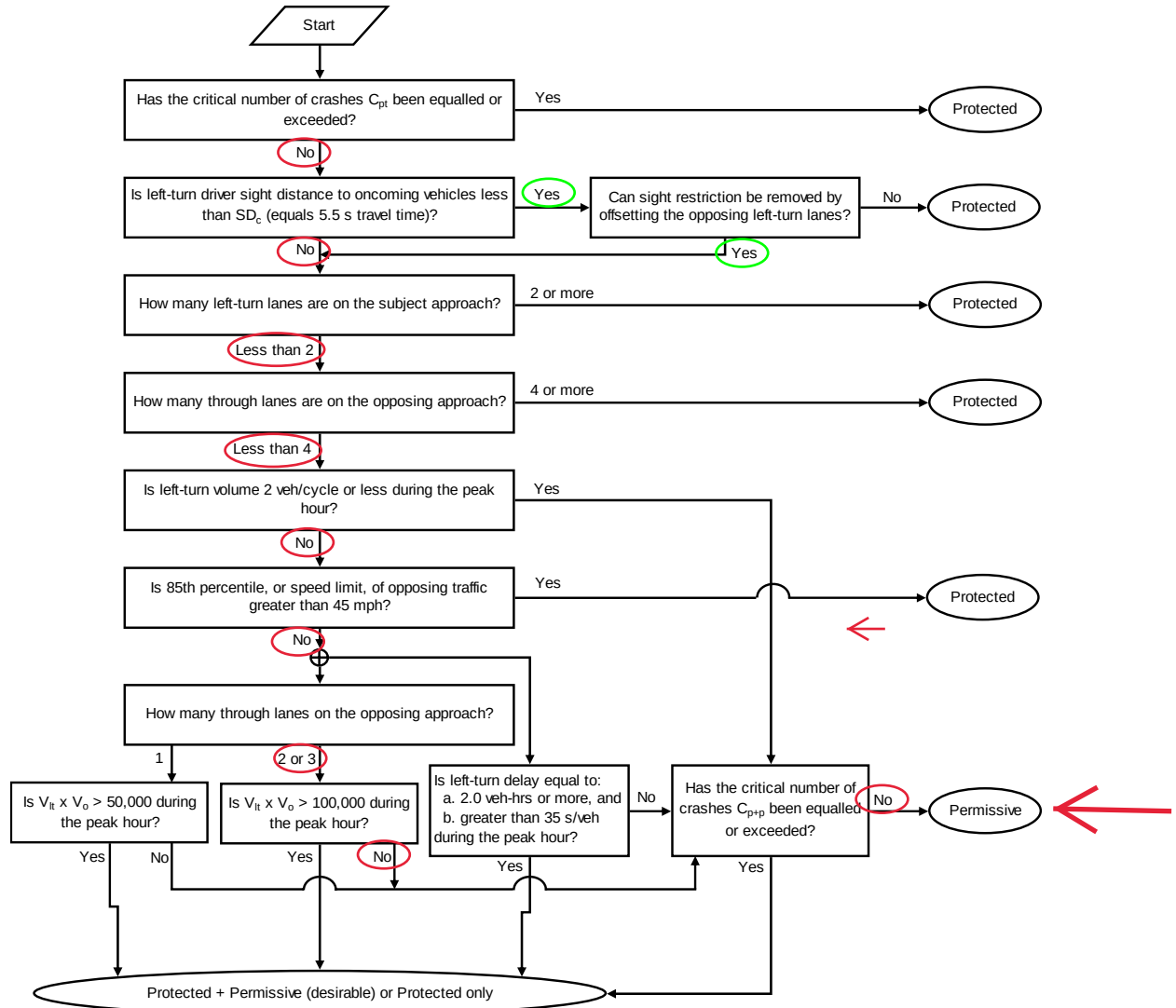


These guidelines were derived from a variety of sources (8;9). Application of the flowchart requires the separate evaluation of each left-turn movement on the subject road.

Figure 4-11 Guidelines for determining the potential need for a left-turn phase



Total Collisions Per Direction for 3 Year Sample:

EBL = 4 collisions total

WBL = 3 collisions total

DOES NOT MEET WARRANT

Number of Left-turn Movements on Subject Road	Period During Which Crashes are Considered (years)	Critical Left-Turn-Related Crash Count	
		When Considering Protected-only, C_{pt} (crashes/period)	When Considering Prot.+Perm, C_{pt+p} (crashes/period)
One	1	6	4
One	2	11	6
One	3	14	7
Both	1	11	6
Both	2	18	9
Both	3	26	13

Variables

V_{lt} = left-turn volume on the subject approach, veh/h

V_o = through plus right-turn volume on the approach opposing the subject left-turn movement, veh/h

Oncoming Traffic Speed Limit (mph)	Minimum Sight Distance to Oncoming Vehicles, SD_c (ft)
25	200
30	240
35	280
40	320
45	360
50	400
55	440
60	480

Source: Adapted from (Kell and Fullerton, 1998; Orcutt, 1993; Traffic Engineering Manual, 1999).

The objective of the flow chart is to identify the least restrictive left-turn operational mode. A secondary objective is to provide a structured procedure for the evaluation of left-turn phasing for the purpose of promoting consistency in left-turn phase application.

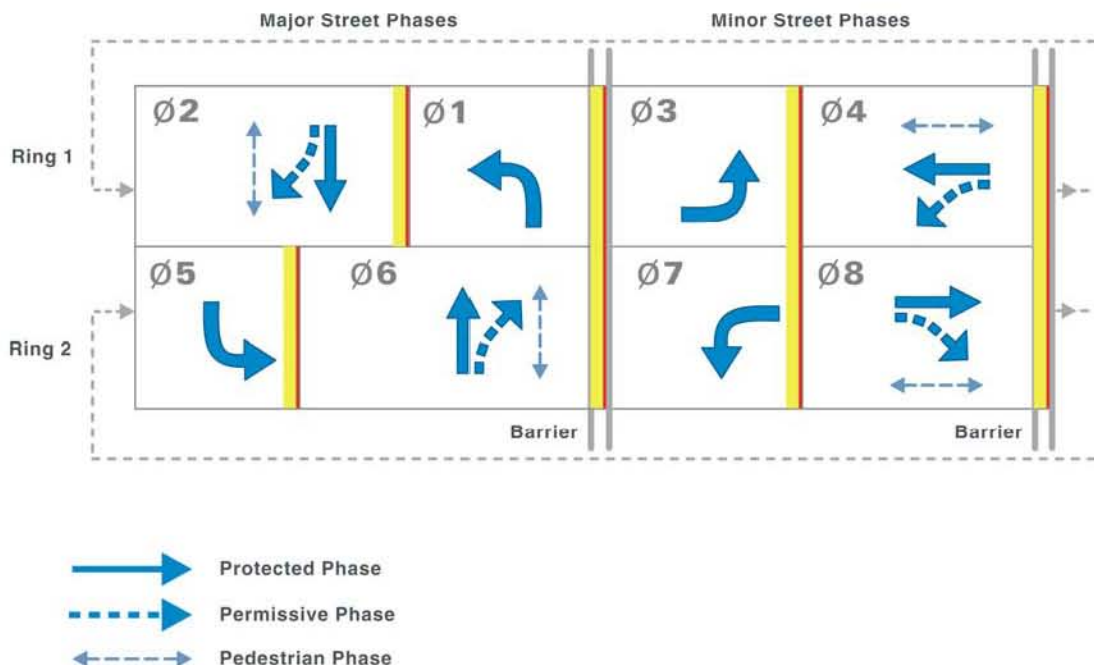
The critical left-turn crash counts identified in the figure are based on an underlying average critical crash frequency and recognize the inherent variability of crash data. The underlying averages are 1.3 crashes per year and 3.0 crashes per year when considering protected-permissive and protected only left-turn phasing, respectively. If the reported crash count for existing permissive operation exceeds the critical value, then it is likely that the subject intersection has an average left-turn crash frequency that exceeds the aforementioned average (5 percent chance of error) and a more restrictive operational mode would likely improve the safety of the left-turn maneuver.

The flowchart has two alternative paths following the check of opposing traffic speed. One path requires knowledge of left-turn delay; the other requires knowledge of the left-turn and opposing through volumes. The left-turn delay referred to in the flowchart is the delay incurred when no left-turn phase is provided (i.e., the left-turn movement operates in the permissive mode).

4.4 LEFT-TURN PHASE SEQUENCE OPTIONS

It may be advantageous under certain circumstances to change the sequence in which left turns are served relative to their complementary through movements. This is done by reversing the sequence of a pair of complementary phases, as is shown for phases 1 and 2 in Figure 4-4. In this example, phase 1 is said to "lag" phase 2. Specifically, Figure 4-12 shows phases 2 and 6 starting and ending at different times in the cycle. This independence between the through phases can be desirable under coordinated operations because it can accommodate platoons of traffic arriving from each direction at different times.

Figure 4-12 Ring-and-barrier diagram showing protected lead-lag left turns



4.4.1 Lead-Lead Left-Turn Phase Sequence

The most commonly used left-turn phase sequence is the "lead-lead" sequence which has both opposing left-turn phases starting at the same time. If a single ring structure is used, then the two phases also end at the same time. If an actuated dual ring structure is used, then each left-turn phase

Exhibit 31-40

Planning-Level Analysis: Left-Turn Treatment Worksheet

PLANNING-LEVEL ANALYSIS: LEFT-TURN TREATMENT WORKSHEET														
General Information AM Peak Hour Review														
Description <u>Mission Inn Ave at Redwood Dr (Eastbound & Westbound Review)</u>														
Check # 1. Left-Turn Lane Check														
Approach	EB	WB	NB	SB										
Number of left-turn lanes	0	0												
Protected left turn (Y or N)?	N	N												
If the number of left-turn lanes on any approach exceeds 1, then it is recommended that the left turns on that the approach be protected. Those approaches with protected left turns need not be evaluated in subsequent checks.														
Check # 2. Minimum Volume Check														
Approach	EB	WB	NB	SB										
Left-turn volume	9	10												
Protected left turn (Y or N)?	N	N												
If left-turn volume on any approach exceeds 240 veh/h, then it is recommended that the left turns on that the approach be protected. Those approaches with protected left turns need not be evaluated in subsequent checks.														
Check # 3. Minimum Cross-Product Check														
Approach	EB	WB	NB	SB										
Left-turn volume, V_L (veh/h)	9	10												
Opposing mainline volume, V_o (veh/h)	301	347												
Cross product ($V_L * V_o$)	2,709	3,470												
Opposing through lanes	2	2												
Protected left turn (Y or N)?	N	N												
<table border="0"> <thead> <tr> <th colspan="2">Minimum Cross-Product Values for Recommending Left-Turn Protection</th> </tr> <tr> <th>Number of Through Lanes</th> <th>Minimum Cross Product</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>50,000</td> </tr> <tr> <td>2</td> <td>90,000</td> </tr> <tr> <td>3</td> <td>110,000</td> </tr> </tbody> </table>					Minimum Cross-Product Values for Recommending Left-Turn Protection		Number of Through Lanes	Minimum Cross Product	1	50,000	2	90,000	3	110,000
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Number of Through Lanes	Minimum Cross Product													
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2	90,000													
3	110,000													
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Notes														
1. If any approach is recommended for left-turn protection but the analyst evaluates it as having permitted operation, then the planning-level analysis method may give overly optimistic results. The analyst should instead use the automobile methodology described in Chapter 19, Signalized Intersections. 2. All volumes used in this worksheet are unadjusted hourly volumes.														

← Does not meet criteria

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Planning-Level Analysis: Left-Turn Treatment Worksheet

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Description <u>Mission Inn Ave at Redwood Dr (Eastbound & Westbound Review)</u>												
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Check # 2. Minimum Volume Check												
Approach	EB	WB	NB	SB								
Left-turn volume	34	7										
Protected left turn (Y or N)?	N	N										
If left-turn volume on any approach exceeds 240 veh/h, then it is recommended that the left turns on that the approach be protected. Those approaches with protected left turns need not be evaluated in subsequent checks.												
Check # 3. Minimum Cross-Product Check												
Approach	EB	WB	NB	SB								
Left-turn volume, V_L (veh/h)	34	7										
Opposing mainline volume, V_o (veh/h)	436	851										
Cross product ($V_L * V_o$)	14,824	5,957										
Opposing through lanes	2	2										
Protected left turn (Y or N)?	N	N										
Minimum Cross-Product Values for Recommending Left-Turn Protection <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center;">Number of Through Lanes</th> <th style="text-align: center;">Minimum Cross Product</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">1</td> <td style="text-align: center;">50,000</td> </tr> <tr> <td style="text-align: center;">2</td> <td style="text-align: center;">90,000</td> </tr> <tr> <td style="text-align: center;">3</td> <td style="text-align: center;">110,000</td> </tr> </tbody> </table>					Number of Through Lanes	Minimum Cross Product	1	50,000	2	90,000	3	110,000
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