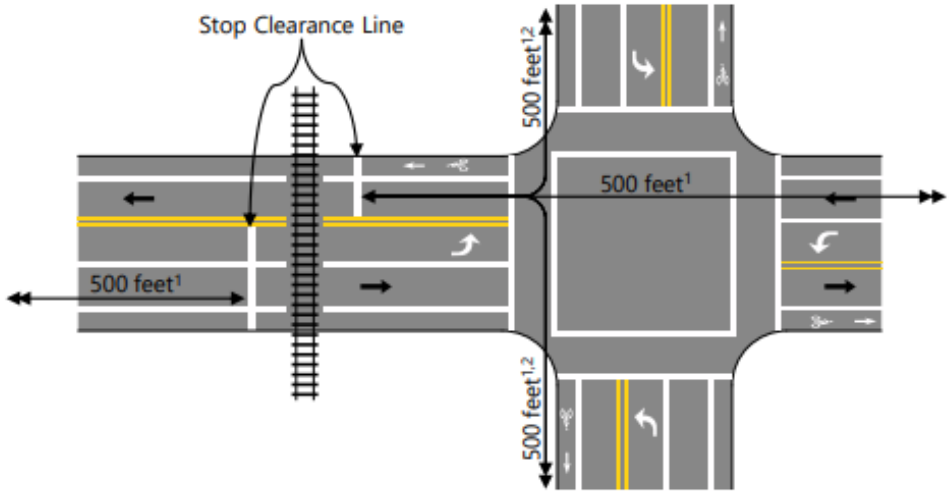
Chapter 16

Contents

16 Railroad & Preemption Plan

The regulation of railroad-highway grade crossings are under the jurisdiction of the ODOT commerce and compliance division (includes staff formally known as rail division). Their jurisdiction extends a distance equal to the safe stopping distance (SSD) for the posted or statutory speed, measured back from the location of the stop clearance line at the railroad crossing (OAR 741-100-0005). See Figure 16-1.

Figure 16-1 | SSD at Railroad At-Grade Crossings and Signalized Intersections



SSD Requirement	
Speed (MPH)	SSD (Feet)
15	80
20	115
25	155
30	200
35	250
40	305
45	360
50	425
55	495
60	570
65	645

[1] ODOT Commerce and Compliance Division jurisdiction extends the safe stopping distance from the stop clearance line (assume 500 feet for simplicity).

[2] ODOT Commerce and Compliance Division jurisdiction extends along the parallel roadway because turns from an intersection near the railroad crossing might have an impact on the railroad crossing.

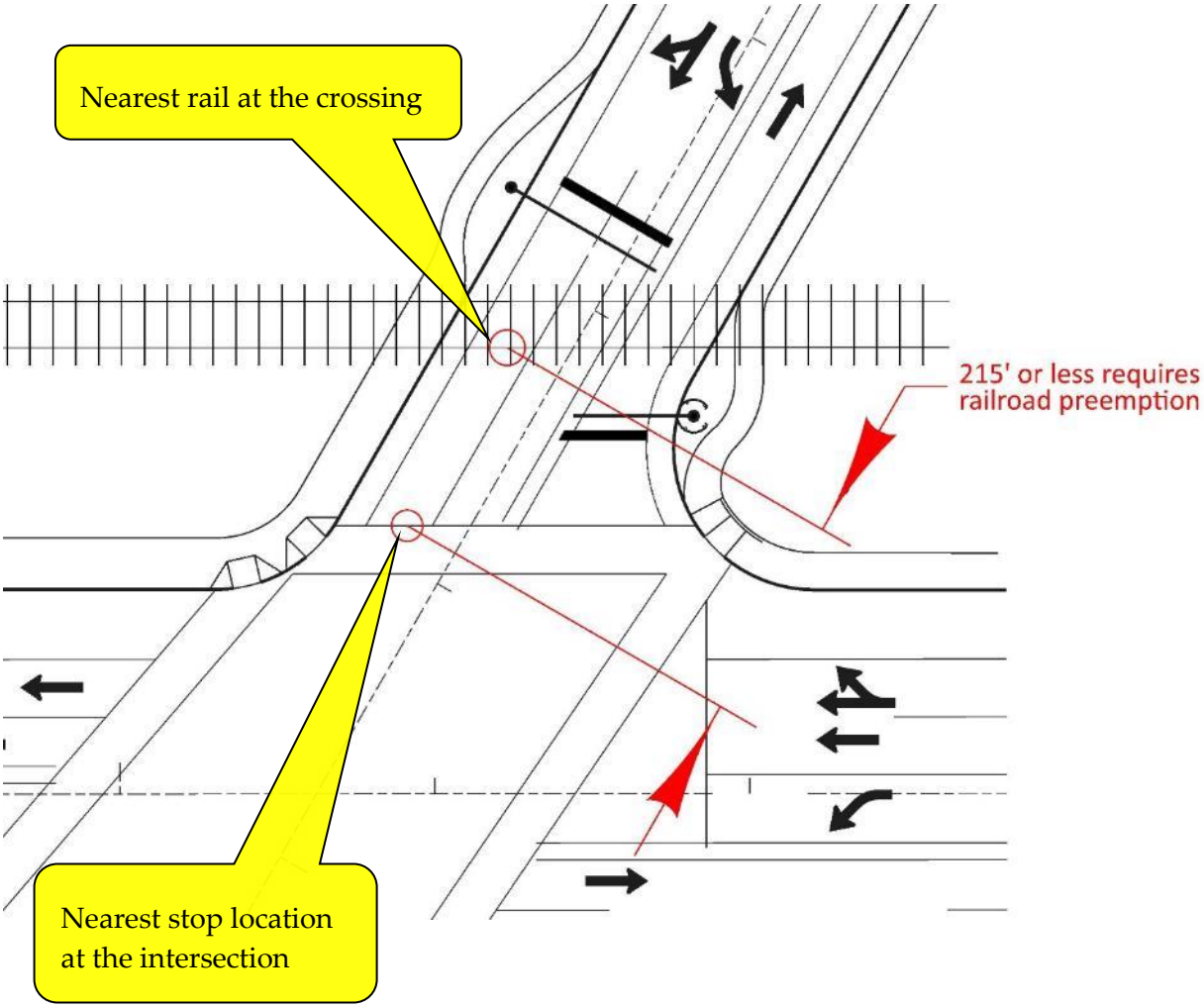
Because ODOT commerce and compliance division has jurisdiction within the SSD from the stop clearance line, it is important to include them in project scoping and early in the project design process so that there is enough time to obtain a rail crossing order if needed. See the ODOT Traffic Manual for additional procedural and coordination information related to rail crossings.

NOTE: Failure to coordinate with the ODOT commerce and compliance division can result in excessive delays to your project schedule.

16.1 When is Railroad Preemption Needed?

Railroad preemption is required if a traffic signal has an approach located within 215 feet of a railroad crossing as per the ODOT Traffic Signal Policy and Guidelines. See Figure 16-2. Depending on the site-specific circumstances, railroad preemption may be desirable for an approach located further than 215 feet from a railroad crossing (e.g., high volume approach with queues routinely reaching or exceeding the rail crossing, high percentage of heavy/long trucks, etc.). See section 16.1.2 for additional information on evaluating preemption and other traffic control devices when the rail crossing is located further than 215 feet. In these cases, the need for preemption will be determined by the field diagnostic review.

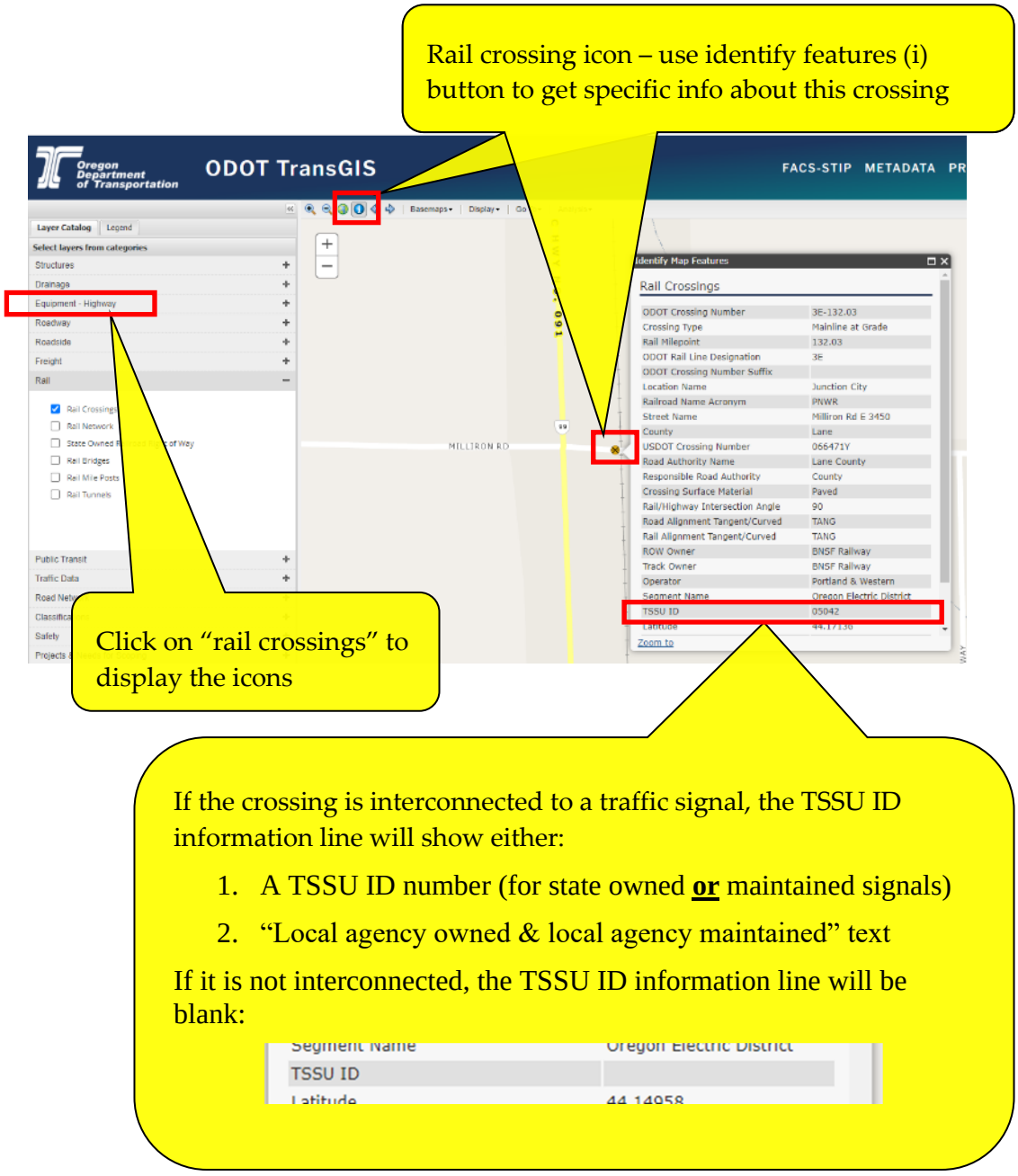
Figure 16-2 | Railroad Preemption Required



16.1.1 Verification of Railroad Interconnection at Existing Traffic Signals

TransGIS can be used to determine if an existing signal is interconnected. See Figure 16-3. ODOT commerce and compliance division also stores this information in the rail crossing safety system database.

Figure 16-3 | TransGIS Rail Crossing Information



16.1.2 Evaluating Preemption and Traffic Control Devices at Rail Crossings Further Than 215 Feet from a Signalized Intersection

The potential for queues to extend to or go beyond the tracks, which can lead to vehicles inappropriately stopping on the tracks, is the main concern to address for tracks located further than 215 feet from a signalized intersection. A traffic queue analysis should be conducted by region traffic. If the potential is low (the traffic analysis shows that the 95th percentile queue will not extend to tracks), additional treatments should not be necessary. If the potential is medium (the traffic analysis shows that 95th percentile queue will extend to the tracks, but the 50th percentile queue will not) additional treatments may be desirable. If the potential is high (traffic analysis shows that 50th percentile queue will extend to the tracks), additional treatments should be considered.

Rail crossing that are located more than 215 feet from the signalized intersection are typically not well suited for interconnection as it will take a considerably long VCOI phase (track clearance green time) before a vehicle stuck on the track will be able to move forward and clear the track. We generally want to limit the VCOI track clearance green time to 20 seconds maximum as this works within the typical time frame the rail owner uses for activating the simultaneous railroad input (which activates the VCOI phase). FRA requires this input is active a minimum of 20 seconds before a train arrives in the crossing, with most rail owners programing this input between 25 to 35 seconds before a train occupies the crossing. VCOI track clearance green times in excess of 20 seconds are undesirable as it pushes both the simultaneous railroad input and the advance preemption railroad input (used to activate the PCOI phase) further out which can result in less consistency of the input timing and also be prohibitively expensive. As such, rail owners strongly prefer that all inputs are activated within 55 seconds or less of the train occupying the crossing.

Due to the issues described above for interconnecting a traffic to a rail crossing located more than 215 feet away, the recommended treatments (alone, or in combination) listed below should be considered first to address any queuing concerns.

Recommended treatments:

- Grade separation
- Signal timing, phasing and/or intersection geometry modifications that prioritize queue reduction on the approach leg with the rail crossing (e.g., removing split phasing, adding overlap phasing, modifying lane use, adding PPLT, adjusting max green times & gap timing, etc.)
- Extra wide shoulder just beyond the rail crossing to function as an escape route for a vehicle stuck on the tracks when the queue ahead can't move

- Static DO NOT STOP ON TRACKS signs (consider overhead mounting, or an additional supplemental sign on the left side for more conspicuity)
- Illumination of the rail crossing
- Dynamic envelope pavement marking
- A "do not stop on tracks" PSA and enforcement campaign

Other treatments to consider if an adequate trial of the above treatment(s) has failed to reduce the frequency of vehicles stopping on the tracks, or if the potential for queues is high (note: all treatments below require STE operational approval):

- Flashing beacons on a static DO NOT STOP ON TRACKS sign, or a DO NOT STOP ON TRACKS PTR sign that is activated by detection of queued vehicles. Operated via the traffic signal controller cabinet.
- Queue cutter signal (operates independent of the downstream traffic signal and is trigger by detection of queued vehicles). Operated via a separate traffic signal controller cabinet.
- Use of dump detection at the downstream traffic signal.
- Railroad preemption with downstream traffic signal.

16.2 Field Diagnostic Review

The field diagnostic review is required by the ODOT commerce and compliance division to determine the appropriate traffic control devices for the crossing and produce a rail crossing order. This will occur early in the design process (project scoping or prior to DAP plans) and is coordinated by the ODOT commerce and compliance division. The review typically includes:

- Project team leader
- ODOT commerce and compliance division representative
- Railroad company representative
- Region traffic signal operations representative
- Construction representative
- Designers (signal, roadway, and others as needed)

The field diagnostic review team will meet on-site to determine the required upgrades to the railroad crossing. The findings from the field diagnostic review are the starting point for:

- Identifying design constraints and work to be done;
- Completing the railroad-highway public crossing safety application (which is required to obtain the rail crossing order); and
- Obtaining any region and/or state traffic engineer operational approvals.

16.3 Rail Crossing Order

Each public railroad crossing is required to have a rail crossing order. Rail crossing orders are issued by the ODOT commerce and compliance division and authorize the alterations to the grade crossing. Private crossings are not regulated by the ODOT commerce and compliance division (except for the STOP sign and PRIVATE CROSSING sign as per OAR 741-115-0060) and therefore do not typically require a rail crossing order. The majority of projects involving a railroad crossing will require a rail crossing order. New at-grade crossings are rarely approved because state law directs ODOT commerce and compliance division to eliminate at-grade railroad crossings wherever possible. Grade separated railroad crossings are strongly preferred by the railroads and ODOT.

Rail crossing orders contain specific requirements for installation, operation, and maintenance of traffic control devices, roadway geometry, and roadway features. The rail crossing order must be completed prior to PS&E. In order to obtain a rail crossing order, a railroad-highway public crossing safety application must be completed and submitted to ODOT commerce and compliance division. This application is typically done by the project team leader or designer, with assistance from the ODOT commerce and compliance division.

Existing rail crossing orders can be accessed online (ODOT staff link or external staff link) or by contacting the ODOT commerce and compliance division.

Plan sheets must comply with the rail crossing order.

16.4 Railroad Utility Permits

If any signal equipment crosses over or under the railroad right-of-way, the railroad requires a utility permit. This permit is separate from the other construction permits that the contractor must obtain as per standard specification 00170.02 and the rail crossing order. It should be obtained as early as possible in the design phase (prior to PS&E) to avoid unnecessary delays during design and construction. Follow all design requirements stated in the permit.

Typical signal work that triggers the need for this permit includes conduits for detection, traffic signal interconnection and/or railroad interconnection. The signal designer should contact the state utility and railroad liaison for assistance in obtaining this permit.

Contact: State utility and railroad liaison

Nicole Frankl

503-385-6594

E-mail: UtilityandRailProgra@odot.oregon.gov (note: the "m" is intentionally missing in "program")

16.5 Railroad Preemption Operation

ODOT's standard for railroad preemption is comprised of the following sequence:

1. Pedestrian clear-out interval (PCOI)
2. Vehicle clear-out interval (VCOI)
3. Return to normal operation

The rail diagnostic review determines the type of preemption operation and necessary traffic control devices to accommodate the desired operation. Any deviations from the standards should be documented and approved as per the direction of the state traffic engineer (STE) in consultation with the ODOT rail crossing safety manager.

16.5.1 PCOI – Advance Preemption

The pedestrian clear-out interval (PCOI) value (in seconds) is shown on the railroad preemption plan sheet and is calculated and provided by the region signal operations engineer. This value is placed in the railroad controller by railroad employees. NOTE: at existing railroad interconnected traffic signals, the existing PCOI value should be field verified and then calculated (based on current standards) to determine if the existing PCOI value is adequate. Typically, existing PCOI values should be increased by several seconds. The decision to increase an existing PCOI value is determined by the field diagnostic review. The calculated PCOI value should be used whenever possible, but it may not always be feasible (e.g., cost prohibitive, outside the scope of the project, railroad equipment limitations, etc.).

The PCOI is used to give pedestrians time to finish crossing a crosswalk prior to the vehicle clear-out interval (VCOI). Without the PCOI, pedestrians could get stranded in the crosswalk when the VCOI sequence starts. This is because the traffic signal controller will immediately truncate the walk or flashing don't walk interval upon receiving the input to activate the VCOI sequence.

The operation of a PCOI requires train detection provided by the railroad to activate an "advance preemption railroad input". The advance preemption railroad input initiates the "pedestrian inhibit" traffic signal software feature which starts the following operation:

1. No change to vehicle phase sequence
2. All active pedestrian phase walk intervals immediately advance to and complete the flashing don't walk interval
3. All pedestrian phase calls are inhibited from being serviced
4. PTR signs remain off
5. Rail crossing equipment (flashing lights, audible devices and gates) remain off and up.

16.5.2 PCOI – Advance Preemption Used to Move Vehicles

The PCOI may also be used to clear vehicles queued between the intersection and the tracks (like the VCOI operation described in the following section) and help provide a free-flow condition for the VCOI phases prior to the simultaneous preemption input IF NO PEDESTRIAN CALLS ARE ACTIVE. The need for this type of operation will be determined by the diagnostic field review. If this operation is used, the appropriate traffic signal railroad preemption sequence text used on the railroad preemption plan sheet can be found in the ODOT workspace under "rail matrix advanced".

16.5.3 VCOI – Simultaneous Preemption

The VCOI value is NOT shown on the railroad preemption plan sheet (this value is calculated by the region signal operations engineer and placed in the traffic signal controller), but the vehicle clear-out phases and the limited service vehicle phases (phases with movements that don't conflict with the rail crossing) are listed on the railroad preemption plan sheet.

The VCOI is used to give vehicles on the road approach crossing the railroad track (stopped between the railroad tracks and intersection) time to advance through the intersection and away from the railroad crossing. This accomplished by providing green signal indications to the signal phases that cross the tracks (commonly called "green clear-out"). In the past, a flashing yellow indication was used for the VCOI (commonly called "yellow clear-out"), but this practice was ended in the late 1990's because it tended to result in driver confusion.

The VCOI requires train detection equipment that will provide a "simultaneous preemption railroad input" to activate the rail crossing equipment and the VCOI signal operation sequence. The simultaneous preemption railroad input follows the advance preemption railroad input (and operation sequence of the PCOI) and initiates the "railroad preemption" traffic signal software feature which starts the following operation at the traffic signal:

1. PTR signs turn on
2. Rail crossing equipment (flashing lights and audible devices) activate. After a three to six second delay, the railroad automatic gates start to descend. The total time from activation of the flashing lights to when the gates are horizontal may be 10 to 15 seconds.
3. All active pedestrian phase flashing don't walk intervals immediately advance to solid don't walk.
4. Any active vehicle clear out phase displaying green remains green and all non-vehicle clear out phases displaying green immediately terminate by advancing through their yellow and red clearance intervals.
5. Once all vehicle clear out phases display green simultaneously, the signal controller programmed VCOI is timed followed by the vehicle clear out phases advancing through their yellow and red clearance intervals.

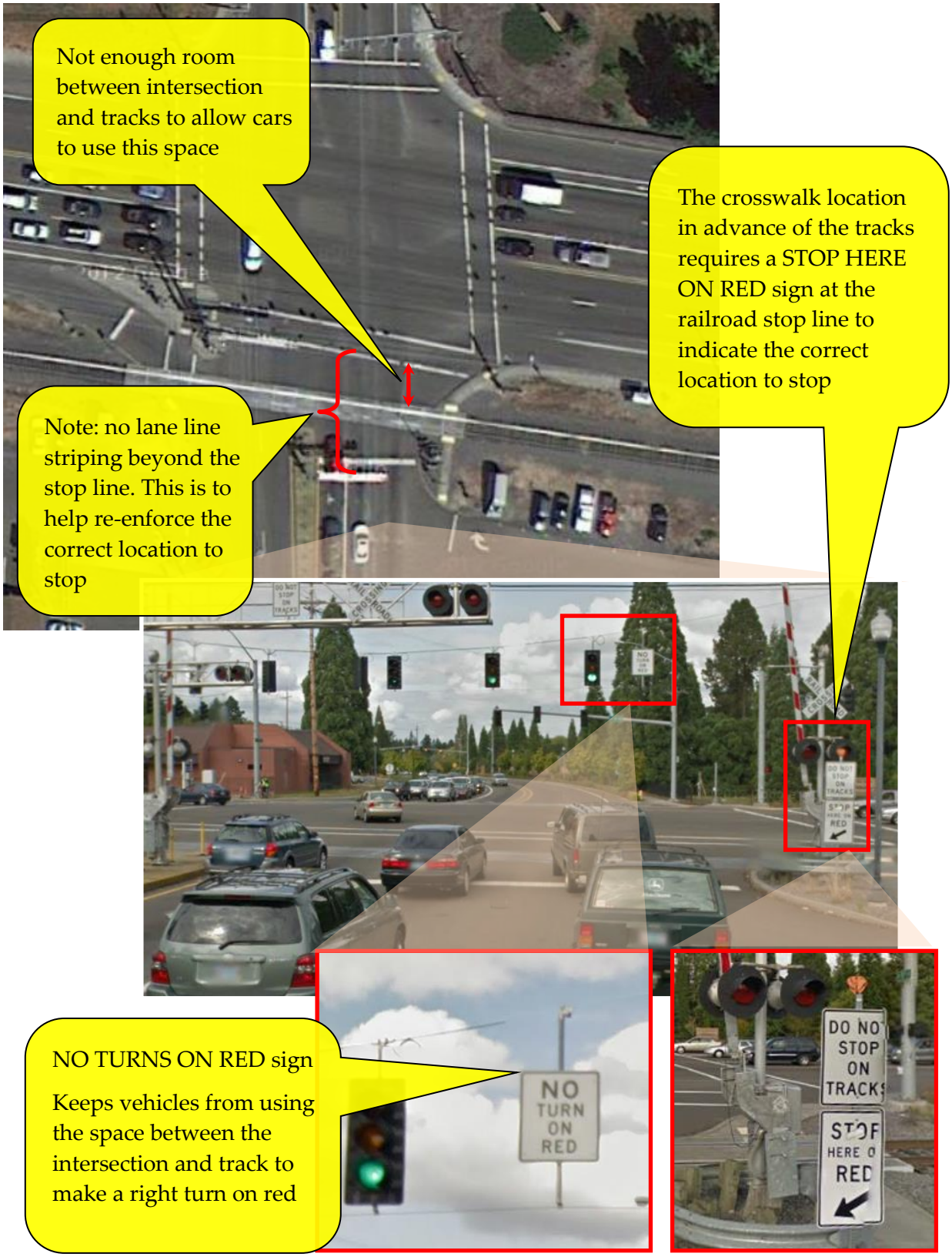
6. All programmed limited service vehicle phases and their associated pedestrian phase are serviced in their normal sequence based on demand. Limited service vehicle phases consist of any phase that does not conflict with crossing the track.

Note: The railroad owner may elect to program the railroad controller to deliver the simultaneous input to the traffic signal controller slightly before the rail crossing equipment activates. If used, approx. 5 to 10 seconds is common, based on site specifics. This is not shown on the preemption plan. Starting the VCOI sequence a little early can help mitigate equipment lag issues and better protect the railroad gate arms from breakage.

A VCOI is not always required. If the diagnostic field review determines that vehicles should stop prior to the track under normal signal operation (typically because the distance between the intersection and the track is less than the length of a passenger vehicle) the VCOI may not be needed (e.g., no vehicles to clear-out between the intersection and the track). This type of operation typically includes a post mounted STOP HERE ON RED sign at the railroad stop line, with a NO TURN ON RED sign mounted on signal pole or mast arm. Site specifics such as intersection geometry, normal signal operation, placement of all traffic control devices, traffic volumes, and driver behavior/expectations should be considered when determining if no VCOI is an appropriate treatment. See Figure 16-4 and Figure 16-5 for examples.

Figure 16-4 | VCOI is Not Required, Example 1

Figure 16-5 | VCOI is Not Required, Example 2



16.5.4 Return to Normal Operation

After the railroad preemption inputs return to non-preempt status, normal operation of the signal phasing resumes, the PTR sign turns off, the rail signal equipment turns off and gates go up.

16.6 Required Plan Sheets

On a project with railroad preemption, there will be coordination between the rail company, the road authority and the ODOT commerce and compliance division for determining who is responsible for installation, maintenance, and costs of the required traffic control devices. Depending on the scope of the project and the requirements in the rail crossing order, some or all of the plan sheets will be required:

1. Signal plan sheet
2. Railroad preemption plan sheet
3. Other plan sheets (disciplines outside of signal design, such as roadway, striping and signing)

Refer to the following sections for more in depth information.

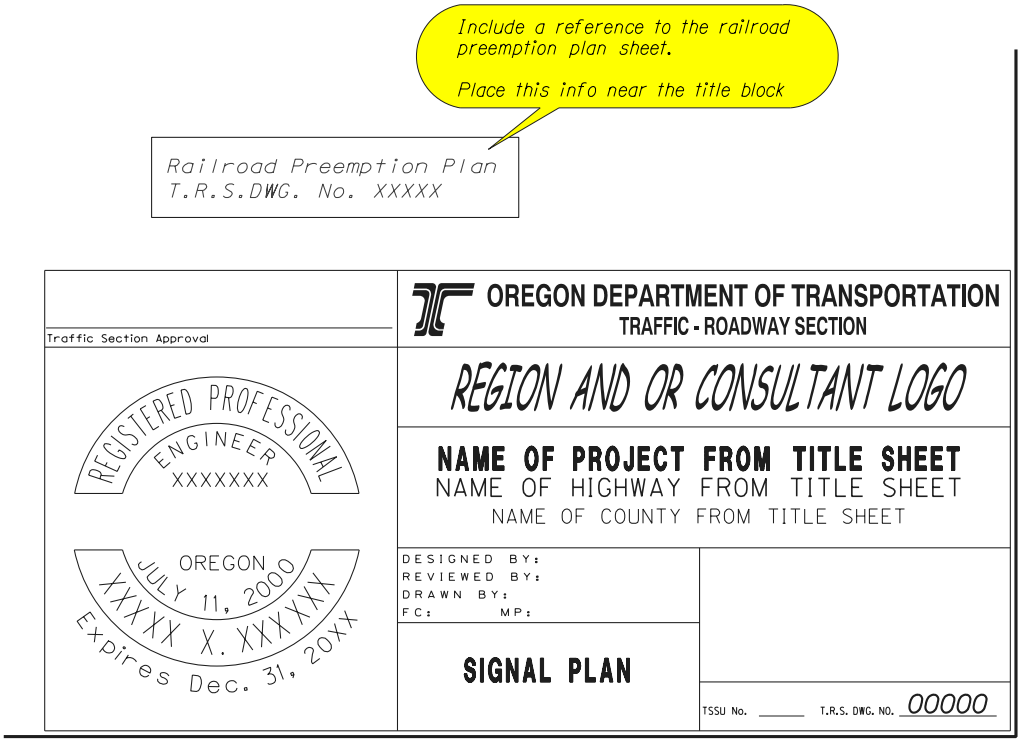
NOTE: It is important to keep equipment owned and maintained by the rail owner (e.g., gate arms, cantilever structures, etc.) completely separate from equipment that is owned and maintained by ODOT or a local agency (e.g., signs, signal heads, etc.). This will clearly define responsibilities for maintenance and avoid issues with other parties accessing and potentially impacting equipment that they are not responsible for. Mixing infrastructure between two or more different responsible agencies becomes very complicated and should be avoided.

16.7 Signal Plan Sheet References

The signal plans will need to detail all work that the contractor will be responsible for. See section 16.8 for more information on work that the contractor will be responsible for.

Do NOT detail work that the contractor is NOT responsible for. References to other work the contractor is not responsible for should be shown on the signal plan sheets as per Figure 16-6 (for the railroad preemption plan sheet) and section 16.10 (for the rail equipment).

Figure 16-6 | Referencing Other Work on the Signal Plan Sheets – Preemption Plan Sheet



16.8 Interconnected Traffic Signal Specific Design Elements and Considerations

Interconnected traffic signals have several unique design elements and considerations due to the preemption operation and coordination with rail equipment. The design elements for all interconnected signals must be considered on a case-by-case basis as each site and each project will have different characteristics, issues, constraints, and goals. The following subsections are common design elements that pertain to interconnected traffic signals:

- Pre-signals
- Supplemental signals
- Queue cutter signals
- Queue activated warning devices
- Detection
- Channelized right turn lanes
- Median islands
- Crosswalk placement and stop lines
- PTR signs
- STOP HERE ON RED and NO TURN ON RED signs
- DO NOT STOP ON TRACK signs and high level warning device
- Lane use signs
- Conduit and wiring
- Pedestrian features
- Type 7 signal heads
- Limited right-of-way for equipment

The following subsections provide definitions and general guidance. They should be used to evaluate the appropriate treatment(s) to be implemented at a particular project/site and facilitate communication between the various stake holders. Consistency of traffic control devices used on a corridor, historical observations, and risk assessment should also be considered when evaluating treatments. It is important to include the diagnostic team in this decision making process to obtain feedback from the various stakeholders and to help make the rail crossing order process go smoothly.

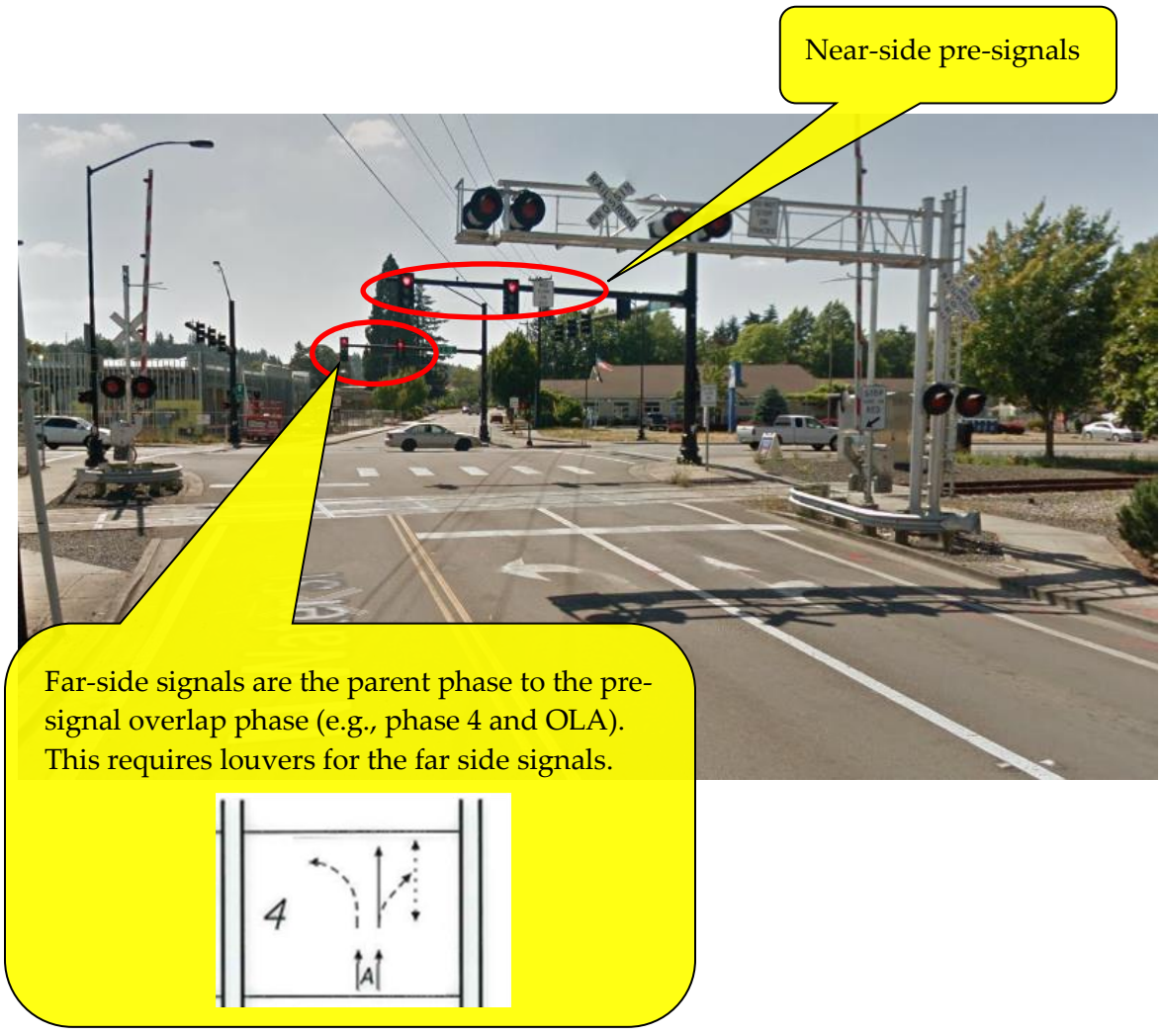
Good communication between the signal designer and the various stakeholders on the diagnostic team is important to determine the most appropriate treatment(s) to be used. Note that the road authority (e.g., traffic staff) and rail owners may use the same terms/acronyms but have different definitions for them (e.g., VCOI) and each party has unique terms/acronyms specific to their discipline that the other party will not readily understand. Always take the time to explain and make sure everyone is actually on the same page.

We are striving to correct these issues to improve communication in future but this is a long-term task that will require high level agreement from both parties.

16.8.1 Pre-Signals

Pre-signals are defined as near-side signals that operate on an overlap phase with the normal signal phase rotation. The far-side signal phase will be the parent phase for the near-side pre-signal overlap phase. This allows the near-side pre-signals to operate in conjunction with the far-side signals plus the flexibility for the far-side signals to display a different indication than the near-side pre-signals as necessary. Pre-signals should operate with a VCOI sequence. During the VCOI sequence, the overlap phase (pre-signals) will be red while the far-side signals display green to clear any vehicles that may have queued between the intersection and the tracks (even though theoretically they should never be there). This operation eliminates the option of using the advance preemption (PCOI) to move vehicles as described in 16.5.2 (because the VCOI phase green is only associated with the far side signals, not the pre-signals). See Figure 16-7 for an example.

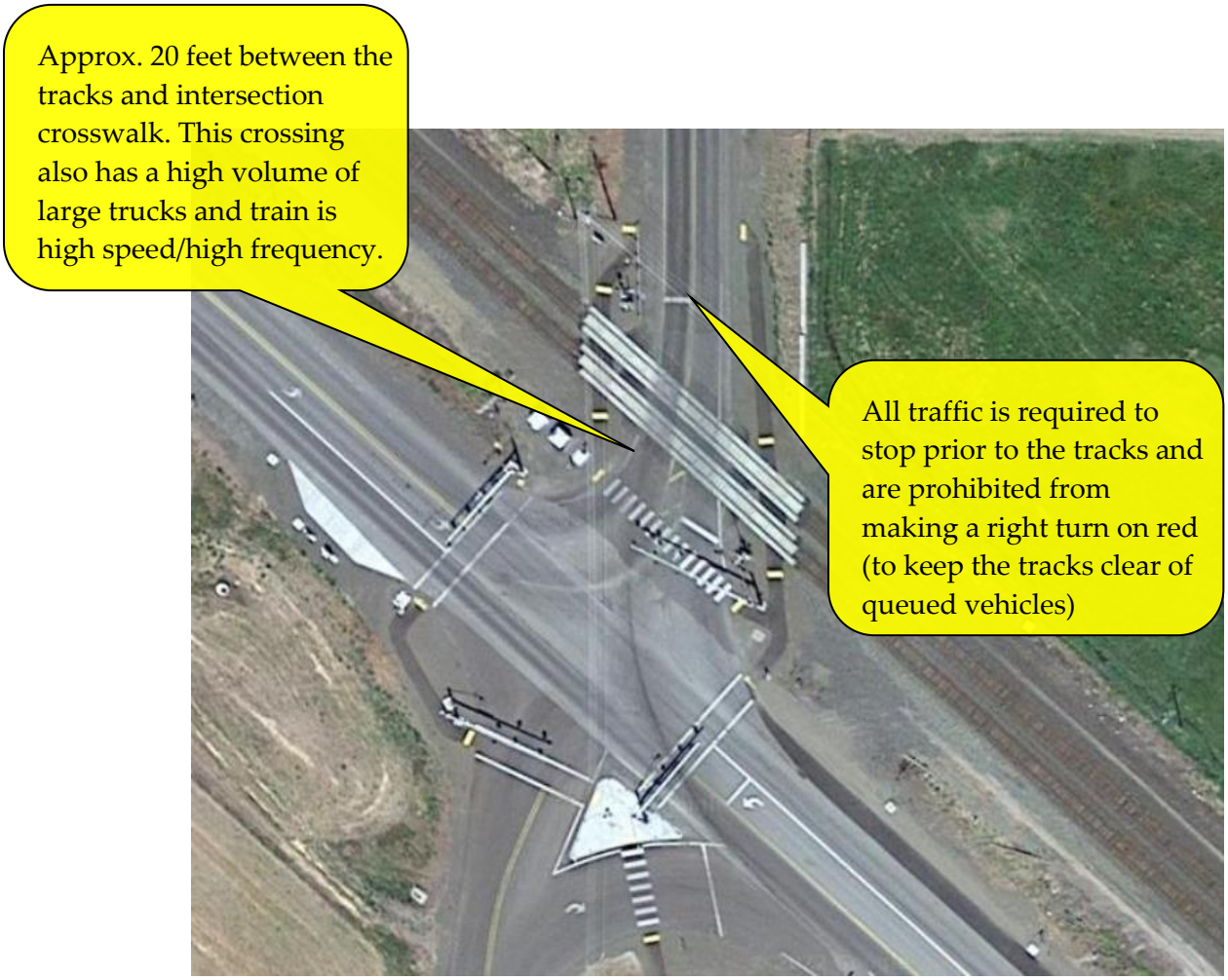
Figure 16-7 | Pre-Signal Example 1



Because pre-signals do not always display the exact same indications as the far-side signals and they are located relatively close to the far-side signals, the far-side signals are required to have louvers in all indications so that the driver can only see the far-side signals AFTER they lose sight of the near-side pre-signals. Also, drivers must stop and remain stopped at the stop location for the pre-signal, which is the location of the rail crossing stop line (this requires the use of STOP HERE ON RED and NO RIGHT TURN signs as per section 16.8.10).

Pre-signals may be beneficial when tracks are located such that it is not even possible for a passenger vehicle to queue without stopping on the tracks or when the risk is deemed too high to allow vehicles to even attempt to queue between the tracks and the intersection (e.g., a high percentage of heavy trucks and/or the train is frequent and/or the train is high speed). See Figure 16-8. However, the drawbacks of a pre-signal must be seriously considered before using this treatment.

Figure 16-8 | Pre-Signal Example 2



Pre-signals drawbacks that should be considered:

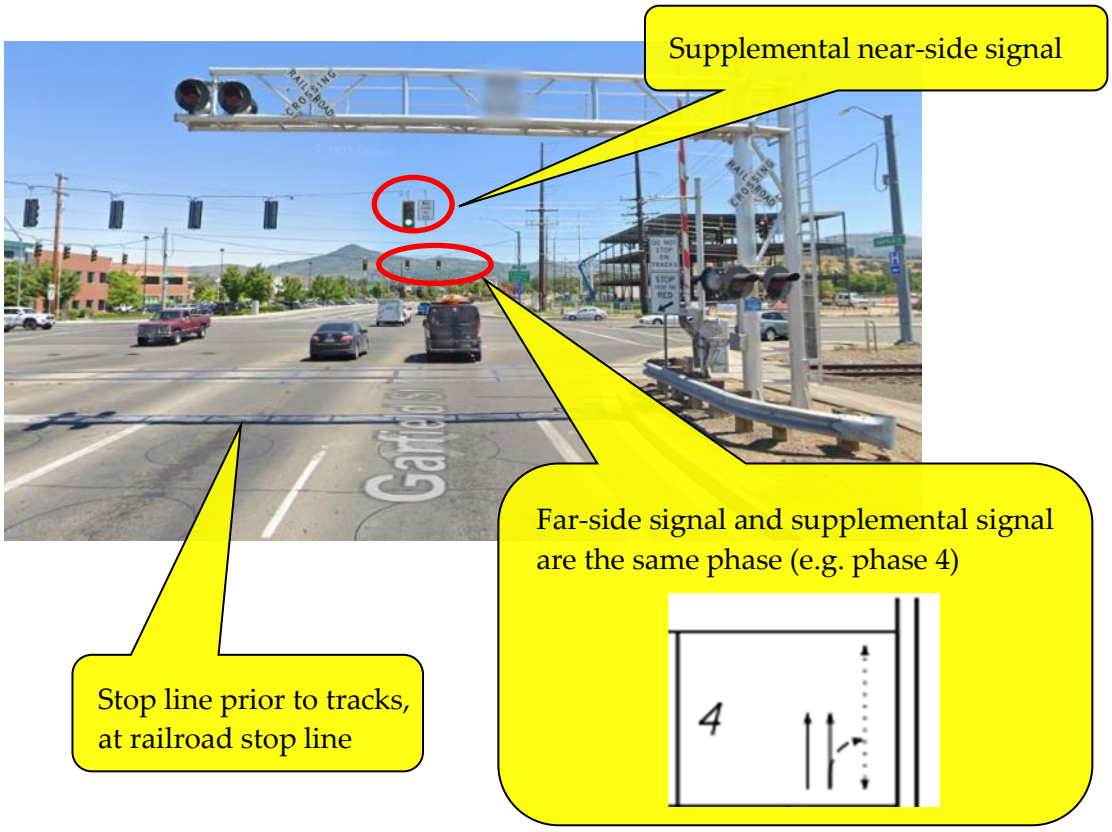
- Eliminates the option of using the PCOI to move vehicles as per section 16.5.2. Using the PCOI to move vehicles addresses queueing and any vehicles stopped on the tracks when the train is approaching, which may be a more desirable operation than using a pre-signal given the next three bullet points.
- If the right turn volume is heavy and there is also a good line of sight, the STOP HERE ON RED and NO TURN ON RED signs may not be respected by drivers and result in numerous intentional violations that would require heavy enforcement to correct.
- As the distance between the pre-signal stop line and the intersection stop location increases, a driver may not expect or respect the need to stop before the tracks, especially if they are in a smaller vehicle.
- Pre-signals add complexity of the driving task. Louvered signal heads are not ideal in this application as it is difficult to adequately block the line of sight of the far side signal indications due to the challenging geometry angles of the approaching driver's eye. This can result in far-side signals that are visible before they should be or blocked longer than they should be.

If possible, geometric solutions to modify the distance between the tracks and the intersection or using the PCOI to move vehicles are preferred alternatives to a pre-signal.

16.8.2 Supplemental Signals

Supplemental signals are defined as near-side signals that have the same output terminations as the far-side signals. Unlike a pre-signal, a supplemental signal will always display the exact same indications as the far-side signals. As such, louvers are not necessary. See Figure 16-9 for an example.

Figure 16-9 | Supplemental Signal Example



Near-side supplemental signals are typically only installed to mitigate for a large intersection (signal heads located at the normal location are over 180 feet from the stop location), mitigate for sight distance limitations due to approach geometry, or to improve conspicuity/visibility to the signalized intersection (as per chapter 5), and not specifically for rail preemption interconnection operation. However, if near-side supplemental signals happen to be needed at on the approach with the tracks at a rail interconnected signal, it is very important to determine the proper stopping location to reduce driver confusion. Having the stop line prior to the tracks is ideal, as shown in Figure 16-9. See section 16.8.8 for more information on crosswalk placement and stop lines adjustment considerations. If the stop line is prior to the tracks, a VCOI phase may not be necessary as per section 16.5.3.

If possible, geometric solutions to eliminate the need for supplemental signals is the preferred solution.

16.8.3 Queue Cutter Signals

Queue cutter signals are defined as a completely stand-alone traffic signal that only controls vehicles at the rail crossing. It operates independently of any adjacent traffic signals. The queue cutter signal remains green until a queue is detected which will terminate the green phase.

The detection zone should be placed beyond the tracks so the signal will terminate the green phase when queue is forming but hasn't yet crossed the tracks. The exact location and amount of delay on the detection will need to be field verified to ensure the device activates at the proper time for approaching vehicles to react to it.

Queue cutter signals may be beneficial at locations where:

- Vehicles are routinely observed stopping on the tracks, and
- The rail crossing is located beyond 215 feet from the signalized intersection, and
- The observed typical queue (or 50th percentile queue) will reach to or go beyond the rail crossing.

As of 2022, there are no true queue cutter signals operating on the state highway system. As such, contact the state traffic signal engineer for more guidance on using/designing this device if it is being considered on a project. Also, see section 16.1.2 for alternatives to queue cutter signals.

16.8.4 Queue Activated Warning Devices

Queue activated warning devices are either a flashing beacon for a DO NOT STOP ON TRACKS sign or a DO NOT STOP ON TRACKS part time restriction (PTR) sign.

Queue activated warning devices may be beneficial at locations where:

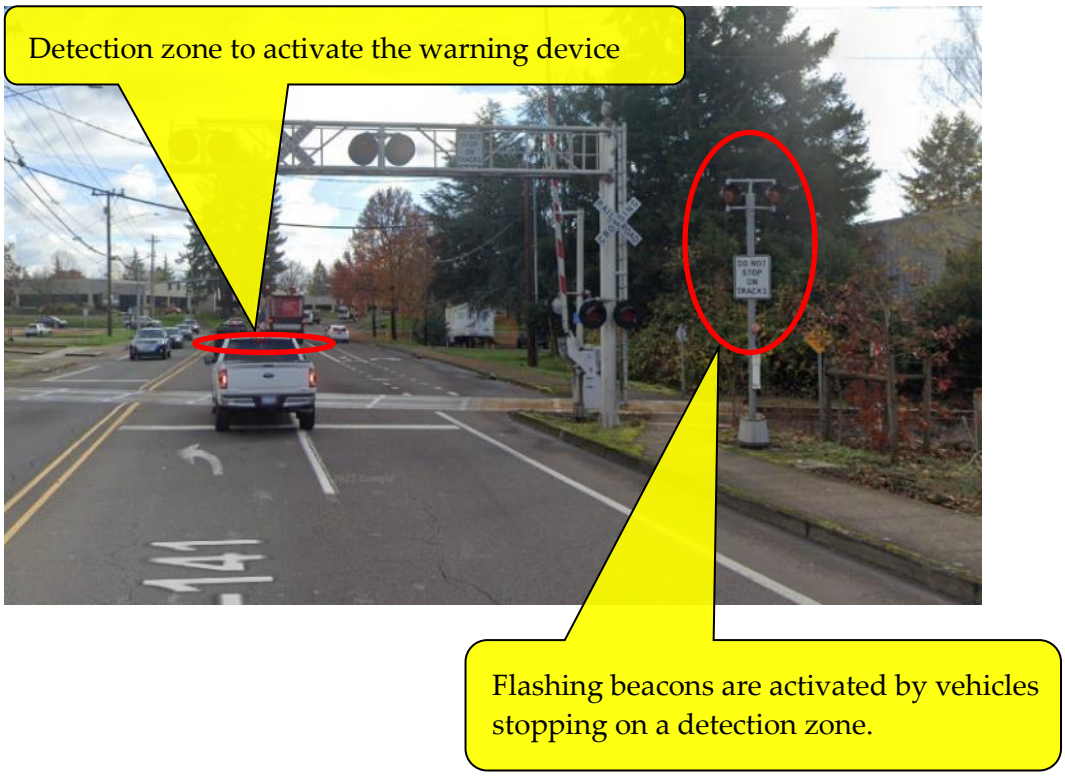
- Vehicles are routinely observed stopping on the tracks, and
- The rail crossing is located at least 100 feet from the signalized intersection, and
- The observed typical queue (or 50th percentile queue) will reach to or go beyond the rail crossing.

The detection will activate the warning device via a traffic signal controller cabinet (it may be the same cabinet for a rail interconnected traffic signal) when a vehicle stops on the detection zone for a set amount of time (approx. 3 to 5 seconds). It does NOT preempt an interconnected traffic signal. Note that a queue activated warning device could be installed at a crossing that isn't interconnected to a traffic signal or even near a traffic signal. This would be a stand-alone queue activated warning device.

The detection zone should be placed approximately 2 to 3 car lengths beyond the tracks so the warning device will turn on when queue is forming but hasn't yet crossed the tracks. The exact location and amount of delay on the detection will need to be field verified to ensure the device activates at the proper time for approaching vehicles to react to it.

The default standard detection for this application is a near-side radar unit. See chapter 6 for information about placement of detection devices.

Figure 16-10 | Queue Activated Warning Device Example



16.8.5 Detection

SIDE STREET DETECTION

Typically the rail crossing is located on the side street approach of a signalized intersection. Side street phases are only serviced if there is demand. Non-invasive detection should be placed to provide normal side street detection zones from the vehicle stop location. Detection zones should also be located in the area between the crosswalk and tracks even if vehicles will not normally occupy that area. This allows the traffic signal the opportunity to serve the side street phase in the rare event of a vehicle stopping in a location they shouldn't occupy.

QUEUE DUMP DETECTION

Queue dump detection may be beneficial at locations where:

- The rail crossing is located over 200 feet from the signalized intersection, and
- The observed typical queue (or 50th percentile queue) will reach to or go beyond the rail crossing, and
- The normal max green time for the approach is not long enough to clear the observed or expected 95th percentile queue.

The queue dump detection would trigger the traffic signal to provide a longer max green to dissipate the queue on the next phase cycle when a vehicle stops on the detection zone for a set amount of time (approx. 3 to 5 seconds). It does NOT preempt the traffic signal.

The detection zone would need to be placed according to the queue analysis but will typically be located near the rail crossing. However, using a normal max green time with appropriate gap timing that can clear the observed or 95th percentile queue is strongly preferred over using queue dump detection for two main reasons:

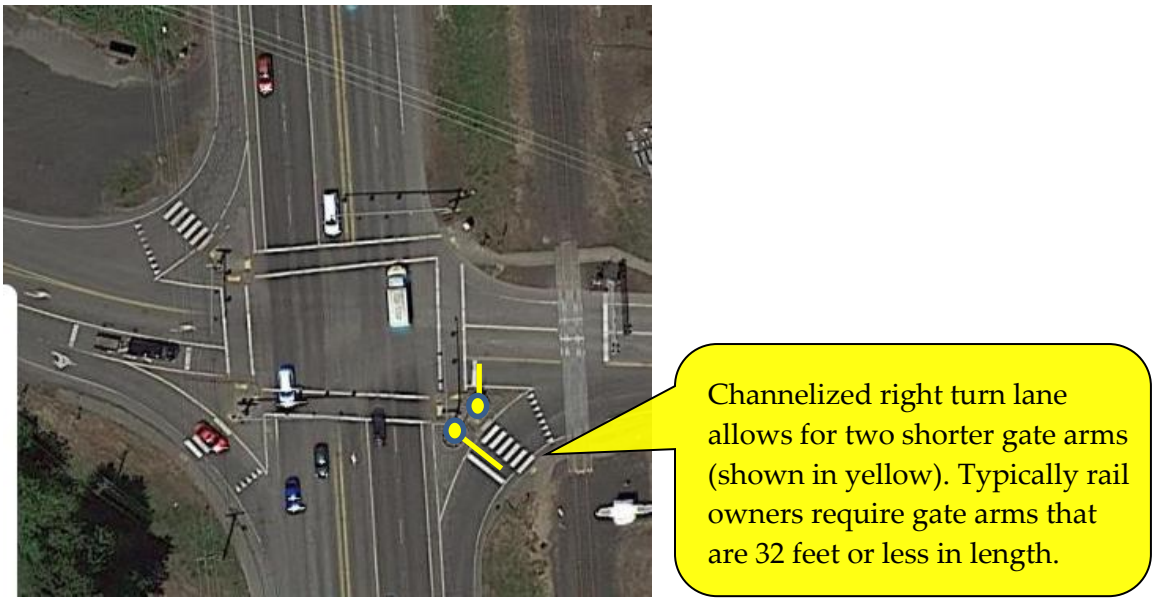
- The dump detection is only truly beneficial if the triggered max green time needs to be substantially longer than a reasonable normal max green time for the approach. While increasing a reasonably normal max green by a nominal amount (to dissipate the queue) will be slightly less efficient if detection isn't functioning, it is a simple and effective solution to address the queue dissipation.
- The cost of extra equipment, maintenance, and labor to keep it functioning as intended.

The default standard detection for this application is a near-side radar unit. See chapter 6 for information about placement of detection devices.

16.8.6 Channelized Right Turn Lanes

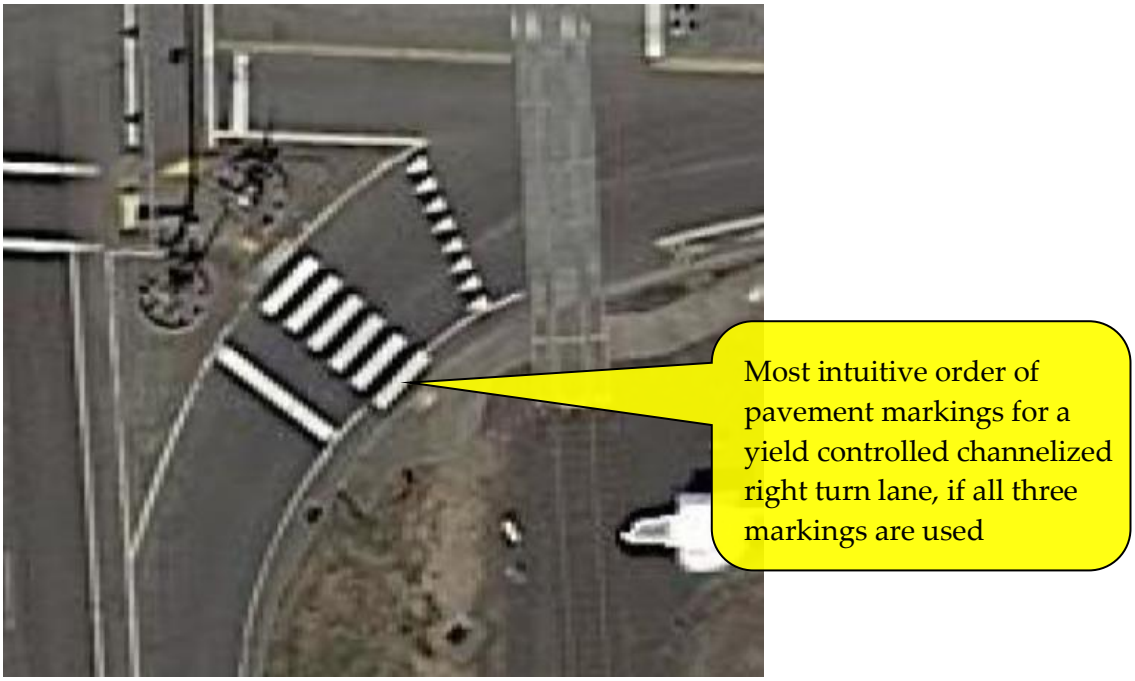
If a right turn only lane exists or is needed, a channelized right turn lane (typically from the mainline onto the side street) is a common request from rail owners. It is typically used at intersections with a rail crossing that is located very close to the intersection in order to keep the rail gate arm lengths to a minimum, especially at locations that have a large radius to accommodate large truck off-tracking. See Figure 16-11. Channelized right turn lanes typically don't require PTR signs. See section 16.8.9.

Figure 16-11 | Channelized Right Turn Lane Example



Yield controlled right turn lanes will have a stop line for the rail gate arm and may also have markings for a crosswalk and a yield line. If all three markings are used, the best order is rail stop line followed by crosswalk marking followed by yield line. This order will help determine the placement of the related traffic control devices. See Figure 16-12.

Figure 16-12 | Yield Controlled Channelized Right Turn Lane Pavement Marking Example

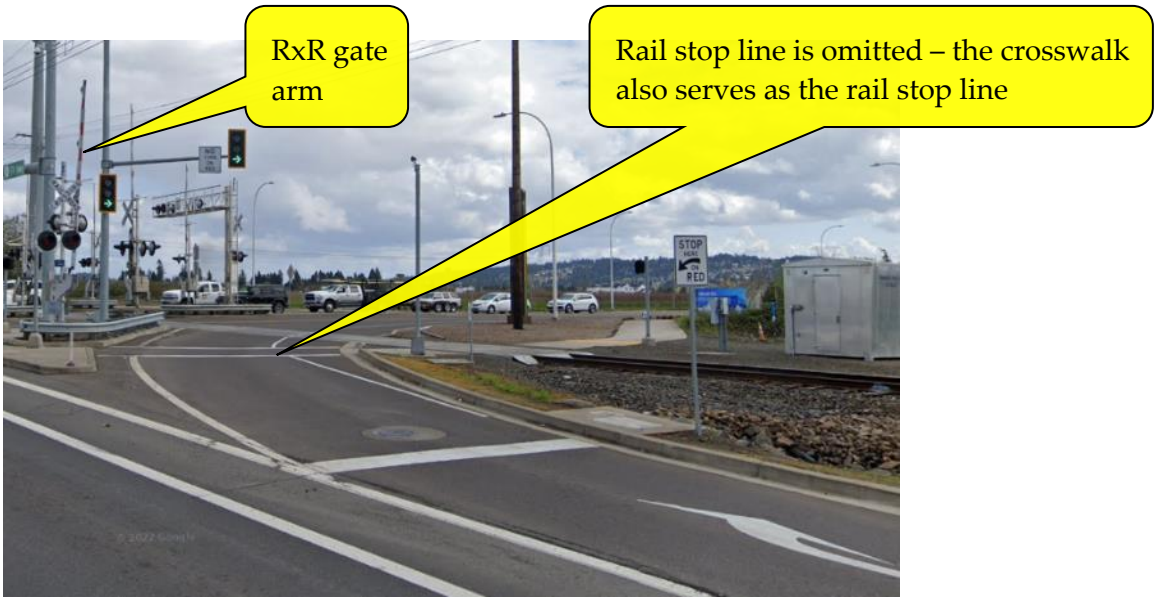


Signal controlled channelized right turn lanes can present a challenge for determining the proper placement of all the necessary traffic control devices, such as the stop line necessary for the signal indications, the crosswalk markings, and the stop line necessary for the rail gate arm. Consider the following standards, that when used together in a small area like a channelized right turn lane, will require some compromise so that final product is not a confusing mess of traffic control device clutter and three different locations for the driver to stop:

- The standard placement of the signal indications for the channelized right turn lane is overhead on a mast arm. This then requires a stop line that is 45 feet from these indications.
- Standard placement of the rail stop line is one foot prior to the gate arm
- The signalized crosswalk requires crosswalk markings and is dependent on the channelized island cut through/ramp geometry

It is nearly impossible to get the crosswalk location to function as the stop line for the signal indications (which would be ideal), but it is typically possible to get the crosswalk location to function as the stop line for the rail gate arm. See Figure 16-13 for example.

Figure 16-13 | Signal Controlled Channelized Right Turn Lane Pavement Marking Example 1



Having the stop line for the right turn lane 45 feet from the signal indications makes that location pretty far away from the crosswalk and normal stopping location of the adjacent through phase; this may not get good compliance from drivers. If a driver pulls too far forward, they won't be able to see the signal indications. To mitigate this concern and also allow some flexibility to move the stop location closer to the intersection (to a more intuitive stop location), a low mounted supplemental signal head (14' to bottom of signal head) on the mast arm pole is recommended. See Figure 16-14.

Figure 16-14 | Signal Controlled Channelized Right Turn Lane Pavement Marking Example 2

16.8.7 Median Islands

Median islands are common on the approach leg of a railroad crossing. They typically serve two main purposes. See Figure 16-15.

- To keep vehicles from driving around a gate arm that is down
- To keep the rail gate arm lengths to a minimum (maximum length allowed is typically 32 feet)

Figure 16-15 | Median Island Example

16.8.8 Crosswalk Placement and Stop Lines

Crosswalk and stop line locations at a rail interconnected signal are important considerations as they have an impact on preemption operation and driver compliance.

When the tracks are located very close to the intersection, there may be an opportunity to place the crosswalk for that approach prior to the railroad tracks. This provides a very clear stop location (only one marking) vs. two separate stop locations (a stop line prior to the tracks and a crosswalk marking after the tracks). A VCOI phase may not be needed. However, it does typically pull the crosswalk farther back from the intersection which can impact sight lines (see chapter 5 for more info on sight lines) and typically requires a NO TURN ON RED sign. See Figure 16-16 and Figure 16-17 for examples.

Figure 16-16 | Crosswalk Prior to Railroad Crossing Example 1

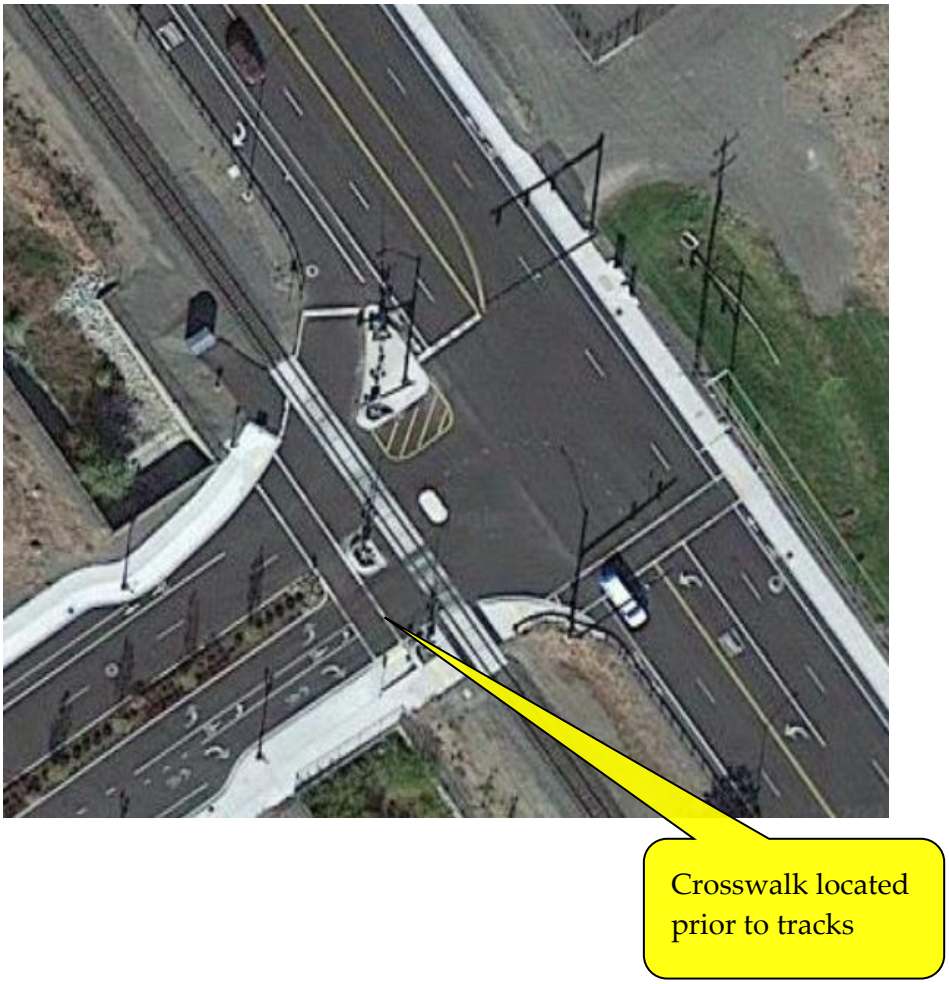


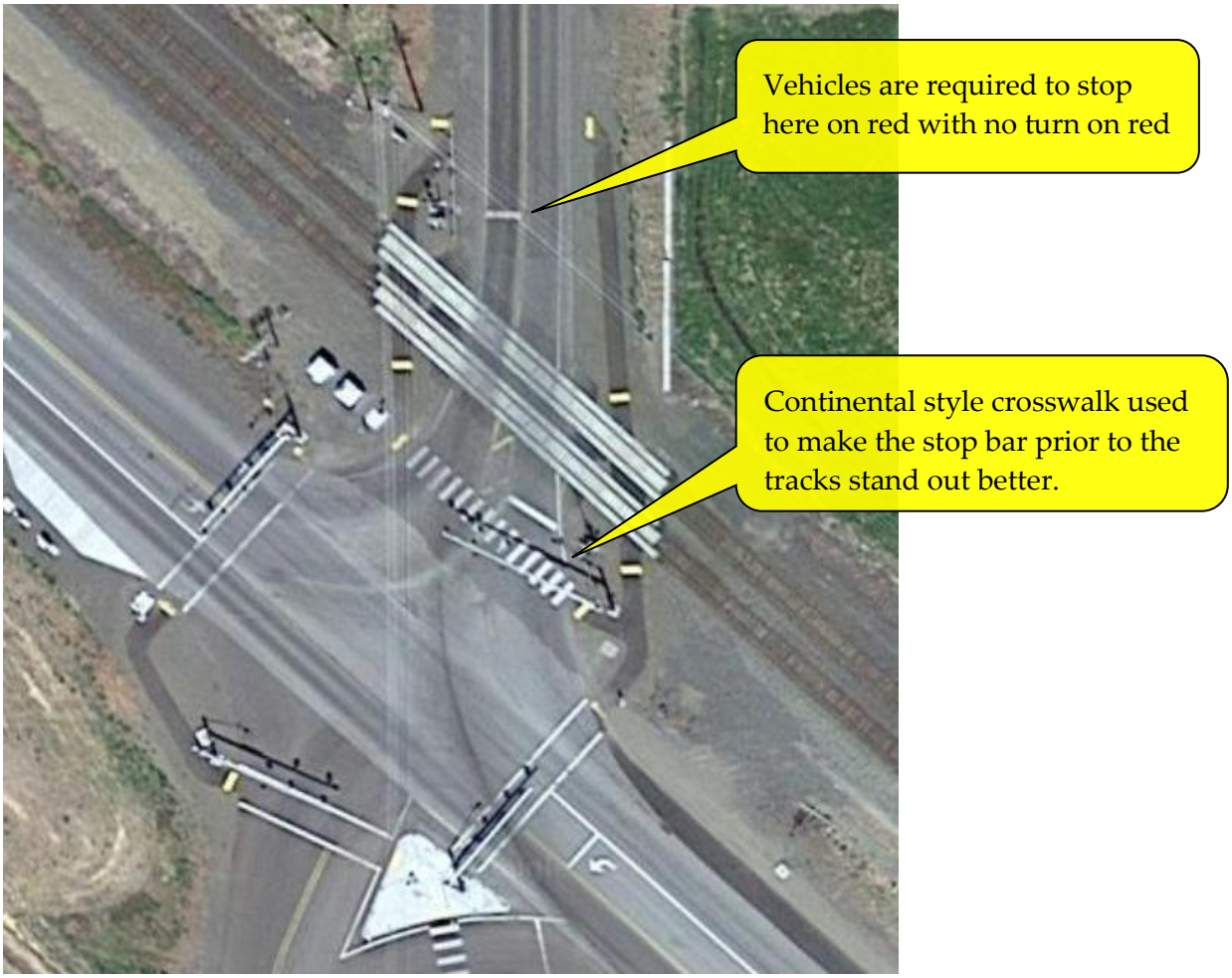
Figure 16-17 | Crosswalk Prior to Railroad Crossing Example 2

Two separate stop locations: A marked crosswalk after the tracks and a stop bar prior to the tracks. Drivers may inappropriately decide to stop at crosswalk. Below is a potential solution

Same intersection as above, but with marked crosswalk moved prior to the tracks. One clear place to stop now, driver compliance may improve, but sight lines and ped circulation path may be impacted.

Using a continental style crosswalk, instead of the standard transverse bars, when two separate stopping locations must be marked may also be beneficial to make each marking stand out better and in theory help with driver compliance (when the intent is for all drivers to stop and remain stopped at the stop line prior to the tracks).

Figure 16-18 | Continental Crosswalk Used at a Rail Crossing with an Advance Stop Location



It is best to keep crosswalk distances as short as possible at rail interconnected traffic signals as the PCOI time needed at the intersection is based on the longest flashing don't walk time. The extra seconds from an unnecessarily long crosswalk can add a lot of expense and may be very difficult or not even feasible for the rail owner to provide in certain cases.

For channelized right turn lanes crosswalk and stop line information, see section 16.8.6.

16.8.9 Signs – Part Time Restriction (PTR)

Part-time restriction (PTR) signs are typically installed at the traffic signal based on MUTCD section 8B.08 and the field diagnostic review. These signs state a turn restriction, such as NO LEFT TURN sign (R3-2) or NO RIGHT TURN sign (R3-1) that are used for permissive only turns that will cross the railroad tracks when the simultaneous input is triggered (e.g., PTR sign will be ON and restrict the turn movement only during the VCOI and limited service phases). See Figure 16-19 and Figure 16-20.

Figure 16-19 | Part-Time Restriction "NO LEFT TURN" Sign Example

Figure 16-20 | Part-Time Restriction "NO RIGHT TURN" Sign Example

The NO RIGHT TURN sign (R3-1) is the most common PTR sign used for rail preemption, as most right turn movements toward the rail crossing are permissive and right turns on red are typically allowed. The NO LEFT TURN sign (R3-2) is rarer, as the left turn toward the rail crossing is typically not a permissive only left turn and left turns on red are typically not legal. These PTR signs are valuable in most circumstances to provide additional warning of a train preemption and a necessary prohibition of turning movements (which can also help prevent damage to the railroad gate arms when tracks are located very close to the intersection), but they should be omitted for certain geometries or signal phasing (to avoid the PTR sign contributing to traffic control device clutter):

- The distance from the intersection to the rail crossing is greater than 100 feet (e.g., there is adequate sight distance for the turning vehicle to see and react to the RxR lights/gate and room to store the design vehicle without blocking the intersection or crosswalk. See Figure 16-21.
- The left or right turn movement toward the rail crossing is a protected only or protected/permitted movement and turns on red are not allowed (e.g., the signal head for the turn movement is capable of displaying an independent red indication when the simultaneous preempt input is triggered and statue or signs prohibit turns on red). See Figure 16-22 and Figure 16-23.
- The right turn is channelized with YIELD or STOP control. See Figure 16-24.

When used, these signs are mounted on the signal mast arm (preferred) or on the signal mast arm pole and are detailed on the signal plan sheet.

Figure 16-21 | Omitting the Part-Time Restriction Signs Example 1

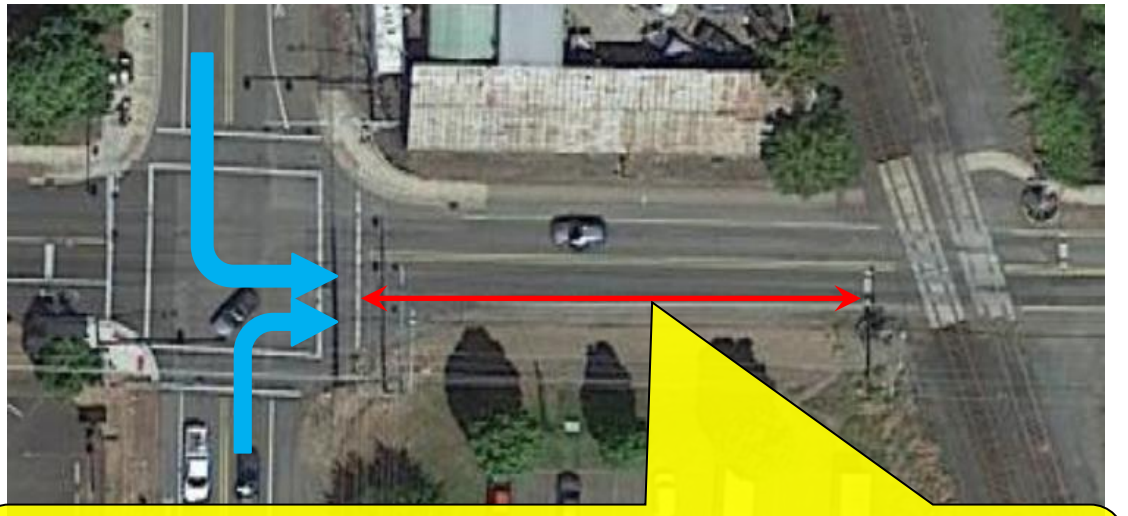


Figure 16-22 | Omitting the Part-Time Restriction Sign Example 2

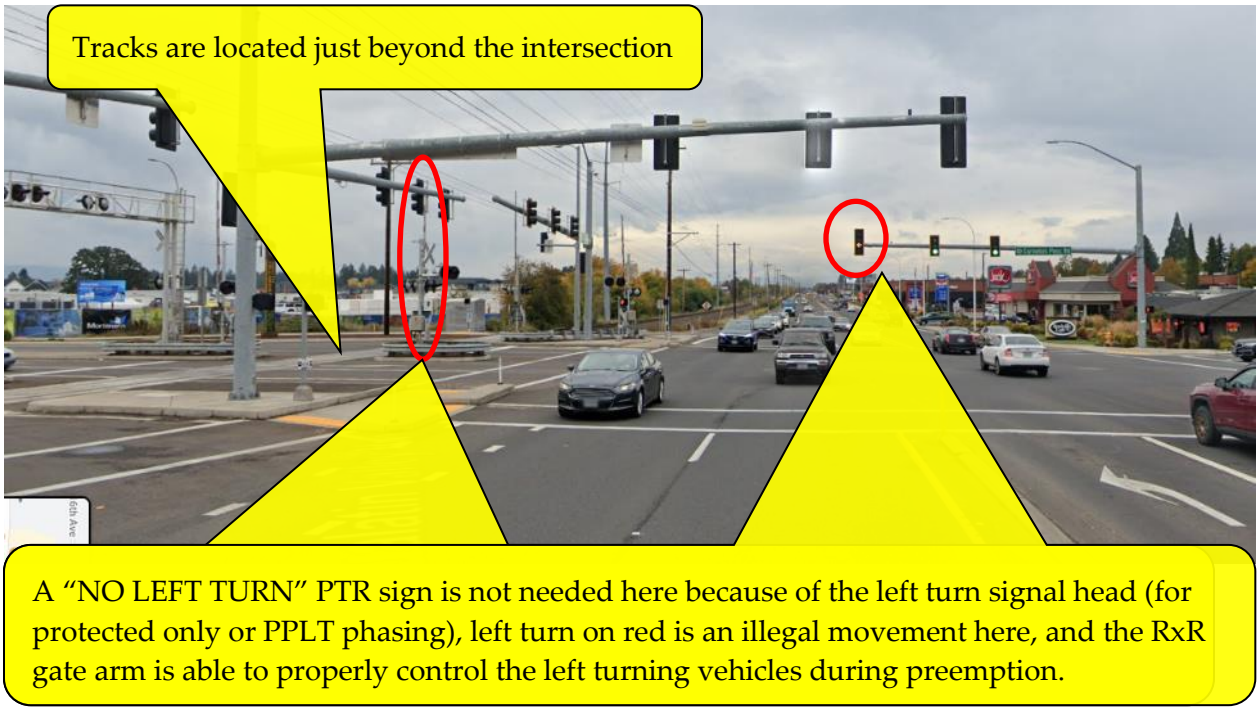


Figure 16-23 | Omitting the Part-Time Restriction Sign Example 3

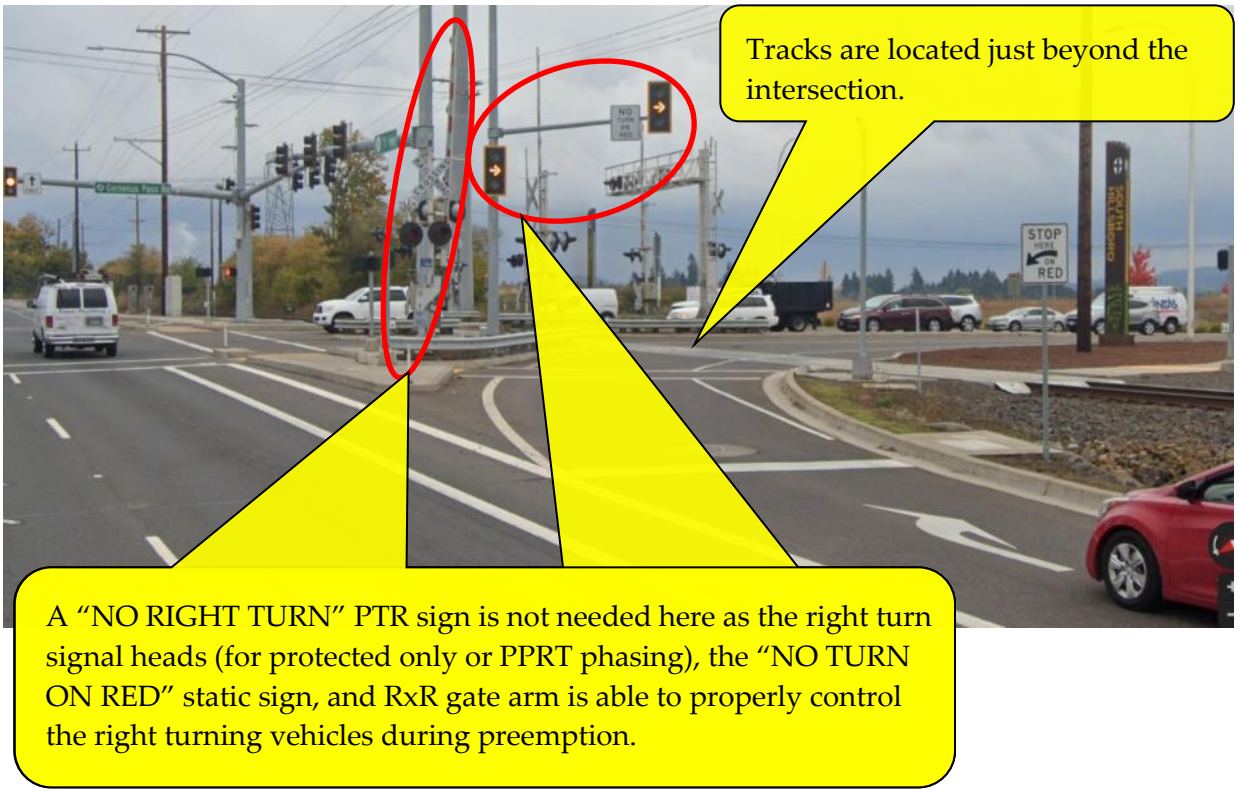


Figure 16-24 | Omitting the Part-Time Restriction Sign Example 4

16.8.10 Signs – STOP HERE ON RED & NO TURN ON RED

The STOP HERE ON RED sign (R10-6) and the NO TURN ON RED sign (R10-11a) can be beneficial at interconnected rail crossing with certain geometries and are critical signs for how the preemption will operate.

The STOP HERE ON RED sign is placed at the railroad stop line (see Figure 16-25) and should be considered when:

- There is not enough room for a single passenger vehicle to safely queue without stopping on the tracks. The volume/frequency of freight and other larger vehicles should also be taken into consideration.
- If the crosswalk for the intersection is located prior to the railroad tracks. In this case, there is not a separate railroad stop line and the STOP HERE ON RED sign would be located at the near side of the crosswalk line (the near side of the crosswalk line functions as the stop location for the intersection as well as for the tracks). See Figure 16-26.

Figure 16-25 | STOP HERE ON RED sign example 1

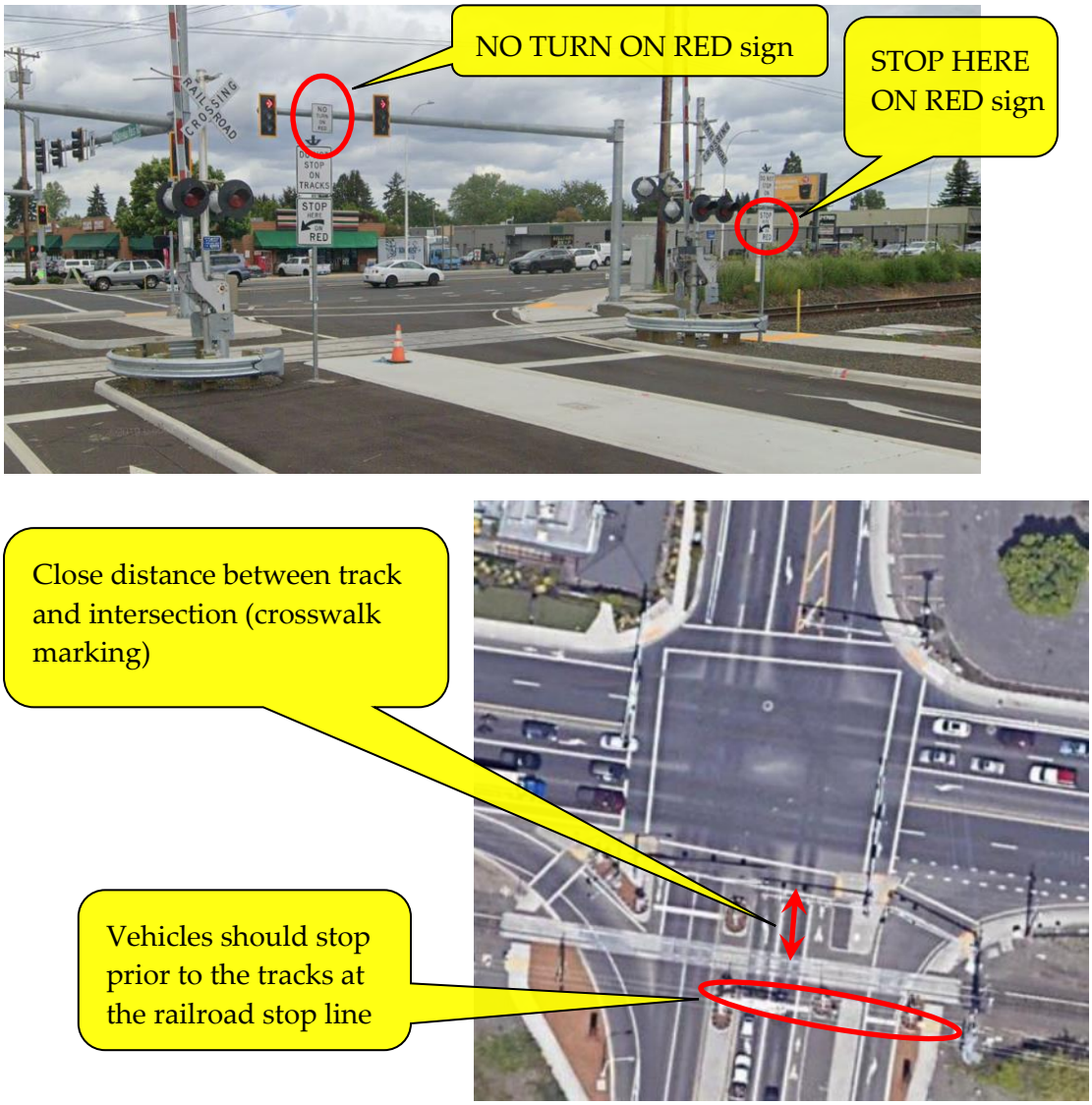
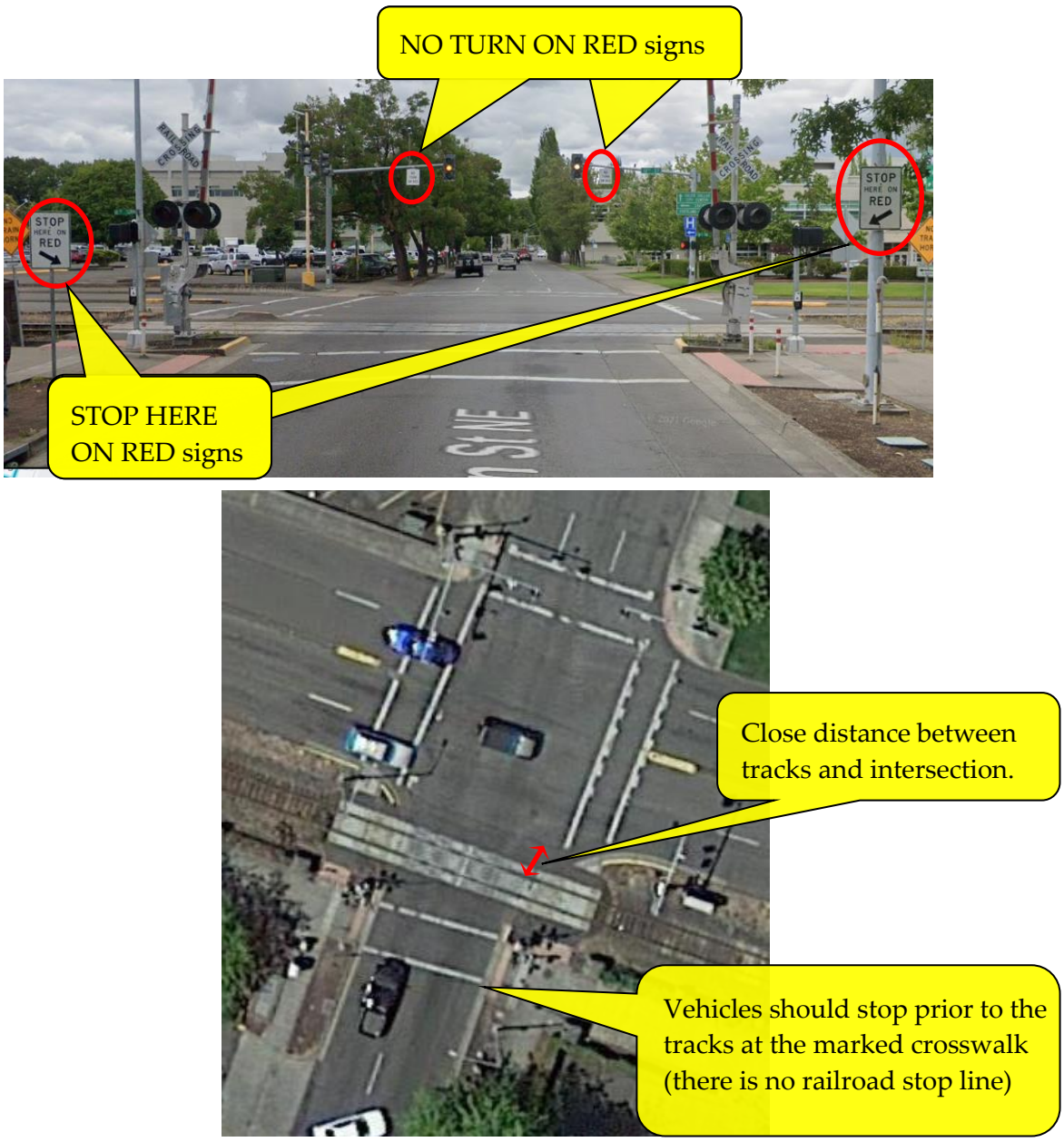


Figure 16-26 | STOP HERE ON RED sign example 2



The NO TURN ON RED sign for the right turn movement (or left turn movement if a left turn on red is legal) shall be used in conjunction with the STOP HERE ON RED sign to reduce the risk of a right on red vehicle stopping on the tracks.

If pre-signals are used at the intersection, the NO TURN ON RED sign should be placed only with the pre-signals, not with the downstream signals. If the sign is placed on the downstream signals, a driver that was inattentive of the NO TURN ON RED sign at the pre-signals and

pulled forwarded between the tracks and the intersection (to get better sight distance to judge gaps) might remain stopped there if they happen to notice a NO TURN ON RED sign placed with the downstream signals. If they missed sign at the pre signal (and they are now stopped where they should not be), it is better that they just complete their turn on red rather than remaining stopped on the tracks.

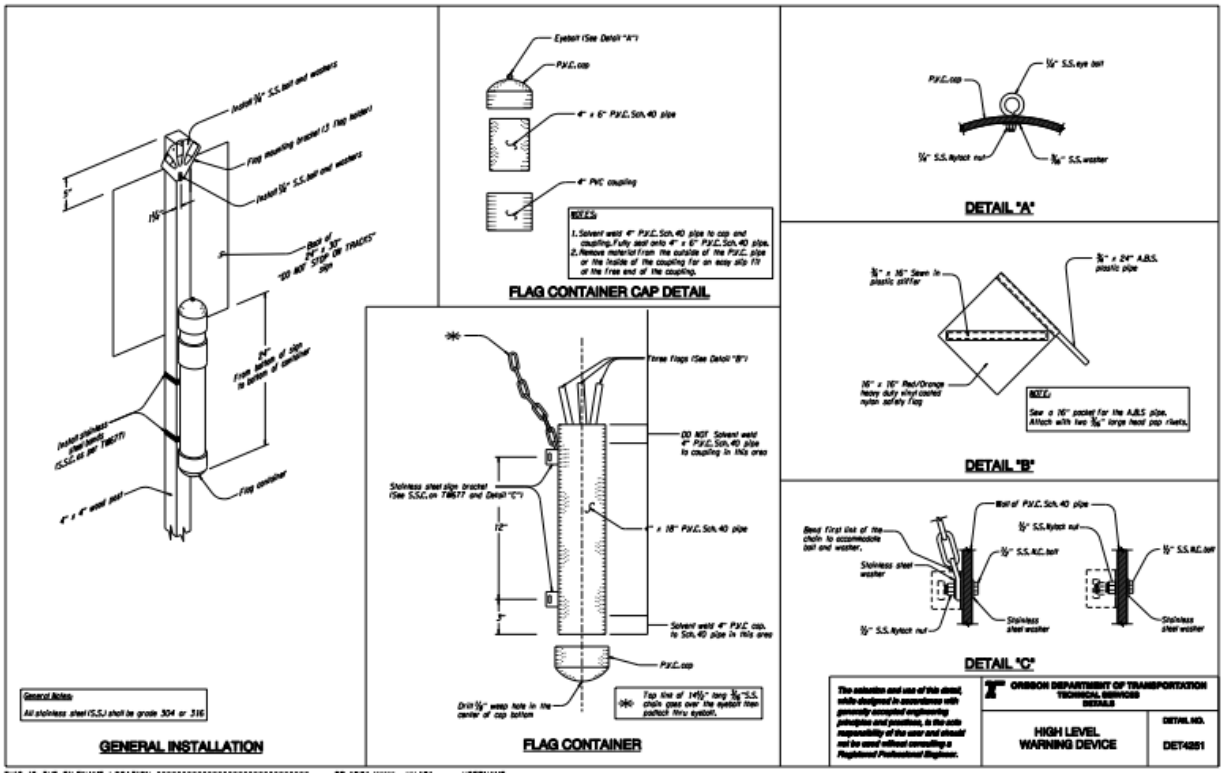
The NO TURN ON RED sign is typically mounted on the signal mast arm or signal mast arm pole and is detailed in the signal plan.

The STOP HERE ON RED sign is typically ground mounted near the stop line and is shown and detailed in the sign plan sheets only.

16.8.11 Signs – DO NOT STOP ON TRACKS & High-Level Warning Device

All rail interconnected traffic signals require a DO NOT STOP ON TRACKS sign (R8-8) that is capable of holding 3 flags (i.e., the high-level warning device) as per OAR 741-115-0040. The high-level warning device fabrication and installation is shown in standard detail DET4251. This sign with the high-level warning device is ground mounted near the railroad tracks and is shown and detailed in the sign plan sheets only. See Figure 16-27.

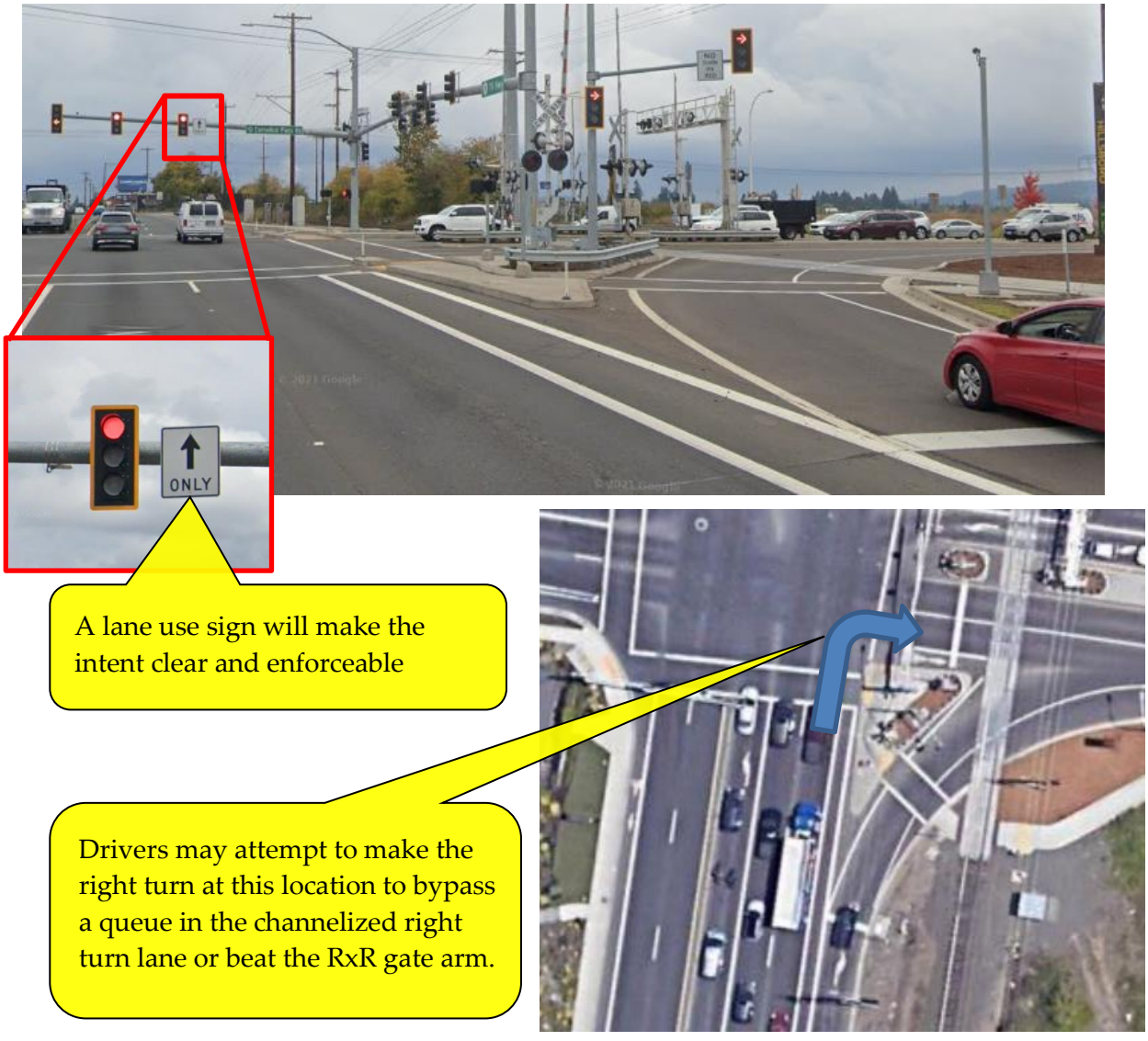
Figure 16-27 | High Level Warning Device – DET4251



16.8.12 Signs – Lane Use

Lane use signs can also be beneficial for certain intersection geometries to help deter drivers from attempting to go around/beat the RxR gate arm or bypass the right turning queue. When a channelized right turn is provided towards the tracks, it can still be physically possible (and debatably legal) for a vehicle to make a right turn from the adjacent thru lane past the pork-chop island even though that is not the intent. A THRU ONLY sign (R3-5) installed on the mast arm for the lane adjacent to the right turn slip lane is a good solution to make the intent clear and enforceable when there is an actual or expected issue with this driver behavior. See Figure 16-28.

Figure 16-28 | Lane Use Sign Example



16.8.13 Conduit and Wiring

The railroad preemption operation is triggered by the railroad controller that monitors the railroad tracks and detects an approaching train. The traffic signal receives the preemption inputs from the railroad controller via the interconnect circuits, which are hardwired from the signal controller cabinet to the railroad control cabinet.

The conduit and wiring required to connect the traffic signal controller to the railroad controller, providing the ability for railroad preemption, is shown on the signal plan sheet. This wiring consists of one 10 conductor No. 12 AWG gauge control cable from the controller cabinet to the railroad cabinet. In retrofit situations, eight No. 12 AWG THWN wires can be used if conduit fill rate is an issue. An exclusive conduit for this wire should be used for new construction.

Figure 16-29 shows an example of how this should be detailed on the signal plan sheet. The railroad will typically install an access box on the outside of their bungalow for the conduit and wiring. See Figure 16-30. The contractor needs to coordinate with rail owner when installing the conduit and wiring at the railroad bungalow.

Figure 16-29 | Railroad Preemption Wiring Example

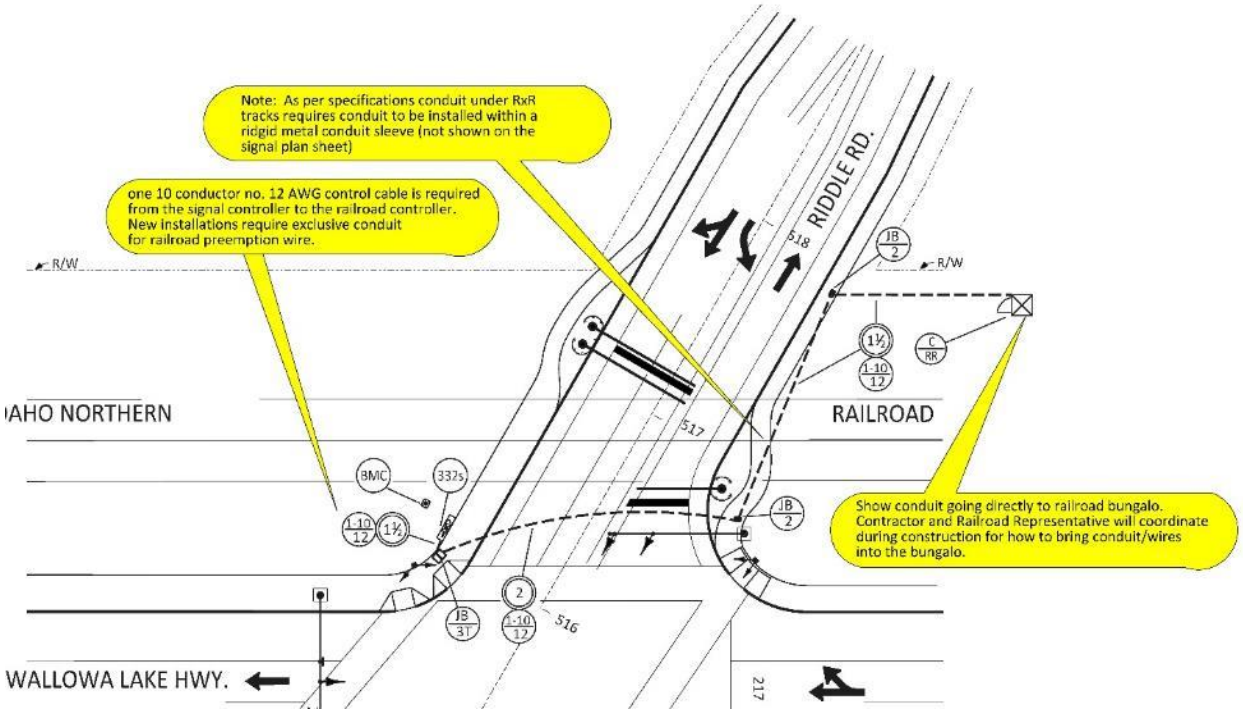


Figure 16-30 | Railroad Bungalow Access Box for Interconnect Conduit and Wiring

16.8.14 Pedestrian Features

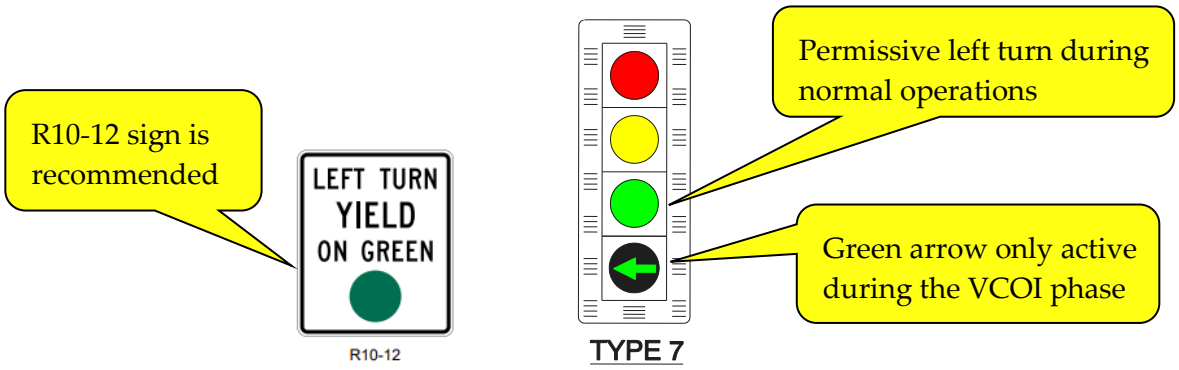
When upgrading existing traffic signals that have railroad preemption, the PCOI time will need to be recalculated using the 2009 MUTCD guidelines. The recalculated PCOI will likely result in a longer PCOI, which requires a rail crossing order for the alteration of the rail detection equipment. If funding is available and the project timeline allows, a rail crossing order and alteration of the rail detection equipment should be completed.

In situations where the recalculated PCOI is longer than the existing PCOI and funding is not available or there is not enough time to process a rail crossing order, the use of two pedestrian change intervals may be used. This allows the use of a consistent flashing don't walk time with two different walk times in order to satisfy the MUTCD requirements AND keep the countdown pedestrians heads functioning as normally as possible during and after a preemption event. See chapter 5 "Extended Pushbutton Press Feature" section for more information.

16.8.15 Type 7 Signal Heads

A type 7 signal head is required for the vehicle clear-out phase when the vehicle clear-out phase contains a permissive only left turn movement. See Figure 16-31. The "LEFT TURN YIELD ON GREEN ball" sign (R10-12) should be installed when a type 7 head is installed. This allows use of a green arrow only during the vehicle clear-out interval (VCOI) so that vehicles will be aware they have a protected left turn movement during the railroad preemption sequence. In the past when green balls were used during the VCOI, motorists would often hesitate when making a left turn as they weren't sure if/why the opposing through traffic was stopping.

Figure 16-31 | Type 7 Signal Head



Note that permissive only left turns from the stem of a t-intersection or permissive only left turns with no opposing vehicular traffic (e.g., one way street) can operate acceptably without a type 7 signal head. See Figure 16-32. While a type 7 signal head will still be used in these situations for new construction (for consistency/uniformity), the message it conveys (to make it clear to drivers that the normal need to yield to oncoming vehicles doesn't apply when a train is approaching) isn't applicable when there normally isn't oncoming vehicles.

Figure 16-32 | Permissive Only Left Turn (No Oncoming Traffic) – Type 7 Signal Head Not Critical for Proper Preemption Operation

16.8.16 Limited Right-Of-Way for Equipment

It can be challenging at times to fit in all the required rail equipment and all the required traffic signal equipment while still maintaining proper clearances, sight lines to all traffic control devices, and meeting all standards. In these cases, work closely with the state traffic signal engineer and ODOT commerce and compliance division to determine if any unique solutions can be implemented or where compromises can be made. See Figure 16-33 and Figure 16-34 for examples.

Figure 16-33 | Unique Solutions – Example 1

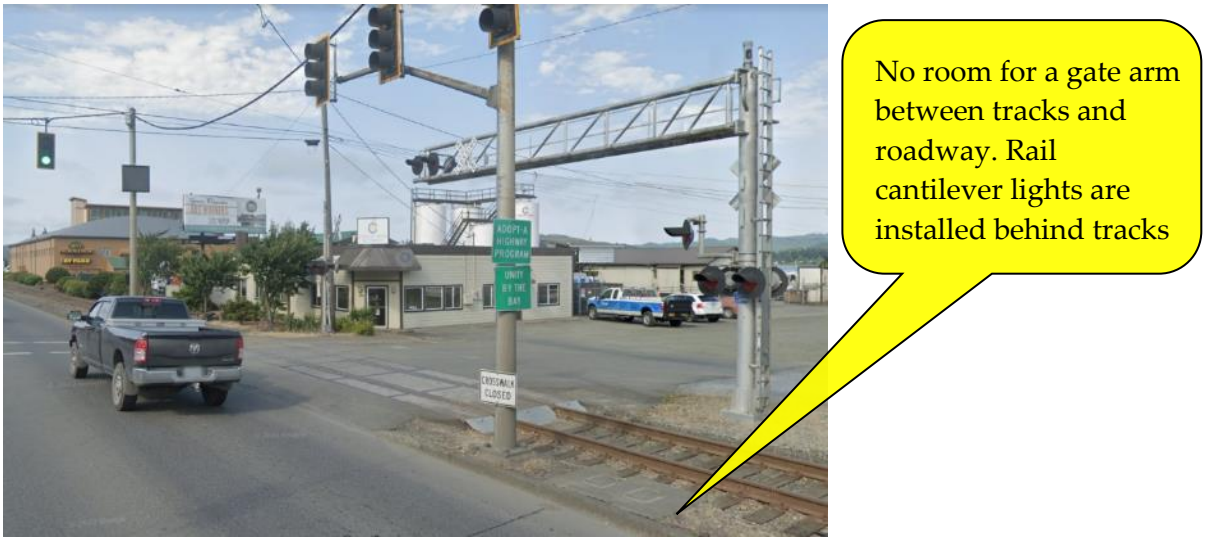


Figure 16-34 | Unique Solutions – Example 2

16.9 Traffic Control Devices Activated by The Rail Controller Cabinet

It is rare, but not uncommon to have traffic control devices (TCD) directly and exclusively activated via the rail controller cabinet rather than going through a traffic signal controller. Typical examples of these type of systems include "be prepared to stop when lights flash" signs, PTR signs, and VMS. See Figure 16-35 and Figure 16-36 for examples.

Figure 16-35 | Example 1 of Rail Controller Cabinet Activated Traffic Control Device

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Figure 16-36 | Example 2 of Rail Controller Cabinet Activated Traffic Control Device

When a project has a rail controller cabinet activated traffic control device, follow the guidance listed below:

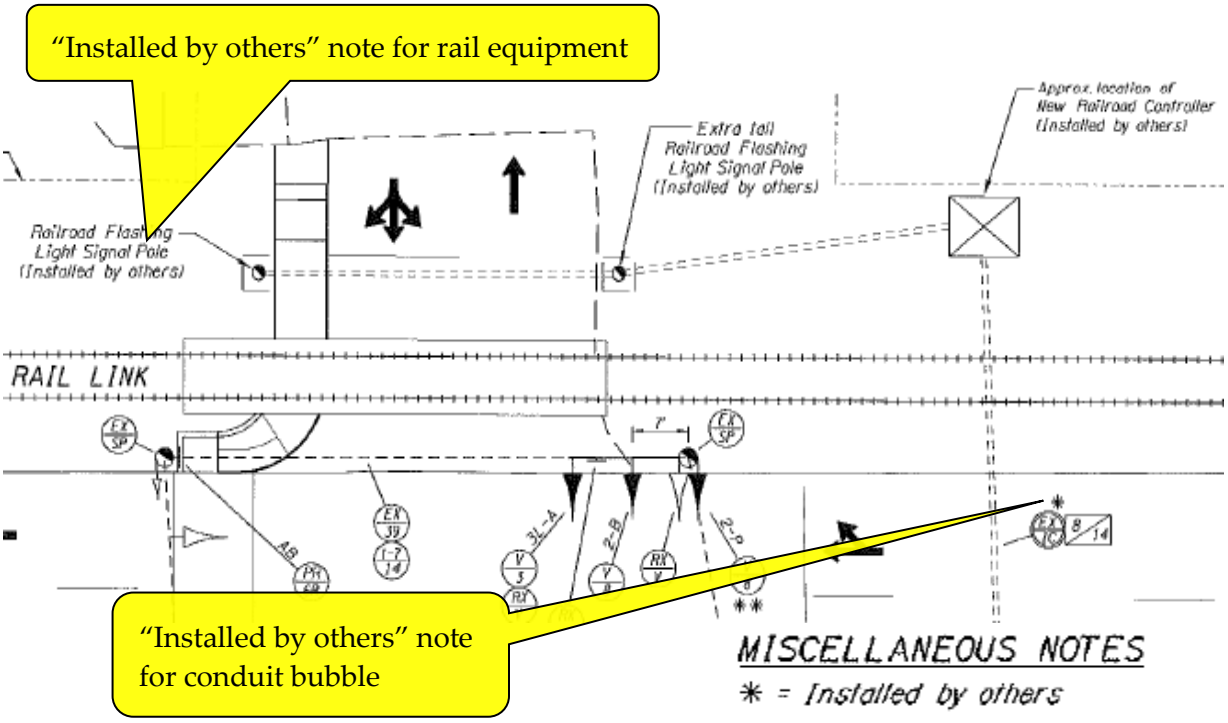
- The signal designer will produce a plan sheet that shows the TCD, junction boxes, & conduit and wiring (up to the rail bungalow). The contractor will install these devices.
- The rail owner will provide an interface box on the outside of their bungalow.
- The rail owner is responsible for the control system that activates the TCD. The rail owner will install wiring/devices in their cabinet.
- On state highways, the rail activated TCD requires STE operational approval (the STE operational approval will state requirements as necessary, with concurrence from ODOT commerce and compliance division).
- Off state highways, the ODOT commerce and compliance division shall document any necessary operational/design requirements as per the diagnostic team in the rail crossing order. The local agency's policies/procedures for TCDs shall also be followed.
- The rail crossing order will establish who owns and maintains the TCD. Typically, the road authority will own and maintain the TCD (and the conduit/wiring from the TCD to the railroad bungalow). The rail equipment and TCD should be powered from separate services. If the TCD is powered from the rail equipment service, a power disconnect that that highway agency can easily access will be necessary to safely maintain the TCD.
- When the TCD will go into service, the owner & maintainer of the TCD will be on-site and verify proper operation and approve the installation.

16.10 Other Work – Railroad Grade Crossing System

The railroad owner is typically responsible for installing the grade crossing system, including train detection equipment on the rails, gate arms, railroad flashing beacon assemblies, and the railroad cabinet. This work is paid for through railroad agreements and typically not shown in ODOT contract plans. The resident engineer's office will coordinate with the contractor and the railroad owner to install these items.

The grade crossing system may be symbolically shown, but not detailed, on the signal plan sheets. If needed, these features may also be noted as "installed by others" to clarify which features the contractor is NOT responsible for. See Figure 16-37.

Figure 16-37 | Railroad Equipment Installed by Others



Other disciplines will be responsible for detailing work that is needed as per the crossing order.

Roadway plans will detail the following:

- The location of the crossing signal equipment, foundations, railroad signal house.
- The quantity of new crossing surfacing materials
- Sidewalk work to be constructed up to the crossing surface

Sign plans will detail ground mounted signs required by the crossing order.

Striping plans will detail the pavement markings required by the crossing order.

16.11 Other Work – Railroad Preemption Plan Sheet

ODOT commerce and compliance division requires a separate, sealed railroad preemption plan sheet to be included with the railroad-highway public crossing safety application. This plan sheet contains the operational requirements of the preemption. See chapter 21 for the drafting requirements and examples. In the past, this plan sheet was included in the contract plans, but is now contained within the rail crossing order (as it doesn't include any information pertinent to the contractor's work). It is still archived in filenet and now also included with the cabinet print (see chapter 20 for more information about the cabinet print).

NOTE: The field diagnostic review determines the type of preemption operation and necessary traffic control devices to accommodate the desired operation. The railroad preemption plan sheet is part of the operational documentation required for the rail crossing order.

The railroad preemption plan sheet will be completed early on in the project, DAP or preliminary plans, prior to completion of the other signal plan sheets for the project. Therefore, the traffic engineering section will issue a TRS drwg. no. for ONLY the railroad preemption plan sheet at this time.

The rail preemption plan sheet shall be reviewed by region traffic, ODOT commerce and compliance division, and the traffic engineering section.

The final stamped and digitally signed rail preemption plan sheet should be sent to the traffic engineering section for approval. The traffic engineering section will then submit an electronic copy of the approved plan sheet to the ODOT commerce and compliance division for use in the rail crossing order and archive the plan sheet.

The railroad preemption plan sheet is NOT part of the contract plan set.

16.11.1 Signal Modifications That Require Updating the Preemption Plan Sheet

It is important to always contact the ODOT commerce and compliance division when any work or maintenance is being considered within their jurisdiction, no matter how minor. See the ODOT Traffic Manual for more information about the process and coordination.

The rail preemption plan is part of the crossing order and needs to be accurate for the initial installation and future routine maintenance inspections performed by ODOT commerce and compliance division inspectors and TSSU. Therefore, the following list states common intersection/traffic signal modifications that require updating the preemption plan sheet in the

crossing order, even if they don't have a direct impact on the rail crossing. Note that the crossing order process may be abbreviated if the changes are minor or they do directly impact the rail crossing.

- Adding or removing lanes
- Changing existing lane use
- Opening or closing crosswalks
- Adding or removing type 7 signal heads
- Adding or removing any vehicle/pedestrian signal phases
- Adding or removing split phasing
- Changing existing left turn phasing (e.g., protected to PPLT, etc.)
- Adding or removing any signs used for or are critical to railroad preemption (e.g., PTR signs, NO TURN ON RED signs, STOP HERE ON RED signs)
- Modifying anything in the rail preemption operation sequence

This list is not all inclusive. It is intended to inform you of when a preemption plan sheet is likely needed for retro-fit projects and to help facilitate communication with the ODOT commerce and compliance division.

Certain traffic signal items are purposely not shown on the preemption plan sheet, such as fire preemption, signal head types (except for type 7), signal head spacing, conduit, wiring, etc. Changes to these items don't require an updated preemption plan sheet. However, even if an updated preemption plan sheet is not required, a crossing order could still be required depending on the scope of work, which is why it is important to always contact the ODOT commerce and compliance division. ODOT commerce and compliance division is the final authority regarding the requirements within their jurisdiction.