

# Pacific Northwest Snowfighters 2016

## Central Maintenance/UDOT Weather Group Snow Removal Performance Metric

Presented By  
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Method Engineer UDOT

UDOT Weather Page:  
[www.udottraffic.utah.gov/forecastview](http://www.udottraffic.utah.gov/forecastview)

# Indexes and Measures

- Winter Severity Indexes
  - Climate Network (National Weather Service)
    - No road data
- Idaho Winter Performance Measure
  - Based on Road Weather Information System (RWIS) data
  - Thanks Idaho
- Utah Road Weather Index
  - Real-time index to evaluate weather, road conditions and maintenance performance
  - Snowfall rates and road temperatures are critical
  - Account for blowing snow and freezing rain
  - Developed in-house with the UDOT Research Meteorologist Group

# Winter Road Weather Index

## Winter Road Weather Index

- Quantifies atmospheric conditions and road conditions into one value
  - Accounts for snowfall rate, road temperature, blowing snow, freezing rain, and road grip/condition
- Benefits:
  - Represents the overall road weather conditions such as a traveler will face
  - Could be used as a TATS reporter
  - Established foundation for Winter Maintenance Performance Metric
  - Won Best of ITS Award for Best New Innovative Practice – Sustainability in Transportation in September 2015

# Winter Road Weather Index - RWIS Variables

*When road temperature < 35 °F and road is not dry...*

- Road Condition
  - Snow, ice and road grip (coefficient of friction)
- Road Temperature
  - The colder the road, the more difficult to mitigate
- Visibility
  - Used to estimate snowfall rate
  - Precipitation occurrence (yes or no)
    - Define start and end time of storm event
    - Precipitation occurrence used to differentiate fog from snow
- Wet-bulb Temperature
  - Lower the wet-bulb temperature equates to drier snow thus more transportable
  - Used to distinguish rain from snow
- Wind Gust ( $\geq 20$  mph)
  - More impact with lowering wet-bulb temperatures

# Winter Maintenance Performance Metric

## Winter Maintenance Performance Metric

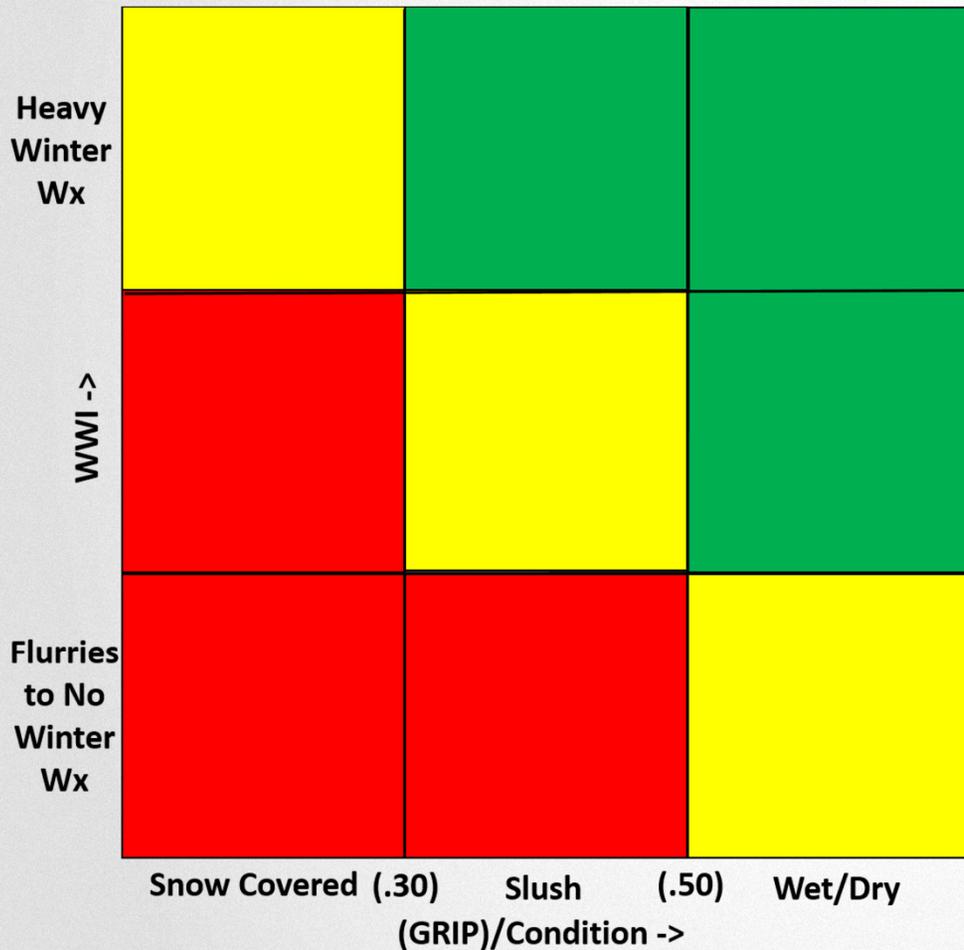
- Cause vs. effect approach
  - Atmospheric conditions and road temperature (cause) vs. resulting road grip or condition (effect)
- 1” per hour snowfall rate is the benchmark
- Road grip/conditions categorized into snow-covered, partially snow-covered/slushy, or wet/dry
- Benefits
  - Assess winter plow performance in real-time, storm, month, or seasonal basis
  - Resource assessment tool
  - Public response

# Winter Maintenance Performance Metric

- Winter Maintenance Performance Metric Basis

Winter Weather Index	Snowfall Rate	Expected Mitigated Road Condition	Expected Grip
*** Heavy	> 1" per hour	Snow Covered	< .30
** Light to Moderate	.25 to 1" per hour	Slushy/ Partially Snow Covered	.30 to .50
* Flurries or no snow	< .25" per hour	Wet or dry	.50 to .82
<b>Contributing factors also considered with Winter Weather Index</b>			
Road Temperature	Blowing snow	Wet or dry snow	

# Performance Metric “Rubik’s Cube”



Snowfall Rate = 1"/hr  
 Road Temp = 32°  
 Wet-Bulb Temp = 32°  
 Light winds

Snowfall Rate = 1/4"/hr  
 Road Temp = 32°  
 Wet-Bulb Temp = 32°  
 Light winds

## Definitions:

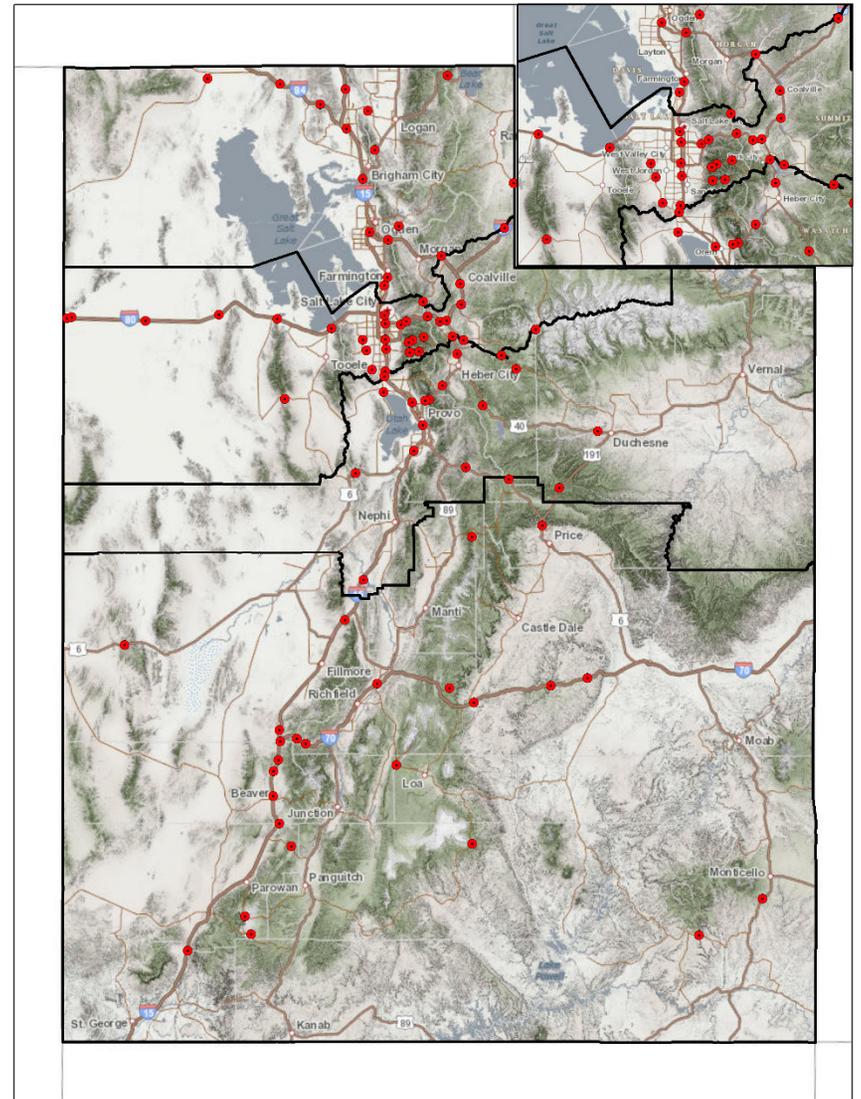
**Green** – Road condition exceeds acceptable road conditions per given weather conditions

**Yellow** – Acceptable road conditions per given weather conditions

**Red** – Recovery time. Potential for improved road conditions per given weather conditions

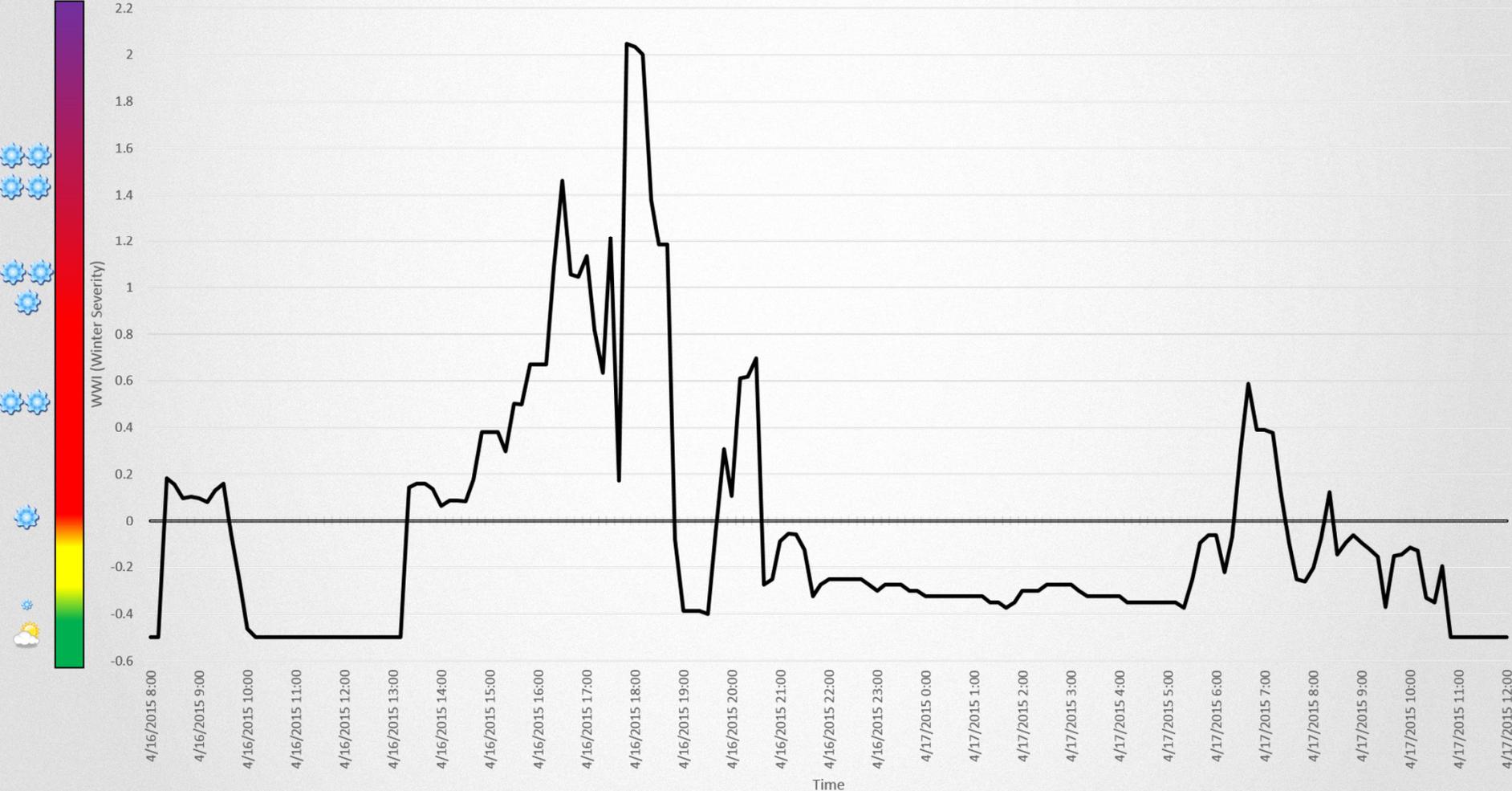
# UDOT's RWIS Network

- 92 RWIS Sites
  - 5 portable RWIS trailers
  - 75 RWIS sites are upgraded and now compatible with Road Weather Index
- RWIS upgrade
  - Visibility sensor
  - Non-invasive road sensor



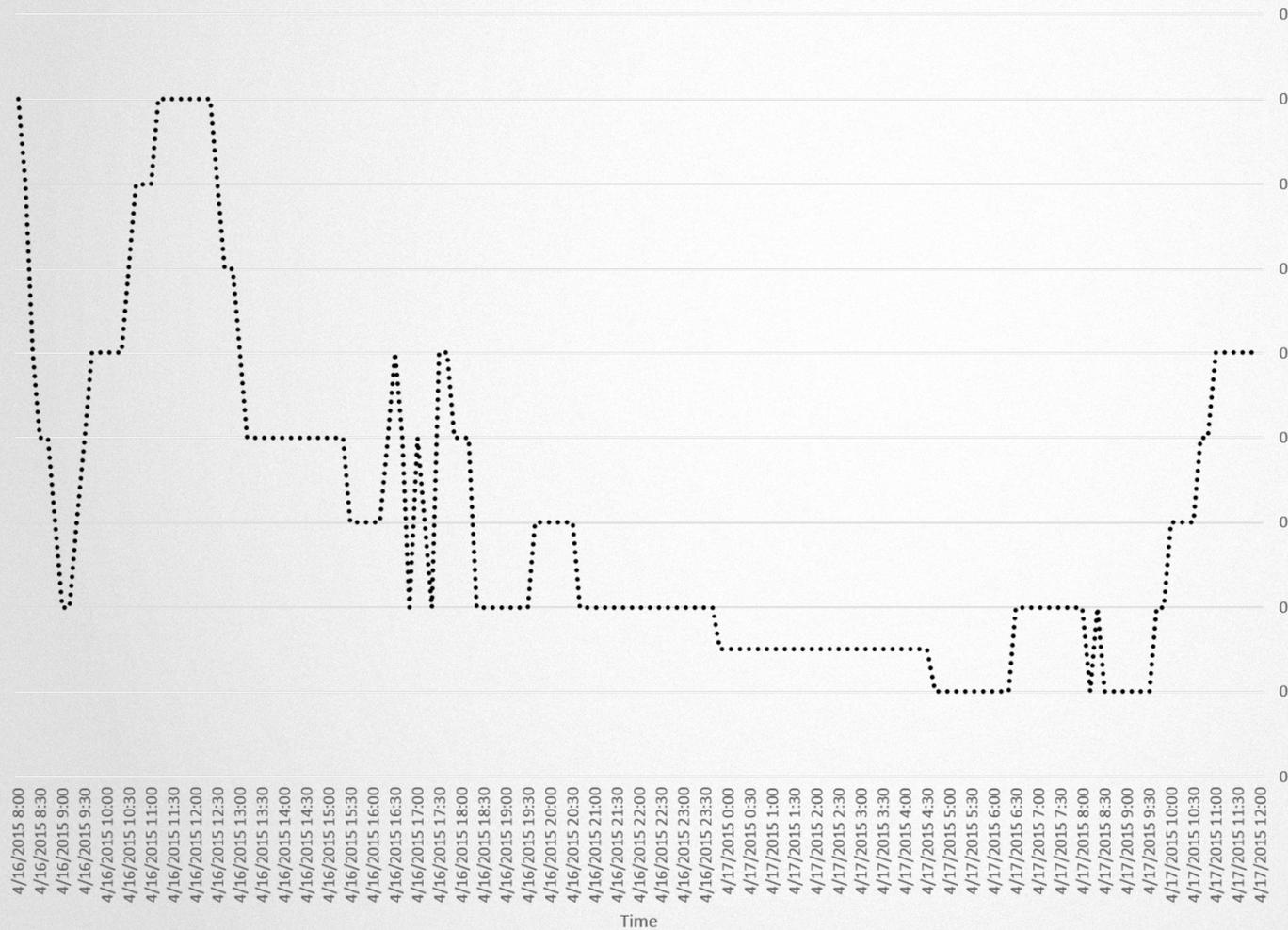
# Boulder Summit - Winter Weather Index (cause)

Boulder Summit WWI 4/16-17



# Boulder Summit – Road Grip (effect)

Boulder Summit Grip 4/16-17



udot.utah.gov 11:20AM 04/16



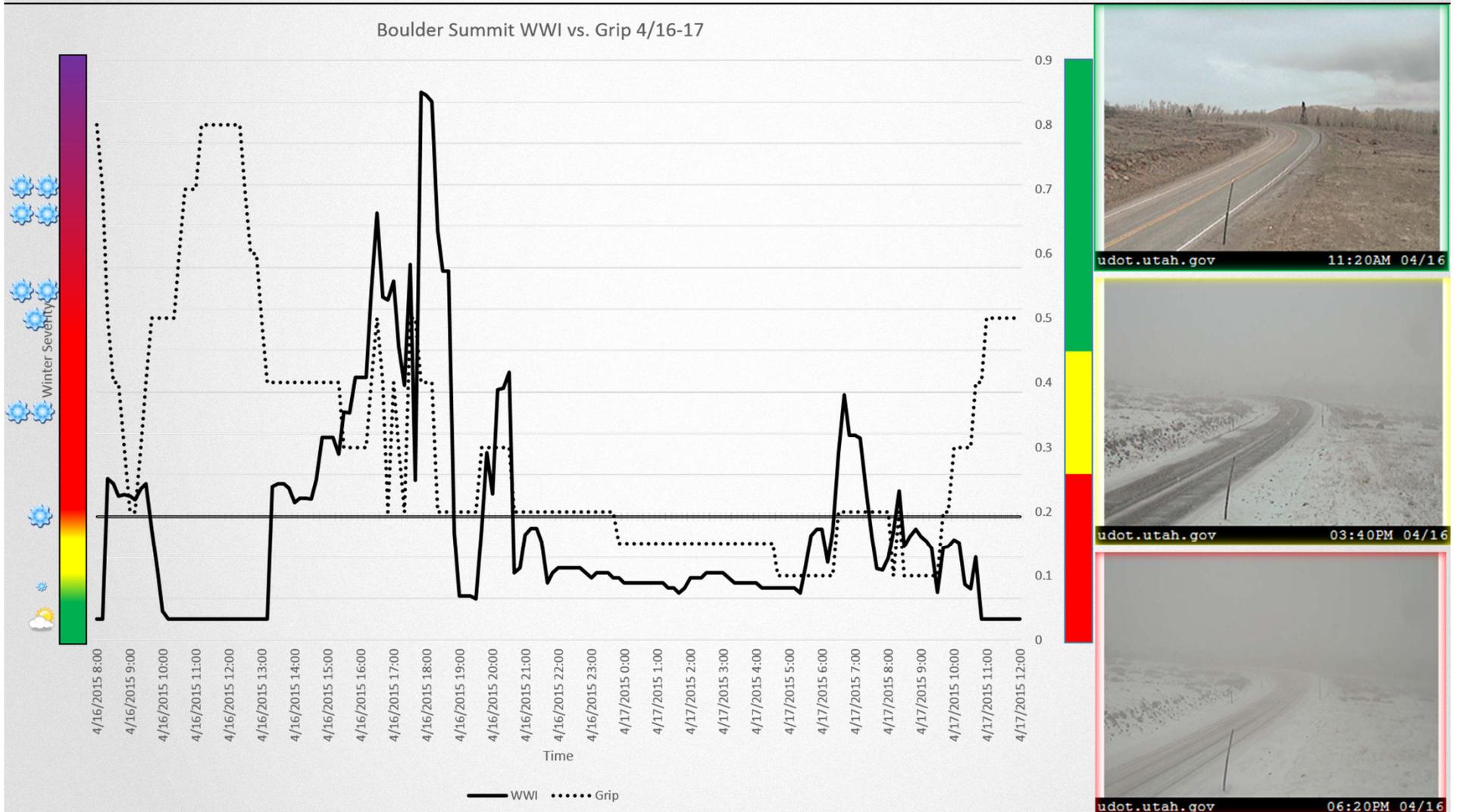
udot.utah.gov 03:40PM 04/16



udot.utah.gov 06:20PM 04/16

# Boulder Summit

## Winter Weather Index/Road Grip

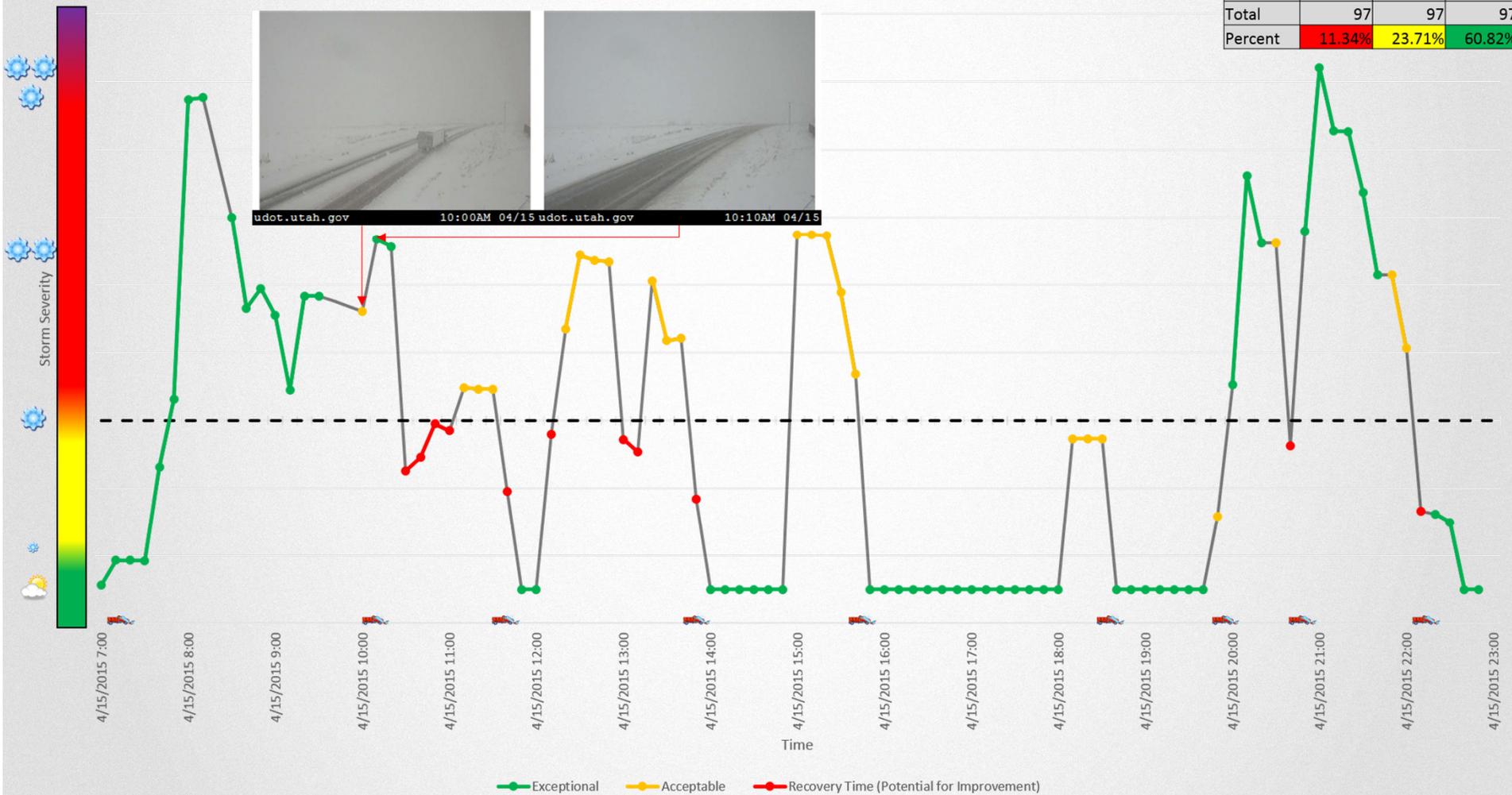


# Bacchus RWIS – SR-111 (Level 1)

## Winter Maintenance Performance Metric – 1"/hr

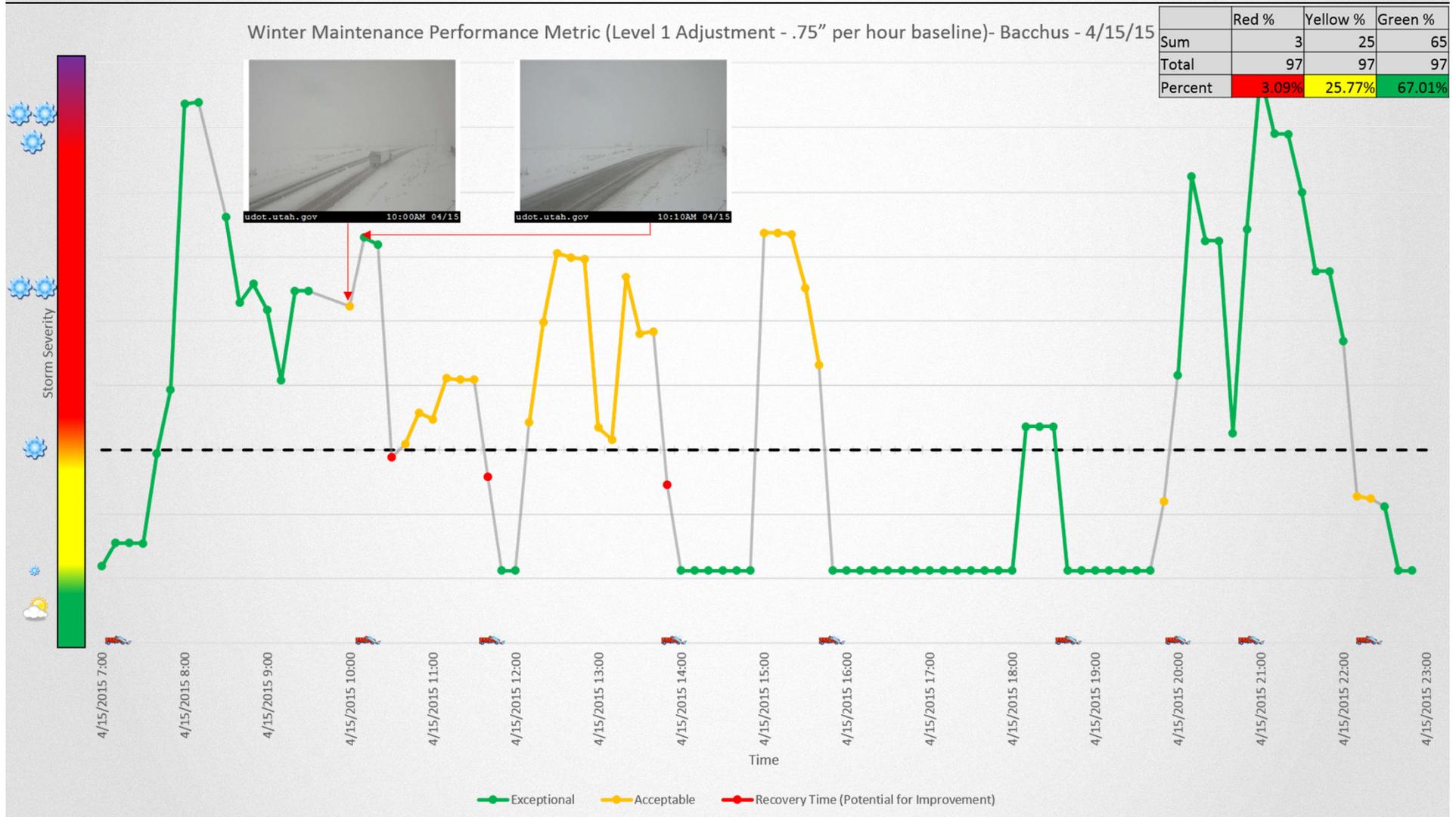
Winter Maintenance Performance Metric – Bacchus - 4/15/15

	Red %	Yellow %	Green %
Sum	11	23	59
Total	97	97	97
Percent	11.34%	23.71%	60.82%



# Bacchus RWIS - SR-111 (Level 1)

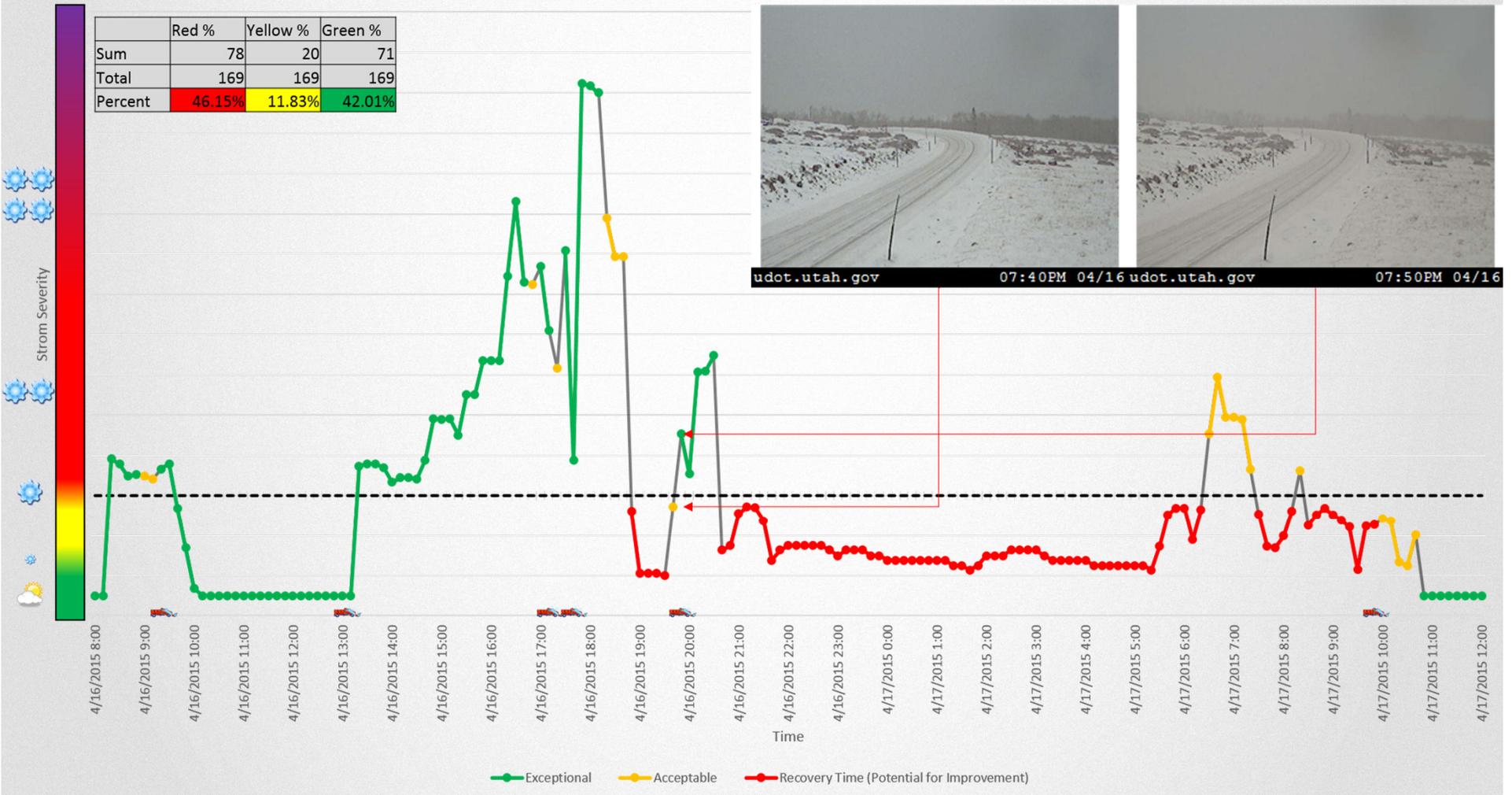
## Winter Maintenance Performance Metric - .75"/hr



# Boulder Summit- SR-12 (Level 2)

## Winter Maintenance Performance Metric - 1"/hr

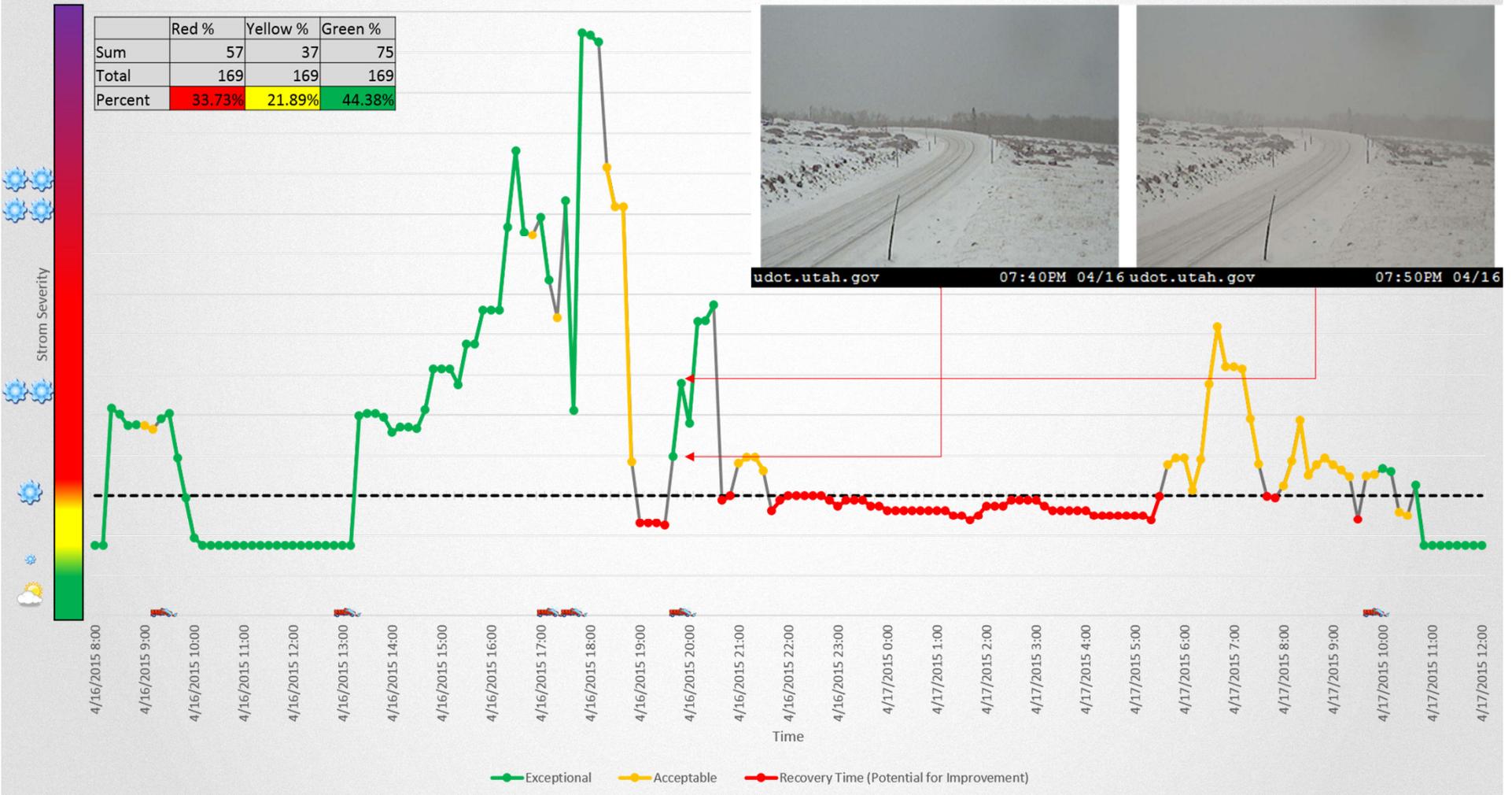
Winter Maintenance Performance Metric - Boulder Summit - 4/16-17



# Boulder Summit- SR-12 (Level 2)

## Winter Maintenance Performance Metric - .5"/hr

Winter Maintenance Performance Metric (Level 2 Adjustment - .50" per hour baseline) - Boulder Summit - 4/16-17



# Graphical User Interface

UDOT Weather Page

[www.udottraffic.utah.gov/forecastview](http://www.udottraffic.utah.gov/forecastview)

# SR-12 @ Boulder Summit

Link to Mesowest

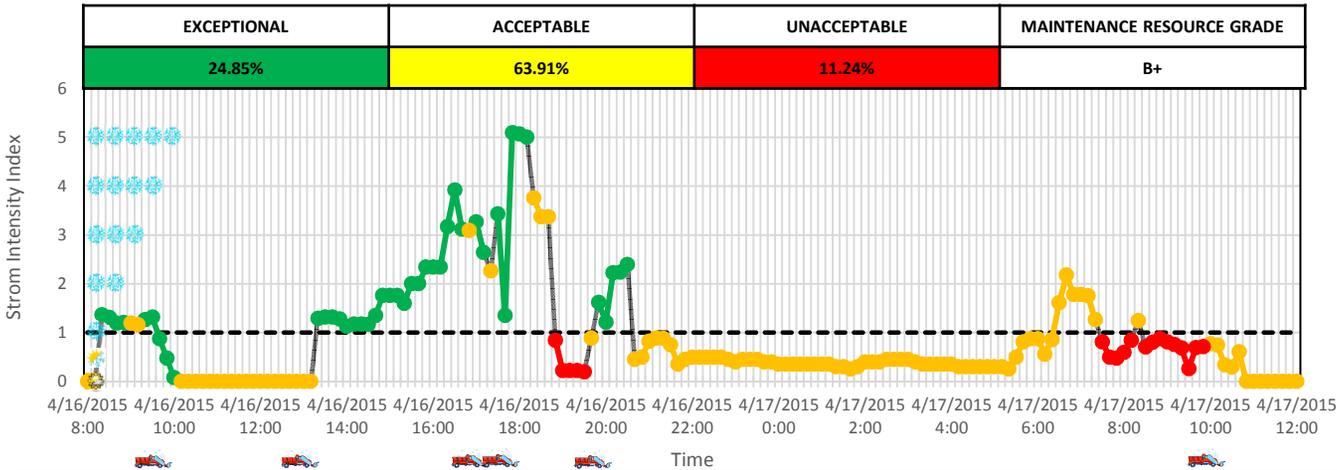
Select time frame by number of hours ago OR Select time frame by start and end date

Start Date 


 End Date

! Data during the selected time period has been manually flagged for potential quality errors. Please contact 801-887-37 with any questions. !

## Resource Performance Statistics – Storm 16



<b>Current Conditions</b>	
Sample Time:	8/26/15 10:00 AM
Temp/RH:	49 °F / 99%
Wind:	S 15 MPH, Gust 24 MPH
Visibility:	0.14 mi
Snowfall Rate:	n/a
Precipitation Intensity:	Heavy
Snow Depth:	n/a
Road:	50 °F, Wet
Road Grip:	0.50
Storm Intensity Index:	0.00 (Sun/snowflake symbol)

<b>Legend</b>	
<span style="color:green">●</span>	Road conditions exceptional given weather conditions
<span style="color:yellow">●</span>	Road conditions acceptable given weather conditions
<span style="color:red">●</span>	Unacceptable given weather conditions
<span style="border-bottom: 1px dashed black; width: 20px; display: inline-block;"></span>	Winter maintenance baseline

<b>Selected Storm Event Summary – Storm 16</b>			
WEATHER STATISTICS	MINIMUM	AVERAGE	MAXIMUM
Air Temp.	14.5 °F	23 °F	30.0 °
Road Temp.	18.0 °F	32 °F	63.0 °
Wind Gust	10.5 mph	20 mph	33.5 mph
Est. Snowfall Rate	0"/hr	0.3"/hr	4.8"/hr
IceSight Grip	0.10	0.50	0.82

<b>Current Winter Summary</b> (through 4/26/2015 8:30 AM)		
Average Resource Performance:	92.8% (A-)	(high)
Number of Storms:	17	(moderate)
Average Storm Duration (hrs):	30.2	(moderate)
Total Storm Duration: (hrs)	513.4	(high)
Average Storm Intensity Index:	0.74	(low)
Storm Intensity Index Sum:	12.6	(moderate)
Average Storm Severity Index:	20.1	(moderate)
Storm Severity Index Sum:	341.7	(moderate)

**More information on the Storm Intensity Index and snow and ice performance:**

[Video](#)

[Powerpoint](#)

UDOT Weather Desk: 801-887-3703

**Variable Graph Options**    Left Axis: Storm Intensity Index ▼    Right Axis: ▼



Conditions at 4/17/2015 10:30 AM  
 Temp/RH: 28.4 °F | Wind: N 17 mph, Gust 25 mph | Road: 35.1 °F, Ice | Visibility: 10.00 mi | Snowfall rate: n/a | Snow Depth: n/a | Precip. Intensity: Light | Road Grip: 0.3 | SII: 0.30

Current Season	2014-2015	2013-2014			
Storm Event	Avg. Storm Intensity	Storm Duration (hrs)	Storm Severity Index	Performance	
17 4/24/2015 11:10:00 PM - 4/26/2015 8:30:00 AM	0.81 *****	33.3	26.9	91.5% (A-)	
16 4/16/2015 7:50:00 AM - 4/18/2015 8:50:00 AM	0.54	50	27.0	88.8% (B+)	
15 4/15/2015 1:50:00 AM - 4/15/2015 9:10:00 AM	0.88	7.3	6.4	98.1% (A+)	

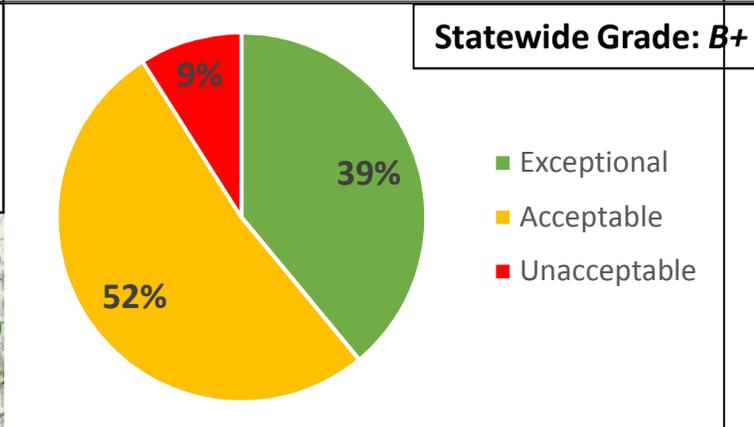
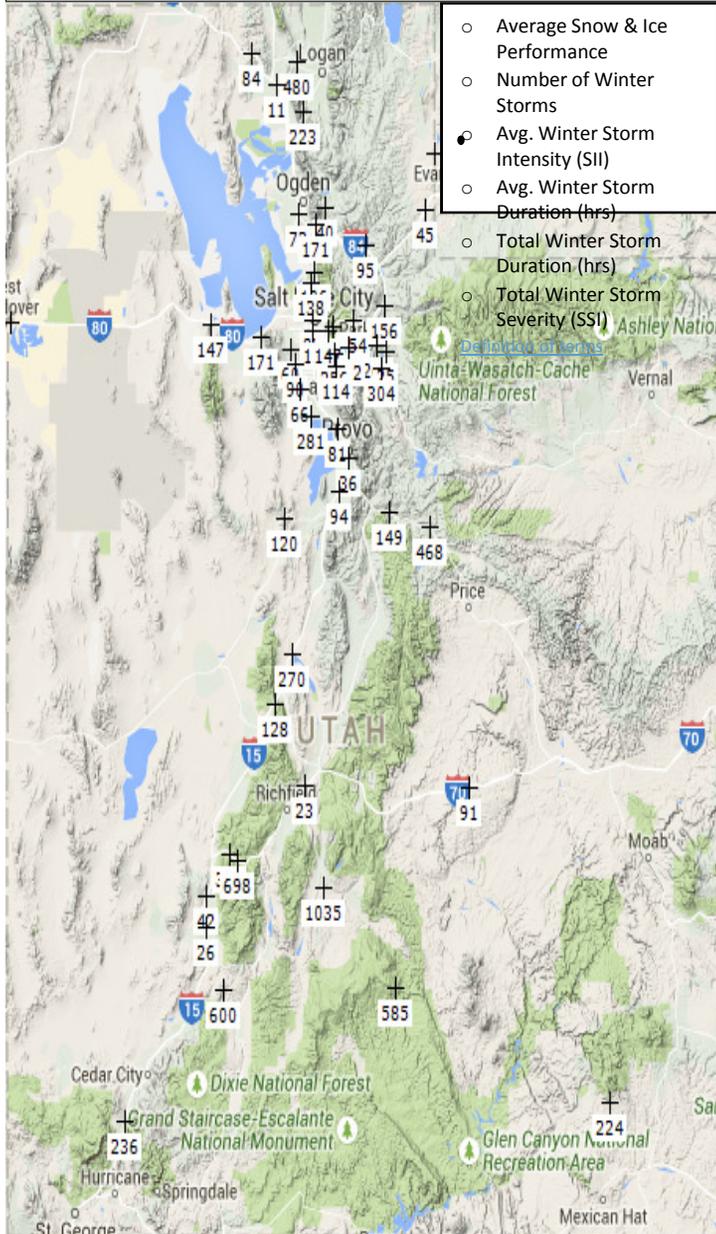
# Statewide Snow and Ice Performance Dashboard

Data for winter storm events:  
10/01/15 12:00 A.M. – 04/30/16  
12:10 P.M.

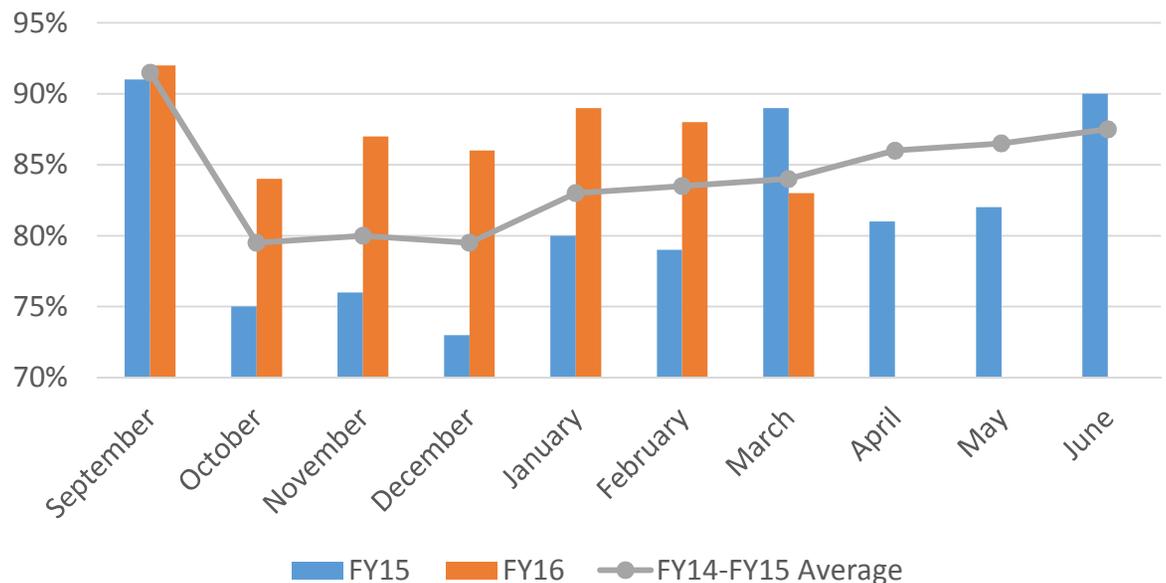
## 2015-2016 Statewide Winter Storm Statistics

## 2015-2016 Average Statewide Snow and Ice Performance

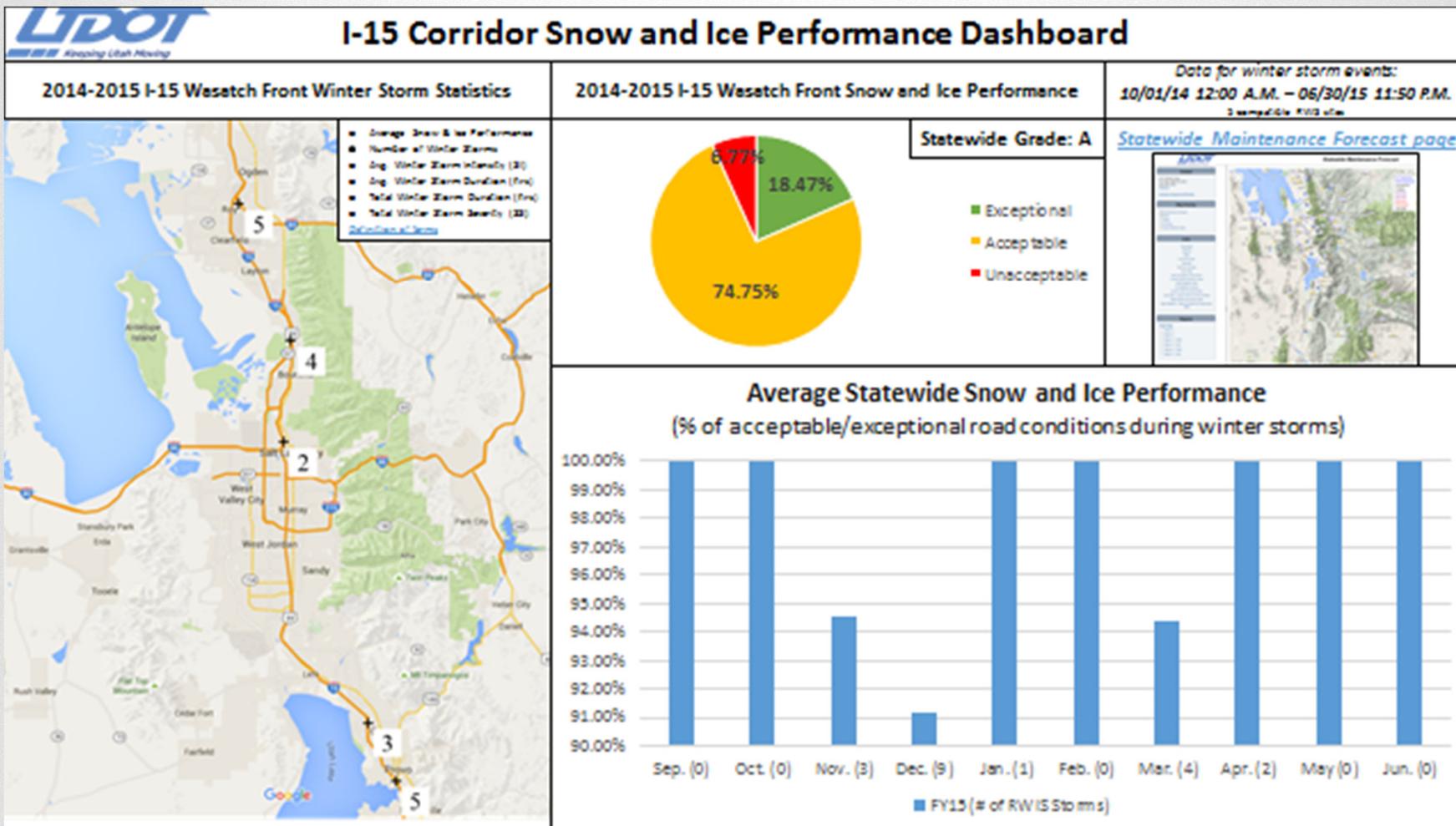
XX compatible RWIS sites  
[Statewide Maintenance](#)



## Average Statewide Snow and Ice Performance (% of acceptable/exceptional ? road conditions during winter storms)



# Information Prepared for Utah Legislature





# WASHTO Quality Award

- **UDOT Snow and Ice Performance Measure was just awarded the 2016 WASHTO Quality Award in February**

# Future Development

- Complete upgrades to remaining RWIS stations
- Develop locations for future RWIS installations
  - Focus on needs of our weather forecasting first
- Identify additional locations to complete Statewide Buildout
- Work with new mobile weather station technologies to provide additional information in areas where RWIS are not needed
- Continue to develop program and develop performance budgeting model

Questions?