Changeable Message LED Billboards
Test Period Observations and Findings
January, 2007 through June, 2007

Introduction

On December 12, 2006, the Common Council of the City of Milwaukee passed Common Council File Number 060300 concerning the operation of changeable message light-emitting diode (LED) billboards in the City. Under this File, the City Code of Ordinances were amended to allow messages on billboards primarily oriented toward the freeway to be changed once every 30 seconds instead of the 60 seconds previously allowed by Code, and to allow an LED billboard with a message changing once every 6 seconds to be installed for a 6 month test period at the intersection of E. North Avenue and N. Oakland Avenue.

The Ordinance change took effect on January 4, 2007, subsequent to which an LED billboard was installed in the southeast quadrant of the intersection of E. North Avenue and N. Oakland Avenue, and at several locations along the Freeway system in the City.

This report summarizes observations and impacts of LED billboard operations in the City during the 6 month test period, primarily with respect to the billboard at N. Oakland Avenue and E. North Avenue. Included is a discussion of accident experience at the intersection subsequent to billboard installation, as well as general observations concerning the installation and operation of the LED billboards. A discussion of recommended guidelines for the development of regulations for future installation and operation of electronic changeable message LED billboards in the City of Milwaukee is also included to support the future expanded use of these billboards.

E. North Avenue and N. Oakland Avenue LED Billboard

Accident Analysis

One of the primary indicators to determine the overall traffic safety impact of the changeable message LED billboards is any change which may occur in accident frequency or patterns during the period of sign operation. Accident frequency and individual crash characteristics were assessed during the test period of operation at the intersection of E. North Avenue and N. Oakland Avenue to determine what, if any, change in accident patterns occurred at the intersection which may be attributable to the introduction of the electronic billboard near the intersection. With the proximity of the

electronic billboard to the intersection, as well as the frequency of message change, particular attention was paid to accidents which could be attributable to driver distraction.

Copies of accident reports for crashes at the intersection of E. North Avenue and N. Oakland Avenue were obtained from the Milwaukee Police Department, and from Department of Public Works records. These accidents were then compared to the frequency and characteristics of crashes which occurred at the intersection in 2004, 2005 and 2006 both on an annual basis and during similar time periods. The crash frequency at this intersection is summarized in Table 1 below.

Table 1

Accident Frequency: Intersection of E. North Avenue and N. Oakland Avenue – 2004 through June 7, 2007

Year	January 4 To June 7	Annual Total
2004	8	15
2005	8	11
2006	2	7
2007	4	- -

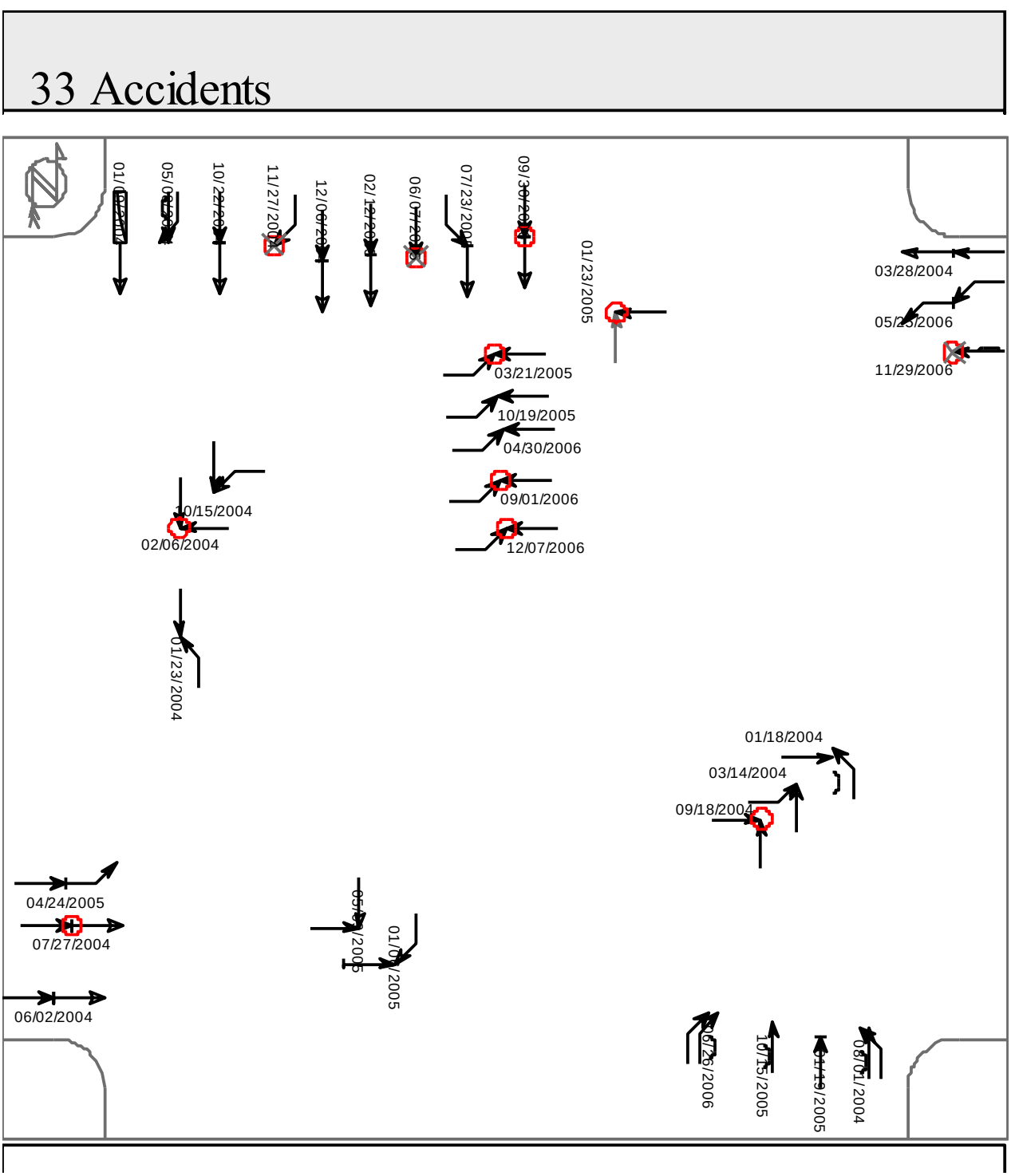
Source: Milwaukee Police Department and Department of Public Works

One of the primary concerns with the introduction of an electronic billboard at this intersection was the potential impact of driver distraction. As can be seen in Table 1, no dramatic increase in crash frequency occurred during the initial period of sign installation, such as that which occurred at the intersection of W. State Street and N. 4th Street following the introduction of the full motion video sign adjacent to Bradley Center. Accidents during the first six months of operation exceeded the total number of accidents in which occurred in the first six months of 2006, while remaining slightly less than that experienced during that same time period in 2004 and 2005. While not directly comparable due to the short duration of sign operation, the three year total average annual accident frequency prior to electronic billboard installation was 11 accidents per year.

Particularly noteworthy when examining the potential effects of driver accidents on crash experience is the direction of travel of the vehicles involved, the type of collision which occurred, and driver actions contributing to the accidents.

A drawing showing the type of collisions which occurred at the intersection of E. North Avenue and N. Oakland Avenue from January 1, 2004 through December 31, 2006 is shown in the collision diagram in Figure 1. As can be seen in this drawing, accidents at this intersection during this three year period primarily involved southbound vehicles in same direction collisions and angle crashes, as well as eastbound left turning accidents.

Figure 1
Collision Diagram for the Intersection of
E. North Avenue and N. Oakland Avenue
2004 through 2006



In total, 25 of the 33 accidents, or 76% of all accidents which occurred at this intersection, involved either a southbound or eastbound driver.

To evaluate the potential impact of the electronic billboard on the accidents which occurred during the test period, it is important to note that the new LED billboard can be directly viewed by traffic in the southbound direction on N. Oakland Avenue, and by eastbound traffic on E. North Avenue. Of the four accidents which occurred during the test period, all four accidents appear to have been caused by either southbound (3 accidents) and eastbound (1 accident) drivers. Additionally, two of the southbound motorists in these accidents failed to yield right of way, while the eastbound driver disregarded the red indication.

Two final observations are presented here concerning the analysis of accidents above. First, six months of crash data is not sufficient to draw any conclusions concerning the affect of the LED billboards on accidents at intersection. A minimum of three years of accident data is necessary to fully assess its impact. Secondly, while some distraction from external sources may have contributed to the failure to yield or signal disregard accidents which occurred at the intersection following the LED billboard installation, it is not possible to draw any definitive conclusion regarding the impact of the billboards on driver distraction from the motor vehicle accident reports and the data available.

Visual Impact of the LED Billboard

Based on accident history at this intersection, both in prior years and during the 6 month test period, the high frequency of crashes involving motorists in the southbound and eastbound direction remain a concern. Measures have already been implemented to address concern for this type of accident, with previously installed improvements to the signal displays on the southbound and eastbound intersection approaches. These improvements, consisting of large 12 inch far side indications and mast arm mounted signals, were installed to increase signal conspicuity with the intent of improving the visibility of the traffic signal indications for motorists in order to achieve better compliance and proper response to the traffic signal indications.

Due to the previous high frequency of crashes involving southbound and eastbound vehicles, past efforts to improve signal conspicuity and driver compliance with the traffic signals, and the orientation of the LED billboard to traffic approaching the intersection from the north and west, observations were made of the visual impact of the electronic billboards on signal displays.

The view of the electronic billboard for eastbound motorists approaching the N. Oakland Avenue intersection is illustrated in Figure 2. As can be seen in these photographs, the LED billboard is located a sufficient distance away from the intersection such that the constantly changing images shown on the billboard do not directly conflict with the signal displays.

Figure 2: View from Eastbound E. North Avenue Approaching N. Oakland Avenue

The opposite is true, however, for southbound traffic approaching E. North Avenue. As can be seen in the photographs in Figure 3, while the electronic billboard is not visible until a motorist nears the intersection because of overhanging tree branches, the colors, intensity and brightness of the billboard overwhelm the far left signal indication, which is directly in line with the LED billboard. This effect is more pronounced during nighttime hours. The signal indication may become increasingly difficult to distinguish when large amounts of greens, yellows, oranges and reds are the predominant colors used in the electronic displays on the LED billboards. In the case of the intersection of E. North Avenue and N. Oakland Avenue, the frequency and type of accidents involving southbound motorists will continue to be closely monitored in the future due to the placement of the LED billboard.

Observations of the test installation reveals that an electronic billboard can be placed near an intersection in a manner which does not directly conflict with signal displays, as demonstrated by the orientation of the billboard at this intersection. As the use of LED billboards may become more prevalent in the City in the future, observations of the sign installation at E. North Avenue and N. Oakland Avenue supports the regulation of sign placement and content based on the following concepts and guidelines suggested by VicRoads[1] and in the literature.

> *An advertisement, or any structure, device or hoarding for the exhibition of an advertisement, is considered to be a road hazard if it:*
>
> - *obstructs a driver's view of a traffic control device, or is likely to create a confusing or dominating background which might reduce the clarity or effectiveness of a traffic control device; or*
>
> - *Is likely to be mistaken for a traffic control device, for example, because it contains red, green or yellow lighting, or has red circles, octagons, crosses or triangles, or arrows.*

Other Observations and Recommendations

With the passage of the City Ordinance allowing the test deployment of the electronic LED billboard at the intersection of E. North Avenue and N. Oakland Avenue, and the concurrent installation of LED billboards which "primarily face the freeway", an opportunity was provided to observe and compare the location, operation and impacts of the new LED billboards. While the new technology in billboards appears to have a significant upside for the billboard industry, we believe that a significant update of current City Code as it relates to off-premise signs is warranted in order to effectively regulate anticipated future expansion of the use of electronic LED billboards, and to minimize the overall impacts of these signs on traffic safety and the surrounding areas in general. The following is an initial series of observations and recommendations on the expansion and use of the LED billboards based on observations of the current sign

Figure 3: View from Southbound N. Oakland Avenue Approaching E. North Avenue

Figure 3: View from Southbound N. Oakland Avenue Approaching E. North Avenue (Cont.)

Figure 3: View from Southbound N. Oakland Avenue Approaching E. North Avenue (Cont.)

installations facing the freeway and at the east side intersection location, as well as a review of recent literature addressing this type of signage.

Sign Placement

The LED billboard located at the east side intersection of E. North Avenue and N. Oakland Avenue clearly illustrates how the location of the billboard with respect to edge of roadway can affect the visibility of traffic signals or other traffic control devices. In this case, the billboard is set back from E. North Avenue, and does not directly interfere with or obstruct the visibility of the traffic signals at the intersection. The same is not true for traffic on N. Oakland Avenue, where a only a minimum setback of the sign from the roadway is provided. In this case, the position of the sign will directly conflict with or overwhelm the signal display.

Although no specific setback is suggested here at this time, it is recommended that a minimum setback from the street right of way be maintained to avoid creating any direct conflict with traffic control devices which may reduce the visibility, conspicuity or clarity and effectiveness of these devices.

One additional observation concerning the placement and orientation of the LED billboards resulted from discussion on Code enforcement following passage of the electronic billboard Ordinance change with the literal interpretation of the terminology "signs which primarily face the freeway". From observations of current freeway oriented sign installations, these signs can be visible for distances of 2 miles or more, with the distances visible and overall impact on the viewscape dependent upon the contrast between ambient light levels and the brightness of the LED signs, as well as the intensity of background colors utilized in the various messages displayed. If specific language is to be retained in code segregating billboards oriented to the freeway from other types of off-premise signs, it is recommended that more definitive language be included to clearly define the intent of the Ordinance as to the orientation and placement of the sign.

Message Duration

Prior to the adoption of Common Council File Number 060300, the minimum duration of messages other than time or temperature displays on changeable message signs was 60 seconds. With the passage of the Ordinance, a separate minimum of 30 second message duration was created for off premise signs primarily facing the freeway, with a 6 second duration established on a temporary basis for the off premise sign located on the southeast corner of E. North Avenue and N. Oakland Avenue.

Various articles and studies suggest minimum message durations on electronic changeable message signs ranging from as low as 4 seconds to 30 seconds and longer. In a comprehensive review of various studies on changeable message signs and their association with distracted driving, VicRoads suggests the use of a minimum duration of

30 seconds for display of any message in a changeable message sign.[1] Additionally, other reports and articles suggest that "image display time shorter than the industry standard of 8 - 10 seconds results in greater distraction for drivers and may be seen as animation, which is prohibited for roadside billboards"[2,3].

The changes to the Code of Ordinances allowing the different message duration provided the opportunity to observe message displays for various lengths of times under different traffic conditions. Qualitative observations by Department of Public Works staff indicate that the message duration of 6 seconds on the billboard at E. North Avenue and N. Oakland Avenue prompted them to look away from roadway more frequently and a for a greater total combined duration of time than signs with a longer message display. These observations suggest that attention to the driving task would be diverted more frequently and for longer durations than signs which display messages for the longer 30 or 60 second intervals.

While we believe the current 60 second minimum time for message displays on changeable message signs in the City is most preferable based on traffic safety concerns, various studies and qualitative observations of recently installed electronic changeable message LED billboards suggest a minimum duration of 30 seconds for changeable message signs. While we believe that the current 60 second duration for all changeable message signs is the preferred alternative for message duration, we recommend that a minimum message duration no less than 30 seconds be included in any regulations to be implemented for changeable message signs.

Sign Content

In addition to the physical factors noted above, the actual content of changeable message signs, as well as any off-premise sign, can affect the level to which a drivers attention is diverted from the task of driving, which could affect traffic safety. While many of the recommended requirements below, which are extracted primarily from the VicRoads Report[1] and other sources, are already contained in current City of Milwaukee Ordinances pertaining to signage, they should be noted here and included in any new regulations developed to effectively regulate expansion of the use of changeable message displays in off premise signs, as well as for all other on- and off- premise signs.

The following minimum standards are recommended to be included in any future City of Milwaukee Ordinances governing sign content to be used with the installation of electronic changeable message signs, whether on or off premise signs.

- No sign shall display animated, scrolling or other moving images, or flashing or intermittent lights.
- Any change of message is to occur in 1 second or less.
- Signs which may distract drivers due to their size, design, coloring, illumination, reflection, animation or flashing are to be prohibited.

- No sign message is to be permitted which may look like, contain, or be mistaken for a traffic control device, such as signs which contain significant amounts of red, green, orange or yellow lighting, or with red circles, octagons, triangles, arrows and other shapes or symbols used in traffic control devices and the message content of these devices.

Additionally, consideration should be given to addressing the following safety considerations in any signing regulations to be implemented.

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- The sign message shall provide content which does not require extended time to read and comprehend sign contents from a moving or stationary vehicle in a location where the vehicle would be unprotected from passing traffic.

- Signage contents should not direct a motorist to turn where the sign location is so close to the driveway or other entry point where sufficient time for signaling, and safe deceleration and turning is not possible.

LED Display Brightness

The amount of light emitted from an LED billboard display, as well as any other on or off premise sign display, should not cause discomfort to approaching motorists, or in any way obscure the visibility of illuminated traffic control devices (i.e. traffic signals, beacons, flashers, railroad crossing lights, etc.) due to their brightness. In addition, a higher potential for driver distraction exists with excessively bright lit signage. The literature suggests a maximum of 0.25 candela per square meter[1]. It is recommended that as a minimum, the LED message displays used in billboards and other signage not exceed the amount of light emitted by traffic signal indications. In addition, display brightness is to be appropriately adjusted (dimming) as ambient light decreases.[4]

Regulation of LED Billboards

With the development and advancement of the use of LED and electronic technology in the billboard industry, local jurisdictions throughout the country are being faced with decisions on the regulation of these advanced billboards without the benefit of experience or a knowledge base dealing with the use and impacts of these new billboards due to the rapid advancement of sign technology. Regulations have been adopted in several jurisdictions throughout the country which liberalizes the operation and usage of these signs, while others have been more conservative in their approach to the deployment of the new technology, waiting until further understanding, experience and a more extensive knowledge base related to the impacts of the initial installation and operation of these new billboards develops. In addition to the trial period for operation of the LED billboard on local streets by the City of Milwaukee, two Milwaukee suburbs, Oak Creek and Hales Corners, have considered or implemented moratoriums on electronic message

boards which utilize LED technology and changeable messages to allow time for further research and review of the use of these billboards.[5,6]

Since implementation of the Highway Beautification Act in 1965, the Federal Highway Administration (FHWA) has been responsible for control of billboards through its Outdoor Advertising Program. Since conflicts among the various stakeholders involved (including members of the outdoor advertising industry, groups concerned about maintaining and improving scenic views, local governments, and state and federal regulators) have arisen over the years, FHWA decided to pursue a conflict assessment to reach out to identify issues that cause controversy and suggest appropriate methods for addressing these conflicts. In a report commissioned by FHWA and prepared for The U.S. Institute for Environmental Conflict Resolution, conflict among stakeholders about the Outdoor Advertising Program was concluded to be "substantive, organizational and attitudinal". One of the conclusions of the study, however, was that the issue of the use of new technology in outdoor advertising was perceived by affected stakeholders as important and having a reasonable potential for agreement.[2] The study recommended further research into whether the new electronic changeable message billboards present risks to drivers. The Federal Government has now allotted $150,000 for the study of the digital signs.[7]

Conclusions

While research into distracted driving and other potential traffic safety impacts of electronic changeable message LED billboards continues, federal funds have been allocated to examine the risks these billboards have on drivers. However, the findings of this study may not be available for some time. A conservative approach could be taken by the City of Milwaukee and follow of a number of jurisdictions both locally and nationally that have placed a temporary moratorium on the installation of these new LED billboards until such time as the FHWA study is completed.

As an alternative, if the City wishes to allow the further deployment of electronic billboards prior to the completion of the federal study, current City Ordinances do not adequately address advanced technology incorporated into electronic changeable message LED billboards, and cannot effectively regulate their installation and operation. It is therefore recommended that if the City wishes to pursue further LED billboard deployment prior to the release of the findings of the federal investigation, the current City Code pertaining to off premise signs be updated to fully address the installation and operation of these billboards to specifically include as a minimum the conditions and recommendations discussed in this report pertaining to sign placement, sign message content, message duration, and LED brightness.

(The Department of Public Works wishes to gratefully acknowledge the assistance of Leslie Silletti of the City's Legislative Reference Bureau and Dan Pomeroy of ClearChannel Outdoor in locating and compiling information used in the preparation of this report.)

References

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3 "Municipalities Considering Amending Digital Billboard Regulations"; Nation's Cities Weekly, February 12, 2007.

4 "The OAAA Code of Industry Principles", Outdoor Advertising Association of America.

5 "LED Sign Moratorium Goes Into Effect"; NOW – Oak Creek, Franklin, Greendale and Hales Corners Edition, May 17, 2007.

6 "Oak Creek to Study Electronic Signs"; Milwaukee Journal Sentinel, January 31, 2007.

7 "Digital Billboard Up Ahead: New Wave Sign or Hazard?"; The New York Times; January 11, 2007.