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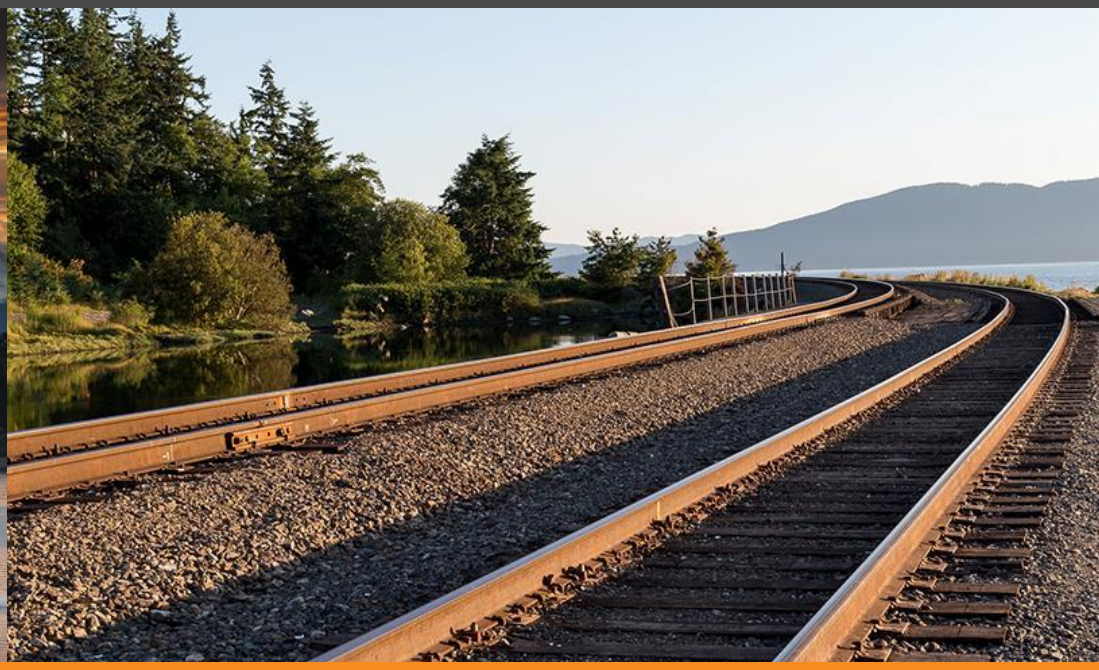
Whatcom Council of Governments (WCOG)

WHATCOM REGIONAL TRANSPORTATION STUDY

Methodology Report | April 10, 2019



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GLOSSARY OF TERMS

Term	Definition
ABS	Address-based sampling (ABS) draws from a complete list of households within a given geographic area. This study's sampling frame was the full list of addresses in the specified census block groups as available from the US Postal Service (USPS) Computerized Delivery Sequence File.
ACS	The American Community Survey (ACS) is an ongoing US Census Bureau survey that gathers demographic and other person- and household-level information. ACS estimates informed this study's sampling and weighting methods.
BG	A Census block group (BG) is a statistical division of a Census tract and a contiguous geographic area that typically contains 600–3,000 people.
GPS	This study included a smartphone component that collected Global Positioning System (GPS) coordinates from participants' smartphone devices. GPS is a satellite system that collects time and location (latitudinal and longitudinal) points.
Group	In the context of this study, a "group" refers to the mode through which households completed the travel diary portion of the study. Group 1 completed Part 2 using rMove (a smartphone app), and Group 2 completed Part 2 using rSurvey (an online survey platform). Groups were not assigned until the end of Part 1 (the demographic and household information section).
HH	In this study, a household (HH) encompassed "anyone who lives in the home, including roommates, relatives, friends, and household help."
rMove™	rMove is a smartphone app designed to collect complete household travel diary information from invited participants. The app is compatible with most Android and iOS phones that are less than four years old.
rSurvey™	rSurvey is an online travel survey platform designed to collect complete household travel diary information from invited participants.
Travel date	In the context of this study, a "travel date" is the first (or only) day on which a household reported its trips.
WCOG	The Whatcom Council of Governments (WCOG) sponsored this study and provided input throughout the project.

1.0 EXECUTIVE SUMMARY

1.1 STUDY OBJECTIVES AND HIGHLIGHTS

The 2018 Whatcom Regional Transportation Study used a modern research approach to collect demographic and travel pattern information from residents throughout Whatcom County in Washington State.

The highlights of this innovative approach include the following:

- **A two-part survey**:
  - Part one (the “recruit survey”) gathered data on the household’s demographic composition and typical travel behaviors.
  - Part two (the “travel diary”) gathered individual travel data during a specified travel period for all members of the household.
- **Multiple modes of data collection**:
  - Households with smartphones completed their travel diaries using the rMove™ smartphone app for up to seven days (Tuesday through Monday).
  - Households without smartphones participated by completing their travel diary online (rSurvey™) or by calling into the study call center. These households reported travel for one day (Tuesday, Wednesday, or Thursday).
- **An address-based sample (ABS) and mailed study invitations**:
  - The ABS included compensatory and targeted oversampling to improve the representativeness and quality of the final dataset. Compensatory oversampling focused on low-income households, higher minority populations areas, and tribal lands. Targeted oversampling focused on college students and walk/bike/transit users.
  - Over the course of two weeks, invited households received an initial postcard invitation, an envelope with more comprehensive details about the study, and two “reminder” postcards.
- **Aligned questionnaires**:
  - The smartphone-based (rMove) and online-based (rSurvey) questionnaires were largely consistent to ensure clean data combination at the end of the study.

- **Advanced technologies and methods**:
  - rMove was the primary mode for travel data collection, which offered significant benefits for data quality and quantity (e.g., detailed trip paths and lower degrees of underreporting).
  - The Google Maps API helped capture and validate location and travel data.
  - The study employed American Community Survey (ACS) data, along with RSG's market research experience and expertise, to develop the sampling plans and data weighting approaches.
- **Minimized respondent burden and increased engagement**:
  - The study offered gift card incentives to households that completed the study to improve the response rates (and thereby lower the overall mailing costs) and representativeness of the dataset. The average household received $19.60 in gift cards for their participation.
  - Study respondents received customized reminders by email, telephone, or within the rMove smartphone app to encourage study completion.
  - Study respondents could also contact user support by telephone, email, or within the rMove smartphone app. Responses were generally provided within one business day.
  - The study branding included an engaging logo and customized website to legitimize the study and encourage responses.

The last household travel survey for Whatcom County occurred in 2008 and surveyed approximately 750 households in Whatcom County. This study nearly doubled the previous effort with 1,451 surveyed households, introduced new travel logging technology, and deployed current data processing methods to support more accurate, representative travel behavior analysis in Whatcom County.

Study Timeline

Table 1 documents the project's schedule. RSG and WCOG conducted a small pretest to evaluate user experience in lieu of conducting a full pilot study. This approach was designed to maximize the number of households and quality of data collected during the main study.

TABLE 1: STUDY TIMELINE

Phase	Timeline
Design the study approach and questionnaire	May 2018–June 2018
Create the sample plan	June 2018
Conduct and review pretest results	July 2018–September 2018
Refine survey and study materials	September 2018
Conduct household travel study	September 2018–November 2018
Clean and weight study data	November 2018–February 2019
Finalize study documentation	March 2019
Project closure	April 2019

2.0 SURVEY SAMPLING

2.1 SAMPLING GOALS

The 2018 study originally aimed to collect 1,000 households of data, which was later revised to a target of 1,150 households soon after the project kickoff, resulting in a 1.42% target sample rate (based on the 2012–2016 ACS). The study collected data for 1,451 households (1.79% sample sate), surpassing the target by 26%.

Sampling Frame and Method

The sampling frame for this study is the list of all households in Whatcom County in Washington State. It excludes one block group (BG) in the eastern half of the county, which falls outside the WCOG planning area. The study used ABS to select households for participation. ABS involves drawing a random sample of addresses from all residential addresses in that area. Using this method, all households within each defined area have an equal chance of selection for the sample. RSG purchased household mailing addresses from Marketing Systems Group, which maintains the Computer Delivery Sequence file from the US Postal Service. RSG stratified the sample using census BG data from the 2012–2016 ACS.

Sample Stratification/Segmentation

RSG coordinated with WCOG to determine key subgroups for sampling. Based on WCOG's interest in gathering data from environmental justice areas and RSG's prior study experience, RSG proposed the following sample groups:

1. **Walk/Bike/Transit Oversample**: Comprised the top 10% of BGs (11 total) with the highest share of persons not commuting by car. Specifically, those in which at least 24% of workers age 16 and over commute to work via walk, bike, transit, or "other" means.[1]
2. **Higher Education Oversample**: Comprised the top 10% of BGs (11 total) with the highest share of persons enrolled in higher education. Specifically, those in which at least 22% of individuals age 3+ are enrolled in undergraduate, graduate, or professional school.[2]
3. **Low-Income Oversample**: Comprised the top 10% of BGs (11 total) with the highest share of low-income households. Specifically, those in which at least 39% of households have annual household incomes below $25,000.[3]

[1] Based on ACS table B08301. "Other means" excludes car, truck, van, taxi, motorcycle, and work from home.
[2] Based on ACS table B14007.
[3] Based on ACS table B19001.

4. **Ethnic/Tribal Oversample**: Comprised 5 BGs in which at least 35% of households are considered minority. WCOG provided RSG with a list of BGs to inform this segment.
5. **General Population**: Comprised 78 BGs in the study region that do not qualify for any of the 4 oversample regions.

BGs that qualified for multiple segments were included in the lowest-numbered segment above. Table 2 lists the number of households and persons in each segment.

TABLE 2: STUDY REGION HOUSEHOLDS AND PERSONS, BY SAMPLE SEGMENT

Sample Group	Census BGs	Total HHs[4]	Total Persons	Persons Per HH
General Population	78 (77.2%)	62,038 (76.6%)	159,653 (76.2%)	2.57
Low-Income	5 (5.0%)	4,622 (5.7%)	10,330 (4.9%)	2.23
Higher Education	2 (2.0%)	1,680 (2.1%)	4,013 (1.9%)	2.39
Walk/Bike/Transit	11 (10.9%)	8,495 (10.5%)	23,284 (11.1%)	2.74
Ethnic/Tribal	5 (5.0%)	4,140 (5.1%)	12,340 (5.9%)	2.98
Total	**101**	**80,975**	**209,620**	**2.59**

Sample Rates

To determine the sample rates, RSG clustered the five sample groups into three sample segments: general population, compensatory oversample, and targeted oversample. These segments were determined based on the invitation rates for each group. The compensatory oversample segment included the low-income and ethnic/tribal groups, and the targeted oversample segment included the higher education and walk/bike/transit groups. The general population group remained its own segment.

[4] Total households and persons as of the 2012–2016 American Community Survey (ACS).

Figure 1 shows the final sample segments on a map. Table 3 shows the estimated and final sample rates, by sample segment.

FIGURE 1: GEOGRAPHIC SAMPLE GROUPS

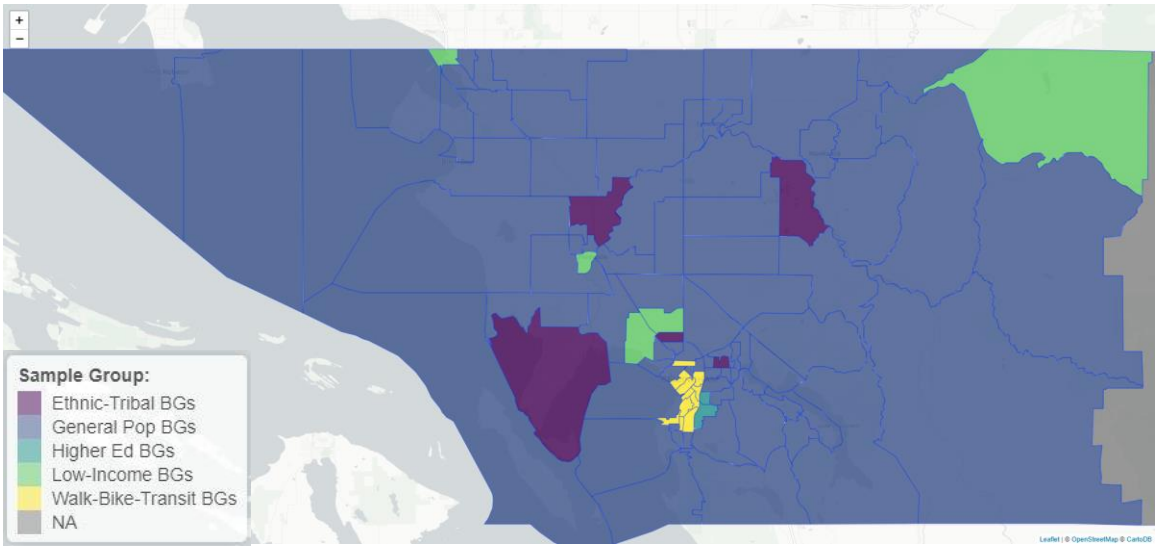


TABLE 3: EXPECTED VS. ACTUAL SAMPLE RATES AND DATASET COMPOSITION

Sample Segment	Complete HHs (Est.)	Complete HHs (Actual)	Sample Rate[5] (Est.)	Sample Rate (Actual)	Representation Rate (Actual)[6]
General Population	822	985	1.32%	1.59%	100%
Compensatory (Low-income, Ethnic/Tribal)	117	173	1.34%	1.97%	124%
Targeted (Higher education, Walk/bike/transit)	211	293	2.07%	2.88%	181%
Total	**1,150**	**1,451**	**1.48%**	**1.79%**	**113%**

The final sample plan memo includes additional details about the sample plan. The companion analytical memo for this project contains a more detailed evaluation of how the sample plan performed in practice.

[5] Sample rate = complete households/total households in that segment.
[6] Representation rate = segment sample rate relative to general population sample rate.

3.0 SURVEY DESIGN

3.1 OVERVIEW

The 2018 study combined multiple data collection methods, including smartphone, online, and telephone. While over 60% of households completed their travel diaries by smartphone, 96% of all trips were collected by smartphone due to the extended travel log period from the smartphone app (up to 7 days) compared with the single-day online log. As described in more detail in the following sections, the survey design included two stages to recruit and collect data about households, their members, and their travel behaviors during the assigned travel period.

3.2 SURVEY STAGES AND PARTICIPATION METHODS

This study used an ABS approach with mailed recruitment materials (shown in Section 4.0). The mailed materials instructed households to visit the study website or call a toll-free number to complete Part 1 (the demographic "recruit" survey). Households received instructions for Part 2 (the travel diary) shortly after completing Part 1.

Participation Group Assignments

Part 1 of the study asked adults (age 18+) to share whether they had smartphones and, if so, what types. RSG then used this information to determine group assignments. Group 2 participants (who resided in households in which not all adults had iOS or Android smartphones) were required to report their travel for one day online using rSurvey. Group 1 participants (who resided in households in which all adults *did* have iOS or Android smartphones) reported their travel for seven days using rMove.

Travel Date Assignments

Group 1 households were assigned to a seven-day travel period beginning on a Tuesday. Their travel period was set 6–12 days in the future to ensure enough time to begin. Group 2 households were assigned to a Tuesday, Wednesday, or Thursday travel day that was set 6–14 days in the future. Group 2 travel days were assigned proportionally across each of the three weekdays.

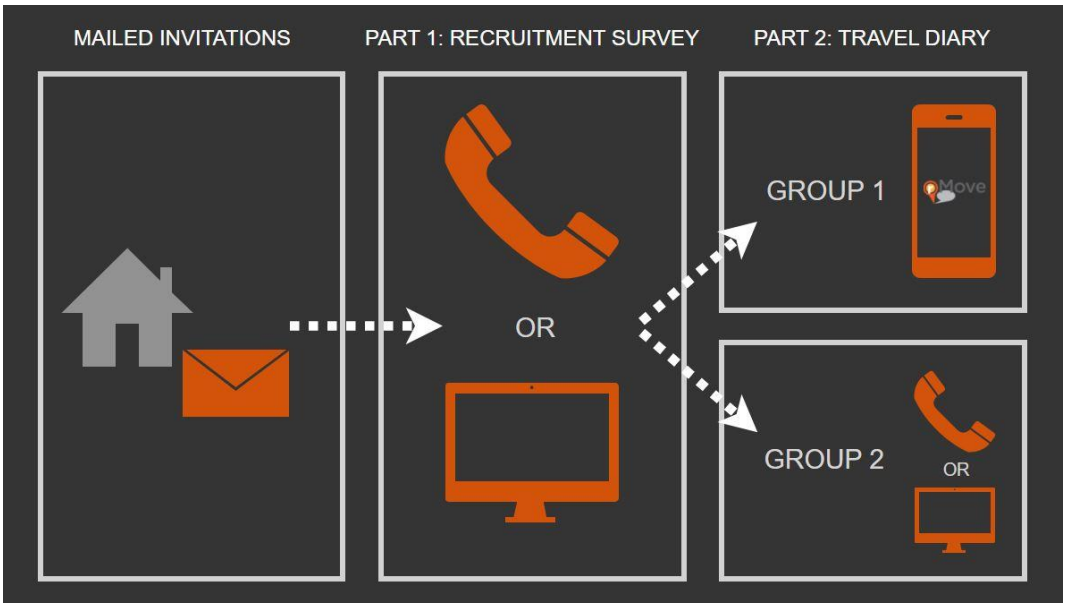
Study Components

All households completed Part 1 either via the online survey or through the call center. If households contacted the call center, a representative utilized the online survey instrument, resulting in consistent data coding for telephone and online responses. Part 1 collected general demographic information (e.g., household size, household income), established information to

facilitate Part 2 (e.g., home/school/work addresses, number of vehicles), and obtained any additional household-level information (e.g., whether the home is owned or rented).

Part 2 collected all trip and travel day information and any person-level information (e.g., how often the participant bikes or uses transit). “Group 1” participants reported their trip and travel day information through rMove, while “Group 2” reported this information again online or through the call center. Figure 2 shows these study components.

FIGURE 2: STUDY COMPONENTS AND GROUP ASSIGNMENTS



Proxy Reporting for Child Trips

In rMove, only adults age 18 or older were required to use the app on their smartphones. If a child in an rMove household was reported as a travel party member on an adult’s trips, the trip was copied to the child’s record.

In rMove, one adult was also designated to proxy report travel information for all children (under 18) in the household. This adult was asked to add trips to a child’s roster if the child made an independent trip (e.g., riding the bus to school) or made a trip with someone outside of the household (e.g., getting a ride with a friend’s parents). In rSurvey, one adult (unassigned) was required to complete a full one-day travel diary for the children of the household. Like rMove, adult proxy reporters could copy children’s trips from other adults and report new trips that the children made on their own.

Language Options

The invitation materials for this study were printed in English. The online survey included a built-in Google Translate bar to assist with 103 other languages.

Survey Incentives

RSG offered $10–15 gift card incentives—as advertised on the study mailed materials—to all households that completed the study. Traditionally, travel surveys offer incentives to boost response rates and the quality of respondent data and to decrease the overall cost of mailed invitations. Without incentives, the number of required households to invite increases, and this increased mailing cost is greater than the cost of providing incentives. Group 1 households were offered one $15 gift card per adult. Group 2 households were offered one $10 gift card per household. Group 1 households could choose between Amazon.com or Walmart e-gift cards. Group 2 households also had the option to request a mailed Walmart gift card. Households could also choose to receive no gift card.

4.0 SURVEY BRANDING, COMMUNICATION, AND ADMINISTRATION

4.1 STUDY BRANDING

RSG developed the study branding collaboratively with WCOG to ensure that the design fit the study region. The complete branding package included the study name, logo, color scheme, and font selections. The final 2018 study logo is shown in Figure 3.

FIGURE 3: 2018 STUDY LOGO

4.2 STUDY INVITATION MATERIALS

Each invited household received four mailings:

- **Prenotice Postcard**: RSG sent one prenotice postcard to invited households in two waves. These postcards invited households to log on to the website or call the toll-free number to learn more about the study and to complete Part 1.
- **Invitation Packet**: One formal study invitation packet arrived at each household approximately two to four days following the arrival of the prenotice postcard. The cover letter explained the study purpose and described the steps necessary to complete the study. The invitation packet also included a frequently asked questions sheet.
- **Reminder Postcard**: One reminder postcard arrived at each household in the first mail wave approximately 3–4 days after the invitation packet. Like the initial postcards, these cards included the study phone number, website address, and participant login information. Due to the high response rate, RSG and WCOG did not send reminder postcards to households in the second mail wave.

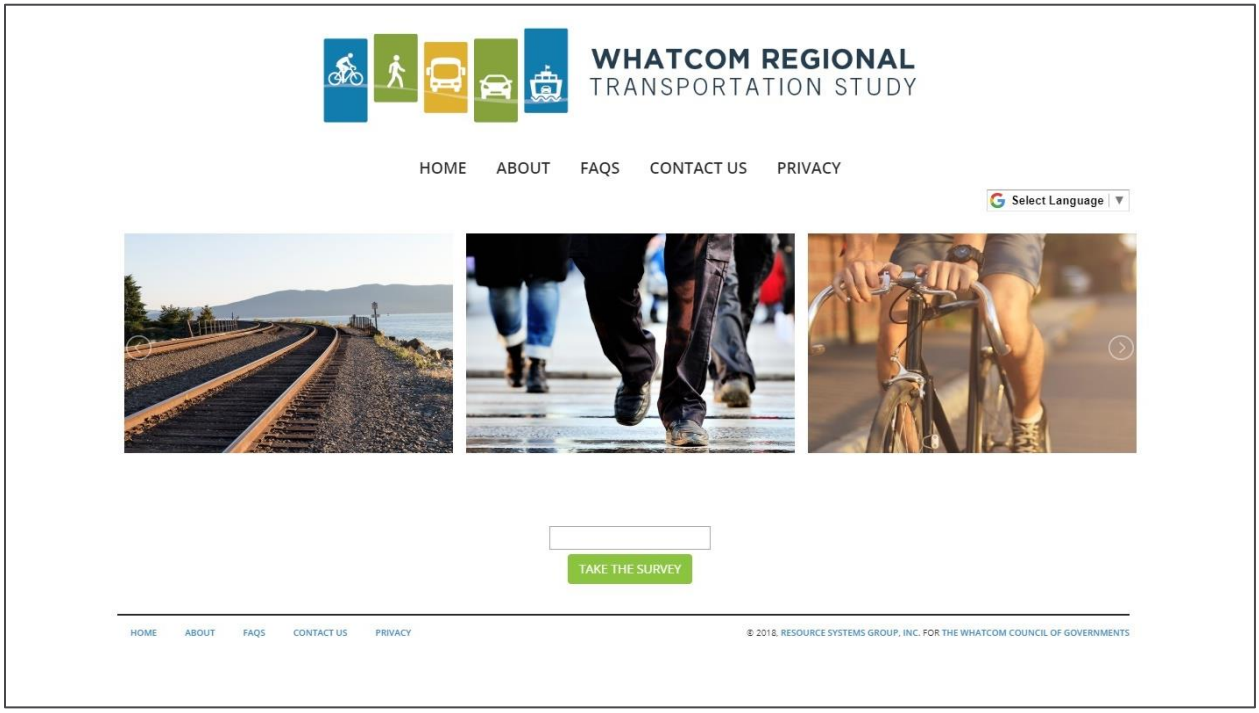
Examples of the final mailed materials are provided separately as part of the projects final deliverables package.

4.3 STUDY WEBSITE

RSG developed a project website to describe the study and facilitate survey participation. This site was simple, intuitive, and easy to navigate on desktop computers and mobile devices.

While the study was open to respondents, participants could access the survey by entering their passwords on the website's home page. Figure 4 shows a screenshot from the study website.

FIGURE 4: PROJECT WEBSITE HOME PAGE



5.0 PARTICIPANT SUPPORT

This study utilized both inbound and outbound participant support. “Inbound” refers to communications that participants initiated, and “outbound” refers to communications that RSG initiated.

Outbound Participant Support

RSG used several types of outbound participant support (beyond the previously mentioned website and invitation materials) to aid study administration. The primary sources of outbound support were automated email reminders, reminder phone calls, and in-app reminders or notifications (rMove participants only).

Email Reminders and Phone Calls

RSG required all rMove participants to provide email addresses, and an additional phone number was optional. rSurvey participants could provide one or the other (phone or email), but most households provided both. Any household that provided an email address received email reminders, while households that only provided a phone number were reminded by phone.

The study call center conducted all phone reminders. These reminders occurred on the following schedule:

- One day before each household’s travel date.
- One day after each household’s travel date.
- Three to five days after each household’s travel date (if the household had not yet completed the study).

Reminder emails occurred on a similar schedule, although more frequently. RSG sent email reminders/notifications throughout the travel period to all households that provided an email address during Part 1 of the survey. Households received emails within an hour of completing Part 1, prior to the rMove travel periods (reminding participants to activate the app), the day before the travel period began, the day after each travel period ended, and 3–5 days after the end of the travel period if the household had not yet completed the study.

In-App Reminders (rMove)

rMove participants also had in-app reminders to encourage them to complete all surveys during their travel periods. Participants received notifications as soon as a new survey was available—either several minutes after the end of a trip or the morning after a travel day. rMove participants reporting their children’s trips by proxy also received daily reminders to review and add to their children’s trip rosters, if needed. Participants had the option to turn off reminders or GPS

tracking, but RSG instructions encouraged them to leave these features enabled to ensure that they did not miss any portion of the study.

Inbound Participant Support

In addition to all outbound participant support, RSG provided three primary means through which participants could contact study administrators. All participants could call a toll-free number to reach the study call center or email the study inbox with questions. rMove participants also had the option to submit feedback directly through the app. The study website included the toll-free number and study email.

6.0 DATASET PREPARATION

Throughout the study, RSG implemented strict dataset preparation and quality control checks to ensure data was properly collected, stored, and analyzed. Before study fielding, survey instrument testing confirmed that survey responses were recorded correctly. During data collection, all survey instruments employed numerous real-time validations and logic checks to ensure consistent coding and logical response combinations and to prevent skipped questions. After the data collection period ended, additional time was spent reviewing, cleaning, and processing the raw data to prepare the unweighted dataset for analysis. This included combining rMove and rSurvey travel data. The full steps and details of data processing are provided in the separate dataset guide.

Completion and Exclusion Criteria

Completion Criteria

Households were considered complete if they met the following conditions:

1. The household completed the recruit survey by answering all required questions.
2. All household members completed all trip and travel day surveys on at least one concurrent day throughout their travel period.

All rSurvey households have a single complete travel day. rMove households must have at least one complete travel day (where all surveys are completed on the same day by all household members) but may have up to seven completed travel days. Partially complete rMove travel days are included in the final dataset but flagged separately.

Exclusion Criteria

Households were excluded for several reasons. The primary reason for exclusion was that all household members did not complete all trip and daily surveys on at least one concurrent day. Households that reported a home address outside the study region were also excluded from the final dataset.

7.0 EXPANSION AND WEIGHTING

Household travel surveys cover a fraction of the population, yet the resulting datasets help analyze and make inferences about the population at large. Weighting is the process of comparing selected demographics in the survey to external control data, like the census or the ACS, and adjusting the profile of the survey dataset to improve the representativeness of the population in the study area.

The full weighting memo provided to WCOG contains the detailed description of the weighting process. One of the key items of that process is which 'targets' are included, basically determining which demographics or behaviors are carefully controlled and ensured to be accurately represented in the final dataset. These targets are summarized in Figure 5.

FIGURE 5: WEIGHTING TARGETS

Household-level:	**Person-level:**
• Total households • Household size • Number of household workers • Household income • Number of household vehicles • Dwelling type • Presence of children	• Total persons • Gender • Age • Worker status • Race • University student status

The full weighting process is delineated in a separate weighting memo provided with the final dataset delivery.

8.0 CONCLUSION

The methods used in the 2018 Whatcom Regional Transportation Study provided higher-quality and more versatile data compared to traditional methods. The combination of targeted and compensatory oversampling techniques resulted in a more representative sample than conventional random sampling would have allowed. Coherent, professional study branding and user-friendly survey tools (e.g. Google Maps API) clarified expectations with participants and maximized the total participation rate. The high proportion of smartphone-collected data allowed for more precise trip rates and greater quantity of trip information captured across multiple days. Overall, the study applied innovative methods to capture higher-quality and higher-quantity data which will lead to greater analytical opportunities in the future.