MEMORANDUM

TO: ANDREW BEACHER

FROM: LORNA PARKINS, MICHAEL BAKER JR., INC

SUBJECT: RESPONSE TO PLANNING COMMISSION MODEL QUESTIONS

DATE: 7/14/2009

CC: TERRIE LAYCOCK, GEORGE PHILLIPS, FENG LIU, BILL THOMAS

To assist OTS staff in responding to the e-mail from Planning Commissioner Keeney dated June 17, 2009, several issues are explained below with regard to the modeling process for the CTP update and the technical documentation of that process. The original text of the e-mail is provided at the end of this memo.

Commissioner Keeney's first request is to identify the credentials of the staff members who performed the modeling. The responsible senior staff members are Feng Liu, who managed the modeling work, and Bill Thomas, who is department manager responsible for quality management. I can send their resumes by separate transmission if you would like them – they certainly would demonstrate that our staff members are focused on this type of modeling work and have tremendous depth of experience.

Commissioner Keeney's second request is for our technical report(s) describing the modeling work. We have discussed providing him with the model validation report. There also are a couple of internal memos that are available, one on the adjustments to external growth rates and one on travel patterns in western Loudoun, that are relevant to the detailed questions in the Commissioner's e-mail. I also think the presentations posted on the project website, including the March 27, 2007 TLUC, April 30, 2007 TLUC, and the August and September presentations in western Loudoun County are helpful in explaining the modeling process, assumptions, and results used to develop the CTP recommendations.

As far as a memorandum detailing the content, input files, and processes used for each model run that contributed to the development of the CTP, as we have discussed, such a memorandum was not in our scope of work but could be developed. We estimate that it would cost approximately $6,500 and take a minimum of 2 weeks' time to prepare a memo that would provide a detailed record of the model runs. However, this memo would not address every request of Commissioner Keeney, as some of his requests itemized in the third section of his e-mail are either not feasible in light of the tools and processes we use, or they are not reasonable in light of the limited extent to which the modeling process can be translated for review and interpretation outside the framework of trained personnel using the software that is required. These points are addressed in the remainder of this memo.

- Request 3a for all data files: these files exist but would be difficult-to-impossible for a lay person to execute and interpret without extensive explanation/training. Each model run uses a socioeconomic input file, a network file, a set of other input and model parameter files, and a set of scripts (in TP+ programming language) that would be needed to run the model in a proprietary software. The socioeconomic file, which was developed with the County demographers/planners based on the latest planning assumptions at the time, is fairly transparent. The network file, which is much more complex and is not as transparent, was also developed in close consultation with the county planners. The network file varies by years and alternatives and undertook extensive refinements during the modeling process -- it was refined for performance first for model validation and then in an ongoing fashion throughout the modeling process as each model run provided more information about the network performance. In other words, the network file starts out as accurate as possible representing the factual base network, but adjustments are made that are necessitated by the modeling process to 1) improve performance and 2) test alternatives. County planners helped modelers improve the network files to better represent network on the ground -- George sat with Avinash for an entire day to update the latest on-the-ground improvements to the network as well as network attribute assumptions. Without a full understanding of these assumptions and processes, it is impossible to interpret the network files themselves accurately. In addition to the socioeconomic and network files, there are also a few dozen input files that are required for each model run. Not transparent to lay people, all these model files need specialized training to understand and interpret. Some of these files are in proprietary formats and are not readily suitable for analyses. As for the scripts, they are in programming language and are used to "tell" the model how to process input data files and what output to provide, and they are only understandable to programmers who are trained in this particular software package.

- Request 3b for dates when "simulation" work was completed. Assuming this request refers to the travel demand model runs, this information can be included in the documentation memo if it is prepared. However, the TLUC meeting presentations from November to May of 2007 provide a good record of the modeling process, as does the project scope of work.

- Request 3c for simulation tools and software names, versions, vendors and websites. The modeling tools used for this project were CitiLabs' TP+ software version 4.0 (http://www.citilabs.com/) and the two TP+ -based models for Loudoun County and the Metropolitan Washington Council of Governments (COG). As noted in other correspondence, the COG model is very well documented and can be researched on that agency's website. The software used for the Loudoun model is known to the staff and would be included in the documentation memo if prepared.

- Request 3d for a sufficiently detailed description of the modeling methodology so that an appropriately trained professional could replicate the modeling procedure. Much of the general methodology was provided in the staff's March 4, 2009 presentation to the Planning Commission. The requested information could be provided in a documentation memo, with the understanding that it is not the intent to provide data

files and scripts to an outside party to literally replicate the work. Such an exercise would require additional Baker staff time to coordinate with the trained staff conducting the validation. The amount of time would depend on the level of the other party's training and the extent of the validation. An important point to address this issue is that the model output is handled as raw data and undergoes fairly extensive post-processing and interpretation by experienced transportation planners before it is translated to results and recommendations. Baker does not use a "black box" approach to modeling and this means that even if someone replicated the raw data, it would not reflect the extensive effort and professional value added in the interpretation of that information.

- Sub-points of Request 3d:

    - *Include all assumptions in analyses and methodology*. A lot of this information is in the presentations to the TLUC, but could also be included in the documentation memo if prepared.

    - *Describe settings and selections in the modeling process*. This request does not fit the modeling process used. As noted above, we write a unique script to conduct each model run. The TP+ software is not user-friendly as typically found in Microsoft Office software, but rather based on a sophisticated programming language, which requires intensive specialized training. The TP+ software is now part of the Cube Voyager (for an overview, go to http://www.citilabs.com/cube_voyager.html).

    - *Describe the overall balance and trade-offs in the modeling results between regional needs and local needs.* This is addressed in the TLUC presentations from 2007 and is addressed extensively in the analyses for western Loudoun County as presented and discussed in the series of PC workshops in summer/fall 2007. These presentations are on the project website.

    - *Describe how the effects of gasoline prices were included in the model.* This is a long-range model and it assumes that fuel prices are consistent over time relative to other values in the user cost attributes (such as time, other vehicle operating costs, parking, etc.). The COG model documentation is the best source for this information. The dilemma of making a long-range model sensitive to the effects of gasoline prices is a very complex subject. Baker staff have ideas about how this could be addressed (bearing in mind that this issue was not on the table in 2007 when the model runs were being done), but the COG staff might be a better resource for that discussion with their regional perspective.

    - *List all developments, applications, projects, etc having any influence on increasing roads – number of houses and businesses by district in sub-planning areas.* The county demographer prepares the forecasts that were used in the modeling process and would be the best source for this information; however, the modeling process uses long-range forecasts at a TAZ level and is therefore

not "responding" to specific developments. It might be helpful to explain the cooperative forecasting process to the PC to underscore that the forecasts are not just a measure of approved development, but rather a planning exercise that considers forecasted regional growth which Loudoun County has a role in preparing in light of its comprehensive land use plan and economic development objectives.

- *Describe how estimates for typical number of car trips were determined*. The trip generation model and mode split component of the COG model are the source of this function in the Loudoun County model. See COG documentation for more detail (Chapter 4 in TPB Travel Forecasting Model, Version 2.2 Specification, Validation, and User's Guide, available at the MWCOG website--http://www.mwcog.org/uploads/committee-documents/kl5fWlle20080303164551.pdf.)

- *Describe percentages of car trips by Loudoun County residents and non-residents by corridor.* This calculation can only be done link-by-link and is fairly labor intensive. Thus the information is provided for select corridors where through-traffic was an identified issue and not for each individual corridor. This information is included in the August 29th and September 6th PC outreach meeting presentations which are on the project website (for western Loudoun corridors specifically).

- *Describe assumptions or projections concerning jobs and/or employment areas or centers*. See the response to the question on developments, applications, projects, etc having influence on increasing roads. The November 2006 presentation to the PC and the August 29th and September 6th PC outreach meeting presentations all include information on employment forecasts and employment centers included in the modeling.

- *Describe how effects of random events were included in the model*. The travel demand model is designed for a long-term planning process that addresses average peak and daily travel demand conditions, not random events.

- *Specify criteria for including or excluding local roads in any analyses – a*nd – *Specify criteria for including or excluding secondary roads in any analyses.* The OTS staff members such as George Phillips are probably best qualified to address any specific local and/or secondary roads that are or are not included in the model. The main reason for which the county has its own model is to allow a much more detailed roadway network to be included in the model and to make that model more valid and responsive to analysis of the complete county roadway network. However, the detail also requires that data on volumes and physical characteristics of these roads be available, which is a cost to the development and maintenance of the model. Given the data requirements and the fact that the validation requirements for lower level facilities are not as stringent as higher-volume roads, there are diminishing returns to the addition of more detail on local roads in the model. However, the model is calibrated to

reflect the observed volumes on roads that are in the model, which in effect takes into account the traffic that uses roads that are not in the model.

- *Describe methodology used to support or demonstrate the validity of results of the modeling*. See the memo documenting the validation of the Loudoun model in 2006. The model was validated based on the federal model validation guidelines such as the FHWA's Model Validation and Reasonableness Checking Manual (available at the FHWA website http://tmip.fhwa.dot.gov/resources/clearinghouse/124).

- *Describe effects of current economic downturn on continued validity of models based upon historical trend data or assumptions*. The model generates traffic based on the long-term forecasted land use. The regional forecasts in use have proven to be very reliable historically, through all types of economic cycles. It must be borne in mind that the CTP is based on long-range forecasts for 2030 and not short-term forecasts, while existing conditions are assessed based on observed traffic levels. If the current economic downturn were to have long-term, lasting effects on the region, it would make the traffic forecasts represent a later time-frame such as 2035 or 2040 but would not fundamentally alter the results.

- *Describe how impacts on environmental quality were included in models*. *If not included, describe why descriptions of potentially adverse impacts are not reported to decision-makers along with benefits of increased road capacity.* The March 27, 2007 TLUC presentation addresses this issue directly, and the CTP update scope of work also addresses how environmental impacts were incorporated. It is not possible to include environmental impact document-level impact analysis in planning studies such as the CTP update (that is done at the time of individual project execution), but an extensive process was undertaken to gather and incorporate existing data on environmental resources into the analysis of each of the 14 corridors, as specified in the project scope of work. This is reflected in summary fashion in the Corridor Analysis appendix of the draft CTP update (what used to be Chapter 2) and the March 27, 2007 TLUC presentation. Air quality impacts generally relate to the total amount of travel (VMT) and congestion in the region, and these summary statistics were presented and noted as indicators of air quality in presentations including the March 27 TLUC and the September 19th Route 9 presentations, though the comments may have been verbal and not documented directly on the presentation slides. The regional air quality model documentation provides insight into the relationships between transportation measures (vehicle travel, congestion and speed) and pollutants*. For the latest documentation, go to the MWCOG website http://www.mwcog.org/transportation/activities/quality, or http://www.mwcog.org/clrp/resources/AirQuality/2009/c10%20conformity%20full%20report.pdf.*

- *Describe how alternatives to adding or expanding roads were considered in recommending increases to size of roads*. As discussed at length in the March 27

TLUC presentation and the western Loudoun PC Outreach meeting presentations in August and September of 2007, the study methodology specifically addressed this question by focusing not only on LOS but also on levels of "excess demand" in the corridors and the extent to which other strategies (as related to the "opportunity areas" in the March 2^{7th} presentation) might play a role in reducing travel demand rather than increasing capacity. You might direct the Planning Commission member to the white paper on Traffic Abatement Strategies that was prepared for this study which has specific strategies for reducing travel demand through design, land use, and workforce housing. These recommendations are explicitly included in the policy recommendations of the CTP update.

- *Identify when modeling was performed for each road.* All roads are included in every model run – the modeling exercise is not corridor-by-corridor, but for the whole network, including the regional network.

- The final request is to post the responses to the project website. As we have discussed, the existing presentations and memos that answer some of the questions are largely already posted on the website. To post more detailed work products such as our training of the Loudoun staff on the model or the model scripts is putting Baker's work product in the public domain in a way that gives other consultants access to our detailed methods and approaches.

>>> Michael Keeney 6/17/2009 10:09 PM >>>

John and Andy:

In response to the request made during the 16 Jun 09 Planning commission CTP work session, I would like staff to provide the following information pertaining to the modeling methodology used to create and/or update the Countywide Transportation Plan.

Rather than being provided directly to me, I would prefer that this information be posted on the Planning Commission (http://www.loudoun.gov/Default.aspx?tabid=1000) and/or CTP (http://www.loudounctp.com/#) web sites so that it will be available to interested members of the public as soon as possible.

Please notify me by e-mail when responses to the below are posted.

1. Identify persons and describe the relevant technical, educational, and professional qualifications of each (such as would be listed on resumes) who performed the modeling work and/or contributed to consultant's technical report(s) concerning the modeling.

2. Provide complete copy of the consultants' technical report(s) describing the modeling work.

3. If not included in the consultants' technical report, provide the following:

3.a. List all data files used in the analysis and make copies of these files available (either by posting files or providing working hyperlinks). Provide files in formats readily suitable for analyses, such as Excel worksheets or character- or tab-delimited text files, rather than formats such as .pdf or html.

3.b. Provide date(s), within at least a month, when the simulation work was completed.

3.c. List all simulation tools and software used to perform the analyses by vendor, name, and version number and vendor web site.

3.d. Provide a sufficiently detailed description of the simulation and modeling methodology that appropriately trained professional could, with appropriate software and data, replicate the modeling procedure.

3.d.i. List all assumptions included in any analyses and modeling methodology. Describe why relevant data were not available, necessitating the use of assumptions.

3.d.ii. Describe any settings or selections made in the modeling software (such as from drop-down menus), as applicable, as part of the modeling process.

3.d.iii. Describe the overall balance and trade-offs in the modeling results between meeting regional needs and the needs of Loudoun

County residents.

3.d.iv. Describe how effects of gasoline prices were included in the model.

3.d.v. List all developments, applications, projects, etc. having any influence on increasing roads (both homes and commercial). List number of houses and businesses by district in sub-planning areas.

3.d.vi. Describe how estimates for typical number of car trips were determined.

3.d.vii. Describe percentages of car trips by Loudoun county residents and non-residents by corridor.

3.d.viii. Describe assumptions or projections concerning jobs and/or employment areas or centers.

3.d.ix. Describe how effects of random events (such as accidents or falling trees) were included in the model.

3.d.x. Specify criteria for including or excluding local roads in any analyses.

3.d.xi. Specify criteria for including or excluding secondary roads in any analyses.

3.e. Describe methodology used to support or demonstrate the validity of results of the modeling and simulation (such as validation and verification studies; see http://en.wikipedia.org/wiki/Verification_and_Validation_(software).

3.f. Describe effects of current economic downturn on continued validity of models based upon historical trend data or assumptions.

3.g. Describe how impacts on environmental quality (including air, water, light, and noise) were included in models. If not included, describe why descriptions of potentially adverse impacts are not reported to decision-makers along with benefits of increased road capacity.

3.h. Describe how alternatives to adding or expanding roads (such as mass transit or reductions in development) were considered in recommending increases to size of roads.

3.i. Identify when modeling was performed for each road (for example, were some modeled for previous editions of the CTP and not re-modeled for the ongoing review?).

4. Please post this request, plus staff responses or explanations why requested information cannot be provided, on the Planning Commission and/or CTP web sites.

Thanks.

Michael J. Keeney, PhD

Planning Commissioner, Sugarland Run

Michael J. Keeney, PhD

Loudoun County Planning Commission

Sugarland Run Representative