FINAL REPORT ON RESPONSES TO TRAFFIC COMMENTS IN THE EIR[1]

[1] A previous version of this report was submitted to SEC on August 28 by its subcommittee on LRDP/EIR traffic issues (F. Crosby, O. Narayan and Q. Williams). The assessments and recommendations are unchanged from that version.

This report on the administrative responses to CPB's comments on the draft EIR about traffic numbers the responses according to the numbering in the EIR (which differ from CPB's numbering within its original comments). Where appropriate, documents provided by the administration in addition to the responses to CPB/SEC's EIR comments were used to formulate our responses.

In summary, we recommend that the deficiencies in the administration's responses to the Senate do not merit SEC asking that the LRDP not be sent to the Regents. However, there are places where we recommend that SEC should communicate alternative perspectives to the Regents (OPA 1-6 and OPA 1-12), one issue to be pursued with the administration (OPA 1-8), and one issue that remains pending (OPA 1-5).

Comment OPA 1-5

Traffic flow maps have not yet been provided to us. Worksheets from which the maps will be constructed were only provided on August 22. We sought clarifications about how to read these worksheets on August 23. No reply was received as of the drafting of this document. It is not clear why this material could not have been provided earlier, since the draft response to our comment states that all traffic counts have been reexamined and corrected, so presumably the revised traffic counts should have been ready before the draft response. In meetings with administrators in April and June, we told them that if they did not provide maps in time, they ran the risk that errors could be found and brought to the Regents' meeting.

It is, therefore, impossible to examine the university's revised traffic counts to see if they are satisfactory, and it is not possible to accept them before August 31. We recommend that SEC should make it clear to the administration that this item will only be fully resolved after the final traffic maps are released. (This may only happen when the final EIR is released.) Perhaps SEC could also decide before August 31 what will be done if errors are found in the final traffic maps.

Regarding the points raised in the response to this comment, it is plausible that Levels of Service do not change significantly with corrected traffic counts. It is not clear what the response means by "because traffic counts are conducted over a series of days, variations between intersections are expected". If it means that traffic counts for different intersections were measured on different days, the statement is correct, but we were (and will be) looking for larger discrepancies than expected from this effect.

[1] A previous version of this report was submitted to SEC on August 28 by its subcommittee on LRDP/EIR traffic issues (F.Crosby, O. Narayan and Q. Williams). The assessments and recommendations are unchanged from that version.

Comment OPA 1-6

Summary: The analysis appears to conform to the procedure for Method B of the HCM, and so complies with SEC's request (but see iv below). However, there are reasons why the analysis may significantly mislead a reader about the traffic delays to expect. We recommend that SEC take steps to inform the Regents about the proper interpretation of these results.

The response to CPB's EIR comments implies that the various methods in the Highway Capacity Manual (HCM) are all valid, and yield slightly different results. As a matter of fact, all the methods in the HCM are underestimates. Method A and B are of equal complexity and equal level of precision, so whichever yields the greater delay is superior. For highly oversaturated intersections, this is Method B. The fact that Method A is "established and nationally accepted" is not really relevant, but we would note that it has only been applied after the 2000 HCM, so it has not been established for very long. CPB's original EIR comments requested a Method C analysis, which is more complex.

The reasons why the analysis provided may be misleading are

- The delay reported is the average for all approaches to the intersection. This is in accordance with the HCM, but a reader may not understand that some approaches can be much worse.
- The delay reported is the *average* for rush hour. The various methods in the HCM all try to estimate the worst delays on an average day. For oversaturated intersections, Method B underestimates the worst delay (which occurs at the end of rush hour) by as much as a factor of 2.

The results of a simple 'bathtub analysis' for the delay at the end of rush hour for selected approaches for the Mission/King intersection is given below[2]:

Mission/King:

	2020 No Project		2020 With Project		Existing conditions	
	AM	PM	AM	PM	AM	PM
SBL/SBT	11.3	8.5	17.2	16.7	6.3	3.9
WBT	18.6	1.4	24.0	5.4	---	---
EBT	6.7	10.8	6.1	19.9	13.3	3.7
Method B delay reported in EIR	7.7	4.7	9.6	7.7	3.1	1.8

SBL=Southbound left turning traffic (King→ Eastbound Mission), EBT = Eastbound through traffic, etc. Units used in the table are minutes.

[2] In this approximation, we assume that traffic arrives at an exactly uniform rate, with no fluctuations, throughout rush hour. In practice, fluctuations will make delays worse. In fact, it is possible to obtain the delay at the end of rush hour from Method B: if $D_A(T)$ is the average delay during a time interval T, and $D_E(T)$ is the delay at the end of the time interval, then $D_E(T) = d/dT\ [T\ D_A(T)]$; differentiating Eq.(16-12) of the HCM is easy. However, for ease of calculation we have used the bathtub approximation, which yields smaller delays and can be proved to be a lower bound on the actual delays.

A few comments about this table:

i. The d_2 delay (due to backed up vehicles) is estimated with the bathtub approximation, which is guaranteed to be an underestimate. The d_1 delay (because you may arrive when the light is red) is taken from the EIR worksheets.
ii. Only oversaturated approaches are shown in this table; over saturation means that the number of vehicles approaching the intersection exceed the number that can leave the intersection.
iii. For reasons that are not clear, the EIR worksheets project different delays in the two lanes of King Street. Since most of the traffic turns left here, the loads must balance, which is what we have done, making the worst case less bad.
iv. There is a minor error in the calculations[3] and a probable error.[4] These do not affect the calculations significantly, but they do raise concerns about the parts of the consultants' work that we are not able to verify.
v. All calculations in the EIR are for 21,000 students. For 19,500 students, the EIR projects that the traffic generated by the LRDP will be 18% lower. One can approximately estimate the result of this by a weighted average of the 2020 No Project and 2020 Project columns.

There are two more factors that affect the delays, but in ways that cannot be quantified with the data available to us. First, delays are only calculated with one hour of traffic projections. If an intersection reaches over saturation before rush hour, there will already be a backlog of cars at the start of rush hour, and if the intersection stays oversaturated beyond rush hour, the delays will keep getting worse. The HCM says that for oversaturated conditions, the analysis period should be extended to cover the entire period of over saturation. With a Peak Hour Factor (the ratio of the average traffic rate during rush hour to the rate during the worst fifteen minutes) of 0.98 and an over saturation of 1.3 at King/Mission, this strongly suggests that oversaturated conditions will extend on both sides of rush hour.

Second, delay estimates are with unmitigated conditions, and use the full traffic demand. Mitigations can reduce delays, but the university has not provided any analysis of how specific and realistic mitigations could reduce delays, and to what extent. And although people will adjust their driving practices to avoid highly congested intersections, so that the full traffic demand is not achieved, this cannot be quantified.

The conditions at the Bay/Mission intersection are much better: the only long delays are for 2020 PM with project, for which the bathtub analysis yields slightly over 12 minute delays for

[3] At least for the Mission/King intersection, the Method B delays are calculated with T=1 hour and T=15 minutes in the two places that the duration of analysis T appears in Eq.(16-12) of the HCM. Of course, both T's should be consistent with each other, and equal to 1 hour for Method B. This error makes the delays appear worse than they are. This error does not afflict our bathtub analysis.

[4] In the Level of Service worksheet for existing conditions at Mission/King during the AM rush hour, Method B delays are estimated at 7 minutes for eastbound through traffic on Mission Street (and delays at the end of rush hour would be 12 minutes). This result is obtained because eastbound traffic is stated to have a green light for only 28% of the time, compared to 69% for westbound traffic, with the remaining 41% allotted to a dedicated left turn light for westbound traffic. Considering that this traffic would be turning onto the relatively small Union Street or making a U-turn, this magnitude of traffic is highly implausible.

southbound traffic on Bay Street and for westbound traffic on Mission Street. Some amount of rebalancing traffic between Bay and High Streets might be possible, but this cannot be carried too far to avoid choking intersections like Bay/Escalona.

Comment OPA 1-8

In preliminary meetings with the administration, it was agreed by the Senate representatives that we do not expect financial information to be included in the EIR. The administration has provided calculations estimating that the cost of A parking permits will double over 15 years. We believe that their estimates of expenditures are reasonable, but estimates of revenue they can raise from other sources may be slightly optimistic. Moreover, these parking fees will increase while A permits are effectively almost downgraded to what are currently R permits, as close-in parking is largely eliminated.

Although the results are unpleasant, the financial projections are reasonable and comply with the request for adequate information. The main uncertainty in the projections is the question of what mitigation and infrastructure costs will be pushed into the parking budget; the projections assume that there will be such cost transfers will be minimal. If such transfers were to occur, the mitigation/infrastructure costs could consume the TAPS budget. It is recommended that SEC work with the administration as soon as possible, as part of the LRDP discussion, to determine a guiding set of principles on which costs can be charged to the TAPS budget and which costs cannot.

Comment OPA 1-9

The draft response states that "The text of Mitigation TRA-4C has been revised to require implementation solutions identified in the Draft EIR if the transit time between the two most widely separated colleges exceeds the time interval between class periods." This is a satisfactory response.

Comment OPA 1-12

Summary: The columns that list Mitigated Delays have not been substantiated, and seriously undermine the impact of the delay statistics elsewhere in the EIR. Also, the total travel time is (not surprisingly) calculated with Method A. We recommend that SEC should pursue this with the administration, or bring these objections to the notice of the Regents; at the very least, the Mitigated Delays column should be disregarded.

This is a straightforward addition of delays at each intersection and travel times between intersections. As far as we can see, there are no errors. However:

i. The last columns in these tables claim to give the 2020 Plus Project mitigated delays. The mitigation measures are supposed to be those in the draft EIR. The mitigated numbers are dramatically better than the unmitigated ones; in some cases the total travel time is less

than for 2020 without project (and without mitigations). This has a strong impact, and cannot be ignored. These numbers cannot be accepted because

- Despite our requesting the calculations to support these numbers, they have not been provided. Mitigated delays were not shown in the DEIR, so we did not request these calculations earlier.
- We have found some unambiguous errors in the consultants' work: for example, the traffic maps in the DEIR, item iv in OPA 1-6 above, and an error in the first version of the Total Travel Times which we pointed out. Therefore, we cannot simply assume, absent verification, that their results must be correct.
- There may be hidden assumptions or model parameters (e.g. the fact that a 15 minute analysis period was used had to be dug out from the DEIR) that might impact the reliability of the calculation.

The delays given at the intersections are the Method A delays. As discussed in OPA 1-6, Method B delays are more accurate at highly oversaturated intersections, and even they are off by a factor of approximately 2. Hence the total delays are significantly

ADDENDUM: REPORT ON TRAFFIC FLOW MAPS IN THE EIR

Summary: *The traffic flow maps provided by the university in the DEIR, as corrected in the final EIR, still contain significant inconsistencies. Only after these are eliminated can more subtle tests be applied to verify that the flows are self-consistent. As far as we can see, there are no major flaws in the methodology by which the traffic counts were generated. It remains to be seen whether the errors we have found can be easily corrected, or are the result of an accumulation of approximations that are intrinsic to the model.*

Introduction and Background: The traffic section of the draft EIR (DEIR) for the UCSC 2005 LRDP included traffic flow maps, which formed the basis for the analysis of traffic impacts. At various key intersections on and off campus, predictions were made for the number of vehicles for each turning movement[5] during one hour of rush hour traffic in the morning and evening. These predictions were made for the year 2020, both with and without the project (i.e. the growth proposed in the LRDP). From these projected traffic volumes, the delay that a vehicle could expect at each intersection was calculated, and converted into a Level of Service (LOS) using standard criteria. The LOS predictions were used to estimate where the impact of the project would be significant. Detailed LOS worksheets (from which the traffic flow maps had been constructed) were included in the appendices to the DEIR.

In its comments on the DEIR, the Committee on Planning and Budget (CPB) pointed out inconsistencies in the traffic flow maps. From the turning movements at an intersection, it is possible to calculate the traffic volume that arrives at the intersection along each approach. Traffic volumes for departures along each approach can be similarly calculated. For a pair of adjacent intersections, the volume of traffic that leaves the first of them in the direction of the second during the hour of observation must be consistent with the volume of traffic that arrives at the second from the direction of the first. By 'consistent' we do not mean equal: if the number of vehicles in transit between the intersections changes during the hour of observation, or if the interval between the intersections is interrupted by lanes or parking lots, the two traffic volumes could be different. Clearly, the consistency test is strongest for a closely spaced pair of intersections with no interruptions between them. As an example of inconsistencies in the traffic maps, CPB cited the pair of intersections at Campus Facilities/Coolidge and Hagar/Coolidge (intersections 1 and 2 respectively in the DEIR).

In its response to the comment, labeled OPA-1-5 in the final EIR, the university acknowledged that there were errors in the predicted traffic volumes at some intersections for 2020, both with and without the project. This was because the traffic volumes at intersection 2 (hereafter I2)

[5] A turning movement refers to vehicles coming towards the intersection along one of the approaches, and leaving along one of the other approaches. At a simple intersection of two streets, there are four approaches by which vehicles can arrive, and they can turn left, go straight, or turn right. This results in a total of twelve turning movements.

mistakenly portrayed an earlier option developed (and rejected) for the 2020 with project scenario. This error was corrected, and other intersections were also rechecked.
The response to the comment also pointed out that the traffic projections were made from measurements of existing traffic, inflated by growth factors based on predicted growth. Any discrepancy between successive intersections would be the result of discrepancies in the existing traffic counts. Since traffic counts are conducted over a series of days, variations between intersections are expected, and a variation of plus or minus ten percent in the traffic at an intersection is considered normal.[6] The review found some pairs of intersections where the discrepancy between the traffic volumes at the two intersections was greater than ten percent. In such cases, the two intersections were made consistent at the higher traffic volume. It is not clear why such an adjustment beyond the "normal" range was needed unless the traffic counts are unreliable, in which case the adjusted counts, while self-consistent, would not be correct.

For all the intersections where corrections and adjustments were made, LOS worksheets were included in the final EIR, released on September 6. Traffic flow maps were provided to the Academic Senate around the same time. A further meeting to clarify the methodology used was held on September 15.

Results of analysis: The traffic flow maps as provided to the Academic Senate have been examined to see if inconsistencies in flow volumes have been eliminated. Following the criterion given in the final EIR, we adopt a threshold of 20% discrepancy between two successive intersections (with no intervening traffic generators) to count inconsistencies. Wherever possible, the LOS worksheets have been compared with the traffic flow maps to ensure that any inconsistencies found are not the result of errors in transcription from the worksheets to the maps; since the worksheets were the primary source, they must prevail in the case of any differences.

Although time and resources did not permit an exhaustive analysis, we have been able to find a few significant inconsistencies in the traffic flow maps. The ones which are hardest to explain are given below:

1. There is a discrepancy between Hagar/East Remote (I3) and Hagar/McLaughlin (I4) for 2020 with and without the project, for both AM and PM traffic, for traffic flowing in both directions. For instance, for 2020 without project (PM), 35 vehicles leave I3 northwards, whereas 425 vehicles arrive at I4 from the south. Although some traffic might be generated from the OPERS facility and the Hahn peninsula, it cannot explain such a large discrepancy.

Does this discrepancy echo a similar effect in the existing traffic counts, as claimed in the response to our comment? Applying the same analysis to existing counts from 2003-04 reveals similar discrepancies, indicating that these measurements were erroneous. However, the error is *opposite* to that in the projections: traffic volumes are higher at I3. Therefore, it cannot be the cause for the discrepancy in the 2020 projections. In any case, whether the error in 2020 traffic projections is because of faulty measurements in 2003-04 or incorrect extrapolations is immaterial so far as the reliability of these projections is concerned.

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[6] We assume that this means that traffic was measured at different intersections on different days, since otherwise the effect of fluctuations in traffic volume would be the same at successive intersections.

It is possible that this discrepancy is partly due to the same cause as identified in the response to comment OPA-1-5: treating Hagar Avenue as one-way or two-way differently at the two intersections. But this cannot explain why the discrepancy should occur for traffic in both directions.

2. There are discrepancies between traffic volumes at the three successive intersections at Storey/King (I23), King/Mission (I19) and Mission/Hwy 1 (I20) for 2020 With Project. For AM traffic, 896 vehicles leave I23 towards I19, but 1238 vehicles approach I19 from I23. For PM traffic, 2801 vehicles leave I20 towards I19, but 1971 vehicles approach I19 from I20. Again, comparing with existing traffic counts from 2003-04, the corresponding numbers are (753, 916) for the I23/I19 pair and (2028, 1374) for the I20/I19 pair. The discrepancy is similar for the second pair of intersections, indicating that the 2020 discrepancy might be because of erroneous 2003-04 counts, but this is not true for the first pair of intersections.

3. Some other pairs of intersections and their discrepancies are listed below:

Upstream intersection	*Upstream traffic vol.*	*Downstream intersection*	*Downstream traffic vol.*	*Ratio*
I1 Campus Facilities/Coolidge	290	I10 Bay/Coolidge	228	0.79
I6 Meyer/Heller	256	I5 Heller/McLaughlin	158	0.62
I5 Heller/McLaughlin[7]	158	I6 Meyer/Heller	107	0.68
I4 Hagar/McLaughlin	325	I44 Chinquapin/McLaughlin	249	0.77
I4 Hagar/McLaughlin[8]	206	I2 Coolidge/Hagar	101	0.49

In each case, the traffic counts refer to 2020 Without Project AM traffic, although similar discrepancies exist in some of the other cases as well. The pairs shown here are those for which discrepancies are most noticeable; this is not an exhaustive list.

4. Although not an internal inconsistency, we note that the projected traffic volumes for 2020 with and without the LRDP at the Campus Facilities/Coolidge intersection, along the approach opposite Campus Facilities, are identical to the 2003-04 measured traffic counts. This is despite the fact that a significant amount of employee housing (Ranch View Terrace) is planned here. Our understanding is that this is because traffic for 2020 Without Project on campus has been frozen at 2003-04 levels (however, see footnote 4 above), and the additional traffic due to the LRDP is assumed to be tied to parking structures, thereby ignoring residential parking and traffic. However, comparing to traffic volumes from existing employee housing at I2, the error from this is small.

ii.

[7] There is a side road to Kresge apartments between I5 and I6, but it is unlikely to explain such a large discrepancy. The error here is in the 2003-04 measurements, which yield identical results.

[8] It is possible that this line may be because of a parking structure near Cowell-Stevenson colleges. However, this parking structure is not listed in Proposed Parking Structures on page 4.14-29 of the DEIR. Moreover, we have realized that it is not clear to us whether the 2020 Without Project scenario assumes no growth in campus population but with the roadways and parking lots changed, or with no change to the roadways and parking lots; the language on page 4.14-38 and the absence of anything corresponding on page 4.14-34 suggests the second option, in which case there should be no substantial changes from 2003-04 counts to 2020 Without Project projections on campus, which is not the case at some intersections. This may be resolved after clarification.