As these studies indicate, driver responses can vary to CMS information, resulting in lower rates of the desired behaviors that the information is intended to foster, including diversion. (*1,3,5*) Ultimately, driver response is tied to the fundamental comprehension of the messages that are displayed. For this reason, the WZSAS system messages were designed in an attempt to make information presented clear and easy to understand for users.

SITE DESCRIPTION

In 2002, the Nebraska Department of Roads (NDOR) began the reconstruction of the interchange at I-680 and Dodge Street as part of the larger West Dodge Road improvement project in Omaha. The WZSAS was deployed in advance of a work zone on northbound I-680 between Pacific Street and West Dodge Road, which was part of the reconstruction project.

Construction activities in the work zone necessitated the closing one of the three northbound lanes. The posted speed limit in advance of the work zone was 60 mph, and the posted speed in the work zone was 55 mph. The average daily traffic on this section of I-680 in 2001 was about 88,000 vehicles per day, of which 4 percent were trucks. The estimated capacity for the northbound Dodge Street exit ramp was approximately 2,000 vehicles per hour.

Work Zone Geometrics

The work zone studied extended from the beginning of the Dodge Street exit ramp (south of Dodge) to the end of the Dodge Street entrance ramp (north of Dodge). A map of the WZSAS study area is shown in Figure 1. North of the Pacific Street exit ramp, I-680 has three northbound through lanes up to Dodge Street. Construction activity at Dodge Street limited I-680 to two northbound through lanes for the entire length of the work zone. To accommodate construction, the outside lane on I-680 was converted to a single exit-only lane to the Dodge Street exit ramp.

Traffic Concerns

Traffic in the study area became congested during peak hours because of the existence of four separate traffic conflict points adjacent to the work zone as shown in Figure 2. The beginning of the work zone and lane drop coincided with the Dodge Street exit ramp gore, creating the primary conflict point (point A). Here drivers were required to either continue northbound on I-680 on a two-lane section (reduced from three lanes) or exit onto Dodge Street. Just upstream from point A an additional conflict point was created as vehicles exiting I-680 on dodge street and vehicles entering I-680 from Pacific Street had to cross paths in a weaving section in advance of the work zone (point B).

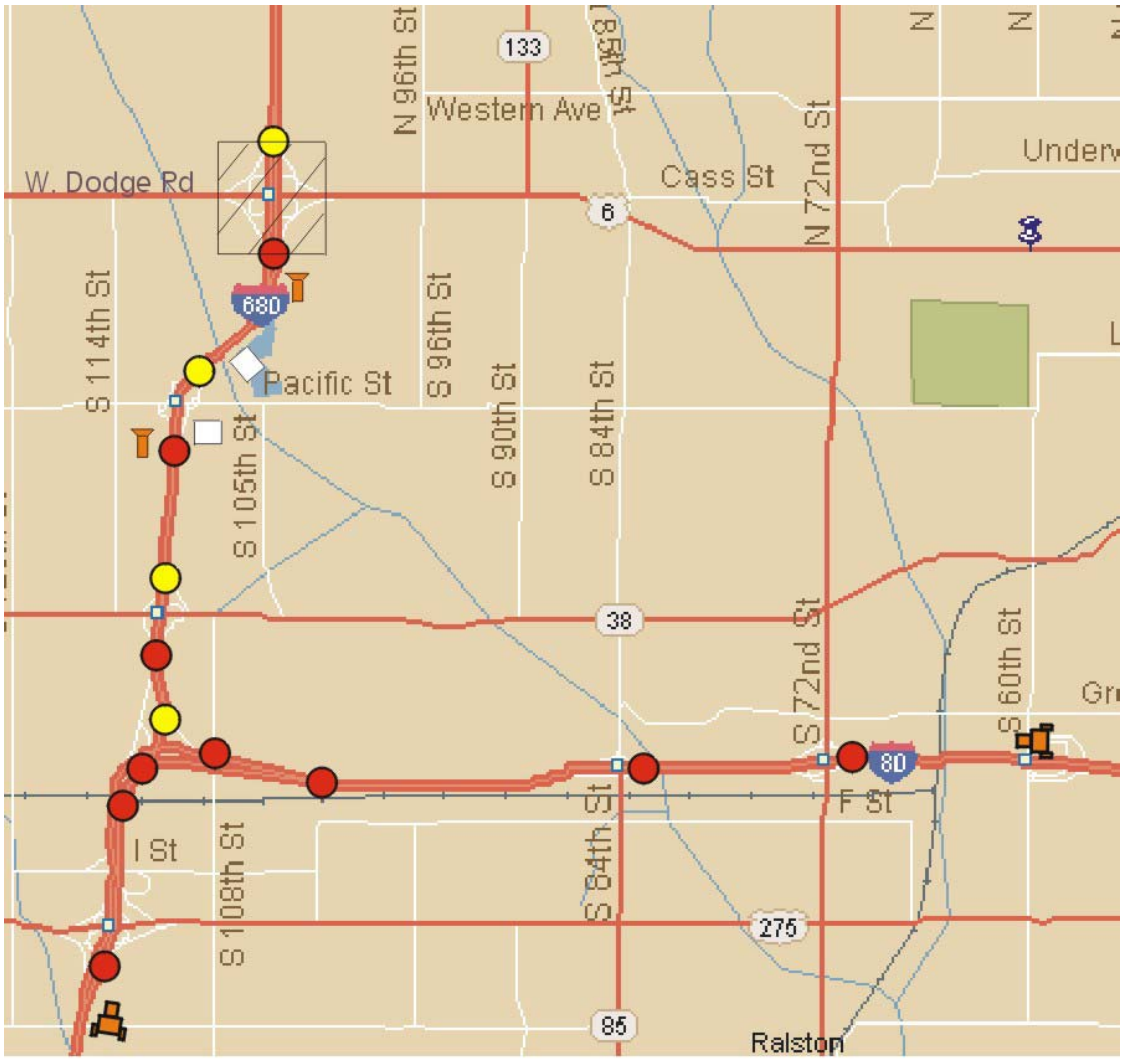

Figure 1. WZSAS Study Area.

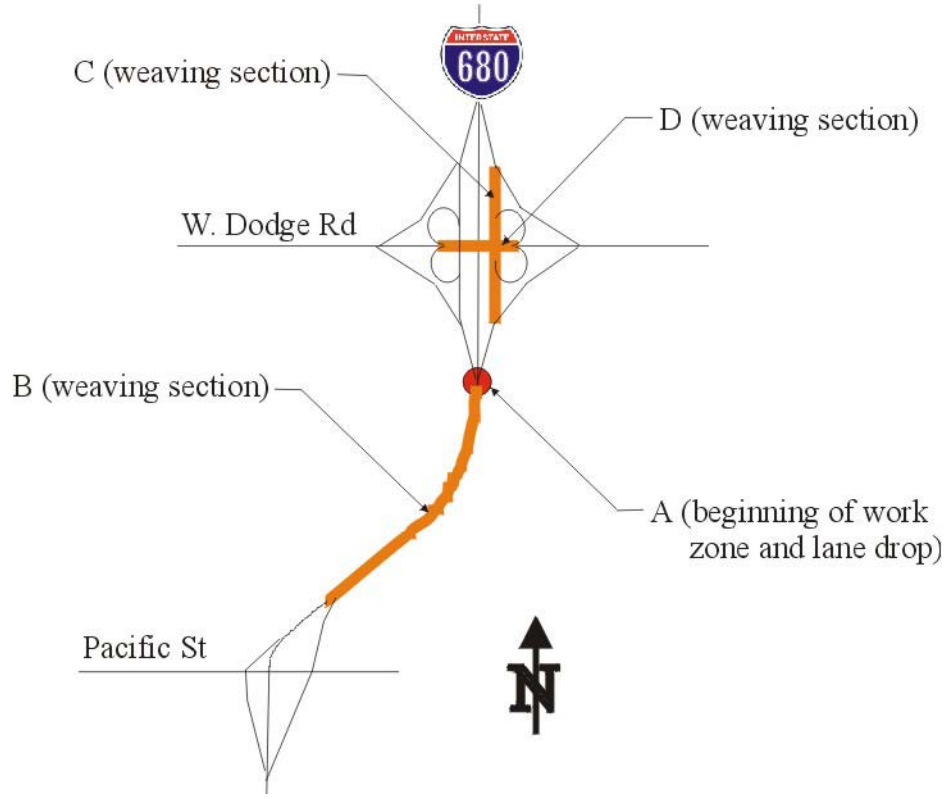

Figure 2. WZSAS Study Area Traffic Conflict Points.

Construction activity in the work zone also affected traffic flow in the weaving sections on the Dodge Street exit collector-distributor road (point C) and mainline West Dodge Road (point D), which contributed to traffic congestion in the study area. The construction activity adjacent to these weaving sections would cause delays and congestion during peak hours with queues extending back the Dodge Street exit ramp to the I-680 exit gore.

On-site observations indicated the northbound I-680 Dodge Street exit ramp often became congested at peak traffic hours due to the four traffic conflict points. Queues were observed in November 2001 building up from the Dodge Street exit ramp gore back into the outside lane of I-680. Some queues extended over 2,000 feet upstream past the Pacific Street overpass. At peak hour conditions, the speed of traffic in all three lanes was slowed due to congestion.

Although congestion and queues were observed in November 2001, daily traffic conditions varied. On some days congestion was non-existent; other days half-mile queues were observed. The variance in traffic conditions limited the use of traditional static warning signs and messages. This provided an opportunity to test the WZSAS, which is a dynamic traffic-activated warning system.

WZSAS DESCRIPTION

The WZSAS is comprised of three primary components: (1) a video detection system, (2) two portable CMSs, and (3) a control system. The video detection system was used to measure the speeds of traffic at two selected points in advance of the work zone. Average speeds measured at the two points were displayed on the two portable CMSs which were placed upstream of diversion points in advance of the work zone. The control system, installed on a computer at the NDOR District 2 office, coordinated communications between the video detection system and the portable CMSs necessary to display the appropriate speed messages. NDOR personnel were alerted when speeds dropped below the selected threshold of 15 miles per hour, which enabled them to display incident-related messages when necessary.

A web page was also provided that displayed real-time traffic condition information for the work zone to the public. The system was designed to inform drivers of traffic conditions at the work zone prior to entering the northbound I-680 corridor. This allowed drivers to decide if I-680 congestion at the work zone was severe enough to warrant a route change.

Video Detection System

Two video detection units were installed to collect traffic information at the work zone. Each video detection unit included a camera mounted over the roadway on a sign bridge, as shown in Figure 3, and a controller box on the side of the road. The detection units collected speed, vehicle type, and volume information for each lane. The information collected by the two units was stored on-site and periodically sent via radio to the control system at the NDOR District 2 office. This local storage capability made it possible to downloaded raw data in the field. Each detector unit also included video output jacks for system settings adjustments, and on-site system monitoring.

Figure 3. WZSAS Camera Mounted Above Roadway.

One video detection unit was installed in advance of the work zone just south of the Pacific Street overpass. The other unit was installed at the south end of the work zone, at the beginning of the Dodge Street exit ramp. The locations of the video detection units are shown in Figure 4.

The use of two detectors provided two subsections of the roadway to be analyzed simultaneously; one south of Pacific Street ("South") and another north of Pacific Street ("North"). The South subsection begins just after Center Street and ends at Pacific Street. It is approximately one-half mile upstream of the work zone and is the location to which maximum queues extended. The North subsection begins at Pacific Street and ends at the south edge of the work zone, where congestion usually occurred on a daily basis. Each video detection unit collected data from three lanes of traffic on northbound I-680. Figure 4 also shows the locations of changeable message signs, the subsection boundaries, and lane numbering convention.

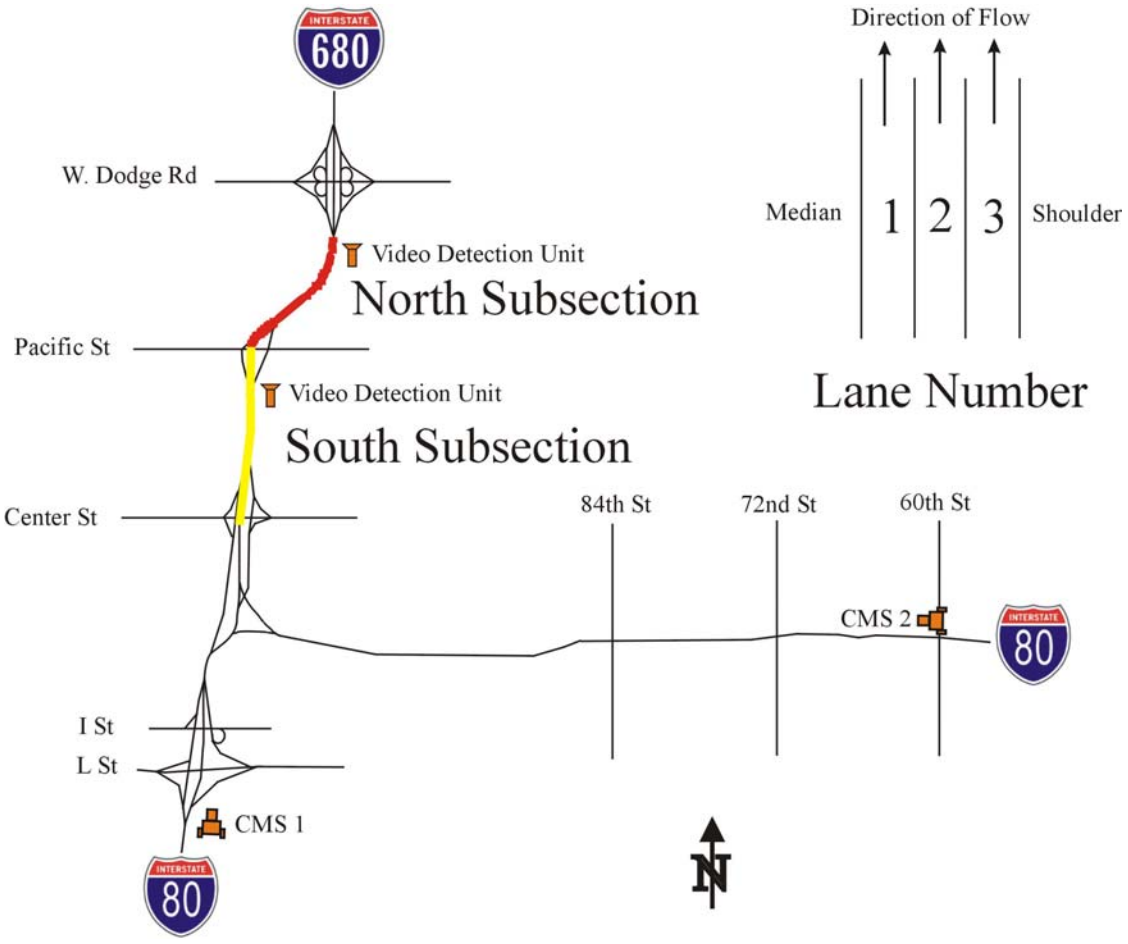

Figure 4. Video Detection and CMS Locations.

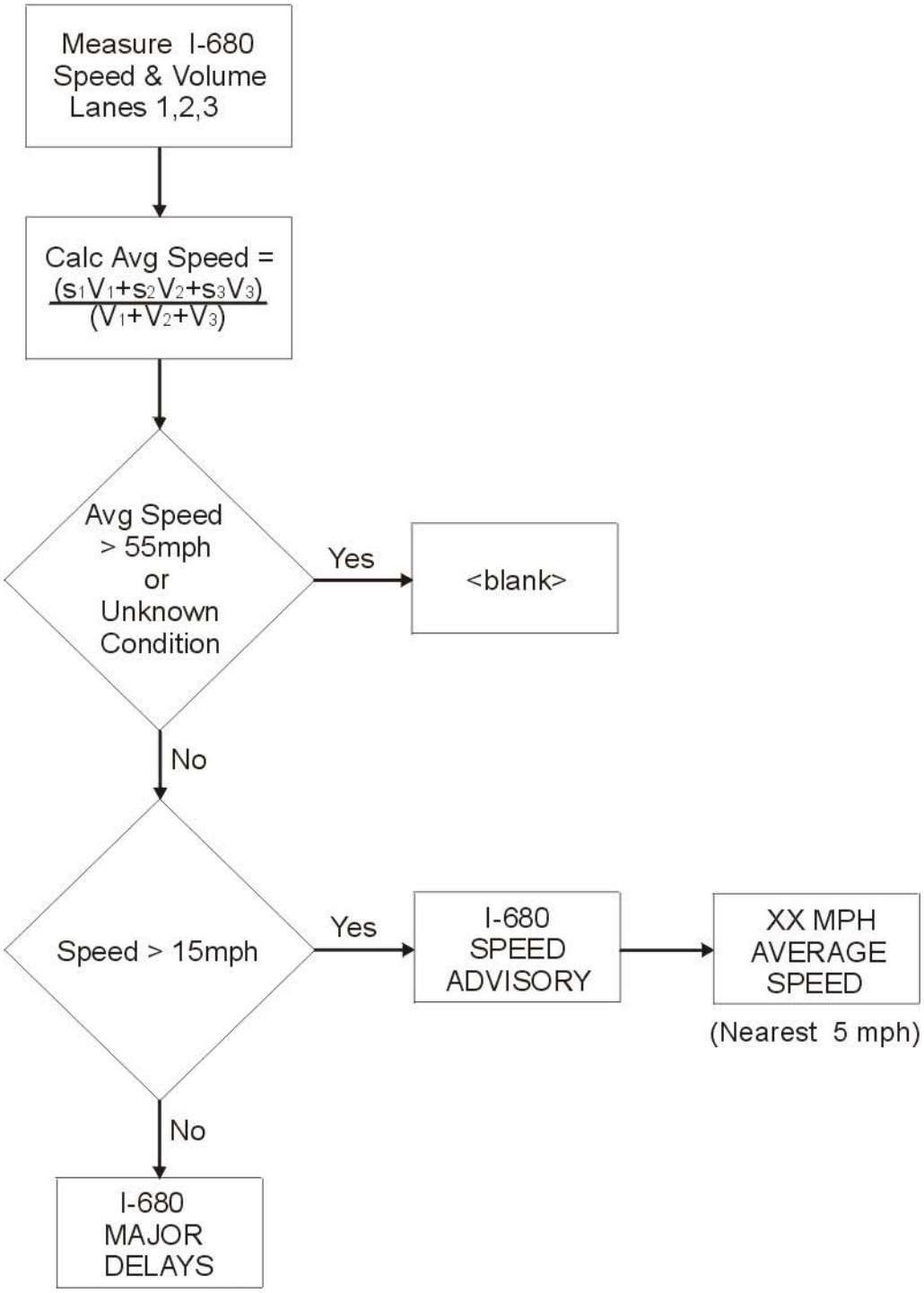

Figure 6. CMS Message Selection Logic.