



RWIS Automated Advisory System Centralized advisory system for the control of Dynamic Message Signs

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Alberta  Transportation

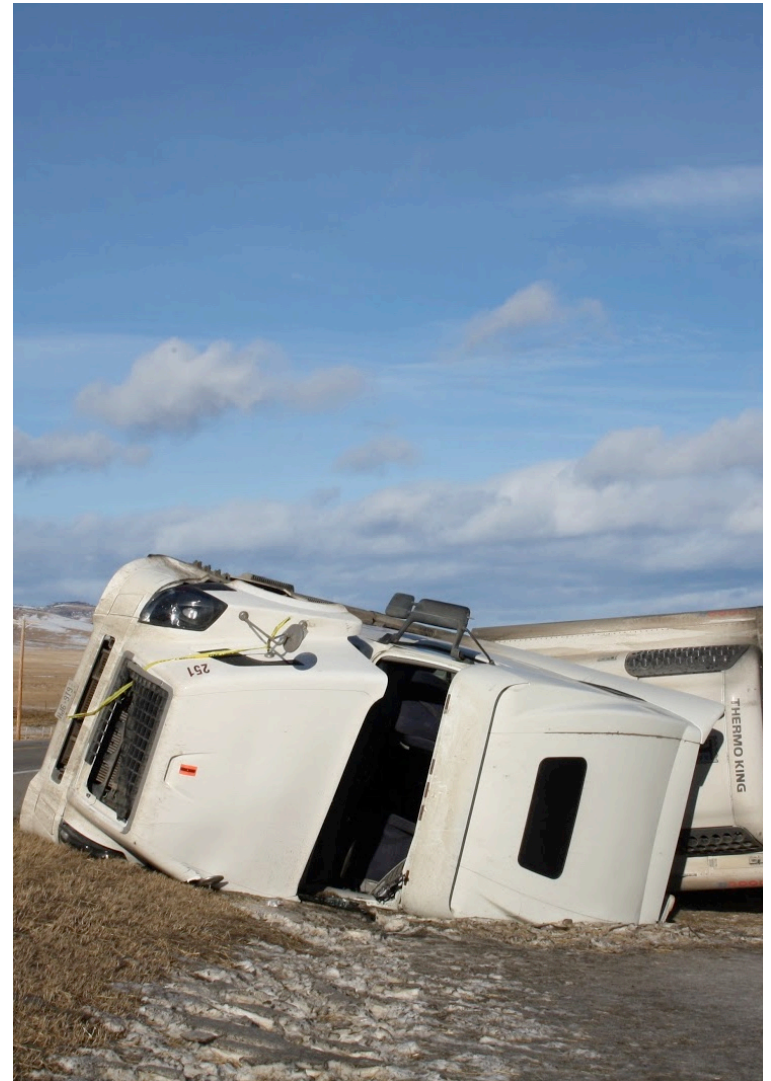
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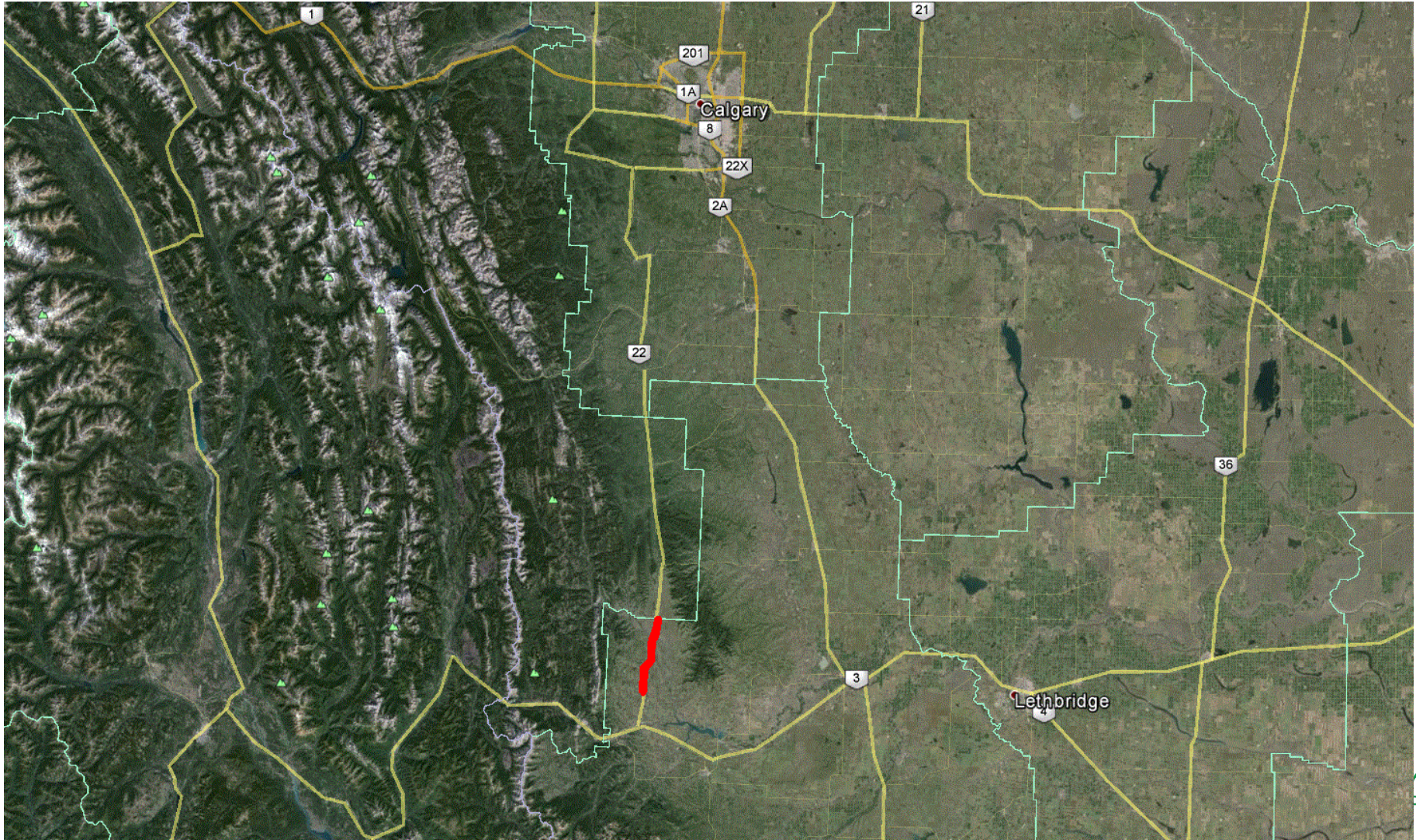
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Introduction

- **Alberta Highway #22 experiences dangerous wind gusts**
 - Mostly occurring between kilometres 7 and 27
 - Dubbed by locals as the “Wind Tunnel”
 - Local geography and Chinook winds are the cause
- **Between November and April, motorists are at highest risk**
 - Strong wind gusts blow vehicles over, even if they are parked
 - Vehicles are blown into on-coming traffic in the other lane
- **Alberta Transportation wanted to take a pro-active approach**
 - Try to reduce the number of wind related accidents and improve safety for the motoring public.





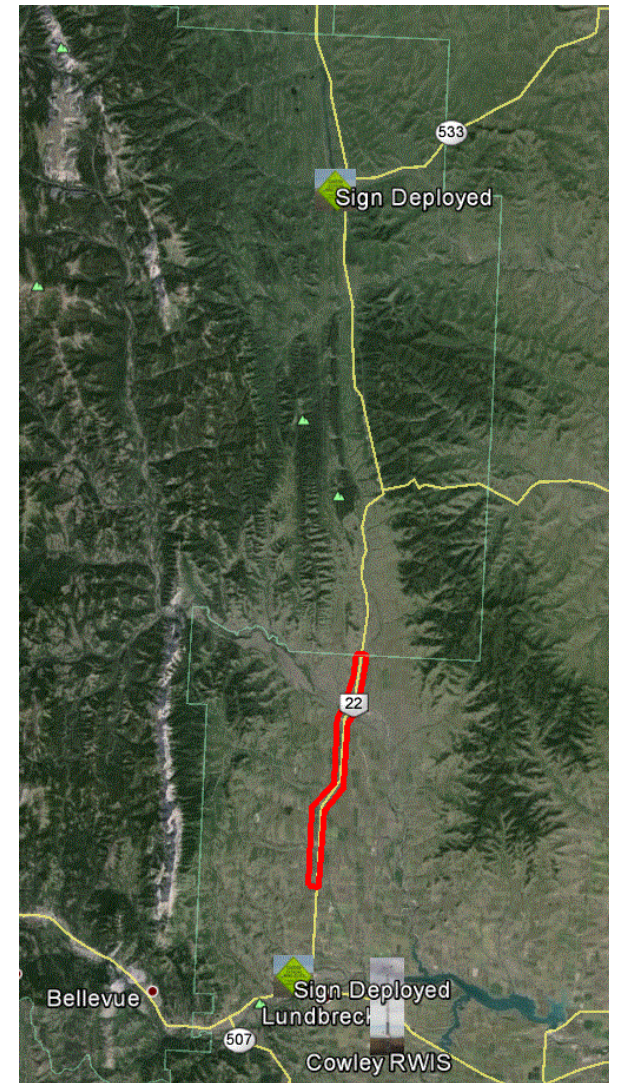
Serious Accidents

- On February 11, 2011 approximately eight vehicles were blown over
 - 6 semi trailer units
 - **3 from BC, 2 from Ontario and 1 from Nevada**
 - 1 pick-up with a utility trailer
 - 1 R.V. unit.
- Between September 2010 to April 2011 there were 16 similar accidents, and **previous years had 4-6 accidents each**
- Large cost per accident
 - Estimates range from \$25k to \$40k
 - Other DOTs estimate upwards of \$80k



The Existing Advisory System

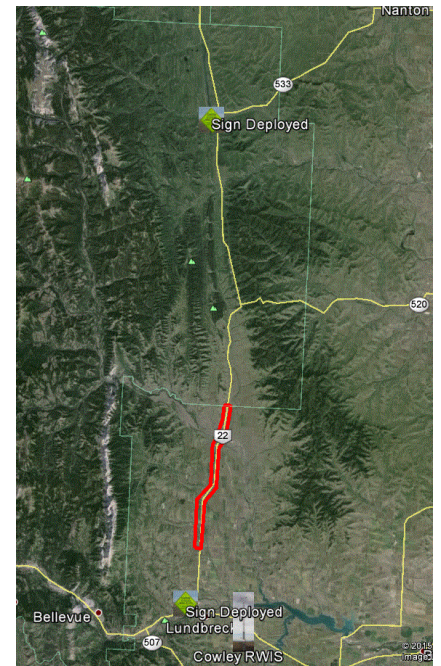
- **Wind speed measured** at the Cowley RWIS
 - Located approximately 8 kilometres east of the #22/#3 junction.
- When the wind gusts exceed 80 km/h at Cowley RWIS, the HMC Volker Stevin would **deploy portable signs**:
 - 150 meters north on #22.
 - Junction #533 and #22 near Chain Lakes to warn the south bound traffic
 - Calls would be placed to
 - Burmis VIS, if opened, who warns all other VIS sites in southern Alberta
 - Alberta Transportation & B.C. Ministry of Transportation.



Limitations of the Existing System



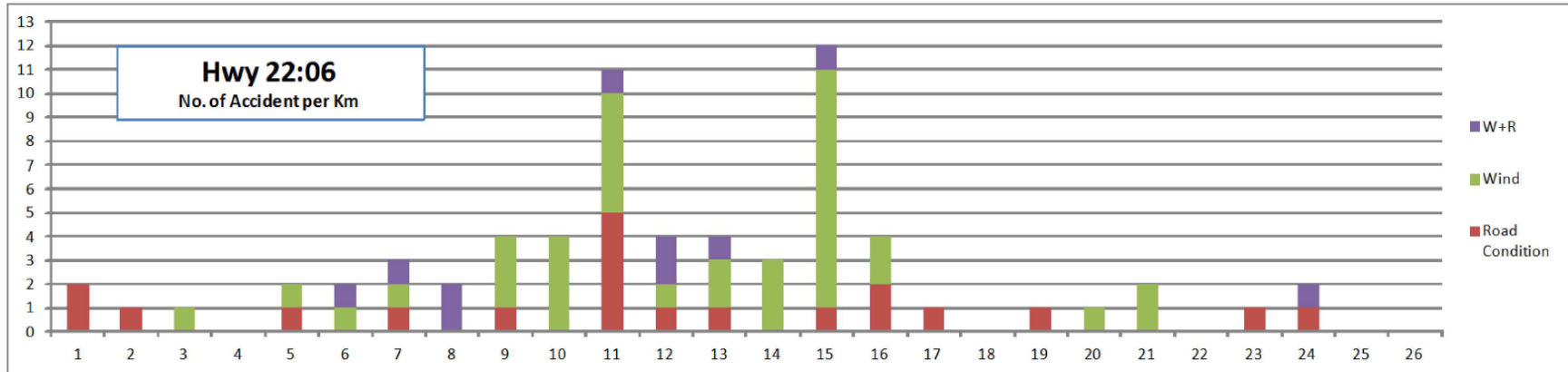
- The RWIS site at Cowley **doesn't accurately reflect the wind speed on highway #22.**
 - Experience has shown that only moderate winds are experienced at Cowley while extreme winds are occurring in the danger zone.
 - The other RWIS north on #22 is also not representative of the danger zone.
- **This procedure is completely manual**, and not fast enough
 - Monitoring the wind speed
 - Someone had to monitor the wind speed continuously, or by instinct.
 - New alerting capabilities from RWIS data management system helped
 - Deploying the signs
 - **By the time personnel arrive the wind event is subsided or has already claimed a couple of vehicles.**
 - Poor Sign Placement
 - Only HWY #22 is signed, and nothing on Highway #3 or Highway #2..



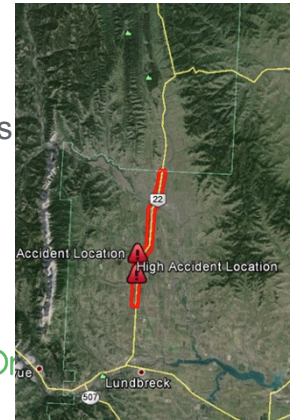
Wind Task Group

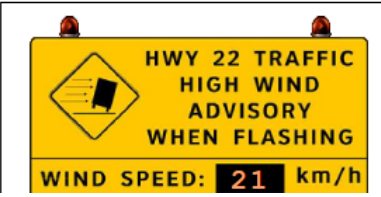
- The **Wind Warning Task Group was formed** in June 2011
 - With representatives from local RCMP, Landowners, Emergency Services, local MLA, District AT MCI, local gas plant owner and HMC Volker Stevin
- Concluded with two options proposed:
 - Plan A
 - A **simplified RWIS** station near Compton
 - Site chosen to reduce cost by partnering with private business for power and communications
 - Measures only wind
 - Wind data fed into AMA (now 511 Alberta) road reports
 - Plan B
 - Additional **static signage** on Hwy 22 and 3
 - Signs would include a wind-sock as seen in other jurisdictions
- In the end, elements of these were combined into the final requirements

Accident Study



- A study was done to analyse MVA data
 - A clear picture started to form of where the wind and road condition accidents were occurring
 - The **RWIS station was proposed near kilometre 15**, also the location of the highest number of collisions
- Research from other DOTs was reviewed
 - Clear indications that an automated system can bring immediate benefits





Higher Wind-Threshold
 0 km/h — 150 km/h
Current Value: 50 km/h

Beacon Activation Hold Timer ●
 0 mins — 120 mins
Current Value: 41 mins (0.68hrs)

Select Data Set:
 Lundbreck Small
 Previous 24 hours Previous 48 hours
 Previous 72 hours Show All data

Wind Advisory System Simulator - Pre-Alpha Version

© 2014 Schneider Electric [JH, JL]
 • DMS driven by average speed (if enabled)
 • Beacons driven by gust speed only

Final Requirements

Initial Requirements

- Wind-only RWIS, located at km 15
 - Save cost with less sensors
- Four advisory signs with dynamic elements
 - Installed at key turn-off points
 - Power and communications **TBD**
- Automatic updates of signs from RWIS
 - Parameters **TBD**
 - Data smoothing
 - Signs controlled by simple close-contact relays
 - SMS alerting on activity

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Final Requirements

- A **full RWIS site** at this site
 - Upgrade to most rugged wind sensor available
 - Include full set of measurements
- **Six advisory signs** with dynamic elements
 - Installed at key turn-off points
 - 3 signs have power, 3 don't. All have cell coverage
- Automatic control from the **central server**
 - Wind speed display constantly updating
 - Data smoothing by way of activity hold timers
 - Some signs have full NTCIP interface, some are simple close-contact relays
 - SMS & email alerting on activity, with rate limiting

Sign Design



- **Solar Sites**

- Flashing Beacons
- Modbus controlled
- Solar Powered
- Local Override switch

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- **DMS Sites**

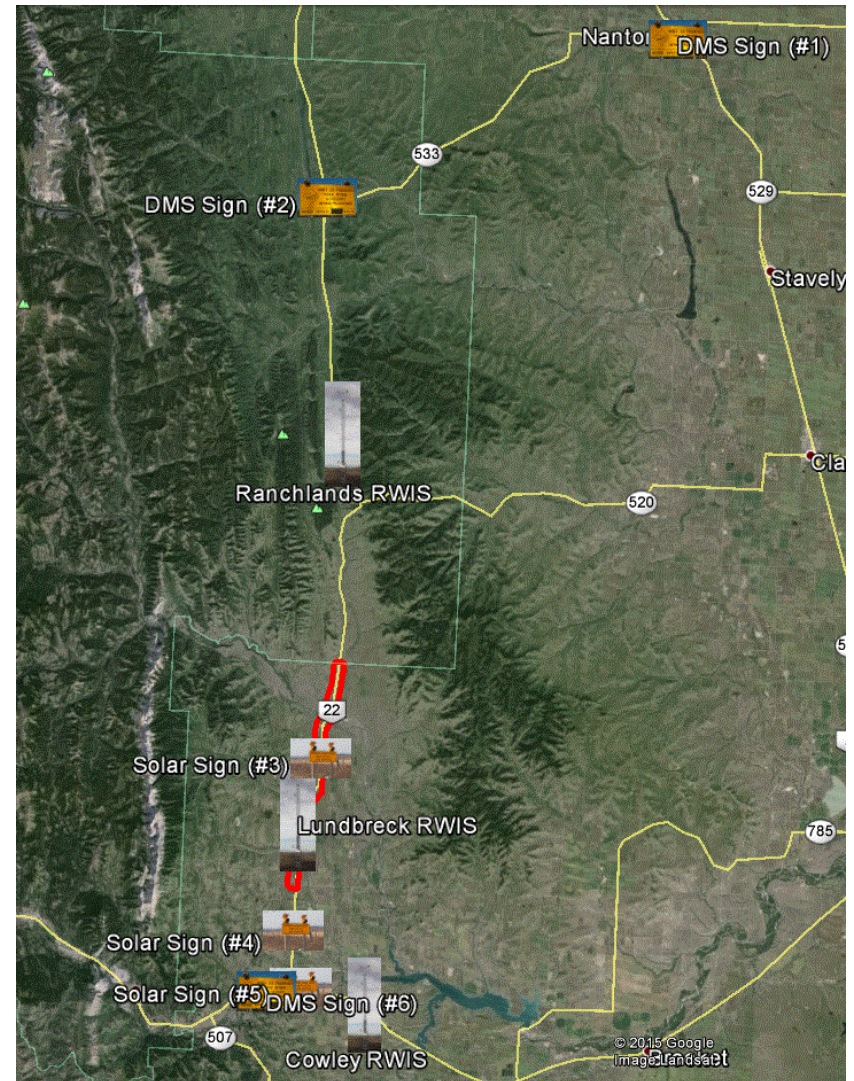
- Flashing Beacons
- Wind Speed display in the DMS
- NTCIP controlled
- Utility power
- Local Override Switch

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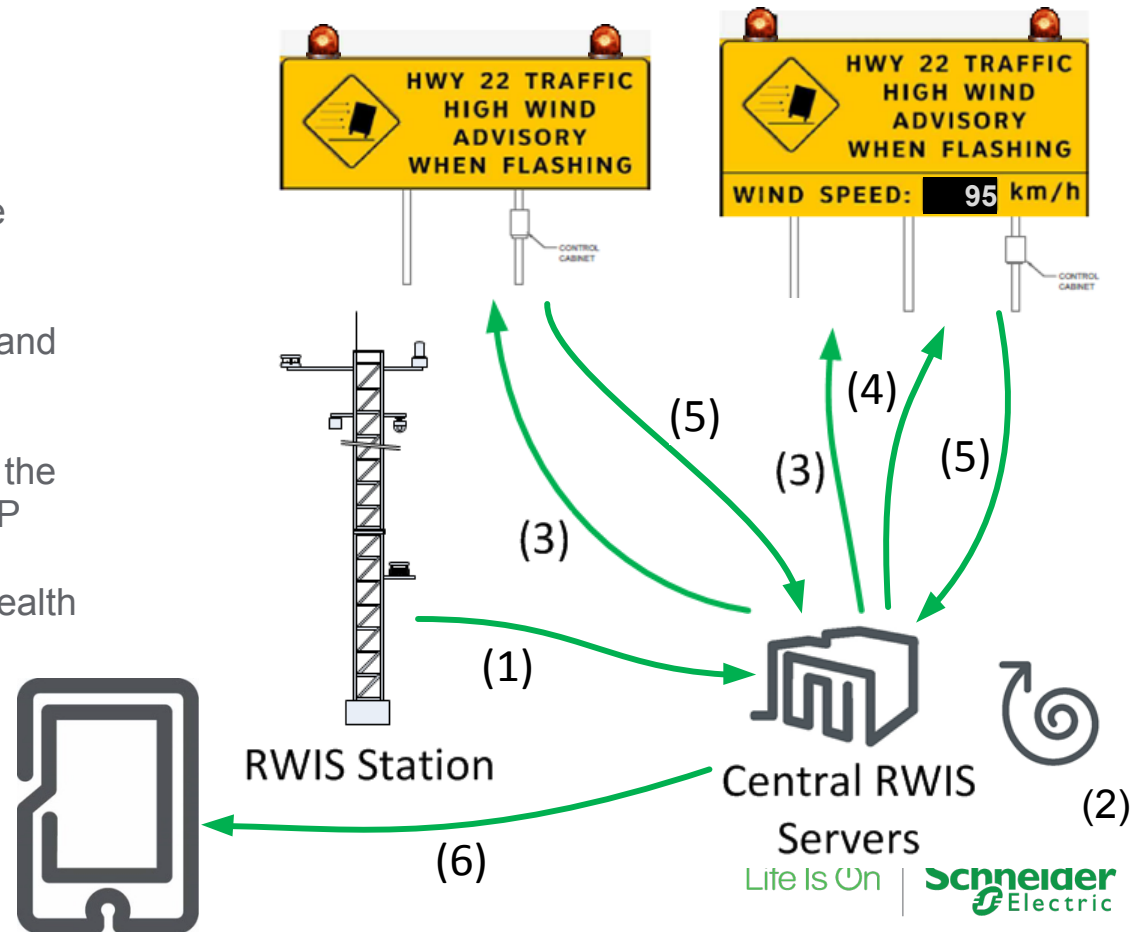
Sign Placement

- 6 Advisory signs were installed
 - **Locations prior to turn off points were chosen**, to give drivers the chance to choose alternate routes.
 - **Not all drivers in the February 2011 accident were local**
 - Local drivers rely on tricks of the trade to know if Hwy 22 is dangerous
 - E.g A flag flying 4 miles east of the #22/#3 turn-off
- **Signs were located over a 100 km stretch of roadways**
 - Traditional radio communication designs would not be appropriate



Overview of Operation

1. Wind Data from the Lundbreck RWIS retrieved by Central Server
2. The rule engine decides to activate the beacons.
3. The beacons are activated via NTCIP and Modbus
4. Every minute, the rule engine updates the wind speed on the DMS sign via NTCIP
5. As part of the regular poll cycle, sign health is brought back and analysed for faults
6. Text messages are sent to the appropriate parties



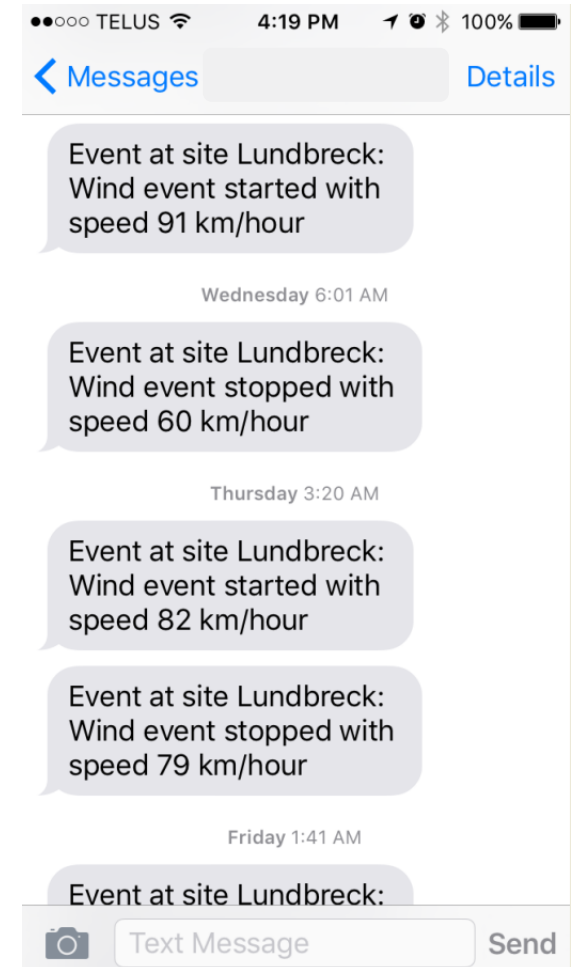
Rule Engine Benefits

- AT wanted to keep the door open to future research on advisory algorithms
 - **Can easily implement new rules** as research progresses
 - **Can use inputs from others sources**
 - Example: forecasted weather, other observation stations or groups of stations (static, mobile), national meteorological service alerts
 - **Can control DMS assets anywhere.**
 - Example: mobile DMS trailers during storms or certain seasons
- **Re-useable**
 - Spring 2016 implementation for bridge decks will use the same rule engine. No custom coding required.
- All automation happens in the central system
 - Fully automated. No humans required. Works 24x7 unaided
 - Easy access to all operational reports and logs.
 - Notifications via SMS and email are easy and reliable.
- **Safe**
 - Obeys the local override setting on each sign
 - Obeys remote override from 511 operations
 - Monitors itself and the signs for proper operation, and will blank all signs on major problems



Notifications

- **Groups of interest (provincial, regional, etc.)**
 - Users are placed in a group attached to a site
 - Only users interested in notifications for that site get the notifications
- **Categories (event notification, system health, etc.)**
 - Notifications fall into different categories, and users will only get the types of notifications they care about.
- Rate Limiting
 - Fully automated systems need to rate limit themselves so that they don't spam the users
 - Rate-limiting is per-category.



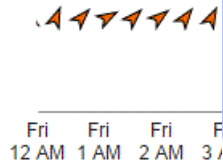
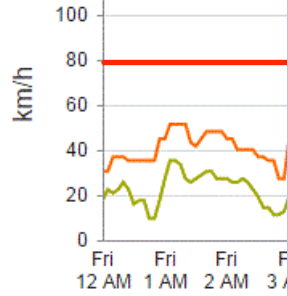
Current Performance

- The system (hardware + software) is fully deployed at one site
- Accuracy thus far
 - **Wind season came early** (see following slides)
 - The system has correctly controlled all 6 signs through dozens of high wind events
 - The data smoothing employed has made the system responsive and without “chatter”
 - **Having the RWIS at the exact trouble zone has made the system more representative of the area**
 - Nothing can substitute for local measurements to rely on
 - Communications are not perfect, and the system is now handling it well
 - Improvements to the communications infrastructure were required to make the system more resilient

October 30th, 2015

Date: 15/10/30 11:45
 Subject: Event at site Lundbreck

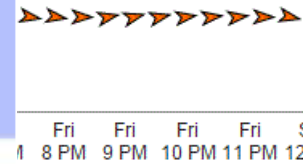
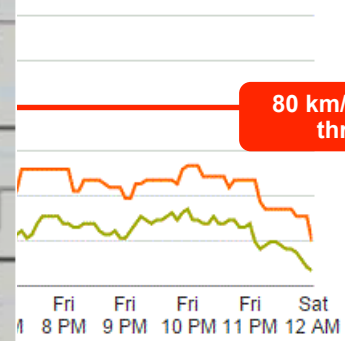
Event at site Lundbreck: Wind event



17:40
 site Lundbreck: Wind event stopped with speed 59 km/hour

ck: Wind event stopped with speed 59 km/hour

80 km/hr (50mph) threshold



Nov

Date:
Subject:

5 Wind Event

speed 85 km/hour

015

Preferences

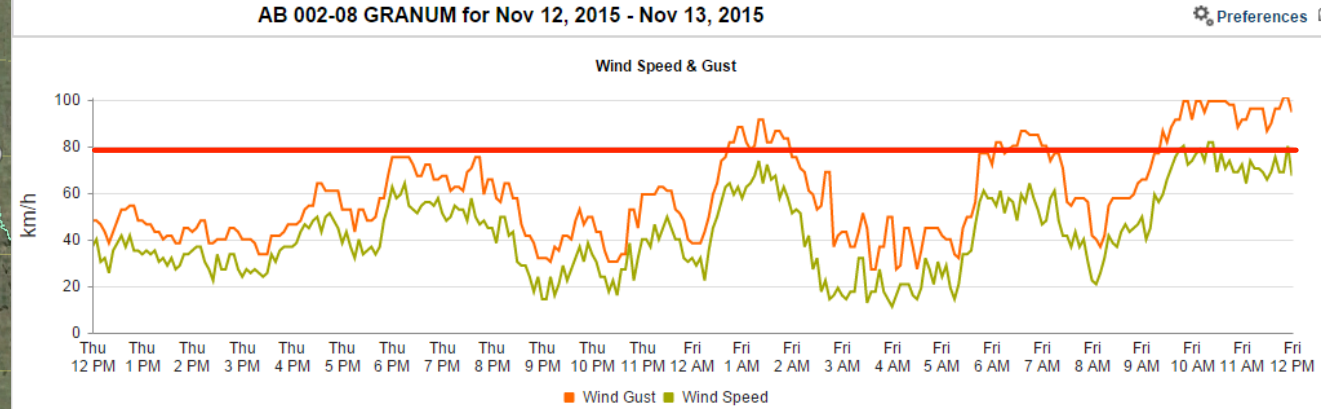
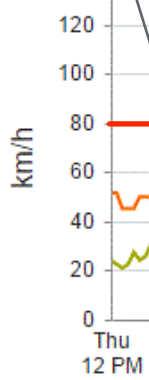
ent started with speed 86 km/hour

15/11/12 17:51

Event at site Lundbreck: Wind event started with speed 90 km/hour

AB 002-08 GRANUM for Nov 12, 2015 - Nov 13, 2015

Preferences



Date:
Subject:

with speed 73 km/hour

Date:
Subject:

Event at site Lundbreck: Wind event stopped with speed 76 km/hour

Wind Direction



Thu 9 PM Thu 10 PM Thu 11 PM Fri 12 AM Fri 1 AM Fri 2 AM Fri 3 AM Fri 4 AM Fri 5 AM Fri 6 AM Fri 7 AM Fri 8 AM Fri 9 AM Fri 10 AM Fri 11 AM Fri 12 PM

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Summary

- Weather can have large impacts on small sections of roadway
 - Accidents were statistically abnormal on a stretch of highway 22....and expensive; **don't assume travellers are local**
 - Despite best efforts, **manual deployment of weather-driven countermeasures was not quick enough**
- Local knowledge, experience and field support is very valuable
 - Years of maintenance **experience is the foundation of this project** and knowledge of local conditions was priceless
 - Excellent support from AT district staff and Volker Stevin
- Getting system design and requirements finalized takes work, but can pay future benefits
 - Get the control system people involved early in the requirements gathering
 - Be aware of who is giving initial requirements and who the end user is; be prepared for requirements to change/deepen
 - **Simulators help people visualise difficult concepts**; use it with a broad range of stakeholders and are invaluable for testing
 - A full FAT including all equipment for multiple days may be required
 - Never underestimate the availability of cellular communications; over-engineer the communications component
 - **A hosted central system allows flexibility in inputs and field hardware** for future projects

Next Steps

- Short-term
 - Remove false alarms from communication outages
 - **Spring 2016 expands to include a bridge site with 3-line 20 character DMS sign**
 - New notification types, new rule engine logic, new sensors (visibility and pavement)
 - Monitor more power supply information
- Long-term
 - **Fall 2016 a second bridge site with DMS**
- Future Direction(s)
 - Accident reduction and benefit analysis for 2015-2016 wind season (Nov – Feb)
 - Integration into 511 Alberta?
 - **Utilize additional inputs**
 - Weather forecasts, National Meteorological Services alerts
 - Xband radar for dust storms



Acronyms Used

511 Alberta	Alberta road information service	Modbus	Control Systems Protocol
AMA	Alberta Motoring Association	MLA	Member of the Legislative Assembly
AT	Alberta Transportation	MVA	Motor Vehicle Accident
BC	British Columbia	NTCIP	National Transportation Communications for ITS Protocol
DMS	Dynamic Message Sign	RCMP	Royal Canadian Mounted Police
DOT	Department of Transportation	RWIS	Road Weather Information System
EHWE/EHWSE	Extreme High Wind (Speed) Event	SAT	Site Acceptance Testing
FAT	Factory Acceptance Test	SMS	Short Message Service
HMC	Highway Maintenance Contractor	TBD	To Be Determined
HWE/HWSE	High Wind (Speed) Event	VIS	Vehicle Inspection Station
ITS	Intelligent Transportation Systems	VS	Volker Stevin
MCI	Maintenance Contract Inspector		

Thank You!

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