



September 7, 2021

Maricopa County
Members of Planning Commission and Board of Supervisors
301 W Jefferson Street
Phoenix, Arizona 85003

Dear Members:

Attached to this letter please find my report in the matter of Maricopa County TA2018001, which is scheduled for the Planning Commission agenda on September 9, 2021.

Thank you.

Yours truly,

A handwritten signature in black ink, appearing to read "Jerry Wachtel", with a long horizontal line extending to the right.

Jerry Wachtel
President

A REPORT ON THE SAFETY IMPACTS OF DIGITAL BILLBOARDS

Submitted to The Maricopa County Planning Commission and Board of Supervisors

By Jerry Wachtel, President, The Veridian Group, Inc., Berkeley, California

INTRODUCTION.

In his letter dated August 22, 2021, Mark D. Becker of Becker Boards (applicant) addresses five separate issues that have apparently led to opposition to the “proposed digital billboard text amendment” in Maricopa County. One of the five issues concerns “driver safety/distraction.” As this writer’s expertise and concern lie with issues of traffic safety (of which one component is distraction) this report addresses this issue only.

BILLBOARDS, DRIVER DISTRACTION, AND TRAFFIC SAFETY.

In the applicant’s letter of August 22, 2021, he includes a section titled “Driver Safety/Distracted,” In a dramatic, and dramatically untrue opening statement on this issue he says: “This myth has been completely debunked.” In fact, quite the opposite is true, as well more than 100 technical papers have been written on this subject in the past two decades alone. The current author has the space to cite just a few of them in this report, and the reader may choose to read his detailed and critical Compendium¹ of the recent literature, an ongoing document that currently reviews 27 such papers published between 2008 and 2019. The current version of the Compendium was requested by and undertaken for the Legal Division of the California Department of Transportation (Caltrans). An earlier paper by the current author² discusses and peer reviews articles on this topic prior to 2009. A third paper³, published in the journal *Transportation Research Part A: Policy and Practice*, discusses some 90 research studies on the subject and concludes: “...there is an emerging trend in the literature suggesting that roadside advertising, particularly those signs with changeable messages, can increase crash risk.” Still other recent papers, by Sisiopiku, et al⁴ Gitelman, et al.⁵, and even the Conference of European Directors of Roads (CEDR)⁶ have reached the same conclusion. In fact, the more thorough and more recent the research, the more likely it is that the study found links (correlations) between the presence of roadside advertising, particularly with digital billboards, and driver distraction, which is known to be causative of traffic accidents.

THE FEDERAL HIGHWAY ADMINISTRATION'S (FHWA) ROLE IN THIS ISSUE.

On page 2 of his August 22, 2021 letter, the applicant further states: "The federal government (meaning the Federal Highway Administration - FHWA) studied this issue (driver safety and distraction) exhaustively and issued a formal opinion before adopting language to allow billboards on its freeways." Because the applicant did not identify the source document he refers to, it seems that he has conflated at least two documents, as discussed below. Regardless, he demonstrates a serious misunderstanding of FHWA's activities in this field, in an apparent attempt to strengthen his case.

The first such document, and the only one that can be seen as a "formal opinion" is a Memorandum from the agency's Associate Administrator for Planning, Environment, and Realty dated September 25, 2007.⁷ As someone who worked for FHWA for 11 years and was the author of the agency's (and the world's) first study on digital billboards⁸ this writer can say with confidence that the applicant's statement is false. The "formal opinion" issued by FHWA in 2007 was based on no research or study whatsoever. It simply reported on current practice in the industry regarding details such as billboard brightness, frequency of message change, etc. and adopted that practice into its opinion. For example, when it came to brightness, the Memorandum issued this vague statement: "Adjust brightness in response to light levels so that the signs are not unreasonably bright for the safety of the motoring public" (pg. 2). This non-helpful, unsupported statement was made despite the availability to FHWA of substantial research complete with specific recommended brightness levels. To restate, FHWA's 2007 Memorandum had zero basis in research and cited no references, despite the fact that considerable research was available to the agency at that time.

The second FHWA document that may have been inappropriately referred to by the applicant was a study performed for the agency by Perez, et al.⁹, and dated 2012. The draft version of this report was criticized so severely by its reviewers that FHWA took 33 months to revise the study (it usually takes 30-60 days for such revision), which, although dated September 2012 was not posted to the agency's website until December 30, 2013. This revised version of the report was, in turn, reviewed by the present author,¹⁰ whose highly critical report was reviewed and agreed-to by 14 independent expert peer reviewers. To our knowledge, the revised FHWA report was not subjected to independent peer review by the agency prior to its issuance on the agency's website. Significantly, the document has never been given an official agency report number, which means that it has never been officially published. Thus, any reviewers of this work will likely only discover the seriously flawed draft document (which *does* have an agency report number because it was actually published for review).

BRIGHTNESS (LUMINANCE) AND TRAFFIC SAFETY.

The applicant's discussion of digital billboard light output was addressed only in the context of upward light trespass (which he called "spillage") which adversely affects dark skies in the surrounding area. But sign brightness has specific, and negative effects on driver vision, and hence plays a role in driver distraction. The brightness (properly called luminance) of a digital

billboard is first set upon manufacture of the sign, but once installed, a billboard's brightness can be readily adjusted on-site or remotely by the billboard owner/operator. There are two significant characteristics of digital billboard brightness that can adversely impact traffic safety. The first is discomfort or disability glare that can impair a driver's vision upon approach to the billboard. The second is the instantaneous change in brightness as the billboard transitions from one display to the next. This instant change in brightness level is what triggers an eye glance from the driver toward the billboard and contributes to driver visual distraction away from the forward roadway. Experts generally define driver distraction as any behavior or activity that takes that driver's attention (including visual attention such as glances and eye movements) away from the principal driving task, however briefly.

In the case of luminance, both of these concerns can be addressed by simply reducing the maximum brightness of the digital billboard to a reasonable level. We can define a reasonable level as one that is no brighter than conventional billboards that have existed adjacent to roadways for decades without complaint on this issue, and that reduces glare to acceptable limits as defined by internationally accepted standards¹¹ .

Because the applicant discusses brightness only in the context of the Dark Skies movement, ignoring its contribution to glare and to distraction, he suggests that his proposed billboards can solve the brightness problem by using louvres that reduce light coming from the billboard screen to shine upwards. While this solution may assist with the dark sky problem (which is beyond the scope of this report), it does nothing for, and in fact exacerbates the problem of excess brightness into the eyes of drivers and other road users. That is because the same amount of light that would normally be broadcast outward at 360 degrees from the billboard face is now focused downward by the louvres, into drivers' eyes. Indeed, the applicant's letter of August 22, 2021 specifically states that these louvres "limit the visibility of the billboard except to oncoming traffic" (pg. 2). It is, of course, of great concern that the applicant never mentions the actual proposed brightness levels of his signs, when brightness is a key component in traffic safety and driver behavior.

MESSAGE CHANGE INTERVAL (DWELL TIME) AND DRIVER DISTRACTION.

The applicant is silent on the impact of the billboards' dwell time (the length of time that each message is visible on the sign). This is a significant oversight as dwell time has a critical role to play in driver distraction. The principal benefit claimed for digital billboards by their proponents is that multiple advertisements can share time on the billboard platform by rotating their message every several seconds, minutes, or hours. Obviously, the more messages that can be rotated through any time cycle, the more revenue the owner of the billboard can achieve. Over time, the billboard industry has settled upon an 8-second "dwell" time. It must be noted that there has been no research to support this message change interval, and no such support has ever been claimed by the industry. It simply seems that this is the shortest time interval the industry could support without running into the risk of claims by regulators that their signs present "flashing lights" or "flashing messages." Such "flashing lights" are expressly forbidden in most government zoning codes that address roadside billboards.

It has been shown that it is the moment of the message change, with its attendant change in imagery and brightness, that attracts the driver's eye and thus causes the distraction. It therefore follows that, the more frequent the message change, the greater distraction is produced, thus suggesting that longer dwell times are appropriate. Rather than the unsupported 8-second message change interval, some jurisdictions have increased their dwell time to minutes, and even hours.

This author has developed a simple formula to determine an appropriate dwell time for different roads and traffic conditions. This formula derives from the goal that no given driver will see more than a single message change during his or her approach to a digital billboard. The basis of this goal, of course, is to reduce to a minimum the number of distractions from the message change that are presented to a driver in the environment.

The formula is based on knowing the speed limit and the distance from which a digital billboard can first be seen by the approaching driver. Specifically, one applies the formula by dividing the sight distance (in feet) by the speed limit (in feet per second) to arrive at a value. This value, rounded up to the next whole number if necessary, is the suggested dwell time. To take an example, if a specific digital billboard can be seen from 1,000 feet upstream of the sign, and if the speed limit is 65 MPH (95 feet per second), the dwell time would need to be 12 seconds at a minimum. Longer sight distances would require longer dwell times. Of course, the billboard industry seeks a single, constant dwell time for all of its digital billboards along a given roadway or in a specific region. This makes the sign companies' marketing and billing more straightforward. The solution is to set as a default dwell time the longest calculated dwell time for the given roadway or region.

DRIVER DISTRACTION AND ACCIDENTS.

Do billboards cause accidents? The applicant states that there is no known example of a billboard operating in accordance with the FHWA's 2007 Memorandum causing an accident. That may be the common narrative among billboard proponents, but it is not true. A recent Israeli study, the most comprehensive, systematic, epidemiological study in this field,¹² published in 2018, shows that billboards actually have a dramatic connection to accidents. Specifically, what the study shows is that when existing billboards were covered or removed by the local governing authority (as part of a larger study), accidents on the affected roadway declined by 30-40%, depending on road section. At the end of the study period, when billboards were returned to operation, accidents increased by 30-60%. Directly to the point, a study by Sisiopiku, et al⁴ was conducted in Florida and Alabama, and concluded: "The overall results were consistent between the two states. The presence of digital billboards increased the overall crash rates at "digital advertising billboard influence zones" by 25% in Florida and 29% in Alabama."

What the human factors community says on this issue is that billboards lead to driver distraction, and when a driver's available information-processing capacity is diminished by

demanding driving conditions (e.g., heavy traffic, complex roadway interchanges, adverse weather, driving on unfamiliar roads, etc.), distraction can lead to driver error which in turn may cause a crash.

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