ITE Transportation Capacity and Mobility Task Force - SB 743 Modeling Subcommittee

Considerations for When to Perform a SANDAG Regional Travel Demand Model Run for SB 743 VMT Analysis

Version: January 30, 2023

Authors: Katy Cole (Fehr & Peers), Cundo Arellano (SANDAG), Rick Curry (WSP), Erik Ruehr (VRPA Technologies), Sabita Tewani (Dudek), Maureen Gardiner (City of San Diego)

Introduction/Purpose

The SANDAG travel demand model is a tool that provides metrics for evaluating existing and future year transportation conditions in the San Diego region. Transportation professionals often use the SANDAG model as a data source for evaluating vehicle miles traveled (VMT) to assess transportation impacts for CEQA purposes for individual development projects, for larger community/specific planning efforts, or for roadway projects. The SANDAG model has historically been used as an analysis tool for evaluating an individual development project's trip generation, trip distribution, and total VMT, and a custom model run has typically been performed if the individual development project generated at least 2,400 daily vehicle trips. The purpose of this white paper is to re-consider the project characteristics that would necessitate performing a custom model run for an individual project (i.e. should something other than 2,400 daily vehicle trips be used as the typical criteria for performing custom modeling using the SANDAG Model?).

Overview of the SANDAG Regional Travel Demand Model

Basic Model Information

The SANDAG travel demand model is an Activity Based Model (ABM) that simulates individual and household transportation decisions that compose their daily travel itinerary. People travel outside their home for activities such as work, school, shopping, healthcare, and recreation. The ABM attempts to predict whether, where, when and how this travel occurs. The result is a forecasting and alternative analysis tool that can help gain insight into the potential future outcomes of land use growth, transportation network investments, and travel policies.

For more information, please visit SANDAG's modeling websites for Transportation Modeling and Activity Based Models.

Model Version

SANDAG continuously updates the ABM and releases a new version for use in the development of the Regional Plan, which typically occurs every four (4) years. The ABM is updated to include new features that reflect changes to current or future mobility options, re-estimated based on new travel survey data, and calibrated to the latest observed data, such as jurisdiction traffic counts and transit passenger counts.

Other data included in updates to the ABM for new version releases include:

- Transportation networks
- Land use and demographics

- Surveys of travel behaviors
- Forecasts of exogenous variables (e.g. auto operating/fuel costs by the US EIA, airport enplanements by FAA/SDIA, international and national freight movements by FHWA via the Freight Analysis Framework, etc.)
- Transportation policies and costs
- Changes to the components and computer code that make up the ABM

The current version of the SANDAG ABM software is ABM2+ used in the San Diego Forward: The 2021 Regional Plan (RP) adopted December 10, 2021. SANDAG makes continuous incremental improvements and fixes to their software and the latest model release version should be used during analysis. Each version release is given a unique version id. The 2021 RP used ABM2+ 14.2.2 which was subsequently improved to version 14.3.0.

Data Sets Series 14 Land Use Patterns

SANDAG utilizes two land use patterns and scenarios as part of the Series 14 Regional Growth Forecast These two scenarios use California Department of Finance population projections from 2020 as initial inputs. SANDAG applies a unique ID to each forecast scenario known as a data source number (DS). Land use patterns used in the 2021 Regional Plan had minor error fixes applied and were rereleased as a new DS ID for the ABM2+ 14.3.0 release. The latest land use pattern releases should be used during analysis.

1. Baseline Forecast (DS 41) – Jurisdictions in the San Diego Region worked with SANDAG to incorporate their latest general plan, expected near-term land use developments, and expected growth patterns based on the existing land use plans and policies. SANDAG released this information in conjunction with State demographic projections and other demographic trends as a baseline forecast.
2. Sustainable Communities Strategy (SCS) Forecast (DS 42) – As a part of the 2021 PRP, SANDAG developed a land use pattern that intended to minimize VMT by coordinating population and employment growth and planned Mobility Hubs transportation options. Population was also reallocated from the baseline scenario to areas that had low projected VMT per household in the future. Land use pattern changes were made to help reach the SB 375 GHG targets set by CARB.

The following table lists the different years that were modeled for the 2021 Regional Plan. Note that since the 2021 Regional Plan was approved in December 2020, the scenarios below have been re-run to accommodate ABM version updates (i.e. 14.3.0) and the 2021 Regional Plan Amendment.

Scenario ID[1]	Scenario Name[2]	Forecast Year	Land Use Version	SB 743 VMT
186	2016	2016	DS-ID 42	Available
189	2023 Build	2023	DS-ID 42	
140	2025 No Build	2025	DS-ID 41	
188	2025 Build	2025	DS-ID 42	Available
187	2026 Build	2026	DS-ID 42	
190	2029 Build	2029	DS-ID 42	
N/A	2030 No Build	2030	DS-ID 41	
191	2030 Build	2030	DS-ID 42	
192	2032 Build	2032	DS-ID 42	
141	2035 No Build	2035	DS-ID 41	
193	2035 Build	2035	DS-ID 42	Available
N/A	2040 No Build	2040	DS-ID 41	
N/A	2040 Build	2040	DS-ID 42	
142	2050 No Build	2050	DS-ID 41	
194	2050 Build	2050	DS-ID 42	Available

[1] These scenario IDs may change has SANDAG is performing updated modeling related to the 2021 Regional Plan Amendment (removal of road user charge).

[2] **Build – Future land use, population, housing and transportation networks developed and forecasted under a Sustainable Communities Strategy (SCS). An SCS must demonstrate how development patterns and transportation network, policies and programs can work together to achieve greenhouse gas reductions targets for cars and light trucks, if there is a feasible way to do so. An SCS must also be financially constrained to existing and reasonably assumed sources of revenue to implement the plan.**
No Build – Future land use, population, housing and transportation networks forecasted without a Sustainable Communities Strategy. The no build alternative does not assume any additional revenue. Therefore, future networks and transportation policies are very similar to the baseline condition.

Model Data

Data can be accessed through the SANDAG Transportation Forecast Information Center at http://tfic.sandag.org. Pursuant to SANDAG Board Policy No. 012, SANDAG Service Bureau, SANDAG member agencies, non-member government agencies, and private organizations and individuals may request specific services, including modeling, through the SANDAG Service Bureau.

All code and scripts related to running SANDAG's ABM and reporting processes are open sourced and hosted on GitHub. GitHub is a repository used by many organizations and companies to store and keep track of edits to code for projects. SANDAG uses GitHub to keep changes to the ABM transparent to the public. The SANDAG ABM GitHub repository provides all travel demand model code, reports, user guides and a wiki.

Modeling Products & Services

After a model run is complete, there are several outputs generated which can be shared upon request. For a full list of model outputs, refer to the SANDAG GitHub Wiki. In addition to model outputs, model inputs and reporting data can also be shared upon request.

There are several modeling services and products that can be produced from the outputs. The services and products, listed and described in the table below, can be requested via a scope of work and agreement with the SANDAG Service Bureau. Work performed through the Service Bureau shall be contracted using a deliverables-based firm fixed price. Each of these products and services have an associated cost which are developed using the agency's current salary schedules to ensure full cost recovery of services.

Product & Service	Description
Select Zone/Link Assignment	Standard output includes a plot with Selected Zone/Link volumes and percentages plus 24-hour volumes. Can also provide analysis outputs in shapefile format.
Mode Choice Reports	A list of Traffic Analysis Zones (TAZs) is required from the client. Standard output includes mode choice and trip lengths. The report is generated in Microsoft Power BI.
VMT Report	VMT per Resident and VMT per Employee per scenario for custom geographic area. A list of Master Geographic Reference Areas (MGRAs) is required from the client. The report is generated in Microsoft Power BI.
VMT Analysis	Customized disaggregation of VMT per scenario.

If requesting any of the above products and services for a Regional Plan scenario (i.e. no build/project), no custom model run is required. The requestor must simply state for which year and land use forecast (e.g. DS 41, DS 42) the requested products and services are needed.

A model run is typically needed when changes to the forecasted land use, transportation networks or travel policies are made. Like the products and services listed above, custom model scenarios are priced by tier depending on required edits to the highway, transit, and active transportation networks along with changes to land use.

Considerations for Choosing When to Perform A SANDAG Model Run

The use of VMT analysis for individual projects is a relatively recent consideration that was necessitated by the implementation of SB 743 in July 2020. Prior to SB 743, VMT analysis was typically only conducted for transportation analysis for regional plans, community plans, and corridor studies. The ITE San Diego Regional Transportation Impact Study Guidelines (ITE San Diego Section, 2019) included guidelines for VMT analysis of individual land development projects. It recommended that the VMT analysis of small projects be conducted using maps provided by SANDAG that showed VMT analysis per capita and VMT per employee. For large projects, the guidelines recommended running the regional model to conduct the VMT analysis. A trip generation of 2,400 vehicles per day was recommended as the determinant of whether a project was large or small for this purpose.

The 2019 Regional TIS Guidelines did not state a reason for recommending 2,400 vehicles per day as the determinant of when to run the regional model for VMT analysis. However, it was based on historical precedent as follows:

- In 1990, Proposition 111 was passed in California and it required preparation of a Congestion Management Program (CMP) for each California's urbanized counties. The San Diego Traffic Engineers Council (SANTEC) and the San Diego ITE Section prepared guidelines recommending

that large projects be the subject of a traffic impact analysis to determine the impact of large land development projects on the CMP (Guidelines for Congestion Management Program Transportation Impact Report for the San Diego Region (SANTEC/ITE San Diego Section, 1994). A trip generation of 2,400 vehicles per day was recommended as the determinant of whether a project was large or small for this purpose. No reason was given for selection of this value.

- The SANTEC/ITE guidelines for CMP analysis were subsequently adopted by SANDAG and were used as a standard for CMP analysis for many years.
- The previous level-of-service based regional TIS guidelines, SANTEC/ITE Guidelines for Traffic Impact Studies in the San Diego Region (SANTEC/ITE, 2000) also referred to the 2,400 value as the as the determinant for when a project required a CMP analysis.
- The City of San Diego's LOS-based TIS guidelines used prior to the implementation of SB 743 included a value of 2,400 ADT that determined when a project would conduct a "computerized" traffic impact analysis as opposed to a "manual" traffic impact analysis with use of the SANDAG model being a requirement for a computerized traffic impact analysis.
- The previous LOS-based TIS guidelines for both the City of San Diego and San Diego County referred to the use of 2,400 ADT as a determinant of whether a traffic impact analysis would need to include analysis to meet CMP guidelines.
- SANDAG has opted out of the CMP process and the 2,400 value is no longer applicable for this purpose

In conclusion, the value of 2,400 daily trips as the determinant for large versus small projects appears to have been developed based on professional judgment and then successfully used for many years without a methodological basis for use of this value.

The process of determining when a project would require a SANDAG model run was discussed in the sub-committee meetings. It would help reduce time and resources, if using the SANDAG SB 743 Maps[1] or other reliable methods were available to prepare VMT analysis for residential and work-based projects. The current practice generally follows the requirement set forth in the *Guidelines for Transportation Impact Studies in the San Diego Region*, January 22, 2019[2]. The first step, for most residential and employment-based projects, is to determine the amount of daily vehicle trips a project generates to determine the level of VMT analysis and then consistency with the General Plan or Community Plan of the jurisdiction.

- If a project generates 2,400 ADT or more, a project specific SANDAG model run is warranted for the project's VMT analysis.
- Note that the amount of daily vehicle trips that a project generates is also used to determine if a project can be screened from performing VMT transportation CEQA analysis. The *Guidelines for Transportation Impact Studies in the San Diego Region* provide various options for an agency to consider when setting a "small project" screening criteria, refer to the ITE Guidelines or a specific agencies guidelines for additional information on screening criteria.

---

[1] SANDAG SB 743 VMT Maps are available at https://sandag.maps.arcgis.com/apps/webappviewer/index.html?id=bb8f938b625c40cea14c825835519a2b

[2]Guidelines for Transportation Studies in the San Diego Region: It is recommended that projects be subjected to different levels of VMT analysis, depending on the size of the project and whether the project is consistent with the local jurisdiction's General Plan or Community Plan.

Most members of the sub-committee agreed that the 2,400 ADT value for requiring a project-specific model run was low, and wanted to investigate a rational basis for increasing or changing this daily trip threshold. A daily trip threshold of 5,000 ADT was discussed, however as described in this section, the sub-committee could not make a specific recommendation of using a higher trip threshold that could be used for requiring a project-specific model run. Also, setting a total project generated VMT value for conducting a model run was also discussed, however, was determined to be cumbersome.

One option considered whether consistency with the General Plan/Community Plan as well as presence of similar land uses in the TAZ or census tract, would be adequate for a project with a higher trip generation than 2,400 ADT to use the VMT metrics provided in the SANDAG SB 743 maps. Therefore, first step would be to determine if the project is consistent with the General Plan/ Community Plan[3]. Next step would be to compare the land uses in the TAZ or census tract with the proposed project's land use. If the project is similar in land uses which currently exist in the TAZ or census tract, check if there is enough data for the VMT result to be statistically valid. The current SANDAG SB 743 VMT Maps provide results for TAZs or census tracts that have at least 300 residents or 500 employees. The maps do not provide VMT metrics for TAZs or census tracts that have less than 300 residents or 500 employees. Therefore, if the answer to the two steps described above is yes, then the VMT/capita or VMT/employee can be inferred from the metrics provided for the TAZ or census tract and compared to the regional mean to determine the project's VMT impact. If the answer to both steps is no, then a project-specific model run may be the most appropriate method for analysis.

One of the limitations discussed was that some of the TAZs or census tracts on current SANDAG SB 743 VMT Maps do not provide a value for VMT per capita or VMT per employee if there are fewer than 300 residents or 500 employees, in that specific geography. Therefore, if a project was in a TAZ or census tract that did not have a statistically adequate number of employees or residents, then a SANDAG SB 743 VMT map value would not be available for that project's analysis. Thereby, an alternate method would need to be used, such as a project-specific model run or using an average value of adjacent TAZs or census tracts which have similar land uses as the project.

Another option that was discussed was to review the SANDAG model reports to identify the difference or variation in results each time the model was run to determine what size of project could affect the regional VMT result significantly. For this purpose, SANDAG staff provided ABM2+ Variability for SB 743 VMT Reports[4]. The variability report is produced by running the model five times in a row to see how much variability in Mode Choice and SB 743 VMT results is provided by consecutive model runs. The variability report included data for the San Diego region and a few sub-areas. The reports included a large amount of data on mode choice and share, trip length, and VMT. The variability in the regional resident VMT and regional resident trips from these reports were selected for comparison.

[3] Per SANDAG staff, the latest/upcoming version of the SANDAG model would consist of two options: ABM2+/2021 RTP which has land uses that are consistent with Sustainable Communities Strategy (SCS) and ABM2+ version which has land uses that are consistent with the General Plans or Community Plans of various jurisdictions in the region.

[4] These reports were analyzed by SANDAG to set Population/Employment thresholds for valid reporting of SB743 Resident/Employee VMT.

- Regional Resident VMT Variability over five model runs was 53K for fixed random seed[5] and 126K for variable random seed[6] which in range percentage[7] was only 0.08 and 0.20, respectively.
- Regional Resident Trips Variability over five model runs was 4.8K for fixed random seed and 8.1K for variable random seed, which in range percentage was only 0.05 and 0.08, respectively.

Per discussion with SANDAG staff it was determined this really small change in regional VMT and trips over five consecutive model runs could be attributed to model "noise" and not due to the change in model input or seeds. Therefore, review of the variability reports at a regional scale was deemed to be inconclusive in terms of determining the size of project which could result in a significant change in VMT output. The sub-committee members discussed that reviewing this data for a smaller geographic area or at a project-level may provide a better understanding of the size of a project or number of trips generated by a project that could influence a project's VMT result. However, due to unavailability of project-level or sub-area data per recent model update as well as concerns regarding using or publishing specific project results, this option was not considered viable by the sub-committee members at this time.

Some projects such as regional retail, recreation, public facilities and roadway projects require estimation of change in total VMT i.e. net VMT. These projects are also required to follow similar process as residential and employment uses – i.e. determining the project's consistency with the General Plan or Community Plan and similar uses in the TAZ or census tract. The sub-committee also discussed if manual calculations could be done using average trip lengths and trip generation to estimate total VMT for such projects. Other tools and methods of estimating VMT are discussed later in this paper.

Even though having a minimum trip value provides a guideline that every project and jurisdiction can follow consistently, the sub-committee members also considered not having a specific trip value to determine when a project-specific model run should be conducted. This would require a case-by-case evaluation by the jurisdiction and the applicant based on project's characteristics such as use, size and intensity to determine if the project's VMT should be modeled.

The sub-committee members, City staff and/or consultants would not like to be seen as "cherry picking" when selecting the method of VMT analysis – a project-specific model run or using SANDAG SB 743 VMT Maps or other methods. It is not easy to determine which method of VMT estimation is more accurate, however it would be ideal if two sources for estimating a project's VMT analysis were available, and it could be demonstrated that the VMT results are similar using either method.

When Should a Project Perform a SANDAG Model Run?

Given the discussion above, the sub-committee concluded that setting one value of ADT for when the model should be run using a data driven process is not possible within the constraints of this sub-committee. This is because of the number of variables that affect the decision of when a custom model should be run such as location, what's already in the TAZ/MGRA (or adjacent), the type of project, etc.

---

[5] Fixed Random Seed: This uses the same random seeding across multiple model runs which causes the modeling results to have less variability. This is the default for the SANDAG model. When testing land use it is more appropriate to use fixed random seed to attempt to isolate the changes due to adding the land use.

[6] Variable Random Seed: This allows the model to generate a different random seed for each model run, which results in more variability across modeling results.

[7] Range Percentage is calculating using the formula: (*100 x (maximum - minimum) / mean*)

The sub-committee recommends that each lead agency allow for flexibility in determining when a custom model run is necessary. As noted above, the collective sub-committee "gut feeling" is that 2,400 ADT is too low of a number, but may be an appropriate fall back value. If a project can provide evidence such as noting the location and similarity of uses that are in the model, use of the screening maps or "off-the-shelf" readily available model data may be appropriate even if the project generates more than 2,400 ADT. The sub-committee also recognizes that there are other types of tools available for estimating VMT that are appropriate in certain circumstances.

Other Tools/Models for Estimating VMT

There are other tools and techniques that can be used to estimate various VMT metrics. The following provides an overview of the two categories of models available for estimating VMT:

- Travel Forecasting Models: A travel forecasting model is a computer model used to estimate travel behavior for a specific base year or horizon year based on land use and transportation network supply inputs. VMT is one output of a travel forecasting model run. The SANDAG regional travel demand model is an example of a travel forecasting model.

- Other models and tools: Use of a travel forecasting model is not always the most appropriate method for estimating VMT (or may not be available in some cases), VMT can also be estimated using sketch models or spreadsheet tools. Typically, these types of models/tools estimate VMT directly by multiplying the number of trips by an average trip length. Trips can be estimated using the results of local trip generation surveys or trip generation rate data published by the Institute of Transportation Engineers (ITE). Trip lengths can be extracted from models, from standardized averages, or travel pattern data from household travel surveys, big data, or other sources. These methodologies could also be paired with a travel model and used between major model updates or to estimate project generated VMT for smaller projects that would "get lost" or be part of the "model noise" in a regional travel demand model.

Note that a project that uses a method other than the SANDAG model would also need to set a threshold using the selected method. The threshold and project analysis must be developed using the same tools/methodology to allow for an "apples-to-apples" assessment.