CITY OF LODI

TM

COUNCIL COMMUNICATION

AGENDA TITLE: Discuss Almond North Residential Development as per Council's Request at the October 1, 2003 meeting

MEETING DATE: October 15, 2003

PREPARED BY: Community Development Director
Public Works Director

RECOMMENDED ACTION: Receive and File.

BACKGROUND INFORMATION: At the October 1st City Council meeting, several people spoke in opposition to a development proposal by Kirst Development on Almond Drive.

In 1994, Concord Development received approval to construct 100 homes on the vacant property north of Almond Drive and east of Stockton Street. In 1998, the allocations were expired by the City Council due to inactivity. In 2002, Concord Development returned with a new plan that did not include the two parcels owned by the Ruhl family. That plan was approved and allocated. As shown, pursuant to city requirement, a conceptual street layout was included for the Ruhl property to ensure neighborhood connectivity.

In May 2003, Kirst Development submitted a development plan for the property he purchased from Mrs. Ruhl. The plan encompasses 28 lots and 34 units (12 duplexes on the corner lots). The difference between the previous plan and the Kirst proposal was the location of Cherrywood Way connecting to Almond Drive and the use of duplex units on the corner lots.

DISCUSSION: At the City Council meeting, a number of comments were made that will be responded to as follows:

Growth Management Development Plan Approval: The Planning Commission met on September 24th to consider 8 different projects, one of which was the Kirst proposal. After considerable public input, the Planning Commission voted 5-1 to approve the development plan and recommend the 34 allocations. The one vote in opposition actually wanted a higher density project on the site. The appeal period for Planning Commission actions is 5 days. The appeal process is clearly stated on the front of the Planning Commission Agenda. Once the appeal period has expired, no further action by the City is allowed. Therefore, the Council cannot change the design of this project.

Fuel Tank: It was asserted that ground contamination had occurred on the Ruhl property. In fact, no contamination has been found. The Ruhls did have an above-ground agricultural diesel tank, but it was removed prior to the sale to Mr. Kirst, and an investigation around the tank location found no leakage.

APPROVED: _____
J.D. Dixon-Flynn -- City Manager

Duplexes within the Development: The Kirst proposal includes duplex units on corner lots. The ability to develop that type of unit is allowed by right within the R-2 single-family zone. This is the designation that was placed on the property when it was annexed into the City in 1992. The ability to have duplex units dates back in the Zoning Ordinance prior to 1965. In fact, the Noma Ranch Development, built in the mid 1980's immediately to the east of the Kirst proposal, includes duplex units on all 23 corner lots. It is staff's and the Planning Commission's opinion that this provides good planning, more efficient utilization of land and more opportunities for families to find housing in Lodi.

Almond Drive Traffic: Almond Drive is 44 feet wide between the curbs in a 60-foot right-of-way and is classified as a "Minor Collector" street. This classification is a result of the physical location of the street – a straight link between Cherokee Lane and Stockton Street – as it was in the County before it was annexed, and the fact that it collects traffic from the adjacent neighborhoods. The City's design standards provide for a traffic volume range of 4,000 to 10,000 vehicles per day (vpd) on minor collectors. The current volume on Almond Drive is just under 4,000 vpd. The posted speed limit is 30 mph, and the actual average and "85th percentile" speeds are approximately 32/38.5 mph, respectively. Additional counts are being conducted and will be presented at the Council meeting. These figures are similar to many other residential minor collectors such as Tokay Street, Vine Street and Mills Avenue. City traffic volumes are shown on Exhibit C.

The neighborhoods served by Almond Drive are shown on Exhibit D. The design of neighborhood streets attempts to minimize traffic volumes on local residential streets and provide multiple access points to adjacent collector streets. The design of the street layout in this area is constrained by a number of factors:

- Industrial development on the west side of Stockton Street – This had led to reverse frontage lots on the east side of Stockton Street and a minimal number of streets accessing Stockton Street to keep noise levels down in the neighborhood.
- Limited Kettleman Lane access – The only street connecting to Kettleman Lane is Academy Street, located at the far east end of the neighborhood. With the Highway 12 median construction, Academy Street access will be limited to right turns.
- No Cherokee Lane access – Given pre-existing development on Cherokee Lane, there is no opportunity for neighborhood streets to connect to the east.

As part of the planning for the Almondwood Estates project currently under construction, Elgin Drive will be extended to Stockton Street, as well as a new street connecting to Almond Drive near Stockton Street. At the time of approval, the developer asked to eliminate the Almond Drive connection, offering that it could be made with the next development to the east (now called Almond North). Staff felt both were necessary, and the Planning Commission approved the map with the Almond Drive connection. We also note that we require developers to submit a potential street layout for adjacent properties to assure that we are not leaving an adjacent property with a difficult-to-develop situation and to plan adequate access. While the

developer may have indicated a cul-de-sac for the Planning Commission, it was for the purpose of indicating a potential development layout, and as noted above, the desire for a street connection was discussed.

Past requests for traffic-related service on Almond Drive have focused on truck traffic and parking/sight-distance issues. In response to these requests, the street has a number of no-parking zones and trucks over 2 axles are prohibited.

The Almond North project (34 units) will generate approximately 316 vehicles per day, well less than 10% of the traffic on Almond Drive, even if all the traffic used that street. Staff will present additional traffic volume information at the meeting.

Stop signs as speed control devices: Staff is providing background information on our often repeated statement that stop signs are not an effective speed control device. As we indicated, numerous studies support this statement. Attached are:

- Exhibit E – A recent analysis of over 70 technical papers on the subject.
- Exhibits F thru I – Four specific studies on the subject from 1976 through 1994.
- Exhibit J – Copy of a staff report to the Council in 1988 in which we tested a specific location in Lodi and found a slight increase in speeds following installation of an unneeded stop sign.

FUNDING: None required

Respectfully Submitted,

Konradt Bartlam
Community Development Director

Richard C. Prima, Jr.
Public Works Director

KB/RCP/lw

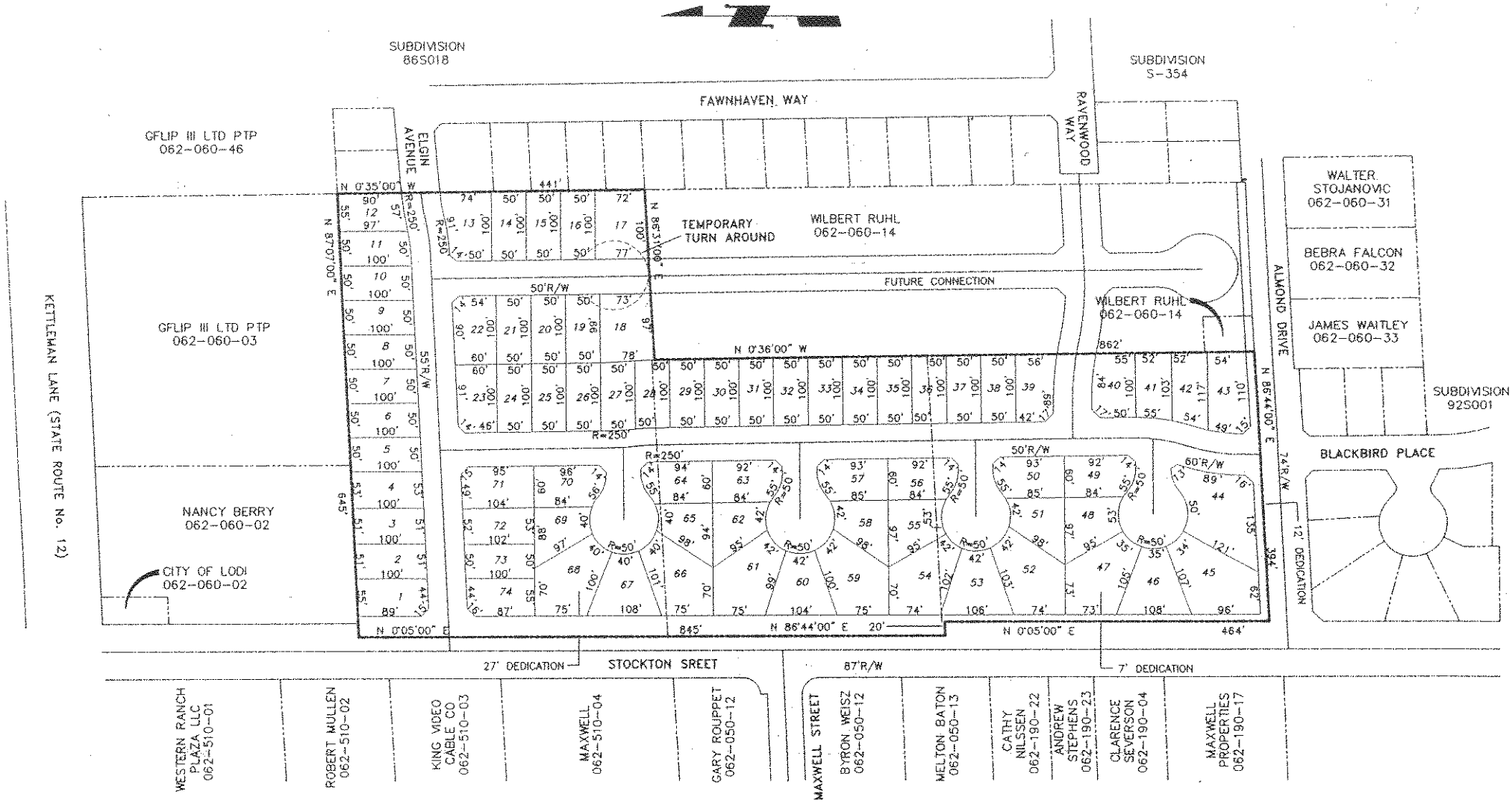
Attachments

Exhibit "A" Almond Wood Estates Development Plan (Concord Development/KB Home)
Exhibit "B" Almond North Development Plan (Kirst)
Exhibit "C" City traffic volumes
Exhibit "D" Neighborhoods served by Almond Drive
Exhibit "E" Analysis of technical papers
Exhibit "F" thru "I" Specific studies on the subject from 1976 through 1994
Exhibit "J" Copy of staff report to Council in 1988

EXHIBIT "A"

ALMOND WOOD ESTATES

14.5 ACRES
74 LOTS



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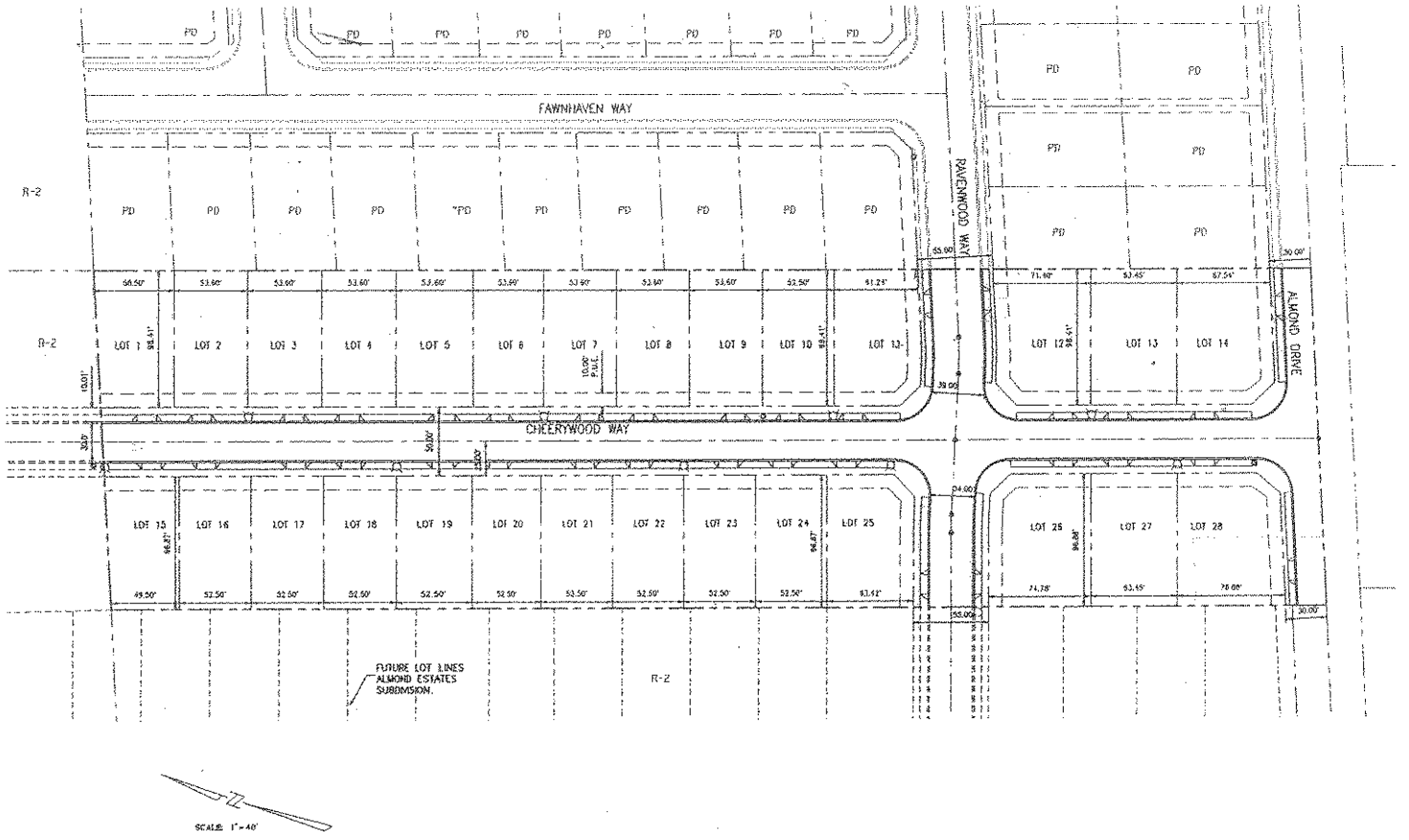


SCALE: 1"=40'

NOTES:

1. THIS SUBDIVISION CONTAINS 2 PARCELS: APN: 062-060-14, 062-060-15 TOTALING 5.00 ACRES.
2. PUBLIC IMPROVEMENTS WILL BE INSTALLED IN ACCORDANCE WITH THE CITY OF LODI STANDARDS.
3. DOMESTIC WATER SERVICE, SANITARY SEWER AND STORM WATER DRAINAGE SERVICE WILL BE BY THE CITY OF LODI WITHIN DEDICATED PUBLIC UTILITY EASEMENTS IN ACCORDANCE WITH AN APPROVED PUBLIC MASTER PLAN.
4. PROPOSED STREET RIGHT OF WAY WIDTH IS 30' FEET FROM FACE OF CURB TO FACE OF CURB
5. PUBLIC UTILITY EASEMENTS (P.U.E.) SHALL BE DEDICATED AS REQUIRED
6. STREET NAMES WILL BE ENGLISH ON THE FINAL MAP.
7. THE SITE IS CURRENTLY VACANT.
8. THE SITE IS ZONED R-2.
9. 1.42 ACRES WILL BE DEDICATED AS PUBLIC RIGHT OF WAY.

OWNER:

TOKAY DEVELOPMENT, INC., ET AL
222 W. LOCKFORD STREET, SUITE 1
LODI, CA 95240
(209) 334-4944
ATTN: JEFFREY KIRST

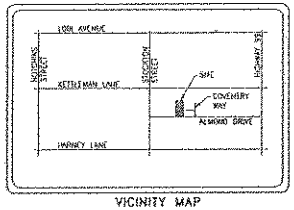
SUBDIVIDER:

TOKAY DEVELOPMENT, INC.
222 W. LOCKFORD STREET, SUITE 1
LODI, CA 95240
(209) 334-4944
ATTN: JEFFREY KIRST

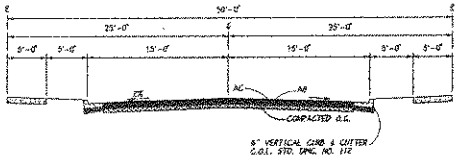
MAP PREPARER:

SIEGFRIED ENGINEERING, INC.
4045 CORONADO AVENUE
STOCKTON, CALIFORNIA 95204
PHONE: (209) 943-2021
ATTN: PAUL J. SCHNEIDER, R.E. 62498

EXHIBIT "B"



VICINITY MAP
NOT TO SCALE



PROPOSED CHERRYWOOD WAY
TYPICAL STREET SECTION
NOT TO SCALE

LEGEND:

EXISTING ZONING	R-2
FUTURE LOT LINE ALMOND ESTATES SUBDIV.	
PROPOSED P.U.E.	
SUBDIVISION BOUNDARY	
PROPOSED LOT LINE	
PROPOSED STREET LIGHT	
PROPOSED FIRE HYDRANT	
PROPOSED DETACHED SIDEWALK	

DEVELOPMENT PLAN

ALMOND NORTH SUBDIVISION

BEING A PORTION OF LOT 14, A.J. LARSON'S SUBDIVISION AND A PORTION OF THE NORTHEAST QUARTER OF SECTION 13, T.3N., R. 6E., M.D.B. & M.
CITY OF LODI, SAN JOAQUIN COUNTY, CALIFORNIA

SIEGFRIED ENGINEERING, INC.

MAY 2003

SHEET 1 OF 1
S.E.I. JOB NO. 03216

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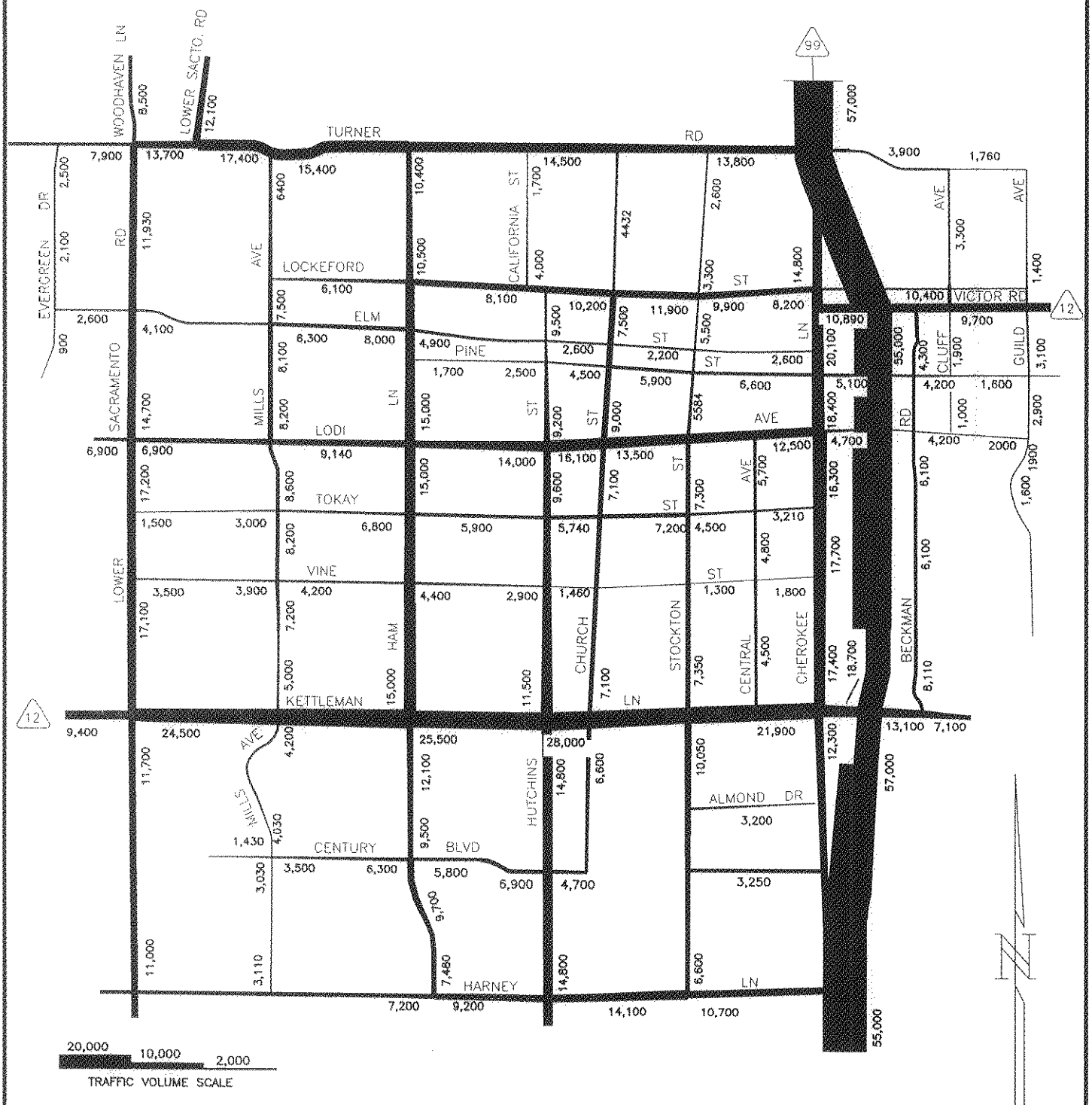
CITY OF LODI

PUBLIC WORKS DEPARTMENT

AVERAGE DAILY TRAFFIC VOLUME MAP

Exhibit C



NOTE:
Figures based on weekday counts, no seasonal adjustment except State Highway counts are annual average days. Peak month days are approximately 20% higher.

April, 2003

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CITY OF LODI

PUBLIC WORKS DEPARTMENT

Neighborhoods Served By Almond Drive

Exhibit D

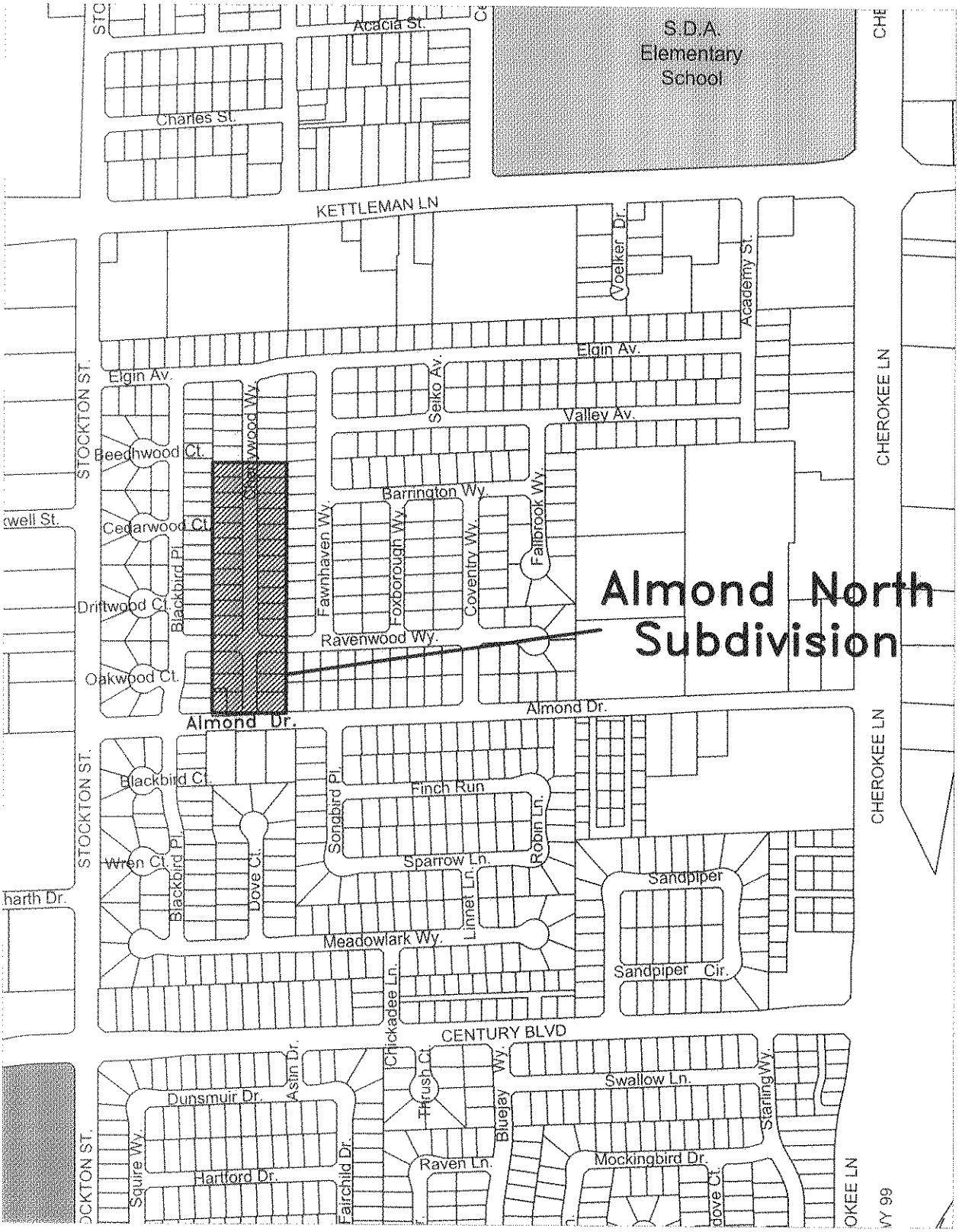

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Exhibit E

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) ($.04291/Stop)	$ 111,737/year
Delay & Travel Costs (1990) ($.03401/Stop)	$ 88,556 /year
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.

W. Martin Bretherton Jr., P.E.

Chief Engineer, Traffic Studies Section

Gwinnett County Department of Transportation

75 Langley Drive

Lawrenceville, Georgia 30045

770-822-7412

brethema@co.gwinnett.ga.us

Appendix A

References used in Research of Multi-Way Stop Signs

1. Gerald L. Ullman, "Neighborhood Speed Control - U.S. Practices", ITE Compendium of Technical Papers, 1996, pages 111- 115.

2. Richard F. Beaubein, "Controlling Speeds on Residential Streets", ITE Journal, April 1989, pages 37-39.

3. "4 Way Stop Signs Cut Accident Rate 58% at Rural Intersections", ITE Journal, November 1984, pages 23-24.

4. Michael Kyte & Joseph Marek, "Collecting Traffic Data at All-Way Stop Controlled

Intersections", ITE Journal, April 1989, pages 33-36.

5. Chan, Flynn & Stocker, "Volume Delay Relationship at Four Way Stop Controlled

Intersections: A Response Surface Model", ITE Journal, March 1989, pages 27-34.

6. La Plante and Kripidlowkdki, "Stop Sign Warrants: Time for Change", ITE Journal, October 1992, pages 25-29.

7. Patricia B. Noyes, "Responding to Citizen Requests for Multi Way Stops", ITE Journal, January 1994, pages 43-48.

8. Chadda and Carter, "Multi-Way Stop Signs - Have We Gone Too Far?", ITE Journal, May 1983, pages 19-21.

9. Gary Moore,"Gwinnett County Legal Opinions on Unwarranted Multi-Way Stops",

March 6,1990.

10. Chadda and Carter, " The Changing Role of Multi-Way Stop Control", ITE

Compendium of Technical Papers, 1983, pages 4-31 to 4-34.

11. Lovell and Haver, "The Safety Effect of Conversion to All-Way Stop Control", Transportation Research Record 1068, pages 103-107.

12. "Indiana Suggests Ways to Halt Stop Sign Misuse", Transafety Reporter, February 1989, page 7.

1978.

14. "State of the Art: Residential Traffic Management", US DOT, FHWA/RD-80/092, December 1980, pages 63-65, 22-23.

15. Dick Williams, "A New Direction for Traffic Dispute", Atlanta Journal, January 14, 1988, Section E, page 1.

16. "Warrants for Multi-Way Stop Signs" (2B-6), Manual on Uniform Traffic Control Devices, US DOT , FHWA, pages 2B-3 to 2B-4.

17. "Stop and Yield Sign Control", Traffic Control Devices Handbook, US DOT, FHWA, 1983, pages 2-14 to 2-16.

18. La Pante & Kropidlowdki, "Stop Sign Warrants ", Presented at ITE Conference, San Diego, CA, September 18, 1989.

19. Walt Rekuc, "Traffic Engineering Study of Multi-Way Stop Signs". City of Roswell,

February 15, 1988.

20. Homburger, etal, Residential Street Design and Traffic Control, ITE, Washington, DC, 1989.

21. Speed Zone Guidelines, ITE, Washington, DC, 1993.

22. A Policy on Geometric Design of Highways and Streets, AASHTO, Washington, DC, 1994.

23. A.J. Ballard, "Efforts to Control Speeds on Residential Collector Streets", ITE

Compendium of Technical Papers, 1990, pages 445-448.

24. C.E. Walter, "Suburban Residential Traffic Calming", ITE Compendium of Technical Papers, 1994, pages 445-448.

25. K.L. Gonzalez, " Neighborhood Traffic Control: Bellevue's Approach", ITE Journal, Vol. 43, No.5, May 1993, pages 43-45.

26. Brian Kanely & B.E. Ferris, "Traffic Diverter's for Residential Traffic Control - The Gainesville Experience", ITE Compendium of Technical Papers, 1985, pages 72-76.

27. Marshall Elizer, "Guidelines for the Design and Application of Speed Humps", ITE Compendium of Technical Papers, 1993, pages 11-15.

28. T. Mazella & D. Godfrey, "Building and Testing a Customer Responsive Neighborhood Traffic Control Program", ITE Compendium of Technical Papers, 1995, pages 75-79.

29. W.M. Bretherton and J.E. Womble, "Neighborhood Traffic Management Program", ITE Compendium of Technical Papers, 1992, pages 398-401.

30. J.E. Womble, "Neighborhood Speed Watch: Another Weapon in the Residential Speed Control Arsenal", ITE Journal, Vol. 60, No. 2, February 1990, pages 1- 17.

31. Michael Wallwork, "Traffic Calming", The Genesis Group, unpublished.

32. Doug Lemov, "Calming Traffic", Governing, August 1996, pages 25-27.

33. Michael Wallwork, "Traffic Calming", The Traffic Safety Toolbox, ITE, Washington, DC, 1993, pages 234-245.

34. Ransford S. McCourt, Neighborhood Traffic Management Survey, ITE District 6, Technical Chair, unpublished, June 3, 1996.

35. Halbert, etal, "Implementation of Residential Traffic Control Program in the City of San Diego", District 6 Meeting, July 1993.

36. Anton Dahlerbrush, "Speed Humps & Implementation and Impact on Residential Traffic Control", City of Beverly Hills, California, District 6 Meeting, July 1993.

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Exhibit F

Stop Signs for Speed Control?

Though they are frequently suggested as appropriate traffic control devices for reducing vehicular speeds in residential areas, they are not only ineffective in this respect but also frequently ignored, as this study shows.

By Richard F. Beaubien, P.E.

City officials are frequently confronted by citizens demanding that stop signs be placed on residential streets to control speeding. These citizens are convinced that stop signs will reduce speeds on their streets, thereby enhancing the safety of children playing near or in the streets. City councils usually respond favorably to these requests in order to provide a tangible sign of their concern for public safety at a relatively low cost. Moreover, it seems obvious to them also that stop signs will reduce speeds and promote public safety.

The *Manual on Uniform Traffic Control Devices for Streets and Highways** states that stop signs *should not* be installed for speed control. One argument for this is that misuse of this traffic control device promotes lack of respect for all traffic control devices, and nonobservance of such devices is potentially hazardous. Perhaps a more effective argument is that stop signs are *not* effective in reducing speeds. Recent studies in the City of Troy, Michigan suggest that placing stop signs for speed control tends to increase peak speeds. The studies also showed an alarmingly high disobedience rate for these signs. The speed and stop sign observance studies were made from an unmarked city car, the former with a radar unit before and after the installation of stop signs. The highest speed observed for each vehicle was the speed recorded. The results are as follows:

Anvil Drive. Anvil Drive is a collector street in a new residential area. The street is approximately 0.6 miles long and has a curved alignment to emphasize its residential character and discourage speeding. Residents felt that speeding was a problem, however, and spot speed studies were conducted to determine the extent of it.

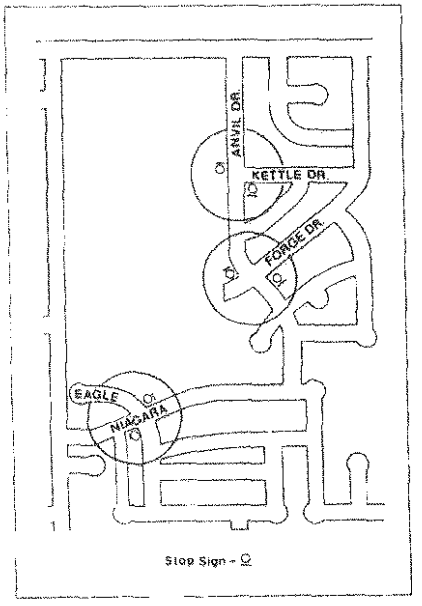

Figure 1.

The average peak speed was 24.1 miles per hour—a typical result for residential streets in Troy. Residents petitioned City Council, and stop signs were placed on Anvil at Forge and Kettle Drives, two local streets, as a result of council action (Figure 1). Studies conducted on Anvil between these two streets 30 days after the stop signs were installed showed that the average peak speed was 24.6 mph—or no significant difference because of the signs.

Stop sign observance studies made at Anvil and Kettle at the same time showed that only 25 percent of the motorists came to a full stop, suggesting that drivers don't feel that a stop is required at this intersection. Study results are shown in Table 1.

Table 1. Anvil Drive.

Speed Studies		
Speed	Without Stop Signs mph	With Stop Signs mph
Low	15	15
Average	24.1	24.6
85th Percentile	28	28
High	38	35

Stop Sign Observance		
	Number	Percent
Full Stop	14	25
Roll Stop	35	64
No stop	6	11
Total	55	100

Niagara Drive. Niagara Drive is a collector street in a new residential area. Approximately 0.4 miles long, Niagara, too, has a curved alignment to emphasize its residential character and discourage speeding. Residents in the area, concerned about speeding, petitioned City Council for installation of stop signs on Niagara and Eagle, a local street (Figure 1). Spot speed studies made to determine the extent of the speeding problem found average peak speed to be 23.8 mph. Stop signs were installed, and speed studies were conducted again 30 days after installation. With the signs in place, average peak speed was 25.2 mph, indicating that the

* U.S. Department of Transportation, Federal Highway Administration, Washington, D.C., 1971.

stop signs were not effective in reducing speeds.

Stop sign observance studies, made at the same time, showed that 51 percent of the motorists came to a full stop at Eagle and Niagara, suggesting that about half of them don't feel that a stop sign is necessary at Eagle. Study results are shown in Table 2.

Robinwood Street. Robinwood is a collector street in an established residential area. It is about 0.5 miles long; its connection with other streets provides a continuous route between Livernois and Rochester, both arterials. In 1964, stop signs were placed on Robinwood at Van Courtland (Figure 2), creating a three-way intersection, in response to citizen requests after a child was killed near the intersection. The accident report indicates that the child was struck by a car going approximately 12 mph at a point some 150 feet east of the intersection. The driver was not considered to be at fault. Studies showed an average speed of 24.4 mph and that only 26 percent of the motorists came to a full stop. The latter indicates that over a period of more than 11 years, motorists have developed a habit of not stopping for the signs on Robinwood at Van Courtland. The signs were removed on a temporary basis and speed studies conducted 30 days later. The average peak speed was 23.4 mph, so there was no significant difference in speeds after the stop signs were removed. Study results are shown in Table 3.

Crimson Street. Crimson is a collector street in a new residential area; many homes are still under construction. It is about 0.6 miles long and has a curved alignment, like Anvil and Niagara. However, speeding seemed to be a problem and residents in the area asked that stop signs be installed on Crimson at Crestline and on Crimson at Lakewood to reduce speeds (Figure 3), but they

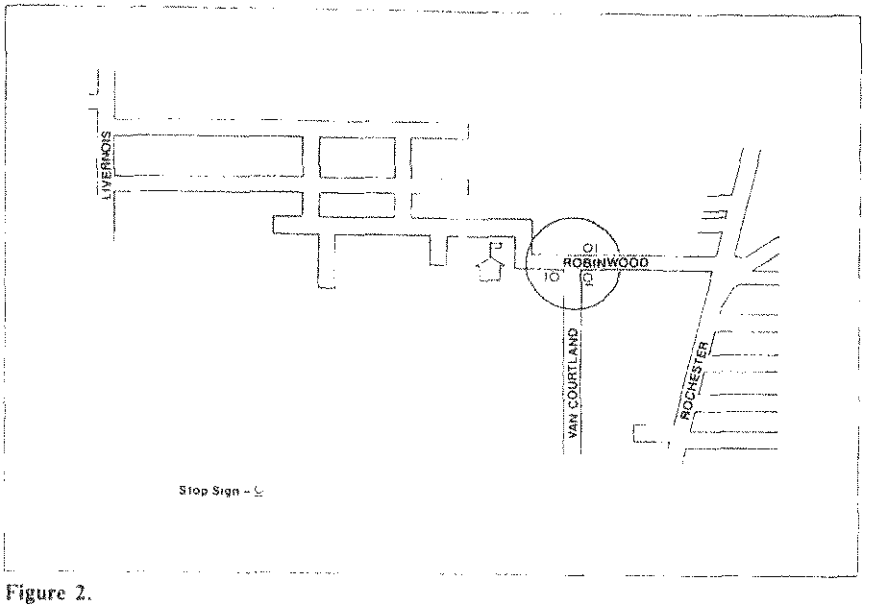

Figure 2.

Table 2. Niagara Drive.

Speed Studies		
Speed	Without Stop Signs mph	With Stop Signs mph
Low	15	15
Average	23.8	25.2
85th Percentile	26	29
High	34	34

Stop Sign Observance		
	Number	Percent
Full Stop	21	51
Roll Stop	14	34
No Stop	6	15
Total	41	100

Table 3. Robinwood Street.

Speed Studies		
Speed	Without Stop Signs mph	With Stop Signs mph
Low	10	13
Average	23.4	24.4
85th Percentile	30	30
High	38	38

Stop Sign Observance		
	Number	Percent
Full Stop	21	26
Roll Stop	39	48
No Stop	21	26
Total	81	100

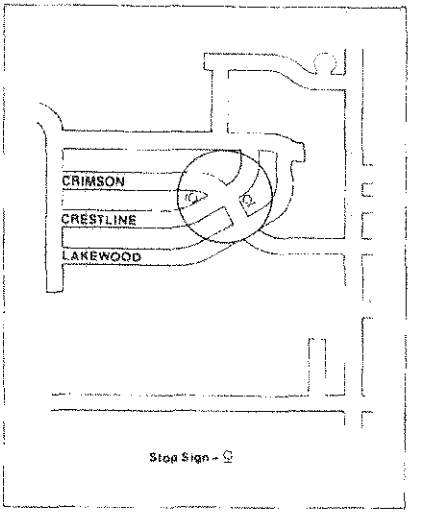

Figure 3.

Table 4. Crimson Street.

Speed Studies

Speed	Without Stop Signs mph	With Stop Signs mph
Westbound Crimson East of Crestline		
Low	12	15
Average	21.6	23.7
85th Percentile	25	26
High	32	30
Westbound Crimson West of Crestline		
Low	7	15
Average	24.0	23.7
85th Percentile	29	27
High	40	32
Eastbound Crimson East of Crestline		
Low	10	10
Average	23.5	24.8
85th Percentile	27	27
High	32	34
Eastbound Crimson West of Crestline		
Low	8	15
Average	24.5	26.6
85th Percentile	31	32
High	39	36

Stop Sign Observance

	Number	Percent
Eastbound		
Full Stop	2	6
Roll Stop	19	54
No Stop	14	40
Total	35	100
Westbound		
Full Stop	10	10
Roll Stop	42	43
No Stop	46	47
Total	98	100

agreed to await the results of an evaluation of a temporary stop sign on Crimson at Crestline before pressing their request for permanent signs. Before and after speed studies were made at locations chosen with the cooperation of the residents. The speed studies were made on both sides of the signs, the results separated by direction of travel. The after studies were made 30 days following installation of the temporary signs.

Sign observance studies were made at the same time. These showed that only 9 percent of the motorists came to a full stop, revealing that the other 91 percent *did not consider a full stop necessary.* Results of the studies are shown in Table 4. After seeing the results, residents agreed that stop signs were not effective in reducing speeds in their area. The temporary signs have been removed.

Conclusions. The studies conducted in Troy show that stop signs are not effective in controlling speeds in residential areas. The difference in average speeds is not significant after installation of stop signs but the tendency is for a slight increase in speeds, possibly because motorists are trying to make up for lost time after passing the sign. The same tendency occurs in reverse when stop signs which have been in place for many years are removed. After removal, there was no significant change in speeds, but *speeds were slightly lower without the* stop signs.

The stop sign observance studies showed that stop signs placed for speed control are generally disregarded. Approximately *half of the motorists made a* rolling stop; one quarter came to a full stop; one quarter did not stop at all.

Mr. Beaubien (M) is transportation engineer for the City of Troy, a suburban community in the metropolitan area of Detroit. Before entering this position in 1975, he was chief engineer with the firm of Reid, Cool & Michalski, Detroit. From 1968 to 1973 he served with the Federal Highway Administration in various parts of the country.

Exhibit G

By Himmat S. Chadda, Ph.D., P.E. and
Everett C. Carter, Ph.D.

Multi-Way Stop Signs—Have We Gone Too Far?

Problem

Over the past two or three decades, right-of-way control at many intersections has become multi-way stop sign control, resulting in the proliferation of stop signs at urban intersections. Multi-way stop signs have been installed for many reasons, including the following:

- Conformance with MUTCD warrants (traffic volumes and accidents).
- An interim measure prior to installing a traffic signal (—until such time that signal warrants are fully met and/or funds for signal installation become available).
- Safety improvements at an intersection with inadequate sight distance resulting in excessive right-angle collisions.
- Speed control device, for discouraging through traffic on urban residential streets.
- City officials yield to citizen requests (viewing stop signs as a "cure-all" for their perceived traffic safety problems) and install unwarranted multi-way stops (which have low initial installation cost but rather measurable adverse economic, operational, environmental, and social impacts).

Even though the *Manual on Uniform Traffic Control Devices* (MUTCD) has specific warrants for the application of multi-way stop control, the "political" warrant, in some cases, is the only one that is met. Some local agencies, particularly those where elected officials and political appointees influence decision-making, believe that multi-way stops are a panacea for urban traffic problems, promoting speed control, accident reduction, and pedestrian safety. In some cities and counties, multi-way stop control remains the predominant urban intersection traffic control, resulting in these jurisdictions being the most flagrant violators of the MUTCD warrants for the multi-way stop controls.

The MUTCD emphatically states that stop signs should not be installed for speed control.[1] Research[2, 3, 4, 5] has established that the installation of stop signs for the purpose of controlling vehicle speed does not achieve the desired results. Despite this fact, citizens frequently request the installation of stop signs to solve perceived traffic problems. Studies in the City of Troy, Michigan[3] and in Howard County, Maryland[5] revealed that placing stop signs for speed control increased peak speeds. The study in Berkeley, California, showed that signs placed for the purpose of speed reduction were flagrantly violated.[5]

Impacts

Unwarranted stop signs increase stops, cause delays, increase vehicle operating costs (including fuel consumption), and increase pollutants. Further, installation of unwarranted traffic control devices, especially stop signs, breeds disrespect for such devices and can result in potentially dangerous driver behavior and real safety problems. For these reasons, it is desirable to remove unwarranted and unneeded stop signs which hinder traffic flow, rather than aid it. Removing unwarranted stop signs would reduce the number of vehicles required to stop, thereby increasing fuel economy. A recent study for the City of Inglewood, California,[7] revealed that approximately 0.0173 gallons of fuel is consumed in deceleration and acceleration for each stop made by the average passenger car. The study also noted that the conversion of 15 multi-way stop controlled intersections (out of 38 investigated) to two-way stop controlled would result in annual savings of about $486,000. Another recent research study[8] has shown that, in some cases, intersections which are currently controlled by four-way stop signs would operate much more economically under two-way control. That study also noted that there are thousands of multi-way stop sign controlled intersections nationwide which should be converted to two-way control.

Based upon a survey of the literature and a telephone survey of several city and state agencies, the problems/

impacts of unwarranted stop signs are briefly summarized below.

A. *Safety Problems*
- Drivers who do not obey the right-of-way rule at multi-way stop intersections.
- Drivers who do not make a complete stop (rather a partial or rolling stop).
- Drivers who recognize that stop signs are not needed at a particular intersection, tend to ignore the control resulting in safety problems. This has led to a general increase in disrespect and a decrease in compliance with traffic control devices. This has resulted in potential for increase in right-angle accidents—the very type which stop signs are designed and installed to prevent.
- Drivers who obey and make a complete stop, tend to increase speed at mid-block to make up for time lost between multi-way stops.

B. *Economic Impacts*
- Increased delays.
- Increased fuel consumption.
- Increased vehicle operating costs (including fuel, oil, and maintenance costs).

C. *Operational Impacts*
- Increased stops (and delays).
- Increased traffic congestion at intersections.
- Driver anguish/anxiety.
- Increased accidents—under certain circumstances.

D. *Environmental Impacts*
- Increased noise pollution.
- Increased air pollution.

Current Thinking

Many local jurisdictions are beginning to question the need for stop signs at many locations and better understand the air pollution, delay, and energy impacts resulting from excessive use of multi-way stops. As a result of this awareness, some cities have initiated studies and plans to convert multi-way stop signs to two-way stop control (and occasionally to yield control). Examples of cities with experience in removal of unnecessary stop signs are described below. Some of these examples are based on discussions between the authors and city and state officials.

Peoria, Illinois initiated a program in the mid-1950s for the removal of unwarranted stop signs, including four-way stops.[9] As a result of their program, the number of four-way stops was reduced from 41 to 18. Of the 23 four-way stops removed, only one met minimum four-way stop warrants, and that location was ultimately signalized. Peoria also found that the conversions won public support and improved driver obedience at "justified" stop signs.

In 1977, the City Commission of Helena, Montana ordered installation of ten four-way stop signs along two streets (one an arterial and the other a collector) in a residential neighborhood. The residents along these streets complained about increasing traffic volumes and perceived speed and safety problems to be significant on their streets. The before-and-after studies revealed that the installation of unwarranted four-way stop signs does not significantly change the speed, and a majority of motorists do not respect stop signs installed as a speed-control measure. The results of the before-and-after study in Helena clearly showed that the goal of increased traffic safety had not been fully realized.[10]

In 1974, the Missouri Auto Club (AAA) conducted a study in St. Louis on the cost to motorists caused by unnecessary four-way stop signs. Over a period of several years, the City of St. Louis used the four-way stops along arterial streets as an interim measure until traffic signal warrants were met or until traffic signal funding could be obtained. When funding sources became scarce, however, these four-way stops remained on arterial streets much longer than was originally intended. The Auto Club engineers investigated 44 locations along major streets and found that four-way stop signs caused an increase of 555,000 hours of travel time each year. This resulted in an increase of $1,623,000 in the operating cost of those vehicles required to stop. In addition, the Auto Club engineers estimated that an additional 1.5 million gallons of gasoline were consumed because of the four-way stops placed on the arterial streets.[11, 12]

Philadelphia has approximately 900 four-way stop signs on its street system and has recently started to convert the existing four-way stop control to other types of control including signalization and two-way stops. Four-way stop signs at approximately fifteen intersections have been removed with some degree of success.

The Michigan DOT is utilizing federal highway safety 402 funds for upgrading stop signs in several cities and counties. Two Michigan cities, Berkeley and Harpers Woods, have developed plans for removing several unwarranted four-way stop signs.

Minneapolis, Minnesota has approximately 150 existing intersections controlled by multi-way stop signs and recently prepared a plan to remove unwarranted installations. Subject to the approval of the City Council, approximately 30 of the existing 150 locations (about 20 percent) will be changed to two-way stop control.

Dayton, Ohio, with four-way stop signs at approximately 80 intersections, successfully converted unwarranted control to two-way stops at about 6 locations. This conversion program is still in progress.

Seattle, Washington is currently conducting a study of the existing all-way stop signs (both warranted and unwarranted) to evaluate economic, operational, safety and environmental impacts of this type of traffic control. The results of the study expected to be available during early 1983 will address the problem of unwarranted stop signs.

The multi-way stop signs at approximately 100 intersections in Bloomington, Indiana constitute the predominant type of traffic control at the city intersections, involving all types of roadways (arterials, collectors and locals). It is estimated that approximately 30 percent of the multi-way stops are not warranted and need to be converted to other forms of traffic control.

Memphis, Tennessee has multi-way stop control existing at approximately 90 intersections and has converted to other types of controls at about 6 locations.

Bloomingdale, a suburb of Chicago, Illinois, experienced a rapid population growth, from 2,500 in 1970 to 135,000 in 1981, resulting in numerous stop signs at intersections. The city recently removed 179 unwarranted stop signs and replaced them with yield signs at 43 locations. The remainder became uncontrolled. The city reported a positive response from most residents in regard to this revised traffic management plan.[13]

In addition to the above, many other cities in California, Ohio, Illinois, Tennessee, Missouri, and Wisconsin are

also in the process of removing unnecessary multi-way stop signs.

A New Direction

For several decades, traffic engineering changes have, almost without exception, involved installing more positive or rigid control; for example, going from no control to two-way stop control or two-way to four-way stop control. Removal of unwarranted stop signs is never easy, automatic, nor simple. The conversion process requires public awareness of the change and the resulting benefits, as well as the safety aspects for subsequent public acceptance. Multi-way stop conversions need to be conducted in a careful and systematic fashion in order to avoid safety problems. Rational public notification and advance warning strategies should be employed for informational purposes before the conversion process is implemented. What is needed is a standardized multi-way stop conversion methodology, one that minimizes the danger of increased accidents yet preserves the positive energy, economic, and environmental benefits. There are, however, political and institutional constraints to overcome. There is also the concern of traffic engineers for the safety of pedestrians and motorists who are worried that accidents may increase. Recent computer simulation studies[8] indicate that this may indeed be a very real concern for certain combinations of traffic volumes.

The following are suggested steps in the study for identifing unwarranted stop control and for providing data for decisions on subsequent removal.

- Prepare a complete inventory of all multi-way stop signs within the political jurisdiction.
- Determine whether MUTCD warrants for installation of multi-way stop control were met based on the existing traffic conditions.
- Identify the intersections, preferably by roadway type (arterial, collector, local residential, etc.) where MUTCD warrants are not met.
- Prioritize candidate intersections starting with arterial roadways.
- Prepare a detailed analysis of each study site to include evaluation of safety (i.e., sight distance, approach speed, accident experience, etc.), economic, and environmental effects based on field data showing driver compliance, delays, volumes, speeds, etc.
- Identify and quantify benefits resulting from reduction in traffic controls, for example, traffic not required to stop on certain approaches of an intersection.
- Identify candidate locations where less restrictive control can be recommended and carefully document study results highlighting the real cost savings to highway users (excess vehicle operating, delay, and driver discomfort costs).
- Present study results to elected officials or other decision makers.
- Involve area community groups—or citizens in the process.

The key to a successful method which will overcome political and local resident pressure in removing unwarranted stop signs may be a strong public relations campaign and citizen involvement. This approach has been successfully used in some jurisdictions; for example, in Troy, Michigan where the citizen involvement process is generally used in establishing or changing traffic regulations. In the opinion of the City Traffic Engineer "no unwarranted stop sign will be removed in any political jurisdiction without some similar kind of citizen involvement".[14]

The intent of this paper is not to discredit the use of multi-way stop signs but to suggest their rational and judicious application, conforming to MUTCD standards. Multi-way stop control, when properly justified, provides an efficient, effective and safe intersection control. The problem lies mainly with clusters of unwarranted multi-way stop signs that exist at the nations' urban intersections, resulting in substantial adverse economic, energy, and environmental effects.

The authors are aware that further research and study of this problem is now underway. Hopefully, these efforts will provide answers to some of the problems identified in this paper.

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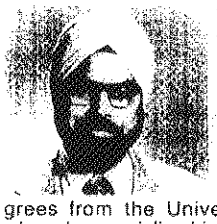
14. Correspondence of March 5, 1982 from Mr. Richard F. Beaubien, Transportation Engineer, City of Troy, Michigan addressed to Mr. Himmat S. Chadda.



Chadda (A) is the Assistant Chief, Traffic Surveys, Data Collection and Analysis Branch of the Bureau of Traffic Engineering & Operations, D.C. DOT. He received his M.S. and Ph.D. degrees from the University of Maryland, where he specialized in transportation planning. He also obtained his B.S. degree in civil engineering and his M.S. degree in highway design from Punjab University, India. His 22 years of professional experience include 14 years in traffic engineering, transportation planning, and transportation research in the United States.

Carter (F) is a Professor of Civil Engineering and Director of the Transportation Studies Center at the University of Maryland, College Park, Maryland. He received his BSCE degree from the Virginia Polytechnic Institute, his Master's from the University of California at Berkeley, and his Ph.D. from Northwestern University in civil engineering (transportation). His professional experience includes 19 years in teaching and research and 3 years in traffic engineering and transportation planning.

Exhibit H

Controlling Speeds on Residential Streets

BY RICHARD F. BEAUBIEN

Complaints of speeding on residential streets are a continuing problem for local traffic engineers and police departments. The observations in this article describe the experiences of Troy, Michigan, in dealing with this problem over the past decade. Comparisons of 1975 speed study and observance study results with 1985 and 1986 results at the same locations are included.

The Nature of the Problem

Because the complaints of speeding in residential areas are often emotional, it is important to put the problem into perspective. By understanding the nature of the problem, we may be able to arrive at better solutions for our citizens.

The problem is partly social and partly political. Elected officials confronted with a citizen request for a stop sign might find it easy and inexpensive to grant the request, thus demonstrating their "compassion" and "concern for local needs." Although this demonstration of compassion is inexpensive in terms of immediate capital costs, its long-term impact can be detrimental to public health, safety, and welfare. Studies have shown that unwarranted stop signs are ineffective in controlling speeds; such signs are often disregarded, leading to a lack of respect for traffic control devices.[1]

In 1987, 90% of all accidents and 96% of the injury accidents in Troy occurred on arterial, rather than residential, streets. This suggests that transportation professionals should be spending more than 90% of their time dealing with the problems of accidents on arterial streets. However, because the speeding problem in residential areas is "close to home," traffic engineers and police departments spend a disproportionate amount of their time addressing problems on local streets, which are not connected to accident experience.

Speeding on residential streets is a seasonal problem. In northern climates, such as in Michigan, the complaints of speeding on residential streets virtually disappear during the months of November through March; when residents spend less time out doors, the problem or perceived problem seems to disappear.

A 25-mph speed limit may be unreasonably low in new subdivision areas with adequate street design standards. The national basic speed limit recommended in the *Uniform Vehicle Code* is 30 mph. In Michigan, the lowest speed limit permitted under state law (except in park areas) is 25 mph. Naturally, residents insist that the speed limit be as low as possible in their neighborhood, although the design speed on their street may exceed 25 mph. Motorists who travel local streets every day tend to travel closer to the design speed than the speed limit, and this creates observed speeds in excess of the posted speed limit. This condition is viewed with alarm by neighborhood residents, but it may not actually be a traffic safety problem because the design speed may be greater than 25 mph.

The speeding problem on residential streets tends to become associated with the problem of through traffic in residential areas. The through traffic is, in part, a symptom of inadequate capacity on major arterial streets. If adequate capacity were available on the arterial streets, "outsiders" would stay on arterial streets rather than seek alternate paths through residential areas.

Stop Signs Not Effective

Many citizens, particularly those concerned about the safety of their children, suggest that "maybe a stop sign will slow traffic on our street."

Before-and-after speed studies conducted in the City of Troy indicate that stop signs are not effective in controlling speeds. Compliance with these stop signs is very poor, and over a period of years the compliance degrades to a point where motorists behave as if the sign were not present at all. This degradation is shown in Table 1, which compares the compliance rates for stop signs installed to control speeds on residential streets in Troy. The locations of these stop signs in relation to the surrounding street system are shown in Figures 1 and 2.

Tables 2, 3, and 4 compare the results of 1975 speed studies on streets with unwarranted stop signs to 1986 study results on the same streets. Sample sizes for these speed studies were limited because of the relatively low volumes present on these residential streets. Observers were instructed

to collect as much data as possible in a 30- to 60-minute time period. As a result, samples were generally in the size range of 40 to 100. In all cases the sample size was greater than 40.

Two-way daily traffic volume is approximately 1500 on Anvil Drive, 2700 on Niagara Drive, and 1100 on Robinwood Street. Peak hour volumes are approximately 170 on Anvil Drive, 300 on Niagara Drive, and 120 on Robinwood Street.

All of the intersection study sites were relatively flat in terrain, so there were no sight distance restrictions resulting from vertical curves. Horizontal alignment of these streets has a minimal impact on available sight distance. On Anvil Drive, horizontal alignment is relatively straight for a distance of 500 feet to the north and south of Forge Drive. It is also straight for a distance of 900 feet north and 700 feet south of Kettle Drive. On Niagara Drive, horizontal alignment is straight for a distance of 600 feet to the west and 300 feet to the east of Eagle Drive. On Robinwood Street, horizontal alignment is straight for a distance of 300 feet to the west and 1000 feet to the east of Van Courtland Street. Intersection sight distance at all locations is limited by houses at the corners. Houses at the Anvil/Forge intersection are 40 feet from the edge of the pavement, and houses at the Niagara/Eagle intersection are 40-50 feet from the edge of the pavement. Houses at the Robinwood/Van Courtland intersection are 30 feet from Van Courtland Street and 50 feet from Robinwood Street.

Unwarranted stop signs were placed on Anvil and Niagara in 1975. In 1979 the Anvil/Forge intersection was converted to a four-way stop, despite the fact that warrants for a multi-way stop were not met. Unwarranted stop signs were placed on Robinwood in 1964; they were removed for a brief trial period in 1975. In each case, the average speed in 1986 was higher than in 1975 at the same location. Although the differences may not be statistically significant, it seems apparent that the passage of time does not make stop signs effective in controlling speeds.

Speed studies were made using a radar unit on an unmarked city car. The highest speed observed for each vehicle for a distance of approximately 500 feet either side of the intersection was the speed recorded.

Stop signs installed in the City of Troy that do not meet the warrants established in the *Manual on Uniform Traffic Control Devices* are considered to be legal and enforceable. The signs were installed pursuant to an ordinance adopted by the Troy City Council, the local legislative body. There is no known case law in Michigan that would force the removal of unwarranted stop sign installations.

The Solution...in Parts

There is no one, simple answer to the problem of speeding in residential areas. The traffic engineering department in the City of Troy has suggested to residents that the neighborhood itself must take some responsibility for the solution. A majority of the speeding violations issued in residential areas go to residents of that street or to streets in the immediately surrounding area. Residents of the immediate area can thus address the problem by increasing the awareness of the problem in the neighborhood and by assisting the police department.

A program in which license plate number reports are used to identify the owners of vehicles found to be speeding has been somewhat successful in controlling speeds. In that program, neighborhood residents report license plate numbers of speeding

Table 1. Stop Sign Observance on Selected Residential Streets in Troy

Location	1975 (%)	1985 (%)
Anvil Drive		
Full stop	25	13
Roll stop	64	60
No stop	11	27
Niagara Drive		
Full stop	51	21
Roll stop	34	74
No stop	15	5
Robinwood Street		
Full stop	26	16
Roll stop	48	65
No stop	26	19

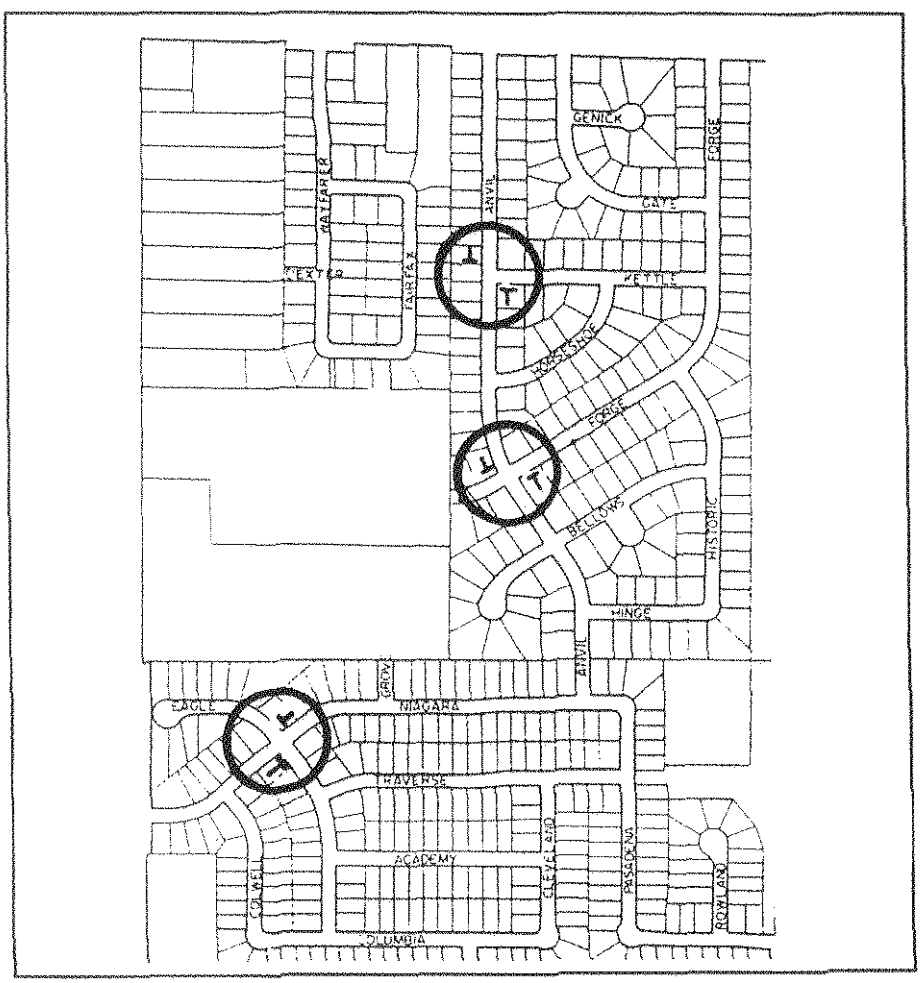


Figure 1. Street plan showing Anvil and Niagara study sites.

vehicles to the police department and the police department locates the vehicle owner through the secretary of state's records; the police department then writes to the vehicle owner, requesting safe driving practices and compliance with local traffic ordinances. One of the positive effects of this program has been to convert many of Troy's younger drivers into pedestrians: These younger drivers found that a vehicle was no longer available to them after the vehicle owner (a parent) learned how it was being used.

The City of Troy has a committee of citizens appointed to advise the City Council on proposed traffic regulations. This Traffic Committee gives a "first hearing" to neighborhood traffic problems and recommends new traffic regulations for City Council approval. Traffic Committee involvement is important because it allows the light of objectivity to shine on the problem before the political decision is made.[2] Discussions between committee members and citizens concerned about speeding on their neighborhood streets are helpful in achieving an understanding that stop signs are not a panacea and that there is no one easy solution. This discussion itself is part of the solution to the social and political aspects of the problem.

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1. Beaubien, Richard F. "Stop Signs for Speed Control?" *Traffic Engineering* 46(November 1976): 26-28.
2. Beaubien, Richard F. "Citizen Participation in Traffic Safety." *ITE Journal* 52(March 1982):29-31. ■

Richard F. Beaubien is the transportation director for Hubbell, Roth and Clark, Inc., consulting engineers, Bloomfield Hills, Michigan. Before entering this position in 1989, he served 14 years as transportation director for the City of Troy, Michigan. Beaubien received his M.S.C.E., B.S.C.E., and A.B. degrees from the University of Michigan. Beaubien is a registered professional engineer in Michigan, Illiniois, and California. He is a Fellow Member of the Institute of Transportation Engineers and currently serves as the Institute's International Vice-President.

Table 2. Speed Studies, Anvil Drive

Speed (mph)	Without Stop Signs, 1975	With Stop Signs, 1975	With Stop Signs, 1986
Low	15	15	18
Average	24.1	24.6	26
85th Percentile	28	28	30
High	38	35	34

Table 3. Speed Studies, Niagara Drive

Speed (mph)	Without Stop Signs, 1975	With Stop Signs, 1975	With Stop Signs, 1986
Low	15	15	20
Average	23.8	25.2	26
85th Percentile	26	29	29
High	34	34	33

Table 4. Speed Studies, Robinwood Street

Speed (mph)	Without Stop Signs, 1975	With Stop Signs, 1975	With Stop Signs, 1986
Low	10	13	21
Average	23.4	24.4	30
85th Percentile	30	30	34
High	38	38	42

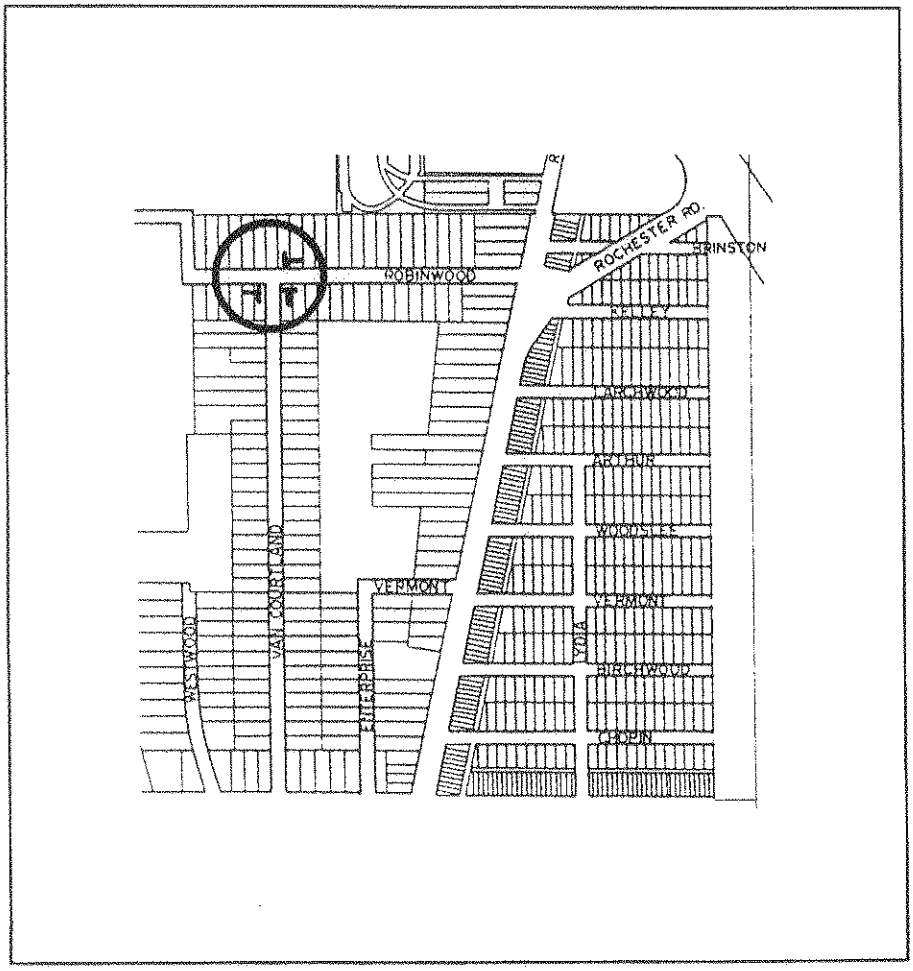

Figure 2. Street plan showing Robinwood study site.

Exhibit I

Responding to Citizen Requests for Multiway Stops

BY PATRICIA B. NOYES

The use of multiway stops for speed control is a subject that has received a great deal of attention from citizens and far too little conclusive discussion by traffic engineers. In an effort to address the ongoing surge of citizen requests to install four-way stops for speed control, the staff of the Boulder (Colo.) Transportation Division completed a literature search on the use of multiway stops and conducted local studies on their effectiveness and driver compliance. The purpose of this study was to identify the issues related to the use of multiway stops and to help citizens understand some of the negative side effects of their use. The effort was intended to develop an information piece that could be used in discussions with citizens. The remainder of this article is intended for that use and can be used as a basis for other local efforts to develop public information strategies.

Considerations for the Installation of Stop Signs

Multiway stop signs usually are requested to address speeding and safety problems in residential areas. Boulder's studies on compliance and speed were an attempt to examine the effectiveness of stop signs for these uses. In addition to these issues, there are several other areas that need to be examined and discussed in considering the use of multiway stops. A number of these are outlined below.

Conversion Factors

To convert from	to	multiply by
ft	m	0.3048
mph	kmh	1.609

Compliance

Stop signs are used to improve the safety of an intersection by assigning right-of-way; therefore, compliance with stop signs is essential for their effectiveness. Several studies have shown that in situations where stop signs are installed but are not warranted, based on nationally adopted standards, there is a low level of compliance. In these cases, motorists were observed either rolling or running a stop sign. When a driver does not believe that a restrictive sign appropriately reflects the conditions, the driver often disregards it.

This was studied in Boulder and the results are summarized in Table 1. Stop sign compliance studies were completed at nine four-way and four three-way stop locations. Of the 900 cars observed at the four-way locations, 23 percent made a full stop. Of the 350 vehicles observed at three-way locations, 7 percent stopped. The majority of the observed cars at all locations made a rolling stop (slowed to less than 3 miles per hour (mph) but did not come to a complete stop).

The highest compliance levels occurred at the higher volume, four-way stop locations. The three locations that significantly exceeded the average compliance rate involved higher volumes with higher percentage side street traffic. These locations experienced 39 percent to 40 percent compliance. The one other location that exceeded the average compliance level experienced 26 percent compliance. This location would require tree trimming for sight distance in order to remove the stops from the main street.

Three-way stops showed the lowest compliance with 11 percent of the 350 cars observed driving through the stop sign in excess of 3 mph.

Speed Control

There is a common belief among the general public that stop signs provide relief from traffic speeding problems. On the face, it would appear reasonable that when approaching a stop sign, motorists have to slow down. However, studies conducted nationwide have shown that the speeds within a block of the stop sign are either unaffected by the stop sign or, in some cases, actually increase. At the point of installation, speeds are reduced, but the effect on traffic approaching or leaving the controlled location is negligible. Some motorists actually increase their speed to make up for the inconvenience.

Speeds approaching and downstream of multiway stop signs in Boulder were studied are summarized in Table 2. Speed studies were conducted an average of 500 feet (ft) from the stop sign on the approach to, and downstream from, four four-way and two three-way stop locations. The average 85th percentile speeds (85 percent of the vehicles traveled that speed or less) were 35 mph on the approach and 34

Table 1. City of Boulder Stop Sign Compliance Study

	Stop Sign Compliance			
Four-Way Stops *Location* *Date/Time*	*Stop %*	*Roll %*	*No Stop %*	*Total Observed*
Maxwell & 9th 6-20/3:30-3:39	21	75	4	100
Manhattan & Illini 6-19/4:30	26	71	3	100
Alpine & 13th 6-19/3:42-3:58	39	60	1	100
Balsam & 19th 6-19/3:30-3:38	40	59	1	100
Walnut & 33rd 6-19/3:12-3:22	19	79	2	100
Arapahoe & 6th 6-19/2:50-3:05	39	60	1	100
Wonderland & Poplar 6-29/8:08-8:40	11	82	7	100
Brooklawn & Laurel 6-28/4:20-5:05	7	88	5	100
College & 7th 6-29/4:20-5:30	6	79	15	100
Average Compliance	23	73	4	900
Three-way Stops				
Kalmia & 26th 6-20/3:47-4:14	9	76	15	100
Gallaspie & Julliard 6-22/4:00-4:55	11	80	9	100
Albion & Toedtli 6-26/4:30-5:30	8	82	10	50
Manhattan & Cimmaron 6-21/4:33-5:15	2	89	9	100
Average Compliance	7	82	11	350

mph downstream from the stop sign. The mean vehicular speeds were 31 mph and 30 mph, respectively.

Two of the six locations were posted 30 mph and the others were posted 25 mph. The average 85th percentile speed for the 30 mph locations was 36 mph and the mean speed was 32 mph. The average 85th percentile speed for the 25 mph locations was 34 mph and the mean speed was 30 mph. These are comparable or greater than speeds observed on other Boulder residential streets.

Safety

Studies have shown differing effects on accident rates at intersections before and after the installation of multiway stops. In some cases the accident rates

increased, in others they decreased and in still others there were no significant changes. General engineering belief is that the unwarranted use of stop signs potentially decreases safety at the intersection because of the disregard of these controls as observed in the compliance studies; however, no study has definitively proved this. A recent article on Chicago's (Ill.) experience with the use of multiway stops indicates that the accident rates might be reduced at low-volume intersections (see LaPlante and Kropidlowski[1]).

Motorist Delay

The unwarranted use of stop signs increases vehicle delay. Where the proper use of multiway stops occurs, the increase in delay on the main street is offset somewhat by the reduced delay on the side street. However, in an unwarranted situation, there is minimal delay on the side street and overall delay is increased significantly by the required stop of all traffic on the main street.

Excessive Restrictions on the Public

The unwarranted use of stop signs creates excessive restrictions on the motoring public. This creates a great deal of frustration and, as previously mentioned, disrespect for traffic control devices. It also is contradictory to the legislative intent of the Uniform Vehicle Code and Model Traffic Ordinance 1987, which states that, "The proper purpose of all traffic legislation is not to impose unnecessary or unreasonable restrictions on highway traffic, but to insure, as far as this can be done by law and its application, that traffic shall move smoothly, expeditiously and safely."

The motto of the committee is "Safety with Freedom Through Law," which summarizes its philosophy "to provide to every highway user, through law, a maximum degree of safety within the framework of traditional freedoms."

The *Traffic Control Devices Handbook* states, "The most effective traffic control device is that which is the least restrictive while still accomplishing the intended purpose."[2]

Environmental Effects

The unwarranted use of stop signs affects the environment in terms of air pollution, noise impacts and fuel consumption.

Air Pollution

The effects of stopping and idling increase automobile exhaust. A study of 10 four-way stop intersections in Michigan found: "The total additional emissions of carbon monoxide were 1,287,500 pounds per year, hydrocarbons totaled 79,200 pounds per year and oxides of nitrogen totalled 83,000 pounds per year. These quantities indicate the magnitude of the additional emissions attributable to four-way stop sign control at these intersections."

Noise Impacts

Additional traffic noise also is associated with stopping and starting. Braking and acceleration increase tire noise and engine noise. Stop signs also increase the amount of time any one vehicle is at a particular point. Therefore, residents living near the stop controlled intersection will experience an increase in traffic noise.

Fuel Consumption

Stopping, accelerating and idling also increase the amount of fuel consumed by a vehicle. A California study in 1982 found that deceleration and acceleration for each stop an average passenger car makes, 0.0173 gallons of fuel is consumed. This would mean that for every unwarranted stop sign installed on a street with 10,000 cars per day, 173 additional gallons of gasoline would be consumed in a day, or 63,145 additional gallons would be consumed in a year.

Pedestrian Exposure

Although it is commonly believed that stop-controlled intersections provide increased safety for pedestrians, this might not be accurate at locations where adequate gaps in traffic exist and the stop signs are unwarranted. If a stop sign is installed under these conditions, a vehicle is present at the intersection for a much longer period while it slows, stops and accelerates. This actually causes an increase in the exposure time

Table 2. City of Boulder Speed Study

	Speed Studies	
Stop Location Street/posted speed	*Approach Speed 85th% Average*	*Downstream Speed 85th% Average*
Balsam & 19th	38	39
19th Street/30 mph	33	35
Walnut & 33rd	35	32
Walnut/30 mph	31	29
Brooklawn & Laurel	33	32
Brooklawn/25 mph	30	29
Arapahoe & 6th	33	31
Arapahoe/25 mph	29	28
N. 26th & Kalmia	37	37
N. 26th/25 mph	32	32
Gillaspie & Emerson	33	32
Gillaspie/25 mph	29	29
Average 85th	35	34
Mean Speed	31	30

100 Observations were made at each location, 50 each direction.
Speeds were shot 400ft.-600 ft. from stop sign.

of the pedestrian to vehicles and reduces or eliminates the natural gaps in traffic at the intersection by increasing the time each vehicle is present.

The other major exposure issue is that of the pedestrians to drivers who will violate the stop control. As has been observed, compliance at unwarranted stops is low and this leaves pedestrians vulnerable to these violations. This presents a particular hazard to children, whose size might make them less immediately visible to drivers.

Clarity of Traffic Control

Traffic control devices are designed to inform drivers of roadway and traffic conditions with minimal opportunity for confusion or misinterpretation. Stop signs are used to assign right-of-way to a through street by stopping traffic on the minor street. The motoring public expects the uniform application of traffic control devices and would not expect a stop sign on the major street. This potential for confusion aggravates the observed compliance problem and cre-

ates a potential safety hazard.

Legal Responsibilities

Variations from accepted warrants without documented exceptional conditions present potential liability concerns for the responsible jurisdiction. If a stop sign installation could be considered irresponsible or in clear contradiction to accepted standards, liability suits could result.

Summary

Existing studies and information on the use of multiway stop signs are far from conclusive. There are however, a variety of studies that provide some important insights into their use. The recent article by LaPlante and Kropidlowski provides a comprehensive review of the use of accident experience associated with the use of multiway stop signs. It recommends that the existing *Manual on Uniform Traffic Control Devices* warrants for multiway stops be reviewed and potentially revised to address local residential streets in urban areas more effectively. Although a review of the warrants might be appropriate, it should be done with respect to a variety of implications.

The issues for consideration discussed in this article include:

- Compliance
- Speed Control
- Safety
- Motorist Delay
- Excessive Restrictions on the Public
- Environmental Effects
- Pedestrian Exposure
- Clarity of Traffic Control
- Legal Responsibilities

These issues should be included in any discussion on the use of multiway stop signs. This list and the discussion of these issues is an attempt to open the discussion in a way that helps engineers and citizens alike examine the implications of using multiway stops. There are certainly other concerns that could be added to this list based on the experience of others.

The engineering community and the public need to consider all of the implications of multiway stop sign use and continue to study the impacts of their use so in order to work together to appropriately address specific traffic control issues.

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1. LaPlante, John N. and Chester R. Kropidlowski. "Stop Sign Warrants: Time for Change." *ITE Journal*, Vol. 62, No. 10 (October 1992): 25-29.
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***Patricia B. Noyes** is a principal in the engineering and management consulting firm of Pat Noyes & Associates. Previously, she was traffic operations engineer for the city of Boulder, Colo., for eight years and transportation planning engineer for Boulder County before that. She currently serves as secretary/treasurer for the Colorado/Wyoming Section of ITE and chaired the section's Technical Committee on Residential Speed Control in 1987-88. She received an M.S.C.E. from the University of Colorado, Boulder; and M.A. from McMaster University, Hamilton, Ontario; and a B.A. from Northwestern University, Evanston, Ill. She is an Associate Member of ITE.*

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CITY OF LODI

PUBLIC WORKS DEPARTMENT

Exhibit J

COUNCIL COMMUNICATION

TO: City Council

FROM: City Manager

MEETING DATE: April 20, 1988

AGENDA TITLE: Traffic Studies - Discussion and Appropriate Action
c) School Street at Vine Street, Before and After Study

RECOMMENDED ACTION: None. Information only.

BACKGROUND INFORMATION: In September 1987, City Council received a petition from a School Street neighborhood regarding speed problems on School Street near Vine Street. City Council directed staff to perform a traffic study on School Street. Staff's study included 24-hour vehicle counts, radar speed surveys, a four-way stop control study, and an accident review at School Street and Vine Street. The requested four-way stop at School Street and Vine Street did not meet the warrants. Staff's study concluded the primary solution to speed problems is enforcement and suggested the Police Department continue enforcement on School Street.

The City Council voted to install four-way stop signs at School Street and Vine Street. Staff indicated to the City Council that there were studies that showed installing stop signs may actually increase speed. At the request of the City Council, staff sent the Council the attached memo dated November 9, 1987 transmitting the studies and stop sign installation versus speed.

Under the November 9, 1987 memo, the Public Works Department shared with the Council that we would be performing a "before" and "after" speed study on School Street. Radar surveys were performed in October 1987, one day before four-way stop signs were installed. These results were compared with recent radar surveys. The Public Works Department recently performed a radar study on the same day of the week and in the same time frame as the work done last October. The 85th percentile speed increased by 1-2 mph after the installation of stop signs. The following table presents the radar speed results:

School Street

Direction	N/Vine Street Before	N/Vine Street After	S/Vine Street Before	S/Vine Street After
NB	32	33	33	35
SB	32	34	36	37

APPROVED:

THOMAS A. PETERSON, City Manager

FILE NO.

CTRAFF13/TXTW.02M

April 13, 1988

The traffic volumes on School Street have decreased. In September, the daily traffic volume on School Street north of Vine Street was 1,910 vehicles per day. A recent count of 1,690 vehicles per day was taken at the same location. Staff feels this could be due to seasonal variation or vehicles have re-routed to other streets due to the inconvenience of stop signs.

The Council should be aware that stop signs do not necessarily reduce speed. If City Council desires to reduce speeds on School Street, consideration should be given to removing the School Street stop signs and increasing enforcement.

Jack L. Ronsko
Public Works Director

JLR/PJF/ma

Attachments

cc: Street Superintendent
Police Chief
Richard Mullins

MEMORANDUM, City of Lodi, Public Works Department

TO: City Manager
City Council

FROM: Public Works Director

DATE: November 9, 1987

SUBJECT: Studies Related to Unwarranted Stop Sign Installations

---

At the request of the City Council at the October 21, 1987 meeting, we are providing the following attachments:

1. Automobile Club study showing that unneeded stop signs have a major affect on the traveling public in the area of wasted hours, dollars, gasoline, and safety.

2. City of El Monte study showing that stop signs have a questionable value as a speed control measure and that their unwarranted installation has a financial impact on the motoring public.

3. City of La Mirada study showing that vehicle speeds do not change after the installation of regulatory speed signs, nor after the installation of stop signs. Stop signs only slow traffic at the stop sign location and vehicles are back to normal speed within a few hundred feet from the stop sign. Stop signs do not reduce mid-block vehicle speeds. In fact, it was found that vehicle speeds actually increased slightly.

4. Article from Traffic Engineering magazine entitled "Stop Signs for Speed Control?". This study points out that the Manual on Uniform Traffic Control Devices for Streets and Highways clearly states that stop signs should not be installed for speed control. This study also shows that the difference in average speeds is not significant after installation of stop signs, but speeds do increase slightly. It also indicated that unwarranted stop signs installed for speed control are generally disregarded by approximately one-half of the motorists (i.e., making only a rolling stop).

5. Publication of the Western District Institute of Transportation Engineers entitled "Lee Street; A Twelve-Year Case History of Residential Street Traffic Management Problems". This study indicated that for unwarranted stop signs, only 14.5% of the drivers came to a complete stop. The study showed there is little effect on vehicle speed other than in the immediate vicinity of the stop sign controls. It also pointed out that the installation of stop signs had no effect on intersection accidents. The final action of the Lakewood, Colorado City Council was to remove all the unwarranted stop signs.

Prior to the installation of the stop signs at School and Vine Streets, I directed the Traffic Engineering personnel to do additional radar speed studies north and south of the new stop sign installation. In three to four months, we will bring back to the City Council the School Street before and after traffic data results.

The Public Works staff feels that additional emphasis should be placed on effects on the motoring public when stop signs are installed. Unwarranted stop signs waste time and energy, cause air and noise pollution, and most importantly, encourage noncompliance. This increases the hazard to pedestrians, bicyclists, and the motoring public. In addition, it is felt that this noncompliance can be habit-forming and increase the City-wide safety problem rather than decrease it.

Jack L. Ronsko
Public Works Director

JLR/ma

Attachments

cc: City Attorney
Police Chief

bcc: Public Works Director
Lodi News Sentinel

Supplemental Information

ITEM I-03

Street	Existing Traffic Volume (vehicles per day)	Existing Plus Project (vehicles per day)
Academy Street	1,100	620
Coventry Way	1,400	1,060
Blackbird Place	0	355
Cherrywood Way	0	160
Elgin Avenue	0	1,360
Almond Drive (west)	3,900	3,700
Almond Drive (east)	3,200	3,450
Stockton Street (north)	10,200	10,900

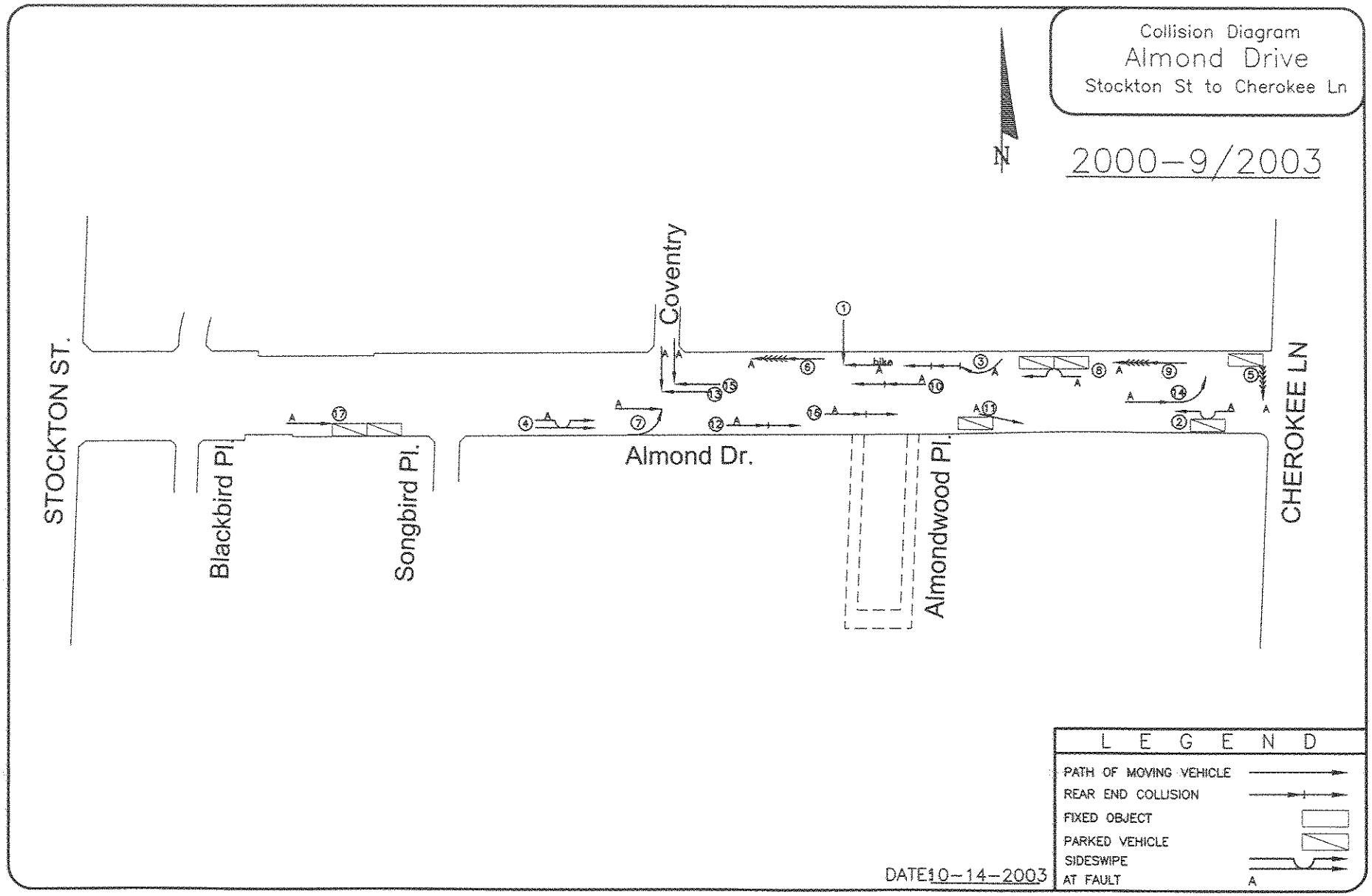
Notes:

1. Existing plus project traffic includes turn restriction at Kettleman Lane and Academy Street with median installation, and redistributed traffic to/from Coventry Way.
2. Daily Traffic projections: 316 vpd for Almond North, 740 vpd for Almond Wood Estates.

Speed Data

Day/ Percentile	Eastbound (mph)	Westbound (mph)
Weekday/ 85th	35.8	37.1
Weekend/ 85th	34.8	36.9
Weekday/ 50th	30.8	31.6
Weekend/ 50th	29.3	31.3

Note: Speed data count performed on Almond Drive east of Songbird Place in October 2003.


Collision Diagram
Almond Drive
Stockton St to Cherokee Ln
2000-9/2003
N
STOCKTON ST.
Blackbird Pl.
Songbird Pl.
Coventry
Almond Dr.
Almondwood Pl.
CHEROKEE LN
LEGEND
PATH OF MOVING VEHICLE
REAR END COLLUSION
FIXED OBJECT
PARKED VEHICLE
SIDESWIPE
AT FAULT
A
DATE10-14-2003

Location: Almond/ Stockton-Cherokee Year(s): 2000-9/2003

PD#	No.	DATE	TIME	DAMAGE	INJURIES	APPARENT CAUSE (A)
00-3673	1.	4/19/2000	1503	none	0	Kid riding a bike and ran in to a car.
00-5879	2.	6/5/2000	800	mod.-mod.	0	Right of way violation.
00-8547	3.	8/28/2000	1534	tot.-tot.	0	DUI and unsafe turning.
01-04871	4.	5/7/2001	1143	unk.-min.	0	Cause unknown, Appears to be unsafe passing.
01-04858	5.	5/7/2001	503	mod.-non.	0	Unsafe backing.
01-13801	6.	12/6/2001	839	non.-min.	0	Hit and run Cause unknown.
02-00506	7.	1/12/2002	1744	min.-min.	0	Driving on wrong side of the road.
02-05604	8.	5/12/2002	1551	min.-min.	0	unsafe turning.
02-07091	9.	6/13/2002	849	unk.-min.	0	Unknown, appears to be unsafe backing.
02-08404	10.	7/6/2002	815	maj.-mod.	1	Following too closely.
03-00858	11.	1/21/2003	1433	min.-min.	0	Unsafe turning.
03-01270	12.	1/30/2003	1814	maj.-mod.	1	Unsafe speed.
03-01783	13.	2/12/2003	748	maj.-maj.	1	Unsafe left turn.
03-02070	14.	2/18/2003	1815	min.-min.	0	Cause unknown.
03-06932	15.	6/14/2003	350	min.-mod.	1	Unsafe left turn.
03-08520	16.	7/23/2003	1946	mod.-mod	0	Unsafe speed.
03-08489	17.	8/14/2003	1454	maj.-maj.	0	unsafe turning.
	18.					
	19.					
	20.					
	21.					
	22.					
	23.					
	24.					
	25.					
	26.					
	27.					
	28.					
	29.					
	30.					

Filed 10-15-03
J. Kirst Item 1-3

CALIFORNIA ASSOCIATION OF REALTORS®

October 14, 2003

Jeffrey Kirst
Tokay Realty
P.O. Box 1259
Woodbridge, CA 95258

Dear Mr. Kirst:

In a continuing and demonstrated successful effort to expand housing supply and increase housing affordability, the California Association of REALTORS® will co-sponsor a new series of housing bills before the California Legislature next year.

One of those housing issues is of interest to your community. Building on the commitment of many local governments to encourage housing, we will co-sponsor a bill with all of the housing advocates to permit developers of new single family housing subdivisions to place duplex units on corner lots. The City of Sacramento and the County of Sacramento are two nearby governments that have implemented this proposal. Property owners are quite pleased with the results.

We look forward working with you next year.

Sincerely,

Ronald M. Kingston

980 Ninth Street, Suite 1430, Sacramento, CA 95814 Tel 916.444.2045 Fax 916.444.2033 www.car.org