

TRAFFIC CONTROL STUDY - WARRANTS FOR TRAFFIC SIGNALS

North Dakota Department of Transportation, Programming
SFN 7924 (3-2023)

23 USC § 407 Documents
NDDOT Reserves All Objections

Date	Prepared by	City	Analysis Year
Major Road		Speed Limit (mph)	Number of Lanes
Minor Road		Speed Limit (mph)	Number of Lanes

Minor road right-turn traffic excluded from the analysis because there is an exclusive right-turn lane and right-turn traffic enters the Major Road with minimal conflict:

1. Posted or 85th-percentile speed of major road traffic is > 40 mph:

☐ Yes ☐ No

☐ Yes ☐ No

2. In built-up area of isolated community < 10,000 population:

☐ Yes ☐ No

If question 1 or 2 is answered yes, then use 70% volume criteria:

☐ 70% ☐ 100%

WARRANT 1, EIGHT-HOUR VEHICULAR VOLUME

Requirements: Either Condition A (Minimum Vehicular Volume) or Condition B (Interruption of Continuous Traffic) is satisfied to 100% of the stated volumes for each of any 8 hours of an average day.

Or: Both Condition A and Condition B are satisfied to 80% of the stated volumes for each of any 8 hours of an average day.

Table 4C-1. Warrant 1, Eight-Hour Vehicular Volume

Condition A - Minimum Vehicular Volume

Number of lanes for moving traffic on each approach		Vehicles per hour on major street (total of both approaches)				Vehicles per hour on higher-volume minor-street approach (one direction only)			
Major Street	Minor Street	100% ^a	80% ^b	70% ^c	56% ^d	100% ^a	80% ^b	70% ^c	56% ^d
1	1	500	400	350	280	150	120	105	84
2 or more	1	600	480	420	336	150	120	105	84
2 or more	2 or more	600	480	420	336	200	160	140	112
1	2 or more	500	400	350	280	200	160	140	112

Condition B - Interruption of Continuous Traffic

Number of lanes for moving traffic on each approach		Vehicles per hour on major street (total of both approaches)				Vehicles per hour on higher-volume minor-street approach (one direction only)			
Major Street	Minor Street	100% ^a	80% ^b	70% ^c	56% ^d	100% ^a	80% ^b	70% ^c	56% ^d
1	1	750	600	525	420	75	60	53	42
2 or more	1	900	720	630	504	75	60	53	42
2 or more	2 or more	900	720	630	504	100	80	70	56
1	2 or more	750	600	525	420	100	80	70	56

^a Basic minimum hourly volume

^b Used for combination of Conditions A and B after adequate trial of other remedial measures

^c May be used when the major-street speed exceeds 40 mph or in an isolated community with a population of less than 10,000

^d May be used for combination of Conditions A and B after adequate trial of other remedial measures when the major-street speed exceeds 40 mph or in an isolated community with a population of less than 10,000

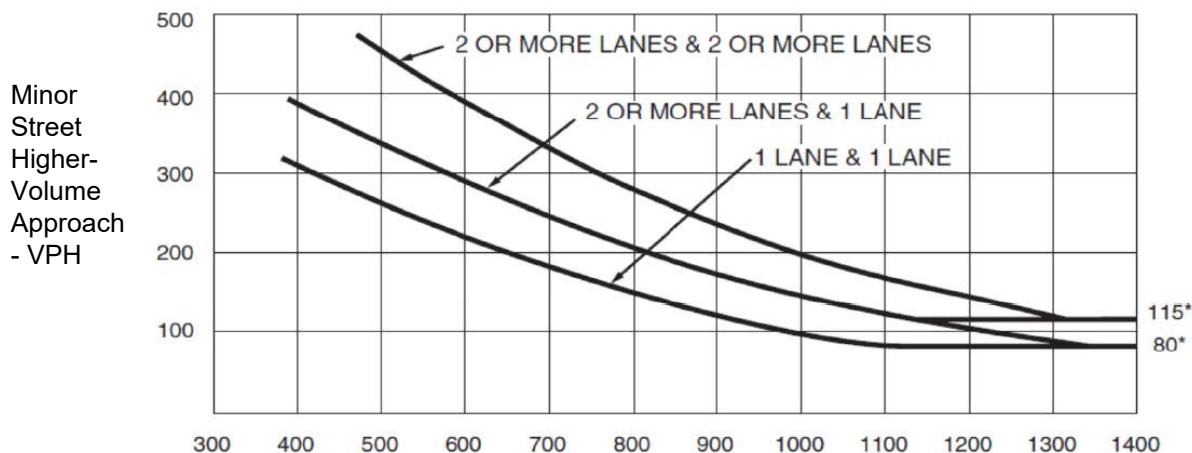
8 Highest Hour Volumes								
	1	2	3	4	5	6	7	8
Both Approaches Major Road								
Highest Approach Minor Road								

Warrant 1 Met? ☐ Yes ☐ No ☐ Does not apply

WARRANT 2, FOUR-HOUR VEHICULAR VOLUME

Requirements: Plot four highest hour volumes on the applicable figure below. If four points lie above the applicable curve then the warrant is satisfied.

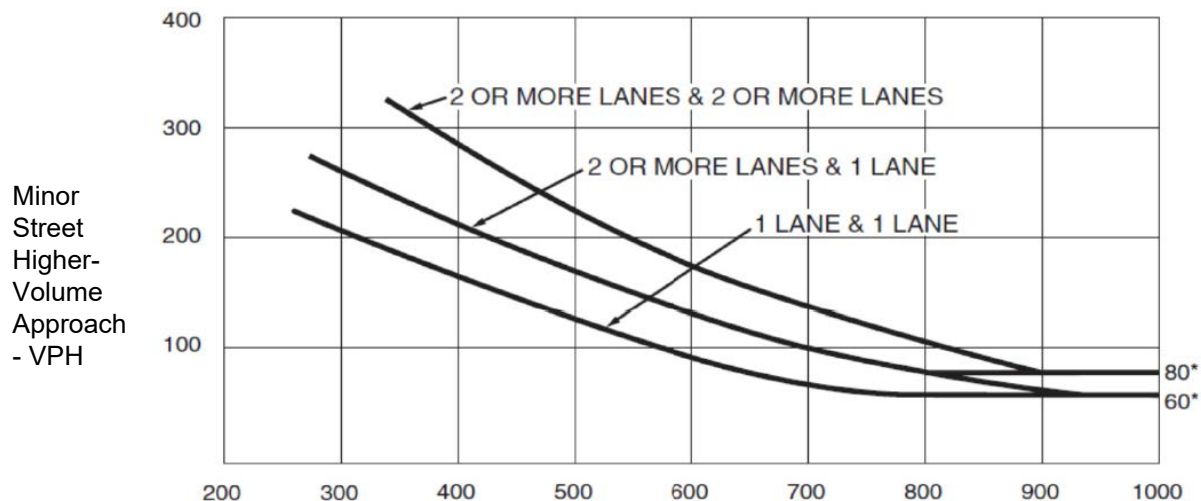
Figure 4C-1. Warrant 2, Four-Hour Vehicular Volume



MAJOR STREET - TOTAL OF BOTH APPROACHES
VEHICLES PER HOUR (VPH)

*Note: 115 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 80 vph applies as the lower threshold volume for a minor-street approach with one lane.

Figure 4C-2. Warrant 2, Four-Hour Vehicular Volume (70% Factor)
(Community Less than 10,000 Population or Above 40 MPH on Major Street)



MAJOR STREET -- TOTAL OF BOTH APPROACHES
VEHICLES PER HOUR (VPH)

*Note: 80 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 60 vph applies as the lower threshold volume for a minor-street approach with one lane.

Warrant 2 Met? ☐ Yes ☐ No ☐ Does not apply

WARRANT 3, PEAK HOUR

Requirements: This signal warrant shall only be applied in unusual cases. Such cases include, but are not limited to, office complexes, manufacturing plants, industrial complexes, or high occupancy vehicle facilities that attract or discharge large numbers of vehicles over a short time.

Unusual Condition

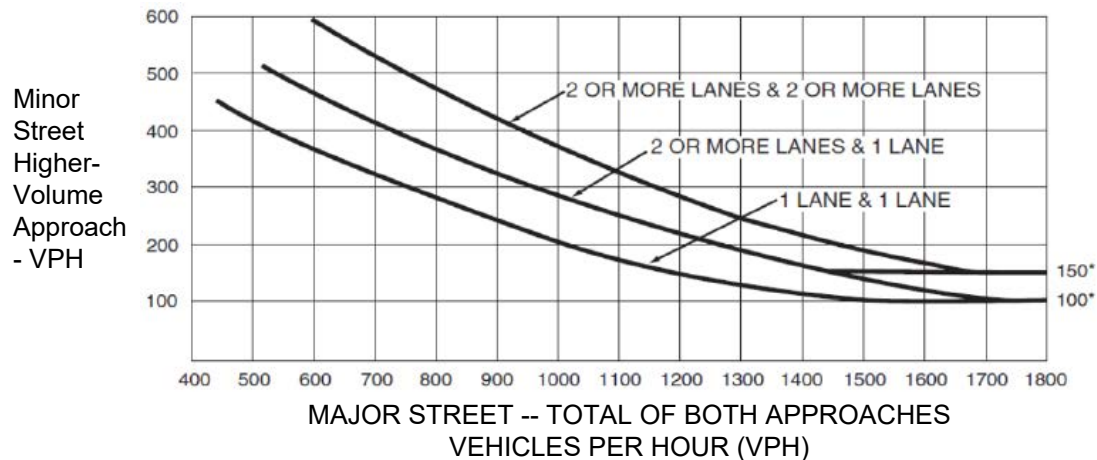
Either Condition A or Condition B is satisfied.

Condition A: The condition is satisfied if all three of the criteria are satisfied.

Criteria	Criteria Met if	Peak-Hour Value	Satisfied?	
			Yes	No
Delay on Minor Approach (veh-hr)	4 veh-hr for 1 lane approach or 5 veh-hr for two-lane approach		<input type="checkbox"/>	<input type="checkbox"/>
Volume on Minor Approach (veh/hr)	100 veh/hr for one moving lane of traffic, or 150 veh/hr for two lanes		<input type="checkbox"/>	<input type="checkbox"/>
Total Entering Volume (veh/hr)	650 veh/hr for 3 approaches or 800 veh/hr for 4 or more		<input type="checkbox"/>	<input type="checkbox"/>

Condition B: Plot peak hour volumes on the applicable figure below. These conditions exist for the same 1 hour (and four consecutive, 15-minute periods) of an average day. If the point is above the appropriate line, then the warrant is satisfied.

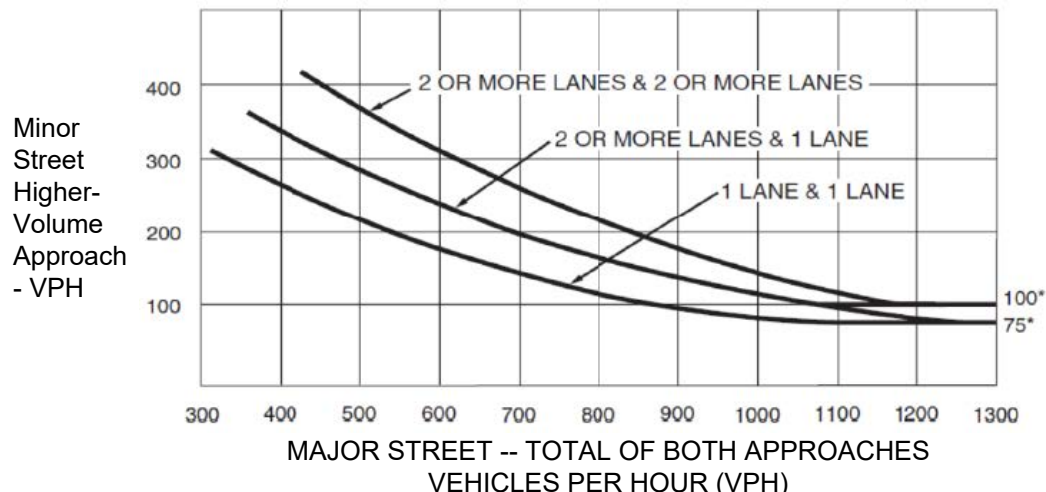
Figure 4C-3. Warrant 3, Peak Hour



*Note: 150 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 100 vph applies as the lower threshold volume for a minor-street approach with one lane.

Figure 4C-4. Warrant 3, Peak Hour (70% Factor)

(Community Less than 10,000 Population or Above 40 MPH on Major Street)



*Note: 100 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 75 vph applies as the lower threshold volume for a minor-street approach with one lane.

Warrant 3 Met? ☐ Yes ☐ No ☐ Does not apply

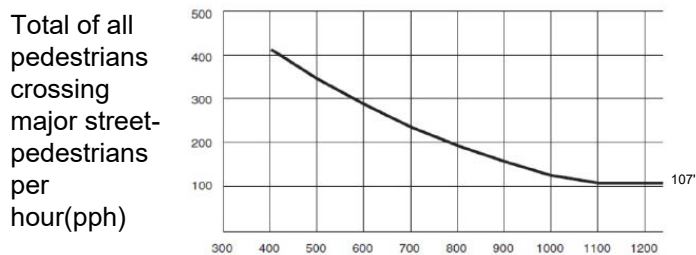
WARRANT 4, PEDESTRIAN VOLUME

Requirements: This warrant is intended for application where the traffic volume on a major street is so heavy that pedestrians experience excessive delay in crossing the major street. It shall not be applied at locations where the distance to the nearest traffic signal or stop sign controlling the street that pedestrians desire to cross is less than 300 feet.

Either criterion A or criterion B is satisfied.

A: For each of any 4 hours of an average day, the plotted point representing the vehicles per hour on the major street (total of both approaches) and the corresponding pedestrians per hour crossing the major street (total of all crossings) all fall above the curve in Figure 4C-5.

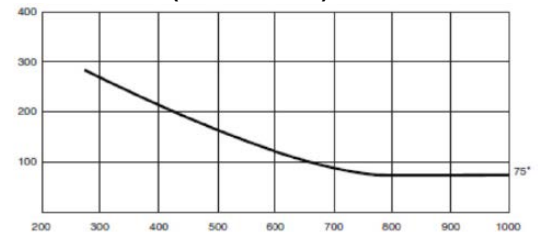
**Figure 4C-5. Warrant 4,
Pedestrian Four-Hour Volume**



MAJOR STREET -- TOTAL OF BOTH APPROACHES
VEHICLES PER HOUR (VPH)

*Note: 107 pph applies as the lower threshold volume.

**Figure 4C-6. Warrant 4,
Pedestrian Four-Hour Volume
(70% Factor)**

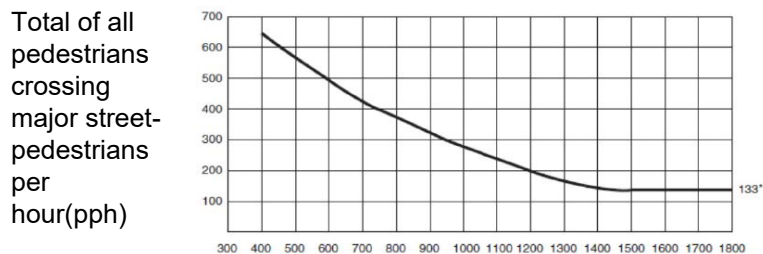


MAJOR STREET -- TOTAL OF BOTH APPROACHES
VEHICLES PER HOUR (VPH)

*Note: 75 pph applies as the lower threshold volume.

B: For 1 hour (any four consecutive 15-minute periods) of any 4 hours of an average day, the plotted points representing the vehicles per hour on the major street (total of both approaches) and the corresponding pedestrians per hour crossing the major street (total of all crossings) all fall above the curve in Figure 4C-7.

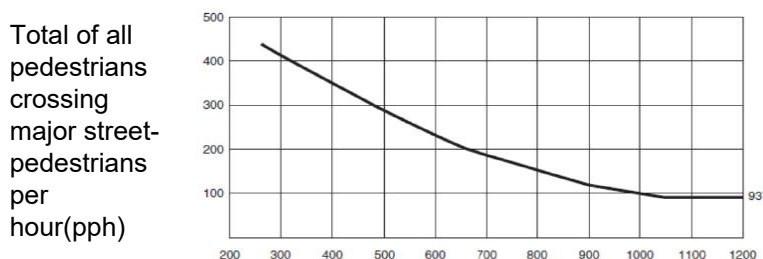
Figure 4C-7. Warrant 4, Pedestrian Peak Hour



MAJOR STREET -- TOTAL OF BOTH APPROACHES
VEHICLES PER HOUR (VPH)

*Note: 133 pph applies as the lower threshold volume.

Figure 4C-8. Warrant 4, Pedestrian Peak Hour (70% Factor)



MAJOR STREET -- TOTAL OF BOTH APPROACHES
VEHICLES PER HOUR (VPH)

*Note: 93 pph applies as the lower threshold volume.

If the speed on major street exceeds 40 mph, or if population is less than 10,000, Figure 4C-6 or 4C-8 may be used.

Warrant 4 Met? ☐ Yes ☐ No ☐ Does not apply

WARRANT 5, SCHOOL CROSSING

Requirements: This warrant is intended for application where the fact that schoolchildren cross the major street is the principal reason to consider installing a traffic control signal. For the purposes of this warrant, the word "schoolchildren" includes elementary through high school students.

The warrant is satisfied if all three of the criteria are satisfied.

Criteria	Satisfied?	
	Yes	No
During the time period when schoolchildren are using the crossing: Gaps < Number of minutes	<input type="checkbox"/>	<input type="checkbox"/>
There are a minimum of 20 schoolchildren during the highest crossing hour	<input type="checkbox"/>	<input type="checkbox"/>
The nearest traffic signal along the major road is located more than 300 ft away. Or, the nearest traffic signal is within 300 ft but the proposed traffic signal will not restrict the progressive movement of traffic.	<input type="checkbox"/>	<input type="checkbox"/>

Warrant 5 Met? ☐ Yes ☐ No ☐ Does not apply

WARRANT 6, COORDINATED SIGNAL SYSTEM

Requirements: This warrant is satisfied if either criteria is satisfied. This warrant should not be applied when the resulting signal spacing would be less than 1000 ft.

Criteria	Satisfied?	
	Yes	No
On a one-way street or a street that has traffic predominantly in one direction, the adjacent signals are so far apart that they do not provide the necessary degree of vehicular platooning.	<input type="checkbox"/>	<input type="checkbox"/>
On a two-way street, adjacent traffic control signals do not provide the necessary degree of platooning and the proposed and adjacent traffic control signals will collectively provide a progressive operation.	<input type="checkbox"/>	<input type="checkbox"/>

Warrant 6 Met? ☐ Yes ☐ No ☐ Does not apply

WARRANT 7, CRASH EXPERIENCE

Requirements: The warrant is satisfied if all three of the criteria are satisfied.

Criteria		Hour				Satisfied?	
						Yes	No
One of the warrants to the right is met:	Warrant 4.1 at 80% of volume requirements: 80 ped/hr for 4 hrs or 152 ped/hr for 1 hr					<input type="checkbox"/>	<input type="checkbox"/>
	Warrant 1, Condition A (80% satisfied)					<input type="checkbox"/>	<input type="checkbox"/>
	Warrant 1, Condition B (80% satisfied)					<input type="checkbox"/>	<input type="checkbox"/>
Adequate trial of other remedial measures has failed to reduce crash frequency.		Measures Tried				<input type="checkbox"/>	<input type="checkbox"/>
Five or more reported crashes, of types susceptible to correction by signal control, have occurred within a 12 month period.		Number of Crashes				<input type="checkbox"/>	<input type="checkbox"/>

Warrant 7 Met? ☐ Yes ☐ No ☐ Does not apply

WARRANT 8, ROADWAY NETWORK

Requirements: A "major route" as used in this signal warrant shall have at least one of the following characteristics:

Characteristics of a Major Route	Satisfied?	
Yes	No	
Part of the street or highway system that serves as a principal roadway network for through traffic flow.	<input type="checkbox"/>	<input type="checkbox"/>
Rural or suburban highway outside of, entering, or traversing a city.	<input type="checkbox"/>	<input type="checkbox"/>
Appears as a major route on an official plan.	<input type="checkbox"/>	<input type="checkbox"/>

The need for a traffic control signal shall be considered if an engineering study finds that the common intersection of two or more major routes meets one or both of the following criteria:

Criteria			Satisfied?	
Yes	No			
1. Both of the criteria to the right are met.	a. Total entering volume of at least 1,000 veh/hr during typical weekday peak hour.	Entering Volume: <input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>
	b. Five-year projected volumes that satisfy one or more of Warrants 1,2, or 3.	Warrant(s) satisfied: <input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Total entering volume of at least 1,000 veh/hr for each of any 5 hours of a non-normal business day (Sat. or Sun.)		Hour	Volume	
		<input type="text"/>	<input type="text"/>	<input type="checkbox"/>
		<input type="text"/>	<input type="text"/>	<input type="checkbox"/>
		<input type="text"/>	<input type="text"/>	<input type="checkbox"/>
		<input type="text"/>	<input type="text"/>	<input type="checkbox"/>
		<input type="text"/>	<input type="text"/>	<input type="checkbox"/>

Warrant 8 Met? ☐ Yes ☐ No ☐ Does not apply

WARRANT 9, INTERSECTION NEAR A GRADE CROSSING

Requirements: This warrant is intended for use at a location where none of the conditions described in the other eight traffic signal warrants are met, but the proximity to the intersection of grade crossing on an intersection approach controlled by a STOP or YIELD sign is the principal reason to consider installing a traffic signal.

Both condition A and condition B are satisfied.

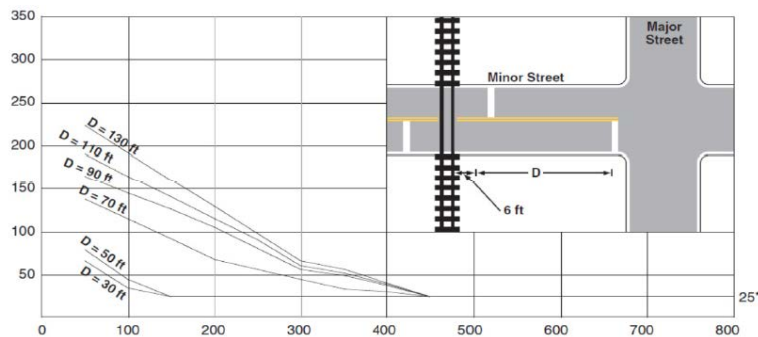
Criteria	Satisfied?	
Yes	No	
A. A grade crossing exists on an approach controlled by a STOP or YIELD sign and the center of the track nearest to the intersection is within 140 feet of the stop line or yield line on the approach.	<input type="checkbox"/>	<input type="checkbox"/>
B. During the highest traffic volume hour during which rail traffic use the crossing, the plotted point representing the vehicles per hour on the major street (total of both approaches) and the corresponding vehicles per hour on the minor-street approach that crosses the track (one direction only, approaching the intersection) falls above the applicable curve in Figure 4C-9 or 4C-10 for the existing combination of approach lanes over the track and the distance D, which is the clear storage distance as defined in Section 1A.13.	<input type="checkbox"/>	<input type="checkbox"/>

Warrant 9 Continued on next page

WARRANT 9, CONTINUED

**Figure 4C-9. Warrant 9, Intersection near a Grade Crossing
(one Approach Lane at the Track Crossing)**

Minor Street,
Crossing
Approach-
Equivalent
VPH**



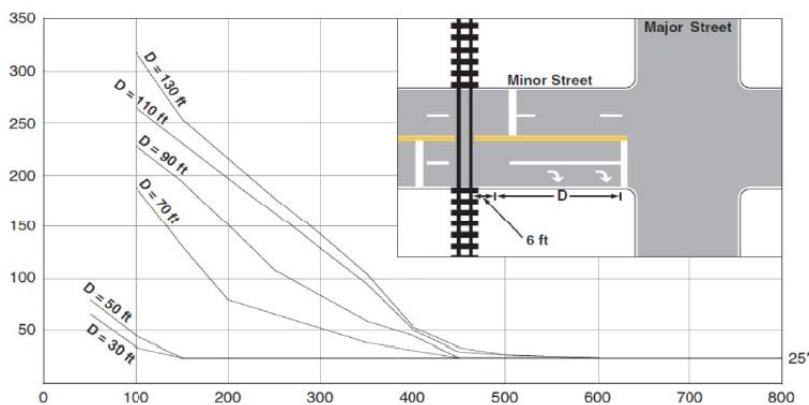
MAJOR STREET -- TOTAL OF BOTH APPROACHES - VEHICLES PER HOUR (VPH)

*Note: 25 vph applies as the lower threshold volume.

**Note: VPH after applying the adjustment factors in Tables 4C-2, 4C-3, and/or 4C-4, if appropriate.

**Figure 4C-10. Warrant 9, Intersection near a Grade Crossing
(Two or More Approach Lanes at the Track Crossing)**

Minor Street,
Crossing
Approach-
Equivalent
VPH**



MAJOR STREET -- TOTAL OF BOTH APPROACHES - VEHICLES PER HOUR (VPH)

*Note: 25 vph applies as the lower threshold volume.

**Note: VPH after applying the adjustment factors in Tables 4C-2, 4C-3, and/or 4C-4, if appropriate.

Warrant 9 Met? ☐ Yes ☐ No ☐ Does not apply

CONCLUSION

Warrants Satisfied

Signal Warranted ☐ Yes ☐ No

Remarks