Transportation Measure Toolkit

The Metropolitan Transportation Plan (MTP), included a Sustainable Communities Strategy (SCS) which identified preferred land use "Place Types" and complementary transportation projects to achieve desired reductions in per capita greenhouse gas emissions (GHG) by 2035. The matrix below identifies potential transportation projects that local jurisdictions and transit agencies can consider in order to support SCS goals. It includes Place Type categories and potential transportation projects that may be appropriate for the given land use. These are intended as example project; consideration of location context within a particular jurisdiction and consultation with local stakeholders should be undertaken before applying these strategies.

	APPLICABILITY TO GIVEN PLACE TYPES					
SCS TRANSPORTATION MEASURE	**URBAN**	**SUBURBAN**	**TOWN**	**NON-URBAN**	**OTHER**	**NOTES**
Enhance Pedestrian Connections	High	Moderate/high in opportunity areas, low elsewhere	Moderate/ High	High in opportunity areas; varies elsewhere depending on location	Varies depending on land use context	Could be combined with transit measures
Enhance Bicycle Connections	High	Moderate/high in opportunity areas, low elsewhere	High	High in opportunity areas; varies elsewhere depending on location	Varies depending on land use context	Measure is geared toward on-street connections
Enhance Local Transit Connections to Regional Transit	Moderate	Moderate in opportunity areas, low elsewhere	Moderate	Moderate in opportunity areas; low elsewhere	Typically low	
Increase Transit Service Effectiveness and Frequency	Moderate/High	Moderate/high in opportunity areas, low elsewhere	Moderate	Moderate in opportunity areas; low elsewhere	Typically low	
Implement Site Scale TDM Measures	High in opportunity areas; moderate elsewhere	Moderate in opportunity areas, low elsewhere	Moderate	Low	Typically low	
Upgrade Bus Stops	Moderate	Moderate/high in opportunity areas, low elsewhere	Moderate/ High	Moderate in opportunity areas; low elsewhere	Typically low	Could be combined with other transit or pedestrian measures
Develop Local Mobilty Hub	High	Moderate/high in opportunity areas, low elsewhere	High	Low	Low	
Develop Transit Streets and Corridors	High	Moderate/high in opportunity areas; low elsewhere	Moderate	Low	Low	
Develop New Trail Connections	High	High	High	Moderate	Varies depending on land use context	
New On-Demand Transit Service	Low	High	High	High	Varies depending on land use context	
Carsharing/Ridesharing Strategy with Park and Ride Lots	High	High	Moderate/ High	Moderate in opportunity areas; low elsewhere	Varies depending on land use context	
New Express Transit Service	High	High	Moderate/ High	Moderate in opportunity areas; low elsewhere	Low	
Develop Electric/ Autonomous Vehicle Implementation Strategy	High	High	Moderate/ High	Moderate in opportunity areas; low elsewhere	Varies depending on land use context	Longer term potential benefit

Carsharing/Ridesharing Strategy With Park And Ride Lots

Carsharing refers to a model in which multiple people can rent cars for short periods of time, thus enabling the rental car to be shared among multiple users on a daily basis. Ridesharing, on the other hand, is the sharing of car journeys so that more than one person travels in a car, such as carpooling, vanpooling or using a Transportation Network Company (TNC) ridesharing service like Uberpool, Lyft Line, or Scoop. Carsharing and ridesharing programs are being utilized more often as strategies to reduce vehicle miles traveled (VMT) and create more sustainable travel environments. Coupling these strategies with park and ride lots can further incentivize transit use by providing travelers with a means of accessing sustainable travel options.

The evaluation of this strategy is listed below. In general, carsharing and ridesharing strategies with park and ride lots score well in several categories and are considered widely applicable as an SCS implementation strategy.

Job Accessibility	Multimodal Safety	Low Income Access to Transit	Pedestrian Connectivity	GHG Reduction	Notes
High	Low	High	Low	High	Generally, carsharing and ridsharing are appropriate in park and ride lots with hight parking demand rates or corridors with high traffic congestion.

Example of a carsharing program utilizing on-street parking.

Carsharing/Ridesharing Strategy With Park And Ride Lots

Potential carsharing and ridesharing strategies with park and ride lots are listed below. Many of these improvements can be used in combination or conjunction with one another in order to provide facilities needed for successful implementation and encourage sustainable travel options.

Measure	Description	Benefits	Applications	Impacts/Constraints
Carsharing Program	Carsharing programs at park and ride lots and downtown areas provide transit users with direct and seamless connection between the transit station and their final destination. Membership status or advance registration is required.	This strategy facilitates the carsharing process, enhances mobility, and improves the first/last mile connectivity. It also incentivizes the use of transit system, which reduces car use and the need to own an automobile.	Appropriate for local transit hubs with park and ride lots; also appropriate for downtown areas.	Typically low to moderate cost, requires one parking space (on or off street) per carsharing vehicle.
Carsharing Availability Monitoring Program	Monitoring programs would track the availability and turnover rate of shared vehicles in order to adjust the rental car supply accordingly.	The monitoring program ensures the availability of rental vehicles at park and ride lots, provides users with greater confidence, and thus encourages the use of carsharing services.	Appropriate to all carsharing programs at park and ride lots.	Typically low cost, monitoring can be done on an annual, semi-annual, or monthly basis.
Reserved Parking Locations for Carsharing Vehicles	Park and ride lots and on-street locations can provide reserved and prioritized parking spaces for carsharing vehicles only.	Reserved parking facilitates the pick-up and drop-off process of carsharing cars, thus encouraging the use of carsharing and the transit system.	Appropriate to all carsharing programs at park and ride lots and downtown locations with high parking demand rates.	Typically low to moderate cost, requires one parking space (on or off street) per carsharing vehicle.
Reserved/ Priority Parking Locations for Ridesharing Vehicles	Park and ride lots may provide reserved/priority parking spaces for registered ridesharing vehicles only.	Reserved/priority parking makes carpooling and vanpooling more attractive, especially in busy park and ride lots, thus encouraging the use of ridesharing program, reducing parking demand, and limiting car use.	Applicable to all park and ride lots with high parking demand rates.	Typically low to moderate cost, requires one parking space per ridesharing vehicle.
Ridesharing or Ride Matching Services	Ridesharing or ride matching services assist travelers in finding people to share the ride together to/from the park and ride lots on a regular basis. Services can be web-based or be accomplished with a smartphone app.	This service increases the chances of finding co-workers who have a similar route and schedule to share the ride together. It encourages the use of ridesharing program, and reduces the parking demand and car use.	Applicable to all locations. App-based ridesharing such as Uberpool, Lyft Line, and Scoop are currently only available in limited areas.	Typically low to moderate cost, requires program website and/or smartphone application development, or partnership agreement with a Transportation Network Company or existing rideshare service.
Guaranteed Ride Home Program	A program that provides ridesharing commuters with a reliable ride home if an unexpected situation arises.	This program gives commuters who use rideshare peace of mind and confidence they'll always have a way to get home, which overall encourages the use of ridesharing programs.	Case-by-case judgement needed; focus should be on major employment areas.	Typically moderate to high cost, requires shuttles, operators and coordination with transit and ridesharing agencies, or employer agreement to pay for taxi ride home.
Discounted Parking/Transit Tickets for Ridesharing Users	Discounted parking and/or transit tickets can be provided to registered users of ridesharing programs and often requires advance registration.	Discounted parking and/or transit tickets incentivizes the use of ridesharing and transit system, which reduces car use and supports public transit.	Case-by-case judgement needed; focus should be on major employment areas.	Typically moderate cost; requires distribution and regulation of transit passes.

Develop Electric/Automated Vehicle Implementation Strategy

Electric Vehicles (EVs)

Plug-in electric vehicle (PEV) is a term used to describe any car that runs on battery power that is recharged from the electricity grid. Battery electric vehicles, extended range electric vehicles, and plug-in hybrid electric vehicles are the major types of PEVs, often referred to simply as EV to represent all types of plug-in electric vehicles. EVs typically produce lower tailpipe emissions than conventional vehicles; however, there are emissions associated with the majority of electricity production in the United States. Vehicles running only on electricity have zero tailpipe emissions, but emissions may be produced by power plants supplying the electrical power.

An electric vehicle charging at the workplace.

Automated Vehicles (AVs)

Automated vehicles, also termed autonomous, driverless, self-driving and robotic vehicles, are those which are capable of sensing their own environments in order to perform at least some aspects of the safety-critical control without direct human input. Examples of automated technologies range from completely self-driving vehicles, where no human is required, to more basic functions, such as traffic responsive cruise control. For this discussion, fully-automated vehicles are vehicles which can handle all aspects of the dynamic driving task (steering, throttle, braking, tactical maneuvers, turn signals, etc.) in special applications and do not require a driver.

The evaluation of this strategy is listed below. In general, electric/automated vehicle implementation strategies score well in several categories and are considered widely applicable as an SCS implementation strategy. It should be noted that EVs could be a short-term strategy, with AVs as a mid- to long-term strategy.

Job Accessibility	Multimodal Safety	Low Income Access to Transit	Pedestrian Connectivity	GHG Reduction	Notes
High	High	Low to Medium	Low	High for EVs; Medium for AVs	Automated vehicles, while emerging quickly, are still relatively new to the transportation field, making it difficult to determine how and where they will be implemented.

Develop Electric/Automated Vehicle Implementation Strategy

Potential electric/automated vehicle implementation strategies are listed below. Many of these measures can be used in combination or conjunction with one another in order to encourage electric/automated vehicle support and implementation.

Measure	Description	Benefits	Applications	Impacts/ Constraints
Electric Vehicle Implementation Strategies				
Public Education and Outreach	Public education and outreach is an activity of providing information to people who may not be aware of the benefits associated with EVs.	Boosts consumer interest and addresses many of the myths and misperceptions of EVs. Form partnerships with local businesses to encourage installation of EV charging stations.	Education and outreach initiatives are relatively inexpensive compared to other measures and should be applied in almost all situations. However, it is important to consider the high up-front costs of EVs to low-income populations, as well as other barriers to EV adoption.	Typically low cost, requires development of educational programs and marketing initiatives.
Provide EV Charging Stations	Providing more EV charging stations along major corridors and at high activity locations.	Increases charging opportunities and minimizes risk of EV owners being unable to find a convenient charging station.	Can be implemented in public parking facilities and on-street in activity centers. Can also be added in private developments or specialized charging facilities.	Typically low to moderate cost, usually possible to fit within existing right-of-way.
Provide EV Charging Signage	Providing more EV charging signage using standardized symbol to identify accessible electric vehicle charging stations along major roadways.	Increases public awareness of charging station availability.	Installing signage is appropriate along state highways, county roads, and city streets, as well as regulatory signage and striping at charging stations.	Typically low to moderate cost, usually possible to fit within existing right-of-way.
Explore Other Incentives to Increase Use of EVs	Incentives can include support for installing charging stations at private residences or local businesses, or subsidized charging at charging stations. Another incentive can include special parking privileges for EVs.	Additional incentives can substantially accelerate the installation of charging stations, which would also increase EV sales and/or leasing.	Appropriate for areas that would like to accelerate EV usage.	Costs vary depending on type of incentive, may require outreach and education initiatives.
Support Workplace Charging	Supporting workplace charging includes providing incentives, raising awareness among CEOs and business leaders, encouragement to support the national workplace charging challenge, and encouraging other electric technologies.	Workplace charging is an important consideration for employees considering an EV, especially if they do not have access to charging at home. Workplace charging extends electric miles, builds range confidence, shows other employees that EVs may work for them as well.	Benefits employers looking to achieve environmental goals, attracts talented employees, and enhances company's brand as more environmentally responsible.	Costs vary depending on type of incentive, may require outreach and education initiatives.
Hybrid Technology Options for Public Transit and Fleet Vehicles	EV pick-up trucks and larger electric vehicles, such as mass transit buses, are becoming viable alternatives since the technology has advanced, making batteries smaller, more powerful and less expensive.	Reduces tailpipe emissions, offer significantly less maintenance and are significantly less expensive to operate over their lifetime.	Appropriate for all transit agencies since hybrid electric and fully electric buses have become viable alternatives to traditional diesel-fueled buses.	Moderate to high cost, generally requires investment into new fleet vehicles.

Matrix continues on next page

Develop Electric/Automated Vehicle Implementation Strategy

Measure	Description	Benefits	Applications	Impacts/Constraints
Automated Vehicle Implementation Strategies				
Automated Vehicle Implementation Plan	An automated vehicle implementation plan is a city or county plan for policy infrastructure and programmatic changes to proactively accommodate automated vehicles (street design, parking, safety, etc.)	Fosters an environment conducive to changes in vehicle automation.	Applicable in all cities, focus should be on urban and suburban environments.	Typically low to moderate cost. Requires additional research since few of these plans have been produced.
Automated Vehicle Technology Task Force	Task forces would be responsible for remaining informed and providing updates on advancements in vehicle automation technology, products/services, and policies. These groups would also provide a medium of communication for the public and stakeholders to discuss this new technology with their respective jurisdictions.	Remaining informed on the many potential implementation of autonomous vehicles will allow government agencies to efficiently adapt and incorporate these new technologies as they become available. In addition, tasks forces will be responsible for conceiving, confronting, and correcting the unpredicted and unintended consequences that may arise as a result of autonomous vehicles.	Appropriate for all organizations since autonomous vehicles have recently become a popular topic in many professional fields and may become available for use in the near future.	Typically low to moderate cost, generally requires people with some knowledge of vehicle automation as a baseline.
Automated Shuttle Feasibility Analysis	Automated shuttles are made up of a fleet of driverless vehicles, designed to operate in a loop or line, and serve multiple destinations. The analysis would assess the technical and financial feasibility of building an automated shuttle route to link nearby transit stations with popular destinations or transportation hubs.	Facilitates the closing of the "last mile" between transit stations and final destinations, encourage non-automobile travel, and provide high-quality passenger service.	Appropriate for urban and suburban areas where connections to existing mass public transportation systems and/or transportation hubs are limited.	Low to moderate cost, requires additional research since few of these analyses have been developed.

An automated vehicle capable of driverless operation.

Develop Local Mobility Hub

Mobility hubs are typically major transit stations with existing and/or planned transit service within a high potential for adjacent residential and/or employment development. These hubs are places of connectivity where different modes of transportation meet and are often coupled with concentrations of employment, residential, commercial, or leisurely activities. In more rural areas, they can be places close to commercial centers where regional transit service may exist and where connections to park and ride lots are available. The evaluation of this strategy is listed below. In general, local mobility hub development measures score well in several categories and are considered widely applicable as an SCS implementation strategy.

Job Accessibility	Multimodal Safety	Low Income Access to Transit	Pedestrian Connectivity	GHG Reduction	Notes
High	Medium	Varies depending on project context	Medium	Medium	Mobility hubs are generally most appropriate in areas where multiple transit lines intersect and where there is high transit demand.

Transit center

Transit information.

Local mobility hub enhancements are listed below. Many of these measures can be used in combination or conjunction with one another in order to provide a well-integrated mobility hub and encourage sustainable travel.

Measure	Description	Benefits	Applications	Impacts/Constraints
Off-Vehicle Fare Payment	Off-vehicle fare payment is a payment system that allows riders to purchase tickets before they board.	Minimizes transit delays from on-board fare payment and reduce congestion in station areas.	Appropriate for all local mobility hub stations, especially stations with high transit demand.	Typically low to moderate cost, usually possible to fit within existing station area.
Drop-Off Only Zone	Drop-off only zones, also known as "kiss-and-ride" zones, are designated areas within or adjacent to the mobility hub for drop-off purposes only. They can also serve as access for transportation network companies (TNCs) such as Urber or Lyft.	Reduces passenger congestion at transit stations, especially in parking lots.	Appropriate for transit stations with high level of alighting passengers.	Typically moderate cost, requires curb space or right of way for dedicated drop-off only zones.

Matrix continues on next page

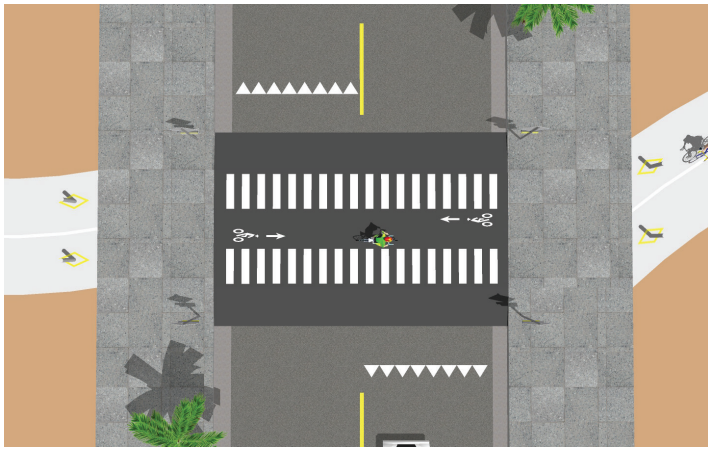
Develop Local Mobility Hub

Measure	Description	Benefits	Applications	Impacts/Constraints
Coordinated Transit Schedules and Operations	Coordination across transit agencies to ensure local and regional transit services operate seamlessly as a connected system.	Promotes efficient local and regional transit connection, minimize transfer wait time and service duplication.	Appropriate for connected local and regional transit routes run by different agencies, especially if they run on a relatively low frequency.	Typically moderate cost, usually requires transit scheduling and operation adjustments.
Bicycle and Pedestrian Accessibility Improvements	Bicycle and pedestrian connection enhancements such as bike lanes, intersection treatments, and signals.	Makes biking and walking safer to transit riders. Minimize auto travel to and from the local mobility hub. Encourage street level activities and business around the local mobility hub.	Appropriate for areas with poor pedestrian and cyclist accessibility and potential for redevelopment. Pedestrian accessibility is essential for primary and secondary zones of the local mobility hub. Bicycle accessibility is essential for the tertiary zone and beyond.	Typically moderate cost, may sometimes require additional right-of-way depending on treatment type.
Secure Bicycle Storage	Secure bicycle storage facilities at the local mobility hub can range from bike racks to bike lockers.	Promotes cycling as a sustainable way of travel to and from the local mobility hub.	Appropriate for local mobility hubs with insufficient bicycle parking facilities.	Moderate cost, may be possible to locate within existing station area.
Bikeshare Program	Bikeshare is a program that allows users to pick up bicycles at one location and return it to another location within the service area.	Provides a solution to the first/last mile connectivity issues by providing bicycles at the local mobility hub, reduce car use, support public transit, and promote active transportation and improve personal health.	Appropriate for local mobility hubs that lack last-mile connections to origins/destinations.	Typically moderate to high cost, may require additional right-of-way for stations and may require service vehicles for rebalancing.
Transit Smart Card	A transit smart card is a fare medium which allows riders to deposit transit fares into a prepaid card ahead of time. Riders can use transit smart cards on multiple transit agencies, local and regional.	Promotes seamless regional, interagency travel and transfer, resulting in reduced transit delay.	Appropriate on corridors with high ridership volumes. Application requires user costs of smart cards, capital costs of card readers, and operations and maintenance costs.	Typically moderate to high up front development costs, may sometimes require additional agency coordination and payment infrastructure.
Adequate Passenger Amenities	Passenger amenities can include real-time transit information, adequate seating/waiting areas, retail options, and wayfinding facilities.	Reduces transit rider uncertainty and perceived burdens while waiting for transit, and improve passenger experience at transit stations.	Appropriate for all local mobility hubs.	Typically moderate cost, may sometimes require additional infrastructure.
Parking Management	Charge market price for parking at the local mobility hub and lower parking requirements for developments around the hub. In rural areas, provide adequate park and ride space near transit hubs.	Provides incentive for redevelopment around the local mobility hub and reduce vehicle travel demand. In rural areas, provides an opportunity for carpooling or transfers to regional transit routes.	Appropriate for all local mobility hubs, especially those with redevelopment potential. Improved local transit service should compensate for the “loss” of parking spaces.	Typically low to moderate cost, requires coordination between surrounding parking areas.

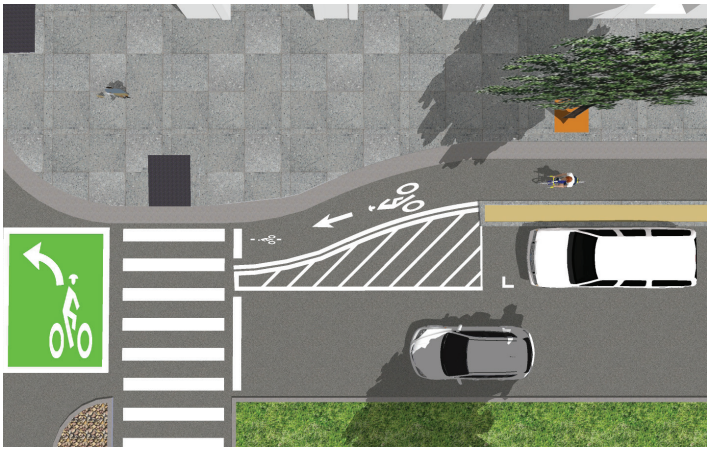
Develop New Trail Connections

Developing new trail connections closes gaps in existing bike and pedestrian networks, which increases accessibility to popular destinations and transit by extending the networks for people choosing to travel by active modes. Trails and on-street routes provide a safe and efficient right-of-way for pedestrians and bicyclists, which encourages more active travelers, thus reducing vehicular use and GHG emissions. The evaluation of this strategy is listed below. In general, new trail connection measures score well in several categories and are considered widely applicable as an SCS implementation strategy.

Job Accessibility	Multimodal Safety	Low Income Access to Transit	Pedestrian Connectivity	GHG Reduction	Notes
Varies depending on project context	High	Medium	High	High	Developing new trail connections expands and strengthens the connectivity of existing trail networks for users.



Safety measures at potential conflict points.



Cycle track serving as an alternative on-street route.

New trail connections measures are listed below. Many of these measures can be used in combination or in conjunction with one another in order to provide a continuous trail network to nearby destinations.

Measure	Description	Benefits	Applications	Impacts/Constraints
Connection to Popular Destinations and Transit	Network of connector trails that provide bikers and pedestrians direct access to points of interest such as schools, transit, parks, neighborhoods, and landmarks.	Enhances accessibility to popular destinations, promote active transportation and reduce vehicle travel.	Appropriate if the development patterns around popular points of interest allow new trail constructions.	Costs vary depending on type of treatment, may require new right-of-way.
Connection to Regional Trail Systems	Network of local connector trails that provide bicyclists and pedestrians access to regional trail systems.	Enhances the mobility and accessibility of active transportation modes to promote additional trips via biking and walking.	Appropriate if the development patterns allow connection between local and regional trail systems.	Costs vary depending on type of treatment, may require new right-of-way.

Matrix continues on next page

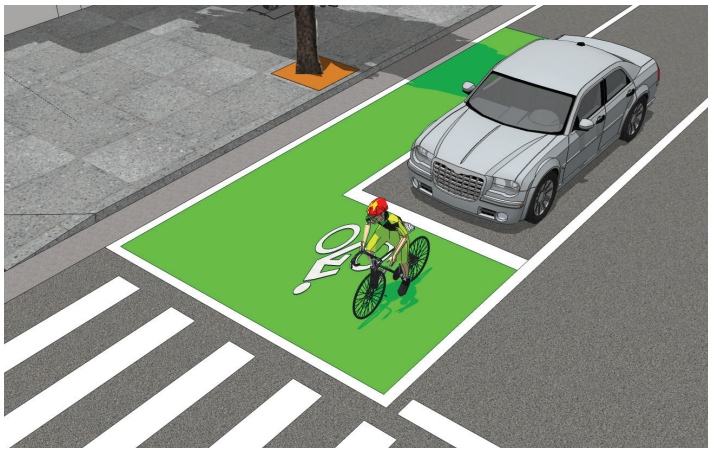
Develop New Trail Connections

Measure	Description	Benefits	Applications	Impacts/Constraints
Alternative On-Street Routes	Alternative on-street routes are bike/pedestrian routes with high quality intersection crossings/treatments that encourage users to use alternative routes that are generally separated or buffered from roadways with high vehicular volumes.	Ensures safe and continuous trail connections for people, which encourages active transportation and reduce vehicle travel.	Appropriate if development patterns interfere with trail connections.	Typically low to moderate cost, usually possible to fit within existing right-of-way.
Safety Measures at Potential Conflict Points	Safety measures can include, but is not limited to traffic calming devices, zebra-striped crosswalks, or pedestrian refuge islands. Conflict points, also referred to as connection points, are locations where the trail intersects the roadways.	Enhances safety for bicyclists and pedestrians by increasing awareness of potential conflicts for all users.	Beneficial for intersections with high volume of vehicular traffic.	Moderate cost, fits within existing right-of-way.
Trailhead Amenities	Amenities can include, but are not limited to, drinking fountains, restrooms, bike/auto parking facilities, and trail maps.	Enhances user experience of the trail network.	Beneficial for all trail connections, especially if the trail network is extensive.	Low to moderate cost, fits within existing right-of-way.
Land Acquisition/ Partnership	Land acquisition is the act of acquiring land for trail connection development. In certain situations, partnerships may be formed with land-owners.	Identify and acquire, or come to a partnership agreement with, necessary lands (through voluntary participation of landowners) for trail connection development to ensure the success of the project.	Essential if the proposed trail route crosses private property.	Costs vary depending on situation, may require new right-of-way.
Community Involvement	Community involvement engages the public in the trail planning process, especially the initial route planning phase. Involvement strategies can include, but is not limited to, community meetings, workshops, surveys, and stakeholder interviews.	Ensures that the new trail connections meet community needs, build trust in the community, and get familiar with possible constraints early in the planning process.	Essential for all new trail connection developments, especially if the new trail may affect potential stakeholders.	Typically low cost, requires development and execution of community involvement programs.
Equitable Access	Equitable access considers that new trail connection developments should take into account geographic equity (i.e. even distribution of access points) and users with limited mobility.	Creates healthy recreation and transportation opportunities for people of different age groups and socio-economic status.	Should be considered for all new trail connection developments.	Costs vary depending on population distribution. Additional studies may be required to further understand population distributions and needs.

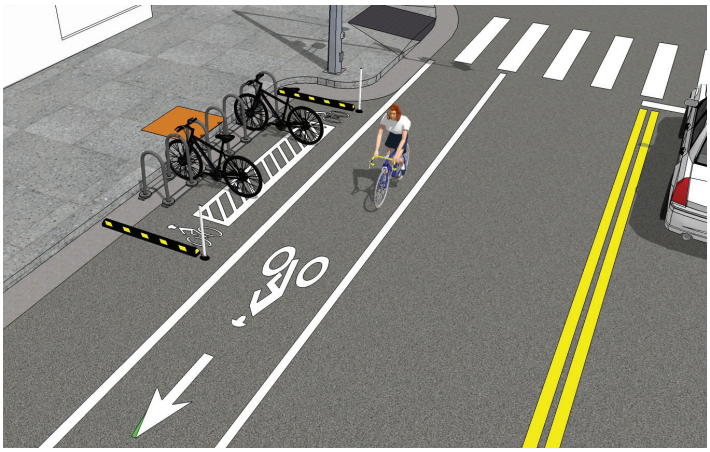
Enhance Bicycle Connections

The evaluation of this strategy is listed below. In general, bicycle enhancements score well in several categories and are considered widely applicable as an SCS implementation strategy. Enhanced bicycle connections can be used to improve bicycling access and safety for people of all ages. They are generally most appropriate in areas with poor existing facilities and in areas with higher levels of bicycling activity.

Job Accessibility	Multimodal Safety	Low Income Access to Transit	Pedestrian Connectivity	GHG Reduction	Notes
Medium	High	High	Varies depending on project context	Medium to High	Generally appropriate for areas with poor facilities and/or high bicyclist demand



Bicycle Box



Bicycle Lane

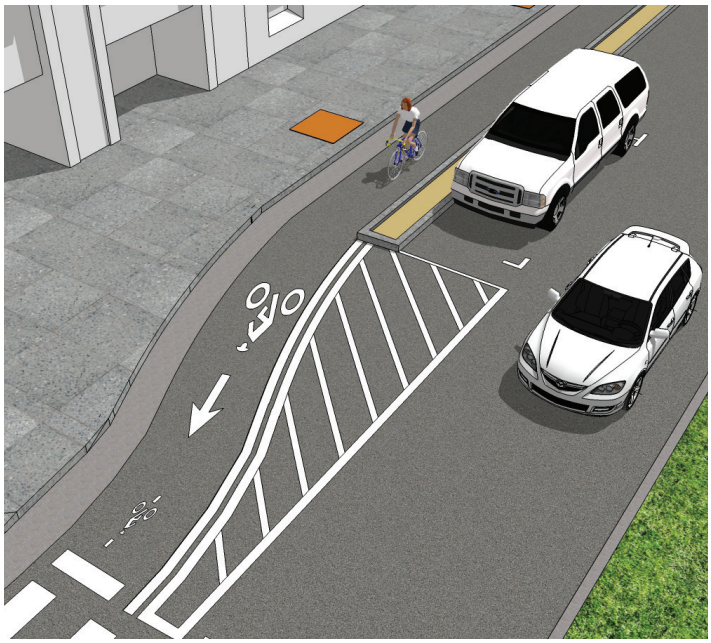
Potential bicycle connectivity enhancements are listed below. Many of these improvements can be used in combination or conjunction with one another in order to provide a continuous bicycle route along a corridor or to nearby destinations.

Measure	Description	Benefits	Applications	Impacts/Constraints
Bike Lanes	Bike lanes are a portion of the roadway that has been designated by signage, striping, and pavement markings for use of bicyclists. Pavement markings can include bicycle directional arrows, bicycle symbols, painted bike lanes, lane striping and buffers from vehicles lanes, or shared lane markings.	Facilitates predictable behavior and movements between bicyclists and motorists and enable bicyclists to ride at their preferred speed without interfering with traffic.	Bike lanes are most helpful on streets with moderate to high traffic volume, regular truck and transit vehicle use, high parking turnover, and with posted speed limits above 25 mph.	Typically low to moderate cost, usually possible to fit lanes within existing right-of-way.

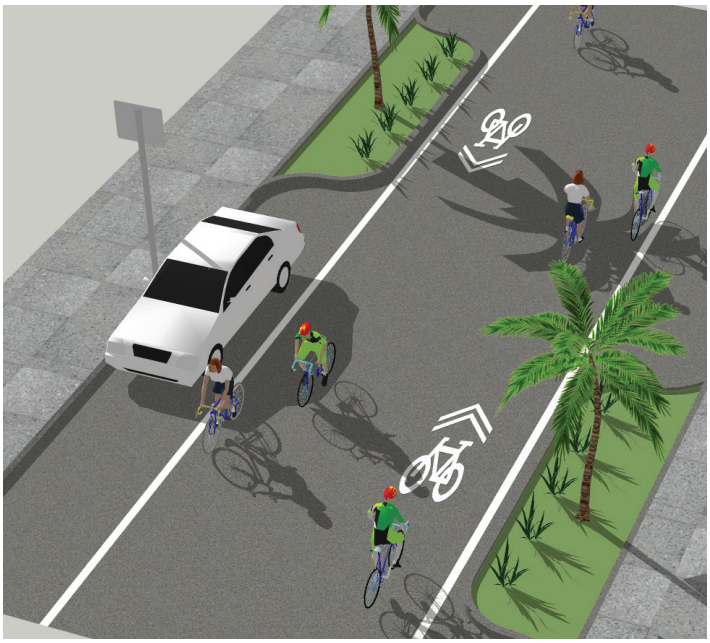
Matrix continues on next page

Enhance Bicycle Connections

Measure	Description	Benefits	Applications	Impacts/Constraints
Cycle Tracks	Cycle tracks are exclusive bike facilities that can be designed as one-way protected, raised, or two-way cycle tracks. Cycle tracks combine the user experience of a separated path with the on-street infrastructure of conventional bike lanes.	Provides space for the exclusive or primary use of bicyclists.	Streets with high bicycle volumes where typical bike lanes would cause many bicyclists to feel stress because of multiple traffic lanes, high traffic volumes, high traffic speeds, high demand for double parking, and high parking turnover.	Typically moderate cost, may sometimes require additional right-of-way.
Bicycle Boulevards (also known as Bicycle Greenways)	Bicycle boulevards or greenways are streets designated and designed to give bicycle travel priority.	Bicycle boulevards can provide direct access to destinations, slow motor vehicle speeds, reduce motor vehicle volumes, reduce bicyclist delay, provide safe and convenient crossings, and enhance surrounding environments.	On streets with low existing motorized speeds and traffic.	Typically low to moderate cost, usually possible to fit lanes within existing right-of-way.



One-way cycle track

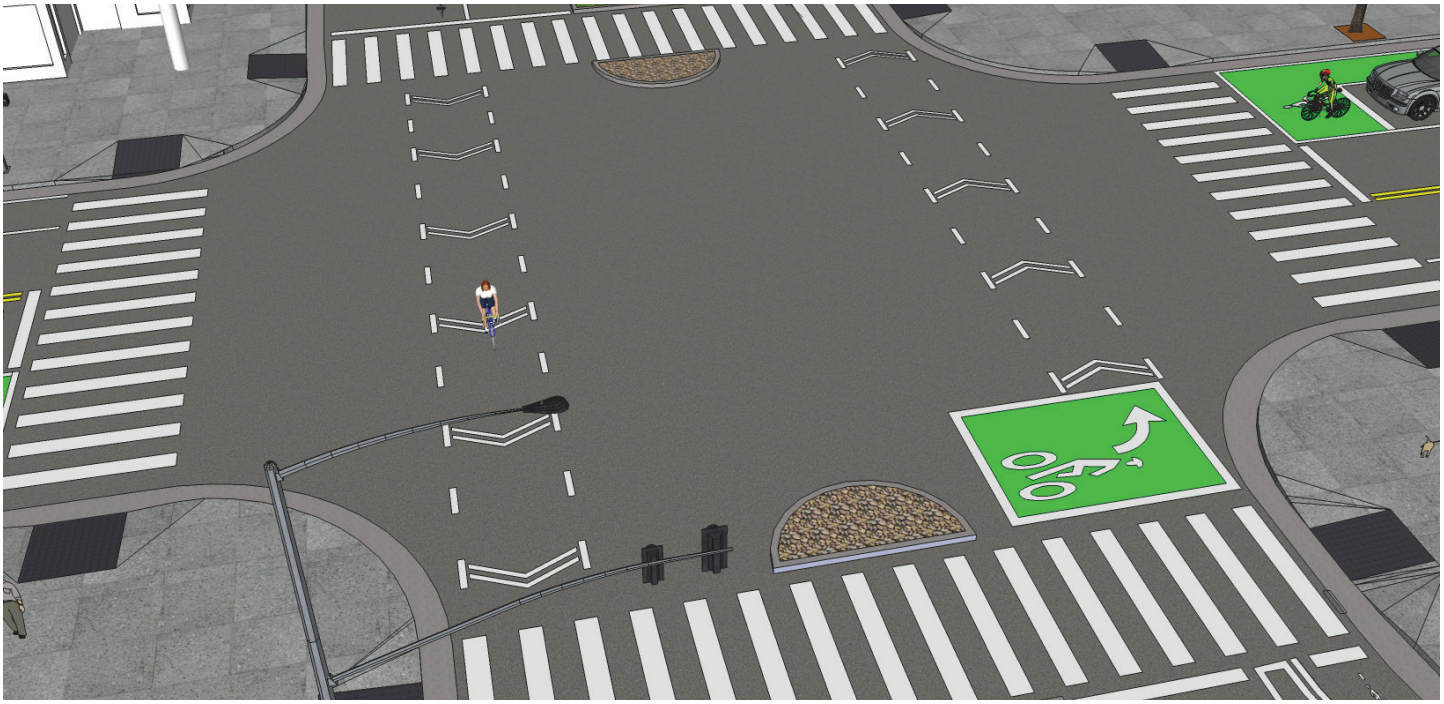


Bicycle Boulevard or Greenway

Matrix continues on next page

Enhance Bicycle Connections

Measure	Description	Benefits	Applications	Impacts/Constraints
Intersection Treatments	Intersection treatments can include bike boxes, intersection crossing markings, two-stage turn queue boxes, through bike lanes, combined bike lane/turn lane, and cycle track intersection approaches.	Reduces conflict between bicyclists (and other vulnerable users) and vehicles by increasing the level of visibility, identifying a clear right-of-way, and facilitating eye contact and awareness with competing modes.	At signalized and unsignalized intersections with high bicycle and motor vehicle volumes.	Costs vary depending on type of treatment, does not require new right-of-way.
Bicycle Signals	Bicycle signals and beacons clarify when bicyclists can enter an intersection and restrict conflicting vehicle or pedestrian movements.	Bicycle signals facilitate bicyclists crossings of roadways.	The type of signal or beacon to use for a particular intersection can depend on speed limits, average daily traffic (ADT), bicycle crossing traffic, and existing bicycle facilities.	Moderate cost, fits within existing right-of-way.
Bikeway Signing & Marking	Bikeway signing and marking includes wayfinding and route signage, regulatory signage, and warning signage.	Designed either to indicate the presence of a bicycle facility or to distinguish that facility for bicyclists, pedestrians, or motorists.	Beneficial in areas with high bicyclists activity.	Typically low cost, fits within existing right-of-way.



Bike lanes through an intersection

Enhance Local Transit Connections to Regional Transit

Enhancing local transit connections to regional transit improves connectivity for passengers using more than one transit system for a single trip. Local transit typically provides access via bus or shuttle from local neighborhoods and commercial areas to the central area of a city. Regional transit typically refers to bus or rail service between cities or counties. Good connectivity between local and regional transit will reduce total travel times, provide more reliable connections, make it easier to pay and ensure transfers are easy and safe. These improvements can encourage more transit ridership, which reduces vehicular use and GHG emissions. Local mobility hubs, which are transit stations that serve multiple transit routes, work well with enhancing local transit connections to regional transit. The evaluation of this strategy is listed below. In general, local and regional transit connection enhancements score well in several categories and are considered widely applicable as an SCS implementation strategy.

Job Accessibility	Multimodal Safety	Low Income Access to Transit	Pedestrian Connectivity	GHG Reduction	Notes
High	High	High	Varies depending on project	High	Generally appropriate for areas with inefficient local and regional transit connections.

Real-time transit vehicle locations with estimated departure/arrival time.

Transit information and wayfinding signage.

Potential local and regional transit connectivity improvements are listed below. Many of these improvements can be used in combination or conjunction with one another in order to provide an efficient integration of local and regional transit systems.

Measure	Description	Benefits	Applications	Impacts/Constraints
Coordinated Transit Schedules and Operations	Local and regional transit agency coordination on scheduling and operation related issues (i.e. local feeder transit schedules should match that of regional transit ones).	Promotes efficient local and regional transit connection, minimize transfer wait time and service duplication.	Appropriate for connected local and regional transit routes run by different agencies, especially if they run on a relatively low frequency.	Typically moderate cost, usually requires transit scheduling and operation adjustments.

Matrix continues on next page

Enhance Local Transit Connections to Regional Transit

Measure	Description	Benefits	Applications	Impacts/Constraints
Coordinated Transit Routes	Coordination between local and regional agencies can ensure an efficient layout of transit network.	Minimizes transit route overlap among local and regional transit agencies. Support the planning for coordinated transit schedules and operations.	Appropriate for all areas seeking to enhance local transit connections to regional transit.	Typically low to moderate cost, requires coordination between transit agencies and some route restructuring.
Transit Smart Card and Mobile Fare Payment	A transit smart card is a fare medium which allows riders to deposit transit fares into a prepaid card ahead of time. Riders can use transit smart cards on multiple transit agencies, local and regional. Mobile fare payment refers to smartphone-based payments such as Apple Pay or Android Pay so fares can be purchased in advance of boarding.	Promotes seamless regional, inter-agency travel and transfer, resulting in reduced transit delay.	Application requires user costs of smart cards, capital costs of card readers, and operations/maintenance costs. Beneficial for areas served by multiple local and regional transit agencies.	Typically moderate to high cost for smart cards and mobile fare payment, may sometimes require additional agency coordination and infrastructure.
Integrated Traveler Information System	Integrated traveler information system compiles traveler information across different transit agencies into one place. Traveler information includes, but is not limited to, transit schedules and fares, real-time transit vehicle locations with estimated departure/ arrival time, and wayfinding signage.	Reduces transit rider uncertainty, especially during local and regional transfers. Alleviate the perceived burden of waiting at transit stops.	Appropriate for transit stops that serve multiple local and regional transit routes, especially those with lower service frequency.	Costs vary depending on type of treatment, may require additional infrastructure.
Region-wide Unified Branding	Unified brandings strategies present individual transit agencies serving the same region as a single unified system/alliance using shared logo, transit vehicle, and/or personnel uniforms.	Bridges the perceived gap among different transit agencies and make transfer between local and regional transit easier to riders.	Beneficial for areas served by multiple transit agencies.	Costs vary depending on type of treatment.

Enhance Pedestrian Connections

The evaluation of this strategy is listed below. In general, enhanced pedestrian connections score well in several categories and are considered widely applicable as an SCS implementation strategy. Enhanced pedestrian connections can be used to improve walking access to local destinations and promote pedestrian safety. They are generally most appropriate in areas with poor existing facilities and in areas with higher levels of walking activity.

Job Accessibility	Multimodal Safety	Low Income Access to Transit	Pedestrian Connectivity	GHG Reduction	Notes
Medium/Low	High	High	High	Varies depending on project context	Generally appropriate for areas with poor facilities and/or high pedestrian demand.

Pedestrian Refuge Island

Pedestrian Curb Extension

Potential pedestrian connectivity improvements are listed below. Many of these improvements can be used in combination or conjunction with one another in order to provide a continuous pedestrian route along a corridor or to nearby destinations.

Measure	Description	Benefits	Applications	Impacts/Constraints
Pedestrian Hybrid Beacon (High Intensity Activated Crosswalk, or HAWK) or Rectangular Rapid Flash Beacon (RRFB)	Pedestrian Hybrid Beacons (PHBs) are pedestrian-actuated signals that combine a beacon flasher and a traffic control signal. When actuated, HAWK displays a yellow (warning) indication followed by a solid red light. RRFBs are rapid flashing LED lamps that are installed on overhead signs, in advance of the crosswalk or at the entrance to the crosswalk. The beacons may be push- button activated or activated with pedestrian detection.	Reduces pedestrian-vehicle conflicts and slows traffic speeds. Can be combined with curb extensions where parking lanes are present.	Useful in areas where it is difficult for pedestrians to find gaps in automobile traffic to cross safely, but where normal signal warrants are not satisfied. Typically appropriate for multi-lane roadways.	Moderate cost, fits within existing right-of-way.

Matrix continues on next page

Enhance Pedestrian Connections

Measure	Description	Benefits	Applications	Impacts/Constraints
High-Visibility Signs and Crosswalks	High-visibility markings include a family of crosswalk styles such as "continental" and "ladder" style striping. High-visibility fluorescent yellow green signs are posted at crossings to increase the visibility of a pedestrian crossing ahead.	Multi-stripe treatments provide greater visibility than traditional crosswalks	Beneficial in areas with high pedestrian activity, such as near schools, and in areas where travel speeds are high and/or visibility is low.	Typically low to moderate cost, usually possible to fit within existing right-of-way.
Median Refuge Island	Raised islands are placed in the center of a roadway, separating opposing lanes of traffic with cutouts for accessibility along the pedestrian path.	This measure provides pedestrians with a better view of oncoming traffic as well as allowing drivers to see pedestrians more easily.	Recommended for multi-lane roads wide enough to accommodate an ADA-accessible median.	Typically moderate cost, may sometimes require additional right-of-way.
Curb Extension	Also known as a pedestrian bulb-out, this traffic-calming measure is meant to slow traffic and increase driver awareness. It consists of an extension of the curb into the street, making the pedestrian space (sidewalk) wider.	Curb extensions narrow the distance that a pedestrian has to cross and increase sidewalk space at corners. The additional space can be used for landscaping, seating, or bicycle parking. Curb extensions also encourage drivers to turn more slowly.	Most suitable on streets with high pedestrian activity, on-street parking, and infrequent (or no) curb-edge transit service.	Typically low to moderate cost, may sometimes require utility relocation or drainage modifications. May slightly increase maintenance costs.
Reduced Curb Radii	The radius of a curb can be reduced to require motorists to make a tighter turn.	Smaller curb radii at street corners narrow the distance that pedestrians have to cross; increases space available to pedestrians and streetscape elements. Like curb extensions, reduced curb radii reduce traffic speeds and increase driver awareness.	This measure would be beneficial on streets with high pedestrian activity and on-street parking. It is more suitable for wider roadways and roadways with low volumes of heavy truck traffic.	Typically low to moderate cost, may sometimes require utility relocation or drainage modifications.
Curb Ramps	ADA–compliant curb ramps are sloped ramps that are constructed at the edge of a curb (normally at intersections) as a transition between the sidewalk and a crosswalk. Truncated domes should be included whenever curb ramps are added or rebuilt.	Curb ramps provide easy access between the sidewalk and roadway for people using wheelchairs, strollers, walkers, and also for pedestrians with mobility impairments who have trouble stepping up and down high curbs.	Curb ramps must be installed at all intersections and mid-block locations where pedestrian crossings exist, as mandated by federal legislation. Where feasible, separate directional curb ramps for each crosswalk at an intersection should be provided.	Typically low to moderate cost, usually possible to fit within existing right-of-way. Also mandated when certain road surface treatments are needed, which affect costs for corridor-resurfacing projects.

Matrix continues on next page

Enhance Pedestrian Connections

Measure	Description	Benefits	Applications	Impacts/Constraints
Raised Crosswalk	A crosswalk whose surface is elevated above the travel lanes.	Attracts drivers' attention; encourages lower travel speeds by providing visual and tactile feedback when approaching the crosswalk and crossing the street.	Appropriate for multi-lane roadways, roadways with lower speed limits that are not emergency routes, and roadways with high levels of pedestrian activity, such as near schools, shopping malls, etc.	Typically low to moderate cost, may sometimes require utility relocation or drainage modifications. Design should accommodate access for those who are visually impaired.
Contrasting or Special Paving Materials	Pavers and colored concrete treatments or patterned thermoplastic asphalt inlays can be constructed to create a contrasting or patterned pedestrian crosswalk that is visually conspicuous to drivers and pedestrians alike.	Highly visible to motorists, this measure creates a clearly delineated space for pedestrians. It also aesthetically enhances the streetscape and can be used to create district identity.	Appropriate for areas with high volumes of pedestrian traffic and roadways with low visibility and/or narrow travel ways, as in downtown areas, commercial districts, main streets and the centers of smaller cities/towns.	Typically low to moderate cost.

Implement Site Scale Transportation Demand Management (TDM) Measures

The evaluation of this strategy is listed below. Site scale TDM measures include a variety of strategies that can help encourage commuter travel by modes other than private automobile. TDM measures can be most effective in areas with high levels of traffic congestion and where there are high concentrations of jobs. In general, site scale TDM measures score well in several categories and are considered widely applicable as an SCS implementation strategy.

Job Accessibility	Multimodal Safety	Low Income Access to Transit	Pedestrian Connectivity	GHG Reduction	Notes
Medium/High	Medium	Medium	Low	High	Strategies can vary widely depending on project context, but are generally appropriate for sites with high-vehicle trip generation.

A bike share station.

Car sharing.

Potential site scale TDM measures are listed below. Many of these measures should be used in combination or in conjunction with one another in order to reduce the number of vehicle trips to and from a major employment location. Some TDM measures are generally less applicable for smaller employers or in rural areas.

Measure	Description	Benefits	Applications	Impacts/Constraints
Bicycle Amenities and Incentives	Bike amenities and incentives can include on-site bicycle infrastructure improvements, bicycle rider encouragement program, bicycle parking, showers and lockers for active transportation users, subsidized bicycle expenses, bicycle repair stands/shop, and bicycle riders guides.	Encourages people to ride their bicycles to work and signals a commitment to providing for non-motorized means of transportation to a site.	Recommended for site locations where users show or have expressed a desire or need for infrastructure or programs which supports active travel.	Typically low to moderate cost, usually possible to fit within existing right-of-way.

Matrix continues on next page

Implement Site Scale Transportation Demand Management (TDM) Measures

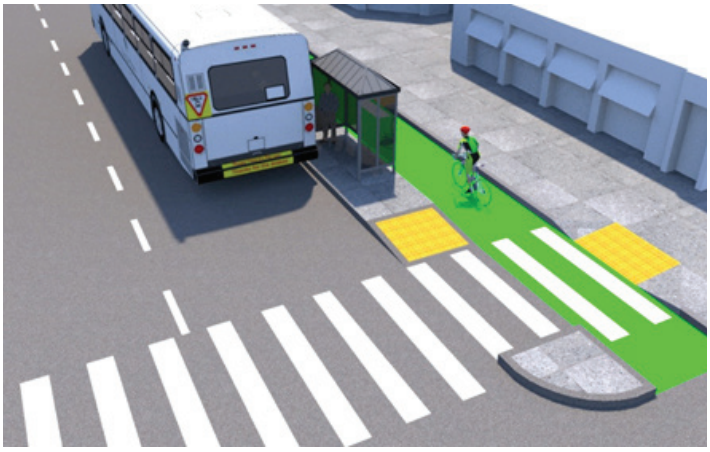
Measure	Description	Benefits	Applications	Impacts/Constraints
Bikesharing	Bikesharing is a short-term bike rental program managed by an employer, landlord, or agency to provide shared bicycles to employees for use in and around workplaces. Bikesharing programs can use traditional or electric bicycles, and can be checked out via a smartphone or smart card.	Bikesharing can encourage travel by bicycle during the day and to get to local destinations around workplaces. It can also provide mid-day travel options for employees who do not have a car available at work.	Recommended for locations with high job concentrations or where users have expressed a desire for additional travel options throughout the day. Broader application can also be considered on a citywide or regional scale.	Typically low to moderate cost, usually possible to fit stations within existing right-of-way.
Public or Private Transit Shuttle Services	Circulator shuttles provide people with access to nearby transit stations and provide an opportunity for users to travel to other locations within the area.	Shuttles address the "first mile/ last mile" problem, namely getting from the transit station to the ultimate destination.	Coordinated with existing routes and planned routes to ensure that the operations of all shuttle services are optimized.	Typically moderate to high cost, requires shuttles, operators, and coordination with transit agencies.
Subsidized or Free Transit Passes	Subsidized transit passes are employer- or property-owner subsidized transit passes.	Provides a financial incentive for people to use public transit, which reduces vehicle trip production, parking demand and the general public.	Recommended for locations where good public transit access exists.	Typically moderate cost, requires method of providing transit passes.
Ridesharing Programs	Ridesharing programs can include ridesharing matching services, subsidized or free vanpools or carpools, expanded carpool matching, and preferential parking for ridesharing, that allows groups of people to share rides to and from work.	Facilitates carpools and vanpools by matching drivers and passengers based on location and schedules.	Ridesharing programs are becoming easier to implement almost everywhere due to new technology and mobile phone applications.	Costs vary depending on type of program, generally requires web interface and/or smartphone application, or ridesharing liaison for coordination.
Carsharing	Carsharing is a car rental service where people can rent cars for short periods of time, often by the hour.	Carsharing gives people, who do not normally have access to a car, the flexibility of a private vehicle.	Recommended near employment centers, campuses, and urban environments where there are more potential users.	Typically low to moderate cost, requires one parking space per carsharing vehicle.
Education and Promotion	Educational and promotional events to encourage employees and their families to use alternative modes to travel to and from the workplace.	Encourages people to use already existing forms of alternative transportation, like carpooling, public transit, and active travel.	Encouraged for all environments where alternative forms of travel are available.	Typically low cost, requires development and execution of education and promotional programs.
Commuter Website/ Smartphone Application	A commuter website or downloadable smartphone app provides ride matching, route planning, and real-time transit and shuttle information.	Reduces vehicle trips by encouraging alternative modes of transportation, which reduces parking demand and improves peoples' health.	Recommended for work places with high vehicle trip generations.	Typically low to moderate cost for website and/or app development.
Telecommuting/ Flexible Work Scheduling	Telecommuting allows people to work remotely via telecommunications. Flexible work schedules allow people to set or modify their arrival and departure times which can alleviate some demand during typical peak travel periods.	Reduces trips made to the employer site and may provide the flexibility people need to use alternative modes of transportation.	Can be incorporated into a company's policies to create more flexibility for employees.	Typically low cost, requires coordination of employers with employees.

Increase Transit Service Effectiveness and Frequency

Transit service effectiveness and frequency generally depends on the reliability of service and headway, or average interval time between transit vehicles moving in the same direction. Effective transit is transit that travels fast, is reliable and is prioritized at intersections to reduce transit vehicle delay. The evaluation of this strategy is listed below. Increased transit service effectiveness and frequency can help attract new transit riders and reduce the proportion of trips that need to be taken by private automobiles. Increased transit service can be most effective in areas with less-reliable or frequent service or where transit demand is high. In general, transit service effectiveness and frequency enhancements score well in several categories and are considered widely applicable as an SCS implementation strategy.

Job Accessibility	Multimodal Safety	Low Income Access to Transit	Pedestrian Connectivity	GHG Reduction	Notes
High	Low	Varies depending on project context	Low	High	Generally appropriate for areas with high transit demand, poor transit service, or low frequency.

A dedicated bus lane.



A bus bulb.

Potential transit service effectiveness and frequency enhancements are listed below. Many of these measures can be used in combination or conjunction with one another in order to reduce transit delay and improve transit service effectiveness.

Measure	Description	Benefits	Applications	Impacts/Constraints
Scheduling and Frequency	Scheduling and frequency involves the manipulation of service hours and headways, and arrival and departing timing of vehicles.	Regularized schedules and frequency adjustments can result in easy-to-remember departure times, better coordination at transfer stations, and alignments with regularly scheduled activities.	Beneficial in areas with high bus or passenger volumes.	Typically moderate cost, may require additional studies to determine optimal schedule and frequency.

Matrix continues on next page

Increase Transit Service Effectiveness and Frequency

Measure	Description	Benefits	Applications	Impacts/Constraints
Dedicated Bus Lanes	A dedicated bus lane is an exclusive lane restricted to buses.	Provides faster and more reliable bus travel by separating buses from mixed traffic.	Beneficial in areas with high bus or passenger volumes and where there is a significant delay of bus travel due to vehicular traffic.	Typically moderate to high cost, may require new right of way unless existing auto lane is converted to bus lane.
Transit Signal Priority (TSP)	TSP technology detects approaching transit vehicles to an intersection and holds green lights longer or shortens red lights.	Reduces delay at intersections and thus increase frequency and reliability throughout the transit network. Reduce fuel costs and greenhouse gas emissions.	Beneficial on corridors with highest ridership and substantial delay. TSP works more effectively with far-side stops.	Moderate cost, may require installation of new signal control equipment and communications technology.
Bus Bulbs	Bus bulbs are sidewalk extensions at the transit stop from the edge of the curb to the edge of the travel lane. Normally, a transit bulb replaces a portion of a parking lane.	Reduces delay by eliminating the need for buses to pull in and out of traffic. Provide larger space for transit stop amenities (i.e. bus shelters, wayfinding maps, landscaping). Reduce risk of traffic collisions and improve safety for riders as they no longer need to enter the street for boarding.	Effective for high-volume transit stops. Beneficial in areas where there are at least two travel lanes or areas with one travel lane and a parking lane. When appropriate, it is recommended to provide cut-through lanes for cyclists.	Typically moderate cost, usually does not require new right-of-way. Designs should address possible drainage issues and conflicts with bike lanes.
Real-Time Technology	Real-time technology shows riders the current location of transit vehicles and other related information (i.e. estimated arrival time).	Reduces rider uncertainty while waiting at a transit stop, which alleviates the perceived burden of waiting.	Appropriate for transit stops with relatively lower service frequency or higher ridership. Implementation can either be physical bus finders at the stop or mobile device applications.	Moderate cost, may require installation of new communications technology and equipment.
Off-Vehicle Fare Payment	Off-vehicle payment systems allow riders to purchase tickets online through mobile payment or at a ticket vending machine at the transit stop before they board.	Reduces transit vehicle dwell time at transit stops. Make all-door boarding possible, which further reduces travel time and increases frequency.	Appropriate on corridors with high ridership volumes.	Typically moderate cost, may sometimes require additional agency coordination and payment infrastructure.
Transit Smart Card and Mobile Fare Payment	A transit smart card is a fare medium which allows riders to deposit transit fares into a prepaid card ahead of time. Riders can use transit smart cards on multiple transit agencies, local and regional. Mobile fare payment refers to smartphone-based payments such as Apple Pay or Android Pay so fares can be purchased in advance of boarding.	Reduces on-board fare processing time and promote seamless regional, inter-agency transfer.	Application requires user costs of smart cards, capital costs of card readers, and operations and maintenance costs.	Typically moderate cost for smart cards and mobile fare payment, may sometimes require additional agency coordination and payment infrastructure.

Matrix continues on next page

Increase Transit Service Effectiveness and Frequency

Measure	Description	Benefits	Applications	Impacts/Constraints
Optimal Stop Location/ Spacing	Bus stop locations and the space between them can have a significant effect on transit service effectiveness and frequency.	Optimal bus stop spacing can ensure efficient coverage yet still keep a desired overall travel time through the corridor. Optimal stop location varies from street to street as each location type (near-side, far-side, and mid-block) has its advantages and drawbacks.	When making decisions of bus stop locations and spacing, it is essential to consider the specific context of the street (i.e. traffic volume, signal phase, and passenger traffic generator) and the type of the transit line (i.e. express, rapid, or local).	Typically moderate cost, may require additional studies to determine optimal stop configuration.
Bicycle Storage at Transit Stops or on Transit	Bicycle storage facilities at transit stops can range from bike racks to bike lockers. Bicycle storage facilities on transit can be mounted bike racks inside or outside the vehicle.	While transit is effective for moderate or long distance travel, bicycles can effectively cover the first/last-mile travel of a transit trip. Safe and adequate bicycle storage facilities make bike/ transit integration possible.	Appropriate for moderate- and long-distance transit routes in areas with high cycling activity.	Low to moderate cost, may be possible to locate within existing station area or installed on existing transit.

New Express Transit Service

Express service refers to bus or light rail service that is intended to run faster compared to normal service. This is made possible by stopping less frequently along the route and/or taking quicker routes. There are several common types of express transit service:

- Commuter express service typically runs over longer distances during commute periods and provides direct access to employment centers.
- Rapid bus service runs along high ridership corridors with limited stops, which generally are only at high-ridership locations or city centers.
- Bus Rapid Transit, or BRT, service typically includes high-frequency service running in dedicated lanes using specialized high-capacity transit vehicles.

By increasing the average speed and reducing transit travel time, express transit service has proved to be an effective strategy for incentivizing transit use among users. Express transit service can also be effective at serving longer distance travel between cities along a freeway or highway corridor. Express transit services have been implemented by transit agencies throughout California, such as VTA, Caltrain, LA Metro, AC Transit, and San Diego Metropolitan Transit System.

The evaluation of this strategy is listed below. In general, express transit service scores well in several categories and is considered widely applicable as an SCS implementation strategy.

Job Accessibility	Multimodal Safety	Low Income Access to Transit	Pedestrian Connectivity	GHG Reduction	Notes
High	Medium	Varies depending on project context	Low	High	Beneficial in areas with high bus or passenger volumes and where there is a significant delay of bus travel due to vehicular traffic.

An express bus.

On-freeway bus stop.

Potential express transit service strategies are listed in the next page. Many of these improvements can be used in combination or in conjunction with one another in order to successfully implement express transit services to serve peoples' mobility needs.

New Express Transit Service

Measure	Description	Benefits	Applications	Impacts/Constraints
Express Transit Service Study	Express transit service studies assess the potential market for new express transit service. Assessment can include, but is not limited to, service area density, travel demand/pattern, and on-board transit rider survey.	Comprehensive analysis of the current service gap and the potential market for express service set the foundation for successful express transit service plan in the long term.	Appropriate for the initial planning of the new express transit service.	Typically low to moderate cost, may sometimes require additional research to determine feasibility.
Marketing	Marketing efforts would inform potential riders about the new express transit service through advertisements or promotions. This can also be used in combination of new branding and/or slogan.	Marketing increases awareness and encourages engagement among potential riders. A large number of transit riders ensures the efficiency of the express transit service, which is essential in successfully serving the people's mobility needs.	Necessary for new express transit services. Marketing strategies can vary based on need and budget.	Costs vary depending on type of program, limited to resources available for marketing development and deployment.
Biannual Service Monitoring and Community Outreach Program	Service monitoring and community outreach programs track the new express service and to obtain community feedback on a regular basis.	This program can increase the efficiency of the new express transit service through monitoring and community feedback over time.	Necessary for new express transit services. Monitoring and outreach strategies can vary based on need and budget.	Typically low cost, limited to resources available for community outreach.
Dedicated Bus Lanes	Dedicated bus lanes separate busses from mixed traffic.	Provides faster and more reliable bus travel, which encourages more users.	Beneficial in areas with high bus or passenger volumes and where there is a significant delay of bus travel due to vehicular traffic.	Typically moderate to high cost, may require new right of way unless existing auto lane is converted to bus lane.
Transit Signal Priority (TSP)	TSP technology detects approaching transit vehicles to an intersection and holds green lights longer or shortens red lights.	Reduces delay at intersections and thus increase frequency and reliability throughout the transit network. Reduces fuel costs and greenhouse gas emissions.	Beneficial on corridors with substantial delay and for allowing express buses to easily enter and exit highway and freeway corridors at interchanges.	Moderate cost, may require installation of new signal control equipment and communications technology.
Real-Time Transit Location Website and Application	Real-time transit location website and application is a publicly accessible website or free smart phone application (app) that provides location information about express transit vehicles.	The provision of real-time app enables transit riders to plan their trips with greater confidence. Studies showed improvements in both the overall satisfaction and ridership once the website/app becomes available.	Appropriate for all new express services. Recommended integration with other connecting transit routes.	Low to moderate cost, may require installation of new communications technology and equipment if not already existing.
Transit Stop Upgrades	Transit stop upgrades include shelters, benches, route signs, passenger information displays, complementary Wi-Fi hot spot, and lighting.	Enhances rider experience, increases overall satisfaction, and encourages the use of express transit services.	Beneficial along express routes. Detailed upgrades can vary based on need and budget.	Costs vary depending on type of treatment, may require new infrastructure.

New Express Transit Service

Measure	Description	Benefits	Applications	Impacts/Constraints
Transit Vehicle Upgrades	Transit vehicle upgrades include lower emission vehicle fleets, level platform access, greater security, complimentary Wi-Fi, cell phone service, charging outlets, and more.	Provides riders with better experience, enhance overall service quality, increase service satisfaction, and thus encourage the use of express transit services.	Applicable to all new express service. Beneficial especially with new brand marketing for transit revitalization.	Typically moderate to high cost, may require new infrastructure, maintenance, and training.
Off-Vehicle Fare Payment System	Off-vehicle fare payment systems allow transit riders to purchase transit tickets before boarding the vehicle.	Streamlines the ticketing procedure, thus facilitates boarding process, which results in reduced boarding time.	Most cost-effective at stations where the boarding demand is high.	Typically moderate cost, may sometimes require additional agency coordination and payment infrastructure.

New On-Demand Transit Service

On-demand transit services, sometimes referred to as demand-responive transit, dial-a-ride transit, or flexible transport services, is a form of public transport offering flexible routing and scheduling of small/medium sized vehicles operating between origins and destinations according to passenger needs. Private transit services, like Chariot in San Francisco, have recently started becoming available. In other locations Transportation Network Companies (TNCs) such as Uber and Lyft have contracted with local transit providers to provide on-demand service in low density areas or as a first/last mile connection to a regional transit station. On-demand transit can be used to serve areas with low passenger demand or where providing fixed-route transit service is inefficient or cost prohibitive.

The evaluation of this strategy is listed below. In general, new on-demand transit service measures score well in several categories and are considered widely applicable as an SCS implementation strategy.

Job Accessibility	Multimodal Safety	Low Income Access to Transit	Pedestrian Connectivity	GHG Reduction	Notes
High	Medium	Varies depending on project context	Low	Medium	On-demand transit services generally serve areas with low passenger demand, such as rural areas, or as a first/last mile connection to regional transit stations.

On-demand transit bus/shuttle.

Private transit service.

Potential on-demand transit service measures are listed below. Many of these measures can be used in combination or in conjunction with one another in order to provide a successful on-demand transit service to serve people's mobility needs.

Measure	Description	Benefits	Applications	Impacts/Constraints
Transit Service/ Coverage Area Study	Transit service/coverage area studies assess the potential market for on-demand transit service. Assessment can include, but is not limited to, service area density, travel demand/pattern, gaps in current fixed route transit system, and population needs (i.e. special care or premium service).	Comprehensive analysis of a potential service area sets the foundation for successful on-demand transit systems in the long term. For instance, density ensures economies of scale and promotes efficiency when matching up passengers to similar destinations.	Appropriate for the initial planning of the on-demand transit service area.	Typically moderate cost, may sometimes require additional research to determine feasibility.

Matrix continues on next page

New On-Demand Transit Service

Measure	Description	Benefits	Applications	Impacts/Constraints
Transit Service/ Coverage Area Study	Transit service/coverage area studies assess the potential market for on-demand transit service. Assessment can include, but is not limited to, service area density, travel demand/pattern, gaps in current fixed route transit system, and population needs (i.e. special care or premium service).	Comprehensive analysis of a potential service area sets the foundation for successful on-demand transit systems in the long term. For instance, density ensures economies of scale and promotes efficiency when matching up passengers to similar destinations.	Appropriate for the initial planning of the on-demand transit service area.	Typically moderate cost, may sometimes require additional research to determine feasibility.
Integrated Service Network	An integrated service network is an on-demand transit service that complements the current fixed route transit system. It can be provided through a local transit agency or contracted through a private provider such as Chariot, Uber, or Lyft.	Serves as a first/last mile solution to bridge the accessibility gap and expand the transit network. Minimizes service duplication and increase efficiency. Meet people's diverse travel needs.	Beneficial if there are substantial gaps in the existing fixed route transit system.	Moderate cost, may require cross-agency coordination. May also require development of partnership and funding agreement with a Transportation Network Company or private transit service provider.
Integrated Ticketing	Integrated ticketing is a technology that allows transit riders to board different transit modes across agencies using a single ticket or fare medium (i.e. smart cards, smart phones).	Improves overall efficiency and quality of on-demand transit service and its connection to fixed route transit system. Promotes seamless transfer and reduce transfer delay.	Application requires a high level of cooperation among transit agencies/operators. Beneficial for areas envisioning an integrated on-demand and fixed route transit network.	Typically moderate to high cost, may sometimes require additional agency coordination and infrastructure.
On-Board Amenities	On-board amenities can include, but is not limited to, complimentary Wi-Fi or charging outlets.	Increases on-demand transit attractiveness, enhances transit service quality, and improves rider experience.	Beneficial for all on-demand transit services.	Typically moderate to high cost, may require new infrastructure, maintenance, and training.
Public-Private Partnership	Through cooperation, the public sector and the private sector share certain assets/skills to provide a public service. The private sector can provide technology, algorithm, and marketing support; the public sector can provide transit vehicles and operators.	Supplements limited public sector capacities. Provides more efficient on-demand transit service with private sector technology support while maintaining public oversight. Enhances the economics of on-demand transit service model.	Beneficial for new on-demand transit services, or for operators who want to increase cost efficiency and expand new services. Appropriateness depends on context. Risk/benefit analysis is often needed to determine appropriateness.	Typically moderate cost, may sometimes require additional agency coordination. Requires development of funding agreement for private sector services or operations.
Marketing	Marketing effects inform potential riders about the new on-demand transit service through advertisements or promotions.	Increases awareness and encourage engagement among potential riders. A large number of transit riders ensures the economies of scale of the on-demand transit service, which is essential in matching riders cost-effectively to destinations.	Necessary for new on-demand transit services. Marketing strategies can vary based on need and budget.	Typically low cost, requires development of informational programs and marketing initiatives (both traditional and through social media).

New On-Demand Transit Service

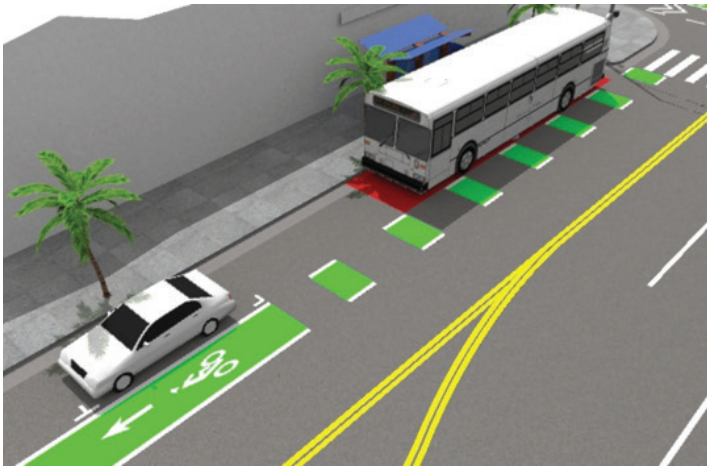
Measure	Description	Benefits	Applications	Impacts/Constraints
Equitable Access	By providing service in previously unserved areas, on-demand transit service can ensure more equitable access for all riders, especially for those with disabilities. Telephone scheduling can ensure equitable access for those with no access to smartphones or Internet.	Enhances mobility and accessibility for all people in the service area. Increases overall transit ridership.	Beneficial transit service providers aiming for an equitable public transit system.	Costs vary depending on population distributions. Additional studies may be required to further understand population distributions and needs.
Pilot Program	A pilot program is a short-term, experimental on-demand transit service on a smaller scale.	Informs transit services providers of how the actual service might work in practice. Provides them the opportunity to fix problems (if any) and implement improvements before the launch of the actual long-term service.	Beneficial for new on-demand transit services, especially if there are known uncertainties about the actual long-term implementation.	Typically low to moderate cost, may require additional research to determine results of pilot program.

Signal Coordination with Transit Priority

Signal coordination with transit priority includes a set of operational improvements that use technology and roadway design to reduce dwell time for transit vehicles at traffic signals. Signal coordination with transit priority is recognized as having the potential to improve performance for transit vehicles, thus improving schedule reliability, reducing operating costs, and increasing ridership. As a supportive strategy, dedicated bus lanes, which are exclusive lanes restricted primarily to buses, provide faster, more reliable, and predictable bus travel between signals. The evaluation of this strategy is listed below. In general, signal coordination strategies with transit priority score well in several categories and are considered widely applicable as an SCS implementation strategy.

Job Accessibility	Multimodal Safety	Low Income Access to Transit	Pedestrian Connectivity	GHG Reduction	Notes
Medium	Low	Medium	Low	High	Generally appropriate for intersections that are in close proximity to each other with high traffic volumes and high transit demand.

Dedicated bus lane.



Far-side bus stop.

Potential signal coordination with transit priority measures are listed below. Many of these measures can be used in combination or in conjunction with one another in order to support or measure signal coordination.

Measure	Description	Benefits	Applications	Impacts/Constraints
Passive Transit Signal Priority	Passive transit signal priority is a technology with pre-developed traffic signal timing plan that takes into account the slower travel speed of transit vehicles along a corridor.	Reduces transit delay by allowing more transit vehicles to arrive at intersections during a green signal phase.	Appropriate for corridors with relatively predictable and stable transit vehicle operations.	Low to moderate cost, typically integrates with existing signal infrastructure but may require some equipment upgrades.

Matrix continues on next page

Signal Coordination with Transit Priority

Measure	Description	Benefits	Applications	Impacts/Constraints
Active/Intelligent Transit Signal Priority	Active/intelligent transit signal priority is a technology that allows two-way communication between transit vehicles and traffic signals.	Takes into account not only the real-time transit vehicle locations but also external factors (i.e. ridership, traffic conditions, transit on-time performance) when prioritizing signal phases. Minimizes unnecessary delay on non-transit vehicles and total passenger delay across all modes.	Appropriate for corridors with significant transit delay and high transit demand, especially on corridors with high side-street traffic volumes and unpredictable transit operations.	Moderate cost, may require installation of new communications infrastructure.
Queue Jumper	Queue jumpers are roadway geometries (one additional transit only lane on the approach to a signalized intersection) that allows transit vehicles to bypass mixed traffic queues at signalized intersections.	Reduces delay and increases transit efficiency by providing transit vehicles with an early or extended green light at signalized intersections.	Only beneficial for corridors with known traffic congestion and low/ moderate volumes of right turning traffic.	Typically moderate cost, may sometimes require additional right-of-way.
Cycle Length Evaluation	Cycle length refers to the time required for a complete sequence of signal phases at an intersection. Cycle lengths are evaluated to see if signals at coordinated intersections are in proper working order along a bus corridor.	Potential to improve level-of-service for buses at specific intersections or along a corridor.	Recommended for coordinated signals along a bus route or corridor.	Costs vary depending on size of evaluation, may require targeted operations analysis.
Hourly Flow Rate Evaluation	Hourly flow rates are a measure of traffic volume in terms of vehicles per hour, which can be used to improve signal timing and coordination along a corridor.	When used correctly, intersection peak volumes and flow rates can be used to improve signal timing and coordination along a corridor.	Appropriate for signal timing evaluation for coordinated signals.	Costs vary depending on size of evaluation, may require expert analysis.
Far-Side Bus Stops	Far-side transit stops are stations located immediately after the intersection, which allows vehicles to pass through an intersection before stopping.	Facilitates bus reentry into traffic stream, which improves predictability of bus travel times between signals. This provides an advantage for transit signal priority technology.	Appropriate for corridors with transit signal priority technology and low to moderate transit volumes. Queuing transit vehicles can block the intersection.	Typically moderate cost, may sometimes require additional right-of-way.
Adaptive Signal Timing	Adaptive signal timing is a specialized form of signal timing that dynamically adjusts signal cycles and phasing in response to real-time traffic conditions. It can be used on heavily traveled corridors to reduce delays for all modes, including transit.	Adaptive signal timing can reduce levels of congestion along a major street corridor, which benefits private automobiles and transit.	Appropriate for corridors with high levels of congestion and moderate transit volumes.	Moderate cost, may require installation of new communications infrastructure.

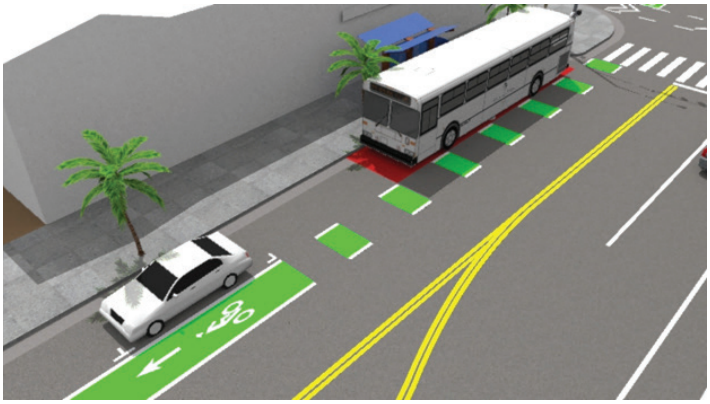
Develop Transit Streets And Corridors

Transit streets are streets and corridors that emphasize the use of transit through their design and function. Transit streets can support effective transit service by prioritizing design features that improve the speed, reliability and attractiveness of transit along a corridor. Transit streets are "complete streets" in that they are well-designed to accommodate travel by all modes. They can also be centers of activity that bring people together around stations and stops, as well as providing access to local and regional destinations.

The evaluation of this strategy is listed below. Transit streets are generally more appropriate where high frequency transit exists, but they may also be considered in planned or potential opportunity areas that could support higher levels of transit service in the future. Transit streets score well in several categories and are considered highly applicable as an SCS implementation strategy.

Job Accessibility	Multimodal Safety	Low Income Access to Transit	Pedestrian Connectivity	GHG Reduction	Notes
High	High	Varies depending on project context	Low	Moderate	Generally appropriate for areas with poor facilities and/or high bus ridership demand.

Example of well-designed transit street (Source: NACTO)



Bus stop adjacent to bicycle lane

Potential transit street features and associated improvements are listed below. Many measures can be used in combination with one another in order to improve transit service along a corridor, and they also fit well in transportation strategies like Local Mobility Hubs and Upgraded Bus Stops.

Measure	Description	Benefits	Applications	Impacts/Constraints
Dedicated Bus Lanes	A dedicated bus lane is an exclusive lane restricted to buses.	Provides faster and more reliable bus travel by separating buses from mixed traffic.	Beneficial in areas with high bus or passenger volumes and where there is a significant delay of bus travel due to vehicular traffic.	Typically moderate to high cost, may require new right-of-way unless existing auto lane is converted to bus lane.

Matrix continues on next page

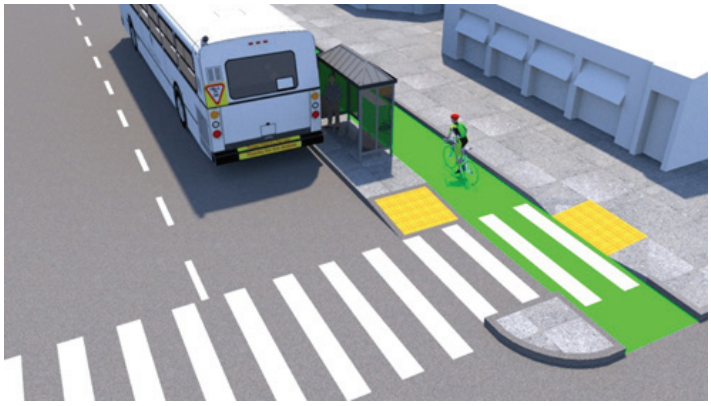
Develop Transit Streets And Corridors

Measure	Description	Benefits	Applications	Impacts/Constraints
Transit Signal Priority (TSP)	TSP technology detects approaching transit vehicles to an intersection and holds green lights longer or shortens red lights.	Reduces delay at intersections and thus increase frequency and reliability throughout the transit network. Reduces fuel costs and greenhouse gas emissions.	Beneficial on corridors with highest ridership and substantial delay. TSP works more effectively with far-side stops.	Moderate cost, may require installation of new signal control equipment and communications technology.
Bus Bulbs	TSP technology detects approaching transit vehicles to an intersection and holds green lights longer or shortens red lights.	Reduces delay by eliminating the need for buses to pull in and out of traffic. Provide larger space for transit stop amenities (i.e. bus shelters, wayfinding maps, landscaping). Reduce risk of traffic collisions and improve safety for riders as they no longer need to enter the street for boarding.	Effective for high-volume transit stops. Beneficial in areas where there are at least two travel lanes or areas with one travel lane and a parking lane. When appropriate, it is recommended to provide cut-through lanes for cyclists.	Typically moderate cost, usually does not require new right-of-way. Designs should address possible drainage issues and conflicts with bike lanes.
Real-Time Technology	Real-time technology shows riders the current location of transit vehicles and other related information (i.e. estimated arrival time).	Reduces rider uncertainty while waiting at a transit stop, which alleviates the perceived burden of waiting.	Appropriate for transit stops with relatively lower service frequency or higher ridership. Implementation can either be physical bus finders at the stop or mobile-device applications.	Moderate cost, may require installation of new communications technology and equipment.
Transit Stop Upgrades	Transit stop upgrades include shelters, benches, route signs, passenger information displays, complementary Wi-Fi hotspot, and lighting.	Enhances rider experience, increases overall satisfaction, and encourages the use of transit.	Beneficial along transit corridors, especially along corridors planned for new land use growth or other increases in activity.	Costs vary depending on type of treatment, may require new infrastructure.
Optimal Stop Location/ Spacing	Bus stop locations and the space between them can have a significant effect on transit service quality and frequency.	Optimal bus stop spacing can ensure efficient coverage yet still keep a desired overall travel time through the corridor. Optimal stop location varies from street to street as each location type (near-side, far-side, and mid-block) has its advantages and drawbacks.	When making decisions of bus stop locations and spacing, it is essential to consider the specific context of the street (i.e. traffic volume, signal phase, and passenger traffic generator) and the type of the transit line (i.e. express, rapid, or local).	Typically moderate cost, may require additional studies to determine optimal stop configuration.
Bicycle Storage at Transit Stops or on Transit	Bicycle storage facilities at transit stops can range from bike racks to bike lockers. Bicycle storage facilities on transit can be mounted bike racks inside or outside the vehicle.	While transit is effective for moderate or long distance travel, bicycles can effectively cover the first/last mile travel of a transit trip. Safe and adequate bicycle storage facilities make bike/transit integration possible.	Appropriate for moderate- and long-distance transit routes in areas with high cycling activity.	Low to moderate cost, may be possible to locate within existing station area or installed on existing transit.
Bicycle and Pedestrian Accessibility Improvements	Bicycle and pedestrian connection enhancements such as bike lanes, intersection treatments, and signals.	Make biking and walking safer to transit riders. Minimize auto travel along transit corridors by reducing demand or encouraging the use of other routes. Encourage street level activities and business along transit corridors.	Appropriate for areas with poor pedestrian and cyclist accessibility and potential for redevelopment. Pedestrian accessibility is essential for primary and secondary zones of the local mobility hub. Bicycle accessibility is essential for the tertiary zone and beyond.	Typically moderate cost, may sometimes require additional right-of-way depending on treatment type.

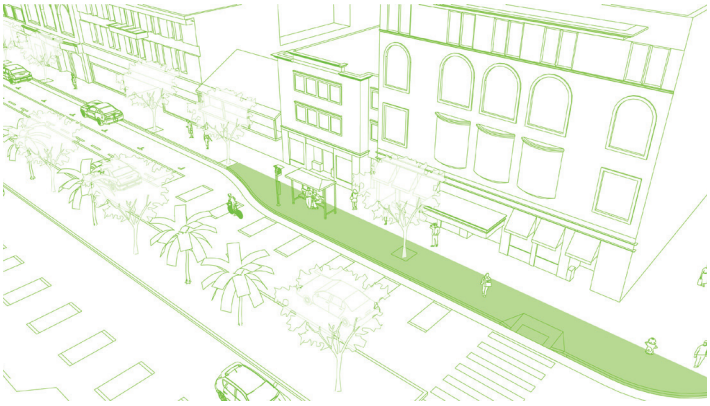
Upgrade Bus Stops

The evaluation of this strategy is listed below. Upgraded bus stops can help improve the appearance and function of transit stops, making transit service more visible and convenient to use. Bus stop upgrades are appropriate where substandard facilities exist or where bus transit demand is high. In general, bus stop enhancements score well in several categories and are considered widely applicable as an SCS implementation strategy.

Job Accessibility	Multimodal Safety	Low Income Access to Transit	Pedestrian Connectivity	GHG Reduction	Notes
Low to Medium	High	Low	Low to Medium	Low	Generally appropriate for areas with poor facilities and/or high bus ridership demand.



A bus shelter.



A bus "bulbout" where the curb is extended to provide more passenger waiting space.

Potential bus stop upgrades are listed below. Many of these upgrades can be used in combination or conjunction with one another in order to improve existing bus stop facilities.

Measure	Description	Benefits	Applications	Impacts/Constraints
Pedestrian Access	Pedestrian access provides defined and direct route to and from the bus stop.	Provides a safe, accessible, and ADA-compliant route to and from the bus stop.	Recommended coordination with commercial development and/or residential development surrounding the bus stop.	Typically low cost, may sometimes require coordination and separation between modes, and additional right-of-way.
Waiting or Accessory Pads	Waiting or accessory pads are paved areas at a bus stop that can provide riders with amenities such as benches, shelters, bike racks or trash receptacles, and may also be built as a bus bulb or curb extension.	Provides the space needed to locate amenities for bus riders.	Waiting pads are generally separated from the sidewalk to preserve pedestrian flow. Transit agencies usually have one or two accessory pad variations depending on different configurations and accessories that may be installed.	Typically moderate to high cost, may sometimes require additional right-of-way.

Matrix continues on next page

Upgrade Bus Stops

Measure	Description	Benefits	Applications	Impacts/Constraints
Shelters	Shelters, ranging from rudimentary to sophisticated, are structures over designated waiting areas for bus users. Shelters may have a full or partial roof, supported by two, three or four sided construction.	Shelters provide users with protection from the elements while waiting for a bus.	Recommended at bus stops with a high estimated number of passengers, in most instances.	Typically low to moderate cost, usually possible to fit within existing right-of-way.
Benches	Benches are seating areas for people who are waiting for a bus.	Provides comfort and convenience at bus stops.	Recommended at bus stops with high ridership figures, long headways, frequent usage by elderly people or people with disabilities, and/or evidence that riders are sitting or standing on nearby land or structures.	Typically low cost, usually possible to fit within existing right-of-way.
Route and Passenger Information	Route and passenger information are signs used by transit agencies to generally display logos, route numbers available at the stop, type of route (local or express), and destination. Real time passenger information displays also show the expected arrival time of transit vehicles.	Provides riders the most updated or real time information on routes and schedules.	Should be made available at all bus stops. Real time information is appropriate at high ridership bus stops.	Typically low cost, usually possible to include within existing bus stop facilities.
Optimal Stop Location/Spacing	Bus stop locations and the space between them can have a significant effect on transit service quality and frequency. By optimizing bus stop spacing, transit service can be made more accessible and reliable.	Optimal bus stop spacing can ensure efficient coverage yet still keep a desired overall travel time through the corridor. Optimal stop location varies from street to street as each location type (near-side, far-side, and mid-block) has its advantages and drawbacks.	Recommended on routes with irregular stop spacing or where reliability is low. When making decisions of bus stop locations and spacing, it is important to consider effects on traffic signal operations and access to nearby land uses.	Typically moderate cost, may require additional studies to determine optimal stop configuration.
Bicycle Storage Facilities	Bicycle storage facilities include bike racks and bike lockers.	Discourages bicycle riders from locking bikes onto bus facilities or on adjacent property, and can reduce amount of visual clutter at a stop by confining bikes to one area.	Best at bus stops when demand warrants, which is primarily at major suburban stops.	Typically low to moderate cost, usually possible to fit within existing right-of-way.
Lighting	Lighting may be direct, specifically installed at the bus stop, or indirect, located near the bus stop, such as street lights.	Improves perception of safety and security at a bus stop, as well as discouraging use of the bus stop by non-bus riders.	Particularly important where users may arrive and return to the bus stop in darkness during the winter season.	Typically low to moderate cost, usually possible to fit within existing right-of-way.