



Integrating Mobile Observations about Road Weather Conditions for Decision-Making

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**CTSO RWM Workshop & Peer Exchange
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Nevada DOT WRMS Framework

Instrumented Maintenance Vehicles

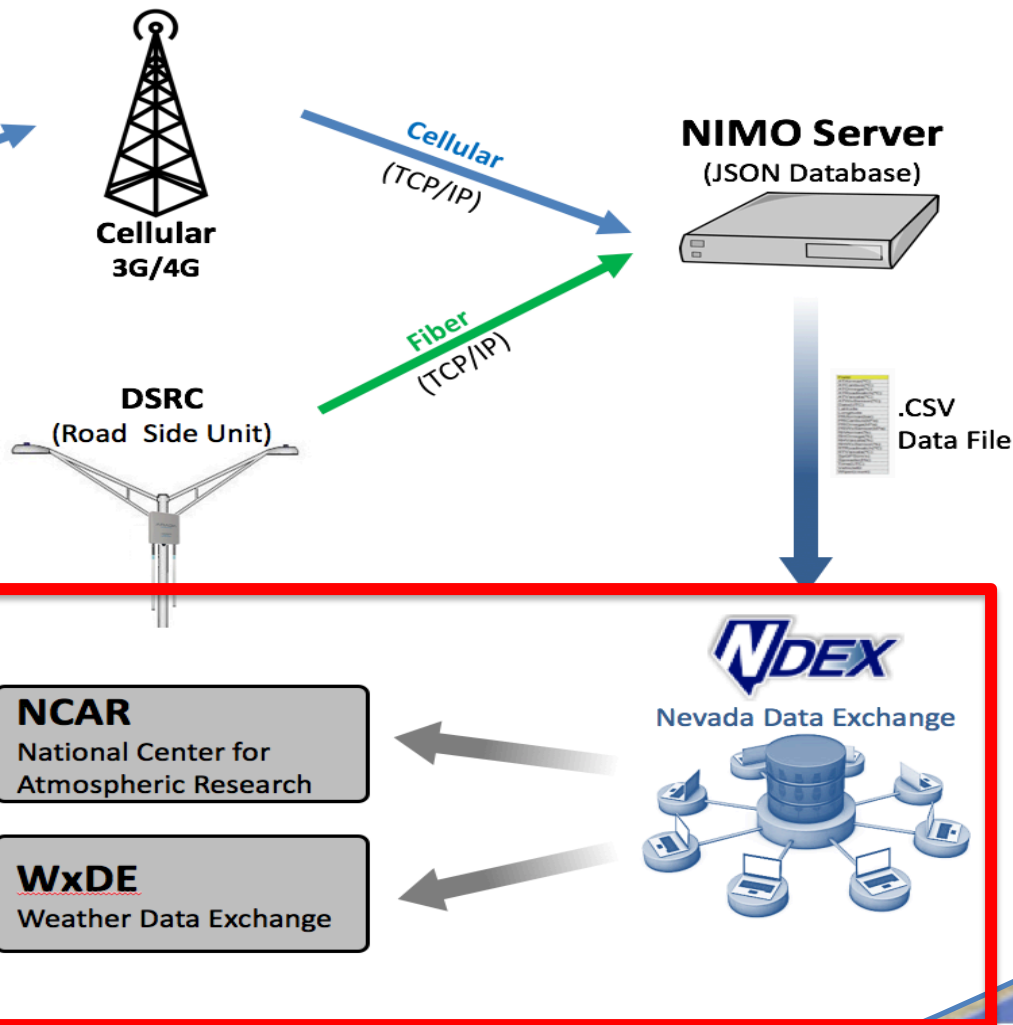


In-Vehicle Equipment:

- Weather Sensors
- Vehicle Sensors (OBU, CANBus)
- Equipment Sensors (Spreader)
- Location Sensor (GPS)
- Radio

Applications and MMS:

- Winter Maintenance
 - Treatment Recommendations
 - Material Usage Tracking
- Traffic Management
 - Traveler Information
- Data Management Systems
 - WxDE, NCAR, etc





NDEX Device Types

- Detector Station
- CCTV
- Dynamic Message Sign (DMS)
- Environmental Sensors (ESS)
- **Mobile Environmental Sensors (mESS)** — (No National Standard)
- Highway Advisory Radio (HAR)
- Incidents/Events
- Ramp Meter
- Node, Link, Traffic Network

NDEX messages include
inventory and device status



Nevada Data Exchange

- Environmental Sensor Stations (ESS)
 - Road Weather Information Sites (RWIS)
 - 135 Nevada DOT non-invasive and invasive sites
 - Wind Speed and Direction; Gust Speed and Direction; Visibility; Air Temperature; Relative Humidity; Dew Point; Rain (Yes/No), Rate; Road Grip; Water Layer, Ice Layer; Snow Depth, Snow Layer; Surface Temperature; Pavement Temperature; Soil Temperature; Surface Status and Surface Freeze Point
- Mobile Environmental Sensor Stations (mESS)
 - IMO
 - Approximately 60 vehicles equipped to receive mobile weather data
 - Air Temperature
 - Surface Temperature
 - Relative Humidity
 - Atmospheric Pressure
 - AVL
 - Wiper Status and Rate
 - Spreader Rate



NIMO 3 Sensor Package Inventory

Sensor ID	Manufacturer	Source Unit of Measure	Target Observation Type
ATRoadwatch	Roadwatch	Temperature Celsius	NTCIP 1204 ESS Air Temperature
RTRoadwatch			NTCIP 1205 ESS Surface Temperature
ATComet	Comet	Temperature Celsius	NTCIP 1204 ESS Air Temperature
RHComet		Relative Humidity, percent	NTCIP 1204 ESS Relative Humidity
APComet		Atmospheric Pressure, Bar	NTCIP 1205 ESS Atmospheric Pressure
GPGGA	Cradlepoint	NMEA 0183 Sentence GPGGA	NMEA 0183 Sentence GPGGA
WRAdam	Adam	Wiper Rate	SAE J2735



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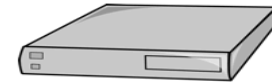


Cellular
3G/4G



DSRC
(Road Side Unit)

NIMO Server (JSON Database)



.CSV
Data File



Nevada Data Exchange



NCAR
National Center for
Atmospheric Research

WxDE
Weather Data Exchange

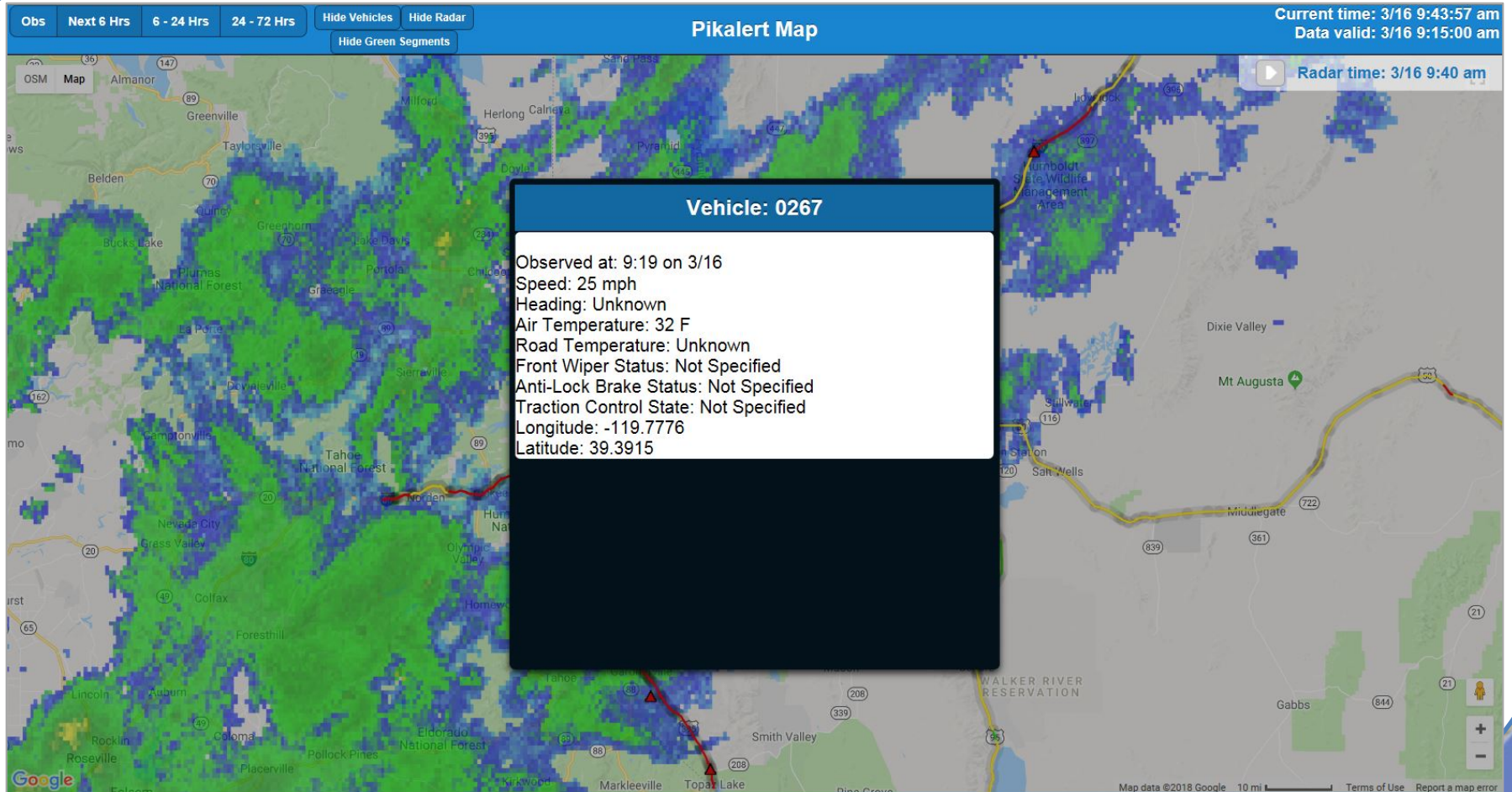


Enhanced MDSS

- Treatment Recommendations
 - Configure road condition and treatment module for Nevada salt brine, salt, and salt/sand treatment
 - Treatments are based upon the FHWA guidelines and NDOT practices
- Traffic Management
 - Provide MAW
 - Email alerts to the Road Operations Center for 4 alert levels: Clear, Notice, Caution and Warnings
 - Include the NOAA watch, warning and alert information
 - Integrating with 511 and Spillman CAD
 - Incorporate blow over forecasting
- Data Management
 - Continue to provide mESS and ESS data to the Weather Data Environment (WxDE)

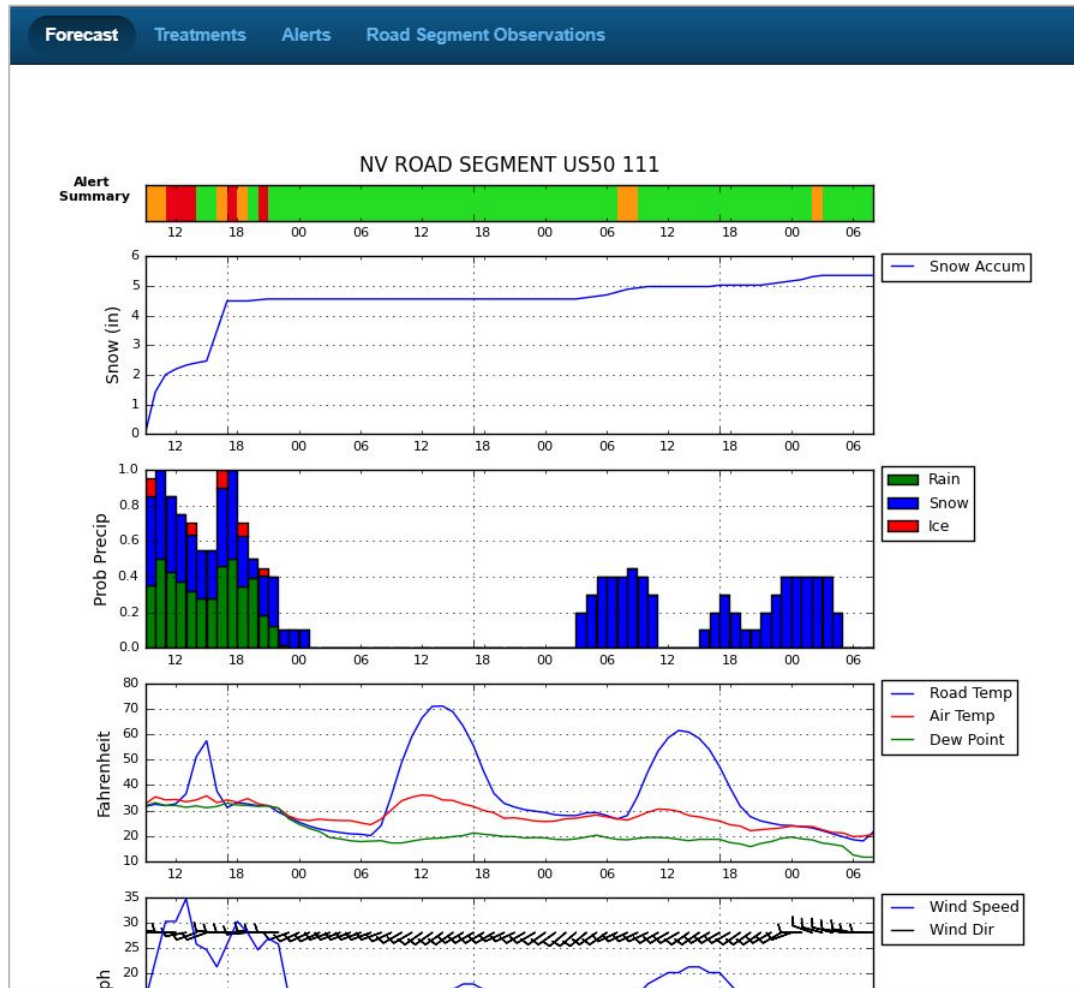


Pikalert





Pikalert US 50 Spooner Summit





Pikalert US 50 Spooner Summit

Forecast	Treatments	Alerts	Road Segment Observations
Thurs 3/22 9:35 am		●	Treatment: Plow and Apply Prewet Caliber at Concentration 6.637 Condition: Road temp: 32, Explanation: Treatment exceeds maximum. May need additional plowing.
Thurs 3/22 10:00 am		●	Treatment: Plow and Apply Prewet Caliber at Concentration 6.415 Condition: Road temp: 32, Explanation: Treatment exceeds maximum. May need additional plowing.
Thurs 3/22 11:00 am		●	No treatment recommended at this time
Thurs 3/22 12:00 pm		●	Treatment: Plow and Apply Prewet Caliber at Concentration 6.977 Condition: Road temp: 33, Explanation: Treatment exceeds maximum. May need additional plowing.
Thurs 3/22 1:00 pm		●	No treatment recommended at this time
Thurs 3/22 2:00 pm		●	Treatment: Plow and Apply Prewet Caliber at Concentration 7.917 Condition: Road temp: 51, Explanation: Normal anti-icing operations.
Thurs 3/22 3:00 pm		●	No treatment recommended at this time
Thurs 3/22 4:00 pm		●	Treatment: Plow and Apply Prewet Caliber at Concentration 9.337 Condition: Road temp: 38, Explanation: Treatment exceeds maximum. May need additional plowing.
Thurs 3/22 5:00 pm		●	No treatment recommended at this time
Thurs 3/22 6:00 pm		●	Treatment: Plow and Apply Prewet Caliber at Concentration 9.167 Condition: Road temp: 33, Explanation: Treatment exceeds maximum. May need additional plowing.
Thurs 3/22 7:00 pm		●	No treatment recommended at this time
Thurs 3/22 8:00 pm		●	No treatment recommended at this time
Thurs 3/22 9:00 pm		●	No treatment recommended at this time
Thurs 3/22 10:00 pm		●	Treatment: Plow and Apply Prewet Caliber at Concentration 14.22 Condition: Road temp: 29, Explanation: Normal anti-icing operations.
Thurs 3/22 11:00 pm		●	No treatment recommended at this time
Fri 3/23 0:00 am		●	No treatment recommended at this time
Fri 3/23 1:00 am		●	No treatment recommended at this time
Fri 3/23 2:00 am		●	No treatment recommended at this time
			No treatment recommended at this time



Pikalert US 50 Spooner Summit

Forecast		Treatments	Alerts	Road Segment Observations
Site Name	NV ROAD SEGMENT US50 111			
Site Type	Road Segment			
Mean Air Temp	40 deg F			
Model Air Temp	35 deg F			
Model Dewpoint Temp	33 deg F			
Radar Reflectivity	26.00 dBZ			
Dual Pol Digital Hybrid Reflectivity	missing			
Mean Barometric Pressure	missing			
Model Barometric Pressure	767 mb (22.66 inch Hg)			
Dual Pol Hybrid Hydrometeor Classification	40.00			
Mean Vehicle Speed	missing			
Number of Valid Speeds	missing			
Mean Vehicle Air Temp	missing			
Mean Vehicle Barometric Pressure	missing			
Mean Vehicle Surface Temp	missing			
Number of Wipers On	missing			
Number of Wipers Off	missing			



Pikalert US 50 Spooner Summit

Forecast	Treatments	Alerts	Road Segment Observations
Thurs 3/22 9:35 am		●	Advisory: Precip: moderate rain, Pavement: wet, Visibility: low
Thurs 3/22 10:00 am		●	Advisory: Precip: heavy mixed, Pavement: wet, Visibility: low
Thurs 3/22 11:00 am		●	Warning: Precip: heavy snow, Pavement: slick, icy, Visibility: blowing snow
Thurs 3/22 12:00 pm		●	Warning: Precip: light snow, Pavement: slick, icy, Visibility: blowing snow
Thurs 3/22 1:00 pm		●	Warning: Precip: light snow, Pavement: wet, Visibility: blowing snow
Thurs 3/22 2:00 pm		●	Clear
Thurs 3/22 3:00 pm		●	Clear
Thurs 3/22 4:00 pm		●	Advisory: Precip: moderate snow, Pavement: wet, Visibility: low
Thurs 3/22 5:00 pm		●	Warning: Precip: heavy snow, Pavement: slick, icy, Visibility: heavy snow
Thurs 3/22 6:00 pm		●	Advisory: Precip: light mixed, Pavement: wet, Visibility: normal
Thurs 3/22 7:00 pm		●	Clear
Thurs 3/22 8:00 pm		●	Warning: Precip: light snow, Pavement: slick, icy, Visibility: normal
Thurs 3/22 9:00 pm		●	Clear
Thurs 3/22 10:00 pm		●	Clear
Thurs 3/22 11:00 pm		●	Clear
Fri 3/23 0:00 am		●	Clear
Fri 3/23 1:00 am		●	Clear
Fri 3/23 2:00 am		●	Clear



Material Usage Tracking

- NDOT Equipment Division
 - Implementing snow plows with Cirrus Spreaders
 - NIMO3 rear mounted custom spreader rate system
- Tasks with Pikalert include the following:
 - Plow information
 - Location of maintained roads
 - Display for initial load improvements and vehicle display improvements
- Which Materials
 - salt brine, salt, and salt/sand treatment