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Date:
October 4, 2019

To:
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Sylvia Gallegos
Deputy County Executive, County of Santa Clara
Geoff Bradley, M-Group

Memo

Subject: Reverse Commute Performance Standard Recommended for the Proposed Stanford University General Use Permit Conditions of Approval

Background

The 2018 Stanford General Use Permit (GUP) proposes development of a maximum of 3,500,000 square feet of academic development and student beds. These developments will be implemented in 25% increments or phases, each over a 5-year interval or more, subjected to review for compliance with the conditions of approval at the end of each phase. AECOM has worked closely with the County of Santa Clara to help establish a three-tier system to ensure that development under the proposed GUP would not substantially worsen traffic congestion affecting the surrounding area or otherwise be detrimental to the public health, safety or general welfare[1]:

- Tier 1—no net new commute trips during peak hour/direction and 3-hour peak period;
- Tier 2—no exceedance of reverse commute trips baseline during peak hour and peak period; and,
- Tier 3—limit growth in average daily traffic.[2]

Reverse Commute Trips

Typically, a reverse commute trip is defined as a trip from the urban core of a metropolitan area to the suburban or exurban periphery in the morning and returning to the urban core in the evening. The term is almost universally applied to trips to work or school in the suburbs or exurbs from homes in the urban core. By contrast, the "regular" commute direction is from a home in the periphery to work or school in the urban core.

The traditional model of commuter traffic patterns (from a home in the periphery to work or school in the urban core) is not always directly applicable to all metropolitan areas, particularly those in the Sun Belt region, stretching from the Southeast to the Southwest and portions of the Western United States. These regions experienced substantial development growth after World War II, with major employment concentrations outside of the traditional urban core, leading to a more decentralized or polycentric model for commute travel. In the Los Angeles Basin, for example, the Santa Monica Freeway carries more traffic in the morning peak hour heading westbound towards Santa Monica than eastbound towards Downtown Los Angeles.

[1] County of Santa Clara Zoning Ordinance §§ 5.20.120, 5.65.030
[2] Average Daily Trips (ADT) are the total number of automobile trips, both inbound and outbound, within a 24-hour weekday period

The presumption behind the concept of a reverse commute trip is that the commuter is traveling in the opposite direction of the regular (i.e., dominant) traffic flow and therefore encounters less traffic congestion than faced by regular commuters. The reverse commuter typically takes advantage of otherwise unused transportation capacity that additional public transit service or travel lanes are usually not necessary to accommodate them. In addition, increasing reverse commute trips with the hope of reducing the dominant commute trips at the same time, makes sense where the infrastructures would see more balanced use in both directions. Otherwise highways and public transit will be highly congested in one direction while being almost empty in the other direction, which is an inefficient use of the resources and the capital investment of the infrastructure.

Stanford University represents a non-traditional situation in terms of commute travel. Although located outside the urban core of the Bay Area, Stanford is a large "trip attracter" (as opposed to a "trip generator" like a residential area). The campus serves an enrollment of approximately 17,000 students and more than 13,000 jobs[3]. It experiences high volumes of trips twice in a day: inbound peak in the morning and outbound peak in the evening.

The 2000 GUP traffic monitoring program identifies Stanford as the job center; the emphasis is placed on the effects caused by traffic heading to the campus in the morning and leaving the campus in the evening. However, a large number of people also live on or near the campus and will travel all across the Bay Area for work and school, including Silicon Valley to the south and San Francisco, the Peninsula, and the North Bay (to the north), and the East Bay (to the east). In this case, the "reverse commute trip" is defined as trips going the opposite direction as dominant travel.

While campus housing is primarily intended to serve Stanford students, faculty, and staff, many of these households will have other members (e.g., spouses, children) who will work or go to school off-campus. Therefore, even though housing more Stanford students, faculty and staff on campus will reduce the commuting for these individuals in the commute direction, the reductions may be offset by other members of these households traveling off-campus for work or school during commute hours. This can be seen in Table 1 that shows the number of trips eliminated by the proposed additional housing together with the trips brought about by it per traditional trip generation calculation. Considering both outbound and inbound trips, the additional housing on campus could remove up to 350 trips in the morning peak hour and up to 344 trips in the evening. But in turn, it would add about 1,000 trips during either of the peak hours. The outbound trips generated by housing in the morning and inbound trips generated in the evening are greater than 600 trips in both cases (before any off-sets) and they track close to the main commute direction trips that are regulated under the existing peak hour monitoring measures. Hence, the reverse commute trips should be subjected to the same level of monitoring and management as they are in the same magnitude as the main commute direction.

In addition, the "reverse commute" direction for campus housing coincides with the "peak direction" for residents in the surrounding communities. The reverse commute trips leaving the campus in the morning and entering the campus in the evening will be adding to the peak direction trips made by residents from the surrounding communities. This has led to to some community members expressing concern about the impact of additional on-campus housing development on

[3] https://facts.stanford.edu/ & https://facts.stanford.edu/administration/

traffic because the addition of significantly more housing under the proposed GUP at Stanford could increase commute traffic to other parts of the Bay Area from the Palo Alto area.

Table 1 Trips Generated by Proposed Additional Housing on Campus[4].

Trip Type	AM Peak Hour			PM Peak Hour		
	In	Out	Total	In	Out	Total
Full Offset Housing Alternative						
Commuter Trips Eliminated	(244)	(106)	(350)	(130)	(213)	(344)
Resident Trips Added	357	664	1,021	625	459	1,084
Net Number of trips	113	558	671	495	246	740
Half Offset Housing Alternative						
Commuter Trips Eliminated	(122)	(53)	(175)	(65)	(107)	(172)
Resident Trips Added	179	332	510	313	229	542
Net number of trips	56	279	335	247	123	370

With the proposed increase in employment under the GUP and coupled with the acute lack of affordable housing and market-rate housing in the areas surrounding Stanford and the regulatory structure requiring Stanford to construct housing commensurate with its academic development, the County of Santa Clara is recommending in the conditions of approval for the proposed GUP that a minimum of 2,172 housing units be constructed. To ensure that traffic generated from these new housing units constructed at Stanford will not substantially worsen traffic congestion in the surrounding area, the County is proposing the application of a new "reverse commute" monitoring requirement for the GUP in addition to the "peak" (i.e., commute) direction monitoring that has been in effect for nearly 20 years. The intent of this is to protect surrounding intersections from being further impacted by increased reverse commute travel associated with the GUP development.

Keeping a close eye on reverse commute trips generated by new development has local precedent whether as a trip cap or a per-trip fee. The City of Palo Alto recently implemented a new "Citywide Transportation Impact Fee"[5] based on a standard traffic analysis process[6] coefficients for peak hour traffic. However, trip generation is only the first step in the traffic analysis process—it is the second step (trip distribution) that forecasts where the new trips will be going to or coming from. Thus, this fee is based on trips traveling in any direction (commute or reverse commute).

Ultimately, the intent of the reverse commute monitoring is to ensure that traffic congestion in the areas around the campus is not substantially worsened over time by new campus housing development and to encourage Stanford to continue its success in expanding and innovating its award-winning transportation demand management program (TDM).

[4] Stanford 2018 GUP: Housing Alternatives TIA, April 2018
[5] https://www.cityofpaloalto.org/civicax/filebank/documents/63250 accessed in 10/2/2019
[6] The traditional four-step model has been widely used in travel demand forecasting. It considers trip generation (travel choice), trip distribution (destination choice), modal split (mode choice) and traffic assignment (route choice) sequentially in a top-down sequential process (Ortuzar and Willumsen, 2001).

Data from the Reverse Commute Traffic Impact Analysis

All of the data presented below are from the Fehr & Peers memorandum dated October 5, 2018 (see Attachment A), except for Table 7 which is calculated from that data.

The 2018 GUP EIR included a Traffic Impact Analysis, with trip generation projections for commute direction and reverse commute direction trips. Table 2 displays the projected trip generation of the proposed GUP developments. For the purposes of this discussion, the Stanford campus is characterized as the employment destination, with the main commute being inbound during the AM peak hour and outbound during the PM peak hour. Reverse commute direction would be outbound during the AM peak hour and inbound during the PM peak hour.

Table 2 - Trips Generated by Proposed GUP development (without additional Housing)

	AM Peak Hour			PM Peak Hour		
	In	Out	Total	In	Out	Total
Total GUP Trips	751	428	1179	600	779	1379

Note: "Reverse Commute" direction highlighted in grey

The net number of trips generated by the proposed additional housing on campus (after the offset in the main commute direction) are extracted from Table 1 and shown in Table 3. It shows that the Full Offset Housing alternative could produce as many outbound trips in the AM peak and inbound trips in the PM peak as proposed by Stanford in its original GUP application shown in Table 2.

Table 3 - Additional Trips Generated by Additional Housing

	AM Peak Hour			PM Peak Hour		
	In	Out	Total	In	Out	Total
Full Offset Housing	113	558	671	495	246	740
Half Offset Housing	56	279	335	247	123	370

Note: "Reverse Commute" Direction highlighted in grey

Adding Table 2 and Table 3 will give the total number of trips generated by the GUP development with the additional on-campus housing as shown Table 4. The reverse commute trips generated by the Full Offset Housing alternative are doubled from the reverse commute trips generated by Stanford's GUP application (Table 2). This table clearly shows that the reverse commute trips increase to the same magnitude as the main commute directions. The reverse commute should therefore be given the same amount of attention as the main commute direction as it is no longer a "negligible" portion of the campus trip generation. This is further demonstrated below where the discussion looks at the number of study intersections affected by the increase in reverse commute trips.

Table 4 - Total Trips generated by GUP with additional Housing

	AM Peak Hour			PM Peak Hour		
	In	Out	Total	In	Out	Total
Full Offset Housing	864	986	1,850	1,095	1,025	2,119
Half Offset Housing	807	707	1,514	847	902	1,749

Note: "Reverse Commute" Direction highlighted in grey

In order to isolate the impacts of the new campus housing in the reverse commute direction, Stanford's consultant Fehr & Peers performed an analysis on the surrounding roadways using only the reverse commute trips. The results of the Fehr & Peers' "reverse commute" analysis under the 2035 cumulative conditions (i.e. full built-out of the GUP and/or its alternatives) are summarized below in Table 5. As shown in Table 5, the number of intersections impacted by only the reverse commute trips could double or triple, depending on which housing alternative is selected. As such, a reverse commute threshold is appropriate to continue to encourage Stanford to provide programs and services that prevent GUP related development from substantially worsening traffic in the area or adversely impacting public health or safety.

Table 5 - Number of Intersections Impacted by Reverse Commute Trips only

	AM Peak Hour	PM Peak Hour
Total GUP Trips	1	2
Full Offset Housing	3	6
Half Offset Housing	2	4

Reverse Commute Monitoring Baseline and Threshold

As the Stanford campus traffic monitoring program has been effective over nearly 20 years (since 2001) AECOM recommends that the methodology to determine the reverse commute trip baseline and exceedance threshold be the same as it is used in the current monitoring program. The existing traffic monitoring program has collected a substantial amount of data on traffic volumes in both commute and reverse commute directions over the years, which can be used to support the application of trip caps in the reverse commute direction. For example, data collected from the traffic monitoring program can be used to estimate an average volume (over several years) for the peak periods and peak hours, establishing a statistically defensible baseline.

For illustrative purposes, an estimation of the reverse commute trip baseline volumes for the AM and PM peak periods and peak hours, based on historical data collected for the traffic monitoring program, are shown in Table 6. These numbers are obtained from the graphs as indicated in Attachment A. If the proposed methodology is adopted, detailed monitoring and calculations will be performed to establish the actual baseline.

Table 6 – Estimated[7] Baseline for Reverse Commute

	AM	PM
Peak Period	4,700	7,200
Peak Hour	1,800	2,500

It is proposed that an allowance of 2% overage from the established baseline (estimated in Table 6) be used for the reverse commute trips monitoring instead of the 1% overage applied in the peak commute direction. This threshold is to allow for variation in traffic. The intent is to ensure that the reverse commute traffic remain constant (baseline level) and not increase uncontrollably that the conditions become substantially worse over time. The higher percentage is appropriate to maintain approximately the same number of threshold trips for the reverse commute direction as the peak direction. From a statistical standpoint, this data is derived from 18 years of traffic monitoring which provides a solid data foundation known to be true. Table 7 compares the trigger

[7] Values used in Table 6 are for discussion purpose only as currently only historical data from the monitoring program is available. It is not definitive that the eventual baselines established will be exactly these numbers. Actual calculations will have to be performed to determine the actual baselines to be used.

volumes for both directions using the proposed 2% threshold reverse commute trips and the established 1% threshold for the commute direction during the peak hour and peak periods.

Table 7 – Comparison of Trigger Volumes

	AM		PM	
	Main Commute (1%)	**Reverse Commute (2%)**	**Main Commute (1%)**	**Reverse Commute (2%)**
Peak Period	100*	94*	100	144*
Peak Hour	35	36*	36	50*

*Estimated values. Peak period thresholds for main commute direction are also estimates because actual baselines have not been established.

In the reverse commute analysis memo referenced throughout this document, Stanford pointed out that "data collected during implementation of the 2000 GUP do not support an assumption that an increase in reverse commute direction vehicle trips would occur."[8] It also stated that historical data indicated that Stanford's TDM program "has effectively controlled the growth of reverse commute direction trips, in addition to commute direction trips." In addition, similar to the adopted monitoring methodology for commute trips, the methodology for reverse commute trips could include requests for and application of relevant approved trip credits, as well as potential adjustments for cut-through and hospital-related trips.

Monitoring the reverse commute volumes during phase 1 may be preferable due to the long duration of the GUP, calculating the exact threshold trips (based on the recommended 2%) and determining the consequences for exceeding it during phase 2. In addition, it is suggested that non-compliance for Stanford be defined as exceeding the 2% threshold in two years out of any three years. This clarification will allow for unexpected traffic fluctuation unrelated to Stanford and gives the university sufficient time to improve or expand its transportation demand management measures. Throughout the 20-year history of the existing monitoring program, Stanford has never exceeded the main commute direction threshold for two years out of any three years. In addition, as discussed above and shown on the graphs in Attachment A, the reverse commute trips have remained fairly constant despite the steady increase of on-campus housing over the years as approved under the 2000 GUP.

Recommendations

The recommendations explained in this memo are summarized in brief below:

- Reverse commute trip count data should be tabulated and formally noted in the monitoring report beginning in 2020.
- A 2% exceedance threshold based on the peak hour and peak period reverse commute volumes to ensure that the reverse commute trips are kept constant throughout the GUP period.
- At the beginning of the Phase 2 development, the reverse commute trip baselines should be determined. A Stanford prepared reverse commute management plan should also be required by the County at this time. Traffic over the defined standard during the remainder of the GUP should require a deficiency plan to provide an opportunity for refinements and improvements to the reverse commute trip reduction programs. Additional consequences should be as determined by the County.

[8] See page 2 of Attachment A

- The data collection methodology for the 2018 GUP should remain consistent with the traffic counting system established under the 2000 GUP. This would include the application of adjustments in the same manner that they are applied to the peak hour data. Any methodological refinements to the data collection implemented over time should also be applied to reverse commute trip counts.
- Stanford should be considered in non-compliance with the established reverse commute threshold if it is exceeded in two out of three years.
- Trip Credits may be used to offset traffic count overages and keep Stanford in compliance per this threshold

Attachment A

FEHR PEERS

MEMORANDUM

(Note: Appendices not included)

Date: October 5, 2018

To: Lesley Lowe, Stanford University

From: Ellen Poling and Ashley Brooks, Fehr & Peers

Subject: 2018 Stanford General Use Permit: Reverse-Commute Analysis

SJ15-1585.01

A. Introduction

The purpose of this memorandum is to assist the County of Santa Clara in responding to comments on the Draft EIR and Recirculated Draft EIR that pose questions as to whether the No Net New Commute Trips monitoring program and performance standard sufficiently addresses the potential impacts caused by vehicle trips in the reverse-commute direction (meaning cars exiting the campus during the morning peak hour, and cars entering the campus during the evening peak hour). This memorandum presents supplementary information regarding mitigation measures to address potential impacts of the 2018 General Use Permit project, as well as Housing Alternatives A and B. This information does not replace or supersede the information presented in the 2018 General Use Permit Draft EIR (October 2017) or the Recirculated Draft EIR (June 2018). Nor does this analysis replace or supersede the information presented in the Transportation Impact Assessment (TIA).

The TIA evaluated the potential impacts of traffic traveling in all directions, based on a conservative assumption that Stanford does not expand its transportation demand management programs to achieve the No Net New Commute Trips standard. The impact analysis therefore assumed an increase in both commute direction vehicle trips and reverse-commute direction vehicle trips would occur. The impact analysis identifies the intersections and freeway segments that would experience significant impacts under this conservative worst-case scenario.

Mitigation Measure 5.15-2 in the Draft EIR addresses the potential impacts of the proposed Project through a tiered approach. First, the mitigation measure requires Stanford to fund County monitoring of the campus gateways. Second, the mitigation measure requires calculation of trip reduction credits approved by the

County of Santa Clara for trips removed outside the campus within the local impact area, and requires a comparison of the number of vehicle trips at the campus gateways as modified by trip reduction credits to a baseline count established in 2001 to determine whether the baseline has been exceeded by more than one percent. Third, the mitigation measure requires a payment of a per trip fee if the comparison in step two is exceeded in two of three years. The per trip fee would be used by the County of Santa Clara to fund further trip reduction measures or to fund intersection improvements identified in the Draft EIR. The Recirculated Draft EIR applies this same mitigation approach to address impacts of Housing Alternatives A and B.

Commenters on the Draft EIR and Recirculated Draft EIR questioned whether a mitigation approach that monitors vehicle trips in the commute direction will ensure that there is not a significant impact triggered by an increase in reverse-commute direction. In other words, could an increase in reverse direction vehicle trips result in significant impacts that are not addressed by Mitigation Measure 5.15-2, even if the No Net New Commute Trips standard is achieved?

Data collected during implementation of the 2000 General Use Permit do not support an assumption that an increase in reverse-commute direction vehicle trips would occur. Historical data, as described in the next section, indicates that Stanford's transportation demand management (TDM) program has effectively controlled the growth of reverse-commute direction trips, in addition to commute direction trips, under the 2000 General Use Permit. Based on these data, it would be reasonable to assume that the mitigation measure, as presented in the Draft EIR, would be sufficient to reduce impacts of the proposed Project to a less-than-significant level. However, given the larger increase in reverse-commute direction trips associated with Housing Alternatives, and to provide an additional measure of conservatism, a sensitivity test has been performed.

For purposes of analysis, it is conservatively assumed that *none* of the reverse direction trips would be reduced by expansion of Stanford's transportation demand management programs. The analysis presented here assesses a scenario in which the No Net New Commute Trips standard is met, such that commute direction trip growth is eliminated, but reverse-commute direction trips are still generated at the existing trip rates.

This analysis then identifies intersections where significant impacts would occur under this conservative scenario, and presents mitigation measures in the form of intersection improvements to address assumed growth in reverse-commute direction trips. Fair share contributions to these intersection improvements could be provided in advance of implementation of the proposed Project or Housing Alternatives to ensure that a significant impact associated with reverse-commute direction trips is mitigated to the extent feasible.

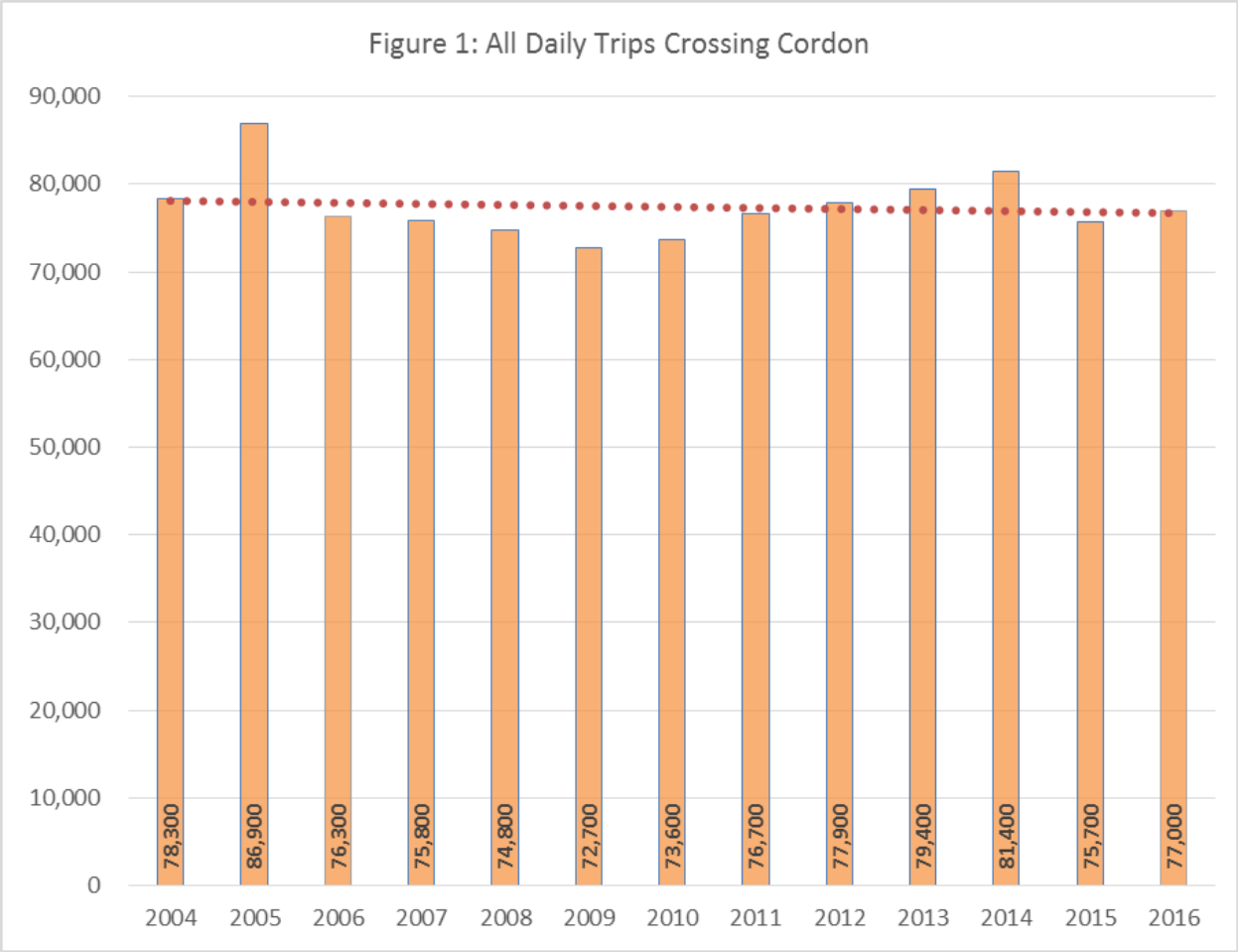
This memorandum also considers an alternative mitigation approach of monitoring trips crossing the campus cordon in the reverse-commute direction. Such an approach would require both monitoring reverse commute-trips, and implementing a new "no net new reverse trips" standard, with intersection improvements as a backup measure if the new standard is not achieved. To establish such a new standard, it would be necessary to establish a baseline to measure no net new reverse trips against; however, such an approach would be infeasible given the absence of baseline data.

B. Commute Direction/Reverse-Commute Direction Vehicle Trip Historical Trends

An analysis of the annual traffic data available from the 2000 General Use Permit traffic monitoring program shows that, while reverse-commute direction trips have varied over the years, volumes of such trips have not grown since 2004 (the first year with a complete available data set).

Daily Traffic Volume History

Figure 1 presents the compilation of all eight weeks (40 weekdays) for each year of traffic monitoring since 2004, with the bars representing the average number of cars crossing the cordons each weekday. Figure 1 demonstrates that, while there has been some fluctuation from year to year, the average daily number of cars crossing the cordon in 2004 was almost identical to the average daily number of cars crossing the cordon in 2016. Thus, while Stanford has met the No Net New Commute Trips standard each year under the 2000 General Use Permit, the data indicate that the University has also been controlling daily traffic volumes entering and exiting the campus. It is important to recognize that the daily volume data have not been processed to remove non-Stanford campus vehicles. The daily volume data include pass-through vehicle trips and trips bound for the Stanford Hospitals. The University is not responsible for non-campus related trips.



Peak Hour Traffic Volume History

Figures 2 and **3** show the average daily traffic flow on an hourly basis at the campus gateways between 2004 and 2016 for the inbound and outbound movements respectively. The graphs illustrate that the daily distribution of traffic at the campus gateways is consistent year by year. There are clear peaks in the AM (at 8:00 AM) and PM (at 5:00 PM) that reflect commuters with relatively fixed schedules (8:00 AM to 5:00 PM). The pattern shows that the morning peak is more pronounced than the evening peak, which is not an atypical pattern for both employment centers and academic institutions.

The data presented in Figures 2 and 3 also indicate that reverse-commute direction trips have not increased over the years covered by the 2000 General Use Permit annual monitoring. In Figure 2, the inbound trips in the PM peak hour, 5:00 PM – 6:00 PM, have varied by about 300 trips, and in Figure 3, the outbound trips in the AM peak hour (8:00 AM – 9:00 AM) have varied by a similar number. The most recent year in the charts, 2016, shows reverse-commute direction trips during the peak commute hours on the high end of

the variation; however, mid-day trips between the two peak hours in 2016 track approximately at or lower than previous years.

Figure 2: Comparison of Average Hourly Inbound Volume

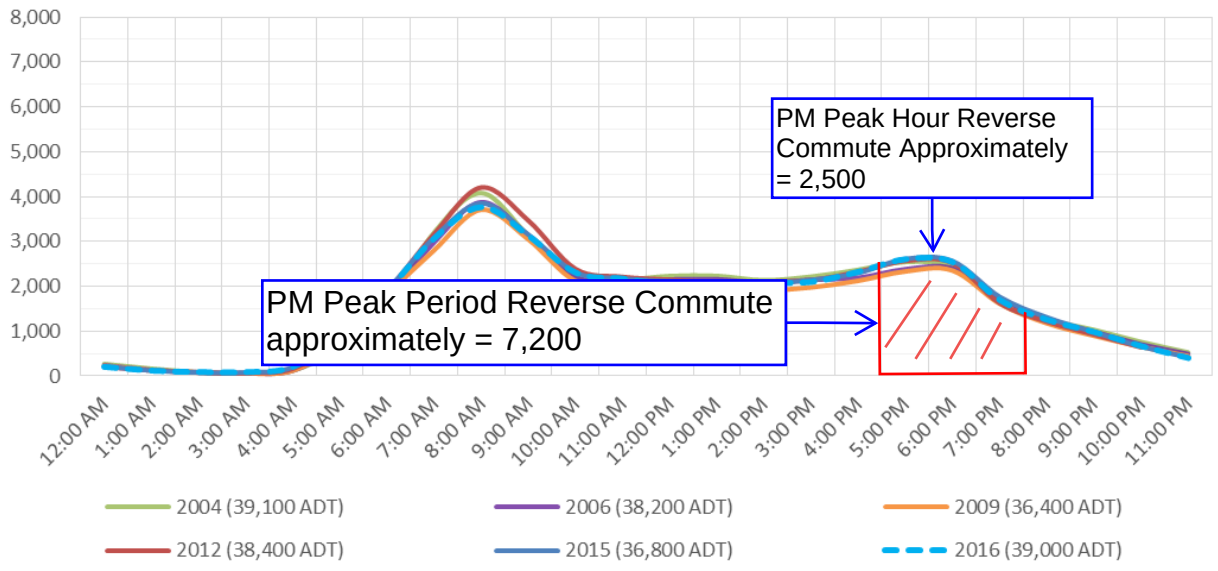
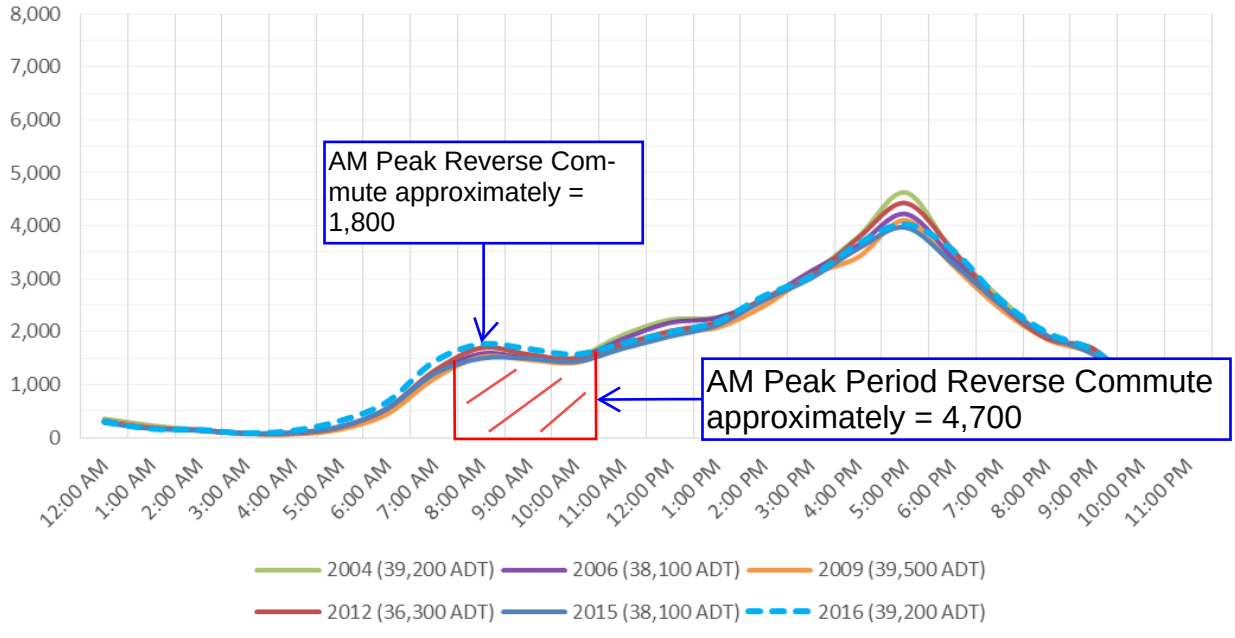


Figure 3: Comparison of Average Hourly Outbound Volume



As with the daily volume data, it is important to recognize that the hourly volume data in Figures 2 and 3 have not been processed to remove non-Stanford campus vehicles. The peak hour volume data presented below include pass-through vehicle trips and trips bound for the Stanford Hospitals. The University is not responsible for non-campus related trips.

C. Reverse-Commute Direction Trips Only Analysis

This analysis conservatively assumes that Stanford achieves the No Net New Commute Trips standard using TDM measures, but that the TDM measures do not have any effect on reverse-commute direction vehicle trips. As described above, this is considered unlikely as historical data indicate that Stanford has controlled the growth in reverse-commute direction trips along with growth in commute direction trips under the 2000 General Use Permit.

This conservative sensitivity analysis was performed for the proposed 2018 General Use Permit, as well as for Housing Alternatives A and B.

Trip Generation

The trip generation for the proposed Project and the two Housing Alternatives was calculated and presented in the Draft EIR and Recirculated Draft EIR, respectively, and a summary of the trip generation totals is presented in **Table 1**.

Table 1: 2018 General Use Permit and Housing Alternatives Trip Generation

Scenario	AM Peak Hour			PM Peak Hour		
	In	Out	Total	In	Out	Total
Draft EIR (proposed Project)	751	428	1,179	600	779	1,379
Recirculated Draft EIR (Alternative B)	807	707	1,514	847	902	1,749
Recirculated Draft EIR (Alternative A)	864	986	1,850	1,095	1,025	2,120

Source: Fehr & Peers, 2017-2018.

The reverse-commute direction trips only analysis uses the trip generation presented in Table 1, without the commute direction trips; this is shown in **Table 2**.

Table 2: General Use Permit – Reverse-Commute Direction Trip Generation Only

Scenario	AM Peak Hour			PM Peak Hour		
	In	Out	Total	In	Out	Total
Draft EIR (proposed Project)	0	428	428	600	0	600
Recirculated Draft EIR (Alternative B)	0	707	707	847	0	847
Recirculated Draft EIR (Alternative A)	0	986	986	1,095	0	1,095

Source: Fehr & Peers, 2018.

Intersection Analysis

The determination of significance for impacts under the reverse-commute direction analysis is based on the same policies, regulations, goals, and guidelines defined by Santa Clara County and the surrounding jurisdictions of San Mateo County, Palo Alto, Menlo Park, East Palo Alto, Mountain View, Los Altos, and Atherton, as described in Section 5.15.5 of the Draft EIR.

The service levels for the reverse-commute direction analysis and the TRAFFIX 8.0 calculation sheets are included in **Attachment A**. **Tables 3 and 4** present a summary of the significantly impacted intersections under the reverse-commute direction analysis for the proposed Project and Housing Alternatives A and B for Background and Cumulative Conditions, respectively.

For the proposed Project and both Housing Alternatives, a total of three intersections with significant impacts are identified under Background (2018) With Project conditions, in the reverse-commute direction analysis; this compares to five intersections significantly impacted with full trip generation, for all three cases. In the Cumulative (2035) analysis, the reverse-commute direction analysis results in significant impacts at three intersections for the proposed project (compares to 21 significant impacts in the full trip generation); five significant impacts for Housing Alternative B (compares to 21 significant impacts in the full trip generation analysis); and eight significant impacts for Housing Alternative A (compares to 23 significant impacts in the full trip generation analysis). The higher reverse-commute direction trips associated with the Housing Alternatives result in additional impacts when compared to the proposed Project. Note that, in the results tables below, Housing Alternative B is presented before Housing Alternative A, because the number of reverse-commute direction trips for Housing Alternative B falls between the number of reverse-commute direction trips for the proposed Project (lowest number of trips) and Housing Alternative A (highest number of trips). All the identified intersections with significant impacts are a subset of the intersections with significant impacts identified in the Draft EIR and the Recirculated Draft EIR.

Table 3: Background (2018) Intersection Impacts: Full Trip Generation and Reverse-Commute Direction

Intersection		Peak Hour	Proposed Project Impacts		Housing Alternative B Impacts		Housing Alternative A Impacts	
			Full Trip Generation	Reverse-Commute Direction Only	Full Trip Generation	Reverse-Commute Direction Only	Full Trip Generation	Reverse-Commute Direction Only
2	I-280 NB Off-Ramp / Sand Hill Rd	AM	X	-	X	-	X	-
		PM	-	-	-	-	-	-
13	I-280 SB Ramps / Page Mill Rd	AM	X	X	X	X	X	X
		PM	X	X	X	X	X	X
17	Junipero Serra Blvd - Foothill Expy / Page Mill Rd	AM	X	X	X	X	X	X
		PM	X	X	X	X	X	X
30	Foothill Expy / Arastradero Rd	AM	-	-	-	-	-	-
		PM	X	-	X	-	X	-
58	Alma St / Charleston Rd	AM	-	-	-	-	-	-
		PM	X	X	X	X	X	X
Number of Intersections Impacted			**5**	**3**	**5**	**3**	**5**	**3**

Notes:
X=Impact under Background (2018) with Project or Housing Alternative Conditions
Source: Fehr & Peers, 2018.

Table 4: Cumulative (2035) Intersection Impacts: Full Trip Generation and Reverse-Commute Direction

Intersection		Peak Hour	Proposed Project Impacts		Housing Alternative B Impacts		Housing Alternative A Impacts	
			Full Trip Generation	Reverse-Commute Direction Only	Full Trip Generation	Reverse-Commute Direction Only	Full Trip Generation	Reverse-Commute Direction Only
2	I-280 NB Off-Ramp / Sand Hill Rd	AM	X*	-	X*	-	X*	-
		PM	-	-	-	-	-	-
17	Junipero Serra Blvd - Foothill Expy / Page Mill Rd	AM	X*	X*	X*	X*	X*	X*
		PM	X*	-*	X*	X*	X*	X*
19	Hanover St / Page Mill Rd	AM	X	-	X	-	X	X
		PM	-	-	-	-	-	-
20	El Camino Real / Page Mill Rd – Oregon Expy	AM	X	-	X	-	X	-
		PM	X	X	X	X	X	X
21	Middlefield Rd / Oregon Expy	AM	X	-	X	-	X	-
		PM	-	-	-	-	-	-
29	Foothill Expy / Hillview Ave	AM	X	-	X	X	X	X
		PM	-	-	-	-	-	-
30	Foothill Expy / Arastradero Rd	AM	X	-	X	-	X	-
		PM	X*	-	X*	-	X*	-
31	Foothill Expy / San Antonio Rd	AM	-	-	-	-	-	-
		PM	X	-	X	-	X	-
32	Foothill Expy / El Monte Ave	AM	X	-	X	-	X	-
		PM	-	-	-	-	-	-
33	Foothill Expy / Springer Road-Magdalena Ave	AM	X	-	X	-	X	-
		PM	X	-	-	-	-	-
34	Bowdoin St / Stanford Ave	AM	-	-	-	-	-	-
		PM	-	-	-	-	X	-
37	El Camino Real / Encinal Ave	AM	-	-	-	-	-	-
		PM	X	-	X	-	X	-
38	El Camino Real / Valparaiso Ave	AM	-	-	-	-	-	-
		PM	X	-	X	-	X	-
41	El Camino Real / Ravenswood Rd	AM	-	-	-	-	-	-
		PM	X	X	X	X	X	X
48	El Camino Real / Embarcadero Rd	AM	-	-	-	-	-	-
		PM	X	-	X	-	X	X

Table 4: Cumulative (2035) Intersection Impacts: Full Trip Generation and Reverse-Commute Direction

Intersection		Peak Hour	Proposed Project Impacts		Housing Alternative B Impacts		Housing Alternative A Impacts	
			Full Trip Generation	Reverse-Commute Direction Only	Full Trip Generation	Reverse-Commute Direction Only	Full Trip Generation	Reverse-Commute Direction Only
56	Alma St / Hamilton Ave	AM	-	-	-	-	-	-
		PM	X	-	X	X	X	X
58	Alma St / Charleston Rd	AM	-	-	X	-	X	-
		PM	X*	-*	X*	-*	X*	X*
59	Middlefield Rd / Marsh Rd	AM	X	-	X	-	X	-
		PM	-	-	-	-	-	-
63	Middlefield Rd / Lytton Ave	AM	-	-	-	-	-	-
		PM	X	-	X	-	X	-
66	Middlefield Rd / Embarcadero Rd	AM	X	-	X	-	X	-
		PM	X	-	X	-	X	-
69	Middlefield Rd / Charleston Rd	AM	-	-	-	-	-	-
		PM	-	-	-	-	X	-
89	Central Expy / Moffett Blvd	AM	X	-	-	-	-	-
		PM	-	-	X	-	X	-
90	Foothill Expy / Edith Ave	AM	-	-	-	-	-	-
		PM	X	-	X	-	X	-
Number of Intersections Impacted			**21**	**3**	**21**	**5**	**23**	**8**

Notes:
X=Impact under Cumulative (2035) with Project or Housing Alternative Conditions
*Indicates that an impact occurs under the Background (2018) with Project or Housing Alternative Conditions
Source: Fehr & Peers, 2018.

Intersection Improvements to Reduce Impact of Reverse-Commute Direction Vehicle Trips

In developing mitigation measures for the assumed reverse-commute direction impacts, the intersection improvements that were presented in the Draft EIR and the Recirculated Draft EIR were tested, then refined where appropriate to specifically mitigate the reverse-commute direction impact. Some improvements are the same as identified in the Draft EIR or Recirculated Draft EIR, and others were adjusted because they were found to require lesser improvements to mitigate the reverse-commute direction impact.

These adjustments to mitigation measures were made only for purposes of identifying which improvements would be required to address reverse trips, and therefore subject to the up-front fair share fees. Fair share contributions to the remainder of the identified improvements necessary to reduce the full-trips assignment scenarios would be funded through a per trip fee if the no net new commute trips standard is exceeded in the future. This is because the reverse-commute direction trip assignment to the study intersections impacts the intersections differently than the full-trip assignment scenarios.

There is one adjusted improvement, relative to that proposed in the Recirculated Draft EIR and Draft-Final EIR:

- Intersection #17: Junipero Serra Boulevard-Foothill Expressway / Page Mill Road (Housing Alternative A)
    - In the Recirculated Draft EIR, the mitigation measure at Intersection #17 for Housing Alternative A was to install a grade separation. However, with the removal of Stanford's commute-direction trips, this mitigation measure was not required to mitigate the impact. The addition of a second southbound left-turn lane would mitigate the reverse-commute trips impact at Intersection #17 under Housing Alternative A.

A summary of the reverse-commute direction intersection impacts and the proposed mitigation measures are presented in **Tables 5, 6** and **7,** for the proposed Project, Housing Alternative B, and Housing Alternative A, respectively (refer to the end of this memo for Tables 5, 6 and 7).

Stanford's fair share contribution percentage for the reverse-commute direction trips is also presented in Tables 5 through 7. The volumes and formula used to determine fair share contribution may be found in **Attachment B**.

D. Baseline[1] for No Net New Commute Trips Monitoring

As described above, while Stanford has met the No Net New Commute Trips standard under the 2000 General Use Permit, it has also controlled growth in daily trips and reverse-peak direction trips. Therefore, a change to the monitoring baseline to incorporate a larger portion of the day or reverse-peak direction trips is not warranted based on Stanford's performance to date. In addition, there are two practical reasons that changing or re-setting the baseline would be infeasible and inadvisable, described below.

[1] The 2001 Baseline is the standard used to measure achievement of no net new commute trips. It does not refer to the CEQA Baseline; however, as explained in this section, the 2001 Baseline is roughly the same as the conditions that would be expected at completion of the 2000 General Use Permit.

Insufficient Data is Available to Modify the 2001 Baseline

There is insufficient data available from the 2001 baseline monitoring to expand the baseline to encompass reverse-peak direction trips. A full set of cordon count data from the 2001 monitoring period were not preserved by the County's independent consultants; therefore, an eight-week average of the reverse-peak direction trips at all 16 cordon gateways cannot be calculated. The specific data preserved includes seven of the eight weeks of gateway counts, for only six of the sixteen gateways (Bowdoin Street, Oberlin Street, Olmsted Road, Raimundo Way, Wellesley Street and Yale Street). No license plate data, parking lot counts, nor parking permit data were preserved.

The 2001 Baseline Reasonably Reflects Conditions Expected at the Completion of the 2000 General Use Permit

The 2000 General Use Permit Conditions of Approval allow the University to generate trips at the baseline level set in 2001, with the one percent threshold defined to allow for statistically insignificant variation in traffic volumes. In many years of monitoring, including the most recent monitoring year, Stanford has generated fewer trips than the baseline trip count due to its very aggressive and continuously escalating travel demand management programs. However, there is no reasonable rationale to lower the baseline for monitoring under the 2018 General Use Permit based on the most recent year's performance given the fact that there remains some campus growth allowed under the 2000 General Use Permit, including growth associated with the unique Escondido Village Graduate Residences project. If trips from growth authorized under the remainder of the 2000 General Use Permit are added to the current trip count, the resulting baseline would be similar to the 2001 baseline count.

Figure 4 shows the annual monitoring results including the 2001 baseline and the 1% threshold specified by the 2000 General Use Permit Conditions of Approval. The resulting standards are 3,474 inbound trips in the morning peak hour and 3,591 outbound trips in the evening peak hour. Figure 4 also shows that the annual counts have fluctuated between 2001 baseline and counts reported in 2016. In 2004 and 2005 there were exceedances in the PM peak hour and the University documented sufficient trip credits to offset the cordon trips. Between 2006 and 2010, Stanford met the No Net New Commute Trips standard. Between 2011 and 2014, there were again some exceedances in the PM peak hour at the cordon and the University used trip credits to offset cordon trips. In 2015 and 2016 peak hour trips at the cordon once again fell below the 2001 baseline. These data show that the 2001 baseline remains a reasonable baseline to continue to apply.

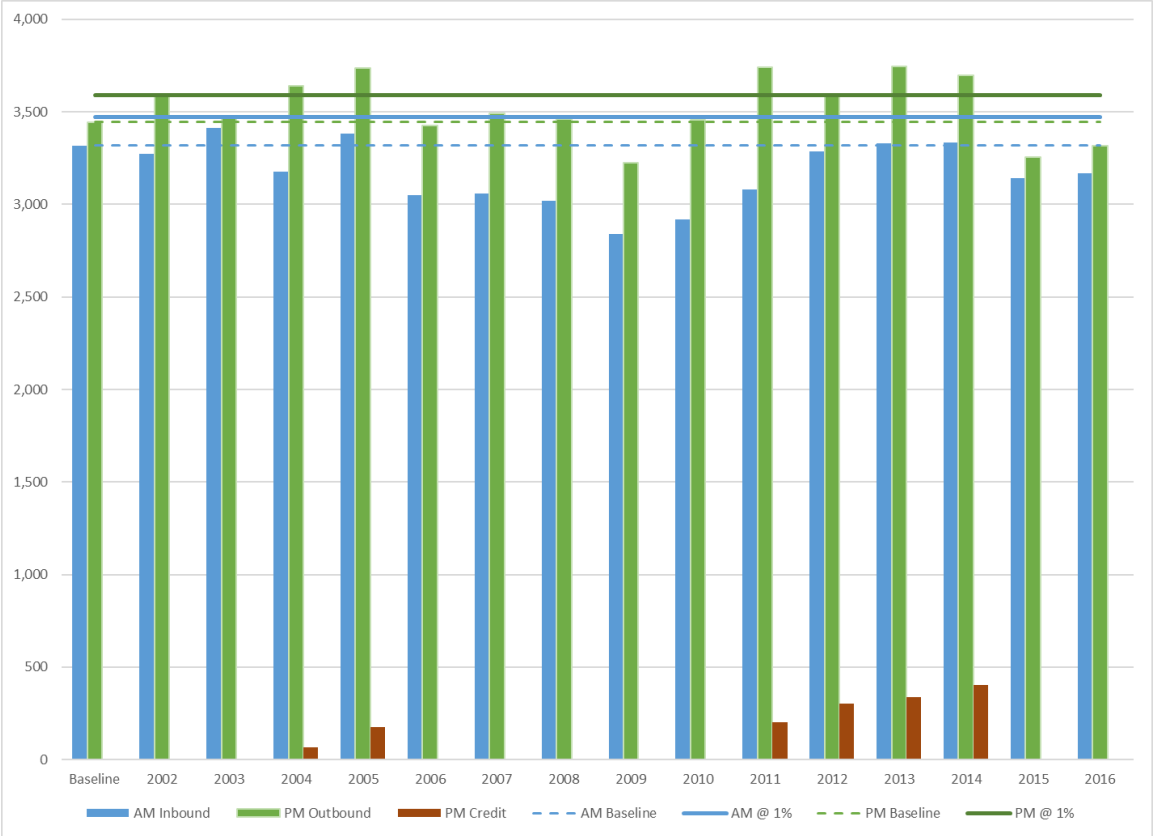


Figure 4: Historic 2000 General Use Permit Monitoring Results, 2001 - 2016

While the cordon counts in 2016 are below the 2001 baseline counts, there are additional development projects allowed under the 2000 General Use Permit that should not be counted against 2018 General Use Permit growth. The 2000 General Use Permit allows for an additional 632,450 square feet of academic space, and 2,404 residential units.[2] As these development projects are completed and occupied additional trips could occur, which would be expected to result in a cordon count similar to the 2001 baseline count. **Figure 5** shows the cordon count projection with completion of all development under the 2000 General Use Permit, using the 2016 monitoring results and adding the trip generation associated with the remaining development. The projections indicate that, at completion of the 2000 General Use Permit development allocation (including the completion and occupancy of the Escondido Village Graduate Residences Project in 2020), the cordon counts would be slightly under the AM peak hour inbound threshold and right at the

[2] The remaining square footage and housing units allowed under the 2000 GUP, as of August 2016 to align with the 2016 count data referenced in this report (2000 GUP Annual Report No. 16, June 2017).

PM peak hour outbound threshold. Thus, the best available projections of trip generation at commencement of the 2018 General Use Permit line up with the actual 2001 baseline.

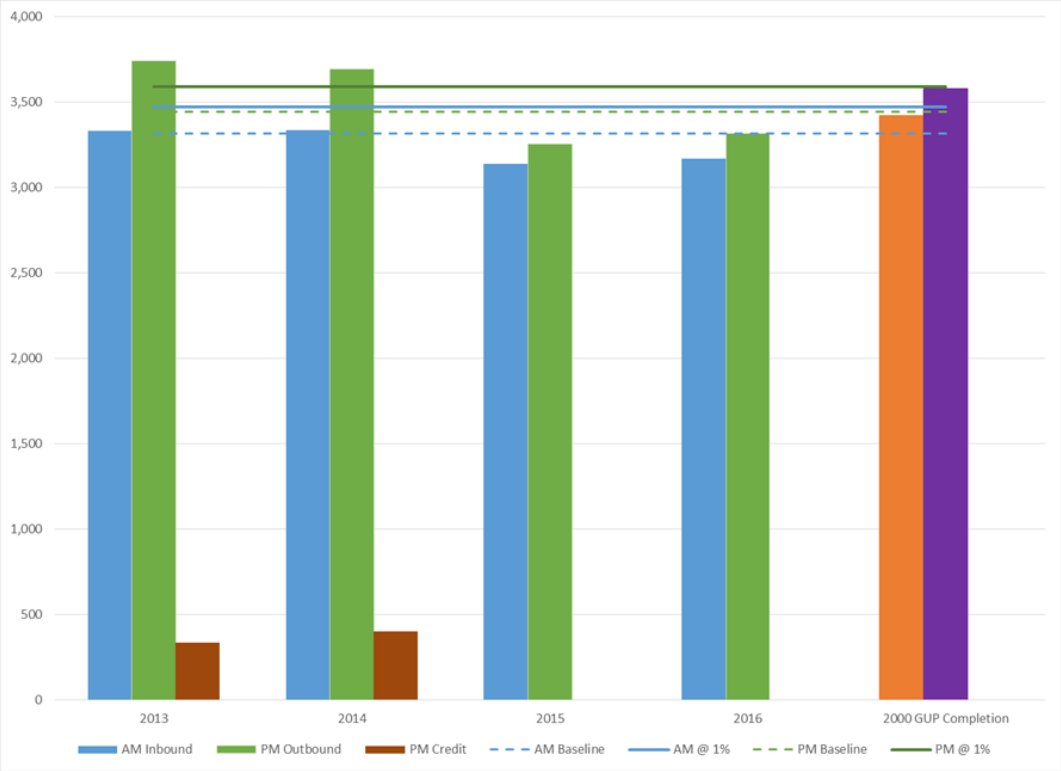


Figure 5: Projected Cordon Trips at Completion of the 2000 General Use Permit

Based on the projections in Figure 5, it is appropriate to continue using the 2001 baseline for monitoring the No Net New Commute Trips standard going forward under the 2018 General Use Permit. In addition, it is important to realize that it would be infeasible to set a new baseline based on new counts because completion and occupancy of projects authorized by the 2000 General Use Permit is likely to overlap with completion and occupancy of projects authorized by the 2018 General Use Permit.

E. Summary

The analysis presented above indicates that, under the conservative assumptions used to prepare the sensitivity analysis, some significant intersection impacts would occur if reverse-commute direction trip growth occurs even if Stanford meets the No Net New Commute Trips standard. The reverse commute trips significant impacts are a subset of those identified in the Draft EIR and Recirculated Draft EIR. The number

of intersection impacts is five for the proposed Project, nine for Housing Alternative A, and seven for Housing Alternative B. These impacts could be reduced through payment of Stanford's fair share contribution to the intersection improvements needed to mitigate the reverse-commute direction impacts. Each jurisdiction could then use this funding toward their preferred intersection improvements.

Attachments:

Attachment A: Intersection LOS Calculation Sheets

Attachment B: Fair Share Calculation Sheets

Table 5: Proposed Project Reverse-Commute Direction Mitigation Measures

	Intersection	Jurisdiction	Impacted Scenario[1]	Mitigation Measure[2]	Fair Share Contribution[3]
13	I-280 SB Ramps / Page Mill Rd	Santa Clara County	B	Contribute a fair share toward the installation of a signal. (Background Impact ONLY.)	12.9%
17	Junipero Serra Blvd / Foothill Expy / Page Mill Rd	Santa Clara County (SC CMP)	B + C	Contribute fair-share funding toward the installation of an overlap phase for northbound and southbound right-turning vehicles and the widening of the southbound approach to two lanes between Page Mill Road and Stanford Avenue to align with the existing designated right-turn lane. ~~Contribute fair-share funding toward the installation of a third westbound through lane and associated receiving lane with a westbound right-turn overlap phase.~~	12.6%
20	El Camino Real / Page Mill Rd - Oregon Expy	Santa Clara County (SC CMP)	C	Contribute fair share funding toward the reconfiguration of the east leg of the intersection to include one right-turn lane, two through lanes, two left-turn lanes, two receiving lanes, and no on-street parking, as well as the extension of the double left-turn lanes (Page Mill Expressway Corridor Study Report).	7.3%
41	El Camino Real / Ravenswood Rd	Menlo Park	C	Contribute fair share funding toward the conversion of the northbound right-turn lane to a shared through/right-turn lane.	4.3%
58	Alma St / Charleston Rd	Palo Alto	B	Contribute fair share funding toward the addition of a designated northbound right-turn lane through acquisition of additional right of way ~~and installation of an overlap phase for the northbound and southbound right-turn movements~~.	1.5%

Notes:
1. B=Background (2018); C=Cumulative (2035)
2. The full mitigation text identifies the improvements needed to mitigate the Project's full trip generation impact. The strikethrough text represents the previously identified improvements that are not needed to mitigate the Project's reverse-commute direction trip generation impact.
3. Fair Share Contribution is based on the total number of Proposed Project Reverse-Commute Direction trips at the intersection divided by the difference between the total cumulative intersection volume and the existing intersection volume. The value presented in this table is the maximum percentage between the AM and PM peak hours. Additional calculations may be found in Attachment B.
Source: Fehr & Peers, 2018.

Table 6: Housing Alternative B Reverse-Commute Direction Mitigation Measures

	Intersection	Jurisdiction	Impacted Scenario[1]	Mitigation Measure[2]	Fair Share Contribution[3]
13	I-280 SB Ramps / Page Mill Rd	Santa Clara County	B	Contribute a fair share toward the installation of a signal. (Background Impact ONLY.)	17.9%
17	Junipero Serra Blvd / Foothill Expy / Page Mill Rd	Santa Clara County (SC CMP)	B/C	Contribute fair-share funding toward the installation of an overlap phase for northbound and southbound right-turning vehicles and the widening of the southbound approach to two lanes between Page Mill Road and Stanford Avenue to align with the existing designated right-turn lane. ~~Contribute fair-share funding toward the installation of a third westbound through lane and associated receiving lane with a westbound right-turn overlap phase.~~	16.0%
20	El Camino Real / Page Mill Rd - Oregon Expy	Santa Clara County (SC CMP)	C	Contribute fair share funding toward the reconfiguration of the east leg of the intersection to include one right-turn lane, two through lanes, two left-turn lanes, two receiving lanes, and no on-street parking, as well as the extension of the double left-turn lanes (Page Mill Expressway Corridor Study Report). ~~Contribute fair share funding toward the installation of a southbound right-turn lane and overlap phase.~~	10.8%
29	Foothill Expy / Hillview Ave	Santa Clara County	C	No feasible mitigation measure.	4.7%
41	El Camino Real / Ravenswood Rd	Menlo Park	C	Contribute fair share funding toward the conversion of the northbound right-turn lane to a shared through/right-turn lane. ~~Contribute fair share funding toward widening Menlo Avenue for an exclusive left-turn lane (500 El Camino Real).~~	5.1%
56	Alma St / Hamilton Ave	Palo Alto	C	Contribute fair-share funding toward the reconfiguration of the westbound approach to have one left-turn lane and one right-turn lane, by removing a portion of the parking.	4.6%
58	Alma St / Charleston Rd	Palo Alto	B	Contribute fair share funding toward the addition of a designated northbound right-turn lane through acquisition of additional right of way and installation of an overlap phase for the northbound and southbound right-turn movements.	1.8%

Notes:
1. B=Background (2018); C=Cumulative (2035).
2. The full mitigation text identifies the improvements needed to mitigate the Project's full trip generation impact. The strikethrough text represents the previously identified improvements that are not needed to mitigate the Project's reverse-commute direction trip generation impact.
3. Fair Share Contribution is based on the number of total Housing Alternative B Reverse-Commute Direction trips at the intersection divided by the difference between the total cumulative intersection volume and the existing intersection volume. The value presented in this table is the maximum percentage between the AM and PM peak hours. Additional calculations may be found in Attachment B.
Source: Fehr & Peers, 2018.

Table 7: Housing Alternative A Reverse-Commute Direction Mitigation Measures

	Intersection	Jurisdiction	Impacted Scenario[1]	Mitigation Measure[2]	Fair Share Contribution[3]
13	I-280 SB Ramps / Page Mill Rd	Santa Clara County	B	Contribute a fair share toward the installation of a signal. (Background Impact ONLY.)	22.8%
17	Junipero Serra Blvd / Foothill Expy / Page Mill Rd	Santa Clara County (SC CMP)	B/C	~~Contribute fair share funding toward a grade separation project (County Expressway Plan 2040).~~ Contribute fair share funding toward a second southbound left-turn lane.	20.0%
19	Hanover St / Page Mill Rd	Santa Clara County (SC CMP)	C	Contribute fair-share funding toward the addition of a second westbound left-turn lane (Page Mill Expressway Corridor Study Report).	26.0%
20	El Camino Real / Page Mill Rd - Oregon Expy	Santa Clara County (SC CMP)	C	Contribute fair share funding toward the reconfiguration of the east leg of the intersection to include one right-turn lane, two through lanes, two left-turn lanes, two receiving lanes, and no on-street parking, as well as the extension of the double left-turn lanes (Page Mill Expressway Corridor Study Report). ~~Contribute fair share funding toward the installation of a southbound right-turn lane and overlap phase.~~	14.5%
29	Foothill Expy / Hillview Ave	Santa Clara County	C	No feasible mitigation measure.	5.6%
41	El Camino Real / Ravenswood Rd	Menlo Park	C	Contribute fair share funding toward the conversion of the northbound right-turn lane to a shared through/right-turn lane. ~~Contribute fair share funding toward widening Menlo Avenue for an exclusive left-turn lane (500 El Camino Real).~~	5.8%
48	El Camino Real / Embarcadero Rd	Palo Alto (SC CMP)	C	Contribute fair share funding toward the addition of a second northbound left-turn lane by reducing lane widths, reducing width of center median, and removing on-street parking	19.3%
56	Alma St / Hamilton Ave	Palo Alto	C	Contribute fair-share funding toward the reconfiguration of the westbound approach to have one left-turn lane and one right-turn lane, by removing a portion of the parking.	5.9%
58	Alma St / Charleston Rd	Palo Alto	B/C	Contribute fair share funding toward the addition of a designated northbound right-turn lane through acquisition of additional right of way and installation of an overlap phase for the northbound and southbound right-turn movements.	2.5%

Notes:
1. B=Background (2018); C=Cumulative (2035)
2. The full mitigation text identifies the improvements needed to mitigate the Project's full trip generation impact. The strikethrough text represents the previously identified improvements that are not needed to mitigate the Project's reverse-commute direction trip generation impact. Underlined text represents alternative mitigation identified for the Housing Alternative A Reverse-Commute Direction impact.

3. Fair Share Contribution is based on the number of total Housing Alternative A Reverse-Commute Direction trips at the intersection divided by the difference between the total cumulative intersection volume and the existing intersection volume. The value presented in this table is the maximum percentage between the AM and PM peak hours. Additional calculations may be found in Attachment B.
Source: Fehr & Peers, 2018.