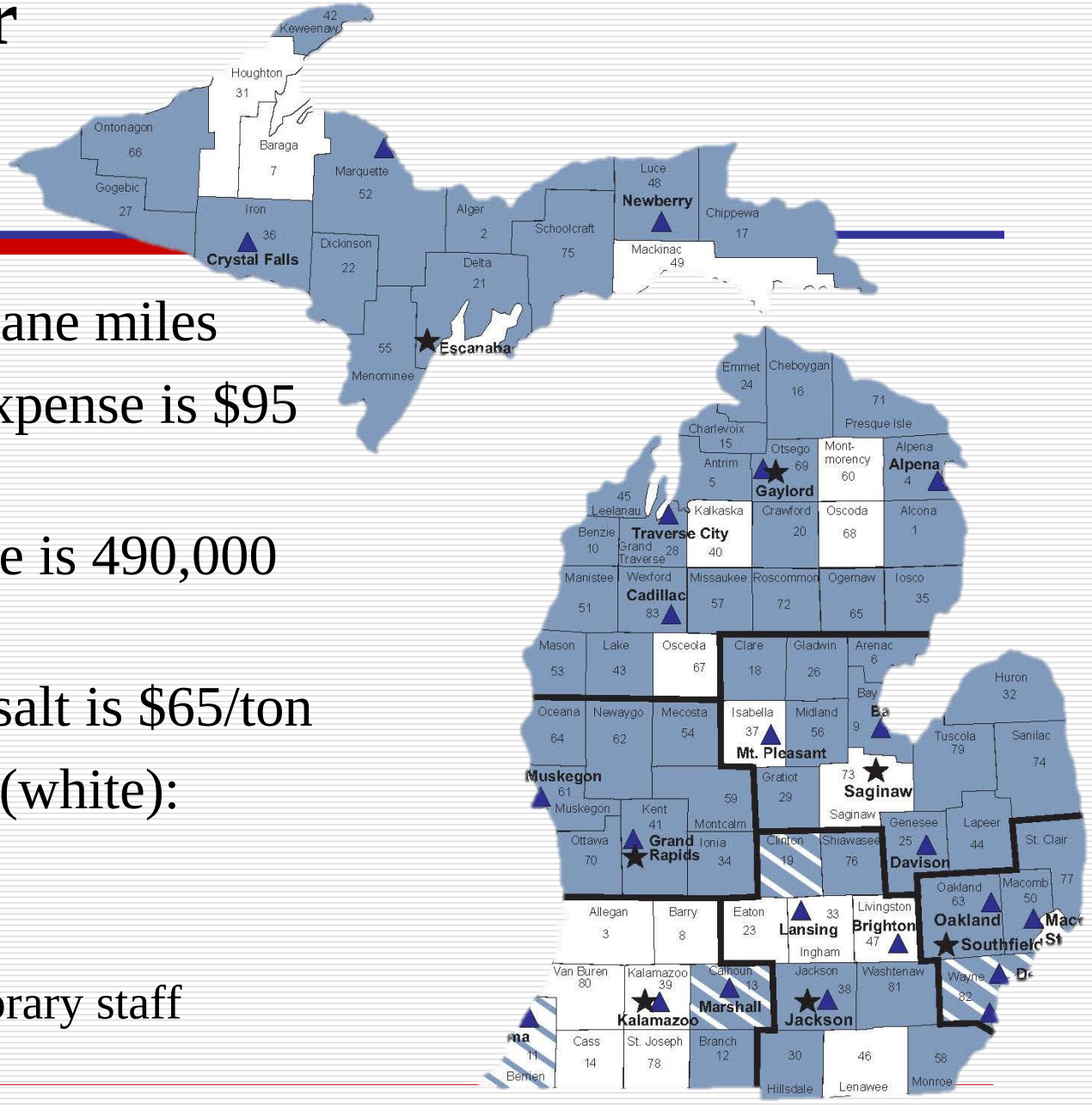
AVL/GPS/MDSS for Improving Winter Operations

Justin Droste P.E.

Michigan Department of Transportation (USA)

August 3, 2015

MDOT Winter Statistics



- 32,000 trunkline lane miles
- Average winter expense is $95 Million
- Average salt usage is 490,000 Tons
- Average price of salt is $65/ton
- MDOT Facilities (white):
  - 300 snowplows
  - 380 operators
  - Over 100 temporary staff

Center for Environmentally Sustainable Transportation in Cold Climates
CESTiCC

AVL/MDSS Contract Overview

- Awarded Contract to Delcan Technologies September 15th, 2013

- Contract is for 3 years with options for 2 additional years.

- Initial priority is Winter Maintenance Trucks
  - Permanent assigned truck
  - 2000 model year or newer
  - Dickey John Control Point spreader controller

- Vendor is responsible for providing weather forecast and treatment recommendations

Vendor's Role

- Provide working AVL equipment and sensors
- Secure and manage cellular communications for AVL devices
- Ensure necessary information is available to users for both AVL and MDSS websites
- Provide customer support to all users
- Provide training and training materials as needed
- Project management and weekly calls with MDOT

MDOT's Role

Equipment Installation by Region Mechanics

- MDOT Mechanic installations with vendor support
- Installation inspection and sign off

Project Management

- Weekly conference calls with vendor
- Ensure contract and Department goals are being met

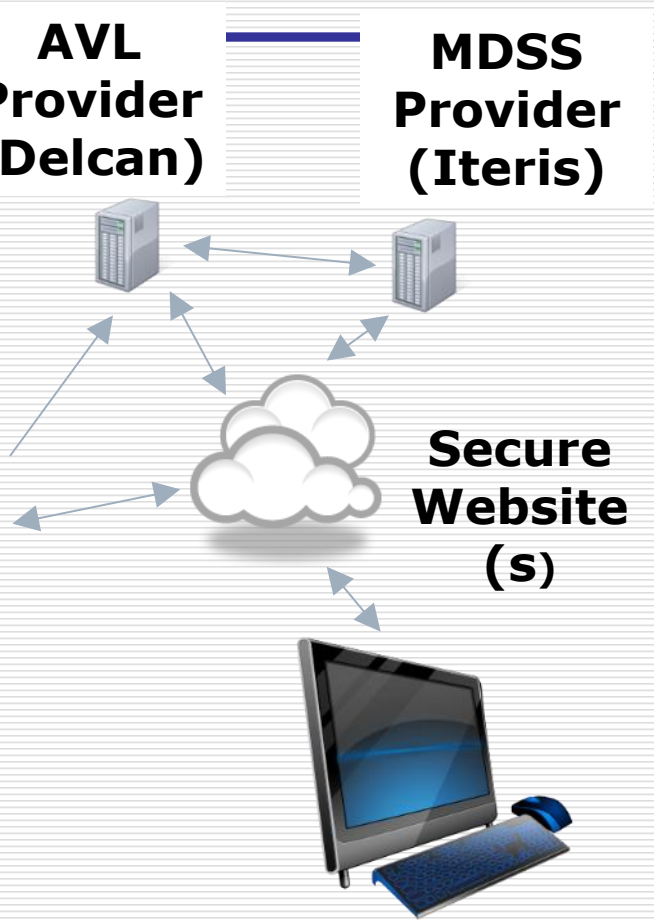
Support

- Provide support to region and garage employees
- Schedule trainings and provide classroom facilities

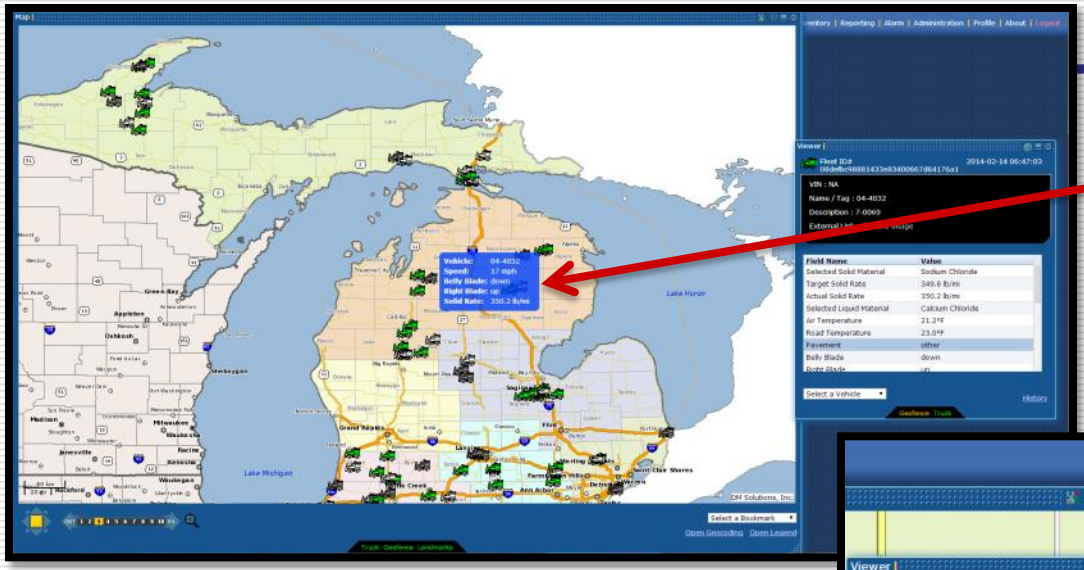
Data Transmission

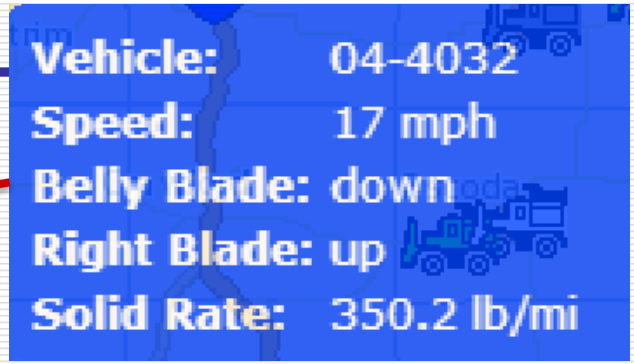
- Air and pavement temps
- Plow position
- Camera images
- Spreader information
  - material type
  - application rate
- Engine data
- Location
- Weather information
- Maintenance treatment recommendations

WMTs



AVL Website





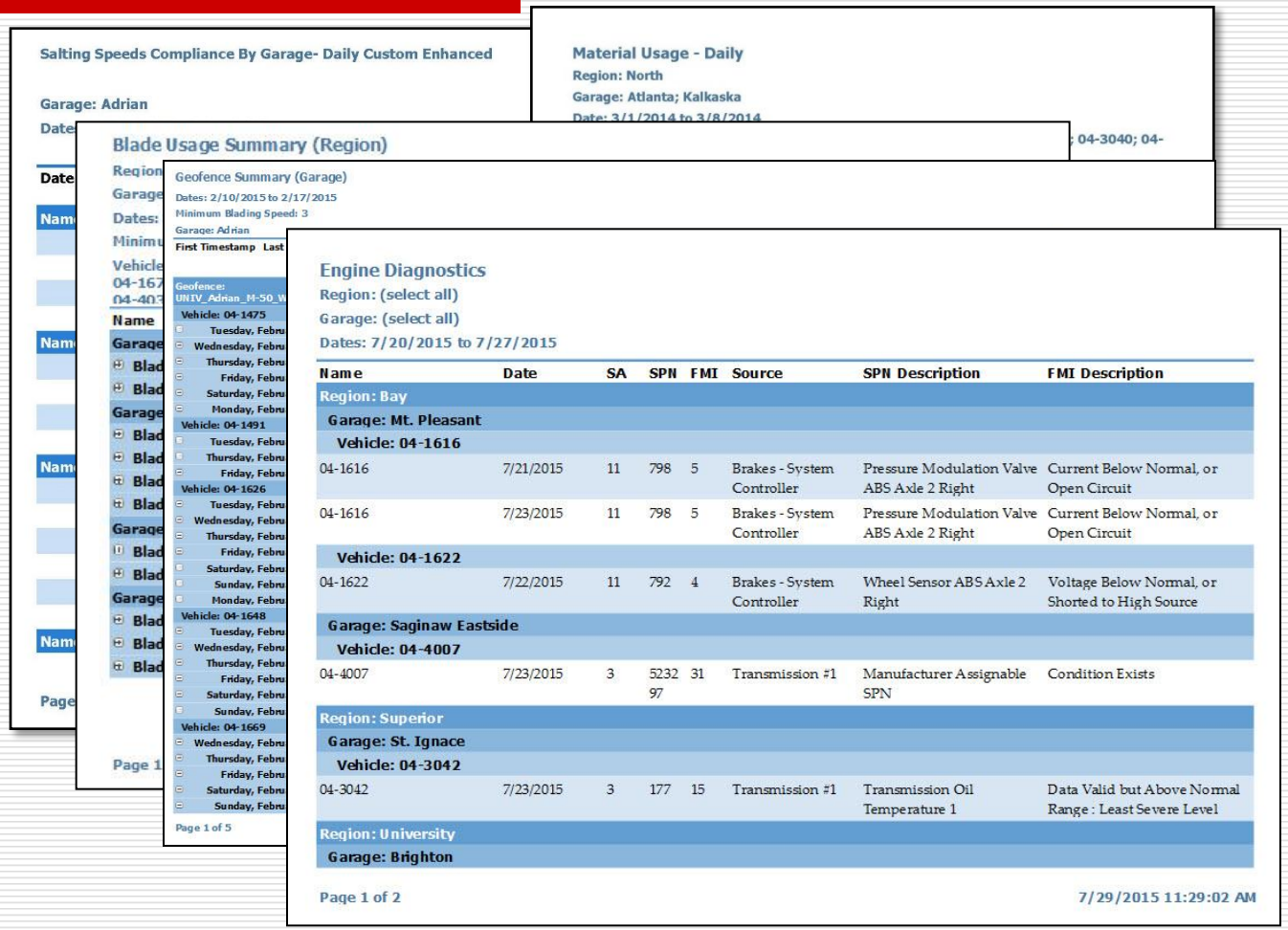
Real-time Data

- Operational
- Engine
- Camera Images

AVL Data Reports

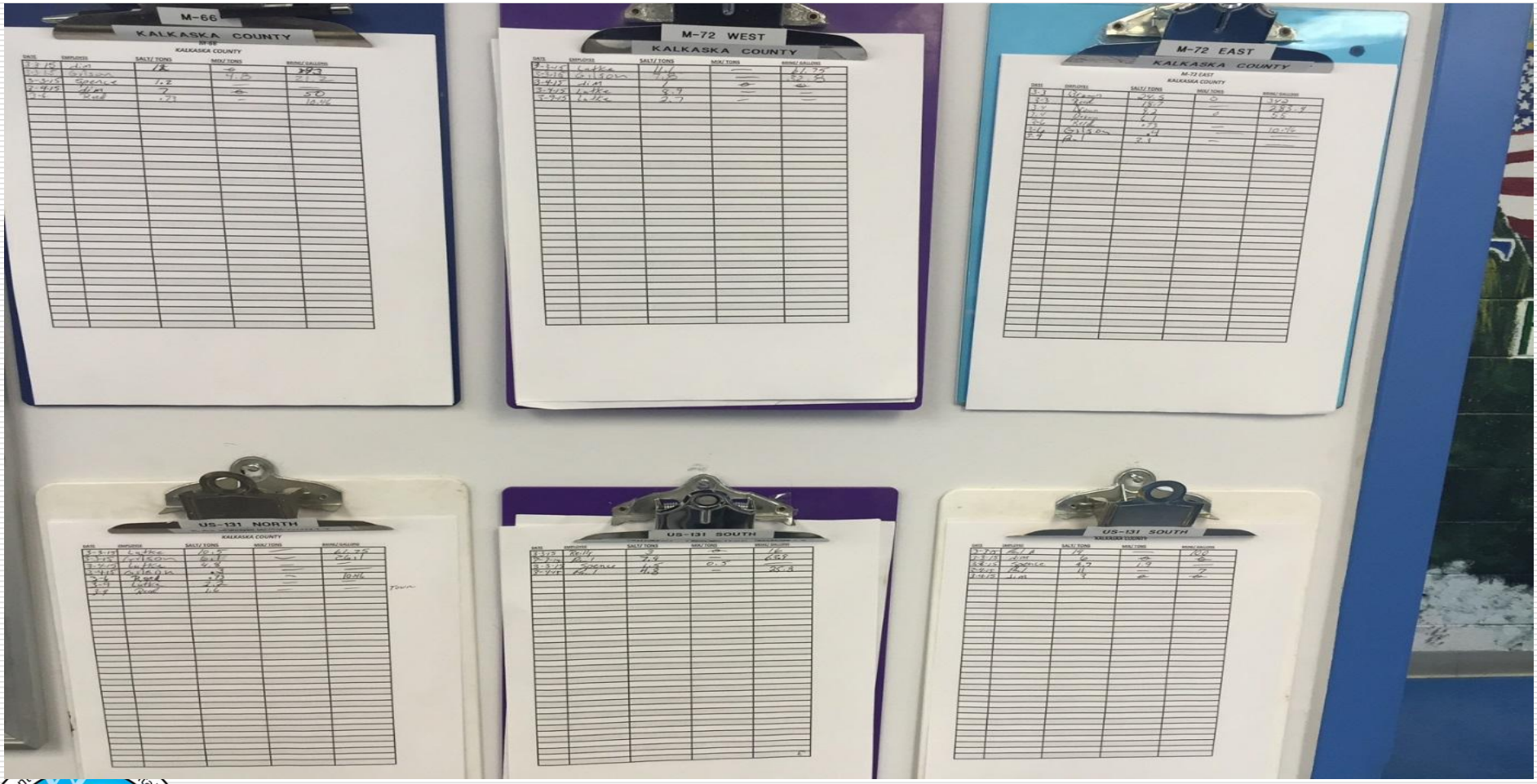
Primary Data Reports

- Salting Speed Compliance
- Material Usage
- Blade usage
- Engine Idle & Diagnostics
- Geofence Data



Material Usage Reporting

(Traditionally done by manual logging of estimated use per shift/route)



AVL Data Reports

Material Usage Report

Material Usage

- Data from Spreader Controller
- Consistent Naming is critical

Solid Material	Solid Code
Prewet Salt with Calcium Chloride (8 gal per ton)	WSalCa
Prewet Salt with Salt Brine (8 gal per ton)	WSalBr
Dry Salt for spreader prewet	DSalt
Sand only (dry)	Sand
Salt/Sand Blend	SalSan

Material Usage - Daily

Region: North

Garage: Atlanta; Kalkaska

Date: 3/1/2014 to 3/8/2014

Vehicles: 04-1556; 04-1558; 04-1653; 04-1685; 04-3016; 04-3027; 04-3035; 04-3040; 04-4029; 04-4032; 04-4035

Date	Material	Solids Spread	Season Total
Material: DSALT		**533.2 ton**	
Region North			
Garage: Atlanta		**430.2 ton**	
Vehicle: 04-3027		**3.4 ton**	**232.1 ton**
3/4/2014	DSALT	3.4 ton	232.1 ton
Vehicle: 04-4032		**426.8 ton**	**451.9 ton**
3/1/2014	DSALT	11.4 ton	439.3 ton
3/4/2014	DSALT	414.8 ton	450.6 ton
3/5/2014	DSALT	0.6 ton	451.9 ton
Garage: Kalkaska		**103.0 ton**	
Vehicle: 04-1556		**33.6 ton**	**501.5 ton**
3/1/2014	DSALT	15.9 ton	483.8 ton
3/4/2014	DSALT	17.7 ton	501.5 ton
Vehicle: 04-1558		**23.0 ton**	**323.7 ton**
3/1/2014	DSALT	16.6 ton	317.3 ton
3/4/2014	DSALT	6.4 ton	323.7 ton
Vehicle: 04-4029		**46.4 ton**	**538.4 ton**
3/1/2014	DSALT	26.2 ton	518.2 ton
3/4/2014	DSALT	20.2 ton	538.4 ton
Material: SALSAN		**8.7 ton**	
Region North			
Garage: Kalkaska		**8.7 ton**	
Vehicle: 04-1558		**6.8 ton**	**111.7 ton**
3/1/2014	SALSAN	6.8 ton	111.7 ton
Vehicle: 04-4029		**1.7 ton**	**164.7 ton**
3/4/2014	SALSAN	1.7 ton	164.7 ton
Vehicle: 04-4035		**0.2 ton**	**366.1 ton**
3/4/2014	SALSAN	0.2 ton	366.1 ton

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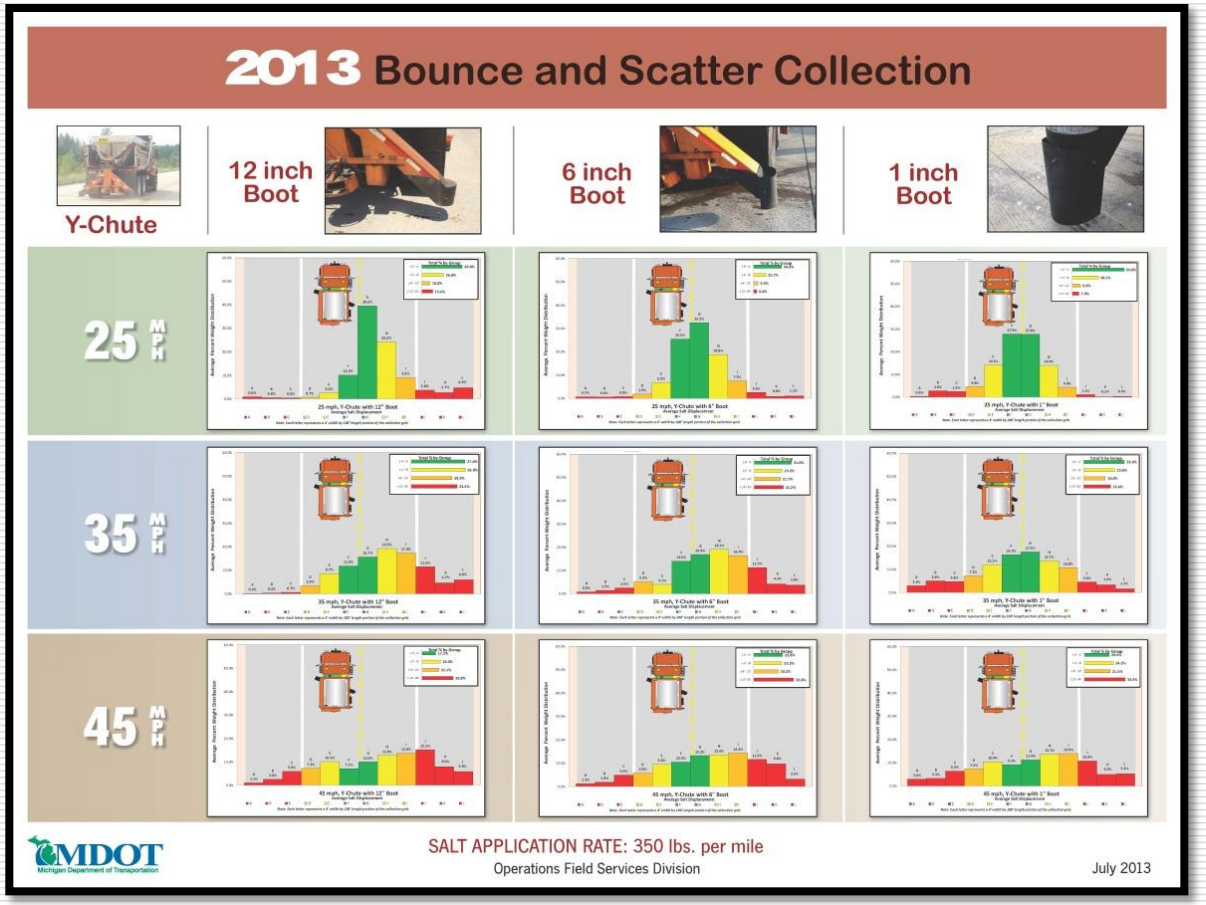
Truck Speed and Effect on Salt Bounce and Scatter

(Michigan DOT 2012 and 2013 studies)

- Truck speed has most influence on salt B&S
- Slower salting speeds reduce costs and benefit the environment
- MDOT Movement to reduce salting speeds to 25mph or less



AVL Data Reports

Speed Compliance Report

Salting Speeds Compliance By Garage- Daily Custom Enhanced

Garage: Adrian

Dates: 3/1/2014 to 3/15/2014

Date	First Timestamp	Last Timestamp	25mph Compliance	(Data Points)	35mph Compliance	(Data Points)	Total Data Points	Solids Spread (ton)
Name: 04-1475			**22.46 %**	**227**	**75.81 %**	**581**	**776**	**15.2**
3/2/2014	7:39 AM	12:33 PM	**40.28 %**	143	**100.00 %**	355	355	8.0
3/5/2014	7:52 AM	8:50 AM	**26.92 %**	35	**78.46 %**	102	130	2.1
3/12/2014	6:41 AM	7:04 AM	**18.75 %**	18	**69.79 %**	67	96	2.7
3/13/2014	5:24 AM	6:38 AM	**15.90 %**	31	**29.23 %**	57	195	2.4
Name: 04-1626			**25.17 %**	**608**	**95.70 %**	**2171**	**2264**	**60.5**
3/1/2014	8:56 PM	11:59 PM	**25.19 %**	97	**100.00 %**	385	385	10.1
3/2/2014	12:00 AM	12:00 PM	**33.03 %**	433	**98.40 %**	1290	1311	21.2
3/3/2014	5:31 AM	10:48 AM	**75.00 %**	9	**100.00 %**	12	12	0.5
3/12/2014	6:01 AM	10:04 PM	**12.41 %**	69	**87.05 %**	484	556	28.7
Name: 04-1648			**30.12 %**	**1242**	**87.00 %**	**3633**	**4162**	**55.6**
3/1/2014	8:36 PM	9:13 PM	**16.27 %**	27	**100.00 %**	166	166	3.1
3/2/2014	1:38 AM	6:42 AM	**50.23 %**	429	**100.00 %**	854	854	9.2
3/3/2014	3:03 AM	10:49 AM	**40.68 %**	24	**91.53 %**	54	59	1.1
3/8/2014	9:59 AM	12:54 PM	**4.07 %**	22	**56.19 %**	304	541	4.8
3/10/2014	12:19 AM	12:28 AM	**25.64 %**	10	**69.23 %**	27	39	0.1
3/12/2014	8:26 AM	11:27 PM	**29.17 %**	730	**89.01 %**	2228	2503	37.3
Name: 04-1669			**20.14 %**	**1218**	**94.88 %**	**5815**	**6122**	**75.3**

FY 2015 Salt Speed Compliance and Efficiency*

2/1 to 2/16/15

Salt Usage and Effectiveness

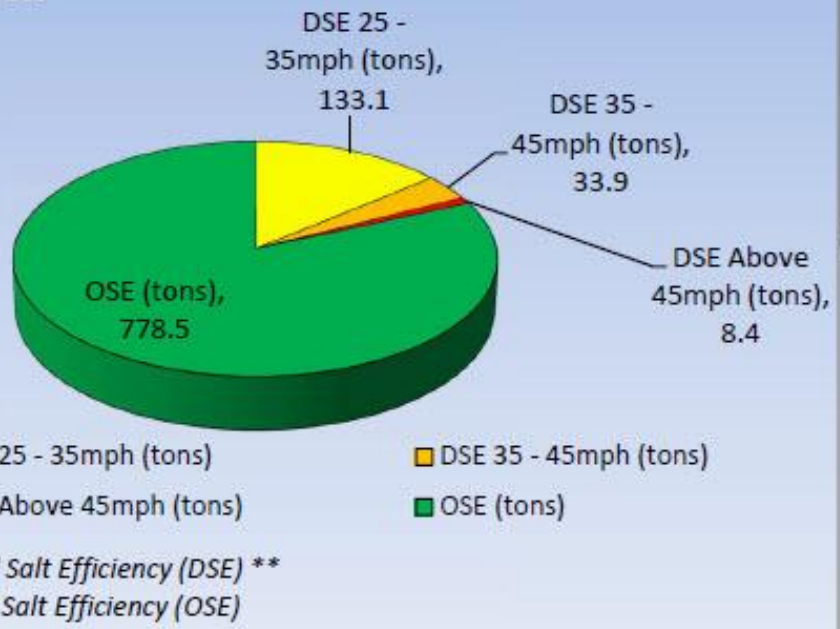
Region: North

Date Range: 2/1/2015 to 2/16/2015

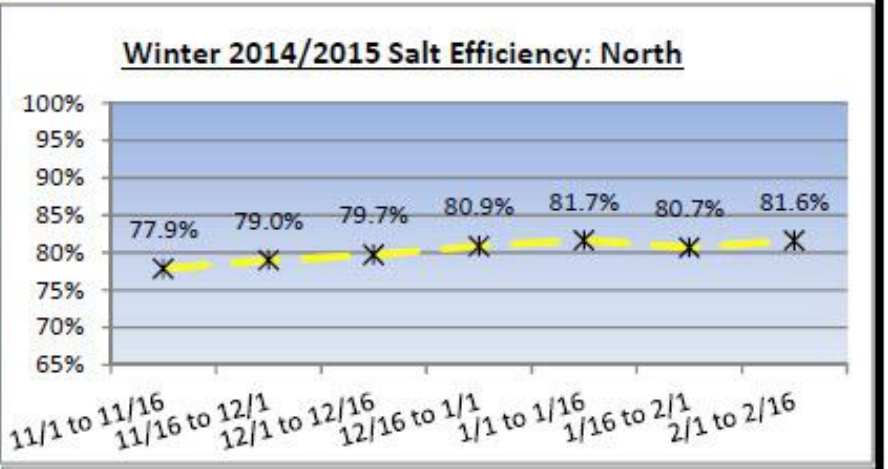
Total Salt Spread (tons) 953.8

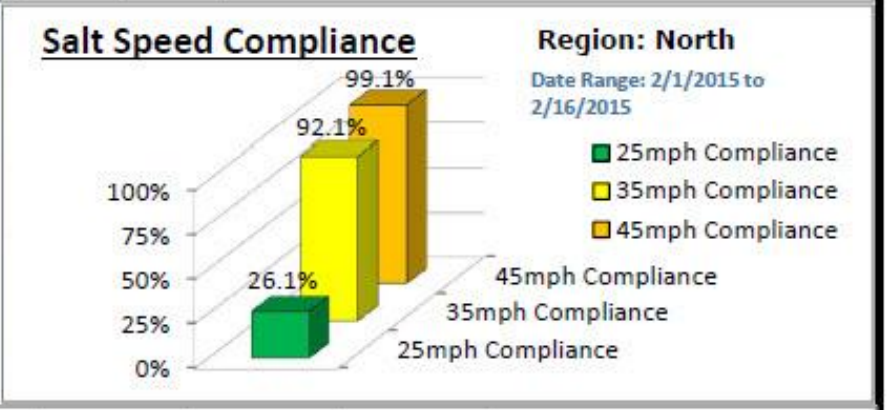
DSE (tons)** 175.3

Salting Efficiency 81.62%



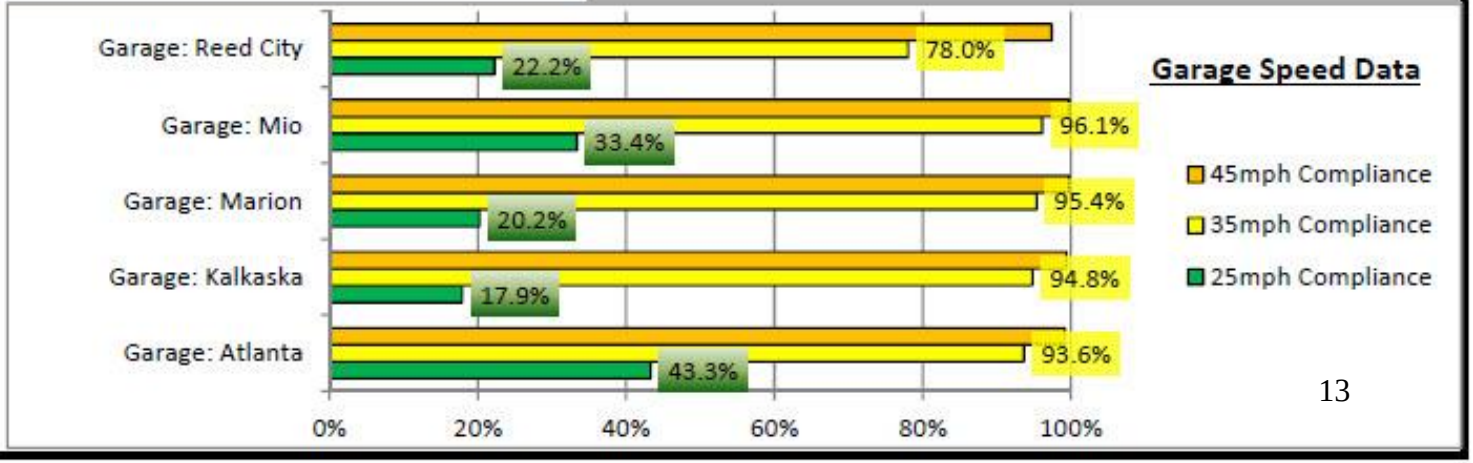
*Diminished Salt Efficiency (DSE) ***
Optimized Salt Efficiency (OSE)





* Efficiency based on AVL salt speed compliance data and empirical data from the MDOT Salt Bounce and Scatter Studies. Data assumes standard spreaders used.

** Salt applied at speeds faster than 25 mph can still benefit the traveled roadway. Increased bounce and scatter at faster speeds diminishes salting efficiency.

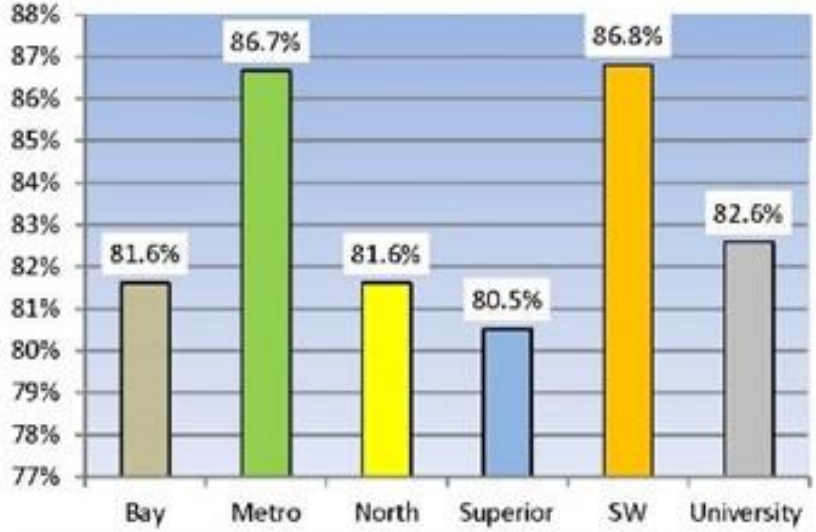


FY 2015 MDOT Direct Force Salt Efficiency Data*

2/1 to 2/16/15

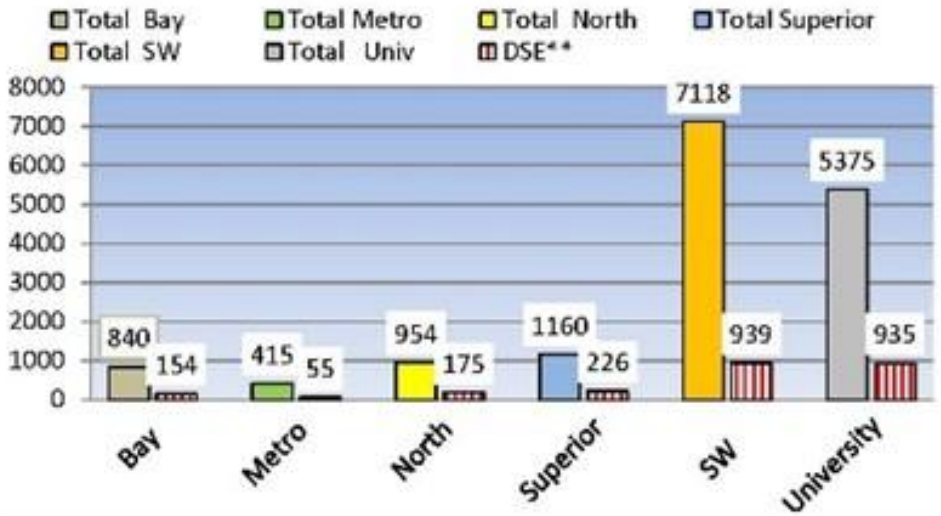
Salt Efficiency per Region

2/1 to 2/16



AVL Salt Tonnage per Region

2/1 to 2/16



Statewide Direct Force Salt Data

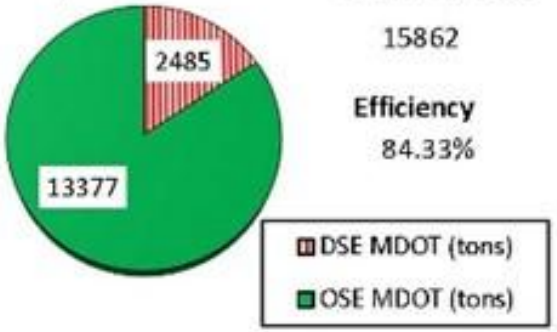
2/1 to 2/16

Total Tons Salt

15862

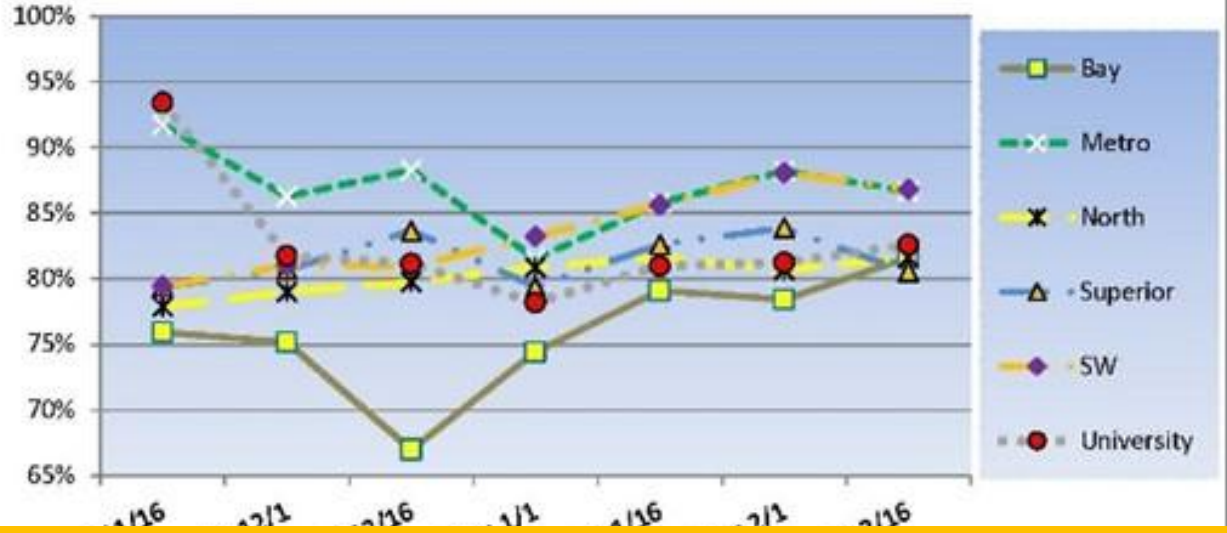
Efficiency

84.33%



* Based on AVL data and MDOT Salt Bounce and Scatter Study findings.

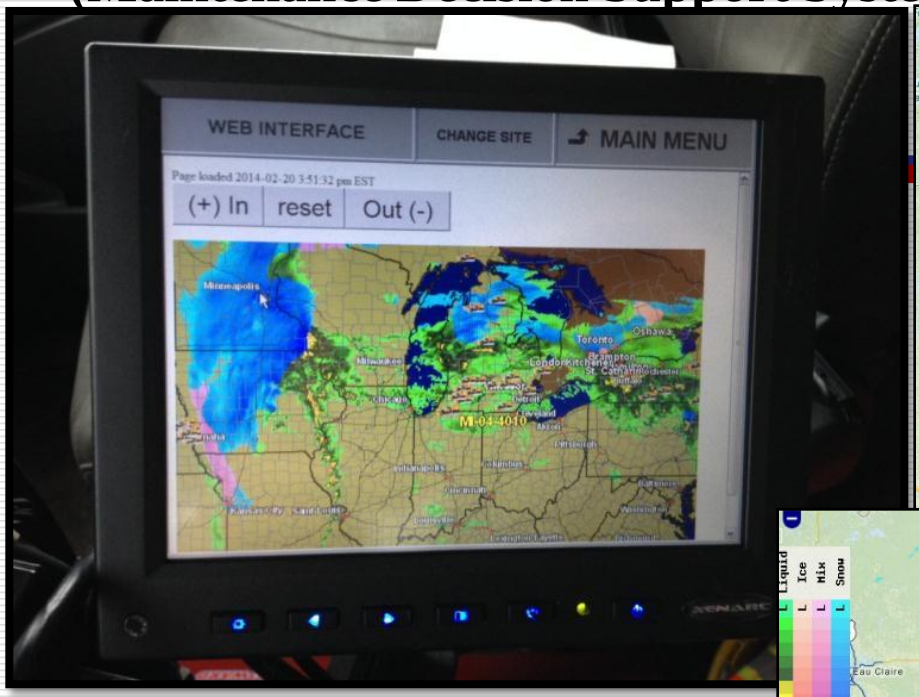
Winter 2014/2015 Salt Efficiency per Region

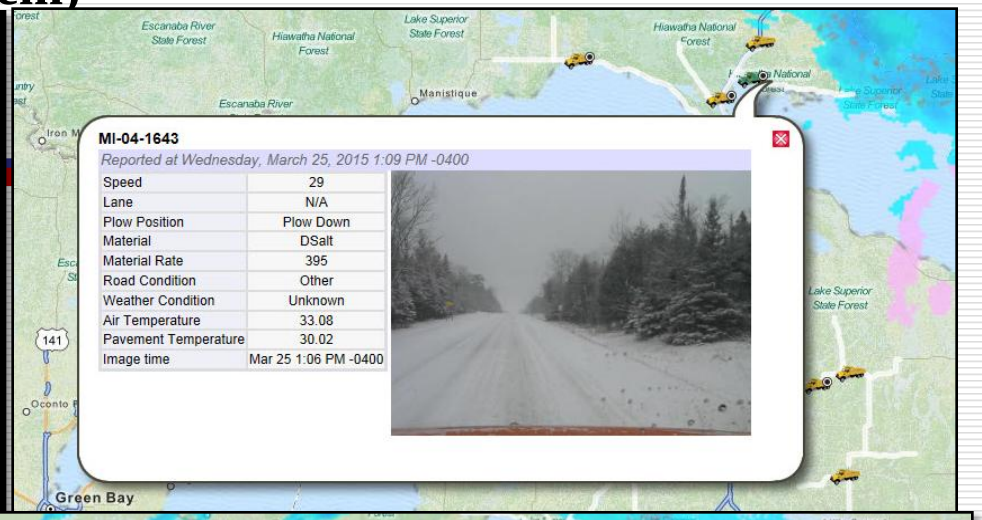


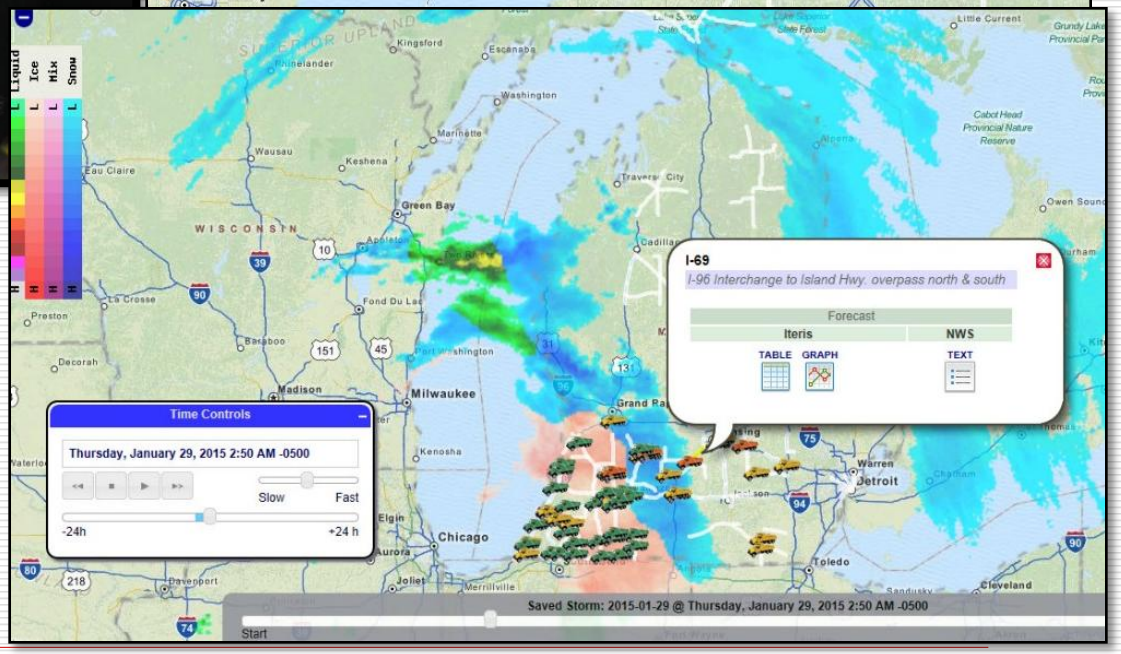
Overall MDOT Efficiency has increased more than 5% since start of season

MDSS Website

(Maintenance Decision Support System)

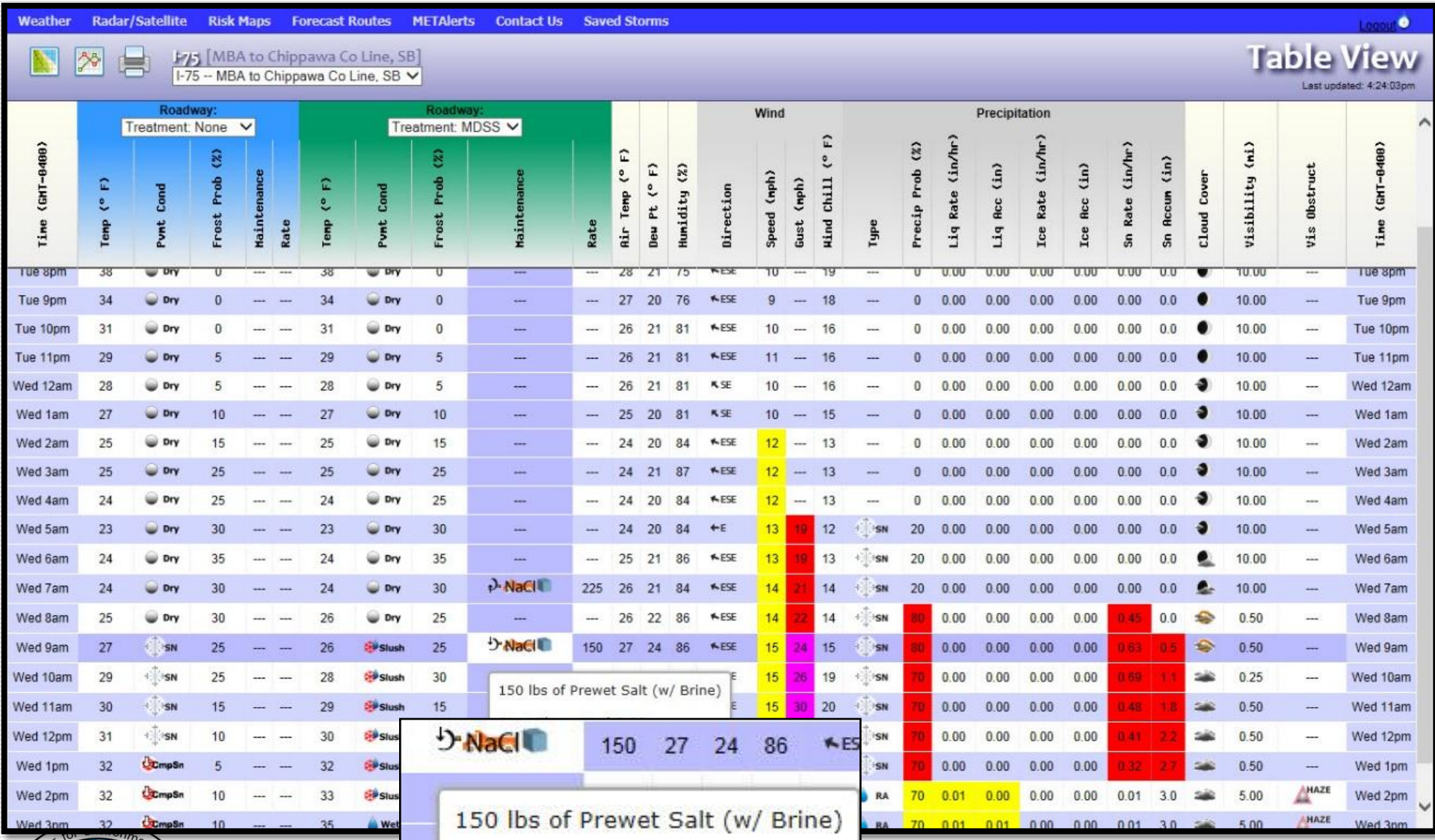




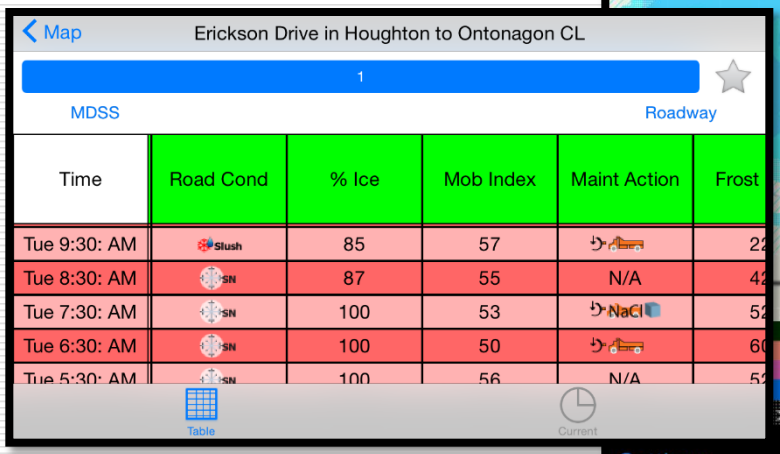


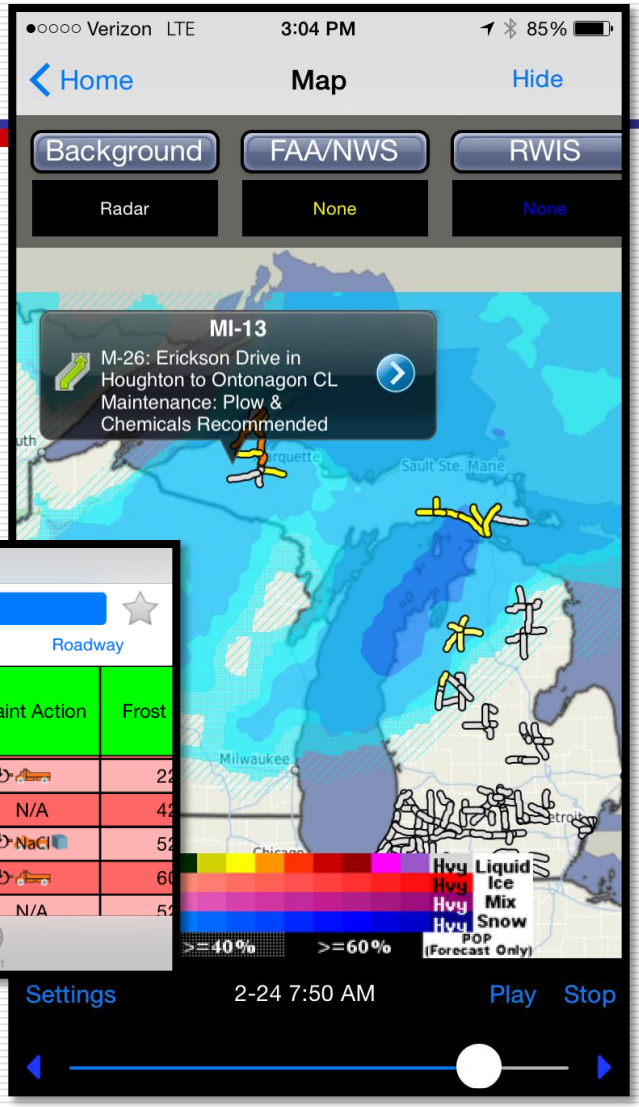
- Weather Radar with WMT info.
- Info provided to in-cab monitors or desktop.
- Detailed weather forecasts
- Treatment recommendations per route.

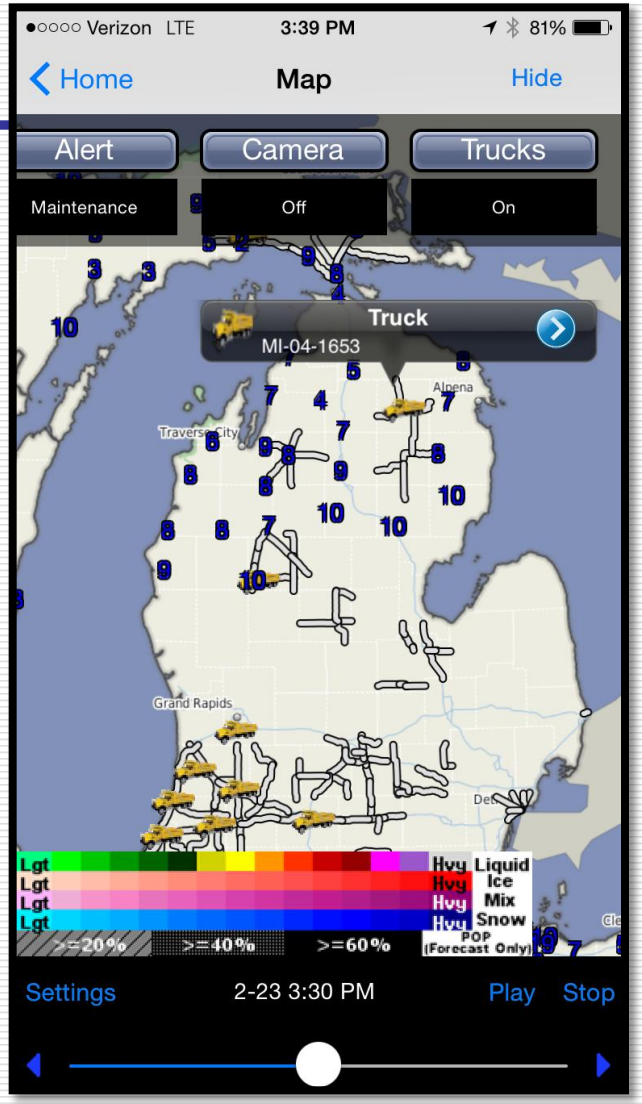
Pavement Forecast and Recommendations



MDSS Mobile App

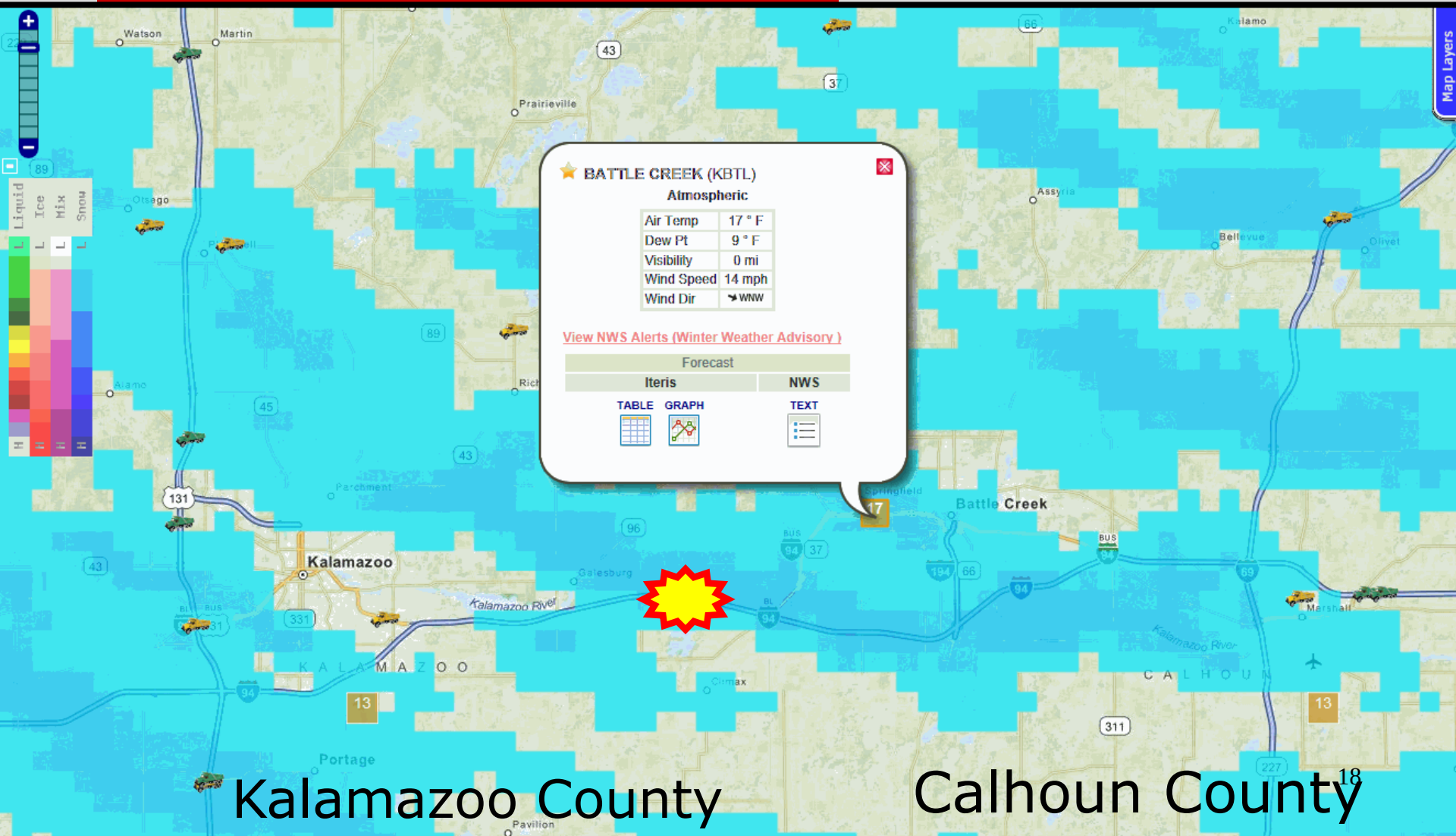






Additional Benefits:
Post Storm/Incident Reviews

January I-94 Mega Crash



Kalamazoo County

Calhoun County

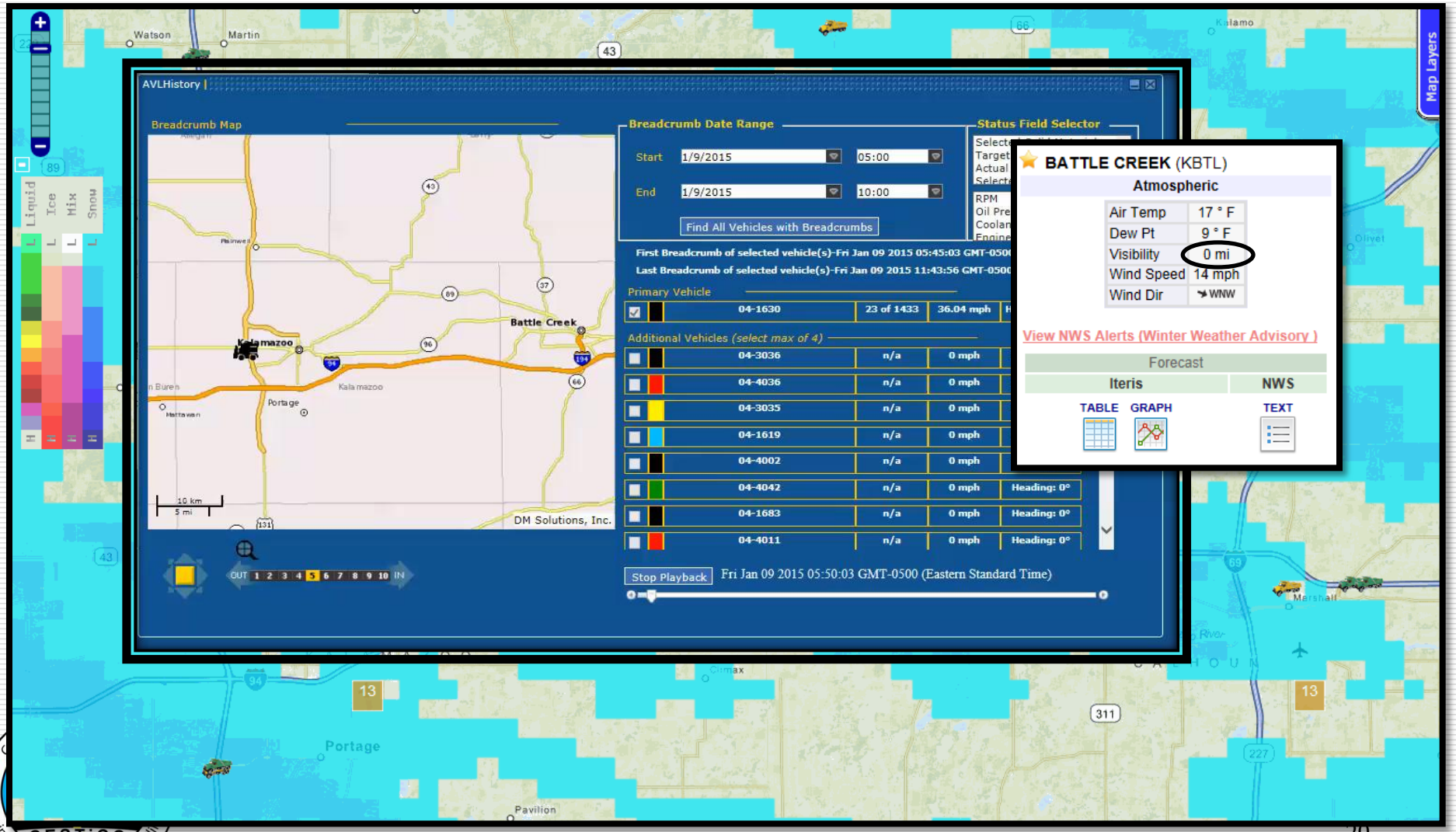
I-94 Mega Crash

- By the numbers
  - 193 Total vehicles:
  - EB
    - 26 Trucks
    - 34 Cars
    - 44-hour closure
  - WB
    - 50 Trucks
    - 83 Cars
    - 39-hour closure

- 1 Fatality
- 22 Injuries

- 40,000 lb of fireworks
- 6,000 gal of formic acid

I-94 Mega Crash



I-94 Mega Crash

"We've never experienced anything of this magnitude and I hope we never do again," - Michigan State Police Lt. Dale Hinz

MDSS: Forecast and Strategy

- Communication Tool

From: Giles, Brian (MDOT) ↑ Next ↓ Previous
Sent: Wednesday, January 07, 2015 5:45 AM
To: Smith, Joe (MDOT); Weaver, Fredrick (Rick) (MDOT); Ingold, Glenn (MDOT); Brink, Stephen (MDOT); Stineback, Terry (MDOT); Steele, Ty (MDOT); Martin, Ed (MDOT); Marsh-McCarty, Lisa (MDOT); Wilson, Zachary (MDOT); Roland, Jason (MDOT); Iocca, Michael (MDOT); Winchester, Michael (MDOT); Owsiany, Jeanne (MDOT); Eckler, Matt (MDOT); Brown, Jeffrey M. (MDOT); Strefling, Sarah (MDOT); Shindeldecker, Douglas (MDOT); Collins, Danny (MDOT); Braybrooks, Charles (MDOT); Riever, Randy (MDOT); Streeter, Mike (MDOT); Bessey, Al (MDOT); Cooper, Janine (MDOT); Smith, Jonathon (MDOT); Reiter, Brian (MDOT); DenBraber, Kerry (MDOT)
Subject: FW: Winter Wig

Good morning all,

Last night South haven finally had a small break from the snow at approximately 7pm. I don't believe that other areas were as fortunate. But then at midnight it started all over again. MDSS is calling for 5.8 inches of snow to fall between now and 5pm with temps hovering around 13 degrees and wind at 18mph gusting to 33mph. Everyone is in and all trucks are on the road.

VAN BUREN-
INCLUDING THE CITIES OF...SOUTH HAVEN
338 AM EST WED JAN 7 2015

...WINTER WEATHER ADVISORY IN EFFECT UNTIL 4 PM EST THIS AFTERNOON...

.TODAY...SNOW SHOWERS. AREAS OF BLOWING SNOW. SNOW ACCUMULATION 5 TO 7 INCHES. HIGHS 10 TO 15. NORTHWEST WINDS 15 TO 25 MPH WITH GUSTS TO AROUND 35 MPH. CHANCE OF SNOW 100 PERCENT. WIND CHILL READINGS AS LOW AS MINUS 12.
.TONIGHT...SNOW. SNOW ACCUMULATION AN INCH OR LESS. LOWS 5 TO 10 ABOVE NEAR LAKE MICHIGAN AND ZERO TO 5 INLAND. WEST WINDS 15 TO 20 MPH WITH GUSTS TO AROUND 30 MPH. CHANCE OF SNOW 80 PERCENT. WIND CHILL READINGS AS LOW AS 9 BELOW TO 19 BELOW ZERO.

Lessons Learned

AVL and MDSS are game changers

- Proactive vs reactive
- Adapting operational approach based on MDSS
- Incorporating pavement forecasts into pre-storm planning
- Supervisors and operators are more informed

Takes time to gain trust in MDSS treatment recommendations
(weather forecasting has been a big positive)

Lots of data; What's the most useful?

- Material usage report
- Salting speed compliance reports
- Blade usage
- Supervisors know what their operators are applying

Questions

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