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# Travel Demand Modeling and Project Coding Procedures

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Revised  
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As described in the Final Transportation Conformity Rule (section 93.122), travel demand models used to generate emission estimates after January 1, 1997 in previously designated serious, severe, and extreme ozone nonattainment areas must meet certain requirements. Those requirements are:

- General Model requirements
  - Including capacity and volume sensitive speed and delay estimates
  - Including consistency with Highway Performance Monitoring System (HPMS) vehicle miles traveled (VMT) estimates
- Reasonable methods to estimate off-network vehicle miles traveled (VMT)

Section I below describes how each of these requirements was met for the NJTPA Conformity determination for the FY2009-2012 Transportation Improvement Program (TIP) and the 2005 Regional Transportation Plan (RTP). Section II provides information on how individual projects are accounted for in the transportation conformity modeling process including how off-network VMT are estimated.

### **I. Travel Demand Modeling Description**

The travel demand forecasting model currently used by NJTPA is called the North Jersey Regional Transportation Model Enhancement (NJRTME). This model is a standard four-step model which uses Citilabs software products CUBE (as an interface) and Voyager with additional FORTRAN programs used for mode choice.

The NJRTME has 2,545 traffic analysis zones (about 1,800 of these are in the NJTPA region) and no external stations. The model has been expanded to include all of New York City and Long Island, portions of southern New Jersey, portions of southern New York State, and portions of eastern Pennsylvania.

Within the NJTPA region, the highway network includes most arterials (major and minor) including most 500 level and 600 level county roads but does not include some collector or local roads. Outside the NJTPA region, the highway network is more schematic, representing major regional roadways.

The model has eight trip purposes:

- Home-Based Work Direct (trips between home and work with no intermediate stops),
- Home-Based Work Strategic (trips between home and work with one or more intermediate stops),
- Home Based Shopping (trips between home and shopping destinations),
- Home Based Other (all other trips that either begin or end at home),
- Work Based Other (trips based at work, other than those associated with the trip from or to home),
- Non-Home-Non-Work (all other trips that have neither origins or destinations at home or work),
- Airport Trips (trips to or from regional airports), and
- University Trips (trips to or from regional colleges and universities made by students).

The model has six modes for most trip purposes (seven modes for the Home Based Work trip purpose):

- Trucks,
- SOV,
- HOV-2,
- HOV-3,
- HOV-4+ (only for Home Based Work),

- Transit-Walk Access, and
- Transit-Drive Access.

There is also a portion of the model that estimates non-motorized mode use (e.g., walking and biking).

The transit network includes New Jersey Transit’s rail and bus network. The network also includes ferry services. (This part of the model was not used in the FY09 Conformity Determination because validation has not been completed).

The model uses population, household (with a split into households that contain retirees, households that do not contain retirees but contain children, and households with no retirees or kids) and income data.

There are four separate networks for the four different time periods: AM Peak (6 to 9 AM), Midday, PM Peak (3 to 6 PM), and Night.

The following sections describe how projects are coded into the model, and how non-modeled projects are accounted for in transportation conformity.

## **II. Exempt and Non-Exempt Projects: Coding Procedures and Non-modeled Network Improvements**

In order to demonstrate conformity, projects from the RTP and TIP are classified into "Exempt" and "Non-Exempt" projects. "Non-Exempt" projects, are further classified into "regionally significant" and "not regionally significant". All projects that can be modeled, will be modeled, however small their impact on air quality emissions may be.

Projects defined as "regionally significant" are then categorized as either projects that can be "modeled" or "can not be modeled". An example of a project that can not be modeled is an ITS project. Although its impact is regional, there is no specific way to properly define and abstract it in the travel demand model. Projects classified as "modeled", will be either directly coded into the travel demand model or will be estimated in an "off-model" process. Projects treated as "off-model" include those projects their impact are estimated by other models, such as the New Jersey Transit Demand Forecasting Model, or with other techniques.

A description and example of how projects get coded into the NJRTME model and how projects are evaluated off-model are provided below.

### **A. Coding Procedures for Modeled Projects**

In conjunction with the NJTPA Conformity Analysis, highway network project coding and project transaction for the NJRTME will be performed using the “LOG” feature within the Cube environment. The “LOG” feature enables Cube users to store all changes made to a highway network file within the CUBE environment during a particular session. Those changes or updates to the highway network file will be saved to a “log” file (with “.LOG” extension), which is basically a text file cataloging all changes made during that particular session.

In this approach, each project will be coded as a separate “project” log file, a similar approach to the former NJTRM project coding. Coding each project individually will provide flexibility for future changes, such as revising or deleting the project. These projects will then be grouped into a “scenario log file” that corresponds to each model year or scenario during a transaction process. The scenario log file is a file containing all projects for a particular model year or scenario. The project coding and project transaction for the NJRTME will be discussed further in the following sessions.

## **PROJECT CODING PROCEDURES**

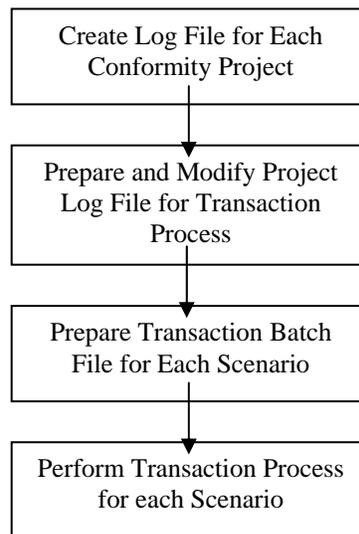
The project coding procedures are described schematically by the flowchart shown in Figure 1. The procedure consists of four steps:

1. Create log file for each project in Cube Environment. In this step, the highway network will be revised or updated to reflect changes indicated in the project description.

2. Prepare and modify project log file for transaction process. The modification includes adding the project description to the log file, creating the title information and header log file, deleting title/header information from each project log file.
3. Prepare transaction batch file for each scenario. The preparation includes combining all project log files pertaining to certain scenario into one scenario log file.
4. Perform transaction process. The transaction process is performed in Cube environment by executing the scenario log file.

Each step will be discussed in detail in the following sessions

**Figure 1 – Project Coding Procedures**

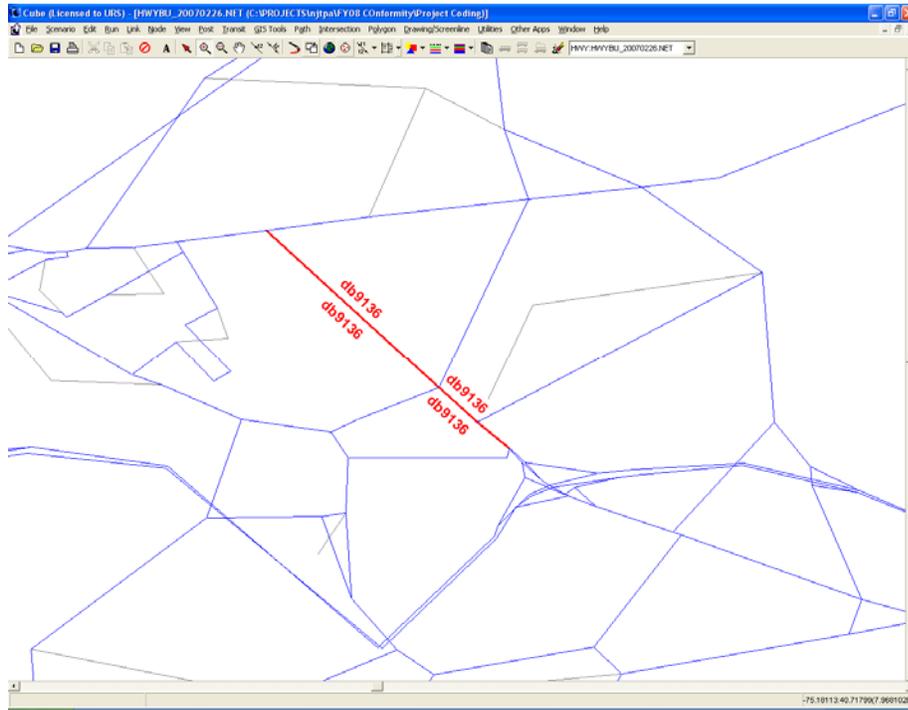


### **CREATE LOG FILE FOR EACH CONFORMITY PROJECT**

A log file for each project is created in the Cube Environment using “Save Log File” command under “FILE” menu. The log file is created as follows:

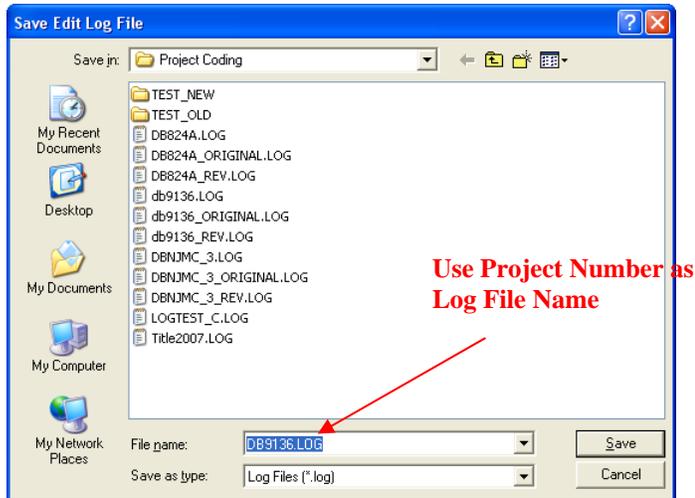
1. Open the base highway network in Cube. The base highway network is the highway network from the year prior to the analysis year. For example, if model years are 2007, 2009, 2010, 2015. The base network for analysis year 2010 is the 2009 highway network.
2. For the Conformity Analysis, URS will add two more variables to highway networks: PROJN (Project Number) and PROJYR (Project Completion Year).
3. Update or revise highway network to reflect changes for a particular project. Project DB9136 is selected as a sample in this discussion. This project widens Rt. 22/Rt. 519, in Warren County, from three lanes per direction to four lanes. Figure 2 displays the location of the updated highway network links pertaining to this project.

**Figure 2 – Revised Highway Links for DB9136 Project**



4. After the network revision is completed for this project, save the log file using “Save Log File” command in File Menu. Use the project number as the file name (see Figure 3) to help identifying the project easily.

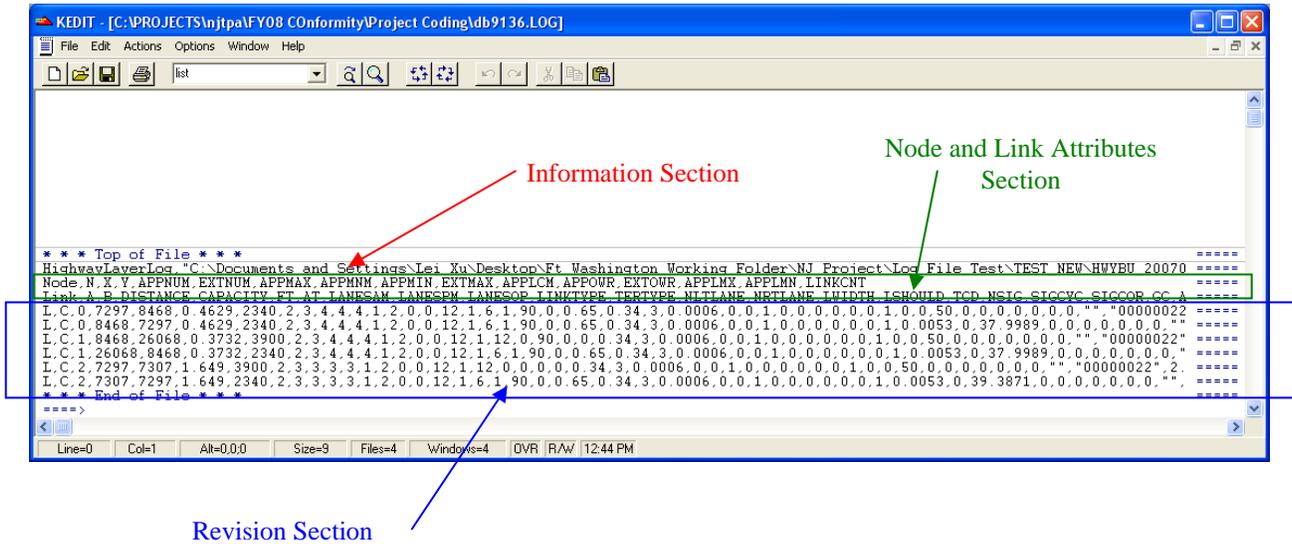
**Figure 3 – Save Log File Window**



A project log file is a text file with a file structure shown in Figure 4 which includes:

- Information section (first line) contains highway network name, number of node variables, number of link variables, date and time.
- Node and link attributes section (second and third lines) contains the list of node and link variable names.
- Revision section contains the revised link and node attributes. The first character in each line indicates whether the revisions were applied to nodes (“N”) or links (“L”). The second character indicates revision types: “C” for change, “A” for add, and “D” for delete. The rest of the values corresponds to the variables listed in the node and link attributes sections.

**Figure 4 –Log File Structure**



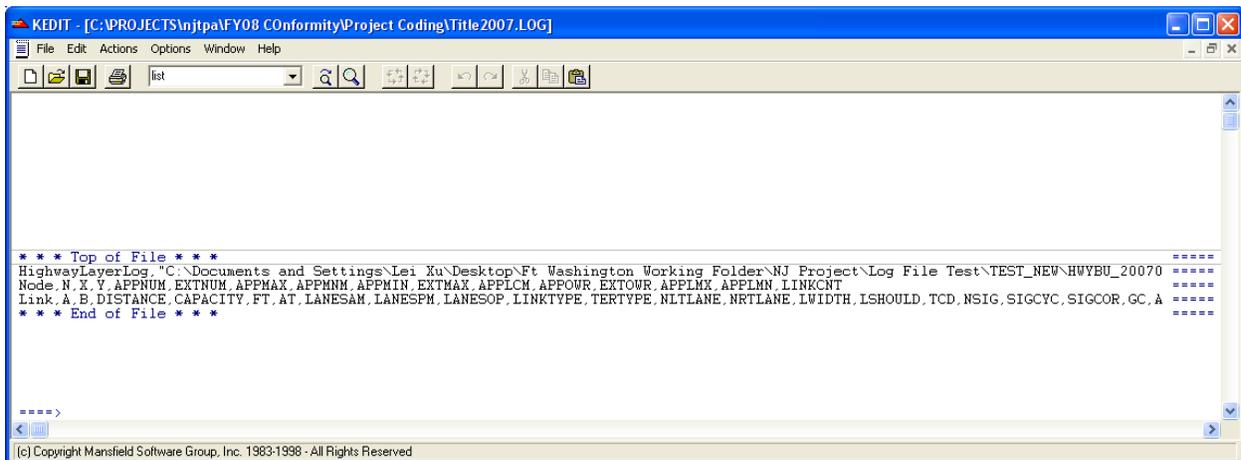
**PREPARE PROJECT LOG FILES FOR TRANSACTION PROCESS**

Each project log file contains the information and node/link attributes sections as previously described. During the transaction process all project log files belonged to a specific scenario will be combined together into one scenario log file. The scenario log file, however, should only contain one “information and node/link attributes sections”. Therefore, before copying all individual project log files into a single scenario log file. To accommodate the process, there are a few modifications that should be made:

- Create one title log file that contains information and node/link attributes sections only. This can be done by extracting the information from any individual project log file. It should be noted that the information and node/links attributes sections in the individual project log files are the same for the same scenario.
- Delete information and node/link attributes sections from all project log files and add the project number and description for identification purposes. Figure 5 shows a sample of title log file modified project log file.

**Figure 5 – Title Log File and Modified Project Log File.**

*Title Log file*



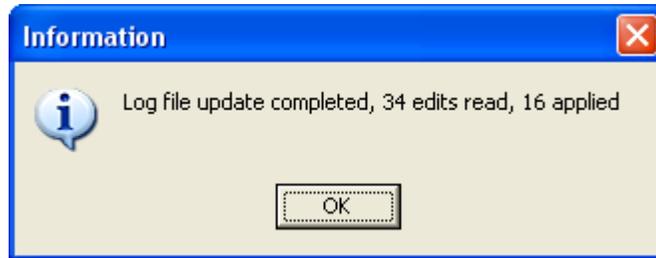


## PERFORM TRANSACTION PROCESS

The transaction process is performed to generate the analysis year highway network by adding the scenario log file to the base highway network. The transaction steps are as follows:

- Open the base year network in Cube
- Open the scenario log file using “Play Log File” command in the FILE Menu.
- If the transaction is successful, Cube will display a message window shown in Figure 8.

**Figure 8 – Successful Transaction Window**



- If, somehow, the transaction is failed because certain links are not in the highway network, Cube will display a message indicating that the link does not exist (see Figure 9). Unfortunately, in the current Cube version this message is only displayed on the screen and not logged to a file. Therefore, the users have to record each link manually for further check or revision. URS envisions that this type of error will occur infrequently.

**Figure 9 – Link Does Not Exist Message**



Upon the completion of a successful transaction process, the highway network file will then be saved as the model year highway network.

Currently, new transit projects (those implemented after 1996) are estimated by an off model process using VMT estimates provided by New Jersey Transit’s Demand Forecasting Model to ensure consistency between regional modeling and regional emissions estimates.

## LIMITATIONS

There are several limitations related to this approach:

- Turning penalty can not be coded using the log file approach. Therefore, for projects that contain turning penalty, those turning penalty should be coded separately in a turning penalty file (or added to the current turning penalty file if such file exists).
- The log file approach cannot completely update transit lines automatically. A separate process has to be performed to revise transit lines to be consistent with the updated highway network.

### *B. Non-modeled Network Improvements*

Non-modeled project means the project can not be adequately reflected within the travel demand model. These projects are assumed to increase speed and improve traffic flow, although no attempt has been made to quantify their impacts. Most of these projects are relatively minor and would not cause any significant diversions between competing network paths. A summary of these is as follows:

ITS Improvements - Roadway information signing projects (MAGIC) as well as traffic operations center are falling into this category. These improvements will enable motorists to have additional warnings about congested locations on the highway network and will supplement existing information currently provided to motorists by radio stations.

Modeling of the ITS improvements is not possible within the NJRTME, or most other regional models, since the assignment algorithms used by these packages assume that all trips (drivers) are "aware" of the shortest travel time paths between their origin and destination. It should also be noted that some of the influences of ITS technology are currently incorporated indirectly in the model chain, to the extent that observed traffic patterns and counts are influenced by information currently provided to motorists.

### **III. Conclusion**

As stated above, NJTPA's travel demand model and estimates for off-network VMT estimation meet the requirements established by the Transportation Conformity Rule.