Vermont Transit Corridor South Bay Extension Feasibility Study

FINAL REPORT
April 2022

MOTT MACDONALD

Prepared by:

Mott MacDonald
1000 Wilshire Boulevard
Suite 400
Los Angeles, CA 90017

Metro

Los Angeles County Metropolitan Transportation Authority

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABBREVIATIONS & ACRONYMS

$..... Dollar (amount)

BRT..... Bus Rapid Transit

Caltrans..... California Department of Transportation

EFCs ..... Equity Focus Communities

FLM..... First/Last Mile

Gardena Transit ..... GTrans

HBW(-pk) ..... Home-based work (peak period)

HRT ..... Heavy Rail Transit

I-(###) ..... Interstate-(Highway Number)

IOS..... Initial Operating Segments

LADOT..... City of Los Angeles Department of Transportation

LACDPW..... County of Los Angeles Department of Public Works

LOS..... Level of Service

LRT ..... Light Rail Transit

Metro ..... Los Angeles County Metropolitan Transportation Authority

MRDC ..... Metro Rail Design Criteria

MSF ..... maintenance and storage facilities

NTD ..... National Transit Database

O&M..... Operating and Maintenance

PCH ..... Pacific Coast Highway

ROW..... Right-of-Way

SR-(##) ..... State Route-(Highway Number)

TOC ..... Transit-Oriented Communities

TSP..... Transit Signal Priority

TWG ..... Technical Working Group

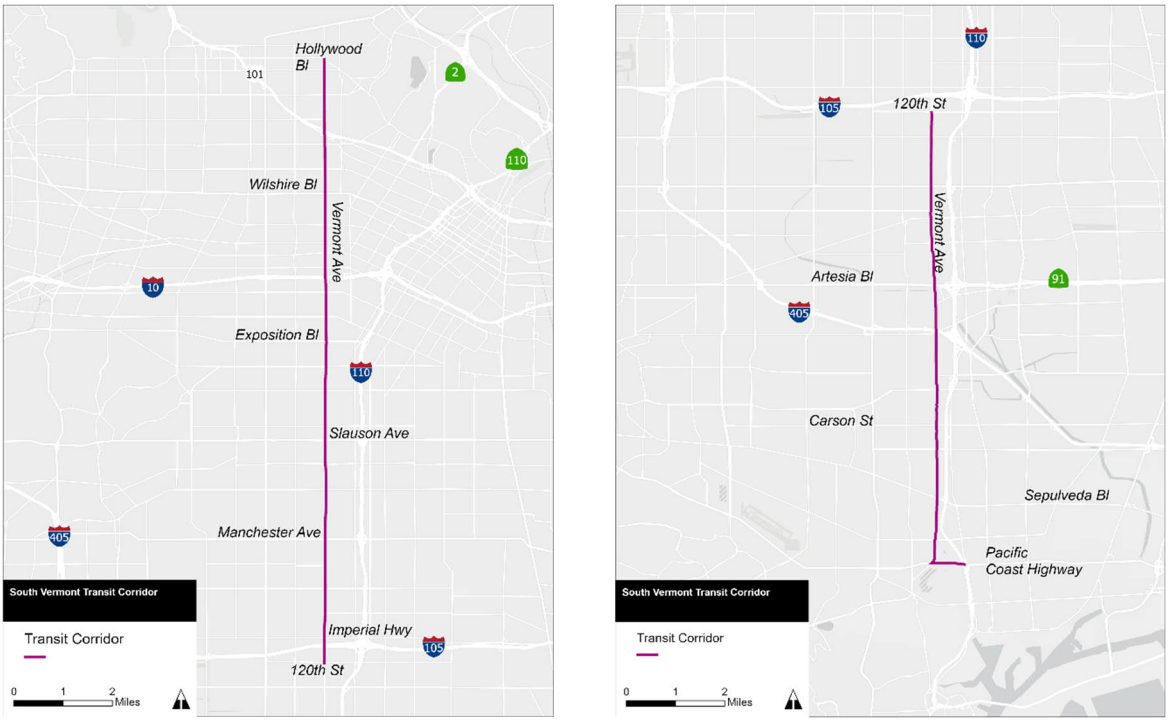
UPRR..... Union Pacific Railroad

EXECUTIVE SUMMARY

STUDY BACKGROUND

Vermont Avenue is one of the longest-running north-south streets in the City and County of Los Angeles (approximately 23.3 miles). The northern segment of Vermont Avenue extends approximately 12 miles from Hollywood Boulevard in the north to 120th Street in the south (North Vermont Corridor). This segment of the corridor is the second busiest transit corridor in Los Angeles County with approximately 45,000 daily boardings (pre-covid). The southern half of the corridor (South Vermont Corridor) extends from 120th Street to the Metro J Line (Silver) PCH transitway station. It is currently served by three transit agencies (Metro, GTrans, and Torrance Transit) with a total of 2,900 daily boardings. **Error! Not a valid bookmark self-reference.** demonstrates both the North Vermont Corridor and South Vermont Corridor.

Figure ES.1: North and South Vermont Corridors



The Vermont Transit Corridor (North Vermont Corridor) is a Measure M project and has an expected opening date of Fiscal Year 2028. Currently, $425 million is included in the Measure M Expenditure Plan for the Vermont Transit Corridor.

In February 2017, Metro completed the Vermont Bus Rapid Transit (BRT) Technical Study, which evaluated the feasibility of implementing BRT on the North Vermont Corridor including bus lanes and other key BRT features. The study identified two promising BRT concepts: an end-to-end side-running BRT and a combination side and center-running BRT.

At the direction of the Metro Board, the Vermont Transit Corridor - Rail Conversion/Feasibility Study was completed in February 2019. The purpose of this study was to ensure that any BRT concept considered for the corridor, would not preclude a future conversion to rail. The study also identified three rail concepts, which included: 1) Light Rail Transit (LRT) High-Floor, Center-Running; 2) Heavy Rail Transit (HRT) with Direct Connection to Metro B (Red) Line; and 3) HRT with Stand-Alone Alignment (beginning/ending at Vermont/Wilshire).

In April 2019, the Metro Board directed staff to advance the BRT alternatives and the three rail concepts identified in the Vermont Transit Corridor Rail Conversion/ Feasibility Study into environmental review. Additionally, the Board directed staff to include a separate feasibility study looking at extending the Vermont Transit Corridor to the South Bay Metro J Line (Silver) Pacific Coast Highway (PCH) transitway station to ensure regional connectivity.

STUDY PURPOSE

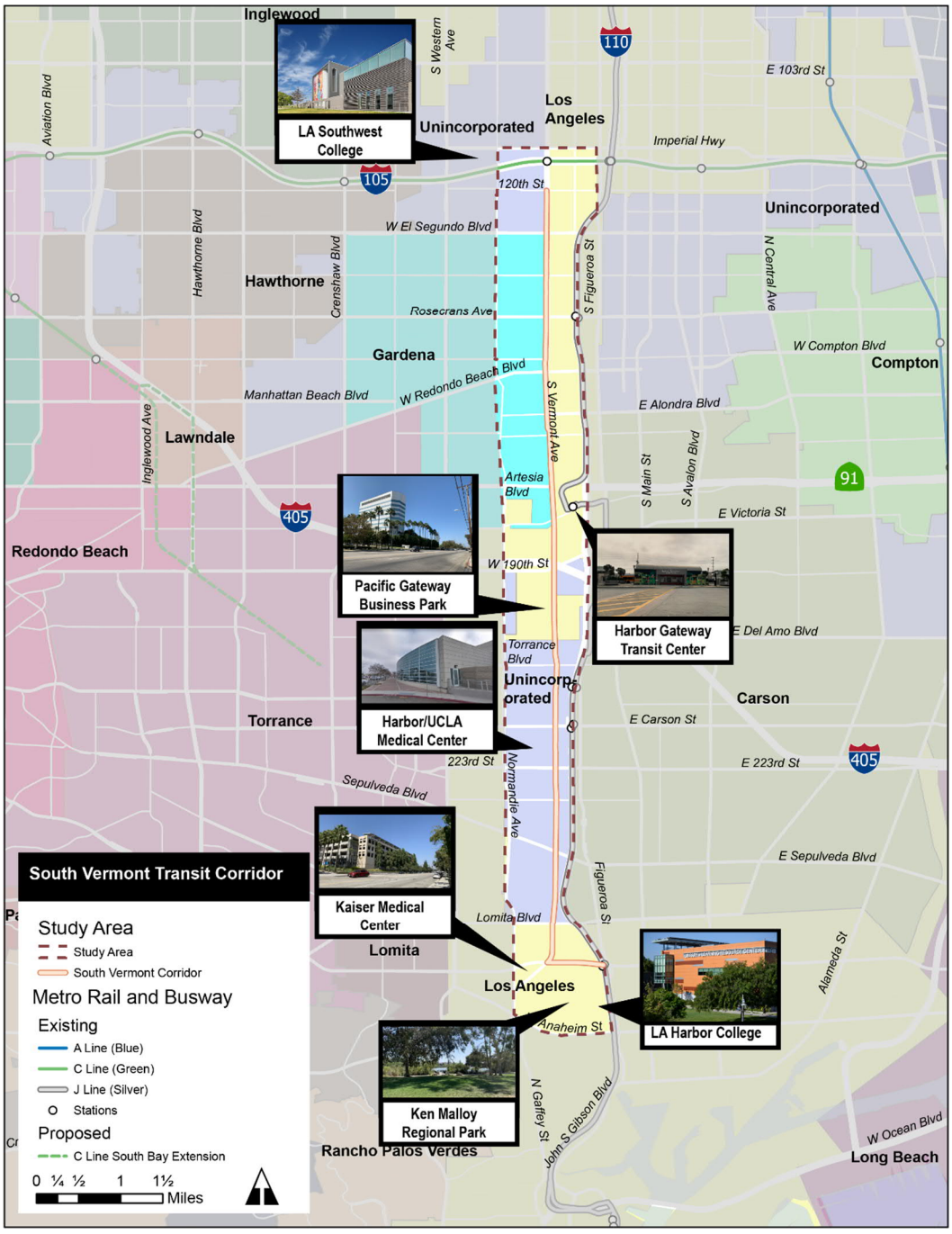
The purpose of the Vermont Transit Corridor South Bay Extension Feasibility Study is to evaluate the feasibility of a ten-mile extension of the Vermont Transit Corridor from 120th Street to the South Bay Metro J Line (Silver) PCH transitway station. The alternatives evaluated include end-to-end Side-Running BRT, Center-Running BRT, LRT, and HRT. The following were the key study objectives:

1. Assess the feasibility of implementing BRT, LRT, and HRT concepts;
2. Identify and analyze potential impacts on existing communities (traffic, parking, etc.) and traffic circulation on Vermont Avenue and adjacent major arterials;
3. Develop operating scenarios corresponding to each of the BRT and rail alternatives to identify planning-level capital and operating cost estimates and ridership forecasts;
4. Identify potential Initial Operating Segments (IOS), including potential maintenance and storage facility (MSF) sites;
5. Evaluate opportunities to facilitate and promote Transit-Oriented Community (TOC) outcomes for each BRT and rail alternative.

STUDY AREA

The South Vermont Corridor is a 10-mile corridor extending south along Vermont Avenue from 120th Street to PCH, then continuing along PCH to the Metro J Line (Silver) PCH transitway station as shown in Figure ES.2. The corridor runs through the Cities of Los Angeles, Gardena, and the unincorporated areas of the County of Los Angeles. The corridor features a variety of land uses, roadway and right-of-way (ROW) widths, lane configurations, and other physical features. It provides access to several major key activity centers, including the UCLA Harbor Medical Center, Kaiser Permanente South Bay Medical Center, Ken Malloy Regional Park, Pacific Gateway Business Park, and Harbor Gateway Transit Center.

Figure ES.2: South Vermont Corridor Study Area



The ROW along the South Vermont Corridor varies significantly. Vermont Avenue is the widest north of 164th Street, ranging from 130 to 160 feet in width and providing two to three travel

lanes and parking in each direction, as well as a landscaped raised median. Between 164th Street and Artesia Boulevard, Vermont Avenue narrows considerably to a width of 58 to 75 feet, allowing only two travel lanes and parking in each direction and, in some areas, a striped median. From Artesia Boulevard to PCH, Vermont Avenue widens slightly to 70 to 85 feet, allowing for two travel lanes per direction plus a two-way left-turn lane or a raised median in the middle

MOBILITY CHALLENGES

While the North Vermont Corridor consists of the second busiest bus corridor in Los Angeles County with over 45,000 boardings per weekday on Metro Lines 204 and 754, the South Vermont Corridor currently has significantly lower bus ridership. There is currently no continuous transit service along Vermont Avenue between 120th Street and PCH, which may be a factor contributing to the low bus ridership of approximately 2,900 daily boardings per weekday. Currently, to travel the entirety of the South Vermont Corridor a bus rider can take GTrans Line 2 at 120th Street all the way to 182nd Street and then transfer to either Metro Line 205 or 550 at 182nd Street to end at PCH.

Upon full implementation of Metro's NextGen Bus Plan, Metro Line 550 would no longer serve south Vermont Avenue, and service on Metro Line 205 would also be altered. Metro Line 205 would no longer serve Vermont Avenue at 182nd Street; the service on Vermont would start at Carson Street leaving the portion of the corridor between 182nd Street to Carson Street to be served by Torrance Transit Line 1. This change would force riders to make two transfers (GTrans to Torrance Transit to Metro) to be able to ride the full length of the corridor.

The existing bicyclist activities along the corridor are relatively low. While many portions of the South Vermont Corridor feature Class II bike lanes in both directions, there are some gaps, including the stretch next to the Harbor Gateway Transit Center, which forces bicyclists to share a travel lane. Several arterials intersect with Vermont Avenue to provide regional connectivity, but 120th Street is the only cross street in the east-west direction that has a bike lane. Additionally, some segments of the corridor have narrow sidewalks with street furniture and utilities competing for space and faded crosswalks intersections that further contribute to the existing mobility challenges.

DEVELOPMENT OF BRT CONCEPTS

Two BRT concepts were proposed for the North Vermont Corridor and were assessed for their extension along the South Vermont Corridor:

- End-to-End Side Running BRT
- Combination Side and Center-Running BRT

The extension of these two concepts was developed for the South Vermont Corridor. Near the southern terminus, the BRT would be in mixed flow operation in the curb lane on PCH between Vermont Avenue and Metro J Line (Silver) PCH transitway station in both BRT concepts. Ultimately, this Study determined that it is feasible to implement either a Center-Running BRT or a Side-Running BRT along Vermont Avenue between 120th Street and PCH. A combination of Side-Running and Center-Running BRT could be implemented, if desired, but was not determined to be a necessity to implement BRT along the South Vermont Corridor.

CENTER-RUNNING BRT

The northbound and southbound inside vehicular travel lanes on Vermont Avenue between 120th Street and PCH would be converted to dedicated BRT lanes, which results in a loss of one general vehicular travel lane in each direction. This transit concept would require removal or modification of the existing center medians along the corridor. To minimize conflicts with the dedicated BRT lanes, uncontrolled left-turn movements across the center BRT lanes might not be permitted. Left-turn movements that are currently allowed at mid-block locations may be redistributed to signalized intersections where left-turn movements would still be allowed.

Figure ES.3: Vermont North Center-Running BRT Rendering

Figure ES.4: Vermont North Side-Running BRT Rendering

SIDE-RUNNING BRT

The northbound and southbound outside vehicular travel lane on Vermont Avenue between 120th Street and PCH would be converted to a dedicated BRT lane, which results in a loss of one general vehicular travel lane in each

direction. The Side-Running BRT lane travels between a general vehicular travel lane and a bike lane where the roadway width is wide enough, on-street parking along the curb is also provided.

BRT stations would include a number of passenger amenities including shelters, bus benches, trash cans, next bus information, and lighting. For side-running BRT the stations would either be integrated into the existing sidewalk or on a raised “island” or sidewalk “bulbout”, and for center-running BRT the stations would be raised “island” platforms located between the BRT lane and general travel lane.

DEVELOPMENT OF RAIL CONCEPTS

Three rail concepts were proposed for the North Vermont Corridor and were assessed for their extension along the South Vermont Corridor:

- A Center-Running LRT concept
- A fully below-grade HRT concept with no direct connection to existing Metro Lines
- A fully below-grade HRT concept connected to Metro B Line (Red) at the Wilshire/Vermont Station

The extension of these three concepts was developed for the South Vermont Corridor.

CENTER-RUNNING LRT

The LRT concept is a dual-track center-running guideway using Metro’s High-Floor light-rail vehicles that are powered by an overhead catenary system, consistent with all of Metro’s existing LRT lines. At the north end of the corridor, the LRT guideway is proposed to operate at-grade (street level) in the existing raised median between 120th Street and 155th Street. Grade-separated LRT segments have been proposed between 155th Street and Knox Street and between 245th Street and Metro J Line (Silver) PCH transitway station to avoid significant permanent impacts on elements such as traffic, ROW, and freight operations. Between Knox Street and Lomita Boulevard, the LRT would be at-grade center-running; the two travel lanes in each direction would be maintained while on-street parking is anticipated to be removed.

In general, the number of travel lanes would remain the same as the existing conditions. Left-turn movements that are currently allowed at mid-block locations may be redistributed to signalized intersections where left-turn movements would still be allowed.

Figure ES.5: LRT High-Floor Example: Metro E Line (Expo)

HRT – Stand Alone (HRT1)

The HRT concept would be fully underground along both the North Vermont Corridor and South Vermont Corridor. HRT is the technology used on the Metro B and D Lines and would be compatible with the existing HRT fleet and is shown in Figure ES.6.

Figure ES.6: HRT Example – Metro B Line (Red)

The northern terminus for the HRT1 concept would be at a new station near the existing Metro B Line (Red) /D Line (Purple) Wilshire/Vermont Station.

HRT – Connected to Metro B Line (HRT2)

This HRT concept would be the same as the HRT1 concept along the South Vermont Corridor. The HRT2 concept differs from the HRT1 concept in the North Vermont Corridor in that the HRT2 concept would be connected to the Metro B Line (Red) and provide a one-seat ride for passengers from North Hollywood to the South Bay.

Operating Plan and Capacity

The service span, headways, peak hour capacity, number of stations, runtime, and average speed for the five assessed transit concepts are summarized in Table ES.1. The rail concepts have a faster average speed and more capacity than the BRT concepts. The BRT concepts have more stations than the rail concepts because the spacing between BRT stations is typically shorter than the rail concepts.

Table ES.1: Transit Concept Operating Plan and Capacity

	Center Running BRT	Side-Running BRT	LRT	HRT1 – Stand Alone	HRT2 – Connected to Metro B Line
Service Span	4AM to 1AM (21 hours)				
Headway in Minutes (Peak/Off-peak)	5/10			4/10	
Peak Hour Capacity (one direction)	900	900	4,800	11,800	
Number of Stations	12	12	9	8	
Runtime in Minutes	30	37	28	20	
Average Speed in miles per hour (mph)	20	16	21	31	

ESTIMATED RIDERSHIP AND PROJECT BENEFITS

The two HRT concepts have the highest forecasted weekday ridership, followed by the LRT concept, the Center-Running BRT concept, and then the Side-Running BRT concept (see Table ES.2).

The HRT Concepts are forecasted to attract approximately 11,800 to 12,800 new transit riders (meaning people would shift from driving to taking transit). The LRT and Center-Running BRT would attract approximately 7,000 to 7,200 transit riders, and the Side-Running BRT would attract about 6,100 new transit riders. All BRT and rail concepts would provide a one-seat ride along the entire South Vermont Corridor, saving both in-vehicle-time[1] and wait time for transit riders. It currently takes approximately 77 minutes to travel the 10-mile South Vermont Corridor by riding the existing bus routes GTrans Line 2 and transferring to Metro Line 205. The two HRT concepts are estimated to save a total of 55 minutes of travel time since it is estimated to take a total of 22 minutes to travel the entire corridor while the Side-Running BRT is estimated to save a total of 38 minutes. The travel time of the BRT and rail concepts, summarized in Table ES.2, would also be more competitive with traveling by car, which currently takes approximately 25 to 28 minutes.

[1] the time of the journey that is spent riding the bus or rail service, excluding the wait time

In comparison to the North Vermont Corridor, the estimated ridership for the BRT concepts along the South Vermont Corridor is approximately 80 percent lower. The estimated ridership for the rail concepts along the South Vermont Corridor is approximately 60 percent lower than that of the North Vermont Corridor.

Table ES.2: Transit Concept Ridership and Benefits

	Center-Running BRT	Side-Running BRT	LRT	HRT1 Stand Alone	HRT2 Connected to Metro B Line
Estimated Weekday Ridership – South Vermont Corridor	10,100	8,800	13,700	18,500	19,300
Estimated Weekday Ridership – Entire Vermont Corridor	58,400	55,900	46,800	64,600	66,400
Transit Trip Time (Minutes) – South Vermont Corridor	32	39	31	22	22
Transit Trip Time Savings (Minutes) – South Vermont Corridor	45	38	46	55	55
New Transit Riders – South Vermont Corridor	7,200	6,100	7,000	11,800	12,800

PROJECT IMPACTS

The Center-Running BRT and LRT concepts are estimated to present the most traffic operation challenges due to the fact they operate at surface level. The LRT concept would cause the longest average delay per automobile at the signalized intersections along the study corridor. The Center-Running BRT concept would impact the highest number of signalized intersections operating at LOS values of E or F (indicating traffic congestion). There would be 15 intersections in the AM peak hour and 18 in the PM peak hour at LOS E or F compared to eight in the AM peak hour and ten in the PM peak hour under the existing conditions.

There are approximately 1,613 on-street parking spaces on Vermont Avenue between 120th Street and PCH. The LRT concept could potentially remove the greatest number of parking spaces, as many as 734, mainly because most curbside parking spaces would be removed south of the I-405 freeway to maintain two vehicular travel lanes in each direction. In the Center-Running BRT concept, up to 657 parking spaces could be removed, to accommodate

reconfigured left-turn lanes and BRT station platforms in the median. In the Side-Running BRT concept, up to 292 parking spaces could be removed.

The two fully underground HRT concepts would have the least impact on ROW, traffic operation, and on-street parking spaces due to the fact the alignment would be fully underground. The LRT and HRT concepts could potentially cause environmental impacts such as cultural resources, displacements and acquisitions, and noise and vibration while the BRT concepts typically would not.

Cost Estimates

As summarized in Table ES.3, the capital and Operating and Maintenance (O&M) costs for the rail concepts are significantly higher than those for the BRT concepts. If built in 2021, the capital cost for the HRT concepts is estimated to be in the range of $10.8 to 12.7 billion, which is 37 times that for the BRT concepts. The Annual O&M cost for the two HRT concepts is estimated to be in the range of $137.9 to $167.5 million, which is about ten times those for the BRT concepts.

Table ES.3: Cost Estimates for Transit Concepts, 2021 $ in Millions

	Center-Running BRT	Side-Running BRT	LRT	HRT1 Stand Alone	HRT2 Connected to Metro B Line
Capital Cost	$290 - $350	$290 - $340	$4,650 - $5,550	$10,800 - $12,750	
Annual O&M Cost	$15.7 - $16.4	$16.4 - $19.4	$74.9 - $81.6	$147 - $167.5	$136.9 - $167.5

The capital and annual O&M cost for all the transit concepts were also developed for the future year 2045 (see Table ES.4).

Table ES.4: Cost Estimates for Transit Concepts, 2045 $ in Millions

	Center-Running BRT	Side-Running BRT	LRT	HRT1 Stand Alone	HRT2 Connected to Metro B Line
Capital Cost	$770 - $910	$760 - $900	$12,350 - $14,600	$28,500 - $33,700	
Annual O&M Cost	$31.3 - $32.7	$32.7 - $38.7	$144.8 - 157.8	$315.2 - $359.3	$264.6 - $323.8

MAINTENANCE AND STORAGE FACILITY (MSF) AND PHASING OPTIONS

Due to the high capital cost, the rail concepts most likely need to be delivered in phases. For the rail concepts, siting the maintenance and storage facility (MSF) is the largest driving force to determine the Initial Operating Segment (IOS) since an MSF would be needed for the South Vermont Corridor. The recommended southern terminus of the IOS, i.e., Phase 1, is Vermont Avenue and 182nd Street, near the Harbor Gateway Transit Center. This terminus would allow for transfer connections to buses at the Harbor Gateway Transit Center and connections to two potential MSF sites that have been identified. The remainder of the corridor could be implemented in one to two additional phases, depending on the funding availability.

Since the BRT concepts cost less to implement, compared to the rail options, phasing was not considered. A new MSF is not needed since the existing Metro Bus Divisions have available space to accommodate the number of buses for Vermont BRT service. If funding becomes a constraint, it is recommended to implement the dedicated bus lanes on Vermont Avenue between Redondo Beach Boulevard and 190th Street later. This stretch of the corridor has the narrowest ROW and the construction of the BRT concepts would have the most disruption to civil infrastructure and traffic operation. The Vermont BRT service could operate in mixed-flow traffic on this portion of the corridor before closing the gap and operating continuously in dedicated bus lanes on Vermont Avenue.

FACILITATION OF TRANSIT-ORIENTED COMMUNITIES AND FIRST/LAST MILE IMPROVEMENTS

For Transit-oriented community (TOC) facilitation, the population, employment, and land use densities are relatively low along the South Vermont Corridor. The number of parcels that are available for redevelopment is also quite limited. More TOC supportive planning with local jurisdictions will be needed to increase the land use density, especially around the potential station areas to support increased ridership.

For First /Last Mile (FLM) improvements, the existing gaps in the bike lanes on Vermont Avenue (see Figure ES.7) were assumed to be filled for the BRT concept design plans. More bike lanes on east-west cross streets are needed since 120th Street is currently the only street that has a bike lane. Coordination with local jurisdictions is needed to improve pedestrian facilities and bus stop amenities.

Coordination with local jurisdictions and transit agencies to encourage denser residential and mixed-use commercial development, expanding bicycle and pedestrian infrastructure,

improving transit service and amenities, locating economic development sites, and investing in EFCs, would support TOC and FLM improvements along the South Vermont Corridor.

Figure ES.7: Gap in the Bike Lane on Vermont Avenue near the Harbor Gateway Transit Center

STAKEHOLDER OUTREACH

Metro initiated an early and sustained outreach process targeting key public and partner agency stakeholders along the corridor to seek feedback on the proposed transit concepts. A total of six stakeholder meetings were held that included elected officials and/or their staff, key institutions and organizations, businesses, religious institutions, schools, hospitals, community and neighborhood groups, major cultural centers, neighborhood councils, Chambers of Commerce, affected City of Los Angeles Council Districts, and other cities along the corridor.

The outreach process also included a special project Technical Working Group (TWG) consisting of representatives from several Metro departments, staff from the City of Los Angeles, County of Los Angeles, and representatives from Torrance Transit, GTrans, Caltrans District 7, County of Los Angeles Department of Public Works (LACDPW), and Union Pacific Railroad (UPRR). A website was also created to provide the community at large with information about the Study.

Stakeholders generally support the extension of the BRT/rail concepts further south along the Vermont Corridor. However, some of the key issues raised at these meetings included the

availability and/or lack of funding, desire to extend the alternatives further south to San Pedro, potential traffic, and parking impacts from the loss of any travel lane or parking spaces and how we might address them, potential issues accessing the I-405 and SR-91 freeways, and the potential for near-term transit improvements.

STUDY MAIN CONCLUSIONS

Overall, the Study found that along the South Vermont Corridor:

- Improvements are needed to the existing fragmented transit service, which currently operates with long headways;
- It is feasible to implement and extend the BRT and rail concepts from the North Vermont Corridor;
- In comparison to the North Vermont Corridor, the estimated ridership for the BRT concepts along the South Vermont Corridor is approximately 80 percent lower. The estimated ridership for the rail concepts along the South Vermont Corridor is approximately 60 percent lower than that of the North Vermont Corridor;
- The LRT and HRT concepts have major costs;
- The BRT and LRT concepts are anticipated to present the most challenges for traffic operations;
- TOC supportive policies and programs by local jurisdictions will be needed to increase the land use density, especially around the potential station areas.
- Partnership with local jurisdictions is needed to improve pedestrian and bicycle facilities along the corridor and near the potential station areas;
- The stakeholders generally support the extension of the BRT/rail concepts into the South Bay. There is also strong advocacy for further extension to San Pedro. Meanwhile, some stakeholders are concerned with the potential traffic, parking, and environmental impacts on the local communities;
- It is feasible to implement the rail concepts in phases.

RECOMMENDED NEAR TERM IMPROVEMENTS

While it usually takes years if not decades to implement BRT or rail services, some improvements could be made in the near term to enhance transit service along the South Vermont Corridor to increase transit riders' mobility. These improvements include providing continuous bus service and improving traffic signal operation.

Providing continuous bus service on the study corridor with increased service frequency could reduce riders' out-of-vehicle time[2] effectively, and thus make the bus service more competitive. This would require coordination between Metro and the two municipal transit operators along the corridor: GTrans and Torrance Transit. Should the Metro Board direct further work be done, funding and partnerships with the local municipal transit operators and cities will be needed to potentially provide continuous bus service, and identify and implement other near-term improvements for the corridor including improvements to pedestrian and bicycle facilities.

Many signalized intersections along the South Vermont Corridor are congested during the peak period, which leads to slow bus speed. Currently, the traffic signals along the study corridor are not fully synchronized. This is because some signal synchronization takes place along the cross streets in the east-west direction. The signals along the study corridor are operated by four different agencies: the City of Los Angeles Department of Transportation (LADOT), County of Los Angeles Department of Public Works (LACDPW), City of Gardena, and California Department of Transportation (Caltrans). As part of near-term improvements, Metro could work with these agencies to study the feasibility of signal timing optimization and synchronization, and implementing Transit Signal Priority (TSP) along Vermont Avenue.

[2] wait time and transfer time

1. Introduction

1. INTRODUCTION AND BACKGROUND

1.1 STUDY BACKGROUND AND PURPOSE

Vermont Avenue is one of the longest-running north-south streets in the City and County of Los Angeles (approximately 23.3 miles). The northern segment of Vermont Avenue extends approximately 12 miles from Hollywood Boulevard in the north to 120th Street in the south (North Vermont Corridor). This segment of the corridor is the second busiest transit corridor in Los Angeles County with approximately 45,000 daily boardings (pre-covid). The southern half of the corridor (South Vermont Corridor) extends from 120th Street to the Metro J Line (Silver) PCH transitway station. It is currently served by three transit agencies (Metro, GTrans, and Torrance Transit) with a total of 2,900 daily boardings.

The Vermont Transit Corridor (North Vermont Corridor) is a Measure M project and has an expected opening date of Fiscal Year 2028. Currently, $425 million is included in the Measure M Expenditure Plan for the Vermont Transit Corridor.

In February 2017, Metro completed the Vermont Bus Rapid Transit (BRT) Technical Study, which evaluated the feasibility of implementing BRT on the North Vermont Corridor including bus lanes and other key BRT features. The study identified two promising BRT concepts: an end-to-end side-running BRT and a combination side and center-running BRT.

At the direction of the Metro Board, the Vermont Transit Corridor - Rail Conversion/Feasibility Study was completed in February 2019. The purpose of this study was to ensure that any BRT concept considered for the corridor would not preclude a future conversion to rail. The study also identified three rail concepts, which included: 1) Light Rail Transit (LRT) High-Floor, Center-Running; 2) Heavy Rail Transit (HRT) with Direct Connection to Metro B (Red) Line; and 3) HRT with Stand-Alone Alignment (beginning/ending at Vermont/Wilshire).

In April 2019, the Metro Board directed staff to advance the BRT alternatives and the three rail concepts identified in the Vermont Transit Corridor Rail Conversion/ Feasibility Study into environmental review. Additionally, the Board directed staff to include a separate feasibility study looking at extending the Vermont Transit Corridor to the South Bay Metro J Line (Silver) Pacific Coast Highway (PCH) transitway station to ensure regional connectivity.

There are five primary objectives for this Study:

1. Assess the feasibility of implementing BRT, LRT, and HRT concepts;
2. Identify and analyze potential impacts to existing communities (traffic, parking, etc.) and traffic circulation on Vermont Avenue and adjacent major arterials;

3. Develop operating scenarios corresponding to each of the BRT/rail alternatives to identify planning-level capital and operating cost estimates and ridership forecasts;
4. Identify potential Initial Operating Segments (IOS), including potential maintenance and storage facility (MSF) sites;
5. Evaluate opportunities to facilitate and promote transit-oriented communities (TOC) outcomes for each BRT and rail alternative.

1.2 STUDY CORRIDOR

The South Vermont Corridor is defined as the 10-mile segment of Vermont Avenue between 120th Street and PCH, and a half-mile segment of PCH between Vermont Avenue and I-110. The corridor encompasses the Cities of Los Angeles and Gardena, and the unincorporated areas of the County of Los Angeles.

For this Study, the corridor has been divided into nine segments, as shown in Figure 1.1, based on curb-to-curb width, the number of travel lanes, median type, bike lanes, and parking restrictions. Figure 1.1 provides a comparison of the existing roadway characteristics for each segment. As the table shows, Vermont Avenue is the widest north of 164th Street, ranging from 130 to 160 feet in width and providing two to three travel lanes and parking in each direction, as well as a landscaped raised median. Between 164th Street and Artesia Boulevard/State Route-91 (SR-91), Vermont Avenue narrows considerably to a width of 58 to 75 feet, allowing only two travel lanes and parking in each direction and, in some areas, a striped median. From Artesia Boulevard/SR-91 to PCH, Vermont Avenue widens slightly to 70 to 85 feet, allowing for two travel lanes per direction plus a two-way left-turn lane or a raised median in the middle. Bike lanes are provided in at least one direction between 120th Street and Marine Avenue and Artesia Boulevard and Lomita Boulevard.

A Union Pacific Railroad (UPRR) freight track enters the corridor just south of Marine Avenue where it crosses the northbound lanes and then continues south within the median. The freight track runs along the median until the median's terminus at 164th Street, and then briefly runs within the travel lanes before turning off Vermont Avenue (to the west) south of Gardena Boulevard.

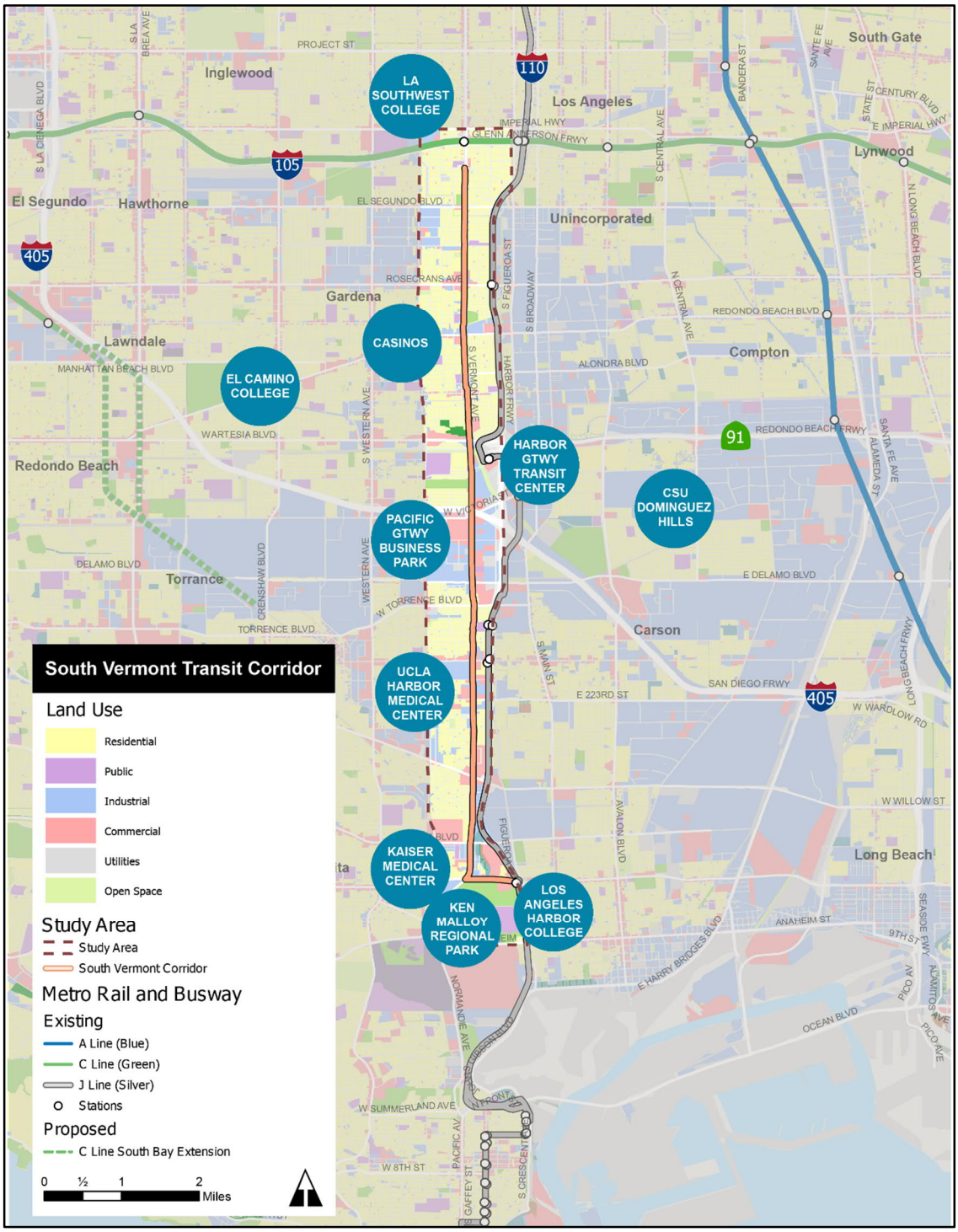
Figure 1.1: South Vermont Corridor Segments

Table 1.1: South Vermont Corridor Segments by Existing Roadway Characteristics

Segment (Distance)	From	To	Curb-to-Curb Width (feet)	Travel Lanes (N/S)	Median Type	Bike Lane	Parking
A (2.07 Mile)	120th St	Marine Ave	130-156	3/3	Landscape median with channelized left-turn lanes	NB; SB between 120th Street and El Segundo Blvd	Both sides; parking in the median between 140th St and Rosecrans Ave
B (0.88 Mile)	Marine Ave	164th St	140-160	2/3	Landscape median	No	Both sides
C (0.71 Mile)	164th St	Artesia Blvd	58-75	2/2	Double yellow	No	Both sides
D (0.97 Mile)	Artesia Blvd	I-405	70-80	2/2	Two-way left-turn lane	Both sides in most portions of the segment	Both sides in most portions of the segment
E (1.16 Mile)	I-405	Torrance Blvd	80-85	2/2	Two-way left-turn lane	Both sides	Restricted parking in some areas
F (1.21 Mile)	Torrance Blvd	223rd St	80-85	2/2	Landscape median/two-way left-turn lane	Both sides	Both sides between Clarion Dr and 223rd St
G (1.84 Mile)	223rd St	Lomita Blvd	80-85	2/2	Raised median	Both sides	Both sides
H (0.48 Mile)	Lomita Blvd	PCH	80-85	2/2	Two-way left-turn lane	No	Both sides
I (PCH) (0.61 Mile)	Vermont Ave	I-110	78-80	3/2 (W/E)	Two-way left-turn lane	No	No parking

As shown in Figure 1.2, the most common land uses along the South Vermont Corridor are single-family residential and multi-family residential. The land use between Artesia Boulevard/SR-91 and Del Amo Boulevard is mainly light industrial. Commercial and service land uses are concentrated at major cross streets such as Rosecrans Avenue, Redondo Beach Boulevard, Gardena Boulevard, and Artesia Boulevard/SR-91. In addition, the corridor provides access to several key destinations and trip generators, including the UCLA Harbor Medical Center (one of only two level I trauma centers operated by Los Angeles County), Kaiser Permanente South Bay Medical Center, Ken Malloy Regional Park, Pacific Gateway Business Park, and a couple of gaming facilities. Other regional activity centers in the vicinity of the corridor include Los Angeles Southwest College, Los Angeles Harbor College, El Camino College, and California State University (CSU) Dominguez Hills.

Figure 1.2: South Vermont Corridor Land Uses and Key Destinations




Metro

2. MOBILITY PROBLEMS

Residents and workers in the South Vermont Corridor have limited available travel options. Transit service is fragmented, and service frequency is relatively low. Additionally, there are gaps for dedicated bicycle facilities and sub-optimal infrastructure for pedestrians. The limited accessibility to jobs by transit is an equity issue as the majority of the corridor's census tracts are low-to-middle income by regional standards.

2.1 EXISTING TRAFFIC OPERATIONS

Most of the traffic congestion along the South Vermont Corridor occurs at major intersections. Traffic operations were evaluated using Level of Service (LOS) values. LOS is a way to measure the operational performance of a roadway or intersection, ranging from LOS A (free flow) to LOS F (extreme congestion). Generally speaking, LOS values of A through D represent satisfactory operating conditions.

During both the AM and PM peak hours[3], seven of the eight segments on Vermont Avenue operate with LOS values of A or B based on volume to capacity (v/c) ratio, representing the most satisfactory traffic operating conditions. The only exception is Segment D from Artesia Boulevard/SR-91 to I-405, which currently operates at LOS values of D and E during the peak hours.

Figure 2.1 shows the 25 signalized intersections along the study corridor. Currently, eight out of the 25 intersections operate at LOS values of E or F in the AM peak hour, while ten out of the 25 intersections operate at LOS values of E or F in the PM peak hour.

The following intersections currently operate at LOS values of E or F in both peak hours:

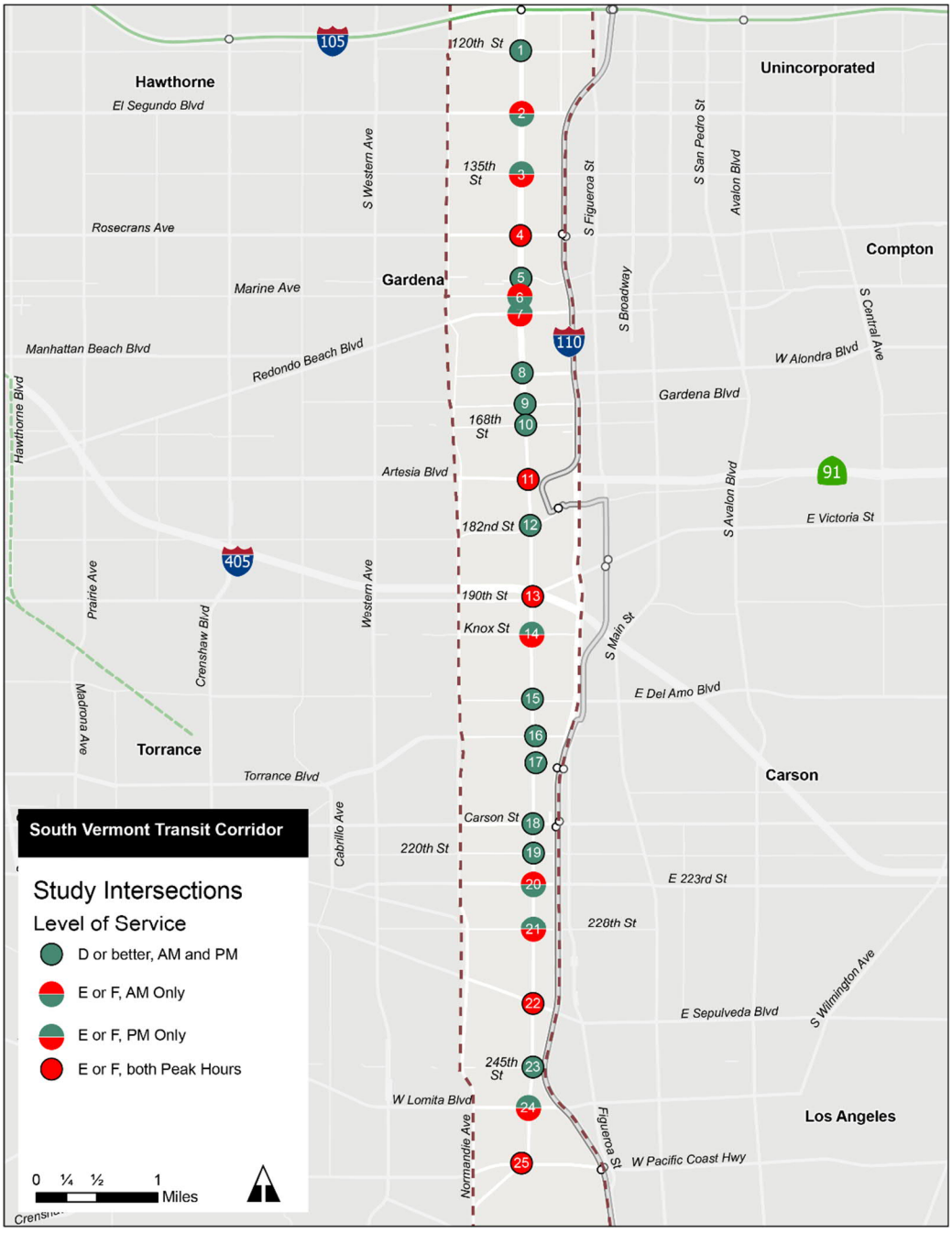
- Vermont Avenue & Rosecrans Avenue (#4)
- Vermont Avenue & Artesia Boulevard/SR-91 (#11)
- Vermont Avenue & 190th Street (#13)
- Vermont Avenue & Sepulveda Boulevard (#22)
- Vermont Avenue & PCH (#25)

Each of these intersections lies at the junction of Vermont Avenue and a major cross-street in the east-west direction. The cross-streets serve as regional thoroughfares in their own right.

[3] The busiest four consecutive 15 minutes during the AM peak period (7-10 AM) and PM peak period (3-6 PM), respectively

Therefore, it is not surprising that these junctions should experience a high level of congestion during peak hours.

Figure 2.1:Existing Traffic Operations for Signalized Intersections



2.2 EXISTING TRANSIT SERVICE AND PERFORMANCE

The North Vermont Corridor has some of the most frequent bus services in the city, largely provided by Metro Lines 204 and 754, which both operate between Hollywood Boulevard and 120th Street. In contrast, the South Vermont Corridor has fragmented and less frequent transit services. As shown in Figure 2.2, there is currently no bus route that continuously serves Vermont Avenue within the Study Area. Gardena Transit (GTrans) Line 2 is the only bus service between 120th Street and Gardena Boulevard. Torrance Transit Lines 1 and 4X enter Vermont Avenue at Gardena Boulevard, continuing past 182nd Street (where GTrans Line 2 turns west) to Carson Street and Torrance Boulevard, respectively. Finally, Metro Lines 205 and 550 operate on Vermont Avenue between 182nd Street and PCH.

Figure 2.2:South Vermont Corridor Existing Transit Service

Moreover, transit routes serving the corridor offer infrequent service, especially outside of peak hours (see Table 2.1). While GTrans Line 2 has a weekday peak headway of only 12 minutes, Torrance Transit Line 1 and Metro Bus Lines 205 and 550 have weekday peak period headways exceeding 30 minutes. Off-peak and weekend headways are around 30 minutes or higher on every line serving the South Vermont Corridor except for GTrans Line 2's 14-minute weekday mid-day headway. Transfers between lines with a low frequency typically result in riders enduring long waits. Since transit riders perceive time spent waiting as more inconvenient than time spent in transit, long transfers tend to deter ridership.

Table 2.1: South Vermont Corridor Existing Bus Service Frequency

Line	From	To	Time of Day	Service frequency (headway) in Minutes[3]			
				Peak	Mid-day	Evening	Owl
Metro 205	Willowbrook/Rosa Parks Station	Downtown San Pedro	Weekday	37	34	56	--
			Saturday	56	55	63	--
			Sunday/Holiday	60	63	55	--
Metro 550	Downtown Los Angeles[1] Harbor Gateway Transit Center	7th Street and Patton Avenue (San Pedro)	Weekday	36	54	60	--
			Saturday	61	60	61	--
			Sunday/Holiday	61	60	60	--
GTrans 2	Vermont Green Line Station	Normandie Avenue/Pacific Coast Highway[2]	Weekday	12	14	31	--
			Saturday	29	30	30	--
			Sunday/Holiday	29	30	30	--
Torrance Transit 1	Harbor Freeway Green Line Station	Carson/Hawthorne Hub (Torrance)	Weekday	40	45	60	--
			Saturday	55	55	55	--
			Sunday/Holiday	60	60	60	--

Source: LA Metro NextGen Proposals (July 2020), GTrans, Torrance Transit

1. Weekday Peak Period Only. Weekday Off-peak service begins at Harbor Gateway Transit Center.
2. Line 2 circles back to the Vermont Avenue C Line Station from its terminus on Normandie
3. Peak: 6-9am/3-7pm, Mid-day: 9am-3pm, Evening: 7pm-12am, Owl: 12-4am

Bus ridership decreases sharply on Vermont Avenue between the North and South Vermont Corridors. While Metro's 754 Rapid and 204 Local lines each had over 20,000 boardings per day prior to the COVID-19 pandemic, GTrans Line 2, the line with the highest ridership on the South Vermont Corridor, had only approximately 1,200 boardings on a typical weekday (see Table 2.2). However, concentrations of ridership can still be observed near important

destinations further south on Vermont Avenue, for instance, near the Harbor-UCLA Medical Center at the Vermont Avenue/Carson Street intersection, which has approximately 350 boardings per day.

Table 2.2: Pre-COVID Bus Ridership on North and South Vermont Corridors

Corridor	North Vermont			South Vermont[2]				
Line	Metro 204	Metro 754	Total-All Lines	Metro 205	Metro 550	G Trans 2	Torrance Transit 1	Total-All Lines
Boardings[1]	21,660	20,690	42,340	860	520	1,200	320	2,890
Alightings	21,660	20,730	42,390	820	550	1,220	290	2,880

Source: LA Metro, GTrans, Torrance Transit

1. Boardings and Alightings are averages of 2018 and 2019 Boardings and Alightings in Stop-level ridership data provided by LA Metro
2. Only the boardings/alightings on the bus stops on South Vermont Corridor are included

Upon full implementation of Metro's NextGen Bus Plan, Metro Line 550 would no longer serve the South Vermont Corridor, and service on Metro Line 205 would also be altered. Metro Line 205 would no longer serve Vermont Avenue at 182nd Street; the service on Vermont would start at Carson Street leaving the portion of the corridor between 182nd Street and Carson Street to be served by Torrance Transit Line 1. This change would force riders to make two transfers (GTrans to Torrance Transit to Metro) to be able to ride the full length of the corridor.

2.3 BICYCLE AND PEDESTRIAN FACILITIES

The South Vermont Corridor lacks a complete bicycle network. A gap exists between the bike lanes running along the north part of the corridor (extending from 120th Street to El Segundo Boulevard in the southbound direction and from 120th Street to Redondo Beach Boulevard in the northbound direction) and those running along the south part of the corridor (from south of Artesia Boulevard/SR-91 to Lomita Boulevard in the northbound direction, and from 182nd Street to Lomita Boulevard in the southbound direction). Among cross-streets intersecting the corridor, only 120th Street has a bicycle facility.

Sidewalks are present throughout the South Vermont Corridor on both sides of the street and marked crosswalks are provided at every intersection. However, some sidewalks lack adequate width for wheelchairs to pass through comfortably. Crosswalks at certain locations (such as at the intersection of Vermont and Artesia Boulevard/SR-91) are badly faded.

Figure 2.3 depicts the existing conditions of bicycle and pedestrian facilities on the corridor. It shows, proceeding clockwise from the top left corner, narrow sidewalks; the absence of bike lanes along Vermont Avenue; faded crosswalks; a missing sidewalk; and well-worn/outdated bus stop furniture that competes for sidewalk space.

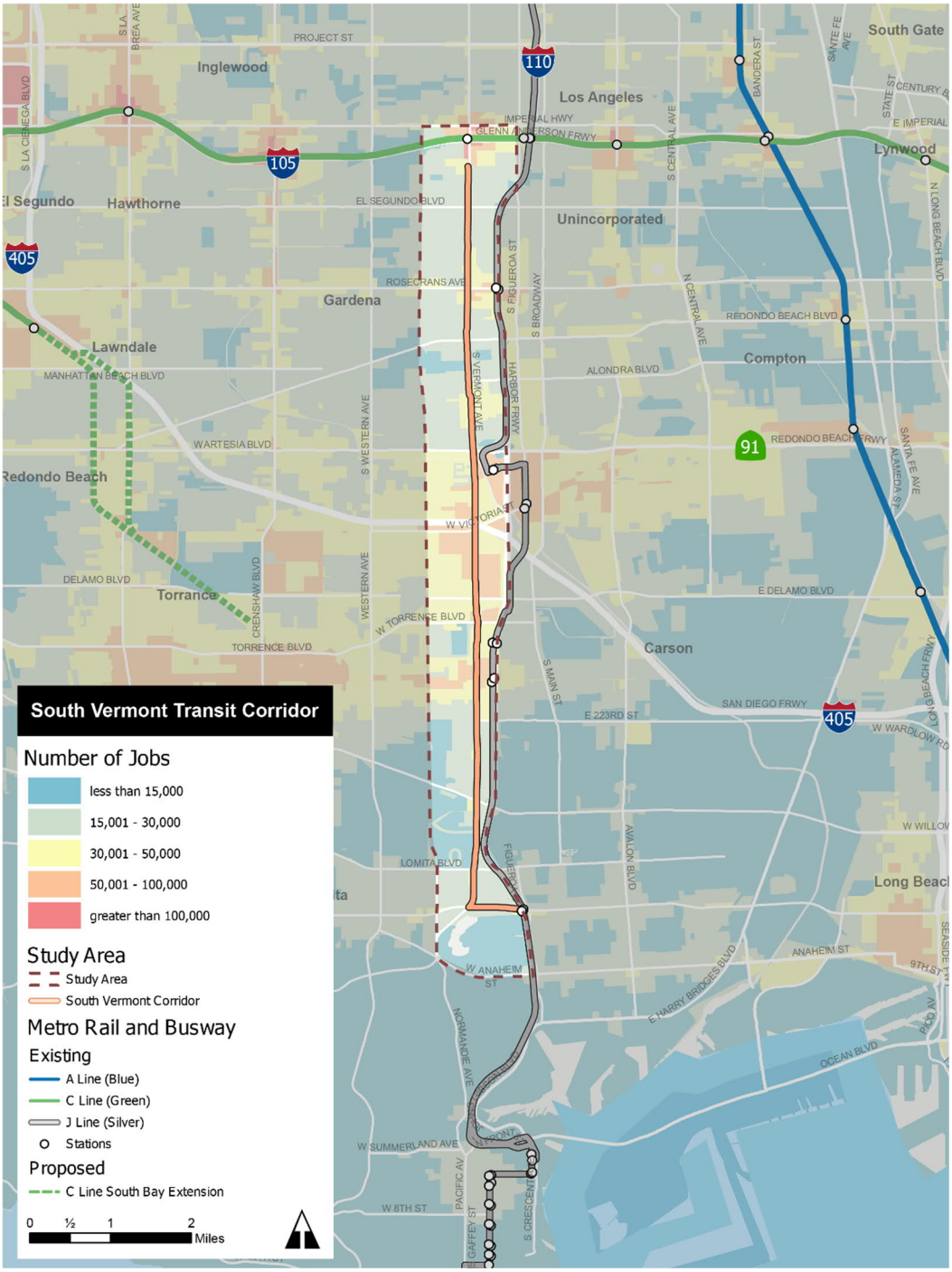
Figure 2.3: Collage of Existing Bicycle and Pedestrian Facilities on Vermont Avenue

2.4 JOB ACCESSIBILITY AND EQUITY

Unreliable and infrequent transit service along the South Vermont Corridor impacts residents' access to employment. Residents along much of the Study Corridor (between 120th Street and Artesia Boulevard/SR-91, and between 223rd Street and PCH) can access fewer than 30,000 jobs by public transit service within 30 minutes between 7 and 9 AM, as Figure 2.4 shows. The exception is the segment between Artesia Boulevard/SR-91 and 223rd Street, which has relatively high job accessibility by transit (between 30,000 and 100,000 jobs), owing to its proximity to the Harbor Gateway Transit Center and the higher number of bus routes and higher service frequency on this segment of Vermont Avenue.

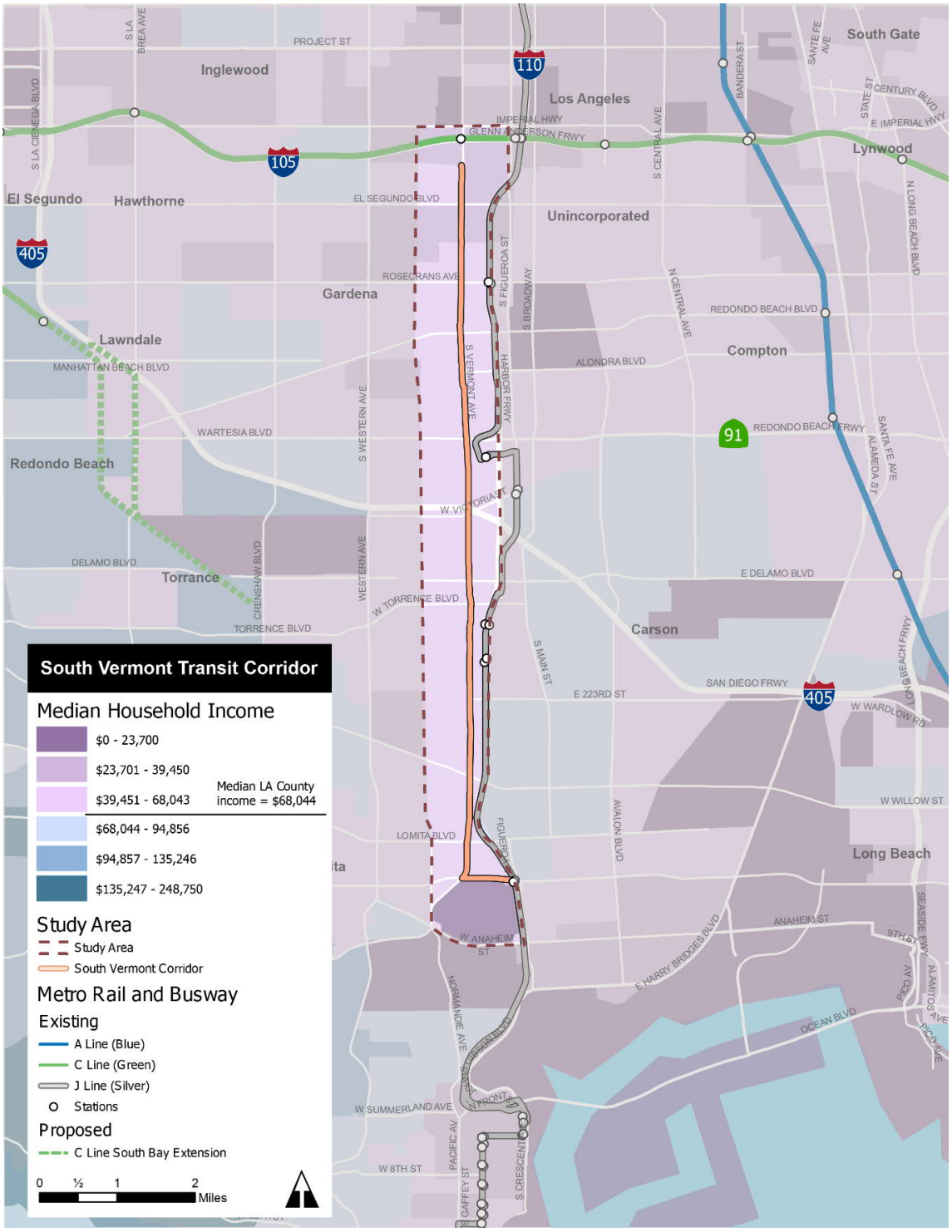
Low transit access is an equity problem since the communities around the South Vermont Corridor generally have low to medium household incomes. As Figure 2.5 shows, most census tracts along the corridor have a median household income lower than the Los Angeles County median household income of $68,044 per year.

Figure 2.4: 2018 Job Accessibility by Transit within 30 Minutes, 7-9 AM



Source: Accessibility Observatory at the University of Minnesota (U of M). Metro received the authorization from Andrew Owens of the University of Minnesota to make this map based on the source map in the GIS format he created.

Figure 2.5: Median Household Income



Source: American Community Survey (ACS) 5-year 2015-2019 estimates.

2.5 MARKET ANALYSIS

Although the length of the South Vermont Corridor is similar to that of the North Vermont Corridor, its travel market is much smaller. In 2017, approximately 580,900 person trips (of all transportation modes) had at least one trip end within the South Vermont Corridor, which is about one-third of those of the North Vermont Corridor. This is mainly because the South Vermont Corridor does not have as many regional destinations as the North Vermont Corridor, and the land use density is lower. As shown in Table 2.3, only 11 percent of these 580,900 person trips, or nearly 63,200 trips will stay within the corridor. Another 3.5 percent of the person trips travel between the North Vermont Corridor and South Vermont Corridor. In 2047, the number of total person trips going to and/or coming from the South Vermont Corridor is forecasted to grow 13 percent to approximately 658,100 trips.

Home-based work peak period (HBW-pk) trips, which are commuting trips from home to the workplace in the morning and from workplace to home in the evening, are usually the major travel market for transit services. As shown in Table 2.3, approximately 74,300 HBW-pk trips have at least one trip end within the South Vermont Corridor, which is about 34 percent of those of the North Vermont Corridor. Among these 74,300 person trips, nearly five percent stay within the South Vermont Corridor, and another three percent travel between the North Vermont Corridor and the South Vermont Corridor. In 2047, the number of HBW-pk person trips going to or/and coming from the South Vermont Corridor is forecasted to grow 16 percent to more than 86,200.

Table 2.3: Person Trips Going To and/or Coming from South Vermont Corridor, 2017 and 2047

	Home-based Work Peak Trips			All Daily Trips		
	2017	2047	% Growth	2017	2047	% Growth
Within South Vermont Corridor	3,500	4,040	16%	63,160	70,850	12%
Between South Vermont Corridor and North Vermont Corridor	2,170	2,720	25%	19,860	23,530	18%
Between South Vermont Corridor and rest of the Southern California region	68,670	79,470	16%	497,840	563,690	13%
Total	**74,340**	**86,230**	**16%**	**580,860**	**658,070**	**13%**

Source: LA Metro Model

In 2017, only 2.7 percent of all the person trips took transit as the main transportation mode (transit share). The HBW purpose is the largest market for transit service. As shown in Table 2.4, approximately 52 percent of all the transit trips with at least one trip ending in the South Vermont Corridor are HBW trips. The transit share of the HBW purpose is about 7.1 percent, the highest among all the trip purposes. Home-based University (HBU) trips have a comparable transit share to the HBW trips (6.7 percent). The Home-based Other (HBO) trips and Non-home based (NHB) trips have a large number of trips, but the transit share is only around one percent. A continuous and more efficient transit service along the South Vermont Corridor could potentially increase the transit mode share of these markets. The enhanced transit service could provide the communities along the corridor more access to health care, shopping, and other essential services.

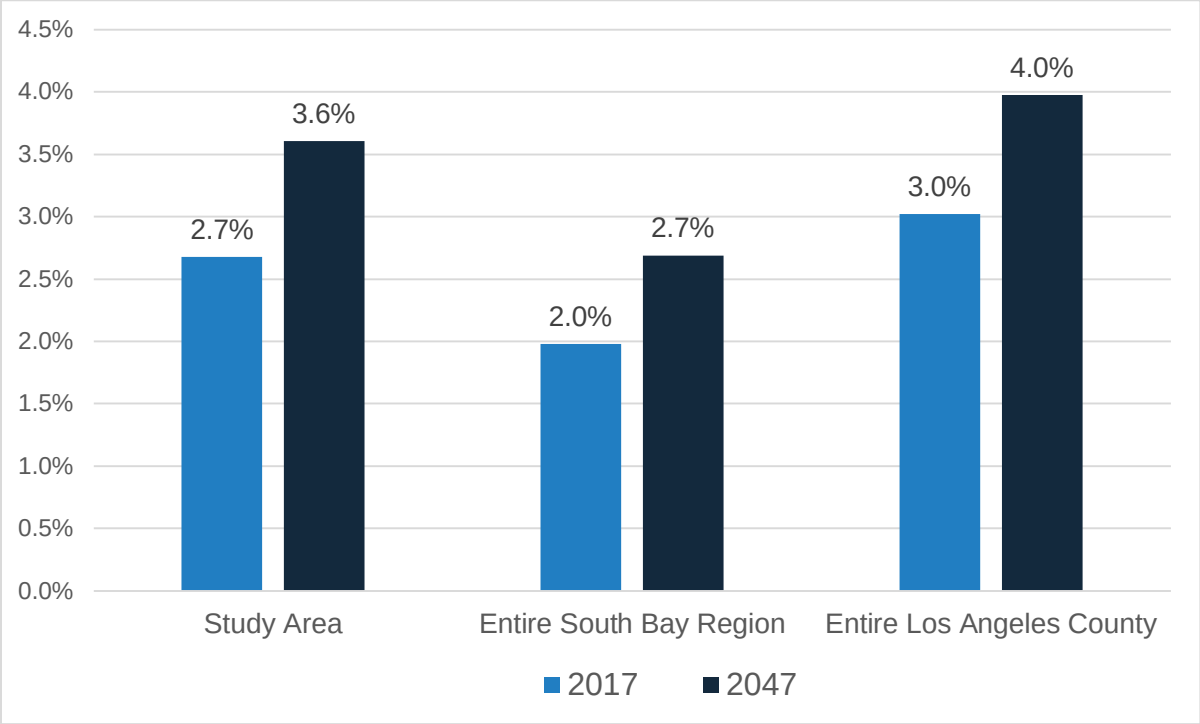
Table 2.4: Transit Trips and Transit Mode Share of the Study Area by Trip Purpose, 2017

	HBW	HBU	HBO	NHB	All Purposes
Person Trips	115,260	39,910	267,170	158,490	580,850
Transit Trips	8,140	2,680	2,880	1850	15,560
% of Daily Transit Trips	52%	17%	19%	12%	100%
% Transit Share	7.1%	6.7%	1.1%	1.2%	2.7%

Source: LA Metro Model

It is estimated that the enhanced regional transit network created by Measure M projects will increase the transit share in the future year 2047. The operation of a BRT, LRT, or HRT service along the North Vermont Corridor is one of the Measure M projects. As shown in Figure 2.6, the transit share for the trips going to and coming from the South Vermont Corridor is forecasted to increase from 2.7 percent in 2017 to 3.6 percent in 2047. The 2047 transit share is forecasted to be higher than that of the entire South Bay subregion, but still lower than that of the entire Los Angeles County. Extending the BRT/LRT/HRT service on the North Vermont Corridor to the South Vermont Corridor is anticipated to increase the transit share for the trips going into or coming from South Vermont Corridor.

Figure 2.6: Transit Share, 2017 and 2047



Source: LA Metro Model


12
Metro

3. INSTITUTIONAL STAKEHOLDER ENGAGEMENT INPUTS

Metro initiated an early and sustained outreach process targeting key public and partner agency stakeholders along the corridor. The Vermont South Bay Extension Feasibility Study focused its public outreach program by targeting key public agencies and large institutional stakeholders along the Vermont corridor, south of 120th Street into Metro J Line (Silver) PCH transitway station. Metro focused efforts on these high-level stakeholders rather than the public-at-large because the South Bay segment of the Vermont Transit Corridor under study is not funded, and has not been identified as a project.

The goals for the public outreach program included:

- Identifying key institutional stakeholders along the corridor
- Eliciting stakeholder feedback
- Incorporating stakeholder feedback into the feasibility study

The study outreach also included a Technical Working Group (TWG) comprised of the three primary municipalities along or near the study corridor: Gardena, Torrance, and Los Angeles. Additionally, other public agencies that potentially could be affected were invited to participate. These included:

- Gardena Transit (GTrans)
- Torrance Transit
- City of Los Angeles Department of Transportation
- County of Los Angeles Department of Public Works
- Los Angeles Department of Transportation
- Union Pacific Railroad
- Caltrans District 7

The Feasibility Study was completed over a 12-month period. The stakeholder outreach program was conducted in three phases to align with the study's major milestones:

- From April to June 2021, Metro staff initiated the elected officers' briefings and the first round of TWG and institutional stakeholder meetings. These meetings introduced the Study and provided an overview of the corridor's existing conditions and mobility challenges.
- In November 2021, the second phase of TWG and institutional stakeholder meetings were held. This phase served to present the preliminary concepts and obtain initial feedback.

- The final phase of outreach took place in February 2022. The performance and benefits of the proposed transit concepts were presented at these meetings to the TWG and the institutional stakeholders. The potential impacts of the concepts were discussed as well.

All communication and engagement for the Study occurred during the COVID-19 global pandemic. Therefore, all the TWG meetings and stakeholder engagement meetings were conducted virtually. TWG meetings were held in a standard virtual meeting format utilizing MS Teams that allowed for free communication similar to an in-person meeting. Stakeholder meetings, however, were conducted in a Zoom webinar format. Only Metro staff and project team members were on camera during presentations; questions, answers, and discussions were mainly conducted via the chat and through the question/answer function within the Zoom platform. Nevertheless, stakeholders had the opportunity to ask questions and make oral comments.

Several elected officials representing segments of the South Vermont Corridor as well as some cities close to the study corridor were engaged in the stakeholder outreach process. The stakeholders engaged are included in Figure 3.1.

Figure 3.1: Institutional Stakeholders

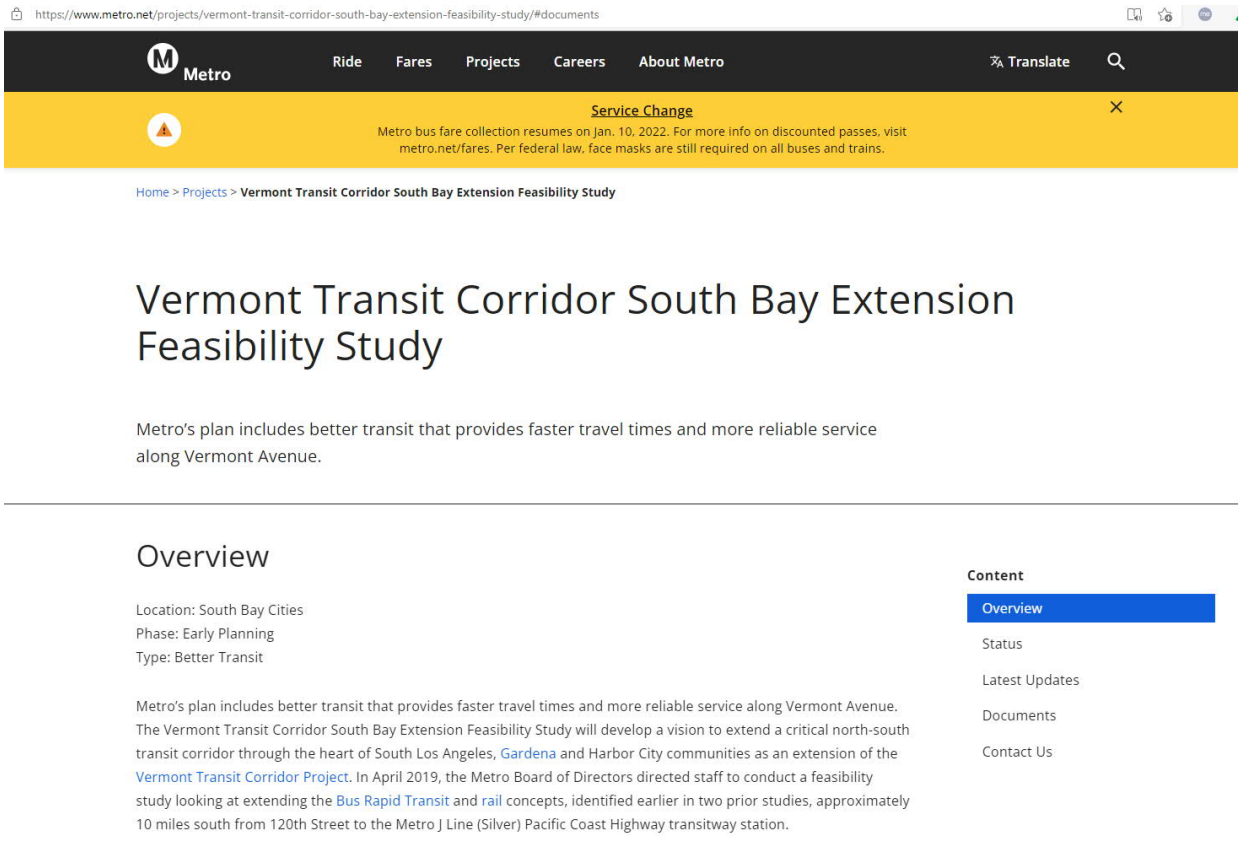
County of Los Angeles Supervisor Janice Hahn Supervisor Holly Mitchell	**City of Gardena** Mayor and City Council City Manager Public Works Director GTrans	**State** Senator Steve Bradford Assemblymember Mike Gipson Assemblymember Autumn Burke Assemblymember Al Muratsuchi
Metro Board Deputies Metro staff	**City of Carson** Mayor and City Council City Manager Public Works Director	**Federal** Congresswoman Maxine Waters Congresswoman Nanette Barragan Congressman Ted Lieu
City of Los Angeles City Councilmember Joe Buscaino Office of Mayor Eric Garcetti	**City of Lomita** Mayor and City Council City Manager Public Works Director	**Neighborhood Councils** Harbor Gateway North Harbor Gateway South Harbor City Wilmington Northwest San Pedro

City of Torrance Mayor and City Council City Manager Public Works Director Torrance Transit	**South Bay Council of Governments** Jackie Bacharach Redondo Beach Councilmember Christian Horvath, Transportation Committee Chair	**Other Highly Engaged Stakeholders - Chambers** Gardena The LA Gateway Wilmington Lomita Greater Torrance Carson San Pedro South Bay Associations of Chambers of Commerce

The community at large was invited to receive information about the Study and provide comments via the project webpage on Metro's website[4]. As shown in Figure 3.2, the webpage provides an overview, a fact sheet, and status updates on the Study. The public notifications of the institutional stakeholder meetings were not only distributed to the identified institutional stakeholders but also released on the study webpage and other Metro communication channels such as Metro Community Relations Monthly Update. The presentation slides and recordings of the institutional stakeholders are available on the webpage as well.

[4] https://www.metro.net/projects/vermont-transit-corridor-south-bay-extension-feasibility-study/#overview

Figure 3.2: Vermont Transit Corridor South Bay Extension Feasibility Study Webpage



During the stakeholder engagement process, the Metro team gathered inputs and feedback regarding the proposed BRT and rail concepts and alignments, potential station locations and development opportunities, project funding, potential impacts to the community, transit ridership and performance, and a potential further extension of the Vermont Transit Corridor to San Pedro.

The following key takeaways were received from the stakeholder outreach process:

- General support for the Vermont Transit Corridor South Bay Extension: Stakeholders generally support the extension of the BRT/rail concepts to be implemented along the North Vermont Corridor to the South Bay.
- Advocate for a Further Extension to San Pedro: Stakeholder meeting participants raised several comments about extending the BRT/rail concept alignment into San Pedro in all three rounds of meetings. This topic dominated the second round of the stakeholder meetings. Their reasons included: San Pedro has been underfunded with

transit projects; Los Angeles waterfront development and expected growth in cruise ship port of calls would create a need or attract riders.

- Funding: Stakeholder meeting participants asked about the potential cost of various alternatives; whether Metro has identified funding sources for the implementation of the Study; where funding sources potentially could come from; different sources including government grants, public-private partnerships, transit-oriented development in collaboration with municipalities purchasing/leasing land around station sites.
- Traffic and Parking Impact Concerns: Some stakeholders are concerned about the loss of a vehicular travel lane in the proposed BRT concepts; the loss of on-street parking spaces in the BRT and LRT concepts; increased traffic congestion; and issues accessing I-405 and SR-91.
- Environmental Impact Concerns: Some stakeholders are concerned with other environmental impacts stemming from the construction and operation of transit concepts. Some are also concerned about geotechnical effects and safety if the rail concepts are underground and whether a rail system could be built near the PCH/I-110 interchange.
- Concerns from Torrance Transit and GTrans: Both of these municipal transit operators expressed concerns that the transit concepts proposed along the study corridor would compete with their bus service for ridership. A question was raised about whether GTrans would take over Metro Line 205 and if dedicated bus lanes are under consideration currently. Metro and GTrans are currently meeting to discuss both options.
- Station development urban design elements: Some stakeholders raised questions about the First/Last Mile (FLM) connections and lighting conditions around potential station locations. They were also wondering what future development at the stations will be like.

4. Proposed Transit Concepts

4. PROPOSED TRANSIT CONCEPTS

This Study assesses the feasibility of extending transit concepts that were proposed for the North Vermont Corridor to the South Vermont Corridor. Those transit concepts include three high-capacity transit modes: Bus Rapid Transit (BRT), Light Rail Transit (LRT), and Heavy Rail Transit (HRT).

4.1 BUS RAPID TRANSIT (BRT)

Figure 4.1: Metro G Line (Orange) - An Exclusive Dedicated Busway

The BRT concept would convert one general-purpose travel lane in each direction to a dedicated bus-only lane. Both a Center-Running concept, with BRT lanes located in the middle of the street, and a Side-Running concept, with a BRT lane located on the outer side of general travel lanes, have been considered. In constrained segments, if needed, the bus could operate in mixed-flow traffic. Generally, BRT is also associated with additional infrastructure to elevate the bus transit experience, such as enhanced bus station stop design and amenities, off-board fare collection, traffic signal priority, and opportunities for TOC. Boarding on only the right side of the bus is assumed for this Study to be consistent with Metro's current bus fleet.

4.2 LIGHT RAIL TRANSIT (LRT)

Figure 4.2: Metro E Line (Expo)

The LRT concept is a dual-track guideway operating 'high-floor' LRT vehicles that are used on all current Metro LRT lines, such as the A (Blue), C (Green), E (Expo), and L (Gold). The LRT would be powered by an overhead catenary system and could operate at-grade, elevated, or below grade. The at-grade LRT guideway would operate in the median of the roadway, separated from adjacent traffic, but would allow cross-

traffic at select intersections (grade crossings).

4.3 HEAVY RAIL TRANSIT (HRT)

The HRT concept is a dual-track guideway that would be compatible with Metro's current HRT vehicles that are used on the B (Red) and D (Purple) Lines. The HRT vehicles are powered by a 'third' contact rail that is located alongside the tracks. While HRT vehicles can operate at-grade, they are typically located in exclusive corridors, either elevated or below grade, to avoid any public crossing conflicts with the contact rail.

Figure 4.3: Metro B Line (Red)

4.4 CHARACTERISTICS OF TRANSIT CONCEPTS

The characteristics of the transit concepts assessed for the South Vermont Corridor are summarized below in Table 4.1.

Table 4.1: Characteristics of Transit Concepts under Assessment

	Center-running BRT	Side-running BRT	LRT	HRT
Right-of-way (ROW)	Exclusive with street crossings	Exclusive with street crossings/shared Lane	Exclusive with or without street crossings	Exclusive
Vehicle Length (feet)	40-60 / bus		90 / car	75 / car
Passenger Capacity[1]	49-74 / bus		133 / car	131 / car
Preferred Maximum Average Station Spacing[1]	1.25 miles		1.5 miles	1.5 miles
Minimum Station Platform Length (feet)	150	120	270	450
Vehicle Boarding Height	14" from street level for level boarding	From curb height to 10" from street level for near-level boarding	3.25' (from top of rail)	3.67' (from top of rail)
Maximum Operating Speed	Roadway posted speed limit		35-65 mph	70 mph
Typical Number of Buses or Train Cars	1 bus		Up to 3 cars (peak period)	Up to 6 cars (peak period)
Minimum Headways[2] (peak period)	N/A		5 minutes (for a single line)	4 minutes (for a single line)
Maximum Headways (normal weekday operations)	10 minutes peak 15 minutes off-peak		10 minutes (for a single line)	10 minutes (for a single line)
Vertical Alignment	At-grade (street level)		Primarily at-grade (street level); Potentially above or below street level	Primarily underground; Potentially at-grade or above grade
Effects to Existing Travel Lanes	Medium-High	Medium	High (at-grade); Medium (elevated) Low (below grade)	Low
Cost Factor	Low to Medium	Lowest	At-grade: Medium Grade-separated: High	Highest

[1] Source: 2020 Metro Transit Service Policies & Standards; 2021 Visioning BRT Design Guidelines

[2] Further analysis regarding Minimum Headways when comparing modes should be studied further in the next planning phase for the Vermont Corridor South project.

4.5 BRT CONCEPTS

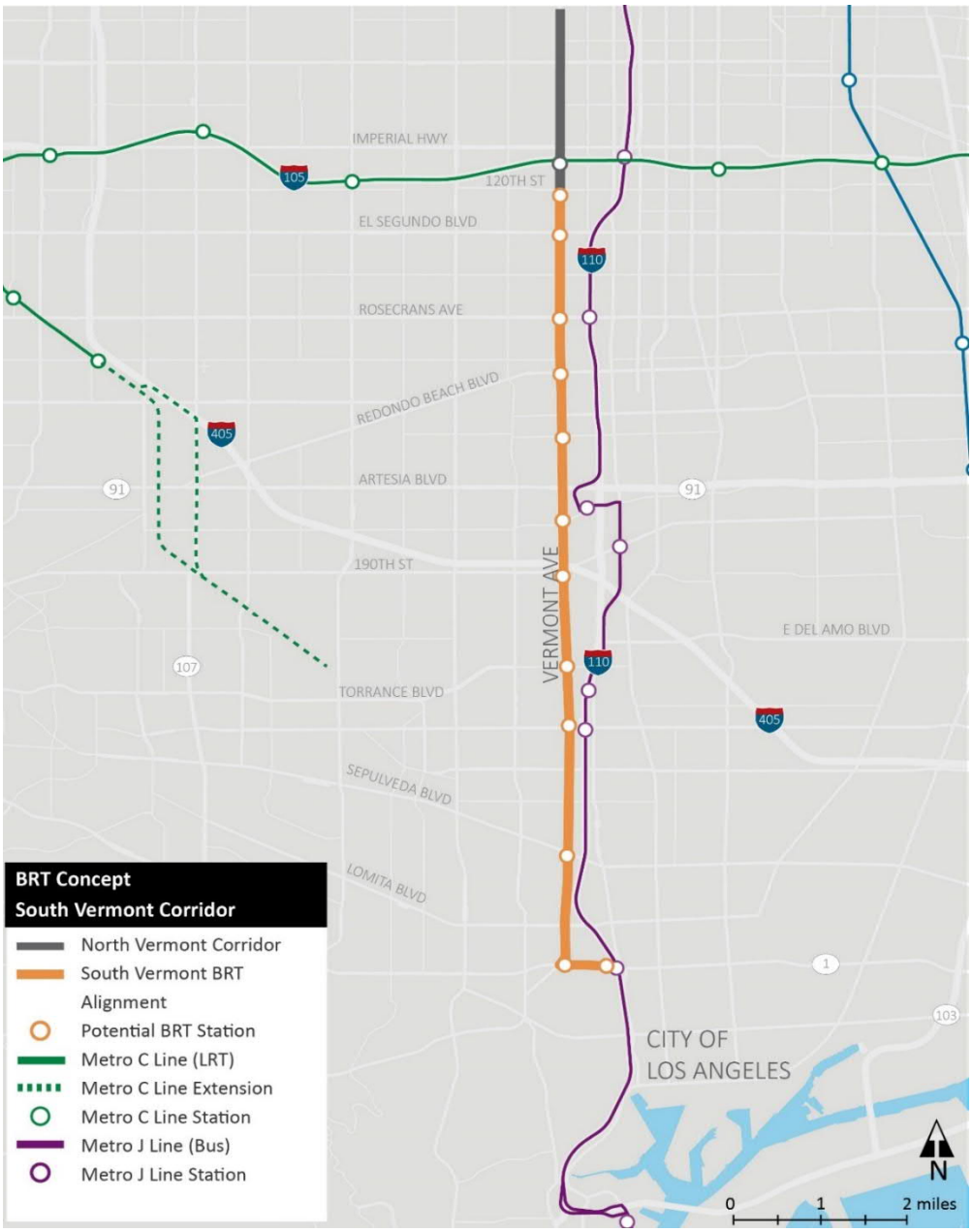
Two BRT concepts were proposed for the North Vermont Corridor and were assessed for their extension to the South Vermont Corridor:

- End-to-End Side-Running BRT
- Combination Side and Center-Running BRT. Side-Running dedicated bus lanes were proposed north of Gage Avenue to minimize impacts to the existing roadway infrastructure. Center-Running BRT was proposed south of Gage Avenue, where the existing roadway widens considerably.

For the South Vermont Corridor, a Center-Running BRT concept and a Side-Running BRT concept were developed. Near the southern terminus, the BRT would be in mixed-flow operation in the curb lane on PCH between Vermont Avenue and the Metro J Line (Silver) PCH transitway station in both BRT concepts. While a Combination Side-/Center-Running BRT could be implemented along the South Vermont Corridor, it was not specifically designed and assessed as a separate concept since there are no major flaws to implementing an end-to-end Center-Running BRT alignment.

The primary alignment for the Center- and Side-Running BRT concepts would provide service along Vermont Avenue and PCH between 120th Street and the Metro J Line (Silver) PCH transitway station, serving 12 stations en route as shown in Figure 4.4.

Figure 4.4: BRT Concepts' Alignment



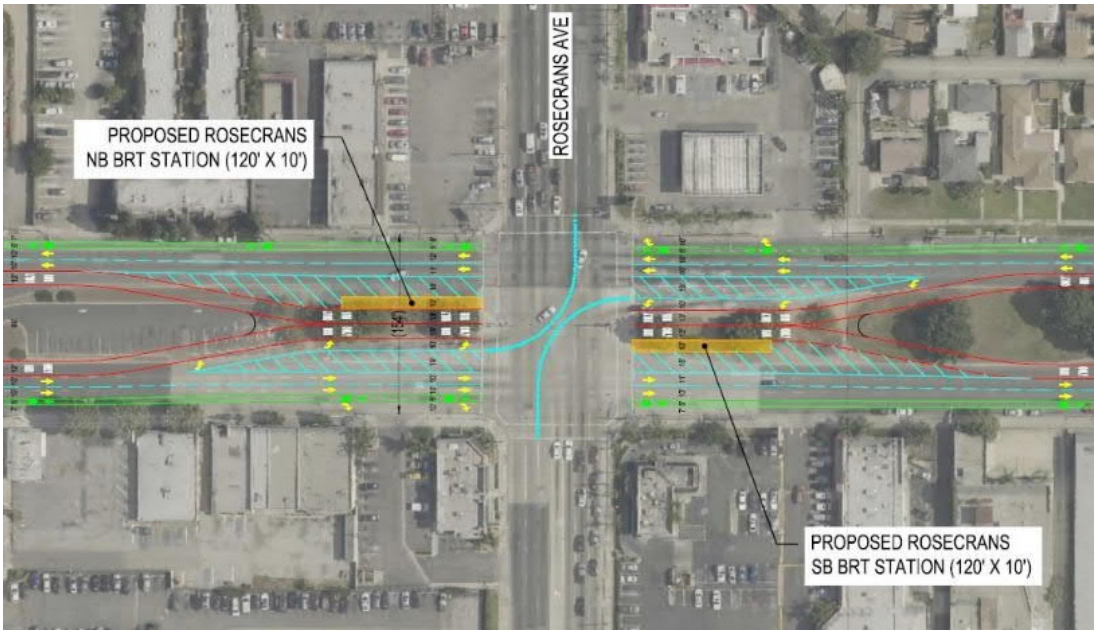
4.5.1 CENTER-RUNNING BRT

The Center-Running BRT scenario would provide high-quality, frequent BRT service by converting the northbound and southbound inside vehicular travel lanes on Vermont Avenue into dedicated BRT lanes between 120th Street and PCH, as shown in Figure 4.5. The BRT would run in mixed traffic flow along PCH between Vermont Avenue and the Metro J Line

(Silver) PCH transitway station. Generally, Center-Running BRT is preferred from an operations standpoint since it separates the bus from general traffic and would avoid conflicts with curb parking and right-turning vehicles. Center-Running BRT would offer passengers the fastest travel times and the most reliable service for a BRT concept; see Section 5 for further discussion on the performance of the BRT concepts.

Center-Running BRT Stations are typically ten feet by 120 feet and are 'split' on either side of the intersection. The station stops are located on new islands (or medians) between the BRT Lane and the adjacent travel lane, in line with the left-turn pocket, as shown in Figure 4.5.

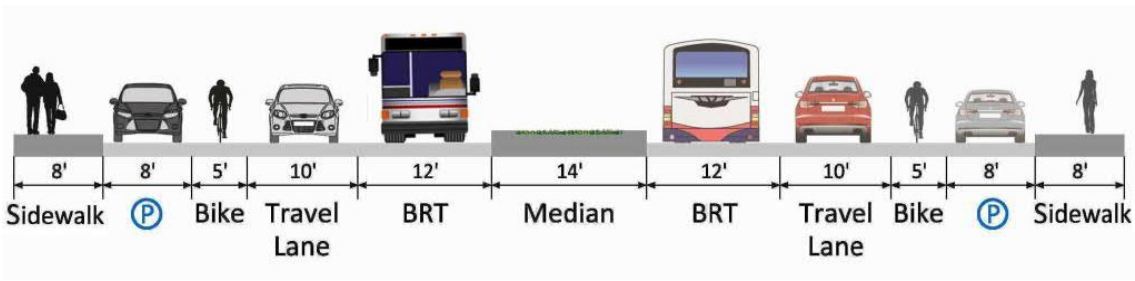
Figure 4.5: Typical Center-Running BRT Station at Intersections with Wide Landscaped Medians



Left-turn movements across the BRT lanes might not be permitted at uncontrolled locations. As described in Section 6, these left turns might be diverted to another signalized intersection.

Figure 4.6 is a typical cross-section of the Center-Running BRT concept for the segments on Vermont Avenue south of I-405.

Figure 4.6: Typical Cross-Section of Center-Running BRT



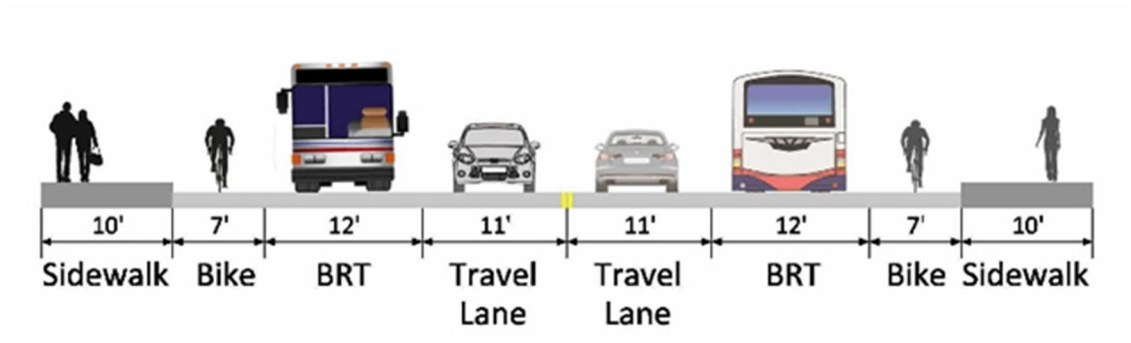
The main challenges to implementing Center-Running BRT on South Vermont Corridor include:

- Widening: In localized areas, roadway widening may be required to accommodate a station stop or the Class II bike lane.
- UPRR Track: It is assumed the UPRR freight track would continue its current operating plan along Vermont Avenue, but further coordination with UPRR in future design phases would be needed to confirm if any new arrangements would be required to operate BRT.
- Intersection capacity: All the left-turn pockets at signalized intersections would need to be reconfigured to the right side of the bus lanes, which could lead to the reduction of through and right-turn lanes. Left turns at unsignalized intersections might be eliminated and diverted to signalized intersections. Dual left-turn lanes at signalized intersections might be reduced to a single left-turn lane.

4.5.2 SIDE-RUNNING BRT

The Side-Running BRT scenario would convert the northbound and southbound outside vehicular travel lane to a dedicated BRT lane on Vermont Avenue between 120th Street and PCH. The bus would operate in mixed-flow traffic on PCH from Vermont Avenue to the Metro J Line (Silver) PCH transitway station. A continuous Class II bike lane is proposed in both directions on Vermont Avenue in the study corridor. The BRT Lane would travel between a general vehicular travel lane and the Class II bike lane as shown in Figure 4.7. The Side-Running BRT lane would not be physically separated from general travel lanes and buses may come into conflict with parking maneuvers and right-turn movements.

Figure 4.7: Typical Section of Side-Running BRT Lane Adjacent to Bike Lane



Side-Running BRT Stations are typically eight feet by 120 feet in size and are located on the far side of the intersection as shown in Figure 4.8. The station widths are typically narrower than center-running BRT stations since the station platforms are typically either an extension of the sidewalk or bordered by a bike lane. In constrained locations, the length of the station stop

could be reduced to 75 feet. One challenge with Side-Running BRT stations is locating a station stop close to the intersection, where there may be existing businesses with one or more driveways. At some locations, such as the one shown in Figure 4.9, driveway conflicts may require the station location to shift to the near side of the intersection or further up on the far side of the intersection.

Figure 4.8: Typical Side-Running BRT Station

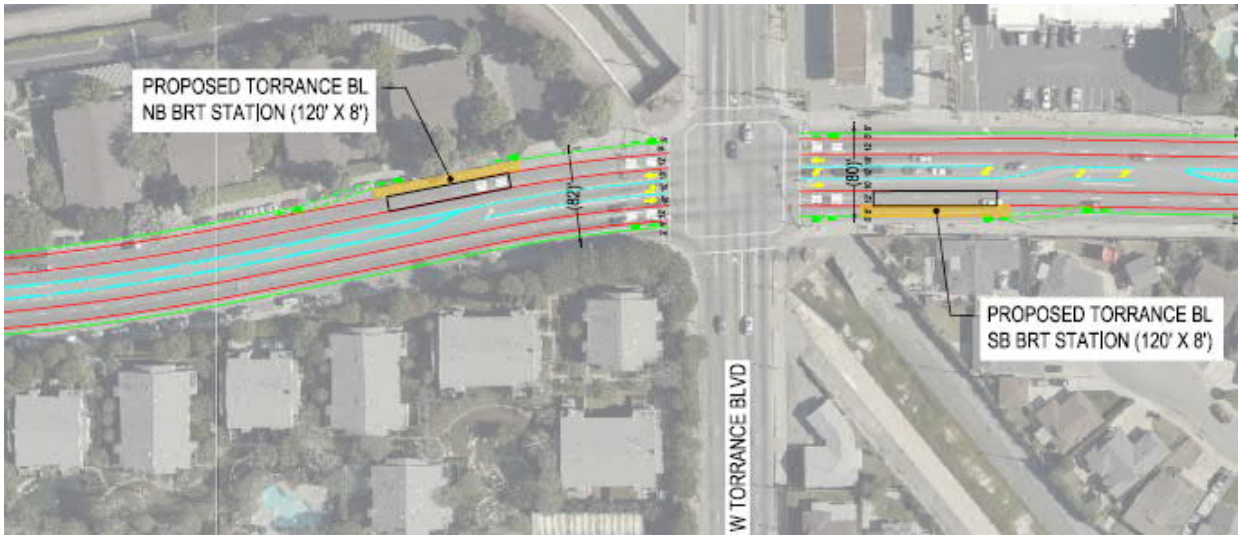
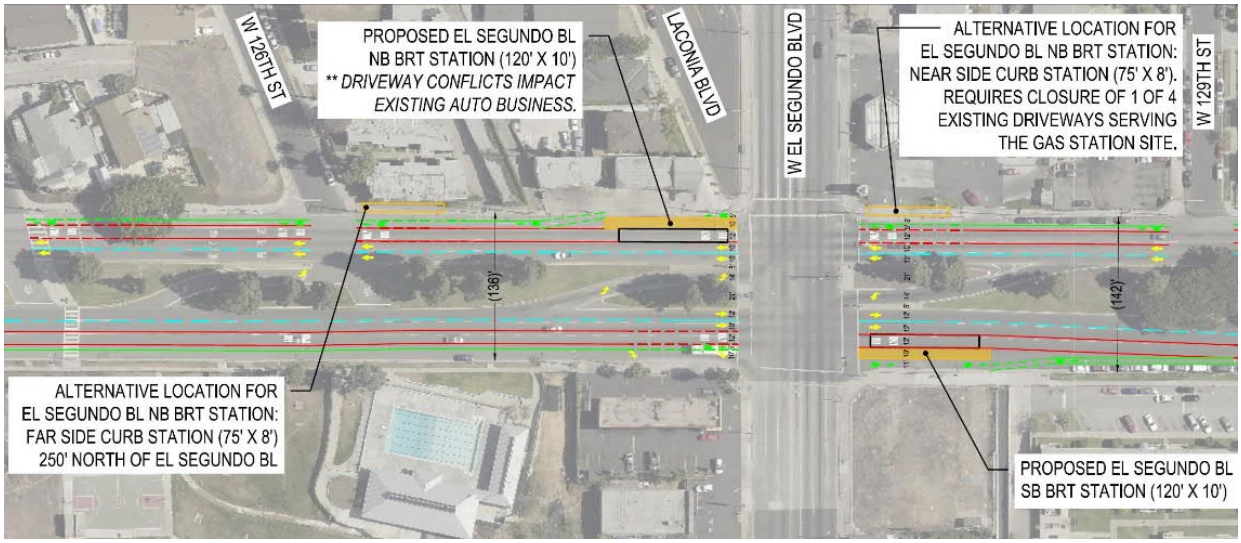


Figure 4.9: Example of Driveway Conflicts with Typical Side-Running BRT Far Side Station Locations



The main challenges to implementing Side-Running BRT on South Vermont Corridor include:

- Widening: In localized areas, roadway widening may be required to accommodate a station stop or the Class II bike lane.
- UPRR Track: It is assumed the UPRR freight track would continue its current operating plan along Vermont Avenue, but further coordination with UPRR in future design phases would be needed to confirm if any new arrangements would be required to operate BRT.
- Intersection Capacity: Due to the loss of a through lane on Vermont Avenue, the capacity of all the signalized intersections on Vermont Avenue would be reduced.
- Station Locations: Potential for conflicts with existing driveways may require near-side stations or stops located further from the intersection.
- Conflicts: One of the main challenges of Side-Running BRT is that the buses could experience conflicts from both sides: from general vehicles crossing/entering the bus lane to enter/exit parking spaces or to make right-turn movements. The more often general vehicles enter or cross the BRT lane, the more delay will be experienced by the BRT buses, impacting the speed of operation and/or travel time for BRT service. As noted in Section 5, the Side-Running BRT is forecast to operate with the slowest travel time and longest runtime.

4.6 RAIL CONCEPTS

Three rail concepts were proposed for the North Vermont Corridor and were assessed for their extension to the South Vermont Corridor:

- A Center-Running LRT concept partially at-grade (south of Slauson Avenue) and partially below-grade (north of Slauson Avenue)
- A fully below-grade HRT concept (HRT1) with no connection to existing Metro Lines
- A fully below-grade HRT concept (HRT2) connected to the Metro B Line (Red) near 1st Street, south of the Vermont/Beverly Station

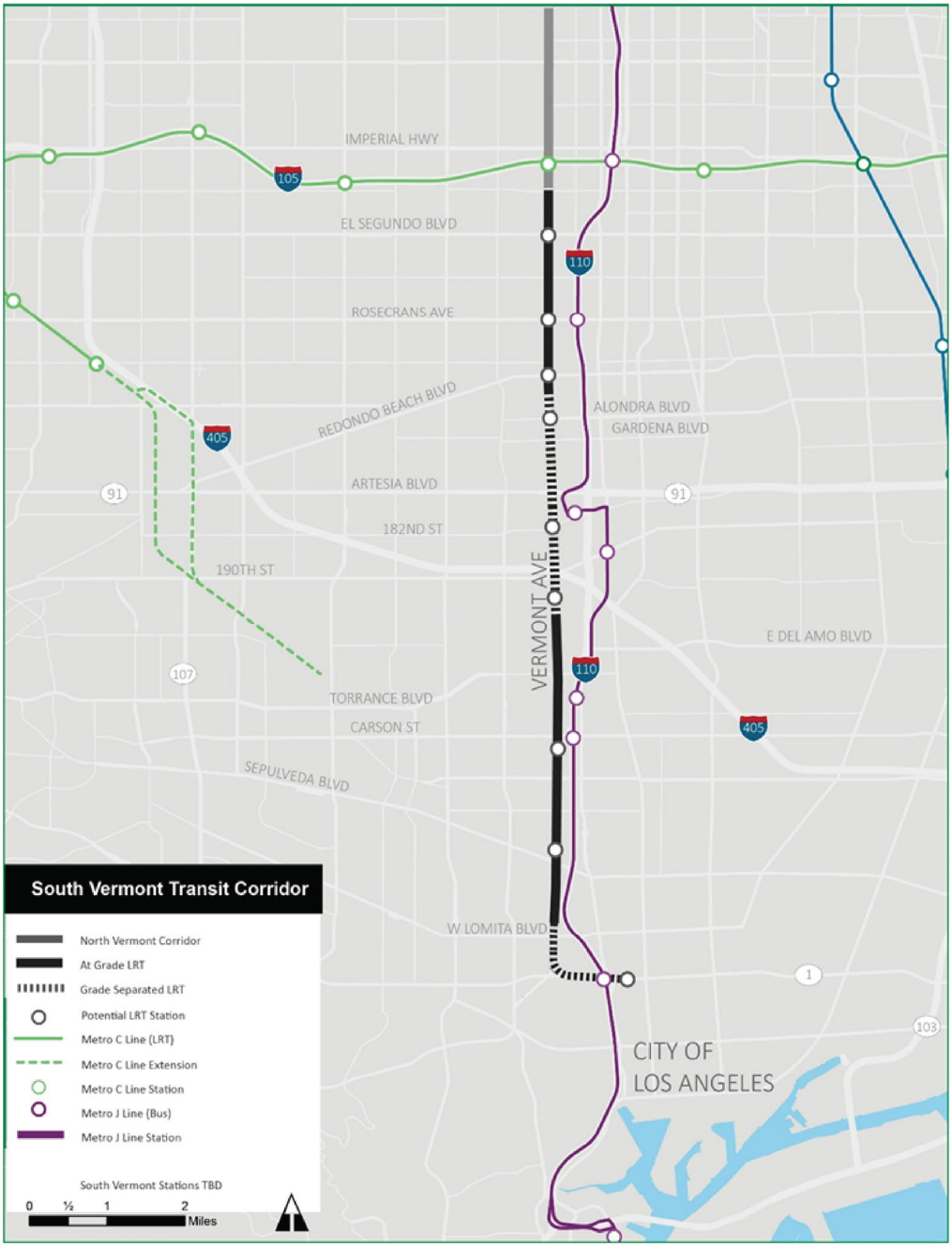
4.6.1 LRT

The LRT concept is a dual-track guideway consisting of high-floor vehicles, consistent with Metro's current LRT vehicle fleet. The LRT guideway was designed to comply with the Metro Rail Design Criteria (MRDC) and developed to consider cost-effectiveness, service performance, and increase in transit ridership. The guideway is primarily at-grade center-running along Vermont Avenue and then transitions to operating on the north side of PCH to its southern terminus. An initial screening following the Milestone 1 criteria of Metro's Grade Crossing Safety Policy was performed for 25 signalized intersections along Vermont Avenue. All the intersections fell within the 'at grade operation should be feasible' or 'possible at grade operation' categories, the latter which calls for 'engineering study required to define at grade

operation'. However, grade-separated segments have been proposed to avoid significant permanent effects on elements such as traffic, ROW, and freight operations.

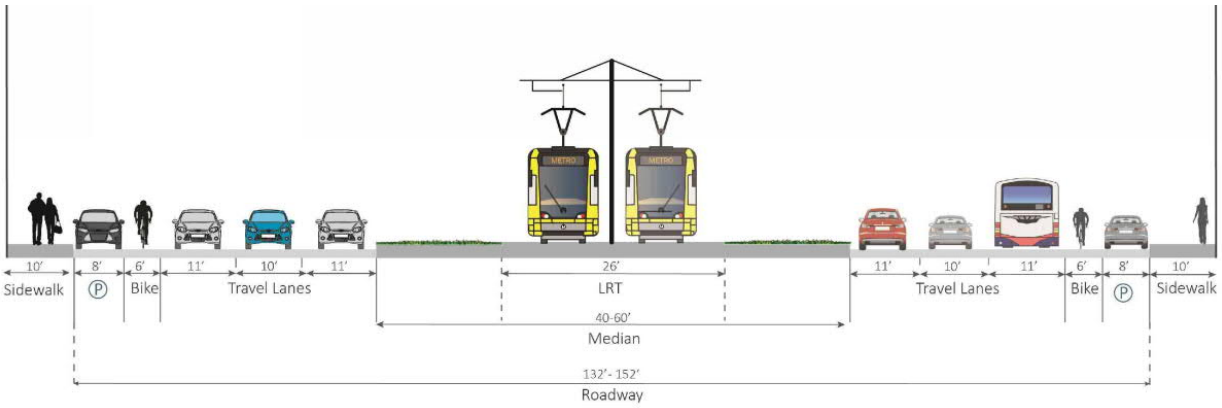
The LRT concept would have nine stations (center platform configuration) as shown in Figure 4.10.

Figure 4.10: Map of Proposed LRT Concept along South Vermont Corridor



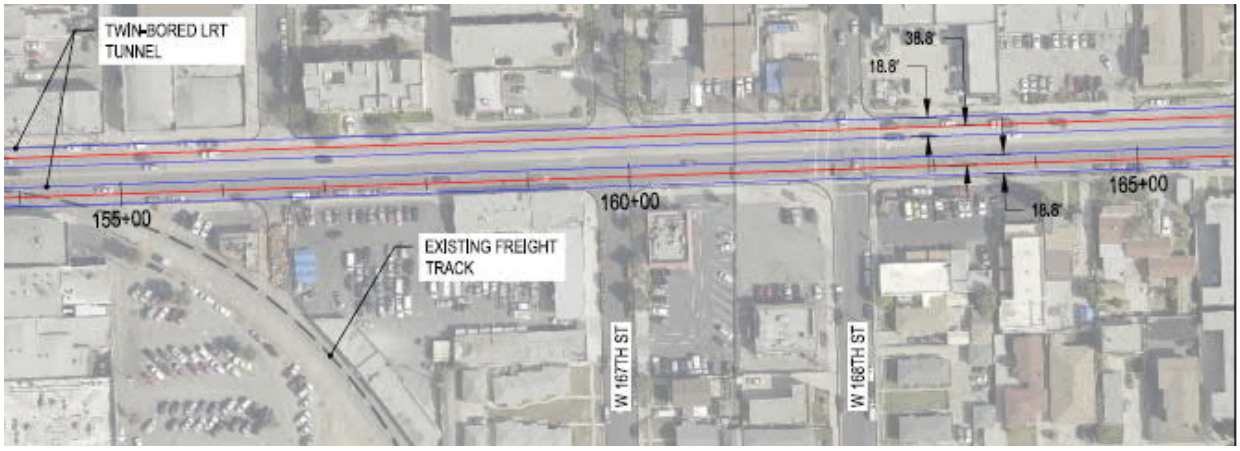
In the northern part of the South Vermont Corridor, the LRT guideway would be located within the existing median, as shown in Figure 4.11. This configuration would require removal/modifications to existing landscaping and trees but would maintain the existing travel, parking, and turn lane configurations in both directions on Vermont Avenue. Similar to the BRT concepts, the unsignalized left-/U-turn lanes would be removed to minimize the number of at-grade crossings to increase safety and improve travel time.

Figure 4.11: Typical Section of At-Grade LRT in Landscaped Median



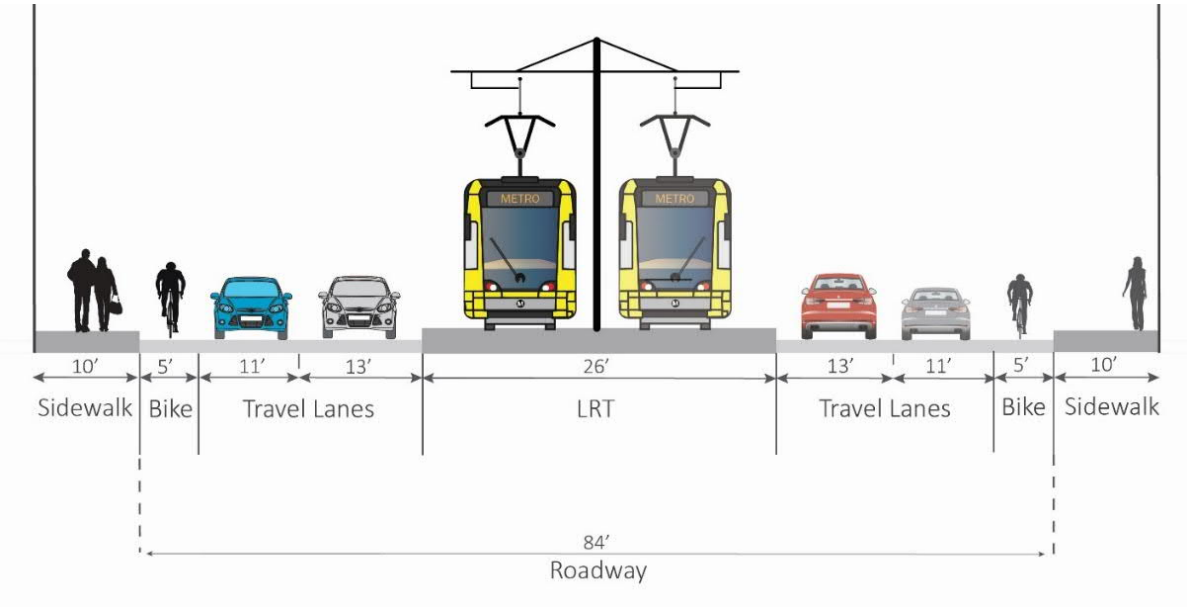
To avoid significant permanent impacts to traffic, roadway, UPRR track, and/or ROW, an underground LRT alignment is proposed through the narrowest segments of the corridor (see Figure 4.12).

Figure 4.12: Underground LRT Concept Near 168th Street



The at-grade LRT alignment in the southern part of the corridor on Vermont Avenue proposes to eliminate on-street parking in order to provide a bike lane and two travel lanes in each direction as shown in Figure 4.13. Stations in this part of the corridor are proposed to be shifted farther from the intersection. While this may introduce a mid-block crossing for station access, it would maintain left-turn lanes at the major cross-streets.

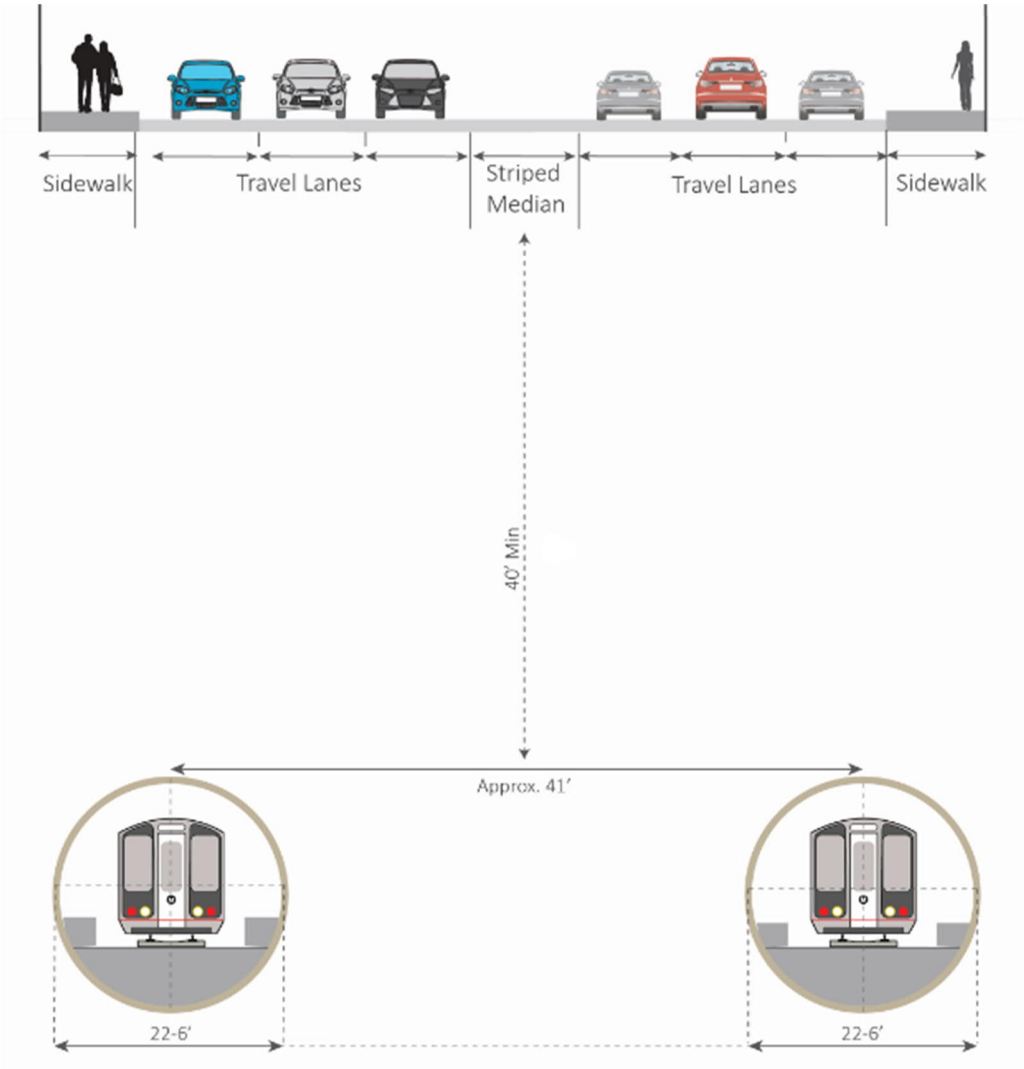
Figure 4.13: Typical At-Grade LRT Section Between Stations



4.6.2 HRT CONCEPTS

The HRT alternative for the South Vermont Corridor Feasibility Study is an underground grade-separated alignment assuming Metro's current HRT fleet. It is assumed that the North Vermont Corridor Project terminus station would be located at Vermont Avenue/Athens (I-105) and that the tie-in for these two corridor projects would be located south of this station. Most of the alignment would be a twin-bore tunnel design (Figure 4.14) with exceptions for the stations and tie-in points for the North and South Vermont Corridor Projects. The HRT alignment is consistent with Metro's current design criteria and is compatible with the existing environment.

Figure 4.14: HRT Twin-Bored Tunnel Concept



4.7 STATION LOCATIONS

Station locations for each transit concept, which are shown below in Table 4.2, were primarily selected based on station spacing; proximity and accessibility to existing activity generators/attractors; future potential development; and regional connectivity opportunities.

During the development of the conceptual designs, several rail stations were eliminated due to proximity to adjacent stations and/or to avoid significant impacts. Additionally, some stations were shifted further away from the identified cross-street to minimize traffic impacts at the major intersections. The two BRT concepts would have the greatest number of stations (12) while the HRT concepts would have the lowest number of stations (8). This is mainly because the spacing between stations is usually shorter for the BRT service than for the HRT service.

Table 4.2: Station Locations for Transit Concepts

Stations - South Vermont Corridor	Distance[1] (miles)	BRT	LRT	HRT
120th Street (North Vermont Corridor)	0.00	X		
El Segundo Boulevard	0.50	X	X	X
Rosecrans Avenue	1.00	X	X	X
Redondo Beach Boulevard	0.66	X	X	
164th Street/Gardena Boulevard	0.75	X	X	X[2]
182nd Street/Harbor Gateway Transit Center	1.00	X	X	X
190th Street	0.66	X	X	X
Torrance Boulevard	1.08	X		
Carson Street	0.72	X	X	X[2]
Sepulveda Boulevard	0.60	X	X	X
Pacific Coast Highway	0.48	X		
PCH/I-110 (on PCH)	0.61	X	X	X
Total number of stations		**12**	**9**	**8**

Notes:

[1] Distance shown reflects the distance between the center of intersection; actual distance between stations varies depending on the location of the station platform.

[2] For the HRT alternative, 164th Street/Gardena Boulevard station is sited closer to Vermont Ave/Alondra Ave and Carson Street station was sited closer to Vermont Ave/220th Street.

4.8 MAINTENANCE AND STORAGE FACILITY SITE

Metro's fleet of bus and rail vehicles are maintained and stored at numerous bus, light rail, and heavy rail maintenance and storage facilities (MSF), also referred to as Divisions, located throughout Los Angeles County.

Based on discussions with Metro Bus Operations staff, there is excess capacity at existing bus Divisions 5 and 18 to accommodate buses for the South Vermont Corridor, although the capacity for articulated buses at these Divisions may change as a result of NextGen Bus Plan service changes. The fleet size for the two BRT concepts was calculated and is discussed below in Section 4.8.1. It should be noted that while the bus fleet needed for the South Vermont Corridor could be accommodated at existing bus Divisions 5 and 18, there would be a shortage of approximately seven to 11 buses when assessing the entire Vermont Transit Corridor. It is assumed these buses could be stored at other Metro Divisions; thus, this Study does not propose a new MSF for either of the BRT concepts. If it is later determined in a future project phase that there is no longer excess capacity at Divisions 5 and 18 or that a new bus

Division is required for the Vermont Transit Corridor, then one of the MSF sites identified for the rail concepts may be a potential candidate for a new bus Division.

Based on discussions with Metro Rail Operations staff, none of the existing rail MSFs would be able to store vehicles required for the operation of the Vermont Corridor.

4.8.1 Fleet Size and MSF Size

The fleet size depends on the peak period headways, runtimes, dwell times, and spares. The fleet size for the rail concepts also includes one gap train and one maintenance reserve train. In turn, the fleet size is then used to determine the size range needed for an MSF. The fleet size for each transit concept is summarized in Table 4.3 for the entire Vermont Transit Corridor and for the South Vermont Corridor. The table also includes a range in acres of the approximate property size needed for a single rail MSF.

Table 4.3: Fleet Size and MSF Size

Transit Concept	South Vermont Only		Entire Vermont Corridor	
	Total Vehicles (Buses or Trains[1])	MSF Size Range (acres)	Total Vehicles (Buses or Trains[1])	MSF Size Range (acres)
Center-Running BRT	20	N/A	44	N/A
Side-Running BRT	22	N/A	48	N/A
LRT	20	7-17	34	11-29
HRT1 (stand-alone)	17	17-30	29	29-52
HRT2 (connected to B Line)	17	17-30	41	41-73

[1] LRT assumes 3-car trains and HRT assumes 6-car trains operating during peak periods.

Ideally, the entire Vermont Corridor would be served by a single MSF that directly connects to the corridor and would provide heavy service, repairs, and enough storage capacity for the entire fleet. However, the size of the MSF property needed to service the entire Vermont Corridor fleet has the potential to be quite large, which can make it challenging to locate. If the Metro Board deems the South Vermont Corridor is a feasible long-term project, the next phase of the North Vermont Corridor Project could consider the future extension of the corridor in its MSF analysis. The MSF could be designed with future storage and service considerations that would be constructed in a future build-out. If the North Vermont Corridor selects a site that cannot accommodate the extension to the South Bay, then an additional MSF would be required for the South Vermont Corridor.

4.8.2 POTENTIAL RAIL MSF SITES

Nine potential rail MSF sites, ranging in size from 12 to 39 acres, were identified along the South Vermont Corridor based on the size, location, dimensions, and land use-related factors. The South Vermont Corridor is largely comprised of residential and industrial uses. All of the parcels identified for a potential MSF site are currently zoned for commercial or light industrial uses. Any potential new MSF location would be subject to community outreach, environmental clearance, existing land use and zoning policies, and property impacts.

Several potential sites could support the MSF needs of any of the rail concepts, but most of the sites would only be large enough to support the LRT concept. These smaller sites could partially support the HRT concept in conjunction with a second facility located along the corridor, such as in the North Vermont Corridor.

4.9 SERVICE SPAN, FREQUENCY, AND TOTAL RUNTIME

Table 4.4 presents the key operating characteristics for each of the five concepts. All five concepts would operate 21 hours a day from 4 AM to 1 AM. The BRT and LRT concepts have slightly longer peak headways (five minutes) than the HRT concept (four minutes). One-direction peak hour capacity increases from 900 persons per hour for the BRT concepts to around 11,800 persons per hour for the HRT concepts, with the LRT concept having an intermediate peak hour capacity of 5,000 persons per hour. The LRT and BRT concepts offer similar runtimes along the South Vermont Corridor, between 28 and 37 minutes, while the HRT concepts have a runtime of under 20 minutes. The average speed is less than 16 miles per hour for the Side-Running BRT concept, 20 to 21 miles per hour for the Center-Running BRT and LRT concepts, and 31 miles per hour for the HRT concepts.

Table 4.4: Concept Service Span, Frequency, Peak Capacity, and Runtimes

	Center Running BRT	Side-Running BRT	LRT	HRT1 – Stand Alone	HRT2 – Connected to Metro B Line
Service Span	4AM to 1AM (21 hours)				
Headway in Minutes (Peak/Off-peak)	5/10			4/10	
Peak Hour Capacity (per direction)	900	900	4,800	11,800	11,800
Runtime in Minutes	30	37	28	20	20
Average Speed in miles per hour (mph)	20	16	21	31	31

5. Performance and Benefit of the Transit Concepts

5. PERFORMANCE AND BENEFITS OF THE TRANSIT CONCEPTS

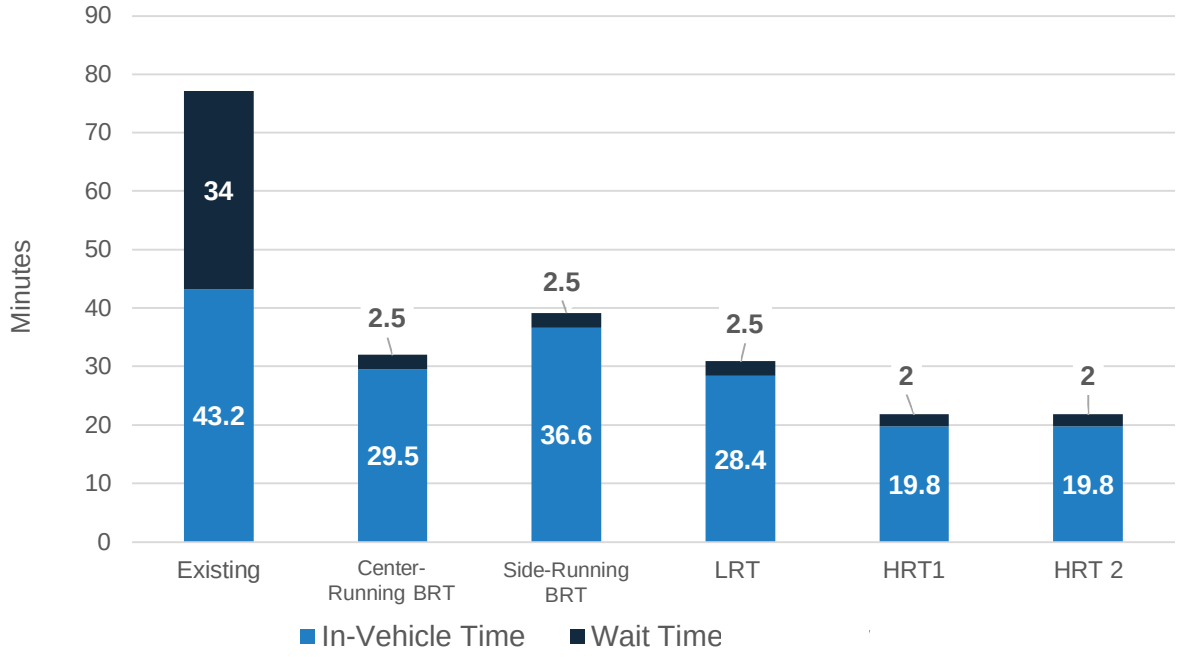
The performance and benefits of the two BRT and three rail concepts were assessed for the South Vermont Corridor, including ridership, new transit riders, travel time savings, and carrying capacities.

5.1 TRANSIT TRIP TIME SAVINGS

All of the proposed transit concepts provide considerable trip time savings over the existing transit scenario. Transit trip times account for both the in-vehicle travel time and the wait time (equal to half of the service frequency). Figure 5.1 shows the total transit trip time on Vermont Avenue between 120th Street and PCH during the AM and PM peak periods (6-9 AM, 3-7 PM).

Under existing conditions, the total transit trip time is approximately 77 minutes. While the in-vehicle time is approximately 43 minutes, the wait time is 34 minutes. Low service frequency and the additional wait time involved in transferring (refer back to Section 2.2) make for a lengthier trip. All of the transit concepts considerably reduce the transit trip time relative to the existing scenario, with the HRT concepts providing the most time savings, cutting the transit trip time down to only 22 minutes, or roughly an hour less than existing. While each of the concepts provides a faster in-vehicle travel time, the bulk of the trip time reduction comes from the reduced waiting time due to the concepts' frequent peak hour service (frequency of four to five minutes). The trip time by the five transit concepts would also become much more competitive compared with the driving mode, which takes approximately 25 to 28 minutes currently.

Figure 5.1: Average Weekday Peak Corridor-wide (End-to-End) Transit Trip Time



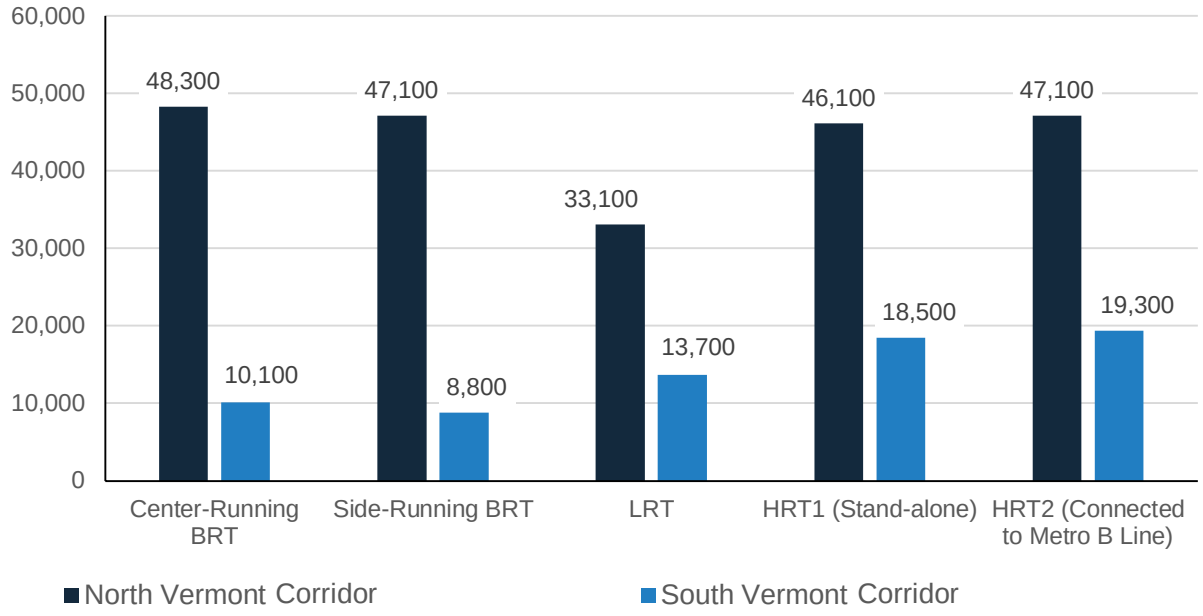
Notes:

1. Where northbound and southbound travel times differ (for existing and BRT alternatives), the average travel time was used.
2. Existing travel times and wait times come from the Metro and GTrans transit schedules. Concept travel times and wait times come from the proposed operating plans.

5.2 RIDERSHIP

The estimated daily station boardings on the South Vermont Corridor vary from less than 9,000 daily boardings in the Side-Running BRT concept to almost 20,000 daily boardings in the HRT2 concept (connected to the Metro B (Red) Line), as shown in Figure 5.2.

Figure 5.2: Daily Station Boardings on the North and South Vermont Corridors by Scenario



On the South Vermont Corridor, the Center-Running BRT has slightly more daily boardings than the Side-Running BRT, likely owing to its faster speed. The rail concepts have more daily boardings than the BRT concepts (with HRT having more boardings than LRT), owing to the rail concepts' increased speed.

In comparison to the North Vermont Corridor, the estimated ridership numbers for the BRT concepts along the South Vermont Corridor are approximately 80 percent lower. The estimated ridership numbers for the rail concepts along the South Vermont Corridor are approximately 60 percent lower than those for the rail concepts along the North Vermont Corridor.

The higher daily boardings on the North Vermont Corridor are driven, to an extent, by boardings at a few key transfer stations. Boardings at the stations at Wilshire Boulevard, Exposition Boulevard, and Athens Transit Center (Metro C Line (Green)) are at least three times higher than boardings at the highest-ridership stations on the South Vermont Corridor: Carson Street and Metro J Line (Silver) PCH transitway station.

5.3 NEW TRANSIT RIDERS

A successful transit service would encourage travelers on a corridor to switch from less sustainable private vehicles to transit. Table 5.1 shows the number of motorists who are estimated to switch to riding transit under each of the concept scenarios.

Among the estimated 19,300 daily riders on the HRT2 concept, approximately 12,800 transit riders would be shifted from the driving mode. The remaining 6,500 riders would be shifted from existing bus lines. The LRT and Center-Running BRT would attract approximately 7,000 to 7,200 new transit riders, and the Side-Running BRT would shift about 6,100 riders from the driving mode. The transit concepts with the larger transit trip time savings are estimated to shift more motorists to riding transit.

Table 5.1: New Transit Ridership by Alternative

Variable	Center Running BRT	Side-Running BRT	LRT	HRT1 – Stand Alone	HRT2 – Connected to Metro B Line
New transit riders (shifted from driving)	7,200	6,100	7,000	11,800	12,800
Existing transit riders (shifted from another bus line)	2,900	2,700	6,700	6,700	6,500
Total ridership estimates	10,100	8,800	13,700	18,500	19,300

5.4 Peak Hour Load and Capacity

Peak loading refers to the peak hourly volumes carried by a transit service in a particular direction and is used to assess a transit system's capacity. For each of the concepts, capacity is determined by service frequency, capacity per bus/train car, and the number of cars per train in the rail concepts. The peak hour and peak direction volumes define the peak hour load.

As shown in Table 5.2, each of the five concepts provides ample capacity to accommodate peak hour loading on the South Vermont Corridor. The Side-Running and Center-Running BRT alternatives have the capacity to transport 900 passengers per hour, with peak hour BRT ridership projected to take up roughly 65 to 75 percent of capacity (roughly 570 and 690 passengers per hour, respectively). While the LRT and HRT alternatives can provide a capacity of roughly 4,800 and 11,800 passengers per hour, respectively, they are estimated to carry peak loads no higher than 1,300 passengers per hour. The rail capacity would be under-utilized, especially along South Vermont Corridor.

Table 5.2: Peak Hour Load and Capacity by Transit Concept

Alternative	Headway (minutes)	# of buses/ trains per hour	# of cars per train	Passenger capacity per bus or train car	Total Capacity (Hourly)	Peak Hour Load[1], North Vermont Corridor	Peak Hour Load, South Vermont Corridor
Center-Running BRT	5	12	N/A	74	900	1,340	690
Side-Running BRT	5	12	N/A	80	900	1,280	570
LRT	5	12	3	133	4,800	1,770	650
HRT1-Stand Alone	4	15	6	131	11,800	3,270	1,200
HRT2-Connected to Metro B Line	4	15	6	131	11,800	3,790	1,310

[1] Peak Hour Load is equivalent to the peak direction volume in the Peak Hour.

Since each of the concepts serves both the North and South Vermont Corridors, peak hour loads on the North Vermont Corridor were also examined. While the LRT and HRT concepts comfortably accommodate the North Vermont Corridor peak hour load (no higher than 3,800 passengers per hour), the peak hour load of the BRT concepts (1,280 to 1,340 passengers per hour) exceeds the concepts' capacity (900 passengers per hour).

6. Impacts of Transit Concepts

6. IMPACTS OF TRANSIT CONCEPTS

Metro strives to limit negative impacts on the community in the form of right-of-way (ROW), traffic, parking, and environmental effects in planning new transit infrastructure. This chapter evaluates the impacts of each of the five concepts on the South Vermont Corridor.

6.1 TRAVEL LANE AND ROW

Table 6.1 presents the impacts of each scenario on vehicle travel lanes as well as areas affected by each scenario in the ROW. The Center- and Side-Running BRT could each result in the loss of a vehicle travel lane, as they would convert the central or outer travel lane to a bus-only lane. The LRT concept may run in the median from 120th Street to south of Redondo Beach Boulevard and then run underground, in a twin-bored tunnel, from south of Redondo Beach Boulevard to Knox Street. These alignments avoid impacts to travel lanes in Segments A through D. In Segments E through H, where the LRT runs at-grade in the roadway, the existing number of through travel lanes would be preserved by removing on-street parking and left-turn lanes at some intersections.

Table 6.1: Travel Lane Impacts by Concept

Segment	Segment Name	Curb-to-Curb Widths	Existing # Lanes	# Lanes with BRT	# Lanes with LRT/HRT
A	120th St to Marine Ave	130-156	3	2	3
B	Marine Ave to 164th St	140-160	2/3*	1/2**	2/3*
C	164th St to Artesia Blvd	58-75	2	1	2
D	Artesia Blvd to I-405	70-80	2	1	2
E	I-405 to Torrance Blvd	80-85	2	1	2
F	Torrance Blvd to 223rd St	80-85	2	1	2
G	223rd St to Lomita Blvd	80-85	2	1	2
H	Lomita Blvd to PCH	80-85	2	1	2

*2 lanes northbound, 3 lanes southbound

**1 lane northbound, 2 lanes southbound

Table 6.2 shows impacts to physical elements of the roadway ROW (i.e. excluding modifications (mods) that only involve striping). Since the HRT runs entirely underground, it has no impact on the ROW except for the stations. The BRT and LRT scenarios, however, would require modifying physical elements to accommodate the concepts at-grade.

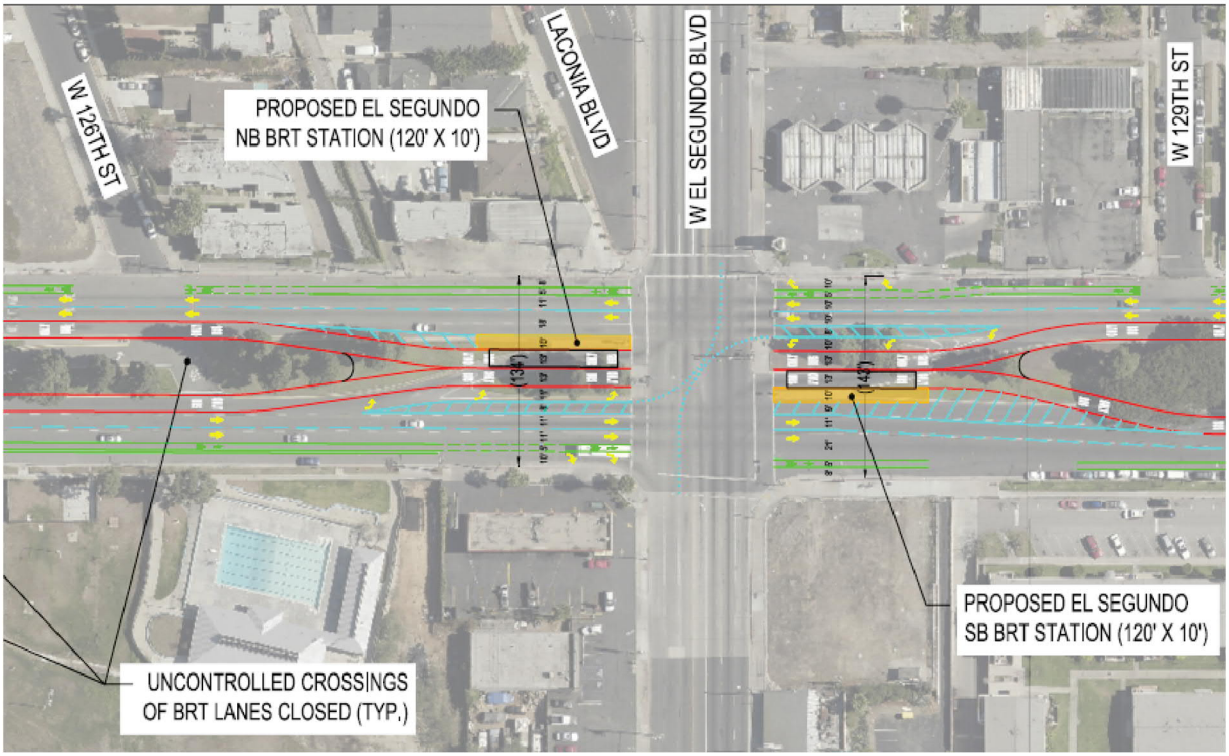
Table 6.2: Potential Effects to Right-of-Way by Concept

Segment	Segment Name	Center-Running BRT	Side-Running BRT	LRT	HRT
A	120th St to Marine Ave	Median mods	Driveway conflicts	Median mods	Grade-separated; Stations Only
B	Marine Ave to 164th St	Median mods, curb mods at (NB) 157th St, Alondra Blvd, and 163rd St	Curbside stations, widening at Alondra	Grade-separated	
C	164th St to Artesia Blvd	Median mods, curb mods at (NB) 168th St	Median mods, driveway conflicts, curbside stations		
D	Artesia Blvd to I-405	Median mods, curbside stations			
E	I-405 to Torrance Blvd			Median mods	
F	Torrance Blvd to 223rd St				
G	223rd St to Lomita Blvd				
H	Lomita Blvd to PCH			Grade-separated	

6.1.1 CENTER-RUNNING BRT

The Center-Running BRT concept would require modifications to the median, curb, and left-turn lanes. Between 120th Street and Marine Avenue, the concept would modify the existing landscaped median adjacent to signalized intersections. Existing channelized left-turn pockets in the median might be removed, and the raised medians might be modified to accommodate BRT lanes in the center of the roadway, new left-turn pockets to the right of the BRT lane, and BRT stations on the far sides of the intersection. Figure 6.1 shows an example of median modification at Vermont Avenue and El Segundo Boulevard.

Figure 6.1: Median Modification at Intersection of Vermont Avenue and El Segundo Boulevard



South of Gardena Boulevard, Center-Running BRT lanes would run in the center of the roadway, displacing all existing center median islands. Roadway widening would be required at 157th Street (northbound direction), Alondra Boulevard, 163rd Street, and 168th Street (northbound). Figure 6.2 shows a potential widening at 168th Street to accommodate left-turn lanes alongside the BRT.

Figure 6.2: Widening at 168th Street with Center-Running BRT

A curbside station is proposed at Vermont Avenue and PCH, where the BRT transitions to mixed-flow traffic.

6.1.2 SIDE-RUNNING BRT

The Side-Running BRT concept may require the removal or narrowing of medians to provide sufficient ROW at three locations in the southern half of the corridor: between Torrance Boulevard and Clarion Drive, between Gian Drive and 228th Street, and South of Lomita Boulevard. A spot widening at Alondra Boulevard would be needed to provide sufficient width for a general northbound travel lane and Class II bike lane alongside the 12-foot-wide northbound BRT lane, as shown in Figure 6.3.

Figure 6.3: Spot Widening at Alondra Boulevard with Side-Running BRT

Side-Running BRT stations, situated between the BRT lane and the curb, may present conflicts with driveways to commercial properties. Side-Running BRT could have curb BRT stations, modifying sidewalk and curb space, at three locations. At Gardena Boulevard, curb stations are proposed in the northbound and southbound directions, as shown in Figure 6.4, to avoid ROW acquisition or roadway widening in this narrow segment. A curb station is also proposed in the northbound direction at 190th Street to avoid ROW acquisition or roadway widening. Finally, curb stations are proposed in both directions at PCH, where the BRT transitions to mixed-flow operations.

Figure 6.4: Proposed Curbside Gardena Boulevard Stations with Side-Running BRT

6.1.3 LRT

The LRT concept could run underground from south of Redondo Beach Boulevard to just north of Knox Street and from north of 245th Street to the terminus at the PCH Metro J Line (Silver) transitway station, avoiding right-of-way impacts on segments corresponding to these locations. Between 120th Street and south of Redondo Beach Boulevard, the LRT runs on a guideway in the existing landscaped median. On this portion of the corridor, existing channelized left-turn pockets in the median may be removed: left-turn pockets could be accommodated either through restriping or modification of the raised median. From north of Knox Street to north of 245th Street, the LRT guideway could run in the center of the roadway, displacing existing raised medians (refer back to cross-sections in Section 4).

6.2 TRAFFIC OPERATION

Traffic operations at roadway segments and intersections deteriorate between existing conditions and each of the transit concepts due to a combination of projected growth in traffic volumes and loss in roadway capacity. As shown in Table 6.3, roadway operations deteriorate from the existing scenario in the BRT concepts, due to the loss of travel lane capacity. By contrast, the rail scenarios, which retain the current number of through lanes, operate similarly to the existing conditions, with congested LOS values of E and F occurring only on Segment D between Artesia Boulevard/SR-91 and I-405.

Table 6.3: Existing and 2045 Roadway Segment Level of Service (LOS) Values

Segments		Existing	BRT	LRT/HRT
A-C	**120th St to Artesia Blvd/SR-91**	A	A-D	A-C
D	**Artesia Blvd/SR-91 to I-405**	D/E	E/F	E/F
E-F	**I-405 to PCH**	A/B	F in at least one direction in most segments	A/B

In 2045, the LRT scenario is estimated to have the worst traffic operation among the five transit concepts in terms of total average control delay per car at all the signalized intersections. This is because of the loss of capacities at intersections and the prohibition of left-turn movements at all the intersections that are not controlled by signals. Although the number of vehicular travel lanes may not be reduced in the LRT concept, the left-turn lanes in the medians would need to be reconfigured to the right side of the light rail tracks in the middle of the roadway,

which leads to reduced width for the through and right-turn lanes. Therefore, lane geometry at most signalized intersections may be changed and capacity could be reduced. During the AM and PM peak hours, the number of intersections estimated to operate at LOS values of E and F grows from eight and ten under existing conditions to 14 and 16 in the LRT alternative, respectively.

As shown in Table 6.4, among the five transit concepts, the Center-Running BRT scenario is estimated to have the largest number of signalized intersections to be operating at LOS values of E and F. Similar to the LRT concept, the left-turn vehicles at non-signalized intersections might be redistributed to nearby signalized intersections. The intersection capacity may also be reduced due to the loss of one vehicular through lane and the reconfiguration of the left-turn lanes at the signalized intersections. The Side-Running BRT scenario operates slightly better than the LRT scenario. Overall, the two BRT concepts experience loss in capacity at more intersections than the LRT scenario but have lower volumes than the LRT scenario as traffic diverts due to the loss of a travel lane.

Table 6.4: Number of Signalized Intersections Operating at Level of Service (LOS) Values E or F

	Existing	2045 Center-Running BRT	2045 Side-Running BRT	2045 LRT	2045 HRT
AM Peak Hour	8	15	13	14	10
PM Peak Hour	10	18	16	16	13

Finally, the HRT concepts operate better than the LRT or BRT concepts as they are fully below-grade. The lane geometry and capacity of all the signalized intersections would remain unchanged from the existing conditions. However, the shift of vehicle trips to the proposed transit concepts is not estimated to overweigh the traffic growth from the existing year to 2045. Therefore, the traffic operation would still be worse in the two HRT alternatives than in the existing conditions.

6.3 PARKING IMPACTS

Existing parking inventory and occupancy rates during the AM, midday, PM, and evening time periods were recorded at the block level in May and June 2021. The peak parking occupancy is usually observed during the evening next to residential land uses and during the AM peak hour next to industrial and commercial land uses.

Table 6.5 summarizes the potential loss of on-street parking spaces for the five proposed transit concepts for the segments on Vermont Avenue. Since the BRT concepts could operate in mixed-flow traffic and the rail concepts could operate underground in Segment I on PCH,

and the number of existing parking spaces is only available for a short stretch on the north side of the roadway, parking analysis was not conducted for Segment I.

Table 6.5: Potential On-Street Parking Space Loss by Transit Concept

Segment		Existing Average Peak Occupancy	Existing Number of Parking Spaces	Potential Number of Lost Parking Spaces			
				Center-Running BRT	Side-Running BRT	LRT	HRT
A	120th St to Marine Ave	62%	441	46	0	70	0
B	Marine Ave to 164th St	73%	167	134	91	36	0
C	164th St to Artesia Blvd	80%	85	67	77	0	0
D	Artesia Blvd to I-405	18%	97	42	68	0	0
E	I-405 to Torrance Blvd	76%	158	82	4	113	0
F	Torrance Blvd to 223rd St	67%	183	129	0	183	10
G	223rd St to Lomita Blvd	39%	385	97	0	332	0
H	Lomita Blvd to PCH	65%	104	60	52	0	0
Total			**1,620**	**657**	**292**	**734**	**10**
Percentage of lost parking inventory				**40.6%**	**18.0%**	**45.5%**	**0.6%**

In the Center-Running BRT concept, some on-street parking could potentially be removed on every segment on Vermont Avenue for a total of 657 spaces. Parking could be removed to maintain left-turn pockets alongside a Center-Running BRT lane, fill in all the gaps of the bike lane on Vermont Avenue, and accommodate future stations where the center median does not provide sufficient room. Much of the on-street and median parking potentially removed serves commercial or multi-family residential uses, for which parking is needed to accommodate guests or customers. Detailed parking analysis at the block level revealed that other than Segment D where existing parking utilization is low, the potential loss of on-street parking spaces may impact at least a few blocks on every segment, where the existing peak occupancy rates already exceed or approach 85 percent, and replacement on-street parking spaces are hard to find on nearby parallel or cross streets.

In the Side-Running BRT scenario, on-street parking could potentially be removed to maintain a through travel lane and bike lane or a two-way left-turn lane in areas where the ROW is too narrow to accommodate those alongside on-street parking, and to accommodate a curbside

station. Altogether, parking might be removed on five of the eight segments with a total of 292 spaces, which is less than half the number of spaces removed by the Center-Running BRT. Several of the segments where parking is removed, however, have low maximum peak occupancies, low amounts of parking being removed, and/or serve industrial land uses with off-street parking already provided. Parking impacts are estimated to occur on a few blocks on Segments B, C, and H.

The LRT scenario potentially requires the removal of parking in the median on Segment A, as well as curbside parking on a short stretch of Segment B where the LRT runs at-grade alongside a freight rail ROW. From Segments E through G, the LRT runs at-grade. To keep two vehicular travel lanes in each direction and a continuous bike lane, most curbside parking spaces could be removed. In total, on-street parking spaces could potentially be removed at five out of the eight segments with a total of 734 spaces, the most among the five transit concepts. The removal of parking spaces is anticipated to cause parking impacts on at least a few blocks in five segments where existing peak parking utilization is high and nearby replacement parking spaces are not available.

Finally, since the HRT runs entirely underground, it only requires the potential removal of ten spaces to accommodate a station entrance on the northbound side of the block between Carson Street and 220th Street. Since this block has a high peak occupancy of 87 percent and replacement parking is not available nearby, the removal might have some parking impact on this block.

6.4 ENVIRONMENTAL IMPACTS

Environmental screening of the five alternatives was conducted to identify the potential environmental effects of each of the concepts. The screening was conducted in line with Appendix G of the California Environmental Quality Act (CEQA) Guidelines and National Environmental Policy Act (NEPA) guidance. Results for the 23 categories evaluated are presented in Table 6.6.

The LRT and HRT concepts have a high potential for environmental effects in more categories than the BRT concepts. The two rail concepts would have a high potential for effects regarding cultural resources, displacement and acquisitions, and noise and vibration, categories where the BRT concepts have low to moderate potential for effects. The increased potential for impacts stems largely from more extensive construction activities and property acquisition required for grade separation and noise generated during operations. In addition, the HRT concept would have a high potential for effect on air quality as a result of increased use of construction equipment and truck haul trips to excavate and dump soil off-site, during the construction phase.

Table 6.6: Summary of Potential Environmental Effects by Project Concept

● No Potential for Effect ◑ Low Potential for Effect ◐ Moderate Potential for Effect ○ High Potential for Effect

Environmental Resource	Center-Running BRT	Side-Running BRT	LRT	HRT
Aesthetics	◑	◑	◐	◐
Agriculture and Forestry Resources	●	●	●	●
Air Quality	◑	◑	◐	○
Biological Resources	◑	◑	◑	◑
Cultural Resources	◑	◑	○	○
Displacements and Acquisitions	◑	◑	○	○
Environmental Justice	◑	◑	◑	◑
Energy Resources	◐	◐	◑	◑
Geology and Soils	●	●	◑	◑
Greenhouse Gas Emissions	●	●	●	◑
Hazards and Hazardous Materials	◑	◑	◑	◐
Hydrology and Water Quality	◑	◑	◐	◐
Land Use and Planning	◑	◑	◐	◐
Mineral Resources	◑	◑	◑	◑
Noise and Vibration	◐	◐	○	○
Population and Housing	●	●	●	●
Public Services	◑	◑	◑	◑
Recreation	◑	◑	◑	◑
Section 4(f) Resources	◐	◐	◐	◐
Transportation and Traffic	○	○	○	◐
Tribal Cultural Resources	◑	◑	◐	◐
Utilities and Service Systems	◑	◑	◐	◐
Wildfire	●	●	●	●

On the other hand, the BRT and LRT concepts would have a high potential for impact on transportation and traffic, due to the reduction in general travel capacity required to accommodate these modes at street level. Running entirely underground, the HRT concept would have limited potential for impact on transportation and traffic following the construction phase. This is largely in line with the operations analysis shown in Section 5.


MEDICAL CENTER

7. COST ESTIMATES

Capital cost and Operating and Maintenance (O&M) cost estimates were prepared for each concept. The cost estimates were prepared in 2021$ and have been escalated to the proposed year of expenditure, 2045. It should be noted the project is not currently funded or identified in Measure M, so the realistic year of expenditure is likely to be much further out. The year 2045 was used for the 'year of expenditure' to align with the travel impacts and ridership forecast year.

7.1 CAPITAL COST ESTIMATES

The capital cost estimate assumes a full build-out construction of each concept. The capital cost estimating methodology is structured to comply with the FTA Standard Cost Categories (SCC) for Major Capital Projects. In order to estimate project capital cost quantities, a breakdown of the conceptual design elements was performed. Each cost option was developed using the conceptual design alignment drawings, typical cross-sections, potential station locations, and/or written descriptions defining each of the major cost components.

An annual growth rate of 1.041 was developed based on the Engineering News-Record (ENR) Building Cost Index (BCI) in the Greater Los Angeles Area from the years 2016 to 2021 for escalation to 2045, with the growth rate compounded annually.

As shown in Table 7.1, the rail concepts have higher capital costs than the BRT concepts, with the HRT concept having the highest cost in the range of $10.8 to $12.7 billion in 2021$. The largest drivers of these cost differentials are the higher costs of constructing grade-separated guideways (with the HRT concept having a longer length of tunnel than the LRT concept) and stations. In addition, the rail concepts require support facilities that the BRT concepts do not need, utilize more expensive vehicles, and would require ROW acquisition for a maintenance and storage facility (MSF).

The Side-Running BRT is estimated to have the lowest capital cost among the five transit concepts in the range of $290 to $350 million in 2021$.

Table 7.1: Capital Costs by Transit Concept (million)

Concept	Total Project (2021$)	Total Project (2045$)
Center-Running BRT	$290-$350	$770-$910
Side-Running BRT	$ 290-$340	$760-$900
LRT	$4,650-$5,550	$12,350-$14,600
HRT	$10,800-$12,750	$28,500-$33,700

7.2 Operating and Maintenance (O&M) Cost Estimates

The annual O&M cost estimate is based on the annual vehicle revenue hours (revenue hours) and annual vehicle revenue miles (revenue miles) of the five transit concepts. The unit costs developed are based on Metro's submitted data to the Federal Transit Administration (FTA) National Transit Database (NTD). The NTD's 2019 Annual Agency Profile for Metro includes metrics of cost per vehicle revenue hour and cost per vehicle revenue mile.

An annual growth rate of 2.8 percent was developed based on the Los Angeles – Long Beach – Anaheim Metropolitan Area Consumer Price Index (CPI) from the years 2016 to 2020 for escalation to 2045, with the growth rate compounded annually.

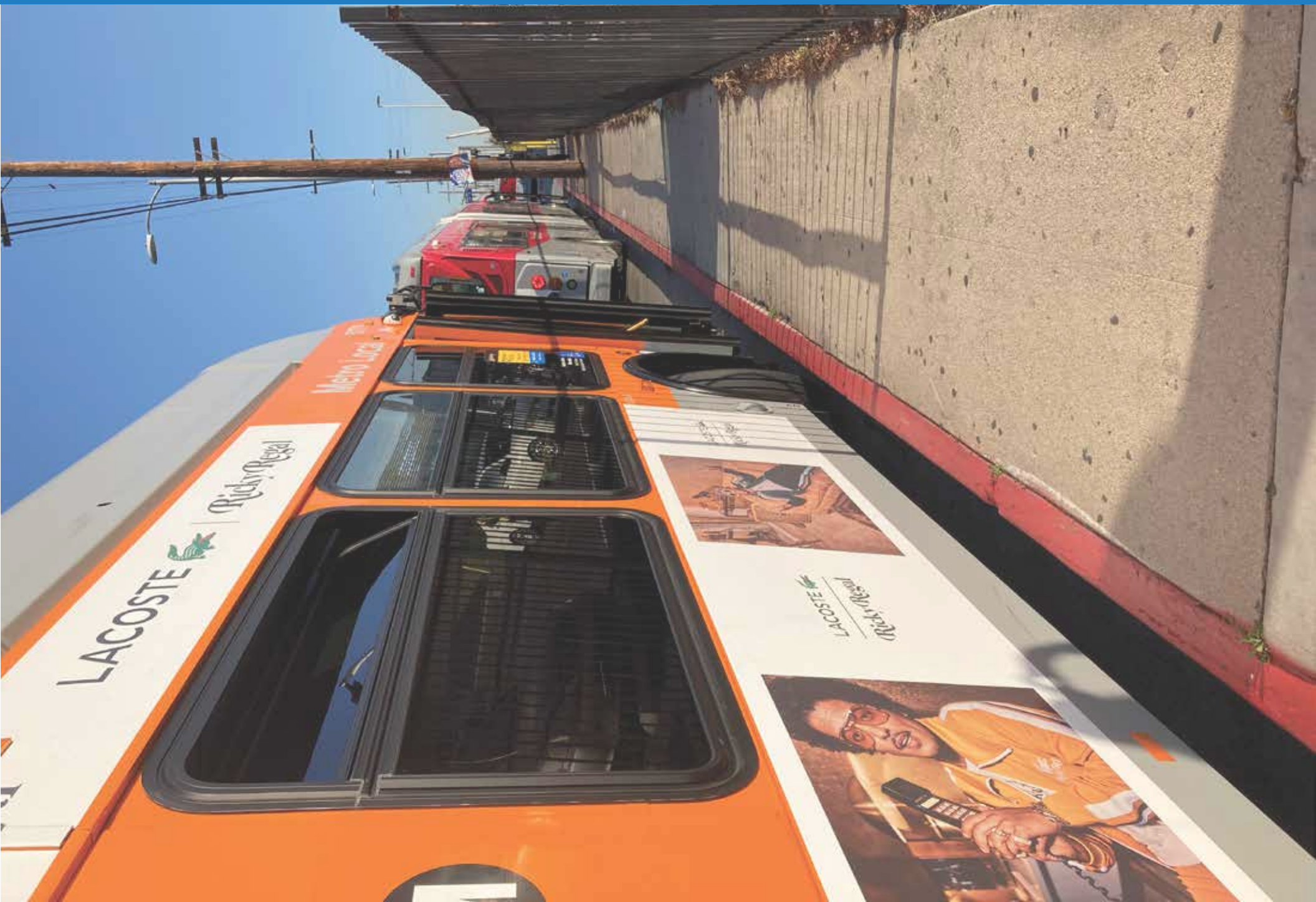
As shown in Table 7.2, annual Operating and Maintenance (O&M) Costs are also higher for the rail concepts than for the BRT concepts. The LRT concept costs are estimated to range from $74.9 million to $81.6 million in 2021$ (roughly $144.8 to $157.8 million in 2045$), more than four times the upper-bound cost of BRT. The HRT operating costs are estimated to be about ten times the O&M costs for the Center-Running BRT alternative.

Table 7.2: Annual Operating and Maintenance Costs by Transit Concept (millions)

Concept	2021$ Range	2045$ Range
Center-Running BRT	$15.7-16.4	$31.3 to $32.7
Side-Running BRT	$16.4 to $19.4	$32.7 to $38.7
LRT	$74.9 to $81.6	$144.8 to $157.8
HRT1 (Stand Alone)	$147 to $167.5	$315.2 to $359.3
HRT2 (Connected to Metro B Line)[1]	$136.9 to $167.5	$264.6 to $323.8

[1] South Vermont Corridor operations only

8. Phasing Options



8. PHASING OPTIONS

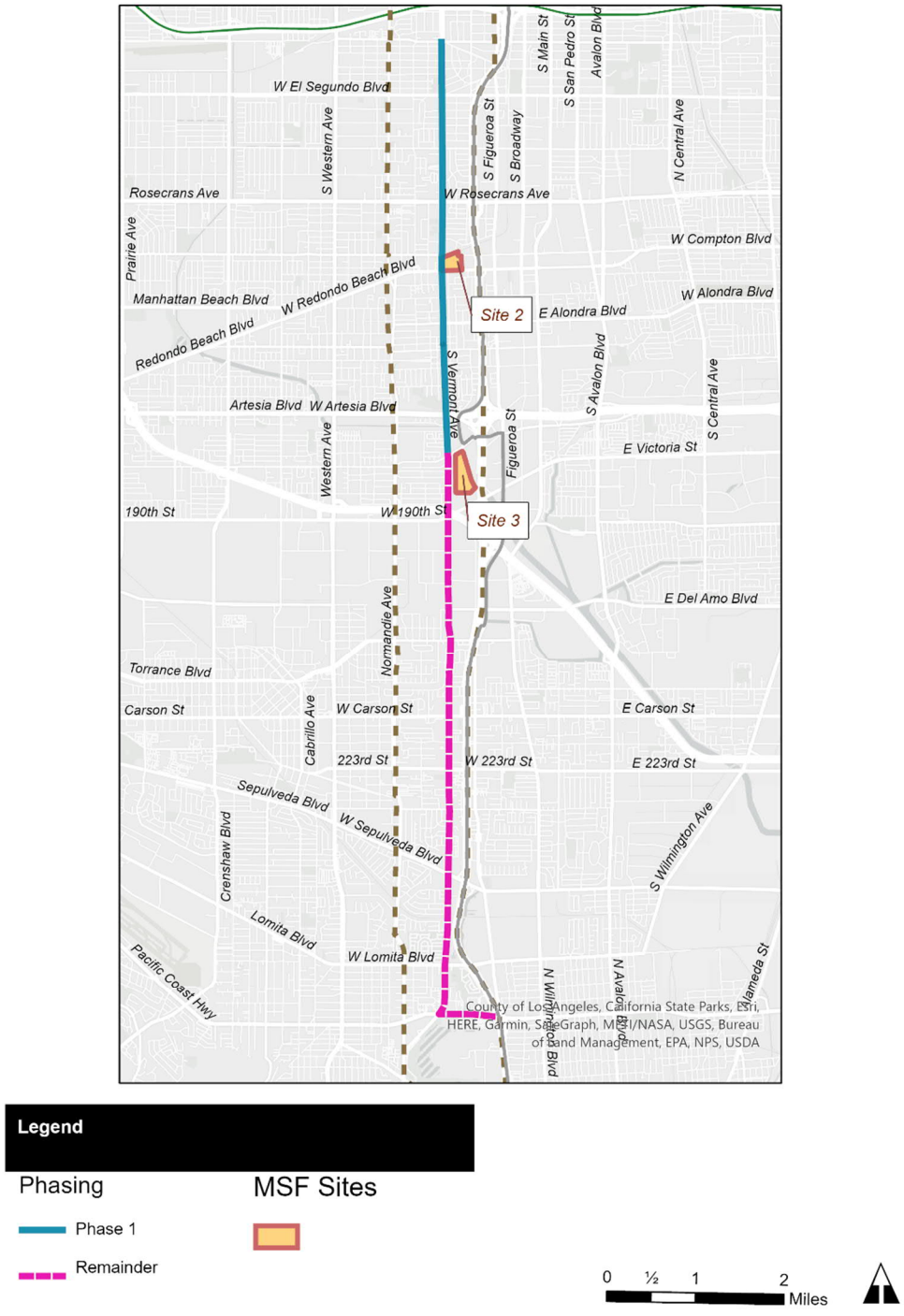
Given the length of the corridor and the concepts' high capital cost, implementing the rail concepts would most likely need to be done in phases. For the LRT and HRT concepts, the most logical terminus station for the Initial Operating Segment (IOS) would be at Vermont Avenue and 182nd Street, considering its proximity to numerous transfer connections at the Harbor Gateway Transit Center and a potential MSF site. Metro's existing rail facilities have insufficient space to store the vehicles required for the operation of the South Vermont Corridor, necessitating the construction of a new MSF along the corridor. Two of the nine examined sites along the corridor met the minimum requirements for an MSF, (see Site 2 and Site 3 in Figure 8.1), one of which lies southeast of Vermont Avenue and 182nd Street. The size, layout, and location of this property could support the LRT concept or partially support the HRT concept if there were a second facility located elsewhere along the corridor.

As shown in Table 8.1, the IOS for the LRT and HRT alternatives extends from 120th Street to 182nd Street, serving four to five stations en route. The remainder of the corridor could be constructed in one to two phases, depending on the funding availability.

Table 8.1: Recommended Phasing for Rail Concepts

	IOS	Length	New Stations	Remainder	Length	New Stations
LRT	Vermont Avenue/120th Street to Vermont Avenue/182nd Street	4.2 miles	5	Vermont Avenue/182nd Street to Metro J Line (Silver) PCH transitway station	5.9 miles	4
HRT	Vermont Avenue/120th Street to Vermont Avenue/182nd Street	4.3 miles	4	Vermont Avenue/182nd Street to Metro J Line (Silver) PCH transitway station	5.9 miles	4

Figure 8.1: Proposed Phasing and Rail MSF Sites for South Vermont Corridor



Since the BRT concepts cost less to implement compared to the rail options, phasing was not considered. A new MSF is not needed for the Vermont BRT since the existing Metro Divisions have available space to accommodate the buses used for Vermont BRT service. If funding becomes a constraint, it is recommended to postpone the portion of the dedicated bus lane on Vermont Avenue between Redondo Beach Boulevard and 190th Street. This stretch of the corridor has the narrowest ROW and the construction of the BRT concepts would have the most disruption to civil infrastructure and the traffic operation. The Vermont BRT service could operate in mixed-flow traffic on this portion of the corridor before the full implementation of the dedicated bus lanes on Vermont Avenue.

9. First/Last Mile and Transit-Oriented Communities

9. FIRST/LAST MILE AND TRANSIT-ORIENTED COMMUNITIES

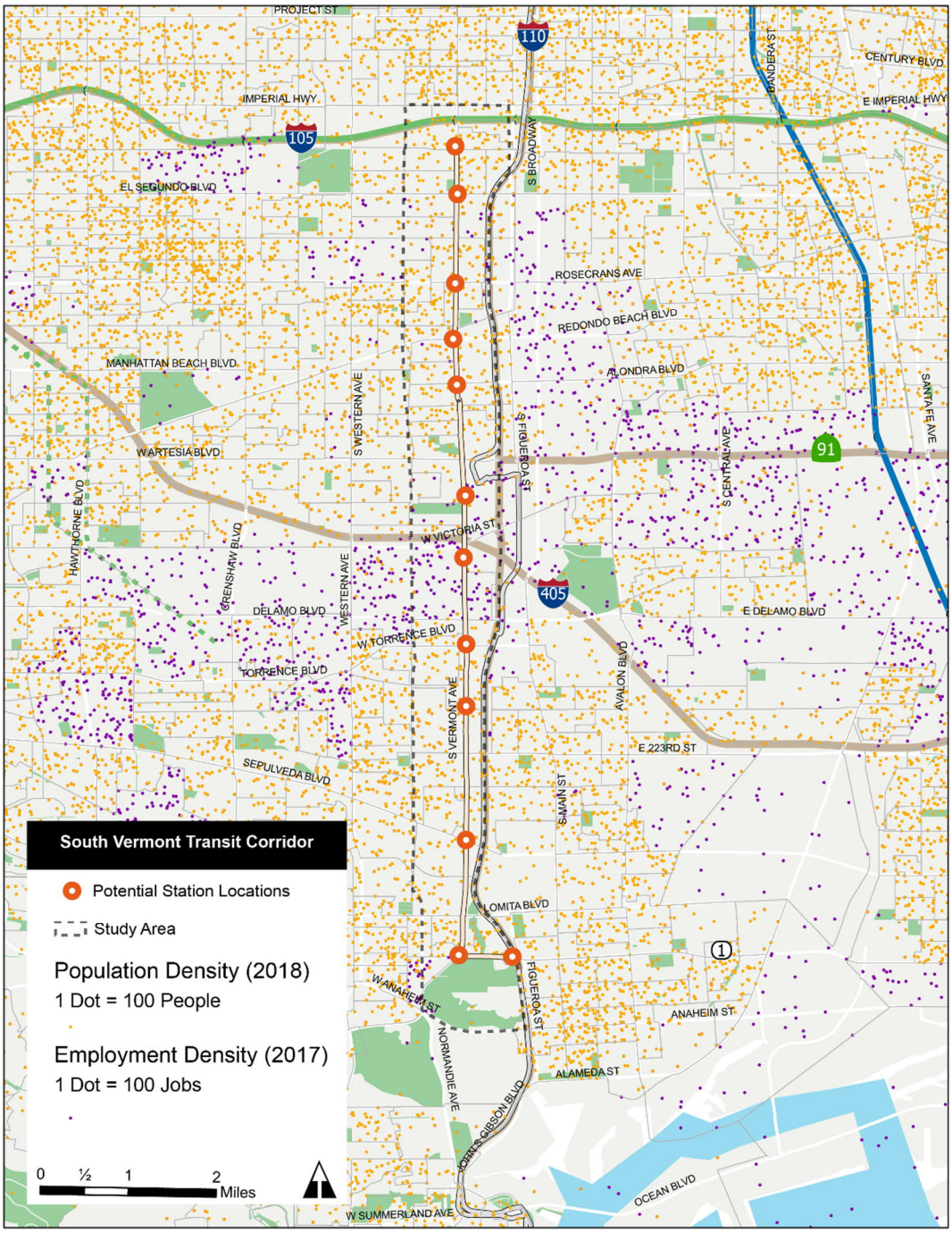
In developing new transit corridors, Metro aims to not merely build infrastructure but strengthen connections with the surrounding streets, public space, and the built environment. To this end, Metro's Transit-Oriented Communities (TOC) program encourages the development of equitable, sustainable, and multi-modal communities around transit corridors through First/Last Mile (FLM) planning of bicycle and pedestrian connections to and from stations; collaboration with developers through Metro's Joint Development real estate program; Systemwide Station Design Standards to enhance station aesthetics; and transit-supportive planning that integrates transportation and land use planning to support multiple mobility choices (walking, biking, and transit).

Opportunities for TOC around the South Vermont Corridor were assessed by the following criteria:

- Population and employment density, existing land uses
- Existing FLM connections: block and intersection density, bicyclist and pedestrian safety, bicycle connections, walkability, and transit connections
- Low-opportunity Equity Focus Communities (EFCs)
- Economic development opportunities, and
- Transit stop design and amenities.

The corridor currently has low employment and population densities in most areas (see Figure 9.1), reflecting the predominantly single-family residential and low-intensity commercial and industrial land uses around the corridor (Figure 1.2). Higher-density housing and employment are essential to supporting higher-frequency transit services. Supporting a higher frequency service like BRT or rail in this corridor would require re-zoning that encourages transit-oriented development, especially around major intersections where stations would likely be placed.

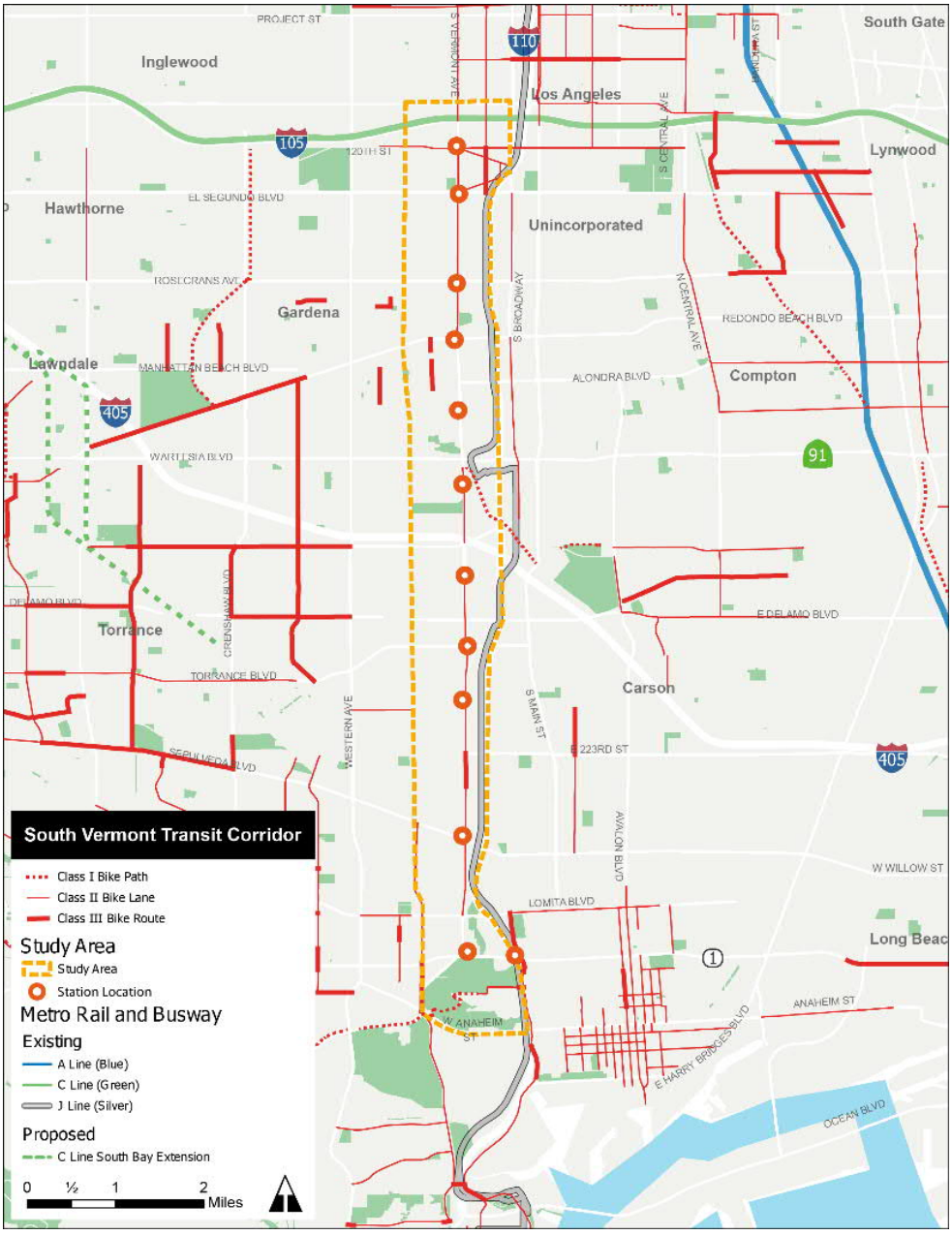
Figure 9.1: Population and Employment Density



Sources: 2018 Census American Community Survey (5-Year Estimate) for Population and 2017 Census Longitudinal Employer-Household Dynamics (LEHD) Workplace Area Characteristics (WAC) for Employment

Gaps in the bicycle network, with few connections to the east or west (see Figure 9.2), hinder FLM connections by bike. Low intersection densities (which require people to walk farther between blocks) on the section south of Gardena Boulevard and low walkability, in terms of pedestrian-friendly design and pedestrian access, limit pedestrian FLM access. Local transit services, dispersed among multiple operators with infrequent or peak-only service, also need better coordination to ensure non-automobile access to the South Vermont Corridor.

Figure 9.2: Bicycle Network



In addition, given the high number of pedestrian and bicycle collisions within the corridor, with three fatalities and 16 severe injuries experienced by pedestrians and bicyclists between 2014 and 2018, substantial improvements would be needed to address pedestrian and bicyclist safety near all potential station sites. Lighting was observed as being poor in the corridor and would need to be improved for personal safety.

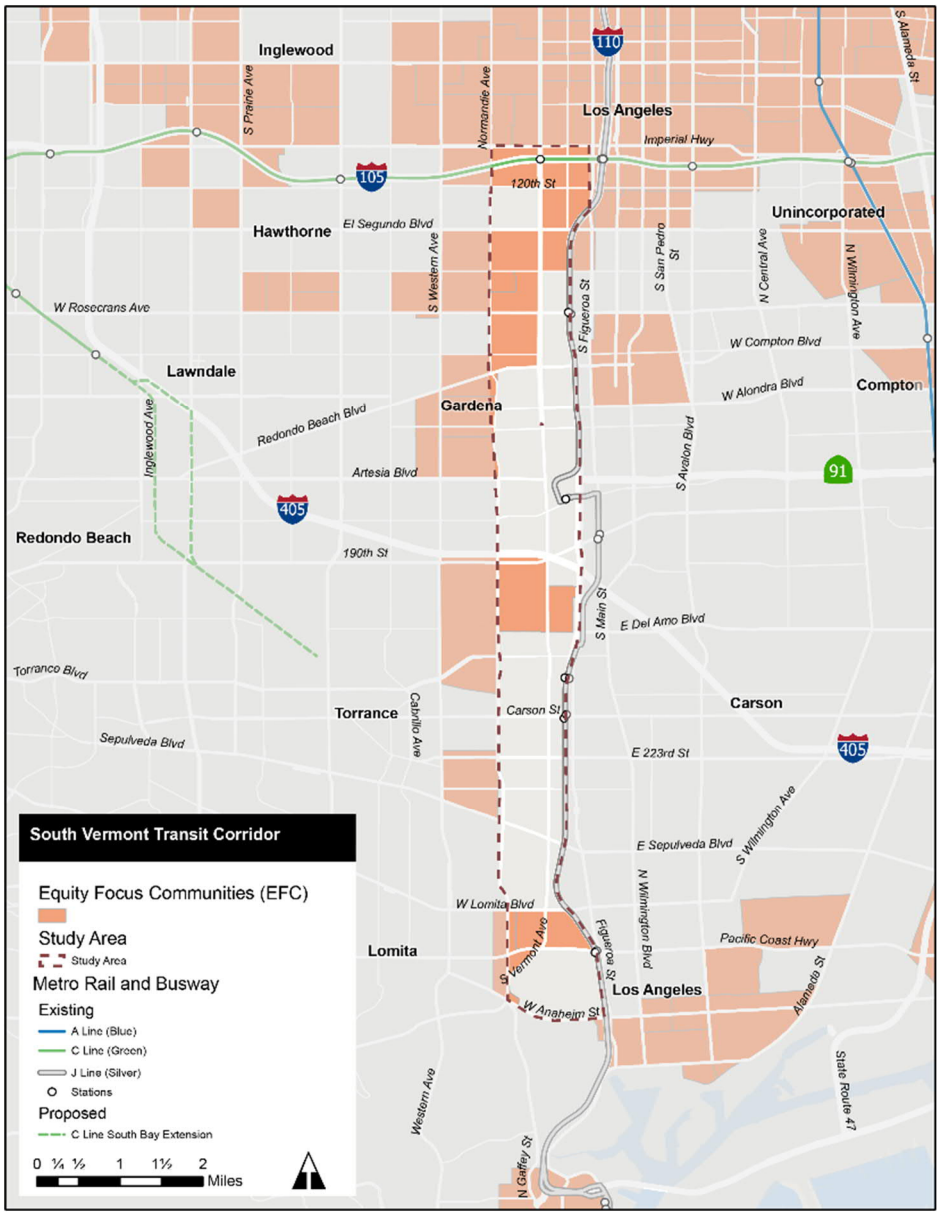
Equity Focus Communities (EFCs)[5], communities that highly correlate with gaps in opportunities such as access to jobs and education, occur intermittently throughout the northern, central, and southern portions of the corridor (see Figure 9.3). Prioritization of projects based on equity would need to be considered. Potential station locations near or adjacent to EFCs may serve as focus areas for the implementation of Metro's larger or longer-term equity initiatives.

Economic development opportunities on the corridor are limited. The South Vermont Corridor is fully built out with a few large parcels that are readily available for development. Some of the larger potential development sites have major environmental concerns that would require extensive remediation for reuse. The disjointed jurisdictional boundaries along the corridor (refer to Figure 1.1) could also affect economic development, as policies and priorities would likely vary among the cities and unincorporated areas of Los Angeles County. The implementation of TOC-supportive land-use strategies, involving cross-jurisdictional coordination, could provide for increased potential for economic development.

Finally, providing consistent and high-quality amenities and service at transit stops and stations along the corridor requires extensive coordination between the corridor's transit service providers. As further study is initiated for the South Vermont Corridor, a more detailed station design could be developed consistent with Metro's Systemwide Station Design Standards for BRT, LRT, and HRT stations.

[5] Defined by LA Metro based on non-white population, low-income (defined as household income < $35,000/year, and households without a vehicle

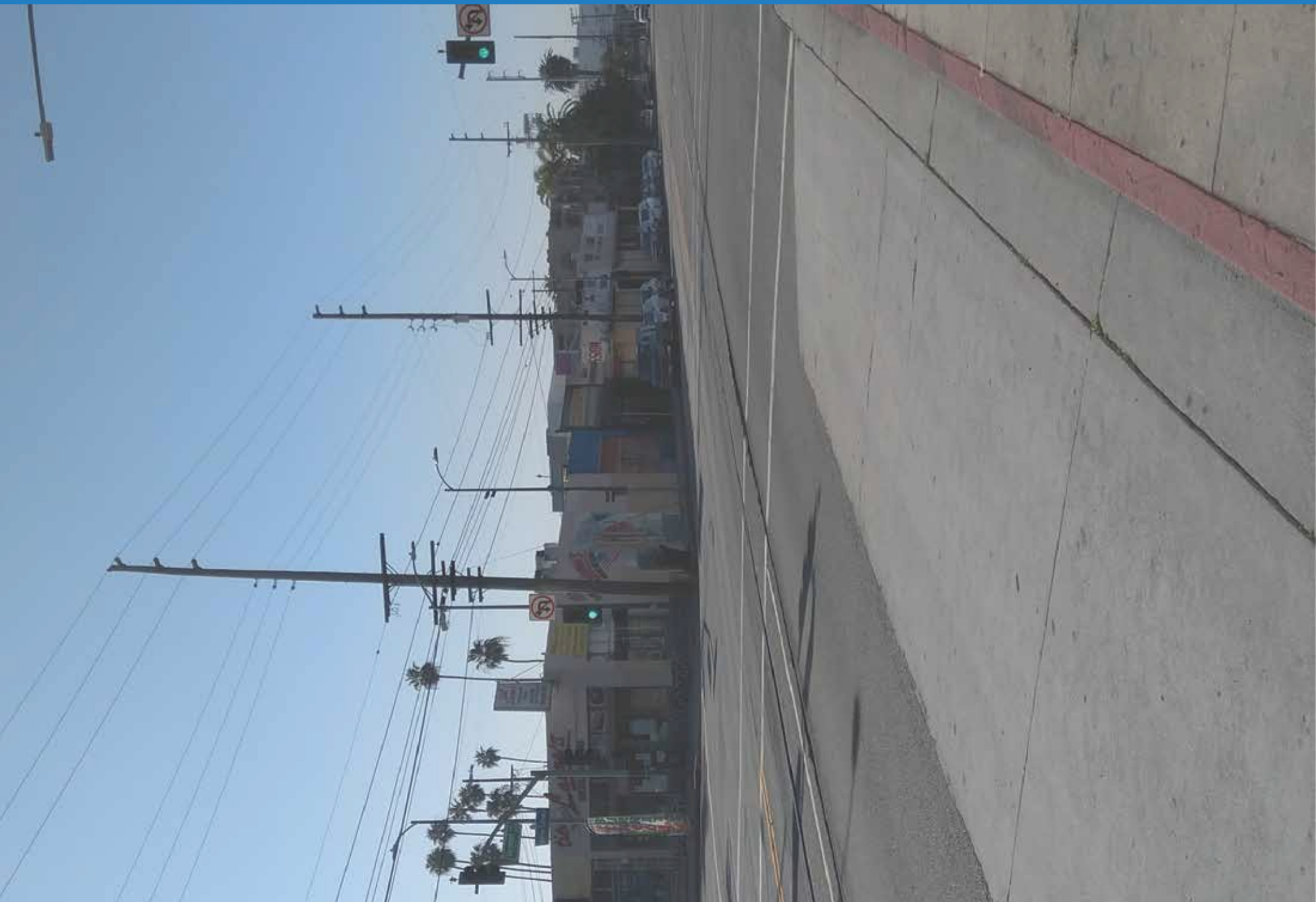
Figure 9.3: Equity Focus Communities (EFCs)



Source: LA Metro

Altogether, the challenges facing TOC on the corridor require proactive, integrated policymaking. By coordinating with local jurisdictions and transit agencies to encourage denser residential and mixed-use commercial development, expand bicycle and pedestrian infrastructure, improve transit service and amenities, locate economic development sites, and invest in EFCs, Metro can achieve complete, connected TOCs on the South Vermont Corridor.

10. Recommended Near-Term Improvements



10. RECOMMENDED IMPROVEMENTS IN NEAR-TERM

While it usually takes years if not decades to implement BRT or rail services, some improvements could be made in the near term to enhance transit service along the South Vermont Corridor and increase transit riders' mobility. These improvements include providing continuous bus service and improving traffic signal operation.

Providing continuous bus service on the study corridor with increased service frequency could reduce riders' out-of-vehicle time effectively, and thus make the bus service more competitive. This would require coordination between Metro and the two municipal transit operators along the corridor: GTrans and Torrance Transit. Should the Metro Board direct further work be done, funding and partnerships with the local municipal transit operators and cities will be needed to potentially provide continuous bus service, and identify and implement other near-term improvements for the corridor including improvements to pedestrian and bicycle facilities.

As discussed previously in the report, many signalized intersections along the South Vermont Corridor are congested during the peak period, which leads to slow bus speed. Currently, the traffic signals along the study corridor are not fully synchronized. This is because some signal synchronization takes place along the cross streets in the east-west direction. The signals along the study corridor are operated by four different agencies:

- City of Los Angeles Department of Transportation (LADOT): five intersections
- County of Los Angeles Department of Public Works (LACDPW): ten intersections
- City of Gardena: nine intersections
- California Department of Transportation (Caltrans): one intersection at Vermont Avenue and SR-91/Artesia Boulevard

As part of near-term improvements, Metro could work with these agencies to study the feasibility of signal timing optimization and synchronization, and implementing Transit Signal Priority (TSP) along Vermont Avenue.

11. Findings and Conclusions

11. FINDINGS AND CONCLUSIONS

The key objectives of this technical study were to:

1. Assess the feasibility of implementing BRT, LRT, and HRT concepts;
2. Identify and analyze potential impacts to existing communities (traffic, parking, etc.) and traffic circulation on Vermont Avenue and adjacent major arterials;
3. Develop operating scenarios corresponding to each of the rail alternatives to identify planning-level capital and Operating and Maintenance (O&M) cost estimates and ridership forecasts;
4. Identify potential Initial Operating Segments (IOS), including potential maintenance and storage facility (MSF) sites;
5. Evaluate opportunities to facilitate and promote Transit-Oriented Community (TOC) outcomes for each BRT and rail alternatives.

It has been determined, through the development of conceptual design, that it is feasible to extend the BRT and rail concepts from the North Vermont Corridor and implement them along the South Vermont Corridor. While impacts to traffic, parking, bike, and other roadway infrastructure were identified, no major flaws were identified that would prohibit the implementation of any of the transit concepts considered.

Through the course of this Study, several findings have been identified for Metro Board consideration:

1. Improvements are needed to the existing fragmented and infrequent transit service;
2. Support and concerns about this Study identified during the outreach procedure:
    a. Stakeholders generally support the extension of the BRT/rail concepts to be implemented along the North Vermont Corridor to the South Bay;
    b. There is strong advocacy for extending the BRT/rail concept alignment into San Pedro;
    c. Some stakeholders are concerned about the loss of a vehicular travel lane in the proposed BRT concepts, the loss of on-street parking spaces in the BRT and LRT concepts, and the increased traffic congestion and access issues to I-405 and SR-91;
    d. Torrance Transit and GTrans expressed concerns that the proposed transit concepts along the study corridor would compete with their bus service for ridership.
3. The estimated ridership ranges from approximately 8,800 for the Side-Running BRT concept to 19,300 for the HRT connected to the Metro B Line (Red) concept. These ridership numbers are much lower than those for the North Vermont Corridor, which are

approximately 33,100 for the LRT concept and in the range of 46,000 to 48,000 for the HRT;

4. The capital costs for the LRT and HRT concepts are 16 times and 37 times, respectively, more expensive than for the BRT concepts. The O&M costs for the LRT and HRT concepts are five times and ten times, respectively, higher than for the BRT concepts;
5. Higher-density developments will be needed to support BRT and rail services. Partnership with local jurisdictions is also needed to improve pedestrian and bicycle facilities along the corridor and, especially, near the potential station areas;
6. The biggest environmental impact to implementing the BRT/rail concepts would be traffic (loss of vehicular lanes, reconfiguration of turn-lanes, increased congestion, etc.) and loss of parking spaces on Vermont Avenue;
7. The recommended IOS southern terminus for the LRT/HRT concepts is Vermont Avenue and 182nd Street near the Harbor Gateway Transit Center;
8. The recommended near-term improvements include providing continuous bus service and improving traffic signal operation.

Figure 11.1 summarizes the performance of each of the five concepts in terms of operating characteristics, benefits, costs, and impacts. The Center- and Side-Running BRT concepts have the lowest projected peak hour capacity, travel time savings, and ridership among the five concepts studied, with the Side-Running BRT having lower ridership and time savings than the Center-Running BRT. At the same time, the BRT concepts cost significantly less to construct and operate than the rail concepts and are anticipated to have fewer environmental impacts. Since one vehicular lane would be converted to a dedicated bus lane in the two BRT concepts, the traffic operation of both roadway segments and signalized intersections along the corridor would deteriorate from the existing conditions, especially south of Artesia Boulevard/SR-91.

By contrast, the HRT concepts have the highest capital and operating costs among the transit concepts. While the HRT concepts are expected to garner the highest ridership and provide the biggest benefits in travel time savings and peak hour capacity, their capacity would be significantly under-utilized. The HRT concepts are anticipated to have minimal impacts on travel lanes and the roadway ROW and have fewer impacts on traffic operations than the BRT concepts, although HRT has a high potential for environmental impacts such as air quality, cultural resources, displacement and acquisitions, and noise and vibrations.

Finally, the LRT concept falls in between the BRT and HRT concepts in terms of costs, projected ridership, and peak hour capacity. Travel time savings are only slightly higher than for Center-Running BRT. While LRT has no effect on the number of vehicular travel lanes and

fewer potential impacts than BRT on roadway segment operations and the ROW, it is estimated to have considerable effects on traffic operation at signalized intersections. LRT has a high potential for environmental impacts such as cultural resources, displacement and acquisitions, and noise and vibrations.

Figure 11.1: Summary of Transit Concepts' Performance

	Center-Running BRT	Side-Running BRT	LRT	HRT1	HRT2
Estimated Weekday Ridership[1]	10,100	8,800	13,700	18,500	19,300
Peak Hour Capacity (One Direction)	900 persons per hour	900 persons per hour	4,800 persons per hour	• 11,800 persons per hour	11,800 persons per hour
Average Weekday Frequencies	• Peak: 5 minutes • Off-Peak: 10 minutes	• Peak: 5 minutes • Off-Peak: 10 minutes	• Peak: 5 minutes • Off-Peak: 10 minutes	• Peak: 4 minutes • Off-Peak: 10 minutes	• Peak: 4 minutes • Off-Peak: 10 minutes
Travel Time Savings	48 minutes	41 minutes	49 minutes	58 minutes	58 minutes
Capital Costs[2]	$293,900	$292,500	$4,709,400	$10,756,300	$10,756,300
Operations & Maintenance Costs[2]	$14,600 to $16,900	$16,900 to $18,400	$74,900 to $81,600	$147,000 to $167,500	$136,900 to $167,500
Right-of-Way Impacts	• Median mods • Left-turn lane mods • Curb mods at 157th St, 163rd St, 168th St	• Driveway conflicts • Median mods • Curbside stations at Gardena • Widening at Alondra	• Median Mods • Left-turn lane mods • Bike lane mods	• Stations	• Stations
Travel Lanes Removed	1 lane per direction	1 lane per direction	None	None	None
# of Intersections with LOS E or F	• AM Peak: 15 • PM Peak: 18	• AM Peak: 13 • AM Peak: 16	• AM Peak: 14 • PM Peak: 16	• AM Peak 10 • PM Peak 13	• AM Peak 10 • PM Peak 14
Roadway Segment Operations	• Artesia Blvd/SR-91 to I-405: E/F • I-405 to PCH: F • Artesia Blvd/SR-91 to I-405: E/F • I-405 to PCH: F		• Artesia Blvd/SR-91 to I-405: E/F • I-405 to PCH: A/B		
Environmental Effects	• Transportation and Traffic	• Transportation and Traffic	• Cultural Resources • Displacements and Acquisitions • Noise and Vibration • Transportation and Traffic	• Air Quality • Cultural Resources • Displacements and Acquisitions • Noise and Vibration	• Air Quality • Cultural Resources • Displacements and Acquisitions • Noise and Vibration

[1] South Vermont corridor only
[2] 2021 USD dollars, in thousands