

Stanford 2018 General Use Permit: SB 743 VMT Analysis

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FEHR  PEERS

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This report presents an evaluation of the impacts of the proposed Stanford 2018 General Use Permit (GUP) in terms of criteria proposed by the California Governor's Office of Planning and Research (OPR) to implement California State Law Senate Bill (SB) 743 (Steinberg, 2013). OPR proposes that metrics based on vehicle miles traveled (VMT) be used to evaluate a project's transportation effects, and that projects within 1/2 mile of certain transit facilities be presumed to result in less-than-significant impacts to transportation. OPR also suggests numeric thresholds of significance related to generation of VMT.

SENATE BILL 743

SB 743 was signed into law in 2013 with the intent to change the focus of transportation impact assessments conducted under the California Environmental Quality Act (CEQA). In its explanation of its *Revised Updates to the CEQA Guidelines Implementing Senate Bill 743*, OPR states:

Senate Bill 743 mandates a change in the way that public agencies evaluate transportation impacts of projects under the California Environmental Quality Act. Legislative findings in that bill plainly state that California's foundational environmental law can no longer treat vibrant communities, transit and active transportation options as adverse environmental outcomes. On the contrary, aspects of project location and design that influence travel choices, and thereby improve or degrade our air quality, safety, and health, must be considered. – Section I-A, Page I: 1

SB 743 reflects a Legislative policy to balance the needs of congestion management with statewide goals related to infill development, promotion of public health through active transportation, and reduction of greenhouse gas emissions. SB 743 requires OPR to prepare proposed revisions to the CEQA Guidelines for determining the significance of transportation impacts. Under SB 743, the criteria must promote the reduction of greenhouse gas emissions, the development of multimodal transportation networks, and a diversity of land uses.

SB 743 dictates that once the CEQA Guidelines are amended to include new thresholds, **automobile delay, as described by level of service or similar measures of vehicular capacity or congestion, shall no longer be considered a significant impact under CEQA** in all locations in which the new thresholds are applied. The Legislature gave OPR the option of applying the new thresholds only to transit priority areas, or more broadly to areas throughout the State.

A "transit priority area" is an area within one-half mile of a major transit stop. Public Resources Code section 21064.3 defines a "major transit stop" to mean a site containing an existing rail transit station, a ferry terminal served by either a bus or rail transit service, or the intersection of two or more major bus routes with a frequency of service interval of 15 minutes or less during the morning and afternoon peak commute periods.

PROPOSED CEQA GUIDELINES AND DRAFT TECHNICAL REPORT

OPR released its preliminary discussion draft of the CEQA Guidelines amendments to implement SB 743 in August 2014. The initial draft focused generally on an assessment whether a project would result in VMT that would exceed regional averages, and OPR proposed to apply the new VMT-based thresholds broadly throughout the State rather than limiting their application to transit priority areas.

In presentations on the preliminary draft, OPR explained that the shift from level of service metrics to VMT will provide important benefits. Elimination of congestion-based metrics can remove a key barrier to infill development. Congestion based analyses often result in measures to expand roadways and intersections, which result in high capital and maintenance costs. Further, level of service does not equate to quality of life. OPR has shown that level of service metrics do not measure the total amount of time that an individual spends commuting; rather the focus is on delay at a single intersection. Total travel time can be reduced by bringing housing and jobs closer together. According to OPR, VMT-based metrics attack regional congestion and overall driving behavior. Reducing VMT also will reduce greenhouse gas emissions. In addition, OPR has explained that VMT is easier to model than congestion based approaches.

In the revised draft CEQA Guidelines released on January 2016, *Revised Proposal on Updates to the CEQA Guidelines on Evaluating Transportation Impacts under CEQA*, OPR continues to propose applying a new VMT-based approach to all areas of the State. Agencies would have a two-year period to transition to the new VMT-based approach. As under the initial draft, once this transition period ends, automobile delay can no longer be considered a significant adverse effect under CEQA.

The revised draft CEQA Guidelines include **a presumption that development projects that are located within one-half mile of an existing major transit stop or a stop along an existing high quality transit corridor will not cause a significant transportation impact.** A high-quality transit corridor is a corridor with fixed route bus service with service intervals no longer than 15 minutes during peak commute hours. In its explanation document, OPR notes that this presumption encourages transit oriented development, and “transit-oriented development itself is a key strategy for reducing VMT, and thereby reducing environmental impacts and developing healthy, walkable communities.”

A key difference between the revised draft CEQA Guidelines and the initial draft is that, except for the presumption that projects near major transit stops and high quality transit corridors will not result in significant impacts, the revised draft CEQA Guidelines themselves do not set forth specific standards to assess whether a project’s VMT effect is significant. Much of the detail is now found in a draft Technical Advisory.

Where a development project is not presumed to result in a less-than-significant impact, the draft Technical Advisory recommends thresholds for specific types of land uses, including the following:

- Residential: A project exceeding both existing city household daily VMT per capita minus 15 percent, and existing regional household daily VMT per capita minus 15 percent, may indicate a significant transportation impact.
- Office: A project exceeding a level of 15 percent below existing regional daily VMT per employee may indicate a significant transportation impact.
- Retail: A net increase in total VMT may indicate a significant transportation impact.
- Mixed Use: Lead agencies can evaluate each component independently, and apply the significance threshold for each project type included (e.g. residential and retail). In the analysis of each use, a project may take credit for internal capture.

OPR explains that 15 percent better than existing averages is roughly consistent with the reduction targets set by the California Air Resources Board for the larger metropolitan planning organizations pursuant to SB 375. For development in an unincorporated county, residential VMT that both exceeds 15 percent below existing daily VMT per capita in the aggregate of all incorporated jurisdictions in that county, and exceeds 15 percent below existing regional daily VMT per capita, may indicate a significant transportation impact.

In addition, the draft Technical Advisory suggests screening thresholds to determine whether a quantitative analysis is needed. Agencies could determine not to conduct additional analysis for projects that generate fewer trips than the threshold for studying consistency with a congestion management plan (typically 100 trips). Further, agencies may create maps that identify low-VMT areas and presume that projects in those areas that incorporate features similar to the existing low-VMT development will tend to exhibit similarly low VMT.

The draft Technical Advisory also provides guidance for addressing impacts to transit. OPR states that a project that blocks access to a transit stop or blocks a transit route may interfere with transit functions. By contrast, when evaluating multimodal transportation networks:

[L]ead agencies generally should not treat the addition of new users as an adverse impact. Any travel-efficient infill development is likely to add riders to transit systems, potentially slowing transit vehicle mobility, but also potentially improving overall destination proximity. Meanwhile, such development improves regional vehicle flow generally by loading less travel onto the regional network than if that development was to occur elsewhere. – Section III D-5, Page III: 26

OPR recognizes that increased demand throughout a region may cause a cumulative impact requiring new or additional transit infrastructure. However, OPR states such impacts may be best addressed through a fee program that fairly allocates the cost of improvements not just to projects that locate near transit, but rather across a region to all projects that impose burdens on the entire transportation system.

More information is available on the OPR website at https://www.opr.ca.gov/s_sb743.php.

The remainder of this document evaluates the VMT generation of the proposed Stanford 2018 General Use Permit. It does so in the context of the stated intent of SB 743 and the draft proposals developed by OPR for performing SB 743 assessments in CEQA documents.

STANDARDS OF SIGNIFICANCE AND IMPACT THRESHOLDS

In its January 2016 *Revised Proposed Changes to the CEQA Guidelines*, OPR proposes the following criteria for analyzing transportation impacts of land use projects:

Proposed New Section 15064.3. Determining the Significance of Transportation Impacts.

(a) *Purpose.*

Section 15064 contains general rules governing the analysis, and the determination of significance of, environmental effects. Specific considerations involving transportation impacts are described in this section. Generally, vehicle miles traveled is the most appropriate measure of a project's potential transportation impacts. For the purposes of this section, "vehicle miles traveled" refers to the amount and distance of automobile travel attributable to a project. Other relevant considerations may include the effects of the project on transit and non-motorized travel and safety of all travelers. A project's effect on automobile delay does not constitute a significant environmental impact.

(b) *Criteria for Analyzing Transportation Impacts.*

Lead Agencies may use thresholds of significance for vehicle miles traveled recommended by other public agencies or experts provided the threshold is supported by substantial evidence.

(1) Vehicle Miles Traveled and Land Use Projects. A development project that results in vehicle miles traveled exceeding an applicable threshold of significance may indicate a significant impact. Generally, development projects that locate within one-half mile of either an existing major transit stop or a stop along an existing high quality transit corridor may be presumed to cause a less-than-significant transportation impact. Similarly, development projects that decrease vehicle miles traveled in the project area compared to existing conditions may be considered to have a less than significant transportation impact. – Section II, Page II: 7

Other than the two presumptions listed in proposed CEQA Guidelines section 15064.3(b)(1), OPR does not propose to establish numeric significance criteria through the CEQA Guidelines. OPR proposes to change the transportation questions in Appendix G to the CEQA Guidelines to read as follows:

XVI. Transportation-- Would the project:

- (a) Conflict with a plan, ordinance, or policy addressing the safety or performance of the circulation system, including transit, roadways, bicycle lands and pedestrian paths (except for automobile level of service)?*
- (b) Cause substantial additional vehicle miles traveled (per capita, per service population, or other appropriate efficiency measure)?*
- (c) Substantially induce additional automobile travel by increasing physical roadway capacity in congested areas (i.e., by adding new mixed-flow lanes) or by adding new roadways to the network?*
- (d) Result in inadequate emergency access?*

Section II, Pages 8-9 [strikeout text removed]

OPR's January 2016 draft *Technical Advisory on Evaluating Transportation Impacts in CEQA* provides numeric thresholds that an agency could choose to use when assessing the significance of a project's additional vehicle miles traveled in the event that the presumptions in proposed CEQA Guidelines section 15064.3(b)(1) do not apply. Based on OPR's *Revised Proposed Changes to the CEQA Guidelines* and OPR's draft *Technical Advisory on Evaluating Transportation Impacts in CEQA*, the following significance criteria are used to assess VMT in this report:

1. Is the project within 1/2 mile of an existing major transit stop or an existing stop along a high quality transit corridor? If so, the project will be presumed to result in a less than significant impact on VMT.
2. Alternatively, the project will be considered to result in a significant impact to VMT if project-related VMT exceeds the following numeric thresholds:
 - **Residential Per Capita Daily VMT:** A project exceeding *both* existing household daily VMT per capita in the aggregate of all incorporated jurisdictions in the County minus 15 percent *and* existing regional household daily VMT per capita minus 15 percent.
 - **Worker Per Capita Daily VMT:** A project exceeding a level of 15 percent below existing regional daily VMT per worker.

OPR's draft Technical Advisory states that lead agencies can evaluate each component of a mixed-use project independently, and apply the significance threshold for each project type included. In the analysis of each use, a project may take credit for internal capture. Based on this guidance, residential and worker

VMT are assessed independently in this report.¹ The site-specific data used in the analysis account for internal capture.

OPR's draft Technical Advisory also recommends the following additional significance threshold for all projects:

- Would the project result in development outside of areas contemplated for development in a Sustainable Communities Strategy?

POPULATIONS INCLUDED IN THE ANALYSIS

Stanford anticipates that the 2018 GUP will continue to cover all of its lands in unincorporated Santa Clara County. However, the GUP does not apply to land uses within those areas that are permitted as of right. The single family and two-family residences in the faculty/staff subdivision are permitted as of right, and therefore are not included in this VMT analysis. In addition, Stanford does not propose development under the 2018 General Use Permit in two areas zoned for medium-density faculty and staff housing (the Peter Coutts housing area and the Olmsted Terrace housing area). Nor does Stanford propose development outside the Academic Growth Boundary, including on the Stanford Golf Course. Therefore, these areas are not included in the VMT analysis.

The daily VMT analysis includes all of the Academic Campus and Campus Open Space lands, including the Stanford Driving Range, which Stanford proposes to designate as Academic Campus rather than medium density residential. Thirty-eight existing faculty/staff housing units are included in the study area for the 2018 GUP. These units are located in the Searsville and Olmsted staff rental subdivision and were included in the daily VMT analysis.

PROXIMITY TO TRANSIT

As explained above, OPR proposes that lead agencies generally should presume that residential, retail, and office projects, as well as mixed-use projects that are a mix of these uses, proposed within 1/2 mile of an existing major transit stop or an existing stop along a high quality transit corridor will have a less than significant impact on VMT. A major transit stop is a site containing an existing rail transit station, a ferry terminal served by either a bus or rail transit service, or the intersection of two or more major bus routes with a frequency of service interval of 15 minutes or less during the morning and afternoon peak commute periods. A high quality transit corridor means a corridor with fixed route bus with service intervals no longer than 15 minutes during peak commute hours.

¹ Please see the section of this report titled "Numeric Significance Threshold for 2018 GUP", beginning on page 9, for a discussion of VMT associated with visitors to the Stanford campus.

Figure 1 shows the major transit stops and stops along high quality transit corridors on and near the Stanford campus, and land area within 1/2 mile of such stops and corridors. The Caltrain stations are labeled as major transit stops. The El Camino corridor served by VTA and SamTrans is a high quality transit corridor.

In addition to these three public transit systems, Stanford operates its own private transit system called the Marguerite Shuttle. One of the key aspects of the Marguerite Shuttle service is the provision of “last mile” service between the Stanford campus and the Downtown Palo Alto Intermodal Transit Center where all three public transit systems provide high quality transit service. The Marguerite Shuttle service operates approximately 20 routes to various destinations on- and off-campus. During the morning peak period buses are scheduled to meet each train. This service includes the provision of multiple buses on some routes in the morning to ensure sufficient capacity is available when large numbers of users arrive on the Bullet and Express trains. In the afternoon, the Marguerite Shuttle service is designed to provide sufficient capacity to get Caltrain users to the station ahead of train departures. As a private bus system, the Marguerite Shuttle can easily adjust schedules and equipment to meet the demands of its users. The annual transportation survey is used to understand user preferences and refine the operations.

Based on the operations described above, **Figure 1** shows the bus stops on the Stanford campus that receive four or more buses per hour, during the morning and evening peak periods, by routes that connect to the Downtown Palo Alto Intermodal Transit Center. **Figures 2 and 3** show how many Marguerite buses each stop receives during the AM peak hour and during the PM peak hour. Most of these bus stops have five or more buses and some in the Quarry Road corridor have as many as 20 buses per hour. Therefore, Marguerite users have multiple, frequent opportunities to travel between the campus and the Caltrain Station and, the frequency of service at these stops meets, or exceeds, the level of service standard of providing 15-minute fixed route service.

Development under the proposed 2018 GUP constitutes infill development that represents increased intensity and density compared to existing levels of Stanford. The 2009 Sustainable Development Plan concluded that the pattern of development that Stanford is implementing promotes compact urban development, and prevents sprawl. Stanford is located adjacent to Caltrain stations, and is well served by transit. Therefore, project-specific or location-specific information does not appear to indicate that the project will generate significant levels of VMT.

Based on the revised draft CEQA Guidelines proposed by OPR for assessment of VMT, the proposed 2018 General Use Permit can be presumed to result in a less-than-significant impact. Nevertheless, because OPR has not finalized the proposed CEQA Guidelines and its recommendations may change, Fehr and Peers has performed a quantitative assessment of VMT generated by the proposed 2018 General Use Permit.

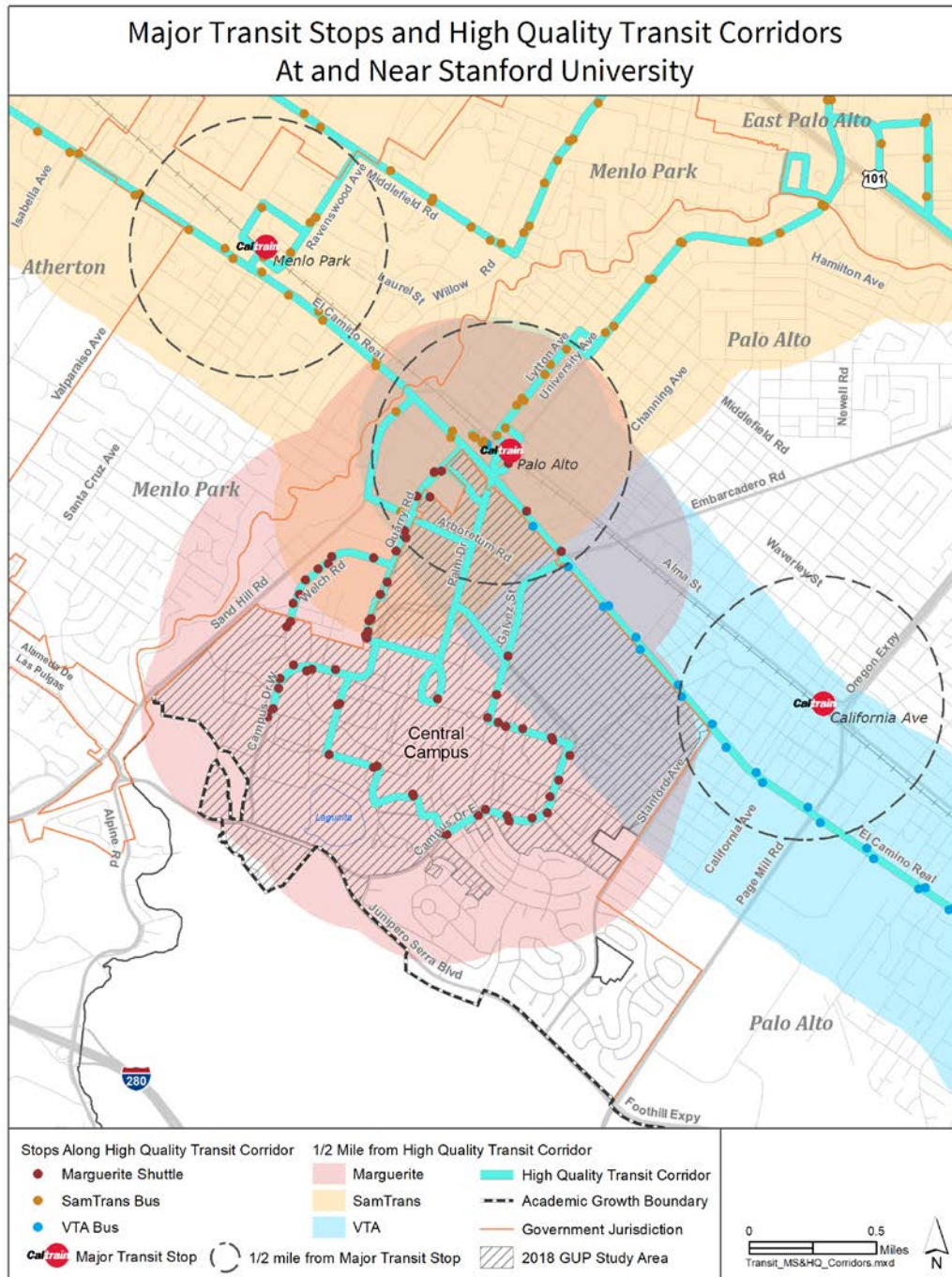


Figure 1: Major Transit Stops & High Quality Transit Corridors

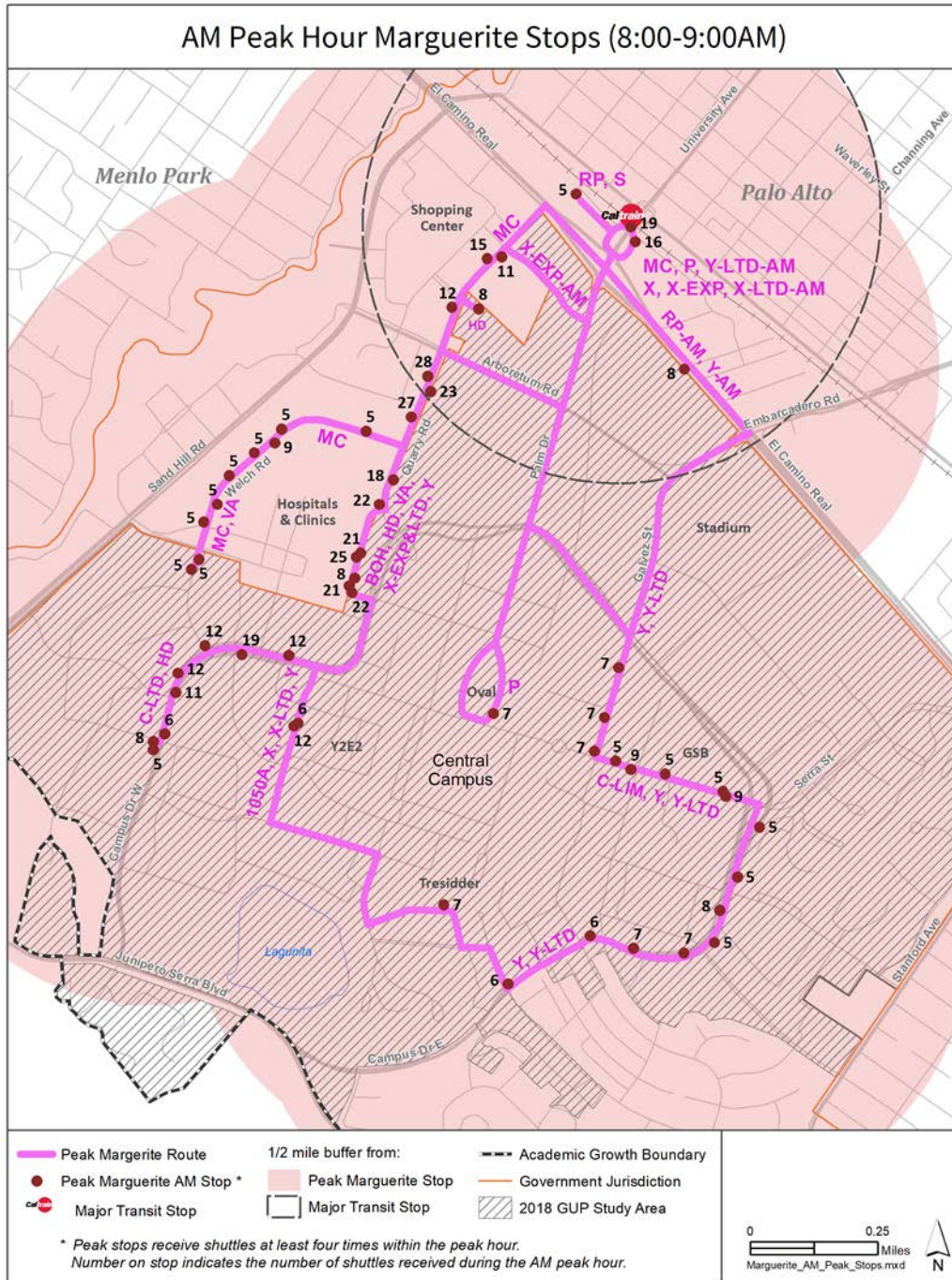


Figure 2: AM Peak Hour Marguerite Stops

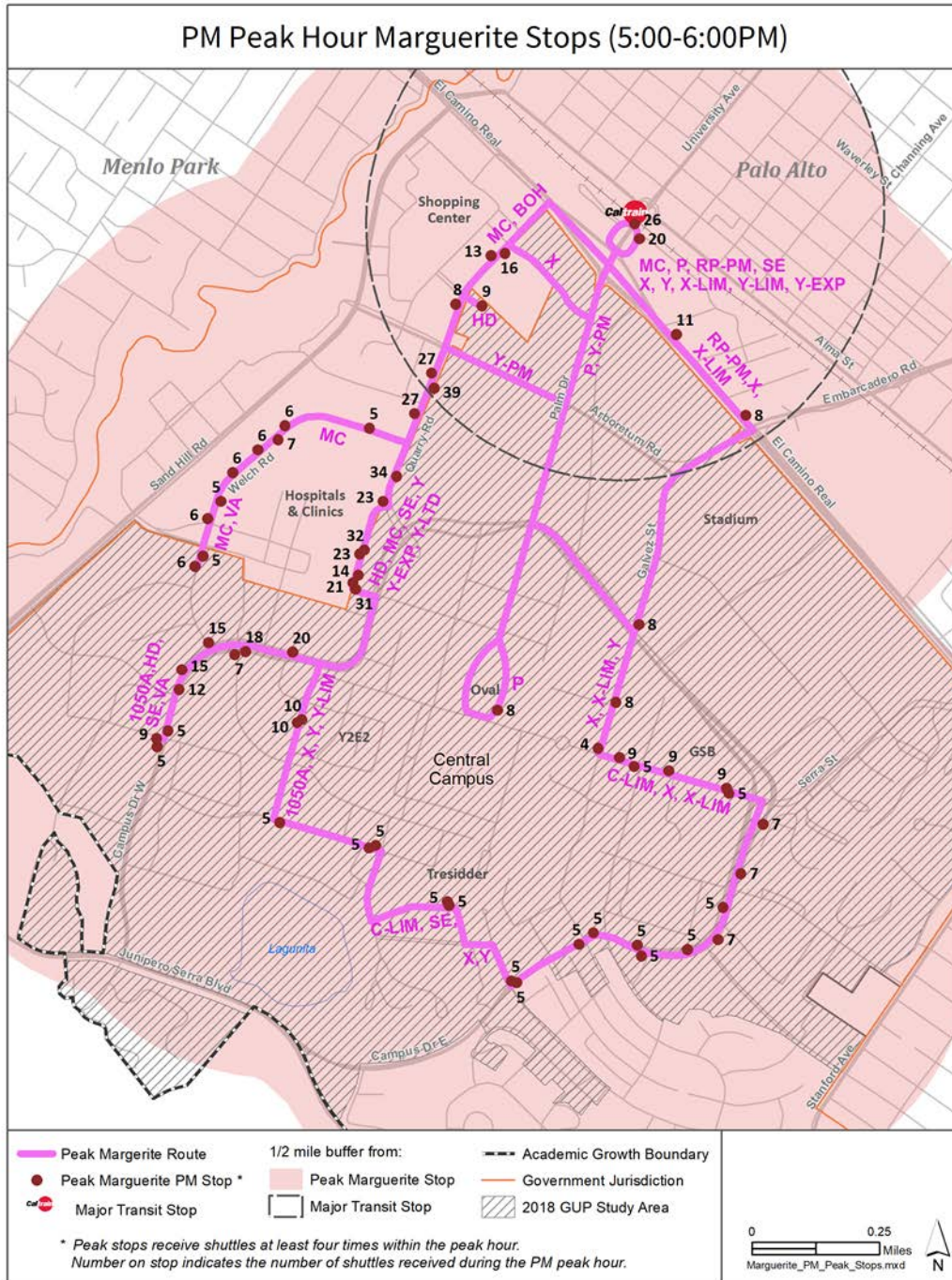


Figure 3: PM Peak Hour Marguerite Stops

NUMERIC SIGNIFICANCE THRESHOLDS FOR 2018 GUP

Based on the OPR guidance described above, the numeric benchmarks against which the 2018 General Use Permit worker and resident VMT will be compared are:

- the Bay Area regional daily average home-based-work VMT per worker; and
- both the Bay Area regional daily average and the Santa Clara County daily average home-based VMT per capita.

The VTA transportation model is consistent with the recommendations in OPR's draft Technical Advisory on geographic scope, covering the entire Bay Area region, and modeling standards described in the California Transportation Commission *Regional Transportation Plan Guidelines*. The VTA model is a trip-based model. OPR's draft Technical Advisory states that home-based trips can be the focus for analysis of residential projects, and home-based-work trips can be the focus of the analysis for office projects². Therefore, the VTA model is a reliable source to establish the Bay Area and Santa Clara County average daily VMT per worker and per capita at an aggregate level. **Table 1** presents the VTA model estimates for the regional and Santa Clara County benchmarks.

OPR's draft Technical Advisory recommends that regional, not city or county-level VMT averages should be used for judging impacts of employment-generating projects. The draft Technical Advisory also recommends that the benchmark for residential projects should be the higher of the county-level (aggregate of all incorporated jurisdictions) and regional averages. In this case, the regional average is higher and will represent the benchmark for residential VMT generation.

TABLE 1: VMT BENCHMARKS FOR 2018 GUP

Traveler and Trip Type	Average Daily VMT per Capita	
	Santa Clara County ¹	Bay Area
Worker Home-Based-Work Daily VMT per Worker	N/A	16.18
Resident Home-Based Daily VMT per Capita (Home-based Work + Home-based Other)	13.08	17.33

¹ – Incorporated and unincorporated Santa Clara County
Source: 2015 VTA Travel Model

OPR's draft Technical Advisory does not address travel by college students. Trips to and from elementary, middle and high schools, and to some extent colleges, are included as a type of home-based "other" trip generated by residential projects, and therefore are included in the resident daily VMT per capita analyses.

² Governor's Office of Planning and Research (OPR), *Revised Proposal on Updates to the CEQA Guidelines on Evaluating Transportation Impacts in CEQA Implementing Senate Bill 743*, January 20, 2016, page III 16.

However, trips by Stanford students traveling to and from the campus are not captured as Stanford-related resident trips. The omission of VMT from students traveling to and from the campus would leave a large gap in the VMT picture for Stanford University; therefore, Stanford has elected to also include student trips in its assessment of Worker VMT.

Stanford students behave like workers in that they travel by foot, bicycle, mass transit and automobiles to and from their work site (campus) on a regular basis from a variety of locations around the Bay Area. Stanford has data regarding the locations where students live, the frequency of their commutes, and the transportation modes that they use. Accordingly, for this analysis, Stanford students are considered part of the "Worker" population and the daily VMT associated with their travel to and from the campus is included in the Worker VMT.

While student travel behavior is similar to that of faculty and staff, a sensitivity analysis was prepared for Worker VMT that did not include the student travel. This analysis was prepared to document that inclusion of the students did not overly influence or obscure the level of VMT per worker generated by the faculty and staff alone. The analysis results are presented for each scenario and demonstrate that using this alternative method for calculating Daily VMT per worker would also be lower than the numeric significance standards.

OPR's draft Technical Advisory recommends setting thresholds of significance at 15 percent below the regional benchmark for average daily VMT per worker or per capita. Taking all of these recommendations into account, **Table 2** indicates the VMT generation thresholds to be applied to the proposed 2018 GUP. These thresholds will be used for determining whether the 2018 GUP would have significant VMT impacts.

TABLE 2: APPLICABLE BENCHMARKS AND NUMERIC SIGNIFICANCE THRESHOLDS

Traveler and Trip Type	Daily VMT per Capita	
	Benchmark (region-wide average)	Numeric Threshold of Significance (85% of benchmark)
Worker Home-Based-Work Daily VMT per Worker	16.18	13.75
Resident Home-Based Daily VMT per Capita	17.33	14.73

Source: Fehr & Peers, 2016

In addition to numeric comparisons to regional benchmarks. OPR presents a third approach that can be used to assess the significance of VMT -- evaluation of the change in total VMT caused by the project. OPR states the third method is useful when a project is likely to divert or substitute trips. The OPR Technical Advisory states:

A third method, estimating the change in total VMT with and without the project, can evaluate whether a project is likely to divert existing trips, and what the effect of those diversions will be on total VMT. This method answers the question, "What is the net effect of the project on area VMT?" As an illustration, assessing the total change in VMT for a grocery store built in a food desert that diverts trips from more distant stores could reveal a net VMT reduction. The analysis should address the full area over which the project affects travel behavior, even if the effect on travel behavior crosses political boundaries. – Section III B-1, Page III: 15

Fehr & Peers considered whether use of this third approach might be appropriate for analyzing the significance of VMT associated with visitor trips to and from the Stanford campus; however, this method does not appear to be well-suited to the specifics of the proposed 2018 General Use Permit. OPR has not provided guidance as to how an agency should assess significance using this method if the relevant visitor trips are not of the type that would be redistributed from one location to another. The OPR Technical Advisory states:

"Because new retail development typically redistributes shopping trips rather than creating new trips, estimating the total change in VMT (i.e. the difference in total VMT in the area affected with and without the project) is the best way to analyze a retail project's transportation impacts.

By adding retail opportunities into the urban fabric and thereby improving retail destination proximity, local-serving retail development tends to shorten trips and reduce VMT. Lead agencies generally, therefore, may presume such development creates a less than significant transportation impact. Regional-serving retail development, on the other hand, which can lead to substitution of longer trips for shorter ones, might tend to have a significant impact. Where such development decreases VMT, lead agencies may consider it to have a less than significant impact." – Section III D-2, Page III: 23-24

Here, the additional academic square footage and housing proposed for the 2018 General Use Permit would be constructed on the existing Stanford campus, and would not tend to redistribute visitor trips from one location to another. As shown on the page 6 of Appendix C, no growth is expected in campus visitor trips associated with large-scale athletic events and live performances. The types of visitor trips that are expected to increase under the project are those associated with population growth: vendors and deliveries, conferences, and tours. Development under the 2018 General Use Permit would not tend to divert or redistribute these trips from one location to another, or cause these types of trips to be longer or shorter than they are under existing conditions. The same holds true for trips made by Stanford fleet vehicles and mid-day trips by Stanford workers. Trip lengths would tend to be the same as under current conditions.

This report identifies the annual VMT for campus visitors; however, the evaluation of significance is based on a comparison of Worker and Resident daily VMT per capita to regional benchmarks for those same

categories. This serves as a proxy for evaluating visitor VMT, for which there is no regional benchmark. This approach is consistent with OPR's guidance that a project located within 1/2 mile of a major transit stop or along a high quality transit corridor can be presumed to have a VMT impact that is less than significant, and that an agency can use maps of low-VMT areas to conclude that new projects would tend to have the same low VMT as the existing businesses. The approach is further supported by the Greenhouse Gas Technical Report prepared for the project by Ramboll Environ, which finds that emissions under the 2018 General Use Permit (including those from visitor trips to and from the campus) would be below the State's greenhouse gas emissions targets for 2020 and 2030.

METHODOLOGY FOR CALCULATING 2018 GUP VMT

In its *Revised Proposed Changes to the CEQA Guidelines*, OPR proposes general guidance regarding selection of a methodology to assess a project's vehicle miles traveled:

Proposed New Section 15064.3. Determining the Significance of Transportation Impacts

(b) Criteria for Analyzing Transportation Impacts

(4) Methodology. The lead agency's evaluation of the vehicle miles traveled associated with a project is subject to a rule of reason. A lead agency should not confine its evaluation to its own political boundary. A lead agency may use models to estimate a project's vehicle miles traveled, and may revise those estimates to reflect professional judgment based on substantial evidence. Any assumptions used to estimate vehicle miles traveled and any revisions to model outputs should be documented and explained in the environmental document prepared for the project.

Source: Section II E-b-4, Pages II: 7-8

On page III-15, the OPR Technical Advisory makes a similar point:

To the extent possible, lead agencies should choose models that have sensitivity to features of the project that affect VMT. Those tools and resources can also assist in establishing thresholds of significance and estimating VMT reduction attributable to mitigation measures and project alternatives. When using models and tools for those various purposes, agencies should use comparable data and methods, in order to set up an "apples-to-apples" comparison between thresholds, VMT estimates, and mitigation VMT estimates.

Models can work together. For example, agencies can use travel demand models or survey data to estimate existing trip lengths and input those into sketch models such as CalEEMod to achieve more accurate results. Whenever possible, agencies should input localized trip lengths into a sketch model to tailor the analysis to the project location. However, in doing so, agencies should be careful to avoid double counting if the sketch model includes other inputs or toggles that

are proxies for trip length (e.g. distance to city center). Generally, if an agency changes any sketch model defaults, it should record and report those changes for transparency of analysis. Again, trip length data should come from the same source as data used to calculate thresholds, to be sure of an “apples-to-apples” comparison.

Source: Section II B-1, Pages II: 15

For the VMT analysis, Fehr and Peers considered whether calculation of project-related daily VMT per capita should be performed exclusively through the use of a regional transportation model. To determine whether an existing regional transportation model would be representative of travel patterns at Stanford, Fehr and Peers gathered relevant information about Stanford’s worker and resident populations including driving patterns such as mode choice and single occupant vehicle rates, and the cordon counts measuring the number of vehicular trips in and out of the campus over the past 15 years.

Fehr and Peers compared this available site-specific data to the assumptions and results for the Stanford campus as represented in both the Metropolitan Transportation Commission (MTC) and Santa Clara Valley Transportation Authority (VTA) models. This comparison considered the TA-Zs that represent the Stanford campus in each model. Fehr and Peers found that these models do not accurately represent travel characteristics at Stanford.

This result is not surprising because universities tend to be unique land uses in terms of travel characteristics, with an unusual mix of employment-generating land uses, visitor-generating land uses, and onsite housing occupied by workers and students. The travel assumptions for universities and colleges in the forecast models are based on regional or national averages that contain a mixture of urban and suburban campuses. In addition, the models do not reflect the extensive set of TDM programs offered by Stanford and the high level of participation in the TDM programs.

Another factor is that agencies developing regional models do not regularly perform any specific validation for college campuses including mode of travel unless there is an identified need. In the case of the VTA model, there are only two campuses that have been validated based on traffic volumes: San Jose State University (SJSU) and the University of California Berkeley (UCB) campuses. The SJSU campus was reviewed in conjunction with the BART Extension Project since it was a major destination for BART. Similarly, the UCB campus was validated in conjunction with a recent validation for Alameda County³. For the other campuses in the region, including Stanford, college travel is only validated in terms of regional averages on travel generation and non-mode specific county-to-county movements. Therefore, Fehr & Peers determined it would be inaccurate to rely solely on the regional models for calculating VMT for the Stanford campus.

³ Conversation with George Naylor, Transportation Planning Manager, Santa Clara Valley Transportation Authority, April 13, 2017.

For improved accuracy in calculating Stanford-specific VMT, Fehr & Peers utilized trip generation rates directly measured and monitored by Stanford and peer reviewed by Santa Clara County, and it used the same approach that the VTA model uses for calculating trip origins and destinations and trip lengths for home-based work, home-based other, and non-home-based trips. Therefore, the approach provided the best apples-to-apples comparison between the VMT produced by the two models. For example, when calculating the home-based work trip length for Stanford workers, the place of residence data and mode of travel were used. The Stanford specific home to work trips were adjusted to be consistent with the VTA VMT calculation by using the VTA model's assumption regarding the percentage of home-based work trips that travel directly from home to work (73%). Therefore, when Stanford-specific data was available, it was used in the site-specific model including trip rates, travel modes, and trip length. When Stanford-specific data was not available, the assumptions were based on values from the VTA model or California Household Transportation Survey (which is a source used by the VTA). Additional detail on the model assumptions is described in the following sections.

The description below explains the methodologies used to calculate Stanford's worker and resident daily VMT per capita. The VMT estimations were made for four timeframes:

- Fall 2015 Existing Conditions,
- Fall 2018 Conditions prior to Implementation of the 2018 GUP (which does not include occupancy of the new Escondido Village Graduate Residences project),
- Fall 2020 Conditions (which is identical to the Fall 2018 scenario except this scenario also includes occupancy of the new Escondido Village Graduate Residences project), and
- Fall 2035 Conditions with Implementation of the 2018 GUP.

CAMPUS POPULATION

An understanding of the campus population is relevant both to developing an inventory of contributors to worker and resident VMT, and to determining the total numbers of workers and residents to use as the denominators in arriving at daily VMT per capita. The typical weekday population on the Stanford campus is made up of students, faculty, staff, contractors and other onsite workers, visitors, and household members of students, faculty and staff residing on the campus. The worker VMT calculations include students, faculty, staff, contractors and other onsite workers. The resident VMT calculations include students, faculty, staff, and other household members living on campus within the study area.

An inventory of annual visitor VMT is presented in the last section of this report and on the last pages of Appendices A, B and C.

The following population groups were included in the daily VMT per capita calculations for workers and residents.

Workers

- Undergraduate Students – all undergraduate students
- Graduate Students – all graduate students
- Faculty – professoriate faculty members and regular benefits-eligible employees in academic/instructional positions, including Academic Council faculty, Center fellows, Medical Center line faculty, lecturers, acting professors, coaches, some emeriti, and teaching fellows
- Staff – regular benefits-eligible employees in non-academic positions such as human resources, information technology, facilities, financial aid, etc.
- Post- doctoral students (post-docs) – trainees by appointment with doctoral degrees, for the purpose of advanced studies and training under mentorship of a Stanford faculty member, involved in research projects
- Contingent – salaried workers with roles that are comparable to academic staff, working less than 50% FTE and/or working less than six months
- Casual – hourly workers less than 50% FTE and working no more than 980 hours a year, including summer camp staff, summer grounds/facilities work, special projects in academic units
- Temporary workers – hourly workers at 50% FTE or more working no longer than six months, including summer camp staff, summer grounds/facilities work, special projects in academic units
- Other non-employee academic affiliates – affiliated teaching staff, adjunct professors, visiting scholars, typically not full time
- Third party contract workers – food service workers at on-campus cafeterias and childcare center workers
- Janitorial contract workers – working off-peak hour morning and evening shifts
- Construction contract workers – related to ongoing construction projects on campus

Residents

- Faculty / staff – faculty and staff living on campus within the study area
- Graduate students – graduate students (single and married) living on campus within the study area
- Undergraduate students – undergraduate students living on campus within the study area
- Other household members - spouses, children and other household members of graduate students, faculty, and staff living on campus within the study area

Table 3 provides the campus worker populations by group and the associated growth for Fall 2015, Fall 2018, Fall 2020 and Fall 2035. **Table 4** shows the campus resident populations by group and the added housing growth in the study area for each time period.

TABLE 3: WORKER POPULATION GROWTH – FALL 2015, 2018, 2020, & 2035

Population	Fall 2015	Fall 2015 to Fall 2018		Fall 2018 to Fall 2020 ¹		Fall 2018 to Fall 2035	
	Total	Increase	Total	Increase	Total	Increase	Total
Students							
Undergraduate students	6,994	91	7,085	0	7,085	1,700	8,785
Graduate students	9,196	332	9,528	0	9,528	1,200	10,728
<i>Total Students</i>	<i>16,190</i>	<i>423</i>	<i>16,613</i>	<i>0</i>	<i>16,613</i>	<i>2,900</i>	<i>19,513</i>
Stanford Faculty/Staff							
Faculty	2,959	114	3,073	0	3,073	789	3,862
Staff	8,612	373	8,985	0	8,985	2,438	11,423
Post-Doctoral Students	2,264	139	2,403	0	2,403	961	3,364
<i>Total Faculty/Staff</i>	<i>13,835</i>	<i>626</i>	<i>14,461</i>	<i>0</i>	<i>14,461</i>	<i>4,188</i>	<i>18,649</i>
Stanford Other Workers							
Casual	2,080	87	2,167	0	2,167	579	2,746
Contingent	980	41	1,021	0	1,021	273	1,294
Temporary	1,390	58	1,448	0	1,448	387	1,835
Non-Employee Affiliates (including Non-matriculated Students)	2,636	111	2,747	0	2,747	733	3,480
<i>Total Stanford Other Workers</i>	<i>7,086</i>	<i>297</i>	<i>7,383</i>	<i>0</i>	<i>7,383</i>	<i>1,971</i>	<i>9,354</i>
Non-Stanford Workers							
Third Party Contractors	300	24	324	0	324	72	396
Janitorial Shift Contractors	240	19	259	0	259	57	316
Construction Contractors	1,200	0	1,200	0	1,200	0	1,200
<i>Total Non-Stanford Workers</i>	<i>1,740</i>	<i>43</i>	<i>1,783</i>	<i>0</i>	<i>1,783</i>	<i>129</i>	<i>1,912</i>
Grand Total	38,851	1,389	40,240	0	40,240	9,188	49,428

1 – Fall 2018 to Fall 2020 Scenario evaluates the change in VMT with the new Escondido Village Graduate Residences (2020 beds).

Source: Stanford Land Use & Environmental Planning (LUEP) & Fehr & Peers, 2016

TABLE 4: STUDY AREA RESIDENT POPULATION GROWTH – FALL 2015, 2018, 2020, & 2035

Population	Fall 2015		Fall 2015 to Fall 2018			Fall 2018 to Fall 2020			Fall 2018 to Fall 2035		
	Affiliates	Population ¹	Added Housing ²	Affiliates	Population ¹	Added Housing ²	Affiliates	Population ¹	Added Housing ²	Affiliates	Population ¹
Undergraduate Student	6,401	6,401	216	6,617	6,617	0	6,617	6,617	1,700	8,317	8,317
Graduate Student	5,001	6,065	200	5,245	6,285	2,020	7,221	8,507	900 ³	8,183	9,497
Faculty / Staff	38 ⁴	98	0	38	98	0	38	98	550	616	1,539
Postdoctoral Students	28	28	0	28	28	0	28	28	N/A ⁵	N/A	N/A
<i>Total</i>		12,592			13,028			15,250			19,353

Source: Stanford LUEP & Fehr & Peers, 2016

1 Population = Stanford affiliates plus other household members – spouses and children

2 Added Housing = beds for students and dwelling units for faculty and staff

3 The application proposes 3,150 new housing units, 550 of which may be occupied by faculty/staff. For purposes of analysis, this report assumes 900 beds are for graduate students, 1,700 are for undergraduate students, and 550 are for faculty/staff.

4 Thirty-eight faculty live within the study area boundary for this VMT Report. Additional faculty/staff live within other areas of the campus, as described in the first paragraph on page 6.

5 Because post-doctoral students are eligible for rental faculty-staff housing, they are included in the faculty/staff population potentially housed under the 2035 General Use Permit.

Stanford proposes to increase the amount of on campus housing for students and faculty/staff. The change in where students, faculty and staff live is reflected in the VMT calculation methodology for workers and residents. Compared to 2015, by Fall 2018, Stanford will have increased the student housing by up to 416 beds. By Fall 2020, Stanford will add another 2,020 student beds. The addition of these beds will reduce Stanford's off-campus student population, which will reduce worker VMT because moving off campus students to campus eliminates home-based work vehicle trips since on-campus students commute to class by bike or walking. Once the Stanford 2018 General Use Permit is fully implemented, Stanford estimates there would be an additional 1,700 undergraduate beds, 900 graduate beds, and 550 faculty/staff dwelling units. These estimates equate to an assumption that Stanford would house 95% of Stanford's projected undergraduate population and 70% of Stanford's projected graduate student population on campus by 2020 and could maintain these same percentages during the implementation of the Stanford 2018 General Use Permit.

GENERAL METHODOLOGY FOR COUNTING VMT

OPR's January 2016 draft *Technical Advisory on Evaluating Transportation Impacts under CEQA* presents considerations about what types of VMT to count in a CEQA analysis. OPR provides two approaches to measuring VMT associated with residents and workers, and an example to illustrate the differences between the two. In the example, the following hypothetical travel day (all by automobile) is considered:

1. Residence to coffee shop
2. Coffee shop to work
3. Work to sandwich shop
4. Sandwich shop to work
5. Work to residence
6. Residence to store
7. Store to residence

A *trip-based* assessment of a project's effect on travel behavior counts VMT from individual trips to and from the project. It is the most basic, and traditionally most common, method of counting VMT. A trip-based VMT assessment of the residence in the above example would consider segments 1, 5, 6, and 7. For residential projects, the sum of home-based trips is called *home-based* VMT.

A *tour-based* assessment counts the entire home-back-to-home tour that includes the project. A tour-based VMT assessment of the residence in the above example would consider segments 1, 2, 3, 4, and 5 in one tour, and 6 and 7 in a second tour. A tour-based assessment of the workplace would include segments 1, 2, 3, 4, and 5. Together all tours comprise *household* VMT.

Based on the data available to conduct this analysis and the format of the VTA travel model, Fehr and Peers has completed a trip-based assessment for both the worker and resident populations at Stanford. OPR states in its draft Technical Advisory that where a trip-based approach is used for residential and office projects, "home based trips can be the focus for analysis of residential projects; home-based work trips can be the focus of the analysis for office projects."

To perform the analysis, Fehr and Peers relied in part on annual transportation data collected by Stanford. Stanford Parking & Transportation Services (P&TS) conducts an annual transportation survey to evaluate the performance of its TDM programs and preferences of Stanford workers and residents. The annual survey includes all university faculty and staff, undergraduate and graduate students, post-doctoral students, and affiliates of the University. The 2015 transportation survey of University affiliates (students/faculty/staff) had a response rate of 33%. The survey collects a wide range of travel characteristics including key data on mode of travel, time of travel, and frequency - days per week on campus.

The Stanford Transportation Survey is a voluntary survey that has been conducted every year since 2002. The survey is conducted online and is distributed to all campus employees and students. There are several common forms of bias that could occur in a voluntary survey that might not occur in a random survey. For this type of survey, these common forms of bias could include:

- Voluntary Bias – People that choose to "opt-in" to the survey may be over represented by groups that are interested in the survey subject.
- Non-response Bias – The non-responsive population could have different commute behavior that respondents.
- Missed Population Bias – This could include persons that don't have access to computers to fill out the survey.

Stanford has worked to control these potential forms of bias in the following manner:

- Comparison of survey data to the cordon monitoring data.
- Review of transit data including Marguerite and Caltrain ridership and comparison to reported transit mode use.
- Weighting of results based on employee participation in the Commute Assist Club (CAC). CAC participants are given a lower weight and non-CAC employees a higher weight due to the level of responses by these groups. This weighting helps to reduce Voluntary and Non-response bias.
- Coordination with managers to increase the number of responses by employees without access to computers by providing a means to participate in the survey.

Stanford's efforts to control bias combined with the high response rate from workers and students make the annual survey a reasonable source of data for evaluating commute travel by Stanford workers and students.

These surveyed travel characteristics along with data for Santa Clara County from the California Household Travel Survey (CHTS) and the VTA travel demand model were used to calculate the VMT for campus workers and residents.

Worker analysis: Based on available site-specific data, data from the California Household Travel Survey, and assumptions from the VTA model, Fehr and Peers determined the home-based work trips for those Stanford workers who travel directly from their residences to and from their work sites within the study area, including trips from the Stanford campus to other destinations and internal to the Stanford campus during the workday. A calculation of the “first mile travel” from home to transit was also included for Stanford workers and students. Fehr and Peers reduced the home to work trips based on data from the VTA model that indicates 73 percent of the home-based trips in the region are workers who travel directly from home to work without making stops along the way. By applying this same 73 percent assumption, the resulting Stanford-specific home-based work VMT per worker can be compared to the relevant average home-based work VMT per worker in the VTA model using the same trip counting methodology, resulting in an apples-to-apples comparison.

Resident analysis: Fehr and Peers determined the VMT per campus resident based on the sum of all home-based trips, including both home-based trips to and from work (home-based work trips) and home-based trips to and from other destinations (home-based other trips). For household members who are Stanford workers (faculty, staff and students), site-specific assumptions were made regarding the frequency, length, and mode of home-based work trips as described above.

For other home-based work trips by other household members and for home-based other trips for all residents, default assumptions were used from the California Household Travel Survey (CHTS) and the VTA model. The relationship between home-based work and home-based other trips was developed using data from the 2012 CHTS. The trip lengths for home-based work and home-based other trips were derived from the VTA model and checked against the trip lengths in the CHTS. Vehicle trips to be made on the Stanford Campus were estimated to be 1 mile in length.

Figure 2 shows the components of Worker and Resident VMT and the relationship between these two calculations. Worker VMT is focused on trips that start at home and end at work, or start at work and end at home. Trips with an intermediate stop between home and work, such as the grocery store or cleaners, are not included in the calculation of Worker VMT. Resident VMT includes all trips that originate at the home, including trips related to work, shopping, recreation, or school. Many of home-based trips are relatively short, but there is a larger number of trip types included in the Resident VMT as compared to the Worker VMT.

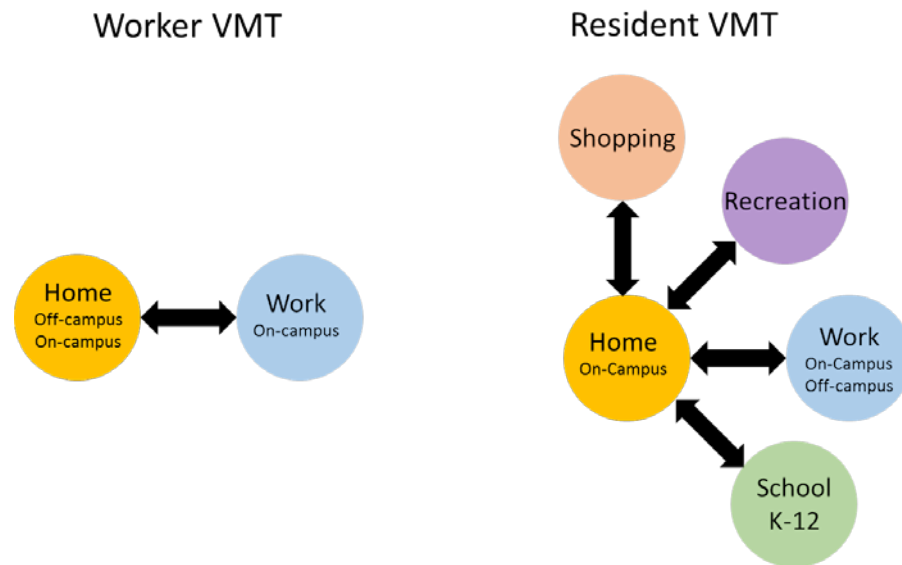


Figure 4: Components of Stanford Worker and Resident VMT

Therefore, Resident VMT on a per capita basis may be larger than Worker VMT per capita. In addition, Stanford Worker daily VMT per worker is very low due to Stanford's aggressive TDM program that provides incentives that reduce the number of drive-alone commuters. Resident daily VMT per capita at Stanford is largely calculated based on average defaults given that little information is available with regard to non-Stanford employee household members' trips and home-based other trips.

The follow sections describe how the daily VMT was calculated for Stanford workers and on-campus residents (student, faculty and staff). **Appendices A, B1, B2, and C** include the work sheets used to calculate the VMT for each of the four timeframes. Each appendix has six pages:

- Daily VMT Summary
- Worker Student VMT (includes daily and annual VMT)
- Residential Daily VMT
- Annual VMT Summary
- Residential Annual VMT
- Other GHG VMT (visitors, vendors, events, and fleet vehicles)

WORKER VMT

This section describes the “Worker Student VMT (Commute 100% HBW)” tab in Appendices A through C. As presented in **Table 1** (page 9), the regional benchmark for average daily commute VMT per worker is based on HBW trips. Therefore, the Worker VMT calculation was based on the worker population on the campus, their place of residence, and their travel behavior (mode choice and vehicle occupancy) on their daily commute. Worker VMT was calculated for all 12 groups of workers, described on pages 15-16, using the same methodology. The first nine worker groups are included in the P&TS annual transportation survey, so their travel behavior was determined from the survey results. For the other three groups – third party contractors, janitorial contractors and construction contractors – their travel behavior and trip length⁴ was determined based on available data for Santa Clara County from the California Household Travel Survey (CHTS) and VTA model.

For each worker group, the following travel factors were developed:

- **Commute Frequency (Column D)** – the number of days per week a worker travels to campus. Utilizing the responses from the transportation survey, a weighted average was calculated based on how often the first nine categories of Stanford workers were on campus. The commute frequency accounts for part-time workers, alternative work schedules, and telecommuting. For third party contractors, janitorial and construction workers, it was conservatively assumed these workers traveled to campus every work day.
- **Commute Mode (Column E)** – percent of commuters traveling by automobile by driving alone or in a carpool or vanpool. Stanford’s surveyed drive-alone rate for employees and students living off-campus is around 50% which substantially reduces the amount of vehicle miles traveled compared to all workers in the county with a drive-alone rate of 77%. Transportation survey data were used to calculate commute mode for the first nine categories of Stanford workers. For third party contractors, janitorial contractors and construction contractors, the auto mode split was assumed to be 87% (drive alone, carpool, and vanpool) based on the US Census Journey to Work data⁵.
- **Vehicle Occupancy (Column F)** – was calculated for each of the first nine Stanford worker categories based on the surveyed number of drive-alone commuters, carpool participants and vanpool participants. For third party contractors, janitorial contractors and construction contractors, the vehicle occupancy was assumed to be 1.07 persons per vehicle (drive alone, carpool, and vanpool) based on the US Census Journey to Work data⁶.

⁴ Fact Finders Journey to Work Data, 2014 – Santa Clara County, California <http://factfinder.census.gov>

⁵ Ibid.

⁶ Ibid.

- **Trip Length (Column H)** – average weighted trip lengths for the first nine Stanford worker categories were calculated based on the worker place of residence and commute modes by auto such as drive-alone, carpool and vanpool. By considering both commute mode and geography, the average vehicle trip length accounts for the high use of Caltrain on the Peninsula and Dumbarton Bridge Express/U-Line bus service in the East Bay by Stanford workers. For third party contractors, janitorial contractors and construction contractors, the trip length was assumed to be the VTA model's average HBW trip length for Santa Clara County. Note that the use of mode choice in the calculation of the average trip length is independent of the Commute Mode in Column E. The Commute Mode is used to calculate the number of vehicle trips that occur on a given day.

Using these factors, the number of daily commute trips and commute VMT for each worker category can be calculated as follows using columns C, D, E, F, and H on the Worker Student VMT tab:

Daily HBW VMT =

((Number of Workers X Frequency X Mode) / Vehicle Occupancy) X 2 trips per day X Trip Length

Daily Person Trips (by auto) = Number of Workers X Frequency X Mode (auto)

Vehicles = Daily Person Trips / Vehicle Occupancy

Daily Vehicle Commute Trips = Vehicles X 2 trips per day

In the VTA model, HBW trips represent 73% of the all trips to the work place. The remaining 27% are trips that have one or more intermediate stops between the work place and home. The Stanford VMT methodology above assumes 100% of the trips are between home and work, so the Stanford VMT must be reduced by 27% for a valid comparison with the VTA benchmark. Another adjustment to the Stanford VMT estimate is to account for absenteeism - vacations and sick days. For the Stanford VMT analysis, absenteeism was assumed to be 10%, which is approximately three weeks of vacation or sick leave per year. The final calculation of the Stanford VMT for worker home-based work trips is shown below:

Stanford HBW VMT =

*Daily Commute VMT * 73% HBW trips * 90% absenteeism factor*

The sum of this calculation represents the total daily VMT for Stanford workers. The total daily commute VMT is divided by the total number of workers to develop the daily commute VMT per worker that is compared to the regional average daily VMT per worker.

RESIDENTIAL VMT

This section describes the "Resident Daily VMT" tab in Appendices A through C. The residential regional average VMT per capita benchmark presented in **Table 1** (page 9) includes all home-based trips. The VTA

model includes two basic trip types for residential units. Home-based Work (HBW), trips between home and work, and Home-based Other (HBO), trips between home and other activities such as shopping, recreation, school, etc. In order to estimate the number of trips for each trip type, it was necessary to establish daily trip generation rates for the three categories of households on the Stanford campus: faculty/staff, graduate students, and undergraduate students.

Fehr & Peers conducted 24-hour vehicle counts at faculty/staff and graduate student housing locations to establish local daily trip generation rates. Undergraduate student trip rates were developed by adjusting the graduate student housing rates for factors such as: no freshmen are allowed to have cars on campus, parking permits sales, and marital status⁷ (single). Once the daily trip generation rates were established for each residential use, these daily trip totals were used to estimate the resident VMT.

The following sections describe how the total daily trips were used to calculate the daily VMT. The methodology was applied to each residential category: faculty/staff, graduate students, and undergraduate students. **Figure 5** shows the process flow of the residential VMT calculations:

- **HBW versus HBO Trips (Columns E – K)** – In the VTA model, HBW trips represent 24% of the total daily trips for Santa Clara County residents (including all cities within the County) and the remaining 76% of the trips are HBO trips. Since the trip generation rates for campus residents were developed from actual counts, these counts would not capture the HBW trip made by alternative modes including walk, bike and transit. Therefore, for Stanford residents, the HBW trips as a percentage of all vehicle trips (counted) would not be the same as for all Santa Clara county residents. In addition, it varies based on the population – faculty/staff, graduate and undergraduate. For faculty/staff housing, the HBW trips would be similar to the county average; however, for graduate student housing the number of HBW trips would be lower since most of the resident graduate students do not travel to off-campus jobs. For couples and married graduate students, their spouses may travel off-campus to jobs. Therefore, the HBW trips for campus residents were adjusted based on the ratios of spouses and other adult members of the households that were assumed to work off campus. For undergraduate students, it was assumed that they were single and all trips are HBO. The resulting HBW percentages for faculty/staff households, graduate student households, and undergraduate students were 24%, 3% and 0%, respectively.

⁷ Undergraduate housing is available only to single students. The small number of married undergraduates who live on campus are required to live in graduate student housing and would be included in that population.

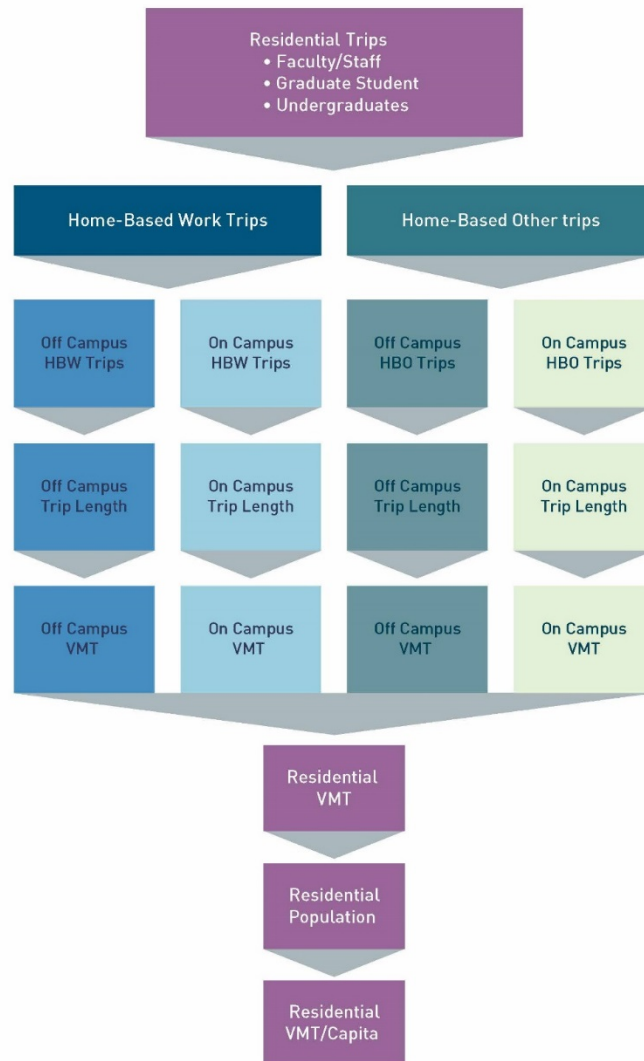


Figure 5: Calculation of Resident Vehicle Miles Traveled (VMT)

- **On- and Off-Campus Trips (Columns J - O)** – Once the numbers of HBW and HBO trips were established, the trips for each trip type were divided into trips made on-campus (internal) and trips made off campus. The annual transportation survey captures information on peak period vehicle travel on- and off-campus by faculty, staff and graduate students. Using the survey data, the following splits were assumed for the campus residents:
 - Faculty/staff 85% off-campus / 15% on-campus
 - Graduate Students 70% off-campus / 30% on-campus
 - Undergraduate Students 50% off-campus / 50% on-campus

- **Off-Campus & On-Campus Trip Length (Columns P–S)** – The P&TS transportation survey does not capture sufficient information to determine trip lengths for spouses of faculty, staff or graduate students who work off-campus. Similarly, the survey is not designed to capture the trip lengths of the home-based other trips made by residents. Therefore, for the HBW off-campus trips of other household members and HBO off-campus trips, the trip lengths from the VTA model were used. For trips on-campus an average trip length of one mile was used since the core campus is approximately two miles wide.

Using these factors, the HBW and HBO VMT for Stanford residents can be calculated for each resident category, by trip type and for on-campus and off-campus travel.

$$HBW \text{ Off-Campus Daily VMT} = \text{Daily Trips} \times HBW \% \times \text{Off-Campus} \% \times HBW \text{ Off-Campus Trip Length}$$

The sum of these calculations represents the total daily VMT for Stanford residents. The total daily VMT is divided by the total number of residents to develop the daily VMT per capita that is compared to the regional average daily VMT per capita. Since the residential trip generation was based on actual counts no adjustment was needed for comparing the Stanford-specific residential VMT to the VTA model outputs.

DAILY VEHICLE TRIP VALIDATION

In addition to the annual transportation survey conducted by P&TS, Santa Clara County performs an ongoing traffic monitoring program at Stanford that was required as a condition of the 2000 GUP. The annual cordon monitoring includes the collection of 24-hour traffic volumes at 16 campus gateways (roadways) and peak period license plate counts. The traffic count data are collected for all five weekdays over eight weeks during the spring and fall by an independent third party for Santa Clara County. The license plate data are collected one day per week during the eight-week period. The license plate data are used to determine the number of trips that pass through the campus in a short period of time (entering and exiting the cordon) and are therefore assumed to not have an origin or destination within the campus. Examples of pass through trips would include patient trips to the medical center, patrons of the shopping center, and drivers using the campus roadways to access locations in the adjoining communities.

To validate the daily vehicle trip estimates for the workers and residents and to determine daily vehicle trip estimates for campus visitors, Fehr & Peers compared the vehicle trips estimated for workers (including students) and residents to the volume of traffic entering and exiting the campus cordon each day. In addition to the trips made by Stanford affiliates, estimates were made for the following other trip types that would access the campus:

- **Known Visitor trips** – visitors that are known to, or tracked by, Stanford such as formal conference attendees, student tours, tour buses, Alumni center visitors, scheduled events, etc.
- **General Visitor trips** – visitors that come to campus for business meetings, academic meetings, social meetings, vendors, etc.

- **Worker Non-Commute trips** – these are trips that Stanford workers make off campus during the work day.
- **Deliveries / Trucks** – these trips include deliveries to the campus and heavy construction trucks/vehicles.
- **Fleet Vehicles**- vehicles that are operated by Stanford including Marguerite buses, maintenance vehicles, car share vehicles and public safety vehicles.

Based on the analysis of the daily cordon volumes documented in *Stanford 2018 GUP Daily Trips – VMT Validation/Calibration and Projections*, Fehr & Peers, March 20, 2017, the breakdown of daily traffic at the cordon is estimated to be as follows:

• Stanford Affiliates (commuters and residents)	56%
• Known Visitors	1%
• General Visitors	24%
• Worker Non-Commute	3%
• Deliveries / Trucks	2%
• Fleet Vehicles	1%
• Pass Thorough	13%

This breakdown of trips assigns 87% of the traffic crossing the cordon to employee and student commuters, residents living on campus, deliveries to the campus (including construction vehicles), and visitors to the Stanford campus. Approximately, two thirds of the daily traffic is related to Stanford affiliates (employees and students) and the remaining one-third are visitors to the campus. Based on engineering judgment, this breakdown in the trips validates that the estimates for employee and resident trips are a reasonable proportion of the total trips traveling across the cordon.

STANFORD VMT TRIP LENGTH

As explained in the preceding sections, estimated trip lengths for the worker and resident categories were calculated using the Stanford annual travel survey and the VTA travel model. The average trip length by worker category was used in the detailed VMT calculations which are documented in **Appendices A – C**.

For third party contractors, janitorial contractors and construction contractors, non-Stanford household members, and home-based other trips, Stanford did not have data for trip length and default trip lengths from the VTA model were used. A comparison between the Santa Clara countywide average trip lengths by trip type from the VTA model and the average trip lengths for the county among respondents to the CHTS generally confirms the reasonableness of the VTA model estimates. The VTA model estimates are about 7 percent higher than CHTS for HBW trips and about 11 percent higher for HBO trips. Therefore, the VTA model estimates were used for this analysis where site-specific data were not available to maintain

consistency between the project-specific analysis and the model-produced benchmark to which it is compared.

FALL 2015 CAMPUS VMT GENERATION

Using the methodology described above, estimates of worker and resident VMT for the conditions existing in Fall 2015 were prepared using the following assumptions. The study area in Fall 2015 included 22,660 faculty, employees, postdoctoral students and contractors and an enrollment of 16,190 undergraduate and graduate students. The worker population was 38,850. Approximately 11,400 undergraduate and graduate students were living on-campus, along with 28 postdoctoral scholars, 38 faculty (within the study area), and 1,124 other household members, resulting in a total resident population within the study area of 12,590 students, faculty, and staff including spouses and family members. Using group-specific trip generation and mode choice rates, typical weekday vehicle trip generation per capita (for residents) and per worker are indicated in **Table 5**. As a sensitivity test, Worker VMT excluding students has been provided. The detailed VMT calculations for Fall 2015 are documented in **Appendix A**.

TABLE 5: FALL 2015 TYPICAL WEEKDAY VMT

Traveler	Trip Purposes	Population	VMT	VMT per Capita
Workers (Including Students)	HBW	38,851	181,196	4.66
Workers (Excluding Students)	HBW	22,661	163,631	7.22
Study Area Residents	HBW + HBO	12,592	116,748	9.24

Source: Fehr & Peers, 2016

FALL 2018 CAMPUS VMT GENERATION

As discussed previously, some growth under the 2000 GUP is anticipated between 2015 and 2018. This growth includes an increase of 966 faculty, employees, postdoctoral students, and contractors, and an increase in enrollment of 423 undergraduate and graduate students. Stanford also plans to add 416 student beds on the campus by 2018. The additional beds will increase the campus residential population by approximately 436 people including spouses. In addition, the University Terrace subdivision located adjacent to the campus will open by Fall 2018. This housing development will add 180 dwelling units for Stanford faculty and staff within easy walking and bicycling distance to the campus, reducing the trip lengths for the 180 Stanford workers living in that housing.

In Fall 2018, the GUP study area will provide jobs for approximately 23,627 on- and off-campus faculty, employees, postdoctoral students and contractors, and have a resident population of approximately 13,030 students, faculty, and staff including spouses and family members. Using the methodology outlined above, the estimated daily VMT per capita for workers and residents is shown in **Table 6**. Similar to the 2015 analysis, Worker VMT excluding students has been provided as a sensitivity analysis. Detailed support for the VMT calculations are provided in **Appendix B1**.

TABLE 6: FALL 2018 TYPICAL WEEKDAY VMT

Traveler	Trip Purposes	Population	VMT	VMT per Capita
Workers (Including Students)	HBW	40,240	186,739	4.64
Workers (Excluding Students)	HBW	23,627	169,326	7.17
Residents	HBW + HBO	13,028	121,192	9.27

Source: Fehr & Peers, 2016

FALL 2020 CAMPUS VMT GENERATION (WITH ESCONDIDO VILLAGE GRADUATE RESIDENCES)

Stanford has received approval to construct a new housing complex in Escondido Village that will add 2,020 beds for graduate students. The housing is expected to be completed and to come online in 2020. This section discusses how the additional on-campus housing will affect the daily VMT per capita for campus residents and workers. This 2020 analysis assumes the same number of workers and students as the 2018 analysis, but shifts 2,020 graduate students from off-campus to on-campus housing. The additional 2,020 beds will increase the campus residential population by approximately 2,222 people including spouses, which will add home-based trips. However, adding these student beds will reduce the number of graduate students currently living off campus and commuting to the campus, which will reduce the student commute VMT.

In Fall 2020, the GUP study area will have a resident population of 15,250 students, faculty, and staff including spouses and family members. Using the methodology outlined above, the estimated daily VMT per capita for workers and residents is shown in **Table 7**. Similar to the 2015 analysis, Worker VMT excluding students has been provided as a sensitivity analysis. Detailed support for the VMT calculations are provided in **Appendix B2**.

TABLE 7: FALL 2020 TYPICAL WEEKDAY VMT

Traveler	Trip Purposes	Population	VMT	VMT per Capita
Workers (Including Students)	HBW	40,240	179,362	4.46
Workers (Excluding Students)	HBW	23,627	169,326	7.17
Residents	HBW + HBO	15,250	154,296	10.09

2018 GUP VMT IMPACT EVALUATION

FALL 2035 CAMPUS VMT GENERATION

Between 2018 and 2035, the campus is anticipated to add approximately 6,290 faculty, employees, postdoctoral students and contractors and increase enrollment by 2,900 undergraduate and graduate students. The campus resident population within the study area would increase by approximately 4,105 persons including spouses and families. In 2035, the GUP study area would include 29,915 faculty, employees, postdoctoral students and contractors and an enrollment of 19,515 undergraduate and graduate students. The worker population including faculty, employees, postdoctoral students, contractors and undergraduate and graduate students would be 49,430.

The estimate of Fall 2035 travel is based on group-specific trip generation and mode choice rates as described above. Trip lengths for the 2035 calculations were adjusted from the 2015 levels based on the projected changes in the 2040 VTA travel model, taking into account the regional forecasts of growth patterns and future distribution of Bay Area housing and jobs and improvements and transportation system and services and their effects on travel mode choice. The 2035 trip lengths were increased by 2% to 3% based on a review of the future trip lengths from the VTA 2040 model. The detailed calculations are documented in **Appendix C**. The resulting Fall 2035 daily VMT per capita for campus workers and residents is indicated in the **Table 8**. Similar to the previous scenarios, Worker VMT excluding students has been provided as a sensitivity analysis.

TABLE 8: FALL 2035 TYPICAL WEEKDAY VMT

Traveler	Trip Purposes	Population	VMT	VMT per Capita*
Workers (Including Students)	HBW	49,428	223,842	4.53
Workers (Excluding Students)	HBW	29,915	212,555	7.11
Residents	HBW + HBO	19,353	207,986	10.75

* - Worker HBW trips were adjusted by +2% and Resident HB trips were adjusted by +3% to reflect changes in trip length derived from the VTA model.

Source: Fehr & Peers, 2016

Resident daily VMT per capita is expected to increase from Fall 2018 to Fall 2035 because the ratio of graduate student housing to undergraduate student housing will change. Prior to the Escondido Village Graduate Residences project, Stanford housed approximately 55 percent of its graduate students on the campus. With the Escondido Village Graduate Residences, Stanford will house approximately 70 percent of its graduate students on campus. Graduate students have a higher daily VMT per capita than undergraduate students. Some spouses of graduate students are assumed to generate home-based work trips off-campus and both the graduate students and spouses generate more home-based-other trips than undergraduate students. Further, by Fall 2035, Stanford is proposing to add up to 550 new housing units occupied by faculty/staff.

Worker and residential daily VMT per capita generated by the project in 2035 and the VMT Thresholds of Significance are shown in **Table 9**. The 2018 GUP home-based work VMT per worker, and home-based VMT per resident are well below the significance thresholds, allowing a determination of less-than-significant impacts for the project.

TABLE 9: FALL 2035 WITH PROJECT VMT COMPARED TO SIGNIFICANCE THRESHOLDS

Traveler	Trip Purposes	Fall 2035 VMT per Capita	Significance Threshold VMT per Capita (85% of Regional Average)	Finding
Workers	HBW	4.53	13.75	Less than Significant
Residents	HBW + HBO	10.75	14.73	Less than Significant

Source: Fehr & Peers, 2016

VMT COMPARISON AND CONCLUSIONS

EVALUATION CONCLUSIONS

Table 10 shows that Stanford's daily VMT generation per worker is substantially lower than the regional average. Primary reasons that Stanford's VMT generation is so low compared to the regional average are: an aggressive and successful TDM program, and the provision of on campus housing for faculty and students.

TABLE 10: STANFORD WORKER VMT 2015, 2018, 2020 & 2035

Year / Traveler	Trip Purpose	Population	VMT	VMT per Capita	Threshold of Significance (85% of Regional Average)
2015					
Workers	HBW	38,851	181,196	4.66	13.75
2018					
Workers	HBW	40,240	186,739	4.64	13.75
2020					
Workers	HBW	40,420	179,362	4.46	13.75
2035					
Workers	HBW	49,428	223,842	4.53	13.75

Source: Fehr & Peers, 2016

Table 10 shows that Stanford's daily VMT generation per capita for residents is substantially lower than the regional average. The primary reason that Stanford's VMT generation per capita is so low compared to the regional average is that Stanford campus residents can commute to work or class without using personal vehicles.

COMPARISON OF CHANGES

Fall 2015 and Fall 2018 Conditions

Table 11 shows that between Fall 2015 and Fall 2018 daily VMT per worker will be reduced. The reasons for the reduction in the daily VMT per worker are that the University Terrace housing development, located in Palo Alto adjacent to the campus, will add 180 faculty housing units. Due to the proximity to campus, a substantial portion of these workers will choose to use alternative modes of travel (bike, walk, or use Marguerite) to campus. For those that do choose to drive to campus their average trip length would be

reduced from over 11 miles to less than 2 miles. During this same time period Stanford plans to add 416 student beds to the campus, while increasing enrollment by only 423 undergraduate and graduate students.

TABLE 11: STANFORD RESIDENT VMT 2015, 2018, 2020, & 2035

Traveler	Trip Purpose	Population	VMT	VMT per Capita	Threshold of Significance (85% of Regional Average)
2015					
Residents	HBW + HBO	12,592	116,748	9.24	14.73
2018					
Residents	HBW + HBO	13,028	121,192	9.27	14.73
2020					
Residents	HBW + HBO	15,250	154,296	10.08	14.73
2035					
Residents	HBW + HBO	19,353	207,986	10.75	14.73

Source: Fehr & Peers, 2016

Table 11 shows that daily VMT per capita for residents will increase slightly between Fall 2015 and 2018, but will remain at a level that is well below regional averages. Stanford will have added a similar number of undergraduate student beds (216) and graduate student beds (200). The increase in resident daily VMT per capita is due to the fact that graduate student housing generates higher VMT per capita than undergraduate student housing.

Fall 2018 and Fall 2020 Conditions

Table 10 shows that between Fall 2018 and Fall 2020 daily VMT per worker will be reduced. The reason for the reduction in the daily VMT per worker is the addition of 2,020 new graduate student beds in Escondido Village. The new housing reduces the number of students commuting to the campus.

Table 11 shows that daily VMT per resident will increase between Fall 2018 and 2020, but remains at a level that is well below regional averages. The increase in resident daily VMT per capita is due to the fact that the Escondido Village Graduate Student Residences project will add a large number of graduate student beds, which will increase the ratio of graduate student to undergraduate beds on the campus. Because graduate student housing generates higher VMT per capita than undergraduate student housing, this proportionate shift will slightly increase daily VMT per capita for campus residents.

Fall 2018 and Fall 2035 Conditions

Table 10 shows that between Fall 2018 and Fall 2035 daily VMT per worker will increase primarily due to the projected increase in trip length for the Bay Area. The amount of the increase in daily VMT per worker is reduced by adding 550 faculty housing units on the campus. Since these units would be in the core area of the campus, these workers would choose to use alternative modes of travel including bicycling, walking, or the riding the Marguerite.

Daily VMT per capita for campus residents would increase between Fall 2018 and Fall 2035, but would remain at a level that is well below regional averages. During this time period Stanford would construct up to 550 faculty/staff units. These new faculty and staff would generate additional home-based trips at a per capita rate that is higher than the addition of student housing units.

STANFORD'S TRAVEL DEMAND MANAGEMENT PROGRAM

The success of Stanford University's acclaimed Travel Demand Management (TDM) program is monitored by annual cordon counts, Stanford can add or remove TDM activities based on their success and cost effectiveness in reducing trips. This flexibility in the program operation has been a key to making the most cost effective program feasible and effective.

The key strategies in Stanford's TDM program include:

- Direct incentives to commuters who choose alternative modes
- Parking permits and meters at all campus parking structures or lots
- Fare-free shuttles (last-mile to Caltrain and campus circulator shuttles)
- Subsidized carpools and vanpools with expanded rideshare matching
- Subsidized transit passes (Go-Pass and Eco-Pass)
- Extensive promotional campaigns offering cash rewards and prizes
- A commute buddy program and individualized commute planning services
- Subsidized car share memberships
- Bicycle infrastructure and end-of-trip facilities

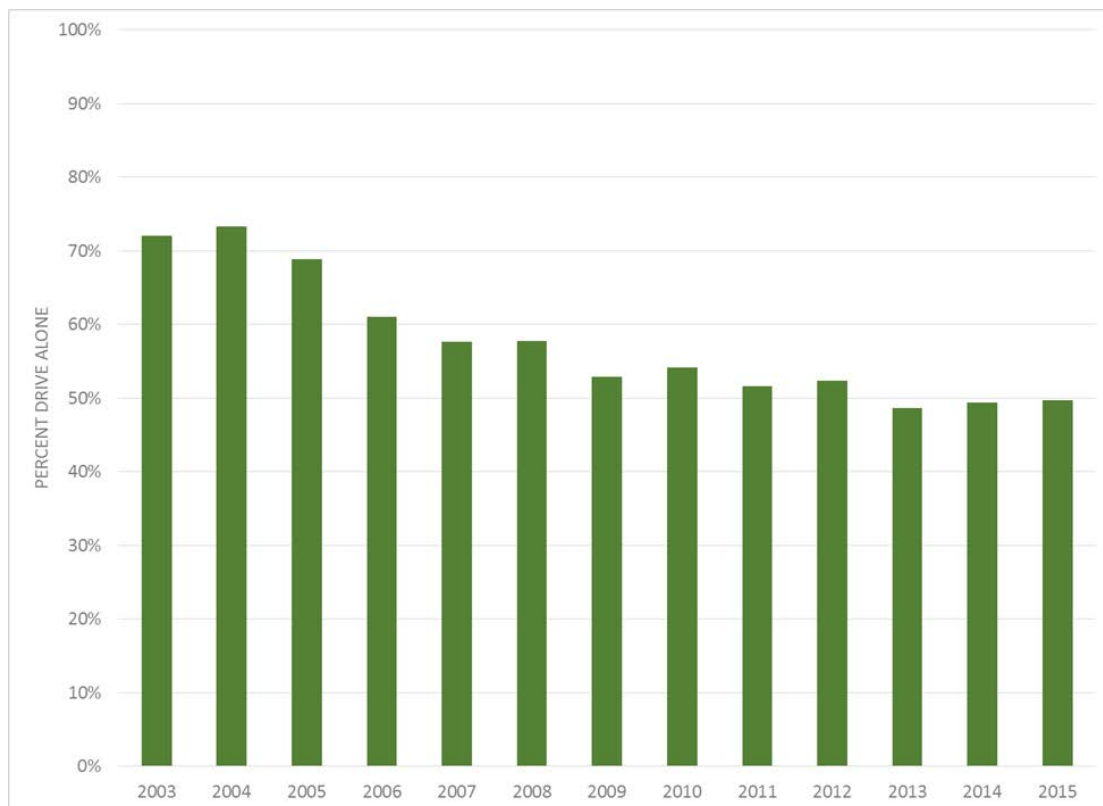
Stanford currently provides free Caltrain Go-passes and VTA Eco-passes to their employees that live outside the Stanford zip codes. Stanford also provides the Marguerite shuttles that provide last mile connections to Caltrain and internal mobility within the campus. **Figure 6** shows the coverage of the Marguerite service on the campus. In addition to the free transit passes available to all employees, campus employees can participate in the Commute Club where they receive a monetary incentive (Clean Air Cash) if they don't drive alone to campus. Anyone driving a vehicle to the campus must pay for parking. Stanford Parking &

Figure 6: Marguerite Transit Service

Transportation Services administers the TDM program including the Commute Club that provides information, management, and incentives for commuters (employees and students) living off campus who commit to not driving alone.

In 2003, the drive alone rate for Stanford commuters (workers and off campus students) was 72%. As the TDM program has expanded the drive alone rate of Stanford commuters has decreased to around 50%. **Figure 7** shows how the commuter drive-alone rate has decreased between 2003 and 2015. This decrease in solo drivers directly reduces the number of vehicle trips to the campus and vehicles miles traveled. At the simplest level, a two-person carpool reduces the VMT generated by the users by almost half. For riders of the east bay shuttle service, each Dumbarton Express or U-Line coach carries between 30 to 40 passengers in a single trip. For Caltrain riders, each peak period train can carry hundreds of passengers.

Based on the success of the TDM program in getting more people into fewer vehicles, Stanford's VMT per worker would be expected to be substantially below County or regional averages.



Source: Stanford Parking & Transportation Services, 2015

Figure 7: Historical Mode Share

2018 GUP CONSISTENCY WITH SUSTAINABLE COMMUNITIES STRATEGY

For a land use project such as the 2018 General Use Permit, the draft OPR Technical Advisory recommends determining whether the project would result in development outside of areas contemplated for development in a Sustainable Communities Strategy (SCS). OPR explains that developing a location where the Regional Transportation Plan (RTP) and SCS do not specify any development may indicate a significant impact on transportation.

The draft OPR Technical Advisory recommends an additional analysis for the adoption of land use plans such as General Plans, Area Plans, and Community Plans. Stanford proposes only minor amendments to the Stanford Community Plan; the proposed 2018 General Use Permit does not include adoption of a new land use plan. Nevertheless, the additional considerations for land use plans are presented here. The OPR draft Technical Advisory states that for the purpose of determining whether a land use plan is consistent with the SCS, all of the following must be true:

- Development specified in the plan is also specified in the SCS (*i.e.*, the plan does not specify development in outlying areas specified as open space in the SCS)
- Taken as a whole, development specified in the plan leads to VMT that is equal to or less than the daily VMT per capita and daily VMT per employee specified in the SCS

Fehr & Peers reviewed the land use data for TAZs 347, 350, 352, 353, 354, and 355 from the MTC model for 2015 and 2040. These TAZs include the Stanford lands within the 2018 GUP planning area. The MTC land use data shows 2040 growth projections under the RTP and SCS increase in both residents (14%) and jobs (28%) for the 2018 GUP transportation analysis zones (TAZ). Therefore, the proposed 2018 GUP is consistent with the SCS in terms of proposing additional land use in locations where the SCS contemplates development. The analysis presented in the preceding sections of this report also indicates that the proposed 2018 GUP would generate less than 85% of the VMT per resident and VMT per worker compared to the existing regional averages.

As **Table 12** demonstrates, the proposed 2018 GUP is also consistent with the regional goals and targets expressed in the *Plan Bay Area Sustainable Communities Strategy*.

TABLE 12: 2018 GUP CONSISTENCY WITH SCS GOALS & TARGETS

SCS Goals and Targets	Stanford 2018 GUP
Reduce GHG by 15% per capita	Through its transportation services, travel demand management programs, on-campus housing and low-carbon fleets, Stanford will continue to keep its vehicle miles per capita and resulting emissions at levels that achieve or exceed the regional goals. Daily VMT per capita will be lower than 15% below the regional average
Improve air quality and reduce exposure	
Reduce VMT per capita by 10%	
Direct growth to occur within established urban growth boundaries protecting open space and ag land	The 2018 GUP development areas are within SCS transportation analysis zones designated for population and employment growth within the <i>Plan Bay Area</i> Regional Transportation Plan and SCS.

Source: *Plan Bay Area Sustainable Communities Strategy*, <http://planbayarea.org/plan-bay-area/goals-targets.html>

ANNUAL VMT CALCULATIONS

The air quality and greenhouse gas analyses prepared for the 2018 General Use Permit utilize annual vehicle trips and vehicle miles traveled. The following section describes how the annual VMT for the campus was calculated. The annual VMT calculations includes three basic components: worker-student commute trips, resident trips, and visitor trips. The annual trips and VMT for commuter and resident trips were derived from the daily trips, which were calculated based on the methodology described previously. Estimates for annual visitor trips were developed separately through a collaboration between Fehr & Peers and Ramboll Environ. The methodologies for all three components of annual vehicle trips and VMT are described below.

WORKER ANNUAL VMT

The annual VMT for workers, including students, is calculated on the “Worker Student VMT” tab (page 2) in the appendices (**Appendices A, B1, B2, and C**) for each of the four timeframes. Annual vehicle trips and VMT is calculated for worker and student commuters by multiplying the daily vehicle trips and daily VMT by the number of days that workers or student travel to campus each year. Stanford Parking & Transportation Services (P&TS) provided information on the number of work or class days per year for Stanford employees (including faculty, staff, postdoctoral students, and other worker categories), graduate students, and undergraduate students. These annual factors account for typical travel patterns such as: employee vacations, holidays, number of weekdays graduate students are on campus, and number of weekdays undergraduate students are campus.

Based on the information provided by P&TS, the following annual factors were applied to the three commuter groups:

- Employees 222 days per year
- Graduate Students 208 days per year
- Undergraduate Students 150 days per year
- Contractors 222 days per year

In the appendices, the Worker Student Tab (page 2) columns L, M, N, and O shows the results of the annual vehicle trips, annual VMT and annual VMT per capita for each of the worker categories.

RESIDENT ANNUAL VMT

Resident annual VMT includes both weekday and weekend travel. Resident travel also includes both work trips and non-work trips such as shopping, recreation, school (K-12), etc. The calculation of annual trips and VMT is based on the daily calculations described above and documented on the Residential Daily VMT tab in the appendices. The annual VMT calculations are shown on the Residential Annual VMT tab (page 5) of the appendices. The weekday residential trips were transferred from the Residential Daily VMT tab and factored up to represent annual trips. The weekend trips were then added to the weekday trips. A description of the process is provided below.

Annual Weekday VMT

The residential weekday daily VMT was factored by the number of week days per year that faculty/staff, graduate students or undergraduate students are on campus. For faculty/staff the number of weekdays was assumed to be 251 days. This was calculated by subtracting 104 weekend days and 10 holidays from 365 days per year. This factor is higher than used for off-campus commuters, which are assumed to not travel to campus when on vacation, etc.

For graduate students, it was assumed that they are on campus a total of 322 days per year with some time off campus during school breaks. This number accounts for the fact that many graduate students work on research and reside on campus for a greater portion of the year as compared to undergraduate students. For undergraduate students, they were assumed to be on-campus a total of 210 days per year. Most undergraduate students leave the campus during the summer break, when there are numerous activities such as summer campus, executive training programs and special classes on campus. The trips and VMT associated with these summer activities are accounted for in the visitor trips described later in this section.

These annual, weekday vehicle trip and VMT calculations are shown in columns E, F, G, H, I and J on the Resident Annual VMT tab (page 5) of the appendices.

Annual Weekend VMT

Weekend vehicle trips and VMT were calculated by factoring weekday trips based on the relation between weekday and weekend travel. The relationship between these trips was developed based on information provided in the Institute of Transportation Engineers Trip (ITE) Generation Manual, 9th Edition. The ITE trip generation manual includes residential trip generation rates for weekday, Saturday and Sunday travel. Based on the trip rates for single family and multi-family residential uses, the following weekday to weekend factors were calculated based on the relationships between average daily trip rates for weekday, Saturday and Sunday:

- Weekday trips 100%
- Saturday trips 105% for faculty/staff housing (single family rates)
109% for graduate/undergraduate student housing (multi-family rates)
- Sunday trips 92% all housing

Based on these relationships, the 2-day average of weekend traffic is 100% of an average an weekday. Therefore, the number of daily trips on weekends and holidays were considered to be the same as on a typical weekday. Since most Stanford residents work a normal Monday through Friday work week, all weekend trips were conservatively assumed to be home-based other (HBO) trips. Weekend average trip lengths were calculated using data from the California Household Transportation Survey, 2012. Based on the CHTS data, the average weekend trip length for Santa Clara County HBO trips was 7.80 miles. The CHTS data shows that for HBW trips the average length is 5.1 miles, since the longer commute trips do not occur on weekends. For trips internal to the campus, an average trip length of 1.0 miles was used based on the size of the overall campus. Using these assumptions, the annual VMT for weekends and holidays is shown in the Resident Annual VMT tab (Page 5) in columns M, N, O, P, Q, R and S.

Total Annual VMT

Columns T and U on the Residential Annual VMT tab in the appendices present the total annual VMT which combines vehicle trips and VMT for weekdays and weekends/holidays.

VISITOR ANNUAL VMT

To calculate annual VMT from campus visitors, Ramboll Environ coordinated with various Stanford departments and services organizations including the Athletic Department, Event Services, Parking & Transportation Services, Public Safety and Building, Grounds and Maintenance. Through this process they compiled data on a range of visitor trips accessing the campus and an accounting of fleet vehicle activity on the campus. This information was compiled and is presented in the Other GHG Inputs tab (page 6) in the appendices. These Other GHG Inputs were generally broken down into four categories: events (single day), non-events (daily), fleet vehicles and other trips. The types of trips considered in each category are listed below:

Events – one day or limited time period (red shading)

- Athletics – football, basketball, baseball, tennis, swimming, etc.
- Stanford Live Performances – Bing Center, Frost Amphitheater, Memorial Auditorium, etc.
- Big 5 Events – graduation, homecoming, etc.
- Camps – Sports (Department of Athletics Physical Education, and Recreation - DAPER)
- Camps – Academic
- Executive Education

Non-Events - daily (green shading)

- Alumni Center
- Hosted Conferences – meeting hosted by Stanford Event Services
- Walking Tours – student campus tours and hosted tour groups
- Tour Buses – unscheduled sightseeing tour groups

Fleet Vehicles - daily (purple shading)

- Marguerite Transit Services
- Peninsula Sanitary Service Incorporate (PSSI)
- Bonair Vehicle Fleet – Buildings, Grounds and Maintenance, and Event Services
- Public Safety

Other Visitor Trips – daily (gold shading)

- Vendors, Business or Academic Meetings (not schedule through Event Services)
- Employee non-commute trips – personal business
- Deliveries and large trucks (such as food services or construction)

For each of these trip types in the first three categories (event, non-event and fleet), estimates were prepared in terms of the number of vehicle trips, mode usage, vehicle occupancy, frequency of trips (length of event), and trip length. These assumptions are documented on the Other GHG Inputs tab (page 6) of the appendices in columns B, C, D, E, and G. The total vehicle trips and VMT for Fall 2015 were calculated as annual totals for the campus.

For the Other Visitor Trips, trip estimates were derived from the calibration of the Daily VMT model to the annual monitoring cordon counts as described in the memorandum *Stanford 2018 GUP Daily Trips – VMT Validation/Calibration and Projections*, Fehr & Peers, March 20, 2017. The memorandum describes how these trips, made by vendors, business or academic visitors, employees that leave and return to the campus during the work day, and delivery/construction vehicles, were accounted for at the monitoring Cordon.

Growth Projections

The projected growth for “Other Trips” were developed based on a case-by-case assessment of the potential for growth in individual activities. Some input was provided by the organizations that provided the 2015 data.

For athletic and cultural (performances) events, no growth was anticipated for the 2018 Stanford General Use Permit because these programs and their venues already exist on the campus and are not expected to expand. However, other activities, such as academic and business meetings, were projected to grow in proportion to the increase in academic and academic support space. For these activities, the growth would be 8% from Fall 2015 to Fall 2018 and 22% from Fall 2018 to Fall 2035. A third group of activities, such as executive education, academic camps, and sports campus were assumed to increase based on the growth in the workforce that would provide these programs. For these activities, the growth would be 3% from Fall 2015 to Fall 2018 and 26% from Fall 2018 to Fall 2035. Change in fleet vehicle travel was estimated based on input from the Stanford organizations that provided the 2015 data.

The growth factor used for each trip type is shown in the Other GHG Input tab (page 6) in the appendices in columns I and K for growth by Fall 2018 and Fall 2035, respectively.

TOTAL ANNUAL VMT

The total annual trips and VMT are summarized in the Annual VMT tab (page 4) in the appendices and are summarized below in **Table 13**. The total annual VMT combines the totals for each type of trip including worker/student commuters, residents, and visitors. Please note that VMT associated with campus residents who also are campus workers/students appears both in the Worker VMT tables and in Resident VMT tables. VMT associated with home-based-work vehicle trips by campus residents who are campus workers is only counted once in arriving at the total annual VMT for the campus.

**TABLE 13: ANNUAL VEHICLE MILES TRAVELLED (VMT)
BY SCENARIO AND TRIP TYPE**

Year	Worker Student (Commute)	Resident	Visitor & Other	Total
Fall 2015	60,653,583	35,955,561	46,606,107	143,215,251
Fall 2018	62,571,641	37,338,845	49,045,018	148,955,504
Fall 2020	60,236,063	48,689,895	49,045,018	157,970,976
Fall 2035	73,760,888	64,722,587	57,036,169	195,519,644

Source: Fehr & Peers, 2017

APPENDIX A: FALL 2015 EXISTING VMT CALCULATIONS

STANFORD FALL 2015 EXISTING CONDITIONS
DAILY VMT SUMMARY

Category	Workers			Students		Residents All Ages	Source Tab
Workers	People	VMT		People	VMT	People	VMT
Worker Commute - all employee types including all resident F/S	● 22,661	249,058					Worker Student - D28 & J28
Student Commute to Campus (live off campus)	● 4,788	26,735	● 4,788	26,735			Worker Student - D30+D33, & J35
Resident Students - Grad / Undergrad	● 11,402	0	● 11,402	0			Worker Student - D36+D37, & J38
Residents							
Commute Trips - Off Campus						(HBW)	
Faculty / Staff (including other household members)						● 98	392 Resident Daily - C8 & T8+U8
Graduate Students (including other household members)						● 6,065	5,038 Resident Daily - C9 & T9+U9
Undergrad Students						● 6,401	0 Resident Daily - C10 & T10+U10
Post Doctoral						● 28	0 Resident Daily - C11 & T11+U11
Home-based Other						(HBO)	
Faculty / Staff (including other household members)						● Same	1,264 Resident Daily - V8 + W8
Graduate Students (including other household members)						● as	75,322 Resident Daily - V9 + W9
Undergrad Students						● above	34,299 Resident Daily - V10 + W10
Post Doctoral Students						●	434 Resident Daily - V11 + W11
Totals	●	38,851	275,793	●	16,190	26,735	● 12,592 116,748
VMT / Person - Workers including Students	Absentee	HBW	VMT*	VMT**		VMT**	
Adjustments for comparison to model HBW VMT	90%	73%	181,196				
			4.66	1.65		9.24	
Threshold - 85% of the VTA Model Regional VMT			13.75			14.73	
VMT / Person - Workers Excluding Students	Absentee	HBW	VMT*				
Adjustments for comparison to model HBW VMT	90%	73%	163,631				
			7.22				

* For the comparison to the VTA model threshold, the manual calculation is reduced to reflect that HBW trips are only 73% of trips at the work place and by 10% for daily absenteeism.

** No adjustments required for Student or Resident VMT since the calculated and model results are directly comparable.

STANFORD FALL 2015 EXISTING CONDITIONS
WORKER STUDENT VMT (COMMUTER 100% HBW)

Col >	B	C	D	E	F	G	H	I	J	K	L	M	N	O
Row	Workers	Workers / Students	Commute Population	Commute Frequency	Vehicle Mode Split	Vehicle Occup	Daily				Days per Year	Annual		
							Total Daily Vehicle Trips	Home - Work Trip Length	VMT	VMT / Capita		VT	VMT	VMT / Capita
6	Benefit Eligible Employees													
7	Off Campus - Faculty	2,022	2,022	92%	58%	1.14	1,880	12.47	23,441	11.59	222	417,315	5,203,917	2,574
8	Off-Campus - Staff	8,612	8,612	92%	58%	1.14	8,006	12.47	99,839	11.59	222	1,777,407	22,164,261	2,574
9	On Campus - Faculty/Staff in Faculty Subdivision*	899	899	92%	58%	1.00	959	2.00	1,919	2.13	222	212,990	425,979	474
10	On Campus - Faculty/Staff within GUP Study Area	38	38	92%	58%	1.00	41	1.00	41	1.07	222	9,003	9,003	237
11	Post-Docs													
12	Off-Campus	2,236	2,236	96%	31%	1.18	1,110	9.48	10,522	4.71	222	246,412	2,335,983	1,045
13	On-Campus	28	28	96%	0%	1.00	0	1.00	0	0.00	222	0	0	0
14	Casual	2,080	2,080	20%	80%	1.10	603	13.39	8,080	3.88	222	133,960	1,793,719	862
15	Contingent	980	980	52%	63%	1.09	587	12.25	7,193	7.34	222	130,354	1,596,836	1,629
16	Temporary	1,390	1,390	78%	65%	1.16	1,208	12.76	15,413	11.09	222	268,165	3,421,786	2,462
17	Non-Employee Affiliates													
18	Non-Employee Affiliates: 20% FTEs	1,259	1,259	17%	83%	1.05	338	11.88	4,020	3.19	222	75,118	892,407	709
19	Non-Employee Affiliates: FTEs	1,377	1,377	85%	83%	1.05	1,850	11.88	21,983	15.96	222	410,795	4,880,239	3,544
20	Subtotal Workers (Stanford Employees)	20,921	20,921				16,583	11.61	192,451	9.20	222	3,681,517	42,724,130	2,042
21	Third Party Contractors	300	300	100%	87%	1.07	487	14.21	6,924	23.08	222	108,178	1,537,214	5,124
22	Janitorial Shift Workers	240	240	100%	87%	1.07	390	14.21	5,540	23.08	222	86,543	1,229,771	5,124
23	Construction	1,200	1,200	100%	87%	1.07	1,949	14.21	27,698	23.08	222	432,713	6,148,856	5,124
24	Subtotal Workers (Contract Workers)	1,740	1,740				2,826	14.21	40,161	23.08	na	627,434	8,915,841	5,124
25	First Mile to Transit All Workers (Carpool)			94%	1%	2.00	259	5.02	1,300	0.06	222	57,508	288,692	13
26	First Mile to Transit All Workers (Drive-Alone)			91%	9%	1.00	3,712	4.08	15,145	0.67	222	824,060	3,362,164	148
27	First Mile to Transit (all workers)						3,971	4.14	16,445	0.73	na	881,568	3,650,856	161
28	Total Workers (excluding students)	22,661	22,661				23,381	10.65	249,058	10.99	na	5,190,520	55,290,826	2,440
29	Students													
30	Off Campus - Graduate (Drive Alone/Rideshare)	4,195	4,195	82%	41%	1.12	2,519	9.15	23,046	5.49	208	523,894	4,793,631	1,143
31	First Mile to Transit (Carpool)			100%	0.4%	2.00	18	2.42	43	0.01	208	3,691	8,932	2
32	First Mile to Transit (Drive-Alone)			92%	1%	1.00	90	2.56	230	0.05	208	18,675	47,809	11
33	Off Campus - Undergraduate	593	593	89%	50%	1.12	469	7.29	3,416	5.76	150	70,286	512,385	864
34	Non-Matriculated (trips in visitor trips)	918	0	0%	0%	1.00	0	0.00	0	0.00	208	0	0	0
35	Subtotal Student Non-resident	5,706	4,788				3,095	8.64	26,735	5.58	na	616,546	5,362,757	1,120
36	Resident - Graduate	5,001	5,001	100%	0%	1.00	0	1.00	0	0.00	208	0	0	0
37	Resident -Uundergraduate	6,401	6,401	100%	0%	1.00	0	1.00	0	0.00	150	0	0	0
38	Subtotal Student Residents	11,402	11,402				0	1.00	0	0.00	na	0	0	0
39	Total Stanford Students	17,108	16,190				3,095		26,735	1.65	na	616,546	5,362,757	331
40	Total Wokers (including Students)	39,769	38,851				26,476		275,793	7.10	na	5,807,066	60,653,583	1,561

* The Faculty Subdivision is housing areas adjacent to the campus, outside the GUP study area. The area is bounded by Junipero Serra Blvd, Page Mill Road, Bowdoin Avenue, and Mayfield Road

- Column CWorkers & Students provided by Stanford Land Use Environmental Planning (LUEP) / Institutional Research & Decision Support (IRDS)
- Column DPopulation equals workers or student except for Non-Matriculating Students whose trips are treated as visitors. Residential tables add family members.
- Column EP&TS Annual Survey (2015) commute frequency adjustment for how often workers come to campus
- Column FP&TS Annual Survey (2015) vehicle mode split including drive alone, carpool, and vanpool
- Column GFor non Stanford workers (third party, janitorial and construction) mode split from Census Fact Finder 2014 Journey to Work data Santa Clara County workers
- Column H
- Column IP&TS Annual Survey (2015) vehicle occupancy drive alone = 1, carpool = 2 and vanpool = 5
- Column HCalculation = Population * Commute Freqenct * Vehicle Mode Split / Vehicle Occupancy * 2
- Column I
- Column IAverage one-way trip length ror campus workers and off campus students, calculated by P&TS from place of residence and survey mode choice data
- Column JFor non Stanford workers (third party, janitorial and construction) HBW trip length from the Santa Clara Valley Transportation Authority (VTA) 2015 model checked against California Household Transportation Survey (CHTS) 2012 for Santa Clara County workers
- Column JCalculation = Daily Vehicle Trips x Trip Length
- Column K
- Column KCalculation total VMT / total population
- Column L
- Column LWork day estimated by P&TS adjusting for weekends, holidays and standard PTO for Stanford
- Columns M, N, & O
- Columns M, N, & OStudents estiamted by P&TS based on academic schedule for Grad and Undergrads
- Columns M, N, & OCalculations daily VT & VMT times number of days per year and VMT divided by population

Journey to work, FactFinders, 2014	Mode	%
	Drive Alone	76.5%
	2-person	8.2%
	3-person	1.4%
	4+ person	0.8%
	Total	86.9%
	Persns/Veh	1.07

http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk

STANFORD FALL 2015 EXISTING CONDITIONS
RESIDENTIAL DAILY VMT

B																										C		D		E		F		G		H		I		J		K		L		M		N		O		P		Q		R		S		T		U		V		W		X		Y		Z	
Resident Type		Stanford Affiliates Units/Affili ates	Population	Daily Trips (weekday)	Palo Alto Distribution		Stanford Workforce HBW Adjustment	Stanford Adjusted		HBO		Vehicle Trips				Trip Length (miles)				Total Daily VMT (Weekday)																																																					
					HBW	HBO		HBW	HBW	HBO	External	Internal	HBW	HBO	HBW	HBO	HBW	HBO	HBW	HBO	HBW	HBO	HBW	HBO	HBW	HBO	Total	VMT / capita	Average Trip Len																																												
					%	%		%	%	%	%	%	%	External	Internal	External	Internal	External	Internal	External	Internal	External	Internal	External	Internal	External	Internal																																														
Existing					Used for Calculating Columns H & I																																																																				
Faculty / Staff		38	98	300	24%	76%	100%	24%	76%	85%	15%	31	41	194	34	11.17	1.0	6.34	1.0	351	41	1,230	34	1,656	16.90	5.5																																															
Graduate Student		5,001	6,065	16,349	24%	76%	12%	3%	97%	70%	30%	451	0	11,128	4,770	11.17	1.0	6.34	1.0	5,038	0	70,552	4,770	80,359	13.25	4.9																																															
Undergraduate Student		6,401	6,401	9,345	24%	76%	0%	0%	100%	50%	50%	0	0	4,673	4,672	11.17	1.0	6.34	1.0	0	0	29,627	4,672	34,299	5.36	3.7																																															
Post Doctoral		28	28	92	24%	76%	0%	0%	100%	70%	30%	0	0	64	28	11.17	1.0	6.34	1.0	0	0	406	28	434	15.49	4.7																																															
		11,468	12,592	26,086								482	41	16,059	9,504					5,389	41	101,814	9,504	116,748	9.27	4.5																																															

Column B **Affiliates**
Households for Faculty Staff / Students for Graduates & Undergraduates
Source: Land Use & Environmental Planning, Institutional Research & Decision Support

Column J & K **External / Internal Trips**
Split derived from P&TS Survey info on peak period travel

Cloumn C	Population	Fall 2015		2018 GUP		2035 GUP	
		Affiliates	Population	Affiliates	Population	Affiliates	pulation
	F/S	38	98	38	98	588	1,540
	Grads	5,001	6,065	7,265	8,507	8,183	9,497
	UG	6,401	6,401	6,617	6,617	8,317	8,317
	Post Doc	28	28	28	28	28	28
			12,592		15,250		19,382

Column L **Column D * Column H**

Column M **Come from Worker Student VMT - "Resident Faculty/Staff Inside Cordon" Column H**

Column N **Column D * Column J**

Column O **Column D - Column L -- Column M - Column O**

Column D	Daily Trip Generation (Fehr & Peers)				
	Affiliate	Number	Rate	Trips	
	Faculty	38	7.89	300	Residential trip generation rates are based on ground counts at existing sites on-campus and parking permit data. Additional detail in report.
	Grads	5,001	3.27	16,349	
	Undergrad	6,401	1.46	9,345	
	Post Doc	28	3.27	92	

Column P, Q, R, S **Trip Length**
HBW & HBO trip lengths from from VTA 2015 model checked against CHTS 2012 for Palo Alto Residents
Interal trip length F&P assumption based on campus size (~2 miles wide)

Column T, U, V, W **Calculated Daily VMT**

Column X **Total Daily VMT (Sum of T, U, V & W)**

Columns E & F **Relationship of HBW to HBO** for Palo Alto Residents for weekdays from California Household Transportation Survey 2012

Column G **Stanford Force Adjustment** - modified Palo Alto distribution of HBW and HBO trips based on the relation of Graduate affiliates to spouses.

Columnsn H & I **Adjusted HBW & HBO** split for daily trips to reflect fewer external HBW trips for students.

Column Y **Total VMT / Total Population**

Column Z **Total VMT / Total Trips**

**STANFORD FALL 2015 EXISTING CONDITIONS
ANNUAL VMT SUMMARY**

Category	F&P Use Only Annual VMT Total Population			Source Tab
Workers	Annual VMT			
Worker Commute - all employee types including all resident F/S	● 22,661	5,190,520	55,290,826	Worker-Student D28, M28, N28
Student Commute to Campus (live off campus)	● 4,788	616,546	5,362,757	Worker-Student D35, M35, N35
Resident Students - Grad / Undergrad	● 11,402	0	0	Worker-Student D38, M38, N38
Residents				
<i>Home-based Work / Home-based Other</i>	(All Trips)			
Faculty / Staff (including family members)	● 98	94,698	619,941	Resident Annual C9, T9, U9
Graduate Students (including family members)	● 6,065	5,264,378	27,554,538	Resident Annual C10, T10, U10
Undergraduate Students	● 6,401	1,962,450	7,612,107	Resident Annual C11, T11, U11
Post Doctoral	● 28	33,580	168,975	Resident Annual C12, T12, U12
Visitors				
General Visitors (Vendor) - business/academic meetings, deliveries by auto, informal unhosted conferences	●	4,032,408	25,001,480	Other GHG Inputs H27
Worker Non-Commute Trips	●	301,920	935,952	Other GHG Inputs H28
Deliveries via trucks	●	336,108	2,083,870	Other GHG Inputs H29
Non-event Visitor Trips - Alumni Center, Conferences, Tours distributed over 303 days excludes Sundays & Holidays	●		3,338,443	Other GHG Inputs H31
Event Visitor Traffic (not typical weekday)	●		6,652,357	Other GHG Inputs H30
Marguerite Shuttle/Bus Fleet	●		1,983,931	Other GHG Inputs H21
PSSI Fleet	●		2,601,593	Other GHG Inputs H22
Bonair Fleet	●		3,775,762	Other GHG Inputs H23
Public Safety Fleet	●		232,720	Other GHG Inputs H24
Totals	● 51,443	17,832,608	143,215,251	

STANFORD FALL 2015 EXISTING CONDITIONS
RESIDENTIAL ANNUAL VMT

Resident Type	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U		
				Weekday						Weekends / Holidays												
	Stanford Affiliates or D.U.s	Population	Daily Trips (weekday)	Vehicle Trips						Vehicle Trips				Trip Length								
				HBW		HBO		Total	Annual	HBW		HBO		HBW	HBO	Internal	Total	Total	Total			
				External	Internal	External	Internal	Daily VMT	VMT	External	Internal	External	Internal	miles/trip	miles/trip	miles/trip	Daily VMT	Annual	VT	VMT		
Existing																						
Faculty / Staff	38	98	300	31	0	194	34	1,656	415,598	0	0	225	34	5.10	7.80	1.00	1,792	204,343	94,698	619,941		
Graduate Student	5,001	6,065	16,349	451	0	11,128	4,770	80,359	16,714,712	0	0	11,579	4,770	5.10	7.80	1.00	95,086	10,839,827	5,264,378	27,554,538		
Undergraduate Student	6,401	6,401	9,345	0	0	4,673	4,672	34,299	5,144,823	0	0	4,673	4,672	5.10	7.80	1.00	41,121	2,467,284	1,962,450	7,612,107		
Post Doctoral	28	28	92	0	0	64	28	434	108,874	0	0	64	28	5.10	7.80	1.00	527	60,101	33,580	168,975		
	11,468	12,592	26,086	482	0	16,059	9,504	116,748	22,384,007	0	0	16,541	9,504				138,527	13,571,555	7,355,106	35,955,561		

Columns B through I	Carried over from Residential VMT Daily Calculation Column F is not carried over to avoid double counting affiliate HBW trips.	F/S Week daysper year		251	52 Weekends / 10 Holiday days per year												114	
		Graduate Week days per year		208	52 Weekends / 10 Holiday days per year												114	
		UG Week days per year		150	30 Weekends / No Holiday days per year												60	
		Post Doc Week daysper year		251 Same as F/S	52 Weekends / 10 Holiday days per year												114	

Column J Calculated annual week day VMT using week days shown below calculations

Columns K, L, M, N	Weekend trip generation was assumed to be equal to daily based on ITE Trip Generation data.	ITE Trips Rates		Weekday	Saturday		Sunday	Averaged	
	ITE shows that Saturday trip generation is 5 - 9 percent higher and Sunday is 8 percent lower.	Single Family Housing - Faculty	D.U.	9.57	10.08	105%	8.77	92%	98%
	Assumed that all trips are HBO trips.	Condo/Townhouse - Faculty	D.U.	6.59	7.16	109%	6.07	92%	100%
	Used same internal to external relationship for weekend trips.	Graduate Apartments - Low Rise	D.U.	6.59	7.16	109%	6.07	92%	100%

Columns O, P, Q Weekend trip lengths from California Household Transportation Suvey 2012 data for Palo Alto

Column R Calculated average weekend daily VMT = trips x trip length

Column S Calculated annual weekend VMT using weekend daily VMT and weekend/holiday days shown

Column T Total Daily Vehicle Trips = Column I + Column R

Column U Total Daily Vehicle Miles Traveled = Column J + Column S

STANFORD FALL 2015 EXISTING CONDITIONS
OTHER GREENHOUSE GAS VMT

	B	C	D	E	F	G	H	I	J	K	L	M	N
Categories	Population	Mode Split: % Driving	Persons/ vehicle	Trips per Vehicle per Year	Total Vehicle Trips	Trip Length [miles]	Fall 2015 Total VMT		2018 Baseline		2035 GUP	Fleet Assumption (Passenger, Vans, Bus, Mix)	Proposal for Scaling for 2018/2035
Athletic events	411,250	68%	3	2	186,083	26.0	4,838,167	0%	4,838,167	0%	4,838,167	Passenger	No change
Alumni center	53,540	75%	1.25	2	64,248	25.0	1,606,200	8%	1,734,696	22%	2,118,064	Passenger	KSF
Big 5	50,000	75%	2.5	2	30,000	25.0	750,000	3%	769,500	17%	900,315	Passenger	Students
Conferences - to and from	20,472	75%	1.25	2	24,566	25.0	614,160	8%	663,293	22%	809,881	Passenger	KSF
Conferences - during	20,472	25%	1.25	6	24,566	2.5	61,416	8%	66,329	22%	80,988	Passenger	KSF
Camps (DAPER) - Visitors	6,079	100%	2	4	12,157	25.0	303,925	3%	314,258	26%	395,966	Passenger	UG Beds
Camps (DAPER) - Locals	6,079	100%	2	6	18,236	10.0	182,355	3%	188,555	26%	237,579	Passenger	UG Beds
Walking Tours - Buses	40,000	100%	40	2	2,000	25.0	50,000	0%	50,000	0%	50,000	Passenger	No change
Walking Tours - Cars	40,000	100%	3	2	26,667	25.0	666,667	0%	666,667	0%	666,667	Passenger	No change
Stanford Live Performances, Major events	64,388	75%	2	2	48,291	10.0	482,910	0%	482,910	0%	482,910	Passenger	No change
Visitors by Tour Bus	170,000	100%	40	2	8,500	40.0	340,000	0%	340,000	0%	340,000	Coach buses, Vans	No change
Executive Education - to and from	1,300	100%	1	2	2,600	25.0	65,000	8%	70,200	22%	85,714	Passenger	KSF
Executive Education - during	1,300	25%	1	6	1,950	10.0	19,500	8%	21,060	22%	25,714	Passenger	KSF
Camps (Academic) - Visitors	300	100%	2	2	300	25.0	7,500	3%	7,755	26%	9,771	Passenger	UG Beds
Camps (Academic) - Locals	300	100%	2	2	300	10.0	3,000	3%	3,102	26%	3,909	Passenger	UG Beds
Marguerite Shuttle/Bus Fleet							1,983,931	8%	2,144,233	22%	2,618,108	Bus	KSF
PSSI							2,601,593	0%	2,601,593	0%	2,601,593	Mix	No change
Bonair Fleet							3,775,762	-5%	3,586,974	0%	3,586,974	Mix	No change
Public Safety Fleet							232,720	0%	232,720	0%	232,720	Passenger	No change

Category	Annual Trips	Daily Trips	Fall 2015	2018 Baseline	2035 GUP	Avg Day Cordon	Number of days
Vendors / business or academic meetings			25,001,480	8%	27,001,599	22%	32,968,952 Passenger
Worker Non-commute - Personal Business			935,952	8%	1,010,828	22%	1,234,221 Passenger
Deliveries / trucks @ 2% of traffic			2,083,870	8%	2,250,579	22%	2,747,957 Trucks
Event Trips	540,995	299,917	NA	6,652,357	6,695,507	6,980,045	
Non-Event Trips (daily)	344,484	150,547	500	3,338,443	3,520,985	4,065,599	11,088 303
Fleet Vehicles		NA	NA	8,594,006	8,565,520	9,039,395	

- Column B Estiamted attendance provided by Stanford Event Planning or Athletics
- Column C Ramboll assumption
- Column D Ramboll assumption
- Column E 2 - in/out or 6 include mid-day or evening trips by attendees
- Column F Column B * Column C / Column D * Column E
- Column G Ramboll assumption
- Column H Column F * Column G
- Columns I & K Growth assumption as documented in Column N
- Columns J & L Calculated using I & K
- Column M Vehicle type for emissions calculation
- Column N Basis for growth in 2018 and 2035

**APPENDIX B1: FALL 2018 WITHOUT PROJECT
VMT CALCULATIONS**

STANFORD FALL 2018 WITHOUT PROJECT
DAILY VMT SUMMARY

Category	Workers			Students			Residents All Ages		Source Tab
Workers		People	VMT		People	VMT	People	VMT	
Worker Commute - all employee types including all resident F/S	●	23,627	257,726						Worker Student - D29 & J29
Student Commute to Campus (live off campus)	●	4,751	26,504	●	4,751	26,504			Worker Student - D31+D34, & J36
Resident Students - Grad / Undergrad	●	11,862	0	●	11,862	0			Worker Student - D37+D38, & J39
Residents									
Commute Trips - Off Campus									(HBW)
Faculty / Staff (including other household members)							● 98	392	Resident Daily - C8 & T8+U8
Graduate Students (including other household members)							● 6,285	5,250	Resident Daily - C9 & T9+U9
Undergrad Students							● 6,617	0	Resident Daily - C10 & T10+U10
Post Doctoral							● 28	0	Resident Daily - C11 & T11+U11
Home-based Other									(HBO)
Faculty / Staff (including other household members)							● Same	1,264	Resident Daily - V8 + W8
Graduate Students (including other household members)							● as	78,394	Resident Daily - V9 + W9
Undergrad Students							● above	35,459	Resident Daily - V10 + W10
Post Doctoral Students							●	434	Resident Daily - V11 + W11
Totals	●	40,240	284,230	●	16,613	26,504	●	13,028	121,192
VMT / Person - Workers Including Students	Absentee	HBW	VMT*			VMT**			VMT**
non-students only (HBW trips)	90%	73%	186,739						
			4.64			1.60			9.27
Threshold - 85% of the VTA Model Regional VMT			13.75						14.73
VMT / Person - Workers Excluding Students	Absentee	HBW	VMT*						
Adjustments for comparison to model HBW VMT	90%	73%	169,326						
			7.17						

* For the comparison to the VTA model threshold, the manual calculation is reduced to reflect that HBW trips are only 73% of trips at the work place and by 10% for daily absenteeism.

STANFORD FALL 2018 WITHOUT PROJECT
WORKER STUDENT VMT (COMMUTER 100% HBW)

Col >	B	C	D	E	F	G	H	I	J	K	L	M	N	O
Row	Work - Commuters	Workers / Students	Commute Population	Commute Frequency	Vehicle Mode Split	Vehicle Occup	Daily				Annual			
							Total Daily Vehicle Trips	Home - Work Trip Length	VMT	VMT / Capita	Days per Year	VT	VMT	VMT / Capita
6	Benefit Eligible Employees													
7	Off Campus - Faculty	1,956	1,956	92%	58%	1.14	1,818	12.47	22,676	11.59	222	403,693	5,034,056	2,574
8	Off-Campus - Staff	8,985	8,985	92%	58%	1.14	8,353	12.47	104,163	11.59	222	1,854,389	23,124,232	2,574
9	University Terrace*	180	180	92%	58%	1.00	192	2.00	384	2.13	222	42,645	85,291	474
10	On Campus - Faculty/Staff in Faculty Subdivision**	899	899	92%	58%	1.00	959	2.0	1,918.8	2.13	222	212989.6416	425,979	473.8
11	On Campus - Faculty/Staff within GUP Study Area	38	38	92%	58%	1.00	41	1.00	41	1.07	222	9,003	9,003	237
12	Post Doctoral													
13	Off-Campus	2,375	2,375	96%	31%	1.18	1,179	9.48	11,177	4.71	222	261,730	2,481,198	1,045
14	On-Campus	28	28	96%	0%	100%	0	9.5	0.0	0.00	222	0	0	0.0
15	Casual	2,167	2,167	20%	80%	1.10	629	13.39	8,418	3.88	222	139,563	1,868,744	862
16	Contingent	1,021	1,021	52%	63%	1.09	612	12.25	7,494	7.34	222	135,808	1,663,642	1,629
17	Temporary	1,448	1,448	78%	65%	1.16	1,258	12.76	16,057	11.09	222	279,355	3,564,566	2,462
18	Non-Employee Affiliates													
19	Non-Employee Affiliates: 20% FTEs	1,312	1,312	17%	83%	1.05	353	11.88	4,189	3.19	222	78,281	929,974	709
20	Non-Employee Affiliates: FTEs	1,435	1,435	85%	83%	1.05	1,928	11.88	22,909	15.96	222	428,097	5,085,797	3,544
21	Subtotal Workers (Stanford Employees)	21,844	21,844				17,322	11.51	199,426	9.13	222	3,845,553	44,272,483	2,027
22	Third Party Contractors	324	324	100%	87%	1.07	526	14.21	7,478	23.08	222	116,833	1,660,191	5,124
23	Janitorial Shift Workers	259	259	100%	87%	1.07	421	14.21	5,978	23.08	222	93,394	1,327,128	5,124
24	Construction	1,200	1,200	100%	87%	1.07	1,949	14.21	27,698	23.08	222	432,713	6,148,856	5,124
25	Subtotal Workers (Contract Workers)	1,783	1,783				2,896	14.21	41,154	23.08	na	642,940	9,136,175	5,124
26	First Mile to Transit All Workers (Carpool)			94%	1%	2.00	270	5.02	1,356	0.06	222	59,960	300,999	13
27	First Mile to Transit All Workers (Drive-Alone)			91%	9%	1.00	3,870	4.08	15,790	0.67	222	859,188	3,505,487	148
28	First Mile to Transit (all workers)						4,140	4.14	17,146	0.73	na	919,148	3,806,486	161
29	Total Workers (excluding students)	23,627	23,627				24,359	10.58	257,726	10.91	na	5,407,641	57,215,143	2,422
30	Students													
31	Off Campus - Graduate	4,283	4,283	82%	41%	1.12	2,572	9.15	23,530	5.49	208	534,884	4,894,189	1,143
32	First Mile to Transit (Carpool)			100%	0.4%	2.00	18	2.42	44	0.01	208	3,768	9,119	2
33	First Mile to Transit (Drive-Alone)			92%	1%	1.00	92	2.56	235	0.05	208	19,067	48,811	11
34	Off Campus - Undergraduate	468	468	89%	50%	1.12	370	7.29	2,696	5.76	150	55,470	404,378	864
35	Non-Matriculated (trips in visitor trips)	977	0	0%	0%	1.00	0	0.00	0	0.00	208	0	0	0
36	Subtotal Student Non-resident	5,728	4,751				3,051	8.69	26,504	5.58	na	613,190	5,356,498	1,127
37	Resident - Graduate	5,245	5,245	100%	0%	1.00	0	1.00	0	0.00	208	0	0	0
38	Resident -Uundergraduate	6,617	6,617	100%	0%	1.00	0	1.00	0	0.00	150	0	0	0
39	Subtotal Student Residents	11,862	11,862				0	1.00	0	0.00	na	0	0	0
40	Total Stanford Students	17,590	16,613				3,051		26,504	1.60	na	613,190	5,356,498	322
41	Total Wokers (including Students)	41,217	40,240				27,410		284,230	7.06	na	6,020,830	62,571,641	1,555

* University Terrace is located very close to the campus in the area bounded by Page Mill Road, California Avenue and Hanover Street.

** The Faculty Subdivision is housing areas adjacent to the campus, outside the GUP study area. The area is bounded by Junipero Serra Blvd, Page Mill Road, Bowdoin Avenue, and Mayfield Road

Column C Workers & Students provided by Stanford Land Use Environmental Planning (LUEP) / Institutional Research & Decision Support (IRDS)

Column D Population equals workers or student except for Non-Matriculating Students whose trips are treated as visitors. Residential tables add family members.

Column E P&TS Annual Survey (2015) commute frequency adjustment for how often workers come to campus

Column F P&TS Annual Survey (2015) vehicle mode split including drive alone, carpool, and vanpool

For non Stanford workers (third party, janitorial and construction) mode split from Census Fact Finder 2014 Journey to Work data Santa Clara County workers

Column G P&TS Annual Survey (2015) vehicle occupancy drive alone = 1, carpool = 2 and vanpool = 5

Column H Calculation = Population * Commute Frequenct * Vehicle Mode Split / Vehicle Occupancy * 2

Column I Average one-way trip length ror campus workers and off campus students, calculated by P&TS from place of residence and survey mode choice data

For non Stanford workers (third party, janitorial and construction) HBW trip length from the Santa Clara Valley Transportation Authority (VTA) 2015 model checked against California Household Transportation Survey (CHTS) 2012 for Santa Clara County workers

Column J Calculation = Daily Vehicle Trips x Trip Length

Column K Calculation total VMT / total population

Column L Work day estimated by P&TS adjusting for weekends, holidays and standard PTO for Stanford

Students estiamted by P&TS based on academic schedule for Grad and Undergrads

Columns M, N, & O Calculations daily VT & VMT times number of days per year and VMT divided by population

Journey to work, FactFinders, 2014	Mode	%
	Drive Alone	76.5%
	2-person	8.2%
	3-person	1.4%
	4+ person	0.8%
	Total	86.9%
	Persns/Veh	1.07

http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk

STANFORD FALL 2018 WITHOUT PROJECT
RESIDENTIAL DAILY VMT

	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z		
Resident Type	Stanford Affiliates Units/Affilia tes	Population	Daily Trips (weekday)	Palo Alto Distribution		Stanford Workforce HBW Adjustment	Stanford Adjusted		HBO		Vehicle Trips				Trip Length (miles)				Total Daily VMT (Weekday)								
				HBW	HBO		HBW	HBO	External	Internal	HBW		HBO		HBW		HBO		HBW		HBO		Total	VMT / capita	Average Trip Len		
				%	%		%	%	%	%	External	Internal	External	Internal	External	Internal	External	Internal	External	Internal	External	Internal					
Existing				Used for Calculating Columns H & I																							
Faculty / Staff	38	98	300	24%	76%	100%	24%	76%	85%	15%	31	41	194	34	11.17	1.0	6.34	1.0	351	41	1,230	34	1,656	16.90	5.5		
Graduate Student	5,205	6,285	17,016	24%	76%	12%	3%	97%	70%	30%	470	0	11,582	4,964	11.17	1.0	6.34	1.0	5,250	0	73,430	4,964	83,644	13.31	4.9		
Undergraduate Student	6,617	6,617	9,661	24%	76%	0%	0%	100%	50%	50%	0	0	4,831	4,830	11.17	1.0	6.34	1.0	0	0	30,629	4,830	35,459	5.36	3.7		
Post Doctoral	28	28	92	24%	76%	0%	0%	100%	70%	30%	0	0	64	28	11.17	1.0	6.34	1.0	0	0	406	28	434	15.49	4.7		
	11,888	13,028	27,069									501	41	16,671	9,856					5,601	41	105,694	9,856	121,192	9.30	4.5	

Column B **Affiliates**
Households for Faculty Staff / Students for Graduates & Undergraduates
Source: Land Use & Environmental Planning, Institutional Research & Decision Support

Column J & K **External / Internal Trips**
Split derived from P&TS Survey info on peak period travel

Cloumn C	Population	Fall 2015		2018 GUP		2035 GUP	
		Affiliates	Population	Affiliates	Population	Affiliates	pulation
	F/S	38	98	38	98	588	1,540
	Grads	5,001	6,065	5,205	6,285	8,183	9,497
	UG	6,401	6,401	6,617	6,617	8,317	8,317
	Post Doc	28	28	28	28	28	28
			12,592		13,028		19,382

Column L **Column D * Column H**

Column M **Come from Worker Student VMT - "Resident Faculty/Staff Inside Cordon" Column H**

Column N **Column D * Column J**

Column O **Column D - Column L -- Column M - Column O**

Column D	Daily Trip Generation (Fehr & Peers)				
	Affiliate	Number	Rate	Trips	
	Faculty	38	7.89	300	Residential trip generation rates are based on ground counts at existing sites on-campus and parking permit data. Additional detail in report.
	Grads	5,205	3.27	17,016	
	Undergrad	6,617	1.46	9,661	
	Post Doc	28	3.27	92	

Column P, Q, R, S **Trip Length**
HBW & HBO trip lengths from from VTA 2015 model checked against CHTS 2012 for Palo Alto Residents
Interal trip length F&P assumption based on campus size (~2 miles wide)

Column T, U, V, W **Calculated Daily VMT**

Column X **Total Daily VMT (Sum of T, U, V & W)**

Column Y **Total VMT / Total Population**

Column Z **Total VMT / Total Trips**

Columns E & F **Relationship of HBW to HBO** for Palo Alto Residents for weekdays from California Household Transportation Survey 2012

Column G **Stanford Force Adjustment** - modified Palo Alto distribution of HBW and HBO trips based on the relation of Graduate affiliates to spouses.

Columnsn H & I **Adjusted HBW & HBO** split for daily trips to reflect fewer external HBW trips for students.

**STANFORD FALL 2018 WITHOUT PROJECT
ANNUAL VMT SUMMARY**

Category	Annual VMT Total Population			Source Tab
Workers	People	VT	Annual VMT	
Worker Commute - all employee types including all resident F/S	● 23,627	5,407,641	57,215,143	Worker-Student D29, M29, N29
Student Commute to Campus (live off campus)	● 4,751	613,190	5,356,498	Worker-Student D36, M36, N36
Resident Students - Grad / Undergrad	● 11,862	0	0	Worker-Student D39, M39, N39
Residents				
<i>Home-base Work / Home-based Other</i>			(All Trips)	
Faculty / Staff (including family members)	● 98	94,698	619,941	Resident Annual C9, T9, U9
Graduate Students (including family members)	● 6,285	5,479,152	28,680,441	Resident Annual C10, T10, U10
Undergraduate Students	● 6,617	2,028,810	7,869,489	Resident Annual C11, T11, U11
Post Doctoral	● 28	33,580	168,975	Resident Annual C12, T12, U12
Visitors				
General Visitors (Vendor) - business/academic meetings, deliveries by auto, informal unhosted conferences	●	4,355,001	27,001,599	Other GHG Inputs H27
Worker Non-Commute Trips	●	326,074	1,010,828	Other GHG Inputs H28
Deliveries via trucks	●	362,997	2,250,579	Other GHG Inputs H29
Non-event Visitor Trips - Alumni Center, Conferences, Tours distributed over 303 days excludes Sundays & Holidays	●		3,520,985	Other GHG Inputs H31
Event Visitor Traffic (not typical weekday)	●		6,695,507	Other GHG Inputs H30
Marguerite Shuttle/Bus Fleet	●		2,144,233	Other GHG Inputs H21
PSSI Fleet	●		2,601,593	Other GHG Inputs H22
Bonair Fleet	●		3,586,974	Other GHG Inputs H23
Public Safety Fleet	●		232,720	Other GHG Inputs H24
Totals	● 53,268	18,701,142	148,955,504	

STANFORD FALL 2018 WITHOUT PROJECT
RESIDENTIAL ANNUAL VMT

	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
				Weekday						Weekends / Holidays										
Resident Type	Stanford Affiliates or D.U.s	Population	Daily Trips (weekday)	Vehicle Trips				Total	Annual	Vehicle Trips				Trip Length			Total	Total	Total	Total
				HBW		HBO		Daily VMT	VMT	HBW		HBO		HBW	HBO	Internal	Daily	Annual	VT	VMT
				External	Internal	External	Internal			External	Internal	External	Internal	miles/trip	miles/trip	miles/trip				
Existing																				
Faculty / Staff	38	98	300	31	0	194	34	1,656	415,598	0	0	225	34	5.10	7.80	1.00	1,792	204,343	94,698	619,941
Graduate Student	5,205	6,285	17,016	470	0	11,582	4,964	83,644	17,397,906	0	0	12,052	4,964	5.10	7.80	1.00	98,970	11,282,534	5,479,152	28,680,441
Undergraduate Student	6,617	6,617	9,661	0	0	4,831	4,830	35,459	5,318,781	0	0	4,831	4,830	5.10	7.80	1.00	42,512	2,550,708	2,028,810	7,869,489
Post Doctoral	28	28	92	0	0	64	28	434	108,874	0	0	64	28	5.10	7.80	1.00	527	60,101	33,580	168,975
	11,888	13,028	27,069	501	0	16,671	9,856	121,192	23,241,159	0	0	17,172	9,856				143,801	14,097,686	7,636,240	37,338,845

Columns B through I		F/S Week daysper year	251	52 Weekends / 10 Holiday days per year	114
	Carried over from Residential VMT Daily Calculation	Graduate Week days per year	208	52 Weekends / 10 Holiday days per year	114
	Column F is not carried over to avoid double counting affiliate HBW trips.	UG Week days per year	150	30 Weekends / No Holiday days per year	60
		Post Doc Week daysper year	251 Same as F/S	52 Weekends / 10 Holiday days per year	114

Columns K, L, M, N	Weekend trip generation was assumed to be equal to daily based on ITE Trip Generation data.	ITE Trips Rates		Saturday		Sunday		Averaged	
	ITE shows that Saturday trip generation is 5 - 9 percent higher and Sunday is 8 percent lower.	Single Family Housing - Faculty	D.U.	9.57	10.08	105%	8.77	92%	98%
	Assumed that all trips are HBO trips.	Condo/Townhouse - Faculty	D.U.	6.59	7.16	109%	6.07	92%	100%
	Used same internal to external relationship for weekend trips.	Graduate Apartments - Low Rise	D.U.	6.59	7.16	109%	6.07	92%	100%

Columns O, P, Q Weekend trip lengths from California Household Transportation Suvey 2012 data for Palo Alto

Column R Calculated average weekend daily VMT = trips x trip length

Column S Calculated annual weekend VMT using weekend daily VMT and weekend/holiday days shown

Column T Total Daily Vehicle Trips = Column I + Column R

Column U Total Daily Vehicle Miles Traveled = Column J + Column S

STANFORD FALL 2018 WITHOUT PROJECT
OTHER GREENHOUSE GAS VMT

	B	C	D	E	F	G	H	I	J	K	L	M	N
Categories	Population	Mode Split: % Driving	Persons/ vehicle	Trips per Vehicle per Year	Total Vehicle Trips	Trip Length [miles]	Fall 2015 Total VMT		2018 Baseline		2035 GUP	Fleet Assumption (Passenger, Vans, Bus, Mix)	Proposal for Scaling for 2018/2035
Athletic events	411,250	68%	3	2	186,083	26.0	4,838,167	0%	4,838,167	0%	4,838,167	Passenger	No change
Alumni center	53,540	75%	1.25	2	64,248	25.0	1,606,200	8%	1,734,696	22%	2,118,064	Passenger	KSF
Big 5	50,000	75%	2.5	2	30,000	25.0	750,000	3%	769,500	17%	900,315	Passenger	Students
Conferences - to and from	20,472	75%	1.25	2	24,566	25.0	614,160	8%	663,293	22%	809,881	Passenger	KSF
Conferences - during	20,472	25%	1.25	6	24,566	2.5	61,416	8%	66,329	22%	80,988	Passenger	KSF
Camps (DAPER) - Visitors	6,079	100%	2	4	12,157	25.0	303,925	3%	314,258	26%	395,966	Passenger	UG Beds
Camps (DAPER) - Locals	6,079	100%	2	6	18,236	10.0	182,355	3%	188,555	26%	237,579	Passenger	UG Beds
Walking Tours - Buses	40,000	100%	40	2	2,000	25.0	50,000	0%	50,000	0%	50,000	Passenger	No change
Walking Tours - Cars	40,000	100%	3	2	26,667	25.0	666,667	0%	666,667	0%	666,667	Passenger	No change
Stanford Live Performances, Major events	64,388	75%	2	2	48,291	10.0	482,910	0%	482,910	0%	482,910	Passenger	No change
Visitors by Tour Bus	170,000	100%	40	2	8,500	40.0	340,000	0%	340,000	0%	340,000	Coach buses, Vans	No change
Executive Education - to and from	1,300	100%	1	2	2,600	25.0	65,000	8%	70,200	22%	85,714	Passenger	KSF
Executive Education - during	1,300	25%	1	6	1,950	10.0	19,500	8%	21,060	22%	25,714	Passenger	KSF
Camps (Academic) - Visitors	300	100%	2	2	300	25.0	7,500	3%	7,755	26%	9,771	Passenger	UG Beds
Camps (Academic) - Locals	300	100%	2	2	300	10.0	3,000	3%	3,102	26%	3,909	Passenger	UG Beds
Marguerite Shuttle/Bus Fleet							1,983,931	8%	2,144,233	22%	2,618,108	Bus	KSF
PSSI Fleet							2,601,593	0%	2,601,593	0%	2,601,593	Mix	No change
Bonair Fleet							3,775,762	-5%	3,586,974	0%	3,586,974	Mix	No change
Public Safety Fleet							232,720	0%	232,720	0%	232,720	Passenger	No change

Category	Annual Trips	Daily Trips	Fall 2015	2018 Baseline	2035 GUP	Avg Day Cordon	Number of days
Vendors / business or academic meetings			25,001,480	8%	27,001,599	22%	32,968,952 Passenger
Worker Non-commute - Personal Business			935,952	8%	1,010,828	22%	1,234,221 Passenger
Deliveries / trucks @ 2% of traffic			2,083,870	8%	2,250,579	22%	2,747,957 Trucks
Event Trips	540,995	299,917	NA	6,652,357	6,695,507	6,980,045	
Non-Event Trips (daily)	344,484	150,547	500	3,338,443	3,520,985	4,065,599	11,088 303
Fleet Vehicles		NA	NA	8,594,006	8,565,520	9,039,395	

Column B Estiamted attendance provided by Stanford Event Planning or Athletics
Column C Ramboll assumption
Column D Ramboll assumption
Column E 2 - in/out or 6 include mid-day or evening trips by attendees
Column F Column B * Column C / Column D * Column E
Column G Ramboll assumption
Column H Column F * Column G
Columns I & K Growth assumption as documented in Column N
Columns J & L Calculated using I & K
Column M Vehicle type for emissions calculation
Column N Basis for growth in 2018 and 2035

**APPENDIX B2: FALL 2020 WITHOUT PROJECT
VMT CALCULATIONS**

STANFORD FALL 2020 WITHOUT PROJECT
DAILY VMT SUMMARY

Category	Workers		Students		Residents All Ages	Source Tab
	People	VMT	People	VMT	People	VMT
Workers						
Worker Commute - all employee types including all resident F/S	● 23,627	257,726				Worker Student - D29 & J29
Student Commute to Campus (live off campus)	● 2,731	15,275	● 2,731	15,275		Worker Student - D31+D34, & J36
Resident Students - Grad / Undergrad	● 13,882	0	● 13,882	0		Worker Student - D37+D38, & J39
Residents						
<i>Commute Trips - Off Campus</i>						(HBW)
Faculty / Staff (including other household members)					● 98	392 Resident Daily - C8 & T8+U8
Graduate Students (including other household members)					● 8,507	7,328 Resident Daily - C9 & T9+U9
Undergrad Students					● 6,617	0 Resident Daily - C10 & T10+U10
Post Doctoral					● 28	0 Resident Daily - C11 & T11+U11
<i>Home-based Other</i>						(HBO)
Faculty / Staff (including other household members)					● Same	1,264 Resident Daily - V8 + W8
Graduate Students (including other household members)					● as	109,420 Resident Daily - V9 + W9
Undergrad Students					● above	35,459 Resident Daily - V10 + W10
Post Doctoral Students					●	434 Resident Daily - V11 + W11
Totals	● 40,240	273,001	● 16,613	15,275	● 15,250	154,296
VMT / Person - Workers Including Students	Absentee	HBW	VMT*	VMT**	VMT**	
non-students only (HBW trips)	90%	73%	179,362			
			4.46	0.92	10.09	
Threshold - 85% of the VTA Model Regional VMT			13.75		14.73	
VMT / Person - Workers Excluding Students	Absentee	HBW	VMT*			
Adjustments for comparison to model HBW VMT	90%	73%	169,326			
			7.17			

* For the comparison to the VTA model threshold, the manual calculation is reduced to reflect that HBW trips are only 73% of trips at the work place and by 10% for daily absenteeism.

STANFORD FALL 2020 WITHOUT PROJECT
WORKER STUDENT VMT (COMMUTER 100% HOME BASED)

Col >	B	C	D	E	F	G	H	I	J	K	L	M	N	O
Row	Work - Commuters	Workers / Students	Commute Population	Commute Frequency	Vehicle Mode Split	Vehicle Occup	Daily				Annual			
							Total Daily Vehicle Trips	Home - Work Trip Length	VMT	VMT / Capita	Days per Year	VT	VMT	VMT / Capita
6	Benefit Eligible Employees													
7	Off Campus - Faculty	1,956	1,956	92%	58%	1.14	1,818	12.47	22,676	11.59	222	403,693	5,034,056	2,574
8	Off-Campus - Staff	8,985	8,985	92%	58%	1.14	8,353	12.47	104,163	11.59	222	1,854,389	23,124,232	2,574
9	University Terrace*	180	180	92%	58%	1.00	192	2.00	384	2.13	222	42,645	85,291	474
10	On Campus - Faculty/Staff in Faculty Subdivision**	899	899	92%	58%	100%	959	2.0	1,918.8	2.13	222	212989.6416	425,979	473.8
11	On Campus - Faculty/Staff within GUP Study Area	38	38	92%	58%	1.00	41	1.00	41	1.07	222	9,003	9,003	237
12	Post Doctoral													
13	Off-Campus	2,375	2,375	96%	31%	1.18	1,179	9.48	11,177	4.71	222	261,730	2,481,198	1,045
14	On-Campus	28	28	96%	0%	100%	0	9.5	0.0	0.00	222	0	0	0.0
15	Casual	2,167	2,167	20%	80%	1.10	629	13.39	8,418	3.88	222	139,563	1,868,744	862
16	Contingent	1,021	1,021	52%	63%	1.09	612	12.25	7,494	7.34	222	135,808	1,663,642	1,629
17	Temporary	1,448	1,448	78%	65%	1.16	1,258	12.76	16,057	11.09	222	279,355	3,564,566	2,462
18	Non-Employee Affiliates													
19	Non-Employee Affiliates: 20% FTEs	1,312	1,312	17%	83%	1.05	353	11.88	4,189	3.19	222	78,281	929,974	709
20	Non-Employee Affiliates: FTEs	1,435	1,435	85%	83%	1.05	1,928	11.88	22,909	15.96	222	428,097	5,085,797	3,544
21	Subtotal Workers (Stanford Employees)	21,844	21,844				17,322	11.51	199,426	9.13	222	3,845,553	44,272,483	2,027
22	Third Party Contractors	324	324	100%	87%	1.07	526	14.21	7,478	23.08	222	116,833	1,660,191	5,124
23	Janitorial Shift Workers	259	259	100%	87%	1.07	421	14.21	5,978	23.08	222	93,394	1,327,128	5,124
24	Construction	1,200	1,200	100%	87%	1.07	1,949	14.21	27,698	23.08	222	432,713	6,148,856	5,124
25	Subtotal Workers (Contract Workers)	1,783	1,783				2,896	14.21	41,154	23.08	na	642,940	9,136,175	5,124
26	First Mile to Transit All Workers (Carpool)			94%	1%	2.00	270	5.02	1,356	0.06	222	59,960	300,999	13
27	First Mile to Transit All Workers (Drive-Alone)			91%	9%	1.00	3,870	4.08	15,790	0.67	222	859,188	3,505,487	148
28	First Mile to Transit (all workers)						4,140	4.14	17,146	0.73	na	919,148	3,806,486	161
29	Total Workers (excluding students)	23,627	23,627				24,359	10.58	257,726	10.91	na	5,407,641	57,215,143	2,422
30	Students													
31	Off Campus - Graduate	2,263	2,263	82%	41%	1.12	1,359	9.15	12,432	5.49	208	282,616	2,585,933	1,143
32	First Mile to Transit (Carpool)			100%	0.4%	2.00	10	2.42	23	0.01	208	1,991	4,818	2
33	First Mile to Transit (Drive-Alone)			92%	1%	1.00	48	2.56	124	0.05	208	10,074	25,790	11
34	Off Campus - Undergraduate	468	468	89%	50%	1.12	370	7.29	2,696	5.76	150	55,470	404,378	864
35	Non-Matriculated (trips in visitor trips)	977	0	0%	0%	1.00	0	0.00	0	0.00	208	0	0	0
36	Subtotal Student Non-resident	3,708	2,731				1,787	8.55	15,275	5.59	na	350,151	3,020,920	1,106
37	Resident - Graduate	7,265	7,265	100%	0%	1.00	0	1.00	0	0.00	208	0	0	0
38	Resident -Uundergraduate	6,617	6,617	100%	0%	1.00	0	1.00	0	0.00	150	0	0	0
39	Subtotal Student Residents	13,882	13,882				0	1.00	0	0.00	na	0	0	0
40	Total Stanford Students	17,590	16,613				1,787		15,275	0.92	na	350,151	3,020,920	182
41	Total Wokers (including Students)	41,217	40,240				26,145		273,001	6.78	na	5,757,792	60,236,063	1,497

* University Terrace is located very close to the campus in the area bounded by Page Mill Road, California Avenue and Hanover Street.

** The Faculty Subdivision is housing areas adjacent to the campus, outside the GUP study area. The area is bounded by Junipero Serra Blvd, Page Mill Road, Bowdoin Avenue, and Mayfield Road

Column C Workers & Students provided by Stanford Land Use Environmental Planning (LUEP) / Institutional Research & Decision Support (IRDS)

Column D Population equals workers or student except for Non-Matriculating Students whose trips are treated as visitors. Residential tables add family members.

Column E P&TS Annual Survey (2015) commute frequency adjustment for how often workers come to campus

Column F P&TS Annual Survey (2015) vehicle mode split including drive alone, carpool, and vanpool

For non Stanford workers (third party, janitorial and construction) mode split from Census Fact Finder 2014 Journey to Work data Santa Clara County workers

Column G P&TS Annual Survey (2015) vehicle occupancy drive alone = 1, carpool = 2 and vanpool = 5

Column H Calculation = Population * Commute Frequenct * Vehicle Mode Split / Vehicle Occupancy * 2

Column I Average one-way trip length ror campus workers and off campus students, calculated by P&TS from place of residence and survey mode choice data

For non Stanford workers (third party, janitorial and construction) HBW trip length from the Santa Clara Valley Transportation Authority (VTA) 2015 model checked against California Household Transportation Survey (CHTS) 2012 for Santa Clara County workers

Column J Calculation = Daily Vehicle Trips x Trip Length

Column K Calculation total VMT / total population

Column L Work day estimated by P&TS adjusting for weekends, holidays and standard PTO for Stanford

Students estiamted by P&TS based on academic schedule for Grad and Undergrads

Columns M, N, & O Calculations daily VT & VMT times number of days per year and VMT divided by population

Journey to work, FactFinders, 2014	Mode	%
	Drive Alone	76.5%
	2-person	8.2%
	3-person	1.4%
	4+ person	0.8%
	Total	86.9%
	Persns/Veh	1.07

http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk

STANFORD FALL 2020 WITHOUT PROJECT
RESIDENTIAL DAILY VMT

	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z		
Resident Type	Stanford Affiliates Units/Affilia tes	Population	Daily Trips (weekday)	Palo Alto Distribution		Stanford Workforce HBW Adjustment	Stanford Adjusted		HBO		Vehicle Trips				Trip Length (miles)				Total Daily VMT (Weekday)								
				HBW	HBO		HBW	HBO	External	Internal	HBW		HBO		HBW		HBO		HBW		HBO		Total	VMT / capita	Average Trip Len		
				%	%		%	%	%	%	External	Internal	External	Internal	External	Internal	External	Internal	External	Internal	External	Internal					
Existing				Used for Calculating Columns H & I																							
Faculty / Staff	38	98	300	24%	76%	100%	24%	76%	85%	15%	31	41	194	34	11.17	1.0	6.34	1.0	351	41	1,230	34	1,656	16.9	5.5		
Graduate Student	7,265	8,507	23,750	24%	76%	12%	3%	97%	70%	30%	656	0	16,166	6,928	11.17	1.0	6.34	1.0	7,328	0	102,492	6,928	116,748	13.7	4.9		
Undergraduate Student	6,617	6,617	9,661	24%	76%	0%	0%	100%	50%	50%	0	0	4,831	4,830	11.17	1.0	6.34	1.0	0	0	30,629	4,830	35,459	5.4	3.7		
Post Doctoral	28	28	92	24%	76%	0%	0%	100%	70%	30%	0	0	64	28	11.17	1.0	6.34	1.0	0	0	406	28	434	15.5	4.7		
	13,948	15,250	33,803									687	41	21,255	11,820					7,679	41	134,757	11,820	154,296	10.1	4.6	

Column B	Affiliates					
	Households for Faculty Staff / Students for Graduates & Undergraduates					
	Source: Land Use & Environmental Planning, Institutional Research & Decision Support					
Cloumn C	Population	Fall 2015		2020 GUP		2035 GUP
		Affiliates	Population	Affiliates	Population	Affiliates pulation
	F/S	38	98	38	98	588 1,540
	Grads	5,001	6,065	7,265	8,507	8,183 9,497
	UG	6,401	6,401	6,617	6,617	8,317 8,317
	Post Doc	28	28	28	28	28 28
Column D	Daily Trip Generation (Fehr & Peers)					
	Affiliate	Number	Rate	Trips	Residential trip generation rates are based on ground counts at existing sites on-campus and parking permit data. Additional detail in report.	
	Faculty	38	7.89	300		
	Grads	7,265	3.27	23,750		
	Undergrad	6,617	1.46	9,661		
	Post Doc	28	3.27	92		
		12,592		15,250		19,382
Columns E & F						
Relationship of HBW to HBO for Palo Alto Residents for weekdays from California Household Transportation Survey 2012						
Column G						
Stanford Force Adjustment - modified Palo Alto distribution of HBW and HBO trips based on the relation of Graduate affiliates to spouses.						
Columnsn H & I						
Adjusted HBW & HBO split for daily trips to reflect fewer external HBW trips for students.						

Column J & K	External / Internal Trips Split derived from P&TS Survey info on peak period travel
Column L	Column D * Column H
Column M	Come from Worker Student VMT - "Resident Faculty/Staff Inside Cordon" Column H
Column N	Column D * Column J
Column O	Column D - Column L -- Column M - Column O
Column P, Q, R, S	Trip Length HBW & HBO trip lengths from from VTA 2015 model checked against CHTS 2012 for Palo Alto Residents Interal trip length F&P assumption based on campus size (~2 miles wide)
Column T, U, V, W	Calculated Daily VMT
Column X	Total Daily VMT (Sum of T, U, V & W)
Column Y	Total VMT / Total Population
Column Z	Total VMT / Total Trips

**STANFORD FALL 2020 WITHOUT PROJECT
ANNUAL VMT SUMMARY**

Category	Annual VMT Total Population			Source Tab
Workers	People	VT	Annual VMT	
Worker Commute - all employee types including all resident F/S	● 23,627	5,407,641	57,215,143	Worker-Student D29, M29, N29
Student Commute to Campus (live off campus)	● 2,731	350,151	3,020,920	Worker-Student D36, M36, N36
Resident Students - Grad / Undergrad	● 13,882	0	0	Worker-Student D39, M39, N39
Residents				
<i>Home-base Work / Home-based Other</i>			(All Trips)	
Faculty / Staff (including family members)	● 98	94,698	619,941	Resident Annual C9, T9, U9
Graduate Students (including family members)	● 8,507	7,647,500	40,031,490	Resident Annual C10, T10, U10
Undergraduate Students	● 6,617	2,028,810	7,869,489	Resident Annual C11, T11, U11
Post Doctoral	● 28	33,580	168,975	Resident Annual C12, T12, U12
Visitors				
General Visitors (Vendor) - business/academic meetings, deliveries by auto, informal unhosted conferences	●	4,355,001	27,001,599	Other GHG Inputs H27
Worker Non-Commute Trips	●	326,074	1,010,828	Other GHG Inputs H28
Deliveries via trucks	●	362,997	2,250,579	Other GHG Inputs H29
Non-event Visitor Trips - Alumni Center, Conferences, Tours distributed over 303 days excludes Sundays & Holidays	●		3,520,985	Other GHG Inputs H31
Event Visitor Traffic (not typical weekday)	●		6,695,507	Other GHG Inputs H30
Marguerite Shuttle/Bus Fleet	●		2,144,233	Other GHG Inputs H21
PSSI Fleet	●		2,601,593	Other GHG Inputs H22
Bonair Fleet	●		3,586,974	Other GHG Inputs H23
Public Safety Fleet	●		232,720	Other GHG Inputs H24
Totals	● 55,490	20,606,452	157,970,976	

STANFORD FALL 2020 WITHOUT PROJECT
RESIDENTIAL ANNUAL VMT

	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
Resident Type	Stanford Affiliates Units/Affilia tes	Population	Daily Trips (weekday)	Weekday						Weekends / Holidays										
				Vehicle Trips				Total	Annual	Vehicle Trips				Trip Length			Total	Total	Total	Total
				HBW		HBO		VMT	VMT	HBW		HBO		HBW	HBO	Internal	Daily	Annual	VT	VMT
				External	Internal	External	Internal			External	Internal	External	Internal	miles/trip	miles/trip	miles/trip				
Existing																				
Faculty / Staff	38	98	300	31	0	194	34	1,656	415,598	0	0	225	34	5.10	7.80	1.00	1,792	204,343	94,698	619,941
Graduate Student	7,265	8,507	23,750	656	0	16,166	6,928	116,748	24,283,576	0	0	16,822	6,928	5.10	7.80	1.00	138,140	15,747,914	7,647,500	40,031,490
Undergraduate Student	6,617	6,617	9,661	0	0	4,831	4,830	35,459	5,318,781	0	0	4,831	4,830	5.10	7.80	1.00	42,512	2,550,708	2,028,810	7,869,489
Post Doctoral	28	28	92	0	0	64	28	434	108,874	0	0	64	28	5.10	7.80	1.00	527	60,101	33,580	168,975
	13,948	15,250	33,803	687	0	21,255	11,820	154,296	30,126,829	0	0	21,942	11,820				182,971	18,563,066	9,804,588	48,689,895

Columns B through I		F/S Week daysper year	251	52 Weekends / 10 Holiday days per year	114
	Carried over from Residential VMT Daily Calculation	Graduate Week days per year	208	52 Weekends / 10 Holiday days per year	114
	Column F is not carried over to avoid double counting affiliate HBW trips.	UG Week days per year	150	30 Weekends / No Holiday days per year	60
		Post Doc Week daysper year	251 Same as F/S	52 Weekends / 10 Holiday days per year	114

Columns K, L, M, N	Weekend trip generation was assumed to be equal to daily based on ITE Trip Generation data. ITE shows that Saturday trip generation is 5 - 9 percent higher and Sunday is 8 percent lower. Assumed that all trips are HBO trips. Used same internal to external relationship for weekend trips.	ITE Trips Rates		Saturday		Sunday		Averaged	
		Single Family Housing - Faculty	D.U.	9.57	10.08	105%	8.77	92%	98%
		Condo/Townhouse - Faculty	D.U.	6.59	7.16	109%	6.07	92%	100%
		Graduate Apartments - Low Rise	D.U.	6.59	7.16	109%	6.07	92%	100%

Columns O, P, Q	Weekend trip lengths from California Household Transportation Suvey 2012 data for Palo Alto
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Column R	Calculated average weekend daily VMT = trips x trip length
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Column S	Calculated annual weekend VMT using weekend daily VMT and weekend/holiday days shown
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Column T	Total Daily Vehicle Trips = Column I + Column R
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Column U	Total Daily Vehicle Miles Traveled = Column J + Column S
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STANFORD FALL 2020 WITHOUT PROJECT
OTHER GREENHOUSE GAS VMT

	B	C	D	E	F	G	H	I	J	K	L	M	N
Categories	Population	Mode Split: % Driving	Persons/ vehicle	Trips per Vehicle per Year	Total Vehicle Trips	Trip Length [miles]	Fall 2015 Total VMT	2020 Conditions		2035 GUP		Fleet Assumption (Passenger, Vans, Bus, Mix)	Proposal for Scaling for 2018/2035
Athletic events	411,250	68%	3	2	186,083	26.0	4,838,167	0%	4,838,167	0%	4,838,167	Passenger	No change
Alumni center	53,540	75%	1.25	2	64,248	25.0	1,606,200	8%	1,734,696	22%	2,118,064	Passenger	KSF
Big 5	50,000	75%	2.5	2	30,000	25.0	750,000	3%	769,500	17%	900,315	Passenger	Students
Conferences - to and from	20,472	75%	1.25	2	24,566	25.0	614,160	8%	663,293	22%	809,881	Passenger	KSF
Conferences - during	20,472	25%	1.25	6	24,566	2.5	61,416	8%	66,329	22%	80,988	Passenger	KSF
Camps (DAPER) - Visitors	6,079	100%	2	4	12,157	25.0	303,925	3%	314,258	26%	395,966	Passenger	UG Beds
Camps (DAPER) - Locals	6,079	100%	2	6	18,236	10.0	182,355	3%	188,555	26%	237,579	Passenger	UG Beds
Walking Tours - Buses	40,000	100%	40	2	2,000	25.0	50,000	0%	50,000	0%	50,000	Passenger	No change
Walking Tours - Cars	40,000	100%	3	2	26,667	25.0	666,667	0%	666,667	0%	666,667	Passenger	No change
Stanford Live Performances, Major events	64,388	75%	2	2	48,291	10.0	482,910	0%	482,910	0%	482,910	Passenger	No change
Visitors by Tour Bus	170,000	100%	40	2	8,500	40.0	340,000	0%	340,000	0%	340,000	Coach buses, Vans	No change
Executive Education - to and from	1,300	100%	1	2	2,600	25.0	65,000	8%	70,200	22%	85,714	Passenger	KSF
Executive Education - during	1,300	25%	1	6	1,950	10.0	19,500	8%	21,060	22%	25,714	Passenger	KSF
Camps (Academic) - Visitors	300	100%	2	2	300	25.0	7,500	3%	7,755	26%	9,771	Passenger	UG Beds
Camps (Academic) - Locals	300	100%	2	2	300	10.0	3,000	3%	3,102	26%	3,909	Passenger	UG Beds
Marguerite Shuttle/Bus Fleet							1,983,931	8%	2,144,233	22%	2,618,108	Bus	KSF
LBRE Fleet							2,601,593	0%	2,601,593	0%	2,601,593	Mix	No change
Bonair Fleet							3,775,762	-5%	3,586,974	0%	3,586,974	Mix	No change
Public Safety Fleet							232,720	0%	232,720	0%	232,720	Passenger	No change

Category	Annual Trips	Daily Trips	Fall 2015	2020 Conditions	2035 GUP	Avg Day Cordon	Number of days
Vendors / business or academic meetings			25,001,480	8%	27,001,599	22%	32,968,952 Passenger
Worker Non-commute - Personal Business			935,952	8%	1,010,828	22%	1,234,221 Passenger
Deliveries / trucks @ 2% of traffic			2,083,870	8%	2,250,579	22%	2,747,957 Trucks
Event Trips	540,995	299,917	NA	6,652,357	6,695,507	6,980,045	
Non-Event Trips (daily)	344,484	150,547	500	3,338,443	3,520,985	4,065,599	11,088 303
Fleet Vehicles		NA	NA	8,594,006	8,565,520	9,039,395	

Column B Estiamted attendance provided by Stanford Event Planning or Athletics
Column C Ramboll assumption
Column D Ramboll assumption
Column E 2 - in/out or 6 include mid-day or evening trips by attendees
Column F Column B * Column C / Column D * Column E
Column G Ramboll assumption
Column H Column F * Column G
Columns I & K Growth assumption as documented in Column N
Columns J & L Calculated using I & K
Column M Vehicle type for emissions calculation
Column N Basis for growth in 2018 and 2035

**APPENDIX C: FALL 2035 WITH PROJECT
VMT CALCULATIONS**

STANFORD FALL 2035 WITH PROJECT VMT
DAILY VMT SUMMARY

Category	Workers			Students		Residents All Ages	Source Tab
Workers		People	VMT		People	VMT	
Worker Commute - all employee types including all resident F/S	●	29,915	317,180				Worker Student - D29 & J29
Student Commute to Campus (live off campus)	●	3,013	16,843	●	3,013	16,843	Worker Student - D31+D34, & J36
Resident Students - Grad / Undergrad	●	16,500	0	●	16,500	0	Worker Student - D37+D38, & J39
Residents							
Commute Trips - Off Campus						(HBW)	
Faculty / Staff (including other household members)						● 1,511	6,050 Resident Daily - C8 & T8+U8
Graduate Students (including other household members)						● 9,497	8,243 Resident Daily - C9 & T9+U9
Undergrad Students						● 8,317	0 Resident Daily - C10 & T10+U10
Post Doctoral Students						● 28	0 Resident Daily - C11 & T11+U11
Home-based Other						(HBO)	
Faculty / Staff (including other household members)						● Same	19,523 Resident Daily - V8 + W8
Graduate Students (including other household members)						● as	123,249 Resident Daily - V9 + W9
Undergrad Students						● above	44,567 Resident Daily - V10 + W10
Post Doctoral						●	434 Resident Daily - V11 + W11
Totals	●	49,428	334,023	●	19,513	16,843	● 19,353 202,067
2035 Trip Length Adjustment based on VTA Model (2% HBW* / 3% HBO)			340,703	17,180		207,986	
VMT / Person - Workers Including Students	Absentee	HBW	VMT**	VMT***		VMT***	
non-students only (HBW trips)	90%	73%	223,842				
			4.53	0.88		10.75	
Threshold - 85% of the VTA Model Regional VMT			13.75			14.73	
VMT / Person - Workers Excluding Students	Absentee	HBW	VMT*				
Adjustments for comparison to model HBW VMT	90%	73%	212,555				
			7.11				

* The 2% growth factor was applied to all Home-Based Work trips including HBW trips on campus. This is a conservative approach for campus trips.

** For the comparison to the VTA model threshold, the manual calculation is reduced to reflect that HBW trips are only 73% of trips at the work place and by 10% for daily absenteeism.

*** No adjustments required for Student or Resident VMT since the calculated and model results are directly comparable.

STANFORD FALL 2035 WITH PROJECT
WORKER STUDENT VMT (COMMUTE 100% HOME BASED)

Col >	B	C	D	E	F	G	H	I	J	K	L	M	N	O
Row	Workers	Workers / Students	Commute Population	Commute Frequency	Vehicle Mode Split	Vehicle Occup	Daily				Annual			
							Total Daily Vehicle Trips	Home - Work Trip Length	VMT	VMT / Capita	Days per Year	VT	VMT	VMT / Capita
6	Benefit Eligible Employees													
7	Off Campus - Faculty	2,195	2,195	92%	58%	1.14	2,041	12.47	25,447	11.59	222	453,020	5,649,158	2,574
8	Off-Campus - Staff	11,423	11,423	92%	58%	1.14	10,620	12.47	132,427	11.59	222	2,357,561	29,398,787	2,574
9	University Terrace*	180	180	92%	58%	1.00	192	2.00	384	2.13	222	42,645	85,291	474
10	On Campus - Faculty/Staff in Faculty Subdivision**	899	899	92%	58%	100%	959	2.0	1,918.8	2.13	222	212989.6416	425,979	473.8
11	On Campus - Faculty/Staff within GUP Study Area	588	588	92%	58%	1.00	628	1.00	628	1.07	222	139,308	139,308	237
12	Post-Docs													
13	Off-Campus	3,336	3,336	96%	31%	1.18	1,656	9.48	15,699	4.71	222	367,634	3,485,170	1,045
14	On-Campus	28	28	96%	0%	100%	0	9.5	0.0	0.00	222	0	0	0.0
15	Casual	2,746	2,746	20%	80%	1.10	797	13.39	10,665	3.88	222	176,826	2,367,699	862
16	Contingent	1,294	1,294	52%	63%	1.09	775	12.25	9,495	7.34	222	172,068	2,107,835	1,629
17	Temporary	1,835	1,835	78%	65%	1.16	1,594	12.76	20,344	11.09	222	353,942	4,516,305	2,462
18	Non-Employee Affiliates													
19	Non-Employee Affiliates: 20% FTEs	1,662	1,662	17%	83%	1.05	447	11.88	5,308	3.19	222	99,182	1,178,277	709
20	Non-Employee Affiliates: FTEs	1,818	1,818	85%	83%	1.05	2,443	11.88	29,026	15.96	222	542,399	6,443,705	3,544
21	Subtotal Workers (Stanford Employees)	28,003	28,003				22,151	11.35	251,340	8.98	222	4,917,575	55,797,514	1,993
22	Third Party Contractors	396	396	100%	87%	1.07	643	14.21	9,132	23.08	222	142,671	2,027,352	5,124
23	Janitorial Shift Workers	316	316	100%	87%	1.07	514	14.21	7,300	23.08	222	114,049	1,620,630	5,124
24	Construction	1,200	1,200	100%	87%	1.07	1,949	14.21	27,698	23.08	222	432,713	6,148,856	5,124
25	Subtotal Workers (Contract Workers)	1,912	1,912				3,106	14.21	44,130	23.08	na	689,433	9,796,838	5,124
26	First Mile to Transit All Workers (Carpool)			94%	1%	2.00	342	5.02	1,717	0.06	222	75,918	381,108	13
27	First Mile to Transit All Workers (Drive-Alone)			91%	9%	1.00	4,900	4.08	19,993	0.67	222	1,087,856	4,438,453	148
28	First Mile to Transit (all workers)						5,242	4.14	21,710	0.73	na	1,163,774	4,819,561	161
29	Total Workers (excluding students)	29,915	29,915				30,499	10.40	317,180	10.60	na	6,770,782	70,413,912	2,354
30	Students													
31	Off Campus - Graduate	2,545	2,545	82%	41%	1.12	1,528	9.15	13,982	5.49	208	317,833	2,908,174	1,143
32	First Mile to Transit (Carpool)			100%	0.4%	2.00	11	2.42	26	0.01	208	2,239	5,419	2
33	First Mile to Transit (Drive-Alone)			92%	1%	1.00	54	2.56	139	0.05	208	11,330	29,004	11
34	Off Campus - Undergraduate	468	468	89%	50%	1.12	370	7.29	2,696	5.76	150	55,470	404,378	864
35	Non-Matriculated (trips in visitor trips)	1,397	0	0%	0%	1.00	0	0.00	0	0.00	208	0	0	0
36	Subtotal Student Non-resident	4,410	3,013				1,963	8.58	16,843	5.59	na	386,873	3,346,976	1,111
37	Resident - Graduate	8,183	8,183	100%	0%	1.00	0	1.00	0	0.00	208	0	0	0
38	Resident -Uundergraduate	8,317	8,317	100%	0%	1.00	0	1.00	0	0.00	150	0	0	0
39	Subtotal Student Residents	16,500	16,500				0	1.00	0	0.00	na	0	0	0
40	Total Stanford Students	20,910	19,513				1,963		16,843	0.86	na	386,873	3,346,976	172
41	Total Wokers (including Students)	50,825	49,428				32,462		334,023	6.76	na	7,157,654	73,760,888	1,492

* University Terrace is located very close to the campus in the area bounded by Page Mill Road, California Avenue and Hanover Street.

** The Faculty Subdivision is housing areas adjacent to the campus, outside the GUP study area. The area is bounded by Junipero Serra Blvd, Page Mill Road, Bowdoin Avenue, and Mayfield Road

Column C
Workers & Students provided by Stanford Land Use Environmental Planning (LUEP) / Institutional Research & Decision Support (IRDS)

Column D
Population equals workers or student except for Non-Matriculating Students whose trips are treated as visitors. Residential tables add family members.

Column E
P&TS Annual Survey (2015) commute frequency adjustment for how often workers come to campus

Column F
P&TS Annual Survey (2015) vehicle mode split including drive alone, carpool, and vanpool

For non Stanford workers (third party, janitorial and construction) mode split from Census Fact Finder 2014 Journey to Work data Santa Clara County workers

Column G
P&TS Annual Survey (2015) vehicle occupancy drive alone = 1, carpool = 2 and vanpool = 5

Column H
Calculation = Population * Commute Frequenct * Vehicle Mode Split / Vehicle Occupancy * 2

Column I
Average one-way trip length ror campus workers and off campus students, calculated by P&TS from place of residence and survey mode choice data

For non Stanford workers (third party, janitorial and construction) HBW trip length from the Santa Clara Valley Transportation Authority (VTA) 2015 model checked against California Household Transportation Survey (CHTS) 2012 for Santa Clara County workers

Column J
Calculation = Daily Vehicle Trips x Trip Length

Column K
Calculation total VMT / total population

Column L
Work day estimated by P&TS adjusting for weekends, holidays and standard PTO for Stanford

Students estiamted by P&TS based on academic schedule for Grad and Undergrads

Columns M, N, & O
Calculations daily VT & VMT times number of days per year and VMT divided by population

Journey to work, FactFinders, 2014	Mode	%
	Drive Alone	76.5%
	2-person	8.2%
	3-person	1.4%
	4+ person	0.8%
	Total	86.9%
	Persns/Veh	1.07

http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk

STANFORD FALL 2035 WITH PROJECT VMT
RESIDENTIAL DAILY VMT

	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z		
Resident Type	Stanford Affiliates Units/Affilia tes	Population	Daily Trips (weekday)	Palo Alto Distribution		Stanford Workforce HBW Adjustment	Stanford Adjusted		HBO		Vehicle Trips				Trip Length (miles)				Total Daily VMT (Weekday)								
				HBW	HBO		HBW	HBO	External	Internal	HBW		HBO		HBW		HBO		HBW		HBO		Total	VMT / capita	Average Trip Len		
				%	%		%	%	%	%	External	Internal	External	Internal	External	Internal	External	Internal	External	Internal	External	Internal					
Existing				Used for Calculating Columns H & I																							
Faculty / Staff	588	1,511	4,637	24%	76%	100%	24%	76%	85%	15%	485	628	2,996	528	11.17	1.0	6.34	1.0	5,423	628	18,995	528	25,573	16.92	5.5		
Graduate Student	8,183	9,497	26,751	24%	76%	12%	3%	97%	70%	30%	738	0	18,209	7,804	11.17	1.0	6.34	1.0	8,243	0	115,445	7,804	131,493	13.85	4.9		
Undergraduate Student	8,317	8,317	12,143	24%	76%	0%	0%	100%	50%	50%	0	0	6,072	6,071	11.17	1.0	6.34	1.0	0	0	38,496	6,071	44,567	5.36	3.7		
Post Doctoral	28	28	92	24%	76%	0%	0%	100%	70%	30%	0	0	64	28	11.17	1.0	6.34	1.0	0	0	406	28	434	15.49	4.7		
	17,116	19,353	43,623									1,223	628	27,341	14,431					13,666	628	173,342	14,431	202,067	10.44	4.6	

Column B	Affiliates Households for Faculty Staff / Students for Graduates & Undergraduates Source: Land Use & Environmental Planning, Institutional Research & Decision Support							Column J & K	External / Internal Trips Split derived from P&TS Survey info on peak period travel
Cloumn C	Population	Fall 2015		2018 GUP		2035 GUP		Column L	Column D * Column H
		Affiliates	Population	Affiliates	Population	Affiliates pulation		Column M	Come from Worker Student VMT - "Resident Faculty/Staff Inside Cordon" Column H
	F/S	38	98	38	98	588	1,511		
	Grads	5,001	6,065	5,245	6,531	8,183	9,497	Column N	Column D * Column J
	UG	6,401	6,401	6,617	6,617	8,317	8,317		
	Post Doc	28	28	28	28	28	28	Column O	Column D - Column L -- Column M - Column O
		12,592		13,274		19,353			
Column D	Daily Trip Generation (Fehr & Peers)							Column P, Q, R, S	Trip Length HBW & HBO trip lengths from from VTA 2015 model checked against CHTS 2012 for Palo Alto Residents Interal trip length F&P assumption based on campus size (~2 miles wide)
	Affiliate	Number	Rate	Trips	Residential trip generation rates are based on ground counts at existing sites on-campus and parking permit data. Additional detail in report.				
	Faculty	588	7.89	4,637					
	Grads	8,183	3.27	26,751					
	Undergrad	8,317	1.46	12,143					Column T, U, V, W
	Post Doc	28	3.27	92					Calculated Daily VMT
Columns E & F	Relationship of HBW to HBO for Palo Alto Residents for weekdays from California Household Transportation Survey 2012							Column X	Total Daily VMT (Sum of T, U, V & W)
Column G	Stanford Force Adjustment - modified Palo Alto distribution of HBW and HBO trips based on the relation of Graduate affiliates to spouses.							Column Y	Total VMT / Total Population
Columnsn H & I	Adjusted HBW & HBO split for daily trips to reflect fewer external HBW trips for students.							Column Z	Total VMT / Total Trips

STANFORD FALL 2035 WITH PROJECT VMT
ANNUAL VMT SUMMARY

Category	Annual VMT Total Population			Source Tab
Workers	People	VT	Annual VMT	
Worker Commute - all employee types including all resident F/S	● 29,915	6,770,782	70,413,912	Worker-Student D29, M29, N29
Student Commute to Campus (live off campus)	● 3,013	386,873	3,346,976	Worker-Student D36, M36, N36
Resident Students - Grad / Undergrad	● 16,500	0	0	Worker-Student D39, M39, N39
Residents				
<i>Home-based Work / Home-based Other</i>			(All Trips)	
Faculty / Staff (including family members)	● 1,511	1,463,463	9,574,762	Resident Annual C9, T9, U9
Graduate Students (including family members)	● 9,497	8,613,822	45,087,773	Resident Annual C10, T10, U10
Undergraduate Students	● 8,317	2,550,030	9,891,078	Resident Annual C11, T11, U11
Post Doctoral	● 28	33,580	168,975	Resident Annual C12, T12, U12
Visitors				
General Visitors (Vendor) - business/academic meetings, deliveries by auto, informal unhosted conferences	●	5,313,101	32,968,952	Other GHG Inputs H27
Worker Non-Commute Trips	●	397,810	1,234,221	Other GHG Inputs H28
Deliveries via trucks	●	442,856	2,747,957	Other GHG Inputs H29
Non-event Visitor Trips - Alumni Center, Conferences, Tours distributed over 303 days excludes Sundays & Holidays	●		4,065,599	Other GHG Inputs H31
Event Visitor Traffic (not typical weekday)	●		6,980,045	Other GHG Inputs H30
Marguerite Shuttle/Bus Fleet	●		2,618,108	Other GHG Inputs H21
PSSI Fleet	●		2,601,593	Other GHG Inputs H22
Bonair Fleet	●		3,586,974	Other GHG Inputs H23
Public Safety Fleet	●		232,720	Other GHG Inputs H24
Totals	● 68,781	25,972,316	195,519,644	

STANFORD FALL 2035 WITH PROJECT VMT
RESIDENTIAL ANNUAL VMT

	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	
				Weekday						Weekends / Holidays											
Resident Type	Stanford Affiliates Units/Affilia tes	Population	Daily Trips (weekday)	Vehicle Trips				Total	Annual	Vehicle Trips				Trip Length							
				HBW		HBO				HBW		HBO		HBW	HBO	Internal	Total	Total	Total	Total	
				External	Internal	External	Internal	VMT	VMT	External	Internal	External	Internal	miles/trip	miles/trip	miles/trip	Daily	Annual	VT	VMT	
Existing																					
Faculty / Staff	588	1,511	4,637	485	0	2,996	528	25,573	6,418,832	0	0	3,481	528	5.10	7.80	1.00	27,684	3,155,930	1,463,463	9,574,762	
Graduate Student	8,183	9,497	26,751	738	0	18,209	7,804	131,493	27,350,444	0	0	18,947	7,804	5.10	7.80	1.00	155,591	17,737,328	8,613,822	45,087,773	
Undergraduate Student	8,317	8,317	12,143	0	0	6,072	6,071	44,567	6,685,122	0	0	6,072	6,071	5.10	7.80	1.00	53,433	3,205,956	2,550,030	9,891,078	
Post Doctoral	28	28	92	0	0	64	28	434	108,874	0	0	64	28	5.10	7.80	1.00	527	60,101	33,580	168,975	
	17,116	19,353	43,623	1,223	0	27,341	14,431	202,067	40,563,272	0	0	28,564	14,431				237,234	24,159,315	12,660,895	64,722,587	

Columns B through I		F/S Week daysper year	251	52 Weekends / 10 Holiday days per year	114
	Carried over from Residential VMT Daily Calculation	Graduate Week days per year	208	52 Weekends / 10 Holiday days per year	114
	Column F is not carried over to avoid double counting affiliate HBW trips.	UG Week days per year	150	30 Weekends / No Holiday days per year	60
		Post Doc Week daysper year	251 Same as F/S	52 Weekends / 10 Holiday days per year	114

Column J	Calculated annual week day VMT using week days shown below calculations											
Columns K, L, M, N	Weekend trip generation was assumed to be equal to daily based on ITE Trip Generation data.					ITE Trips Rates						
	ITE shows that Saturday trip generation is 5 - 9 percent higher and Sunday is 8 percent lower.					Saturday						
	Assumed that all trips are HBO trips.					Sunday						
	Used same internal to external relationship for weekend trips.					Averaged						
	Single Family Housing - Faculty					D.U.	9.57	10.08	105%	8.77	92%	98%
	Condo/Townhouse - Faculty					D.U.	6.59	7.16	109%	6.07	92%	100%
	Graduate Apartments - Low Rise					D.U.	6.59	7.16	109%	6.07	92%	100%

Columns O, P, Q Weekend trip lengths from California Household Transportation Suvey 2012 data for Palo Alto

Column R Calculated average weekend daily VMT = trips x trip length

Column S Calculated annual weekend VMT using weekend daily VMT and weekend/holiday days shown

Column T Total Daily Vehicle Trips = Column I + Column R

Column U Total Daily Vehicle Miles Traveled = Column J + Column S

STANFORD FALL 2035 WITH PROJECT VMT
OTHER GREENHOUSE GAS VMT

	B	C	D	E	F	G	H	I	J	K	L	M	N
Categories	Population	Mode Split: % Driving	Persons/ vehicle	Trips per Vehicle per Year	Total Vehicle Trips	Trip Length [miles]	Fall 2015 Total VMT		2018 Baseline		2035 GUP	Fleet Assumption (Passenger, Vans, Bus, Mix)	Proposal for Scaling for 2018/2035
Athletic events	411,250	68%	3	2	186,083	26.0	4,838,167	0%	4,838,167	0%	4,838,167	Passenger	No change
Alumni center	53,540	75%	1.25	2	64,248	25.0	1,606,200	8%	1,734,696	22%	2,118,064	Passenger	KSF
Big 5	50,000	75%	2.5	2	30,000	25.0	750,000	3%	769,500	17%	900,315	Passenger	Students
Conferences - to and from	20,472	75%	1.25	2	24,566	25.0	614,160	8%	663,293	22%	809,881	Passenger	KSF
Conferences - during	20,472	25%	1.25	6	24,566	2.5	61,416	8%	66,329	22%	80,988	Passenger	KSF
Camps (DAPER) - Visitors	6,079	100%	2	4	12,157	25.0	303,925	3%	314,258	26%	395,966	Passenger	UG Beds
Camps (DAPER) - Locals	6,079	100%	2	6	18,236	10.0	182,355	3%	188,555	26%	237,579	Passenger	UG Beds
Walking Tours - Buses	40,000	100%	40	2	2,000	25.0	50,000	0%	50,000	0%	50,000	Passenger	No change
Walking Tours - Cars	40,000	100%	3	2	26,667	25.0	666,667	0%	666,667	0%	666,667	Passenger	No change
Stanford Live Performances, Major events	64,388	75%	2	2	48,291	10.0	482,910	0%	482,910	0%	482,910	Passenger	No change
Visitors by Tour Bus	170,000	100%	40	2	8,500	40.0	340,000	0%	340,000	0%	340,000	Coach buses, Vans	No change
Executive Education - to and from	1,300	100%	1	2	2,600	25.0	65,000	8%	70,200	22%	85,714	Passenger	KSF
Executive Education - during	1,300	25%	1	6	1,950	10.0	19,500	8%	21,060	22%	25,714	Passenger	KSF
Camps (Academic) - Visitors	300	100%	2	2	300	25.0	7,500	3%	7,755	26%	9,771	Passenger	UG Beds
Camps (Academic) - Locals	300	100%	2	2	300	10.0	3,000	3%	3,102	26%	3,909	Passenger	UG Beds
Marguerite Shuttle/Bus Fleet							1,983,931	8%	2,144,233	22%	2,618,108	Bus	KSF
LBRE Fleet							2,601,593	0%	2,601,593	0%	2,601,593	Mix	No change
Bonair Fleet							3,775,762	-5%	3,586,974	0%	3,586,974	Mix	No change
Public Safety Fleet							232,720	0%	232,720	0%	232,720	Passenger	No change

Category	Annual Trips	Daily Trips	Fall 2015	2018 Baseline	2035 GUP	Avg Day Cordon	Number of days
Vendors / business or academic meetings			25,001,480	8%	27,001,598	22%	32,968,952 Passenger
Worker Non-commute - Personal Business			935,952	8%	1,010,828	22%	1,234,221 Passenger
Deliveries / trucks @ 2% of traffic			2,083,870	8%	2,250,579	22%	2,747,957 Trucks
Event Trips	540,995	299,917	NA	6,652,357	6,695,507	6,980,045	
Non-Event Trips (daily)	344,484	150,547	500	3,338,443	3,520,985	4,065,599	11,088 303
Fleet Vehicles		NA	NA	8,594,006	8,565,520	9,039,395	

Column B Estiamted attendance provided by Stanford Event Planning or Athletics
Column C Ramboll assumption
Column D Ramboll assumption
Column E 2 - in/out or 6 include mid-day or evening trips by attendees
Column F Column B * Column C / Column D * Column E
Column G Ramboll assumption
Column H Column F * Column G
Columns I & K Growth assumption as documented in Column N
Columns J & L Calculated using I & K
Column M Vehicle type for emissions calculation
Column N Basis for growth in 2018 and 2035