



**AgEcon** SEARCH  
RESEARCH IN AGRICULTURAL & APPLIED ECONOMICS

*The World's Largest Open Access Agricultural & Applied Economics Digital Library*

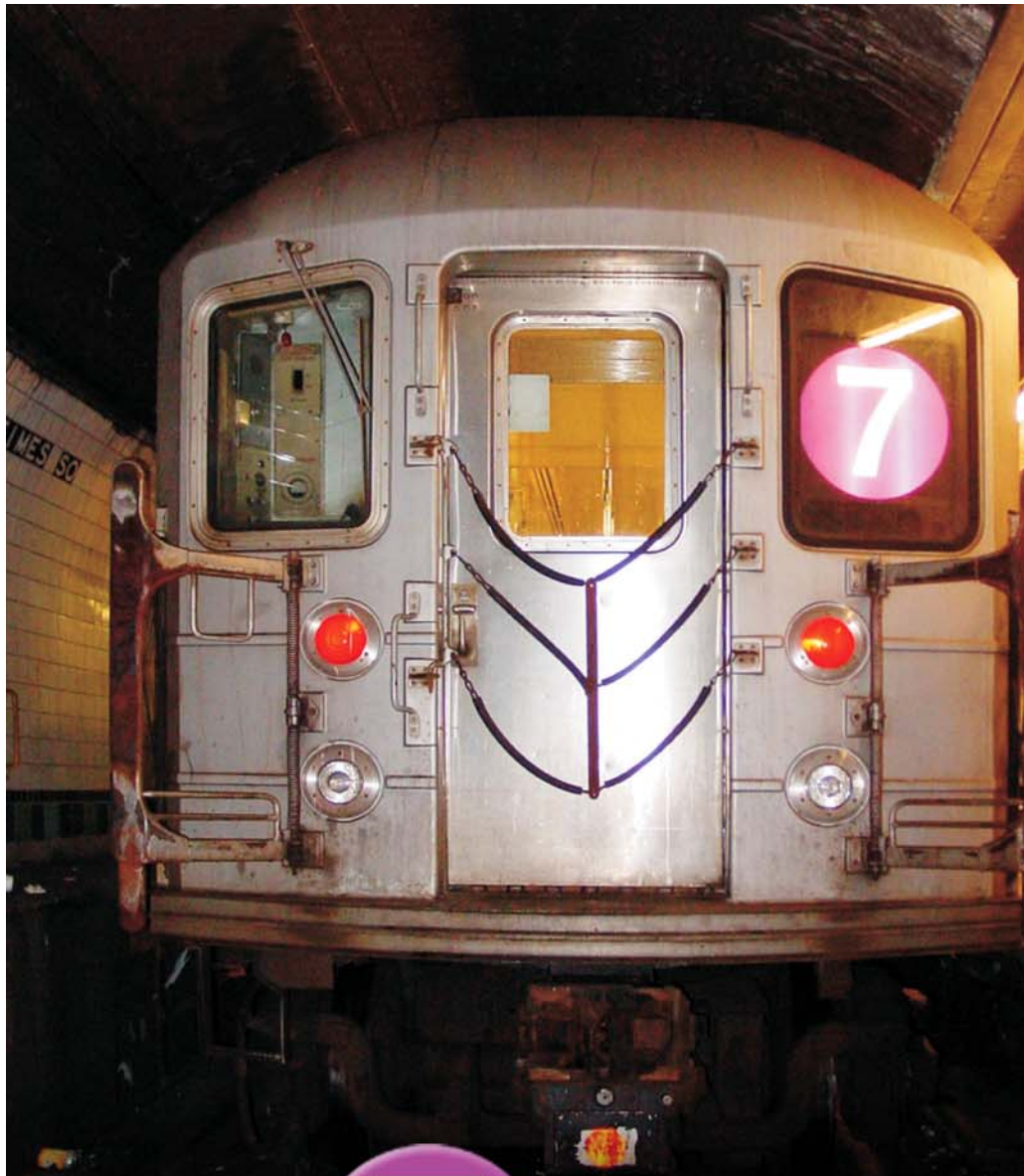
**This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.**

**Help ensure our sustainability.**

Give to AgEcon Search

AgEcon Search  
<http://ageconsearch.umn.edu>  
[aesearch@umn.edu](mailto:aesearch@umn.edu)

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*



**Joseph F. Trainor,**  
**P.E.,**

***Vice President &  
Chief Engineer***

**Transportation  
Research Forum**

***March 23, 2006***

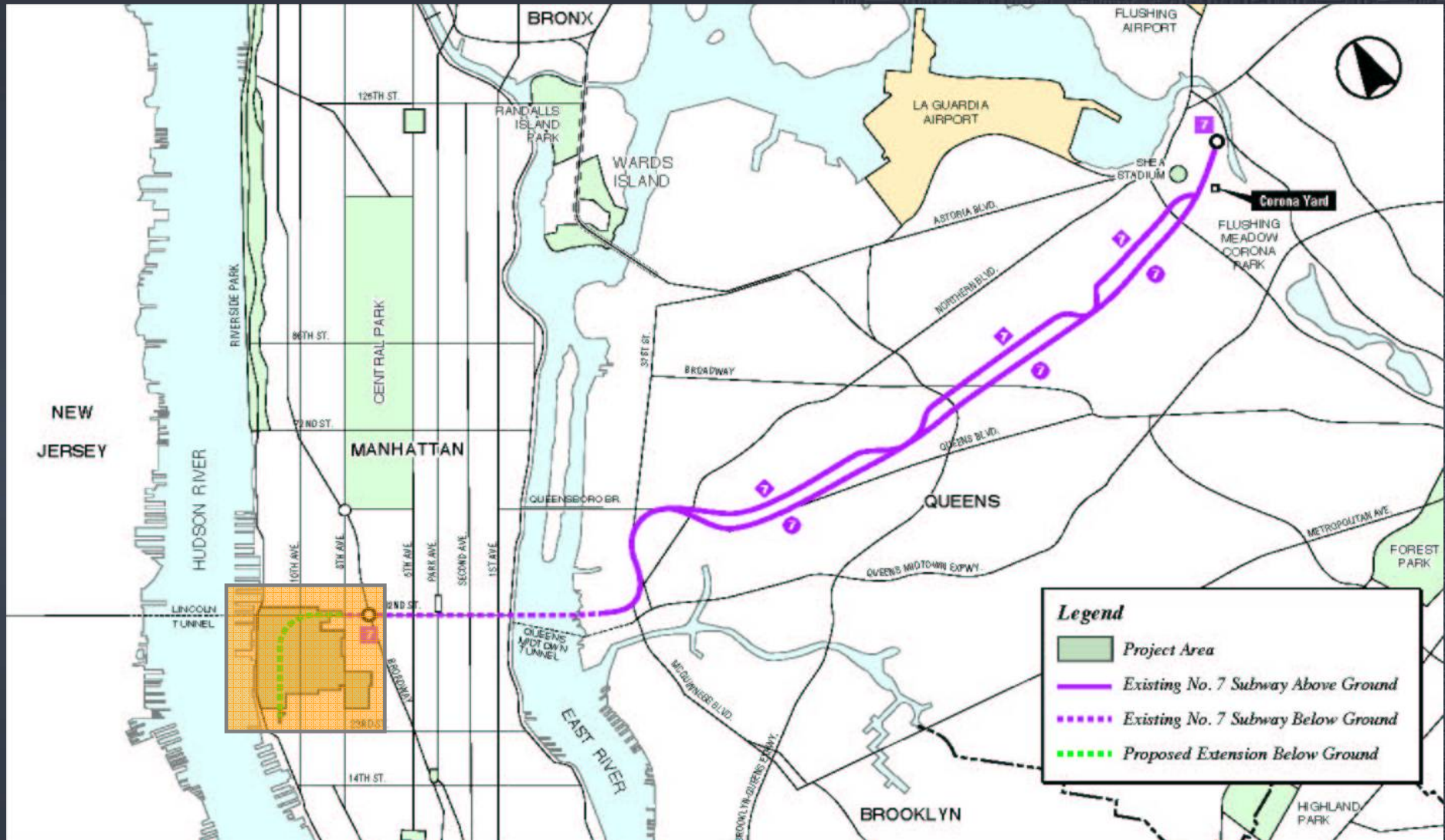
**No.  Subway Line Extension**

# Number 7 Subway Line Extension

## Project Background



# No. 7 Project Context





# Far West Midtown Manhattan Rezoning Hudson Yards Development Area





# Existing Hudson Yards Area



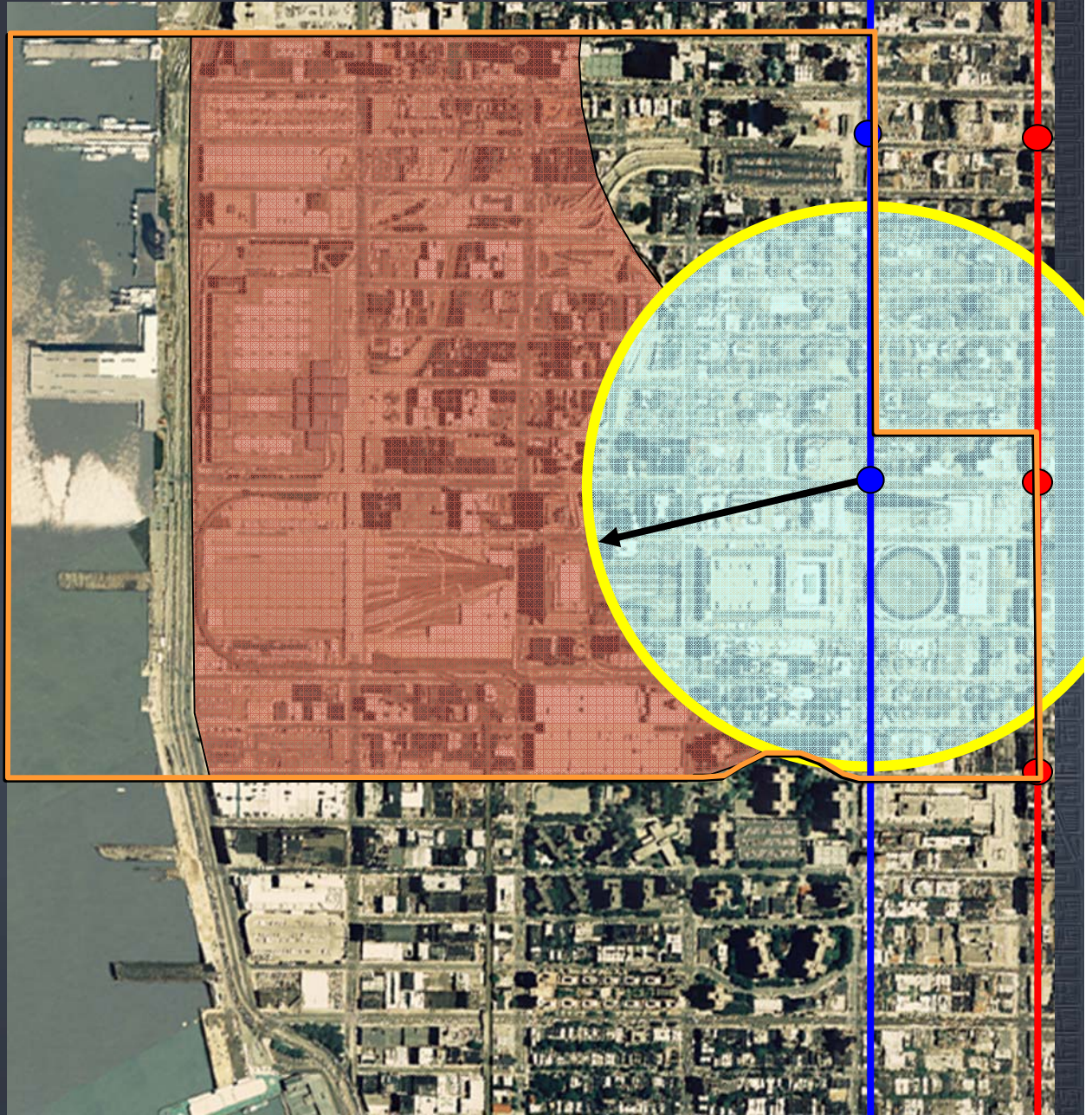






# TRANSPORTATION

- Existing service



Metropolitan Transportation Authority

OVERVIEW **HYDC**  
Hudson Yards Development Corporation

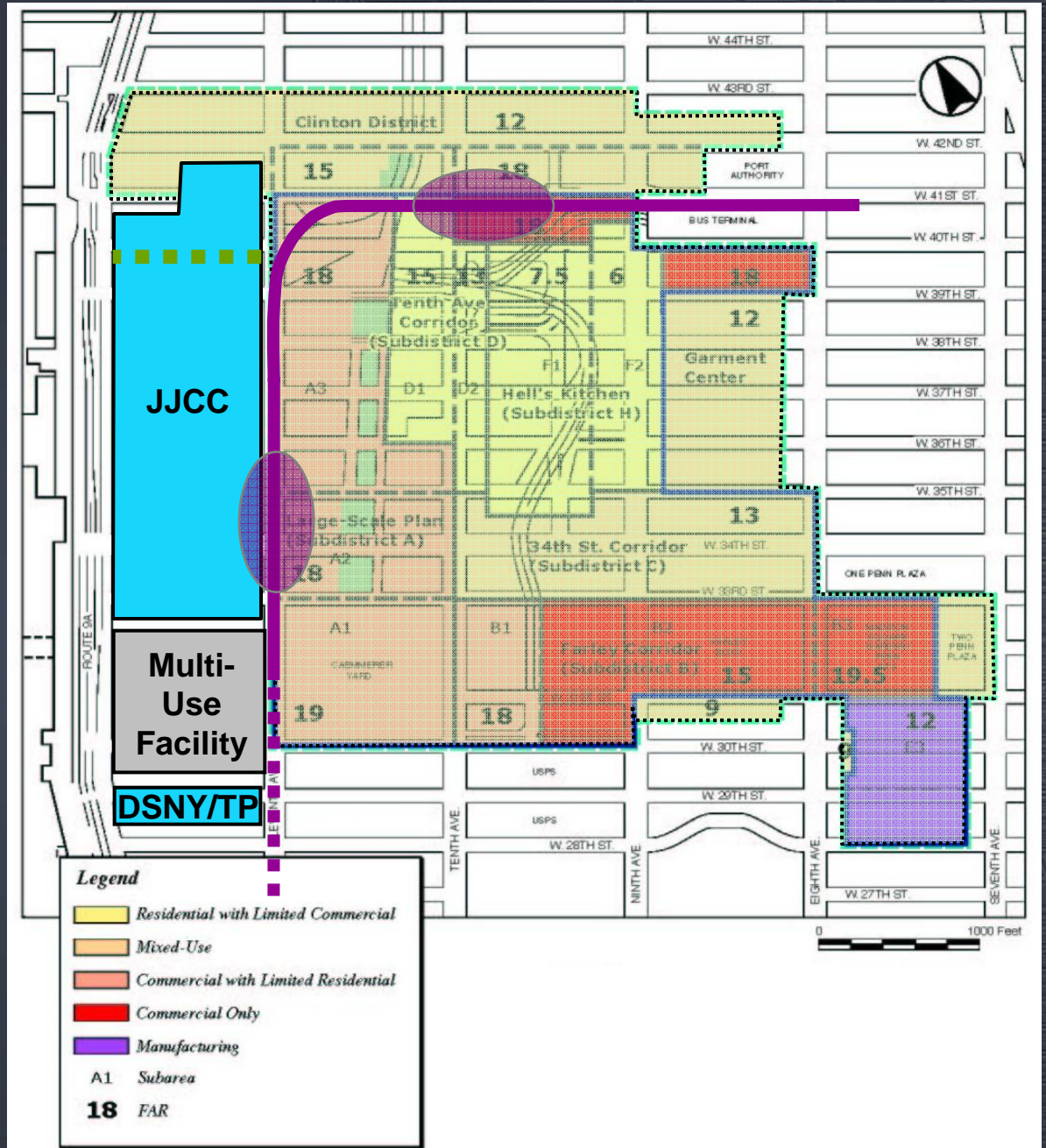


PB Team

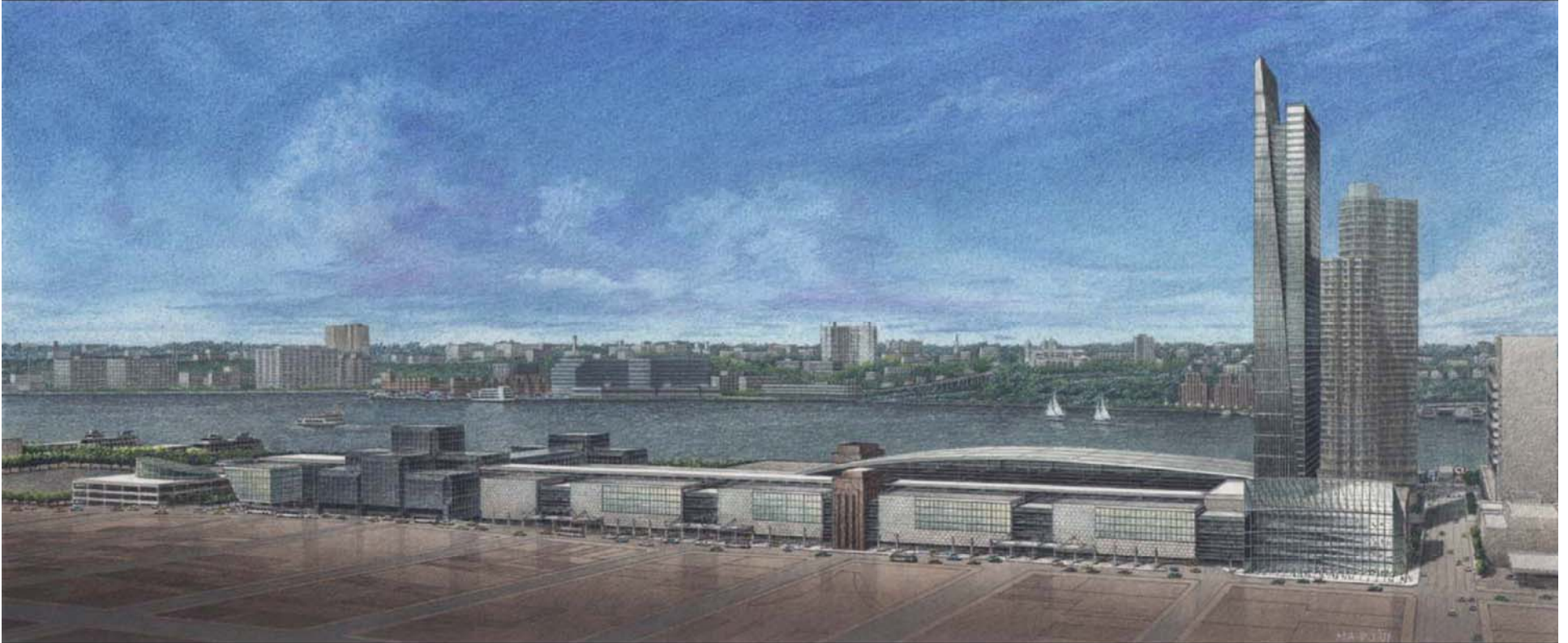


# Proposed Action

- Proposed Rezoning
- Open Space Network
- No. 7 Subway Extension
- Convention Center Expansion
- *Multi-Use Facility*
- DSNY / NYPD Tow Pound Facility



# Jacob Javits Convention Center Expansion





# Proposed Multi-Use Facility





# No. 7 Proposed Alignment



Metropolitan Transportation Authority

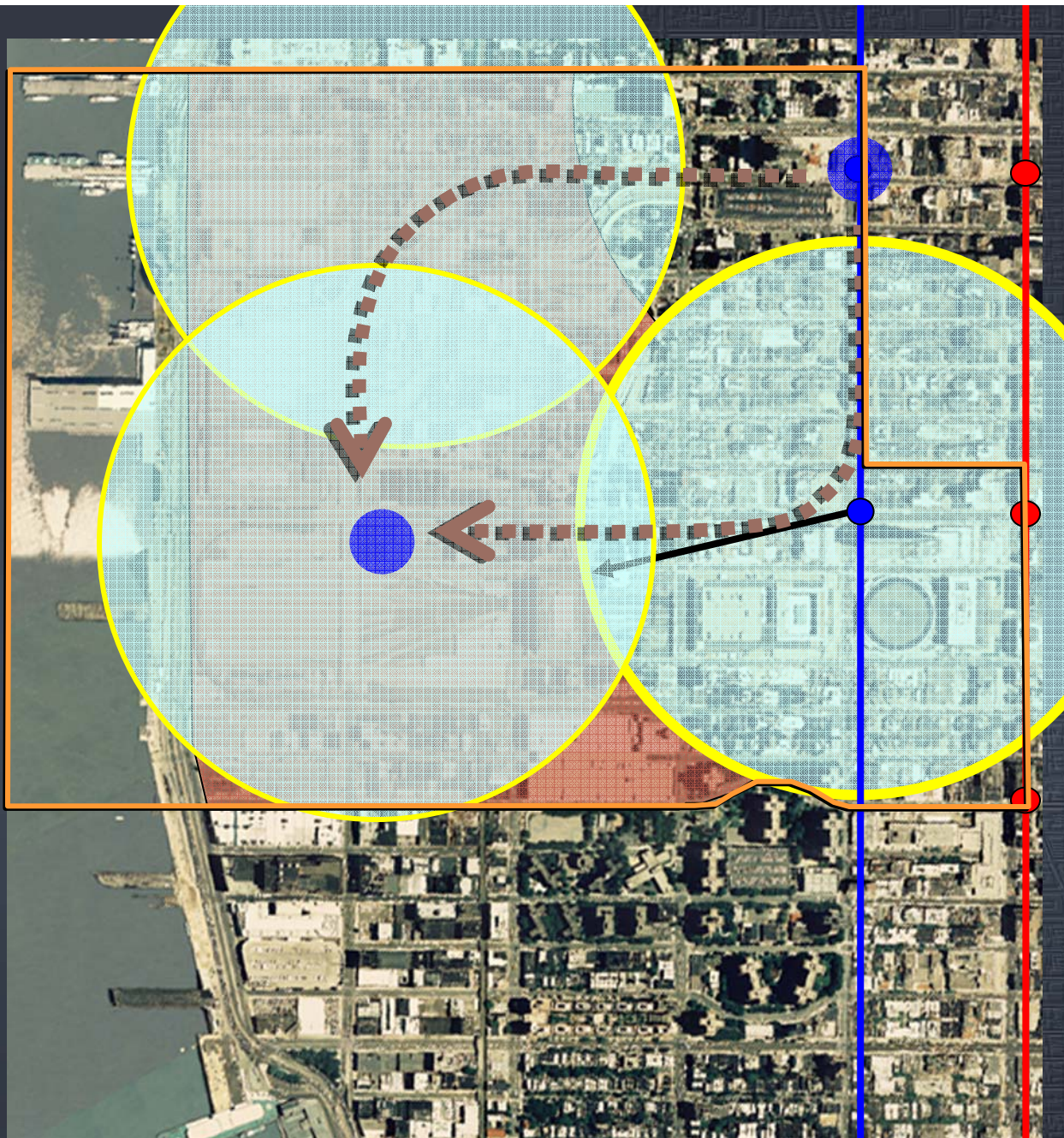


PB Team



# PUBLIC ACTIONS:

- Expand transportation



Metropolitan Transportation Authority

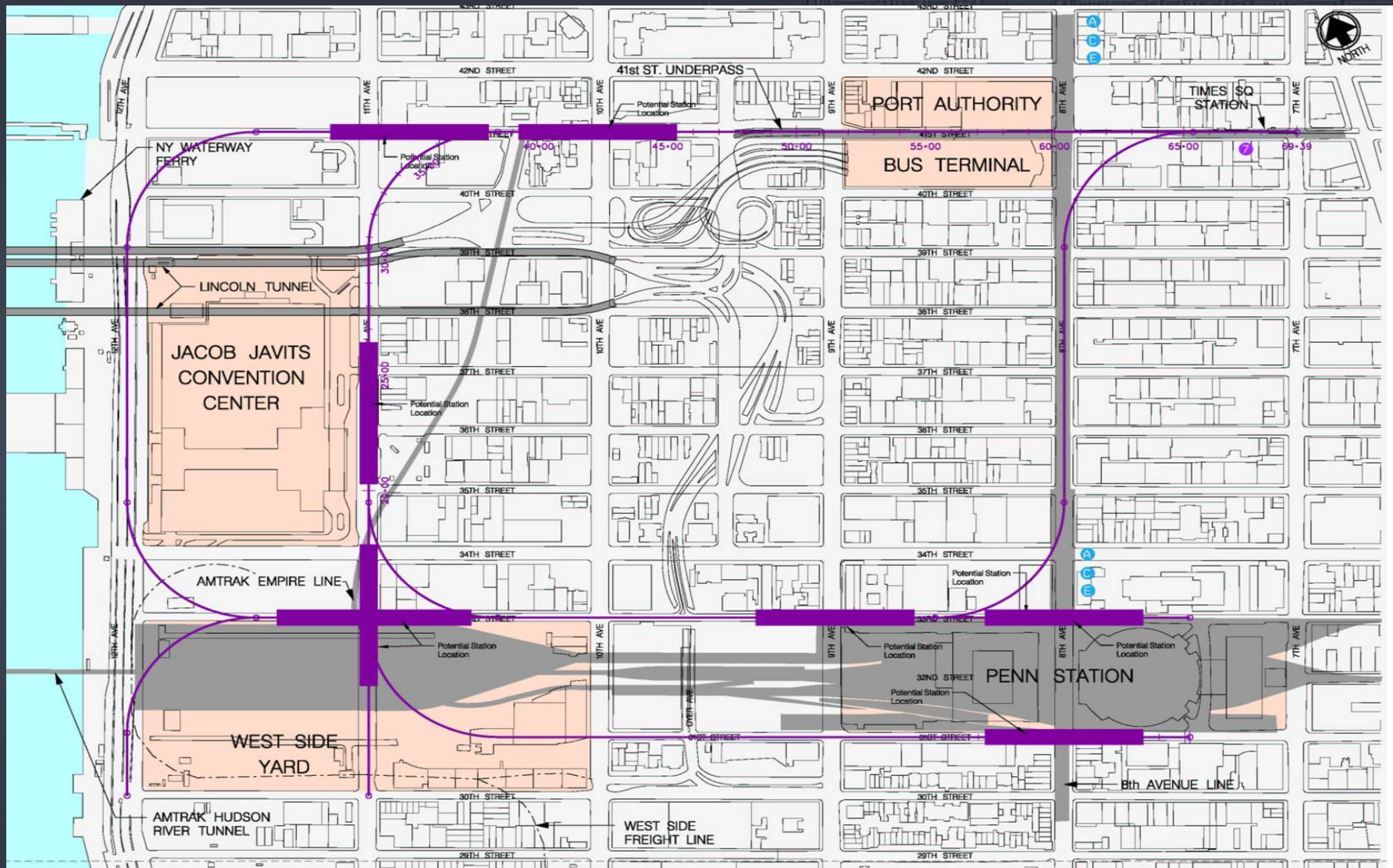
OVERVIEW **HYDC**  
Hudson Yards Development Corporation



PB Team



# Alternative Alignments





# 2025 Projected Development



Metropolitan Transportation Authority



PB Team



# Future Development - 2025

- **2010 Analysis Year**

- ◆ First full year of operation for the No. 7 Line
- ◆ Completion of the Multi-Use Facility
- ◆ Completion of Convention Center expansion
- ◆ Portion of development within rezoning area completed

- **2025 Analysis Year**

- ◆ Commercial
- ◆ Residential
- ◆ Hotel
- ◆ Retail
- ◆ Theater
- ◆ Community Facility

24.3M SF

13.4M SF

1.0M SF

1.0M SF

0.1M SF

0.7M SF

- **Total Development**

**40.5M SF**



# \$ Funding \$

- Hudson Yard Infrastructure Corp (HYIC)
  - ◆ Issue Bonds
    - No. 7 Extension
    - Open Space & Future Development Sites
    - New Street & Park System
- Financing Vehicle
  - ◆ PILOTS (Payment in lieu of taxes)
  - ◆ Property Taxes on New Residential Development
  - ◆ Bonds Payments by Developers – Zoning Based District Improvement Fund
  - ◆ Sale or Lease of publicly owned parcels



# Final Environmental Impact Statement

## NO. 7 SUBWAY EXTENSION HUDSON YARDS REZONING & DEVELOPMENT PROGRAM

*No. 7 Subway Extension  
Hudson Yards Rezoning & Development Program  
Jacob K. Javits Convention Center Expansion  
Multi-Use Facility*

F I N A L

### GENERIC ENVIRONMENTAL IMPACT STATEMENT

CEQR NO. 03DCP031M

NOVEMBER 2004

### EXECUTIVE SUMMY



Metropolitan Transportation Authority



City Planning Commission  
City of New York

#### Chapter

#### Pages

*Executive  
Summary +  
Volumes 1 - 8*

*Approx.  
6,700*

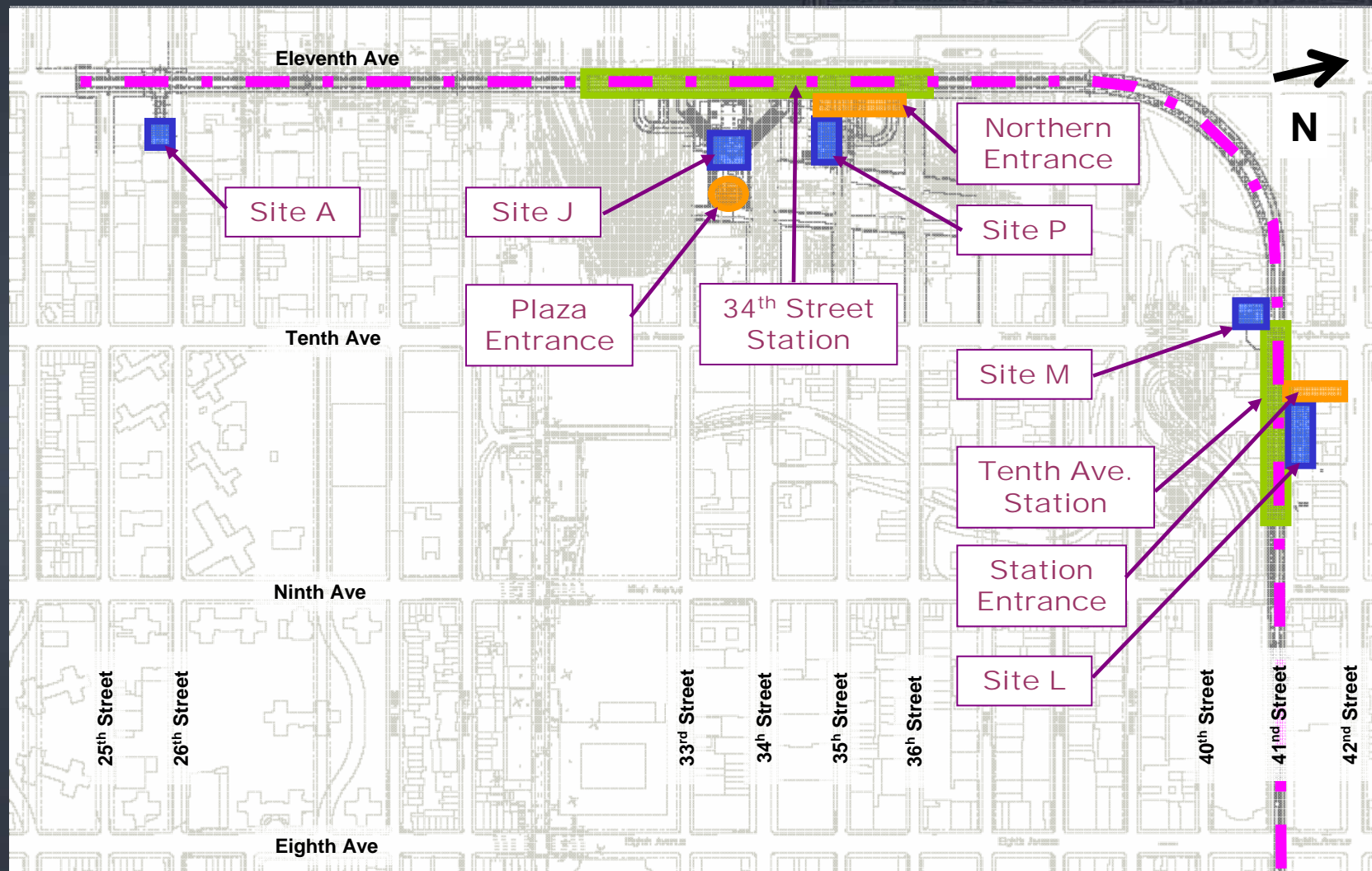


# Number 7 Subway Line Extension

## Project Scope



# Project Key Plan





# Number 7

## Shaft & Laydown Areas:

Site A

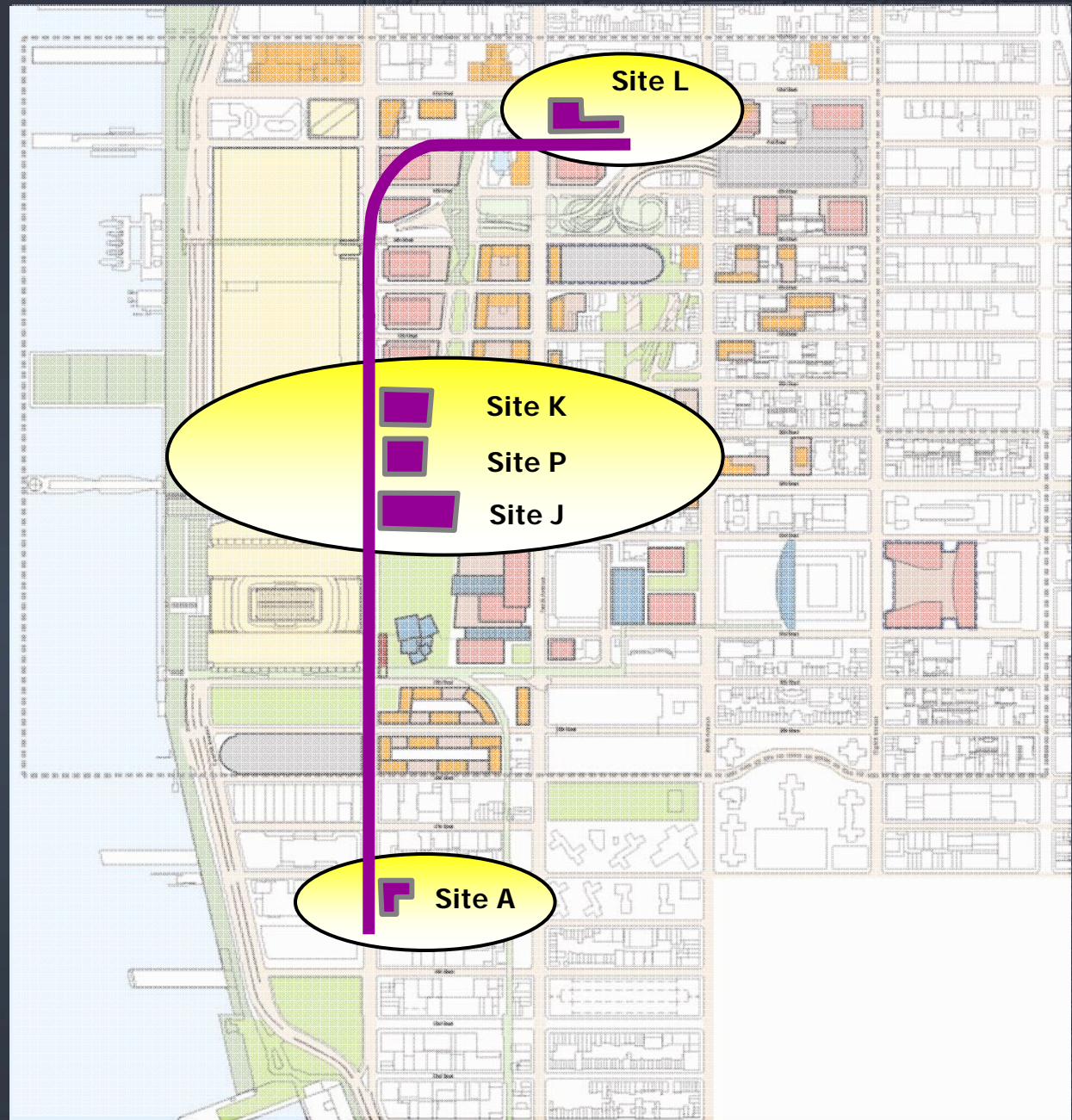
Site P

Site K

## Construction Access & Laydown Areas:

Site J

Site L



Metropolitan Transportation Authority

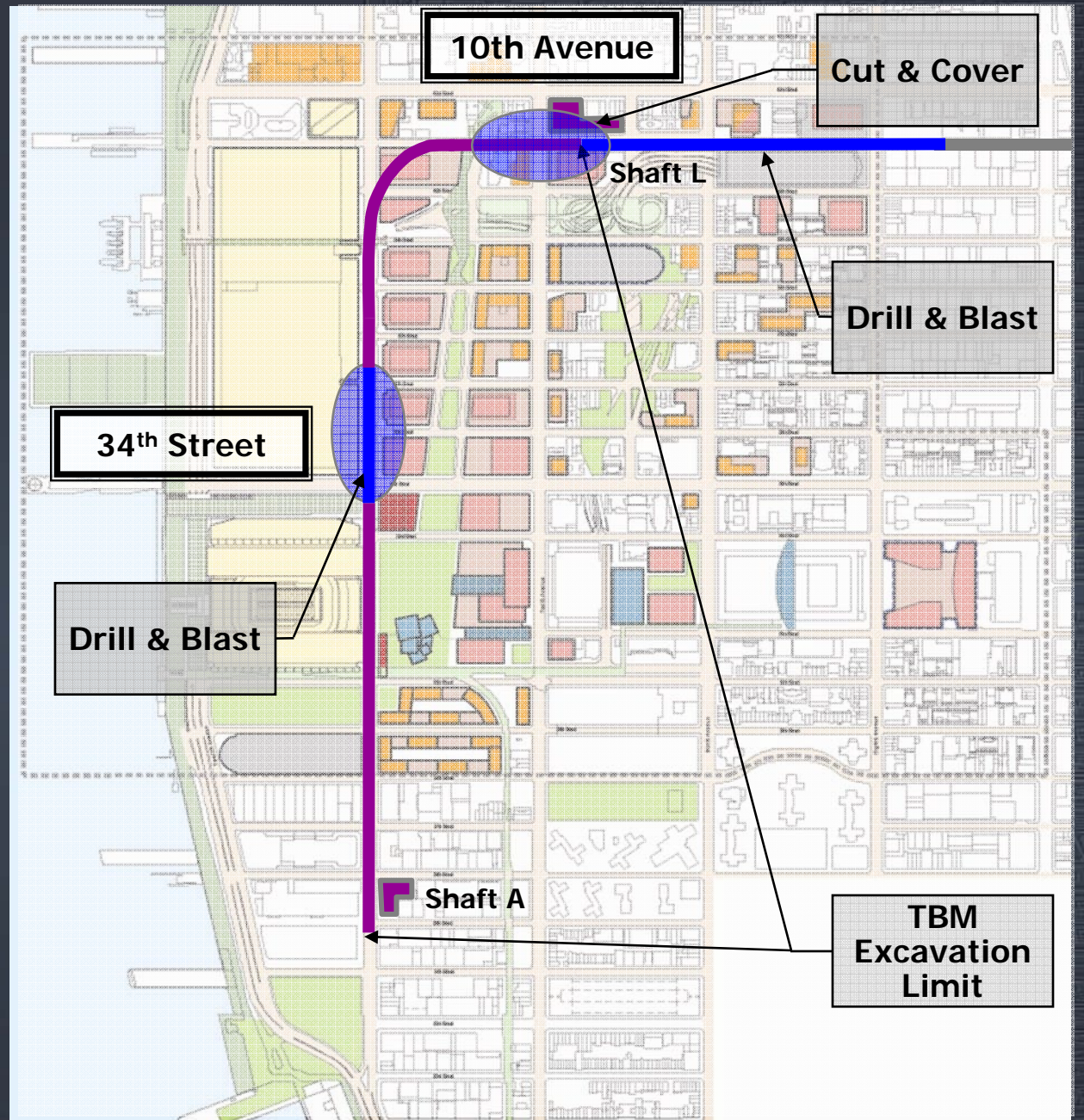
HYDC  
Hudson Yards Development Corporation



PB Team



# TBM Drill & Blast Cut & Cover Limits





# Site A

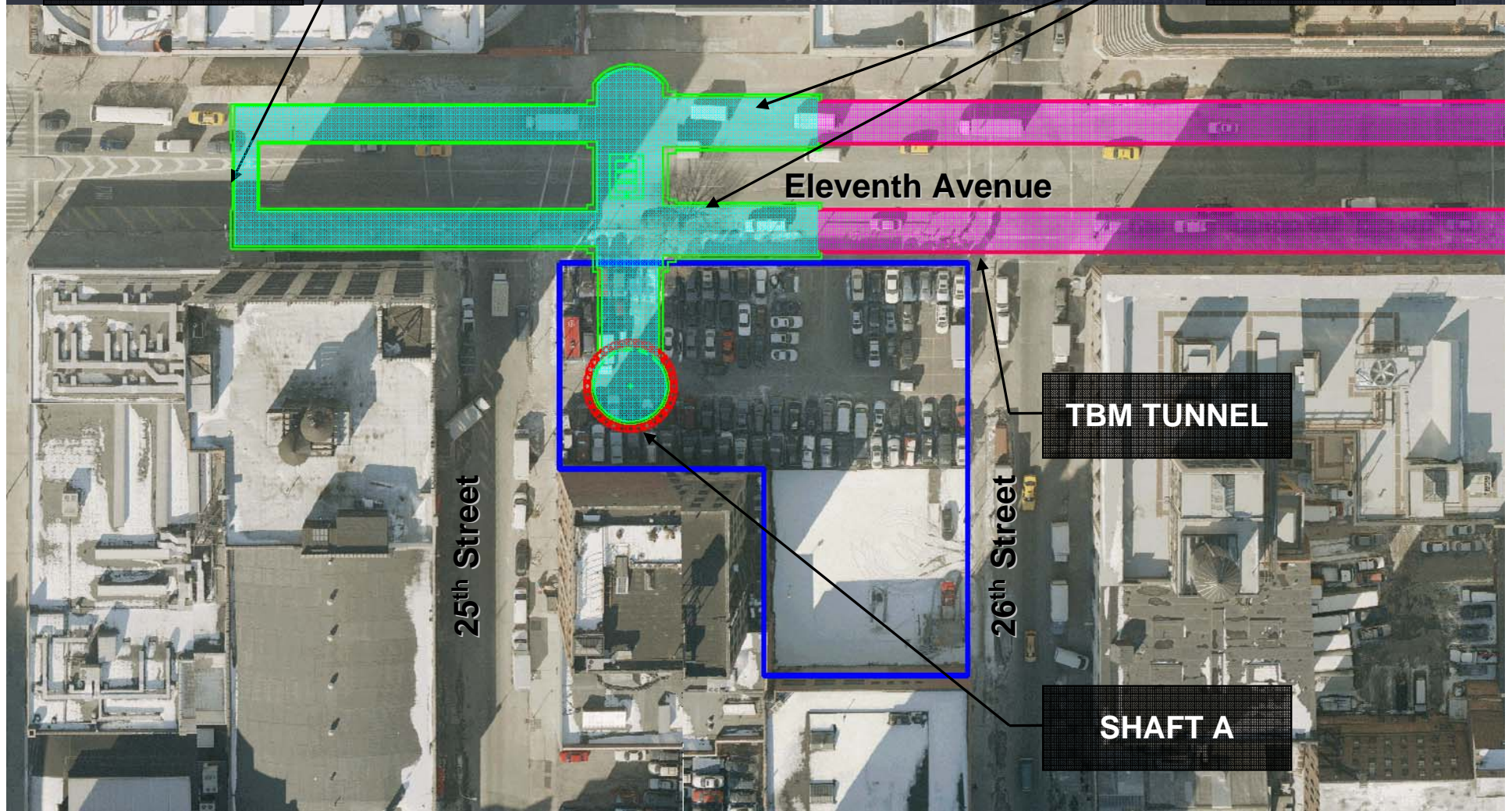




**CONSTRUCTION  
LIMIT**

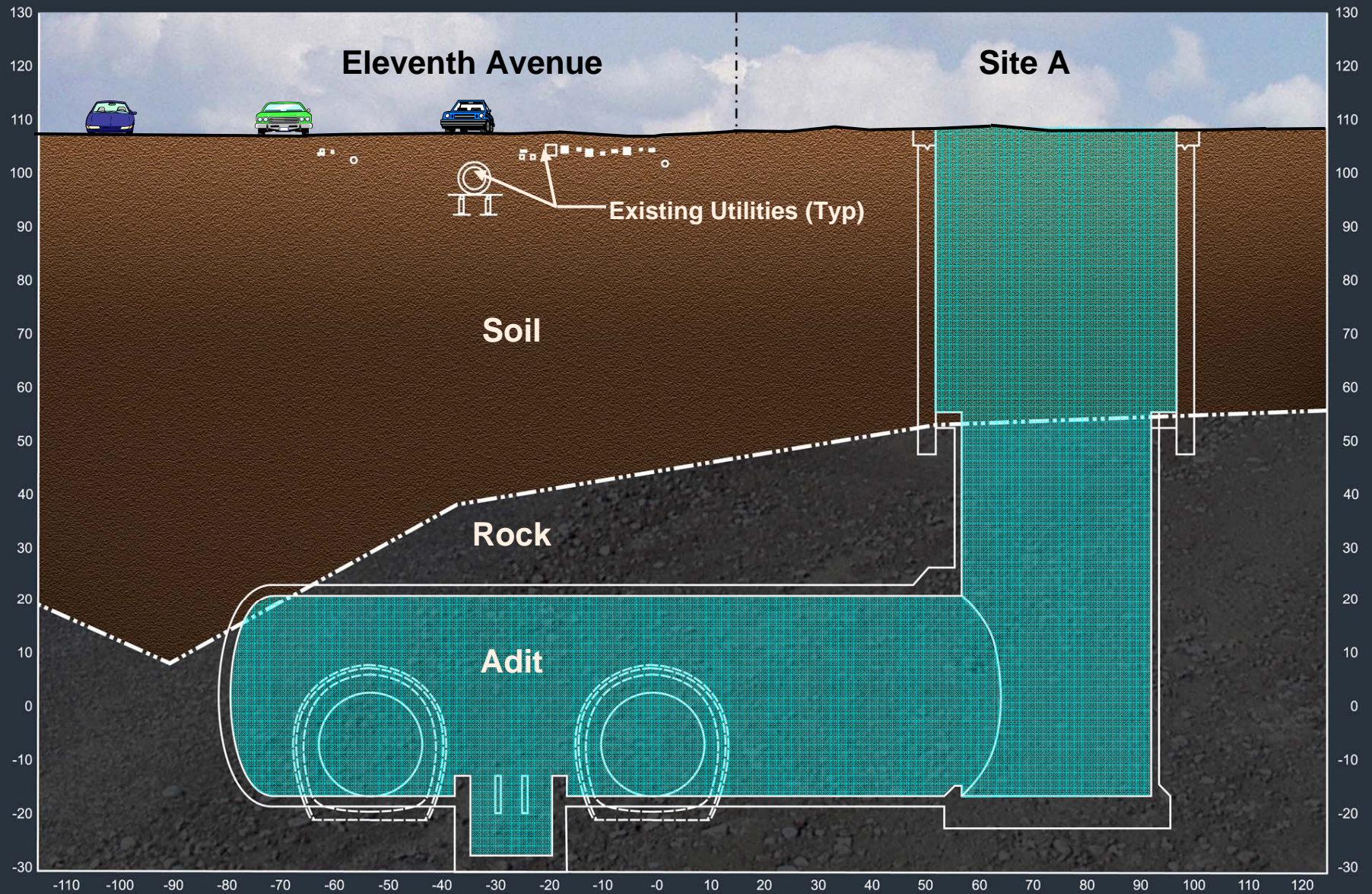
# Site A Construction Activities

**TBM STARTER  
TUNNELS**





# Site A Shaft and Adit





# Site L

CONSTRUCTION  
LIMIT



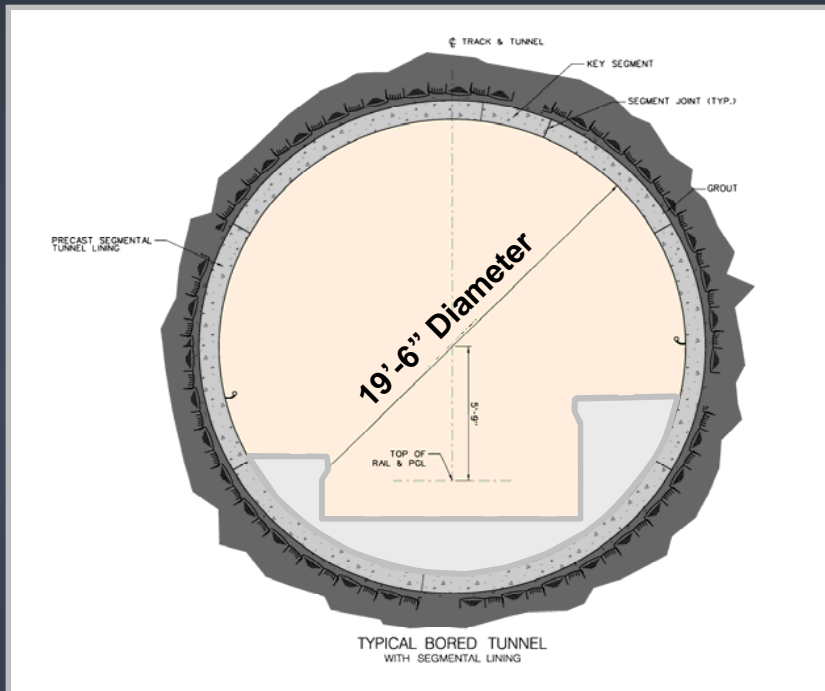
Metropolitan Transportation Authority



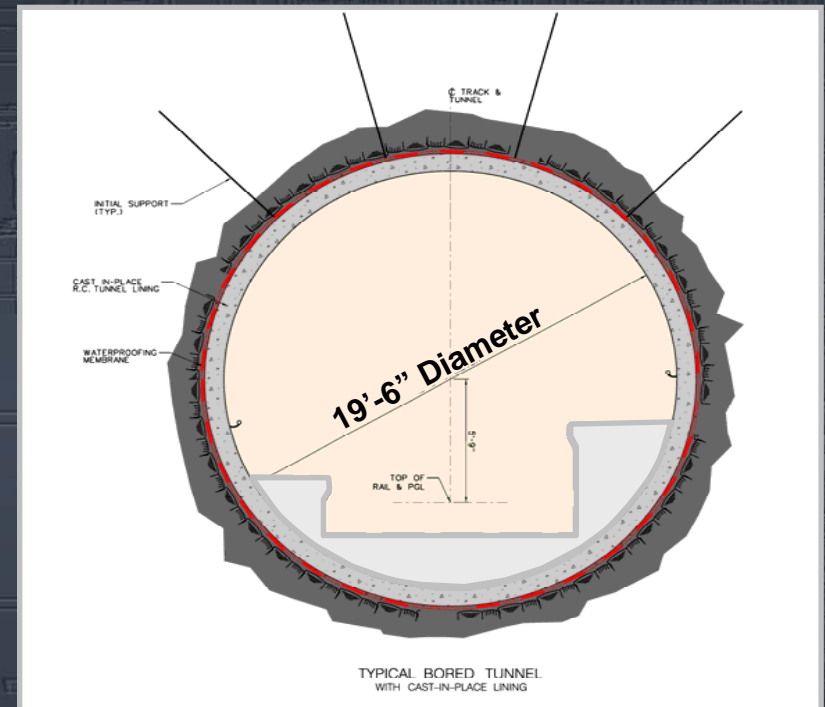
PB Team



# Lining Options



**Pre-Cast Segmental Lining**



**Cast-in-Place Lining**



# TBM Performance Requirements



Metropolitan Transportation Authority



PB Team



# TBM Performance Requirements

- Tunnel ID = minimum 19 feet 6 inches + construction tolerances
- 650 ft minimum horizontal radius
- Full-face hard rock TBM with capability to negotiate short reaches of mixed face and possible soft ground conditions.
- Capable of negotiating very strong & very/extremely abrasive rock (Manhattan Schist & Pegmatites)
- Option to utilize:
  - ◆ pre-cast segmental lining systems- both to be watertight undrained systems.
  - ◆ Gripper, Shield or Double-shield type TBMs





## TBM Performance Requirements cont'd

- Equipped with:
  - ◆ provisions for drilling probe holes and grout holes.
  - ◆ 17 inch or larger disc cutters
- Back-loaded cutter mountings
- Automated guidance system
- New or refurbished TBM's





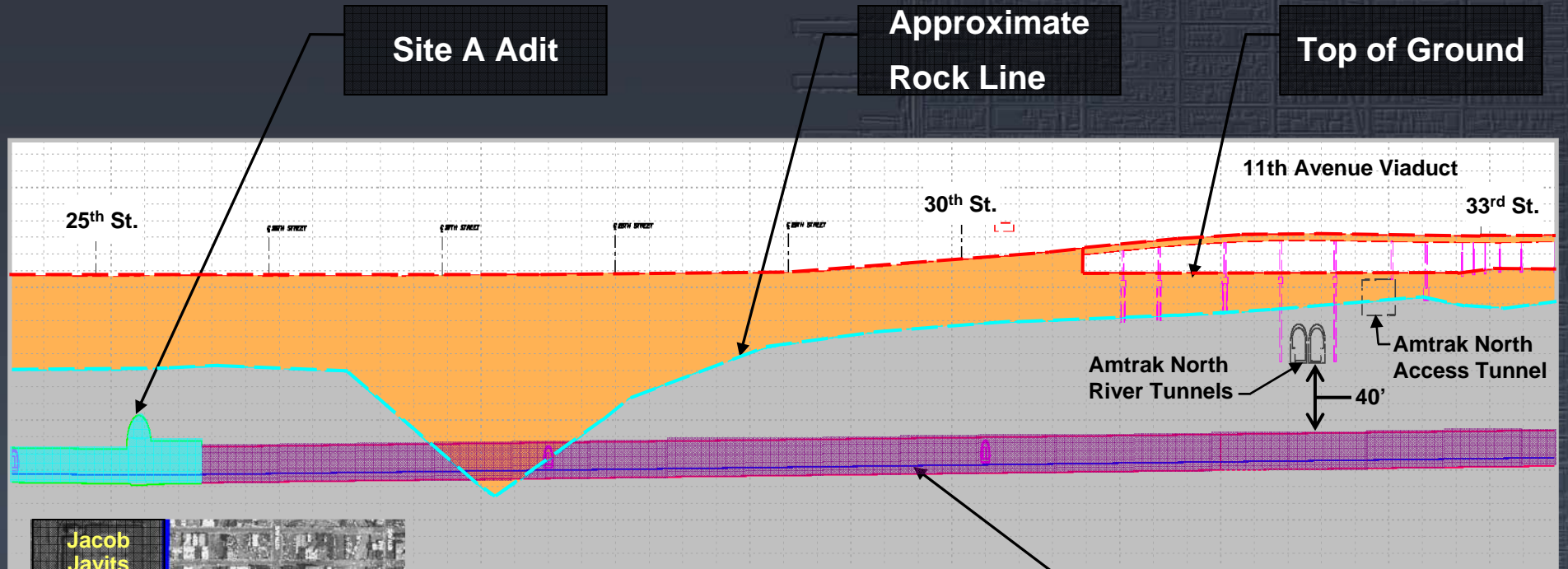
# CHALLENGES

- Ground Modifications
  - ◆ Low rock (Mixed Face) at 27<sup>th</sup> Street along TBM path
  - ◆ Tenth Avenue – Underground Stream bed
- Close proximity of existing structures:
  - ◆ Amtrak North River tunnels
  - ◆ Amtrak Access tunnel (Empire Line)
  - ◆ Lincoln Tunnels
  - ◆ Port Authority (Below Bus Terminal)
- Schedule





# Profile and Rock Line - 1

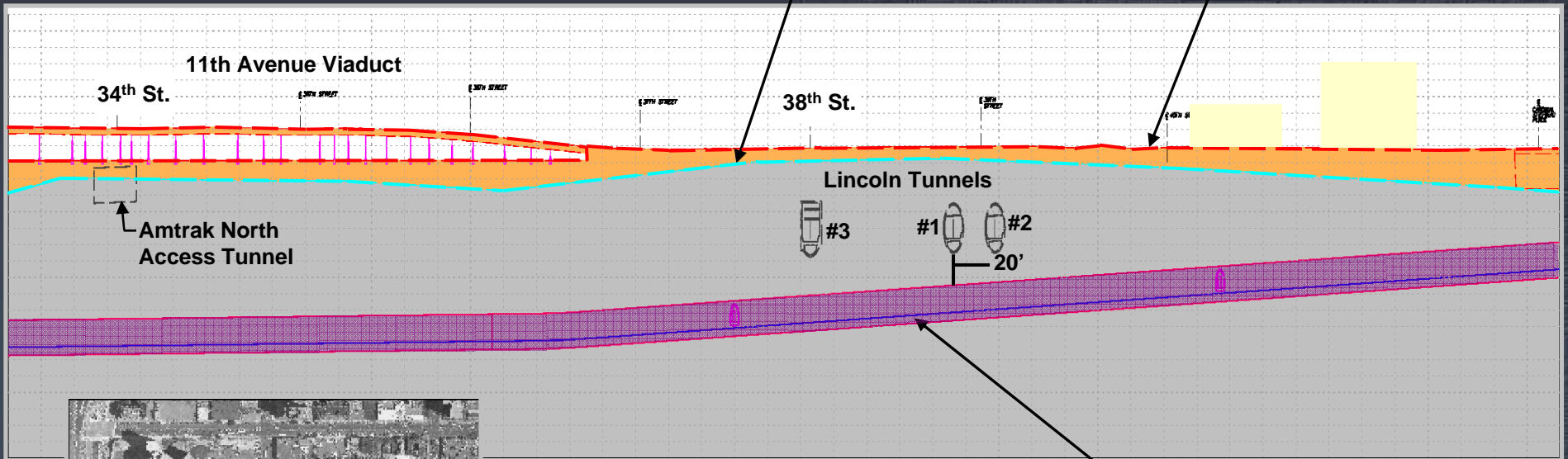




# Profile and Rock Line - 2

Approximate  
Rock Line

Top of Ground



Future Tenth  
Avenue  
Station

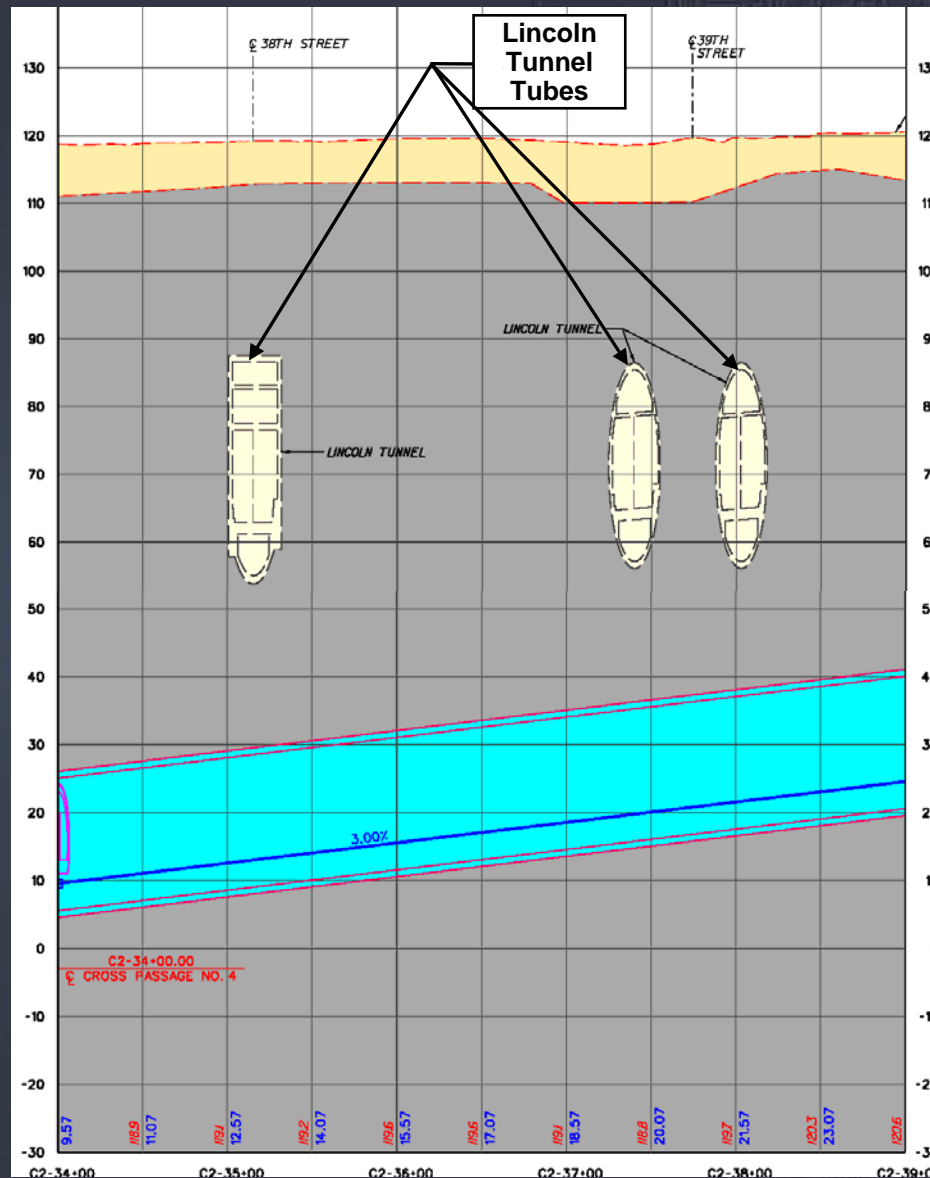
Jacob  
Javits  
Convention  
Center

Future 34th  
Street  
Station

No. 7 Tunnel

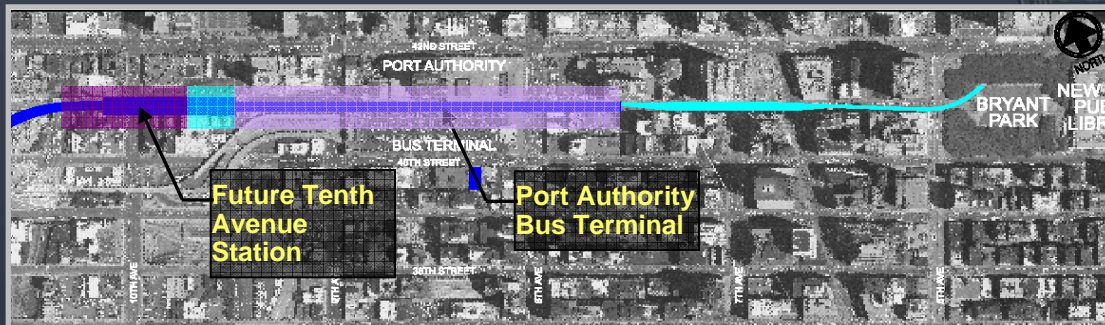
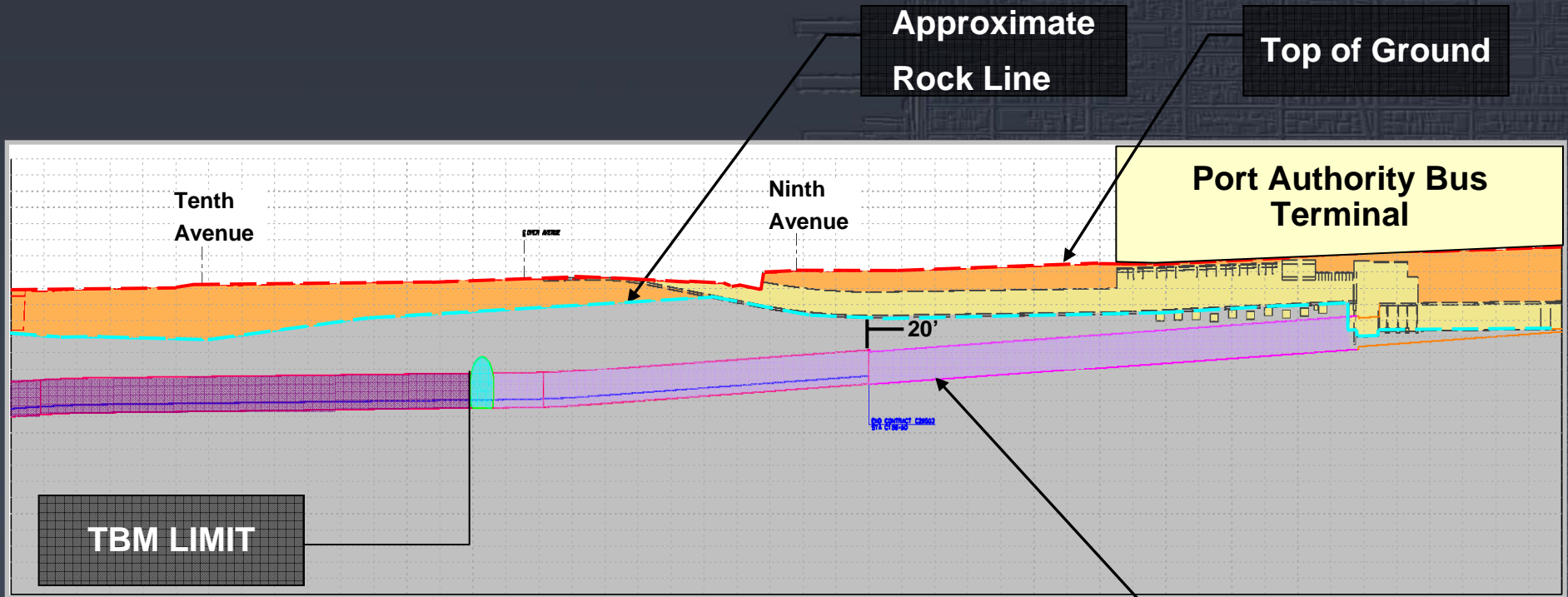


# Running Tunnels Profile Lincoln Tunnel Tubes





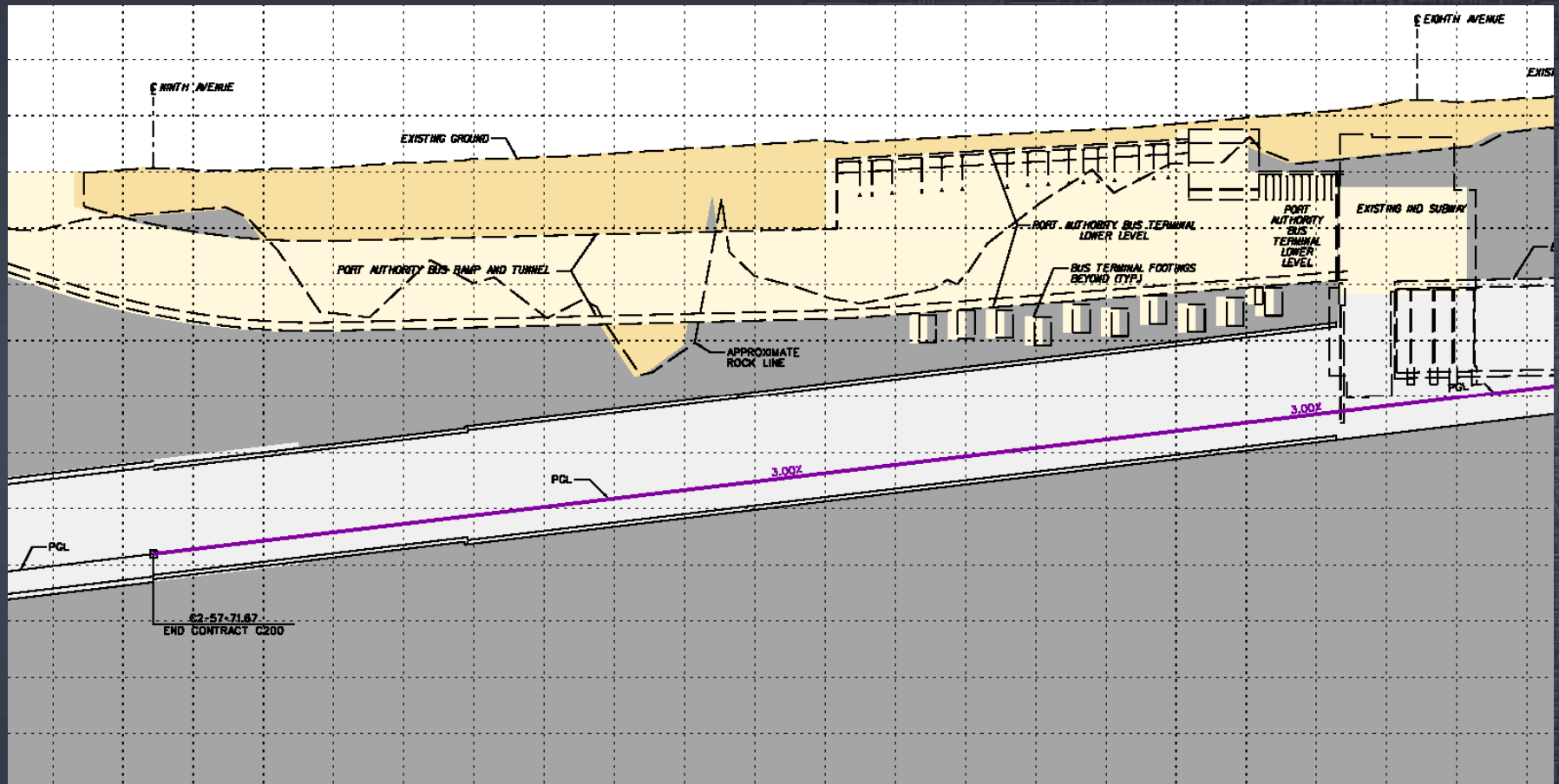
# Profile and Rock Line - 3



No. 7 Tunnel

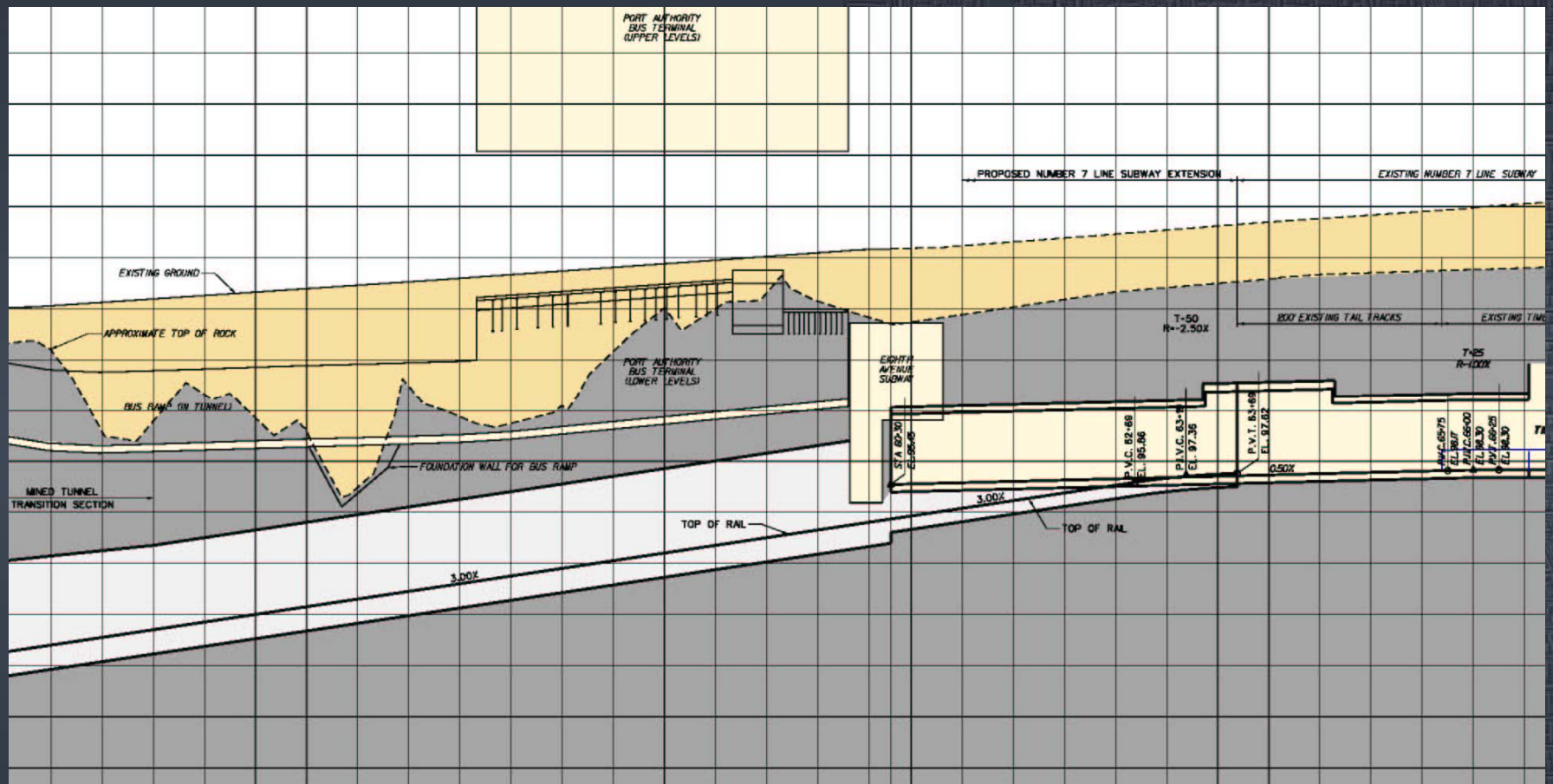


# Port Authority Bus Ramp

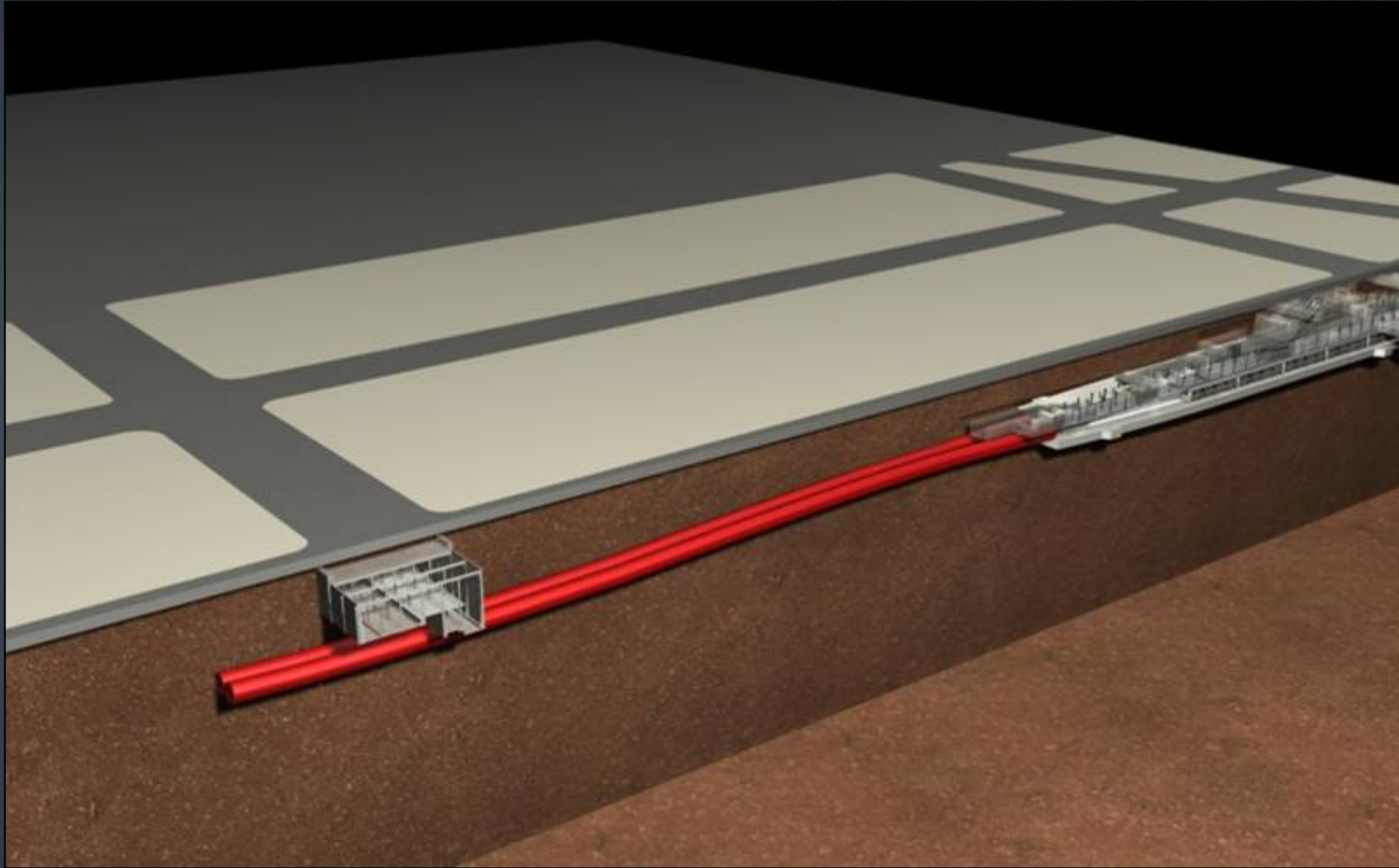




# Tail Track Configuration Near Existing Times Square Station

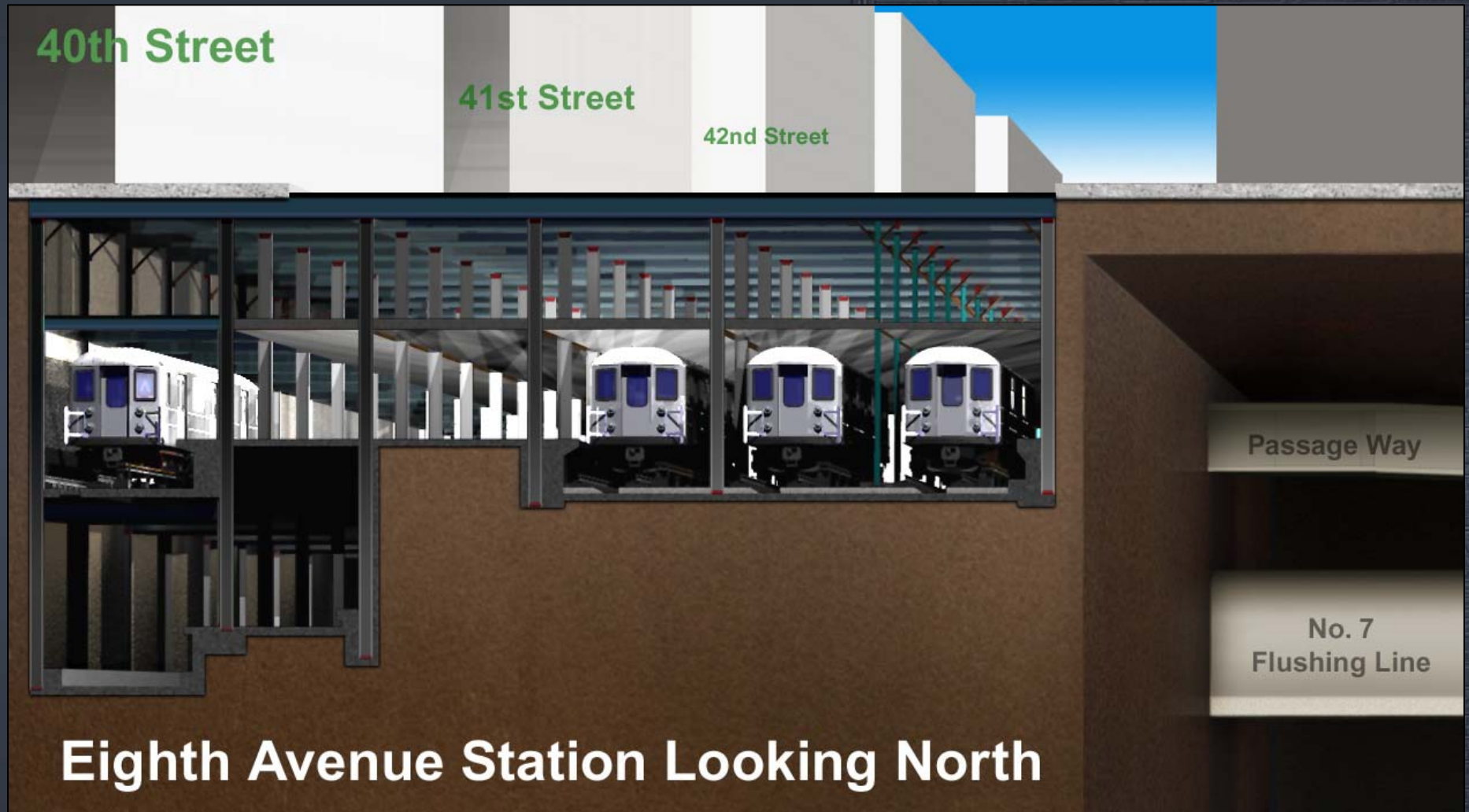


# Existing IND Eighth Avenue Station





# Existing IND Eighth Avenue Station



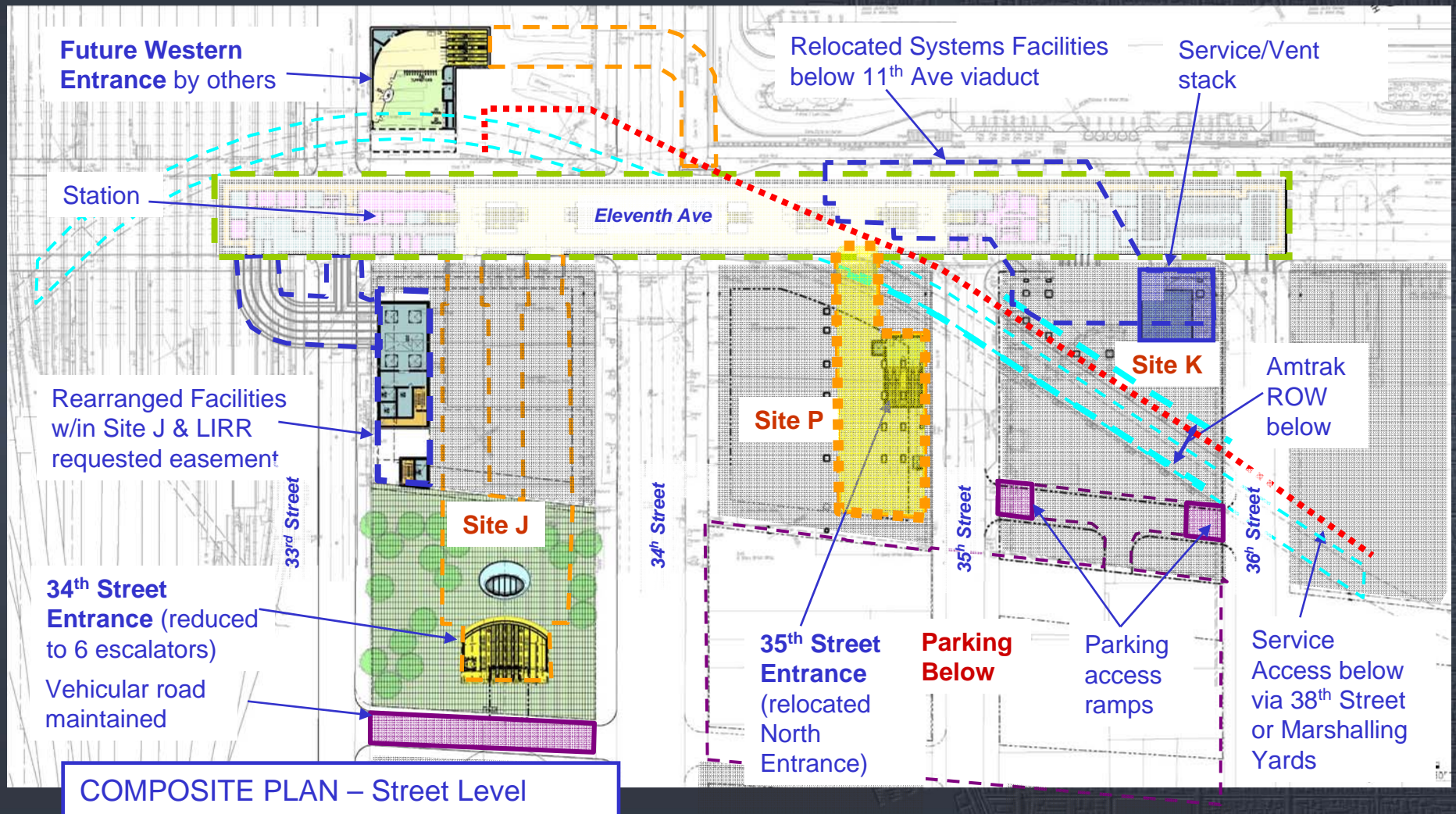
# Number 7 Subway Line Extension

## Stations



# 34<sup>th</sup> Street Station

## Final Design Configuration



# 34<sup>th</sup> Street Entrance

## Plaza Entrance



Metropolitan Transportation Authority



PB Team



# 34<sup>th</sup> Street Entrance

## Street Level Plan



[illegible]



# 34<sup>th</sup> Street Entrance

## View at Upper Mezzanine



# 34<sup>th</sup> Street Station

## Cavern Rendering





# 34<sup>th</sup> Street Station Canopy Entrance – Upper Mezzanine



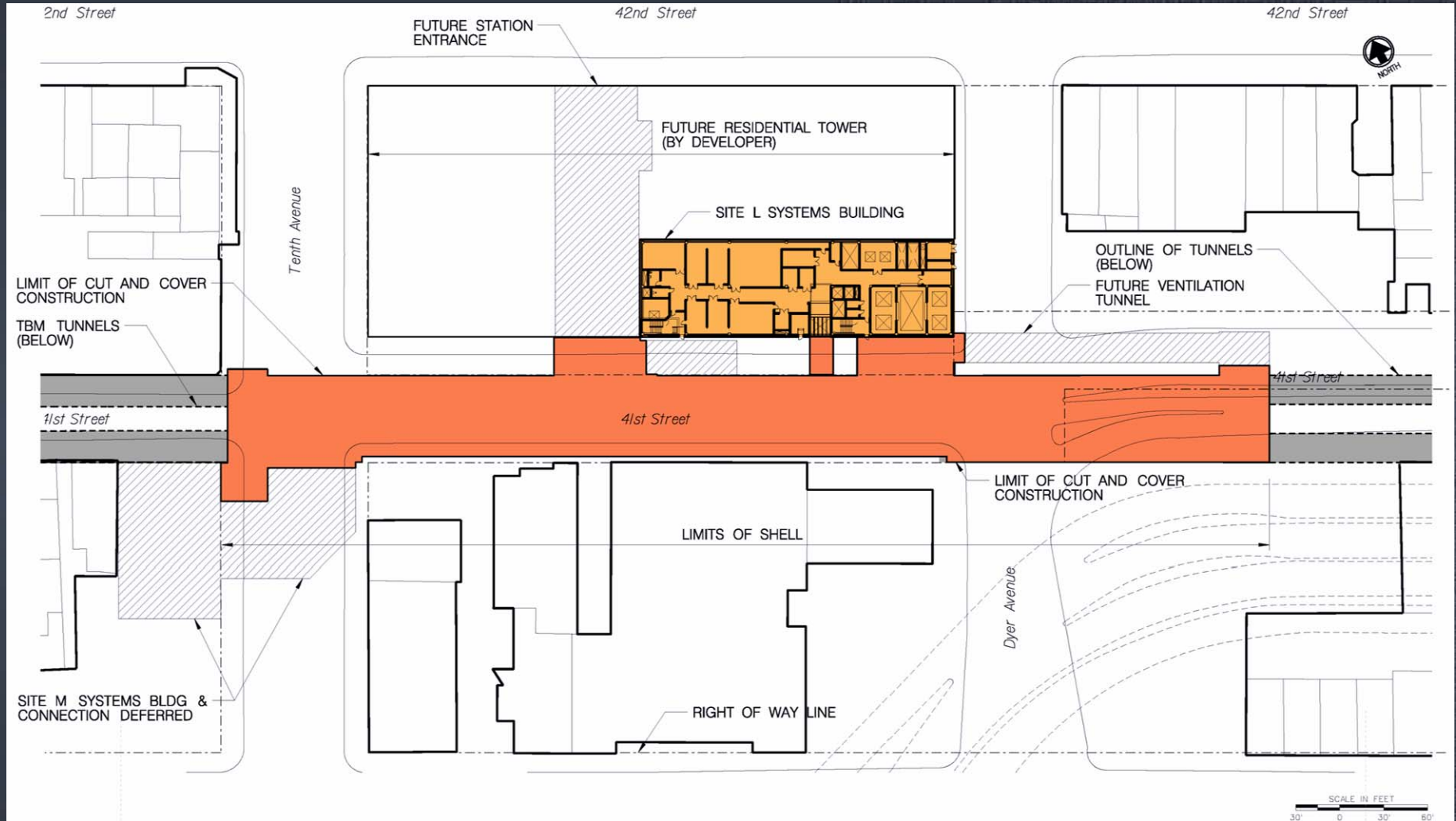
PB Team / Richard Dattner & Partners

# Number 7 Subway Line Extension

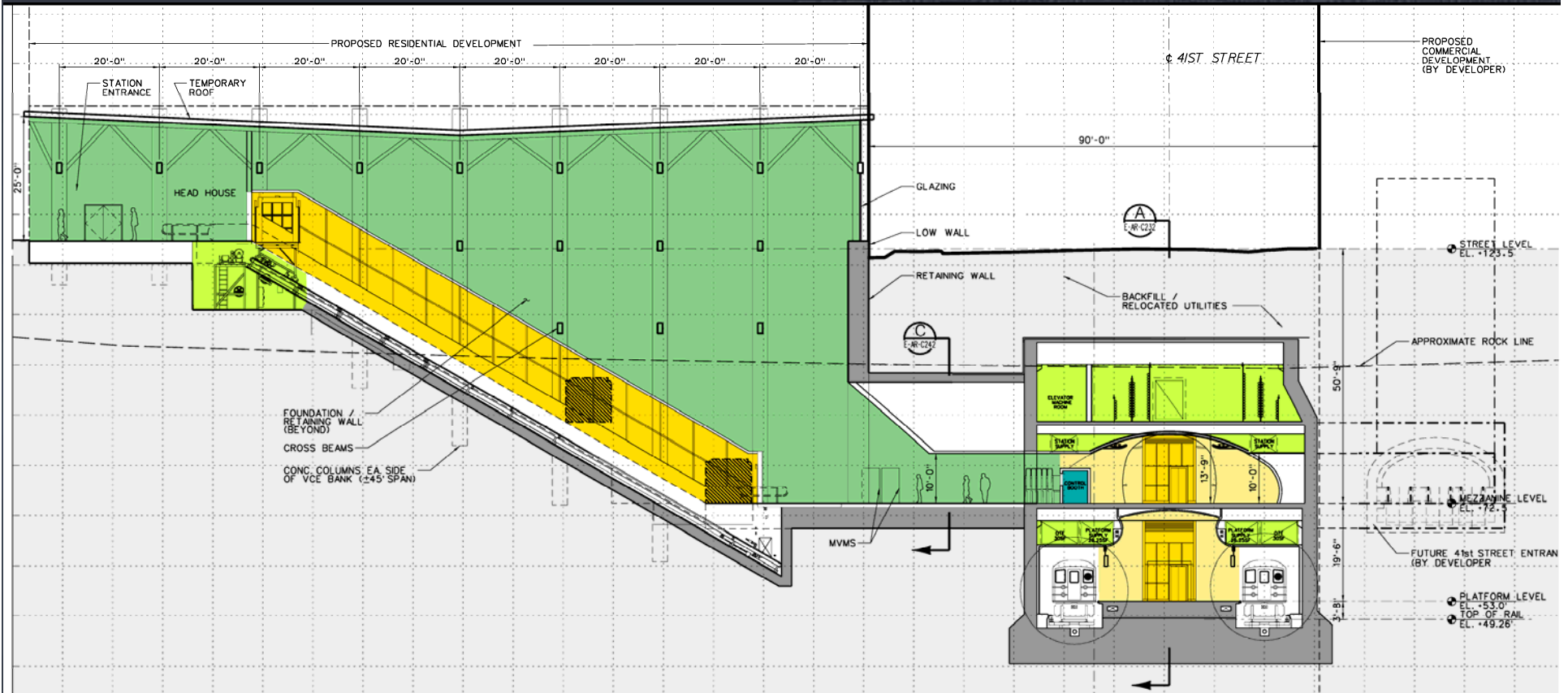
## Tenth Avenue Station



# Tenth Avenue Shell – Street Plan



# Tenth Avenue Station Section at 42<sup>nd</sup> Street Entrance





# Tenth Avenue Station Rendering





# Tenth Avenue Station Fare Control Area – 42nd Street Entrance



PB Team / Richard Dattner & Partners Architects PC



Metropolitan Transportation Authority



PB Team



# Number 7 Subway Line Extension

## Coordination

# Proximity to Adjacent Subsurface Structures



— No. 7 Subway

— Hudson North River  
Tunnels (Amtrak &  
NJ Transit)

— Lincoln Tunnel  
Tubes (1, 2, 3)

— Hudson North  
Access Tunnel  
(Empire Line)



Metropolitan Transportation Authority



PB Team



# 34th Street Station Coordination Tool





# 34th Street Station Coordination Tool





# 34th Street Station Coordination Tool



# 34th Street Station Coordination Tool





# Number 7 Subway Line Extension

## Vibration & Settlement Criteria



Metropolitan Transportation Authority



PB Team

# Proposed Criteria

- The blasting vibration design criterion will be a mean vibration level of 2 in/sec , with no vibration level to exceed 4 in/sec at the Port Authority Bus Terminal and Bus Ramp
- Threshold settlement of type A structures shall not exceed 3/8 –inch
- Threshold angular distortion of type A structures shall not exceed 1:500





# Number 7 Subway Line Extension

## Schedule

# Number 7 Subway Line Extension

## Contract Packages

**D200 - Excavation of Running Tunnels and 34<sup>th</sup> Street Station Caverns**

**D300 - 34<sup>th</sup> Street Station Liner and Sites A, J and P Construction**

**D305 - 34<sup>th</sup> Street Station and Sites A, J, and P Finishes**

**D310 - Tenth Avenue Station Shell, Tunnels and Sites L and M Construction**

***D315 - Tenth Avenue Station Finishes - Deferred***

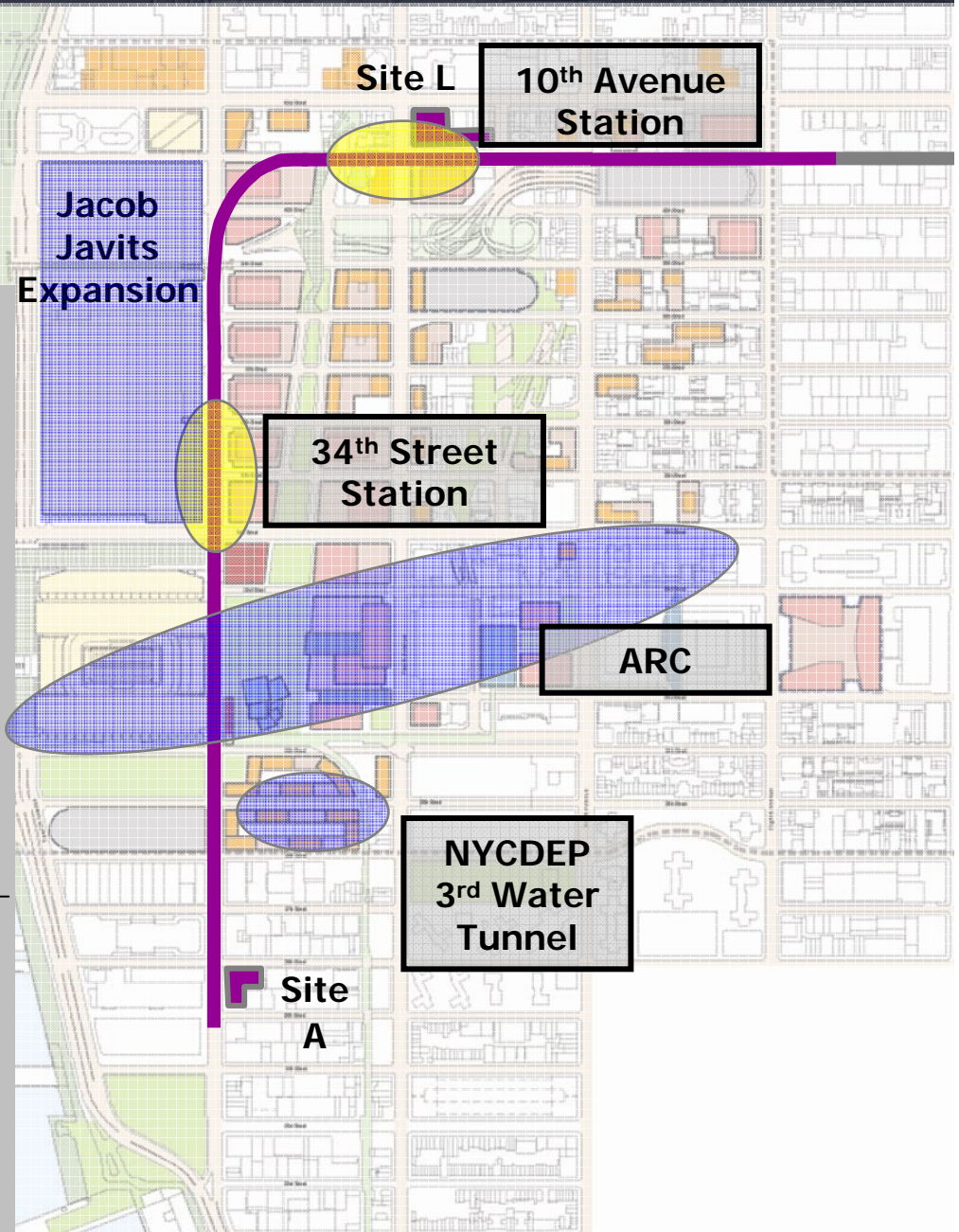
**D400 - Track Signals and Systems Installation**



# No. 7 Schedule

No. 7 Construction Summary

2007 2008 2009 2010 2011 2012



# Projected Award Schedule

Construction Package Description	Type	Projected Award Date
Consultant Construction Manager	RFP	Aug 06
Excavation of Running Tunnels and Station Caverns	IFB	Nov 06
Tenth Avenue Station Shell Construction	IFB	Jan 07
34th Street Station Construction	IFB	May 07
Track Signal and Systems Installation	IFB	Aug 07





Questions ?

No. **7** Subway Line Extension