ORIGINATOR Director, Bureau of Traffic Operations		3-4-7
CHAPTER 3	Project Scoping Process & Geometric Design Considerations	
SECTION 4	Operational Considerations	
SUBJECT 7	Railroads	

According to the *MUTCD*, Part 8C.09, whenever a traffic control signal is located within 200-ft of a highway-rail grade crossing equipped with a flashing-light signal system, the traffic control signals *should* be interconnected to provide preemption. This distance criteria *may* need to be greater than 200-ft when conditions warrant (i.e. percent large trucks, queuing over tracks based on 95% probability levels, or unique geometric conditions).

Any planned traffic signal in the vicinity of a highway-rail grade crossing will require close coordination with WisDOT Railroads & Harbors Section (RHS) in the Bureau of Transit & Local Roads (BTLR) and the appropriate railroad authority. Such coordination will likely affect the project budget and schedule. Early coordination will help minimize project delays, especially if work needs to be performed by the railroad (i.e. new or relocated control cabinet, interconnection, advance pre-emption circuits, gates, constant warning time circuitry, etc.)

A protected left turn signal indication **shall** be provided for the left turns from the intersection approach that crosses the tracks. The protected left turn indication (displayed as a green arrow) may or may not be displayed during normal signal operation depending on the normal signal phase sequence. Refer to TSDM 3-4-1 for guidance on left turn phasing. Protected left turn indications at intersection approaches that cross the tracks **shall** display a green signal indication during the track clearance interval. The intent of the protected left turn indication is to minimize hesitation from drivers waiting to clear the crossing.

Timing calculations for appropriate advance warning will need to be provided to RHS for purposes of determining proper railroad systems design. Advance preemption calculations **shall** be determined for best-case and worst-case scenarios, based on planned phasing/timing schemes.

A railroad preemption timeline *should* be prepared and submitted to RHS with the advanced preemption calculations.

Highway Safety Improvement Program (HSIP) funding *may* be available for highway-rail grade signal interconnection projects. The WisDOT RHS *may* also be able to provide such funding.

If a traffic control signal will be pre-empted by railroad operations, then a signal cabinet battery back-up unit **shall** be used per TEOpS 4-2-8.

The following is a resource that *may* be used to determine proper design and timing principles include the following links: http://tti.tamu.edu/documents/1439-9.pdf

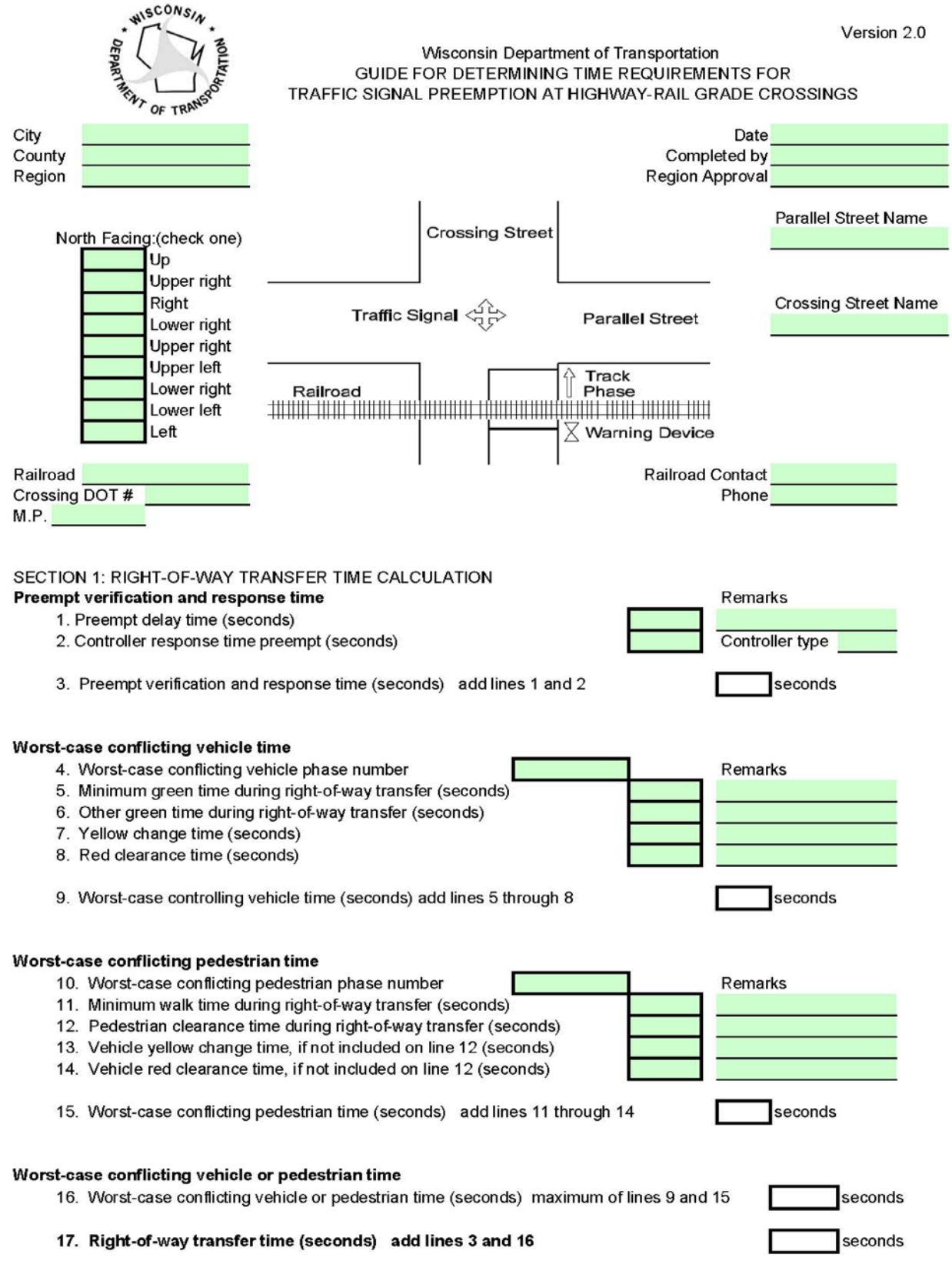
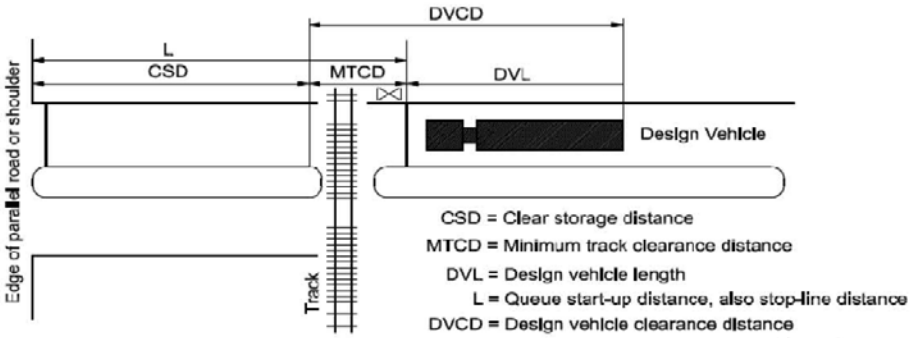


Figure 1a. Railroad Preemption Time Requirements

SECTION 2: QUEUE CLEARANCE TIME CALCULATION



Remarks

18. Clear storage distance (CSD, feet)
19. Minimum track clearance distance (MTCD, feet)
20. Design vehicle
    School Bus (use 45 feet)
    WB-62 (Semi Trailer) - (use 75 feet)

21. Queue start up distance, L (feet) add lines 18 and 19

Remarks

22. Time required for design vehicle to start moving (seconds): calculated as 2+(L/20)
23. Design vehicle clearance distance, DVDC (feet): add lines 19 and 20
24. Time for design vehicle to accelerate through the DVCD (seconds) See Figure 2
25. **Queue clearance time (seconds): add lines 22 and 24**

SECTION 3: MAXIMUM PREEMPTION TIME CALCULATION

Remarks

26. Right-of-way transfer time (seconds): line 17
27. Queue clearance time (seconds): line 25
28. Desired minimum separation time (seconds)
29. Maximum preemption time (seconds): add lines 26 through 28

SECTION 4: SUFFICIENT WARNING CHECK TIME

Remarks

30. Required minimum time, MT (seconds): per regulations
31. Clearance time, CT (seconds): get from railroad
32. Minimum warning time, MWT (seconds): add lines 30 and 31
33. Advance preemption time, APT, if provided (seconds): get from railroad
34. Warning time provided by the railroad (seconds): add lines 32 and 33
35. **Additional warning time required from railroad (seconds): subtract lines 34 from line 29, round up to nearest full second, enter 0 if less than 0**

If the additional warning time required (line 35) is greater than zero, additional warning time has to be requested from the railroad. Alternatively, the maximum preemption time (line 29) may be decreased after performing an engineering study to investigate the possibility of reducing the values on lines 1,5,6,7,8,11,12,13 and 14.

Remarks

Figure 1b. Railroad Preemption Time Requirements

SECTION 5: TRACK CLEARANCE GREEN TIME CALCULATION (OPTIONAL)

Preempt Trap Check

36. Advance preemption time (APT) provided (seconds): — Line 33 only valid if line 35 is zero.
37. Multiplier for maximum APT due to train handling — See instructions for details
38. Maximum APT (seconds): multiply line 36 and 37 — Remarks
39. Minimum duration for the track clearance green interval (seconds) — For 0 advance preemption time
40. Gates down after start of preemption (seconds): add lines 38 and 39
41. Preempt verification and response time (seconds): line 3 — Remarks
42. Best-case conflicting vehicle or pedestrian time (seconds): usually 0
43. Minimum right-of-way transfer time (seconds): add lines 41 and 42
44. Minimum track clearance green time (seconds): subtract line 43 from line 40

Clearing of Clear Storage Distance

45. Time required for design vehicle to start moving (seconds). Line 22
46. Design vehicle clearance (DVCD, feet), line 23 — Remarks
47. Portion of CSD to clear during track clearance phase (feet) — CSD* in figure 3 in Instructions
48. Design vehicle relocation distance (DVRD, feet): add lines 46 and 47
49. Time required for design vehicle to accelerate through DVRD (seconds)
50. Time to clear portion of clear storage distance (seconds): add lines 45 and 49
51. **Track clearance green interval (seconds): maximum of lines 44 and 50, round up to nearest full second**

SECTION 6: VEHICLE-GATE INTERACTION CHECK (OPTIONAL)

52. Right-of-way transfer time (seconds): line 17
53. Time required for design vehicle to start moving (seconds), line 22
54. Time required for design vehicle to accelerate though DVL (seconds) — DVL= 0 ft
55. Time required for design vehicle to clear descending gate (seconds): add lines 52 through 54
56. Duration of flashing lights before gate descent starts (seconds): get from railroad
57. Full gate descent time (seconds): get from railroad
58. Proportion of non-interaction gate descent time (percent - show as decimal) — d=
59. Non-interaction gate descent time (seconds): multiply lines 57 and 58
60. Time available for design Vehicle to clear descending gate (seconds): add lines 56 and 59
61. Advance preemption time (APT) required to avoid design vehicle-gate interaction (seconds): subtract line 60 from 55, round up to nearest full second, enter 0 if less than 0

Figure 1c. Railroad Preemption Time Requirements