# SUNNYSIDE YARD
## FEASIBILITY STUDY: APPENDIX

**February 06, 2017**

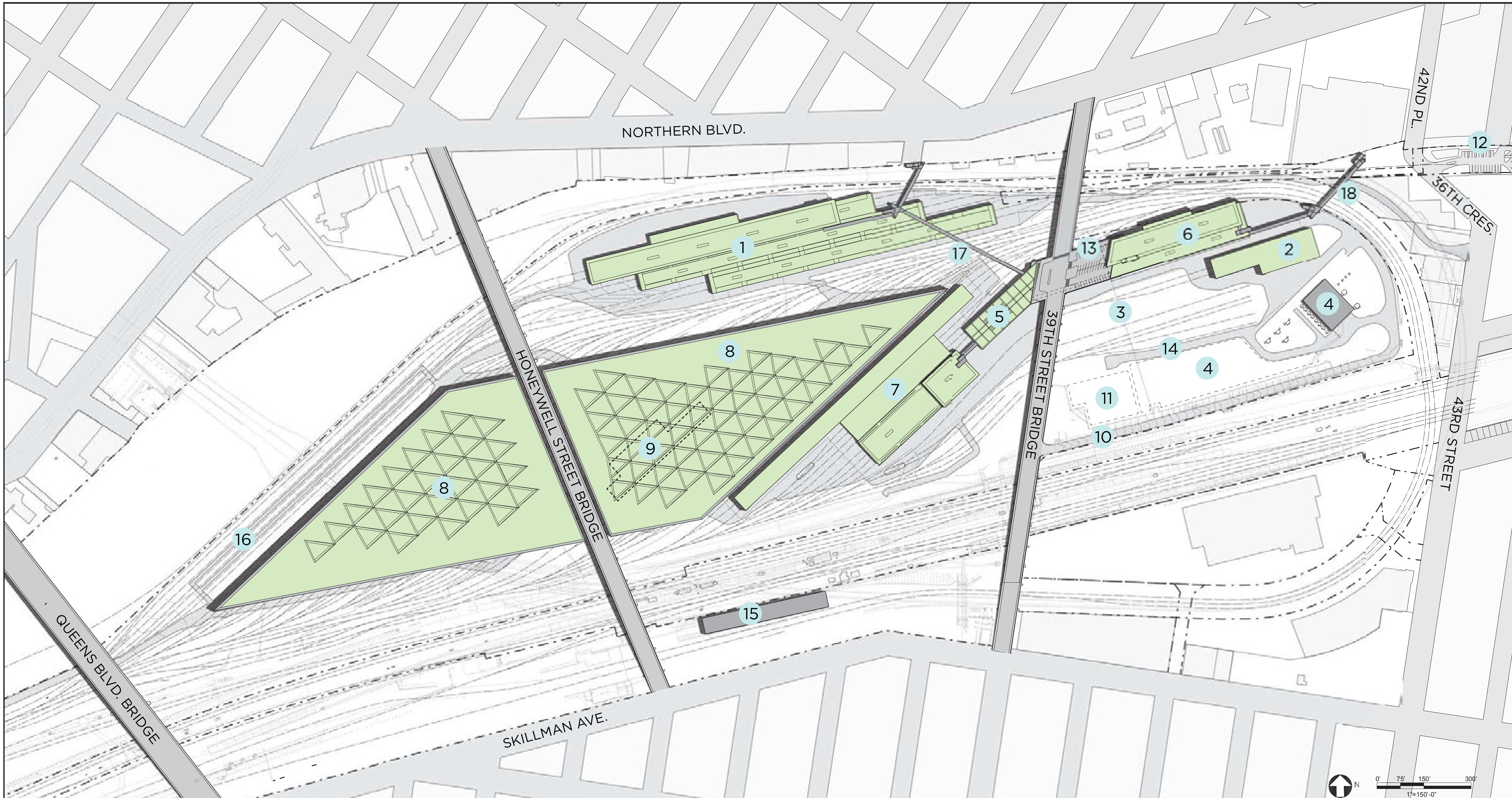
NYCEDC

City of New York

# Appendix

## Appendix

# Appendix A.
# Engineering Drawings




1 SITE PLAN FULL BUILDOUT

1 HSR S&I BUILDING
2 ENGINEERING / MOW / PRODUCTION SHOP
3 MOW YARD
4 SUBSTATION & IMPROVEMENT AREA
5 FOCUS BUILDING
6 COMMISSARY & MATERIALS MANAGEMENT BUILDING
7 CONVENTIONAL MECHANICAL SHOP
8 TRAIN SHED
9 WHEEL TRUE / DROP TABLE BUILDING
10 SECURITY CHECKPOINT
11 ENGINEERING STORAGE AREA
12 AMITYVILLE EMPLOYEE PARKING
13 VISITOR PARKING
14 PRIVATE CAR TRACK
15 TRAIN WASH (BY OTHERS)
16 READY TRACKS
17 ELEVATED CONCOURSE SYSTEM
18 AMITYVILLE BRIDGE
PROPOSED
EXISTING

15% CONCEPTUAL DESIGN
NOT FOR CONSTRUCTION

| No. | Revisions | Date | By |
|---|---|---|---|

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STRUCTURES

| Approved | Date |
|---|---|

In Joint Venture
Gannett Fleming STV
in association with
WSP Parsons Brinckerhoff FXFOWLE sowinskisullivan architects

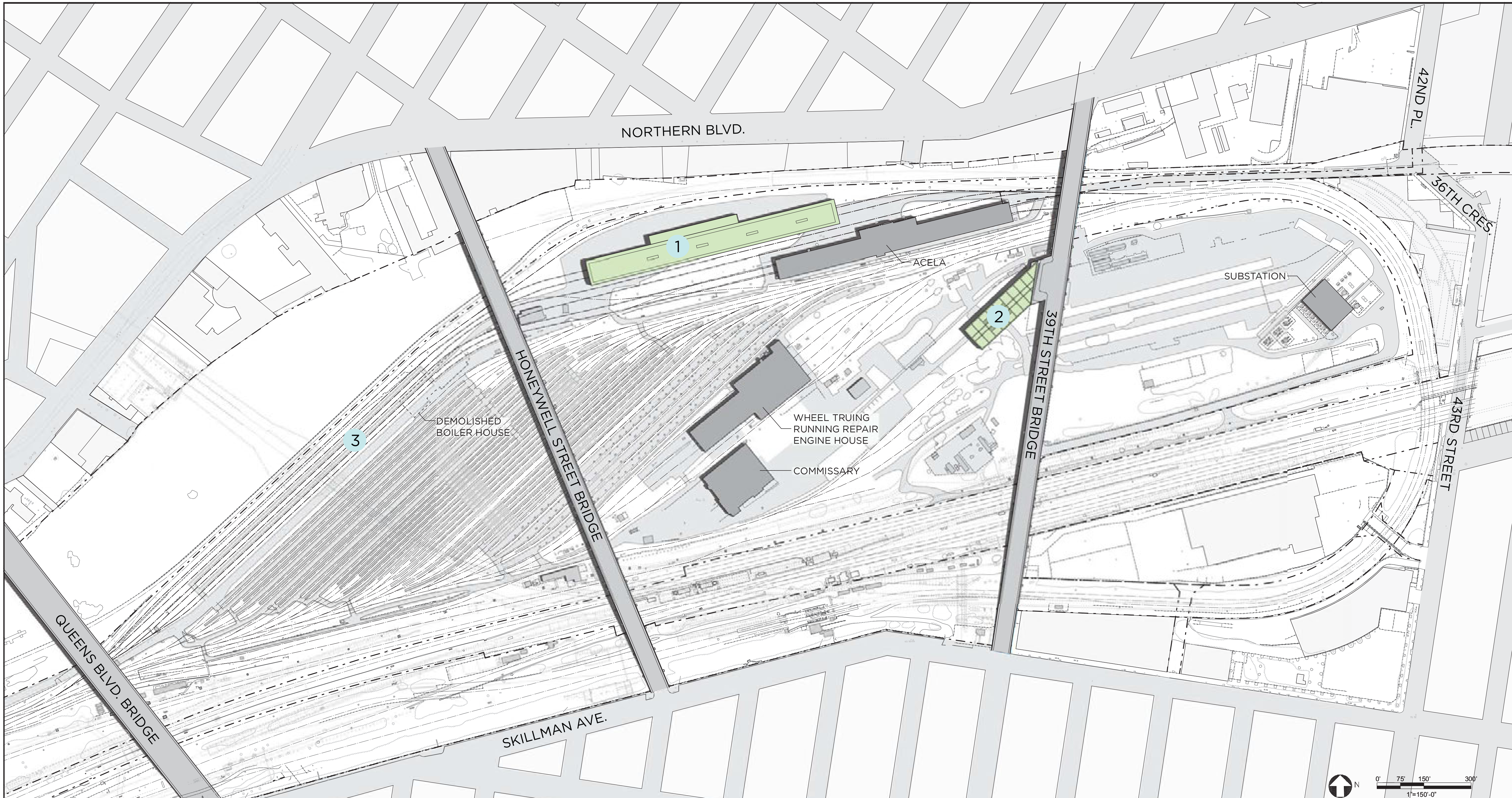
LONG ISLAND CITY NEW YORK
SUNNYSIDE YARD EXPANSION PHASE 1
FULL BUILDOUT

SITE PLAN FULL BUILDOUT

Designed DW | Drawn DL | Checked JT | Date 03/18/16

Project Code:
WBS:
Sheet No. OF
Dwg. No. A1-004

**Figure B1 - Amtrak Yard Expansion - 15% Design - Full Buildout**




1 SITE PLAN PHASE 1

1 HSR S&I PHASE A BUILDING
2 FOCUS BUILDING
3 READY TRACKS
PROPOSED
EXISTING

15% CONCEPTUAL DESIGN
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| No. | Revisions | Date | By |
|---|---|---|---|
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LONG ISLAND CITY NEW YORK
SUNNYSIDE YARD EXPANSION PHASE 1
FULL BUILDOUT

SITE PLAN PHASE 1

Designed DW | Drawn DL | Checked JT | Date 3/18/16

Project Code:
WBS:
Sheet No. OF
Dwg. No. A1-005

Figure B2 - Amtrak Yard Expansion - 15% Design - Phase 1

15% CONCEPTUAL DESIGN
NOT FOR CONSTRUCTION

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| | | | |

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LONG ISLAND CITY NEW YORK
SUNNYSIDE YARD EXPANSION PHASE 1
FULL BUILDOUT

FULL BUILDOUT VIEW TO SOUTHWEST

| Designed | DW | Drawn | JDM | Checked | JT | Date | 03/18/16 |
|---|---|---|---|---|---|---|---|

Project Code:
WBS:
Sheet No. OF
Dwg. No. A1-001

**Figure B3 - Amtrak Yard Expansion - 15% Design - Rendering Looking SW**

15% CONCEPTUAL DESIGN
NOT FOR CONSTRUCTION

| No. | Revisions | Date | By |
| --- | --- | --- | --- |

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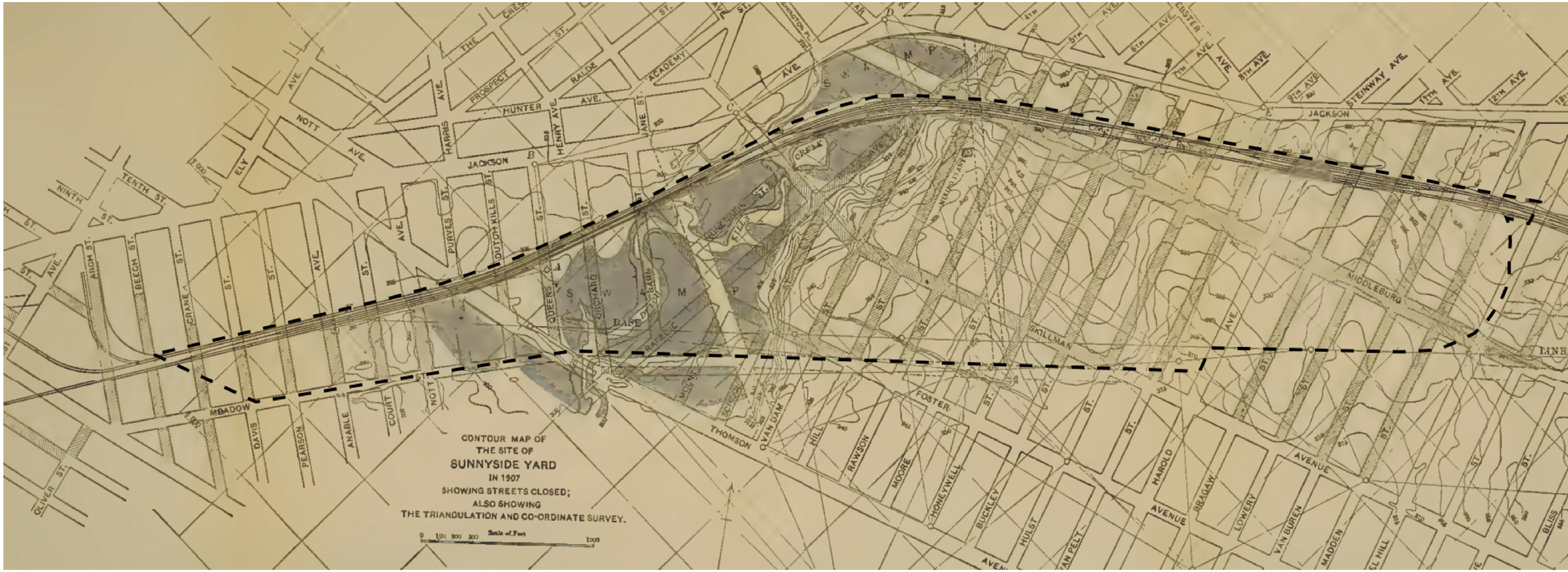
LONG ISLAND CITY NEW YORK
SUNNYSIDE YARD EXPANSION PHASE 1
FULL BUILDOUT

FULL BUILDOUT VIEW TO NORTHEAST

| Designed | DW | Drawn | JDM | Checked | AR | Date | 03/18/16 |
| --- | --- | --- | --- | --- | --- | --- | --- |

| | |
| --- | --- |
| Project Code: | |
| WBS: | |
| Sheet No. | OF |
| Dwg. No. | A1-003 |

**Figure B4 - Amtrak Yard Expansion - 15% Design - Rendering Looking NE**




Note:
Map obtained from Barker, L.H., "The New York Tunnel Extension of the Pennsylvania Railroad, The Sunnyside Yard", Transactions of the ASCE, Vol. LXIX, October, 1910.

**Figure B5 - Ground Contours Prior to the Existence of Sunnyside Yard**

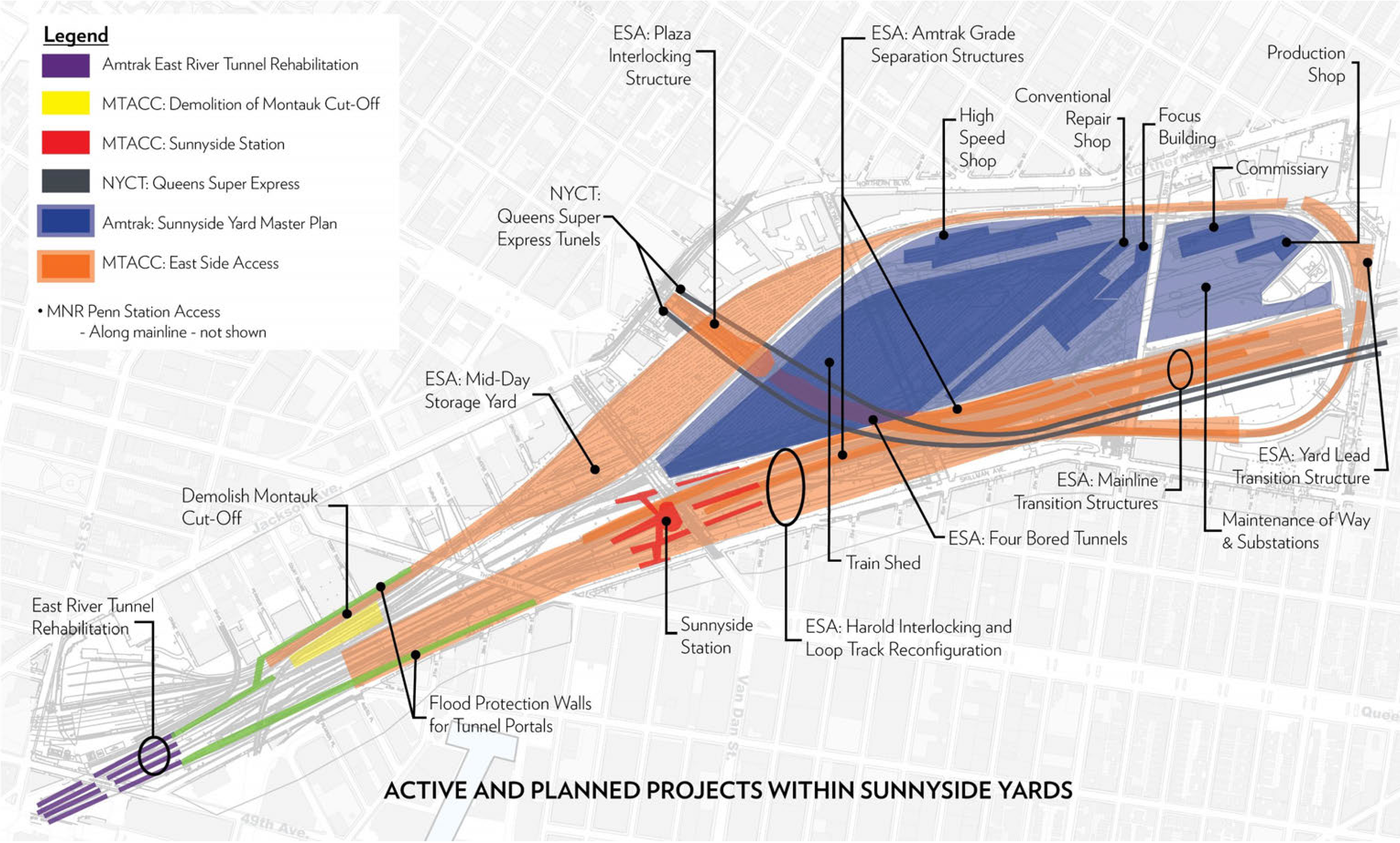



**Figure B6 - Active and Planned Projects Within Sunnyside Yard**

PARSONS BRINCKERHOFF HR&A FXFOWLE

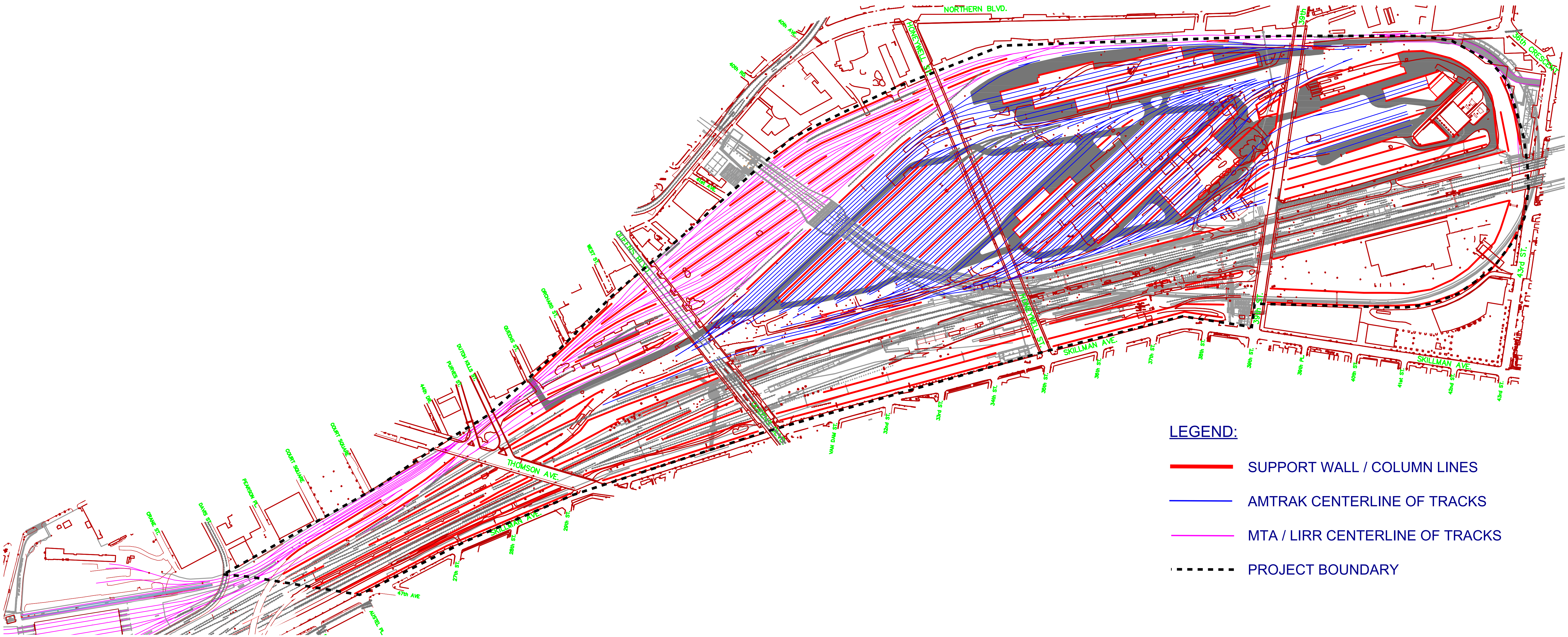
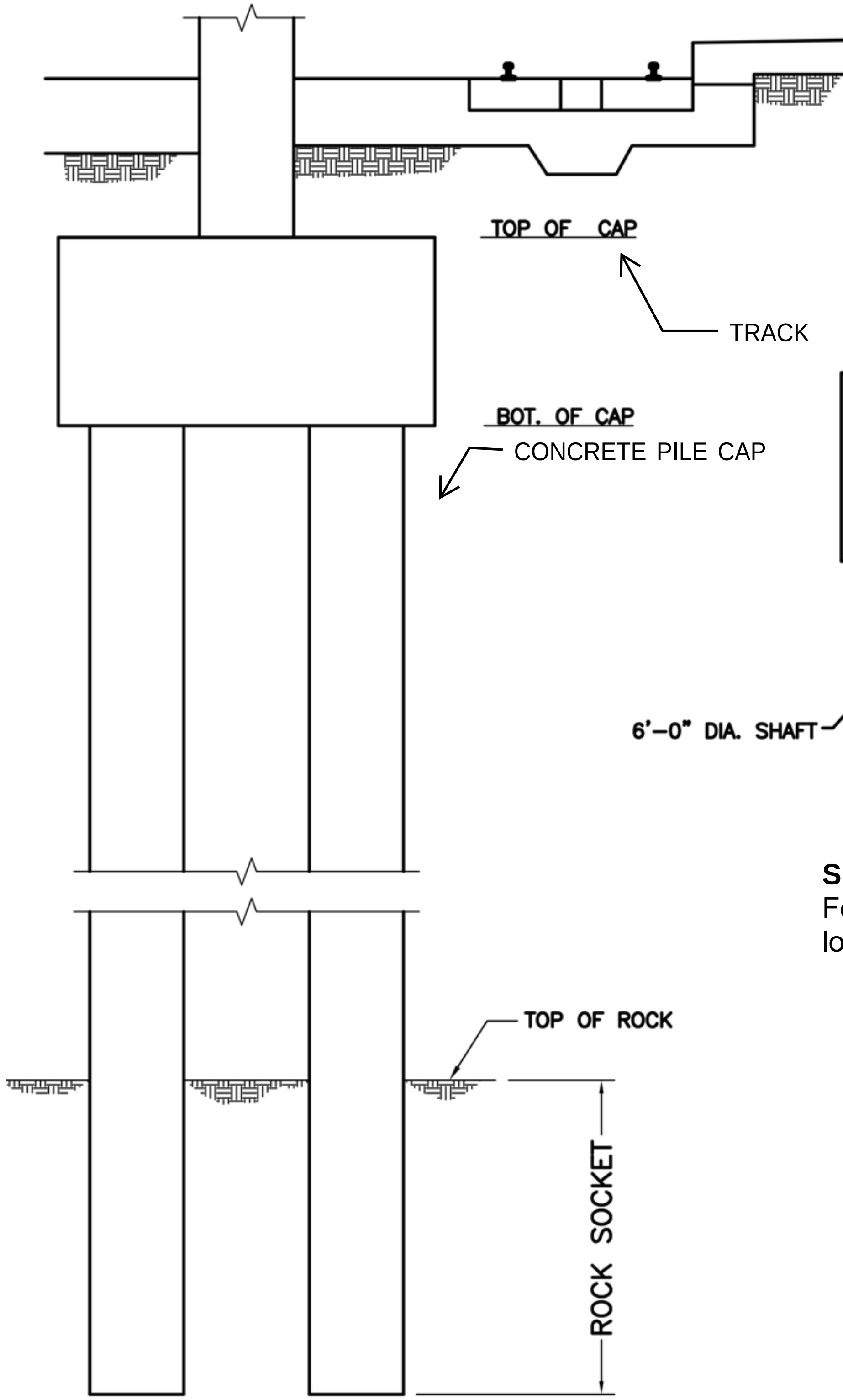
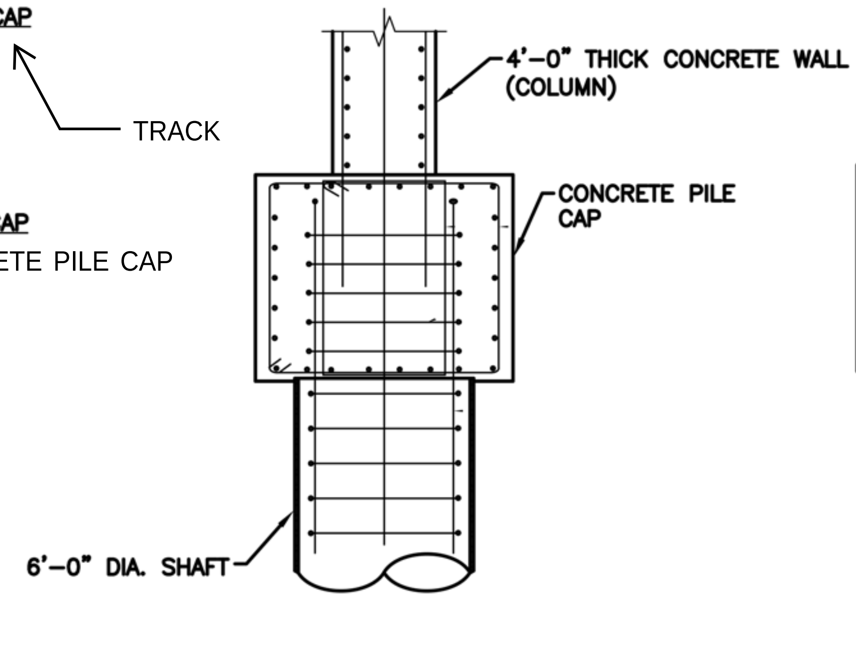
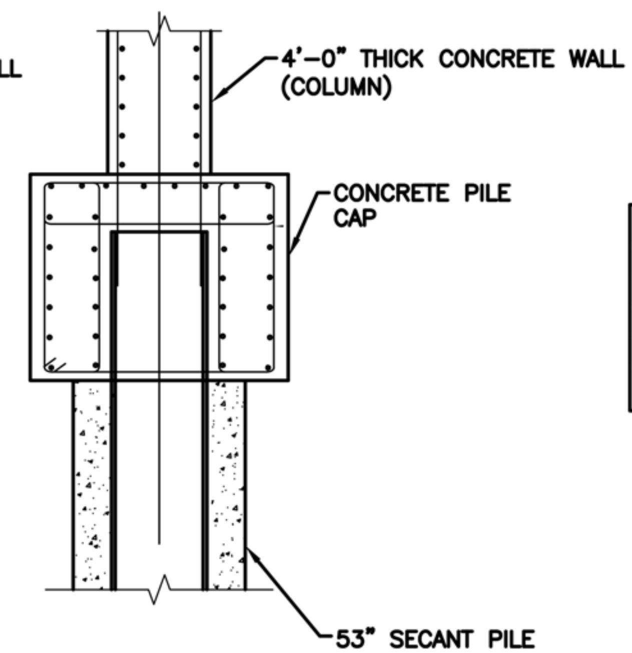



**Figure B7 - Potential Support Wall / Column Lines**

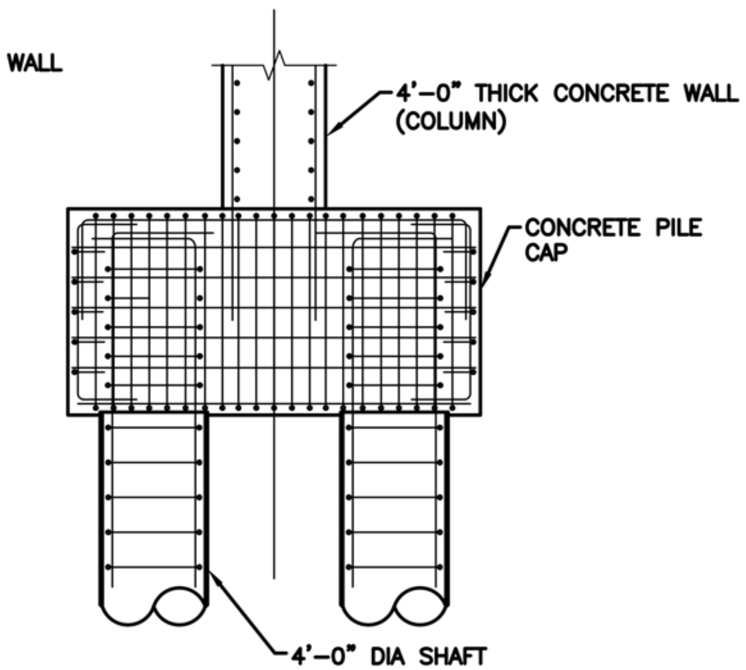


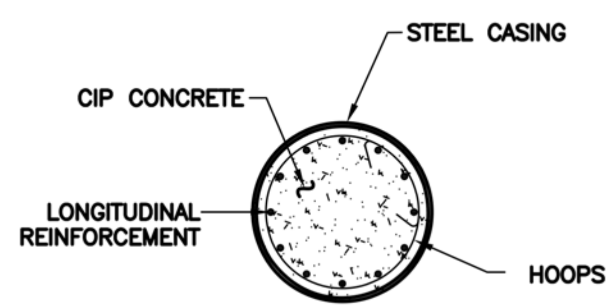

**Single Drilled Shaft**
For shorter spans and lo-rise overbuild



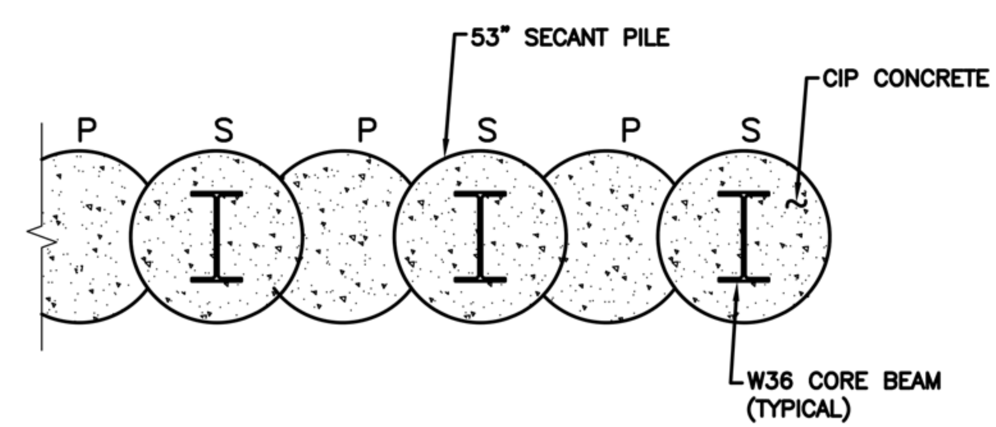

**Secant Pile Wall**
For moderate spans and mid-rise overbuild adjacent to active tracks




**Double Drilled Shaft**
For longer spans and mid-rise to hi-rise overbuild away from active tracks




**Single Drilled Shaft**




**Secant Pile Wall**

## Figure B8 - Foundation Types

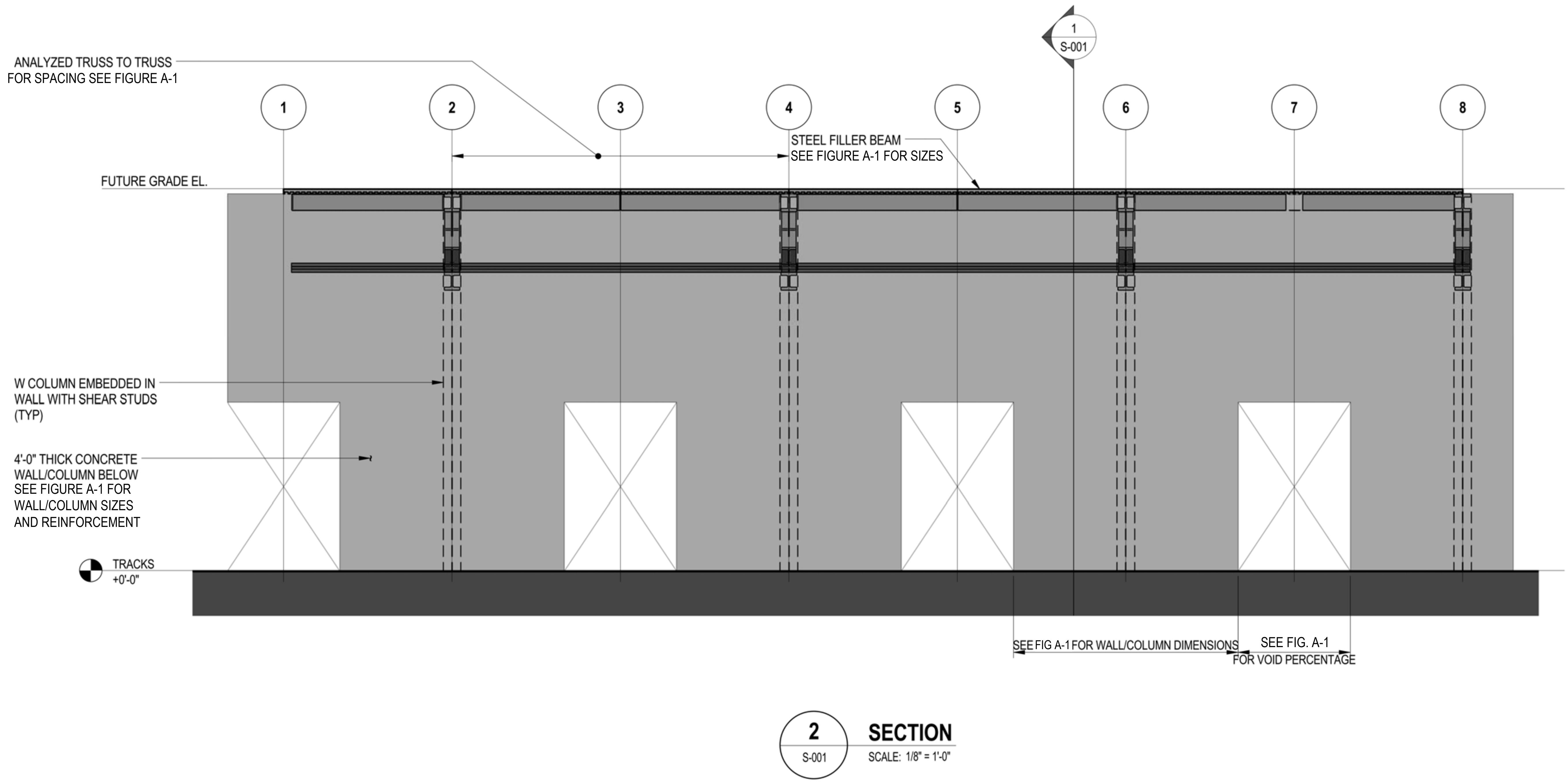
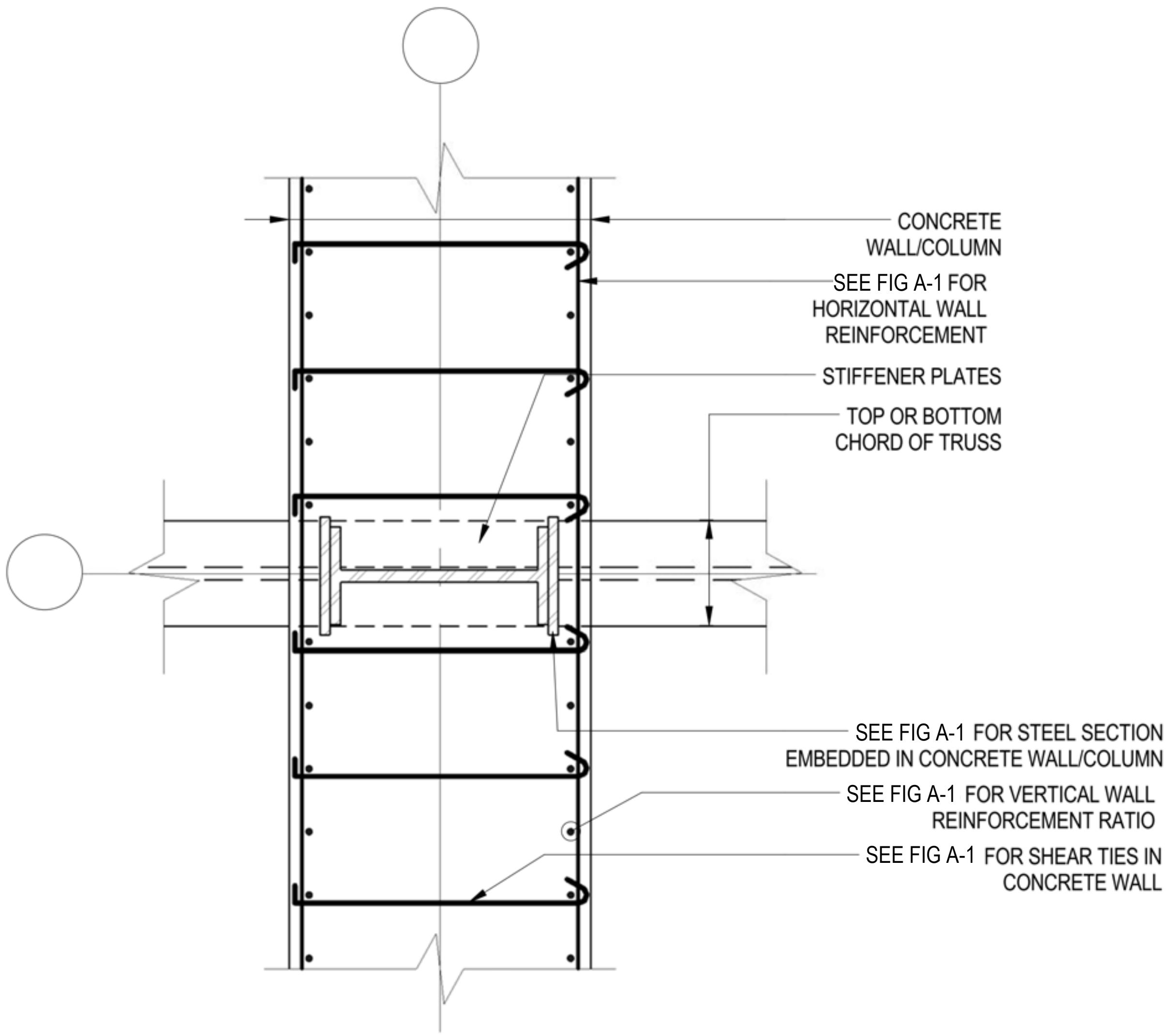
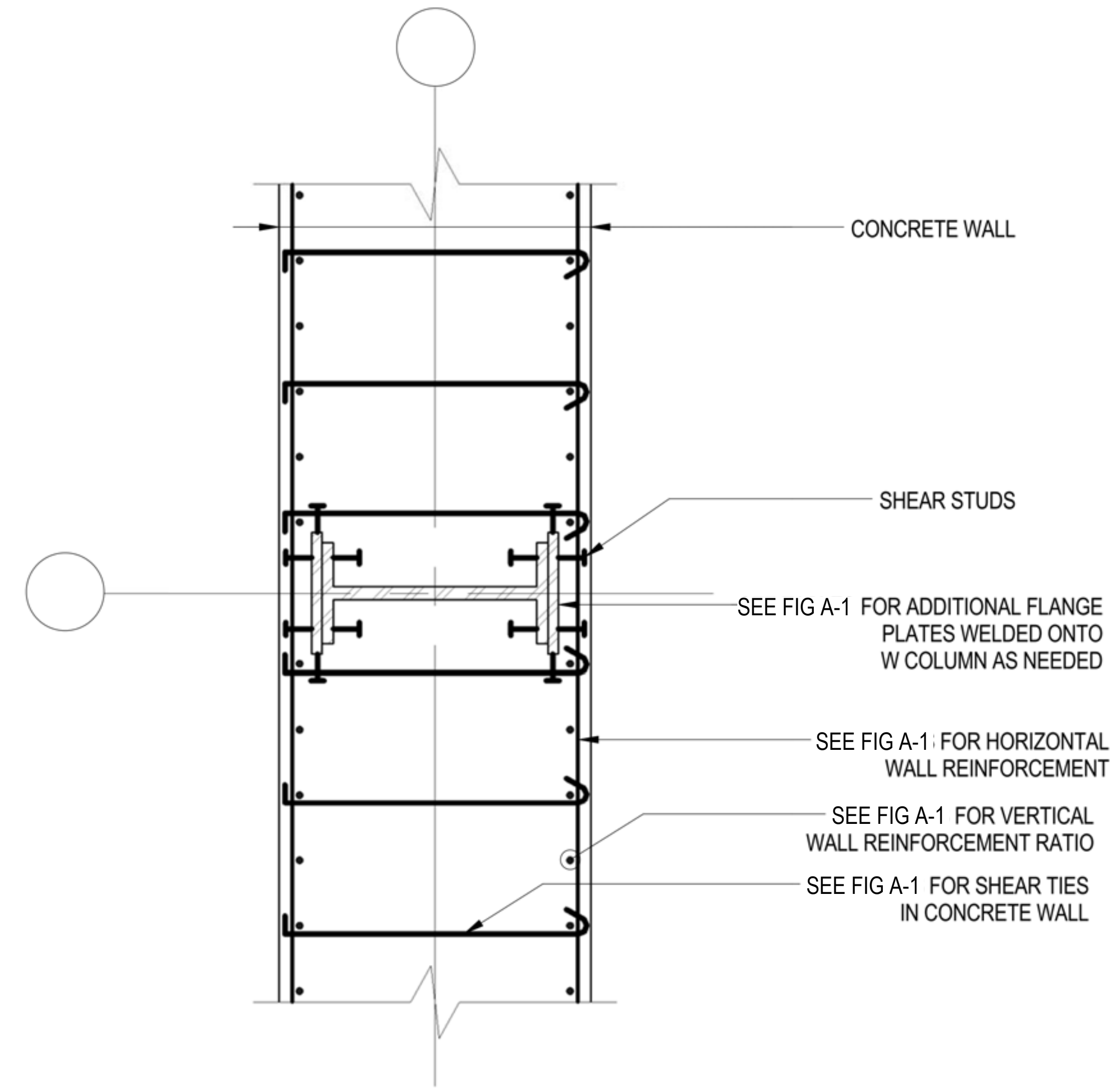



**Figure B9 - Concrete Support Wall Elevation**




3
S-001
**PLAN DETAIL AT WALL BY TOP CHORD**
SCALE: 1/2" = 1'-0"

NOTE:
1. SEE FIG A-1 FOR SIZE OF WALL, QUANTITY OF REINF. & W COLUMN DETAILS




4
S-001
**PLAN DETAIL AT WALL BETWEEN TOP & BOTTOM CHORD**
SCALE: 1/2" = 1'-0"

NOTE:
1. SEE FIG A-1 FOR SIZE OF WALL, QUANTITY OF REINF. & W COLUMN DETAILS

**Figure B10 - Concrete Support Wall Details**

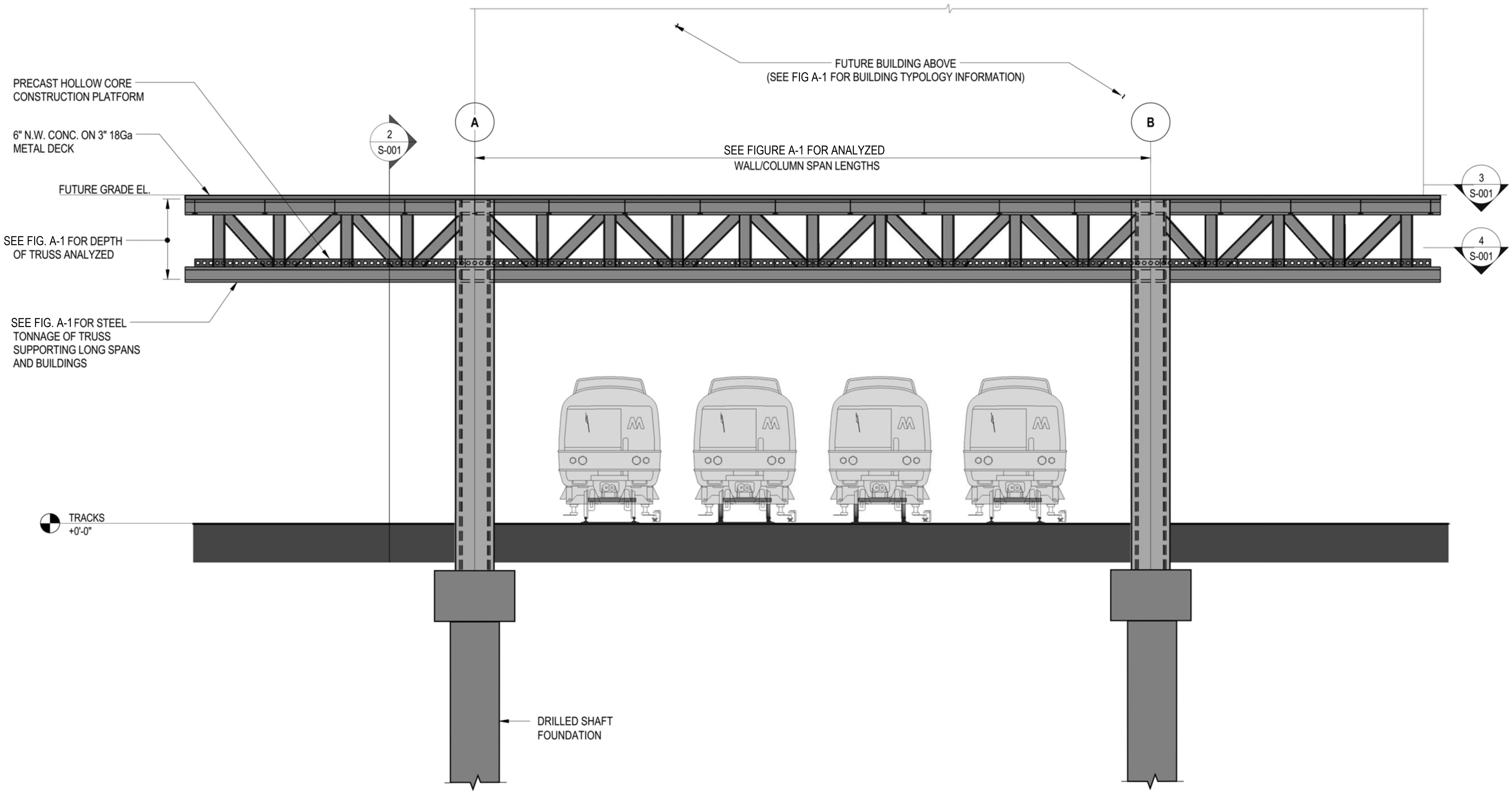



**Figure B11 - Structural Steel Deck Truss - Section**

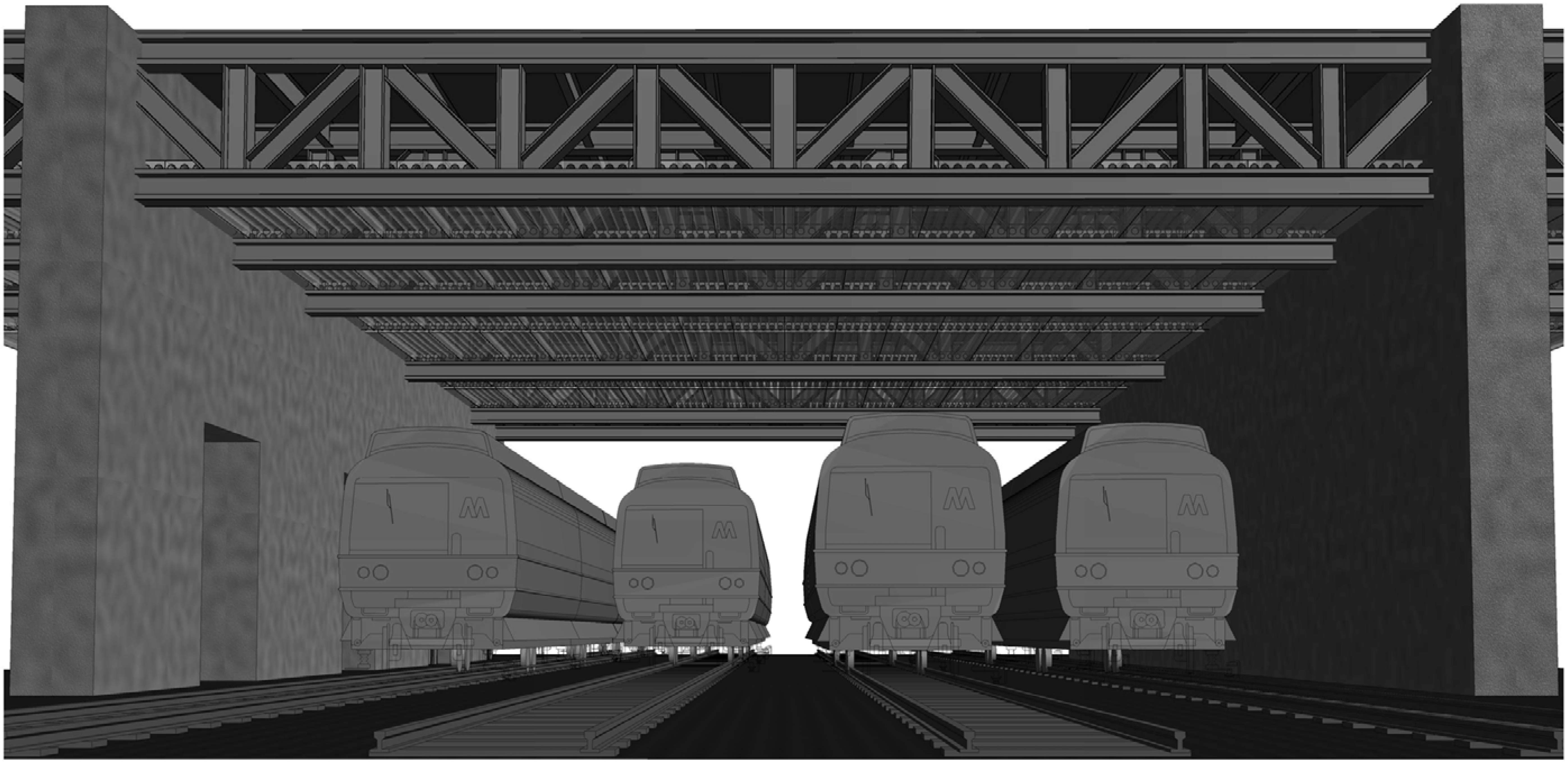


Figure B12 - Structural Steel Deck Truss and Support Walls - Rendering 1 of 2

**Figure B13 - Structural Steel Deck Truss and Support Walls - Rendering 2 of 2**

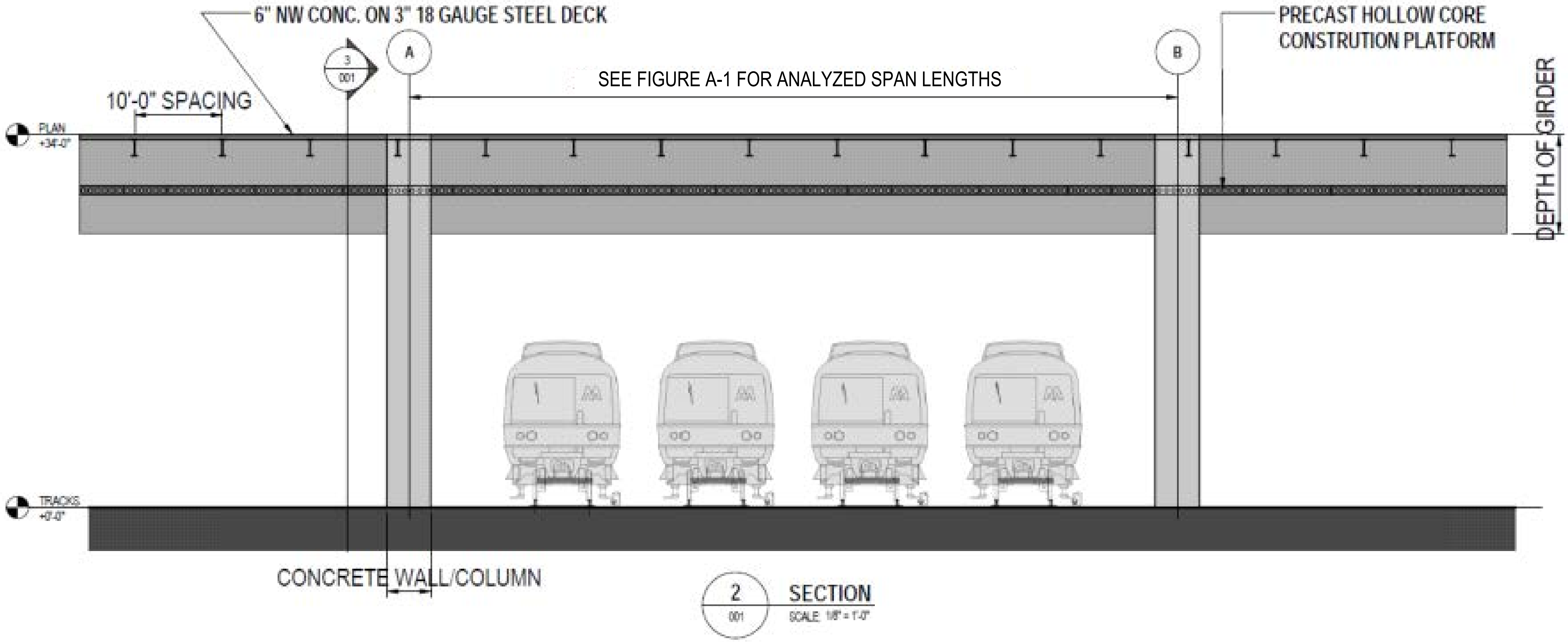



**Figure B14 - Precast Concrete Deck Beam (Alternative to Steel Truss)**

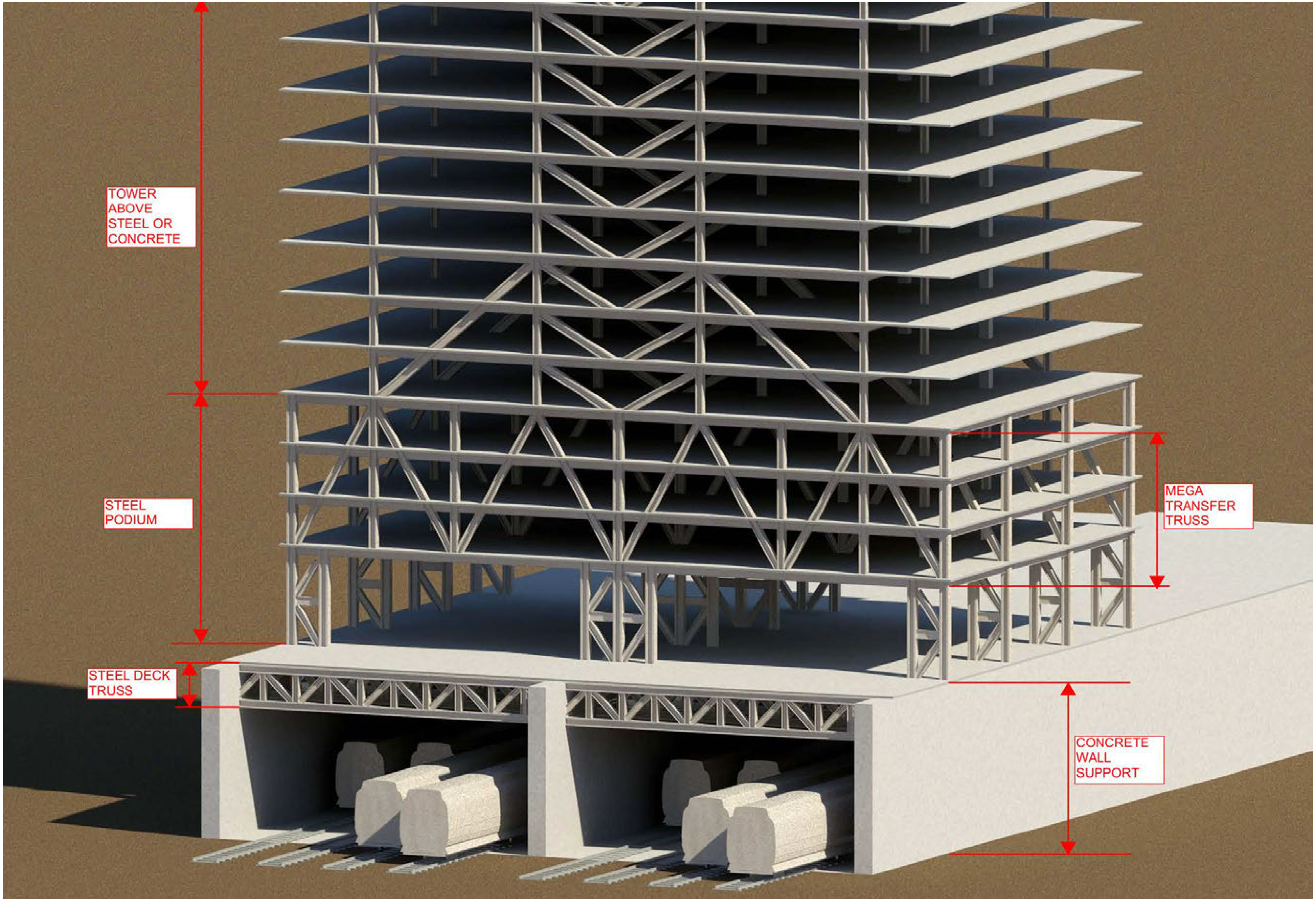



**Figure B15 - Structural System - Rendering**

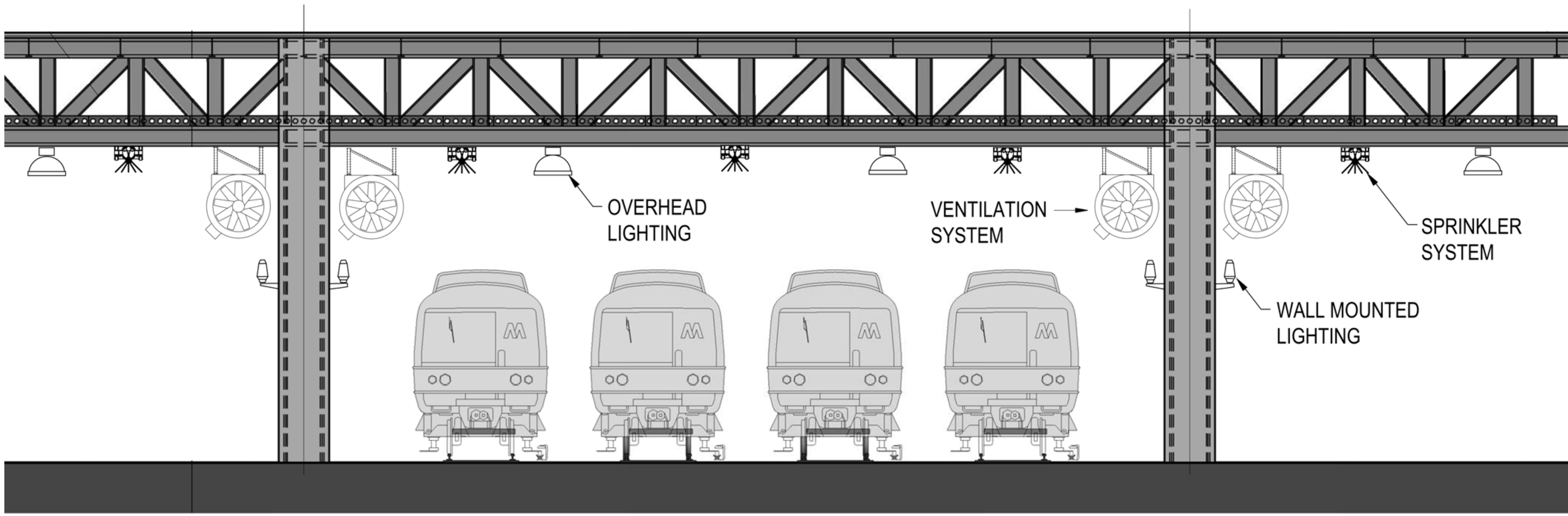
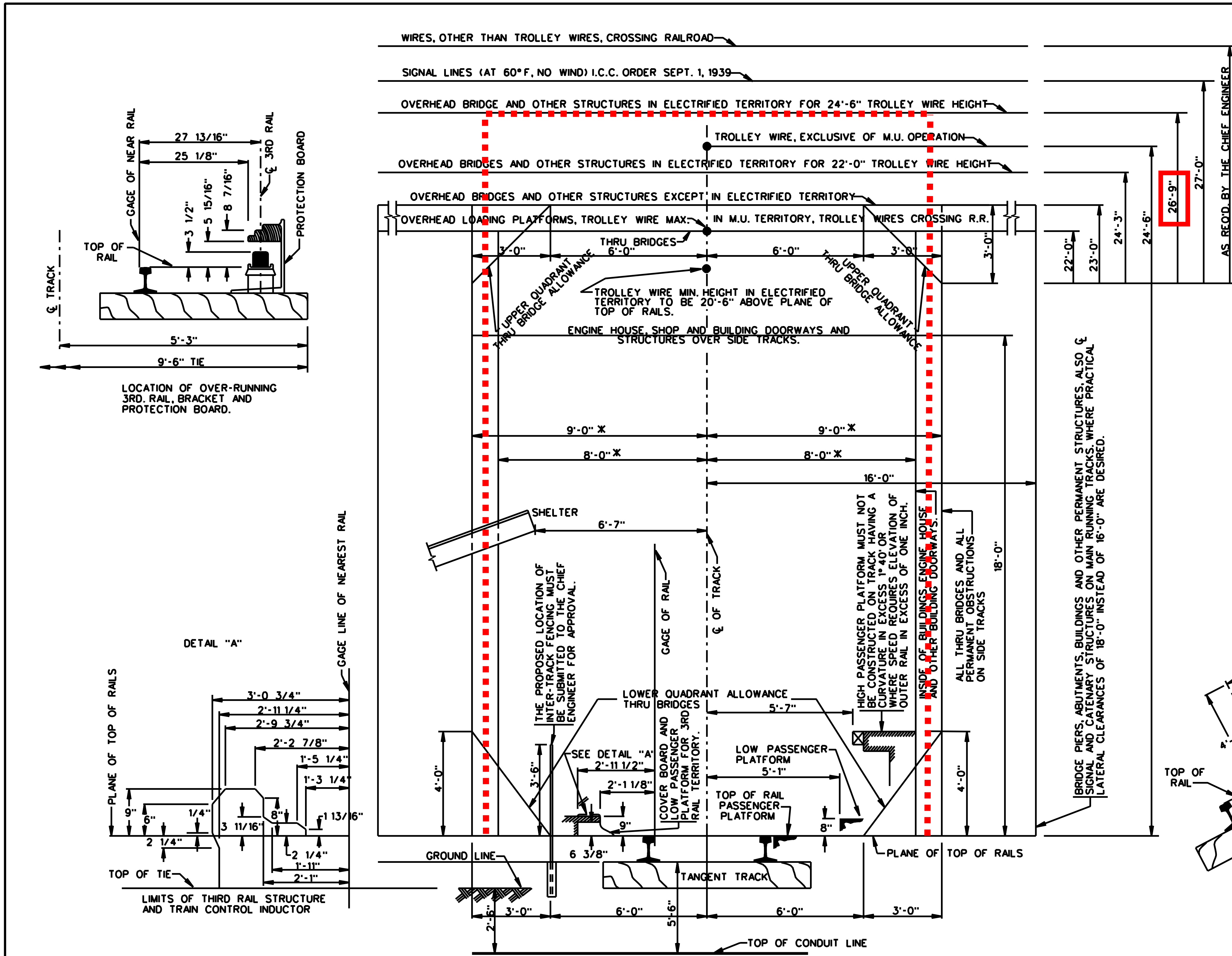



**Figure B16 - Under-Deck Utilities and Safety Systems**




NOTES:

CLEARANCE REQUIREMENTS SHOWN ON THIS PLAN APPLY ONLY TO NEW CONSTRUCTION OR RECONSTRUCTION. EXISTING STRUCTURES AND TRACKS MAY BE MAINTAINED AND EXTENDED AT PRESENT CLEARANCES, UNLESS OTHERWISE REQUIRED BY LOCAL OR STATE AUTHORITIES.

STRUCTURES MUST NOT BE LOCATED NEARER TO THE TRACK THAN THE MINIMUM CLEARANCE LIMITS SHOWN ON THIS PLAN AND THESE DISTANCES SHOULD BE EXCEEDED WHERE POSSIBLE. CONSIDERATION SHOULD BE GIVEN TO THE PROBABILITY OF INCREASED DISTANCE BETWEEN TRACK CENTER LINES. WIDENING ROADBED SHOULDERS AND WIDENING AND DEEPENING DITCHES, AND THE STRUCTURES SHOULD BE LOCATED ACCORDINGLY.

FOR STANDARD DISTANCES BETWEEN TRACK CENTER LINES AND THE SPACING OF TRACKS WHERE INTERTRACK CLEARANCE - LIMITING OBJECTS ARE LOCATED, SEE MW-1000 SPECIFICATIONS FOR INSPECTION, CONSTRUCTION AND MAINTENANCE OF TRACK

WHERE PHYSICAL CONDITIONS IMPOSE INSURMOUNTABLE RESTRICTIONS, NECESSITATING CLEARANCES CLOSER THAN THOSE SHOWN, THE MATTER MUST BE SUBMITTED TO THE CHIEF ENGINEER FOR ANY MODIFICATIONS, AND ALSO TO THE LOCAL OR STATE AUTHORITIES IF NECESSARY.

MINIMUM CLEARANCES SHOWN ON THIS PLAN ARE FOR TANGENT LEVEL TRACK.

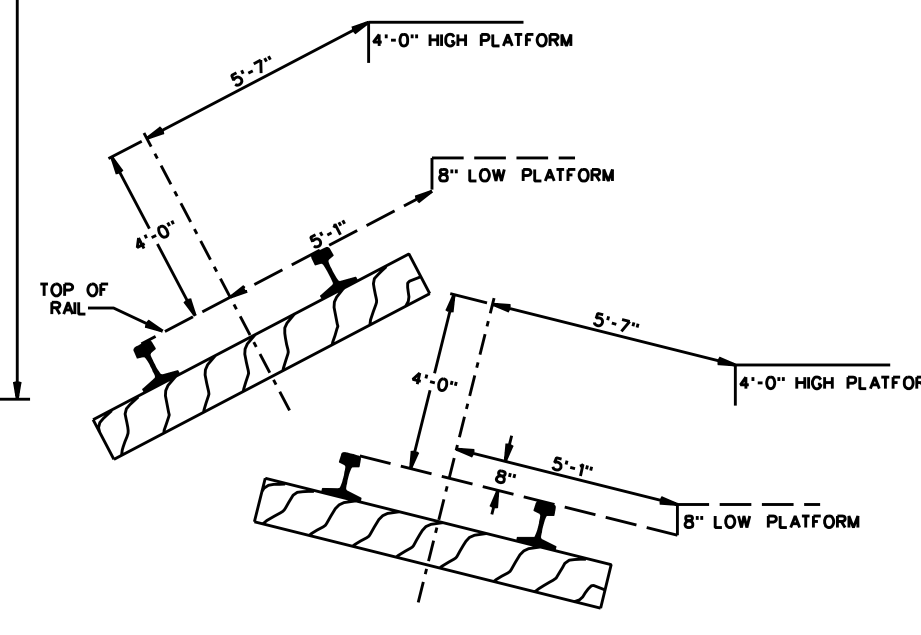
FOR CURVED TRACK THE FOLLOWING PROVISIONS APPLY.

VERTICAL - MEASURED VERTICALLY ABOVE HIGH RAIL EXCEPT FOR PASSENGER AND FREIGHT PLATFORMS WHICH ARE MEASURED PERPENDICULAR TO THE PLANE OF TOP OF RAIL.

LATERAL - OUTSIDE AND INSIDE CLEARANCES SHALL BE MEASURED RADIALLY AND (EXCEPT FOR LOW PASSENGER PLATFORMS ON CURVES 13° OR LESS) HORIZONTALLY AND INCREASED BY 1 1/2 INCHES PER DEGREE OF CURVATURE OVER THAT SHOWN FOR TANGENT TRACK (EXCEPT LOW PASSENGER PLATFORMS ON CURVES 13° OR LESS). IN ADDITION, THE INSIDE CLEARANCE FOR SUPER ELEVATED TRACK SHALL BE FURTHER INCREASED BY 1 INCH FOR EACH 1 INCH OF SUPERELEVATION FOR EACH 5 FEET OF HEIGHT ABOVE TOP OF LOW RAIL.

**LOW PASSENGER PLATFORMS WILL NOT BE COMPENSATED FOR CURVATURE UP TO 8°.**

**FOR CUVATURE IN EXCESS OF 8°, LOW PLATFORM SHOULD BE DESIGNED AT TOP OF RAIL ELEVATION AND EXTENDED TO THE FIELD SIDE OF THE NEAR RAIL.**




VERTICAL MEASUREMENT ON CURVED TRACK

* FOR STATE CLEARANCE REQUIREMENTS, SEE A.R.E.M.A. MANUAL, CHAPTER 28, SECTION 3.6, LEGAL CLEARANCE REQUIREMENTS BY STATES.

| | | | | | |
|---|---|---|---|---|---|
| Amtrak® | OFFICE OF THE CHIEF ENGINEER OF TRACK | No. / Revisions / Date / By | STANDARD TRACK PLAN MINIMUM ROADWAY CLEARANCES | Dwg. No. AM70050G | Sheet No. 1 of 1 |
| | Phila., PA Date: April 20, 2000 Approved: | | Designed: Amtrak Drawn: TDI-SLC Checked: NJS Date: 5-11-99 | | |



Figure B16 - Amtrak Train Clearance Envelopes

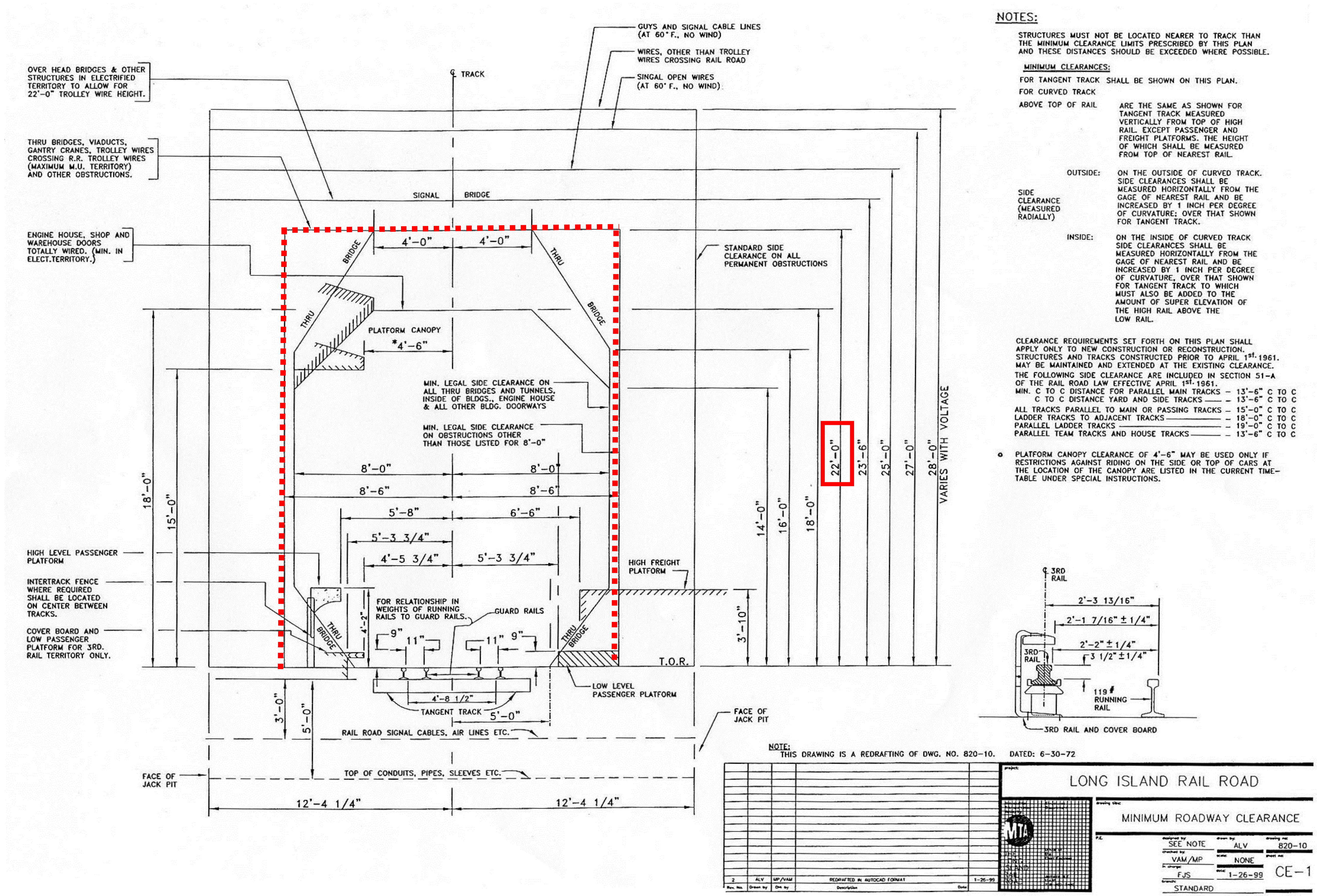



**Figure B17 - LIRR Train Clearance Envelopes**

# Appendix B.
# Constructability & Railroad Operations Drivers

# Sunnyside Yard – Key Features

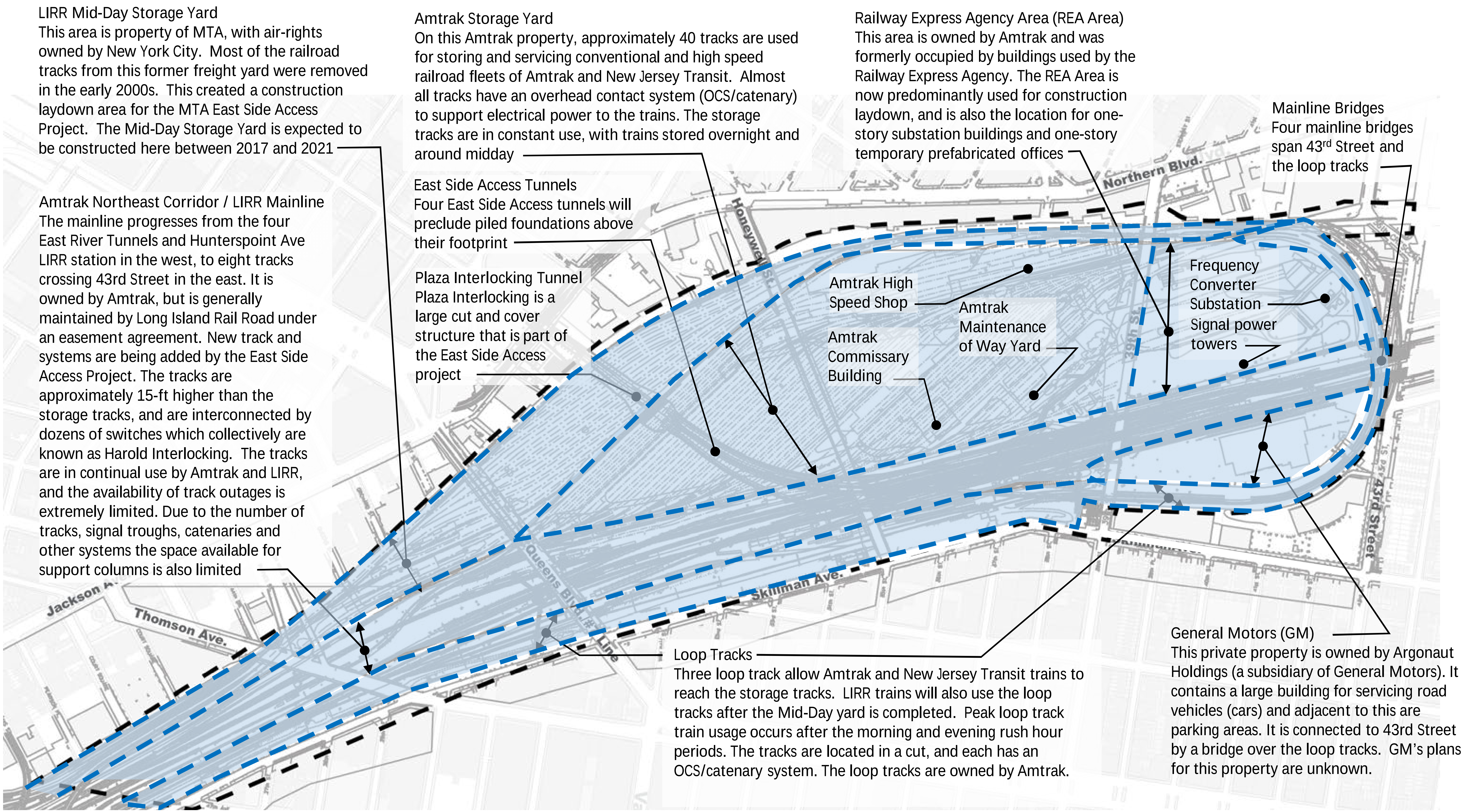
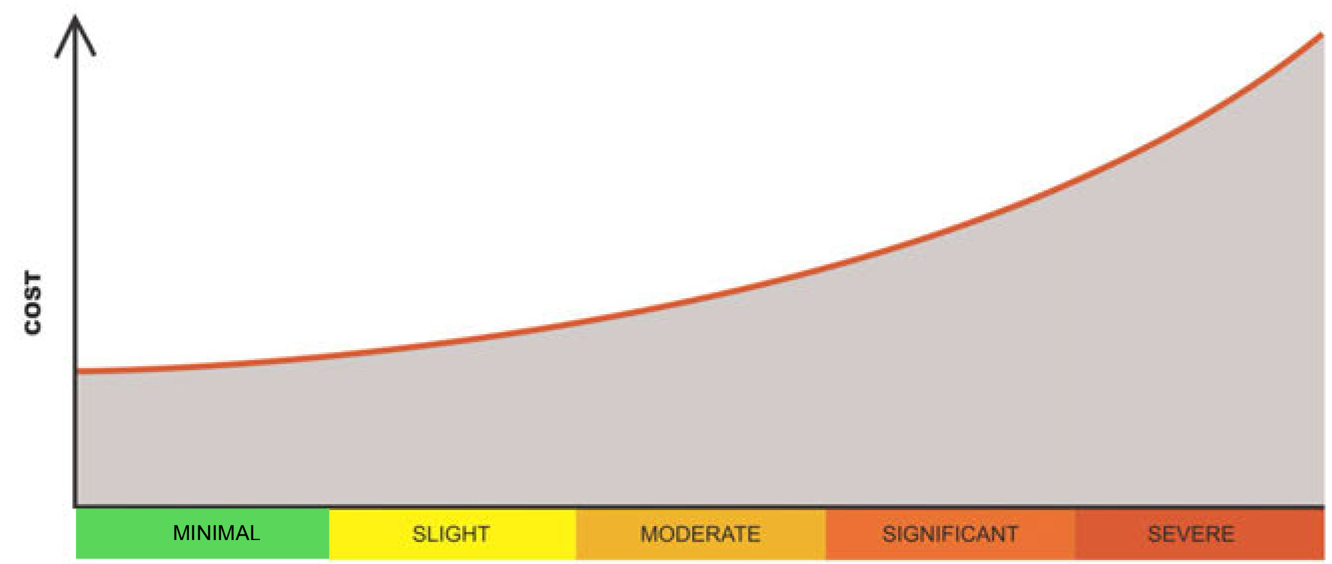



**Figure C1 - Sunnyside Yard - Key Features**

## CONSTRUCTABILITY AND COST

The following maps of **Railroad Operations and Constructability** present the potential for development within each area of the Yard with consideration of other planned projects and railroad activity. A map is presented for each of the years 2015, 2020 and 2025 Each map includes a narrative of constraints and opportunities for construction, based on the anticipated implementation schedules for the MTA East Side Access project, Amtrak's 'Master Plan' Sunnyside Yard Expansion project, and other projects.

The coloring on each map represents the constraints on construction due to railroad operations and due to the complexities imposed by railroad infrastructure. The amount of train traffic is a key driver of available work windows, construction efficiency and schedule, and therefore of construction cost. Another key factor is the availability of column/wall touchdown points. In general, there are fewer touchdown points in areas with heavier railroad use due to there being more tracks, catenary, signal troughs and other infrastructure. Fewer touchdown points for support columns and walls results in longer spans, increased structural steelwork and increased foundation costs. Taken together, these two considerations result in an exponential increase in cost when railroad operations become more intensive, as shown on the adjacent diagrammatic graph.




**Minimal Constraint:** These areas are typically terra firma, and provide the lowest-cost opportunities for overbuild construction. Some areas that currently have minimal railroad activity will become active areas of the yard by 2030.

**Slight Constraint:** These areas typically have no active tracks within them or tracks with minimal use. There may be active tracks on adjacent areas, which results in increased costs due restrictions on crane use, installation of boundary fences, railroad force account costs for flagging, and other factors.

**Moderate Constraint:** These areas typically have active tracks on or adjacent to them, but extended track outages for overbuild development may be possible, when coordinated with other railroad construction projects. Timing of construction work will be restricted to either certain years (to be concurrent with other railroad construction) or to certain work-hour windows, such as nights or weekends.

**Significant Constraint:** These areas experience frequent train traffic. The ability to take tracks out of service for extended periods will be limited, requiring some construction in short work windows. Unless overbuild development has previously been planned and coordinated with other railroad construction, significant modification of railroad infrastructure is likely to be required. Performing overbuild construction and modifying railroad facilities in short work windows will be expensive, and will require an extended schedule to implement.

**Severe Constraint:** These areas experience continuous train traffic. It will generally not be possible to take tracks out of service for extended periods. Construction will need to be performed on nights or weekends, planned several months in advance. Significant modification of tall structures such as the Overhead Contact System (OCS/catenary) will be required. There will be significant restrictions on crane/equipment placement and use. Force account costs for planning, flagging, Electrical Traction group, and other functions will be high. Overbuild of these areas is possible, but only after long term coordination and planning with the operating railroads.

# Figure C2 - Constructability and Cost

# Railroad Operations and Constructability – 2016

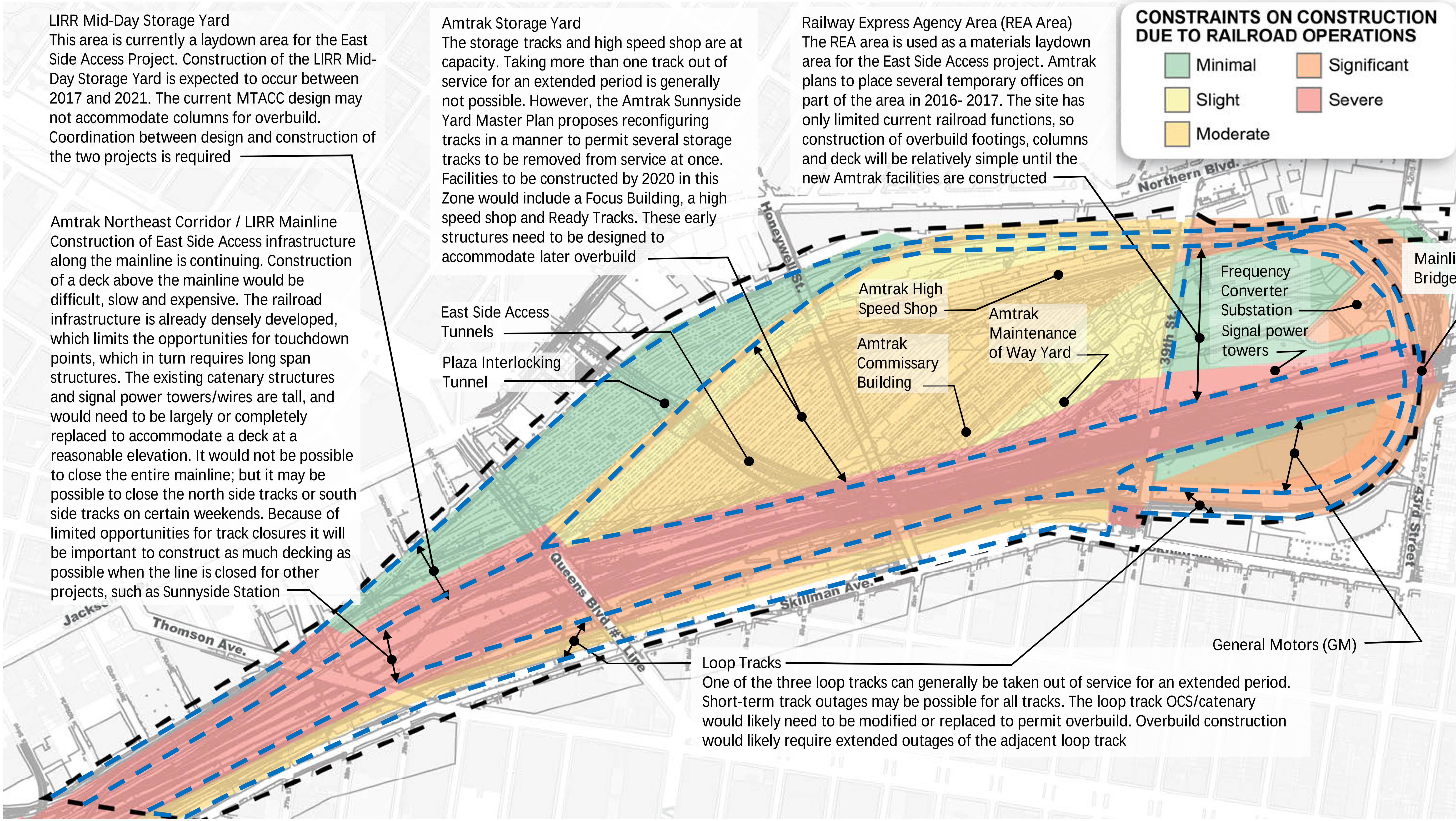



**Figure C3 - Railroad Operations and Constructability – 2016**

# Railroad Operations and Constructability – 2020

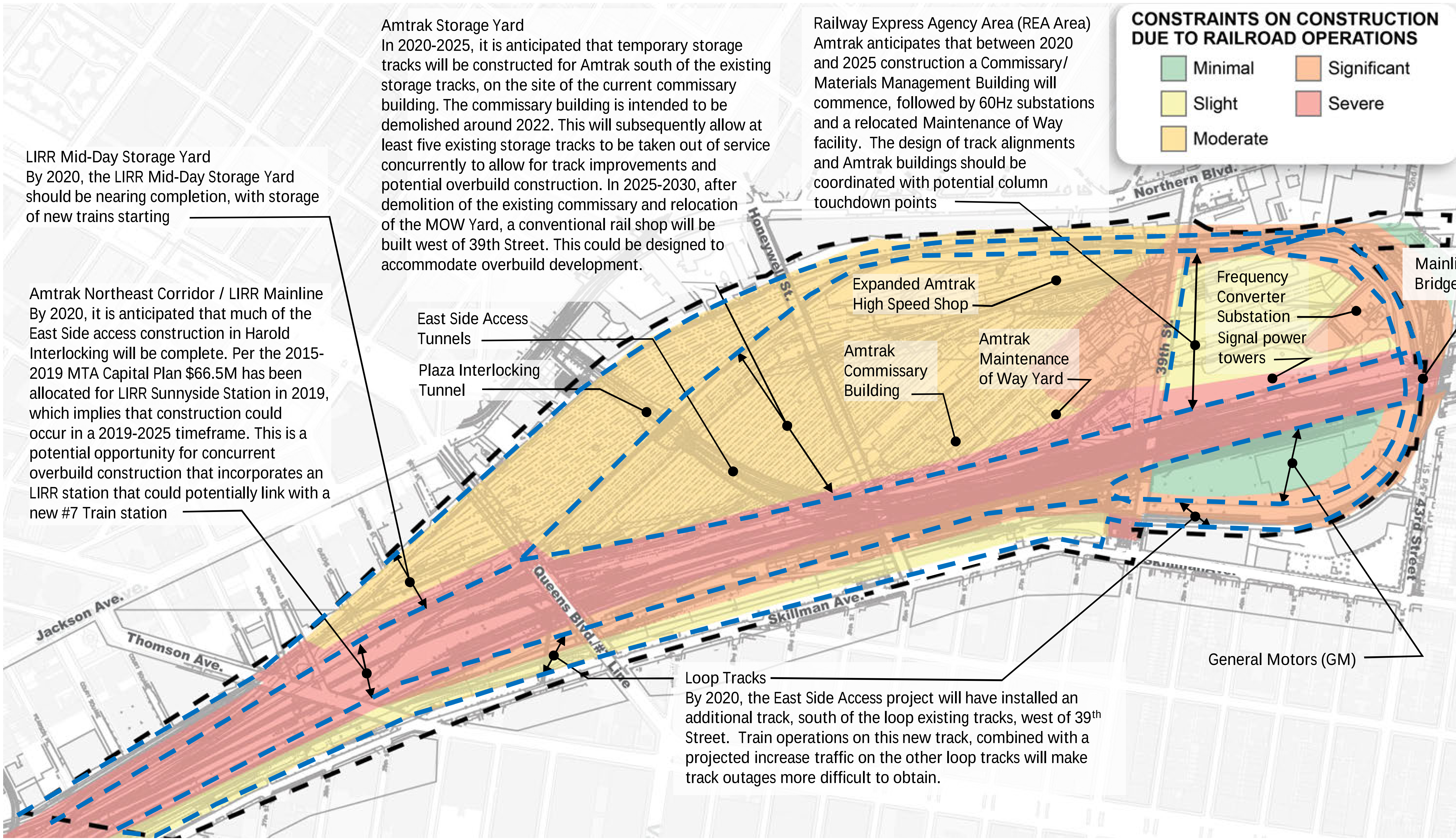



**Figure C4 - Railroad Operations and Constructability – 2020**

# Railroad Operations and Constructability – 2030

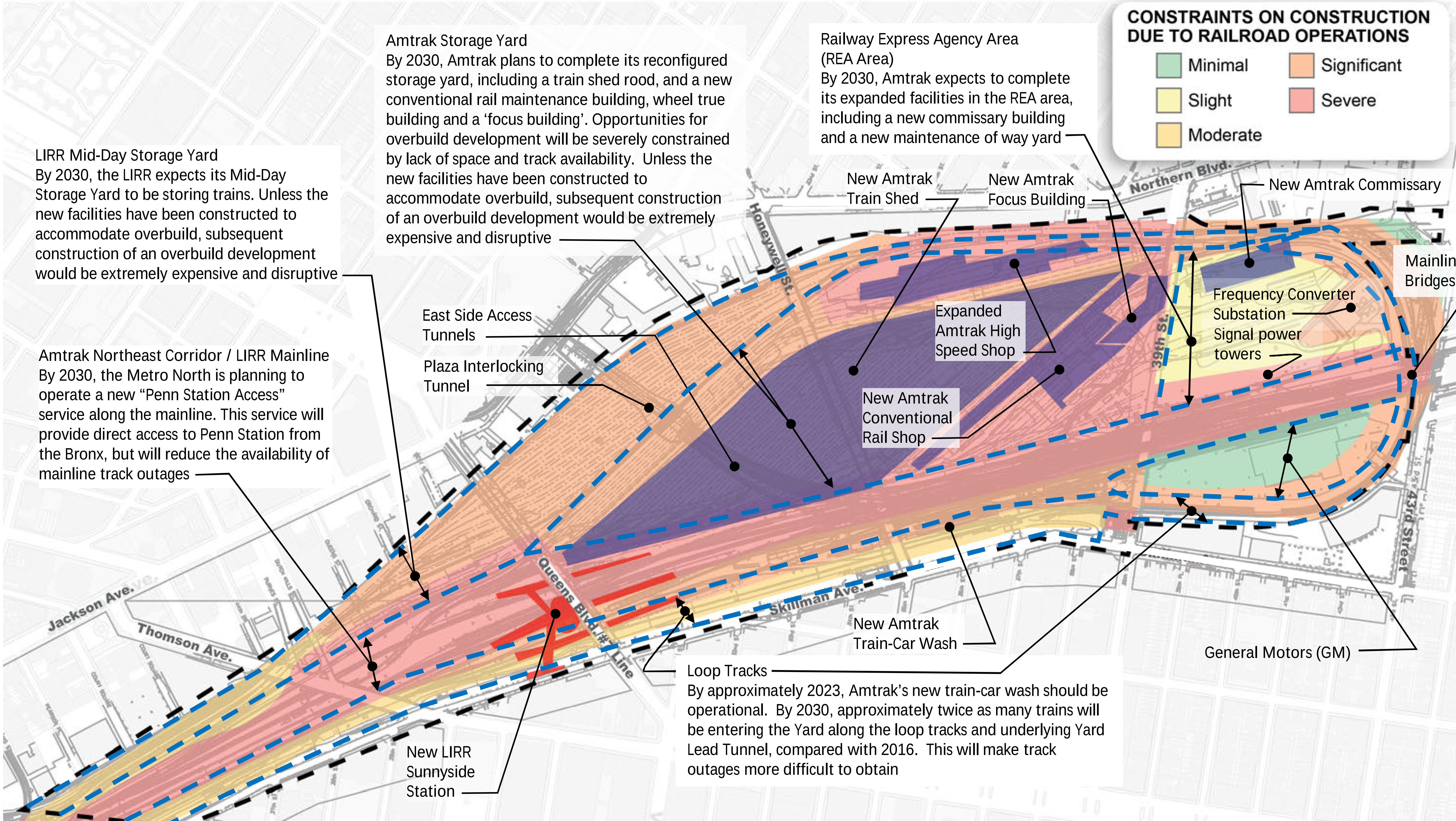



**Figure C5 - Railroad Operations and Constructability – 2030**

# Appendix C.
# Contamination in Sunnyside Yard- NYS DEC Operable Units

# Contamination within Inactive Hazardous Waste Disposal Site

### Contamination within Inactive Hazardous Waste Disposal Site

Introduction

As discussed in the main report, the New York State Department of Environmental Conservation (NYSDEC) has listed approximately 133 acres of Sunnyside Yard as a Class 2 Site in the Registry of Inactive Hazardous Waste Disposal Sites in New York (also known as the State Superfund Site registry). A Class 2 Site is a site at which hazardous waste presents a significant threat to the public health or the environment and action is required.

Operable Units

NYSDEC has determined that the Superfund Site is too large to effectively manage as a single area, and has therefore divided it into six sub-areas known as "operable units" or "OU", each of which has a separate remediation plan. This appendix provides details of the OUs.

Each OU will receive a Record of Decision (ROD) from NYSDEC, which contains the results of the remedial investigation and remedy selection process, including the information and rationale used to arrive at the decision. Figure D-1 depicts the operable units. The Operable Units are described as follows:

- OU-1: Soil above the water table within the footprint of the existing High Speed Train set Facility (HSTF) Service and Inspection Building;
- OU-2: Soil above the water table within the areas adjacent to the HSTF Service and Inspection Building;
- OU-3: Approximately eight acres in the northcentral portion of the site, consisting of saturated and unsaturated soil and separate-phase petroleum hydrocarbon (SPH) above the water table;
- OU-4: Soil above the water table (unsaturated zone) in the remainder of the yard; however it was expanded to include saturated soil. This OU extends from Thomson Ave in the west to the loop tracks in the east;
- OU-5: Sewer system (water and sediment) beneath the Superfund Site;
- OU-6: Saturated soil and the groundwater beneath the Superfund Site (delineation of soil to be conducted as appropriate); however it was modified to exclude saturated soil (now OU-4) and include soil vapor.

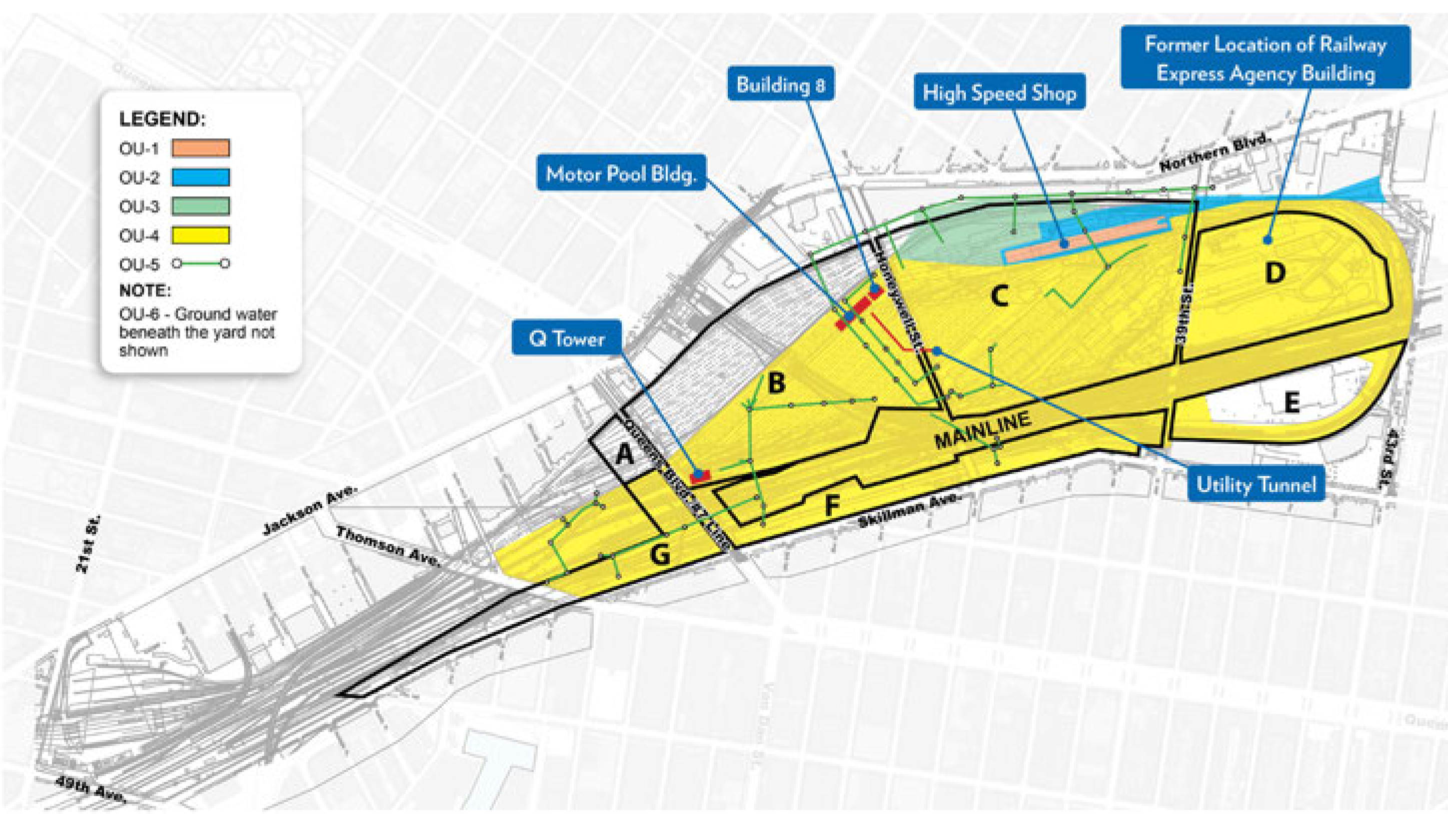



FIGURE D-1

Each Operable Unit is detailed below, based on information sourced from the references cited at the end of this appendix.

Operable Unit 1

OU-1 is designated as the soils above the water table within the footprint of the existing HSTF Service and Inspection Building at the Superfund Site. This parcel of land is approximately 60 feet by 790 feet.

OU-1 has been part of a railroad yard since the early 1900s. An investigation of the HSTF building construction site was conducted in April 1996. Testing was performed to confirm that the location of the previously delineated separate-phase petroleum delineation located west of OU-1 had not changed. Visual observations in boreholes confirmed the previously determined extent of the separate-phase petroleum accumulation. SVOCs, metals, and PCBs were detected above recommended soil cleanup objectives (RSCO) in the soil. However, the levels were below the site specific soil cleanup levels. For disposal purposes, the soil in OU-1 was considered non-hazardous, but landfill permit requirements may mandate the submission of the toxicity characteristics of the soil. SVOCs and metals were detected above groundwater standards.

In accordance with the NYSDEC Record of Decision (ROD) for OU-1, 472 tons of soil were disposed at a permitted landfill in December 1997. Additionally, 280 cubic yards of asphalt and concrete, and 2,450 gallons of liquid pumped from excavation pits were also properly disposed of. Work was completed at OU-1 in April 1998.

Operable Unit 2

OU-2 is designated as the soils above the water table within the areas adjacent to the existing HSTF Service and Inspection Building. OU-2 encompasses slightly less than 2 acres.

An investigation of the HSTF building ancillary areas was conducted in March 1997. VOCs, SVOCs, metals, and PCBs were detected in soil samples collected in OU-2. However, the results were below the site specific soil cleanup levels established for Sunnyside Yard. The remedial investigation showed that the contaminant levels are below the recommended soil cleanup levels established for the entire Yard. No portion of OU-2 requires remediation. Soil excavated from OU-2 is to be reused elsewhere in the Yard.

Operable Unit 3

OU-3 encompasses approximately 8 acres in the north central portion of Sunnyside Yard. OU-3 consists of saturated and unsaturated soil and separate-phase petroleum hydrocarbon (SPH) above the water table. OU-3 was operated as a storage and maintenance facility for railroad rolling stock and formerly housed 9 underground storage tanks (USTs), several subsurface structures, and one aboveground structure. OU-3 is contaminated with predominantly petroleum products and PCBs. Groundwater is shallow in OU-3, at approximately 12-18 inches below grade.

Environmental investigations have been undertaken in OU-3 since 1985. In February 1986, an investigation of the former UST area was conducted to determine if leakage of hydrocarbon compounds had occurred and to determine the extent of impact to the soil and groundwater. A June 1986 report indicated a plume of SPH existed in the area east of the Engine House, originating from the USTs of the former fuel storage area and had migrated beyond the northern property boundary.

Remedial investigations were conducted in OU-3 from October 1990-December 2003. These investigations included the installation of numerous soil borings, test pits, and monitoring wells for the analysis of soil and groundwater within OU-3 and to delineate the SPH plume. Prior to 2003, several interim remedial measures (IRMs) resulted in the recovery of a significant amount of SPH (more than 11,500 gallons), hydrocarbon impacted soil, and polycyclic aromatic hydrocarbon (PAH)-impacted soil.

From June 2008-October 2013, remediation activities were performed within OU-3. OU-3 was remediated to industrial use standards and continues to be used for railroad purposes. Remedial tasks involved the excavation and offsite disposal of hydrocarbon impacted surface soil; the excavation and offsite disposal of soil and SPH within a delineated area; the implementation of a dual phase vacuum extraction remediation system to remove measureable SPH and soil vapor; offsite disposal of excavated soil impacted by PCBs and lead with concentrations exceeding the Yard soil cleanup level for these contaminants; removal of any former structures, pits, fuel vaults, and USTs; the in situ application of calcium nitrate to enhance biodegradation of saturated soil in certain areas located within the SPH plume; and groundwater monitoring of product thickness.

Upon completion of the remedial activities, the mobile SPH plume still remains in OU-3. Full time operation of the dual-phase vacuum extraction system began in November 2013 and is ongoing. Additionally, various debris, including USTs, concrete slabs, and subsurface piping, has been identified as buried in OU-3.

Operable Unit 4

OU-4 consists of the soil above the water table (unsaturated zone) at the Superfund Site, excluding OU-1, OU-2, and OU-3. OU-4 comprises 120 acres of Sunnyside Yard. The Amtrak Master Plan (Ref 13) notes that the former REA Building in this OU (east of 39th Street) was built on contaminated fill. It also notes that on-site contaminants were found at each of the inspected and sampled locations below:

- Building No. 8
- Utility Tunnel
- Motor Pool Sub-Basement/Utility Tunnel
- Q Tower
- Utility Trenches

The soil cleanup levels for compounds of concern (COC) at the Yard were reestablished for Operable Unit 4 (OU-4) to:

- Total PCBs – 25 mg/kg;
- Total cPAHs – 500 mg/kg; and
- Lead – 3,900 mg/kg.

Investigations in OU-4 began in 1983. The remedial investigation (RI) was conducted from October 1990-April 2009. According to the Remedial Action Work Plan for OU-4, the Phase I RI was a comprehensive, facility-wide investigation to identify and determine the nature and extent of contamination in the Yard. The objective of the OU-4 Phase II RI was to provide further delineation of contaminated areas and confirm analytical results of samples collected in the Phase I RI. Numerous soil sampling investigations were performed during track maintenance, utility installation, and construction. Over 1,500 soil samples were collected within OU-4. Several of these remedial investigations identified concentrations exceeding the Superfund Site cleanup level for the COCs. As part of site maintenance activities, identified COC exceedances were often excavated so the maintenance/construction activities could be completed and served as an interim remedial measure (IRM). 7,200 cubic yards of soil and UST removals and abandonments were performed as IRMs.

The 2009 NYSDEC ROD for OU-4 outlined several remedial actions to be implemented. The actions included excavation and off-site disposal of soil classified as PCB hazardous waste; excavation and off-site disposal of soil exceeding the site specific cleanup levels for PCBs, SVOCs, and lead; removal of subsurface structures; placement of one foot of clean fill cover; imposition of an institutional control in the form of an environmental easement that limits the use of the property; and a site management plan.

Remedial actions are ongoing.

Operable Unit 5

Operable Unit 5 (OU-5) is applicable to the sewer system beneath the Yard. OU-5 received a Record of Decision (ROD) from New York State in March 2012 (Ref 21). An extensive cleanup program was completed in 1996 to remove PCB contaminated sediment from impacted sewer manholes (MH). Subsequent sampling identified sewer segments and manholes with recurring PCB contaminated sediment impacts. PCB concentrations at MH-6 (one sample) and MH-38 (two samples) exceeded the 25 mg/kg NYSDEC recommended soil cleanup level for the Yard. MH-6 has since been remediated. In addition, MH-40 contains a weir that acts as a sediment trap for potential contaminants. Approximately 11,000 gallons of PCB contaminated sediment and water will be removed and disposed of from manholes MH-38 and MH-40 in accordance with all federal, state, and local rules and regulations

Most of the remedial work has been completed.

To provide sufficient stormwater capacity for an overbuild development, it is probable that much of the sewer system will need to be water jetted and flushed to remove sediment. Although PCB levels in the sampled sediments were generally below site-specific cleanup levels, disturbing the sediment could potentially cause PCBs to be released and is likely to require specific control measures. Per Amtrak's Master Plan, it is anticipated that cleanout of the sewers will be completed by Amtrak before reconstruction of the Yard. Figure D-2 shows an example of removing silt from a sewer in Sunnyside Yard. Many sewers in Sunnyside Yard are believed to be heavily silted. This photo shows silt being removed from a sewer near Honeywell Street Bridge."]

Operable Unit 6

Operable Unit 6 (OU-6) is applicable to the saturated soil and groundwater beneath the Superfund site. OU-6 received a Record of Decision (ROD) from New York State in March 2010 (Ref 22).

Releases associated with fueling operations, maintenance activities, train-mounted transformers, historic fill activities, and peeling lead-based paint from the four bridges spanning the site

FIGURE D-2 SEWER FULL OF SILT

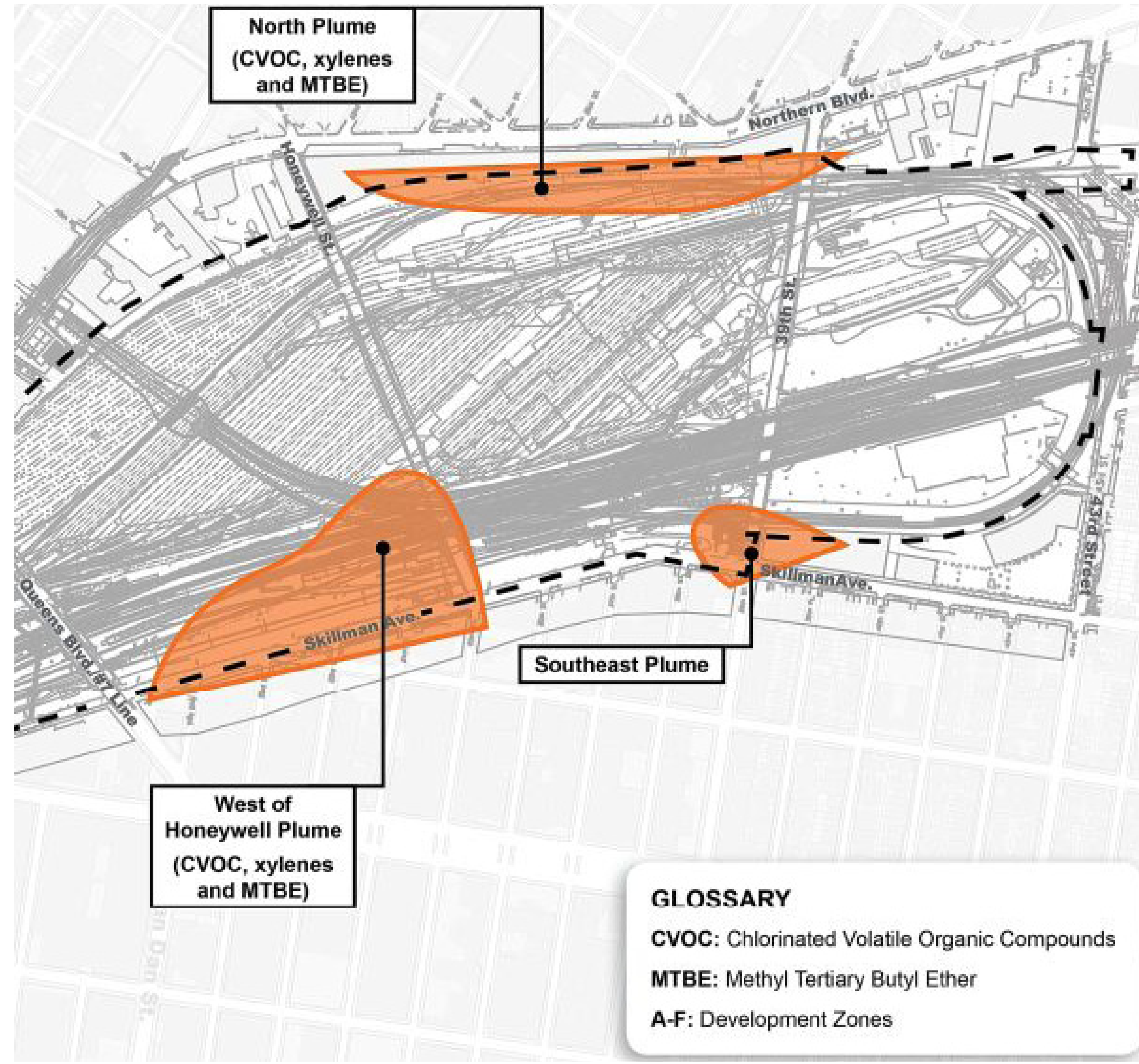



FIGURE D-2 SEWER FULL OF SILT

have resulted in the disposal of hazardous wastes, including polychlorinated biphenyls (PCBs), semi-volatile organic compounds (SVOCs), carcinogenic polycyclic aromatic hydrocarbons (cPAHs), and lead. Additionally, off-site sources of chlorinated volatile organic compounds (CVOCs) have migrated on-site in groundwater. These wastes from off-site sources have contaminated the groundwater at the Superfund Site.

NYSDEC has determined that the past disposal of hazardous waste at the site does not pose a significant threat to human health or the environment via groundwater, saturated soil, or soil vapor, "No Action" was selected as the remedy for OU-6.

The remedial investigation did not identify any significant groundwater impacts attributed to Amtrak or NJTC, or their present or former operations at the Yard. All significant groundwater impacts identified were attributed to off-site contamination migrating on to the Yard. Three distinct groundwater plumes have been identified, as shown on Figure D-3. Chlorinated volatile organic compounds (CVOCs), benzene, toluene, ethylbenzene, xylenes and methyl tertiary butyl ether (MTBE) in groundwater have migrated on-site in these plumes from upgradient off-site sources:

Although "No Action" is the remedy noted in the NYSDEC Record of Decision, there are certain components of the remedy which could affect an overbuild development. These include:

- "Imposition of an institutional control in the form of an environmental easement that will require (a) limiting the use and development of the property to industrial use; (b) compliance with the approved site management plan;"
- "Development of a site management plan which will include the following institutional and engineering controls: (a) continued evaluation of the potential for vapor intrusion for any buildings developed on the site, including provision for mitigation of any impacts identified; (b) in coordination with the off-site remedial parties, monitoring of wells in off-site source plume areas to determine if continued migration is occurring; (c) residual contaminated soils that may be excavated on-site during future redevelopment will be addressed through soil characterization and, where applicable, disposal/reuse in accordance with NYSDEC regulations; (d) identification of any use restrictions on the site; and (d) fencing to control site access. The OU-6 site management plan will be incorporated into an overall site-wide site management plan upon completion of all OUs on the site."
- Development of the site would require coordination with NYCDEC, including the need to address the controls on development for non-industrial use.

### References


1. Limited Phase II Environmental Site Assessment Report, High Speed Trainset Facility, Sunnyside Yard, Queens, NY, December 3, 1996, by Roux Associates, Inc., Islandia, NY.

2. Operable Unit 1 Remedial Action Report, Sunnyside Yard, Queens, NY, March 11, 1998 (revised April 9, 1998), by Remedial Engineering, PC, Islandia, NY.

3. Record of Decision, Amtrak Sunnyside Yard Operable Unit 1: Proposed High Speed Trainset Facility (HSTF) Building, Queens, NY, Site Number 241006, August 1997, by Roux Associates, Inc., Islandia, NY.

4. Focused Remedial Investigation for Operable Unit 2, Sunnyside Yard, Queens, NY, June 15, 1997 (revised August 22, 1997), by Roux Associates, Inc., Islandia, NY.

5. Record of Decision, Amtrak Sunnyside Yard Operable Unit 2: Proposed High Speed Trainset Facility (HSTF) Building Ancillary Areas, Queens, NY, Site Number 241006, November 1997, by Roux Associates, Inc., Islandia, NY.

6. Final Operable Unit 3 Remedial Investigation Report, Volume I-III, Sunnyside Yard, Queens, NY, May 2005, by Roux Associates, Inc., Islandia, NY.

7. Record of Decision, Amtrak Sunnyside Yard Operable Unit 3: Long Island City, Queens County, NY, Site Number 241006, March 2007, by Roux Associates, Inc., Islandia, NY

8. OU-3 Construction Completion Report, Amtrak Sunnyside Yard, Queens County, NY, NYSDEC Site Number 241006, March 2014, by Remedial Engineering, PC, Islandia, NY.

9. Operable Unit 4 Remedial Investigation Report Volume I-II, Sunnyside Yard, Queens, NY, October 2, 2008, by Roux Associates, Inc., Islandia, NY.

10. Operable Unit 4 Remedial Action Work Plan, Sunnyside Yard, Queens, NY, September 24, 2009, by Remedial Engineering, PC, Islandia, NY.

11. Addendum to the Operable Unit 4 Remedial Action Work Plan, Sunnyside Yard, Queens, NY, August 26, 2010, by Roux Associates, Inc., Islandia, NY.

12. Record of Decision, Amtrak Sunnyside Yard Operable Unit 4: Long Island City, Queens County, NY, Site Number 241006, March 2009, by Roux Associates, Inc., Islandia, NY.

13. Existing Conditions Report, April 2013, by Parsons Brinckerhoff and Gannett Fleming.

14. Record of Decision, Amtrak Sunnyside Yard Operable Unit 5: Long Island City, Queens County, NY, Site Number 241006, March 2012, New York State Department of Environmental Conservation.

15. Record of Decision, Amtrak Sunnyside Yard Operable Unit 6: Long Island City, Queens County, NY, Site Number 241006, March 2010, New York State Department of Environmental Conservation.

# Appendix D.
# Structural Design Criteria, Quantities and Requirements

## STRUCTURAL DESIGN CRITERIA

**A.1 Codes and Standards**

The structure is designed under the provisions of the following Codes:

- New York City Building Code-2014 Edition and all applicable standards as referenced by NYCBC-2014
- American Concrete Institute, ACI 318-11 Building Code, as referenced by NYCBC-2014
- ASTM- American Society for Testing Materials
- AISC-LRFD- American Institute of Steel Construction
- AISC ASD Steel Construction Manual for the design of the structural elements resisting seismic forces
- AWS-D1.1 American Welding Society Standard for Welding
- AWS-D1.4 Structural Welding Code – Reinforcing Steel

**A.2 Materials**

A. Concrete:

| | |
|---|---|
| - Column/Wall Below Deck: | 10000 psi. |
| - Deck | 7000 psi |
| - Overbuild | Varies |

Note: Higher strengths to be considered during detailed design

B. Steel Reinforcement: Grade 60 (Fy = 60,000 psi)

Note: Higher strengths to be considered during detailed design

C. Structural Steel: Grade 50 (Fy = 50,000 psi)

Note: Higher strengths to be considered during detailed design

**A.3 Deflection Criteria**

A. Floor Deflections (The portion of deflection after installation of nonstructural elements)

Floor slab deflection between supporting columns:

- Precomposite Wet Concrete Load (No Construction LL) = L/360
- Postcomposite Total Service Load = L/240
- Postcomposite Live Load Only = L/360

B. Wind lateral deflection / drift index (50 year return period):

Overbuild Towers: $\Delta$ / h = h / 400
h = inter-story height

Podium: $\Delta$ / h = h / 1000

C. Seismic drift index:

Inelastic drift: $\Delta$ / h = h / 50
h = inter-story height

**A.4 Acceleration Criteria**

A. 10-year return period acceleration criteria:

- Residential: 15 – 18 milli-g
- Office: 25 milli-g

B. 1-year return period acceleration criteria:
Per ISO 10137:2007 (International Organization for Standardization)

C. Torsional Velocity:
CTBUH (The Council on Tall Buildings and Urban Habitat)

**A.5 Gravity Loads**

Self-weight of the materials used for the construction of the structure are considered. Self-weight of overbuilds are estimated based on typical structural systems of residential and office buildings in the area.

The assumed design super-imposed dead and live load are as follows:

**Table A.1:** Gravity Load Schedule for Block & Plank + CIP Concrete Residential Building

| Location | Super-imposed Dead Load (PSF) | | | Live Load (PSF) | Comments |
|---|---|---|---|---|---|
| | Partitions &Fill/Finish | Ceiling & MEP | Total SDL | | |
| Non-accessible Roof | 10 | 25 | 35 | 30 | |
| Roof | 25 | 25 | 50 | 100 | |
| Residential Floors | 15 | 5 | 20 | 40* | |
| Mechanical Floors | 25 | 10 | 35 | 100 | Or equipment weight |
| Lobby | 25 | 10 | 35 | 100 | Ground Floor |
| Parking | 15 | 10 | 25 | 50 | |
| Stair | - | 5 | 5 | 100 | |
| Façade | - | - | 25 | - | Applied on façade surface |

**Note: * Reducible live loads per NYCBC**

**Table A.2:** Gravity Load Schedule for Steel Office Buildings

| Location | Super-imposed Dead Load (PSF) | | | Live Load (PSF) | Comments |
|---|---|---|---|---|---|
| | Partitions &Fill/Finish | Ceiling & MEP | Total SDL | | |
| Non-accessible Roof | 10 | 25 | 35 | 30 | |
| Office Floors | 20 | 5 | 25 | 50* | |
| Mechanical Floors | 25 | 10 | 35 | 100 | Or equipment weight |
| Lobby | 25 | 10 | 35 | 100 | Ground Floor |
| Parking | 15 | 10 | 25 | 50 | |
| Stair | - | 5 | 5 | 100 | |
| Façade | - | - | 25 | - | Applied on façade surface |

**Note: * Reducible live loads per NYCBC**

**Table A.3:** Gravity Load Schedule for Open Space/Roadway

| Location | Super-imposed Dead Load (PSF) | | | Live Load (PSF) | Comments |
|---|---|---|---|---|---|
| | Landscaping | MEP | Total SDL | | |
| Deck | 360 | 25 | 385 | 300 | 3' Soil Landscaping |

# Structural Design Criteria

## A.6 Wind Loads

Wind loading per ASCE7-05

Basic Wind Speed: 105 mph 3 sec. gust at 30 ft above ground

Basic Wind, (W): 50 year wind return period

Importance Factor, Iw = 1.00 (Cat. II) [NYC'14 Table 1604.5]

Exposure Type: C

## A.7 Seismic Loads

The seismic criteria used for the project is listed below

**Ss** = 0.281g (short period) [NYC'14 – 1613.5.1]
**S1** = 0.073g (1-second period) [NYC'14 – 1613.5.1]

Site Class: TBC by Geotechnical Consultant

**Fa** = TBC
**Fv** = TBC

**Sms** = Fa*Ss = TBC
**Sm1** = Fv*S1 = TBC

**Importance Factor, Ie** = 1.00 (Cat. II) [NYC'14 Table 1604.5]

**Seismic Use Group** = I [NYC'14 Table 1604.5]

**Sds** = (2/3)*Sms = TBC
**Sd1** = (2/3)*Sm1 = TBC

**Seismic Design Category** = TBC [NYC'14 – Tables 1613.5.6 (1) & (2)]

**Assumed Basic Seismic Force Resisting System:** Steel Ordinary Concentrically Braced Frame (Mega Transfer Truss Podium Only)
**Response Modification Coefficient, R** = 3.25 [NYC'14 – Table 1613.8]
**System Over-strength Factor, Omega** = 2 [NYC'14 – Table 1613.8]
**Deflection Amplification Factor, Cd** = 3.25 [NYC'14 – Table 1613.8]

## A.8 Additional Loads/Criteria

Additional loads/criteria which may be considered include threat, derailment of train, Key Element Analysis has not been accounted for. [NYC'14 – 1615.5, 1615.6, 1616,]

## Steel System

| Construction Platform At Bottom Chord | | |
|---|---|---|
| **Truss to Truss Span** | **Hollow Core Plank** | **Additional Comments** |
| 10'-'0" O.C. | 8"x48" Hollow Core Plank | |
| 20''-0" O.C. | 12"x48" Hollow Core Plank | |

**Overall Notes:**

1) Threat Analysis which includes, but is not limited to, derailment of train and impact has not been designed for.

2) Connection Design is not included in tonnages of steel reported.

3) Key Element Analysis and Design per Code is not included in tonnages of steel reported.

| Steel Deck System At Top Chord, Future Grade | | | |
|---|---|---|---|
| **Truss to Truss Span** | **Filler Beam Spacing** | **Deck Type** | **Filler Beam Size (Based On Park Road Load)** |
| 10'-'0" O.C. | 10'-0" O.C. | 6" NW Conc On 3" 18 GA Steel Deck | W16x26 |
| 20''-0" O.C. | 10'-0" O.C. | 6" NW Conc On 3" 18 GA Steel Deck | W18x35 |

| Building Analysis | | | | | | | Column/Wall Below Deck | | | | | Mega Transfer Truss Structure | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Building Typology** | **Levels** | **Construction** | **Tower Footprint Size** | **Podium Footprint Size[4]** | **Description** | **Orientation To Train Tracks Below** | **Size Of Wall/Column Below Truss** | **Percent Reinforcement In Wall/Column** | **Steel Section Embedded In Wall/Column** | **Vertical Ties** | **Horizontal Reinforcement** | **Total Tonnage** | **Premium Tonnage** |
| Residential-1 | 15 Floors | Block And Plank Tower with Steel Transfer Podium | 60'x200' | 100'x240' | 15 Floors / 160' to Main Roof (plus Mechanicals):13 Residential Floors @ 10'; 1 Parking Floor @ 10'; GF @ 20' | Parallel | 4'x6' (70% Void) | 1.4% | W14x74 | #4@11 | #7@10 | 1100 Tons | 550 Tons |
| | | | | | | Perpendicular | 4'x5' (75% Void) | 1.3% | W14x74 | #4@11 | #7@10 | 1100 Tons | 550 Tons |
| Residential-2 | 43 Floors | Reinforced Concrete Tower with Steel Transfer Podium | 60'x175' | 100'x215' | 43 Floors / 440' to Main Roof (plus Mechanicals):40 Residential Floors @ 10'; 2 Parking Floors @ 10'; GF @ 20' | Parallel | 4'x20' (0% Void) | 1.3% | W14x90 | #4@11 | #7@10 | 2800 Tons | 1400 Tons |
| | | | | | | Perpendicular | 4'x10' (50% Void) | 1.3% | W14x90 | #4@11 | #7@10 | 2800 Tons | 1400 Tons |
| Residential-3 | 69 Floors | Reinforced Concrete Tower with Steel Transfer Podium | 60'x175' | 100'x215' | 69 Floors / 700' to Main Roof (plus Mechanicals): 65 Residential Floors @ 10'; 3 Parking Floors @ 10'; G @ 20' | Parallel | | | | | | | |
| | | | | | | Perpendicular | 4'x20' (0% Void) | 1.3% | W14x120 | #4@11 | #7@10 | 5200 Tons | 2600 Tons |
| Office-1 | 18 Floors | Steel Tower with Steel Transfer Podium | 150'x250' | 190'x290' | 18 Floors/ 260' to Main Roof (plus Mechanicals); 14 Office Floors @15'; 3 parking floors @ 10'; GF @ 20' | Parallel | 4'x5' (75% Void) | 1.0% | W14x74 | #4@11 | #7@10 | 5500 Tons | 2750 Tons |
| | | | | | | Perpendicular | 4'x5' (75% Void) | 1.0% | W14x74 | #4@11 | #7@10 | 5500 Tons | 2750 Tons |
| Office-2 | 33 Floors | Steel Tower with Steel Transfer Podium | 125'x200' | 165'x240' | 33 Floors/ 475' to Main Roof (plus Mechanicals); 29 Office Floors @14'; 3 parking floors @10; GF @ 19' | Parallel | 4'x20' (0% Void) | 1.3% | W14x90 | #4@11 | #7@10 | 6800 Tons | 3400 Tons |
| | | | | | | Perpendicular | 4'x6' (70% Void) | 1.3% | W14x90 | #4@11 | #7@10 | 6800 Tons | 3400 Tons |
| Office-3 | 44 Floors | Steel Tower with Steel Transfer Podium | 130'x210' | 170'x250' | 44 Floors/ 595' to Main Roof (plus Mechanicals); 39 Office Floors @14'; 4 Parking Floors @ 10'; GF @ 19' | Parallel | | | | | | | |
| | | | | | | Perpendicular | 4'x20' (0% Void) | 1.3% | W14x120 | #4@11 | #7@10 | 10000 Tons | 5000 Tons |

| | |
|---|---|
| | Shaded box is tentatively viable pending additional Foundation Information. |
| | Crossed Out Box reperesents a a Building Typology And Orientation that fails deflection criteria. |
| **Notes:** | 1) Span Of Wall/Column below Assumed to Be 70'-0" O.C for Building Analysis. |
| | 2) For all Building Analysis Designs: Truss to Truss Spacing = 20'-0" O.C.. 9'-0" Total Depth Of Truss. |
| | 3) Tonnage of Mega Transfer Truss does not include podium filler beams or any Future Tower material above the podium. |
| | 4) Due to unknown location of tracks below Tower, Podium estimated to extend beyond Tower Footprint by 20'-0" on all sides. Number and Length of Column/Wall Deck Supports to be updated based on Podium Footprint Size. |
| | 5) Mega Transfer Truss assumed to be 30'-0" Deep for all Building Typologies. |

| Open Space Long Span Analysis | | | | Column/Wall Below Deck | | | | | Steel Premium |
|---|---|---|---|---|---|---|---|---|---|
| Load Type | **Truss to Truss Spacing** | **Wall/Column Span Below Deck** | **Overall Depth Of Truss (See Note 1)** | **Size Of Wall/Column Below Truss** | **Percent Reinforcement In Wall/Column** | **Steel Section Embedded In Wall/Column** | **Vertical Ties** | **Horizontal Reinforcement** | **Tonnage (Steel In Deck Truss/Linear Foot)** |
| 5- Story Block And Plank Construction (See Note 2) | 10'-0" O.C. | 70' | 9'-0" | 4'x4' (60% Void) | 2.50% | W30x90 | #4@11 | #7@10 | 225 lbs/ft |
| | | 100' | 9'-0" | 4'x4' (60% Void) | 2.50% | W33x387 | #4@11 | #7@10 | 300 lbs/ft |
| | | 150' | 14'-0" | 4'x10' (0% Void) | 4.50% | W33x387 | #4@11 | #7@10 | 400 lbs/ft |
| | | 200' | 16'-0" | 4'x10' (0% Void) | 4.50% | W30X391 + 5.5"x20" Flange Plates | #4@11 | #7@10 | 1000 lbs/ft |
| | 20'-0" O.C. | 70' | 9'-0" | 4'x4' (80% Void) | 2.50% | W33x387 | #4@11 | #7@10 | 450 lbs/ft |
| | | 100' | 9'-0" | 4'x9' (55% Void) | 4% | W33x387 | #4@11 | #7@10 | 600 lbs/ft |
| | | 150' | 14'-0" | | | | | | |
| | | 200' | 16'-0" | | | | | | |
| 5- Story Steel Construction (See Note 2) | 10'-0" O.C. | 70' | 9'-0" | 4'x4' (60% Void) | 1.00% | W30x90 | #4@11 | #7@10 | 180 lbs/ft |
| | | 100' | 9'-0" | 4'x4' (60% Void) | 2.50% | W30x90 | #4@11 | #7@10 | 225 lbs/ft |
| | | 150' | 14'-0" | 4'x10' (0% Void) | 4.50% | W33x387 | #4@11 | #7@10 | 350 lbs/ft |
| | | 200' | 16'-0" | 4'x10' (0% Void) | 4.50% | W30X391 + 4.5"x20" Flange Plates | #4@11 | #7@10 | 750 lbs/ft |
| | 20'-0" O.C. | 70' | 9'-0" | 4'x4' (80% Void) | 2.50% | W30x90 | #4@11 | #7@10 | 360 lbs/ft |
| | | 100' | 9'-0" | 4'x9' (55% Void) | 4% | W33x387 | #4@11 | #7@10 | 450 lbs/ft |
| | | 150' | 14'-0" | | | | | | |
| | | 200' | 16'-0" | | | | | | |
| Park/Roadway | 10'-0" O.C. | 70' | 9'-0" | 4'x4' (60% Void) | 2.50% | W30x90 | #4@11 | #7@10 | 225 lbs/ft |
| | | 100' | 9'-0" | 4'x4' (60% Void) | 2.50% | W33x387 | #4@11 | #7@10 | 300 lbs/ft |
| | | 150' | 14'-0" | 4'x10' (0% Void) | 4.00% | W33x387 | #4@11 | #7@10 | 400 lbs/ft |
| | | 200' | 16'-0" | 4'x10' (0% Void) | 4.50% | W30X391 + 4.5"x20" Flange Plates | #4@11 | #7@10 | 1000 lbs/ft |
| | 20'-0" O.C. | 70' | 9'-0" | 4'x4' (80% Void) | 2.50% | W33x387 | #4@11 | #7@10 | 450 lbs/ft |
| | | 100' | 9'-0" | 4'x10' (50% Void) | 4% | W33x387 | #4@11 | #7@10 | 600 lbs/ft |
| | | 150' | 14'-0" | | | | | | |
| | | 200' | 16'-0" | | | | | | |

| | |
|---|---|
| | Shaded box is tentatively viable pending additional information. |
| | Crossed Out Box reperesents a Span and Truss to Truss Spacng Combination that does not meet Deflection and/or Strength Criteria |
| **Notes:** | 1) 9'-0" Overall Depth Of Truss Analyzed is based on Elevations taken at the center of Honeywell Street Bridge. Otherwise depth is what is required to meet deflection criteria and/or strength criteria. |
| | 2) Steel Deck is assumed raised to Future Grade. No Soil Load applied. |
| | 3) Steel Tonnage Per Truss does not include any buildings on top of the deck. |

# Structural Quantities for Walls, Deck and Trusses

| Building Analysis | | | | | | | Supplemental Damping Requirement | |
|---|---|---|---|---|---|---|---|---|
| **Building Typology** | **Levels** | **Construction** | **Building Footprint Size** | **Description** | **Orientation To Train Tracks Below** | **Slenderness Ratio** | **Tuned Slosh Damper (Section 2.10 Structural Design Basis Report)** | **Tuned Mass Damper (Section 2.10 Structural Design Basis Report)** |
| Residential-1 | 15 Floors | Block And Plank Tower with Steel Transfer Podium | 60'x200' | 15 Floors / 160' to Main Roof (plus Mechanicals):13 Residential Floors @ 10'; 1 Parking Floor @ 10'; GF @ 20' | Parallel<br>Perpendicular | 2.7 | 0%-33% | 0%-33% |
| Residential-2 | 43 Floors | Reinforced Concrete Tower with Steel Transfer Podium | 60'x175' | 43 Floors / 440' to Main Roof (plus Mechanicals):40 Residential Floors @ 10'; 2 Parking Floors @ 10'; GF @ 20' | Parallel<br>Perpendicular | 7.3 | 34%-66% | 0%-33% |
| Residential-3 | 69 Floors | Reinforced Concrete Tower with Steel Transfer Podium | 60'x175' | 69 Floors / 700' to Main Roof (plus Mechanicals): 65 Residential Floors @ 10'; 3 Parking Floors @ 10'; G @ 20' | Parallel<br>Perpendicular | 11.7 | 67%-100% | 34%-66% |
| Office-1 | 18 Floors | Steel Tower with Steel Transfer Podium | 150'x250' | 18 Floors/ 260' to Main Roof (plus Mechanicals); 14 Office Floors @15'; 3 parking floors @ 10'; GF @ 20' | Parallel<br>Perpendicular | 1.7 | 0%-33% | 0%-33% |
| Office-2 | 33 Floors | Steel Tower with Steel Transfer Podium | 125'x200' | 33 Floors/ 475' to Main Roof (plus Mechanicals); 29 Office Floors @14'; 3 parking floors @10; GF @ 19' | Parallel<br>Perpendicular | 3.8 | 0%-33% | 0%-33% |
| Office-3 | 44 Floors | Steel Tower with Steel Transfer Podium | 130'x210' | 44 Floors/ 595' to Main Roof (plus Mechanicals); 39 Office Floors @14'; 4 Parking Floors @ 10'; GF @ 19' | Parallel<br>Perpendicular | 4.6 | 34%-66% | 0%-33% |

## Structural Damping Requirements

# Appendix H.
# Estimated Cost of Off-Site Utility Improvements

## Water Distribution Piping

**Estimated Cost:**

| WATER DISTRIBUTION PIPING | |
|---|---|
| **Zone** | **Cost** |
| A | $1,000,000 |
| B.N | $1,000,000 |
| B.S | $2,000,000 |
| C.N | $1,000,000 |
| C.S | $4,000,000 |
| D | $30,000,000 |
| E | $13,000,000 |
| F | $16,000,000 |
| G | $20,000,000 |
| **TOTAL:** | **$88,000,000** |

Assumptions:

1. Generally good water pressure and supply in vicinity but local distribution mains undersized and old.
2. No trunk water supply mains required to support development – assume primary supply source to area is 60" trunk main in Jackson Ave/23rd St., limiting need for more extensive off-site improvements to network.
3. Upgrade of distribution supply network piping is required to meet increased demand and redundancy in case of pipe breaks and water.
4. Provide for redundant distribution mains around perimeter of development area (Jackson/Northern Blvd/Skillman) with connecting mains in major streets crossing Sunnyside (Thompson, Queens Blvd., Honeywell, 39th and 43rd Streets).
5. Offsite distribution network enhancements can be phased with the individual SSY development phasing.

| PHASE | NEW WATER MAINS, LF | | | | |
|---|---|---|---|---|---|
| | **30"** | **24"** | **20"** | **12"** | COMMENTS |
| B.N, B.S | 5,000 | 1,000 | | | No existing connection except old 12" pipe in Queens Blvd. Assume new 30" in Jackson/ Northern Blvd. from Davis, 24" including new main at Honeywell and Queens Blvd. from Northern Blvd. to SSY |
| C.N, C.S | 2,000 | | 500 | | New 30" in Northern Blvd. between Honeywell and 39th St; and new 20" to supplement existing 12" at 39th St. from Northern Blvd. to SSY |
| F | 500 | 4,000 | | 4,000 | New parallel 24" and 12" mains in Skillman between Queens Blvd. and 39th Street |
| D.W, D.E | 2,000 | 3,000 | | | Extend 30" main in Northern Blvd between 39th and 43rd Street; and new 24" in 43rd St. from Northern Blvd. to Skillman |
| G | 500 | 5,000 | | 6,000 | New parallel mains in Skillman from 47th Ave. to Queens Blvd. |
| E | | 3,000 | | 3,000 | Parallel mains in Skillman from 39th to 43rd St and other local improvements |
| A | | | | | No additional improvements required |
| **TOTAL** | 10,000 | 16,000 | 500 | 13,000 | |

Other estimating criteria for offsite water mains:

- Assume ductile iron pipe with internally locking joints as per NYCDEP Cover depth within roadways = 4ft. nominal
- All water mains installed within roadbed of NYC streets
- Pavement restoration – assume 12" pavement depth (2.5" min asphalt overlay of 10" unreinforced concrete) on 12" subbase (recycled material)
- Pavement restoration width – minimum width of 1 travel lane (12 ft.)

Additional Water Mains within SSY

| PHASE | NEW WATER MAINS, LF | | | | |
|---|---|---|---|---|---|
| | **30"** | **24"** | **20"** | **12"** | COMMENTS |
| B.N, B.S | | 3,000 | | | New mains across Honeywell and Queens Blvd. bridges (attached to bridge) |
| C.N, C.S | | 1,500 | 1,500 | | New mains across 39th St Bridge (attached to bridge) |
| Total | | 4,500 | 1,500 | | |

### Sanitary Sewers – Offsite Improvements

**Estimated Cost:**

| SANITARY SEWERS | |
|---|---|
| **Zone** | **Cost** |
| A | $4,000,000 |
| B.N | $1,000,000 |
| B.S | $4,000,000 |
| C.N | $5,000,000 |
| C.S | $5,000,000 |
| D | $10,000,000 |
| E | $9,000,000 |
| F | $10,000,000 |
| G | $10,000,000 |
| **TOTAL:** | **$58,000,000** |

Assumptions:

- Existing sewers in SSY vicinity generally combined sewers.
- Adequate capacity in local collector and trunk sewers for additional sanitary load if stormwater-only network is constructed to divert existing stormwater from the combined network.
- Many of existing sewers are old and of unknown condition. Premise for sanitary sewer recommendations is that some local area sanitary sewers associated with each Development Phase may warrant reconstruction on basis of age and condition, and potentially can be downsized due to development of storm-only sewers in some locations.

| Development Phase | Sewer Pipe Size | Length | Location |
|---|---|---|---|
| B.N, B.S | 24" Dia. | 1,000 LF | Unspecified adjacent local streets |
| C.S | 24" Dia. | 1,000 LF | Unspecified adjacent local streets |
| C.N | 24" Dia. | 1,000 LF | Unspecified adjacent local streets |
| F | 24" Dia. | 2,000 LF | Skillman from 39th St. to Honeywell |
| D.W, D.E | 24" Dia. | 2,000 LF | Unspecified adjacent local streets |
| G | 24" Dia. | 2,000 LF | Skillman from 39th St. to Honeywell |
| E | 24" Dia. | 2,000 LF | Unspecified adjacent local streets |
| A | 24" Dia. | 1,000 LF | Unspecified adjacent local streets |

### Storm-Only Sewers - Offsite Improvements

**Estimate Cost:**

| STORM WATER SEWERS | |
|---|---|
| **Zone** | **Cost** |
| A | $0 |
| B.N | $1,000,000 |
| B.S | $6,000,000 |
| C.N | $1,000,000 |
| C.S | $2,000,000 |
| D | $61,000,000 |
| E | $0 |
| F | $0 |
| G | $0 |
| **TOTAL:** | **$71,000,000** |

Assumptions:

1. NYCDEP wastewater treatment plants cannot accept any new/increased stormwater flows.
2. In order to minimize any increase in number of CSO events or volume of CSO discharges, additional sanitary flows generated by the development must be accompanied by comparable/greater volume of stormwater reduction.
3. To achieve this reduction, developments will utilize green building techniques for stormwater management; however, the existing SSY has relatively low discharges into NYCDEP sewers due to low runoff coefficient – most of runoff infiltrates directly into track subballast.
4. Network of storm-only sewers proposed would add two new outfalls to Dutch Kill, and is intended to divert all SSY overflow/high storm event runoff into Dutch Kill (after appropriate pre-treatment to reduce sediment/floatables/grease/oil load).
5. Storm-only network would also divert local surface roads south of SSY along Skillman to Dutch Kill.
6. No indepth drainage analysis has been performed – pipe sizes shown are indicative only.

| Development Phase | Pipe Size | Length | Location | Comments |
|---|---|---|---|---|
| B.N, B.S | 24" Dia. | 600 LF | Queens Blvd from Northern Blvd to SSY | Underground pipe |
| | 42" Dia. | 750 LF | Queens Blvd from SSY to Skillman | Microtunnel Installation - route feasibility not tested |
| | 5" x 8" FTRC | 1,200 LF | Skillman from Queens Blvd to 29th St. | |
| | 5" x 8" FTRC | 800 LF | 29th St. from Skillman to Dutch Kill outfall | |
| | Tide Gate | | Dutch Kill | Tide gate chamber and outfall structure |
| C.N, C.S | 36" Dia. | 600 LF | Honeywell from LIRR mainline to Skillman | Microtunnel installation - route feasibility not tested |
| | 54" Dia. | 1,500 LF | Skillman from Honeywell to Queens Blvd. | Pile supported |
| F | 36" Dia. | 1,100 LF | Skillman from 39th St. to Honeywell | No additional work to (C.S) |
| D.W, D.E | 24" Dia. | 600 LF | 39th Street from SSY to south abutment | Underground pipe - pile supported |
| | 36" Dia. | 200 LF | 39th St. from south abut. To Skillman | Attach to bridge? - route feasibility not tested |
| G | 24" Dia. | 750 LF | Skillman from 49th Ave. to Davis | Uses Phase 1C Outfall |
| | | | | |
| E | 24" Dia. | 1,000 LF | 43rd St to Skillman | |
| | 36" Dia. | 1,300 LF | Skillman from 43rd to 39th Street | |

| PHASE | ESTIMATED DEMAND LOAD | SUB-STATION NUMBER | COMMENT |
|---|---|---|---|
| B.N, B.S | 50 | 2 | Site location likely too distant for collocation with Substation 1 |
| C.S | 30 | 3 | Possible collocation with Sub #2 |
| C.N | | | Supply from Sub. 3 |
| F | 20 | 4 | |
| D.W, D.E | 35 | 5 | Potential to co-locate with Sub. #3 |
| G | 30 | 6 | |
| E | 10 | | Supply from either Sub. #4 or Sub. #5 |
| A | | | |
| **TOTAL** | 175 | | |

**Electrical Distribution Network Offsite Improvements**

Assumptions:

1. CON ED distribution substations will be required to supply the project.
2. Additional transmission feeders to the area capital expenditure funded by Con Ed through their user rate structure. Same for distribution substations; however, if possible land should be set aside and reserved for this purpose. Cost of land/lost opportunity cost for the land may be a project cost.
3. Each substation requires a site of 15,000 to 20,000 sq. ft. (approx. ½ acre)
4. An estimated seven substations, ave. demand load of 35 MW, will be required.
5. Multiple substations could be collocated; however, geographic location of demand loads limits possible collocation suggests that a minimum of 3 or 4 larger sites would still be required.
6. Size and configuration of substations are such that, unlike local distribution substations that provide power to individual sites, the distribution substations are impractical to locate in mezzanine/utility services level of overbuild deck.

# Appendix E.
# Fire Safety and Code Analysis

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# FIRE SAFETY AND CODE ANALYSIS FOR NEW YORK CITY EDC SUNNYSIDE YARD OVERBUILD PROTOYPE PLAN

**Prepared For**

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22 West 19th Street
New York, New York 10011

**August 26, 2016**

Project #: 1CXB16002





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## 1. INTRODUCTION

Sunnyside Yards is an open rail yard network, of approximately 200 acres, supporting active rail use by AMTRAK, Metropolitan Transit Authority / Long Island Rail Road (MTA/LIRR), and New Jersey Transit (NJT). It is approximately one and three-quarters miles in length and 1,600 feet across at its widest point. AMTRAK, MTA and several private parties own the land that makes up Sunnyside Yards. The City of New York owns the air rights for certain parcels. Sunnyside Yards currently serves as a primary active rail corridor, as well as a primary storage and maintenance facility, for AMTRAK and NJT trains. Sunnyside Yards serves the electric fleets of both AMTRAK and NJT. Both railroads' electric trains are powered via overhead (catenary) wire. LIRR passenger trains also traverse the length of the yards in route to the East River Tunnels to the west and the Main Line to the east. Freight trains also make use of the Sunnyside Yards.

The Project Site generally consists of Sunnyside Yards in Queens and adjacent areas, and will focus on the property owned by AMTRAK and the City, including any air rights. The Project Site is generally bounded:

- by Northern Boulevard to the north;
- by Skillman Avenue/49$^{th}$ Avenue to the south;
- by a line extending from 47$^{th}$ Avenue to the west; and
- by 43$^{rd}$ Street to the east.

MTA's property in the area immediately adjacent to the Project Site is included in the Feasibility Study.

The Sunnyside Yard Feasibility Study (Project) is intended to provide guidance to the City, AMTRAK, and the community of Queens as to the viability of an overbuild project at Sunnyside Yards, and provide recommendations for the implementation of such a project. The Feasibility Study is envisioned as a comprehensive and detailed assessment that considers all of the relevant aspects needed to establish the feasibility of developing any potential program at Sunnyside Yards, including technical, environmental, market, and financial analyses.

Specific factors to be evaluated include but are not limited to the following:

- Configuration of the rail yards and their impact on development
- On-going requirements of the rail operations
- Geotechnical conditions, infrastructure/utility conditions/requirements
- Requirements and limitations of proposed deck structures over the rail yards
- Local environmental impacts of the development project
- Financial feasibility of the project and financing strategies
- Which land should be developed, which should be merely decked over, and which should remain untouched.
- Division of the overbuild into development phases, each including ratings of interaction with the railroad, the type of decking that should be utilized, the massing available to be programmed, and suggested mitigation pathways to minimize costs and development timeline.

The following three Test Cases were developed:

- Test Case 1 – Residential
- Test Case 2 – Live, Work, Play
- Test Case 3 – Destination

Based on those test cases, a final Prototype Plan was developed. This report will summarize the applicable codes requirements for the following aspects of fire and life safety for the Prototype Plan.

- Occupancy and Construction Type
- Fire-Resistance Rated Separations and Enclosures
- Penetrations
- Fire Protection Systems
- Means of egress

- Special Occupancy Requirements
- Hazardous Material Control Areas
- Fire Department Access

### 1.1. APPLICABLE CODES – BELOW THE OVERBUILD DECK

Overbuild areas at track level, up to and including the structure supporting the street level, will be designed in compliance with the requirements imposed by the various rail transportation agencies.

1.1.1 AMTRAK

AMTRAK typically serves as its own Authority Having Jurisdiction (AHJ) on AMTRAK projects. Work associated with the current SSY Expansion project is being designed to be in compliance with the following:

- Title 28 of the *New York City Administrative Code - 2014 New York City Construction Codes*
- Title 29 of the *New York City Administrative Code - 2014 New York Fire Code*

Specifically the 2014 New York City Building Code (NYCBC) and the 2014 New York City Fire Code (NYCFC) are being used to evaluate the fire protection and life safety aspects of the Sunnyside Yard expansion project and will also be used for the track level, up to and including the structure supporting the street level for the overbuild Prototype Plan.

NFPA 130 *Standard for Fixed Guideway Transit and Passenger Rail Systems* would also be applied to any areas that include passenger terminals and transit ways used for public occupied trains. With respect to transit stations Chapter 5 of NFPA 130 is supplemental to the requirements of the local building codes. Where the requirements in this chapter do not address a specific feature of fire protection or life safety, the requirements of the local codes shall be considered applicable. Though NFPA 130 does not specifically address rail storage and maintenance areas it may be used as a guide for those areas because compliant egress may not be otherwise possible under the NYCBC.

1.1.2 MTA / LIRR

The current East Side Access (ESA) project is being designed to comply with the following:

- The Building Code of the State of New York (BCNYS)
- NFPA 130 *Standard for Fixed Guideway Transit and Passenger Rail Systems*
- NFPA 101 *Life Safety Code*

Both an above deck MTA station, and an above and below deck LIRR station are proposed within the Sunnyside Yard Overbuild Prototype Plan. With respect to transit stations Chapter 5 of NFPA 130 is supplemental to the requirements of the local building codes. Where the requirements in this chapter do not address a specific feature of fire protection or life safety, the requirements of the local codes shall be considered applicable.

The State of New York is currently in the process of adopting the 2015 Edition of the ICC Family of Codes which will collectively be known as the 2016 Codes of New York State. That adoption will become fully effective October 3, 2016. Therefore with respect to fire protection and life safety, the 2015 ICC International Building Code (IBC) will be used as the basis for the BCNYS.

### 1.2. APPLICABLE CODES – OVERBUILD DECK & ABOVE

The overbuild deck, and the development on and above the deck will be designed in compliance with the following requirements of the New York City Building and Fire Departments:

- Title 28 of the *New York City Administrative Code - 2014 New York City Construction Codes*
- Title 29 of the *New York City Administrative Code - 2014 New York Fire Code*



- NFPA 130 *Standard for Fixed Guideway Transit and Passenger Rail Systems*

With respect to transit stations Chapter 5 of NFPA 130 is supplemental to the requirements of the local building codes. Where the requirements in this chapter do not address a specific feature of fire protection or life safety, the requirements of the local codes shall be considered applicable.

## 2. OCCUPANCY AND CONSTRUCTION TYPE

The structures comprising the Prototype Plan will consist of varying occupancy classifications and construction types.

- Each building occupancy will be determined using Chapter 3 of the NYCBC and BCNYS.
- The construction types necessary and construction element fire resistant ratings of the various structures associated with the Prototype Plan will be in accordance with Chapters 5 and 6 of the NYCBC and BCNYS.

For the most part, occupancy classifications, construction classifications, and fire resistance ratings in the NYCBC mirror those in the proposed BCNYS because they are both based on IBC.

### 2.1. OCCUPANCY CLASSIFICATION

Buildings will be classified based on their use as determined by Chapter 3. Occupancies which may be present in the proposed structures of the Sunnyside Yard Overbuild Prototype Plan are shown in Table 2-1 below.

**Table 2-1: Sunnyside Yard Prototype Plan Occupancies**

| BCNYS Chapter 3 | | |
|---|---|---|
| **BELOW DECK** | | |
| **Occupancy** | **Use Group** | **Comments** |
| Assembly | A-3 | Rail Station Waiting Areas |
| Business | B | Administrative Offices & Support |
| Factory | F-1 | Train Maintenance |
| Factory | F-2 | Mechanical & Electrical Equipment Rooms |
| Storage | S-1 | Storage (Moderate Hazard) |
| Storage | S-2 | Storage of Rail Cars & Engines (Low Hazard) |
| **NYCBC Chapter 3** | | |
| **ABOVE DECK** | | |
| **Occupancy** | **Use Group** | **Comments** |
| Assembly | A-1 | Uses, usually with fixed seating, intended for the production and viewing of the performing arts or motion pictures |
| Assembly | A-2 | Uses intended for food and/or drink consumption |
| Assembly | A-3 | Uses intended for worship, recreation or amusement |
| Assembly | A-4 | Uses intended for viewing of indoor sporting events and activities with spectator seating |
| Business | B | Offices, Higher Education |
| Educational | E | Schools (K – 12) |
| Mercantile | M | Retail |
| Factory | F-2 | Mechanical & Electrical Equipment Spaces |
| Residential | R-1 | Hotels |
| Residential | R-2 | Apartments, Condominiums |
| Storage | S-1 | Storage (Moderate Hazard) |
| Storage | S-2 | Storage (Low Hazard) – Parking Garages |

### 2.2. HEIGHT AND AREA

Based on the building size and the occupancy, the height and area limitations are prescribed by chapter 5 of the NYCBC [Table 503] and BCNYS [Table 504.4]. Based on the proposed sizes and heights of the majority of the buildings in the Prototype Plan, it is anticipated that most will be either Type IA or Type IB construction. The main overbuild deck (street level) and supporting structure will be Type IA construction because of the size of its total area and because in many cases it will be supporting structures of Type IA construction. Smaller standalone buildings might fall into the categories of Type IIA, and IIB construction.

### 2.3. CONSTRUCTION TYPE

#### 2.3.1. NYCBC & BCNYS

The requirements for construction types, Types IA, IB, IIA, and Type IIB construction, are shown below in Table 2-2 [Table 601 NYCBC and BCNYS].

**Table 2-2: Construction Element Fire-Resistance Rating**

| CONSTRUCTION ELEMENT | Construction Type | | | |
|---|---|---|---|---|
| | Type IA Ratings (hr) | Type IB Ratings (hr) | Type IIA Ratings (hr) | Type IIB Ratings (hr) |
| Primary Structural Frame | 3[a] | 2[a] | 1 | 0 |
| Bearing Walls (Interior & Exterior) | 3[a] | 2[a] | 1 | 0 |
| Interior Nonloadbearing Walls and Partitions | 0 | 0 | 0 | 0 |
| Floor Construction and Secondary Members | 2 | 2 | 1 | 0 |
| Roof Construction and Secondary Members | 1 ½ [b] | 1[b] | 1 | 0 |
| Enclosure of Vertical Exits [1022.1 NYCBC, 1023.2 BCNYS] | 2 (4 stories or more)<br>1 (Less than 4 stories) | | | |
| Hoistways and Shafts [708.4 NYCBC, 713.4 BCNYS] | 2 (penetrating 3 or more stories)<br>1 (penetrating fewer than 3 stories) | | | |
| Exit Passageways [1023.3 NYCBC, 1024.3 BCNYS)] | Same as the fire-resistance rating of the vertical exit enclosure it connects but not less than 1-hour | | | |
| Structural Members Supporting a Wall [704.1 NYCBC & BCNYS] | Same as the required fire-resistance rating of the wall supported, but not less than the rating required for the member by the construction classification | | | |

a. Roof supports: Fire-resistance ratings of primary structural frame and bearing walls are permitted to be reduced by 1 hour where supporting a roof only.
b. Except in Group F-1, M, and S-1 occupancies, fire protection of structural members shall not be required, including protection of roof framing and decking where every part of the roof construction is 20 feet or more above any floor immediately below.



#### 2.3.2. NFPA 130

NFPA 130 requires new enclosed stations[1] to be of either Type I or Type II construction as defined in NFPA 220 and in accordance with NFPA 101 *Life Safety Code* [5.2.2.1]. For a sprinklered building, NFPA 101 would allow NFPA 220 Type II (111) for stations no more than three stories and with a maximum of 1 story below the level of exit discharge. Type II (111) mirrors IBC Type IIA. Type II (222) and Type I (332) would both allow unlimited height and levels below the level of exit discharge. NFPA 220 Type II (222) mirrors IBC Type IB. NFPA 220 Type I (332) mirrors IBC Type IA.

For trainways[2], NFPA 130 requires NFPA 220 Type I and Type II construction for tunnel construction [6.2.2.1], Type II for surface construction [6.2.2.6], and Type I and Type II for elevated construction [6.2.2.7].

NFPA 130 requires railroad ties in enclosed locations to be of non-combustible materials [6.2.8.1]. Rail ties used at switch or crossover locations must be either of non-combustible materials or fire-treated wood in accordance with NFPA 703 [6.2.8.2]. Rail ties and tie blocks in enclosed locations may be of wood encased in concrete where only the top surface of the wood is exposed [6.2.8.3].

## 3. FIRE-RESISTANCE RATED SEPARATIONS AND ENCLOSURES

Above deck building separation distances and construction type will determine the required exterior wall ratings and allowable exterior openings. The interior wall ratings required will be based on their location and the use/rooms that they divide or surround.

When two or more buildings are constructed on the same tax lot, they can be regulated as separate buildings or as one building at the discretion of the owner [503.1.2 NYCBC and BCNYS]. If they are regulated as one building they must meet the requirements for height and area of Table 503 for the most restrictive use, or meet one of the conditions for an unlimited area building in Section 507.

### 3.1. FIRE-RESISTANCE RATING (INTERIOR)

The required fire-resistance ratings for interior walls, vertical exit enclosures, exit passageways, and hoistways are shown in the previous section in Table 2-2.

#### 3.1.1. Occupancy Separations

In many of the buildings above the deck, there will be multiple occupancies present. If treated as separated mixed-use buildings, the separations between occupancies must follow Section 508.4 of the NYCBC. These requirements are summarized in Table 3-1 below. Table 508.4 in the BCNYS has similar requirements.

**Table 3-1: Required Separation of Occupancies**

| Occupancy | A, E | | R | | F-2, S-2 | | B | | F-1 | | M | | S-1 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | S | NS | S | NS | S | NS | S | NS | S | NS | S | NS | S | NS |
| A, E | N | N | 1 | 2 | N | 1 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 |
| R | - | - | N | N | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 |
| F-2, S-2 | - | - | - | - | N | N | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 |
| B | - | - | - | - | - | - | N | N | 2 | 3 | 1 | 2 | 2 | 3 |
| F-1 | - | - | - | - | - | - | - | - | N | N | 2 | 3 | 2 | 3 |
| M | - | - | - | - | - | - | - | - | - | - | N | N | 2 | 3 |
| S-1 | - | - | - | - | - | - | - | - | - | - | - | - | N | N |

[1] Station - a place designated for the purpose of loading and unloading passengers, including patron service areas and ancillary spaces associated with the same structure [NFPA 130].
[2] Trainway - that portion of the system in which the vehicles operate [NFPA 130].

S= Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1 of the NYCBC
NS= Building not equipped throughout with an automatic sprinkler system installed in accordance with Section 903.1.1 of the NYCBC.
N= No separation requirement

If the buildings are treated as non-separated mixed-use buildings in accordance with NYCBC or BCNYS Section 508.3, no separations are required, however the height and area and construction type must be based on the most restrictive use.

3.1.2. Accessory Uses

Accessory uses, as defined in NYCBC and BCNYS Section 508.2 do not need to be separated from the main occupancy use of the building as long as the aggregate area of all accessory uses in a story constitute no more than 10% of the area of that story, and the height and area of the accessory uses do not exceed the values in NYCBC Table 503 and BCNYS Table 504.4 without building area increases.

3.1.3. Incidental Uses

Incidental uses are ancillary functions associated with a given occupancy that generally pose a greater level of risk to that occupancy and are limited to those uses listed in Table 3-2 below [NYCBC Table 509]. Requirements in BCNYS Section 509 are similar.

**Table 3-2: Fire-Resistance Rating of Elements or Spaces**

| ROOM OR AREA | Separation and/or Protection |
|---|---|
| Furnace room where any piece of equipment is over 350,000 Btu per hour input | 2 hour; or 1 hour and provide automatic sprinkler system |
| Furnace room where any piece of equipment is 350,000 Btu per hour input or less | 1 hour or provide automatic sprinkler system |
| Rooms with a high pressure steam or water boiler that exceeds 350,000 Btu per hour input | 2 hour, or 1 hour and provide automatic fire-extinguishing system |
| Rooms with a high pressure steam or water boiler that is 350,000 Btu per hour input or less | 1 hour or provide automatic sprinkler system |
| Rooms that contain a low pressure steam or water boiler regardless of Btu per hour input | 1 hour or provide automatic sprinkler system |
| Refrigerant machinery room | 1 hour or provide automatic sprinkler system |
| Paint shops, not classified as Group H, located in occupancies other than Group F | 2 hours; or 1 hour and provide automatic sprinkler system |
| Laundry rooms over 100 square feet | 1 hour or provide automatic sprinkler system |
| Waste and linen collection rooms over 100 square feet | 1 hour or provide automatic sprinkler system |
| Stationary storage battery systems having a liquid electrolyte capacity of more than 50 gallons for flooded lead-acid, nickel cadmium or VRLA, or more than 1,000 pounds for lithium-ion and lithium metal polymer used for facility standby power, emergency power or uninterruptable power supplies | 1 hour in Group B, F, M, and S occupancies; 2 hours in Group A occupancies. |
| Rooms containing fire pumps in non-high-rise buildings (NYCBC Only) | 2 hours; or 1 hour and provide automatic sprinkler system |
| Rooms containing fire pumps in high-rise buildings (NYCBC Only) | 2 hours |



Where Table 3-2 specifies a fire resistance-rated separation, the incidental uses shall be separated from the remainder of the building by a fire barrier constructed in accordance with NYCBC/BCNYS Section 707 or a horizontal assembly constructed in accordance with NYCBC Section 712 (BCNYS 711), or both.

Incidental uses must be included in the building occupancies within which they are located. Incidental uses must not occupy more than 10 percent of the building area of the story in which they are located [NYCBC/BCNYS 509.3].

3.1.4. NFPA 130

NFPA 130 requires public areas in stations to be separated from non-public areas [5.2.4.2], and non-system occupancies[3] [5.2.4.5] by fire separations. Trainways are required to be separated from ancillary areas[4] by 2-hour rated fire-resistance separations [6.2.4.2].

## 3.2. FIRE-RESISTANCE RATING (EXTERIOR)

The separation distance of buildings located on individual lots is determined by measuring the distance from a building face to the lot line or to the centerline of a public way. The separation distance between two buildings on the same lot is determined by locating an assumed imaginary line between them [705.3 NYCBC and BCNYS]. The required rating for exterior walls are shown in the NYCBC Tables 601 and 602. The applicable requirements for the construction types proposed are summarized in Table 2-2 above [Table 601 NYCBC and BCNYS] and Table 3-3 below [Table 602 NYCBC and BCNYS].

**Table 3-3: Fire-Resistance Rating by Fire Separation Distance**

| Fire Separation Distance (feet) | Type of Construction | Occupancy Group F-1, M, S-1 | Occupancy Group A, B, E, F-2, R, S-2 |
|---|---|---|---|
| X < 5 | All | 2 | 1 |
| 5 ≤ X< 10 | IA, IB<br>IIB<br>IIA | 1<br>0<br>1 | 1<br>0<br>1 |
| 10 ≤ X < 30 | IA, IB<br>IIB<br>IIA | 1<br>0<br>1 | 1<br>0<br>1 |
| X ≥ 30 | All | 0 | 0 |

The required fire-resistance rating of exterior walls with a fire separation distance of greater than 10'- 0" may be rated for exposure to fire from the inside only. If the fire separation distance is less than 10'- 0" the wall must be rated for exposure from both sides [705.5].

Where buildings on the same lot are considered a single building in accordance with NYCBC 503.1.2, 602.1, and the exception to NYCBC 705.2, no ratings of the exterior walls facing one another is required.

Where a party wall is located on a property line, the requirements of Table 706.4 of the NYCBC and BCNYS are applicable. Party walls fall under the requirements of Section 706.1.1 [NYCBC and BCNYS]. The requirements for party wall separations of uses are summarized in Table 3-4 below.

**Table 3-4: Fire Wall Fire-Resistance Ratings (Party Walls)**

| Occupancy Group | Fire-Resistance Rating |
|---|---|
| A, B, E, R-1, R-2 | 3 |

[3] Non-system occupancy - an occupancy not under the control of the system-operating authority [NFPA 130].
[4] Ancillary Area - the nonpublic areas or spaces of the stations usually used to house or contain operating, maintenance, or support equipment and functions [NFPA 130].

| | |
|---|---|
| F-1, M, S-1 | 3 |
| F-2, S-2 | 2 |

The maximum allowable area of unprotected and protected openings in exterior walls are specified in Table 705.8 of the NYCBC and BCNYS. However, for buildings whose exterior bearing walls, nonbearing walls, and primary structural frame are not required to be fire-resistant, the building is permitted to have an unlimited area of unprotected openings [705.8.1].

## 4. PENETRATIONS

Penetrations which provide openings in any fire rated walls are required to be protected by Section 713 of the NYCBC and 714 of the BCNYS. All through-penetrations in fire-resistant walls are required to be protected by a firestop system which is not less than the rating of the penetrated wall [713.3.1.2 NYCBC, 714.3.1.2 BCNYS]. Similarly, penetrations of horizontal assemblies, such as floors and ceilings, are required to be protected by the same requirements [713.4.1.1.2 NYCBC, 714.4.1.2 BCNYS]. Membrane penetrations for both walls and horizontal assemblies are required to be protected by membrane firestop installations and comply with the applicable sections if the wall or horizontal assembly is also fire rated.

Fire and smoke dampers are required to be installed in all ducts/air transfer openings penetrations of rated assemblies per Section 716 of the NYCBC and 717 of the BCNYS. Fire dampers are required at all fire walls, fire barriers, and fire partitions penetrations [716.5.1 and 716.5.2 NYCBC, 771.5.1 and 771.5.2 BCNYS]. Smoke dampers are required to be installed at all penetrations through walls which are smoke barriers and serve as horizontal exits [716.5.1.1 and 716.5.2.1 NYCBC, 717.5.1.1 and 717.5.2.1 BCNYS]. Any penetrations through a shaft enclosure or horizontal assembly (floors or ceilings) shall be protected by a combination fire/smoke damper [716.5.3 NYCBC, 717.5.3 BCNYS].

Ducts which are less than 20 square inches and pass through a fire-resistant rated assembly are not required to be protected by a fire or smoke damper [716.5 NYCBC]. This exception does not apply to the BCNYS. Where ducts penetrate a fire rated assembly and are not required to be protected per the NYCBC, they shall be protected in accordance with the requirements of Section 713 of the NYCBC [716.1.1 NYCBC], or 714 of the BCNYS [717.1.2].

Where required, fire dampers shall be rated in accordance with the requirements of the Table 4-1 below.

**Table 4-1: Required Fire Damper Ratings**

| Type of Penetration | Minimum Damper Rating (Hour) |
|---|---|
| Less than 3-hour fire-resistance rated assembly | 1.5 |
| 3 hour or greater fire-resistance rated assembly | 3 |

Smoke dampers are required to be no less than Class II leakage [716.3.2.2 NYCBC, 717.3.2.2 BCNYS]. Where combination fire/smoke dampers are installed, they are required to meet both requirements for smoke and fire dampers as described above.

## 5. FIRE PROTECTION SYSTEMS

The requirements for fire protection systems are found in Chapter 9 of the NYCBC and BCNYS. Sprinkler systems and fire alarm systems are required based on the occupancy of the subject building. The requirements for automatic sprinkler systems are found in Section 903 while the requirements for fire alarm and detection systems are found in Section 907. Requirements for standpipe and hose systems are found in Chapter 9 Section 905. Requirements for smoke control systems for stair and elevator shaft pressurization, and atrium smoke control are found in Chapter 9 Section 909. Requirements for fire command centers are found in Chapter 9 Section 911.

NFPA 130 also specifies requirements for sprinkler, standpipe, fire alarm, fire command center, and smoke control systems in stations and trainways.



### 5.1. Automatic Sprinkler Systems

Automatic sprinkler systems are required to be installed in the locations described in Section 903.2 of the NYCBC and BCNYS. The following table, Table 5-1, indicates where automatic sprinkler systems are required for the occupancies which are present in the Sunnyside Yard Overbuild Prototype Plan.

A fire area, as used in Table 5-1 below is defined as the aggregate floor area enclosed and bounded by fire walls, fire barriers, exterior walls and/or horizontal assemblies of a building. Areas of the building not provided with surrounding walls shall be included in the fire area if such areas are included within the horizontal projection of the roof or floor next above [NYCBC 902.1, BCNYS 202].

**Table 5-1: Required Automatic Sprinkler Systems**

| Occupancy | Required by Section 907.2 | Where Required |
|---|---|---|
| A-1 | Yes | Throughout the floor area where the assembly occupancy occurs and floors between the assembly occupancy and the level of exit discharge [903.2.1].<br>• The fire area exceeds 12,000 square feet [903.2.1.1]<br>• The occupant load of the space is 300 or greater [903.2.1.1]<br>• The aggregate occupant load on the floor is 300 or greater [903.2.1.1]<br>• The fire area is located on a floor other than the level of exit discharge [BCNYS 903.2.1.1]<br>• The fire area contains a multi-theater complex [903.2.1.1] |
| A-2 | Yes | Throughout the floor area where the assembly occupancy occurs and floors between the assembly occupancy and the level of exit discharge [903.2.1].<br>• The fire area exceeds 5,000 square feet [903.2.1.2]<br>• The occupant load of the space is 300 or greater [NYCBC 903.2.1.2]<br>• The occupant load of the space is 100 or greater [BCNYS 903.2.1.2]<br>• The aggregate occupant load on a floor other than the level of exit discharge is 300 or greater [NYCBC 903.2.1.2]<br>• The fire area is located a floor other than the level of exit discharge [BCNYS 903.2.1.2]<br>• The occupancy is used as a cabaret [NYCBC 903.2.1.2] |
| A-3, A-4 | Yes | Throughout the floor area where the assembly occupancy occurs and floors between the assembly occupancy and the level of exit discharge [NYCBC 903.2.1].<br>• The fire area exceeds 12,000 square feet [NYCBC 903.2.1.3]<br>• The occupant load of the space is 300 or greater [NYCBC 903.2.1.3]<br>• The aggregate occupant load on the floor is 300 or greater [NYCBC 903.2.1.3]<br>The fire area is located a floor other than the level of exit discharge [BCNYS 903.2.1.3] |
| B | No | • High Rise office buildings require an automatic sprinkler system per NYCBC and BCNYS Section 403<br>• Ambulatory Care Facilities when four or more care recipients are incapable of self-preservation, or one or more care recipients are incapable of self-preservation and are located at other than the level of exit discharge [903.2.2] |
| E | Yes | Entire building to be protected if:<br>• The fire area exceeds 12,000 square feet [BCNYS 903.2.3] |

| Occupancy | Required by Section 907.2 | Where Required |
|---|---|---|
| | | • The fire area exceeds 20,000 square feet [NYCBC 903.2.3]<br>• Throughout every portion of educational buildings below the level of exit discharge [903.2.3] |
| F-1 | Yes | Entire building to be protected if:<br>• The fire area exceeds 12,000 square feet [903.2.4]<br>• The combined area of all Group F-1 fire areas exceed 24,000 square feet [903.2.4]<br>Group F-1 Occupancy protected if:<br>• Fire area is located more than 3 stories above grade plane [903.2.4.3]<br>Fire area exceeds 7,500 square feet [NYCBC 903.2.4.3] |
| M | Yes | Entire building to be protected if:<br>• The fire area exceeds 12,000 square feet [903.2.7]<br>• The combined area of all Group M fire areas exceed 24,000 square feet [903.2.7]<br>• Fire area is located more than 3 stories above grade plane [903.2.4.7]<br>Group M Occupancy protected if:<br>Fire area exceeds 7,500 square feet [NYCBC 903.2.7.2] |
| R-1, R-2 | Yes | An automatic sprinkler system shall be installed throughout buildings with a main use or dominant occupancy of Group R |
| S-1 | Yes | Entire building to be protected if:<br>• Fire area exceeds 12,000 square feet [903.2.9]<br>• Fire area is located more than 3 stories above grade plane [903.2.9]<br>• Building is greater than 1,000 square feet in area or the main use is S-1 [BCNYS 903.2.9]<br>• The combined area of all Group S-1 occupancies exceeds 24,000 square feet [903.2.9]<br>Group S-1 Occupancy protected if:<br>Fire area is greater than 500 square feet [BCNYS 903.2.9] |
| S-2 | Yes | Entire building to be protected if:<br>• Fire area exceeds 12,000 square feet in an enclosed parking garage [BCNYS 903.2.10]<br>• Where an enclosed parking garage is located below another use [BCNYS 903.2.10]<br>• In all enclosed parking garages or where an open parking garage is located below another use [NYCBC 903.2.10.3]<br>• The building is greater than 5,000 square feet and S-2 is the main occupancy. [NYCBC 903.2.10]<br>Group S-2 Occupancy protected if:<br>Fire areas greater than 5,000 square feet [NYCBC 903.2.10.2] |

Sprinklers may also be required for the protection of Incidental Use areas in accordance with NYCBC and BCNYS Table 509.

High-rise buildings must be equipped throughout with an automatic sprinkler system in accordance with Section 28.2-903.3.1.1. A secondary water supply shall be provided where required by Section 28.2-903.3.5.2. [NYCBC 403.3]

Additionally in building spaces having a floor level used for human occupancy more than 30 feet below the finished floor of the lowest level of exit discharge, the highest level of exit discharge serving the underground portions of the building and all levels below must be equipped with an automatic sprinkler system installed in accordance with NYCBC and BCNYS Section 28.2-903.3.1.1. Water-flow switches and control valves



must be supervised in accordance with NYCBC and BCNYS Section 28.2-903.4. [NYCBC and BCNYS 505.3]

NFPA 130 requires sprinkler protection in areas of stations used for concessions, in storage areas, in trash rooms, and other similar areas with combustible loadings, except trainways [5.4.4.1]. Sprinkler protection of trainways is not required.

### 5.2. Standpipe & Hose Systems

Standpipe systems are required to be installed in the locations described in Section 905.3.1 of the NYCBC. The locations requiring Class III standpipes are as follows:

- In buildings two stories or more in height with floor area of 10,000 square feet or greater on any story;
- In buildings three stories or more in height with floor area of 7,500 square feet or greater on any story;
- In buildings of any area with a floor level having an occupant load of 30 or more that is located 55 feet or more above the lowest level of Fire Department vehicle access;
- In high-rise buildings of any area, constructed in accordance with Section 403, with occupied floors located 75 feet or more above the lowest level of Fire Department vehicle access.

An exception to NYCBC Section 503.1 allows the use of Class I standpipe systems in buildings protected throughout with an automatic sprinkler system when also provided with hose cabinets for fire department use at the entry level and every 10th level above or below. Where Class I standpipe systems are installed, Class I hose connections are required at the following locations:

- At each floor level in each required egress stair.
- On either side of the wall adjacent to each horizontal exit opening.
- Where a roof has a slope of less than 4:12, for each standpipe a hose connection must be provided at the roof or highest landing in a stair leading to the roof.
- On any floor where there is any area more than 150 feet from a hose connection, additional hose connections must be provided.

NFPA 130 requires Class I standpipes in enclosed stations [5.4.5.1]. Standpipes are not required to be enclosed in fire-rated construction if they are cross fed and isolation valves are installed not more than 800 feet apart [5.4.5.2]. Dry standpipes are allowed where approved by the AJH [5.4.5.4].

In trainways, NFPA 130 requires Class I standpipes in enclosed trainways where physical factors prevent or impede access to the water supply or fire apparatus, and where required by the AHJ [6.4.4.1]. Standpipes are not required to be enclosed in fire-rated construction if they are cross fed and isolation valves are installed not more than 800 feet apart [6.4.4.3]. Dry standpipes are allowed where approved by the AHJ [6.4.4.4]. A fire department access road shall extend to within 100 feet of the fire department connection(s) [6.4.4.10].

### 5.3. Fire Alarm and Detection Systems

Fire alarm and detection systems are required to be installed in the locations described in Section 907.2 of the NYCBC and BCNYS. The following table, Table 5-2, indicates what occupancies require fire alarm and detection systems for the Sunnyside Yard Overbuild Prototype Plan.

**Table 5-2: Required Manual and Automatic Fire Alarm Systems**

| Occupancy | Required by Section 907.2 | Where Required |
|---|---|---|
| A | Yes[a] | • In areas of Group A occupancies where the occupant load equals or exceeds 300 occupants. [907.2.1] |

| Occupancy | Required by Section 907.2 | Where Required |
|---|---|---|
| | | • In areas of Group A occupancies where the occupant load equals or exceeds 300 occupants a pre-signal automatic fire alarm system is required. [NYCBC 907.2.1]<br>• Group A-2 occupancy used as a cabaret with an occupant load of 75 or more, including associated stages, dressing rooms, and property rooms, shall be equipped with a manual fire alarm system. [NYCBC 907.2.1]<br>• Group A-2 occupancy used as a cabaret with an occupant load of 300 or more shall also be equipped with an automatic fire alarm system. [NYCBC 907.2.1]<br>• Group A occupancies with a stage in accordance with Section 28.2-410, and having an occupant load of 75 or more, shall be provided with a voice/alarm communication system. [NYCBC 907.2.1] |
| B[b] | Yes[c] | If one of the following exists<br>• Combined Group B occupant load of all floors is 500 or more. [907.2.2]<br>• Group B occupant load is more than 100 above or below the lowest level of exit discharge. [907.2.2]<br>• Group B fire area contains a Group B ambulatory health care facility. [907.2.2]<br>• Group B occupancies having a total gross area exceeding 100,000 square feet located in buildings where the highest occupied floor is less than 75 feet above the lowest level of Fire Department vehicle access shall be provided with automatic smoke detection connected to an automatic fire alarm system and an emergency voice/alarm communication system. [NYCBC 907.2.2.2] |
| E | Yes | • A manual and automatic fire alarm system shall be installed. When automatic sprinkler systems or smoke detectors are installed, such systems or detectors shall be connected to the building fire alarm system. [907.2.3] |
| F | Yes[a] | • If two or more stories in height and have an occupant load of 100 or more. [NYCBC 907.2.4]<br>• If two or more stories in height and have an occupant load of 100 or more. [BCNYS 907.2.4]<br>• 25 persons or more are located above the lowest level of exit discharge. [907.2.4] |
| M | Yes | If one of the following exists<br>• Where the fire area exceeds 12,000 square feet. [NYCBC 907.2.7]<br>• Where the fire area is located more than three stories above grade. [NYCBC 907.2.7]<br>• The combined area of all Group M fire areas exceed 24,000 square feet. [NYCBC 907.2.7]<br>• Where the fire area of a below-grade story exceeds 1,500 square feet. [NYCBC 907.2.7]<br>• Group M occupancies having a total gross area exceeding 100,000 square feet located in buildings where the highest occupied floor is less than 75 feet above the lowest level of Fire Department vehicle access and covered mall buildings having a total gross area exceeding 50,000 square feet. [NYCBC 907.2.7.1]<br>• The combined Group M occupant load of all floors is 500 or more persons. [BCNYS 907.2.7]<br>• The Group M occupant load is more than 100 persons above or below the lowest level of exit discharge. [BCNYS 907.2.7] |



| Occupancy | Required by Section 907.2 | Where Required |
|---|---|---|
| R-1 | Yes | |
| R-2 | Yes | |
| S-1 | No | |
| S-2 | No | |

a. Manual fire alarm boxes are not required where the building is equipped throughout with an automatic sprinkler system and the notification appliances will activate upon sprinkler water flow.
b. Where protected by an automatic sprinkler system
c. If one of the criteria is met and an automatic sprinkler system is not installed, partial coverage smoke detection or automatic heat detection shall be installed.

In high-rise buildings an emergency voice/alarm communication system must be provided in accordance with Section 28.2-907.5.2.2 9 [NYCBC 403.4.3], and be provided with automatic smoke detection connected to the automatic fire alarm system. Emergency responder radio coverage must be in accordance with the New York City Fire Code and Section 28.2-907.2.13.2 of this code [NYCBC 403.4.4]. A fire command center complying with Section 28.2-911 must also be provided in a location approved by the Fire Department.

In underground building spaces having a floor level used for human occupancy more than 30 feet below the finished floor of the lowest level of exit discharge, a fire alarm system must be provided where required by NYCBC and BCNYS Sections 28.2-907.2.18 and 28.2-907.2.19.

NFPA 130 requires enclosed stations to be provided with a fire command center in accordance with NFPA 72 [5.4.1]. It also requires a public address system and emergency voice alarm reporting devices, such as emergency telephone boxes or manual fire alarm boxes conforming to NFPA 72 in stations [5.4.3.1]. Emergency alarm reporting devices must be located on passenger platforms and throughout the stations such that the travel distance from any point in the public area shall not exceed 325 feet unless otherwise approved [5.4.3.4].

In trainways, NFPA 130 requires Blue Light Stations[5] to be installed at the ends of station platforms, at cross-passageways, at emergency access points, at traction power substations, and in enclosed trainways [6.4.2.1].

### 5.4. Emergencey Alarm Systems

Emergency alarm systems are required to be installed in the locations described in Section 908 of the NYCBC. The following table, 5-3, indicates what occupancies require fire alarm and detection systems for the Sunnyside Yard Overbuild Prototype Plan.

**Table 5-3: Required Emergency Alarm Systems**

| Occupancy | Required by Section 908 | Where Required |
|---|---|---|
| A-1, A-2, A-3 | Yes[a] | • Listed carbon monoxide detectors shall be installed in buildings that are equipped with a fire alarm system.<br>• Detectors shall have built-in sounder bases, shall transmit a signal to a central supervising station and shall be permitted to initiate an audible and visual supervisory alarm at a constantly attended location. |
| B[b] | Yes[a] | In assembly spaces classified as Business Occupancies (occupant load less than 75). |

[5] Blue Light Station - a location along the trainway, indicated by a blue light, where a person can communicate with the operations control center and disconnect traction power. [NFPA 130]

| Occupancy | Required by Section 908 | Where Required |
|---|---|---|
| | | • Listed carbon monoxide detectors shall be installed in buildings that are equipped with a fire alarm system.<br>• Detectors shall have built-in sounder bases, shall transmit a signal to a central supervising station and shall be permitted to initiate an audible and visual supervisory alarm at a constantly attended location. |
| E | Yes | • Listed carbon monoxide detectors with built-in sounder bases shall transmit a signal to a central supervising station and shall be permitted to initiate an audible and visual supervisory alarm at a constantly attended location.<br>• Carbon monoxide detectors with built-in sounder bases shall be installed within any room containing carbon monoxide-producing equipment.[b]<br>• Carbon monoxide detectors with built-in sounder bases shall be installed in corridors on the story where carbon monoxide-producing equipment unit is located, as well as one story above and one story below.<br>• Carbon monoxide detectors with built-in sounder bases shall be installed in all corridors on the story where enclosed parking is located, as well as one story above and one story below. |
| F | No | |
| M | No | |
| R-1 | Yes | Where the main use or dominant occupancy of a building is classified as Group R-2 student apartments.<br>• Carbon monoxide detectors and audible notification appliances shall be installed in affected dwelling units as per Section 28.2-908.7.1.1 and shall be annunciated by dwelling unit at a constantly attended location from which the fire alarm system is capable of being manually activated. |
| R-2 | Yes | Where the main use or dominant occupancy of a building is classified as Group R-2 student apartments.<br>• Carbon monoxide detectors and audible notification appliances shall be installed in affected dwelling units as per Section 28.2-908.7.1.1 and shall be annunciated by dwelling unit at a constantly attended location from which the fire alarm system is capable of being manually activated.<br><br>Where the main use or dominant occupancy of a building is not classified as Group R-2 student apartments.<br>• Carbon monoxide detectors and audible notification appliances shall be installed in affected dwelling units as per Section 28.2-908.7.1.1. |
| S-1 | No | |
| S-2 | No | |

a. Carbon monoxide detectors are not required in kitchens.
b. Not required in kitchens and laboratories.

### 5.5. Smoke Control Systems

With the exception of R-2 occupancies, the NYCBC requires smokeproof exit enclosures in egress stairs serving floors more than 75 feet above the level of fire department access [403.5.4] and those serving underground space more than 30 feet below the finished floor of the lowest level of exit discharge. Where



stair pressurization is used to provide smoke proof enclosures, such systems must comply with Section 909.20. Atriums connecting more than two stories must be provided with a smoke control system in accordance with Section 909 [NYCBC 404.5]. Pressurization of elevator shafts in accordance with NYCBC Section 708.14.12 and Section 909 maybe be used in lieu of elevator lobbies where required in high-rise buildings.

NFPA 130 requires an emergency ventilation system in enclosed trainways [6.4.6.1]. Exceptions are allowed for storage track[6] [6.4.6.3] and tail track[7] [6.4.6.2] areas where based on an engineering analysis it can be shown that a fire in those areas will not affect passengers or passenger areas. Emergency ventilation systems must be designed in accordance with NFPA 130 Chapter 7. Mechanical emergency ventilation systems are required in enclosed system stations and in enclosed trainways greater than 1000 feet in length [7.1.2.2]. Non-mechanical emergency ventilation systems are allowed in enclosed stations where an engineering analysis supports tenability requirements, and in trainways greater than 200 feet in length but less than or equal to 1000 feet in length [7.1.2.4].

In accordance with NFPA 130 vent or fan shafts utilized for ventilation of underground system structures are not allowed to terminate at grade on any vehicle roadway [5.2.3.2]. They are permitted to terminate in the median strips of divided highways, on sidewalks designed to accept such shafts, or in open space areas, provided that the grade level of the median strips, sidewalk, or open-space is at a higher elevation than the surrounding grade level and is separated from any roadway by a concrete curb at least 6 inches in height [5.2.3.3].

## 6. MEANS OF EGRESS

The requirements of NYCBC and BCNYS Chapter 10 will be used to determine the means of egress requirements of each building/structure at Sunnyside Yard. The occupant load, egress capacity, and travel distances will be used to determine compliance with the applicable code sections

### 6.1. Occupant Load

Occupant load calculations will follow the requirements of Section 1004 of the NYCBC and BCNYS. The occupant load factors are summarized below for the functions present in the Sunnyside Yard Overbuild Prototype Plan. Occupant loads are required to be calculated based on actual square footage unless otherwise approved by the AHJ.

**Table 6-1: Occupant Load Factors [NYCBC Table 1004.1.1, BCNYS Table 1004.1.2]**

| Function of Space | Floor Area in Square Feet per Occupant |
|---|---|
| Assembly – Standing/Waiting | 5 Net |
| Assembly – Concentrated (chairs only) | 7 Net |
| Assembly – Unconcentrated (tables & chairs) | 15 Net |
| Terminal Waiting Areas (BCNYS) | 15 Gross |
| Classrooms | 20 Net |
| Business Areas | 100 Gross |
| Mercantile (NYCBC)<br>Areas on Other Floors<br>Basement & Grade Floor Areas | <br>60 Gross<br>30 Gross |
| Mercantile (BCNYS) | 60 Gross |
| Mall Buildings | Per Section 402.4.1.2.1 (NYCBC)<br>Per Section 402.8.2 (BCNYS) |
| Residential (NYCBC) | 200 Gross (Within Dwelling Units) |
| Residential (BCNYS) | 200 Gross |

[6] Storage Track - A portion of the trainway used for temporary storage or light cleaning of trains and not intended to be used for trains occupied by passengers. [NFPA 130]
[7] Tail Track – a portion of dead-end trainway used for temporary storage, turn-around, or light cleaning of trains and not intended to be used for trains occupied by passengers. [NFPA 130]

| Function of Space | Floor Area in Square Feet per Occupant |
|---|---|
| Manufacturing, Commercial Kitchens, Parking Garages | 200 Gross |
| Locker Rooms, Exercise Rooms | 50 Gross |
| Warehouses | 500 Gross |
| Accessory Storage Area, Mechanical Equipment Room | 300 Gross |
| Storage, Stock, Shipping Areas | 300 Gross |

NFPA 130 requires the occupant load of stations to be based on the train load of trains simultaneously entering the station on all tracks in normal traffic direction plus the simultaneous entraining load awaiting trains [5.3.2.1]. For stations servicing areas such as civic centers, sports complexes, and convention centers, the peak ridership figures shall consider events that establish occupant loads not included in normal passenger loads [5.3.2.2].

## 6.2. Egress Capacity

The capacity of the components of the means of egress are described in Section 1005 of the NYCBC and BCNYS and are summarized in Table 6-2 below. When multiple means of egress are sized, they shall be sized to ensure that the loss of one does not reduce total capacity from the floor to less than 50% of the required capacity [NYCBC1005.1].

**Table 6-2: Required Width of Egress Components**

| Component | Required Width | Minimum Width |
|---|---|---|
| Stairs | 0.3 inches/occupant[e] | 44[a] inches |
| Doors | 0.2 inches/occupant[f] | 32[b] inches |
| Corridors | 0.2 inches/occupant[f] | 44[b,c] inches |
| Ramps | 0.2 inches/occupant[f] | 36 inches[d] |

a. 36 inches is allowed if the occupant load of the area served is less than 50 from all stories
b. Denotes required clear width
c. 24 inches is allow where providing access to electrical, mechanical, or plumbing system equipment
d. Measured between handrails
e. BCNYS allows 0.2 inches/occupant in buildings in buildings equipped throughout with an automatic sprinkler system and an emergency voice/alarm communication system.
f. BCNYS allows 0.15 inches/occupant in buildings in buildings equipped throughout with an automatic sprinkler system and an emergency voice/alarm communication system.

NFPA 130 Section 5.3.3 provides the requirements for egress capacity and egress times in stations. Generally 44 inches is the minimum width for platforms, corridors, ramps, and stairs. NFPA 130 allows escalators and elevators to be used for means of egress under certain circumstances, however this would require a variance under the NYCBC or BCNYS.

In trainways, NFPA 130 requires a minimum clear width of 44 inches for stairs [6.3.2.3] and 32 inches for doors [6.3.2.4]. Within the trainway itself the means of egress must be provided with an unobstructed clear width graduating from 24 inches at the walking surface to 30 inches at 62 inches above the walking surface to 17 inches at 80 inches above the walking surface [6.3.2.1].

The number of means of egress are outlined in Section 1021 of the NYCBC and Section 1006 of the BCNYS. The requirements are summarized in Table 6-3 below.

**Table 6-3: Required Number of Exits (per story)**

| Occupant Load (persons per story) | Minimum Number of Exits (per story) |
|---|---|
| 1-500 | 2 |
| 501-1000 | 3 |
| More than 1000 | 4 |



NFPA 130 requires a minimum of two means of egress remote from each other from station platforms [5.3.3.7].

## 6.3. Travel Distance

Travel distance requirements are provided in Chapter 10 of the NYCBC and BCNYS and cover the maximum travel distance allowed to exits [NYCBC 1016, BCNYS 1017], dead end corridor distances [NYCBC 1018.4, BCNYS 10201.1], and common path of travel distances [NYCBC 1014.3, BCNYS 1006.2.1]. The requirements related to these distances have been summarized in Table 6-4 below.

**Table 6-4: Travel Distance Requirements Where Protected by an Automatic Sprinkler System**

| Occupancy | Travel Distance | Dead End Corridor | Common Path of Travel |
|---|---|---|---|
| A (NYCBC) | 150 (Primary)<br>250 (Secondary) | 20[a] | 30 |
| A (BCNYS) | 250 | 50[a] | 75 |
| B | 300 | 50[a] | 100 |
| M, R (NYCBC) | 200 | 50[a] | 100 |
| M, R (BCNYS) | 250 | 50[a] | 75 (M, R-1)<br>125 (R-2) |
| F-1, S-1 (NYCBC) | 200 | 50[a] | 100 |
| F-1, S-1 (BCNYS) | 250 | 50[a] | 100 |
| F-2, S-2 (NYCBC) | 250 | 50[a] | 100 |
| F-2, S-2 (BCNYS) | 400 | 50[a] | 100 |

a. Or 2 ½ times the least width of the dead end corridor.

In stations NFPA 130 allows a maximum travel distance of 325 feet [5.3.3.5] and a common path of travel of 82 feet (or the length of one car) [5.3.3.6] from platforms.

Within enclosed trainways, NFPA 130 allows a maximum travel distance of 2500 feet between exits [6.3.1.4].

# 7. SPECIAL OCCUPANCY REQUIREMENTS

## 7.1. Mezzanine Requirements

The requirements for mezzanines are covered in Section 505 of the NYCBC and BCNYS. In order to be considered a mezzanine, there are requirements which dictate the allowable clear height [505.1 NYCBC, 505.2.1 BCNYS], area with respect to the surrounding room [505.2 NYCBC and BCNYS], egress from the mezzanine [505.3 NYCBC, 505.2.2 BCNYS], and the openness of the mezzanine [505.4 NYCBC, 505.2.3 BCNYS].

Mezzanines are required to provide a clear height of not less than 7ft above and below the floor. The area of all mezzanines located within a space shall not exceed one-third of the area of the space which they are located. For special industrial occupancies [NYCBC and BCNYS 503.1.1], if the structure is of Type I or II construction, the area limitation is increased to two-thirds of the area which it is located. Mezzanines are required to have at least two independent means of egress and fall under the common path travel distance discussed in Section 0.

The NYCBC requires that a mezzanine be open and unobstructed to the room within which it is located. However, there are many exceptions which apply and allow for a mezzanine to be enclosed. A mezzanine is not required to be open if any of the following apply:

- The occupant load is less than 10
- One of the required means of egress provides direct access to an exit
- If the enclosed space is less than 10% of the mezzanine floor space
- Where used for control equipment in industrial facilities
- Where all of the following are present
  - The occupancy is no more than two stories above grade
  - The occupancy is equipped throughout with an automatic sprinkler system
  - An approved fire alarm system is installed throughout the entire building
  - Notification appliances are installed throughout the mezzanine level in accordance with NFPA 72

**7.2. Special Separation Provisions**

7.2.1. Horizontal Separation Allowances [NYCBC and BCNYS 510.2]

Buildings may be considered as separate and distinct from each other for the purpose of determining area limitations, continuity of fire walls, limitation of number of stories and type of construction, where all of the following conditions are met:

- The buildings are separated with a horizontal floor assembly having a minimum 3-hour fire-resistance rating.
- The building below the horizontal assembly is no more than one story above grade plane.
- The building below the horizontal assembly is of Type IA construction.
- Shaft, stairway, ramp or escalator enclosures through the horizontal floor assembly must have a minimum of 2-hour fire-resistance rating with opening protectives in accordance with NYCBC Section 715.4 and BCNYS 713.4.
- The building or buildings above the horizontal assembly may be permitted to have multiple Group A occupancy uses, each with an occupant load of less than 300, or Group B, M, R, or S occupancies.
- The building below the horizontal assembly must be protected throughout by an approved automatic sprinkler system in accordance with NYCBC and BCNYS Section 903.3.1.1, and may be permitted to be any of the following occupancies:
  - Group S-2 parking garage used for the parking and storage of private motor vehicles.
  - Uses incidental to the operation of the building (including entry lobbies, mechanical rooms, storage areas and similar uses).

7.2.2. Group S-2 Enclosed Parking Garage with Group S-2 Open Parking Garage Above [NYCBC and BCNYS 510.3]

A Group S-2 enclosed parking garage with no more than one story above grade plane and located below a Group S-2 open parking garage must be classified as a separate and distinct building for the purpose of determining the type of construction where all of the following conditions are met:

- The allowable area of the building must be such that the sum of the ratios of the actual area divided by the allowable area for each separate occupancy must not exceed 1.
- The Group S-2 enclosed parking garage is of Type I or II construction and is at least equal to the fire-resistance requirements of the Group S-2 open parking garage.
- The height and the number of the tiers of the Group S-2 open parking garage must be limited as specified in NYCBC Table 406.3.5 and BCNYS Table 406.4.
- The floor assembly separating the Group S-2 enclosed parking garage and Group S-2 open parking garage must be protected as required for the floor assembly of the Group S-2 enclosed parking garage. Openings between the Group S-2 enclosed parking garage and Group S-2 open parking garage, except exit openings, shall not be required to be protected.
- The Group S-2 enclosed parking garage is used exclusively for the parking or storage of private motor vehicles, but must be permitted to contain an accessory office, waiting room and toilet room



having a total area of not more than 1,000 square feet, and mechanical equipment rooms incidental to the operation of the building.

7.2.3. Parking Beneath Group R [NYCBC and BCNYS 510.4]

Where a maximum one-story above grade plane Group S-2 parking garage, enclosed or open, or combination thereof, of Type I construction, with grade entrance, is provided under a building of Group R, the number of stories to be used in determining the minimum type of construction shall be measured from the floor above such a parking area. The horizontal floor assembly between the parking garage and the Group R above must comply with the type of construction required for the parking garage and must also provide a fire-resistance rating not less than the mixed occupancy separation required in NYCBC and BCNYS Section 508.4 (Table 3-1 Above).

7.2.4. Open Parking Garage Beneath Groups A, I, B, M And R [NYCBC and BCNYS 510.7]

Open parking garages constructed under Groups A, I, B, M and R must not exceed the height and area limitations permitted under NYCBC Section 406.3 and BCNYS 406.5. The height and area of the portion of the building above the open parking garage must not exceed the limitations in Section 503 for the upper occupancy. The height, in both feet and stories, of the portion of the building above the open parking garage must be measured from grade plane and must include both the open parking garage and the portion of the building above the parking garage.

Fire barriers constructed in accordance with Section 707 or horizontal assemblies constructed in accordance with Section 712 between the parking occupancy and the upper occupancy must correspond to the required fire-resistance rating prescribed in Table 508.4 (Table 3-1 Above) for the occupancies involved. The type of construction must apply to each occupancy individually, except that structural members, including main bracing within the open parking structure, which is necessary to support the upper occupancy, must be protected with the more restrictive fire-resistance-rated assemblies of the groups involved as shown in Table 601 (Table 2-2 Above).

7.2.5. Multiple Buildings above Group S-2 Parking Garages [NYCBC and BCNYS 510.9]

Where two or more buildings are provided above the horizontal assembly separating a Group S-2 open or closed parking garage from the buildings above in accordance with the special provisions in Sections 510.2, 510.3 or 510.8, the buildings above the horizontal assembly shall be regarded as separate and distinct buildings from each other and shall comply with all other provisions of this code as applicable to each separate and distinct building.

**7.3. High-Rise Requirements**

The requirements for high-rise buildings are covered by NYCBC Section 403. A high-rise building is defined as having occupied stories more than 75 feet above the lowest level of fire department access.

High-rise buildings less than 420 feet in height may be of either Type IB or IIA construction as long as they conform to the height and area requirements of Table 601. Regardless, the ratings of columns supporting floors must meet the requirements of Type IA construction. Buildings greater than 420 feet in height must be of Type IA construction.

In buildings five stories or greater in height, elevator service must be provided for fire department emergency access to all floors. Elevator cabs for fire department use must be sized to accommodate a 24 inch by 84 inch ambulance stretcher in horizontal position [NYCBC 3002.4].

In other than Group R-2 buildings, an additional egress stair is required in buildings greater than 420 feet in height [NYCBC 403.5.2]. Exceptions allow the use of occupant evacuation elevators conforming to NYCBC Section 3008 to be used in lieu of the additional elevator.

Buildings with an occupied floor more than 120 feet above lowest level of fire department access must have no less than one Fire Service Access Elevator (FSAE) [403.6.1].

A Fire Command Center in accordance with Section 911 is required by NYCBC 403.4.5. Also see Section 5.3 above.

An emergency voice/alarm communication system is required for high-rise buildings by NYCBC 403.4.3, and emergency responder radio coverage by NYCBC 403.4.4. Also see Section 5.3 above.

Luminous egress path markings, as defined in NYCBC Section 1024, are required for High-Rise buildings [403.5.5]. Egress path markings shall be provided in interior exit stairways, interior exit ramps, and exit passageways.

To facilitate smoke removal in post-fire salvage and overhaul operations, high-rise buildings and structures must be equipped with a natural or mechanical ventilation for removal of products of combustion as required by NYCBC 403.4.6 and in accordance with NYCBC Section 916.

As previously noted in Section 5.5 above, stair pressurization is required in egress stairs serving level greater than 75 feet above fire department access [503.5.4].

## 8. FIRE DEPARTMENT ACCESS

The ability to get emergency response vehicles (fire trucks, ambulances, etc.) throughout the below deck rail yard and buildings, and to each building above deck falls under the requirements of Chapter 5 of the NYCFC. Where the frontage of a building doesn't directly front a public street, a fire apparatus access road is required to be provided from the public way to the building [503.2.1 NYCFC]. The access road is required to have a minimum clear width of 34 feet and have an unobstructed height not less than 14 feet [503.2.3 NYCFC]. A turnaround is required when a length of the access road is a dead-end and exceeds 150 feet from the curb line of the nearest non dead-end public street. If all buildings further than 150 feet on this access road are provided with an approved automatic sprinkler system, a turnaround is not required. If the access road is greater than 400 feet in length and is a dead-end, the road must be approved by the commissioner.

Roof Access to the fire department is required to be provided for fire operations [504.4 NYCFC]. The rooftop must be provided with a clear landing, path, and proper path protection in accordance with Section 504.4 of the NYCFC. Rooftop access plans are required to be approved by the FDNY.

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