Memorandum

Date: October 25, 2016

To: To Whom It May Concern

From: Brett Walinski, T.E.

Subject: Traffic Impact Analysis for Booster Fuels

Background

Booster Fuels provides mobile gasoline delivery service for passenger vehicles. The service is initiated through an application on a smartphone device. A typical patron transaction consists of the following: (1) a patron uses the application to request fuel delivery; (2) a fuel truck is routed to the vehicle where gasoline has been requested (typically at a patron's place of employment); and (3) the fuel truck arrives onsite to deliver gasoline to the vehicle. This process is hereafter referred to as simply a "Patron Transaction." As a result of mobile fuel delivery, a passenger vehicle trip to and from a fixed gasoline station is removed from the roadway network.

Objective

The purpose of this analysis is to determine the overall traffic impact of Booster Fuels' delivery service in the south Bay Area relative to traditional use of fixed gasoline stations. The analysis seeks to determine this by comparing the patron vehicle-miles traveled (VMT) removed by the service to the VMT added to the roadway network by Booster Fuels' trucks.

Study Methodology

The metric used in this study to determine the overall impact to the roadway network is net VMT per patron transaction. VMT is a measure of overall roadway usage, and is in the process of being formally implemented into the California Environmental Quality Act (CEQA) guidelines as the primary metric to determine a project's traffic impact. VMT is calculated by multiplying the number of new vehicle trips generated to and from a project by the average length of those trips.

Booster Fuels' service has three primary effects on the roadway network. First, when patrons use the service, trips to and from fixed gasoline stations are removed from the roadway (hereafter referred to as the "Patron VMT"). Second, trips are added to the roadway network when Booster Fuels' trucks are routed to serve patrons (hereafter referred to as the "Booster Truck VMT"). Last, tanker truck trips are removed from the roadway network because fewer fuel deliveries are needed between refueling terminals and fixed gasoline stations. Because of the difficulty in accurately calculating this last effect, it was ignored in this analysis. In this respect, this analysis is conservative because it underestimates the tanker truck trips VMT removed from the roadway network when Booster Fuels service is utilized.

Patron VMT. The Patron VMT removed from the roadway network was determined through direct survey of Booster Fuels' existing customers on the smart phone application. Patrons were asked (1) how far they would have driven to a fixed service station if they didn't use the service and (2) what time they normally buy fuel at a fixed service station. Based on these data, the average number of miles that would have been driven to and from fixed gasoline stations, had Booster Fuels service not been used, was determined per patron transaction.

Booster Truck VMT. Booster Fuels' trucks fill their tanks at the same south Bay Area refueling terminals as those used by fixed gasoline stations. The Booster Truck VMT added to the roadway network was determined from mileage logs in Booster Fuels' trucks. The mileage logs provide the total number of miles driven by trucks each day, as well as the total number of patron transactions. When the total number of miles driven by Booster Fuels' trucks is divided by the total number of patron transactions, the average number of miles per patron transaction is determined.

By comparing the Patron VMT removed from the roadway network to the increase in Booster Truck VMT created by the service, the net VMT can be calculated.

Patron VMT

Booster Fuels administered the aforementioned patron survey designed by Hexagon to determine Patron VMT in early October of 2016. Altogether, 1209 patrons responded to the survey. The survey data are shown in Table 1. The average patron VMT savings was computed to be 1.89 vehicle-miles per patron transaction (round-trip). This implies an average one-way trip length to a fixed service station of 0.94 miles. Using a statistical analysis assuming a normal distribution and an infinite population, these data are accurate to plus or minus 0.13 vehicle-miles with 95 percent reliability.

Table 1
Survey Results - Patron Trips

Approx. Miles Driven	Responses
0	231
0.1 -0.2	116
0.2 - 0.5	157
0.5 - 1.0	121
1.0 - 2.0	196
2.0 - 4.0	197
4.0 - 6.0	111
6.0 - 10.0	60
10+	20
Total Responses	1209
Weighted Average (miles)	1.89

This result was compared to other trip length surveys reported by Institute of Transportation Engineers' (ITE) studies. A study conducted by Steven A. Tindale in 1991, published in the ITE International Conference Compendium Papers, cited an average one-way trip length for gasoline service stations of 1.90 miles for sites in Florida, including primary and diverted-linked trips. Similarly, a study conducted by Tipton Associates Inc. in 1991, published in the ITE International Conference Compendium Papers, cited an average one-way trip length of 0.95 miles for a convenience store with gas pumps for sites in Florida. However, this survey included only primary trips. While these surveys are not precisely analogous, in part, because they were conducted 25 years ago in Florida, they show that the results of the Booster survey are within a range that is consistent with past findings. Also, it is hypothesized that some segment of Booster Fuels patrons may find the service useful precisely because they lack access to close fixed gasoline stations. The logical result of this hypothesis is that the trip lengths of Booster Fuels patrons may be longer than those of the general population.

Booster Truck VMT

Graphics of sample routes are provided in the attached Appendix (Exhibits A & B). Booster's trucks are stored within a couple blocks of the refueling terminal on Dado Street in San Jose (Exhibit C). Booster's trucks typically load fuel at the terminal, and head out on route between 8:30 AM and 9:30 AM. Typical destinations include office parks in North San Jose, Santa Clara, and Sunnyvale. Trucks usually return to the overnight storage facility between 2:00 PM and 5:00 PM.

Mileage logs from Booster Fuels' vehicles were recorded in early October 2016. Drivers were instructed to report their starting odometer, ending odometer, and the number of patron transactions. These data are shown in Table 2. The average miles per patron transaction was then computed by dividing the total truck mileage by the number of patron transactions. For the given sample, a total of 158 truck-miles were driven, and 549 total patron transactions were recorded, to produce an average VMT of 0.29 vehicle-miles per patron transaction.

Booster Truck Operational Characteristics

It is widely recognized that the operational characteristics of truck trips are different than those of passenger vehicles. Booster Fuels' trucks hold approximately 1,200 gallons of fuel, but are considerably smaller and lighter than typical fuel tankers, which hold approximately 9,000 gallons. Booster's fleet is comprised of singe unit trucks designed to function in tight spaces with a turn radii similar to large sport utility vehicles. They have 2 axles and 6 wheels. Booster's trucks measure approximately 17.1 feet long, which is approximately as long as a Chevrolet Tahoe or Suburban. For comparison purposes, a SU-30 truck, the smallest single unit truck as defined by the American Association of State Highway and Transportation Officials (AASHTO) "Green Book," is 30 feet long.[1] A photo of a Booster Fuels' truck is provided in the attached Appendix (Exhibit D).

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[1] AASHTO *A Policy on Geometric Design of Highways and Streets*, 2011, Page 2-11

Table 2
Booster Fuels' Drivers Log

Date	Start Odometer	End Odometer	Total Mileage	Transactions (Fills)	Miles per Fill
10/3/2016	2,479	2,508	29	79	0.37
10/4/2016	5,543	5,558	15	59	0.25
10/3/2016	1,238	1,250	12	69	0.17
10/4/2016	1,250	1,260	10	51	0.20
10/5/2016	1,260	1,275	15	43	0.35
10/6/2016	1,276	1,289	13	53	0.25
10/6/2016	2,443	2,465	22	59	0.37
10/6/2016	1,239	1,249	10	46	0.22
10/7/2016	1,289	1,302	13	44	0.30
10/7/2016	3,405	3,424	19	46	0.41
Totals			**158**	**549**	
Weighted Average (total Miles/Total Fills) =			**0.29**		

To account for the differences in operational characteristics between trucks and passenger vehicles, truck trips are converted to passenger car equivalents (PCE) in accordance with Transportation Research Board (TRB) Highway Capacity Manual (HCM) recommendations. PCE typically varies in accordance with terrain. For the purposes of this study, Booster's trucks were assumed to operate on flat terrain in urban or suburban areas. A truck is defined by the HCM as any vehicle with more than four wheels.[2] For intersection analysis, a PCE factor of 2.0 is commonly used to convert truck trips to passenger vehicle trips.[3] That is, one truck trip is equivalent to two passenger vehicle trips. However, this method assumes all trucks, from interstate semitrailers (WB-50) to single unit garbage trucks (SU-30), have the same operational characteristics. The HCM also discusses recreational vehicles in terms of PCEs, and assigns them a PCE factor of 1.2 on level terrain. It is our opinion that, given the weight, size, and maneuverability of Booster Fuels' trucks, a PCE of 1.5 would be a reasonable, perhaps conservative, estimate of their operational characteristics.

Given all of the above stated information, Hexagon's net estimate of the VMT removed as a result of Booster Fuels' existing service is 1.46 vehicle-miles per patron transaction (1.89 Patron VMT – [0.29 Booster Truck VMT x 1.5 PCE]).

[2] 2010 HCM, Page 11-13

[3] 2010 HCM, Page 18-36

Proximity Considerations

The distance between the refueling terminal and the service areas (i.e. locations of customers) are an important component in determining Booster Fuels' net VMT. For example, if Booster trucks were to fill 55 transactions within one mile of the refueling terminal, the Booster Truck VMT per patron transaction would be on the order of 0.04 vehicle-miles (2 miles of VMT round-trip / 55 patron transactions). Conversely, if Booster Fuels were to service Marin County from its San Jose refueling terminal, the Booster Truck VMT per patron transaction would be on the order of 3.27 vehicle-miles (180 miles of VMT / 55 patron transactions). Thus, there exists is a break-even point, beyond which, the distance between the service area and the refueling terminal would result in VMT being added to the roadway network instead of subtracted. Hexagon computed the break-even distance for Booster Fuels' trucks using the following assumptions:

- Booster Truck PCE = 1.50
- Average number of transactions per Booster Truck trip = 55
- Average Patron VMT Savings = 1.89 miles per patron transaction

It was determined that the break-even truck route distance (round-trip) would be approximately 69 total miles (Patron VMT = Booster Truck VMT; 1.89 = 69.4 miles x 1.5 PCE / 55 transactions per route). Thus, Booster Fuels' service would create a net reduction in VMT when the distance between the refueling terminal/truck storage facility and service area are within approximately 30 to 35 miles of each other. [4]

Commute Period Impacts

When assessing the overall traffic impacts of Booster Fuels' service, another important factor is the timing of Patron VMT. According to the survey results, 56% of Booster Fuels' patrons would have filled up their tanks at a fixed service station during the AM or PM commute periods. Using a statistical analysis assuming a normal distribution and an infinite population, these data are accurate to plus or minus 3 percent with 95 percent reliability. Given that Booster Fuels' trucks mostly operate during non-commute hours, there is evidence to suggest that the service could result in some VMT being shifted from the commute periods to the non-commute periods, when more roadway capacity is available.

[4] This rough calculation is dependent on the distance needed to locate patron transactions within the service area. The 30 mile estimate assumes approximately 10 miles of Booster Truck route distance is dedicated to locating patrons, while the 35 mile estimate assumes that all patrons would be at the same location. As shown on Exhibits A & B, deliveries tend to be clustered in employment areas.

Conclusions

Booster Fuels surveyed its patrons and tracked its trucks to determine the net impact on vehicle-miles traveled on south Bay Area roadways. This study reached the following conclusions:

- The net VMT estimates are likely conservative because some tanker truck trips that serve fixed gasoline stations would be removed from the roadway network as a result of Booster Fuels' service. This effect could not be accounted for and was therefore ignored in the calculations.
- Booster Fuels' existing service in the south Bay Area currently results in a VMT reduction of approximately 1.60 vehicle-miles per patron transaction (1.89 Patron VMT – 0.29 Booster Truck VMT).
- Accounting for the differences in operational characteristics between trucks and passenger vehicles, Hexagon's estimate of the net VMT removed as a result of Booster Fuels' existing service is 1.46 vehicle-miles per patron transaction.
- The reduction in VMT is dependent on the distance between the refueling terminal and the service area. Booster Fuels' service would create a net reduction in VMT when the distance between the refueling terminal/truck storage facility and service area are within approximately 30 to 35 miles of each other.
- The survey data showed that more than half of Booster Fuels' patrons would have refueled at a fixed service station during peak commute periods. Given that Booster Fuels' trucks mostly operate during non-commute hours, there is evidence to suggest that the service could result in some VMT being shifted from the commute periods to the non-commute periods, when more roadway capacity is available.

Based on these findings, it is Hexagon's opinion that Booster Fuels' service has an overall beneficial impact on the roadway network when operated within approximately 30 to 35 miles of the refueling terminal/truck storage facility.

Future Research

This study represents an initial attempt to quantify the traffic operations impacts of mobile fuel truck delivery. The level of detail provided in this analysis is consistent with standards typically applied for CEQA analysis. Due to the unique nature of the service, additional study could be considered as mobile fuel delivery services become more common. The following additional research could be considered:

- Quantification of the removal of tanker truck VMT between the refueling terminal and fixed service stations,
- Refinement on the PCE assumptions for mobile fuel trucks,
- Measurement on the effects of employment density on Booster Fuel truck VMT,
- Correlation between population density and Patron VMT to fixed service stations, and
- Quantification of VMT by time of day for Booster Fuels trucks and Patron vehicles.