SIRWEC 2016
The use of performance indices and the advancement in their development for improved accountability

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Winter Service – Cost Benefit

- Thornes, Dr J. E. (1996). The Cost-Benefit of Winter Road Maintenance in the United Kingdom. In proceedings of the 8th International Road Weather Commission. SIRWEC Birmingham, pp. 1-10
- 1 to 9 Cost to benefit ratio
- Underpinned early investment into RWIS and proactive treatment regimes
- Times have changed – difficult to assess what this benefit is
- MDSS – 1.33 to 8.67
- Cost allocations are well understood
  - Vaisala Value Calculator (Bridge, Attalah)
  - FHWA cost of accidents…
- But how to apply to the real world where treatment already takes place and in fact avoids many issues that do cost?
- Costs of weather have been reduced as the system has been interfered with intentionally!

Winter Service – Cost Benefit

- This paper combines two existing studies to create a first pass on how the benefit of an operational winter service can be assessed.
- Measurement of conditions to assess performance levels
  - Jensen, D. (2013). Development of winter maintenance performance measures. 9th European Congress, Dublin, TP 0141
- Cost allocations by route in Scotland
  - Johnston, K. (2014). Estimating the cost of disruption to travel caused by severe winter weather. PIARC XIVth International Winter Road Congress Andorra 2014. IP0247-Johnston-E

Measuring the weather

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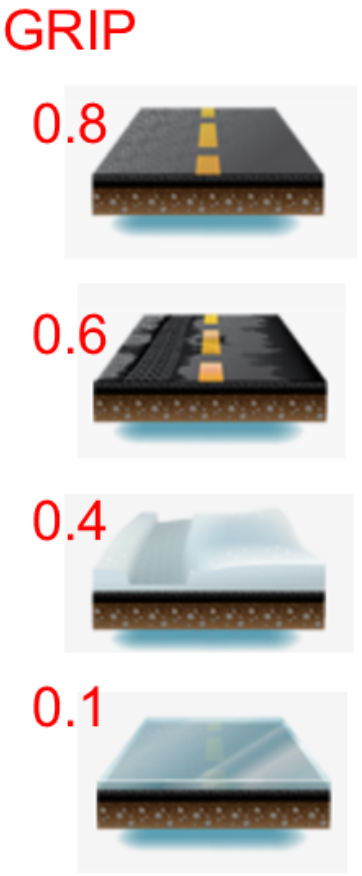
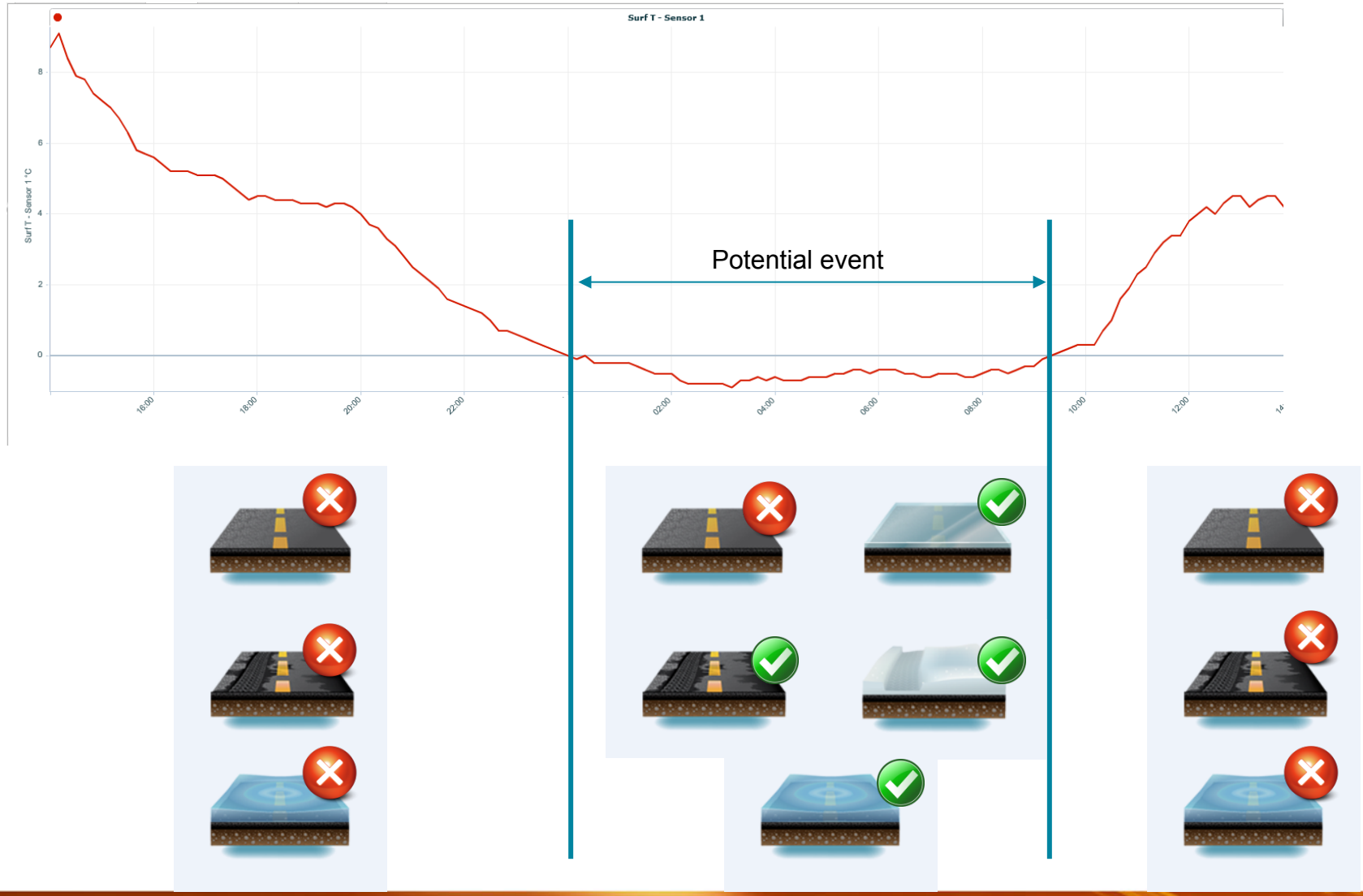
Measuring the weather

- DSC111 provides a reading of ‘GRIP’ by assessing the three layer thicknesses present at the sampling site
  - Water layer thickness
  - Ice layer
  - Snow layer
- 0.82 = dry road
- 0.1 = hard packed ice
- One simple measurement of the loss of GRIP due to the weather.



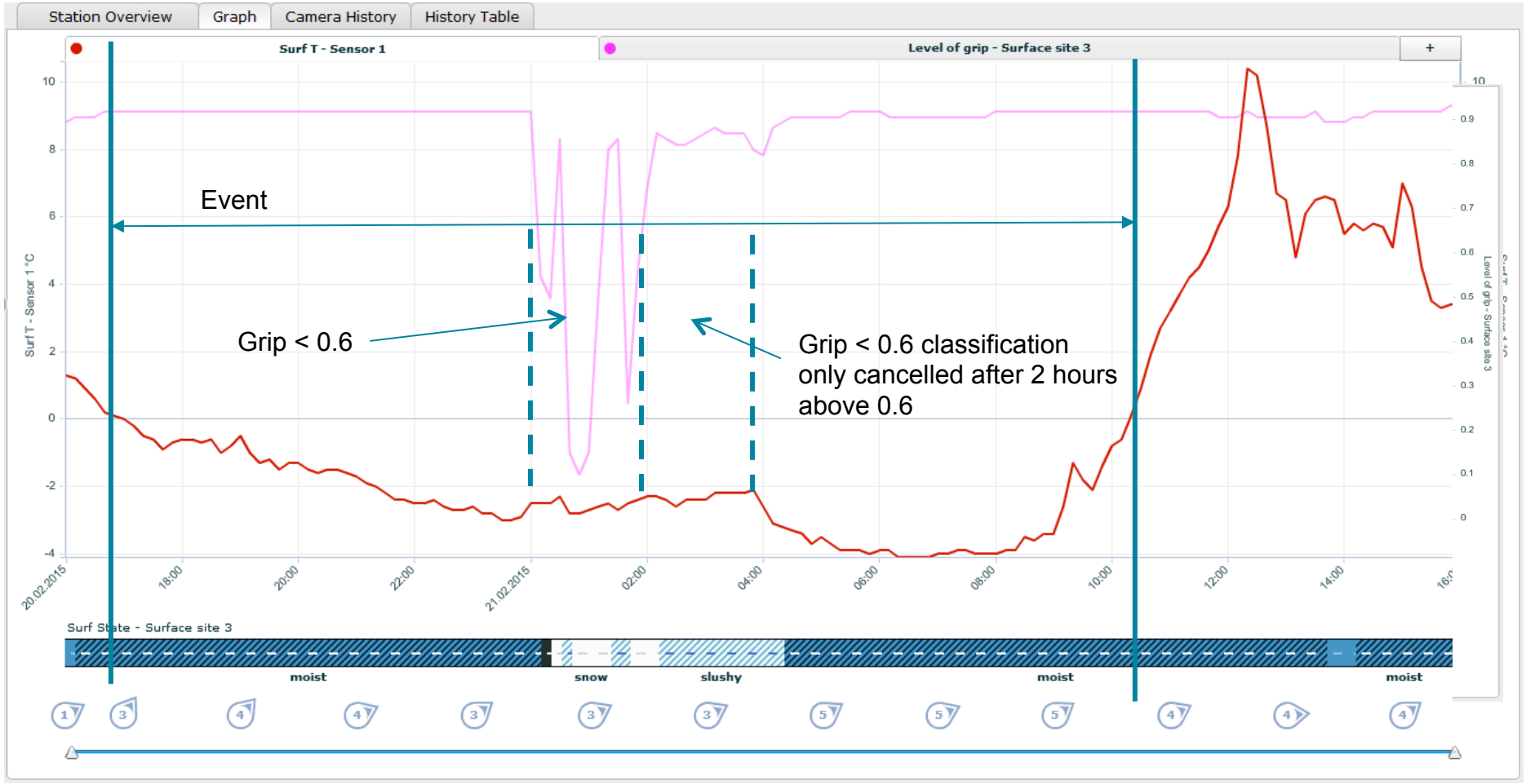
A potential Ice/snow event?



How well was the road actually treated?

A perfect result

How well was the road actually treated?



Total event = 17hours, Grip <0.6 for 4 hours. Mobility maintained for 76% of time

How well was the road actually treated?

Mobility nearly zero, untreated event

Idaho Index

$$MobilityIndex = \frac{Grip >= 0.60\, Duration(hours)}{CombinedEventsDuration(hours)}\%$$

$$SeverityIndex = MaxWindSpeed(mph) + MaxLayerThickness(mm) + \left(\frac{300}{MinSurfaceTemp(^{\circ}F)}\right)$$

where $MaxLayerThickness(mm) = \max(IceLayer, SnowLayer, WaterLayer)$

$$PerformanceIndex = \frac{Grip < .6 Duration(hours)}{SeverityIndex}$$

Winter Performance Index Legend

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

What does the Mobility Index tell us?

Département Conseil Général des Vosges (CG88)

Le Collet winter 2012-13	Hours	Percentage of total
Total Event Hours	1832	
Total with Grip < 0.6	807	44%
Total saved hours	1025	56%

No overnight operations – low traffic reasoning

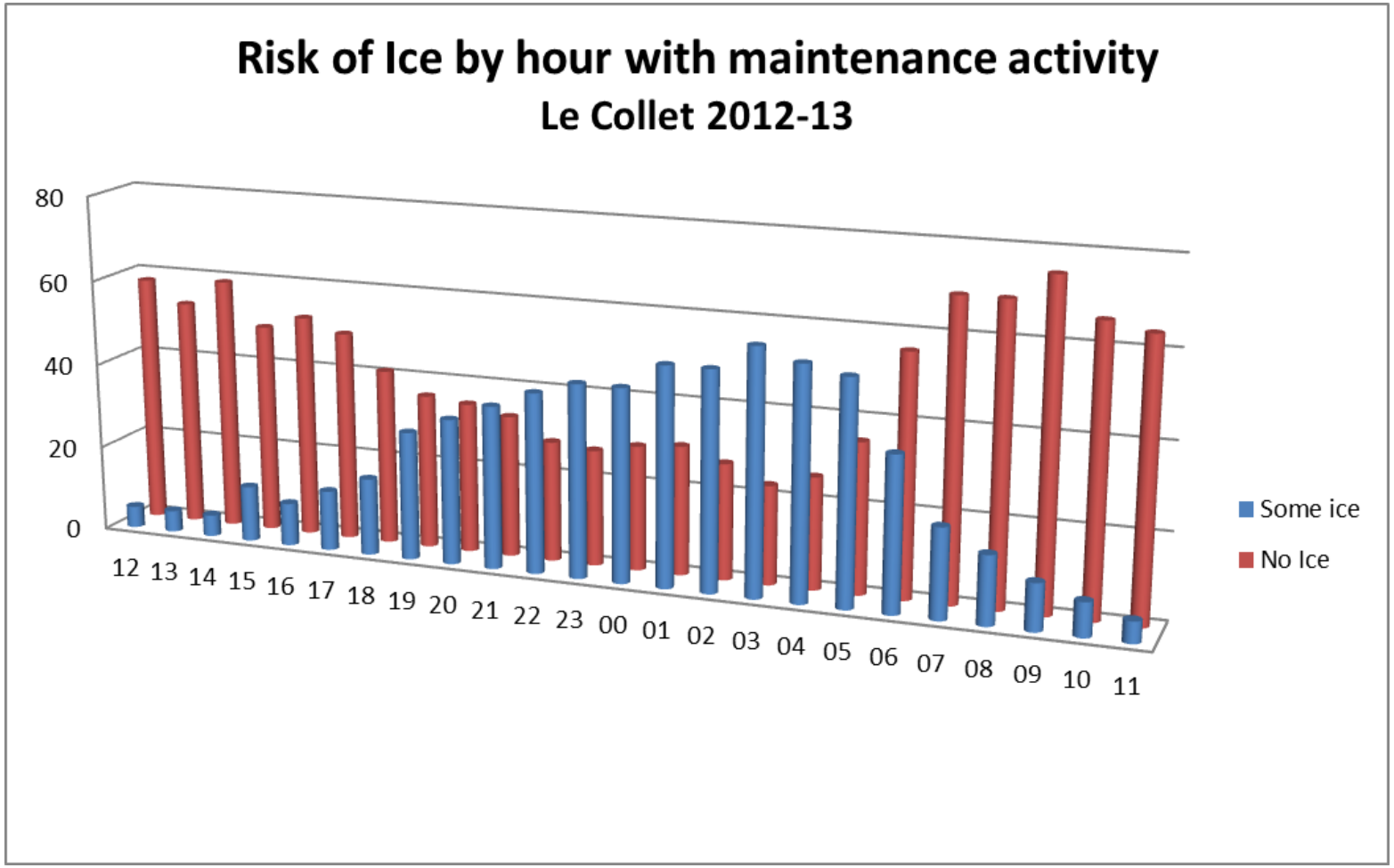
Transport Scotland primary network

A702 Boghall winter 2012-13	Hours	Percentage of total
Total Event Hours	301.7	
Total with Grip < 0.6	25.2	8%
Total saved hours	276.5	92%

24 Hour operations – no ice policy as critical route

- Total Event hours
  - Summarizes the weather in terms of the potential for ice formation on the road/pavement surface without intervention
- Grip < 0.6
  - The total number of hours where some form of ice did in fact appear and was measured
- Grip > 0.6
  - The total Number of hours where active winter service ‘saved’ the road/pavement surface from becoming slippery due to ice

Using Mobility Index parameters to study outcomes



Step 1 complete

- Have a clear observation of how many hours of ice/snow were saved by winter maintenance activities.
- Able to assess different policies against each other
- Can be used to measure changes to practices such as chemical amounts or type
- Transport Scotland currently reviewing the use of Brine by measuring the success against traditional pre-wet

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Cost Allocations

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Cost allocations – Transport Scotland

	Point 1 (high)	Point 2 (middling)	Point 3 (low)
Hours Saved by Avoiding 1 Hour Delay	18,000	6,000	3,000
Value of Time Benefit (£) (2010 Market Prices)	140,000	50,000	20,000

- Value of time per route in terms of hourly delay being saved
  - Point 1 (high) – highly trafficked strategic routes
  - Assumes other routes are open so this is for this route alone being affected
  - Benefit does not include the cost of accidents
- Immediately evident why primary route policies are so important

Assessing different methodologies - Scotland

Total hours of weather likely to lead to reduced mobility (winter 2012-13)	302
Economic cost of 1 hour delay (£)	140,000
Cost of winter service operations to Scotland (£)	14,000,000

Assumption 1 hour Grip below 0.6 = 1 hour delay	Estimated economic loss	Estimated saving over do nothing	Cost to benefit ratio
No treatment	42,238,000		
Assuming national daytime only treatement (44%)	18,584,720	23,653,280	**1.7**
24 hour treatment (8%)	3,379,040	38,858,960	**2.8**

- Basic assumption 1 hour Grip < 0.6 is equal to 1 hour delay
  - Frost likely to be less but snow easily could be more
- Note total cost of operation used not a percentage for an individual route
- Could be termed worse case with very mild winter with only one route being affected at any one time

Assessing different methodologies
Widespread event as in 2010 – multiple routes being affected

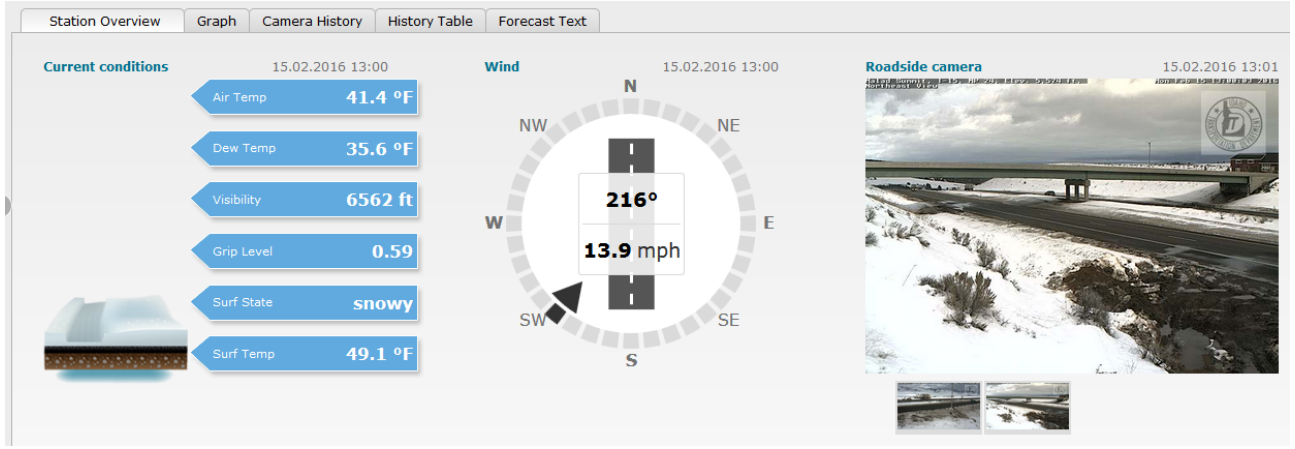
Assume 302 hours for 8 strategic routes per annum	2416
Economic cost of 1 hour delay (£)	140,000
Cost of winter service operations to Scotland (£)	14,000,000

Assumption 1 hour Grip below 0.6 = 1 hour delay	Estimated economic loss	Estimated saving over do nothing	Cost to benefit ratio
No treatment	338,240,000		
Assuming national daytime only treatement (44%)	148,825,600	189,414,400	**13.5**
24 hour treatment (8%)	27,059,200	311,180,800	**22.2**

- Cost to benefit for partial treatment not accurate due to £14M figure being used however Highland region do operate this way
- However for 24hr operations a 22:1 ratio is suggested
- Note as a sense check Transport Scotland estimated the 2010 winter cost £330M

Summary

- Clear evidence of a real and substantial benefit from conducting a full winter service program
- Figures suggest this has increased since the early days
  - Just in time deliveries, larger economies, road transportation increased rapidly
- Now have a way to measure differing methodologies effectiveness
- Focus on hourly benefit will allow more accurate assessments to be conducted
- Fully transferable methodology
- All available through Vaisala RoadDSS



Thank you

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