The greatest benefit can be derived by signal system upgrading with signal removal or relocation as previously stated. Nearly $1 million in benefits can be returned each year to the public from an initial investment of $1 million. Therefore the cost/benefit ratio is about 20.

Signal System Modernization and Timing Optimization Study: Ludington Street, Escanaba

Kenneth L. Slee

The major function of the Community Assistance subunit is to provide traffic engineering assistance to local governments for improving safety at problem locations. By request from the city of Escanaba, Michigan, a complete engineering study was performed with recommendations for improving traffic flow and reducing accidents.

The city's entire signal system was studied focusing on Ludington Street, which is the major arterial street through the central business district. Existing Ludington Street is a narrow four-lane, two-way facility with angle parking on both sides of the street and functions basically as a two-lane, two-way roadway due to restrictions and narrow laneage. The network studied is a 30-block area with the major portion of the traffic in the seven-block central business district.

DATA COLLECTION

The existing signal system in Escanaba included 10 outdated, one-headed signals centered on the main streets, all working independently. The six signals along Ludington Street operate on a two-dial system.

Traffic volume data include 24-h machine counts as well as 8-h turning movement counts at the 10 signalized locations. The Ludington Street corridor averaged 15 000 vehicles/24-h period. The speed limit is posted at 25 mph.

Ludington Street is 64 ft wide from face-of-curb to face-of-curb. The cross streets are 54 ft wide with 12-ft radii in all quadrants of each location.

Accident patterns for the three-year study period included head-on, left-turn, and rear-end accidents. The major accident pattern involved angle-parked cars.

NETSIM ANALYSIS

The network simulation model was used to provide measures of effectiveness for existing traffic flow statistics. The proposed alternative included signal modernization, interconnection, removal of unwanted signals, parallel parking, and a five-lane facility with a center lane for left turns. The "existing" and "proposed" NETSIM analyses were compared for improvements in the traffic flow. The major statistics compared were average speed ("proposed" indicated a +72 percent), average delay per vehicle ("proposed" indicated a -72 percent), total delay ("proposed" indicated a -72 percent), and stops per vehicle ("proposed" indicated a -25 percent). These statistics appear along with the remainder of the measures of effectiveness in Table 1.

Table 1. NETSIM analysis: Escabana.

Measure of Effectiveness	Existing	Proposed	Change (%)
Stops per vehicle	2.37	1.77	-25
Avg speed (mph)	11.07	19.06	+72
Avg delay per vehicle (s)	133.5	37.03	-72
Total delay (min)	10 379.9	2953.6	-72
Hydrocarbon (g/mile)	4.23	2.78	-34
Carbon monoxide (g/mile)	74.63	42.69	-43
Nitrous oxide (g/mile)	4.52	4.24	-6
Fuel consumption (gal)	399.77	282.39	-29

CONCLUSIONS AND RECOMMENDATIONS

Cost/benefit analyses were computed by using projected accident reductions. Project costs were estimated at $120 000 with a 0.66 year time-of-return based on accident reduction.

Benefits were estimated by using a cost of $1.25/gal and $3 per person/h of delay. A factor of 3000 (a factor of 10 for daily x a factor of 300 for yearly) was multiplied by the hourly fuel and delay consumption to estimate a yearly value. The yearly benefits are $440 000 in fuel consumption and $1 336 000 in delay reduction. This reflects a 352 140-gal reduction in fuel consumption and 445 312 h of delay reduction.

NETSIM provides a more real-world view of existing and proposed traffic characteristics than other methods available. It makes available other measures of effectiveness that were not previously considered. NETSIM helps sell many safety projects to the use of the general public because the model outputs statistics into common terminology.