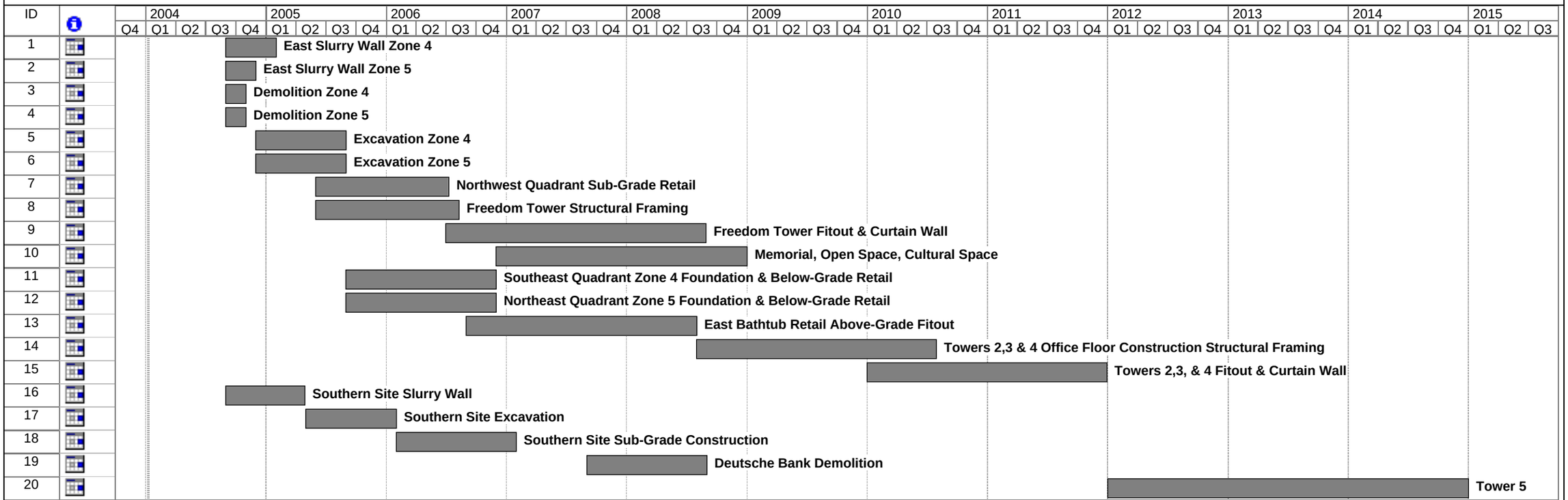
APPENDIX J

CONSTRUCTION

Appendix J-1

World Trade Center Construction Phasing



Source: The Louis Berger Group, Inc., 2003

PRELIMINARY DRAFT

	Fulton Street Transit Center	Permanent PATH Terminal Construction	WTC Memorial and Redevelopment	Route 9A - Short Bypass Alternative	South Ferry Station
1. Work Hours	Monday to Saturday – two shifts over a 16 hour period from 0700 to 2300	Monday to Saturday – one 10 Hour Shift from 0700 to 1800	Monday to Saturday – one 10 Hour Shift from 0700 to 1800	Monday to Saturday – one 10 Hour Shift from 0700 to 1800	Monday to Saturday – two shifts over a 16 hour period from 0700 to 2300.
2. Work Location	a) Dey Street Concourse between Church Street and Broadway b) Fulton Street between Broadway and William Street c) Transit Center Entry Facility on western portion of block bordered by Broadway, Church Street, and John Street. d) Dey Street Entrance House e) 4/5 Southbound entrance at 195 Broadway f) Various Elevator and Stairwell entrances on Nassau, John, and William Streets g) 2/3 Station, 4/5 Station rehabilitation h) Connection to FSTC under N/R i) 2 underpasses under 4/5 line	a) Tracks, Platform, Mezzanine – Entirely within the west bathtub b) Tunnels under 1 & 9 Subway – Within existing 1 & 9 Subway tunnels and from west bathtub. c) Temporary and Permanent PATH Station – Within east bathtub and along Church Street with sidewalk closings for truck staging and material removal/delivery area. d) Underpasses for concourses (in addition to tunnels under 1/9). • Cortlandt St. Connection under Church St. • Liberty Plaza Connection under Church St. • WFC Connection under 9A Short Bypass	a) East of 1 & 9 Subway to Church St. – north and south of Temporary PATH Station. b) West Bathtub surrounding Permanent PATH Terminal c) Expanded southern site south of Liberty Street including site of Deutsche Bank Building	a) Route 9A from Barclay Street intersection to Albany Street intersection. b) Entire width of roadway and associated ROW will be utilized	a) Northeastern Portion of Battery Park b) Sub-grade space within existing 1/9 loop c) N/R connection to the east of existing 1/9 loop d) Bellmouth structure and fan plant beneath intersection of Battery Place and Greenwich St,
3. Site Access	a) Dey Street Concourse – at either end of street from Broadway and Church Street b) Transit Center Entrance House – from Broadway, Fulton and John Streets c) Additional sites - from adjacent streets	a) West bathtub – Existing ramp from Liberty Street. b) East of 1 & 9 – From Liberty Street and from Church Street/Vesey St.	a) East of 1 & 9 – From Liberty Street to southeast section of site and from Vesey Street to northeast section of site. b) West of 1 & 9 – From Liberty Street along existing ramp. c) Liberty and Vesey Streets to remain closed for delivery of materials and staging of trucks. d) Pedestrian access on north side of Vesey and south side of Liberty to remain open at all times. e) Church Street left lane and west sidewalk closure between Liberty and Vesey Streets. (if necessary)	a) Route 9A from north and south.	Battery Place and State Street
4. Equipment and Material Laydown Area	a) Full width and length of Dey Street throughout concourse construction – truck staging will occur at either end of Dey Street at intersections of Broadway and Dey, and Church and Dey b) The full width of Fulton Street from Broadway to Nassau Street c) The eastern sidewalk of Broadway between Fulton Street and John Street d) The western sidewalk of Broadway outside 195 Broadway. e) In locations of new stairwells/elevators etc. the sidewalk and nearside lane may be used.	a) West bathtub – within bathtub area/Vesey St./ Liberty St. b) East of 1 & 9 – within footprint of site and adjacent to site along Church St sidewalk area. c) No construction equipment sited within 1WTC and 2WTC footprints. d) Assumes use of Greenwich street for staging and locating site trailers	a) Within existing bathtub area west of 1 & 9 and within footprint of site east of 1 & 9. b) Liberty and Vesey Streets to remain closed to public for materials delivery and staging of equipment and trucks in addition to Church St. c) Assumes use of Greenwich street for staging and locating site trailers	a. Temporary haulage and lay-down areas will be established in strip sections adjacent and between operational traffic lanes and work and areas under construction.	Peter Minuit Plaza
5. Construction Methods	a) Demolition will be incremental top-down deconstruction. b) Permanent and temporary retaining walls – Slurry Wall construction c) Majority of structures are steel framed. d) Concrete floor diaphragms. No internal floor diaphragms in Entrance House above street level. e) Entrance House and Dey Street Entrance is supported on piles. Dey Street Concourse is supported by slurry walls to the north and south of tunnel. No major roc excavation is expected. f) Underpasses/tunnels constructed using incremental under-pinning methods in combination with soil jet-grouting. Existing MTA subway lines are not supported on piles. g) Tunneling under 1 & 9 subway may require use of roadheader	a) Permanent and temporary retaining walls – Slurry Wall construction b) Majority of structures are steel framed. c) Concrete floor diaphragms. d) No major elements supported on piles (except underpasses). Supported on bedrock with minor rock excavation expected. e) Underpasses/tunnels constructed using incremental under-pinning methods in combination with soil jet-grouting. f) Tunneling under 1 & 9 subway may require use of roadheader in northern and southern (bus) tunnels and hand mining in center tunnel.	a) Permanent and temporary retaining walls – Slurry Wall construction b) Majority of structures are steel framed c) Concrete floor diaphragms d) No major elements supported on piles (except underpasses). Supported on bedrock with minor rock excavation expected e) Deutsche Bank to be staged de-constructed in pieces and to occur in 2007 following removal of contamination.	a) Existing utilities relocated to new dedicated conduits beneath east and west sidewalks of new roadway b) Permanent and temporary retaining walls – 3' Slurry Wall construction to bedrock. c) Bypass construction to be cast-in-place concrete. d) 3' concrete base to sub-grade roadway to counteract buoyancy. e) 3' concrete support walls at west and east boundaries of sub-grade roadway f) 1' concrete divider walls to separate northbound, southbound, and service access tunnels (non structural) g) permanent road deck to be pre-cast concrete box-beams overlaid with 6'' cast-in-place concrete deck h) Assumes that the sub-grade box structure is built in two phases; the permanent southbound tunnel and the permanent northbound tunnel. i) Vehicular traffic will be maintained on 9A at all times. j) The first tunnel phase will be constructed within the confines of two slurry walls; one permanent and one temporary. k) Construction of the subsequent tunnel phase will require the demolition of the temporary slurry wall l) Left turn movements from SB 9A onto Liberty and Vesey Streets will be maintained	a) Cut and Cover Construction b) Staged Underpinning of 4/5 line and existing 1/9 loop. c) Permanent and temporary retaining walls – 3' Slurry Wall construction to bedrock. d) Base to be conscrete slab. Tunnel roof and walls to be supported by structural stee e) Assumes that the project is built in three components; Battery Park cut and cover tunnel, station/mezzanine, and the Bellmouth structure beneath Battery Place. Cut and Cover construction occur concurrently in a maximum of two locations. f) The entire street level area of the project will be closed to pedestrian and vehicular traffic during construction of tunnel structure
6. Crane Placement	a) Demolition – Crawler Crane within Entrance House site. b) Slurry Wall – Crawler Cranes within Entrance House site, and on Dey Street and Fulton Street c) Tower Crane located somewhere within Entrance House site.	a) Demolition – Crawler Crane within west bathtub and footprint of temporary terminal east of 1 & 9 subway. b) Slurry Wall – Crawler Cranes within footprint of Permanent Terminal c) Construction of Platforms, Mezzanine, etc. in west bathtub – Crawler Crane within west bathtub. d) Construction of Permanent Terminal – Crawler crane within footprint of Permanent Terminal east of 1 & 9 subway and in sidewalk area of Church St. Tower crane within footprint of Permanent Terminal.	a) Demolition – Crawler Crane within west and east bathtub. b) Slurry Wall – Crawler Cranes within footprint of east bathtub. c) Construction to Street Level and Towers – Crawler Crane within footprint of building and Tower Cranes within the footprint of the buildings. (To be attached to side of towers) d) De-construction of Deutsche Bank Building – Tower Cranes and crawler crane within the sidewalk area and closed lanes of Greenwich, Liberty, Albany and Washington Streets.	a) Slurry Wall – Crawler Cranes within work area boundaries	a) Slurry Wall – Crawler Cranes within work area boundaries
7. Slurry Mixing and Desanding Plant	Located within footprint of Entrance House, on Fulton Street, and on Dey Street.	Located within footprint of Permanent Terminal.	Located within the footprint of Zones 4 and 5	Located within work area boundaries	Located within work area boundaries
8. Removal of Demo Debris	15 CY Tri-axle Dump Trucks or 30 CY Demolition Trailers, maximum load – 20 Tons on either truck.	15 CY Tri-axle Dump Trucks or 30 CY Demolition Trailers, maximum load – 20 Tons on either truck.	15 CY Tri-axle Dump Trucks or 30 CY Demolition Trailers, maximum load – 20 Tons on either truck.	15 CY Tri-axle Dump Trucks or 30 CY Demolition Trailers, maximum load – 20 Tons on either truck.	15 CY Tri-axle Dump Trucks or 30 CY Demolition Trailers, maximum load – 20 Tons on either truck.
9. Spoil Removal	15 CY Tri-axle Dump Trucks	20-40 CY Tri-axle Dump Trucks.	20-40CY Tri-axle Dump Trucks	20-40 CY Tri-axle Dump Trucks	15 CY Tri-axle Dump Trucks
10. Concrete Delivery	10 CY Tri-axle or tandem axle transit mix concrete truck – delivered and pumped from staging areas on street.	10 CY Tri-axle or tandem axle transit mix concrete truck – delivered and pumped from staging areas on street.	10 CY Tri-axle or tandem axle transit mix concrete truck – delivered and pumped from staging areas on street	10 CY Tri-axle or tandem axle transit mix concrete truck – delivered on haulage routes to positions immediately adjacent final placement.	10 CY Tri-axle or tandem axle transit mix concrete truck – delivered on haulage routes to positions immediately adjacent final placement.
11. Steel Deliveries	20 Ton loads on 45-foot trailers pulled by tandem axle cabs	20 Ton loads on 45-foot trailers pulled by tandem axle cabs.	20 Ton loads on 45-foot trailers pulled by tandem axle cabs.	20 Ton loads on 45-foot trailers pulled by tandem axle cabs.	20 Ton loads on 45-foot trailers pulled by tandem axle cabs
12. Service/Fuel/Utility	single axle light duty utility trucks and tankers.	single axle light duty utility trucks and tankers.	single axle light duty utility trucks and tankers	single axle light duty utility trucks and tankers	single axle light duty utility trucks and tankers
13. Light Trucks	single axle pickups, flatbeds or vans	single axle pickups, flatbeds or vans.	single axle pickups, flatbeds or vans	single axle pickups, flatbeds or vans	single axle pickups, flatbeds or vans
14. Truck Generation Totals	See Tables on Next Page	See Tables on Next Page	See Tables on Next Page	See Tables on Next Page	See Tables on Next Page
15. Traffic Management - Vehicular and Pedestrian	a) Lane Closures • Dey Street closed entirely during construction to traffic • Fulton closed to traffic between Broadway and Nassau Street • Easternmost and westernmost lanes of Broadway between Fulton and John Street (NOT simultaneously). • The northern lane of John Street from Broadway to rear of proposed Entry Facility. • Eastern lane of Church Street at Dey Street b) Building Displacements and Sidewalk closures – it is assumed that all businesses and building occupants on Dey Street, Fulton Street between Broadway and Nassua, and the west side of Broadway between Dey street and Fulton street, will be subject to a single period where pedestrian access is prohibited for a single period of between 2 weeks and 2 months. Outside of this period, a 5 foot minimum egress will be maintained to all buildings. Residents and businesses will relocate during this period. The loading dock of Century 21 will also be subject to access restrictions. c) Pedestrian Traffic/Construction Truck Flagmen Crossover points • The eastern side of intersection of Fulton Street and Broadway • The eastern side of intersection of John Street and Broadway • The western side of intersection of Broadway and Dey Street • The eastern side of intersection of Church and Dey Streets.	a) Left turn movements from SB 9A onto Liberty and Vesey Streets will be required to greatest extent possible except for temporary closures required for unavoidable 9A construction activities. b) The use of Greenwich Street from Vesey to Liberty, will be necessary for the following reasons • Truck haulage routes • Staging areas for construction activities east of the 1/9 line • Location of contractors trailers in an elevated multi-tiered platform above the road surface.	a) Left turn movements from SB 9A onto Liberty and Vesey Streets will be required to greatest extent possible except for temporary closures required for unavoidable 9A construction activities. b) The use of Greenwich Street from Vesey to Liberty, will be necessary for the following reasons • Truck haulage routes • Staging areas for construction activities east of the 1/9 line • Location of contractors trailers in an elevated multi-tiered platform above the road surface.	a) Northbound/Southbound Traffic maintained throughout construction on West Street b) 4 lanes in constant operation c) Left turn movements from SB 9A onto Liberty and Vesey Streets will be required to greatest extent possible except for temporary closures required for unavoidable 9A construction activities.	No access to northeast of Battery Park No access to Peter Minuit Plaza

Source: The Louis Berger Group, Inc.

APPENDIX J-3 CONSTRUCTION METHODS AND IMPACTS

WTC MEMORIAL AND REDEVELOPMENT

CONSTRUCTION TRAFFIC AND CONSTRUCTION EQUIPMENT

Demolition/Excavation of East Bathtub (Zones 4 & 5) – Traffic and Construction Equipment

All work estimated based on one 10-hour shift commencing at 0700 and ending at 1800, Monday to Saturday. This analysis assumes two one-hour Peak Traffic Periods occurring some time in the morning and evening

East Slurry Wall – East Slurry Wall construction will consist of creating two bathtubs – one bounded by Vesey St., Church St., north side of Permanent PATH Terminal and along 1 & 9 subway tunnel. The other will be bounded by the north side of the divided PATH concourse, Church St., Liberty St., and the east side of the 1 & 9 subway tunnel. The slurry wall and excavation will be conducted down to a level of EL 238'. As the Slurry Wall progresses around the site, the area immediately adjacent to the wall will be benched down to the first level of tieback anchors, to allow installation of the anchors to commence prior to completion of the wall. Some excavation activities will coincide with the slurry wall and tieback anchoring activities. Traffic and Construction Equipment for the tie back installation is covered under Excavation below.

Delivery Type **ZONE 4**	**Quantity**	**Units**	**Total No. Of Loads**	**Trips per Day (Peak Day impact Calculation)**	**Trips per Day (cumulative impact calculation)**	**Estimated Duration** **Worst Case**
Slurry Wall – Exc.	6,600	CY	440	16	7.3	5 Months
Slurry Wall – Conc.	6,600	CY	660	18	11	
Slurry Wall – Rebar	1,600	Tons	80	2	1.33	
Service/Utility /Fuel				16	12	
Subcontractors Light Trucks				8	4	
Construction Workers	20 to 30					
Arriving by Personal Vehicle	4 to 6					
Arriving by Mass Transit	16 to 24					
Supervisory/QA	4 to 6					
Arriving by Personal Vehicle	1 to 2					
Arriving by Mass Transit	3 to 4					

Delivery Type **ZONE 5**	**Quantity**	**Units**	**Total No. Of Loads**	**Trips per Day (Peak Day impact Calculation)**	**Trips per Day (cumulative impact calculation)**	**Estimated Duration** **Worst Case**
Slurry Wall – Exc.	6,600	CY	440	16	7.3	5 Months
Slurry Wall – Conc.	6,600	CY	660	18	11	
Slurry Wall – Rebar	1,100	Tons	55	2	1.33	
Service/Utility /Fuel				16	12	
Subcontractors Light Trucks				8	4	
Construction Workers	10 to 20					
Arriving by Personal Vehicle	2 to 4					
Arriving by Mass Transit	8 to 16					
Supervisory/QA	4 to 6					
Arriving by Personal Vehicle	1 to 2					
Arriving by Mass Transit	3 to 4					

Equipment – Construction of the Slurry Wall surrounding Zone 4 will be performed from within the footprint of the proposed development within those zones. The Slurry Wall will be constructed by the panel method and will require two crews of men and equipment to meet the proposed schedule. Percentage of Daily Use for construction equipment has been based on operating 9 hours out of a 10-hour shift. The 9 hours are based on allowing for morning start-up, coffee breaks, lunch break and daily fueling/maintenance. Percentage of Daily Use for Concrete Trucks and Dump Trucks are based on waiting time and unloading/loading time on site only. Equipment required is as follows:

Equipment Type Zone 4	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily Use	Duration
Slurry Plant Mixing Plant	100 m^3 per hour – Diesel 50 HP	Diesel	50	2	2	90%	5 months
Desanding Plant	100 m^3 per hour – Diesel 50 HP	Diesel	50	2	2	50%	
Crawler Crane w/clam shell	100 Ton	Diesel	350	2	2	90%	
Hydraulic All Terrain Crane	50 Ton	Diesel	165	1	1	25%	
Crawler Crane for rebar placement)	200 Ton	Diesel	450	2	2	50%	
Hi-Lift (Forklift)	5 ton – 40 foot boom	Diesel	120	2	2	90%	
Concrete Pump	150 CY/Hour – 100 foot boom	Diesel	300	2	2	50%	
Concrete Trucks	10 Cubic Yard Tandem or Tri-Axle	Diesel	325	9	5.5	5%	
Dump Trucks	Tandem Axle – 15 CY	Diesel	325	8	3.7	10%	
Hydraulic Excavators (lead in trench)	3.5 CY	Diesel	320	1	1	90%	
Dozer (maintain site grading)	150 HP	Diesel	150	1	1	20%	
Diesel Generators	100 HP	Diesel	100	4	4	90%	

Equipment Type **Zone 5**	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily Use	Duration
Slurry Plant Mixing Plant	100 m^3 per hour – Diesel 50 HP	Diesel	50	1	1	90%	5 months
Desanding Plant	100 m^3 per hour – Diesel 50 HP	Diesel	50	1	1	50%	
Crawler Crane w/clam shell	100 Ton	Diesel	350	1	1	90%	
Hydraulic All Terrain Crane	50 Ton	Diesel	165	1	1	25%	
Crawler Crane (for rebar placement)	200 Ton	Diesel	450	1	1	50%	
Hi-Lift (Forklift)	5 ton – 40 foot boom	Diesel	120	1	1	90%	
Concrete Pump	150 CY/Hour – 100 foot boom	Diesel	300	1	1	50%	
Concrete Trucks	10 Cubic Yard Tandem or Tri-Axle	Diesel	325	9	5.5	5%	
Dump Trucks	Tandem Axle – 15 CY	Diesel	325	8	3.7	10%	
Hydraulic Excavators (lead in trench)	3.5 CY	Diesel	320	1	1	10%	
Dozer (maintain site grading)	150 HP	Diesel	150	1	1	10%	
Diesel Generators	100 HP	Diesel	100	2	2	90%	

Demolition – The demolition of the existing H&M coffer dam and station will occur concurrently with the slurry wall construction. Estimated duration for demolition is 2 months for the former Hudson & Manhattan station along Church Street in Zone 4.

Delivery Type	Quantity	Units	Total No. Of Loads	Trips per Day (Peak Day impact Calculation)	Trips per Day (cumulative impact calculation)	Estimated Duration
Demolition Debris	3,000	Tons	100	10	4.2	2 Months
Service/Utility /Fuel Trucks				8	6	
Subcontractors Light Trucks				16	12	
Total Construction Workers	10 to 15					
Arriving by Personal Vehicle	2 to 3					
Arriving by Mass Transit	8 to 12					
Supervisory/QA	3 to 5					
Arriving by Personal Vehicle	1 to 2					
Arriving by Mass Transit	2 to 3					

Equipment – All demolition work occurs within the east bathtub. Percentage of Daily Use for construction equipment has been based on operating 9 hours out of a 10-hour shift. The 9 hours are based on allowing for morning start-up, coffee breaks, lunch break and daily fueling/maintenance. Percentage of Use for Dump Trucks is based on waiting time and loading time on site only. Equipment required is as follows:

Equipment Type	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily Use	Duration
Hydraulic All Terrain Crane	50 Ton	Diesel	165	1	1	50%	2 months
Hydraulic Excavator w/Hoe Ram	3.5 Cubic Yard	Diesel	320	4	4	90%	
Hydraulic Excavator w/Thumb	3.5 Cubic Yard	Diesel	320	1	1	90%	
Hydraulic Excavator w/Grapple	3.5 Cubic Yard	Diesel	320	1	1	90%	
Hydraulic Excavator w/Shear	3.5 Cubic Yard	Diesel	320	1	1	50%	
Track Loader w/Waste Handling Bucket	5.5 Cubic Yard	Diesel	160	1	1	90%	
Dump Trucks	Tandem Axle – 15 CY	Diesel	325	5	2.1	10%	
Air Compressor for Pavement Breakers	1600 CFM	Diesel	460	1	1	50%	
Pavement Breakers	90 lbs.			4	4	50%	

Excavation – After completion of the east slurry wall construction, the east bathtub will be created by excavating within the slurry walls to bedrock at EL 238'. The area immediately adjacent to the slurry walls will be benched to allow the installation of the tieback anchors for temporary support of the slurry wall during construction of the basement levels of the development. The soil excavation can continue in the northern central and southern central portions of the bathtub, zones 4 and 5 respectively. Areas immediately adjacent to the slurry wall will be conducted last until the final row of tieback anchors has been completed.

Delivery Type **ZONE 4**	**Quantity**	**Units**	**Total No. Of Loads**	**Trips per Day (Peak Day impact Calculation)**	**Trips per Day (cumulative impact calculation)**	**Estimated Duration** **Worst Case**
Soil/Rock Anchors	1,280	Ea	16	2	.14	9 Months
Excavate to 238’	225,000	CY	15,000	170	138	
Service/Utility /Fuel				12	8	
Subcontractors Light Trucks				8	4	
Construction Workers	20 to 30					
Arriving by Personal Vehicle	4 to 6					
Arriving by Mass Transit	16 to 24					
Supervisory/QA	4 to 6					
Arriving by Personal Vehicle	1 to 2					
Arriving by Mass Transit	3 to 4					

Delivery Type **ZONE 5**	**Quantity**	**Units**	**Total No. Of Loads**	**Trips per Day (Peak Day impact Calculation)**	**Trips per Day (cumulative impact calculation)**	**Estimated Duration**
Soil/Rock Anchors	880	Ea	12	2	2	9 Months
Excavate to 238’	206,000	CY	13,750	153	127	
Service/Utility /Fuel				12	8	
Subcontractors Light Trucks				8	6	
Construction Workers	10 to 20					
Arriving by Personal Vehicle	2 to 4					
Arriving by Mass Transit	8 to 16					
Supervisory/QA	4 to 6					
Arriving by Personal Vehicle	1 to 2					
Arriving by Mass Transit	3 to 4					

Equipment – Percentage of Daily Use for construction equipment has been based on operating 9 hours out of a 10-hour shift. The 9 hours are based on allowing for morning start-up, coffee breaks, lunch break and daily fueling/maintenance. Percentage of Use for Dump Trucks is based on waiting time and loading time on site only. Equipment required is as follows:

Equipment Type Zone 4	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily Use	Duration
Hydraulic Drill Rig for Anchors	Diesel 150 HP	Diesel	150	2	2	90%	9 months
Crawler Crane to support Anchor Operation	100 Ton	Diesel	350	1	1	50%	
Hi-Lift (Forklift) for Anchor Oper.	5 ton – 40 foot boom	Diesel	120	1	1	90%	
Hydraulic Excavators	3.5 CY	Diesel	320	3	3	90%	
Dozer	150 HP	Diesel	150	2	2	90%	
Dump Trucks	15 CY	Diesel	325	85	69	5%	
Diesel Generators	100 HP	Diesel	100	2	2	90%	

Equipment Type Zone 5	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily Use	Duration
Hydraulic Drill Rig for Anchors	Diesel 150 HP	Diesel	150	2	2	90%	9 months
Crawler Crane to support Anchor Oper.	100 Ton	Diesel	350	1	1	50%	
Hi-Lift(Forklift) for Anchor Oper.	5 ton – 40 foot boom	Diesel	120	1	1	90%	
Hydraulic Excavators	3.5 CY	Diesel	320	2	2	90%	
Dozer	150 HP	Diesel	150	1	1	90%	
Dump Trucks	15 CY	Diesel	325	76	64	5%	
Diesel Generators	100 HP	Diesel	100	2	2	90%	

Tunnels – Traffic and Construction Equipment

The driving of the ramp tunnels under 1/9 line will take place from within the existing west bathtub and the east bathtub in Zone 4 and 5 as described above. Estimated duration of tunneling driving and construction is 15 months. Mobilization of equipment, removal of excavated spoils and delivery of construction materials will be minor in nature to the overall site operations and will add the following traffic:

Delivery Type	Quantity	Units	Total No. Of Loads	Trips per Day (Peak Day impact Calculation)	Trips per Day (cumulative impact calculation)	Estimated Duration
Spoil Removal	11,000	CY	750	8	4.2	15 Months
Underpinning	1,500	Tons	75	2	0.42	
Concrete / Steel	1,800	CY	180	8	1	
Service/Utility /Fuel				8	4	
Subcontractors Light Trucks				20	14	
Construction Workers	20 to 25					
Arriving by Personal Vehicle	4 to 5					
Arriving by Mass Transit	16 to 20					
Supervisory/QA	4 to 8					
Arriving by Personal Vehicle	1 to 2					
Arriving by Mass Transit	3 to 6					

Equipment –Tunneling will be accomplished with a tunnel roadheader and staged underpinning, and will require removal of spoils to the surface adjacent to Liberty and West Streets by lifting to the surface with a crane and skip box. Percentage of Daily Use for construction equipment has been based on operating 9 hours out of a 10-hour shift. The 9 hours are based on allowing for morning start-up, coffee breaks, lunch break and daily fueling/maintenance. Percentage of Use for Concrete Trucks and Dump Trucks are based on waiting time and unloading/loading time on site only. The following construction equipment will be required for the underpinning operation that will take approximately 5 months of the 15-month construction period:

Equipment Type	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily Use	Duration
Air Operated Grout Drills				3	1	90%	15 months
Hi-Lift (Forklift)	5 ton – 40 foot boom	Diesel	120	2	.67	90%	
Concrete Pump	150 CY/Hour – 100 foot boom	Diesel	300	1	.33	30%	
Concrete Trucks	10 Cubic yard Tandem or Tri-axle	Diesel	325	1	.2	5%	
Welding Machines	35 HP Diesel Engine	Diesel	35	4	1.33	90%	

The following construction equipment will be required for the excavation of the tunnel and spoil removal operation that will take approximately 5 months of the 15-month construction period:

Equipment Type	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily Use	Duration
Roadheader for tunneling	12 foot Diameter	Diesel	120	1	.33	33%	15 months
Hi-Lift (Forklift)	5 ton – 40 foot boom	Diesel	120	2	.67	90%	
Crawler Crane for spoil removal	100 Ton	Diesel	350	1	.33	90%	
Dump Truck	Tandem Axle – 15 CY	Diesel	325	4	2.1	5%	

The following construction equipment will be required for the tunnel lining operation that will take approximately 5 months of the 15-month construction period:

Equipment Type	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily Use	Duration
Hi-Lift (Forklift)	5 ton – 40 foot boom	Diesel	120	2	.67	90%	15 months
Crawler Crane for Material and Form support	100 Ton	Diesel	350	1	.33	80%	
Concrete Pump	150 CY/Hour – 100 foot boom	Diesel	300	1	.33	30%	
Concrete Trucks	10 Cubic yard Tandem or Tri-axle	Diesel	325	4	0.5	5%	
Welding Machines	35 HP Diesel Engine	Diesel	35	2	.67	90%	

Northwest Quadrant Subgrade Retail – WTC Concourse, Freedom Tower Foundations (Zone 2) – Traffic and Construction Equipment

Construction – This activity includes the construction of all structural elements in Zone 2 within the northwest quadrant (north of WTC Tower 2 footprint) of the site and within the west bathtub for the foundations and sub-grade levels for WTC Concourses, cultural space and performing arts program to El. 364'. The activity does not include Permanent WTC PATH platforms, track, mezzanine and concourse areas in Zone 2. Concrete Truck Trips have been generated based on a worst-case scenario of a maximum pour of 600 CY.

Delivery Type Northwest Quadrant	Quantity	Units	Total No. Of Loads	Trips per Day (Peak Day impact Calculation)	Trips per Day (cumulative impact calculation)	Estimated Duration
Concrete	11,000	CY	1,100	120	7	13 Months
Reinforcing Steel*	1,800	Tons	90	4	0.6	
Structural Steel 306' to 364'*	5,000	Tons	250	6	1.6	
Curtain Wall*	87,000	SF	116	8	0.74	
Interior Fitout*	464,000	SF	700	6	4.5	
Service/Utility /Fuel				36	32	
Subcontractors Light Trucks				44	40	
Construction Workers	300 to 400					
Arriving by Personal Vehicle	60 to 80					
Arriving by Mass Transit	240 to 320					
Supervisory/QA	40 to 45					
Arriving by Personal Vehicle	8 to 9					
Arriving by Mass Transit	32 to 36					
**Assumed to be evenly distributed throughout the subtask duration*						

Equipment – In general the construction within the Northwest Quadrant will be performed from within the footprint of the proposed structures. Foundation and subbasement work will be primarily of concrete construction to street level. Percentage of Daily Use for construction equipment has been based on operating 9 hours out of a 10-hour shift. The 9 hours are based on allowing for morning start-up, coffee breaks, lunch break and daily fueling/maintenance. Percentage of Use for Concrete Trucks and Tractor Trailers are based on waiting time and unloading time on site only. The following construction equipment will be required:

Equipment Type	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily Use	Duration
Crawler Crane	200 Ton	Diesel	450	2	2	90%	13 months
Tower Crane	100 Ton	Diesel	250	4	4	90%	
Hi-Lift (Forklift)	5 ton – 40 foot boom	Diesel	120	1	1	90%	
Concrete Pump	150 CY/Hour – 100 foot boom	Diesel	300	1	1	60%	
Concrete Trucks	10 Cubic Yard Tandem or Tri-Axle	Diesel	325	60	3.5	5%	
Diesel Generators	100 HP	Diesel	100	4	4	35%	
Tractor Trailer	Tandem Axle Tractor w/45 Foot Trailer	Diesel	325	12	3.7	5%	
Welding Machines	35 HP Diesel Engine	Diesel	35	4	4	80%	
Air Compressor for Impact Wrenches	800 CFM	Diesel	310	2	2	80%	
Impact Wrenches	1” Socket Drive			16	16	60%	

Memorial, Open Space, Cultural Space (Zones 1 & 2) – Traffic and Construction Equipment

Construction – This activity includes the construction of all structural elements in Zone 1 & 2 within the west bathtub for the Memorial Site, Open Space and Cultural Space from the proposed location of Fulton Street on the north and Liberty Street on the south to El. 364’. This activity does not include Permanent WTC PATH platforms, track, mezzanine and concourse areas in Zone 2. Preliminary estimates for the duration of the construction of these areas are 25 months. For the Cultural Spaces it is anticipated that some of the structural steel framing will be pre-fabricated trusses to span the width of the atrium/open areas and should not require lane closings, since the affected streets, Greenwich, Fulton and Liberty will be under construction within the boundaries of the WTC Redevelopment. Concrete Truck Trips have been generated based on a worst-case scenario of a maximum pour of 600 CY.

Delivery Type **Memorial, Open and Cultural Spaces**	**Quantity**	**Units**	**Total No. Of Loads**	**Trips per Day (Peak Day impact Calculation)**	**Trips per Day (cumulative impact calculation)**	**Estimated Duration**
Concrete	25,500	CY	2,550	120	8.5	25 Months
Reinforcing Steel	4,100	Tons	205	2	0.68	
Structural Steel 306' to 364'*	3,000	Tons	150	4	0.5	
Curtain Wall*	67,000	SF	90	4	0.3	
Interior Fitout*	766,000	SF	1,150	10	3.8	
Service/Utility /Fuel				36	32	
Subcontractors Light Trucks				44	40	
Construction Workers	200 to 250					
Arriving by Personal Vehicle	10 to 15					
Arriving by Mass Transit	190 to 235					
Supervisory/QA	40 to 45					
Arriving by Personal Vehicle	4 to 6					
Arriving by Mass Transit	36 to 39					

Equipment – In general the construction within the Memorial Site, Open Space and Cultural Space will be performed from within the footprint of the proposed structures over the Permanent PATH Terminal. Foundation and subbasement work will be primarily of concrete construction to street level. Percentage of Daily Use for construction equipment has been based on operating 9 hours out of a 10-hour shift. The 9 hours are based on allowing for morning start-up, coffee breaks, lunch break and daily fueling/maintenance. Percentage of Use for Concrete Trucks and Tractor Trailers are based on waiting time and unloading time on site only. The following construction equipment will be required:

Equipment Type	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily Use	Duration
Crawler Crane	200 Ton	Diesel	450	1	1	90%	25 months
Tower Crane	100 Ton	Diesel	250	2	2	90%	
Hi-Lift (Forklift)	5 ton – 40 foot boom	Diesel	120	2	2	90%	
Concrete Pump	150 CY/Hour – 100 foot boom	Diesel	300	1	1	60%	
Concrete Trucks	10 Cubic Yard Tandem or Tri-Axle	Diesel	325	60	4.2	5%	
Diesel Generators	100 HP	Diesel	100	4	4	20%	
Tractor Trailer	Tandem Axle Tractor w/45 Foot Trailer	Diesel	325	10	2.65	5%	
Welding Machines	35 HP Diesel Engine	Diesel	35	4	4	80%	
Air Compressor for Impact Wrenches	800 CFM	Diesel	310	2	2	80%	
Impact Wrenches	1” Socket Drive			16	16	60%	

Southeast Quadrant Sub-grade – Towers 3 & 4 Foundations & Retail Below Grade (Zone 4) – Traffic and Construction Equipment

Construction – This activity includes the construction of all structural elements in Zone 4 for the foundations of Towers 3 and 4 and retail areas south of the Permanent PATH Terminal to El. 364’. The activity does not include the Permanent WTC PATH Terminal in Zone 6. Preliminary estimates for the duration of the construction of these areas are 15 months commencing Oct 2005 thru Dec 2006 Concrete Truck Trips have been generated based on a worst-case scenario of a maximum pour of 600 CY.

Delivery Type Zone 4	Quantity	Units	Total No. Of Loads	Trips per Day (Peak Day impact Calculation)	Trips per Day (cumulative impact calculation)	Estimated Duration
Concrete	18,000	CY	1,800	120	10	15 Months
Reinforcing Steel	2,800	Tons	140	2	0.78	
Structural Steel 306' to 364'*	3,000	Tons	150	4	0.83	
Curtain Wall*	81,000	SF	108	4	0.6	
Interior Fitout*	715,000	SF	1,075	10	6	
Service/Utility /Fuel				36	32	
Subcontractors Light Trucks				44	40	
Construction Workers	150 to 200					
Arriving by Personal Vehicle	5 to 8					
Arriving by Mass Transit	145 to 192					
Supervisory/QA	20 to 25					
Arriving by Personal Vehicle	2 to 5					
Arriving by Mass Transit	18 to 20					
**Assumed to be evenly distributed throughout the subtask duration*						

Equipment – In general the construction of the foundations of Towers 3 and 4 and retail levels to El.364' in the Zone 4 will begin within the east bathtub and will be performed from within the footprint of the proposed structures Foundation and subbasement work will be primarily of concrete construction to street level. Percentage of Daily Use for construction equipment has been based on operating 9 hours out of a 10-hour shift. The 9 hours are based on allowing for morning start-up, coffee breaks, lunch break and daily fueling/maintenance. Percentage of Use for Concrete Trucks and Tractor Trailers are based on waiting time and unloading time on site only. The following construction equipment will be required:

Equipment Type	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily Use	Duration
Crawler Crane	200 Ton	Diesel	450	1	1	90%	15 months
Tower Crane	100 Ton	Diesel	250	2	2	90%	
Hi-Lift (Forklift)	5 ton – 40 foot boom	Diesel	120	2	2	90%	
Concrete Pump	150 CY/Hour – 100 foot boom	Diesel	300	1	1	60%	
Concrete Trucks	10 Cubic Yard Tandem or Tri-Axle	Diesel	325	60	5	5%	
Diesel Generators	100 HP	Diesel	100	4	4	20%	
Tractor Trailer	Tandem Axle Tractor w/45 Foot Trailer	Diesel	325	10	4.1	5%	
Welding Machines	35 HP Diesel Engine	Diesel	35	4	4	80%	
Air Compressor for Impact Wrenches	800 CFM	Diesel	310	2	2	80%	
Impact Wrenches	1" Socket Drive			20	20	60%	

Northeast Quadrant Sub-grade – Tower 2 Foundation & Retail Below Grade (Zone 5) – Traffic and Construction Equipment

Construction – This activity includes the construction of all structural elements in Zone 5 for the foundations of Tower 2 and retail spaces from sub-grade levels to El. 364' north of the Permanent PATH Terminal including the sub-grade levels below the proposed location of Fulton Street through the redevelopment site. The activity does not include Permanent WTC PATH Terminal in Zone 6. Preliminary estimates for the duration of the construction of these areas are 12 months commencing Sept 2005 thru Sept 2006. Lane closings along Vesey Street will be required. Concrete Truck Trips have been generated based on a worst-case scenario of a maximum pour of 600 CY.

Delivery Type **Northeast Quadrant**	**Quantity**	**Units**	**Total No. Of Loads**	**Trips per Day (Peak Day impact Calculation)**	**Trips per Day (cumulative impact calculation)**	**Estimated Duration**
Concrete	15,000	CY	1,500	120	8.3	15 Months
Reinforcing Steel	2,500	Tons	125	2	.7	
Structural Steel to 306' - 364'*	1,000	Tons	50	2	0.27	
Curtain Wall*	70,000	SF	95	4	0.52	
Interior Fitout*	540,000	SF	810	14	4.5	
Service/Utility /Fuel				36	32	
Subcontractors Light Trucks				44	40	
Construction Workers	100 to 150					
Arriving by Personal Vehicle	5 to 10					
Arriving by Mass Transit	95 to 140					
Supervisory/QA	20 to 25					
Arriving by Personal Vehicle	2 to 5					
Arriving by Mass Transit	18 to 20					

Equipment – In general the construction of the foundations of Tower 2 and retail levels to El.364' in the Zone 4 will begin within the east bathtub and will be performed from within the footprint of the proposed structures. Foundation and subbasement work will be primarily of concrete construction to street level. Percentage of Daily Use for construction equipment has been based on operating 9 hours out of a 10-hour shift. The 9 hours are based on allowing for morning start-up, coffee breaks, lunch break and daily fueling/maintenance. Percentage of Use for Concrete Trucks and Tractor Trailers are based on waiting time and unloading time on site only. The following construction equipment will be required:

Equipment Type	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily Use Use	Duration
Crawler Crane	200 Ton	Diesel	450	1	1	90%	15 months
Tower Crane	100 Ton	Diesel	250	2	2	90%	
Hi-Lift (Forklift)	5 ton – 40 foot boom	Diesel	120	2	2	90%	
Concrete Pump	150 CY/Hour – 100 foot boom	Diesel	300	1	1	60%	
Concrete Trucks	10 Cubic Yard Tandem or Tri-Axle	Diesel	325	60	4.1	5%	
Diesel Generators	100 HP	Diesel	100	4	4	20%	
Tractor Trailer	Tandem Axle Tractor w/45 Foot Trailer	Diesel	325	11	3	5%	
Welding Machines	35 HP Diesel Engine	Diesel	35	4	4	80%	
Air Compressor for Impact Wrenches	800 CFM	Diesel	310	2	2	80%	
Impact Wrenches	1” Socket Drive			20	20	60%	

East Bathtub Retail Above Grade Fitout (Zones 4, 5 & 6)

This activity includes the fitout of the retail development to El. 364’ east of Greenwich Street and including the 7,200 SF of retail space within the Permanent PATH Terminal. Work includes all retail store finishes and furnishings, including necessary HVAC, Electrical and Mechanical. The preliminary schedule indicates that the work will require 23 months.

Delivery Type **East Bathtub Retail Fitout Above Grade**	**Quantity**	**Units**	**Total No. Of Loads**	**Trips per Day (Peak Day impact Calculation)**	**Trips per Day (cumulative impact calculation)**	**Estimated Duration**
Interior Fitout (Retail Store & Restaurant Fixtures)	150,000	Tons	7,500	30	26	23 Months
Service/Utility /Fuel				34	30	
Subcontractors Light Trucks				44	40	
Construction Workers	200 to 250					
Arriving by Personal Vehicle	5 to 10					
Arriving by Mass Transit	195 to 240					
Supervisory/QA	30 to 35					
Arriving by Personal Vehicle	2 to 5					
Arriving by Mass Transit	28 to 30					

Equipment – Retail Fitout will involve work almost entirely within the shell of the completed retail levels. Since the sub-grade parking and truck delivery areas will have been completed by this stage of construction, it is anticipated that most of the deliveries and staging/storage area of materials will occur within the underground parking and truck delivery areas.

Equipment Type	**Size**	**Engine Type**	**Size** **HP**	**Quantity (peak calculation)**	**Quantity (cumulative calculation)**	**Percentage Daily Use**	**Duration**
Hi-Lift (Forklift)	5 ton – 40 foot boom	Diesel	120	2	2	90%	23 months
Tractor Trailer	Tandem Axle Tractor w/45 Foot Trailer	Diesel	325	15	13	5%	
Welding Machines	35 HP Diesel Engine	Diesel	35	2	2	60%	

Tower Development Construction (Zones 2, 4 and 5) – Traffic and Construction Equipment

Tower Construction – Tower No. 1 will be fast tracked due to its symbolic nature. Towers 2 thru 5 will most likely follow at a normal pace, and it is assumed that the towers 2, 3 and 4 will be constructed simultaneously with tower 5 commencing at or near the completion of towers 2, 3 and 4. Construction activities for the tower construction include all levels above the highest retail level at El. 364. Concrete Truck Trips have been generated based on a worst-case scenario of a maximum pour of 600 CY.

Tower 1

Structural Framing

Delivery Type **Tower 1** **2.6 Million SF - 70 Stories**	**Quantity**	**Units**	**Total No. Of Truckloads**	**Trips per Day (Peak Day impact Calculation)**	**Trips per Day (cumulative impact calculation)**	**Estimated Duration**
Concrete - Floors	40,000	CY	4,000	120	24	14 months
Structural Steel	35,000	Tons	1,750	20	10.4	
Service/Utility /Fuel				36	32	
Subcontractors Light Trucks				44	40	
Construction Workers	300 to 350					
Arriving by Personal Vehicle	60 to 65					
Arriving by Mass Transit	240 to 285					
Supervisory/QA	20 to 25					
Arriving by Personal Vehicle	4 to 5					
Arriving by Mass Transit	16 to 20					

Fitout and installation of curtain wall will commence some time after steel erection and concrete pours have commenced

Delivery Type **Tower 1** **2.6 Million SF - 70 Stories**	**Quantity**	**Units**	**Total No. Of Truckloads**	**Trips per Day (Peak Day impact Calculation)**	**Trips per Day (cumulative impact calculation)**	**Estimated Duration**
Curtain Wall	5,000	Tons	250	3	0.8	26 months
Interior Fitout			1,000	10	3.2	
Service/Utility /Fuel*				36	32	
Subcontractors Light Trucks*				44	40	
Construction Workers	300 to 350					
Arriving by Personal Vehicle	60 to 65					
Arriving by Mass Transit	240 to 285					
Supervisory/QA	20 to 25					
Arriving by Personal Vehicle	4 to 5					
Arriving by Mass Transit	16 to 20					
**Service/Utility/Fuel/Light Truck numbers NOT to be cumulative with Service/Utility/Fuel/Light Truck totals for Structural Framing activity where Structural Framing and "Fitout and Curtain Wall" activities overlap (i.e: only count them once)*						

Equipment – In general the construction of Tower 1 be performed from within the footprint of the proposed structure and site. Lane closure along Vesey Street will continue to be necessary for receiving material deliveries. Percentage of Daily Use for construction equipment has been based on operating 9 hours out of a 10-hour shift. The 9 hours are based on allowing for morning start-up, coffee breaks, lunch break and daily fueling/maintenance. Percentage of Use for Concrete Trucks and Tractor Trailers are based on waiting time and unloading time on site only. The following construction equipment will be required:

Structural Framing

Equipment Type	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily Use	Duration
Crawler Crane	200 Ton	Diesel	450	2	2	90%	14 months
Tower Crane	100 Ton	Diesel	250	4	4	90%	
Hi-Lift (Forklift)	5 ton – 40 foot boom	Diesel	120	2	2	90%	
Concrete Pump	150 CY/Hour – 100 foot boom	Diesel	300	2	2	60%	
Concrete Trucks	10 Cubic Yard Tandem or Tri-Axle	Diesel	325	60	12	10%	
Diesel Generators	100 HP	Diesel	100	10	10	20%	
Tractor Trailer	Tandem Axle Tractor w/45 Foot Trailer	Diesel	325	10	5.2	5%	
Welding Machines	35 HP Diesel Engine	Diesel	35	10	10	90%	
Air Compressor for Impact Wrenches	800 CFM	Diesel	310	2	2	90%	
Impact Wrenches	1” Socket Drive			20	20	80%	

Curtain Wall and Fitout

Equipment Type	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily Use	Duration
Tower Crane	100 Ton	Diesel	250	4	4	90%	26 months
Hi-Lift (Forklift)	5 ton – 40 foot boom	Diesel	120	2	2	90%	
Diesel Generators	100 HP	Diesel	100	10	10	20%	
Welding Machines	35 HP Diesel Engine	Diesel	35	10	10	90%	
Air Compressor for Impact Wrenches	800 CFM	Diesel	310	2	2	90%	
Impact Wrenches	1” Socket Drive			20	20	80%	
Tractor Trailer	Tandem Axle Tractor w/45 Foot Trailer	Diesel	325	6	2	5%	

Towers 2, 3, and 4

Structural Framing

Delivery Type **Towers 2, 3 & 4** **2.05 Million SF – 65 Stories** **2.0 Million SF - 60 Stories** **1.73 Million SF – 55 Stories**	**Quantity**	**Units**	**Total No. Of Truckloads**	**Trips per Day (Peak Day impact Calculation)**	**Trips per Day (cumulative impact calculation)**	**Estimated Duration**
Concrete	90,000	CY	9,000	100	31.3	24 Months
Structural Steel	84,000	Tons	4,200	26	14.5	
Service/Utility /Fuel				26	22	
Subcontractors Light Trucks				44	40	
Construction Workers	700 to 900					
Arriving by Personal Vehicle	50 to 60					
Arriving by Mass Transit	650 to 840					
Supervisory/QA	60 to 75					
Arriving by Personal Vehicle	4 to 5					
Arriving by Mass Transit	56 to 70					

Curtain Wall and Fitout

Delivery Type **Towers 2, 3 & 4** **2.05 Million SF – 65 Stories** **2.0 Million SF - 60 Stories** **1.73 Million SF – 55 Stories**	**Quantity**	**Units**	**Total No. Of Truckloads**	**Trips per Day (Peak Day impact Calculation)**	**Trips per Day (cumulative impact calculation)**	**Estimated Duration**
Curtain Wall	9,800	Tons	490	6	1.7	24 Months
Interior Fitout				20	18	
Service/Utility /Fuel*				26	24	
Subcontractors Light Trucks*				44	40	
Construction Workers	700 to 900					
Arriving by Personal Vehicle	50 to 60					
Arriving by Mass Transit	650 to 840					
Supervisory/QA	60 to 75					
Arriving by Personal Vehicle	4 to 5					
Arriving by Mass Transit	56 to 70					
**Service/Utility/Fuel/Light Truck numbers NOT to be cumulative with Service/Utility/Fuel/Light Truck totals for Structural Framing activity where Structural Framing and "Fitout and Curtain Wall" activities overlap (i.e: only count them once)*						

Equipment – Towers 2, 3 and 4 will be constructed primarily from within the tower. Percentage of Daily Use for construction equipment has been based on operating 9 hours out of a 10-hour shift. The 9 hours are based on allowing for morning start-up, coffee breaks, lunch break and daily fueling/maintenance. Percentage of Use for Concrete Trucks and Tractor Trailers are based on waiting time and unloading time on site only. The following construction equipment will be required:

Structural Framing

Equipment Type	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily Use	Duration
Crawler Crane	200 Ton	Diesel	450	4	4	90%	24 months
Tower Crane	100 Ton	Diesel	250	6	6	90%	
Hi-Lift (Forklift)	5 ton – 40 foot boom	Diesel	120	3	3	90%	
Concrete Pump	150 CY/Hour – 100 foot boom	Diesel	300	4	4	60%	
Concrete Trucks	10 Cubic Yard Tandem or Tri-Axle	Diesel	325	50	15	5%	
Diesel Generators	100 HP	Diesel	100	16	16	20%	
Tractor Trailer	Tandem Axle Tractor w/45 Foot Trailer	Diesel	325	13	7	5%	
Welding Machines	35 HP Diesel Engine	Diesel	35	6	6	90%	
Air Compressor for Impact Wrenches	800 CFM	Diesel	310	3	3	90%	
Impact Wrenches	1” Socket Drive			60	60	80%	

Curtain Wall and Fitout

Equipment Type	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily Use	Duration
Tower Crane	100 Ton	Diesel	250	6	6	90%	24 months
Hi-Lift (Forklift)	5 ton – 40 foot boom	Diesel	120	3	3	90%	
Diesel Generators	100 HP	Diesel	100	13	10	20%	
Tractor Trailer	Tandem Axle Tractor w/45 Foot Trailer	Diesel	325	10	9	5%	
Welding Machines	35 HP Diesel Engine	Diesel	35	6	6	90%	
Air Compressor for Impact Wrenches	800 CFM	Diesel	310	3	3	90%	
Impact Wrenches	1" Socket Drive			60	60	80%	

De-construction of Deutsche Bank Building – Traffic and Construction Equipment

The de-construction of the Deutsche Bank Building will require sidewalk and lane closings on Greenwich, Liberty, Albany and Washington Streets for the entire duration. The building is a 40-story building with a height of 565 feet and an approximate footprint of 40,000 SF per floor. Our estimate is that it will require a minimum of 12 months to take down the structure after the completion of any hazardous abatement for asbestos and mold. The demolition has been estimated on a single 8-hour shift.

Delivery Type	Quantity	Units	Total No. Of Loads	Trips per Day (Peak Day impact Calculation)	Trips per Day (cumulative impact calculation)	Estimated Duration
Gutting Floors	72,000	CY	1,800	18	12.5	12 Months
Concrete Floors	40,000	Tons	2,800	24	19.4	
Curtain Wall	3,400	Tons	225	4	1.6	
Structural Steel	18,400	Tons	1,000	10	7	
Service/Utility /Fuel				12	8	
Subcontractors Light Trucks				10	6	
Construction Workers	60 to 80					
Arriving by Personal Vehicle	12 to 16					
Arriving by Mass Transit	48 to 64					
Supervisory/QA	3 to 8					
Arriving by Personal Vehicle	1 to 2					
Arriving by Mass Transit	2 to 6					

Equipment – All demolition work occurs within the footprint and the adjacent sidewalk areas and lane closings around the perimeter of the site. Demolition is assumed to commence after hazardous materials abatement and will consist of the systematic gutting of the interiors prior to the cutting and removal of structural floor slabs and structural steel. Percentage of Daily Use for construction equipment has been based on operating 9 hours out of a 10-hour shift. The 9 hours are based on allowing for morning start-up, coffee breaks, lunch break and daily fueling/maintenance. Percentage of Use for Demolition Trailers is based on waiting time and loading time on site only. Equipment required is as follows:

Equipment Type	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily Use	Duration
Fixed Leg Derrick	100 Ton	Diesel	250	1	1	90%	12 months
Hydraulic All Terrain Crane	50 Ton	Diesel	165	1	1	50%	
Concrete Saws – Diamond Blade	50 HP Diesel Engines	Diesel	50	4	4	80%	
Skid Steer Loaders w/Demolition Hammers		Diesel	40	8	8	90%	
Hydraulic Excavator w/Thumb	3.5 Cubic Yard	Diesel	320	1	1	80%	
Hydraulic Excavator w/Concrete Pulverizer Attachment	3.5 Cubic Yards	Diesel	320	4	4	90%	
Rubber Tire Loader	3.5 Cubic Yard	Diesel	196	1	1	80%	
Demolition Trailers	Tandem Axle Tractor w/25 CY Dump Trailer	Diesel	325	19	20	5%	
Air Compressor for Pavement Breakers	1600 CFM	Diesel	460	2	2	100%	
Pavement Breakers	90 lbs.			8	8	80%	

Southern Expansion – 5TH Tower South of Liberty Street – Traffic and Construction Equipment

Slurry Wall – The existing western bathtub will be enlarged to encompass the area south of Liberty Street from West Street to Greenwich Street and south to Cedar Street and including the city block bounded by Washington Street, Albany Street and Greenwich Street south of Cedar Street. The slurry wall construction will follow the demolition/de-construction of the Deutsche

Bank Building. The slurry wall and excavation will be conducted down to a level of EL 238'. As the Slurry Wall progresses around the site, the area immediately adjacent to the wall will be benched down to the first level of tieback anchors, to allow installation of the anchors to commence prior to completion of the wall. Some excavation activities will coincide with the slurry wall and tieback anchoring activities. Traffic and Construction Equipment for the tie back installation is covered under Excavation below.

Delivery Type **South of Liberty St.**	**Quantity**	**Units**	**Total No. Of Loads**	**Trips per Day (Peak Day impact Calculation)**	**Trips per Day (cumulative impact calculation)**	**Estimated Duration** **Worst Case**
Slurry Wall – Exc.	10,300	CY	674	10	7	8 Months
Slurry Wall – Conc.	10,300	CY	1,010	16	10.5	
Slurry Wall – Rebar	2,275	Tons	114	2	1.2	
Service/Utility /Fuel				14	12	
Subcontractors Light Trucks				8	6	
Construction Workers	20 to 30					
Arriving by Personal Vehicle	4 to 6					
Arriving by Mass Transit	16 to 24					
Supervisory/QA	4 to 6					
Arriving by Personal Vehicle	1 to 2					
Arriving by Mass Transit	3 to 4					

Equipment – Construction of the Slurry Wall surrounding the southern expansion south of Liberty Street will be performed from within the footprint of the proposed development. The Slurry Wall will be constructed by the panel method and will require one crew of men and equipment to meet the proposed schedule. Percentage of Daily Use for construction equipment has been based on operating 9 hours out of a 10-hour shift. The 9 hours are based on allowing for morning start-up, coffee breaks, lunch break and daily fueling/maintenance. Percentage of Use for Concrete Trucks and Dump Trucks are based on waiting time and unloading/loading time on site only. Equipment required is as follows:

Equipment Type	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily Use	Duration
Slurry Plant Mixing Plant	100 m^3 per hour – Diesel 50 HP	Diesel	50	1	1	90%	8 months
Desanding Plant	100 m^3 per hour – Diesel 50 HP	Diesel	50	1	1	50%	
Crawler Crane w/clam shell	100 Ton	Diesel	350	1	1	90%	
Hydraulic All Terrain Crane	50 Ton	Diesel	165	1	1	25%	
Crawler Crane for rebar placement)	200 Ton	Diesel	450	1	1	50%	
Hi-Lift (Forklift)	5 ton – 40 foot boom	Diesel	120	1	1	90%	
Concrete Pump	150 CY/Hour – 100 foot boom	Diesel	300	1	1	50%	
Concrete Trucks	10 Cubic Yard Tandem or Tri-Axle	Diesel	325	8	5.2	5%	
Dump Trucks	Tandem Axle – 15 CY	Diesel	325	5	3.5	10%	
Hydraulic Excavators (lead in trench)	3.5 CY	Diesel	320	1	1	10%	
Dozer (maintain site grading)	150 HP	Diesel	150	1	1	10%	
Diesel Generators	100 HP	Diesel	100	2	2	90%	

Excavation - The area immediately adjacent to the slurry walls will be benched to allow the installation of the tieback anchors for temporary support of the slurry wall during construction of the basement levels of the southern expansion area development. The soil excavation can

continue in the central portions of the bathtub during the tieback anchors operation. Areas immediately adjacent to the slurry wall will be conducted last until the final row of tieback anchors has been completed.

Delivery Type **Southern Expansion Bathtub**	**Quantity**	**Units**	**Total No. Of Loads**	**Trips per Day (Peak Day impact Calculation)**	**Trips per Day (cumulative impact calculation)**	**Estimated Duration** **Worst Case**
Soil/Rock Anchors	1,680	Ea	21	2	.2	9 Months
Excavate to 241'	350,000	CY	23,500	260	217	
Service/Utility /Fuel				12	10	
Subcontractors Light Trucks				8	6	
Construction Workers	20 to 30					
Arriving by Personal Vehicle	4 to 6					
Arriving by Mass Transit	16 to 24					
Supervisory/QA	4 to 6					
Arriving by Personal Vehicle	1 to 2					
Arriving by Mass Transit	3 to 4					

Equipment – Excavation work will be performed from within the southern bathtub and will not require a staging area outside of the bathtub. The installation of the soil/rock anchor tiebacks will also be performed from within the bathtub and will not require a staging area outside of the bathtub. A lane closure will be required along Liberty Street to facilitate the staging of dump trucks and for receiving materials for the tie back operation. Percentage of Daily Use for construction equipment has been based on operating 9 hours out of a 10-hour shift. The 9 hours are based on allowing for morning start-up, coffee breaks, lunch break and daily fueling/maintenance. Percentage of Use for Dump Trucks is based on waiting time and loading time on site only. Equipment required is as follows:

Equipment Type	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily Use	Duration
Hydraulic Drill Rig for Anchors	Diesel 150 HP	Diesel	150	2	2	90%	9 months
Crawler Crane to support Anchor Oper.	100 Ton	Diesel	350	1	1	50%	
Hi-Lift (Forklift) for Anchor Oper.	5 ton – 40 foot boom	Diesel	120	1	1	90%	
Hydraulic Excavators	3.5 CY	Diesel	320	3	3	90%	
Dozer	150 HP	Diesel	150	2	2	90%	
Dump Trucks	Tandem Axle – 15 CY	Diesel	325	130	109	5%	
Diesel Generators	100 HP	Diesel	100	2	2	90%	

Construction – This activity includes the construction of all of the structural elements for the non-tower sub-grade development within the southern expansion area to El. 364'. Concrete Truck Trips have been generated based on a worst-case scenario of a maximum pour of 600 CY.

Delivery Type **South of Liberty Street to El. 364'**	**Quantity**	**Units**	**Total No. Of Loads**	**Trips per Day (Peak Day impact Calculation)**	**Trips per Day (cumulative impact calculation)**	**Estimated Duration**
Concrete	13,300	CY	1,330	120	9.2	12 Months
Reinforcing Steel	2,100	Tons	105	4	0.7	
Structural Steel to 364'	1,300	Tons	65	8	0.45	
Interior Fitout				26	26	
Service/Utility /Fuel				36	30	
Subcontractors Light Trucks				44	40	
Construction Workers	300 to 400					
Arriving by Personal Vehicle	60 to 80					
Arriving by Mass Transit	240 to 320					
Supervisory/QA	40 to 45					
Arriving by Personal Vehicle	8 to 9					
Arriving by Mass Transit	32 to 36					

Equipment – In general the construction within the southern expansion area will be performed from within the footprint of the proposed structures. Foundation and subbasement work will be primarily of concrete construction to street level. Percentage of Daily Use for construction equipment has been based on operating 9 hours out of a 10-hour shift. The 9 hours are based on allowing for morning start-up, coffee breaks, lunch break and daily fueling/maintenance. Percentage of Use for Concrete Trucks and Tractor Trailers are based on waiting time and unloading time on site only. The following construction equipment will be required:

Equipment Type	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily Use	Duration
Crawler Crane	200 Ton	Diesel	450	2	2	90%	12 months
Tower Crane	100 Ton	Diesel	250	2	2	90%	
Hi-Lift (Forklift)	5 ton – 40 foot boom	Diesel	120	2	2	90%	
Concrete Pump	150 CY/Hour – 100 foot boom	Diesel	300	2	2	60%	
Concrete Trucks	10 Cubic Yard Tandem or Tri-Axle	Diesel	325	60	5	5%	
Diesel Generators	100 HP	Diesel	100	10	10	20%	
Tractor Trailer	Tandem Axle Tractor w/45 Foot Trailer	Diesel	325	19	14	5%	
Welding Machines	35 HP Diesel Engine	Diesel	35	20	20	90%	
Air Compressor for Impact Wrenches	1600 CFM	Diesel	460	1	1	90%	
Impact Wrenches	1” Socket Drive			8	8	80%	

Tower Construction – This activity includes the construction of Tower 5 from El. 364 to the topping out of the building. Concrete Truck Trips have been generated based on a worst-case scenario of a maximum pour of 530 CY.

Delivery Type **Tower 5** **1.67 Million SF - 50 Stories**	**Quantity**	**Units**	**Total No. Of Truckloads**	**Trips per Day (Peak Day impact Calculation)**	**Trips per Day (cumulative impact calculation)**	**Estimated Duration**
Concrete	26,000	CY	2,600	106	9	24 Months
Structural Steel	20,000	Tons	1,000	16	3.5	
Curtain Wall	4,100	Tons	205	2	0.71	
Interior Fitout				26	26	
Service/Utility /Fuel				36	32	
Subcontractors Light Trucks				44	40	
Construction Workers	500 to 600					
Arriving by Personal Vehicle	50 to 60					
Arriving by Mass Transit	450 to 540					
Supervisory/QA	40 to 45					
Arriving by Personal Vehicle	4 to 5					
Arriving by Mass Transit	36 to 40					

Equipment – The construction of Tower 5 will be performed within the footprint of the proposed structure Percentage of Daily Use for construction equipment has been based on operating 9 hours out of a 10-hour shift. The 9 hours are based on allowing for morning start-up, coffee breaks, lunch break and daily fueling/maintenance. Percentage of Use for Concrete Trucks and Tractor Trailers are based on waiting time and unloading time on site only. The following construction equipment will be required:

Equipment Type	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily Use	Duration
Tower Crane	100 Ton	Diesel	250	1	1	90%	24 months
Hi-Lift (Forklift)	5 ton – 40 foot boom	Diesel	120	2	2	90%	
Concrete Pump	150 CY/Hour – 100 foot boom	Diesel	300	1	1	60%	
Concrete Trucks	10 Cubic Yard Tandem or Tri-Axle	Diesel	325	53	4.5	5%	
Diesel Generators	100 HP	Diesel	100	6	6	90%	
Tractor Trailer	Tandem Axle Tractor w/45 Foot Trailer	Diesel	325	22	15	5%	
Welding Machines	35 HP Diesel Engine	Diesel	35	4	4	90%	
Air Compressor for Impact Wrenches	800 CFM	Diesel	310	2	2	90%	
Impact Wrenches	1” Socket Drive			20	20	80%	

PERMANENT WTC PATH TERMINAL

(A) CONSTRUCTION METHODS AND IMPACTS

Permanent Tracks, Platform Conversion, Mezzanine and Concourse Construction (Zone 1) – Traffic and Construction Equipment

Construction period for this activity is estimated to consist of demolition and construction activities occurring simultaneously. Following the construction of a temporary sixth track adjacent to the westernmost existing fifth track, demolition and conversion activities would occur in 3 major sections, each further broken down into 2 components; a northern and a southern component (6 stages total). To maintain train service and passenger safety and access, only one half (either northern or southern half) would be demolished and converted then the second half would follow. This cycle, of stage, of activity would continue until all six tracks and platforms were converted.

Duration of completing all 6 stages is estimated to run for 21 months. All work estimated based on one 10-hour shift commencing at 0700 and running to 1800 Monday to Saturday. All work is within the west bathtub of the site with access from the existing ramp from Liberty Street. No street closings, lane closings or sidewalk closings are anticipated for this work to take place.

Demolition – Temporary sixth track to be built prior to any demolition and conversion activities. Demolition to occur in total of six stages. Demolition will occur on only the northern or southern half of platform and sets of tracks at one time to ensure continuous train service and passenger access. Estimated duration for demolition per stage is 24 days or 24 shifts. Demolition is included in the 3.5-month overall duration per stage.

Delivery Type ***Per Stage (6 Stages total)***	**Quantity**	**Units**	**Total No. Of Truckloads**	**Trips per Day (Peak Day impact Calculation)**	**Trips per Day (cumulative impact calculation)**	**Estimated Duration per stage**
Demolition Debris	1,000	Tons	68	10	6	1 month
Service/Utility /Fuel Trucks				6	4	
Subcontractors Light Trucks				16	12	
Total Construction Workers	15 to 20					
Arriving by Personal Vehicle	3 to 4					
Arriving by Mass Transit	12 to 16					
Supervisory/QA	3 to 5					
Arriving by Personal Vehicle	1 to 2					
Arriving by Mass Transit	2 to 3					

Equipment– All demolition work occurs within the existing western bathtub of the WTC site. Demolition work will occur periodically over the 21-month construction schedule for periods up to 24 days each. Percentage of Daily Use for construction equipment has been based on operating 9 hours out of a 10-hour shift. The 9 hours are based on allowing for morning start-up, coffee breaks, lunch break and daily fueling/maintenance. Percentage of Use for Dump Trucks is based on waiting time and loading time on site only. Equipment required is as follows:

Equipment Type	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily of Use	Duration
Hydraulic All Terrain Crane	50 Ton	Diesel	165	1	1	80%	1 month
Crawler Crane	200 Ton	Diesel	450	1	1	90%	
Hydraulic Excavator w/Hoe Ram	3.5 Cubic Yard	Diesel	320	1	1	90%	
Hydraulic Excavator w/Thumb	3.5 Cubic Yard	Diesel	320	1	1	90%	
Dump Trucks	Tandem Axle – 15 CY	Diesel	325	5	3	5%	
Air Compressor for Pavement Breakers	1600 CFM	Diesel	460	1	1	90%	
Pavement Breakers	90 lbs			4	4	90%	

Construction – Preliminary estimates for the duration of the stage construction of the PATH permanent tracks, platform conversion, mezzanine and concourse construction is 6 months per stage and roughly 21 months overall. Concrete Truck Trips have been generated based on a worst case scenario of a maximum pour of 500 CY.

Delivery Type ***Per Stage (6 Stages total)***	**Quantity**	**Units**	**Total No. Of Truckloads**	**Trips per Day (Peak Day impact Calculation)**	**Trips per Day (cumulative impact calculation)**	**Estimated Duration per stage**
Concrete	950	CY	95	100	3.2	2.5 months
Reinforcing Steel	150	Tons	8	2	0.27	
Structural Steel	1300	Tons	68	8	2.3	
Service/Utility /Fuel				6	4	
Subcontractors Light Trucks				26	22	
Construction Workers	30 to 40					
Arriving by Personal Vehicle	6 to 8					
Arriving by Mass Transit	24 to 32					
Supervisory/QA	10 to 15					
Arriving by Personal Vehicle	2 to 3					
Arriving by Mass Transit	8 to 12					

It is anticipated that a Construction Crew of 30 to 40 craft workers will be required on site during the peak period of each stage, with an additional 10 to 15 supervisory, quality assurance or administrative personnel. Our assumption is that most individuals will arrive at the site using mass transit, however we would estimate that 10 to 15 light trucks will arrive at the site during the first and second shift shape-up times, (coinciding with morning and evening peak traffic periods) with an additional 5 to 10 service/utility/delivery truck frequenting the site during each shift.

Equipment – All construction work takes place within the western bathtub. Access is by way of the existing ramp from Liberty Street. Construction laydown area for materials will be within the footprint of the permanent PATH Station or immediately adjacent to the footprint within the western bathtub. Percentage of Daily Use for construction equipment has been based on operating 9 hours out of a 10-hour shift. The 9 hours are based on allowing for morning start-up, coffee breaks, lunch break and daily fueling/maintenance. Percentage of Use for Concrete Trucks and Tractor Trailers are based on the approximate waiting time and loading/unloading time on site only. The following construction equipment will be required:

Equipment Type	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily of Use	Duration
Hydraulic All Terrain Crane	50 Ton	Diesel	165	1	1	80%	2.5 months
Crawler Crane	200 Ton	Diesel	450	1	1	90%	
Hi-Lift (Forklift)	5 ton – 40 foot boom	Diesel	120	2	2	90%	
Concrete Pump	150 CY/Hour – 100 foot boom	Diesel	300	1	.1	50%	
Concrete Truck	10 CY Tandem or Tri-axle	Diesel	325	50	1.6	5%	
Tractor Trailer	Tandem Axle Tractor w/45 Foot Trailer	Diesel	325	5	1.3	5%	
Welding Machines	35 HP Diesel Engine	Diesel	35	2	2	90%	
Air Compressor for Impact Wrenches	1600 CFM	Diesel	460	2	2	90%	
Impact Wrenches	1" Socket Drive			20	20	80%	

Tunnels under 1 & 9 Line (Zone 3) – Traffic and Construction Equipment

The driving of the mezzanine and concourse tunnels under the 1 & 9 subway tunnel beneath Greenwich Street will take place from within the existing subway tunnel (grouting operation) and from within the existing west bathtub. Estimated duration of tunneling driving and construction is 20 months. Tunneling, Underpinning, and Construction activities will occur throughout this period. Mobilization of equipment, removal of excavated spoils and delivery of construction materials will be minor in nature to the overall site operations and will add the following traffic:

Delivery Type	Quantity	Units	Total No. Of Truckloads	Trips per Day (Peak Day impact Calculation)	Trips per Day (cumulative impact calculation)	Estimated Duration
Spoil Removal	10,000	CY	670	12	2.8	20 Months
Underpinning	1,000	Tons	50	2	.21	
Concrete / Steel	1,500	CY	150	4	.63	
Service/Utility /Fuel				4	2	
Subcontractors Light Trucks				10	6	
Construction Workers	15 to 20					
Arriving by Personal Vehicle	3 to 4					
Arriving by Mass Transit	12 to 16					
Supervisory/QA	3 to 8					
Arriving by Personal Vehicle	1 to 2					
Arriving by Mass Transit	2 to 6					

Equipment – Grouting beneath the existing subway tunnel will be performed from within the tunnel and will involve the use of compressed air operated drill rigs and grout pumps. Tunneling beneath the subway will occur from the western bathtub and proceeding east. Tunneling will be accomplished with a tunnel roadheader and will require removal of existing piling supporting the existing tunnel and replacement with new piles/foundations. Spoils will be removed via the existing ramp to Liberty Street, or by lifting to the surface with a crane and skip box. Percentage of Daily Use for construction equipment has been based on operating 9 hours out of a 10-hour shift. The 9 hours are based on allowing for morning start-up, coffee breaks, lunch break and daily fueling/maintenance. Percentage of Use for Concrete Trucks and Tractor Trailers are based on the approximate waiting time and loading/unloading time on site only. The following construction equipment will be required for the underpinning operation that will take approximately 6 months of the 20-month construction period:

Equipment Type	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily of Use	Duration
Air Operated Grout Drills				3	1	90%	20 months
Hi-Lift (Forklift)	5 ton – 40 foot boom	Diesel	120	2	.67	90%	
Concrete Pump	150 CY/Hour – 100 foot boom	Diesel	300	1	.33	30%	
Concrete Trucks	10 Cubic yard Tandem or Tri-axle	Diesel	325	2	.67	5%	
Welding Machines	35 HP Diesel Engine	Diesel	35	2	.67	90%	

The following construction equipment will be required for the excavation of the tunnel and spoil removal operation that will take approximately 6 months of the 20-month construction period:

Equipment Type	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily of Use	Duration
Roadheader for tunneling	12 foot Diameter	Diesel	120	1	.33	33%	20 months
Hi-Lift (Forklift)	5 ton – 40 foot boom	Diesel	120	2	.67	90%	
Crawler Crane for spoil removal	100 Ton	Diesel	350	1	.33	90%	
Dump Truck	Tandem Axle – 15 CY	Diesel	325	1	.33	5%	

The following construction equipment will be required for the tunnel lining operation that will take approximately 8 months of the 20-month construction period:

Equipment Type	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily of Use	Duration
Hi-Lift (Forklift)	5 ton – 40 foot boom	Diesel	120	2	.67	90%	20 months
Crawler Crane for Material and Form support	100 Ton	Diesel	350	1	.33	80%	
Concrete Pump	150 CY/Hour – 100 foot boom	Diesel	300	1	.33	30%	
Concrete Trucks	10 Cubic yard Tandem or Tri-axle	Diesel	325	1.4	.67	5%	
Welding Machines	35 HP Diesel Engine	Diesel	35	2	.8	90%	

Tunnels and Concourses (Zones 2 & 4) – Traffic and Construction Equipment

The driving of the concourse tunnels under West and Church Streets will take place from within the existing west bathtub and the east bathtub in Zone 4 as described above. The West Street concourse will provide access to the World Financial Center under Route 9A and may be affected by the Route 9A project if the Short Bypass Alternative is selected. Estimated duration of underpinning, tunnel driving and construction is 15 months. Tunneling, Underpinning, and Construction activities will occur throughout this period. Mobilization of equipment, removal of excavated spoils and delivery of construction materials will be minor in nature to the overall site operations and will add the following traffic:

3a West Street Tunnel

Delivery Type	Quantity	Units	Total No. Of Truckloads	Trips per Day (Peak Day impact Calculation)	Trips per Day (cumulative impact calculation)	Estimated Duration
Spoil Removal	10,000	CY	670	10	3.7	15 months
Underpinning	1,000	Tons	50	2	.28	
Concrete / Steel	1,500	CY	150	4	.83	
Service/Utility /Fuel				4	2	
Subcontractors Light Trucks				10	8	
Construction Workers	15 to 20					
Arriving by Personal Vehicle	3 to 4					
Arriving by Mass Transit	12 to 16					
Supervisory/QA	3 to 8					
Arriving by Personal Vehicle	1 to 2					
Arriving by Mass Transit	2 to 6					

Equipment – Tunneling beneath Liberty will occur from the western bathtub. Percentage of Daily Use for construction equipment has been based on operating 9 hours out of a 10-hour shift. The 9 hours are based on allowing for morning start-up, coffee breaks, lunch break and daily fueling/maintenance. Percentage of Use for Concrete Trucks and Dump Trucks are based on the approximate waiting time and loading/unloading time on site only. The following construction equipment will be required for the underpinning operation that will take approximately 5 months of the 15-month construction period (but may be assumed to be evenly distributed over the 15 month period:

Equipment Type	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily of Use	Duration
Air Operated Grout Drills				3	1	90%	15 months
Hi-Lift (Forklift)	5 ton – 40 foot boom	Diesel	120	2	.67	90%	
Concrete Pump	150 CY/Hour – 100 foot boom	Diesel	300	1	.33	30%	
Concrete Trucks	10 Cubic yard Tandem or Tri-axle	Diesel	325	2	.1	5%	
Welding Machines	35 HP Diesel Engine	Diesel	35	2	.67	90%	

The following construction equipment will be required for the excavation of the tunnel and spoil removal operation that will take approximately 5 months of the 15-month construction period:

Equipment Type	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily of Use	Duration
Roadheader for tunneling	12 foot Diameter	Diesel	120	1	.33	33%	15 months
Hi-Lift (Forklift)	5 ton – 40 foot boom	Diesel	120	2	.67	90%	
Crawler Crane for spoil removal	100 Ton	Diesel	350	1	.33	90%	
Dump Truck	Tandem Axle – 15 CY	Diesel	325	5	1.9	5%	

The following construction equipment will be required for the tunnel lining operation that will take approximately 5 months of the 15-month construction period:

Equipment Type	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily of Use	Duration
Hi-Lift (Forklift)	5 ton – 40 foot boom	Diesel	120	2	.67	90%	15 months
Crawler Crane for Material and Form support	100 Ton	Diesel	350	1	.33	80%	
Concrete Pump	150 CY/Hour – 100 foot boom	Diesel	300	1	.33	30%	
Concrete Trucks	10 Cubic yard Tandem or Tri-axle	Diesel	325	2	.42	5%	
Welding Machines	35 HP Diesel Engine	Diesel	35	2	.67	90%	

3b Church Street Tunnel

Delivery Type	Quantity	Units	Total No. Of Truckloads	Trips per Day (Peak Day impact Calculation)	Trips per Day (cumulative impact calculation)	Estimated Duration
Spoil Removal	10,000	CY	670	10	3.7	15 months
Underpinning	1,000	Tons	50	2	.28	
Concrete / Steel	1,500	CY	150	4	.83	
Service/Utility /Fuel				4	2	
Subcontractors Light Trucks				10	8	
Construction Workers	15 to 20					
Arriving by Personal Vehicle	3 to 4					
Arriving by Mass Transit	12 to 16					
Supervisory/QA	3 to 8					
Arriving by Personal Vehicle	1 to 2					
Arriving by Mass Transit	2 to 6					

Equipment – Tunneling beneath Church St. will occur from the eastern bathtub. Tunneling will be accomplished with a tunnel roadheader and will require removal of spoils to the surface adjacent to Liberty and West Streets by lifting to the surface with a crane and skip box. Percentage of Daily Use for construction equipment has been based on operating 9 hours out of a 10-hour shift. The 9 hours are based on allowing for morning start-up, coffee breaks, lunch break and daily fueling/maintenance. Percentage of Use for Concrete Trucks and Dump Trucks are based on the approximate waiting time and loading/unloading time on site only. The following construction equipment will be required for the underpinning operation that will take approximately 5 months of the 15-month construction period:

Equipment Type	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily of Use	Duration
Air Operated Grout Drills				3	1	90%	15 months
Hi-Lift (Forklift)	5 ton – 40 foot boom	Diesel	120	2	.67	90%	
Concrete Pump	150 CY/Hour – 100 foot boom	Diesel	300	1	.33	30%	
Concrete Trucks	10 Cubic yard Tandem or Tri-axle	Diesel	325	2	.1	5%	
Welding Machines	35 HP Diesel Engine	Diesel	35	2	.67	90%	

The following construction equipment will be required for the excavation of the tunnel and spoil removal operation that will take approximately 5 months of the 15-month construction period:

Equipment Type	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily of Use	Duration
Roadheader for tunneling	12 foot Diameter	Diesel	120	1	.33	33%	15 months
Hi-Lift (Forklift)	5 ton – 40 foot boom	Diesel	120	2	.67	90%	
Crawler Crane for spoil removal	100 Ton	Diesel	350	1	.33	90%	
Dump Truck	Tandem Axle – 15 CY	Diesel	325	5	1.9	5%	

The following construction equipment will be required for the tunnel lining operation that will take approximately 5 months of the 15-month construction period:

Equipment Type	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily of Use	Duration
Hi-Lift (Forklift)	5 ton – 40 foot boom	Diesel	120	2	.67	90%	15 months
Crawler Crane for Material and Form support	100 Ton	Diesel	350	1	.33	80%	
Concrete Pump	150 CY/Hour – 100 foot boom	Diesel	300	1	.33	30%	
Concrete Trucks	10 Cubic yard Tandem or Tri-axle	Diesel	325	2	.42	5%	
Welding Machines	35 HP Diesel Engine	Diesel	35	2	.67	90%	

Excavation/Deconstruction Temporary Station (Zone 6) – Traffic and Construction Equipment

Demolition – Demolition of Temporary Station east of 1 & 9 Subway and north of Zone 4. Estimated duration for demolition work is 3.5 months.

Delivery Type	Quantity	Units	Total No. Of Truckloads	Trips per Day (Peak Day impact Calculation)	Trips per Day (cumulative impact calculation)	Estimated Duration
Demolition Debris	7,500	Tons	500	16	12	3.5 Months
Service/Utility /Fuel Trucks				6	4	
Subcontractors Light Trucks				16	12	
Construction Workers	15 to 20					
Arriving by Personal Vehicle	3 to 4					
Arriving by Mass Transit	12 to 16					
Supervisory/QA	3 to 5					
Arriving by Personal Vehicle	1 to 2					
Arriving by Mass Transit	2 to 3					

Equipment – All demolition work occurs within and immediately adjacent to the footprint of the Temporary PATH Station. Percentage of Daily Use for construction equipment has been based on operating 9 hours out of a 10-hour shift. The 9 hours are based on allowing for morning start-up, coffee breaks, lunch break and daily fueling/maintenance. Percentage of Use for Dump Trucks is based on the approximate waiting time and loading time on site only. Equipment required is as follows:

Equipment Type	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily of Use	Duration
Hydraulic All Terrain Crane	50 Ton	Diesel	165	1	1	80%	3.5 months
Crawler Crane	200 Ton	Diesel	450	1	1	90%	
Hydraulic Excavator w/Hoe Ram	3.5 Cubic Yard	Diesel	320	1	1	90%	
Hydraulic Excavator w/Thumb	3.5 Cubic Yard	Diesel	320	1	1	90%	
Hydraulic Excavator w/Grapple	3.5 Cubic Yard	Diesel	320	1	1	90%	
Track Loader w/Waste Handling Bucket	5.5 Cubic Yard	Diesel	160	1	1	90%	
Dump Trucks	Tandem Axle – 15 CY	Diesel	325	8	6	5%	
Air Compressor for Pavement Breakers	1600 CFM	Diesel	460	2	2	90%	
Pavement Breakers	90 lbs.			12	12	80%	

Excavation- It is assumed that sheet piling will be used at the northern and southern portions of Zone 6 to allow for removal following excavation and construction of pedestrian concourses.

Delivery Type	Quantity	Units	Total No. Of Truckloads	Trips per Day (Peak Day impact Calculation)	Trips per Day (cumulative impact calculation)	Estimated Duration
Excavate to 238'	135,000	CY	9,000	250	250	3 Months
Service/Utility /Fuel				8	6	
Subcontractors Light Trucks				34	30	
Construction Workers	30 to 40					
Arriving by Personal Vehicle	6 to 8					
Arriving by Mass Transit	24 to 32					
Supervisory/QA	4 to 6					
Arriving by Personal Vehicle	1 to 2					
Arriving by Mass Transit	3 to 4					

Equipment – Construction of the Slurry Wall closure pieces along Greenwich and Church Streets will be performed from within the footprint of the proposed Permanent PATH Terminal. The Slurry Wall closures will be constructed first, with excavation to EL 238' and the installation of soil/rock anchors to tie back the slurry wall second. Excavation and tie back installation will be performed within the footprint of the terminal and will require a lane closing along Church Street for access and staging of dump trucks for spoil removal. Percentage of Daily Use for construction equipment has been based on operating 9 hours out of a 10-hour shift. The 9 hours are based on allowing for morning start-up, coffee breaks, lunch break and daily fueling/maintenance. Percentage of Use for Concrete Trucks and Dump Trucks are based on the approximate waiting time and loading/unloading time on site only. Equipment required is as follows:

Equipment Type	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily of Use	Duration
Hydraulic Excavators	3.5 CY	Diesel	320	2	2	90%	3 months
Dozer	150 HP	Diesel	150	1	1	90%	
Dump Trucks	Tandem Axle - 15 CY	Diesel	325	125	125	5%	
Diesel Generators/ Compressors	100 HP	Diesel	100	2	2	90%	

Construction of the PATH Terminal Building (Zone 6) – Traffic and Construction Equipment

Construction – Construction of the PATH Terminal Building includes construction of all sub-grade (El. 238') and above grade levels. For the Grand Space it is anticipated that some of the structural steel framing will be pre-fabricated trusses to span the width of the Grand Space and may require lane closings on Church Street for erection. Assumes 500 CY concrete pours

Structural Framing

Delivery Type	Quantity	Units	Total No. Of Truckloads	Trips per Day (Peak Day impact Calculation)	Trips per Day (cumulative impact calculation)	Estimated Duration
Concrete	12,000	CY	1,200	100	10	10 months
Reinforcing Steel	1,800	Tons	90	2	.75	
Structural Steel to 306'	16,000	Tons	800	8	6.7	
Structural Steel – Grand Space	3,000	Tons	150	4	1.25	
Service/Utility /Fuel*				16	12	
Subcontractors Light Trucks*				16	12	
Construction Workers	50 to 60					
Arriving by Personal Vehicle	10 to 12					
Arriving by Mass Transit	40 to 48					
Supervisory/QA	10 to 15					
Arriving by Personal Vehicle	2 to 3					
Arriving by Mass Transit	8 to 12					

** Service/Utility /Fuel/ Subcontractors Light Truck totals are constant throughout the construction of the Terminal. Where Structural Framing and "Glazing and Fitout" overlap, the Service/Utility /Fuel/ Subcontractors Light Truck totals are not additive (only count them once)*

Glazing and Fitout

Delivery Type	Quantity	Units	Total No. Of Truckloads	Trips per Day (Peak Day impact Calculation)	Trips per Day (cumulative impact calculation)	Estimated Duration
Curtain Wall	400	Tons	20	2	.12	13 months
Interior Fitout				8	6	
Service/Utility /Fuel*				16	12	
Subcontractors Light Trucks*				16	12	
Construction Workers	50 to 60					
Arriving by Personal Vehicle	10 to 12					
Arriving by Mass Transit	40 to 48					
Supervisory/QA	10 to 15					
Arriving by Personal Vehicle	2 to 3					
Arriving by Mass Transit	8 to 12					
** Service/Utility /Fuel/ Subcontractors Light Truck totals are constant throughout the construction of the Terminal. Where Structural Framing and "Glazing and Fitout" overlap, the Service/Utility /Fuel/ Subcontractors Light Truck totals are not additive (only count them once)*						

Equipment – In general the construction of the Permanent PATH Terminal will be performed from within the footprint of the proposed structure. A lane closure along Church Street will be required for receiving material deliveries and for the positioning of a crane for the erection of the pre-fabricated trusses for the grand space and for the structural steel framing. Foundation and subbasement work will be primarily of concrete construction to street level. Percentage of Daily Use for construction equipment has been based on operating 9 hours out of a 10-hour shift. The 9 hours are based on allowing for morning start-up, coffee breaks, lunch break and daily fueling/maintenance. Percentage of Use for Concrete Trucks and Tractor Trailers are based on the approximate waiting time and loading time on site only. The following construction equipment will be required:

Structural Framing

Equipment Type	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily of Use	Duration
Crawler Crane	200 Ton	Diesel	450	1	1	90%	10 months
Tower Crane	100 Ton	Diesel	250	1	1	90%	
Hi-Lift (Forklift)	5 ton – 40 foot boom	Diesel	120	2	2	90%	
Concrete Pump	150 CY/Hour – 100 foot boom	Diesel	300	2	2	50%	
Concrete Trucks	10 Cubic Yard Tandem or Tri-Axle	Diesel	325	50	5	5%	
Diesel Generators	100 HP	Diesel	100	2	2	90%	
Tractor Trailer	Tandem Axle Tractor w/45 Foot Trailer	Diesel	325	7	4.4	5%	
Welding Machines	35 HP Diesel Engine	Diesel	35	4	4	90%	
Air Compressor for Impact Wrenches	1600 CFM	Diesel	460	2	2	90%	
Impact Wrenches	1” Socket Drive			10	10	80%	

Glazing and Fitout

Equipment Type	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily of Use	Duration
Tower Crane	100 Ton	Diesel	250	1	1	90%	13 months
Hi-Lift (Forklift)	5 ton – 40 foot boom	Diesel	120	2	2	90%	
Diesel Generators	100 HP	Diesel	100	2	2	90%	
Welding Machines	35 HP Diesel Engine	Diesel	35	4	4	90%	
Air Compressor for Impact Wrenches	1600 CFM	Diesel	460	2	2	90%	
Impact Wrenches	1” Socket Drive			10	10	80%	
Tractor Trailer	Tandem Axle Tractor w/45 Foot Trailer	Diesel	325	5	3.2	5%	

CONSTRUCTION METHODS AND IMPACTS

ROUTE 9A PROJECT

CONSTRUCTION TRAFFIC AND EQUIPMENT

Early Action Items – Utility Relocations – Traffic and Construction Equipment

The relocation of existing utilities within the Route 9A Right-of-Way (ROW) will be performed prior to the construction of temporary detour roadways and the permanent bypass structures. The relocation of the 78" sanitary interceptor sewer is not in this stage. Relocation work will be performed outside of the current travel lanes with possible lane closings for construction vehicle access and temporary staging areas.

Delivery Type	Quantity	Units	Total No. Of Truckloads	Trips per Day (Peak Day impact Calculation)	Trips per Day (cumulative impact calculation)	Estimated Duration
Spoil Removal	1,000	CY	67	8	0.93	6 Months
Service/Utility /Fuel				4	2	
Subcontractors Light Trucks				10	4	
Construction Workers	20 to 30					
Arriving by Personal Vehicle	2 to 3					
Arriving by Mass Transit	18 to 27					
Supervisory/QA	3 to 8					
Arriving by Personal Vehicle	1 to 2					
Arriving by Mass Transit	2 to 6					

Construction Equipment – Hydraulic excavators, rubber tire loaders and backhoes will be utilized for the excavation of the utility trenches and placement of electric and telephone ducts and water and sanitary sewer pipe. Concrete deliveries are for encasement of electrical ducts for protection. Percentage of Daily Use for construction equipment has been based on operating 9 hours out of a 10-hour shift. The 9 hours are based on allowing for morning start-up, coffee breaks, lunch break and daily fueling/maintenance. Percentage of Use for Dump Trucks and Concrete Trucks are based on the approximate waiting time and loading/unloading time on site only. The following construction equipment will be required:

Equipment Type	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily of Use	Duration
Hydraulic Excavator	1.5 CY	Diesel	138	2	2	90%	6 months
Rubber Tire Loader	3.5 CY	Diesel	196	2	2	90%	
Rubber Tire Backhoe/Loader	1.25 CY	Diesel	88	4	4	90%	
Dump Trucks	15 CY Tandem or Tri-axle	Diesel	325	4	0.47	5%	
Concrete Trucks	10 Cubic yard Tandem or Tri-axle	Diesel	325	2	0.1	5%	
Pumps for Dewatering	4" Gasoline Powered	Gasoline	16	8	8	90%	
Compressor	185 CFM	Diesel	80	3	3	80%	
Pavement Breakers	90 Lbs			6	6	80%	
Generators	Gasoline Powered	Gasoline	12	6	6	90%	

Stage I – Temporary SB & NB Route 9A – Traffic and Construction Equipment

For Worst Case Situation it is assumed that the temporary roadways for Route 9A SB and NB will be constructed on fill to provide protection for the relocated utilities and to provide sufficient cover to bridge over the World Trade Center (WTC) Slurry Wall projections at the PATH tunnels. After fill placement the temporary roadways will be paved with asphalt concrete and separated from the work zones by temporary concrete jersey type barrier.

Fill placement

Delivery Type	Quantity	Units	Total No. Of Truckloads	Trips per Day (Peak Day impact Calculation)	Trips per Day (cumulative impact calculation)	Estimated Duration
Fill Placement.	77,000	CY	5,200	100	86	5 Months
Service/Utility /Fuel				6	4	
Subcontractors Light Trucks				10	8	
Construction Workers	20 to 30					
Arriving by Personal Vehicle	4 to 6					
Arriving by Mass Transit	16 to 24					
Supervisory/QA	4 to 6					
Arriving by Personal Vehicle	1 to 2					
Arriving by Mass Transit	3 to 4					

Paving and Barriers

Delivery Type	Quantity	Units	Total No. Of Truckloads	Trips per Day (Peak Day impact Calculation)	Trips per Day (cumulative impact calculation)	Estimated Duration
Paving Operations.	10,000	Tons	500	66	42	1 Month
Temporary Barriers	8,000	LF	100	10	8	
Service/Utility /Fuel				6	4	
Subcontractors Light Trucks				10	8	
Construction Workers	20 to 30					
Arriving by Personal Vehicle	4 to 6					
Arriving by Mass Transit	16 to 24					
Supervisory/QA	4 to 6					
Arriving by Personal Vehicle	1 to 2					
Arriving by Mass Transit	3 to 4					

Equipment – Construction of the temporary roadways will be accomplished within the existing ROW of Route 9A. Temporary lane closures may be required for the delivery of materials. Percentage of Daily Use for construction equipment has been based on operating 9 hours out of a 10-hour shift. The 9 hours are based on allowing for morning start-up, coffee breaks, lunch break and daily fueling/maintenance. Percentage of Use for Dump Trucks is based on the approximate waiting time and unloading time on site only. Equipment required for the estimated 5-month schedule for placement of temporary fill and roadway sub-grade is as follows:

Equipment Type	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily of Use	Duration
Dump Truck (Fill Placement)	Tandem or Tri-axle – 15 CY	Diesel	325	50	43	5%	5 months
Bulldozer	150 HP	Diesel	150	2	2	90%	
Vibratory Compactor	10 Ton	Diesel	100	2	2	80%	
Graders	16 Foot Blade	Diesel	140	1	1	20%	
Rubber Tire Loader	3.5 CY	Diesel	196	2	2	60%	
Compressors	185 CFM	Diesel	80	2	2	25%	
Pavement Breakers	90 Lbs			4	4	25%	
Arrow Board		Solar		4	4	100%	
VMS Board		Solar		2	2	100%	

Equipment required for the one-month paving operation:

Equipment Type	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily of Use	Duration
Asphalt Paving Machine	12 Foot Width	Diesel	153	1	1	90%	1 month
Asphalt Compactor	10 Ton	Diesel	70	3	3	90%	
Dump Trucks	Tandem or Tri-axle – 15 CY	Diesel	325	38	25	5%	
Rubber Tire Loader	3.5 CY	Diesel	196	2	2	60%	
Compressor	185 CFM	Diesel	80	1	1	25%	
Pavement Breakers	90 Lbs			2	2	25%	
Arrow Board		Solar		4	4	100%	
VMS Board		Solar		2	2	100%	

Stage II Slurry Wall and SB Bypass Tunnel – Traffic and Construction Equipment

Slurry Wall – It is assumed that a slurry wall will be constructed on the east and west sides of the proposed SB tunnel alignment to facilitate the construction of the tunnel and the relocation of the 78" sanitary interceptor sewer. The slurry wall would be excavated to bedrock to limit the drawdown of groundwater and to prevent the intrusion of Hudson River water into the excavation. Pressure grouting at the PATH tunnels will be necessary along the westerly slurry wall. It is assumed that the easterly slurry wall would tie into the existing WTC slurry wall projections to form a seal to the existing WTC bathtub.

Delivery Type	Quantity	Units	Total No. Of Truckloads	Trips per Day (Peak Day impact Calculation)	Trips per Day (cumulative impact calculation)	Estimated Duration
Slurry Wall – Exc.	28,000	CY	1,860	30	22	7 Months
Slurry Wall – Conc.	28,000	CY	2,800	40	33	
Slurry Wall - Rebar	6,300	Tons	315	4	3.8	
Service/Utility /Fuel Trucks				2	2	
Subcontractors Light Trucks				6	4	
Construction Workers	25 to 30					
Arriving by Personal Vehicle	1 to 3					
Arriving by Mass Transit	24 to 27					
Supervisory/QA	3 to 5					
Arriving by Personal Vehicle	1 to 2					
Arriving by Mass Transit	2 to 3					

Equipment – Construction of the slurry walls will be from within the Stage II Work Zone. No lane closings are anticipated. Percentage of Daily Use for construction equipment has been based on operating 9 hours out of a 10-hour shift. The 9 hours are based on allowing for morning start-up, coffee breaks, lunch break and daily fueling/maintenance. Percentage of Use for Dump Trucks and Concrete Trucks are based on the approximate waiting time and loading/unloading time on site only. Equipment required is as follows:

Equipment Type	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily of Use	Duration
Slurry Plant Mixing Plant	100 m^3 per hour – Diesel 50 HP	Diesel	50	2	2	100%	7 months
Desanding Plant	100 m^3 per hour – Diesel 50 HP	Diesel	50	2	2	50%	
Crawler Crane w/clam shell	100 Ton	Diesel	350	2	2	100%	
Crawler Crane	100 Ton	Diesel	350	2	2	50%	
Hi-Lift (Forklift)	5 ton – 40 foot boom	Diesel	120	2	2	100%	
Concrete Pump	150 CY/Hour – 100 foot boom	Diesel	300	2	2	50%	
Concrete Trucks	10 Cubic Yard Tandem or Tri-Axle	Diesel	325	20	16	5%	
Dump Trucks	Tandem Axle – 15 CY	Diesel	325	15	11	5%	
Rubber Tire Loader	3.5 CY	Diesel	196	1	1	100%	
Diesel Generators	100 HP	Diesel	100	2	2	100%	
Arrow Board		Solar		4	4	100%	
VMS Board		Solar		2	2	100%	

Excavation – After the slurry wall is complete, the excavation for the SB Bypass Tunnel will be performed. The entire width between slurry walls will be excavated to the proposed invert of the sub-grade for the tunnel. It is assumed that temporary struts bridging the excavation will be utilized to support the slurry wall.

Delivery Type	Quantity	Units	Total No. Of Loads	Trips per Day (Peak Day impact Calculation)	Trips per Day (cumulative impact calculation)	Estimated Duration per stage
Excavate to Invert	125,000	CY	8,300	230	230	3 Months
Service/Utility /Fuel Trucks				8	6	
Subcontractors Light Trucks				6	4	
Total Construction Workers	20 to 25					
Arriving by Personal Vehicle	4 to 5					
Arriving by Mass Transit	16 to 20					
Supervisory/QA	3 to 5					
Arriving by Personal Vehicle	1 to 2					
Arriving by Mass Transit	2 to 3					

Equipment – Excavation work will be performed within the Stage II Work Zone and should not require any additional lane closings. Excavated spoils will be removed from the site by dump truck following the proposed truck routes. Percentage of Daily Use for construction equipment has been based on operating 9 hours out of a 10-hour shift. The 9 hours are based on allowing for morning start-up, coffee breaks, lunch break and daily fueling/maintenance. Percentage of Use for Dump Trucks is based on the approximate waiting time and loading time on site only. Equipment required is as follows:

Equipment Type	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily of Use	Duration
Hydraulic Excavator	3.5 Cubic Yard	Diesel	320	2	2	90%	3 months
Hydraulic All Terrain Crane (Struts)	50 Ton	Diesel	165	2	2	50%	
Dozer	150 HP	Diesel	150	1	1	90%	
Dozer	100 HP	Diesel	100	1	1	90%	
Dump Trucks	Tandem Axle – 15 CY	Diesel	325	115	115	5%	
Air Compressor	1200 CFM	Diesel	360	1	1	50%	
Pavement Breakers	90 Lbs			6	6	50%	
Arrow Board		Solar		4	4	100%	
VMS Board		Solar		2	2	100%	

Construct SB Bypass Tunnel – The SB Bypass Tunnel will be constructed within the excavated area between the slurry walls. In addition the relocated 78" Sanitary Interceptor Sewer will be constructed parallel to the tunnel along the western side. Tunnel construction assumes a 3-foot thick bottom slab with 3-inch wearing surface, 3-foot thick outer walls, 1-foot thick infill walls, a precast concrete beam top to support a 6-inch thick permanent surface roadway for West Street. Concrete Truck Trips have been generated based on a worst case scenario of a possible maximum pour of 600 CY.

Concrete Box

Delivery Type	Quantity	Units	Total No. Of Truckloads	Trips per Day (Peak Day impact Calculation)	Trips per Day (cumulative impact calculation)	Estimated Duration
Concrete	16,500	CY	1,650	120	22	6 Months
Reinforcing Steel	1,350	Tons	66	2	0.9	
Service/Utility /Fuel*				16	12	
Subcontractors Light Trucks*				16	12	
Construction Workers	100 to 120					
Arriving by Personal Vehicle	10 to 12					
Arriving by Mass Transit	90 to 108					
Supervisory/QA	10 to 15					
Arriving by Personal Vehicle	2 to 3					
Arriving by Mass Transit	8 to 12					

** The number of Service/Fuel/Utility and Subcontractor Light Trucks indicated is uniform through all Stage II activities. Where activities overlap, the Service/Fuel/Utility and Subcontractor Light Truck totals are NOT additive (i.e.: only count once)*

Road Deck

Delivery Type	Quantity	Units	Total No. Of Truckloads	Trips per Day (Peak Day impact Calculation)	Trips per Day (cumulative impact calculation)	Estimated Duration
Precast Beams	600	Ea	600	20	12.5	4 Months
Service/Utility /Fuel*				16	12	
Subcontractors Light Trucks*				16	12	
Construction Workers	100 to 120					
Arriving by Personal Vehicle	10 to 12					
Arriving by Mass Transit	90 to 108					
Supervisory/QA	10 to 15					
Arriving by Personal Vehicle	2 to 3					
Arriving by Mass Transit	8 to 12					

** The number of Service/Fuel/Utility and Subcontractor Light Trucks indicated is uniform through all Stage II activities. Where activities overlap, the Service/Fuel/Utility and Subcontractor Light Truck totals are NOT additive (i.e.: only count once)*

Backfill

Delivery Type	Quantity	Units	Total No. Of Truckloads	Trips per Day (Peak Day impact Calculation)	Trips per Day (cumulative impact calculation)	Estimated Duration
Backfill Tunnel & 78" Int.	13,000	CY	890	76	76	1 Month
Service/Utility /Fuel*				16	12	
Subcontractors Light Trucks*				16	12	
Construction Workers	100 to 120					
Arriving by Personal Vehicle	10 to 12					
Arriving by Mass Transit	90 to 108					
Supervisory/QA	10 to 15					
Arriving by Personal Vehicle	2 to 3					
Arriving by Mass Transit	8 to 12					

** The number of Service/Fuel/Utility and Subcontractor Light Trucks indicated is uniform through all Stage II activities. Where activities overlap, the Service/Fuel/Utility and Subcontractor Light Truck totals are NOT additive (i.e.: only count once)*

Roadway

Delivery Type	Quantity	Units	Total No. Of Truckloads	Trips per Day (Peak Day impact Calculation)	Trips per Day (cumulative impact calculation)	Estimated Duration
West St. – Perm. SB Rdwy	10,000	Tons	500	68	42	1 Months
Service/Utility /Fuel*				16	12	
Subcontractors Light Trucks*				16	12	
Construction Workers	100 to 120					
Arriving by Personal Vehicle	10 to 12					
Arriving by Mass Transit	90 to 108					
Supervisory/QA	10 to 15					
Arriving by Personal Vehicle	2 to 3					
Arriving by Mass Transit	8 to 12					

** The number of Service/Fuel/Utility and Subcontractor Light Trucks indicated is uniform through all Stage II activities. Where activities overlap, the Service/Fuel/Utility and Subcontractor Light Truck totals are NOT additive (i.e.: only count once)*

Equipment – The SB Bypass Tunnel and 78" Sanitary Interceptor Sewer will be constructed entirely within the Stage II Work Zone. Accommodations at the northern and southern limits of the zone will be necessary to provide access to the Work Zone by concrete trucks and other material deliveries. Percentage of Daily Use for construction equipment has been based on operating 9 hours out of a 10-hour shift. The 9 hours are based on allowing for morning start-up, coffee breaks, lunch break and daily fueling/maintenance. Percentage of Use for Concrete Trucks and Tractor Trailers are based on the approximate waiting time and unloading time on site only. Equipment required for the estimated 6-month period for the construction of the base slab and walls of the SB Tunnel is as follows:

Equipment Type	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily of Use	Duration
Crawler Crane	100 Ton	Diesel	350	2	2	90%	6 months
Hydraulic All Terrain Crane	50 Ton	Diesel	165	1	1	80%	
Hi-Lift (Forklift)	5 ton – 40 foot boom	Diesel	120	2	2	90%	
Dozer (Sub-grade Prep)	100 HP	Diesel	100	1	1	50%	
Rubber Tire Loader	3.5 CY	Diesel	196	1	1	90%	
Concrete Pump	150 CY/Hour – 100 foot boom	Diesel	300	1	1	50%	
Concrete Trucks	10 Cubic Yard Tandem or Tri-Axle	Diesel	325	60	11	5%	
Generators	100 HP	Diesel	100	2	2	90%	
Arrow Board		Solar		4	4	100%	
VMS Board		Solar		2	2	100%	

Equipment required for the estimated 4-month period for the installation of the precast concrete beams is as follows:

Equipment Type	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily of Use	Duration
Crawler Crane	100 Ton	Diesel	350	2	2	90%	4 months
Hydraulic All Terrain Crane	50 Ton	Diesel	165	1	1	80%	
Tractor Trailer	Tandem Axle Tractor w/45 Foot Trailer	Diesel	325	10	6.2	2%	
Welding Machine	35 HP Diesel Engine	Diesel	35	1	1	80%	
Air Compressor for Impact Wrenches	185 CFM	Diesel	80	2	2	80%	
Impact Wrenches	1” Socket Drive			4	4	80%	
Arrow Board		Solar		4	4	100%	
VMS Board		Solar		2	2	100%	

Equipment required for the estimated 1-month schedule for placement of backfill over and around the tunnel and roadway sub-grade is as follows:

Equipment Type	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily of Use	Duration
Dump Truck (Fill Placement)	Tandem or Tri-axle – 15 CY	Diesel	325	38	38	5%	1 month
Bulldozer	150 HP	Diesel	150	2	2	90%	
Vibratory Compactor	10 Ton	Diesel	100	2	2	80%	
Graders	16 Foot Blade	Diesel	140	1	1	20%	
Rubber Tire Loader	3.5 CY	Diesel	196	2	2	60%	
Compressors	185 CFM	Diesel	80	2	2	25%	
Pavement Breakers	90 Lbs			4	4	25%	
Arrow Board		Solar		4	4	100%	
VMS Board		Solar		2	2	100%	

Equipment required for the estimated one-month paving operation:

Equipment Type	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily of Use	Duration
Asphalt Paving Machine	12 Foot Width	Diesel	153	1	1	90%	1 month
Asphalt Compactor	10 Ton	Diesel	70	3	3	90%	
Dump Trucks (Asphalt Paving)	Tandem or Tri-axle – 15 CY	Diesel	325	34	21	5%	
Rubber Tire Loader	3.5 CY	Diesel	196	2	2	60%	
Compressor	185 CFM	Diesel	80	1	1	25%	
Pavement Breakers	90 Lbs			2	2	25%	
Arrow Board		Solar		4	4	100%	
VMS Board		Solar		2	2	100%	

Stage III Construct NB Bypass Tunnel – Traffic and Construction Equipment

Excavation and Demolition – After NB traffic is diverted to the completed SB Bypass Tunnel, the area between the western slurry wall of the WTC site and the temporary slurry wall separating the SB Bypass Tunnel work area will be excavated. Work will include the demolition of the temporary slurry wall to an elevation below the proposed sub-grade elevation of the proposed NB Bypass Tunnel. It is assumed that the entire width will be excavated with temporary sheeting/shoring to protect the duct banks to the east of the proposed NB Bypass Tunnel. Truck access is assumed to be from Route 9A at the northern and southern terminus of the tunnel excavation.

Delivery Type	Quantity	Units	Total No. Of Loads	Trips per Day (Peak Day impact Calculation)	Trips per Day (cumulative impact calculation)	Estimated Duration
Excavate to Invert	66,700	CY	4,450	186	186	2 Months
Demolition Debris from Slurry Wall	4,000	CY	300	12	12	
Service/Utility /Fuel Trucks				8	6	
Subcontractors Light Trucks				6	4	
Total Construction Workers	20 to 25					
Arriving by Personal Vehicle	4 to 5					
Arriving by Mass Transit	16 to 20					
Supervisory/QA	3 to 5					
Arriving by Personal Vehicle	1 to 2					
Arriving by Mass Transit	2 to 3					

Equipment – Excavation work will be performed within the Stage III Work Zone and should not require any additional lane closings. Excavated spoils will be removed from the site by dump truck following the proposed truck routes. Accommodations at the northern and southern limits of the zone will be necessary to provide access to the Work Zone for dump trucks and other material deliveries. Percentage of Daily Use for construction equipment has been based on operating 9 hours out of a 10-hour shift. The 9 hours are based on allowing for morning start-up, coffee breaks, lunch break and daily fueling/maintenance. Percentage of Use for Dump Trucks is based on the approximate waiting time and loading time on site only. Equipment required is as follows:

Equipment Type	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily of Use	Duration
Hydraulic Excavator	3.5 Cubic Yard	Diesel	320	1	1	9%	2 months
Hydraulic Excavator w/Hoe Ram	3.5 Cubic Yard	Diesel	320	1	1	90%	
Crawler Crane (Temp. Sheeting)	100 Ton	Diesel	350	1	1	60%	
Dozer	150 HP	Diesel	150	1	1	90%	
Dozer	100 HP	Diesel	100	1	1	90%	
Dump Trucks	15 CY Tandem	Diesel	325	93	93	5%	
Air Compressor	1200 CFM	Diesel	360	1	1	60%	
Pavement Breakers	90 Lbs			6	6	60%	
Arrow Board		Solar		4	4	100%	
VMS Board		Solar		2	2	100%	

Construct NB Bypass Tunnel – The NB Bypass Tunnel will be constructed within the excavated area between the slurry walls. Tunnel construction assumes a 3-foot thick bottom slab with 3-inch wearing surface, 3-foot thick outer walls, 1-foot thick infill walls, a precast concrete beam top to support a 6-inch thick permanent surface roadway for West Street. Concrete Truck Trips have been generated based on a worst case scenario of a possible pour of a maximum of 600 CY.

Concrete Box

Delivery Type	Quantity	Units	Total No. Of Truckloads	Trips per Day (Peak Day impact Calculation)	Trips per Day (cumulative impact calculation)	Estimated Duration
Concrete	15,000	CY	1,500	120	21	6 Months
Reinforcing Steel	1,350	Tons	66	2	0.9	
Service/Utility /Fuel*				16	12	
Subcontractors Light Trucks*				16	12	
Construction Workers	100 to 120					
Arriving by Personal Vehicle	10 to 12					
Arriving by Mass Transit	90 to 108					
Supervisory/QA	10 to 15					
Arriving by Personal Vehicle	2 to 3					
Arriving by Mass Transit	8 to 12					

** The number of Service/Fuel/Utility and Subcontractor Light Trucks indicated is uniform through all Stage II activities. Where activities overlap, the Service/Fuel/Utility and Subcontractor Light Truck totals are NOT additive (i.e.: only count once)*

Road Deck

Delivery Type	Quantity	Units	Total No. Of Truckloads	Trips per Day (Peak Day impact Calculation)	Trips per Day (cumulative impact calculation)	Estimated Duration
Precast Beams	600	Ea	600	12	12	4 Months
Service/Utility /Fuel*				16	12	
Subcontractors Light Trucks*				16	12	
Construction Workers	100 to 120					
Arriving by Personal Vehicle	10 to 12					
Arriving by Mass Transit	90 to 108					
Supervisory/QA	10 to 15					
Arriving by Personal Vehicle	2 to 3					
Arriving by Mass Transit	8 to 12					

** The number of Service/Fuel/Utility and Subcontractor Light Trucks indicated is uniform through all Stage II activities. Where activities overlap, the Service/Fuel/Utility and Subcontractor Light Truck totals are NOT additive (i.e.: only count once)*

Backfill

Delivery Type	Quantity	Units	Total No. Of Truckloads	Trips per Day (Peak Day impact Calculation)	Trips per Day (cumulative impact calculation)	Estimated Duration
Backfill Tunnel & 78" Int.	13,000	CY	890	76	76	1 Month
Service/Utility /Fuel*				16	12	
Subcontractors Light Trucks*				16	12	
Construction Workers	100 to 120					
Arriving by Personal Vehicle	10 to 12					
Arriving by Mass Transit	90 to 108					
Supervisory/QA	10 to 15					
Arriving by Personal Vehicle	2 to 3					
Arriving by Mass Transit	8 to 12					

** The number of Service/Fuel/Utility and Subcontractor Light Trucks indicated is uniform through all Stage II activities. Where activities overlap, the Service/Fuel/Utility and Subcontractor Light Truck totals are NOT additive (i.e.: only count once)*

Roadway

Delivery Type	Quantity	Units	Total No. Of Truckloads	Trips per Day (Peak Day impact Calculation)	Trips per Day (cumulative impact calculation)	Estimated Duration
West St. – Perm. SB Rdwy	10,000	Tons	500	68	42	1 Months
Service/Utility /Fuel*				16	12	
Subcontractors Light Trucks*				16	12	
Construction Workers	100 to 120					
Arriving by Personal Vehicle	10 to 12					
Arriving by Mass Transit	90 to 108					
Supervisory/QA	10 to 15					
Arriving by Personal Vehicle	2 to 3					
Arriving by Mass Transit	8 to 12					

** The number of Service/Fuel/Utility and Subcontractor Light Trucks indicated is uniform through all Stage II activities. Where activities overlap, the Service/Fuel/Utility and Subcontractor Light Truck totals are NOT additive (i.e.: only count once)*

Equipment – The NB Bypass Tunnel will be constructed entirely within the Stage III Work Zone. Accommodations at the northern and southern limits of the Work Zone will be necessary to provide access to the Work Zone by concrete trucks and other material deliveries. Percentage of Daily Use for construction equipment has been based on operating 9 hours out of a 10-hour shift. The 9 hours are based on allowing for morning start-up, coffee breaks, lunch break and daily fueling/maintenance. Percentage of Use for Concrete Trucks and Tractor Trailers are based on the approximate waiting time and unloading time on site only. Equipment required for the estimated 6-month period for the construction of the base slab and walls of the NB Tunnel is as follows:

Equipment Type	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily of Use	Duration
Crawler Crane	100 Ton	Diesel	350	2	2	90%	6 months
Hydraulic All Terrain Crane	50 Ton	Diesel	165	1	1	80%	
Hi-Lift (Forklift)	5 ton – 40 foot boom	Diesel	120	2	2	90%	
Dozer (Sub-grade Prep)	100 HP	Diesel	100	1	1	50%	
Rubber Tire Loader	3.5 CY	Diesel	196	1	1	90%	
Concrete Pump	150 CY/Hour – 100 foot boom	Diesel	300	1	1	50%	
Concrete Trucks	10 Cubic Yard Tandem or Tri-Axle	Diesel	325	60	10.5	5%	
Generators	100 HP	Diesel	100	2	2	90%	
Arrow Board		Solar		4	4	100%	
VMS Board		Solar		2	2	100%	

Equipment required for the estimated 4-month period for the installation of the precast concrete beams is as follows:

Equipment Type	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily of Use	Duration
Crawler Crane	100 Ton	Diesel	350	2	2	90%	4 months
Hydraulic All Terrain Crane	50 Ton	Diesel	165	1	1	80%	
Tractor Trailer	Tandem Axle Tractor w/45 Foot Trailer	Diesel	325	6	6	2%	
Welding Machine	35 HP Diesel Engine	Diesel	35	1	1	80%	
Air Compressor for Impact Wrenches	185 CFM	Diesel	80	2	2	80%	
Impact Wrenches	1” Socket Drive			4	4	80%	
Arrow Board		Solar		4	4	100%	
VMS Board		Solar		2	2	100%	

Equipment required for the estimated 1-month schedule for placement of backfill over and around the tunnel and roadway sub-grade is as follows:

Equipment Type	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily of Use	Duration
Dump Truck (Fill Placement)	Tandem or Tri-axle – 15 CY	Diesel	325	38	38	5%	1 month
Bulldozer	150 HP	Diesel	150	2	2	90%	
Vibratory Compactor	10 Ton	Diesel	100	2	2	80%	
Graders	16 Foot Blade	Diesel	140	1	1	20%	
Rubber Tire Loader	3.5 CY	Diesel	196	2	2	60%	
Compressors	185 CFM	Diesel	80	2	2	25%	
Pavement Breakers	90 Lbs			4	4	25%	
Arrow Board		Solar		4	4	100%	
VMS Board		Solar		2	2	100%	

Equipment required for the estimated one-month paving operation:

Equipment Type	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily of Use	Duration
Asphalt Paving Machine	12 Foot Width	Diesel	153	1	1	90%	1 month
Asphalt Compactor	10 Ton	Diesel	70	3	3	90%	
Dump Trucks (Asphalt Paving)	Tandem or Tri-axle – 15 CY	Diesel	325	34	21	5%	
Rubber Tire Loader	3.5 CY	Diesel	196	2	2	60%	
Compressor	185 CFM	Diesel	80	1	1	25%	
Pavement Breakers	90 Lbs			2	2	25%	
Arrow Board		Solar		4	4	100%	
VMS Board		Solar		2	2	100%	

Stage IV Surface and Tunnel Finishes – Traffic and Construction Equipment

Streetscape and Tunnel Finishes – The work of this stage includes completing all of the surface items such as street lamps, traffic signals, signage, landscaping and plantings, etc. Additionally, all final tunnel finishes such as permanent signing, lighting, ventilation will be completed.

Delivery Type	Quantity	Units	Total No. Of Truckloads	Trips per Day (Peak Day impact Calculation)	Trips per Day (cumulative impact calculation)	Estimated Duration
Misc. Mat'ls	12,000	CY	1,200	20	14	7 Months
Service/Utility /Fuel				20	15	
Subcontractors Light Trucks				20	15	
Construction Workers	50 to 60					
Arriving by Personal Vehicle	10 to 12					
Arriving by Mass Transit	40 to 48					
Supervisory/QA	10 to 15					
Arriving by Personal Vehicle	2 to 3					
Arriving by Mass Transit	8 to 12					

Equipment – The work of this stage will involve landscaping and streetscape type activities. Work will be performed throughout the surface area and within the tunnels. Temporary lane closings will be required at various times to accomplish the final fitout of the project. Percentage of Daily Use for construction equipment has been based on operating 9 hours out of a 10-hour shift. The 9 hours are based on allowing for morning start-up, coffee breaks, lunch break and daily fueling/maintenance. Percentage of Use for Concrete Trucks is based on the approximate waiting time and unloading time on site only. The following construction equipment will be required:

Equipment Type	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily of Use	Duration
Rubber Tire Backhoe/Loader	1 CY	Diesel	88	4	4	90%	7 months
Dump Trucks	Single Axle – 10 CY	Diesel	200	10	7	90%	
Rack Body Trucks	2 Ton Capacity	Diesel	200	2	2	80%	
Hi-Lift (Forklift)	5 ton – 40 foot boom	Diesel	120	2	2	80%	
Hydraulic All Terrain Crane	35 Ton	Diesel	165	1	1	50%	
Concrete Trucks	10 Cubic Yard Tandem or Tri-Axle	Diesel	325	2	2	10%	
Arrow Board		Solar		4	4	100%	
VMS Board		Solar		2	2	100%	

FULTON STREET TRANSIT CENTER

CONSTRUCTION METHODS AND IMPACTS

Tunneling for Underpasses – Traffic and Construction Equipment

Tunneling operations will be required to construct concourse beneath the N/R Line at Church Street and the 4/5 Line beneath Broadway. The tunneling operations will be performed from within the existing tunnels (grouting operations) and from the cut and cover excavations for the Transit Center and the Dey Street Concourse. It is assumed here that grouting equipment will access the tunneling locations from within the existing subway tunnels. Spoils from tunneling operations will be removed through the cut and cover excavations to street level for hauling from the site. Grouting and underpinning operations will most likely be performed overnight and on weekends to minimize disruption to transit operations. No street closings are anticipated for this work to take place since the grouting will be performed within the subway tunnels and the tunneling work will be performed from the cut and cover excavation of Dey Street and the open excavation for the Transit Center.

4/5 underpasses

Delivery Type	Quantity	Units	Total No. Of Truckloads	Trips per Day (Peak Day impact Calculation)	Trips per Day (cumulative impact calculation)	Estimated Duration
Spoil Removal	7,000	CY	470	8	6.5	6 Months
Underpinning	1,000	Tons	50	2	0.7	
Concrete / Steel	1,000	CY	100	4	1.4	
Service/Utility /Fuel				4	2	
Subcontractors Light Trucks				10	6	
Construction Workers	15 to 20					
Arriving by Personal Vehicle	3 to 4					
Arriving by Mass Transit	12 to 16					
Supervisory/QA	3 to 8					
Arriving by Personal Vehicle	1 to 2					
Arriving by Mass Transit	2 to 6					

Equipment – Grouting beneath the existing subway tunnel will be performed from within the tunnel and will involve the use of compressed air operated drill rigs and grout pumps. Access to the tunnel will be from Transit Authority maintenance access points. Minimal laydown area exterior to the tunnel will necessary. Tunneling beneath the subway lines will occur from the cut and cover and open excavations. Tunneling will be accomplished with a tunnel roadheader and will require removal of existing piling supporting the existing tunnel and replacement with new piles/foundations. Spoils will be removed by lifting to the surface with a crane and skip box. Percentage of Daily Use is based on construction operations working 9 hours during a 10 hour shift, with the remaining hour taken up by maintenance of equipment, lunch and breaks. Percentage of Use for Concrete Trucks is based on the approximate waiting time and unloading time on site only. Underpinning operations will require approximately 2 months of the 6 month overall schedule. For the underpinning operation the following construction equipment will be required:

Equipment Type	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily of Use	Duration
Air Operated Grout Drills				4	1.3	90%	6 Months
Concrete Pump	150 CY/Hour – 100 foot boom	Diesel	300	1	.33	20%	
Concrete Trucks	10 Cubic yard Tandem or Tri-axle	Diesel	325	2	0	5%	
Air Compressor for Drills	1600 CFM	Diesel	460	2	0.67	90%	
Welding Machines	35 HP Diesel Engine			2	0.67	70%	

Spoil removal operations will require approximately 2 months of the 6 month overall schedule. For the spoil removal operation the following construction equipment will be required:

Equipment Type	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily of Use	Duration
Crawler Crane	100 Ton	Diesel	450	1	0.3	90%	6 Months
Roadheader for tunneling	12 foot Diameter	Diesel	120	2	0.67	90%	
Dump Trucks	15 Cubic Yard Tandem	Diesel	325	4	3.2	5%	

Concrete Liner construction operations will require approximately 2 months of the 6 month overall schedule.

Equipment Type	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily of Use	Duration
Hi-Lift (Forklift)	5 ton – 40 foot boom	Diesel	120	2	0.67	90%	6 Months
Crawler Crane for Material and Form support	100 Ton	Diesel	350	1	0.33	80%	
Concrete Pump	150 CY/Hour – 100 foot boom	Diesel	300	1	0.33	30%	
Concrete Trucks	10 Cubic yard Tandem or Tri-axle	Diesel	325	2	.7	5%	
Welding Machines	35 HP Diesel Engine	Diesel	35	2	.67	90%	

N/R underpass

Delivery Type	Quantity	Units	Total No. Of Truckloads	Trips per Day (Peak Day impact Calculation)	Trips per Day (cumulative impact calculation)	Estimated Duration
Spoil Removal	7,000	CY	470	8	3.3	12 Months
Underpinning	1,000	Tons	50	2	0.35	
Concrete / Steel	1,000	CY	100	4	0.7	
Service/Utility /Fuel				4	2	
Subcontractors Light Trucks				10	6	
Construction Workers	15 to 20					
Arriving by Personal Vehicle	3 to 4					
Arriving by Mass Transit	12 to 16					
Supervisory/QA	3 to 8					
Arriving by Personal Vehicle	1 to 2					
Arriving by Mass Transit	2 to 6					

Equipment – Grouting beneath the existing subway tunnel will be performed from within the tunnel and will involve the use of compressed air operated drill rigs and grout pumps. Access to the tunnel will be from Transit Authority maintenance access points. Minimal laydown area exterior to the tunnel will necessary. Tunneling beneath the subway lines will occur from the cut and cover and open excavations. Tunneling will be accomplished with a tunnel roadheader and will require removal of existing piling supporting the existing tunnel and replacement with new piles/foundations. Spoils will be removed by lifting to the surface with a crane and skip box. Percentage of Daily Use is based on construction operations working 9 hours during a 10 hour shift, with the remaining hour taken up by maintenance of equipment, lunch and breaks. Percentage of Use for Concrete Trucks is based on the approximate waiting time and unloading time on site only. Underpinning operations will require approximately 4 months of the 12 month overall schedule. For the underpinning operation the following construction equipment will be required:

Equipment Type	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily of Use	Duration
Air Operated Grout Drills				4	1.33	90%	12 Months
Concrete Pump	150 CY/Hour – 100 foot boom	Diesel	300	1	0.33	20%	
Concrete Trucks	10 Cubic yard Tandem or Tri-axle	Diesel	325	2	0	5%	
Air Compressor for Drills	1600 CFM	Diesel	460	2	0.67	90%	
Welding Machines	35 HP Diesel Engine			2	0.67	70%	

Spoil removal operations will require approximately 4 months of the 12 month overall schedule. For the spoil removal operation the following construction equipment will be required:

Equipment Type	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily of Use	Duration
Crawler Crane	100 Ton	Diesel	450	1	0.33	90%	12 Months
Roadheader for tunneling	12 foot Diameter	Diesel	120	2	0.67	90%	
Dump Trucks	15 Cubic Yard Tandem	Diesel	325	4	1.6	5%	

Concrete Liner construction operations will require approximately 4 months of the 12 month overall schedule.

Equipment Type	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily of Use	Duration
Hi-Lift (Forklift)	5 ton – 40 foot boom	Diesel	120	2	0.67	90%	12 Months
Crawler Crane for Material and Form support	100 Ton	Diesel	350	1	0.33	80%	
Concrete Pump	150 CY/Hour – 100 foot boom	Diesel	300	1	0.33	30%	
Concrete Trucks	10 Cubic yard Tandem or Tri-axle	Diesel	325	2	0.35	5%	
Welding Machines	35 HP Diesel Engine	Diesel	35	2	0.67	90%	

Concourse Construction Under Dey Street – Traffic and Construction Equipment

For Worst Case Situation it is assumed that the Dey Street Concourse will be constructed by a cut and cover excavation operation. The first operation will be to relocate all utility lines from the area in which the excavation support system will be constructed. This scenario includes the use of a concrete retaining wall system along the building lines parallel to Dey Street. The concrete retaining wall would be constructed by the slurry trench method of construction using the panel method. The panel method allows an approximate 20 ft. length of wall to be excavated, steel reinforcement installed, and concrete tremie poured to complete the panel before moving to the next section. Panels can also be alternately skipped to allow continuous excavation while placing the reinforcing steel and concrete in the previous excavation.

Dey Street is approximately 350 ft in length from Church to Broadway. Separate excavation retention systems will be required at Church St. and Broadway to facilitate the tunneling operation under the N/R Lines at Church St. and the 4/5 Lines at Broadway. Assume that the excavation support will terminate at 10 feet below the invert of the excavation for the Downtown Concourse or approximately 55 feet from the surface of existing Dey Street. Assume width of slurry trench and wall at 3 feet. Assume that the maximum production rate is 40 lineal feet (2 panels) of wall per week.

The slurry walls along Dey Street will be constructed by closing one side of the street at a time. Additionally, temporary piles and grade beam will be constructed at the center of Dey Street to support the precast temporary roadway over the cut and cover excavation.

Utility Relocations

The relocation of existing utilities within the Dey Street Right-of-Way (ROW) will be performed prior to the excavation.

Delivery Type	Quantity	Units	Total No. Of Truckloads	Trips per Day (Peak Day impact Calculation)	Trips per Day (cumulative impact calculation)	Estimated Duration
Spoil Removal	1,000	CY	67	8	1.8	3 Months
Service/Utility /Fuel				4	2	
Subcontractors Light Trucks				10	6	
Construction Workers	20 to 30					
Arriving by Personal Vehicle	2 to 3					
Arriving by Mass Transit	18 to 27					
Supervisory/QA	3 to 8					
Arriving by Personal Vehicle	1 to 2					
Arriving by Mass Transit	2 to 6					

Equipment – Hydraulic excavators, rubber tire loaders and backhoes will be utilized for the excavation of the utility trenches and placement of electric and telephone ducts and water and sanitary sewer pipe. Percentage of Daily Use for construction equipment has been based on operating 9 hours out of a 10-hour shift. The 9 hours are based on allowing for morning start-up, coffee breaks, lunch break and daily fueling/maintenance. Percentage of Use for Dump Trucks and Concrete Trucks are based on the approximate waiting time and loading/unloading time on site only. The following construction equipment will be required:

Equipment Type	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily of Use	Duration
Hydraulic Excavator	1.5 CY	Diesel	138	2	2	90%	3 Months
Rubber Tire Loader	3.5 CY	Diesel	196	2	2	90%	
Rubber Tire Backhoe/Loader	1.25 CY	Diesel	88	4	4	90%	
Dump Trucks	15 CY Tandem or Tri-axle	Diesel	325	4	0.9	5%	
Pumps for Dewatering	4" Gasoline Powered	Gasoline	16	2	2	90%	
Compressor	185 CFM	Diesel	80	2	2	80%	
Pavement Breakers	90 Lbs			2	2	80%	
Generators	Gasoline Powered	Gasoline	12	2	2	90%	
Air hammers (ringing and ripping)	Gasoline	Gasoline		2	2	25%	

Slurry Wall – Construction will consist of closing half of Dey Street at one time for the excavation and placement of the slurry wall. Prior to slurry wall construction the utilities within the closed portion of Dey Street will be temporarily relocated. A single lane closing along Broadway or Church Street will be required to stage materials and support equipment since excavation of the Transit Center site is scheduled concurrently.

Delivery Type	Quantity	Units	Total No. Of Truckloads	Trips per Day (Peak Day impact Calculation)	Trips per Day (cumulative impact calculation)	Estimated Duration
Slurry Wall – Exc.	4,500	CY	300	8	6.3	4 Months
Slurry Wall – Conc.	4,500	CY	450	12	9.4	
Slurry Wall - Rebar	1,000	Tons	50	2	1	
Service/Utility /Fuel				6	6	
Subcontractors Light Trucks				12	10	
Construction Workers	20 to 30					
Arriving by Personal Vehicle	4 to 6					
Arriving by Mass Transit	16 to 24					
Supervisory/QA	4 to 6					
Arriving by Personal Vehicle	1 to 2					
Arriving by Mass Transit	3 to 4					

Equipment – Construction of the Slurry Wall along Dey Street will be performed from within the closed portion of the street. Lane closures will be required along Church and Broadway to accommodate the delivery of materials and the staging of equipment. Percentage of Daily Use is based on construction operations working 9 hours during a 10 hour shift, with the remaining hour taken up by maintenance of equipment, lunch and breaks. Percentage of Use for Concrete Trucks and Dump Trucks are based on the approximate waiting time and loading/unloading time on site only. Equipment required is as follows:

Equipment Type	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily of Use	Duration
Slurry Plant Mixing Plant	100 m^3 per hour – Diesel 50 HP	Diesel	50	1	1	90%	4 Months
Desanding Plant	100 m^3 per hour – Diesel 50 HP	Diesel	50	1	1	50%	
Crawler Crane w/clam shell	100 Ton	Diesel	350	1	1	90%	
Crawler Crane	100 Ton	Diesel	350	1	1	50%	
Crawler Crane w/Pile Driving Setup	100 Ton	Diesel	350	1	1	50%	
Compressor for Piling Driving	800 CFM	Diesel	310	1	1	50%	
Hydraulic All Terrain Crane	35 Ton	Diesel	165	1	1	80%	
Hi-Lift (Forklift)	5 ton – 40 foot boom	Diesel	120	1	1	90%	
Concrete Pump	150 CY/Hour – 100 foot boom	Diesel	300	1	1	40%	
Concrete Trucks	10 Cubic Yard Tandem or Tri-Axle	Diesel	325	6	4.7	5%	
Dump Trucks	Tandem Axle – 15 CY	Diesel	325	4	3.1	5%	
Rubber Tire Loader	3.5 CY	Diesel	196	2	2	80%	
Diesel Generators	100 HP	Diesel	100	2	2	90%	

Excavation – After the completion of the slurry walls on both sides of Dey Street, including closure pieces at Church and Broadway a cut and cover excavation operation will proceed to bring the excavation to the proposed invert grade. The entire width between the retaining walls would be excavated to the proposed invert elevation of the concourse tunnel. Excavation would be slowed at intermediate levels to allow the installation of struts to brace the concrete retaining walls across the excavation. Assume that struts would be installed to support temporary

roadway, just above proposed tunnel and midway between crown and invert of proposed tunnel. Assume stepped excavation and production rate of 4 vertical feet and 50 lineal feet per day.

Delivery Type	Quantity	Units	Total No. Of Loads	Trips per Day (Peak Day impact Calculation)	Trips per Day (cumulative impact calculation)	Estimated Duration
Excavate to Invert	25,000	CY	1,670	40	34	4 Months
Service/Utility /Fuel				6	4	
Subcontractors Light Trucks				8	6	
Construction Workers	20 to 30					
Arriving by Personal Vehicle	4 to 6					
Arriving by Mass Transit	16 to 24					
Supervisory/QA	4 to 6					
Arriving by Personal Vehicle	1 to 2					
Arriving by Mass Transit	3 to 4					

Equipment – Excavation work will be performed from within the closed portion of Dey Street and will require a lane closing on Church or Broadway to accommodate a staging area for dump trucks and material deliveries of structural steel for support of the slurry wall and support of the temporary precast roadway over the excavation. As the excavation progresses, the spoil will be lifted to the surface in skip box by crane. Percentage of Daily Use is based on construction operations working 9 hours during a 10 hour shift, with the remaining hour taken up by maintenance of equipment, lunch and breaks. Percentage of Use for Dump Trucks is based on the approximate waiting time and loading/unloading time on site only. Equipment required is as follows:

Equipment Type	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily of Use	Duration
Hydraulic All Terrain Crane (Struts)	50 Ton	Diesel	165	1	1	50%	4 Months
Crawler Crane	100 Ton	Diesel	350	1	1	70%	
Hydraulic Excavator	3.5 CY	Diesel	320	1	1	100%	
Dozer	100 HP	Diesel	100	1	1	70%	
Dump Trucks	Tandem Axle – 15 CY	Diesel	325	20	17	5%	
Welding Machines (Strut Installation)	35 HP Diesel Engine	Diesel	35	1		50%	
Air Compressor for Pavement Breakers	800 CFm	Diesel	310	1	1	25%	
Pavement Breakers	90 Lbs.			2	2	25%	

Construct Concourse

Delivery Type	Quantity	Units	Total No. Of Truckloads	Trips per Day (Peak Day impact Calculation)	Trips per Day (cumulative impact calculation)	Estimated Duration
Concrete	12,440	CY	830	26	8.6	12 Months
Structural Steel	1,000	tons	100	6	.35	
Fitout	500	CY	50	2	.35	
Service/Utility /Fuel				6	4	
Subcontractors Light Trucks				12	10	
Construction Workers	20 to 30					
Arriving by Personal Vehicle	4 to 6					
Arriving by Mass Transit	16 to 24					
Supervisory/QA	4 to 6					
Arriving by Personal Vehicle	1 to 2					
Arriving by Mass Transit	3 to 4					

Equipment

Equipment Type	Size	Engine Type	Size HP	Quantity		Percentage of Daily Use	
Crawler Crane	100 Ton	Diesel	350	1	1	90%	12 Months
Hi-Lift (Forklift)	5 ton – 40 foot boom	Diesel	120	1	1	90%	
Concrete Pump	150 CY/Hour – 100 foot boom	Diesel	300	1	1	50%	
Concrete Trucks	10 Cubic Yard Tandem or Tri-Axle	Diesel	325	13	4.3	5%	
Rubber Tire Loader	3.5 CY	Diesel	196	1	1	50%	
Diesel Generators	100 HP	Diesel	100	2	2	90%	

Reinstate Dey Street

Delivery Type	Quantity	Units	Total No. Of Loads	Trips per Day (Peak Day impact Calculation)	Trips per Day (cumulative impact calculation)	Estimated Duration
Refill	11,000	CY	730	40	30.4	2 Months
Service/Utility /Fuel				6	4	
Subcontractors Light Trucks				8	6	
Construction Workers	20 to 30					
Arriving by Personal Vehicle	4 to 6					
Arriving by Mass Transit	16 to 24					
Supervisory/QA	4 to 6					
Arriving by Personal Vehicle	1 to 2					
Arriving by Mass Transit	3 to 4					

Equipment – Excavation work will be performed from within the closed portion of Dey Street and will require a lane closing on Church or Broadway to accommodate a staging area for dump trucks and material deliveries of structural steel for support of the slurry wall and support of the temporary precast roadway over the excavation. As the excavation progresses, the spoil will be lifted to the surface in skip box by crane. Percentage of Daily Use is based on construction

operations working 9 hours during a 10 hour shift, with the remaining hour taken up by maintenance of equipment, lunch and breaks. Percentage of Use for Dump Trucks is based on the approximate waiting time and loading/unloading time on site only. Equipment required is as follows:

Equipment Type	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily of Use	Duration
Hydraulic All Terrain Crane (Struts)	50 Ton	Diesel	165	1	1	50%	2 Months
Crawler Crane	100 Ton	Diesel	350	1	1	70%	
Hydraulic Excavator	3.5 CY	Diesel	320	1	1	100%	
Dozer	100 HP	Diesel	100	1	1	70%	
Dump Trucks	Tandem Axle – 15 CY	Diesel	325	20	15	5%	
Welding Machines (Strut Installation)	35 HP Diesel Engine	Diesel	35	1	1	50%	
Air Compressor for Pavement Breakers	800 CFm	Diesel	310	1	1	25%	
Pavement Breakers	90 Lbs.			2	2	25%	

Building Stabilization – Traffic and Construction Equipment

Corbin Building – It is assumed that the Corbin Building will become a part of the final design of the proposed Fulton Street Transit Center. For this exercise it is assumed that the above grade portions of the façade on the Broadway and John Street sides will be retained. During demolition of the adjacent structures and the portions of the Corbin Building that will not be retained, it will be necessary to construct a structural support system for the façade on the Broadway and John Street sides of the façade. Most likely this will employ an augered pile foundation with a structural steel skeleton erected within the sidewalk area of Broadway and John Street. The sidewalk and one lane on Broadway and John Street will be closed during erection of the support system. The sidewalk and closed lane on John Street can be opened after erection of the support system and a protective cover over the sidewalk. Traffic impacts are as follows:

Delivery Type	Quantity	Units	Total No. Of Truckloads	Trips per Day	Estimated Duration
Mobilization	4	Ea	4	2	2 Day
Pile Foundation for Support System	12	Ea	2	2	2 Days
Structural Steel Support System	500	Tons	25	2	2 Month
Service/Utility /Fuel Trucks				2	2 Months
Subcontractors Light Trucks				4 to 6	2 Months
Construction Workers	15 to 20				
Arriving by Personal Vehicle	3 to 4				
Arriving by Mass Transit	12 to 16				
Supervisory/QA	3 to 5				
Arriving by Personal Vehicle	1 to 2				
Arriving by Mass Transit	2 to 3				

Equipment – Erection of the temporary support structure for the façade will be from the John Street side of the Corbin Building, including the driving/augering of support piles in the sidewalk area. The sidewalk and one lane on John Street will need to be closed during erection. The hydraulic all terrain crane and crawler crane with auger or pile driver would be utilized for approximately one month in this activity. All remaining equipment in list below would be used the following month. Percentage of Daily Use is based on construction operations working 9 hours during a 10 hour shift, with the remaining hour taken up by maintenance of equipment, lunch and breaks. Percentage of Use for Tractor Trailers is based on the approximate waiting time and unloading time on site only. Installation of the piles for the temporary support structure is estimated to take 1-month of the 2-month schedule. Equipment required is as follows:

Equipment Type	Size	Engine Type	Size HP	Quantity	Percentage of Daily Use
Hydraulic All Terrain Crane	50 Ton	Diesel	165	1	50%
Crawler Crane w/Auger or Pile Driver	100 Ton	Diesel	350	1	50%
Air Compressor for Pile Driving	1600 CFM	Diesel	460	1	50%

The erection of the temporary façade support is estimated to take 1-month of the 2- month schedule. Equipment required for erection of the temporary façade support is as follows:

Equipment Type	Size	Engine Type	Size HP	Quantity	Percentage of Daily Use
Crawler Crane	200 Ton	Diesel	450	1	90%
Hi-Lift(Forklift)	5 ton – 40 foot boom	Diesel	120	1	90%
Tractor Trailer	Tandem Axle Tractor w/45 FT Trailer	Diesel	325	2	1%
Welding Machine	35 HP Diesel Engine	Diesel	35	1	90%
Air Compressor for Impact Wrenches	800 CFM	Diesel	310	1	90%
Impact Wrenches	1" Socket Drive			4	90%
Welding Machine	35 HP Diesel Engine	Diesel	35	1	90%

Transit Center Construction – Traffic and Construction Equipment

Demolition of Existing Buildings (194-204 Broadway,)– All buildings within the footprint of the proposed Transit Center (194-204 Broadway) will be demolished to grade and the basements removed and the site made level for the installation of a slurry wall and other earth retention systems to support the surrounding streets and buildings during excavation for the Transit Center. The one to three story buildings will be demolished first with the 12-story building demolished floor-by-floor next. The area will then be used as a staging area for activities within the Dey Street right-of-way and concourse until construction of the Dey Street Head (Entrance) House. The Corbin Building will have the interior floors and rear walls removed after the erection of the temporary support structure for the façade.

Delivery Type	Quantity	Units	Total No. Of Loads	Trips per Day (Peak Day impact Calculation)	Trips per Day (cumulative impact calculation)	Estimated Duration per stage
Demolition Debris	1,000	Tons	500	20	13.9	3 Months
Service/Utility /Fuel Trucks				8	6	
Subcontractors Light Trucks				6	4	
Total Construction Workers	20 to 25					
Arriving by Personal Vehicle	4 to 5					
Arriving by Mass Transit	16 to 20					
Supervisory/QA	3 to 5					
Arriving by Personal Vehicle	1 to 2					
Arriving by Mass Transit	2 to 3					

Equipment – For the one and three story buildings, demolition will be accomplished from within the footprint of the existing buildings with lane closings and sidewalk closings along Broadway and Fulton Street to facilitate staging of dump trucks for debris removal and safety. The 12-story building will be demolished from the top down from within the site with debris brought to ground level for sorting and loading out. The Corbin Building will be de-constructed last, also from the top down with the removal of the rear walls and interior floors to grade for sorting and loading out. Percentage of Daily Use is based on construction operations working 9 hours during a 10 hour shift, with the remaining hour taken up by maintenance of equipment, lunch and breaks. Percentage of Use for Dump Trucks is based on the approximate waiting time and loading time on site only. Equipment required is as follows:

Equipment Type	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily of Use	Duration
Crawler Crane w/clamshell or grapple	200 Ton	Diesel	450	1	1	90%	3 months
Hydraulic Excavator w/Hoe Ram	3.5 Cubic Yard	Diesel	320	1	1	90%	
Hydraulic Excavator w/Grapple	3.5 Cubic Yard	Diesel	320	1	1	90%	
Track Loader w/Waste Handling Bucket	5.5 Cubic Yard	Diesel	160	1	1	80%	
Dump Trucks	Tandem Axle – 15 CY	Diesel	325	10	7	5%	
Air Compressor for Pavement Breakers	1600 CFM	Diesel	460	1	1	50%	
Pavement Breakers	90 lbs.			4	4	50%	

Slurry Wall and Sheeting/Shoring – Construction will be performed within the footprint of the proposed Transit Center site with access to the site from Fulton Street for removal of spoils and delivery of materials. Soldier beam and lagging may be used for support of portions of the excavation at penetrations for concourse connections to the transit center.

Delivery Type	Quantity	Units	Total No. Of Truckloads	Trips per Day (Peak Day impact Calculation)	Trips per Day (cumulative impact calculation)	Estimated Duration
Slurry Wall – Exc.	3,900	CY	260	8	5.4	4 Months
Slurry Wall – Conc.	3,900	CY	390	10	8	
Slurry Wall - Rebar	1,000	Tons	50	2	1	
Service/Utility /Fuel				6	4	
Subcontractors Light Trucks				12	10	
Construction Workers	20 to 30					
Arriving by Personal Vehicle	4 to 6					
Arriving by Mass Transit	16 to 24					
Supervisory/QA	4 to 6					
Arriving by Personal Vehicle	1 to 2					
Arriving by Mass Transit	3 to 4					

Slurry Wall and Sheeting/Shoring Construction Equipment – Construction of the Slurry Wall around the Transit Center site will be performed from within the footprint of the site. Percentage of Daily Use is based on construction operations working 9 hours during a 10 hour shift, with the remaining hour taken up by maintenance of equipment, lunch and breaks. Percentage of Use for Concrete Trucks and Dump Trucks are based on the approximate waiting time and unloading/loading time on site only. Equipment required is as follows.

Equipment Type	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily of Use	Duration
Slurry Plant Mixing Plant	100 m^3 per hour – Diesel 50 HP	Diesel	50	1	1	90%	
Desanding Plant	100 m^3 per hour – Diesel 50 HP	Diesel	50	1	1	50%	
Crawler Crane w/clam shell	100 Ton	Diesel	350	1	1	90%	
Crawler Crane	100 Ton	Diesel	350	1	1	50%	
Crawler Crane w/Piling Driving Setup	100 Ton	Diesel	350	1	1	50%	
Hi-Lift (Forklift)	5 ton – 40 foot boom	Diesel	120	1	1	90%	
Concrete Pump	150 CY/Hour – 100 foot boom	Diesel	300	1	1	50%	
Concrete Trucks	10 Cubic Yard Tandem or Tri-Axle	Diesel	325	5	4	5%	
Dump Trucks	Tandem Axle – 15 CY	Diesel	325	4	2.7	5%	
Rubber Tire Loader	3.5 CY	Diesel	196	1	1	80%	
Diesel Generators	100 HP	Diesel	100	1	1	90%	

Excavation – After the completion of the earth retention systems, the Transit Center site will be excavated to the proposed grade.

Delivery Type	Quantity	Units	Total No. Of Loads	Trips per Day (Peak Day impact Calculation)	Trips per Day (cumulative impact calculation)	Estimated Duration Worst Case
Excavate to Sub-grade	45,000	CY	3,000	200	83	3Months
Service/Utility /Fuel				6	4	
Subcontractors Light Trucks				8	6	
Construction Workers	10 to 20					
Arriving by Personal Vehicle	2 to 4					
Arriving by Mass Transit	8 to 16					
Supervisory/QA	4 to 6					
Arriving by Personal Vehicle	1 to 2					
Arriving by Mass Transit	3 to 4					

Equipment – Excavation work will be performed from within the footprint of the Transit Center. A lane closing will be required on Broadway and Fulton to queue dump trucks and to allow access to the site. As the excavation progresses, tiebacks or rakers will be installed to temporarily support the slurry wall and soldier beams. Percentage of Daily Use is based on construction operations working 9 hours during a 10 hour shift, with the remaining hour taken up by maintenance of equipment, lunch and breaks. Percentage of Use for Dump Trucks is based on the approximate waiting time and loading time on site only. Equipment required is as follows:

Equipment Type	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily of Use	Duration
Crawler Crane	100 Ton	Diesel	350	1	1	50%	3 Months
Hydraulic Excavator	3.5 CY	Diesel	320	1	1	90%	
Hydraulic Excavator	2 CY	Diesel	300	1	1	90%	
Dozer	100 HP	Diesel	100	1	1	80%	
Dump Trucks	Tandem Axle – 15 CY	Diesel	325	100	42	5%	
Welding Machines (Support Installation)	35 HP Diesel Engine	Diesel	35	1	1	50%	
Air Compressor for Pavement Breakers	800 CFM	Diesel	310	1	1	50%	
Pavement Breakers	90 Lbs.			2	2	50%	

Foundation– The foundations of the Transit Center will be constructed from within the footprint of the site, however access to the site from Fulton Street will need to be maintained to allow pile driving equipment access to the sub-grade. It is assumed that an earthen ramp or one constructed of a temporary bridge structure will be the means of access. The estimated length of time is six months for foundations.

Delivery Type	Quantity	Units	Total No. Of Truckloads	Trips per Day (Peak Day impact Calculation)	Trips per Day (cumulative impact calculation)	Estimated Duration
Concrete	3,000	CY	200	20	2.8	6 Months
Reinforcing Steel	600	Tons	30	2	0.42	
Service/Utility /Fuel				20	12	
Subcontractors Light Trucks				20	12	
Construction Workers	80 to 100					
Arriving by Personal Vehicle	16 to 20					
Arriving by Mass Transit	64 to 80					
Supervisory/QA	10 to 15					
Arriving by Personal Vehicle	2 to 3					
Arriving by Mass Transit	8 to 12					

Foundation Equipment – Foundation and subbasement work will be primarily of concrete construction to street level. Lane closing along Fulton Street will be required for access to the site and queuing of delivery trucks. Percentage of Daily Use is based on construction operations working 9 hours during a 10 hour shift, with the remaining hour taken up by maintenance of equipment, lunch and breaks. Percentage of Use for Concrete Trucks and Dump Trucks are based on the approximate waiting time and loading time on site only. The estimated time for foundation and concrete construction is 6 months; pile driving will take 2-months of the 6-month foundation work. The following construction equipment will be required for foundation and pile driving:

Pile equipment

Equipment Type	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily of Use	Duration
Crawler Crane	200 Ton	Diesel	450	2	0.67	90%	6 Months
Crawler Crane w/Pile Driving Setup	100 Ton	Diesel	350	1	0.33	90%	
Compressor for Pile Driving	1600 CFM	Diesel	460	1	0.33	90%	
Hi-Lift (Forklift)	5 ton – 40 foot boom	Diesel	120	1	0.33	90%	
Concrete Pump	150 CY/Hour – 100 foot boom	Diesel	300	1	0.33	50%	
Concrete Trucks	10 Cubic Yard Tandem or Tri-Axle	Diesel	325	10	0	5%	
Diesel Generators	100 HP	Diesel	100	2	0.67	90%	
Tractor Trailer	Tandem Axle Tractor w/45 Foot Trailer	Diesel	325	2	0.1	5%	
Welding Machines	35 HP Diesel Engine	Diesel	35	2	0.67	100%	

Foundation Concrete Equipment - The foundation and concrete work is estimated to take 4 months of the 6-month foundation and concrete schedule. The following equipment is required for the foundation and concrete work:

Equipment Type	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily of Use	Duration
Crawler Crane	200 Ton	Diesel	450	2	1.33	90%	6 Months
Hi-Lift (Forklift)	5 ton – 40 foot boom	Diesel	120	1	0.67	90%	
Concrete Pump	150 CY/Hour – 100 foot boom	Diesel	300	1	0.67	50%	
Concrete Trucks	10 Cubic Yard Tandem or Tri-Axle	Diesel	325	8	1.4	5%	
Diesel Generators	100 HP	Diesel	100	2	0.67	90%	
Tractor Trailer	Tandem Axle Tractor w/45 Foot Trailer	Diesel	325	2	0.21	5%	
Welding Machines	35 HP Diesel Engine	Diesel	35	2	0.67	90%	

Superstructure

Delivery Type	Quantity	Units	Total No. Of Truckloads	Trips per Day (Peak Day impact Calculation)	Trips per Day (cumulative impact calculation)	Estimated Duration
Structural Steel	1,500	Tons	75	4	1	6 Months
Structural Steel – Grand Space	3,000	Tons	150	4	2	
Curtain Wall	400	Tons	20	2	0.28	
Service/Utility /Fuel				20	12	
Subcontractors Light Trucks				20	12	
Construction Workers	80 to 100					
Arriving by Personal Vehicle	16 to 20					
Arriving by Mass Transit	64 to 80					
Supervisory/QA	10 to 15					
Arriving by Personal Vehicle	2 to 3					
Arriving by Mass Transit	8 to 12					

Superstructure Equipment - The erection of the superstructure and enclosing facade is estimated to take 6-months. The following equipment is required:

Equipment Type	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily of Use	Duration
Crawler Crane	200 Ton	Diesel	450	2	2	100%	6 Months
Hi-Lift (Forklift)	5 ton – 40 foot boom	Diesel	120	1	1	100%	
Concrete Pump	150 CY/Hour – 100 foot boom	Diesel	300	1	1	50%	
Concrete Trucks	10 Cubic Yard Tandem or Tri-Axle	Diesel	325	8	2	5%	
Diesel Generators	100 HP	Diesel	100	2	2	100%	
Tractor Trailer	Tandem Axle Tractor w/45 Foot Trailer	Diesel	325	5	2	5%	
Welding Machines	35 HP Diesel Engine	Diesel	35	2	2	100%	
Air Compressor for Impact Wrenches	1600 CFM	Diesel	460	2	2	100%	
Impact Wrenches	1" Socket Drive			10	10	80%	

Widening of A/C Mezzanine – Traffic and Construction Equipment

The A/C Mezzanine widening will be accomplished using a sequential cut and cover operation to allow the existing platforms to remain in service during construction. The operation will require a minimum of a lane closing along Fulton Street to accommodate the operation and staging area for equipment and materials. Construction activities include grouting, temporary bracing, demolition and excavation of roadway, slurry wall construction, concrete construction, interior fitout of mezzanine and reconstruction of Fulton Street over the widened mezzanine.

Utility Relocations -The relocation of existing utilities within the Fulton Street Right-of-Way (ROW) will be performed prior to the excavation

Delivery Type	Quantity	Units	Total No. Of Truckloads	Trips per Day (Peak Day impact Calculation)	Trips per Day (cumulative impact calculation)	Estimated Duration
Spoil Removal	1,000	CY	67	8	0.62	9 Months
Service/Utility /Fuel				4	2	
Subcontractors Light Trucks				10	4	
Construction Workers	20 to 30					
Arriving by Personal Vehicle	2 to 3					
Arriving by Mass Transit	18 to 27					
Supervisory/QA	3 to 8					
Arriving by Personal Vehicle	1 to 2					
Arriving by Mass Transit	2 to 6					

Equipment – Hydraulic excavators, rubber tire loaders and backhoes will be utilized for the excavation of the utility trenches and placement of electric and telephone ducts and water and sanitary sewer pipe. Percentage of Daily Use for construction equipment has been based on operating 9 hours out of a 10-hour shift. The 9 hours are based on allowing for morning start-up, coffee breaks, lunch break and daily fueling/maintenance. Percentage of Use for Dump Trucks and Concrete Trucks are based on the approximate waiting time and loading/unloading time on site only. The following construction equipment will be required:

Equipment Type	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily of Use	Duration
Rubber Tire Loader	3.5 CY	Diesel	196	1	0.25	90%	9 Months
Rubber Tire Backhoe/Loader	1.25 CY	Diesel	88	1	0.25	90%	
Dump Trucks	15 CY Tandem or Tri-axle	Diesel	325	4	0.23	5%	
Pumps for Dewatering	4" Gasoline Powered	Gasoline	16	2	2	90%	
Compressor	185 CFM	Diesel	80	2	0.25	80%	
Pavement Breakers	90 Lbs			2	0.25	80%	
Air hammers (ringing and ripping)				2	0.1	80%	

Slurry Wall

Delivery Type Per Segment	Quantity	Units	Total No. Of Truckloads	Trips per Day (Peak Day impact Calculation)	Trips per Day (cumulative impact calculation)	Estimated Duration
Slurry Wall – Exc.	2000	CY	35	6	1.9	6 Month
Slurry Wall – Conc.	2000	CY	50	6	2.8	
Slurry Wall - Rebar	120	Tons	2	2	0.1	
Service/Utility /Fuel				6	4	
Subcontractors Light Trucks				12	10	
Construction Workers	40 to 50					
Arriving by Personal Vehicle	8 to 10					
Arriving by Mass Transit	32 to 40					
Supervisory/QA	4 to 6					
Arriving by Personal Vehicle	1 to 2					
Arriving by Mass Transit	3 to 4					

Slurry Wall Equipment

Equipment Type	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily of Use	Duration
Slurry Plant Mixing Plant	100 m^3 per hour – Diesel 50 HP	Diesel	50	1	1	90%	6 Months
Desanding Plant	100 m^3 per hour – Diesel 50 HP	Diesel	50	1	1	90%	
Crawler Crane w/clam shell	100 Ton	Diesel	350	1	1	90%	
Crawler Crane	100 Ton	Diesel	350	1	1	50%	
Hi-Lift (Forklift)	5 ton – 40 foot boom	Diesel	120	1	1	90%	
Concrete Pump	150 CY/Hour – 100 foot boom	Diesel	300	1	1	35%	
Concrete Trucks	10 Cubic Yard Tandem or Tri-Axle	Diesel	325	3	1.4	5%	
Dump Trucks	Tandem Axle – 15 CY	Diesel	325	3	.9	5%	
Rubber Tire Loader	3.5 CY	Diesel	196	1	1	50%	
Compressor for Pavement Breakers	1600 CFM	Diesel	460	1	1	25%	
Pavement Breakers	90 Lbs			10	10	35%	
Diesel Generators	100 HP	Diesel	100	2	2	90%	

Construction will be performed in segments along the length of the widening. Each segment will be completed in its entirety before work begins on the next segment in order to maintain access to the platforms. Temporary stairs will be utilized to move passengers around the out of service segment of mezzanine. It is anticipated that the work will take approximately 9 months for the entire widening. Impacts and durations in table below are based on new segment.

Widening Construction Sequence - Estimated 40 days for excavation, concrete placement for mezzanine is 4 month per stage, Street reconstruction is 40 days

Delivery Type Per Segment	Quantity	Units	Total No. Of Truckloads	Trips per Day (Peak Day impact Calculation)	Trips per Day (cumulative impact calculation)	Estimated Duration
Excavation	8000	CY	266	26	5	9 Months
Bracing Delivery	600	Tons	30	2	.28	
Concrete for Mezzanine	2400	CY	240	6	2.2	
Reconstruct Fulton St	4,000	Tons	200	10	1.85	
Service/Utility /Fuel				6	4	
Subcontractors Light Trucks				12	10	
Construction Workers	40 to 50					
Arriving by Personal Vehicle	8 to 10					
Arriving by Mass Transit	32 to 40					
Supervisory/QA	4 to 6					
Arriving by Personal Vehicle	1 to 2					
Arriving by Mass Transit	3 to 4					

A/C Widening Construction Equipment – Roadway Demolition and slurry wall construction will require lane closing for the work as well as a staging area for equipment and materials. Grout injection will be performed from within the existing subway tunnel and from the surface. Percentage of Daily Use is based on construction operations working 9 hours during a 10 hour shift, with the remaining hour taken up by maintenance of equipment, lunch and breaks. Percentage of use is based on the Estimated Duration from the above table at 3 Months per segment, for a total of 12 months of construction time. Percentage of Use for Concrete Trucks and Dump Trucks are based on the approximate waiting time and loading time on site only. Equipment required for the estimated 4-months of total grout injection is as follows:

Equipment Type	Size	Engine Type	Size HP	Quantity (peak calculation)	Quantity (cumulative calculation)	Percentage Daily of Use	Duration
Air Operated Grout Injection Drills				3	1.3	90%	9 Months
Compressor for Grout Injection	1600 CFM	Diesel	460	3	1.3	90%	
Grout Plant	10 m^3 per hour	Diesel	50	1	.44	90%	
Hi-Lift (Forklift)	5 ton – 40 foot boom	Diesel	120	1	.44	90%	
Rubber Tire Loader	3.5 CY	Diesel	196	1	.44	50%	
Compressor for Pavement Breakers	1600 CFM	Diesel	460	1	.44	25%	
Pavement Breakers	90 Lbs			10	4.4	25%	
Diesel Generators	100 HP	Diesel	100	2	.88	90%	

The excavation for the mezzanine construction is estimated to take 40 total

Equipment Type	Size	Engine Type	Size HP	Quantity		Percentage of Daily Use	
Crawler Crane	100 Ton	Diesel	350	1	0.14	50%	9 Months
Hi-Lift (Forklift)	5 ton – 40 foot boom	Diesel	120	1	0.14	90%	
Hydraulic Excavator	2 CY	Diesel	300	1	0.14	90%	
Hydraulic Excavator w/Hoe Ram	2 CY	Diesel	300	1	0.14	90%	
Dump Trucks	Tandem Axle – 15 CY	Diesel	325	13	2.5	5%	
Rubber Tire Loader	3.5 CY	Diesel	196	1	0.14	50%	
Compressor for Pavement Breakers	1600 CFM	Diesel	460	1	0.14	90%	
Pavement Breakers	90 Lbs			10	1.4	90%	
Diesel Generators	100 HP	Diesel	100	2	.28	90%	

The concrete placement for mezzanine construction is estimated at 4-month

Equipment Type	Size	Engine Type	Size HP	Quantity		Percentage of Daily Use	
Crawler Crane	100 Ton	Diesel	350	1	.44	90%	9 Months
Hi-Lift (Forklift)	5 ton – 40 foot boom	Diesel	120	1	.44	90%	
Concrete Pump	150 CY/Hour – 100 foot boom	Diesel	300	1	.44	50%	
Concrete Trucks	10 Cubic Yard Tandem or Tri-Axle	Diesel	325	5	1.2	5%	
Rubber Tire Loader	3.5 CY	Diesel	196	1	.44	50%	
Diesel Generators	100 HP	Diesel	100	2	.88	90%	

The reconstruction of Fulton Street is estimated to take 40 total days

Equipment Type	Size	Engine Type	Size HP	Quantity		Percentage of Daily Use	
Asphalt Paving Machine	10 Foot Screed Width	Diesel	153	1	0.14	90%	9 Months
Asphalt Compactor	Vibratory 10 Ton	Diesel	70	1	0.14	90%	
Dump Trucks (Asphalt Paving)	Tandem Axle – 15 CY	Diesel	325	5	.19	5%	
Rubber Tire Loader	3.5 CY		196	1	0.14	50%	
Compressor for Pavement Breakers	1600 CFM		460	1	0.14	20%	
Pavement Breakers	90 Lbs			2	0.28	20%	

SOUTH FERRY STATION

CONSTRUCTION METHODS AND IMPACTS

Tunneling for Underpasses – Traffic and Construction Equipment

Tunneling operations will be required to construct concourse beneath the existing 1/9 loop and the 4/5 line. The tunneling operations will be performed from within the existing tunnels (grouting operations) and from the surface. It is assumed here that grouting equipment will access the tunneling locations from within the existing subway tunnels. Spoils from tunneling operations will be removed through the cut and cover excavations to street level for hauling from the site. All tunneling work estimated based on 2 x 8-hour shifts within a 16-hour period. Grouting and underpinning operations will most likely be performed overnight and on weekends to minimize disruption to transit operations. No street closings are anticipated for this work to take place since the grouting will be performed within the subway tunnels and the tunneling work will be performed from the cut and cover excavation.

Delivery Type	Quantity	Units	Total No. Of Truckloads	Trips per Day	Estimated Duration
Mobilization	6	Ea	6	0	5 Days
Spoil Removal	7,000	CY	470	8	6 Months
Underpinning	1,000	Tons	50	2	6 Months
Concrete / Steel	1,000	CY	100	2 to 4	6 Months
Service/Utility /Fuel				2 to 4	6 Months
Subcontractors Light Trucks				4 to 10	6 Months
Construction Workers	15 to 20				
Arriving by Personal Vehicle	3 to 4				
Arriving by Mass Transit	12 to 16				
Supervisory/QA	3 to 8				
Arriving by Personal Vehicle	1 to 2				
Arriving by Mass Transit	2 to 6				

Construction Equipment – Grouting beneath the existing subway tunnel will be performed from within the tunnel and will involve the use of compressed air operated drill rigs and grout pumps. Access to the tunnel will be from Transit Authority maintenance access points. Minimal laydown area exterior to the tunnel will necessary. Tunneling beneath the subway lines will occur from the cut and cover and open excavations. Tunneling will be accomplished with a tunnel roadheader and will require removal of existing piling supporting the existing tunnel and replacement with new piles/foundations. Spoils will be removed by lifting to the surface with a crane and skip box. Percentage of use is based on the Estimated Duration from the above table. Percentage of Use for Concrete Trucks is based on the approximate waiting time and unloading time on site only. The following construction equipment will be required:

Equipment Type	Size	Quantity	Percentage of Use
Air Operated Grout Drills		4	50%
Roadheader for tunneling	12 foot Diameter	2	50%
Concrete Pump	150 CY/Hour – 100 foot boom	1	20%
Concrete Trucks	10 Cubic yard Tandem or Tri-axle	2	5%
Welding Machines	35 HP Diesel Engine	2	80%

Bellmouth, Approach Tunnel and South Ferry Terminal Excavation – Cut and Cover

For Worst Case Situation it is assumed that the Bellmouth, fan plant structure, Approach Tunnel and South Ferry Terminal Station will be constructed by a cut and cover excavation operation. The first operation will be to relocate all utility lines from the area in which the excavation support system will be constructed. The concrete retaining wall would be constructed by the slurry trench method of construction using the panel method. The panel method allows an approximate 20 ft. length of wall to be excavated, steel reinforcement installed, and concrete tremie poured to complete the panel before moving to the next section. Panels can also be alternately skipped to allow continuous excavation while placing the reinforcing steel and concrete in the previous excavation.

Slurry Wall and Sheeting/Shoring – Construction will be performed within the footprint of the proposed realigned subway tunnels and South Ferry Terminal Station with access to the site from Greenwich Street and Battery Place for removal of spoils and delivery of materials. Soldier beam and lagging may be used for support of portions of the excavation at locations along Greenwich Street where the new subway tunnel connects to the existing tunnel.

Delivery Type	Quantity	Units	Total No. Of Truckloads	Trips per Day	Estimated Duration
Mobilization	6	Ea	6	2	10 Days
Slurry Wall – Exc.	18,350	CY	1,225	20 to 22	6 Months
Slurry Wall – Conc.	18,350	CY	1,835	30	6 Months
Slurry Wall - Rebar	2,100	Tons	105	2	6 Months
Piling and Lagging Delivery	300	Tons	15	2	1 Month
Service/Utility /Fuel				4 to 6	4 Months
Subcontractors Light Trucks				8 to 10	4 Months
Construction Workers	20 to 30				
Arriving by Personal Vehicle	4 to 6				
Arriving by Mass Transit	16 to 24				
Supervisory/QA	4 to 6				
Arriving by Personal Vehicle	1 to 2				
Arriving by Mass Transit	3 to 4				

Slurry Wall and Sheeting/Shoring Construction Equipment – Construction of the Slurry Wall along the proposed Bellmouth, Approach Tunnel and South Ferry Terminal site will be performed from within the footprint of the site. Percentage of use is based on the Estimated Duration from the above table. Percentage of Use for Concrete Trucks and Dump Trucks are based on the approximate waiting time and unloading/loading time on site only. Equipment required is as follows:

Equipment Type	Size	Quantity	
Slurry Plant Mixing Plant	100 m^3 per hour – Diesel 50 HP	1	100%
Desanding Plant	100 m^3 per hour – Diesel 50 HP	1	50%
Crawler Crane w/clam shell	100 Ton	1	100%
Crawler Crane	100 Ton	1	50%
Crawler Crane w/Piling Driving Setup	100 Ton	1	15%
Hi-Lift (Forklift)	5 ton – 40 foot boom	1	100%
Concrete Pump	150 CY/Hour – 100 foot boom	1	50%
Concrete Trucks	10 Cubic Yard Tandem or Tri-Axle	5	5%
Dump Trucks	Tandem Axle – 15 CY	4	5%
Rubber Tire Loader	3.5 CY	1	80%
Diesel Generators/Compressors	100 HP	2	100%

Excavation – After the completion of the slurry walls on either side of new subway tunnel and terminal station, a cut and cover excavation operation will proceed to bring the excavation to the proposed invert grade. The entire width between the retaining walls would be excavated to the proposed invert elevation of the subway terminal tunnel. Excavation would be slowed at intermediate levels to allow the installation of struts to brace the concrete retaining walls across the excavation. Assume that struts would be installed to support temporary roadway, just above proposed tunnel and midway between crown and invert of proposed tunnel. Assume stepped excavation and production rate of 4 vertical feet and 50 lineal feet per day.

Delivery Type	Quantity	Units	Total No. Of Loads	Trips per Day	Estimated Duration Worst Case
Mobilization	2	Ea	2	2	2 Days
Excavate to Invert	65,000	CY	4,350	18 to 20	24 Mos.
Service/Utility /Fuel				4 to 6	24 Mos.
Subcontractors Light Trucks				4 to 8	24 Mos.
Construction Workers	50 to 80				
Arriving by Personal Vehicle	4 to 6				
Arriving by Mass Transit	46 to 74				
Supervisory/QA	10 to 20				
Arriving by Personal Vehicle	1 to 2				
Arriving by Mass Transit	9 to 16				

Construction Equipment – Excavation work will be performed from within the cut and cover operation and should not require any lane closings. As the excavation progresses, the spoil will be lifted to the surface in skip box by crane, or trucked directly from the excavation. Percentage of use is based on the Estimated Duration from the above table. Percentage of Use for Dump Trucks is based on the approximate waiting time and loading time on site only. Equipment required is as follows:

Equipment Type	Size	Quantity	Percentage of Use
Hydraulic All Terrain Crane (Struts)	50 Ton	1	50%
Crawler Crane	50 Ton	1	70%
Hydraulic Excavator	3.5 CY	2	100%
Air Track for Drilling & Blasting	3" Diameter Drill	4	50%
Air Compressors for Drilling & Blasting	1200 CFM	2	50%
Dozer	100 HP	1	70%
Dump Trucks	Tandem Axle – 15 CY	6	5%
Welding Machines (Strut Installation)	35 HP Diesel Engine	1	50%
Diesel Generators/Compressors	100 HP	2	100%

Tunnel and Terminal Station Construction – Traffic and Construction Equipment

The new South Ferry Terminal Station is a two level station enclosure with tracks and platform at the lower level, and mezzanine and facility space at the upper level. The south end of the station will pass beneath the existing two track South Ferry loop and station, the excavation of which is covered under No. 1 above. The Approach Tunnels will accommodate two tracks and will contain crossovers for flexible routing of trains into and out of the terminal station. Tunnel and station construction will be primarily of reinforced concrete construction and will utilize the reinforced concrete slurry walls as a part of the permanent construction. It is assumed, that after excavation a tunnel mud slab will be constructed of reinforced concrete on which the track and platform structures will be constructed. It is also assumed that the top slab of the tunnels and terminal station will also be of reinforced concrete construction. It is anticipated that the construction work will take place from within the footprint of the proposed subway tunnel and terminal station however storage and laydown areas will be required adjacent to both construction sites within the park. The anticipated traffic impacts are as follows:

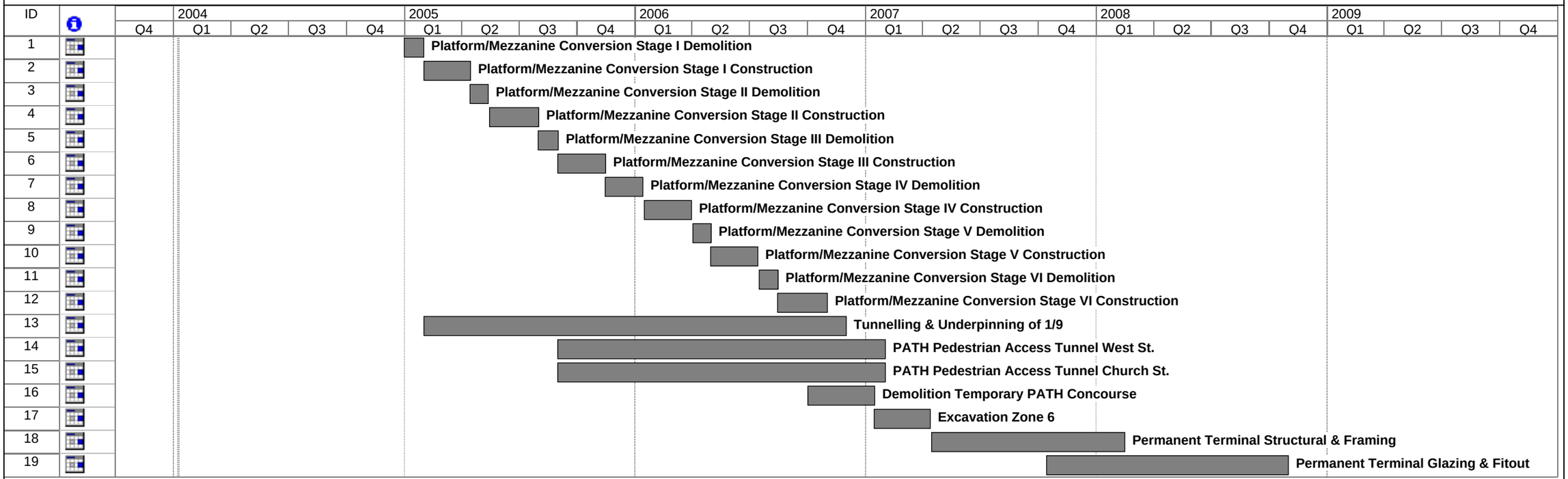
Delivery Type	Quantity	Units	Total No. Of Truckloads	Trips per Day	Estimated Duration
Mobilization	6	Ea	6	2	3 Days
Concrete	10,000	CY	1,000	8	12 Months
Reinforcing Steel	900	Tons	45	1	12 Months
Structural Steel	500	Tons	25	4	12 Months
Interior Fitout				10	4 Months
Service/Utility /Fuel				8 to 16	12 Months
Subcontractors Light Trucks				8 to 16	12 Months
Construction Workers	80 to 100				
Arriving by Personal Vehicle	16 to 20				
Arriving by Mass Transit	64 to 80				
Supervisory/QA	10 to 15				
Arriving by Personal Vehicle	2 to 3				
Arriving by Mass Transit	8 to 12				

Construction Equipment – Percentage of use is based on the Estimated Duration from the above table. Percentage of Use for Concrete Trucks and Dump Trucks are based on the approximate waiting time and loading time on site only. The following construction equipment will be required:

Equipment Type	Size	Quantity	Percentage of Use
Crawler Crane	200 Ton	2	100%
Hi-Lift (Forklift)	5 ton – 40 foot boom	1	100%
Concrete Pump	150 CY/Hour – 100 foot boom	2	50%
Concrete Trucks	10 Cubic Yard Tandem or Tri-Axle	16	5%
Diesel Generators	100 HP	2	100%
Tractor Trailer	Tandem Axle Tractor w/45 Foot Trailer	2	5%
Welding Machines	35 HP Diesel Engine	2	100%
Air Compressor for Impact Wrenches	1600 CFM	2	100%
Impact Wrenches	1” Socket Drive	10	80%

Appendix J-4

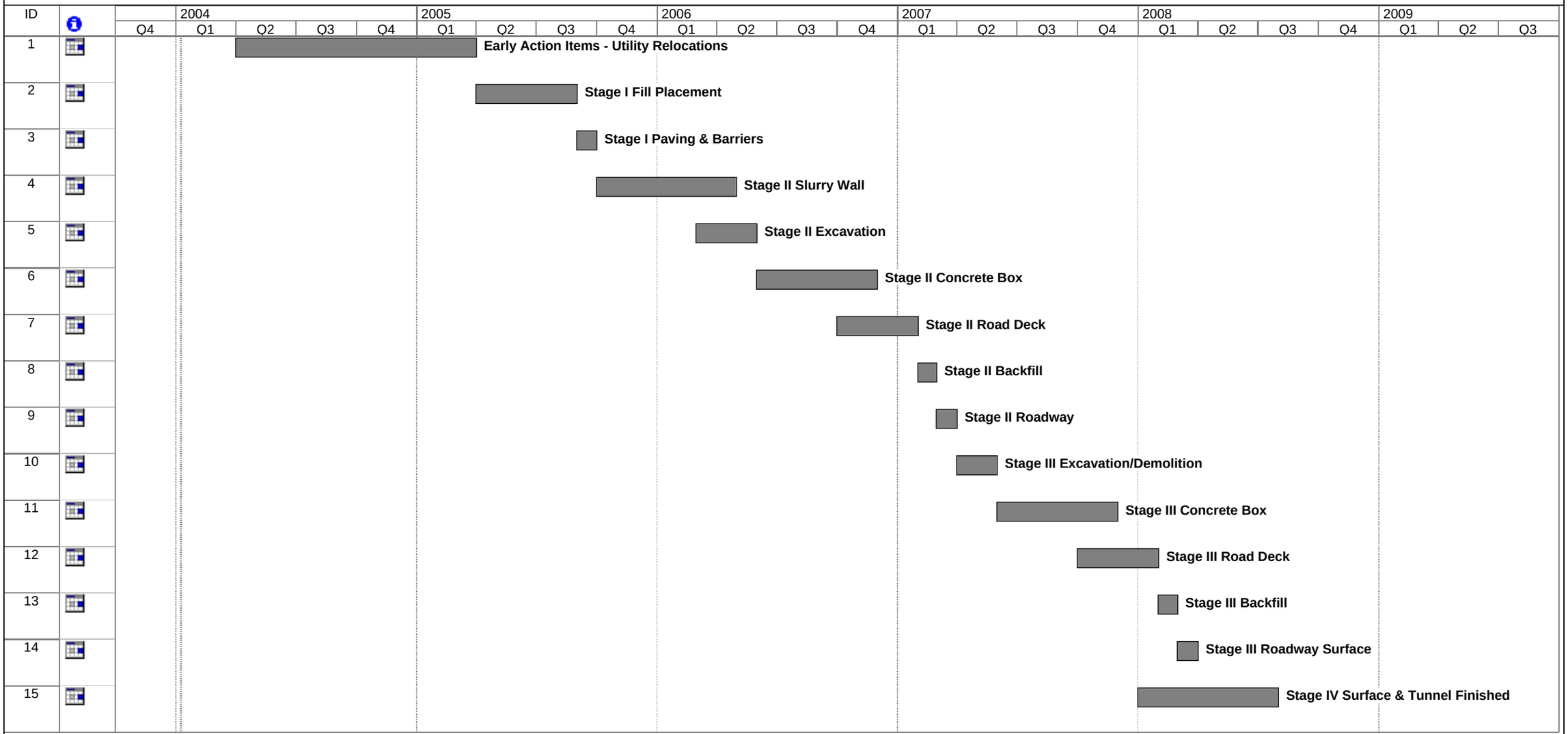
PATH Construction Phasing



Source: The Louis Berger Group, Inc., 2003

Appendix J-5

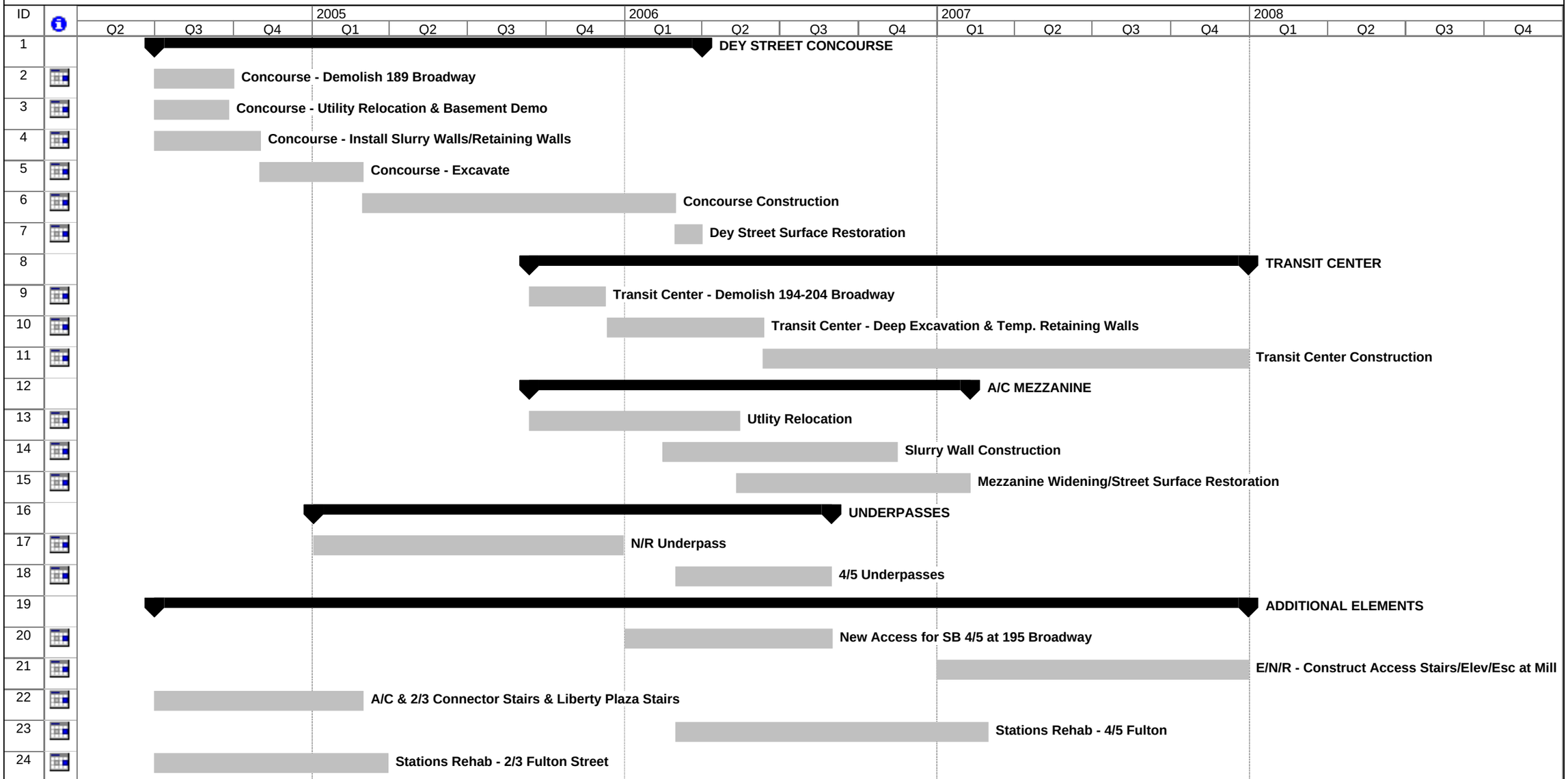
Route 9A Construction Phasing Schedule



Source: The Louis Berger Group, Inc., 2003

Appendix J-6

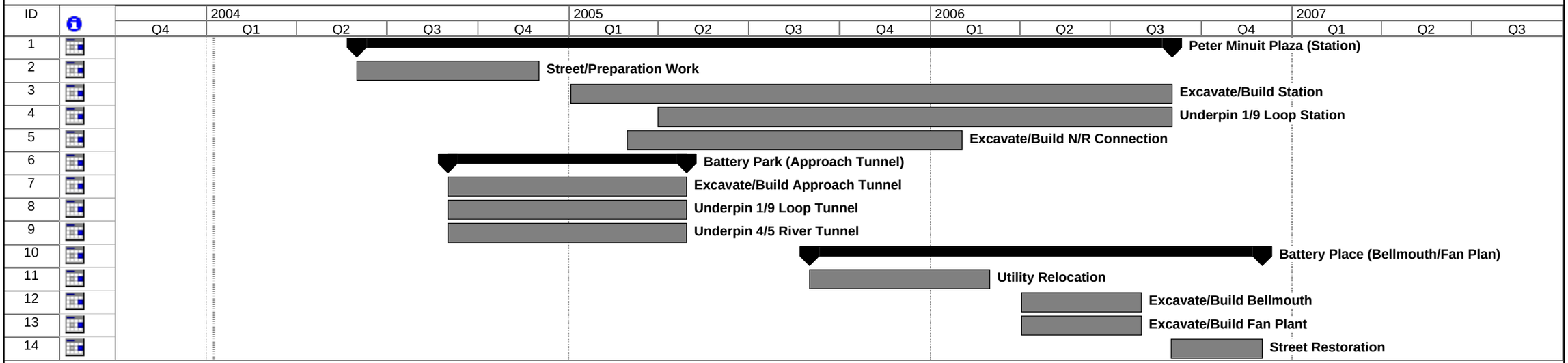
MTA/NYCT Fulton Street Transit Center Construction Schedule



Source: The Louis Berger Group, Inc., 2003

Appendix J-7

South Ferry Construction Schedule



Source: The Louis Berger Group, Inc., 2003

Appendix J-8 TABLE 1
LEVEL OF SERVICE FOR CRITICAL WTC INTERSECTIONS
2006 AM PEAK (8:15 - 9:15 AM)

INTERSECTION AND APPROACH	Future Without the Proposed Action (FWOPA)				Future With the Proposed Action (FWPA)				SIGNIFICANT IMPACT?
	Lane Group	V/C (1) Ratio	Delay (2)	LOS	Lane Group	V/C Ratio (1)	Delay (2)	LOS	FWOPA vs. FWPA
Canal Street/West Street (NYS Rt. 9A) (Signalized)									
Westbound (Canal Street)	L	0.20	43.2	D	L	0.22	43.6	D	NO
Westbound (Canal Street)	LR	0.45	50.1	D	LR	0.45	50.1	D	NO
Westbound (Canal Street)	R	0.53	53.3	D	R	0.53	53.3	D	NO
Northbound (West Street)	T	0.66	2.4	A	T	0.66	2.4	A	NO
Southbound (West Street)	T	0.57	1.8	A	T	0.58	1.9	A	NO
Intersection			4.3	A			4.3	A	NO
Canal Street/West Street (NYS Rt. 9A) (Signalized)									
Northbound (West Street)	TR	0.90	19.6	B	TR	0.91	20.1	C	NO
Northbound (West Street)	R	0.41	11.4	B	R	0.42	11.5	B	NO
Southbound (West Street)	L	1.02	103.7	F	L	1.02	103.7	F	NO
Southbound (West Street)	T	0.99	18.1	B	T	1	33.2	C	NO
Intersection			29.8	C			35.9	D	NO
Chambers Street/West Street (NYS Rt. 9A) (Signalized)									
Eastbound (Chambers Street)	LTR	0.63	47.6	D	LTR	0.63	47.6	D	NO
Westbound (Chambers Street)	LT	0.73	52.8	D	LT	0.73	52.8	D	NO
Westbound (Chambers Street)	R	0.43	25.8	C	R	0.43	25.8	C	NO
Northbound (West Street)	TR	0.94	27.2	C	TR	0.95	28.4	C	NO
Southbound (West Street)	L	0.68	13.5	B	L	0.67	13.2	B	NO
Southbound (West Street)	TR	0.63	16.4	B	TR	0.64	16.5	B	NO
Intersection			24.7	C			25.3	C	NO
Vesey Street/West Street (NYS Rt. 9A) (Signalized)									NO
Eastbound (Vesey Street)	L	0.67	54.4	D	L	0.67	54.4	D	NO
Eastbound (Vesey Street)	TR	0.2	34.7	C	TR	0.20	34.7	C	NO
Westbound (Vesey Street)	L	0.01	33.9	C	L	0.06	34.7	C	NO
Westbound (Vesey Street)	TR	0.04	32.8	C	TR	0.04	32.8	C	NO
Northbound (West Street)	TR	1.01	150.3	F	TR	1.01	151.3	F	YES
Southbound (West Street)	L	0.10	9.5	A	L	0.19	11.5	B	NO
Southbound (West Street)	TR	1.07	60.0	E	TR	1.08	63.0	E	NO
Intersection			103.8	F			105	F	NO
Liberty Street/West Street (NYS Rt. 9A) (Signalized)									
Eastbound (Liberty Street)	L	0.59	45.1	D	L	0.59	45.1	D	NO
Eastbound (Liberty Street)	R	0.13	35.2	D	R	0.13	35.2	D	NO
Northbound (West Street)									
Northbound (West Street)	TR	0.91	19.5	B	TR	0.91	19.8	B	NO
Southbound (West Street)	L	0.02	47.1	D	L	0.11	48.7	D	NO
Southbound (West Street)	TR	0.83	15.8	B	TR	0.83	16	B	NO
Intersection			19.4	B			19.7	B	NO
Rector Street/West Street (NYS Rt. 9A) (Unsignalized)									
Northbound (West Street)	R	-	0.0	A	R	-	0.0	A	NO
Intersection			0.0	A			0.0	A	NO
Brooklyn Battery Tunnel Exit/West Street (NYS Rt. 9A) (Signalized)									
Eastbound (Brooklyn Battery Tunnel Exit)	R	0.64	27.4	C	R	0.64	27.4	C	NO
Westbound (Brooklyn Battery Tunnel Exit)	L	0.73	62.8	E	L	0.73	62.8	E	NO
Westbound (Brooklyn Battery Tunnel Exit)	R	0.41	64.4	E	R	0.41	64.7	E	NO
Northbound (West Street)	T	0.78	35.4	D	T	0.78	35.4	D	NO
Northbound (West Street)	R	0.70	36.6	D	R	0.70	36.6	D	NO
Southbound (West Street)	TR	0.85	38.0	D	TR	0.85	38.0	D	NO
Intersection			50.7	D			50.8	D	NO
Barclay Street/West Street (NYS Rt. 9A) (Unsignalized)									
Westbound (Barclay Street)	R	0.55	24.4	C	R	0.64	28.2	D	NO
Intersection			24.4	C			28.2	D	NO
Barclay Street/Greenwich Street (Unsignalized)									
Southbound (Greenwich Street)	R	0.07	9.4	A	R	0.07	9.6	A	NO
Intersection			9.4	A			9.6	A	NO
Canal Street/Hudson Street (Signalized)									
Eastbound (Canal Street)	L	1.05	67.9	E	L	1.06	71.7	E	NO
Eastbound (Canal Street)	LT	0.61	10.7	B	LT	0.61	10.7	B	NO
Westbound (Canal Street)	T	1.00	72.1	E	T	1.00	72.1	E	NO
Westbound (Canal Street)	R	0.20	5.7	A	R	0.20	5.7	A	NO
Northbound (Hudson Street)	LTR	0.87	44.1	D	LTR	0.88	44.8	D	NO
Northbound (Hudson Street)	R	0.56	36.1	D	R	0.56	36.1	D	NO
Intersection			41.9	D			42.9	D	NO
Canal Street/Varick Street (Signalized)									
Eastbound (Canal Street)	TR	0.45	10.4	B	TR	0.45	10.4	B	NO
Westbound (Canal Street)	LT	0.93	49.8	D	LT	0.93	49.8	D	NO
Southbound (Varick Street)	L	0.21	23.2	C	L	0.21	23.2	C	NO
Southbound (Varick Street)	T	0.67	29.8	C	T	0.67	29.8	C	NO
Southbound (Varick Street)	R	0.12	22.1	C	R	0.12	22.1	C	NO
Intersection			29.8	C			29.8	C	NO

Appendix J-8 TABLE 1
LEVEL OF SERVICE FOR CRITICAL WTC INTERSECTIONS
2006 AM PEAK (8:15 - 9:15 AM)

INTERSECTION AND APPROACH	Future Without the Proposed Action (FWOPA)				Future With the Proposed Action (FWPA)				SIGNIFICANT IMPACT?
	Lane Group	V/C (1) Ratio	Delay (2)	LOS	Lane Group	V/C Ratio (1)	Delay (2)	LOS	FWOPA vs. FWPA
Barclay Street/West Broadway (Signalized)									
Westbound (Barclay Street)	T	0.30	18.6	B	T	0.36	19.4	B	NO
Southbound (West Broadway)	R	0.09	12.0	B	R	0.09	12.0	B	NO
Intersection			17.4	B			18.2	B	NO
Worth Street/Church Street (Signalized)									
Eastbound (Worth Street)	LT	0.98	65.8	E	LT	0.98	65.8	E	NO
Westbound (Worth Street)	TR	0.88	44.4	D	TR	0.88	44.4	D	NO
Northbound (Church Street)	LTR	1.12	83.7	F	LTR	1.13	85.3	F	NO
Intersection			72.7	E			73.8	E	NO
Chambers Street/Church Street (Signalized)									
Eastbound (Chambers Street)	LT	1.02	103.3	F	LT	1.02	103.3	F	NO
Westbound (Chambers Street)	TR	0.77	27.8	C	TR	0.77	27.8	C	NO
Northbound (Church Street)	LTR	1.31	169.6	F	LTR	1.31	171.4	F	YES
Intersection			125.3	F			126.4	F	YES
Barclay Street/Church Street (Signalized)									
Westbound (Barclay Street)	TR	0.13	19.4	B	T	0.13	19.1	B	NO
Westbound (Barclay Street)	R	1.86	433.1	F	R	1.26	168.4	F	NO
Northbound (Church Street)	LT	1.01	47.5	D	LT	1.05	60.0	E	YES
Intersection			139.8	F			84.0	F	NO
Vesey Street/Church Street (Signalized)									
Eastbound (Vesey Street)	LT	0.05	19.2	B	LT	0.08	19.5	B	NO
Northbound (Church Street)	LTR	0.91	21.5	C	LTR	0.93	24.0	C	NO
Northbound (Church Street)	R	0.35	9.0	A	R	0.35	9.0	A	NO
Intersection			20.2	C			22.5	C	NO
Fulton Street/Church Street (Signalized)									
Westbound (Fulton Street)	R	0.14	19.6	B	R	0.14	19.6	B	NO
Northbound (Church Street)	T	0.87	24.5	C	T	0.89	26.0	C	NO
Intersection			24.3	C			25.7	C	NO
Dey Street/Church Street (Signalized)									
Westbound (Dey Street)	R	0.00	24.2	C	R	0.00	24.2	C	NO
Northbound (Church Street)	T	0.76	13.5	B	T	0.77	14.0	B	NO
Intersection			13.5	B			14.0	B	NO
Cortland Street/Church Street (Signalized)									
Westbound (Cortland Street)	R	0.92	55.4	E	R	0.93	58.0	E	NO
Northbound (Church Street)	T	0.61	10.4	B	T	0.63	10.6	B	NO
Intersection			24.1	C			25.0	C	NO
Liberty Street/Church Street (Signalized)									
Eastbound (Liberty Street)	LT	0.07	18.7	B	LT	0.10	19.0	B	NO
Northbound (Church Street)	T	0.58	9.9	A	T	0.58	9.9	A	NO
Northbound (Church Street)	R	0.15	6.6	A	R	0.15	6.6	A	NO
Intersection			10.2	B			10.4	B	NO
Canal Street/Broadway (Signalized)									
Eastbound (Canal Street)	TR	0.46	19.3	B	TR	0.47	19.4	B	NO
Westbound (Canal Street)	DefL	0.71	30.9	C	DefL	0.72	31.7	C	NO
Westbound (Canal Street)	T	0.32	8.7	A	T	0.32	8.7	A	NO
Southbound (Broadway)	LTR	0.38	19.3	B	LTR	0.38	19.3	B	NO
Intersection			19.9	B			20.1	C	NO
Worth Street/Broadway (Signalized)									
Eastbound (Worth Street)	TR	0.96	98.4	F	TR	0.96	98.4	F	NO
Westbound (Worth Street)	LT	0.72	35.1	D	LT	0.72	35.1	D	NO
Southbound (Broadway)	LTR	1.25	290.2	F	LTR	1.26	292.8	F	YES
Intersection			191.1	F			192.9	F	YES
Chambers Street/Broadway (Signalized)									
Eastbound (Chambers Street)	TR	0.91	42.6	D	TR	0.91	42.6	D	NO
Westbound (Chambers Street)	L	0.52	25.8	C	L	0.52	25.8	C	NO
Westbound (Chambers Street)	T	0.68	23.7	C	TR	0.68	23.7	C	NO
Southbound (Broadway)	LTR	0.90	25.8	C	LTR	0.91	26.2	C	NO
Intersection			29.4	C			29.6	C	NO
Vesey Street/Ann Street/Broadway (Signalized)									
Eastbound (Vesey Street/Ann Street)	L	0.46	44.8	D	L	0.46	44.8	D	NO
Eastbound (Vesey Street/Ann Street)	TR	0.31	39.7	D	TR	0.31	39.1	D	NO
Southbound (Broadway)	L	0.93	40.2	D	L	0.93	40.2	D	NO
Southbound (Broadway)	LT	1.00	50.1	D	LT	1.01	51.0	D	NO
Intersection			46.6	D			47.2	D	NO

Source: The Louis Berger Group, Inc. (2003)

(1) Note: Volume to Capacity Ratio

(2) Note: Delay is measured in seconds per vehicle

(na) Not Applicable

Appendix J-8 TABLE 2
LEVEL OF SERVICE FOR CRITICAL WTC INTERSECTIONS
2006 MIDDAY PEAK (12:00 - 1:00 PM)

INTERSECTION AND APPROACH	Future Without the Proposed Action (FWOPA)				Future With the Proposed Action (FWPA)				SIGNIFICANT IMPACT?
	Lane Group	V/C (1) Ratio	Delay (2)	LOS	Lane Group	V/C Ratio (1)	Delay (2)	LOS	FWOPA vs. FWPA
Canal Street/West Street (NYS Rt. 9A) (Signalized)									
Westbound (Canal Street)	L	0.34	43.8	D	L	0.37	44.3	D	NO
Westbound (Canal Street)	R	0.62	55.1	E	R	0.62	55.1	E	NO
Northbound (West Street)	T	0.45	1.7	A	T	0.46	1.7	A	NO
Southbound (West Street)	T	0.39	1.4	A	T	0.39	1.4	A	NO
Intersection			8.2	A			8.2	A	NO
Canal Street/West Street (NYS Rt. 9A) (Signalized)									
Northbound (West Street)	TR	0.60	11.9	B	TR	0.61	12.0	B	NO
Northbound (West Street)	R	0.42	11.4	B	R	0.43	11.6	B	NO
Southbound (West Street)	L	1.01	72.5	E	L	1.01	72.5	E	NO
Southbound (West Street)	T	0.96	17.3	B	T	0.98	21.1	C	NO
Intersection			22.5	C			23.9	C	NO
Chambers Street/West Street (NYS Rt. 9A) (Signalized)									
Eastbound (Chambers Street)	LTR	0.34	39.2	D	LTR	0.34	39.2	D	NO
Westbound (Chambers Street)	LT	0.48	41.8	D	LT	0.48	41.8	D	NO
Westbound (Chambers Street)	R	0.47	27.1	C	R	0.47	27.1	C	NO
Northbound (West Street)	TR	0.66	16.9	B	TR	0.67	17.1	B	NO
Southbound (West Street)	L	0.67	11.9	B	L	0.67	12.3	B	NO
Southbound (West Street)	TR	0.54	15.1	B	TR	0.55	15.3	B	NO
Intersection			17.9	B			18.1	B	NO
Vesey Street/West Street (NYS Rt. 9A) (Signalized)									
Eastbound (Vesey Street)	L	0.55	47.1	D	L	0.55	47.1	D	NO
Eastbound (Vesey Street)	TR	0.21	34.8	C	TR	0.21	34.8	C	NO
Westbound (Vesey Street)	L	0.02	34.1	C	L	0.07	34.9	C	NO
Westbound (Vesey Street)	TR	0.04	32.8	C	TR	0.04	32.8	C	NO
Northbound (West Street)	TR	1.00	64.6	E	TR	1.00	66.8	E	NO
Southbound (West Street)	L	0.11	7.2	A	L	0.20	9.5	A	NO
Southbound (West Street)	TR	1.05	59.6	E	TR	1.06	62.7	E	NO
Intersection			60.4	E			62.5	E	NO
Liberty Street/West Street (NYS Rt. 9A) (Signalized)									
Eastbound (Liberty Street)	L	0.43	40.4	D	L	0.43	40.4	D	NO
Eastbound (Liberty Street)	R	0.09	34.5	C	R	0.09	34.5	C	NO
Northbound (West Street)									
Northbound (West Street)	TR	0.67	11.9	B	TR	0.67	12.0	B	NO
Southbound (West Street)	L	0.02	47.1	D	L	0.11	48.7	D	NO
Southbound (West Street)	TR	0.72	12.9	B	TR	0.72	13.0	B	NO
Intersection			14.0	B			14.2	B	NO
Rector Street/West Street (NYS Rt. 9A) (Unsignalized)									
Northbound (West Street)	R	-	0.0	A	R	-	0.0	A	NO
Intersection			0.0	A			0.0	A	NO
Brooklyn Battery Tunnel Exit/West Street (NYS Rt. 9A) (Signalized)									
Eastbound (Brooklyn Battery Tunnel Exit)	R	0.20	22.0	C	R	0.20	22.0	C	NO
Westbound (Brooklyn Battery Tunnel Exit)	L	0.44	65.1	E	L	0.44	65.1	E	NO
Westbound (Brooklyn Battery Tunnel Exit)	R	0.29	42.4	D	R	0.30	42.6	D	NO
Northbound (West Street)	T	0.52	30.0	C	T	0.52	30.0	C	NO
Northbound (West Street)	R	0.75	71.7	E	R	0.75	71.7	E	NO
Southbound (West Street)	TR	0.57	31.1	C	TR	0.57	31.1	C	NO
Intersection			46.0	D			46.0	D	NO
Barclay Street/West Street (NYS Rt. 9A) (Unsignalized)									
Westbound (Barclay Street)	R	0.19	12.8	B	R	0.25	13.4	B	NO
Intersection			12.8	B			13.4	B	NO
Barclay Street/Greenwich Street (Unsignalized)									
Southbound (Greenwich)	R	0.02	8.8	A	R	0.02	9.0	A	NO
Intersection			8.8	A			9.0	A	NO
Canal Street/Hudson Street (Signalized)									
Eastbound (Canal Street)	L	0.95	42.3	D	L	0.96	44.7	D	NO
Eastbound (Canal Street)	LT	0.90	34.2	C	LT	0.90	34.2	C	NO
Westbound (Canal Street)	T	0.90	47.7	D	T	0.90	47.7	D	NO
Westbound (Canal Street)	R	1.00	64.5	E	R	1.00	64.5	E	NO
Northbound (Hudson Street)	LTR	0.66	34.4	C	LTR	0.67	34.6	C	NO
Northbound (Hudson Street)	R	0.55	35.7	D	R	0.55	35.7	D	NO
Intersection			42.7	D			43.3	D	NO
Canal Street/Varick Street (Signalized)									
Eastbound (Canal Street)	TR	0.31	8.9	A	TR	0.31	8.9	A	NO
Westbound (Canal Street)	LT	1.04	59.2	E	LT	1.04	59.2	E	NO
Southbound (Varick Street)	L	0.34	25.4	C	L	0.34	25.4	C	NO
Southbound (Varick Street)	T	0.57	27.7	C	T	0.57	27.7	C	NO
Southbound (Varick Street)	R	0.38	26.4	C	R	0.38	26.4	C	NO
Intersection			34.9	C			34.9	C	NO
Barclay Street/West Broadway (Signalized)									
Westbound (Barclay Street)	T	0.16	17.0	B	T	0.22	17.7	B	NO
Southbound (West Broadway)	R	0.01	11.3	B	R	0.01	11.3	B	NO

Appendix J-8 TABLE 2
LEVEL OF SERVICE FOR CRITICAL WTC INTERSECTIONS
2006 MIDDAY PEAK (12:00 - 1:00 PM)

INTERSECTION AND APPROACH	Future Without the Proposed Action (FWOPA)				Future With the Proposed Action (FWPA)				SIGNIFICANT IMPACT?
	Lane Group	V/C (1) Ratio	Delay (2)	LOS	Lane Group	V/C Ratio (1)	Delay (2)	LOS	FWOPA vs. FWPA
Intersection			16.8	B			17.5	B	NO

Appendix J-8 TABLE 3
LEVEL OF SERVICE FOR CRITICAL WTC INTERSECTIONS
2006 PM PEAK (5:00 - 6:00 PM)

INTERSECTION AND APPROACH	Future Without the Proposed Action (FWOPA)				Future With the Proposed Action (FWPA)				SIGNIFICANT IMPACT?
	Lane Group	V/C (1) Ratio	Delay (2)	LOS	Lane Group	V/C Ratio (1)	Delay (2)	LOS	FWOPA vs. FWPA
Canal Street/West Street (NYS Rt. 9A) (Signalized)									
Westbound (Canal Street)	L	0.2	39.3	D	L	0.22	39.6	D	NO
Westbound (Canal Street)	R	0.41	44.9	D	R	0.41	44.9	D	NO
Northbound (West Street)	T	0.63	2.4	A	T	0.64	2.5	A	NO
Southbound (West Street)	T	0.67	2.5	A	T	0.67	2.5	A	NO
Intersection			4.3	A			4.3	A	NO
Canal Street/West Street (NYS Rt. 9A) (Signalized)									
Northbound (West Street)	TR	0.81	15.9	B	TR	0.82	16.1	B	NO
Northbound (West Street)	R	0.23	9.2	A	R	0.24	9.2	A	NO
Southbound (West Street)	L	1.01	73.8	E	L	1.01	73.8	E	NO
Southbound (West Street)	T	1.00	31.7	C	T	1.01	34.7	C	NO
Intersection			29.0	C			30.5	C	NO
Chambers Street/West Street (NYS Rt. 9A) (Signalized)									
Eastbound (Chambers Street)	LTR	0.30	38.1	D	LTR	0.30	38.1	D	NO
Westbound (Chambers Street)	LT	0.72	54.3	D	LT	0.72	54.3	D	NO
Westbound (Chambers Street)	R	0.67	33.1	C	R	0.67	33.1	C	NO
Northbound (West Street)	TR	0.76	19.2	B	TR	0.78	19.4	B	NO
Southbound (West Street)	L	0.84	20.6	C	L	0.84	20.6	C	NO
Southbound (West Street)	TR	0.83	21.2	C	TR	0.85	21.6	C	NO
Intersection			22.6	C			22.9	C	NO
Vesey Street/West Street (NYS Rt. 9A) (Signalized)									
Eastbound (Vesey Street)	L	0.76	61.6	E	L	0.76	61.6	E	NO
Eastbound (Vesey Street)	TR	0.19	34.5	C	TR	0.19	34.5	C	NO
Westbound (Vesey Street)	L	0.01	33.9	C	L	0.06	34.7	C	NO
Westbound (Vesey Street)	TR	0.01	32.4	C	TR	0.01	32.4	C	NO
Northbound (West Street)	TR	1.05	65.6	E	TR	1.06	67.2	E	NO
Southbound (West Street)	L	0.04	8.0	A	L	0.13	9.9	A	NO
Southbound (West Street)	TR	1.05	67.9	E	TR	1.06	70.1	E	NO
Intersection			65.6	E			67.2	E	NO
Liberty Street/West Street (NYS Rt. 9A) (Signalized)									
Eastbound (Liberty Street)	L	0.41	39.9	D	L	0.41	39.9	D	NO
Eastbound (Liberty Street)	R	0.23	37.2	D	R	0.23	37.2	D	NO
Northbound (West Street)									
Northbound (West Street)	TR	0.72	12.8	B	TR	0.73	12.9	B	NO
Southbound (West Street)	L	0.02	47.1	D	L	0.10	48.4	D	NO
Southbound (West Street)	TR	1.09	83.1	F	TR	1.09	85.2	F	NO
Intersection			52.9	D			54.1	D	NO
Rector Street/West Street (NYS Rt. 9A) (Unsignalized)									
Northbound (West Street)	R	-	0.0	A	R	-	0.0	A	NO
Intersection			0.0	A			0.0	A	NO
Brooklyn Battery Tunnel Exit/West Street (NYS Rt. 9A) (Signalized)									
Eastbound (Brooklyn Battery Tunnel Exit)	R	0.53	24.7	C	R	0.53	24.7	C	NO
Westbound (Brooklyn Battery Tunnel Exit)	L	0.48	63.7	E	L	0.48	63.7	E	NO
Westbound (Brooklyn Battery Tunnel Exit)	R	0.42	50.3	D	R	0.42	50.6	D	NO
Northbound (West Street)	T	0.72	33.1	C	T	0.72	33.1	C	NO
Northbound (West Street)	R	1.10	100.9	F	R	1.10	100.9	F	NO
Southbound (West Street)	TR	1.00	59.5	E	TR	1.00	59.5	E	NO
Intersection			63.7	E			63.7	E	NO
Barclay Street/West Street (NYS Rt. 9A) (Unsignalized)									
Westbound (Barclay Street)	R	0.27	14.5	B	R	0.34	15.4	C	NO
Intersection			14.5	B			15.4	C	NO
Barclay Street/Greenwich Street (Unsignalized)									
Southbound (Greenwich Street)	R	0.01	9.0	A	R	0.01	9.2	A	NO
Intersection			9.0	A			9.2	A	NO
Canal Street/Hudson Street (Signalized)									
Eastbound (Canal Street)	L	0.67	33.7	C	L	0.68	34.2	C	NO
Eastbound (Canal Street)	T	0.62	12.9	B	T	0.62	12.9	B	NO
Westbound (Canal Street)	T	0.76	43.2	D	T	0.76	43.2	D	NO
Westbound (Canal Street)	R	0.94	35.8	D	R	0.94	35.8	D	NO
Northbound (Hudson Street)	LTR	0.82	39.6	D	LTR	0.82	40.0	D	NO
Northbound (Hudson Street)	R	0.70	40.9	D	R	0.70	40.9	D	NO
Intersection			34.7	C			34.9	C	NO
Canal Street/Varick Street (Signalized)									
Eastbound (Canal Street)	TR	0.29	8.8	A	TR	0.29	8.8	A	NO
Westbound (Canal Street)	LT	1.06	121.2	F	LT	1.06	121.2	F	NO
Southbound (Varick Street)	L	0.75	45.9	D	L	0.75	45.9	D	NO
Southbound (Varick Street)	T	0.49	26.3	C	T	0.49	26.3	C	NO
Southbound (Varick Street)	R	0.11	22.0	C	R	0.11	22.0	C	NO
Intersection			66.5	E			66.5	E	NO
Barclay Street/West Broadway (Signalized)									
Westbound (Barclay Street)	T	0.22	17.7	B	T	0.28	18.4	B	NO
Southbound (West Broadway)	R	0.04	11.6	B	R	0.04	11.6	B	NO

Appendix J-8 TABLE 3
LEVEL OF SERVICE FOR CRITICAL WTC INTERSECTIONS
2006 PM PEAK (5:00 - 6:00 PM)

INTERSECTION AND APPROACH	Future Without the Proposed Action (FWOPA)				Future With the Proposed Action (FWPA)				SIGNIFICANT IMPACT?
	Lane Group	V/C (1) Ratio	Delay (2)	LOS	Lane Group	V/C Ratio (1)	Delay (2)	LOS	FWOPA vs. FWPA
Intersection			16.8	B			17.7	B	NO

Appendix J-8 TABLE 3
LEVEL OF SERVICE FOR CRITICAL WTC INTERSECTIONS
2006 PM PEAK (5:00 - 6:00 PM)

INTERSECTION AND APPROACH	Future Without the Proposed Action (FWOPA)				Future With the Proposed Action (FWPA)				SIGNIFICANT IMPACT?
	Lane Group	V/C (1) Ratio	Delay (2)	LOS	Lane Group	V/C Ratio (1)	Delay (2)	LOS	FWOPA vs. FWPA
Worth Street/Church Street (Signalized)									
Eastbound (Worth Street)	LT	0.61	31.7	C	LT	0.61	31.7	C	NO
Westbound (Worth Street)	TR	0.81	38.8	D	TR	0.81	38.8	D	NO
Northbound (Church Street)	LTR	1.04	82.4	F	LTR	1.05	83.6	F	NO
Intersection			67.7	E			68.5	E	NO
Chambers Street/Church Street (Signalized)									
Eastbound (Chambers Street)	LT	1.03	70.9	E	LT	1.03	70.9	E	NO
Westbound (Chambers Street)	TR	0.63	22.1	C	TR	0.63	22.1	C	NO
Northbound (Church Street)	LTR	1.29	162.7	F	LTR	1.30	164.1	F	YES
Intersection			115.1	F			116.0	F	NO
Barclay Street/Church Street (Signalized)									
Westbound (Barclay Street)	TR	0.17	21.3	C	TR	0.17	21.3	C	NO
Westbound (Barclay Street)	R	1.31	196.4	F	R	1.31	196.4	F	NO
Northbound (Church Street)	LT	0.76	19.5	B	LT	0.8	21.3	C	NO
Intersection			60.1	E			60.2	E	NO
Vesey Street/Church Street (Signalized)									
Eastbound (Vesey Street)	LT	0.03	19.0	B	LT	0.07	19.3	B	NO
Northbound (Church Street)	LTR	0.63	10.0	A	LTR	0.65	10.3	B	NO
Northbound (Church Street)	R	0.23	6.8	A	R	0.23	6.8	A	NO
Intersection			9.8	A			10.3	B	NO
Fulton Street/Church Street (Signalized)									
Westbound (Fulton Street)	R	0.24	20.9	C	R	0.24	20.9	C	NO
Northbound (Church Street)	T	0.61	14.8	B	T	0.63	15.2	B	NO
Intersection			15.5	B			15.8	B	NO
Dey Street/Church Street (Signalized)									
Westbound (Dey Street)	R	0.00	24.2	C	R	0.00	24.2	C	NO
Northbound (Church Street)	T	0.57	9.4	A	T	0.58	9.6	A	NO
Intersection			9.4	A			9.6	A	NO
Cortland Street/Church Street (Signalized)									
Westbound (Cortland Street)	R	0.96	64.0	E	R	0.98	66.8	E	NO
Northbound (Church Street)	T	0.35	7.5	A	T	0.36	7.6	A	NO
Intersection			31.6	C			32.5	C	NO
Liberty Street/Church Street (Signalized)									
Eastbound (Liberty Street)	LT	0.00	18.1	B	LT	0.03	18.3	B	NO
Northbound (Church Street)	T	0.34	7.4	A	T	0.34	7.4	A	NO
Northbound (Church Street)	R	0.11	6.2	A	R	0.11	6.2	A	NO
Intersection			7.4	A			7.7	A	NO
Canal Street/Broadway (Signalized)									
Eastbound (Canal Street)	TR	0.94	41.4	D	TR	0.94	41.9	D	NO
Westbound (Canal Street)	DefL	1.09	96.1	F	DefL	1.10	100.4	F	YES
Westbound (Canal Street)	T	0.69	16.7	B	T	0.70	16.8	B	NO
Southbound (Broadway Street)	LTR	0.61	22.7	C	LTR	0.61	22.7	C	NO
Intersection			38.9	D			39.8	D	NO
Worth Street/Broadway (Signalized)									
Eastbound (Worth Street)	TR	0.65	25.7	C	TR	0.65	25.7	C	NO
Westbound (Worth Street)	LT	0.71	26.9	C	LT	0.71	26.9	C	NO
Southbound (Broadway Street)	LTR	1.26	295.3	F	LTR	1.27	297.9	F	YES
Intersection			196.3	F			198.2	F	YES
Chambers and Broadway (Signalized)									
Eastbound (Chambers Street)	TR	0.84	32.8	C	TR	0.84	32.8	C	NO
Westbound (Chambers Street)	L	0.37	20.5	C	L	0.37	20.5	C	NO
Westbound (Chambers Street)	T	0.61	21.5	C	T	0.61	21.5	C	NO
Southbound (Broadway Street)	LTR	0.91	26.0	C	LTR	0.91	26.3	C	NO
Intersection			26.6	C			26.7	C	NO
Vesey Street/Ann Street/Broadway (Signalized)									
Eastbound (Vesey Street/Ann Street)	L	0.33	40.0	D	L	0.33	40.0	D	NO
Eastbound (Vesey Street/Ann Street)	TR	0.36	40.6	D	TR	0.36	40.6	D	NO
Southbound (Broadway Street)	L	1.04	69.1	E	L	1.04	69.1	E	NO
Southbound (Broadway Street)	LT	0.64	17.4	B	LT	0.65	17.5	B	NO
Intersection			40.9	D			40.9	D	NO

Source: The Louis Berger Group, Inc. (2003)
(1) Note: Volume to Capacity Ratio
(2) Note: Delay is measured in seconds per vehicle
(na) Not Applicable

Appendix J-9 AIR QUALITY

MOBILE SOURCE ANALYSIS

Mobile source analyses were run for the three scenarios defined in the chapter. The increments were added, where applicable, to increments from the stationary construction modeling results. The totals included background from monitoring stations as well as local background traffic increments that would not be included in background monitors (e.g. Route 9a).

Road dust was included for all PM_{10} runs, based on the procedure delineated in AP–42 (EPA December, 2003). Silt loading was based on the average daily traffic volumes for Route 9A and Church Street; a silt loading factor of 0.16 g/m^2 was used for the construction site entrance. This is the highest loading factor used in New York City, and assumes that access roads would be cleaned regularly.

All other assumptions and procedures for mobile source modeling were identical to those used in analyses in the Air Quality chapter.

As in the analyses in the Air Quality chapter, Neighborhood scale $PM_{2.5}$ concentrations are conservatively high due to the fact that the minimum distance between the roadway and receptors of 15 meter was used for that analyses, rather than a distance of approximately 30 meters based on one meter per 1,000 vehicles ADT.

STATIONARY SOURCE ANALYSIS

All emission factors for on-site engine emissions were calculated for the normal application of diesel using the draft EPA NONROAD2002a model—the most current data available, based on the engine size and including the loading factor for operation of that type of engine, as presented in Table 1 below. These factors were then scaled down to represent emissions from engines using ULSD and emissions reduction technologies, as follows: 14 percent reduction for ULSD alone; 40 percent for ULSD and diesel oxidation catalysts (DOC); 80 percent for ULSD and diesel particle filters (DPF—the latter was applied only for average emissions estimates for mitigation.) These reductions are based on actual measurements studied by NESCAUM as detailed in Chapter 21.

All emissions were assumed to occur 10 hours per day, from 7 am to noon, and from 1 pm to 6 pm, with a usage percent applied depending on the actual daily hours for the equipment (for example, if a certain engine in needed on the peak day only for 4 hours, the emission factor is scaled by 4/10=0.4).

Emission factors for sources modeled as discrete point sources, such as generators and tower cranes, were calculated based on the above factors, the size of the engine and the daily use percentage as presented above in the construction description, and therefore varied depending on location and construction phase.

Table 1
Emission Factors for Construction Equipment

Equipment Type	Power Output	NONROAD Emission Factor		Adjusted NONROAD Emission Factor *	
	(hp)	(g/hp-hr)		(g/hp-hr)	
		PM_{10}	$PM_{2.5}$ *	PM_{10}	$PM_{2.5}$ *
Air Compressor	310, 360, 460	0.172	0.159	0.103	0.095
Air Compressor	80	0.267	0.246	0.160	0.148
Concrete Pump	300	0.265	0.244	0.159	0.146
Crawler Crane	350	0.144	0.132	0.086	0.079
Diesel Generator	100	0.389	0.358	0.233	0.215
Dozer	100	0.371	0.341	0.222	0.205
Dozer	150	0.214	0.197	0.128	0.118
Hi-Lift (Forklift)	120	0.242	0.222	0.145	0.133
Hydraulic All Terrain Crane	165	0.137	0.126	0.082	0.076
Hydraulic Drill Rig	150	0.232	0.213	0.139	0.128
Hydraulic Excavator	320	0.167	0.154	0.100	0.092
Roadheader for tunneling	120	0.208	0.191	0.125	0.115
Rubber tire loader	196	0.199	0.183	0.119	0.110
Slurry mixing or desanding plant	50	0.383	0.352	0.329	0.303
Tower Crane	250	0.119	0.109	0.071	0.066
Track Loader	160	0.176	0.162	0.106	0.097
Welding Machine	35	0.315	0.290	0.271	0.250

Notes: * 40% reduction for ULSD on all engines and an additional 14% reduction for DOCs on engines > 60 hp.

Sources: NONROAD2003a model, New York

Area sources were defined for phase and zone, which included all sources that do not have a fixed location. Total emission factors for these sources are presented in Table 2 below. Area sources were all given an initial vertical dispersion of five meters, aside from the Freedom Tower, where sources would be vertically distributed on a number of floors, which was conservatively assumed all to occur within a few ground floors and modeled with an initial dispersion of 18 meters.

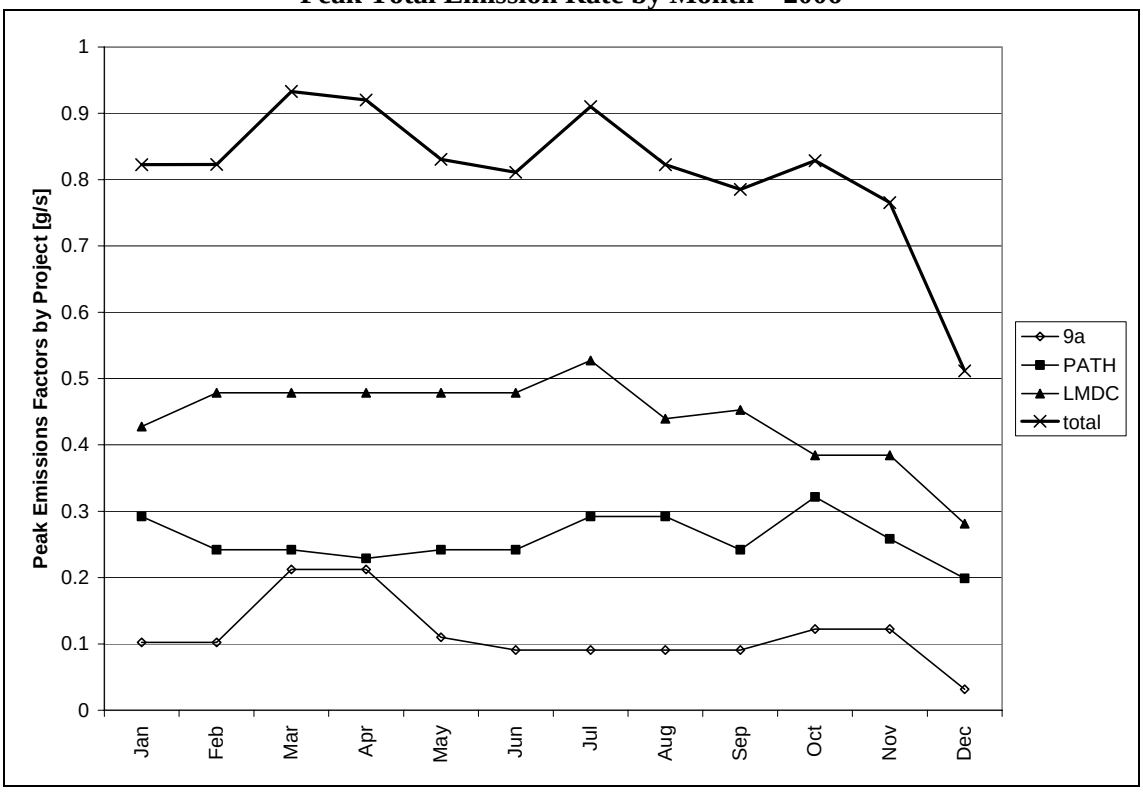
Cumulative emissions would clearly be the highest in 2006, as can be seen by the activities planned (see Chapter 21, "Construction".) The peak 24-hour model was based on the 2006 July emissions. The cumulative 2006 July emissions would include the peak emissions from the Proposed Action, and would be insignificantly lower than the cumulative peak calculated for the month of March 2006, as presented in Figure 1 below; these emissions were therefore used to represent both peaks.

Table 2
Area Source Emission Factors

Zone	Area [m^2]	Emission Factor [g/s-m^2]			
		$PM_{2.5}$		PM_{10}	
		Peak Day Average	Annual Average	Peak Day Average	Annual Average
LMDC					
Tunneling Under 1/9 Line	4,600	6.76E-06	2.02E-06	7.37E-06	2.21E-06
Northwest Quadrant blow grade Retail	11,705	3.65E-06	2.50E-06	4.06E-06	2.74E-06
Memorial, Open Space, Cultural Space (Zones 1 & 2)	30,500	—	1.23E-07	—	1.36E-07
Southeast Quadrant blow grade - Towers 3 & 4 (Zone 4)	12,090	3.82E-06	3.43E-06	4.63E-06	3.78E-06
Northeast Quadrant blow grade - Tower 2 (Zone 5)	8,665	5.32E-06	4.78E-06	6.12E-06	5.22E-06
East Bathtub Above Grade Fit-out	28,935	—	1.26E-07	—	1.48E-07
Freedom Tower Structural Framing, Curtain Wall & Fit-out	5,150	2.38E-05	1.56E-05	2.65E-05	1.7E-05
Southern Expansion - Excavation & Construction	12,075	7.96E-06	7.58E-06	9.14E-06	8.41E-06
PATH					
Platform/Mezzanine Conversion - Demolition & Construction	8,390	1.11E-05	5.72E-06	1.35E-05	6.41E-06
1/9 Tunnel Underpinning, Excavation, Lining Operation	2,670	2.04E-05	5.55E-06	2.23E-05	6.06E-06
West St Tunnel Underpinning, Excavation, Lining Operation	965	5.65E-05	1.86E-05	6.18E-05	2.03E-05
Church St Tunnel Underpinning, Excavation, Lining Operation	400	1.36E-04	4.50E-05	1.49E-04	4.90E-05
Demolition Temporary PATH Concourse	8,210	—	1.92E-06	—	2.32E-06
Route 9A					
Stage II Slurry Wall, Excavation, Concrete Box, Road Deck	9,245	4.92E-06	6.26E-06	8.55E-06	8.38E-06

Notes: All factors were applied to 10 hours per day only

Figure 1
Peak Total Emission Rate by Month—2006



IMPACT ASSESSMENT

The impacts presented in Chapter 21, "Construction", include three types of results:

1. *Highest*—these results were usually from locations immediately adjacent to the construction site boundary of the Proposed Action, in the case of Proposed Action results, or of one of the other major reconstruction projects, in the case of cumulative results. Those results were mostly in accessible public spaces, such as sidewalks; some of those results were predicted at residential locations immediately adjacent to the site.

2. *Residential only*—these results were extracted from receptors representing residential or hotel locations where exposure time would be expected to be the longest. The firehouse was included as well since firemen often spend extended living hours in the firehouse.

3. *Other Locations on Access Routes*—these results represent the mobile source impacts only, representing other sites along the access routes that would not be exposed to emissions from the construction site itself, but rather only to increased construction vehicle traffic. Since all construction vehicles converge on the site, this is a conservative estimate for other locations that may experience only part of the traffic increment.

For total concentrations, in addition to measured backgrounds, local mobile source background was added from the CAL3QHC model results. All mobile source maximums were extracted for each intersection and added to the ISCST3 construction model results in that area.