

## CHAPTER 4B. TRAFFIC CONTROL SIGNALS—GENERAL

### Section 4B.01 General

Support:

01 Words such as pedestrians and bicyclists are used redundantly in selected Sections of Part 4 to encourage sensitivity to these elements of “traffic.”

02 Standards for traffic control signals are important because traffic control signals need to attract the attention of a variety of road users, including those who are older, those with impaired vision, as well as those who are fatigued or distracted, or who are not expecting to encounter a signal at a particular location.

### Section 4B.02 Basis of Installation or Removal of Traffic Control Signals

Guidance:

01 *The selection and use of traffic control signals should be based on an engineering study of roadway, traffic, and other conditions.*

Support:

02 A careful analysis of traffic operations, pedestrian and bicyclist needs, and other factors at a large number of signalized and unsignalized locations, coupled with engineering judgment, has provided a series of signal warrants, described in Chapter 4C, that define the minimum conditions under which installing traffic control signals might be justified.

Guidance:

03 *Engineering judgment should be applied in the review of operating traffic control signals to determine whether the type of installation and the timing program meet the current requirements of all forms of traffic.*

04 *If changes in traffic patterns eliminate the need for a traffic control signal, consideration should be given to removing it and replacing it with appropriate alternative traffic control devices, if any are needed.*

05 *If the engineering study indicates that the traffic control signal is no longer justified, and a decision is made to remove the signal, removal should be accomplished using the following steps:*

A. *Determine the appropriate traffic control to be used after removal of the signal.*

B. *Remove any sight-distance restrictions as necessary.*

C. *Inform the public of the removal study.*

D. *Flash or cover the signal heads for a minimum of 90 days, and install the appropriate stop control or other traffic control devices.*

E. *Remove the signal if the engineering data collected during the removal study period confirms that the signal is no longer needed.*

Option:

06 Because Items C, D, and E in Paragraph 5 are not relevant when a temporary traffic control signal (see Section 4D.32) is removed, a temporary traffic control signal may be removed immediately after Items A and B are completed.

07 Instead of total removal of a traffic control signal, the poles, controller cabinet, and cables may remain in place after removal of the signal heads for continued analysis.

**Standard:**

08 **Once a traffic signal at an intersection or pedestrian crossing has been energized, it shall not be turned off unless arrangements have been made for temporary control by traffic officers, temporary stop signs or an approved temporary signal.**

### Section 4B.03 Advantages and Disadvantages of Traffic Control Signals

Support:

01 When properly used, traffic control signals are valuable devices for the control of vehicular and pedestrian traffic. They assign the right-of-way to the various traffic movements and thereby profoundly influence traffic flow.

02 Traffic control signals that are properly designed, located, operated, and maintained will have one or more of the following advantages:

- A. They provide for the orderly movement of traffic.
  - B. They increase the traffic-handling capacity of the intersection if:
    - 1. Proper physical layouts and control measures are used, and
    - 2. The signal operational parameters are reviewed and updated (if needed) on a regular basis (as engineering judgment determines that significant traffic flow and/or land use changes have occurred) to maximize the ability of the traffic control signal to satisfy current traffic demands.
  - C. They reduce the frequency and severity of certain types of crashes, especially right-angle collisions.
  - D. They are coordinated to provide for continuous or nearly continuous movement of traffic at a definite speed along a given route under favorable conditions.
  - E. They are used to interrupt heavy traffic at intervals to permit other traffic, vehicular or pedestrian, to cross.
- <sup>03</sup> Traffic control signals are often considered a panacea for all traffic problems at intersections. This belief has led to traffic control signals being installed at many locations where they are not needed, adversely affecting the safety and efficiency of vehicular, bicycle, and pedestrian traffic.
- <sup>04</sup> Traffic control signals, even when justified by traffic and roadway conditions, can be ill-designed, ineffectively placed, improperly operated, or poorly maintained. Improper or unjustified traffic control signals can result in one or more of the following disadvantages:
- A. Excessive delay,
  - B. Excessive disobedience of the signal indications,
  - C. Increased use of less adequate routes as road users attempt to avoid the traffic control signals, and
  - D. Significant increases in the frequency of collisions (especially rear-end collisions).

#### **Section 4B.04 Alternatives to Traffic Control Signals**

*Guidance:*

<sup>01</sup> *Since vehicular delay and the frequency of some types of crashes are sometimes greater under traffic signal control than under STOP sign control, consideration should be given to providing alternatives to traffic control signals even if one or more of the signal warrants has been satisfied.*

*Option:*

- <sup>02</sup> These alternatives may include, but are not limited to, the following:
- A. Installing signs along the major street to warn road users approaching the intersection;
  - B. Relocating the stop line(s) and making other changes to improve the sight distance at the intersection;
  - C. Installing measures designed to reduce speeds on the approaches;
  - D. Installing a flashing beacon at the intersection to supplement STOP sign control;
  - E. Installing flashing beacons on warning signs in advance of a STOP sign controlled intersection on major and/ or minor-street approaches;
  - F. Adding one or more lanes on a minor-street approach to reduce the number of vehicles per lane on the approach;
  - G. Revising the geometrics at the intersection to channelize vehicular movements and reduce the time required for a vehicle to complete a movement, which could also assist pedestrians;
  - H. Revising the geometrics at the intersection to add pedestrian median refuge islands and/or curb extensions;
  - I. Installing roadway lighting if a disproportionate number of crashes occur at night;
  - J. Restricting one or more turning movements, perhaps on a time-of-day basis, if alternate routes are available;
  - K. If the warrant is satisfied, installing multi-way STOP sign control;
  - L. Installing a pedestrian hybrid beacon (see Chapter 4F) or In-Roadway Warning Lights (see Chapter 4N) if pedestrian safety is the major concern;
  - M. Installing a roundabout; and
  - N. Employing other alternatives, depending on conditions at the intersection.

#### **Section 4B.05 Adequate Roadway Capacity**

*Support:*

<sup>01</sup> The delays inherent in the alternating assignment of right-of-way at intersections controlled by traffic control signals can frequently be reduced by widening the major roadway, the minor roadway, or both roadways. Widening the minor roadway often benefits the operations on the major roadway, because it reduces the green

time that must be assigned to minor-roadway traffic. In urban areas, the effect of widening can be achieved by eliminating parking on intersection approaches. It is desirable to have at least two lanes for moving traffic on each approach to a signalized location. Additional width on the departure side of the intersection, as well as on the approach side, will sometimes be needed to clear traffic through the intersection effectively.

**Guidance:**

*02 Adequate roadway capacity should be provided at a signalized location. Before an intersection is widened, the additional green time pedestrians need to cross the widened roadways should be considered to determine if it will exceed the green time saved through improved vehicular flow.*

*03 Other methods of increasing the roadway capacity at signalized locations that do not involve roadway widening, such as revisions to the pavement markings and the careful evaluation of proper lane-use assignments (including varying the lane use by time of day), should be considered where appropriate. Such consideration should include evaluation of any impacts that changes to pavement markings and lane assignments will have on bicycle travel.*

### **Section 4B.101(CA) Traffic Signal Development Procedures – Introduction**

**Support:**

*01 General requirements for the development of traffic signal, lighting and electrical systems projects are noted in Caltrans' Project Development Procedures Manual. See Section 1A.11 for information regarding this publication. The cost of traffic signals on Federal Aid highway projects is eligible for federal participation under certain conditions.*

**Option:**

*02 The preparation of a Project Study Report may be required for major traffic signal, lighting and/or electrical system projects for scoping and programming purposes.*

**Guidance:**

*03 Caltrans' Project Development Procedures Manual and the appropriate Program Advisor should be consulted to determine specific reporting requirements.*

### **Section 4B.102(CA) Project Report**

**Standard:**

**01 The Caltrans' District shall prepare a project report of the investigation of conditions at locations where a new traffic signal is to be installed, an existing traffic signal is to be modified or an existing traffic signal is to be removed on the State highway. Caltrans District Directors are authorized to approve project reports in accordance with the current departmental policies contained in the Project Development Procedures Manual. Three copies of the District-approved project report shall be forwarded to Caltrans' Chief, State and Local Project Development. A project report shall be prepared whether the work is performed by the State or by others, if the traffic signal is located on the State highway.**

**Guidance:**

*02 General requirements for project reports are noted in Caltrans' Project Development Procedures Manual. A project report for the installation, modification (except for upgrading projects involving specific equipment) or removal of a traffic signal should include the following specific information:*

**1. Traffic Counts.**

- a) Both pedestrian and vehicular traffic counts should include the periods of the average day when the signals would appear to be needed most. The counts should be at least eight hours in duration, not necessarily consecutive, but including a.m. and p.m. peak hours.*
- b) Traffic counts for a new signal shall be shown on appropriate Traffic Signal Warrant Sheets and a Directional Traffic Count Sheet. See Figures 4C-101(CA) thru 4C-103(CA).*
- c) Where pedestrian volumes are significant, show the volume on each crosswalk for the same periods as the vehicle count.*
- d) When estimated traffic volumes are used in establishing traffic signal warrants, they should be prepared on Form TS-10D. See Figure 4C-103(CA).*

**2. Collision Diagram.**

*A collision diagram for the intersection covering the recent collision experience history. The diagram should cover a 3-year interval.*

3. *Condition Diagram.*  
*A condition diagram showing existing roadway conditions. Any railroad grade crossing within 200 feet of the intersection should be shown.*
4. *Improvement Diagram.*  
*A diagram showing existing and proposed signals, phasing, channelization and other proposed improvements. This may be combined with 1, 2 and/or 3 on a single plan.*
5. *Estimate.*  
*An estimate of the cost of the project (including State furnished materials) and the proposed method of financing.*
6. *Other Specialized Data When Appropriate:*
  - a. *Classification of Vehicles.* *The classification is required when it is a significant factor in affecting intersection capacity.*
  - b. *Critical Speed (85th percentile) of Approaching Vehicles.* *This is the speed at a point unaffected by existing controls.*
  - c. *Time-Space Diagram.* *When the project involves a coordinated traffic signal system.*

### **Section 4B.103(CA) Submittals**

**Support:**

<sup>01</sup> General requirements for the submittal of plans, specifications and estimates are noted in the Caltrans' Project Development Procedures Manual and the Ready to List and Construction Contract Award Guide. See Section 1A.11 for information regarding these publications.

**Standard:**

- <sup>02</sup> **All electrical plans shall bear the following: "Note: This plan accurate for electrical work only."**

### **Section 4B.104(CA) Financing**

**Guidance:**

<sup>01</sup> *Unless previously budgeted, the financing of a project should be considered only after receipt of the PS&E Report and cooperative agreements.*

**Support:**

<sup>02</sup> Normally, the costs of a new traffic signal or the modification of a signal or signal system are to be shared with a local agency.

**Option:**

<sup>03</sup> In situations where a new traffic signal or a modification to an existing traffic signal or traffic signal system is urgently needed to improve safety or traffic flow on the State highway and the local agencies are unable to finance their prorated share of the cost, the State may accept a lesser participation, or even no participation, by the local authorities.

**Standard:**

- <sup>04</sup> **The definition of "urgently needed" shall be made by the Caltrans District Director.**
- <sup>05</sup> **The cost of small projects such as modifications to existing traffic signals (detectors, signal heads, mast arms, etc.) where the prorated share of the local agency is \$3,000 or less, shall be at 100% State expense.**

### **Section 4B.105(CA) Design Cost**

**Standard:**

<sup>01</sup> **The following criteria shall apply in determining the amount of participation in the design cost by the State and a local agency:**

- A. Where the State prepares plans for the installation or modification of a traffic signal or a traffic signal system on a State highway, the design costs should be shared with the local agency. Where the local agency is to prepare the plans, the State may participate in the design costs. Participation should be the same as construction cost participation and be covered by a cooperative agreement.**

**Guidance:**

- B. Estimated design costs should be determined on the basis of an agreed fixed percentage of the total project costs. The fixed percentage should be based on historical design costs for projects in the price range concerned.**

**Standard:**

- C. Where the State is requested by a local agency to prepare plans and specifications for a traffic signal project that does not involve State participation in the construction costs, the design costs shall be borne entirely by the local agency or others. The State may, however, assume the design engineering costs and the construction engineering costs, where the local agency agrees to pay all of the construction costs for a warranted project and where all of the costs would normally be shared on a prorated basis.**

**Section 4B.106(CA) Construction Costs - Conventional Highways**

**Standard:**

- 01 The following criteria shall apply in determining the amount of the construction costs by the State and local agency for a traffic signal, safety lighting, and channelization or widening project on conventional State highways.**
- 02 Channelization and/or Widening Costs. On cooperatively financed projects, the channelization and/or widening costs shall be shared as follows:**
  - A. Channelization on and/or widening of the State highway shall be at 100% State expense.**
  - B. Channelization on and/or widening of the local street shall be at 100% local agency expense.**
  - C. Where the local agency's portion of the channelization or widening is a minor part of the channelization or widening being constructed by the State and the local agency's share of the work amounts to \$3,000, or less, the State may assume the entire cost of the channelization or widening.**
- 03 Channelization and/or widening required, as a part of the conditions of a permit by a private party shall be at 100% expense of the private party.**
- 04 In Cases A, B, and D listed below, the costs of constructing the electrical facilities are to be shared by the State and local agencies. The costs shall be shared on a prorated basis in the same ratio as the number of legs in the intersection under each agency's jurisdiction bears to the total number of legs.**
  - Case A. Installation or Modification of a Traffic Signal and/or Safety Lighting at an Existing Intersection. When a traffic signal and/or safety lighting is to be installed or modified at the intersection of a State highway and a local road, local agency participation in the installation or modification costs shall be sought.**

*Guidance:*

- Case B. Existing Driveways at Existing Signalized Intersections. A private driveway that constitutes a leg at an existing signalized intersection should be treated as follows:*
  - 1. If the driveway does not generate appreciable traffic, no control is required.*
  - 2. If the driveway serves an area that generates sufficient traffic to constitute a problem, it should be controlled. One example of control is the use of a red flashing beacon and/or a Right Turn ONLY (R3-5R) sign to control egress from the private driveway. Another would be to provide signal indications for the private driveway.*

**Standard:**

- 3. Costs shall be as in Case D.**
- Case C. A New Road or Driveway at an Existing Signalized Intersection. Where a new road or driveway is to be constructed to enter an existing "T" intersection, the cost of necessary right-of-way, traffic signal and/or safety lighting shall be at 100% local agency or permittee expense. The cost shall include the signal faces and detectors for the new approach and signal faces and detectors for left turns into the new approach and channelization, if necessary.**
- Case D. Installation of a Traffic Signal and/or Safety Lighting at an existing intersection with a Driveway. Where a traffic signal and/or safety lighting is to be installed at an existing intersection serving an area which generates sufficient traffic to constitute a problem that includes a private driveway as the fourth approach, the cost of signal and lighting equipment for the driveway approach shall be included in the cost of the entire installation.**
  - Where one or more legs of the intersection are under the jurisdiction of a local agency, the construction costs shall be shared with the local agency. The cost of the driveway leg shall be included with the local agency's share. It shall be the responsibility of the local agency to obtain the right-of-way, right-of-entry or easement necessary to install and maintain the signal equipment to be located on private property.**
- Case E. Reconstruction of a Conventional State Highway. When it is necessary to widen or reconstruct a State highway, the reconstruction and relocation of traffic control devices and safety lighting systems, shall be at 100% State expense. Local participation for purposes of expediting a project should be accepted. Additional**

**traffic control devices installed in connection with reconstruction of a conventional highway are to be treated as in Case A.**

**Case F. Relocation of a Conventional State Highway.** When an existing State highway is relocated, the State will install warranted traffic control devices and safety lighting at State expense. Local participation will not be required. If, however, a local authority wishes to participate in a project in order to expedite it, local participation should be accepted.

**Case G. Installation of a Traffic Signal and/or Safety Lighting at a Private Driveway or Privately Owned Street.** The cost of a new traffic signal and/or safety lighting installed at a private driveway or privately owned street (i.e., not under the jurisdiction of a city or county) shall be entirely at the expense of the property owner or developer.

The permittee shall grant the State access rights to the private property at any time for the purpose of maintaining or timing the signal and lighting.

Upon installation, all rights, title and interest in the traffic signal equipment shall be granted to the State by the permittee. In the event that the State finds it advisable for the signals to be removed, the State will remove and salvage the equipment.

**Case H. Reconstruction of Existing Facilities.** When affected by State highway construction, existing roadway lighting, police and fire alarm systems, and similar systems owned by a city, county or publicly owned service district shall be relocated at the sole expense of the owner, unless prior rights can be established.

**Case I. School Traffic Signals and Flashing Beacons.** Where traffic signals and/or flashing beacons are justified only by the School Area Traffic Signal Warrant on a State highway, the installation shall be at 100% State expense. When any other warrant is met also, the cost is shared in the usual manner.

#### **Section 4B.107(CA) Construction Costs – Freeways**

##### **Standard:**

**01 The installation of electrical work and channelization at an intersection of a freeway ramp and a local road shall be at 100% State expense if such improvements are warranted at the time the freeway is to be opened to traffic, or if they are estimated to be warranted within five years after the date the freeway is opened to traffic.**

##### **Support:**

**02 It can be difficult to accurately predict the traffic pattern at interchanges at the time of the freeway design. Therefore, the need for signals at the ramp connections to local roads cannot always be anticipated.**

##### **Standard:**

**03 If within five years after the date of completion of the freeway, the interchange does not operate in the manner intended, and signal warrants are met, it shall be the policy to provide signals, lighting, channelization or roadway widening as necessary to facilitate the flow of traffic through the interchange. This work shall be done entirely at State expense in the same manner as it would have been done had it been planned in the original freeway project. This shall include widening of roadway approaches to proposed signalized ramp intersections in accordance with present design practice entirely at State expense.**

**04 After the five-year period, the cost of installation shall be financed in the same manner as for existing intersections.**

##### **Guidance:**

**05 Approval by local agencies should be obtained for changes to roads under their jurisdiction.**

##### **Option:**

**06 In lieu of treating each ramp intersection individually and sharing the costs on the basis of the number of legs under each jurisdiction, the concept of the overall facility as described in Caltrans' Maintenance Manual may be used. See Section 1A.11 for information regarding this publication.**

##### **Standard:**

**07 Frontage roads or portions of frontage roads, which serve as connections between ramps to or from the freeway and existing public roads and which are retained under State jurisdiction, shall be considered as freeway ramps and electrical work at the intersections shall be financed as described above.**

**08 Any time the interchange is revised by adding or relocating ramps, it is considered a new interchange and the cost of signals at the ramp terminals and/or the connection to the local road shall be at 100% State expense.**

### **Section 4B.108(CA) Roadway Improvements by Local Agencies**

**Standard:**

**01 Any new connection of a local street to a State highway, including any electrical work, widening and/or channelization required within the State highway right of way, shall be at 100% local agency expense.**

**02 At existing intersections any relocation or improvement of electrical facilities due to widening and/or channelization of the local street shall be at 100% local agency expense.**

### **Section 4B.109(CA) Cooperative Agreements**

**Support:**

**01 When a local agency participates in the various project costs, a cooperative agreement is required.**

**Standard:**

**02 Each agreement shall include a statement of ownership, maintenance and operation.**

**Support:**

**03 Pre-approved agreement forms and procedure details are available.**

### **Section 4B.110(CA) Engineering Services for Local Agencies**

**Standard:**

**01 Contracts with local agencies for the State to provide traffic signal control system engineering services shall include a clause relating to "Legal Relationships and Responsibilities".**

**Support:**

**02 Pre-approved wording is available.**

### **Section 4B.111(CA) Salvaged Electrical Equipment**

**Support:**

**01 A construction project sometimes includes the removal of traffic signal, lighting or other electrical equipment that is not to be reused on the particular project.**

**Guidance:**

**02 *The determination as to whether particular electrical equipment is salvable should be made at the Caltrans District level. The determination as to whether or not to salvage existing equipment should be made on the basis of the economic benefit to the State and on the conservation of energy and/or materials that would result from salvaging and/or reinstallation. Equipment should be salvaged if it falls within one of the following categories:***

- A. *It is an item for which there is a foreseeable use.***
- B. *It is part of an electrical installation owned jointly with another agency and the other agency has requested the salvaged equipment.***
- C. *It is usable in some other Caltrans District.***
- D. *It can be immediately disposed of by other means.***

**Standard:**

**03 All electrical equipment removed and determined not to be salvable shall become the property of the contractor.**

**04 Equipment determined to be salvable shall be disposed of as follows:**

- A. If the electrical installation is jointly owned by the State and one or more local agencies, each of the owners shall share in the salvage value. The local agencies shall be given first choice in obtaining the salvaged equipment. The agency obtaining the salvaged equipment shall reimburse the other agency in accordance with the proportionate ownership.**
- B. Where the State or local agency is replacing existing electrical equipment without the other agency participating in the cost of the new equipment, the salvaged equipment shall belong to the party or parties who bore the cost of the new equipment unless otherwise specified in an agreement or encroachment permit.**

**05 The salvage value shall be determined at the Caltrans District level during preparation of the preliminary report.**

**Guidance:**

**06 *The salvage value should be such that if the equipment were taken into State storage it could be used economically for maintenance or as State-furnished material on contracts. The estimated salvage value should make the equipment more attractive to local agencies than the money representing the other partner's share of the salvage value. Wire and wiring***

*supplies such as conduit, junction boxes, and connectors, and other materials should be considered as a lot at no value, or in any case, not more than the nominal sum of \$1.*

Support:

*07 Often, salvaged electrical equipment is available for use on new installations; in many cases this will result in considerable savings.*

#### **Section 4B.112(CA) Encroachment Permits**

**Standard:**

**01 Encroachment permits shall be required for a local agency or a private party to install or modify traffic signals and roadway lighting on a State highway.**

*Guidance:*

*02 Plans and Specifications prepared by Permittees should conform to State Standard Specifications, Standard Plans and be submitted to the Caltrans District for review and approval.*

**Standard:**

**03 In each case, a statement of ownership, maintenance and operation shall be included in the permit.**

Support:

*04 A Permit Engineering Evaluation Report (PEER) may be prepared in lieu of a project report for all projects estimated to cost \$1,000,000 or less, as part of the encroachment permit review process. Instructions for PEER's are found in Caltrans' Project Development Procedures Manual and the Encroachment Permits Manual. See Section 1A.11 for information regarding these publications.*

**Standard:**

**05 All projects financed, in whole or in part, from retail transactions and use taxes and projects costing more than \$1,000,000 requires a cooperative agreement.**

#### **Section 4B.113(CA) Modifications of Existing Signals**

*Guidance:*

*01 Where existing signals are to be modified, construction plans should include a separate plan of the existing system as well as a plan showing the modifications.*

Option:

*02 It may also be necessary to include a tabulation on the plan showing such appurtenances as backplates and special signal faces that may be difficult to discern on a complicated plan.*

*Guidance:*

*03 The design of any signal modification project should include adequate consideration for keeping the existing signals in operation while the modification work is being done.*

#### **Section 4B.114(CA) Signals on Poles Owned by Others**

Option:

*01 Traffic signal equipment may be attached to poles owned by utility companies or other agencies when it is desired to keep the number of poles at an intersection to a minimum.*

*Guidance:*

*02 In such cases, the Agency should enter into an agreement with the owner of the pole. The agreement should be written to hold the owner of the pole free of liability relative to operation of the traffic signal or damage to the pole and to make the State or Local Transportation Agency responsible for moving the equipment in the event the pole is removed or relocated.*