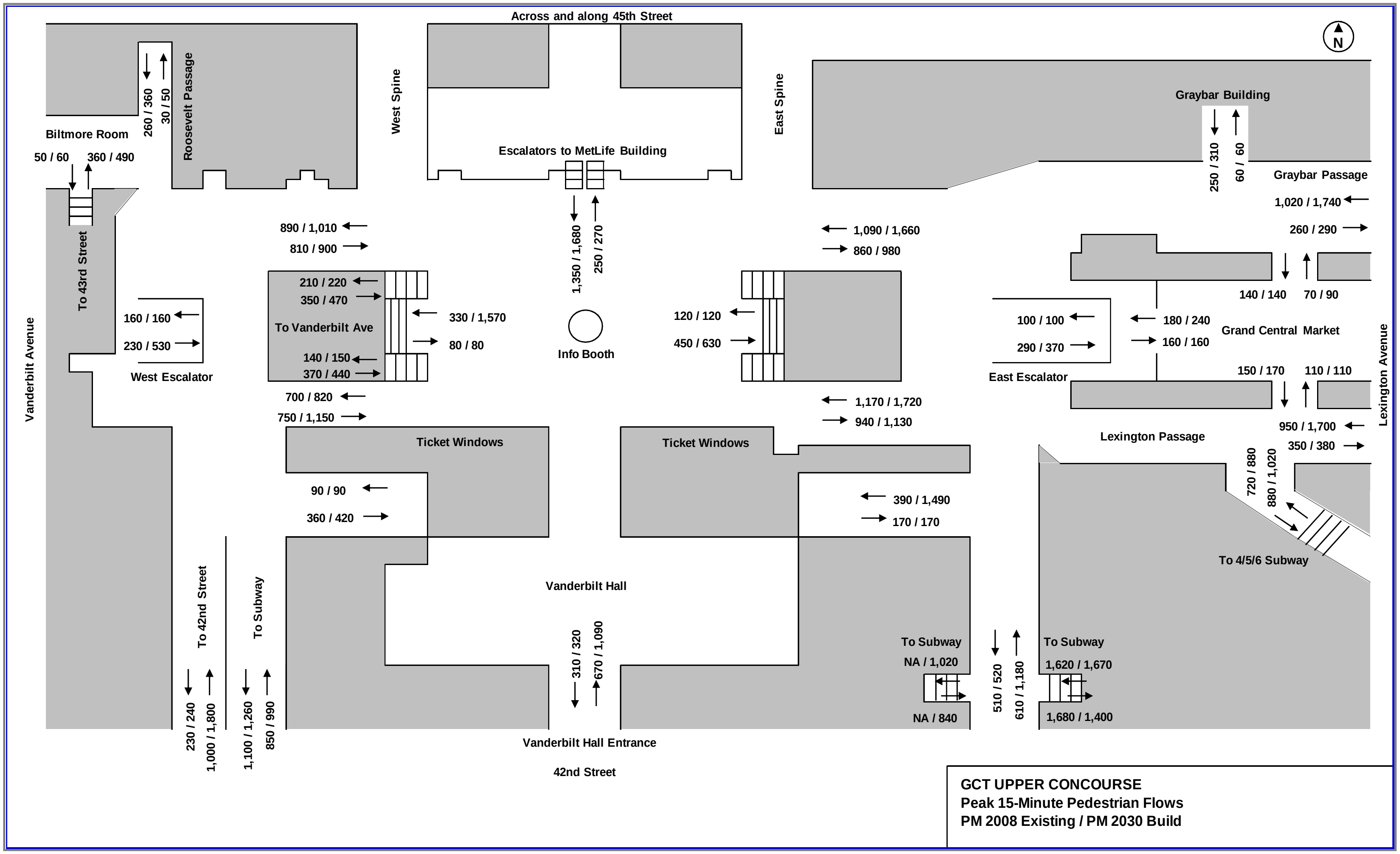
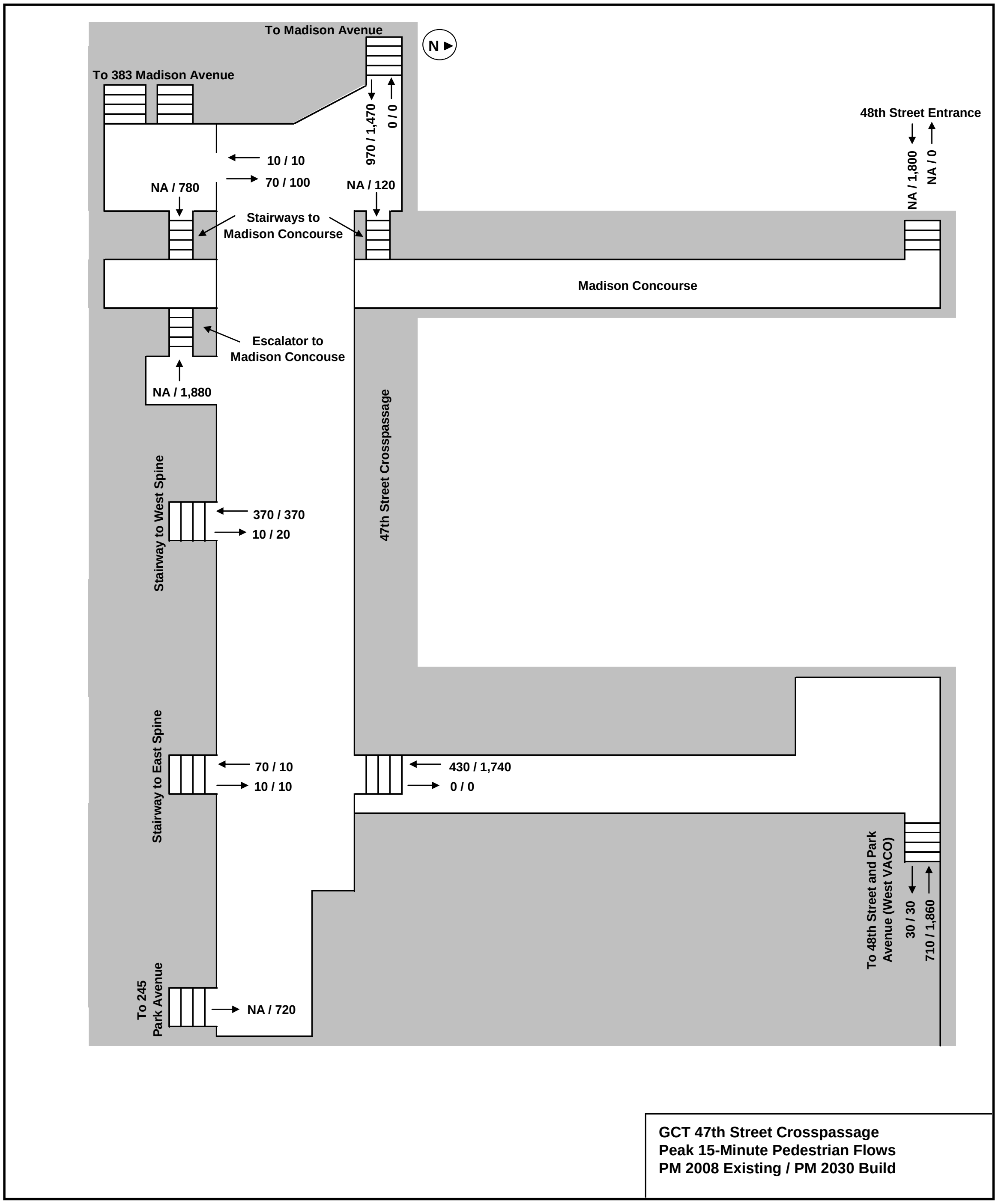


Figure 11: 47th Street Passageway 2030 Build Volumes during PM 15-Minute Peak Period



APPENDIX B: GCT Pedestrian Volume Growth Rate Methodology

The following discussion focuses on the methodology for determining the background growth rate for the pedestrian population entering GCT, which will be used as an input for the STEPS pedestrian simulation modeling effort.

The March 2001 MTA/LIRR East Side Access FEIS indicated that the pedestrian flows within GCT consist of three primary users, Metro-North Railroad (MNR) riders, New York City Transit (NYCT) riders, and pedestrians who do not use the rail services at all, but simply use the terminal to walk through[1]. Consequently, the FEIS assumed different annual background rate for each pedestrian user group, specifically: 1.1 percent for MNR, 0.5 percent for NYCT, and 0.26 for all other pedestrians. However, the final rates used for NYCT were based on the Regional Transit Model, with 22 percent growth for the year 2005 to 2035 and 13 percent growth between the year 2005 and 2020. Weighted averages of these growth rates were used at many analysis locations, since some pedestrian flows within GCT are composed of a combination of MNR riders, NYCT riders, and pass-through pedestrians.

The most recently available MNR daily ridership forecasts to Manhattan[2] were obtained from MNR to update the annual ridership growth rates for MNR riders. These forecasts project a total MNR annual average growth rate of 1.6 percent for the 2007-2020 time period and a growth rate of 1.5 percent for the 2007-2030 time period[3].

The NYCT population growth rate at GCT was assumed to remain the same as the FEIS as no new information was obtained from NYCT. Similarly, the 0.26 percent annual growth rate for non-rail users of GCT was assumed remain the same, which seems reasonable based on available NYC census data[4].

Pedestrian volumes are assigned to into the STEPS pedestrian simulation model based on their point of access into GCT. The composition (i.e., MNR rider, NYCT rider, other) of the pedestrian population at each GCT access point was estimate based on:

- the location of the access point,
- existing pedestrian flow patterns based on recent pedestrian counts, and
- sample pedestrian tracings performed through the terminal.

In some situations, a MNR rider may transfer to the subway and vice versa through GCT. The annual growth rate for the originating pedestrian population would govern for these cases. For example, the MNR growth rate was applied to MNR riders arriving to GCT and transferring to NYCT and the NYCT growth rate was applied to NYCT riders entering GCT and then transferring to MNR. Table 1 lists the annual growth rates applied to the pedestrian volumes entering from each GCT access point.

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[1] The FEIS indicated that as much as a third of all pedestrians do not use the rail services with GCT but simply walk through the terminal.
[2] MNR ridership forecasts used Fall 2007 ridership data as the baseline for existing conditions.
[3] Growth rates are a weighted average for AM peak inbound Manhattan trips for all three MNR lines – Harlem, Hudson, and New Haven.
[4] 1980 to 2000 average annual population growth of Manhattan Community District 5 was 0.5 percent (NYCDCP Dec. 2007) and 1990 to 2000 average annual worker growth for New York City was 0.08 percent (Table CTPP P-6, U.S. Census Bureau).

Table 1: GCT Population Growth Rates

GCT Origin	Percentage of Total Population			2020 Overall Growth Rate (%)	2030 Overall Growth Rate (%)	2020 Growth (%)	2030 Growth (%)
	MNR	NYCT	Other				
Tracks 11-42 (Upper Concourse)	100	0	0	1.60	1.50	21.0	38.8
Tracks 101-117 (Lower Concourse)	100	0	0	1.60	1.50	21.0	38.8
Stairs from Lower Level MNR tracks near Oyster Bar	100	0	0	1.60	1.50	21.0	38.8
Corridor from Lower Level Service Elevators	100	0	0	1.60	1.50	21.0	38.8
Roosevelt Passage	100	0	0	1.60	1.50	21.0	38.8
Northwest Passage	100	0	0	1.60	1.50	21.0	38.8
Northeast Passage	100	0	0	1.60	1.50	21.0	38.8
Graybar Building	57	13	30	1.12	1.02	14.3	25.0
Graybar Lexington Ave entrance	88	7	5	1.49	1.38	19.4	35.2
South Lexington Ave entrance	43	54	3	1.24	1.01	15.9	24.9
Central Market - North door to Graybar	64	0	36	1.12	1.05	14.3	25.9
Central Market - West	100	0	0	1.60	1.50	21.0	38.8
Central Market - South to south Lexington	0	100	0	1.01	0.67	12.8	15.8
East NYCT 4,5,6	0	100	0	1.01	0.67	12.8	15.8
West NYCT 4,5,6	0	100	0	1.01	0.67	12.8	15.8
SE 42nd Street entrance (near Oren's)	39	60	1	1.23	0.99	15.8	24.2
Vanderbilt Ave entrance (north stairs)	90	6	4	1.51	1.40	19.7	35.8
Vanderbilt Ave entrance (south stairs)	30	62	8	1.13	0.89	14.4	21.4
SW 42nd Street entrance (Kitty Kelly ramp)	82	17	1	1.49	1.35	19.4	34.2
Shuttle Passage	0	100	0	1.01	0.67	12.8	15.8
Vanderbilt Hall entrance (main entrance)	85	10	5	1.47	1.36	19.2	34.5
43rd Street entrance (to Biltmore room)	91	6	3	1.52	1.41	19.9	36.2
MetLife Building	42	46	12	1.17	0.97	14.9	23.6

APPENDIX C: Development of STEPS Model

Physical Background

The first step in model development is the importation of Autodesk 3ds Max model of GCT into STEPS. Autodesk 3ds Max is software used for three-dimensional modeling and animating. The 2D AutoCAD drawings can be imported directly into STEPS; however, for presentation purposes, 3D models create more realistic visualization. The importation creates *meshes*[5] within the STEPS model that outline the physical elements of the terminal. The meshes are used to create *items,* which can be turned into *planes* for pedestrians to walk on (i.e., floors) and *blockages* to form walls and corridors. STEPS is a grid-based system, a *plane* is made up of many grids. The grid size defined for each plane in this model is 0.5 meter or 1.64 feet (0.25 square meter; 2.7 SF), which is the average size space that a person occupies.

Throughout the modeling process, various physical background items are adjusted in order to realistically simulate pedestrian conditions and control pedestrian maneuvers. For example, blockages are created adjacent to escalator landings and platform edges to control access and properly shape pedestrian movement restrictions.

Vertical circulation elements (VCEs) within the facility, such as escalators and stairs, are simulated by two methods. The first method is through the creation of two components, *paths* and *exits.* Pedestrians must pass through the *exit* in order to get on the *path,* which could be connected to another path or a plane. A VCE aisle is made of an *exit* and *paths.* A *path* is a line joining two specific points that people will walk on during the simulation. There are two control factors for *paths*, speed and minimum spacing. The speed at which pedestrians can walk along each path can be adjusted, thereby allowing for different traveling speeds on escalators versus staircases. The minimum spacing is the smallest allowable distance between two adjacent persons traveling on the *path* (from the center of a person to another). These two factors and the exit's flow rate control the processing rate of the VCE. In general, each aisle on a 40-inch-wide (two aisle) escalator can process 35 pedestrians per minute (ppm); this equates to a rate of 70 ppm for each escalator unit. At LOS C/D, a stair aisle (two feet wide) would process 20 ppm. However, to match field observations, certain VCEs had to be calibrated to reflect existing conditions in GCT. For example, at FCA 238 in the PM peak period (when multiple subways just unloaded), it was observed that an escalator unit could process up to 75 ppm, while two stair aisles (four feet wide) could process up to a maximum of 70 ppm, which equals to LOS E/F. To match the model to field observations, a minimum spacing of 1.1 meters (3.6 ft) was used, the path speeds ranged from 0.7 to 0.75 m/s (2.3 to 2.5 ft/s), and the exit capacities were set at 44 to 54 ppm depending on the direction of travel. In future scenarios, certain VCEs had to be re-calibrated to accommodate higher volumes. For FCA 238 area, the processing rate for the existing VCEs essentially remained the same since the VCEs already set to operate at LOS E.

Paths can only operate in one direction, either up or down, and cannot actively overlap each other; consequently, the effect of a single person descending a staircase against a surge of ascending pedestrians cannot be simulated by using this method. In addition, the simulation may look unrealistic at times, for example, when an aisle is used to capacity, yet the one next to it is

[5] STEPS model terminology has been italicized.

empty because it is set in the reversed direction. The logical way would be to change the direction of the aisle to meet the demand; however, when there is only one staircase (two aisles) to connect the two levels at a location, it is necessary to keep one aisle for each direction to accommodate both directional flows.

Due to the shortcomings of this method, it was only used for creating escalators and staircases, which operate at or above capacity. For escalators, pedestrians already tend to form two aisles on a 40-inch-wide escalator, one for standing patrons and the other for walkers. Despite the fact that those who choose to walk on an escalator ascend/descend faster than those who decide to stand, the processing rate for each aisle is the same. That is, walking on a moving escalator does not significantly increase escalator capacity, but rather, its capacity is established at its throat or entrance. Also, a moving pedestrian actually occupies more physical space than do standees, creating a larger spacing between walking escalator users compared to standees. As for staircases, people in STEPS are not programmed to efficiently navigate around each other in crowded areas. Paths are needed to keep order and prevent blockages that can happen when people cannot seem to find their way around one another in tight spaces. In addition, based on field observations, people on crowded staircases naturally form aisles.

The <u>second method</u> of creating VCEs solves the shortcomings mentioned in the first method by allowing people to interact with each other. This method creates VCEs through the use of planes and exits. This essentially creates a plane (floor) that can rise and twist to look like a stair based on a centerline *shape*. Although there is no set aisle on this type of VCE, the same processing rate from the first method would still apply. The benefit of no defined aisle is that people can overtake each other, free to move linearly to avoid opposing flow. Pedestrians would enter and exit the stair through *exits* at the top and bottom. The only shortcoming of this method is that when the element gets crowded and requires too much interaction between pedestrians, they tend to freeze and eventually the element will break down. Therefore, this method was used for staircases that operate below capacity, for example, the grand staircases on both sides of GCT's Upper Concourse.

As noted previously, *exits* were created for pedestrian movements onto and off of VCEs, but they were also used for movements out of the terminal, and through turnstiles. For turnstiles, in general, a processing rate of 30 passengers per minute was used. However, as with the VCEs, modifications had to be made for the ones that are in high demand to realistically represent existing conditions.

Exits can be controlled by e*xit events* to adjust the time that a particular exit is open or closed to pedestrians and to assign or change the exit's *tag* (a tag number is used to group elements together when their purpose is identical). These specialized exit controls were used in the model to properly time the opening and closing of turnstiles changing demands, thereby better reflecting each turnstile's directional usage (i.e., inbound or outbound).

Table 1 summarized the assumed flow rates for VCEs, turnstiles, gates, and corridors in the model.

Table 1: Assumed Flow Rates in the Model

Facility	Flow Rate for LOS C/ D	Flow Rate for LOS E/ F (observation at FCA 238)[1]
Standard ESC (2 aisle)	*70 ppm*	*75 ppm*
Standard Staircases (2 aisles, 4 ft wide)	*40 ppm*	*70 ppm*
Turnstiles - Into paid area[2]	*30 ppm*	*40 ppm*
Turnstiles - out paid area[2]	*50 ppm*	*80 ppm*
Corridor Rate[3]	*see Note 3*	
Gates between track and GCT[2]	Bigger Gates (on Upper Concourse)	Smaller Gates (on Lower Concourse)
	3 pps	*2 pps*

Notes:

1. At FCA 238, VCE flow rates are adjusted to match field observations, which might be slightly higher than Fruin E/F.
2. Based on our counts in the field
3. Since a complete plane was created for the whole upper or lower concourse, there is no need to set up any exit/entrance rate for corridors (they are part of the whole plane). Instead, checkpoints were placed at the connection points based on the number of aisles of walking people on certain corridors observed in the field.

Development of Pedestrian Characteristics / Assignments

The creation of pedestrian movements within STEPS requires a specific sequence of model development procedures. These pedestrian building actions include: 1) the development of pedestrian characteristics, 2) the grouping and sizing of pedestrians events, 3) the frequency by which pedestrian groups are distributed into the model, and 4) the assignment of pedestrians through the model.

The first step within pedestrian development is establishing the *people types*; this includes the modeled person's physical dimensions, average walking speed, and patience level. Each people type is defined by a given width, depth and height that represent the overall size of people of the type. Patience factor influences the person's perception of queues at targets in the decision process. Impatient people types are less likely to choose an exit with a longer queuing time, even if moving to a less congested exit will eventually result in a longer traveling time.

Many people categories defined within the model for Grand Central Terminal, such as tourists and MNR commuters, and all other terminal users; however, the most important one is the commuters. The average body characteristics defined for commuters are a shoulder breadth or width of 0.7 m (27.6 in), a body depth of 0.4 m (15.7 in), and a height of 1.8 m (70.9 in). The patience level of commuters ranges from 0.25 to 0.50 (0.01 characterizes very impatient people, 0.99 typifies a very patient person); this range was based on field observations. Although average walking speeds could be defined when creating people types, in the GCT model, people's walking speed were defined within the plane they walk on instead. Based on field observations, an average walking speed of 1.0 m/s (3.3 fps) was assigned to the main terminal and 0.5 m/s (1.6 fps) was given to NYCT areas (these rates were similar to those used in the conduct of various support analyses for the FEIS). In the model, each type of origin has a different people type, for example, even though people arriving at the terminal by NYCT or MNR are commuters, they were defined as separate people type.

People Groups are used to group together people types and to define how many people in the group; however, since there are already many kinds of people types defined in the model, each people group is made up only one people type. The amount of people in a group depends on how many people are desired to appear in the model at once, for example, if 150 people are in a people group, then all of these people will enter the model together at once.

Once the people types and groups have been defined, *people events* need to be created to assign people groups from: 1) the appropriate starting location, 2) along the appropriate route, 3) at assumed frequencies to replicate observed pedestrian volumes (whether in large groups, such as in train surges, or individually), and 4) to a specific destination.

People groups were assigned to their respective origin/destination routes by either *routes* or *matrices*. Routes assign pedestrians through the model along a specific path identified by a series of *tag* numbers. Matrices are similar to routes in that they use tags to assign pedestrians through the model; however, instead of assigning pedestrians to a specific route, matrices guide pedestrians to the next target based on a weighted list of target options. The 47th Street Cross Passageway is the only portion of the model that was created using matrix because models built with STEPS tend to grow quickly in size and matrices are difficult to check when they grow too large. Routes and matrices can both be used in the same model; however, a specific route cannot consist of a combination of route and matrix assignments. Also, no more than one origin can be assigned to a matrix since there is no way to separate the decision matrix percentages for a specific tag among multiple origins.

Interim activities, such as people standing at certain locations, buying tickets, waiting for the trains, etc., are also shown in the simulation. The locations where people stand and the number of people were surveyed. The queue lengths and the waiting time at ticket machines, ATMs, and directories were also observed. These activities were then modeled based on the above information collected from the field. The following are some examples to show how the interim activities were created in our model:

1) Approximately 20 percent of the people originate from FCA 238 and 105 East 42nd Street entrance would pause at the train schedule kiosk in the corridor for an average time of five seconds, which created a “people blockage” around that kiosk to realistically represent the existing condition.
2) People queuing at the ticket windows on the southwest side of GCT’s Upper Concourse were modeled as six queue lines with ten persons on each line, which narrowed the walking space to only one aisle between the end of the most western ticket-window queue and the west stairs leading to Vanderbilt Avenue.
3) People who required direction or stand around the central information booth on the Upper Concourse were modeled as a blockage buffer around the clock area.
4) Around 50 percent of the MNR people would wait outside the track gates or under the information board before they enter their destination track gate. The waiting time was set up in a range from one to ten minutes.

Pedestrian Analysis Methodology

The procedures for estimating and evaluating pedestrian capacity and level of service (LOS) are based on criteria established by Fruin[6] and recommended within the Transportation Research Board's *Transit Capacity and Quality of Service Manual, 2nd Edition*. Pedestrian LOS thresholds related to walking are based on the freedom to select desired walking speeds and the ability to bypass slower-moving pedestrians.

Pedestrian level of service for walkways is based on average pedestrian space and average flow rate. For queuing and waiting areas, the primary measure for defining LOS is the average space available to each person.

On stairways, the capacity is largely affected by the stairway width. The width of a stairway determines both the number of distinct lines (lanes) of people who can traverse the stair and the side-to-side spacing between people. Consequently, meaningful increases in capacity are not directly proportional to the width, but in increments of about 30 inches (the width of a pedestrian walking lane).

[6] Fruin, John, J., *Pedestrian Planning and Design,* Revised Edition, Elevator World, Inc. Mobile, AL (1987).

APPENDIX D: Assessment of LOS in STEPS Model

In addition to visual evaluation, STEPS also provides information that can be printed to an *output* file (opened in Microsoft Excel) for post-processing. To create an *output* file, a *variable* must be defined to identify the element (such as *exit*, *location*, *plane*, etc) in the model for monitoring. This variable is called up when creating the output to specify the interval and frequency to be recorded.

For this project, to get the level of service of an area, a *location* (a defined region) was drawn on the *plane*. A *variable* was then created to monitor the amount of people on that *location*. Finally, the modeler created the *output* to record the number of people on the location at every second for 15 minutes. For each second, the number of people was divided by area of the location to get the density. The density was used to get the LOS based on Fruin's methodology (Table 1).

Table 1: Fruin's Levels of Service (Walkway)

Level of Service	Space per Person (ft^2/ped)	Density (ped/ft^2)
A	> 34.72	< 0.029
B	25.03 to 34.72	0.029 to 0.040
C	14.95 to 25.03	0.040 to 0.067
D	9.97 to 14.95	0.067 to 0.100
E	4.96 to 9.97	0.100 to 0.202
F	< 4.96	> 0.202

The weighted average was calculated by taking the average density of each level multiplied by the occurrence percentage. The following example shows how the existing PM weighted average was calculated for FCA 238 at location # 1:

- Levels-of-service A to C were counted as one group, the average density for this LOS A-C group would be $\frac{0.029 + 0.067}{2} = 0.048\, ped / ft^2$
- For LOS D, $\frac{0.067 + 0.100}{2} = 0.084\, ped / ft^2$
- For LOS E, $\frac{0.100 + 0.202}{2} = 0.151\, ped / ft^2$
- For LOS F, 0.202 ped/ft^2 was used

Weighted Average = (0.048 × 49% of the peak 15-minute in LOS A) + (0.084 × 8%) + (0.202 × 29%) = 0.109 ped/ft^2, which is equivalent to LOS E.

APPENDIX E: Reference LOS Tables

Fare Control Area 238 AM Levels of Service

Example: “14” is the number of seconds in LOS E during the 1st minute

LOC # 1 / Time (min)	Existing						2020 with Kenneth Cole Stairs at Fare Control Area 238																	
							2020 No Build (without ESA)						2020 Build (with ESA Current Design[1])						2020 Build (with ESA Alternative 2[2])					
	Level of Service						Level of Service						Level of Service						Level of Service					
	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F
1	26	11	2	4	13	4	31	8	8	7	6		25	5	8	5	17		27	5	8	10	10	
2	27	6	5	5	8	9	30	9	11	5	5		29	10	4	5	12		30	5	6	5	14	
3	27	11	6	8	8		36	6	2	4	12		31	6	9	9	5		32	7	8	8	5	
4	57		2	1			55	3	2				52	4	3	1			44	6	4	4	2	
5	17	5	2	1	6	29	11	6	6	4	20	13	12	6	6	1	11	24	18	2	9		10	21
6	17	2	3	2	4	32	45	1	5	7	2		32	4	3	2	14	5	30	1	6	3	13	7
7	28	4	5	5	10	8	36	7	13	4			35	5	9	8	3		24	7	9	3	17	
8	31	4	5	2	12	6	30	4	4	5	8	9	34	5	8	9	4		35	3	14	4	4	
9	25	10	6	3	10	6	36	1	4	4	15		25	7	7	5	16		34	8	9	7	2	
10	28	9	5	1	11	6	31	5	4	7	11	2	29	4	10	1	15	1	34	5	7	8	6	
11	56	2	2				51	2	5	2			51	3	4	2			48	4	3	4	1	
12	8	2	3	1	5	41	12	2	1	3	9	33	13	1	4		8	34	12	1	4	4	6	33
13						60	13	2	2		8	35				2	10	48			5	3	7	45
14	32	3	5		3	17	55	2	3				45	4	8	3			48	6	3		3	
15	29	4	4	5	9	9	33	8	8	4	7		34	4	4	7	11		35	9	12	3	1	
Total	408	73	55	38	99	227	505	66	78	56	103	92	447	68	87	60	126	112	451	69	107	66	101	106

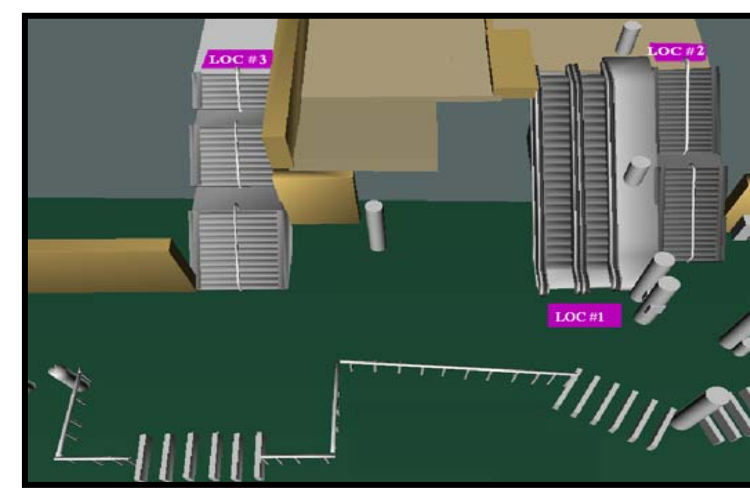
LOC # 1 / Time (min)	2030 with Kenneth Cole Stairs at Fare Control Area 238																	
	2030 No Build (without ESA)						2030 Build (with ESA Current Design)						2030 Build (with ESA Alternative 2)					
	Level of Service						Level of Service						Level of Service					
	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F
1	26	3	9	5	17		23	6	5	6	19	1	24	9	5	8	14	
2	32	7	3	2	16		25	7	10	11	7		31	7	9	7	6	
3	30	2	5	3	19	1	23	6	7	7	17		31	6	2	9	11	1
4	55	2	3				47	4	9				49	6	3	2		
5	13	7	5	2	6	27	14	2	7	6	7	24	15	4	3	3	13	22
6	36	1	1	3	13	6	23	3	3	3	6	22	22	9	3	1	7	18
7	31	4	6	3	16		25	5	15	5	10		25	11	14	4	6	
8	36	1	5	3	14	1	16	9	11	6	18		26	9	5	3	12	5
9	26	8	6	3	17		17	8	2	5	13	15	21	11	3	9	16	
10	30	3	6	5	16		31	4	3	18	4		25	13	4	8	10	
11	52	6	2				51		5		4		49	3	4	3	1	
12	12	1	5	2	6	34	7	3	10	2	5	33	11	5	4		5	35
13	2	2		2	4	50						60					9	51
14	55	3	2				40		6	3	3	8	46	6	4	1	3	
15	28	8	6	4	12	2	22	5	13	8	12		26	8	9	9	8	
Total	464	58	64	37	156	121	364	62	106	80	125	163	401	107	72	67	121	132

LOC # 2 / Time (min)	Existing						2020 with Kenneth Cole Stairs at Fare Control Area 238																	
							2020 No Build (without ESA)						2020 Build (with ESA Current Design)						2020 Build (with ESA Alternative 2)					
	Level of Service						Level of Service						Level of Service						Level of Service					
	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F
1	45	14	1				55	2	3				33	8	13	6			57	3				
2	52	5	3				57	3					39	14	7				50	8	2			
3	53	5	2				59	1					38	10	6	6			32	10	15	3		
4	46	12	2				53	7					29	7	5	9	10		49	6	4	1		
5	52	7	1				41	10	9				38	10	12				49	7	4			
6	48	11	1				54	6					48	7	5				57	3				
7	44	14	2				51	8	1				28	1	10	8	13		48	7	5			
8	46	13	1				59	1					20	16	8	11	5		52	3	4	1		
9	48	12					55	4	1				35	10	9	6			46	12	2			
10	54	3	3				49	8	3				31	11	12	6			55	5				
11	44	9	7				45	11	4				41	14	5				54	4	2			
12	45	12	3				56	4					36	9	12	3			52	6	2			
13	50	7	3				51	7	2				37	13	10				49	9	2			
14	54	5	1				54	6					41	5	14				46	6	8			
15	46	10	4				45	14	1				28	8	7	12	5		54	5	1			
Total	727	139	34				784	92	24				522	143	135	67	33		750	94	51	5		

LOC # 2 / Time (min)	2030 with Kenneth Cole Stairs at Fare Control Area 238																	
	2030 No Build (without ESA)						2030 Build (with ESA Current Design)						2030 Build (with ESA Alternative 2)					
	Level of Service						Level of Service						Level of Service					
	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F
1	49	3	8				13	7	16	11	13		42	5	13			
2	57		3				1	7	23	25	4		42	12	3	3		
3	53	2	5				20	11	17	11	1		51	5	4			
4	49	6	5				9	10	19	21	1		53	5	2			
5	41	8	10	1			29	14	9	8			49	11				
6	58	1	1				42	10	8				55	5				
7	43	7	10				14	5	14	22	5		39	5	2	9	5	
8	47	3	10							14	46		43	2	7	6	2	
9	50	1	9				7	8	10	20	15		51	5	4			
10	54		6				43	4	3	10			51	6	3			
11	50	1	9				36	7	9	7	1		40	14	4	2		
12	53	2	5				5	4	15	32	4		50	6	4			
13	49	3	8				6	9	14	28	3		50	8	1	1		
14	56	1	3					5	7	9	39		51	8	1			
15	48	5	6	1						5	55		46	10	4			
Total	757	43	98	2			225	101	164	223	187		713	107	52	21	7	

LOC # 3 / Time (min)	2020 with Kenneth Cole Stairs at Fare Control Area 238																	
	2020 No Build (without ESA)						2020 Build (with ESA Current Design)						2020 Build (with ESA Alternative 2)					
	Level of Service						Level of Service						Level of Service					
	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F
1	57	2	1				29	20	9	2			42	11	6	1		
2	60						33	12	14	1			40	15	4	1		
3	60						36	11	10	3			39	13	8			
4	60						42	13	5				47	10	2	1		
5	51	4	5				32	17	11				42	12	4	2		
6	60						19	17	20	4			34	12	14			
7	59	1					32	13	12	3			38	8	13	1		
8	60						36	14	8	2			41	10	8	1		
9	59	1					33	11	13	3			32	21	5	2		
10	57	3					37	11	11	1			33	13	11	3		
11	56	3	1				42	14	4				51	8	1			
12	60						28	17	14	1			38	13	9			
13	58	2					20	19	17	4			36	11	12	1		
14	60						43	11	6				51	6	3			
15	59		1				32	16	12				42	15	3			
Total	876	16	8				494	216	166	24			606	178	103	13		

LOC # 3 / Time (min)	2030 with Kenneth Cole Stairs at Fare Control Area 238																	
	2030 No Build (without ESA)						2030 Build (with ESA Current Design)						2030 Build (with ESA Alternative 2)					
	Level of Service						Level of Service						Level of Service					
	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F
1	57	3					31	15	12	2			41	12	5	2		
2	60						30	17	12	1			40	11	7	2		
3	58	2					32	14	14				33	13	13	1		
4	54	3	3				41	13	5	1			51	5	4			
5	51	6	3				28	16	15	1			37	13	9	1		
6	59	1					19	16	21	4			32	12	14	2		
7	53	5	2				33	13	13	1			37	13	9	1		
8	57	3					31	13	16				36	11	8	5		
9	59	1					29	20	9	2			40	11	8	1		
10	60						25	10	20	5			29	19	10	2		
11	59	1					42	10	6	2			54	5	1			
12	58	2					29	15	16				35	11	10	4		
13	57	1	2				27	14	15	4			29	22	8	1		
14	59	1					46	11	3				46	13	1			
15	54	4	2				32	10	17	1			29	16	14	1		
Total	855	33	12				475	207	194	24			569	187	121	23		



Notes:
1. Current Design: without Biltmore escalators, without subway shortloop
2. Alternative 2: with Biltmore escalators, with subway shortloop

LIRR Concourse AM Levels of Service

Loc#1 / Time (min)	2020 Build (with ESA Current Design[1])						2020 Build (with ESA Alternative 2[2])						2030 Build (with ESA Current Design)						2030 Build (with ESA Alternative 2)					
	Level of Service						Level of Service						Level of Service						Level of Service					
	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F
1	37	11	12				43	11	6				30	21	9				36	14	10			
2	28	12	18	2			39	15	6				27	18	13	2			29	18	13			
3	35	16	8	1			44	13	3				34	18	8				53	5	2			
4	25	17	18				37	18	5				23	19	18				35	19	6			
5	27	16	14	3			41	11	8				31	18	11				36	18	5	1		
6	39	16	5				43	11	6				28	23	9				47	10	3			
7	19	21	15	5			40	14	5	1			20	20	18	2			35	15	8	2		
8	24	24	12				40	15	5				29	19	9	3			42	14	4			
9	31	19	10				46	8	5	1			20	15	22	3			28	18	13	1		
10	30	15	15				38	12	9	1			24	15	19	2			36	15	9			
11	38	12	10				44	11	5				34	16	8	2			41	11	8			
12	18	17	23	2			42	13	5				21	18	19	2			45	8	7			
13	36	19	5				48	8	4				41	13	6				51	8	1			
14	27	21	12				34	21	5				20	16	22	2			45	14	1			
15	21	21	14	4			39	11	9	1			31	20	9				31	15	11	3		
Total	435	257	191	17			618	192	86	4			413	269	200	18			590	202	101	7		

Loc#2 / Time (min)	2020 Build (with ESA Current Design)						2030 Build (with ESA Current Design)					
	Level of Service						Level of Service					
	A	B	C	D	E	F	A	B	C	D	E	F
1	58	2					57	3				
2	54	6					53	7				
3	50	10					40	20				
4	60						59	1				
5	51	9					41	19				
6	41	19					47	11				
7	47	13					44	16	2			
8	59	1					48	12				
9	48	12					41	19				
10	58	2					59	1				
11	57	3					57	3				
12	44	16					44	16				
13	59	1					59	1				
14	51	9					44	16				
15	57	3					51	9				
Total	794	106					744	154	2			

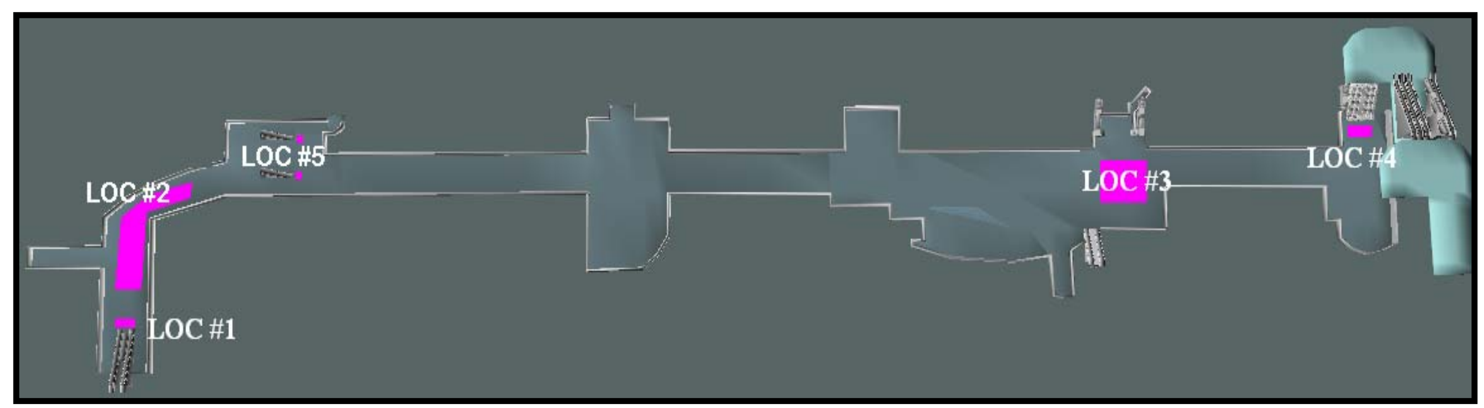
Loc#3 / Time (min)	2020 Build (with ESA Current Design)						2020 Build (with ESA Alternative 1[3])						2030 Build (with ESA Current Design)						2030 Build (with ESA Alternative 1)					
	Level of Service						Level of Service						Level of Service						Level of Service					
	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F
1	60						60						60						60					
2	60						60						60						60					
3	60						60						60						60					
4	60						60						60						60					
5	60						60						60						60					
6	60						60						60						60					
7	60						60						60						60					
8	60						60						60						60					
9	60						60						60						60					
10	60						60						60						60					
11	60						60						60						60					
12	60						60						60						60					
13	60						60						60						60					
14	60						60						60						60					
15	60						60						60						60					
Total	900						900						900						900					

Loc#4 / Time (min)	2020 Build (with ESA Current Design)						2030 Build (with ESA Current Design)					
	Level of Service						Level of Service					
	A	B	C	D	E	F	A	B	C	D	E	F
1	59	1					58	2				
2	58	2					59	1				
3	58	2					54	6				
4	60						60	0				
5	59	1					57	3				
6	60						58	2				
7	60						60	0				
8	58	2					56	4				
9	59	1					59	1				
10	57	2	1				59	1				
11	56	4					58	1	1			
12	60						60	0				
13	60						57	3				
14	59	1					59	1				
15	57	3					60	0				
Total	880	19	1				874	25	1			

Loc#5 / Time (min)	2020 / 2030 Build (with ESA Alternative 1)					
	Level of Service					
	A	B	C	D	E	F
1	46	11	3			
2	44	16				
3	44	15	1			
4	45	15				
5	45	13	2			
6	45	14	1			
7	50	10				
8	44	15	1			
9	48	12				
10	44	16				
11	48	12				
12	47	12	1			
13	47	13				
14	48	12				
15	44	14	2			
Total	689	200	11			

Notes:

1. Current Design: without Biltmore escalators, without subway shortloop
2. Alternative 2: with Biltmore escalators, with subway shortloop
3. Alternative 1: with Biltmore escalators, without subway shortloop



47th Street Crosospassage AM Levels of Service

LOC # 1 Time (min)	Existing Level of Service						2020 No Build (without ESA) Level of Service						2020 Build (with ESA Current Design[1]) Level of Service						2020 Build (with ESA Alternative 1[2]) Level of Service						2030 No Build (without ESA) Level of Service						2030 Build (with ESA Current Design) Level of Service						2030 Build (with ESA Alternative 1) Level of Service					
	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F
1	60						60						41	9	10				60						60						36	16	8				60					
2	60						60						60						60						60						60						60					
3	60						60						60						60						60						60						60					
4	60						60						60						60						60						60						60					
5	60						60						59	1					60						60						60						60					
6	60						60						60						60						60						29	13	18				60					
7	60						60						60						60						60						60						60					
8	60						60						60						60						60						60						59	1				
9	60						60						56	4					60						60						60						60					
10	60						60						60						60						60						60						60					
11	60						60						41	3	16				60						60						45	11	4				60					
12	60						60						51	1	8				60						59	1					44	11	5				60					
13	60						60						60						60						60						51	6	3				60					
14	60						60						60						60						60						43	10	7				60					
15	60						60						59	1					60						60						57	2	1				60					
Total	900						900						847	19	34				900						899	1					785	69	46				899	1				

LOC # 2 Time (min)	Existing Level of Service						2020 No Build (without ESA) Level of Service						2020 Build (with ESA Current Design) Level of Service						2030 No Build (without ESA) Level of Service						2030 Build (with ESA Current Design) Level of Service					
	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F
1	56	1	3				26	13	21				32	15	9	4			25	7	27	1			1	7	35	14	3	
2	54	4	2				41	10	9				35	21	4				46	9	5				14	11	26	9		
3	55	3	2				53	3	4				46	11	3				55	4	1				38	10	11	1		
4	56	4					47	7	6				47	4	9				38	10	12				33	14	13			
5	44	6	10				32	8	18	2			6	10	38	6			33	15	12				12	14	20	12	2	
6	56	4					37	7	16				31	12	16	1			41	11	8				3		6	23	28	
7	52	2	6				54	2	4				34	10	16				36	12	12				21	12	11	12	4	
8	57	2	1				32	13	15				21	14	22	3			44	6	9	1				3	15	38	4	
9	57	3					54	4	2				51	4	5				41	10	9				42	7	10	1		
10	46	5	8	1			48	6	6				25	6	19	9	1		39	9	12				12	14	22	12		
11	45	11	4				31	16	13						18	32	10		30	11	18	1					7	24	29	
12	35	12	12	1			34	16	10				13	7	31	7	2		39	8	12	1				1	20	27	12	
13	50	8	2				25	10	21	4			1	1	14	30	14		30	11	15	4					9	38	13	
14	58	2					51	7	2				47	6	6	1			24	21	14	1			5	8	13	16	18	
15	54	4	2				31	5	20	4			30	13	17				11	13	26	10						2	58	
Total	775	71	52	2			596	127	167	10			419	134	227	93	27		532	157	192	19			181	101	218	229	171	

LOC # 3 Time (min)	Existing Level of Service						2020 No Build (without ESA) Level of Service						2020 Build (with ESA Current Design) Level of Service						2030 No Build (without ESA) Level of Service						2030 Build (with ESA Current Design) Level of Service					
	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F
1	60						60						27	14	16	3			54	3	3				29	12	12		7	
2	55	5					53	6	1				17	16	19	6	2		54	6					22	12	23	3		
3	47	12	1				49	8	3				23	14	17	6			50	6	4				18	11	12	12	7	
4	49	8	3				49	9	2				6	15	28	11			46	11	3				7	8	14	13	18	
5	46	12	2				50	9	1				10	13	19	12	6		52	8					2	3	16	24	15	
6	55	4	1				50	9	1				16	16	23	5			49	6	5				6	16	28	10		
7	51	8	1				49	8	3				12	16	22	8	2		45	9	6				15	9	24	10	2	
8	58	2					55	4	1				25	14	17	4			47	10	3				17	13	19	9	2	
9	51	8	1				45	12	3				17	9	26	8			34	13	12	1			2	4	7	13	34	
10	49	10	1				49	10	1				20	13	26	1			47	8	5				6	7	10	5	31	1
11	47	7	6				43	13	4				16	11	22	10	1		40	16	4				8	5	18	21	8	
12	29	17	12	2			30	18	9	3						3	44	13	23	22	15					1	4	16	39	
13	38	11	11				27	18	14	1						1	45	14	22	15	22	1							15	45
14	47	11	2				24	9	25	2				2	9	9	38	2	13	14	25	8								60
15	57	3					42	10	8				15	9	6	6	24		27	14	15	4			1	3	6	4	11	35
Total	739	118	41	2			675	143	76	6			204	162	250	93	162	29	603	161	122	14			133	104	193	140	189	141

LOC # 4 Time (min)	Existing Level of Service						2020 No Build (without ESA) Level of Service						2020 Build (with ESA Current Design) Level of Service						2030 No Build (without ESA) Level of Service						2030 Build (with ESA Current Design) Level of Service					
	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F
1	60						60						60						60						60					
2	60						60						59	1					60						59	1				
3	60						60						57	3					60						56	4				
4	60						60						59	1					60						57	3				
5	60						60						58	2					60						56	4				
6	60						60						59	1					60						57	3				
7	60						60						59	1					60						58	2				
8	60						60						57	2	1				60						55	4	1			
9	60						60						54	5	1				60						51	8	1			
10	60						60						58	1	1				60						55	5				
11	60						60						50	9	1				60						55	4	1			
12	60						60						49	8	3				60						47	12	1			
13	60						59	1					39	14	7				58	2					34	16	10			
14	60						60						57	3					60						44	8	8			
15	60						60						60						60						58	2				
Total	900						899	1					835	51	14				898	2					802	76	22			

LOC # 5 Time (min)	2020 Build (with ESA Current Design) Level of Service						2030 Build (with ESA Current Design) Level of Service					
	A	B	C	D	E	F	A	B	C	D	E	F
1	57	3					60					
2	52	4	4				58	2				
3	42	12	6				44	9	6	1		
4	54	3	3				55	4	1			
5	54	4	2				52	4	4			
6	47	5	6	2			50	7	3			
7	44	10	4	2			53	5	1	1		
8	56	3	1				43	9	6	2		
9	53	4	3				45	9	5	1		
10	50	8	2				51	6	2	1		
11	52	4	4				53	6	1			
12	34	12	14				22	12	23	2	1	
13			31	26	3		11	10	18	20	1	
14	24	3	15	15	3		6	4	13	30	7	
15	58	2					48	6	6			
Total	677	77	95	45	6		651	93	89	58	9	

LOC # 6 Time (min)	Existing Level of Service						2020 No Build (without ESA) Level of Service						2020 Build (with ESA Current Design) Level of Service						2030 No Build (without ESA) Level of Service						2030 Build (with ESA Current Design) Level of Service					
	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F
1	60						60						14	28	18				60						11	25	24			
2	60						60						35	21	4				60						26	23	11			
3	60						60						7	41	12				60						14	30	16			
4	60						60						4	14	42				52	8					2	11	46	1		
5	59	1					45	15					6	11	43				54	6					9	25	26			
6	60						55	5					1	10	49				51	9					3	5	51	1		
7	60						52	8					11	10	37	2			49	10	1				2	11	46	1		
8	60						60						15	30	15				51	9					4	29	27			
9	60						59	1					12	29	19				60						1	24	35			
10	60						59	1					17	26	17				58	2					19	29	12			
11	60						60						11	25	24				60						3	24	33			
12	60						57	3					10	25	25				60						12	30	18			
13	60						60						9	23	27	1			60						11	13	36			
14	60						56	4					6	15	38	1			50	10					1	14	40	5		
15	60						57	3					19	24	17				60						18	16	26			
Total	899	1					860	40					177	332	387	4			845	54	1				136	309	447	8		

LOC # 7 Time (min)	2020 / 2030 Build (with ESA Current Design) Level of Service					
	A	B	C	D	E	F
1	30	15	13	2		
2	36	13	10	1		
3	40	14	5	1		
4	26	19	14	1		
5	37	12	8	3		
6	28	18	13	1		
7	41	15	4			
8	33	12	14	1		
9	34	13	13			
10	42	9	9			
11	25	9	26			
12	37	7	14	2		
13	27	20	12	1		
14	34	16	9	1		
15	38	15	6	1		
Total	508	207	170	15		

Notes:

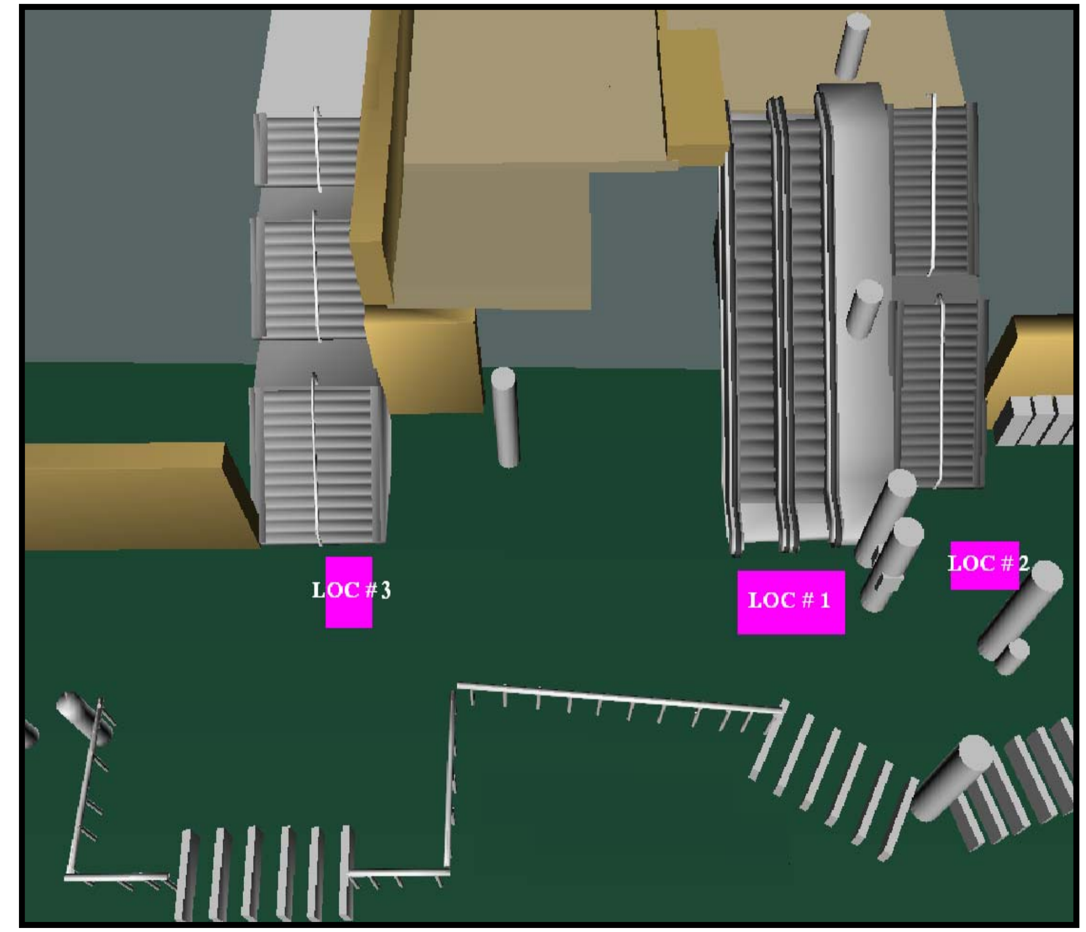
1. Current Design: without Biltmore escalators, without subway shortloop
2. Alternative 1: with Biltmore escalators, without subway shortloop

Fare Control Area 238 PM Levels of Service

LOC #1 Time (min)	Existing						2020 with Kenneth Cole Stairs at Fare Control Area 238												2030 with Kenneth Cole Stairs at Fare Control Area 238											
							2020 No Build (without ESA)						2020 Build (with ESA Current Design[1])						2030 No Build (without ESA)						2030 Build (with ESA Current Design)					
	Level of Service						Level of Service						Level of Service						Level of Service						Level of Service					
	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F
1	7	12	9	6	14	12	6	9	18	10	16	1	5	8	15	16	15	1	11	13	17	9	10		13	5	6	12	15	9
2	13	8	9	9	10	11	13	10	9	8	20		8	7	16	7	14	8	14	8	13	11	13	1	5	11	6	19	15	4
3	12	5	12	3	12	16	13	6	13	16	12		6	5	17	14	18		13	13	16	12	6		7	7	7	16	23	
4	28	14	16	2			28	14	14	4			18	21	21				28	15	13	4			42	7		11		
5	6	5	3		7	39	13	4	8	3	5	27	5	4	8	3	10	30	13	3	11	3	3	27	7	5	3	6	7	32
6		1	4	8	6	41	9	2	9	10	12	18	2	3	4	3	12	36	10	4	11	7	8	20					13	47
7	5	14	12	6	18	5	14	9	15	13	9		7	10	9	11	23		15	8	13	8	16		2	1	8	15	33	1
8	9	12	8	4	18	9	14	12	16	9	9		8	4	16	8	24		12	14	11	13	10		16	7	3	13	21	
9	9	6	8	8	14	15	14	12	26	7	1		4	5	17	23	11		15	11	11	8	15		13	13	15	13	6	
10	9	12	14	7	15	3	14	11	16	13	6		4	8	10	7	31		16	8	12	12	12		1	5	3	11	18	22
11	15	15	19	8	3		30	22	8				25	14	11	9	1		24	12	19	5			38	7	3	10	2	
12	7	3	2	1	6	41	5	3	6	5	8	33	4	1	9		5	41	4	8	6	4	4	34	7	5	1	4	9	34
13						60					6	54						60						60						60
14	16	14	10	4	6	10	23	14	10	1	12						9	51	19	12	14		4	11			1	1	11	47
15	30	13	15	2			34	18	8				1	3	7	12	28	9	30	13	12	4	1		13	10	9	21	7	
Total	166	134	141	68	129	262	230	146	176	99	116	133	97	93	160	113	201	236	224	142	179	100	102	153	164	83	65	152	180	256

LOC # 2 Time (min)	Existing						2020 with Kenneth Cole Stairs at Fare Control Area 238												2030 with Kenneth Cole Stairs at Fare Control Area 238											
							2020 No Build (without ESA)						2020 Build (with ESA Current Design)						2030 No Build (without ESA)						2030 Build (with ESA Current Design)					
	Level of Service						Level of Service						Level of Service						Level of Service						Level of Service					
	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F
1	15	14		17	14		20	12		13	15		27	15		12	6		24	16		13	7		21	25		12	2	
2	16	15		4	18	7	22	18		10	10		22	12		10	15	1	20	25		9	6		18	19		12	11	
3	13	20		12	13	2	23	19		13	5		20	18		13	9		23	24		9	3	1	11	18		15	16	
4	30	20		6	4		31	24		4	1		30	23		6	1		32	21		6	1		29	27		3	1	
5	5	5		6	6	38	14	12		3	27	4	7	17		4	2	30	16	6		8	11	19	10	12		4		34
6	11	9		10	10	20	37	17		5	1		16	13		7	9	15	26	18		8	5	3					7	53
7	11	12		12	20	5	26	16		16	2		21	15		6	18		19	25		9	7		4	5		3	38	10
8	12	15		12	14	7	27	22		6	5		22	24		11	3		23	22		8	7		16	14		11	14	5
9	16	18		8	16	2	23	20		11	6		18	21		7	13	1	28	17		9	6		23	21		11	5	
10	16	17		9	15	3	28	16		10	6		18	20		6	16		24	19		8	8	1	8	13		9	25	5
11	29	24		5	2		35	21		4			32	17		11			33	21		5	1		31	14		7	8	
12	7	2		1	4	46	7	14		5	8	26	6	9		4	7	34	10	8		3	9	30	8	7		2	6	37
13					3	57	4	7		6	22	21					3	57		1		3	15	41						60
14	17	16		12	12	3	43	14		3			24	20		3	10	3	35	19		6							5	55
15	20	25		12	3		44	10		5	1		32	23		4	1		45	11		4			28	13		5	10	4
Total	218	212		126	154	190	384	242		114	109	51	295	247		104	113	141	358	253		108	86	95	207	188		94	148	263

LOC # 3 Time (min)	2020 with Kenneth Cole Stairs at Fare Control Area 238												2030 with Kenneth Cole Stairs at Fare Control Area 238											
	2020 No Build (without ESA)						2020 Build (with ESA Current Design)						2030 No Build (without ESA)						2030 Build (with ESA Current Design)					
	Level of Service						Level of Service						Level of Service						Level of Service					
	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F
1	48	10	2				22	19	15	4			22	20	18				11	7	9	5	17	11
2	45	5	10				14	10	16	6	14		29	14	13	3	1		16	7	7	13	17	
3	46	9	4	1			7	8	17	6	22		24	14	17	5			13	11	7	19	10	
4	54	4	2				27	20	11	2			31	18	9	2			17	25	8	6	4	
5	21	8	9	2	20		9	6	3	3	9	30	11	8	8	10	19	4	7	4	4	8	5	32
6	22	5	4	2	11	16	14	6	4	8	11	17	11	7	9	3	8	22	1	1	2	10	19	27
7	43	9	8				15	7	13	9	16		29	14	14	3			4	11	6	11	24	4
8	46	6	6	1	1		12	15	12	10	11		20	17	17	5	1		4	9	8	14	25	
9	47	6	6	1			18	14	14	6	8		19	19	17	5			12	11	6	14	17	
10	39	4	14	2	1		14	12	24	9	1		26	17	12	5			14	6	15	15	9	1
11	55	4	1				23	26	11				35	16	9				23	26	6	5		
12	17	7	12	7	17		11	2	6		12	29	11	3	7	9	29	1	10	2	3		6	39
13	21	3	6	19	11						2	58	6	4	7	2	30	11						60
14	48	7	5				6	10	14	11	14	5	34	14	12				13	14	10	8	8	7
15	51	4	5				25	17	17	1			32	15	13				28	12	8	10	2	
Total	603	91	94	35	61	16	217	172	177	75	120	139	340	200	182	52	88	38	173	146	99	138	163	181



Notes:
1. Current design: without biltmore room, without subway short loop

LIRR Concourse PM Levels of Service

LOC # 1 / Time (min)	2020 / 2030 Build (with ESA Current Design[1])					
	Level of Service					
	A	B	C	D	E	F
1	48	12				
2	32	18	10			
3	35	19	6			
4	33	8	15	4		
5	39	17	4			
6	39	11	8	2		
7	50	4	6			
8	50	10				
9	57	2	1			
10	57	3				
11	58	2				
12	55	3	2			
13	57	3				
14	57	3				
15	59	1				
Total	726	116	52	6		

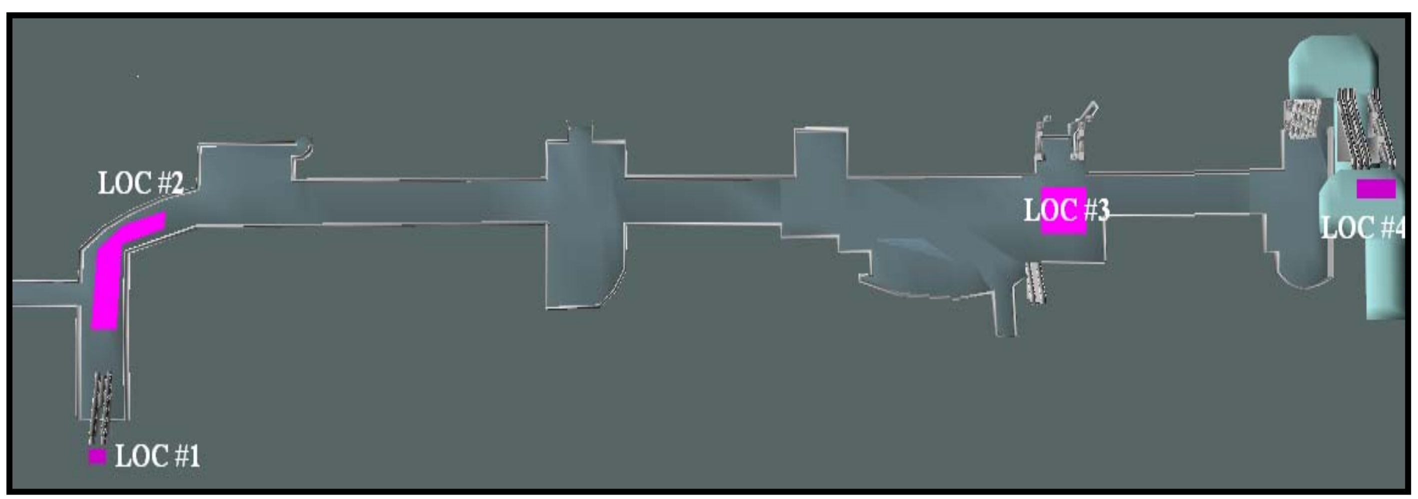
LOC # 2 / Time (min)	2020 / 2030 Build (with ESA Current Design)					
	Level of Service					
	A	B	C	D	E	F
1	34	26				
2	28	29	3			
3	31	23	6			
4	7	41	12			
5	33	24	3			
6	17	29	14			
7	45	15				
8	56	4				
9	44	15	1			
10	58	2		1		
11	52	8				
12	54	6				
13	60					
14	52	8				
15	55	5				
Total	626	235	39			

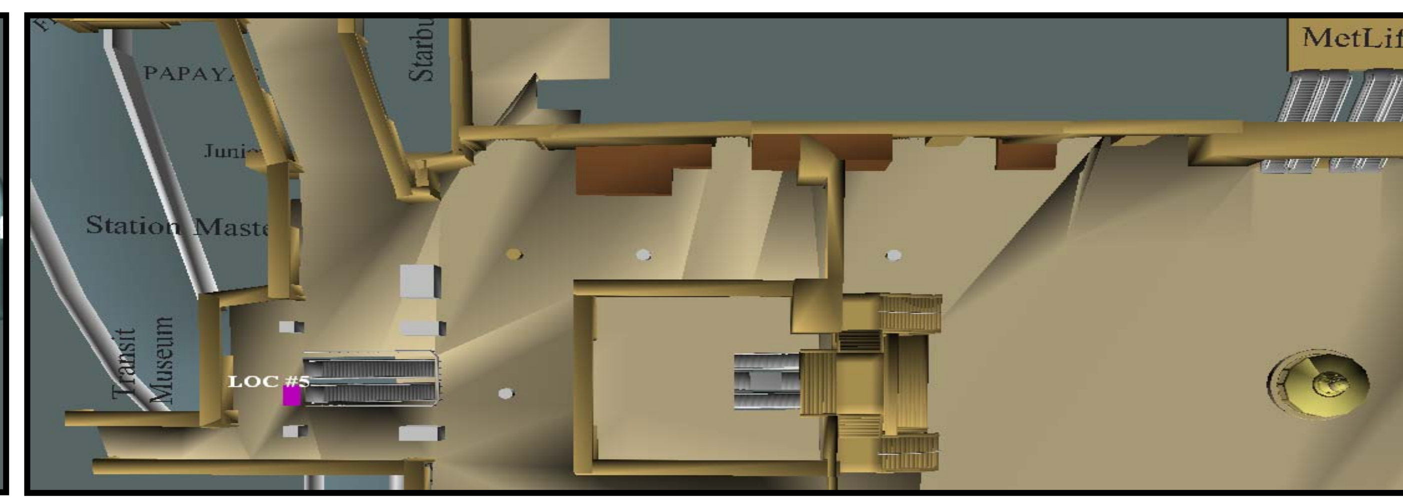
LOC # 3 / Time (min)	2020 / 2030 Build (with ESA Current Design)					
	Level of Service					
	A	B	C	D	E	F
1	60					
2	60					
3	60					
4	60					
5	60					
6	60					
7	60					
8	60					
9	60					
10	60					
11	60					
12	60					
13	60					
14	60					
15	60					
Total	900					

LOC # 4 / Time (min)	2020 / 2030 Build (with ESA Current Design)					
	Level of Service					
	A	B	C	D	E	F
1	60					
2	59	1				
3	59	1				
4	58	2				
5	58	2				
6	60					
7	60					
8	57	3				
9	60					
10	59	1				
11	59	1				
12	58	2				
13	59	1				
14	60					
15	59	1				
Total	885	15				

LOC # 5 / Time (min)	Existing						2020 No Build (without ESA)						2020 Build (with ESA Current Design)						2030 No Build (without ESA)						2030 Build (with ESA Current Design)					
	Level of Service						Level of Service						Level of Service						Level of Service						Level of Service					
	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F
1	56	4					55	4	1				51	9					51	9					52	7	1			
2	55	5					53	6	1				53	7					55	5					51	9				
3	55	5					56	4					53	7					57	3					55	5				
4	56	4					54	6					56	4					54	6					53	7				
5	56	4					56	4					53	7					54	6					52	8				
6	55	5					53	7					40	17	3				55	5					38	10	8	4		
7	55	5					52	8					25	10	12	8	5		56	4					22	10	10	13	5	
8	56	4					56	3	1				55	5					53	7					52	7	1			
9	55	5					54	6					53	7					52	8					53	7				
10	56	4					55	5					54	6					54	4	1	1			54	6				
11	53	7					53	7					52	8					52	6	1	1			54	6				
12	58	2					56	4					54	6					55	5					57	3				
13	56	4					53	7					53	5	2				56	4					51	9				
14	54	6					54	6					56	4					56	4					56	4				
15	55	5					56	4					53	7					54	6					52	8				
Total	831	69					816	81	3				761	109	17	8	5		814	82	2	2			752	106	20	17	5	

Note:
1. Current design: without biltmore room, without subway short loop





47th Street Crosspassage PM Levels of Service

LOC # 1 Time (min)	Existing						2020 No Build (without ESA)						2020 Build (with ESA Current Design[1])						2030 No Build (without ESA)						2030 Build (with ESA Current Design)					
	Level of Service						Level of Service						Level of Service						Level of Service						Level of Service					
	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F
1	60						60						57	3					60						58	2				
2	60						60						60						60						59	1				
3	60						60						59	1					60						56	4				
4	60						60						60						60						60					
5	60						60						58	2					60						58	2				
6	60						60						57	3					60						60					
7	60						60						59	1					60						57	3				
8	60						60						58	2					60						56	3	1			
9	60						60						58	1	1				60						59	1				
10	60						60						57	3					60						56	4				
11	60						60						58	2					60						56	3	1			
12	60						60						59	1					60						56	3	1			
13	60						60						59	1					60						60					
14	60						60						59	1					60						58	2				
15	60						60						60						60						57	3				
Total	900						900						878	21	1				900						866	31	3			

LOC # 2 Time (min)	Existing						2020 No Build (without ESA)						2020 Build (with ESA Current Design)						2030 No Build (without ESA)						2030 Build (with ESA Current Design)					
	Level of Service						Level of Service						Level of Service						Level of Service						Level of Service					
	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F
1	59	1					58	2					47	2	11				49	11					39	18	2	1		
2	60						55	5					37	12	10	1			55	5					42	14	3	1		
3	60						60						52	8					49	10	1				39	12	8	1		
4	59	1					60						43	13	4				50	9	1				36	16	5	3		
5	59	1					58	2					35	10	13	2			53	7					33	17	8	2		
6	60						57	3					55	5					48	11	1				44	14	1	1		
7	60						60						47	9	3	1			52	8					44	10	6			
8	60						57	3					32	17	11				53	7					40	15	3	2		
9	60						60						47	8	5				55	5					36	17	7			
10	60						59	1					36	13	11				52	8					38	14	6	2		
11	60						59	1					18	17	20	5			56	4					40	11	7	2		
12	60						57	3					28	10	16	6			56	4					35	17	6	2		
13	60						58	2					36	15	9				53	7					38	15	3	4		
14	58	2					57	3					32	14	14				53	6	1				39	11	8	2		
15	59	1					59	1					51	5	4				55	5					41	11	6	2		
Total	894	6					874	26					596	158	131	15			789	107	4				584	212	79	25		

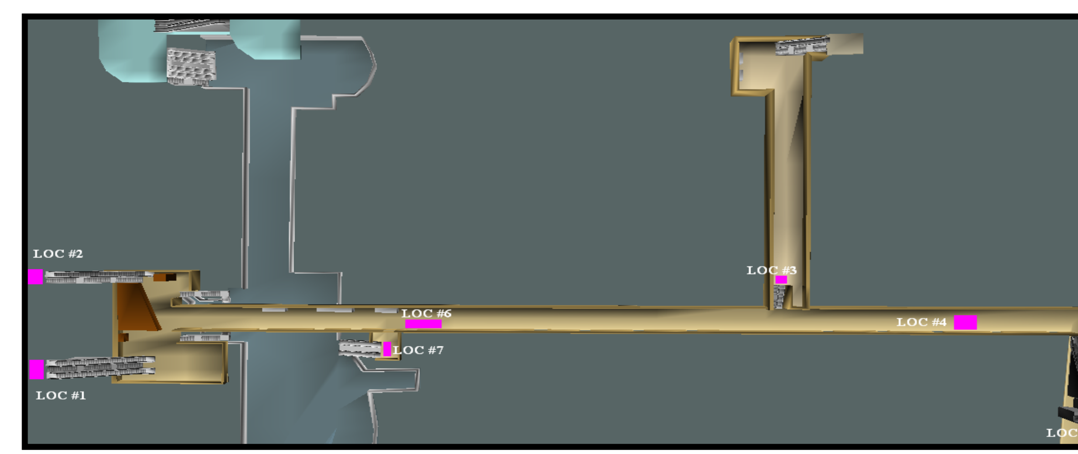
LOC # 3 Time (min)	Existing						2020 No Build (without ESA)						2020 Build (with ESA Current Design)						2030 No Build (without ESA)						2030 Build (with ESA Current Design)					
	Level of Service						Level of Service						Level of Service						Level of Service						Level of Service					
	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F
1	51	9					48	11	1				16		19	7	18		54		6				19		26	10	5	
2	54	6					47	13					7		29	12	12		53		6	1			26		25	6	3	
3	54	6					45	14	1				19		29	7	5		52		8				5		15	9	31	
4	52	8					48	11	1				20		32	7	1		50		9	1			9		23	7	21	
5	54	6					51	9					20		25	5	10		51		9				10		21	7	20	2
6	51	9					52	8					17		30	7	6		51		9						12	14	34	
7	47	11	2				44	13	2				13		35	4	8		45		15				3		24	12	21	
8	52	8					49	9	2				8		26	11	15		52		7	1			14		27	13	6	
9	52	8					47	13					30		22	4	4		49		10		1		17		26	8	9	
10	50	9	1				42	12	3	3			15		28	12	5		49		11				17		28	11	3	1
11	52	8					43	15	1	1			12		28	8	12		51		7	1	1		14		29	6	9	2
12	44	16					50	10					17		21	10	12		49		11				11		29	9	11	
13	48	12					44	15	1				11		28	6	13	2	47		13				12		24	11	13	
14	51	9					45	15					26		24	3	7		53		7				30		23	4	3	
15	47	13					49	11					13		29	9	9		52		7	1			12		22	9	17	
Total	759	138	3				704	179	12	5			244		405	112	137	2	758		135	5	2		199		354	136	206	5

LOC # 4 Time (min)	Existing						2020 No Build (without ESA)						2020 Build (with ESA Current Design)						2030 No Build (without ESA)						2030 Build (with ESA Current Design)					
	Level of Service						Level of Service						Level of Service						Level of Service						Level of Service					
	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F
1	60						60						59	1					60						58	2				
2	60						60						59	1					60						58	2				
3	60						60						59	1					60						56	4				
4	60						60						59	1					60						59	1				
5	60						60						60						60						58	2				
6	60						60						59	1					60						59	1				
7	60						60						58	2					60						56	4				
8	60						60						59	1					60						57	3				
9	60						60						59	1					60						60					
10	60						60						59	1					60						58	1	1			
11	60						60						58	2					60						59		1			
12	60						60						58	2					60						58	2				
13	60						60						58	2					60						59	1				
14	60						60						59	1					60						59	1				
15	60						60						58	2					60						60					
Total	900						900						881	19					900						874	24	2			

LOC #5 Time (min)	2020 / 2030 Build (with ESA Current Design)					
	Level of Service					
	A	B	C	D	E	F
1	54	3	3			
2	53	7				
3	56	3	1			
4	57	3				
5	51	8	1			
6	52	6	2			
7	48	7	5			
8	57	3				
9	51	3	6			
10	35	15	10			
11	38	11	8	3		
12	28	16	15	1		
13	39	10	9	2		
14	39	11	10			
15	43	10	7			
Total	701	116	78	6		

LOC # 6 Time (min)	Existing						2020 No Build (without ESA)						2020 Build (with ESA Current Design)						2030 No Build (without ESA)						2030 Build (with ESA Current Design)					
	Level of Service						Level of Service						Level of Service						Level of Service						Level of Service					
	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F
1	60						55	5					13	15	31	1			47	13					3	20	35	2		
2	57	3					52	8					9	27	23	1			55	5					10	15	35			
3	59	1					56	4					8	27	25				56	4					6	18	36			
4	57	3					52	8					6	20	34				49	11					10	19	30	1		
5	60						55	5					4	27	29				48	12					9	9	42			
6	54	6					55	5					11	22	26	1			50	10					9	23	27	1		
7	58	2					60						5	18	36	1			53	6	1				5	14	40	1		
8	60						57	3					15	21	23	1			55	5					5	24	27	4		
9	60						59	1					17	11	29	3			48	11	1				6	17	37			
10	54	6					55	5					4	20	31	5			48	6	6				7	21	30	2		
11	60						51	9					15	22	23				41	16	3				10	23	27			
12	60						57	3					8	22	30				53	7					6	22	31	1		
13	56	4					48	11	1				10	11	38	1			54	6					7	17	34	2		
14	59	1					56	4					12	20	26	2			56	4					6	12	36	6		
15	58	2					58	2					8	26	26				46	14					4	23	33			
Total	872	28					826	73	1				145	309	430	16			759	130	11				103	277	500	20		

LOC # 7 Time (min)	2020 / 2030 Build (with ESA Current Design)					
	Level of Service					
	A	B	C	D	E	F
1	44		16			
2	46		13	1		
3	34		22	4		
4	43		14	3		
5	43		11	6		
6	45		11	4		
7	50		9	1		
8	40		17	3		
9	20		30	10		
10	50		10			
11	58		2			
12	53		6	1		
13	30		22	8		
14	27		28	5		
15	36		20	4		
Total	619		231	50		



Notes:

1. Current design: without biltmore room, without subway short loop

APPENDIX F: Assessment of Number of Pedestrians (per minute) Through Major Connections and Exits

Assessment for number of pedestrians per minute increment was conducted in 2020 Build Scenario. The first step was to select representative locations or exits for monitor. Figures 1, 2, and 3 show the selected locations or exits on the map of GCT Upper Concourse, 47^{th} Street Crosspassage, and LIRR Concourse, respectively. As shown in the figures, the red ellipses label the locations in corridors or connections between corridors, of which the output volume includes crossing people from both or even more than two directions. The red rectangles label the exits and entrances between model planes or between a plane and VCEs, of which the volumes of each direction (up/down or exit/entrance) could be distinguished and thus are presented separately.

The volumes of these locations were then output in time steps of 60 seconds while the model was running for 30 minutes. Note that only the last 15 minutes volumes were used, while the first 15-minute run was just used to fully populate the model. The results are summarized in Tables 1, 2, and 3; each table is accompanied by a corresponding figure (i.e., Figure 1, 2, and 3) which illustrates analysis locations. Note that the total volume output in the last row may not be exactly equal to the volume input as shown in figures, due to the random seeds for the simulation model.

Figure 1: Location Labels on GCT Upper Concourse

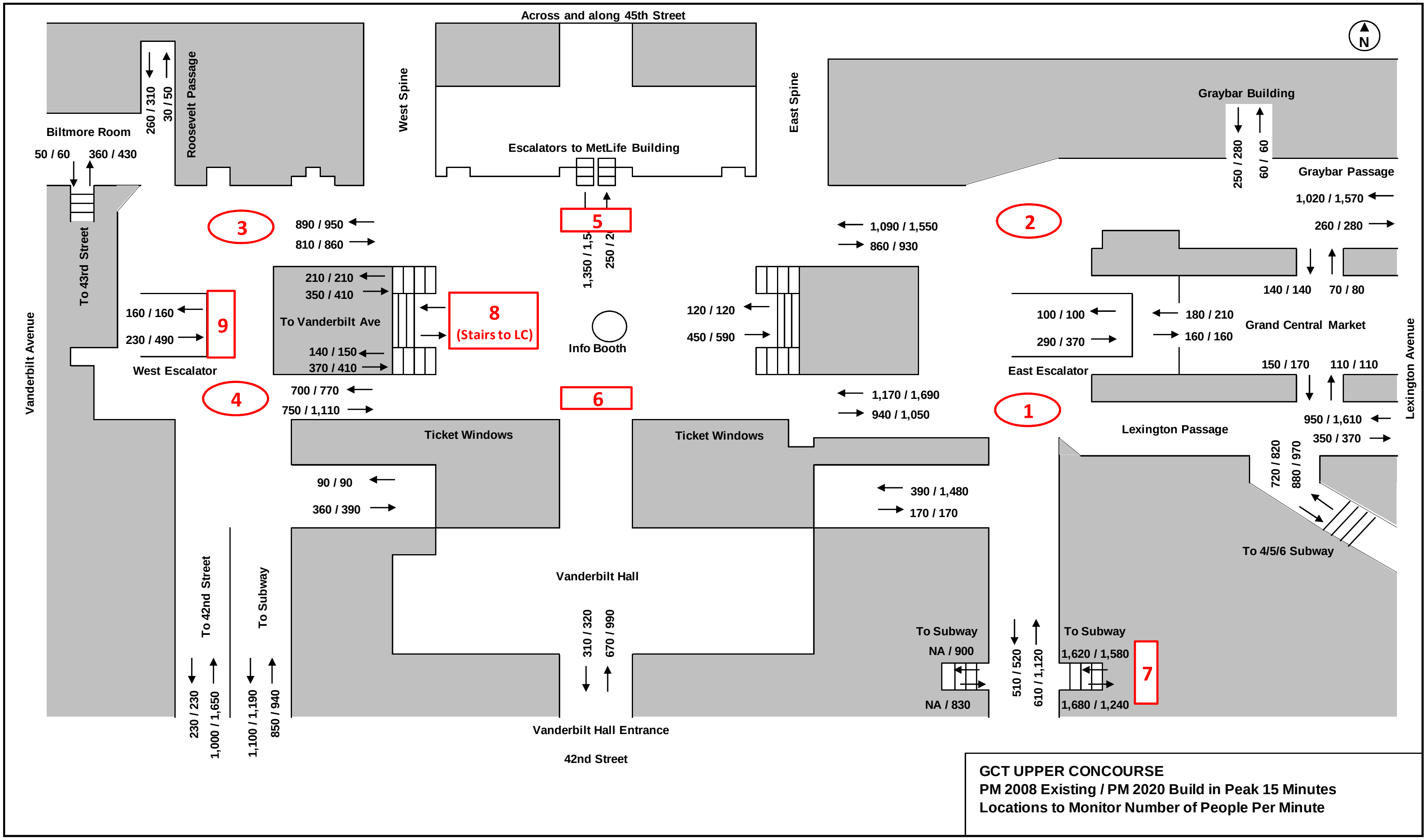


Table 1: Number of Pedestrians (per minute) Through Major Connections and Exits on GCT Upper Concourse (2020 Build PM)

Minutes	Main Concourse																		
	Location																		
	1	2	3	4	5				6		7						8		9
	GCT - Lexington Passage	GCT-Graybar Passage	GCT - Roosvelt	GCT-Shuttle Passage	To MetLife	From MetLife-Esc1	From MetLife-Esc2	From MetLife-Esc3	From GCT to Vanderbilt	From Vanderbilt to GCT	KCS-up	KCS-down	ESC-up	ESC-down	Stair-up	Stair-down	Down to DC	Up from DC	Down to Transit Musem ESC
1	327	161	210	114	42	31	27	44	52	64	49	54	63	42	39	29	114	4	33
2	351	179	207	247	60	34	26	43	55	65	57	60	63	43	40	41	114	4	34
3	357	172	178	107	23	32	29	44	15	66	61	65	67	42	42	35	102	26	34
4	365	244	172	178	11	24	26	51	16	60	26	54	48	44	18	38	103	4	37
5	332	219	177	124	10	32	27	44	12	69	58	64	72	72	68	65	108	4	32
6	370	244	298	179	12	35	29	39	19	64	53	56	71	46	70	28	102	4	42
7	372	193	555	194	16	29	27	46	17	68	52	58	65	43	42	38	118	1	64
8	344	172	211	254	13	27	33	39	18	60	53	59	68	46	40	36	96	11	38
9	366	230	197	141	23	28	32	41	37	68	45	67	65	41	47	33	112	20	32
10	383	214	203	185	17	31	25	42	12	63	72	75	63	46	47	50	102	3	39
11	349	154	174	108	8	32	29	37	16	68	25	53	38	42	19	35	108	3	29
12	312	154	185	162	11	35	25	39	12	65	64	40	74	56	61	31	102	5	37
13	348	158	165	115	9	31	24	42	14	67	68	57	60	17	59	35	108	2	33
14	376	171	156	194	11	34	25	40	18	66	39	45	55	40	59	36	95	4	36
15	330	159	159	116	10	28	25	47	13	58	36	58	57	70	39	32	109	3	35
Total Volume	5,282	2,824	3,247	2,418	276	463	409	638	326	971	758	865	929	690	690	562	1,593	98	555

Figure 2: Location Labels on 47th Street Crosspassage

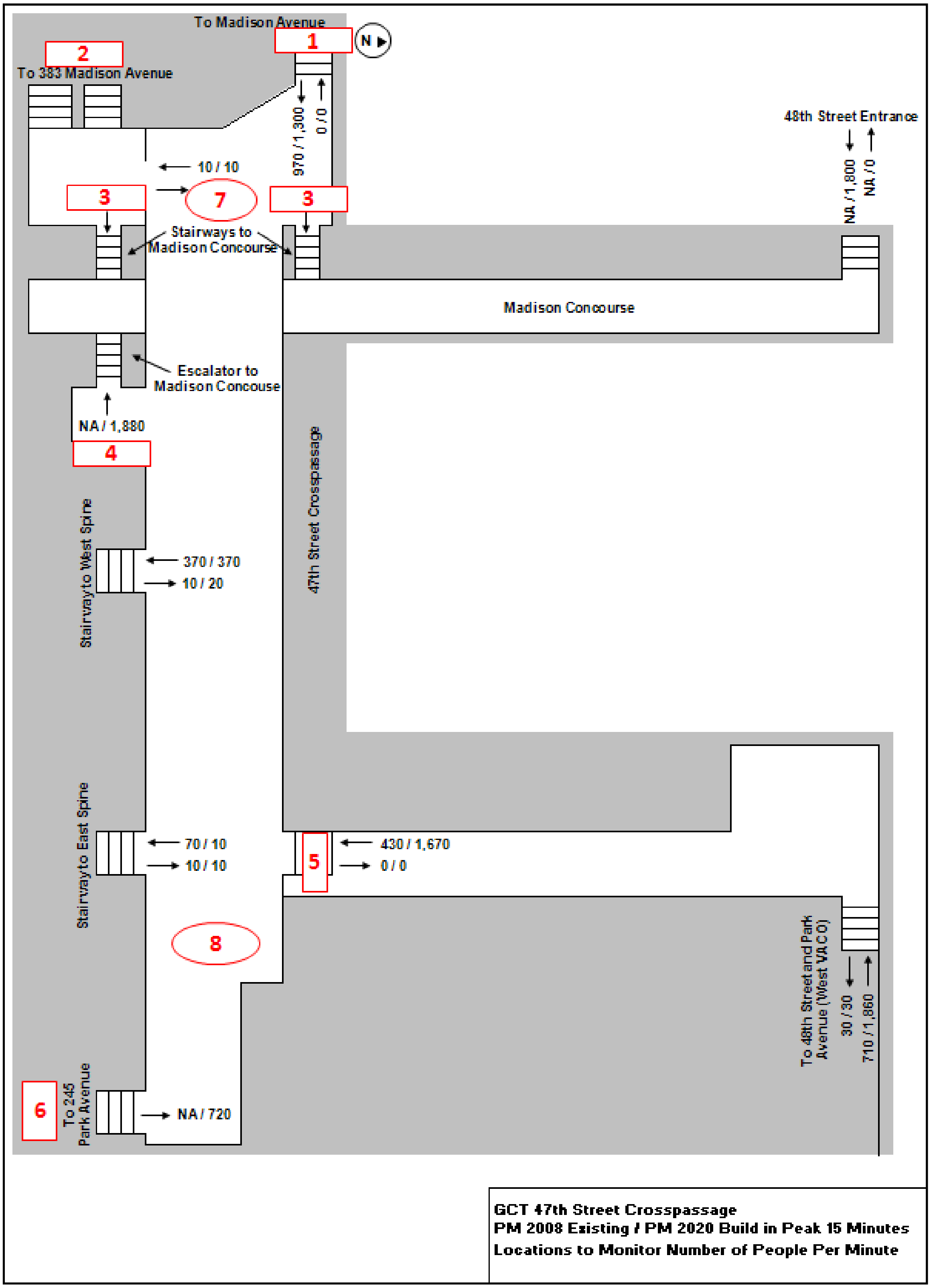


Table 2: Number of Pedestrians (per minute) Through Major Connections and Exits on 47 Crosspassage (2020 Build PM)

Minutes	47th Street Crosspassage														
	Location														
	1		2			3		4		5		6		7	8
	47st to Chase-stair	47st to Chase-esc	47st to JP-stair	47st to JP-esc1	47st to JP-esc2	47xpw to MadStair1	47xpw to MadStair2	47xpw to MadESC1	47xpw to MadESC2	47xpw-eastspine-stair	47xpw-eastspine-esc	47xpw-248park-esc2	47xpw-248park-stair	North End	South End
1	22	62	11	23	24	23	33	56	65	41	72	27	21	85	51
2	27	61	13	21	23	33	30	52	60	28	67	28	21	76	51
3	23	65	11	22	24	30	27	57	64	30	67	29	19	84	54
4	22	62	10	24	24	31	30	55	60	24	68	32	17	87	60
5	25	61	9	25	23	30	29	59	61	32	64	30	17	77	57
6	24	64	9	25	24	28	29	57	68	32	66	30	19	87	50
7	25	62	9	24	25	39	25	50	61	41	71	32	16	76	55
8	22	62	12	21	25	24	31	48	60	30	66	26	19	87	53
9	26	62	9	20	28	33	31	51	64	32	65	28	23	92	49
10	25	58	9	23	24	28	32	56	64	27	66	28	18	81	57
11	27	61	10	26	22	23	34	55	61	34	67	33	17	87	49
12	24	62	7	27	24	31	30	54	64	36	66	30	15	92	55
13	25	61	11	21	25	29	28	54	62	24	67	31	19	81	58
14	26	59	11	20	26	33	31	48	60	34	69	27	19	84	50
15	22	64	9	27	23	29	29	59	61	21	66	37	12	85	56
Total Volume	365	926	150	349	364	444	449	811	935	466	1,007	448	272	1,261	805

Figure 3: Location Labels on LIRR Concourse

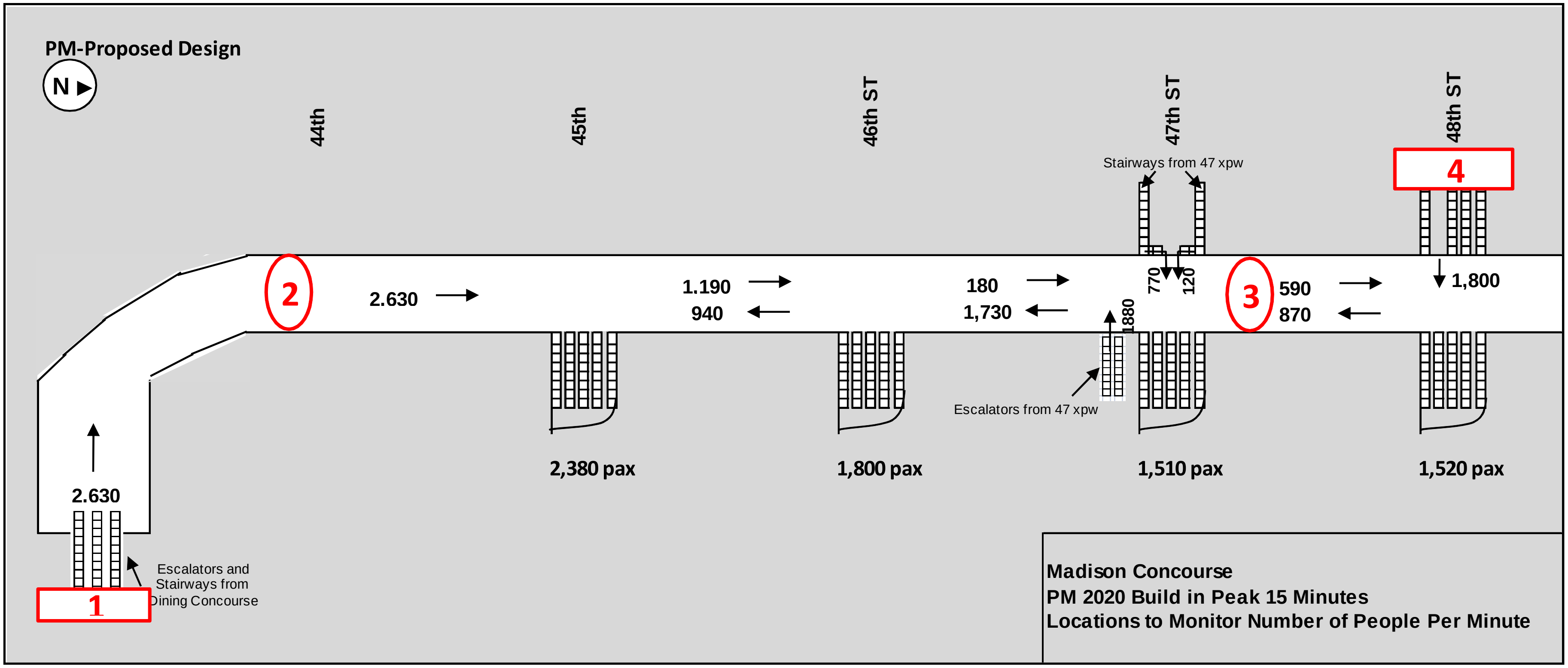


Table 3: Number of Pedestrians (per minute) Through Major Connections and Exits on LIRR Concourse (2020 Build PM)

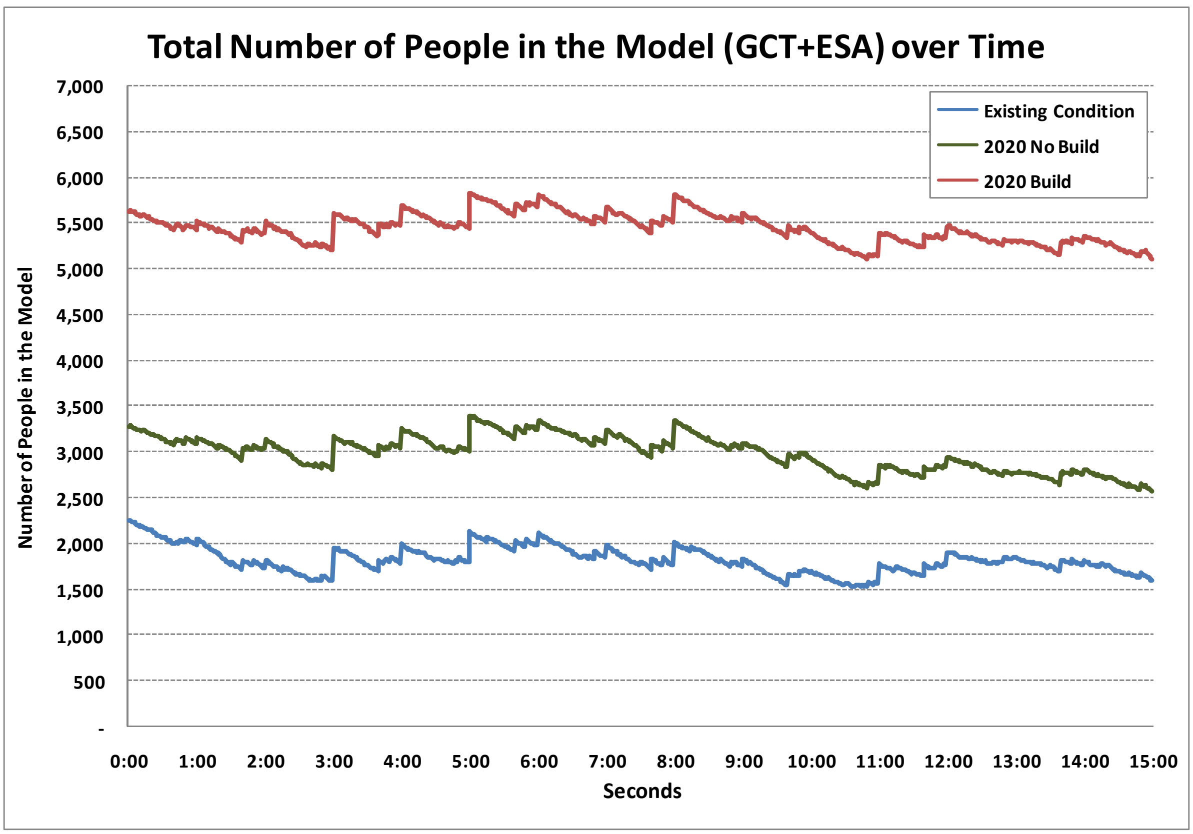
Minutes	Madison Concourse								
	Location								
	1			2	3	4			
	LIRR-stair	LIRR-esc1	LIRR-esc2	West-end	East-end	48st-stair	48st-esc1	48st-esc2	48st-esc3
1	43	65	57	184	95	16	52	49	6
2	42	70	55	160	96	25	45	41	8
3	43	70	61	173	96	15	46	51	10
4	43	71	61	165	98	18	48	47	5
5	41	70	71	182	96	17	49	46	6
6	36	59	57	186	96	25	45	40	12
7	38	65	58	156	92	26	47	43	5
8	44	59	65	161	104	24	47	43	5
9	41	65	71	166	87	20	42	47	8
10	43	69	63	181	98	24	47	46	7
11	46	64	65	180	96	16	44	42	14
12	50	74	65	176	98	16	50	50	5
13	35	56	51	184	94	24	46	42	8
14	40	63	62	145	99	18	47	47	7
15	43	61	63	160	90	19	46	50	5
Total Volume	628	1,306	925	2,559	1,435	303	701	684	111

APPENDIX G: Assessment of Total Number of Pedestrians in the Model over Time

Total number of people in the entire model was output from STEPS second by second for 30 minutes in each PM scenario (existing, 2020 No Build, and 2020 Build). Note that the first 15-minute run is only for the model to be fully populated and the outputs from the last 15-minute run were used for the results representation in Figure 1 below.

As shown in Figure 1, the blue line represents the existing condition, indicating that the total number of people is in a range of 1,500 to 2,300. The green line gives the total number of people in 2020 No Build model, which is in a range of 2,500 to 3,500. The red line shows that the total number of people in the 2020 Build model would increase to the maximum of 5,800 after the LIRR riders were introduced into the model. Note that the people counted include pedestrians in the entire model, including GCT, FCA 238, 47th Street Crosspassage, LIRR Concourse, etc.

Figure 1: Total Number of Pedestrians in the Model over Time



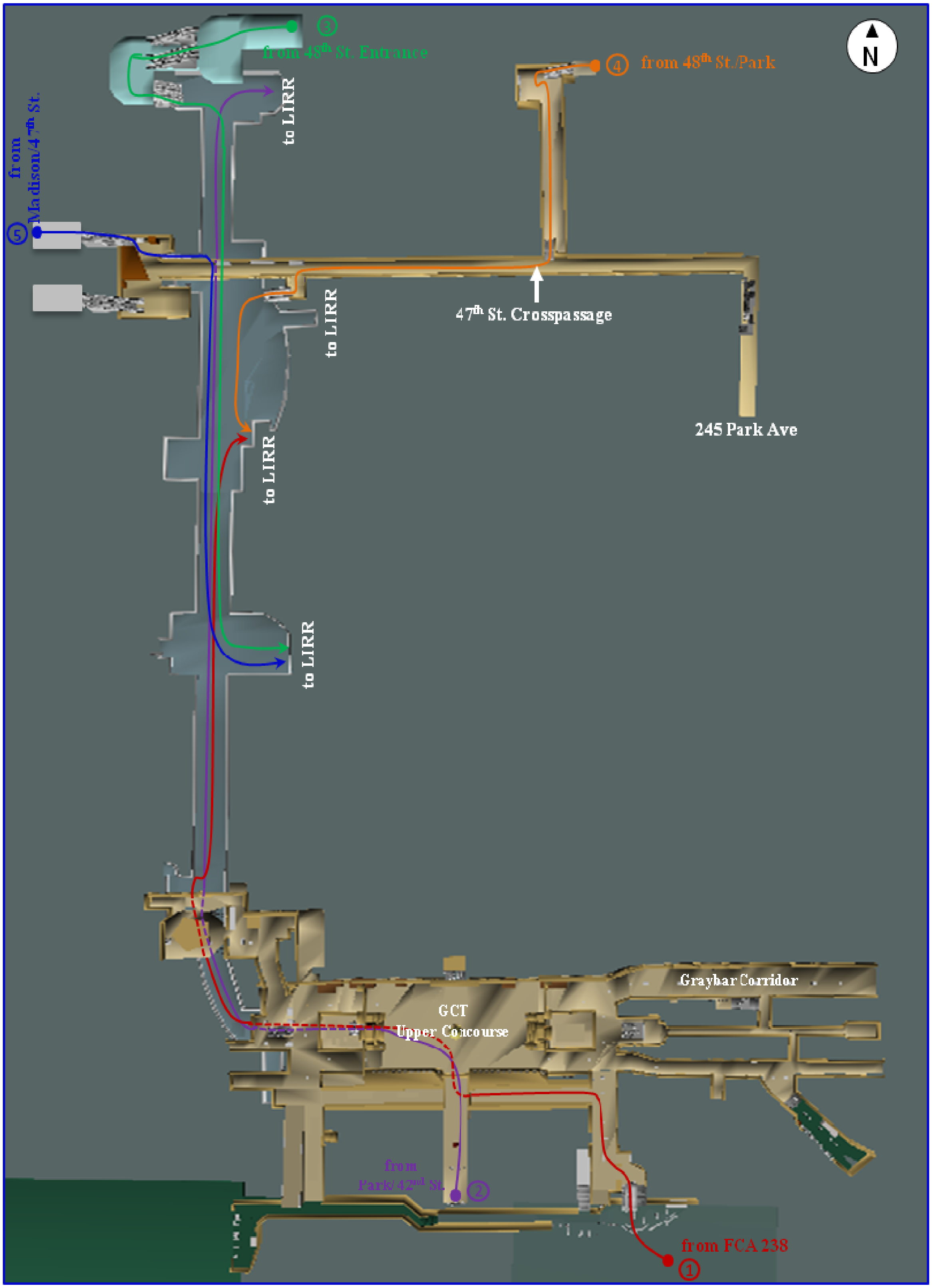
APPENDIX H: Assessment of Journey Time

First, major routes were selected to assess the journey time, as shown in Figure 1. Lines with different colors and numbers represent different routes, including,

1) From Park Avenue/42nd Street to LIRR Concourse LIRR (48th Street)
2) From FCA 238 to LIRR Concourse LIRR (46th Street)
3) From 48th street entrance to LIRR Concourse LIRR (46th Street)
4) From 48th Street/Park Avenue to LIRR Concourse LIRR (45th Street)
5) From Madison Avenue/47th Street to LIRR Concourse LIRR (45th Street)

Then a "sample person" was assigned for each route in the model. The journey time for each person to finish its route was monitored and output while running the simulation. Note that the simulation was run for at least three times to overcome the randomness. Finally, the average of the journey time in each run was calculated for each route. Table 1 summarized the results of the journey time for each selected route.

Figure 1: Selected Routes for Journey Time Assessment (Proposed Design)



Note: The dash line indicates that part of the route is under the displayed scene, such as in Lower Concourse, Oyster Bar, Madison Concourse, etc.

Table 1: Journey Time Results

Routes	1	2	3	4	5
	Park Ave/42nd St. - LIRR (48th St.)	**FCA 238 - LIRR (46th St.)**	**48th St. Entrance - LIRR (46th St.)**	**48th St./Park Ave - LIRR (45th St.)**	**Madison/47th St. - LIRR (46th St.)**
Journey Time	*7:30 min*	*6:45 min*	*4:30 min*	*6:30 min*	*3:05 min*

ADDENDUM TO TECHNICAL MEMO NO.4
37TH STREET VENTILATION PLANT CONSTRUCTION ACTIVITIES

V. PROPOSED MODIFICATIONS TO CONSTRUCTION ACTIVITIES AT 37TH STREET VENTILATION PLENUM

Two construction activities are now proposed to occur in the area of the 37th Street ventilation plenum at Park Avenue that were not anticipated in the earlier analyses conducted for the East Side Access Project. These activities are: the use of the ventilation plenum for construction access to the train tunnels, and blasting in the tunnels near 38th Street to complete the installation of fans there. These new activities would extend the construction period at 37th Street and Park Avenue by about two years.

Description of Proposed Construction Activities

Previously Approved Design

The FEIS design did not include tail tracks south of GCT or its associated ventilation. Technical Memorandum No. 2, prepared in February 2002, analyzed the design modification that added four tail tracks south of GCT and anticipated a ventilation plenum and street-level gratings at a location between East 37th and East 40th Street. Construction activities at 37th Street and Park Avenue were evaluated in Technical Memorandum No. 3: Tail Tracks Ventilation Plenum and Grate, prepared in February 2008. That memorandum evaluated the addition of ventilation gratings in the sidewalk along the west side of Park Avenue just south of East 37th Street (i.e., between East 36th and East 37th Streets).

Technical Memorandum No. 3 described and evaluated construction activities required for the ventilation plenum at 37th Street and Park Avenue. The activities evaluated included removal of street trees, relocation of utilities, and the mining of three ventilation shafts using the raise bore technique on the western sidewalk at Park Avenue between 36th and 37th Streets. An eight-month construction period was anticipated.

Following approval by the FTA of the 37th Street ventilation plenum, construction was undertaken. Construction of the 37th Street plenum and shafts was mostly completed in December 2009. Three shafts are now present, extending from the tunnels up to the sidewalk. The shafts are located at the southwest corner of East 37th Street and Park Avenue, in front of the Union League Club. These shafts will be covered with a sidewalk grate once all activities at the site are complete.

Proposed Tunnel Access from 37th Street

The temporary use of the completed plenums at 37th Street and Park Avenue for tunnel access is proposed to facilitate the overall construction of the East Side Access Project. The proposal includes use of the ventilation shafts for delivery of concrete, delivery of other materials, and access by tunnel construction personnel:

- **Concrete Deliveries:** The southernmost shaft would be used for concrete and shotcrete deliveries. Between 10 and 30 concrete trucks per day (depending on the pour size) would supply concrete to the tunnels via a concrete pump located within the air plenum beneath the sidewalk or in the tunnel, approximately 140 feet below the sidewalk. These deliveries would be made between 8 AM and 7 PM on weekdays, on average about three days per week. A maximum of four concrete mixer trucks would be in the 37th Street vicinity at the same time. Two would be in the west curb lane of Park Avenue to the south of 37th Street—one delivering concrete and one having its concrete chute washed out after completing its delivery. The other two trucks would be in the west curb lane of Park Avenue north of 37th Street, waiting to make their deliveries. Concrete-related deliveries are anticipated to be needed for about 16 months over a 20-month period.

- **Deliveries of Other Construction Materials:** The southernmost shaft would also be used for deliveries of construction materials (formwork, rebar, etc) to support the concrete operations in the tunnels, requiring a mobile crane to be stationed adjacent to the plenum. Materials would be lowered into the tunnels via the crane. Concrete and materials deliveries would be coordinated and would not occur at the same time. Every effort would be made to locate the crane in the parking lane and not on the sidewalk, to minimize noise levels at adjacent properties during its operation. The crane would be on site daily during an initial six- to eight-week mobilization period and, thereafter, two to three times per week for a 22-month period. Deliveries would be made on weekdays between the hours of 8 AM and 7 PM.

- **Personnel Access:** The northern shaft would be use for personnel access for about a 22-month period. Approximately 30 workers per shift, three shifts per day Monday thru Friday, would use this access route into the tunnels. A small guard booth would be located on the sidewalk above the middle plenum and a stairway would be installed leading to the base of the plenum. Workers would walk to the northern shaft where an elevator (also referred to as an Alimak) would be installed for tunnel access. A guard would be at the site during all working hours.

After the 22-month construction access period, the sidewalk grates will be installed and the site will be restored over a two-month period.

During preparation of the FEIS, the EA, and Technical Memorandum No. 3, it was anticipated that concrete would be delivered to the tunnels from three access points: the Northern Boulevard shaft in Queens, and the 50th Street Facility site and the 44th Street Facility site in Manhattan. Due to the delay in the awards of the contracts for both the 44th and 50th Street Facilities, tunnel shafts at these locations have not been constructed and access to the southern end of the tunnels is difficult and time consuming. Furthermore, the Manhattan Tunnels contract was expanded to include construction of the ventilation fan chambers located in the tunnels beneath Park Avenue at about 38th Street. The advancement of this work provides for better ventilation during the ESA construction period. As a result, concrete pours will be needed sooner than anticipated at the southern end of the tunnels. Tunnel access at 37th Street would enable discrete work locations for the different contractor activities that will be occurring simultaneously in the tunnels. Discrete access for different contractor work locations reduces the potential for construction hazards/risks as well as the potential for delay claims.

Proposed Blasting to Complete Excavation of Fan Chambers

To complete the installation of fans in the 37th Street ventilation plenum, controlled drill and blast activities is required. As noted earlier, blasting was not evaluated in Technical Memorandum No. 3 for construction of the 37th Street ventilation plenum.

Approximately 12 months of controlled drill-and-blast activities would occur over a period of 18 months. During that time, on days when blasting would occur, one or two blasts would be discharged between the hours of 9AM to 10 PM on weekdays only. Blasting would be conducted in coordination with the New York City Fire Department (FDNY). Residents of the immediate area would be notified prior to any blasting activities.

Previous Analyses Related to 37th Street Ventilation Plenum

Technical Memorandum No. 3 included analysis of the anticipated construction impacts associated with East Side Access Project activities at the 37th Street ventilation plenum site. The memo concluded that these activities might be disruptive, but given their short duration and limited scope, they would not result in significant adverse impacts at that site.

Technical Memorandum No. 3 identified one historic resource within the Area of Potential Effect (APE) for the 37th Street ventilation plenum: the Union League Club, which is immediately adjacent to the ventilation site. The East Side Access Project's Construction Protection and Advance Field Testing Plan sets forth procedures to protect historic structures from accidental damage during construction. This plan was developed in accordance with the project's Programmatic Agreement, as amended, among the Federal Transit Administration, the New York State Historic Preservation Officer (SHPO), and the Metropolitan Transportation Authority (MTA), with the New York City Landmarks Preservation Commission (LPC) as a consulting party. The Construction Protection and Advance Field Testing Plan was reviewed and approved by SHPO and LPC.[1] Technical Memorandum No. 3 indicated that the procedures set forth in the Construction Protection Plan would be followed to protect the Union League Club from accidental damage during construction of the nearby underground ventilation structure.

[1] Approval from SHPO was in a letter dated November 9, 2007; approval from LPC was in a letter dated October 5, 2007.

Assessment of Effects of the Proposed Changes

For most of the analysis areas considered in the FEIS and Technical Memorandum No. 3, the proposed additional construction activities at the 37th Street site and the corresponding extension of the construction schedule at that site would not change the overall conclusions of the FEIS and Technical Memorandum No. 3. The construction activities proposed at 37th Street and Park Avenue would be temporary (an estimated 2 years) and, during that time, would be sometimes be disruptive to surrounding land uses. Technical Memorandum No. 3 already described the effects of short-term construction activities on the surrounding area, and for most areas these effects would be the same with the longer construction schedule.

The proposed modifications to the construction activities at 37th Street do not require acquisition of property and would not affect or disturb areas outside the initial 37th Street construction zone. Specifically, no significant adverse impacts would occur in the following categories:

- Land Use, Zoning, Socioeconomic Impacts, since the proposed modifications would not cause significant adverse impacts and the construction zone is smaller than the initial one analyzed in Tech Memo No.3;
- Parkland, since no parkland is in the area;
- Archaeology or Hazardous Materials, since no excavation is proposed;
- Utilities, since no additional utilities at 37th Street would be disturbed;
- Natural, Water Resources/Coastal Zone/Waterfront Revitalization, since none exist in the area.

This technical memorandum considers the construction effects for four areas where effects could differ from those previously considered: historic resources, transportation, air quality, and noise.

Historic Built Properties

As noted in Technical Memorandum No. 3, one historic resource, the Union League Club is located within the APE for the proposed construction site. The procedures set forth in the East Side Access Project's Construction Protection and Advance Field Testing Plan would be followed to protect this building from accidental damage during construction activities, including the tunnel access activities and the blasting.

Transportation

With the proposed use of the 37th Street ventilation plenum for tunnel access, concrete deliveries to the site would take place intermittently over a period of 20 months. No deliveries would occur during the New York City Department of Transportation's (NYCDOT) embargo period for street disruptions, which is between Thanksgiving and New Year's Day. During operations, the deliveries would be made between 8 AM and 7 PM for an average of three weekdays per week. Depending on the size of the concrete pour, there could be up to 30 deliveries on a given day.

All activities would take place along the southbound side of Park Avenue. After delivering concrete, the concrete chute of each truck would be washed out at the construction site. At the same time, up to two other trucks would be queued along the west curb north of East 37th Street. No more than four concrete trucks would be present in the vicinity of the construction site at the same time, because of the time constraints for concrete transport. Also, given that there would be no more than 30 deliveries on a given day, there would not be a large number of hourly truck arrivals and departures at the site. According to the *CEQR Technical Manual*, an action that generates more than 50 vehicle trips in a peak hour could warrant a detailed traffic analysis. Since the proposed concrete deliveries would not yield peak hour trips that exceed the CEQR threshold, no further detailed traffic analysis is required and the operations are not expected to result in any significant adverse traffic impacts.

With regard to the maintenance and protection of traffic, permit approvals would be obtained from NYCDOT to ensure that all requirements are met, including the protection of pedestrian flow. All operations would be limited to the site on the west sidewalk between 36th and 38th Streets and along the associated curb lane of southbound Park Avenue. Unlike the previous construction activities at the site, for the proposed tunnel access activities, pedestrian access on the sidewalk would be maintained, with a minimum of a 5-foot-wide sidewalk maintained alongside the 37th Street ventilation plenum shafts. Concrete delivery trucks would use the curb lane (i.e., parking lane), and no moving traffic lanes would be closed.

Prior to commencement of construction of the ventilation plenum at 37th Street, a bus stop for the southbound M1 bus was located at the construction site. As described in Technical Memorandum No. 3 (February 2008), the bus stop was temporarily relocated to accommodate the East Side Access construction activities for the 37th Street ventilation plenum. To use this site for tunnel access, the period of bus stop relocation would be extended for the additional construction period. Temporary bus stop relocation is typical in New York City during utility work, roadway repairs, and other construction efforts. North of East 37th Street, prior to the beginning of East Side Access construction activities on the block to the south, the curb lane on southbound Park Avenue approaching East 37th Street is used for daytime deliveries and nighttime parking, which would be displaced for the construction activities. An estimated four to five parking spaces would be displaced.

As was done for the previous construction at East 37th Street, all travel lanes would be maintained on Park Avenue. In addition, unlike the previous work conducted for the ventilation plenum construction, the concrete deliveries would not require staging on the north side of East 37th Street between Park and Madison Avenues. The north curb lane, which has weekday daytime No Standing regulations, would be available for moving traffic, thereby creating a more favorable condition than experienced during the prior construction activities on this Thru-Street. Finally, in accordance with NYCDOT stipulations made as part of the permit approval process, MTA will engage NYPD to provide traffic agents to manage traffic flow during concrete deliveries and other construction activities at the site.

Air Quality

The equipment used at the 37th Street construction site for tunnel access would generate pollutant emissions in the immediate area around the construction site, however, the proposed construction activities are not expected to result in any significant adverse air quality impacts. At the construction site, these emissions would be very low when compared to emissions for typical New York City construction projects, which involve other types of activities that generate air emissions in addition to concrete pours, such as demolition, excavation, soil dumping, grading, foundation and structural tasks, and erecting building facades.

The primary pollutant of concern for the proposed construction activities is particulate matter (PM) specifically, fine particles with an aerodynamic diameter of less than or equal to 10 micrometers (PM_{10}) and fine particles with an aerodynamic diameter of less than or equal to 2.5 micrometers ($PM_{2.5}$). New York City (and much of the surrounding metropolitan area) is classified as non-attainment for the $PM_{2.5}$ National Ambient Air Quality Standard (NAAQS) of 35 $\mu g/m^3$ on a 24-hour average basis and 15 $\mu g/m^3$ on an annual average basis. For PM10, current ambient levels monitored in New York City are well below the current standard of 150 micrograms per cubic meter ($\mu g/m^3$) which is based on a 24-hour average.

New York City's $PM_{2.5}$ guidance requires a quantified analysis to determine the maximum increases in concentrations if the number of heavy-duty trucks is projected to be greater than 19 during any one hour. The proposed project would generate approximately 10 to 30 concrete truck deliveries over an 11-hour operating day, resulting in a maximum average of three per hour, or, at most four per hour, well below the City threshold. Consequently, no analysis of traffic-related $PM_{2.5}$ impacts is required.

The crane and concrete pump to be used for the proposed construction activities would incorporate the latest air emissions reduction technology, including diesel particulate filters (DPFs) for the control of PM emissions. In general, DPFs reduce $PM_{2.5}$ emissions by 90 percent or greater, and are considered Best Available Technology (BAT). Additionally, all construction equipment and trucks would use Ultra Low Sulfur Diesel Fuel, as required by law.

Emissions and impacts of $PM_{2.5}$ from construction-related activities (engine emissions from truck queuing and concrete pumping, and fugitive emission from truck cleanout) would be extremely low when factoring in the level of construction activities over a longer term (annual) basis.

Similarly, emissions of PM_{10} from the proposed construction activities are not expected to result in any exceedance of the NAAQS. The levels of PM_{10} produced by these activities would be well below the NAAQS and background concentrations, based on the maximum number of concrete trucks operating during a 24- hour period and the duration of concrete pumping activities.

Noise

A screening assessment for construction noise was performed in accordance FTA's guidance document, *Transit Noise and Vibration Impact Assessment*, May 2006 to determine whether a more detailed noise assessment would be required.

The FTA screening methodology specifies guideline values, shown in Table 1, to be used for evaluating the potential for construction noise impacts. When the General Assessment indicates that construction noise levels (based on an evaluation of the two noisiest pieces of equipment operating simultaneously) would be lower than the values shown in the table, no detailed analysis is warranted.

Table 1
FTA Construction Noise Criteria: General Assessment

Land Use	$L_{eq(1)}$ (dBA)	
	Day	Night
Residential	90	80
Commercial	100	100
Industrial	100	100

For the tunnel access construction activities, the noisiest pieces of equipment are the concrete mixer trucks and the mobile crane. Based on the proposed construction phasing, the mobile crane would not be operated at the same time as the concrete mixer trucks. It is assumed that the contractor would use concrete mixer trucks that each generate an L_{max} of 79 dBA or less at a distance of 50 feet, and a mobile crane that generates an L_{max} of 79 dBA or less at 50 feet. The only other piece of construction equipment at the construction site would be located below grade in the tunnel and therefore would be shielded from the adjacent residential buildings.

As shown in Table 2, in all cases the analysis results are below the FTA guideline levels. Accordingly, the proposed construction activities would not result in any significant adverse noise impacts, and no further analysis is required.

Table 2
General Assesment Analysis Results

Case	$L_{eq(1)}$ (dBA)
1: Impact of two concrete mixer trucks at 50 Park Avenue	87 dBA
2: Impact of two concrete mixer trucks at Union League Club	83 dBA
3: Impact of mobile crane at Union League Club	81 dBA
4: Impact of mobile crane at 40 Park Avenue	89
5: Impact of two concrete mixer trucks at 40 Park Avenue	87

Controlled blasting activities that are proposed at the 37th Street site would also result in additional noise and vibration, it would occur intermittently and over very short periods of time, i.e., 4-5 seconds once or twice within a 24-hour period. The blasting would adhere to the requirements of the East Side Access Project's noise and vibration control specifications, and all efforts would be made to notify nearby building occupants in advance. Based on the implementation of these measures, the proposed blasting activities would not result in any significant adverse noise or vibration impacts.

Public Outreach

MTA has been conducting ongoing public outreach related to the East Side Access Project, including specific outreach meetings with representatives of the neighborhood surrounding the project site for the ventilation shaft, plenum, and grates at East 37^{th} Street and Park Avenue. The outreach related to the 37^{th} Street ventilation plenum began in 2006, prior to selection of the final location of the ventilation plenum and sidewalk grates, and continued into 2008 and 2009 as Technical Memorandum No. 3 was prepared and the final location was approved by FTA and incorporated into the East Side Access Project.

Since then, outreach has continued as construction has been under way at 37^{th} Street. More recently, public outreach has included specific discussions of the proposed construction activities at 37^{th} Street and Park Avenue, including a presentation to Community Board 6 in December 2009. Table 3 lists the various outreach activities conducted related to the 37^{th} Street ventilation plenum and other East Side Access construction activities at this site.

Table 3
Public Outreach Related to East Side Access Project Activities at 37^{th} Street and Park Avenue

Date of meeting	Individuals/Groups Present
Presentation of prior locations for ventilation plenum	
Sept 7^{th} 2006	Community Board 6 - Transportation Committee
October 10^{th} 2006	CB6 Transportation Committee, Murray Hill Board of Trustees, Kitano Hotel representatives, American-Scandinavian House representatives
Presentation of current sidewalk configuration	
August 15^{th} 2007	Union League Club
October 1^{st} 2007	CB6 – Transportation Committee
February 2008	Union League Club
May 15^{th} 2008	El Salvadorian Mission and Consulate
June 2^{nd} 2008	Union League Club
August 20^{th} 2008	Kitano Hotel
August 26^{th} 2008	American-Scandinavian House
September 10^{th} 2008	CB6 – Full Board
September 18^{th} 2008	Rudin Management – 40 Park Avenue
September 2008	50 Park Avenue
October 9^{th} 2008	Kitano Hotel

October 20th 2008	Union League Club
December 12th 2008	CB6, local elected officials representatives, property representatives
December 23rd 2008	Rudin Management – 40 Park Avenue
January 9th 2009	El Salvadorian Mission and Consulate
March 27th 2009	CB6 – Full Board
Current proposal for construction activities	
October 20th 2009	CB6 – District Manager and small number of representatives
October 30th 2009	50 Park Avenue
November 11th 2009	CB6 – District Manager and small number of representatives
December 9th 2009	CB6 – Full Board
December 14th 2009	CB6 District Manager and small number of representatives, NYCDDC

Since construction began, there have been many informal meetings with property representatives that have occurred as East Side Access Project representatives stopped at nearby buildings to discuss upcoming work or address concerns. Numerous e-mails have been distributed to provide updates and notifications. A community update that provides a description of construction work under way and what to expect related to construction impacts is distributed approximately every three months.

The current proposal for additional construction activities at the 37th Street site related to tunnel access was first raised at a meeting with District Manager of Community Board 6 and small number of district representatives on October 20th 2009. The Community Board was advised that 44th Street Vent Facility was not a viable an option for concrete drop activity because that contract was awarded behind schedule.

Concerns that were raised included the following:

- Construction noise and dust
- Expanding construction footprint
- Construction activities continuing outside of work hours
- Insufficient information provided on construction progress
- Project time-line extended.

Several meetings followed where other alternatives to the 37th Street location were reviewed. On December 14th 2009, East Side Access Project representatives presented the current proposal to use the southbound curb lane on Park Avenue north and south of 37th Street. Other alternatives that were also reviewed were:

- Pershing Square (near East 42nd Street), which was deemed technically infeasible, because New York City Transit facilities and a number of major utilities are located close to the surface below street level.
- 38th Street, which was suggested by the Community Board to avoid impacts to 37th Street while another street construction project is under way. The Community Board determined that the 38th Street option was not necessary, since the other construction project would not have the impact originally anticipated.

U.S. Department
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**Federal Transit
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March 3, 2010

Christopher Boylan
Deputy Executive Director, Corporate and Community Affairs
Metropolitan Transportation Authority
347 Madison Avenue
New York, NY 10017-3739

Dear ~~Mr.~~ Chris Boylan:

FTA has reviewed the Metropolitan Transportation Authority's (MTA) "MTA LIRR East Side Access Technical Memorandum Assessing Design Changes: LIRR Concourse and Street Entrances" (referred to as Technical Memorandum No. 4), dated July 30, 2009. MTA also submitted the following documents as part of the environmental record in order to support FTA's review and decision on Technical Memorandum No. 4:

- August 28, 2009, October 22, 2009, and February 19, 2010 emails from MTA to FTA.
- December 2009 Categorical Exclusion Documentation for "Grand Central Terminal Recycling and Waste Management Facility".
- November 2009 "Pedestrian Simulation of East Side Access and Grand Central Terminal".
- January 11, 2010 "Addendum to Technical Memorandum No. 4 – 37th Street Ventilation Plant Construction Activities".

This documentation was submitted to FTA pursuant to CFR 450.771.130(c) to determine if any new significant environmental impacts would result from the proposed design changes since the East Side Access (ESA) Final Environmental Impact Statement (FEIS) and Record of Decision (ROD).

Based on FTA's analysis of Technical Memorandum No. 4 and supporting documentation, FTA finds that the refinements, as described in the above documentation, would not result in any significant environmental impacts that were not evaluated in the FEIS or ROD.

In addition, the MTA LIRR, NYSHPO, and the FTA are executing an Amendment to the 2006 East Side Access Amended Programmatic Agreement in order to ensure that if any resource is discovered when Areas of Potential Effects are modified, an amendment to the Amended PA will not be necessary. Attached for your file is one, original executed copy of the Amendment to the ESA Amended Programmatic Agreement.

If you have any question regarding this, please call me at 212-668-2170.

Sincerely,

Brigid

Brigid Hynes-Cherin
Regional Administrator

Cc: A. Heffernan, MTACC
S. Rios, MTA