SECTION 4: BRT ALTERNATIVES EVALUATION

VAN NESS AVENUE BRT FEASIBILITY STUDY

DECEMBER 2006

CONTENTS

1 Introduction

1.1 OVERVIEW

This section presents the results of the study team's evaluation of likely benefits and impacts of BRT on Van Ness Avenue. The analysis is documented here through ten chapters that describe the alternatives evaluated; the evaluation approach and criteria, the performance of BRT alternatives with respect to transit operations, transit rider experience, access and pedestrian amenities, urban and landscape design, traffic operations and parking, capital cost, and construction impacts; and a summary of the evaluation results. Key findings that indicate the benefits and impacts of BRT relative to the future with no BRT are identified at the end of each chapter.

1.2 SUMMARY OF EVALUATION RESULTS

The key findings of this section are as follows:

- **Van Ness can accommodate BRT.** Several BRT designs are feasible. This means that there are choices about how to implement BRT on Van Ness Avenue.
- **BRT offers significant transit performance benefits.** BRT offers significant transit performance benefits, encompassing faster travel times, more reliable wait times, more comfortable service, and systemwide performance benefits.

  All BRT alternatives are expected to provide significant transit performance benefits by reducing travel times and increasing reliability. BRT on Van Ness Avenue is expected to improve travel times on Van Ness Avenue by up to 37 percent on its most congested mile, up to 30% total between Mission and Lombard Streets. This would save up to 3,100 hours of transit passenger travel time daily. In addition to these travel time benefits, BRT is expected to significantly improve reliability by eliminating most or all conflicts with mixed traffic, and by streamlining passenger loading and unloading.

  Finally, BRT on Van Ness Avenue is part of a network of rapid transit that improves systemwide performance. The transit travel time and reliability improvements of BRT are expected to attract growth in new riders as much as 32 percent, reversing the citywide trend toward declining transit mode share. Sixty percent of these new Van Ness BRT riders are likely to be former drivers.

  The Center Lane BRT alternatives (Alternative 3, 4, and 5) provide the greatest benefits to transit travel times and transit reliability because they are not permeable to mixed traffic, and effectively eliminate conflicts with vehicles. Alternative 2 is permeable to mixed traffic, allowing right turns and parallel parking, diminishing the travel time and reliability benefits of BRT. Because Alternatives 3, 4, and 5 provide the greatest transit performance benefits, they attract the most riders and provide a greater share of benefits to low-income households and households without access to a car. Alternative 5 is able to improve the ease of operating transit vehicles by eliminating conflicts with mixed traffic as well as reducing weaving.

  All BRT alternatives improve the transit rider's experience and provide a new level of service that is distinct from current Muni service. All BRT Alternatives provide transit station platform amenities and safety improvements including lighting, shelters, signage and wayfinding information, and real-time transit arrival information. The size and shape of the transit station platforms, and the extent to which the transit lanes weave, and the key variables among alternatives in their effect on transit rider experience.
- **BRT offers benefits beyond transit performance.** All BRT alternatives improve pedestrian safety and access by reducing pedestrian crossing distances, providing visible crosswalks, and providing a complete set of countdown signals. BRT increases opportunities to create a distinctive identity for the street, upgrade street furniture and lighting, and increase the amount of green space and trees on Van Ness Avenue. The BRT alternatives vary primarily in the size and shape of the center landscaped median; their design of the median pedestrian refuges; and the amount of buffer they provide to pedestrians on the sidewalk.
- **BRT impacts are relatively minor and can be minimized.** All of the BRT alternatives are expected to divert traffic from Van Ness Avenue to other streets in the corridor and in

the city. The magnitude of those diversions and their impact on congestion on parallel streets requires further study. However, this initial analysis suggests that traffic will continue to flow smoothly on Van Ness Avenue itself, and that the volume of traffic diverted to parallel streets will amount to only about three additional cars per minute (during the peak period). This magnitude of diversions can be easily managed with traffic signal timing adjustments. The time it takes to drive from Mission Street to Lombard Street is expected to increase by about 1 minute. Two of the four BRT alternatives have designs that result in an increase in the supply of parallel parking on Van Ness Avenue.

BRT on Van Ness is expected to cost between $60-65 Million – significantly less than a subway or light rail project. BRT is expected to reduce operating costs by reducing the amount of time required for a bus to complete its route. Finally, new low-floor buses will be procured through Muni's vehicle replacement cycle.

The BRT alternatives do not have significantly different expected construction impacts. Several strategies to reduce any construction impacts are feasible with all BRT alternatives.

- **Begin next phase of project development.** Several BRT alternatives, including the Curb Lane BRT Alternative, should continue on to the next phase of project development – environmental analysis and preliminary engineering.

2 Evaluation Approach and Criteria

This section describes the study team's approach to evaluating alternative BRT designs for Van Ness Avenue, including the measures of evaluation and corresponding methodologies.

2.1 MEASURES OF EVALUATION

The following chapters document the results of the study team's evaluation of benefits and impacts of each BRT alternative. The alternative BRT concepts are evaluated against a set of seven evaluation measures. Four of the seven measures capture expected project benefits, while three address potential impacts or constraints:

Benefits

- Transit operations and performance
- Transit rider experience
- Access and pedestrian amenity
- Urban and landscape design

Impacts/Constraints

- Traffic operations and parking
- Capital and operating costs
- Construction impacts

Some evaluation measures are qualitative and others are quantitative. The primary sources of data for evaluating BRT performance include:

- San Francisco's Countywide Travel Demand Forecasting model (SF-CHAMP)
- Synchro traffic operations model
- VISSIM traffic and transit micro-simulation model
- Conceptual engineering designs
- Data on the performance of other BRT systems around the world
- Stakeholder and community outreach

The models used for this study (VISSIM, SF-CHAMP, and Synchro) are described in more detail in the next section. A table describing the evaluation measures and subcriteria is provided in Appendix 17.

2.2 THREE-STEP MODELING APPROACH

Many key aspects of BRT performance are assessed using a three-step approach to modeling transportation conditions, summarized in Figure 4-1. The three key models used are:

- San Francisco's Countywide Travel Demand Forecasting model (CHAMP)
- Synchro traffic operations model
- VISSIM traffic and transit micro-simulation model

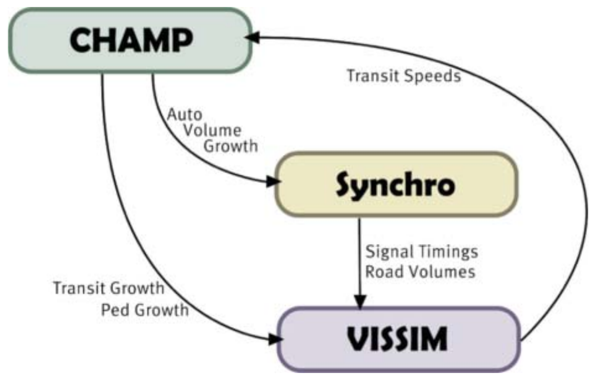


Figure 4-1: Three-Step BRT Modeling Process

2.2.1 San Francisco Countywide Travel Demand Forecasting Model (SF-CHAMP)

The Authority's travel demand forecasting model (SF-CHAMP) forecasts how changes in land use, roadway networks, and transit networks are likely to affect travel demand in San Francisco. Complete documentation of SF-CHAMP is included as Appendix 3. Key inputs to the model include:

- Expected changes to land use, in terms of number of jobs, households, and employed residents
- Estimates of future travel demand from outside San Francisco
- Known future roadway network modifications, taking into account major roadway projects (such as Octavia Boulevard) as well as all planned changes to Van Ness Avenue and parallel streets
- Planned future transit network modifications, including changes to bus routes and the addition of major projects such as the Third Street light-rail line

An SF-CHAMP model for the year 2010 without BRT (the "No Project" alternative) was created in addition to SF-CHAMP models for the other four alternatives. The SF-CHAMP modeling yields the following information:

- Changes in numbers of travelers and vehicles on Van Ness and parallel streets
- Changes in the proportion of people walking or bicycling
- Changes in transit ridership on each route in the Van Ness corridor
- Changes in the origins and destinations of travelers in cars and on transit

2.2.2 Synchro Traffic Operations Model

MTA operates a Synchro traffic operations model that covers much of the city. Complete documentation of the Synchro model is included as Appendix 6. This model focuses on intersections, since in urban areas, the smoothness of travel at intersections is a key factor in congestion. Synchro assesses how well intersections serve expected numbers of vehicles, and estimates the delays caused at intersections. It also models how changes to signal timing and intersection geometry (the presence of turn pockets, for example) affect intersection operation. Inputs to the Synchro model include:

- The roadway configuration of the corridor
- Expected vehicle volumes, including on parallel streets
- Number, length, and type of turn pockets
- The signal timing plan
- The Synchro model outputs that are used for evaluation include:
- Queues of vehicles waiting at traffic lights
- The average amount of delay to vehicles at each intersection
- An overall metric for the performance of the intersection, called a "level of service" (LOS) grade

2.2.3 VISSIM Micro-Simulation Model

Results from the SF-CHAMP and Synchro models are used as inputs to this third modeling step. Documentation of the VISSIM model is included as Appendix 18. Unlike SF-CHAMP, VISSIM simulates the individual behavior of pedestrians, drivers, and transit riders at each intersection. Unlike Synchro, VISSIM distinguishes between people in vehicles, on transit, and on the sidewalk, and is also able to model transit signal priority – each instance that a bus triggers an extended green light as it approaches an intersection. Key inputs to the VISSIM model include:

- Numbers of people on buses, walking, and driving
- Movements made by each vehicle at an intersection (e.g., turn left or right, or go through)
- Signal timing and locations where signal priority is permitted
- The outputs from the VISSIM modeling include:
- Transit, truck, and car travel times
- Transit reliability
- Delay at intersections for people, whether traveling by car, by bus, or on foot.

3 Transit Performance

3.1 PURPOSE

The purpose of this evaluation measure is to assess the benefits of the BRT alternatives on transit performance. As shown in Table 4-1, transit performance is measured by transit travel time; service reliability (the variation in bus headways and passenger waiting times); ease of operation; equity analysis (the travel time savings for transit-dependent groups compared to the general population); and attracting/retaining transit riders.

3.2 METHODOLOGY

The three-step modeling process described in Section 2-2 provided the bulk of the transit performance results. The VISSIM model simulated transit and auto travel times and speeds. SF-CHAMP provided estimates of how overall demand for transit trips changes as a result of curb-lane or center-lane BRT, and how changes in transit performance benefit different types of travelers (the equity analysis). Finally, focus group input was used to assess criteria not easily modeled.

Table 4-1: Transit Operations and Performance

Criterion	Description	Source(s)
Transit travel time	The time it takes for buses to travel along the corridor. Overall average transit travel time is modeled and compared to the modeled average auto travel time. Modeled transit operating speeds are also compared as a percentage of modeled auto travel speeds in the corridor.	VISSIM
Service reliability	Measures the variation in bus headways and passenger waiting times. The standard deviation in travel time (in minutes) is calculated from model simulations of transit operations, complemented by a review of the reliability performance of other BRT systems around the world.	VISSIM / review of other projects
Ease of operation	Captures the difficulty of operating the transit vehicles along their route. The most important elements of operating difficulty are determined through operator focus groups, including: the extent of transit mixing with other traffic, the extent of transit weaving along the corridor, and the enforceability of the right-of-way.	Operator focus groups / engineering designs
Equity analysis	Compares the share of travel time savings for transit-dependent groups to the share of travel time savings for the non-target groups. Travel time benefits for zero-car households and low-income households are tabulated separately from SF Model forecasts, and compared to SF Model forecasts of travel time savings for San Franciscans in general.	Authority's travel demand model (CHAMP)
Attract/retain transit riders	Reports how well transit services are attracting trips. The SF Model reports the change in the overall number of transit riders on Van Ness Avenue routes, as well as the share of all trips made by transit.	Authority's travel demand model (CHAMP)

3.3 FINDINGS

3.3.1 Transit Travel Times

BRT on Van Ness A is estimated to improve transit travel time significantly compared to the future No Project alternative. Over the completed two-mile corridor from Mission to Lombard, a 30 percent reduction in total transit travel time is expected. In the stretch between Mission and Post, a 37 percent travel time savings is expected. This improvement in travel time amounts to up to six minutes saved each trip, or between 2,600-3,100 hours of transit passenger travel time daily. The transit trip time from Mission to Lombard is reduced from over 19 minutes to under 14 minutes.

No travel time improvements are expected for transit in Alternative 1, the No Project scenario.

Transit speeds are further impeded by slight mixed-traffic increases in the future, and bus travel times will be longer than they are today in the absence of a BRT project.

Alternative 2, Curb Lane BRT, improves transit travel time by 24 percent on average from Mission to Lombard, whereas Alternatives 3-5 improve transit travel times by at least 30 percent over that two-mile stretch.

These travel time savings are consistent with the improvements experienced by other BRT systems worldwide. BRT projects in other US cities have reduced travel times anywhere from 11 to 35 percent.

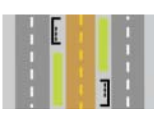
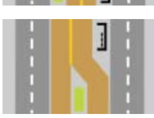
Alternative	Travel Time	
2010 No Project 		Without BRT, transit travel time takes almost 2 times as long as auto. Transit travel time from Mission to Lombard is 19.4 minutes.
Curbside BRT 		Transit travel times improve 24% from Mission to Lombard About 2,600 hours saved for transit riders daily Transit travel time from Mission to Lombard is 14.9 minutes.
Center-side BRT   		Transit travel times **improve 30%** from Mission to Lombard About **3,100 hours saved** for transit riders daily Transit travel time from Mission to Lombard is 13.5 minutes.

Figure 4-2: Transit Travel Time Results

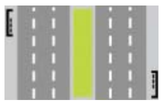
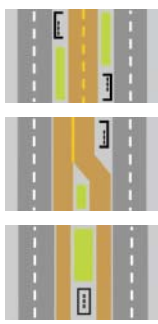
Alternative	Transit Travel Time	Auto Travel Time
2010 No Project 	19.4 minutes	11.2 minutes
Curbside BRT 	14.9 minutes	11.2 minutes
Center-side BRT 	13.5 minutes	11.5 minutes

Figure 4-3: Transit/Auto Travel Times from Mission to Lombard

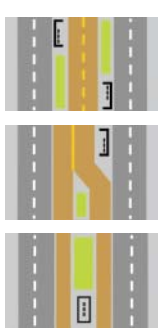
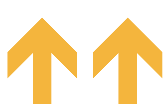
Alternative	Reliability	
2010 No Project 		Increased congestion
Curbside BRT 		Reduces some conflicts with cars Remaining conflicts with right-turning and parking cars
Center-side BRT 		All conflicts with cars removed

Figure 4-4: Reliability Results

3.3.2 Service Reliability

All BRT alternatives improve the reliability of transit service along Van Ness Avenue from Mission to Lombard by reducing conflicts with mixed traffic and streamlining passenger loading and unloading. Under Alternative 1, buses remain subject to delays caused by operating in mixed traffic and show no improvements to reliability.

Alternatives 3, 4, and 5 provide the greatest reliability improvements for transit by eliminating conflicts with mixed traffic and streamlining passenger loading and unloading. Alternative 2 remains subject to some mixed-traffic delays caused by cars parking and making right turns across the bus lane, and does not improve reliability as much as do the Alternatives 3-5. Because the center-running BRT alternatives have exclusive bus lanes that are not permeable to mixed traffic, they are not susceptible to these delays, and show the greatest improvements to service reliability.

3.3.3 Ease of Operation

All BRT alternatives improve the ease of operating buses by reducing conflicts with traffic and eliminating the need for buses to pull in and out of traffic at bus stops.

Alternative 2 does not remove this problem entirely; buses must weave around parking and right-turning vehicles, as well as around cars that use the bus lane illegally.

Alternatives 3 and 4 are physically separated from mixed traffic by landscaped medians or a low curb, which improves operations. However, Alternative 3 may present problems in removing disabled buses from the bus lanes in the event of a breakdown, and both designs require some weaving of the transit lanes around left-turn pockets and station platforms.

Alternative 5 provides the greatest total improvement to transit operations because its design includes very little weaving along the corridor, making the route easier and safer for bus operators to navigate.

3.3.4 Equity Analysis

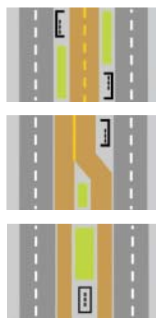
A number of steps in the planning process are intended to advance projects with an equitable distribution of benefits and impacts. Broad participation by stakeholders as early as possible helps to ensure that concerns about project design and impacts, as well as about distribution of project benefits, are addressed effectively in the design process.

The Van Ness corridor passes through a diverse set of neighborhoods ranging from very low income to very high income. Moreover, 46 percent of households in the corridor do not own cars. The following evaluation measure captures the degree to which low-income households and households without a car benefit from BRT on Van Ness relative to households that aren't low income and that have access to a car.

The SF-CHAMP model can calculate transportation outcomes for different groups of people, such as low-income or zero-car households. To measure the equity of a BRT investment on Van Ness Avenue, the study team measured the share of project benefits that would accrue to low-income and zero-car households, as well as the share of project benefits that would accrue to households that aren't low income and that have access to a car. An equitable project is one that benefit "target" and "non-target" populations proportionately.

Figure 4-5 reports how BRT project benefits accrue to target and non-target populations. The measures were calculated by dividing the share of total travel time savings from BRT that accrue to each group by the share of that group in the population of San Francisco (see Appendix 4 for more details). A result of one is a perfectly equitable result, meaning that the project benefits the group in exact proportion to that group's share of the total population; a result less than one means that the group gets disproportionately less benefit from the project; and a result greater than one means that the group accrues disproportionately more of the project benefits.

The evaluation shows that a *disproportionate* share of the BRT benefits on Van Ness go to low-income and zero-car households. Although all BRT alternatives disproportionately benefit these target households, Alternatives 3, 4, and 5 provide greater benefits to these populations than does Alternative 2, a consequence of the superior transit performance of the center-running BRT lanes.

Alternative	Share of Total Travel Time Savings / Share of Total Population	
	Zero Car Households	Households with 1+ Cars
Curbside BRT 	1.21	0.95
Center-side BRT 	1.72	0.82

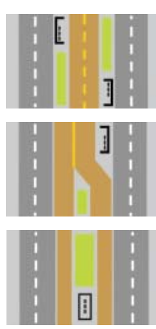
Alternative	Share of Total Travel Time Savings / Share of Population	
	Low-Income Households	Households Not Low-Income
Curbside BRT 	1.04	0.99
Center-side BRT 	1.71	0.88

Figure 4-5: Equity Results

3.3.5 Attract and Retain Transit Riders

By 2010, without BRT improvements, transit ridership on Van Ness Avenue routes will drop by about two percent. This is the consequence of worsening transit performance if no measures are taken to speed travel times and improve reliability. The improved transit travel times that result from Alternative 2 are expected to increase ridership on the Van Ness Avenue routes by 16 percent relative compared to the No Project scenario. Alternatives 3, 4, and 5 improve transit performance more than Alternative 2, and therefore are expected to attract additional ridership. Relative to the No Project alternative, ridership on Alternatives 3, 4, and 5 will increase by 23 percent. Sixty percent of these expected new riders are former drivers. The rest previously either made their trip using a different transit route or by walking.

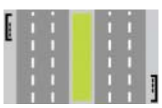
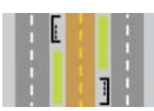
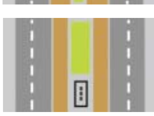
Alternative	Ridership	
2010 No Project 		-2.2% (relative to 2005)
Curbside BRT 		+16% (relative to No Project)
Center-side BRT   		+23% (relative to No Project)

Figure 4-6: Ridership Results

3.4 WORKSHOP FEEDBACK

At public workshops hosted by the Authority in October 2006, participants were asked questions about their views on Van Ness BRT in small groups. Participants gave their reasons for attending the workshop and described their views of the potential benefits and potential negative impacts of BRT. The small discussion groups were followed by a question-and-answer session. The complete summary of workshop results is included as Appendix 19.

Service quality was a common theme. Faster and more reliable service was mentioned most frequently as the key benefit of BRT. Participants also hoped to see more frequent service and a reduction in bus bunching. Some participants expected BRT on Van Ness Avenue to increase transit ridership and wanted to see an upgraded fleet of buses as part of the project. Workshop participants were enthusiastic about the prospect of removing some bus stops, though participants wanted to ensure that high-volume stops and stops serving key land uses would be retained.

Some workshop participants noted that left-turning vehicles could slow buses, as would the use of bus lanes by other transit lines, emergency vehicles, and tour buses. Participants were also concerned about the transition between BRT lanes and regular lanes as buses entered and exited the BRT portion of Van Ness. Some participants were unconvinced that Muni's current bus fleet would be able to deliver the benefits of BRT. Workshop participants recommended that the Authority study further the relationship between BRT on Van Ness routes and changes in other transit lines.

3.5 KEY CONCLUSIONS

The following table summarizes the evaluation of transit operations and performance.

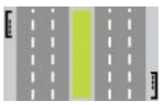
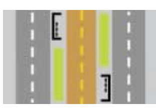
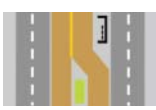
Alternative	Transit Travel Times	Service Reliability	Ease of Operation	Equity	Attract and Retain Transit Riders
No Project 	↓	↓	↓	↓	↓
Curbside BRT 	↑	↑	↑	↑	↑
Center-side BRT (two medians) 	↑↑	↑↑	↑	↑↑	↑↑
Center-side BRT (one median) 	↑↑	↑↑	↑	↑↑	↑↑
Center-side BRT (center medians) 	↑↑	↑↑	↑↑	↑↑	↑↑

Figure 4-7: Transit Operations and Performance Scoring

4 Transit Rider Experience

4.1 PURPOSE

The purpose of this evaluation is to measure the benefits of the BRT alternatives on transit rider experience. Transit rider experience is measured by the quality of the waiting and boarding experience; quality of the in-vehicle experience; wayfinding ability; safety and security of waiting riders; and the ability to brand a unique identify for the BRT transit route. Table 4-2 below describes the sub-criteria that measure transit rider experience.

4.2 METHODOLOGY

Transit rider experience is measured both qualitatively and quantitatively. Conceptual engineering drawings are the source of estimates for bus weaving, platform capacity, and the buffers between cars and waiting passengers. The SF-CHAMP model provides information on bus crowding. Branding, marketing, the quality of the station platform amenities, and security are assessed qualitatively.

Table 4-2: Transit Rider Experience

Criterion	Description	Source(s)
Quality of waiting and boarding experience	Captures the quality of the passenger waiting and boarding experience. Street layout and geometry are reviewed to determine the effects of the designs on the reliability of transit service, the width of platforms, and buffers between waiting passengers and auto traffic.	Engineering designs – quantitative Design charrettes – qualitative
Quality of in-vehicle experience	Captures the quality of the ride on transit from the passenger's perspective. Street layout and geometry are reviewed to assess the effects of the designs on how much buses have to weave along their route and the distance that buses have to travel in mixed traffic. The Authority's travel demand model provides forecasts of how full buses will be at their peak load points.	Engineering designs – quantitative Authority travel demand model (CHAMP)
Wayfinding ability	Captures how visible and legible transit routes and information will be to potential riders. Street and transit station platform layout and geometry are reviewed to assess how the designs affect the quality and level of information given to passengers, and the ease of transferring from the Van Ness Avenue service to other intersecting routes.	Engineering designs – qualitative Design charrettes – qualitative
Security of waiting riders	Captures the level of perceived safety and security for waiting passengers. Street and transit station platform layout and geometry are reviewed to assess the visibility of waiting passengers to other passengers and to people occupying nearby buildings.	Engineering designs – qualitative Design charrettes – qualitative
BRT transit route branding / identity	Captures the distinctiveness of transit as a special service and the distinctiveness of the entire street. Street and transit station platform layout and geometry are reviewed to assess the opportunities for unique and distinctive design treatments, the ability to establish consistent design themes and patterns, and the opportunities for raising the visibility of transit service.	Engineering designs – qualitative Design charrettes – qualitative

4.3 FINDINGS

4.3.1 Quality of Waiting and Boarding Experience

The total quality of a passenger's waiting and boarding experience is affected by the reliability of transit service, the width of the platform at a station, and the degree of separation between passengers and moving traffic. All BRT alternatives improve the quality of passengers' waiting and boarding experience by providing real-time arrival information, better lighting, more seating, and larger shelters. However, the alternatives also affect the quality of the waiting experience for different reasons.

Alternative 2 improves reliability somewhat, though some conflicts with mixed traffic remain. But because the station platforms are located on the sidewalk, they are wide (17 feet), and buffer waiting passenger from auto traffic by the parking lane and the bus lane.

Alternatives 3, 4 and 5 offer the most improved reliability, but the eight-foot wide platforms in Alternatives 3 and 4 are comparatively narrow and the platforms are separated from auto traffic only by a physical barrier. Alternative 5 perhaps provides the best waiting experience. Station platforms are an ample 11-14 feet wide and the bus lane also acts as a buffer between the platform and auto traffic.

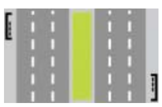
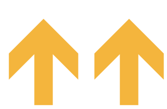
Alternative	Waiting and In-Vehicle Experience	
No Project 		Some real time information; bus must "weave" around right-turning and parking cars
Curbside BRT 		Real time information; larger station platforms Bus must "weave" around right-turning and parking cars
Center-side BRT (two medians) 		Real time information; no conflicts with mixed traffic Eight foot station platform in between traffic lanes; transit lanes "weave" around left turn pockets and at station platforms
Center-side BRT (one median) 		Real time information; no conflicts with mixed traffic Eight foot station platform in between traffic lanes; transit lanes "weave" around left turn pockets and at station platforms
Center-side BRT (center medians) 		Real time information; no conflicts with mixed traffic 14 foot station platform in between traffic lanes; transit lanes "weave" around left turn pockets and at station platforms

Figure 4-8: Waiting and In-Vehicle Experience Results

4.3.2 Quality of In-Vehicle Experience

The quality of the in-vehicle riding experience is a function of the smoothness (or jerkiness) of the ride and of crowding on the buses. Alternatives 3 and 5 provide the best in-vehicle experience because these alternatives operate separately from mixed traffic and have moderate to minimal weaving along the corridor, allowing for a smoother passenger ride. Alternatives 2 and 4 involve more weaving of the buses due to either the design itself (Alternative 4) or the need to avoid parking and left-turning vehicles (Alternative 2), both of which reduce passenger comfort.

4.3.3 Wayfinding

Each BRT alternative provides additional signage to improve general transit wayfinding and the transfer experience in particular. Providing consistent wayfinding is simplest in Alternative 5 because the same platform is used for travel in both directions.

4.3.4 Sense of Security for Waiting Riders

BRT station platforms improve security for waiting passengers by providing closed-caption TV monitoring, better lighting, and real-time arrival information. Proof-of-payment zones will be enforced on station platforms. Riders using the system under any of the alternatives will benefit from a combination of informal surveillance by other riders and physical platform separation from the roadway. Alternatives 2 and 5 might provide an additional perception of security to waiting passengers because they either allow for more passengers on the station platform (Alternative 5) or allow passengers to wait on the sidewalk, with easy access to adjacent land uses (Alternative 2).

4.3.5 BRT Transit Route Branding/Identity

This sub-criterion measures the ability of a design to be recognized by the general public as a high-quality and rapid service.

Although each BRT alternative features colored transit lanes to discourage mixed traffic, Alternative 2 has a diluted appearance as rapid transit by allowing cars to travel in the bus lane to turn right or park. Moreover, because they are adjacent to the sidewalk, the station platforms in Alternative 2 may be identified with the sidewalk environment rather than with transit service.

Alternatives 3, 4, and 5 provide the best branding opportunity and strongest identity for BRT because the bus lanes are physically separated from auto lanes, reinforcing their identity as rapid transit. The location of station platforms in the center of the roadway offers the ability to design them uniquely to help advertise the BRT service and coordinate their design with station platforms associated with Geary BRT at the O'Farrell intersection. The width of the station platforms permitted by Alternative 5 creates the opportunity to design signature platforms at Market Street and at City Hall.

4.4 WORKSHOP FEEDBACK

At public workshops hosted by the Authority in October 2006, participants had the opportunity to provide feedback on the Van Ness BRT alternatives evaluation. Many comments addressed the transit rider experience. A complete summary of the workshop input is included as Appendix 19.

Workshop participants hoped that BRT would enhance the rider experience by providing low-boarding technology to make it easier for seniors and others to board the bus. Participants supported NextBus and external fare-vending machines. Some participants said that BRT on Van Ness would increase the safety of transit riders waiting for the bus.

While some participants expected BRT to reduce crowding on buses, others expressed the concern that BRT could make buses more crowded. Some participants noted that rider and motorist education would be important for the success of the project but potentially challenging and recommended that the Authority develop a marketing plan. Participants also recommended that the Authority further study the costs and benefits of ticket-vending machines on transit performance.

4.5 KEY CONCLUSIONS

The following table summarizes the evaluation results of each alternative on transit rider experience.

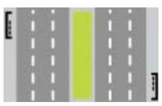
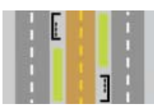
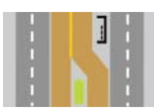
Alternative	Quality of Waiting and Boarding Experience	Quality of invehicle Experience	Way-finding Ability	Sense of Security for Waiting Riders	BRT Transit Route Branding/ Identity
No Project 	-	↓	-	-	↓
Curbside BRT 	↑↑	↑	↑	↑↑	↑
Center-side BRT (two medians) 	↑	↑	↑	↑	↑↑
Center-side BRT (one median) 	↑	↑	↑	↑	↑↑
Center-side BRT (center medians) 	↑↑	↑↑	↑	↑↑	↑↑

Figure 4-9: Scoring for Transit Rider Experience Evaluation

5 Access and Pedestrian Amenities

5.1 PURPOSE

The purpose of this evaluation is to measure the benefits of BRT on pedestrian safety and conditions. Access and pedestrian amenities are measured by the street-crossing experience and sidewalk conditions (including safety and comfort for pedestrians); quality of bicycle access (including safety and comfort for bicyclists); and increased employment, retail and consumer accessibility for neighborhoods (the increase in work and shopping opportunities available by transit).

5.2 METHODOLOGY

Much of the evaluation results for this measure were assessed through review of the conceptual engineering drawings prepared for each alternative. The VISSIM microsimulation model contributed traffic speed results and CHAMP measured changes in economic opportunities as a result of BRT.

5.3 FINDINGS

5.3.1 Crossing Experience

All BRT alternatives improve the pedestrian crossing experience by installing visible crosswalks and a complete set of countdown signals, as well as increasing the amount of time pedestrians have to cross Van Ness and reducing average crossing distances.

Each alternative reduces average crossing distances for pedestrians by adding curb bulb-outs at many locations. Where bulb-outs are added, crossing distance is reduced by eight feet. Alternative 5 reduces average pedestrian crossing distances the most: from the existing 91.3 feet to 82 feet. Alternative 2 reduces average crossing distance to 83 feet and Alternatives 2 and 4 reduce the average distance to 83.3 feet.

Table 4-3: Access and Pedestrian Amenities

Criterion	Description	Source(s)
Crossing experience	Measures safety and comfort for pedestrians crossing Van Ness. Street and transit station platform layout and geometry are reviewed to calculate the number of traffic lanes pedestrians must cross before reaching a refuge; the width of pedestrian islands; and average crossing distances.	Engineering designs – quantitative Signal timing plan
Sidewalk conditions	Measures safety and comfort for pedestrians on the sidewalks. Street and transit station platform layout and geometry are reviewed to calculate the width of the sidewalks under each alternative and whether there are buffers between the sidewalk and moving traffic (e.g., a parking lane). The speed of traffic moving adjacent to the sidewalk is measure through the VISSIM micro-simulation model.	VISSIM micro-simulation model Engineering designs - quantitative
Quality of bicycle access	Measures the safety and comfort for bicyclists riding in the corridor. Street layout and geometry are reviewed to measure the space available for bicyclists to navigate corridor streets, including the width of the vehicle lane next to parking lanes.	Engineering designs – quantitative
Increased employment, retail and consumer accessibility for neighborhoods	Captures the increase in work and shopping opportunities available by transit. SF Model forecasts the change in the number of jobs, retail opportunities, and potential customers reachable within a 30 minute transit trip, relative to a 30 minute car trip.	Authority's travel demand model (CHAMP)

The BRT alternatives vary in the design of their median pedestrian refuges and in the number of traffic lanes that pedestrians must cross before reaching a refuge. Alternative 2 increases the median pedestrian refuge by two feet and eliminates all locations on Van Ness where pedestrians currently must cross more than four lanes of traffic before reaching a refuge. Alternatives 3 and 4 decrease the average refuge width by three feet. Alternatives 3, 4, and 5 increase the number of locations where pedestrians must cross more than four lanes of traffic before reaching a refuge by 14, eight, and five locations respectively.

5.3.2 Sidewalk Conditions

All BRT alternatives improve sidewalk conditions on Van Ness through pedestrian-scale street lighting and improved landscaping. Alternative 2 provides an extensive buffer between pedestrians on the sidewalk and moving traffic through the 12-foot bus lane and either an eight-foot parking lane or a station platform. Although Alternatives 3 and 4 preserve Van Ness Avenue's wide sidewalks, some blocks lose the parallel parking, losing the buffer between pedestrians and moving auto traffic.

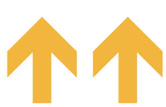
Alternative	Crossing Experience and Sidewalk Conditions	
No Project 		Long crossing distance; few countdown signals Parallel parking buffers peds from traffic
Curbside BRT 		Reduced crossing distance; countdown signals; larger median refuges; parallel parking increased; bus bulbs widen sidewalk
Center-side BRT (two medians) 		Reduced crossing distance; countdown signals Parallel parking reduced
Center-side BRT (one median) 		Reduced crossing distance; countdown signals Parallel parking reduced
Center-side BRT (center medians) 		Reduced crossing distance; countdown signals larger median refuges; parallel parking increased

Figure 4-10: Results for Crossing Experience and Sidewalk Conditions

5.3.3 Quality of Bicycle Access

All BRT alternatives benefit cyclists by lowering traffic volumes on Van Ness. Alternative 2 presents a drawback to cyclists riding on Van Ness by requiring them to cross the bus lane to make a right turn, as it requires regular mixed-traffic to do. Under all alternatives, Polk Street continues to function as the best bicycle route through the study area.

5.3.4 Increased Employment and Retail Accessibility for Neighborhoods

Alternative 1, the No Project scenario, does not contribute to expanded accessibility on transit to job and shopping opportunities. Van Ness transit reaches about ¾ of the shopping and work opportunities that can be reached within a half hour by car (70 percent and 82.2 percent of total opportunities available by car, respectively).

All BRT alternatives increase the numbers of jobs and shopping opportunities that can be accessed by transit, and help to close the accessibility gap between transit and cars. Alternative 2 increases the number of shopping and job opportunities accessible by transit to 72.4 percent and 83.2 percent of the number of opportunities available by car, respectively. Because Alternatives 3, 4, and 5 increase transit travel times the most, they increase transit accessibility to shopping and work by the greatest amounts, bringing the number of shopping and job opportunities to 74.1 percent and 84.3 percent of those available by auto, respectively.

5.4 WORKSHOP FEEDBACK

At public workshops hosted by the Authority in October 2006, citizens had the opportunity to provide feedback on the Van Ness BRT alternatives evaluation. In their comments, some participants addressed access and pedestrian amenities. A complete summary of the workshop is included as Appendix 19.

Many workshop participants expressed concern about BRT's effect on pedestrian safety, since pedestrians would have to cross several lanes of traffic to access the station platforms. However, some participants also stated that a BRT project would have a positive effect on Van Ness aesthetically. The potential for jaywalking was also noted as a concern, and participants recommended that the Authority study ways to minimize potential jaywalking between station platforms and the sidewalks.

5.5 KEY CONCLUSIONS

The following figure summarizes the scores given to each alternative.

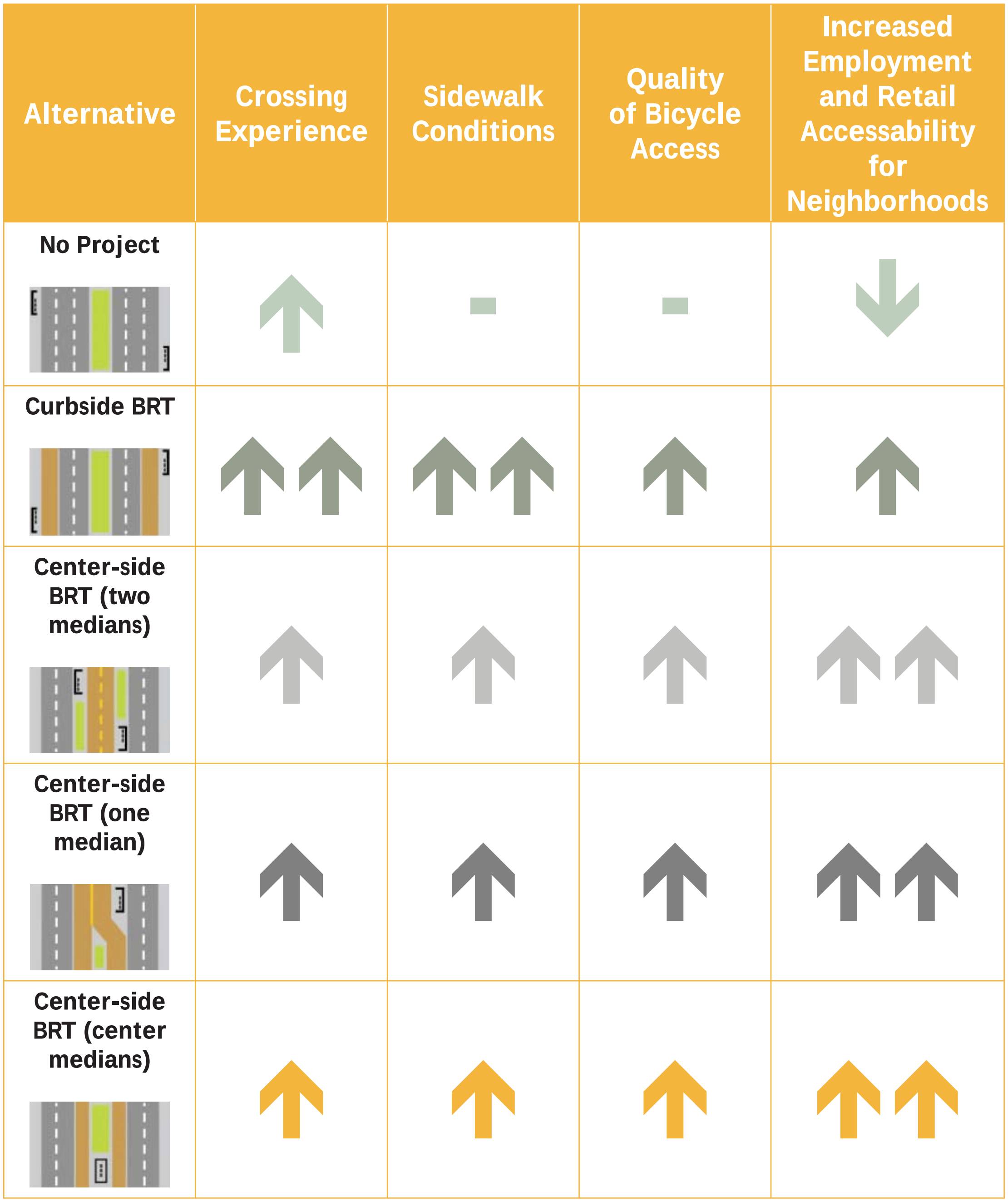


Figure 4-11: Access and Pedestrian Amenity Scoring

6 Urban and Landscape Design

6.1 PURPOSE

The purpose of this evaluation is to measure the benefits of BRT to urban landscape and design. These amenities are measured by the ability to provide a distinctive landscape and design identity; how well adjacent land uses can access transit; whether public open space is created; how much green space is developed and its quality and character; and how much each alternative contributes to sustainable stormwater management practices and the quality of their contributions.

6.2 METHODOLOGY

These measures are primarily calculated from engineering drawings of each alternative that include the dimensions of the landscaped median. Urban design considerations were assessed through design charrettes based on the physical layout indicated in the engineering drawings.

6.3 FINDINGS

6.3.1 Street Identity

The presence of dedicated bus lanes and high-quality station platforms alone serve to strengthen the design identity of Van Ness in each BRT scenario, although the permeability of the bus lanes in Alternative 2 weakens their

Table 4-4: Urban and Landscape Design Criteria

Criterion	Description	Source(s)
Street identity	Captures the ability of an alternative to support a distinctive design for Van Ness Avenue. Street and transit station platform layout and geometry are reviewed to determine the opportunities to support distinctive street design through the BRT platforms, street furniture, and landscaping.	Engineering designs – qualitative Design charrettes – qualitative
Integration with adjacent land uses	Considers the ease of accessing transit from adjacent land uses. Street and transit station platform layout and geometry are reviewed to assess the relationship between bus stops and adjacent storefronts.	Engineering designs – qualitative Design charrettes – qualitative
Ability to create usable public open space	Evaluates the quality of any new open space established by the design alternatives. Street and transit station platform layout and geometry are reviewed to calculate the amount of new open space created and the quality of that space for comfortable, multi-purpose public use.	Engineering designs – qualitative Design charrettes – qualitative
Quality, quantity, and character of landscaping	Describes the amount and quality of green space provided by each of the alternatives. Street and transit station platform layout and geometry are reviewed to calculate the number of trees that can be supported, the square footage of landscaped area, and the size and shape of landscaped sections of the street.	Engineering designs – qualitative
Quality of sustainable stormwater management treatments	Assesses the contribution of the BRT alternatives toward sustainable stormwater management practices. Street and transit station platform layout and geometry are reviewed to calculate the number of mature trees and permeable ground surface area provided by each alternative design.	Engineering designs – qualitative

design impact somewhat. All BRT alternatives also include at least one signature station unified with other major transit routes (at Market), and the center-running alternatives also include an additional unified station at O'Farrell. Alternatives 2, 3, and 5 provide for a strong linear axis with consistent central medians, as well as a new gateway median from Mission to Market. Because the median in Alternative 4 weaves and narrows at many points, it results in a weaker design impact. Alternative 5 provides the greatest opportunity for establishing a distinctive identity for Van Ness Avenue with its large, combined-platform stations and the potential for additional unified stations at the Jackson/Pacific and Vallejo/Green intersections.

6.3.2 Integration with Adjacent Land Uses

Alternative 2 is the most directly integrated with adjacent Van Ness land uses because pedestrians walking along the sidewalk can easily stop and wait for a bus without crossing any travel lanes.

One key advantage of Alternative 5, Center-Side (Center Median), is the opportunity it provides through the unified station platforms for three block-long stations, which connect more seamlessly with land uses at each corner where stops are located. Center Alternatives 3 and 4 have just one block-long station. It should be noted that the southbound station platform nearest the proposed hospital at Geary/Post is

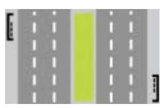
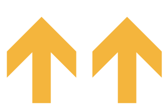
Alternative	Landscaping Opportunities	
No Project 		Strong center median; 89 median trees; 51,000 s.f. planted area
Curbside BRT 		Strong center median; 200 median trees; 94,000 s.f. planted area
Center-side BRT (two medians) 		Signature station platforms; 241 median trees; 50,000 s.f. planted area Inconsistent median shape
Center-side BRT (one median) 		Signature station platforms; 169 median trees; 65,000 s.f. planted area Inconsistent median shape
Center-side BRT (center medians) 		Strong center median; signature station platforms; 143 median trees; 55,000 s.f. planted area

Figure 4-12: Landscaping Opportunities

located farther from this major land use in Alternative 2 than in the other alternatives.

6.3.3 Ability to Create Usable Public Open Space

Each of the BRT alternatives provides the opportunity for a plaza space to be created at 12th Street. Additionally, Alternative 2 creates the wider sidewalks at BRT stops, freeing sidewalk space for tables or other outdoor retail activities.

6.3.4 Quality, Quantity, and Character of Landscaping

All BRT alternatives increase the number of trees on Van Ness and the total square footage of green landscaping, as well as fill gaps in the existing tree line of the sidewalk through the current bus stops.

However, the shape and consistency of the landscaped median varies among the alternatives. Alternative 2 preserves the existing wide median, which offers flexible but consistent landscape design and ease of maintenance. The same is true of Alternative 5, which maintains a more consistent tree pattern in a more consistent center median than the other center lane alternatives. Under Alternative 4, the median is often narrow and irregularly shaped, which makes it more difficult to maintain and restricts the landscaping choices. Alternative 3 reconfigures the medians into narrower lengths, a disadvantage when maintaining and selecting landscaping specimens, particularly trees.

6.3.5 Sustainable Storm Water Management

Storm water management depends heavily upon the amount of landscaped area, which allows water to be absorbed into the ground, as well as the number of mature trees that help hold soil in place. All of the BRT alternatives either sustain current levels of landscaped area or increase those amounts. Alternative 2 doubles the amount of median landscaped area to 94,000 square feet. Alternative 4 has the second highest amount of planted median area, 64,700 square feet. Alternatives 5 and 3 maintain or slightly increase the amount of planted median area.

6.4 WORKSHOP FEEDBACK

At public workshops hosted by the Authority in October 2006, citizens had the opportunity to provide feedback on the Van Ness BRT alternatives evaluation. In their comments, some participants addressed how a BRT project would change the urban and landscape design of Van Ness.

In general, workshop participants felt that a BRT project would improve the urban design of the Van Ness corridor. However, they recommended that the Authority further study the impact of BRT on adjacent land uses, including retail uses and large institutions such as the California-Pacific Medical Center.

6.5 KEY CONCLUSIONS

The following figure summarizes the evaluation results for each alternative on landscape and urban design.

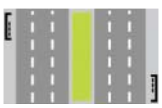
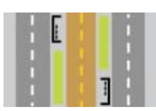
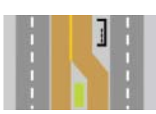
Alternative	Street Identity	Integration with Adjacent Land Uses	Ability to Create Usable Public Open Space	Quality, Quantity, and Character of	Sustainable Storm Water
No Project 	↑	-	-	↑	-
Curbside BRT 	↑	↑↑	↑↑	↑↑	↑↑
Center-side BRT (two medians) 	↑	↑	↑	↑	↑
Center-side BRT (one median) 	↑	↑	↑	↑	↑
Center-side BRT (center medians) 	↑	↑	↑	↑↑	↑↑

Figure 4-13: Urban Design and Landscaping Scoring

7 Traffic Operations and Parking

7.1 PURPOSE

The purpose of this evaluation is to measure the effect of BRT on traffic operations and parking. Traffic operations are assessed based on the delay experienced at intersections; the smoothness of traffic flow; overall changes in auto travel times; and the extent of traffic diversions to other streets. Parking is measured by the change in number of spaces available.

7.2 METHODOLOGY

Measuring traffic operation impacts required extensive use of computer models. The VISSIM micro-simulation model was used to assess delay not only for autos but for all people traveling on Van Ness. VISSIM and Synchro models were used to assess intersection and roadway performance. SF-CHAMP was used to quantify the extent of traffic diversions, and Synchro was used to assess the impacts of those diversions on traffic flow. Parking impacts were tallied based on engineering drawings.

Table 4-5: Traffic Operation and Parking Criteria

Criterion	Description	Source(s)
Person delay	Measures the operation of intersections and the flow of traffic for vehicles and for overall person-throughput. The VISSIM micro-simulation model tabulates delays for vehicles, buses, and pedestrians, and reports these figures based on the number of people traveling in cars and on buses to provide figures of total changes in delay for people traveling along the corridor. Three measures of person delay are considered: the average delay for all people waiting at an intersection, regardless of how they get there (car, bus, or on a bike or walking); the average delay for people waiting in cars; and the average delay of people waiting in buses.	VISSIM micro-simulation model
Accommodate traffic circulation and access	Provides a direct measure of impacts to drivers. The VISSIM micro-simulation model and Synchro traffic operations model produce tabulations of total intersection performance (expressed as the Volume/ Capacity ratio) and delays to cars (expressed as Level of Service, or LOS).	VISSIM micro-simulation model Synchro traffic model
Traffic volumes on parallel streets	Provides a sense of the amount of traffic diverted from Van Ness due to the project and its impact on the traffic flow of parallel streets. The Authority's travel demand model provides estimates of the volumes of traffic to divert and the likely locations of those diversions. The MTA Synchro traffic operations model assesses the impact of those diversions on the traffic flow on parallel streets.	Synchro traffic model Authority's travel demand model (CHAMP)
On-street parking	Identifies the change in number of parallel parking spaces on Van Ness as a result of BRT designs. Street layout and geometry are reviewed to calculate the number of parallel parking spaces added and removed for each alternative.	Engineering designs – quantitative

7.3 FINDINGS

7.3.1 Person Delay

In an urban setting, intersections are the key determinants of how smoothly traffic flows. A good way to evaluate the overall flow of traffic is to assess how well intersections serve the traffic passing through them. Conventional traffic operations models such as Synchro provide a variety of measures to analyze intersection operations on a vehicle-by-vehicle basis. Up to 30% of the people using Van Ness, however, are in transit vehicles, which are not captured by Synchro.

VISSIM provides similar measures of intersection operations that are adjusted for the number of *people* using an intersection, not just the number of vehicles. One of the most basic measures of intersection performance is the average amount of time that a person (or vehicle) spends delayed at an intersection – called "person delay" (or "vehicle delay"). VISSIM also calculates the amount of delay experienced by riders of BRT specifically. Figure 4-14 below presents three delay measures: the change in average delay to each person at the average Van Ness intersection; the change in average delay to each BRT rider at the average Van Ness intersection; and the average delay to each vehicle.

All BRT alternatives cut in half the delays experienced by riders of the 47 and 49 lines on Van Ness. Because such a large proportion of Van Ness travelers are on transit, all the BRT alternatives also cut in half the total person-delays at Van Ness intersections.

Despite those gains to transit riders, drivers are not substantially impacted. Average delays for vehicles do increase slightly under Alternatives 3-5. However, all vehicles, not just transit vehicles, benefit from the green signal extensions given to transit, keeping negative impacts to vehicles in check. Detailed delay results are included as Appendix 25.

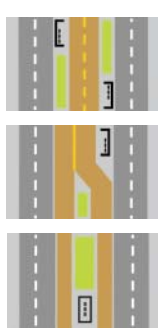
Alternative	BRT Rider Delay	Vehicle Delay	Total Person Delay
No Project 	↓ 20.9	↓ 19.3	↓ 20.8
Curbside BRT 	↑ 10.6	– 19.3	– 19.1
Center-side BRT (center medians) 	↑ 10.2	↓ 20.9	↓ 19.7

Figure 4-14: Person Delay, in Seconds, at an Average Van Ness Intersection

7.3.2 Accommodate Traffic Circulation and Access

Synchro provides at least two measures intended to capture the overall performance of an intersection for serving traffic: intersection "level of service," or LOS, and the intersection volume to capacity (V/C) ratio. LOS is provided as a grade level between A and F. The V/C ratio is the ratio of the volume of cars traveling through the intersection relative to the capacity of the intersection to serve vehicle traffic. Each measure is a slightly different way to capture how congested an intersection is. A table of expected intersection operations by direction is provided as Appendix 20.

All BRT alternatives somewhat increase the level traffic congestion at Van Ness intersections. The average intersection LOS along the corridor decreases from B in the No Project to C with BRT, as shown in Figure 4-16. Travel times for cars from Mission to Lombard do increase, but by less than a minute in each direction.

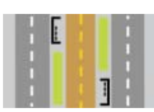
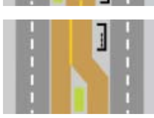
Alternative	Auto Travel Time (min), Mission to Lombard	
No Project 		11.2
Curbside BRT 		11.2
Center-side BRT (center medians)   		11.5

Figure 4-15: Auto Travel Time Results

7.3.3 Traffic Volumes on Parallel Streets, PM Peak Period

Converting a lane of mixed traffic in each direction of Van Ness to dedicated transit lanes will reduce mixed traffic capacity by 33 percent, resulting in some diversion of traffic from Van Ness onto other streets. SF-CHAMP was used to assess the magnitude of those diversions and the corridors to which that traffic would likely divert. The Synchro traffic operations model was used to assess the impact of those diversions on intersection operation on Van Ness and its parallel streets. Documentation is included as Appendix 21.

About 29 percent of the traffic currently on Van Ness is expected to divert if one lane in each direction is converted to a dedicated transit lane. Because diversions are primarily the results of dedicating a lane and removing some left-turn pockets, all alternatives have about the same expected level of diverted traffic.

Less than half the diverted traffic is expected to remain within the corridor, and about half is expected to divert outside the corridor altogether, making use of San Francisco's grid system. The rest are new transit trips made by former drivers.

This finding is consistent with the nature of the traffic using Van Ness today. Van Ness Avenue carries a high volume of regional and through trips with destinations outside the corridor. An assessment using CHAMP indicates that about 52 percent of the total trips using Van Ness today have no origin or destination on the corridor itself, and thus don't need to be on the corridor, as shown in Table 4-6.

Table 4-6: Trip Origin/Destination

Through trips	No trip origin or destination on Van Ness corridor	52%
Corridor trips	Trip origin or destination on Van Ness corridor	48%
Total	All trips using Van Ness	100%

At the same time, more than half of the travelers using Van Ness today are local to San Francisco:

Regional Trips	Trip origin or destination outside SF	33%
Local Trips	Both origin and destination within SF	67%
Total	All trips using Van Ness	100%

The volume of trips expected to divert to parallel streets amounts to about three added cars per minute. These added cars are not expected to break down traffic operations on the parallel streets. Figure 4-17 shows how intersection operations on parallel streets might be affected. The magnitude of expected diversions onto parallel streets, and the expected impacts of those diversions on traffic flow, will be studied in greater detail in the next phase of this project.

7.3.4 On-Street Parking

There are 393 on-street parking spaces on Van Ness Avenue between Mission and Lombard streets. BRT Alternatives 2 and 4 would increase the overall supply of parallel parking by 16

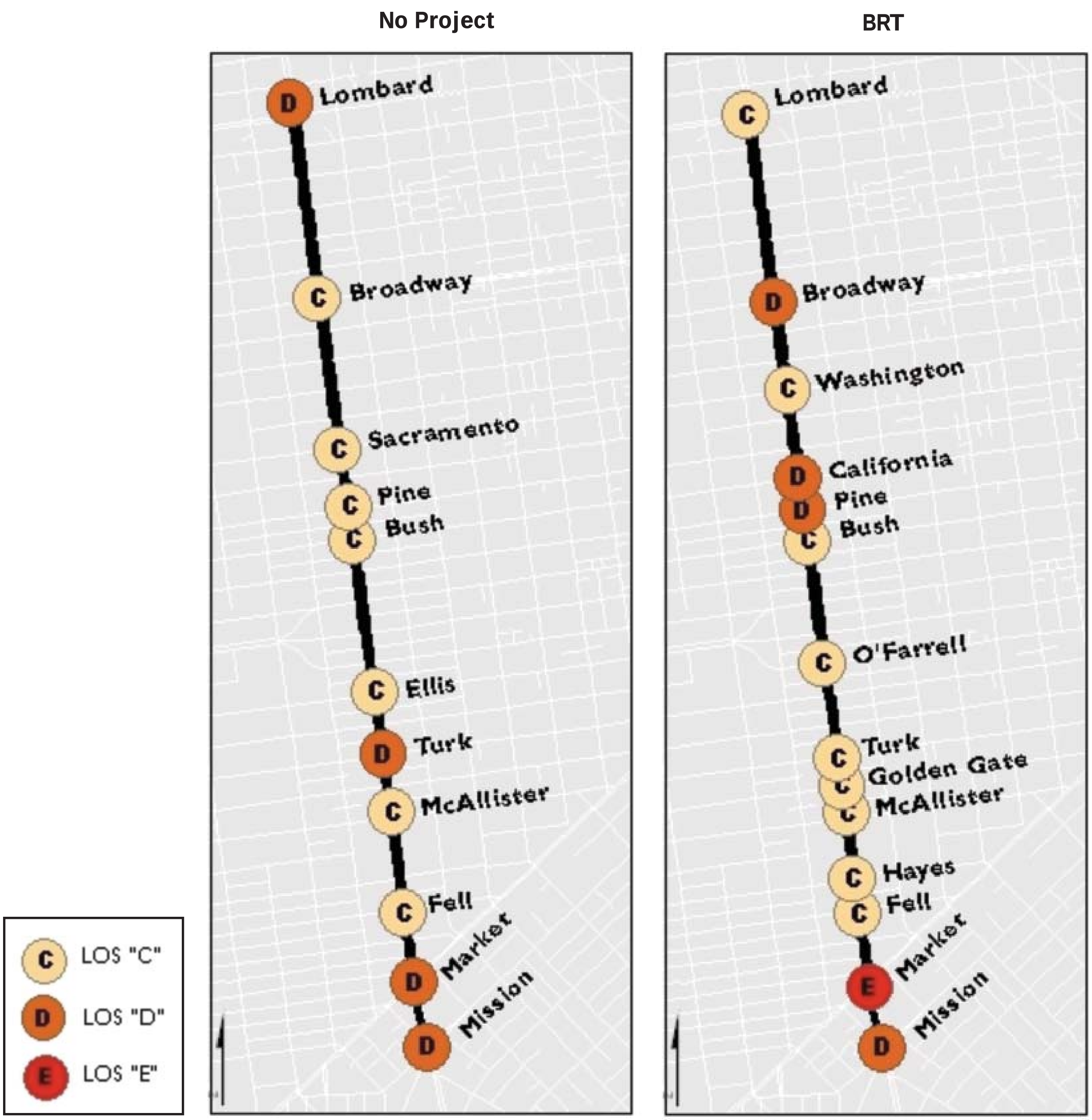


Figure 4-16: Auto LOS Results

and 24 spaces respectively, primarily by adding new spaces at former curbside bus stops. Alternatives 3 and 4 would slightly decrease the parking supply by 36 and 24 spaces respectively, but each of these represents less than 10 percent of the 393 total spaces along Van Ness. Alternative 5 is able to add net new parking because of the minimal weaving necessitated by this design, which lessens the need to remove spaces to accommodate station platforms. A tabulation of changes in parking by block is provided in Appendix 22.

7.4 WORKSHOP FEEDBACK

At public workshops hosted by the Authority in October 2006, citizens had the opportunity to provide feedback on the Van Ness BRT alternatives evaluation. Many of the comments received at these workshops related to the effect of a BRT project on traffic operations and parking.

Traffic congestion and other impacts to drivers were commonly cited as concerns about the impacts of BRT. Workshop participants also expressed concern that traffic would be diverted to parallel streets, such as Polk, Franklin, and Gough. Other participants considered increased scarcity of parking, road rage, auto-bus conflict, and the blockage of emergency vehicles as potential concerns. Several participants were concerned about the impact of BRT on businesses that require deliveries.

Workshop participants urged the Authority to study further the project's traffic impacts, including diversion to side streets.

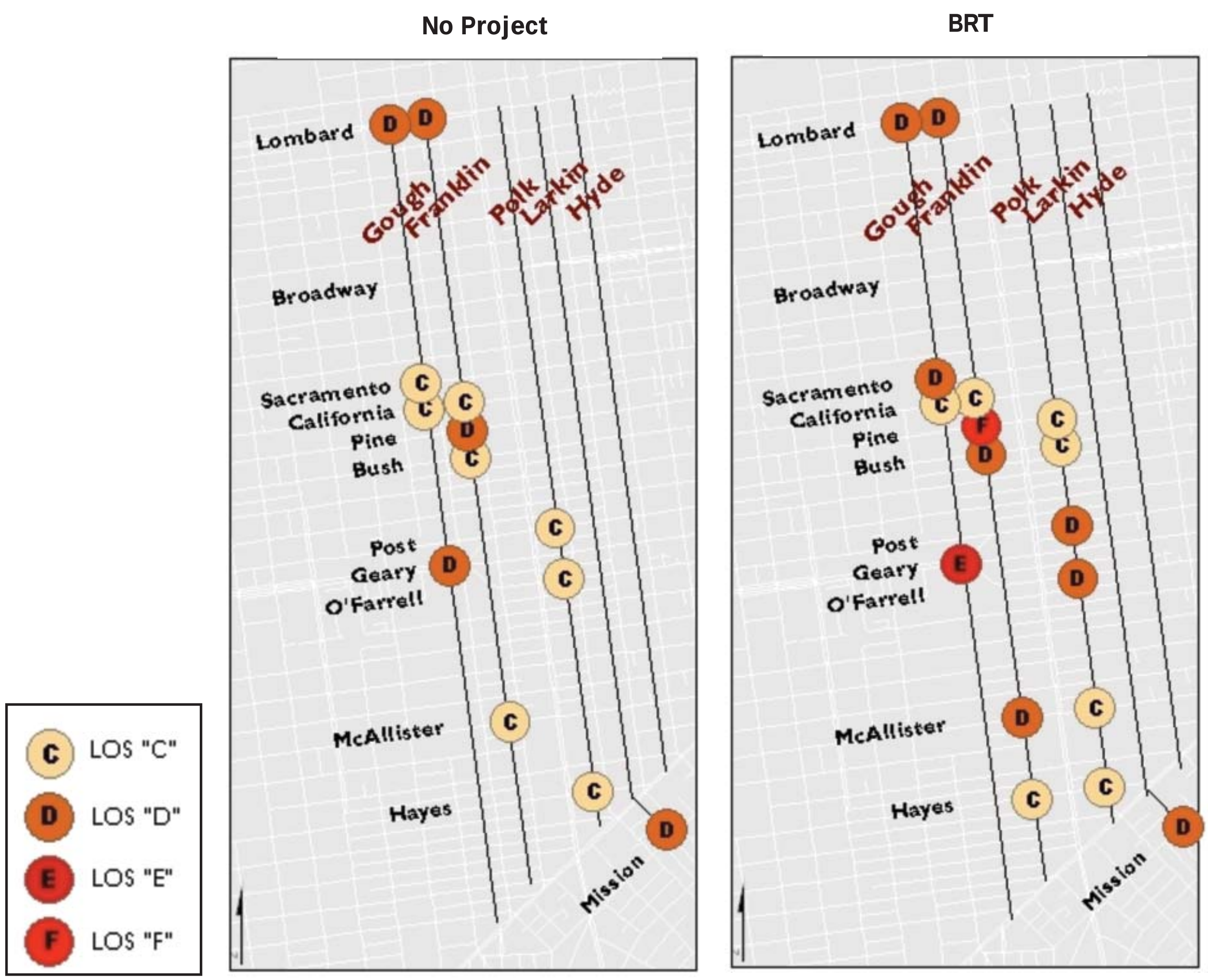


Figure 4-17: Parallel Street LOS Results

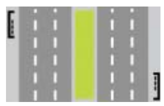
Alternative	Parking	
No Project 		393 spaces
Curbside BRT 		+4.1% 16 new spaces
Center-side BRT (two medians) 		-9.2% 36 spaces removed
Center-side BRT (one median) 		-6.1% 24 spaces removed
Center-side BRT (center medians) 		+6.4% 25 new spaces

Figure 4-18: Parking Results

7.5 KEY CONCLUSIONS

The following figure summarizes the evaluation of each alternative for traffic circulation and access.

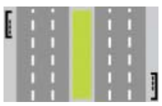
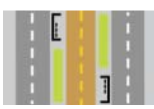
Alternative	Person Delay	Accommodate Traffic Circulation and Access	Traffic Volumes on Parallel Streets	On-street Parking
No Project 	↓	-	-	-
Curbside BRT 	↑	-	↓	↑
Center-side BRT (two medians) 	↑	↓	↓	↓
Center-side BRT (one median) 	↑	↓	↓	↓
Center-side BRT (center medians) 	↑	↓	↓	↑

Figure 4-19: Evaluation Results for Traffic Circulation and Access

8 Cost

This section provides conceptual capital cost estimates for BRT on Van Ness, including all project elements affecting capital cost. Likely impacts to operating costs are also addressed.

8.1 PURPOSE

The purpose of this measure is to provide the best conceptual estimates of the capital cost of each BRT alternative, and to identify a plan for funding transit improvements on Van Ness.

8.2 METHODOLOGY

The cost of BRT on Van Ness was estimated by the study team based on the conceptual engineering designs for each alternative, adjusted to reflect the historical costs of implementing transit construction projects in San Francisco.

8.3 FINDINGS

8.3.1 Capital Costs

BRT on Van Ness between Mission and Lombard streets is expected to cost between $60 million and $65 million (in 2005 dollars). These cost estimates include the landscape, urban design, and pedestrian environment elements of Van Ness BRT. New BRT buses will be procured through Muni's regular vehicle-replacement cycle, which is funded through Prop K. Further detail on capital cost estimates is provided as Appendix 23.

8.3.2 Operating Costs

Operating cost savings are an expected result of BRT on Van Ness. This study assumed an operations cost envelope equivalent to today's operating costs for the Van Ness routes. The key determinant of the cost to operate a service is the route "cycle time," which dictates the number of buses and drivers that are required to operate at a given frequency of service. By improving bus travel times and by reducing delays, BRT shortens the amount of time it takes a bus to complete its route. This enables the same number of drivers and buses to operate more cycles and ultimately provide a higher frequency of service.

8.4 KEY CONCLUSIONS

- BRT on Van Ness from Mission to Lombard will cost $60-65 million
- BRT is expected to reduce operating costs by reducing the amount of time required for a bus to complete its route

9 Construction Impacts

This section describes the likely duration and intensity of Van Ness BRT construction, and identifies strategies to reduce the construction impact on adjacent land uses.

9.1 PURPOSE

The purpose of this evaluation is to anticipate the duration and intensity of construction on neighboring land uses. Construction impacts are assessed based on the expected duration of construction, in months, and the expected intensity, in the amount of street area under construction for the project.

9.2 METHODOLOGY

Construction impacts were assessed through consultations with construction firms with experience in San Francisco. Based on conceptual engineering drawings of the BRT alternatives, the study team developed potential construction approaches to minimize the duration and intensity of BRT construction.

9.3 FINDINGS

9.3.1 Construction Duration

BRT on Van Ness can be constructed within a one-year time frame. If the full segment from Mission to Lombard streets were implemented, construction would likely take place in two simultaneous segments. Construction of BRT would involve 3-4 street blocks at a time, each under construction for about three months, including some nights and weekend construction as appropriate. One lane of traffic as well as pedestrian access would be maintained throughout construction.

All feasible project delivery methods that could potentially reduce construction time will be explored.

9.3.2 Construction Intensity

Construction of BRT is of low intensity compared to light-rail or subway construction, as it is similar to a resurfacing and curbing project. If the complete BRT project from Mission to Lombard is implemented, two short segments of Van Ness of 3-4 blocks would be under construction at any given time. Construction could be underway at opposite ends of the corridor simultaneously. During that time, roadway access for the land uses fronting Van Ness could be preserved.

Each alternative involves several key construction elements: repaving, curb bulb-outs, median work and transit station platforms. Because each alternative involves all four of these elements, the construction impacts do not differ significantly among the alternatives.

9.4 WORKSHOP FEEDBACK

At public workshops hosted by the Authority in October 2006, citizens had the opportunity to provide feedback on the Van Ness BRT alternatives evaluation. Several workshop participants expressed concern about the impact of project construction, especially on local merchants, and urged the Authority to take steps to minimize the construction impact of any project on adjacent land uses.

Table 4-7: Construction Impacts Criteria

Criterion	Description	Source(s)
Maintain access to local businesses	This sub-criterion provides an assessment of the construction impact of BRT alternatives on adjacent land uses by estimating the expected duration (months) and intensity (amount of street) under construction to build the project, and considers the opportunities for approaches to reduce construction duration and intensity.	Engineering designs – quantitative

9.5 KEY CONCLUSIONS

- BRT construction is low-intensity and quick relative to major transportation projects such as light-rail or subway construction
- BRT on Van Ness can be constructed in a year, in 3-4 block segments for three months apiece
- The BRT alternatives do not have significantly different expected construction impacts
- An array of construction approaches is available to reduce the duration and intensity of construction, including night and weekend construction
- Roadway access to businesses could be preserved throughout the construction time period
-

10 Summary of Results and Conclusions

A detailed matrix synthesizing the key results for each evaluation measure is included as Appendix 30.

10.1 TRANSIT OPERATIONS AND PERFORMANCE

All BRT Alternatives are expected to provide significant transit performance benefits by reducing travel times and increasing reliability. BRT on Van Ness improves travel times on the most congested part of Van Ness – Mission to Post – by 28 percent with Alternative 2 and by 37 percent with Alternatives 3-5. These savings amount to about 2,600 hours of transit passenger travel time saved daily for Alternative 2, and 3,100 hours of transit passenger travel time saved daily for Alternatives 3-5. In addition to these travel time benefits, BRT is expected to significantly improve reliability by eliminating most or all conflicts with mixed traffic, and by streamlining passenger loading and unloading.

Finally, BRT on Van Ness is part of a network of rapid transit that improves systemwide performance. The transit travel time and

Alternative	Transit Operations and Performance	Transit Rider Experience	Access and Pedestrian Amenities	Urban and Landscape Design
No Project 	↓	↓	-	-
Curbside BRT 	↑	↑	↑	↑ ↑
Center-side BRT (two medians) 	↑ ↑	↑	↑	↑
Center-side BRT (one median) 	↑ ↑	↑	↑	↑
Center-side BRT (center medians) 	↑ ↑	↑ ↑	↑	↑ ↑

Figure 4-20: Benefits Evaluation Summary

reliability improvements of BRT are expected to attract 16 percent more riders under Alternative 2 and 32 percent more riders under Alternatives 3-5, reversing the citywide trend toward declining transit mode share. Sixty percent of these new Van Ness BRT riders are likely to be former drivers.

Alternatives 3-5 provide the greatest benefits to transit travel times and transit reliability because they are not permeable to mixed traffic, effectively eliminating conflicts with automobiles. Alternative 2 is permeable to mixed traffic to allow right turns and parallel parking, a design that diminishes the travel time and reliability benefits of BRT. Because Alternatives 3-5 provide the greatest transit performance benefits, they attract the most riders and provide a greater share of benefits to low-income households and households without access to a car. Alternative 5 is able to improve the ease of operating transit vehicles by eliminating conflicts with mixed traffic as well as by reducing weaving.

10.2 TRANSIT RIDER EXPERIENCE

All BRT alternatives improve transit riders' experience and provide a new level of service that is distinct from current Muni service. All BRT alternatives provide transit station platform amenities and safety improvements including lighting, shelters, signage and wayfinding information, and real-time transit arrival information. The size and shape of the transit station platforms and the extent to which the transit lanes weave are the key variables among alternatives in their effect on transit rider experience. Alternative 5 provides the most ample and comfortable transit station platform conditions, combined with straight, dedicated Center-side BRT lanes. Alternatives 2, 3, and 4 each involve some amount of transit-lane weaving, which detracts from riders' in-vehicle experience.

10.3 ACCESS AND PEDESTRIAN SAFETY

All BRT alternatives improve pedestrian safety and access by reducing pedestrian crossing distances, providing visible crosswalks, and providing a complete set of countdown signals. BRT alternatives vary primarily in their design of the median pedestrian refuges and the amount of buffer they provide to pedestrians on the sidewalk. Alternative 2 provides the most ample median refuges for pedestrians and the greatest buffer between pedestrians and mixed traffic. Additionally, Alternative 2 achieves the design principle of allowing no more than four traffic lanes between each pedestrian refuge. However, Alternative 5 provides the shortest pedestrian crossing distances. Alternatives 3-5 provide the greatest access to jobs and shopping opportunities for land uses and residents along the corridor.

10.4 URBAN AND LANDSCAPE DESIGN

All BRT alternatives improve landscaping and urban design of Van Ness by increasing opportunities to provide a distinctive identity for the street, upgrade street furniture and lighting, and increase the amount of green space and trees on Van Ness. Alternatives 2 and 5 provide the greatest increases in landscaping in the most consistent and easily maintained configuration. Because Alternative 2 locates station platforms on the sidewalk, it is the most directly connected to adjacent land uses and creates new sidewalk space that could be shared by adjacent land uses. The linear center median would be expanded as some left-turn pockets are replaced with greenery. Alternative 5 also provides significant opportunities for strong landscape and urban design statements using the median station platforms and the strong linear form of the medians. Alternatives 3 and 4 have a less consistent and more broken median form, somewhat weakening their design impact.

10.5 TRAFFIC OPERATIONS AND PARKING

All of the BRT alternatives are expected to divert traffic from Van Ness to other streets in the corridor and elsewhere in the city. The magnitude of those diversions and their impact on congestion on parallel streets requires further study. However, this initial analysis suggests that traffic will continue to flow smoothly on Van Ness itself, and that the volume of traffic diverted to parallel streets will amount to only about three additional cars per minute during the peak period. This degree of diversion can be easily managed with adjustments to the timing of traffic signals. The time it takes to drive from Van Ness to Lombard is not expected to increase significantly with BRT. The delay to the automobile traffic that remains on Van Ness if BRT is implemented is expected to increase by less than one minute.

All BRT alternatives divert about the same amount of traffic to parallel streets and increase travel times for drivers about the same amount. Alternative 2 may be considered friendlier to drivers because cars are more likely to use the BRT lane (to make right turns and to parallel park).

Alternatives 2 and 5 increase the supply of parallel parking on Van Ness. Although Alternatives 3 and 4 would remove some parallel parking spaces from Van Ness, the removal is a total of less than 10 percent of the nearly 400 spaces along the street between Mission and Lombard.

10.6 CAPITAL AND OPERATING COSTS

BRT on Van Ness is expected to cost $60-65 million – significantly less than a subway or light-rail project (which could reach $1 billion, based on cost estimates developed for such projects on other San Francisco corridors). BRT is expected to reduce operating costs by reducing the amount of time required for a bus to complete its route. Finally, new low-floor buses with left and right doors will be procured through Muni's vehicle replacement cycle.

10.7 CONSTRUCTION IMPACTS

The BRT alternatives do not have significantly different expected construction impacts. An array of strategies to reduce any construction impacts are feasible with all BRT alternatives, including some nighttime and weekend construction; preserving traffic access to land uses fronting Van Ness during construction; and minimizing the length of construction time and the amount of street that is under construction at one time.