North Jersey Regional Transportation Model- Enhanced

Overview for Experienced Modelers

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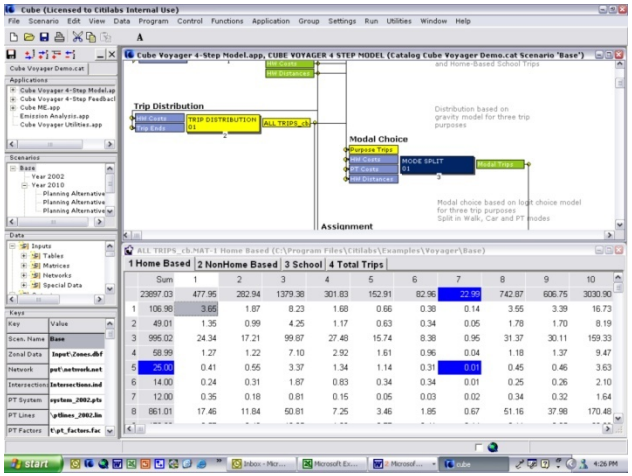
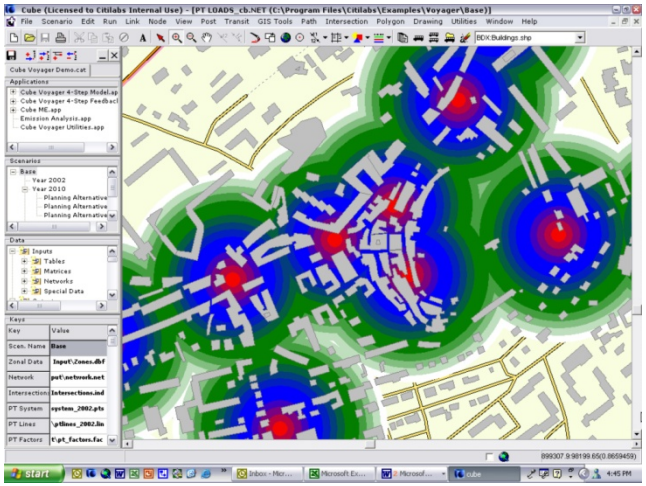
Agenda

- Design Considerations
- Comparisons with Earlier Versions of the Model
- Diagnostics & Reports
- Data Requirements
- User Interface
- Validation Results
- Possible Future Enhancements

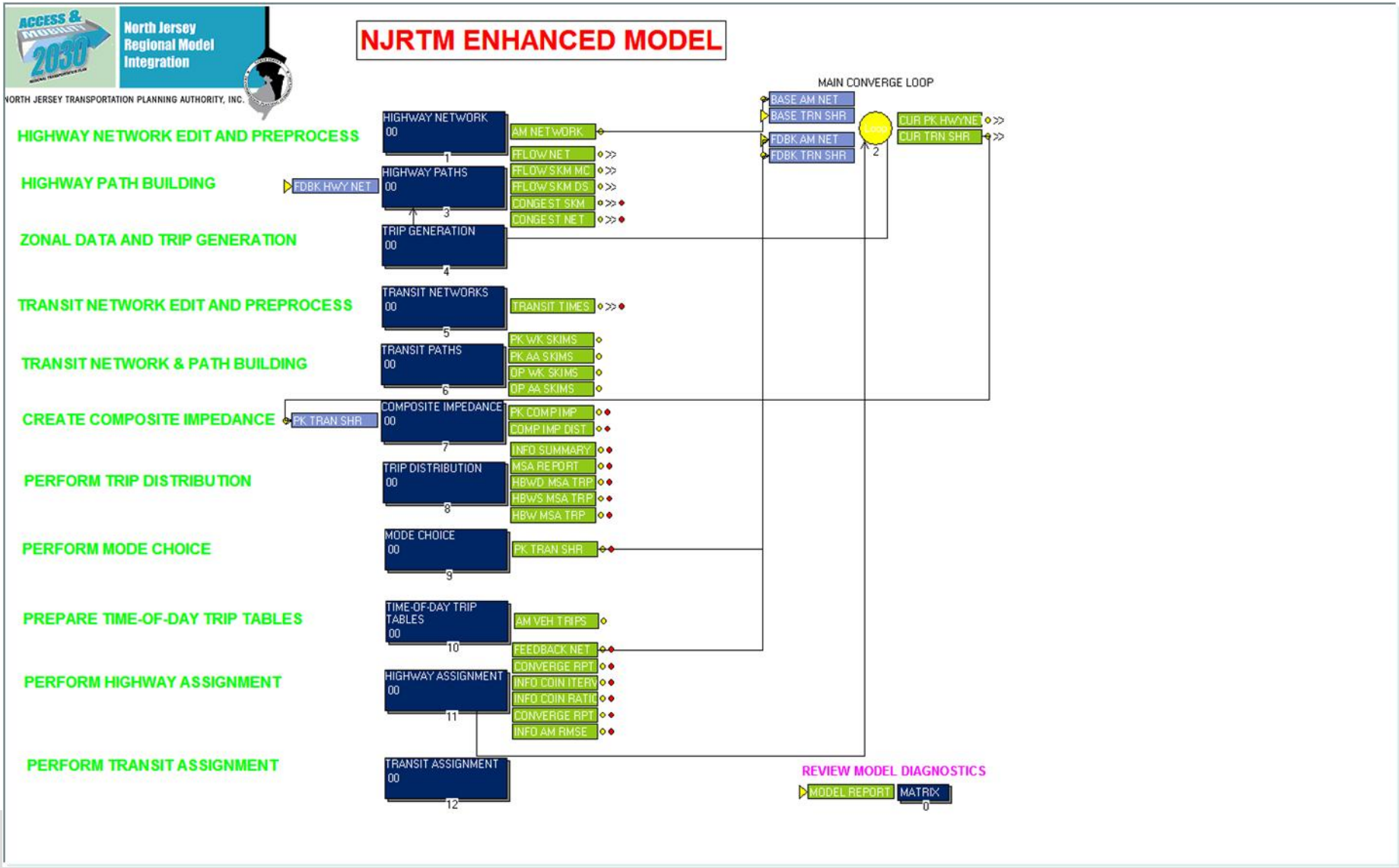




NJRTM-E Design Considerations

- Create Single Unified Model for Northern NJ
  - Suitable for Regional Planning and Project Planning
  - Utilizing “best features” of existing regional models
- Retain Key features required by Agencies
  - NJ Transit’s Network and Mode Choice Model
  - NJTPA’s Iterative Model Structure

NJTRM-E "FLOWCHART"



NJRTM-E Design Considerations

- Operating Platform
  - Cube Base
  - Cube Voyager / Cube Cluster
  - Retain User-written programs
- Support Applications for Alternatives Analysis
  - SUMMIT/ FTA New Starts
  - Air Quality Tools
  - Post Processing Tools
- Peer Review/Findings
- Subregional Models

NJRTM-E Design Considerations

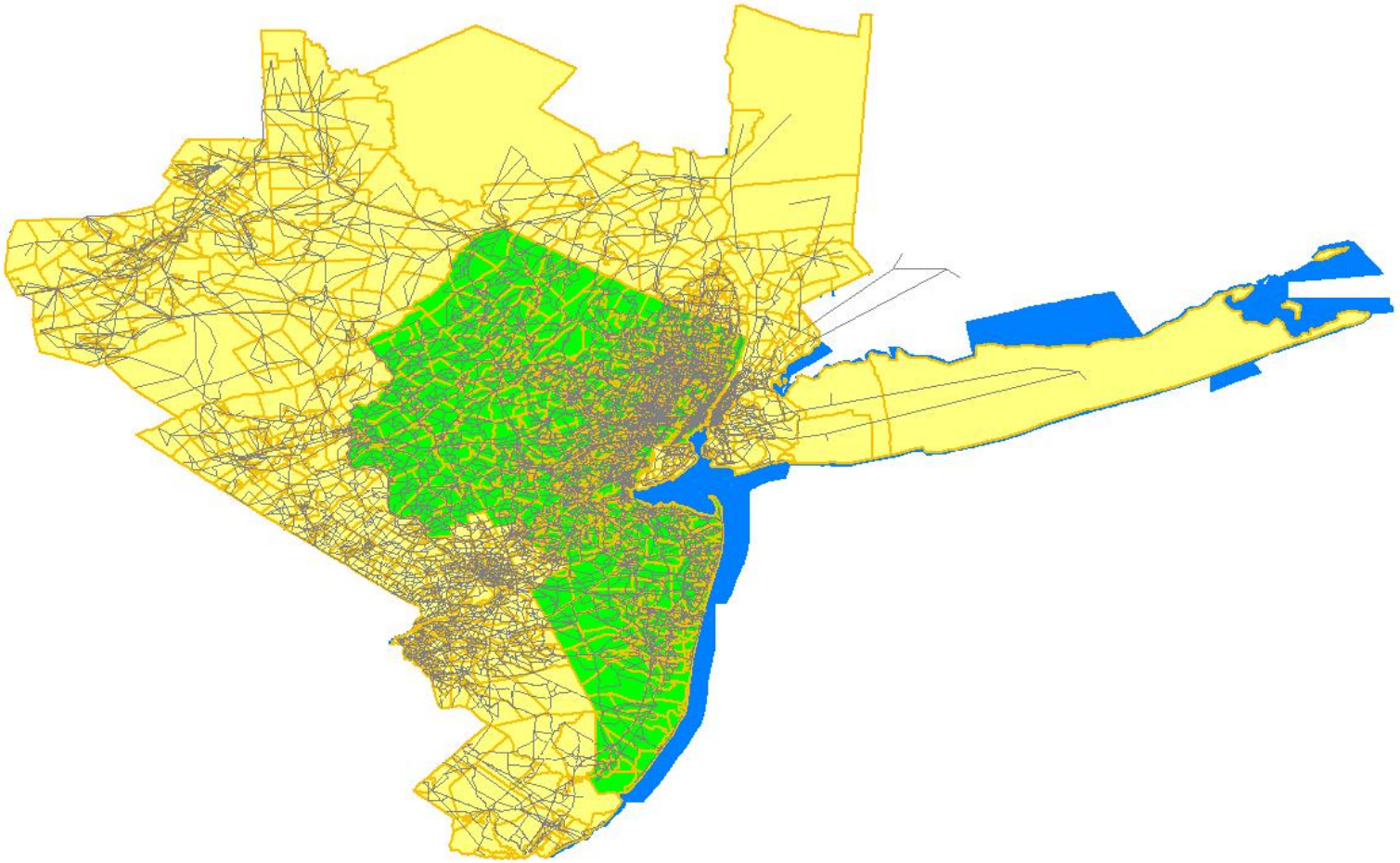
- Network & Model Complexity Issues
  - User Support Requirement
- Execution Control
  - Full Model & Stepwise Execution
  - Execution Control by Diagnostic Conditions
    - Software & User Defined
    - Warning / Fatal Controls
- Model Diagnostics
  - Routine Diagnostics
  - In-line Statistical Summary Reports
- Zone Independent Model Structure

Comparing the NJRTM-E with Previous Versions of the Model

- Model Features and Capabilities
- Model Application Environment

Comparing the NJRTM-E with Previous Versions

- Expanded Model Region



New Model Features & Capabilities

- Detailed Representation of Highway Network
  - Enhanced Representation of Capacity & Speed
    - Based on HCM 2000 Procedures
    - Link Capacity a function of Traffic Control Devices
    - Approach Capacity a function of turning lanes
  - Detailed Coding of Limited Access Roadways
    - Bifucated coding / Detailed Ramp coding
  - Geocoded Network
    - Shaped Network / Identification Attributes
  - Highway Network includes Special Purpose Transit Facilities
    - Exclusive Busways
    - Link-Specific Scalable factors penalties for “shared-use” roadways

New Model Features & Capabilities

- Trip Generation Enhancements
  - Generation now a function Life Cycle and Number of Workers in addition to Household Size and Income
  - Additional University-Based Trip Purpose
  - Airport Trip Purpose (Newark International)
  - Non-Motorized Trip Estimation
  - Adoption of NJ Statewide Model Truck Trip Estimation Procedures

New Model Features & Capabilities

- Incorporation of NJ Transit Mode Choice Model
  - Nested Logit Structure
    - 6 Line-haul Modes / 2 access modes
    - Geographic Market Segmentation
      - Area / Density Related
    - Mode Choice by Purpose segmented into Peak and Off-Peak

New Model Features & Capabilities

- Highway Assignment Enhancements
  - HCM 2000 Volume-Delay Functions
  - Simplified Queuing Procedures
  - Advanced Toll Diversion Modeling
    - Embedded Route Choice Submodel by Purpose & Vehicle Occupancy
    - Direction-Specific Toll Modeling

NJRTM-E Trip Purposes

- Trips are Classified Based on Whether they are Oriented Toward **Home** or **Work:**
  - Home-Based **Work Direct** (from home to work)
  - Home-Based **Work Strategic** (e.g., drop off kids, pick up coffee on the way)
  - Home-Based **Shopping**
  - **Home-Based Other** (e.g., leisure, visit family)
  - Home-Based **University**
  - **Work-Based Other** (e.g., to lunch, shopping)
  - **Non-Home Non-Work** (all the rest - e.g., from a store to school)
  - **Trucks**

NJRTM-E Trip Generation

- Productions: Cross-Classification Technique
  - Work Trips (Income x Life Cycle x Workers /HH)
  - Nonwork Trips (Income x Life Cycle x Persons /HH)
- Attractions: Linear Equations
  - Households
  - Employment by Type
  - Area Type
  - Density

NJRTM-E Trip Generation

- Cross-classification
  - Household Lifecycle Groups (3)
    - With Retirees (at least 1)
    - With Children
    - Without Retirees or Children
  - Household Income Groups (5)
    - 0-15K
    - 15-35K
    - 35-75K
    - 75-150K
    - 150k+
  - Workers Per Household (4)
    - 0 Worker
    - 1 Worker
    - 2 Workers
    - 3+Workers
  - Persons Per Household (6)
    - 1 to 6+ Persons

CODE	HBSH	HBO	HBU	NHNW
1	0.56	0.76	0.01	0.49
2	1.34	1.19	0.01	0.65
3	1.55	1.67	0.16	0.65
4	1.55	3.57	0.04	0.63
5	1.65	4.52	0.33	0.7
6	2.17	7.33	0.33	1.29
7	0.6	1.17	0.01	0.84
8	1.4	2.02	0.01	0.91
9	0.8	2.7	0.14	0.75
10	1.5	3.75	0.04	0.75
11	0.7	4.75	0.23	0.75
12	2.35	8	0.23	1.3
13	0.65	1.52	0.01	1.1

An example of NJRTM-E trip rates

NJRTM-E Trip Generation

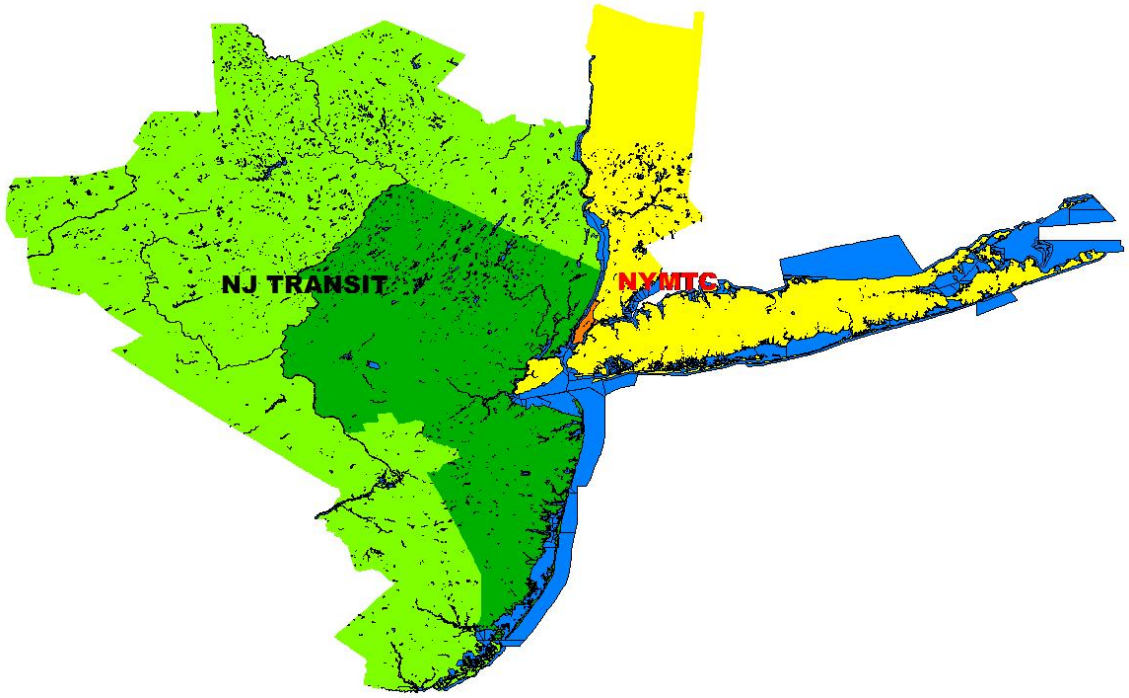
- External Trips abstracted as part of the Buffer Region
- Truck Trip Estimation
  - Employment by Type & Households
  - Major Truck Generators
  - Intermodal Facilities
- Post Generation Non-Motorized Trip Estimation
  - Autos / Person
  - Population & Employment Density
  - Network Density (Street Layer)
  - Network Restrictiveness (Highway Network)
    - Limited Access Roadways
    - Multilane / High Speed Arterials

NJRTM-E Distribution

- Gravity Model Structure
  - Stratified By Income
  - Composite Impedance Term
    - Includes Highway / Transit times and costs
  - Includes K-Factors
    - Use was Minimized
    - Primarily for NYC Destinations
  - Calibration Against Household Survey and NJT Survey-based Trip Tables

NJRTM-E Mode Choice

- "Two-Region" Approach for Mode Choice
  - Trips Originating in "NJT Region" estimated via the NJT Mode Choice Model
  - Trips Originating in the NYMTC Region estimated via shares obtained from NYMTC BPM



NJRTM-E Mode Choice

- NJT Region - Nested Logit Model
  - Auto (SOV, HOV2, HOV3, HOV4+)
  - Transit (12 access/Line-Haul Combinations)
    - 6 Line-Haul (Bus, Rail, PATH, LRT, Ferry, Long-Haul Ferry)
    - 2 Access Modes (Walk & Auto)
  - Each Purpose Partitioned into Peak & Off Peak with separate mode choice applications

NJRTM-E Mode Choice

- NYMTC Region – Share Calculation
  - Derived from the NYMTC BPM
  - Generalized Estimation
    - Auto (SOV, HOV2, HOV3+)
    - Transit
  - Processed via Input Support Application
    - Optional Process

NJRTM-E Assignment

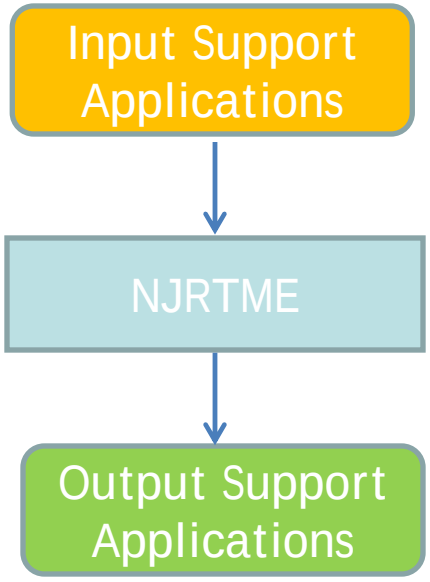
- Highway Assignment
  - Four Periods (AM/PM Peak Periods, Midday, Night)
  - Route Choice Assigns Nine Vehicle Type/Path Conditions:
    - SOV, HOV, Truck
    - NonToll, Cash Toll, ETC Toll
    - Sensitive to Directional Toll biases
  - Assignment Options:
    - Standard BPR
    - 2000 HCM & Simple Queuing
    - Akcelik Method
    - Detailed HCM Method

NJRTM-E Assignment

- Universal Select-Link Analysis Option
- Toll Diversion Sensitive to Payment Method
- Congestion Pricing Analysis

Model Application Environment

- "Flow Chart Style" Cube Applications
- Scenarios Defined as Combinations of Socioeconomic Data and Network Conditions
  - Socioeconomic Data (example – "2020 Trend")
  - Network (example "2010 No-build")
- Limited Use of Scenario "Keys"
- Application Types
  - Main Application – NJRTME
  - Support Applications
    - Input Support
    - Output Support



Input Support Applications

- Purpose – Preparation of Input Data
- Use is optional, conditioned on analysis need
- Application Tasks:
  - Process Trips & Create Shares for NYMTC BPM Region
  - Calculate Initial Transit Composite Impedance
  - Calculate Zonal Level Walk Access Coverage

Output Support Applications

- Purposes:
  - Post Processor Preparation
    - PPSUITE
    - SUMMIT
  - Custom Analysis Tasks
    - Subregional Extraction
    - Fixed Distribution Analysis
  - Daily Network Traffic / Summary Statistics
- Use is optional, conditioned on analysis need
- Application Tasks:
  - PPSUITE Network Merge - Network Preparation for PPSUITE
  - Subarea Processing – Extract Subarea Networks and Trip Tables
  - Daily Network Statistics – Summarize Daily Network Statistics
  - SUMMIT Analysis – Mode Choice Execution For Use with SUMMIT
  - Fixed Distribution Analysis – Process Model with Fixed Trips

Execution Control and Diagnostics

- Execution Control
  - Full Model
  - Stepwise Execution
    - Primarily for Debugging Purposes
  - Execution Control by Diagnostic Conditions
    - Software & User Defined
    - Warning / Fatal Controls
- Model Diagnostics
  - Routine Diagnostics
  - Cumulative Model Summary
- Component Summary Reports
  - Selected Components

Diagnostics & Reporting

- Purpose
  - User Support – Assist with Complex Coding
  - Provide Flexibility for Execution
- Diagnostic Message Types:
  - User Defined
    - Information
    - Warning Messages
    - Fatal Messages
    - Primarily Data Preparation / Processing
    - Expandable Process
  - Software Generated
    - Information / Warning Messages
    - Fatal Messages

User Defined Messages – Network Examples

- Information
  - *Link has User-Defined Speed*
- Warning
  - *Signalized Traffic Control Device Coded, but Number of Signals = 0, Set to 1*
- Fatal
  - *Undefined Facility Type for Link*

Software Generated Messages – Examples

- Information
  - *Number of zones processed or records processed*
- Warning
  - *Turn Penalty inconsistent with network coding*
- Fatal
  - *Missing File*

Diagnostic Reports

- Report Types
  - Routine Diagnostics
  - Cumulative Model Summary

```
****************** HIGHWAY PATH STATUS REPORT 1 - PHASE 1 - MESSAGE SUMMARY **
****************** ITERATION =       1.00  ************************************
**** APPLICATION WARNING MESSAGE(S) STEP 1, QUANTITY=     0
**** APPLICATION WARNING MESSAGE(S) STEP 2, QUANTITY=     0
**** APPLICATION FATAL MESSAGE(S) STEP 1, QUANTITY=     0
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**** ROUTINE WARNING MESSAGES -- RETURNCODE = 1

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**** ROUTINE WARNING MESSAGES -- RETURNCODE = 1
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Data Driving the NJRTM-E

- Socioeconomic
  - Households by Lifestyle, Income and Persons
  - Employment by Type
  - Truck Trip Generators
  - Etc.
- Network
  - Facility Type
  - Lanes
  - Transit Services
  - Etc.
- Behavioral
  - Parameters, rates, coefficients, etc.

NJRTM-E Data Requirements

- Socioeconomic Data
  - Population
  - Households
  - Income
  - Life Cycle Stratifications
  - Autos Per Person
  - Employment (10 Classifications)
  - Parking Costs
  - Zone Area
  - University Enrollment
  - Truck Terminals / Warehouses

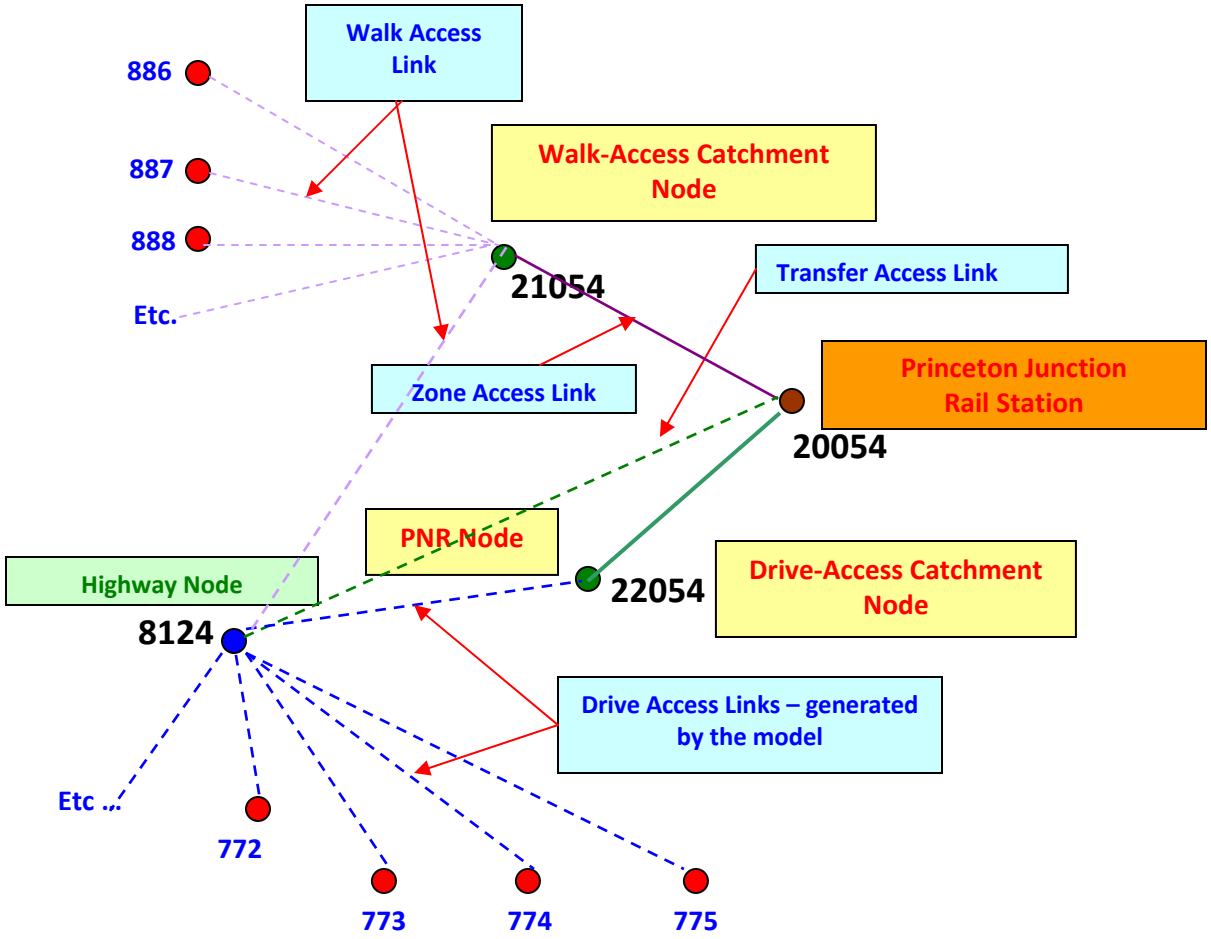
NJRTM-E Data Requirements

- Highway Network
  - Physical Data
    - Length
    - Lanes / Lane Widths / Shoulder Conditions
    - Terrain Type
  - Operational Data
    - Facility Type
    - Traffic Control Devices
    - G/C ratios & Progression
    - Turning Restrictions
  - Cost Data
    - Tolls & Associated Factors
  - Identification / Reference Data
    - Zone
    - Route / Name

NJRTM-E Data Requirements

- Transit Network
  - Route Data
  - Link / Node Data
  - Access Data
    - Non Transit Links
    - Walk & Transfer Links
  - Park / Ride Data
    - Catchment Areas
  - Fare Data
  - Walk Access Coverage
- Editing Procedures Maintained in the NJT Formats
  - Separate “card files” for each transit network element
  - Custom procedures developed to retain comment records

NJRTM-E – Rail Mode Access Coding Procedures

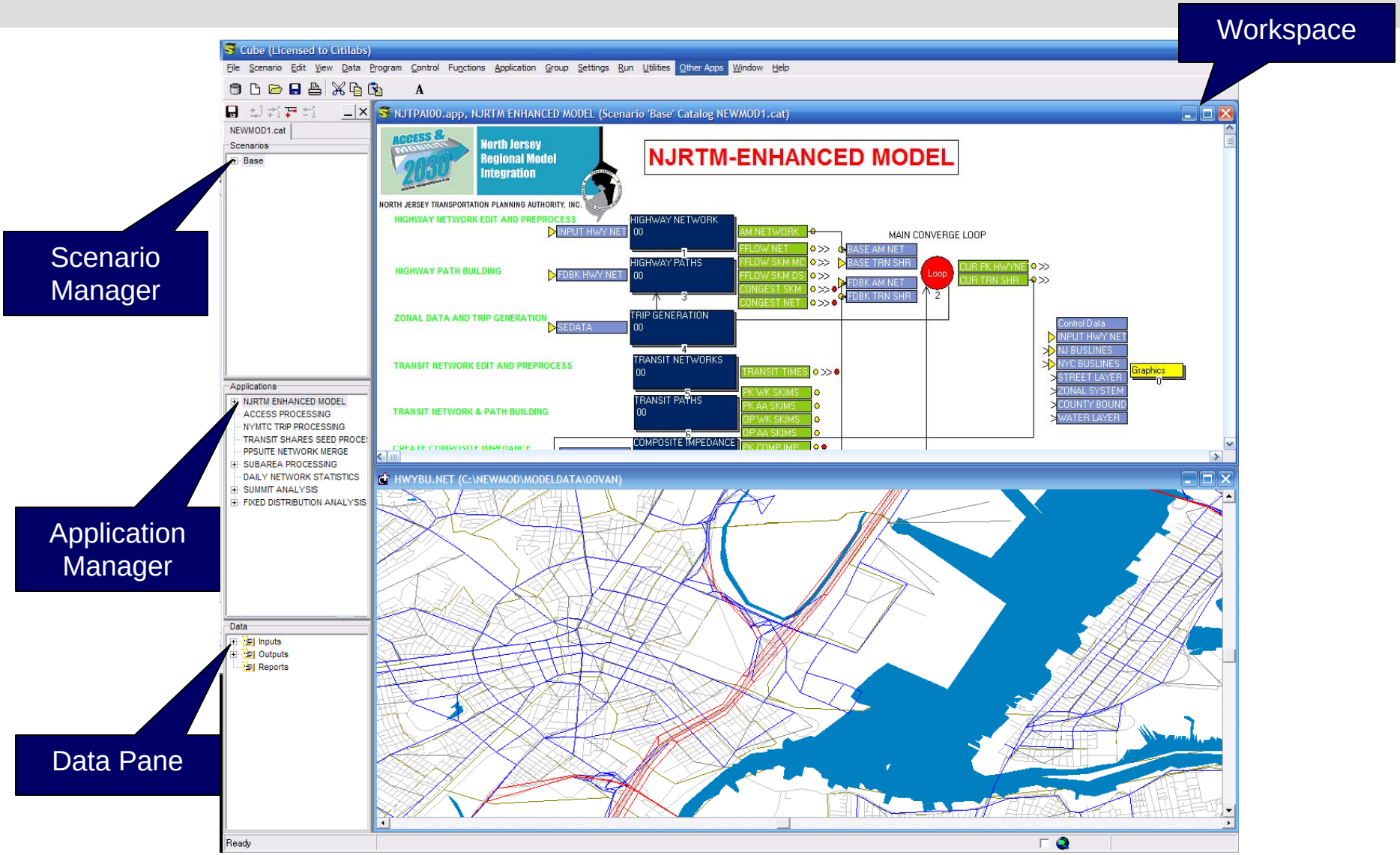


NJRTM-E Rail Station Access Coding at Princeton Junction

NJRTM-E Data Requirements

- Recommended Procedures
  - Node Allocation
    - Existing Highway Network
    - Transit Network
    - Long Range Planning Analysis (Projects for TIP / LRP)
    - Unallocated (Agency / Consultant Use)
    - Facilitates Transferable Networks
  - Project Database
    - TIP projects stored as “transactions”
    - Implemented via CUBE Log Feature
    - Minimizes Coding Errors and Provides Audit Control
  - Annual Coordination
    - Network / Service Revisions

The User Interface



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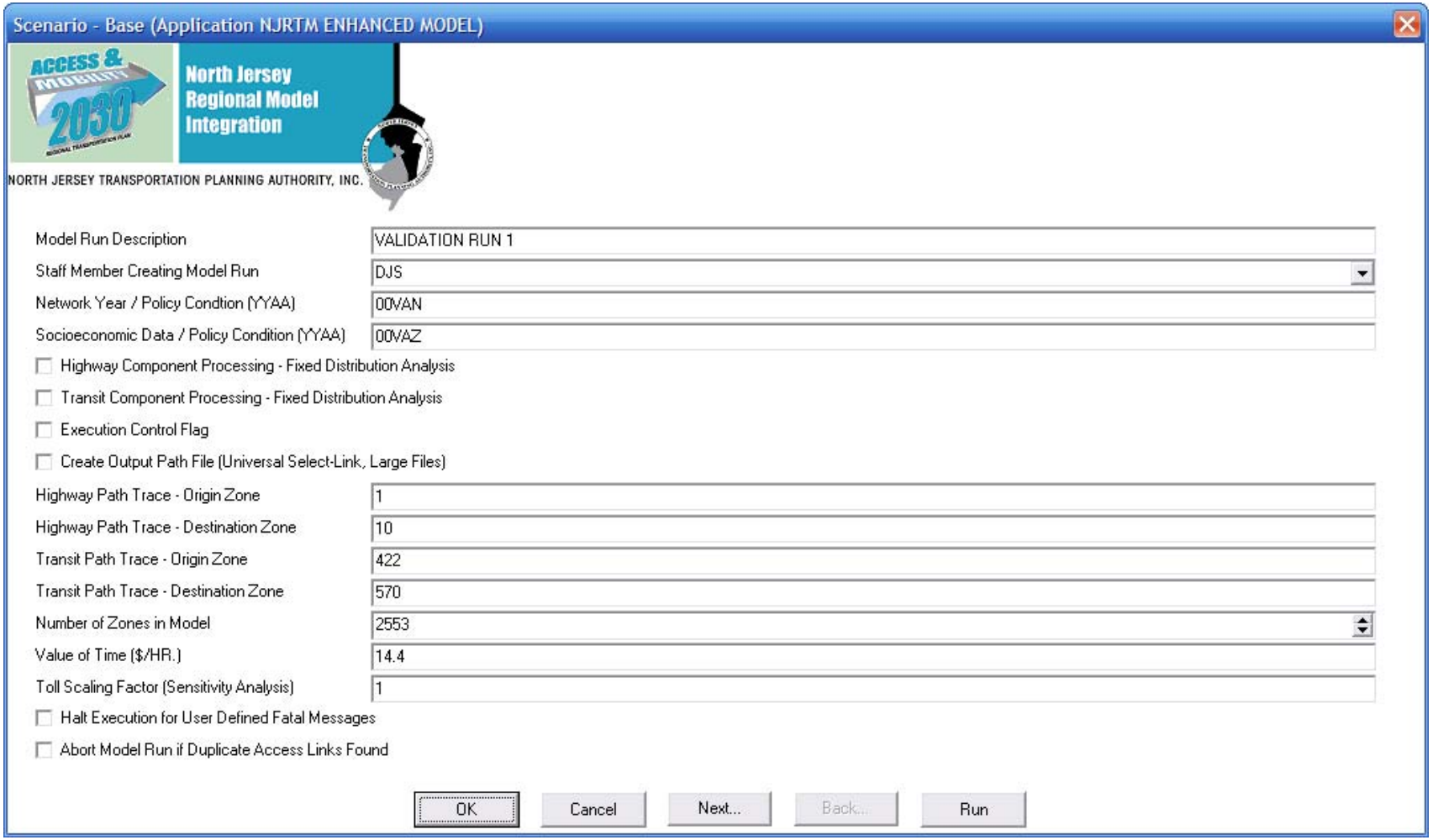

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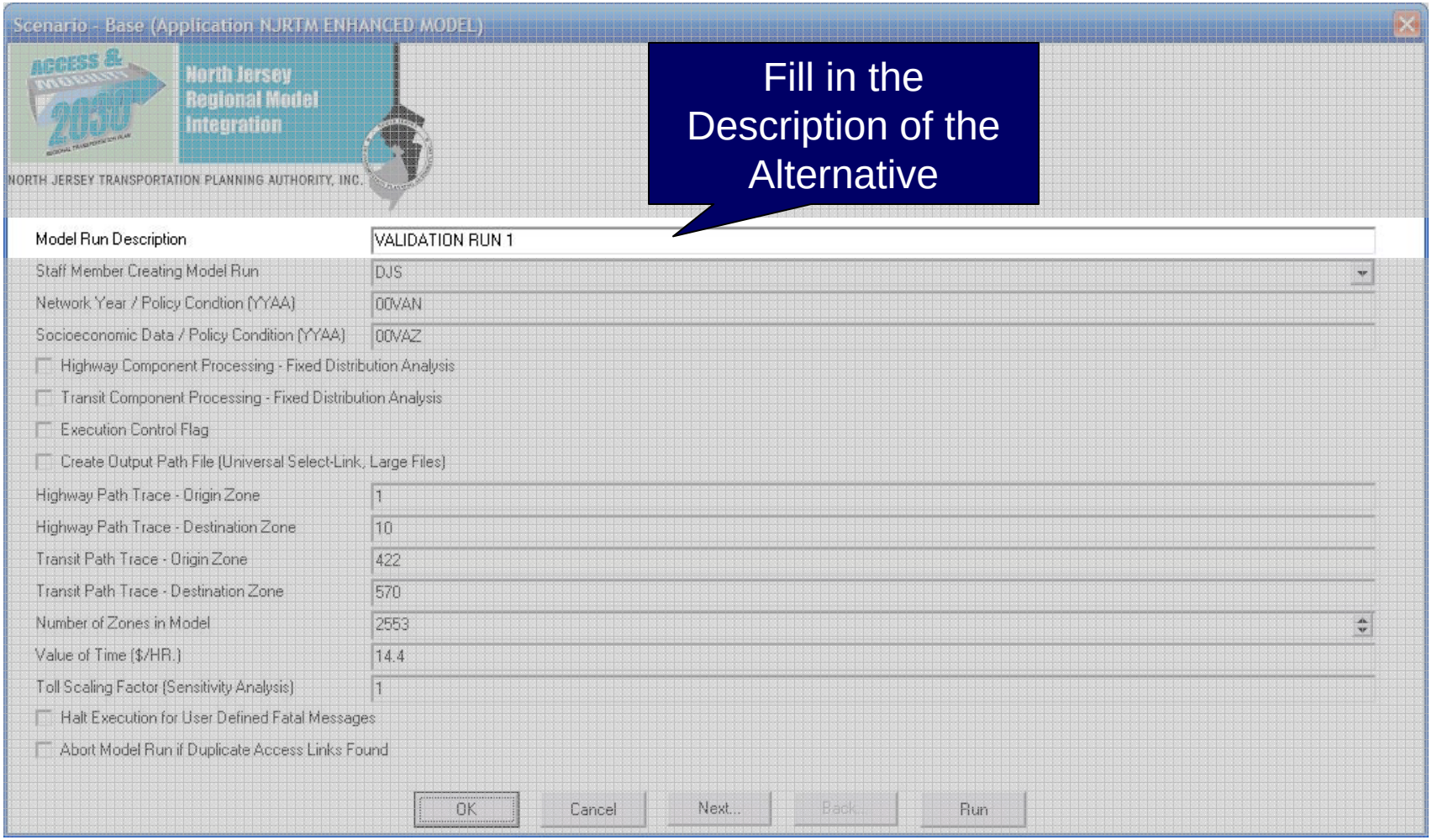

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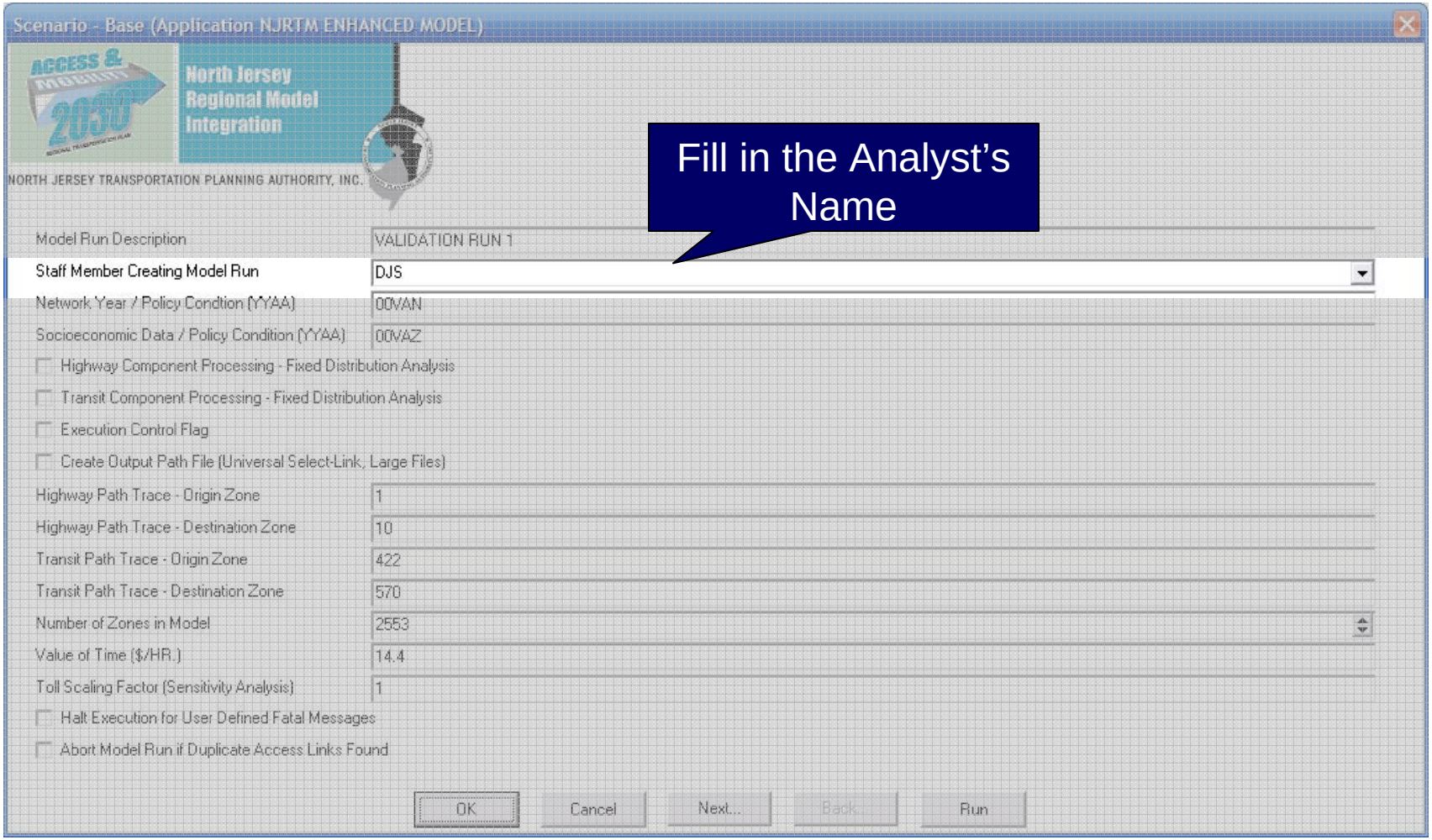

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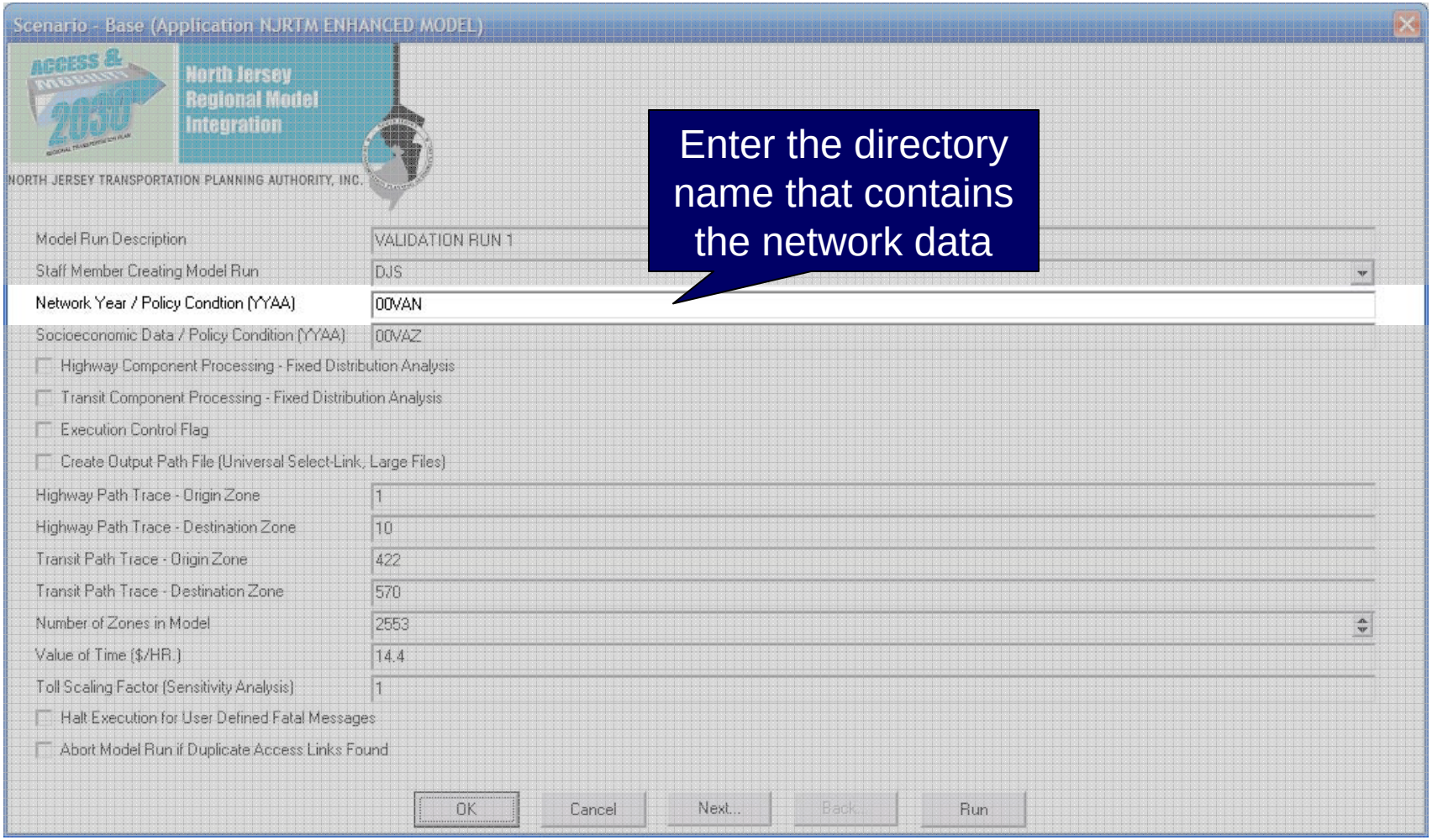

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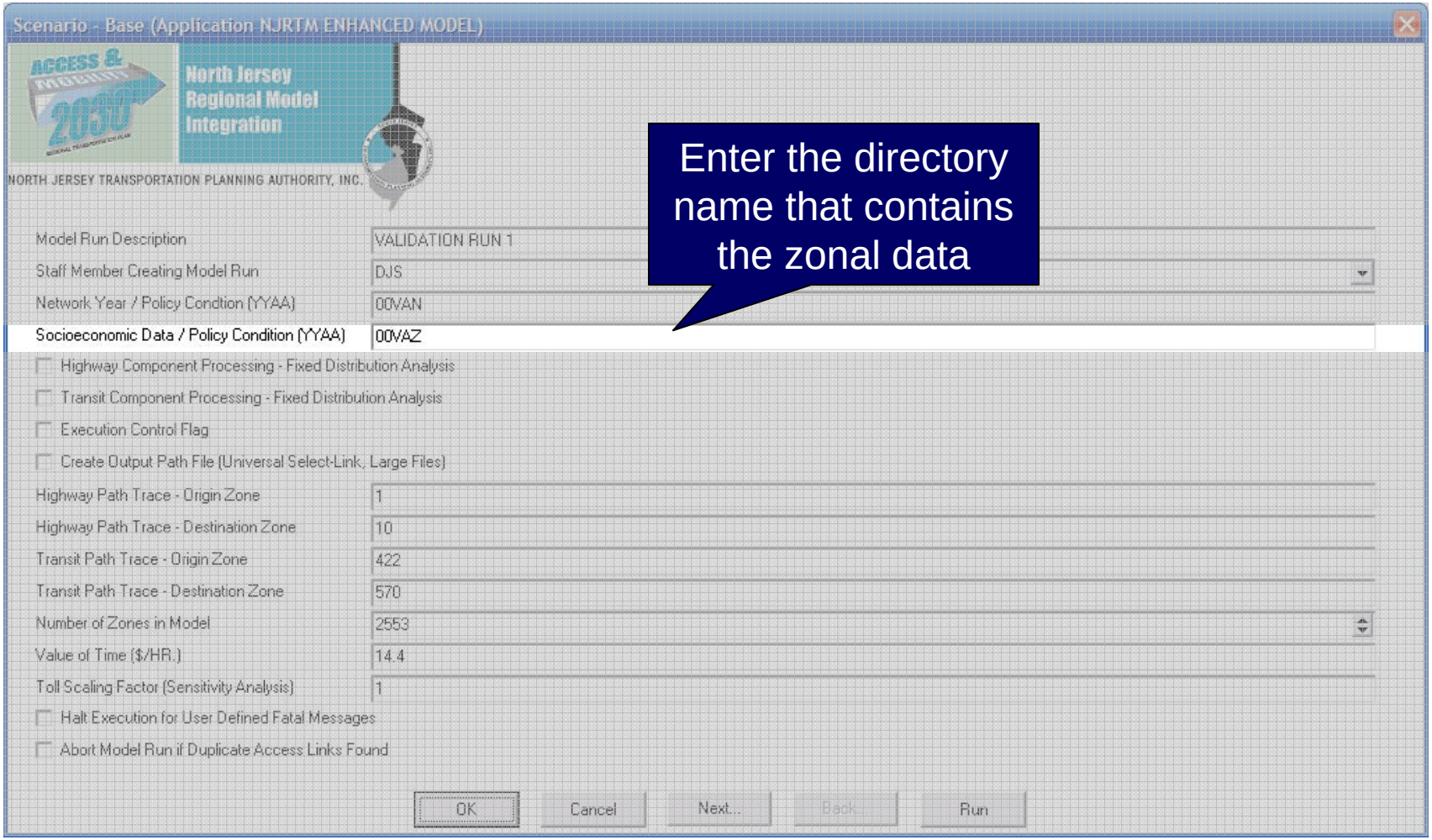

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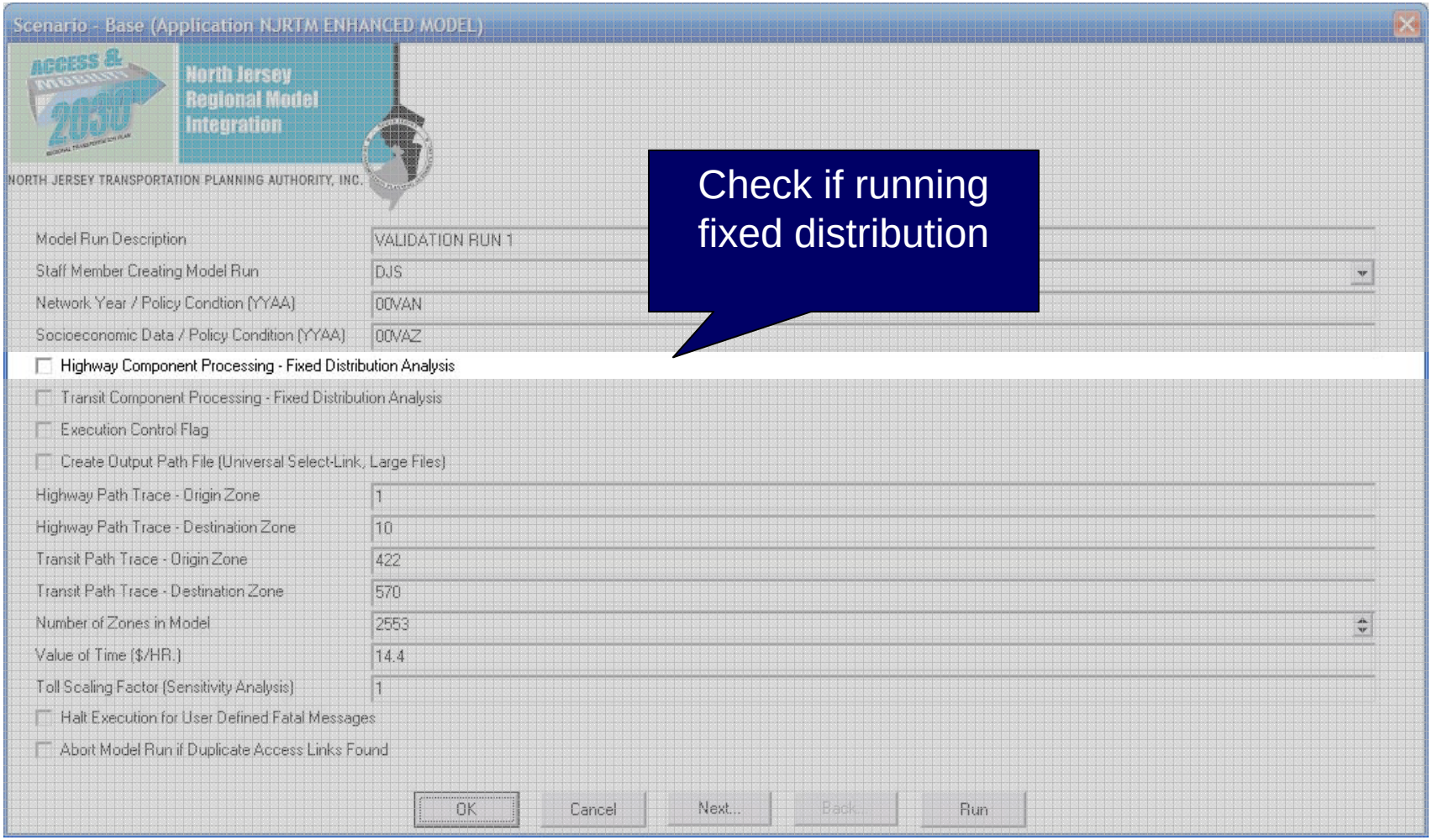

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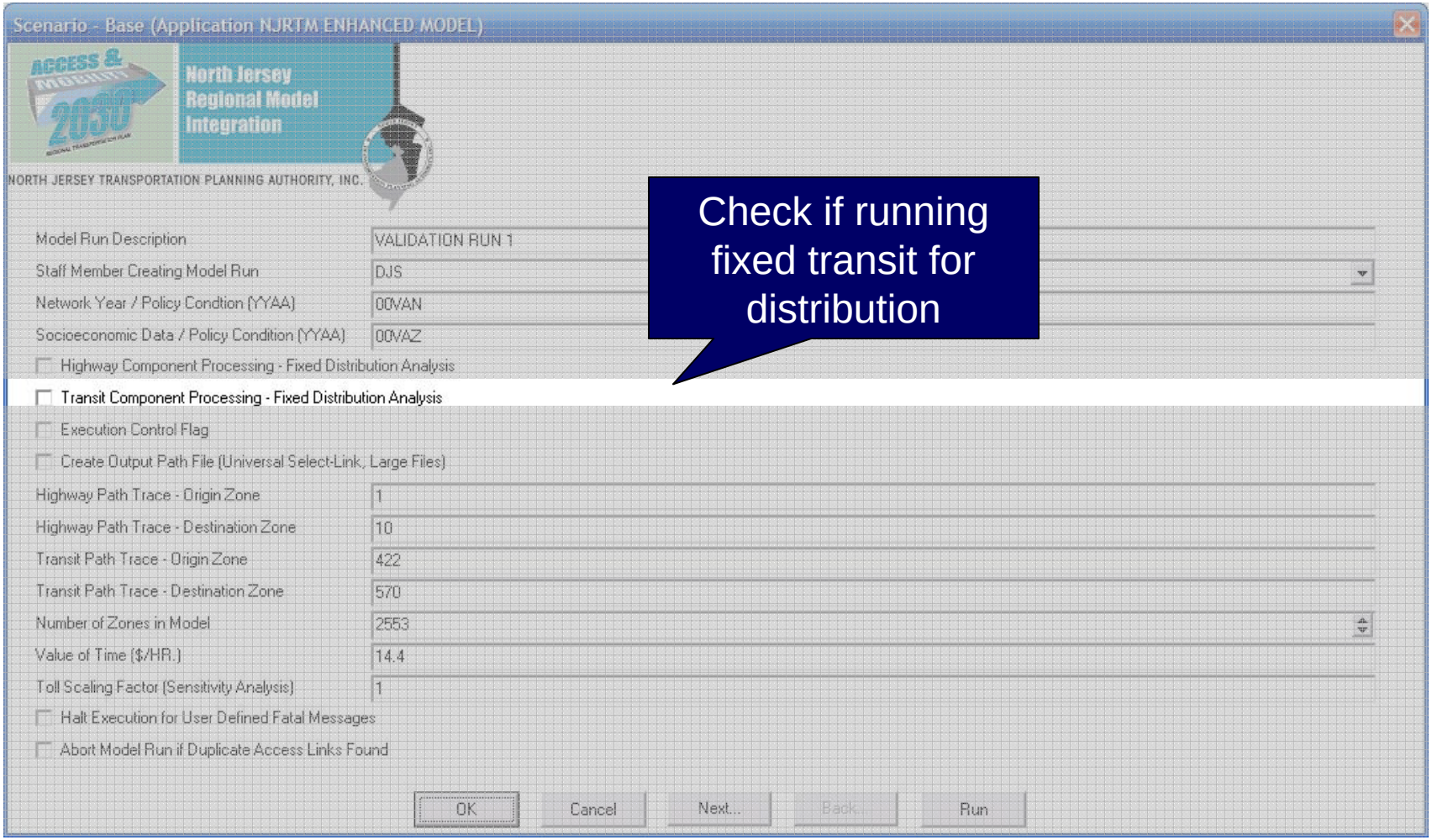

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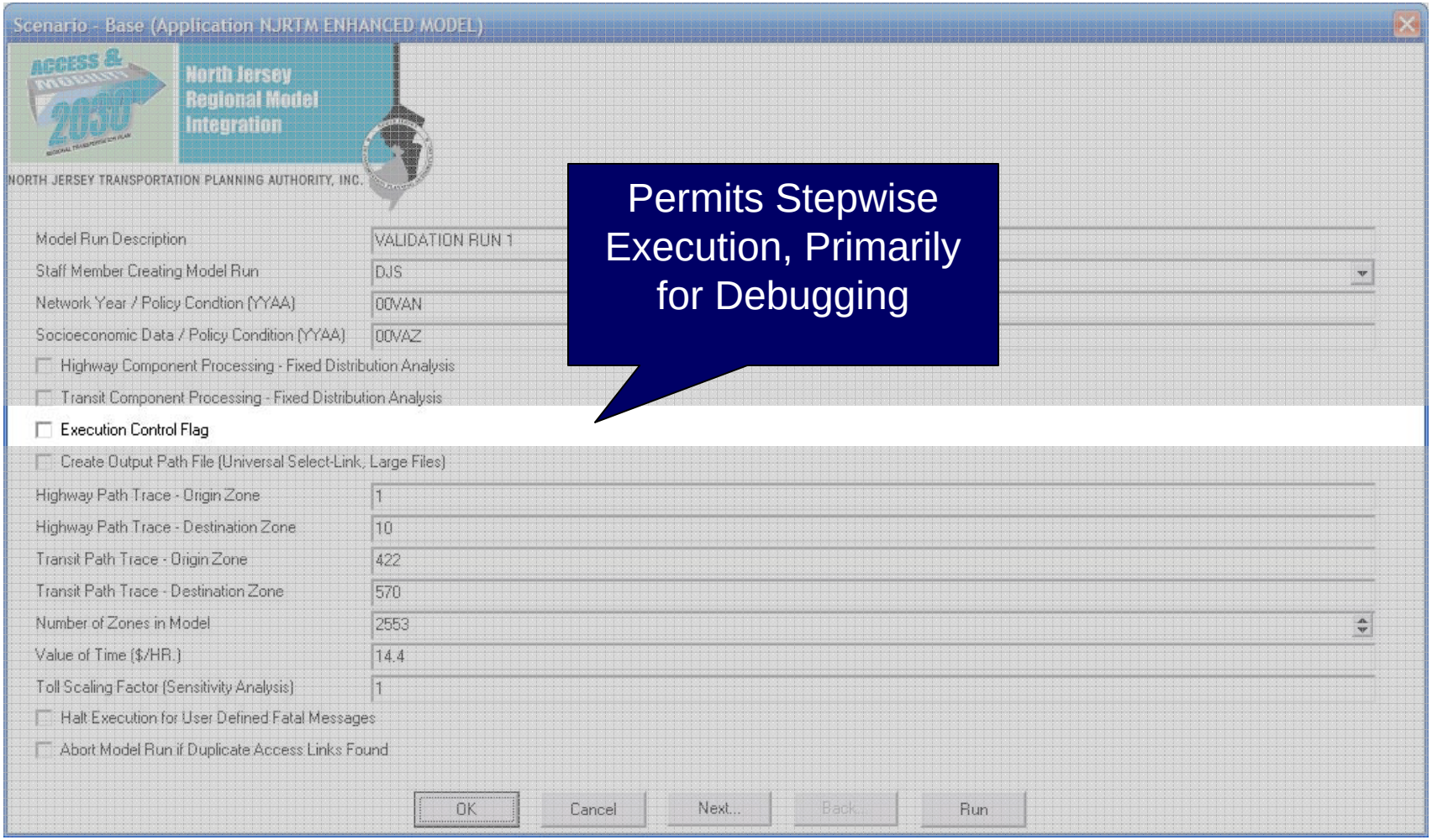

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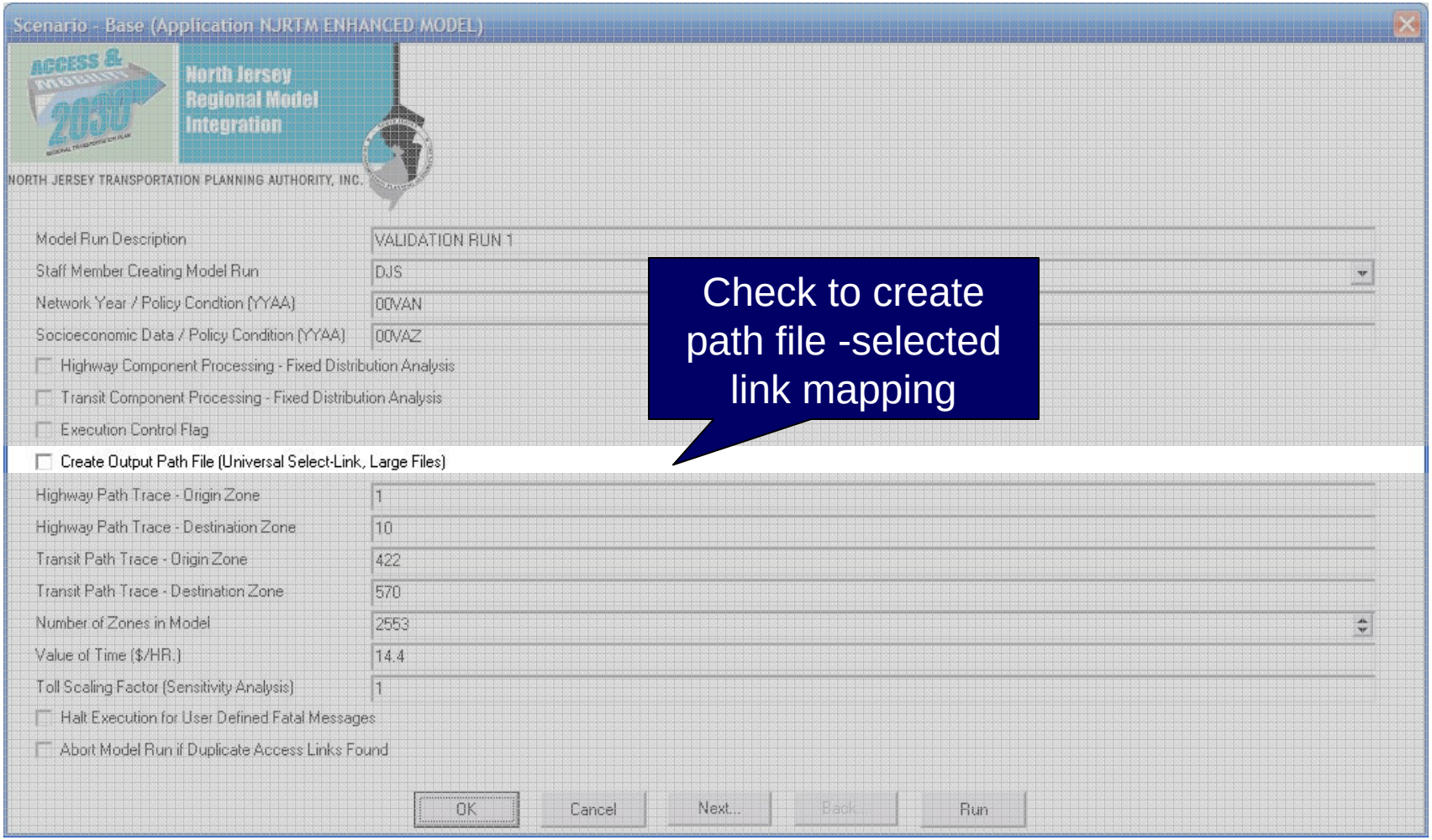

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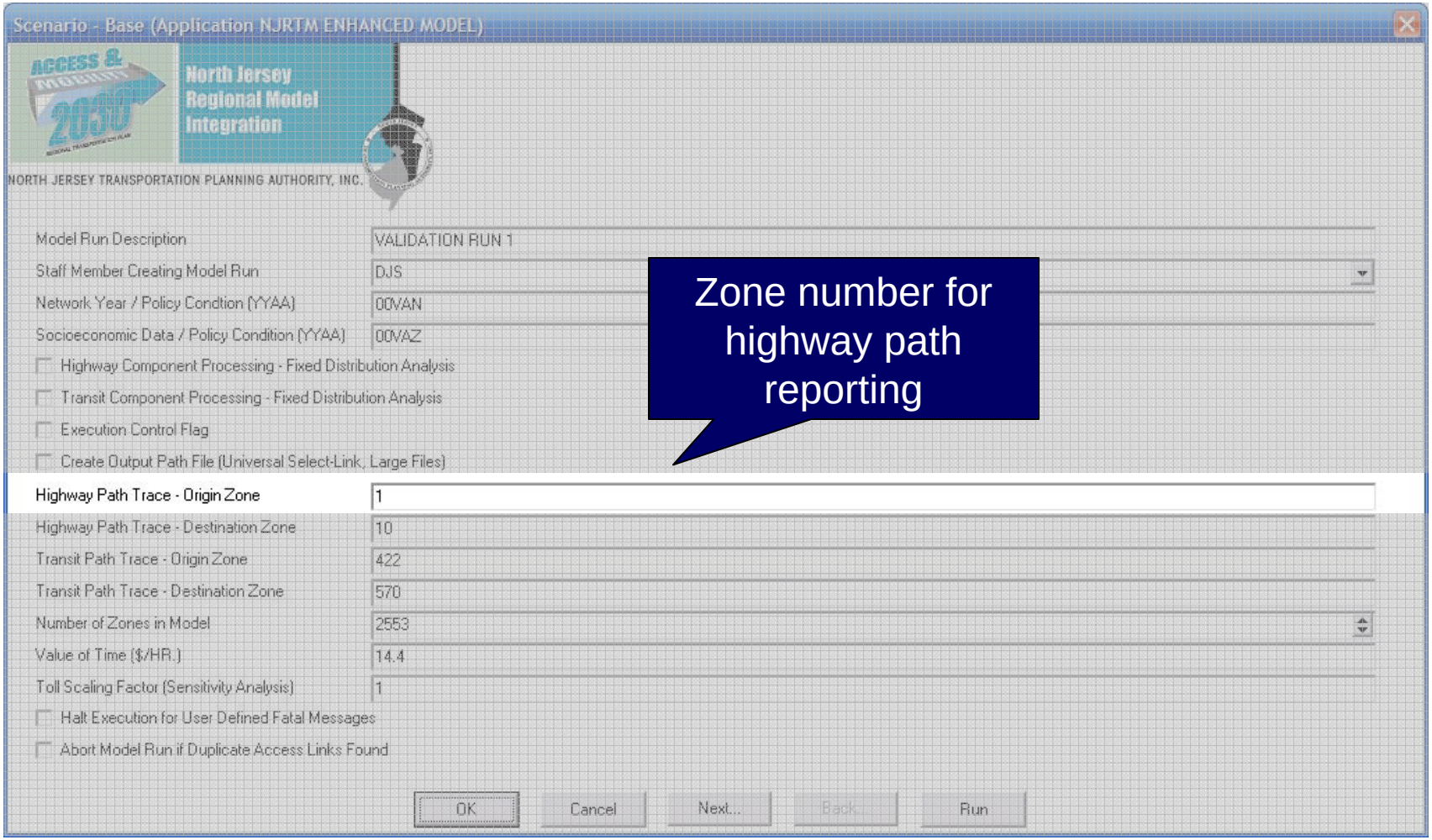

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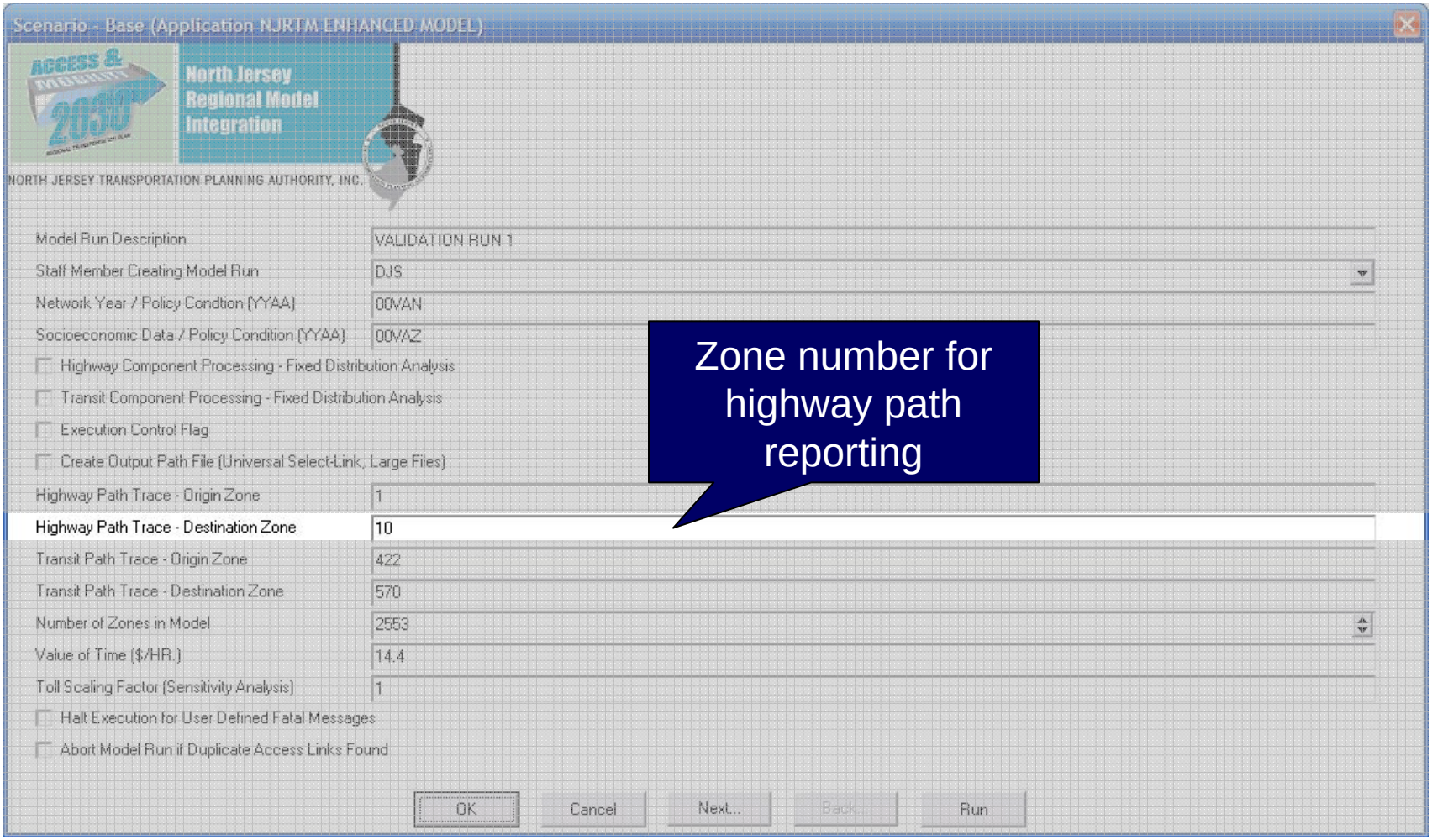

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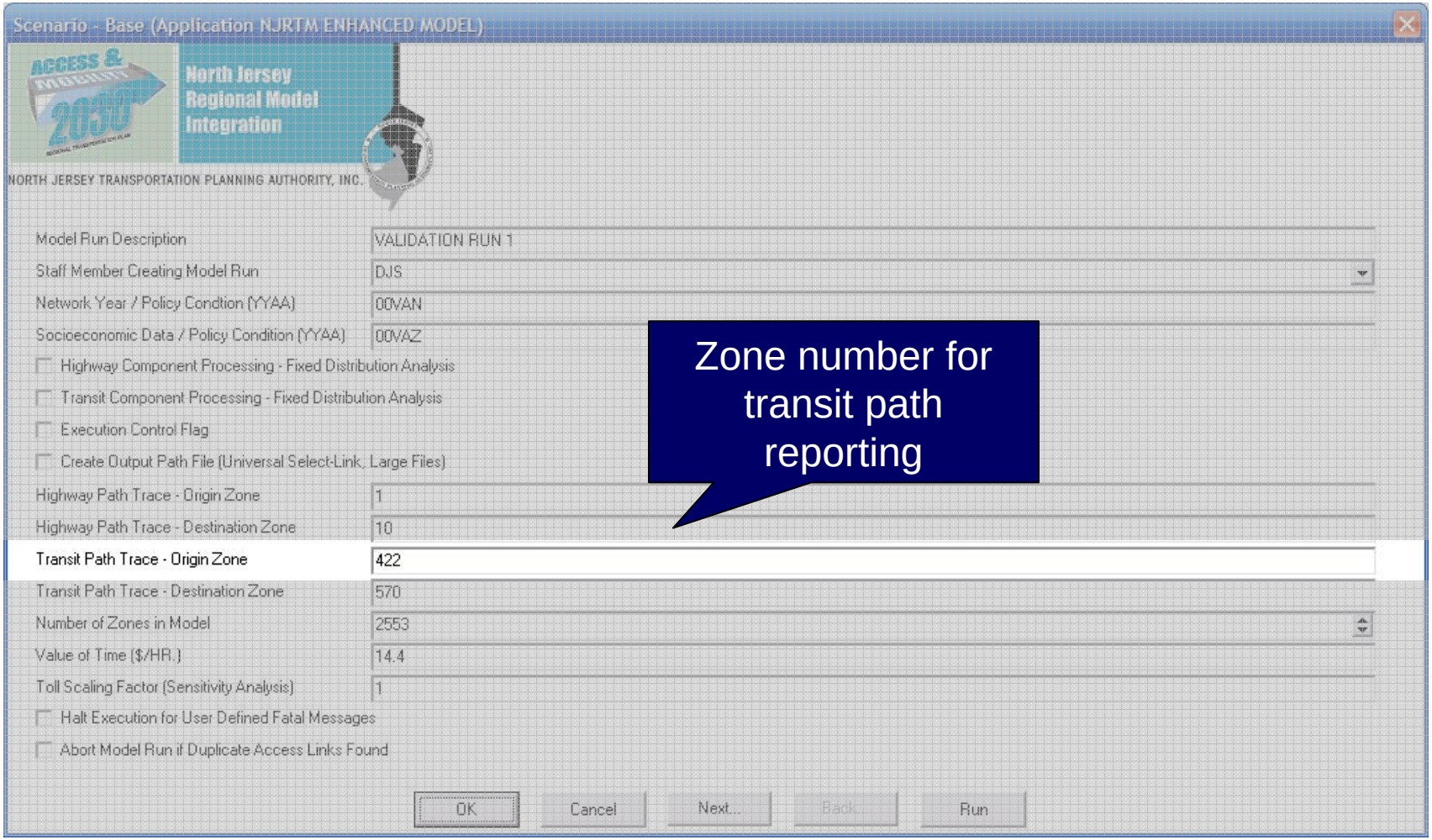

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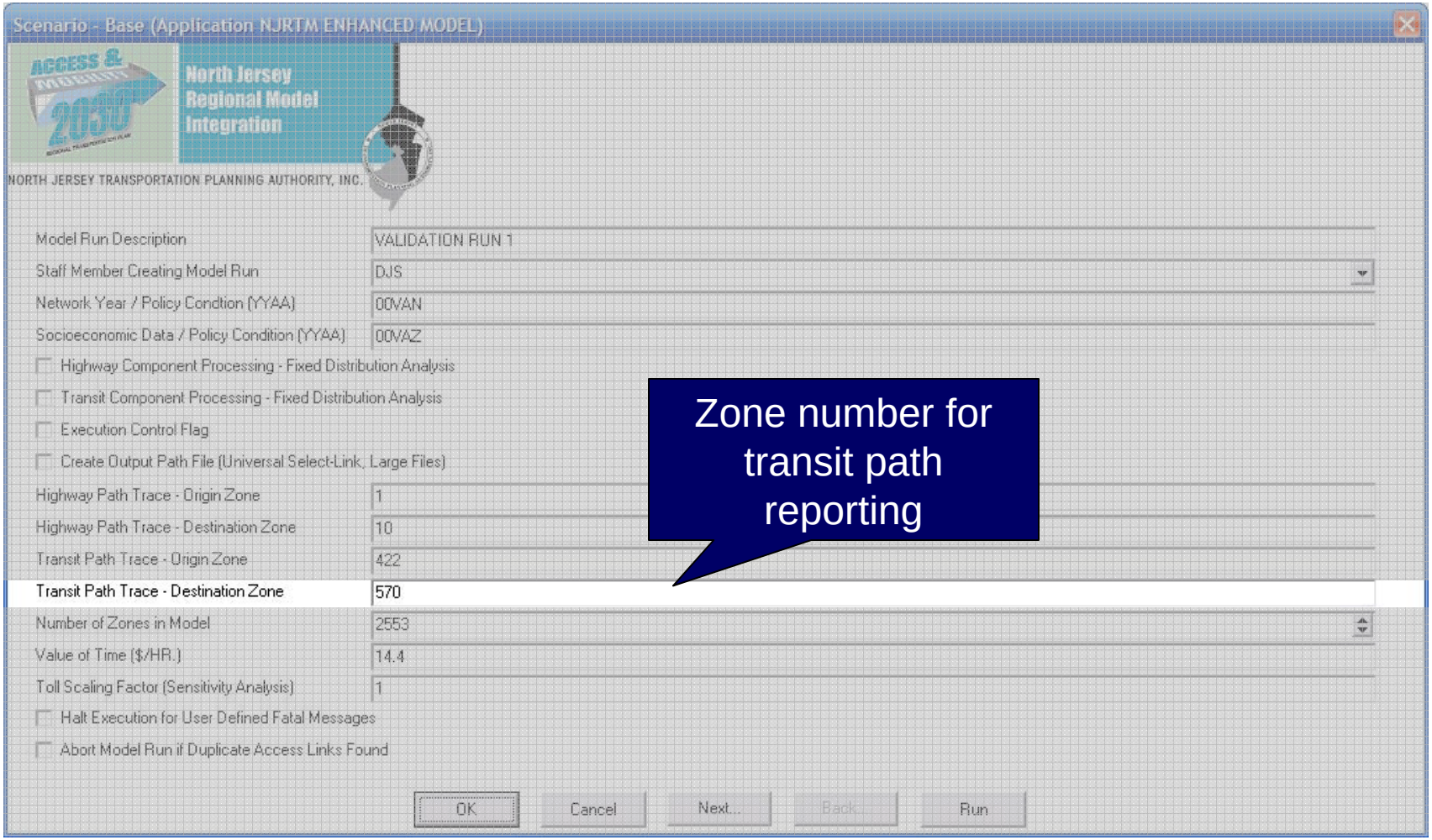

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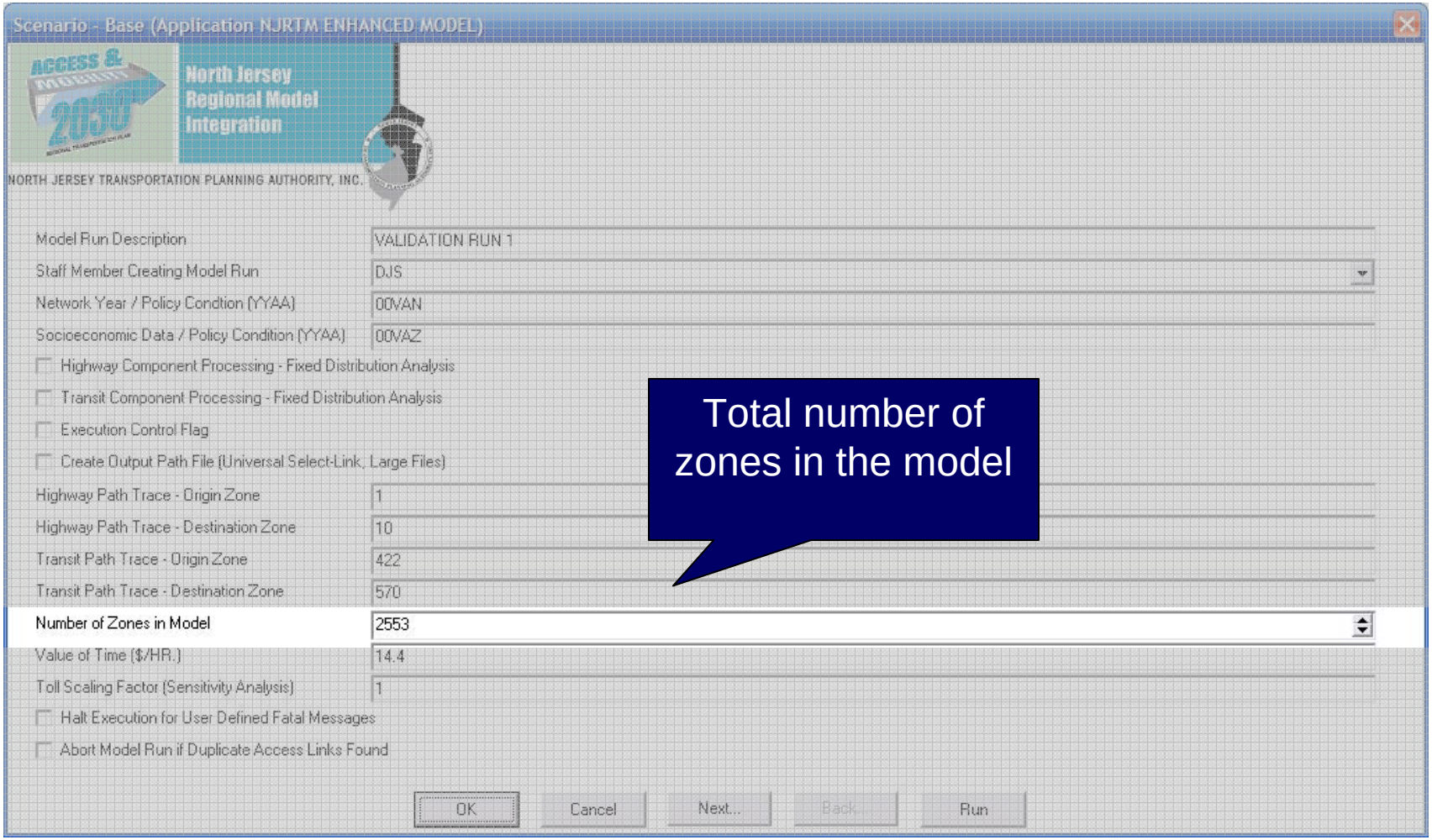

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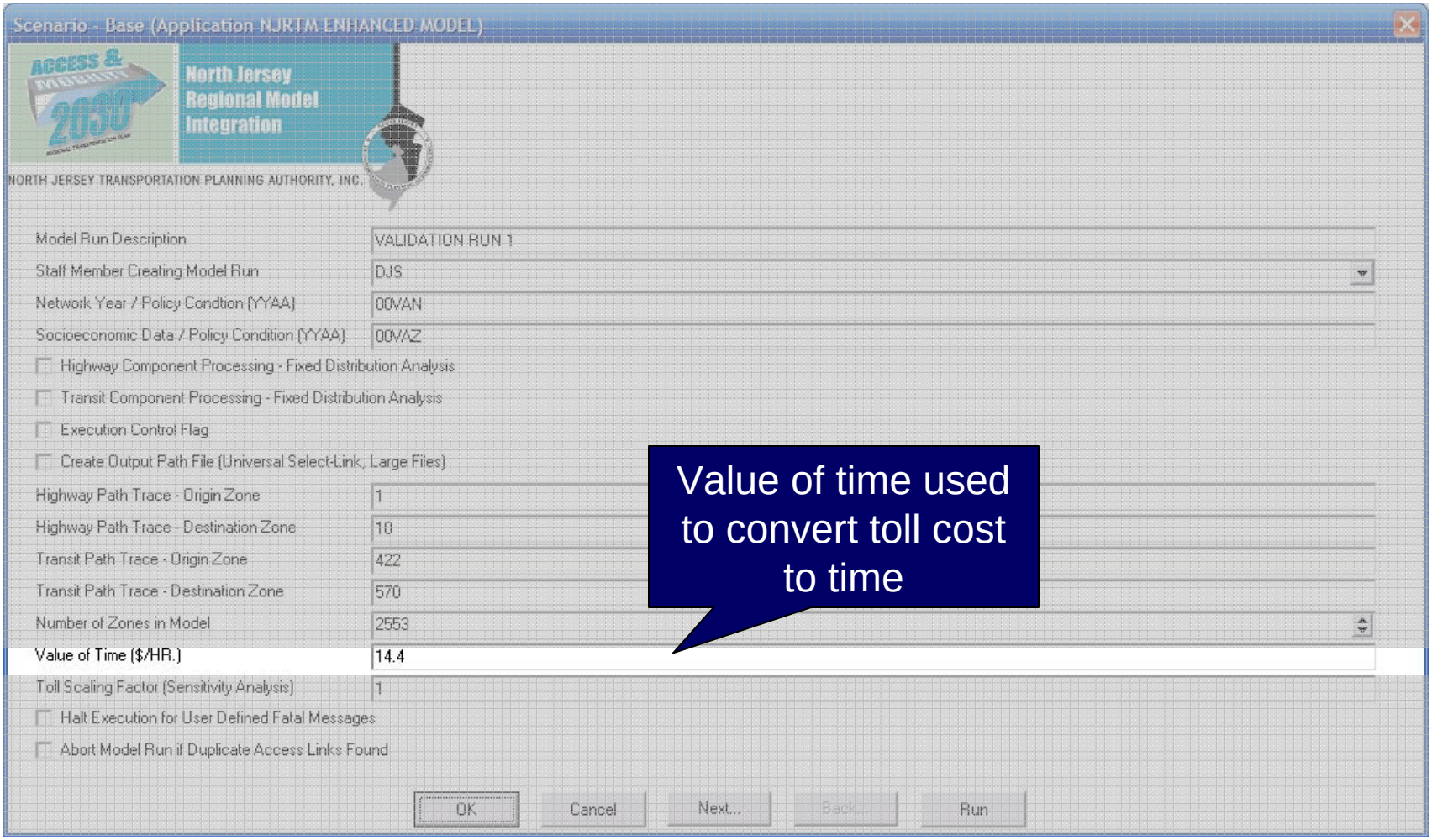
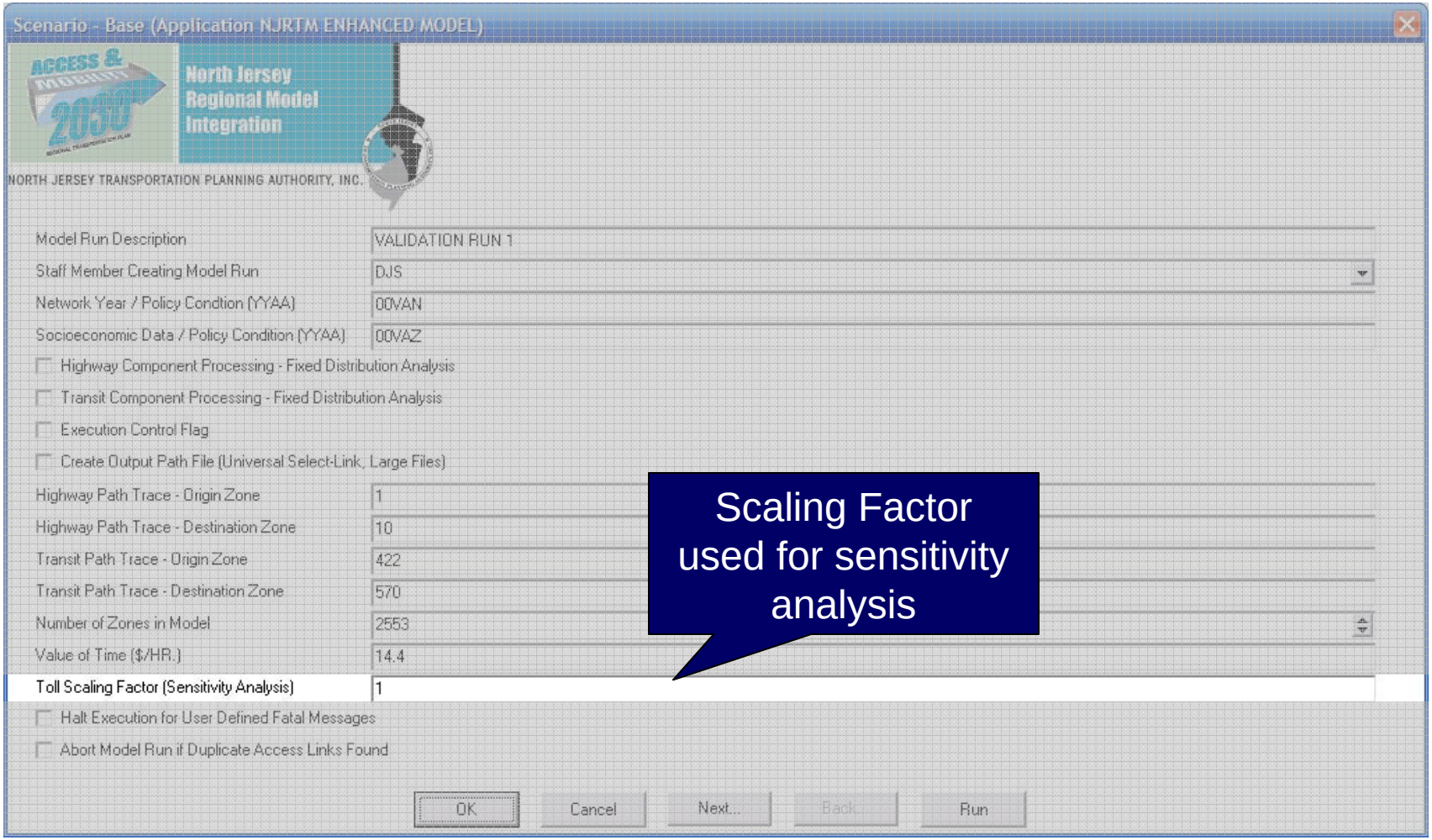


The User Interface



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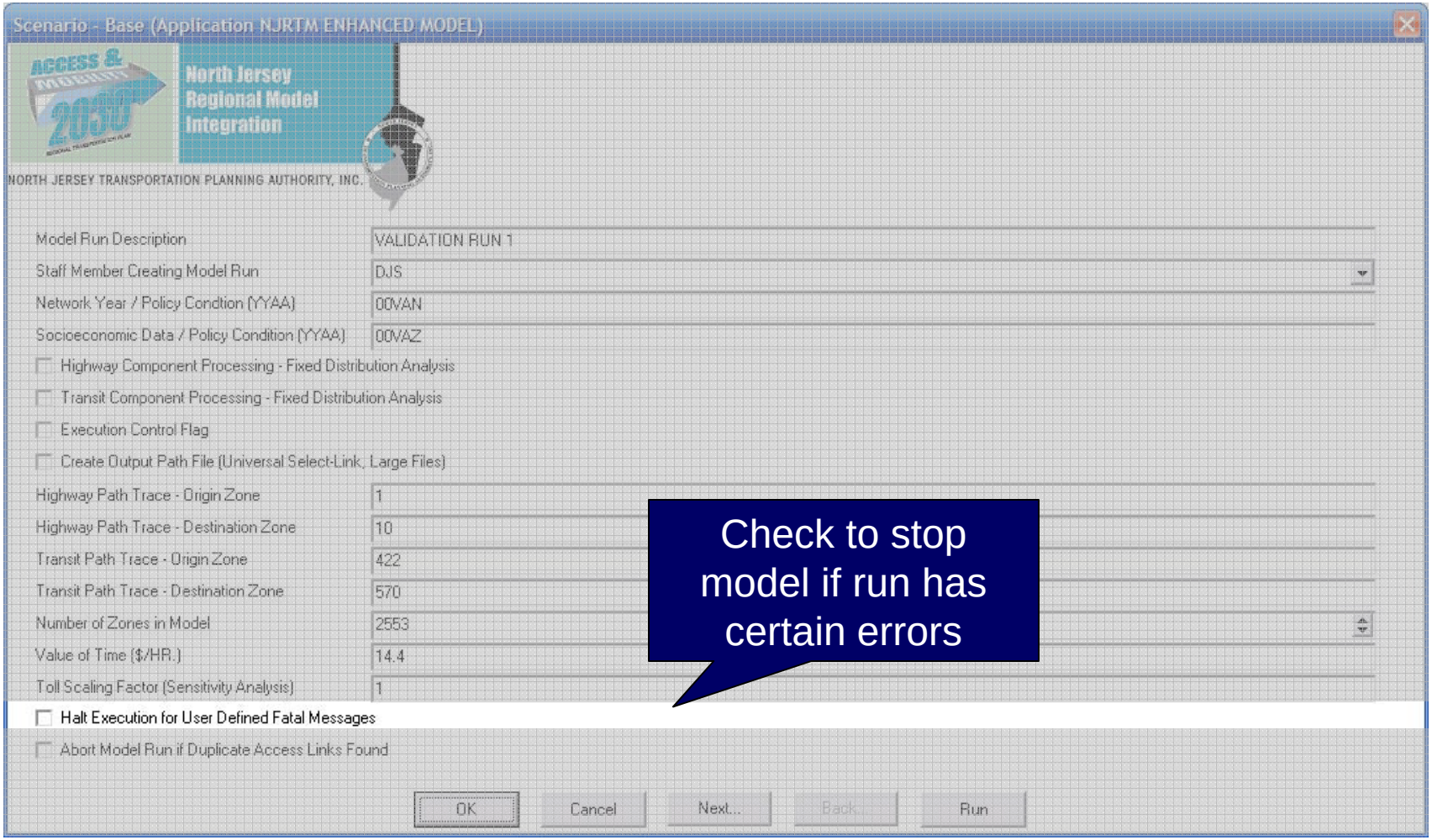

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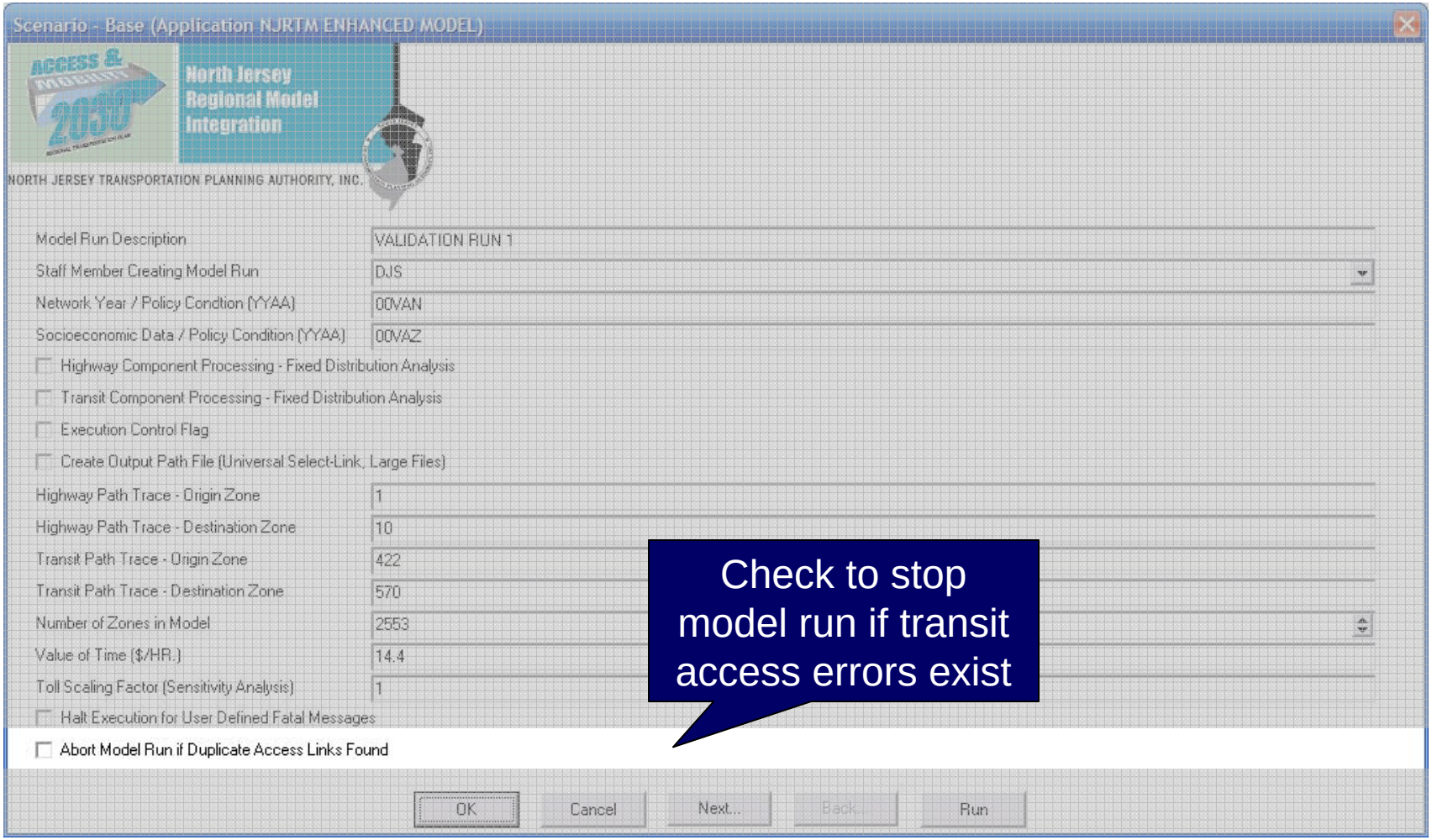

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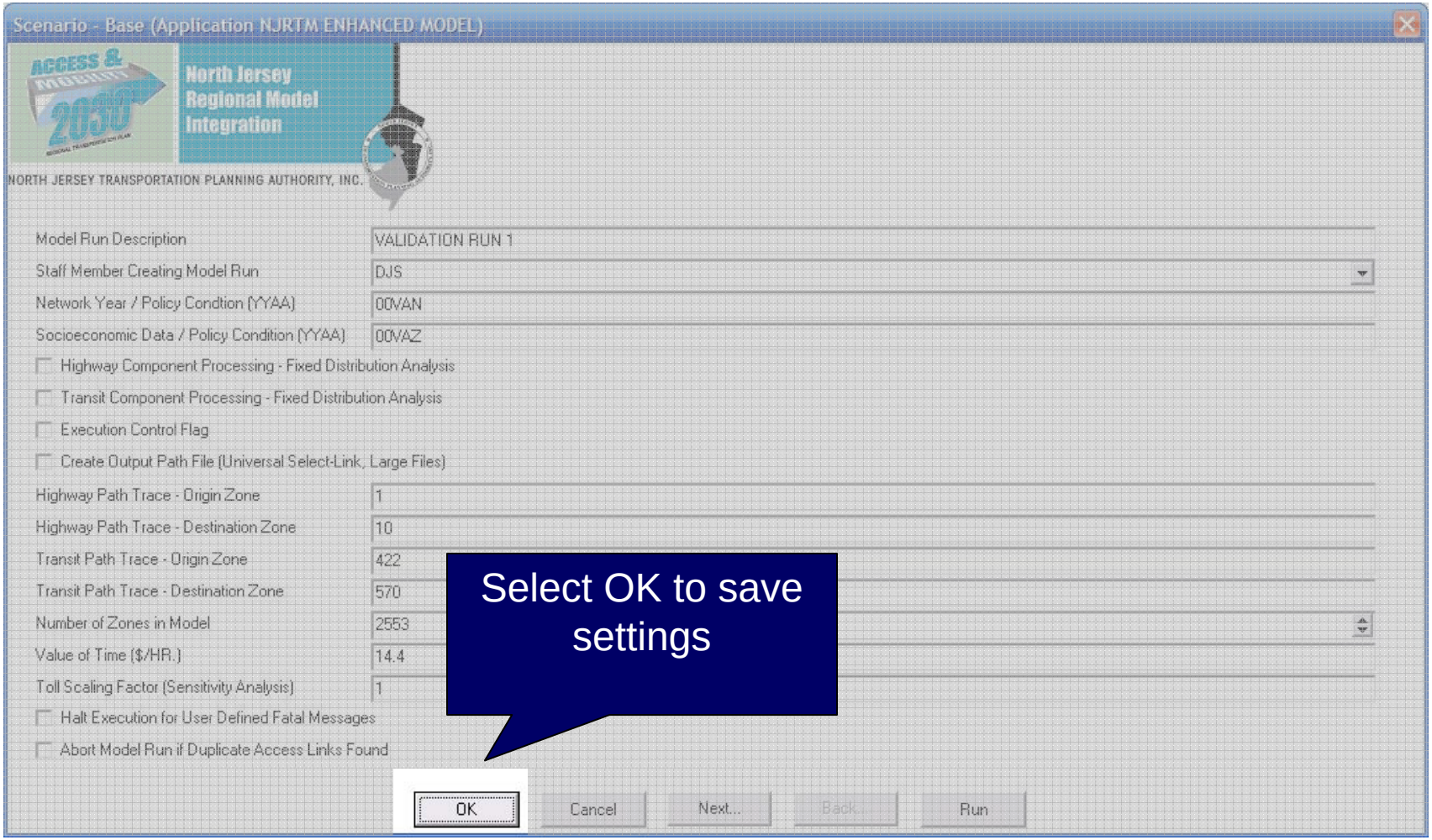

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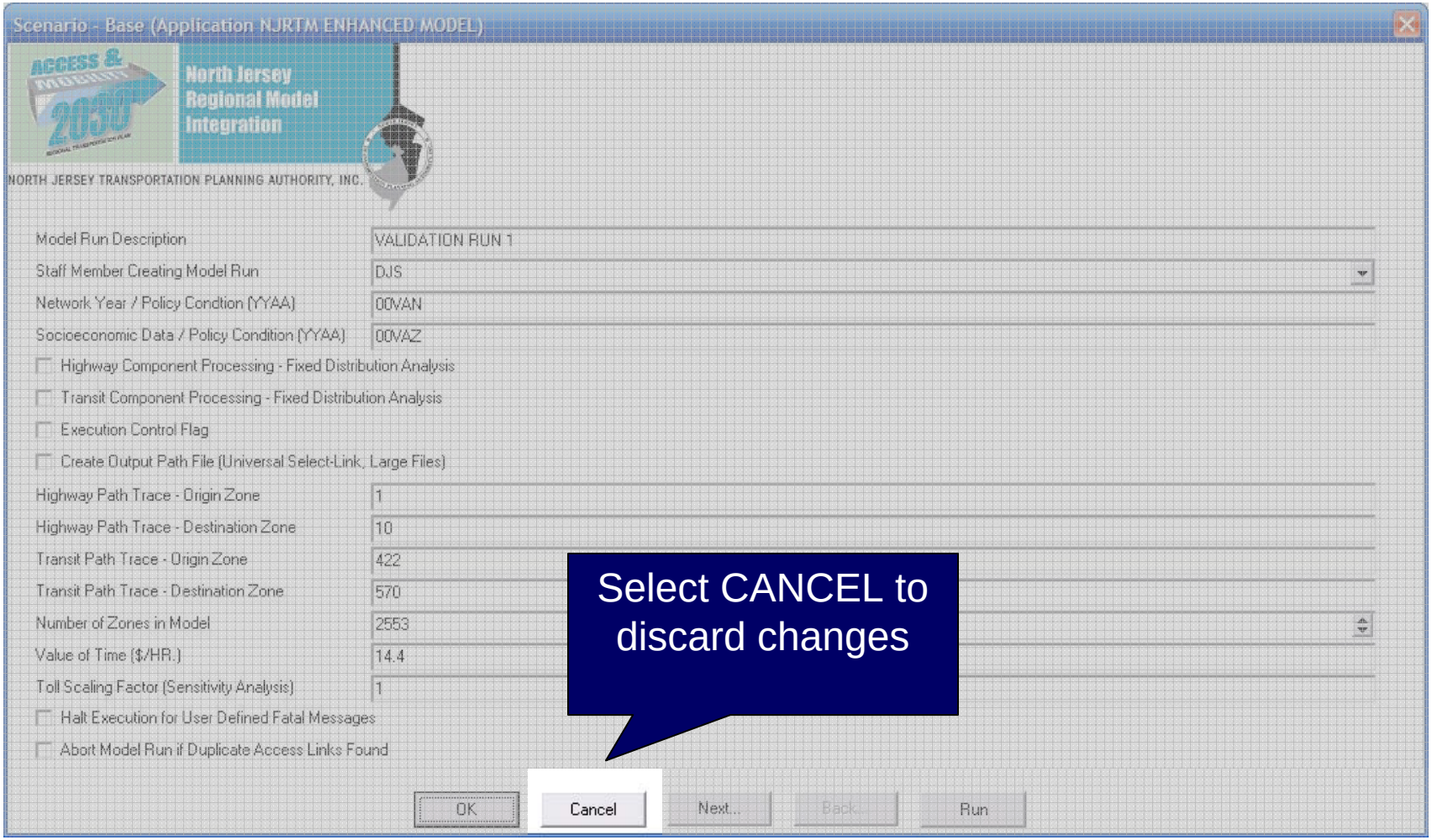

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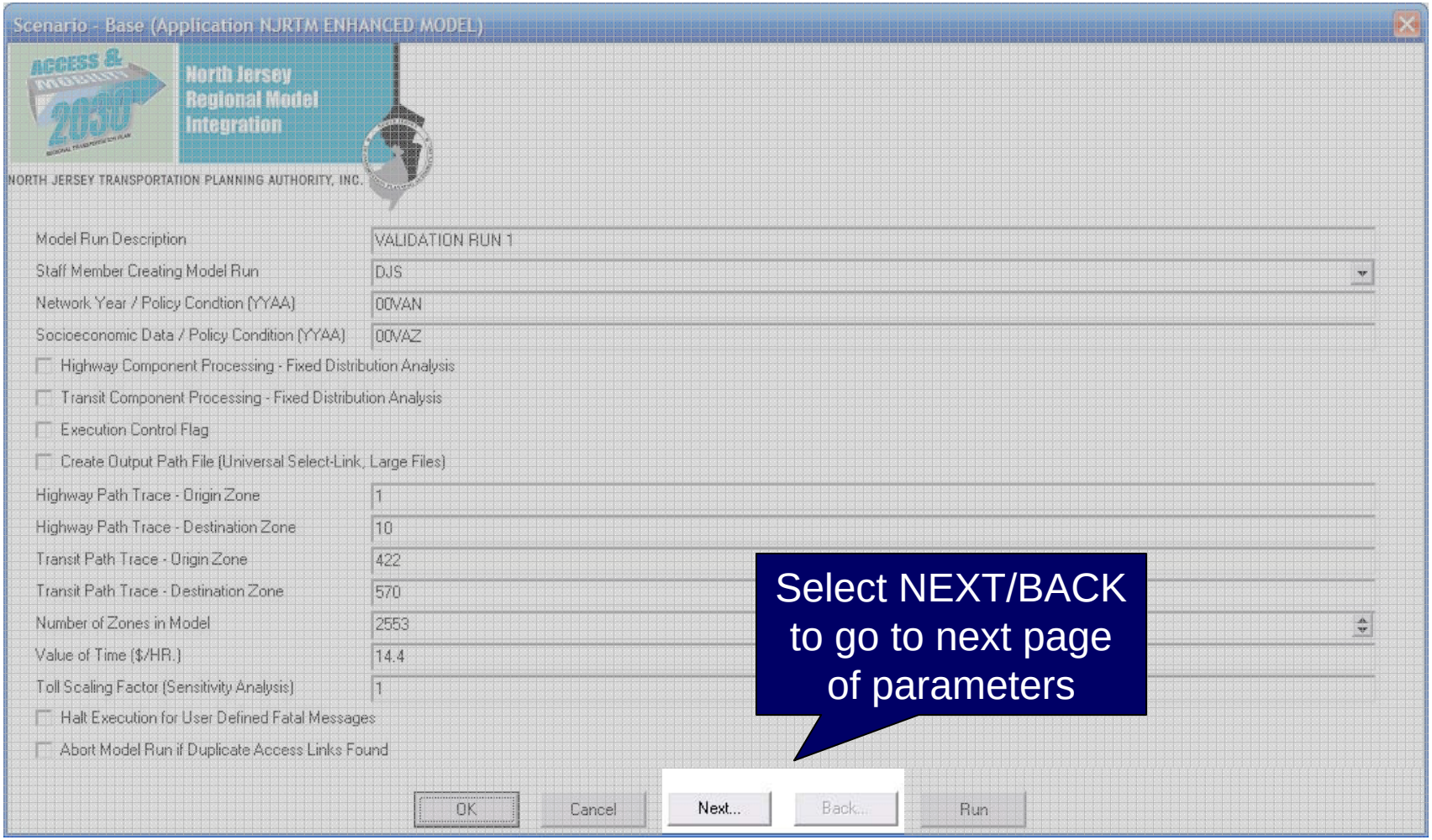
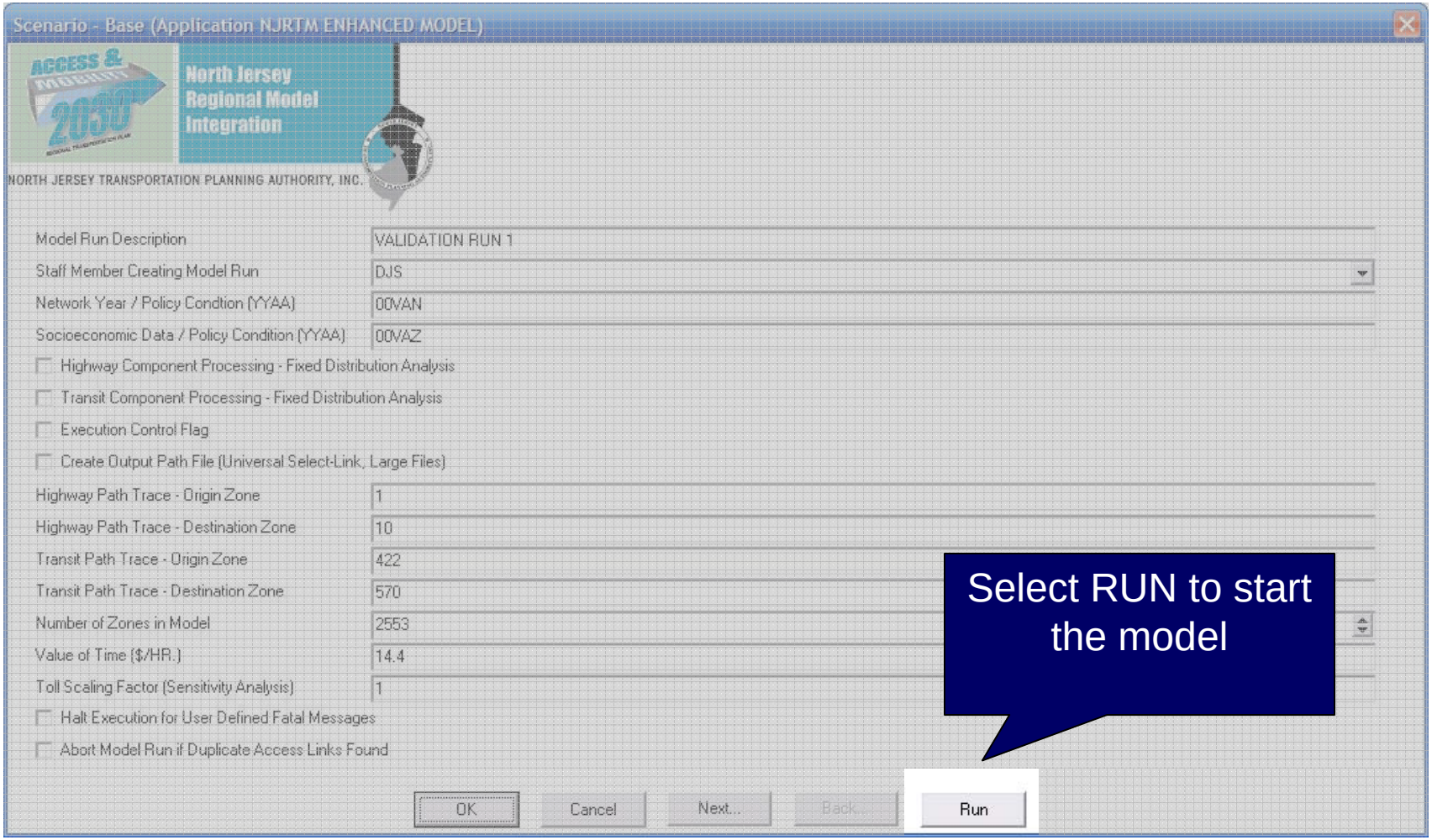


The User Interface



- Break !

NJRTM-E Validation Results

- Comparisons at Regional, subregional, roadway and transit system
- Comparisons of Model Inputs with Other Known Data Sources
- Comparisons of Model Outputs with Other Known Data Sources
- Sensitivity Tests

Persons/Household & Workers/Household Submodels Estimation Comparison

COUNTY	Persons/Household			Workers/Household		
	EST	OBS	EST/OBS	EST	OBS	EST/OBS
BERGEN	2.69	2.69	1.00	1.31	1.29	1.02
ESSEX	2.76	2.78	0.99	1.22	1.14	1.07
HUDSON	2.60	2.66	0.98	1.20	1.14	1.06
HUNTERDON	2.82	2.74	1.03	1.45	1.44	1.01
MERCER	2.74	2.71	1.01	1.28	1.26	1.02
MIDDLESEX	2.81	2.80	1.00	1.32	1.34	0.98
MONMOUTH	2.76	2.76	1.00	1.33	1.30	1.02
MORRIS	2.81	2.77	1.02	1.42	1.41	1.01
OCEAN	2.54	2.55	0.99	1.09	1.05	1.04
PASSAIC	2.98	3.00	0.99	1.27	1.27	1.00
SOMERSET	2.75	2.74	1.00	1.41	1.38	1.02
SUSSEX	2.84	2.86	0.99	1.38	1.44	0.96
UNION	2.81	2.83	0.99	1.27	1.27	1.00
WARREN	2.65	2.66	1.00	1.27	1.31	0.97
TOTAL	2.74	2.75	1.00	1.28	1.26	1.02

Note: Observation is summarized from Census.

Comparison of Trip Productions by Income Group

Trip Productions from Model by Income Group

INCOME	HBWD	HBWS	HBSH	HBO	HBU	WBO	NHNW	TOTAL
0-$14,999	115,534	52,775	188,107	473,496	42,629	29,368	170,336	1,072,244
$15,000-$34,999	470,164	118,835	326,900	1,122,280	41,488	125,158	366,891	2,571,717
$35,000-$74,999	1,282,778	455,821	699,505	2,526,212	95,534	630,364	818,217	6,508,430
$75,000-$149,999	1,407,772	488,522	591,415	2,729,794	111,974	756,692	804,401	6,890,571
>=$150,000	470,103	161,057	205,881	1,079,364	26,087	275,813	318,917	2,537,222
Total	3,746,351	1,277,010	2,011,808	7,931,146	317,712	1,817,395	2,478,762	19,580,184

Trip Productions from Household Survey by Income Group

INCOME	HBWD	HBWS	HBSH	HBO	HBU	WBO	NHNW	TOTAL
0-$14,999	116,865	51,860	188,235	482,193	40,261	28,062	172,769	1,080,246
$15,000-$34,999	476,824	118,820	326,973	1,137,007	40,675	124,964	372,829	2,598,091
$35,000-$74,999	1,281,997	453,993	698,596	2,518,653	91,761	629,676	828,595	6,503,270
$75,000-$149,999	1,390,464	483,622	589,060	2,691,024	106,830	756,341	812,597	6,829,937
>=$150,000	460,322	158,868	201,591	1,052,860	23,579	275,575	319,942	2,492,737
Total	3,726,472	1,267,163	2,004,455	7,881,737	303,105	1,814,617	2,506,732	19,504,281

Ratio of Trip Productions by Income Group (Model v.s Household Survey)

INCOME	HBWD	HBWS	HBSH	HBO	HBU	WBO	NHNW	TOTAL
0-$14,999	98.9%	101.8%	99.9%	98.2%	105.9%	104.7%	98.6%	99.3%
$15,000-$34,999	98.6%	100.0%	100.0%	98.7%	102.0%	100.2%	98.4%	99.0%
$35,000-$74,999	100.1%	100.4%	100.1%	100.3%	104.1%	100.1%	98.7%	100.1%
$75,000-$149,999	101.2%	101.0%	100.4%	101.4%	104.8%	100.0%	99.0%	100.9%
>=$150,000	102.1%	101.4%	102.1%	102.5%	110.6%	100.1%	99.7%	101.8%
Total	100.5%	100.8%	100.4%	100.6%	104.8%	100.2%	98.9%	100.4%

Trip Production Summary by Purpose and Mode

Trip Productions by Mode (Model)

Purpose	Total		
	Total	Non-Motorized	%Non-Motorized
HBWD	3,746,351	150,949	4.0%
HBWS	1,277,011	39,667	3.1%
HBSH	2,011,808	135,454	6.7%
HBO	7,951,944	878,764	11.1%
HBU	296,914	29,474	9.9%
WBO	3,320,209	291,957	8.8%
NHNW	4,884,567	499,607	10.2%
TOTAL	23,488,805	2,025,871	8.6%

Trip Productions by Mode (Survey)

Purpose	Total		
	Total	Non-Motorized	%Non-Motorized
HBWD	3,726,472	149,547	4.0%
HBWS	1,267,163	38,509	3.0%
HBSH	2,004,455	136,728	6.8%
HBO	7,881,737	876,208	11.1%
HBU	303,105	28,404	9.4%
WBO	3,262,427	287,742	8.8%
NHNW	4,904,220	504,967	10.3%
TOTAL	23,349,579	2,022,105	8.7%

Ratio of Productions by Mode (Model vs. Survey)

Purpose	Total		
	Total	Non-Motorized	%Non-Motorized
HBWD	1.01	1.01	1.00
HBWS	1.01	1.03	1.02
HBSH	1.00	0.99	0.99
HBO	1.01	1.00	0.99
HBU	0.98	1.04	1.06
WBO	1.02	1.01	1.00
NHNW	1.00	0.99	0.99
TOTAL	1.01	1.00	1.00

Note:
(1). Unallocated trips from HBU trip process were merged to HBO purpose.
(2). For WBO and NHNW purposes, trip ends instead of trip productions are listed.

Comparison of HBW Trip Attractions by Income Group

Motorized HBW Trip Attractions by Income Group

Income Group	Model			Survey	Census	Model
	HBWD	HBWS	Total	%	%	%
0-$14,999	96,372	33,505	129,877	3.2%	3.0%	3.0%
$15,000-$34,999	358,280	125,362	483,642	12.6%	11.1%	11.0%
$35,000-$74,999	1,127,111	397,418	1,524,528	35.9%	34.7%	34.6%
$75,000-$149,999	1,252,418	442,501	1,694,918	37.4%	38.4%	38.5%
>=$150,000	419,357	148,095	567,452	11.0%	12.8%	12.9%
Total	3,253,538	1,146,880	4,400,418	100.0%	100.0%	100.0%

Note:
HBWD--- home-based work direct
HBWS--- home-based work strategic

Comparison of Trip Attractions by Income Group (Continued)

Motorized Trip Attractions by Purpose by Income Group (Model)

Income Group	HBSH	HBO	WBO	NHNW	Total
0-$14,999	166,823	313,838	21,483	133,419	635,564
$15,000-$34,999	276,134	852,801	115,053	293,533	1,537,520
$35,000-$74,999	674,604	2,283,504	558,573	787,961	4,304,643
$75,000-$149,999	532,833	2,430,947	622,601	702,409	4,288,790
>=$150,000	182,662	922,399	216,340	277,537	1,598,937
Total	1,833,056	6,803,490	1,534,051	2,194,858	12,365,455

Motorized Trip Attractions by Purpose by Income Group (Survey)

Income Group	HBSH	HBO	WBO	NHNW	Total
0-$14,999	161,856	313,588	20,965	125,729	622,138
$15,000-$34,999	266,836	861,858	110,509	292,680	1,531,883
$35,000-$74,999	664,830	2,242,992	536,355	758,025	4,202,202
$75,000-$149,999	550,900	2,426,988	597,866	720,509	4,296,262
>=$150,000	189,536	935,352	207,331	285,429	1,617,647
Total	1,833,958	6,780,778	1,473,026	2,182,371	12,270,132

Ratio of Attractions by Purpose by Income Group (Model vs. Survey)

Income Group	HBSH	HBO	WBO	NHNW	Total
0-$14,999	1.03	1.00	1.02	1.06	1.02
$15,000-$34,999	1.03	0.99	1.04	1.00	1.00
$35,000-$74,999	1.01	1.02	1.04	1.04	1.02
$75,000-$149,999	0.97	1.00	1.04	0.97	1.00
>=$150,000	0.96	0.99	1.04	0.97	0.99
Total	1.00	1.00	1.04	1.01	1.01

Note:
For WBO and NHNW purposes, values are trip ends.

Regional Trip Statistics

Regional Trips Summary

Source	Trip Productions					
	Total	Per Household	Per Person	Motorized	Per Household	Per Person
Model	19,580,184	8.09	2.94	17,776,573	7.34	2.67
Survey	19,504,281	8.05	2.93	17,643,117	7.29	2.65
Model/Survey	1.00	1.00	1.00	1.01	1.01	1.01

Expected range for trips per household is 7.5-10
Expected range for trips per person is 2.5-3.4

Household Life Cycle	TripProductions			Average Trips/Household	
	Model	Survey	Model/Survey	Model	Survey
Households with Retirees	3,611,461	3,468,137	1.04	5.84	5.61
Households with Children and No Retirees	10,072,899	10,034,749	1.00	12.15	12.11
Households without Children or Retirees	5,895,825	6,001,396	0.98	6.05	6.16
Total	19,580,185	19,504,281	1.00	8.09	8.05

Trip Distribution - Average Trip Length Comparison

Trip Distribution Summary

Purpose	Composite Impedance		Diff	Diff%
	Observed	Estimated		
HBWD	31.85	33.54	1.69	5.3%
HBWS	30.09	31.75	1.66	5.5%
HBSH	15.91	15.84	-0.07	-0.4%
HBO	15.99	15.62	-0.37	-2.3%
WBO	21.87	21.71	-0.15	-0.7%
NHNW	16.20	16.03	-0.17	-1.1%

Time and Distance Comparisons

Purpose	Travel Time		Distance	
	Observed	Estimated	Observed	Estimated
HBWD	31.49	33.33	13.51	14.15
HBWS	29.74	31.62	12.92	12.98
HBSH	15.67	15.65	5.69	5.63
HBO	15.61	15.28	5.72	5.62
WBO	21.00	21.14	9.66	9.63
NHNW	15.89	15.81	5.93	5.58

$I_C = 1.0 / (1.0/I_H + MS_T/I_T)$

Where:

I_C = Composite impedance for zonal pair i-j

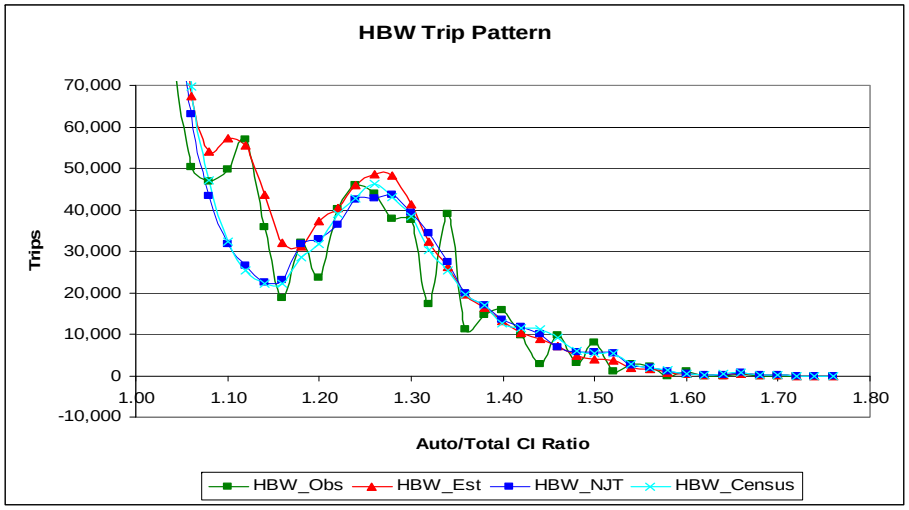
I_H = Highway impedance for zonal pair i-j for the "representative" auto mode

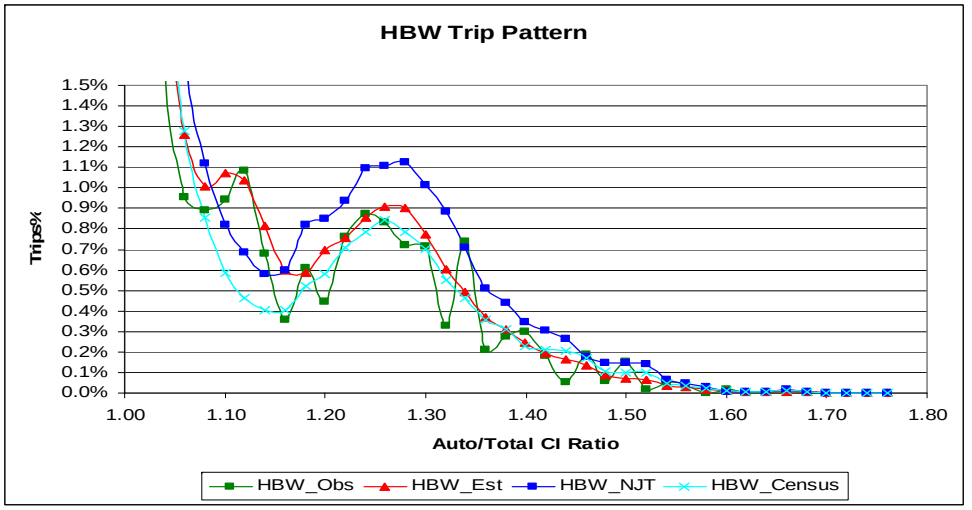
MS_T = Transit mode share for zonal pair i-j

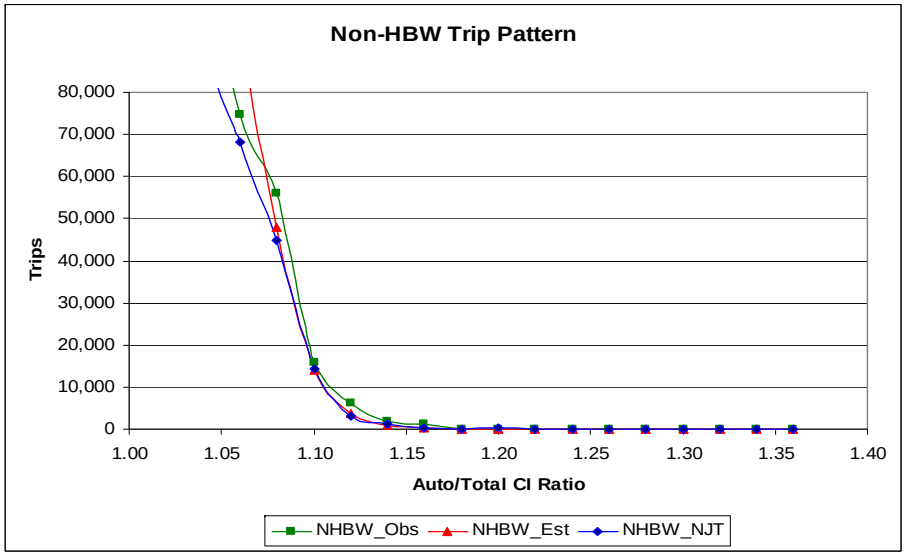
I_T = Transit impedance for zonal pair i-j for the "representative" transit mode

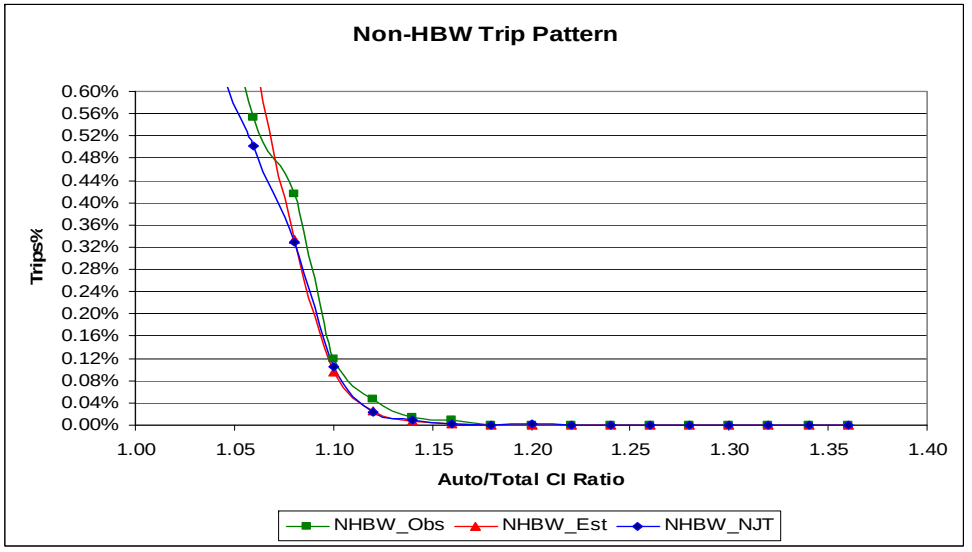
Note: impedance for each mode includes travel time and costs.

Trip Pattern by Auto/Total CI Ratio









Trans-Hudson Person Trips Summary

Trans-Hudson Trips Summary for NJT Controlled Region

Person Trips	Original Survey	Adjusted Survey (1)	NJRTME	Model/Survey
Total	1,207,973	1,235,875	1,268,089	1.03
	Orginal Survey	**AECOM/NJT MODEL (2)**	**NJRTME**	**Model/NJT**
Transit	548,086	515,079	524,020	1.02

(1) - Adjusted survey - Household survey adjusted for changes implemented as result of NJT discussions.
(2) - AECOM/NJT model - Transit trips from existing NJT model

Mode Choice - Trans-Hudson Trips by Mode Comparison

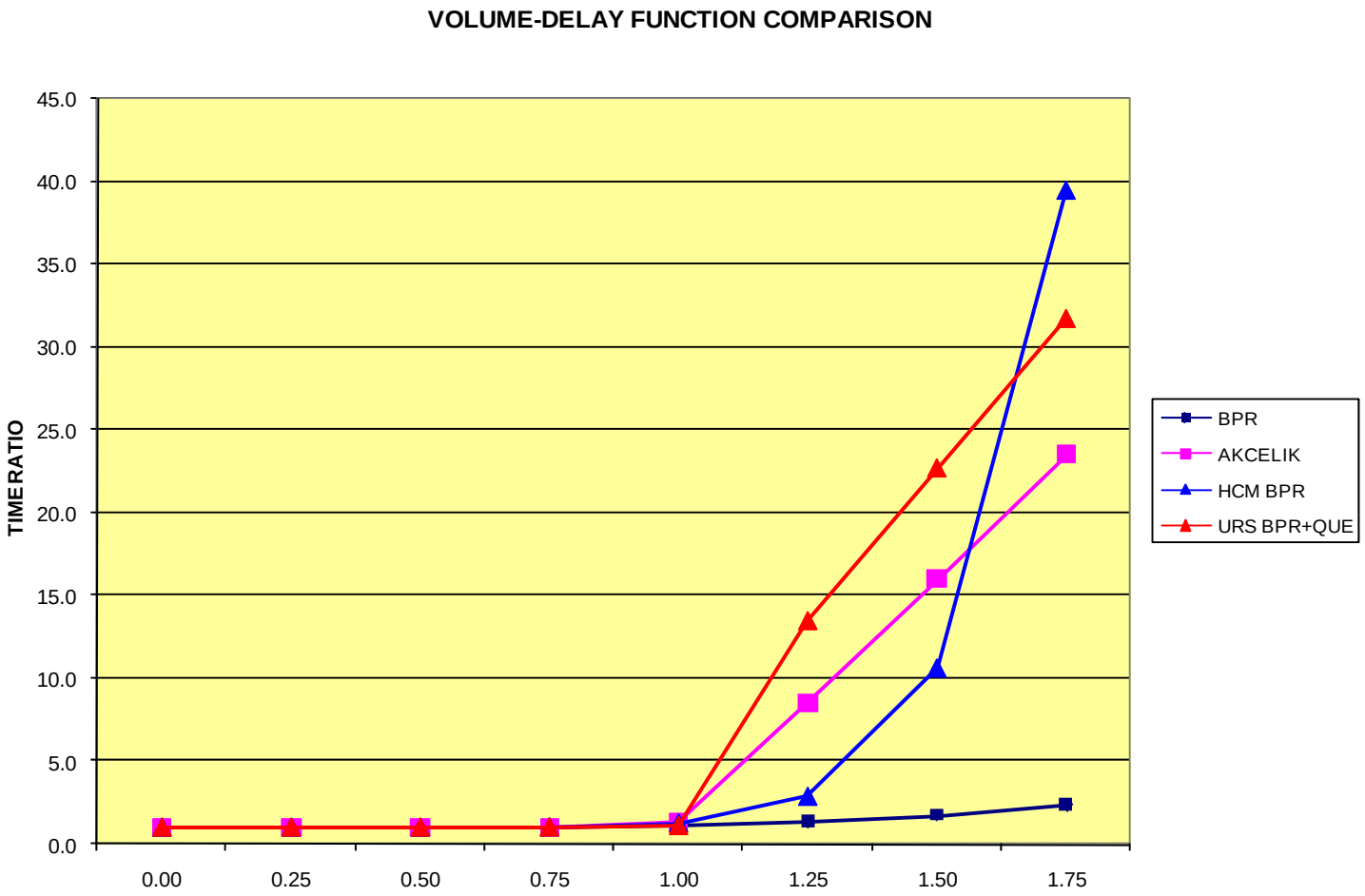
One of 11 Geographic Market Segments

Trips by Mode Comparison (Trans-Hudson Regions: 1,5,7)

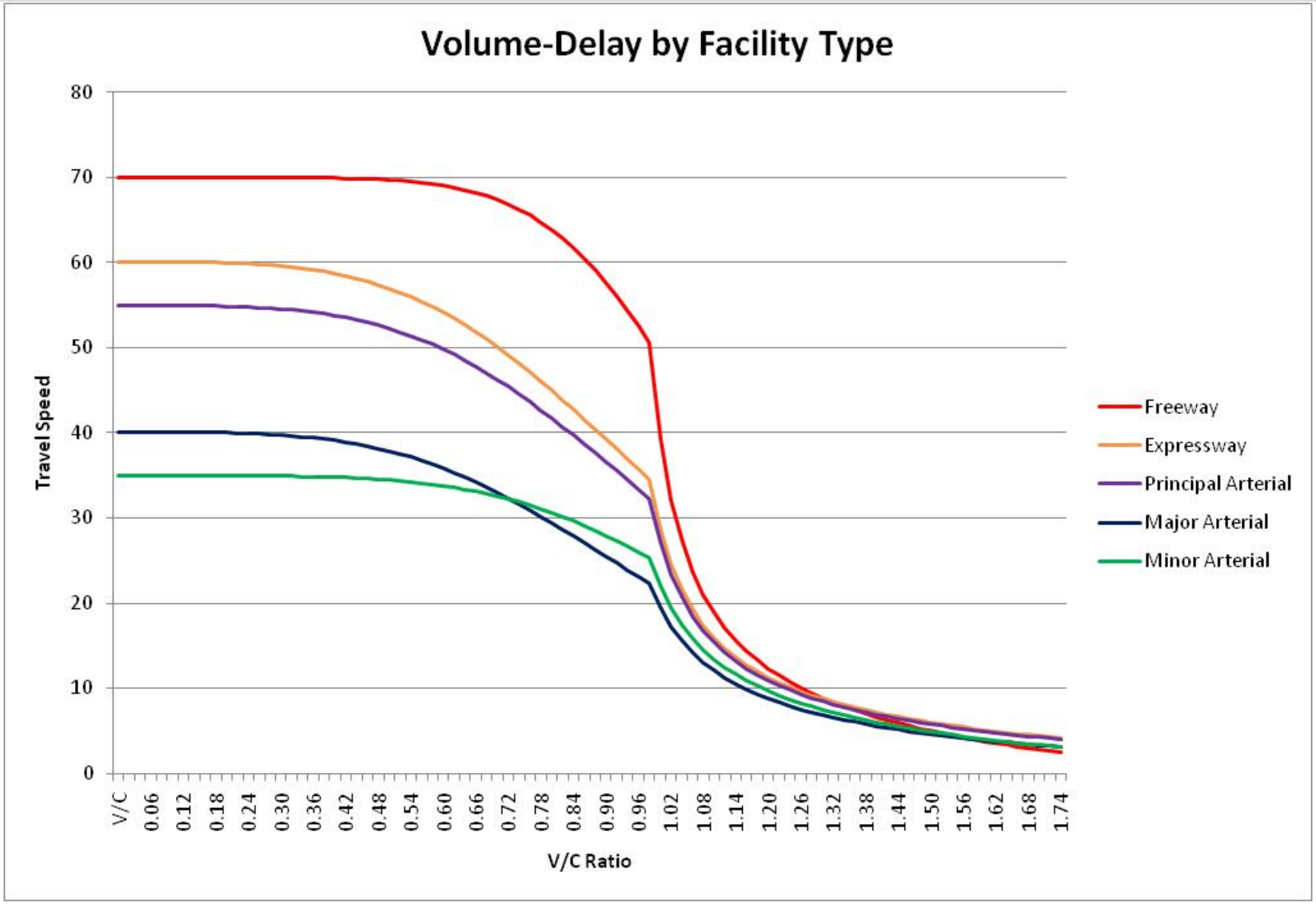
MODE	DAILY TOTAL					
	NJT Model**		Integration Model		Survey	
SOV	279,630	26.3%	347,983	27.4%	486,553	35.7%
HOV2	156,833	14.8%	224,253	17.7%	171,551	12.6%
HOV3	56,222	5.3%	98,750	7.8%	51,574	3.8%
HOV4	55,008	5.2%	73,089	5.8%	40,458	3.0%
AUTO	547,695	51.5%	744,075	58.7%	750,138	55.1%
Wk-Rail	44,879	4.2%	43,956	3.5%	120,179	8.8%
Wk-PATH	90,202	8.5%	114,143	9.0%	107,445	7.9%
Wk-Bus	107,222	10.1%	152,445	12.0%	155,361	11.4%
Wk-Ferry	14,331	1.3%	8,079	0.6%	5,130	0.4%
Wk-LRT	8,940	0.8%	3,057	0.2%	0	0.0%
Wk-Long Ferry	158	0.0%	125	0.0%	0	0.0%
Dr-Rail	126,023	11.9%	78,087	6.2%	151,142	11.1%
Dr-PATH	41,466	3.9%	38,589	3.0%	17,450	1.3%
Dr-Bus	64,848	6.1%	76,244	6.0%	50,693	3.7%
Dr-Ferry	3,803	0.4%	7,391	0.6%	4,077	0.3%
Dr-LRT	8,745	0.8%	507	0.0%	0	0.0%
Dr-Long Ferry	4,463	0.4%	1,394	0.1%	0	0.0%
TRANSIT	515,086	48.5%	524,018	41.3%	611,476	44.9%
TOTAL	1,062,783	100.0%	1,268,089	100.0%	1,361,614	100.0%

** AECOM/NJT Trip Table

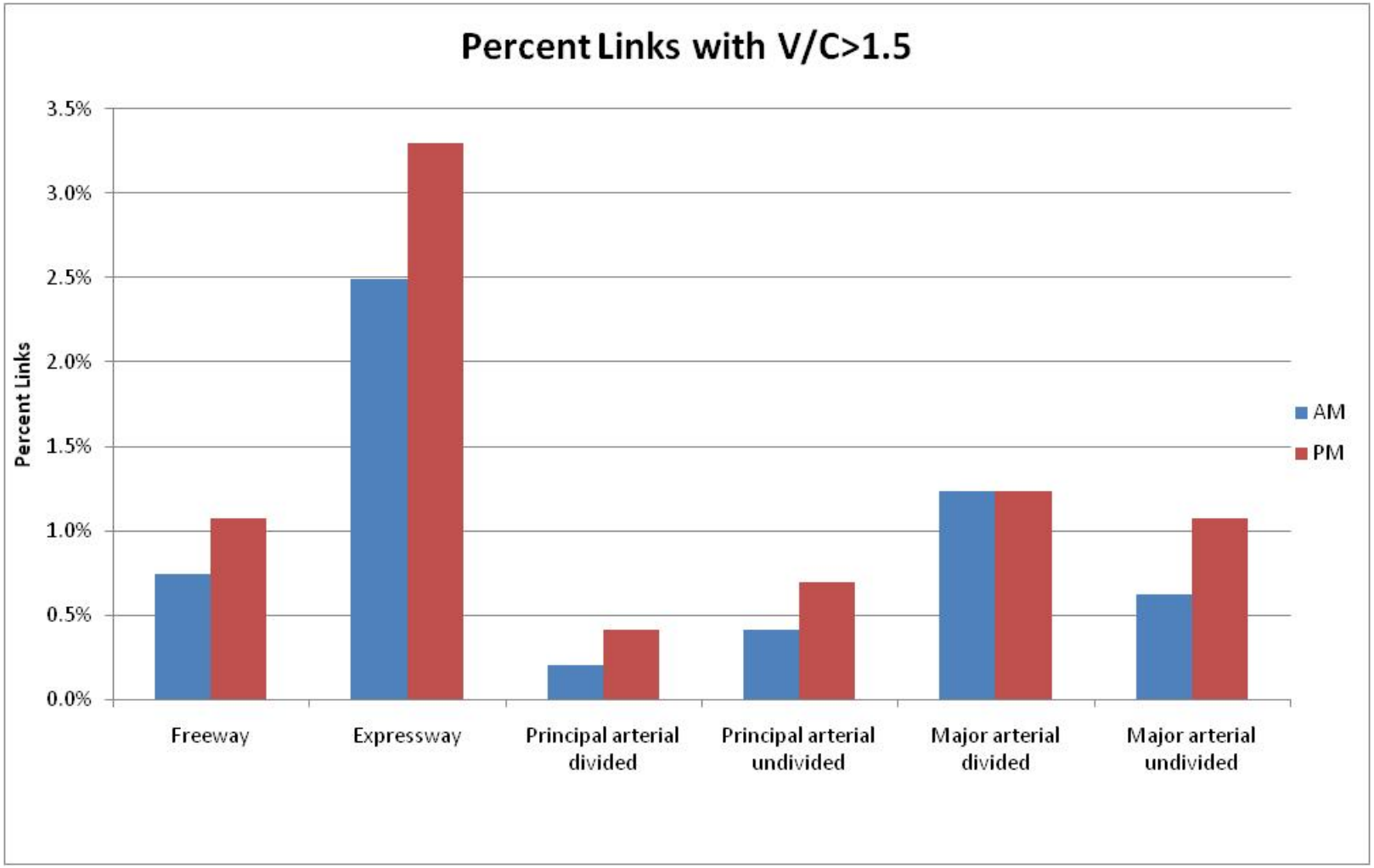
Highway Assignment - Volume-Delay Function Comparison



NJRTM-E Delay Functions



NJRTM-E Assignment Results



Regional VMT Summary

VMT Summary

Facility Type	Observed	Estimated	Ratio
Freeway	20,459,061	21,381,971	105%
Expressway	2,671,680	2,552,583	96%
Principal arterial divided	3,341,529	3,260,569	98%
Principal arterial undivided	2,915,434	2,943,843	101%
Major arterial divided	29,160	35,676	122%
Major arterial undivided	2,367,306	2,478,058	105%
Minor arterial	1,114,110	987,420	89%
Total	32,898,280	33,640,120	102%

Area Type	Observed	Estimated	Ratio
CBD	424,528	453,185	107%
Urban	4,789,400	4,967,504	104%
Suburban	18,772,525	19,275,159	103%
Rural	8,911,827	8,944,272	100%
Total	32,898,280	33,640,120	102%

RMSE Summary by Volume Group

RMSE Summary by Volume Group

Volume Group	Model v.s Desirable Percent Deviation		
	Model	NJRTM	FHWA
>=90,000	11	11	15
80,000-90,000	21	16	16
70,000-80,000	17	23	16
60,000-70,000	19	23	18
50,000-60,000	24	26	20
40,000-50,000	28	32	21
30,000-40,000	26	43	23
20,000-30,000	32	42	25
10,000-20,000	44	65	27
0-10,000	88	65	40-60
Total	35	50	35-40

Note:
Percent RMSE from U.S. Models
(Source:Model Validation and Reasonableness Checking Manual - FHWA)

Atlanta	27%
Chicago	47%
Dallas	43%
Norfolk	42%
Phoenix	37%
Tampa	46%
Washington	50%

R-Square by Facility Type

R-Squared Analysis: Estimated Volume v.s Observed Count

Facility Type	Observations	R-Square
Freeway	427	87.5%
Expressway	167	75.2%
Principal Arterial Divided	215	60.3%
Principal Arterial Undivided	348	73.8%
Major Arterial Divided	4	NA
Major Arterial Undivided	479	37.3%
Minor Arterial	454	54.9%
All Roads	2,094	93.0%

FHWA recommended the regionwide R-square should be greater than 88%.
Source: Model Validation and Reasonableness Checking Manual. Feb. 1997.

VMT/Volume Comparison by County

Observed Volume v.s Estimated Volume by Subregion

	VMT			Volume		
County	**Observed**	**Estimated**	**Ratio**	**Observed**	**Estimated**	**Ratio**
Bergen	2,948,949	2,904,781	99%	4,256,279	4,122,307	97%
Essex	2,402,024	2,680,549	112%	3,782,505	4,304,276	114%
Hudson	1,512,702	1,641,823	109%	2,461,370	2,624,184	107%
Hunterdon	1,171,362	1,137,260	97%	1,156,902	1,133,606	98%
Mercer	2,679,712	2,462,962	92%	2,986,784	2,699,285	90%
Middlesex	4,766,061	5,097,133	107%	5,670,767	6,221,359	110%
Monmouth	3,550,741	3,448,515	97%	2,559,064	2,459,363	96%
Morris	3,279,109	3,811,018	116%	3,538,268	4,100,614	116%
Ocean	2,085,785	1,975,002	95%	1,367,528	1,280,241	94%
Passaic	1,587,312	1,616,364	102%	2,612,437	2,757,743	106%
Somerset	3,089,158	3,149,370	102%	2,376,559	2,487,349	105%
Sussex	753,343	683,558	91%	626,646	577,899	92%
Union	1,930,198	1,980,792	103%	3,390,464	3,433,323	101%
Warren	1,188,622	1,076,122	91%	1,181,628	1,062,093	90%
Total(NJTPA+MERCER)	32,945,078	33,665,249	102%	37,967,201	39,263,642	103%

Screenline Summary

Screenline Summary

Screenline	Location	%With Counts	Observed	Estimated	Ratio	Truck%
1	Below I-80 (From I-80&I-280 Fork to Hudson River)	27	690,240	732,330	106%	6.4%
2	East of I-95 (From I-495 to I-78)	89	416,052	471,368	113%	5.0%
3	East of GSP (From NJ-3 to I-78 then turn to I-95)	47	901,388	929,286	103%	7.7%
4	Union<-->Middlesex (From I-280 to Goethals Bridge)	39	789,107	767,356	97%	7.5%
5	Lower Middlesex(NJ-27,US-1,I-95,US-130, CR-535,CR-527)	55	275,696	278,323	101%	10.4%
6	Morris Cross (From I-80 to I-287)	69	353,332	399,193	113%	7.1%
7	Morris Cross (From I-80 to I-78 then to NJ-28)	39	310,926	312,909	101%	10.4%
8	Upper GSP (From GSP,US-202 to I-80)	55	222,202	229,403	103%	7.9%
9	Upper Middlesex(From GSP to Outerbridge Crossing)	59	659,201	676,375	103%	6.8%
10	NY<-->NJ Land Border Crossing	70	309,459	320,341	104%	9.2%
11	Upper Delaware River Crossing	100	176,092	188,489	107%	13.0%
12	Lower Delaware River Crossing	100	249,294	256,446	103%	6.1%
13	In between NJ-18 & CR-520 (from CR-527 to Coast)	63	357,322	322,682	90%	2.9%
14	Middlesex Bay Crossing (GSP+US-9+NJ-35)	100	331,112	379,070	114%	3.5%
15	NY<-->NJ Hudson River Crossing	100	703,577	741,442	105%	5.2%
16	NY<-->NY Hudson River Crossing (Three Bridges)	100	214,495	228,607	107%	10.4%
17	Newark CBD Cordon Line	44	251,114	316,058	126%	11.2%
18	Downtown Jersey City Cordon Line	28	252,325	243,586	97%	0.2%
19	NJ Other<-->NJTPA+MERCER Border Crossing	53	299,344	309,956	104%	10.7%
20	Middlesex<-->Somerset Border (partial,from I-78 to I-95)	45	526,844	552,360	105%	7.2%
Total			41,893,110	42,830,431	102%	6.8%

Notes: Anticipated percent deviation between the estimated and observed volumes expected to be within 5-15%.

Regional Performance Comparison

VMT, VHT, and Average Speed Statistics

City/Region	System VMT (x1000)	System VMT per Capita	Freeway VMT (x1000)	Principal Arterial VMT (x1000)	Average Peak Period Freeway Speed (mph)	Average Peak Period Principal Arterial Speed (mph)
NJTPA's 13 Counties + Mercer	**146,121**	**22**	**56,811**	**44,991**	**45**	**30**
Atlanta	95,110	37	38,650	14,575	43	27
Detroit	87,620	22	29,355	28,365	43	27
Boston	58,285	19	21,800	16,110	45	26
Kansas City	39,130	29	17,310	5,730	52	28
Baltimore	43,245	29	20,775	8,915	46	28

NOTE:
Source: 1999 Texas Transportation Institute Annual Mobility Study (for Regional Models other than NJTPA)

Unweighted Speed Comparison

Speed Comparison by Period by Facility Type

Period	Facility Type	Observed Speed (All Runs)		Estimated Speed (All Runs)		Estimated Speed (All Links)		Summer Speed (PPSUITE)	
		Mean	Stand. Dev.	Mean	Stand. Dev.	Mean	Stand. Dev.	Mean	Stand. Dev.
AM	Freeway	50.15	13.74	53.32	15.95	57.78	14.79	57.93	10.56
	Expressway	51.43	10.54	48.81	10.83	46.80	11.32	42.64	7.59
	Principal arterial divided	29.01	12.48	36.09	13.99	44.67	10.87	34.14	6.72
	Principal arterial undivided	38.56	14.05	42.52	11.69	43.79	12.92	29.13	8.47
	Major arterial divided	31.79	12.88	40.39	10.08	39.84	10.09	32.50	5.22
	Major arterial undivided	21.91	11.66	32.39	13.58	37.59	13.54	26.10	7.28
	Minor arterial	21.26	9.98	28.24	9.81	30.66	9.78	19.86	8.31
	Collector/Local	32.20	5.21	32.63	2.60	16.97	6.30	19.70	5.74
	Average	34.57	16.70	43.41	15.96	37.53	14.64	28.00	15.45
MD	Freeway	57.95	8.77	62.04	8.17	64.19	11.03	60.19	5.81
	Expressway	48.33	9.39	53.46	5.63	52.83	5.86	44.97	3.34
	Principal arterial divided	34.96	9.38	40.45	10.37	48.70	8.10	35.19	5.65
	Principal arterial undivided	39.27	12.24	46.13	9.85	46.46	10.91	30.42	7.61
	Major arterial divided	27.48	11.99	41.87	9.24	43.08	8.18	32.98	5.00
	Major arterial undivided	24.24	13.13	36.15	12.32	40.45	10.80	27.07	6.52
	Minor arterial	23.10	11.20	30.07	8.58	32.18	8.25	21.37	7.13
	Collector/Local	33.94	4.93	32.69	2.55	17.85	5.53	19.97	5.61
	Average	36.54	17.56	48.47	14.65	40.33	13.90	29.40	14.91
PM	Freeway	51.13	10.74	45.49	19.38	54.75	16.99	58.11	10.29
	Expressway	41.97	9.00	47.77	12.45	44.55	11.92	43.81	5.17
	Principal arterial divided	25.68	12.82	35.22	14.58	43.29	11.71	30.76	9.32
	Principal arterial undivided	31.04	13.55	41.47	12.43	42.62	13.85	27.51	9.55
	Major arterial divided	30.75	12.99	38.90	11.89	37.19	13.93	31.91	5.06
	Major arterial undivided	25.75	12.96	30.31	15.72	36.09	14.60	25.11	7.52
	Minor arterial	20.75	9.70	26.05	12.37	29.51	10.89	18.63	8.85
	Collector/Local	30.74	4.14	32.69	2.55	15.80	7.24	19.36	5.91
	Average	33.36	16.32	39.79	16.98	36.04	15.32	26.96	15.90

Toll Road Performance

Toll Road Volumes Comparison

Road	BEGIN	END	Count	Volume	Ratio	Obs. VMT	Est. VMT	Ratio
NJTPK	Interchange 7	G.S.P. (Interchange 11)	998,254	929,444	0.93	1,867,522	1,708,379	0.91
NJTPK	G.S.P. (Interchange 11)	George Washington Bridge	2,481,945	2,633,987	1.06	2,397,778	2,562,865	1.07
G.S.P.	Burlington&Ocean Border	NJTPK	1,555,952	1,532,969	0.99	2,365,827	2,252,979	0.95
G.S.P.	US-22	I-87 (NYS)	1,171,144	1,117,394	0.95	730,389	688,746	0.94
TOTAL			6,207,295	6,213,793	1.00	7,361,516	7,212,969	0.98

NJTPK Summary

	2000 Count (One Way)			Model (Avg. of Both Directions)		
Interchanges	Heavy	Total	%Heavy	Heavy	Total	%Heavy
Total in NJTPA Area	**133,006**	**1,262,943**	**10.5%**	**121,708**	**1,295,980**	**9.4%**

GSP Summary

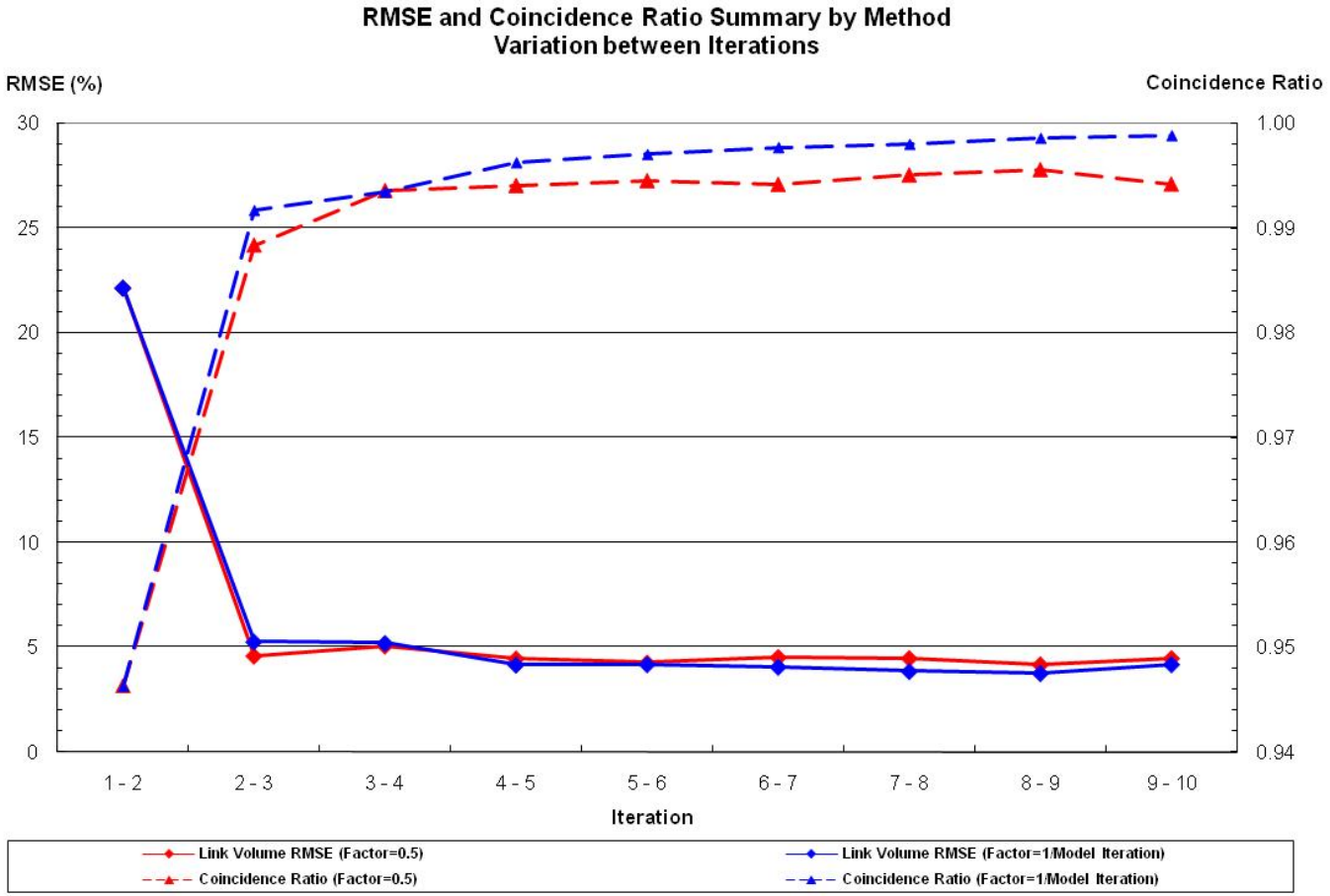
	2000 Count			2000 Model		
	Both Directions			Both Directions		
Toll Plaza	Heavy	Total	%Heavy	Heavy	Total	%Heavy
Pascack Valley	NA	78,010	NA	NA	69,095	NA
Bergen	NA	123,900	NA	NA	122,552	NA
Essex	NA	144,900	NA	NA	140,635	NA
Union	NA	194,300	NA	NA	199,096	NA
Raritan River	NA	232,000	NA	NA	262,000	NA
Asbury	1,007	146,956	0.7%	607	131,250	0.5%
Toms River	1,566	85,352	1.8%	2,100	77,341	2.7%
Barnegat	1,243	62,395	2.0%	1,724	52,363	3.3%
New Gretna	894	42,283	2.1%	1,896	43,083	4.4%
TOTAL	**4,710**	**1,032,086**	**1.4%**	**6,328**	**1,028,320**	**2.1%**

Trans-Hudson Traffic Comparison

Trans-Hudson Vehicular Traffic by Type

LOCATION	Count				Model		
	Direction	Auto	Heavy	Total	Auto	Heavy	Total
Newburgh-Beacon Bridge	EB	30,501	3,943	34,444	32,910	3,788	36,698
	WB	30,501	3,943	34,444	33,492	3,990	37,482
Bear Mountain Bridge	EB	9,009	91	9,100	7,537	267	7,804
	WB	9,009	91	9,100	7,453	395	7,848
Tappan Zee Bridge	EB	61,693	6,767	68,460	65,105	7,177	72,282
	WB	56,031	6,146	62,177	58,432	8,062	66,493
George Washington Bridge	EB	143,216	10,245	153,461	158,015	11,917	169,933
	WB	153,129	10,959	164,088	146,518	10,880	157,399
Lincoln Tunnel	EB	61,995	521	62,516	67,004	0	67,004
	WB	66,167	560	66,727	64,757	0	64,757
Holland Tunnel	EB	48,730	756	49,486	43,249	0	43,249
	WB	50,846	789	51,635	54,370	0	54,370
Verrazano-Narrows Bridge	EB	100,856	7,282	108,138	109,973	5,463	115,435
	WB	92,054	6,646	98,700	95,526	4,487	100,013
Total	EB	456,000	29,605	485,605	483,793	28,612	512,405
	WB	457,737	29,134	486,871	460,548	27,814	488,362
Goethals Bridge	EB	35,227	2,692	37,919	35,362	5,730	41,092
	WB	32,413	2,476	34,889	27,387	4,248	31,635
Outerbridge Crossing	EB	37,548	1,929	39,477	38,868	2,068	40,936
	WB	32,279	1,657	33,936	36,080	2,342	38,422
Bayonne Bridge	SB	9,696	613	10,309	16,916	451	17,367
	NB	7,716	487	8,203	14,589	691	15,280
Total	EB/NB	80,491	5,108	85,599	88,819	8,488	97,307
	WB/SB	74,388	4,746	79,134	80,383	7,041	87,424

Convergence Performance



Transit Demand

Transit Ridership Summary

Rail/Ferry Services	Observed	Estimated	Diff	% Diff
Main/Bergen/Port Jervis Line	22,380	26,192	3,812	17.0%
Pascack Valley Line	7,018	3,352	-3,666	-52.2%
Boonton Line	9,824	14,620	4,796	48.8%
Morris/Essex Line	40,250	30,904	-9,346	-23.2%
Raritan Valley Line	18,070	16,556	-1,514	-8.4%
North Jersey Coastline/Northeast Corridor Line	106,052	94,154	-11,898	-11.2%
Metro North Trips from West of Hudson Locations	5,248	3,224	-2,024	-38.6%
Total Rail Service	208,842	189,002	-19,840	-9.5%
PATH	500,532	519,082	18,550	3.7%
Newark City Subway Line	36,232	30,385	-5,847	-16.1%
Hudson-Bergen LRT	22,000	31,838	17,580	123.3%
NJ Ferry Service	23,097	14,838	-8,259	-35.8%
Total	790,703	785,145	-5,558	-0.7%

Sensitivity Analysis

- Sensitivity Trials
  - Cost Trials
    - NJ Turnpike 100% Toll Increase
    - Transit System – 30% Fare Increase
  - New Transit Facility
    - Secaucus Transfer Station
    - Best toll route

Sensitivity Analysis Results

- NJ Turnpike Toll Increase
  - Tolls Increased 100%
    - Elasticity Range from TCRP Report 95 – (-.10 to -.34)
    - Observed Turnpike Elasticity from 1991 increase - (-.104)
    - NJRTM-E Estimated Elasticity – (-.159)

Sensitivity Analysis Results

- NJ Transit Fare Increase
  - Transit Fares increased 30% systemwide
  - TCRP Estimates provide a wide range for bus mode
  - Commuter Type Services exhibit reasonable results
  - Local Bus elasticity may reflect captive patrons
  -

Mode	Elasticity Values	
	TCRP Report 95 Range	NJRTM-E Value
Commuter Rail	-0.18 to -0.22	-0.22
Long Haul Bus	-0.20 to -0.40	-0.29
Local Bus	-0.20 to -0.40	-0.09

Sensitivity Analysis Results

- New Transit Facility - Secaucus Station
  - Observed Ridership (2004) – 11,000
  - Estimated Ridership (2000 Model) – 8,400
  - Ridership by Access Mode is generally reasonable

Secaucus Junction Ridership Summary

Mode	Estimated Average Weekday Ridership	% Share	
		Estimated	Observed[1]
Rail			
Main/Port Jervis/Bergen Lines	4,112	49%	65%
Pascack Valley Line	2,084	25%	11%
Total Rail	**6,196**	**74%**	**76%**
Bus	**2,195**	**26%**	**24%**
Total Ridership	**8,391**	**100%**	**100%**

Note:

[1] Obtained from "September Secaucus Junction Ridership" Technical Memorandum from NJ Transit (October 3, 2007)

Discussion- Possible Future Enhancements to the NJRTM-E

- Network
- Demographic
- Process
- Data Management

Potential Enhancements

- Near Term Refinements
  - Minor Updates to Data / Procedures
  - Should Not Interfere with On-Going Projects / Studies
- Longer Term Enhancements
  - Significant Revisions to the Existing Components
  - Addition of new Procedures / Components
  - Coordination Required

Near Term Refinements

- Improve Calibration in Selected Corridors
  - Peak Period Turnpike Speeds north of Interchange 11
  - Improvement to Bus Speed Estimation
  - Improvements to Selected Rail Lines
- Full Testing of Diagnostic Reports
- Queuing Function Improvements
  - Contingent on Network Data
- Transit Node Integration

Near Term Enhancements

- Zone Independent Routines
  - Largely Complete
  - Transit Skims & Mode Choice
- Implement Cube Cluster
- Develop Life Cycle Submodel
- Implement Cube Reports
- Develop Additional Support Applications

Near Term Enhancements

- Year 2005 Calibration
- Additional Sensitivity Testing
- Geocoding Rail Stations & Alignments

Long Term Enhancements

- Update Transit Path-Building
  - Trnbuild to Public Transport (PT)
- Integration with NJTPA Land Use Routine
- Unified Mode Choice Process
- Intersection Modeling – Junction Process
- Cube Avenue Assignment Processing

Caveats

- The NJRTM-E Model Is A Tool
  - Based on Average Human Behavioral Characteristics and Responses and the Transport System's Characteristics
  - Remember, the AVERAGE family has 2.5 kids (none do)
  - For Every Average (mean), there is a standard deviation
  - The NJRTM-E is Built Upon the Most Recent AVAILABLE Data (some data are dated and some data are not available locally)
- Detailed Studies (FTA New Starts, Corridor Studies, Impact Assessment, etc) Should ALWAYS review the Model Data, Assumptions and Results and TAILOR the Tool to Fit the Conditions/Needs of the Study
- The NJRTM-E is now being reviewed by NJ Transit and has not yet been approved for use with project-level planning studies in the high-density urbanized areas.

Access to Documentation

- Users Guide is now on the NJTPA Website which accessed via the following link:

  http://www.njtpa.org/DataMap/Perf/Model/default.aspx

- Model Development Report will be posted on the website when it is finalized.

Now it is Time for Q&A