

## **Technical Background Document on the Impacts of Traffic Incident Clearance Programs (Freeway Service Patrols) Based on a Review of the Empirical Literature**

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### **Study Selection**

Most studies of traffic incident clearance programs are cost-benefit analyses, some of which quantify reductions in criteria emissions as part of the benefit calculation. The main criterion for including studies in this review is information on vehicle emission changes that are associated with the traffic incident clearance program. In addition, studies were drawn from the academic literature, either peer-reviewed journals or research conducted by university-related research organizations. In one instance, comparable data were available from an agency (the Metropolitan Transportation Commission in the San Francisco Bay Area) and those results are also presented in the policy brief. In all cases, the emissions studied were criteria pollutants; the studies reviewed did not make inferences about changes in greenhouse gas (GHG) emissions.

### **Effect Size, Methodology and Applicability Issues**

The earliest and likely still most-cited study on traffic incident clearance programs is the Skabardonis et al. study (1995), which implemented a “before and after” research design to assess the impact of the Freeway Service Patrol program in the San Francisco Bay Area. Speed was calculated on a stretch of the I-880 freeway in the East Bay using loop detectors in the highway pavement. Emission reductions were calculated using an emissions factor model (EMFAC7) developed by the California Air Resources Board (CARB). The observed reductions in congestion delays and associated changes in peak hour travel times were inputs into the emissions model. To date, this is one of only two studies that quantify congestion reduction associated with traffic incident clearance by measuring congestion and/or travel speed before and after the incident clearance program is implemented.

A similar study, by Skabardonis et al. (1998), examined a segment of the I-10 in Los Angeles County. The authors implemented a “before” and “after” research design by comparing speeds following incidents on highway segments serviced by the traffic incident clearance program with speeds on the same segments before the program was instituted (using historical data). The study used pavement loop detectors, combined with a vehicle probe, to calculate speed. Air pollution reductions were calculated in the same way as in Skabardonis et al. (1995).

Raw data on the 2004-2005 emissions changes attributable to the Freeway Service Patrol program in the San Francisco Bay Area are available through the Metropolitan Transportation Commission Service Authority for Freeway and Expressways (MTC-SAFE) program, administered by the Bay Area Metropolitan Transportation Commission (MTC). The MTC used Freeway Service Patrol data in conjunction with the state Performance Emissions Measurement System to calculate pollutant reduction levels from the Freeway Service Patrol. The data allowed an estimate of per diem, not per incident, reductions in criteria emissions.

Haghani et al. (2006) looked at the effectiveness of the Hudson Valley Highway Emergency Local Patrol (HELP), operated by the New York State Department of Transportation. Conducted in 2004-05, this study examined traffic volumes and travel speed during peak hours, comparing incident clearance times during HELP hours (weekday peak) to incident clearance times when the program did not provide service (at night and on weekends). This is not a true before-and-after research design, as the control (or comparison) group is incident clearance on nights and weekends as opposed to a comparison of pre-program peak hour and with-program peak hour conditions, as in Skabardonis et al. (1995 and 1998). Inferred changes in travel speeds were input into an emissions model.

Chang et al. (2003) looked at data collected under the Coordinated Highways Action Response Team (C.H.A.R.T.), operated by the Maryland State Highway Administration in the Washington DC-Baltimore region. This study was conducted in 2001, and examined the cost effectiveness of the C.H.A.R.T. program. Changes in incident clearance times were inferred by comparing the duration of incidents cleared by tow companies in the program with incident durations serviced by companies or entities not affiliated with the program. Chang et al. (2003) used a Maryland Department of Transportation formula designed for the Washington, DC-Baltimore area to determine emissions changes associated with changes in traffic delays.

Guin et al. (2007) examined benefits from the NaviGator system using system data, including vehicle volume and speed, for segments throughout the Atlanta region for one year, taking care to avoid weather anomalies such as hurricanes. Various parameters such as average incident duration and the total number of incidents were calculated. Rather than using an emissions model, the authors calculated emission reductions from US Environmental Protection Agency tables that relate vehicle-hour reductions to emissions.

Theoretically, reducing congestion from clearing traffic incidents more quickly could induce more travel. It is important to note that the empirical evidence on induced travel, which is compelling (e.g. Duranton and Turner, 2010 or Hansen and Huang, 1997), may or may not apply to traffic incident clearance programs. The distinction between average travel times and the variance around the average travel time is important. Traffic incident clearance programs might work mostly by increasing the reliability of travel time – stated equivalently, reducing

the variance around an average travel time on a particular route. The literature gives little evidence on whether reduced travel time variance induces more travel, although it is clear that increases in highway capacity (e.g. lane miles) lead to essentially one-for-one increases in traffic (Duranton and Turner, 2010). Given the current state of knowledge, it would be prudent to view any capacity-increasing policy, including traffic incident clearance, as potentially subject to induced travel. For that reason, emission reductions from traffic incident clearance programs should be viewed as potentially short-term gains that may not persist in the long run. More research that directly examines the effect of traffic incident clearance or other improvements in operational efficiency on induced travel is needed.

#### *Comparison of Incident Management Program Emissions Reduction to Total Highway Vehicle Emissions*

Data from the Skabardonis et al. (1998) study in Los Angeles County was used to compare the emission reductions associated with the traffic incident clearance program to total transport-sector emissions in the county. Skabardonis et al. (1998) concluded that, for the 7.8 mile highway segment in their study (I-10, near the Santa Anita exit), 472 kg of carbon monoxide (CO) and 122 kg of nitrous oxides (NOx) were reduced per day. For comparison, the California Air Resources Board's emissions inventories show that annual emissions, from passenger vehicles, trucks, motorcycles, busses, and motor homes in Los Angeles County in 1996 and 1997 average to 1,306,331 tons of CO and 173,134 tons of NOx per year. (Note that 1996 and 1997 are the years that correspond to the Skabardonis et al. study.) Skabardonis et al. (1998) reported that the broader incident management program covered 400 centerline highway miles in Los Angeles County. To get the full impact of the Los Angeles County incident management program, the estimated emission reduction was scaled by a factor of 400/7.8, which assumes that the emission reduction on the 7.8 mile segment of I-10 scaled directly to the full program. This was a necessary simplification and, in general, the effect of incident management programs on congestion and emission reduction will vary with highway conditions. Emission reductions from the incident management program were estimated as a percentage of Los Angeles County emissions from highway vehicles with the following formula:

$$\% \text{ reduction} = \frac{(\text{kg} / \text{day} * 365 \text{days} / \text{year}) \div 907.18 \text{kg} / \text{ton} \times \left( \frac{400 \text{programmiles}}{7.8 \text{evaluationmiles}} \right)}{\text{LACounty, emissions, tons} / \text{year}}$$

where "kg/day" is the estimated reduction in emissions on the 7.8 mile segment which Skabardonis et al. (1998) evaluated, in kilograms per day, and "LACounty, emissions, tons/year" is the emissions, in tons per year, from vehicles in Los Angeles County, from the Air Resources Board's emissions inventory.

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## Acknowledgments

This document was produced through an interagency agreement with the California Air Resources Board with additional funding provided by the University of California Institute of Transportation Studies MultiCampus Research Program on Sustainable Transportation and the William and Flora Hewlett Foundation.