NATMEC - 2010

PrepME for WIM Data Processing for MEPDG

Presented by

Mike Moravec, FHWA

Kelvin CP Wang, University of Arkansas

Doc Zhang, Louisiana Transportation Research Center (LTRC)

U.S. Department of Transportation
Federal Highway Administration

Presentation Format

- Background
- Darwin ME
- PrepME
- Pooled Fund Project

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DARWin ME Pre-Alpha Screen Shots

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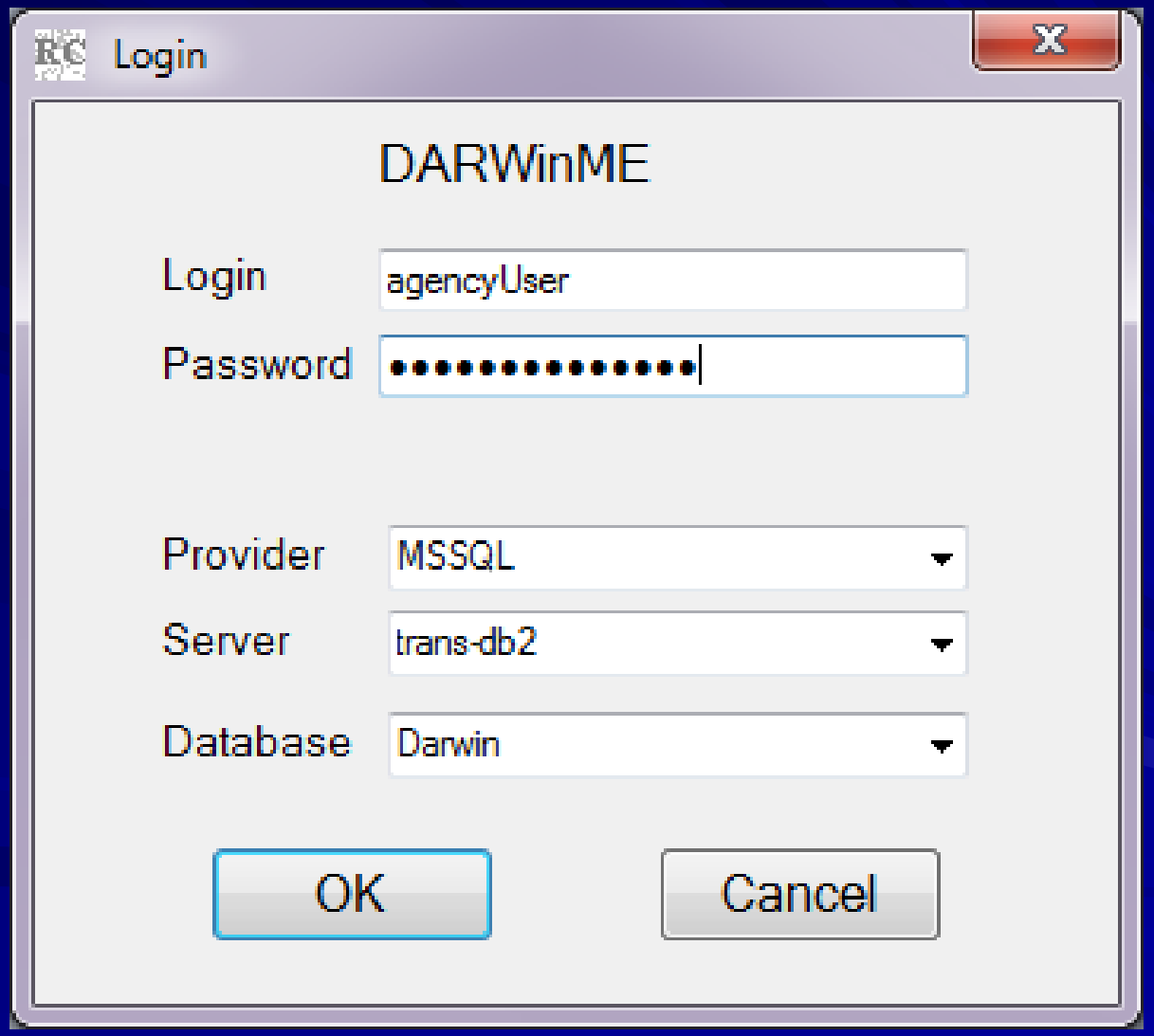
Enterprise Software



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Darwin ME Costs

Annual License Fees

Single user
$5,000
Site License – 5 - 9 users
$20,000
Site License – 10 -14 users
$30,000
Site License – unlimited users
$40,000

An educational use option will be offered in FY 2012.

AASHTO DarwinME 2.0 Alpha

DarwinME Explorer Wind...

- Projects
  - Project1
  - Project 101-F
  - Project 102-F
- Multiple Project Summary
- Settings
- Tools
- DarwinME calibration factors

DarwinME Menu

Recent Files | New | Open | SaveAs | Save | Save All | Close | Exit | Run | Import | Export | Select | Insert | Undo | Redo

Project1 | Project 101-F | **Project 102-F**

General Information

Analysis type: New Pavement

Pavement type: Jointed Plain Concrete Pavement(JPCP)

Design life (years): 7

Base construction: August 2006

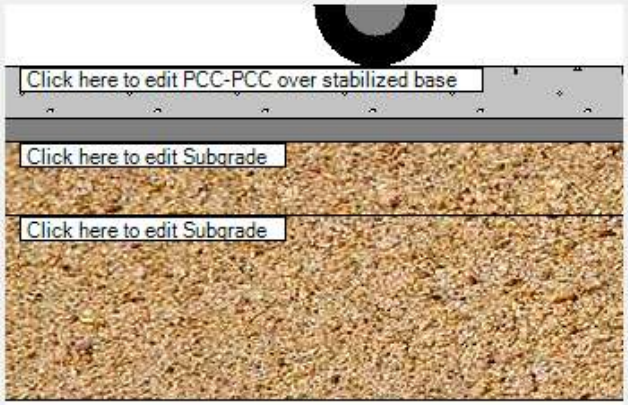
Pavement construction: September 2006

Traffic opening: October 2006

Use special traffic loading for flexible analyses.

Use	Analysis	Limit	Reliability
☑	intialIRI	63	
☑	terminalIRI	172	90
☑	crackingPCC	15	90
☑	faulting	0.12	90

Add Layer | Remove | Up | Down



Layer: Layer PCC:PCC over stabilized base

- **PCC**
  - Thickness (mm): 8.5 *Warning: Value is less than the reco*
  - Unit weight (pcf): 150
  - Poisson's ratio: 0.2
- **Thermal**
  - coefficientThermalExpansion: 5.5
  - thermalConductivity: 1.25
  - heatCapacity: 0.28
- **Mix**
  - cementType: Type I (1)
  - cementContent: 0

Thickness (mm):
This is the thickness of the concrete layer (thickness).
Minimum:25
Maximum:500

Error List

Project	Object	Property	Description

DarwinME Output Window | Compare | Error List

DARWin ME Toolbar

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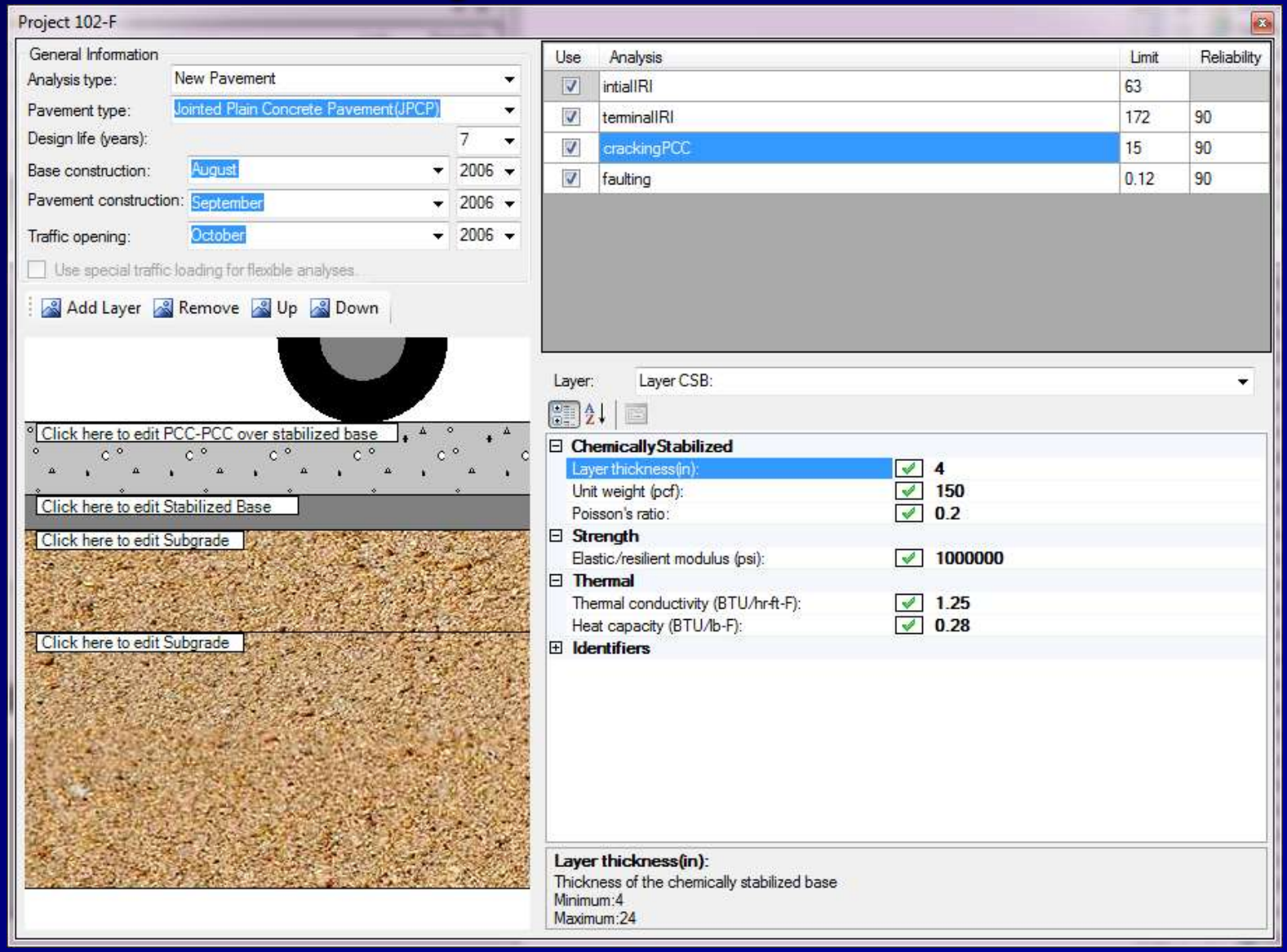
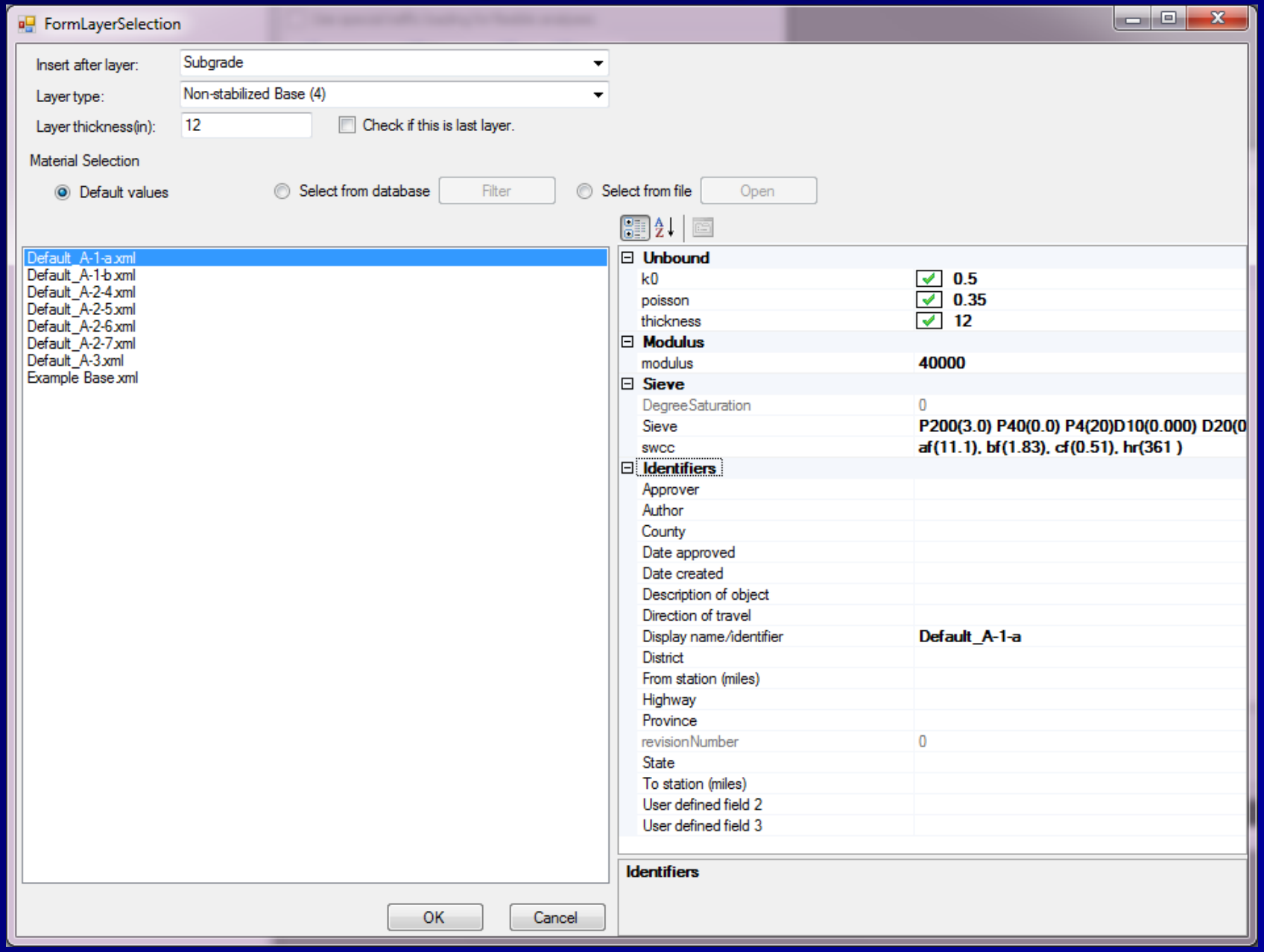
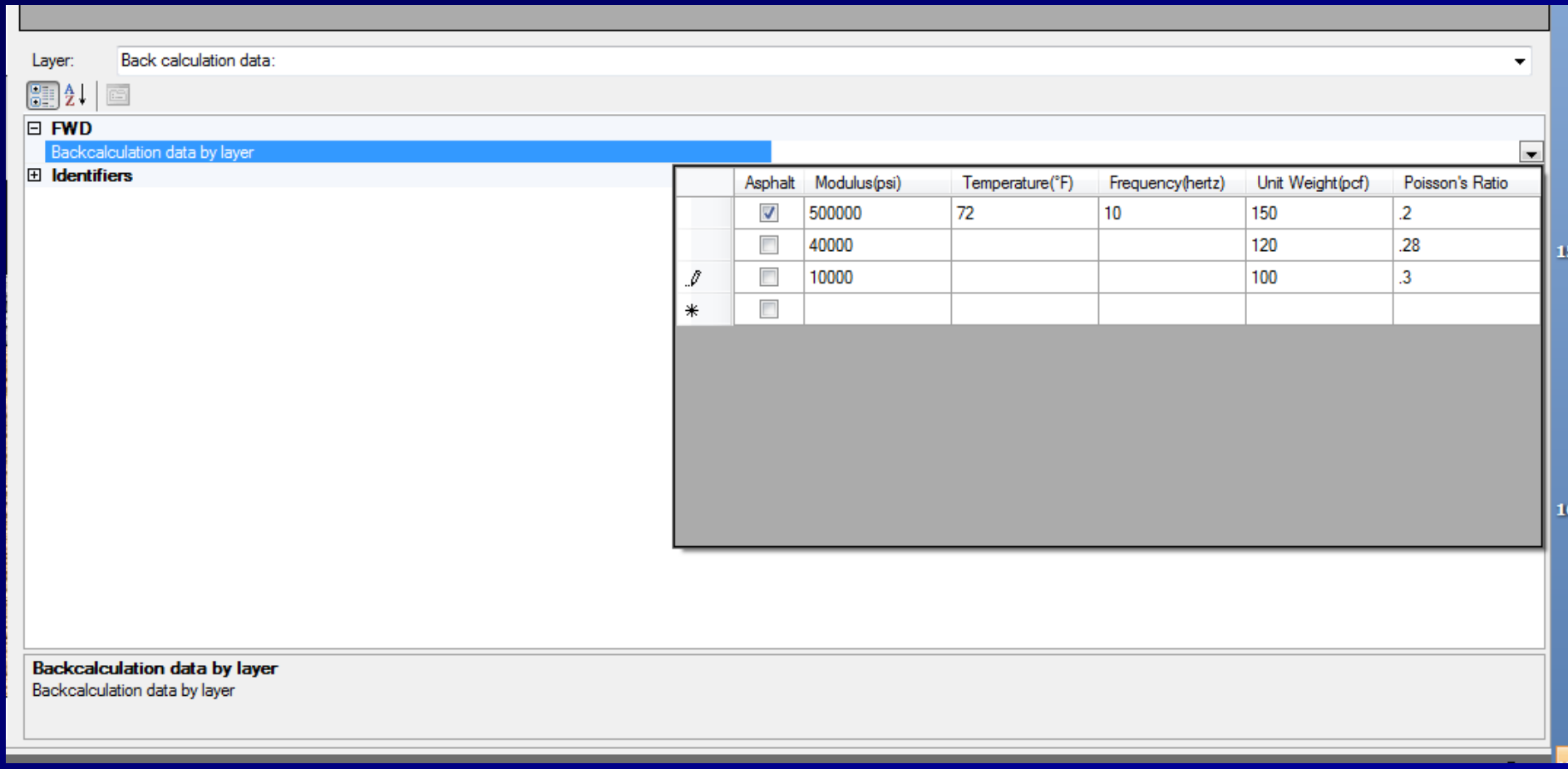
Project Creation



National Defaults



Backcalculated Data Import



Traffic

Project1:Traffic

AADTT		
AADTT	✓	**4001**
Number of lanes	✓	**2**
Trucks design direction(%)	✓	**50**
Trucks in design lane (%)	!	**95** *Warning: Value is greater t*
Traffic speed (mph)	✓	**60**
Limit of Service	!	**0** *Warning: Value is less than*
Axle Configuration		
axleWidth	✓	**8.5**
dualTireSpacing	✓	**12**
singleTirePressure	✓	**120**
dualAxleSpacing	✓	**51.6**
tripleAxleSpacing	✓	**49.2**
quadAxleSpacing	✓	**49.2**
Lateral Wander		
meanWheelLocation	✓	**18**
trafficWander	✓	**10**
laneWidth	✓	**12**
Wheelbase		
shortAxleSpacing	✓	**12**
mediumAxleSpacing	✓	**15**
longAxleSpacing	✓	**18**
percentShortTruck	✓	**33**
percentMediumTruck	✓	**33**
percentLongTruck	✓	**34**
Identifiers		
Misc		
axlesPerTruckMain		DarwinDataObjects.AxlesPerTru

AADTT
AADTT (Average Annual Daily Truck Traffic)
Minimum:10
Maximum:5000

TTCGrowth

Load Default Growth

Vehicle Class	Percent	Growth	Growth Type
Class 4	3.3	3	Linear
Class 5	34	3	Linear
Class 6	11.7	3	Linear
Class 7	1.6	3	Linear
Class 8	9.9	3	Linear
Class 9	36.2	3	Linear
Class 10	1	3	Linear

MonthlyAdjustment

Month	Class4	Class5	Class6	Class7	Class8	Class9	Class10	Class11	Cla
January	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
February	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
March	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
April	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
May	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
June	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
July	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
August	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Septe...	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
October	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Nove...	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Dece...	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

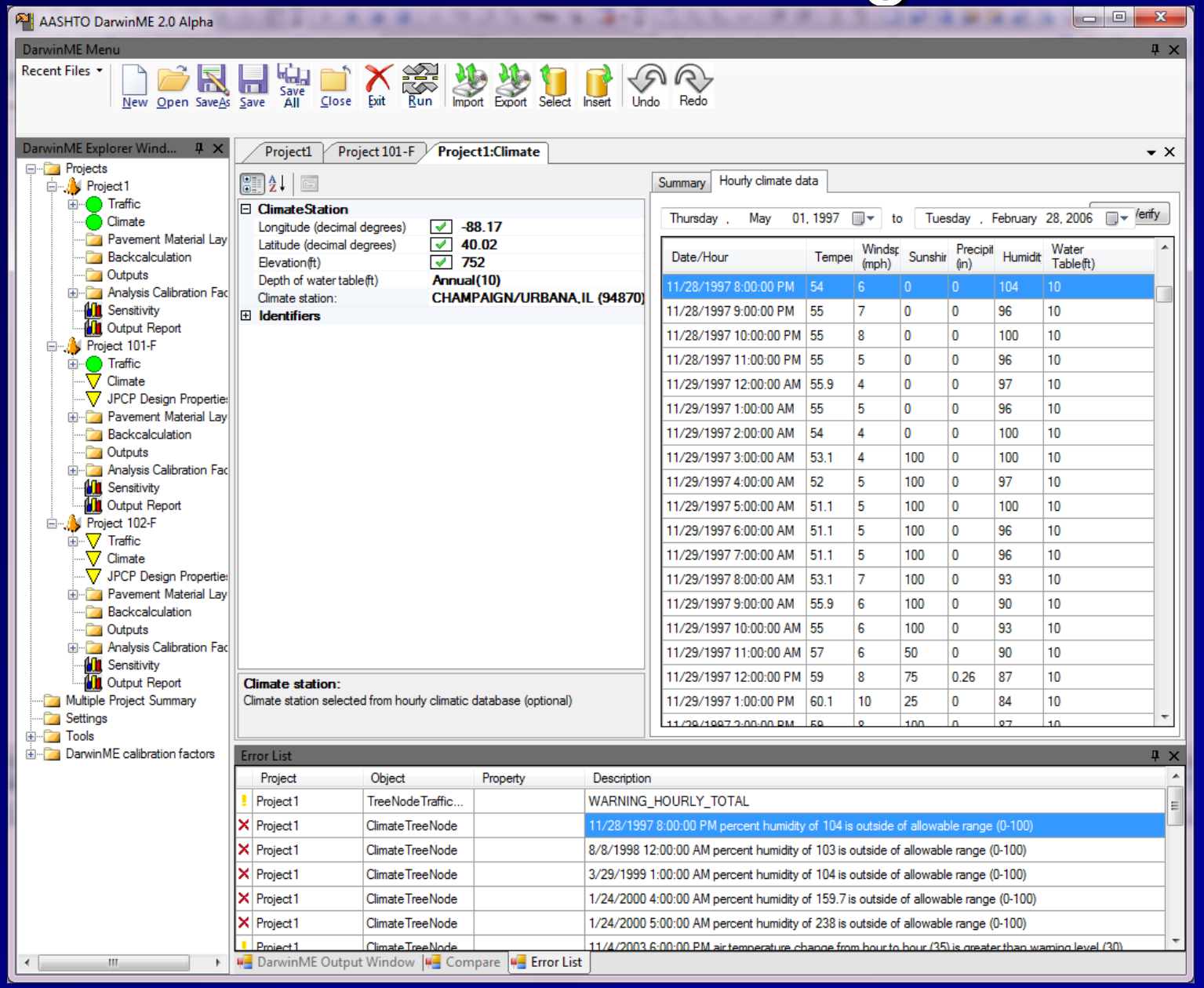
AxlesPerTruck

Vehicle Class	Single	Tandem	Tridem	Quad
Class 4	1.62	0.39	0	0

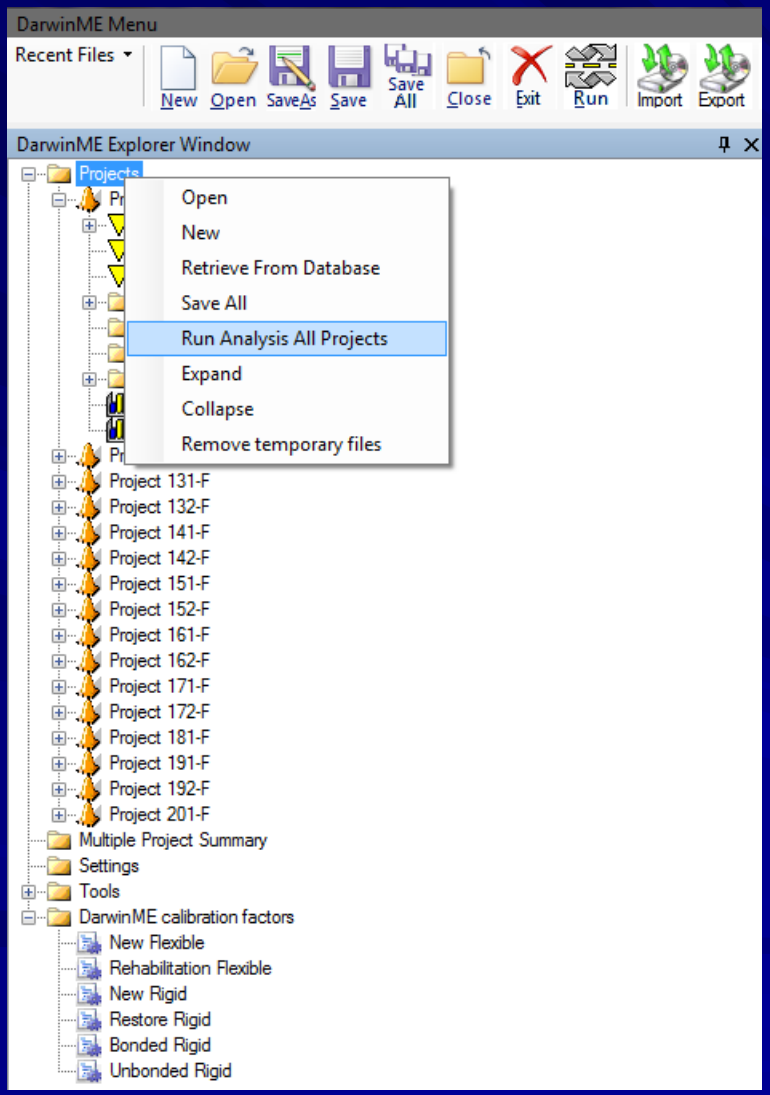
HourlyAdjustment

Time of Day	Percent
12:00 am	2.3
1:00 am	2.3
2:00 am	2.3
3:00 am	2.3
4:00 am	2.3
5:00 am	2.3
6:00 am	5
7:00 am	5
8:00 am	5
9:00 am	5
10:00 am	5.9
11:00 am	5.9
12:00 pm	5.9
1:00 pm	5.9
2:00 pm	5.9
3:00 pm	5.9
4:00 pm	4.6
5:00 pm	4.6
6:00 pm	4.6
7:00 pm	4.6
8:00 pm	3.1
9:00 pm	3.1
10:00 pm	3.1
11:00 pm	3.1
Total	100.0

Error Checking



Batch Mode



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Integrated Reports

Project 101-F:Report

1 of 28 100%

Report

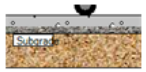
DARWin ME

AASHTOWare

Design Inputs

Design Life: 20 years
Design Type: JPCP
Construction Begin: September, 2006
Traffic Open Date: October, 2006
Climate Stations:

Design Structure



Layer type	Material Type	Thickness (in)
PCC		10.0
NonStabilized		6.0
Subgrade		Semi-infinite

Joint Design:

Spacing (in)	15.0
Dowel Dia. (in)	1.25
Widened Slab (ft)	n/a

Traffic

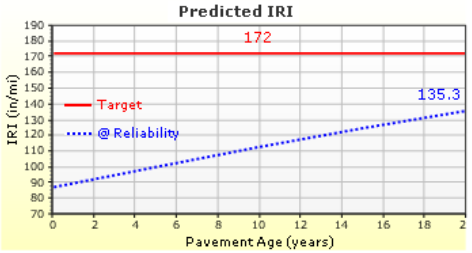
Age (year)	Heavy Trucks (cummulative)
2006 (initial)	4000
2016 (10 years)	8331940
2026 (20 years)	20665200

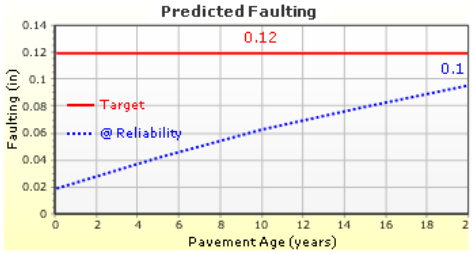
Design Outputs

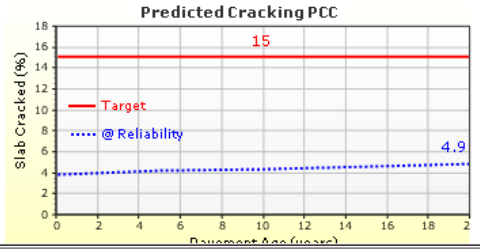
Reliability Summary

Distress Type	Distress @ Specified Reliability		Reliability (%)		Criterion Satisfied?
	Target	Predicted	Target	Achieved	
terminalIRI (in/mi)	172.00	135.32	90.00	64.31	Fail
faulting (in)	0.12	0.10	90.00	0.00	Fail
crackingPCC (%)	15.00	4.88	90.00	0.00	Fail

Distress Charts







No Distress Reliability Data

DARWin ME Development Status

Milestones	Percent Complete, Date of Completion
Kick-Off	100%
User Requirements Spec & Review/Approval	100%
Preliminary Design Review	100%
System Requirement Spec & Review/Approval	100%
Requirements Tracebility Matrix	100%
Critical Design Review	100%
Implementation & Integration Process Audit	40%, 7/31/10
Test Readiness Review	80%, 6/15/10
Testing Process Audit	0%, 9/30/10
Software Alpha Test	0%, 8/15/10
Software Beta Test	0%, 10/15/10
Acceptance Test	0%, 11/30/10
Release	0%, 12/31/10

PrepME Capabilities

- Import Raw Data to the Database Tables
- Traffic Data Check
- Interpolate Traffic Data
  - **PrepME prepares the 11 files that can be directly imported into the MEPDG software**

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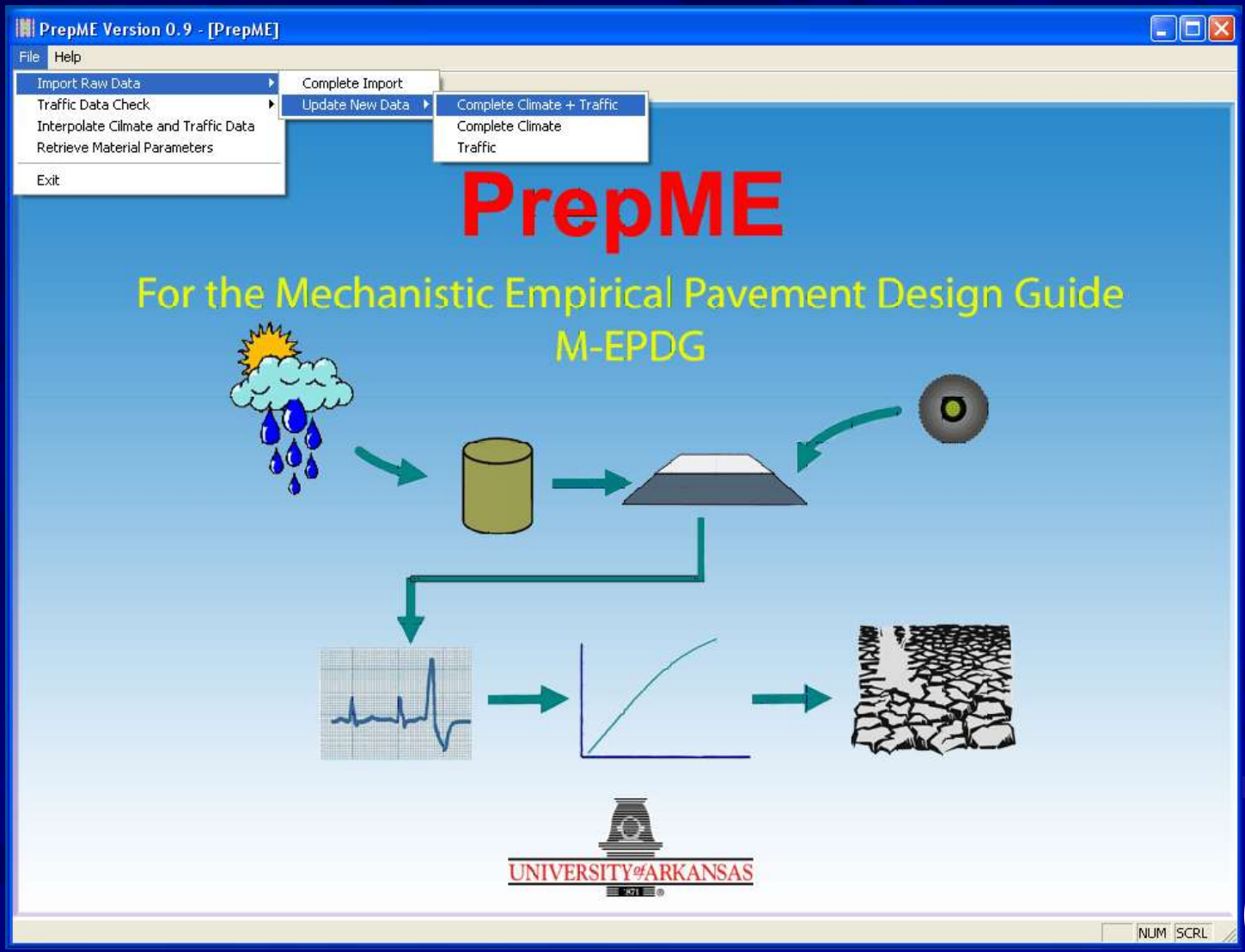
Data Importing Menu



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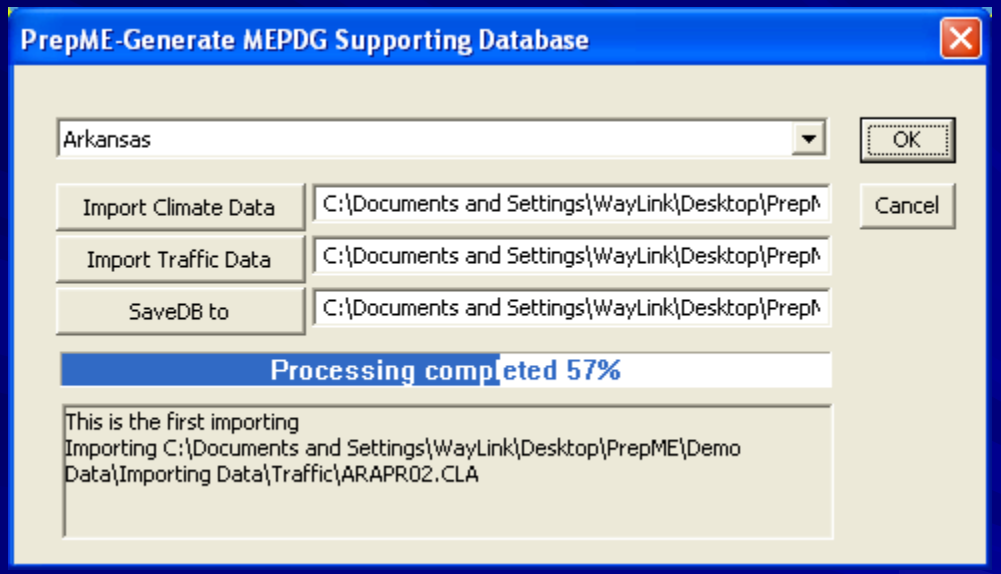
Data Importing Processing Window



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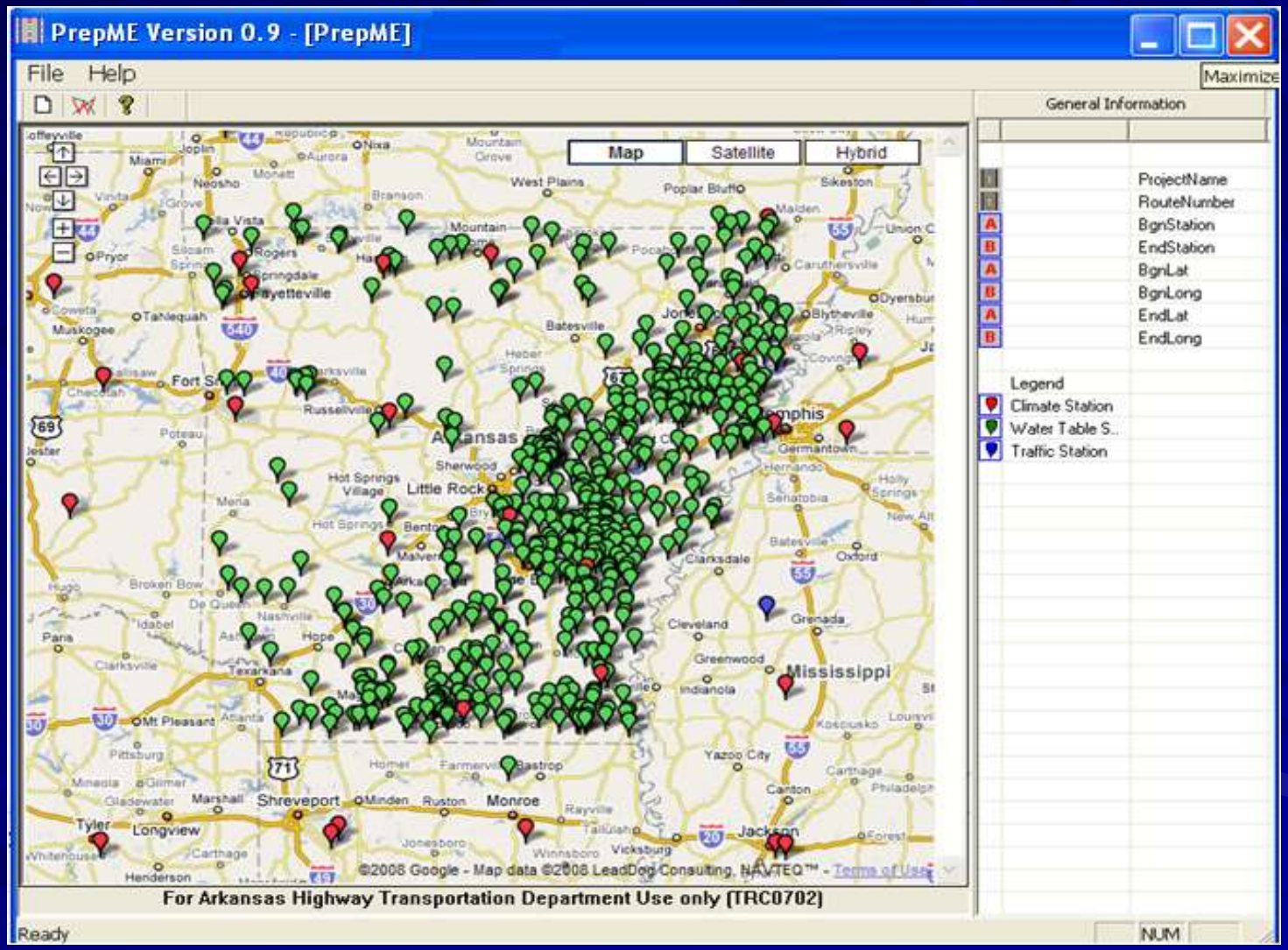
Google Map Utility



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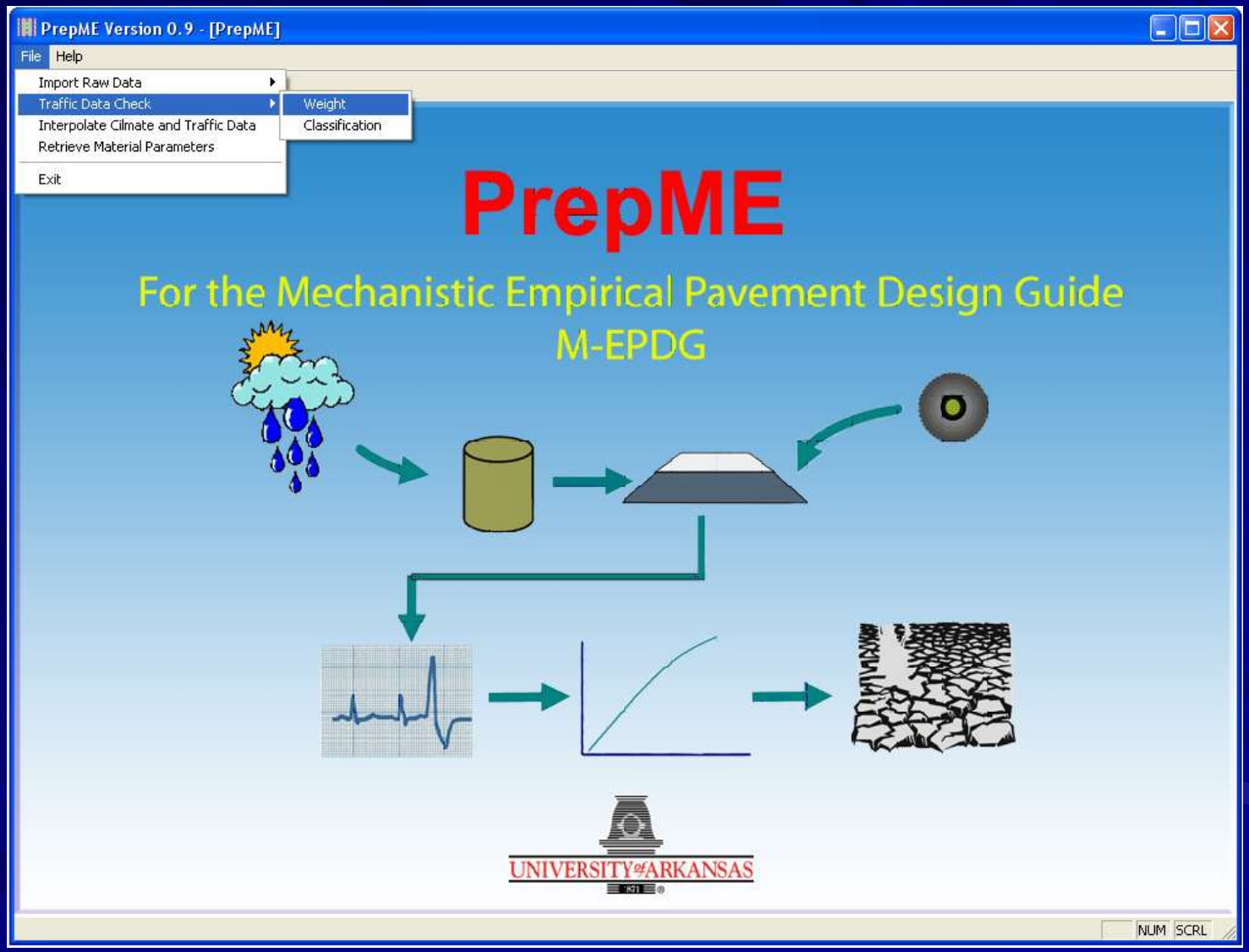
Traffic Data Check



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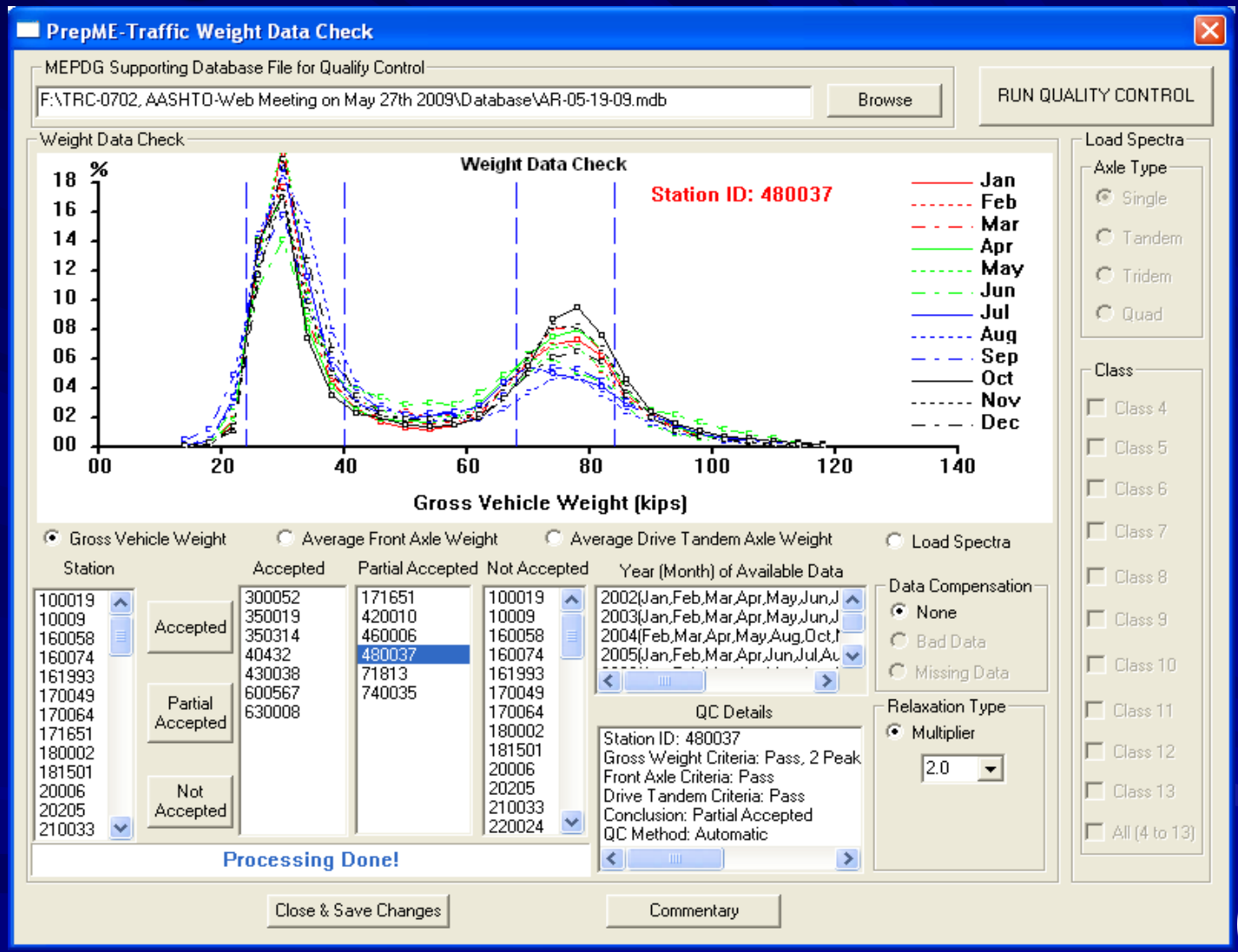
Weight Data Check Window



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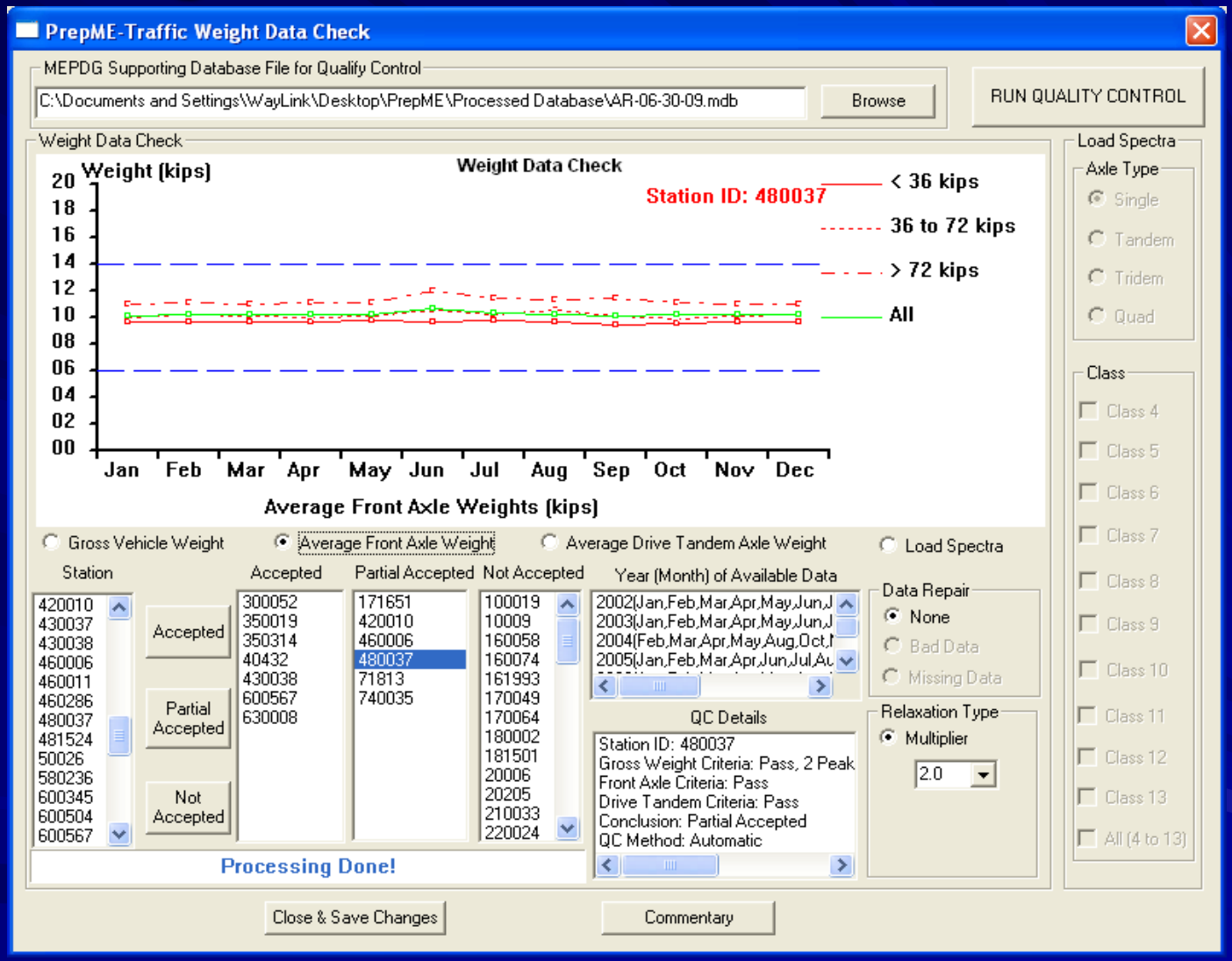
Weight Data Check Window



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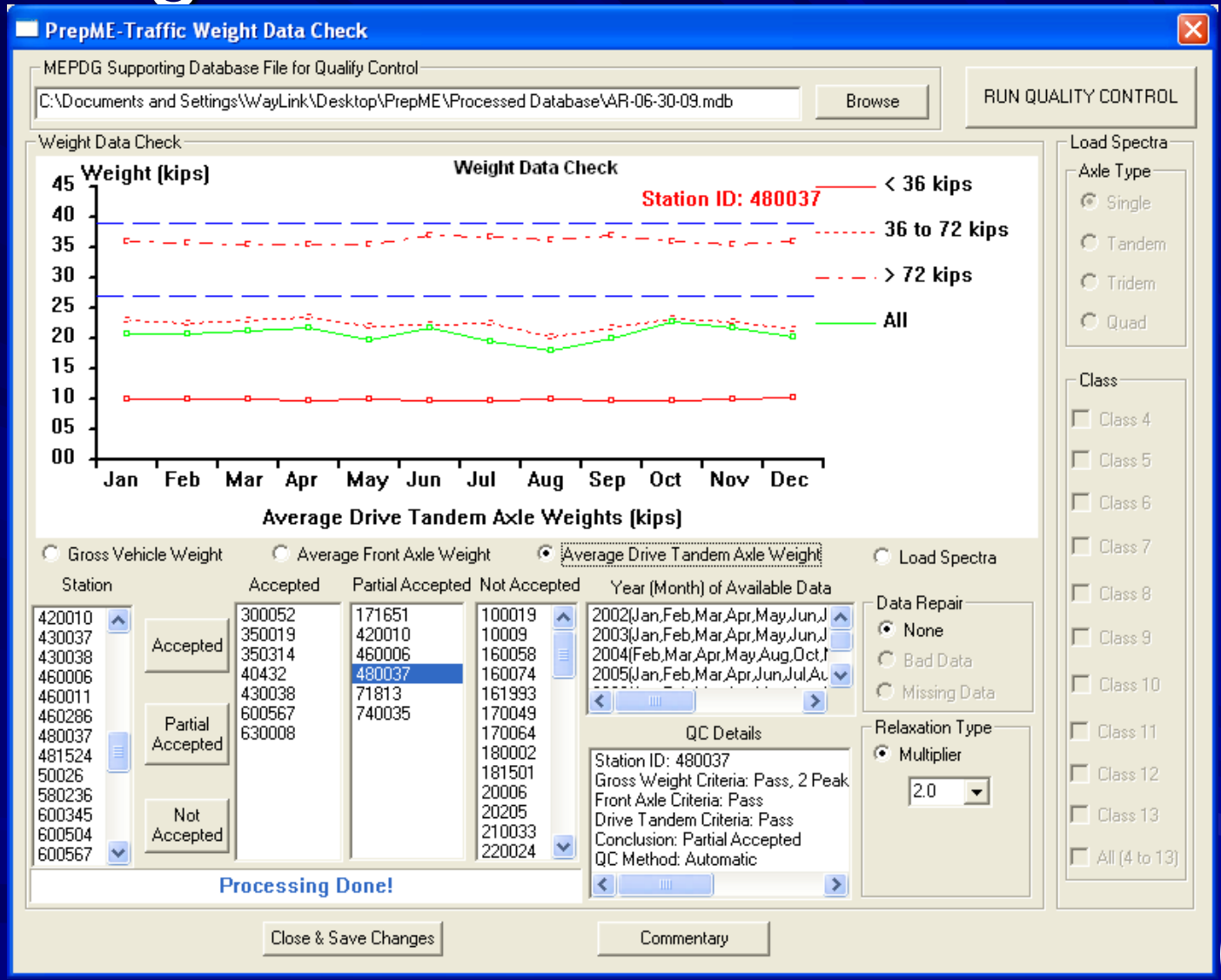
Weight Data Check Window



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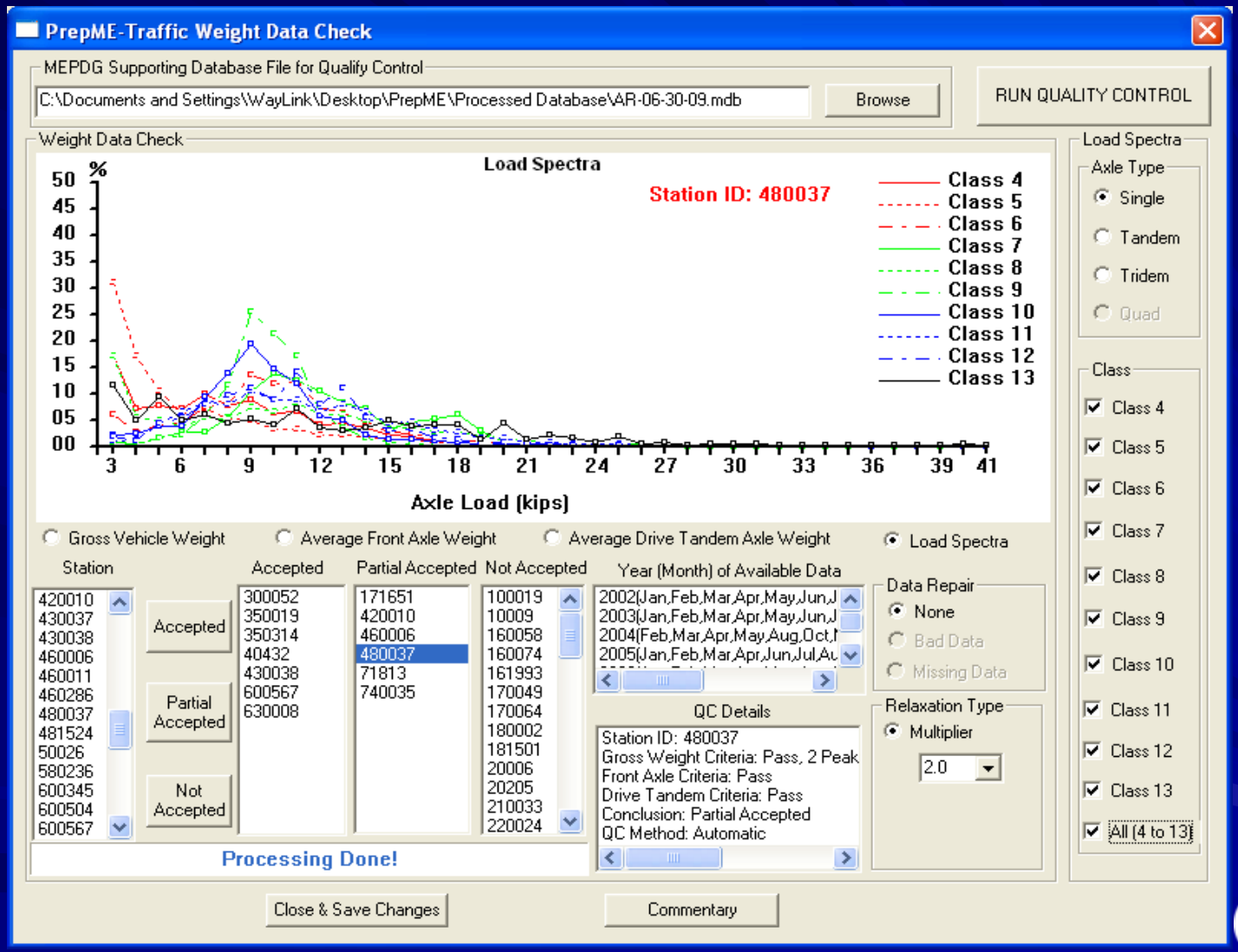
Weight Data Check Window



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Weight Data Check

- Multipliers
  - If No Multiplier: Few Stations Passed the Weight Data Check
  - Need to Relax Requirements—Multipliers
  - If multiplier=1.0, LTPP Weight Range, e.g.. 10,000 ± 2,000 lb;
  - If Multiplier=2.0, For Example, the Range for Front Axle 10,000 ± (2,000 × 2.0) lb.

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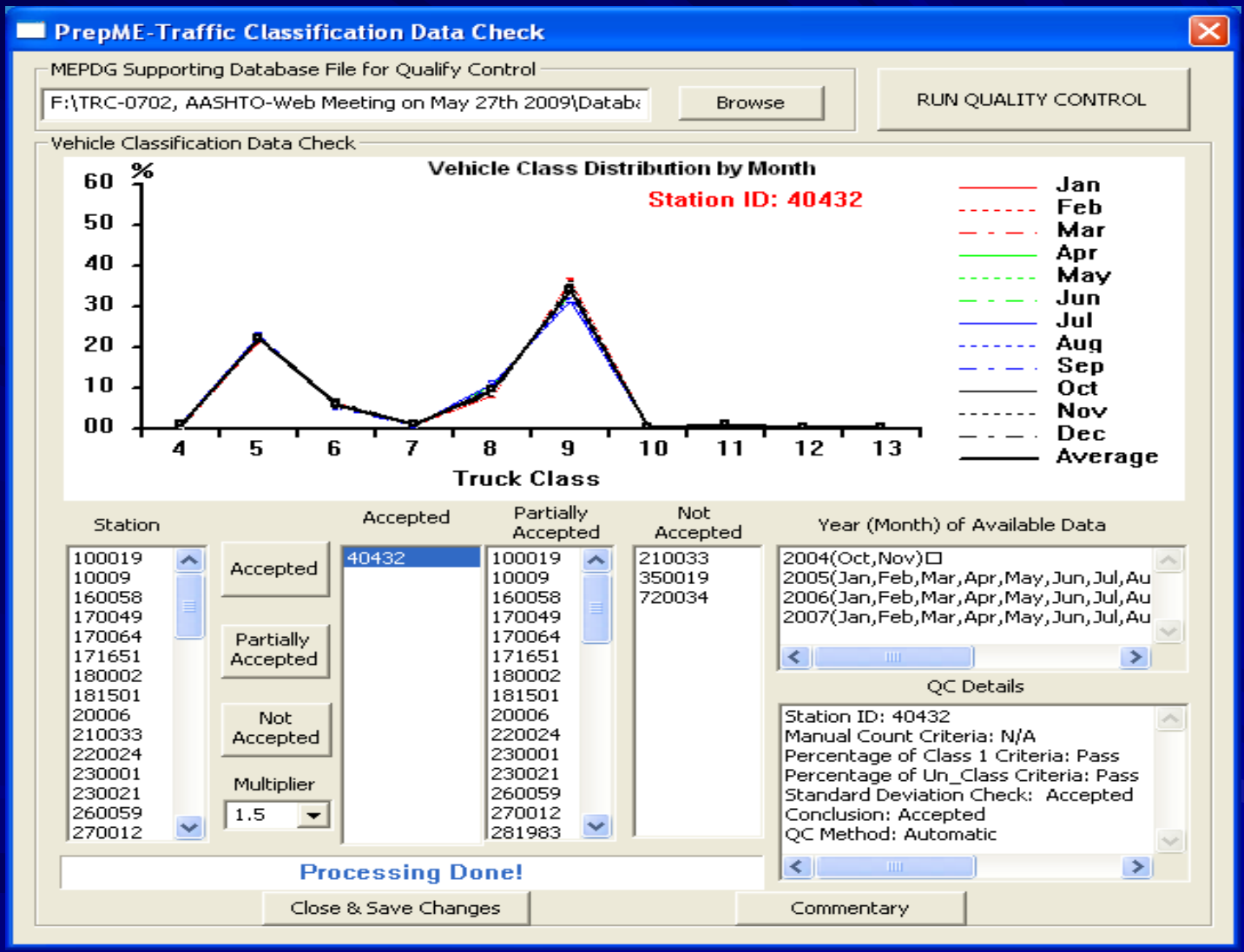
Vehicle Classification Data Check



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Vehicle Classification Data Check

- Multiplier
  - Use Standard Deviation to Identify the Consistence of the Data
  - If Multiplier=1.0, then 2 Standard Deviation.
  - If Multiplier=1.5, then 3 Standard Deviation

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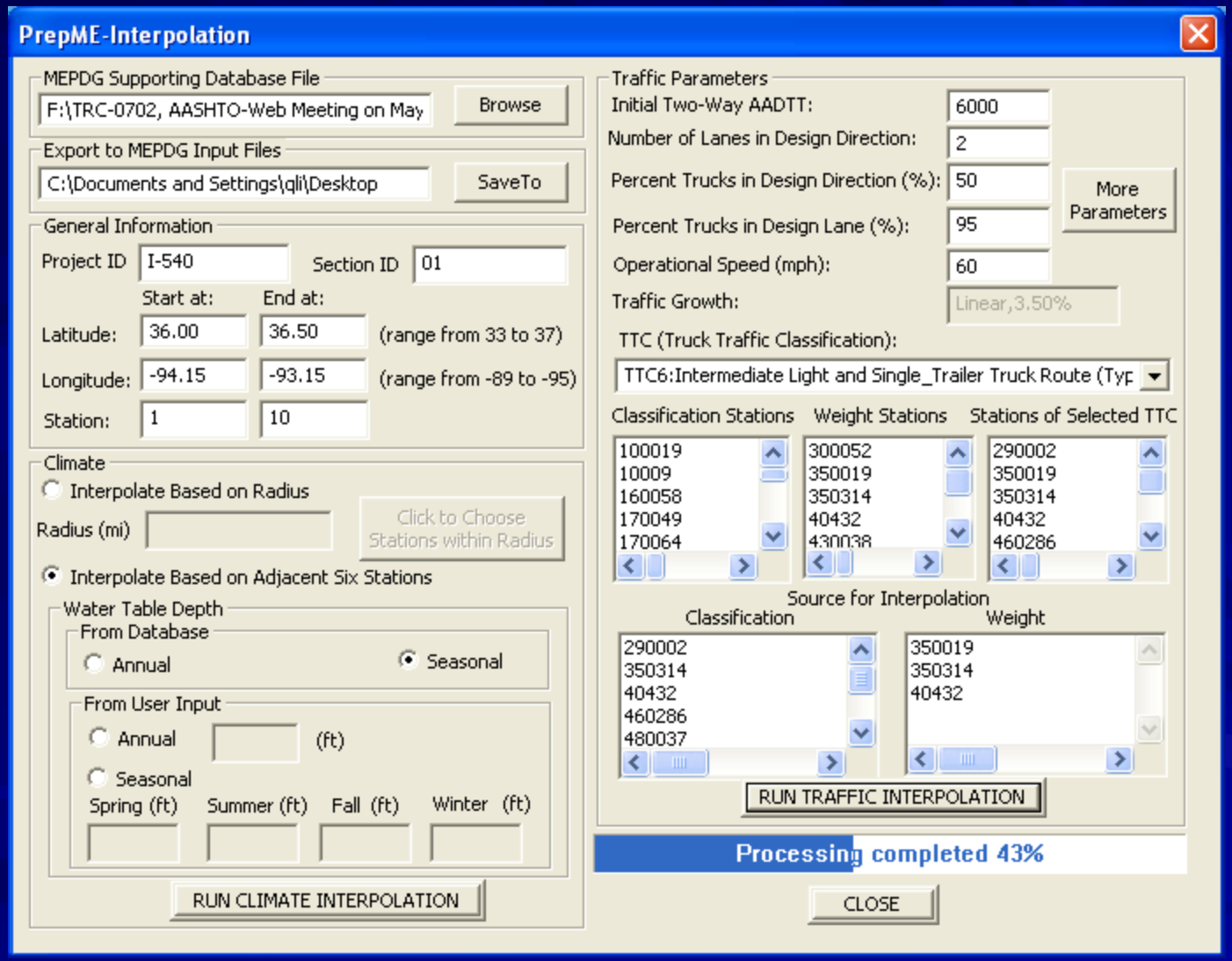
Traffic Files Generation



This process shows 11 files to be generated which can be imported to the MEPDG software

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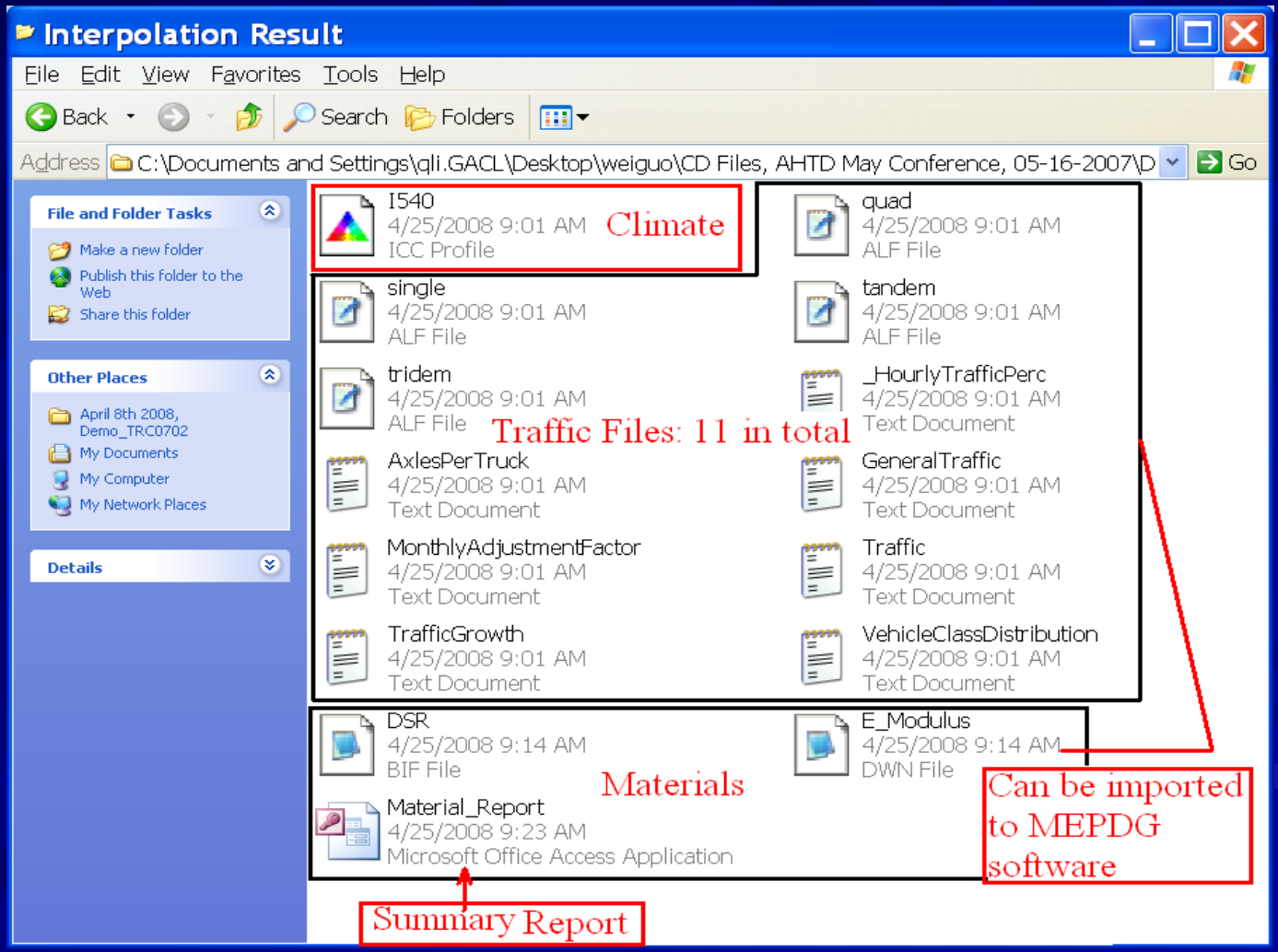
Software Generates the 11 Traffic Files



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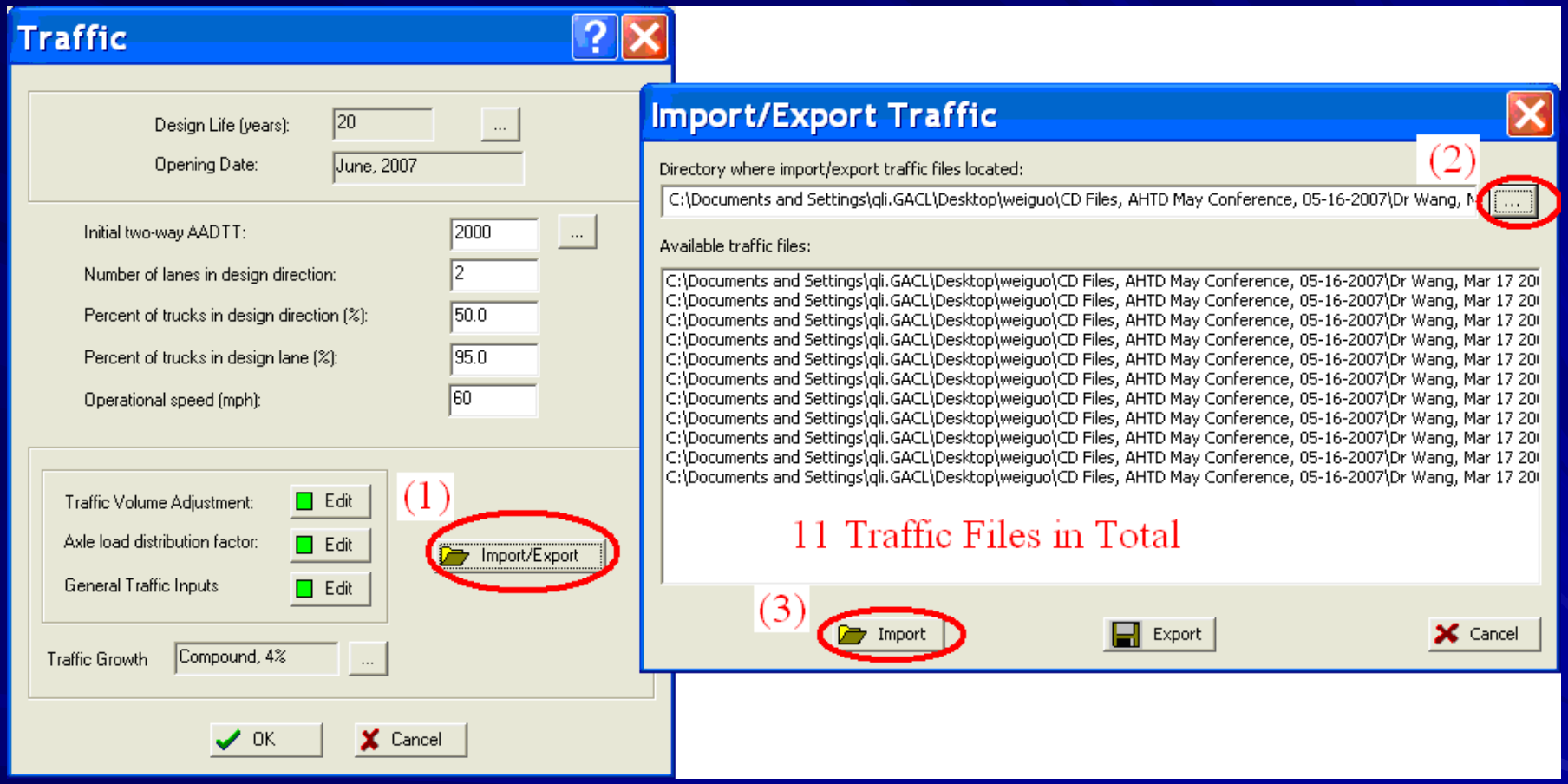
Import Generated Traffic Files to MEPDG



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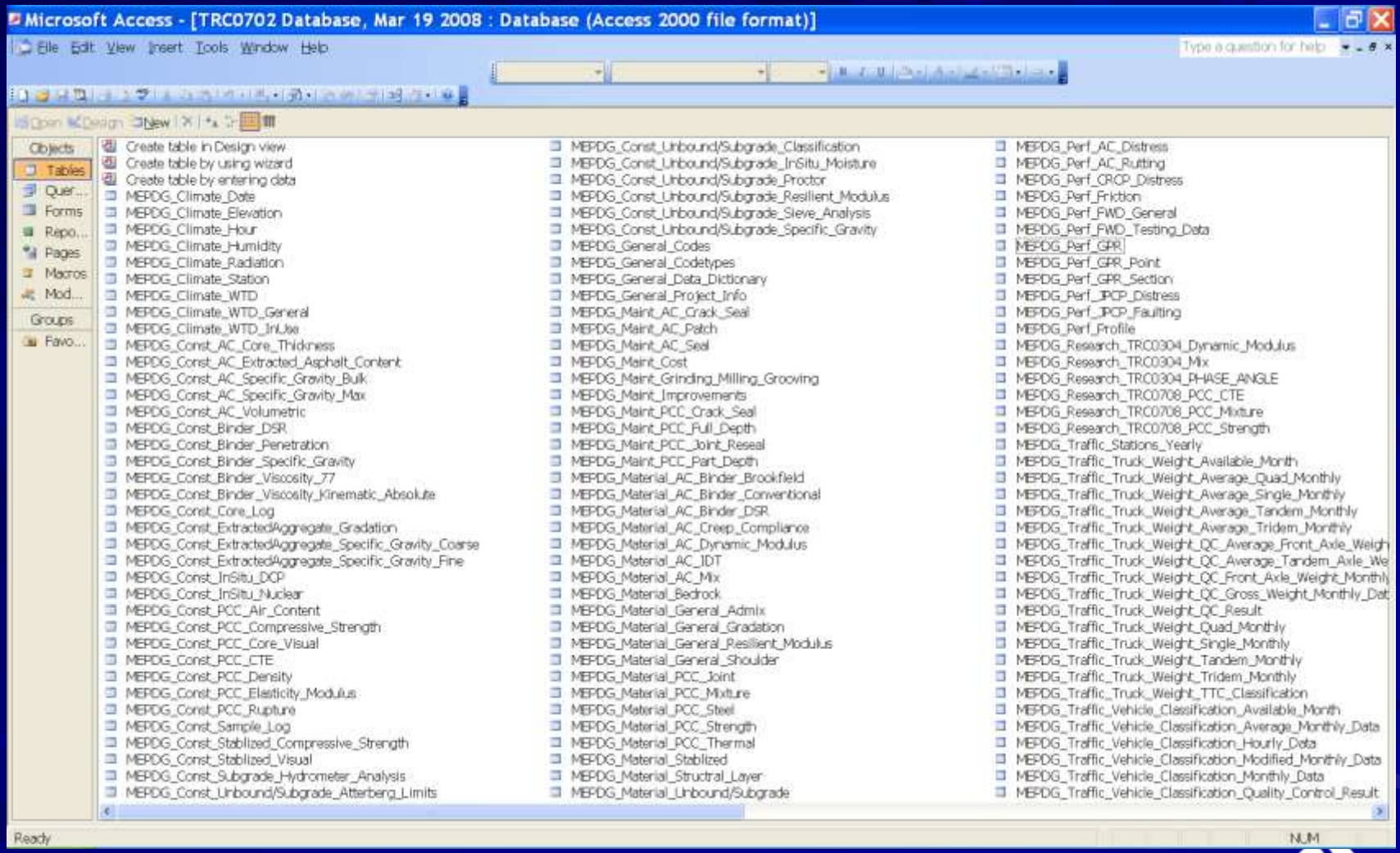
Database Tables



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Data Dictionary

Table 6 The structure of MEPDG_Climate_Hourly Table

Field Name	Data Type	Unit	Short Definition	Code Type	Field Key
WS_ID	VARCHAR2(7)		Unique identification number for a particular weather station		PK
WS_Date	Date		Date when climate data were collected		
WS_Hour	NUMBER(2,0)		Hour of day when climate data were collected		
Temperature	NUMBER(4,1)	deg F	Hourly ambient air temperature		
Precipitation	NUMBER(5,1)	mm	Hourly precipitation		
Wind_Speed	NUMBER(3,1)	m/s	Hourly mean wind speed		
Percent_Sunshine	NUMBER(3,1)	%	Hourly percent of sunshine		
Relative_Humidity	NUMBER(3,2)	%	Hourly relative humidity		

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Other Features of the Software

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Pavement Performance Module

- AC
  - Distress
  - Rutting
  - IRI
- CRCP
  - Distress
  - IRI
- JPCP
  - Distress
  - Faulting
  - IRI
- Others
  - FWD (2)
  - GPR (3)
  - Friction

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Pavement Performance Module

- Distress (MEPDG Required)
  - Based on LTPP Survey Manual
- FWD
  - FWD Equipment Information
  - Point to Point Dropping Data
- GPR
  - GPR Equipment Information
  - GPR Point Data
  - GPR Section Data
- Friction

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Construction and Related Testing Module

- As Built Construction Data
- Field Materials Sampling
- AC Construction Related Testing
- PCC Construction Related Testing
- Stabilized Materials Construction Related Testing
- Unbound Materials and Subgrade Construction Related Testing

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Construction and Related Testing Module

- As Built Construction Data (11)
  - Compaction Data (AC)
  - Construction Data (AC)
  - Overlay (AC)
  - Aggregate (PCC)
  - Construction Data (PCC)
  - Joints (PCC)
  - Mix (PCC)
  - Steel (PCC)
  - Overlay (PCC)
  - Subgrade Preparation
  - Unbound Aggregate

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Construction and Related Testing Module

- Field Materials Sampling (4)
  - Hole Log
  - Sample Log
  - Nuclear Gauge
  - Dynamic Cone Penetrometer（DCP)

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Construction and Related Testing Module

AC Construction Related Testing (12)

- Core Exam (Thickness)
- Bulk Specific Gravity
- Max Specific Gravity
- Extracted Asphalt Content
- Volumetric Properties
- Binder Penetration
- Binder Specific Gravity
- Binder Kinematic Viscosity
- Binder DSR
- Bulk Specific Gravity & % Moisture of Extracted Coarse Aggregate
- Bulk Specific Gravity & % Moisture of Extracted Fine Aggregate
- Gradation of Extracted Aggregates

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Construction and Related Testing Module

- PCC Construction Related Testing (6)
  - Core Exam (Thickness)
  - Density
  - Compressive Strength
  - Elastic Modulus
  - Rupture Strength
  - Coefficient of Thermal Expansion (CTE)

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Construction and Related Testing Module

- Stabilized Materials Construction Related Testing (2)
  - General: Classification of Treated Materials
  - Unconfined Compressive Strength

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Construction and Related Testing Module

- Unbound Materials and Subgrade Construction Related Testing (7)
  - Sieve Analysis
  - Classification
  - Atterberg Limits
  - Proctor Test
  - In Situ Mositure
  - Specific Gravity
  - Resilient Modulus

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Maintenance Module

- PCC Pavement
  - Crack Seal
  - Full Depth Repair
  - Partial-Depth Patching
  - Joint Reseal
- AC Pavement
  - Crack Seal
  - Patching
  - Seal Coat
- Others
  - Grinding, Milling, Grooving
  - Costs
  - Improvements

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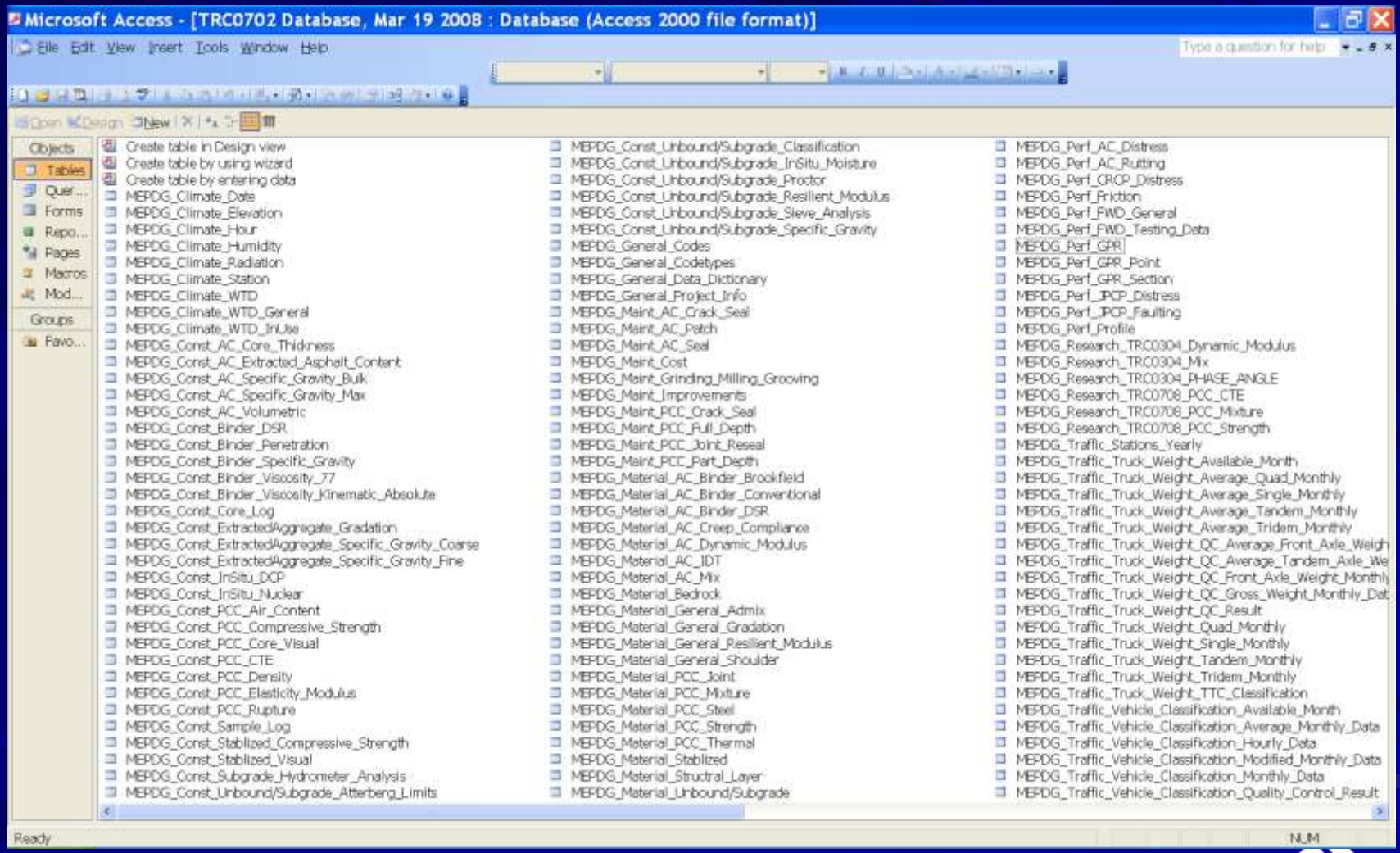
Database Tables



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Precipitation	NUMBER(5,1)	mm	Hourly precipitation		
Wind_Speed	NUMBER(3,1)	m/s	Hourly mean wind speed		
Percent_Sunshine	NUMBER(3,1)	%	Hourly percent of sunshine		
Relative_Humidity	NUMBER(3,2)	%	Hourly relative humidity		

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Future Work in the Pooled-Fund Study

http://www.pooledfund.org/

Solicitation Number: 1260

Traffic and Data Preparation for Darwin ME Analysis and Design

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Future Work

- Re-write the software for universal usage for any state and any WIM equipment
- Refine code development and debugging
- Refine database engine and visual/geo interface
- Allow manual processing of traffic data by user
- Enhance the importing speed using multi-thread programming techniques.

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Future Work (cont.)

- Integrate with efforts in PMS, materials, and construction, et al
  - Add Resilient Modulus if the data are available
- Adapt database tables for SQL Express
- Add database security feature
- Compatible with new Darwin ME software

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Pooled Fund Study

- Lead State: Louisiana Dept. Of Transportation and Development (LaDOTD)
- Starting Date: Late 2010
- Commitment: $50,000/State for three years
- Sponsor Contact: Harold Paul, harold.paul@la.gov
- Lead Agency Contact: Doc Zhang doc.zhang@la.gov
- FHWA Contact: Mike Moravec, mike.moravec@dot.gov

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Q&A

Thank You!

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