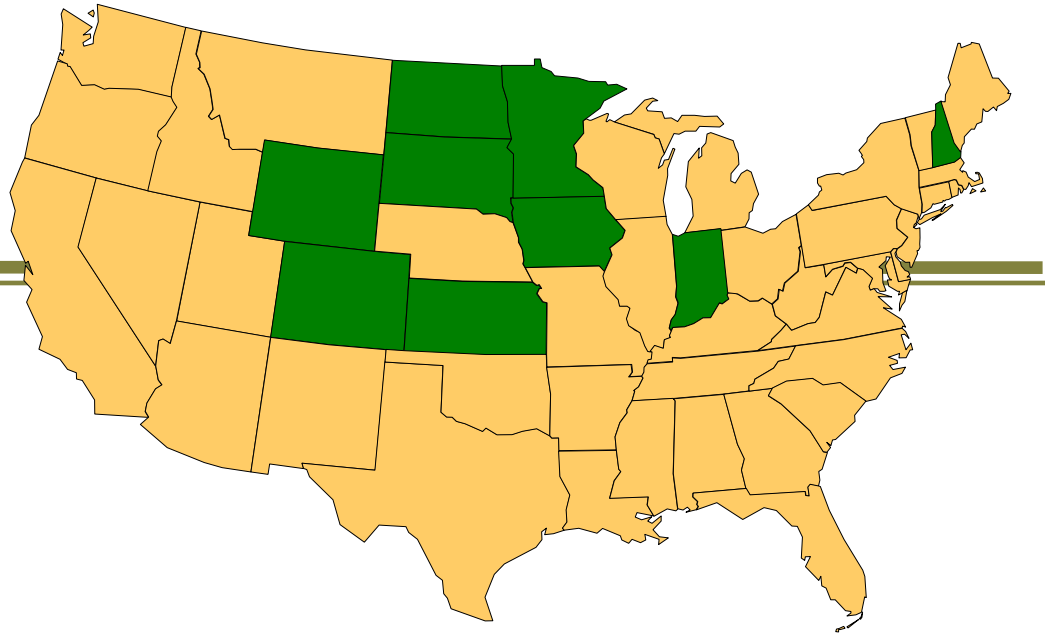
Connecting South Dakota and the Nation



Maintenance Decision Support System Pooled Fund Study TPF-5(054)

David Huft, South Dakota DOT

August 14, 2006

MDSS Premise

If you know:

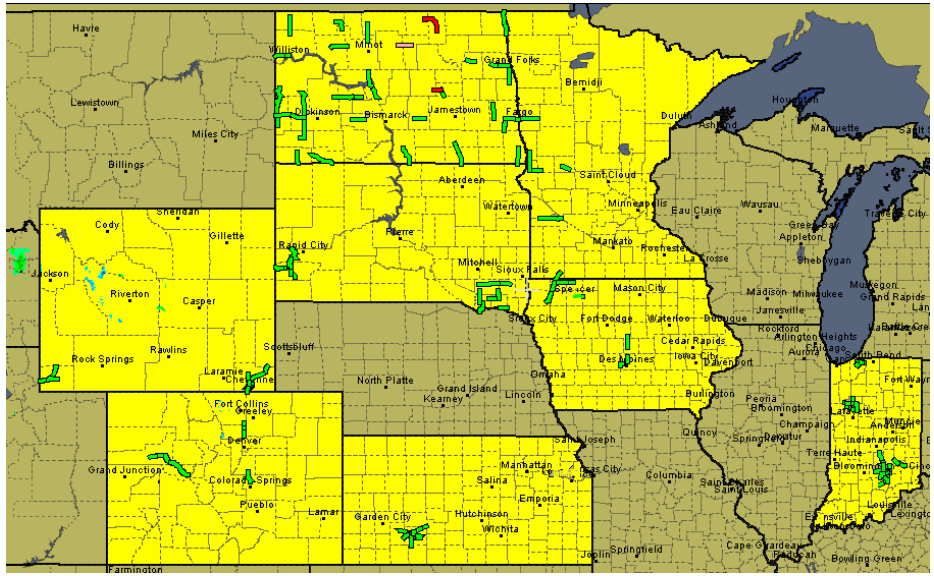
- Current road conditions
- Weather forecast
- Chemistry & physics of road surfaces
- Available maintenance resources

Then MDSS can:

- Recommend best treatments and timing
- Advise on resulting road conditions

Pooled Fund Study TPF-5(054) Project Partners

- Colorado
- Indiana
- Iowa
- Kansas
- Minnesota
- New Hampshire
- North Dakota
- South Dakota (lead state)
- Wyoming Federal Highway Administration
- Meridian Environmental Technology



Winter Maintenance Challenges

- Rising expectations of traveling public and commercial carriers
- Constrained agency funding and staffing
- Reliable, timely, specific reports of conditions difficult to obtain
- Some weather conditions are difficult to forecast
- Pavement response to weather conditions and maintenance treatments is not well established
- Effects and effectiveness of innovative maintenance treatments not entirely understood
- Retiring maintenance staff replaced by less experienced workers

Project Objectives

- Assess needs, benefits, and receptivity to MDSS in participating DOTs
- Define functional and user requirements for an operational and sustainable Maintenance Decision Support System
- Evaluate FHWA Functional Prototype
- Build and evaluate an operational and sustainable Maintenance Decision Support System
- Improve the ability to forecast road conditions in response to changing weather and applied maintenance treatments

Essential Elements of MDSS

- Report actual road surface conditions
- Report actual maintenance treatments
- Assess past & present weather conditions
- Assess present state of the roadway
- Predict storm-event weather
- Recognize resource constraints
- Identify feasible maintenance treatments
- Predict road surface behavior
- Communicate recommendations to supervisors and workers

Essential Element

Report Actual Road Surface Conditions

Sources

- RWIS
- Visual Observation
- On-vehicle Sensors

Frequency

- Real time
- Near real time

Media

- Wireless
- Telephony
- Graphical User Interface

Items Reported

- Pavement temperature
- Pavement moisture type
- Pavement moisture depth
- Blowing snow

Essential Element

Report Actual Maintenance Treatments

Sources

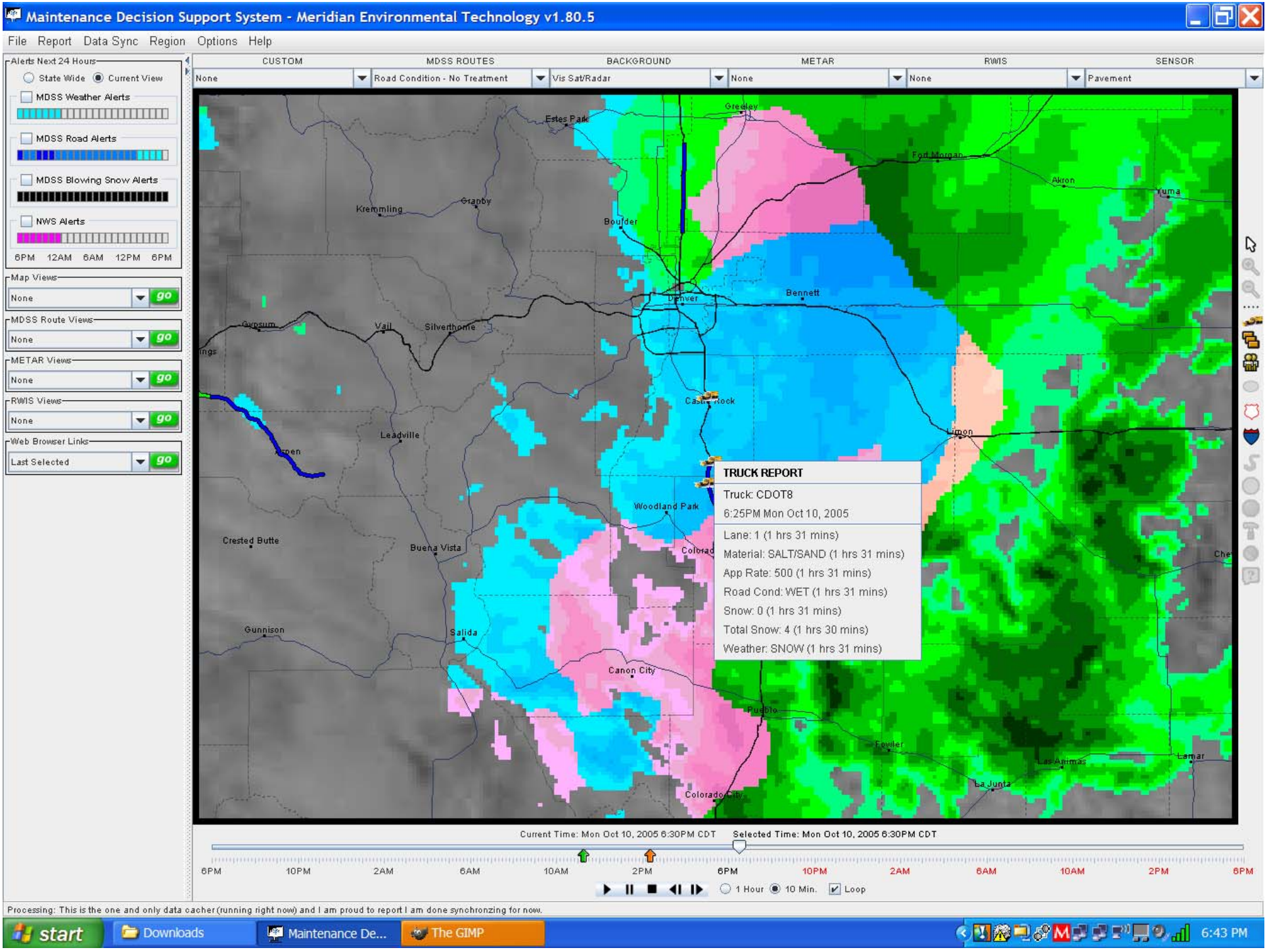
- Supervisors
- Truck operators
- On-vehicle sensors

Media

- Wireless
- Telephony
- Graphical User Interface

Elements Reported

- Time & Location
- Plow Position
- Material(s) Applied
- Application Rate


Maintenance Decision Support System - Meridian Environmental Technology v1.80.5
File Report Data Sync Region Options Help
Alerts Next 24 Hours
State Wide
Current View
MDSS Weather Alerts
MDSS Road Alerts
MDSS Blowing Snow Alerts
NWS Alerts
6PM 12AM 6AM 12PM 6PM
Map Views
None
go
MDSS Route Views
None
go
METAR Views
None
go
RWIS Views
None
go
Web Browser Links
Last Selected
go
CUSTOM
MDSS ROUTES
BACKGROUND
METAR
RWIS
SENSOR
None
Road Condition - No Treatment
Vis Sat/Radar
None
None
Pavement
Greeley
Estes Park
Ft Morgan
Akron
Yuma
Kremmling
Granby
Boulder
Denver
Bennett
Gypsum
Vail
Silverthorne
Leadville
Aspen
Limon
Woodland Park
Crested Butte
Buena Vista
Gunnison
Salida
Canon City
Pueblo
Fowler
Las Animas
Lamar
La Junta
TRUCK REPORT
Truck: CDOT8
6:25PM Mon Oct 10, 2005
Lane: 1 (1 hrs 31 mins)
Material: SALT/SAND (1 hrs 31 mins)
App Rate: 500 (1 hrs 31 mins)
Road Cond: WET (1 hrs 31 mins)
Snow: 0 (1 hrs 31 mins)
Total Snow: 4 (1 hrs 30 mins)
Weather: SNOW (1 hrs 31 mins)
Current Time: Mon Oct 10, 2005 6:30PM CDT
Selected Time: Mon Oct 10, 2005 6:30PM CDT
6PM 10PM 2AM 6AM 10AM 2PM 6PM 10PM 2AM 6AM 10AM 2PM 6PM
1 Hour
10 Min.
Loop
Processing: This is the one and only data cacher (running right now) and I am proud to report I am done synchronzing for now.
start
Downloads
Maintenance De...
The GIMP
6:43 PM

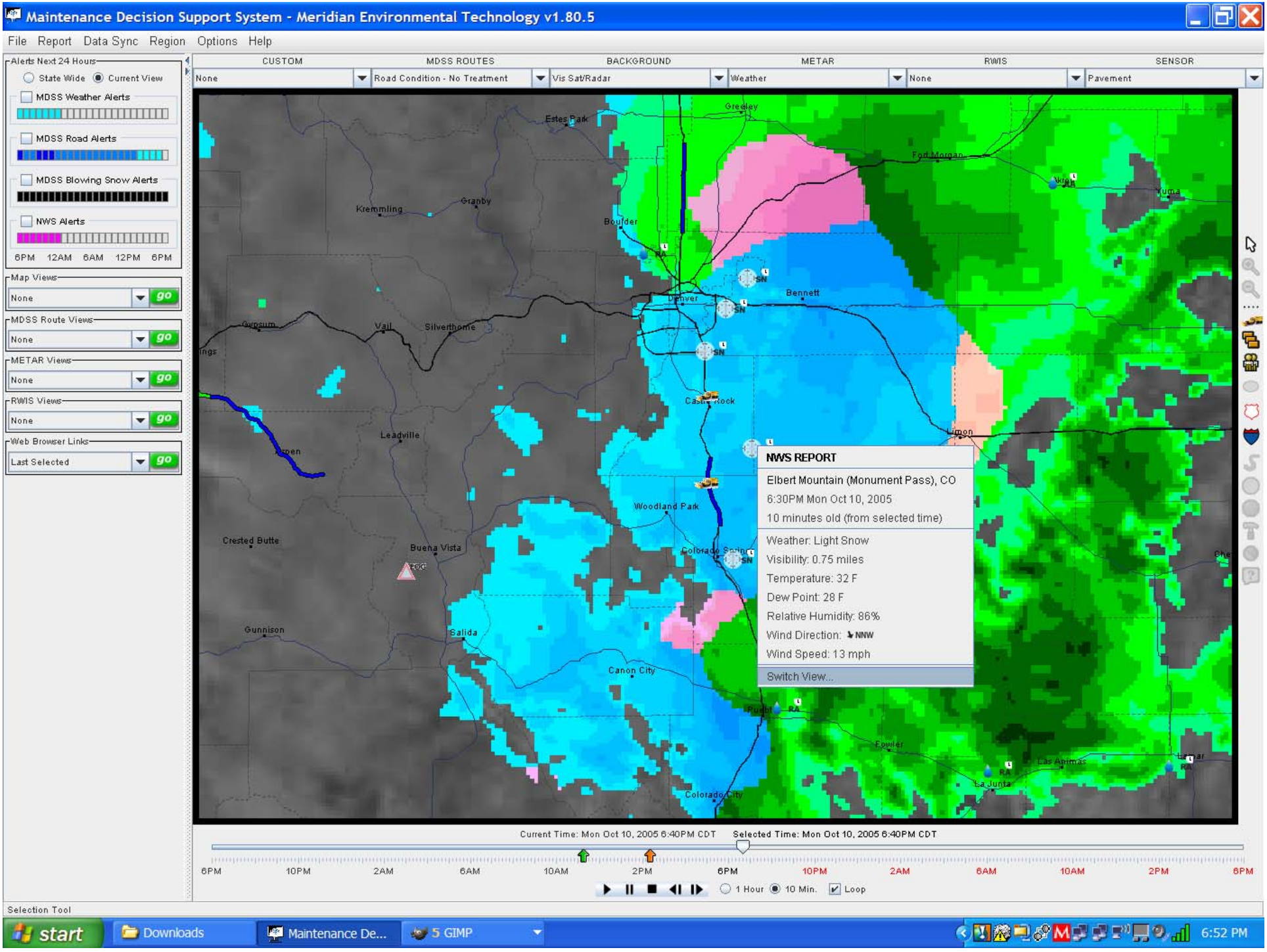
Essential Element
Assess Past, Present Weather Conditions

Sources

- RWIS
- FAA / NWS
- Radar
- Satellite
- Field Personnel
- On-vehicle sensors

Conditions Reported

- Air Temperature
- Dew Point (Humidity)
- Wind Velocity
- Precipitation Type
- Precipitation Rate
- Blowing & Drifting
- Cloudiness
- Visibility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Current View
MDSS Weather Alerts
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6PM 12AM 6AM 12PM 6PM
Map Views
None
go
MDSS Route Views
None
go
METAR Views
None
go
RWIS Views
None
go
Web Browser Links
Last Selected
go
CUSTOM
MDSS ROUTES
BACKGROUND
METAR
RWIS
SENSOR
None
Road Condition - No Treatment
Vis Sat/Radar
Weather
None
Pavement
Greeley
Estes Park
Ft Morgan
Yuma
Kremmling
Granby
Boulder
Denver
Bennett
Gypsum
Vail
Silverthorne
Castle Rock
Limon
Leadville
Aspen
Woodland Park
Crested Butte
Buena Vista
Colorado Springs
Gunnison
Salida
Canon City
Pueblo
Fowler
Las Animas
La Junta
Colorado City
NWS REPORT
Elbert Mountain (Monument Pass), CO
6:30PM Mon Oct 10, 2005
10 minutes old (from selected time)
Weather: Light Snow
Visibility: 0.75 miles
Temperature: 32 F
Dew Point: 28 F
Relative Humidity: 86%
Wind Direction: NNW
Wind Speed: 13 mph
Switch View...
Current Time: Mon Oct 10, 2005 6:40PM CDT
Selected Time: Mon Oct 10, 2005 6:40PM CDT
6PM 10PM 2AM 6AM 10AM 2PM 6PM 10PM 2AM 6AM 10AM 2PM 6PM
1 Hour
10 Min.
Loop
Selection Tool
start
Downloads
Maintenance De...
5 GIMP
6:52 PM

Essential Element

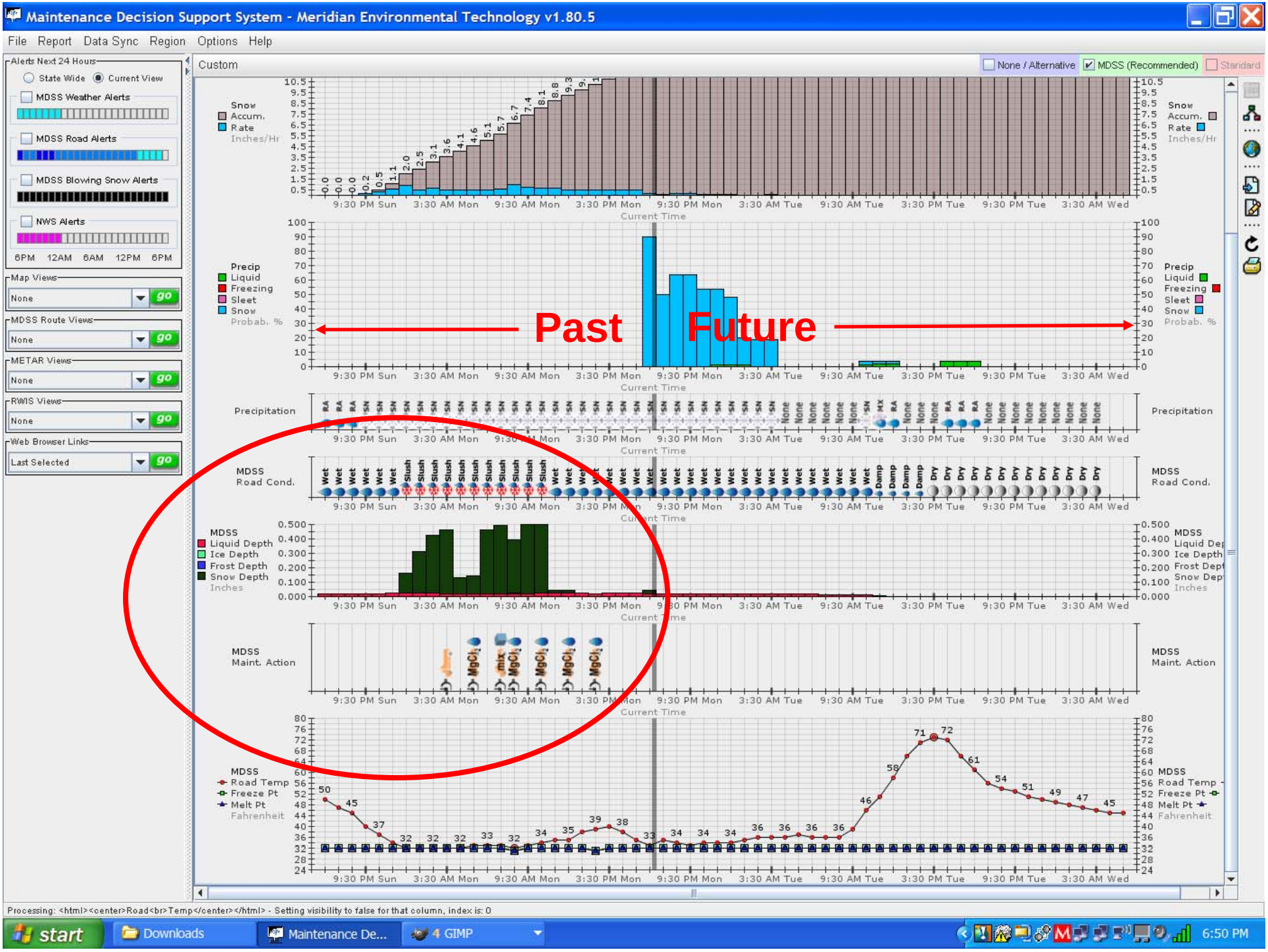
Assess Present State of the Roadway

Methodology

- Pavement Model with the Capability of Integrating:
  - Observed Weather
  - Reported Road Conditions
  - Reported Maintenance Actions

Items Predicted

- Pavement temperature
- Pavement moisture type(s)
- Pavement moisture depth(s)
- Chemical concentration(s)
- Percent ice


Maintenance Decision Support System - Meridian Environmental Technology v1.80.5
File Report Data Sync Region Options Help
Alerts Next 24 Hours
State Wide
Current View
MDSS Weather Alerts
MDSS Road Alerts
MDSS Blowing Snow Alerts
NWS Alerts
6PM 12AM 6AM 12PM 6PM
Map Views
MDSS Route Views
METAR Views
RWIS Views
Web Browser Links
Custom
None / Alternative
MDSS (Recommended)
Standard
Snow
Accum.
Rate
Inches/Hr
Precip
Liquid
Freezing
Sleet
Snow
Probab. %
Past
Future
Precipitation
MDSS
Road Cond.
Liquid Depth
Ice Depth
Frost Depth
Snow Depth
Inches
Maint. Action
Road Temp
Freeze Pt
Melt Pt
Fahrenheit
9:30 PM Sun
3:30 AM Mon
9:30 AM Mon
3:30 PM Mon
9:30 PM Mon
3:30 AM Tue
9:30 AM Tue
3:30 PM Tue
9:30 PM Tue
3:30 AM Wed
Current Time
Processing: <html> Road
Temp </html> - Setting visibility to false for that column, index is: 0
start
Downloads
Maintenance De...
4 GIMP
6:50 PM

Essential Element

Predict Storm Event Weather

Methodologies

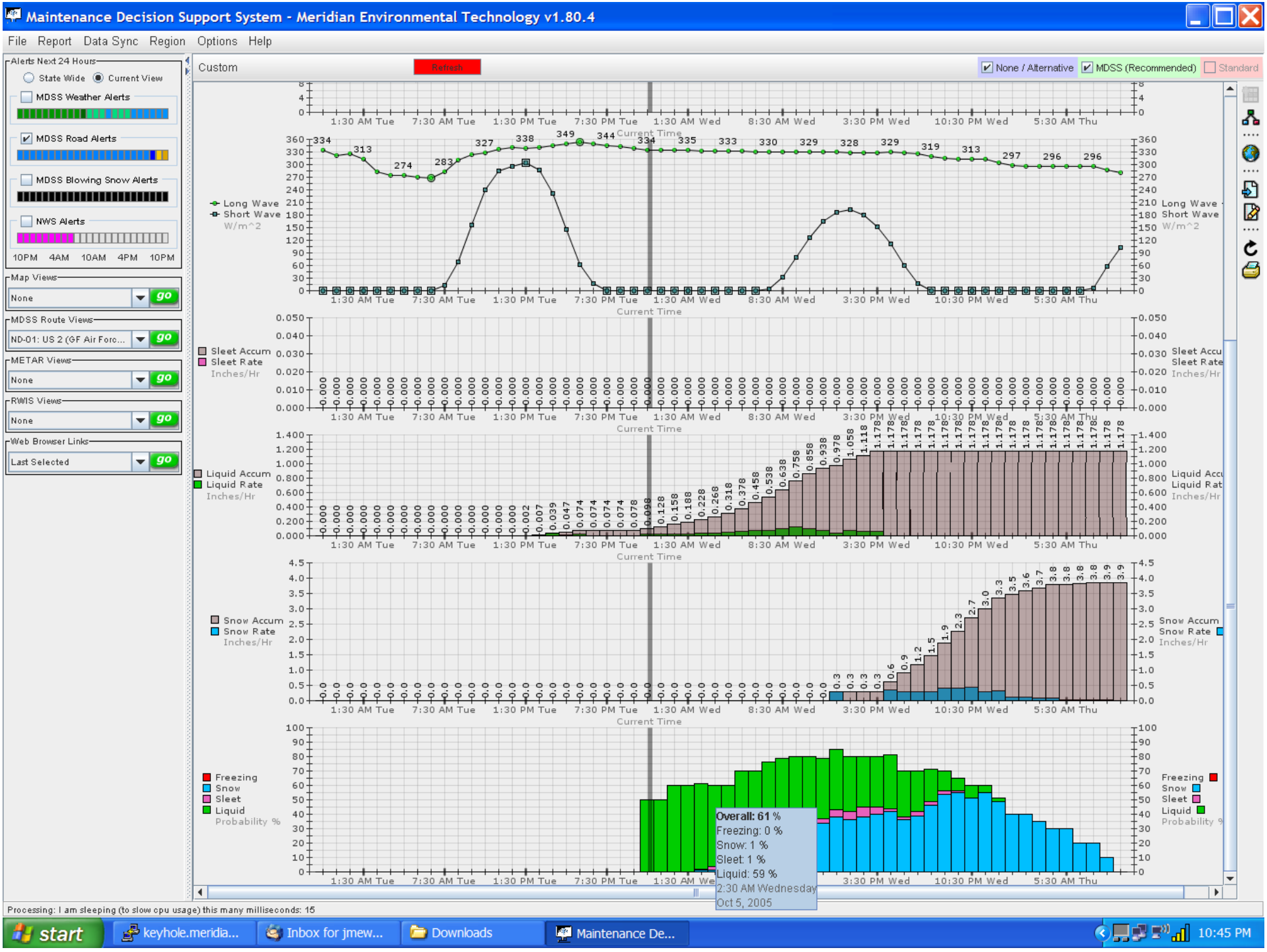
- Computer Model
- Ensemble of Models
- Meteorologists
- Man/Machine Mix

Time Horizon

- Near-term (<6 hours)
- Long-term

Items Predicted

- Air Temperature
- Dew Point (Humidity)
- Wind Velocity
- Precipitation Type
- Precipitation Rate
- Blowing & Drifting
- Cloudiness/Radiation


Maintenance Decision Support System - Meridian Environmental Technology v1.80.4
File Report Data Sync Region Options Help
Alerts Next 24 Hours
State Wide
Current View
MDSS Weather Alerts
MDSS Road Alerts
MDSS Blowing Snow Alerts
NWS Alerts
10PM 4AM 10AM 4PM 10PM
Map Views
None
go
MDSS Route Views
ND-01: US 2 (GF Air Forc...
METAR Views
None
RWIS Views
None
Web Browser Links
Last Selected
Custom
Refresh
None / Alternative
MDSS (Recommended)
Standard
Long Wave
Short Wave
W/m^2
Sleet Accum
Sleet Rate
Inches/Hr
Liquid Accum
Liquid Rate
Inches/Hr
Snow Accum
Snow Rate
Inches/Hr
Freezing
Snow
Sleet
Liquid
Probability %
1:30 AM Tue
7:30 AM Tue
1:30 PM Tue
7:30 PM Tue
1:30 AM Wed
8:30 AM Wed
3:30 PM Wed
10:30 PM Wed
5:30 AM Thu
Current Time
Overall: 61 %
Freezing: 0 %
Snow: 1 %
Sleet: 1 %
Liquid: 59 %
2:30 AM Wednesday
Oct 5, 2005
Processing: I am sleeping (to slow cpu usage) this many milliseconds: 15
start
keyhole.meridia...
Inbox for jmew...
Downloads
Maintenance De...
10:45 PM

Essential Element
Identify Feasible Maintenance Treatments

Identify

- Treatment Type
- Treatment Timing
- Application Rate

Resource Constraints

- Vehicles
- Attachments (by vehicle)
- Materials (by vehicle)
- Staff
- Schedules
- Cycle Times
- Priorities

Essential Element

Predict Road Surface Behavior

Methodology

- Pavement Model to Predict the Effects of Maintenance Actions

Time Horizon

- Near-term (<6 hours)
- Long-term

Predicted

- Surface temperature
- Moisture type(s)
- Moisture depth(s)
- Chemical concentration(s)
- Percent ice

Essential Element:
Communicate Recommendations

'Optimal' Treatment

- Maintenance action deemed optimal by the system; safety first, cost second

'Standard' Treatment

- Anticipated maintenance based on standard local operating practices

'What-If' Treatments

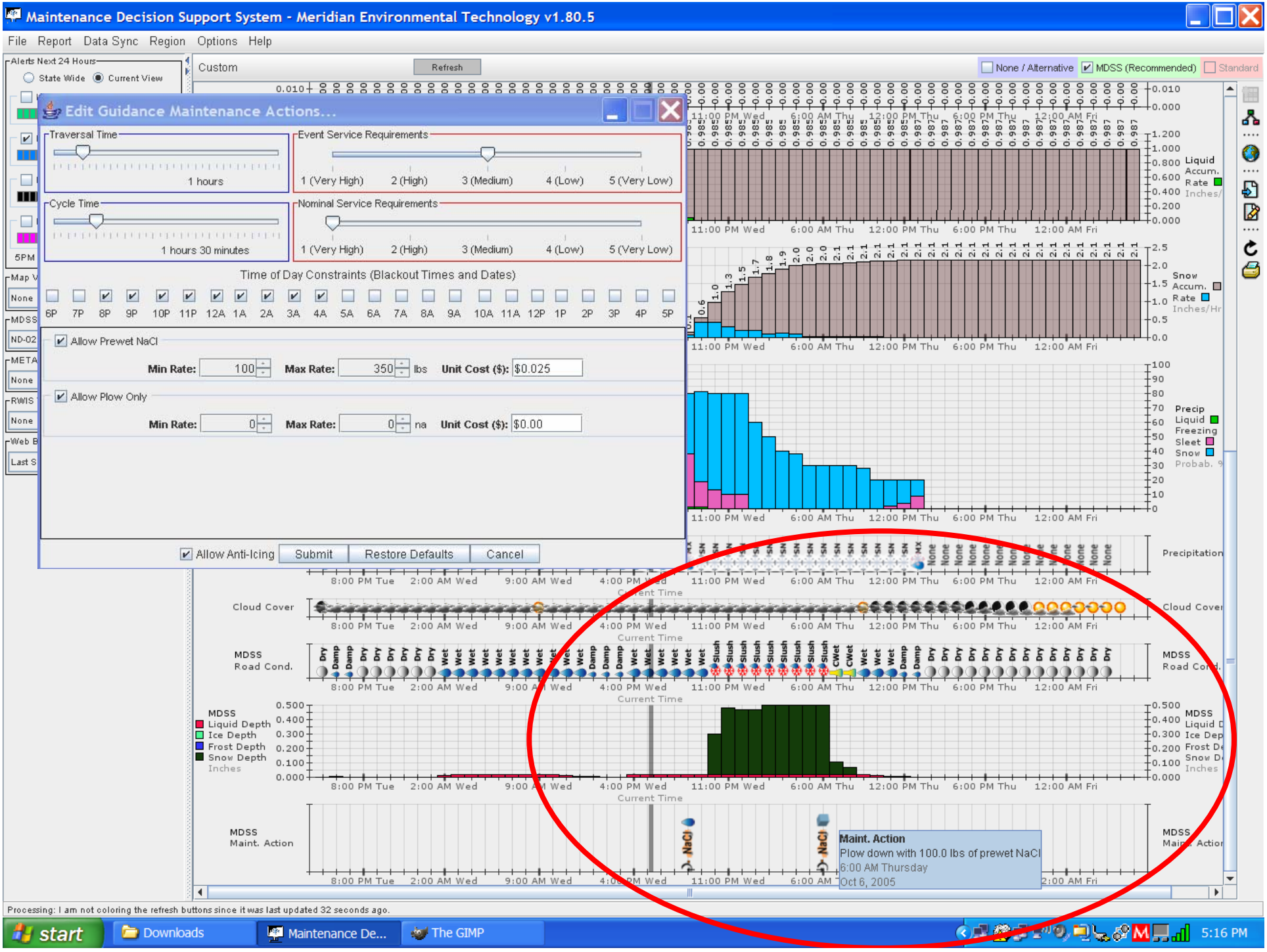
- Allows user to try any number of alternative maintenance actions

Media

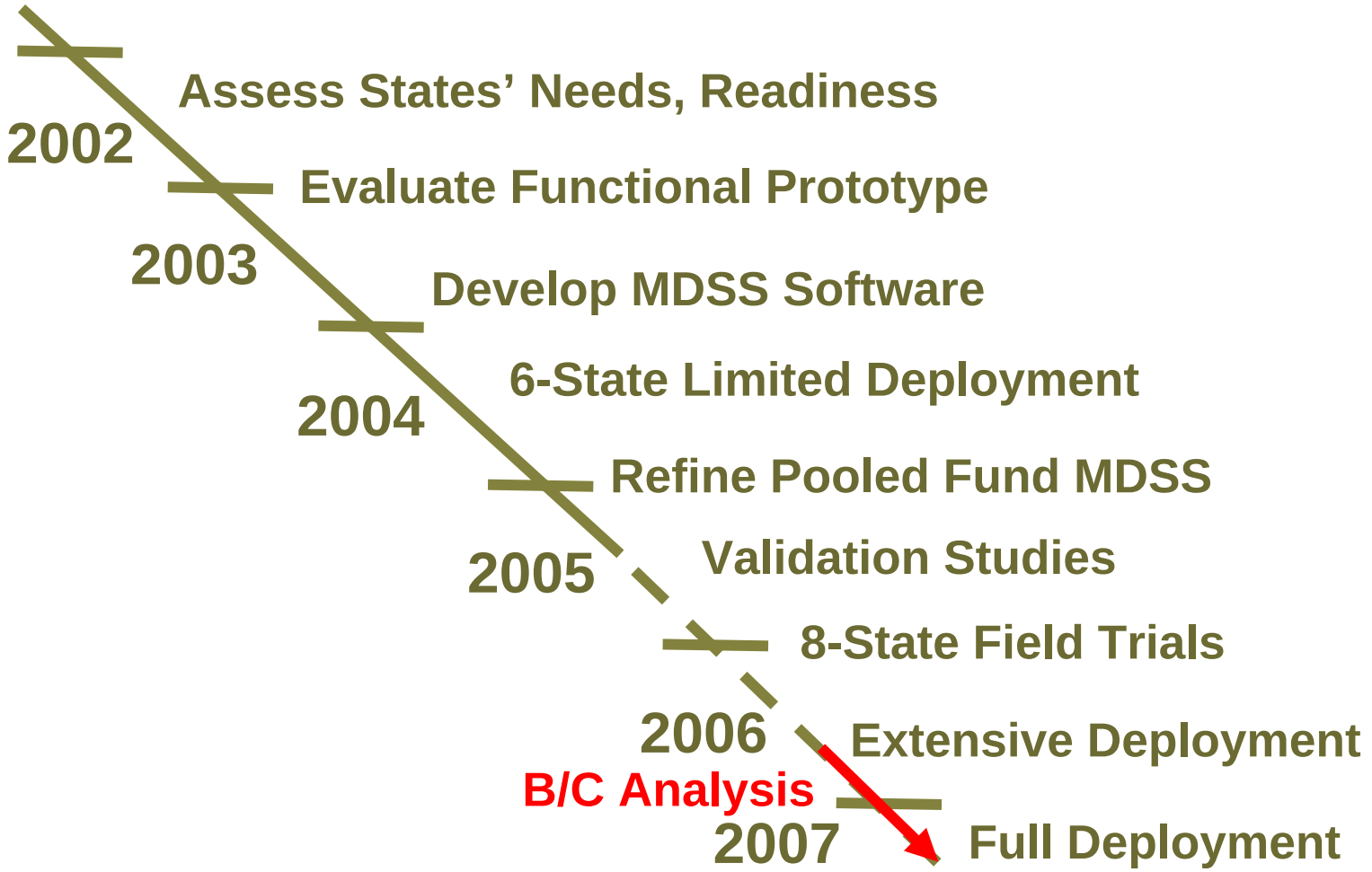
- Graphical User Interface
- Wireless

Information Provided

- Anticipated or recommended maintenance action(s)
- Expected impact of those maintenance actions on the roadway


Maintenance Decision Support System - Meridian Environmental Technology v1.80.5
File Report Data Sync Region Options Help
Edit Guidance Maintenance Actions...
Traversal Time
1 hours
Cycle Time
1 hours 30 minutes
Event Service Requirements
Nominal Service Requirements
1 (Very High) 2 (High) 3 (Medium) 4 (Low) 5 (Very Low)
Time of Day Constraints (Blackout Times and Dates)
6P 7P 8P 9P 10P 11P 12A 1A 2A 3A 4A 5A 6A 7A 8A 9A 10A 11A 12P 1P 2P 3P 4P 5P
Allow Prewet NaCl
Min Rate: 100 Max Rate: 350 lbs Unit Cost ($): $0.025
Allow Plow Only
Min Rate: 0 Max Rate: 0 na Unit Cost ($): $0.00
Allow Anti-Icing
Submit
Restore Defaults
Cancel
Custom
Refresh
None / Alternative
MDSS (Recommended)
Standard
Liquid Accum. Rate Inches/
Snow Accum. Rate Inches/Hr
Precip Liquid Freezing Sleet Snow Probab.
Precipitation
Cloud Cover
MDSS Road Cond.
MDSS Liquid Depth Ice Depth Frost Depth Snow Depth Inches
MDSS Maint. Action
Maint. Action
Plow down with 100.0 lbs of prewet NaCl
6:00 AM Thursday
Oct 6, 2005
Current Time
Processing: I am not coloring the refresh buttons since it was last updated 32 seconds ago.
start
Downloads
Maintenance De...
The GIMP
5:16 PM

Pooled Fund Study Timeline (simplified)



Technical Directions

- More Extensive Deployment
- Weather & Road Prediction Validation
- In-Vehicle Instrumentation
- In-Vehicle Information to Operators
- Improved Physical Models
  - Difficult Weather Conditions
  - Chemical Effects
- Integration with DOT Information Systems (Equipment, Scheduling, Traveler Information, etc.)
- Cost & Benefits Analysis

Potential Benefits & Costs

- Safety
- User costs
- Work hours
- Material use
- Equipment use
- Environmental impact
- ?
- Software
- Instrumentation
- Data processing
- Training
- Management
- ?

Sustainability Issues

- Intellectual Property
  - **NOT** Public Domain
  - Equity for partners and non-partners
- Architecture
  - Open Architecture
  - Interface Standards
  - System Modularity
- Institutional Issues
  - Fit to specific DOT cultures & practices
- Advancing the State of Art & Practice

Partner Responsibilities

- Contribute Financially
- Contribute Intellectually
  - Project Panel Meetings
  - Conference Calls
  - Technical Product Reviews
- Conduct Field Trials
- Intellectual Property Stewardship

For More Information:

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Pierre, SD 57501-2586
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http://mdss.meridian-enviro.com

http://www.pooledfund.org