Chapter 13
RAMP METERS

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13 RAMP METERS

This chapter discusses only ramp meter specific design information. Other general information that also may also pertain to ramp meters (e.g. signal wiring, detection, etc.) can be found in the previous chapters of this manual.

Installation of a new ramp meter or modification of an existing ramp meter requires Region Traffic Engineer Operational Approval as per chapter 3.

13.1 Ramp Meter Operation

Ramp meters are used to control the frequency of traffic entering a highway facility. By controlling the rate of vehicles entering the highway, the traffic flow on the highway facility becomes more consistent and allows for more efficient use of existing highway capacity. They are programmed to release one vehicle at a time. Just prior to activating, the ramp meter indications will flash yellow (from the yellow indication of the Type 2 signal head) for a short, predetermined amount of time to warn traffic that the ramp meter is starting up. The ramp meter will then display a solid yellow interval followed by an all red interval prior to the start of the normal red-green alternating ramp meter cycle.

For ramp meters that control two or more lanes of traffic, each indication for each lane must operate on a separate phase to properly alternate the red-green phase between each lane.

Ramp meters remain dark when not in use.

13.1.1 Location of the Ramp Meter Stop Line

The location of the ramp meter stop line is determined by engineering judgment. Each ramp alignment is unique and the site specifics play a major role in determining the most appropriate location. The basic goal is to place the stop line far enough down the ramp to provide reasonable storage of vehicles but not so near the highway that acceleration and merging onto the highway becomes a problem. Some things to consider determining the most appropriate location:

- Design Hour Queue Length: The operational analysis and RTE Operational Approval will determine the required length for storage.
- Ramp alignment length (from ramp entrance to the painted gore point): the ramp alignment length should accommodate the design hour queue length if possible.
- Number of lanes controlled by the ramp meter: The number of lanes needed will be addressed in the operation analysis and RTE Operational approval. This will directly affect the required queue length. Single and dual lane ramp meters are common.
- The vertical grade: A downhill vertical grade will allow the stop line to be placed closer to the highway, while an uphill vertical grade will require additional space between the stop line and the merge point.

- The length of acceleration lane (from painted gore point to the downstream acceleration lane taper point): A standard length acceleration lane will allow the stop line to be placed closer to the highway, while a substandard length acceleration lane may require additional space between the stop line and the merge point.
- Sight distance from stop line to the highway: The location where vehicles stop should have adequate sight distance to the highway to help facilitate a safe and efficient merge.
- Percentage of truck traffic using the ramp: Trucks require more distance to come up to speed and may require additional space between the stop line and the merge point.

Work with Region Traffic and the roadway designer when determining the appropriate location.

13.2 Ramp Meter Signal Indication Mounting

There are two choices for mounting ramp meter signal indications; vehicle pedestal and overhead (mast arm). The vehicle pedestal mount is typically used unless there is a specific reason that requires an overhead mount, such as:

- The ramp meter will control <u>more</u> than 2 lanes of traffic. See Figure 13-1 for an example.

- The ramp meter will control 2 lanes of traffic with the stop line located beyond the physical gore point of ramp. See Figure 13-2 for an example.

- Physical constraints prevent proper location of pedestal(s), such as: retaining walls, bridges, barrier, sound walls, etc.). See Figure 13-3 for an example.

Figure 13-1 |Ramp Meter Controls More Than 2 lanes of Traffic – Requires Overhead Mount

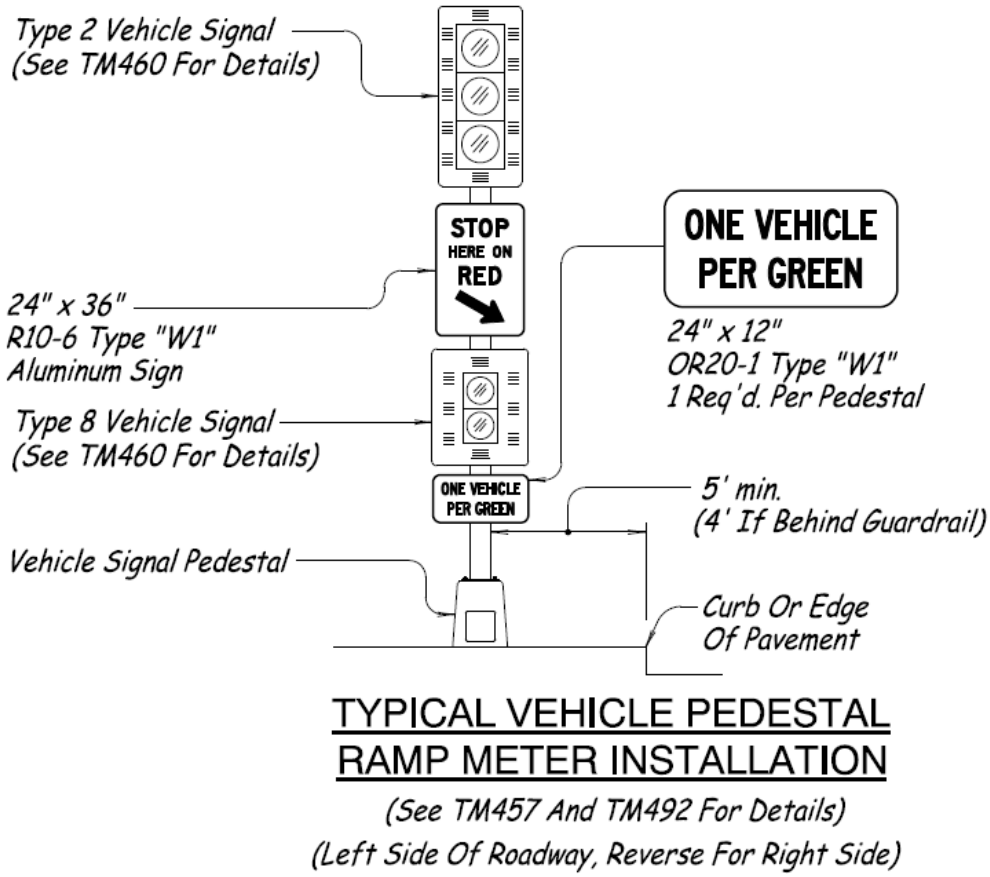
Figure 13-2 |Ramp Meter Controls 2 lanes of Traffic with Stop Line Located Beyond Physical Gore Point – Requires Overhead Mount

Figure 13-3 | Physical Constraints (Barrier on Left Hand Side) - Requires Overhead Mount

13.2.1 Pedestal Mounted Assembly

The ramp meter indications mounted on a vehicle pedestal includes the following four components as per standard drawing TM492 (listed from top to bottom of pedestal): A Type 2 vehicle signal head, a “STOP HERE ON RED” aluminum sign, a Type 8 vehicle signal head, and a “ONE VEHICLE PER GREEN” aluminum sign. See Figure 13-4.

Figure 13-4 | Ramp Meter Pedestal Mounted Assembly (Std. Dwg. TM497)



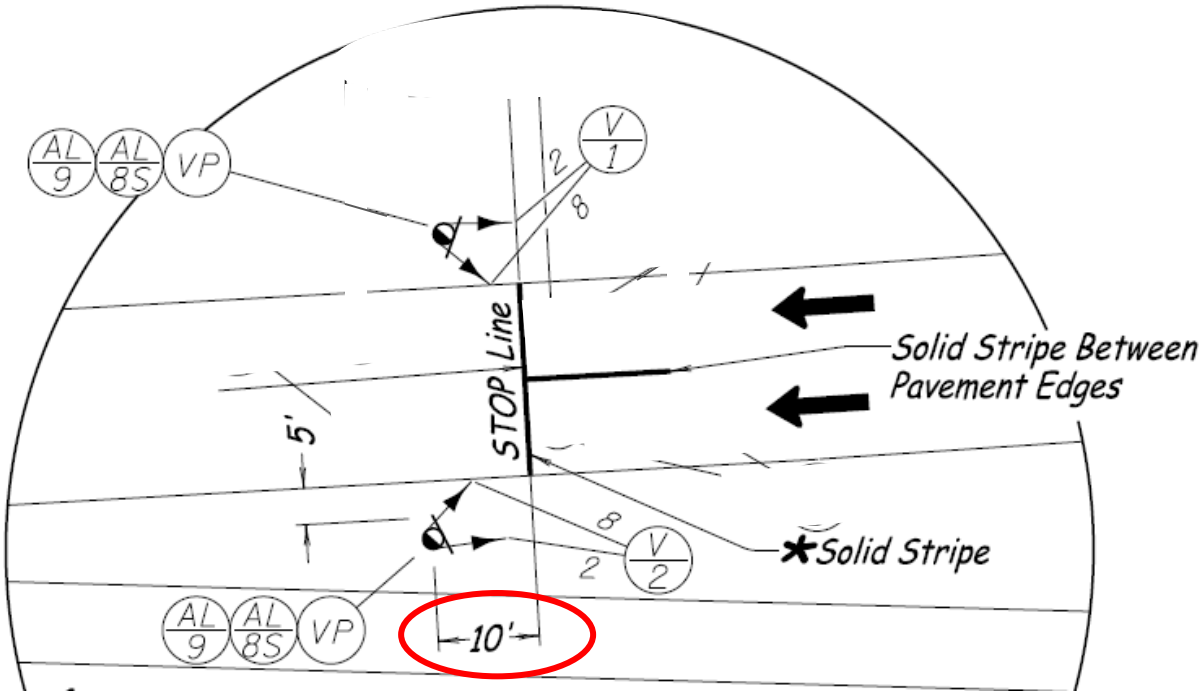
For a ramp meter that will control a single lane of traffic, this pedestal assembly is required only on the right-hand side for a ramp. See Figure 13-5. For a ramp meter that will control two lanes of traffic, this pedestal assembly is required on both the sides of the ramp. See Figure 13-6.

Figure 13-5 |Ramp Meter Pedestal Mounted Assembly Example – Controlling a Single Lane of Traffic

Figure 13-6 |Ramp Meter Pedestal Mounted Assembly Example – Controlling Two Lanes of Traffic

The pedestal mounted assembly is placed 10 feet from the stop line location.

Figure 13-7 | Location of Pedestal Mounted Assembly from the Stop Line



13.2.2 Overhead Mounted (Mast Arm)

Overhead mounted ramp meter signals require a Type 2 vehicle signal head and an aluminum "ONE VEHICLE PER GREEN" sign for each lane that is controlled by the ramp meter. The "ONE VEHICLE PER GREEN" sign used overhead is 24"x30". Type 8 heads are NOT used when indications are mounted overhead. The overhead signal indications are located 55 feet from the stop line. Two aluminum "STOP HERE ON RED" signs are located at the stop line, one on each side of the ramp. See Figure 13-8 and Figure 13-9 for an example.

Figure 13-8 | Overhead Mounted Details

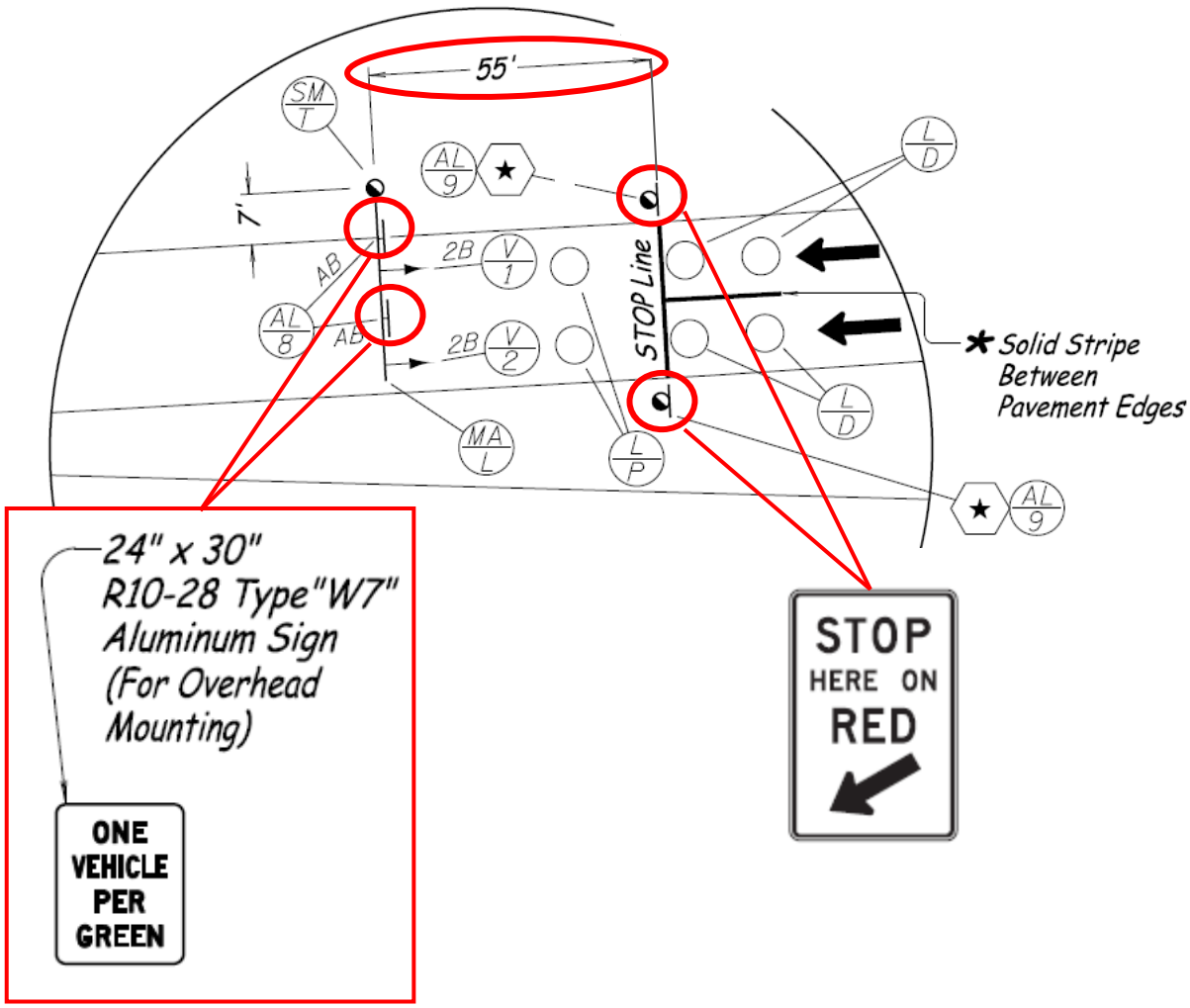
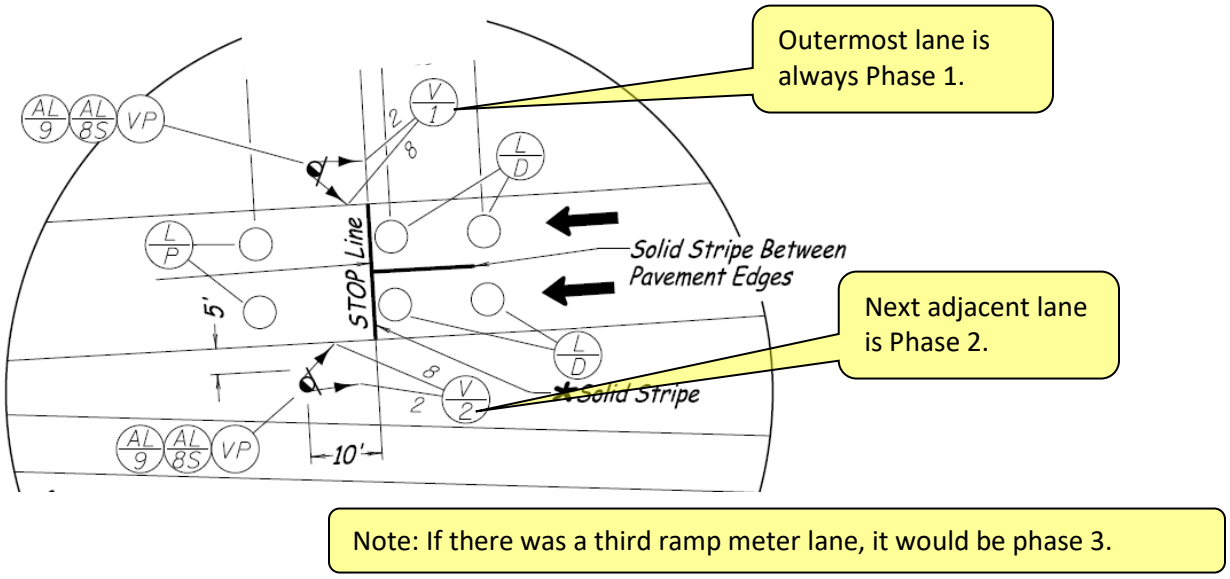


Figure 13-9 | Overhead Mounting Example

13.2.3 Ramp Meter Phasing

Each lane controlled by the ramp meter will be assigned a unique phase, starting with phase 1. When two (or more) lanes are controlled by the ramp meter, Phase 1 is always the outermost lane of the ramp, which each adjacent lane towards the highway being assigned the next consecutive phase. See Figure 13-10.

Figure 13-10 | Ramp Meter Phasing



13.3 Ramp Meter Signs

The standard layout for ramp meter signing is shown below. Starting at the ramp terminal and going forward toward the painted gore point, the following signs should be used (See Figure 13-11 thru Figure 13-13):

- "RAMP METERED WHEN FLASHING" aluminum sign with flashing yellow beacon: This sign is required for all ramp meter installations. It is located at the entrance to the ramp and it must be visible to each legal move that enters the ramp. This may require more than one sign depending on the ramp terminal geometry. This sign is intended to provide warning before the motorist commits to entering the ramp, allowing the motorist to seek an alternate route if desired.

  This sign is mounted on a pedestrian pedestal as per standard drawing TM492. It is detailed on the Ramp Meter plan sheet and paid for under the Ramp Meter lump sum bid item.

- "BE PREPARED TO STOP" aluminum sign with flashing yellow beacon and "WHEN FLASHING" rider: This sign is required if there is not adequate sight distance to the ramp meter signal indications. The need for this sign will be documented in the RTE operational approval. It is located upstream from the anticipated queue length. Two signs (one on each side of the ramp) required.

  This sign is mounted on a pedestrian pedestal. It is detailed on the Ramp Meter plan sheet and paid for under the Ramp Meter lump sum bid item.

- "FORM 2 LANES WHEN METERED" aluminum sign: This sign is required only for single lane ramps with ramp meters that control two lanes of traffic. It is located upstream from the anticipated queue length. Two signs (one on each side of the ramp) required.

  This sign is mounted on an appropriate standard sign support (i.e. wood post or square tube sign support). It is detailed on the Signing plan sheet (NOT on the Ramp Meter plan sheet) and is measured and paid for under the applicable sign and post bid items.

- "STOP HERE ON RED" aluminum sign: This sign is required at the stop line. If the ramp meter only controls one lane of traffic, only one of these signs on the right side of the ramp is required. For all other applications, two of signs are required, one on each side of the ramp.

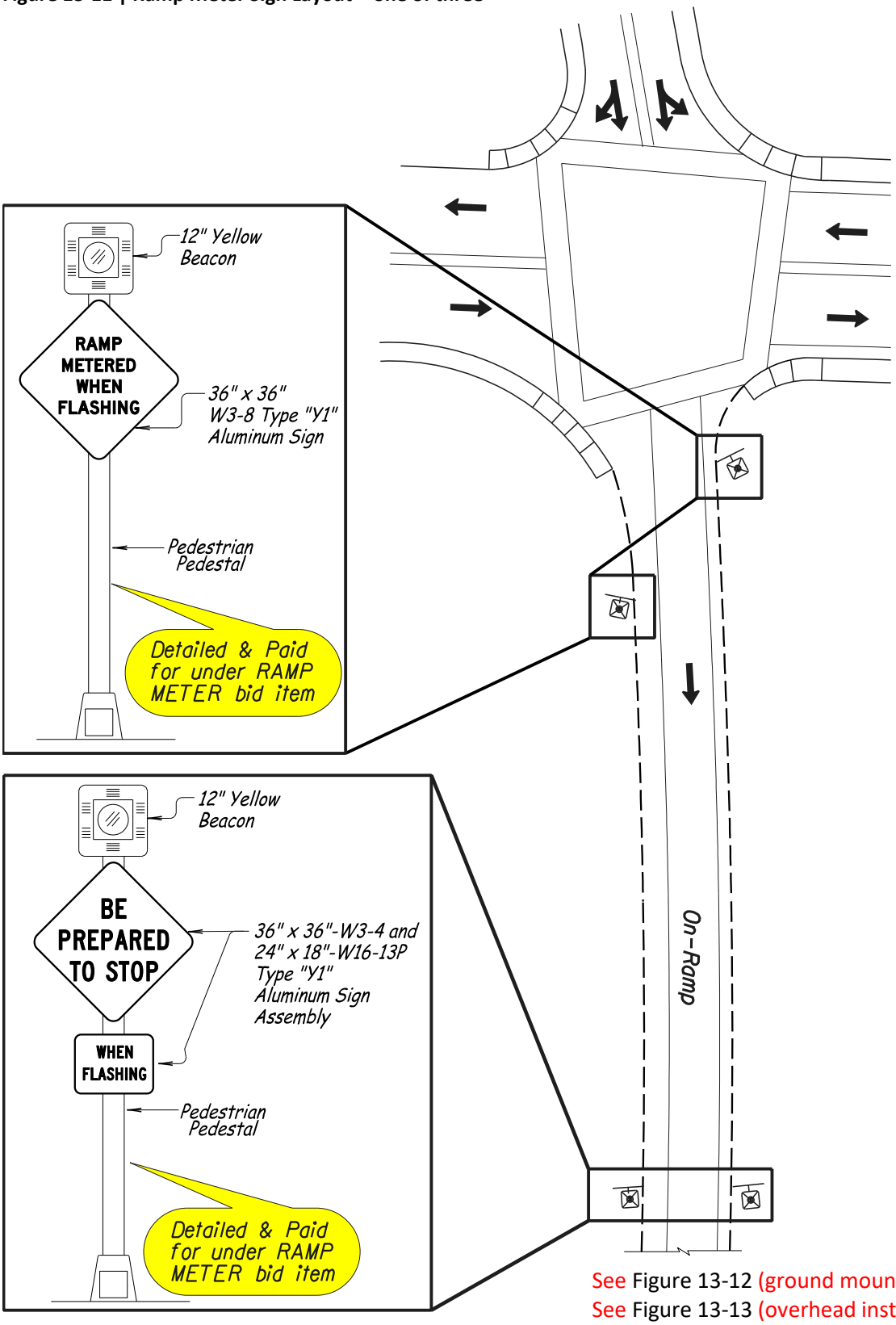
  For ground mounted installations, this sign is part of the standard ramp meter assembly which is detailed on the Ramp Meter plan sheet and paid for under the Ramp Meter lump sum bid item.

For overhead mounted ramp meters, this sign is ground mounted at the stop line on an appropriate standard sign support (i.e. wood post or square tube sign support) which is detailed on the Signing plan sheet (NOT on the Ramp Meter plan sheet) and is measured and paid for under the applicable sign and post bid items.

- "ONE VEHICLE PER GREEN" aluminum sign: This sign is required for all installations, one for each lane of traffic controlled by the ramp meter. For ground mounted ramp meter installations, this sign is a part of the standard ramp meter assembly. For overhead mounted ramp meters this sign is installed with an adjustable sign bracket adjacent to each signal indication. In both cases, it is detailed on the Ramp Meter plan sheet and paid for under the Ramp Meter lump sum bid item.

Other signs on the ramp (i.e. merge, lane transition, curve w/advisory speed, etc.) will need to be taken into consideration when locating the signs and equipment specific to the ramp meter. Work with the Region sign designer.

Figure 13-11 | Ramp Meter Sign Layout – one of three



See Figure 13-12 (ground mounted installation)
See Figure 13-13 (overhead installation)

Figure 13-12 | Ramp Meter Sign Layout – two of three (ground mounted ramp meter installation)

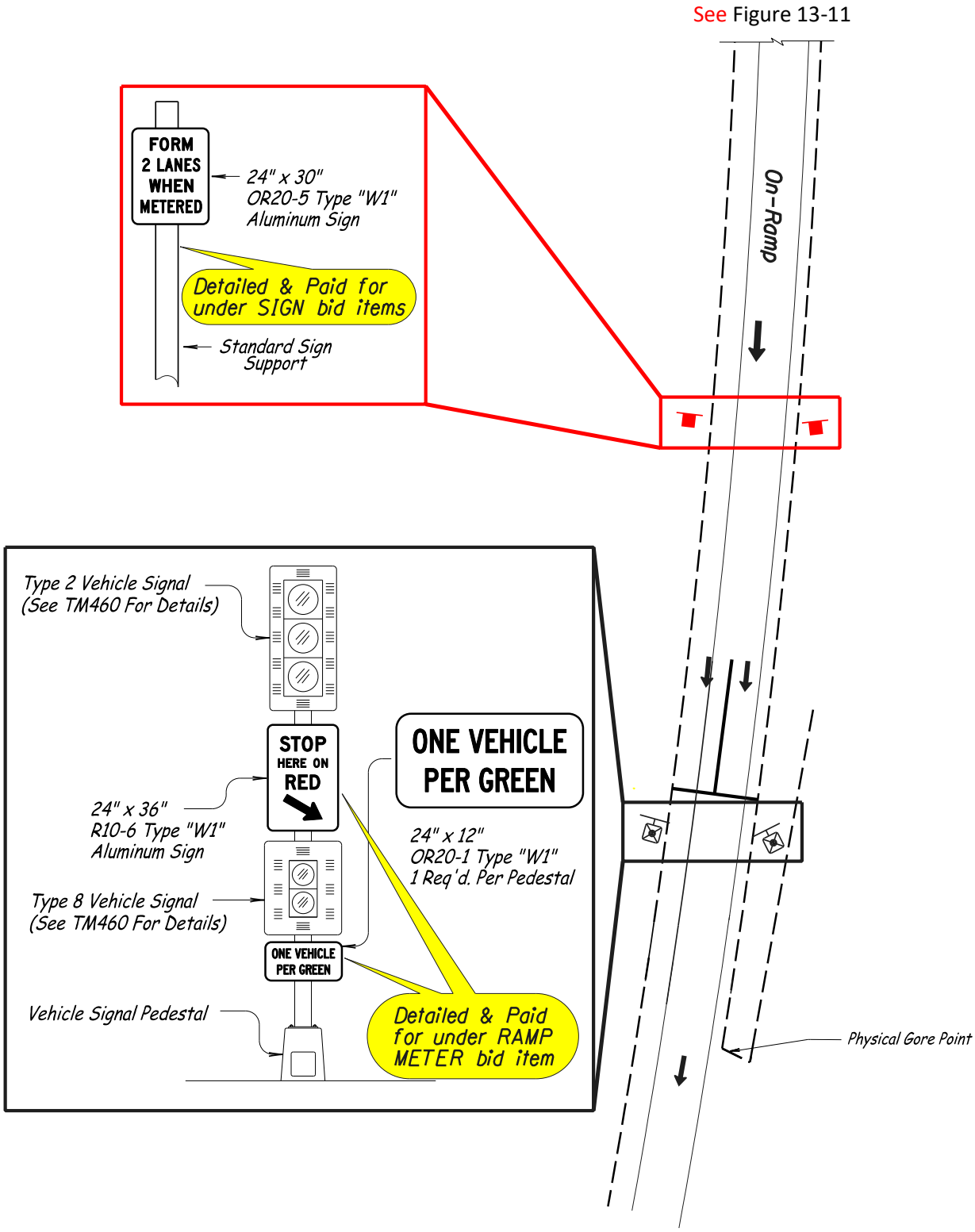
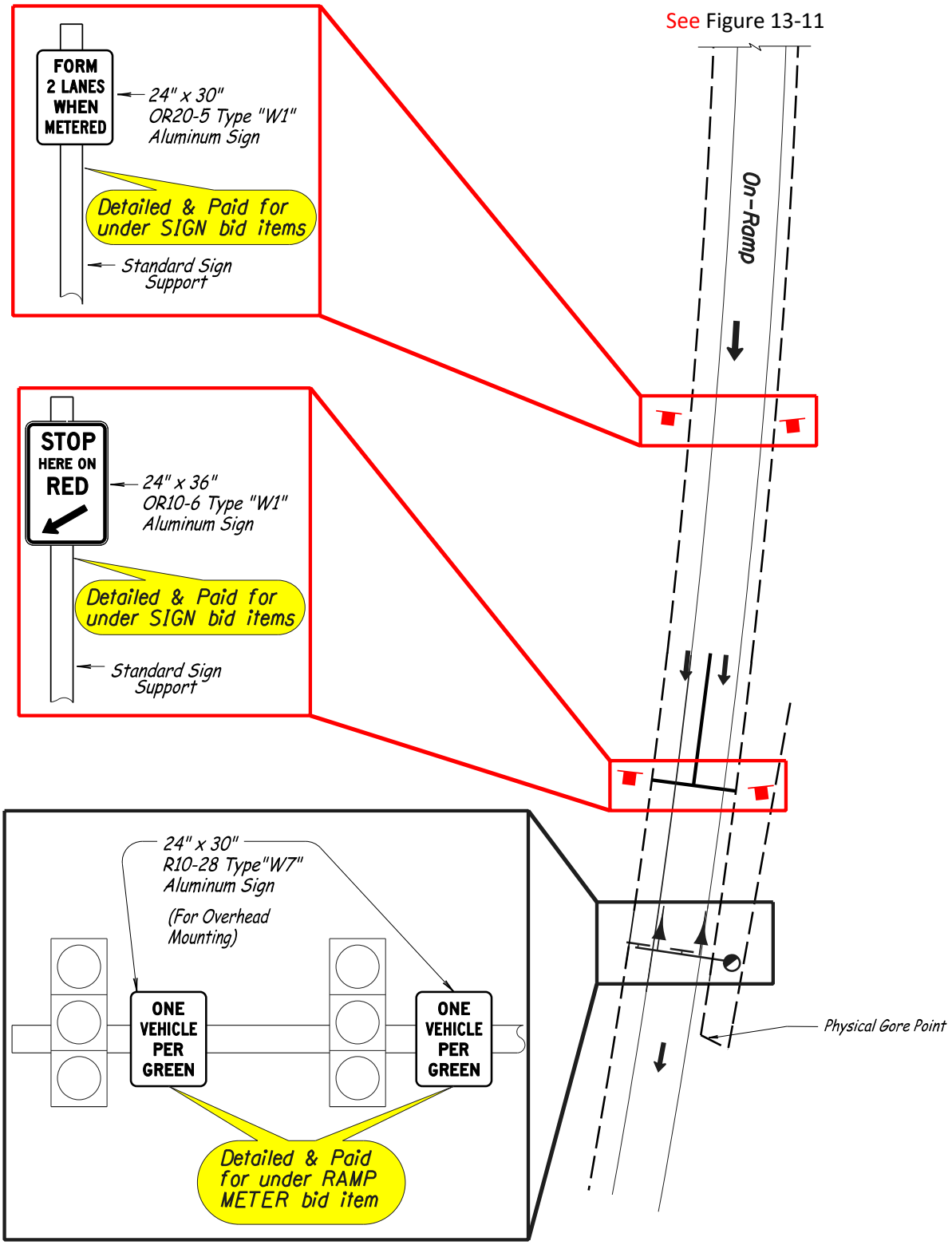


Figure 13-13 | Ramp Meter Sign Layout – three of three (overhead ramp meter installation)

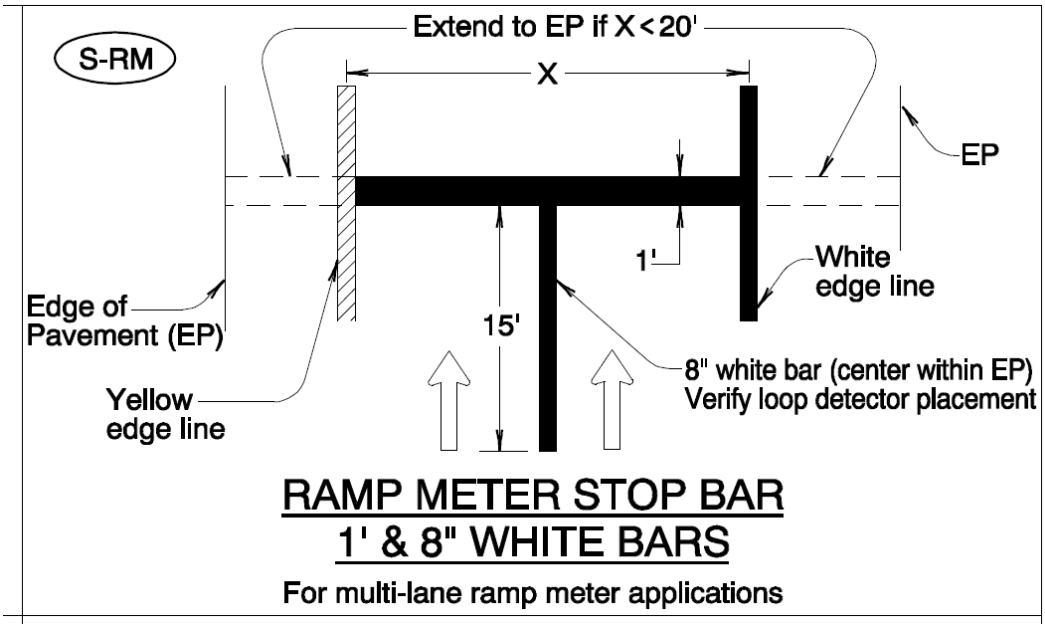


13.4 Ramp Meter Striping

The ramp meter requires a stop line. For single lane ramps with a ramp meter that controls two lanes, an 8” wide white line is extended back from the stop line as per Standard Drawing TM503, detail “S-RM”. See Figure 13-14.

Ramp meter striping is detailed on the striping plans and paid for under the striping bid items. Work with the striping designer.

Figure 13-14 | Ramp Meter Striping (TM503)



13.5 Ramp Meter Cabinets and Controllers

Ramp metering devices are controlled by an ATC controller in a model 334 ground-mounted controller cabinet. The ATC controllers are agency supplied and purchased by the agency through a price agreement managed by ITS.

The service cabinet for ramp meters is the standard base mounted service cabinet (BMC) that is also used for traffic signals.

The controller cabinet and service cabinet should be located near the ramp meter signal indications for ease of maintenance and operational convenience. Include a maintenance landing pad for maintenance vehicle access near the controller (See Standard Drawing **RD160**).

13.6 Ramp Meter Detection

Radar detection is the standard form of detection for ramp meters. This section provides ramp meter detection specific information. Refer to Chapter 6 for more general information related to detection.

13.6.1 Detector Functions & Location

Ramp meter detection serves four different functions (see Figure 13-15):

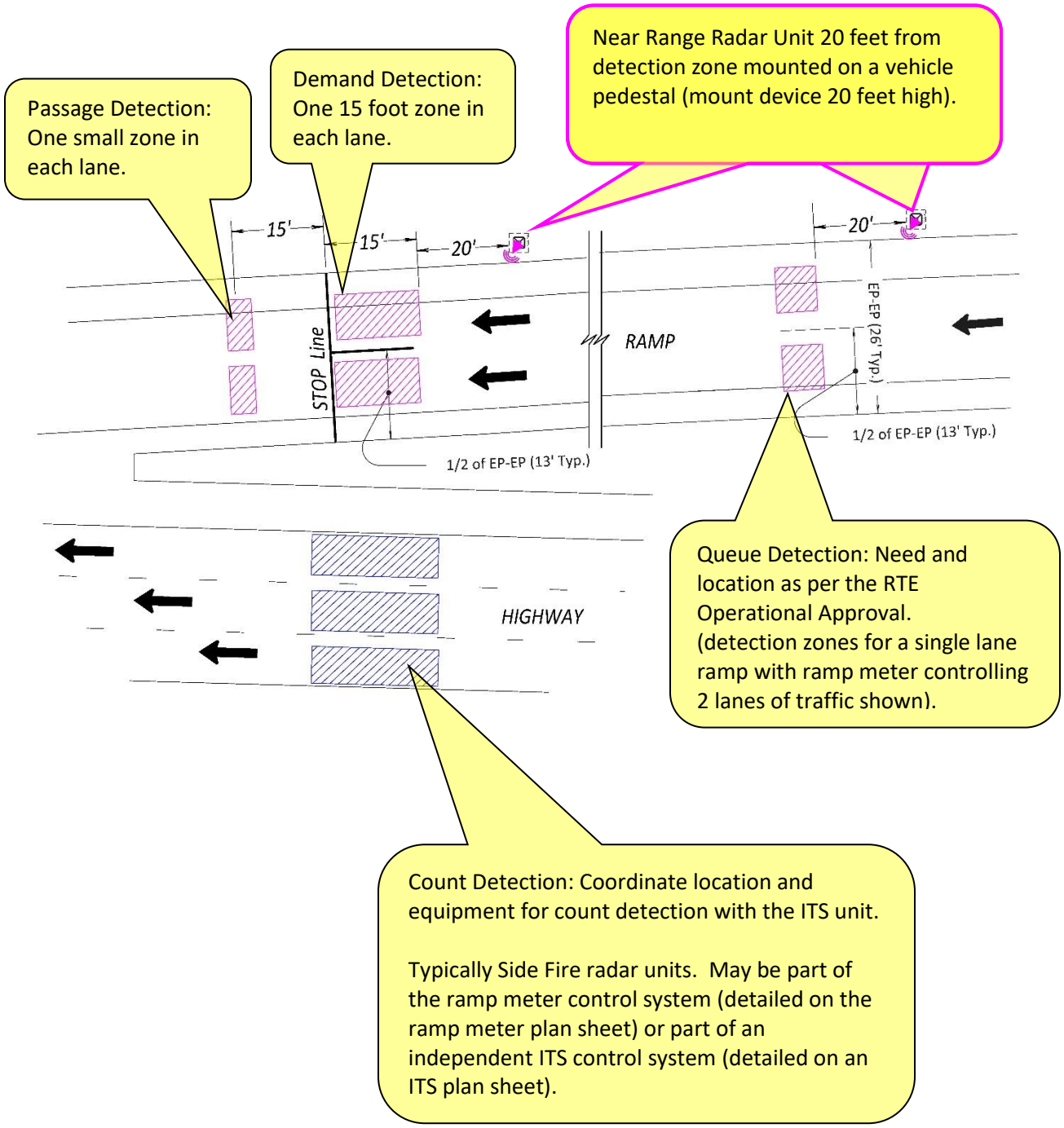
- Demand: This type of detection is 15 feet long and located at the stop line. It is used to place a call into the controller to bring up the green phase of the ramp meter cycle.

- Passage: This type of detection is a small zone located 15 feet downstream from the stop line. It is used count ramp meter traffic, perform truck extension, and violation extension.

- Count: This type of detection is located on the freeway main line. Typically this detection is installed prior to the ramp entrance point, but the exact location on the freeway is determined by the ITS unit. Coordinate with the ITS Unit for determining the count detection location, equipment, and responsibility for design work.

- Queue: This type of detection is a small zone located upstream of the stop line used to detect an extensive queue length. When an extensive queue length is detected (by a vehicle stopping on the queue detector for a pre-determined amount of time), the meter rate is increased as necessary to quickly dissipate the extensive queue. These queue detectors also activate the “BE PREPARED TO STOP” with “WHEN FLASHING” sign if one is present. The need for and location of this detection is determined by an engineering study, documented in the RTE operational approval.

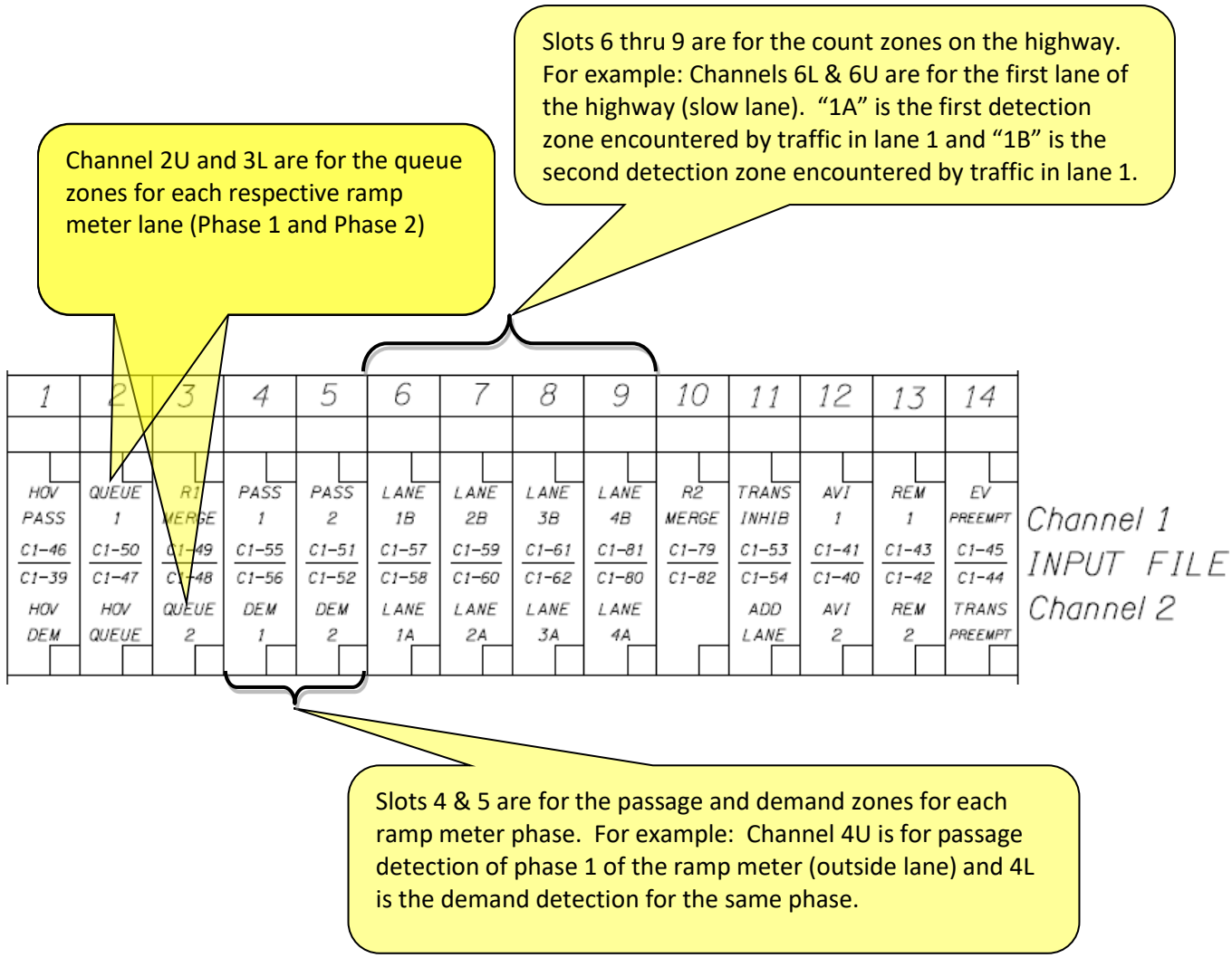
Figure 13-15 | Ramp Meter Detection – Function & Location



13.6.2 334 Controller Cabinet Input Detection File

An SDLC connection is the default standard. When an SDLC connection is used, the input file will remain blank on the cabinet print. See Chapter 6 and chapter 20 for more information. Figure 13-16 shows the 334 controller cabinet detector input file, with the standard termination layout for each ramp meter function if SDLC is not used.

Figure 13-16 | 334 Controller Cabinet Input Detection File



13.6.3 Detector Wiring Diagram

The detector wiring diagram for a ramp meter is no longer needed on the ramp meter plan sheet when non-invasive detection (radar) is used. The ramp meter timer will configure and document the detection zone set up. If not using SDLC, coordinate with the ramp meter timer to ensure that the cabinet print accurately reflects the appropriate equipment in the input file.