

Transit Bus on Shoulder Pilot Program Guidance

October 2026

Caltrans

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Section 1 Introduction

The California Department of Transportation (Caltrans) has developed this guidance for the implementation of public Transit Bus on Shoulder (TBOS) pilot programs on the State Highway System (SHS).

The goal of this program is to improve public transit performance and access on the SHS in alignment with the Caltrans Director's Transit Policy (DP-40) by establishing freeway shoulders as transit priority facilities that transit buses may use during congested conditions.

The purpose of this document is to provide guidance for all partners in the program and ensure consistent development and implementation of TBOS pilot programs across California. It is intended as a supplement to the *Project Development Procedures Manual (PDPM)*, *Highway Design Manual (HDM)*, *California Manual on Uniform Traffic Control Devices (CA MUTCD)*, *Traffic Safety Systems Manual (TSSM), Ramp Metering Design Manual (RMDM)*, Managed Lanes Guidelines, and all other current applicable Caltrans standards and guidelines.

For additional reference on TBOS design and operation, project sponsors should refer to the Federal Highway Administration (FHWA) document titled, "Use of Freeway Shoulders for Travel — Guide for Planning, Evaluating, and Designing Part-Time Shoulder Use as a Traffic Management Strategy" (hereinafter referred to as the FHWA Part-Time Shoulder Use Guide).

Section 2 Transit Bus on Shoulder Defined

TBOS is a Transportation System Management and Operations (TSMO) strategy in which a freeway shoulder is made available for specially trained transit bus operators to safely enter and use the shoulder to bypass congested mainline traffic during periods of recurrent heavy congestion. As a TSMO strategy, TBOS is intended to improve corridor performance by increasing person throughput and enhancing travel time reliability through shorter and more consistent transit travel times, while supporting increased transit ridership and leveraging existing highway infrastructure more efficiently. Transit bus usage on the shoulder is a secondary use of the shoulder, meaning authorized transit buses traveling on the shoulder must yield to all other vehicles, objects, or people occupying the shoulder. The shoulder's primary functions remain unchanged. These include use as a refuge for vehicles in emergencies, access for first responders, a clear recovery area for drivers to avoid conflicts, and space for maintenance and enforcement activities. Shoulder use for these purposes will continue to take precedence over TBOS operations.

The most well-known example of TBOS is found in Minneapolis and St. Paul, Minnesota. The first of these facilities began operating in 1991. By partnering with the Minnesota Department of Transportation, the regional transit provider, Metro Transit developed the program to move transit buses through traffic more efficiently, and therefore, more cost-effectively by leveraging the state's existing freeway network. Metro Transit identified that TBOS operations provide the following benefits:

- Shorter and more reliable transit times.
- Fewer missed transfer connections.
- Increased transit ridership.
- Decreased operational costs.

In some cases, travel times have decreased enough to allow for schedules to be revised and for a transit bus to be eliminated on a route. The Minnesota Twin Cities region now has more than 300 miles of TBOS operations. Based on this experience, other cities have implemented TBOS systems, including in Atlanta, Georgia; Chicago, Illinois; Columbus, Ohio; Miami, Florida; and Raleigh-Durham-Chapel Hill, North Carolina.

FHWA has recognized TBOS and other types of part-time shoulder use as TSMO strategies for addressing congestion and reliability issues. For this reason, FHWA developed the FHWA Part-Time Shoulder Use Guide in February 2016. This FHWA guidance provides case studies of part-time shoulder use projects, including TBOS, throughout the United States and discusses factors to consider when planning these projects, including stakeholder engagement and public input.

Although allowing transit buses to use shoulders can be a cost-effective solution to improve transit performance and person throughput, this strategy may not be

appropriate where it could significantly impact safety or where minimum geometric requirements cannot be met.

Section 3 History of Transit Bus on Shoulder Projects in California

Several TBOS pilot projects have been proposed or implemented in various urban areas in California.

In 2005, the San Diego Association of Governments (SANDAG), in partnership with the Metropolitan Transit System (MTS), Caltrans District 11, and the California Highway Patrol (CHP), implemented a two-year demonstration project in the City of San Diego to evaluate the effectiveness of allowing transit buses to use the right shoulder of State Route 52 and Interstate 805 to bypass congested freeway lanes and improve on-time performance. The 8-mile-long project was implemented on State Route 52 between Interstate 805 and Kearny Villa Road and on Interstate 805 between State Route 52 and Nobel Drive using MTS Express Route 960. This project included installing new signage and pavement markings to indicate the shoulder was for authorized buses only. It proved successful at meeting the following objectives:

- Prioritizing safety. No transit-related collisions or near-misses were reported. CHP and Caltrans indicated no safety or operational issues associated with the pilot project.
- Benefitting transit operations. MTS Express Route 960 reported a 99 percent on-time performance, meaning nearly all transit buses operating along the freeway shoulder arrived at the next terminal at or before the scheduled time. A travel time comparison showed that buses using the shoulder saved approximately five minutes compared to cars.
- Improving transit bus operator and passenger perceptions of transit route performance.
- Maintaining mainline freeway operations and level of service.
- Avoiding shoulder structural issues.

Based on the successful demonstration in San Diego, the Monterey-Salinas Transit District and the Santa Cruz Metropolitan Transit District pursued and obtained legislative authority to allow their transit buses to use freeway shoulders within their service areas. Efforts are underway to implement a project on State Route 1 in Santa Cruz County, where transit buses will use the right shoulder through freeway interchanges and operate in the auxiliary lanes in between those interchanges.

In June 2022, SANDAG began a second TBOS pilot project for MTS transit buses on Interstate 805 and State Route 94 for MTS South Bay Rapid Route 225. This project implemented advanced technologies and multi-system connectivity innovations and included pavement resurfacing, shoulder widening by restriping general-purpose lanes from 12 ft to 11 ft, modifying ramp meter signals, and installing new signage. Based on the final report for the three-year pilot project, the TBOS operations provided:

- Safe Operations. Effective safety protocols and on-board driver assistance systems led to zero reported collisions involving the Rapid Route 225 buses for the duration of the project.
- Improved transit performance. Most buses that used the shoulder were able to improve travel times and provide a more reliable service. Once the program matured, southbound morning peak period buses saw average travel time savings of 5-6 minutes, with some TBOS operation trips saving 20-25 minutes of travel time, when compared to general-purpose lane traffic. Meanwhile, the lack of performance improvement during the afternoon peak period provided important lessons learned on improving TBOS design and operation.
- Positive bus operator and rider feedback. Surveys indicated that a majority of bus operators and passengers felt positively about the TBOS operations in regard to its safety, effectiveness, and potential for implementation on other corridors.
- Advanced Technologies. Transit Signal Priority and Advanced Driver Assistance Systems played a key role in operations. However, there were significant challenges related to the reliability of on-board systems and the maintenance of roadside equipment.
- Inter-agency collaboration. The pilot relied on close coordination between stakeholders and navigating between SANDAG, Caltrans, CHP, and MTS institutional policies and processes.
- Cost-Effectiveness. Benefit-cost analysis shows that this TBOS pilot represented a cost-effective, near-term improvement for freeway bus operations by leveraging existing roadway infrastructure.

In October 2025, the Contra Costa Transportation Authority (CCTA) conducted closed-course TBOS testing at GoMentum Station in Concord, California. This testing evaluated multiple operational scenarios, including on-ramp and off-ramp maneuvers, typical right shoulder operations, and obstruction avoidance, to simulate real-world TBOS conditions. The project involved collaboration among CCTA, Caltrans, CHP, and Central Contra Costa Transit Authority (County Connection). Key objectives included assessing transit bus operator navigation, safety performance, and technology integration for ramp metering and bus detection systems. The draft report, released in January 2026, indicated that most configurations were deemed feasible for implementation on live freeway segments. The findings from this testing were used to support the TBOS operational guidelines and procedures provided in this document.

Section 4 Applicable State Statutes for Transit Bus on Shoulder

The following statutes from the California Streets and Highways Code grant Caltrans the authority to designate the shoulder as a temporary facility for TBOS operations:

- Section 92 – Authorizes that Caltrans may do anything necessary, convenient or proper for the construction, improvement, maintenance or use of all state highways.
- Section 148.1 - Specifically authorizes the Monterey-Salinas Transit District and the Santa Cruz Metropolitan Transit District to operate transit buses on the shoulders of certain state highways within the areas served by the transit services of the districts, with the approval of Caltrans and CHP.
- Section 149 – Permits Caltrans to construct exclusive or preferential facilities for buses and to permit such use on existing highways as part of the SHS.
- Section 149.3 - Permits Caltrans to construct exclusive facilities pursuant to a cooperative agreement with any public or private agency that provides mass transit services. Such cooperative agreement shall establish geometric design standards, scheduling, reservations, restrictions, and conditions as the department deems necessary or desirable.

Given these statutes, approved TBOS projects shall be considered pilots. The maximum duration of an approved pilot project will be three years from the date the TBOS pilot begins operation. Evaluation of the individual projects, such as the evaluation criteria in Section 10, Topic 3, "Evaluation of TBOS Projects," will be used to determine whether to permanently permit transit buses to use shoulders (and if there is a need for permanent legislative authority for such a program), or to discontinue the practice.

Regarding traffic control devices for TBOS operations, Section 21655.1 of the California Vehicle Code (CVC) prohibits the operation of motor vehicles on a portion of a highway that has been designated for the exclusive use of public transit buses. The transit agency, with Caltrans approval, is to place and maintain signs and other official traffic control devices, as necessary, indicating that a portion of a highway is designated for use by transit buses and advising motorists of the hours of transit bus operation on the shoulder. The traffic control devices shall also indicate that the shoulder shall still be accessible for use as a refuge for vehicles in emergencies, first responders, a clear recovery area for drivers to avoid conflicts, and space for maintenance and enforcement activities, as stated in Section 2, "Transit Bus on Shoulder Defined."

Section 5 Transit Bus on Shoulder Project Eligibility Criteria

A transit operator, in cooperation with the regional transportation planning agency, or multiple agencies for proposals spanning multiple jurisdictions (such as a metropolitan planning organization, transportation planning agency, county transportation commission, or local transportation agency) may propose a TBOS pilot project to the Caltrans district with jurisdiction over the route, or routes, where the TBOS project is proposed. While any freeway is theoretically eligible for a TBOS project, eligibility does not guarantee approval for TBOS operations, nor does it automatically provide additional Caltrans funding for improvements needed to implement TBOS. The criteria that shall be met for a pilot TBOS project to be evaluated for approval by the Caltrans district include the following:

- The facility for the proposed TBOS operations must be a freeway or expressway with controlled access.
- At least one fixed transit route must use the freeway for at least one year prior to the implementation of the pilot TBOS project.
- Bicyclists and pedestrians must not be allowed to travel along the freeway shoulder for the proposed route segment. The NO PEDESTRIANS BICYCLES MOTOR-DRIVEN CYCLES (R5-10) or NO PEDESTRIANS OR BICYCLES (R5-10b) sign shall be posted in accordance with requirements of *CA MUTCD* Section 2B.45.
- For TBOS projects that plan to operate in the inside (left) shoulder, there must not be any on-ramps or off-ramps on the left side of the freeway along the TBOS corridor.

Additional criteria that should be considered when evaluating a TBOS proposal include, but are not limited to, the following:

- The number of fatal and serious injury (K and A on 5-point KABCO scale) crashes on the proposed route segment should not exceed the value derived from the corresponding safety performance function based on the most recent 3 years of available safety data.
- Demonstrated potential for quantifiable improvement in transit bus travel times along the corridor by bypassing recurrent heavy congestion.
- Existing or planned managed lanes and supporting infrastructure, such as direct access ramps to local arterials.
- Adequate interchange spacing to limit frequent weaving between the shoulder and general-purpose traffic. Refer to *HDM*, Chapter 500, for guidance on analyzing weaving sections.

- Potential for multimodal connectivity, including nearby transit stations and mobility hubs served by transit using TBOS.
- Existing or planned ramp metering along the TBOS corridor.
- At locations along the proposed route where incidents of bicyclists or pedestrians illegally occupying the freeway shoulder have been reported or observed, additional fencing or other mitigation efforts should be considered to discourage illegal use of the freeway shoulder.
- Existing rumble strips, which may need to be removed or modified as discussed in Section 7, Topic 9, "Rumble Strips."
- Existing shoulder structural capacity to withstand bus loads.
- Existing shoulder widths. See Section 7, Topic 2 "Shoulder Width" for information on minimum shoulder widths for TBOS operations.
- Potential conflicts with other future planned or proposed state freeway projects.

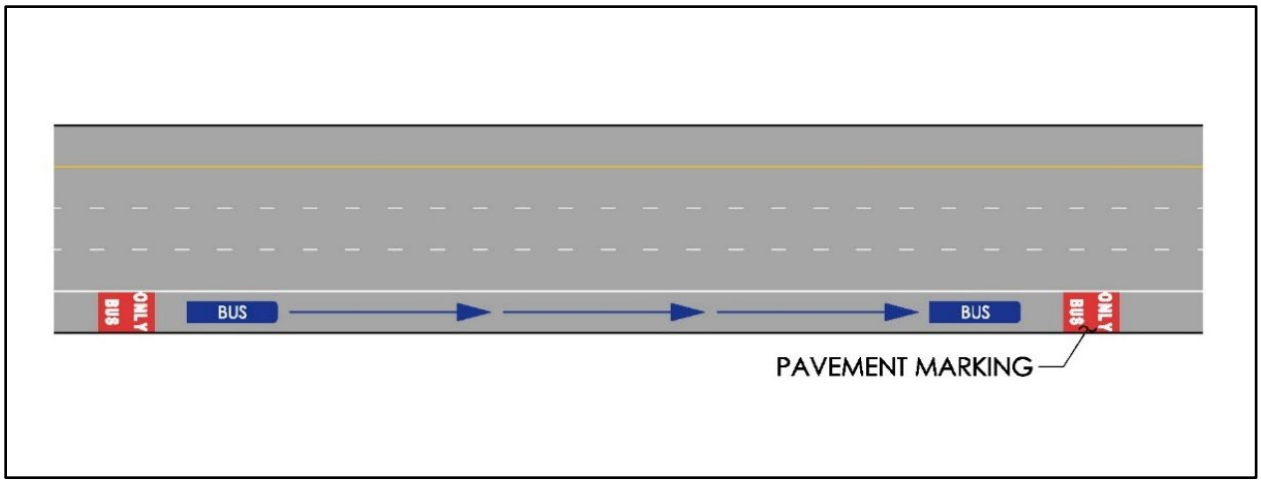
Section 6 Operational Policies and Practices for Transit Bus on Shoulder

Topic 1 Primary Operational Policies

The core elements of TBOS policies concern restrictions on shoulder usage during congested periods. Listed below are the primary operational policies, including vehicle restrictions, maximum operating speeds, shoulder utilization, transit bus operator training, and communication requirements that Caltrans will require TBOS project sponsors to follow. The figures in this section are intended to provide guidance on transit bus maneuvers during TBOS operations and are not intended to be a supplement to the *CA MUTCD*. Additionally, these figures represent idealized situations for generalized operations and maneuvers. Site-specific conditions, such as roadway geometry, slopes, and lane transitions, shall be considered when determining the operations for a specific TBOS corridor.

- Transit buses entering or exiting the shoulder shall do so safely and only operate on the paved portions of routes where signs or other traffic control devices identify the shoulder as being available for transit bus use and only during the time periods indicated. Normal operation is shown in Figure 6-1 below.

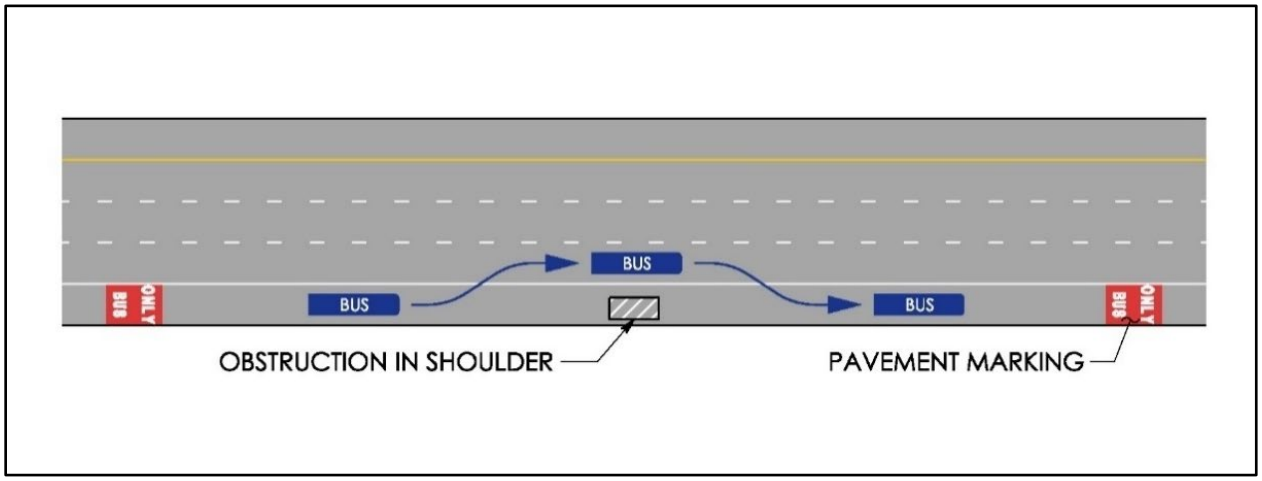
Figure 6-1 Normal Operation



- Transit buses shall safely exit the shoulder as shown in Figure 6-2 when:
  - The shoulder is blocked or unavailable for any reason, including, but not limited to, the presence of any disabled vehicles, enforcement activities, maintenance operations, incident clearing measures, bicyclists or pedestrians on the shoulder.

- An authorized emergency vehicle is sounding a siren or displaying a flashing red or blue light and is approaching on the shoulder.
- A tow truck or Caltrans maintenance vehicle is approaching on the shoulder displaying flashing amber lights.

Figure 6-2 Unavailable Shoulder



- Shoulders shall not be used during periods of inclement weather. Inclement weather is defined in Section 24400 of the CVC as a weather condition that prevents a driver of a motor vehicle from clearly discerning a person or another motor vehicle on the highway from a distance of 1,000 feet or requires windshield wipers to be in continuous use due to rain, mist, snow, fog, or other precipitation or atmospheric moisture.
- Use of the shoulder by a transit bus operator is voluntary. If the transit bus operator does not feel it is safe to operate in the shoulder, then the transit bus operator shall operate in the travel lanes.
- 'Out-of-Service' transit buses shall not use the shoulder to bypass traffic.
- Transit buses shall only use the shoulder when the speed on the freeway in the direction of travel is below 35 miles per hour (MPH). Mainline operating speeds in the adjacent general-purpose lane will dictate when entry onto the shoulder is permitted.
- Transit buses shall not travel more than what is reasonable or prudent and shall not travel 15 MPH faster than other vehicles on the adjacent travel lane and shall not exceed 35 MPH. While 35 MPH is the maximum shoulder operating speed, buses must maintain a speed differential of no more than 15 MPH relative to the adjacent lane. If traffic is stopped, 15 MPH is the limiting speed for shoulder travel.

- Only authorized transit buses as defined in Section 642 of the CVC shall be permitted to use shoulders. Private buses and shuttles, including, but not limited to, employer shuttles, hotel shuttles, and airport shuttles, are prohibited.
- Transit buses longer than 45 feet shall not be allowed to use the shoulder for TBOS operations and shall be in accordance with Section 35400 of the CVC. Additionally, the maximum length of the bus shall be dependent on the facility such that the bus can maneuver safely within the shoulder so as not to have any portion of the bus enter the mainline when operating in the shoulder. The width of the bus, including the side mirrors, shall be at least 6 inches less than the width of the shoulder at the shoulder's narrowest point on which the bus operates.
- Transit buses shall be clearly and identifiably marked on all sides of the vehicle with the name of the transit agency.
- Transit buses that use shoulders shall be appropriately marked to indicate that the bus is authorized to use the shoulder and inform motorists not to follow the transit bus onto the shoulder. An example of a transit bus with these markings is shown in Figure 6-3 below.

Figure 6-3 Transit Bus Marked with Shoulder Use Messages

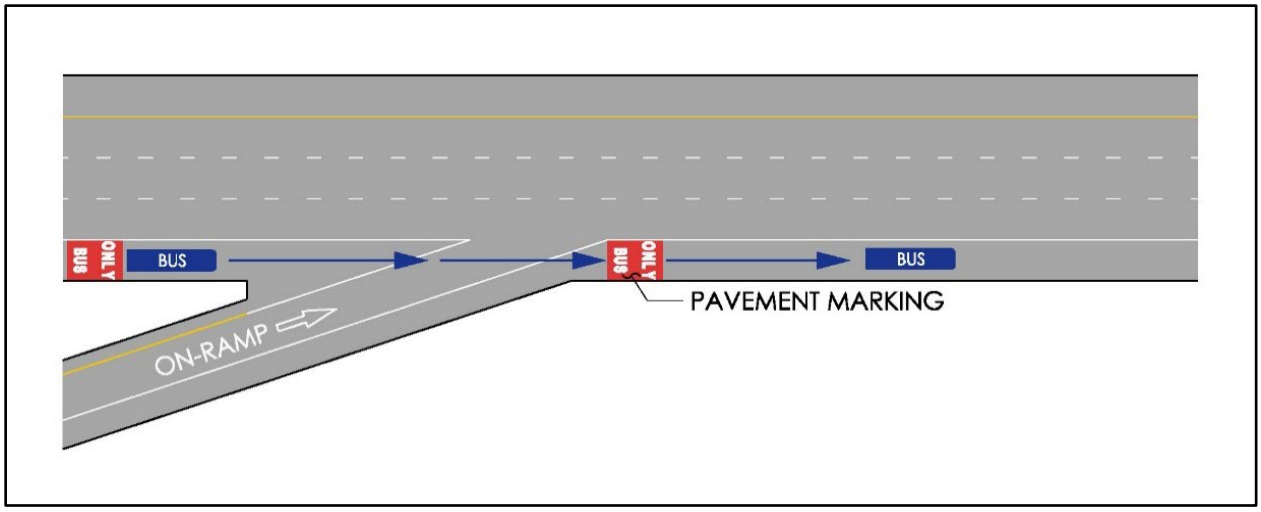


Topic 2 Operations at Ramps

Provisions must be made to minimize conflicts between transit buses and traffic entering or exiting the freeway. The transit bus operator must use caution and yield to other vehicles entering or exiting the freeway before crossing a ramp.

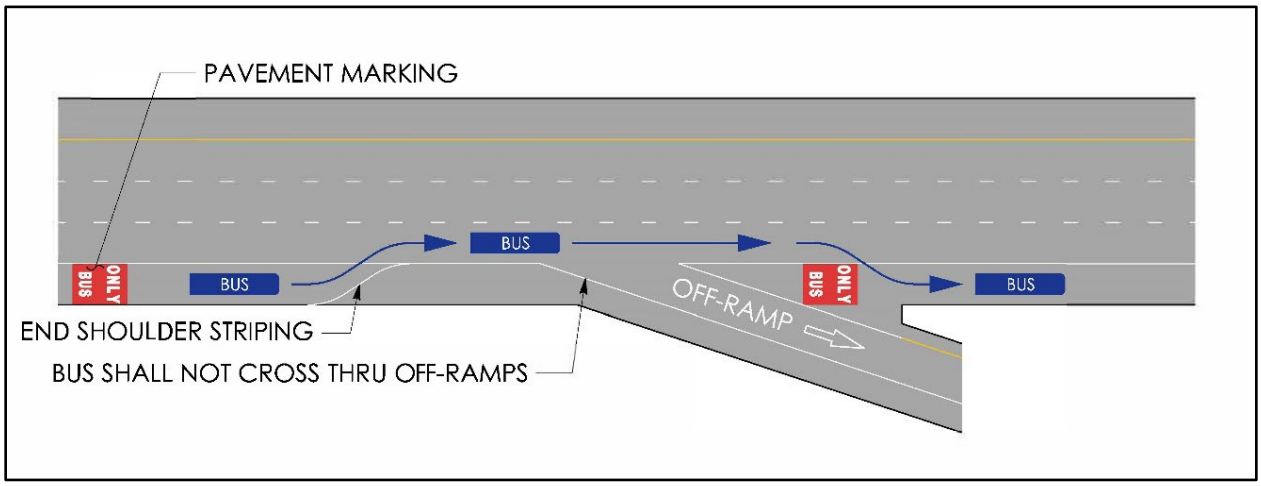
- **Single Lane On-Ramp**: Transit buses may cross single lane on-ramps as shown in Figure 6-4.

Figure 6-4 Single Lane On-Ramp



- **Single Lane Off-Ramp (No Auxiliary Lane):** Transit buses shall exit the shoulder prior to the off-ramp and should resume shoulder operations downstream of the ramp as shown in Figure 6-5.

Figure 6-5 Single Lane Off-Ramp

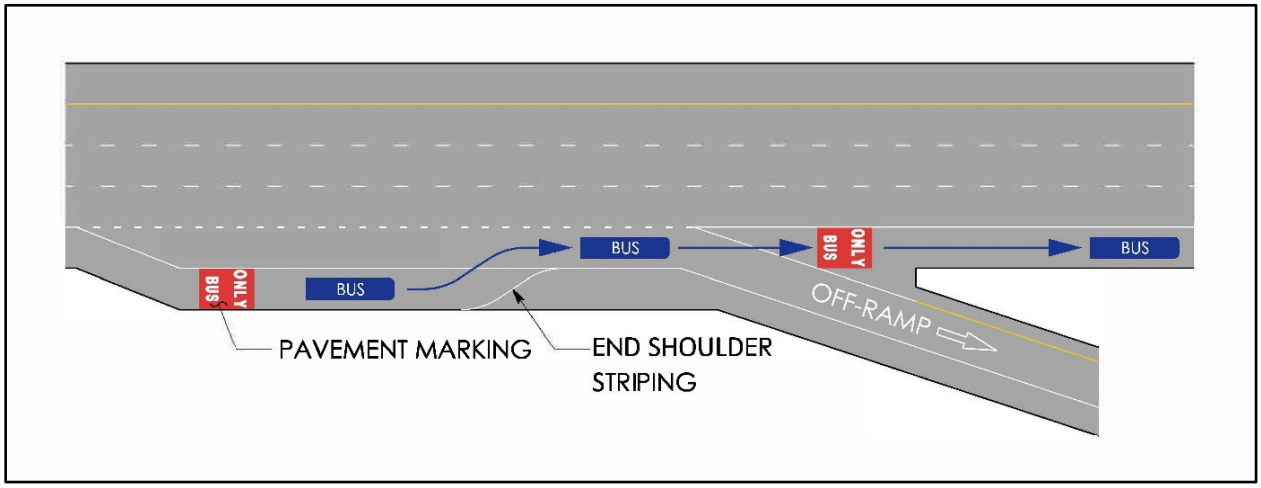


- **Ramps with Exit-Only or Auxiliary Lanes**: Transit buses shall operate in the exit-only lane, auxiliary lane, or rightmost through lane as outlined below:

  1. **Single-Lane Off-Ramp with Exit-Only or Auxiliary Lane**: Transit buses shall exit the shoulder and merge into the adjacent exit-only or auxiliary lane between the onset of the adjacent lane and the end of the shoulder striping when it is safe to do so. Signage, striping, and pavement markings shall indicate where TBOS is prohibited and where buses must begin to merge into the exit-only or auxiliary lane. If continuing past the ramp, the transit bus may enter the

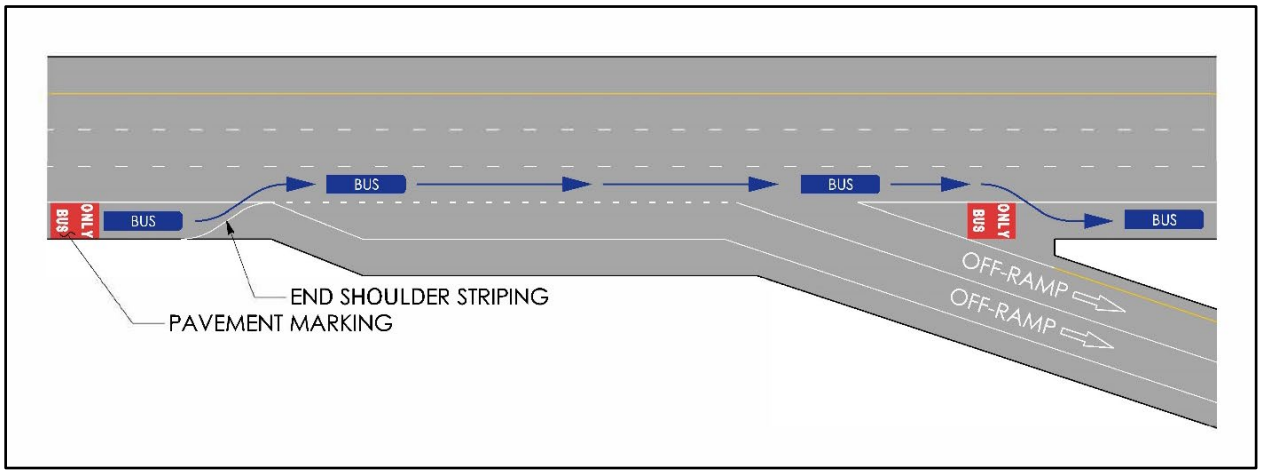
paved gore area and proceed into the shoulder at the end of the gore. This movement is shown in Figure 6-6.

Figure 6-6 Exit-Only Lane or Auxiliary Lane at Off-Ramp



2. **Multilane Off-Ramp**: Transit buses shall be required to exit the shoulder prior to the start of an exit-only lane and use the rightmost through lane approaching the ramp for multilane off-ramps. Signage, striping, and pavement markings shall be placed to indicate where TBOS is prohibited, and transit bus operators must be trained to merge into the rightmost through lane. If continuing past the off-ramp, the transit bus should resume shoulder operations downstream of the ramp. This movement is shown in Figure 6-7.

Figure 6-7 Multilane Off-Ramp



3. **Multilane On-Ramp:** Transit buses shall be required to exit the shoulder prior to the on-ramp gore point and use the rightmost through lane approaching the ramp. Signage, striping, and pavement markings shall be placed to indicate

where TBOS is prohibited, and transit bus operators must be trained to merge into the rightmost through lane. Unless the on-ramp becomes an auxiliary lane downstream, the transit bus may resume using the shoulder at the end of the gore. This movement is shown in Figure 6-8 and Figure 6-9.

Figure 6-8 Multilane On-Ramp

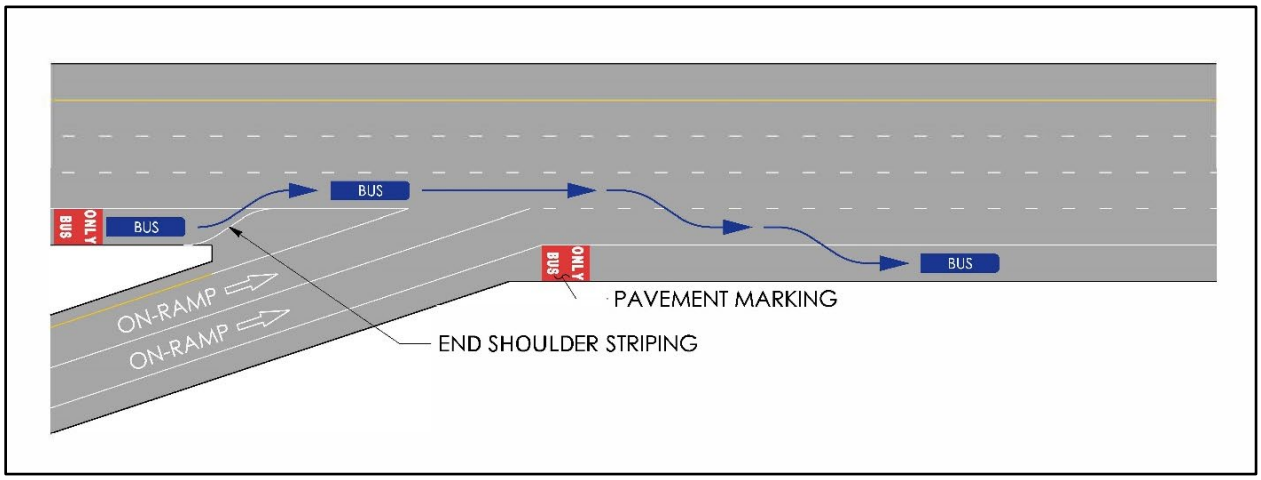
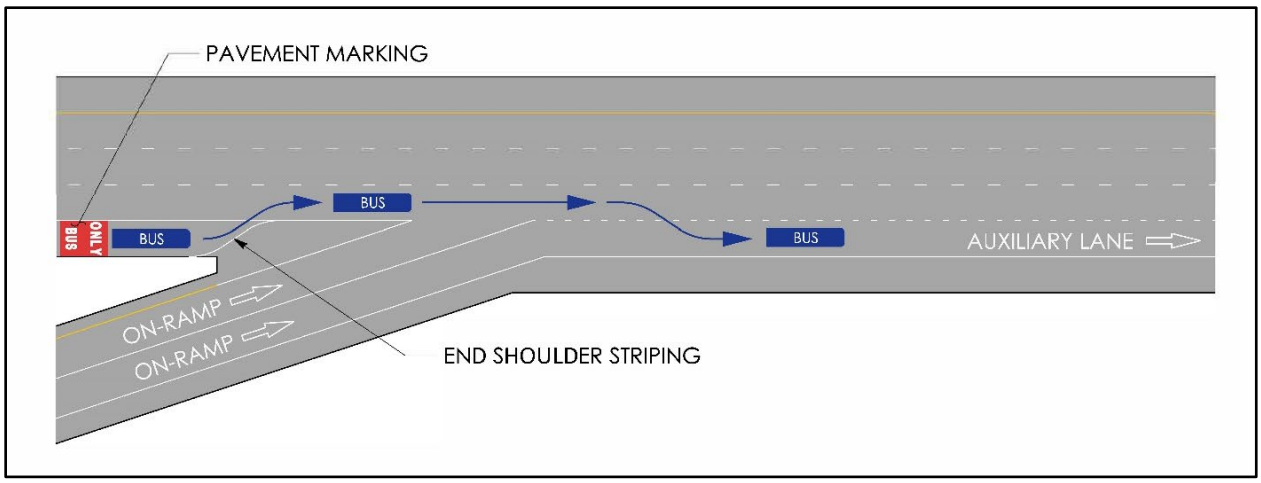
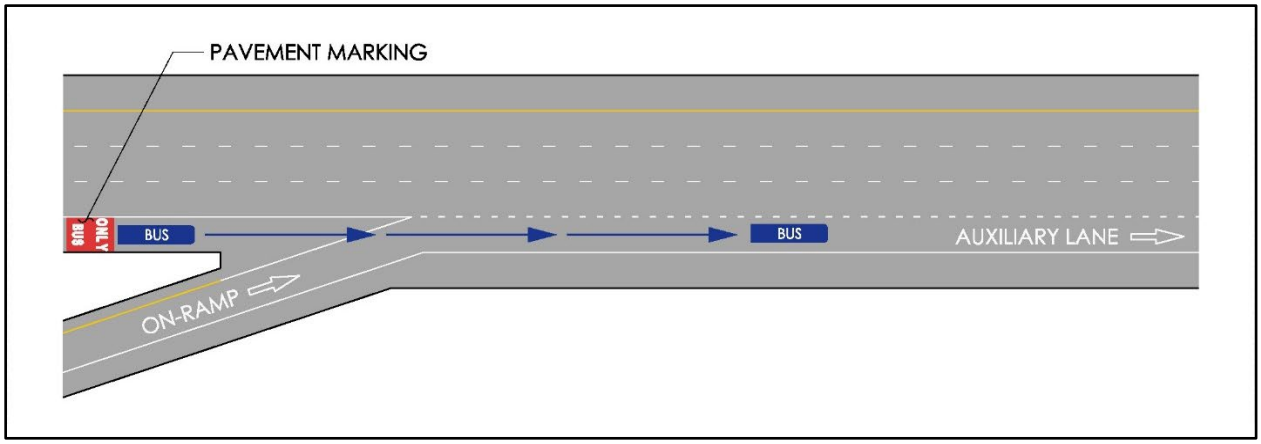


Figure 6-9 Multilane On-Ramp with Auxiliary Lane



4. **Single-Lane On-Ramp becoming Auxiliary Lane**: Shoulder use will terminate at the on-ramp gore point. Signage shall be placed to indicate where TBOS is prohibited and to indicate where the transit bus operators must merge into the auxiliary lane. Transit buses will be required to use the auxiliary lane past the ramp merge. This movement is shown in Figure 6-10.

Figure 6-7 On-Ramp with Auxiliary Lane



For on-ramps, ramp metering can be effective in managing the conflicts at merge locations. The 2022 TBOS pilot project in San Diego incorporated signal pre-emption at the metered on-ramps, which hold the meter in the red phase as a transit bus travels through the merge area. If on-ramps are not metered, ramp volumes and expected volume of transit buses using the shoulder should be analyzed carefully to determine if there will be significant conflicts which could be addressed by metering.

Topic 3 Communication and Coordination

Each TBOS pilot project will need to include interagency and intra-agency communication protocols to ensure effective operation of the freeway under normal, congested, and emergency situations, and during inclement weather and other traffic incidents. Effective communication procedures between Caltrans, CHP, the transit agency, and transit bus operators should be developed to ensure that TBOS operations are effective and safe. Examples might include communicating about vehicles or debris in the shoulders, ponding or snow on the shoulder, enforcement activity, work zone activities, etc.

TBOS projects will typically be implemented on urban freeways with high volumes and high levels of congestion. These facilities normally have transportation management system (TMS) elements in place such as ramp metering, closed-circuit television (CCTV) cameras, and changeable message signs (CMSs). Each Caltrans district has a Traffic Management Center (TMC) which:

- Uses TMS elements to monitor and manage traffic.
- Coordinates with CHP and emergency responders on incidents.
- Dispatches resources to assist in incident management and response.
- Communicates with local media regarding traffic conditions.

If TMS elements are in place and available, these systems and programs should be used to support TBOS operations. While transit bus operators will be trained on how to avoid blocked shoulders that they were not previously notified of, the additional communication between Caltrans, CHP, the transit agency, and transit bus operators can be helpful in notifying of shoulder conditions proactively. For instance, the TMC could use CCTV cameras to monitor the shoulder before and during its operation to ensure that it is not blocked by disabled vehicles or debris. The TMC should develop standard operating procedures to communicate with CHP and transit agencies regarding any activity or incident that would affect TBOS operations.

During times of congested traffic when transit buses are allowed to occupy the shoulders, transit bus operators can provide live updates of locations where shoulders are blocked. When shoulders are blocked, transit bus operators report the information to dispatchers who can relay this information to CHP and/or Caltrans, as appropriate.

Vehicle-to-infrastructure, vehicle-to-vehicle, or infrastructure-to-vehicle technology on the transit buses or on the roadside should also be considered, as appropriate, for TBOS projects. This type of technology can further enhance operations and safety.

Topic 4 Maintenance

The Caltrans district and the project sponsor will need to establish, implement, monitor, and modify maintenance policies, strategies, and procedures as needed. These may include maintenance strategies such as shoulder cleaning to remove debris and maintain drainage, pavement preservation and preventive maintenance to protect pavement condition and extend service life, and shoulder backing maintenance to reduce longitudinal edge drop-offs. The district, project sponsor, and transit agency shall enter into a Maintenance Agreement that addresses the roles and responsibilities along with reimbursements for labor and material costs from the project sponsor and participating transit agencies for any maintenance above the normal level of service.

The Maintenance Agreement defines responsibilities for maintaining physical assets above the normal level of service, such as pavement improvements, barriers and railing, drainage upgrades, rumble strip modifications, constructed turnouts, and traffic control devices. This work is typically assigned to Caltrans, and the project sponsor shall fully reimburse Caltrans for the associated costs, as specified in the agreement. The project sponsor should be responsible for the work required to maximize shoulder availability by clearing debris and should cover the cost of such work.

The Maintenance Agreement shall also discuss the process for decommissioning the physical assets installed as part of the TBOS operations and restoring the condition of the shoulder pavement when the pilot project ceases operation. Caltrans should be responsible for performing the work to remove the TBOS infrastructure and return the facility to normal operations as provided prior to the TBOS pilot project, which shall be fully reimbursed by the project sponsor as outlined in the Maintenance Agreement.

Topic 5 Other Enforcement Considerations

The Caltrans district, project sponsor, transit agency, and CHP must coordinate the implementation of an effective enforcement program to support the safe operation of the freeway and TBOS operations. These may include items such as:

- Public awareness of applicable statutes and operational policies.
- Enforcement procedures for speeds, speed differentials, and yielding right-of-way.
- Enforcement of unauthorized use of shoulders by motorists.
- Enforcement of unauthorized use of shoulders by non-transit buses, transit buses operated by uncertified drivers, and operation not designated for TBOS.
- Coordination with other emergency response vehicles and agencies.

Topic 6 Transit Bus Operator Training

Each transit agency that will operate transit buses on a freeway shoulder must develop and periodically review a transit bus operator training and certification program that is customized to the corridor with Caltrans and CHP oversight. Each transit bus operator must be trained on the TBOS operation. Training must provide TBOS information from an overall policy basis as well as for the specific transit route corridor. Training must occur before a transit bus operator can use the shoulder to bypass traffic. Training should include closed-course test track training, such as at GoMentum Station, so transit bus operators become familiar with TBOS operations and can handle new and unfamiliar operations. Each transit agency must provide training to its bus operators and is responsible for approving and certifying their drivers to operate transit buses on shoulders. The transit agency shall regularly share the transit bus operator completion records with CHP on a quarterly basis at minimum.

Agencies shall keep records of which drivers have undergone training and issue a certificate (a card), which the transit bus operator must have in possession when performing TBOS operations. The transit operator must provide their valid certification card to law enforcement officials when requested. Transit bus operators without their training certification card shall not operate in the shoulder. CHP may suspend TBOS operations if transit bus operators operate in the shoulder without their valid training certification card. If CHP suspends TBOS operations, the transit agency must provide a plan for CHP's approval to ensure all transit bus operators that operate in the shoulder will have the training certification card in their possession.

At a minimum, the policy training needs to cover the following subjects:

- Purpose of the TBOS program.
- Operational policies.

    - Handling emergencies and other situations where the shoulder is occupied.
    - Travel through interchange areas.
    - Navigating the paved shoulder.
    - Judging operating speeds of mainline traffic.
- Signs and pavement markings.
- Applicable statutes and enforcement.
- Communications, including Intra-agency, inter-agency, driver to motorist/driver courtesy, and emergencies.

At a minimum, the individual TBOS corridor training needs to address:

- TBOS operation safety.
- Shoulder ingress and egress.
- Start and end points.
- Shoulder widths.
- Restricted locations.
- Interchange locations.
- Corridor-specific traffic patterns.
- Other specific corridor characteristics that may pose challenges.

Each certified driver shall still have the ability to determine whether or not to travel on all or a portion of the shoulder on an available TBOS route on a trip-by-trip basis, and each agency can establish additional restrictions on TBOS usage as long as those additional policies are identified and included in the initial or follow-up driver training.

Section 7 Design Considerations for Transit Bus on Shoulder

TBOS projects shall be designed to *Highway Design Manual (HDM)* lane standards to accommodate transit bus operation, with the shoulder remaining designated as a shoulder. While the maximum speed for TBOS operation is 35 MPH, which reduces most concerns related to speed-related geometric design elements, utilizing the shoulder for bus travel can create new design challenges.

The primary geometric design criteria for TBOS operation include, but are not limited to, the pavement structural section, shoulder widths, horizontal clearance, cross slopes, drainage, and sight distances. A Design Standard Decision Document (DSDD) will be required for elements that do not meet *HDM* standards, such as nonstandard clearances, stopping sight distances, and clear recovery zones.

The following subsections highlight some of the design considerations related to TBOS operation. A complete list of design considerations and associated technical engineering information is provided in the *HDM*, *TSSM*, or other relevant Caltrans publications.

Topic 1 Pavement Structural Section

The structural section of the shoulder shall be designed to accommodate the projected traffic loading over its design life. The design shall be based on a thorough investigation of project-specific conditions, including subgrade soils and structural materials, environmental conditions, cost-effectiveness, and the performance of other pavements in the same area. This may require pavement reconstruction or rehabilitation. A full pavement structural evaluation, including cores, R-values, Traffic Indexes, and an assessment of concentrated wheel path loading is recommended prior to TBOS operations. Features not adequate for traffic loading, such as pull box covers and drainage systems, shall be evaluated and upgraded or relocated as necessary.

Topic 2 Shoulder Width

The paved shoulder shall maintain, at minimum, a width of at least 6 inches greater than the width of a bus, including the side mirrors, approved to operate in the shoulder for the entire TBOS corridor for which the bus may operate. For example, if the width of the widest bus approved to operate in the shoulder is 10 feet, a minimum width of 10.5 feet for the entire TBOS corridor segment shall be required. A width of 12 feet is recommended for the entire TBOS corridor. Where lateral obstructions exist such as bridge rail, retaining walls, guardrail, concrete barrier, and other traffic safety systems, additional shoulder width above the minimum width required is recommended. See Section 7, Topic 3, "Horizontal Clearance," for more information. Whenever possible,

provide additional shoulder width for horizontal clearance and ensure structural support so that vehicles do not degrade the pavement edge and to prevent longitudinal edge drop-off failures.

Adjustments to the width of general-purpose lanes may be considered to accommodate a wider shoulder; documentation will be required for any resulting nonstandard features. The lane adjacent to the outside shoulder shall be maintained at a width of 12 feet to accommodate trucks.

Topic 3 Horizontal Clearance

The clear recovery zone on bus-on-shoulder facilities is measured from the edge of the traveled way (the outside edge of the adjacent general-purpose lane) as per the *HDM*. Intermittent transit bus operation on the shoulder does not shift the edge of the traveled way. Because this use is limited to congested conditions at reduced speeds, the shoulder continues to serve as a recovery area and for other typical shoulder functions. Because this use is limited to congested conditions at reduced speeds, the shoulder continues to serve as a recovery area and for other typical shoulder functions. Any existing fixed objects within the clear recovery zone, especially at narrow bridges or structures, shall be treated in accordance with *HDM* Chapter 300 and the Caltrans Traffic Safety Systems Guidance. Maintain the minimum horizontal clearances as specified in the *HDM*. Verify that clearances are also maintained for traffic safety systems, sign panels, structures, lighting poles, and other vertical elements, especially if the cross slope is not changed to accommodate TBOS operations.

Topic 4 Cross Slopes

Cross slopes shall not exceed 5 percent for a shoulder that is on the right side of the roadway section and shall not exceed 2 percent for a shoulder that is on the left side of the roadway except when matching superelevation rates in the adjacent lane. Grade breaks and superelevation rates should be checked and addressed as necessary, especially in locations where the transit buses may traverse a ramp merge or diverge.

Topic 5 Drainage

Depending on the number of transit buses using the shoulder, the frequency of drainage systems, the cross slope, and the presence of obstacles and other conditions, modifications to, or the addition of, drainage systems may be needed. Inlet grates shall be traffic rated. Evaluate the need to reconstruct inlet depressions to ensure transit buses can safely and comfortably traverse the inlet. Reconstructing and raising the inlet to pavement grade may be necessary. A hydraulic analysis shall be performed to ensure that operationally significant ponding of water does not occur in the shoulder. Shoulder water spread shall be reevaluated and minimized to the extent practicable. While TBOS operations are prohibited during periods of inclement weather, TBOS

operations after inclement weather can cause splash, spray, and reduced visibility in the adjacent general-purpose lane where shoulder water spread is present. Additional drainage capacity may be necessary. Dike modifications should be evaluated. Close coordination with drainage design is essential to prevent pavement deterioration.

Topic 6 Sight Distance

On the inside of horizontal curves, transit buses using a shoulder will be closer to guardrails, barriers, or other obstructions. This may reduce sight distance, and it may reduce it below the minimum design values in the *HDM*. The design speed for TBOS facilities should be 35 MPH. Documentation and development of mitigating measures may be necessary.

Topic 7 Termini

Logical termini for TBOS operations should be established during project scoping and preliminary design. TBOS operations should begin just downstream of an on-ramp and terminate at an off-ramp (if the transit buses are expected to exit the freeway at that ramp) or upstream of an off-ramp. The beginning or end of a TBOS operation shall be located such that it is highly visible to approaching drivers. Additional lighting should be considered at termini where feasible to improve visibility. Horizontal curves, vertical curves, and overpasses may limit a driver's visibility of a downstream roadway, and beginning or terminating TBOS operations within or immediately beyond these features should be avoided if possible. Likewise, beginning or terminating TBOS operations in or immediately beyond an area with extensive, complex signing or other features contributing to high driver workload should be avoided if possible. Refer to the *HDM* for decision sign distances for freeways and expressways.

Topic 8 Turn-Outs

Caltrans and CHP will evaluate the need for turnouts based on the length of the shoulder that will be used, hours of operation, and volume of transit buses expected to use the shoulder. Enforcement needs, breakdown refuge areas, and maintenance needs may warrant their inclusion. These areas also allow the CHP or Freeway Service Patrol to clear the travel lanes faster and maintain freeway operations. Refuge areas should be at least 15 feet wide and 75 feet long, with 30-foot-long tapers. Pullouts will be signed with the R8-4 "EMERGENCY PARKING ONLY" sign.

Topic 9 Rumble Strips

Rumble strips located between the shoulder and the adjacent general-purpose lane can introduce localized exterior noise and create an uncomfortable or perceived unsafe experience for transit riders when buses enter or exit the shoulder. To minimize

these impacts while maintaining the safety benefits of rumble strips, design considerations should be made to limit instances where the rumble strips are traversed. This can include removing the rumble strips only at predetermined merge or transition points where buses are expected to transition between the shoulder and general-purpose lanes. Where rumble strips are fully or partially removed, supplemental safety measures may be required to mitigate the increased risk of lane departures. This can include installing sinusoidal "mumble" strips in place of rumble strips, audible rumble stripes, enhancing pavement markings, upgrading delineation and reflectorizing, adding channelizers or other edge-line treatments, and adjusting shoulder width and clearance.

Any decision to retain, remove, modify, or replace rumble strips should include input from transit agencies and bus operators and be supported by analysis of lane-departure crash history, expectant noise sensitivity, and TBOS merge locations and frequency. Lane-departure rates shall be monitored following the removal of rumble strips, and rumble strips shall be reinstalled if those rates increase. In this event, TBOS operations should be modified. Additionally, the pavement structural section and drainage shall be reevaluated if rumble strips are removed or modified.

Section 8 Traffic Control Devices for Transit Bus on Shoulder

The traffic control devices discussed in this section shall conform to the requirements of the *CA MUTCD*. The *CA MUTCD* is the legal standard for traffic control devices in the State, so information on signage and markings provided in this guidance is for reference purposes only. In the case of discrepancies between this document and the *CA MUTCD*, the *CA MUTCD* shall govern.

Topic 1 Signing

Signage shall conform to the requirements of Part 2 of the *CA MUTCD*. Refer to *CA MUTCD* Sections 2G.20 through 2G.23 for instructions on regulatory, warning, and guide signs for TBOS operations. Figure 2G-32, Figure 2G-32(CA), and Figure 2G-101(CA) in the *CA MUTCD* provide the typical application of TBOS signage.

The key signing needs for TBOS operations are to notify drivers and transit bus operators where transit buses are permitted to use the shoulder, who is authorized to use it, and to provide the specific times that such use is permitted. Static signs mounted on the roadside are used for this purpose. Signs should be placed far enough from the shoulder edge to avoid conflicts with buses using the shoulder while remaining clearly visible.

An effective communication process or communication system as outlined in Section 6.3 can minimize the need for extensive signing.

The 'AUTHORIZED BUSES ONLY' regulatory sign (R130(CA)) shown below in Figure 8-1 shall be used at the beginning of and at one-half (1/2) mile, or less, intervals along the TBOS facility. The times and days on the sign may be edited. The 'EMERGENCY STOPPING ALLOWED' plaque (R130P(CA)) is used to reinforce public use of the shoulder for emergencies during TBOS operations.

Figure 8-8 Regulatory Signs for Transit Bus on Shoulder Operation – R130(CA) & R130P(CA)



For facilities with emergency turn-outs adjacent to the shoulder, the standalone 'EMERGENCY STOPPING ONLY' sign (R8-7), shown in Figure 8-2 can also be used.

Figure 8-9 Emergency Stopping ONLY Sign – R8-7



In addition, the R131(CA) sign should be installed in advance of the location where part-time bus travel on the shoulder begins, while signs R132(CA) and R133(CA) shall be used to indicate the end of the TBOS operation. These signs are shown in Figure 8-3.

Figure 8-10 Regulatory R131(CA), R132(CA), and R133(CA) Signs for Transit Bus on Shoulder Operation



R131(CA) **R132(CA)** **R133(CA)**

The "BUSES USING SHOULDER" warning sign (W130(CA)) may be placed along on-ramps to a freeway or expressway that intersect the TBOS corridor. This sign is shown in Figure 8-4.

Figure 8-11 'BUSES USING SHOULDER' Warning Sign – W130(CA)



Table 8-1 Summary of Signage Elements for Transit Bus on Shoulder Operation

Sign	Sign Code	Location
SHOULDER AUTHORIZED BUSES ONLY/EMERGENCY STOPPING ALLOWED	R130(CA) and R130P	Beginning of where TBOS operations are permitted, at every ½-mile interval, and at the end of the acceleration lane of an on-ramp merge
EMERGENCY STOPPING ONLY	R8-7	Used at Emergency Turn-Outs
BUSES ON SHOULDER BEGINS ½ MILE	R131(CA)	½-mile prior to beginning of TBOS operation
BUSES ON SHOULDER ENDS ½ MILE	R132(CA)	½-mile prior to end of TBOS operation
END BUSES ON SHOULDER	R133(CA)	End of TBOS operation
BUSES USING SHOULDER	W130(CA)	At on-ramp entering freeway or expressway where TBOS operations are permitted

Topic 2 Markings

Markings shall conform to the requirements of Chapter 3 of the *CA MUTCD*. Refer to *CA MUTCD* Section 3E.04 for Markings for Part-Time Travel on a Shoulder. Figure 3E-5 in the *CA MUTCD* illustrates the appropriate TBOS markings.

The six-inch-wide solid white or yellow edge lines typically used at the edge of traveled way for the general-purpose traffic must remain in place. An additional longitudinal six-inch-wide solid line shall be used on the outside of the shoulder. This line functions as an edge line for transit buses using the shoulder. The additional line shall be continuous even when the shoulder narrows or has a physical barrier beside it, such as a bridge rail. The additional line shall be the same color as the existing line for the edge of traveled way (white for TBOS located on the outside shoulder and yellow for TBOS on the inside shoulder). This additional shoulder stripe shall transition to the general-purpose edge of the traveled way line with a diagonal taper to indicate the end of permitted transit bus on shoulder operations and to mark the location of where the transit bus must merge into the adjacent general-purpose lane. The end of the shoulder striping shall occur where the END BUSES ON SHOULDER R133(CA) sign is located.

Striping for TBOS shoulders must use a single solid line, not a double solid line. This allows transit buses to enter the shoulder freely during operation and to return quickly to the general-purpose lanes if the shoulder is blocked. It will also reduce confusion over any access restrictions during those times when the buses are not permitted to use the shoulder. In some locations, solid double yellow lines may have been placed on the left edge of traveled way to emphasize prohibition against driving in the shoulder. These markings must be converted to single solid yellow lines.

A wide dotted lane line should be used at locations where the transit bus is to cross entrance and exit ramps. The wide dotted lane line shall be white for TBOS located on the right side of the freeway and yellow for TBOS on the left side of the freeway. For additional standards on lane markings, refer to Chapter 3 of the *CA MUTCD* for examples.

A "BUS ONLY" pavement marking shall be placed immediately downstream of the end of the gore of any off-ramp and at ¼-mile intervals on the shoulder. Diamond pavement marking symbols shall not be used. The pavement marking may optionally be placed on top of a red pavement marking background.

Section 9 Development and Approval of Transit Bus on Shoulder Projects

In addition to the policies and procedures outlined in this guidance, a TBOS project must follow established project planning and development procedures and policy, including all relevant environmental procedures, laws, and regulations. Note that Senate Bill 288 (Wiener, 2020) created an exemption for TBOS projects from California Environmental Quality Act review. The new statutory exemption took effect on January 1, 2021, and remains in effect through January 1, 2030. Projects will likely still require National Environmental Policy Act review.

Implementation of a TBOS project shall be coordinated by a steering committee, which will have the primary coordinating responsibility for project design and operation, including the application of the policies and procedures outlined in these guidelines. The steering committee should, at a minimum, include District Design, Traffic Operations and Safety, Maintenance, sponsoring agency representatives, and CHP. Other participants should include functional units potentially impacted by the project such as Environmental Analysis and Engineering Services. The Office of Mobility Programs in Headquarters Division of Traffic Operations, the appropriate Headquarters Project Delivery Coordinator, the Office of Multimodal System Planning in Headquarters Division of Transportation Planning, and FHWA (for projects on the Interstate system) should also be invited to participate in steering committee meetings.

Topic 1 Conceptual Approval Request

Project sponsors will need to contact their respective Caltrans district and nominate proposed TBOS pilot projects for conceptual approval. TBOS Conceptual Approval Requests are to be completed by the project sponsor and the district with the following information:

- TBOS Project Name.
- Nominating Local Agency and District.
- District-County-Route-Post Mile (Back)/ Post Mile (Ahead).
- Project Location (Limits), Description (Scope of Work), and Map.
- Project Summary.
    - Provide project summary of the proposed TBOS pilot project.
    - Summarize any stakeholder engagement to address local/regional transit systems improvements.
    - Summarize any travel and cost effectiveness of TBOS improvements.

The TBOS Conceptual Approval Request shall be signed by the Caltrans District Director as well as an authorized representative for the project sponsor. A copy of the signed request needs to be provided to Headquarters Division of Traffic Operations.

Topic 2 Transit Bus on Shoulder Project Review

Once the District Director has given conceptual approval for a pilot TBOS project, a comprehensive geometric and operational review of the corridor must be conducted by the steering committee. This involves a field and as-built review of the roadway elements along the proposed project, including lane and shoulder widths, interchange on- and off-ramp configuration and geometry, vertical clearance, horizontal clearance, bridges and other large structures, drainage structures, etc., to determine existing conditions. Additional analysis may include a review of structural design of bridges; structural section evaluation with data cores and R-value testing; need for turnouts for maintenance, enforcement, and emergencies; an examination of drainage impacts due to vehicle loading, ponding, and an increase in overall impervious surface area associated with any shoulder expansions; and any needs for right-of-way modifications, utility relocations, permits, etc.

Maintenance and operational reviews must also be conducted to examine the corridor for potential issues and opportunities that may emerge under TBOS operation. This includes a review of existing traffic volumes, speeds, and collision data; an examination of those locations that may require special attention under TBOS operation, including interchange and intersection areas and restricted shoulder width areas; and other factors as appropriate. It is recommended that a conceptual TBOS "operation map" be provided that illustrates how the bus will navigate all on- and off-ramps, termination points, and any other locations where the bus would be expected to exit and enter the shoulder. The potential for restriping mainline roadways in restricted shoulder width areas can be examined, along with the capacity, operational, and safety impacts of such a possible change. The review should also include the locations of existing signs and the need for additional signage and TMS elements.

A Traffic Engineering Performance Assessment (TEPA) resulting in a Traffic Operation Analysis Report (TOAR) will also be required. Upon completion of all field reviews and analyses for the proposed project, the steering committee shall compile a list of any required infrastructure improvements, pavement rehabilitation, drainage structure strengthening, relocations of existing signs or other roadside interferences as needed to avoid conflicts, guardrail adjustments, concrete barrier upgrades and reconstruction, any restriping, permits, etc. that would be required to implement TBOS. Review of the improvements by District functional units, the Office of Mobility Programs in Headquarters Traffic Operations, and the HQ Project Delivery Coordinator is necessary. Funding for these improvements will need to be addressed in a cooperative agreement with the project sponsor, which would include various stakeholders covering the roles and responsibilities during development and construction in addition to the funding. Refer to the Managed Lanes Guidelines for additional information on cooperative

agreements. Additional agreements will be necessary to address maintenance and operations. The steering committee shall also identify specific recommended start and end points for the various segments and identify any locations where the TBOS will not be implemented due to potential operational and safety impacts, inadequate shoulder width, insufficient horizontal or vertical clearance, or inadequate bridge or pavement structural strength. The Project Report (PR) shall also include a holistic benefit-cost analysis, where the benefit-cost ratio should at least include the expected safety performance, operational performance, and estimated capital costs.

Topic 3 Concept of Operations

The Concept of Operations document must be developed by the project sponsor with input from the steering committee and approved by the Caltrans district and the CHP. This document needs to be developed prior to beginning final design of the project. A Concept of Operations provides a high-level description of the system, how it will operate, roles and responsibilities, and describes the anticipated scenarios under which the system will be operated. The Concept of Operations for a TBOS project shall, at a minimum, describe the design and operational characteristics of the operation, enforcement, incident management, agency, and stakeholder coordination, and how performance of the TBOS will be measured and reported.

Topic 4 Transit Bus on Shoulder Project Approval

The final decision to implement the pilot TBOS project rests with the respective Caltrans district in coordination with CHP and Headquarters' Divisions of Design, Traffic Operations, and Road Safety. Prior to completion of the Project Approval phase, a Pilot Project Decision Document will need to be developed by the district and the project sponsor and submitted to the Commissioner of the CHP along with the Caltrans chiefs of Headquarters' Divisions of Design, Traffic Operations, and Road Safety for review and approval. This decision document shall describe the design and operational characteristics of the TBOS facility and operations; any deviations from Caltrans' design standards; agency and stakeholder coordination; and how performance of the TBOS operations will be measured and reported.

Section 10 Transit Bus on Shoulder Implementation and Evaluation

As a TBOS project is approved, designed, and eventually implemented, project sponsors will need to focus on communicating the details of the project to the public. Once the project is in operation, it will need to be monitored, and operations may need to be adjusted. Projects will also need to be evaluated to determine their effectiveness. Further details on these items are outlined below.

Topic 1 Public Outreach

A public outreach program aimed at informing motorists about the project and how it will operate must be developed and implemented prior to beginning TBOS operations. Each regional outreach campaign should be a cooperative effort of Caltrans, CHP, the regional transportation planning agency, and the participating transit agencies. While the specifics of each program will depend on the individual project, each outreach program should utilize multiple communication channels well in advance of the implementation as well as upon commencement of TBOS operations.

The public outreach efforts should cover, at a minimum, the following topics:

- A definition of TBOS.
- The limits of TBOS operations.
- The duration of the pilot project.
- TBOS operations – how transit buses will use the shoulder, hours of operation, signing, pavement markings, etc.

Figure 10-1 provides an example of a public outreach document developed by the Oregon Department of Transportation for a TBOS pilot in Portland.

Figure 10-12 Fact Sheet for Interstate 5 Bus on Shoulder Pilot Project in Oregon



Ride BUS ON SHOULDER SMART

Interstate 5

BUS ON SHOULDER

Pilot Project in Wilsonville

Overview

The Oregon Department of Transportation is collaborating with South Metro Area Regional Transit to support more reliable travel by using the highway shoulder for transit vehicles. This innovative concept is referred to as Bus on Shoulder.

The pilot project extends approximately two miles in both directions of I-5 between the I-205 interchange and Elligsen Road. Authorized buses may use the shoulder in clearly marked areas when traffic drops below 35 mph.

No other vehicles are authorized to use road shoulders to bypass traffic. Emergencies always take priority in use of the shoulder.

Who

SMART is the only authorized transit provider to use the shoulder for this pilot project. Their experienced and highly trained bus operators will undertake additional training to support safe and efficient travel in the corridor.

When

This pilot will launch in November 2021, following the completion of a paving project. The pilot will last for one year, followed by a two-year review and assessment period. After the pilot evaluation, ODOT will consider steps to make this Bus on Shoulder corridor permanent.

SMART 2X service will travel in the Bus on Shoulder pilot corridor.

Why

Bus on Shoulder is a low-cost multi-modal transportation solution used throughout the country with proven results including safe and cost-efficient means of addressing congestion.

ODOT's goals for this pilot are to create a more reliable transit commute and promote improved transit accessibility.

With less time on the road, vehicles will emit fewer emissions, helping support cleaner air in the community.

With small, but clear adjustments to road striping and other signage, Bus on Shoulder supports more efficient travel on Oregon's freeways without large infrastructure improvements that can take years to be realized. This Bus on Shoulder pilot project maximizes use of existing transportation infrastructure and planned highway maintenance, reducing the needed resources for implementation.

How

In the designated 2-mile stretch of highway, buses may merge onto the shoulder if and when the traffic drops below 35 mph. Buses may drive up to 15 miles per hour faster than the flow of traffic in the main lanes, up to a maximum speed of 35 mph.

Cars, trucks and other non-emergency vehicles must remain in the designated highway lanes, and are not permitted to use the shoulder unless it's an emergency, to avoid large highway debris, or to make room for a passing emergency vehicle.

Emergencies take priority over buses. Transit operators are required to yield the shoulder to all emergency vehicles and to merge back into the main traffic lanes. Bus operators encountering an emergency will report back to dispatch so that subsequent operators on those routes are made aware of the obstructions ahead of time.

Contact

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For ADA (Americans with Disabilities Act) or Civil Rights Title VI accommodations, translation/interpretation services, or more information call 503-731-4128,

TTY 800-735-2900 or Oregon Relay Service 7-1-1.

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tinyurl.com/i5busonshoulder

Oregon Department of Transportation

SMART WILSONVILLE, OREGON

Topic 2 Ongoing Monitoring and Review of Transit Bus on Shoulder Projects

Adjustments to operational, maintenance, enforcement, and public outreach strategies or policies will almost certainly be needed as the TBOS project moves from planning to implementation. During the implementation period, the steering committee shall continue to meet on at least a quarterly basis to share information, identify potential improvements, and cooperatively implement those improvements.

Caltrans and CHP reserve the right to terminate any TBOS pilot project that results in adverse impacts to safety or freeway operations, and for which no effective solution can be found.

Topic 3 Evaluation of Transit Bus on Shoulder Projects

The project sponsor shall be responsible for developing an evaluation plan to assess the performance of the TBOS project in a comprehensive performance report in collaboration with Caltrans and CHP. Below are some suggested measures of effectiveness for TBOS operations. The project sponsor may include other metrics as necessary or as requested by the steering committee.

Safety

- Number and type of collisions within the limits of TBOS operation, including any collisions that result in a fatality or serious injury.
- Number and types of collisions attributable to TBOS operations.
- Instances of Caltrans maintenance crews experiencing safety-related issues due to TBOS operation.
- Instances of CHP officers experiencing safety-related issues due to TBOS operations.
- TBOS impacts on incident response and management.
- Transit bus video footage of collisions or near-misses.

Freeway Operations

- Increase/decrease in freeway performance (speeds or volume) due to TBOS operations.
- Impacts of vehicle transitions to and from the shoulder (e.g., abrupt changes in speed or flow) on freeway traffic.
- Contribution of any nonstandard freeway features introduced by the TBOS to noticeable disturbances (abrupt changes in speed or flow) in freeway traffic.
- Increased work efforts and disruptions to maintenance efforts due to TBOS operations.
- Changes in CHP enforcement patterns and rates.
- Instances of use of shoulder by unauthorized vehicles during TBOS operations and outside of TBOS operations.

Transit Operations

- Locations where shoulders were used for TBOS operations and frequency of use.
- Measurable and repeatable time savings and enhanced trip reliability.
- Transit Operators' perceptions of safety during TBOS operations.

- Transit riders' perception of travel time, trip reliability, and safety.
- Instances of transit buses exiting the shoulder due to obstructions.
- Number of transit bus breakdowns during TBOS operations.

The project sponsor, in collaboration with the steering committee, shall prepare and submit an annual monitoring report summarizing Transit Bus on Shoulder (TBOS) operations, including operational data, safety performance, travel time and reliability impacts, enforcement issues, identified challenges, and any recommendations for continued operation or program improvements. The annual report shall be provided to the steering committee. At the end of the pilot period, the project sponsor, in collaboration with the steering committee, shall provide a final summary report with the findings from the TBOS pilot program and provide recommendations regarding safety, operations, shoulder pavement condition, and other issues relevant to the TBOS pilot to the steering committee. As noted in Section 4, the findings from the individual TBOS pilot projects will be used to determine whether to permanently permit TBOS programs (and if there is a need for legislative authority for permanent TBOS operations), or to discontinue them. If a decision is made to permit permanent TBOSs, all related Caltrans standards and policies will need to be evaluated and documented following appropriate procedures.

At the end of the pilot period, signs and pavement markings shall be removed along the freeway facility where the TBOS operated in accordance with the Maintenance Agreement.