PW021412-16

ALL-WAY STOP CONTROL WARRANT STUDY

E. OAKLAND ST. & MERLOT DR.

8 FEBRUARY 2012

TRAFFIC OPERATIONS SECTION
ENGINEERING SERVICES DIVISION
PUBLIC WORKS DEPARTMENT

INTRODUCTION

- This traffic control evaluation was completed in response to a citizen's request. The primary reason for need cited by the requesting party was the operating speed of traffic on E. Oakland St. Even though STOP signs are **not** to be used for controlling speed, the study was completed to determine if the volumes or crash history were sufficient to warrant the installation of an ALL-WAY STOP.

- A location map is attached for reference.

- The intersection currently operates with STOP control for Merlot Dr.

- The existing speed limit on both roads is 25 MPH.

EVALUATION

The evaluation criteria used are from the Federal Highway Administration's Manual on Uniform Traffic Control Devices 2009 (MUTCD). The MUTCD since 1971 has defined the standards used by road managers nationwide to install and maintain traffic control devices on all public streets, highways, bikeways, and private roads open to public traffic. The MUTCD is the definitive compilation of national standards for all traffic control devices, including road markings, highway signs, and traffic signals. The evolution of each criterion follows:

1. Where traffic control signals are justified, the multi-way stop is an interim measure that can be installed quickly to control traffic while arrangements are being made for the installation of the traffic control signal.

   No traffic signal is planned at this location.

2. A crash problem, as indicated by five or more reported crashes in a 12-month period that are susceptible to correction by a multi-way stop installation. Such crashes include right- and left-turn collisions as well as right-angle collisions.

   Data for 2009 to present was queried for any State reportable crashes (property damage greater than $1,000 or involving injuries) that occurred at this intersection. No crashes were found to have occurred at this location.

   The Rapid City Police Department's crash report database was also queried for any crashes that were estimated to have caused *less than $1,000* worth of property damage. No non-State reportable crashes were found for this location.

3. Minimum volumes warranting a multi-way stop:

a. The vehicular volume entering the intersection from the major street approaches (total of both approaches) averages at least 300 vehicles per hour for any 8 hours of an average day, and

b. The combined vehicular, pedestrian, and bicycle volume entering the intersection from the minor street approaches (total of both approaches) averages at least 200 units per hour for the same 8 hours, with an average delay to minor-street vehicular traffic of at least 30 seconds per vehicle during the highest hour.

The current volumes do not meet the above criteria – (see attached warrant evaluation).

4. Where no single criterion is satisfied, but where Criteria 2, 3a and 3b are all satisfied to 80 percent of the minimum values. Criterion C.3 is excluded from this condition.

There have been no correctable crashes at this intersection in the most recent three years of available data so this criterion is not applicable.

The MUTCD further suggest the following additional criteria to be considered in an engineering study:

1) The need to control left-turn conflicts.

Left turn conflicts are not a significant factor at this intersection.

2) The need to control vehicle/pedestrian conflicts near locations that generate high pedestrian volumes.

The intersection does not have high pedestrian volumes.

3) Locations where a road user, after stopping, cannot see conflicting traffic and is not able to reasonably safely negotiate the intersection unless conflicting cross traffic is also required to stop.

Intersection sight distance is not a factor at this location.

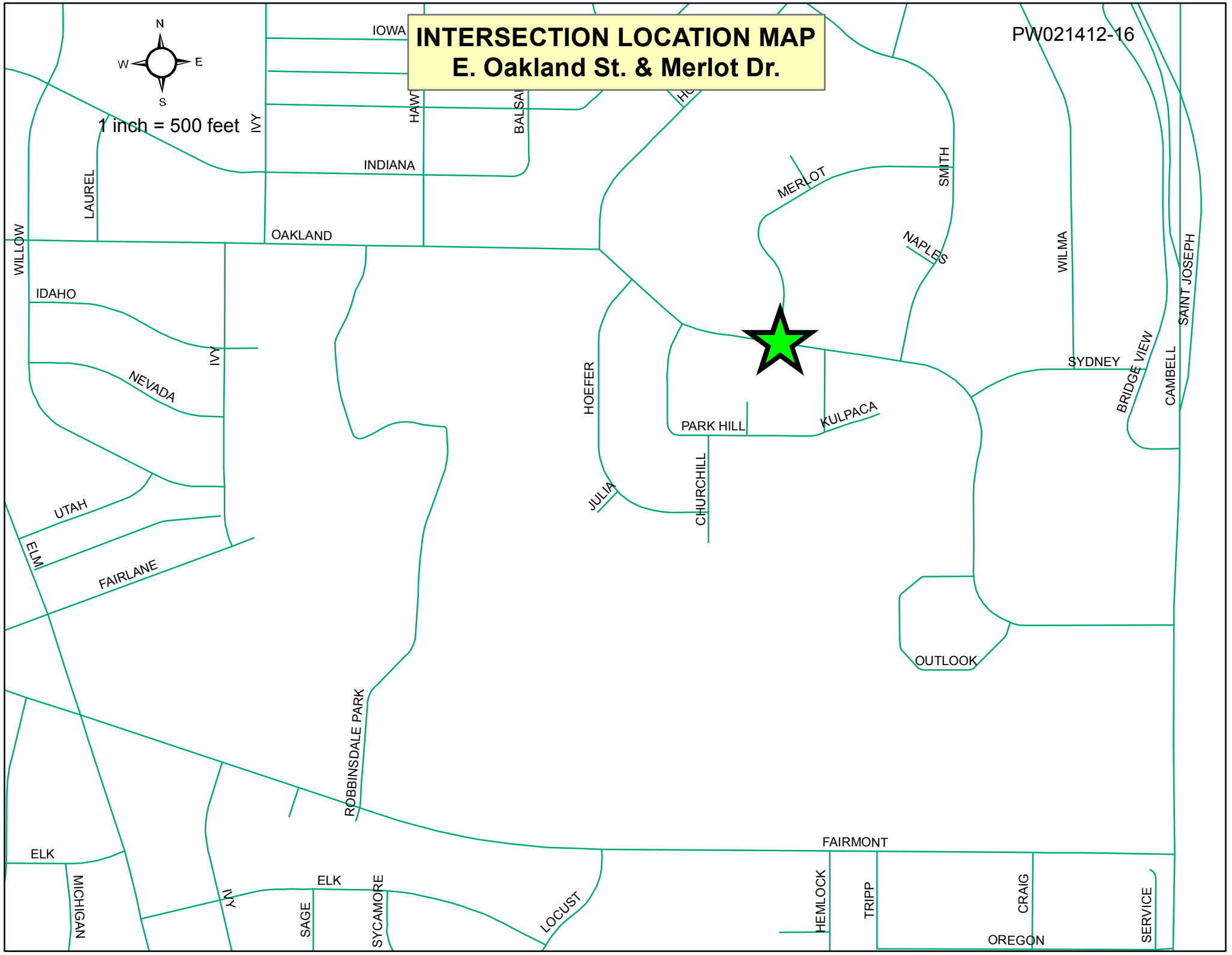
4) An intersection of two residential neighborhood collector streets of similar design and operating characteristics where multiway stop control would improve traffic operational characteristics of the intersection.

There are no significant operations issues at the intersection.

CONCLUSIONS/RECOMMENDATIONS

1) The existing traffic conditions do not meet the warrants for ALL-WAY STOP operation.

2) The use of STOP signs as speed control measures is expressly prohibited in the MUTCD. Research has shown that (a) the installation of STOP signs, while reducing roadway speeds immediately adjacent to the STOP sign, has no effect on overall neighborhood speed limit compliance, and, (b) unwarranted STOP signs tend to have a lower driver compliance rate. A paper detailing the ineffectiveness of STOP signs as speed control devices is attached as an appendix


INTERSECTION LOCATION MAP
E. Oakland St. & Merlot Dr.
PW021412-16
N
W
E
S
1 inch = 500 feet
IOWA
INDIANA
OAKLAND
IDAHO
NEVADA
UTAH
ELM
FAIRLANE
ELK
FAIRMONT
OUTLOOK
SYDNEY
PARK HILL
MERLOT
NAPLES
SMITH
WILMA
SAINT JOSEPH
CAMBELL
BRIDGE VIEW
KULPACA
CHURCHILL
JULIA
HOEFER
LAUREL
WILLOW
IVY
MICHIGAN
SAGE
SYCAMORE
LOCUST
ROBBINSDALE PARK
HEMLOCK
TRIPP
CRAIG
SERVICE
OREGON

MULTI-WAY STOP
VOLUME WARRANT

01/31/12

	MERLOT MINOR ROAD VOLUMES				E.OAKLAND MAJOR ROAD VOLUMES				
HOUR BEGINNING	SB		TOTAL	REQUIRED FOR WARRANT	EB	WB	TOTAL	REQUIRED FOR WARRANT	WARRANT MET?
0000	0		0	200	1	6	7	300	NO
0100	0		0	200	1	1	2	300	NO
0200	0		0	200	0	1	1	300	NO
0300	0		0	200	1	0	1	300	NO
0400	1		1	200	3	3	6	300	NO
0500	4		4	200	16	15	31	300	NO
0600	6		6	200	38	13	51	300	NO
0700	32		32	200	83	82	165	300	NO
0800	10		10	200	36	35	71	300	NO
0900	8		8	200	20	34	54	300	NO
1000	6		6	200	24	31	55	300	NO
1100	7		7	200	30	52	82	300	NO
1200	3		3	200	36	40	76	300	NO
1300	5		5	200	28	48	76	300	NO
1400	11		11	200	49	81	130	300	NO
1500	6		6	200	67	60	127	300	NO
1600	7		7	200	57	85	142	300	NO
1700	12		12	200	45	100	145	300	NO
1800	4		4	200	35	56	91	300	NO
1900	10		10	200	22	50	72	300	NO
2000	1		1	200	15	32	47	300	NO
2100	2		2	200	10	22	32	300	NO
2200	1		1	200	10	15	25	300	NO
2300	2		2	200	3	4	7	300	NO
TOTAL	138	0			630	886			

HOURS WARRANT MET 0

WARRANT MET? NO

APPENDIX A

"Multi-way Stops - The Research Shows the MUTCD is Correct!"

Multi-way Stops - The Research Shows the MUTCD is Correct!

W. Martin Bretherton Jr., P.E.(M)

Abstract

This paper reviewed over 70 technical papers covering all-way stops (or multi-way stops) and their success and failure as traffic control devices in residential areas. This study is the most comprehensive found on multi-way stop signs

The study looked at how multi-way stop signs have been used as traffic calming measures to control speed. There have been 23 hypotheses studied using multi-way stop as speed control. The research found an additional 9 hypotheses studied showing the effect multi way stops have on other traffic engineering problems.

The research found that, overwhelmingly, multi-way stop signs do NOT control speed except under very limited conditions. The research shows that the concerns about unwarranted stop signs are well founded.

Introduction

Many elected officials, citizens and some traffic engineering professionals feel that multi-way stop signs should be used as traffic calming devices. Many times unwarranted stop signs are installed to control traffic. The Manual on Uniform Traffic Control Devices (MUTCD)(16) describes warrants for installing multi-way stop signs. However, it does not describe many of the problems caused by the installation of unwarranted stop signs. These problems include concerns like liability issues, traffic noise, automobile pollution, traffic enforcement and driver behavior.

This paper is a result of searching over 70 technical papers about multi-way stop signs. The study concentrated on their use as traffic calming devices and their relative effectiveness in controlling speeds in residential neighborhoods. The references found 23 hypotheses on their relative effectiveness as traffic calming devices. One study analyzed the economic cost of installing a multi-way stop at an intersection. The reference search also found 9 hypotheses about traffic operations on residential streets.

The literature search found 85 papers on the subject of multi-way stops. There are probably many more references available on this very popular subject. The seventy-one references are shown in Appendix A. There was a problem finding the 14 papers found in

literature searches. The 14 papers are listed in Appendix B for information only. Most of the papers were from old sources and are probably out of print.

Multi-Way Stop Signs as Speed Control Devices

A summary of the articles found the following information about the effectiveness of multi-way stop signs and other solutions to controlling speeds in residential neighborhoods.

1. Multi-way stops do not control speeds. Twenty-two papers were cited for these findings. (Reference 1, 2, 7, 8, 10, 12, 13, 14, 15, 16, 17, 19, 20, 39, 45, 46, 51, 55, 62, 63, 64, 66 and 70).

2. Stop compliance is poor at unwarranted multi-way stop signs. Unwarranted stop signs means they do not meet the warrants of the MUTCD. This is based on the drivers feeling that the signs have no traffic control purpose. There is little reason to yield the right-of - way because there are usually no vehicles on the minor street. Nineteen references found this to be their finding. (Reference 7, 8, 10, 12, 13, 14, 15, 17, 19, 20, 39, 45, 46, *51*, *55*, 61, 62, 63 and 64).

3. Before-After studies show multi-way stop signs do not reduce speeds on residential streets. Nineteen references found this to be their finding. (Reference 19 (1 study), 55 (5 studies), 60 (8 studies) and 64(5 studies)).

4. Unwarranted multi-way stops increased speed some distance from intersections. The studies hypothesizing that motorists are making up the time they lost at the "unnecessary" stop sign. Fifteen references found this to be their finding.(Reference 1, 2, 7, 8, 10, 13, 14, 17, 19, 20,39, 45,46, 51, 55, 70 and 71).

5. Multi-way stop signs have high operating costs based on vehicle operating costs, vehicular travel times, fuel consumption and increased vehicle emissions. Fifteen references found this to be their finding. (Reference 3, 4, 7, 8, 10, 14, 15, 17, 45, 55 ,61, 62, 63, 67 and 68).

6. Safety of pedestrians is decreased at unwarranted multi-way stops, especially small children. It seems that pedestrians expect vehicles to stop at the stop signs but many vehicles have gotten in the habit of running the "unnecessary" stop sign. Thirteen references found this to be their finding. (References 7, 8, 10, 13, 14, 15, 17, 19, 20, 45, 51, 55 and 63).

7. Citizens feel "safer" in communities "positively controlled" by stop signs. Positively controlled is meant to infer that the streets are controlled by unwarranted stop signs. Homeowners on the residential collector feel safer on a 'calmed' street. Seven references found this to be their finding. (Reference 6, 14, 18, 20, 51, 58 and 66).
Hypothesis twelve (below) lists five references that dispute the results of these studies.

8. Speeding problems on residential streets are associated with" through" traffic. Frequently homeowners feel the problem is created by 'outsiders'. Many times the problem is the person complaining or their neighbor. Five references found this to be their finding. (References 2, 15, 45, 51 and 55).

9. Unwarranted multi-way stops may present potential liability problems for undocumented exceptions to accepted warrants. Local jurisdictions feel they may be incurring higher liability exposure by 'violating' the MUTCD. Many times the unwarranted stop signs are installed without a warrant study or some documentation. Cited by six references. (Reference 7, 9, 19, 46, 62 and 65).

10. Stop signs increase noise in the vicinity of an intersection. The noise is created by the vehicle braking noise at the intersection and the cars accelerating up to speed. The noise is created by the engine exhaust, brake, tire and aerodynamic noises. Cited by five references. (Reference 14, 17, 20, 45, 55).

11. Cost of installing multi-way stops are low but enforcement costs are prohibitive. many communities do not have the resources to effectively enforce compliance with the stop signs. Five references found this to be their finding. (Reference 1, 10, 45, 51, 55).

12. Stop signs do not significantly change safety of intersection. Stop signs are installed with the hope they will make the intersection and neighborhood safer. Cited by five references. (Reference 55, 60, 61, 62, 63).

Hypothesis seven (above) lists seven references that dispute the results of these studies.

13. Unwarranted multi-way stops have been successfully removed with public support and result in improved compliance at justified stop signs. Cited by three references. (Reference 8, 10, 12).

14. Unwarranted multi-way stops reduce accidents in cities with intersection sight distance problems and at intersections with parked cars that restrict sight distance. The stop signs are unwarranted based on volume and may not quite meet the accident threshold. Cited by three references. (Reference 6, 18, 68).

15. Citizens feel stop signs should be installed at locations based on traffic engineering studies. Some homeowners realize the importance of installing 'needed' stop signs. Cited by two references. (References 56, 57).

16. Multi-way stops can reduce cut-through traffic volume if many intersections along the road are controlled by stop signs. If enough stop signs are installed on a residential or collector street motorists may go another way because of the inconvenience of having to start and stop at so many intersections. This includes the many drivers that will not stop but slowly 'cruise' through the stop signs. This driving behavior has been nicknamed the 'California cruise'. Cited by two references. (Reference 14, 61).

17. Placement of unwarranted stop signs in violation of Georgia State Law 32-6-50 (a) (b) (c). This study was conducted using Georgia law. Georgia law requires local governments to install all traffic controls devices in accordance with the MUTCD. This is probably similar to traffic signing laws in other states. Cited by two references. (Reference 19, 62).

18. Special police enforcement of multi-way stop signs has limited effectiveness. This has been called the 'hallo' effect. Drivers will obey the 'unreasonable' laws as long as a policemen is visible. Cited by two references. (Reference 39, 46).

19. District judge orders removal of stop signs not installed in compliance with city ordinance. Judges have ordered the removal of 'unnecessary' stop signs. The problem begins when the traffic engineer and/or elected officials are asked to consider their intersection a 'special case'. This creates a precedent and results in a proliferation of 'special case' all-way stop signs. Cited by two references. (Reference 59, 62).

20. Some jurisdictions have created warrants for multi-way stops that are easier to meet than MUTCD. The jurisdiction feel that the MUTCD warrants are too difficult to meet in residential areas. The reduced warrants are usually created to please elected officials. Cited by two references. (Reference 61 and 70).

21. Citizens perceive stop signs are effective as speed control devices because traffic "slows" at stop sign. If everybody obeyed the traffic laws, stop signs would reduce speeds on residential streets. Cited by one reference. (Reference 55).

22. Removal of multi-way stop signs does not change speeds but they are slightly lower without the stop signs. This study findings support the drivers behavior referenced in item #4, speed increases when unwarranted stop signs are installed. Speed decreases when the stop signs were removed! Cited by one reference. (Reference 64).

23. Multi-way stops degrade air quality and increase CO, HC, and Nox. All the starting and stopping at the intersection is bad for air quality. Cited by one reference. (Reference 68).

Speed Control Issues

24. There area many ways to "calm" traffic. Cited by twenty-two references. (Reference 1, 14, 20, 32, 33, 34, 35, 36, 37, 38, 40,41,42, 44, 45, 46, 47, 48, 50, 51, 53 and 66).

They include:

(a) Traffic Chokers (f) Sidewalks and Other Pedestrian Solutions

(b) Traffic Diverters (g) Neighborhood Street Design

(c) Speed Humps (h) On-Street Parking

(d) Roundabouts (i) One Way Streets

(e) Neighborhood Speed Watch (j) Street Narrowing

25. Other possible solutions to residential speed. Most speeding is by residents - Neighborhood Speed Watch Programs may work. This program works by using the principle of 'peer' pressure. Cited by seven references. (Reference 2, 30, 31, 36, 42, 48 and 53).

26. Reduced speed limits are not effective at slowing traffic. Motorists do not drive by the number on the signs, they travel a safe speed based on the geometrics of the roadway. Cited by five references. (Reference 1, 20, 39, 46 and 69).

27. Local streets should be designed to discourage excessive speeds. The most effective way to slow down traffic on residential streets is to design them for slow speeds. Cited by two references. (Reference 43, 52).

28. Speeding on residential streets is a seasonal problem. This is a myth. The problem of speeding is not seasonal, it's just that homeowners only see the problem in 'pleasant' weather. That's the time they spend in there front yard or walking the neighborhood. Cited by one reference. (Reference 2).

29. Speed variance and accident frequency are directly related. The safest speed for a road is the speed that most of the drivers feel safest driving. This speed creates the lowest variance and the safest road. Cited by one reference. (Reference 47).

30. The accident involvement rate is lowest at the 85th percentile speed. The 85th percentile speed is the speed that most drivers feel comfortable driving. The lowest variance is usually from the 85th percentile speed and the 10 mph less. Cited by one reference. (Reference 47).

31. Psycho-perceptive transverse pavement markings are not effective at reducing the 85th percentile speed but do reduce the highest speed percentile by 5 MPH. Cited by one reference. (Reference 47).

32. The safest residential streets would be short (0.20 miles) non-continuous streets that are 26 to 30 feet from curb to curb width. The short streets make it difficult of drivers to get up to speed. Cited by one reference. (Reference 52).

Economics of Multi-Way Stop Signs

Studies have found that installing unwarranted stop signs increases operating costs for the traveling public. The operating costs involve vehicle operating costs, costs for increased

delay and travel time, cost to enforce signs, and costs for fines and increases in insurance premiums.

The total costs are as follows (Reference 55):

Operating Costs (1990) $ 111,737/year
($.04291/Stop)

Delay & Travel Costs (1990) $ 88,556 /year
($.03401/Stop)

Enforcement Costs (1990) $ 837/year

Cost of Fines (19 per year) $ 1,045/year

Cost of 2 stop signs (1990) $ 280

Costs of increased insurance (1990) $7,606/year

Total (1990) $210,061/year/intersection

The cost to install two stops signs is $280. The cost to the traveling public is $210,061 (1990) per year in operating costs. This cost is based on about 8,000 vehicles entering the intersection per day.

Another study (62) found that the average annual road user cost increased by $2,402.92 (1988 cost) per intersection when converting from two to four way stop signs for low volume intersections.

Summary of Stop Signs as Speed Control Devices

Researchers found that multi-way stop signs do not control speed. In analyzing the 23 hypotheses for multi-way stop signs, five were favorable and 18 were unfavorable toward installing unwarranted all-way stop signs. The Chicago study (6) was the only research paper that showed factual support for "unwarranted" multi-way stop signs. They were found to be effective at reducing accidents at intersections that have sight distance problems and on-street parking.

It is interesting to note that residential speeding problems and multi-way stop sign requests date back to 1930 (63). The profession still has not "solved" this perception problem.

Summary of Economic Analysis

Benefits to control speeds by installing multi-way stop signs are perceived rather than actual and the costs for the driving public are far greater than any benefits derived from the installation of the multi-way stop signs.

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Appendix A

References used in Research of Multi-Way Stop Signs

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Appendix B

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