ITEM #8

COMMUTER CONNECTIONS
TRANSPORTATION DEMAND MANAGEMENT
EVALUATION PROJECT

TRANSPORTATION EMISSION REDUCTION MEASURES (TERMS)
REVISED EVALUATION FRAMEWORK
FY2015 – FY2017

DRAFT

Prepared for:

National Capital Region Transportation Planning Board
Metropolitan Washington Council of Governments
777 North Capitol Street, NE, Suite 300
Washington, DC 20002-4290

Prepared by:

LDA Consulting
Washington D.C.
PH (202) 548-0205

In conjunction with:

Eric N. Schreffler, Transportation Consultant
Center for Urban Transportation Research (University of South Florida)
and
CIC Research, Inc.

December 2, 2015

EXECUTIVE SUMMARY

The Commuter Connections Program of the Metropolitan Washington Council of Governments (COG), in concert with program partners, is responsible for implementing four Transportation Emission Reduction Measures (TERMs) in support of the metropolitan Washington region's efforts to meet the conformity requirements of federal transportation and clean air mandates. The TERMs include:

- Maryland Telework – Provides information and assistance to Maryland commuters and employers to further in-home and telecenter-based telework programs.
- Guaranteed Ride Home – Eliminates a barrier to use of alternative modes by providing free rides home in the event of an unexpected personal emergency or unscheduled overtime for commuters who use alternative modes.
- Employer Outreach – Provides regional outreach services to encourage large, private-sector and non-profit employers voluntarily to implement commuter assistance strategies that will contribute to reducing vehicle trips to worksites, including the efforts of jurisdiction sales representatives to foster new and expanded trip reduction programs. The Employer Outreach for Bicycling TERM also is part of this analysis.
- Mass Marketing – Involves a large-scale, comprehensive media campaign to inform the region's commuters of services available from Commuter Connections as one way to address commuters' frustration about the commute. Various special promotional events also are part of this TERM.

Commuter Connections also operates the Commuter Operations Center (COC), providing direct commute assistance services, such as carpool and vanpool matching, transit information, and other travel information services through telephone and internet assistance to commuters. The COC is not an "official" TERM, however, it supports all the TERMs described above.

This report provides a framework and methodology for evaluating the transportation and air quality impacts of these TERMs. This methodology and numerous surveys and other data collection tools described later in this report have been developed to estimate the TERMs' impacts for the period from July 2014 through June 2017 (FY15 – FY17). These impacts then will be compared against the goals established for each TERM by COG's National Capital Region Transportation Planning Board (TPB), the region's designated Metropolitan Planning Organization (MPO). The TERM evaluation framework and analysis reports are reviewed by the Commuter Connections Subcommittee and the TDM Evaluation Group.

At the early stages of the TERMs' implementation, Commuter Connections elected to undertake significant evaluation for each TERM. The TERM evaluation and analysis process has been ongoing since 1997. The objective of the evaluation process is to provide timely and meaningful information on the performance of the TERMs to decision-makers and other groups, including the TPB and other regional policy makers; COG program funders; Commuter Connections staff; TERM program partners, such as local jurisdictions and Transportation Management Associations (TMA); and employers and commuters who comprise Commuter Connections' clients.

Six previous evaluation frameworks have been prepared, for the following time periods:

- January 1997 through June 1999 (FY97-FY99)
- July 1999 through June 2002 (FY00-FY02)
- July 2002 through June 2005 (FY03-FY05)
- July 2005 through June 2008 (FY06-FY08)
- July 2008 through June 2011 (FY09-FY11)
- July 2011 through June 2014 (FY12-FY14)

The evaluation framework presented in this document builds on the framework used in the FY12-FY14 analysis. Several changes have been made to the TERM evaluation framework for FY15-FY17 to update the methodology to reflect methods applied in the 2014 TERM analysis. These are described later in this document.

The evaluation process outlined in this framework allows for both on-going estimation of program effectiveness and for annual and triennial evaluations. Several types of performance measures are included in the evaluation process to assess effectiveness.

Measures reflecting commuters' and users' awareness, participation, and satisfaction with the program, and their attitudes related to transportation options are included to track recognition, output, and service quality. Measures related to new utilization of alternative modes as a result of TERM service use are used to assess the effectiveness of the services in motivating travel behavior change. Performance on these measures is collected through surveys of users of each program and documented in the survey reports.

Program impact measures are used to quantify five key outcome results, including:

1) Vehicle trips reduced
2) Vehicle miles of travel (VMT) reduced
3) Emissions reduced: Volatile Organic Compounds (VOC), Oxides of Nitrogen (NOx), Particulate Matter (PM2.5), and Carbon Dioxide (CO2) and other associated greenhouse gases
4) Energy reduction (fuel saving)
5) Consumer saving (commuting cost saving)

The evaluation process uses several calculation factors derived from surveys of Commuter Connections' program applicants and/or the public-at-large. These factors include: 1) placement rate (percentage of commuters who shift to alternative modes), 2) vehicle trip reduction (VTR) factor (average daily trips reduced for each commuter placed in an alternative mode), 3) average commute trip distance, and 4) drive alone access percentage (proportion of rideshare and transit users who drive alone to meet their carpool, vanpool, bus, or train).

These performance measures and factors are applied within the basic methodology steps listed below to calculate program impacts for each TERM.

1) Estimate commuter population "base" for the TERM (e.g., all commuters, GRH applicants, rideshare matching applicants, Employer Outreach employees, etc.)
2) Calculate "placement rate" – Percentage of commuters in the population base who made a travel change as a result of the TERM
3) Estimate the number of new alternative mode placements – Multiply placement rate by the population base for the evaluation period
4) Calculate the vehicle trip reduction (VTR) factor for new placements – Average daily vehicle trips reduced per placement
5) Estimate vehicle trips reduced – Multiply number of placements by the VTR factor
6) Estimate vehicle miles traveled (VMT) reduced – Multiply number of vehicle trips reduced by average commute distance
7) Adjust vehicle trips and VMT for access mode – Discount vehicle trips reduced and VMT reduced to account for commuters who drive alone to meet rideshare modes and transit
8) Estimate NOx, VOC, PM2.5, and CO_2 emissions reduced – Multiply adjusted vehicle trips and VMT reduced by emissions factors consistent with the regional planning process
9) Estimate the energy and commuter and societal cost savings – Multiply VMT reduced by fuel efficiency and vehicle operating cost factors and by societal benefit cost factors

The calculations outlined above have been embedded into a spreadsheet used by Commuter Connections and its partners to track estimated results on a quarterly basis. A summary of these results is included in Commuter Connections' Annual Report. The factors used in the spreadsheet are updated as new surveys relevant to each TERM are completed. At the end of the three-year evaluation period, a TERM Analysis Report is prepared to summarize placements; reductions in vehicle trips, VMT, and emissions; and progress toward goals in each of these performance measures for the three-year period.

Throughout the evaluation period, additional reports are prepared to present results of major data collection efforts, such as the rideshare applicant placement survey, the "State-of-the-Commute" survey of regional commuting trends and attitudes, GRH Applicant survey, and others. These reports are distributed to program partners, policy makers, and other with an interest in regional transportation.

This page intentionally left blank.

TABLE OF CONTENTS

TABLE OF CONTENTS (CON'T)

SECTION 1 OVERVIEW

This report provides a framework and methodology for evaluating transportation and air quality impacts of four Transportation Emission Reduction Measures (TERMs) implemented by the Commuter Connections Program of the Metropolitan Washington Council of Governments (COG), in support of the Washington metropolitan region's efforts to meet the conformity requirements of federal transportation and clean air mandates. The TERMs include:

- Maryland Telework – Provides information and assistance to Maryland commuters and employers to further in-home and telecenter-based telework programs.
- Guaranteed Ride Home – Eliminates a barrier to use of alternative modes by providing free rides home in the event of an unexpected personal emergency or unscheduled overtime for commuters who use alternative modes.
- Employer Outreach – Provides regional outreach services to encourage large, private-sector and non-profit employers voluntarily to implement commuter assistance strategies that will contribute to reducing vehicle trips to worksites, including the efforts of jurisdiction sales representatives to foster new and expanded trip reduction programs. The Employer Outreach for Bicycling TERM also is part of this analysis.
- Mass Marketing – Involves a large-scale, comprehensive media campaign to inform the region's commuters of services available from Commuter Connections as one way to address commuters' frustration about the commute. Various special promotional events also are part of this TERM.

Commuter Connections also operates the Commuter Operations Center (COC), providing direct commute assistance services, such as carpool and vanpool matching, transit information, and other travel information services through telephone and Internet assistance to commuters. The COC is not an "official" TERM, however, it supports the TERMs described above.

The evaluation framework serves two purposes. First, it assesses Commuter Connections' progress in meeting the transportation and air quality goals established by COG's National Capital Region Transportation Planning Board (TPB) for the TERMs for the period July 2014 through June 2017 (FY15-FY17). Second, it guides COG's assessment of the effectiveness of each TERM. The TERM evaluation framework and analysis reports are reviewed by the Commuter Connections Subcommittee and the TDM Evaluation Group.

This report represents an update to the most recent of six previous evaluation framework documents developed to evaluate results and progress toward goals during six three-year time periods:

- January 1997 through June 1999[1]
- July 1999 through June 2002[2]
- July 2002 through June 2005[3]
- July 2005 through June 2008[4]
- July 2008 through June 2011[5]
- July 2008 through June 2011[6]

[1] Commuter Connections Transportation Demand Management Evaluation Project: Transportation Control Measures Evaluation Framework, June 30, 1997.
[2] Commuter Connections, Transportation Demand Management Evaluation Project: Transportation Emission Reduction Measures (TERMs) Revised Evaluation Framework 1999-2002, MWCOG, March 20, 2001.
[3] Commuter Connections, Transportation Demand Management Evaluation Project: Transportation Emission Reduction Measures (TERMs) Revised Evaluation Framework 2002-2005, MWCOG, March 16, 2004.
[4] Commuter Connections, Transportation Demand Management Evaluation Project: Transportation Emission Reduction Measures (TERMs) Revised Evaluation Framework 2005-2008, MWCOG, May 15, 2007.
[5] Commuter Connections, Transportation Demand Management Evaluation Project: Transportation Emission Reduction Measures (TERMs) Revised Evaluation Framework 2008-2011, MWCOG, May 18, 2010.
[6] Commuter Connections, Transportation Demand Management Evaluation Project: Transportation Emission Reduction Measures (TERMs) Revised Evaluation Framework 2011-2014, MWCOG, May 21, 2013.

The evaluation seeks to quantify the impacts of the four TERMs, results which will be used in calculations of the region's air quality conformity from the TERM Tracking Sheet. Commuter Connections had previously provided traditional ridematching services. This service is included in the "baseline" of travel and air quality indicators for the purposes of assessing regional air quality conformity.

This evaluation framework report is organized into eight sections:

- Section 1 presents the framework overview
- Section 2 defines evaluation objectives and issues guiding the process.
- Section 3 enumerates performance measures to be used in assessing program effectiveness and cost effectiveness.
- Section 4 discusses evaluation components specific to each TERMs: Maryland Telework, Guaranteed Ride Home, Employer Outreach / Employer Outreach for Bicycling, and Mass Marketing. This section also presents evaluation activities relevant for the Commuter Operations Center (COC) and the Software Upgrade component of the Integrated Rideshare TERM, which was combined with the COC in a prevoius evaluation period.
- Section 5 describes the data sources and data collection tools used to collect TERM analysis data.
- Section 6 outlines the method to calculate travel, air quality, energy, and consumer cost impacts of the TERMs.
- Section 7 describes tools currently used to report Commuter Connections' evaluation results to various stakeholder audiences.
- Section 8 outlines the evaluation schedule and responsibilities.

SECTION 2 EVALUATION OBJECTIVES AND ISSUES

Objectives of the Evaluation

The objective of the evaluation process is to provide timely and meaningful information on the performance of the TERMs to document program benefits for conformity reporting, identify program enhancements, and guide future decision-making about funding priorities. This information includes travel and air quality impacts, such as vehicle trips and miles of travel reduced and emissions reduced from the four TERMs implemented by the Commuter Connections program.

Key audiences for the evaluation results include decision-makers such as the TPB and other regional policy makers; COG program funders; Commuter Connections staff; TERM program partners, such as local jurisdictions and transportation management associations (TMAs); and employers and commuters who comprise Commuter Connections' clients. Specific information relevant to each group includes:

- Regional policy-makers – Effectiveness and cost effectiveness of TERMs in contributing to regional goals for reducing congestion, improving air quality, reducing energy consumption, and improving mobility and accessibility.
- Program funders – Effectiveness and cost-effectiveness of the TERMs implemented via the Commuter Connections program.
- Regional policy-makers and TERM program staff – Regional commute trends and attitudes and the collective impact of Commuter Connections programs on regional traffic and air quality. The 2015-2017 evaluation will continue to explore emerging national and regional requirements in performance measurement. The evaluation also will continue to compile evaluation data to assist program managers to report TERM benefits in ways that are meaningful to policy-makers and funders.
- Commuter Connections staff and program partners – Potential program enhancements to increase service effectiveness and efficiency of service delivery.
- Employers and commuters – Collective, regional impacts of individual participation, benefits for employers that support commute programs, and personal benefits received by commuters who use alternative modes. Evaluation information also can be useful to educate employers about feasible and effective trip reduction strategies for their specific worksite conditions.

Evaluation Principles and Issues

Several overarching principles and issues apply to evaluation of each of the TERMs and the Commuter Operations Center. They are presented here to emphasize the underlying foundation of the evaluation process.

Document Progress Toward TERM Goals and Support Program Management

- The evaluation uses common, quantitative performance measures for all TERMs to allow for comparisons among TERMs and between TERMs and other strategies that could be implemented to address congestion and air quality concerns. A crucial function of this evaluation process is to assess the overall effectiveness of the Commuter Connections Program, collectively. Consistent methodologies also enhance confidence in the results. These common measures are enumerated in Section 3.
- The evaluation framework allows for quarterly benefits projection as a program management information tool. While assessment of travel and air quality benefits is the key purpose of the evaluation, the process also provides information to support administration of the Commuter Connections program.
- The evaluation process follows industry-accepted evaluation techniques; and is rigorous, ongoing, resource efficient, unobtrusive for COG partners, and compatible with regional, state, and national practices.

- The evaluation framework addresses collection of data to assist MWCOG to integrate Commuter Connections' TERMs into its response to the MAP-21 federal performance-based planning requirements.

Separating Impacts of Program Elements

- The evaluation separates the impacts of individual Commuter Connections programs to avoid double counting benefits. For example, carpools might be formed as a joint result of online ridematching and GRH program benefits. These impacts must either be credited to one of the two TERMs or divided between the TERMs. Program benefits are not necessarily additive.

- Similarly, the evaluation separates the baseline impacts of Commuter Operations Center "basic" services from the impacts of the new TERM programs. The method for attributing impacts to a specific TERM or service is discussed in Section 6. This is especially relevant for the Mass Marketing TERM, because its impacts can be "direct," meaning the marketing alone motivated an alternative mode shift, or "referred," meaning the marketing influenced commuters to utilize another Commuter Connections program, such as ridematching. In such cases, the travel and air quality impacts will be assigned to the TERM or to the Commuter Operations Center, based on their respective influences.

- When possible, the evaluation recognizes and attempts to address the possible impacts of exogenous factors. Travel decisions also are influenced by the extent of congestion, work and home locations, economic factors, fuel prices, and other factors. User surveys must explore the reasons for shifting to alternative modes to define the relative importance of TERMs in influencing mode choices. Data collected through the State-of-the-Commute survey also support this objective by suggesting exogenous factors that might have influenced travel changes.

Accounting for Prior Mode and Access Mode

- Prior mode is an important variable in this evaluation, because a shift to an alternative mode does not always mean a vehicle trip was eliminated. Vehicle trips are reduced only in three cases: 1) the commuter shifts from driving alone to an alternative mode, 2) the commuter increases the frequency of use of an alternative mode, or 3) the commuter shifts to a higher-occupancy mode (e.g., from carpool to vanpool). Section 6 describes the development of the vehicle trip reduction (VTR) factor used to convert the number of alternative modes placements into the number of vehicle trips reduced, taking into account various types of before-after alternative mode combinations.

- For air quality evaluation purposes, it is necessary to know the access mode of carpoolers, vanpoolers, and transit riders. Access mode refers to how carpoolers, vanpoolers, and transit riders travel from home to bus stops, train stations, Park & Ride lots, or other places where they meet rideshare partners or board a bus or train. Access mode is a minor issue in the evaluation of VMT reduction, because access trips generally account for a very small portion of the total miles traveled and the alternative mode generally is used for the most congested and longest portion of the trip. However, commuters who drive alone to the meeting point still make a vehicle trip and accumulate some drive-alone VMT, which must be subtracted from the vehicle trips reduced and VMT reduced in the air quality analysis.

Updating Calculation Factors and Assumptions Used in the Evaluation

- The TERM evaluation methodology applies calculation factors developed from surveys and other research conducted during the evaluation period. Revisions will be incorporated in the FY15-FY17 evaluation as noted later in this report for each TERM. Additionally, regional emissions factors will be updated to reflect factors that will apply in 2017.

Apply Life-cycle Assessment to Mode Shifts to Capture the Full Duration of Benefits for TERM Impacts

- In previous TERM evaluations, mode shifts motivated by TERMs during the evaluation period were not carried over to the next evaluation cycle. If mode shifts extend beyond three years, however, additional impacts could be retained from one 3-year evaluation cycle to the next. To address this opportunity, the 2015-2017 evaluation will include a new "Retention Rate" survey to estimate the share of past service users who continued to use alternative modes. The 2016 survey will interview Commuter Connections online system users and GRH users who participated in these programs prior to the start of the evaluation period. Users will be asked about their current modes, how long they have used their current modes, what CC services they received, and how those services influenced them to continue to use alternative modes. The survey data will be used to develop a "retention" curve or lifecycle of continued alternative mode experience. Section 4 provides additional details on this survey.

Specific Evaluation Issues for Individual TERMs

In general, the TERM analysis approaches documented in the 2014 TERM Analysis Report are used as the basis for the TERM evaluation methods described in this framework. A sample of the TERM calculations are included in Appendices F through K, as excerpted from the 2014 TERM Analysis Report.

- Maryland Telework – The Maryland Telework TERM is a resource service to help employers, commuters, and program partners in Maryland initiate and expand telework programs. In evaluating teleworking, several travel changes need to be assessed, including: trip reduction due to telework, the mode on non-telework days, and mode and travel distance to telework locations other than home. Telework impacts are primarily estimated from the State of the Commute survey and from surveys conducted of employers that received telework information or assistance from Commuter Connections.

- Guaranteed Ride Home (GRH) – The primary goal of GRH is to encourage commuters who drive alone to shift to alternative modes and to encourage commuters who were ridesharing before they registered for GRH to continue or expand their use of these modes. The evaluation for GRH will estimate the influence of GRH availability on both mode shifts and frequency of ridesharing. The 2015-2017 methodology will add a "retained" component for registrants who ended their participation in GRH prior to the start of the current evaluation period but who are continuing to use alternative modes to commute.

- Employer Outreach – Employer outreach applies a two-faceted approach employing empirical data on employer programs and modeled impacts. The empirical data come from the ACT! database of employer contacts, including information on trip reduction strategies implemented at each worksite. The EPA COMMUTER model (v 2.0) applies these empirical data to project the likely change in employee commuting behavior for given changes in the employer's program. The Model uses time and cost coefficients based on coefficients used by MWCOG in regional transportation modeling. In the 2011-2014 evaluation, the consulting team updated the COMMUTER Model v. 2.0 coefficients to be consistent with the new regional travel model developed by MWCOG staff. MWCOG continues to use this regional model, thus, the updates made during the 2011-2014 evaluation will be carried over for the 2015-2017 evaluation.

  The FY15-FY17 methodology also will distinguish three types of Employer Outreach impacts: maintained, new, and expanded. The Employer Outreach TERM has been in effect for many years. Beginning with the 2008 analysis, new Employer Outreach goals were established for the overall program and for new program activity during each new evaluation period. The Employer Outreach evaluation now calculates impacts for "maintained" employer programs and "new/expanded" programs.

  - Maintained impacts will include employers that joined EO before the start of the evaluation period (e.g., before July 1, 2014), continued in the program, but made no changes since that date.
  - New impacts will include employers that joined the EO program during the current evaluation period.
  - Expanded impacts will include employers that were involved in EO before the start of the current evaluation period, but expanded their commute assistance services after that date.

The evaluation also estimates impacts for employers that participated in the program during the most recent evaluation period (FY12-FY14), but dropped out of EO before the start of the new period. Commuter Connections determined that the impacts that would have been credited for these employers would have to be replaced or "back-filled" by new/expanded impacts.

Finally, employer bicycle programs, which were evaluated separately from other Employer Outreach services in 2002 and 2005 under the Employer Outreach for Bicycling TERM, are now addressed within the broad Employer Outreach TERM. But the contribution of these bicycle programs will continue to be calculated and reported separately.

- Mass Marketing – The critical issue for this TERM is attributing changes in attitudes and behavior to the mass marketing campaign versus another TERM. Four types of impacts are possible for Mass Marketing:
  1) "Direct" impacts generated by commuters who cite regional commute advertising messages as the reason for their commuting change
  2) "Referred" impacts that are generated when advertising encourages commuters to submit rideshare and GRH applications
  3) Event impacts generated from special event programs, such as the Bike to Work Day and Car-Free Day events
  4) Pool Rewards rideshare start-up incentive program

  One new element in the 2015-2017 evaluation will be the addition of vanpools to the 'Pool Rewards evaluation. The 2014 TERM analysis evaluated the impacts of the carpool component of 'Pool Rewards participation. In FY2012, Commuter Connections expanded the program to include newly-formed vanpools that originate in either the District of Columbia or Maryland and are destined for job locations in the Washington metro region non-attainment area. Vanpools that participate in this program will be included in the 2017 TERM analysis.

  This is explained further in Section 4. The evaluation will be accomplished using a variety of data sources, including the State-of-the-Commuter survey and COC tracking data.

- Commuter Operations Center and Integrated Rideshare–Software Upgrades TERM – Impacts for Commuter Operations Center will be evaluated as in 2012-2014. Integrated Rideshare-Software Upgrades will continue to be evaluated as part of the Commuter Operations Center (COC) under the Integrated Rideshare TERM. However, their impacts will be calculated and reported as a distinct sub-set of the Commuter Operations Center.

  The 2015-2017 methodology for Commuter Operations Center will include two new components. First, it will add a "retained" component for online system applicants who received services before the start of the current evaluation period but who are continuing to use alternative modes to commute. Second, the COC methodology also will be updated to credit impact from Commuter Connections-assisted telework that occurs outside of Maryland, thus are not counted under the Maryland Telework TERM.

The evaluation activities described in Section 4 elaborate on these issues for individual TERMs.

SECTION 3 PERFORMANCE MEASURES

Performance Measures by Category

The previous evaluation frameworks established performance measures for each TERM. Performance measures are measures of a program's success; how well the program is meeting the program objectives, in particular the travel and emission targets set by the TPB for each TERM. Generally, the evaluation framework applies performance measures in the following broad categories:

- Awareness and attitudes
- Program participation and satisfaction
- Mode utilization
- Program impacts

Awareness and Attitudes

Awareness indicators assess how well known the Commuter Connections program and its services are to commuters. Awareness has assumed a larger role in recent evaluation periods because it is a primary objective of the Mass Marketing TERM. A related type of measure is commuters' attitudes toward their commute and toward various commute modes. These measures examine commuters' personal feelings about travel modes and their willingness to consider and try new modes of travel.

- Awareness – Program awareness will be measured by the proportion of residents and commuters who recognize the Commuter Connections "branding" and are aware of transportation infrastructure or alternative modes available to them. Awareness will be assessed by questions in surveys of the public at large.
- Attitudes – One goal of the Mass Marketing TERM is to address commuters' frustration with increasing congestion. The evaluation will document travel attitudes over time, including commute ease and recent shifts to alternative modes. This information is currently captured in the State of the Commute survey and will continue to be tracked as more general population surveys are conducted.

Program Participation and Satisfaction

Participation refers to indicators related to use of TERM services by targeted populations, for example, the number of matchlist requests, the number of GRH applicants, the number of bicyclists who register for Bike-to-Work Day, or the number of employers that participate in Employer Outreach. Participation data measure program output and are needed to calculate program outcomes (impacts).

Satisfaction measures customers' satisfaction with various features of TERM services and the efficiency of service delivery, for example, the speed with which assistance is delivery, and users' impression of the usefulness of the services. These measures are important to track funding, estimate staffing, and identify program improvements.

- Program Participation – Program participation will be measured by the number of clients or customers who request individual Commuter Connections TERM services and the number who are assisted. Participation could include the numbers of new employer clients, GRH applicants, online information system users, telework employer sites, etc. A primary participation measure is generally the *number of applicants or users*, but other measures, specific to individual TERMs, also are described in Section 4.
- Program Satisfaction – A primarily qualitative set of performance measures is suggested to assess client satisfaction and determine whether services are meeting customers' needs and their expectations. This is important to gauge satisfaction of various customers (e.g., employers, commuters, teleworkers, etc.) with the services they receive.

Mode Utilization

Utilization measures new and expanded use of alternative modes motivated by use of TERM services, for example, the percentage of GRH registrants who shift from driving alone to an alternative mode to be eligible for GRH.

- Alternative Mode Placements – The measure of "placements" is defined as the number of commuters who shift to (i.e., are "placed" in) alternative mode arrangements following use of the Commuter Connections services. These commuters could be new carpoolers, vanpoolers, transit riders, bicyclists/walkers, or teleworkers.

Program Impacts

Program impacts estimate the travel, air quality, energy, and commuter cost saving benefits of the TERMs. The impact measures and targets that are currently in place were officially set by the MWCOG Transportation Planning Board (TPB) when the TERM was established. In all cases, the impacts are related to the TERM's contribution to the regional conformity assessment. This section describes several common performance measures recommended for each TERM and for the program as a whole. Performance measures specific to each TERM are listed in Section 4. Impact measure goals also are defined for each TERM in Section 4.

- Vehicle Trips Reduced – The number of vehicle trips reduced is one of two travel impact measures. It estimates the number of daily vehicle trips that alternative mode placements remove from the road during the peak commuting periods. This is a primary measure of congestion relief through its role in reduced delay, increased travel speed, reduced commute time, and improved roadway service levels. In essence, trip reduction equates to a roadway capacity increase. It also is a primary input (trip end emissions) to the air quality analysis.

  Vehicle trip reduction is estimated using a *vehicle trip reduction (VTR) factor*, the average number of vehicle trips reduced per day for each alternative mode placement. The VTR factor accounts for shifts from drive alone to alternative modes, shifts among alternative modes (e.g., from carpool to vanpool and from transit to carpool), increases in the days per week that a commuter uses an alternative mode, and increases in the occupancy of carpools and vanpools. Shifts from alternative modes to drive alone are not included, because these changes are not motivated by commuters' contact with Commuter Connections. Appendix A describes how the VTR factor is calculated. Appendix B shows a sample VTR factor calculation.

- Vehicle Miles of Travel (VMT) Reduced – VMT reduced, the second travel impact measure, estimates the total miles of vehicle travel removed from the road daily. VMT reduction is particularly important to the air quality and energy evaluation, but also is relevant to any assessments of the roadway system performance impacts.

- Emissions Reduced – Emissions reduced measures the decrease in mobile source emissions resulting from reductions in vehicle trips or VMT. From the start of the TERM evaluations, the primary pollutants of concern were Nitrogen Oxides (NOx) and Volatile Organic Compounds (VOC), which are both ozone precursors. The 2008 TERM Analysis added calculation of impacts for two components of particulate matter (PM): direct PM2.5 emission, and NOx precursors. It also added Carbon Dioxide (CO2), the primary greenhouse gas. These measures also will be estimated in the 2015-2017 evaluation.

- Energy Saving – The energy saving, defined as the reduction in the number of gallons of gasoline consumed, resulting when commuters reduce VMT.

- Consumer Cost Saving – Another measure of program impacts is the aggregate cost savings realized by commuters who reduce daily vehicle trips and VMT.

- Societal Costs – Other societal benefits also will be estimated as a function of the change in VMT. These benefits include reductions in societal costs associated with crashes, noise pollution, and additional pollutants.

Future Review and Updates to Performance Measures

The impact measures described above were developed primarily to report the performance of TERMS as compared with regional goals set for them for conformity determination. Conformity remains central to Commuter Connections' evaluation, but climate change, mobility, health/safety, and livability/quality of life are joining congestion and air quality as forces shaping the region's transportation policies, making them also issues relevant to Commuter Connections partners and funders.

The official impact measures for the TERMs were established by the TPB and this evaluation framework does not recommend any official changes, since the TERMs' primary function is to meet a required regional objective linked to emissions and conformity. But the TERMs likely do offer other benefit to residents and commuters of the Washington region, in the societal objectives noted above. Documenting and communicating the type and magnitude of these benefits will demonstrate the broad value of Commuter Connections programs to the community and reinforce the value of investments made in the programs.

One benefit area that is anticipated to be of particular importance by the end of the evaluation period is transportation system performance, as new performance measurement requirements are established by the Federal Highway Administration to comply with MAP-21 transportation funding reauthorization. FHWA's latest schedule shows they were s expected to release a Notice of Proposed Rulemaking (NPRM) on system performance measures by November 2015.

FHWA will establish a 120-day comment/reporting period, followed by a final rule likely by the middle of 2016. MWCOG has already initiated internal activities to coordinate with State DOTs and public transportation agencies to define possible performance measures and track regional progress on system performance. During the FY15-FY17 evaluation period, the consultants will follow the progress of the FHWA rulemaking and identify ways that the TERM evaluation could provide useful data to support MWCOG's regional response.

The SOC and user surveys conducted throughout the evaluation period offer immediate opportunities for Commuter Connections to collect data related to system performance and other regional, societal benefits of TERM programs. For example, the 2013 SOC and GRH surveys added questions about the primary roadways that commuters used for their trip to work and the time they typically arrive at work. The samples were too small to document delay reductions by route, but analysis of the data suggested that some routes had higher shares of alternative mode use than did others.

The 2016 SOC will expand on these data to define the specific roadway segments that alternative mode users would use if they were driving alone. The 2016 SOC survey also will include questions regarding the time penalty commuters' experience when traveling during the peak period and the degree of work start time flexibility that commuters are allowed and their willingness to shift their travel out of the peak period. The survey also will explore how residents' perceptions of quality of life and transportation satisfaction are related to the availability and quality of transportation services.

In some cases, these new data might be used by other MWCOG departments in regional or local planning studies or be analyzed in conjunction with travel data from INRIX or other passive collection sources. Commuter Connections also could apply other existing analytical tools, such as the Trip Reduction Impacts of Mobility Management Strategies (TRIMMS™) model methods to estimates the impacts of a broad range of transportation demand initiatives. TRIMMS™ can help assess program cost effectiveness by estimating the external or societal costs associated with driving, such as congestion delay, air pollution, excess fuel consumption, and increased accident risk, which are not directly incurred by auto users but are borne by society as a whole. At a minimum, the overall impact of VMT reduction on system performance can be calculated using national default factors as to the impact of VMT changes on delay.

SECTION 4 EVALUATION COMPONENTS FOR INDIVIDUAL TERMS

Sections 2 and 3 stated the objectives and issues guiding the evaluation process and defined several common performance measures that will be used for all TERMs. This section details the specific evaluation approach for each of the four TERMs and for the Commuter Operations Center.

The TERMs included are:

- Maryland Telework
- Guaranteed Ride Home
- Employer Outreach/Employer Outreach for Bicycling
- Mass Marketing
- Commuter Operations Center/Integrated Rideshare

For each TERM, the following information is provided:

- TERM description
- Goals defined for the TERM for 2017
- Nature of the evaluation
- Performance measures recommended for the TERM
- Data needed to measure TERM impacts and recommended data sources

Section 5 of this report provides a more detailed description of the surveys and other data sources enumerated in this section. Section 8 presents a schedule for the collection of data and recommends a party to be responsible for collecting the data. Included in the appendices are examples of how travel and emission impacts are calculated for each TERM. These are taken from the 2014 TERM Analysis Report to provide real examples of how the calculations were performed in the last evaluation period. These calculation methods form the basis for the refinements included in this evaluation framework.

The specific data required for each TERM to calculate alternative mode placements, vehicle trips reduced, and VMT reduced are described in the individual TERM evaluation component sections that follow. Additionally, some common data are needed to calculate emissions, commuter cost, and energy impacts of each TERM, including:

- Access mode and distance to meeting locations for alternative mode users (for air quality analysis)
- Regional emissions factors (to determine emission reductions)
- Regional fuel economy data in average miles per gallon consumed (to calculate energy saving)
- Vehicle operating costs (to estimate commuter cost savings)

4-A Maryland Telework

Program Description

In the Maryland Telework TERM, Commuter Connections, working with numerous partners in Maryland, assists employers to establish worksite telework programs and arrangements and provides telework information to individual commuters. The Maryland Telework TERM estimates the impact of the portion of telework among commuters who work or live in Maryland that is attributable to Commuter Connections' telework assistance.

TERM Evaluation Changes Since FY12-FY14

- Counts only Commuter Connections-assisted telework by commuters who live or work in Maryland.[7] The evaluation will count assisted telework among commuters who commute solely within or between the District of Columbia and Virginia through the Commuter Operations Center element.

Stated Goals

The purpose of the Telework TERM is to increase the number of full-time or part-time home-based and telework center-based teleworkers in the region. COG/TPB defined five regional goals for this TERM for 2017:

- Maintain 31,854 teleworkers
- Reduce 11,830 daily vehicle trips
- Reduce 241,209 daily miles of travel
- Reduce 0.122 daily tons of NOx
- Reduce 0.072 daily tons of VOC

Nature of Evaluation

The populations of interest for this TERM include two groups:

- Teleworkers who live and/or work in Maryland who are influenced by Telework services / assistance they receive from Commuter Connections / MWCOG to begin teleworking
- Telework employees at Maryland worksites that are assisted by Commuter Connections

For the first population, the evaluation determines the number of teleworkers who live or work in Maryland who were influenced or assisted by Telework TERM services to begin teleworking and the travel impacts of their teleworking. Data for this component come from the State of the Commute survey:

- Number of Maryland teleworkers and their frequency of teleworking
- Telework locations – the mix between home-based and non-home-based telework
- Teleworkers' commute modes and commute distance on non-telework days
- Teleworkers' travel patterns to telework locations outside the home
- Sources of information teleworkers had used to learn about telework

Placement rates and average trips reduced per placement are derived for home-based teleworkers and for those working at non-home locations.

[7] The Maryland Telework TERM provides services to commuters who either work or live in Maryland. Residents of the District of Columbia and Virginia who also work in one of these states would not be eligible for Telework services. But residents of the District and Virginia who work in Maryland would be included. Similarly, residents of Maryland who work in the District or Virginia also would be included.

For the second population, the evaluation estimates the portion of teleworking influenced by the Telework TERM through direct telework assistance to Maryland employers. This is accomplished through analysis of data from a survey of telework-assisted employers to determine:

- Percentage of employers with telework programs before and after receiving telework assistance
- Percentage of teleworkers at assisted sites before and after receiving assistance

Thus, the evaluation will define the telework universe among Maryland commuters and examine employers' and commuters' sources of information for telework and the value of that information or assistance in their starting or expanding telework programs to estimate the share of telework attributable to the TERM.

Performance Measures

Performance measures recommended to evaluate the Maryland Telework TERM include:

Participation, Satisfaction, and Utilization Measures:

- Number of Maryland employers that receive telework assistance from Commuter Connections
- Number of Maryland employers that implement/expand telework programs after receiving assistance
- Number of Maryland commuters who receive telework information from Commuter Connections
- Number of Maryland commuters who begin teleworking after receiving assistance
- Number of new Maryland teleworkers – home-based and non-home based
- Maryland telework placement rate

Program Impact Measures:

- Daily vehicle trips reduced
- Daily VMT reduced (in miles)
- Daily emissions reduced (in tons of pollutants)

Data Needs and Sources

The following data are needed to assess Telework impacts. Each data source is described in Section 5.

Data Need	*Data Source*
• Home-based teleworkers	State of the Commute (SOC) survey
• Non-home-based teleworkers	SOC survey
• Telework frequency (days/week)	SOC survey
• Percent drive-alone on non-telework days	SOC survey
• Travel distance on non-telework days	SOC survey
• Travel distance to telework centers	SOC survey
• Commuters' source of telework information	SOC survey
• Telework at assisted employers' worksites	TW assistance survey

Proposed timing of data collection

- SOC survey – January-April 2016
- Commuter Connections Telework assistance survey – Early 2017

To avoid double counting benefits, the employers included in the Maryland Telework TERM will be cross-referenced against employers that participate in the Employer Outreach TERM. The telework impacts for any employers that participate in both programs will be subtracted from their impacts in the Employer Outreach TERM, but non-telework impacts for these Maryland employers will continue to be included in the Employer Outreach TERM.

4-B Guaranteed Ride Home TERM

Program Description

The Guaranteed Ride Home (GRH) program eliminates a real or perceived barrier to use of alternative modes – the fear of being stranded without a personal vehicle. GRH provides free return transportation by taxi or rental car in the event of an unexpected personal emergency or unscheduled overtime to commuters who carpool, vanpool, use transit, or bike or walk to work at least two times per week on average. Commuters pre-register for GRH and may use the service up to four times per year. The program also allows "one-time exception" rides provided to non-registered commuters who used an alternative mode on the day a GRH trip was needed. Commuters who wish to use GRH again in the future must then register.

TERM Evaluation Changes Since FY12-FY14

- The 2015-2017 methodology will add a "retained" component for registrants who ended their participation in GRH prior to the start of the current evaluation period but who are continuing to use alternative modes to commute.

Stated Goals

COG/TPB defined the following regional goals for GRH for 2017:

- Maintain 36,992 GRH applicants
- Reduce 12,593 daily vehicle trips
- Reduce 355,136 daily vehicle miles of travel
- Reduce 0.177 daily tons of NOx
- Reduce 0.097 daily tons of VOC

Nature of Evaluation

GRH is intended to encourage drive-alone commuters to shift to alternative modes. Additionally, GRH is expected to help maintain existing alternative mode arrangements and increase frequency of alternative mode use. The evaluation measures the number of new alternative mode users whose shifts were influenced by GRH and the number of commuters who used alternative modes before registering who were influenced to increase use of the modes.

The GRH TERM evaluation for FY15-FY17 will estimate impacts for commuters who fall into either of two participation categories:

- Commuters who were registered for / participating in GRH at any time during the three-year evaluation period, even if they were no longer registered at the end of the period
- Commuters who did not register for GRH but took a "one-time exception" trip during the three-year evaluation period

Performance Measures

The following performance measures are used for GRH:

Participation, Satisfaction, and Utilization Measures:

- Number of GRH applicants
- Number of one-time exception users
- GRH placement rate
- Percentage of GRH participants who take a GRH trip
- Satisfaction of GRH users with the service

Program Impact Measures:

- Daily vehicle trips reduced
- Daily VMT reduced (in miles)
- Daily emissions reduced (in tons of pollutants)

Data Needs and Sources

The following data are needed to estimate GRH impacts. Each data source is described in Section 5.

Data Need	*Data Source*
• GRH applicants	GRH database/archived GRH database
• One-time GRH exception users	GRH database/archived GRH database
• GRH placement rate	GRH Applicant survey
• GRH VTR factor	GRH Applicant survey
• Average travel distance (trip length)	GRH Applicant survey
• GRH retained placement rate	CC Retention Rate survey
• GRH retained VTR Factor and average travel distance	CC Retention Rate survey

Proposed timing of data collection

- Commuter Connections GRH database – ongoing
- Commuter Connections Retention Rate survey – March 2016
- GRH Applicant survey – April-May 2016

Two subgroups are identified for GRH. The first sub-group includes participants who both live and work within the Washington Metropolitan Statistical Area (MSA). The second group includes participants who work within the MSA but live outside it. Placement rates, VTR factors (average trips reduced per placement), and travel distances are estimated for each of the two sub-groups. This distinction is made because credit for the "out of MSA" participants is discounted to eliminate the VMT reduction that occurs outside the MSA.

The analysis of GRH also includes steps to avoid credit double counting from overlap with two other TERMs. Overlap occurs between GRH and the Commuter Operations Center because some GRH applicants also obtain ride-match lists, transit information, or other commute assistance information. The COC impacts are discounted to account for this overlap. GRH results also will be adjusted to assign a portion of the GRH TERM's impacts to the Mass Marketing TERM to recognize that some GRH applicants will be influenced to apply for GRH by hearing a Mass Marketing advertisement.

4-C Employer Outreach TERM

Program Description

The Employer Outreach TERM is designed to encourage employers to implement new commute assistance programs and to expand the services they offer in existing programs. In this TERM, jurisdiction-based sales representatives contact employers, educate them about the benefits commuter assistance programs offer to employers, employees, and the region, and assist them to develop, implement, and monitor worksite commuter assistance programs. Commuter Connections assists the sales force with the following services, designed to enhance regional coordination and consistency:

- Computerized regional employer contact database
- Marketing and information materials
- Employer outreach sales and service force training
- Annual evaluation program
- Support to Employer Outreach Committee

TERM Evaluation Changes Since FY12-FY14

- No changes

Stated Goals

COG/TPB has defined the following regional goals for Employer Outreach for 2017:

- 1,348 total participating employers; 590 with bicycle support
- Reduce 82,120 daily vehicle trips
- Reduce 1,391,362 daily vehicle miles of travel
- Reduce 0.559 daily tons of NOx
- Reduce 0.318 daily tons of VOC

Nature of Evaluation

Employer Outreach is aimed at increasing the number of private employers implementing worksite commuter assistance programs, but Employer Outreach is ultimately designed to encourage employees of client employers to shift from driving alone to alternative modes.

Two primary evaluation questions are thus important. First, how many employers start or expand commuter assistance programs? And second, how many employees use alternative modes in response to new employer-sponsored services at the worksite? The populations of interest for this TERM are:

- Employers that participate in Employer Outreach
- Employees at Employer Outreach worksites
- Employers that offer bicycle services (Employer Outreach for Bicycling)
- Employees at worksites that offer bicycle services

Differentiation Between New and Maintained Impacts – When the Employer Outreach TERM was adopted, the TPB established a goal that was to be achieved by June 2005 and evaluations conducted for periods through June 2005 measured impacts against this goal. Beginning with the 2008 Analysis, the Employer Outreach goals were re-set to include a goal for the overall program and a goal for new program activity since 2005.For this reason, the 2008, 2011, and 2014 TERM Analyses defined two categories of Employer Outreach impacts: "new/expanded" impacts and "maintained" impacts.

For the 2017 analysis, maintained impacts will include those from employers that joined EO before July 1, 2014, the start of the FY15-FY17 evaluation period and made no changes since that date. These impacts are considered part of the FY15-FY17 baseline for EO. New impacts will include those from employers that joined the EO program after June 30, 2014. Expanded impacts will include those for employers that were involved in EO before the start of

the evaluation period but expanded their commute services since June 30, 2014. Additionally, impacts from program reductions will be "back-filled" from new or expanded programs.

Apply Batch Methodology for COMMUTER Model (v2.0) Runs – The TERM Analyses runs the COMMUTER Model (v2.0) in a batch format that allows each employer's program components to be modeled separately and that calculates trip reduction for each employer individually. This method will enable Commuter Connections to define individual employers' contributions to the impacts, should Commuter Connections or local jurisdictions choose to do so.

Employer Outreach for Bicycling – In the 2002 and 2005 TERM evaluations, bicycle programs offered by employers were evaluated separately from other Employer Outreach services under the Employer Outreach for Bicycling (EOB) TERM. EOB was later incorporated into the overall EO TERM and will be addressed similarly in the 2017 evaluation. However, the contribution of these bicycle programs to the overall EO impact will continue to be calculated and reported separately. The Employer Outreach for Bicycling component also will include employers' support for bikesharing programs, particularly for employers that offer Bikeshare Corporate accounts to employees.

Performance Measures:

The following performance measures are recommended for Employer Outreach:

Participation, Satisfaction, and Utilization Measures:

- Number of employer clients (employers with commuter assistance programs and employers with bicycle programs) – total and new/expanded
- Number of employees at client worksites (worksites with commuter assistance programs and bicycle programs) – total and new/expanded
- Level/extent of employers' commuter assistance programs
- Alternative mode use at worksites with commuter assistance programs (placements)
- Employer satisfaction with outreach assistance and services

Program Impact Measures:

- Daily vehicle trips reduced
- Daily VMT reduced (in miles)
- Daily emissions reduced (in tons of pollutants)

Data Needs and Sources

The following data items will be used to calculate program impacts. Each data source is described in Section 5.

Data Need	*Data Source*
• Employers participating in Employer Outreach	ACT! database
• Participating employers that offer bicycling services to employees	ACT! database
• Employer characteristics	ACT! database
• Commuter assistance services at worksite	ACT! database
• Starting Average Vehicle Ridership (AVR)	Employee baseline surveys
• Ending AVR (estimated)	EPA COMMUTER Model 2.0
• Average travel distance	SOC survey

Proposed timing of data collection

- ACT! database – ongoing
- Employee baseline surveys – ongoing; data to be compiled in Fall 2016
- SOC survey – January-April 2016

The Employer Outreach TERM is the only TERM for which placement rates and VTR factors are not directly used to determine the number of new participants, vehicle trips reduced, or VMT reduced. This is because sufficient employee survey data are not available to assess employees' post-program travel behavior. These missing evaluation elements are modeled using the EPA COMMUTER Model (v2.0).

To estimate impacts, employers' starting mode shares and commuter assistance program strategies are input into the COMMUTER Model (v2.0) and the model estimates "after" mode split and average vehicle ridership, that is, with the program in place. The TERM analysis used this model in past evaluations.

The COMMUTER Model uses time and cost coefficients that are compatible with coefficients used by MWCOG in regional transportation modeling. During the 2008 evaluation, COG and the evaluation team adjusted the cost coefficients used in the model, to correct for the COMMUTER Model's tendency to overestimate the likely impacts of financial incentives on shifts to non-SOV modes. Descriptions of the adjustment and the original and adjusted coefficients are presented in Appendix C.

In 2010-2011, COG developed a new regional travel model. This might be expected to require updated COMMUTER Model cost and time coefficients. MWCOG modeling staff reviewed the COMMUTER Model coefficients used by the consulting staff for the 2011 and 2014 evaluations and determined that no further adjustment would be needed to the coefficients for the 2017 TERM analysis.

4-D Mass Marketing TERM

Program Description

In 2003, Commuter Connections embarked on an ambitious effort to educate the region's commuters about alternatives to stress-filled solo commuting and to raise awareness of commute assistance services available through Commuter Connections and its partners. Radio, direct mail, and other media are used to create a new level of public awareness and to provide a call to action to entice commuters to switch to alternative modes. Other marketing-related programs and events have been added to the TERM since the start of the TERM. Support for Bike to Work Day was added to the Mass Marketing TERM in the 2005-2008 evaluation and the 'Pool Rewards carpool incentive program was added in the 2008-2011 evaluation.

The objectives of the Mass Marketing TERM are to:

- Raise regional awareness about the Commuter Connections brand
- Address commuters' frustration with congestion
- Induce commuters to try and adopt alternative commute modes

TERM Evaluation Changes Since FY12-FY14

- Add vanpool component to the 'Pool Rewards evaluation

Stated Goals

COG has defined the following regional goals for Mass Marketing for 2017:

- Encourage 23,168 commuters to switch modes
- Reduce 10,809 daily vehicle trips
- Reduce 181,932 daily vehicle miles of travel
- Reduce 0.085 daily tons of NOx
- Reduce 0.025 daily tons of VOC

Nature of Evaluation

The Mass Marketing TERM has three populations of interest:

1) All commuters in the Commuter Connections service area
2) Commuter Connections rideshare and GRH applicants who were influenced by the marketing campaign to request Commuter Connections services
3) Commuters who participate in special events (e.g., Bike-to-Work Day, Car Free Day) or in the 'Pool Rewards carpool / vanpool incentive program

The Mass Marketing TERM presents two challenges not encountered in most of the other TERMs. First, it is more difficult to assess the influence of a strategy, such as a marketing campaign, that is applied to the general commuting public, than it is to identify and track known participants in a registration-based program such as GRH. Second, when commuters who changed travel behavior can be identified, it is still necessary to identify what motivated their change. So, the critical issue for this TERM is attributing changes in attitudes and behavior – to the mass marketing campaign, another TERM, or to some other outside influence.

Type of Changes Addressed – The Mass Marketing evaluation method examines impacts from TERM components, which are measured separately. The first is for ***"directly" influenced*** changes. These are mode shifts that are made when Mass Marketing ads directly motivate commuters to change mode with no intermediate contact with Commuter Connections. An example of this type of change would be a carpool formed when a commuter hears the ad and asks a co-worker to carpool. Direct influences can only be assessed through a regional survey of commuters that asks about mode change and the reasons for the changes.

This influence of Mass Marketing on the general commuting population will be assessed through questions in the State of Commute survey that estimate the incidence of mode shifting in the region and the motivation for the shift. If a mode shift is attributed to a Mass Marketing campaign message, the associated trip, VMT, and emissions reductions can be credited to the campaign. Note that this calculation needs to correct for double counting with commuters who also cite influence of other TERMs on change.

The second TERM component is for "***referred*** changes." These are mode shifts that occur when a commuter is influenced by an ad to contact Commuter Connections, such as when a commuter hears an ad for GRH and registers for the program. Under the evaluation method, any mode change the commuter makes in response to GRH would be measured through the GRH assessment, but a portion of the influence for that change would be credited to Mass Marketing, which provided the information about GRH.

Referred influences are best measured by tracking changes in the volume of requests of information and services through the Commuter Operations Center and GRH. A comparison of the volumes of requests received during periods of media activity to periods without media activity can provide an estimate of the change in requests as a result of the ads. A pro-rated share of the impacts of these other TERM impacts then can be assigned to Mass Marketing.

The third Mass Marketing component covers "***special event***" changes, such as would occur following a Bike to Work Day or Car-Free Day event, or participation in a "***start-up***" program such as the 'Pool Rewards incentive program. Special events are typically short-term. For example, the Bike to Work Day event is one-day each year. "Start-up" programs provide benefit for a short-term; 'Pool Rewards offers incentives for a 3-month enrollment period. But the influence of these events and program can be longer-lasting; their purpose is to introduce commuters to a new travel option, with the goal that some will continue using the new mode after the event or benefit period ends. Impacts for these activities will be calculated using data from a survey of participants conducted following the event/enrollment period, which defines changes in commuters' travel during the event/program, but also ongoing use of the mode in the months after the event/program ends.

<u>Performance Measures</u>

The following performance measures are proposed for the Mass Marketing TERM:

Direct / Referred Impacts – Participation, Satisfaction, and Utilization Measures:

- Percentage of regional commuters who are aware of ad campaign and messages
- Percentage of commuters with positive attitudes toward alt modes (e.g., willingness to try)
- Percentage of regional commuters aware of Commuter Connections programs/services
- Number of contacts to Commuter Connections (e.g., call volumes, web hits, registrants)
- Direct change placement rates (temporary and continued change)

Special Events / Special Programs – Participation, Satisfaction, and Utilization Measures:

- Number of riders participating in Bike to Work
- Participants' frequency of bike commuting before and after the Bike to Work Day event
- Number of commuters participating in Car Free Day
- Participants' frequency of alternative mode use before and after Car Free Day
- Number of commuters participating in 'Pool Rewards
- Participants' frequency of alternative mode use before, during, and after 'Pool Rewards

Program Impact Measures:

- Daily vehicle trips reduced
- Daily VMT reduced (in miles)
- Daily emissions reduced (in tons of pollutants)

Data Needs and Sources

Data Needs	*Data Source*
Advertising Campaign	
• Regional commuters aware of ads / messages	SOC survey
• Percentage of commuters who make alternative mode changes after ads	SOC survey
• Influence of ads on mode change	SOC survey
• Contacts to CC info sources	SOC survey and COC tracking
• MM placement rates (temporary and continued)	SOC survey and COC tracking
• MM VTR factors	SOC survey, GRH survey, CC Applicant Placement survey
Bike to Work Day (BTWD)	
• Number of BTWD participants	BTWD survey
• Bike use before, during, and after event	BTWD survey
• Average travel distance	BTWD survey
'Pool Rewards ('PR)	
• Number of 'PR participants	'PR database
• Carpool use before, during, and after enrollment	'PR database
• Average travel distance	'PR database
Car Free Day (CFD)	
• Number of CFD participants	CFD database
• Alternative mode use before and during event	CFD database
• Average travel distance	CFD database or SOC survey

Proposed timing of data collection

- SOC survey – January-April 2016
- CC Applicant Placement survey – December 2014 (completed)
- GRH Applicant survey – April-May 2016
- Commuter Operations Center (COC) tracking – Ongoing
- Bike-to-Work Day (BTWD) event survey – Fall 2016
- 'Pool Rewards program mode use – Ongoing
- Car Free Day event survey – TBD 2016 or 2017

Not all increases in program inquiries resulting from indirect impacts will be assigned to the Mass Marketing TERM. The share of GRH and COC indirect impacts to be assigned to MM will be determined by estimating the increase in applications that occur during period when MM ads are run. These credits will be subtracted from GRH or COC to avoid double counting.

4-E Commuter Operations Center

Program Description

Since the 1970's, COG has offered basic commute information and assistance, such as regional ridematching database, to commuters living and/or working in the Washington metropolitan region. Prior to 1997, when Commuter Connections was established, these services were provided by COG's RideFinders program. Because these services were available when the emissions baseline was developed for regional conformity, the Center was not established as a TERM, but was included in the region's TIP as an ongoing program and also is part of the region's congestion management process. But only benefits above the 1997 baseline are included as a TERM.

The function of the Commuter Operations Center is to increase commuters' awareness of alternative modes, through regional and local marketing and outreach programs and to encourage and assist commuters to form ridesharing arrangements. Encouraging commuters who drive alone to shift to alternative modes is a priority for the COC, but the COC also assists commuters who now use alternative modes to continue to do so, by offering ridematching and transit assistance when carpools break up or commuters' travel patterns change and disrupt existing alternative mode arrangements.

Commuter Connections program services include: carpool and vanpool matchlists, transit route and schedule information, information on Park & Ride lot locations and HOV lanes, telework information, commute program assistance for employers, GRH, and bicycling and walking information. Commuters obtain services and information primarily through the Commuter Connections website, but also can call a toll-free telephone number or contact a local partner assistance program for personal assistance from a commuter services representative.

Included within the Commuter Operations Center program is the Integrated Rideshare TERM-Software Upgrades Project. When it began, the Integrated Rideshare TERM provided improvements to the quality and delivery of alternative mode information. In particular, the TERM added transit, park and ride, telecenter, and bicycling information to carpool/vanpool ridematch lists to inform commuters of the range of travel options that were available. Since 2008, when Commuter Connections introduced its updated web-based TDM system, these additional services have been available on a self-service basis through the online information system. But these services represent upgrades to the original ridematching services, so their impacts are captured under the Commuter Operations Center, but are reported separately in the regional TERM tracking sheet.[8]

TERM Evaluation Changes Since FY12-FY14

The 2015-2017 methodology for Commuter Operations Center will include two new components.

- It will add a "retained" component for ongoing impacts from online system applicants who received services before the July 1, 2014 start of the current evaluation period but who are continuing to use alternative modes to commute. Data for this impact will be collected through the Retention Rate survey.
- An impact credit will be calculated for Commuter Connections-assisted telework that occurs outside of Maryland, thus are not counted under the Maryland Telework TERM.

Stated Goals

COG has defined the following goals for the Commuter Operations Center for 2017:

Commuter Operations Center (basic services)

- Register/assist 91,609 commuters
- Reduce 24,425 daily vehicle trips
- Reduce 512,637 daily vehicle miles of travel
- Reduce 0.241 daily tons of NOx
- Reduce 0.115 daily tons of VOC

[8] The Integrated Rideshare TERM originally had two components; Ridematching Software Upgrades, and Inf-Express Kiosks. The InfoExpress Kiosk project was discontinued during the 2005-2008 evaluation period.

Integrated Rideshare-Software Upgrade Project (additional to Basic COC)

- Reduce 2,379 daily vehicle trips
- Reduce 66,442 daily vehicle miles of travel
- Reduce 0.028 daily tons of NOx
- Reduce 0.011 daily tons of VOC

Nature of Evaluation

Since the basic Commuter Connections ridematching and information services are covered in the conformity baseline, this evaluation component seeks to credit the program with any increases in effectiveness due to program enhancements not covered by other TERMs. Thus, the basic approach is to determine the total transportation and air quality impacts for all Commuter Connections services and subtract out impacts assigned to GRH, Mass Marketing, and any other TERM that overlaps with the COC. The balance of impacts equals the impacts of the COC.

The Integrated Rideshare-Software Upgrade component is directed to a subset of Commuter Connections clients; applicants who remember receiving transit and/or Park and Ride, Telecenter locations, and bicycling information with other ridematching information provided through the Commuter Operations Center. This program is aimed at improving the quality and availability of commute information and encouraging commuters to try transit, bicycling, and telework for occasional and full-time use, even if they did not have these options in mind when they contacted Commuter Connections for assistance. Integration of transit and Park & Ride, Telecenter locations, and bicycling information into the computer system will be evaluated through the applicant placement rate survey, described in Section 5. From this survey, a separate placement rate can be derived for those who shifted to an alternative mode after receiving transit or Park & Ride, telework, and bicycling information.

Performance Measures

The following performance measures are proposed for the Commuter Operations Center:

COC (Basic) – Participation, Satisfaction, and Utilization Measures:

- Number of commuters who use the online information system
- Distribution of services accessed (e.g., ridematch, transit, bicycle, telework)
- Online system placement rate
- Applicant satisfaction with online service

Integrated Rideshare-Software Upgrades Project – Participation, Satisfaction, and Utilization Measures:

- Number of applicants who remember receiving or accessing transit, P&R, telework, or bicycle information through the online system
- Number of applicants who use transit, P&R, telework, or bicycle information that was received but not specifically requested
- Software upgrade placement rate (percentage of applicants who use the software upgrade information to shift to an alternative mode)

Program Impact Measures (basic COC and Software Upgrades):

- Daily vehicle trips reduced
- Daily VMT reduced (in miles)
- Daily emissions reduced (in tons of pollutants)

Data Needs and Sources:

The following data items will be used to calculate program impacts for the Commuter Operations Center, including the improved transit information from the software upgrades. Each data source is described in Section 5.

Data Needs	*Data Source*
Commuter Operations Center (Basic)	
• Commuter Connections (CC) online system users	CC online system database
• COC placement rate	CC Online Placement survey
• COC VTR Factor and average travel distance	CC Online Placement survey
• COC retained placement rate	CC Retention Rate survey
• COC retained VTR Factor and average travel distance	CC Retention Rate survey
• Vehicle trips and VMT assigned to other TERMs	Results of other TERM evaluations
Integrated Rideshare–Software Upgrades (IR-SU)	
• Database applicants	CC Online system database
• Applicants who remember receiving transit, P&R, bicycle information	CC Online Placement survey
• IR-SU placement rate	CC Online Placement survey
• IR-SU VTR Factor	CC Online Placement survey
• Average travel distance	CC Online Placement survey

Proposed timing of data collection

- Commuter Connections database – ongoing
- CC Online Placement survey (November 2014) – completed, next survey November 2017
- CC Retention Rate survey – March 2016
- SOC survey – January-April 2016

Double counting is avoided by subtracting the credit assigned to the Integrated Rideshare-Software Upgrades from the impacts calculated for the Commuter Operations Center (Basic).

SECTION 5 DESCRIPTIONS OF DATA SOURCES

Much of the data needed to perform the evaluation outlined in this framework is available from two basic sources. Data on program participation will be obtained from ongoing monitoring activities of Commuter Connections and its partners in the form of application records, GRH registration forms, etc. The basic source of travel impact and attitudinal information is periodic surveys of applicants, service users, or the public-at-large. All but one of the surveys proposed for FY15-FY17 have been used in past years. Previously-administered surveys will be reviewed and modified as needed for the 2017 evaluation. The new Retention Rate survey will be developed and administered for the first time in the spring of 2016. The data sources and surveys can be divided into two groups as follows:

Ongoing Monitoring

- Commuter Connections GRH registrant database and archived GRH database(GRH)
- ACT! Employer Contact database (Employer Outreach and Telework)
- Commuter Operations Center activity tracking (Mass Marketing)
- Bike to Work Day participant records (Mass Marketing)
- 'Pool Rewards registrant database (Mass Marketing)
- Car Free Day participant records (Mass Marketing)
- Commuter Connections online information user database (COC, IR-SU)

Resident and User Surveys

- Telework assisted employer follow-up survey
- State of the Commute survey
- GRH registrant survey
- Employee commute surveys (voluntarily administered by employers)
- Commuter Connections online assistance placement rate survey (completed in November 2014)
- Bike-to-Work Day participant survey
- Retention rate survey

Each data source, survey, and analysis tool is described below, noting the TERM or TERMs for which it collects evaluation data. Table 1 serves as a quick reference for the proposed uses of each data source. In general, the data are used for either or both of two purposes. The first, TERM tracking, monitors use of and user satisfaction with the TERMs. The second purpose, conformity analysis, refers to the calculation of transportation, air quality, energy, and cost impacts of the TERM. This evaluation framework document deals primarily with the second of the purposes.

Table 1
Data Collection Activities
Applicable TERMs and Uses of the Data

Evaluation Activity/Tool	Applicable TERM	Use of Data
Ongoing Monitoring		
• GRH registrant / archived database	Guaranteed Ride Home	TERM tracking, conformity analysis
• ACT! Employer Outreach & Telework Contact Database	Employer Outreach & Telework	TERM tracking, conformity analysis
• COC website and call volume tracking	Mass Marketing (Secondary – COC, GRH)	TERM tracking, conformity analysis
• Documentation of media / marketing activities	Mass Marketing	Conformity analysis
• Bike to Work Day participant records	Mass Marketing (BTW component)	TERM tracking, conformity analysis
• Car Free day participant records	Mass Marketing (CFD component)	TERM tracking, conformity analysis
• 'Pool Rewards participant records	Mass Marketing ('PR component)	TERM tracking, conformity analysis
• CC online information system user database	COC, Integrated Rideshare-Software Upgrades (Secondary – Mass Marketing)	TERM tracking, conformity analysis
Resident and User Surveys		
• Telework assisted employer follow-up survey	Telework	TERM tracking, conformity analysis
• State of the Commute survey	Telework, Mass Marketing	Commute trends, conformity analysis
• GRH registrant survey	Guaranteed Ride Home	Conformity analysis
• Employee commute surveys (employer- administered)	Employer Outreach	TERM tracking, conformity analysis
• CC online system user placement rate survey	COC, Integrated Rideshare-Software Upgrades (Secondary – Mass Marketing)	TERM tracking, conformity analysis
• Bike-to-Work participant survey	Mass Marketing (BTW component)	TERM tracking, conformity analysis
• Retention Rate survey (NEW)	Guaranteed Ride Home and COC	TERM tracking, conformity analysis

Ongoing Monitoring

Program activity and utilization tracking is an ongoing function already performed by Commuter Connections staff and regional partners. Included here are records of services provided (e.g., number of employers contacted and GRH rides provided) and information on requests received (e.g., number of ridematch applications, tracked by individual program element.

The information gathered in the ongoing tracking process is summarized in a quarterly Commuter Connections "report card" that shows participation and utilization data and applies factors generated from the most recent placement rate survey to estimate travel, air quality, energy and consumer savings benefits for the quarter. This tool is used primarily by COG/TPB staff and staff of regional Commuter Connections partner programs as a quarterly check of progress in various activity and program areas. Annual Commuter Connections evaluation results also are reported to other policy-makers and to program funding agencies. Additional details on how Commuter Connections evaluation results will be reported are presented in Section 7.

- GRH Registrant / Archived Database – Ongoing tracking of registered and one-time exception GRH users. Database includes contact information, mode at time of registration, and GRH uses. *(Used for GRH TERM.)*
- ACT! Employer Client Database – Tracks the number of employers participating in Employer Outreach Program and the commuter assistance services they offer in worksite programs, including Telework. Sales representatives who assist employers to begin and maintain commuter assistance programs update the database when new employers join the program and when employers already participating in EO change their commuter assistance services. The database includes information on employer characteristics (e.g., number of employees, location, transit accessibility) and on the strategies (e.g., transit subsidies, GRH, preferential parking, teleworking) that the employer offers. *(Used for Employer Outreach and Telework TERMs)*
- Documentation of Commuter Connections Media / Marketing Activities – Ongoing tracking of the dates and types of media activities (media buys, direct mail, Internet outreach, etc) and the number and time distribution of telephone and Internet information requests made to Commuter Connections. Maintained/compiled by Commuter Connections staff, staff of GRH online system vendor, and COG marketing consultant. *(Used for Mass Marketing TERM; secondary use for GRH TERM and Commuter Operations Center, including Integrated Rideshare-Software Upgrades Project)*
- Bike-to-Work Day Records – Provides contact information on commuters who register to participate in Bike-to-Work Day. *(Used for Mass Marketing TERM)*
- Car Free Day Records – Provides information on commuters who register to participate in Car Free Day. Data include contact information, mode used prior to CFD, and mode registrant pledges to use on CFD. *(Used for Mass Marketing TERM)*
- 'Pool Rewards Registrant Records – Provides information on commuters who register to participate in 'Pool Rewards carpool incentive program. Data include contact information, mode used for commuting prior to registration, and carpool days recorded during the enrollment period. *(Used for Mass Marketing TERM)*
- Commuter Connections Online Information System Database – Ongoing tracking of commuters who establish accounts for the online information system and counts of non-registered users. Includes contact information for account holders *(Used for Commuter Operations Center, including Integrated Rideshare-Software Upgrades Project; secondary use for GRH and Mass Marketing TERMs)*

Resident and User Surveys

Several surveys are conducted by Commuter Connections to follow-up with program applicants and assess user satisfaction. These surveys also provide data used to estimate program impacts. Some of the surveys, such as the online system user placement survey and GRH Survey, also provide information used by Commuter Connections staff to fine tune program operations and policies.

- Employer Telework Assistance Follow-up Survey – Sent to employers in Maryland that received telework assistance from Commuter Connections to determine if and how they used the information they received. Specifically, the survey asks if the employer has started or expanded a telework program since receiving the information and if the information was helpful. This information is used to estimate the number of teleworkers who were indirectly influenced by Commuter Connections Telework Assistance. *(Used for Telework TERM)*

- State of the Commute Survey – The SOC survey, a random sample survey of employed adults in the Washington metro region, serves several purposes. First, it establishes trends in commuting behavior, such as commute mode and distance, and awareness and attitudes about commuting, and awareness and use of transportation services, such as HOV lanes and public transportation, available to commuters in the region. To this end, it will be compared to data from past State of the Commute surveys (2001, 2004, 2007, 2010, and 2013).

  SOC survey data also are used to estimate the impacts of TERMs that have a possible influence on the population-at-large. Specifically, the survey generates information for the Mass Marketing and Telework TERMs, both of which have broad application and for which it is not possible to identify all users from any Commuter Connections database. The survey also is used to assess awareness of the regional GRH program.

  Next, by querying respondents about their attitudes about alternative modes and reasons for choosing or not choosing alternative modes, the survey also suggests how commuter service programs and marketing efforts influence commuting behavior in the region. In this way, it helps to establish the influence of the Mass Marketing advertising messages on mode switching and use of Commuter Connections services, provides opinion research data that could contribute to assessment of broad social and personal benefits of commute programs, and offers an opportunity to test concepts for new services.

  The SOC survey is a triennial survey and will be conducted in early 2016. As in 2014, the survey will include samples for both landline phones and cell phones, with approximately 20% of total interviews being conducted with cell phone users. A small-scale Internet SOC survey also will be conducted in 2016 to test the feasibility of conducting future SOC surveys by Internet alone or by a combination of telephone and Internet. If the Internet survey results are comparable to those from the telephone survey and do not indicate any systematic bias in either respondent characteristics or responses, it would be feasible for Commuter Connections to utilize an Internet survey for future SOC surveys, resulting in considerably cost savings over the cost of the telephone survey *(Used for Telework and Mass Marketing TERMs)*

- GRH Applicant Survey – Commuters who registered with the GRH program or used a one-time exception trip will be surveyed to establish how the availability and use of GRH influenced their decision to use an alternative mode and to maintain that mode. Satisfaction with GRH services also will be polled. Some data collected in the survey, such as current and previous mode, travel distance, and access mode, will be used to develop the GRH placement rate and VTR factor.

  As was done in both 2010 and 2013, the 2016 GRH survey will be conducted by a combination of Internet and telephone methods. COG's online database vendor has programmed the GRH questionnaires for online application. This tool will be used to survey applicants who provided an email address and have a current GRH account. To ensure that all GRH registrants are included in the survey, past registrants who provided an email address will be surveyed by web-based survey administered through a consultant server. Ttelephone interviews will be conducted with GRH respondents who did not provide an email address. The data from these methods will be combined for analysis of the GRH survey and used to estimate impacts for the GRH TERM.

- Employee Commute Surveys – Some employers conduct baseline surveys of employees' commute patterns, before they develop commuter assistance programs. The results of these surveys also are available through an employee survey database. *(Used for Employer Outreach TERM)*

- Commuter Connections Online Information System User Placement Rate Survey – Since May 1997, Commuter Connections has conducted commuter applicant placement surveys to assess the effectiveness of the Commuter Operations Center. Data from the applicant placement surveys are used to calculate placement rates and VTR factors for the Commuter Operations Center and for the Mass Marketing TERM (referred impacts). The surveys also assess users' perceptions of and satisfaction with the services provided.

One placement survey will be used in the FY15-FY17 evaluation period. This was conducted in November 2014. Results of the survey conducted during this evaluation period were presented in a survey report.[9] Reported results are primarily for internal use by program and technical staff, but results also can be summarized for policy makers, such as the TPB, the TPB's Technical Committee, and other regional policy makers. In the future, selected results may also be summarized for distribution to the media, employers, commuters, and the public-at-large. *(Used for the Commuter Operations Center (Basic), and Software Upgrades; secondary use for Mass Marketing and GRH TERMs)*

- Bike-to-Work Day Participant Survey – A survey among registered participants in the Bike-to-Work Day event is undertaken to assess travel behavior before and after the Bike-to-Work Day, as well as commute distance and travel on non-bike days. *(Used for Mass Marketing TERM)*

- Retention Rate Survey – In previous TERM evaluations, mode shifts motivated by GRH registrants and online commute information system users were assumed to extend only through the three-year cycle. That is, a commuter who made a mode shift in the first month of the cycle was assumed to be still using the mode in the last month, but impacts were not assumed to be longer than three-years, so were not carried over to the next evaluation cycle. Questions on the SOC survey regarding duration of alternative mode use suggest that many alternative mode arrangements do extend beyond three years. If this is also the case for commuters who participate in Commuter Connections programs, additional TERM impacts could be retained from one three-year evaluation cycle to the next.

  The Retention Rate survey, new to the FY15-FY17 evaluation methodology, will estimate the share of past GRH and online commute information service users who continued to use alternative modes beyond the 3-year evaluation cycle. The 2016 survey will interview Commuter Connections online system users and GRH users who participated in these programs prior to the start of the evaluation period. Users will be asked about their current modes and modes they were using before they received assistance from Commuter Connections. If they are currently driving alone to work, they will be asked if they used alternative modes in the past and how long ago they started driving alone to work. The survey data will be used to develop a "retention" curve or lifecycle of continued alternative mode experience. The methodology also will define options to collect data on mode use in future TERM evaluations. This could be accomplished through a similar survey, conducted once every three years or six years or through ongoing data collection that is analyzed either as data are collected or at a later point in time. *(Used for Commuter Operations Center (Basic) and for GRH TERM)*

Analysis Tools

The EPA COMMUTER model (v 2.0), which will be used for the 2017 analysis of the Employer Outreach TERM, predicts likely change in employee commuting behavior for given changes in an employer's commute assistance program. The Model uses time and cost coefficients that are compatible with coefficients used by MWCOG in regional transportation modeling. During the 2008 evaluation, COG and the evaluation team adjusted the cost coefficients used in the model, to correct for the COMMUTER Model's tendency to overestimate the likely impacts of financial incentives on shifts to non-SOV modes. Descriptions of the adjustment and the original and adjusted coefficients are presented in Appendix C.

In 2010-2011, COG developed a new regional travel model. This might be expected to require updated COMMUTER Model cost and time coefficients. MWCOG modeling staff reviewed the COMMUTER Model coefficients used by the consulting staff for the 2011 and 2014 evaluations and determined that no further adjustment would be needed to the coefficients for the 2017 TERM analysis.

[9] Fiscal Year 2015 Applicant Database Annual Placement Survey Report, Applications Received During July-September 2014 (November 2014 Survey), May 19, 2015.

SECTION 6 BASIC METHOD FOR CALCULATING PROGRAM IMPACTS

This section presents the methodology for calculating and quantifying the travel, air quality, energy and commuter cost impacts of the TERMs. Following are the basic calculation steps applying a series of multiplier factors to the participation counts in the TERM. This method is common across TERMs, with two exceptions. Employer Outreach uses a modeled method applied to known commute services offered at worksites. And Mass Marketing uses information from the State of the Commute and COC activity tracking to assess mode change due to Mass Marketing campaign activities. Specific examples of the evaluation calculations and unique methodological elements for each TERM and for the Commuter Operations Center are included in Appendices D through I:

- Appendix D – Maryland Telework
- Appendix E – Guaranteed Ride Home
- Appendix F – Employer Outreach
- Appendix G – Mass Marketing
- Appendix H – Commuter Operations Center
- Appendix I – Integrated Rideshare – Software Upgrades Project

Documenting Program Participation and Utilization

The evaluation of program impacts requires first an accurate documentation of the participation of employers and commuters in each TERM program. The calculation methodology begins with consistent and continuous tracking of the number of participants or users of each TERM:

- Employers participating in Commuter Connections' Maryland Telework activities – track through telework contact records maintained by Commuter Connections and in the regional ACT! Employer Outreach database. Telework placement rates (proportion of employees at the worksites who become teleworkers) and a corresponding VTR factor will be developed from data collected in the Maryland employer telework follow-up survey.

- GRH registrants and one-time exception users – track separately from Commuter Connections online system applicants. A GRH placement rate and VTR factor will be developed from the GRH survey.

- Employers participating in the Employer Outreach TERM – track details about the employer size, location, transit access, and commute assistance services offered at the worksite.

- Commuters participating in Bike-to-Work Day, Car Free Day, and other one-time special events/programs - track to determine the total number of commuters who register to participate and number of actual participants, if different from the registration count.

- Commuters participating in 'Pool Rewards carpools and vanpools – track counts of participants, starting mode, pool occupants, and total carpool and vanpool days during the incentive period.

- Commuters who request or access Commuter Connections assistance through online information system – track number of participants, dates of assistance/requests, and type of information requested (e.g. ride-matching, transit information, telework assistance, bicycle information, etc.). Using the results of the online system user placement survey and other surveys conducted under this project, separate placement rates will be developed for the Commuter Operations Center and for the Software Upgrade component previously included in the Integrated Rideshare TERM but now part of the COC section in this report.

The purpose of this tracking process is to determine the "population base" to be used to quantify impacts and then to credit those impacts to the TERM from which they were derived. Other program information, in addition to participation and utilization, also could be tracked and documented for use in program refinement.

Information on participation and utilization will be included in quarterly and annual program summaries. The intent is for Commuter Connections and its partners to input participation results, credited to each TERM, into a form that allows for the calculation of impacts. This is accomplished with a simple spreadsheet that includes the factors discussed below.

Calculating Program Impacts

The following subsection provides an example of how program impacts will be calculated for the four TERM programs and for the Operations Center. As each of these services has become fully operational, tailored surveys have been developed to produce unique placement rates and VTR factors for each TERM.

Nine basic steps are used to calculate program impacts. These steps are described below. A hypothetical numerical example of the steps is presented in Figure 1 for one TERM.

TERM Evaluation
Basic Program Impact Calculation Methodology Steps

1.	Estimate commuter "population base" for the TERM	= e.g., all commuters, GRH applicants, CC online system users, EO employees
2.	Calculate placement rate (from user survey data)	= Proportion of commuters who made a travel change as a result of the TERM
3.	Estimate number of "placements"	= Population base x placement rate
4.	Estimate VTR factor (from user survey data)	= Average daily vehicle trips reduced per placement
5.	Estimate vehicle trips (VT) reduced	
	- GRH, COC, Telework, MM	= placements x VTR factor
	- Employer Outreach	= Modeled method
6.	Estimate VMT reduced	= Vehicle trips reduced x avg. trip length
7.	Adjust VT and VMT for SOV access	
	- Adjusted vehicle trips reduced	= Total vehicle trips – SOV access trips
	- Adjusted VMT reduced	= Total VMT – SOV access VMT
8.	Estimate emissions reduced	= Vehicle trips x "trip end" emission factors = VMT x "running" emission factor
9.	Estimate energy and commuter savings	= VMT reduced x average fuel consumption = VMT reduced x average vehicle operating cost

Figure 1
Example of Basic Program Impact Calculation Methodology Steps for a TERM
(Note: hypothetical example; do not use factors in the example for actual evaluation purposes)

1.	Estimate TERM "population base"	= 8,000 commuters
2.	Calculate placement rate	= 20%
3.	Estimate number of "placements"	= 8,000 x 0.2 =1,600 commuters placed
4.	Estimate VTR factor	= 0.7 daily vehicle trips reduced per placement
5.	Estimate vehicle trips (VT) reduced	= 1,600 x 0.7 trips reduced per placement = 1,120 daily vehicle trips reduced
6.	Estimate VMT reduced	= 1,120 vehicle trips reduced x 25 miles/trip = 28,000 daily VMT reduced
7.	Adjust VT and VMT for SOV access	(assume 60% of placements have SOV access and drive 5 miles to meeting point)
	- Adjusted vehicle trips reduced	= 1,120 trips – 0.6 x 1,120 = 1,120 - 672 = 448 vehicle trips (without SOV access)
	- Adjusted VMT reduced	= 28,000 VMT – (0.6 x 1,120 x 5 miles) = 28,000 – 3,360 = 24,640 VMT
8.	Estimate emissions reduced (VOC)	= 448 trips x 2.857 g/trip = 1,280 g = 24,640 VMT x 0.092 g/VMT = 2,267 gm = (1,280 gm + 2,267 g) / 907,185 gm/ton = 0.0039 daily tons VOC reduced
	Similar calculations used to estimate reductions of NOx, PM2.5 NOx precursors, PM2.5, and CO2	
9.	Estimate energy and commuter savings	
	Energy saving (gallons of fuel)	= 24,640 daily VMT / 19.9 mpg = 1,238 gallons per day x 250 work days/yr = 309,500 gallons saved per year
	Commuter cost saving ($)	= 24,640 VMT x $0.170/mile = $4,189 per day x 250 work days/year = $1,047,250 saved per year / 1,600 placements = $655 saved per placement per year

Step 1 – Determine Commuter Population Base

The first step establishes the population base, or population of interest, relevant to the specific TERM. This is the population that potentially could have been influenced by the TERM. Depending on the TERM being evaluated, this could be all commuters, GRH applicants, teleworkers, or some other population. In the example shown in Figure 1, the population base is 8,000 commuters.

Step 2 – Calculate Placement Rate

The next step in determining program impacts is to calculate the placement rate for the population base exposed to the TERM. The placement rate is equal to the percentage of commuters in the population base who shift to an alternative mode (carpool, vanpool, public transportation, walk/bike, telework) after receiving assistance under the TERM. Placement rates are calculated from user survey data

Two placement rates are calculated for each TERM, to account for the length of time the commuter uses the alternative mode after shifting: continued rate (did not shift back to original mode), and temporary rate (tried new alternative mode but shifted back to original mode within the evaluation period). For simplicity, Figure 1 shows only one placement rate, 20%. This means that 20% of the commuters in the population base made a change to an alternative mode as a result of the TERM. The placement rates for one TERM will not necessarily be the same as the placement rates for any other TERM.

Step 3 – Estimate Number of New Placements

Step 3 estimates the number of new commuter placements in alternative modes. This is the actual number of commuters who are estimated to have made the shift to alternative modes as a result of the TERM. It is calculated by multiplying the placement rate (calculated in Step 2 from a survey of a sample of commuters in the population base) by the total population base. In the example in Figure 1, the calculation of placements is as shown below:

Placements = 8,000 commuters (population base) x 0.2
= 1,600 placements

Step 4 – Estimate VTR Factor

From the same survey data used to calculate placement rate, the Vehicle Trip Reduction (VTR) factor is next calculated. This is equal to the average daily vehicle trips reduced per placement. As described in Section 3, not all commuter placements will reduce the same number of trips. Three types of commute shifts are captured in the VTR factor:

1) Drive alone applicants shifting to alternative modes
2) Alternative mode users shifting to different alternative modes (e.g., carpool to bus or bus to vanpool)
3) Alternative mode users increasing the number of days they use alternative modes

The number of trips reduced also depends on the frequency with which they use the alternative mode, compared to the number of days they used it before. The VTR factor combines the varied trip reduction results of all commuter placements to develop an average reduction per placement. An explanation of how the VTR Factor is calculated is provided in Appendix A and a numeric example is shown in Appendix B. As for placement rate, VTR factors might be different for different TERMs. As shown in Figure 1, the VTR factor for the TERM in the hypothetical example is 0.70. This means that each of the placements for this TERM reduces, on average, 0.7 vehicle trips per day.

Step 5 – Estimate Daily Vehicle Trips Reduced

The number of daily vehicle trips reduced for the TERM is then estimated by multiplying the number of commuter placements from Step 3 by the VTR factor, the average number of daily trips reduced per placement, calculated in Step 4. The calculation of vehicle trips reduced for the example shown in Figure 1 would be as follows:

Vehicle trips reduced = 1,600 placements x 0.7 trips reduced per placement
= 1,120 daily vehicle trips reduced

Step 6 – Estimate Daily VMT Reduced

The total daily VMT reduced is calculated by multiplying the number of daily vehicle trips reduced (Step 5) by the average commute distance for the population of interest. The average distance for the population is calculated from the same survey data used to calculate the placement rate and VTR factor. The example in Figure 1 assumes that the average distance is 25 miles per one-way trip. Using this distance, the total VMT reduced for 1,120 vehicle trips is:

VMT reduced = 1,120 vehicle trips reduced x 25 miles per trips
= 28,000 daily VMT reduced

Step 7 – Adjust Vehicle Trips and VMT for SOV Access

Because a basic purpose for implementing the TERMs is to meet regional air quality emission reduction targets, single occupant vehicle (SOV) access to alternative modes must be considered. Emission reduction, as explained in Step 8, is calculated by multiplying vehicle trips reduced and VMT reduced by emission factors. But because commuters who drive-alone to meet a carpool, vanpool, bus, or train create a "cold start," their trips must be subtracted from the vehicle trip reduction to assess the air quality impact of TERMs. Additionally, the distance they travel to the meeting point must be subtracted from the VMT reduced to obtain an accurate VMT reduction count. It is these "adjusted" vehicle trips reduced and VMT reduced, rather than the initial totals, that are used to calculate emissions reduced.

In the Figure 1 example, it is assumed that 60% of the commuter placements drive alone to the rideshare or transit meeting point and that the average distance to this point is 5 miles. Using these figures, the "adjusted" vehicle trips reduced and VMT reduced are shown below:

Adjusted vehicle trips reduced = 1,120 trips – (1,120 x 0.6 with SOV access)
= 1,120 trips – 672 trips
= 448 vehicle trips reduced (for emissions calculation)

Adjusted VMT reduced = 28,000 VMT – (1,120 trips x 0.6 SOV access x 5 miles)
= 28,000 – 3,360
= 24,640 VMT reduced (for emissions calculation)

Step 8 – Estimate Daily Emissions Reduced

Daily emissions reduced are estimated by applying two regional emission factors, a "trip end emissions" factor and a "running emissions" factor, respectively, to the number of vehicle trips or "trip ends" reduced and to the VMT reduced to determine the pollutants (in this case NOx and VOC) reduced as result of the program. The trip end emissions factor accounts for the emissions created from a "cold start," when a vehicle is first started, and a "hot soak," that occur when the vehicle is later turned off. The running emission factor accounts for the emissions generated per mile of travel by a warmed-up engine.

The emission factors[10] used in the 2014 TERM analysis were:

Emission Factors	NOx	VOC	PM2.5 NOx	PM2.5	CO2
• Trip end *(gm / one-way vehicle trip)*	1.541	2.857	0.037	1.751	239.3
• Running *(gm / mile)*	0.374	0.092	0.017	0.366	404.2

To estimate total daily emissions, the trip end emission factor is multiplied by the adjusted daily vehicle trips reduced (Step 7) and the running factor is multiplied by the adjusted daily VMT reduced (Step 7). These two products are then added to determine total daily NOx and VOC reductions in grams. This total is then divided by 907,185

[10] The emission factors presented here are derived from the EA's MOVES emission model. If the model parameters or inputs change, the emission factors also could change.

grams per ton to convert the emissions reduced to tons per day. Using these emissions factors, the total VOC reduced for our example in Figure 1 is:

VOC = 448 trips x 2.857 g/trip = 1,280 g
= 24,640 VMT x 0.092 g/VMT = 2,267 g
= (1,280 gm + 2,267 g) / 907,185 g/ton

= 0.0039 daily tons VOC reduced

The emission reductions for the other four pollutants (NOx, PM2.5 NOX precursors; PM2.5, and CO2) are calculated similarly, using emission factors noted above for each pollutant. However, emissions for PM2.5, PM2.5 NOx precursors, and CO2 are reported as annual reductions, rather than daily reductions. This additional calculation is made by multiplying daily impacts by 250 working days per year.

Step 9 – Estimate Energy and Commuter Cost Savings

While air quality is the primary impact driving the TERM analysis, energy and consumer benefits also are real and tangible benefits from commuter assistance programs. For this analysis, energy and commuter cost savings factors are applied to the VMT reduced. In 2014, these factors were as follows:

- Energy savings are based on an average fuel consumption factor of 19.9 miles per gallon for the Washington metropolitan area fleet of light duty vehicles (data provided by MWCOG staff)
- Consumer savings are based on an average marginal operating cost per mile (oil, gasoline, maintenance) for a mix of vehicle types and average distance driven per year. The American Automobile Association estimated a composite national average cost to be 17.0 cents per mile in 2014. When the 2017 TERM analysis is conducted, the cost per mile will be updated to reflect expenses at that time.

For this analysis, energy and commuter cost savings are calculated by multiplying the energy and consumer cost factors to the total (not adjusted) VMT reduced. As shown in Figure 1, the daily and annual energy and cost savings for the example TERM are as follows:

Energy saving (gallons of fuel)	= 24,640 daily VMT / 19.9 mpg
Daily saving	= 1,238 gallons per day
Annual saving (250 work days)	= 305,500 gallons saved per year
Commuter cost saving ($)	= 24,640 VMT x $0.170/mile
Daily saving	= $4,189 per day
Annual saving (250 work days)	= $1,047,250 saved per year
Annual saving per commuter (based on 1,600 placements)	= $655 saved per placement per year

Sample Calculations of Impacts for each TERM

The impact calculation methodology described above described the basic steps applied to all TERMs and provided one hypothetical numerical example. However, each TERM has unique placement rates and VTR factors and some of the steps differ slightly. Specific examples are presented for each TERM in Appendices C through H.

It should be noted that the numbers shown in the example are from the 2014 TERM Analysis Report, which forms the basis of this evaluation framework. The actual FY15-FY17 values for placement rates, VTR factors, trip distances, SOV access percentages, and other calculation variables will be computed after the appropriate surveys have been completed and are likely to be somewhat different that the values shown in the appendices examples. The appendices are provided for illustrative purposes only.

SECTION 7 REPORTING AND COMMUNICATION OF EVALUATION RESULTS

The objective of the TERM evaluation process is to provide data on the performance of TERMs to assist regional and local decision-makers, funders, Commuter Connections program staff, and Commuter Connections program partners to make sound program funding and operations decisions. To this end, the TERM evaluation produces a technical assessment of performance to apply to the region's conformity tracking. Because the TERMs were adopted to support the region's efforts to meet the conformity requirements of federal transportation and clean air mandates, these evaluations have focused primarily on analyzing travel and air quality impacts from use of Commuter Connections program.

However, the many surveys and analyses performed for the evaluation also collect a wealth of data on current travel patterns and trends, traveler attitudes, and customer satisfaction that could be used to "tell the Commuter Connections story" to other audiences to achieve purposes beyond conformity determination. By expanding the range of data transmitted and by focusing the presentation of data on the needs and interests of other audiences, Commuter Connections could expand the value of its data collection and analysis investment and provide value to various new audiences.

Existing Reporting

Commuter Connections currently uses four primary reporting mechanisms to disseminate evaluation results:

- Survey reports and presentations
- Quarterly "Report Card"
- Program Annual Report
- TERM Analysis Report

Commuter Connections and/or a contractor produces a technical report for each data collection activity, such as the GRH survey report and the State of the Commute survey report. These reports present technical details of the survey methodology and results. The responsible party also prepares presentation materials to summarize highlights of the research for technical audiences, such as the TDM Evaluation Group, Commuter Connections Subcommittee, the Transportation Planning Board, and the TPB Technical Committee. And MWCOG media/publications staff use survey data in press releases and infographics for other publications.

COG/TPB's Commuter Connections staff prepares quarterly report card summaries for use by internal staff and local jurisdiction program partners to assess on-going progress. Staff compiles an annual report distributed to COG/TPB staff, local jurisdiction program partners, and regional policy-makers for administrative purposes. Finally, Commuter Connections produces a triennial TERM Analysis Report that documents the impacts of the TERMs for the three-year TERM evaluation period. Formal review of each of these documents is an integral part of the work program development for both COG/TPB staff and Commuter Connections program partners.

Repackage / Expand Reporting from Existing Research

In the FY2014-FY2014 Evaluation Framework, the consulting team outlined an approach to identify new audiences for Commuter Connections information, the information that would be useful to them, and communication tools that would be most appropriate.

Commuter Connections staff used this outline in discussions with local TDM staff and determined that brief "top findings" summaries of survey and evaluation data could be useful tools to disseminate evaluation results to audiences that would be unlikely to read technical reports. In the 2015-2017 evaluation period, the consulting team will work with COG staff to provide and format data that Commuter Connections can use to prepare such summaries for the 2016 SOC survey and other TERM-related surveys and to disseminate evaluation data in other new formats, such as online distribution methods (e.g., social media, targeted emails, blogs, net-conferences, etc.).

SECTION 8 EVALUATION SCHEDULES AND RESPONSIBILITIES

The key to any successful evaluation effort is for evaluation information to be generated and reported in a timely manner to decision makers. Commuter Connections prepares quarterly summaries for use by internal staff and local jurisdiction program partners to assess on-going progress. Annual and triennial evaluation results are reported to COG/TPB staff, local jurisdiction program partners, and regional policy-makers for policy purposes. Formal review of the results is an integral part of the work program development for both COG/TPB staff and Commuter Connections program partners.

Evaluation activities fall into three categories, with various recommended schedules as described in Table 2. The first column shows evaluation activities in three categories: surveys, on-going tracking, and reporting. The second column indicates the frequency for administering surveys and on-going tracking. The specific schedule for all data collection activities has been established by Commuter Connections and is included as Appendix J. The final column of Table 2 indicates the party responsible for collecting or maintaining the data.

Table 2 also shows recommended results reporting activities. It is assumed that reports will be prepared following each survey (placement survey, GRH survey, SOC survey, Retention Rate survey, etc.) to document the results of the survey and calculate updated placement rates and VTR factors (if applicable) for the populations surveyed. As Table 2 indicates, in addition to these reports, internal activity and evaluation reports also are produced to report the progress of the Commuter Connections program as a whole and for individual TERMs. A full TERM Analysis Report will be developed every three years to document the TERM impacts during the previous three-year period. Finally, as described in Section 7, Commuter Connections is considering additional methods to present and disseminate results of its TDM evaluations. The specific schedules for these activities will be documented as the activities are defined.

Evaluation Responsibilities

The primary responsibility for performing quarterly and annual evaluations will reside with COG/TPB. COG/TPB will assume responsibility for managing regular and special Commuter Connections survey efforts conducted by outside contractors and will conduct some surveys, such as the GRH satisfaction survey, using in-house staff. COG/TPB staff also will assemble ongoing monitoring data, oversee all activities, and seek input to ensure consistency with accepted TERM analysis methods.

Commuter Connections local jurisdiction program partners will play a role in tracking some ongoing activities, especially in Employer Outreach, and will review and provide input on TERM evaluation activities.

Contractors may be used for some data collection and evaluation activities as directed by Commuter Connections staff. GRH service providers will provide data on usage as required in their contracts. Finally, employers will work with the Commuter Connections network members to provide information on program service utilization.

Table 2
Data Collection and Reporting Activities
Frequency and Responsibility

Evaluation Activity/Tool	Frequency	Responsibility
Ongoing Monitoring		
• Telework assistance database	Ongoing	CC
• GRH registrant / archived database	Ongoing	CC
• ACT! employer contact database	Monthly	Sales representatives
• COC website and call volume tracking	Ongoing	CC
• Documentation of media / marketing activities	Ongoing	CC, Contractor
• Bike-to-Work Day participant records	Annual	CC
• Car Free day participant records	Ongoing	CC
• 'Pool Rewards participant records	Annual	CC
• Commuter Connections Applicant Database	Ongoing	CC, Contractor
Resident / User Surveys		
• Telework-assisted employer follow-up survey	Triennial	CC
• State of the Commute survey	Triennial	Contractor
• GRH registrant survey	Triennial	Contractor
• Employee commute surveys	Ongoing	Contractor
• CC online system user placement rate survey	Triennial	Contractor
• Bike-to-Work participant survey	Triennial	CC
• Retention Rate survey (NEW)	Six-year	Contractor
Evaluation Results Reporting		
• Commuter Connections "Report Card"	Quarterly	CC
• CC Program Annual Report	Annual	CC
• TERM Evaluation Report	Triennial	Contractor
• Commuter Connections survey reports	As produced	Contractor

CC – Commuter Connections

LIST OF APPENDICES

Appendix A
Basic Calculation of VTR Factor

The vehicle trip reduction (VTR) factor represents the average number of vehicle trips that a commuter "placed" in an alternative mode would reduce per day. The VTR factor combines the trip reduction results of three possible types of travel changes that new commuter placements might make:

1. Drive alone commuters shifting to an alternative mode
2. Commuters who currently use an alternative mode shifting to another alternative mode (e.g., from carpool to bus, train to bus, vanpool to carpool, etc)
3. Commuters who currently use an alternative mode increasing their weekly frequency of alternative mode use (e.g., from carpool one time per week to carpool three times per week).

Shown below is a brief example of how the VTR factor would be calculated for seven commuters who made the following travel changes:

- Placement 1 – shifts from driving alone, 5 days per week, to a two-person carpool, 5 days per week
- Placement 2 – shifts from driving alone, 5 days per week, to transit, 5 days per week
- Placement 3 – shifts from driving alone, 5 days per week, to teleworking, 2 days per week and driving alone 3 days per week
- Placement 4 – shifts from driving alone, 5 days per week, to two-person carpool, 2 days per week and driving alone 3 days per week
- Placement 5 – shifts from a two-person carpool, 5 days per week, to transit, 5 days per week
- Placement 6 – shifts from transit, 5 days per week, to a two-person carpool, 5 days per week
- Placement 7 – increases the frequency of carpool from 1 day per week to 3 days per week, driving alone the other 2 days

The VTR factor is calculated by determining the number of vehicle trips all placements would reduce together and dividing that total by the number of placements. We assume that a commuter makes two trips a day, one from home to work and a second from work to home. Thus a commuter who drives alone would make 2 vehicle trips each day. If the commuter carpools, he would make ½ vehicle trip to work and ½ trip back home, for a total of 1 vehicle trip per day. A commuter who uses bus, train, bike, or walk is assumed to make 0 vehicle trips. A commuter who teleworks also makes 0 vehicle trips for telework days.

Shown on the next page are the travel modes and the numbers of vehicle trips each of the seven commuters described above would make for each day of the week before the shift to an alternative mode and after the shift. The third column shows the net vehicle trips (number of trips after the shift minus number of trips before the shift). The final column shows the total weekly trips reduced. Note that commuter #6 actually increases his weekly commute trips, because he shifts from a higher occupancy alternative mode (transit) to a lower occupancy mode (carpool).

Appendix A, continued

Sample VTR Calculation
Travel Modes Before and After Shifts to Alternative Modes
By Commuter and by Day of the Week

	Vehicle Trips Before Shift					Vehicle Trips After Shift					Vehicle Trips Net Trips					Weekly
	M	T	W	T	F	M	T	W	T	F	M	T	W	T	F	Change
Placement 1	D	D	D	D	D	C	C	C	C	C						
DA to 2p CP	2	2	2	2	2	1	1	1	1	1	-1	-1	-1	-1	-1	-5 trips
Placement 2	D	D	D	D	D	T	T	T	T	T						
DA to TR	2	2	2	2	2	0	0	0	0	0	-2	-2	-2	-2	-2	-10 trips
Placement 3	D	D	D	D	D	D	D	C	C	C						
DA to TC/DA (part-time)	2	2	2	2	2	2	2	2	0	0	0	0	0	-2	-2	-4 trips
Placement 4	D	D	D	D	D	D	D	C	C	C						
DA to CP/DA (part-time)	2	2	2	2	2	2	2	2	1	1	0	0	0	-1	-1	-2 trips
Placement 5	C	C	C	C	C	T	T	T	T	T						
2p CP to TR	1	1	1	1	1	0	0	0	0	0	-1	-1	-1	-1	-1	-5 trips
Placement 6	T	T	T	T	T	C	C	C	C	C						
TR to 2p CP	0	0	0	0	0	1	1	1	1	1	+1	+1	+1	+1	+1	+5 trips
Placement 7	D	D	D	D	C	D	D	C	C	C						
DA/CP to CP (part-time)	2	2	2	2	1	2	2	1	1	1	0	0	-1	-1	0	-2 trips
Total weekly trips	11	11	11	11	10	8	8	7	4	4	-3	-3	-4	-7	-6	-23 trips

Total placements	= 7 placements (travel for each shown above)
Total trips reduced per week	= 23 trips per week (all placements together)
Total trips per day (all placements together)	= 23 trips per week / 5 days per week =4.6 trips per day
Average trips reduced per placement	**= 4.6 trips per day / 7 placements** **= 0.66 trips per placement**

The seven commuter placements would reduce a total of 4.6 trips during a single day, thus the average number of trips reduced per day by each of the seven placements would be 0.66. This is the VTR factor.

Appendix B
Sample Full Calculation of Vehicle Trip Reduction (VTR) Factor

Summary of Current and Previous Mode for Survey Respondents Who Made a Shift to an Alternative Mode

Current One-Way Weekly Person Trips					Previous One-Way Weekly Person Trips				New One-Way Weekly Person Trips (current – prev)		
DA	RS	TR	RSOcc.		DA	RS	TR	RSOcc.	DA	RS	TR
Drive alone shift to Transit											
0	0	8	0		8	0	0	0	-8	0	8
0	0	10	0		2	0	8	0	-2	0	2
0	0	10	0		10	0	0	0	-		
10	0	10									
Total	**0**	**0**	**28**		**20**	**0**	**8**		**-**		
20	**0**	**20**									
Drive alone shift to Rideshare											
2	6	0	2		8	0	0	0	-		
6	6	0									
0	2	8	8		2	0	8	0	-		
2	2	0									
0	10	0	3		2	8	0	2	-		
2	2	0									
0	10	0	2		10	0	0	0	-10	10	0
0	10	0	3		10	0	0	0	-		
10	10	0									
0	8	0	13		8	0	0	0	-		
8	8	0									
Total	**2**	**46**	**8**		**40**	**8**	**8**		**-**		
38	**38**	**0**									
Rideshare shift to Transit *											
0	0	10	0		0	2	8	3	0	-	
2	2										
0	0	10	0		0	10	0	3	0	-	
10	10										
0	0	10	0		0	10	0	4	0	-	
10	10										
0	0	10	0		0	8	2	2	0	-	
8	8										
Total	**0**	**0**	**40**		**0**	**30**	**10**		**0**	**-**	
30	**30**										
Rideshare shift to Rideshare (ex. carpool to vanpool)											
0	5	0	3		0	5	0	2	0	0	0
0	5	0	3		0	5	0	13	0	0	0

	0	10	0	3	0	10	0	3	0	0	0
Total	**0**	**20**	**0**		**0**	**20**	**0**		**0**	**0**	**0**

Transit shift to Other Transit (ex. bus to train) *

	0	0	10	0	0	0	10	0	0	0	0
	0	0	10	0	0	0	10	0	0	0	0
Total	**0**	**0**	**20**	**0**	**0**	**0**	**20**		**0**	**0**	**0**

Transit shift to Rideshare*

	0	10	0	2	0	0	10	0	0	10	-10
	0	10	0	2	0	0	10	0	0	10	-10
	0	10	0	12	0	0	10	0	0	10	-10
	0	10	0	4	0	0	10	0	0	10	-10
	0	10	0	3	0	0	10	0	0	10	-10
Total	**0**	**50**	**0**		**0**	**0**	**50**		**0**	**50**	**-50**
Average RS Occupancy		**4.5**				**4.0**					

Appendix B, continued

Summary of Travel Changes for all Respondents

Current One-way Weekly Trips (all respondents)

	DA	RS	TR/BW
Weekly person trips	2	116	96
Average RS occupancy	1	4.5	N/A
Weekly Vehicle trips (Person trips/RS occupancy)	2	25.8	0

Previous One-way Weekly Trips (all respondents)

	DA	RS	TR/BW
Person trips	60	58	96
Average RS occupancy	1	4.0	N/A
Vehicle trips	60	14.5	0

Net One-way Weekly Trips (all respondents) = current trips – previous trips

	DA	RS	TR/BW
Person trips	-58	58	0
Vehicle trips	-58	11.3	0

Weekly person trips reduced *(DA + RS+ TR/BW)*	0
Weekly vehicle trips reduced *(DA + RS + TR/BW)*	-46.7
Respondents with change	23
Average weekly vehicle trips reduced *(Weekly vehicle trips reduced / # of respondents)*	-2.03
Average daily vehicle trips reduced *(Average wkly vehicle trips reduced / 5 days per week)*	**-0.41**

* For purpose of VTR calculation, Transit category also includes bike/walk

NOTE: Numbers shown in this sample calculation are not based on actual survey data. Data were created as a hypothetical example for illustration only.

Appendix C
2008 Adjustment to COMMUTER Model Coefficients

Impacts for the Employer Outreach TERM are calculated using the EPA COMMUTER model (v 2.0). Prior to the 2008 analysis, the default cost and time coefficients for the Washington DC region were used in model runs. Analysis performed by the LDA Consulting team for COG in 2007 suggested the COMMUTER model overestimated the likely impacts of employers' strategies, in particular those related to financial incentives. Thus the team examined possible adjustment to the COMMUTER model to give more conservative results for the 2005-2008 TERM analysis.

The results of the analysis suggested the most acceptable option was to reduce the cost coefficient to a level that could be expected to produce a vehicle trip reduction (VTR) change that approximated employee survey results of employers for which before commuter programs were implemented and after implementation. Because "with program" employee survey data were not available for the MWCOG region, the team used data from the Seattle, WA metropolitan region and determined the Seattle cost coefficient that would have predicted the result found in the Seattle survey data. The team then applied a proportional reduction to the current MWCOG cost coefficient.

The team performed a coefficient sensitivity analysis to estimate the VTR result at various cost coefficient levels. Two sensitivity cases were run, to test two different employer situations. The first included employers that had maintained or expanded the services in their commute programs, regardless of their program level (Level 1-4). The second case included employers that would have been classified as Level 3 or Level 4 in the TERM analysis, regardless of the changes they had made in their program. This case was run because it was consistent with the TERM analysis methodology.

Table 1 below shows the results for the Level 3-4 employer case, which was deemed more appropriate for this analysis.

Table 1 - COMMUTER model Vehicle Trip Rate (VTR) change prediction by travel cost coefficient - Level 3 and 4 Employers (Sample size 609)

Travel Cost Coefficient	Survey VTR Change	COMMUTER VTR Change
-0.0009	-2.32	-1.89
-0.0013	-2.32	-2.19
-0.0015	-2.32	**-2.35**
-0.0019	-2.32	-2.66
-0.0024*	**-2.32**	-3.06
-0.0029	-2.32	-3.46
-0.0031	-2.32	-3.62
-0.0034	-2.32	-3.86
-0.0039	-2.32	-4.26
-0.0043**	-2.32	-4.58
-0.0047	-2.32	-4.9
-0.0049	-2.32	-5.06

Coefficient -0.0024 vs -.0015,
Difference of 0.0009
VTR change difference 0.74

VTR difference 0.74
Coefficient difference of 0.009
-0.0043 vs -0.0034

*Coefficient for Seattle **Coefficient for MWCOG region

As shown, the VTR reduction measured from the Seattle survey for these employers was -2.32. The COMMUTER model, using the Seattle cost coefficient of -0.0024 would have predicted a VTR result of -3.06, or a difference of about 0.74. To obtain a result of -2.32, the cost coefficient would have to have been -0.0015, or a reduction of 0.0009.

Appendix C, continued

When the sensitivity results were plotted with coefficient on one axis and the VTR change on the other, it was clear that the change in VTR was directly proportional to the change in coefficient. Thus, it was reasonable to apply the same 0.74 difference from the Seattle VTR results to the MWCOG predicted result to estimate the coefficient that would produce a proportionately accurate result in the MWCOG region.

The cost coefficient used with the COMMUTER model in the 2002-2005 TERM analysis was -0.0043. Referring again to Table, 1, a coefficient of -0.0043 would predict a VTR change of -4.58. Applying the 0.74 difference in the VTR change result from the Seattle case to the MWCOG coefficient would result in a new VTR change of -3.84. This number does not match the -2.32 VTR change result for the Seattle data, not is it reasonable to expect that it would, since the Seattle area survey results reflect Seattle area conditions. It is not unreasonable to assume that the MWCOG area could have a higher VTR change when similar commuter program conditions are in place.

To obtain this -3.84 VTR value, the coefficient for MWCOG would have to be -0.0034. The VTR result of -3.84 would represent about a 16% reduction in impact compared to that produced using the -0.0043 cost coefficient.

With these changes, the old (2005) and new (2008) coefficients used in the COMMUTER Model were as follows. Note that no changes were made to the time coefficients. The 2008 coefficients also were used in the 2011 and 2014 analyses.

	2008 Coefficients	2005 Coefficients
IVTT- In-vehicle travel time - all modes (minutes)	-0.0300	-0.0300
OVTT - Transit walk time (minutes)	-0.0750	-0.0750
OVTT - Transit wait time (minutes)	-0.0750	-0.0750
Cost - Auto parking (cents)	-0.0034	-0.0034
Cost - Transit fare (cents)	-0.0034	-0.0034

In 2010-2011, COG developed a new regional travel model. This might have been expected to require updated COMMUTER Model cost and time coefficients. MWCOG modeling staff reviewed the COMMUTER Model coefficients used by the consulting staff for the 2011 and 2014 evaluations and determined that no further adjustment would be needed to the coefficients for the 2017 TERM analysis.

Appendix D
Sample Calculations of Maryland Telework Impacts

Populations of Interest

All regional telecommuters	676,053	(from SOC survey)
Teleworkers with MD home or work	287,630	43% (from SOC survey)
Teleworkers not in MD	388,423	57% (from SOC survey)
Employees at TW assisted worksites	26,620	(from TW assistance survey)

Commuter Connections TW Placement Rates

Directly assisted TW

• Within Maryland	9.1%	(% of TC assisted by CC, from SOC survey)
• Not in Maryland	9.1%	(% of TC assisted by CC, from SOC survey)

TW at assisted worksites (MD only

• Within Maryland	0.6%	(% of new TC at sites, from TW assistance survey)
• Not in Maryland	0.0%	Program not in effect outside of Maryland

TW Placements (Mixed home and Non-home based)

Maryland (credited to Telework TERM)

• Directly assisted telecommuters	26,174	(regional TC x directly assisted placement rate)
• Telecommuters at TW assisted sites	160	(employees at assisted sites x assisted site placement rate)
Total assisted telecommuters - MD	**26,334**	

Not Maryland (to be credited to COC)

• Directly assisted telecommuters	35,346	(regional TC x directly assisted placement rate)
• Telecommuters at TW assisted sites	0	(employees at assisted sites x assisted site placement rate)
Total assisted telecommuters – Not MD	**35,346**	

Placements by Location (home-based and non-home-based)

• % Home-based telecommuters	99%	(from SOC survey)
• % Non-home (NH)-based telecommuters	1%	(from SOC survey)

Maryland (credited to Telework TERM)

• Home-based telecommuters	26,071	(total assisted TW x % Home-based TW)
• NH-based telecommuters	263	(total assisted TW x % NH-based TW)

Not Maryland (credited to COC)

• Home-based telecommuters	34,993	(total assisted TW x % Home-based TW)
• NH-based telecommuters	353	(total assisted TW x % NH-based TW)

Appendix D, continued

Daily Vehicle Trips Reduced

VTR Factors

• Home-based factor - MD	0.37	(from SOC survey)
• Home-based factor – Not MD	0.35	(from SOC survey)
• NH-based factor – MD and Not-MD	0.02	(from SOC survey)

Maryland (credited to Telework TERM)

• Home-based VT reduced	9,646	(HB TW x HB VTR factor)
• NH-based VT reduced	5	(NH-based TW x NH VTR factor)
Daily Vehicle Trips Reduced - MD	**9,651**	

Not Maryland (credited to COC)

• Home-based VT reduced	12,248	(HB TW x HB VTR factor)
• NH-based VT reduced	7	(NH-based TW x NH VTR factor)
Daily Vehicle Trips Reduced – Not MD	**12,255**	

Daily VMT Reduced

Ave one-way trip distance (mi) to main workplace

• Home-based – MD	21.3	(SOC survey)
• Home-based – Not MD	15.3	(SOC survey)

Ave one-way trip distance (mi) for non-home based TW (MD and Not-MD)

• Non-home based – to main workplace	20.3	(SOC survey)
• Non-home based – to TW location	10.2	(SOC survey)
• Non-home based – net VMT reduced	10.1	(SOC survey)

VMT reductions on TW days

Maryland (credited to Telework TERM)

• Home-based VMT reduced	205,460	(HB VT reduced x average OW miles to main workplace)
• NH-based VMT reduced	51	(NHB VT reduced x net OW miles reduced per trip)
Daily VMT Reduced - MD	**205,511**	

Not Maryland (credited to COC)

• Home-based VMT reduced	187,394	(HB VT reduced x average OW miles to main workplace)
• NH-based VMT reduced	71	(NHB VT reduced x net OW miles reduced per trip)
Daily VMT Reduced – Not MD	**187,465**	

Appendix D, continued

Maryland (credited to Telework TERM)

Daily Emissions Reduced – NOx and VOC

NOx	Trips	15 Emission Factor	VMT	15 Emission Factor	Tot gm	Tot ton
• From Starts	9,651	1.5408			14,870	0.0164
• From Running			205,511	0.3737	76,799	0.0847
Total NOx reduced (tons)					**Daily**	**0.1011**

VOC	Trips	15 Emission Factor	VMT	15 Emission Factor	Tot gm	Tot ton
• From Starts	9,651	2.8573			27,576	0.0304
• From Running			205,511	0.0915	18,804	0.0207
Total VOC reduced (tons)					**Daily**	**0.0511**

Annual Emissions Reduced – PM 2.5, Precursor NOx, and CO2

PM 2.5	Trips	15 Emission Factor	VMT	15 Emission Factor	Tot gm	Tot ton
• From Starts	9,651	0.0367			354	0.0004
• From Running			205,511	0.0170	3,494	0.0039
Total PM 2.5 reduced (tons)					**Daily**	**0.0043**
					Annual	**1.075**

PM 2.5 Precursor NOx	Trips	15 Emission Factor	VMT	15 Emission Factor	Tot gm	Tot ton
• From Starts	9,651	1.7510			16,899	0.0186
• From Running			205,511	0.3663	75,278	0.0830
Total PM 2.5 Precursor NOx reduced (tons)					**Daily**	**0.1016**
					Annual	**25.400**

CO2	Trips	15 Emission Factor	VMT	15 Emission Factor	Tot gm	Tot ton
• From Starts	9,651	239.26			2,309,098	2.55
• From Running			205,511	404.17	83,061,179	91.56
Total CO2 reduced (tons)					**Daily**	**94.11**
					Annual	**23,527.5**

Appendix D, continued

Not Maryland (credited to COC)

Daily Emissions Reduced – NOx and VOC

NOx	Trips	15 Emission Factor	VMT	15 Emission Factor	Tot gm	Tot ton
• From Starts	12,255	1.5408			18,883	0.0208
• From Running			187,465	0.3737	70,056	0.0772
Total NOx reduced (tons)					**Daily**	**0.0980**

VOC	Trips	15 Emission Factor	VMT	15 Emission Factor	Tot gm	Tot ton
• From Starts	12,255	2.8573			35,016	0.0386
• From Running			187,465	0.0915	17,153	0.0189
Total VOC reduced (tons)					**Daily**	**0.0575**

Annual Emissions Reduced – PM 2.5, Precursor NOx, and CO2

PM 2.5	Trips	15 Emission Factor	VMT	15 Emission Factor	Tot gm	Tot ton
• From Starts	12,255	0.0367			450	0.0005
• From Running			187,465	0.0170	3,187	0.0035
Total PM 2.5 reduced (tons)					**Daily**	**0.0040**
					Annual	**1.000**

PM 2.5 Precursor NOx	Trips	15 Emission Factor	VMT	15 Emission Factor	Tot gm	Tot ton
• From Starts	12,255	1.7510			21,459	0.0237
• From Running			187,465	0.3663	68,668	0.0757
Total PM 2.5 Precursor NOx reduced (tons)					**Daily**	**0.0994**
					Annual	**24.850**

CO2	Trips	15 Emission Factor	VMT	15 Emission Factor	Tot gm	Tot ton
• From Starts	12,255	239.26			2,932,131	3.23
• From Running			187,465	404.17	75,767,608	83.52
Total CO2 reduced (tons)					**Daily**	**86.75**

Appendix E
Sample Calculations of Guaranteed Ride Home Impacts

Populations of Interest		
• New GRH registrants (FY12-FY14)	13,255	(GRH database)
• Re-registrants from FY2012	7,610	
• One-time exceptions	291	(GRH database)
Total GRH base	**21,156**	
Within MSA	63%	13,328
Outside MSA	37%	7,828
GRH Placement Rates (continued rate only)		
• Within MSA placement rate	61.3%	(GRH survey)
• Outside MSA placement rate	61.1%	(GRH survey)
Placements (continued only)		
• Within MSA	**8,170**	(Within MSA base x within MSA placement rate)
• Outside MSA	**4,783**	(Outside MSA base x outside MSA placement rate)
Total Placements	**12,953**	
Daily Vehicle Trips Reduced		
VTR Factors (continued only)		
• Within MSA	0.68	(GRH survey)
• Outside MSA	0.61	(GRH survey)
VT Reduced (continued only)		
• Within MSA	**5,556**	**(**Within MSA placements x within MSA VTR factor)
• Outside MSA	**2,918**	(Outside MSA placements x outside MSA VTR factor**)**
Total Daily Vehicle Trips Reduced	**8,474**	
Daily VMT Reduced		
• Ave one-way trip distance (mi)		
• Within MSA	27.6	(from GRH survey)
• Outside MSA	27.6	(discounted from actual 50.1 miles from GRH survey)
VMT reduced		
• Within MSA	153,346	(Within MSA VT reduced x trip distance)
• Outside MSA	80,537	(Outside MSA VT reduced x trip distance)
Total Daily VMT Reduced	**233,883**	

Appendix E, continued

Trip and VMT Adjustment for SOV Access to HOV Modes (reduce VT and VMT for AQ analysis)

Inside MSA

- SOV access percentage 70% (GRH survey)
- SOV access distance (mi) 5.3 (GRH survey)

Outside MSA

- Adjustments are not applicable, because all access VT and VMT occur outside MSA

Adjusted VT Reduction – net of VMT access

- Total VT reduced 8,474
- Within MSA access VT (deduct) - 3,889 (VT reduction within MSA x SOV access %)
- Outside MSA access VT 0 No deduction (access trips are outside MSA)

Total VT for AQ analysis 4,585

Adjusted VMT Reduction – net of VMT access

- Total VMT reduced 233,883
- Within MSA access VMT (deduct) - 20,612 (SOV Access VT within MSA x SOV access distance)
- Outside MSA access VMT 0 No deduction (access VMT are outside MSA)

Total VMT for AQ analysis 213,271

Daily Emissions Reduced – NOx and VOC

NOx	Trips	15 Emission Factor	VMT	15 Emission Factor	Tot gm	Tot ton
• From Starts	4,585	1.5408			7,065	0.0078
• From Running			213,271	0.3737	79,699	0.0879
Total NOx reduced (tons)					**Daily**	**0.0957**

VOC	Trips	15 Emission Factor	VMT	15 Emission Factor	Tot gm	Tot ton
• From Starts	4,585	2.8573			13,101	0.0144
• From Running			213,271	0.0915	19,514	0.0215
Total VOC reduced (tons)					**Daily**	**0.0359**

Annual Emissions Reduced – PM 2.5, Precursor NOx, and CO2

PM 2.5	Trips	15 Emission Factor	VMT	15 Emission Factor	Tot gm	Tot ton
• From Starts	4,585	0.0367			168	0.0002
• From Running			213,271	0.0170	3,626	0.0040
Total PM 2.5 reduced (tons)					**Daily**	**0.0042**
					Annual	**1.0455**

PM 2.5 Precursor NOx	Trips	15 Emission Factor	VMT	15 Emission Factor	Tot gm	Tot ton
• From Starts	4,585	1.7510			8,028	0.0088
• From Running			213,271	0.3663	78,121	0.0862
Total PM 2.5 Precursor NOx reduced (tons)					**Daily**	**0.0950**
					Annual	**23.7409**

Appendix E, continued

Annual Emissions Reduced – PM 2.5, Precursor NOx, and CO2

CO2	Trips	15 Emission Factor	VMT	15 Emission Factor	Tot gm	Tot ton
• From Starts	4,585	239.26			1,097,007	1.2092
• From Running			213,271	404.17	86,197,740	95.0167
Total CO2 reduced (tons)					**Daily**	**96.2259**
					Annual	**24,056.5**

Correction for Overlap with MM TERM

Total GRH apps FY 12, 13, 14	21,156	
New GRH apps FY 12, 13, 14	13,255	63%
Estimated MM share of new GRH	15%	
Estimated MM share of GRH impact	9%	

Net GRH = GRH Base – Mass Marketing credit

	Net GRH	GRH Base	Mass Mkt
Placements	11,787	12,953	1,166
VMT reduced	7,711	8,474	763
VMT reduced (mi)	212,834	233,883	21,049
Daily Emissions Reduced			
NOx (T)	0.0871	0.0957	0.0086
VOC (T)	0.0327	0.0359	0.0032
Annual Emissions Reduced			
PM 2.5 (T)	0.9514	1.0455	0.0941
PM 2.5 Precursor NOx (T)	21.6042	23.741	2.1367
CO2 (T)	21,891.4	24,056.5	2,165.1

Appendix F
Sample Calculation of Employer Outreach

Populations of Interest

Level 3 or 4 sites (data from ACT! database)

	Employers	Employees
• 2011 unchanged programs	626	228,720
• Expanded programs in 2014	329	179,374
• New programs in 2014	801	241,354
• Deleted programs since 2011	150	42,426

Average Vehicle Occupancy (AVO)

Starting AVO from employee survey data, Final AVO from COMMUTER model

	Starting AVO	Ending AVO
• 2011 unchanged programs	1.26	1.36
• Expanded programs – continued base	1.23	1.31
• Expanded programs – new impacts	1.31	1.33
• New programs	1.29	1.42
• Deleted programs	1.29	1.21

Daily person trips

Total employees x 2 one-way trips per day

Starting (pre-program) and ending (with-program)

	Starting	Ending
• 2011 unchanged programs	457,440	457,440
• Expanded programs	358,748	358,748
• New programs	482,708	482,708
• Deleted programs	84,852	84,852

Daily vehicle trips

Total employees / starting AVO)

Starting (pre-program) and ending (with-program)

	Starting	Ending	Difference
• 2011 unchanged programs	363,048	336,353	26,694
• Expanded programs – maintained base	291,665	273,853	17,812
• Expanded programs – new impact	273,853	269,735	4,118
• New programs	374,192	339,935	34,257
• Deleted programs	65,777	70,126	(4,349)

Total Daily Vehicle Trips Reduced

• 2011 maintained impacts	44,507
• New/expanded impacts	38,375
Net 2014 reduction	**82,882**

Appendix F, continued

Daily VMT reduced

Results produced by COMMUTER model, assuming travel distance by mode from SOC survey

• 2011 unchanged programs	426,893
• Expanded programs – maintained base	258,725
• Expanded programs – new impact	25,143
• New programs	542,935
• Deleted programs	(73,348)

Total Daily VMT Reduced

• 2011 continued impacts	685,618
• New/expanded impacts	568,078
Net 2011 reduction	**1,253,696**

Trip and VMT Adjustment for SOV Access to HOV Modes (reduce VT and VMT for AQ analysis)

• SOV access percentage	29%	(from 2013 SOC survey)
• SOV access distance (mi)	2.9	(from 2013 SOC survey)

VT Reduction without SOV access – used as base for AQ analysis

(VT reduced x non-SOV access %)

• 2011 maintained impacts	31,600
• New/expanded impacts	27,246

VMT Reduction without SOV access

(Total VMT reduced – (VT reduced x SOV % x trip distance)

• 2011 maintained impacts	648,188
• New/expanded impacts	535,804

Emissions Reduced – Maintained from 2011

Daily Emissions Reduced – NOx and VOC

NOx	**Trips**	**15 Emission Factor**	**VMT**	**15 Emission Factor**	**Tot gm**	**Tot ton**
• From Starts	31,600	1.5408			48,689	0.0537
• From Running			648,188	0.3737	242,228	0.2670
Total NOx reduced (tons)					**Daily**	**0.3207**

VOC	**Trips**	**15 Emission Factor**	**VMT**	**15 Emission Factor**	**Tot gm**	**Tot ton**
• From Starts	31,600	2.8573			90,291	0.0995
• From Running			648,188	0.0915	59,309	0.0654
Total VOC reduced (tons)					**Daily**	**0.1649**

Appendix F, continued

Annual Emissions Reduced – PM 2.5, Precursor NOx, and CO2

PM 2.5	Trips	15 Emission Factor	VMT	15 Emission Factor	Tot gm	Tot ton
• From Starts	31,600	0.0367			1,160	0.0013
• From Running			648,188	0.0170	11,019	0.0121
Total PM 2.5 reduced (tons)					**Daily**	**0.0134**
					Annual	**3.356**

PM 2.5 Precursor NOx	Trips	15 Emission Factor	VMT	15 Emission Factor	Tot gm	Tot ton
• From Starts	31,600	1.7510			55,332	0.0610
• From Running			648,188	0.3663	237,431	0.2617
Total PM 2.5 Precursor NOx reduced (tons)					**Daily**	**0.3227**
					Annual	**80.679**

CO2	Trips	15 Emission Factor	VMT	15 Emission Factor	Tot gm	Tot ton
• From Starts	31,600	239.26			7,560,616	8.3342
• From Running			648,188	404.17	261,978,144	288.7814
Total CO2 reduced (tons)					**Daily**	**297.116**
					Annual	**74,278.9**

Emissions Reduced - New / Expanded

Daily Emissions Reduced – NOx and VOC

NOx	Trips	15 Emission Factor	VMT	15 Emission Factor	Tot gm	Tot ton
• From Starts	27,246	1.5408			41,981	0.0463
• From Running			535,804	0.3737	200,230	0.2207
Total NOx reduced (tons)					**Daily**	**0.2670**

VOC	Trips	15 Emission Factor	VMT	15 Emission Factor	Tot gm	Tot ton
• From Starts	27,246	2.8573			77,850	0.0858
• From Running			535,804	0.0915	49,026	0.0540
Total VOC reduced (tons)					**Daily**	**0.1398**

Annual Emissions Reduced – PM 2.5, Precursor NOx, and CO2

PM 2.5	Trips	15 Emission Factor	VMT	15 Emission Factor	Tot gm	Tot ton
• From Starts	27,246	0.0367			1,000	0.0011
• From Running			535,804	0.0170	9,109	0.0100
Total PM 2.5 reduced (tons)					**Daily**	**0.0111**
					Annual	**2.786**

Appendix F, continued

Emissions Reduced - New / Expanded (cont)

Annual Emissions Reduced – PM 2.5, Precursor NOx, and CO2

PM 2.5 Precursor NOx	Trips	15 Emission Factor	VMT	15 Emission Factor	Tot gm	Tot ton
• From Starts	27,246	1.7510			47,708	0.0526
• From Running			535,804	0.3663	196,265	0.2163
Total PM 2.5 Precursor NOx reduced (tons)					**Daily**	**0.2689**
					Annual	**67.234**

CO2	Trips	15 Emission Factor	VMT	15 Emission Factor	Tot gm	Tot ton
• From Starts	27,246	239.26			6,518,878	7,1858
• From Running			535,804	404.17	216,555,903	238,7120
Total CO2 reduced (tons)					**Daily**	**245.8978**
					Annual	**61,474.5**

Distribution of Employer Outreach Impacts to EO Base and EO for Bicycling

	Total EO	EO w/o bike	EO-bike
Vehicle Trips Reduced	78,533	78,210	323
VMT Reduced (miles)	1,327,044	1,325,107	1,937
Daily Emissions Reduced			
NOx (tons)	0.5340	0.5327	0.0013
VOC (tons)	0.3047	0.3035	0.0012
Annual Emissions Reduced			
PM 2.5 (T)	6.1419	6.1295	0.0124
PM 2.5 Precursor NOx (T)	147.9125	147.5612	0.3513
CO2 (T)	135,753.3	135,516.3	237.0

COMMUTER CONNECTIONS
EMPLOYER SERVICES PARTICIPATION LEVELS
(EFFECTIVE July 1, 2013)

SUPPORT STRATEGIES

Likely range of trip reduction 0%

- Expresses Interest and/or distributes/displays information on Ozone Actions Days

LEVEL 1 (BRONZE)

Likely range of trip reduction 0% to 1%

- Expresses interest in telework, transit benefits, Smart Benefits, or other TDM strategy
- Conducts Commuter Survey
- Distributes alternative commute info to employees
- Posts alternative commute information on employee bulletin board(s), intranet sites, newsletter or e-mail

Appendix F, continued

LEVEL 2 (SILVER)

Implements two or more of the following strategies

Likely range of trip reduction **0% to 3% without Telework/Compressed Work Schedules**
0% to 9% with Telework/Compressed Work Schedules

- Installs a permanent display case or brochure holders and stock with alternative commute information
- Installs electronic screens or desktop feed of real-time travel information for transit and/or other alternative mode availability.
- Participates in the Capital Bikeshare Program as a Corporate Partner
- Provides preferential parking for carpools and vanpools
- Implements a telework program with 1-20% of employees participating
- Facilitates car/vanpool formation meetings
- Hosts/sponsors an alternative commute day or transportation fair
- Implements flex-time or staggered work schedule
- Implements compressed work week for 1-20% of employees
- Installs bicycle racks or lockers
- Installs shower facilities for bicyclists and walkers
- Establishes an ETC who regularly provides alternative commute information to employees
- Becomes a Commuter Connections member and provides on-site ridematching
- Supplements GRH program with payment for additional trips or own program

LEVEL 3 (GOLD)

Implements at least one of the following (in addition to the two or more Level 2 strategies):

Likely range of trip reduction **2% to 5% without financial incentive/disincentive, Telework/Compressed Work Schedules**
5% to 20% with financial incentive/disincentive, Telework/Compressed Work Schedules

- Implements a telework program with more than 20% of employees participating
- Implements compressed work week for 21%+ of employees
- Implements a transit/vanpool benefit, Smart Benefits, Federal Bicycle Benefit, or parking "cash out" program
- Implements a carpool/bicycle/walk benefit
- Provides free or significantly reduced fee parking for carpools and vanpools (valid only for companies where employees pay for parking)
- Implements a parking fee (valid only for companies that previously did not charge for parking)
- Provides employee shuttle service to transit stations
- Provides company vanpools for employees' commute to work
- Implements a comprehensive Bicycle/Walking program (includes installation of showers bicycle racks/lockers, and financial incentives for bicycling and/or walking, or a Capital Bikeshare Station)

LEVEL 4 (PLATINUM)

Likely range of trip reduction **2% to 8% without financial incentive, Telework/Compressed Work Schedules**
5% to 30% with financial incentive, Telework/Compressed Work Schedules

- Implements two or more of the Level 3 TDM programs (in addition to the 2 or more Level 2 strategies) and actively promotes these programs and alternative commuting

Appendix G
Sample Calculation of Mass Marketing Impacts

6 impact components
- Part 1 - Commuters influenced by ads to change mode – no contact CC (direct influence)
- Part 2 – Pool Rewards carpool incentive participants
- Part 3 – Car Free Day event
- Part 4 – Bike to Work Day event
- Part 5 – Commuters influenced by ads to contact CC (referred influence)
- Part 6 – GRH credit

PART 1 – Direct Ad Influence

Populations of Interest – commuters influenced by ads to change mode – no contact CC

Total commuters in region	2,481,673	(SOC)
• % recall any commute message	41%	(SOC)
• % recall CC/COG commute message	21%	(SOC)
• % chg to alt mode after CC/COG ads	2.8%	(SOC)
• % changers influenced by ad	84%	(SOC)
Placements – no contact with CC	**12,257**	(Commuters x CC recall X change % x influence %)
Placement Rates		
• Continued placement rate	40%	(SOC)
• Temporary placement rate	60%	(SOC)
Placements		
• Continued placements	4,903	(Placements x continued placement rate)
• Temporary placements	7,354	(Placements x temporary placement rate)
Daily Vehicle Trips Reduced		
• Continued VTR factor	0.70	(SOC)
• Temporary VTR factor	0.62	(SOC)
• Continued VT reduced	3,432	(Continued placements x continued VTR factor)
• Temporary VT reduced	3,511	(Temporary placements x temporary VTR factor x 77% credit for temporary use)
Total Daily Vehicle Trips Reduced	**6,943**	
Daily VMT Reduced		
• Ave one-way trip dist (mi)	15.8	(SOC)
Total Daily VMT Reduced	**109,699**	

Appendix G, continued

PART 1 (Direct Ad Influence) (cont.)

Trip and VMT Adjustment for SOV Access to HOV Modes (reduce VT and VMT for AQ analysis)

• SOV access percentage	30%	(from SOC – transit riders)
• SOV access distance (mi)	2.7	(from SOC – transit riders)

Adjusted VT Reduction

• SOV access VT	2,083	(VT x SOV access %)
• VT with no SOV access	4,860	(Total VT – SOV access VT)

Adjusted VMT Reduction

• SOV access VMT	5,624	(VT x SOV % x trip distance)
• VMT with no SOV access	104,075	(Total VMT – SOV access VMT)

Total VT for AQ analysis	**4,860**
Total VMT for AQ analysis	**104,075**

PART 2 – Pool Rewards Participants

Program participants (through June 2014) 359

Placement Rates – by retention after program ended

• Continued placement rate (June 2014)	65%	(2014 'Pool Rewards follow-up survey)
• Temporary placement rate	35%	(2014 'Pool Rewards follow-up survey)

Placements

• Continued placements	233	(Placements x continued placement rate)
• Temporary placements	126	(Placements x temporary placement rate)
Total placements	**359**	

Daily Vehicle Trips Reduced

• Continued VTR factor	0.72	(2014 'Pool Rewards follow-up survey)
• Temporary VTR factor	0.64	('Pool Rewards logging data for program period)
• Temporary discount	50%	(assumes 13 weeks of program + 13 weeks after program)
• Continued VT reduced	168	(Continued placements x continued VTR factor)
• Temporary VT reduced	41	(Temporary placements x temporary VTR factor x 25% credit for temporary use)
Total Daily Vehicle Trips Reduced	**209**	

Daily VMT Reduced

• Ave one-way trip dist (mi)	31.2	(2014 'Pool Rewards follow-up survey)
Total Daily VMT Reduced	**6,521**	

Appendix G, continued

PART 2 ('Pool Rewards) (cont.)

Trip and VMT Adjustment for SOV Access to HOV Modes (reduce VT and VMT for AQ analysis)

• SOV access percentage	50%	
• SOV access distance (mi)	5.5	

Adjusted VT Reduction

• SOV access VT	105	(VT x SOV access %)
• VT with no SOV access	104	(Total VT – SOV access VT)

Adjusted VMT Reduction

• SOV access VMT	578	(VT x SOV % x trip distance)
• VMT with no SOV access	5,943	(Total VMT – SOV access VMT)

Total VT for AQ analysis	**104**
Total VMT for AQ analysis	**5,943**

PART 3 – Car Free Day Event

Pledges (estimate 75% participation of pledges)

Fall 2011 – 12,000	9,000
Fall 2012 – 6,572	4,929
Fall 2013 – 4,188	3,141
Total Placements	**17,070**

Event Impacts

Daily Vehicle Trips Reduced

• % driving alone on non-Car Free days	46%	(Pledge data)
• Event VTR factor	0.85	(Pledge data)
• Event VT reduced	14,510	(Pledges x event VTR factor)
• Equivalent daily VT	19	(Event VT reduced / 750 days over 3 years)

Daily VMT Reduced

• Ave one-way trip distance (mi)	19.4	(Pledge data)
• Event VMT reduced	281,494	(Event VT reduced x distance)
• Equivalent daily VMT	375	(Event VMT reduced / 750 days over 3 years)

Ongoing Impacts

Daily Vehicle Trips Reduced

• Estimate continued use after CFD	5%	
Ongoing placements	**854**	(Total participants x continued rate)
• Ongoing VTR factor (after CFD)	0.34	
• Ongoing daily VT reduced	290	(Ongoing participants x ongoing VTR factor)
Total Daily VT Reduced	**309**	(Event equivalent daily VT + ongoing daily VT)

Appendix G, continued

PART 3 (Car Free Day) (continued)

Ongoing Impacts (cont)

Daily VMT Reduced

• Trip distance	19.4	
• Ongoing daily VT	5,626	(Ongoing daily VT x trip distance)
Total Daily VMT Reduced	**6,001**	(Event equivalent daily VMT + ongoing daily VMT)

Summary of Travel Impacts for Parts 1, 2, 3

	Total 1, 2, 3	Direct Ads	'Pool Rewards	Car Free Day
Placements	13,470	12,257	359	854
Vehicle Trips Reduced	7,461	6,943	209	309
VMT Reduced (miles)	122,221	109,699	6,521	6,001
Air Quality Adjusted VT / VMT				
Vehicle Trips Reduced	5,273	4,860	104	309
VMT Reduced (miles)	116,019	104,075	5,943	6,001

Daily Emissions Reduced – NOx and VOC – Parts 1, 2, 3

NOx	Trips	15 Emission Factor	VMT	15 Emission Factor	Tot gm	Tot ton
• From Starts	5,273	1.5408			8,125	0.0090
• From Running			116,019	0.3737	43,356	0.0478
Total NOx reduced (tons)					**Daily**	**0.0568**

VOC	Trips	15 Emission Factor	VMT	15 Emission Factor	Tot gm	Tot ton
• From Starts	5,273	2.8573			15,067	0.0166
• From Running			116,019	0.0915	10,616	0.0117
Total VOC reduced (tons)					**Daily**	**0.0283**

Annual Emissions Reduced – PM 2.5, Precursor NOx, and CO2

PM 2.5	Trips	15 Emission Factor	VMT	15 Emission Factor	Tot gm	Tot ton
• From Starts	5,273	0.0367			194	0.0002
• From Running			116,019	0.0170	1,972	0.0022
Total PM 2.5 reduced (tons)					**Daily**	**0.0024**
					Annual	**0.597**

Appendix G, continued

Annual Emissions Reduced – PM 2.5, Precursor NOx, and CO2 (continued) – Parts 1, 2, 3

PM 2.5 Precursor NOx	Trips	15 Emission Factor	VMT	15 Emission Factor	Tot gm	Tot ton
• From Starts	5,273	1.7510			9,233	0.0102
• From Running			116,019	0.3663	42,498	0.0468
Total PM 2.5 Precursor NOx reduced (tons)					**Daily**	**0.0570**
					Annual	**14.256**

CO2	Trips	15 Emission Factor	VMT	15 Emission Factor	Tot gm	Tot ton
• From Starts	5,273	239.26			1,261,618	1.3907
• From Running			116,019	404.17	46,891,399	51.6889
Total CO2 reduced (tons)					**Daily**	**53.0896**
					Annual	**13,269.9**

PART 4 - Bike to Work Day Credit

Participants' riding percentage and frequency

Number of riders	19,707	(BTWD registration data, 2012, 2013, 2014, adjusted for use by some 2012 participants in 2013 and 2014)
% biking to work before event	82.6%	(BTWD survey)
% new riders	10.7%	(BTWD survey)
Number of new riders	2,109	
% who increase riding days	21.8%	
Number of increased riders	4,296	
Total placements	**6,405**	(Total new + increased riders)

Change in Bike Days

Summer Biking		
% new riders in summer	10.2%	(BTWD survey)
Weekly new bike days summer	1.4	(BTWD survey)
Weekly new bike days summer	2,814	
% increased riders in summer	20.3%	(BTWD survey)
Weekly inc bike days summer	1.6	(BTWD survey)
Weekly inc bike days summer	6,401	
Winter Biking		
% new riders biking winter	8.5%	(BTWD survey)
Weekly new bike days winter	1.4	(BTWD survey)
Weekly new bike days winter	2,345	
% increased riders biking winter	13.9%	(BTWD survey)
Weekly increased bike days winter	1.8	(BTWD survey)
Weekly increased bike days winter	4,931	

Appendix G, continued

PART 4 (Bike to Work Day) (continued)

Additional Bike Days (New and Increased Riding)

• NEW bike days summer	9,215	(riders x % new after event x ave new days bike after)
• NEW bike days fall-winter	7,276	(riders x % new after event x % still riding late fall x ave new days bike in late fall)
• Total additional bike days summer	258,020	(weekly summer days x 28 weeks – Apr-Oct)
• Total additional bike days winter	160,072	(weekly winter days x 22 weeks – Nov-Mar)
• Total additional bike days - year	418,092	(summer bike days + winter bike days)
• Additional bike trips - year	836,184	(annual bike days x 2 trips per day)

Additional Bike Trips and Vehicle Trip and VMT Reductions

• Ave new daily bike trips	3,345	(Annual new bike trips / 250)
• % Drive alone/CP/VP on non-bike days	47%	(BTWD survey)
BTWD Daily Vehicle Trips Reduced	**1,572**	(daily new bike trips x DA/CP/VP percentage)

Daily VMT Reduced

• Ave trip distance (mi)	10.4	(BTWD survey)
BTWD Daily VMT Reduced	**16,349**	(vehicle trips reduced x average trip distance)

Daily Emissions Reduced – NOx and VOC – Bike to Work Day

NOx	**Trips**	**15 Emission Factor**	**VMT**	**15 Emission Factor**	**Tot gm**	**Tot ton**
• From Starts	1,572	1.5408			2,422	0.0027
• From Running			16,349	0.3737	6,110	0.0067
Total NOx reduced (tons)					**Daily**	**0.0094**

VOC	**Trips**	**15 Emission Factor**	**VMT**	**15 Emission Factor**	**Tot gm**	**Tot ton**
• From Starts	1,572	2.8573			4,492	0.0050
• From Running			16,349	0.0915	1,496	0.0016
Total VOC reduced (tons)					**Daily**	**0.0066**

Annual Emissions Reduced – PM 2.5, Precursor NOx, and CO2

PM 2.5	**Trips**	**15 Emission Factor**	**VMT**	**15 Emission Factor**	**Tot gm**	**Tot ton**
• From Starts	1,572	0.0367			58	0.0001
• From Running			16,349	0.0170	278	0.0003
Total PM 2.5 reduced (tons)					**Daily**	**0.0004**
					Annual	**0.093**

PM 2.5 Precursor NOx	**Trips**	**15 Emission Factor**	**VMT**	**15 Emission Factor**	**Tot gm**	**Tot ton**
• From Starts	1,572	1.7510			2,753	0.0030
• From Running			16,349	0.3663	5,989	0.0066
Total PM 2.5 Precursor NOx reduced (tons)					**Daily**	**0.0096**
					Annual	**2.409**

Appendix G, continued

PART 4 (Bike to Work Day) (continued)

Annual Emissions Reduced – PM 2.5, Precursor NOx, and CO2 (continued)

CO2	Trips	15 Emission Factor	VMT	15 Emission Factor	Tot gm	Tot ton
• From Starts	1,572	239.26			376,117	0.4146
• From Running			16,349	404.17	6,607,775	7.2838
Total CO2 reduced (tons)					**Daily**	**7.6984**
					Annual	**1,924.6**

PART 5 – Referred Influence (Commuter Operations Center)

Populations of Interest – commuters influenced by ads to contact CC

New CC apps (does not include re-apply or follow-up)

• FY 2012	6,241	(CC database)
• FY 2013	5,736	(CC database)
• FY 2014	4,721	(CC database)
Total new applicants	**16,698**	
Total CC applicants	87,247	(includes new, re-apply, and follow-up)
New apps 12-14 as % of total	19.1%	(new apps FYs 12-14 / total CC apps)
% influenced by ads to contact CC	15%	(COC – monthly applicant analysis)
% all apps influenced by ads	2.9%	

CC Impacts – FY 12-14

Travel Impacts	MM Share	COC base
• CC placements	1,024	35,310
• CC Vehicle trips reduced	498	17,172
• CC VMT reduced	13,650	470,691

Emissions Impacts	MM Share	COC base	
• NOx reduced (daily tons)	0.0060	0.2052	Daily
• VOC reduced (tons)	0.0024	0.0811	Daily
• PM2.5 reduced (tons)	0.0647	2.2304	Annual
• PM2.5-NOx reduced (tons)	1.4801	51.0371	Annual
• CO2 reduced (tons)	1,480.8	51,060.9	Annual

Appendix G, continued

PART 6 – GRH Credit – From GRH Analysis

Total GRH apps FY 12, 13, 14	21,156	
New GRH apps FY 12, 13, 14	13,255	63% of total applications
Estimated MM share of new GRH	15%	
Estimated MM share of GRH impact	9.0%	

GRH Impacts – FY 12-14

Travel Impacts	**MM Share**	**GRH base**
• GRH placements	1,166	12,953
• GRH Vehicle trips reduced	763	8,474
• GRH VMT reduced	21,049	233,883

Emissions Impacts	**MM Share**	**Total**	
• NOx reduced (daily tons)	0.0086	0.0957	Daily
• VOC reduced (tons)	0.0032	0.0359	Daily
• PM2.5 reduced (tons)	0.0941	1.0455	Annual
• PM2.5-NOx reduced (tons)	2.1367	23.7409	Annual
• CO2 reduced (tons)	2,165.1	24,056.5	Annual

Mass Marketing – Summary

Total – PART 1, PART 2, PART 3, PART 4, PART 5, PART 6

	Total MM	**Direct Ad Infl**	**'Pool Rewards**	**Car Free Day**	**BTW**	**COC Credit**	**GRH Credit**
Placements	22,065	12,257	359	854	6,405	1,024	1,166
VT reduced	10,294	6,943	209	309	1,572	498	763
VMT reduced	173,269	109,699	6,521	6,001	16,349	13,650	21,049
		67%	2%	3%	15%	5%	7%
Daily Emissions Reduced							
NOx (T)	0.0808						
VOC (T)	0.0239						
Annual Emissions Reduced							
PM 2.5 (T)	0.8481						
PM 2.5 Precursor (T)	20.281						
CO2 (T)	18,840.4						

Appendix H
Sample Calculation of Commuter Operations Center Impacts

PART 1 – Commute Information Requests

Populations of Interest – Commuter Connections Rideshare Applicants

New, Reapply, Transit/other, follow-up requests

• FY 2012	31,209	(CC database)
• FY 2013	30,656	(CC database)
• FY 2014	25,382	(CC database)
Total assisted commuters	**87,247**	

Within MSA (56%)	48,858
Outside MSA (44%)	38,389

COC Placement Rates	**In MSA**	**Out MSA**	
• Continued rate	32.8%	38.6%	
• Temporary rate	6.0%	4.0%	
• Total	38.8%	42.6%	
Placements			
• Continued	16,025	14,818	(Apps x cont. rate)
• Temporary	2,931	1,536	(Apps x temporary rate)
Total placements 35,310			

Daily Vehicle Trips Reduced

VTR Factors			
• Continued	0.51	0.58	
• Temporary	0.53	0.53	
• Temporary discount	17.1%	17.1%	
• Continued trips reduced	8,173	8,594	(Placements x cont. VTR factor)
• Temporary trips reduced	266	139	(Placements x temp VTR factor)
Total VT reduced 17,172			

Daily VMT Reduced

Ave one-way trip distance (mi)			
• Continued	27.5	27.5	(Actual Outside dist. 50.6 miles)
• Temporary	23.7	23.7	(Actual Outside dist. 43.2 miles)
• Continued VMT reduced	224,758	236,335	(Vehicle trips x ave distance)
• Temporary VMT reduced	6,304	3,294	
Total VMT Reduced 470,691			

Appendix H, continued

Trip and VMT Adjustment for SOV Access to HOV Modes (reduce VT and VMT for AQ analysis)

	In MSA	Out MSA	
• SOV access % -Continued	71%	0%	(CC placement survey)
• SOV access dist (mi) – Continued	3.2	0.0	(CC placement survey)
• Non-SOV access % - Temporary	41%	0%	(CC placement survey)
• SOV access dist (mi) – Temporary	3.2	0.0	(CC placement survey)

Outside MSA – not applicable – all access outside MSA

VT Reduction

• Continued SOV access VT	5,803	0	(Cont VT x SOV access)
• Temporary SOV access VT	109	0	(Temp VT x SOV access)
• Continued VT (without SOV access)	2,370	8,594	(Total Cont VT – SOV access VT)
• Temporary VT (without SOV access)	157	139	(Total Temp VT- SOV access VT)

Total VT (net of SOV access) 11,260

VMT Reduction

• Continued SOV access VMT	18,570	0	(Cont VT x SOV % x access dist)
• Temporary SOV access VMT	349	0	(Cont VT x SOV % x access dist)
• Continued VMT (without SOV access)	206,188	236,335	(Total Temp VMT- SOV access VMT)
• Temporary VMT (without SOV access)	5,955	3,294	(Total Temp VMT- SOV access VMT)

Total VMT (net of SOV access) 451,772

Total VT for AQ analysis 11,260
Total VMT for AQ analysis 451,772

<u>Daily Emissions Reduced</u> – NOx and VOC

NOx	**Trips**	**15 Emission Factor**	**VMT**	**15 Emission Factor**	**Tot gm**	**Tot ton**
• From Starts	11,260	1.5408			17,349	0.0191
• From Running			451,772	0.3737	168,827	<u>0.1861</u>
Total NOx reduced (tons)					**Daily**	**0.2052**

VOC	**Trips**	**15 Emission Factor**	**VMT**	**15 Emission Factor**	**Tot gm**	**Tot ton**
• From Starts	11,260	2.8573			32,173	0.0355
• From Running			451,772	0.0915	41,337	<u>0.0456</u>
Total VOC reduced (tons)					**Daily**	**0.0811**

Appendix H, continued

Annual Emissions Reduced (cont) – PM 2.5, Precursor NOx, and CO2

PM 2.5	Trips	15 Emission Factor	VMT	15 Emission Factor	Tot gm	Tot ton
• From Starts	11,260	0.0367			413	0.0005
• From Running			451,772	0.0170	7,680	0.0085
Total PM 2.5 reduced (tons)					**Daily**	**0.0090**
					Annual	**2.230**

PM 2.5 Precursor NOx	Trips	15 Emission Factor	VMT	15 Emission Factor	Tot gm	Tot ton
• From Starts	11,260	1.7510			19,716	0.0217
• From Running			451,772	0.3663	165,484	0.1824
Total PM 2.5 Precursor NOx reduced (tons)					**Daily**	**0.2041**
					Annual	**51.037**

CO2	Trips	15 Emission Factor	VMT	15 Emission Factor	Tot gm	Tot ton
• From Starts	11,260	239.26			2,694,068	2.9697
• From Running			451,772	404.17	182,592,689	201.2739
Total CO2 reduced (tons)					**Daily**	**204.2436**
					Annual	**51,060.9**

Correction for Overlap between COC Base and Integrated Rideshare and GRH TERMs

Net COC Base = COC Base – Mass Marketing credit – Software Upgrades credit – GRH credit

	Net COC Base	COC base	MM	Soft Upg	GRH
Placements	22,796	35,310	1,024	4,681	6,809
Vehicle Trips Reduced	11,007	17,172	498	2,379	3,288
VMT Reduced (miles)	300,761	470,691	13,650	66,442	89,838
Daily Emissions Reduced					
NOx Reduced (tons)	0.1316	0.2052	0.0060	0.0283	0.0393
VOC Reduced (tons)	0.0520	0.0811	0.0024	0.0112	0.0155
Annual Emissions Reduced					
PM 2.5 (T)	1.4307	2.2304	0.0647	0.3077	0.4273
PM 2.5 Precursor (T)	32.7379	51.0371	1.4801	7.0402	9.7789
CO2 (T)	32,753.5	51,060.9	1,480.8	7,043.1	9,783.5

Notes:
MM influenced commuters – from MM analysis
GRH – 59% of new apps/reapps who made an alt mode change registered for GRH = 23% of COC credit to GRH (59% x 39 new/reapply share of total apps)

Appendix H, continued

PART 2 – Telework Credit (Non Maryland origin / destination)

- Credit for telework assistance provided directly to commuters who do not live or work in Maryland; credit for Maryland residents/workers is assigned to the Telework Assistance TERM

Calculation details shown on Telework Assistance Worksheets

Number of teleworkers (non-MD)	388,423	
Share of TW credited to COC	9.1%	Learned of telework from Commuter Connections
Total TW placements credited to COC	35,346	
Vehicle trips reduced	12,255	
VMT reduced	187,465	
Daily NOx reduced (tons)	0.0980	
Daily VOC reduced (tons)	0.0575	
Annual PM2.5 reduced (tons)	1.0000	
Annual PM2.5-NOx reduced (tons)	24.850	
Annual CO2 reduced (tons)	21,687.5	

Total Commuter Operations Center – Including Base COC and Telework Credit
Net COC = Net COC Base + Non-MD TW

	Net COC	Net COC base	Non-MD TW
Placements	58,142	22,796	35,346
Vehicle Trips Reduced	23,262	11,007	12,255
VMT Reduced (miles)	488,226	300,761	187,465
Daily Emissions Reduced			
NOx Reduced (tons)	0.2293	0.1316	0.0980
VOC Reduced (tons)	0.1095	0.0520	0.0575
Annual Emissions Reduced			
PM 2.5 (T)	2.4307	1.4307	1.0000
PM 2.5 Precursor (T)	57.5879	32.7379	24.850
CO2 (T)	54,441.0	32,753.5	21,687.5

Appendix I
Sample Calculation of Integrated Rideshare - Software Upgrade Project Impacts

Populations of Interest – Commuter Connections Rideshare Applicants

New, Reapply, Transit/other, follow-up requests

• FY 2012	31,209	(CC database)
• FY 2013	30,656	(CC database)
• FY 2014	25,382	(CC database)
Total assisted commuters	**87,247**	

Within MSA (56%)	48,858
Outside MSA (44%)	38,389

COC Placement Rates	**In MSA**	**Out MSA**	
• Continued rate	4.7%	5.2%	
• Temporary rate	0.7%	0.5%	
• Total	5.4%	5.7%	
Placements			
• Continued	2,296	1,996	(Applications x continued rate)
• Temporary	342	192	(Applications x temporary rate)
Total placements 4,826			

Daily Vehicle Trips Reduced

VTR Factors			
• Continued	0.50	0.63	
• Temporary	0.54	0.50	
• Temporary discount	17.1%	17.1%	
• Continued trips reduced	1,148	1,257	(Placements x cont. VTR factor)
• Temporary trips reduced	32	16	(Placements x temp VTR factor)
Total VT reduced 2,453			

Daily VMT Reduced

Ave one-way trip distance (mi)			
• Continued	28.0	28.0	(Actual Outside dist. 48.6 miles)
• Temporary	24.1	24.1	(Actual Outside dist. 53.8 miles)
• Continued VMT reduced	32,144	35,196	(Vehicle trips x ave distance)
• Temporary VMT reduced	771	386	
Total VMT Reduced 68,497			

Appendix I, continued

Trip and VMT Adjustment for SOV Access to HOV Modes (reduce VT and VMT for AQ analysis)

	In MSA	Out MSA	
• SOV access % -Continued	73%	0%	(CC placement survey)
• SOV access dist (mi) – Continued	5.0	0.0	(CC placement survey)
• Non-SOV access % - Temporary	41%	0%	(CC placement survey)
• SOV access dist (mi) – Temporary	5.0	0.0	(CC placement survey)

Outside MSA – not applicable – all access outside MSA

VT Reduction

• Continued SOV access VT	838	0	(Cont VT x SOV access)
• Temporary SOV access VT	13	0	(Temp VT x SOV access)
• Continued VT (without SOV access)	310	1,257	(Total Cont VT – SOV access VT)
• Temporary VT (without SOV access)	19	16	(Total Temp VT- SOV access VT)

Total VT (net of SOV access) 1,602

VMT Reduction

• Continued SOV access VMT	4,190	0	(Cont VT x SOV % x access dist)
• Temporary SOV access VMT	65	0	(Cont VT x SOV % x access dist)
• Continued VMT (without SOV access)	27,954	35,196	(Total Temp VMT- SOV access VMT)
• Temporary VMT (without SOV access)	706	386	(Total Temp VMT- SOV access VMT)

Total VMT (net of SOV access) 64,242

Total VT for AQ analysis 1,602
Total VMT for AQ analysis 64,242

<u>Daily Emissions Reduced</u> – NOx and VOC

NOx	**Trips**	**15 Emission Factor**	**VMT**	**15 Emission Factor**	**Tot gm**	**Tot ton**
• From Starts	1,602	1.5408			2,468	0.0027
• From Running			64,242	0.3737	24,007	<u>0.0265</u>
Total NOx reduced (tons)					**Daily**	**0.0292**

VOC	**Trips**	**15 Emission Factor**	**VMT**	**15 Emission Factor**	**Tot gm**	**Tot ton**
• From Starts	1,602	2.8573			4,577	0.0050
• From Running			64,242	0.0915	5,878	<u>0.0065</u>
Total VOC reduced (tons)					**Daily**	**0.0115**

<u>Annual Emissions Reduced</u> – PM 2.5, Precursor NOx, and CO2

PM 2.5	**Trips**	**15 Emission Factor**	**VMT**	**15 Emission Factor**	**Tot gm**	**Tot ton**
• From Starts	1,602	0.0367			59	0.0001
• From Running			64,242	0.0170	1,092	<u>0.0012</u>
Total PM 2.5 reduced (tons)					**Daily**	**0.0013**
					Annual	**0.317**

Appendix I, continued

Annual Emissions Reduced (cont) – PM 2.5, Precursor NOx, and CO2

PM 2.5 Precursor NOx	Trips	15 Emission Factor	VMT	15 Emission Factor	Tot gm	Tot ton
• From Starts	1,602	1.7510			2,805	0.0031
• From Running			64,242	0.3663	23,532	0.0259
Total PM 2.5 Precursor NOx reduced (tons)					**Daily**	**0.0290**
					Annual	**7.258**

CO2	Trips	15 Emission Factor	VMT	15 Emission Factor	Tot gm	Tot ton
• From Starts	1,602	239.26			383,295	0.4225
• From Running			64,242	404.17	25,964,689	28.6212
Total CO2 reduced (tons)					**Daily**	**29.0437**
					Annual	**7,260.9**

Correction for Overlap with MM TERM

Total CC applications FY 12, 13, 14	87,247	
New CC applications FY 12, 13, 14	16,698	19%
Estimated MM share of new CC	15%	
Estimated MM share of IR impact	3.0%	

Net Software Upgrade = Software Upgrade Base – Mass Marketing credit

	Net SU	SU Base	MM Share
Placements	4,681	4,826	145
VT reduced	2,379	2,453	74
VMT reduced	66,442	68,497	2,055
Daily Emissions Reduced			
NOx reduced (T)	0.0283	0.0292	0.0009
VOC reduced (T)	0.0112	0.0115	0.0003
Annual Emissions Reduced			
PM 2.5 (T)	0.3077	0.3172	0.0095
PM 2.5 Precursor (T)	7.0402	7.2579	0.2177
CO2 (T)	7,043.1	7,260.9	217.8

APPENDIX J
COMMUTER CONNECTIONS TERM EVALUATION SCHEDULE – FY2015 - FY2017

Measure	Data Collection Activity	Deadline(s)	FY Completion
Telework	2016 State of the Commute Survey	June 2016 (Draft Report) June 2017 (Final Report)	FY16 FY17
	Employer Survey	January 2017	FY17
Employer Outreach	Database Information Analysis From ACT!	December 2016 (interim) June 2017 (final)	FY17
GRH	2016 GRH applicant Survey	June 2016 (Draft Report) December 2016 (Final Report)	FY16 FY17
	2016 Retention Rate Survey	June 2016 (Draft Report) December 2016 (Final Report)	FY16 FY17
Commuter Operations Center	Placement Rate survey ***(survey completed)***	November 2014	FY15
	2016 Retention Rate Survey	June 2016 (Draft Report) December 2016 (Final Report)	FY16 FY17
Mass Marketing	2016 State of the Commute Survey	June 2016 (Draft Report) June 2017 (Final Report)	FY16 FY17
	2016 Bike to Work Day Participant Survey	Nov/Dec 2016 (Draft Report) June 2017 (Final Report)	FY17
ALL	2016 State of the Commute Survey	June 2016 (Draft Report) June 2017 (Final Report)	FY16 FY17
	2015 -2017 TERM Analysis Report	June 2017 (Draft Report) January 2018 (Final Report)	FY17 FY18

APPENDIX K
GLOSSARY OF ACRONYMS

CC	-	Commuter Connections
CCWP	-	Commuter Connections Work Program
CO2	-	Carbon dioxide (primary greenhouse gas)
COC	-	Commuter Operations Center
COG	-	Council of Governments
DDOT	-	District of Columbia Department of Transportation
FHWA	-	Federal Highway Administration
GRH	-	Guaranteed Ride Home
HOV(s)	-	High Occupancy Vehicle(s)
MTA	-	Maryland Transit Administration
MDOT	-	Maryland Department of Transportation
MWAQC	-	Metropolitan Washington Air Quality Committee
MWCOG	-	Metropolitan Washington Council of Governments
NO_X	-	Nitrogen Oxides
P & R	-	Park and Ride
PM	-	Particulate Matter
PM2.5	-	Particulate Matter, 2.5 microns
SOC	-	State of the Commute
SOV	-	Single Occupant Vehicle
TDM	-	Transportation Demand Management
TERM	-	Transportation Emission Reduction Measure
TIP	-	Transportation Improvement Program
TMA	-	Transportation Management Association
TMO	-	Transportation Management Organization
TPB	-	Transportation Planning Board
VDOT	-	Virginia Department of Transportation
VDRPT	-	Virginia Department of Rail & Public Transportation
VMT	-	Vehicle Miles Traveled
VOC	-	Volatile Organic Compounds
VRE	-	Virginia Railway Express
VT	-	Vehicle Trips
VTR	-	Vehicle Trip Reduction
WMATA	-	Washington Metropolitan Area Transit Authority