

# **Utilization Assessment of Target Electrification Vehicles at Marine Corps Base Camp Lejeune: Task 3**

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# **Utilization Assessment of Target Electrification Vehicles at Marine Corps Base Camp Lejeune: Task 3**

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## **ABSTRACT**

Battelle Energy Alliance, LLC, managing and operating contractor for the U.S. Department of Energy's Idaho National Laboratory, is the lead laboratory for the U.S. Department of Energy's advanced vehicle testing. Battelle Energy Alliance, LLC contracted with Intertek Testing Services, North America (Intertek) to conduct several U.S. Department of Defense-based studies to identify potential U.S. Department of Defense transportation systems that are strong candidates for introduction or expansion of plug-in electric vehicles (PEVs).

Task 1 consisted of a survey of the non-tactical fleet of vehicles at Marine Corps Base Camp Lejeune to begin the review of vehicle mission assignments and types of vehicles in service. Task 2 involved identifying daily operational characteristics of select vehicles and initiating data logging of vehicle movements in order to characterize the vehicle's mission. Individual observations of these selected vehicles provided the basis for recommendations related to PEV adoption and whether a battery electric vehicle or plug-in hybrid electric vehicle (collectively referred to as PEVs) can fulfill the mission requirements and provide observations related to placement of PEV charging infrastructure.

This report provides the results of the data analysis and observations related to replacement of current vehicles with PEVs. This fulfills part of the Task 3 requirements. Task 3 also includes an assessment of the charging infrastructure required to support this replacement, which is the subject of a separate report.

Intertek acknowledges the support of Idaho National Laboratory, Marine Corps headquarters, and Marine Corps Base Camp Lejeune Fleet management and personnel for participation in this study.



## EXECUTIVE SUMMARY

Federal agencies are mandated<sup>a</sup> to purchase alternative fuel vehicles, increase consumption of alternative fuels, and reduce petroleum consumption. Available plug-in electric vehicles (PEVs) provide an attractive option in the selection of alternative fuel vehicles. PEVs, which consist of both battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs), have significant advantages over internal combustion engine (ICE) vehicles in terms of energy efficiency, reduced petroleum consumption, and reduced production of greenhouse gas (GHG) emissions, and performance benefits with quieter, smoother operation. This study intended to evaluate the extent to which Marine Corps Base Camp Lejeune (MCBCL) could convert part or all of their fleet of vehicles from petroleum-fueled vehicles to PEVs.

It is likely that more fuel-efficient ICE vehicles, including hybrid electric vehicles, exist that may provide improvements for the current fleet; however, this study's focus is on replacing ICE vehicles with suitable PEVs.

BEVs provide the greatest benefit when it comes to fuel and emissions savings because all motive power is provided by the energy stored in the onboard battery pack. These vehicles use no petroleum and emit no pollutants at their point of use. PHEVs provide similar savings when their battery provides motive power, but they also have the ability to extend their operating range with an onboard ICE. Because a PHEV can meet all transportation range needs, the adoption of a PHEV will be dependent on its ability to meet other transportation needs such as cargo or passenger carrying. Operation of PHEVs in battery-only mode can be increased with opportunity charging at available charging stations; however, it should be noted that not all PHEVs have a mode in which the battery provides all motive power at all speeds. This study focuses on the mission requirements of the fleet of vehicles with the objective of identifying vehicles that may be replaced with PEVs, with emphasis on BEVs that provide maximum benefit.

MCBCL borders on the Atlantic Ocean near Jacksonville, North Carolina. The base and surrounding community is home to an active duty, dependent, retiree, and civilian employee population of approximately 170,000 people. Camp Lejeune contains 156,000 acres and 11 miles of beaches.<sup>b</sup>

The geographic size of MCBCL and close proximity to other related facilities in the area create significant opportunities for conversion of some vehicles to PEVs. MCBCL identified 862 vehicles in its fleet of which 784 were selected to be part of this study. From these selected vehicles, 60 vehicles that are representative of the full fleet were selected for closer monitoring. Fleet vehicle mission categories are defined in Section 4 of this report and, while the MCBCL vehicles conduct many different missions, four (i.e., pool, support, enforcement, and specialty missions) were selected to be part of this fleet evaluation. The selected vehicles included many vehicle types.

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<sup>a</sup> Energy Policy act of 1992, Energy Policy Act of 2005, Executive Order 13423, and Energy Independence and Security Act of 2007.

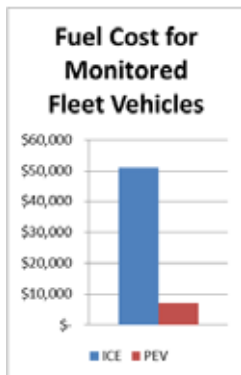
<sup>b</sup> [www.lejeune.marines.mil/About.aspx](http://www.lejeune.marines.mil/About.aspx) accessed January 22, 2015.

The Motor Transport Division manages the non-tactical fleet of vehicles on MCBCL. For purposes of this study, vehicles are identified as assigned to Marine Corps Installations East (MCIE) departments and divisions or to tenant commands (Commands). The Commands group operates 266 vehicles and MCIE operates the remaining 596 vehicles, which includes all pool vehicles. Of the vehicles in the study group, the Commands group operates 249 vehicles and MCIE operates 535 vehicles.

This report actually provides three reports: one for the Commands group, one for the MCIE group, and an overall report. It observes that a mix of BEVs and PHEVs are capable of performing most of the required missions and of providing an alternative vehicle for the pool, support, and enforcement vehicles. Because some vehicles travel long distances, the group could support some BEVs for the short trips and PHEVs for the longer trips. The specialty heavy-duty trucks where potential replacement PEVs have been demonstrated were also considered. The recommended mix of vehicles will provide sufficient range for individual trips and time is available each day for charging to accommodate multiple trips per day. Replacement of vehicles in the current fleet could result in significant reductions in the emissions of GHGs and in petroleum use, as well as reduced fleet operating costs.

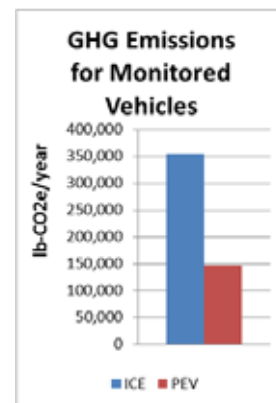
PEVs currently commercially available cannot replace certain vehicles and missions (such as those requiring heavy-duty trucks and certain specialty usage vehicles). However, based on data collected for the monitored vehicles, the 60-vehicle fleet subset could possibly consist of one conventional heavy-duty

specialty truck, 25 BEVs, and 34 PHEVs. Greater emphasis on BEVs may be possible as more BEVs of different types become commercially available.



Duke Energy Progress provides electric power for MCBCL and its generation mix provides lower electrical costs and lower generation of GHG emissions than the national averages. Replacement of the 59 ICE vehicles with PEVs potentially results in an annual fuel savings of over \$43,000 (i.e., 86% reduction) and GHG savings of over 200,000 lb-CO<sub>2</sub>e (i.e., 58% reduction).

The monitored vehicles represent 59 of the 784 on-road-rated vehicles in these represented fleets. Assuming that the balance of the fleet operates in a manner similar to those monitored and without consideration of specific cargo or other mission requirements not previously identified, Intertek suggests that the total fleet composition could consist of 53 conventional heavy-duty specialty trucks, 418 BEVs, and 313 PHEVs. This replacement of ICE vehicles with PEVs could result in an annual fuel savings of over \$645,000 (i.e., 87% reduction) and annual GHG savings of over 3,140,000 lb-CO<sub>2</sub>e (i.e., 61% reduction).



The average monitored vehicle travelled approximately 8,000 miles per year. This is an average of 667 miles per month or 154 miles per week. This may

reflect the opportunity to increase the percentage of BEVs over that analyzed in Section 5. Intertek suggests MCBCL may wish to move forward in the near future with replacement of pool, support, and enforcement vehicles with PEVs as current budget and vehicle replacement schedules allow. Certainly, the vehicle types studied in this report may be candidates for immediate replacement.

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## ACRONYMS

AC	alternating current
BEV	battery electric vehicle
CD	charge depletion
CS	charge sustaining
DC	direct current
EPA	U.S. Environmental Protection Agency
EVSE	electric vehicle supply equipment
GHG	greenhouse gas emissions
GSA	General Services Administration
ICE	internal combustion engine
Intertek	Intertek Testing Services, North America
MCBCL	Marine Corps Base Camp Lejeune
MCIE	Marine Corps Installations East
OEM	original equipment manufacturer
PEV	plug-in electric vehicle (includes BEVs and PHEVs, but not hybrid electric vehicles)
PHEV	plug-in hybrid electric vehicle
SAE	Society of Automotive Engineers
SUV	sports utility vehicle



# Utilization Assessment of Target Electrification Vehicles at Marine Corps Base Camp Lejeune: Task 3

## 1. INTRODUCTION

The U.S. Department of Energy and the U.S. Department of Defense signed a memorandum of understanding on July 22, 2010, for strengthening the coordination of efforts to enhance national energy security and to demonstrate federal government leadership in transitioning the United States to a low-carbon economy. The memorandum of understanding included efforts in the areas of energy efficiency, fossil fuels, alternative fuels, efficient transportation technologies and fueling infrastructure, grid security, smart grid, and energy storage.

In support of the memorandum of understanding, the Idaho National Laboratory, with funding provided by the U.S. Department of Energy's Vehicle Technologies Office and Federal Energy Management Program, directed Intertek Testing Services, North America (Intertek) to conduct several U.S. Department of Defense-based studies to identify potential transportation systems that are strong candidates for introduction or expansion of plug-in electric vehicles (PEVs). Intertek previously has conducted similar fleet, city, state, and countrywide studies using their micro-climate assessment process, which consists of the following four main tasks:

- Task 1: Conduct a non-tactical fleet and infrastructure assessment
- Task 2: Select vehicles for mission and fleet characterizations
- Task 3: Perform detailed assessment of selected vehicles and charging infrastructure needs
- Task 4: Prepare adoption approach for PEV and charging infrastructure.

Assessment of the potential for replacing Marine Corps Base Camp Lejeune (MCBCL) fleet vehicles with PEVs starts with assessment of the fleet vehicles' missions and vehicle characteristics. This assessment was conducted through a thorough review of fleet records and discussions with MCBCL personnel. The Task 1 report titled, *Assessment of Fleet Inventory for Marine Corps Base Camp Lejeune*, dated January 2015, provided a summary and fleet assessment.

PEVs generally are classified into two vehicle types: battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs). A BEV contains an onboard battery that provides all motive power. PHEVs also have an onboard battery that provides some motive power, but this is supplemented by another power source (such as a gasoline engine). Collectively, BEVs and PHEVs are referred to as PEVs.

The Task 1 effort led to identification of fleet vehicles that appear to be good candidates for replacement by PEVs. The Task 2 report titled, *Identification of Vehicles for Installation of Data Loggers for Marine Corps Base Camp Lejeune*, dated February 2015, identified the 60 vehicles within the candidate groups for further monitoring and analysis through addition of vehicle data loggers. These data loggers were installed and data were collected on the selected vehicles. This Task 3 report provides a summary and details of that data collection effort. Assessment of the charging infrastructure is the subject of a separate report.

## 2. METHODS

### 2.1 Fleet Vehicle Survey

MCBCL and Intertek identified 60 vehicles for further study, as identified in the Task 2 report. This subset of vehicles contains four sedans, five minivans, nine sports utility vehicles (SUV), 28 pickup trucks, four cargo vans, eight passenger vans, and two specialty vehicles. This distribution is

approximately representative of the entire non-tactical fleet. Figure 1 shows vehicle type distribution for all vehicles for comparison.

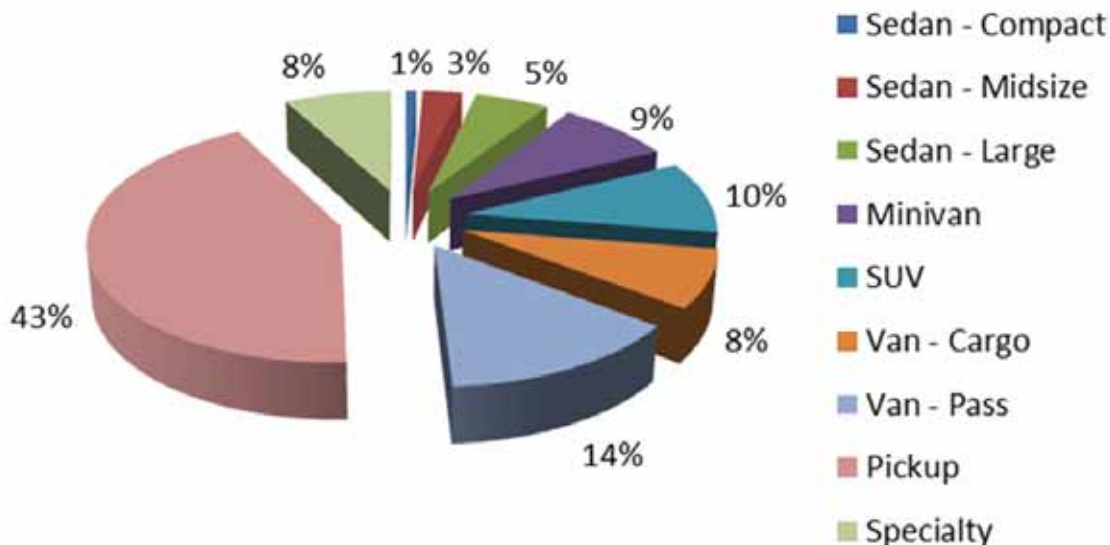


Figure 1. Vehicle type distribution for all vehicles.

Figures 2 through 6 present comparisons of model year, cumulative distance driven, and monthly distance driven of the vehicles monitored to the full fleet. The figures show that the selected vehicles are representative of a wide range of vehicle and mission types.

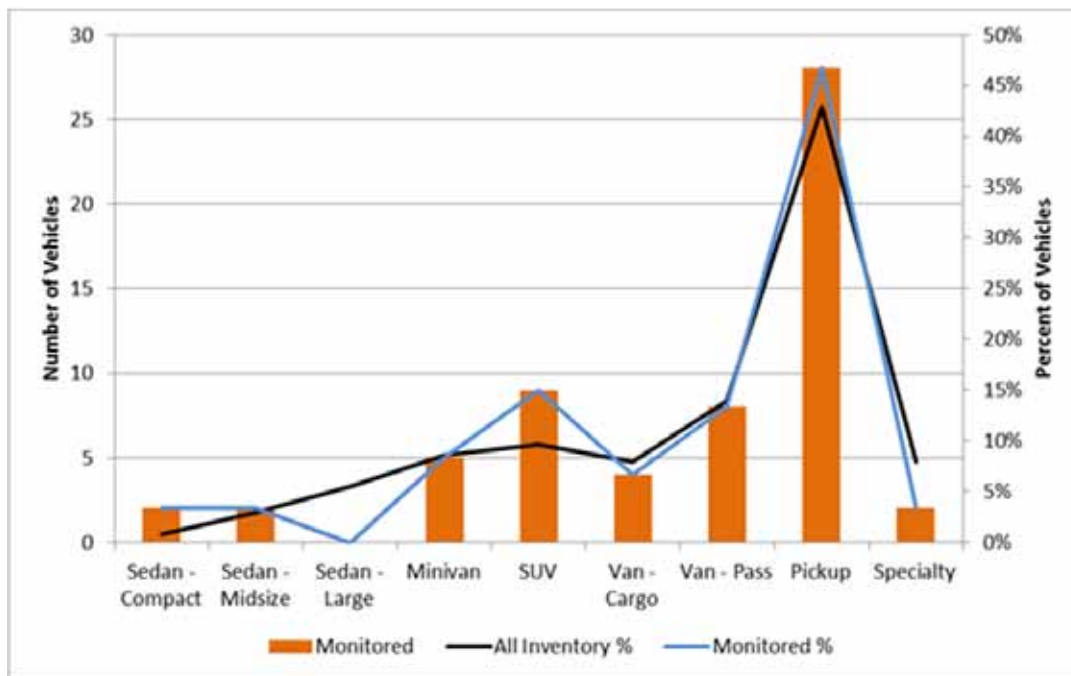


Figure 2. Vehicle types for vehicles with data loggers.

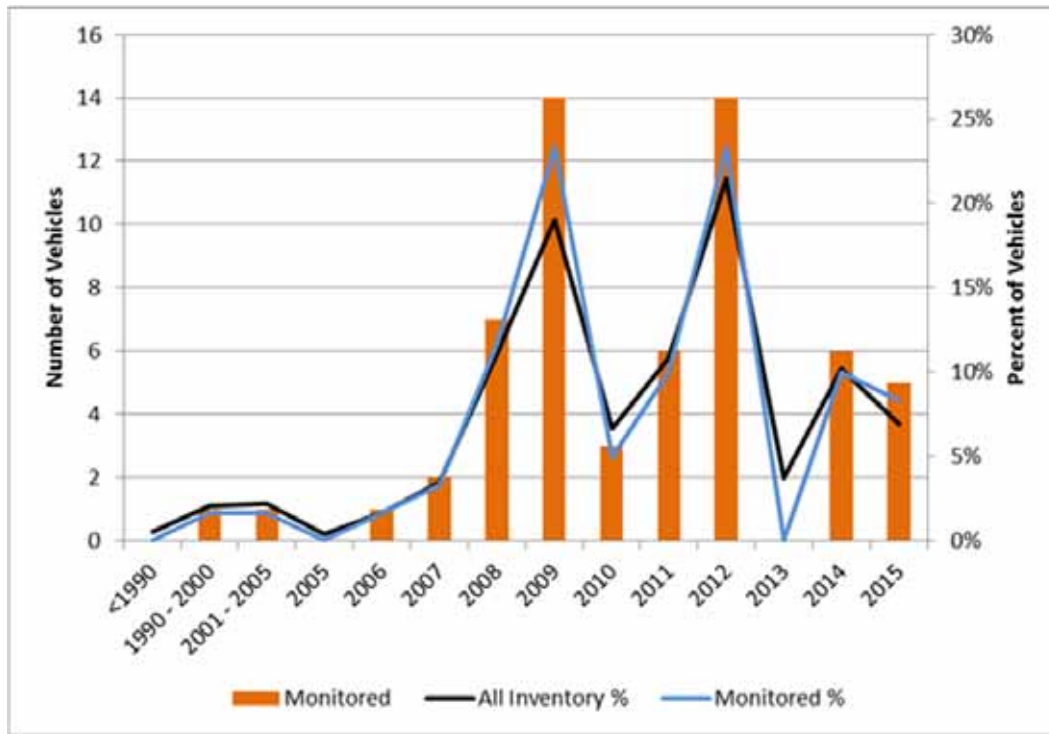


Figure 3. Model year for vehicles with data loggers.

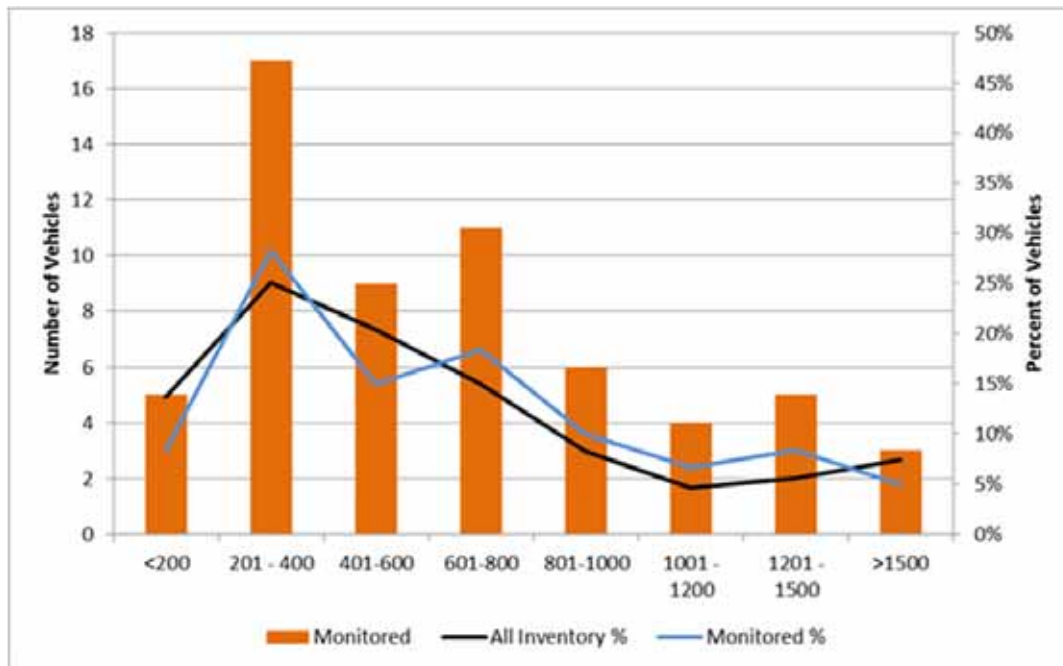


Figure 4. Monthly mileage for vehicles with data loggers.

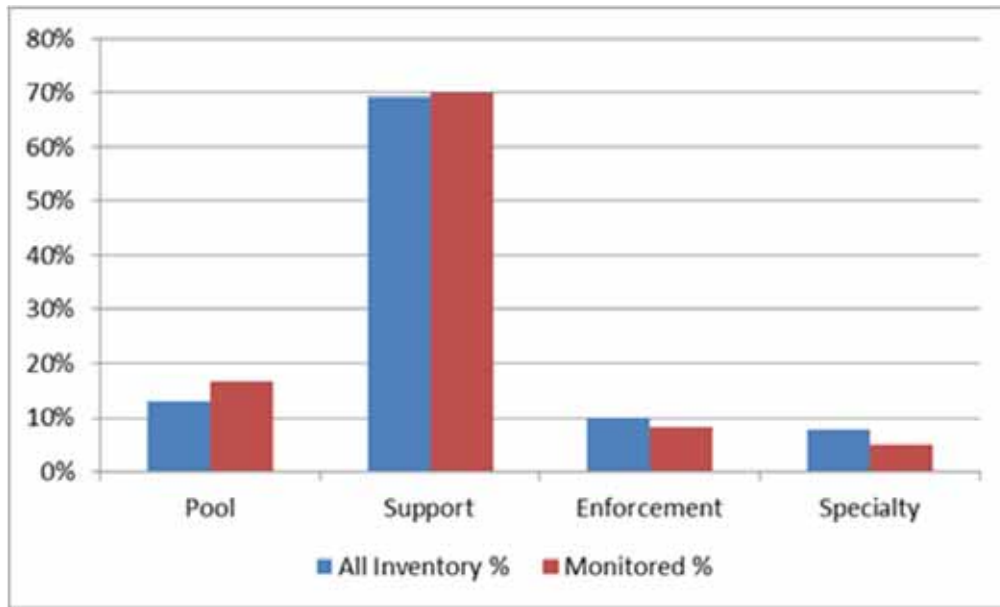


Figure 5. Vehicle mission for vehicles with data loggers.

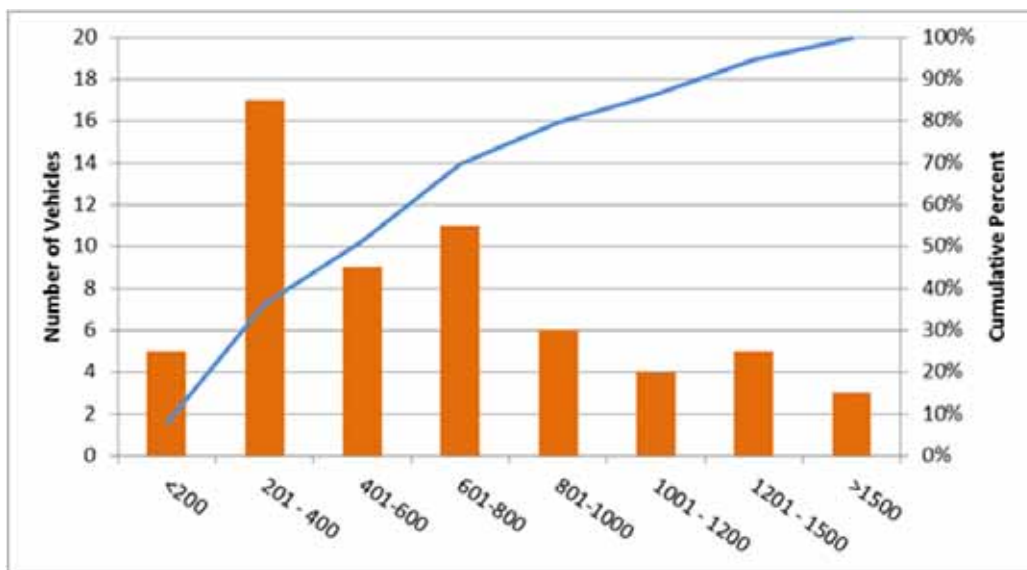


Figure 6. Distribution of monthly distance driven for vehicles with data loggers.

If one assumes a battery range of 70 miles for a BEV and 21 working days per month, then a vehicle that consistently travels the same distance each day would have to travel greater than approximately 1,500 miles per month to exceed the battery capacity. Fully 95% of the monitored vehicles average less than 1,500 miles per month in travel. This is the same percentage as the entire fleet inventory. Therefore, barring charging constraints associated with the timing of daily mission activities, payload requirements, and range issues associated with off-base trips, a significant number of vehicles should be eligible for replacement by BEVs.

MCBCL identified 784 fleet vehicles in its non-tactical, on-road fleet to be included in the study. Table 1 compares the monitored vehicles to the full fleet by mission type. (Note that Section 3 provides descriptions of the vehicle mission types.)

Table 1. Fleet evaluation.

Vehicle Mission	Study Vehicles	Total Fleet Reported	Percentage Studied
Pool Vehicles	10	98	10.2%
Support Vehicles	43	548	7.8%
Enforcement Vehicles	5	78	6.4%
Specialty Vehicles	2	60	3.3%
Total Fleet Vehicles	60	784	7.7%

Intertek coordinated with the MCBCL fleet management to identify the specific vehicles for inclusion in the study. The vehicle selections represent high-interest vehicles based on vehicle missions and vehicle type/class. Selection also favored a typical cross section of the full fleet. Because data loggers rely on the vehicle's battery power, non-use of the vehicle can result in the vehicle having a depleted battery. Intertek received no reports of depleted batteries during the study at MCBCL.

## 2.2 Data Collection

Individual privacy concerns existed when monitoring vehicle movement with data loggers. Data collection occurred through vehicle identification as identified by Intertek, data logger number, and agency-assigned vehicle number. Intertek received no information related to the vehicle operator and provided no raw data to the fleet managers. In this manner, Intertek did not collect, analyze, or report on individual driving habits.

### 2.2.1 Data Logger

Non-intrusive data loggers produced by InTouchMVC<sup>3</sup> and depicted in Figure 7 were installed onto the vehicle's onboard diagnostic port to collect and transmit relevant data. Installation of the data logger and manual recording of information about the vehicle that tied the logger and vehicle together in the data typically took less than 5 minutes. Once installed and activated (during vehicle use), the data loggers transmitted vehicle information every minute during vehicle operation by cellular communication to the data center.



Figure 7. InTouchMVC data logger.<sup>4</sup>

Intertek maintained the data logger's connectivity and verified data transmission weekly. Missing data (reported as "null" values) were frequently the result of lost global positioning system reception, logger device removal, or extended periods in regions with insufficient cellular reception. Intertek filtered

<sup>3</sup> [www.intouchmvc.com](http://www.intouchmvc.com) [accessed July 30, 2014].

<sup>4</sup> *ibid.*

the vehicle and data logger information if these null values presented a significant impact on the data collected and no resolution was possible. This report also identified the statistics on this validation process.

MCBCL requested and installed 60 data loggers into their fleet. MCBCL removed and shipped the data loggers to Intertek at the conclusion of the data collection period.

### 2.2.2 Data Captured

Data consisted of key-on events, key-off events, and position updates logged every minute while the vehicle was keyed-on. InTouchMVC fleet reporting converted these data points into records of trip events, stop events, and idle events.

From these data points, the following information was available for evaluation:

- Trip start and stop time and location
- Trip distance and duration
- Idle start time, location, and duration
- Stop start time, location, and duration.

## 2.3 Data Analysis

### 2.3.1 Definitions

Figure 8 illustrates a vehicle outing, which is comprised of trips, stops, and idle events, that may occur over one day or several days. The following list provides a definition of these terms:

1. **Outing:** An outing is the combination of trips and stops that begin at the home base and includes all travel until the vehicle returns home.
2. **Trip:** A trip begins with a key-on event and ends with the next key-off event.
3. **Vehicle stop:** A vehicle stop includes a key-off/key-on event pair.
4. **Idle time:** Idle time is the amount of time a vehicle spends stationary after a key-on event when the vehicle is not moving for a period of 3 minutes or longer.
5. **Trip travel time:** Trip travel time is the amount of time required to complete a trip, excluding stops but including idle time.

Definitions of additional analysis and survey terms are as follows:

1. **Operating shift:** Fleet manager-defined period worked
2. **Study days:** Days during which the data loggers are connected
3. **Vehicle days:** Study days during which a vehicle is used
4. **Null values:** Data record unusable for analysis for various reasons.

### 2.3.2 Data Evaluation

Processing the data involved removal of null values and aggregation by different spatial and temporal scales. Aggregation was by day, by trip, and by outing to produce figures showing the patterns of use. Aggregation by vehicle mission followed to characterize use for the agency fleet. Section 4 presents these results. Data were extrapolated to provide overall fleet usage and benefit analysis when fleet information was provided. Section 5 presents these benefits. Intertek observations are included in Section 6.

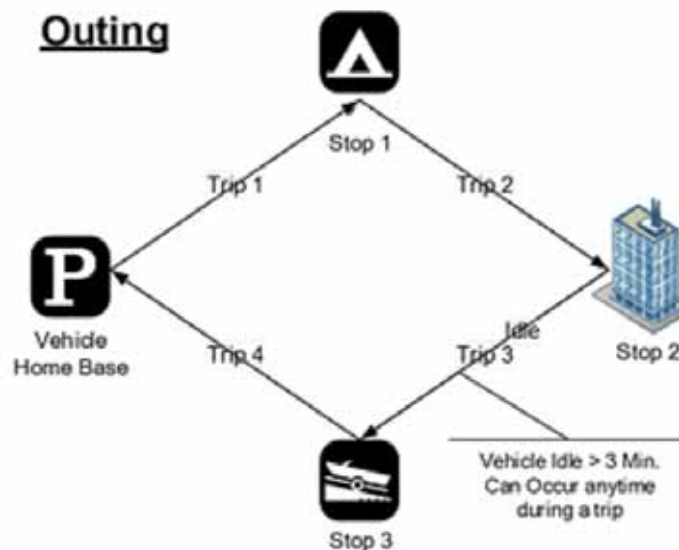


Figure 8. Example vehicle outing.

Statistical data analysis used Microsoft® Excel and Tableau® software. Frequency distributions summarized the travel behavior of each vehicle and vehicle mission during the study period. Rounding of the tables and figures were to three significant digits.

### 3. VEHICLES

#### 3.1 Vehicle Missions

Vehicle mission was an important characteristic in the fleet study. Information used to define the vehicle mission included the vehicle's configuration, vehicle use, classification per 40 CFR Part 600.315-82 and the U.S. Environmental Protection Agency (EPA), the participating agency use, and generally understood vehicle uses. Based on fleet information gathered, Intertek established the following seven mission/vehicle categories for analysis, which are depicted in Figure 9:

1. **Pool vehicles:** A pool vehicle is any automobile (other than the low-speed vehicles identified below) manufactured primarily for use in passenger transportation, with not more than 10 passengers.
2. **Enforcement vehicles:** Vehicles specifically approved in an agency's appropriation act for use in apprehension, surveillance, police, or other law enforcement work. This category also includes site security vehicles, parking enforcement, and general use, but the vehicles are capable of requirements to support enforcement activities. Appendix A provides further definition.
3. **Support vehicles:** Vehicles assigned to a specific work function or group to support the mission of that group. Vehicles are generally passenger vehicles or light-duty pickup trucks and may contain after-market modifications to support the mission.
5. **Transport vehicles:** Light, medium, or heavy-duty trucks used to transport an operator and tools or equipment of a non-specific design or nature. The vehicle's uses include repair, maintenance, or delivery.
6. **Specialty vehicles:** Vehicles designed to accommodate a specific purpose or mission (such as ambulances, mobile cranes, and handicap access assistance).
7. **Shuttles/buses:** Vehicles designed to carry more than 12 passengers and further outlined in 49 CFR 532.2.

8. **Low-speed vehicles:** Vehicles that are legally limited to roads with posted speed limits up to 35 or 45 mph (depending on state law) and that have a limited load-carrying capability.



Figure 9. Vehicle missions.

### 3.2 Alternative Fuel Vehicles

As the operating agency, MCBCL has a unique opportunity to plan for adoption of BEVs and PHEVs, along with planning for supporting infrastructure. The adoption of PHEVs and BEVs is a primary goal of General Services Administration (GSA) and supports many directives in this area.

As GSA increases its certification of PHEVs and BEVs, agencies can plan for vehicle replacement through the GSA for passenger vehicles and trucks. Table 2 presents the replacement requirements for fleet vehicles. Note that both the age and mileage requirements need to be met in order for the vehicle to qualify for replacement, except where noted as “or.”

Table 2. GSA vehicle replacement requirements.

GSA Vehicle Replacement Requirements <sup>5</sup>			
	Fuel Type	Years	Miles
Passenger vehicles	Gasoline or alternative fuel vehicle	3	36,000
		4	24,000
		5	Any mileage
		Any age	75,000
	Hybrid	5	Any mileage
	Low-speed BEV	6	Any mileage
Light trucks 4 x 2	Non-diesel	7 or	65,000
	Diesel	8 or	150,000
	Hybrid	7	Any mileage

<sup>5</sup> <http://www.gsa.gov/graphics/fas/VehicleReplacementStandardsJune2011Redux.pdf> [accessed January 10, 2014].



GSA Vehicle Replacement Requirements <sup>5</sup>			
	Fuel Type	Years	Miles
Light trucks 4 x 4	Non-diesel	7 or	60,000
	Diesel	8 or	150,000
	Hybrid	7	Any mileage
Medium trucks	Non-diesel	10 or	100,000
	Diesel	10 or	150,000
Heavy Trucks	Non-diesel	12 or	100,000
	Diesel	12 or	250,000

### 3.3 Battery Electric Vehicle and Plug-In Hybrid Electric Vehicle Benefits/Challenges

BEVs are powered completely by the battery energy storage system onboard the vehicle. The Nissan Leaf is an example of a BEV. Because the BEV has no other energy source for propulsion, the range, power requirements, and mission of the needed vehicle factor greatly in purchasing decisions. Maximizing BEV capabilities typically requires batteries more than an order of magnitude larger than the batteries in hybrid electric vehicles.

PHEVs obtain their power from two energy sources. The typical PHEV configuration uses a battery and an ICE and is powered by either gasoline or diesel. PHEV designs differ between manufacturers. All PHEVs have a charge-depleting (CD) mode, where the battery discharges its stored energy to propel the vehicle, and a charge-sustaining (CS) mode (or extended-range mode) that is entered after CD mode is complete, where the battery and ICE work together to provide propulsion and the state of charge of the battery is maintained between set limits. Some CD modes are purely electric, while other vehicle designers employ the engine to supplement the battery power during the initial battery depletion to a set state of charge (usually below 50%).

#### 3.3.1 Battery Electric Vehicle Benefits/Challenges

EPA identifies the following benefits and challenges of BEVs:<sup>6</sup>

- **Energy efficient:** Electric vehicles convert about 59 to 62% of electrical energy from the grid to power at the wheels, whereas conventional gasoline vehicles only convert about 17 to 21% of the energy stored in gasoline to power at the wheels.
- **Environmentally friendly:** PEVs emit no tailpipe pollutants, although the power plant producing the electricity may emit them. Electricity from nuclear, hydro, solar, or wind-powered plants causes no air pollutants.
- **Performance benefits:** Electric motors provide quiet, smooth operation and exhibit maximum torque at zero and low speeds, while also requiring less maintenance than ICEs.
- **Reduce energy dependence:** Electricity is a domestic energy source.

EPA also identifies challenges associated with BEVs, including the following:

- **Driving range:** Most BEVs can only travel about 100 to 200 miles (or less) before recharging, whereas gasoline vehicles can often travel over 300 miles before refueling and some much further.
- **Recharge time:** Fully recharging the battery pack can take 4 to 8 hours. Even a “fast charge” to 80% capacity can take 30 minutes.

<sup>6</sup><http://www.fueleconomy.gov/feg/evtech.shtml> [accessed December 27, 2013].

- **Battery cost:** The large battery packs are expensive and may need to be replaced one or more times.
- **Bulk and weight:** Battery packs are heavy and take up considerable vehicle space.

### 3.3.2 Plug-In Hybrid Electric Vehicle Benefits/Challenges

EPA identifies the following benefits and challenges of PHEVs:<sup>7</sup>

- **Less petroleum use:** PHEVs are expected to use about 40 to 60% less petroleum than conventional vehicles. Because electricity is produced primarily from domestic resources, PHEVs reduce dependence on oil.
- **Fewer GHG emissions:** PHEVs are expected to emit fewer GHG emissions than conventional vehicles, but, as with BEVs, the difference depends largely on the type of power plant supplying the electricity.
- **Higher vehicle costs, lower fuel costs:** PHEVs will likely cost \$1,000 to \$7,000 more than comparable non-PHEVs. Fuel will cost less because electricity is much cheaper than gasoline, but the fuel savings depends on how much of the driving is done with off-board electrical energy.
- **Recharging takes time:** Recharging the battery typically takes several hours. However, PHEVs do not have to be plugged in to be driven. They can be fueled solely with gasoline, but will not achieve maximum range, fuel economy, or fuel savings without charging.
- **Measuring fuel economy:** Because a PHEV can operate on electricity alone, gasoline alone, or a mixture of the two, EPA provides a fuel economy estimate for gasoline-only operation (CS mode), electric-only operation (all-electric CD mode), or combined gasoline and electric operation (blended CD mode).

In most cases, the PEV's retail cost is higher than a non-PEV model. This incremental purchase cost may be a fleet budget challenge; however, many original equipment manufacturers (OEMs) have offered incentives to encourage the use and adoption of BEVs and PHEVs. Some OEMs have recently reduced the vehicle cost, while also increasing vehicle range. Additionally, federal and state incentives have increased the attractiveness of purchasing a PEV. A common assumption is that increasing PEV sales will result in a reduction in this incremental purchase cost and a positive feedback loop will ensue.

## 3.4 Plug-In Electric Vehicle Availability

GSA provides a summary of the light and medium-duty passenger vehicles that are available for lease or purchase through the GSA portal,<sup>8</sup> although not all BEVs and PHEVs currently on the market are 'certified' to be GSA replacements. Vehicles not on the GSA list of 'certified' vehicles require an agency to self-certify a functional need or alternative measures for exemptions. Tables 3 and 4 summarize the vehicles that may be suitable replacements and are certified replacements through GSA. Note that the "CD/CS" column provides the EPA fuel economy values for CD and CS modes. The fuel economy of CD mode is provided in units of miles-per-gallon-of-gasoline-equivalent (MPGe). This metric allows for electricity consumption during CD mode to be compared with fuel consumption during CS mode (or against conventional vehicles). The Nissan Leaf and Mitsubishi i-MiEV are not included in the alternative fuel guide for 2015, but they have appeared in previous guides.

Replacement is dependent on vehicle configuration characteristics and vehicle mission. Further evaluation related to vehicle purpose, mission, and need should be completed.

<sup>7</sup> <http://www.fueleconomy.gov/feg/phevtech.shtml> [accessed July 19, 2013].

<sup>8</sup> <http://www.gsa.gov/portal/content/104211> [accessed August 1, 2014].

Table 3. GSA-certified PHEVs for 2014.

Make/Model	GSA Class	Type	CD/CS	GSA Incremental Price
Chevrolet Volt*	Sedan, Subcompact	PHEV	98 MPGe/37 mpg	\$17,692.17
Ford C-MAX Energi	Sedan, Subcompact	PHEV	88/38 mpg	\$14,062.23
Ford Fusion Energi	Sedan, Compact	PHEV	88/38 mpg	\$13,640.05

\* The Chevrolet Volt has an all-electric CD mode rated for 38 miles. The Ford vehicles have blended CD modes rated for 20 miles.

Table 4. GSA-certified BEVs.

Make/Model	GSA Class	Type	City/Highway	GSA Incremental Price
Ford Focus Electric	Sedan, Subcompact	BEV	110/99 MPGe	\$11,351.15
Smart Fortwo ED	Sedan, Microcompact	BEV	123/93 MPGe	\$7,277.05

OEMs provide information related to a vehicle's range in CD mode and EPA provides test results. However, actual results may vary depending on several factors other than travel that may also deplete a vehicle's battery. These factors include changes in the battery's capacity over time, area topography, weather conditions (e.g., cabin cooling/heating), and payload. This report will identify a BEV's "safe range" as 70 miles because this is typically less than the advertised range of most BEV OEMs. PHEV's advertised ranges vary from 6 miles to 72 miles. The average range of PHEVs currently available is about 33 miles. This report will identify the PHEV safe range in CD mode as 30 miles.

Tables 5 through 8 provide summaries of PHEVs and BEVs either currently available or near commercialization in both passenger cars and pickup trucks, but that do not appear on the GSA 'certified' vehicle list. These vehicles may qualify for use by the agency through demonstrating a functional need.

Note that EPA differs in vehicle class. EPA identifies the Volt as a compact, the C-MAX Energi as a midsize, the Fusion Energi as a midsize, and the Focus as a compact.<sup>9</sup>

Table 5. OEM PHEV cars and availability.

Make	EPA Class	Model	Initial Model Year/Estimated Year for Commercialization
Chevrolet	Compact	Volt	2011
Ford	Midsize	C-MAX Energi	2013
Ford	Midsize	Fusion Energi	2013
Toyota	Midsize	Prius PHEV	2012
Honda	Midsize	Accord PHEV*	2014
Cadillac	Subcompact	ELR	2014
Porsche	Large	Panamera S E-Hybrid	2014
BMW	Subcompact	i3 REx	2014
BMW	Subcompact	i8	2014
Hyundai	Midsize	Sonata PHEV	2015 (estimate)
Audi	Compact	A3 e-tron	2016 (estimate)
Mercedes	Subcompact	C350 PHEV	2016 (estimate)
Mercedes	Large	S550 PHEV	2016 (estimate)

\* Honda did not release an MY2015 Accord PHEV; the return of this vehicle model is uncertain.

<sup>9</sup> <http://www.fueleconomy.gov/feg/Find.do?action=sbs&id=34130> [accessed August 1, 2014].

Table 6. OEM BEV cars and availability.

Make	EPA Class	Model	Initial Model Year/Estimated Year for Commercialization
Nissan	Midsize	Leaf	2011
Ford	Compact	Focus Electric	2012
Tesla	Large	Model S	2012
Mitsubishi	Subcompact	i-MiEV*	2012
Fiat	Mini	500e	2013
Honda	Small Station Wagon	Fit EV	2013
smart	Two Seater	Fortwo ED	2013
BMW	Subcompact	i3	2014
Chevrolet	Subcompact	Spark EV	2014
Kia	Small Station Wagon	Soul EV	2014
Volkswagen	Compact	e-Golf	2015
Mercedes-Benz	Midsize	B-Class Electric Drive	2015

\* Mitsubishi did not manufacture an MY15 i-MiEV; the vehicle returned in the 2016 MY.

Table 7. OEM PHEV trucks, vans, and availability.

Make	EPA Class	Model	Initial Model Year/Estimated Year for Commercialization
Via	Standard Pickup Truck	VTRUX VR300	2013
Via	Special Purpose Vehicle	VTRUX Cargo Van	2013
Via	Vans, Cargo Type	VTRUX Pass Van	2013
Mitsubishi	Small SUV	Outlander PHEV	2016 (estimate)

Table 8. OEM BEV trucks, vans, and availability.

Make	EPA Class	Model	Initial Model Year/Estimated Year for Commercialization
Tesla	Standard SUV	Model X	2015 (estimate)
Nissan	Van	e-NV200	2016 (estimate)

As further indication of the expanding market for PEVs, companies are offering after-market vehicle upgrades involving the addition of plug-in capabilities to OEM vehicles. For example, Echo Automotive headquartered in Scottsdale, Arizona offers a "...low-cost, bolt-on, plug-in hybrid system that can quickly be installed on new or existing fleet vehicles to increase fuel efficiency and decrease operating costs – all without affecting the OEM power train or requiring costly infrastructure."<sup>10</sup> EVAOS conducts conversions of Ford F-series pickup trucks to PHEV models and has delivered vehicles to the U.S. Air Force.<sup>11</sup> Options such as this company's conversions might be of benefit to the passenger vans identified in the MCBCL fleet, but for which no replacement PEV is currently available.

<sup>10</sup> [http://www.echoautomotive.com/index.php?option=com\\_content&view=article&id=8](http://www.echoautomotive.com/index.php?option=com_content&view=article&id=8) [accessed July 14, 2014].

<sup>11</sup> <http://www.evaos.com> [accessed November 20, 2014].

### 3.5 Plug-In Electric Specialty Vehicles

Section 3 identifies specialty vehicles as those vehicles designed to accommodate a specific purpose or mission (such as ambulances, mobile cranes, and handicap access assistance). Many specialty vehicles involve heavy-duty truck frames with high power requirements. For MCBCL, specialty vehicles included fire trucks (e.g., ladder trucks and pumpers), rescue vehicles, tankers, mobile cranes, and bucket trucks. MCBCL specifically requested monitoring of some specialty vehicles; a bucket truck and a refrigeration truck were selected. The refrigeration truck recorded no usage during the study period.

Some specialty vehicle manufacturers and some offering after-market modifications provide battery-powered operation of the tools and accessories. For this study, only those specialty vehicles whose motive power is provided at least partly by electric drive are considered.

Recently, Pacific Gas and Electric Company displayed a new plug-in hybrid Class 5 Ford F-550 bucket truck.<sup>12</sup> This vehicle's hybrid system was designed and built by Efficient Drivetrains Inc. The 20,000-pound vehicle is reported to provide more than 35 miles of all-electric driving range at a highway speed of over 65 miles per hour and is capable of exporting 120 kW of AC power. For illustration, this specialty vehicle is included for analysis in Sections 4 and 5. Figure 10 shows specialty trucks converted to PHEVs by Efficient Drivetrains Inc.



Figure 10. Specialty vehicles with electric drive.<sup>13</sup>

### 3.6 Plug-In Electric Vehicle Charging

Refueling electric vehicles presents some challenges and some opportunities not encountered when refueling petroleum-fueled vehicles. Recharging the battery of a PHEV follows the same methodology as that for BEVs. This section provides basic information on recharging PEVs.

#### 3.6.1 Electric Vehicle Supply Equipment Design

**3.6.1.1 Charging Components.** Electric vehicle supply equipment (EVSE) stations deliver electric power from the utility to the applicable charge port on the vehicle. Figure 11 illustrates the primary components of a typical alternating current (AC) Level 2 EVSE.

The electric utility delivers AC current to the charging location. The conversion from AC to the direct current (DC) electricity necessary for battery charging can occur either on or off board the vehicle. Section 3.5.1.2 provides further explanation of the different EVSE configurations. For onboard conversion, AC current flows through the PEV inlet to the onboard charger. The charger converts AC to the DC current required to charge the battery. A connector attached to the EVSE inserts into a PEV inlet to establish an electrical connection to the PEV for charging and information/data exchange. Off-board

<sup>12</sup> *Powerful Plug-Ins*, Charged Electric Vehicle Magazine, March/April 2015, pp.60.

<sup>13</sup> [www.efficientpowertrains.com](http://www.efficientpowertrains.com) [accessed August 1, 2015].

conversion, also known as DC charging, proceeds in a similar manner except that the AC to DC conversion occurs in a charger that is off board the vehicle and, thus, bypasses any onboard charger. For both AC and DC charging, the PEV's battery management system on board the vehicle controls the battery rate of charge, among other functions. All current PEVs have an onboard charger; some BEVs (but no PHEVs currently available in the United States) accommodate DC charging.

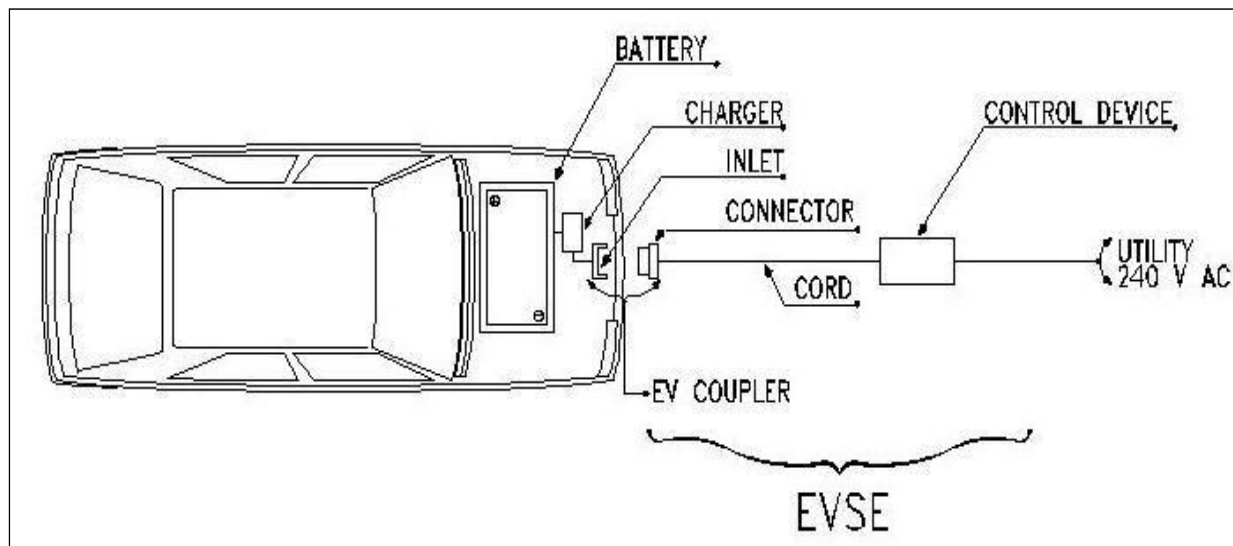


Figure 11. AC Level 2 charging diagram.<sup>14</sup>

**3.6.1.2 Charging Configurations and Ratings.** The Society of Automotive Engineers (SAE) standardized the requirements, configurations, and equipment followed by most PEV suppliers in the United States in the J1772<sup>TM</sup> Standard. Figure 112 summarizes these attributes and the estimated recharge times. Actual recharge times depend on the onboard equipment, including the charger, battery, and battery management system.

PEVs are typically sold with an AC Level 1 cordset included. This cordset is generally intended to be used when a 120-volt electrical outlet is available (and a slower charge rate is acceptable) or in emergencies when the vehicle is away from installed AC Level 2 EVSE. A typical cordset is shown in Figure 13.

AC recharging capabilities found in the public arena more typically are AC Level 2. Figure 14 depicts a typical J1772-compliant inlet and connector for both AC Levels 1 and 2.

The J1772 standard also identifies requirements for DC charging. For PEVs that accept both AC and DC inputs, the SAE approved a single connector and inlet design, known as the combined charging system. Figure 115 shows this connector, which is colloquially known as the J1772 “combo connector.”

Some BEVs delivered in the United States prior to the approval of the J1772 standard for DC charging employed the CHAdeMO (designed in Japan) standard for connector and inlet design. Figure 16 shows this connector. DC EVSE units that are either J1772-compliant or CHAdeMO-compliant are both known as DC fast chargers (DCFCs). Tesla Motors has installed proprietary EVSE units for their vehicles because these vehicles do not meet either DCFC standard; however, Tesla offers adapters for their vehicles that allow for charging at J1772 AC Level 2 and CHAdeMO EVSE.

<sup>14</sup><http://www.theevproject.com/downloads/documents/Electric%20Vehicle%20Charging%20Infrastructure%20Deployment%20Guidelines%20for%20the%20Greater%20Phoenix%20Area%20Ver%203.2.pdf> [accessed January 15, 2014].



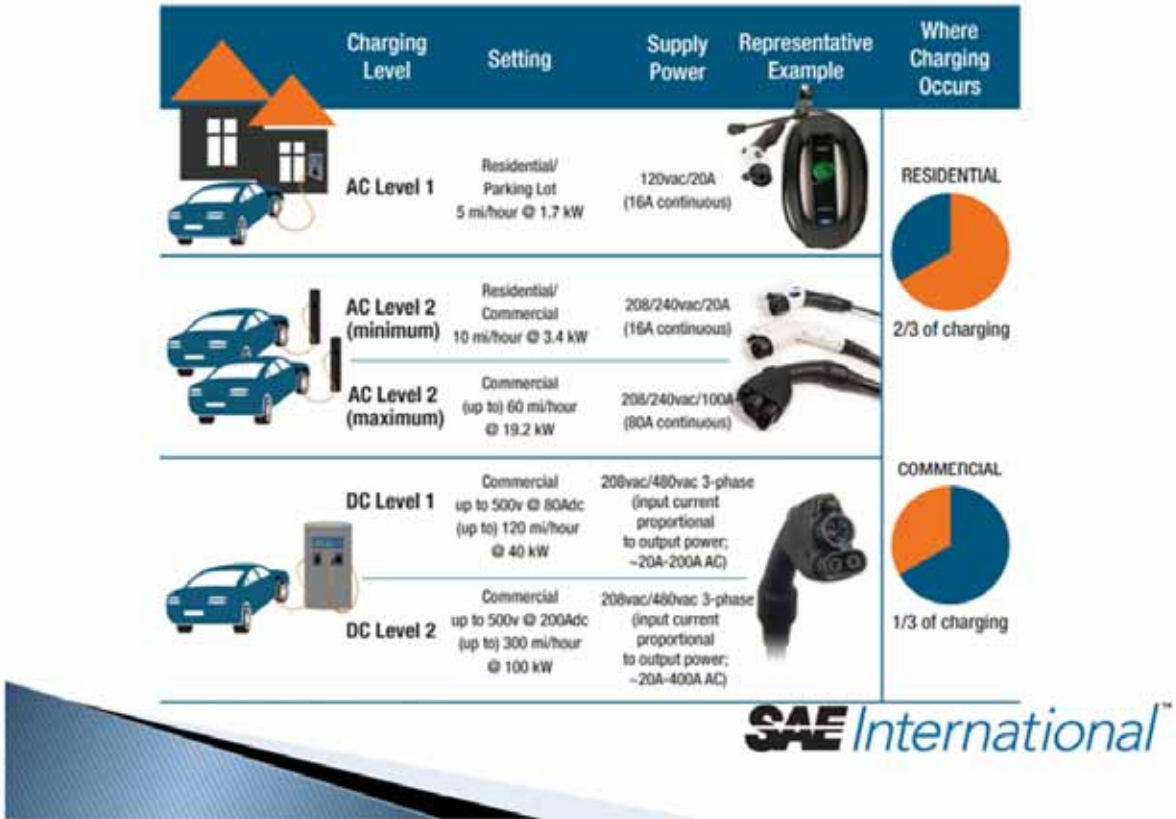


Figure 12. SAE charging configurations and ratings terminology.<sup>15</sup>



Figure 13. Chevrolet Volt AC Level 1 cordset.<sup>16</sup>

<sup>15</sup> [http://www.sae.org/events/gim/presentations/2013/pev\\_charging\\_standards\\_status.pdf](http://www.sae.org/events/gim/presentations/2013/pev_charging_standards_status.pdf) [accessed June 25, 2015].

<sup>16</sup> [www.pluginamerica.org](http://www.pluginamerica.org).



Figure 14. J1772 connector and inlet.<sup>17</sup>



Figure 15. J1772-compliant combo connector.<sup>18</sup>



Figure 16. CHAdeMO-compliant connector.<sup>19</sup>

<sup>17</sup> <http://carstations.com/types/j09> [accessed January 15, 2014].

<sup>18</sup> <http://www.zemotoring.com/news/2012/10/sae-standardizes-j1772-fast-dc-charging-up-to-100-kw> [accessed January 15, 2014].



The presence of three separate standards for DC charging presents challenges for vehicle owners to ensure the EVSE that is accessed provides the appropriate connector for their vehicle inlet. Not all PEV suppliers include DC charging options. BEV suppliers have provided DC inlets where PHEV suppliers have not, because the rapid recharging provides opportunities for expanded vehicle range with minimal operator wait times. PHEV operators can rely on the gasoline drive in the event they deplete the vehicle's battery (and for comparison to the energy transfer of the charge rate, the energy being added by the gasoline pump is about 10 MW). At present, no PHEV on the market or near commercialization has DC charging capability (although the upcoming Mitsubishi Outlander PHEV may offer DC charging capability as an option).

Because the battery of a BEV is typically much larger than that of a PHEV, recharge times are longer (see Figure 12). BEVs that see daily mileage near the limits of the advertised range do better when recharged using AC Level 2 EVSE or DCFC, because AC Level 1 recharge times are usually extensive. PHEVs, on the other hand, generally can use AC Level 1 EVSE for overnight charging to ensure a fully charged battery at the start of daily use. AC Level 2 EVSE units provide greater range in the shortest amount of time when intermediate or opportunity charging. DCFC provides the fastest recharge capability for those vehicles equipped with DCFC inlets.

### **3.6.2 Electric Vehicle Supply Equipment Stations**

AC Level 2 charging is the predominant rating of publicly accessible EVSE because of its wide acceptance by auto manufacturers and faster recharge times than AC Level 1. Purchase and installation costs are more manageable than DCFCs and less space is required. There are several manufacturers of AC Level 2 equipment and the agency should review brands for comparison purposes. Figure 17 provides an example of a public AC Level 2 EVSE unit.<sup>20</sup>



Figure 17. Public AC Level 2 unit.

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<sup>19</sup> <https://radio.azpm.org/p/azspot/2012/5/10/1632-electric-cars/> [accessed January 15, 2014].

<sup>20</sup> [http://www.chargepoint.com/files/73-001061-01-2\\_BR-CT4000-01.pdf](http://www.chargepoint.com/files/73-001061-01-2_BR-CT4000-01.pdf) [accessed March 7, 2015].

DCFCs also are available from several manufacturers. Figure 18 illustrates one such charger.<sup>21</sup> This particular unit uses the CHAdeMO connector standard.



Figure 18. Public DCFC unit.

In general, installation costs are higher for DCFC because of the higher voltage requirements and the inclusion of the AC to DC converter and other safety and design features. Costs for both types are highly dependent on site characteristics such as distance to the nearest power source, asphalt or concrete cutting and repair, conduit requirements, and payment systems, if any.

Payment and equipment control systems included by some suppliers provide the potential for use by privately owned vehicles for a fee, but allow agency fleet vehicle use without direct payment. These systems allow for accurate record keeping of vehicle charging requirements.

## **4. MARINE CORPS BASE CAMP LEJEUNE ANALYSIS**

Sixty vehicles belonging to the tenant commands (i.e., Commands) group and the Marine Corps Installations East (MCIE) group were included in the study at MCBCL. Analysis by user was conducted first and was followed by aggregating across all users and vehicles. The Commands and MCIE groups used the fleet vehicles for a variety of purposes. The Commands group includes II Marine Expeditionary Force, 2nd Marine Division, 2nd Marine Logistics Group, and the naval hospital to name a few. MCIE owns all real estate, hosts entry level and career-level formal schools, and provides support and training for tenant commands.

### **4.1 Analysis Results – Commands**

This section summarizes and aggregates data collection for the Commands group. The details of each vehicle monitored are included in Appendix B.

The Commands group operates 249 of the fleet vehicles, with 18 of those vehicles included as the monitored vehicles. Table 9 provides a summary of all vehicles in this fleet by mission type and vehicle type. The monitored vehicles included two minivans, three SUVs, six passenger vans, and seven pickup trucks. All of these monitored vehicles served the support mission category.

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<sup>21</sup> [http://evsolutions.avinc.com/products/public\\_charging/public\\_charging\\_b](http://evsolutions.avinc.com/products/public_charging/public_charging_b) [Accessed April 16, 2014].

Table 9. Commands total fleet summary.

	Sedan – Compact	Sedan – Midsize	Sedan – Large	Minivan	SUV	Van Cargo	Van Pass	Pickup	Specialty	Total
Support	1	7	5	30	20	12	66	108	—	249

#### 4.1.1 Commands Support Vehicles Evaluation

Grouping the vehicles by mission creates an aggregated view of mission requirements to provide observations related to PEV replacement. All vehicles assigned to the Commands are support vehicles.

Support vehicles provide a specific work function, facilitating the mission of a particular group. The vehicles are generally passenger or light-duty pickup trucks and may contain after-market modifications to support the mission. While assigned to maintenance and service areas, missions may vary depending on agency needs. Incorporation of BEVs and/or PHEVs into the support mission is a definite possibility. Support vehicles used for shorter trips or outings qualify for BEV or PHEV replacement, while other support vehicle activities that are associated with longer trips may require PHEV capabilities.

**4.1.1.1 Summary for Commands Support Vehicles.** Appendix B provides the vehicle data sheets for each of the support vehicles monitored and Appendix D provides the detailed analysis that is summarized in this section. Table 10 summarizes support travel during the study period for those days in which the vehicle was driven. Vehicle use occurred primarily between 0500 and 1500 hours daily. The monitored vehicles traveled 15,512 miles, logged 785 hours, and idled for 245 hours during the 31-day study period.

Table 10. Command support vehicles travel summary.

Support Vehicles Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	46.4/405.0	18.6/1,012.4	7.9/208.1	15,512
Travel Time (Minutes)	133.4/836.0	51.7/1,008.4	22.6/315.0	47,097
Idle Time (Minutes)	2.2/NA	16.7/NA	7.3/NA	14,687

The distance a PEV can travel in CD mode between charge opportunities is the most important factor in considering vehicle replacement. The two most significant factors in vehicle analysis include the vehicle daily travel and vehicle outings. Section 2.3 provides the definitions of these terms. In both graphs of daily travel and outings, the distance axis is divided into 10-mile segments, with green bars indicating all travel less than 20 miles. Thirty miles is the assumed typical PHEV range in CD mode. The blue bars indicate travel between 30 and 70 miles. Seventy miles is considered to be within the BEV safe range (blue and green bars). That is, while BEV range can vary based on several factors, most BEVs provide at least 70 miles of vehicle range on a single battery charge. All travel greater than 70 miles is shown by the gray bars and indicate travel beyond the capability of a BEV. Figure 19 shows the daily travel summary for the monitored vehicles. For example, Figure 19 shows that almost 30% of daily travel was less than 10 miles per day.

The average travel distance per day, when driven, for support vehicles was 46.4 miles. On 79% of these vehicle days, the daily travel was less than the 70 miles and within the BEV safe range. Meanwhile, 21% percent of support daily travel was greater than 70 miles, with 53% of vehicle travel days less than 30 miles. A very basic look might suggest that considering only daily travel, a fleet consisting of 79% BEVs and 21% PHEVs would meet vehicle travel needs. However, other considerations will apply.

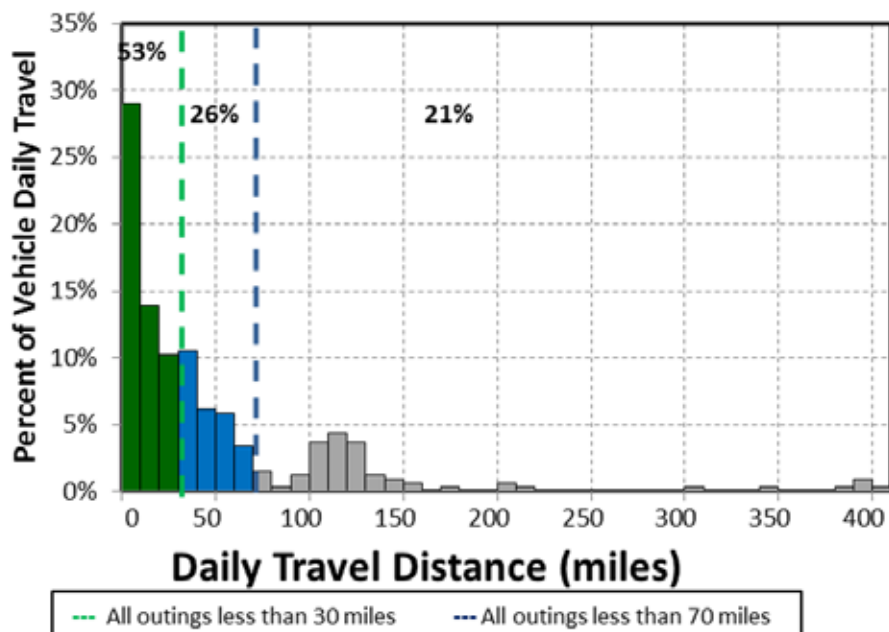


Figure 19. Command support vehicle daily travel miles (all vehicles).

Figure 20 shows the outings for all vehicles. The figure notes that 75% of all vehicle outings travel was less than 10 miles.

The average travel outing when driven for support vehicles was 18.6 miles. On 94% of these vehicle outings, the distance traveled was less than 70 miles and considered to be within the BEV safe range. Meanwhile, only 6% of support outing travel was greater than 70 miles, with 88% of vehicle travel outings less than the 30 miles considered to be within the CD range of a PHEV.

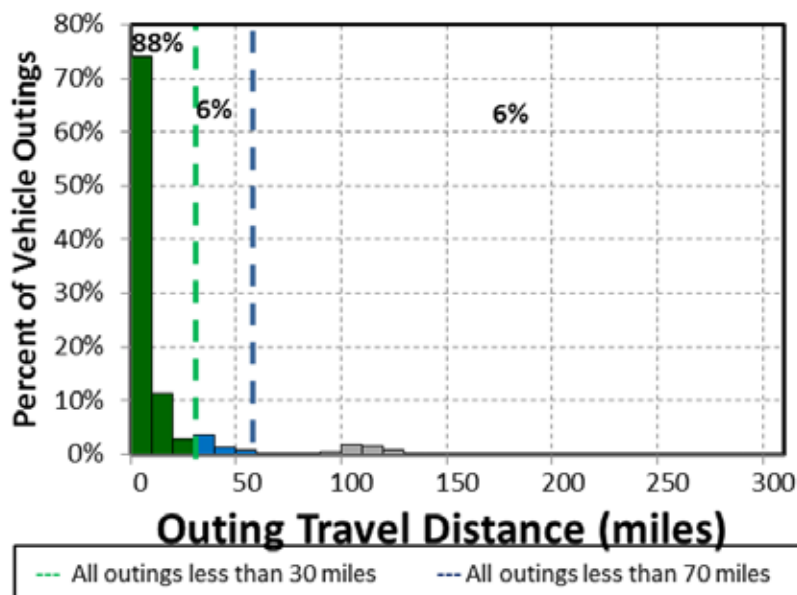


Figure 20. Command support vehicle combined outings. Note that the three longest outings of 1,012, 788, and 785 miles are not for clarity of scale.

**4.1.1.2 Commands Support Vehicle Observations/Summary.** In summary, the vast majority of daily travel and outings were short and well within the capabilities of BEVs. This was consistent with the optimum goal of incorporating as many BEVs as possible to realize the advantages of reduced petroleum usage and reduced emissions of GHGs. A review of the specific vehicles monitored in this study show they were assigned to different groups and not easily shared (i.e., while two vehicles may have only one extended outing each, it may not be possible to have all extended outings on the one vehicle). A conservative approach to vehicle usage suggests eight BEVs and 10 PHEVs would meet the needs of the support vehicles.

Considering a full complement of 249 support vehicles in the Commands fleet, Intertek suggests that a mixed fleet may be possible. Assuming the balance of vehicles are operated similarly to those monitored and considering the average annual (and, thus, monthly) mileage, replacement PEVs are suggested as identified in Table 11. Note that a higher percentage of BEVs is possible because command fleets may have several vehicles to share the longer distance travels. This will be explored in detail in the Task 4 adoption approach. Intertek suggests that a fleet of 143 BEVs and 106 PHEVs (57% BEV/43% PHEV) conservatively meets vehicle travel requirements.

Table 11. Commands PEV potential replacements.

	Sedan – Compact	Sedan – Midsize	Sedan – Large	Minivan	SUV	Van Cargo	Van Pass	Pickup	Specialty	Total
BEV	1	2	3	11	7	11	30	78	—	143
PHEV	—	5	2	19	13	1	36	30	—	106
Total	1	7	5	30	20	12	66	108	—	249

**4.1.1.3 Commands Support Vehicle Charging Needs.** As noted previously, AC Level 2 (240-VAC) overnight charging of BEVs is typical, whereas overnight charging of PHEVs can usually be accomplished with AC Level 1 (110-VAC) charging. Intertek’s experience suggests that each vehicle should have an assigned charging location at its home base. Assigned stations require less management attention to ensure completion of overnight charging. BEVs and PHEVs not assigned to these locations also benefit during visits to the location as part of their normal operation. For the entire fleet of Commands support vehicles, eight BEVs require eight AC Level 2 EVSE units for overnight charging and 10 PHEVs require 10 AC Level 1 outlets for home base charging. Intertek recommends a minimum of two EVSE at each location to maximize charge capability without a significant increase in installation costs. PHEVs can utilize AC Level 2 EVSE at the home base during the day to increase the amount of vehicle miles traveled in CD mode.

At times, fleet vehicles obtain benefit from using public charging infrastructure. Figure 21 displays the availability of public charging at the time of this writing for the MCBCL area. The green-colored sites are AC sites, indicating AC Level 1 and Level 2 public locations.

There is significant development in public charging infrastructure in the Raleigh-Durham area of North Carolina due to great public interest in PEV adoption. However, that infrastructure density does not extend to the MCBCL area.

One station is located at the local Nissan dealership and the other at a hotel. Both are AC Level 2 EVSE.

The Task 3 report on infrastructure provides details about infrastructure planning.

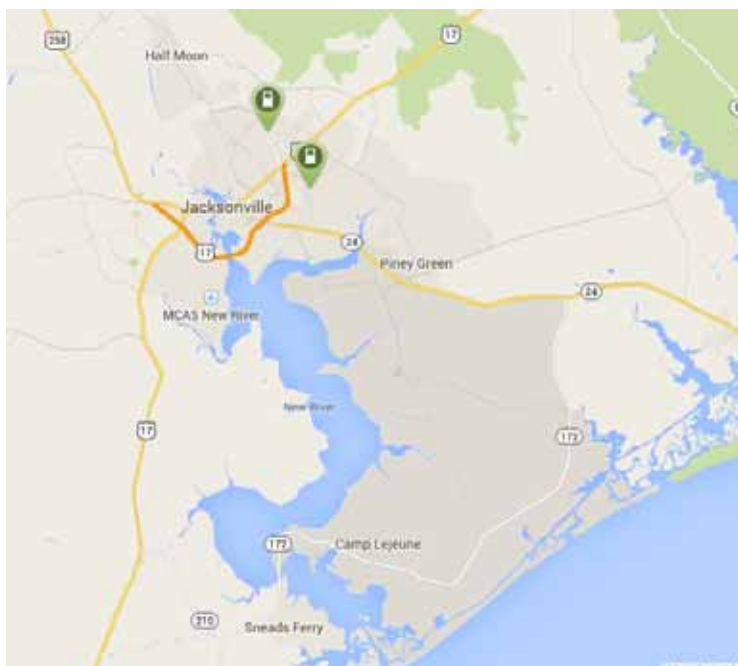


Figure 21. Public EVSE in MCBCL region.<sup>22</sup>

#### 4.1.2 Commands Fleet Vehicles Mileage

The vehicle's annual miles are factored into calculations for replacement of vehicles as noted in Section 5 and Appendix D. The actual miles measured during the study were extrapolated to identify calculated annual miles in the study. This was compared to the mileage provided by MCBCL. The MCBCL figures were used in the calculations. However, there were significant differences between the usage of the vehicle during the study and the average annual usage as noted in Table 12.

Table 12. Commands group monitored vehicle mileage.

Logger	Vehicle ID	Vehicle Class	Study Extrapolated Annual Mileage	MCBCL Reported Annual Mileage
88	291073	Van - Pass	2,686	2,935
17	301321	Pickup	1,012	3,669
95	G41-0762M	Minivan	15,510	20,099
86	G41-1846K	Minivan	12,460	12,317
83	G41-2399K	Pickup	3,906	10,754
90	G42-0216F	Van - Pass	18,336	2,189
92	G42-0883M	Van - Pass	21,806	16,827
84	G42-0898M	Van - Pass	15,305	16,246
18	G43-0326H	Pickup	763	4,863
103	G43-1453G	Van - Pass	5,050	15,539
19	G43-1855P	Pickup	7,733	4,800
20	G43-2025K	Pickup	2,944	3,755

<sup>22</sup> <http://www.plugshare.com/> [accessed February 10, 2015].

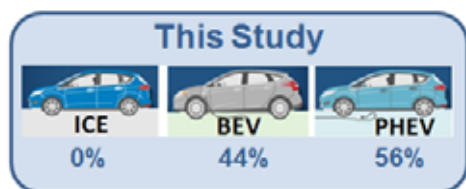
110	G43-4073F	Van - Pass	3,592	4,712
87	G61-0594L	SUV	13,887	10,657
94	G61-2644P	SUV	25,651	24,000
91	G62-0791H	SUV	9,940	9,273
99	G63-0309R	Pickup	8,623	2,469
120	G63-0934G	Pickup	15,505	7,502

For the entire Commands group fleet, the average monthly miles traveled as provided by MCBCL are 707 miles for an average annual travel total of 8,484 miles. On an average basis, this reflects positively on the use of BEVs in the fleet.

#### 4.1.3 Commands Fleet Summary

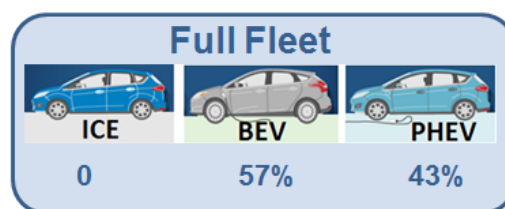
This study provides observations for both the vehicles monitored and for the entire non-tactical fleet of vehicles identified with the Commands group. The study indicates that PEVs offer alternatives to vehicles in the existing fleet if any specific cargo requirements are met by the PEV. In general, a mixed fleet of BEVs and PHEVs is suggested.

The fleet of Commands support vehicles in this study included two minivans, three SUVs, six passenger vans, and seven pickup trucks. Section 3.4 provides information on PEVs currently or soon to be available in the automotive market. Without consideration of specific cargo requirements, replacement PEVs currently exist for all of these vehicles. Appendix D provides details about the observations and summary and, based on these travel data, Intertek suggests that replacing these 18 vehicles with eight BEVs and 10 PHEVs would meet current mission requirements.



The vehicles studied were utilized on 58% of the study days and averaged 2.2 hours of use per day. While daily usage was quite low, the vehicles were used often enough that eliminating a vehicle is not recommended.

Considering a full complement of 249 support vehicles assigned to the Commands group, Intertek suggests that a mixed fleet may be possible. These remaining vehicles were not monitored, but using the data collected for those that were, Intertek suggests that a fleet of 143 BEVs and 106 PHEVs conservatively meets vehicle travel requirements.



With potential replacement by PEVs established, Section 5 and Appendix D provide further evaluation of the benefits of such replacements. This will be factored into further observations and suggestions related to the PEV adoption approach and schedule for any replacements for the Commands group. Those observations will be addressed in Task 4 of this project.

## 4.2 Analysis Results – Marine Corps Installations East Fleet

The MCIE fleet operates 535 vehicles. Table 13 identifies these vehicles by vehicle type according to site records. The mission assignments identified in Table 13 are based on agency records and general assumptions. Forty-two vehicles were monitored as part of this study, including four sedans, three minivans, seven SUVs, four cargo vans, two passenger vans, 21 pickup trucks, and one specialty vehicle. This section summarizes and aggregates data collection for the MCIE fleet. The details of each vehicle



monitored are included in Appendix C. Appendix E presents the full detailed analysis for the vehicles monitored and for the group as a whole.

Table 13. MCIE total fleet characterization.

	Sedan – Compact	Sedan – Midsize	Sedan – Large	Minivan	SUV	Van Cargo	Van Pass	Pickup	Specialty	Total
Pool	—	3	—	11	11	4	32	41	—	102
Support	3	13	2	19	33	42	8	174	—	294
Enforcement	2	—	36	7	12	4	3	13	2	79
Specialty	—	—	—	—	—	—	—	—	60	60
Total	5	16	38	37	56	50	43	228	62	535

Grouping the vehicles by mission creates an aggregated view of mission requirements to provide observations related to PEV replacement. Analysis by mission type is provided in the following subsections.

#### 4.2.1 Marine Corps Installations East Pool Vehicles Analysis

Pool vehicles typically are light-duty motor vehicles for use in passenger transportation, with not more than 10 passengers. Pool missions can vary by agency, location, and jurisdiction. For the MCIE group, the pool vehicles include one sedan, two minivans, two SUVs, two passenger vans, one cargo van, and two pickups.

Incorporation of BEVs and/or PHEVs into the pool mission is a definite possibility. Pool vehicles used for shorter trips or outings qualify for BEV or PHEV replacement, while other pool vehicle activities that are associated with longer trips may require PHEV capabilities.

**4.2.1.1 Summary for Marine Corps Installations East Pool Vehicles.** Appendix C provides the vehicle data sheets for each of the pool vehicles monitored. This section aggregates data for all pool vehicles. Table 14 summarizes pool vehicle travel during the study period for those days when the vehicle was driven. Vehicle use occurred primarily between 0600 and 1500 hours daily. They traveled 6,672 miles, logged 446 hours, and idled for 155 hours during the 31-day study period.

Table 14. Pool vehicles travel summary.

Pool Vehicles Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	35.9/289.4	8.9/537.2	4.6/258.5	6,672
Travel Time (Minutes)	144.0/1,140.0	35.9/875.0	18.4/504.0	26,781
Idle Time (Minutes)	50.2/NA	12.5/NA	6.4/NA	9,328

The distance a PEV can travel in CD mode between charge opportunities is the most important factor when considering vehicle replacement. The two most significant factors in vehicle analysis include vehicle daily travel and vehicle outings. Section 2.3 provides the definitions of these terms. Figure 22 shows the travel summary for all monitored pool vehicles.

The average travel distance per day, when driven, for pool vehicles was 35.9 miles. On 87% of the vehicle travel days, the daily travel was less than the 70 miles considered to be within the BEV safe range (blue and green bars in Figure 22). Meanwhile, 58% of vehicle travel days were less than the 30 miles considered to be within the CD range of a PHEV (green bars of Figure 22). This suggests a fleet of 87% BEVs and 13% PHEVs would meet travel needs without consideration of other factors.



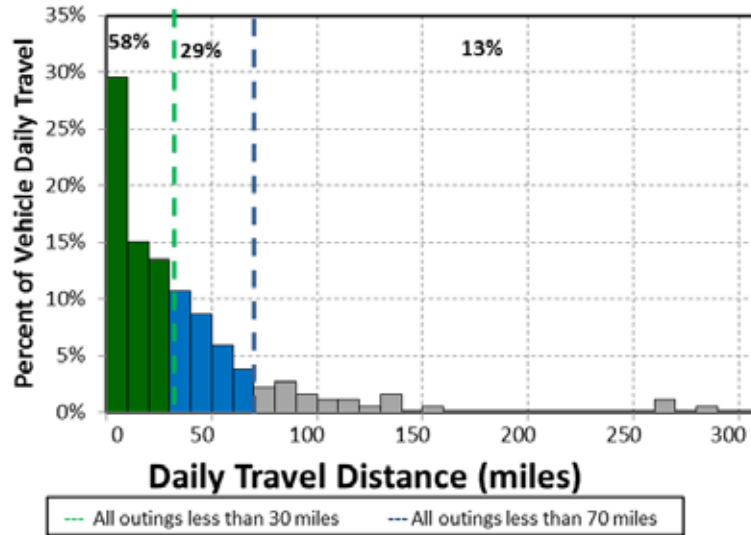


Figure 22. Pool vehicle daily travel miles (all vehicles).

The pool vehicles were used, on average, 58% of the study days. However, there were periods where each vehicle operated several days in a row and days that several vehicles were in use. Figure 23 shows the outings for all vehicles.

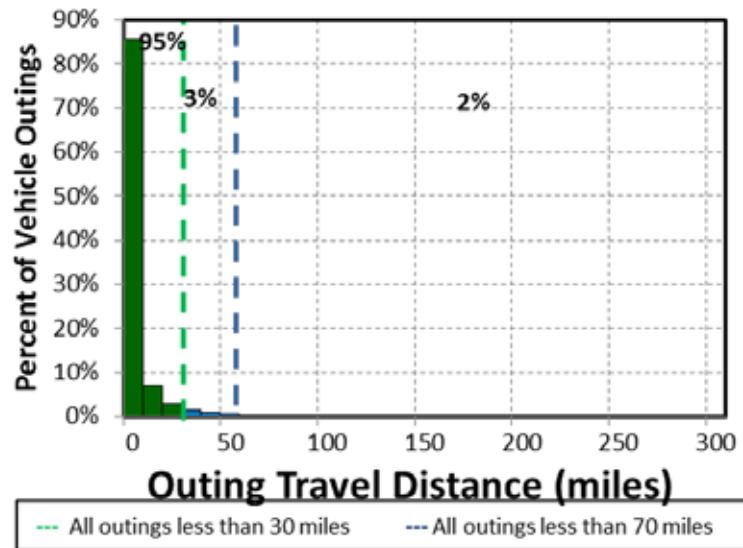


Figure 23. Pool vehicle combined outings. Note that the single longest outing of 537 miles was not shown for clarity of scale.

Appendix D provides the details of each of the pool vehicle's outings. The average travel outing when driven for pool vehicles was 8.9 miles. Further, 98% of the outings were less than the 70 miles considered to be within the BEV safe range and 95% of pool outings were less than the 30 miles considered to be within the CD mode range of a PHEV.

**4.2.1.2 Pool Vehicle Observations/Summary.** The vast majority of daily travel and outings were short and well within the capabilities of BEVs. This is consistent with the optimum goal of incorporating as many BEVs as possible to realize the advantages of reduced petroleum usage and reduced emissions of GHG.

The actual miles measured during the study were extrapolated to identify calculated annual miles in the study. This was compared to the mileage provided by MCBCL. The MCBCL figures were used in the calculations. However, there were significant differences between usage of the vehicle during the study and average annual usage as noted in Table 15.

Table 15. MCIE monitored pool vehicle mileage.

Logger	Vehicle ID	Vehicle Class	Study Extrapolated Annual Mileage	MCBCL Reported Annual Mileage
4	290597	Van - Cargo	2,394	957
5	G10-3327L	Sedan - Midsize	5,225	7,085
7	G41-0379H	Minivan	4,855	5,614
8	G41-0754M	Minivan	10,173	5,183
9	G42-0644M	Van - Pass	2,264	22,209
10	G42-0911L	Pickup	17,658	7,978
13	G43-0310H	Van - Pass	7,096	7,232
14	G43-4075P	Pickup	13,963	12,000
15	G61-1508D	SUV	3,485	1,051
16	G61-1509D	SUV	5,252	3,292

The fleet of pool vehicles in this study included one sedan, two minivans, two SUVs, two passenger vans, one cargo van, and two pickups. Intertek would suggest that five BEVs and five PHEVs could meet mission requirements. Section 3.4 provides information on PEVs currently or soon to be available in the automotive market and Section 5 provides details on the suggestions.

Considering a full complement of 102 pool vehicles in the entire MCIE group fleet, Intertek suggests that in extrapolating the collected data to the entire fleet, a mixed fleet of 69 BEVs and 33 PHEVs (67% BEV/33% PHEV) may be possible.

The vehicle summary shows sufficient time for charging at the base location during the course of the day and additional opportunities at intermediate charging stations. These stations also provide charging opportunities for the visiting public, whose fees may assist in offsetting operating costs.

**4.2.1.3 Pool Vehicle Charging Needs.** Upon review of these data, Intertek suggests replacement of the MCIE pool fleet with 69 BEVs and 33 PHEVs. As noted previously, AC Level 2 overnight charging of BEVs is typical, whereas overnight charging of PHEVs can be accomplished with AC Level 1 charging.

Intertek's experience suggests that each vehicle have an assigned charging location at their home base. Assigned stations require less management attention to ensure completion of overnight charging. BEVs and PHEVs not assigned to these locations also benefit during visits to the location as part of their normal operation. Intertek recommends a minimum of two EVSE at each location to maximize charge capability without a significant increase in installation costs. The PHEVs can utilize AC Level 2 EVSE at the home base during the day to increase the amount of vehicle miles traveled in CD mode.

At times, fleet vehicles obtain benefit from using public charging infrastructure. Figure 21 displays the availability of public charging for the MCBCL area at the time of this writing. Little public infrastructure is available or needed.

## 4.2.2 Marine Corps Installations East Support Vehicles Analysis

Support vehicles provide a specific work function, facilitating the mission of a particular group. The vehicles are generally passenger or light-duty pickup trucks and may contain after-market modifications

to support the mission. While assigned to maintenance and service areas, missions may vary depending on agency needs.

As shown above, MCIE support vehicles that were monitored included three sedans, one minivan, two SUVs, three cargo vans, and 16 pickup trucks.

**4.2.2.1 Summary for Marine Corps Installations East Support Vehicles.** Appendix D provides the vehicle data sheets for each of the 25 MCIE support vehicles monitored. This section aggregates the data for those support vehicles.

Table 16 summarizes support vehicle travel during the study period. Vehicle use occurred primarily between 0600 and 1500 hours daily. The 25 support vehicles traveled 844 miles, logged 38 hours, and idled for 8 hours during the study period.

Table 16. Support vehicle travel summary.

Support Vehicle Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	43.7/154.0	22.8/151.8	6.9/76.8	844
Travel Time (Minutes)	119.1/456.0	60.2/456.0	18.6/362.0	2,304
Idle Time (Minutes)	23.6/NA	11.5/NA	3.9/NA	466

The distance a PEV can travel in CD mode between charge opportunities is the most important factor in considering vehicle replacement. The two most significant factors in vehicle analysis include the vehicle daily travel and vehicle outings. Section 2.3 provides the definitions of these terms. Figure 24 shows the travel summary for the support vehicles monitored.

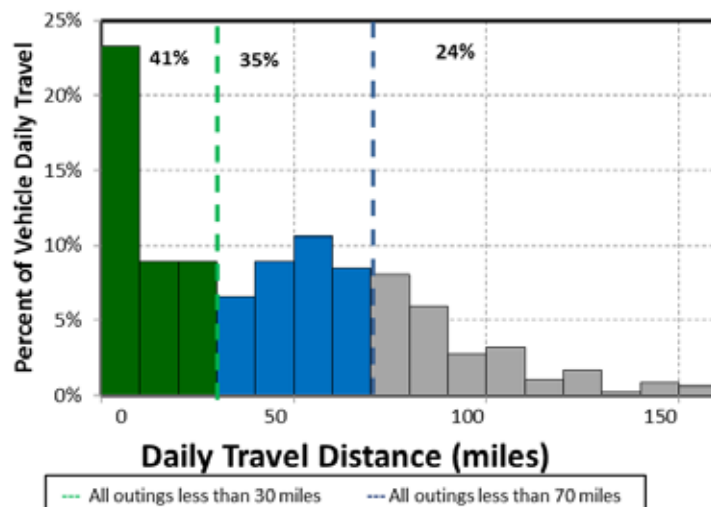


Figure 24. Support vehicle daily travel miles and usage time (all vehicles).

The average travel distance per day, when driven, for support vehicles was 43.7 miles. On 76% of these vehicle days, the daily travel was less than the 70 miles considered to be within the BEV safe range. Meanwhile, 24% percent of support vehicle daily travel was greater than 70 miles. Furthermore, 41% of vehicle travel days were less than the 30 miles considered to be within the CD mode range of a PHEV. Figure 25 shows the outings for all support vehicles combined.

Appendix D provides the details of each of the support vehicle's daily travel. Without consideration of other vehicle requirements, this would suggest a support fleet could consist of approximately 76% BEVs and 24% PHEVs. Figure 25 shows the outings for all vehicles.

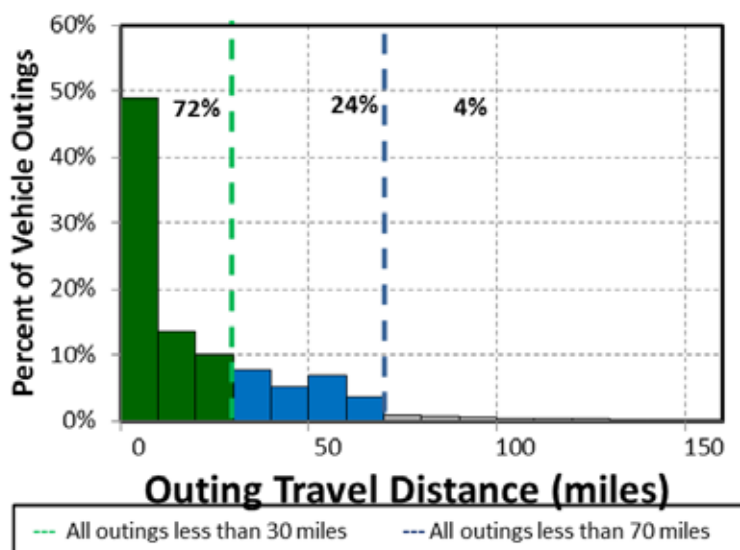


Figure 25. Support vehicle combined outings.

The average travel outing, when driven, for support vehicles was 22.8 miles. On 96% of these vehicle outings, the distance traveled was less than the 70 miles considered to be within the BEV safe range. Furthermore, 72% of vehicle travel outings were less than the 30 miles considered to be within the CD mode range of a PHEV.

**4.2.2.2 Marine Corps Installations East Support Vehicle Observations/Summary.** A significant amount of daily travel and outings were within the capabilities of BEVs. This is consistent with the optimum goal of incorporating as many BEVs as possible to realize the advantages of reduced petroleum usage and reduced emissions of GHG.

The actual miles measured during the study were extrapolated to identify calculated annual miles in the study. This was compared to the mileage provided by MCBCL. The MCBCL figures were used in the calculations. However, there were significant differences between usage of the vehicle during the study and average annual usage as noted in Table 17.

Table 17. MCIE monitored support vehicle mileage.

Logger	Vehicle ID	Vehicle Class	Study Extrapolated Annual Mileage	MCBCL Reported Annual Mileage
35	294285	Sedan - Midsize	10,765	3,795
42	294315	Pickup	6,808	3,208
54	294324	SUV	14,382	8,195
55	302039	Pickup	14,511	6,424
56	302040	Pickup	13,725	10,937
79	302334	Pickup	2,076	1,200
41	G13-0325K	Sedan - Compact	2,149	1,037
39	G13-7974P	Sedan - Compact	12,533	12,000
40	G41-0391H	Pickup	8,938	7,507
57	G41-0806P	Minivan	19,692	12,552
58	G41-1689L	Pickup	5,334	5,649
59	G41-3297K	Pickup	7,997	5,368

Logger	Vehicle ID	Vehicle Class	Study Extrapolated Annual Mileage	MCBCL Reported Annual Mileage
61	G41-3301K	Pickup	5,813	7,306
68	G42-0667P	Pickup	13,116	9,600
69	G42-0671P	Pickup	25,172	7,678
75	G42-0915M	Pickup	4,217	7,072
71	G43-0323H	Van - Cargo	13,656	12,155
74	G43-0324H	Van - Cargo	269	5,969
36	G43-1182M	Van - Cargo	8,006	12,279
77	G61-0161H	Pickup	19,471	14,979
78	G61-0174H	SUV	10,154	8,683
82	G62-1583G	Pickup	9,935	10,816
46	G62-4085L	Pickup	7,374	10,608
98	G63-0163H	Pickup	5,620	9,018
47	G63-2885L	Pickup	5,528	4,112

The fleet of support vehicles in this study included three sedans, one minivan, two SUVs, three cargo vans, and 16 pickup trucks. Intertek would suggest that 10 BEVs and 115 PHEVs could meet mission requirements. This is a lesser percentage than identified above because the vehicles are dispersed among several different groups. Section 3.4 provides information on PEVs currently or soon to be available in the automotive market and Section 5 provides details on the suggestions.

Considering a full complement of 294 support vehicles in the entire MCIE group support fleet, Intertek suggests that in extrapolating the collected data to the entire fleet, a mixed fleet of 189 BEVs and 105 PHEVs may be possible.

The vehicle summary shows sufficient time for charging at the base location during the course of the day and additional opportunities at intermediate charging stations. These stations also provide charging opportunities for the visiting public, whose fees may assist in offsetting operating costs.

**4.2.2.3 Marine Corps Installations East Support Vehicle Charging Needs.** As noted above, AC Level 2 overnight charging of BEVs is typical, whereas overnight charging of PHEVs can be accomplished with AC Level 1 charging. Opportunity charging at intermediate stops obtains greater benefits from AC Level 2 EVSE. Most vehicles returned to their home base daily, with the exception of long trips lasting several days.

Greater management attention provides the possibility of reducing the overall number of AC Level 2 EVSE units. A ratio of two AC Level 2 charging stations to three vehicles typically sustains a normal fleet operation. Fleet managers rotate vehicles on the charger to complete charging of all vehicles in the allotted time. This analysis does assume a fully recharged battery at the start of each day. MCBCL will gain experience in this management as the PEV fleet grows.

## 4.2.3 Marine Corps Installations Enforcement Vehicles Analysis

Enforcement vehicles are typically light-duty motor vehicles specifically approved in an agency's appropriation act for use in apprehension, surveillance, police, or other law enforcement work. Enforcement missions can vary by agency, location, and jurisdiction; however, they typically utilize sedans, minivans, vans, or small pickup trucks and typically do not carry specific cargo or equipment.

As shown above, MCIE enforcement vehicles that were monitored included two SUVs and three pickup trucks.

#### 4.2.3.1 Summary for Marine Corps Installations East Enforcement Vehicles.

Appendix D provides the vehicle data sheets for each of the five enforcement vehicles monitored. This section aggregates the data for all enforcement vehicles.

Table 18 summarizes enforcement vehicle travel during the study period. Vehicle use occurred primarily between 0400 and 1700 hours daily, although many were used at all hours. The five enforcement vehicles traveled 6,106 miles, logged 520 hours, and idled for 295 hours during the study period.

Table 18. Enforcement vehicle travel summary.

Enforcement Vehicle Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	51.3/208.1	20.6/167.6	6.8/99.7	6,106
Travel Time (Minutes)	262.4/1,464.0	105.5/1,209.0	35.0/752.0	31,228
Idle Time (Minutes)	149.7/NA	60.2/NA	20.0/NA	17,726

The distance a PEV can travel in CD mode between charge opportunities is the most important factor when considering vehicle replacement. The two most significant factors in vehicle analysis include the vehicle daily travel and vehicle outings. Section 2.3 provides the definitions of these terms. Figure 226 shows the daily travel summary for the enforcement vehicles monitored. Appendix D provides the details of each of the enforcement vehicle's daily travel.

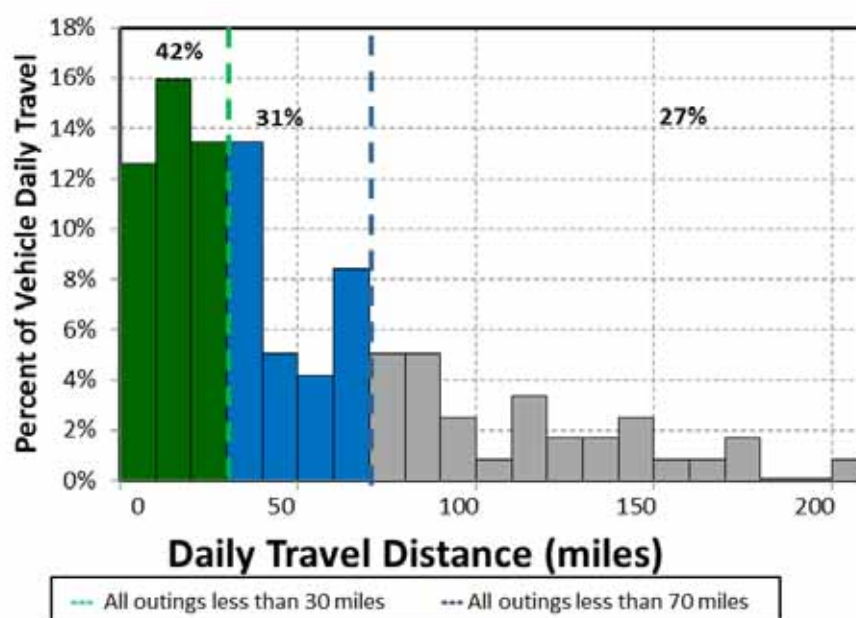


Figure 26. Enforcement vehicle daily travel miles and usage time (all vehicles).

The average travel distance per day, when driven, for enforcement vehicles was 51.3 miles. On 73% of these vehicle days, the daily travel was less than the 70 miles considered to be within the BEV safe range. Meanwhile, 27% percent of enforcement vehicle daily travel was greater than 70 miles. Furthermore, 42% of vehicle travel days were less than the 30 miles considered to be within the CD mode range of a PHEV. Without any other considerations, this would suggest the fleet could be composed of 73% BEVs and 27% PHEVs. However, most enforcement fleet managers prefer vehicles with no range

limitations. Thus, the composition would shift more toward the PHEV preference. Figure 27 shows the outings for all enforcement vehicles combined.

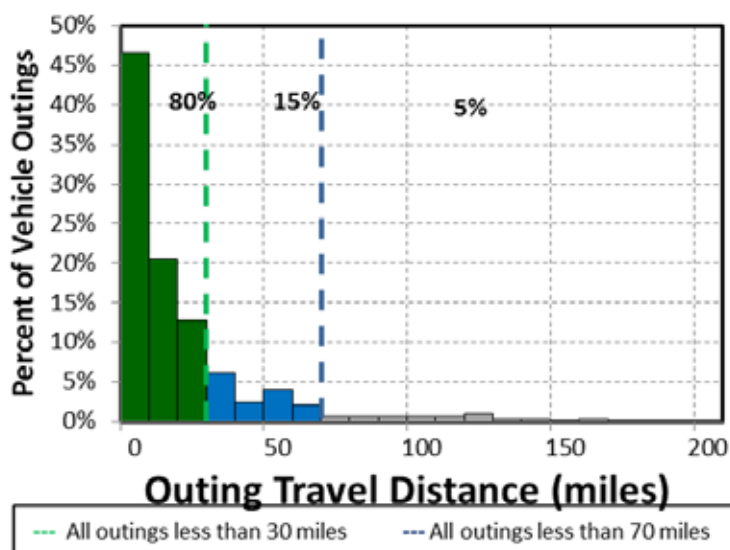


Figure 27. Enforcement vehicle combined outings.

The average travel outing when driven for enforcement vehicles was 20.6 miles. On 95% of these vehicle outings, the distance traveled was less than the 70 miles considered to be within the BEV safe range. Furthermore, 80% of vehicle travel outings were less than the 30 miles considered to be within the CD mode range of a PHEV.

#### 4.2.3.2 Marine Corps Installations East Enforcement Vehicle Observations/Summary.

The vast majority of daily travel and outings were short and well within the capabilities of BEVs. This is consistent with the optimum goal to incorporate as many BEVs as possible to realize the advantages of reduced petroleum usage and reduced emissions of GHG.

The actual miles measured during the study were extrapolated to identify calculated annual miles in the study. This was compared to the mileage provided by MCBCL. The MCBCL figures were used in the calculations. However, there were significant differences between usage of the vehicle during the study and average annual usage as noted in Table 19.

Table 19. MCIE monitored enforcement vehicle mileage.

Logger	Vehicle ID	Vehicle Class	Study Extrapolated Annual Mileage	MCBCL Reported Annual Mileage
48	294293	SUV	4,839	4,214
49	G41-3300K	Pickup	26,944	15,644
50	G42-2985H	Pickup	22,331	20,146
51	G61-0879P	SUV	12,235	4,232
52	G63-2888L	Pickup	6,272	4,480

The fleet of pool vehicles in this study included two SUVs and three pickup trucks. Intertek would suggest that two BEVs and three PHEVs could meet mission requirements. Section 3.4 provides information on PEVs currently or soon to be available in the automotive market and Section 5 provides details on the suggestions.



Considering a full complement of 79 pool vehicles in the entire MCIE group enforcement fleet, Intertek suggests that in extrapolating the collected data to the entire fleet, a mixed fleet consisting of 17 BEVs, 60 PHEVs, and two conventional specialty brig trucks should meet the mission objectives.

The vehicle summary shows sufficient time for charging at the base location during the course of the day and additional opportunities at intermediate charging stations. These stations also provide charging opportunities for the visiting public, whose fees may assist in offsetting operating costs.

**4.2.3.3 Marine Corps Installations East Enforcement Vehicle Charging Needs.** As noted above, AC Level 2 overnight charging of BEVs is typical, whereas overnight charging of PHEVs can be accomplished with AC Level 1 charging. Opportunity charging at intermediate stops obtains the greater benefits from AC Level 2 EVSE. Most vehicles returned to their home base daily.

Greater management attention provides the possibility of reducing the overall number of AC Level 2 EVSE units. A ratio of two AC Level 2 charging stations to three vehicles typically sustains a normal fleet operation. Fleet managers rotate vehicles on the charger to complete charging of all vehicles in the allotted time. This analysis does assume a fully recharged battery at the start of each day. MCBCL will gain experience in this management as the PEV fleet grows.

#### **4.2.4 Marine Corps Installations East Specialty Vehicles Analysis**

Two specialty vehicles were selected for monitoring as part of the study: one bucket truck and one refrigeration truck. The refrigeration truck was a pool vehicle available through Motor Transport and was not used during the study. The operations details of the other specialty truck 300672 are included in Appendix C. The bucket truck identified in Section 3.5 would appear to be a suitable PHEV replacement. Conversion of a refrigeration vehicle may be more difficult because energy would be required for the refrigeration service. A PHEV conversion may be possible, but range in CD mode may be limited. The remaining 60 specialty vehicles were not monitored. Insufficient experience of prototypes for potential conversion of these types of vehicles to PEVs exists to suggest any further replacement. The entire fleet of specialty vehicles contains eight bucket trucks: three of which are on the Ford F550 frame. These eight vehicles have this potential PHEV replacement.

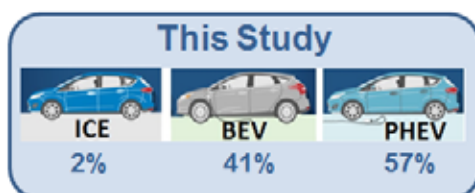
#### **4.2.5 Marine Corps Installations East Group Vehicles Mileage**

The vehicle's annual miles factor into the calculations for replacement of the vehicle, as noted in Section 5 and Appendix E. The actual miles measured during the study were extrapolated to identify the calculated annual miles in the study. MCBCL has also provided vehicle information that identified the average monthly miles and vehicle mileage for December 2014.

For the entire MCIE group fleet, the average monthly miles traveled were 667 miles for an average annual travel of 8,000 miles. This is relatively low mileage and, on an average basis, this reflects positively on the use of BEVs in the fleet.

#### **4.2.6 Marine Corps Installations East Group Summary**

This study provides observations for both the vehicles monitored and for the entire non-tactical fleet of vehicles identified in the MCIE Group. The study indicates that PEVs offer alternatives to existing vehicles provided that any specific cargo requirements are met by the PEV. In general, a mixed fleet of BEVs and PHEVs is suggested.



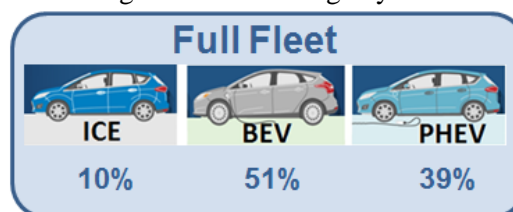
The vehicles monitored in this study included four sedans, three minivans, six SUVs, two passenger vans, four cargo vans, 21 pickup trucks, and two specialty trucks. Based on the travel data, Intertek suggests that retaining the refrigeration truck and replacing the remaining vehicles with 17 BEVs and 24 PHEVs would meet current mission requirements.



Section 5 identifies potential replacement PEVs and Appendix E provides specific recommendations.

The vehicles studied were utilized on 59% of the study days and averaged 2.2 hours of use per day. While daily usage was quite low, the vehicles were used often enough that eliminating any of these vehicles is not recommended.

The MCIE Group's full fleet of vehicles contains 535 vehicles. Intertek suggests retaining most of the conventional specialty vehicles and suggests a fleet of 275 BEVs and 207 PHEVs could meet the balance of vehicle travel requirements.



With the potential replacement by PEVs established, Section 5 and Appendix E provide further evaluation of the benefits of such replacements. This will be factored into further observations and suggestions related to the business case and schedule for any replacements for the MCIE group. Those observations will be addressed in Task 4 of this project.

### 4.3 Analysis Results – Combined Groups

The full fleet in the study contains 784 vehicles, not including the low-speed vehicles and non-powered trailer type vehicles. Table 20 identifies these vehicles by vehicle type according to site records. The mission assignments identified in Table 20 are based on survey responses received and extrapolated to the entire fleet.

Table 1. All fleet vehicles by type and mission.

	Sedan – Compact	Sedan – Midsize	Sedan – Large	Minivan	SUV	Van Cargo	Van Pass	Pickup	Specialty	Total
Pool	—	3	—	11	11	4	32	37	—	98
Support	4	20	7	49	53	55	74	286	—	548
Enforcement	2	—	36	7	12	3	3	13	2	78
Specialty	—	—	—	—	—	—	—	—	60	60
Total	6	23	43	67	76	62	109	336	62	784

Grouping the vehicles by mission creates an aggregated view of mission requirements to provide observations related to PEV replacement. Analysis by mission type is provided in the following subsections.

#### 4.3.1 All Pool Vehicles Analysis

All pool vehicles were assigned to the MCIE Group and analyzed in detail in Section 4.2.1.

#### 4.3.2 All Support Vehicles Analysis

Support vehicles assigned to the Commands group are analyzed in Section 4.1.1 and those assigned to the MCIE group are analyzed in Section 4.2.2. This section combines this analysis for all support vehicles.

**4.3.2.1 Summary for All Support Vehicles.** Appendices B and C provides the vehicle data sheets for each of the 43 support vehicles monitored. This section aggregates the data for all support vehicles.

Table 21 summarizes support vehicle travel during the study period. Vehicle use may occur at any hour, but primarily occurred between 0600 and 1600 hours daily. Support vehicles traveled 36,601 miles, logged 1,745 hours, and idled for 439 hours during the study period.

Table 21. Support vehicle travel summary.

Support Vehicle Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	46.0/405.0	18.1/1,012.4	6.8/208.1	36,601
Travel Time (Minutes)	131.5/836.0	51.7/1,443.0	19.4/362.0	104,690
Idle Time (Minutes)	33.1/NA	13.0/NA	4.9/NA	26,336

The distance a PEV can travel in CD mode between charge opportunities is the most important factor when considering vehicle replacement. The two most significant factors in vehicle analysis include the vehicle daily travel and vehicle outings. Figure 28 shows the travel summary for support vehicles by vehicle.

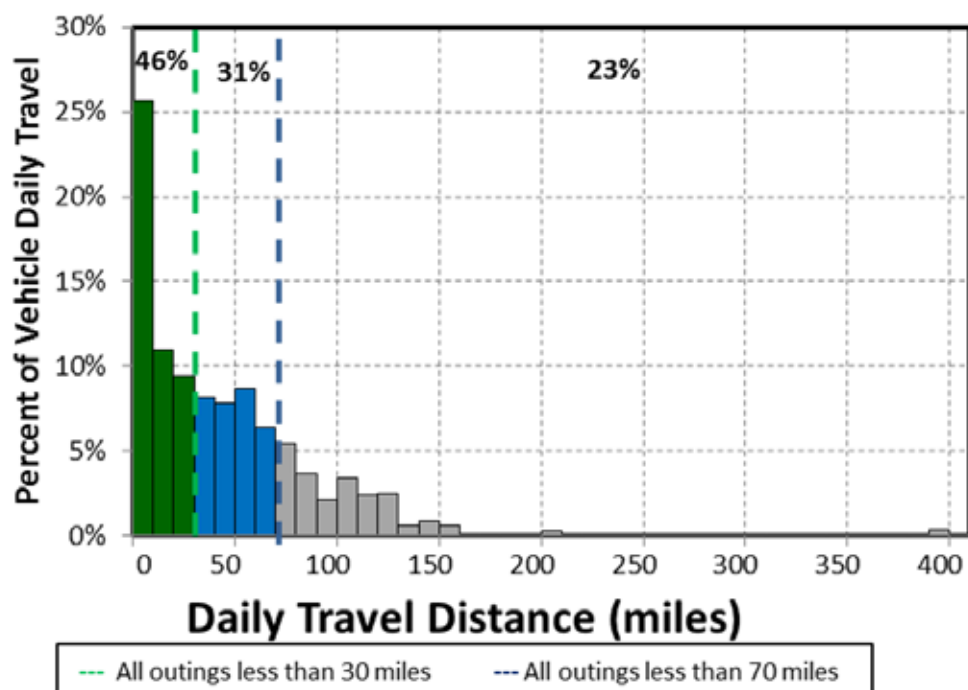


Figure 28. Support vehicle daily travel miles (all vehicles).

The average travel distance per day, when driven, for support vehicles was 46.0 miles. On 77% of these vehicle days, the daily travel was less than the 70 miles considered to be within the BEV safe range. Meanwhile, 23% percent of support vehicle daily travel was greater than 70 miles. Furthermore, 46% of vehicle travel days were less than the 30 miles considered to be within the CD range of a PHEV. Figure 29 shows the outings for all support vehicles combined.

The average travel outing when driven for support vehicles was 18.1 miles. On 95% of these vehicle outings, the distance traveled was less than the 70 miles considered to be within the BEV safe range. Meanwhile, 5% of support outing travel was greater than 70 miles. Furthermore, 80% of vehicle travel outings were less than the 30 miles considered to be within the CD range of a PHEV.

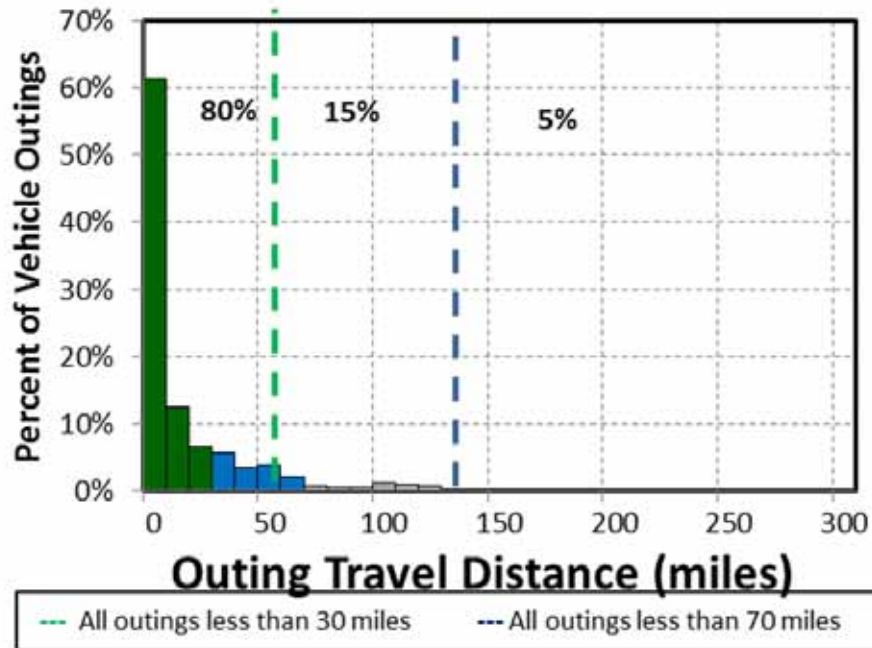


Figure 29. Support vehicle combined outings for all vehicles. Note that the longest outings of 1,012, 788, and 785 miles are not shown in the figure for clarity.

**4.3.2.2 All Support Vehicle Observations/Summary.** The all support vehicle daily travel miles and outings graphs are similar to those of the Commands group and MCIE group analyses, except that MCIE support vehicles tend toward longer distances each day and longer outings as well. The balance of the observations is included in the fleet analysis sections.

### 4.3.3 All Enforcement Vehicles Analysis

All enforcement vehicles were assigned to the MCIE group and analyzed in detail in Section 4.2.3.

### 4.3.4 All Specialty Vehicle Analysis

All specialty vehicles were assigned to the MCIE group and analyzed in detail in Section 4.2.4.

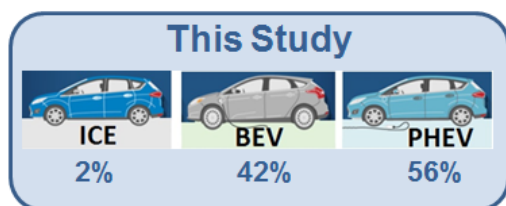
### 4.3.5 All Vehicles Mileage

The vehicle's annual miles factor into the calculations for replacement of vehicles, as noted in Section 5. The actual miles measured during the study were extrapolated to identify calculated annual miles in the study. MCBCL has also provided vehicle information that identified the average monthly miles and vehicle mileage in April 2012.

For all fleet vehicles, the average monthly miles traveled were 668 miles, for an average annual travel of 8,016 miles and typical workday travel of 334 miles. Overall, this average mileage is relatively low and reflects positively on the use of BEVs in the fleet.

### 4.3.6 All Vehicles Summary

This study provides observations for both the vehicles monitored and extrapolates that for the entire non-tactical fleet of vehicles. The study indicates that PEVs offer alternatives to vehicles in the existing fleet, provided any specific cargo requirements are met by the PEV. In general, a mixed fleet of BEVs and PHEVs is suggested.

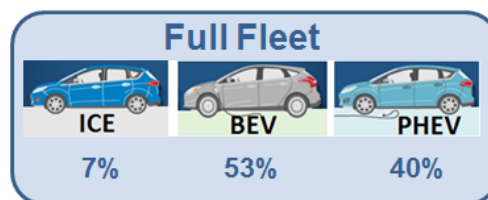


The vehicles monitored in this study included four sedans, five minivans, nine SUVs, four cargo vans, eight passenger vans, 28 pickup trucks, and two heavy-duty specialty trucks. Based on the travel data, Intertek suggests that retaining one specialty heavy-duty truck and replacing the remaining vehicles with 25 BEVs and 34 PHEVs would meet current mission requirements. Section 5 identifies

potential replacement PEVs, while Appendices D and E provide specific recommendations.

The studied vehicles were utilized on 60% of the study days and averaged 2.2 hours of use per day. Daily usage was quite low, although most vehicles showed frequent use.

The all vehicles full fleet of vehicles contains 784 vehicles. Intertek suggests that after retaining 53 conventional specialty vehicles, a fleet of 418 BEVs and 313 PHEVs could meet the vehicle travel requirements.



With potential replacement by PEVs established, Section 5 and Appendices D and E provide further evaluation of the benefits of such replacements. This will be factored into further observations and suggestions related to the replacements adoption approach. Those observations will be addressed in Task 4 of this project.

## 5. GREENHOUSE GAS EMISSIONS AVOIDED AND FUEL COST REDUCTION ANALYSIS

### 5.1 Background and Methods






PEV substitution for an existing conventional vehicle avoids GHG emissions and reduces fuel costs. The GHG emissions avoided occur due to the difference in emissions associated with power plant electricity generation versus fuel combustion that occurs in the engine of a conventional vehicle. This analysis does not account for life-cycle emissions that occur outside of electricity generation and fuel combustion phases (i.e., materials and resource extraction, production supply chains, and decommissioning are not accounted for). These phases are beyond the scope of this report due to the significant effort required to conduct an accurate environmental life-cycle assessment for a transportation system in a very specific setting. The analysis used is known as a “tank-to-wheel” analysis, rather than a “well-to-wheel” analysis that would include the aforementioned phases. Cost reduction also occurs because the cost of electricity is much less than the cost of gasoline and PEVs are more efficient than conventional ICE vehicles. Because fuel logs were not kept, the mileage accumulated by each vehicle during the study is compared to the average miles reported by MCBCL. The MCBCL report provides the source of fuel consumption estimates for the study vehicles.

Several PEV types are available for potential replacement in the MCBCL fleets as shown in Section 3. For this analysis, Table 22 provides the vehicles suggested as replacement vehicles for those identified in the analysis of Section 4. In some cases, the vehicles suggested for replacement may not meet specific cargo or other vehicle requirements. In addition, these are intended to be examples of potential replacement. PEVs are being added each year and, when MCBCL is ready to replace an ICE with a PEV, other PEV options may be available. In most cases, the EPA class of the replacement PEV is the same or similar to the current vehicle class. The energy consumption values for each PEV are displayed with the vehicle; note that for PHEVs, the energy consumption is only for CD mode.

Table 22. PEV substitutions for current vehicles.

Vehicle Class	Current Vehicle Example	Replacement PHEV	Replacement BEV
Sedan – Compact/Subcompact	 Dodge Avenger	 Chevrolet Volt 350 Wh/mi	 Ford Focus Electric 310 Wh/mi
Sedan – Midsize/Large	 Chevrolet Impala	 Ford Fusion Energi* 370 Wh/mi	 Nissan Leaf 300 Wh/mi
SUV and Minivan	 Chevrolet Tahoe	 Mitsubishi Outlander PHEV 440 Wh/mi	 Kia Soul Electric 320 Wh/mi
Pickup Truck	 Chevrolet Colorado	 Via Motors VTRUX 475 Wh/mi	 Nissan eNV200 400 Wh/mi
Pickup Truck (alternate)	 Ford F-150	 Mitsubishi Outlander PHEV 440 Wh/mi	 Kia Soul Electric 320 Wh/mi
Cargo Van	 Chevrolet Express Van	 Via VTRUX Van 475 Wh/mi	 Nissan eNV200 400 Wh/mi



Vehicle Class	Current Vehicle Example	Replacement PHEV	Replacement BEV
Passenger Van	 Ford E-350	 Via VTRUX Van 475 Wh/mi	 Nissan eNV200 400 Wh/mi
Specialty Bucket Truck	 Ford F550 Bucket Truck	 EDI: Ford F550 900 Wh/mi	Not available

Calculations provided for GHG emissions and fuel savings include both a total U.S. perspective and a perspective for the local area. The electricity generation mix of power plants for the total United States is different from the local mix of generation in the MCBCCL area. Likewise, the national average cost for petroleum fuel is different from the local cost for fuel. This analysis includes both approaches in order to allow for local evaluation and to provide potential benefit for fleet vehicles in other locations of the United States that may be of interest.

For the GHG emissions avoided portion of the analysis, the GHG emissions (in pounds of carbon dioxide equivalent, which accounts for other GHGs such as methane and nitrous oxide, lb-CO<sub>2</sub>e) from combustion of gasoline or E85 is the product of the EPA fuel economy and tailpipe emissions converted to lb-CO<sub>2</sub>e/gallon and is approximately 20.1 lb-CO<sub>2</sub>e/gallon.<sup>23</sup> The EPA does not provide emissions information for individual heavy-duty diesel trucks because of the highly varied use. However, the EPA provides guidance for estimates based on modeling. The emission factor for N<sub>2</sub>O and CH<sub>4</sub> are very low compared to CO<sub>2</sub>. The emissions of 10.21 kg CO<sub>2</sub> per gallon diesel in this report are based on those estimates.<sup>24</sup> In a like manner, EPA provides fuel economy estimates for heavy-duty trucks.<sup>25</sup> These factors are used to calculate emissions for diesel vehicles. The United States' average for GHG emissions for the production of electricity is 1.53 lb-CO<sub>2</sub>e/kWh.<sup>26</sup>

MCBCCL reported receiving base power from Duke Energy through Duke Energy Progress (formerly Progress Energy). EPA reports GHG emissions from the production of electricity. The annual report is available in the Emissions and Generation Resource Integrated Database. The most recent publication is for 2010.<sup>27</sup> Using the generation mix reported by Duke Energy in 2014 and the Emissions and Generation Resource Integrated Database plant reports, emissions for 2010 for the production of electricity were 1.134 lb-CO<sub>2</sub>e/kWh. This emissions rate reflects the higher-than-average reliance on nuclear and hydroelectric as the generation source and, thus, emissions are lower than the national average.

<sup>23</sup> <http://avt.inl.gov/pdf/EVProj/106077-891082.ghg.pdf> for the methodology for gasoline [accessed 7 July 2015].

<sup>24</sup> *Emission Factors for Greenhouse Gas Inventories*, 4 April 2014, <http://www.epa.gov/climateleadership/documents/emission-factors.pdf> [accessed 7 July 2015].

<sup>25</sup> Update Heavy-Duty Engine Emission Conversion Factors for MOBILE6, <http://www.epa.gov/otaq/models/mobile6/r02005.pdf> [accessed 7 July 2015].

<sup>26</sup> [op.cit EVProj/106077](http://op.cit/EVProj/106077).

<sup>27</sup> <http://www.epa.gov/cleanenergy/energy-resources/egrid/> [accessed 30 June 2015].

GHG emissions avoided are the annual GHGs emitted by the current vehicle (total annual gallons gasoline  $\times$  GHG emissions/gallon) minus the annual GHG emitted by the replacement PEV (total annual kWh  $\times$  GHG emissions/kWh). For PHEVs, only the percentages of travel less than 30 miles are counted for the annual miles saved in CD mode.

For the cost-avoided piece of the analysis, EPA provides information on current fuel prices. At the time of this report, fuel costs for regular gasoline and diesel fuel were \$2.801/gallon and \$2.843/gallon, respectively, for the United States and \$2.650/gallon and \$2.823/gallon, respectively, for the lower Atlantic region.<sup>28</sup> E85 prices were \$2.13/gallon for the United States and \$2.17/gallon for the Lower Atlantic region.<sup>29</sup> Electrical cost assumptions were 0.1032 \$/kWh<sup>30</sup> for the United States and 0.05566 \$/kWh energy charge for industrial customers on Schedule LGS-32 (Large General Service) in the Duke Energy Progress service territory.<sup>31</sup> Therefore, fuel costs savings are the current vehicle's calculated annual gasoline cost (total annual gallons gasoline  $\times$  cost/gallon) minus the electricity cost (total annual kWh  $\times$  cost/kWh) of the replacement PEV traveling the same distance.

The miles calculated above for CD mode yield estimates for yearly GHG emissions avoided and fuel cost reductions. Appendices D and E provide the details of the results of these analyses for each of the fleets studied. While the appendices provide both national and local figures, only the local North Carolina area figures are reported here for clarity.

## 5.2 Monitored Vehicles Fuel Cost Reduction

Tables 23 provides a summary of the potential fuel cost reductions with the replacement of monitored vehicles with PEVs in the missions identified as noted in Appendices D and E. Only the local North Carolina fuel costs are considered in these tables. Comparison to national averages occurs in the appendices.

Table 23. Fuel cost reduction of monitored vehicles with PEV replacements.

Fleet	Mission	Number of Vehicles	Average % Travel CD Mode	Annual Miles CD Mode	Gallons Fuel Saved	Local Fuel Cost	Local Elect. Fuel Cost	Local Annual Fuel Savings	Local Fuel Cost Reduction
MCIE	Pool	10	76%	59,160	4,807	\$10,552	\$1,289	\$9,264	88%
MCIE	Support	25	70%	125,260	8,542	\$20,311	\$2,961	\$17,350	85%
Command	Support	18	65%	100,478	6,859	\$16,071	\$2,322	\$13,749	86%
MCIE	Enforce	5	65%	24,213	1,398	\$3,367	\$561	\$2,806	83%
MCIE	Specialty	1	68%	2,402	240	\$678	\$120	\$558	82%
Total		59	69%	311,513	21,846	\$50,979	\$7,283	\$43,727	85%

In summary, if all possible monitored vehicles were replaced with PEVs, nearly 22,000 gallons of fuel would be avoided each year. This would save over \$43,000 in fuel costs, while only using about \$7,200 of electricity. This is an average of over \$700 of savings in fuel cost per vehicle annually when replaced by a PEV.

<sup>28</sup> <http://www.eia.gov/petroleum/gasdiesel/> [accessed June 30, 2015].

<sup>29</sup> [http://www.afdc.energy.gov/uploads/publication/alternative\\_fuel\\_price\\_report\\_april\\_2015.pdf](http://www.afdc.energy.gov/uploads/publication/alternative_fuel_price_report_april_2015.pdf) [accessed June 30, 2015].

<sup>30</sup> [http://www.eia.gov/electricity/monthly/epm\\_table\\_grapher.cfm?t=epmt\\_5\\_6\\_a](http://www.eia.gov/electricity/monthly/epm_table_grapher.cfm?t=epmt_5_6_a) [accessed June 30, 2015].

<sup>31</sup> <http://www.duke-energy.com/pdfs/G9-NC-Schedule-LGS-dep.pdf> [accessed June 30, 2015].

## 5.3 Monitored Vehicles Greenhouse Gas Emissions Reduction

Table 24 provides the summary of potential GHG emissions reduction with replacement of monitored vehicles with PEVs in the missions identified in Appendices D and E. Again, no replacements are suggested for most of the specialty heavy-duty vehicles. Only the local North Carolina GHG reductions are considered in these tables. Electrical emissions are significantly lower than petroleum-based fuel emissions. Table 24 provides a total of all vehicles monitored.

Table 24. GHG emissions reduction of monitored vehicles with PEV replacements.

Fleet	Mission	Annual Miles CD Mode	Gallons Fuel Saved	Annual GHG Emissions ICE lb-CO <sub>2</sub> e	Annual PEV GHG Local lb-CO <sub>2</sub> e	Annual GHG Savings lb-CO <sub>2</sub> e	Annual GHG Reduction %
MCIE	Pool	59,160	4,807	67,204	26,254	40,950	61%
MCIE	Support	125,260	8,542	142,186	60,324	81,861	58%
Command	Support	100,478	6,859	116,215	47,306	68,908	59%
MCIE	Enforce	24,213	1,398	23,279	11,431	11,848	51%
MCIE	Specialty	2,402	240	5,406	2,451	2,955	55%
Total		311,513	21,846	354,289	147,767	206,522	58%

In summary, if all possible monitored conventional vehicles are replaced with PEVs, GHG emissions are reduced over 200,000 lb-CO<sub>2</sub>e per year. On average, each vehicle replaced results in an over 3,500 lb-CO<sub>2</sub>e reduction in GHG emissions per year.

## 5.4 Full Fleet Fuel Cost and Greenhouse Gas Reductions

The appendices identify the potential full cost and GHG reductions if all appropriate vehicles in these fleets are replaced by PEVs using the averages identified during the monitoring process (Table 25).

Table 25. Projected fuel costs and GHG reduction potential for all vehicles in monitored fleets.

Annual Miles CD Mode	Annual Fuel Cost	Annual Elect. Fuel Cost	Annual Fuel Savings	Annual Fuel Savings %	Annual GHG Emissions ICE lb-CO <sub>2</sub> e	Annual PEV GHG Local lb-CO <sub>2</sub> e	Annual GHG Savings lb-CO <sub>2</sub> e	Annual GHG Reduction %
4,455,269	\$745,106	\$99,852	\$645,255	87%	5,174,703	2,034,349	3,140,354	61%

For the vehicles represented by the full fleet at MCBCL, the annual potential fuel savings are over \$645,000 and the potential annual GHG reduction is over 1,570 tons-CO<sub>2</sub>e.

## 6. OBSERVATIONS

Intertek appreciates the opportunity to present the results of this evaluation. The following observations provide input to the next phases of this study:

- Suggested PEV replacements lead to identification of charging infrastructure needs and locations to be reported separately as part of Task 3.
- Suggested PEV replacements can be considered with vehicle age to prepare a replacement approach as part of Task 4.
- The replacement schedule will identify the charging infrastructure deployment schedule.
- Vehicle and EVSE schedules can factor into budget considerations for implementing vehicle replacements.



- Vehicle and EVSE schedules can factor into base objectives in fuel cost reductions and GHG emissions reductions.

The analysis of Section 5 shows that the average vehicle travels approximately 8,000 miles per year. This is an average of 667 miles per month or 153 miles per week. This may reflect the opportunity to increase the percentage of BEVs over that analyzed in Section 5.

Intertek suggests that MCBCL may wish to move forward in the near future to replace pool, support, and transport vehicles with PEVs as current budget and vehicle replacement schedules allow. Certainly, the vehicle types studied in this report may be candidates for immediate replacement.

# Appendix A

## Definitions

<i>Alternative fuel</i>	An alternative fuel means any fuel other than gasoline and diesel fuels, such as methanol, ethanol, and gaseous fuels (40 CFR 86.1803-01). A fuel type other than petroleum-based gasoline or diesel as defined by the Energy Policy Act (examples include ethanol, methanol, compressed natural gas, propane, and electrical energy).
<i>City fuel economy (MPG)</i>	City fuel economy means the city fuel economy determined by operating a vehicle (or vehicles) over the driving schedule in the federal emission test procedure or determined according to the vehicle-specific 5-cycle or derived 5-cycle procedures (40 CFR 600.001).
<i>Conventional fuel</i>	A petroleum-based fuel (examples include gasoline and diesel fuel).
<i>Daily travel</i>	The sum of daily trips and stops in one day.
<i>Diesel fuel</i>	Diesel means a type of engine with operating characteristics significantly similar to the theoretical diesel combustion cycle. The non-use of a throttle during normal operation is indicative of a diesel engine (49 CFR 86-1803).
<i>E85</i>	Ethanol fuel blend of up to 85% denatured ethanol fuel and gasoline or other hydrocarbons by volume.
<i>Electric vehicle</i>	<p>Electric vehicle means a motor vehicle that is powered solely by an electric motor drawing current from a rechargeable energy storage system, such as from storage batteries or other portable electrical energy storage devices, including hydrogen fuel cells, provided that</p> <ol style="list-style-type: none"> <li>(1) The vehicle is capable of drawing recharge energy from a source off the vehicle, such as residential electric service</li> <li>(2) The vehicle must be certified to the emission standards of Bin #1 of Table S04-1 in § 86.1811-09(c)(6)</li> <li>(3) The vehicle does not have an onboard combustion engine/generator system as a means of providing electrical energy (40 CFR 86-1803).</li> </ol>
<i>Ethanol-fueled vehicle</i>	Ethanol-fueled vehicle-means any motor vehicle or motor vehicle engine that is engineered and designed to be operated using ethanol fuel (i.e., a fuel that contains at least 50% ethanol (C <sub>2</sub> H <sub>5</sub> OH) by volume) as fuel (40 CFR 86.1803-01).
<i>Federal vehicle standards</i>	The document that establishes classifications for various types and sizes of vehicles, general requirements, and equipment options. It is issued annually by the GSA Vehicle Acquisition and Leasing Service's Automotive Division.
<i>Government motor vehicle</i>	Any motor vehicle that the government owns or leases. This includes motor vehicles obtained through purchase, excess, forfeiture, commercial lease, or GSA fleet lease.
<i>Gross vehicle weight rating</i>	Gross vehicle weight rating (GVWR) means the value specified by the vehicle manufacturer as the maximum design loaded weight of a single vehicle (e.g., vocational vehicle) (US Government Printing Office 2009)
<i>GSA fleet</i>	GSA fleet lease means obtaining a motor vehicle from the General Services Administration fleet (GSA fleet) (41 CFR 102-34).

<i>Heavy light-duty truck</i>	Heavy light-duty truck means any light-duty truck rated greater than 6,000 lb GVWR. The light-duty truck 3 (LDT3) and LDT4 classifications comprise the heavy light-duty truck category (40 CFR 86.1803-01).
<i>Highway fuel economy (Hwy MPG)</i>	Highway fuel economy means the highway fuel economy determined either by operating a vehicle (or vehicles) over the driving schedule in the federal highway fuel economy test procedure or determined according to either the vehicle-specific, 5-cycle equation, or the derived 5-cycle equation for highway fuel economy (40 CFR 600.001).
<i>Hybrid electric vehicle</i>	Hybrid electric vehicle means a motor vehicle that draws propulsion energy from onboard sources of stored energy that are both an internal combustion engine or heat engine using consumable fuel and a rechargeable energy storage system (such as a battery, capacitor, hydraulic accumulator, or flywheel), where recharge energy for the energy storage system comes solely from sources on board the vehicle.
<i>Idle time</i>	Idle time is logged whenever a vehicle idles with the engine running for 3 minutes or longer.
<i>Law enforcement</i>	<p>Law enforcement motor vehicle means a light-duty motor vehicle that is specifically approved in an agency's appropriation act for use in apprehension, surveillance, police, or other law enforcement work or specifically designed for use in law enforcement. If not identified in an agency's appropriation language, a motor vehicle qualifies as a law enforcement motor vehicle only in the following cases:</p> <ol style="list-style-type: none"> <li>(1) A passenger automobile having heavy-duty components for electrical, cooling, and suspension systems and at least the next higher cubic inch displacement or more powerful engine than is standard for the automobile concerned</li> <li>(2) A light truck having emergency warning lights and identified with markings such as "police"</li> <li>(3) An unmarked motor vehicle certified by the agency head as essential for the safe and efficient performance of intelligence, counterintelligence, protective, or other law enforcement duties</li> <li>(4) A forfeited motor vehicle seized by a federal agency that subsequently is used for performing law enforcement activities (41 CFR Part 102-34.35).</li> </ol>
<i>Light-duty motor vehicle</i>	Any motor vehicle with a GVWR of 8,500 pounds or less (41 CFR 102-34).
<i>Light-duty truck</i>	<p>Light-duty truck means any motor vehicle rated at 8,500 pounds GVWR or less, which has a curb weight of 6,000 pounds or less and, which has a basic vehicle frontal area of 45 square feet or less, which is as follows:</p> <ol style="list-style-type: none"> <li>(1) Designed primarily for purposes of transportation of property or is a derivation of such a vehicle</li> <li>(2) Designed primarily for transportation of persons and has a capacity of more than 12 persons</li> <li>(3) Available with special features, enabling off-street or off-highway operation and use.</li> </ol> <p>LDT1 means any light light-duty truck up through 3,750-lb loaded vehicle weight.</p> <p>LDT2 means any light light-duty truck greater than 3,750-lb loaded vehicle weight.</p>

	LDT3 means any heavy light-duty truck up through 5,750-lb adjusted loaded vehicle weight.
	LDT4 means any heavy light-duty truck greater than 5,750-lb adjusted loaded vehicle weight (US Government Printing Office 2009)
<i>Light-duty vehicle</i>	Light-duty vehicle means a passenger car or passenger car derivative capable of seating 12 passengers or less.
<i>Low-speed vehicle</i>	Low-speed vehicle means a motor vehicle <ul style="list-style-type: none"> <li>(1) That is 4-wheeled</li> <li>(2) Whose speed attainable in 1.6 km (1 mile) is more than 32 kilometers per hour (20 miles per hour) and not more than 40 kilometers per hour (25 miles per hour) on a paved level surface</li> <li>(3) Whose GVWR is less than 1,361 kilograms (3,000 pounds) (49 CFR 571.3 – Definitions).</li> </ul>
<i>Medium-duty passenger vehicle</i>	Medium-duty passenger vehicle means any heavy-duty vehicle (as defined in this subpart) with a GVWR of less than 10,000 pounds that is designed primarily for transportation of persons. The medium-duty passenger vehicle definition does not include any vehicle which <ul style="list-style-type: none"> <li>(1) Is an “incomplete truck” as defined in this subpart</li> <li>(2) Has a seating capacity of more than 12 persons</li> <li>(3) Is designed for more than 9 persons in seating rearward of the driver's seat</li> <li>(4) Is equipped with an open cargo area (for example, a pick-up truck box or bed) of 72.0 inches in interior length or more. A covered box not readily accessible from the passenger compartment will be considered an open cargo area for purposes of this definition (US Government Printing Office 2009)</li> </ul>
<i>Model year</i>	Model year means the manufacturer's annual production period (as determined by the administrator), which includes January 1 of such calendar year; provided that if the manufacturer has no annual production period, the term “model year” shall mean the calendar year (40 CFR 86-1803.01).
<i>MPG</i>	“MPG” or “mpg” means miles per gallon. This generally may be used to describe fuel economy as a quantity or it may be used as the units associated with a particular value.
<i>MPGe</i>	MPGe means miles per gallon equivalent. This generally is used to quantify a fuel economy value for vehicles that use a fuel other than gasoline. The value represents miles the vehicle can drive with the energy equivalent of one gallon of gasoline: <ul style="list-style-type: none"> <li>(c) SCF means standard cubic feet</li> <li>(d) SUV means sport utility vehicle</li> <li>(e) CREE means carbon-related exhaust emissions [76 FR 39527, July 6, 2011].</li> </ul>
<i>Non-passenger automobile</i>	A non-passenger automobile means an automobile that is not a passenger automobile or a work truck and includes vehicles described in paragraphs (a) and (b) of 49 CFR 523.5.

<i>Owning agency</i>	Owning agency means the executive agency that holds the vehicle title, manufacturer's Certificate of Origin or is the lessee of a commercial lease. This term does not apply to agencies that lease motor vehicles from the GSA fleet (41 CFR Part 102-34.35).
<i>Passenger automobile</i>	A passenger automobile is any automobile (other than an automobile capable of off-highway operation) manufactured primarily for use in the transportation of not more than 10 individuals (49 CFR 523.4 – Passenger automobile). A sedan or station wagon designed primarily to transport people (41 CFR 102-34).
<i>Pickup truck</i>	Pickup truck means a non-passenger automobile, which has a passenger compartment and an open cargo bed (49 CFR 523.2).
<i>Plug-in hybrid electric vehicle</i>	PHEV means a hybrid electric vehicle that has the capability to charge the battery from an off-vehicle electric source, such that the off-vehicle source cannot be connected to the vehicle while the vehicle is in motion (40 CFR 86.1803).
<i>Vehicle class</i>	The designation of motor vehicle types that include sedans, station wagons, ambulances, buses, and trucks, or different categories of vehicles according to Federal vehicle standards and further defined in 49 CFR 600.315-82.
<i>Vehicle configuration</i>	Vehicle configuration means a unique combination of basic engine, engine code, inertia weight class, transmission configuration, and axle ratio.
<i>Vehicle days</i>	The number of days a vehicle was driven or utilized during the (vehicle) study period.
<i>Vehicle home base</i>	The primary assigned outing beginning and ending parking location for the vehicle.
<i>Vehicle study period</i>	The time period the vehicle, within the study, has been equipped with a data logger.


# Appendix B

## Marine Corps Base Camp Lejeune Commands Group Vehicle Data Sheets

Table B-1. MCBCL Commands Group vehicle index.

Vehicle Index							
Sheet	Log	Fleet Vehicle Id	Make	Model	Year	EPA Class	Mission
1	88	291073	Ford	E250	2007	Van - Pass	Support
2	17	301321	Ford	F350	2012	Pickup	Support
3	95	G41-0762M	Dodge	Grand Caravan	2012	Minivan	Support
4	86	G41-1846K	Dodge	Grand Caravan	2011	Minivan	Support
5	83	G41-2399K	Dodge	Dakota	2010	Pickup	Support
6	90	G42-0216F	Ford	E150	2008	Van - Pass	Support
7	92	G42-0883M	Ford	E150	2012	Van - Pass	Support
8	84	G42-0898M	Ford	E150	2012	Van - Pass	Support
9	18	G43-0326H	Chevrolet	2500HD	2009	Pickup	Support
10	103	G43-1453G	Chevrolet	G2300	2008	Van - Pass	Support
11	19	G43-1855P	Ford	F350	2015	Pickup	Support
12	20	G43-2025K	Ford	F250	2010	Pickup	Support
13	110	G43-4073F	Chevrolet	G2300	2008	Van - Pass	Support
14	87	G61-0594L	Jeep	Patriot	2011	SUV	Support
15	94	G61-2644P	Jeep	Patriot	2015	SUV	Support
16	91	G62-0791H	Ford	Expedition	2009	SUV	Support
17	99	G63-0309R	Ford	F350	2015	Pickup	Support
18	120	G63-0934G	Chevrolet	K3500	2008	Pickup	Support

## Sheet 1: Vehicle 291073

	Make/Model/Year	Ford E250 – 2007
	EPA Class Size	Van - Passenger
	Mission	Support
	Contact	Marine Headquarters
	Parking Location	Building PP2
	Fleet Vehicle ID	291073
	Fuel Type	Gas
	EPA Label/MPG (City/Hwy/Combined)*	14/19/16
	EPA GHG Emissions (Grams CO <sub>2</sub> /Mi)*	555
	Study Logger ID	88
	Total Vehicle Days/Total Study Days	14/33

Vehicle 291073 Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	17.3/45.8	7.1/25.6	4.1/21.8	243
Travel Time (Minutes)	89.0/272.0	36.7/152.0	20.8/130.0	1,249
Idle Time (Minutes)	36.6/NA	15.1/NA	8.6/NA	513

Total Stops			Stop Duration	
Distance From Home Base (Miles)	Stops	Percentages	Stop Duration (Hours)	Stops
Less than 10	57	100%	Less than 2	37
10 to 20	0	0%	2 to 4	4
20 to 40	0	0%	4 to 8	3
40 to 60	0	0%	Greater than 8	13

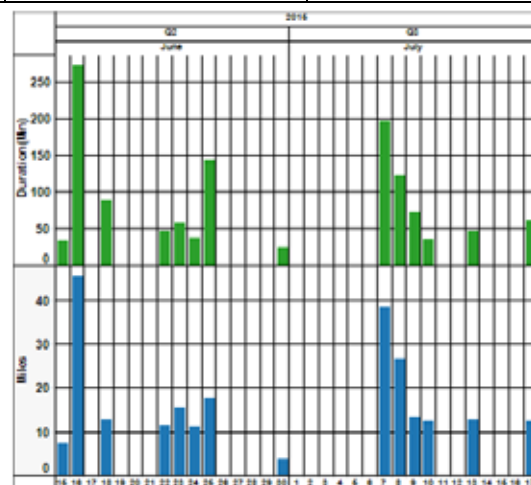
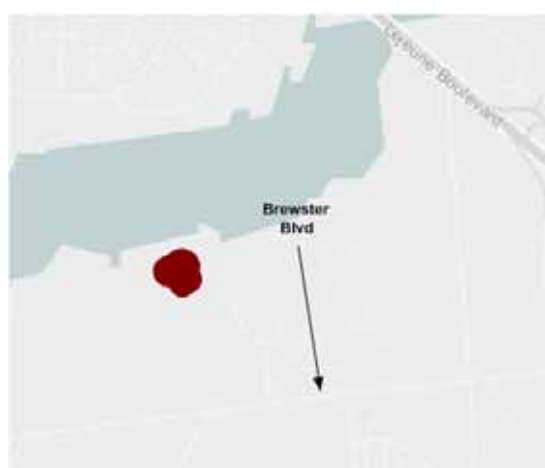


Figure B-1. Vehicle 291073 stops.

Figure B-2. Vehicle 291073 history.

\*EPA economy is not available for E250. Economy used is for F150.

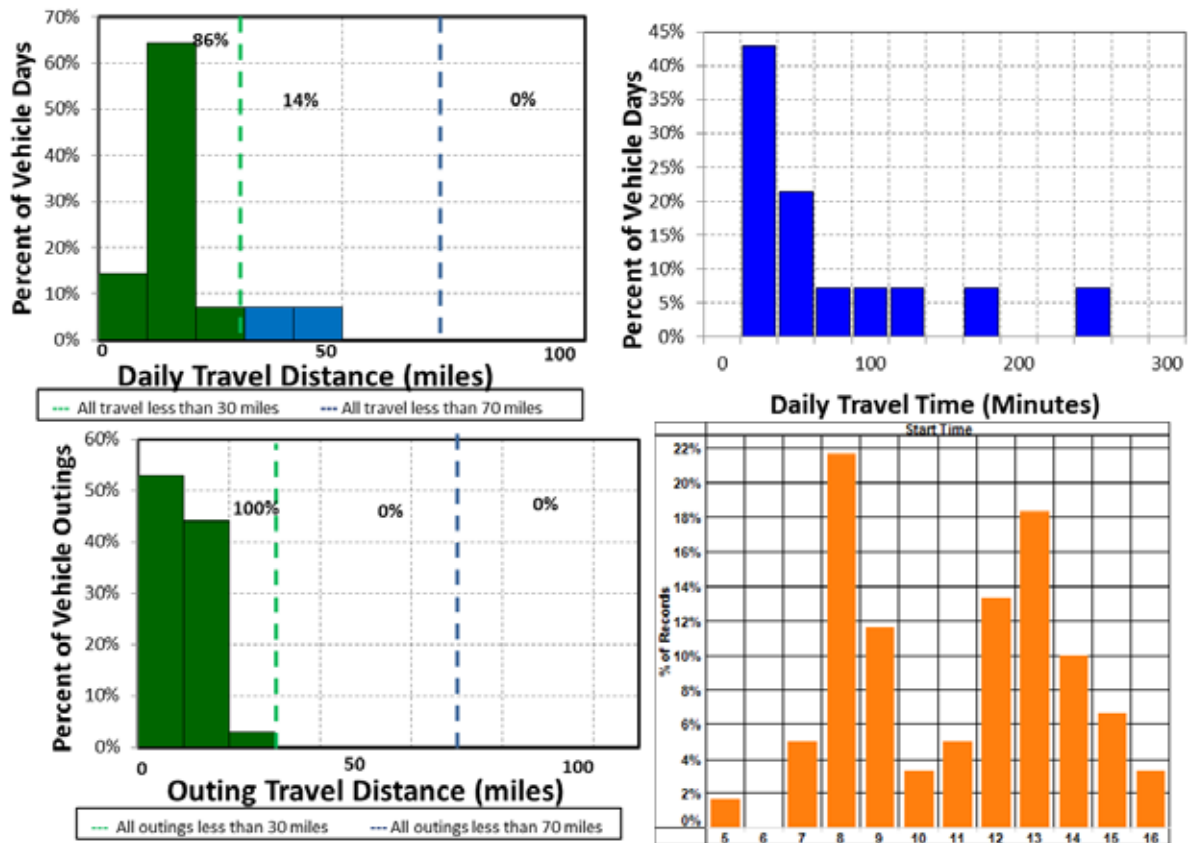


Figure B-3. Vehicle 291073 travel graphs.

### Vehicle 291073 Observations

Logger 88 collected data on this vehicle for a period of 14 days of the 33-day study period. Validation occurred on 97.6% of the input data. Data indicate that this vehicle has a support mission for the Marine Headquarters Group. This vehicle's data indicate it parks near Building PP2 on Hospital Corps Boulevard as shown in the Google Earth figure to the right.

MCBCL reports a recent odometer reading of 45,547 miles and an average annual mileage of 2,935 miles. The vehicle was used on 42% of the available days, with an average daily usage of 1.5 hours and a peak daily usage of 4.5 hours on the days it was used. The vehicle was used primarily during day shift hours.




Figure B-3 shows that all daily travel was within the typically advertised range of a BEV of approximately 70 miles. All outings were also within this range. Further, 86% of daily travel and all outings were within the typically advertised CD mode of 30 miles for PHEVs.

A BEV could meet all daily travel without additional charging opportunities, assuming the vehicle was assigned a home base.



## Sheet 2: Vehicle 301321

	Make/Model/Year	Ford F350 - 2012
	EPA Class Size	Pickup
	Mission	Support
	Contact	School of Infantry
	Parking Location	Building G644
	Fleet Vehicle ID	301321
	Fuel Type	E85
	EPA Label/MPG (City/Hwy/Combined)*	9/12/10
	EPA GHG Emissions (Grams CO <sub>2</sub> /Mi)*	620
	Study Logger ID	17
	Total Vehicle Days/Total Study Days	9/40

Vehicle 301321 Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	12.3/31.7	8.5/31.7	3.6/28.3	111
Travel Time (Minutes)	60.7/137.0	42.0/217.0	17.6/78.0	546
Idle Time (Minutes)	28.7/NA	19.8/NA	8.3/NA	258

Total Stops			Stop Duration	
Distance From Home Base (Miles)	Stops	Percentages	Stop Duration (Hours)	Stops
Less than 10	27	100%	Less than 2	17
10 to 20	0	0	2 to 4	2
20 to 40	0	0	4 to 8	1
40 to 60	0	0	Greater than 8	7



Figure B-4. Vehicle 301321 stops.

\*Fuel Economy for F350 is not available. Figures used are for E350.

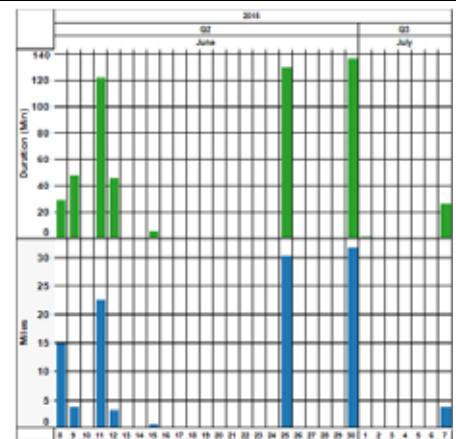


Figure B-5. Vehicle 301321 history.

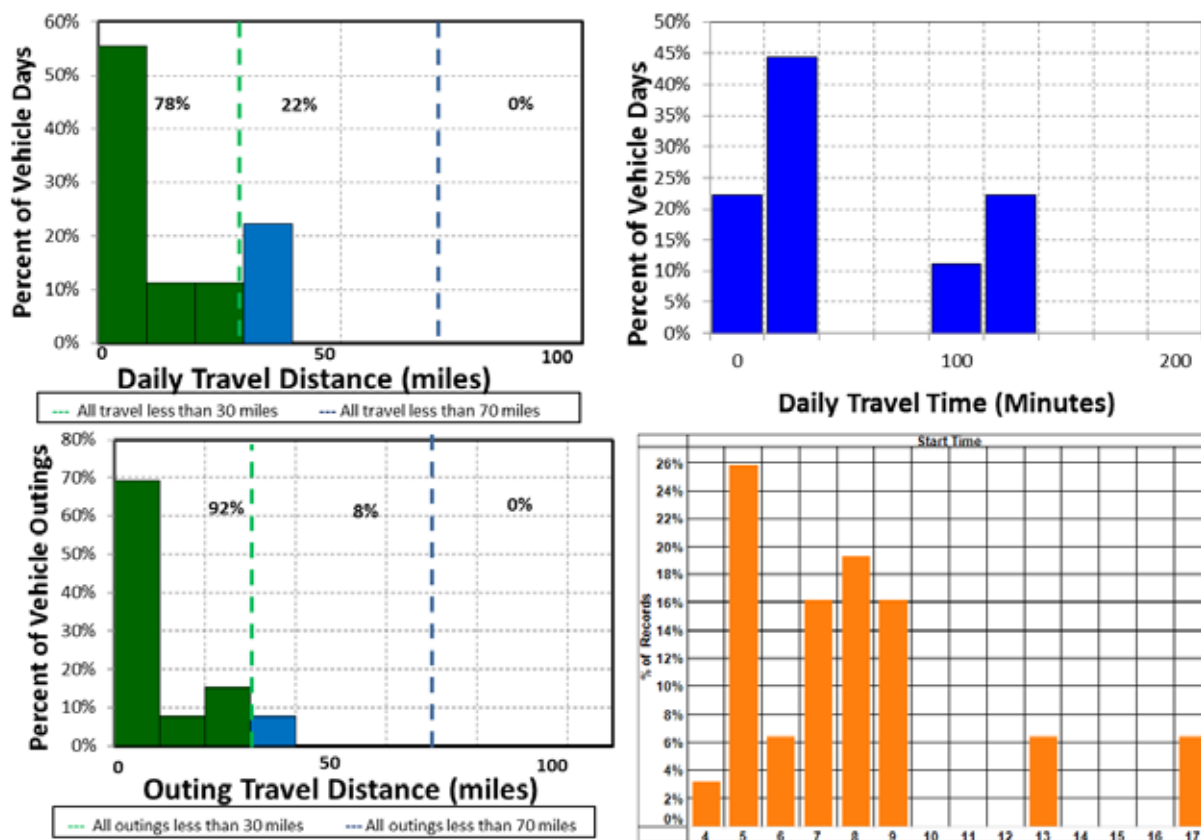


Figure B-6. Vehicle 301321 travel graphs.

## Vehicle 301321 Observations

Logger 17 collected data on this vehicle for a period of 9 days of the 40-day study period. Validation occurred on 100% of the input data. Data indicate that this vehicle has a support mission for the School of Infantry. This vehicle's data indicate it parks near Building TC771 on G Street as shown in the Google Earth figure to the right.


MCBCL reports that the vehicle odometer indicated a recent odometer reading of 11,849 miles at the start of this study and an average annual mileage of 3,669 miles. The vehicle was used on 23% of the available days, with an average daily usage of 1.0 hours and a peak daily usage of 2.3 hours on the days it was used. The vehicle was used during all hours of the day.

Figure B-6 shows all daily travel was within the typically advertised range of a BEV of approximately 70 miles. All outings were also within this range. Further, 78% of daily travel and 92% of outings were within the typically advertised CD mode of 30 miles for PHEVs.

A BEV could meet all daily travel without additional charging opportunities, assuming the vehicle was assigned a home base.



### Sheet 3: Vehicle G41-0762M

	Make/Model/Year	Dodge Grand Caravan – 2012
	EPA Class Size	Minivan
	Mission	Support
	Contact	Marine Aircraft Group 26
	Parking Location	Building AS217
	Fleet Vehicle ID	G41-0762M
	Fuel Type	E85
	EPA Label/MPG (City/Hwy/Combined)	12/18/14
	EPA GHG Emissions (Grams CO <sub>2</sub> /Mi)	443
	Study Logger ID	95
	Total Vehicle Days/Total Study Days	22/33

Vehicle G41-0762M Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	63.7/140.8	27.0/125.4	11.7/59.6	1,402
Travel Time (Minutes)	154.7/411.0	65.5/318.0	28.4/128.0	3,404
Idle Time (Minutes)	37.2/NA	15.8/NA	6.8/NA	819

Total Stops			Stop Duration	
Distance From Home Base (Miles)	Stops	Percentages	Stop Duration (Hours)	Stops
Less than 10	86	78.9%	Less than 2	70
10 to 20	0	0	2 to 4	7
20 to 40	23	21.1%	4 to 8	13
40 to 60	0	0	Greater than 8	19

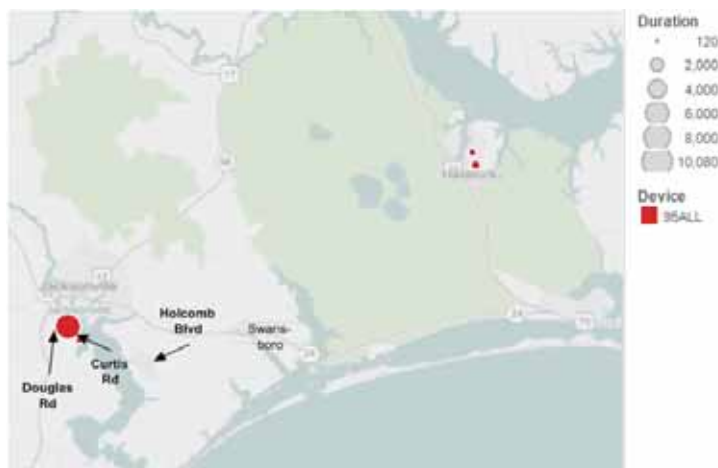


Figure B-7. Vehicle G41-0762M stops.

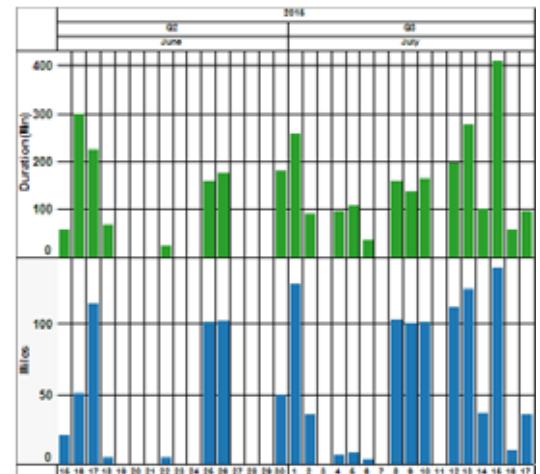


Figure B-8. Vehicle G41-0762M history.

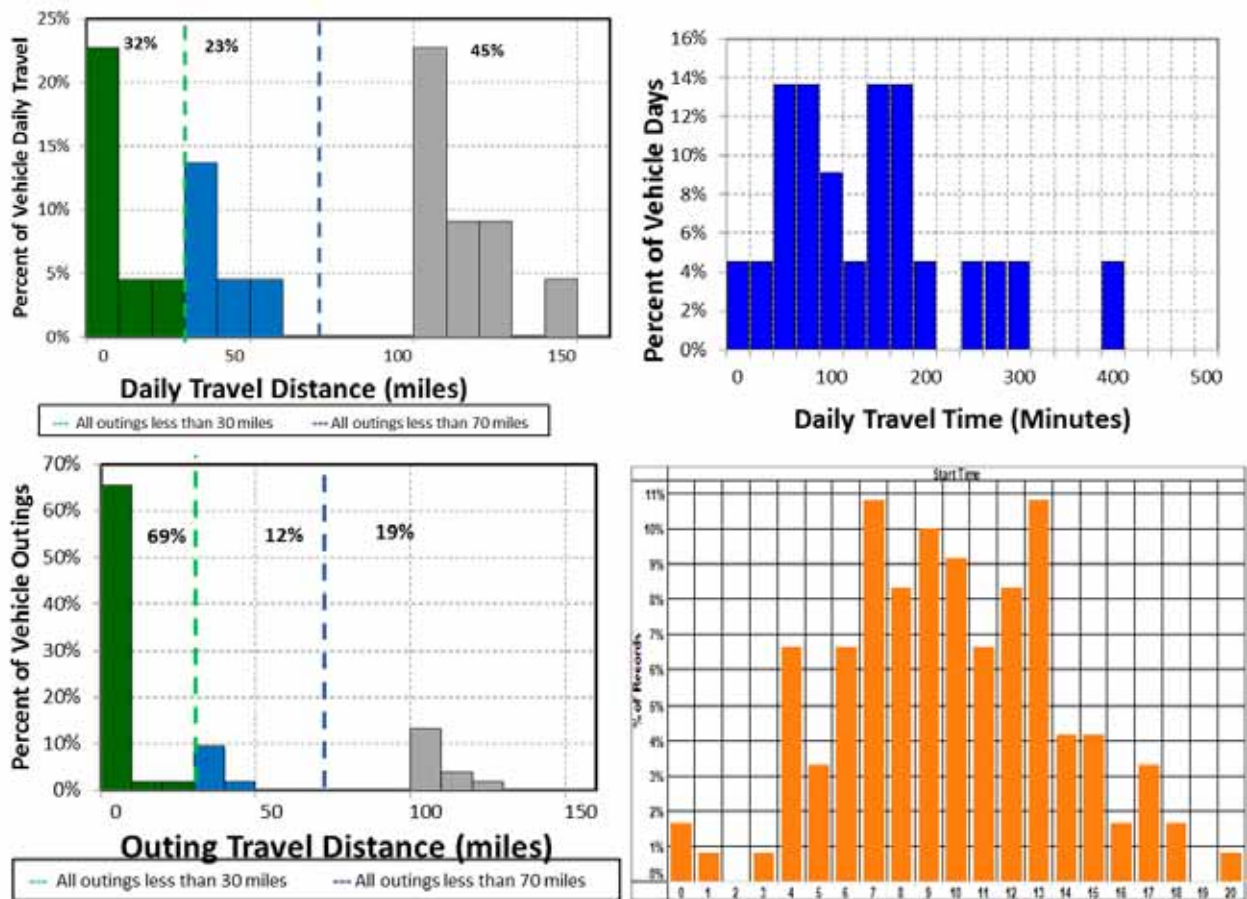


Figure B-9. Vehicle G41-0762M travel graphs.

## Vehicle G41-0762M Observations

Logger 95 collected data on this vehicle for a period of 22 days of the 33-day study period. Validation occurred on 99.4% of the input data. Data indicate that this vehicle has a support mission for MAG26. This vehicle's data indicate it parks near Building AS217 on Campbell Street as shown in the Google Earth figure to the right.


MCBCL reports that a recent odometer indicated 24,992 miles and an average annual mileage of 20,099 miles. The vehicle was used on 67% of the available days, with an average daily usage of 2.6 hours and a peak daily usage of 6.9 hours on the days it was used. The vehicle was used primarily during extended day shift hours.

Figure B-9 shows that 55% of daily travel was within the typically advertised range of a BEV of approximately 70 miles and 81% of outings were also within this range. Further, 32% of daily travel and 69% of outings were within the typically advertised CD mode of 30 miles for PHEVs.

A BEV could not meet all daily travel without additional charging opportunities, assuming the vehicle was assigned a home base. However, because several outings also exceeded the BEV range, a PHEV would be recommended.



# Sheet 4: Vehicle G41-1846K

	Make/Model/Year	Dodge Grand Caravan – 2011
	EPA Class Size	Minivan
	Mission	Support
	Contact	Special Operation Training
	Parking Location	Building BA134
	Fleet Vehicle ID	G41-1846K
	Fuel Type	E85
	EPA Label/MPG (City/Hwy/Combined)	12/18/14
	EPA GHG Emissions (Grams CO <sub>2</sub> /Mi)	443
	Study Logger ID	86
	Total Vehicle Days/Total Study Days	11/30

Vehicle G41-1846K Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	93.1/405.0	42.7/788.0	15.5/208.1	1,024
Travel Time (Minutes)	147.6/510.0	67.7/911.0	24.6/179.0	1,624
Idle Time (Minutes)	37.0/NA	17.0/NA	6.2/NA	407

Total Stops			Stop Duration	
Distance From Home Base (Miles)	Stops	Percentages	Stop Duration (Hours)	Stops
Less than 10	39	81.3%	Less than 2	32
10 to 20	0	0	2 to 4	5
20 to 40	0	0	4 to 8	2
Greater than 40	9	18.7%	Greater than 8	9

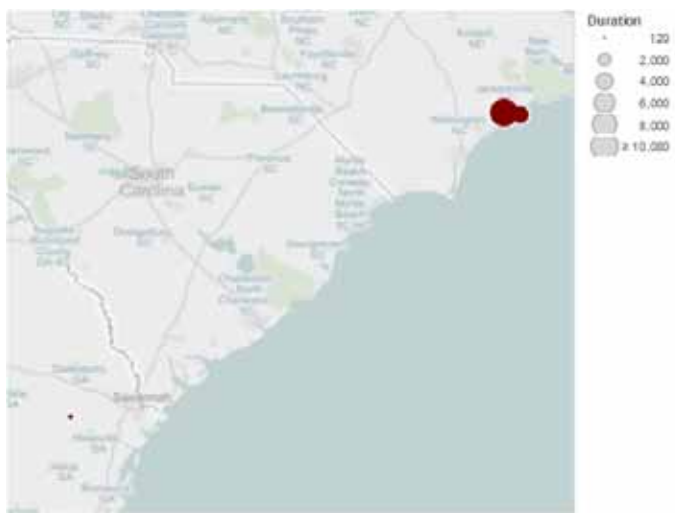


Figure B-10. Vehicle G41-1846K stops.

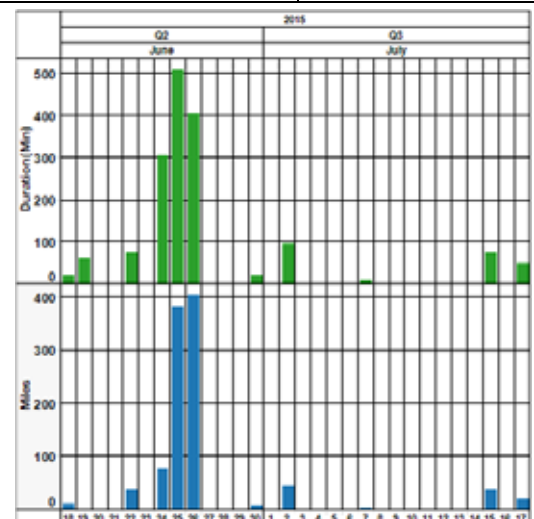


Figure B-11. Vehicle G41-1846K history.



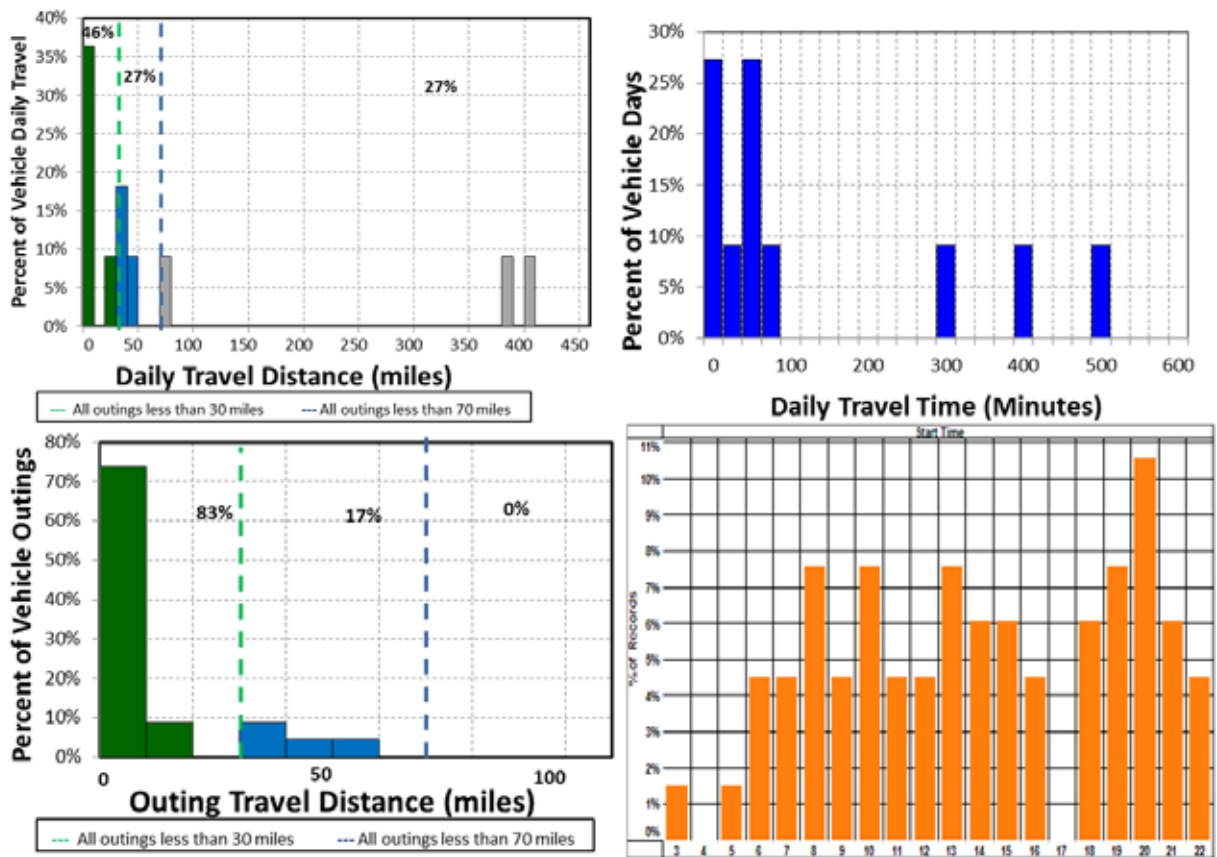


Figure B-12. Vehicle G41-1846K travel graphs. Note that the maximum outing of 788 miles is not shown for clarity of scale.

## Vehicle G41-1846K Observations

Logger 86 collected data on this vehicle for a period of 11 days of the 30-day study period. Validation occurred on 100% of the input data. Data indicate that this vehicle has a support mission for Special Operations Training. This vehicle's data indicate it parks overnight at several different locations, including near Dr G W Carver Street but mostly near Building BA134 on Ocean Drive as shown in the Google Earth figure to the right.


MCBCL reports that a recent vehicle odometer indicated 43,151 miles and an average annual mileage of 12,317 miles. The vehicle was used on 37% of the available days, with an average daily usage of 2.5 hours and a peak daily usage of 8.5 hours on the days it was used. The vehicle was used during all hours of the day.



Figure B-12 shows that 73% of daily travel was within the typically advertised range of a BEV of approximately 70 miles. Nearly 100% of outings were also within this range. Further, 46% of daily travel and 83% of outings were within the typically advertised CD mode of 30 miles for PHEVs. The peak outing of 788 miles occurred over a several day period on an excursion to Hindsville, Georgia and Florence, South Carolina.

A BEV could not meet all daily travel without additional charging opportunities, assuming the vehicle was assigned a home base. In addition, the long excursion exceeded the BEV range, even with additional charge opportunities. A PHEV would be suggested.

## Sheet 5: Vehicle G41-2399K

	Make/Model/Year	Dodge Dakota – 2010
	EPA Class Size	Pickup
	Mission	Support
	Contact	2 <sup>nd</sup> Marine Division
	Parking Location	Building 1707
	Fleet Vehicle ID	G41-2399K
	Fuel Type	E85
	EPA Label/MPG (City/Hwy/Combined)	9/13/10
	EPA GHG Emissions (Grams CO <sub>2</sub> /Mi)	620
	Study Logger ID	83
	Total Vehicle Days/Total Study Days	11/32

Vehicle G41-2399K Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	31.1/100.8	14.3/60.0	7.6/59.7	342
Travel Time (Minutes)	110.6/317.0	50.7/181.0	27.0/165.0	1,217
Idle Time (Minutes)	37.8/NA	17.3/NA	9.2/NA	416

Total Stops			Stop Duration	
Distance From Home Base (Miles)	Stops	Percentages	Stop Duration (Hours)	Stops
Less than 10	38	100%	Less than 2	24
10 to 20	0	0	2 to 4	3
20 to 40	0	0	4 to 8	1
40 to 60	0	0	Greater than 8	10

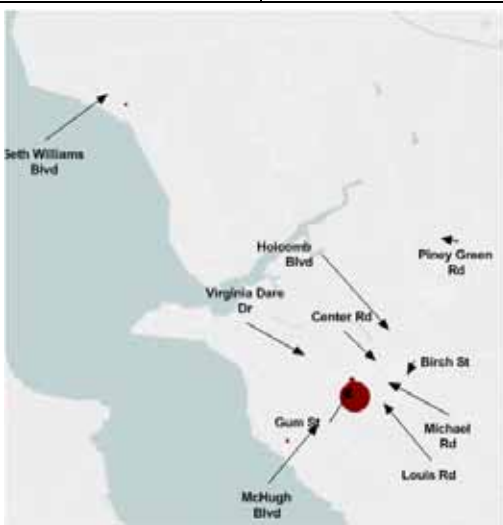


Figure B-13. Vehicle G41-2399K stops.

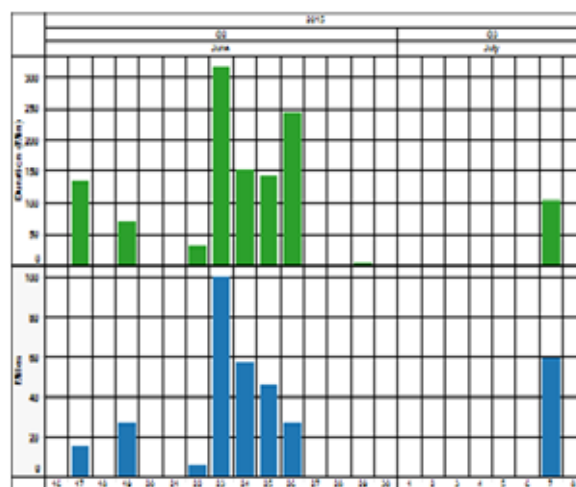


Figure B-14. Vehicle G41-2399K history.

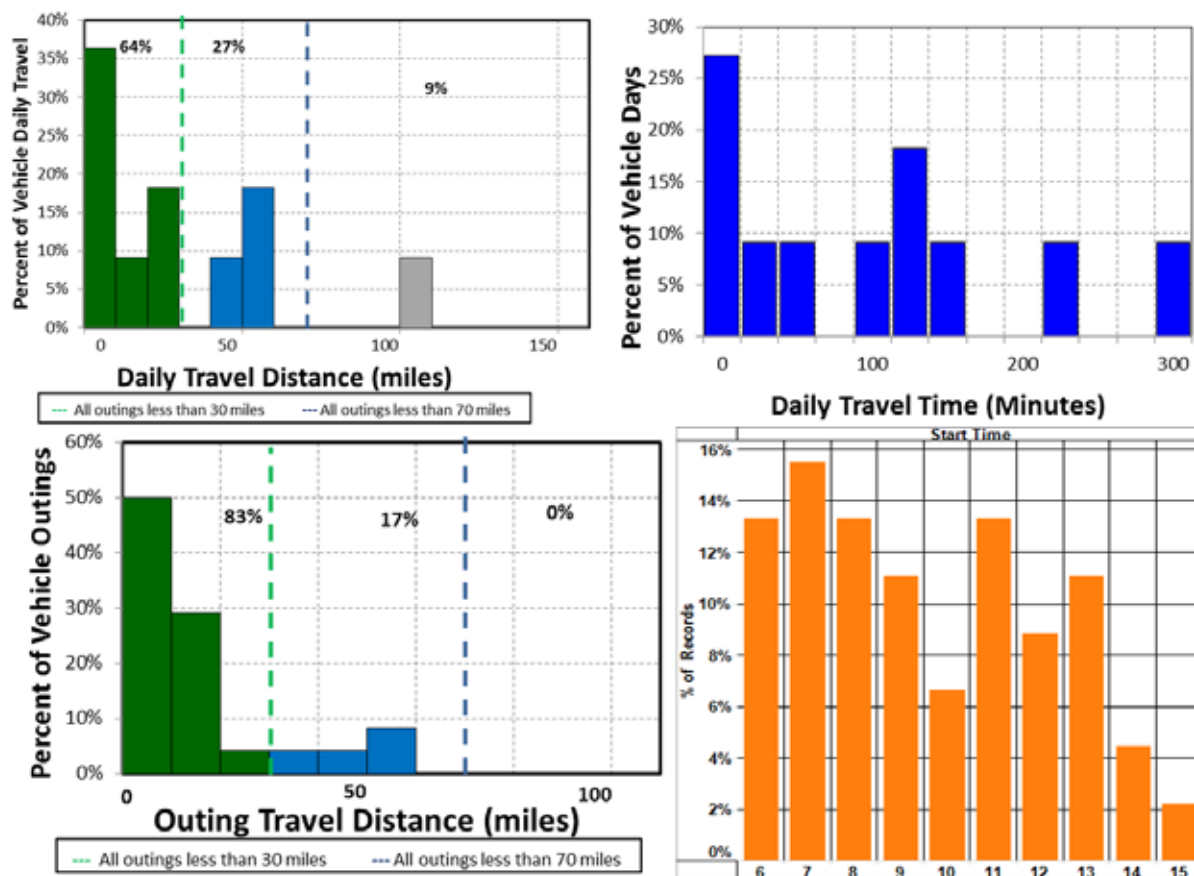


Figure B-15. Vehicle G41-2399K travel graphs.

## Vehicle G41-2399K Observations

Logger 83 collected data on this vehicle for a period of 11 days of the 32-day study period. Validation occurred on 100% of the input data. Data indicate that this vehicle has a support mission for the 2nd Marine Division. This vehicle's data indicate it parks near Building 1707 on Gum Street as shown in the Google Earth figure to the right.

MCBCL reports that a recent vehicle odometer indicated 32,811 miles and an average annual mileage of 10,754 miles. The vehicle was used on 34% of the available days, with an average daily usage of 1.8 hours and a peak daily usage of 5.3 hours on the days it was used. The vehicle was used during typical day shift hours.




Figure B-15 shows that 91% of daily travel was within the typically advertised range of a BEV of approximately 70 miles. All outings were also within this range. Further, 64% of daily travel and 83% of outings were within the typically advertised CD mode of 30 miles for PHEVs.

A BEV could not meet all daily travel without additional charging opportunities, assuming the vehicle was assigned a home base. Time does exist each day for additional charging. Thus, a fleet of support vehicles would likely contain a mix of BEVs and PHEVs.



## Sheet 6: Vehicle G42-0216F

	Make/Model/Year	Ford E150 – 2008
	EPA Class Size	Van – Passenger
	Mission	Support
	Contact	Marine Headquarters Group
	Parking Location	Building 102
	Fleet Vehicle ID	G42-0216F
	Fuel Type	Gas
	EPA Label/MPG (City/Hwy/Combined)*	14/20/16
	EPA GHG Emissions (Grams CO <sub>2</sub> /Mi)*	555
	Study Logger ID	90
	Total Vehicle Days/Total Study Days	32/32

Vehicle G42-0216F Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	50.2/140.1	11.7/97.6	4.3/46.1	1,608
Travel Time (Minutes)	167.4/477.0	39.1/243.0	14.5/116.0	5,356
Idle Time (Minutes)	27.7/NA	6.5/NA	2.4/NA	885

Total Stops			Stop Duration	
Distance From Home Base (Miles)	Stops	Percentages	Stop Duration (Hours)	Stops
Less than 10	348	99.1%	Less than 2	245
10 to 20	2	0.6%	2 to 4	44
20 to 40	1	0.3%	4 to 8	46
40 to 60	0	0	Greater than 8	16



Figure B-16. Vehicle G42-0216F stops.

\*Fuel economy for E150 is not available. Economy used is for F150.

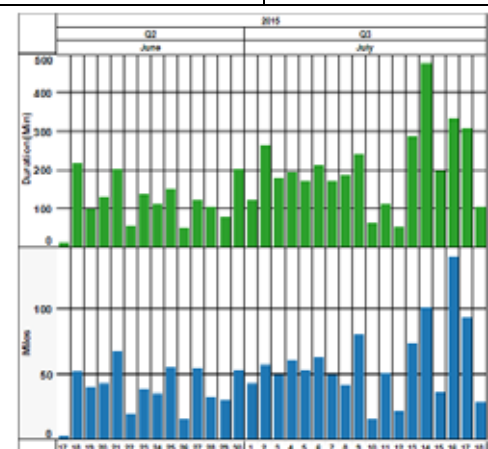


Figure B-17. Vehicle G42-0216F history.

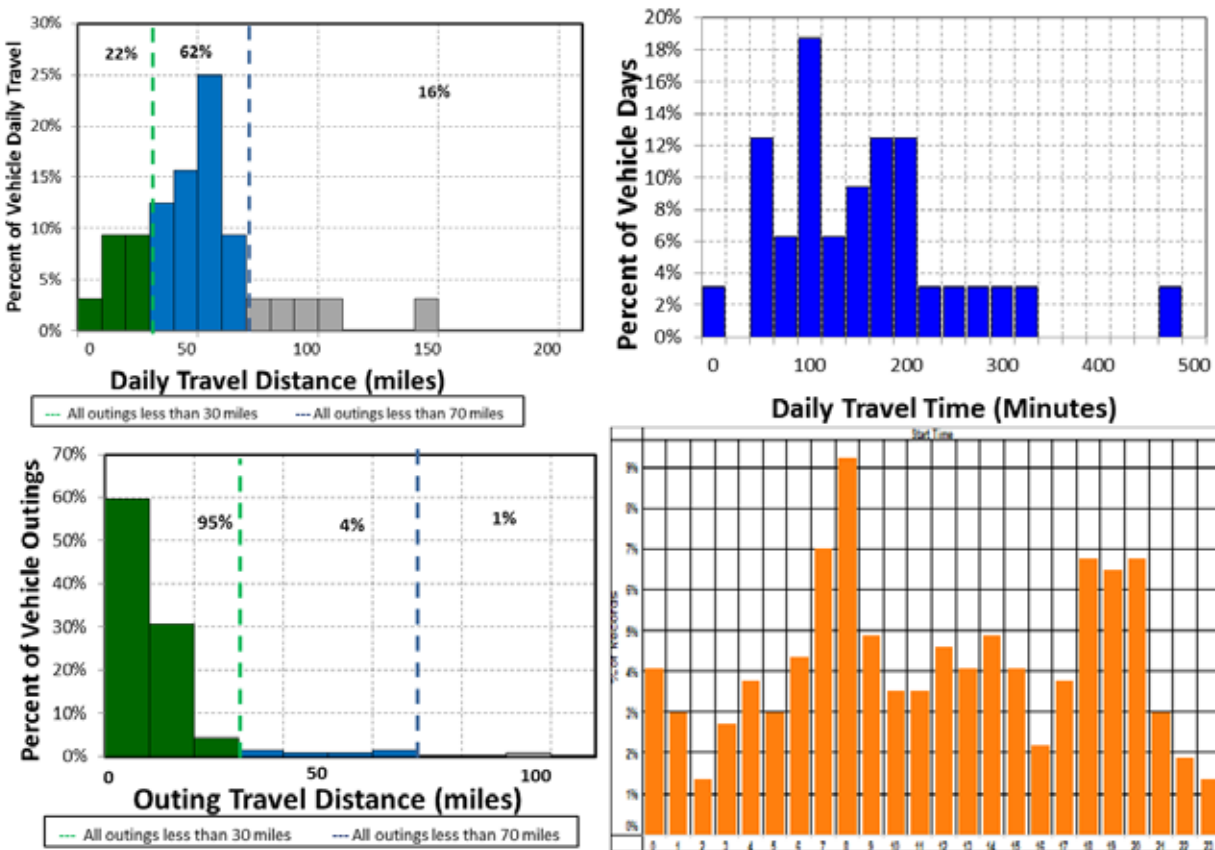


Figure B-18. Vehicle G42-0216F travel graphs.

## Vehicle G42-0216F Observations

Logger 90 collected data on this vehicle for a period of 32 days of the 32-day study period. Validation occurred on 100% of the input data. Data indicate that this vehicle has a support mission for the Marine Headquarters Group. This vehicle's data indicate it parks near Building 102 on A Street as shown in the Google Earth figure to the right.


MCBCL reports that a recent vehicle odometer indicated 16,356 miles and an average annual mileage of 2,189 miles. The vehicle was used on 100% of the available days, with an average daily usage of 2.8 hours and a peak daily usage of 8.0 hours on the days it was used. The vehicle was used during all hours of the day.

Figure B-18 shows that 84% of daily travel was within the typically advertised range of a BEV of approximately 70 miles and 99% of the outings were also within this range. Further, 22% of daily travel and 95% of outings were within the typically advertised CD mode of 30 miles for PHEVs.

A BEV could not meet all daily travel without additional charging opportunities, assuming the vehicle was assigned a home base. However, most of the daily travel was within the BEV's capability. Thus, a fleet of support passenger vehicles would likely contain a mix of BEVs and PHEVs.



## Sheet 7: Vehicle G42-0883M

	Make/Model/Year	Ford E150 – 2012
	EPA Class Size	Van – Passenger
	Mission	Support
	Contact	Marine Aircraft Group 29
	Parking Location	Building AS4108
	Fleet Vehicle ID	G42-0883M
	Fuel Type	E85
	EPA Label/MPG (City/Hwy/Combined)	9/12/10
	EPA GHG Emissions (Grams CO <sub>2</sub> /Mi)	620
	Study Logger ID	92
Total Vehicle Days/Total Study Days		23/33

Vehicle G42-0883M Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	85.7/214.5	38.7/126.8	14.1/94.8	1,972
Travel Time (Minutes)	176.0/363.0	79.4/307.0	28.9/163.0	4,048
Idle Time (Minutes)	27.7/NA	12.5/NA	4.6/NA	637

Total Stops			Stop Duration	
Distance From Home Base (Miles)	Stops	Percentages	Stop Duration (Hours)	Stops
Less than 10	83	67.5%	Less than 2	88
10 to 20	2	1.6%	2 to 4	6
20 to 40	38	30.9%	4 to 8	7
40 to 60	0	0	Greater than 8	22

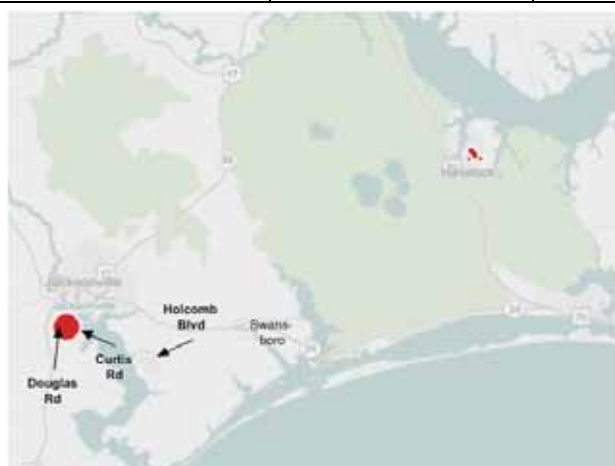


Figure B-19. Vehicle G42-0883M stops.

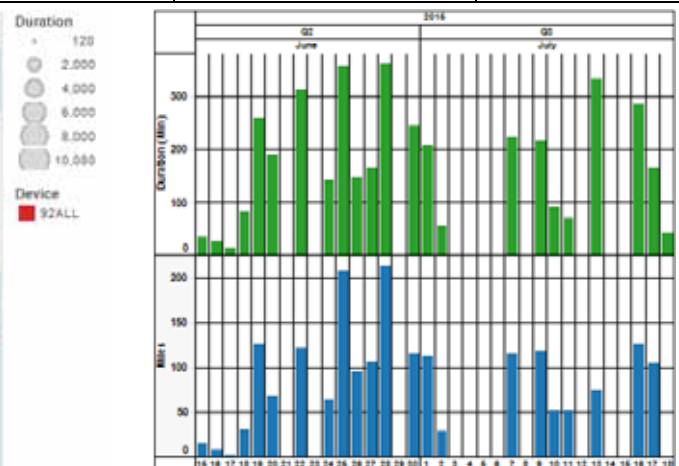


Figure B-20. Vehicle G42-0883M history.

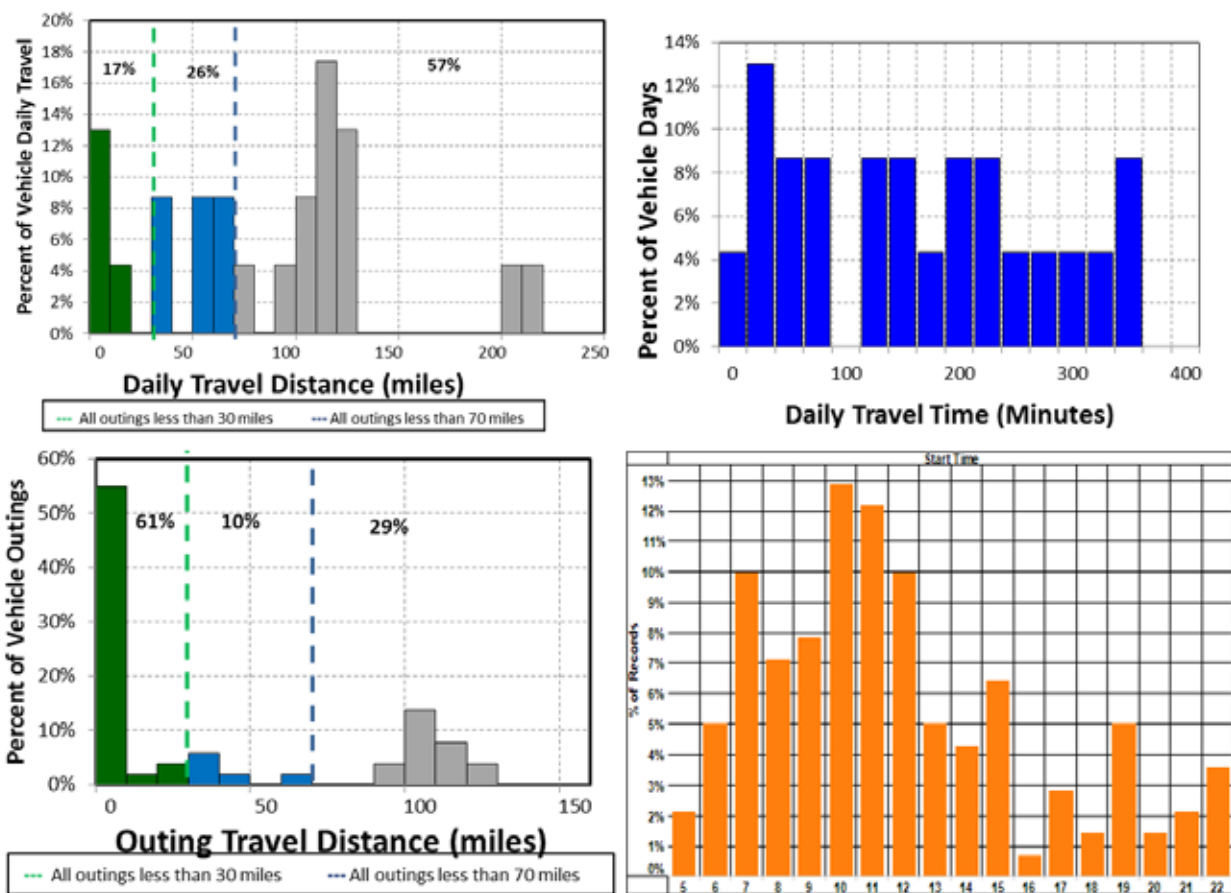


Figure B-21. Vehicle G42-0883M travel graphs.

## Vehicle G42-0883M Observations

Logger 92 collected data on this vehicle for a period of 23 days of the 33-day study period. Validation occurred on 100% of the input data. Data indicate that this vehicle has a support mission for Marine Aircraft Group 29. This vehicle's data indicate it parked overnight equally near Schmidt Street and near Building AS4108 on White Street as shown in the Google Earth figure to the right.


MCBCL reports that a recent vehicle odometer indicated 42,763 miles and an average annual mileage is 16,827 miles. The vehicle was used on 70% of the available days, with an average daily usage of 2.9 hours and a peak daily usage of 6.1 hours on the days it was used. The vehicle was used during day and evening hours.



Figure B-21 shows that 43% of daily travel was within the typically advertised range of a BEV of approximately 70 miles and 71% of the outings were also within this range. Further, 17% of daily travel and 61% of outings were within the typically advertised CD mode of 30 miles for PHEVs.

A BEV could not meet all daily travel. A PHEV would be suggested to replace this vehicle. Thus, a fleet of enforcement vehicles would likely contain a mix of BEVs and PHEVs.

## Sheet 8: Vehicle G42-0898M

	Make/Model/Year	Ford E150-2012
	EPA Class Size	Van – Passenger
	Mission	Support
	Contact	2 <sup>nd</sup> Marine Logistics Group
	Parking Location	Building FC400
	Fleet Vehicle ID	G42-0898M
	Fuel Type	E85
	EPA Label/MPG (City/Hwy/Combined)	9/12/10
	EPA GHG Emissions (Grams CO <sub>2</sub> /Mi)	620
	Study Logger ID	84
Total Vehicle Days/Total Study Days		32/32

Vehicle G42-0898M Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	40.7/201.8	6.2/143.8	4.4/68.1	1,342
Travel Time (Minutes)	231.6/549.0	35.1/269.0	24.9/269	7,644
Idle Time (Minutes)	87.6/NA	13.3/NA	9.4/NA	2,891

Total Stops			Stop Duration	
Distance From Home Base (Miles)	Stops	Percentages	Stop Duration (Hours)	Stops
Less than 10	275	98.9%	Less than 2	176
10 to 20	0	0	2 to 4	41
20 to 40	2	0.7%	4 to 8	44
40 to 60	1	0.4%	Greater than 8	17

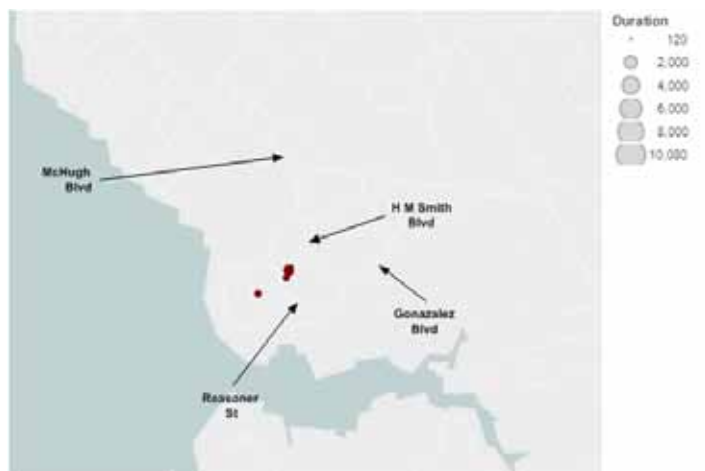


Figure B-22. Vehicle G42-0898M stops.

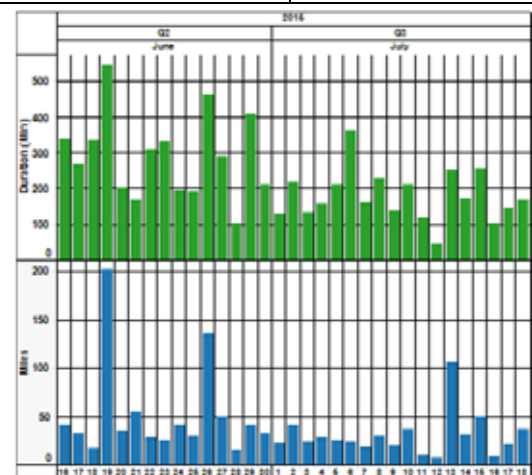


Figure B-23. Vehicle G42-0898M history.



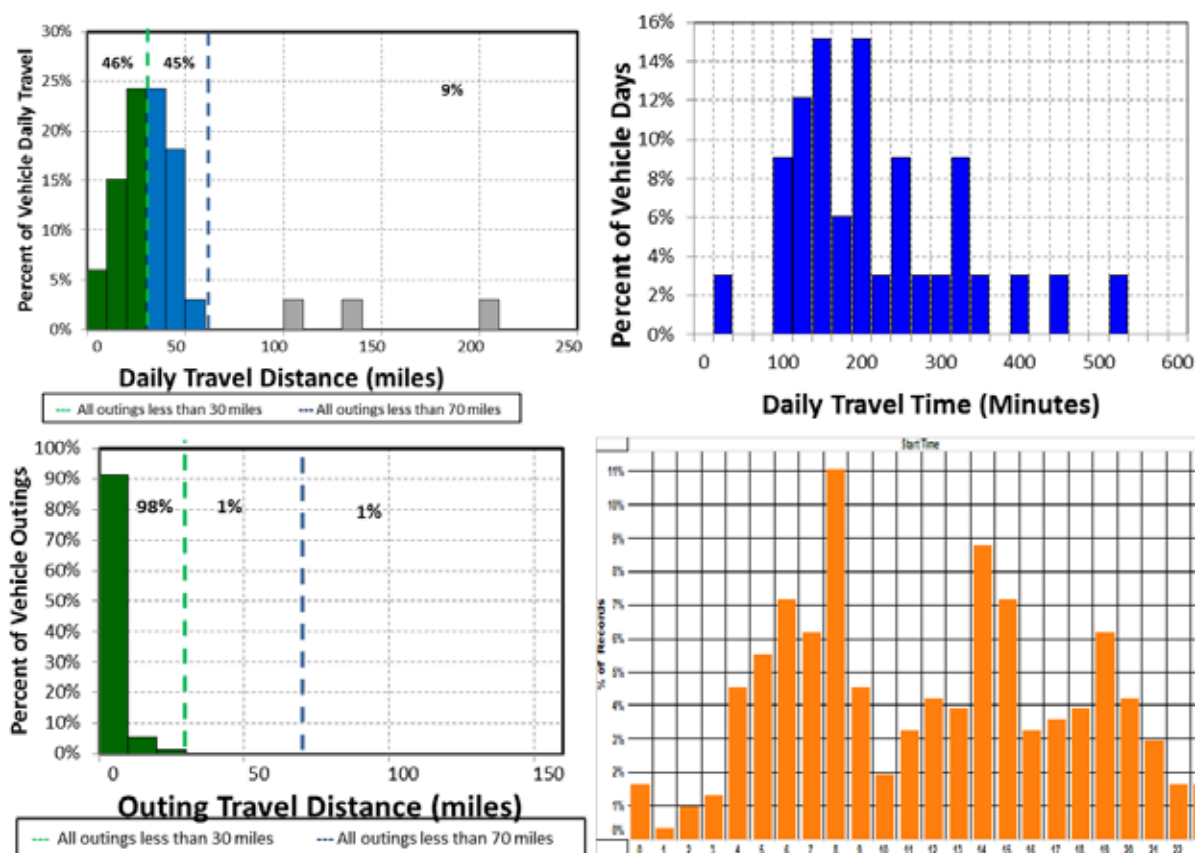


Figure B-24. Vehicle G42-0898M travel graphs. The maximum outing of 143.8 miles is not clearly visible on the above graph because of scale.

## Vehicle G42-0898M Observations

Logger 84 collected data on this vehicle for a period of 32 days of the 32-day study period. Validation occurred on 99.7% of the input data. Data indicate that this vehicle has a support mission for the 2nd Marine Logistics Group. This vehicle's data indicate it parks near Building FC400 on H M Smith Boulevard as shown in the Google Earth figure to the right.


MCBCL reports that a recent vehicle odometer indicated 36,465 miles at the start of this study and an average annual mileage of 16,246 miles. The vehicle was used on 100% of the available days, with an average daily usage of 3.9 hours and a peak daily usage of 9.2 hours on the days it was used. The vehicle was used during all hours of the day.



Figure B-24 shows that 91% of daily travel was within the typically advertised range of a BEV of approximately 70 miles and 99% of outings were also within this range. Further, 46% of daily travel and 98% of outings were within the typically advertised CD mode of 30 miles for PHEVs.

A BEV could not meet all daily travel because of the frequent longer travel days. However, because 91% of daily travel was within the range of a BEV, a fleet of vehicles would likely contain a mix of BEVs and PHEVs.

## Sheet 9: Vehicle G43-0326H

	Make/Model/Year	Chevrolet 2500HD – 2009
	EPA Class Size	Pickup
	Mission	Support
	Contact	School of Infantry
	Parking Location	Building G554
	Fleet Vehicle ID	G43-0326H
	Fuel Type	Gas
	EPA Label/MPG (City/Hwy/Combined)*	15/20/17
	EPA GHG Emissions (Grams CO <sub>2</sub> /Mi)*	592
	Study Logger ID	18
	Total Vehicle Days/Total Study Days	22/31

Vehicle G43-0326H Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	2.9/21.4	1.1/28.8	0.6/14.9	65
Travel Time (Minutes)	31.5/153.0	12.2/298.0	5.9/92.0	693
Idle Time (Minutes)	14.5/NA	5.6/NA	2.7/NA	320

Total Stops			Stop Duration	
Distance From Home Base (Miles)	Stops	Percentages	Stop Duration (Hours)	Stops
Less than 10	105	100%	Less than 2	60
10 to 20	0	0	2 to 4	9
20 to 40	0	0	4 to 8	14
40 to 60	0	0	Greater than 8	22



Figure B-25. Vehicle G43-0326H stops.

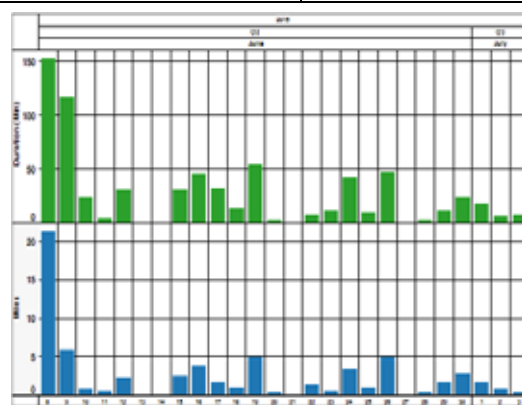


Figure B-26. Vehicle G43-0326H history.

\*Fuel economy for 2500HD is not available. Economy used is for Van 1500.

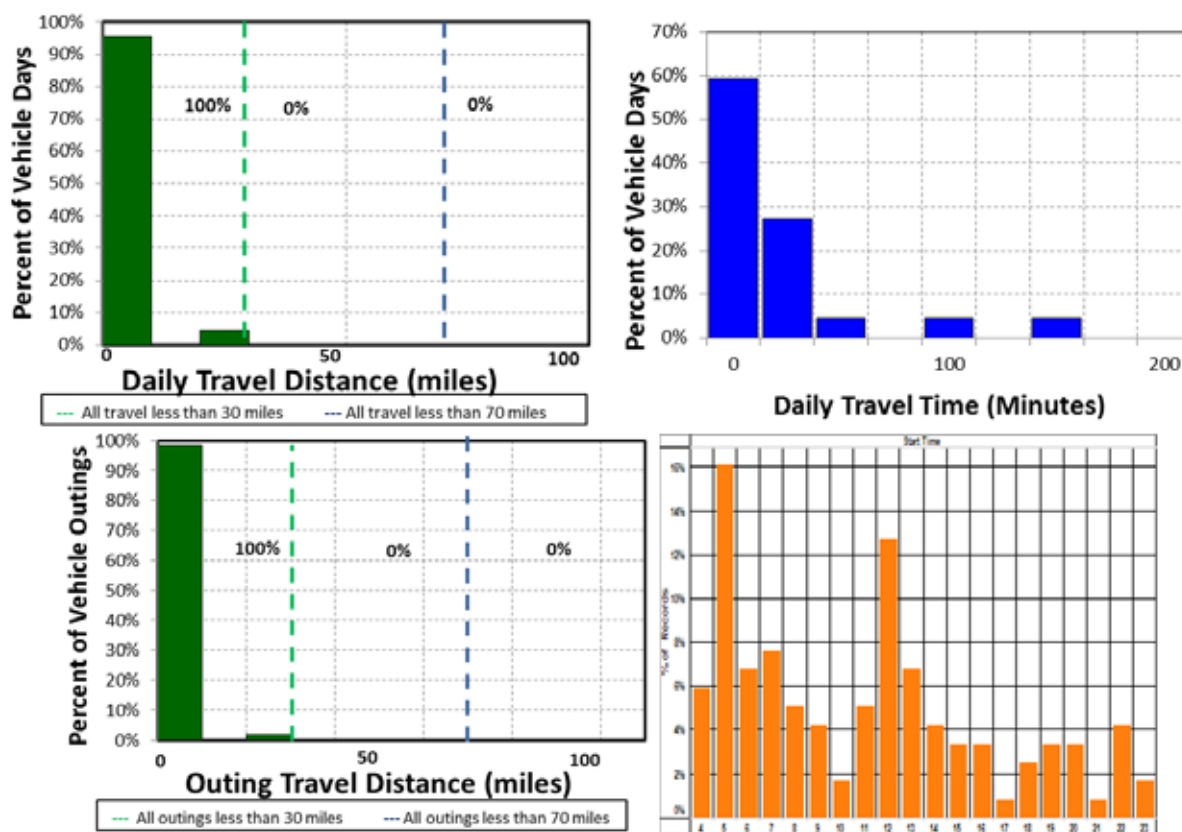


Figure B-27. Vehicle G43-0326H travel graphs.

## Vehicle G43-0326H Observations

Logger 18 collected data on this vehicle for a period of 22 days of the 31-day study period. Validation occurred on 100% of the input data. Data indicate that this vehicle has a support mission for the School of Infantry. This vehicle's data indicate it parks near Building G554 on 4th Street as shown in the Google Earth figure to the right.

MCBCL reports that a recent vehicle odometer indicated 39,522 miles and an average annual mileage of 4,863 miles. The vehicle was used on 71% of the available days, with an average daily usage of 0.5 hours and a peak daily usage of 2.6 hours on the days it was used. The vehicle was used during all hours of the day.




Figure B-27 shows all daily travel was within the typically advertised range of a BEV of approximately 70 miles. All outings were also within this range. Further, all daily travel and all outings were within the typically advertised CD mode of 30 miles for PHEVs.

A BEV could meet all daily travel without additional charging opportunities, assuming the vehicle was assigned a home base. Thus, a fleet of pickups would likely contain some PHEVs.



## Sheet 10: Vehicle G43-1453G

	Make/Model/Year	Chevrolet G2300 – 2008
	EPA Class Size	Van – Passenger
	Mission	Support
	Contact	MARSOC
	Parking Location	Building FC306 near Anderson Street
	Fleet Vehicle ID	G43-1453G
	Fuel Type	Gas
	EPA Label/MPG (City/Hwy/Combined)	15/20/17
	EPA GHG Emissions (Grams CO <sub>2</sub> /Mi)	523
	Study Logger ID	103
	Total Vehicle Days/Total Study Days	14 / 23

Vehicle G43-1453G Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	22.7/113.2	12.2/113.2	4.6/57.1	318
Travel Time (Minutes)	71.6/255.0	38.5/255.0	14.3/143.0	1,002
Idle Time (Minutes)	16.1/NA	8.7/NA	3.2/NA	226

Total Stops			Stop Duration	
Distance From Home Base (Miles)	Stops	Percentages	Stop Duration (Hours)	Stops
Less than 10	64	98.5%	Less than 2	44
10 to 20	0	0	2 to 4	4
20 to 40	1	1.5%	4 to 8	5
40 to 60	0	0	Greater than 8	12



Figure B-28. Vehicle G43-1453G stops.

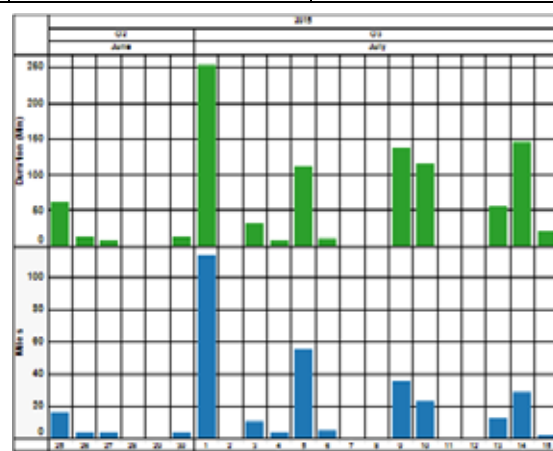


Figure B-29. Vehicle G43-1453G history.

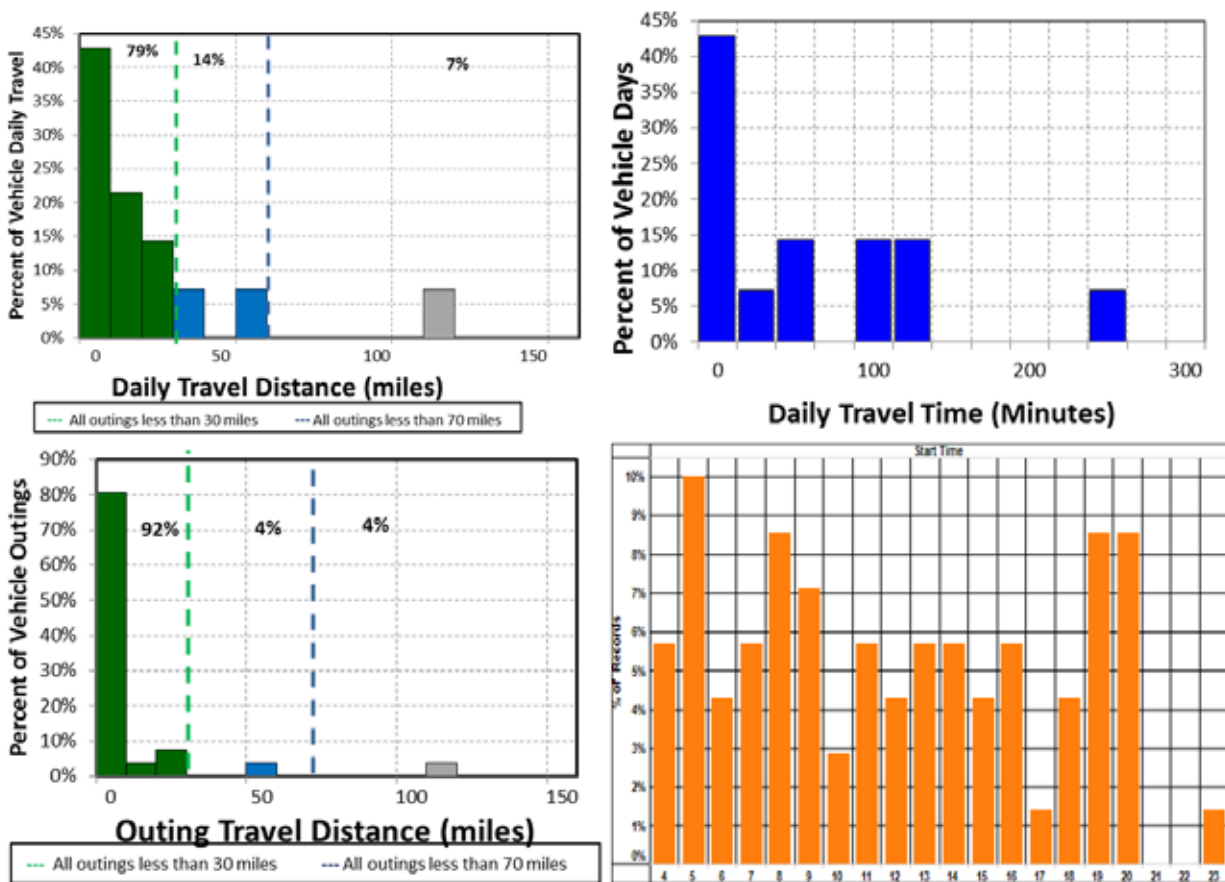


Figure B-30. Vehicle G43-1453G travel graphs.

## Vehicle G43-1453G Observations

Logger 103 collected data on this vehicle for a period of 14 days of the 23-day study period. Validation occurred on 100% of the input data. Data indicate that this vehicle has a support mission for Marine Corps Forces Special Operations Command. This vehicle's data indicate it parks near Building FC306 near Anderson Street as shown in the Google Earth figure to the right.


MCBCL reports that a recent vehicle odometer indicated 64,529 miles and an average annual mileage of 15,539 miles. The vehicle was used on 61% of the available days, with an average daily usage of 1.2 hours and a peak daily usage of 4.3 hours on the days it was used. The vehicle was used during all hours of the day.



Figure B-30 shows that 93% of daily travel was within the typically advertised range of a BEV of approximately 70 miles and 96% of the outings were also within this range. Further, 79% of daily travel and 92% of outings were within the typically advertised CD mode of 30 miles for PHEVs.

A BEV could not meet all daily travel without additional charging opportunities, assuming the vehicle was assigned a home base. However, a significant amount of daily travel was within the range of a BEV and there is sufficient time each day for recharging. Thus, a fleet of passenger vans would likely contain a mix of BEVs and PHEVs.

## Sheet 11: Vehicle G43-1855P

	Make/Model/Year	Ford F350-2015
	EPA Class Size	Pickup
	Mission	Support
	Contact	School of Infantry
	Parking Location	Building G702 on B St
	Fleet Vehicle ID	G43-1855P
	Fuel Type	E85
	EPA Label/MPG (City/Hwy/Combined)*	13/18/15
	EPA GHG Emissions (Grams CO <sub>2</sub> /Mi)*	419
	Study Logger ID	19
	Total Vehicle Days/Total Study Days	18/31

Vehicle G43-1855P Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	36.5/141.6	11.9/99.0	5.6/60.3	657
Travel Time (Minutes)	137.7/393.0	45.1/217.0	21.0/177.0	2,479
Idle Time (Minutes)	58.4/NA	19.1/NA	8.9/NA	1,051

Total Stops			Stop Duration	
Distance From Home Base (Miles)	Stops	Percentages	Stop Duration (Hours)	Stops
Less than 10	86	82.7%	Less than 2	70
10 to 20	18	17.3%	2 to 4	14
20 to 40	0	0	4 to 8	4
40 to 60	0	0	Greater than 8	16



Figure B-31. Vehicle G43-1855P stops.

\*Fuel economy for F350 is not available. Economy used is for F150.

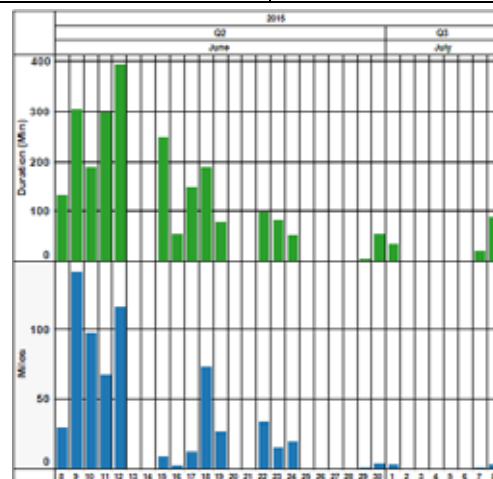


Figure B-32. Vehicle G43-1855P history.

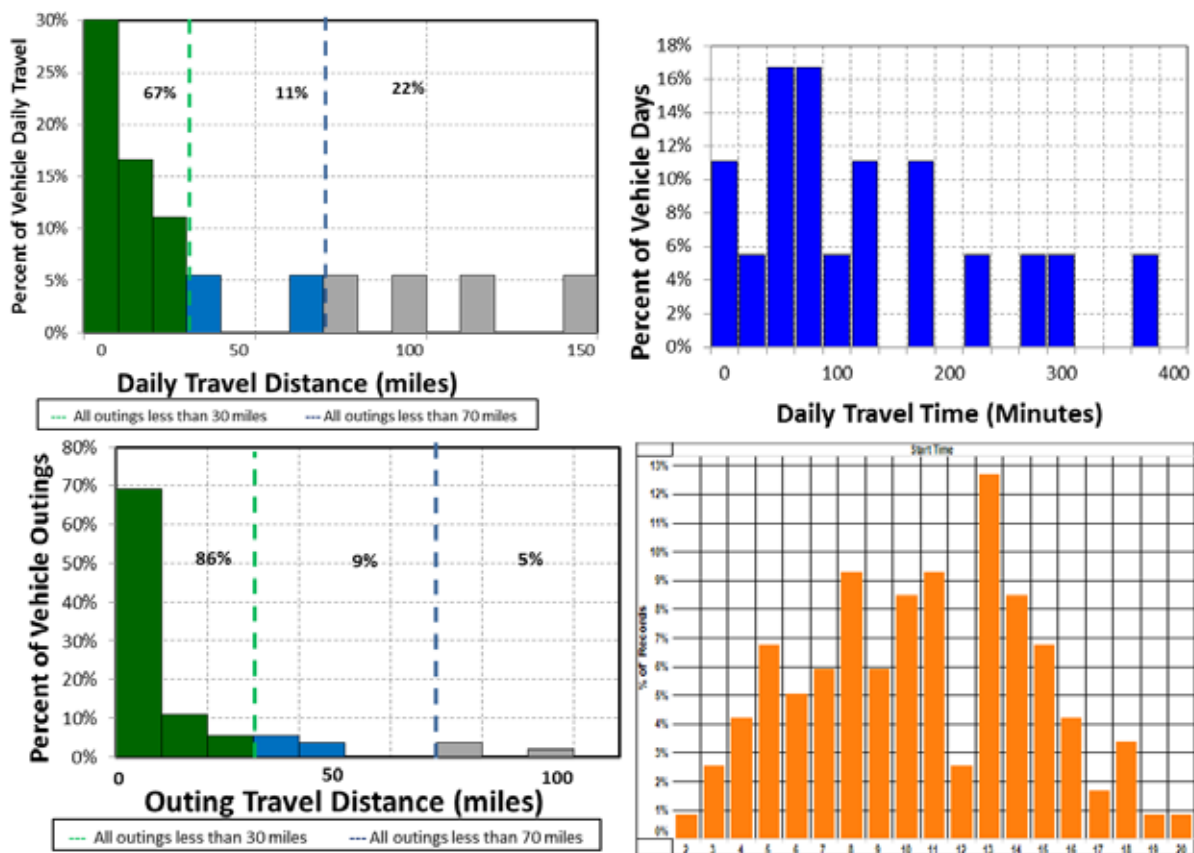


Figure B-33. Vehicle G43-1855P travel graphs.

## Vehicle G43-1855P Observations

Logger 19 collected data on this vehicle for a period of 18 days of the 31-day study period. Validation occurred on 100% of the input data. Data indicate that this vehicle has a support mission for the School of Infantry. This vehicle's data indicate it parked overnight in several different locations but primarily near Building G702 on B Street as shown in the Google Earth figure to the right.


MCBCL reports that a recent vehicle odometer indicated 2,522 miles and an average annual mileage of 4,800 miles. The vehicle was used on 58% of the available days, with an average daily usage of 2.3 hours and a peak daily usage of 6.6 hours on the days it was used. The vehicle was used primarily during day and evening shifts.

Figure B-33 shows that 88% of daily travel was within the typically advertised range of a BEV of approximately 70 miles and 95% of outings were also within this range. Further, 67% of daily travel and 86% of outings were within the typically advertised CD mode of 30 miles for PHEVs.

A BEV could not meet all daily travel without additional charging opportunities, assuming the vehicle was assigned a home base. However, a significant amount of daily travel was within the BEV range; therefore, a fleet of vehicles would likely contain a mix of BEVs and PHEVs.



## Sheet 12: Vehicle G43-2025K

	Make/Model/Year	Ford F250-2010
	EPA Class Size	Pickup
	Mission	Support
	Contact	School of Infantry
	Parking Location	Building TC846
	Fleet Vehicle ID	G43-2025K
	Fuel Type	Gas
	EPA Label/MPG (City/Hwy/Combined)*	15/21/17
	EPA GHG Emissions (Grams CO <sub>2</sub> /Mi)*	523
	Study Logger ID	20
	Total Vehicle Days/Total Study Days	20/31

Vehicle G43-2025K Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	12.5/36.4	4.0/56.4	1.5/36.4	250
Travel Time (Minutes)	88.0/273.0	28.4/263.0	10.5/172.0	1,760
Idle Time (Minutes)	44.5/NA	14.4/NA	5.3/NA	890

Total Stops			Stop Duration	
Distance From Home Base (Miles)	Stops	Percentages	Stop Duration (Hours)	Stops
Less than 10	162	97.6%	Less than 2	115
10 to 20	4	2.4%	2 to 4	22
20 to 40	0	0	4 to 8	12
40 to 60	0	0	Greater than 8	17



Figure B-34. Vehicle G43-2025K stops.

\*Fuel economy for F250 is not available. Economy used is for F150.

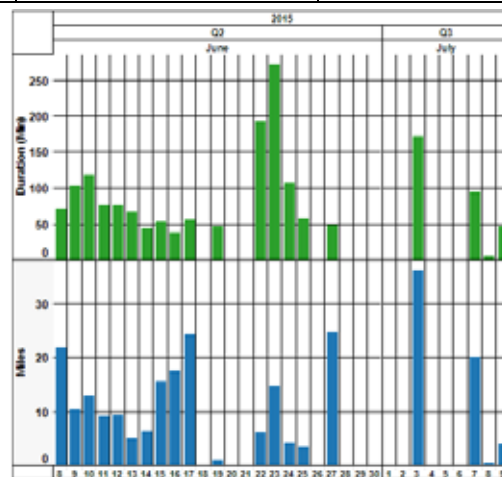


Figure B-35. Vehicle G43-2025K history.



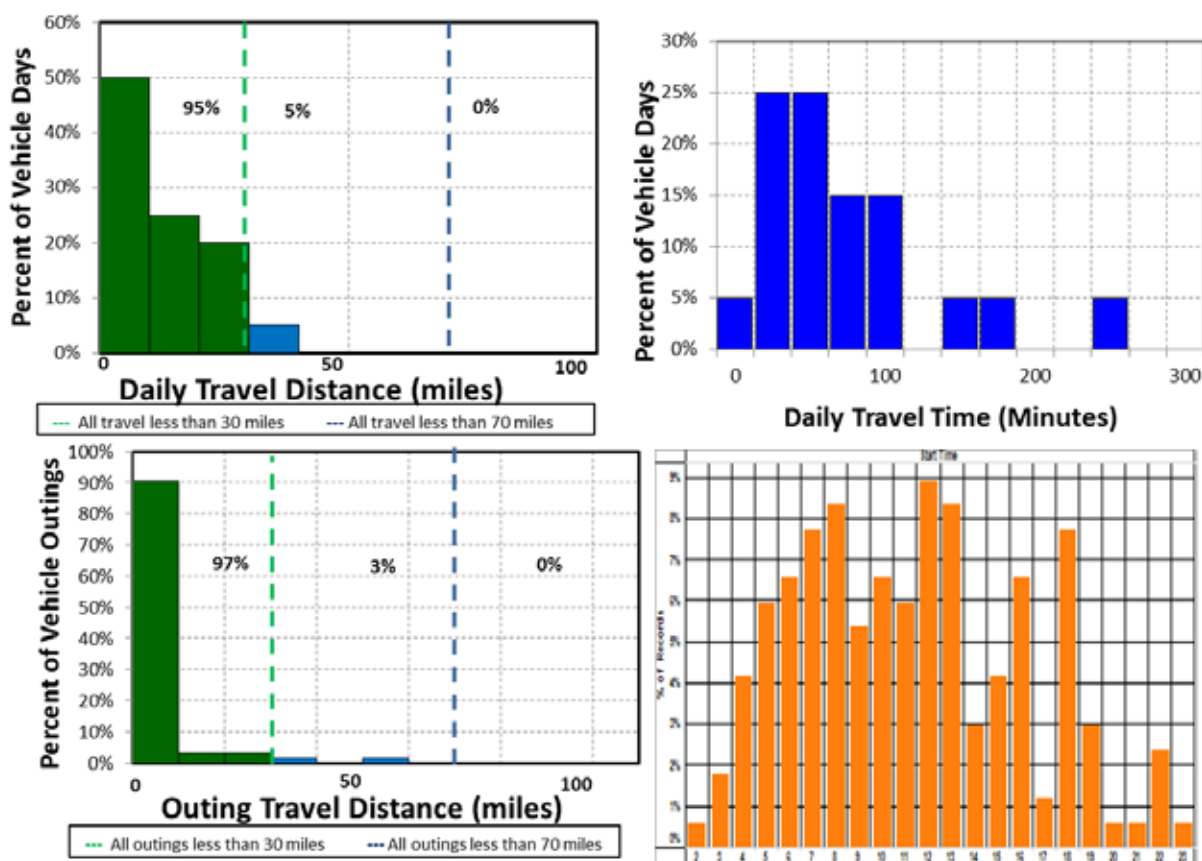


Figure B-36. Vehicle G43-2025K travel graphs.

## Vehicle G43-2025K Observations

Logger 20 collected data on this vehicle for a period of 20 days of the 31-day study period. Validation occurred on 100% of the input data. Data indicate that this vehicle has a support mission for the School of Infantry. This vehicle's data indicate it parked overnight in several different locations but primarily near Building TC846 on E Street as shown in the Google Earth figure to the right.


MCBCL reports that a recent vehicle odometer indicated 12,867 miles and an average annual mileage of 3,755 miles. The vehicle was used on 65% of the available days, with an average daily usage of 1.5 hours and a peak daily usage of 4.6 hours on the days it was used. The vehicle was used primarily overnight and during day shift hours.



Figure B-36 shows that all daily travel was within the typically advertised range of a BEV of approximately 70 miles. All outings were also within this range. Further, 95% of daily travel and 97% of outings were within the typically advertised CD mode of 30 miles for PHEVs.

A BEV could meet all daily travel without additional charging opportunities, assuming the vehicle was assigned a home base. Thus, a fleet of pickup vehicles would likely contain a mix of BEVs and PHEVs.

## Sheet 13: Vehicle G43-4073F

	Make/Model/Year	Chevrolet G2300 – 2008
	EPA Class Size	Van – Passenger
	Mission	Support
	Contact	MARSOC
	Parking Location	Building RR272 on Range Road
	Fleet Vehicle ID	G43-4073F
	Fuel Type	Gas
	EPA Label/MPG (City/Hwy/Combined)*	15/20/17
	EPA GHG Emissions (Grams CO <sub>2</sub> /Mi)*	523
	Study Logger ID	110
	Total Vehicle Days/Total Study Days	11/17

Vehicle G43-4073F Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	15.2/52.8	5.4/45.3	3.6/45.3	167
Travel Time (Minutes)	53.5/132.0	19.0/127.0	12.5/106.0	589
Idle Time (Minutes)	15.6/NA	5.5/NA	3.7/NA	172

Total Stops			Stop Duration	
Distance From Home Base (Miles)	Stops	Percentages	Stop Duration (Hours)	Stops
Less than 10	39	100%	Less than 2	23
10 to 20	0	0	2 to 4	5
20 to 60	0	0	4 to 8	3
Greater than 60	0	0	Greater than 8	8



Figure B-37. Vehicle G43-4073F stops.

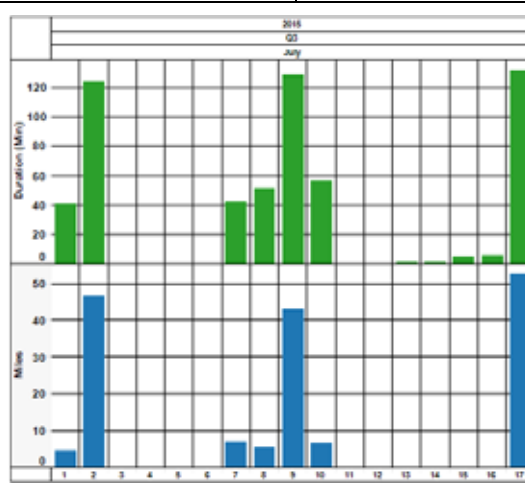


Figure B-38. Vehicle G43-4073F history.

\*Fuel economy for G2300 is not available. Economy used is for 1500/2500 Van.

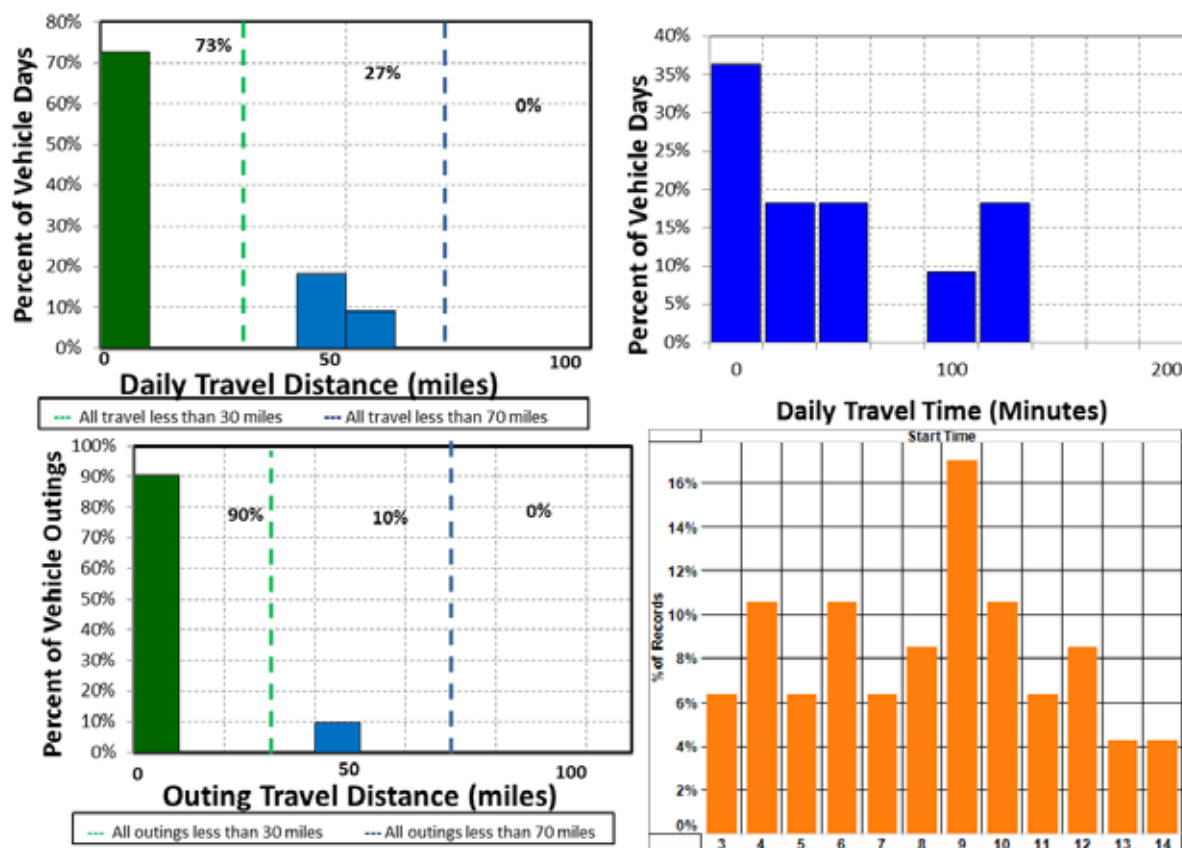


Figure B-39. Vehicle G43-4073F travel graphs.

### Vehicle G43-4073F Observations

Logger 110 collected data on this vehicle for a period of 11 days of the 17-day study period. Validation occurred on 100% of the input data. Data indicate that this vehicle has a support mission for Marine Corps Forces Special Operations Command. This vehicle's data indicate it parks near Building RR272 on Range Road as shown in the Google Earth figure to the right.

MCBCL reports that a recent vehicle odometer indicated 51,238 miles and an average annual mileage of 4,712 miles. The vehicle was used on 65% of the available days, with an average daily usage of 0.9 hours and a peak daily usage of 2.2 hours on the days it was used. The vehicle was used during day shift hours.




Figure B-39 shows that all daily travel was within the typically advertised range of a BEV of approximately 70 miles. All outings were also within this range. Further, 73% of daily travel and 90% of outings were within the typically advertised CD mode of 30 miles for PHEVs.

A BEV could meet all daily travel without additional charging opportunities, assuming the vehicle was assigned a home base. However, fleet managers typically prefer options without range limitations. Thus, a fleet of passenger van vehicles would likely contain a mix of BEVs and PHEVs.



## Sheet 14: Vehicle G61-0594L

	Make/Model/Year	Jeep Patriot – 2011
	EPA Class Size	SUV
	Mission	Support
	Contact	Special Operation Training
	Parking Location	Building 518 near N Street
	Fleet Vehicle ID	G61-0594L
	Fuel Type	Gas
	EPA Label/MPG (City/Hwy/Combined)	23/29/25
	EPA GHG Emissions (Grams CO <sub>2</sub> /Mi)	355
	Study Logger ID	87
Total Vehicle Days/Total Study Days		15/30

Vehicle G61-0594L Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	76.1/393.1	47.6/785.1	16.1/185.6	1,141
Travel Time (Minutes)	168.4/836.0	105.3/1,392.0	35.6/250	2,526
Idle Time (Minutes)	60.7/NA	38.0/NA	12.8/NA	911

Total Stops			Stop Duration	
Distance From Home Base (Miles)	Stops	Percentages	Stop Duration (Hours)	Stops
Less than 10	43	79.6%	Less than 2	35
10 to 20	0	0	2 to 4	4
20 to 40	0	0	4 to 8	1
Greater than 40	11	20.4%	Greater than 8	14



Figure B-40. Vehicle G61-0594L stops.

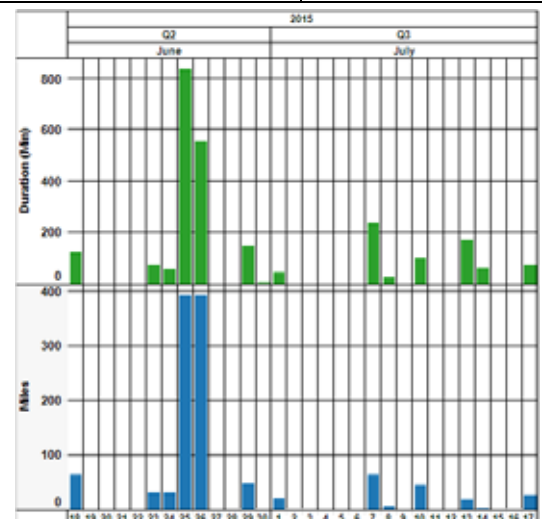


Figure B-41. Vehicle G61-0594L history.

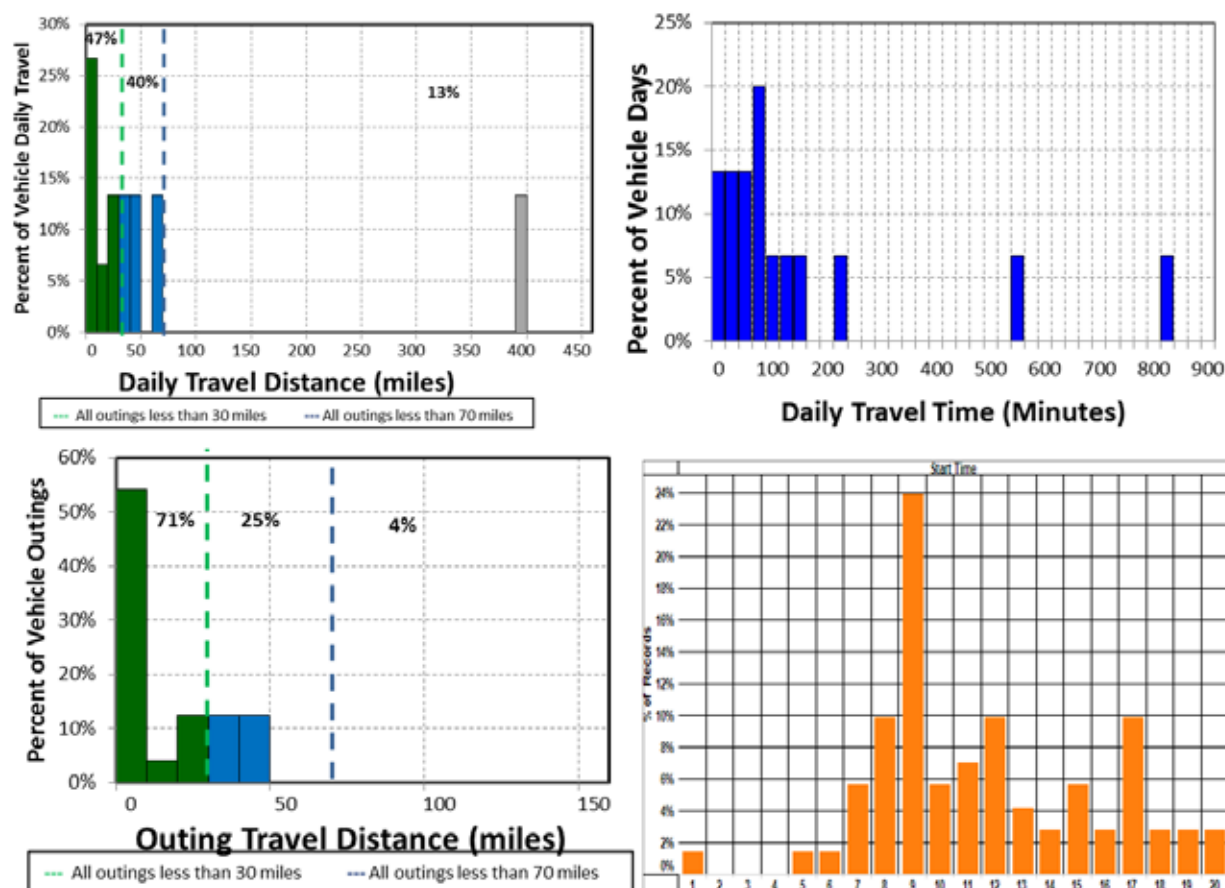


Figure B-42. Vehicle G61-0594L travel graphs. Note that the outing graph does not show the single outing of 785 miles.

## Vehicle G61-0594L Observations

Logger 87 collected data on this vehicle for a period of 15 days of the 30-day study period. Validation occurred on 100% of the input data. Data indicate that this vehicle has a support mission for Special Operation Training. This vehicle's data indicate it parks overnight near Building 518 on N Street (North Street) as shown in the Google Earth figure to the right.


MCBCL reports that a recent vehicle odometer indicated 26,107 miles at the start of this study and an average annual mileage of 10,657 miles. The vehicle was used on 50% of the available days, with an average daily usage of 2.8 hours and a peak daily usage of 13.9 hours on the days it was used. The vehicle was used primarily during day shift hours.



Figure B-42 shows that 87% of daily travel was within the typically advertised range of a BEV of approximately 70 miles and 96% of outings were also within this range. Further, 47% of daily travel and 71% of outings were within the typically advertised CD mode of 30 miles for PHEVs. The peak outing of 785 miles occurred over a several day period on an extended excursion to South Carolina and Georgia.

A BEV could not meet all daily travel because of the long excursion. However, a significant amount of daily travel was within a BEV's capability. Thus, a fleet of SUVs would likely contain a mix of BEVs and PHEVs.

## Sheet 15: Vehicle G61-2644P

	Make/Model/Year	Jeep Patriot – 2015
	EPA Class Size	SUV
	Mission	Support
	Contact	Marine Aircraft Group 29
	Parking Location	Building AS4122
	Fleet Vehicle ID	G61-2644P
	Fuel Type	Gas
	EPA Label/MPG (City/Hwy/Combined)	22/27/24
	EPA GHG Emissions (Grams CO <sub>2</sub> /Mi)	367
	Study Logger ID	94
	Total Vehicle Days/Total Study Days	21/33

Vehicle G61-2644P Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	110.4/157.6	40.0/131.4	17.4/126.2	2,319
Travel Time (Minutes)	279.2/432.0	101.1/432.0	44.1/315.0	5,863
Idle Time (Minutes)	91.0/NA	33.0/NA	14.4/NA	1,912

Total Stops			Stop Duration	
Distance From Home Base (Miles)	Stops	Percentages	Stop Duration (Hours)	Stops
Less than 10	83	69.2%	Less than 2	98
10 to 20	1	0.8%	2 to 4	2
20 to 40	33	27.5%	4 to 8	0
40 to 60	3	2.5%	Greater than 8	20

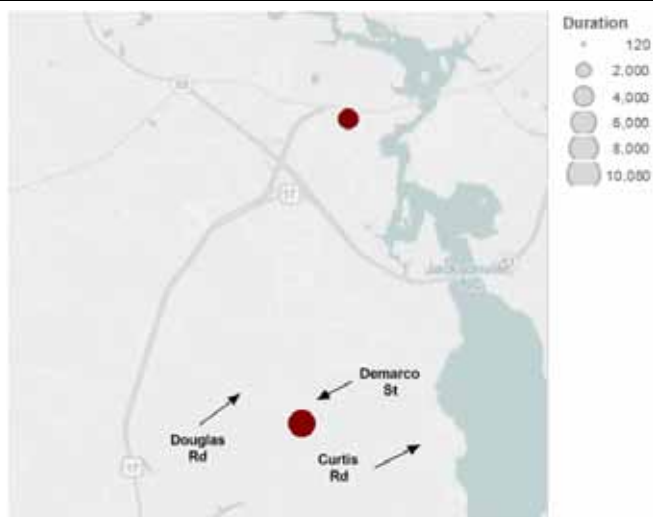


Figure B-43. Vehicle G61-2644P stops.

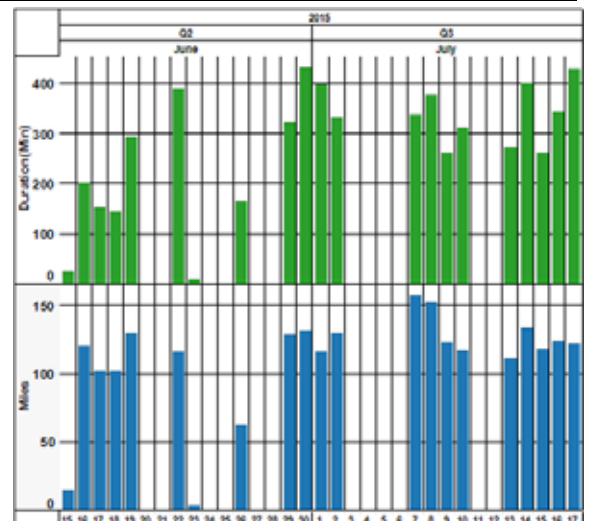


Figure B-44. Vehicle G61-2644P history.

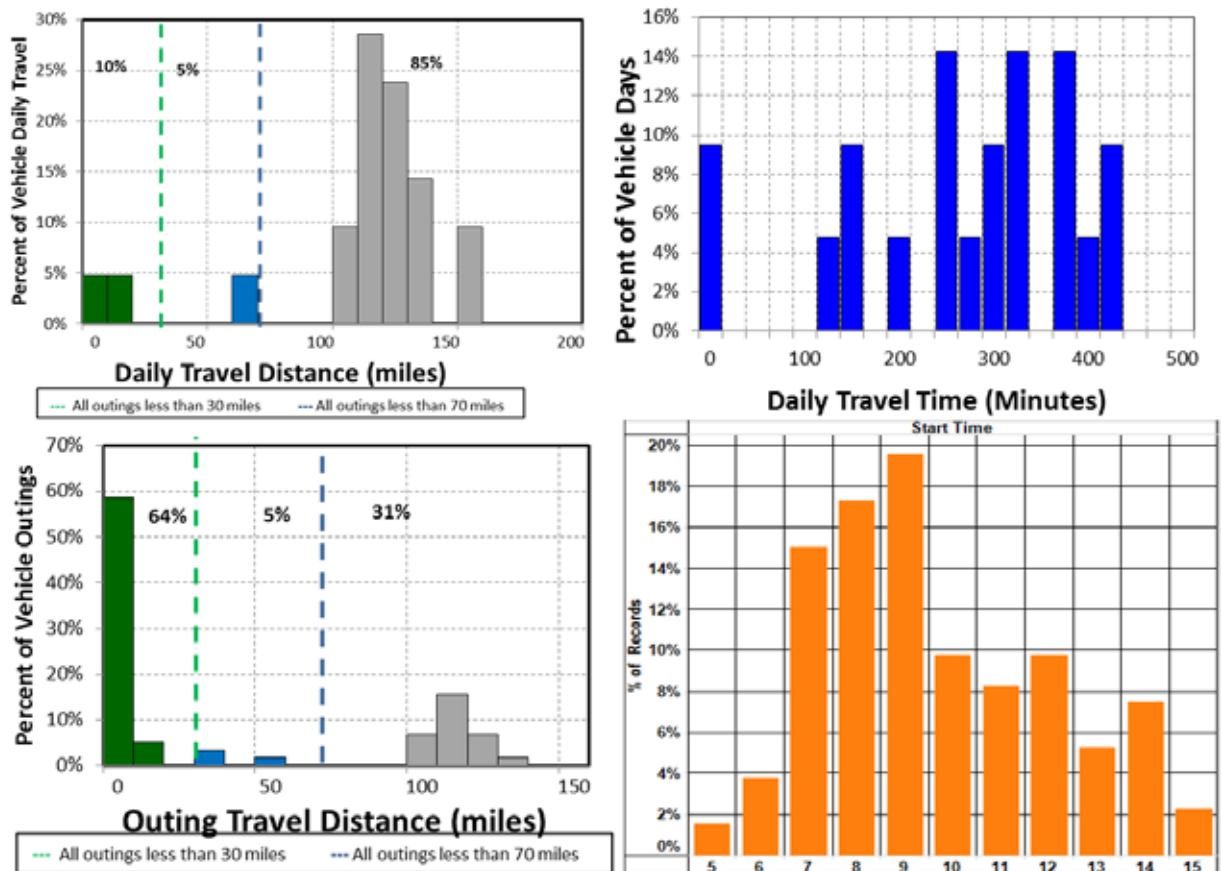


Figure B-45. Vehicle G61-2644P travel graphs.

## Vehicle G61-2644P Observations

Logger 94 collected data on this vehicle for a period of 21 days of the 33-day study period. Validation occurred on 100% of the input data. Data indicate that this vehicle has a support mission for Marine Aircraft Group 29. This vehicle's data indicate it parks near Building AS4122 on White Street as shown in the Google Earth figure to the right.

MCBCL reports that a recent vehicle odometer indicated 10 miles and an average annual mileage of 3,600 miles. The vehicle was used on 64% of the available days, with an average daily usage of 4.7 hours and a peak daily usage of 7.2 hours on the days it was used. The vehicle was used during day shift hours.

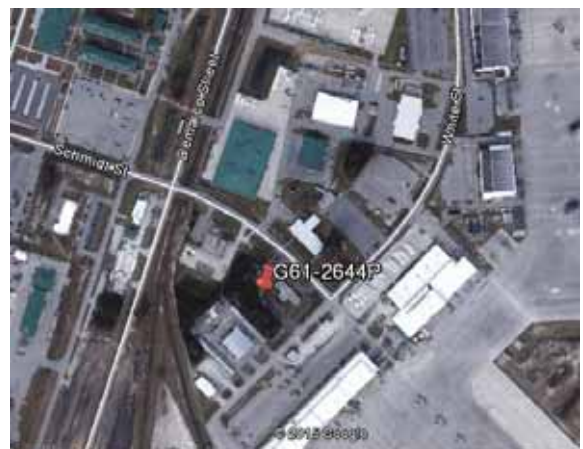



Figure B-45 shows that 15% of daily travel was within the typically advertised range of a BEV of approximately 70 miles and 69% of the outings were also within this range. Further, 10% of daily travel and 64% of outings were within the typically advertised CD mode of 30 miles for PHEVs.

A BEV could not meet all daily travel due to the consistent long distance trips. A PHEV would be recommended as a replacement.

## Sheet 16: Vehicle G62-0791H

	Make/Model/Year	Ford Expedition - 2009
	EPA Class Size	SUV - K9
	Mission	Support
	Contact	Marine Headquarters Group
	Parking Location	Building SAW353
	Fleet Vehicle ID	G62-0791H
	Fuel Type	E85
	EPA Label/MPG (City/Hwy/Combined)	10/14/11
	EPA GHG Emissions (Grams CO <sub>2</sub> /Mi)	564
	Study Logger ID	91
	Total Vehicle Days/Total Study Days	21/33

Vehicle G62-0791H Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	42.8/305.9	24.3/298.3	9.6/138.3	899
Travel Time (Minutes)	167.6/552.0	95.1/477.0	37.4/248.0	3,519
Idle Time (Minutes)	83.4/NA	47.4/NA	18.6/NA	1,752

Total Stops			Stop Duration	
Distance From Home Base (Miles)	Stops	Percentages	Stop Duration (Hours)	Stops
Less than 10	76	92.7%	Less than 2	49
10 to 20	4	4.9%	2 to 4	7
20 to 40	0	0	4 to 8	6
Greater than 40	2	2.4%	Greater than 8	20

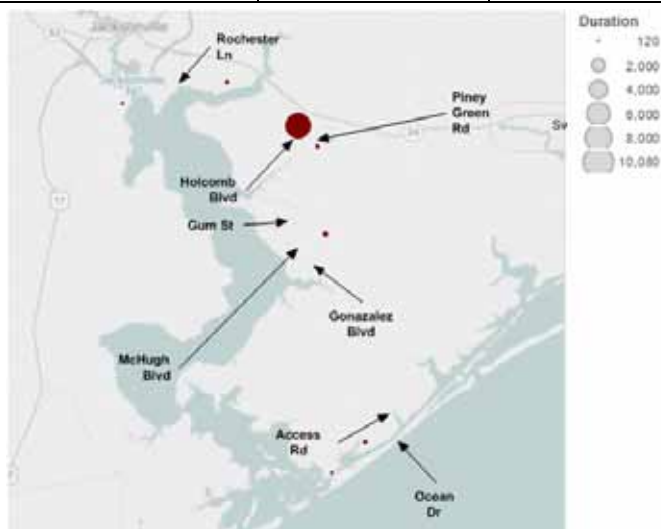


Figure B-46. Vehicle G62-0791H stops.

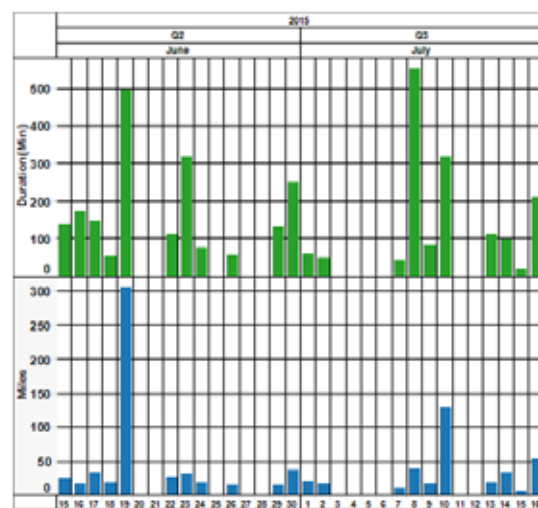


Figure B-47. Vehicle G62-0791H history.



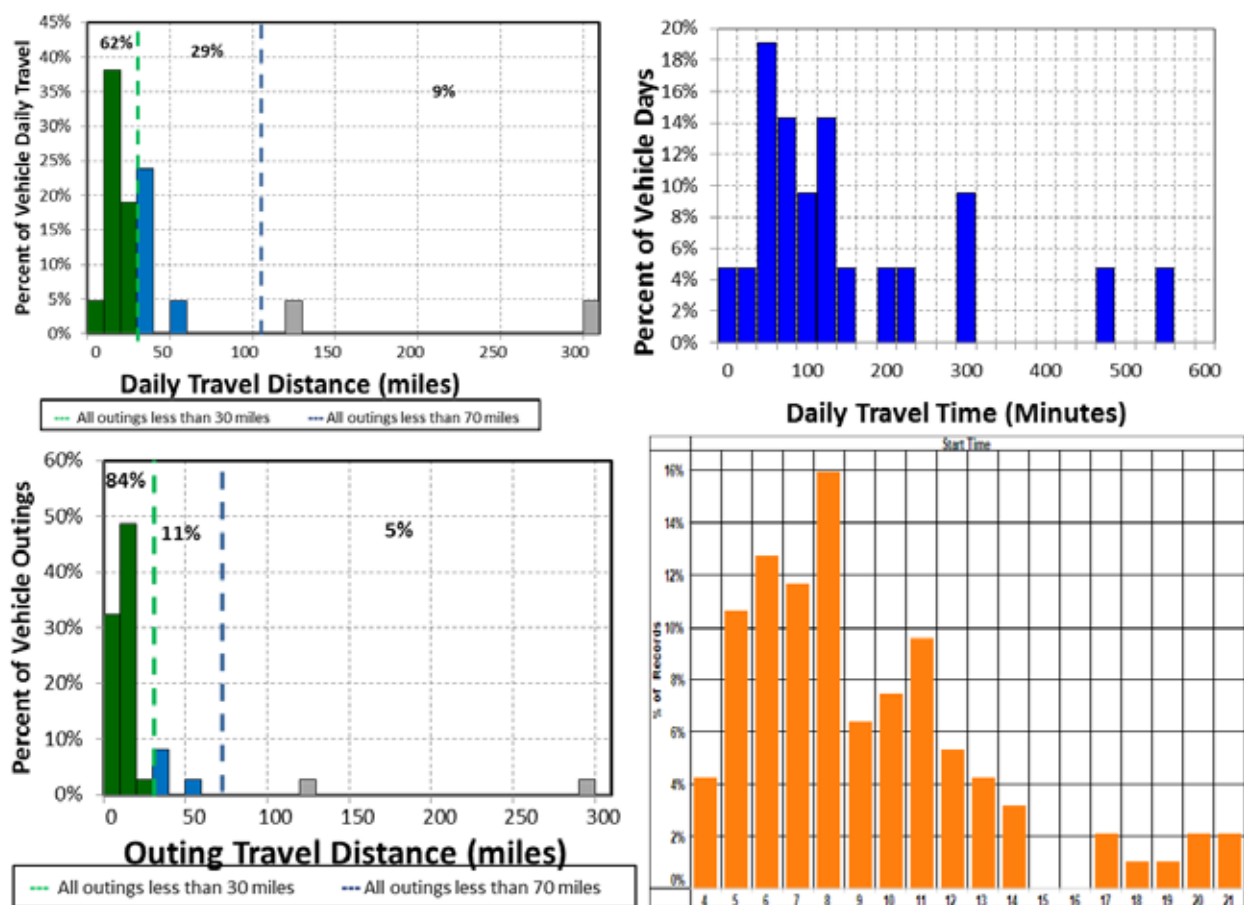


Figure B-48. Vehicle G62-0791H travel graphs.

## Vehicle G62-0791H Observations

Logger 91 collected data on this vehicle for a period of 21 days of the 33-day study period. Validation occurred on 100% of the input data. Data indicate that this vehicle has a support mission for the Marine Headquarters Group. This vehicle's data indicate it parks near Building SAW353 on Sawmill Road as shown in the Google Earth figure to the right.


MCBCL reports that a recent vehicle odometer indicated 45,614 miles at the start of this study and an average annual mileage of 9,273 miles. The vehicle was used on 64% of the available days, with an average daily usage of 2.8 hours and a peak daily usage of 9.2 hours on the days it was used. The vehicle was used primarily during day shift hours and some evening hours.



Figure B-48 shows that 91% of daily travel was within the typically advertised range of a BEV of approximately 70 miles and 95% of outings were also within this range. Further, 62% of daily travel and 84% of outings were within the typically advertised CD mode of 30 miles for PHEVs.

A BEV could not meet not all daily travel because of frequent trips greater than 70 miles. However, a significant amount of daily travel was within the range of a BEV; therefore, a fleet of SUVs would likely contain a mix of BEVs and PHEVs.

## Sheet 17: Vehicle G63-0309R

	Make/Model/Year	Ford F350 – 2015
	EPA Class Size	Pickup
	Mission	Support
	Contact	Marine Wing SS 272
	Parking Location	Building AS4158
	Fleet Vehicle ID	G63-0309R
	Fuel Type	E85
	EPA Label/MPG (City/Hwy/Combined)*	13/18/15
	EPA GHG Emissions (Grams CO <sub>2</sub> /Mi)*	419
	Study Logger ID	99
	Total Vehicle Days/Total Study Days	13/25

Vehicle G63-0309R Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	45.4/171.3	10.4/129.2	6.7/74.2	591
Travel Time (Minutes)	141.9/378.0	32.4/231.0	21.0/132.0	1,845
Idle Time (Minutes)	31.7/NA	7.2/NA	4.7/NA	412

Total Stops			Stop Duration	
Distance From Home Base (Miles)	Stops	Percentages	Stop Duration (Hours)	Stops
Less than 10	109	98.2%	Less than 2	88
10 to 20	0	0	2 to 4	6
20 to 40	2	1.8%	4 to 8	4
40 to 60	0	0	Greater than 8	13

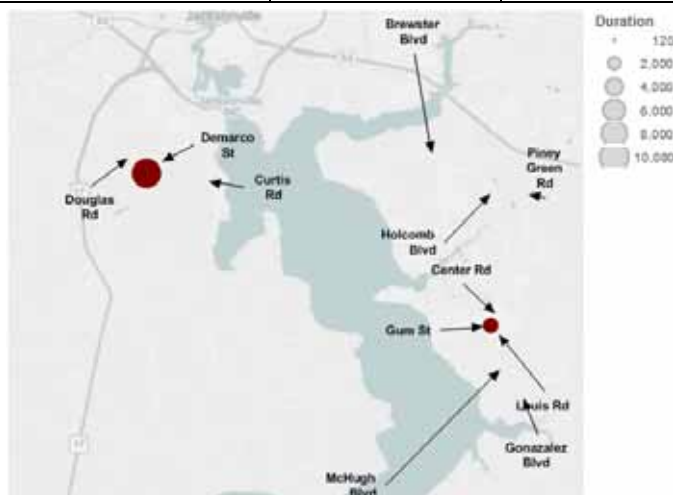


Figure B-49. Vehicle G63-0309R stops.

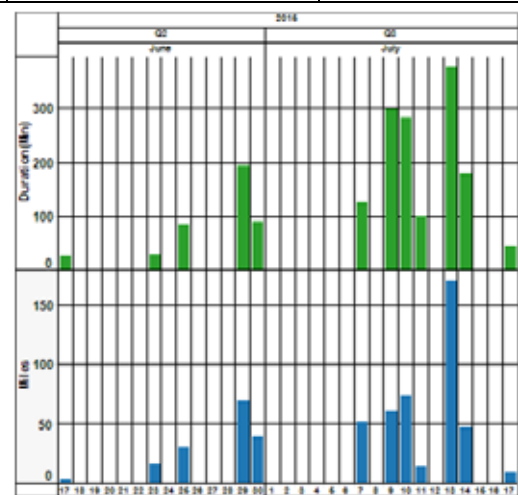


Figure B-50. Vehicle G63-0309R history.

\*Fuel economy for F350 is unavailable. Information is for F150.

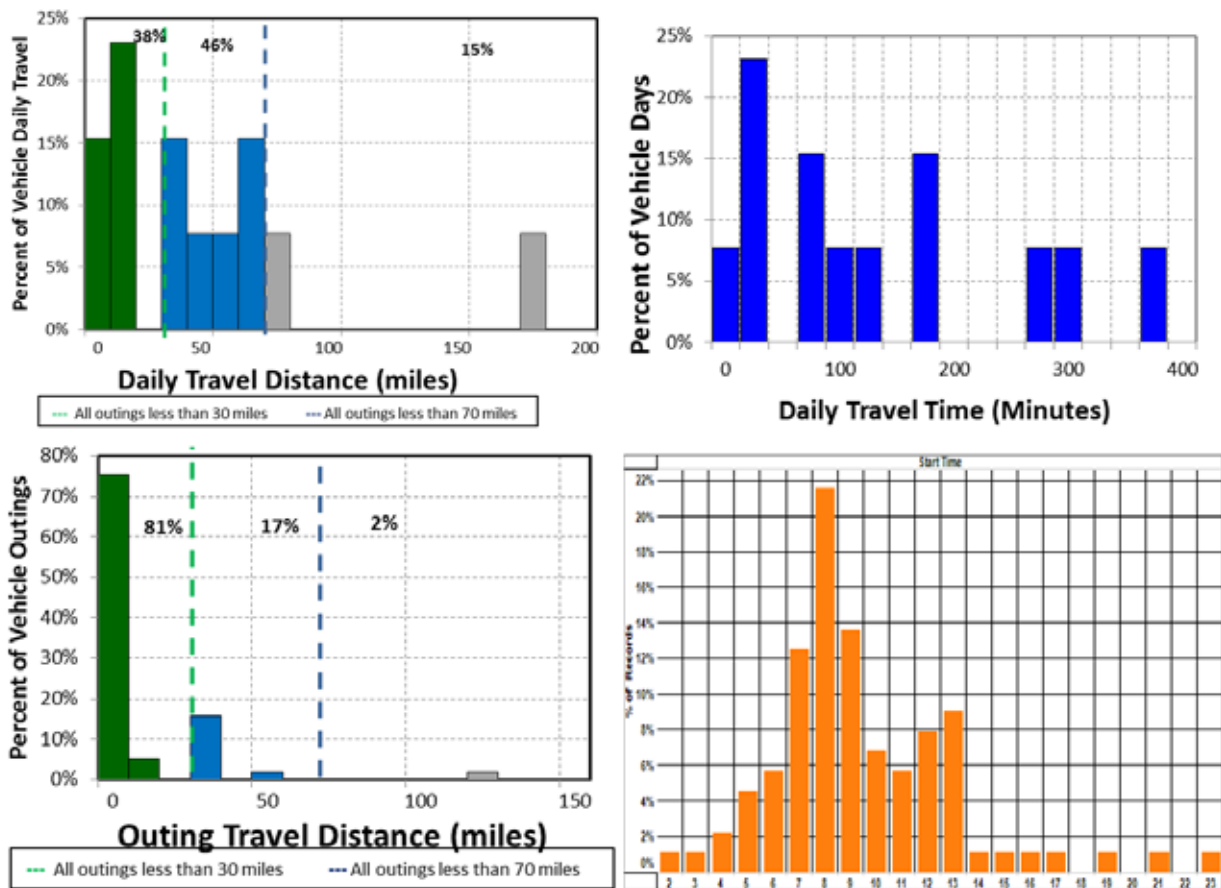


Figure B-51. Vehicle G63-0309R travel graphs.

## Vehicle G63-0309R Observations

Logger 99 collected data on this vehicle for a period of 13 days of the 25-day study period. Validation occurred on 100% of the input data. Data indicate that this vehicle has a support mission for Marine Wing SS 272. This vehicle's data indicate it parks near Building AS4158 near Demarco and Schmidt Street as shown in the Google Earth figure to the right.

MCBCL reports that the vehicle odometer indicated 0 miles for this new vehicle and its average annual mileage is estimated to be 2,469 miles. The vehicle was used on 52% of the available days, with an average daily usage of 2.4 hours and a peak daily usage of 6.3 hours on the days it was used. The vehicle was used during all hours of the day.




Figure B-51 shows that 85% of daily travel was within the typically advertised range of a BEV of approximately 70 miles and 98% of outings were also within this range. Further, 38% of daily travel and 81% of outings were within the typically advertised CD mode of 30 miles for PHEVs.

A BEV could not meet all daily travel without additional charging opportunities because of the single daily trip. However, a significant amount of daily travel was within the range of the BEV. Thus, a fleet of pickups would likely contain a mix of BEVs and PHEVs.



**Sheet 18: Vehicle G63-0934G**

	Make/Model/Year	Chevrolet K3500 – 2008
	EPA Class Size	Pickup
	Mission	Support
	Contact	MARSOC
	Parking Location	Building RR450 near Range Road
	Fleet Vehicle ID	G63-0934G
	Fuel Type	Gas
	EPA Label/MPG (City/Hwy/Combined)*	15/20/17
	EPA GHG Emissions (Grams CO <sub>2</sub> /Mi)*	523
	Study Logger ID	120
	Total Vehicle Days/Total Study Days	14/25

Vehicle G63-0934G Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/10.0/Peak	Total
Travel Distance (Miles)	75.9/396.5	22.6/1,012.4	10.8/202.9	1,062
Travel Time (Minutes)	123.8/485.0	36.9/1,443.0	17.7/218.0	1,733
Idle Time (Minutes)	15.4/NA	4.6/NA	2.2/NA	215

Total Stops			Stop Duration	
Distance From Home Base (Miles)	Stops	Percentages	Stop Duration (Hours)	Stops
Less than 10	51	57.3%	Less than 2	71
10 to 20	0	0	2 to 4	3
20 to 40	0	0	4 to 8	2
> 40	38	42.7%	Greater than 8	13



Figure B-52. Vehicle G63-0934G stops.

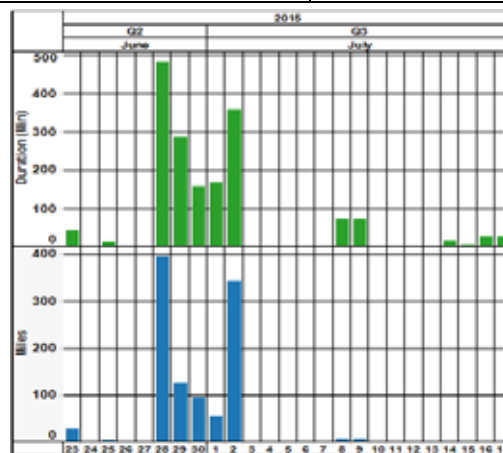


Figure B-53. Vehicle G63-0934G history.

\*Fuel economy for K3500 is not available. Economy used is for 1500/2500.

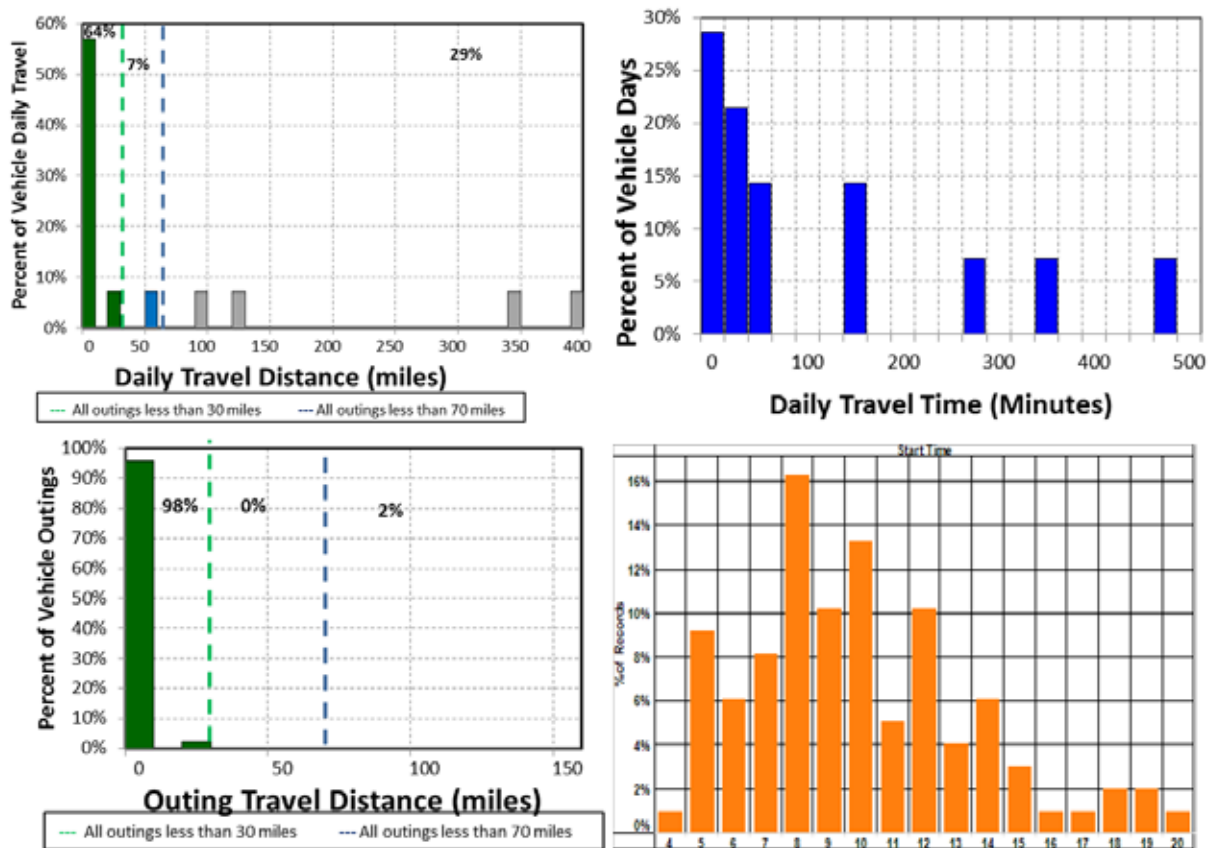


Figure B-54. Vehicle G63-0934G travel graphs. Note that the outing graph does not show the single extended excursion of 1,012 miles.

## Vehicle G63-0934G Observations

Logger 120 collected data on this vehicle for a period of 14 days of the 25-day study period. Validation occurred on 100% of the input data. Data indicate that this vehicle has a support mission for Marine Corps Forces Special Operations Command. This vehicle's data indicate it parks near Building RR450 near Range Road as shown in the Google Earth figure to the right.

MCBCL reports that a recent vehicle odometer indicated 49,385 miles and an average annual mileage of 7,502 miles. The vehicle was used on 56% of the available days, with an average daily usage of 2.1 hours and a peak daily usage of 8.1 hours on the days it was used. The vehicle was used during all hours of the day.



Figure B-54 shows that 71% of daily travel was within the typically advertised range of a BEV of approximately 70 miles and 98% of the outings were also within this range. Further, 64% of daily travel and 98% of outings were within the typically advertised CD mode of 30 miles for PHEVs. The peak outing of 1,012 miles occurred over a several day period during an extended excursion to various locations in North Carolina.

A BEV could not meet all daily travel because of the frequent daily travel exceeding the BEV range. However, a significant amount of daily travel was within a BEV range; therefore, a fleet of pickup trucks would likely contain a mix of BEVs and PHEVs.

## Appendix C


### Marine Corps Installations East Vehicle Data Sheets

Table C-1. MCBCL MCIE vehicle index.

Vehicle Index							
Sheet	Log	Fleet Vehicle Id	Make	Model	Year	EPA Class	Mission
19	4	290597	Ford	E350	1997	Van - Cargo	Pool
20	37	291007	Ford	F550	2004	SP	Specialty
21	35	294285	Chevrolet	Malibu	2009	Sedan - Midsize	Support
22	48	294293	Chevrolet	HHR	2009	SUV	Enforcement
23	42	294315	Chevrolet	3500	2009	Pickup	Support
24	54	294324	Chevrolet	HHR	2009	SUV	Support
25	53	300672	Ford	F550	2011	SP	Specialty
26	55	302039	Ford	F250XL	2014	Pickup	Support
27	56	302040	Ford	F250XL	2014	Pickup	Support
28	79	302334	Ford	F350 Stake	2015	Pickup	Support
29	5	G10-3327L	Chevrolet	Malibu	2012	Sedan - Midsize	Pool
30	41	G13-0325K	Ford	Focus	2012	Sedan - Compact	Support
31	39	G13-7974P	Ford	Focus	2015	Sedan - Compact	Support
32	7	G41-0379H	Dodge	Grand Caravan	2009	Minivan	Pool
33	40	G41-0391H	Dodge	Dakota	2009	Pickup	Support
34	8	G41-0754M	Dodge	Grand Caravan	2012	Minivan	Pool
35	57	G41-0806P	Dodge	Caravan	2014	Minivan	Support
36	58	G41-1689L	Ford	Ranger	2011	Pickup	Support
37	59	G41-3297K	Ford	Ranger	2011	Pickup	Support
38	49	G41-3300K	Ford	Ranger	2011	Pickup	Enforcement
39	61	G41-3301K	Ford	Ranger	2011	Pickup	Support
40	9	G42-0644M	Ford	E150	2012	Van - Pass	Pool
41	68	G42-0667P	Ford	F150	2014	Pickup	Support
42	69	G42-0671P	Ford	F150	2014	Pickup	Support
43	10	G42-0911L	Chevrolet	C1500	2012	Pickup	Pool
44	75	G42-0915M	Ford	F150	2012	Pickup	Support
45	50	G42-2985H	Chevrolet	C1500	2010	Pickup	Enforcement
46	13	G43-0310H	Ford	E350	2009	Van - Pass	Pool
47	71	G43-0323H	Ford	E350	2009	Van - Cargo	Support
48	74	G43-0324H	Ford	E350	2009	Van - Cargo	Support
49	36	G43-1182M	Chevrolet	CG3300	2012	Van - Cargo	Support
50	14	G43-4075P	Ford	F250	2015	Pickup	Pool
51	77	G61-0161H	Dodge	Dakota	2009	Pickup	Support
52	78	G61-0174H	Jeep	Liberty	2009	SUV	Support
53	51	G61-0879P	Chevrolet	Equinox	2014	SUV	Enforcement
54	15	G61-1508D	Jeep	Liberty	2008	SUV	Pool
55	16	G61-1509D	Jeep	Liberty	2008	SUV	Pool
56	82	G62-1583G	Chevrolet	K1500	2008	Pickup	Support
57	46	G62-4085L	Dodge	1500	2012	Pickup	Support
58	98	G63-0163H	Chevrolet	K2500HD	2009	Pickup	Support

Vehicle Index							
Sheet	Log	Fleet Vehicle Id	Make	Model	Year	EPA Class	Mission
59	47	G63-2885L	Chevrolet	K2500HD	2012	Pickup	Support
60	52	G63-2888L	Chevrolet	K2500HD	2012	Pickup	Enforcement

## Sheet 19: Vehicle 290597

	Make/Model/Year	Ford E350 – 1997
	EPA Class Size	Van – Cargo
	Mission	Pool
	Contact	Motor Transport C-Pool
	Parking Location	Building 11407 on Michael Road
	Fleet Vehicle ID	290597
	Fuel Type	Gas
	EPA Label/MPG (City/Hwy/Combined)*	12/17/14
	EPA GHG Emissions (Grams CO <sub>2</sub> /Mi)*	635
	Study Logger ID	4
	Total Vehicle Days/Total Study Days	18/34

Vehicle 290597 Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	12.4/100.7	12.4/145.4	3.1/52.1	223
Travel Time (Minutes)	47.9/192.0	47.9/342.0	12.0/124.0	863
Idle Time (Minutes)	15.4/NA	15.4/NA	3.8/NA	277

Total Stops			Stop Duration	
Distance From Home Base (Miles)	Stops	Percentages	Stop Duration (Hours)	Stops
Less than 10	39	88.6%	Less than 2	24
10 to 20	3	6.8%	2 to 4	2
20 to 40	0	0	4 to 8	4
40 to 60	2	4.5%	Greater than 8	14

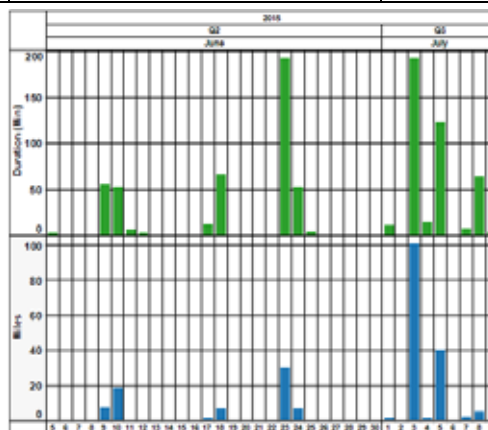


Figure C-1. Vehicle 290597 stops.

Figure C-2. Vehicle 290597 history.

\*Fuel economy for E350 is not available. Economy used is for E250.

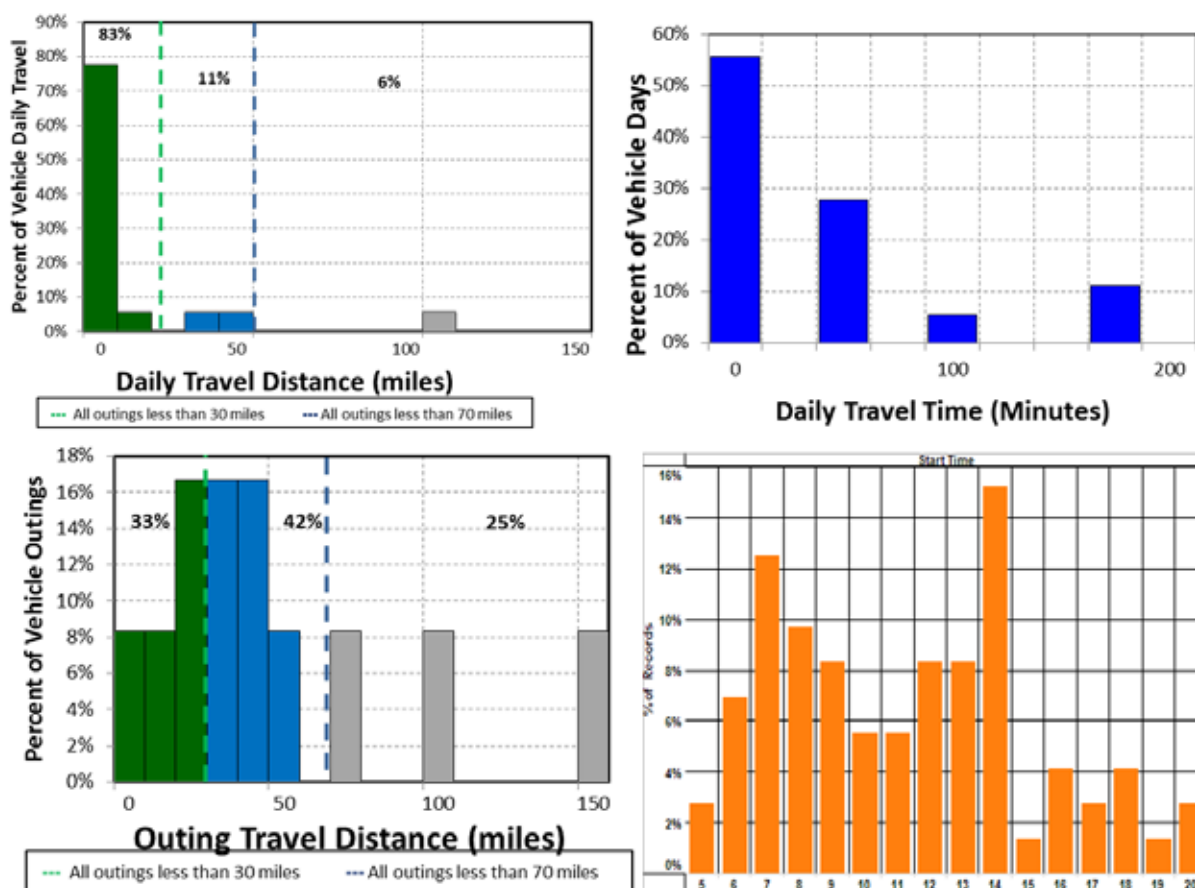


Figure C-3. Vehicle 290597 travel graphs.

## Vehicle 290597 Observations

Logger 4 collected data on this vehicle for a period of 18 days of the 34-day study period. Validation occurred on 100% of the input data. Data indicate that this vehicle has a pool mission for Motor Transport C-Pool. This vehicle's data indicate it parks near Building 1407 near Michael Road as shown in the Google Earth figure to the right.

MCBCL reports that a recent vehicle odometer indicated 27,949 miles and an average annual mileage of 957 miles. The vehicle was used on 53% of the available days, with an average daily usage of 0.8 hours and a peak daily usage of 3.2 hours on the days it was used. The vehicle was used during day and evening hours.




Figure C-3 shows that 94% of daily travel was within the typically advertised range of a BEV of approximately 70 miles and 75% of outings were also within this range. Further, 83% of daily travel and 33% of outings were within the typically advertised CD mode of 30 miles for PHEVs. The peak outing of 145 miles occurred over a several day period when the vehicle traveled to several locations in North Carolina and back to Camp Lejeune, but did not return to Michael Road and parked in several other locations at the main campus.

A BEV could not meet all daily travel. However, a significant amount of daily travel is within the BEV range; therefore, a fleet of vehicles would likely contain a mix of BEVs and PHEVs.



**Sheet 20: Vehicle 291007**

	Make/Model/Year	Ford F560 – 2004
	EPA Class Size	Specialty – Refrigeration Truck
	Mission	Specialty
	Contact	MTO
	Parking Location	Building 327 near H Street
	Fleet Vehicle ID	291007
	Fuel Type	Diesel
	EPA Label/MPG (City/Hwy/Combined)*	10
	EPA GHG Emissions (Grams CO <sub>2</sub> /Mi)*	1021
	Study Logger ID	37
	Total Vehicle Days/Total Study Days	Insufficient Data

Vehicle 291007 Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data
Travel Time (Minutes)	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data
Idle Time (Minutes)	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data

Total Stops			Stop Duration	
Distance From Home Base (Miles)	Stops	Percentages	Stop Duration (Hours)	Stops
Less than 10	Insufficient Data	Insufficient Data	Less than 2	Insufficient Data
10 to 20	Insufficient Data	Insufficient Data	2 to 4	Insufficient Data
20 to 40	Insufficient Data	Insufficient Data	4 to 8	Insufficient Data
40 to 60	Insufficient Data	Insufficient Data	Greater than 8	Insufficient Data

Insufficient Data


**Vehicle 291007 Observations**

Logger 37 was installed in this specialty vehicle that was used as a pool vehicle. However, no usage was obtained during the study period.

MCBCL reports that a recent vehicle odometer indicated 21,217 miles and an average annual mileage of 1,425 miles.



## Sheet 21: Vehicle 294285

	Make/Model/Year	Chevrolet Malibu – 2009
	EPA Class Size	Sedan – Midsize
	Mission	Support
	Contact	Postal
	Parking Location	Building 1770
	Fleet Vehicle ID	294285
	Fuel Type	Gas
	EPA Label/MPG (City/Hwy/Combined)	22/33/26
	EPA GHG Emissions (Grams CO <sub>2</sub> /Mi)	342
	Study Logger ID	35
	Total Vehicle Days/Total Study Days	18/31

Vehicle 294285 Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	50.8/74.8	31.5/64.0	5.9/48.2	914
Travel Time (Minutes)	149.7/224.0	92.9/207.0	17.3/157.0	2,695
Idle Time (Minutes)	24.2/NA	15.0/NA	2.8/NA	435

Total Stops			Stop Duration	
Distance From Home Base (Miles)	Stops	Percentages	Stop Duration (Hours)	Stops
Less than 10	93	100%	Less than 2	71
10 to 20	0	0	2 to 4	2
20 to 40	0	0	4 to 8	2
40 to 60	0	0	Greater than 8	18

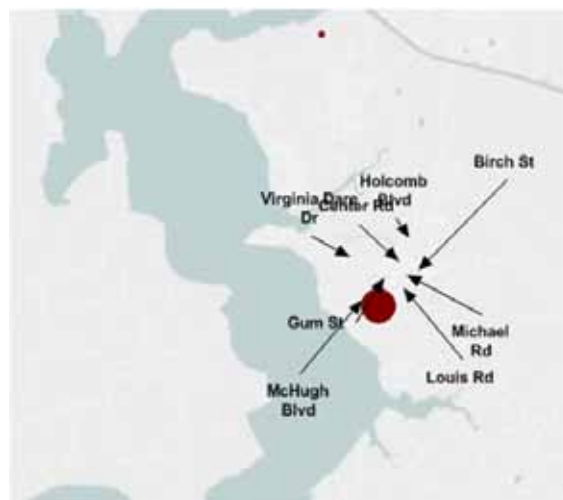


Figure C-4. Vehicle 294285 stops.

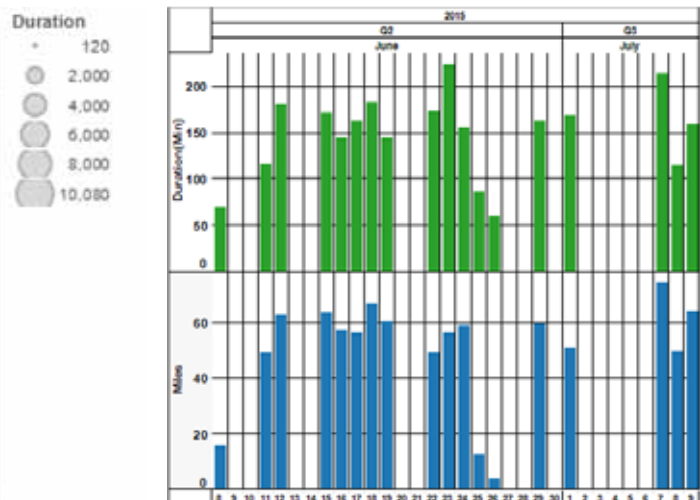


Figure C-5. Vehicle 294285 history.

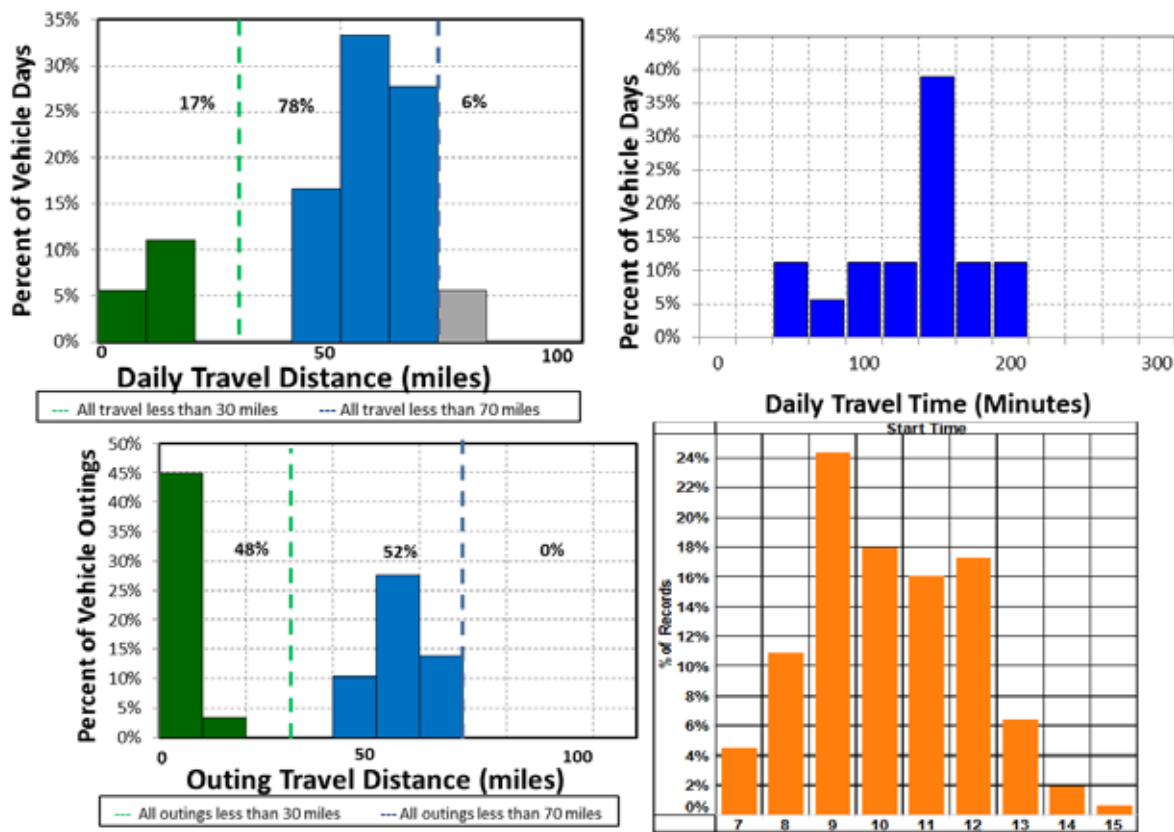


Figure C-6. Vehicle 294285 travel graphs.

## Vehicle 294285 Observations

Logger 35 collected data on this vehicle for a period of 18 days of the 31-day study period. Validation occurred on 100% of the input data. Data indicate that this vehicle has a support mission for the Post Office. This vehicle's data indicate it parks near Building 1770 on Louis Road as shown in the Google Earth figure to the right.

MCBCL reports that a recent vehicle odometer indicated 44,190 miles at the start of this study and an average annual mileage of 3,795 miles. The vehicle was used on 58% of the available days, with an average daily usage of 2.5 hours and a peak daily usage of 3.7 hours on the days it was used. The vehicle was used during day shift hours.

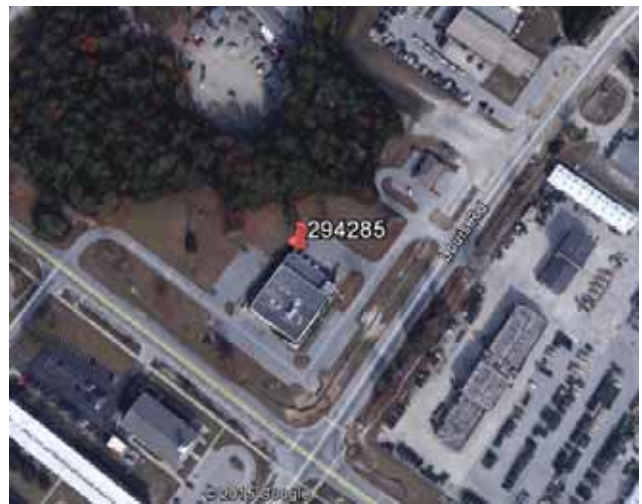



Figure C-6 shows that 94% of daily travel was within the typically advertised range of a BEV approximately 70 miles. All outings were also within this range. Further, 17% of daily travel and 48% of outings were within the typically advertised CD mode of 30 miles for PHEVs.

A BEV could meet all daily travel with additional charging opportunities, assuming the vehicle was assigned a home base. Fleet managers typically prefer a vehicle that does not have range limitations. Thus, a fleet of vehicles would likely contain a mix of BEVs and PHEVs.

## Sheet 22: Vehicle 294293

	Make/Model/Year	Chevrolet HHR – 2009
	EPA Class Size	SUV
	Mission	Enforcement
	Contact	Provost Marshal's Office
	Parking Location	Building AS302
	Fleet Vehicle ID	294293
	Fuel Type	E85
	EPA Label/MPG (City/Hwy/Combined)	16/22/18
	EPA GHG Emissions (Grams CO <sub>2</sub> /Mi)	345
	Study Logger ID	48
	Total Vehicle Days/Total Study Days	16/31

Vehicle 294293 Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	25.7/39.9	22.8/54.7	7.3/16.0	411
Travel Time (Minutes)	52.6/117.0	46.8/148.0	15.0/31.0	842
Idle Time (Minutes)	0.8/NA	0.7/NA	0.2/NA	13

Total Stops			Stop Duration	
Distance From Home Base (Miles)	Stops	Percentages	Stop Duration (Hours)	Stops
Less than 10	56	100%	Less than 2	34
10 to 20	0	0	2 to 4	4
20 to 40	0	0	4 to 8	4
40 to 60	0	0	Greater than 8	14

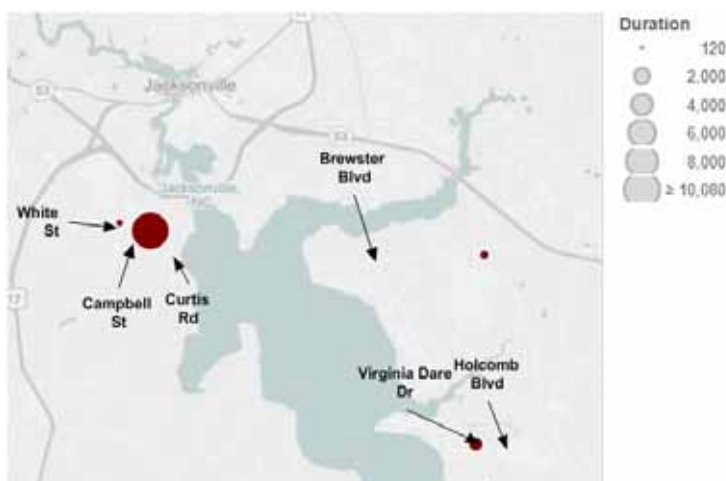


Figure C-7. Vehicle 294293 stops.

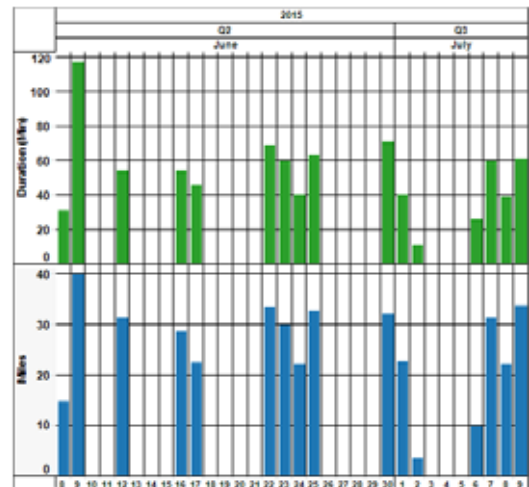


Figure C-8. Vehicle 294293 history.

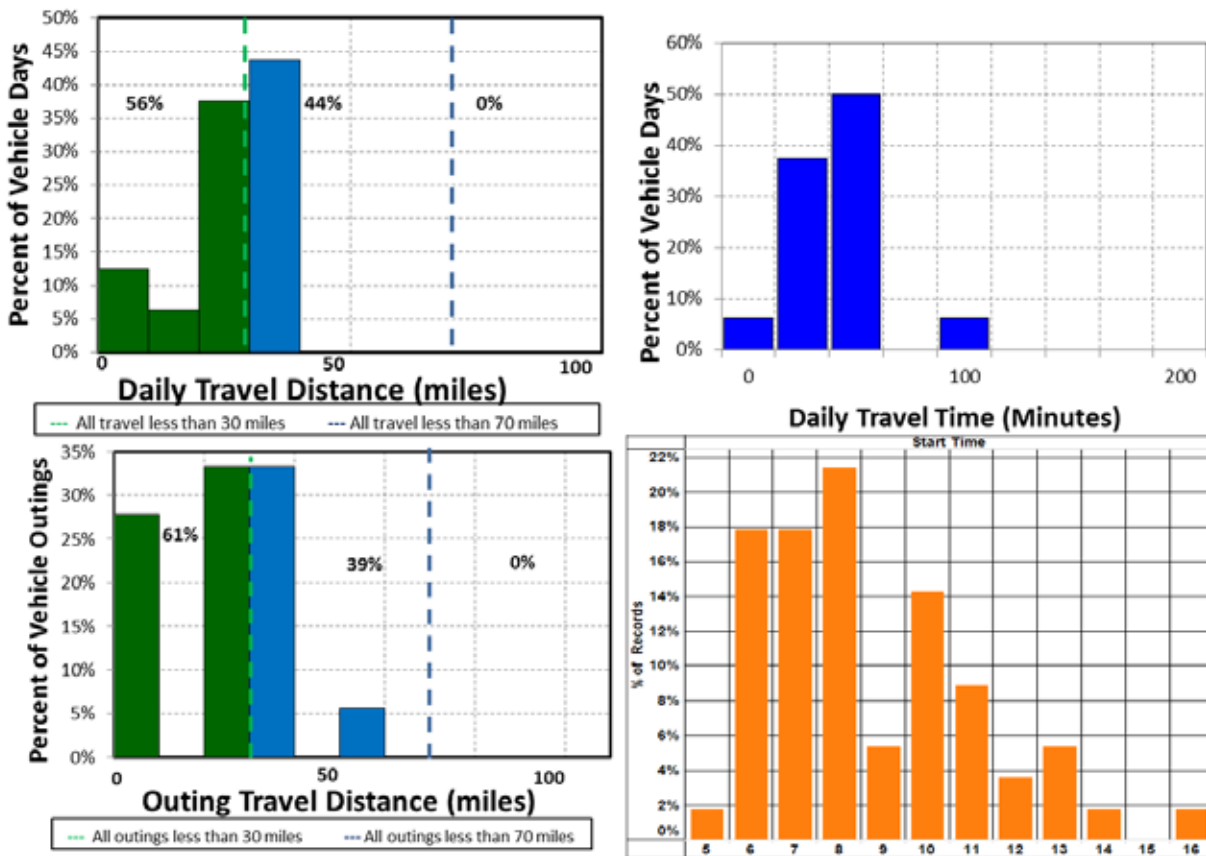


Figure C-9. Vehicle 294293 travel graphs.

## Vehicle 294293 Observations

Logger 48 collected data on this vehicle for a period of 16 days of the 31-day study period. Validation occurred on 100% of the input data. Data indicate that this vehicle has an enforcement mission for the Provost Marshal's Office. This vehicle's data indicate it parks near Building AS 302 on McAvoy Street as shown in the Google Earth figure to the right.


MCBCL reports that a recent vehicle odometer indicated 53,870 miles at the start of this study and an average annual mileage of 4,214 miles. The vehicle was used on 52% of the available days, with an average daily usage of 0.9 hours and a peak daily usage of 2.0 hours on the days it was used. The vehicle was used during all hours of the day.



Figure C-9 shows that all daily travel was within the typically advertised range of a BEV of approximately 70 miles. All outings were also within this range. Further, 56% of daily travel and 61% of outings were within the typically advertised CD mode of 30 miles for PHEVs.

A BEV could meet all daily travel without additional charging opportunities, assuming the vehicle was assigned a home base. However, fleet managers typically do not prefer enforcement vehicles that contain range limitations. Thus, a fleet of enforcement vehicles would likely contain a mix of BEVs and PHEVs.

## Sheet 23: Vehicle 294315

	Make/Model/Year	Chevrolet 3500 – 2009
	EPA Class Size	Pickup
	Mission	Support
	Contact	Fire Department
	Parking Location	Building TC701
	Fleet Vehicle ID	294315
	Fuel Type	Diesel
	EPA Label/MPG (City/Hwy/Combined)*	14
	EPA GHG Emissions (Grams CO <sub>2</sub> /Mi)*	729
	Study Logger ID	42
	Total Vehicle Days/Total Study Days	24/31

Vehicle 294315 Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	24.1/83.2	23.1/98.6	7.1/31.4	578
Travel Time (Minutes)	67.4/243.0	64.7/248.0	20.0/135.0	1,618
Idle Time (Minutes)	23.8/NA	22.8/NA	7.0/NA	570

Total Stops			Stop Duration	
Distance From Home Base (Miles)	Stops	Percentages	Stop Duration (Hours)	Stops
Less than 10	63	96.6%	Less than 2	39
10 to 20	2	3.1%	2 to 4	6
20 to 40	0	0	4 to 8	1
40 to 60	0	0	Greater than 8	19

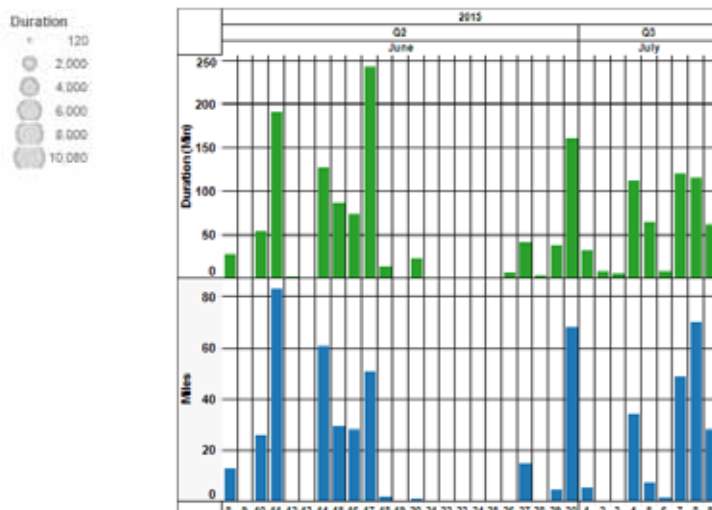
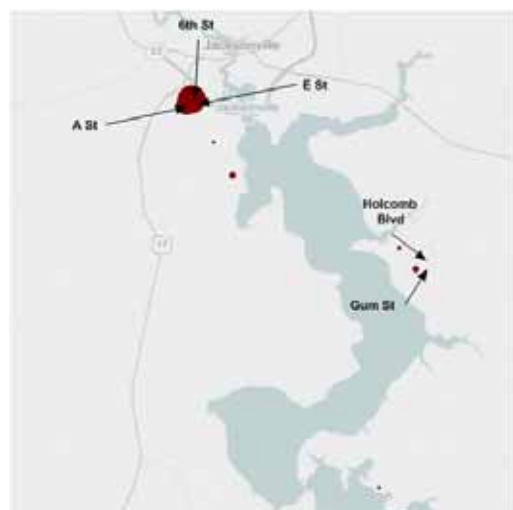


Figure C-10. Vehicle 294315 stops.

Figure C-11. Vehicle 294315 history.

\*EPA fuel economy is not available. Figures calculated for diesel per Section 5.



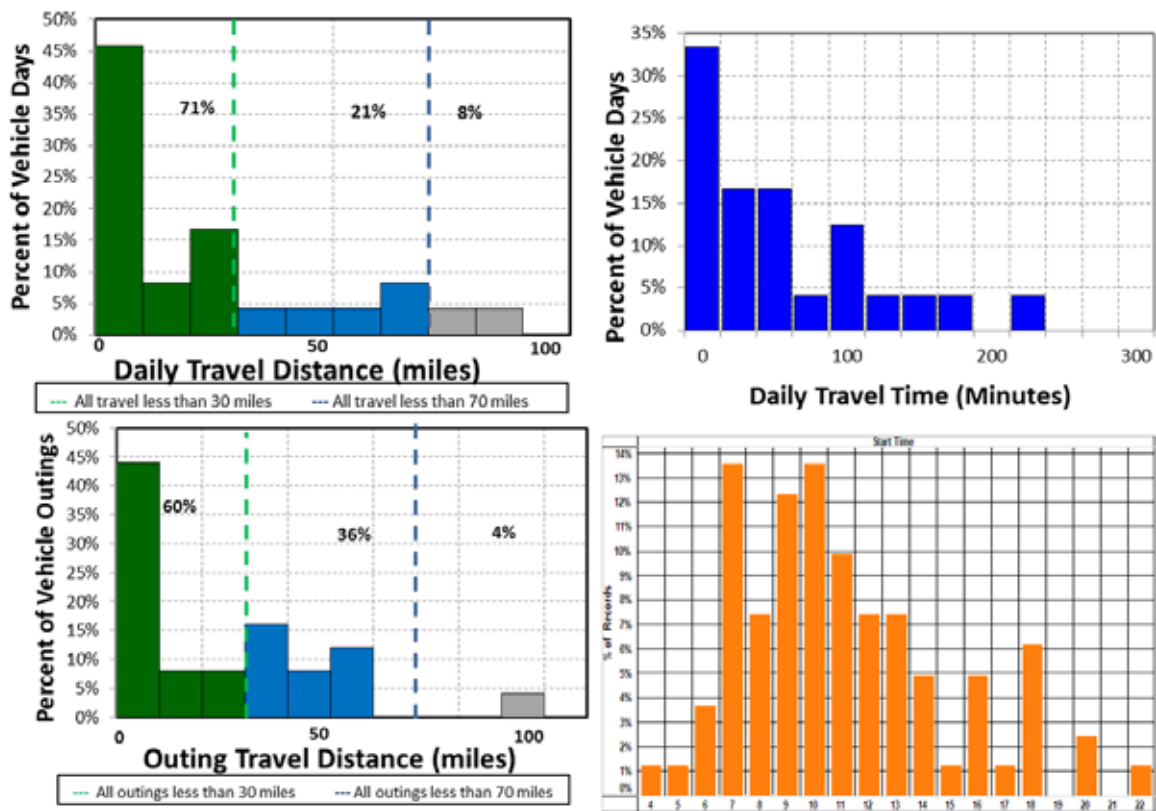


Figure C-12. Vehicle 294315 travel graphs.

## Vehicle 294315 Observations

Logger 42 collected data on this vehicle for a period of 24 days of the 31-day study period. Validation occurred on 92.7% of the input data. Data indicate that this vehicle has a support mission for the fire department. This vehicle's data indicate it parks overnight in several different locations, but primarily near Building TC701 near 7<sup>th</sup> Street as shown in the Google Earth figure to the right.


MCBCL reports that a recent vehicle odometer indicated 23,997 miles and an average annual mileage of 3,208 miles. The vehicle was used on 77% of the available days, with an average daily usage of 1.1 hours and a peak daily usage of 4.1 hours on the days it was used. The vehicle was used primarily during day shift hours.



Figure C-12 shows that 92% of daily travel was within the typically advertised range of a BEV of approximately 70 miles and 96% of outings were also within this range. Further, 71% of daily travel and 60% of outings were within the typically advertised CD mode of 30 miles for PHEVs.

A BEV could not meet all daily travel without additional charging opportunities, assuming the vehicle was assigned a home base. However, a significant amount of daily travel was within the range of a BEV. Thus, a fleet of pickup trucks would likely contain a mix of BEVs and PHEVs.

## Sheet 24: Vehicle 294324

	Make/Model/Year	Chevrolet HHR – 2009
	EPA Class Size	SUV
	Mission	Support
	Contact	Public Works
	Parking Location	Building 1005
	Fleet Vehicle ID	294324
	Fuel Type	E85
	EPA Label/MPG (City/Hwy/Combined)	22/32/26
	EPA GHG Emissions (Grams CO <sub>2</sub> /Mi)	326
	Study Logger ID	54
	Total Vehicle Days/Total Study Days	22/1

Vehicle 294324 Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	55.5/106.3	30.5/60.0	8.1/53.1	1,222
Travel Time (Minutes)	127.2/207.0	70.0/119.0	18.7/96.0	2,798
Idle Time (Minutes)	22.9/NA	12.6/NA	3.4/NA	504

Total Stops			Stop Duration	
Distance From Home Base (Miles)	Stops	Percentages	Stop Duration (Hours)	Stops
Less than 10	146	100%	Less than 2	146
10 to 20	0	0	2 to 4	0
20 to 40	0	0	4 to 8	0
40 to 60	0	0	Greater than 8	0

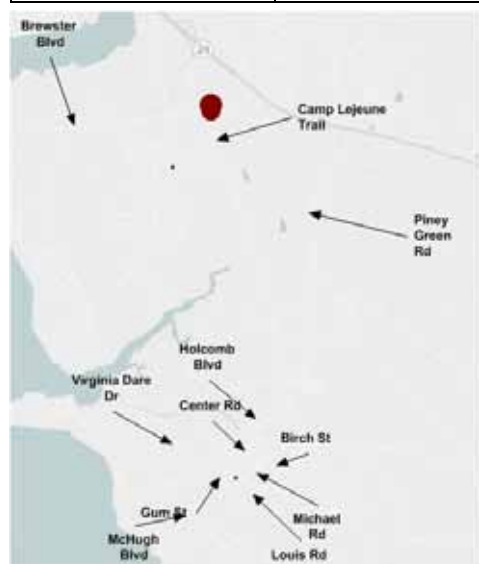


Figure C-13. Vehicle 294324 stops.

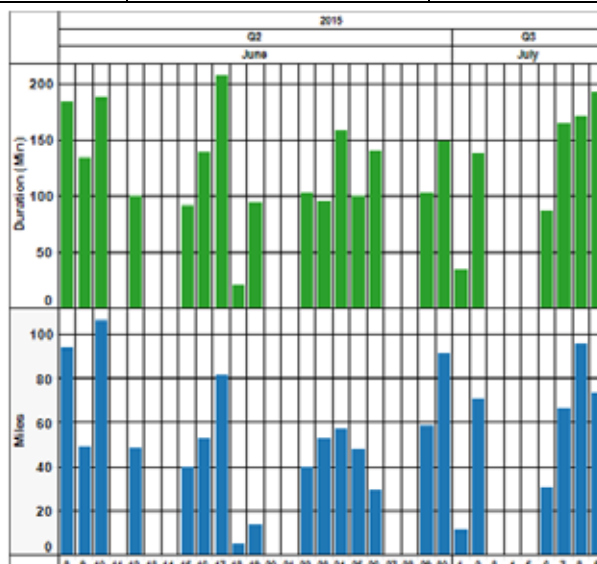


Figure C-14. Vehicle 294324 history.



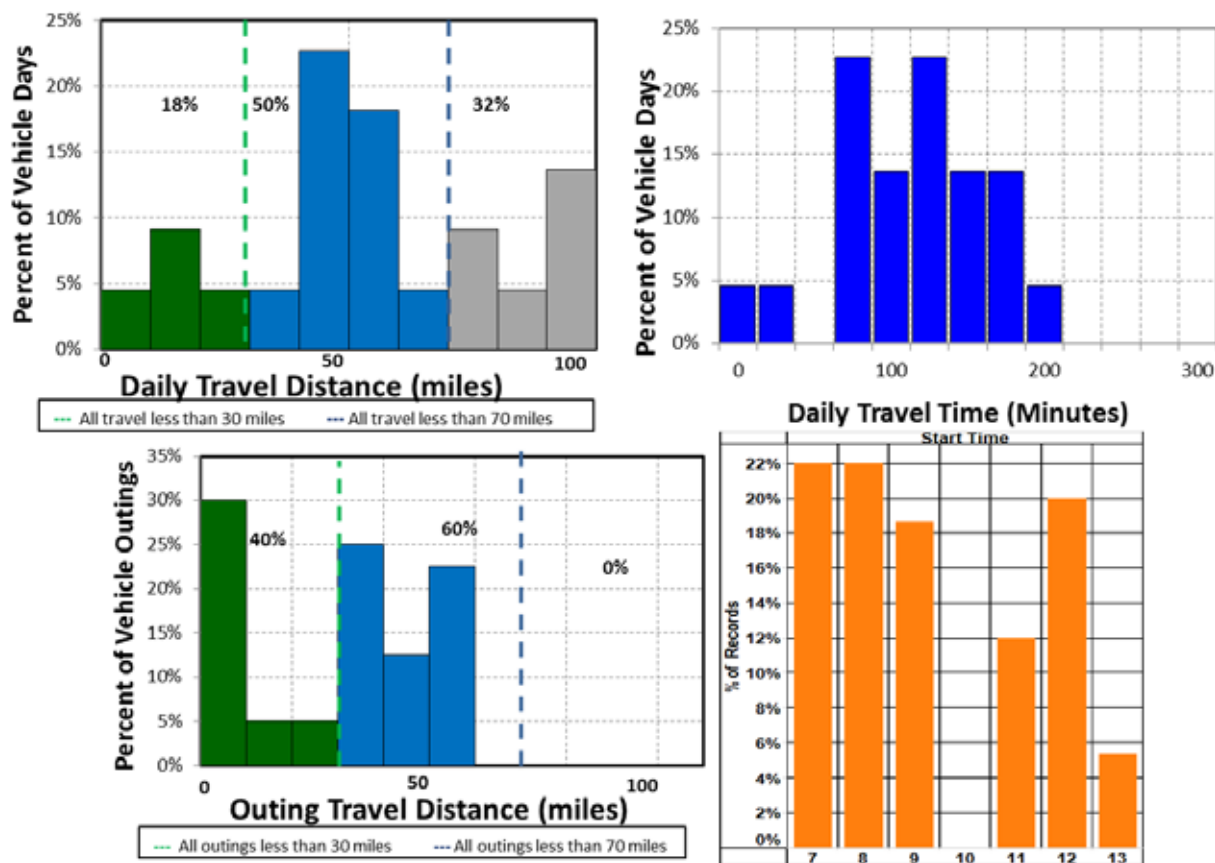


Figure C-15. Vehicle 294324 travel graphs.

## Vehicle 294324 Observations

Logger 54 collected data on this vehicle for a period of 22 days of the 31-day study period. Validation occurred on 100% of the input data. Data indicate that this vehicle has a support mission for Public Works. This vehicle's data indicate it parks near Building 1005 near Ash Street as shown in the Google Earth figure to the right.


MCBCL reports that a recent vehicle odometer indicated 42,589 miles and an average annual mileage of 8,195 miles. The vehicle was used on 71% of the available days, with an average daily usage of 2.1 hours and a peak daily usage of 3.5 hours on the days it was used. The vehicle was used during all hours of the day.

Figure C-15 shows that 68% of daily travel was within the typically advertised range of a BEV of approximately 70 miles. All outings were also within this range. Further, 18% of daily travel and 40% of outings were within the typically advertised CD mode of 30 miles for PHEVs.

A BEV could not meet all daily travel without additional charge opportunities because of the frequent daily travel exceeding its range. However, a significant amount of daily travel is within the BEV's capabilities. Thus, a fleet of vehicles would likely contain a mix of BEVs and PHEVs.



## Sheet 25: Vehicle 300672

	Make/Model/Year	Ford F550 - 2011
	EPA Class Size	Specialty – Bucket Truck
	Mission	Specialty
	Contact	Public Works
	Parking Location	Building 1023 near Michael Road
	Fleet Vehicle ID	300672
	Fuel Type	Diesel
	EPA Label/MPG (City/Hwy/Combined)*	10
	EPA GHG Emissions (Grams CO <sub>2</sub> /Mi)*	1021
	Study Logger ID	53
	Total Vehicle Days/Total Study Days	10/21

Vehicle 300672 Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	23.7/69.4	8.5/39.0	4.8/39.0	237
Travel Time (Minutes)	126.6/271.0	45.2/171.0	25.8/152.0	1,266
Idle Time (Minutes)	2.1/NA	26.6/NA	5.2/NA	746

Total Stops			Stop Duration	
Distance From Home Base (Miles)	Stops	Percentages	Stop Duration (Hours)	Stops
Less than 10	45	100%	Less than 2	30
10 to 20	0	0	2 to 4	4
20 to 40	0	0	4 to 8	1
40 to 60	0	0	Greater than 8	10

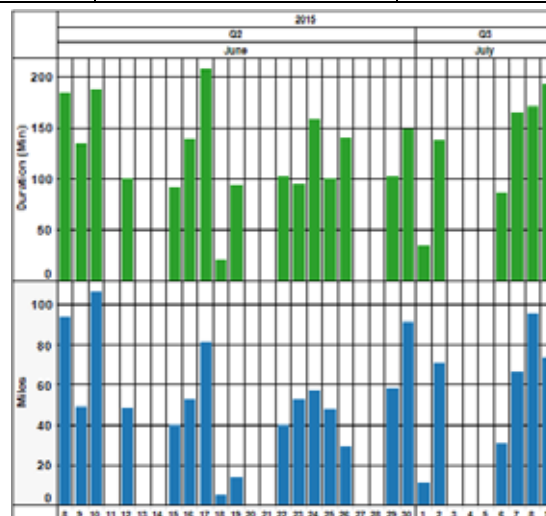
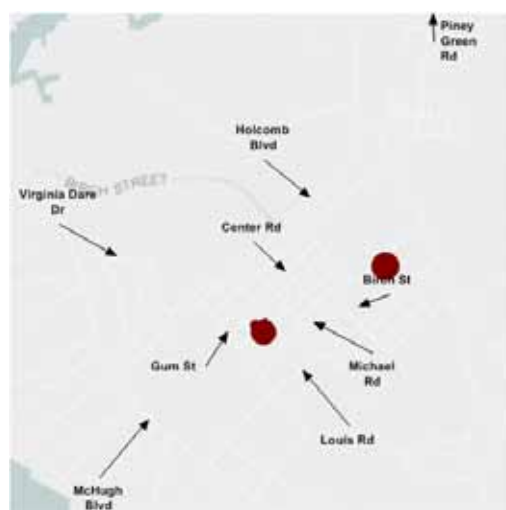


Figure C-16. Vehicle 300672 stops.

Figure C-17. Vehicle 300672 history.

\*EPA fuel economy is not available. Figures calculated for diesel per Section 5.

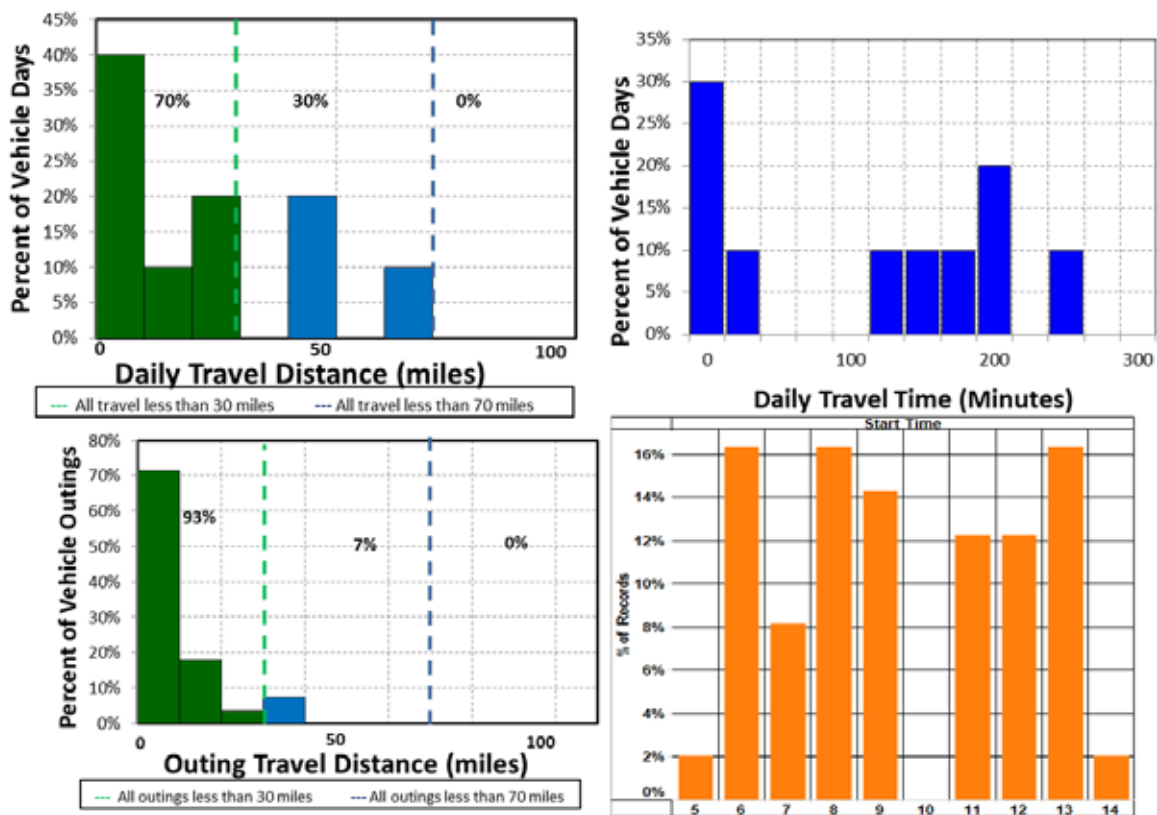


Figure C-18. Vehicle 300672 travel graphs.

## Vehicle 300672 Observations

Logger 53 collected data on this vehicle for a period of 10 days of the 21-day study period. Validation occurred on 100% of the input data. Data indicate that this vehicle has a specialty mission for Public Works. This vehicle's data indicate it parks near Building 1023 on Michael Road as shown in the Google Earth figure to the right.


MCBCL reports that the vehicle odometer indicated 33,968 miles at the start of this study and an average annual mileage of 7,214 miles. The vehicle was used on 48% of the available days, with an average daily usage of 2.1 hours and a peak daily usage of 4.5 hours on the days it was used. The vehicle was used primarily during day shift hours.



Figure C-18 shows that all daily travel was within the typically advertised range of a BEV of approximately 70 miles. All outings were also within this range. Further, 70% of daily travel and 93% of outings were within the typically advertised CD mode of 30 miles for PHEVs.

A BEV could meet all daily travel without additional charging opportunities. However, bucket truck specialty vehicles are not currently being deployed as PHEVs.

## Sheet 26: Vehicle 302039

	Make/Model/Year	Ford F250XL – 2014
	EPA Class Size	Pickup
	Mission	Support
	Contact	Public Works
	Parking Location	Building 670
	Fleet Vehicle ID	302039
	Fuel Type	Diesel
	EPA Label/MPG (City/Hwy/Combined)*	14
	EPA GHG Emissions (Grams CO <sub>2</sub> /Mi)	729
	Study Logger ID	55
	Total Vehicle Days/Total Study Days	18/31

Vehicle 302039 Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	68.5/151.7	20.5/82.2	7.6/70.7	1,232
Travel Time (Minutes)	252.4/421.0	75.7/251.0	28.0/159.0	4,543
Idle Time (Minutes)	89.2/NA	26.8/NA	9.9/NA	1,606

Total Stops			Stop Duration	
Distance From Home Base (Miles)	Stops	Percentages	Stop Duration (Hours)	Stops
Less than 10	131	97.0%	Less than 2	115
10 to 20	4	3.0%	2 to 4	3
20 to 40	0	0	4 to 8	1
40 to 60	0	0	Greater than 8	16

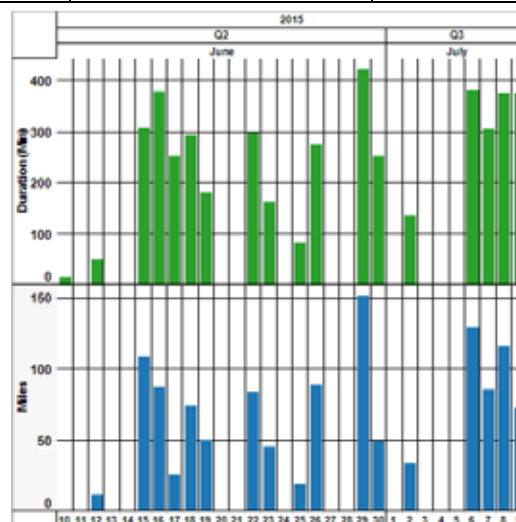
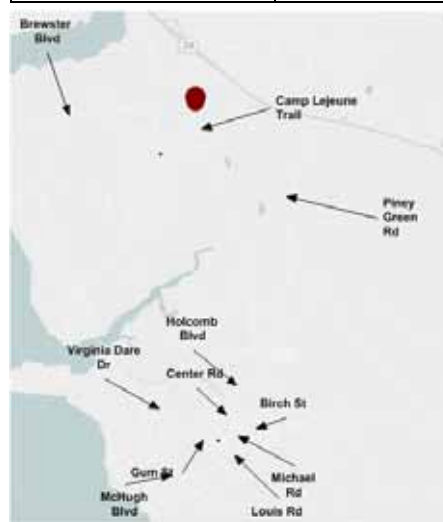


Figure C-19. Vehicle 302039 stops.

Figure C-20. Vehicle 302039 history.

\*EPA fuel economy is not available. Figures calculated for diesel per Section 5.



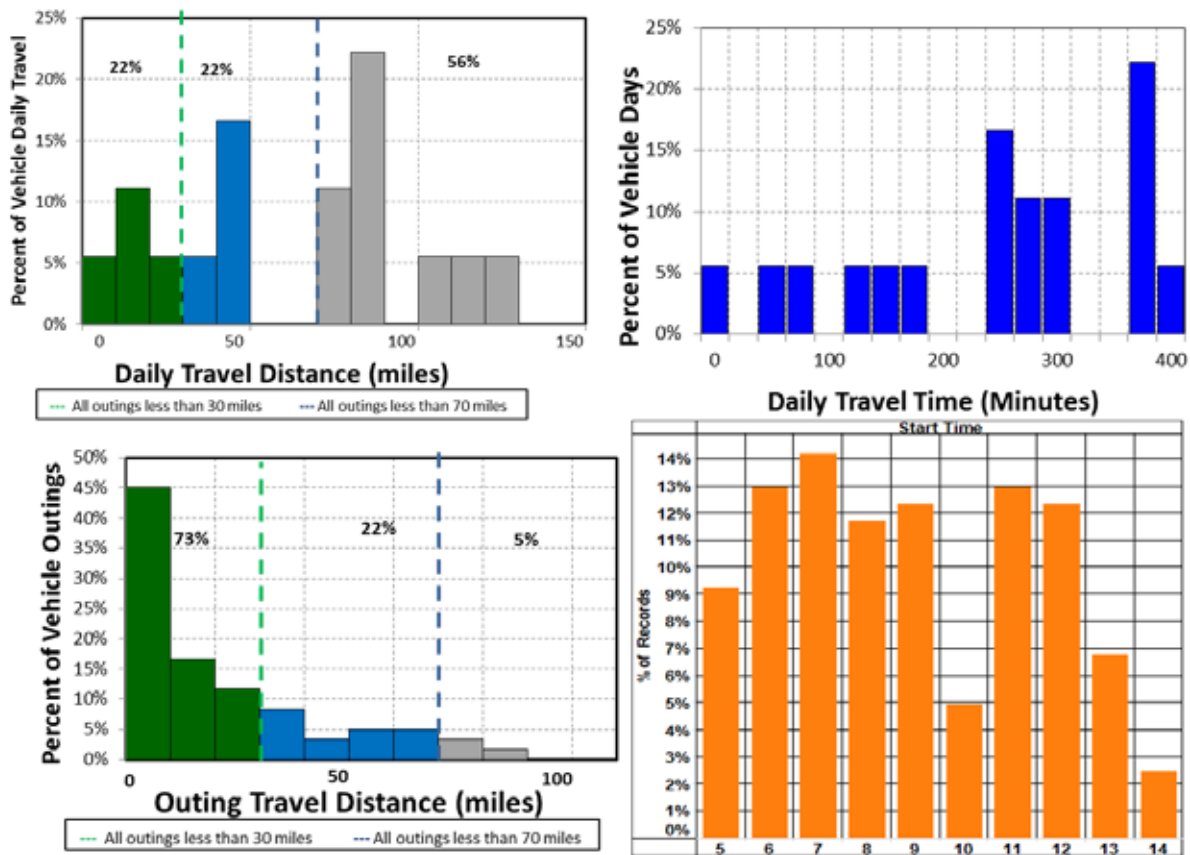


Figure C-21. Vehicle 302039 travel graphs.

## Vehicle 302039 Observations

Logger 55 collected data on this vehicle for a period of 18 days of the 31-day study period. Validation occurred on 100% of the input data. Data indicate that this vehicle has a support mission for Public Works. This vehicle's data indicate it parks near Building 670 near Brewster and Holcomb Boulevard as shown in the Google Earth figure to the right.


MCBCL reports that a recent vehicle odometer indicated 6,871 miles and an average annual mileage of 6,424 miles. The vehicle was used on 58% of the available days, with an average daily usage of 4.2 hours and a peak daily usage of 7.0 hours on the days it was used. The vehicle was used during day shift hours.



Figure C-21 shows that 44% of daily travel was within the typically advertised range of a BEV of approximately 70 miles and 95% of the outings were also within this range. Further, 22% of daily travel and 73% of outings were within the typically advertised CD mode of 30 miles for PHEVs.

A BEV could not meet all daily travel without additional charging opportunities due to the frequent days greater than the BEV range. Thus, a fleet of pickup trucks would likely contain a mix of BEVs and PHEVs.

## Sheet 27: Vehicle 302040

	Make/Model/Year	Ford F250XL – 2014
	EPA Class Size	Pickup
	Mission	Support
	Contact	Public Works
	Parking Location	Building FC436
	Fleet Vehicle ID	302040
	Fuel Type	Diesel
	EPA Label/MPG (City/Hwy/Combined)*	14
	EPA GHG Emissions (Grams CO <sub>2</sub> /Mi)*	729
	Study Logger ID	56
	Total Vehicle Days/Total Study Days	19/31

Vehicle 302040 Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	61.4/113.0	26.5/112.8	3.2/38.5	1,166
Travel Time (Minutes)	211.7/367.0	91.4/367.0	11.2/131.0	4,022
Idle Time (Minutes)	41.1/NA	17.7/NA	2.2/NA	780

Total Stops			Stop Duration	
Distance From Home Base (Miles)	Stops	Percentages	Stop Duration (Hours)	Stops
Less than 10	340	100%	Less than 2	320
10 to 20	0	0	2 to 4	0
20 to 40	0	0	4 to 8	1
40 to 60	0	0	Greater than 8	19

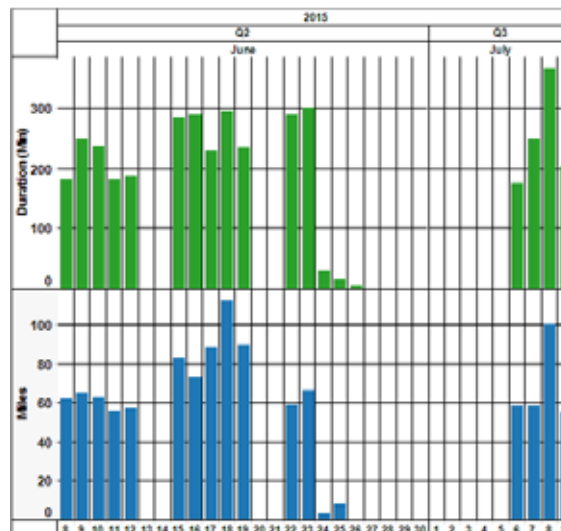
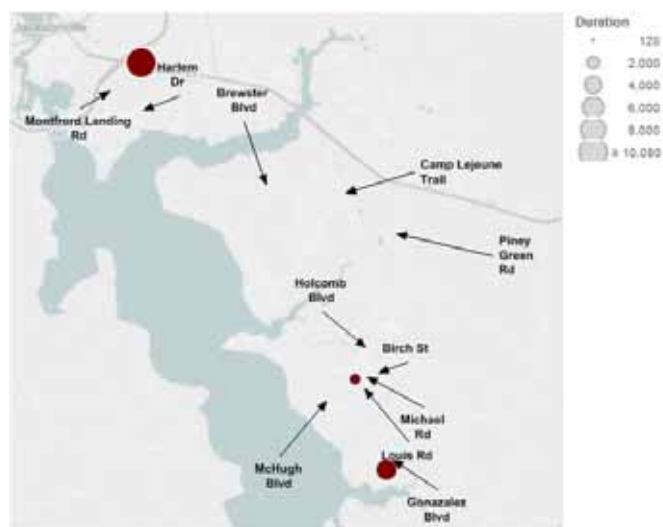


Figure C-22. Vehicle 302040 stops.

Figure C-23. Vehicle 302040 history.

\*EPA fuel economy not available. Figures calculated for diesel per Section 5.

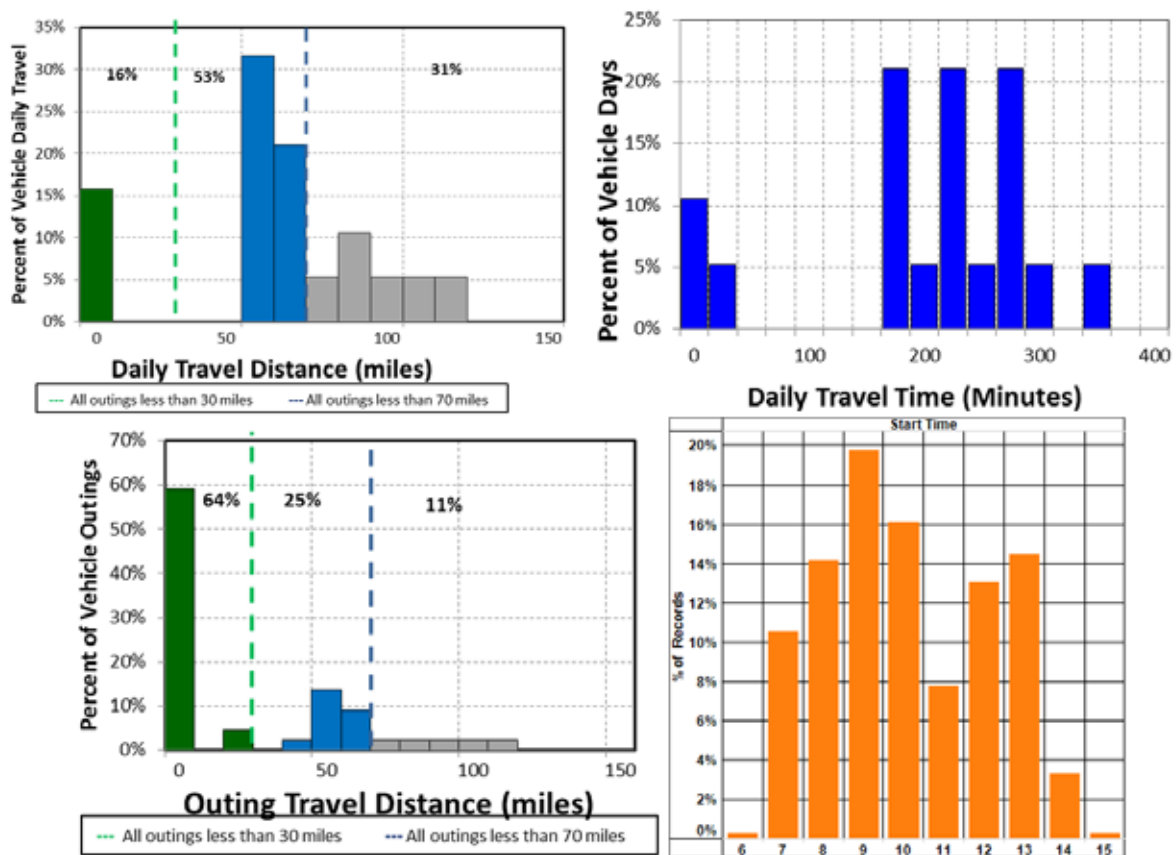


Figure C-24. Vehicle 302040 travel graphs.

## Vehicle 302040 Observations

Logger 56 collected data on this vehicle for a period of 19 days of the 31-day study period. Validation occurred on 100% of the input data. Data indicate that this vehicle has a support mission for Public Works. This vehicle's data indicate it parks near Building FC436 near Gonzalez Boulevard as shown in the Google Earth figure to the right.

MCBCL reports that a recent vehicle odometer indicated 13,083 miles and an average annual mileage of 10,937 miles. The vehicle was used on 61% of the available days, with an average daily usage of 3.5 hours and a peak daily usage of 6.1 hours on the days it was used. The vehicle was used during all hours of the day.




Figure C-24 shows that 69% of daily travel was within the typically advertised range of a BEV of approximately 70 miles and 89% of outings were also within this range. Further, 16% of daily travel and 64% of outings were within the typically advertised CD mode of 30 miles for PHEVs.

A BEV could not meet all daily travel because of the frequent days above the BEV range. However, a fleet of pickup trucks would likely contain a mix of BEVs and PHEVs.



## Sheet 28: Vehicle 302334

	Make/Model/Year	Ford F350 Stake – 2015
	EPA Class Size	Pickup
	Mission	Support
	Contact	G3 – Operations and Training
	Parking Location	Building 56
	Fleet Vehicle ID	302334
	Fuel Type	E85
	EPA Label/MPG (City/Hwy/Combined)*	13/18/15
	EPA GHG Emissions (Grams CO <sub>2</sub> /Mi)*	419
	Study Logger ID	79
	Total Vehicle Days/Total Study Days	18/34

Vehicle 302334 Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	10.7/54.6	5.1/52.9	2.0/22.1	193
Travel Time (Minutes)	34.9/99.0	16.5/91.0	6.3/38.0	628
Idle Time (Minutes)	1.6/NA	0.7/NA	0.3/NA	28

Total Stops			Stop Duration	
Distance From Home Base (Miles)	Stops	Percentages	Stop Duration (Hours)	Stops
Less than 10	91	100%	Less than 2	70
10 to 20	0	0	2 to 4	4
20 to 40	0	0	4 to 8	1
40 to 60	0	0	Greater than 8	16

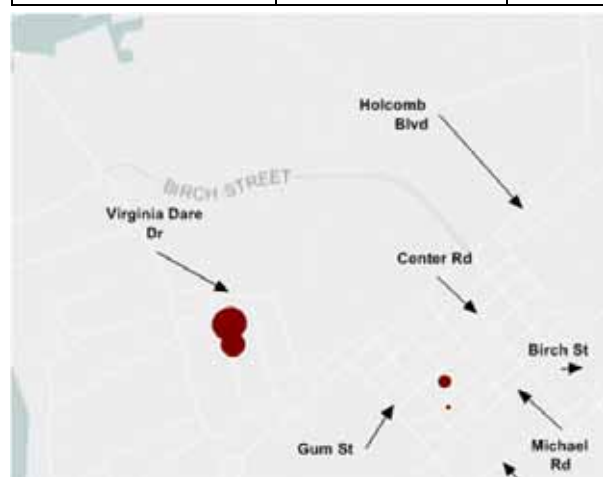


Figure C-25. Vehicle 302334 stops.

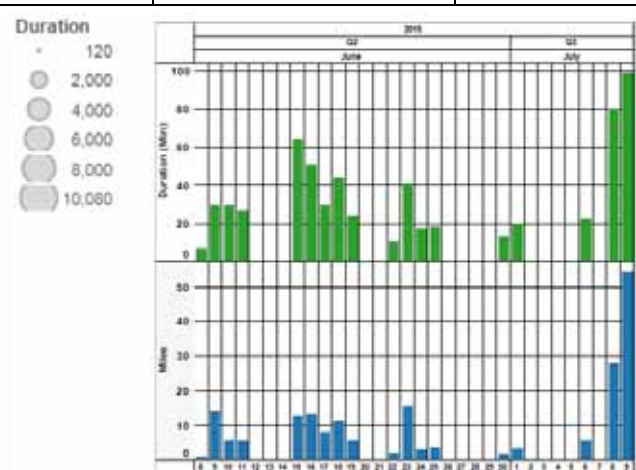


Figure C-26. Vehicle 302334 history.

\*Fuel economy for F350 is not available. Economy used is for F150.

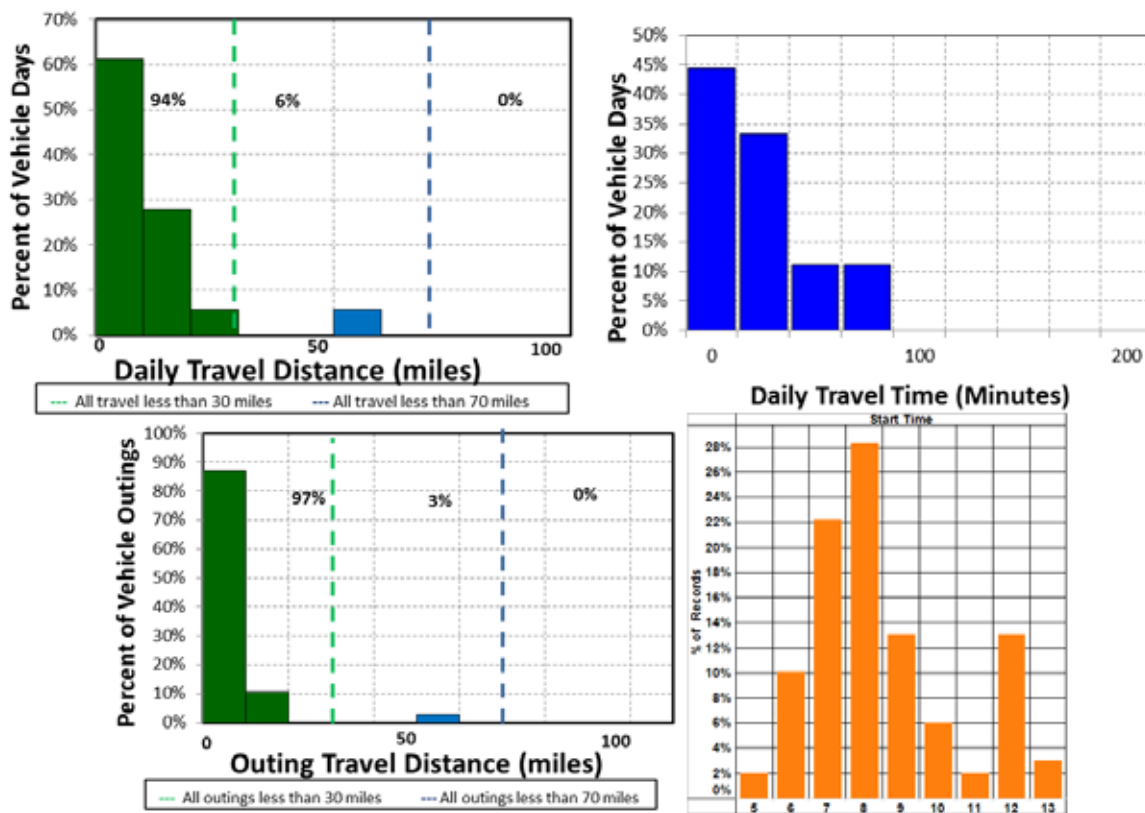


Figure C-27. Vehicle 302334 travel graphs.

## Vehicle 302334 Observations

Logger 79 collected data on this vehicle for a period of 18 days of the 34-day study period. Validation occurred on 100% of the input data. Data indicate that this vehicle has a support mission for G3 – Operations and Training. This vehicle's data indicate it parks near Building 56 near Post Lane as shown in the Google Earth figure to the right.


MCBCL reports that the new vehicle odometer indicated 0 miles at the start of this study and an average annual mileage is estimated to be 1,200 miles. The vehicle was used on 53% of the available days, with an average daily usage of 0.6 hours and a peak daily usage of 1.7 hours on the days it was used. The vehicle was used during day shift hours.



Figure C-27 shows that all daily travel was within the typically advertised range of a BEV of approximately 70 miles. All outings were also within this range. Further, 94% of daily travel and 97% of outings were within the typically advertised CD mode of 30 miles for PHEVs.

A BEV could meet all daily travel without additional charging opportunities. However, a suitable BEV replacement for a stake truck is not currently available. Thus, a PHEV Via Motors VTRUX pickup is suggested.

## Sheet 29: Vehicle G10-3327L

	Make/Model/Year	Chevrolet Malibu – 2012
	EPA Class Size	Sedan – Midsize
	Mission	Pool
	Contact	Motor Transport C-Pool
	Parking Location	Building FC500
	Fleet Vehicle ID	G10-3327L
	Fuel Type	E85
	EPA Label/MPG (City/Hwy/Combined)	15/23/18
	EPA GHG Emissions (Grams CO <sub>2</sub> /Mi)	345
	Study Logger ID	5
	Total Vehicle Days/Total Study Days	21/34

Vehicle G10-3327L Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	23.2/70.8	6.0/51.0	2.6/51.0	487
Travel Time (Minutes)	95.8/242.0	24.8/159.0	10.6/87.0	2,012
Idle Time (Minutes)	25.1/NA	6.5/NA	2.8/NA	528

Total Stops			Stop Duration	
Distance From Home Base (Miles)	Stops	Percentages	Stop Duration (Hours)	Stops
Less than 10	178	99.4%	Less than 2	129
10 to 20	1	0.6%	2 to 4	16
20 to 40	0	0	4 to 8	19
40 to 60	0	0	Greater than 8	14

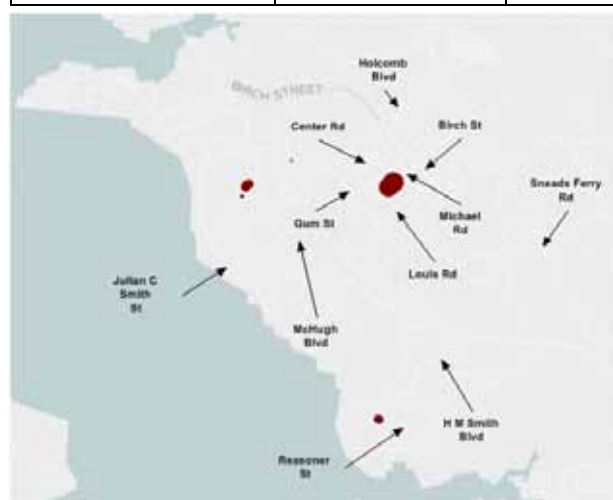


Figure C-28. Vehicle G10-3327L stops.

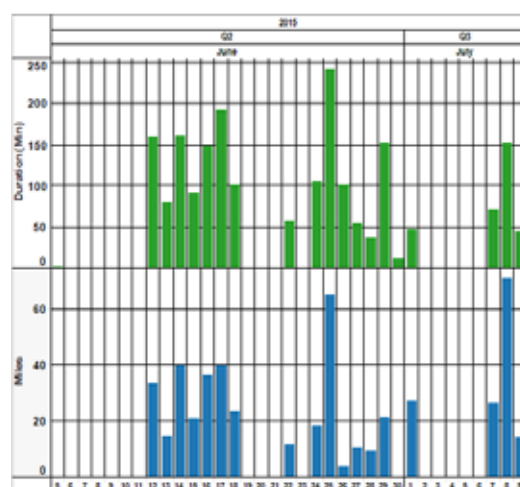


Figure C-29. Vehicle G10-3327L history.

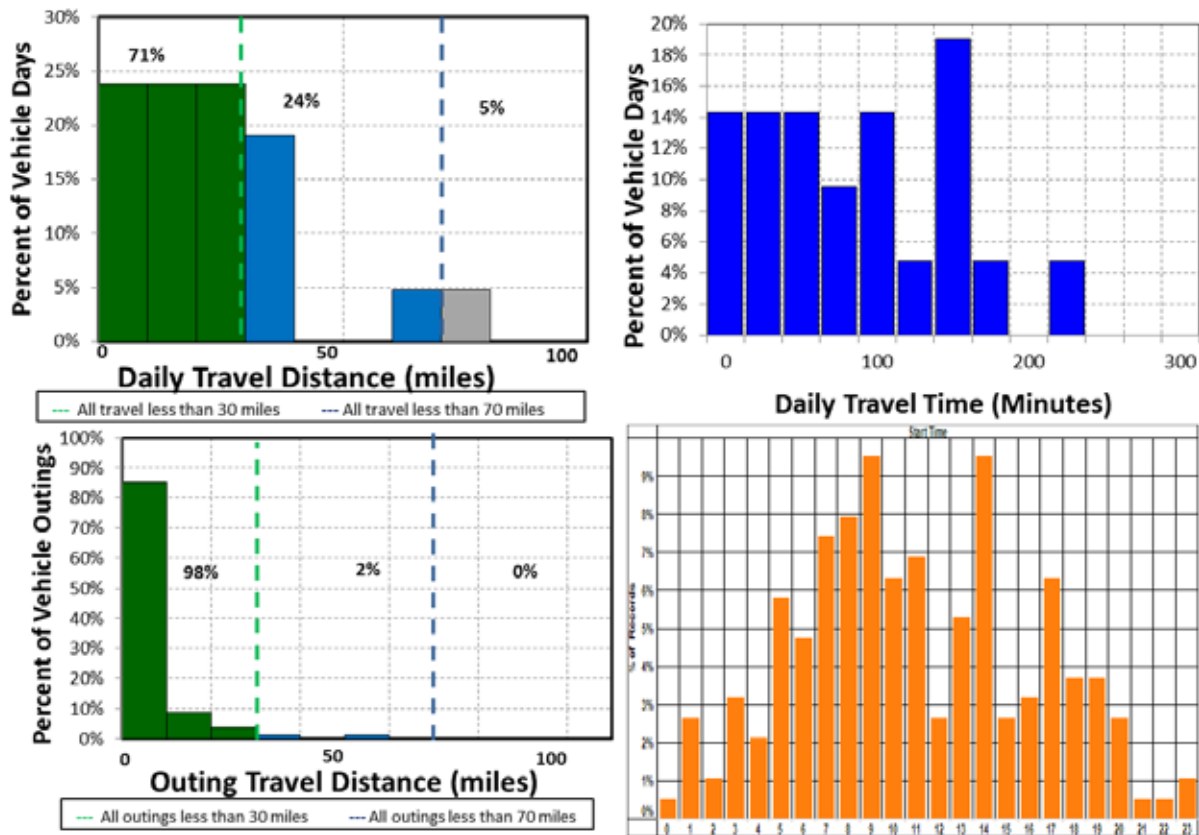


Figure C-30. Vehicle G10-3327L travel graphs.

## Vehicle G10-3327L Observations

Logger 5 collected data on this vehicle for a period of 21 days of the 34-day study period. Validation occurred on 100% of the input data. Data indicate that this vehicle has a pool mission for the Motor Transport C-Pool. This vehicle's data indicate it parked over night at several different locations during the study period: H M Smith Boulevard, Michael Road, F Street, and Flounder Road. The H M Smith location is shown in the Google Earth figure to the right.




MCBCL reports that a recent vehicle odometer indicated 17,359 miles at the start of this study and an average annual mileage of 7,085 miles. The vehicle was used on 62% of the available days, with an average daily usage of 1.6 hours and a peak daily usage of 4.0 hours on the days it was used. The vehicle was used during all hours of the day.

Figure C-30 shows that 95% of daily travel was within the typically advertised range of a BEV of approximately 70 miles. All outings were also within this range. Further, 71% of daily travel and 98% of outings were within the typically advertised CD mode of 30 miles for PHEVs.

A BEV could meet all daily travel with additional charging opportunities, assuming the vehicle was assigned a home base. A fleet of pool sedans would likely contain a mix of BEVs and PHEVs.

# Sheet 30: Vehicle G13-0325K

	Make/Model/Year	Ford Focus – 2012
	EPA Class Size	Sedan – Compact
	Mission	Support
	Contact	Eastern Judicial Circuit
	Parking Location	Building 67
	Fleet Vehicle ID	G13-0325K
	Fuel Type	Gas
	EPA Label/MPG (City/Hwy/Combined)	28/38/31
	EPA GHG Emissions (Grams CO <sub>2</sub> /Mi)	287
	Study Logger ID	41
	Total Vehicle Days/Total Study Days	13/40

Vehicle G13-0325K Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	18.1/94.6	12.4/91.1	5.4/45.7	236
Travel Time (Minutes)	40.8/149.0	27.9/135.0	12.0/71.0	530
Idle Time (Minutes)	1.5/NA	1.0/NA	0.4/NA	19

Total Stops			Stop Duration	
Distance From Home Base (Miles)	Stops	Percentages	Stop Duration (Hours)	Stops
Less than 10	41	97.6%	Less than 2	27
10 to 20	0	0	2 to 4	2
20 to 40	1	2.4%	4 to 8	1
40 to 60	0	0	Greater than 8	12



Figure C-31. Vehicle G13-0325K stops.

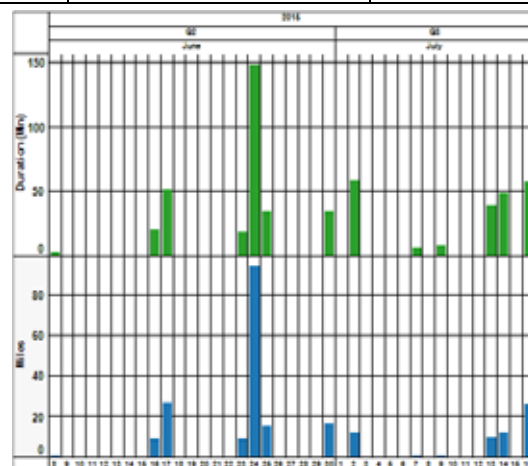


Figure C-32. Vehicle G13-0325K history.



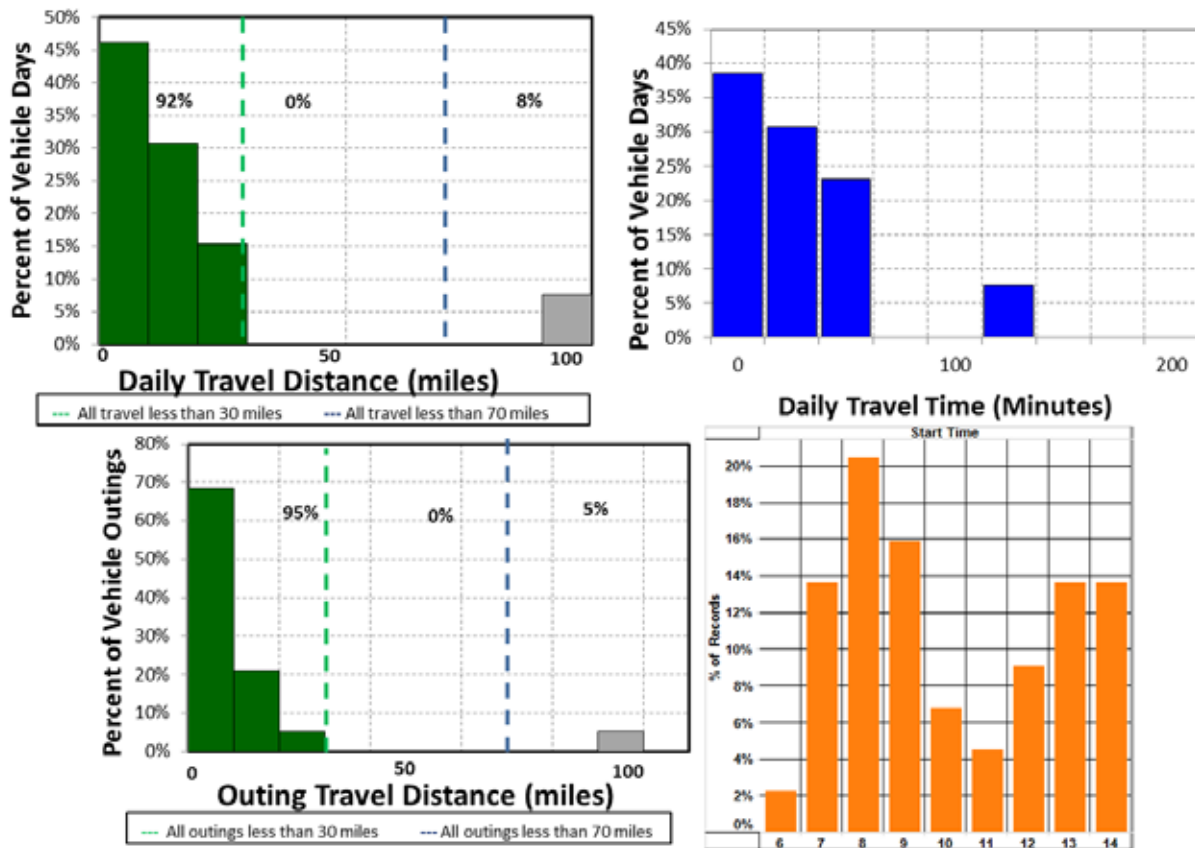


Figure C-33. Vehicle G13-0325K travel graphs.

### Vehicle G13-0325K Observations

Logger 41 collected data on this vehicle for a period of 13 days of the 40-day study period. Validation occurred on 100% of the input data. Data indicate that this vehicle has a support mission for the Eastern Judicial Circuit. This vehicle's data indicate it parks near Building 67 near Virginia Dare Drive as shown in the Google Earth figure to the right.

MCBCL reports that a recent vehicle odometer indicated 6,380 miles at the start of this study and an average annual mileage of 1,037 miles. The vehicle was used on 33% of the available days, with an average daily usage of 0.7 hours and a peak daily usage of 2.5 hours on the days it was used. The vehicle was used during day shift hours.




Figure C-33 shows that 92% of daily travel was within the typically advertised range of a BEV of approximately 70 mile and 95% of the outings were also within this range. Further, 92% of daily travel and 95% of outings were within the typically advertised CD mode of 30 miles for PHEVs.

A BEV could not meet all daily travel because one outing exceeded the BEV range. However, a significant amount of daily travel was less than the BEV range. Thus, a fleet of vehicles for the Eastern Judicial Circuit would likely contain a mix of BEVs and PHEVs.



# Sheet 31: Vehicle G13-7974P

	Make/Model/Year	Ford Focus – 2015
	EPA Class Size	Sedan - Compact
	Mission	Support
	Contact	G4 - Logistics
	Parking Location	Building 1117
	Fleet Vehicle ID	G13-7974P
	Fuel Type	E85
	EPA Label/MPG (City/Hwy/Combined)	27/40/31
	EPA GHG Emissions (Grams CO <sub>2</sub> /Mi)	266
	Study Logger ID	39
	Total Vehicle Days/Total Study Days	12/30

Vehicle G13-7974P Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	85.8/152.1	57.2/143.0	6.8/54.5	1,030
Travel Time (Minutes)	172.6/292.0	115.1/264.0	13.7/73.0	2,071
Idle Time (Minutes)	10.4/NA	6.9/NA	0.8/NA	125

Total Stops			Stop Duration	
Distance From Home Base (Miles)	Stops	Percentages	Stop Duration (Hours)	Stops
Less than 10	91	65.9%	Less than 2	125
10 to 20	28	20.3%	2 to 4	1
20 to 40	14	10.1%	4 to 8	1
40 to 60	5	3.6%	Greater than 8	11



Figure C-34. Vehicle G13-7974P stops.

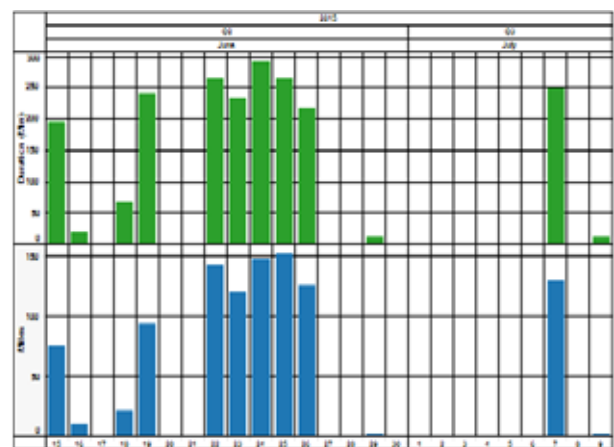


Figure C-35. Vehicle G13-7974P history.

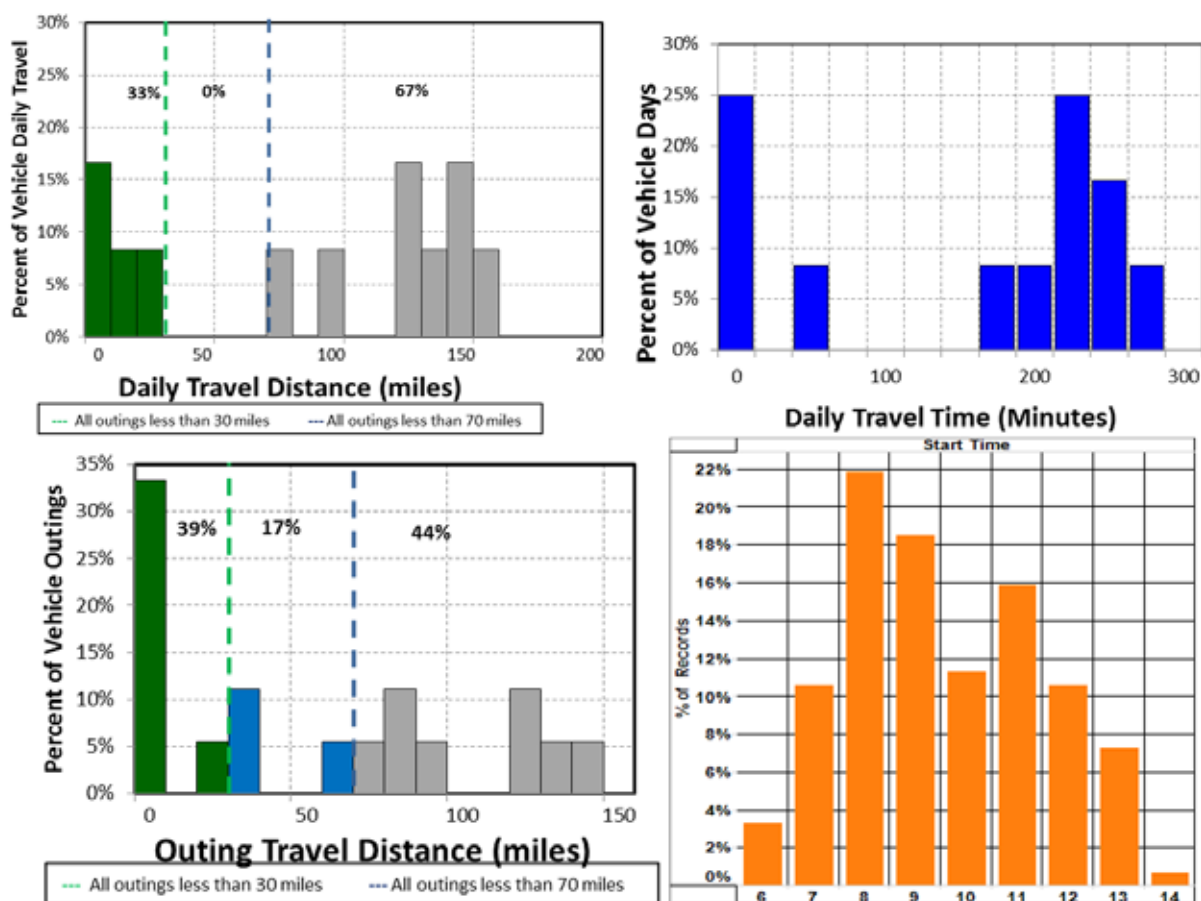


Figure C-36. Vehicle G13-7974P travel graphs.

## Vehicle G13-7974P Observations

Logger 39 collected data on this vehicle for a period of 12 days of the 30-day study period. Validation occurred on 100% of the input data. Data indicate that this vehicle has a support mission for G4 - Logistics. This vehicle's data indicate it parked overnight in two separate locations at different time: initially near Building 1117 near Ash Street as shown in the Google Earth figure to the right and later on Franklin Street.




MCBCL reports that a recent vehicle odometer indicated 6,295 miles at the start of this study on this new vehicle and an average annual mileage of 12,000 miles. The vehicle was used on 40% of the available days, with an average daily usage of 2.9 hours and a peak daily usage of 4.9 hours on the days it was used. The vehicle was used during day shift hours.

Figure C-36 shows that 33% of daily travel was within the typically advertised range of a BEV of approximately 70 miles and 54% of the outings were also within this range. Further, 33% of daily travel and 39% of outings were within the typically advertised CD mode of 30 miles for PHEVs.

A BEV could not meet all daily travel due to the frequent days greater than the BEV range.

## Sheet 32: Vehicle G41-0379H

	Make/Model/Year	Dodge Grand Caravan – 2009
	EPA Class Size	Minivan
	Mission	Pool
	Contact	Motor Transport – C-Pool
	Parking Location	Building M305
	Fleet Vehicle ID	G41-0379H
	Fuel Type	E85
	EPA Label/MPG (City/Hwy/Combined)	11/16/13
	EPA GHG Emissions (Grams CO <sub>2</sub> /Mi)	477
	Study Logger ID	7
	Total Vehicle Days/Total Study Days	16/35

Vehicle G41-0379H Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	29.1/289.4	11.6/270.8	6.2/136.5	466
Travel Time (Minutes)	62.6/409.0	25.0/354.0	13.3/186.0	1,001
Idle Time (Minutes)	11.5/NA	4.6/NA	2.5/NA	184

16 / 35Total Stops			Stop Duration	
Distance From Home Base (Miles)	Stops	Percentages	Stop Duration (Hours)	Stops
Less than 10	65	98.5%	Less than 2	49
10 to 20	0	0	2 to 4	4
20 to 40	0	0	4 to 8	1
> 40	1	1.5%	Greater than 8	12



Figure C-37. Vehicle G41-0379H stops.

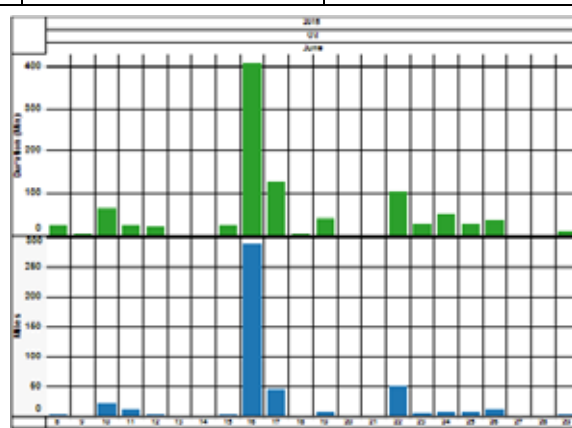


Figure C-38. Vehicle G41-0379H history.

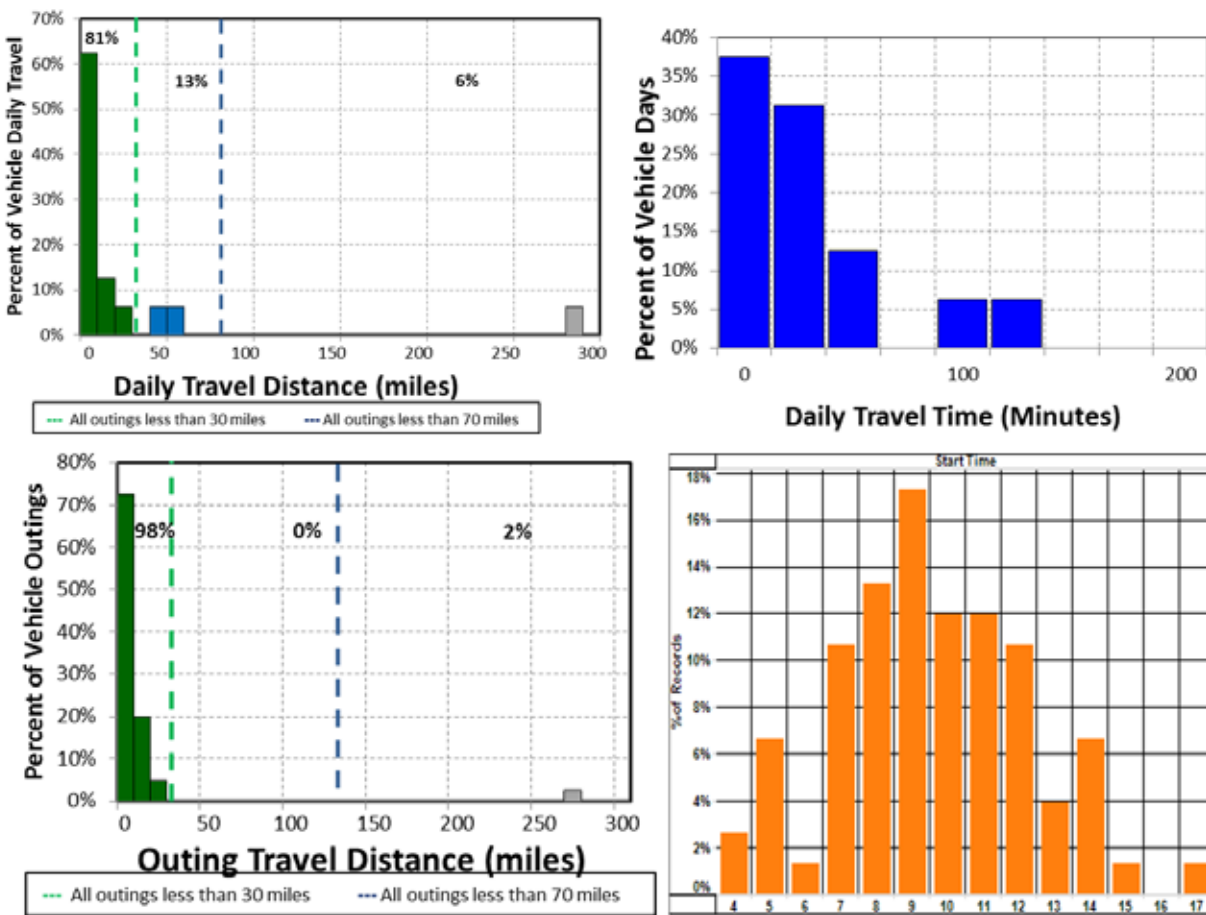


Figure C-39. Vehicle G41-0379H travel graphs.

## Vehicle G41-0379H Observations

Logger 7 collected data on this vehicle for a period of 16 days of the 35-day study period. Validation occurred on 100% of the input data. Data indicate that this vehicle has a pool mission for Motor Transport – C-Pool. This vehicle’s data indicate it parks near Building M305 near Company Street B as shown in the Google Earth figure to the right.


MCBCL reports that a recent vehicle odometer indicated 25,874 miles at the start of this study and an average annual mileage of 5,614 miles. The vehicle was used on 46% of the available days, with an average daily usage of 1.0 hours and a peak daily usage of 6.8 hours on the days it was used. The vehicle was used during day shift hours.



Figure C-39 shows that 94% of daily travel was within the typically advertised range of a BEV of approximately 70 miles and 98% of the outings were also within this range. Further, 81% of daily travel and 98% of outings were within the typically advertised CD mode of 30 miles for PHEVs. The peak outing of 271 miles occurred during a single outing to Cedar Fork, North Carolina.

A BEV could not meet all daily travel because of this single long outing. However, daily travel shows a significant number of days with travel within the BEV range. Thus, a fleet of pool vehicles would likely contain a mix of BEVs and PHEVs.

### Sheet 33: Vehicle G41-0391H

	Make/Model/Year	Dodge Dakota – 2009
	EPA Class Size	Pickup
	Mission	Support
	Contact	G4- Logistics
	Parking Location	Building 1117
	Fleet Vehicle ID	G41-0391H
	Fuel Type	E85
	EPA Label/MPG (City/Hwy/Combined)	9/13/10
	EPA GHG Emissions (Grams CO <sub>2</sub> /Mi)	620
	Study Logger ID	40
	Total Vehicle Days/Total Study Days	13/30

Vehicle G41-0391H Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	56.5/140.5	40.8/128.0	6.6/43.8	735
Travel Time (Minutes)	157.4/329.0	113.7/322.0	18.3/102.0	2,046
Idle Time (Minutes)	29.9/NA	21.6/NA	3.5/NA	389

Total Stops			Stop Duration	
Distance From Home Base (Miles)	Stops	Percentages	Stop Duration (Hours)	Stops
Less than 10	76	73.8%	Less than 2	88
10 to 20	22	21.4%	2 to 4	2
20 to 40	5	4.9%	4 to 8	0
40 to 60	0	0	Greater than 8	13



Figure C-40. Vehicle G41-0391H stops.

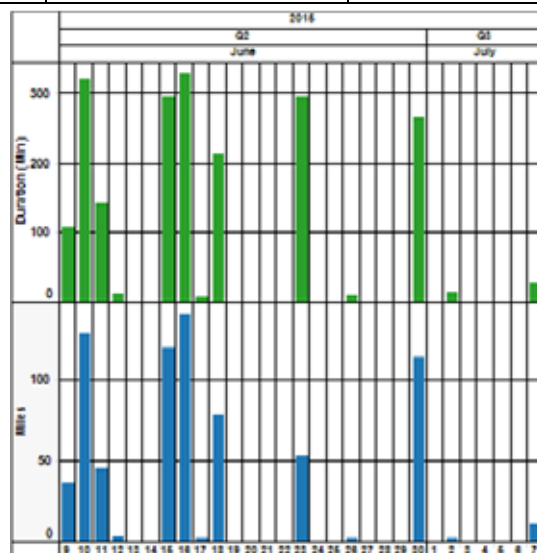


Figure C-41. Vehicle G41-0391H history.



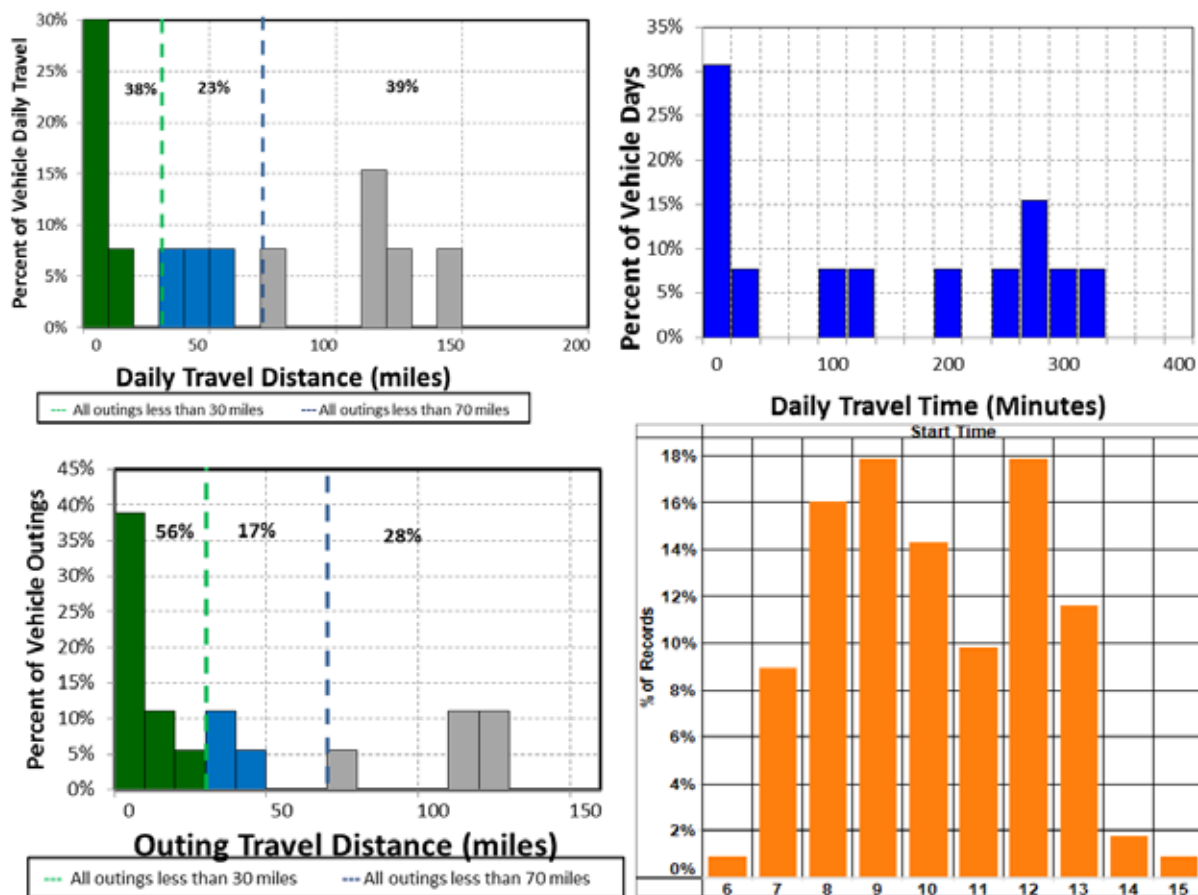


Figure C-42. Vehicle G41-0391H travel graphs.

## Vehicle G41-0391H Observations

Logger 40 collected data on this vehicle for a period of 13 days of the 30-day study period. Validation occurred on 100% of the input data. Data indicate that this vehicle has a support mission for G4- Logistics. This vehicle's data indicate it parked overnight in several different locations, but primarily near Building 1117 on Franklin Street as shown in the Google Earth figure to the right.

MCBCL reports that a recent vehicle odometer indicated 27,140 miles at the start of this study and an average annual mileage of 7,507 miles. The vehicle was used on 43% of the available days, with an average daily usage of 2.6 hours and a peak daily usage of 5.5 hours on the days it was used. The vehicle was used during day shift hours.




Figure C-42 shows that 61% of daily travel was within the typically advertised range of a BEV of approximately 70 miles and 72% of the outings were also within this range. Further, 38% of daily travel and 56% of outings were within the typically advertised CD mode of 30 miles for PHEVs.

A BEV could not meet all daily travel because of the frequent daily travel exceeding the BEV range. However, approximately half the daily travel is within the BEV range. Thus, a fleet of pickup trucks would likely contain a mix of BEVs and PHEVs.



# Sheet 34: Vehicle G41-0754M

	Make/Model/Year	Dodge Grand Caravan – 2012
	EPA Class Size	Minivan
	Mission	Pool
	Contact	Motor Transport – C-Pool
	Parking Location	Building 1407
	Fleet Vehicle ID	G41-0754M
	Fuel Type	E85
	EPA Label/MPG (City/Hwy/Combined)	12/18/14
	EPA GHG Emissions (Grams CO <sub>2</sub> /Mi)	443
	Study Logger ID	8
	Total Vehicle Days/Total Study Days	11/35

Vehicle G41-0754M travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	88.7/269.6	48.8/537.2	16.3/258.5	976
Travel Time (Minutes)	157.5/327.0	86.7/680.0	28.9/285.0	1.733
Idle Time (Minutes)	34.4/NA	18.9/NA	6.3/NA	378

Total Stops			Stop Duration	
Distance From Home Base (Miles)	Stops	Percentages	Stop Duration (Hours)	Stops
Less than 10	33	87.6%	Less than 2	30
10 to 20	0	0	2 to 4	2
20 to 40	5	11.9%	4 to 8	1
> 40	4	9.5%	Greater than 8	9

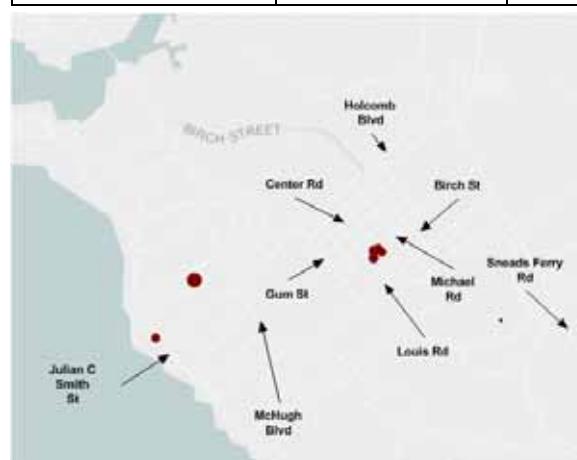


Figure C-43. Vehicle G41-0754M stops.

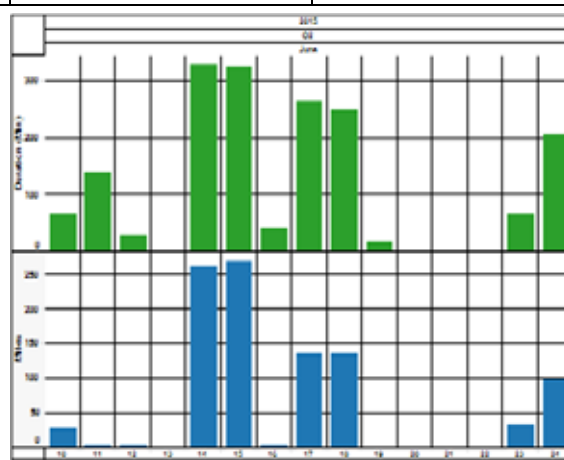


Figure C-44. Vehicle G41-0754M history.

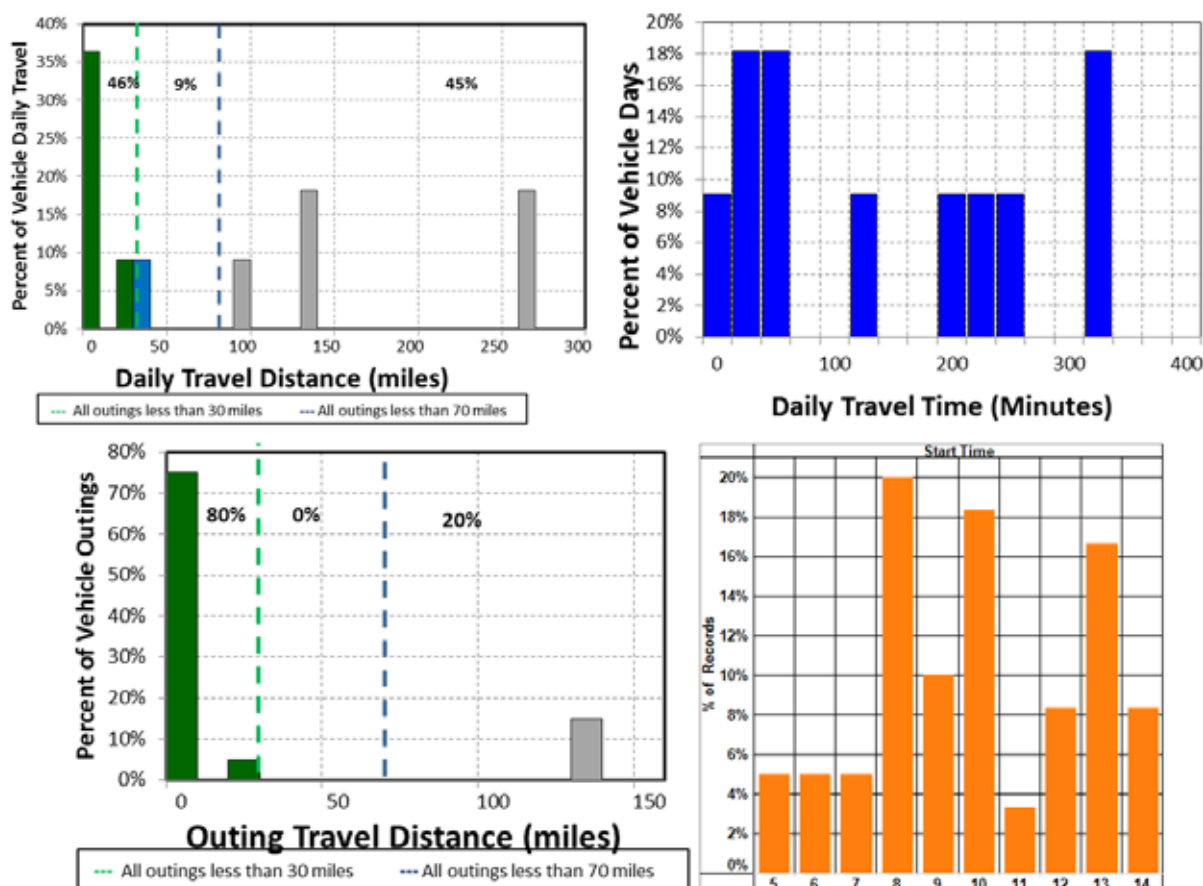


Figure C-45. Vehicle G41-0754M travel graphs. Note that the outing graph does not show the single outing of 537 miles.

## Vehicle G41-0754M Observations

Logger 8 collected data on this vehicle for a period of 11 days of the 35-day study period. Validation occurred on 94.8% of the input data. Data indicate that this vehicle has a pool mission for Motor Transport – C-Pool. This vehicle's data indicate it parks near Building 1407 near Michael Road as shown in the Google Earth figure to the right.


MCBCL reports that a recent vehicle odometer indicated 10,918 miles at the start of this study and an average annual mileage of 5,183 miles. The vehicle was used on 43% of the available days, with an average daily usage of 2.6 hours and a peak daily usage of 5.5 hours on the days it was used. The vehicle was used during day shift hours.

Figure C-45 shows that 55% of daily travel was within the typically advertised range of a BEV of approximately 70 miles and 80% of the outings were also within this range. Further, 46% of daily travel and 80% of outings were within the typically advertised CD mode of 30 miles for PHEVs. The peak outing of 537 miles occurred over a several day period during an excursion to Whiteville and Charlotte.

A BEV could not meet all daily travel because of the extended excursion. However, significant daily travel is within the range of a BEV. Thus, a fleet of pool vehicles would likely contain a mix of BEVs and PHEVs.



# Sheet 35: Vehicle G41-0806P

	Make/Model/Year	Dodge Caravan – 2014
	EPA Class Size	Minivan
	Mission	Support
	Contact	Public Works
	Parking Location	Building 1005
	Fleet Vehicle ID	G41-0806P
	Fuel Type	E85
	EPA Label/MPG (City/Hwy/Combined)	12/18/14
	EPA GHG Emissions (Grams CO <sub>2</sub> /Mi)	434
	Study Logger ID	57
Total Vehicle Days/Total Study Days		22/31

Vehicle G41-0806P Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	76.0/143.2	40.8/74.1	16.9/72.0	1,673
Travel Time (Minutes)	189.2/285.0	101.5/183.0	42.1/147.0	4,163
Idle Time (Minutes)	36.0/NA	19.3/NA	8.0/NA	791

Total Stops			Stop Duration	
Distance From Home Base (Miles)	Stops	Percentages	Stop Duration (Hours)	Stops
Less than 10	100	100%	Less than 2	57
10 to 20	0	0	2 to 4	19
20 to 40	0	0	4 to 8	2
40 to 60	0	0	Greater than 8	22

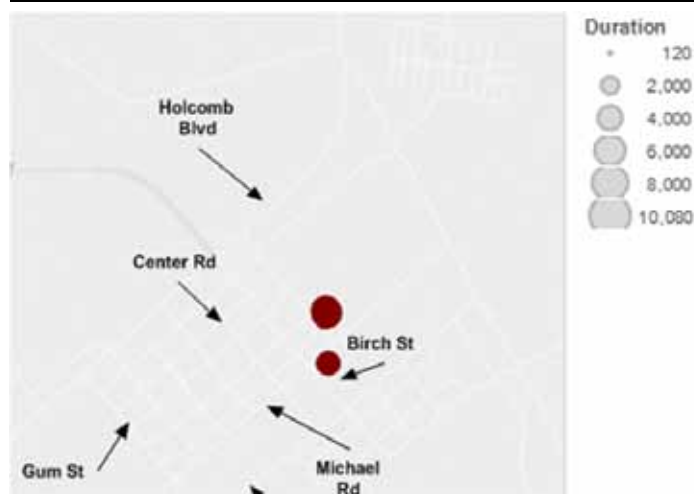


Figure C-46. Vehicle G41-0806P stops.

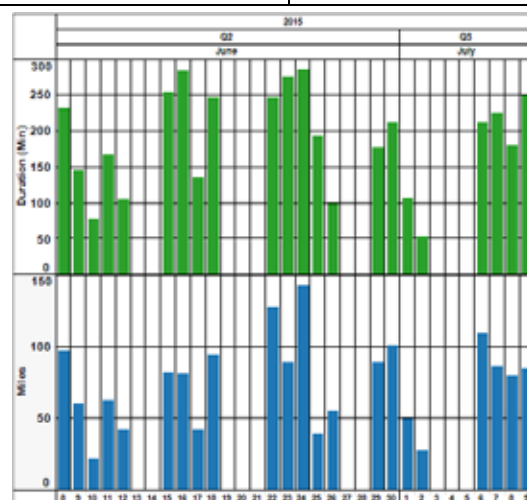


Figure C-47. Vehicle G41-0806P history.

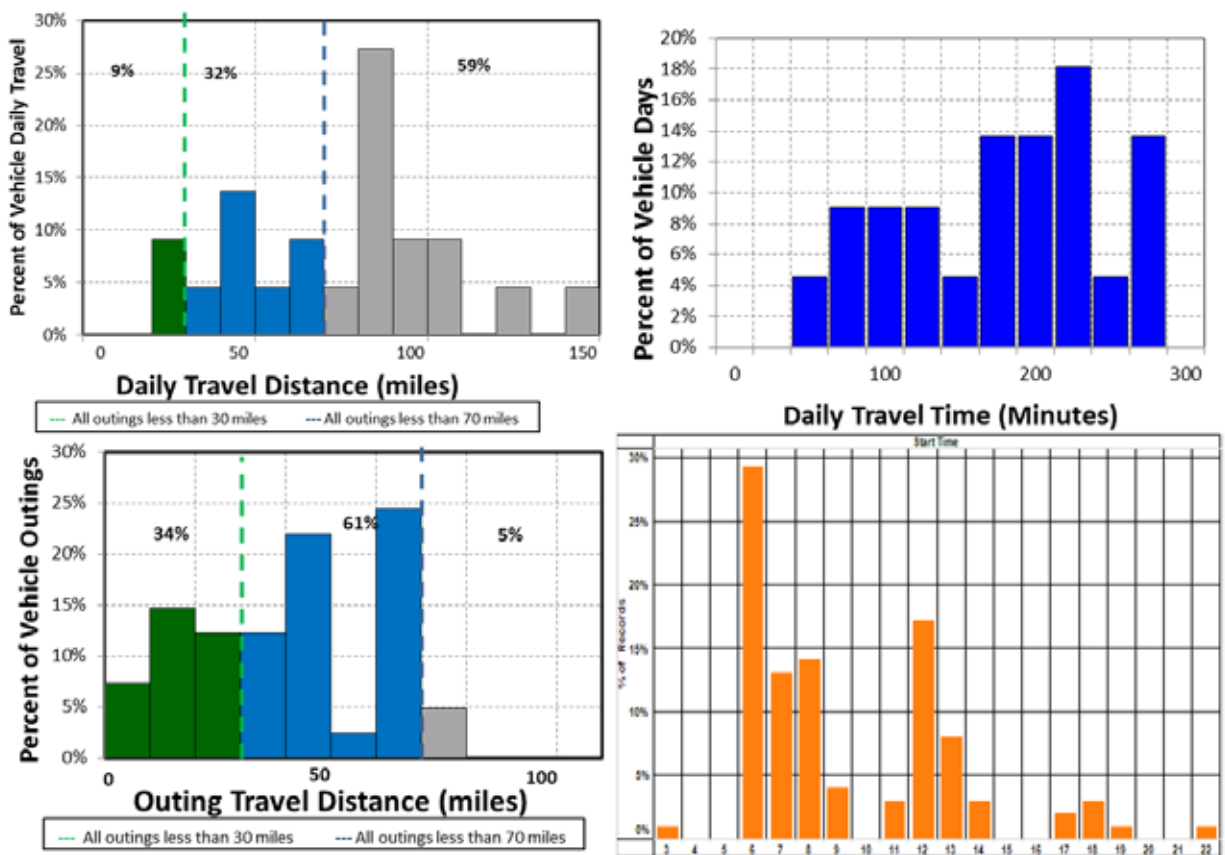


Figure C-48. Vehicle G41-0806P travel graphs.

## Vehicle G41-0806P Observations

Logger 57 collected data on this vehicle for a period of 22 days of the 31-day study period. Validation occurred on 100% of the input data. Data indicate that this vehicle has a support mission for Public Works. This vehicle's data indicate it parks near Building 1005 near Ash Street as shown in the Google Earth figure to the right.


MCBCL reports that a recent vehicle odometer indicated 12,562 miles at the start of this study and an average annual mileage of 12,552 miles. The vehicle was used on 71% of the available days, with an average daily usage of 3.2 hours and a peak daily usage of 4.8 hours on the days it was used. The vehicle was used primarily during day shift hours.



Figure C-48 shows that 41% of daily travel was within the typically advertised range of a BEV of approximately 70 miles and 95% of the outings were also within this range. Further, 9% of daily travel and 34% of outings were within the typically advertised CD mode of 30 miles for PHEVs.

A BEV could not meet all daily travel without additional charging opportunities, assuming the vehicle was assigned a home base. However, all travel is near the home base and there is sufficient charge opportunity during the day. Thus, a fleet of support vehicles would likely contain a mix of BEVs and PHEVs.

# Sheet 36: Vehicle G41-1689L

	Make/Model/Year	Ford Ranger – 2011
	EPA Class Size	Pickup
	Mission	Support
	Contact	Public Works
	Parking Location	Building 1005
	Fleet Vehicle ID	G41-1689L
	Fuel Type	Gas
	EPA Label/MPG (City/Hwy/Combined)	22/27/24
	EPA GHG Emissions (Grams CO <sub>2</sub> /Mi)	370
	Study Logger ID	58
Total Vehicle Days/Total Study Days		16/31

Vehicle G41-1689L Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	28.3/81.6	15.6/66.9	6.6/36.3	453
Travel Time (Minutes)	71.6/163.0	39.5/129.0	16.6/60.6	1,145
Idle Time (Minutes)	15.4/NA	8.5/NA	3.6/NA	247

Total Stops			Stop Duration	
Distance From Home Base (Miles)	Stops	Percentages	Stop Duration (Hours)	Stops
Less than 10	56	96.6%	Less than 2	33
10 to 20	2	3.4%	2 to 4	8
20 to 40	0	0	4 to 8	2
40 to 60	0	0	Greater than 8	15



Figure C-49. Vehicle G41-1689L stops.

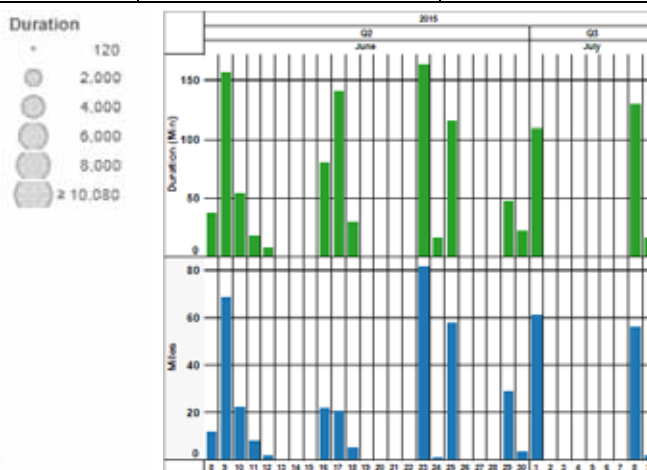


Figure C-50 Vehicle G41-1689L history.



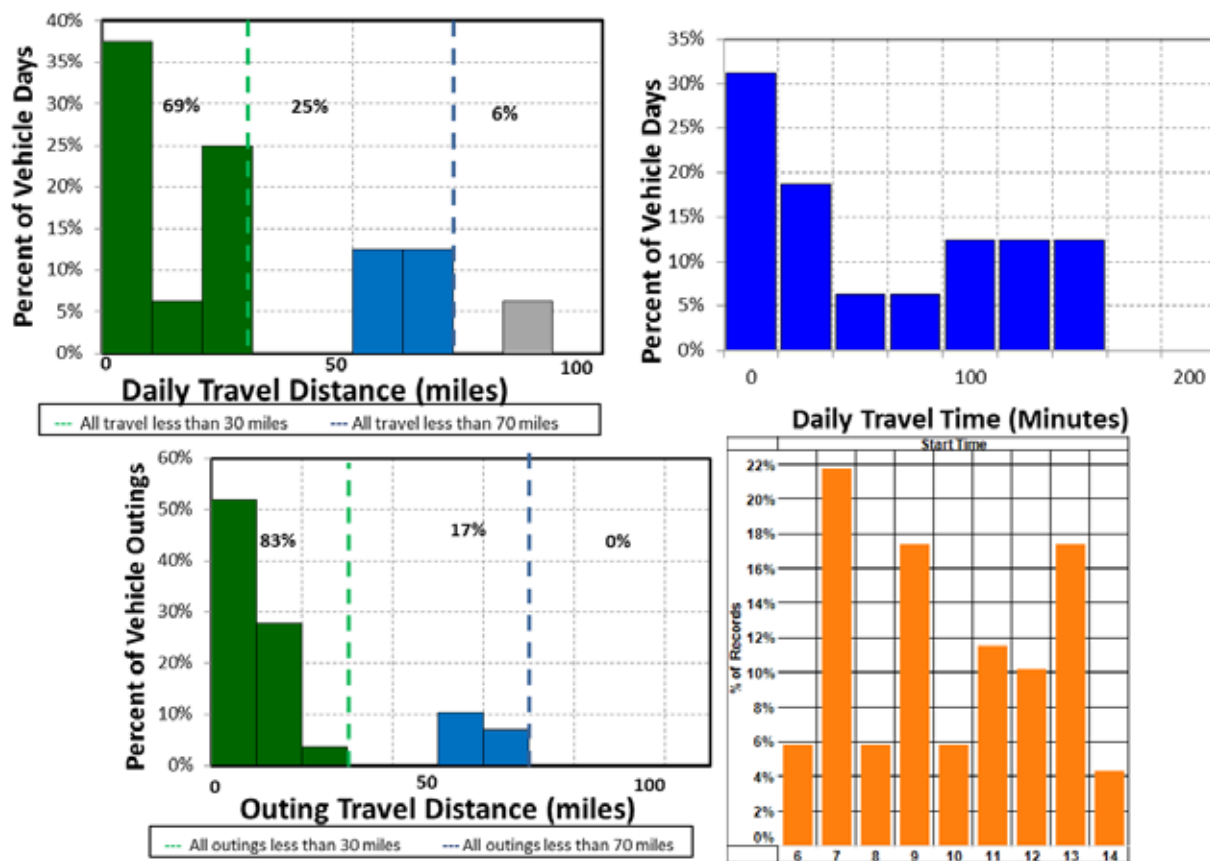


Figure C-51. Vehicle G41-1689L travel graphs.

### Vehicle G41-1689L Observations

Logger 58 collected data on this vehicle for a period of 16 days of the 31-day study period. Validation occurred on 100% of the input data. Data indicate that this vehicle has a support mission for Public Works. This vehicle's data indicate it parks near Building 1005 near Ash Street as shown in the Google Earth figure to the right.

MCBCL reports that a recent vehicle odometer indicated 18,215 miles at the start of this study and an average annual mileage of 5,649 miles. The vehicle was used on 52% of the available days, with an average daily usage of 1.2 hours and a peak daily usage of 2.7 hours on the days it was used. The vehicle was used during day shift hours.




Figure C-51 shows that 94% of daily travel was within the typically advertised range of a BEV of approximately 70 miles. All outings were also within this range. Further, 69% of daily travel and 83% of outings were within the typically advertised CD mode of 30 miles for PHEVs.

A BEV could not meet all daily travel without additional charging opportunities that are possible because all stops are close to the home base and the vehicle has plenty of time each day for charging. However, fleet managers will typically prefer a mix of BEVs and PHEVs.



# Sheet 37: Vehicle G41-3297K

	Make/Model/Year	Ford Ranger – 2011
	EPA Class Size	Pickup
	Mission	Support
	Contact	Public Works
	Parking Location	Building 1005
	Fleet Vehicle ID	G41-3297K
	Fuel Type	Gas
	EPA Label/MPG (City/Hwy/Combined)	22/27/24
	EPA GHG Emissions (Grams CO <sub>2</sub> /Mi)	370
	Study Logger ID	59
	Total Vehicle Days/Total Study Days	19/31

Vehicle G41-3297K Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	35.7/101.6	23.4/56.7	9.1/50.1	679
Travel Time (Minutes)	73.8/159.0	48.3/101.0	18.7/90.0	1,402
Idle Time (Minutes)	8.5/NA	5.6/NA	2.2/NA	162

Total Stops			Stop Duration	
Distance From Home Base (Miles)	Stops	Percentages	Stop Duration (Hours)	Stops
Less than 10	73	98.6%	Less than 2	48
10 to 20	1	1.4%	2 to 4	6
20 to 40	0	0	4 to 8	1
40 to 60	0	0	Greater than 8	19

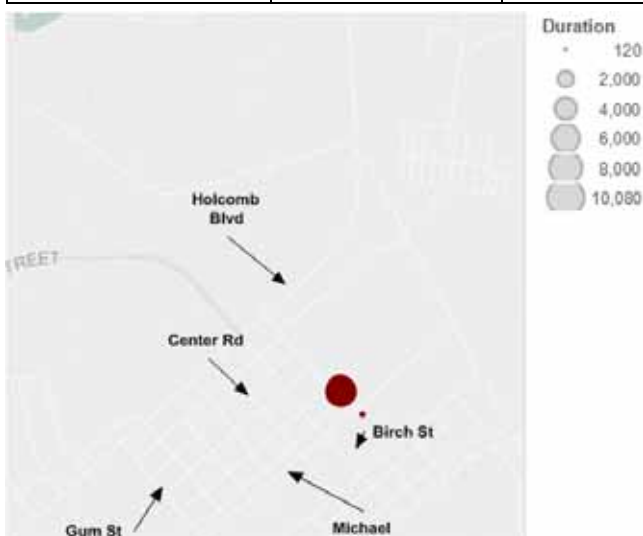


Figure C-52. Vehicle G41-3297K stops.

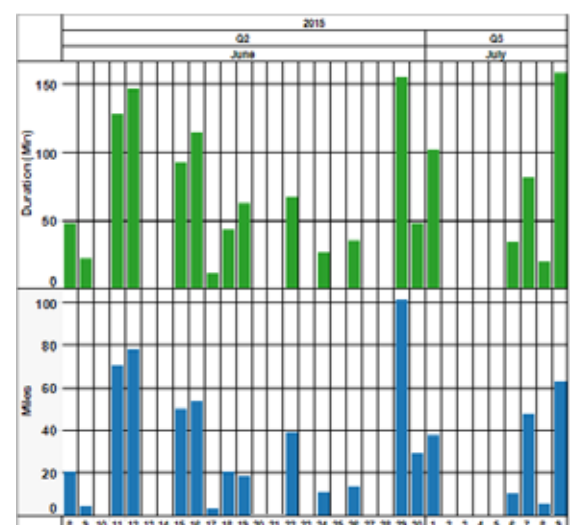


Figure C-53. Vehicle G41-3297K history.

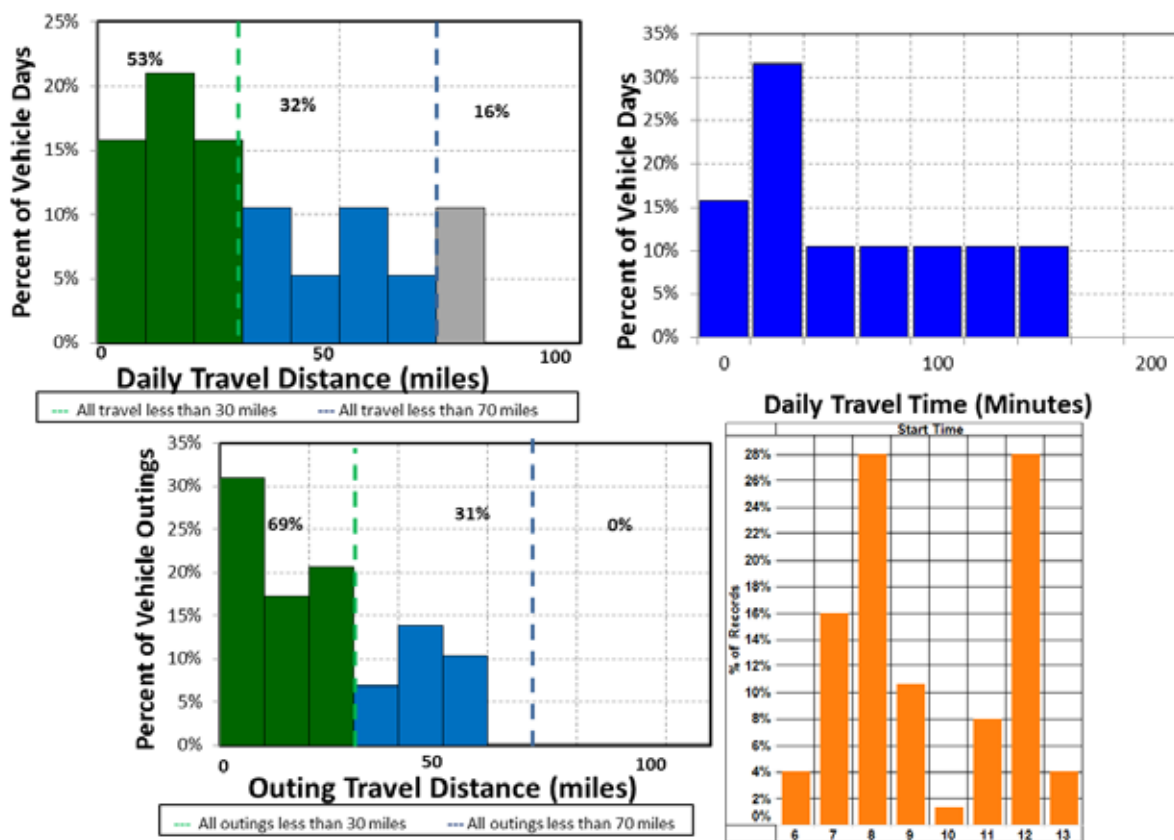


Figure C-54. Vehicle G41-3297K travel graphs.

## Vehicle G41-3297K Observations

Logger 59 collected data on this vehicle for a period of 19 days of the 31-day study period. Validation occurred on 100% of the input data. Data indicate that this vehicle has a support mission for Public Works. This vehicle's data indicate it parks near Building 1005 near Ash Street as shown in the Google Earth figure to the right.


MCBCL reports that a recent vehicle odometer indicated 18,013 miles at the start of this study and an average annual mileage of 5,368 miles. The vehicle was used on 61% of the available days, with an average daily usage of 1.2 hours and a peak daily usage of 2.7 hours on the days it was used. The vehicle was used during day shift hours.



Figure C-54 shows that 84% of daily travel was within the typically advertised range of a BEV of approximately 70 miles. All outings were also within this range. Further, 53% of daily travel and 69% of outings were within the typically advertised CD mode of 30 miles for PHEVs.

A BEV could not meet all daily travel without additional charging opportunities, assuming the vehicle was assigned a home base. However, sufficient time does exist daily for recharging between outings and all outings are within the range of a BEV. Thus, a fleet of pickup trucks in Public Works would likely contain a mix of BEVs and PHEVs.

# Sheet 38: Vehicle G41-3300K

	Make/Model/Year	Ford Ranger – 2011
	EPA Class Size	Pickup
	Mission	Enforcement
	Contact	Provost Marshal's Office
	Parking Location	Building 43
	Fleet Vehicle ID	G41-3300K
	Fuel Type	Gas
	EPA Label/MPG (City/Hwy/Combined)	22/27/24
	EPA GHG Emissions (Grams CO <sub>2</sub> /Mi)	370
	Study Logger ID	49
	Total Vehicle Days/Total Study Days	31/31

Vehicle G41-3300K Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	73.8/208.1	15.9/144.6	6.2/99.7	2,288
Travel Time (Minutes)	432.2/1,464.0	93.0/1,209.0	36.1/752.0	13,397
Idle Time (Minutes)	235.1/NA	50.6/NA	19.6/NA	7,287

Total Stops			Stop Duration	
Distance From Home Base (Miles)	Stops	Percentages	Stop Duration (Hours)	Stops
Less than 10	336	100%	Less than 2	283
10 to 20	0	0	2 to 4	25
20 to 40	0	0	4 to 8	9
40 to 60	0	0	Greater than 8	19

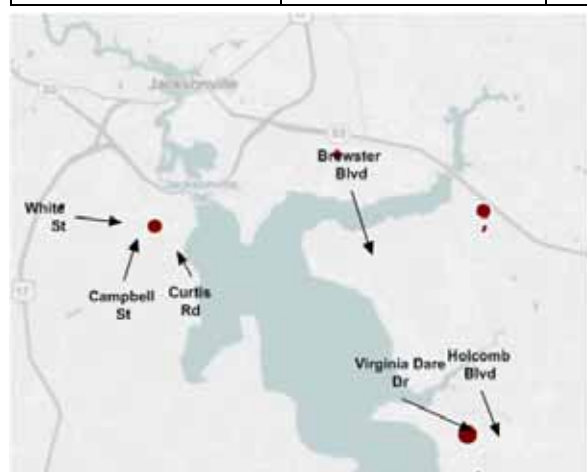


Figure C-55. Vehicle G41-3300K stops.

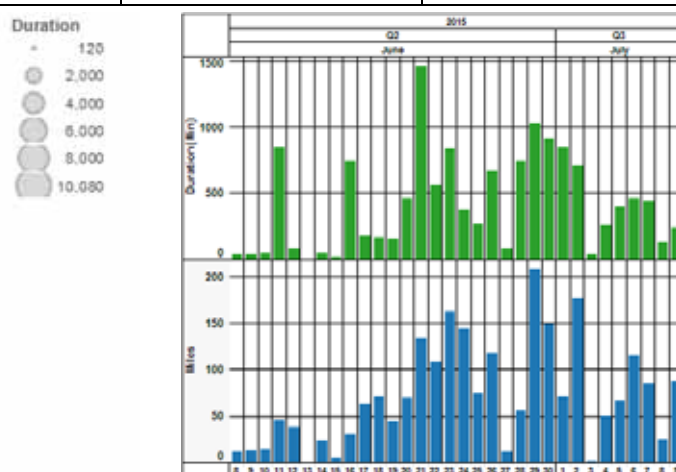


Figure C-56. Vehicle G41-3300K history.

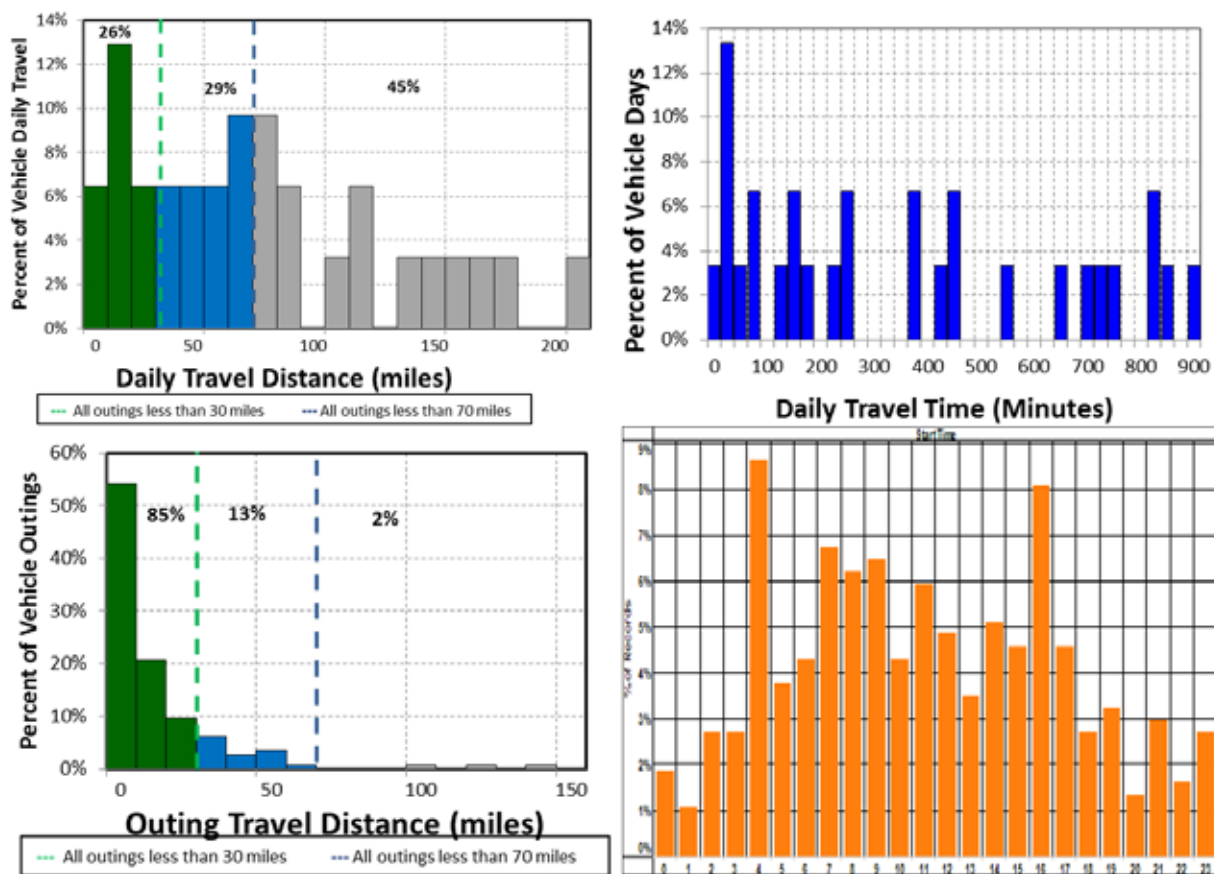


Figure C-57. Vehicle G41-3300K travel graphs.

## Vehicle G41-3300K Observations

Logger 49 collected data on this vehicle for a period of 31 days of the 31-day study period. Validation occurred on 99.9% of the input data. Data indicate that this vehicle has an enforcement mission for the Provost Marshal's Office. This vehicle's data indicate it parked over night near Building 43 near Virginia Dare Drive as shown in the Google Earth figure to the right and later near McAvoy Street.


MCBCL reports that a recent vehicle odometer indicated 39,329 miles at the start of this study and an average annual mileage of 15,644 miles. The vehicle was used on 100% of the available days, with an average daily usage of 7.2 hours and a peak daily usage of 24 hours on the days it was used. The vehicle was used during all hours of the day.



Figure C-57 shows that 55% of daily travel was within the typically advertised range of a BEV of approximately 70 miles and 98% of the outings were also within this range. Further, 26% of daily travel and 85% of outings were within the typically advertised CD mode of 30 miles for PHEVs.

A BEV could not meet all daily travel because of the frequent daily travel exceeding the BEV range and little time for recharging during the day. Fleet managers typically do not prefer enforcement vehicles that contain range limitations. Thus, a fleet of enforcement vehicles would likely contain a mix of BEVs and PHEVs, with preference for PHEVs.

## Sheet 39: Vehicle G41-3301K

	Make/Model/Year	Ford Ranger – 2011
	EPA Class Size	Pickup
	Mission	Support
	Contact	Public Works
	Parking Location	Building 1005
	Fleet Vehicle ID	G41-3301K
	Fuel Type	Gas
	EPA Label/MPG (City/Hwy/Combined)	22/27/24
	EPA GHG Emissions (Grams CO <sub>2</sub> /Mi)	370
	Study Logger ID	61
	Total Vehicle Days/Total Study Days	15/31

Vehicle G41-3301K Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	32.9/58.2	17.0/54.3	6.7/32.2	494
Travel Time (Minutes)	77.3/126.0	40.0/95.0	15.7/61.0	1,160
Idle Time (Minutes)	4.3/NA	2.2/NA	0.9/NA	64

Total Stops			Stop Duration	
Distance From Home Base (Miles)	Stops	Percentages	Stop Duration (Hours)	Stops
Less than 10	66	100%	Less than 2	46
10 to 20	0	0	2 to 4	3
20 to 40	0	0	4 to 8	3
40 to 60	0	0	Greater than 8	14



Figure C-58. Vehicle G41-3301K stops.

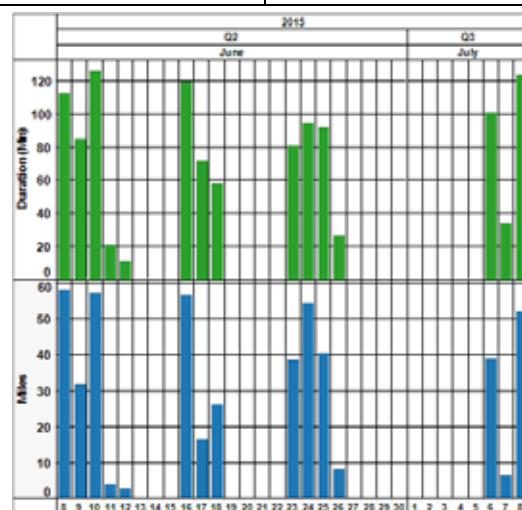


Figure C-59. Vehicle G41-3301K history.



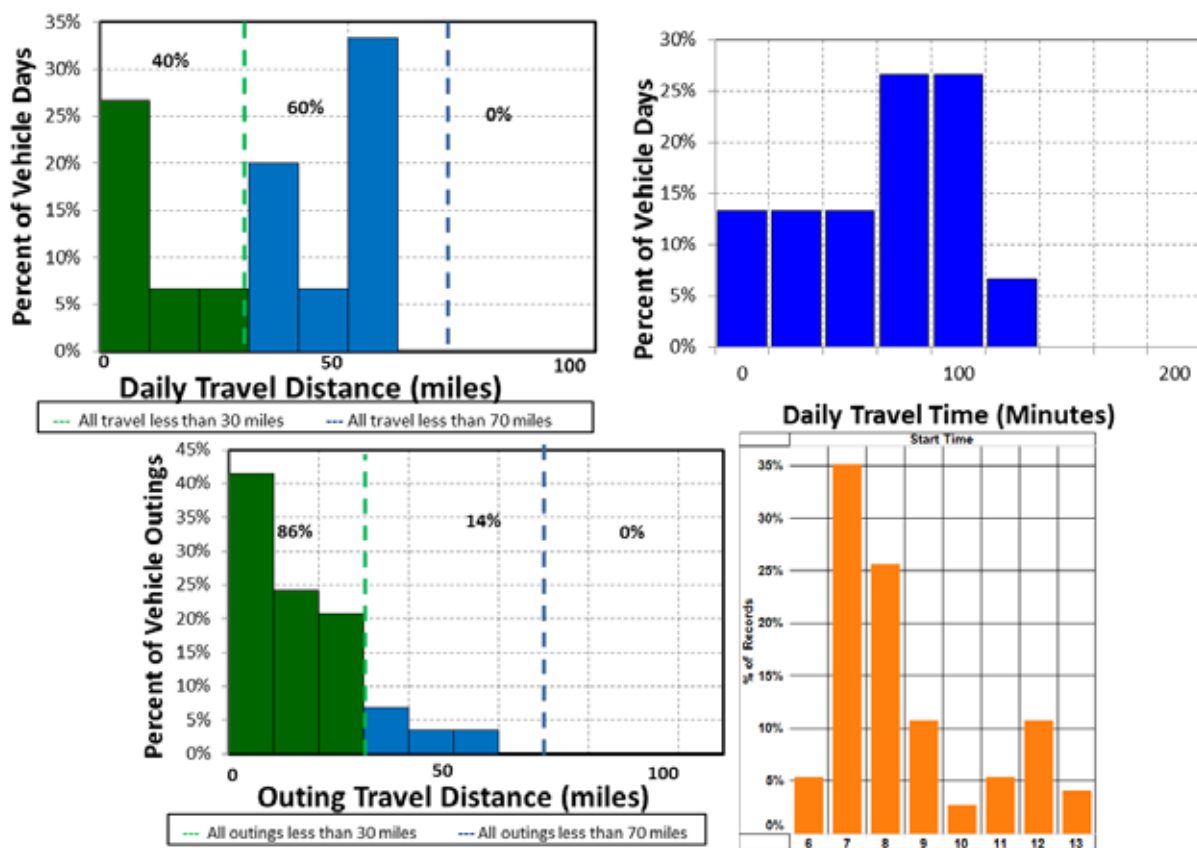


Figure C-60. Vehicle G41-3301K travel graphs.

### Vehicle G41-3301K Observations

Logger 61 collected data on this vehicle for a period of 15 days of the 31-day study period. Validation occurred on 100% of the input data. Data indicate that this vehicle has a support mission for Public Works. This vehicle's data indicate it parks near Building 1005 near Ash Street as shown in the Google Earth figure to the right.

MCBCL reports that a recent vehicle odometer indicated 21,645 miles at the start of this study and an average annual mileage of 7,306 miles. The vehicle was used on 48% of the available days, with an average daily usage of 1.3 hours and a peak daily usage of 2.1 hours on the days it was used. The vehicle was used during day shift hours.




Figure C-60 shows that all of daily travel was within the typically advertised range of a BEV of approximately 70 miles. All outings were also within this range. Further, 40% of daily travel and 86% of outings were within the typically advertised CD mode of 30 miles for PHEVs.

A BEV could meet all daily travel without additional charging opportunities, assuming the vehicle was assigned a home base. However, fleet managers typically prefer vehicles that have no range limitations. Thus, a fleet of Public Works pickups would likely contain a mix of BEVs and PHEVs.



**Sheet 40: Vehicle G42-0644M**

	Make/Model/Year	Ford E150 – 2012
	EPA Class Size	Van – Passenger
	Mission	Pool
	Contact	Motor Transport C-Pool
	Parking Location	Building 58
	Fleet Vehicle ID	G42-0644M
	Fuel Type	E85
	EPA Label/MPG (City/Hwy/Combined)	9/12/10
	EPA GHG Emissions (Grams CO <sub>2</sub> /Mi)	620
	Study Logger ID	9
	Total Vehicle Days/Total Study Days	10/31

Vehicle G42-0644M Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	19.2/57.3	17.5/57.3	4.6/22.2	192
Travel Time (Minutes)	64.2/147.0	58.4/147.0	15.3/64.0	642
Idle Time (Minutes)	12.8/NA	11.6/NA	3.0/NA	128

Total Stops			Stop Duration	
Distance From Home Base (Miles)	Stops	Percentages	Stop Duration (Hours)	Stops
Less than 10	39	100%	Less than 2	27
10 to 20	0	0	2 to 4	2
20 to 40	0	0	4 to 8	0
40 to 60	0	0	Greater than 8	10

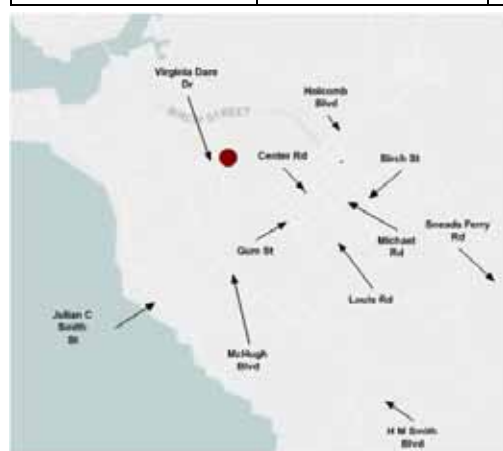


Figure C-61. Vehicle G13-0325K stops.

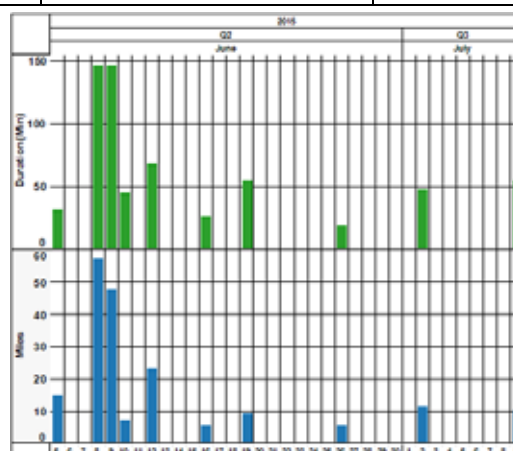


Figure C-62. Vehicle G13-0325K history.

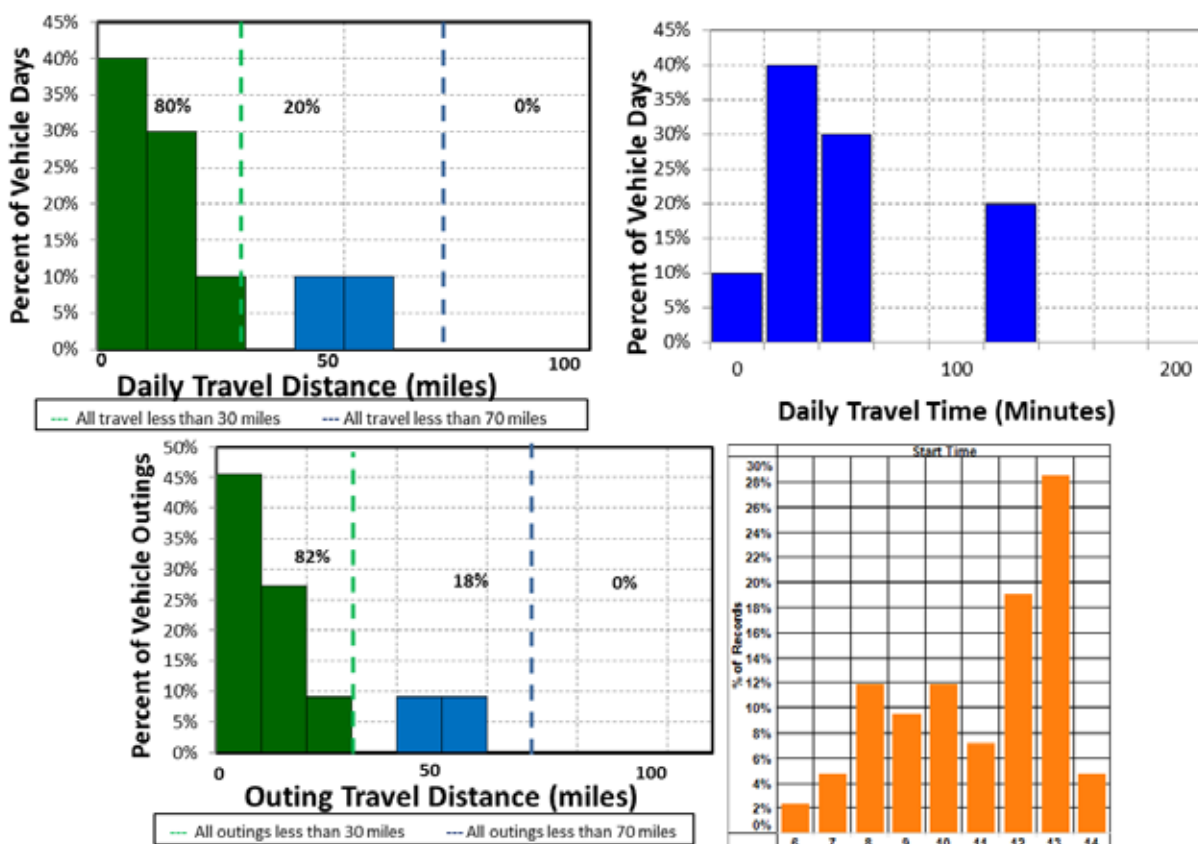


Figure C-63. Vehicle G42-0644M travel graphs.

### Vehicle G42-0644M Observations

Logger 9 collected data on this vehicle for a period of 10 days of the 31-day study period. Validation occurred on 100% of the input data. Data indicate that this vehicle has a pool mission for the Motor Transport C-Pool. This vehicle's data indicate it parks near Building 58 near Virginia Dare Drive as shown in the Google Earth figure to the right.


MCBCL reports that a recent vehicle odometer indicated 42,887 miles at the start of this study and an average annual mileage of 22,209 miles. The vehicle was used on 32% of the available days, with an average daily usage of 1.1 hours and a peak daily usage of 2.5 hours on the days it was used. The vehicle was used during day shift hours.



Figure C-63 shows that all daily travel was within the typically advertised range of a BEV of approximately 70 miles. All outings were also within this range. Further, 80% of daily travel and 82% of outings were within the typically advertised CD mode of 30 miles for PHEVs.

A BEV could meet all daily travel without additional charging opportunities, assuming the vehicle was assigned a home base. Thus, a fleet of passenger vans would likely contain a mix of BEVs and PHEVs.

# Sheet 41: Vehicle G42-0667P

	Make/Model/Year	Ford F150- 2014
	EPA Class Size	Pickup
	Mission	Support
	Contact	Public Works
	Parking Location	Building 1005
	Fleet Vehicle ID	G42-0667P
	Fuel Type	E85
	EPA Label/MPG (City/Hwy/Combined)	12/17/14
	EPA GHG Emissions (Grams CO <sub>2</sub> /Mi)	442
	Study Logger ID	68
	Total Vehicle Days/Total Study Days	17/31

Vehicle G42-0667P Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	65.5/125.6	33.8/75.0	14.3/43.0	1,114
Travel Time (Minutes)	147.5/254.0	76.0/166.0	32.2/90.0	2,508
Idle Time (Minutes)	14.1/NA	7.3/NA	3.1/NA	240

Total Stops			Stop Duration	
Distance From Home Base (Miles)	Stops	Percentages	Stop Duration (Hours)	Stops
Less than 10	77	100%	Less than 2	51
10 to 20	0	0	2 to 4	10
20 to 40	0	0	4 to 8	0
40 to 60	0	0	Greater than 8	16



Figure C-64. Vehicle G42-0667P stops.

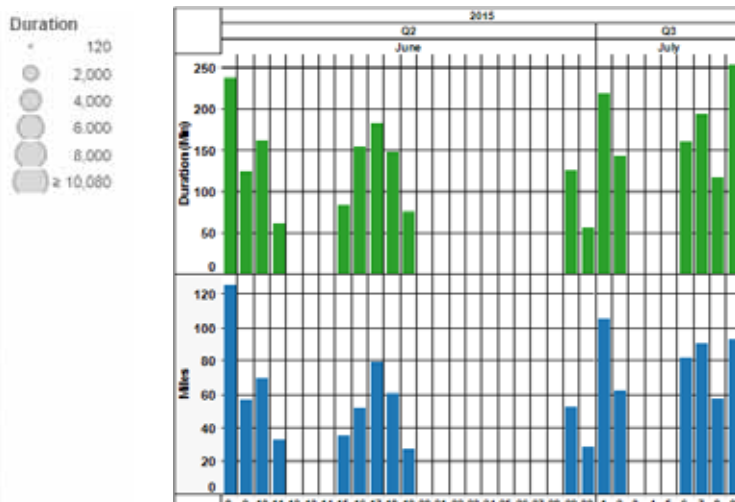


Figure C-65. Vehicle G42-0667P history.

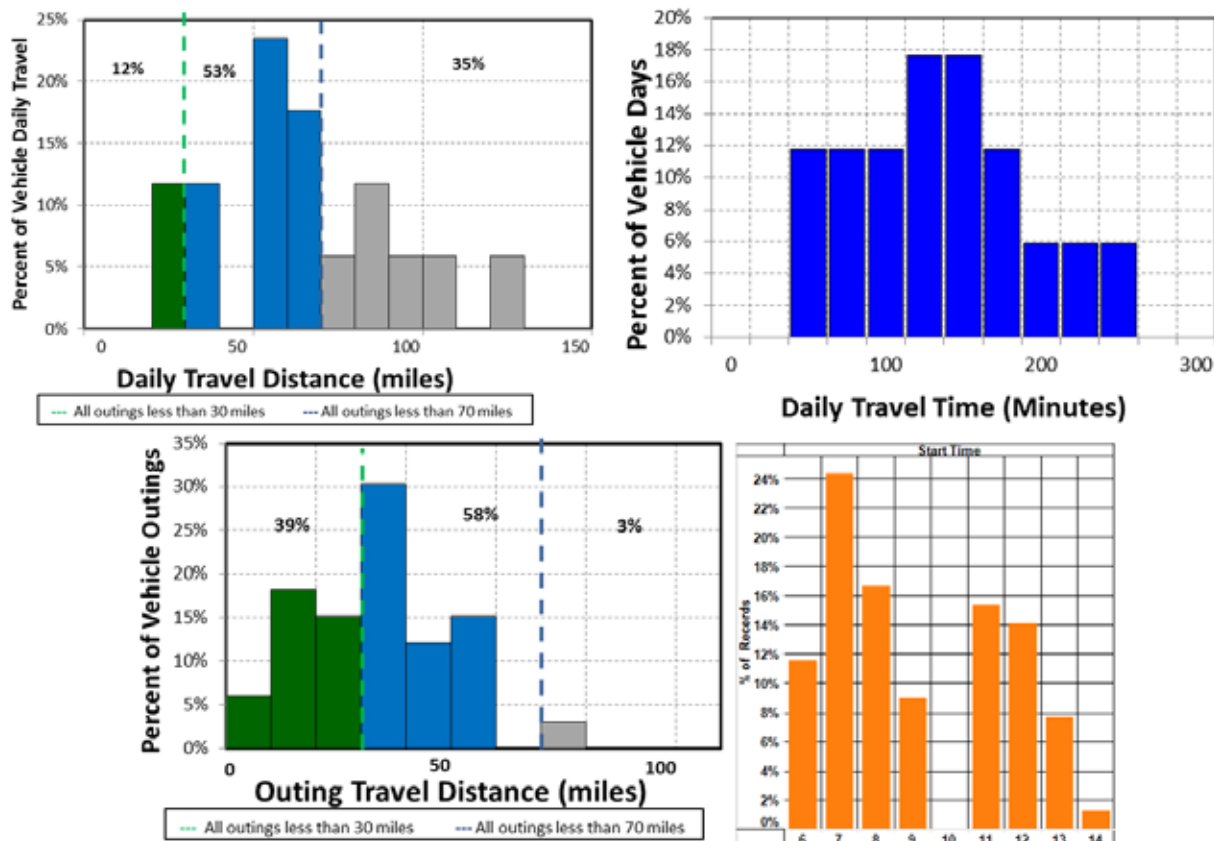


Figure C-66. Vehicle G42-0667P travel graphs.

### Vehicle G42-0667P Observations

Logger 68 collected data on this vehicle for a period of 17 days of the 31-day study period. Validation occurred on 100% of the input data. Data indicate that this vehicle has a support mission for Public Works. This vehicle's data indicate it parks near Building 1005 near Ash Street as shown in the Google Earth figure to the right.


MCBCL reports that a recent vehicle odometer indicated 6,576 miles at the start of this study and an average annual mileage of 9,600 miles. The vehicle was used on 55% of the available days, with an average daily usage of 2.5 hours and a peak daily usage of 4.2 hours on the days it was used. The vehicle was used during day shift hours.



Figure C-66 shows that 65% of daily travel was within the typically advertised range of a BEV of approximately 70 miles and 97% of outings were also within this range. Further, 12% of daily travel and 39% of outings were within the typically advertised CD mode of 30 miles for PHEVs.

A BEV could not meet all daily travel because of the frequent travel beyond the BEV range. However, a significant percentage of travel was within the range of a BEV. Thus, a fleet of support vehicles would likely contain a mix of BEVs and PHEVs.

## Sheet 42: Vehicle G42-0671P

	Make/Model/Year	Ford F150 – 2014
	EPA Class Size	Pickup
	Mission	Support
	Contact	Public Works
	Parking Location	Building BA138
	Fleet Vehicle ID	G42-0671P
	Fuel Type	E85
	EPA Label/MPG (City/Hwy/Combined)	12/17/14
	EPA GHG Emissions (Grams CO <sub>2</sub> /Mi)	442
	Study Logger ID	69
	Total Vehicle Days/Total Study Days	32/32

Vehicle G42-0671P Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	66.8/125.6	17.8/75.0	5.2/43.0	2,138
Travel Time (Minutes)	155.5/254.0	41.5/166.0	12.2/98.0	4,975
Idle Time (Minutes)	2.6/NA	7.4/NA	2.2/NA	885

Total Stops			Stop Duration	
Distance From Home Base (Miles)	Stops	Percentages	Stop Duration (Hours)	Stops
Less than 10	370	94.9%	Less than 2	348
10 to 20	20	5.1%	2 to 4	12
20 to 40	0	0	4 to 8	0
40 to 60	0	0	Greater than 8	30



Figure C-67. Vehicle G42-0671P stops.

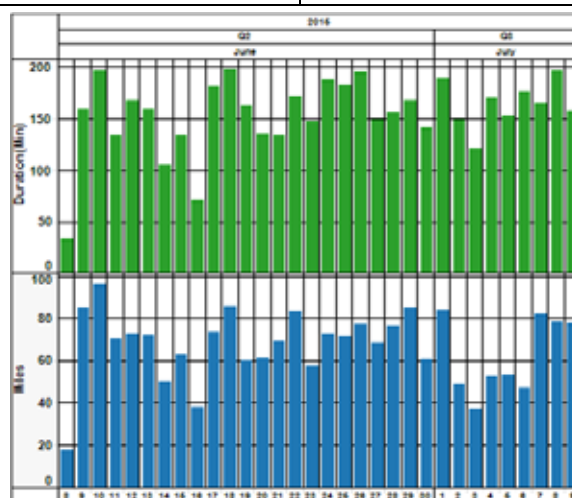


Figure C-68. Vehicle G42-0671P history.



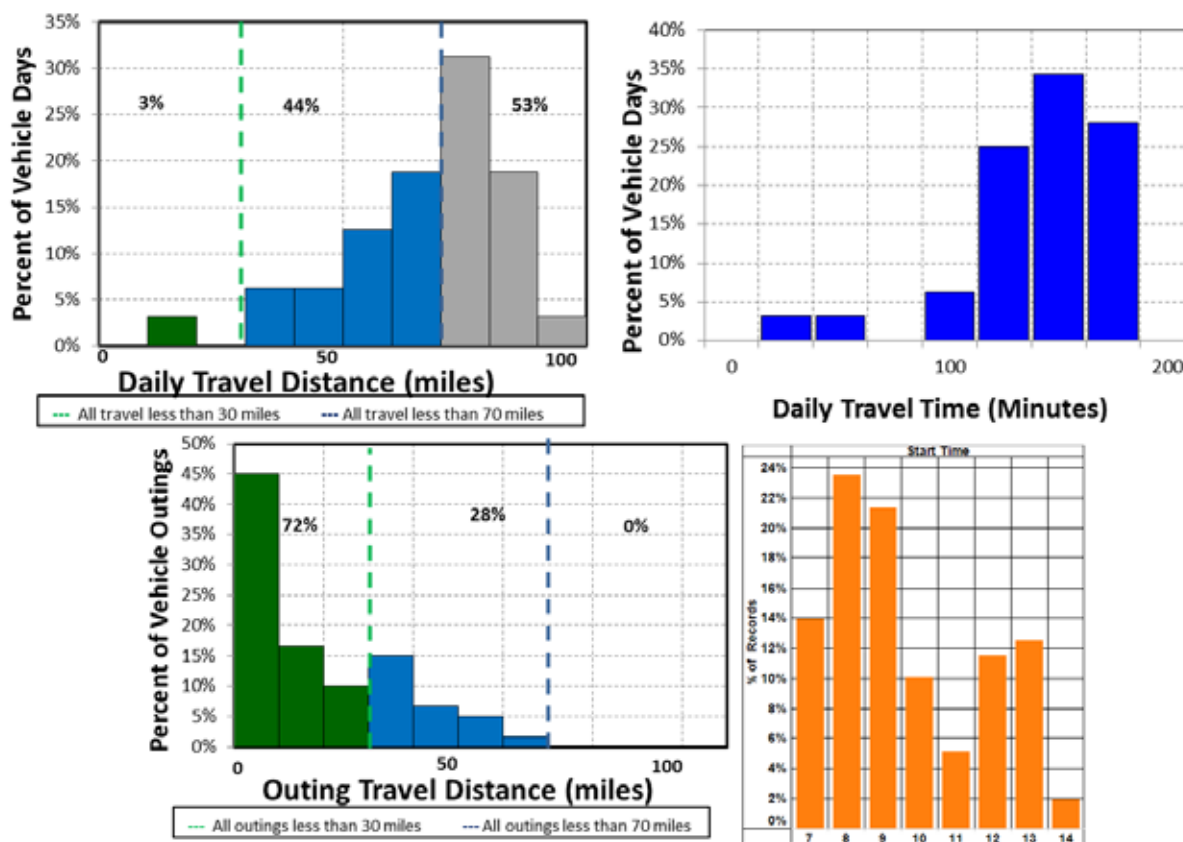


Figure C-69. Vehicle G42-0671P travel graphs.

## Vehicle G42-0671P Observations

Logger 69 collected data on this vehicle for a period of 32 days of the 32-day study period. Validation occurred on 99.8% of the input data. Data indicate that this vehicle has a support mission for Public Works. This vehicle's data indicate it parks near Building BA138 near Access Road to Markup as shown in the Google Earth figure to the right.

MCBCL reports that a recent vehicle odometer indicated 7,688 miles at the start of this study and an average annual mileage of 7,678 miles. The vehicle was used on 100% of the available days, with an average daily usage of 2.6 hours and a peak daily usage of 4.2 hours on the days it was used. The vehicle was used during day shift hours.




Figure C-69 shows that 47% of daily travel was within the typically advertised range of a BEV of approximately 70 miles. All outings were also within this range. Further, 3% of daily travel and 72% of outings were within the typically advertised CD mode of 30 miles for PHEVs.

A BEV could not meet all daily travel without additional charging opportunities, assuming the vehicle was assigned a home base. However, there is sufficient time each day for recharging and all outings are within the BEV range. Thus, a fleet of Public Works pickup trucks would likely contain a mix of BEVs and PHEVs.



# Sheet 43: Vehicle G42-0911L

	Make/Model/Year	Chevrolet C1500 – 2012
	EPA Class Size	Pickup
	Mission	Pool
	Contact	Motor Transport C-Pool
	Parking Location	Building 327
	Fleet Vehicle ID	G42-0911L
	Fuel Type	E85
	EPA Label/MPG (City/Hwy/Combined)	11/16/13
	EPA GHG Emissions (Grams CO <sub>2</sub> /Mi)	477
	Study Logger ID	10
	Total Vehicle Days/Total Study Days	32/32

Vehicle G42-0911L Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	51.4/114.6	5.4/47.8	3.9/46.1	1,645
Travel Time (Minutes)	363.4/1,140.0	38.3/563.0	27.9/504.0	11,628
Idle Time (Minutes)	185.1/NA	19.5/NA	14.3/NA	5,924

Total Stops			Stop Duration	
Distance From Home Base (Miles)	Stops	Percentages	Stop Duration (Hours)	Stops
Less than 10	415	100%	Less than 2	315
10 to 20	0	0	2 to 4	59
20 to 40	0	0	4 to 8	34
40 to 60	0	0	Greater than 8	7

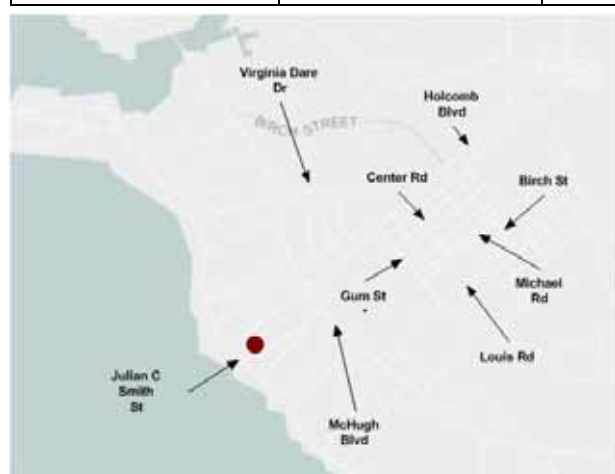


Figure C-70. Vehicle G42-0911L stops.

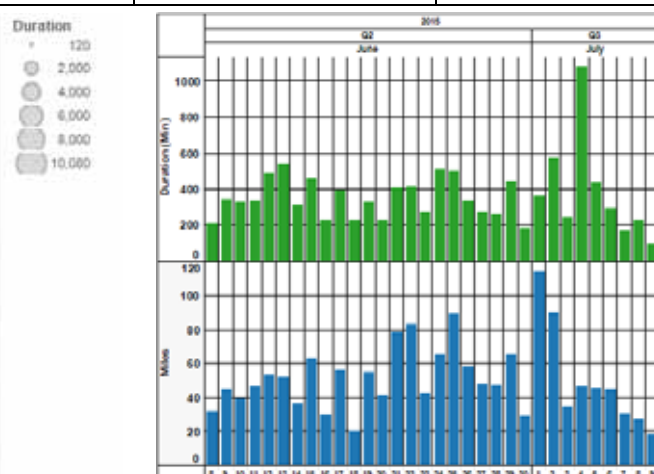


Figure C-71. Vehicle G42-0911L history.

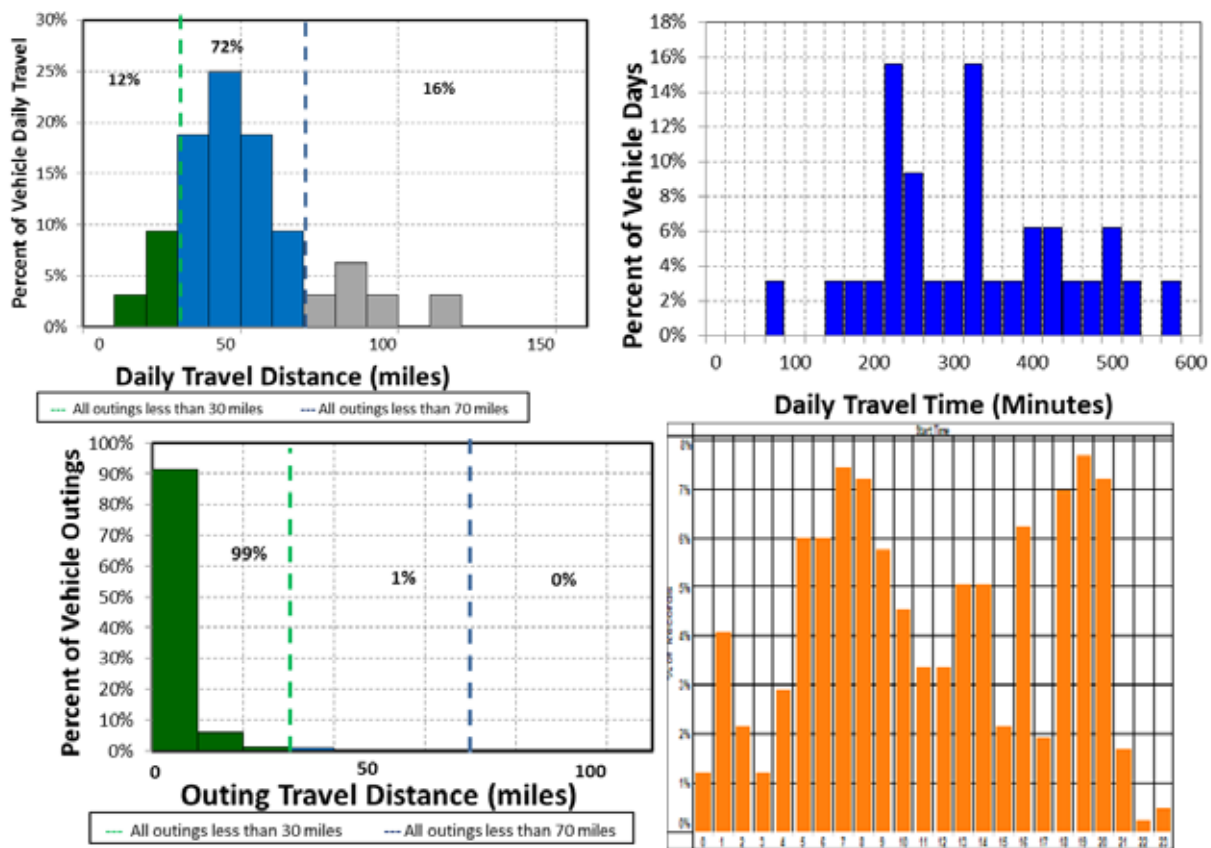


Figure C-72. Vehicle G42-0911L travel graphs. Daily travel time graph does not show maximum time of 1,140 minutes for clarity.

### Vehicle G42-0911L Observations

Logger 10 collected data on this vehicle for a period of 32 days of the 32-day study period. Validation occurred on 100% of the input data. Data indicate that this vehicle has a pool mission for the Motor Transport C-Pool. This vehicle's data indicate it parks near Building 327 near H Street as shown in the Google Earth figure to the right.


MCBCL reports that a recent vehicle odometer indicated 20,898 miles at the start of this study and average annual mileage of 7,978 miles. The vehicle was used on 100% of the available days, with an average daily usage of 6.1 hours and a peak daily usage of 19.0 hours on the days it was used. The vehicle was used during all hours of the day.



Figure C-72 shows that 84% of daily travel was within the typically advertised range of a BEV of approximately 70 miles. All outings were also within this range. Further, 12% of daily travel and 99% of outings were within the typically advertised CD mode of 30 miles for PHEVs.

A BEV could meet all daily travel with additional charging opportunities, assuming the vehicle was assigned a home base. However, the vehicle is highly utilized and charge time may not be available. While the pool fleet will likely contain a mix of BEVs and PHEVs, a PHEV is recommended for this vehicle.

## Sheet 44: Vehicle G42-0915M

	Make/Model/Year	Ford F150 – 2012
	EPA Class Size	Pickup
	Mission	Support
	Contact	Environmental Management
	Parking Location	Building 978 on Piney Green Road
	Fleet Vehicle ID	G42-0915M
	Fuel Type	E85
	EPA Label/MPG (City/Hwy/Combined)	17/23/19
	EPA GHG Emissions (Grams CO <sub>2</sub> /Mi)	443
	Study Logger ID	75
	Total Vehicle Days/Total Study Days	19/30

Vehicle G42-0915M Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	18.2/64.3	10.8/61.3	5.4/54.3	347
Travel Time (Minutes)	44.3/119.0	26.3/112.0	13.1/104.0	841
Idle Time (Minutes)	7.7/NA	4.6/NA	2.3/NA	147

Total Stops			Stop Duration	
Distance From Home Base (Miles)	Stops	Percentages	Stop Duration (Hours)	Stops
Less than 10	63	100%	Less than 2	34
10 to 20	0	0	2 to 4	8
20 to 40	0	0	4 to 8	2
40 to 60	0	0	Greater than 8	19



Figure C-73. Vehicle G42-0915M stops.

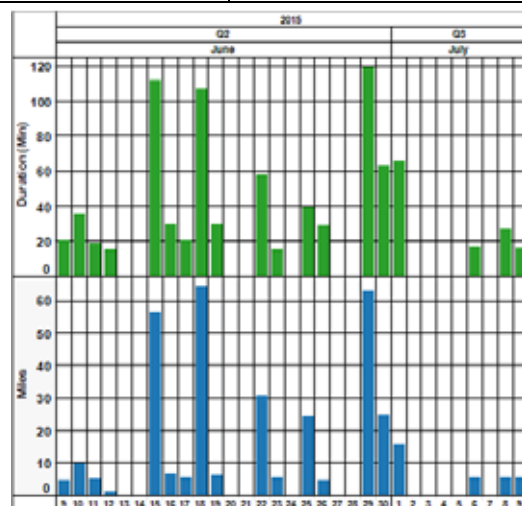


Figure C-74. Vehicle G42-0915M history.

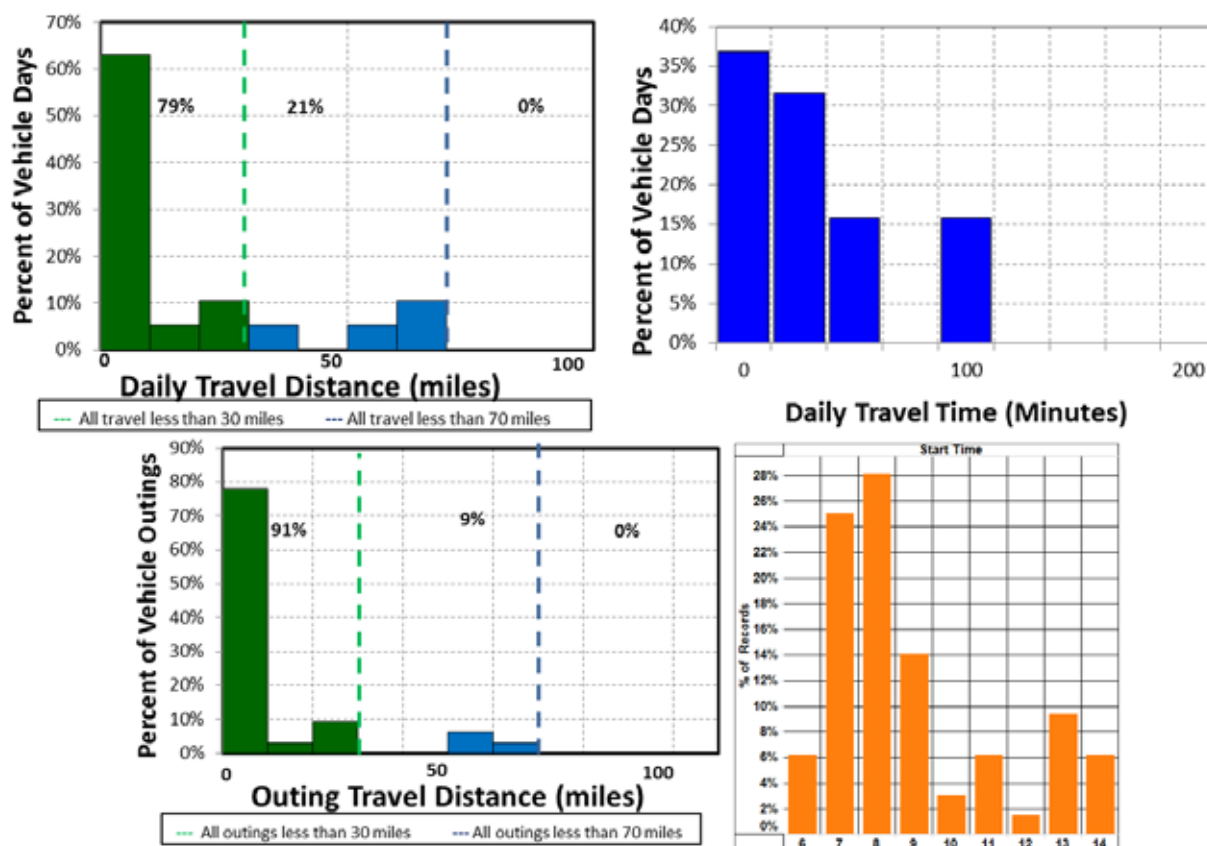


Figure C-75. Vehicle G42-0915M travel graphs.

### Vehicle G42-0915M Observations

Logger 75 collected data on this vehicle for a period of 19 days of the 30-day study period. Validation occurred on 100% of the input data. Data indicate that this vehicle has a support mission for Environmental Management. This vehicle's data indicate it parks near Building 978 near Piney Green Road as shown in the Google Earth figure to the right.


MCBCL reports that a recent vehicle odometer indicated 16,287 miles at the start of this study and an average annual mileage of 7,072 miles. The vehicle was used on 63% of the available days with an average daily usage of 0.7 hours and a peak daily usage of 2.0 hours on the days it was used. The vehicle was used during day shift hours.

Figure C-75 shows that all daily travel was within the typically advertised range of a BEV of approximately 70 miles. All outings were also within this range. Further, 79% of daily travel and 91% of outings were within the typically advertised CD mode of 30 miles for PHEVs.

A BEV could meet all daily travel without additional charging opportunities, assuming the vehicle was assigned a home base. Based on travel alone, a BEV could be a suitable replacement.



## Sheet 45: Vehicle G42-2985H

	Make/Model/Year	Chevrolet C1500 – 2010
	EPA Class Size	Pickup
	Mission	Enforcement
	Contact	Provost Marshal's Office
	Parking Location	Building 43
	Fleet Vehicle ID	G42-2985H
	Fuel Type	Gas
	EPA Label/MPG (City/Hwy/Combined)	15/21/17
	EPA GHG Emissions (Grams CO <sub>2</sub> /Mi)	523
	Study Logger ID	50
	Total Vehicle Days/Total Study Days	30/30

Vehicle G42-2985H Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	61.2/179.1	29.1/167.6	7.5/79.5	1,835
Travel Time (Minutes)	406.1/1,338.0	193.4/793.0	49.5/716.0	12,184
Idle Time (Minutes)	304.3/NA	144.9/NA	37.1/NA	9,128

Total Stops			Stop Duration	
Distance From Home Base (Miles)	Stops	Percentages	Stop Duration (Hours)	Stops
Less than 10	213	100%	Less than 2	166
10 to 20	0	0	2 to 4	11
20 to 40	0	0	4 to 8	9
40 to 60	0	0	Greater than 8	27



Figure C-76. Vehicle G42-2985H stops.

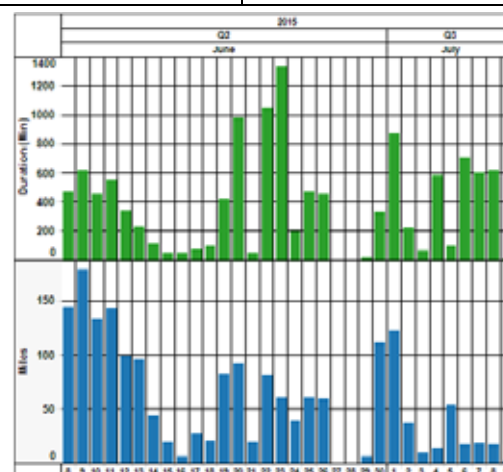


Figure C-77. Vehicle G42-2985H history.



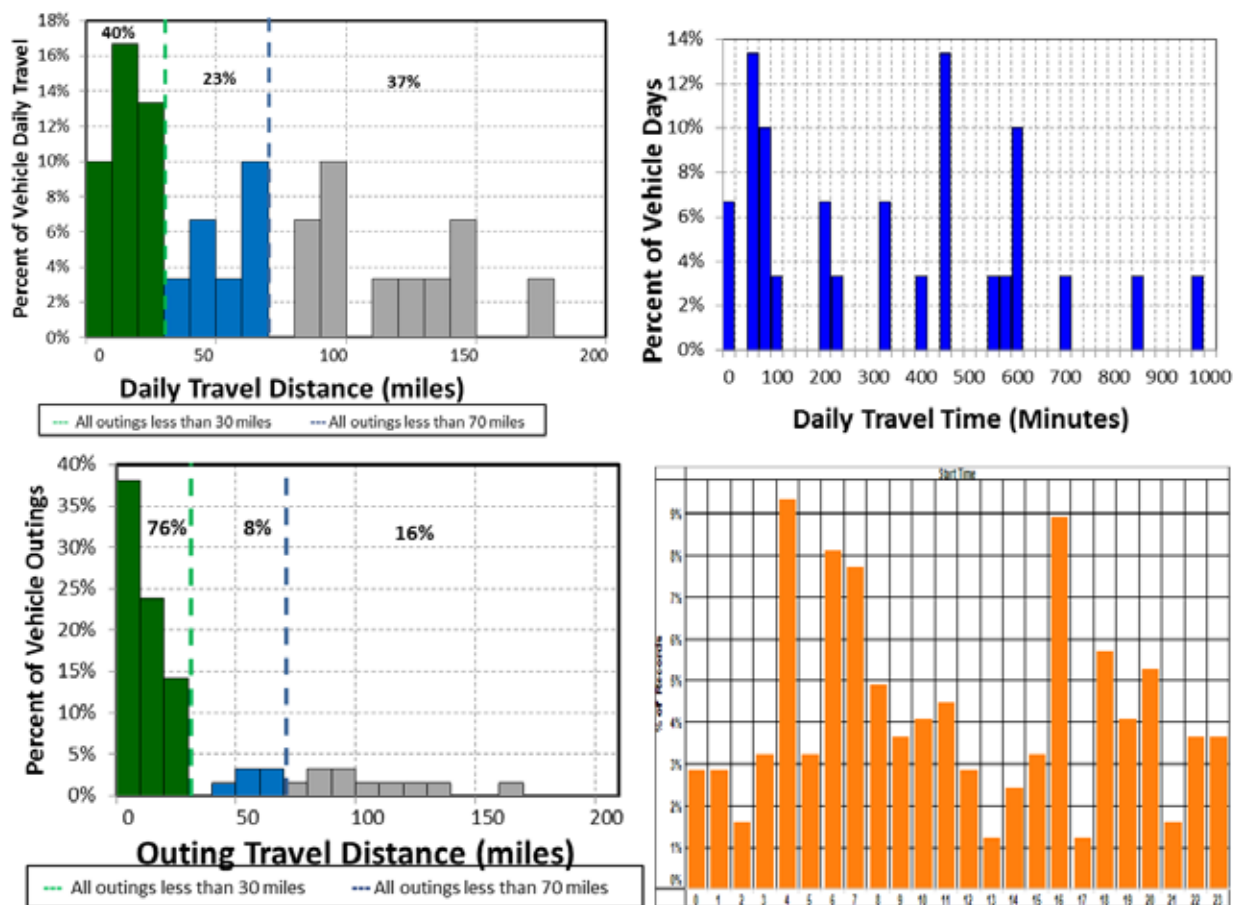


Figure C-78. Vehicle G42-2985H travel graphs. Note that the daily travel time graph does not show the maximums of 1,053 and 1,338 miles for clarity of scale.

## Vehicle G42-2985H Observations

Logger 50 collected data on this vehicle for a period of 30 days of the 30-day study period. Validation occurred on 100% of the input data. Data indicate that this vehicle has a support mission for the Provost Marshal's Office. This vehicle's data indicate it parks frequently in several places but most frequently near Building 43 near Virginia Dare Drive as shown in the Google Earth figure to the right.

MCBCL reports that a recent vehicle odometer indicated 63,594 miles at the start of this study and an average annual mileage of 20,146 miles. The vehicle was used on 100% of the available days, with an average daily usage of 6.8 hours and a peak daily usage of 22.3 hours on the days it was used. The vehicle was used during all hours of the day.




Figure C-78 shows that 63% of daily travel was within the typically advertised range of a BEV of approximately 70 miles and 84% of outings were also within this range. Further, 40% of daily travel and 76% of outings were within the typically advertised CD mode of 30 miles for PHEVs.

A BEV could not meet all daily travel because of the high usage and lack of recharge time. In addition, fleet managers typically do not prefer enforcement vehicles that contain range limitations. Thus, a fleet of enforcement vehicles would likely contain a mix of BEVs and PHEVs. For this vehicle, a PHEV is suggested.



## Sheet 46: Vehicle G43-0310H

	Make/Model/Year	Ford E350 – 2009
	EPA Class Size	Van – Passenger
	Mission	Pool
	Contact	Motor Transport – C-Pool
	Parking Location	Building 1407 near Michael Rd
	Fleet Vehicle ID	G43-0310H
	Fuel Type	E85
	EPA Label/MPG (City/Hwy/Combined)*	10/13/11
	EPA GHG Emissions (Grams CO <sub>2</sub> /Mi)*	564
	Study Logger ID	13
Total Vehicle Days/Total Study Days		13/31

Vehicle G43-0310H Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	46.4/136.4	50.2/205.9	7.5/47.1	603
Travel Time (Minutes)	171.9/577.0	186.3/875.0	27.9/213.0	2,235
Idle Time (Minutes)	75.5/NA	81.8/NA	12.3/NA	982

Total Stops			Stop Duration	
Distance From Home Base (Miles)	Stops	Percentages	Stop Duration (Hours)	Stops
Less than 10	62	91.2%	Less than 2	51
10 to 20	0	0	2 to 4	4
20 to 40	6	8.8%	4 to 8	3
40 to 60	0	0	Greater than 8	10



Figure C-79. Vehicle G43-0310H stops.

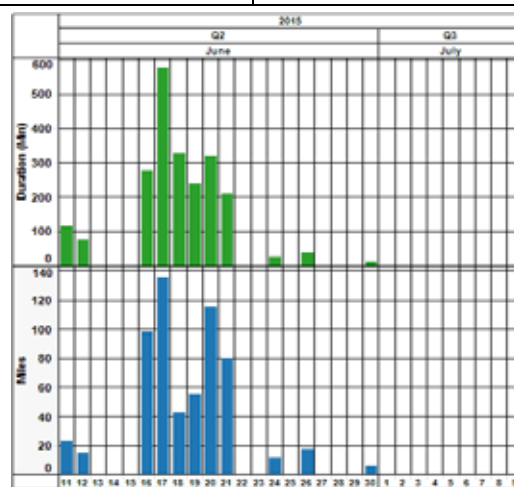


Figure C-80. Vehicle G43-0310H history.

\*Fuel economy for E350 is unavailable. Economy for F150 is used.

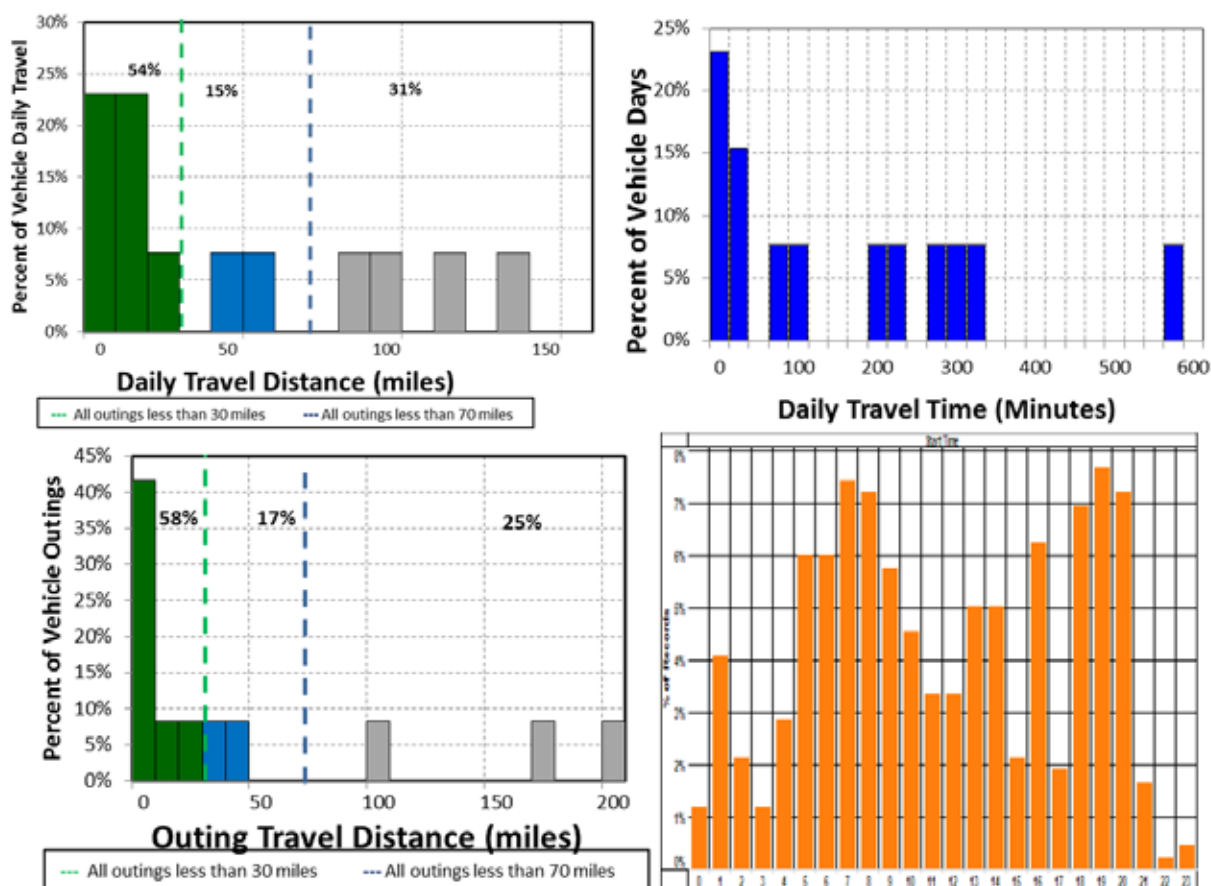


Figure C-81. Vehicle G43-0310H travel graphs.

## Vehicle G43-0310H Observations

Logger 13 collected data on this vehicle for a period of 13 days of the 31-day study period. Validation occurred on 100% of the input data. Data indicate that this vehicle has a pool mission for Motor Transport. This vehicle's data indicate it parked overnight in several different locations, but primarily near Building 1407 on Michael Road as shown in the Google Earth figure to the right.


MCBCL reports that a recent vehicle odometer indicated 55,280 miles at the start of this study and an average annual mileage of 7,232 miles. The vehicle was used on 42% of the available days, with an average daily usage of 2.9 hours and a peak daily usage of 9.6 hours on the days it was used. The vehicle was used during all hours of the day.



Figure C-81 shows that 69% of daily travel was within the typically advertised range of a BEV of approximately 70 miles and 75% of outings were also within this range. Further, 54% of daily travel and 58% of outings were within the typically advertised CD mode of 30 miles for PHEVs. The peak outing of 206 miles occurred over a several day period when the vehicle did not return to Michael Road, but parked in several other locations on base.

A BEV could not meet all daily travel because of significant outing distances. However, a fleet of passenger vans would likely contain a mix of BEVs and PHEVs.

## Sheet 47: Vehicle G43-0323H

	Make/Model/Year	Ford E350 – 2009
	EPA Class Size	Van – Cargo
	Mission	Support
	Contact	Public Works
	Parking Location	Building 670
	Fleet Vehicle ID	G43-0323H
	Fuel Type	Gas
	EPA Label/MPG (City/Hwy/Combined)*	14/18/15
	EPA GHG Emissions (Grams CO <sub>2</sub> /Mi)*	592
	Study Logger ID	71
	Total Vehicle Days/Total Study Days	19/31

Vehicle G43-0323H Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	61.0/116.9	28.3/116.9	11.7/76.8	1,160
Travel Time (Minutes)	226.9/456.0	105.1/456.0	43.5/362.0	4,311
Idle Time (Minutes)	97.1/NA	45.0/NA	18.6/NA	1,845

Total Stops			Stop Duration	
Distance From Home Base (Miles)	Stops	Percentages	Stop Duration (Hours)	Stops
Less than 10	82	93.2%	Less than 2	66
10 to 20	6	6.8%	2 to 4	5
20 to 40	0	0	4 to 8	0
40 to 60	0	0	Greater than 8	17

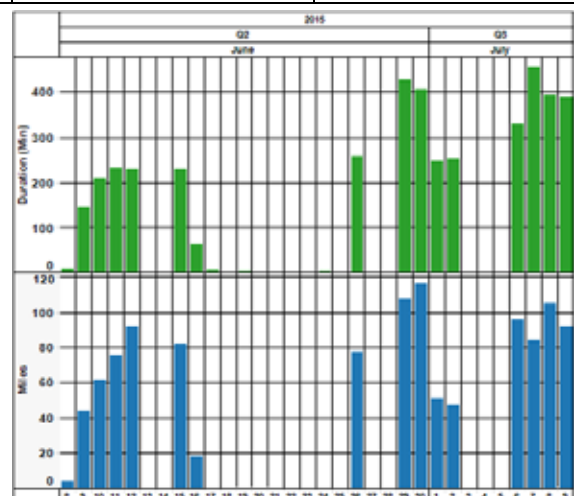


Figure C-82. Vehicle G43-0323H stops.

Figure C-83. Vehicle G43-0323H history.

\*Fuel economy for E350 is not available. Economy used is for F-150.

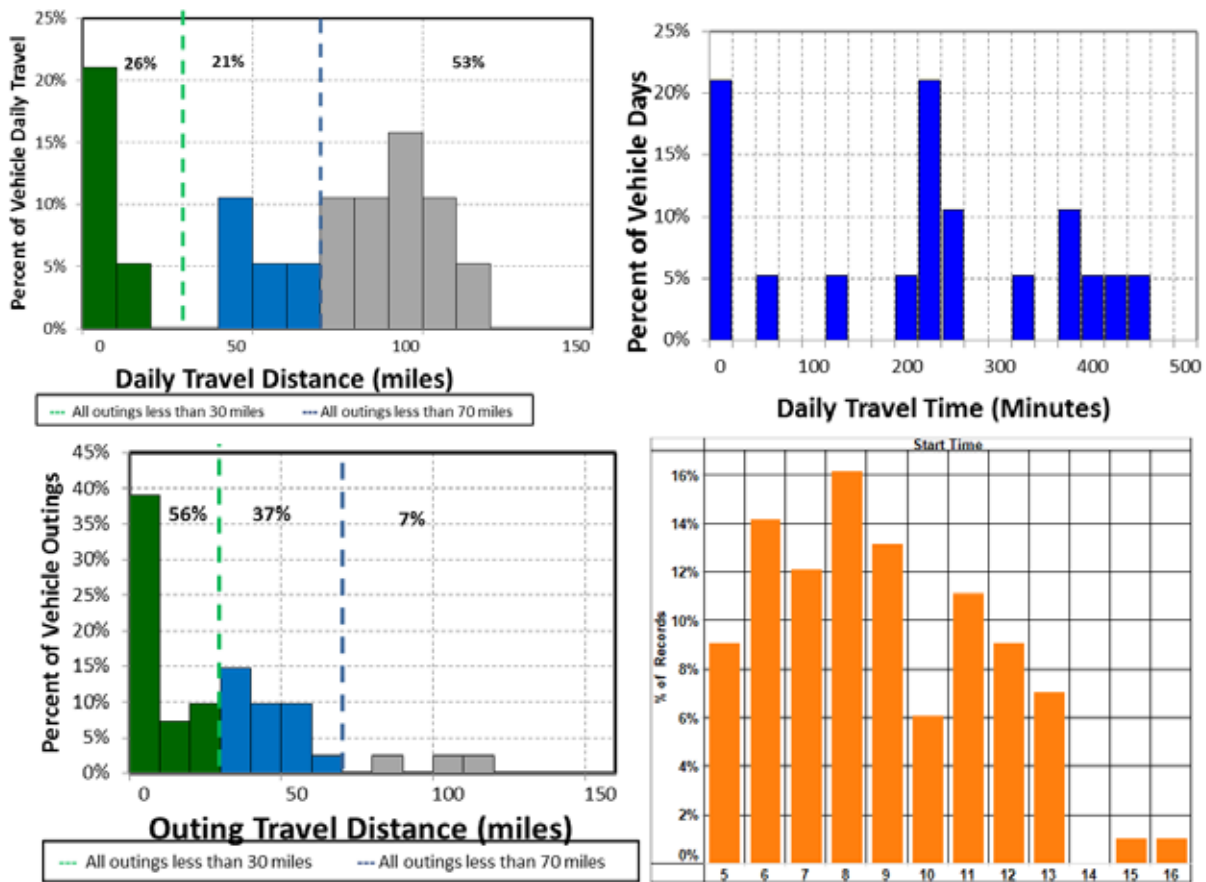


Figure C-84. Vehicle G43-0323H travel graphs.

## Vehicle G43-0323H Observations

Logger 71 collected data on this vehicle for a period of 19 days of the 31-day study period. Validation occurred on 98.7% of the input data. Data indicate that this vehicle has a support mission for Public Works. This vehicle's data indicate it parks near Building 670 near Holcomb and Brewster Boulevard as shown in the Google Earth figure to the right.


MCBCL reports that a recent vehicle odometer indicated 67,585 miles at the start of this study and an average annual mileage of 12,155 miles. The vehicle was used on 61% of the available days, with an average daily usage of 3.8 hours and a peak daily usage of 7.6 hours on the days it was used. The vehicle was used during day shift hours.

Figure C-84 shows that 47% of daily travel was within the typically advertised range of a BEV of approximately 70 miles and 93% of outings were also within this range. Further, 26% of daily travel and 56% of outings were within the typically advertised CD mode of 30 miles for PHEVs.

A BEV could not meet all daily travel without additional charging opportunities and sufficient recharge time may not be available. A fleet of cargo vans would likely contain a mix of BEVs and PHEVs.



## Sheet 48: Vehicle G43-0324H

	Make/Model/Year	Ford E350 – 2009
	EPA Class Size	Van - Cargo
	Mission	Support
	Contact	Public Works
	Parking Location	Building FC360
	Fleet Vehicle ID	G43-0324H
	Fuel Type	Gas
	EPA Label/MPG (City/Hwy/Combined)*	14/18/15
	EPA GHG Emissions (Grams CO <sub>2</sub> /Mi)*	592
	Study Logger ID	74
	Total Vehicle Days/Total Study Days	8/39

Vehicle G43-0324H Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	3.6/12.0	2.9/16.6	1.4/11.7	29
Travel Time (Minutes)	18.6/56.0	14.9/76.0	7.5/36.0	149
Idle Time (Minutes)	9.8/NA	7.8/NA	3.9/NA	78

Total Stops			Stop Duration	
Distance From Home Base (Miles)	Stops	Percentages	Stop Duration (Hours)	Stops
Less than 10	20	100%	Less than 2	8
10 to 20	0	0	2 to 4	2
20 to 40	0	0	4 to 8	2
40 to 60	0	0	Greater than 8	8

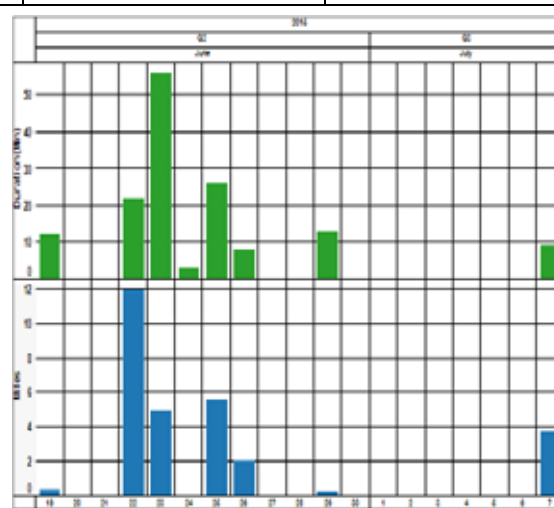
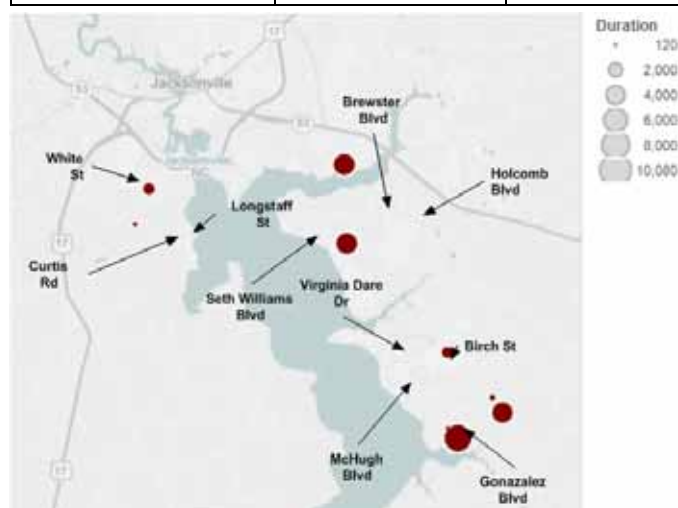


Figure C-85. Vehicle G43-0324H stops.

Figure C-86. Vehicle G43-0324H history.

\*Fuel economy for E350 is not available. Economy used is for Ford F150.



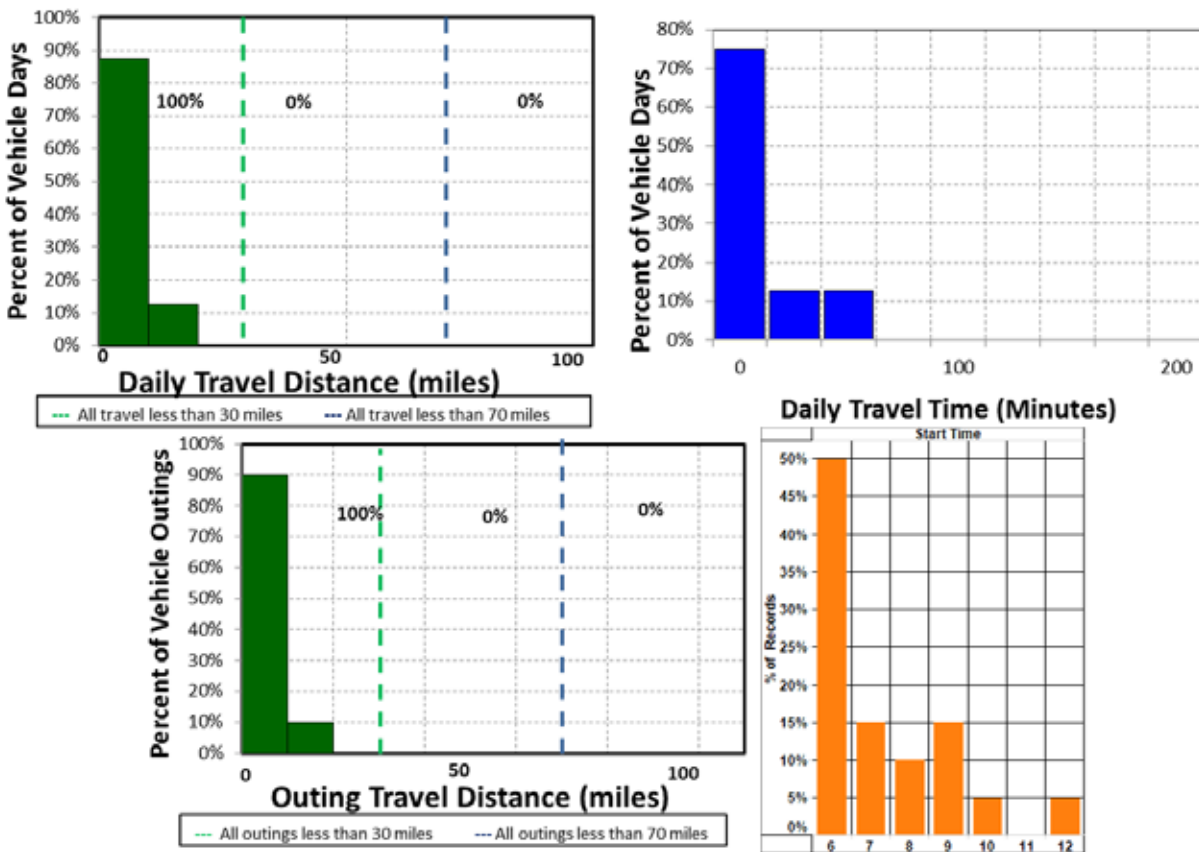


Figure C-87. Vehicle G43-0324H travel graphs.

### Vehicle G43-0324H Observations

Logger 74 collected data on this vehicle for a period of 8 days of the 39-day study period. Validation occurred on 97.9% of the input data. Data indicate that this vehicle has a support mission for Public Works. This vehicle's data indicate it parks near Building FC360 near Gonzalez Boulevard as shown in the Google Earth figure to the right.

MCBCL reports that a recent vehicle odometer indicated 32,035 miles at the start of this study and an average annual mileage of 5,969 miles. The vehicle was used on 21% of the available days, with an average daily usage of 0.3 hours and a peak daily usage of 0.9 hours on the days it was used. The vehicle was used during day shift hours.


Figure C-87 shows that all daily travel was within the typically advertised range of a BEV of approximately 70 miles. All outings were also within this range. Further, all daily travel and all of outings were within the typically advertised CD mode of 30 miles for PHEVs.

A BEV could meet all daily travel without additional charging opportunities, assuming the vehicle was assigned a home base.





## Sheet 49: Vehicle G43-1182M

	Make/Model/Year	Chevrolet CG3300 – 2012
	EPA Class Size	Van – Cargo
	Mission	Support
	Contact	Postal
	Parking Location	Building 1770
	Fleet Vehicle ID	G43-1182M
	Fuel Type	E85
	EPA Label/MPG (City/Hwy/Combined)	7/11/9
	EPA GHG Emissions (Grams CO <sub>2</sub> /Mi)	689
	Study Logger ID	36
	Total Vehicle Days/Total Study Days	19/31

19/31

Vehicle G43-1182M Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	35.8/44.5	15.5/24.1	4.7/12.5	680
Travel Time (Minutes)	97.6/200.0	41.2/148.0	12.7/81.0	1,854
Idle Time (Minutes)	18.3/NA	7.7/NA	2.4/NA	347

Total Stops			Stop Duration	
Distance From Home Base (Miles)	Stops	Percentages	Stop Duration (Hours)	Stops
Less than 10	142	100%	Less than 2	120
10 to 20	0	0	2 to 4	2
20 to 40	0	0	4 to 8	1
40 to 60	0	0	Greater than 8	19

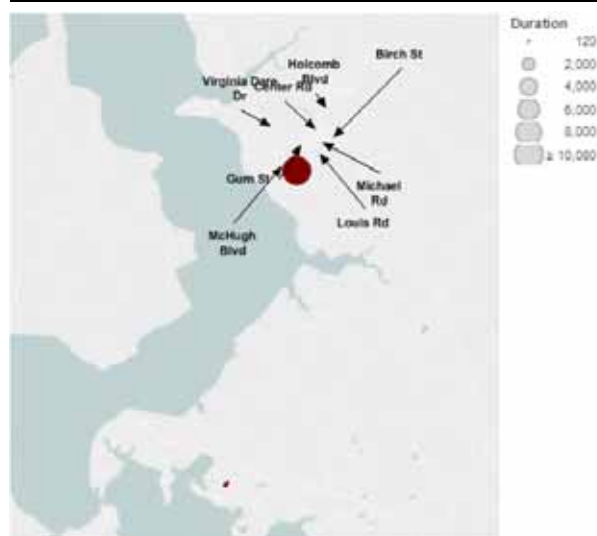


Figure C-88. Vehicle G43-1182M stops.

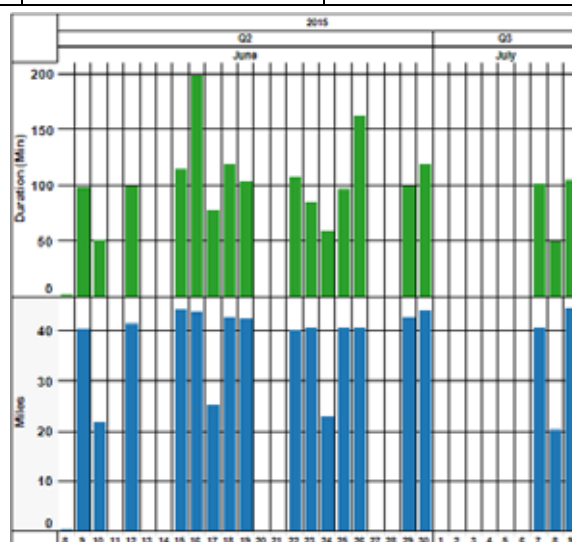


Figure C-89. Vehicle G43-1182M history.

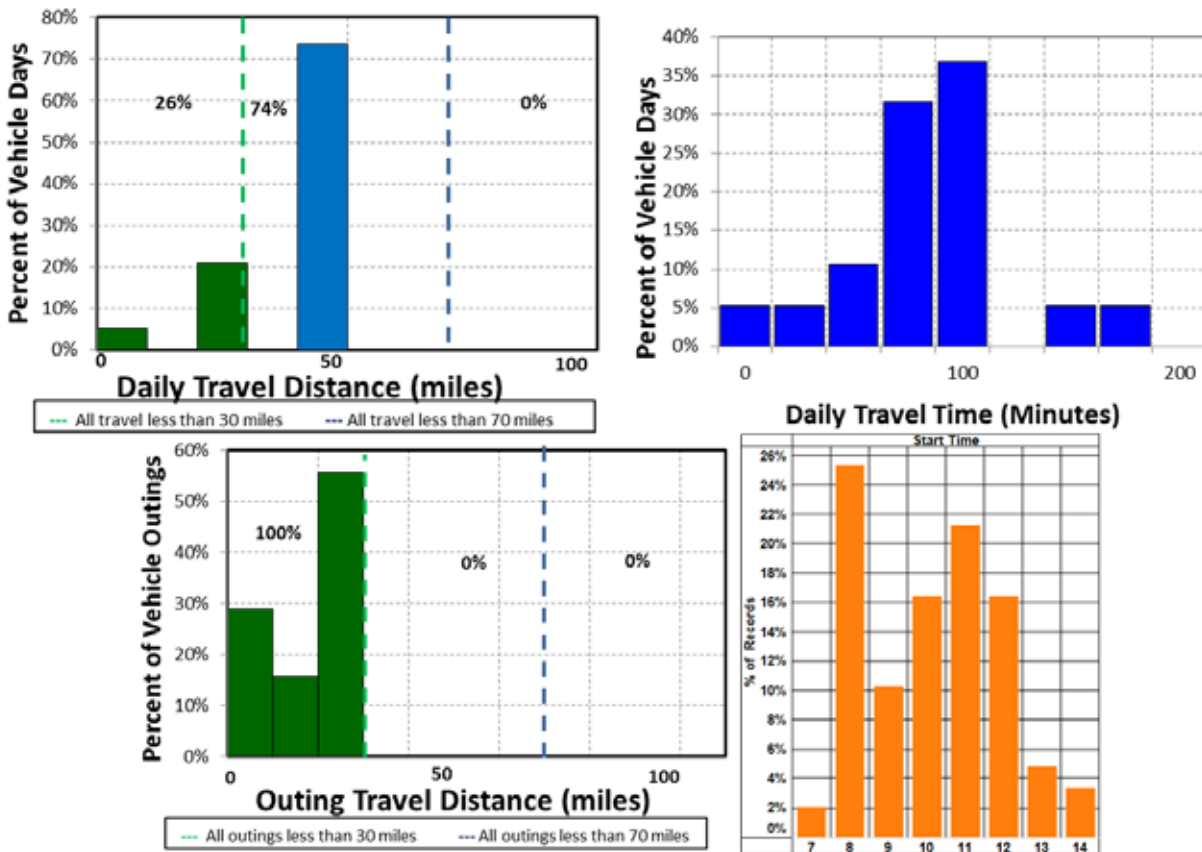


Figure C-90. Vehicle G43-1182M travel graphs.

## Vehicle G43-1182M Observations

Logger 36 collected data on this vehicle for a period of 19 days of the 31-day study period. Validation occurred on 100% of the input data. Data indicate that this vehicle has a support mission for the Post Office. This vehicle's data indicate it parks near Building 1770 near Louis Road as shown in the Google Earth figure to the right.


MCBCL reports that a recent vehicle odometer indicated 28,376 miles at the start of this study and an average annual mileage of 12,279 miles. The vehicle was used on 61% of the available days, with an average daily usage of 1.6 hours and a peak daily usage of 3.3 hours on the days it was used. The vehicle was used during day shift hours.

Figure C-90 shows that all daily travel was within the typically advertised range of a BEV of approximately 70 miles. All outings are also within this range. Further, 26% of daily travel and all outings were within the typically advertised CD mode of 30 miles for PHEVs.

A BEV could meet all daily travel without additional charging opportunities, assuming the vehicle was assigned a home base.



## Sheet 50: Vehicle G43-4075P

	Make/Model/Year	Ford F250 – 2015
	EPA Class Size	Pickup
	Mission	Pool
	Contact	Motor Transport – C-Pool
	Parking Location	Building 316
	Fleet Vehicle ID	G43-4075P
	Fuel Type	E85
	EPA Label/MPG (City/Hwy/Combined)*	13/17/14
	EPA GHG Emissions (Grams CO <sub>2</sub> /Mi)*	442
	Study Logger ID	14
	Total Vehicle Days/Total Study Days	34/34

Vehicle G43-4075P Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	38.3/151.4	6.2/82.8	3.4/56.1	1,301
Travel Time (Minutes)	140.6/456.0	22.9/191.0	12.5/120.0	4,781
Idle Time (Minutes)	24.3/NA	4.0/NA	2.2/NA	826

Total Stops			Stop Duration	
Distance From Home Base (Miles)	Stops	Percentages	Stop Duration (Hours)	Stops
Less than 10	374	99.7%	Less than 2	274
10 to 20	1	0.3%	2 to 4	34
20 to 40	0	0	4 to 8	34
Greater than 40	0	0	Greater than 8	33

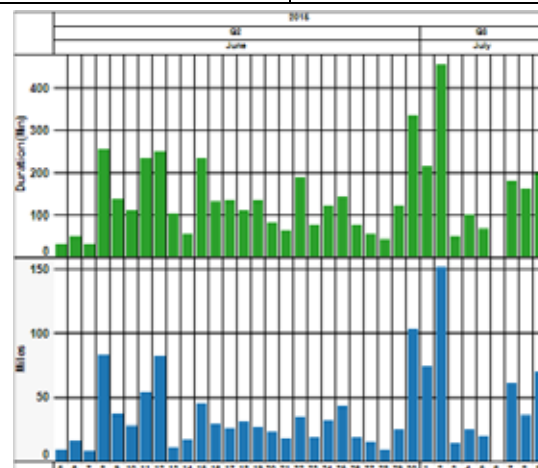


Figure C-91. Vehicle G43-4075P stops.

Figure C-92. Vehicle G43-4075P history.

\*Fuel Economy for F250 is unavailable. Economy for F150 is used.

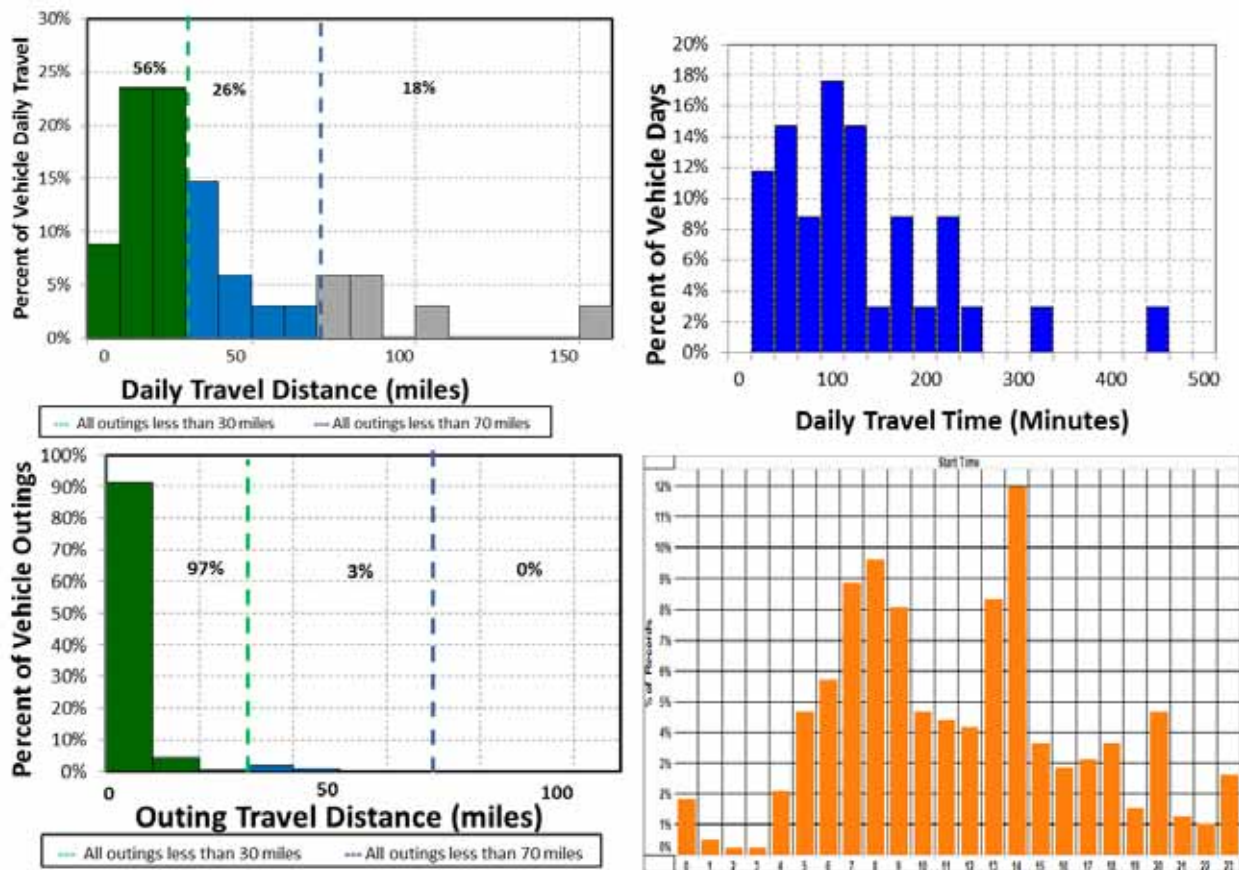


Figure C-93. Vehicle G43-4075P travel graphs.

## Vehicle G43-4075P Observations

Logger 14 collected data on this vehicle for a period of 34 days of the 34-day study period. Validation occurred on 100% of the input data. Data indicate that this vehicle has a pool mission for the Motor Transport – C-Pool. This vehicle’s data indicate it parks near Building 316 near G Street as shown in the Google Earth figure to the right.


MCBCL reports that a recent vehicle odometer indicated 464 miles on this new vehicle at the start of this study and an average annual mileage of 3,600 miles. The vehicle was used on 100% of the available days, with an average daily usage of 2.3 hours and a peak daily usage of 7.6 hours on the days it was used. The vehicle was used primarily during day and evening hours of the day.



Figure C-93 shows 82% of daily travel was within the typically advertised range of a BEV of approximately 70 miles. All outings were also within this range. Further, 56% of daily travel and 97% of outings were within the typically advertised CD mode of 30 miles for PHEVs.

A BEV could not meet all daily travel without additional charging opportunities, but sufficient time during the day may not be available. A significant number of travel days are within the range of a BEV. Thus, a fleet of pickup trucks would likely contain a mix of BEVs and PHEVs.

# Sheet 51: Vehicle G61-0161H

	Make/Model/Year	Dodge Dakota – 2009
	EPA Class Size	Pickup
	Mission	Support
	Contact	Environmental Management
	Parking Location	Building TP464
	Fleet Vehicle ID	G61-0161H
	Fuel Type	E85
	EPA Label/MPG (City/Hwy/Combined)	9/13/10
	EPA GHG Emissions (Grams CO <sub>2</sub> /Mi)	620
	Study Logger ID	77
	Total Vehicle Days/Total Study Days	26/31

Vehicle G61-0161H Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	63.6/154.0	20.9/93.0	9.2/48.6	1,654
Travel Time (Minutes)	176.2/343.0	58.0/350.0	25.5/113.0	4,582
Idle Time (Minutes)	21.2/NA	7.0/NA	3.1/NA	552

Total Stops			Stop Duration	
Distance From Home Base (Miles)	Stops	Percentages	Stop Duration (Hours)	Stops
Less than 10	166	98.2%	Less than 2	141
10 to 20	2	1.2%	2 to 4	2
20 to 40	1	0.6%	4 to 8	1
Greater than 40	0	0	Greater than 8	25

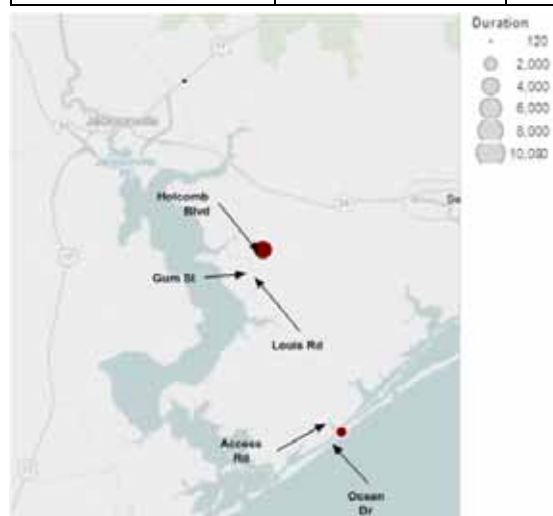


Figure C-94. Vehicle G61-0161H stops.

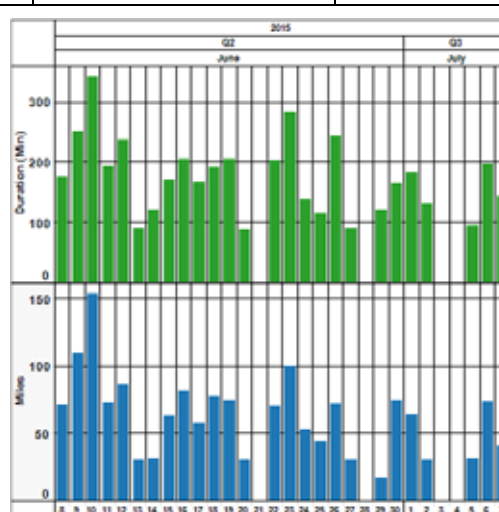


Figure C-95. Vehicle G61-0161H history.



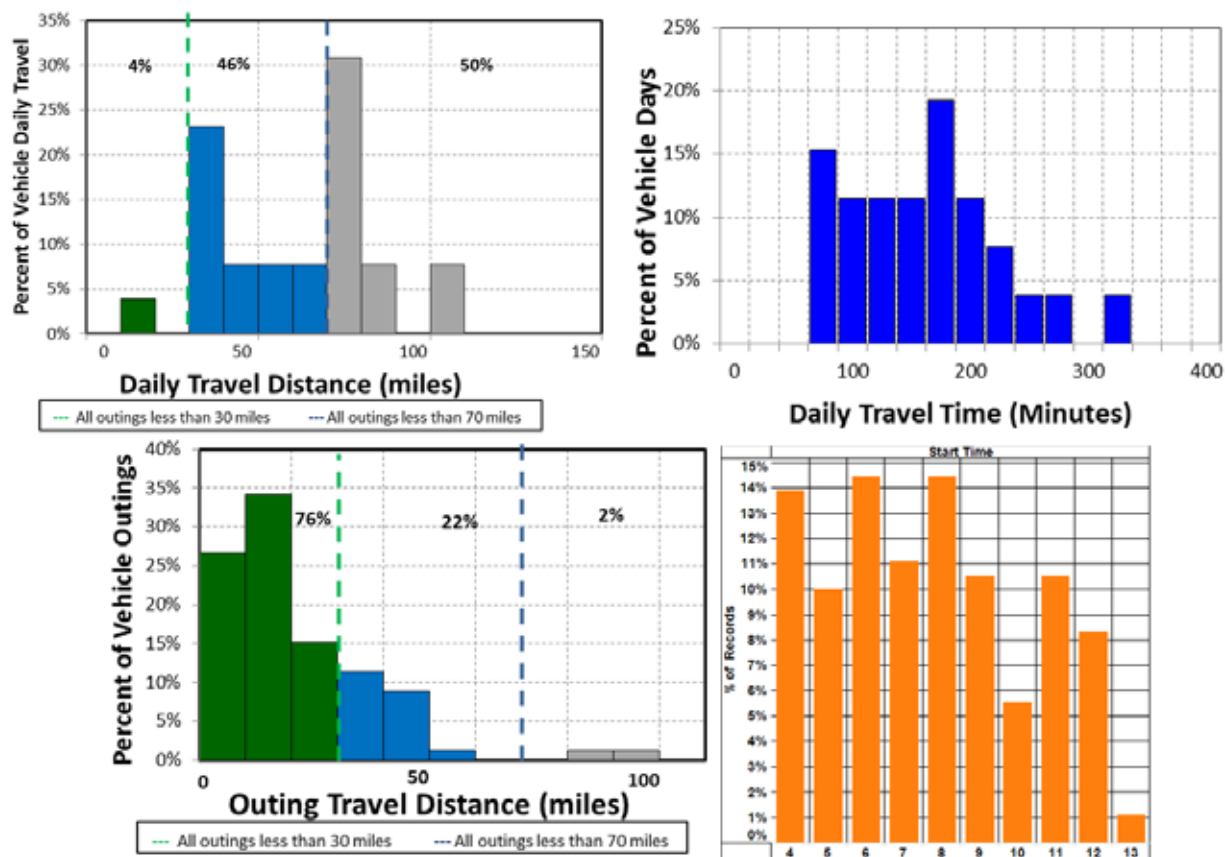


Figure C-96. Vehicle G61-0161H travel graphs.

## Vehicle G61-0161H Observations

Logger 77 collected data on this vehicle for a period of 26 days of the 31-day study period. Validation occurred on 100% of the input data. Data indicate that this vehicle has a support mission for Environmental Management. This vehicle's data indicate it parks near Building TP464 near Piney Green Road as shown in the Google Earth figure to the right.

MCBCL reports that a recent vehicle odometer indicated 46,893 miles at the start of this study and an average annual mileage of 14,979 miles. The vehicle was used on 84% of the available days, with an average daily usage of 2.9 hours and a peak daily usage of 5.7 hours on the days it was used. The vehicle was used during day shift hours.




Figure C-96 shows that 50% of daily travel was within the typically advertised range of a BEV of approximately 70 miles and 98% of outings were also within this range. Further, 4% of daily travel and 76% of outings were within the typically advertised CD mode of 30 miles for PHEVs.

A BEV could not meet all daily travel because of consistent daily travel exceeding the BEV range. However, approximately half of daily travel was within the BEV range. Thus, a fleet of environmental vehicles could likely contain a mix of BEVs and PHEVs.



## Sheet 52: Vehicle G61-0174H

	Make/Model/Year	Jeep Liberty – 2009
	EPA Class Size	SUV
	Mission	Support
	Contact	Environmental Management
	Parking Location	Building 27
	Fleet Vehicle ID	G61-0174H
	Fuel Type	Gas
	EPA Label/MPG (City/Hwy/Combined)	16/22/18
	EPA GHG Emissions (Grams CO <sub>2</sub> /Mi)	494
	Study Logger ID	78
	Total Vehicle Days/Total Study Days	21/31

Vehicle G61-0174H Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	41.1/128.6	23.3/151.8	6.6/59.1	862
Travel Time (Minutes)	100.3/239.0	56.9/292.0	16.2/98.0	2,107
Idle Time (Minutes)	9.4/NA	5.4/NA	1.5/NA	198

Total Stops			Stop Duration	
Distance From Home Base (Miles)	Stops	Percentages	Stop Duration (Hours)	Stops
Less than 10	131	100%	Less than 2	100
10 to 20	0	0	2 to 4	10
20 to 40	0	0	4 to 8	0
40 to 60	0	0	Greater than 8	21

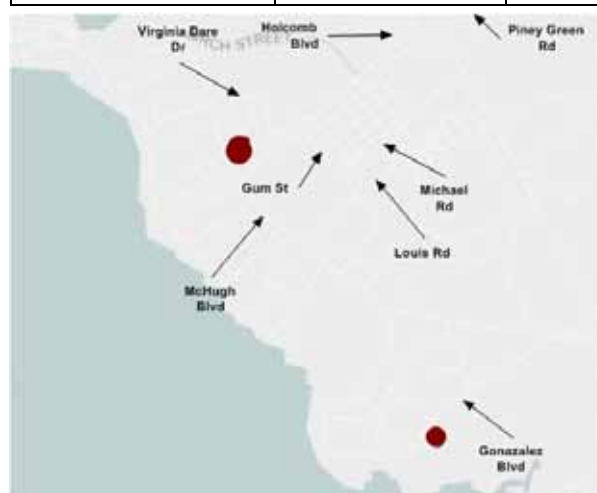


Figure C-97. Vehicle G61-0174H stops.

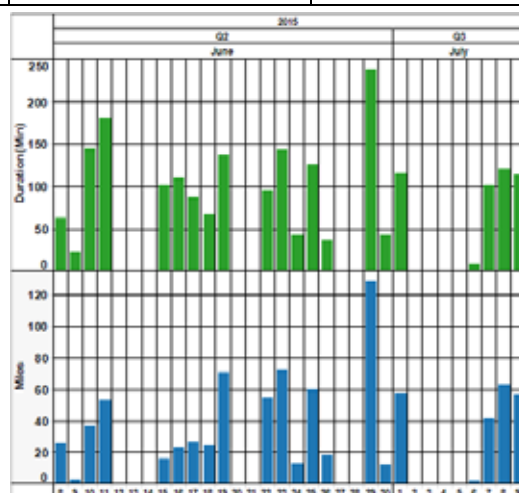


Figure C-98. Vehicle G61-0174H history.

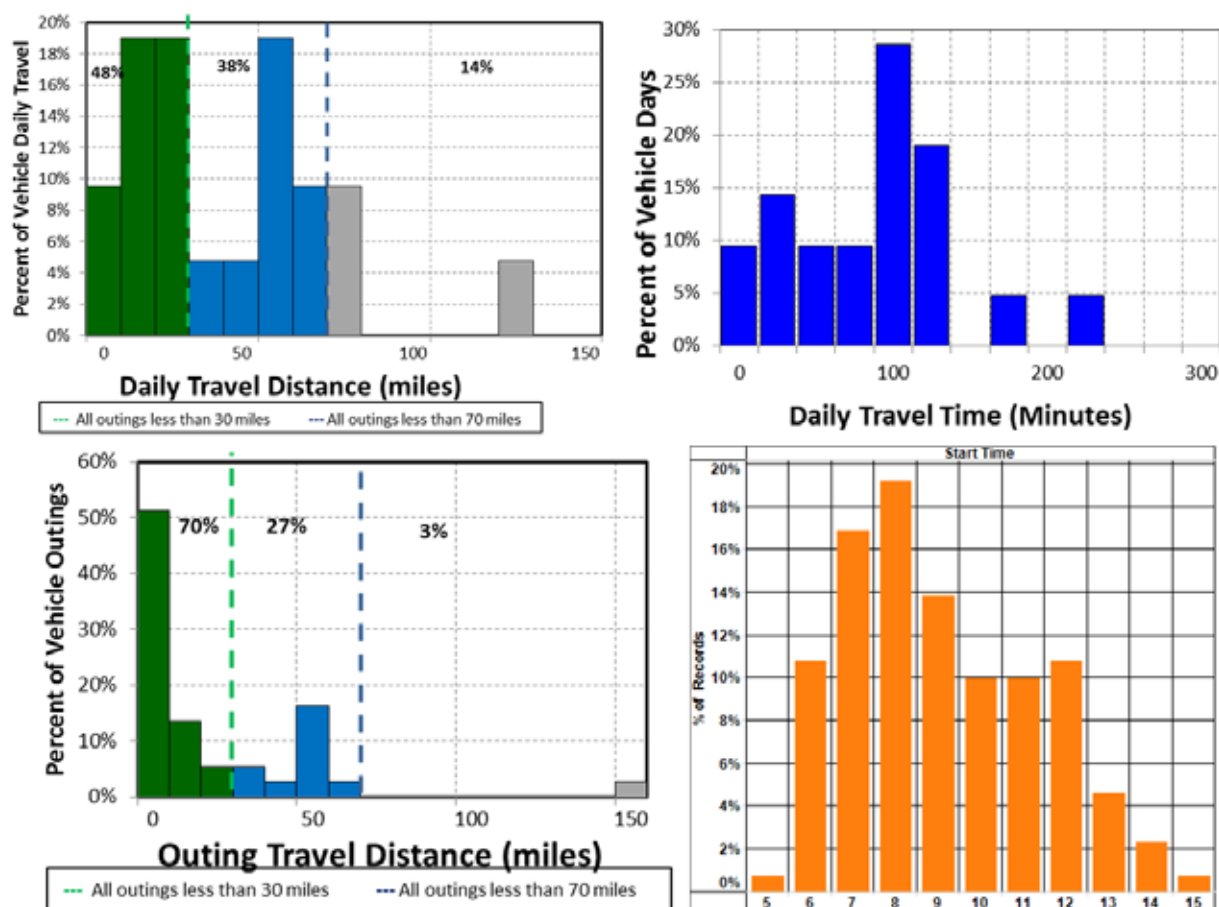


Figure C-99. Vehicle G61-0174H travel graphs.

## Vehicle G61-0174H Observations

Logger 78 collected data on this vehicle for a period of 21 days of the 31-day study period. Validation occurred on 100% of the input data. Data indicate that this vehicle has a support mission for Environmental Management. This vehicle's data indicate it parks near Building 27 near Post Lane as shown in the Google Earth figure to the right.


MCBCL reports a recent vehicle odometer indicated 38,149 miles at the start of this study and an average annual mileage of 8,683 miles. The vehicle was used on 68% of the available days, with an average daily usage of 1.7 hours and a peak daily usage of 4.0 hours on the days it was used. The vehicle was used during day shift hours.

Figure C-99 shows that 86% of daily travel was within the typically advertised range of a BEV of approximately 70 miles and 97% of outings were also within this range. Further, 48% of daily travel and 70% of outings were within the typically advertised CD mode of 30 miles for PHEVs. The peak outing of 152 miles occurred over a several day period when the vehicle did not return to Post Lane but parked in several other locations on the base.

A BEV could not meet all daily travel without additional charging opportunities and the vehicle returning to its home base daily. However, a significant amount of daily travel was within the range of a BEV. Thus, a fleet of Environmental Management vehicles would likely contain a mix of BEVs and PHEVs.



## Sheet 53: Vehicle G61-0879P

	Make/Model/Year	Chevrolet Equinox – 2014
	EPA Class Size	SUV
	Mission	Enforcement
	Contact	Provost Marshal's Office
	Parking Location	Building 979
	Fleet Vehicle ID	G61-0879P
	Fuel Type	E85
	EPA Label/MPG (City/Hwy/Combined)	14/20/17
	EPA GHG Emissions (Grams CO <sub>2</sub> /Mi)	375
	Study Logger ID	51
Total Vehicle Days/Total Study Days		20/31

Vehicle G61-0879P Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	52.0/121.4	28.1/121.4	7.9/70.1	1,039
Travel Time (Minutes)	134.2/349.0	72.5/337.0	20.3/175.0	2,683
Idle Time (Minutes)	25.8/NA	13.9/NA	3.9/NA	515

Total Stops			Stop Duration	
Distance From Home Base (Miles)	Stops	Percentages	Stop Duration (Hours)	Stops
Less than 10	131	100%	Less than 2	98
10 to 20	0	0	2 to 4	10
20 to 40	0	0	4 to 8	5
Greater than 40	0	0	Greater than 8	18

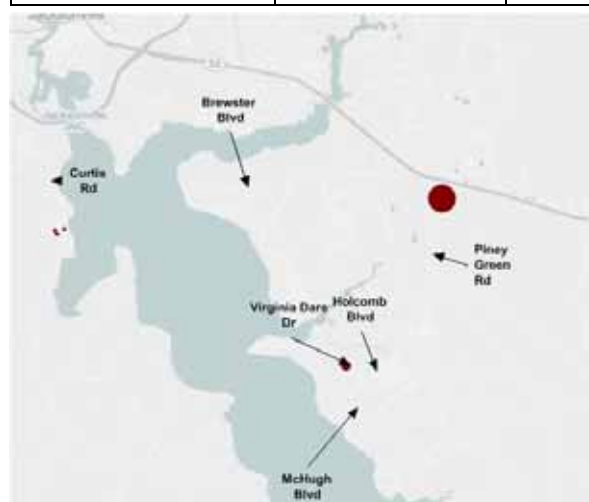


Figure C-100. Vehicle G61-0879P stops.

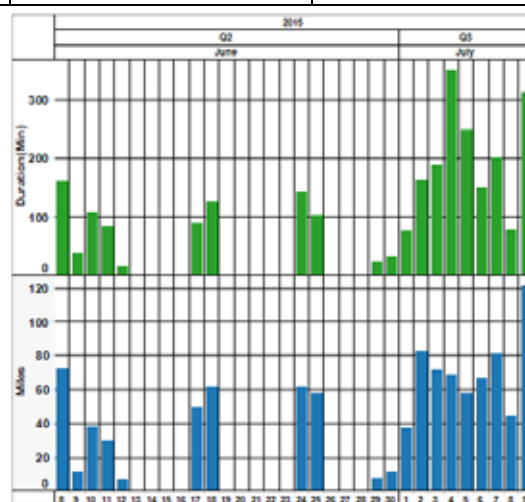


Figure C-101. Vehicle G61-0879P history.

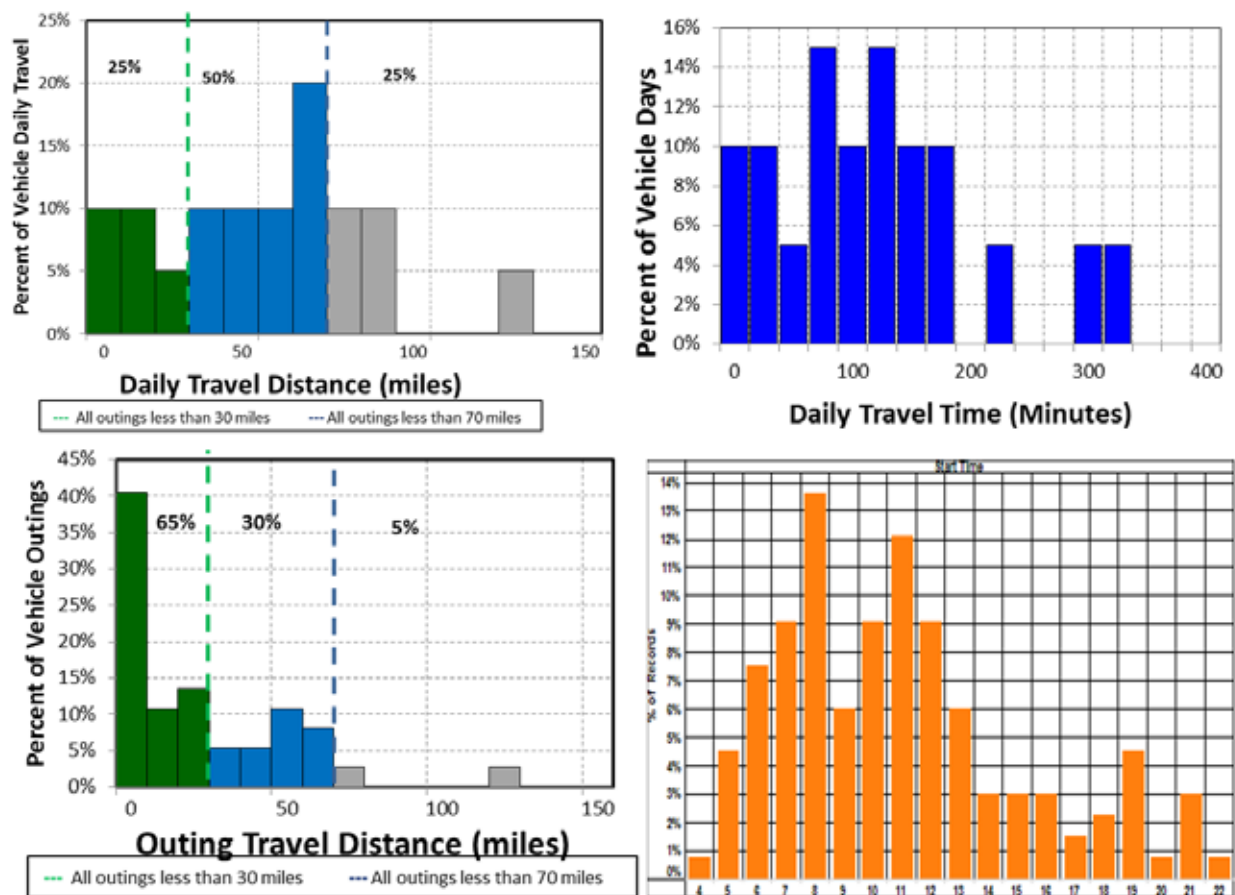


Figure C-102. Vehicle G61-0879P travel graphs.

## Vehicle G61-0879P Observations

Logger 51 collected data on this vehicle for a period of 20 days of the 31-day study period. Validation occurred on 100% of the input data. Data indicate that this vehicle has an enforcement mission for Provost Marshal's Office. This vehicle's data indicate it parks frequently near Virginia Dare Drive but most often near Building 979 on Piney Green Road as shown in the Google Earth figure to the right.


MCBCL reports that a recent vehicle odometer indicated 4,434 miles at the start of this study and an average annual mileage of 4,232 miles. The vehicle was used on 65% of the available days, with an average daily usage of 2.2 hours and a peak daily usage of 5.8 hours on the days it was used. The vehicle was used primarily during day and evening hours.



Figure C-102 shows that 75% of daily travel was within the typically advertised range of a BEV of approximately 70 miles and 95% of outings were also within this range. Further, 25% of daily travel and 65% of outings were within the typically advertised CD mode of 30 miles for PHEVs.

A BEV could not meet all daily travel without additional charging opportunities, assuming the vehicle was assigned a home base. While there is sufficient time each day for additional charges, fleet managers typically do not prefer enforcement vehicles that contain range limitations. Thus, a fleet of enforcement vehicles would likely contain a mix of BEVs and PHEVs, with preference toward PHEVs.

## Sheet 54: Vehicle G61-1508D

	Make/Model/Year	Jeep Liberty – 2008
	EPA Class Size	SUV
	Mission	Pool
	Contact	Motor Transport – C-Pool
	Parking Location	Building 58
	Fleet Vehicle ID	G61-1508D
	Fuel Type	Gas
	EPA Label/MPG (City/Hwy/Combined)	16/22/19
	EPA GHG Emissions (Grams CO <sub>2</sub> /Mi)	468
	Study Logger ID	15
	Total Vehicle Days/Total Study Days	13/35

Vehicle G61-1508D Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	25.7/128.9	13.9/98.9	5.0/53.5	334
Travel Time (Minutes)	64.6/207.0	35.0/156.0	12.5/83.0	840
Idle Time (Minutes)	4.4/NA	2.4/NA	0.9/NA	57

Total Stops			Stop Duration	
Distance From Home Base (Miles)	Stops	Percentages	Stop Duration (Hours)	Stops
Less than 10	62	96.9%	Less than 2	48
10 to 20	0	0	2 to 4	3
20 to 40	2	3.1%	4 to 8	2
Greater than 40	0	0	Greater than 8	11

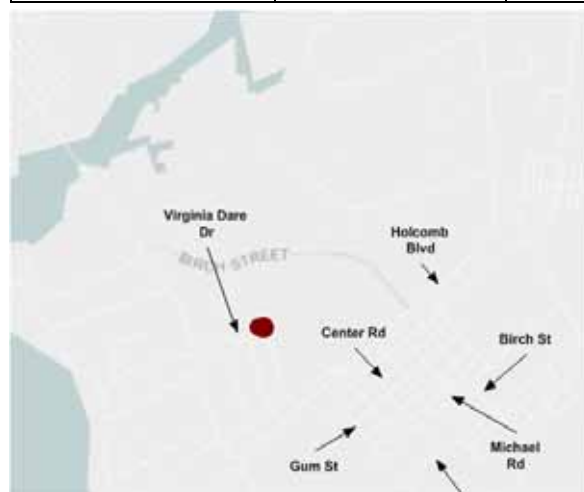


Figure C-103. Vehicle G61-1508D stops.

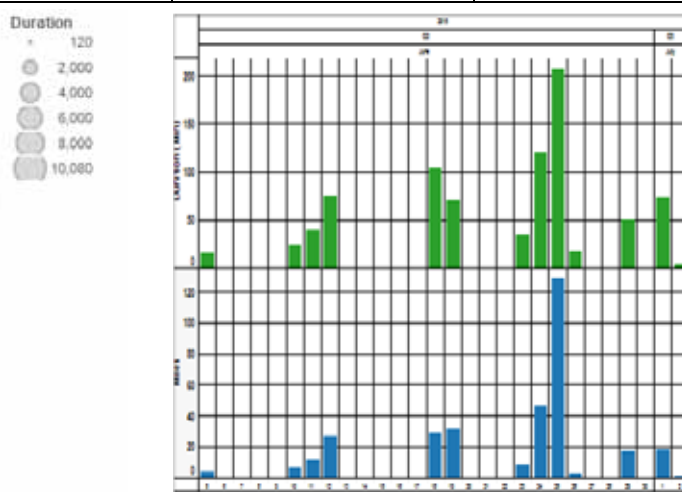


Figure C-104. Vehicle G61-1508D history.



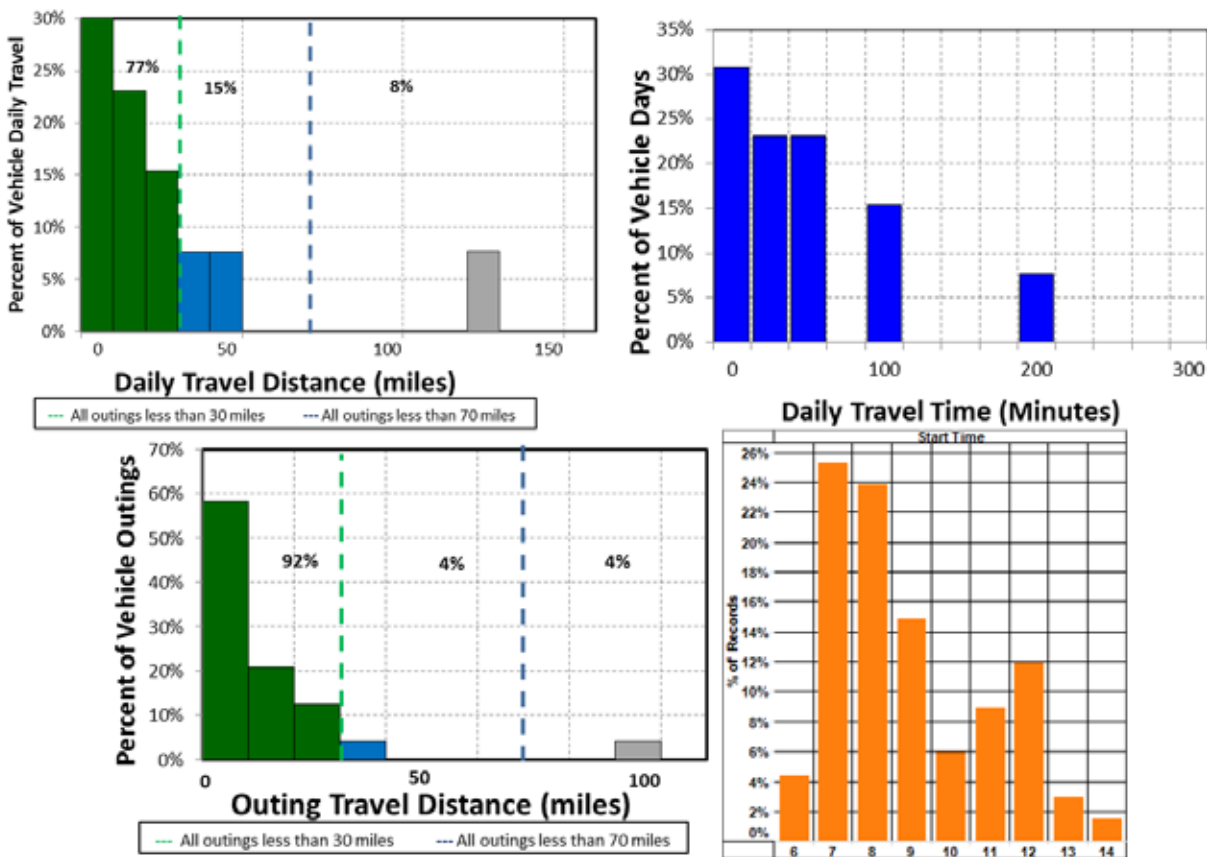


Figure C-105. Vehicle G61-1508D travel graphs.

## Vehicle G61-1508D Observations

Logger 15 collected data on this vehicle for a period of 13 days of the 35-day study period. Validation occurred on 100% of the input data. Data indicate that this vehicle has a pool mission for Motor Transport – C-Pool. This vehicle’s data indicate it parks near Building 58 near Virginia Dare Drive as shown in the Google Earth figure to the right.

MCBCL reports that a recent vehicle odometer indicated 31,152 miles at the start of this study and an average annual mileage of 1,051 miles. The vehicle was used on 37% of the available days, with an average daily usage of 1.1 hours and a peak daily usage of 3.5 hours on the days it was used. The vehicle was used during day shift hours.




Figure C-105 shows that 92% of daily travel was within the typically advertised range of a BEV of approximately 70 miles and 96% of the outings were also within this range. Further, 77% of daily travel and 92% of outings were within the typically advertised CD mode of 30 miles for PHEVs.

A BEV could not meet all daily travel without additional charging opportunities and it appears there is sufficient time for recharge during the day. However, one outing exceeded the BEV range; therefore, a fleet of pool vehicles would likely contain a mix of BEVs and PHEVs.



## Sheet 55: Vehicle G61-1509D

	Make/Model/Year	Jeep Liberty – 2008
	EPA Class Size	SUV
	Mission	Pool
	Contact	Motor Transport – C-Pool
	Parking Location	Building 28211
	Fleet Vehicle ID	G61-1509D
	Fuel Type	Gas
	EPA Label/MPG (City/Hwy/Combined)	16/22/19
	EPA GHG Emissions (Grams CO <sub>2</sub> /Mi)	468
	Study Logger ID	16
	Total Vehicle Days/Total Study Days	18/31

Vehicle G61-1509D Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	24.8/66.2	16.5/61.8	6.3/44.0	446
Travel Time (Minutes)	58.1/137.0	38.7/102.0	14.7/96.0	1,046
Idle Time (Minutes)	2.4/NA	1.6/NA	0.6/NA	44

Total Stops			Stop Duration	
Distance From Home Base (Miles)	Stops	Percentages	Stop Duration (Hours)	Stops
Less than 10	65	98.5%	Less than 2	41
10 to 20	0	0	2 to 4	5
20 to 40	1	1.5%	4 to 8	2
40 to 60	0	0	Greater than 8	18



Figure C-106. Vehicle G61-1509D stops.

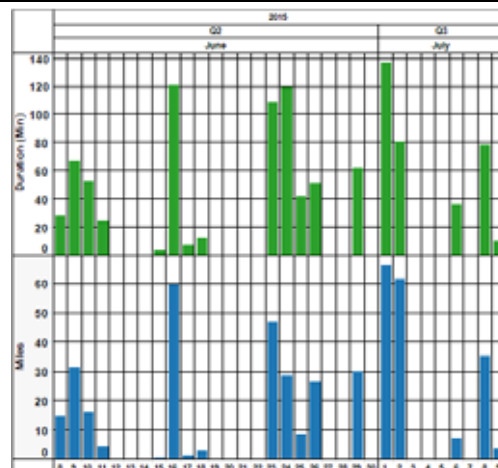


Figure C-107. Vehicle G61-1509D history.

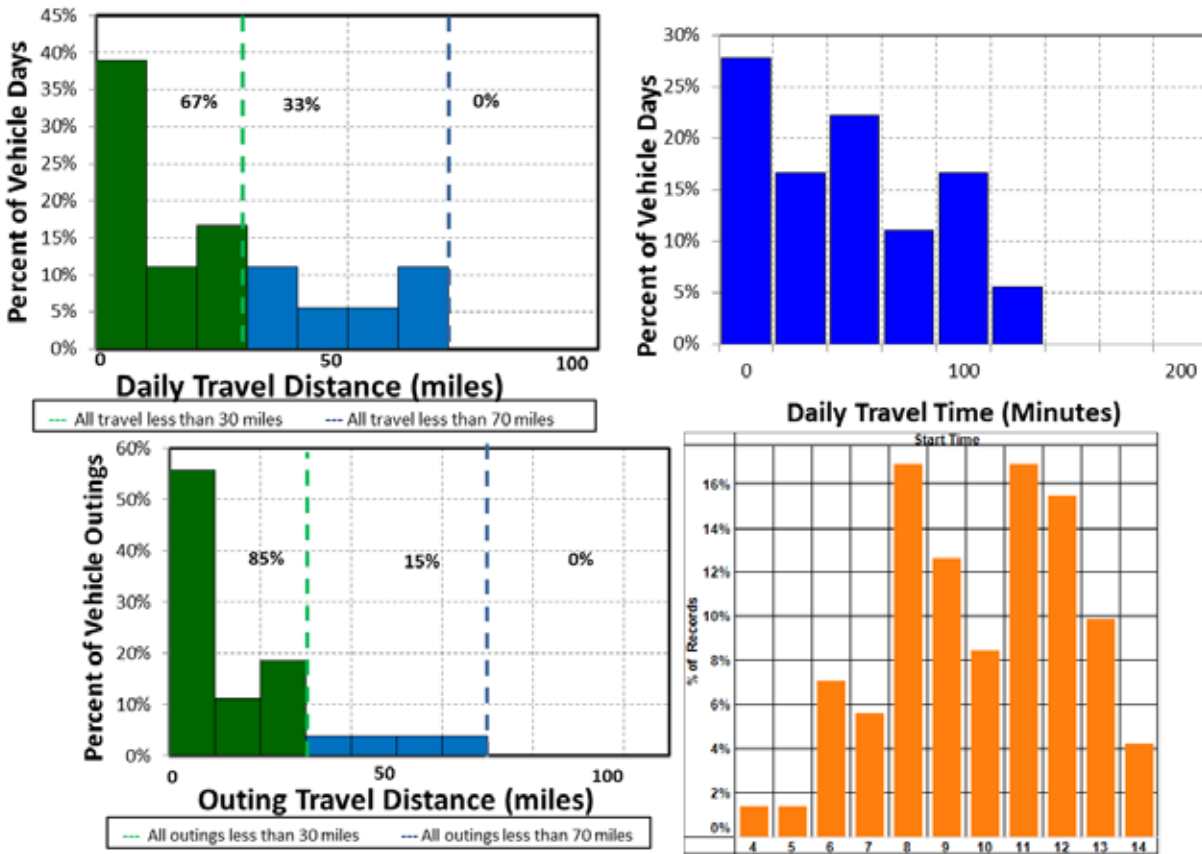


Figure C-108. Vehicle G61-1509D travel graphs.

## Vehicle G61-1509D Observations

Logger 16 collected data on this vehicle for a period of 18 days of the 31-day study period. Validation occurred on 100% of the input data. Data indicate that this vehicle has a pool mission for Motor Transport – C-Pool. This vehicle’s data indicate it parks near Building 28211 near Bancroft Street as shown in the Google Earth figure to the right.


MCBCL reports that a recent vehicle odometer indicated 26,551 miles at the start of this study and an average annual mileage of 3,292 miles. The vehicle was used on 58% of the available days, with an average daily usage of 1.0 hours and a peak daily usage of 2.3 hours on the days it was used. The vehicle was used during day shift hours.



Figure C-108 shows that all daily travel was within the typically advertised range of a BEV of approximately 70 miles. All outings were also within this range. Further, 67% of daily travel and 85% of outings were within the typically advertised CD mode of 30 miles for PHEVs.

A BEV could meet all daily travel without additional charging opportunities, assuming the vehicle was assigned a home base. A fleet of pool vehicles would likely contain a mix of BEVs and PHEVs.

## Sheet 56: Vehicle G62-1583G

	Make/Model/Year	Chevrolet K1500 – 2008
	EPA Class Size	Pickup
	Mission	Support
	Contact	G3 – Operations and Training
	Parking Location	Building 54
	Fleet Vehicle ID	G62-1583G
	Fuel Type	Gas
	EPA Label/MPG (City/Hwy/Combined)	15/20/17
	EPA GHG Emissions (Grams CO <sub>2</sub> /Mi)	523
	Study Logger ID	82
	Total Vehicle Days/Total Study Days	17/33

Vehicle G62-1583G Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	52.8/128.3	39.1/102.9	8.9/38.2	898
Travel Time (Minutes)	104.9/235.0	77.5/179.0	17.7/81.0	1,783
Idle Time (Minutes)	7.4/NA	5.5/NA	1.2/NA	126

Total Stops			Stop Duration	
Distance From Home Base (Miles)	Stops	Percentages	Stop Duration (Hours)	Stops
Less than 10	90	100%	Less than 2	67
10 to 20	0	0	2 to 4	6
20 to 40	0	0	4 to 8	1
40 to 60	0	0	Greater than 8	16

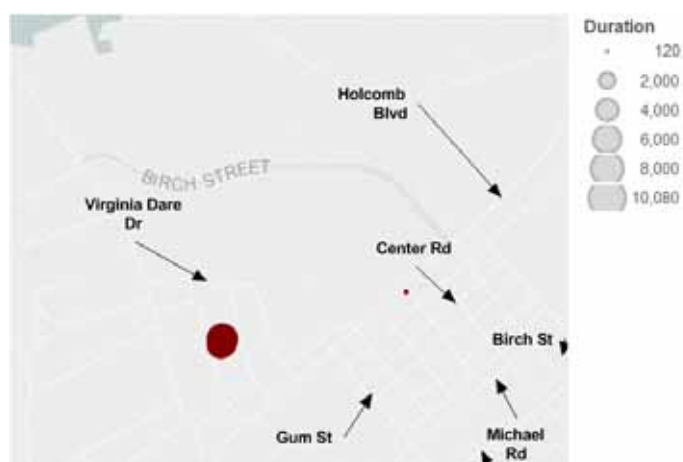


Figure C-109. Vehicle G61-1583G stops.

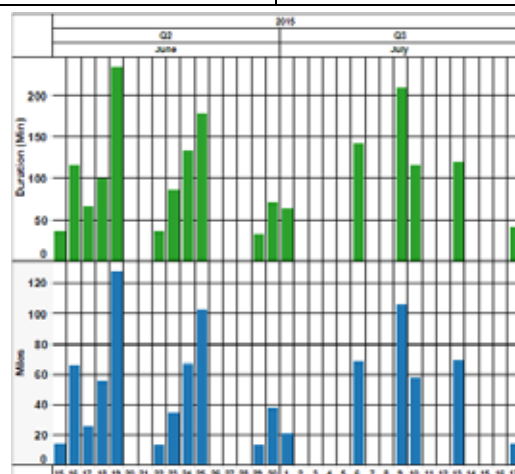


Figure C-110. Vehicle G61-1583G history.

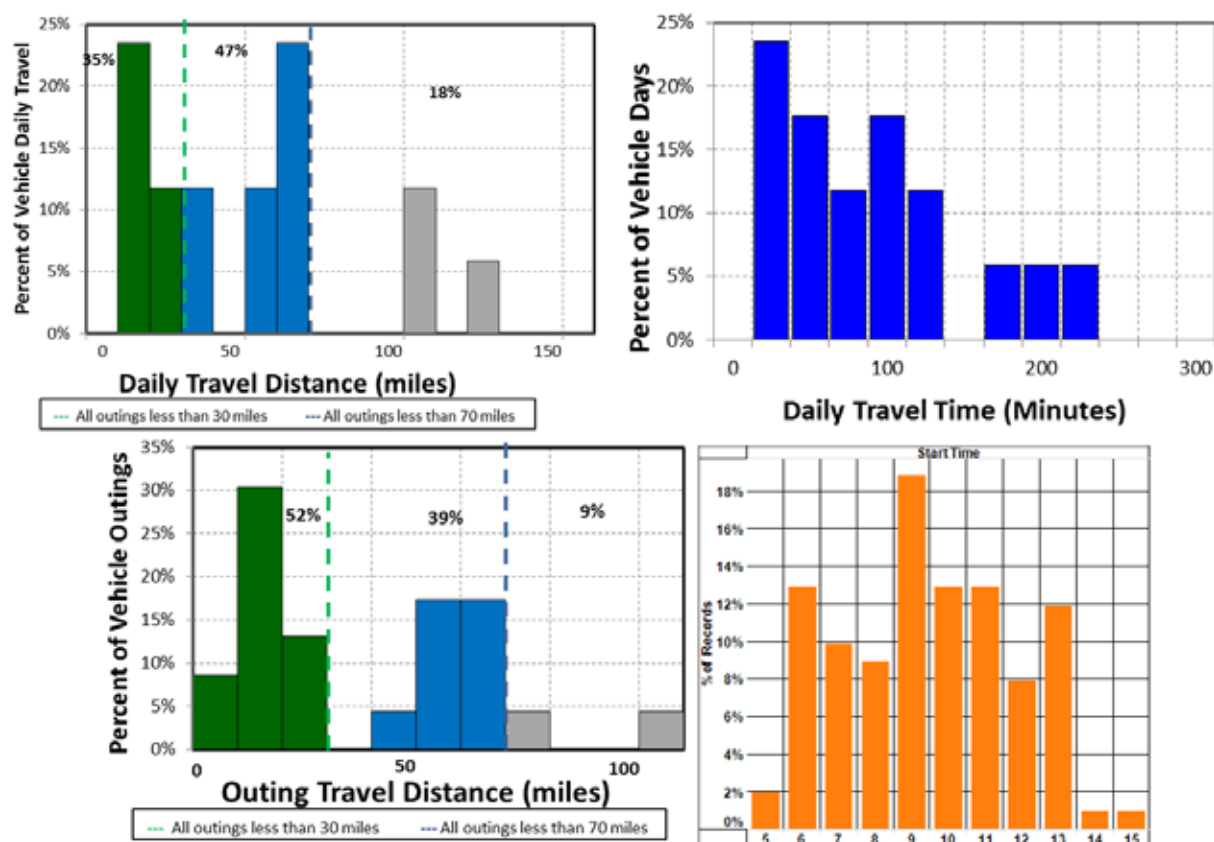


Figure C-111. Vehicle G62-1583G travel graphs.

## Vehicle G62-1583G Observations

Logger 82 collected data on this vehicle for a period of 17 days of the 33-day study period. Validation occurred on 100% of the input data. Data indicate that this vehicle has a support mission for G3 – Operations and Training. This vehicle's data indicate it parks near Building 54 near Post Lane as shown in the Google Earth figure to the right.


MCBCL reports that a recent vehicle odometer indicated 60,381 miles at the start of this study and an average annual mileage of 10,816 miles. The vehicle was used on 52% of the available days, with an average daily usage of 1.7 hours and a peak daily usage of 3.9 hours on the days it was used. The vehicle was used during day shift hours.



Figure C-111 shows that 82% of daily travel was within the typically advertised range of a BEV of approximately 70 miles and 91% of outings were also within this range. Further, 35% of daily travel and 52% of outings were within the typically advertised CD mode of 30 miles for PHEVs.

A BEV could not meet all daily travel without additional charging opportunities; however, there is not enough time each day for these charging opportunities. A significant amount of the daily travel was within the BEV range. Thus, a fleet of G-3 support vehicles would likely contain a mix of BEVs and PHEVs, favoring the BEVs.

## Sheet 57: Vehicle G62-4085L

	Make/Model/Year	Dodge 1500 – 2012
	EPA Class Size	Pickup
	Mission	Support
	Contact	Fire Department
	Parking Location	Building 58
	Fleet Vehicle ID	G62-4085L
	Fuel Type	E85
	EPA Label/MPG (City/Hwy/Combined)	10/12/11
	EPA GHG Emissions (Grams CO <sub>2</sub> /Mi)	564
	Study Logger ID	46
	Total Vehicle Days/Total Study Days	18/31

Vehicle G62-4085L Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	34.8/77.0	19.6/67.8	5.6/30.6	626
Travel Time (Minutes)	97.4/296.0	54.8/213.0	15.8/118.0	1,754
Idle Time (Minutes)	20.3/NA	11.4/NA	3.3/NA	365

Total Stops			Stop Duration	
Distance From Home Base (Miles)	Stops	Percentages	Stop Duration (Hours)	Stops
Less than 10	108	100%	Less than 2	83
10 to 20	0	0	2 to 4	4
20 to 40	0	0	4 to 8	4
40 to 60	0	0	Greater than 8	17

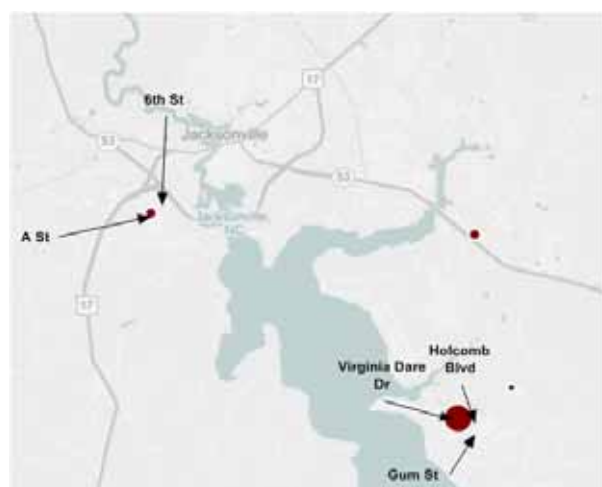


Figure C-112. Vehicle G62-4085L stops.

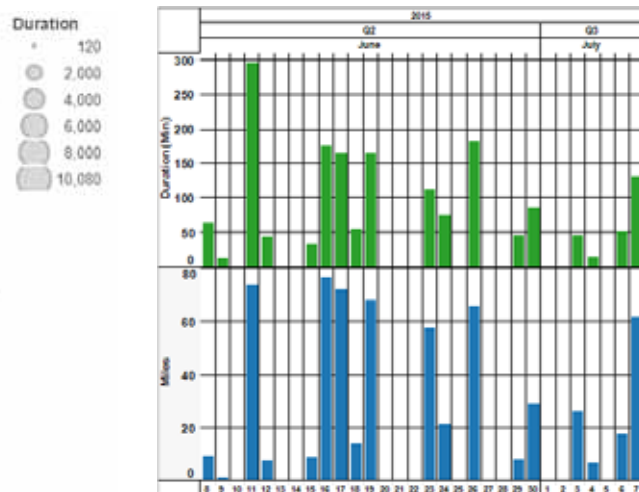


Figure C-113. Vehicle G62-4085L history.



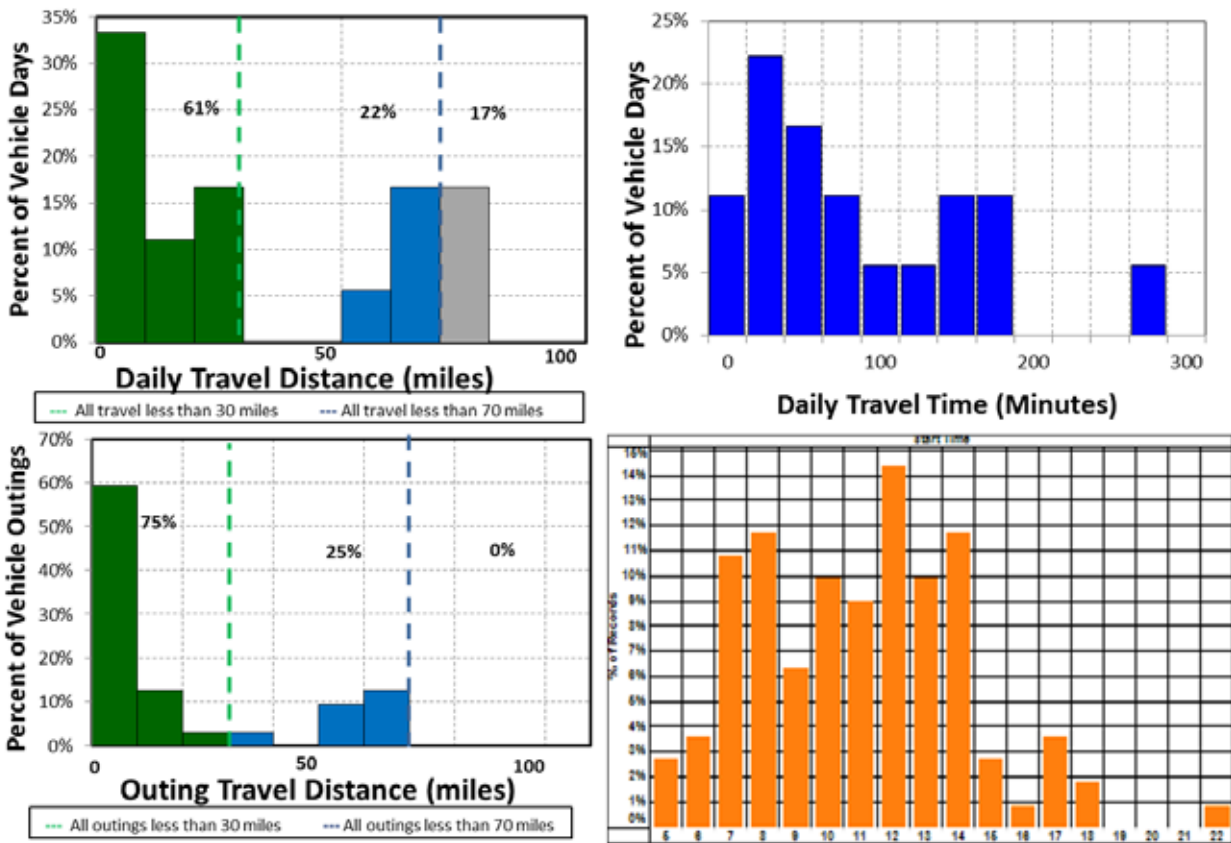


Figure C-114. Vehicle G62-4085L travel graphs.

### Vehicle G62-4085L Observations

Logger 46 collected data on this vehicle for a period of 18 days of the 31-day study period. Validation occurred on 100% of the input data. Data indicate that this vehicle has a support mission for the Fire Department. This vehicle's data indicate it parks near Building 58 near Virginia Dare Drive as shown in the Google Earth figure to the right.

MCBCL reports that a recent vehicle odometer indicated 17,386 miles at the start of this study and an average annual mileage of 10,608 miles. The vehicle was used on 58% of the available days, with an average daily usage of 1.6 hours and a peak daily usage of 4.9 hours on the days it was used. The vehicle was used during extended day shift hours.




Figure C-114 shows that 83% of daily travel was within the typically advertised range of a BEV of approximately 70 miles. All outings were also within this range. Further, 61% of daily travel and 75% of outings were within the typically advertised CD mode of 30 miles for PHEVs.

A BEV could not meet all daily travel without additional charging opportunities and recharge time is available each day to accomplish this. However, fleet managers may desire their fleet of support vehicles to contain a mix of BEVs and PHEVs.



## Sheet 58: Vehicle G63-0163H

	Make/Model/Year	Chevrolet K2500HD - 2009
	EPA Class Size	Pickup
	Mission	Support
	Contact	Marine Corps Air Station
	Parking Location	Building AS427
	Fleet Vehicle ID	G63-0163H
	Fuel Type	Gas
	EPA Label/MPG (City/Hwy/Combined)	14/20/16
	EPA GHG Emissions (Grams CO <sub>2</sub> /Mi)	555
	Study Logger ID	98
	Total Vehicle Days/Total Study Days	18/33

Vehicle G63-0163H Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	28.2/51.6	5.4/51.6	2.4/50.0	508
Travel Time (Minutes)	127.2/269.0	24.4/127.0	10.6/123.0	2,289
Idle Time (Minutes)	22.5/NA	4.3/NA	1.9/NA	405

Total Stops			Stop Duration	
Distance From Home Base (Miles)	Stops	Percentages	Stop Duration (Hours)	Stops
Less than 10	187	100%	Less than 2	145
10 to 20	0	0	2 to 4	12
20 to 40	0	0	4 to 8	18
40 to 60	0	0	Greater than 8	12



Figure C-115. Vehicle G63-0163H stops.

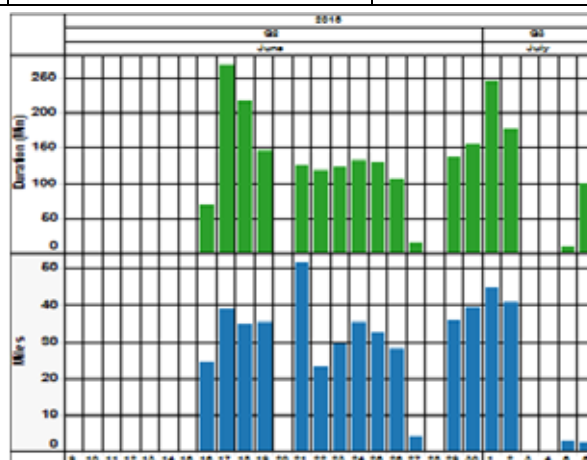


Figure C-116. Vehicle G63-0163H history.

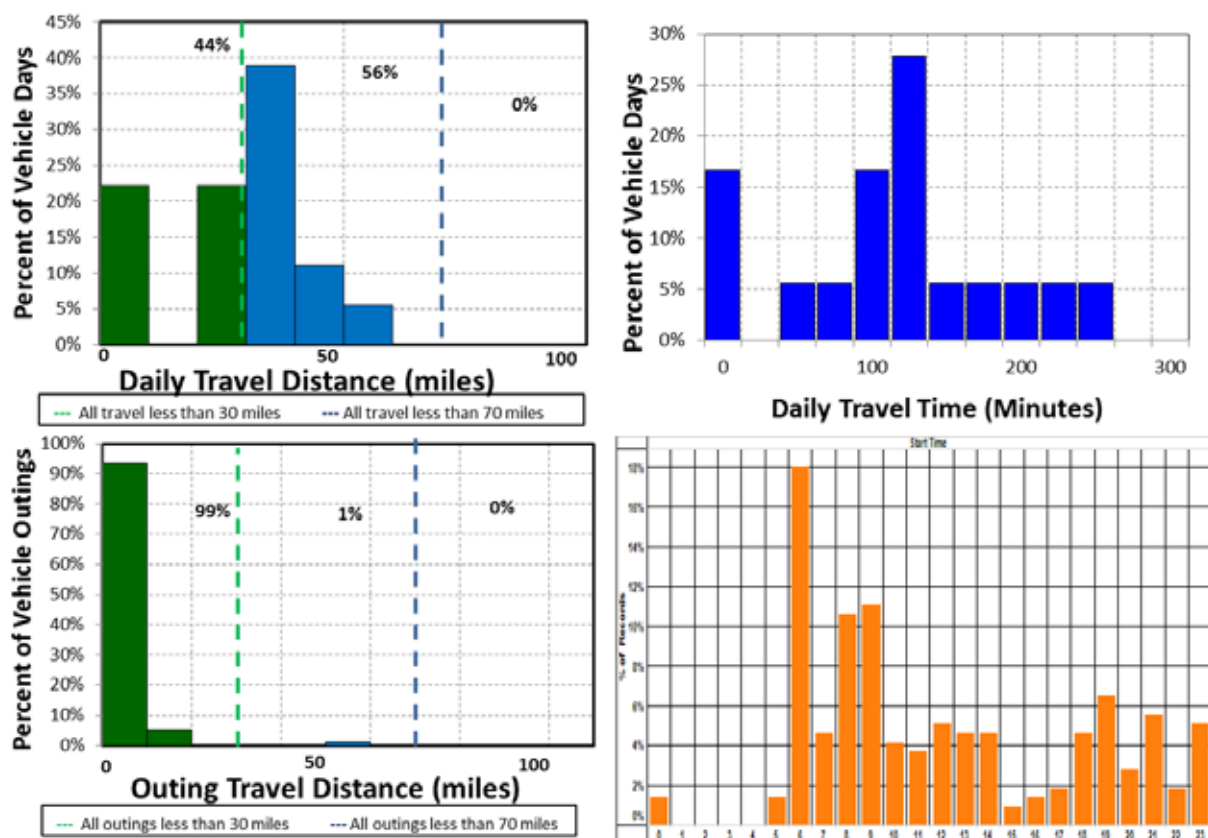


Figure C-117. Vehicle G63-0163H travel graphs.

## Vehicle G63-0163H Observations

Logger 98 collected data on this vehicle for a period of 18 days of the 33-day study period. Validation occurred on 100% of the input data. Data indicate that this vehicle has a support mission for Marine Corps Air Station. This vehicle's data indicate it parks near Building AS427 near Campbell Street as shown in the Google Earth figure to the right.


MCBCL reports that a recent vehicle odometer indicated 57,812 miles at the start of this study and an average annual mileage of 9,018 miles. The vehicle was used on 55% of the available days, with an average daily usage of 2.1 hours and a peak daily usage of 4.5 hours on the days it was used. The vehicle was used during day and evening hours of the day.

Figure C-117 shows that all daily travel was within the typically advertised range of a BEV of approximately 70 miles. All outings were also within this range. Further, 44% of daily travel and 99% of outings were within the typically advertised CD mode of 30 miles for PHEVs.

A BEV could meet all daily travel without additional charging opportunities, assuming the vehicle was assigned a home base. However, fleet managers typically prefer some support vehicles without range limitations. Thus, a fleet of support vehicles would likely contain a mix of BEVs and PHEVs.



# Sheet 59: Vehicle G63-2885L

	Make/Model/Year	Chevrolet K2500HD – 2012
	EPA Class Size	Pickup
	Mission	Support
	Contact	Fire Department
	Parking Location	Building 2600
	Fleet Vehicle ID	G63-2885L
	Fuel Type	E85
	EPA Label/MPG (City/Hwy/Combined)	11/16/13
	EPA GHG Emissions (Grams CO <sub>2</sub> /Mi)	477
	Study Logger ID	47
	Total Vehicle Days/Total Study Days	29/31

Vehicle G63-2885L Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	16.2/107.7	9.2/103.4	6.0/56.0	470
Travel Time (Minutes)	55.8/347.0	31.7/345.0	20.8/129.0	1,619
Idle Time (Minutes)	25.6/NA	14.5/NA	9.5/NA	741

Total Stops			Stop Duration	
Distance From Home Base (Miles)	Stops	Percentages	Stop Duration (Hours)	Stops
Less than 10	33	84.6%	Less than 2	22
10 to 20	0	0	2 to 4	1
20 to 40	6	15.4%	4 to 8	4
40 to 60	0	0	Greater than 8	12

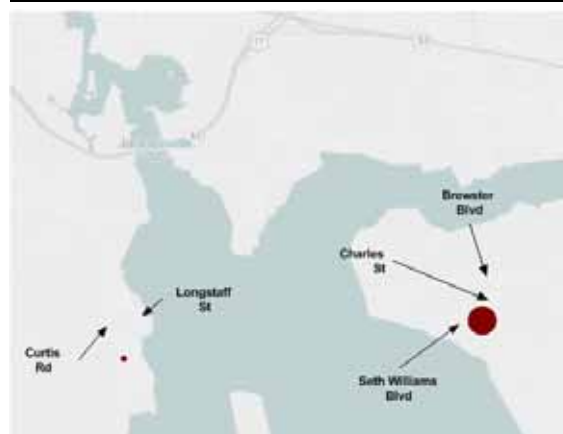


Figure C-118. Vehicle G63-2885L stops.

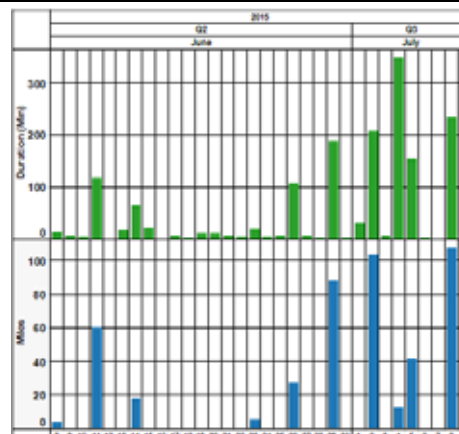


Figure C-119. Vehicle G63-2885L history.

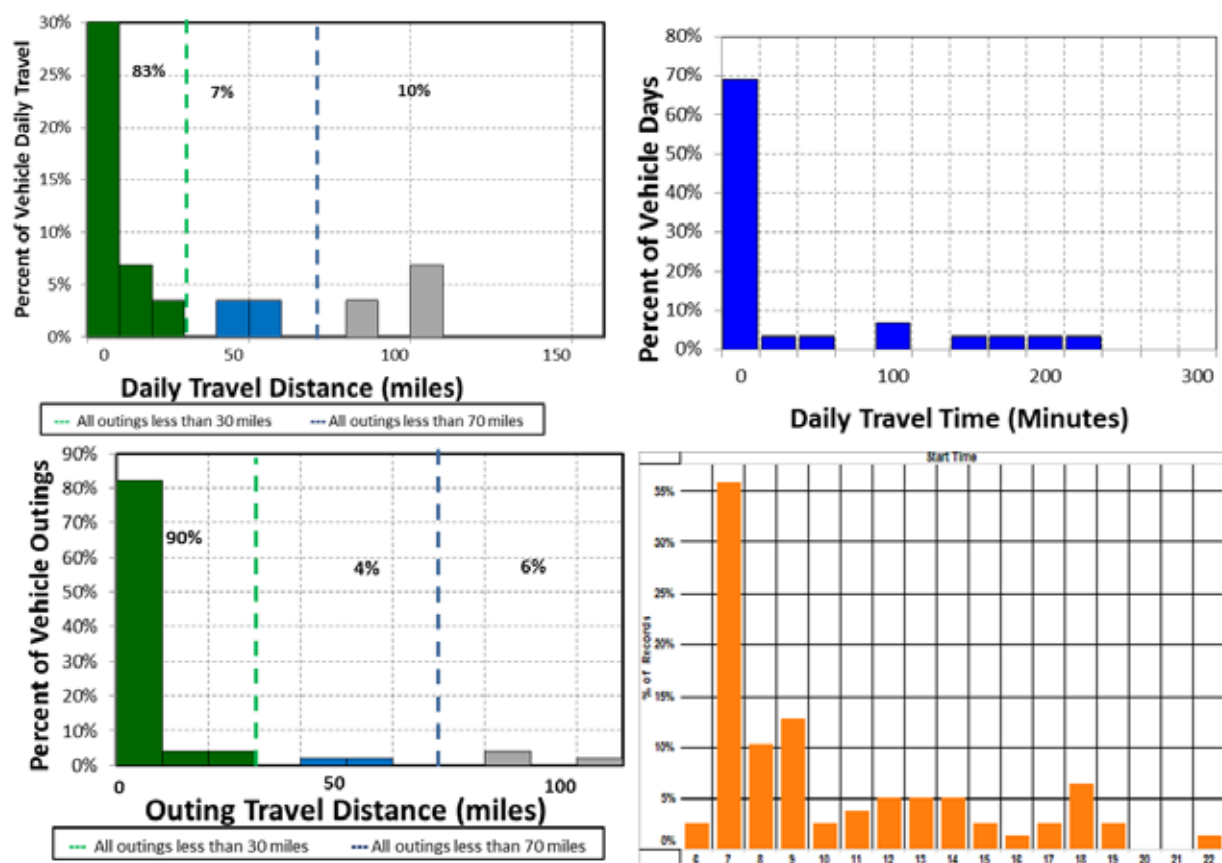


Figure C-120. Vehicle G63-2885L travel graphs.

## Vehicle G63-2885L Observations

Logger 47 collected data on this vehicle for a period of 29 days of the 31-day study period. Validation occurred on 100% of the input data. Data indicate that this vehicle has a support mission for the Fire Department. This vehicle's data indicate it parks near Building 2600 near Charles Street as shown in the Google Earth figure to the right.


MCBCL reports that a recent vehicle odometer indicated 10,474 miles at the start of this study and an average annual mileage of 4,112 miles. The vehicle was used on 94% of the available days, with an average daily usage of 0.9 hours and a peak daily usage of 5.8 hours on the days it was used. The vehicle was used during extended day shift hours.



Figure C-120 shows that 90% of daily travel was within the typically advertised range of a BEV of approximately 70 miles and 94% of outings were also within this range. Further, 83% of daily travel and 90% of outings were within the typically advertised CD mode of 30 miles for PHEVs.

A BEV could not meet all daily travel without additional charging opportunities, but daily use shows sufficient time is available for recharging. All outings were within the range of the BEV, which supports a BEV in this operation. However, fleet managers typically prefer support vehicles that may not have range limitations. Thus, a fleet of support vehicles would likely contain a mix of BEVs and PHEVs, favoring BEVs.

## Sheet 60: Vehicle G63-2888L

	Make/Model/Year	Chevrolet K2500HD – 2012
	EPA Class Size	Pickup
	Mission	Enforcement
	Contact	Provost Marshal's Office
	Parking Location	Building SAW360B
	Fleet Vehicle ID	G63-2888L
	Fuel Type	E85
	EPA Label/MPG (City/Hwy/Combined)	11/16/13
	EPA GHG Emissions (Grams CO <sub>2</sub> /Mi)	477
	Study Logger ID	52
	Total Vehicle Days/Total Study Days	22/31

Vehicle G63-2888L Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	24.4/115.3	15.7/110.2	6.2/55.6	533
Travel Time (Minutes)	96.5/439.0	62.4/231.0	24.7/118.0	2,122
Idle Time (Minutes)	40.1/NA	26.0/NA	10.3/NA	883

Total Stops			Stop Duration	
Distance From Home Base (Miles)	Stops	Percentages	Stop Duration (Hours)	Stops
Less than 10	85	94.4%	Less than 2	60
10 to 20	0	0	2 to 4	6
20 to 40	5	5.6%	4 to 8	2
40 to 60	0	0	Greater than 8	22

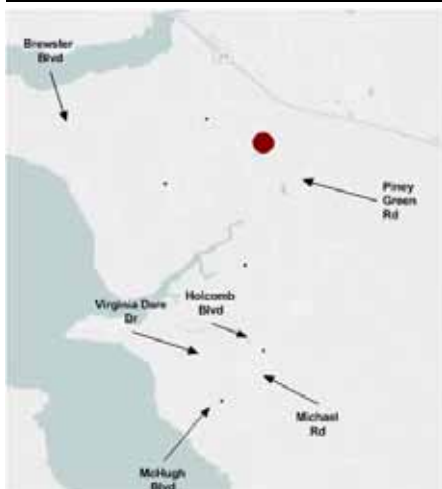


Figure C-121. Vehicle G63-2888L stops.

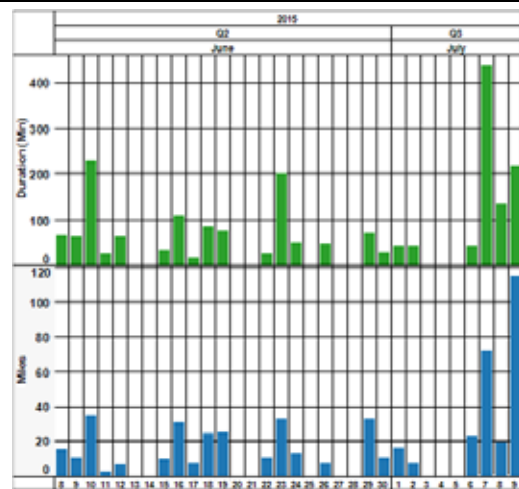


Figure C-122. Vehicle G63-2888L history.



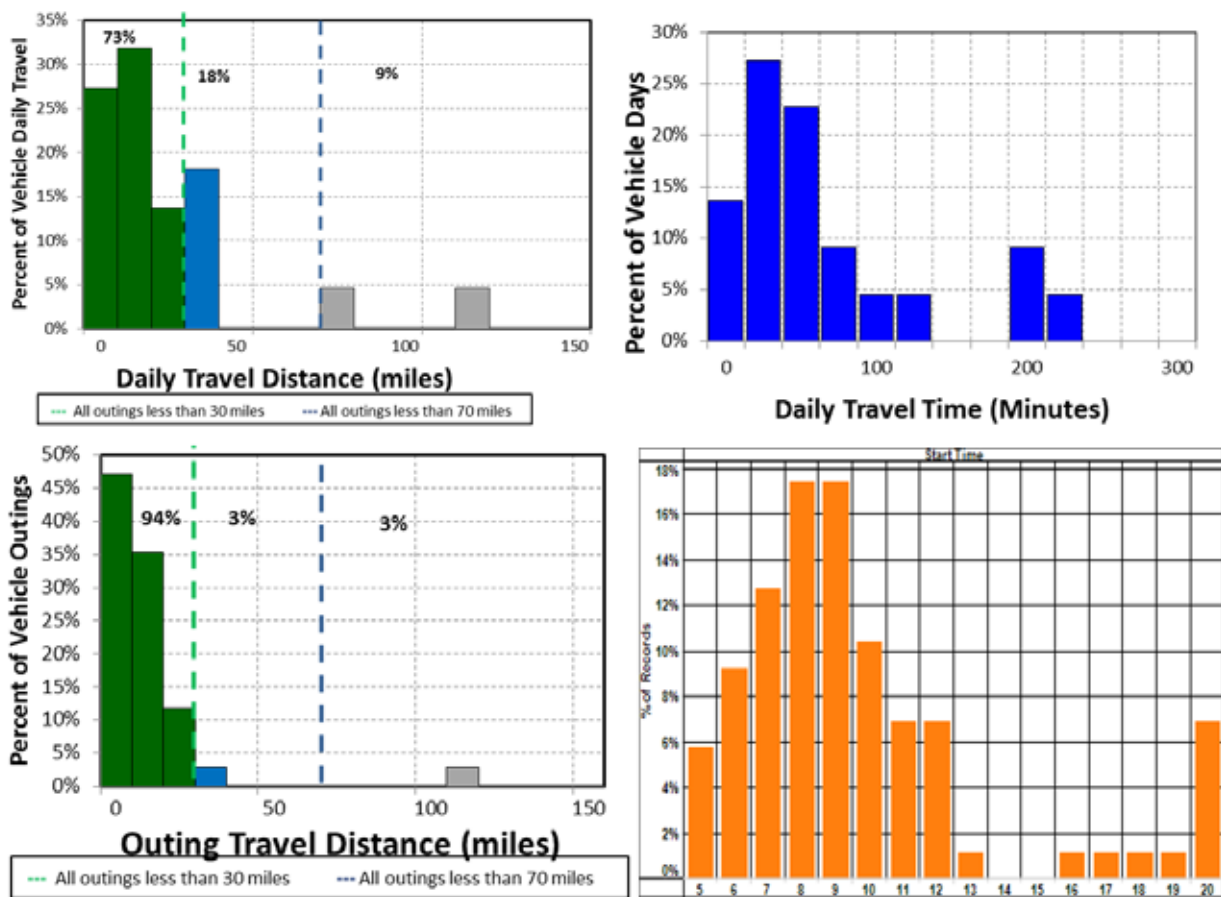


Figure C-123. Vehicle G63-2888L travel graphs.

## Vehicle G63-2888L Observations

Logger 52 collected data on this vehicle for a period of 22 days of the 31-day study period. Validation occurred on 100% of the input data. Data indicate that this vehicle has a support mission for the Provost Marshal's Office. This vehicle's data indicate it parks near Building SAW360B near Sawmill Road as shown in the Google Earth figure to the right.

MCBCL reports that a recent vehicle odometer indicated 13,548 miles at the start of this study and an average annual mileage of 4,480 miles. The vehicle was used on 71% of the available days, with an average daily usage of 1.6 hours and a peak daily usage of 7.3 hours on the days it was used. The vehicle was used during day shift and evening hours.



Figure C-123 shows that 91% of daily travel was within the typically advertised range of a BEV of approximately 70 miles and 97% of the outings were also within this range. Further, 73% of daily travel and 94% of outings were within the typically advertised CD mode of 30 miles for PHEVs.

A BEV could not meet all daily travel without additional charging opportunities; these charge opportunities are available. However, fleet managers typically do not prefer enforcement vehicles that contain range limitations. Thus, a fleet of enforcement vehicles would likely contain a mix of BEVs and PHEVs.



# Appendix D

## Greenhouse Gas Emissions Avoided and fuel Cost Reduction Analysis – Commands Group

### D.1 Replacement Plug-In Electric Vehicles for Commands Group Fleet

Section 4.1 provided the analysis results for the Commands group vehicles that were monitored during the study period based on the data recorded and reported in the vehicle data sheets found in Appendix B. For the study, PEV replacements are based on vehicle class. The observations of Section 4.1.2.3 suggest that replacing these vehicles with eight BEVs and 10 PHEVs would meet current mission requirements.

Specific vehicle cargo requirements have not been specified and were not considered in these replacement suggestions. Table D-1 identifies the PEVs suggested for these ICE vehicle replacements.

Table D-1. MCBCL Commands Group PEV replacements.

			Vehicle Replacements			
Log	Current Vehicle		EPA Class	Replacement PEV		Mission
88	Ford	E250	Van - Pass	Nissan	eNV200	Support
17	Ford	F350	Pickup	Nissan	eNV200	Support
95	Dodge	Grand Caravan	Minivan	Mitsubishi	Outlander	Support
86	Dodge	Grand Caravan	Minivan	Mitsubishi	Outlander	Support
83	Dodge	Dakota	Pickup	Nissan	eNV200	Support
90	Ford	E150	Van - Pass	Nissan	eNV200	Support
92	Ford	E150	Van - Pass	Via Motors	VTRUX Van	Support
84	Ford	E150	Van - Pass	Via Motors	VTRUX Van	Support
18	Chevrolet	2500HD	Pickup	Nissan	eNV200	Support
103	Chevrolet	G2300	Van - Pass	Kia	Soul	Support
19	Ford	F350	Pickup	Via Motors	VTRUX PU	Support
20	Ford	F250	Pickup	Kia	Soul	Support
110	Chevrolet	G2300	Van - Pass	Nissan	eNV200	Support
87	Jeep	Patriot	SUV	Mitsubishi	Outlander	Support
94	Jeep	Patriot	SUV	Mitsubishi	Outlander	Support
91	Ford	Expedition	SUV	Mitsubishi	Outlander	Support
99	Ford	F350	Pickup	Via Motors	VTRUX PU	Support
120	Chevrolet	K3500	Pickup	Via Motors	VTRUX PU	Support

Section 5 provides the methodology and assumptions for calculations of the reduction in GHG emissions and fuel costs. The miles recorded by vehicles during the 31-day study are compared to the MCBCL reported annual miles and where available, the MCBCL annual miles are utilized. If the PEV replacing the monitored vehicle was a BEV, all annual miles could potentially occur in CD mode. If the PEV is a PHEV, the total miles driven per day where all travel was less than 30 miles was calculated. Thirty miles per day for the balance of days where travel occurred was added and a percentage of total miles monitored was calculated. This represents the percentage of all vehicles miles that could be accomplished in CD mode. That percentage was multiplied by annual miles to identify total annual miles available in CD mode. Only these miles were used in the reduction calculations. For example, logger 95 recorded 22 days of use. Seven days recorded travel less than 30 miles for a total of 59.8 miles. The remaining 15 days recorded greater than 30 miles; therefore, at 30 miles per day, a total of 450 miles were added for a total of 509.8 miles potentially in CD mode. A total of 1,402 miles were recorded for this

vehicle; therefore, 36% of all miles driven by this vehicle were potentially in CD mode. This percent was multiplied by the MCBCL-provided annual mileage to identify annual miles in CD mode.

This is conservative because the replacement PHEV is likely more fuel-efficient than the monitored vehicle when powered by the ICE and additional miles may be available if recharging occurs.

## D.2 Monitored Vehicle Fuel Cost Reduction

Table D-2 identifies the calculated miles in CD mode for each replacement vehicle and the projected fuel cost reductions. As noted in Section 5, both the local cost of fuel and the national average were used for comparisons.

North Carolina fuel costs are close to the national average with gasoline and diesel slightly less but E85 slightly more. As noted in Section 5, Duke Energy Progress' electrical fuel costs are lower than the national average. Section 5 summarized these values.

The fuel costs and GHG emissions avoided are all based on the miles driven in CD mode and the resulting savings in petroleum-based fuels. Table D-2 shows the calculated results for each of the Commands vehicles replaced.

Table D-2. Monitored vehicle PEV replacement fuel savings.

Log	Vehicle ID	Vehicle Class	Replacement PEV	Annual Miles CD Mode	Gallons Fuel Saved
88	291073	Van - Pass	eNV200	2,935	183
17	301321	Pickup	eNV200	3,669	367
95	G41-0762M	Minivan	Outlander	7,307	522
86	G41-1846K	Minivan	Outlander	2,651	189
83	G41-2399K	Pickup	eNV200	10,754	566
90	G42-0216F	Van - Pass	eNV200	2,189	137
92	G42-0883M	Van - Pass	VTRUX Van	5,120	512
84	G42-0898M	Van - Pass	VTRUX Van	10,254	1,025
18	G43-0326H	Pickup	eNV200	4,863	286
103	G43-1453G	Van - Pass	Soul	15,539	914
19	G43-1855P	Pickup	VTRUX PU	2,242	149
20	G43-2025K	Pickup	Soul	3,755	221
110	G43-4073F	Van - Pass	eNV200	4,712	277
87	G61-0594L	SUV	Outlander	2,930	117
94	G61-2644P	SUV	Outlander	915	38
91	G62-0791H	SUV	Outlander	4,899	445
99	G63-0309R	Pickup	VTRUX PU	9,160	611
120	G63-0934G	Pickup	VTRUX PU	1,397	82

Table D-3 shows the calculated fuel costs for North Carolina and nationally for the gallons of petroleum-based fuel identified in Table D-2.

Table D-3. Monitored vehicle PEV replacement fuel savings (North Carolina and national factors).

Log	Vehicle ID	Local Fuel Cost	Local Elect. Fuel Cost	Local Annual Fuel Savings	Local Fuel Cost Reduction	National Fuel Cost	National Elect. Fuel Cost	National Annual Fuel Savings	National Fuel Cost Reduction
88	291073	\$486	\$65	\$421	87%	\$514	\$121	\$393	76%
17	301321	\$796	\$82	\$714	90%	\$781	\$151	\$630	81%
95	G41-0762M	\$1,133	\$179	\$954	84%	\$1,112	\$332	\$780	70%
86	G41-1846K	\$411	\$65	\$346	84%	\$403	\$120	\$283	70%
83	G41-2399K	\$1,228	\$239	\$989	81%	\$1,206	\$444	\$762	63%
90	G42-0216F	\$363	\$49	\$314	87%	\$383	\$90	\$293	76%

Log	Vehicle ID	Local Fuel Cost	Local Elect. Fuel Cost	Local Annual Fuel Savings	Local Fuel Cost Reduction	National Fuel Cost	National Elect. Fuel Cost	National Annual Fuel Savings	National Fuel Cost Reduction
92	G42-0883M	\$1,111	\$135	\$976	88%	\$1,091	\$251	\$840	77%
84	G42-0898M	\$2,225	\$271	\$1,954	88%	\$2,184	\$503	\$1,681	77%
18	G43-0326H	\$758	\$108	\$650	86%	\$801	\$201	\$601	75%
103	G43-1453G	\$2,422	\$277	\$2,145	89%	\$2,560	\$513	\$2,047	80%
19	G43-1855P	\$324	\$59	\$265	82%	\$318	\$110	\$208	65%
20	G43-2025K	\$585	\$67	\$518	89%	\$619	\$124	\$495	80%
110	G43-4073F	\$735	\$105	\$630	86%	\$776	\$195	\$582	75%
87	G61-0594L	\$311	\$72	\$239	77%	\$328	\$133	\$195	59%
94	G61-2644P	\$101	\$22	\$79	78%	\$107	\$42	\$65	61%
91	G62-0791H	\$966	\$120	\$846	88%	\$949	\$222	\$726	77%
99	G63-0309R	\$1,325	\$242	\$1,083	82%	\$1,301	\$449	\$852	65%
120	G63-0934G	\$218	\$37	\$181	83%	\$230	\$68	\$162	70%

An example calculation for Logger 86 follows: the MCBCL reported annual miles for this vehicle is 12,317 miles. The suggested replacement PEV is a PHEV. The calculated potential miles in CD mode for the study period was 21.52%; therefore, annual miles in CD mode is 2,651 miles. This vehicle uses E85 and EPA fuel economy for this vehicle is 14 MPG, implying 189 gallons of E85 are unused. North Carolina cost for E85 is \$2.17/gallon for an annual cost of \$411. The replacement PEV requires 440 Wh/mile; therefore, 1,166 kWh are required for recharging the battery. Local power cost is \$0.05566/kWh, resulting in annual electric cost of \$65. The savings are \$346 for an 84% reduction in fuel cost.

### D.3 Monitored Vehicle Greenhouse Gas Reduction

Tables D-4 and D-5 identify the reduction in GHG emissions projected using local power production emissions and national emissions figures, respectively, when replacing the current vehicles with PEVs. The calculated miles in CD mode shown in Table D-2 are also used in the calculations of GHG emissions reduction. As noted in Section 5, emissions from burning petroleum-based fuel are known and emissions from the use of electricity are dependent on the power generation mix used to recharge the PEV battery. As before, both local power production emission figures and the national average are used for comparisons.

The emissions from Duke Energy Progress generation are lower than the national average. In addition, electrical emissions are significantly lower than gasoline emissions.

Table D-4. Monitored vehicle replacement on GHG emissions reduction (Jacksonville, North Carolina area figures).

Log	Vehicle ID	Vehicle Class	Annual GHG Emissions ICE lb-CO <sub>2</sub> e	Annual PEV GHG Local lb-CO <sub>2</sub> e	Annual GHG Local Savings lb-CO <sub>2</sub> e	Annual Local GHG Reduction %
88	291073	Van - Pass	3,591	1,331	2,260	63%
17	301321	Pickup	5,015	1,664	3,351	67%
95	G41-0762M	Minivan	7,136	3,646	3,490	49%
86	G41-1846K	Minivan	2,589	1,323	1,266	49%
83	G41-2399K	Pickup	14,699	4,878	9,821	67%
90	G42-0216F	Van - Pass	2,678	993	1,685	63%
92	G42-0883M	Van - Pass	6,999	2,758	4,241	61%
84	G42-0898M	Van - Pass	14,016	5,523	8,492	61%

Log	Vehicle ID	Vehicle Class	Annual GHG Emissions ICE lb-CO <sub>2</sub> e	Annual PEV GHG Local lb-CO <sub>2</sub> e	Annual GHG Local Savings lb-CO <sub>2</sub> e	Annual Local GHG Reduction %
18	G43-0326H	Pickup	6,347	2,206	4,141	65%
103	G43-1453G	Van - Pass	17,917	5,639	12,278	69%
19	G43-1855P	Pickup	2,071	1,208	863	42%
20	G43-2025K	Pickup	4,330	1,363	2,967	69%
110	G43-4073F	Van - Pass	5,433	2,137	3,296	61%
87	G61-0594L	SUV	2,293	1,462	831	36%
94	G61-2644P	SUV	741	457	284	38%
91	G62-0791H	SUV	6,092	2,444	3,647	60%
99	G63-0309R	Pickup	8,461	4,934	3,527	42%
120	G63-0934G	Pickup	1,611	753	858	53%

Table D-5. Monitored vehicle replacement on GHG emissions reduction (national figures).

Log	Vehicle ID	Vehicle Class	Annual GHG Emissions ICE lb-CO <sub>2</sub> e	Annual PEV GHG Local lb-CO <sub>2</sub> e	Annual GHG Local Savings lb-CO <sub>2</sub> e	Annual Local GHG Reduction %
88	291073	Van - Pass	3,591	1,796	1,795	50%
17	301321	Pickup	5,015	2,245	2,770	55%
95	G41-0762M	Minivan	7,136	4,919	2,217	31%
86	G41-1846K	Minivan	2,589	1,785	804	31%
83	G41-2399K	Pickup	14,699	6,581	8,118	55%
90	G42-0216F	Van - Pass	2,678	1,340	1,339	50%
92	G42-0883M	Van - Pass	6,999	3,721	3,278	47%
84	G42-0898M	Van - Pass	14,016	7,452	6,564	47%
18	G43-0326H	Pickup	6,347	2,976	3,371	53%
103	G43-1453G	Van - Pass	17,917	7,608	10,309	58%
19	G43-1855P	Pickup	2,071	1,629	442	21%
20	G43-2025K	Pickup	4,330	1,838	2,491	58%
110	G43-4073F	Van - Pass	5,433	2,884	2,549	47%
87	G61-0594L	SUV	2,293	1,972	321	14%
94	G61-2644P	SUV	741	616	124	17%
91	G62-0791H	SUV	6,092	3,298	2,793	46%
99	G63-0309R	Pickup	8,461	6,657	1,804	21%
120	G63-0934G	Pickup	1,611	1,015	596	37%

An example calculation for Logger 86 follows: as shown above, annual miles in CD mode is 2,651 miles and 189 gallons of E85 are unused. EPA reports this vehicle's emissions at 443 gm-CO<sub>2</sub>e/mile so after converting grams to pounds; annual emissions for the monitored vehicle are 2,589 lb-CO<sub>2</sub>e. Local power produces 1.134 lb-CO<sub>2</sub>e/kWh. As noted above, 1,166 kWh are required for recharging the battery, resulting in 1,323 lb-CO<sub>2</sub>e. The savings are 1,266 lb-CO<sub>2</sub>e for a 49% reduction in GHG emissions.

## D.4 Commands Group Full Fleet Evaluation

Table 9 in Section 4.1.1 identifies 249 vehicles in the Commands Group fleet. Intertek suggests that a fleet of 143 BEVs and 106 PHEVs conservatively meets vehicle travel requirements.

Using averages for these vehicles, the potential replacements offer fuel cost reductions and GHG emissions reductions shown in Tables D-6 and D-7 (summarized in Section 5).

Table D-6. Commands Group full fleet PEV replacement reductions (Jacksonville, NC area figures).

Annual Miles CD Mode	Annual Fuel Cost	Annual Elect Fuel Cost	Annual Fuel Savings	Annual Fuel Savings %	Annual GHG Emissions ICE lb-CO <sub>2</sub> e	Annual PEV GHG Local lb-CO <sub>2</sub> e	Annual GHG Savings lb-CO <sub>2</sub> e	Annual GHG Reduction %
1,417,634	\$231,822	\$31,799	\$200,023	86%	1,702,381	647,871	1,054,510	62%

Table D-7. Commands group full fleet PEV replacement reductions (national figures).

Annual Miles CD Mode	Annual Fuel Cost	Annual Elect Fuel Cost	Annual Fuel Savings	Annual Fuel Savings %	Annual GHG Emissions ICE lb-CO <sub>2</sub> e	Annual PEV GHG Local lb-CO <sub>2</sub> e	Annual GHG Savings lb-CO <sub>2</sub> e	Annual GHG Reduction %
1,417,634	\$234,983	\$58,960	\$176,024	75%	1,702,381	874,112	832,794	49%

## D.5 Commands Group Summary

Tables D-8 and D-9 provide the average values for all monitored vehicles belonging to the Commands group.

Table D-8. Average fuel savings values for the Commands group's monitored vehicles (North Carolina figures).

Annual Miles CD Mode	Annual Fuel Cost	Annual Elect Fuel Cost	Annual Fuel Savings	Annual Fuel Reduction %
5,294	\$861	\$122	\$739	86%

Table D-9. Average GHG emissions savings values for the Commands group's monitored vehicles (North Carolina figures).

Annual Miles CD Mode	Annual GHG Emissions ICE lb-CO <sub>2</sub> e	Annual PEV GHG Local lb-CO <sub>2</sub> e	Annual GHG Savings lb-CO <sub>2</sub> e	Annual GHG Reduction %
5,294	6,223	2,484	3,739	60%

Tables D-8 and D-9 show that there is a significant opportunity for savings with the deployment of PEVs in this fleet, not only in fuel costs but in GHG emissions.

# Appendix E

## Greenhouse Gas Emissions Avoided and Fuel Cost Reduction Analysis – Marine Corps Installations East Group

### E.1 Replacement Plug-In Electric Vehicles for Marine Corps Installations East Fleet

Section 4.2 provided the analysis results for the MCIE fleet vehicles monitored during the study period based on data recorded and reported in the vehicle data sheets found in Appendix C. For the study, PEV replacements are based on vehicle class. The observations of Section 4.2.2.3 suggest that replacing these vehicles with 17 BEVs and 24 PHEVs would meet current mission requirements. Specific vehicle cargo requirements have not been specified, thus, these vehicles were not considered in these replacement suggestions. Table E-1 identifies the PEVs suggested for these ICE vehicle replacements.

Table E-1. MCBCL MCIE fleet PEV replacements.

Log	Current Vehicle		Vehicle Replacements			Mission
			EPA Class		Replacement PEV	
4	Ford	E350	Van - Cargo	Via Motors	VTRUX Van	Pool
37	Ford	F550	SP/Refrig.	NA	NA	Specialty
35	Chevrolet	Malibu	Sedan - Midsize	Nissan	Leaf	Support
48	Chevrolet	HHR	SUV	Kia	Soul	Enforcement
42	Chevrolet	3500	Pickup	Nissan	eNV200	Support
54	Chevrolet	HHR	SUV	Mitsubishi	Outlander	Support
53	Ford	F550	SP/Bucket	EDI	EDI	Specialty
55	Ford	F250XL	Pickup	Via Motors	VTRUX PU	Support
56	Ford	F250XL	Pickup	Via Motors	VTRUX PU	Support
79	Ford	F350 Stake	Pickup	Via Motors	VTRUX PU	Support
5	Chevrolet	Malibu	Sedan - Midsize	Nissan	Leaf	Pool
41	Ford	Focus	Sedan - Compact	Chevrolet	Volt	Support
39	Ford	Focus	Sedan - Compact	Chevrolet	Volt	Support
7	Dodge	Grand Caravan	Minivan	Kia	Soul	Pool
40	Dodge	Dakota	Pickup	Via Motors	VTRUX PU	Support
8	Dodge	Grand Caravan	Minivan	Mitsubishi	Outlander	Pool
57	Dodge	Caravan	Minivan	Mitsubishi	Outlander	Support
58	Ford	Ranger	Pickup	Via Motors	VTRUX PU	Support
59	Ford	Ranger	Pickup	Nissan	eNV200	Support
49	Ford	Ranger	Pickup	Via Motors	VTRUX PU	Enforcement
61	Ford	Ranger	Pickup	Nissan	eNV200	Support
9	Ford	E150	Van - Pass	Nissan	eNV200	Pool
68	Ford	F150	Pickup	Via Motors	VTRUX PU	Support
69	Ford	F150	Pickup	Nissan	eNV200	Support
10	Chevrolet	C1500	Pickup	Nissan	eNV200	Pool
75	Ford	F150	Pickup	Nissan	eNV200	Support
50	Chevrolet	C1500	Pickup	Via Motors	VTRUX PU	Enforcement
13	Ford	E350	Van - Pass	Via Motors	VTRUX Van	Pool
71	Ford	E350	Van - Cargo	Via Motors	VTRUX Van	Support
74	Ford	E350	Van - Cargo	Nissan	eNV200	Support



Vehicle Replacements						
Log	Current Vehicle		EPA Class	Replacement PEV		Mission
36	Chevrolet	CG3300	Van - Cargo	Nissan	eNV200	Support
14	Ford	F250	Pickup	Via Motors	VTRUX PU	Pool
77	Dodge	Dakota	Pickup	Via Motors	VTRUX PU	Support
78	Jeep	Liberty	SUV	Mitsubishi	Outlander	Support
51	Chevrolet	Equinox	SUV	Mitsubishi	Outlander	Enforcement
15	Jeep	Liberty	SUV	Mitsubishi	Outlander	Pool
16	Jeep	Liberty	SUV	Kia	Soul	Pool
82	Chevrolet	K1500	Pickup	Via Motors	VTRUX PU	Support
46	Dodge	1500	Pickup	Via Motors	VTRUX PU	Support
98	Chevrolet	K2500HD	Pickup	Nissan	eNV200	Support
47	Chevrolet	K2500HD	Pickup	Nissan	eNV200	Support
52	Chevrolet	K2500HD	Pickup	Kia	Soul	Enforcement

Section 5 provides the methodology and assumptions for the reduction in GHG emissions and fuel costs calculations. The miles recorded by vehicles during the 31-day study were compared to the MCBCL reported annual miles and where available, the MCBCL annual miles were utilized. If the PEV replacing the monitored vehicle was a BEV, all annual miles could potentially occur in CD mode. If the PEV was a PHEV, the total miles driven per day where all travel was less than 30 miles was calculated. Thirty miles per day for the balance of days where travel occurred was added and a percentage of total miles monitored was calculated. This represented the percentage of all vehicles miles that could be accomplished in CD mode, with that percentage being multiplied by the annual miles to identify total annual miles available in CD mode. Only these miles were used in the reduction calculations. For example, Logger 40 recorded 13 days of use. Five days recorded travel less than 30 miles for a total of 20.7 miles. The remaining 8 days recorded greater than 30 miles; therefore, at 30 miles per day, a total of 240 miles was added for a total of 261 potential miles in CD mode. A total of 734 miles were recorded for this vehicle; therefore, 35.5% of all miles driven by this vehicle were potentially in CD mode. This percent was multiplied by the MCBCL-provided annual mileage to identify annual miles in CD mode.

This is conservative because the replacement PHEV is likely more fuel-efficient than the monitored vehicle when powered by the ICE and additional miles may be available if recharging occurs.

## E.2 Monitored Vehicle Fuel Cost Reduction

Table E-2 identifies the calculated miles in CD mode for each of the MCIE fleet vehicles replaced. The fuel costs and GHG emissions avoided were all based on the miles driven in CD mode and the resulting savings in petroleum-based fuels.

Table E-2. Fuel savings for PEV replacement of monitored vehicles.

Log	Vehicle ID	Vehicle Class	Replacement PEV	Annual Miles	Gallons Fuel
				CD Mode	Saved
4	290597	Van - Cargo	VTRUX Van	607	43
37	291007	S/Refrig.	NA	0	0
35	294285	Sedan - Midsize	Leaf	3,795	146
48	294293	SUV	Soul	4,214	234
42	294315	Pickup	eNV200	3,208	229
54	294324	SUV	Outlander	4,025	155
53	300672	SP Bucket Truck	EDI	2,402	240
55	302039	Pickup	VTRUX PU	2,478	177
56	302040	Pickup	VTRUX PU	4,617	330
79	302334	Pickup	VTRUX PU	1,047	70
5	G10-3327L	Sedan - Midsize	Leaf	7,085	394

Log	Vehicle ID	Vehicle Class	Replacement PEV	Annual Miles CD Mode	Gallons Fuel Saved
41	G13-0325K	Sedan - Compact	Volt	753	24
39	G13-7974P	Sedan - Compact	Volt	3,256	105
7	G41-0379H	Minivan	Soul	5,614	432
40	G41-0391H	Pickup	VTRUX PU	2,664	266
8	G41-0754M	Minivan	Outlander	1,164	83
57	G41-0806P	Minivan	Outlander	4,884	349
58	G41-1689L	Pickup	VTRUX PU	3,458	144
59	G41-3297K	Pickup	eNV200	5,368	224
49	G41-3300K	Pickup	VTRUX PU	5,470	228
61	G41-3301K	Pickup	eNV200	7,306	304
9	G42-0644M	Van - Pass	eNV200	22,209	2,221
68	G42-0667P	Pickup	VTRUX PU	4,364	312
69	G42-0671P	Pickup	eNV200	7,678	548
10	G42-0911L	Pickup	eNV200	7,978	614
75	G42-0915M	Pickup	eNV200	7,072	372
50	G42-2985H	Pickup	VTRUX PU	7,947	467
13	G43-0310H	Van - Pass	VTRUX Van	3,043	277
71	G43-0323H	Van - Cargo	VTRUX Van	4,639	309
74	G43-0324H	Van - Cargo	eNV200	5,969	398
36	G43-1182M	Van - Cargo	eNV200	12,279	1,364
14	G43-4075P	Pickup	VTRUX PU	7,486	535
77	G61-0161H	Pickup	VTRUX PU	6,957	696
78	G61-0174H	SUV	Outlander	4,997	278
51	G61-0879P	SUV	Outlander	2,102	124
15	G61-1508D	SUV	Outlander	681	36
16	G61-1509D	SUV	Soul	3,292	173
82	G62-1583G	Pickup	VTRUX PU	5,219	307
46	G62-4085L	Pickup	VTRUX PU	6,098	554
98	G63-0163H	Pickup	eNV200	9,018	564
47	G63-2885L	Pickup	eNV200	4,112	316
52	G63-2888L	Pickup	Soul	4,480	345

As noted in Section 5, both the local cost of fuel and the national average were used for comparisons. North Carolina fuel costs are close to the national average, with gasoline and diesel slightly less but E85 slightly more. As noted in Section 5 Duke Energy Progress' electrical fuel costs are lower than the national average. Section 5 summarized these values.

Table E-3 shows the calculated fuel costs both for North Carolina and nationally for the gallons of petroleum-based fuel identified in Table E-2.

Table E-3. Monitored vehicle PEV replacement fuel savings (North Carolina and national factors).

Log	Vehicle ID	Local Fuel Cost	Local Elect. Fuel Cost	Local Annual Fuel Savings	Local Fuel Cost Reduction	National Fuel Cost	National Elect. Fuel Cost	National Annual Fuel Savings	National Fuel Cost Reduction
4	290597	\$115	\$16	\$99	86%	\$121	\$30	\$92	75%
37	291007	NA	NA	NA	NA	NA	NA	NA	NA
35	294285	\$387	\$63	\$323	84%	\$409	\$117	\$291	71%
48	294293	\$508	\$75	\$433	85%	\$499	\$139	\$359	72%
42	294315	\$647	\$71	\$575	89%	\$651	\$132	\$519	80%
54	294324	\$336	\$99	\$237	71%	\$330	\$183	\$147	45%
53	300672	\$678	\$120	\$558	82%	\$683	\$223	\$460	67%
55	302039	\$500	\$66	\$434	87%	\$503	\$121	\$382	76%

Log	Vehicle ID	Local Fuel Cost	Local Elect. Fuel Cost	Local Annual Fuel Savings	Local Fuel Cost Reduction	National Fuel Cost	National Elect. Fuel Cost	National Annual Fuel Savings	National Fuel Cost Reduction
56	302040	\$931	\$122	\$809	87%	\$938	\$226	\$711	76%
79	302334	\$152	\$28	\$124	82%	\$149	\$51	\$97	65%
5	G10-3327L	\$854	\$118	\$736	86%	\$838	\$219	\$619	74%
41	G13-0325K	\$64	\$15	\$50	77%	\$68	\$27	\$41	60%
39	G13-7974P	\$228	\$63	\$164	72%	\$224	\$118	\$106	47%
7	G41-0379H	\$937	\$100	\$837	89%	\$920	\$185	\$734	80%
40	G41-0391H	\$578	\$70	\$508	88%	\$567	\$131	\$437	77%
8	G41-0754M	\$180	\$29	\$152	84%	\$177	\$53	\$124	70%
57	G41-0806P	\$757	\$120	\$637	84%	\$743	\$222	\$521	70%
58	G41-1689L	\$382	\$91	\$290	76%	\$404	\$170	\$234	58%
59	G41-3297K	\$593	\$120	\$473	80%	\$626	\$222	\$405	65%
49	G41-3300K	\$604	\$145	\$459	76%	\$638	\$268	\$370	58%
61	G41-3301K	\$807	\$163	\$644	80%	\$853	\$302	\$551	65%
9	G42-0644M	\$4,819	\$494	\$4,325	90%	\$4,731	\$917	\$3,814	81%
68	G42-0667P	\$676	\$115	\$561	83%	\$664	\$214	\$450	68%
69	G42-0671P	\$1,190	\$171	\$1,019	86%	\$1,168	\$317	\$851	73%
10	G42-0911L	\$1,332	\$178	\$1,154	87%	\$1,307	\$329	\$978	75%
75	G42-0915M	\$808	\$157	\$650	81%	\$793	\$292	\$501	63%
50	G42-2985H	\$1,239	\$210	\$1,029	83%	\$1,309	\$390	\$920	70%
13	G43-0310H	\$600	\$80	\$520	87%	\$589	\$149	\$440	75%
71	G43-0323H	\$819	\$123	\$697	85%	\$866	\$227	\$639	74%
74	G43-0324H	\$1,055	\$133	\$922	87%	\$1,115	\$246	\$868	78%
36	G43-1182M	\$2,961	\$273	\$2,687	91%	\$2,906	\$507	\$2,399	83%
14	G43-4075P	\$1,160	\$198	\$962	83%	\$1,139	\$367	\$772	68%
77	G61-0161H	\$1,510	\$184	\$1,326	88%	\$1,482	\$341	\$1,141	77%
78	G61-0174H	\$736	\$122	\$613	83%	\$778	\$227	\$551	71%
51	G61-0879P	\$268	\$51	\$217	81%	\$263	\$95	\$168	64%
15	G61-1508D	\$95	\$17	\$78	82%	\$100	\$31	\$70	69%
16	G61-1509D	\$459	\$59	\$401	87%	\$485	\$109	\$377	78%
82	G62-1583G	\$814	\$138	\$676	83%	\$860	\$256	\$604	70%
46	G62-4085L	\$1,203	\$161	\$1,042	87%	\$1,181	\$299	\$882	75%
98	G63-0163H	\$1,494	\$201	\$1,293	87%	\$1,579	\$372	\$1,206	76%
47	G63-2885L	\$686	\$92	\$595	87%	\$674	\$170	\$504	75%
52	G63-2888L	\$748	\$80	\$668	89%	\$734	\$148	\$586	80%

An example calculation for Logger 40 follows: The MCBCL reported annual miles for this vehicle is 7,507 miles. The suggested replacement PEV is a PHEV. As noted above, 35.5% of all miles driven by this vehicle were potentially in CD mode; therefore, annual miles in CD mode is 2,664 miles. This vehicle uses E85 and EPA fuel economy for this vehicle is 10 MPG, resulting in 266 gallons of E85 being unused. North Carolina cost for E85 is \$2.17/gallon for an annual cost of \$578. The replacement PEV requires 475 Wh/mile; therefore, 1,265 kWh are required for recharging the battery. Local power cost is \$0.05566/kWh, resulting in annual electric cost of \$70. The savings are \$508 for an 88% reduction in fuel cost.

### E.3 Monitored Vehicle Greenhouse Gas Emissions Reduction

Tables E-4 and E-5 identify the reduction in GHG projected when replacing the current vehicles with PEVs. The calculated miles in CD mode shown in Table E-2 are also used in the calculation of GHG reduction. As noted in Section 5, emissions from burning petroleum-based fuel is known and emissions from use of electricity is dependent on the power generation mix that is used to recharge the PEV battery. As before, both the local power production emission figures and the national average are used for comparisons.

Emissions from Duke Energy Progress generation are lower than the national average. In addition, electrical emissions are significantly lower than gasoline emissions.

Table E-4. GHG emissions reduction for replacement of monitored vehicles (Jacksonville, North Carolina area figures).

Log	Vehicle ID	Vehicle Class	Annual GHG Emissions ICE lb-CO <sub>2</sub> e	Annual PEV GHG Local lb-CO <sub>2</sub> e	Annual GHG Local Savings lb-CO <sub>2</sub> e	Annual Local GHG Reduction %
4	290597	Van - Cargo	850	327	523	62%
37	291007	SP/Refrig.	NA	NA	NA	NA
35	294285	Sedan - Midsize	2,861	1,291	1,570	55%
48	294293	SUV	3,205	1,529	1,676	52%
42	294315	Pickup	5,156	1,455	3,701	72%
54	294324	SUV	2,893	2,009	885	31%
53	300672	SP/Bucket Truck	5,406	2,451	2,955	55%
55	302039	Pickup	3,982	1,335	2,647	66%
56	302040	Pickup	7,420	2,487	4,933	66%
79	302334	Pickup	967	564	403	42%
5	G10-3327L	Sedan - Midsize	5,389	2,410	2,978	55%
41	G13-0325K	Sedan - Compact	476	299	177	37%
39	G13-7974P	Sedan - Compact	1,909	1,292	617	32%
7	G41-0379H	Minivan	5,904	2,037	3,866	65%
40	G41-0391H	Pickup	3,642	1,435	2,206	61%
8	G41-0754M	Minivan	1,137	581	556	49%
57	G41-0806P	Minivan	4,673	2,437	2,236	48%
58	G41-1689L	Pickup	2,821	1,863	958	34%
59	G41-3297K	Pickup	4,379	2,435	1,944	44%
49	G41-3300K	Pickup	4,462	2,946	1,515	34%
61	G41-3301K	Pickup	5,960	3,314	2,646	44%
9	G42-0644M	Van - Pass	30,357	10,074	20,283	67%
68	G42-0667P	Pickup	4,252	2,351	1,902	45%
69	G42-0671P	Pickup	7,482	3,483	3,999	53%
10	G42-0911L	Pickup	8,390	3,619	4,771	57%
75	G42-0915M	Pickup	6,907	3,208	3,699	54%
50	G42-2985H	Pickup	9,163	4,281	4,882	53%
13	G43-0310H	Van - Pass	3,784	1,639	2,145	57%
71	G43-0323H	Van - Cargo	6,054	2,499	3,555	59%
74	G43-0324H	Van - Cargo	7,790	2,708	5,083	65%
36	G43-1182M	Van - Cargo	18,652	5,570	13,082	70%
14	G43-4075P	Pickup	7,294	4,032	3,262	45%
77	G61-0161H	Pickup	9,510	3,748	5,762	61%
78	G61-0174H	SUV	5,442	2,493	2,949	54%
51	G61-0879P	SUV	1,738	1,049	689	40%
15	G61-1508D	SUV	703	340	363	52%
16	G61-1509D	SUV	3,397	1,195	2,202	65%
82	G62-1583G	Pickup	6,018	2,811	3,206	53%
46	G62-4085L	Pickup	7,582	3,284	4,297	57%
98	G63-0163H	Pickup	11,034	4,091	6,944	63%
47	G63-2885L	Pickup	4,324	1,865	2,459	57%
52	G63-2888L	Pickup	4,711	1,626	3,085	65%

Table E-5. GHG emissions reduction for replacement of monitored vehicles (national figures).

Log	Vehicle ID	Vehicle Class	Annual GHG Emissions ICE lb-CO <sub>2</sub> e	Annual PEV GHG National lb-CO <sub>2</sub> e	Annual GHG Savings lb-CO <sub>2</sub> e	Annual National GHG Reduction %
4	290597	Van - Cargo	850	441	409	48%
37	291007	SP/Refrig.	—	—	—	—

Log	Vehicle ID	Vehicle Class	Annual GHG Emissions ICE lb-CO <sub>2</sub> e	Annual PEV GHG National lb-CO <sub>2</sub> e	Annual GHG Savings lb-CO <sub>2</sub> e	Annual National GHG Reduction %
35	294285	Sedan - Midsize	2,861	1,742	1,119	39%
48	294293	SUV	3,205	2,063	1,142	36%
42	294315	Pickup	5,156	1,963	3,192	62%
54	294324	SUV	2,893	2,710	183	6%
53	300672	SP/Bucket Truck	5,406	3,307	2,099	39%
55	302039	Pickup	3,982	1,801	2,181	55%
56	302040	Pickup	7,420	3,355	4,065	55%
79	302334	Pickup	967	761	206	21%
5	G10-3327L	Sedan - Midsize	5,389	3,252	2,137	40%
41	G13-0325K	Sedan - Compact	476	403	73	15%
39	G13-7974P	Sedan - Compact	1,909	1,744	166	9%
7	G41-0379H	Minivan	5,904	2,749	3,155	53%
40	G41-0391H	Pickup	3,642	1,936	1,705	47%
8	G41-0754M	Minivan	1,137	784	353	31%
57	G41-0806P	Minivan	4,673	3,288	1,385	30%
58	G41-1689L	Pickup	2,821	2,513	308	11%
59	G41-3297K	Pickup	4,379	3,285	1,094	25%
49	G41-3300K	Pickup	4,462	3,975	487	11%
61	G41-3301K	Pickup	5,960	4,471	1,488	25%
9	G42-0644M	Van - Pass	30,357	13,592	16,765	55%
68	G42-0667P	Pickup	4,252	3,172	1,081	25%
69	G42-0671P	Pickup	7,482	4,699	2,783	37%
10	G42-0911L	Pickup	8,390	4,883	3,507	42%
75	G42-0915M	Pickup	6,907	4,328	2,579	37%
50	G42-2985H	Pickup	9,163	5,775	3,387	37%
13	G43-0310H	Van - Pass	3,784	2,212	1,572	42%
71	G43-0323H	Van - Cargo	6,054	3,371	2,683	44%
74	G43-0324H	Van - Cargo	7,790	3,653	4,137	53%
36	G43-1182M	Van - Cargo	18,652	7,515	11,137	60%
14	G43-4075P	Pickup	7,294	5,440	1,854	25%
77	G61-0161H	Pickup	9,510	5,056	4,454	47%
78	G61-0174H	SUV	5,442	3,364	2,078	38%
51	G61-0879P	SUV	1,738	1,415	323	19%
15	G61-1508D	SUV	703	459	244	35%
16	G61-1509D	SUV	3,397	1,612	1,785	53%
82	G62-1583G	Pickup	6,018	3,793	2,225	37%
46	G62-4085L	Pickup	7,582	4,431	3,150	42%
98	G63-0163H	Pickup	11,034	5,519	5,515	50%
47	G63-2885L	Pickup	4,324	2,517	1,808	42%
52	G63-2888L	Pickup	4,711	2,193	2,518	53%

An example calculation for Logger 40 follows: as shown above, annual miles in CD mode are 2,664 miles and 266 gallons of E85 are unused. EPA reports this vehicle's emissions at 620 gm-CO<sub>2</sub>e/mile; therefore, after converting grams to pounds, the annual emissions for the monitored vehicle are 3,642 lb-CO<sub>2</sub>e. Local power produces 1.134 lb-CO<sub>2</sub>e/kWh. As above, 1,265 kWh are required for recharging the battery, resulting in 1,435 lb-CO<sub>2</sub>e. The savings are 2,206 lb-CO<sub>2</sub>e for a 61% reduction in GHG emissions.

## E.4 Marine Corps Installations East Group Full Fleet Evaluation

Table 13 in Section 4.2 identifies 535 vehicles in the MCIE fleet. Retaining most of the heavy-duty specialty vehicles, Intertek suggests that a fleet of 53 specialty vehicles, 275 BEVs, and 207 PHEVs would meet vehicle travel requirements.

Using averages for these vehicles, potential replacements offer fuel cost reductions and GHG emissions reductions shown in Tables E-6 and E-7 (summarized in Section 5).

Table E-6. MCIE group's full fleet PEV replacement reductions (Jacksonville, North Carolina area figures).

Annual Miles CD Mode	Annual Fuel Cost	Annual Elect Fuel Cost	Annual Fuel Savings	Annual Fuel Savings %	Annual GHG Emissions ICE lb-CO <sub>2</sub> e	Annual PEV GHG Local lb-CO <sub>2</sub> e	Annual GHG Savings lb-CO <sub>2</sub> e	Annual GHG Reduction %
3,004,441	\$509,619	\$67,239	\$442,380	87%	3,445,465	1,369,916	2,075,550	60%

Table E-7. MCIE group's full fleet PEV replacement reductions (national figures).

Annual Miles CD Mode	Annual Fuel Cost	Annual Elect Fuel Cost	Annual Fuel Savings	Annual Fuel Savings %	Annual GHG Emissions ICE lb-CO <sub>2</sub> e	Annual PEV GHG Local lb-CO <sub>2</sub> e	Annual GHG Savings lb-CO <sub>2</sub> e	Annual GHG Reduction %
3,004,441	\$511,282	\$124,670	\$386,612	76%	3,445,465	1,848,299	1,618,365	47%

## E.5 Marine Corps Installations East Group Summary

Tables E-8 and E-9 provide the average values for all monitored vehicles belonging to the MCIE group.

Table E-8. MCIE group's monitored vehicles average fuel savings values (North Carolina figures).

Annual Miles CD Mode	Gallons Fuel Saved	Annual Fuel Cost	Annual Elect Fuel Cost	Annual Fuel Savings	Annual Fuel Reduction %
5,147	366	\$831	\$117	\$714	86%

Table E-9. MCIE group's monitored vehicles average GHG savings values (North Carolina figures).

Annual Miles CD Mode	Gallons Fuel Saved	Annual GHG Emissions ICE lb-CO <sub>2</sub> e	Annual PEV GHG Local lb-CO <sub>2</sub> e	Annual GHG Savings Lb-CO <sub>2</sub> e	Annual GHG Reduction %
5,147	366	5,807	2,450	3,356	58%

Tables E-8 and E-9 show that there is a significant opportunity for savings, not only in fuel costs, but also in GHG emissions with the deployment of PEVs in this fleet.