Los Angeles County
Metropolitan Transportation Authority

Draft Environmental Impact Report
Appendix 2-B: Construction Methods Memo

Metro

C Line (Green) Extension to Torrance

Draft Environmental Impact Report

Appendix 2-B

Construction Methods Memorandum

January 2023

Metro

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CONSTRUCTION EQUIPMENT, QUANTITIES AND DURATIONS

Construction of the Proposed Project would employ conventional construction techniques and equipment typically used (and permitted) in Southern California for highway, bridge, utility, transit, and railroad projects. The following section summarizes the construction assumptions and requirements for the Proposed Project and Options.

CONSTRUCTION ACTIVITIES

The following construction activities would occur for the Proposed Project and all Options.

- **Clearing and Demolition of Existing Structures** – The ground would be cleared of vegetation in an early stage of the construction work. In some locations, the demolition of existing structures (or parts thereof) would be required to shift the freight track and/or to install the light rail tracks, stations, and facilities. The debris generated from demolition would be recycled in part and disposed of in part.
- **Utility Relocations** – Construction would require some existing utilities to be protected in place or relocated. Utility relocation work would generally occur within the affected ROW and on adjacent and nearby streets. Affected utilities would include storm drains, sanitary sewers, power lines, gas pipelines, electrical duct banks, oil pipelines, electrical transmission lines, lighting, irrigation pipelines, water lines, fiber optic lines, telephone, and cable lines. Aboveground and underground utilities would be relocated or protected in place, if possible, to prevent damage or interruption of use of these facilities. Aboveground utilities, such as poles, would be relocated, or removed with the utility line relocated underground. Underground utilities would require soil excavation to varying depths, and disturbed ground would be backfilled with the same material or clean material.
- **Embankment Work** – The embankment that would support the new or relocated tracks and stations would require the removal of vegetation and debris, shaping and compacting the soil, importing, or exporting soil as needed to achieve the required embankment and compacting the soil and importing crushed rock base material to support the track and structure foundations.
- **At-Grade Street Crossings (Freight)**–The existing freight track at the at-grade crossings would be relocated to accommodate the new light rail tracks. The subgrade would first be constructed and then the new track would be installed. Temporary street and lane closures would be coordinated to ensure no two adjacent streets would be closed concurrently.
- **Bridges and Elevated Structures** –Bridges and elevated structures would be constructed by first installing piles and then the columns and piers that support the superstructure. The horizontal support of the elevated guideway would then be constructed, using cast-in-place concrete temporarily supported by falsework. Where new light rail bridges are adjacent to existing freight track bridges, a portion of the abutment/retaining walls would be demolished before construction of the new structure.
- **Retaining Walls** – Retained fill would be constructed by grading and building a “leveling pad” foundation at the base of the walls followed by placement of prefabricated concrete facing panels and steel geo-reinforcing straps as the wall is back-filled with layers of compacted crushed rock fill material. When the walls have been built to the finished elevations, concrete caps would be placed over the top of the facing panels and safety handrails installed.

- **Stations** – The construction approach varies according to the proposed station location and layout. The Redondo Beach TC Station would be constructed following a similar sequence as described for trenches and retaining walls, with the walls constructed first, followed by the foundation and track bed and then construction of platforms. Platforms would involve cast-in-place concrete or pre-cast panels. The Hawthorne Option elevated South Bay Galleria station would be constructed following a similar sequence as described above for elevated structures, with the foundations and columns constructed first, followed by the station platform which is typically constructed of cast-in-place concrete with falsework. The at-grade Torrance TC Station would involve cast-in-place concrete or pre-cast panels to construct the station platform with ramps and stairs. For all station types, the station operational equipment and furnishings (e.g., vertical circulation elements, lighting, seating, signage, artwork and fare vending equipment) would be added after the station platform is constructed.
- **Railroad/Light Rail Track** – Construction activities for at-grade light rail track would include preparation of the track bed and installation of the supporting base, followed by installation of the rails and ties. Rails would be flash-butt welded either on site or in a nearby staging yard. On-track regulators and tampers would be utilized to set and align the tracks, with grinders used to adjust the rail heads to match train wheel profiles. For elevated guideways, the light rail track would be installed via direct fixation (i.e., rail fastened directly to a bridge superstructure). Construction activities for the relocated BNSF tracks would be coordinated with BNSF.
- **Systems Construction** – This would include the installation of wayside signals, crossing warning signals, conduits, control houses, the OCS, and TPSSs. The OCS construction would start with the foundations for the OCS poles, followed by duct banks and conduit for the electrical feeder lines from the TPSS, and then the OCS poles. TPSS construction would involve first grading the site, and then installing the TPSS structure and connecting it to the utilities. Signal houses are typically prefabricated metal-clad buildings, which are placed upon a concrete foundation.

The Trench Option would also require trench construction. Trenches could be constructed with different methods depending on the trench depth. Shallow guideway trenches (in the southern segment near 170th and 182nd Streets) would likely be constructed by driving steel sheet piles and then excavating between them to construct a U-shaped reinforced concrete trench structure. Where necessary, ground replacement or improvement would be undertaken to strengthen the base of the trench, and any gaps between sheet pile and trench walls would be backfilled with self-compacting material. Deeper sections of trench (in the northern segment) would likely utilize drilled hole piles backfilled with concrete to form the trench walls, with alternating large and small secant piles. Existing soil would then be excavated to form the trench void and construction of the concrete base of the trench structure would follow. The deepest sections of trench would have supporting concrete strut beams installed near the tops of the walls. The top of the pile walls would be capped by a cast-in-place longitudinal reinforced concrete beam.

DURATION OF ACTIVITIES AND QUANTITIES OF MATERIAL USED OR MOVED

Construction is anticipated to last approximately five to seven years, depending on the alignment. Construction would typically occur during daytime hours on weekdays, although some night construction may be required at times to avoid congested freeways and surface streets or due to the nature of certain construction processes, such as construction of freight track to avoid disruption to BNSF operations or construction of bridges over major arterials. Table 1 summarizes the phases and duration of construction of the Proposed Project.

Table 1. Proposed Project Construction Phases and Durations

Phase Name	Total Duration	Activity Frequency (Days per Week)	Estimated Daily Crew Size	Total Import or Export (Cubic Yards)	Approximate Maximum Daily Truck Loads
Early Utility Relocation	18 months	5	40	12,400 CY	2
Project Start Up	6 months	5	40	121,000 CY	101
Utility Relocation	15 months	5	40	3,100 CY	2
Retaining Walls, Grading and Embankment for Freight Track Relocation	12 months	5	40	112,100 CY	60
Freight Track Bridges	10 months	5	25	1,000 CY	1
Freight Railroad At-Grade Crossings	4 months	5	25	4,200 CY	2
Freight Trackwork (By BNSF)	4 months	5	40	72,400 CY	21
Stations and Access	18 months	5	40	11,000 CY	1
Retaining Walls, Grading and Embankment for LRT Guideway	8 months	5	40	72,400 CY	7
LRT Guideway Bridges	25 months		25	66,500 CY	6
LRT Trackwork	15 months	5	40	80,000 CY	21
Systems Construction	12 months	5	20	-	-
Contingency	11 months			-	-
Testing/Commissioning	9 months	5	15		
Revenue Service	0 months				

CY = Cubic Yards, LRT = light rail

Table 2 summarizes the phases and duration of construction of the Trench Option. Construction of the Trench Option would be longer in duration than the Proposed Project due to the additional excavation and structural work that would be required.

Table 2. Trench Option Construction Phases and Durations

Phase Name	Total Duration	Activity Frequency (Days per Week)	Estimated Daily Crew Size	Total Import or Export (Cubic Yards)	Approximate Maximum Daily Truck Loads
Early Utility Relocation	18 months	5	40	13,600 CY	2
Project Start Up	6 months	5	40	49,800 CY	35
Utility Relocation	15 months	5	40	3,400 CY	2
Retaining Walls, Grading and Embankment for Freight Track Relocation	18 months	5	40	105,500 CY	54
Freight Track Bridges	8 months	5	40	14,000 CY	2
Freight Railroad At-Grade Crossings	4 months	5	40	4,200 CY	4
Freight Trackwork (By BNSF)	25 months	5	40	71,100 CY	21
Stations and Access	20 months	5	40	15,100 CY	1
Retaining Walls, Grading and Embankment for LRT Guideway	8 months	5	40	155,800 CY	110
LRT Guideway Bridges	32 months	5	30	22,900 CY	4
LRT Guideway Trench	36 months	5	60	277,700 CY	200
LRT Trackwork	15 months	5	20	80,000 CY	21
Systems Construction	12 months	5	20		
Contingency	15 months				
Testing/Commissioning	9 months	5	15	-	-
Revenue Service	0 months				

CY = Cubic Yards, LRT = light rail

Table 3 summarizes the phases and duration of construction of the Hawthorne Option. Construction of the Hawthorne Option would be longer in duration than the Proposed Project due to the additional structural work that would be required.

Table 3. Hawthorne Option Construction Phases and Durations

Phase Name	Total Duration	Activity Frequency (Days per Week)	Estimated Daily Crew Size	Total Import or Export (Cubic Yards)	Approximate Maximum Daily Truck Loads
Early Utility Relocation	18 months	5	40	8,000 CY	1
Project Start Up	6 months	5	40	87,100 CY	73
Utility Relocation	15 months	5	40	2,000 CY	1
Retaining Walls, Grading and Embankment for Freight Track Relocation	6 months	5	40	68,400 CY	35
Freight Trackwork (By BNSF)	8 months	5	25	29,700 CY	21
Stations and Access	22 months	5	40	7,800 CY	1
Retaining Walls, Grading and Embankment for LRT Guideway	8 months	5	40	2,000 CY	1
LRT Guideway Bridges	35 months	5	60	278,700 CY	27
LRT Trackwork	14 months	5	20	81,000 CY	21
Systems Construction	12 months	5	20	-	-
Contingency	11 months			-	-
Testing/Commissioning	9 months	5	15	-	-
Revenue Service	0 months			-	-

CY = Cubic Yards, LRT = light rail

TYPES OF EQUIPMENT USED

The construction equipment that would be used for the Proposed Project and Options is typical of that found engaged in contemporary highway, building, bridge and utility work plus some specialized railroad track and OCS construction equipment. Table 4 through Table 6 show the equipment that was considered when modeling potential air quality, greenhouse gas emissions, and energy impacts.

Table 4. Proposed Project Construction Equipment

Equipment Type ("X" if included in Phase)	Phase 1 : Early Utility Relocation	Phase 2: Project Start Up	Phase 3: Utility Relocation	Phase 4: Retaining Walls, Grading and Embankment for Freight Track Relocation	Phase 5: Freight Track Bridges	Phase 6: Freight Railroad At-grade Crossings	Phase 7: Freight Trackwork (By BNSF)	Phase 8: Stations and Access	Phase 9: Retaining Walls, Grading and Embankment for LRT Guideway	Phase 10: LRT Guideway Bridges	Phase 11: LRT Trackwork	Phase 12: Systems Construction	Phase 13: Testing and Commissioning
Aerial Lift	X	X	X		X			X	X	X		X	X
Air Compressor	X	X	X	X	X	X	X	X	X	X	X	X	X
Ballast Regulator						X	X				X		
Ballast Tamper/Liner						X	X				X		X
Bore/Drill Rig	X		X	X	X			X	X	X		X	
Cement and Mortar Mixer, Portable	X		X	X	X			X	X	X	X	X	
Concrete/Industrial Saw	X		X	X	X	X		X	X	X	X	X	X
Concrete Mixer Truck	X	X	X	X	X	X		X	X	X	X	X	X
Concrete Pump				X	X			X	X	X	X	X	X
Crane, Truck Mounted	X	X	X	X	X	X	X	X	X	X	X	X	X
Crawler Tractor				X					X				
Crushing/Proc. Equipment	X		X	X	X	X	X	X	X	X	X		
Dumper/Tender	X	X	X	X	X	X	X	X	X	X	X	X	X
Excavator	X	X	X	X	X	X	X	X	X	X	X		X
Forklift	X	X	X	X	X	X	X	X	X	X	X	X	X
Generator Set	X	X	X	X	X	X	X	X	X	X	X	X	X
Grader	X	X	X	X	X	X	X	X	X	X	X	X	
Light Plant	X	X	X	X		X		X	X	X	X	X	X
Other Construction Equipment	X		X	X	X	X		X	X	X	X	X	X
Other General Industrial Equipment	X		X	X	X	X		X	X	X	X	X	X
Other Material Handling Equipment	X		X	X	X	X		X	X	X	X	X	X
Paver	X		X	X		X		X	X	X		X	
Pile Driver with Tractor	X		X	X	X			X	X	X			
Plate Compactor	X		X	X	X	X		X	X	X		X	
Pressure Washer	X	X	X	X	X	X		X	X	X			X
Pump	X	X	X	X	X	X		X	X	X		X	X
Rail Welding Plant							X				X		
Railroad Swing Loader						X	X				X	X	X
Railroad Dumper, Hi-Rail						X	X				X		X
Railroad Work Train (w Locomotive)						X	X				X		
Roller Compactor	X		X	X	X	X	X	X	X	X	X		
Rough Terrain Forklift													
Rubber Tired Dozer	X		X	X					X				
Rubber Tired Loader	X	X	X	X	X	X	X	X	X	X	X	X	X
Signal Boards	X	X	X	X	X	X		X	X	X			X
Skid Steer Loader	X	X		X	X	X		X	X	X		X	X
Scraper													
Sweeper/Scrubber	X	X	X	X	X	X		X	X	X			X
Tractor/Loader/Backhoe	X	X	X	X	X	X		X	X	X	X	X	X
Trencher	X	X	X	X		X		X	X	X		X	X
Truck, Light Duty	X	X	X	X	X	X	X	X	X	X	X	X	X
Water Truck	X	X	X	X		X		X	X	X			
Welder, Portable	X	X	X	X	X	X		X	X	X	X	X	X

Table 5. Trench Option Construction Equipment

Equipment Type ("X" if included in Phase)	Phase 1: Early Utility Relocation	Phase 2: Project Start Up	Phase 3: Utility Relocation	Phase 4: Retaining Walls, Grading and Embankment for Freight Track Relocation	Phase 5: Freight Track Bridges	Phase 6: Freight Railroad At-grade Crossings	Phase 7: Freight Trackwork (By BNSF)	Phase 8: Stations and Access	Phase 9: Retaining Walls, Grading and Embankment for LRT Guideway	Phase 10: LRT Guideway Bridges	Phase 11: LRT Guideway Trench	Phase 12: LRT Trackwork	Phase 13: Systems Construction	Phase 14: Testing and Commissioning
Aerial Lift	X	X	X		X			X	X	X	X		X	X
Air Compressor	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Ballast Regulator						X	X					X		
Ballast Tamper/Liner						X	X					X		X
Bore/Drill Rig	X		X	X	X			X	X	X	X		X	
Cement and Mortar Mixer, Portable	X		X	X	X			X	X	X	X	X	X	
Concrete/Industrial Saw	X		X	X	X	X		X	X	X	X	X	X	X
Concrete Mixer Truck	X	X	X	X	X	X		X	X	X	X	X	X	X
Concrete Pump				X	X			X	X	X	X	X	X	X
Crane, Truck Mounted	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Crawler Tractor				X					X		X			
Crushing/Proc. Equipment	X		X	X	X	X	X	X	X	X	X	X		
Dumper/Tender	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Excavator	X	X	X	X	X	X	X	X	X	X	X	X		X
Forklift	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Generator Set	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Grader	X	X	X	X	X	X	X	X	X	X	X	X	X	
Light Plant	X	X	X	X		X		X	X	X	X	X	X	X
Other Construction Equipment	X		X	X	X	X		X	X	X	X	X	X	X
Other General Industrial Equipment	X		X	X	X	X		X	X	X	X	X	X	X
Other Material Handling Equipment	X		X	X	X	X		X	X	X	X	X	X	X
Paver	X		X	X		X		X	X	X			X	
Pile Driver with Tractor	X		X	X	X			X	X	X	X			
Plate Compactor	X		X	X	X	X		X	X	X	X		X	
Pressure Washer	X	X	X	X	X	X		X	X	X	X			X
Pump	X	X	X	X	X	X		X	X	X	X		X	X
Rail Welding Plant							X					X		
Railroad Swing Loader						X	X					X	X	X
Railroad Dumper, Hi-Rail						X	X					X		X
Railroad Work Train (w Locomotive)						X	X					X		
Roller Compactor	X		X	X	X	X	X	X	X	X	X	X		
Rough Terrain Forklift														
Rubber Tired Dozer	X		X	X					X		X			
Rubber Tired Loader	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Signal Boards	X	X	X	X	X	X		X	X	X				X
Skid Steer Loader	X	X	X	X	X	X		X	X	X	X		X	X
Scraper											X			
Sweeper/Scrubber	X	X	X	X	X	X		X	X	X				X
Tractor/Loader/Backhoe	X	X	X	X	X	X		X	X	X	X		X	X
Trencher	X	X	X	X		X		X	X	X	X		X	X
Truck, Light Duty	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Water Truck	X	X	X	X		X		X	X	X	X			
Welder, Portable	X	X	X	X	X	X		X	X	X	X	X	X	X

Table 6. Hawthorne Option Construction Equipment

Equipment Type ("X" if included in Phase)	Phase 1: Early Utility Relocation	Phase 2: Project Start Up	Phase 3: Utility Relocation	Phase 4. Retaining Walls, Grading and Embankment for Freight Track Relocation	Phase 5: Freight Trackwork (By BNSF)	Phase 6: Stations and Access	Phase 7: Retaining Walls, Grading and Embankment for LRT Guideway	Phase 8: LRT Guideway Bridges	Phase 9: LRT Trackwork	Phase 10: Systems Construction	Phase 11: Testing and Commissioning
Aerial Lift	X	X	X			X	X	X		X	X
Air Compressor	X	X	X	X	X	X	X	X	X	X	X
Ballast Regulator					X				X		
Ballast Tamper/Liner					X				X		X
Bore/Drill Rig	X		X	X		X	X	X		X	
Cement and Mortar Mixer, Portable	X		X	X		X	X	X	X	X	
Concrete/Industrial Saw	X		X	X		X	X	X	X	X	X
Concrete Mixer Truck	X	X	X	X		X	X	X	X	X	X
Concrete Pump				X		X	X	X	X	X	X
Crane, Truck Mounted	X	X	X	X	X	X	X	X	X	X	X
Crawler Tractor				X			X				
Crushing/Proc. Equipment	X		X	X	X	X	X	X	X		
Dumper/Tender	X	X	X	X	X	X	X	X	X	X	X
Excavator	X	X	X	X	X	X	X	X	X		X
Forklift	X	X	X	X	X	X	X	X	X	X	X
Generator Set	X	X	X	X	X	X	X	X	X	X	X
Grader	X	X	X	X	X	X	X	X	X	X	
Light Plant	X	X	X	X		X	X	X	X	X	X
Other Construction Equipment	X		X	X		X	X	X	X	X	X
Other General Industrial Equipment	X		X	X		X	X	X	X	X	X
Other Material Handling Equipment	X		X	X		X	X	X	X	X	X
Paver	X		X	X		X	X	X		X	
Pile Driver with Tractor	X		X	X		X	X	X			
Plate Compactor	X		X	X		X	X	X		X	
Pressure Washer	X	X	X	X		X	X	X			X
Pump	X	X	X	X		X	X	X		X	X
Rail Welding Plant					X				X		
Railroad Swing Loader					X				X	X	X
Railroad Dumper, Hi-Rail					X				X		X
Railroad Work Train (w Locomotive)					X				X		
Roller Compactor	X		X	X	X	X	X	X	X		
Rough Terrain Forklift											
Rubber Tired Dozer	X		X	X		X	X				
Rubber Tired Loader	X	X	X	X	X	X	X	X	X	X	X
Signal Boards	X	X	X	X		X	X	X			X
Skid Steer Loader	X	X	X	X		X	X	X		X	X
Scraper											
Sweeper/Scrubber	X	X	X	X		X	X	X			X
Tractor/Loader/Backhoe	X	X	X	X		X	X	X		X	X
Trencher	X	X	X	X		X	X	X		X	X
Truck, Light Duty	X	X	X	X	X	X	X	X	X	X	X
Water Truck	X	X	X	X		X	X	X			
Welder, Portable	X	X	X	X		X	X	X	X	X	X