2018

SEMCOG 2017
Commercial Vehicle Survey

FINAL REPORT

PREPARED BY ETC INSTITUTE AND CAMBRIDGE SYSTEMATICS

Contents

List of Tables

List of Figures

Executive Summary

Commercial vehicle travel plays a significant role in model development and freight planning for the southeast Michigan region. The region is the long-standing center of the North American automobile manufacturing industry, which relies on just-in-time delivery coordination between manufacturing plants. The region is also host to two of the largest North American commercial border crossings. Understanding the trip making characteristics of these vehicles and the establishments that use them is critical to properly planning and engineering for their needs. Commercial vehicle surveys help fill that critical need in the data toolbox for transportation planning. Focusing on the movement of commercial vehicles rather than passengers, these surveys typically capture arrival and departure times, cargo details (load as well as type), trip purpose, and the standard origin and destination information. The data collected during this project will help SEMCOG and its partners to better understand commercial vehicle operators' travel decision-making processes, and improve the region's ability to model commercial vehicle travel patterns which will improve the region's ability to prioritize infrastructure and operational investments to enhance the overall quality of life in the region.

Beginning in the spring of 2017 and continuing into the spring of 2018 ETC Institute worked with the Southeast Michigan Council of Governments (SEMCOG) and Cambridge Systematics (CS) to conduct a commercial vehicle survey in the seven-county region which includes Livingston, Macomb, Monroe, Oakland, St. Clair, Washtenaw, Wayne (City of Detroit), and Wayne (outside Detroit) counties.

ETC Institute worked extensively with SEMCOG and CS to appropriately design and administer the commercial vehicle survey. Based on regional planning and modeling needs, three types of surveys were designed:

- **Establishment Survey**: The establishment survey was used to better understand the number of and type of commercial vehicles that are operated by establishments in the SEMCOG region. The results of the establishment survey were used to more precisely estimate the number of commercial vehicles in the region that have commercial vehicles based on their size, location, and type. This survey was also used to recruit organizations to participate in the 24-Hour Travel Diary.
- **24-Hour Travel Diary and Trip Information Sheet**: This survey was administered to a subset of the establishments that participated in the Establishment Survey. The 24-Hour Travel Diary was used to gather information about the origins and destinations of the trips that were completed by a vehicle during a 24-hour period, the purpose of these trips, and the types of freight that were moved if applicable. The Trip Information Sheet was used to gather more specific information about the vehicles that participated in the survey (make, model, fuel type, year, etc.).
- **Passive GPS Survey**: The Passive GPS Survey was administered to a subset of the vehicles that participated in the 24-Hour Travel Diary. Since drivers do not always report all trips on the Travel Diary, the Passive GPS survey was used to estimate the under-reporting of trips to ensure that expanded survey database more accurately reflects the actual travel patterns in the region. This was done by comparing the number of trips gathered by the GPS device to the number of trips reported by the survey respondent.

ETC Institute also worked closely with SEMCOG and CS to develop the sampling plan for the survey (which is explained in more detail in section 3). The sampling plan was developed around the following types of goals.

- **Goals by Geography and Vehicle Class.** The geographic goals included targets for each of the eight county groups [Livingston, Macomb, Monroe, Oakland, St. Clair, Washtenaw, Wayne (City of Detroit), and Wayne (outside Detroit)] in the SEMCOG modeling area.
- **Goals by Vehicle Class.** Goals by vehicle class were allocated to one of the following groups: single unit vehicles, tractor-trailer combinations (sometimes abbreviated as "combination" to save space in tables), and light-duty vehicles.
- **Goals by Industry Type and Size**. Goals for industry type were established using the NAICS codes for each establishment. Establishments were grouped into the following **seven** industry categories:
    - Agricultural, Mining, Construction
    - Manufacturing
    - Wholesale
    - Retail
    - Transportation
    - Services
    - Education and Government

Once the survey instruments and sampling plan were completed, ETC Institute conducted a pilot test (consisting of 50 establishments, 12 of which provided at least one usable vehicle travel diary; 30 total usable travel diaries, 10 of which also had usable GPS data) to ensure the survey would run smoothly once the full administration began. After the pilot test was completed and all data gathered during it were analyzed, ETC Institute recommended a few minor changes to the design of the survey to enhance the administration of the survey.

Upon completion of the main survey, the data were gathered and expanded by the ETC Institute Team and the findings were presented to SEMCOG. Various key findings and characteristics of the dataset are further explained in section 7 of this report, including:

- The SEMCOG survey is suitable for the commercial vehicle/truck components of trip-based or tour-based travel demand models.
- The trip rates and average trip lengths that can be derived are consistent with nationally observed values and will support the development of trip-based models.
- The stops per tour that can be derived are consistent with nationally observed values and the attributes surveyed are those that are will support several types of tour submodels.

Data Collected

Some highlights of the collected data are:

- 2,848 establishments participated in the establishment survey (or 1.2% of the 229,666 unique establishments in the seven county region based on data provided by the Michigan Department of Transportation from the Business-Facts® Data Extract provided under the terms of a licensing agreement with Nielsen Services in January 2017).

  - The percentage of establishments in each county that participated in the survey ranged from a low of 1.0% in Wayne County – Inside Detroit to a high of 1.6% in both St. Clair and Livingston counties.
  - The percentage of all respondents to the establishment survey was highest in Oakland County (31.8%), Wayne County – Outside of Detroit (19.2%), Macomb County (16.6%) and Wayne County – Inside Detroit (11.5%).

- The goal and actual number of completed surveys by type of survey are listed below.
  - Establishment Survey (see Appendix D for the survey Instrument)
    - Goal - 2,000
    - Actual number of completed surveys: 2,848
  - 24-Hour Travel Diary Survey (see Appendices E & F for the survey Instruments)
    - Goal - 1,500
    - Number of vehicles that participated: 1,959
    - Number for which useable trip Information for a 24-hour period was collected (some vehicles did provide trip information because they did not travel): 1,769
  - GPS Survey Goal:
    - Goal - 500
    - Actual Number of Completed Surveys: 500

- A total of 10,456 stops (origins and destinations) were collected for the 1,769 vehicles that completed the 24-hour travel diary.

1. Purpose and Objectives

The purpose of this project was to gather updated travel behavior data from commercial vehicle operators in the SEMCOG region. This data will allow for effective planning and engineering of a system that provides for the efficient movement of commercial vehicles and freight, which is an important federal, state, and local goal. This is especially true for a region such as the one served by SEMCOG due to its importance as an international gateway, a major port on the Great Lakes, a hub for the automotive industry, and a major urban center. Central to developing policies that improve the efficiency and effectiveness of commercial vehicles in any given region is the development of a commercial vehicle model that replicates local behavior accurately. This model must not only have a detailed understanding of local movements, but also represent movements into, out of, and through the region that impact travel patterns. Also, the model must be predictive in nature, so the agency may test different policy scenarios to forecast likely commercial vehicle movements.

There are several data elements needed for the development of such a model, including but not limited to:

- Information about regional activity centers that are a driver for commercial vehicle activity. This includes industrial locations, retail centers, as well as special generators such as ports.
- Data pertaining to cross-regional trade that influences freight travel and movement of large trucks.
- Data pertaining to truck movements in serving employment and consumption centers which can be obtained through a combination of sources such as anonymized GPS data as well as establishment surveys, truck diaries and origin-destination surveys.

The data collected during this project will help SEMCOG and its partners better understand commercial vehicle operators' travel decision-making processes. This data will improve the region's ability to model commercial vehicle travel patterns which will improve the region's ability to prioritize infrastructure and operational investments to enhance the overall quality of life in the region.

Prior to the start of this project, SEMCOG and the Project Team assembled data from several sources to prepare for the project. These sources included:

- GPS (origin/destination) data for a large sample of truck that was obtained by SEMCOG from a commercial vendor (Streetlight).
- Employment information from by the U.S. Census and commercial sources.
- Freight activity data through commodity flow databases.
- Establishment data from a database of all establishments in the seven county region provided by MDOT and supplemental information purchased from InfoGroup to augment the data provided by MDOT.

In addition to the data listed above, an establishment survey was conducted as the first phase of this commercial vehicle survey. The establishment survey collected data about the total trips at each location, the number of employees, the types of trips arriving and departing the location, and types of facilities where trips began and ended.

1.1 Survey Organization and Project Management

1.1.1 Internal Communication

Open and frequent communication between SEMCOG and the Project Team was essential to the success of the project and helped to reduce confusion and duplication of efforts.

1.1.2 Project Team Meetings

The Project Team met as needed throughout the project to discuss the project status and upcoming events. Each Project Team member was responsible for disseminating information during the meeting to others in their respective organizations. During the project, ETC Institute, CS, and SEMCOG conducted frequent progress meetings via conference calls. These meetings were to discuss key project activities and key tasks to ensure the project was progressing as desired within budget and on schedule. Identified issues were addressed quickly and efficiently.

1.1.3 Reports

ETC Institute submitted monthly status reports during the development of the survey materials and sampling plan. The monthly status reports were meant to document the following:

- Work done during the month
- Work planned for the upcoming month
- Problems/issues that needed to be addressed

These reports were submitted as an e-mail by ETC Institute's project manager to SEMCOG's project manager. Once the administration of the survey began, ETC Institute submitted a weekly report that included the following:

- Goal for completed surveys
- The number of establishments/vehicles recruited
- The number of useable surveys completed

1.1.4 Stakeholder Involvement

SEMCOG coordinated and involved other agencies as needed and/or to direct the ETC Institute Team to contact certain stakeholders as needed.

1.1.5 Document Retention

The ETC Institute project manager initiated a filing system to identify, collect, maintain, and safe-keep official active project files. The project manager was also responsible for identifying documents needed to be retained for the duration of the project and those documents requiring long-term storage.

1.1.6 Key Personnel

The key members of the team and their role in the project are listed below:

- **Chris Tatham (ETC)**: Project Manager
- **Arum Kuppam (CS):** Assistant Project Manager
- **Dan Beagan and Cemal Ayvalik (CS):** Model Integration
- **Andrew Kolcz (ETC)**: GIS Manager and Information Management Systems Officer
- **Nick Jones (ETC)**: Senior Data Manager
- **Mike Rich (ETC)**: Supervisor for Interviewing and Data Entry Operations
- **Christian Rodriguez and Brad Carlson (ETC)**: Field Supervisors

The following sections further detail planning and implementation of the data collection process, from how the sampling plan was designed from the overarching goals of this project, testing and revision of the survey design to arrive at the final administrative plan and process including the data quality control process, to summarization of the collected data in the data set characteristics section at the end.

2. Survey Design

To appropriately design the survey pieces for this project, the first objective was to review current commercial vehicle survey practices in large metropolitan areas alongside SEMCOG's commercial vehicle model (CVM) needs in order to recommend a final survey design for the commercial vehicle survey (CVS). This process included reviewing the Denver Regional Council of Governments (DRCOG) CVS survey, Maricopa Association of Governments (MAG) establishment survey, Southern California Association of Governments (SCAG) heavy-duty truck survey, North Central Texas Council of Governments (NCTCOG) CVS survey, as well as other additional sources. This review was meant to result in a data collection effort plan that would reflect both best practices and lessons learned in recent efforts.

The project commenced with a kick-off meeting/workshop with the project advisory group consisting of SEMCOG staff and other stakeholders.

As part of this task, the ETC Institute Team developed a survey plan. The survey plan, in part, was meant to address the following questions:

1. What is the most appropriate data collection framework?:
    - Who will be surveyed?
    - What information will be obtained from the data collection effort?
    - How will that information be utilized within a trip-based model context?
    - How will that information be utilized within a tour-based model context?

2. What are the best data collection methodologies and technologies to fulfill that framework?
    - How will the establishments and vehicles be surveyed?
    - What are the best methods to ensure strong participation rates?
    - What are the most appropriate technologies to deploy in the data collection effort?

For the survey to appeal to decision-makers, the survey plan considered survey methods and technologies that have a low respondent burden and minimal interference with business operations. The team employed a Computer Aided Telephone Interview (CATI) based recruitment method for the recruitment and collection of workplace data. This was followed by an on-site collection of the travel-related data.

Following a review of the data requirements for this study, it was accepted that the administration of the data collection effort would focus on the following:

Establishment Survey. A telephone-based survey that collects basic establishment information, fleet inventory characteristics, and details regarding inbound and outbound trucks by type and commodity information. At the end of this survey, establishments were asked to participate in the vehicle information survey and travel behavior portion of the study. It was determined that there would be a goal of 2,000 establishment surveys to be conducted by phone. In addition, field staff were equipped with the same survey software on tablet PCs (connected to a centralized database) to conduct in-person interviews with firms that proved difficult to reach by phone.

Vehicle Survey. A telephone-based survey that collects detailed information regarding vehicle characteristics for each establishment that participated. It was determined that characteristic information needed to be collected for at least 1,500 vehicles.

Travel Diary Survey. A detailed vehicle travel diary was used to capture information about truck movements for a designated 24-hour period. It was determined that of the minimum 1,500 vehicles providing characteristic data each required travel diary information.

Vehicle Probe Data (GPS Data). Devices were used to passively record travel data from a subset of trucks whose drivers were completing the vehicle travel diaries. It was determined of the 1,500 vehicle travel diary participants, 500 were required to provide vehicle probe data. Probe data was collected for a 24-hour period to match the data collected on the travel diary.

It was anticipated that establishments would be less willing to participate in the various components of the survey as the level of effort on their part increased, meaning that more establishments would be willing to participate in the establishment portion of the survey which came first than would be willing to participate in the vehicle information survey, and even fewer establishments would be willing to participate in the travel diary portion of the survey.

The next activity of the survey design was to translate the previous findings and recommendations into survey instruments with the appropriate data elements and a sampling plan (which is discussed in the next section).

2.1 Data Variables by Survey Type

The stratified sampling goals (discussed in greater detail in section 3.1.1) were programmed into the CATI system and the establishments were scheduled for a travel period for their drivers to participate in the vehicle travel diary and vehicle probe collection efforts. It was important that the vehicle travel diaries be simple, easy to complete, and printed on durable paper. Tables 1-4 represent the data variables collected by survey type: Establishment, Vehicle, Trip/Tour Diary and GPS/Trip Vehicle Probe. The tables show the type of survey, variables associated with each survey type, as well as a brief description of each variable. The quality assurance and quality control (QA/QC) associated with many of the variables in the following tables can be found in section 5 of this report.

Table 1. Establishment Survey Variables

FIELD NAME	DESCRIPTION
SOURCE	Month and year in which record was originally delivered
SITEID	Unique ID of the Establishment site
REGION	Geographic region/part of the study area
SIZE	Company size category based on the number of employees
INDUSTRY	Type of establishment based on the NAICS codes groups for the sampling plan
COMPANY_NAME	Name of the company
ADDRESS	Street address of the company
CITY	City where the company is located
STATE	State where the company is located
ZIP	Zip where the company is located
LAT	Latitude coordinates for the company's location
LON	Longitude coordinates for the company's location
TOTAL_EMPLOYEES	Number of full and part time employees employed at this location
FULL_TIME_EMPLOYEES	Number of full time employees employed at this location
PART_TIME_EMPLOYEES	Number of part time employees employed at this location
AVG_EMPLOYEES_ON_WEEKDAY	Average number of employees on site during a typical weekday
EMPLOYEES_WORK_HOME_ONCE_PER_WEEK	Number of employees who work at home at least once a week
OWN_LEASE_BUS_VEH	Does your company own or lease any vehicles (cars, vans, trucks, or large vehicles) as part of the business
USE_PERSNL_VEH	Does anyone in your company use personal vehicles for company business
TOTAL_VEH_OWNED_OR_LEASED	Total number of vehicles owned or leased by the company at this location
OWNED_SINGLE_UNIT	Number of Cargo transport vehicles (single unit) owned/leased

Table 1 (continued)

FIELD NAME	DESCRIPTION
OWNED_COMBO_TRACTOR_TRAILER	Number of Cargo transport vehicles (combo unit/tractor-trailers) owned/leased
OWND_PASSENGER_CAR_OR_SUV	Number of Passenger car or sport utility vehicle owned/leased
OWNED_PICKUP_TRUCK	Number of Pickup trucks owned/leased
OWNED_VAN	Number of Vans owned/leased
OWNED_OTHER_VEH	Number of Other vehicles used for cargo delivery or pickup owned/leased
TOTAL_VEH_NOT_OWNED	Total number of vehicles other vehicles NOT owned/leased by the company that are regularly used for commercial purposes
VEH_NOT_OWNED_SU	Number of Cargo transport vehicles (single unit) NOT owned/leased
VEH_NOT_OWNED_CU	Number of Cargo transport vehicles (combo unit/tractor-trailers) NOT owned/leased
VEH_NOT_OWNED_PCSUV	Number of Passenger car or sport utility vehicle NOT owned/leased
VEH_NOT_OWNED_PICKUP	Number of Pickup trucks NOT owned/leased
VEH_NOT_OWNED_VAN	Number of Vans NOT owned/leased
VEH_NOT_OWNED_OTHER	Number of Other vehicles used for cargo delivery or pickup NOT owned/leased
PARTICIPATED_IN_TRAVEL_DIARY	Did the establishment participate in the travel diary survey
NAICS2	2 digit NAICS code
NAICS3	3 digit NAICS code
NUM_VEH_DLVR_CARGO_OR_SVCS_HERE_AVG_WKDY	Total number of vehicles that deliver cargo or services TO THIS LOCATION on an average weekday
NUM_PC_SUV_PU_DLVR_CARGO_OR_SVCS_HERE_AVG_WKDY	Of these, how many are passenger cars, sport utility vehicles or pickup trucks
NUM_SU_DLVR_CARGO_OR_SVCS_HERE_AVG_WKDY	Of these, how many are single unit vehicles
NUM_CU_DLVR_CARGO_OR_SVCS_HERE_AVG_WKDY	Of these, how many are combo units (tractor/trailers)
PRCNT_DLVR_2HERE_FROM_WRHS	Approximate PERCENTAGE of these vehicles that COME FROM a Warehouse
PRCNT_DLVR_2HERE_FROM_PORT	Approximate PERCENTAGE of these vehicles that COME FROM a Port/Airport/Terminal (intermodal, truck)
PRCNT_DLVR_2HERE_FROM_MANUF	Approximate PERCENTAGE of these vehicles that COME FROM a Manufacturing Facility
PRCNT_DLVR_2HERE_FROM_RETAIL	Approximate PERCENTAGE of these vehicles that COME FROM a Retail Outlet
PRCNT_DLVR_2HERE_FROM_SRVCBUSIN	Approximate PERCENTAGE of these vehicles that COME FROM a Service Business
PRCNT_DLVR_2HERE_FROM_OTHER	Approximate PERCENTAGE of these vehicles that COME FROM other places
PRCNT_DLVR_2HERE_FROM_UNKNWN	Approximate PERCENTAGE of these vehicles that COME FROM unknown places
NUM_VEH_DLVR_CARGO_OR_SVCS_AWAY_AVG_WKDY	Total number of vehicles that deliver cargo or services FROM THIS LOCATION on an average weekday
NUM_PC_SUV_PU_DLVR_CARGO_OR_SVCS_AWAY_AVG_WKDY	Of these, how many are passenger cars, sport utility vehicles, or pickup trucks
NUM_SU_DLVR_CARGO_OR_SVCS_AWAY_AVG_WKDY	Of these, how many are single unit vehicles
NUM_CU_DLVR_CARGO_OR_SVCS_AWAY_AVG_WKDY	Of these, how many are combo units (tractor/trailers)
PRCNT_DLVR_AWAY_2WRHS	Approximate PERCENTAGE of these vehicles that GO TO a warehouse
PRCNT_DLVR_AWAY_2PORT	Approximate PERCENTAGE of these vehicles that GO TO a Port/Airport/Terminal (intermodal, truck)
PRCNT_DLVR_AWAY_2MANUF	Approximate PERCENTAGE of these vehicles that GO TO a Manufacturing Facility
PRCNT_DLVR_AWAY_2RETAIL	Approximate PERCENTAGE of these vehicles that GO TO a Retail Outlet
PRCNT_DLVR_AWAY_2SRVCBUSIN	Approximate PERCENTAGE of these vehicles that GO TO a Service Business
PRCNT_DLVR_AWAY_2OTHER	Approximate PERCENTAGE of these vehicles that GO TO other places
PRCNT_DLVR_AWAY_2UNKNWN	Approximate PERCENTAGE of these vehicles that GO TO unknown places
NOTES	Explanatory note(s) as needed
INDUSTRY_TYPE_EXPANSION	Type of establishment based on the NAICS codes groups for the sampling plan used for expansion
ESTABLISHMENT_WGHT_FCTR_NAME	The establishment weight factor name is created by concatenating the "INDUSTRY_TYPE_EXPANSION" column with the "SIZE" column in the establishment file to create a name that represents both the industry type of each establishment as well as the number of employees each establishment has.
ESTABLISHMENT_WGHT_FCTR	The establishment weight factor represents the number of establishments in the study area with corresponding establishment weight factor name attributes

Table 2. Vehicle Survey Variables

FIELD NAME	DESCRIPTION
SOURCE	Month and year in which record was originally delivered
VEHNUM	Unique vehicle number
SITEID	Unique ID of the Establishment site
COMPANY_NAME	Name of the company
VEH_BASE_ADDRESS	Address of the place (base) where the vehicle was parked just before it started the travel day
VEH_BASE_CITY	Base city
VEH_BASE_STATE	Base state
VEH_BASE_ZIP	Base zip
VEH_BASE_LAT	Base latitude
VEH_BASE_LON	Base longitude
BASE_TYPE_OF_PLACE	Base place type
BASE_TYPE_OF_PLACE_OTHER	Type of place of the vehicle owner's company (OTHER)
TTL_DIARY_STOPS	Number of reported stops on travel day from diary
TTL_GPS_STOPS	Number of reported stops on travel day from GPS device
VEHICLE_TRAVELED_ON_TRAVEL_DATE	Did vehicle physically move on the originally assigned travel day?
WAS_A_TRAVEL_DIARY_COMPLETED	Was a travel diary at some point collected for this vehicle?
VEHICLE_REGISTERED_MICHIGAN	Is this vehicle registered as a commercial vehicle in the state of Michigan?
BUSINESS_USE_ON_TRAVEL_DAY	Was the vehicle used for business on travel date?
VEH_PRIMARY_USE	If vehicle was used for business, what was its primary use
VEH_FUEL_TYPE	Vehicle fuel type
VEH_FUEL_TYPE_other	Vehicle fuel type (OTHER)
MPG	Estimated MPG of the vehicle
VEH_CLASS	Vehicle Classification
VEH_CLASS_other	Vehicle Classification (OTHER)
GROSS_VEHICLE_WEIGHT_IN_LBS	Gross Vehicle Weight (including trailer) in pounds
NOTES	Explanatory note(s) as needed
VEHICLE_TYPE_EXPANSION	Vehicle Classification used for Expansion
INDUSTRY_TYPE_EXPANSION	Type of establishment based on the NAICS codes groups for the sampling plan used for expansion
SIZE_EXPANSION	Company size category based on the number of employees used for vehicle type expansion
WGHT_FCTR_NAME	Concatenate of "VEHICLE_TYPE_EXPANSION", "INDUSTRY_TYPE_EXPANSION", and "SIZE_EXPANSION" used during Expansion.
WGHT_FCTOR	Weight factor that is created by dividing sampling plan figures by number of surveys collected in the corresponding cells.
GPS_UNDER_REPORTING_FACTOR	Multiplier that accounts for the difference between trips recorded via gps and reported trips in diaries
FINAL_FACTOR	WGHT_FCTOR multiplied by GPS_UNDER_REPORTING_FACTOR

Table 3. Trip/Tour Diary Variables

FIELD NAME	DESCRIPTION
SOURCE	Month and year in which record was originally delivered
SORT	An auxiliary column to preserve the sort order
SITEID	Unique ID of the Establishment site
VEHNUM	Unique vehicle number
STOP_SEQ	Numeric stop sequence for the vehicle over the travel day
USID	Unique stop ID
SRID	Stop record ID
COMPANY_NAME	Name of the company
TRAVEL_DATE	Day of week when travel occurred
DAY_OF_WEEK_TRAVEL	Day of week when travel occurred
STOP_BASE_NOTBASE	Did the vehicle start/return to base?
STOP_PLACENAME	Place name of the stop location
STOP_ADDR	Address of the stop location
STOP_CITY	City of the stop location
STOP_STATE	State of the stop location
STOP_ZIP	Zip code of the stop location
STOP_LAT	Latitude of the stop location
STOP_LONG	Longitude of the stop location
STOP_PLACE_TYPE	Stop place type
STOP_PLACE_TYPE_other	Stop place type (OTHER)
ARRIVE_TIME	Time vehicle arrived at the stop location
DEPART_TIME	Time vehicle departed the stop location
STOP_ACTIVITY	Activity that took place at the stop location
STOP_ACTIVITY_other	Activity that took place at the stop location (OTHER)
STOP_HAVE_CARGO	Was the vehicle transporting cargo while at that stop
STOP_CARGO	What was the cargo
STOP_CARGO_other	What was the cargo (OTHER)
STOP_CARGO_WEIGHT	Cargo weight in pounds
NOTES	Explanatory note(s) as needed
WGHT_FCTOR	Weight factor that is created by dividing sampling plan figures by number of surveys collected in the corresponding cells.
GPS_UNDER_REPORTING_FACTOR	Multiplier that accounts for the difference between trips recorded via gps and reported trips in diaries
FINAL_FACTOR	WGHT_FCTOR multiplied by GPS_UNDER_REPORTING_FACTOR
TRAVEL_DISTANCE	Travel distance in miles imputed via Google
TRAVEL_MINUTES	Travel duration in minutes imputed via Google
VEH_CLASS	Vehicle Classification

Table 4. GPS Trip/Vehicle Probe Variables

FIELD NAME	DESCRIPTION
SITEID	Unique ID of the Establishment site
VEHNUM	Unique vehicle number
STOP_SEQ	Numeric stop sequence for the vehicle over the travel day
ISID	Unique stop ID
ACTUAL_TRAVEL_DATE	Day of week when travel occurred
DAY_OF_WEEK_TRAVEL	Day of week when travel occurred
ARRIVE_TIME	Time vehicle arrived at the stop location
DEPART_TIME	Time vehicle departed the stop location

Components of these surveys were also reflected in the creation of the sampling plan detailed in the following section.

3. Sampling Design

This section of the report documents the initial process the ETC Institute Team used to develop the sampling goals that were used to guide the implementation of the Travel Diaries.

In regard to the geographic goals further described in this section, the number of different types of registered commercial vehicles in each of the counties in the study area were reviewed to help determine the appropriate geographic goals for the survey. For this reason, the vehicles participating in the vehicle survey portion of the study were categorized based on their vehicle type (vehicle survey) as well as their establishment location (establishment survey). Then it was important to collect travel information from a representative sample of vehicle types from each of the county groups to represent the travel in those areas (travel survey with a subset also including GPS probe data).

Regarding the industry-type and employment-size goals further described in this section, the distributions of employee count for establishments in various types of industries (as defined by NAICS industry code) were reviewed for each county in the study area to help determine the appropriate industry-type and employment-size goals for the survey. During data collection the industry type was assigned based on the NAICS code for each establishment during the establishment portion of the study. This was done to help ensure that enough surveys were collected in the appropriate industry type categories. During the establishment portion of the survey, the employment size category was assigned based on the number of employees employed at each establishment. This was done to help ensure that enough surveys were collected in the appropriate employment size categories. During the establishment portion of the study, the establishment locations were confirmed and then assigned to the appropriate county group.

Besides accuracy, the guiding principles for this sampling plan included two goals: geography and vehicle classification and industry type and size.

3.1 Types of Goals

The sample plan was developed around the following two types of goals.

Goals by Geography and Vehicle Class. The geographic goals included targets for each of the eight county groups [Livingston, Macomb, Monroe, Oakland, St. Clair, Washtenaw, Wayne (City of Detroit), and Wayne (outside Detroit)] in the SEMCOG modeling area. The county groups were further aggregated into two subareas: Subarea 1 (the Urban Area) consists of Macomb and Oakland counties, Wayne (outside Detroit), and Wayne (City of Detroit). Subarea 2 (the Rural Area) consists of Livingston, Monroe, St. Clair, and Washtenaw counties. Goals by vehicle class were allocated to one of the following groups: single unit vehicles, tractor-trailer combinations (sometimes abbreviated as “combination” to save space in tables), and light-duty vehicles.

Goals by Industry Type and Size. Goals for industry type were established using the NAICS codes for each establishment. Establishments were grouped into the following **seven** industry categories:

- Agricultural, Mining, Construction
- Manufacturing
- Wholesale
- Retail
- Transportation
- Services
- Education and Government

Goals were also established based on the number of employees or size of the establishment. Three size categories were developed:

- Fewer than 10 employees
- 10-49 employees
- 50+ employees

3.1.1 Steps in establishing final stratified sampling goals

Goals by Geography and Vehicle Class

Altogether there were 11 steps in the process to determine the initial goals for this project. The geographic sampling goals were developed as follows:

Step 1: In the first step, the sampling universe was partitioned into 24 strata (8 sampling areas by 3 types of vehicles). The number of registered commercial vehicles by type of vehicle and location was obtained using 2015 commercial vehicle registration data provided by the Secretary of State. Table 5 below shows the number of registered commercial vehicles by type of vehicle and county.

Table 5. 2015 Registered Trucks by County and Vehicle Class

Geographic Area	Vehicle Class			Total
	Single-Unit	Combination	Light	
Livingston	1,615	904	5,128	**7,647**
Macomb	5,765	6,595	21,895	**34,255**
Monroe	1,649	2,058	4,596	**8,303**
Oakland	7,712	3,777	36,728	**48,217**
St. Clair	1,604	940	4,010	**6,554**
Washtenaw	2,350	1,053	7,334	**10,737**
Wayne (Excluding the city of Detroit)	8,250	13,055	26,227	**47,532**
Wayne (City of Detroit)	1,987	2,489	6,542	**11,018**
Area 1: URBAN - Wayne, Oakland, and Macomb Counties	**23,714**	**25,916**	**91,392**	**141,022**
Area 2: RURAL - Livingston, Monroe, St. Clair, and Washtenaw Counties	**7,218**	**4,955**	**21,068**	**33,241**
Total SEMCOG REGION	**30,932**	**30,871**	**112,460**	**174,263**

Step 2: In the next step, the distribution of registered commercial vehicles by county was calculated by dividing the number of vehicles in each cell of Table 5 (above) by the total number of registered commercial vehicles in the region for that type of vehicle. For example, Table 5 shows that there were 5,128 light-duty vehicles registered in Livingston County. This represents 4.6% of the 112,460 light-duty vehicles in the region, which is the reason 4.6% is shown in Table 6 for the portion of all light-duty vehicles in the region that are registered in Livingston County.

Table 6. Distribution of 2015 Registered # of Trucks by County and Vehicle Classes (% of All Vehicles)

Geographic Area	Vehicle Class			Total
	Single-Unit	Combination	Light	
Livingston	5.2%	2.9%	4.6%	**4.4%**
Macomb	18.6%	21.4%	19.5%	**19.7%**
Monroe	5.3%	6.7%	4.1%	**4.8%**
Oakland	24.9%	12.2%	32.7%	**27.7%**
St. Clair	5.2%	3.0%	3.6%	**3.8%**
Washtenaw	7.6%	3.4%	6.5%	**6.2%**
Wayne (Excluding the city of Detroit)	26.7%	42.3%	23.3%	**27.3%**
Wayne (City of Detroit)	6.4%	8.1%	5.8%	**6.3%**
Area 1: URBAN - Wayne, Oakland, and Macomb Counties	**76.7%**	**83.9%**	**81.3%**	**80.9%**
Area 2: RURAL - Livingston, Monroe, St. Clair, and Washtenaw Counties	**23.3%**	**16.1%**	**18.7%**	**19.1%**
Total SEMCOG REGION	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Step 3: The total number of completed travel diaries that were budgeted for this project was 1,500. Since the total number of light-duty vehicles represented 65% of all vehicles in the region, a proportional allocation of travel surveys by type of vehicle would not have yielded an adequate number of completed surveys for the two other types of vehicles (tractor trailers and single unit vehicle goals would have been 262 per type of vehicle and light-duty would have been 975). For this reason, in the next step, the research team increased the allocated travel diaries for both tractor trailers and for single unit vehicles. The allocations for each type of vehicle were then made in proportion to the distribution of each type of vehicle by county. For example, Livingston received 4.6% or 33 of the 732 travel diaries that were allocated for light-duty vehicles as shown in Table 7. The new proportions, which involved completing at least 384 surveys with each type of vehicle, were selected because a random sample of 384 surveys would provide results that had a precision of at least +/5% at the 95% level of confidence, which was the minimum level of statistical accuracy desired for each type of vehicle. In this step, the sample design only looks at total vehicles by county at margin (row/column totals), not the vehicle samples displayed in each stratum (individual cell values).

Table 7. Proportional Goals for the 2017 CVS Survey by Location (Unadjusted Based on a Proportional Assignment)

Geographic Area	Vehicle Class			Total
	Single-Unit	Combination	Light	
Livingston	20	11	33	**65**
Macomb	72	82	143	**296**
Monroe	20	26	30	**76**
Oakland	96	47	239	**382**
St. Clair	20	12	26	**58**
Washtenaw	29	13	48	**90**
Wayne (Excluding the city of Detroit)	102	162	171	**435**
Wayne (City of Detroit)	25	31	43	**98**
Area 1: URBAN - Wayne, Oakland, & Macomb Counties	**294**	**322**	**595**	**1,211**
Area 2: RURAL - Livingston, Monroe, St. Clair, & Washtenaw Counties	**90**	**62**	**137**	**288**
Total Vehicle Surveys To Be Completed in the SEMCOG REGION	**384**	**384**	**732**	**1,500**

Step 4: Since two counties, Livingston and St. Clair, would have received fewer than 70 surveys using the proportional allocation described in the previous step, surveys were reallocated slightly to improve the statistical accuracy of the data collected. In this step, this was done by reducing the number of surveys to be collected in Wayne County (Outside Detroit) from 435 to 400 surveys and reallocating these 35 surveys to other locations. The final geographic sampling goals are shown in the Table 8. Each county has a minimum of 70 surveys, which was one of the guiding principles of the sampling.

Table 8. Final Goals for the 2017 CVS Survey by Location

Geographic Area	Vehicle Class			Total	PRECISION OF SAMPLE
	Single-Unit	Combination	Light		
Livingston	22	12	36	70	+/-10% at the 90% level of Confidence
Macomb	73	83	144	300	+/-6% at the 95% level of Confidence
Monroe	20	26	30	76	+/-10% at the 90% level of Confidence
Oakland	96	48	240	384	+/-5% at the 95% level of Confidence
St. Clair	24	14	32	70	+/-10% at the 90% level of Confidence
Washtenaw	32	15	53	100	+/-10% at the 95% level of Confidence
Wayne (Excluding the city of Detroit)	91	155	154	400	+/-5% at the 95% level of Confidence
Wayne (City of Detroit)	25	32	43	100	+/-10% at the 95% level of Confidence
Area 1: URBAN - Wayne, Oakland, and Macomb Counties	**285**	**318**	**581**	**1,184**	**+/-3% at the 95% level of Confidence**
Area 2: RURAL - Livingston, Monroe, St. Clair, & Washtenaw Counties	**98**	**67**	**151**	**316**	**+/-5% at the 95% level of Confidence**
Total Vehicle Surveys to be completed in the SEMCOG REGION	**383**	**385**	**732**	**1,500**	**+/-2.5% at the 95% level of Confidence**

Goals by Industry and Size

The process for developing the sampling goals for completed vehicle travel diaries based on establishment industry and size is described below.

Step 5: It is important to note that by the completion of the project, a total of 2,848 establishments participated in the establishment survey. However, during the spring and early summer of 2017, ETC Institute conducted an initial establishment survey to better understand the distribution of vehicles by industry type and size of establishment which were used to help create specific goals for the project. As part of the survey, each establishment was asked to report the number of commercial vehicles that were owned or leased by the company for each of several types of vehicles. A total of 2,194 establishment surveys were completed. Table 9 shows the number of establishments that participated in the establishment survey by industry and size.

Table 9. Number of Completed Establishment Surveys by Size (Number of Employees) & Type of Industry (Group)

The counts in the table below are based the number of establishments in a database provided by MDOT. The original database contained multiple listings for some establishments, so the counts in this table show the net number of establishments after the duplicates were removed		NUMBER OF EMPLOYEES			Total
GROUP	NAICS INDUSTRY & CODE(S)	A=Less than 10	B=10-49	C=50+	
1=Agricultural, Mining, Utilities/Construction	Agriculture (11)	137	102		239
	Mining (21)				
	Utilities/Construction (22-23)				
2=Manufacturing	Manufacturing (31-33)	182	173	68	423
3=Wholesale, Warehouse & Storage	Wholesale Trade (42)	157	85		242
	Warehousing and Storage (493+)				
4=Retail	Retail Trade (44-45)	178	199	67	444
5=Transportation	Transportation (48-492)	101	72		173
6=Services	Services (51-56, 62, 71, 72, 81)	164	176	143	483
7=Education and Gov.	Educational Services (61)	60	70	60	190
	Public Administration (92)				
Total					**2,194**

Using the information collected from the establishment survey, ETC Institute calculated the mean number of vehicles for each combination of industry type and size for each of the three major types of vehicles. Since the sample size for some cells in the sampling plan for the establishment survey was small (e.g., only 60 government/education establishments with 50+ employees were surveyed), the mean number of vehicles was normalized by excluding outliers that (1) were more than two standard deviations beyond the mean number of vehicles reported by organization that reported having vehicles or (2) were values that were at least 10 or 50% greater than any other values reported. Outliers were individually reviewed to determine whether they should be kept or removed. No more than five outliers were removed per cell. An example of how this was done is on the following page.

The following is an example of how means from the establishment survey were normalized.
A total of 101 transportation establishments with fewer than 10 employees completed the establishment survey. The mean number of light-duty vehicles reported by these 101 establishments was 1.54 per establishment. To normalize the data, ETC Institute did the following:

- First, ETC Institute reviewed the standard deviation from the mean for the 101 transportation establishments with fewer than 10 employees that were surveyed. The standard deviation was 2.7. Two times the standard deviation (5.4) plus the mean (1.54) was 6.94, so all values greater than 6.94 were reviewed.
- Second, ETC Institute checked to see if any values were 10 or 50% greater than all other values reported. In this example, 18 was the greatest value. The second greatest value was 13. Since 18 was not at least 10 or 50% greater than 13, no further action to normalize the data was taken.

The results showed that 4 of the 101 transportation establishments with fewer than 10 employees reported 7 or more light-duty vehicles. The four highest values were 7, 8, 13 and 18. Thus, the values from these four establishments were classified as “outliers” and removed to normalize the data. Once these values had been removed, the mean was reduced from 1.54 to 1.11, and the standard deviation was reduced from 2.7 to 1.5.

Tables 10, 11, and 12 show the mean number of vehicles for each cell in the sampling plan for single unit vehicles (Table 10), tractor trailers (Table 11), and light-duty vehicles (Table 12). For example, the mean number of Single Unit vehicles owned or leased by manufacturing companies is 0.08 per company.

Table 10. Mean Number of Single Unit Vehicles Owned or Leased from Establishment Survey (Normalized)

		NUMBER OF EMPLOYEES		
GROUP	NAICS INDUSTRY/CODE(S)	A=Less than 10	B=10-49	C=50+
1=Agricultural, Mining, Utilities/Construction	Agriculture (11)	0.41	2.00	
	Mining (21)			
	Utilities/Construction (22-23)			
2=Manufacturing	Manufacturing (31-33)	0.08	0.46	0.77
3=Wholesale, Warehouse & Storage	Wholesale Trade (42)	0.22	0.67	
	Warehousing and Storage (493+)			
4=Retail	Retail Trade (44-45)	0.10	0.19	0.58
5=Transportation	Transportation (48-492)	0.49	2.49	
6=Services	Services (51-56, 62, 71, 72, 81)	0.03	0.07	0.09
7=Education and Government	Educational Services (61)	0.00	0.19	0.56
	Public Administration (92)			

Table 11. Mean Number of Tractor Trailer Vehicles Owned or Leased from Establishment Survey (Normalized)

		NUMBER OF EMPLOYEES		
GROUP	NAICS INDUSTRY/CODE(S)	A=Less than 10	B=10-49	C=50+
1=Agricultural, Mining, Utilities/Construction	Agriculture (11)	0.12	1.55	
	Mining (21)			
	Utilities/Construction (22-23)			
2=Manufacturing	Manufacturing (31-33)	0.04	0.38	0.66
3=Wholesale, Warehouse & Storage	Wholesale Trade (42)	0.28	0.59	
	Warehousing and Storage (493+)			
4=Retail	Retail Trade (44-45)	0.02	0.13	0.42
5=Transportation	Transportation (48-492)	0.78	16.00	
6=Services	Services (51-56, 62, 71, 72, 81)	0.00	0.03	0.20
7=Education and Government	Educational Services (61)	0.00	0.00	0.00

Table 12. Mean Number of Light-duty Vehicles Owned or Leased from Establishment Survey (Normalized)

		NUMBER OF EMPLOYEES		
GROUP	NAICS INDUSTRY/CODE(S)	A=Less than 10	B=10-49	C=50+
1=Agricultural, Mining, Utilities/Construction	Agriculture (11)	1.55	4.98	
	Mining (21)			
	Utilities/Construction (22-23)			
2=Manufacturing	Manufacturing (31-33)	0.67	1.24	1.26
3=Wholesale, Warehouse & Storage	Wholesale Trade (42)	0.86	2.04	
	Warehousing and Storage (493+)			
4=Retail	Retail Trade (44-45)	0.38	0.77	0.95
5=Transportation	Transportation (48-492)	1.11	3.25	
6=Services	Services (51-56, 62, 71, 72, 81)	0.40	0.77	0.60
7=Education and Government	Educational Services (61)	0.06	0.19	0.16

Step 6: The next step was to estimate the total number of commercial vehicles in the SEMCOG region for each of combination of industry type and size in the sampling plan. This was done by multiplying the total number of establishments in each cell of the sampling plan by the mean number of vehicles that was calculated for each cell in Step 5. The total number of establishments in each cell of the sampling plan was derived from a database provided by MDOT at the beginning of the project. This database was cleaned by ETC Institute. The resulting number of establishments in the database was 229,666 as shown in Table 13.

Table 13. Estimated Number of Establishments in the SEMCOG Region by Size & Type of Business

Counts based on counts in database provided by MDOT after duplicates were removed		NUMBER OF EMPLOYEES			Total
GROUP	NAICS INDUSTRY & CODE(S)	A=Less than 10	B=10-49	C=50+	
1=Agricultural, Mining, Utilities/Construction	Agriculture (11)	26,718	1,757		28,475
	Mining (21)				
	Utilities/Construction (22-23)				
2=Manufacturing	Manufacturing (31-33)	6,494	2,231	801	9,526
3=Wholesale, Warehouse & Storage	Wholesale Trade (42)	7,875	1,497		9,372
	Warehousing and Storage (493+)				
4=Retail	Retail Trade (44-45)	22,603	3,213	649	26,465
5=Transportation	Transportation (48-492)	6,339	660		6,999
6=Services	Services (51-56, 62, 71, 72, 81)	127,326	13,595	2,358	143,279
7=Education and Gov.	Educational Services (61)	2,712	1,805	1,033	5,550
	Public Administration (92)				
Total					**229,666**

The mean values shown in each cell of Tables 10, 11, and 12 were then multiplied by the total number of establishments in the corresponding cells of Table 13. The results are shown in Tables 14, 15, and 16. The numbers in these tables are referred to as the "Preliminary Estimate" because in Step 7 (described next) these distributions were corrected to match the actual number of registered commercial vehicles in the region.

Table 14. Preliminary Estimate of Single Unit Vehicles Reported Owned or Leased

Normalized Mean from Establ. Survey Multiplied By Number of Establ. in Cell		NUMBER OF EMPLOYEES			Total
GROUP	NAICS INDUSTRY & CODE(S)	A=Less than 10	B=10-49	C=50+	
1=Agricultural, Mining, Utilities/Construction	Agriculture (11)	10,954	3,514		14,468
	Mining (21)				
	Utilities/Construction (22-23)				
2=Manufacturing	Manufacturing (31-33)	520	1,026	2,163	2,163
3=Wholesale, Warehouse & Storage	Wholesale Trade (42)	1,733	1,003		2,735
	Warehousing and Storage (493+)				
4=Retail	Retail Trade (44-45)	2,260	610	3,247	3,247
5=Transportation	Transportation (48-492)	3,106	1,643		4,750
6=Services	Services (51-56, 62, 71, 72, 81)	3,820	952	4,984	4,984
7=Education and Gov.	Educational Services (61)	0	343	921	921
	Public Administration (92)				
Total					**33,268**

Table 15. Preliminary Estimate of Tractor Trailer Vehicles Reported Owned or Leased

Normalized Mean from Establ. Survey Multiplied By Number of Establ. in Cell		NUMBER OF EMPLOYEES			Total
GROUP	NAICS INDUSTRY & CODE(S)	A=Less than 10	B=10-49	C=50+	
1=Agricultural, Mining, Utilities/Construction	Agriculture (11)	3,206	2,723		5,930
	Mining (21)				
	Utilities/Construction (22-23)				
2=Manufacturing	Manufacturing (31-33)	260	848	529	1,636
3=Wholesale, Warehouse & Storage	Wholesale Trade (42)	2,205	883		3,088
	Warehousing and Storage (493+)				
4=Retail	Retail Trade (44-45)	452	418	273	1,142
5=Transportation	Transportation (48-492)	4,944	10,560		15,504
6=Services	Services (51-56, 62, 71, 72, 81)	0	408	472	879
7=Education and Gov.	Educational Services (61)	0	0	0	0
	Public Administration (92)				
Total					**28,180**

Table 16. Preliminary Estimate of Light-duty Vehicles Reported Owned or Leased

Normalized Mean from Establ. Survey Multiplied By Number of Establ. in Cell		NUMBER OF EMPLOYEES			Total
GROUP	NAICS INDUSTRY/CODE(S)	A=Less than 10	B=10-49	C=50+	
1=Agricultural, Mining, Utilities/Construction	Agriculture (11)	41,413	8,750		50,163
	Mining (21)				
	Utilities/Construction (22-23)				
2=Manufacturing	Manufacturing (31-33)	4,351	2,766	1,009	8,127
3=Wholesale, Warehouse & Storage	Wholesale Trade (42)	6,773	3,054		9,826
	Warehousing and Storage (493+)				
4=Retail	Retail Trade (44-45)	8,589	2,474	617	11,680
5=Transportation	Transportation (48-492)	7,036	2,145		9,181
6=Services	Services (51-56, 62, 71, 72, 81)	50,930	10,468	1,415	62,813
7=Education and Government	Educational Services (61)	163	343	165	671
	Public Administration (92)				
Total					**152,461**

Step 7: The estimates from Step 6 for tractor trailers and single unit vehicles were very close to the actual number of registered vehicles in the region. Step 6 estimated that there were 33,268 single unit vehicles in the region compared to 30,932 that were registered. Step 6 also estimated that there were 28,180 tractor trailers in the region compared to 30,871 that were registered.

Although the estimates for single units and tractor trailers were both within 10% of the actual number of vehicles registered, the estimate for light-duty vehicles was much higher than the actual number of registered vehicles. Step 6 estimated that there were 152,461 light-duty vehicles in the region compared to 112,460 that are registered. Based on ETC Institute's experience, the high estimate probably resulted from small business owners reporting personal vehicles as commercial vehicles. For example, a painter might use a pick-up truck for his business, but the truck is registered as a personal vehicle rather than as a commercial vehicle. Although the light-duty vehicle estimate was high, the distribution of light-duty vehicles by type and size of establishment provided a reasonable basis for estimating for the actual distribution of light-duty vehicles in the region.

Since the total number of registered commercial vehicles in the region would be the count to which the survey data is expanded, the preliminary estimates from Step 6 were modified by multiplying each cell in Step 6 by the following correction factor:

Correction Factor = Actual Number of CV / Estimated Number of CV

This was done for each of the three types of vehicles. The results are shown in Tables 17, 18, and 19

Table 17. Final Estimate of Single Unit Vehicles Owned or Leased to Match Vehicle Registration

GROUP	NAICS INDUSTRY/CODE(S)	NUMBER OF EMPLOYEES			Total
		A=Less than 10	B=10-49	C=50+	
1=Agricultural, Mining, Utilities/Construction	Agriculture (11)	10,185	3,267		13,452
	Mining (21)				
	Utilities/Construction (22-23)				
2=Manufacturing	Manufacturing (31-33)	483	954	573	2,011
3=Wholesale, Warehouse & Storage	Wholesale Trade (42)	1,611	933		2,543
	Warehousing and Storage (493+)				
4=Retail	Retail Trade (44-45)	2,102	568	350	3,019
5=Transportation	Transportation (48-492)	2,888	1,528		4,416
6=Services	Services (51-56, 62, 71, 72, 81)	3,552	885	197	4,634
7=Education and Government	Educational Services (61)	0	319	538	857
	Public Administration (92)				
Total					**30,932**

Table 18. Final Estimate of Tractor Trailer Vehicles Owned or Leased to Match Vehicle Registration

GROUP	NAICS INDUSTRY/CODE(S)	NUMBER OF EMPLOYEES			Total
		A=Less than 10	B=10-49	C=50+	
1=Agricultural, Mining, Utilities/Construction	Agriculture (11)	3,512	2,983		6,496
	Mining (21)				
	Utilities/Construction (22-23)				
2=Manufacturing	Manufacturing (31-33)	285	929	579	1,792
3=Wholesale, Warehouse & Storage	Wholesale Trade (42)	2,416	968		3,383
	Warehousing and Storage (493+)				
4=Retail	Retail Trade (44-45)	495	458	299	1,251
5=Transportation	Transportation (48-492)	5,417	11,568		16,985
6=Services	Services (51-56, 62, 71, 72, 81)	0	447	517	963
7=Education and Government	Educational Services (61)	0	0	0	0
	Public Administration (92)				
Total					**30,871**

Table 19. Final Estimate of Light-duty Vehicles Owned or Leased to Match Vehicle Registration

		NUMBER OF EMPLOYEES			Total
GROUP	NAICS INDUSTRY/CODE(S)	A=Less than 10	B=10-49	C=50+	
1=Agricultural, Mining, Utilities/Construction	Agriculture (11)	30,547	6,454		37,002
	Mining (21)				
	Utilities/Construction (22-23)				
2=Manufacturing	Manufacturing (31-33)	3,209	2,041	744	5,994
3=Wholesale, Warehouse & Storage	Wholesale Trade (42)	4,996	2,253		7,248
	Warehousing and Storage (493+)				
4=Retail	Retail Trade (44-45)	6,336	1,825	455	8,615
5=Transportation	Transportation (48-492)	5,190	1,582		6,772
6=Services	Services (51-56, 62, 71, 72, 81)	37,568	7,722	1,044	46,333
7=Education and Government	Educational Services (61)	120	253	122	495
	Public Administration (92)				
Total					**112,460**

To better understand the number of light-duty vehicles that are registered in the state of Michigan as a commercial vehicle compared to those used for business purposes, ETC Institute added a follow-up question to the vehicle information sheet which asks respondents to "indicate if the vehicle was actually registered as a commercial vehicle in the State of Michigan." The results of this follow-up question helped the ETC Institute Team better understand the extent to which the number of vehicles were over-reported by establishments in the establishment survey. The findings suggested that many respondents and their employees use their own personal vehicles for organizational activities. Approximately forty-one percent (40.8%) of respondents indicated that their light-duty vehicles were in fact not registered as commercial vehicles in the state of Michigan. For this reason, during the expansion process, the table listed below was used as the final estimate of light-duty vehicles owned or leased to better understand what is going on in the region. The numbers in Table 20 were achieved by dividing the cell numbers in Table 19 by the percentage of respondents who indicated that their vehicles were registered as commercial vehicles in the state of Michigan (59.2%). The stratification of cells in Table 20 differs slightly from Table 19 as Table 20 displays the final stratification structure used for expansion.

Table 20. Updated Final Estimate of Light-duty Vehicles Owned or Leased (For Expansion)

		NUMBER OF EMPLOYEES		Total
GROUP	NAICS INDUSTRY/CODE(S)	A=Less than 10	10 or more	
1=Agricultural, Mining, Utilities/Construction	Agriculture (11)	51,615	10,905	62,520
	Mining (21)			
	Utilities/Construction (22-23)			
2=Manufacturing	Manufacturing (31-33)	5,423	4,706	10,129
3=Wholesale, Warehouse & Storage	Wholesale Trade (42)	8,441	3,806	12,247
	Warehousing and Storage (493+)			
4=Retail	Retail Trade (44-45)	10,705	3,852	14,557
5=Transportation	Transportation (48-492)	8,770	2,673	11,443
6=Services	Services (51-56, 62, 71, 72, 81)	63,477	14,810	78,287
7=Education and Government	Educational Services (61)	836		836
	Public Administration (92)			
Total				**190,019**

Step 8: ETC Institute then developed initial sampling goals for each of the three types of vehicles based on the total number of surveys that were to be completed for each type of vehicle: 384 single unit vehicles, 384 tractor trailers, and 732 light-duty vehicles (Step 4). For example, Step 3 estimated that there are 483 single unit vehicles owned/leased by manufacturing companies in the region, which represents 1.6% of the single unit vehicles in the region. In Step 7, the proportional goal for surveys completed with single unit vehicles owned/leased by manufacturing companies is 6, which represents 1.6% of the 384 surveys that are to be completed.

These initial sampling goals for each of the three types of vehicles based on a proportional distribution are shown in Tables 21, 22, and 23.

Table 21. Initial Sampling Goals for Single Unit Vehicles Owned or Leased

		NUMBER OF EMPLOYEES			Total
GROUP	NAICS INDUSTRY/CODE(S)	A=Less than 10	B=10-49	C=50+	
1=Agricultural, Mining, Utilities/Construction	Agriculture (11)	126	41		167
	Mining (21)				
	Utilities/Construction (22-23)				
2=Manufacturing	Manufacturing (31-33)	6	12	7	25
3=Wholesale, Warehouse & Storage	Wholesale Trade (42)	20	12		32
	Warehousing and Storage (493+)				
4=Retail	Retail Trade (44-45)	26	7	4	37
5=Transportation	Transportation (48-492)	36	19		55
6=Services	Services (51-56, 62, 71, 72, 81)	44	11	2	58
7=Education and Government	Educational Services (61)	0	4	7	11
	Public Administration (92)				
Total					**384**

Table 22. Initial Sampling Goals for Tractor Trailer Vehicles Owned or Leased

		NUMBER OF EMPLOYEES			Total
GROUP	NAICS INDUSTRY/CODE(S)	A=Less than 10	B=10-49	C=50+	
1=Agricultural, Mining, Utilities/Construction	Agriculture (11)	44	37		81
	Mining (21)				
	Utilities/Construction (22-23)				
2=Manufacturing	Manufacturing (31-33)	4	12	7	22
3=Wholesale, Warehouse & Storage	Wholesale Trade (42)	30	12		42
	Warehousing and Storage (493+)				
4=Retail	Retail Trade (44-45)	6	6	4	16
5=Transportation	Transportation (48-492)	67	144		211
6=Services	Services (51-56, 62, 71, 72, 81)	0	6	6	12
7=Education and Government	Educational Services (61)	0	0	0	0
	Public Administration (92)				
Total					**384**

Table 23. Initial Sampling Goals for Light-duty Vehicles Owned or Leased

GROUP	NAICS INDUSTRY/CODE(S)	NUMBER OF EMPLOYEES			Total
		A=Less than 10	B=10-49	C=50+	
1=Agricultural, Mining, Utilities/Construction	Agriculture (11)	199	42		241
	Mining (21)				
	Utilities/Construction (22-23)				
2=Manufacturing	Manufacturing (31-33)	21	13	5	39
3=Wholesale, Warehouse & Storage	Wholesale Trade (42)	33	15		47
	Warehousing and Storage (493+)				
4=Retail	Retail Trade (44-45)	41	12	3	56
5=Transportation	Transportation (48-492)	34	10		44
6=Services	Services (51-56, 62, 71, 72, 81)	245	50	7	302
7=Education and Government	Educational Services (61)	1	2	1	3
	Public Administration (92)				
Total					**732**

Step 9: One of the guiding principles for the sampling plan was that **a minimum of 30 travel diaries would be obtained from any cell or combination of cells in the sampling plan for which the data is to be expanded.** A quick review of the initial sampling goals in Tables 21, 22 and 23 shows that most of the cells did not get 30 surveys through the proportional sampling method used in Step 8. In order increase the number of cells for which statistically significant data will be obtained, surveys were redistributed from cells that originally had more surveys than needed to cells which did not have enough.

The revised and final sampling goals for the region are shown in Tables 24, 25, and 26. Cells with fewer than 30 surveys (in gray) were aggregated with adjacent cells for purposes of expanding the data, but ETC Institute monitored the distribution of the survey relative to the sampling goals in the sampling plan to ensure that if cells are aggregated, the aggregated sample had the right mix based on the size of the establishments.

Table 24. Final Regional Sampling Goals for Single Unit Vehicles Owned or Leased

GROUP	NAICS INDUSTRY/CODE(S)	NUMBER OF EMPLOYEES			Total
		A=Less than 10	B=10-49	C=50+	
1=Agricultural, Mining, Utilities/Construction	Agriculture (11)	70	41		111
	Mining (21)				
	Utilities/Construction (22-23)				
2=Manufacturing	Manufacturing (31-33)	10	12	10	32
3=Wholesale, Warehouse & Storage	Wholesale Trade (42)	20	12		32
	Warehousing and Storage (493+)				
4=Retail	Retail Trade (44-45)	30	15	15	60
5=Transportation	Transportation (48-492)	30	30		60
6=Services	Services (51-56, 62, 71, 72, 81)	40	15	5	60
7=Education and Government	Educational Services (61)	0	15	15	30
	Public Administration (92)				
Total					**384**

Table 25. Final Regional Sampling Goals for Tractor Trailer Vehicles Owned or Leased

GROUP	NAICS INDUSTRY/CODE(S)	NUMBER OF EMPLOYEES			Total
		A=Less than 10	B=10-49	C=50+	
1=Agricultural, Mining, Utilities/Construction	Agriculture (11)	44	37		81
	Mining (21)				
	Utilities/Construction (22-23)				
2=Manufacturing	Manufacturing (31-33)	5	15	10	30
3=Wholesale, Warehouse & Storage	Wholesale Trade (42)	34	12		46
	Warehousing and Storage (493+)				
4=Retail	Retail Trade (44-45)	10	10	10	30
5=Transportation	Transportation (48-492)	67	100		167
6=Services	Services (51-56, 62, 71, 72, 81)	10	10	10	30
7=Education and Government	Educational Services (61)	0	0	0	0
	Public Administration (92)				
Total					**384**

Table 26. Final Regional Sampling Goals for Light-duty Vehicles Owned or Leased

GROUP	NAICS INDUSTRY/CODE(S)	NUMBER OF EMPLOYEES			Total
		A=Less than 10	B=10-49	C=50+	
1=Agricultural, Mining, Utilities/Construction	Agriculture (11)	120	67		187
	Mining (21)				
	Utilities/Construction (22-23)				
2=Manufacturing	Manufacturing (31-33)	30	20	10	60
3=Wholesale, Warehouse & Storage	Wholesale Trade (42)	40	30		70
	Warehousing and Storage (493+)				
4=Retail	Retail Trade (44-45)	67	20	10	97
5=Transportation	Transportation (48-492)	41	30		71
6=Services	Services (51-56, 62, 71, 72, 81)	120	67	30	217
7=Education and Government	Educational Services (61)	10	10	10	30
	Public Administration (92)				
Total					**732**

Step 10-11: The last two steps of the sampling plan simply involved the division of the sampling goals in Tables 24, 25, and 26 among the two major geographic areas in Step 4. According to the geographic goals shown in Table 3 of Step 4, a total of on 1,184 surveys were to be completed in Area 1 (Urban Area) and 316 surveys were to be completed in Area 2 (Rural Area).

- Step 10 of the sampling process shows the final sampling goals for the Urban Area. The counts shown in the Tables 27, 28, and 29 reflect the allocation of the 1,184 surveys that were to be completed in urban areas for each type of vehicle by size and type of establishment.

- Step 11 of the sampling process shows the final sampling goals for the Rural Area. The counts shown in the Tables 30, 31, and 32 reflect the allocation of the 316 surveys that were to be completed in rural areas for each type of vehicle by size and type of establishment.

Table 27. Urban Area Sampling Goals for Single Unit Vehicles Owned or Leased

GROUP	NAICS INDUSTRY/CODE(S)	NUMBER OF EMPLOYEES			Total
		A=Less than 10	B=10-49	C=50+	
1=Agricultural, Mining, Utilities/Construction	Agriculture (11)	52	30		82
	Mining (21)				
	Utilities/Construction (22-23)				
2=Manufacturing	Manufacturing (31-33)	7	9	7	24
3=Wholesale, Warehouse & Storage	Wholesale Trade (42)	15	9		24
	Warehousing and Storage (493+)				
4=Retail	Retail Trade (44-45)	22	11	11	45
5=Transportation	Transportation (48-492)	22	22		45
6=Services	Services (51-56, 62, 71, 72, 81)	30	11	4	45
7=Education and Government	Educational Services (61)	0	11	11	22
	Public Administration (92)				
Total					**285**

Table 28. Urban Area Sampling Goals for Tractor Trailer Vehicles Owned or Leased

GROUP	NAICS INDUSTRY/CODE(S)	NUMBER OF EMPLOYEES			Total
		A=Less than 10	B=10-49	C=50+	
1=Agricultural, Mining, Utilities/Construction	Agriculture (11)	36	31		67
	Mining (21)				
	Utilities/Construction (22-23)				
2=Manufacturing	Manufacturing (31-33)	4	12	8	25
3=Wholesale, Warehouse & Storage	Wholesale Trade (42)	28	10		38
	Warehousing and Storage (493+)				
4=Retail	Retail Trade (44-45)	8	8	8	25
5=Transportation	Transportation (48-492)	56	83		139
6=Services	Services (51-56, 62, 71, 72, 81)	8	8	8	25
7=Education and Government	Educational Services (61)	0	0	0	0
	Public Administration (92)				
Total					**318**

Table 29. Urban Area Sampling Goals for Light-duty Vehicles Owned or Leased

GROUP	NAICS INDUSTRY/CODE(S)	NUMBER OF EMPLOYEES			Total
		A=Less than 10	B=10-49	C=50+	
1=Agricultural, Mining, Utilities/Construction	Agriculture (11)	95	53		148
	Mining (21)				
	Utilities/Construction (22-23)				
2=Manufacturing	Manufacturing (31-33)	24	16	8	48
3=Wholesale, Warehouse & Storage	Wholesale Trade (42)	32	24		56
	Warehousing and Storage (493+)				
4=Retail	Retail Trade (44-45)	53	16	8	77
5=Transportation	Transportation (48-492)	33	24		56
6=Services	Services (51-56, 62, 71, 72, 81)	95	53	24	172
7=Education and Government	Educational Services (61)	8	8	8	24
	Public Administration (92)				
Total					**581**

Table 30. Rural Area Sampling Goals for Single Unit Vehicles Owned or Leased

GROUP	NAICS INDUSTRY/CODE(S)	NUMBER OF EMPLOYEES			Total
		A=Less than 10	B=10-49	C=50+	
1=Agricultural, Mining, Utilities/Construction	Agriculture (11)	18	10		29
	Mining (21)				
	Utilities/Construction (22-23)				
2=Manufacturing	Manufacturing (31-33)	3	3	3	8
3=Wholesale, Warehouse & Storage	Wholesale Trade (42)	5	3		8
	Warehousing and Storage (493+)				
4=Retail	Retail Trade (44-45)	8	4	4	15
5=Transportation	Transportation (48-492)	8	8		15
6=Services	Services (51-56, 62, 71, 72, 81)	10	4	1	15
7=Education and Government	Educational Services (61)	0	4	4	8
	Public Administration (92)				
Total					**99**

Table 31. Rural Area Sampling Goals for Tractor Trailer Vehicles Owned or Leased

GROUP	NAICS INDUSTRY/CODE(S)	NUMBER OF EMPLOYEES			Total
		A=Less than 10	B=10-49	C=50+	
1=Agricultural, Mining, Utilities/Construction	Agriculture (11)	8	6		14
	Mining (21)				
	Utilities/Construction (22-23)				
2=Manufacturing	Manufacturing (31-33)	1	3	2	5
3=Wholesale, Warehouse & Storage	Wholesale Trade (42)	6	2		8
	Warehousing and Storage (493+)				
4=Retail	Retail Trade (44-45)	2	2	2	5
5=Transportation	Transportation (48-492)	12	17		29
6=Services	Services (51-56, 62, 71, 72, 81)	2	2	2	5
7=Education and Government	Educational Services (61)	0	0	0	0
	Public Administration (92)				
Total					**66**

Table 32. Rural Area Sampling Goals for Light-duty Vehicles Owned or Leased

GROUP	NAICS INDUSTRY/CODE(S)	NUMBER OF EMPLOYEES			Total
		A=Less than 10	B=10-49	C=50+	
1=Agricultural, Mining, Utilities/Construction	Agriculture (11)	25	14		39
	Mining (21)				
	Utilities/Construction (22-23)				
2=Manufacturing	Manufacturing (31-33)	6	4	2	12
3=Wholesale, Warehouse & Storage	Wholesale Trade (42)	8	6		14
	Warehousing and Storage (493+)				
4=Retail	Retail Trade (44-45)	14	4	2	20
5=Transportation	Transportation (48-492)	8	6		15
6=Services	Services (51-56, 62, 71, 72, 81)	25	14	6	45
7=Education and Government	Educational Services (61)	2	2	2	6
	Public Administration (92)				
Total					**151**

3.2 Survey Accuracy

The sampling plan described above was developed to ensure the data would have the following levels of accuracy:

- **The data would be statistically valid for each of three vehicle types [single unit vehicles, tractor-trailers (combinations), and light-duty vehicles] with a precision of at least +/-5% at the 95% level of confidence.** To achieve this goal, an appropriate number of travel diaries were obtained from each of the three major types of vehicles that were included in the survey.
- **The data would be statistically valid for each of eight county groups [Livingston, Macomb, Monroe, Oakland St. Clair, Washtenaw, Wayne (City of Detroit), and Wayne (outside Detroit)] with a precision of at least +/-10% at the 90% level of confidence.** To achieve this goal, an appropriate number of travel diaries were obtained from each county.

4. Pilot Test

ETC Institute conducted a pilot test for the SEMCOG Commercial Vehicle Survey during the month of February 2017. This section of the report describes the findings of the pilot test and the suggested recommendations to improve the establishment survey.

4.1 Summary of the Pilot Test

Pilot/Pretests are extremely important to ensure that respondents across a variety of operating conditions and knowledge levels can consistently understand the intent of each question and be able to provide usable results. The pilot test was also conducted to assess the methodology for administering both the establishment survey and trip diary components of the SEMCOG Commercial Vehicle Survey. The tasks and outcome for each task are described in the following bullet points:

- **Survey Design:** ETC Institute worked with SEMCOG staff to develop the advance notification letter and survey materials that were tested during the pilot test (see Appendices). These materials were finalized on January 31st of 2017.
- **Sample:** A random sample of 500 organizations were selected for the pilot test. The completion goals for the pilot test were as follows:
    - To obtain at least 50 establishment surveys.
    - To obtain one-day travel surveys from at least 20 commercial vehicles of which at least 10 would participate in the GPS survey.
- **Administration:** The pilot test was administered as follows:
    - **Design of the Survey Materials.** The design of the survey materials, including the advance notification letter, were completed by January 31st of 2017.
    - **Advance Notification Letter.** On February 8th of 2017, advance notification letters were mailed to representatives of each of the 500 establishments that were selected for the pilot test
    - **Administration of the Establishment Survey.** On February 15th of 2017, ETC Institute began contacting representatives from each of the organizations that had been selected for the pilot test. ETC Institute attempted to contact each establishment to schedule a time to complete the survey. Only one attempt was made due to the short period of time for the pilot test. ETC Institute made at least 5 attempts for the main survey (post-pilot data collection).
        - Of the 500 organizations that were selected, ETC Institute was able to reach a representative of 103 organizations by phone. Of the 103 who were reached, 51 completed the establishment survey for a 10.2% response rate, which is in-line with what was expected. ETC Institute tracked response rates during the administration of the main survey to adjust the approach (if needed). The breakdown of the participants by location, size, and type of business is at the top of the following page.

Table 33. Breakdown by Location

COUNTY	COUNT
WAYNE INSIDE DET.	4
LIVINGSTON	9
MACOMB	12
MONROE	0
OAKLAND	18
ST CLAIR	2
WASHTENAW	2
WAYNE OUTSIDE DET.	4
Total	**51**

- **Breakdown by Size**
  - 35 had fewer than 10 employees
  - 15 had 10-49 employees
  - 1 had 50+ employees

ETC Institute observed that the employment size information (number of employees) provided in the sample obtained from MDOT was generally accurate. However, ETC Institute created a new field in the database to capture the number of employees reported by the establishment that was surveyed. This corrected size was used during the data expansion process.

- **Breakdown by Industry Type**
  - 4 Agricultural/Mining/Util/Constr (Category 1)
  - 3 Manufacturing (Category 2)
  - 2 Wholesale Trade (Category 3)
  - 9 Retail Trade (Category 4)
  - 3 Transportation (Category 5)
  - 29 Services (Category 6)
  - 1 Education/Government (Category 7)

The sampling for the pilot test was conducted completely at random and demonstrated that the following will occur without the inclusion of controls during the administration of the main survey

- Macomb and Oakland counties were slightly oversampled during the pilot test relative to the number of establishments in the region, so aggregate goals for each county/geography were added to the sampling plan to ensure geographic coverage for the survey is appropriate.
- Services and retail companies were over represented relative to the goals in the sampling plan, but they were proportionately represented in the pilot test relative to the actual number of establishments in the region. No adjustments for type of business was recommended because there were specific goals for each type of establishment in the sampling plan.
- 13 organizations who participated in the establishment survey also agreed to complete one or more travel diaries over a 24-hour period. A total of 11 of the

13 (85%) organizations who agreed to participate in the travel diary completed it on the date scheduled.

- **Administration of the Vehicle Information Sheet and Travel Diary.** Organizations that agreed to participate in the 24-hour travel diary were e-mailed a travel diary and detailed instructions were given to the primary driver by phone. Travel dates for a total of 30 commercial vehicles were scheduled on February 13-23, 2017. Of these, 21 vehicles completed the survey which included:
  - 5 were passenger cars (1 vehicle was not coded)
  - 3 were pickups
  - 3 were cargo vans
  - 3 were SUVs
  - 5 were Single Unit 2-axle (6 wheels) (tow trucks were originally coded "other")
  - 1 were Single Unit 2-axle (10 wheels)
  - 0 were Single Unit 2-axle (14 wheels)
  - 1 was a semi-tractor/trailer

  ETC Institute then retrieved the information from each driver by e-mail (scanned copies of the travel diaries) and by phone. An interviewer from ETC Institute conducted call-backs with drivers to be sure the drivers understood everything on the survey instrument and to solicit suggestions for improvement. In all cases, the drivers reported that they understood the instructions and no significant suggestions for improvement were made.
- **Prepare Databases.** The data from the establishment survey and travel diary were compiled into three databases, which are described below.
  - Establishment Database: contains the location of the participating organization, number of employees, number of vehicles, and other data about the company
  - Vehicle Database: contains the location where the vehicle is normally based, and other information about the vehicle
  - Trip Database: contains each of the destinations that were visited by the vehicle on the assigned travel day along with the types of places visited, times of travel, and type/amount of cargo if applicable

  Each of these databases were then submitted to SEMCOG and Cambridge Systematics for review to be sure the format and content of the databases would support the modeling requirements for the region.

4.2 Recommendations

The following changes to survey methodology and design were recommended for acceptance based on the results of the pilot test.

4.2.1 Changes to methodology

The establishment survey was originally designed to have ETC Institute's call center call the establishment back at a later time to schedule the diary dates, but it was determined that when possible, especially during spring while school is in session, our team would be more effective scheduling the site visit during the original interview. Establishments that agreed to participate in the travel diary were visited by a member of ETC Institute's field staff who dropped off the travel diaries and reviewed the procedures for completing them.

4.2.2 Changes to survey design

- A code regarding employment size (number of employees) was added to the beginning of the survey. This addition made it easier to track the goals in the sampling plan.
- The skip pattern during the introduction was changed so that all respondents including those who do not have commercial vehicles would complete parts 1, 2, 3 and 4 of the establishment survey. Part 5 (which was originally part 4) was moved to the end of the survey and was only asked of respondents who report having vehicles.
- A question regarding the normal hours of operation was added to the recruitment component to help schedule field visits to sites.
- A question regarding the point of contact's preferences for being contacted by phone or email was added.
- The question about the "company address" was changed to request the address where the vehicle was typically parked or garaged.
- A question was added to ask if the vehicle's travel date was rescheduled because the vehicle did not travel on the date that was originally assigned. This will help assess the percentage of commercial vehicles that travel on an average day.
- A question to capture the year of the travel date was added to ensure all dates match file names and online data entry which minimized errors.

4.3 Summary Statistics

Since the sample for the pilot test was very small, no summary statistics related to vehicle travel information were prepared. ETC Institute provided SEMCOG with several interim datasets for review throughout the life of the project.

4.4 Maps of GPS Data

To assess the coverage of the passive GPS unit data collection efforts, ETC Institute prepared maps that showed where the vehicles that participated in the passive GPS survey traveled (similar to maps shown in Figures 1 and 2). These maps were provided to SEMCOG separately. In general, the coverage looked very good on the maps. ETC Institute also conducted a more detailed review of the maps compared to the information collected in the travel diaries. As anticipated, the GPS data generally showed trips that were not reported on the diaries, which is the primary purpose of the GPS survey, and allows for adjustment during the data expansion process.

5. Survey Administration and QA/QC Procedures

As mentioned in the previous section, after the pilot test was reviewed and scrutinized there were no real changes to the methodology planned for the main survey data collection. However, as mentioned in the previous section, based on the pilot test, changes were made to the: establishment survey, vehicle information sheet, and trip diary. Later in the project an additional question was added to the vehicle information sheet which asked respondents "Is this vehicle registered as a commercial vehicle in the state of Michigan?" The reason for the addition of this question was because respondents and their employees tend to use their own personal vehicles (typically light-duty vehicles) for business related purposes but these vehicles may or may not be registered as commercial vehicles in the state of Michigan. For example, a painter might use a pick-up truck for his business, but the truck is registered as a personal vehicle rather than as a commercial vehicle. This question was very important as it had an impact on the data expansion (explained in the next section).

With the survey instruments and methodology finalized, the bulk of the data collected for the project by ETC Institute's travel survey team was administered from February 2017- April 2018. Throughout the span of the project ETC Institute mailed advance notification letters and contacted over 80,000 organizations. The ETC Institute call center contacted organizations by phone a maximum of 5 times before considering an organization non-responsive.

5.1 Defining Completed Surveys

Prior to survey administration, the ETC Institute Team and SEMCOG determined the key variables necessary for defining what would constitute a completed survey for each of the various survey types. Those key required variables are listed in this section. For a more complete list of data variables captured by each survey type, refer to the Tables in section 2.1.

Key Variables for Establishment Surveys

- **Industry sector of the establishment –** This survey was intended to target all the major industry sectors that generate truck trips in the region. So, it was important to confirm the type of business or sector the establishments belonged to.
- **Number of inbound and outbound trucks –** This was necessary to get an estimate of the number of truck trips generated at the surveyed establishments. It was used to compute the average number of truck trips by industry sector. Outbound trucks are those trucks that had the origin trip end at the establishment being surveyed, that is, trucks leaving the establishment were captured as outbound trucks. The inbound trucks are those trucks that had their destination trip end at the establishments, that is, trucks arriving at the establishments. The outbound trip ends also are known as productions, while the inbound trip ends are known as attractions.
- **Number of employees –** This information was available from the sampling frame and was reconfirmed with the respondent establishments. This variable was used in conjunction with the number of inbound and outbound trucks to derive truck trips per employee by industry sector, which is the truck trip rate.
- **Traveling within the SEMCOG region –** The current model captures both internal and external truck trips, and so it was important to identify truck trips that have both their trip ends within the region versus those that do not, particularly those that have a trip end in Canada.

Key Variables for Vehicle Surveys

- Location where vehicle is based
- Primary use for this vehicle

- Vehicle's classification
- Whether vehicle was registered as a commercial vehicle in Michigan (added after project initially started)

Key variables for Vehicle Travel Diaries

- Origin and destination, including all intermediate stop locations – addresses or latitude/longitude coordinates, activity purpose at the stop (same as land use of the stop) was reviewed as a post-process;
- Time of day departure or arrival at intermediate stops and final destination.

5.2 Establishment Survey and Travel Diary Administration

During the months of April 2017 and July 2017 ETC Institute administered the establishment survey portion of the main study. Although some of the 24-hour travel diaries were collected during that time, a majority were collected from April 2017- April 2018. Travel diaries were not collected on Holidays or during times local schools were not in session.

The first point of contact with each sampled firm was via computer-aided telephone interviewing (CATI) with ETC Institute's specialized team of business interviewers. These were senior interviewers who specialize in conducting business surveys and have learned to successfully navigate gatekeepers and efficiently negotiate the business chain of command to reach the decision-maker. SEMCOG provided a cover letter (see Appendix pg. A-1), explaining the importance of the study on the economy, traffic congestion, and quality of life in the region, which the interviewers could immediately fax or email to the decision-maker in real-time to both legitimize the study and aid in recruitment. The establishment survey was also administered at that point.

After completion of the establishment survey, organizations were asked to participate in the vehicle survey as well as the vehicle travel diary. Once an organization agreed to participate in the 24-hour travel diary they could participate via email (scanned copies of the travel diaries), by phone, or onsite participation. If a company submitted a travel diary via email, an interviewer from ETC Institute called the driver to verify the information submitted was correct and that there were no questions. The final count of usable vehicle travel diaries was updated in the centralized database.

Establishments who participated in the vehicle travel diary portion of the study were also asked to participate in the GPS portion of the study. For those willing to participate in the GPS portion of the study, a field staff representative from ETC Institute followed up with an onsite visit to the establishment.

5.3 Onsite Establishment Visit for GPS Portion of the Study

ETC Institute field staff visited the recruited establishments the day prior to the start of their assigned travel period and provided the forms and GPS devices. Whenever possible, the ETC Institute field staff spoke directly with the drivers and installed the GPS devices in the sampled trucks. ETC Institute field staff would then schedule an appointment to pick up the completed forms and equipment.

The day following the end of the travel period, the ETC Institute field staff would return to the site and retrieve the forms and equipment. ETC Institute field staff updated the centralized database to show that retrieval was completed and note the number of completed vehicle travel diaries and vehicle GPS probe data files. Staff uploaded the vehicle GPS probe data files to a secure site for processing into the final data set.

5.4 Quality Assurance and Control (QA/QC)

The ETC Institute Team developed and implemented appropriate measures customized for each of these survey components based on the survey instrument and data structure. The ETC Institute Team utilized a comprehensive QA/QC program that began with the survey instrument design where we ensure that every data element is appropriately addressed, and each survey question is crafted to maximize respondent comprehension and accuracy of response. The final survey instrument was designed to follow a logical progression of data to avoid question-order bias and to elicit all required information effectively.

Another critical step in the QA/QC process was conducting all surveying in-house with surveyors, supervisors, and managers who have a comprehensive understanding of surveying through project-specific training. The ETC Institute Team also ensured representative samples using incentives, and by establishing and effectively implementing quota controls. The final step in the QA/QC process was tracking, coding, correcting, and validating survey results. ETC Institute used several techniques in this area to maximize data quality, including:

- The first was to silently monitor surveys in progress to ensure that surveyors asked all questions consistently and in a neutral fashion during phone interviews.
- The phone interviews were conducted using a Computer Aided Telephone Interview (CATI) technique where, the interviewer followed a preprogrammed script (See Appendix C) which enabled proper skips and branching patterns. The CATI program included supplementary text to help the interviewer to assist the respondent with their responses.
- The CATI program also included reasonableness and logical checks to improve data quality. These checks were programmed into the survey instrument and brought to the surveyor's attention so that they could be resolved with the respondent on a real-time basis, eliminating the need for a subsequent call-back. Some examples of automated checks included, but were not limited to:
    - If a respondent indicated that there were trucks that were located at their facility, but then subsequently indicated that no trucks left the facility, the interviewer would clarify or correct the responses to these two questions.
    - Respondents were asked to indicate what percent of all trucks leaving the facility left full, empty, or partially full. The same questions were asked about arriving trucks. The automated program would add the results for each of these series of questions to ensure that the responses balance. If the responses do not balance, then the interviewer would revisit the responses to those questions.
    - If the respondent indicated that more than 50% of all trucks go outside the SEMCOG region, the respondents would be asked to tell us about their product and destination, providing a logical reason for this travel pattern.
    - Establishments that were within a predetermined list of NAICS codes were asked to provide the type and percentage of each commodity type that they ship out or deliver. The automated program ensured that the percentage of the primary product was larger or equal to the percentage of the secondary product. Otherwise, the primary and secondary product categories and percentages were reversed.
    - In respect of the respondent's time, each QC check included a comment field, so the interviewer could record the respondent's clarification if needed and complete the survey in a timely manner, then later go back and correct the responses as needed.

- "Other" establishment category responses that do not clearly fit into one of the pre-determined categories in the survey were reviewed through a combination of internet searches and callbacks to determine the appropriate category for the survey.
- During survey transcription, a visual review of each completed survey was conducted by an analyst to ensure that all skip patterns functioned correctly. In addition, all open-ended and "other" responses were checked to ensure that they were logical and sufficiently met the needs of the survey.

5.4.1 GPS Probe Data QA/QC Checks

The ETC Institute Team has developed a series of QA/QC checks for travel behavior surveys focusing on trip rates, trip length distributions by vehicle type and key industry type. These checks were customized for each of the data types. In addition, a set of checks on spatial and temporal consistency of reported and inferred trips was established to assure that vehicle travel diaries and outputs from vehicle probe data processing reasonably matched. This comparative analysis helped impute missing information in one survey by utilizing information from a different survey. In some instances, a well filled-out trip diary may help impute GPS traces with gaps, or vice versa.

More specifically the types of checks applied to the GPS traces included:

1) Smoothing out speed due to GPS noise. A new smoothed speed was calculated using a 15 second rolling mean.
2) A speed threshold of 2.5 mph was applied, and the vehicle was imputed to have stopped any time it fell below this threshold for at least 120s after having been above this threshold.
3) Since noisy GPS data caused an overabundance of imputed stops, an additional distance threshold was applied such that if any stop was < 0.07 miles from the previous stop, it was filtered out as a likely spurious stop. This threshold was chosen by examination of several particularly noisy records such that it removed nearly all spurious stops without inadvertently removing legitimate stops that happen to be located nearby one another.
4) These various thresholds (1-3 above) still leave room for error such as if a legitimate stop lasts less than two minutes, if a vehicle is stuck in slow traffic for a significant time, or if a vehicle drives to different locations on the same site. ETC Institute therefore visually examined every record in which diary stops and putative imputed stops were displayed. This was done to remove spurious imputed stops and (less-frequently) add "imputed" stops for cases where there was a diary stop without a matching imputed stop due to not exceeding the time threshold.

The manual review that ETC Institute staff conducted to compare trip diary stops to GPS imputed stops included looking at the following types of figures below and on the following page. In both examples, the maps blue markers represented GPS imputed stops and orange markers represented trip diary stops. The maps were interactive and allowed ETC Institute staff to zoom in and click the indicated pins, revealing the stop and depart times as well as the trip number sequence.

Figure 1. GPS Imputed Stops Compared to Travel Diary Stops (Example 1)

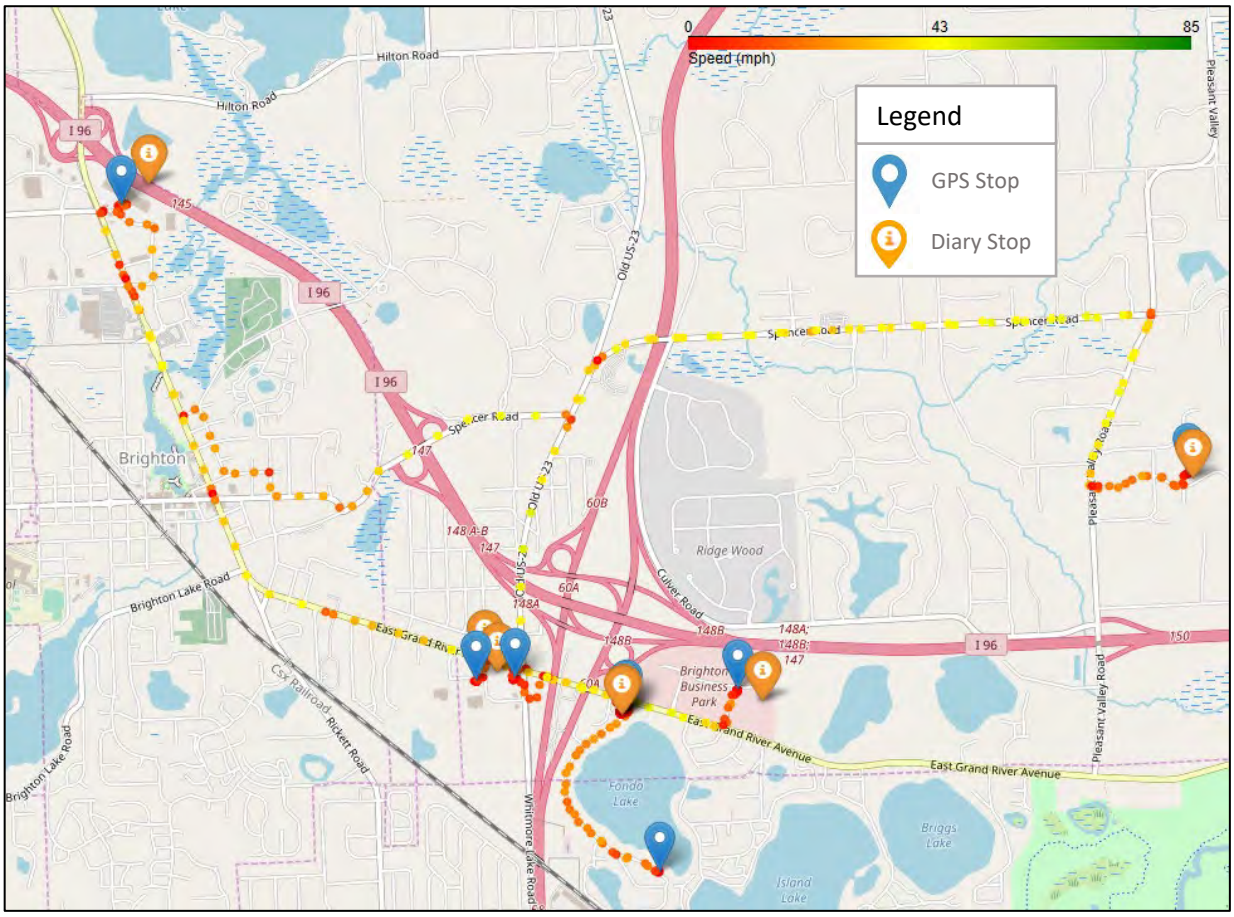
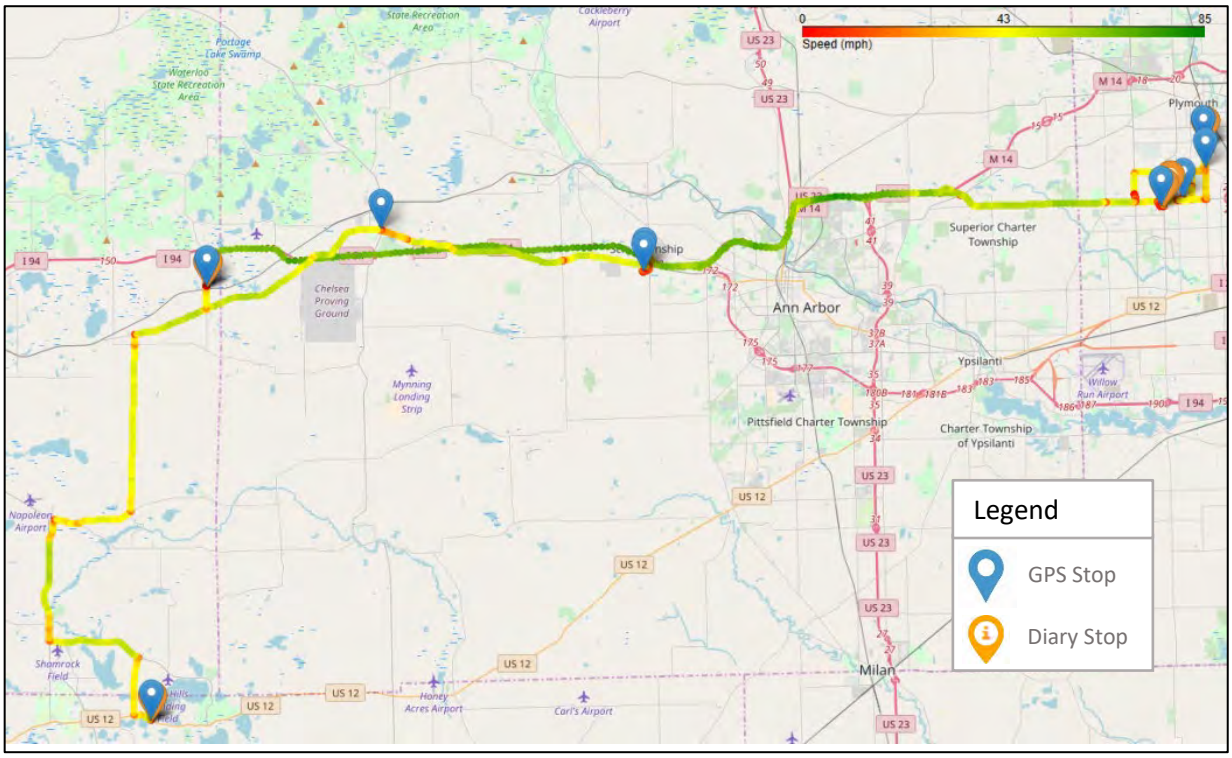


Figure 2. GPS Imputed Stops Compared to Travel Diary Stops (Example 2)



6. Data Expansion Procedures

After the collection of the survey data was completed based on the previously discussed approach in the sample design section of this report, the expansion of the collected data began. During the sample design phase, theoretical numbers were produced to help guide the collection effort. During the collection effort, the surveying goals based on the regional vehicle figures were adjusted so that the total number of vehicles by type, industry and size stayed the same but slight modifications were made to the way those figures were stratified. Ultimately, three classes of regional vehicle figures were stratified in the manner shown in Tables 34, 35, and 36.

Table 34. Final Estimated # of Single Unit Vehicles Owned or Leased (Expansion)

		NUMBER OF EMPLOYEES		Total
GROUP	NAICS INDUSTRY/CODE(S)	A=Less than 10	10 or more	
1=Agricultural, Mining, Utilities/Construction	Agriculture (11)	10,185	3,267	13,452
	Mining (21)			
	Utilities/Construction (22-23)			
2=Manufacturing	Manufacturing (31-33)	2,011		2,011
3=Wholesale, Warehouse & Storage	Wholesale Trade (42)	2,543		2,543
	Warehousing and Storage (493+)			
4=Retail	Retail Trade (44-45)	3,019		3,019
5=Transportation	Transportation (48-492)	2,888	1,528	4,416
6=Services	Services (51-56, 62, 71, 72, 81)	5,490		5,490
7=Education and Government	Educational Services (61)			
	Public Administration (92)			
Total				**30,932**

Table 35. Final Estimated # of Tractor Trailer Vehicles Owned or Leased (Expansion)

		NUMBER OF EMPLOYEES		Total
GROUP	NAICS INDUSTRY/CODE(S)	A=Less than 10	10 or more	
1=Agricultural, Mining, Utilities/Construction	Agriculture (11)	3,512	2,983	6,496
	Mining (21)			
	Utilities/Construction (22-23)			
2=Manufacturing	Manufacturing (31-33)	1,792		1,792
3=Wholesale, Warehouse & Storage	Wholesale Trade (42)	3,383		3,383
	Warehousing and Storage (493+)			
4=Retail	Retail Trade (44-45)	1,251		1,251
5=Transportation	Transportation (48-492)	5,417	11,568	16,985
6=Services	Services (51-56, 62, 71, 72, 81)	963		963
7=Education and Government	Educational Services (61)			
	Public Administration (92)			
Total				**30,871**

Table 36. Final Estimated # of Light-duty Vehicles Owned or Leased (Expansion)

GROUP	NAICS INDUSTRY/CODE(S)	NUMBER OF EMPLOYEES		Total
		A=Less than 10	10 or more	
1=Agricultural, Mining, Utilities/Construction	Agriculture (11)	51,615	10,905	62,520
	Mining (21)			
	Utilities/Construction (22-23)			
2=Manufacturing	Manufacturing (31-33)	5,423	4,706	10,129
3=Wholesale, Warehouse & Storage	Wholesale Trade (42)	8,441	3,806	12,247
	Warehousing and Storage (493+)			
4=Retail	Retail Trade (44-45)	10,705	3,852	14,557
5=Transportation	Transportation (48-492)	8,770	2,673	11,443
6=Services	Services (51-56, 62, 71, 72, 81)	63,477	14,810	78,287
7=Education and Government	Educational Services (61)	836		836
	Public Administration (92)			
Total				**190,019**

The next step was adding the completed surveys into a similar stratification matrix as Tables 34, 35, and 36. The completed surveys are shown in the tables 37, 38, and 39 below:

Table 37. Completed # of Surveyed Single Unit Vehicles Owned or Leased

GROUP	NAICS INDUSTRY/CODE(S)	NUMBER OF EMPLOYEES		Total
		A=Less than 10	10 or more	
1=Agricultural, Mining, Utilities/Construction	Agriculture (11)	52	57	109
	Mining (21)			
	Utilities/Construction (22-23)			
2=Manufacturing	Manufacturing (31-33)	37		37
3=Wholesale, Warehouse & Storage	Wholesale Trade (42)	34		34
	Warehousing and Storage (493+)			
4=Retail	Retail Trade (44-45)	30		30
5=Transportation	Transportation (48-492)	44	53	97
6=Services	Services (51-56, 62, 71, 72, 81)	75		75
7=Education and Government	Educational Services (61)			
	Public Administration (92)			
Total				**382**

Table 38. Completed # of Surveyed Tractor Trailer Vehicles Owned or Leased

GROUP	NAICS INDUSTRY/CODE(S)	NUMBER OF EMPLOYEES		Total
		A=Less than 10	10 or more	
1=Agricultural, Mining, Utilities/Construction	Agriculture (11)	20	47	67
	Mining (21)			
	Utilities/Construction (22-23)			
2=Manufacturing	Manufacturing (31-33)	16		16
3=Wholesale, Warehouse & Storage	Wholesale Trade (42)	16		16
	Warehousing and Storage (493+)			
4=Retail	Retail Trade (44-45)	17		17
5=Transportation	Transportation (48-492)	69	171	240
6=Services	Services (51-56, 62, 71, 72, 81)	6		6
7=Education and Government	Educational Services (61)			
	Public Administration (92)			
Total				**362**

Table 39. Completed # of Surveyed Light-duty Vehicles Owned or Leased

GROUP	NAICS INDUSTRY/CODE(S)	NUMBER OF EMPLOYEES		Total
		A=Less than 10	10 or more	
1=Agricultural, Mining, Utilities/Construction	Agriculture (11)	172	134	306
	Mining (21)			
	Utilities/Construction (22-23)			
2=Manufacturing	Manufacturing (31-33)	72	70	142
3=Wholesale, Warehouse & Storage	Wholesale Trade (42)	47	80	127
	Warehousing and Storage (493+)			
4=Retail	Retail Trade (44-45)	76	60	136
5=Transportation	Transportation (48-492)	52	92	144
6=Services	Services (51-56, 62, 71, 72, 81)	160	170	330
7=Education and Government	Educational Services (61)	30		30
	Public Administration (92)			
Total				**1,215**

The next step was to take the estimated number of vehicles by vehicle type, industry group, and size (number of employees) in Tables 34, 35, and 36 which were then divided by the corresponding number of completed surveys in Tables 37, 38, and 39. This step resulted in the expansion factors for three classes of vehicle, as seen below:

Table 40. Expansion Factors for Single Unit Vehicles Owned or Leased

GROUP	NAICS INDUSTRY/CODE(S)	EXPANSION FACTOR		Avg. Factor
		A=Less than 10	10 or more	
1=Agricultural, Mining, Utilities/Construction	Agriculture (11)	195.9	57.3	123.4
	Mining (21)			
	Utilities/Construction (22-23)			
2=Manufacturing	Manufacturing (31-33)	54.3		54.3
3=Wholesale, Warehouse & Storage	Wholesale Trade (42)	74.8		74.8
	Warehousing and Storage (493+)			
4=Retail	Retail Trade (44-45)	100.6		100.6
5=Transportation	Transportation (48-492)	65.6	28.8	45.5
6=Services	Services (51-56, 62, 71, 72, 81)	73.2		73.2
7=Education and Government	Educational Services (61)			
	Public Administration (92)			
Avg. Factor				**80.97**

Table 41. Expansion Factors for Tractor Trailer Vehicles Owned or Leased

GROUP	NAICS INDUSTRY/CODE(S)	EXPANSION FACTOR		Avg. Factor
		A=Less than 10	10 or more	
1=Agricultural, Mining, Utilities/Construction	Agriculture (11)	175.6	63.5	97.0
	Mining (21)			
	Utilities/Construction (22-23)			
2=Manufacturing	Manufacturing (31-33)	112.0		112.0
3=Wholesale, Warehouse & Storage	Wholesale Trade (42)	211.4		211.4
	Warehousing and Storage (493+)			
4=Retail	Retail Trade (44-45)	73.6		73.6
5=Transportation	Transportation (48-492)	78.5	67.7	70.8
6=Services	Services (51-56, 62, 71, 72, 81)	160.6		160.6
7=Education and Government	Educational Services (61)			
	Public Administration (92)			
Avg. Factor				**85.28**

Table 42. Expansion Factors for Light-duty Vehicles Owned or Leased

GROUP	NAICS INDUSTRY/CODE(S)	EXPANSION FACTOR		Avg. Factor
		A=Less than 10	B=10-49	
1=Agricultural, Mining, Utilities/Construction	Agriculture (11)	300.1	81.4	204.3
	Mining (21)			
	Utilities/Construction (22-23)			
2=Manufacturing	Manufacturing (31-33)	75.3	67.2	71.3
3=Wholesale, Warehouse & Storage	Wholesale Trade (42)	179.6	47.6	96.4
	Warehousing and Storage (493+)			
4=Retail	Retail Trade (44-45)	140.9	64.2	107.0
5=Transportation	Transportation (48-492)	168.6	29.1	79.5
6=Services	Services (51-56, 62, 71, 72, 81)	396.7	87.1	237.2
7=Education and Government	Educational Services (61)	27.9		27.9
	Public Administration (92)			
Avg. Factor				**156.39**

6.1 Expansion Equation Example

As an example, there were 3,267 estimated “Single Unit” vehicles in Industry Group 1, for organizations with 10 or more employees as shown in the table below.

Table 43. Portion of Table 34 to show Single Unit Vehicles in Industry Group 1

GROUP	NAICS INDUSTRY/CODE(S)	NUMBER OF EMPLOYEES	
		A=Less than 10	10 or more
1=Agricultural, Mining, Utilities/Construction	Agriculture (11)	10,185	3,267
	Mining (21)		
	Utilities/Construction (22-23)		

This number was then divided by the corresponding cell for completed surveys shown in the table below:

Table 44. Portion of Table 37 to show Completed Surveys for Single Unit Vehicles in Industry Group 1

		NUMBER OF EMPLOYEES	
GROUP	NAICS INDUSTRY/CODE(S)	A=Less than 10	10 or more
1=Agricultural, Mining, Utilities/Construction	Agriculture (11)	52	57
	Mining (21)		
	Utilities/Construction (22-23)		

The result of the equation (3,267 ÷ 57 = ~57.3) is shown in table 45, below:

Table 45. Portion of Table 40 to Show Results for Single Unit Vehicles in Industry Group 1

		EXPANSION FACTOR	
GROUP	NAICS INDUSTRY/CODE(S)	A=Less than 10	10 or more
1=Agricultural, Mining, Utilities/Construction	Agriculture (11)	195.9	57.3
	Mining (21)		
	Utilities/Construction (22-23)		

6.2 Appending Expansion Factors to Dataset

To attach the expansion factors to the dataset, "Weight Factor Names" were created based on variables in the "Vehicle" dataset. The variables used to create the weight factor names were based on the same variables used in the stratification shown previously: vehicle type (single unit, tractor trailer, or light-duty), industry group (1-7), and size (based on number of employees). The concatenation of those three variables creates a unique weight factor name that corresponds to a weight factor. The expansion factors were then appended to the "Vehicle" dataset based upon the weight factor name. The expansion factors were then appended to the "Trips" dataset based on the vehicle number and corresponding weight factor in the "Vehicle" dataset.

6.3 Weight Factors Adjustment with GPS Data

The weight factors created during the expansion process were relatively similar for both single unit and tractor trailer as Table 46 below shows. Light-duty vehicles were higher, but this is related to the significant increase in estimated light-duty vehicles based on the results from the added question "Is this vehicle registered as a commercial vehicle in the state of Michigan?"

Table 46. Average Weight Factors by Vehicle Type

Vehicle Type	**Average Weight Factor**
Light Duty	156.4
Single Unit	81.0
Tractor Trailer	85.3
Total	**128.5**

To further update the factors in the dataset, the number of trips generated from the trip diaries were compared to the number of trips reported by those vehicles that had corresponding GPS device stop data. This comparison showed that, in general, there were likely to be slightly more stops listed on the GPS device than were written down in the trip diaries. This is not a surprising result, as respondents to these types of surveys will often omit a small number of stops made during their travel day from their

travel diaries. The under reporting of trips is one of the main purposes for using GPS data collection within these projects. To better represent the number of trips occurring by commercial vehicles within the dataset, the weight factors that were collected previously were multiplied by an under-reporting multiplier that was derived by dividing the number of total GPS stops by the number of total travel diary stops by vehicle type. The resulting factors, or multipliers, are listed below:

Table 47. GPS Under-Reporting Factor by Vehicle Type

	Diary Stops	GPS Stops	Multiplying Factor (GPS Stops/Diary Stops)
Light Duty	2,251	2,500	1.11
Single Unit	878	1,025	1.17
Tractor Trailer	527	616	1.17
Total	**3,656**	**4,141**	**1.13**

These under-reporting factors were then multiplied by the existing weight factors to create a final factor in the dataset.

7. Characteristics of Datasets

This section of the report details some of the characteristics for each of the datasets that were collected during the project. A project dashboard featuring the subsequent items along with some additional functionality is accessible via the following link to the dashboard (www.etcinstitute.com/semcog-cv).

7.1 Establishment Characteristics

During the data collection effort for this project, over 2,800 establishments provided information to ETC Institute staff members regarding their establishment. Below and on the following pages are some of the more interesting findings from the unweighted data.

7.1.1 Location of Establishments

The maps below and on the following pages (Figures 3-9) show the location of establishments (by county) that participated in the establishment portion of the survey.

Figure 3. Location of Establishments in Livingston

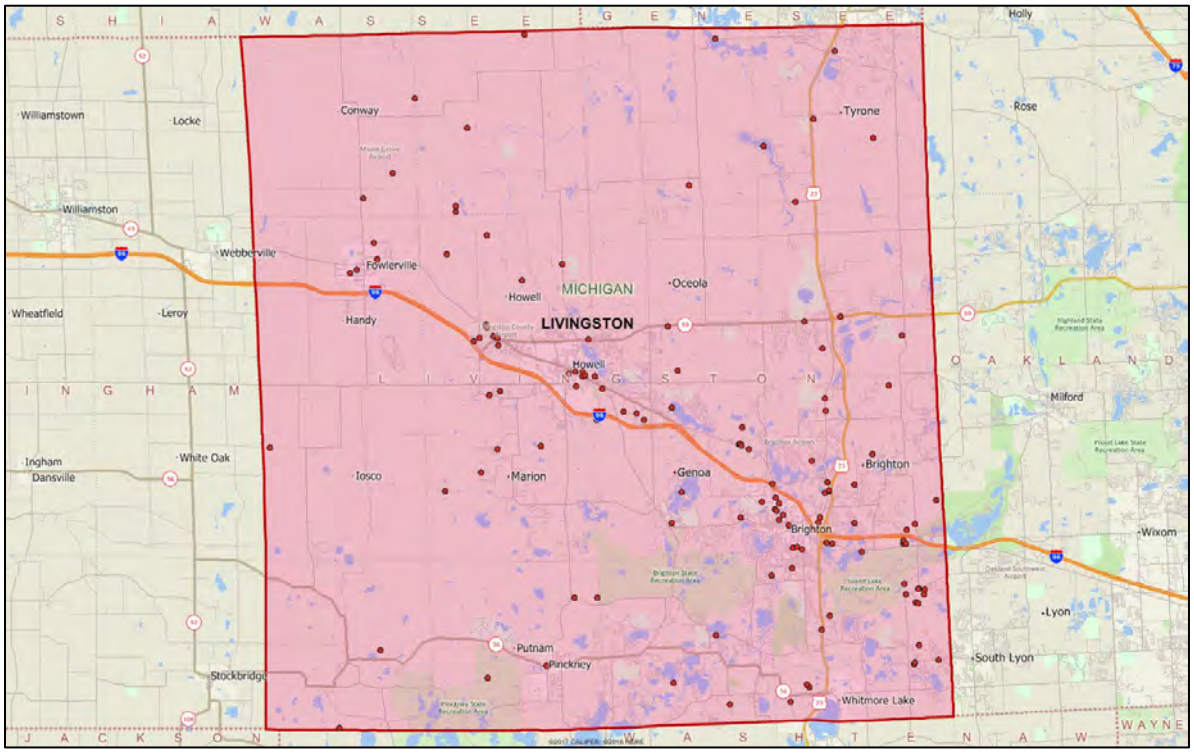


Figure 4. Location of Establishments in Macomb

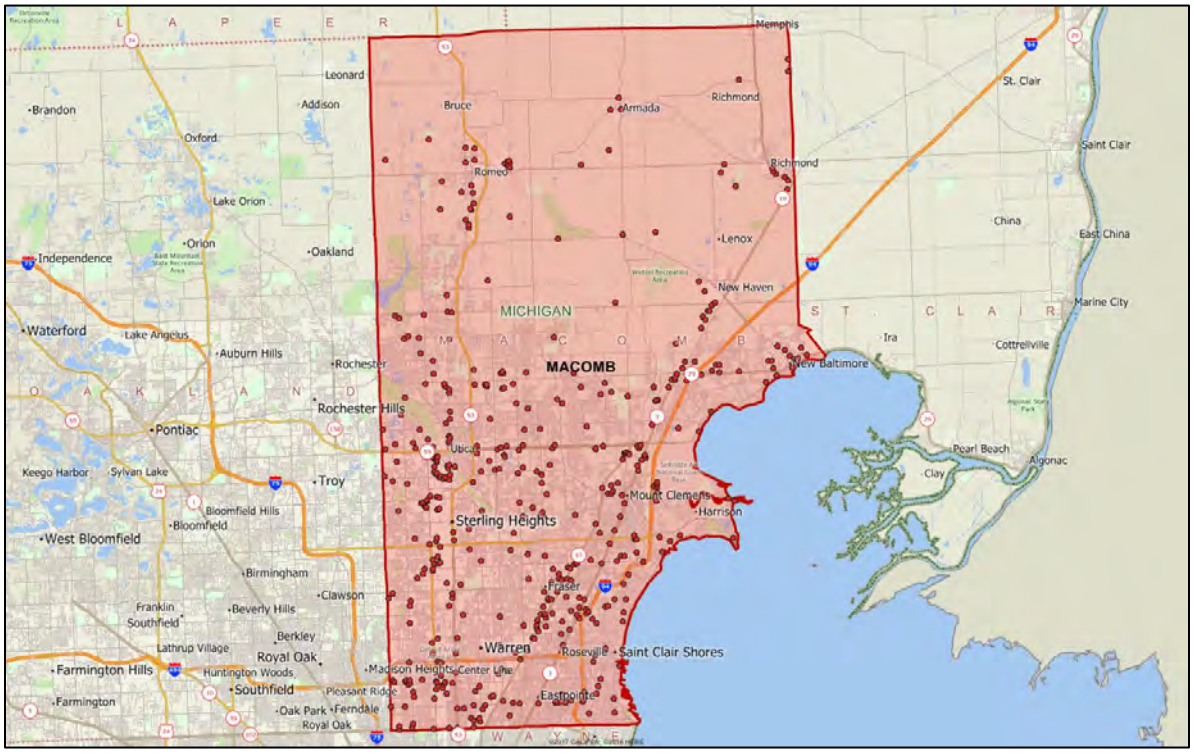


Figure 5. Location of Establishments in Monroe

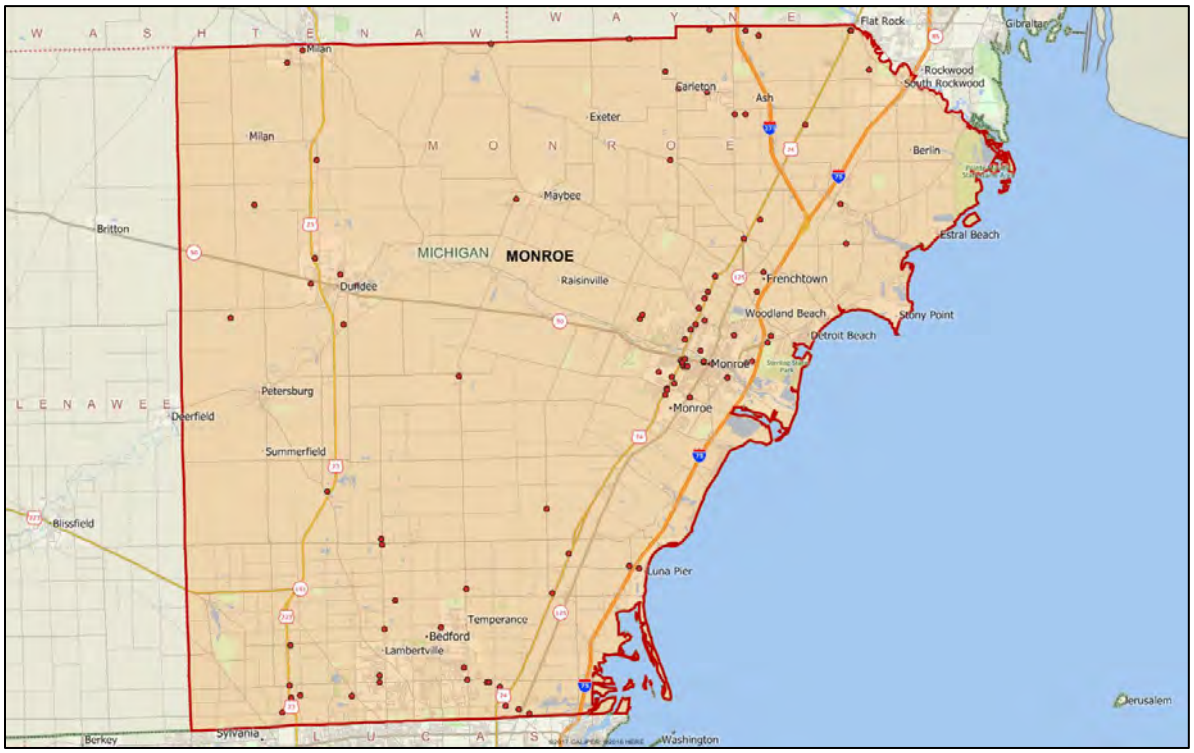


Figure 6. Location of Establishments in Oakland

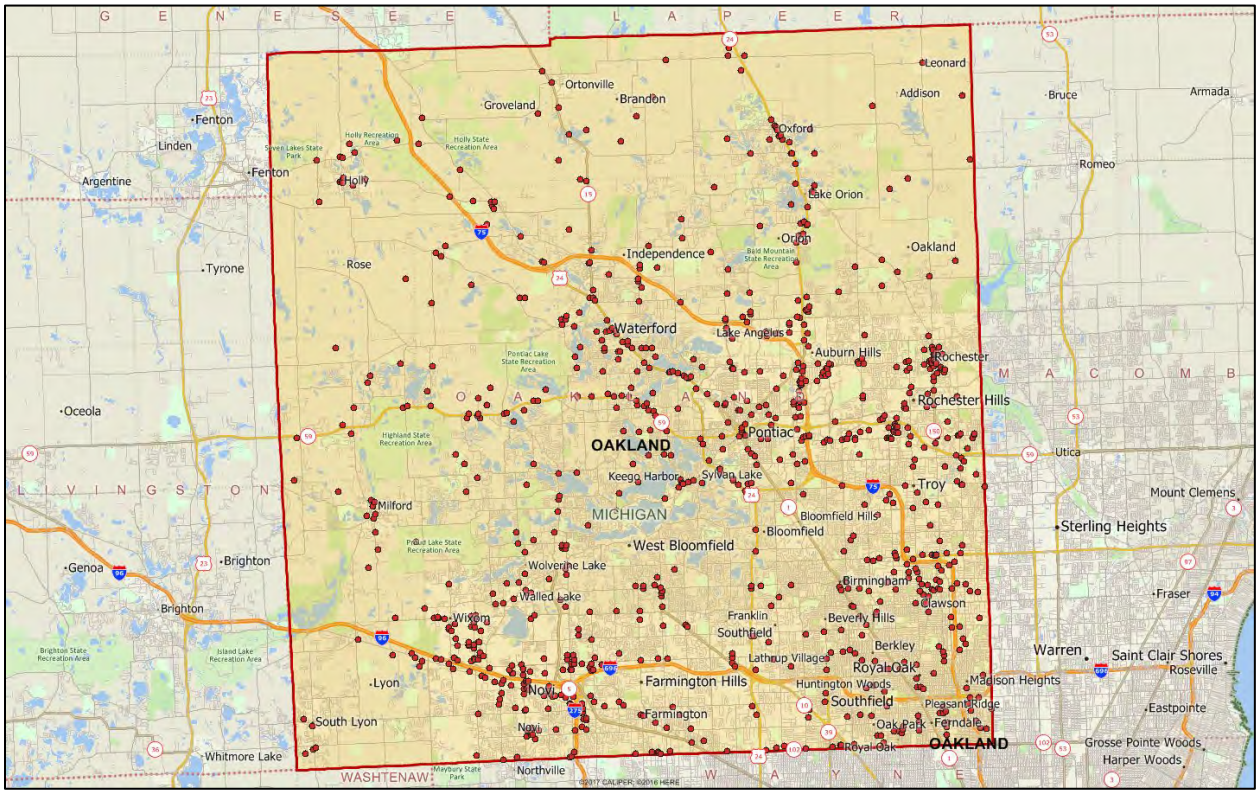


Figure 7. Location of Establishments in St. Clair

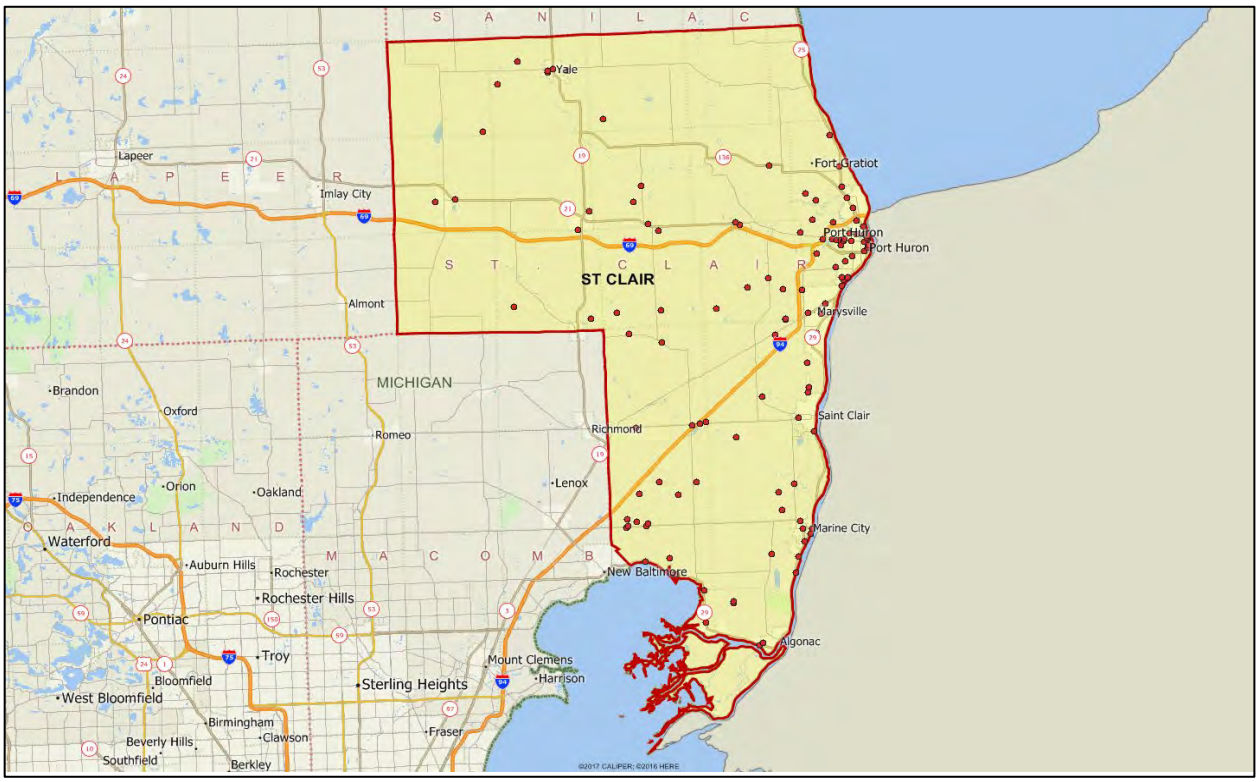


Figure 8. Location of Establishments in Washtenaw

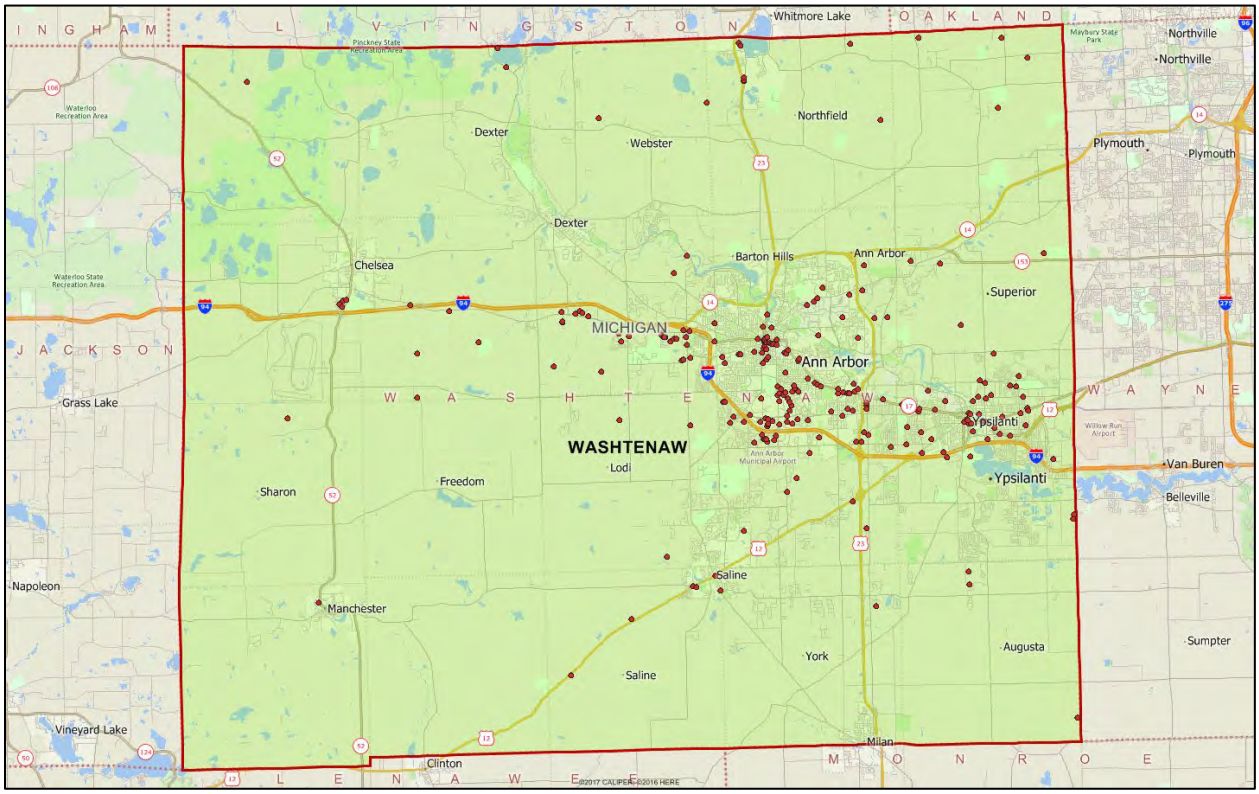


Figure 9. Location of Establishments in Wayne County (Inside Detroit)

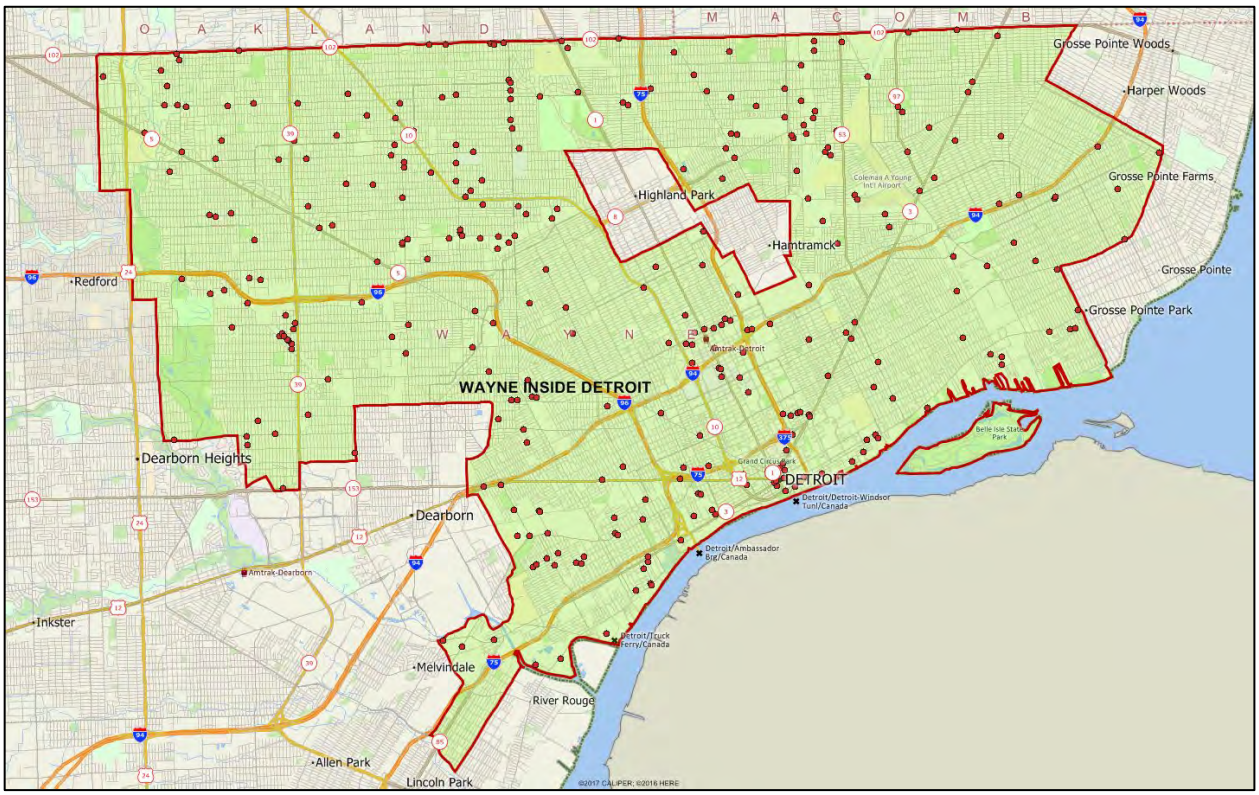
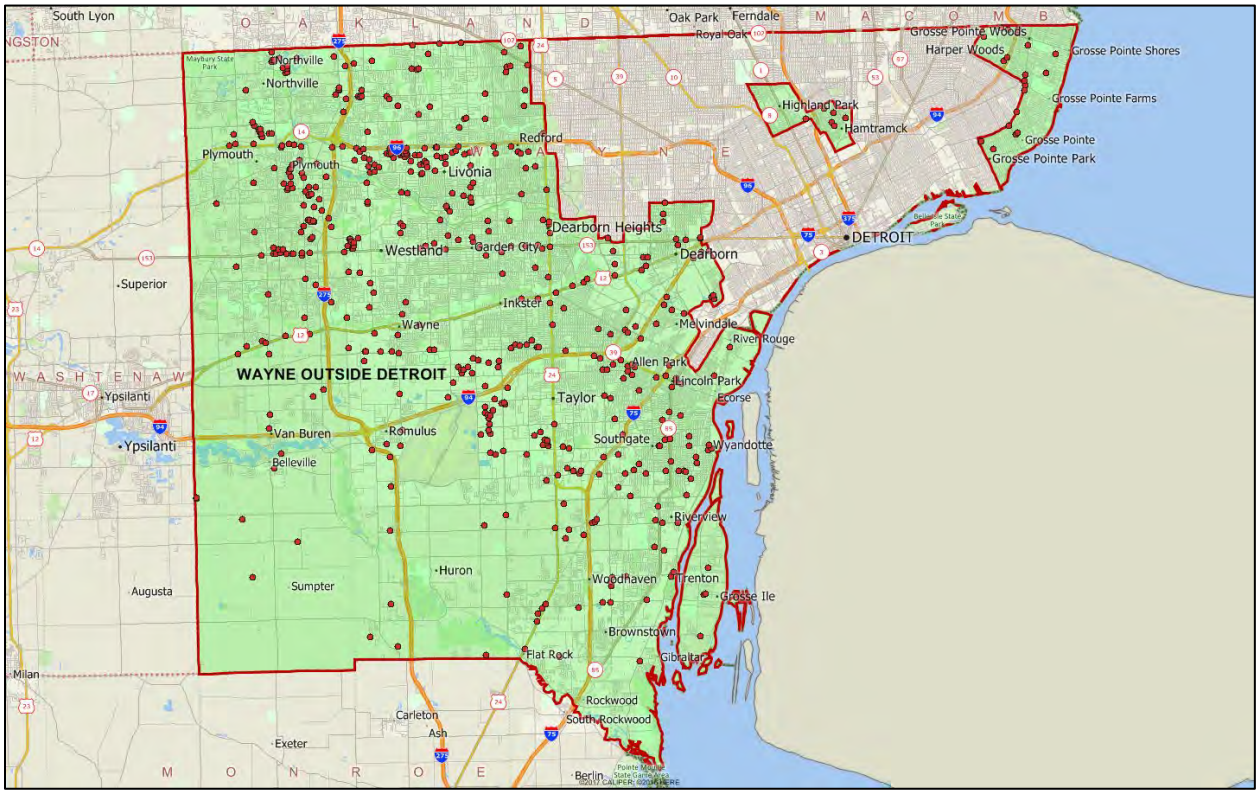


Figure 10. Location of Establishments in Wayne County (Excluding Detroit)



7.1.2 Establishments by County

Overall, Oakland county was the most represented county in the establishment survey with nearly one-third (31.8%) of the records as shown in Figure 11 below. However, Figure 12 on the following page shows that based on the number of estimated establishments per county, Livingston and St. Clair counties had the highest participation.

Figure 11. Establishments by County

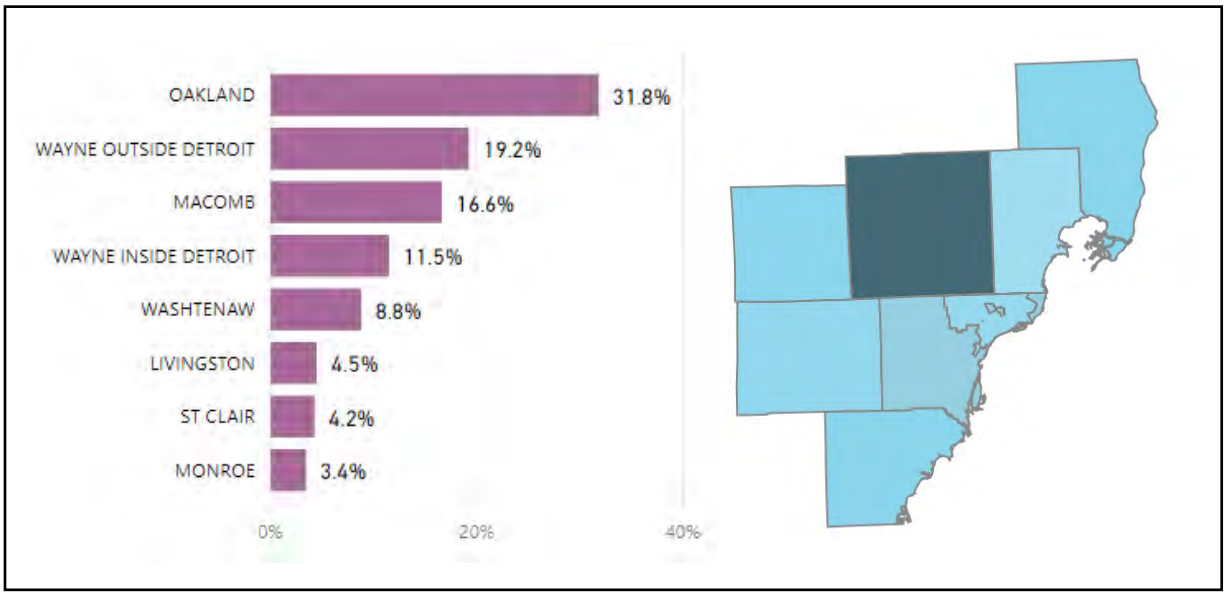
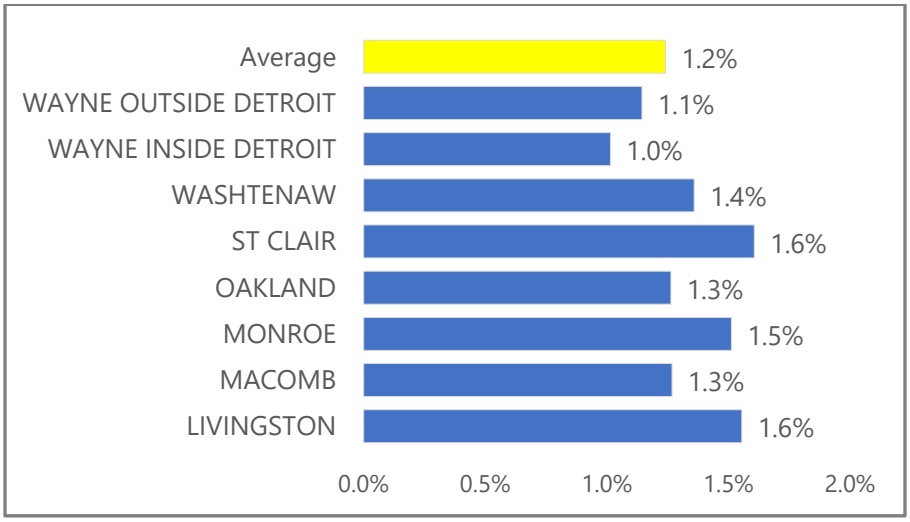


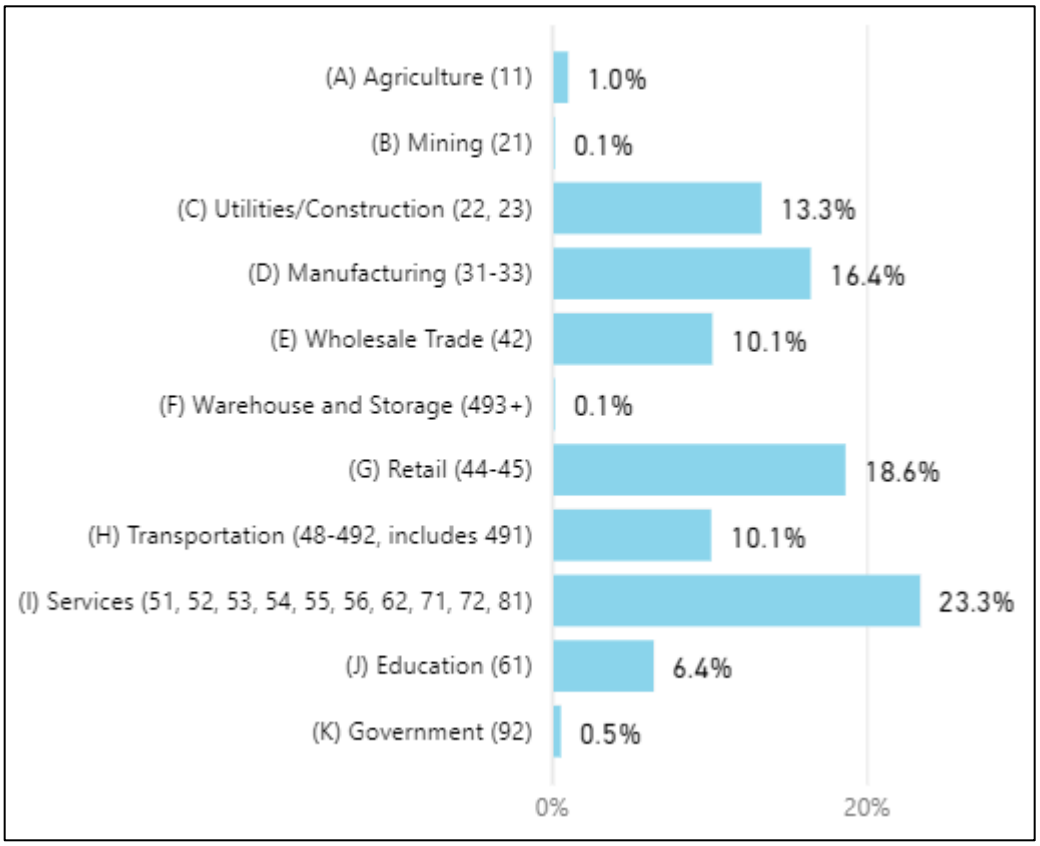
Figure 12. Response by County



7.1.3 Industry Type

Approximately twenty-three percent (23.3%) of the establishments in the establishment survey were in the service industry; 18.6% were in retail, and 16.4% were in manufacturing (Figure 13).

Figure 13. Industry Type



7.1.4 Number of Employees

Almost half (49.6%) of the establishments surveyed had fewer than 10 employees (Figure 14). The mean average number of full-time employees was approximately 24 and the mean average number of part-time employees was approximately 6, as shown in Figures 14 and 15 below and on the following page.

Figure 14. Number of Employees

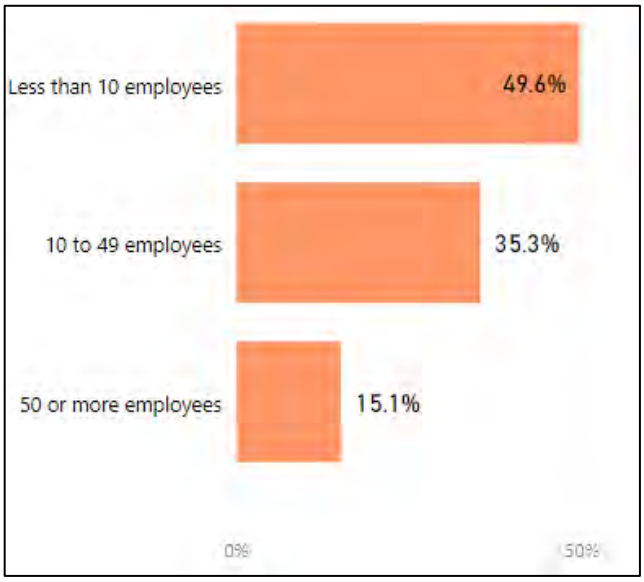


Figure 15. Average Number of Employees

6	23.83	0	5.86
Full-Time (Median)	Full-Time (Avg)	Part-Time (Median)	Part-Time (Avg)

7.1.5 Vehicles Utilized for Business Purposes

For businesses that utilize vehicles for business purposes, the average (mean average) business owns/leases almost 8 vehicles and uses approximately 2 vehicles that they do not own (Figure 16) . The median averages, however, are much different. Considering that almost half the number of businesses in the establishment survey had fewer than 10 employees, it is easy to understand the reason for the discrepancy between median and mean averages.

Figure 16. Vehicles Utilized for Business Purposes (Owned and Not Owned)

2	7.68	0	2.47
Total Vehicles Owned/Leased (Median)	Total Vehicles Owned/Leased (Avg)	Median of Total Vehicles NOT Owned	Average of Total Vehicles Not Owned

7.1.6 Participation in Travel Diaries

Over one-quarter (27.5%) of the establishments who participated in the establishment survey participated in the travel diary portion of the project.

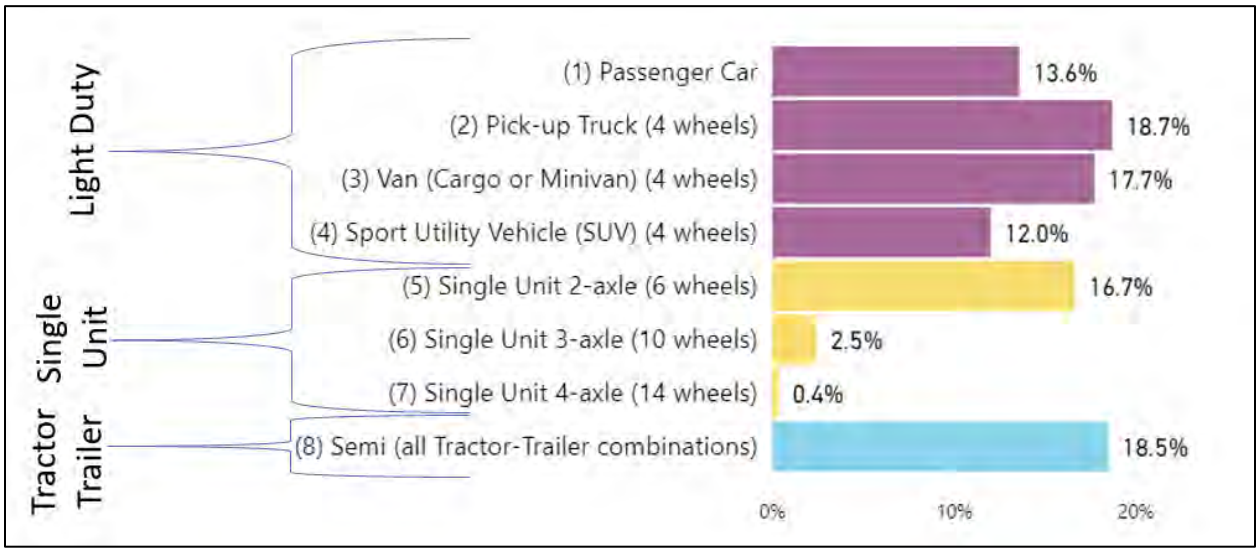
7.2 Vehicle Characteristics

During the data collection effort for this project, 2,848 establishments participated in the establishment portion of the survey and approximately 800 of those establishments provided information regarding over 1,900 vehicles. On the following pages are some of the more interesting findings from the unweighted data.

7.2.1 Vehicle Types (Specific)

The three most common types of vehicles in the vehicle dataset were Pick-up Trucks (18.7%), Semi-Tractor Trailers (18.5%), and Vans/Cargo/Minivan (17.7%) (Figure 17).

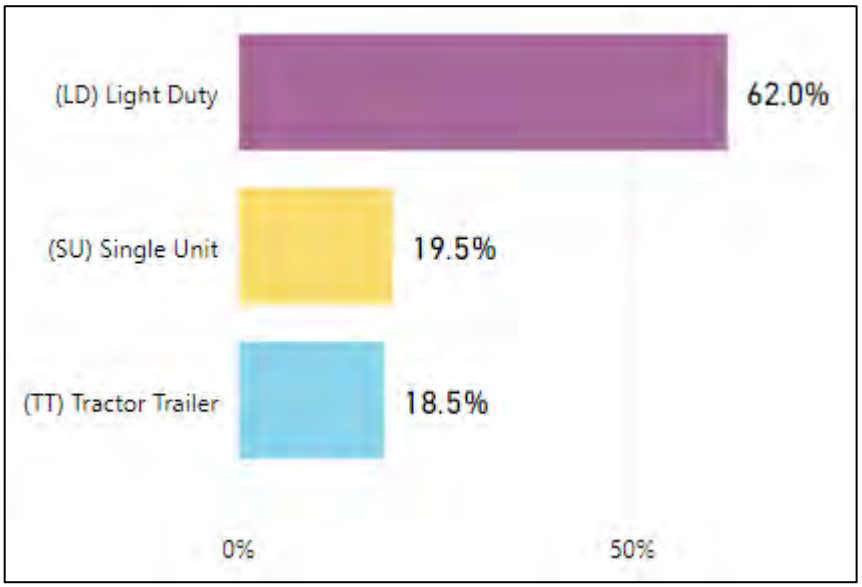
Figure 17. Vehicle Types (Specific)



7.2.2 Vehicle Types (General)

The more specific vehicle types mentioned previously were recoded into three categories for sampling plan and expansion purposes during this project. Most vehicle types collected fit into the “Light-duty” category (62.0%, Figure 18).

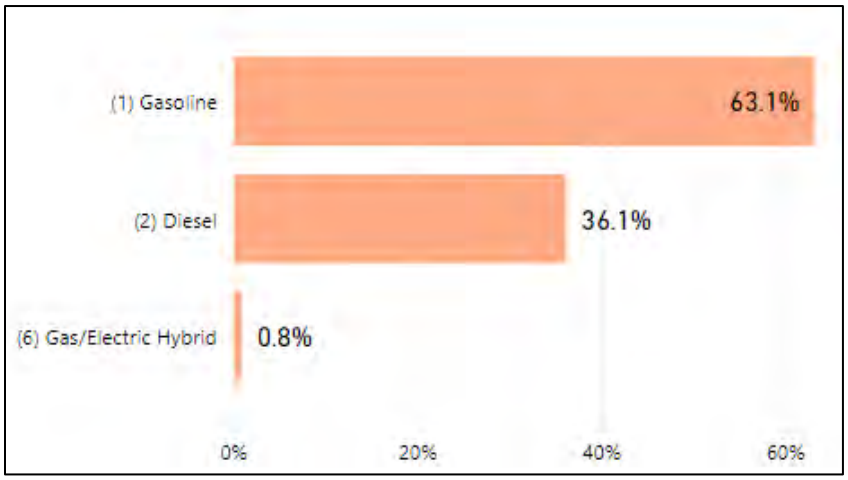
Figure 18. Vehicle Types (General)



7.2.3 Fuel Type

Gasoline (63.1%) was the most common source of fuel in the vehicle dataset (Figure 19), followed by diesel (36.1%) and gas/electric hybrids (0.8%).

Figure 19. Fuel Type



7.3 Trip Characteristics

During the data collection effort for this project, ETC Institute received information for more than 1,900 vehicles. Of those, more than 1,700 vehicles had information regarding trip data on a specific travel day indicating all stops reported by the driver of that vehicle during the course of that workday. Virtually all reported trips were completed on weekdays, with very few reported for a weekend day if the participant indicated such travel was representative of typical workday travel for that vehicle. The following tables and graphs in this section include all trips collected during the trip diary portion of the survey. Some of the more interesting findings from the unweighted data are as follows.

7.3.1 Origin Location by Destination Location

Each origin and destination for every one-way trip in the trip dataset was tagged either with the appropriate study area county or "outside study region" for those locations that were not within the study area. Table 48 below shows that the highest percentage of overall paired locations were trips that originated in Oakland County and ended in Oakland County (16.2%); followed by trips that originated in the Wayne County (Outside of Detroit) and ended in Wayne County (Outside of Detroit) (13.5%), and trips that originated in Macomb County and ended in Macomb County (10.4%).

Table 48. Origin Location by Destination Location (Trips)

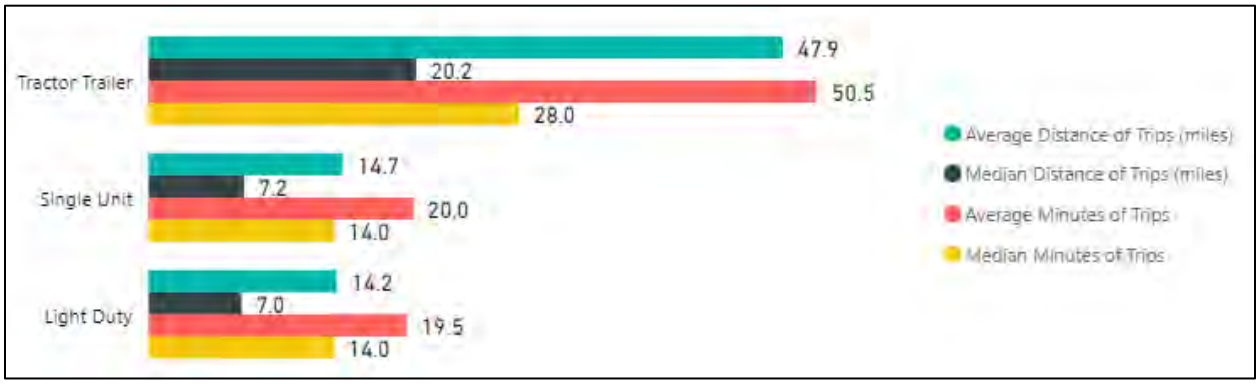
Origin Location (Vertical) by Destination Location (Horizontal) Table (Grand Total %)

ORIGIN	(1) LIVINGSTON	(2) MACOMB	(3) MONROE	(4) OAKLAND	(5) ST CLAIR	(6) WASHTENAW	(7) WAYNE INSIDE DETROIT	(8) WAYNE OUTSIDE DETROIT	(9) OUTSIDE STUDY REGION	Total
(1) LIVINGSTON	2.80%	0.05%	0.03%	0.60%	0.01%	0.37%	0.10%	0.21%	0.26%	**4.43%**
(2) MACOMB	0.03%	10.39%	0.10%	2.05%	0.35%	0.10%	0.78%	0.97%	0.44%	**15.22%**
(3) MONROE	0.02%	0.07%	2.36%	0.20%	0.02%	0.22%	0.08%	0.45%	0.44%	**3.86%**
(4) OAKLAND	0.68%	2.21%	0.17%	16.24%	0.08%	0.62%	1.77%	2.11%	0.74%	**24.62%**
(5) ST CLAIR	0.01%	0.33%	0.01%	0.05%	1.85%		0.03%	0.10%	0.25%	**2.65%**
(6) WASHTENAW	0.37%	0.07%	0.23%	0.69%		8.76%	0.17%	1.07%	0.45%	**11.81%**
(7) WAYNE INSIDE DETROIT	0.09%	0.73%	0.14%	1.61%	0.06%	0.24%	5.16%	2.28%	0.29%	**10.59%**
(8) WAYNE OUTSIDE DETROIT	0.21%	1.08%	0.43%	2.19%	0.05%	1.13%	2.23%	13.47%	0.75%	**21.53%**
(9) OUTSIDE STUDY REGION	0.18%	0.35%	0.39%	0.76%	0.23%	0.38%	0.22%	0.66%	2.13%	**5.30%**
Total	**4.40%**	**15.28%**	**3.87%**	**24.38%**	**2.65%**	**11.82%**	**10.56%**	**21.31%**	**5.74%**	**100.00%**

7.3.2 Google Estimated Distance and Duration of Trips

For each trip in the trip dataset, the Google API was used to estimate the distance between the origin and destination stops and the duration that trip would likely have taken. The mean average and median results by vehicle type are shown in Figure 20 below.

Figure 20. Google Estimated Distance and Duration of Trips by Vehicle Type



7.3.3 Most Popular Origin Stops by County

The latitude and longitude coordinates for each origin and destination stop were fixed to two decimal places to give a slightly more generalized representation of stop activity. Then the coordinates were mapped to show where the heaviest stop activity was in the study area, according to the unweighted trip dataset. The colors represent a specific county in the study area, and the size of the circle represents the number of stops (the larger the circle the more stops in the dataset, minimum of 15 stops are required for display in this map).

Figure 21 displays the origin latitude and longitude coordinate pairs that were the most common in the trip dataset. For example, the arrow on the first map is pointing to a larger black circle in Wayne County (Outside of Detroit) that represents the coordinate pair 42.23, -83.32 or (42°13'48.0"N 83°19'12.0"W). The circle is larger than some others because there were 38 origin stops in the trip dataset that had that latitude and longitude pair combination. Figure 22 shows similar information, except it displays the most popular destinations' paired coordinates.

Figure 21. Most Popular Origin Stop Areas (Coordinates fixed to two decimal locations, minimum 15 stops)

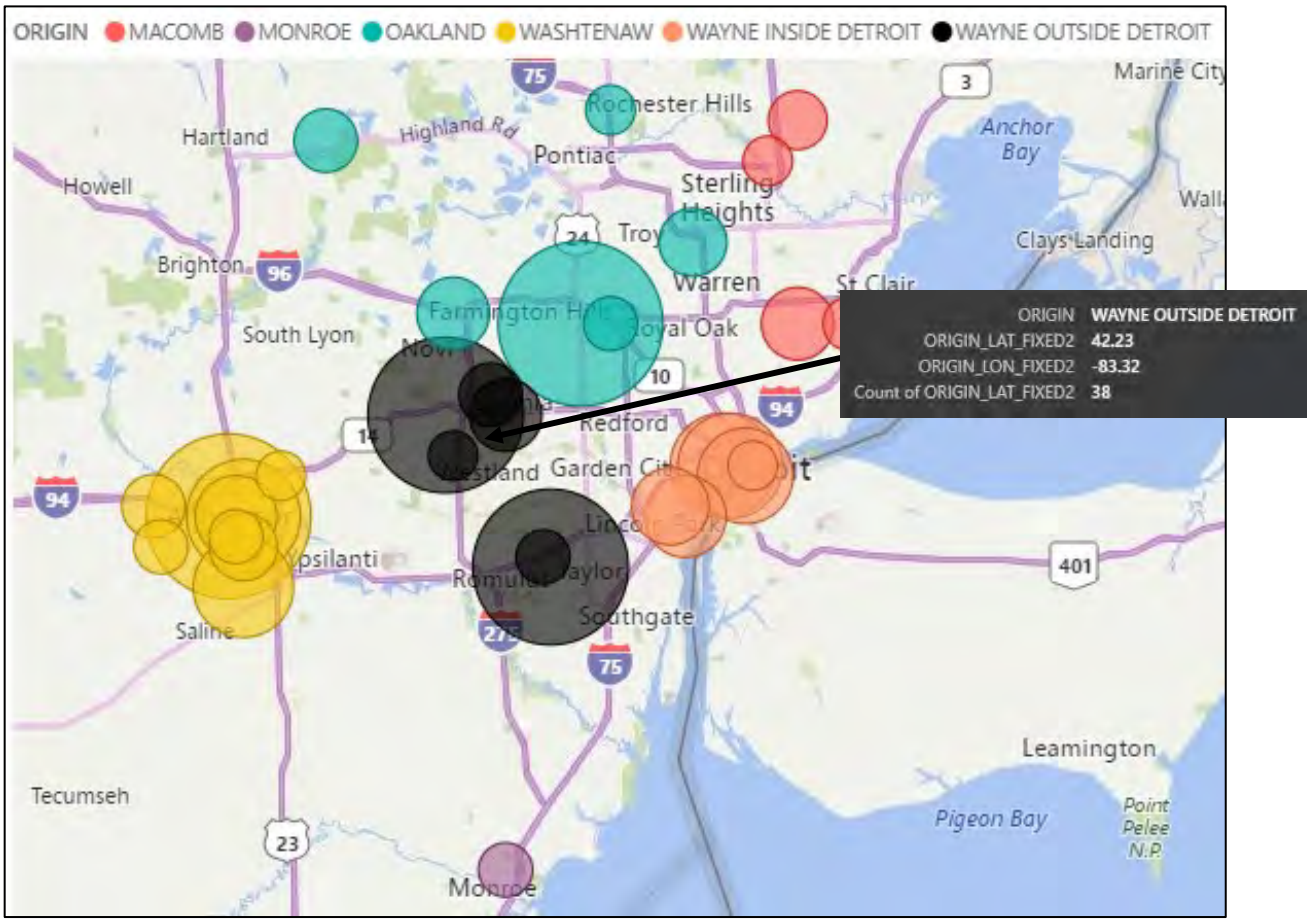
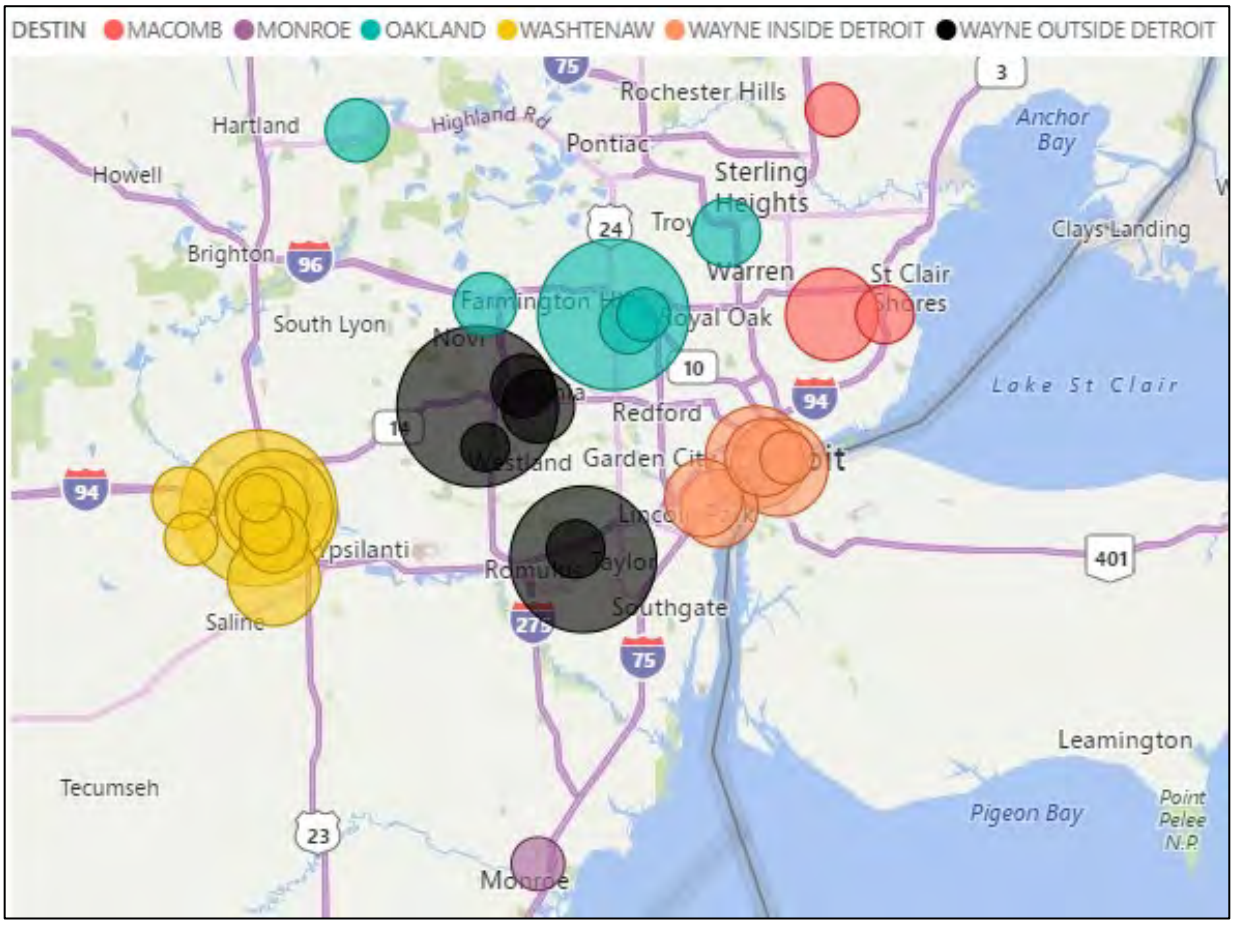


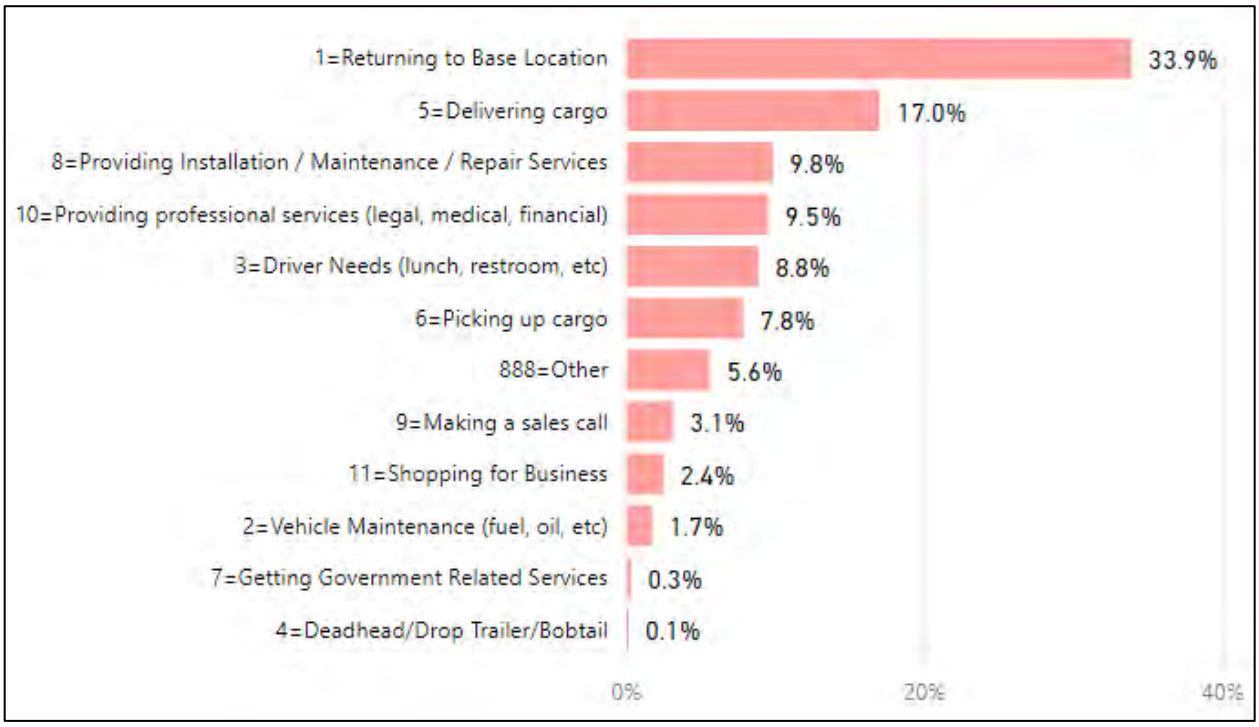
Figure 22. Most Popular Destination Stop Areas (Coordinates fixed to two decimal locations, minimum 15 stops)



7.3.4 Stop Activity

Respondents were asked to record their activity at each stop. Responses are summarized in Figure 23, with the most common selected answer choice being “Returning to Base Location” (33.9%) followed by “Delivering Cargo” (17.0%) and “Providing Installation/Maintenance/Repair Services” (10.3%).

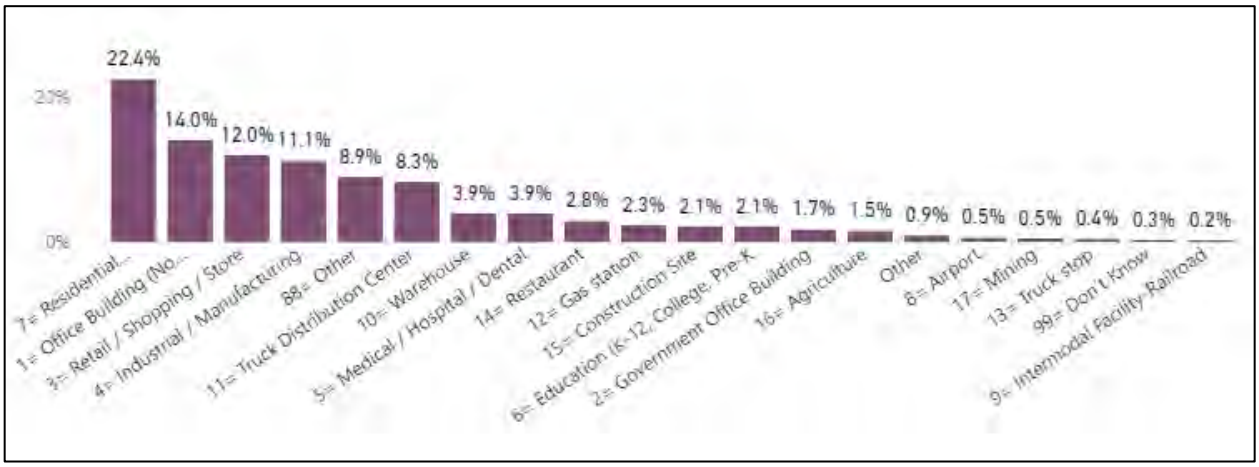
Figure 23. Stop activity frequencies



7.3.5 Stop Place Activity

Respondents were asked to record the type of place they were at for each stop in the travel diary. The most common selected answer choice was "Residential" (22.4%); followed by "Office Building" (14.0%), and "Retail/Shopping/Store" (12.0%) (Figure 24).

Figure 24. Stop place activity frequencies



Finally, we examined some of the key statistics related to commercial vehicle models and created origin-destination (OD) truck trip tables based on expanded survey data that are consistent with truck counts in the SEMCOG region.

7.4 Travel Demand Model Development

The establishment surveys and trip diaries were collected in a manner that should support the development of a variety of different commercial vehicle models under consideration by SEMCOG.

If a trip-based commercial vehicle model is to be developed, the Establishment database should be able to develop trip generation rates, and the Trip database must be able to develop average trip lengths to be used in trip distribution. If tour models are to be developed, the Tour database should be able to develop the various truck tour submodels. The trip information for the diaries is reported as tours, which are the linked trips as reported by each commercial vehicle driver. A stop on a tour is the destination of a trip, and the origin of the next trip. The tour information allows forecasting, through the development of tour submodels, of the trip time (i.e., the difference between the time of departure from the current stop and the time of the arrival at the next stop) and the duration at the stop (i.e., the difference between the arrival time at the current stop and the departure time from that same stop).

7.4.1 Trip Rates

Trip rates were computed from the establishment survey. The survey instrument reported the number of trucks, by size, that arrived to deliver cargo or provide services, or departed to pick up cargo or provide services. These trucks did not have to be owned or leased by the establishment. Because an arrival for delivery of cargo requires a departure after the cargo was delivered, and vice versa, each the trip end, stop, response to these establishments was doubled. Each establishment was queried about the employees at that establishment. Table 49 shows the trip rates for single unit (SU) and combination unit (CU) trucks, which were computed by dividing the reported weekday truck trips by the reported number of employees at that establishment.

Table 49. Truck Trip Ends Per Employee By Industry And Truck Size, Unexpanded

Industry	LD CV Trip Ends per Employee	SU CV Trip Ends per Employee	CU CV Trip Ends per Employee
Agriculture	0.121	0.169	0.147
Mining	---	0.667	14.000
Utilities/Construction	0.378	0.245	0.179
Manufacturing	0.068	0.253	0.239
Wholesale Trade	0.187	0.361	0.337
Warehouse and Storage	0.143	1.143	0.857
Retail	0.072	0.268	0.157
Transportation	0.182	0.294	1.310
Services	0.049	0.093	0.030
Education	0.016	0.125	0.011
Government	0.010	0.056	0.003

These rates can be expanded based on the number of establishments represented by each establishment survey. The trip rates, after expansion, are shown in Table 50.

Table 50. Truck Trips Per Employee By Industry and Truck Size, Expanded

Industry	LD CV trip ends per employee	SU CV trip ends per employee	CU CV trip ends per employee
Agriculture	0.489	0.431	0.245
Mining	-	0.667	14.000
Utilities/Construction	0.456	0.503	0.175
Manufacturing	0.096	0.342	0.261
Wholesale Trade	0.230	0.547	0.401
Warehouse and Storage	0.143	1.143	0.857
Retail	0.192	0.509	0.252
Transportation	0.498	0.477	1.027
Services	0.176	0.383	0.067
Education	0.020	0.150	0.011
Government	0.012	0.079	0.004

These trip rates by industry can be combined. A comparison was made between the trip rates as reported in the 1996 Federal Highway Administration Quick Response Freight Manual (QRFM) and the rates combined for the comparable industries from SEMCOG's commercial vehicle survey. Those results are shown in Table 51. It is noted that the total trip rates are similar, but the share of trip ends by larger trucks for SEMCOG is greater than the QRFM rates (which were themselves derived from a 1992 commercial vehicle survey for Phoenix).

Table 51. Comparison of Trips Rates QRFM and SEMCOG Survey

	QRFM				SEMCOG Survey			
Generator	Four Tire Vehicles	SU Trucks	CU Truck	TOTAL	Four - Tire Vehicles	SU Trucks	CU Truck	TOTAL
Agriculture, Mining and Construction	1.11	0.289	0.174	1.573	0.456	0.499	0.280	1.234
Manufacturing, Transportation, Communications, Utilities and Wholesale Trade	0.938	0.242	0.104	1.284	0.304	0.429	0.334	1.067
Retail Trade	0.888	0.253	0.065	1.206	0.202	0.519	0.292	1.014
Office and Services	0.437	0.068	0.009	0.514	0.159	0.356	0.060	0.575
Households	0.251	0.099	0.038	0.388	#N/A	#N/A	#N/A	#N/A

7.4.2 Average Trip Lengths

The QRFM advised that for trucks, the origin-trip ends and destination-trip ends should be distributed between those zones using a gravity model where the difficulty of travel between zones is a function of the average travel length (in minutes) of truck trips. The average trip lengths (ATLs) for light trucks, medium (single unit) trucks, and heavy tractor trailer (combination unit) trucks are shown in Table 52. The times shown in Table 52 were not recorded, but were estimated based on the locations that were

recorded. Thus no expansion factor was applied. During any model development the actual times should be computed based on the arrival at subsequent stops on the same tour. These ATLs should NOT be used directly in any model development. These ATLs are shown because it is the pattern of those trip ATLs (i.e. heavy tractor trailer ATLs are approximately 2 times larger than those for medium and light trucks; ATLs for medium and light trucks are approximately equal) that is important. This pattern is consistent with the QRFM.

Table 52. Average Trip Length (in minutes) By Vehicle Type

	Vehicle Type	Unexpanded		Expanded		QRFM
Light Duty	Passenger Car	15.02	16.13	15.62	15.20	12.0
	Pick-up Truck (4 wheels)	15.52		14.63		
	Van (Cargo or Minivan) (4 wheels)	18.29		15.67		
	Sport Utility Vehicle (SUV) (4 wheels)	14.61		14.78		
Single Unit Truck	Single Unit 2-axle (6 wheels)	16.21	16.91	16.59	17.25	10.0
	Single Unit 3-axle (10 wheels)	23.16		23.05		
	Single Unit 4-axle (14 wheels)	20.24		19.44		
Combination Unit Truck	Semi (all Tractor-Trailer combinations)	41.27	41.27	38.20	38.20	33.3
	Other	50.14		27.18		

The QRFM reports the coefficients for trip distribution, which we converted to ATLs in minutes for this comparison. The findings are similar to those of the SEMCOG survey, with the same observation as noted for trip rates. The SEMCOG region shows more utilization of commercial vehicle trips by SU and CU trucks and less utilization by four-tire Light Duty Commercial Vehicles, as noted in the computation of trip rates. This could have some impact on the distribution of reported average trip lengths by truck size. The relative differences among truck sizes are as expected. The absolute differences between the expanded CVS ATLs and the QRFM ATLs are probably more attributable to increased congestion in 2018 in the SEMCOG region compared to the national 1996 times, as well as differences in the geographic scale of the SEMCOG region compared to the QRFM national average.

7.4.3 Stops per Tour

Stops per tour are a commonly reported measure. Stops are equivalent to trip ends in trip based modeling. On a tour, a stop is the destination of the trip before that stop, as well as the origin of the trip after that stop. NCFRP Report 8 observed a range of 2.10 to 4.25 stops per tour for heavy truck depending on characteristics of the stops being served. Processed data from a number of metropolitan areas has inferred 3.1 to 3.9 stops per tour.

Truck tour models will require a number of other factors to be considered (e.g., time to the next stop, type of place at the next stop given the type of place at the current stop, duration at the stop). These and other characteristics of a tour are all reported in the Tour database. The stops per tour that can be computed from the Tour database, for both the unexpanded tours and the tours with the expansion factors, are shown in Table 53. Those derived stops per tour are consistent with the national findings for

stops per tour. Any tour model derived from the SEMCOG survey data would appear to be consistent with nationally observed rates. While the QRFM does not report stops per tour, the expanded rates shown are within the range of nationally observed stops per tour.

Table 53. Stops Per Tour by Vehicle type from SEMCOG Survey

Vehicle Type		Unexpanded		Expanded	
Light Duty	Passenger Car	3.30	3.35	3.38	3.25
	Pick-up Truck (4 wheels)	3.02		3.20	
	Van (Cargo or Minivan) (4 wheels)	3.93		3.48	
	Sport Utility Vehicle (SUV) (4 wheels)	2.89		2.83	
Single Unit Truck	Single Unit 2-axle (6 wheels)	4.55	4.39	4.35	4.22
	Single Unit 3-axle (10 wheels)	3.02		3.05	
	Single Unit 4-axle (14 wheels)	3.53		3.57	
Combination Unit Truck	Semi (all Tractor-Trailer combinations)	3.85	3.85	3.79	3.79
	Other	2.29		2.44	

7.4.4 Origin-Destination Matrix Estimation (ODME)

Truck OD tables derived from the SEMCOG survey trip diary data can be used to estimate truck trip tables although users need to be mindful of potential issues which may arise. First, trip diary data represents only a sample of the total trucks in the region and can be biased as representing primarily the companies that were surveyed. Additionally, no OD matrix was estimated for light commercial trucks because there is no available source of commercial light truck counts. The only counts that are available are for all short and long wheelbase four-tire vehicles and cannot distinguish by body type (e.g., automobiles, pickup trucks, vans, SUVs, etc.). The counts also cannot distinguish between commercial and personal uses of those vehicles. The seed trip table was expanded from the commercial vehicles that completed diaries and would be expected to include mostly II and IE trips. The diaries would not include any EE or EI trips unless those trips were made by a vehicle that was registered in the region. It is to be expected then that the seed input table would typically be less than the table than would be output by ODME. The establishment survey by contrast would include all II, IE, and EI truck trips but could not report any EE trips, but only those from the establishment surveys.

ODME is a class of mathematical procedures used to update an existing matrix of origin-destination trip flows (i.e., number of trips between each origin-destination zone pair in a study area) using information on vehicle flows at various locations in the transportation network. ODME procedures factor the seed truck trip flows in such a way that the trips in the resulting estimated OD flow matrix, when assigned to the highway network, closely match the observed truck counts at various locations on the network.

The procedure used for ODME for this project is based on the ODME procedure embedded in TransCAD software from Caliper Corporation. The procedure is essentially an optimization problem that tries to minimize a function of the difference between observed traffic counts and estimated traffic counts (from the estimated OD matrix) and the difference between the seed matrix and the estimated OD matrix, as shown below:

$$\begin{aligned} \arg\min_{X} \quad & J(X) = F(AX - b) + G(X - X_0) \\ \text{subject to} \quad & X \geq 0 \text{ and } X_{lower} \leq X \leq X_{upper} \end{aligned}$$

Where:

- X is the OD matrix to be estimated
- X_0 is the initial (seed) OD matrix
- G is a function measuring the difference between estimated and seed OD matrices
- b is a vector of observed counts at different locations in the study area
- A is the route choice probability matrix obtained from assignment of the OD flows in X on the network
- F is the function measuring the difference between the estimated and observed traffic counts at different locations in the study area

The ODME procedure attempts to arrive at an OD flow matrix X in such a way that the resulting traffic volumes at different locations (A*X) match closely with the observed traffic flows (b). At the same time, the procedure avoids overfitting to the observed traffic flows by including the term $G(X - X_0)$ so that the estimated matrix is not too far from the seed matrix and the boundaries (lower and upper bounds) are within which the estimated matrix should fall. The analyst has an option to use these boundary constraints to set lower and upper bounds on the estimated matrix, relative to the seed matrix.

7.4.5 ODME Results

Using the ODME procedure provided in TransCAD, daily truck OD tables with 166,511 SU truck trips and 115,912 CU truck trips (seed tables) were expanded for the SEMCOG region. Single unit and combination unit truck counts were used as constraints.

Expansion of the seed table with respect to single unit truck counts yielded a total of 208,785 truck trips for the SEMCOG region. Figure 25 shows the comparison between the single unit counts and ODME estimates. Figure 26 shows the single unit counts within the SEMCOG region (for 274 locations), and Figure 27 shows the assignment of the expanded SU truck trips (using ODME) for the SEMCOG region.

Figure 25. Observed vs. Estimated Daily Single Unit Trucks in SEMCOG region

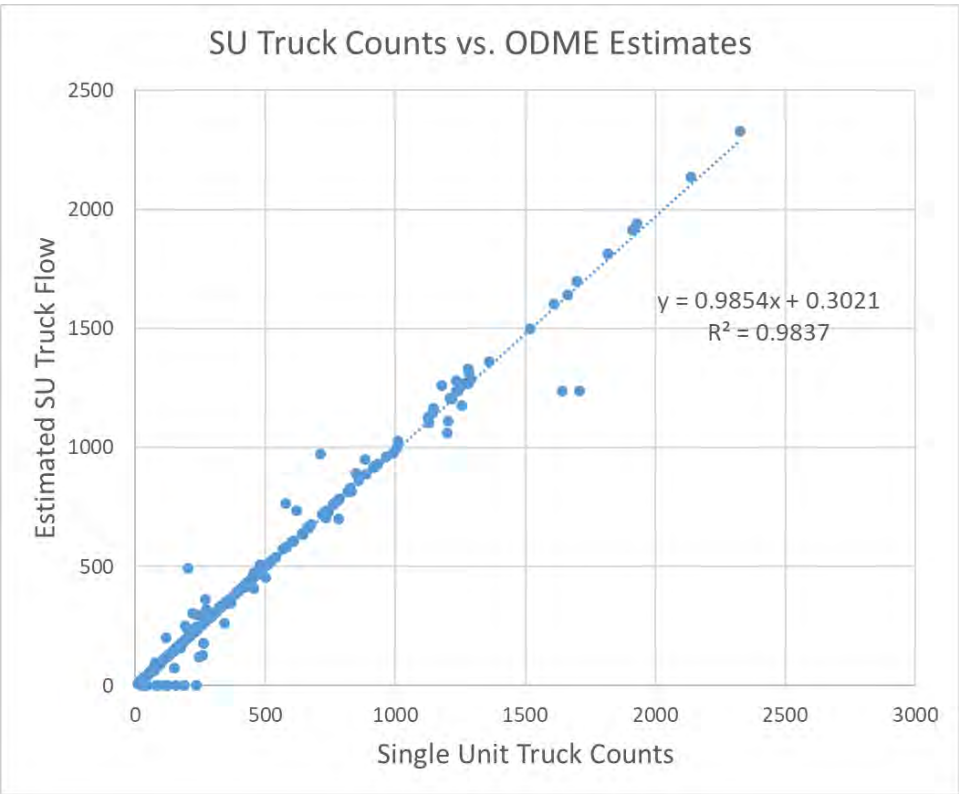


Figure 26. Single Unit Truck Counts in SEMCOG Region

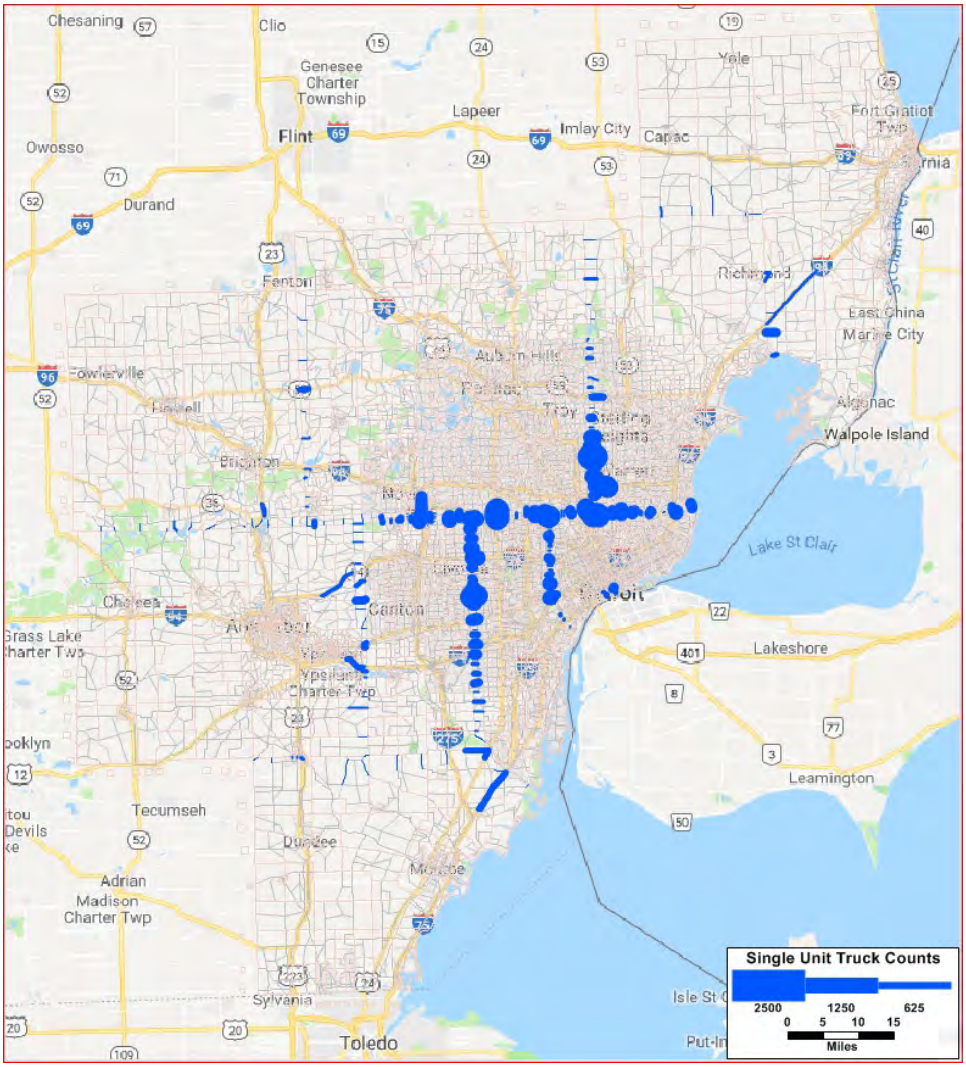
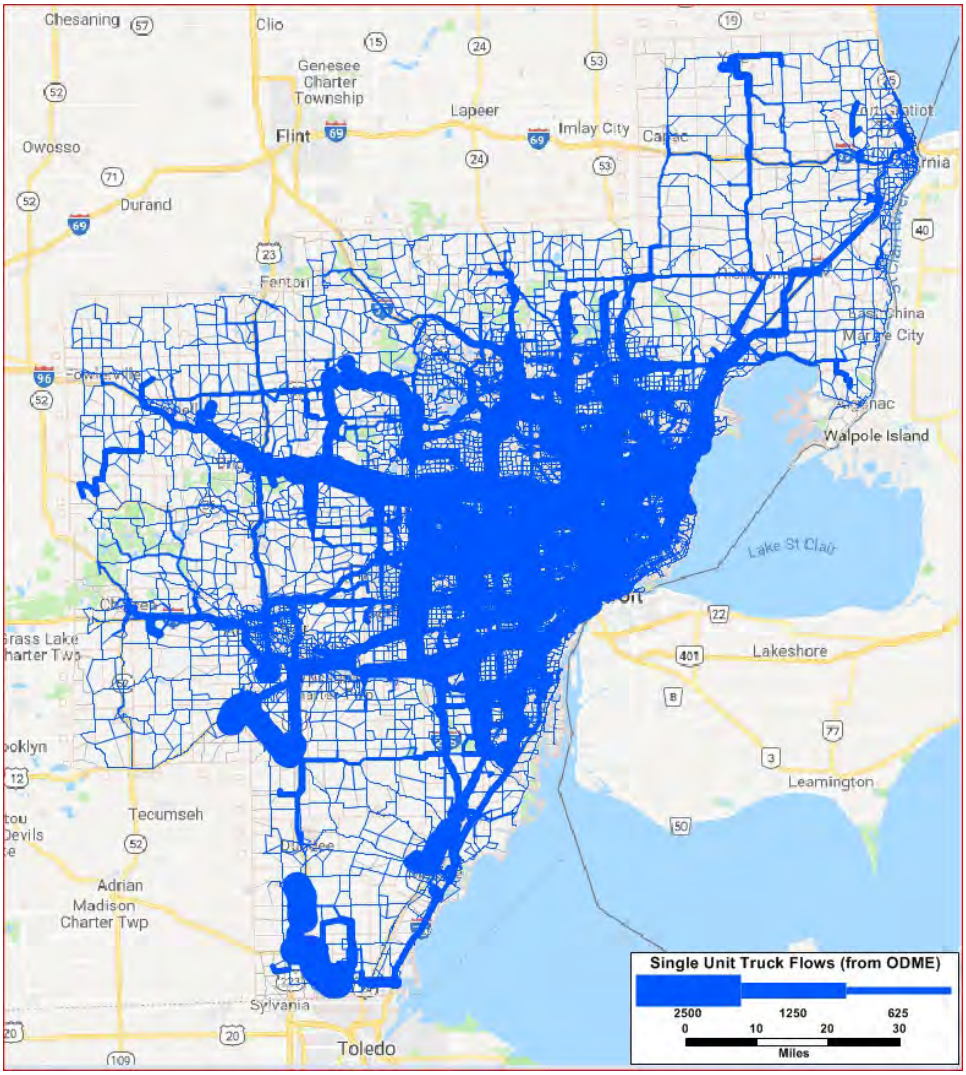


Figure 27. Single Unit Truck Volumes in SEMCOG Region



Analysis of the data also included comparing CU truck counts to ODME estimates. Expansion of the seed table with respect to CU truck counts yielded a total of 129,287 truck trips for the SEMCOG region. Figure 28 shows the comparison between the combination unit counts and ODME estimates. Figure 29 shows the combination unit counts within the SEMCOG region (for 258 locations), and Figure 30 shows the expanded CU truck trips (using ODME) for the SEMCOG region.

Figure 28. Observed vs. Estimated Daily Combination Unit Trucks in SEMCOG Region

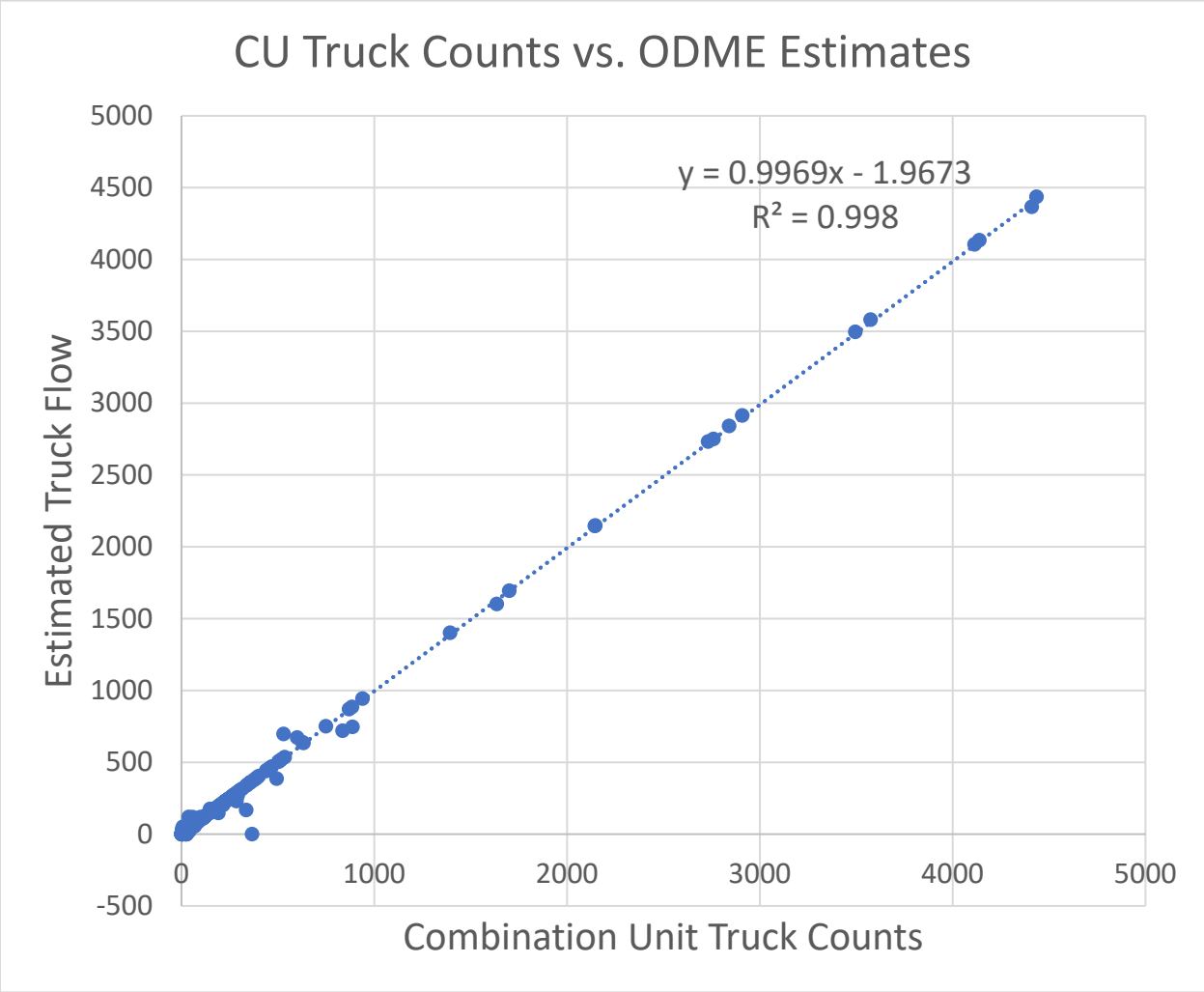


Figure 29. Combination Unit Truck Counts in SEMCOG Region

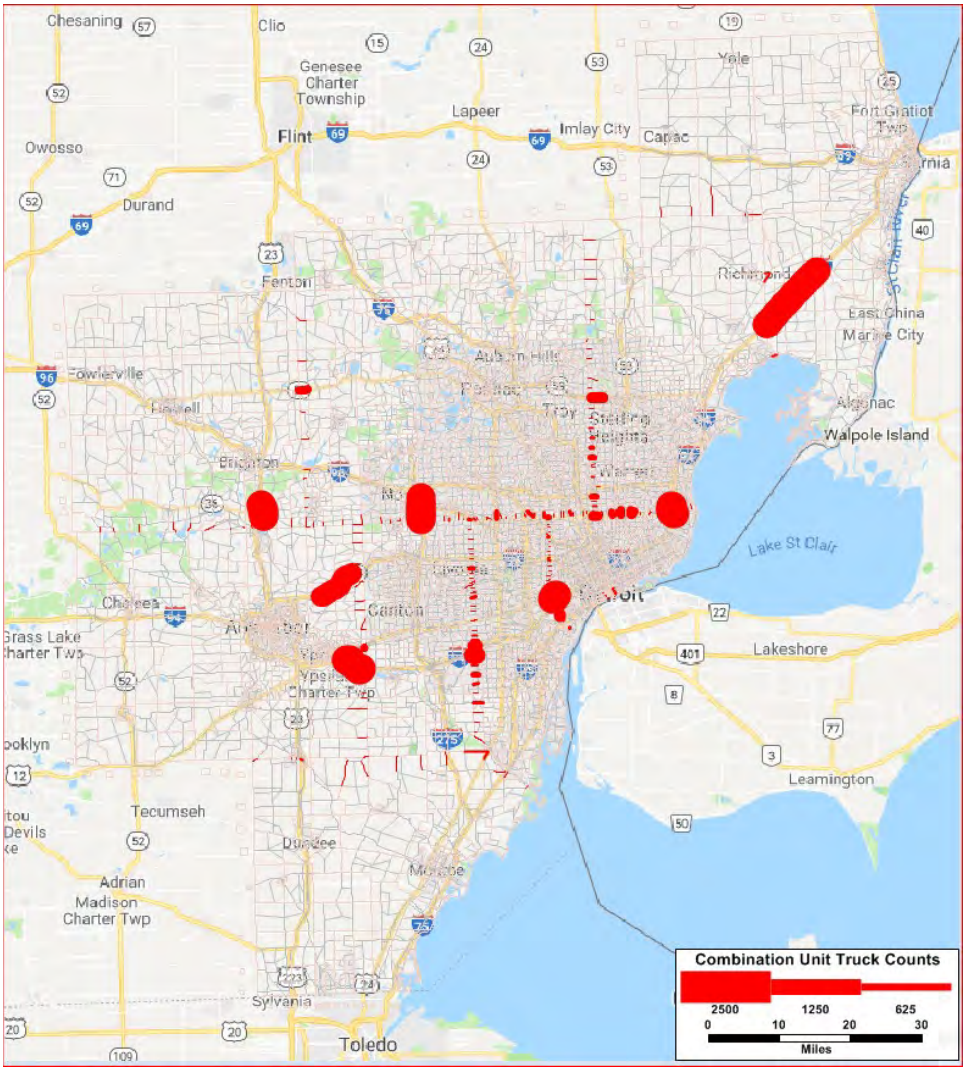
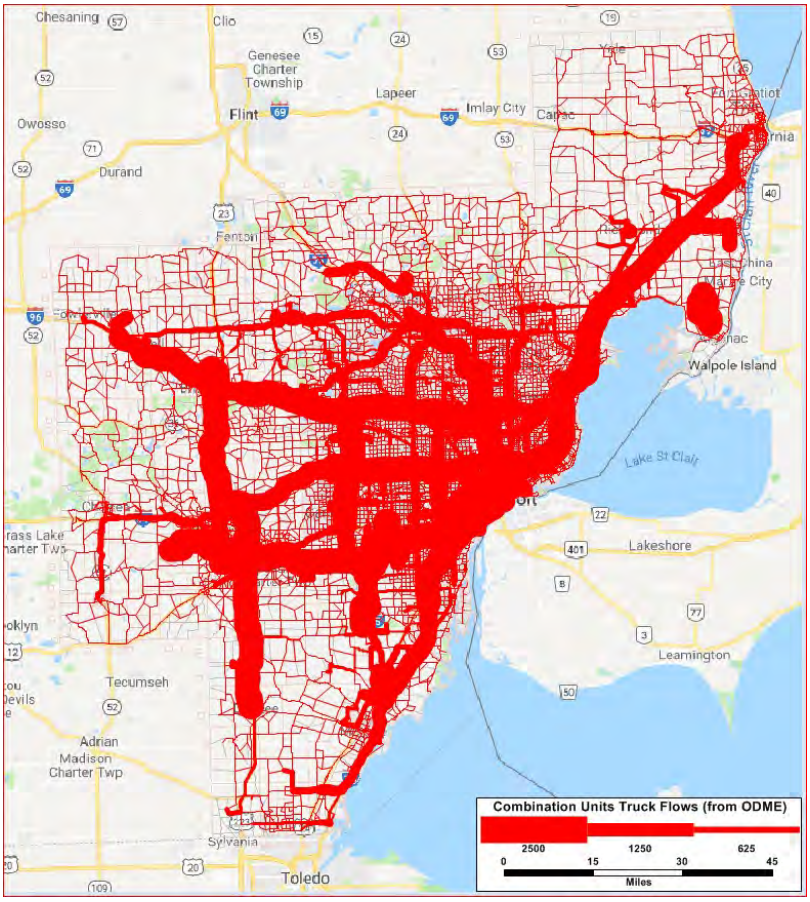


Figure 30. Expanded CU Truck Volumes in SEMCOG Region



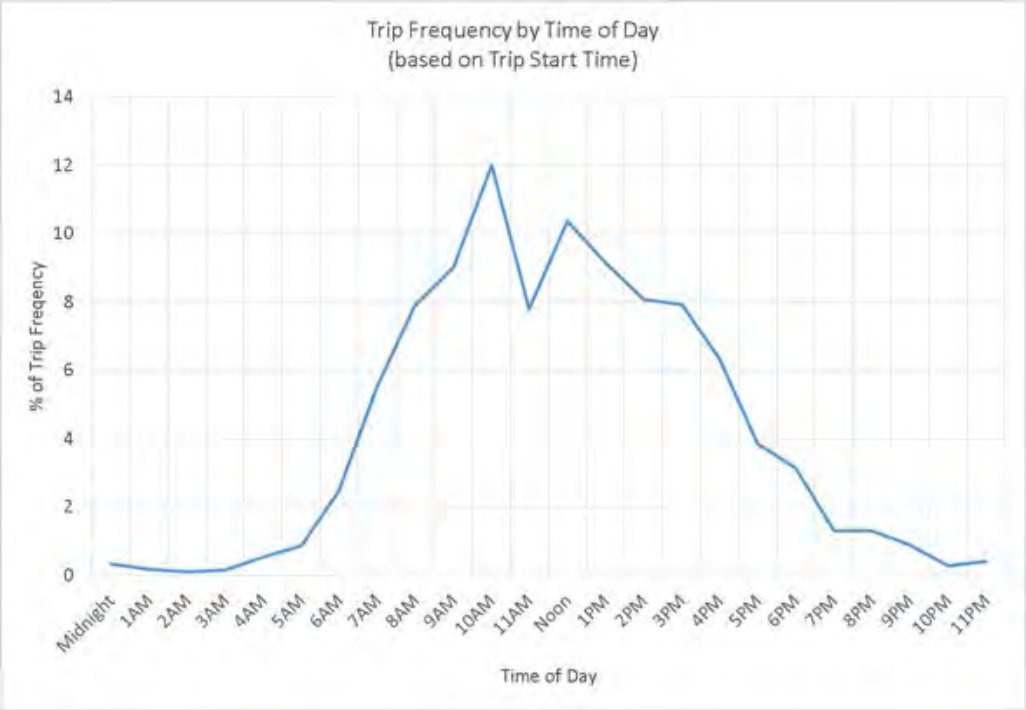
The conclusions that can be drawn from the ODME analysis are that the survey data can be used to successfully create SU and CU truck OD matrices for the SEMCOG region

7.5 Additional Characteristics of the Database

7.5.1 Time of Day

The survey data show that majority of the trips start between 7:00 a.m. and 5:00 p.m. (as shown in Figure 31). This suggests that the trips are predominantly regional/local in nature because those occur within the peak hours for travel in the region.

Figure 31. Trip Frequency by Time of Day



7.6 Conclusions

The SEMCOG survey appears to be suitable to develop the commercial vehicle/truck components of trip-based or tour-based travel demand models.

- The trip rates and average trip lengths that can be derived are consistent with nationally observed values and will support the development of trip-based models.
- The stops per tour that can be derived are consistent with nationally observed values and the attributes surveyed are those that are will support several types of tour submodels.
- The truck trip tables that can be derived from the survey OD tables are consistent with observed counts and the OD tables that could be derived from constraining the OD trips to observed counts can be used directly in vehicle assignments, or to support other analyses.
- As noted, SEMCOG appears to have total truck rates consistent with national standard, however the rates, and thus the usages to and from commercial establishments are higher for heavy trucks and lower for light commercial (e.g., four-tire trucks.) It is not clear how much of this is temporal (i.e. the QRFM is 1996) and how much of this reflects truly different operations in SEMCOG.
- Reported congestion in 2018 in SEMCOG suggests higher average trip times than were reported nationally based on earlier (~1996) values.

8. Appendices

The subsequent pages contain the survey materials that were used during the project including:

SEMCOG Southeast Michigan Council of Governments

Developing Regional Solutions

The Southeast Michigan Council of Governments (SEMCOG) has partnered with ETC Institute to conduct a travel survey of commercial vehicles in the Greater Detroit area, including the counties of Livingston, Oakland, Macomb, Monroe, St. Clair, Washtenaw and Wayne. SEMCOG is a regional planning agency that evaluates the regional transportation system, assesses future transportation needs, and directs investment towards projects that help achieve regional condition, safety, and operational goals. As the center of the U.S. automobile manufacturing industry, goods movement is of particular importance to sustaining regional prosperity and quality of life. The purpose of the survey is to better understand how commercial vehicles of varying size and business type affect travel and traffic patterns in the Greater Detroit area.

Over the next few weeks, you will be contacted by a representative from ETC Institute, who will provide more details about the study and ask of your willingness to participate. ETC Institute is a survey research firm that has been hired to administer the survey for SEMCOG. ETC Institute specializes in conducting this type of research and will ensure that the data is kept confidential.

Although your participation is voluntary, we hope you will consider making it a priority to participate in the survey ensuring that organizations like yours are properly represented. The results will be used by all of the partners to help plan future transportation improvements in the Greater Detroit area and to prioritize funding.

If you would like to ensure that you will have an opportunity to participate in the survey, please contact Elizabeth Rodriguez, Project Coordinator, by e-mail erodriguez@etcinstitute.com or by phone at 913-254-4565.

You can get more information about our study by going to www.semcog.org/Plans-for-the-Region/Transportation/Freight.

If you have any questions regarding the Commercial Vehicle Travel Survey being conducted, please contact the project manager, Chris Tatham, at 1-888-801-5368 or ctatham@etcinstitute.com. Thank you in advance for your participation.

Sincerely,

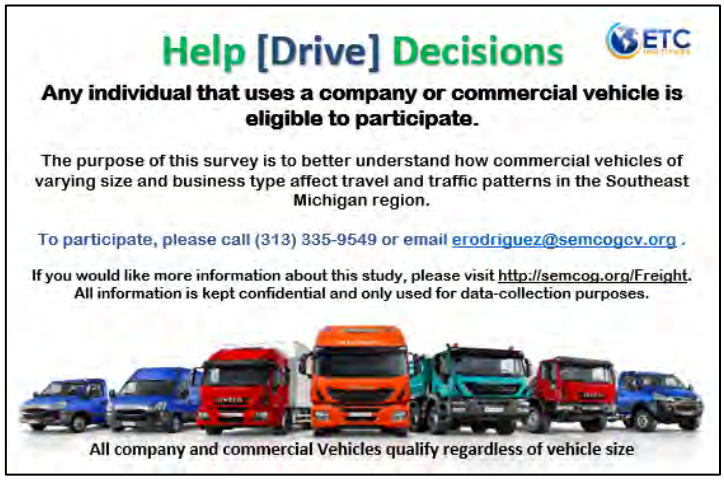
Kathleen Lomako

Kathleen Lomako, AICP, CAE
Executive Director
SEMCOG

1001 Woodward, Suite 1400 • Detroit, Michigan 48226 • (313) 961-4266 • Fax (313) 961-4869 • semcog.org

INCENTIVE POSTCARDS

As the project progressed a decline in company participation was noticed and ETC Institute implemented different strategies to increase participation. The two most significant changes were the mailing of informational postcards and the utilization of incentives as shown in the postcards below.



SEMCOG 2017 COMMERCIAL VEHICLE SURVEY RECRUITMENT AND ESTABLISHMENT SCRIPT

THE FOLLOWING INFO WILL BE CONTAINED IN THE SAMPLE

SITE ID NUMBER: _____ TYPE-SIZE CODE FROM SAMPLING PLAN: _____

COUNTY/LOCATION CODE: _____ NAICS CODE: _____

[Sampling Group Industry and Size Codes (below) will be finalized after the sampling plan is developed]

SAMPLING GROUP INDUSTRY TYPE CODE: 1 2 3 4 5 6 7 SAMPLING GROUP SIZE: 1 2 3

COMPANY NAME: _____

ADDRESS: _____

CITY: _____ ST: _____ ZIP: _____

COMPANY PHONE: _____ SECOND PHONE: _____

FAX NUMBER: _____ E-MAIL: _____

INTERVIEW ENTERS THE FOLLOWING

DATE: _____ RECRUITER: _____

******This box is for SUPERVISORS ONLY******

Number of Attempts:_____

Call Disposition Code: 1) Contact Made 3) Phone Disconnected 5) Busy 7) Computer/Fax 9) Other:_____
2) No Answer 4) Answering Machine 6) Non-Business 8) Sent Email

Recruitment: 1) Will Do Survey 2) Will Not Do Survey

My name is _____ from ETC Institute. I am calling on behalf of the Southeast Michigan Council of Governments (SEMCOG) to collect commercial vehicle data. The purpose of the survey is to better prioritize transportation investment decisions by understanding how commercial vehicles of varying size and business type affect travel and traffic patterns in the Greater Detroit area. We are studying businesses that use, own or lease vehicles, to plan for future road improvements.

Does your company own or lease any vehicles (cars, vans, trucks, or large vehicles) as part of your business?

IF YES – continue (next page)

IF NO: **Does anyone in your company use personal vehicles for company business?**

YES – continue (next page)

If YES: **May I please speak to the owner or manager?**

NO – continue (next page; the respondent will not be asked about numbers of vehicles at end)

(If you have to call back, get):

The manager or owner's name: _____

The phone number? or e-mail address: _____

And, a good time to call back: _____

Day and Time of Day:_____

(If you are transferred to the owner or manager, repeat):

Hello, my name is _____ from (ETC Institute). We are working with the Southeast Michigan Council of Governments (SEMCOG) to collect commercial vehicle travel data at area businesses. Your business has been randomly selected to participate in this data collection effort because SEMCOG needs information about where traffic is being generated. Do you have time to complete a short survey that will help improve transportation planning in the region? The survey will take less than 5 minutes?

If YES: continue (NEXT PAGE)

If NO: **could I call you back another time or send you an e-mail with a link to a website where you can complete the survey at a time that is convenient to you?**

IF NO – AND WILLING TO HELP

What is your name?: _____

E-mail (if desired): _____

And, a good time to call back?

Day and Time of Day:_____

IF NO – AND NOT WILLING

Thank you. We appreciate your time. END INTERVIEW

CONTINUE HERE FROM RECRUITMENT SCRIPT

ESTABLISHMENT SURVEY

Thank you for agreeing to participate in our survey.

First, let me verify your address (this information will already be on the interviewer's screen).

_____
Address

_____ ____ _____
City State Zip

IS THIS THE CORRECT ADDRESS?

IF YES CONTINUE. IF NO, MAKE CORRECTIONS AS NEEDED.

1. **How would you BEST describe the type of activities your organization does at this location?**
[Note to interviewer: be sure the description matches the NAICS Code from the sample, if not make a notation below].

Type of Organization (2-3 Digit NAICS Code).

___(A) Agriculture (11)
___(B) Mining (21)
___(C) Utilities/Construction (22, 23)
___(D) Manufacturing (31-33)
___(E) Wholesale Trade (42)
___(F) Warehouse and Storage (493+)
___(F) Retail (44-45)
___(G) Transportation (48-492, includes 491)
___(H) Services (51, 52, 53, 54, 55, 56, 62, 71, 72, 81)
___(I) Education (61)
___(J) Government (92)
___(Z) Other (describe): _____

INTERVIEWER ONLY
___(1) Matches NAICS Code in Sample
___(2) Does Not Match NAICS Code in Sample

2. How many TOTAL employees do you have at your site? _____

2a. Of these, how many are FULL time employees? _____

2b. Of these, how many are PART time employees? _____

3. On a typical weekday, how many employees (full and part-time) do you have working at this location?

_____

4. Approximately, how many of your employees work at home at least 1 day per week? _____

5. How many vehicles deliver cargo or services <u>TO</u> THIS LOCATION on an average weekday? _____

5a. Of these, how many are passenger cars, sports utility vehicles or pickup trucks? _____

5b. Of these, how many are single unit vehicles? _____

5c. Of these, how many are combo units (tractor/trailers)? _____

5d. Approximately what percentage of these vehicles <u>COME FROM</u> each of the following types of facilities?

(1) Warehouse ....._____%

(2) Port/Airport/Terminal (intermodal, truck)....._____%

(3) Manufacturing Facility....._____%

(4) Retail Outlet ....._____%

(5) Service Business....._____%

(6) Other: _____....._____%

(9) Don't Know

6. How many vehicles deliver cargo or services <u>FROM</u> THIS LOCATION on an average weekday? _____

6a. Of these, how many are passenger cars, sports utility vehicles or pickup trucks? _____

6b. Of these, how many are single unit vehicles? _____

6c. Of these, how many are combo units (tractor/trailers)? _____

6d. Approximately what percentage of these vehicles <u>GO TO</u> each of the following types of facilities?

(1) Warehouse ....._____%

(2) Port/Airport/Terminal (intermodal, truck)....._____%

(3) Manufacturing Facility....._____%

(4) Retail Outlet ....._____%

(5) Service Business....._____%

(6) Other: _____....._____%

(9) Don't Know

<u>END INTERVIEW HERE FOR REPONDENTS WHO DO NOT HAVE VEHICLES. THANK HIM/HER FOR THEIR TIME</u>

7. How many vehicles <u>are owned or leased</u> by your company for business at the address you just gave me for this location?

Total # Vehicles Owned/Leased By the Company: _____

7a. Of these, how many are:

#_____ Single unit vehicles

#_____ Combo unit/tractor-trailers

#_____ Passenger car or sport Utility Vehicles

#_____ Pickup trucks

#_____ Vans

#_____ Other vehicles used for service or other business purposes

8. How many other vehicles does your company use for business purposes at the address you just gave that are <u>NOT owned or leased</u> by your company?

Total # Vehicles <u>NOT</u> Owned/Leased By the Company: _____

8a. Of these, how many are:

#_____ Single unit vehicles

#_____ Combo unit/tractor-trailers

#_____ Passenger car or sport Utility Vehicles

#_____ Pickup trucks

#_____ Vans

#_____ Other vehicles used for service or other business purposes

AFTER ESTABLISHMENT SURVEY IS FINISHED

Thank you for providing information about your workplace. The other part of our research effort involves collecting travel data for commercial vehicles. This part of our study would involve having your organization keep travel logs for up to five of your vehicles for a 24-hour period. The diaries are simple to complete. The driver just records each of the places that are visited for one 24-hour period. Would you be willing to participate in this data collection effort to help improve transportation planning in the region?

IF NO – Thank them and end the survey.

If YES - ask

We'll need to coordinate with someone at your workplace. Should we coordinate with you or is there someone else you would like us to coordinate with on the day of the survey?

Contact Name:_____ Title: _____ Contact Hours:_____

Alternate Name: _____ Title:_____ Contact Hours:_____

E-Mail Address:_____

Drop Off Date/Time:_____ Pick Up Date/Time:_____

What are your normal hours of operation on weekdays? _____

Do you prefer to be contacted by phone or email as our primary method of reaching you? Phone EMAIL

Thank you very much. We will call you in a day or two to schedule an exact date for the data collection. If you have any questions about the survey, please don't hesitate to call Elizabeth at 1-888-801-5368

POST PROCESSING INSTRUCTIONS

ADD A NEW SIZE CODE (SIZE_FINAL) TO THE DATABASE BASED ON THE VALUE REPORTED IN QUESTION 2
(1=less than 10, 2=10-49, 3=50+)

ADD A NEWTYPE CODE (TYPE_FINAL) TO THE DATABASE BASED ON THE VALUE REPORTED IN QUESTION 1
1=Agriculture (11), Mining (21), Utilities/Construction (22, 23)
2=Manufacturing (31-33)
3=Wholesale Trade (42), Warehouse and Storage (493+)
4=Retail (44-45)
5=Transportation (48-492, includes 491)
6=Services (51, 52, 53, 54, 55, 56, 62, 71, 72, 81)
7=Education (61), Government (92)

SEMCOG 2017 COMMERCIAL VEHICLE SURVEY
PART 1: VEHICLE INFORMATION

Vehicle # _____ of _____ Participating

(Please fill out this form, even if the information requested has been provided elsewhere.)

Official Use	Vehicle ID #: _____	GPS#:_____	Location/Zone: _____	NAICS Code: _____	# Stops on Travel Day ____

Travel Day: _____ **Total # Vehicles Owned/Available at this location:** _____
Month / Day / Year

Company or Name of Owner (name on registration):

_____

Address where this vehicle is normally garaged (or parked):

_____
(Street Address or Names of Nearest Intersecting Streets)

_____
City State Zip Code

How would you describe the type of place where this company is located? (See "**PLACE OPTIONS**" codes below):____

PLACE OPTIONS(CODES MATCH TRAVEL DIARY)

1) Office Building (Non Government)	8) Airport	(15) Construction Site
(2) Government Office Building	(9) Intermodal Facility-Railroad	(16) Agriculture
(3) Retail / Shopping / Store	(10) Warehouse	(17) Mining
(4) Industrial / Manufacturing	(11) Truck Distribution Center	(18) Other (specify): _____
(5) Medical / Hospital / Dental	(12) Gas station	(99) Don't Know
(6) Education (K-12, College, Pre-K)	(13) Truck stop	
(7) Residential / Home	(14) Restaurant	

Vehicle Info: Make: _____ Model: _____ Year: _____

Is this vehicle registered as a commercial vehicle in the state of Michigan?
1) ☐YES 2) ☐ NO

Was this vehicle rescheduled for another travel day because it did not go anywhere on the date it was originally scheduled? If the vehicle was rescheduled for any other reason than the lack of travel on the travel date originally assigned (e.g., someone forgot to do it), answer NO.
1) ☐YES 2) ☐ NO

Was this vehicle used for commercial/business purposes on the day its travel diary was completed?
1) ☐YES 2) ☐ NO

IF YES: What Was The Primary Use for Vehicle:
1) ☐Cargo/Freight Transport Vehicle (used PRIMARILY to transport cargo)
2) ☐Commercial Service Vehicle (used PRIMARILY for non-cargo transport purposes)
3) ☐Commercial Service and Cargo Delivery Vehicle (used for both service and cargo)

Vehicle Fuel Type:1) ☐Gasoline 2) ☐ Diesel 3) ☐ Propane 4) ☐Natural Gas

5) ☐ Electric 6) ☐ Gas/Electric Hybrid 9) ☐Other (specify)_____

Estimated Vehicle MPG:_____

Vehicle Classification:

1) ☐ Passenger Car
2) ☐ Pick-up Truck (4 wheels)
3) ☐ Van (Cargo or Minivan) (4 wheels)
4) ☐ Sport Utility Vehicle (SUV) (4 wheels)
9) ☐ Other _____
5) ☐ Single Unit 2-axle (6 wheels)
6) ☐ Single Unit 3-axle (10 wheels)
7) ☐ Single Unit 4-axle (14 wheels)
8) ☐ Semi (all Tractor-Trailer combinations)

Gross Vehicle Weight (including trailer): _____ pounds

SEMCOG 2017 COMMERCIAL VEHICLE SURVEYTRIP INFORMATION WORKSHEET

PART 1: DATE AND STARTING LOCATION FOR THIS VEHICLE'S TRAVEL DAY

1. On which date was travel completed (month/date/year)? _____ **2. What was the day of week?** Mon Tues Wed Thurs

3. Was the place where this vehicle began travel today: ☐ Work / Base Location (Company address) ☐ Other Location – [answer 3a & 3b]

3a. How would you describe the type of place where this vehicle's travel began today? (See "**PLACE OPTIONS**" codes below): _____

3b. What is the address where this vehicle's travel began today? _____
(Street Address or Names of Nearest Intersecting Streets)

_____
(City, State, Zip Code)

4. WHEN DID THIS VEHICLE INITIALLY DEPART ON ITS TRAVEL DAY? TIME: _____ **am / pm**

5. WHERE DID THIS VEHICLE GO DURING ITS TRAVEL DAY? (Record every place this vehicle goes, including brief stops like trips to the gas station or food breaks)

Where did you go? (Record location name & address, including city, state, zip) see EXAMPLE below **If address unknown** record nearest intersection, city, & state **If returning to base** of operations write "BASE"	Is this the Work/Base location for this vehicle?	What type of place is this? (See PLACE OPTIONS below)	What time did you arrive and depart this location? (Record exact times)	What activity are you doing at this location? (See ACTIVITY OPTIONS below)	**If transporting cargo**, what is the Cargo? (See **Cargo Classifications** below) **If HAZMAT** also enter placard #	**If transporting cargo**, record Cargo Weight (Pounds)
EXAMPLE: *Detroit Medical Center* (will be hand printed) *6001 Outer Drive West, Detroit MI 48235*	☐ - Yes ☑ - No	5	Arrive: *8:24* am/pm Depart: *9:00* am/pm	10	17 #1219	*100* in pounds
PLACE 1	☐ - Yes ☐ - No		Arrive: _____ am/pm Depart: _____ am/pm			_____ in pounds
PLACE 2	☐ - Yes ☐ - No		Arrive: _____ am/pm Depart: _____ am/pm			_____ in pounds

PLACE OPTIONS (How would you describe this location ?)

(1) Office Building (Non-Government)
(2) Government Office Building
(3) Retail / Shopping / Store
(4) Industrial / Manufacturing
(5) Medical / Hospital / Dental
(6) Education (K-12, College, Pre-K)
(7) Residential / Home
(8) Airport
(9) Intermodal Facility-Railroad
(10) Warehouse
(11) Truck Distribution Center
(12) Gas station
(13) Truck stop
(14) Restaurant
(15) Construction Site
(16) Agriculture
(17) Mining
(18) Other (specify): _____
(99) Don't Know

ACTIVITY OPTIONS (What were you doing at this location?)

(1) Returning to Base Location
(2) Vehicle Maintenance (fuel, oil, etc)
(3) Driver Needs (lunch, restroom, etc)
(4) Deadhead/Drop Trailer/Bobtail
(5) Delivering cargo
(6) Picking up cargo
(7) Getting Government Related Services
(8) Providing Installation / Maintenance / Repair Services
(9) Making a sales call
(10) Providing professional services (legal, medical, financial)
(11) Shopping for Business
(88) Other Activity (specify): _____

Cargo Classifications

(01) Livestock, fertilizer, dirt, landscaping, etc.
(02) Trees, sod, etc.
(03) Fresh fish, seafood, etc.
(04) Crude petroleum, natural gas, propane, metals, gypsum, ores, etc.
(05) Assorted food products, cosmetics, etc.
(06) Cigarettes, cigars, and chewing tobacco
(07) Clothing, linens, etc.
(08) Lumber, paper, cardboard, wood pulp, etc.
(09) Newspapers, magazines, books, etc.
(10) Soaps, paints, household or industrial chemicals, etc.
(11) Gasoline, etc.
(12) Finished products of rubber, plastic or Styrofoam
(13) Finished products of clay, concrete, glass or stone
(14) Misc. products, such as machinery, appliances, furniture, etc.
(15) Waste products including scrap and recyclable materials
(16) U.S. mail, U.P.S., Federal Express, and other mixed cargo
(17) Hazardous chemicals and substances
(18) Automobiles and other transport vehicles
(19) Empty (including empty shipping containers)
(20) No cargo picked up or delivered
(88) Cargo not falling within one or the above categories
(98) Prefer not to answer
(99) Don't know

SEMCOG 2017 COMMERCIAL VEHICLE SURVEYTRIP INFORMATION WORKSHEET (Continued)

5. WHERE DID THIS VEHICLE GO DURING ITS TRAVEL DAY? (Record every place this vehicle goes, including brief stops like trips to the gas station or food breaks)

Where did you go? (Record location name & address, including city, state, zip) see EXAMPLE below. **If address unknown** record nearest intersection, city, & state. **If returning to base** of operations write "BASE"	Is this the Work/Base location for this vehicle?	What type of place is this? (See PLACE OPTIONS below)	What time did you arrive and depart this location? (Record exact times)	What activity are you doing at this location? (See ACTIVITY OPTIONS below)	**If transporting cargo**, what is the Cargo? (See **Cargo Classifications** below) **IF HAZMAT** also enter placard #	**IF transporting cargo**, record Cargo Weight (Pounds)
PLACE 3	☐ - Yes ☐ - No		Arrive: _____ am/pm Depart: _____ am/pm			_____ in pounds
PLACE 4	☐ - Yes ☐ - No		Arrive: _____ am/pm Depart: _____ am/pm			_____ in pounds
PLACE 5	☐ - Yes ☐ - No		Arrive: _____ am/pm Depart: _____ am/pm			_____ in pounds
PLACE 6	☐ - Yes ☐ - No		Arrive: _____ am/pm Depart: _____ am/pm			_____ in pounds
PLACE 7	☐ - Yes ☐ - No		Arrive: _____ am/pm Depart: _____ am/pm			_____ in pounds
PLACE 8	☐ - Yes ☐ - No		Arrive: _____ am/pm Depart: _____ am/pm			_____ in pounds

PLACE OPTIONS (How would you describe this location?)

(1) Office Building (Non-Government)
(2) Government Office Building
(3) Retail / Shopping / Store
(4) Industrial / Manufacturing
(5) Medical / Hospital / Dental
(6) Education (K-12, College, Pre-K)
(7) Residential / Home
(8) Airport
(9) Intermodal Facility-Railroad
(10) Warehouse
(11) Truck Distribution Center
(12) Gas station
(13) Truck stop
(14) Restaurant
(15) Construction Site
(16) Agriculture
(17) Mining
(18) Other (specify): _____
(99) Don't Know

ACTIVITY OPTIONS (What were you doing at this location?)

(1) Returning to Base Location
(2) Vehicle Maintenance (fuel, oil, etc)
(3) Driver Needs (lunch, restroom, etc)
(4) Deadhead/Drop Trailer/Bobtail
(5) Delivering cargo
(6) Picking up cargo
(7) Getting Government Related Services
(8) Providing Installation / Maintenance / Repair Services
(9) Making a sales call
(10) Providing professional services (legal, medical, financial)
(11) Shopping for Business
(88) Other Activity (specify): _____

Cargo Classifications

(01) Livestock, fertilizer, dirt, landscaping, etc.
(02) Trees, sod, etc
(03) Fresh fish, seafood, etc.
(04) Crude petroleum, natural gas, propane, metals, gypsum, ores, etc.
(05) Assorted food products, cosmetics, etc.
(06) Cigarettes, cigars, and chewing tobacco
(07) Clothing, linens, etc.
(08) Lumber, paper, cardboard, wood pulp, etc.
(09) Newspapers, magazines, books, etc.
(10) Soaps, paints, household or industrial chemicals, etc.
(11) Gasoline, etc.
(12) Finished products of rubber, plastic or Styrofoam
(13) Finished products of clay, concrete, glass or stone
(14) Misc. products, such as machinery, appliances, furniture, etc.
(15) Waste products including scrap and recyclable materials
(16) U.S. mail, U.P.S., Federal Express, and other mixed cargo
(17) Hazardous chemicals and substances
(18) Automobiles and other transport vehicles
(19) Empty (including empty shipping containers)
(20) No cargo picked up or delivered
(88) Cargo not falling within one or the above categories
(98) Prefer not to answer
(99) Don't know

SEMCOG 2017 COMMERCIAL VEHICLE SURVEYTRIP INFORMATION WORKSHEET (Continued)

5. WHERE DID THIS VEHICLE GO DURING ITS TRAVEL DAY? (Record every place this vehicle goes, including brief stops like trips to the gas station or food breaks)

Where did you go? (Record location name & address, including city, state, zip) see EXAMPLE below **If address unknown** record nearest intersection, city, & state **If returning to base** of operations write "BASE"	Is this the Work/Base location for this vehicle?	What type of place is this? (See PLACE OPTIONS below)	What time did you arrive and depart this location? (Record exact times)	What activity are you doing at this location? (See ACTIVITY OPTIONS below)	**If transporting cargo**, what is the Cargo? (See **Cargo Classifications** below) **If HAZMAT** also enter placard #	**If transporting cargo**, record Cargo Weight (Pounds)
PLACE 9	☐ - Yes ☐ - No		Arrive: _____ am/pm Depart: _____am/pm			_____ in pounds
PLACE 10	☐ - Yes ☐ - No		Arrive: _____ am/pm Depart: _____am/pm			_____ in pounds
PLACE 11	☐ - Yes ☐ - No		Arrive: _____ am/pm Depart: _____am/pm			_____ in pounds
PLACE 12	☐ - Yes ☐ - No		Arrive: _____ am/pm Depart: _____am/pm			_____ in pounds
PLACE 13	☐ - Yes ☐ - No		Arrive: _____ am/pm Depart: _____am/pm			_____ in pounds
PLACE 14	☐ - Yes ☐ - No		Arrive: _____ am/pm Depart: _____am/pm			_____ in pounds

PLACE OPTIONS (How would you describe this location?)

(1) Office Building (Non-Government)
(2) Government Office Building
(3) Retail / Shopping / Store
(4) Industrial / Manufacturing
(5) Medical / Hospital / Dental
(6) Education (K-12, College, Pre-K)
(7) Residential / Home
(8) Airport
(9) Intermodal Facility-Railroad
(10) Warehouse
(11) Truck Distribution Center
(12) Gas station
(13) Truck stop
(14) Restaurant
(15) Construction Site
(16) Agriculture
(17) Mining
(18) Other (specify): _____
(99) Don't Know

ACTIVITY OPTIONS (What were you doing at this location?)

(1) Returning to Base Location
(2) Vehicle Maintenance (fuel, oil, etc)
(3) Driver Needs (lunch, restroom, etc)
(4) Deadhead/Drop Trailer/Bobtail
(5) Delivering cargo
(6) Picking up cargo
(7) Getting Government Related Services
(8) Providing Installation / Maintenance / Repair Services
(9) Making a sales call
(10) Providing professional services (legal, medical, financial)
(11) Shopping for Business
(88) Other Activity (specify):_____

Cargo Classifications

(01) Livestock, fertilizer, dirt, landscaping, etc.
(02) Trees, sod, etc
(03) Fresh fish, seafood, etc.
(04) Crude petroleum, natural gas, propane, metals, gypsum, ores, etc.
(05) Assorted food products, cosmetics, etc.
(06) Cigarettes, cigars, and chewing tobacco
(07) Clothing, linens, etc.
(08) Lumber, paper, cardboard, wood pulp, etc.
(09) Newspapers, magazines, books, etc.
(10) Soaps, paints, household or industrial chemicals, etc.
(11) Gasoline, etc.
(12) Finished products of rubber, plastic or Styrofoam
(13) Finished products of clay, concrete, glass or stone
(14) Misc. products, such as machinery, appliances, furniture, etc.
(15) Waste products including scrap and recyclable materials
(16) U.S. mail, U.P.S., Federal Express, and other mixed cargo
(17) Hazardous chemicals and substances
(18) Automobiles and other transport vehicles
(19) Empty (including empty shipping containers)
(20) No cargo picked up or delivered
(88) Cargo not falling within one or the above categories
(98) Prefer not to answer
(99) Don't know

SEMCOG 2017 COMMERCIAL VEHICLE SURVEYTRIP INFORMATION WORKSHEET (Continued)

5. WHERE DID THIS VEHICLE GO DURING ITS TRAVEL DAY? (Record every place this vehicle goes, including brief stops like trips to the gas station or food breaks)

Where did you go? (Record location name & address, including city, state, zip) see EXAMPLE below **If address unknown** record nearest intersection, city, & state **If returning to base** of operations write "BASE"	Is this the Work/Base location for this vehicle?	What type of place is this? (See PLACE OPTIONS below)	What time did you arrive and depart this location? (Record exact times)	What activity are you doing at this location? (See ACTIVITY OPTIONS below)	If transporting cargo, what is the Cargo? (See **Cargo Classifications** below) **If HAZMAT** also enter placard #	**If transporting cargo**, record Cargo Weight (Pounds)
PLACE 15	☐ - Yes ☐ - No		Arrive: _____ am/pm Depart: _____ am/pm			_____ in pounds
PLACE 16	☐ - Yes ☐ - No		Arrive: _____ am/pm Depart: _____ am/pm			_____ in pounds
PLACE 17	☐ - Yes ☐ - No		Arrive: _____ am/pm Depart: _____ am/pm			_____ in pounds
PLACE 18	☐ - Yes ☐ - No		Arrive: _____ am/pm Depart: _____ am/pm			_____ in pounds
PLACE 19	☐ - Yes ☐ - No		Arrive: _____ am/pm Depart: _____ am/pm			_____ in pounds
PLACE 20	☐ - Yes ☐ - No		Arrive: _____ am/pm Depart: _____ am/pm			_____ in pounds

PLACE OPTIONS (How would you describe this location?)

(1) Office Building (Non-Government)
(2) Government Office Building
(3) Retail / Shopping / Store
(4) Industrial / Manufacturing
(5) Medical / Hospital / Dental
(6) Education (K-12, College, Pre-K)
(7) Residential / Home
(8) Airport
(9) Intermodal Facility-Railroad
(10) Warehouse
(11) Truck Distribution Center
(12) Gas station
(13) Truck stop
(14) Restaurant
(15) Construction Site
(16) Agriculture
(17) Mining
(18) Other (specify): _____
(99) Don't Know

ACTIVITY OPTIONS (What were you doing at this location?)

(1) Returning to Base Location
(2) Vehicle Maintenance (fuel, oil, etc)
(3) Driver Needs (lunch, restroom, etc)
(4) Deadhead/Drop Trailer/Bobtail
(5) Delivering cargo
(6) Picking up cargo
(7) Getting Government Related Services
(8) Providing Installation / Maintenance / Repair Services
(9) Making a sales call
(10) Providing professional services (legal, medical, financial)
(11) Shopping for Business
(88) Other Activity (specify): _____

Cargo Classifications

(01) Livestock, fertilizer, dirt, landscaping, etc.
(02) Trees, sod, etc
(03) Fresh fish, seafood, etc.
(04) Crude petroleum, natural gas, propane, metals, gypsum, ores, etc.
(05) Assorted food products, cosmetics, etc.
(06) Cigarettes, cigars, and chewing tobacco
(07) Clothing, linens, etc.
(08) Lumber, paper, cardboard, wood pulp, etc.
(09) Newspapers, magazines, books, etc.
(10) Soaps, paints, household or industrial chemicals, etc.
(11) Gasoline, etc.
(12) Finished products of rubber, plastic or Styrofoam
(13) Finished products of clay, concrete, glass or stone
(14) Misc. products, such as machinery, appliances, furniture, etc.
(15) Waste products including scrap and recyclable materials
(16) U.S. mail, U.P.S., Federal Express, and other mixed cargo
(17) Hazardous chemicals and substances
(18) Automobiles and other transport vehicles
(19) Empty (including empty shipping containers)
(20) No cargo picked up or delivered
(88) Cargo not falling within one or the above categories
(98) Prefer not to answer
(99) Don't know