access; types of vehicles intersecting roadway, if unusual; transit routes and frequency; compatibility with corridor plans or local transportation plans; Interregional Corridor performance and political considerations.

METRO TRAFFIC SIGNAL JUSTIFICATION REPORT METHODOLOGY

The decision to install a traffic signal at a trunk highway intersection in the Metro District is determined by the Program Support Unit of the Traffic Engineering Section. The installation of the signal must be justified through an engineering study. Contained in this document is the current methodology in determining if a signal installation is justified. If a location is justified, it does not necessarily mean that a signal will be programmed or the installation will occur immediately. Funding must be available and the location must be a higher priority than other safety needs.

Qualifying Criteria

For a specific intersection to be considered for a traffic signal installation one of the following criteria must be met.

1. The intersection meets Warrant 1A, 1B or 7 of the current MN MUTCD.
2. Current traffic volumes do not meet Warrant 1A or 1B, but development in the area will occur such that the warrants will be met in a reasonable period of time and state funds are not used for construction.
3. Current traffic volumes do not meet Warrant 1A or 1B, but a significant crash problem exists (an average of at least three correctable crashes per year (any 12-month period) over the most recent 3-year period) and traffic volumes are likely to meet warrants within a reasonable period.
4. The intersection has significant amounts of pedestrian traffic, which can be documented.

Mitigating Factors

As part of the engineering study, the following factors should be considered in determining if a signal installation is justified.

1. Access spacing guidelines. Is spacing between signals on the mainline adequate? Is spacing between all nearby public and private access points adequate?
2. Is the installation of a signal at this location consistent with an adopted access management plan for the roadway?
3. Lane geometrics. Metro requires one lane of approach for each traffic movement for all directions of travel. For a typical four-legged intersection, a minimum of three lanes would be required for each approach, including the minor legs. (Metro will consider 2 lanes of approach from the minor legs under some conditions) Does the proposed layout provide minimal geometrics?
4. Each intersection should be modeled using acceptable simulation software in order to demonstrate acceptable traffic operations for opening day and for a reasonable period into the future (preferably 20 years). Adjacent intersections may be required to be included depending on spacing and other considerations. Will the proposed geometrics provide enough capacity for acceptable operations?
5. Is installation of a traffic signal the only solution or are better alternatives available?
6. Will the intersection be safer after the signal is installed?

Warrants

Warrant 1 – Eight Hour Vehicular Volume

If the intersection meets either Condition A (Minimum Vehicular Volume) or Condition B (Interruption of Continuous Traffic), then the intersection is considered to have met this warrant. Meeting a warrant does not necessarily mean the location is justified for a signal. Engineering judgment is required for that step and all mitigating factors must be considered.

Current traffic volumes must be collected to analyze the volume warrants. It is desirable to collect a 48-hour approach count AND a 6-hour turning movement count (3 in each of the peak periods) for each intersection. These counts should be done between Monday afternoons and Friday Mornings to accurately depict typical weekday traffic volumes.

Right turning traffic from the minor leg is usually not included in the warrant analysis. The rationale for this practice is these movements are usually made relatively easily, have minimal conflicts and therefore do not require a traffic signal to minimize delay or improve safety. However, if right turning traffic is very high and gaps in the mainline cause significant delay a traffic signal may improve overall operations. After the traffic volume data is collected, the percentage of right turning vehicles from the minor legs is determined based upon the turning movement count. This percentage is applied to the approach counts to determine the number of left and through traffic volumes over the entire day. (It is assumed that the percentage of right turns during the two peak periods (6 hours) is representative of the entire day.) This is the data to be used in the warrant analysis. In the event that there is a significant amount of right turning traffic and conflicting traffic, 50% of the right turns can be added back into the approach counts. If the right turning volume exceeds 70% of its potential capacity (see Table 1) for any hour for each approach, 50% of the right turning volume for all hours should be added back in. To use the table determine the conflicting flow rate for each minor approach. The rate will be the conflicting mainline approach traffic, in the lane the right turning vehicles are merging into (For multiple through lane roadways divide the volumes evenly across each lane). Utilizing the correct table (2 lane or 4 lane) the user must determine if the right turn volume exceeds the 70% potential capacity. (The capacity of the minor leg right turning volume is calculated based on procedures documented in the Highway Capacity Manual.)

To be warranted, one of the following must occur:

1. Condition A or B is met for at least 8 hours a day as shown on the 100% column (Table 2)
2. Condition A or B is met for at least 8 hours a day as shown on the 70% column (Table 2) if the posted or 85th percentile speed on the mainline exceeds 40 MPH or the intersection lies within the built-up area of an isolated community having a population of less than 10,000.

TABLE 1- RIGHT TURN CAPACITY

Potential Capacity for Two-Lane Streets		
Conflicting Flow Rate	**Potential Capacity**	**70% of Potential Capacity**
0.01	1090	760
100	960	670
200	850	600
300	740	520
400	650	460
500	570	400
600	500	350
700	440	310
800	390	270
900	340	240
1000	300	210
1100	260	180
1200	230	160
1300	200	140
1400	170	120
1500	150	110
1600	130	90
1700	120	80
1800	100	70
1900	90	60
2000	80	60
2100	70	50
2200	60	40
2300	50	40
2400	40	30
2500	40	30
2600	30	20
2700	30	20
2800	20	10
2900	20	10
3000	20	10

Potential Capacity for Four-Lane Streets		
Conflicting Flow Rate	**Potential Capacity**	**70% of Potential Capacity**
0.01	1090	760
100	940	660
200	810	570
300	700	490
400	610	430
500	520	360
600	450	320
700	390	270
800	330	230
900	290	200
1000	250	180
1100	210	150
1200	180	130
1300	150	110
1400	130	90
1500	110	80
1600	100	70
1700	80	60
1800	70	50
1900	60	40
2000	50	40
2100	40	30
2200	40	30
2300	30	20
2400	30	20
2500	20	10
2600	20	10
2700	20	10
2800	10	10
2900	10	10
3000	10	10

TABLE 2 – WARRANT 1

Condition A – Minimum Vehicle 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]	100%[a]	80%[b]	70%[c]
1	1.....	500	400	350	150	120	105
2 or more....	1.....	600	480	420	150	120	105
2 or more....	2 or more	600	480	420	200	160	140
1	2 or more	500	400	350	200	160	140

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]	100%[a]	80%[b]	70%[c]
1	1.....	750	600	525	75	60	53
2 or more....	1.....	900	720	630	75	60	53
2 or more....	2 or more	900	720	630	100	80	70
1	2 or more	750	600	525	100	80	70

[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.

To determine the number of lanes to use in Table 2, the proposed lane geometrics must be used. Right turn lanes are not counted, but in most cases the row referring to two or more for both the major street and the minor street will be used. Left turn lanes are included in the total number of lanes.

Warrant 7 – Crash Experience

To meet this warrant two conditions must be met:

1. Five or more reported correctible crashes have occurred within any twelve-month period. Data can be used for the last 3 reported calendar years. Correctable crashes are those involving left turning movements from either the mainline or the minor street and through movements from the minor leg. These are typically, right angle and left turn related crashes. All other crashes are not considered (rear ends, run off road, etc...).
2. The eight-hour vehicular warrant described above must be met for the 80% column for either Condition A or Condition B. The treatment of traffic volumes is the same as described above.

If you have questions, please contact Lars Impola or Dave Engstrom of Metro Traffic – Program Support.