



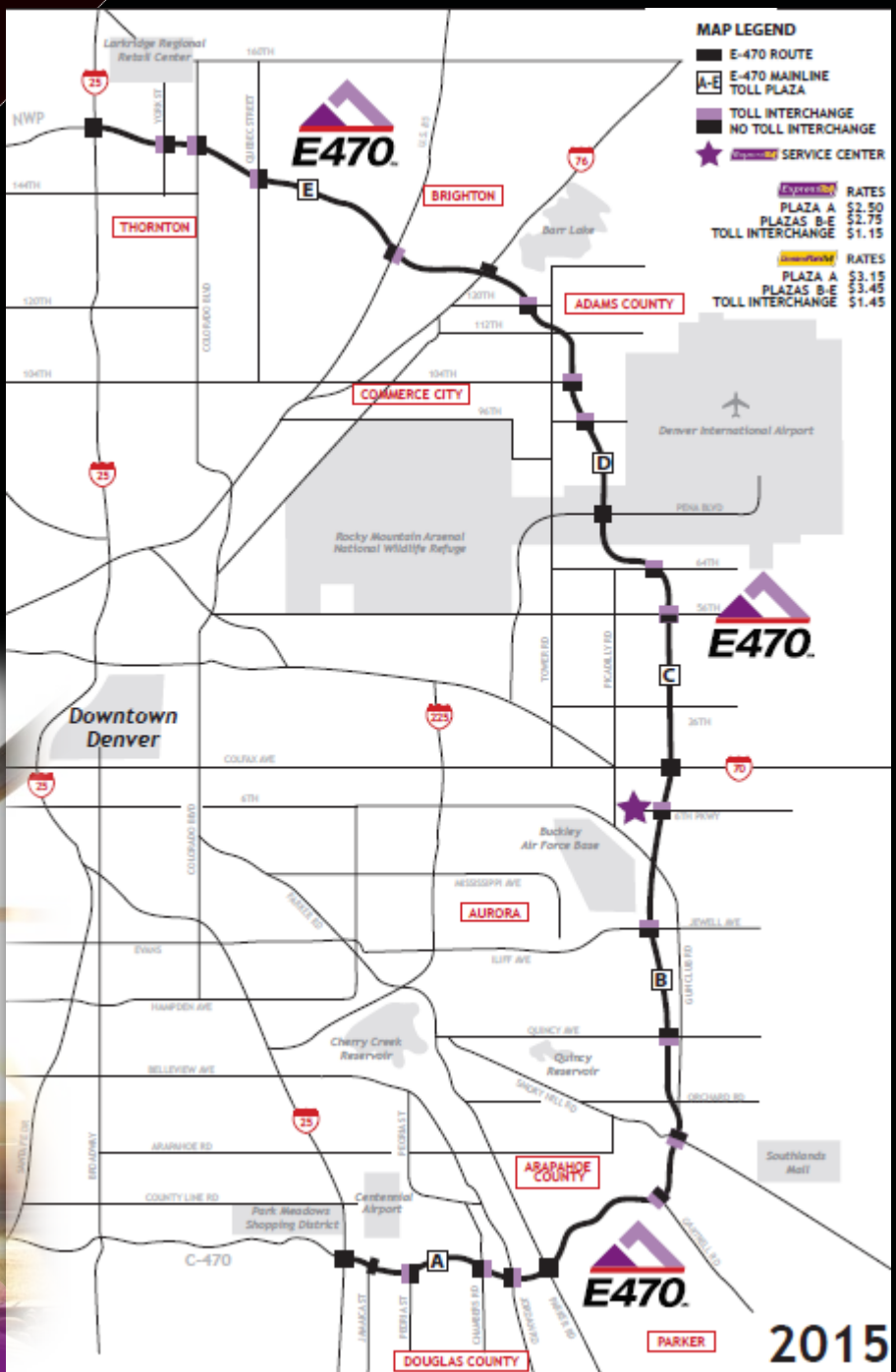
Snow and Ice Operations:

**the Good,
the Bad,
and the
Ugly...**



E470SM

Public Highway Authority





- 47.5 mile, all electronic toll road
- 34 ramps/5 plazas
- 154 license plate cameras



A yellow snowplow is shown from a front-quarter perspective, pushing a large amount of snow. The plow is moving through a deep snowdrift, creating a clear path. The background features snow-covered evergreen trees and a residential street with snow-laden roofs and trees. The overall scene is a winter day in a snowy environment.

The Denver metro area Climate Data







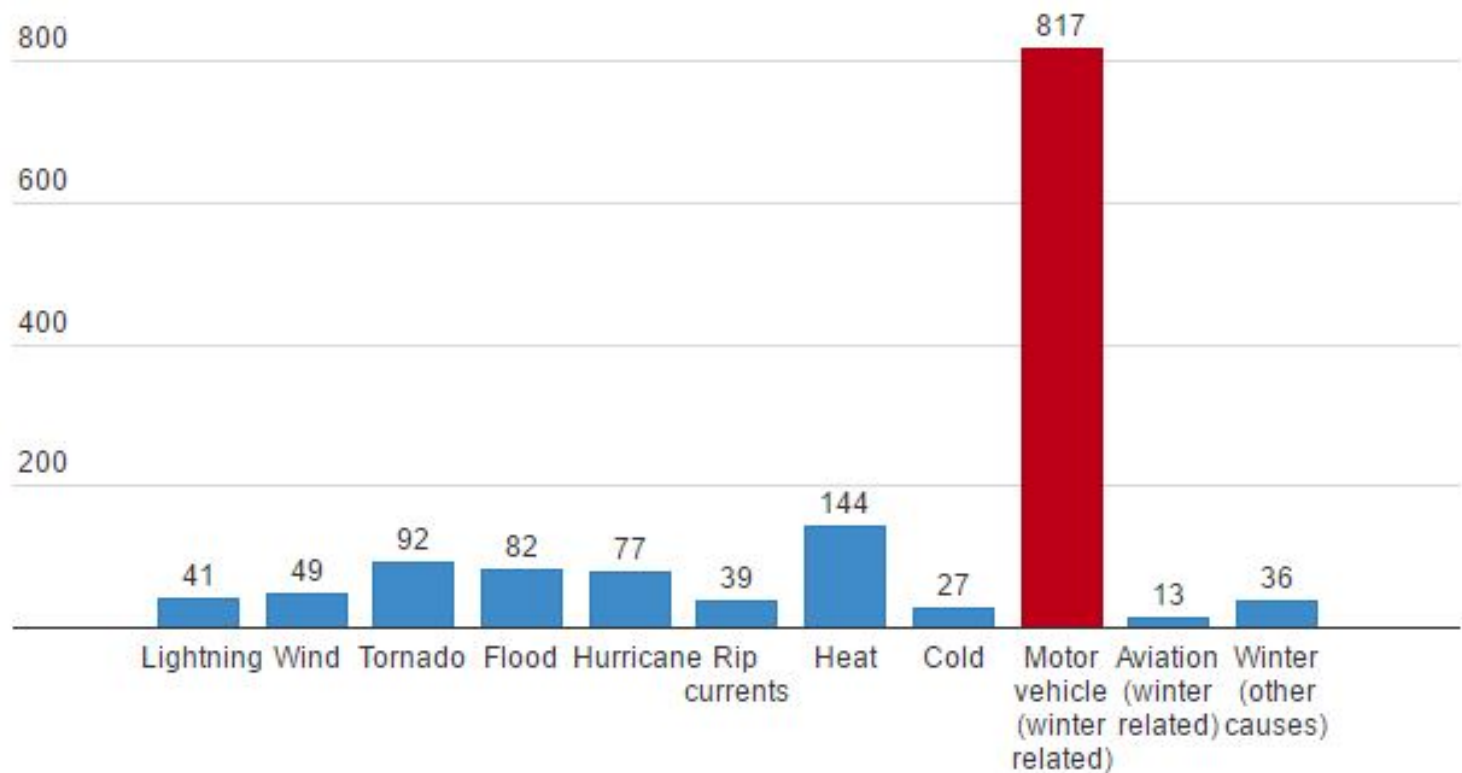
**The elevation of E-470
ranges from approximately
5000 feet to 6000 feet.**



Causes of death due to weather

This chart compares the number of average number of deaths per year caused by bad weather in the U.S. from 1996-2011.

Average deaths per year



Source: NOAA Storm Data Publication, Alan Black

Injuries Due To Ice and Snow

A photograph of a snowy winter scene. In the foreground, a yellow snowplow is heavily covered in snow, with its blade and wheels partially obscured. In the background, a black snowplow is parked on a street. The ground is covered in snow and ice, and a building is visible in the distance.

- About 70% result from vehicle accidents
- About 25% occur in people caught out in a storm
- Most happen to males over 40 years old



Statistics

200,000 miles driven

6,000 truck hours

40,000 gallons of fuel

4,500 tons of solid deicer used

1,000,000 gallons of MgCl used



- **LPT revenue lost due to weather**
 - **2014**
 - **105,663 transactions**
 - **\$142,645**
 - **2015**
 - **174,683 transactions**
 - **\$253,290**



- **8 technicians dedicated to tolling maintenance**
- **Snow event duties:**
 - **Cleaning snow and ice out of cameras**
 - **Cleaning splash from camera lenses**
 - **Responding to equipment failures**





- **Lessons learned**
 - **Timing is everything**
 - **The importance of using the right products**



NOREAD

Time 6:49:33 pm Shutter 11

Read Conf 0 Gain 47

Width 0

Find Conf 2415



409QBB

Time 6:50:19 pm Shutter 11

Read Conf 88 Gain 47

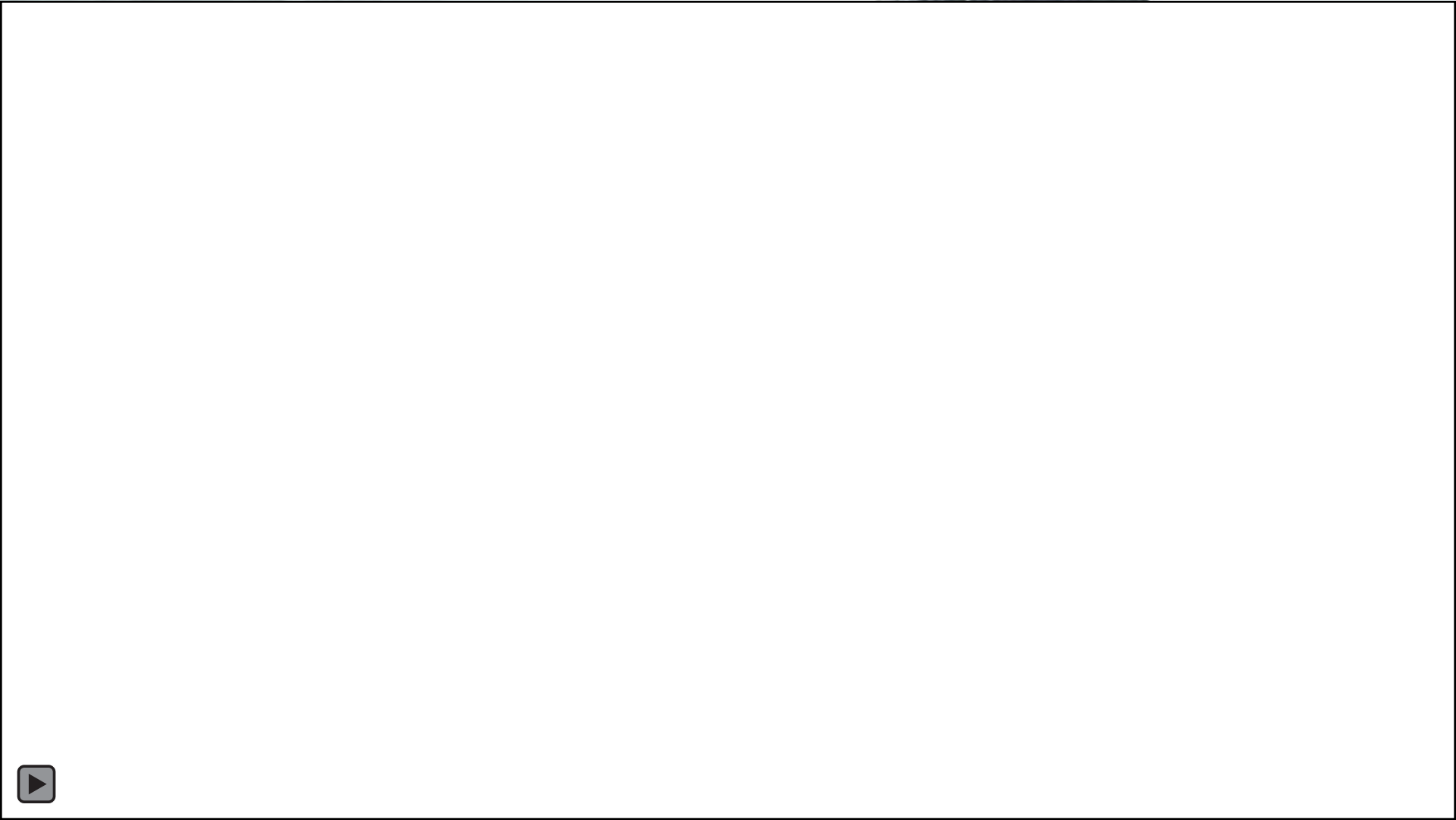
Width 152

Find Conf 0





- **Lessons learned**
 - **Timing is everything**
 - **The importance of using the right products**
 - **Safety is key**





- **Surveillance and Monitoring**
 - **42 Axis cameras**
 - **Challenges during and after snow events**





- **Mitigating Damage**
 - **Camera lenses**
 - **Gantry mounted readers**



IDentity 325P

STATUS

- WAVE
- HEALTHY
- FAULT
- POWER

sirit

IDentity 325P

STATUS

- WAVE
- HEALTHY
- FAULT
- POWER

sirit

01.13.2011 21:24







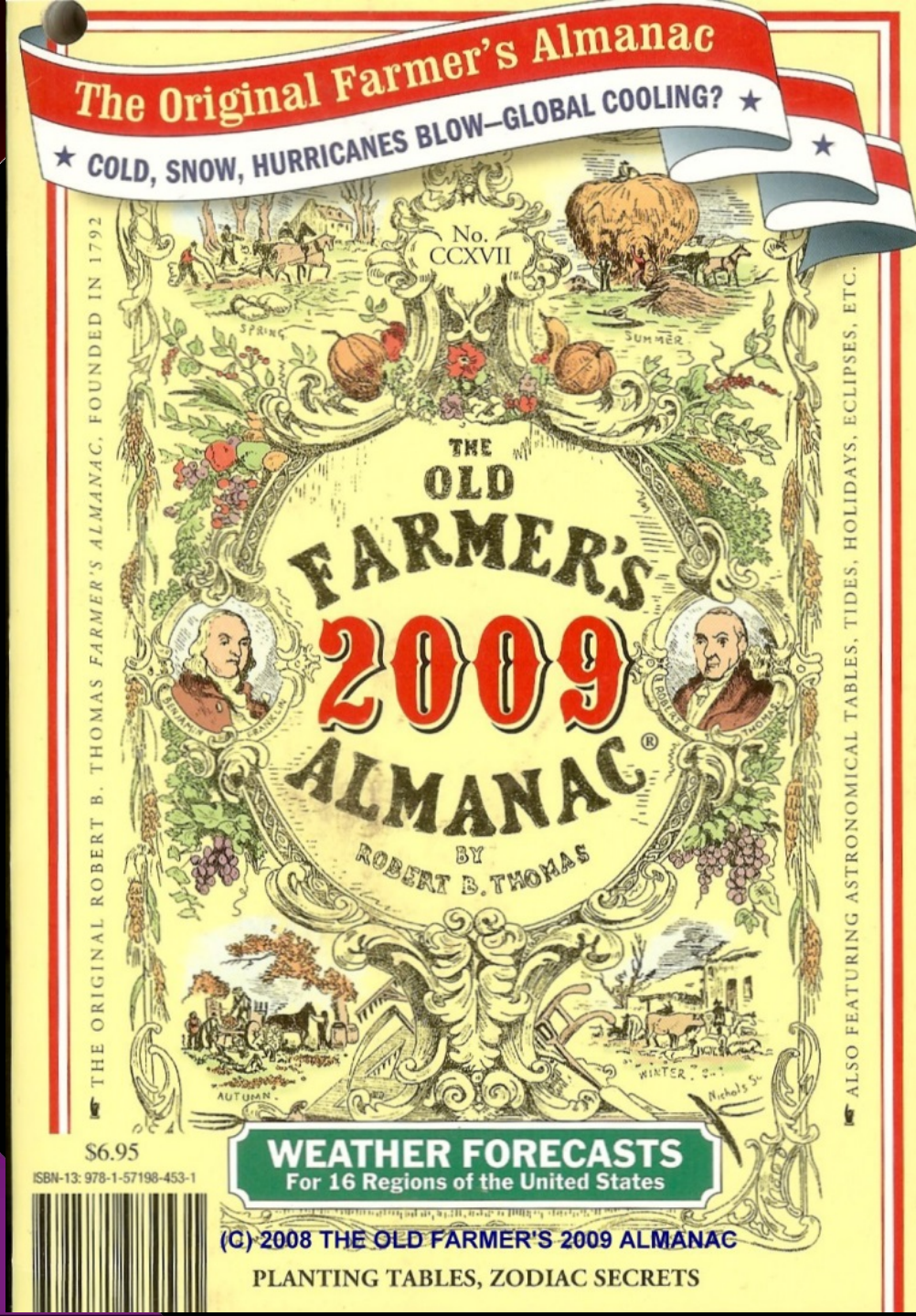








Weather Forecast





YOU KNOW WINTER IS COMING

**WHEN THE TUMBLEWEEDS START
MIGRATING**





Technology



- Cameras
- Weather services
- Weather stations and pavement sensors
- Road Weather Information Systems (RWIS)



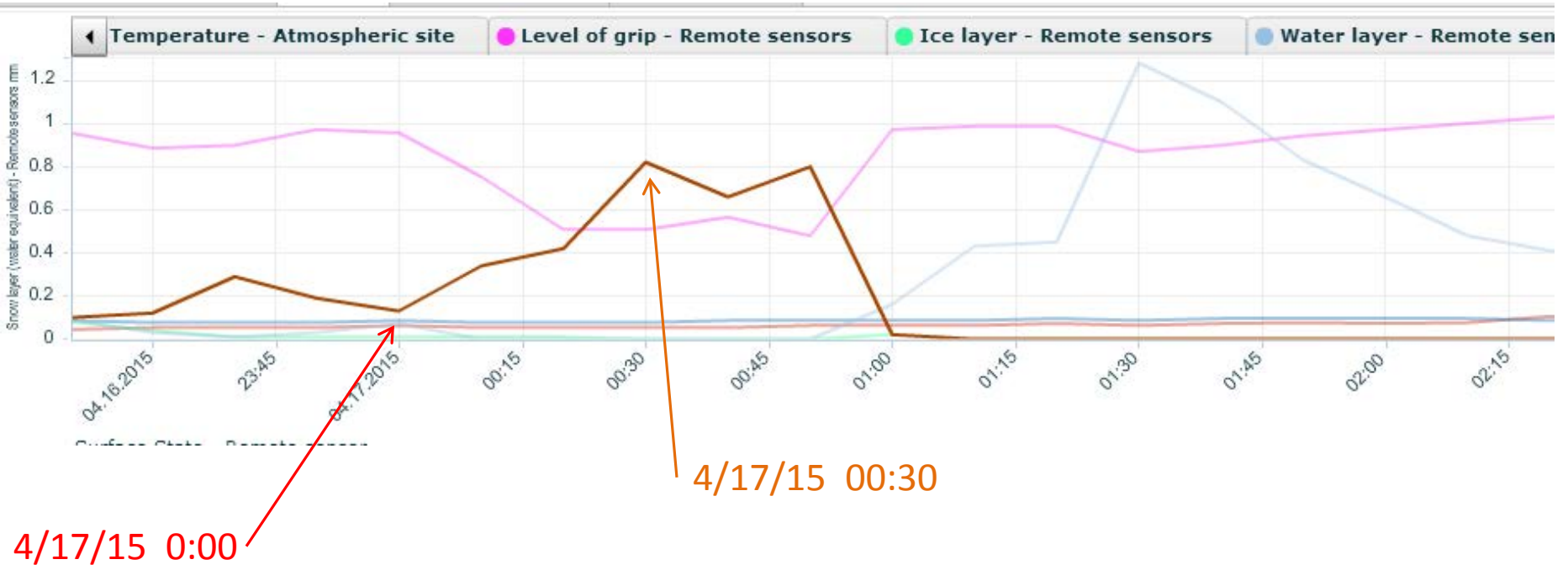
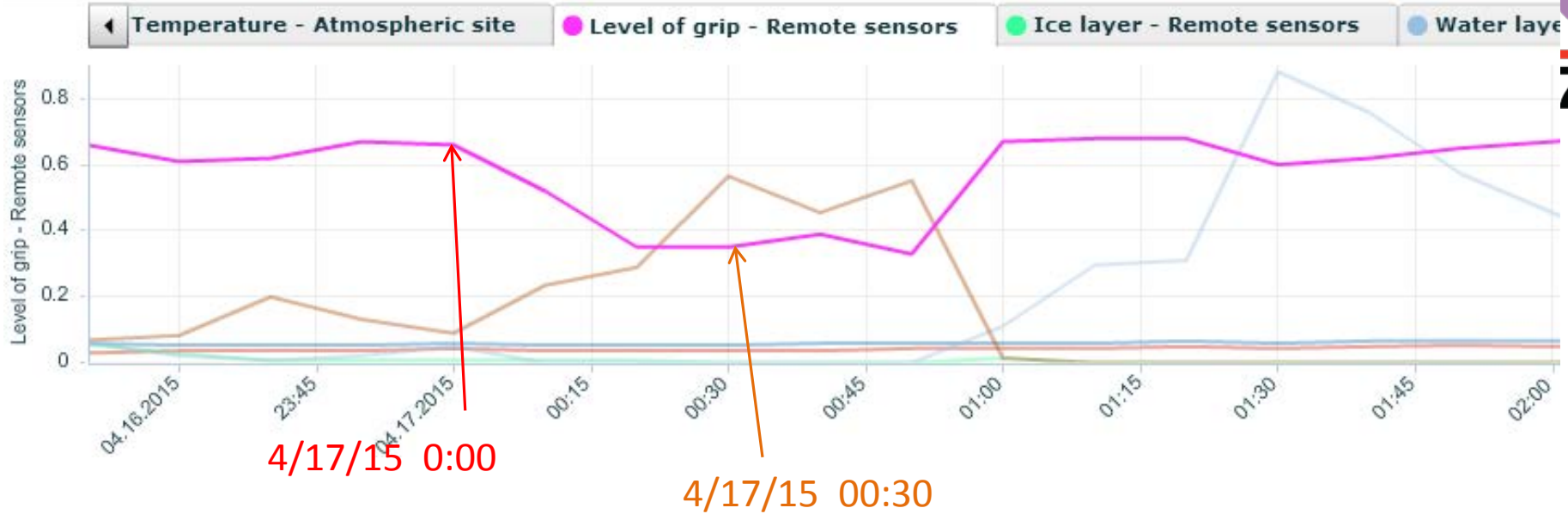
Winter Performance Index Legend (Basic scale)

0.0	Successfully treated
0.00 - 0.30	Significantly accelerated grip recovery
0.31 - 0.49	Some success at grip recovery
0.50 - 0.69	Very little success at deicing
0.70 -	Limited maintenance or no deicer success
	Observation data / parameter missing or temp is below three

Station	Date	Time Range	Event	Duration	Max Wind Speed	Max Ice Layer	Max Snow Layer	Max Water	Min Surface	Severity Index	Performance Index	Mobility Index
Cherry Creek (C/S)												
	01.30.2016	23:20 - 00:30	TREATED	1.17		0.04	0.03	0.20	29.84		0	100%
	01.31.2016	04:50 - 07:00	TREATED	2.17		0.00	0.00	0.10	30.38		0	100%
	01.31.2016	07:00 - 08:30	FROST treated	1.50		0.00	0.00	0.03	30.92		0	
	01.31.2016	17:20 - 20:40	TREATED	3.33		0.00	0.00	0.17	28.22		0	100%
	01.31.2016	20:40 - 03:50	FROST treated	7.17		0.00	0.00	0.03	24.80		0	
	02.01.2016	06:30 - 10:30	FROST treated	4.00		0.00	0.00	0.03	26.60		0	
	02.01.2016	10:30 - 20:00	TREATED	9.50		0.04	0.40	0.18	26.24		0	67%
	02.01.2016	20:00 - 05:40	GRIP<.6	9.67	10	0.02	2.08	0.11	20.12	25.0205	0.39	
	02.02.2016	05:40 - 11:50	TREATED	6.17		0.02	0.51	0.35	20.48		0	
	02.02.2016	16:00 - 18:10	FROST treated	2.17		0.00	0.00	0.02	23.36		0	100%
Platte River Bridge												
	01.31.2016	18:41 - 21:31	FROST treated	2.83	6.26	0.00	0.00	0.03	30.92	16.00	0	100%
	02.01.2016	00:01 - 01:41	TREATED	1.67	10.51	0.11	0.00	0.37	27.86	21.65	0	
	02.01.2016	01:41 - 03:41	GRIP<.6	2.00	8.72	0.23	0.01	0.04	26.96	20.08	0.10	80%
	02.01.2016	05:01 - 05:51	FROST treated	0.83	8.72	0.00	0.00	0.02	28.04	19.44	0	
	02.01.2016	05:51 - 09:53	TREATED	4.03	9.62	0.00	0.00	0.12	27.68	20.58	0	
	02.01.2016	14:51 - 19:02	TREATED	4.18	17.67	0.08	0.05	0.76	27.86	29.20	0	
	02.01.2016	19:11 - 04:01	GRIP<.6	8.83	18.79	0.26	0.43	0.26	22.46	32.58	0.27	
	02.02.2016	04:01 - 06:31	TREATED	2.50	17.22	0.07	0.04	1.38	21.92	32.29	0	53%
	02.02.2016	06:31 - 07:11	GRIP<.6	0.67	14.09	0.18	0.09	0.04	23.18	27.21	0.02	
	02.02.2016	07:11 - 11:01	TREATED	3.83	16.11	0.13	0.04	1.11	21.38	31.25	0	
E-470 & I-25												
	01.28.2016	05:30 - 08:00	FROST treated	2.50		0.00	0.00	0.01	25.70			100%
	01.31.2016	05:30 - 08:10	FROST treated	2.67		0.00	0.00	0.03	24.62		0	100%
	01.31.2016	18:50 - 13:00	TREATED	18.17		0.00	0.00	0.56	25.52		0	100%
	02.01.2016	15:10 - 18:09	TREATED	2.98		0.07	0.55	0.43	27.32		0	
	02.01.2016	18:09 - 01:10	GRIP<.6	7.02	10	0.10	0.97	0.18	21.02	24.4521	0.29	
	02.02.2016	01:10 - 07:40	TREATED	6.50		0.11	0.13	1.59	19.58		0	55%
	02.02.2016	07:40 - 09:50	GRIP<.6	2.17	10	0.06	0.52	0.03	20.84	24.4254	0.09	
	02.02.2016	09:50 - 11:30	TREATED	1.67		0.05	0.18	1.31	22.82		0	
	02.02.2016	16:20 - 09:10	FROST treated	16.83		0.00	0.00	0.03	-0.04	-7500	0	100%

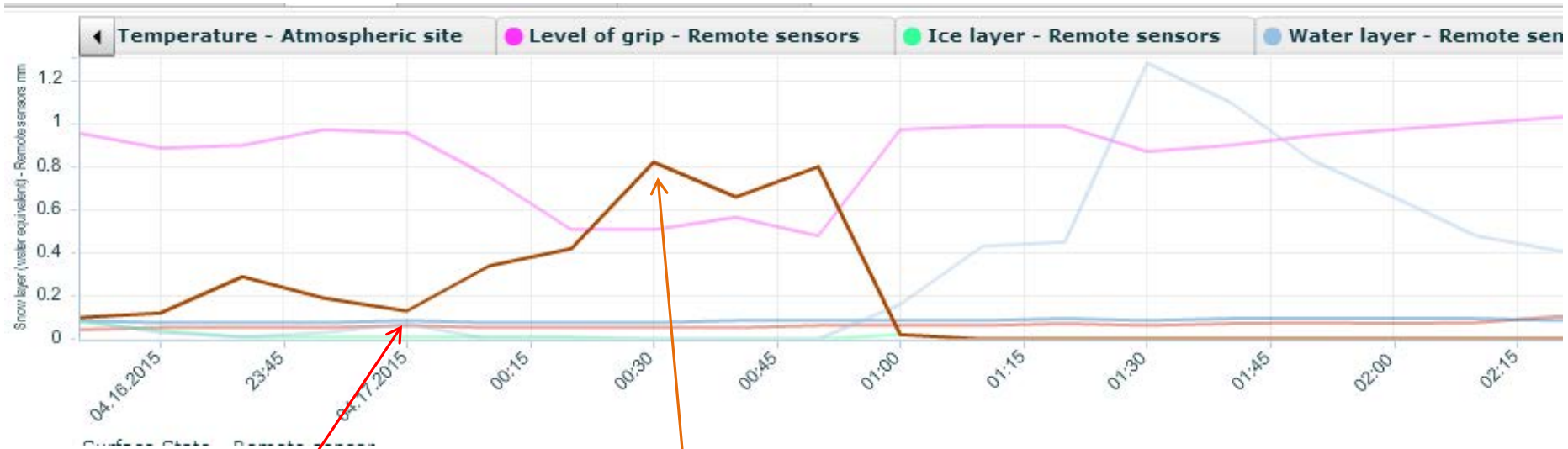
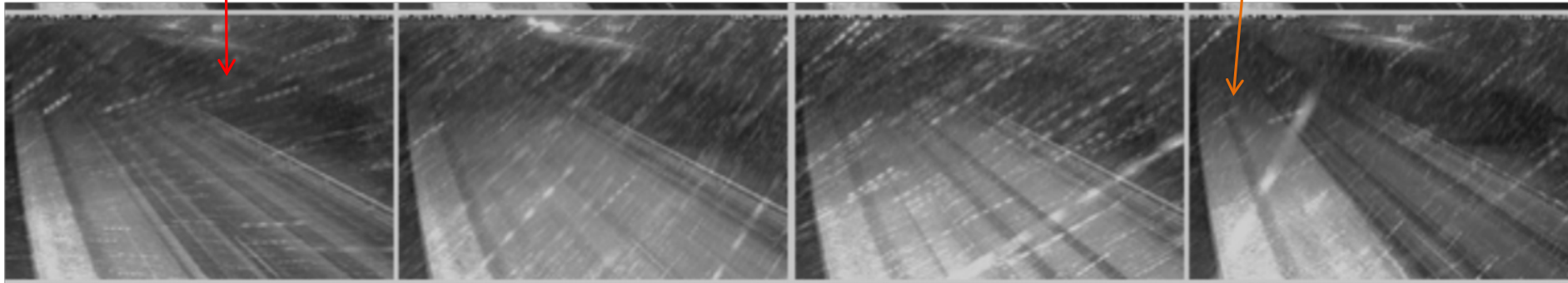


- **General ranges of grip**
 - **.60-.82 wet**
 - **.50-.60 slush or ice forming**
 - **.40-.50 snow pack or icy**
 - **Below .40 cars may start to slide off the road**



4/17/15 0:00

4/17/15 00:30

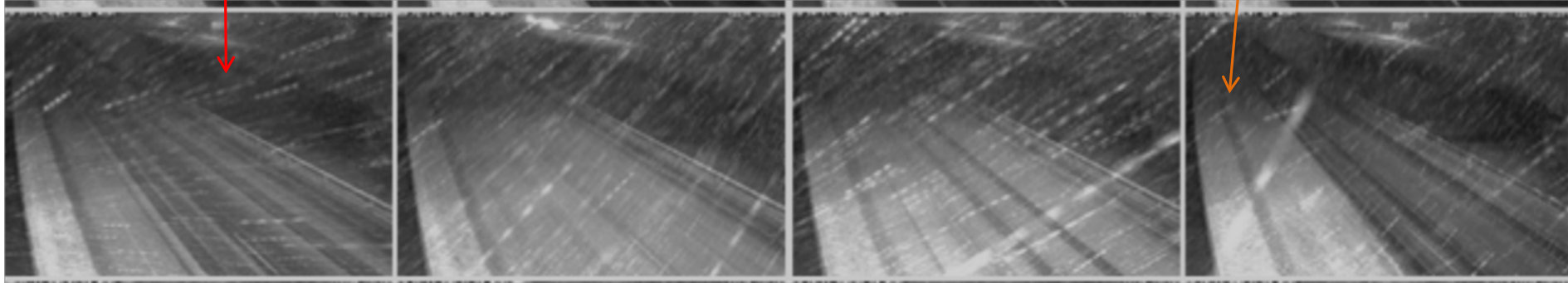


4/17/15 00:30

4/17/15 0:00

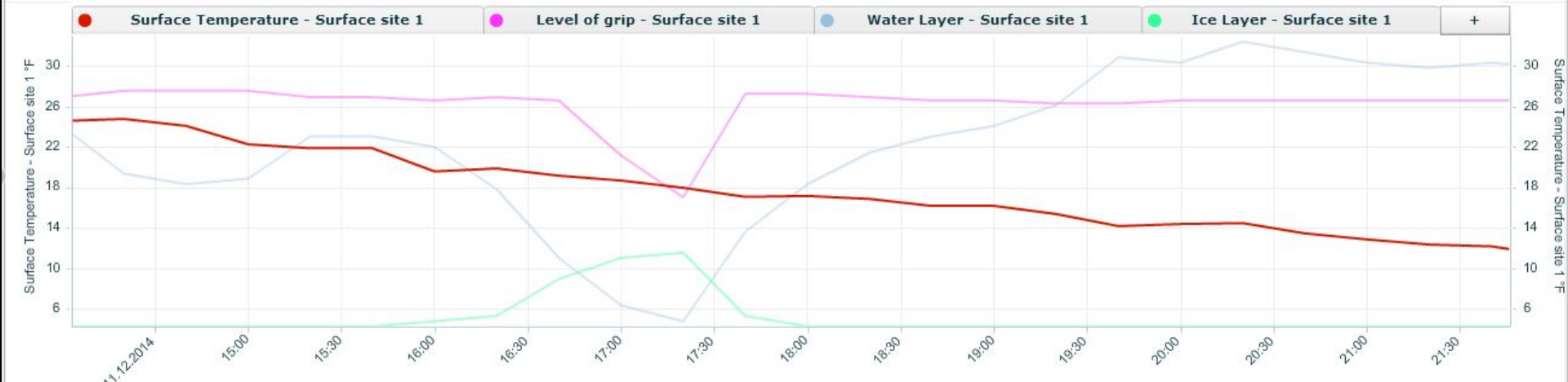
4/17/15 0:00

4/17/15 00:30



T
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P
S









Plowing hail 5-21-2014



Other Duties as Assigned!





- **Nicki Beckford**
 - **nbeckford@e-470.com**

- **Derek Slack**
 - **dslack@e-470.com**