The use of Pavement Management Systems (PMS) to manage and process the "big data" sets generated from continuous measurement road condition surveys to develop practical maintenance plans and budgets.

By

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Big Data… e.g. vehicle based continuous road condition surveys

Safety measurements

e.g. Continuous Friction using SCRIM® :

WDM's SCRIM® combines Texture, Skid Resistance, IRI and Alignment measurements nominally every 4 inches and summarized every 33 feet (10m).

Around 5000 pieces of data per mile.

Structural measurements

e.g. Deflection Measurement (Deflectograph):

WDM's Deflectograph Data is collected and summarized at around 120 inch intervals and collects deflection on both wheeltracks

Around 3000 pieces of data per mile.

Functional, Safety and Structural measurements

Road Assessment Vehicles(RAV): e.g. WDM's SCANNER and TRACS4:

"road speed" measurement of around 40 parameters including Texture, Rutting, Alignment, Profile, Cracking etc. Collected at down to 1 inch intervals summarized at 33 feet (10m intervals):

Around 7000 pieces of data per mile.

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Big Data…Typical Road Network

e.g. Scottish Government Major Road Network is 2,200 miles.

Similar length to the National Highway System of a medium size US State (Utah or NJ)

Each year, they survey around:

- 4400 miles SCRIM
- 2200 miles SCANNER
- 800 miles Deflectograph

TRANSPORT SCOTLAND
CÒMHDHAIL ALBA

Approximately 35 million pieces of data per annum.

This data has been collected continuously since 1989 and this is managed within their Asset Management System (around 1 billion pieces of data).

RAV's - New TRACS4 Vehicle

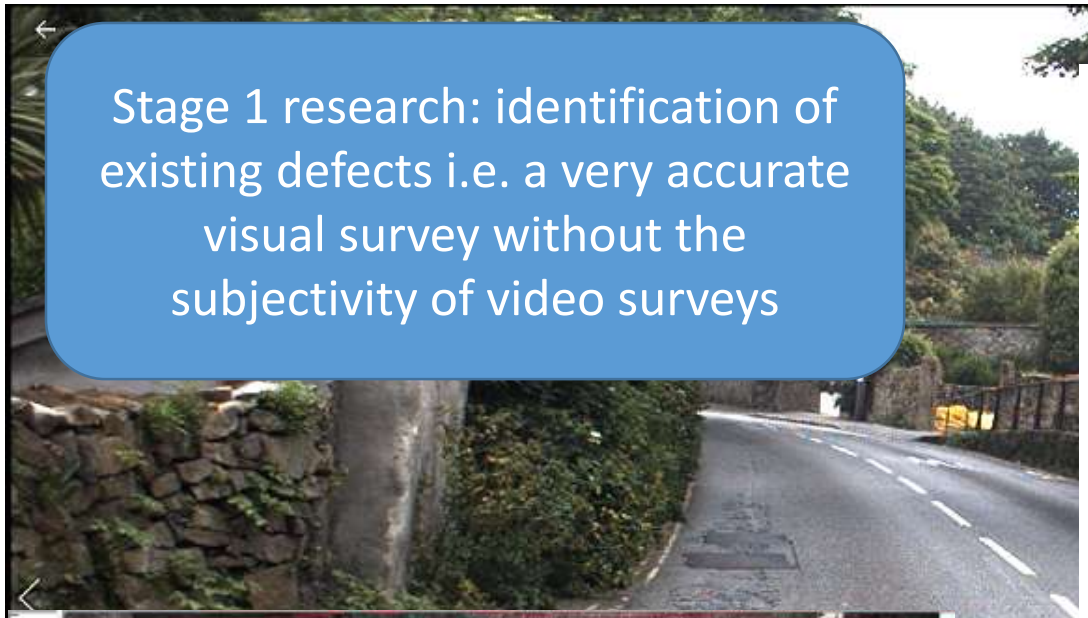
WDM have been working on the development of models making better use of the very detailed 3d profiles from SCANNER and TRACS4 vehicles (around 1.5 million measurements per mile)

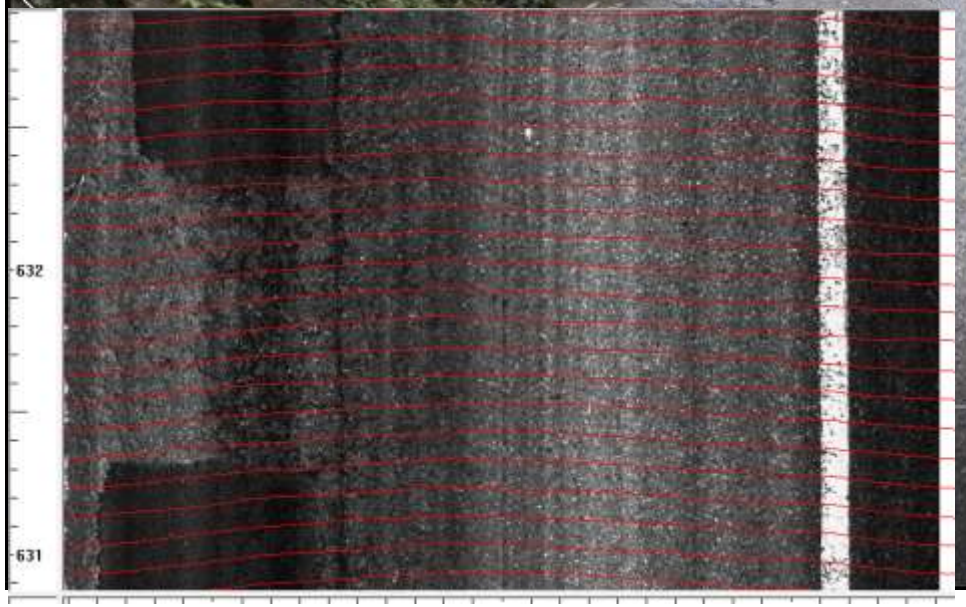
Latest RAV vehicle developed by W.D.M. Limited for Highways England TRACS4 Contract (English Government)

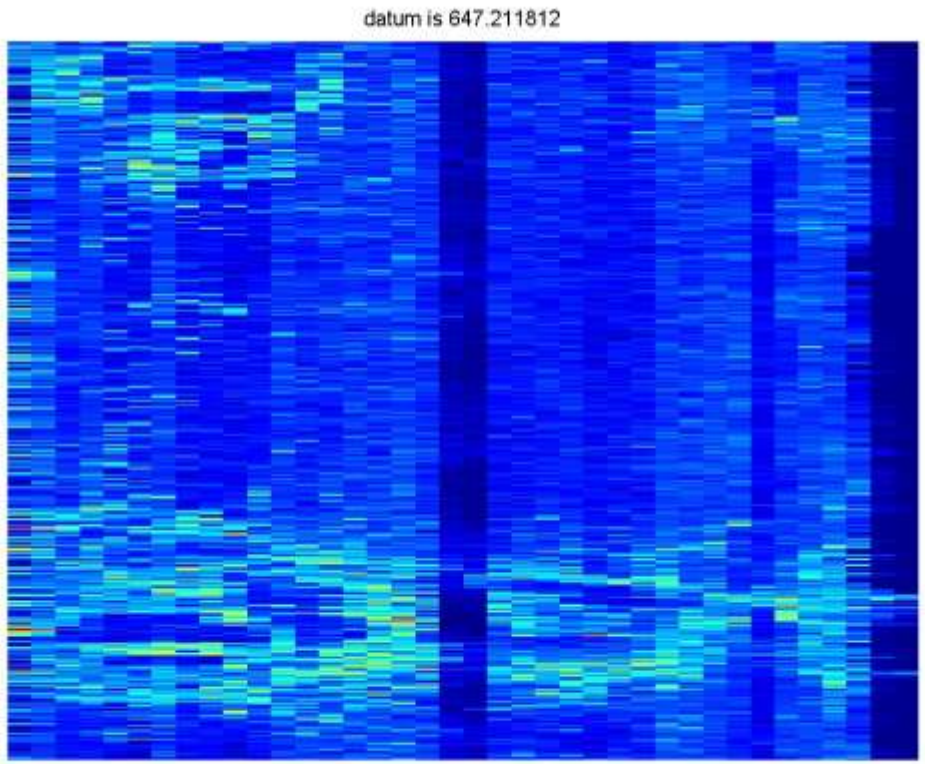
Uses Laser Crack Measurement System (LCMS) 3d Crack detection plus Retro-Reflectivity sensors and greater detail for transverse and longitudinal profile measurements

Fretting/Ravelling Prediction – using SCANNER and TRACS

Stage 1 research: identification of existing defects i.e. a very accurate visual survey without the subjectivity of video surveys







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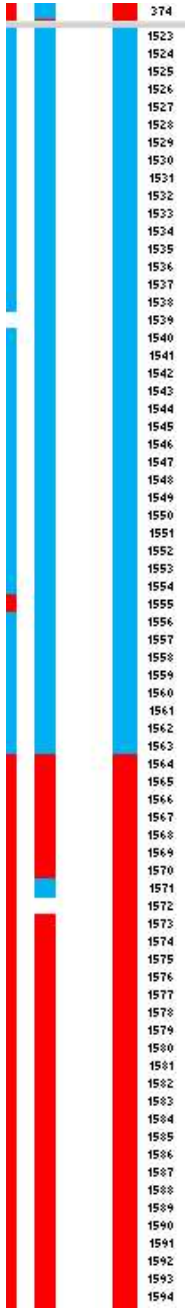
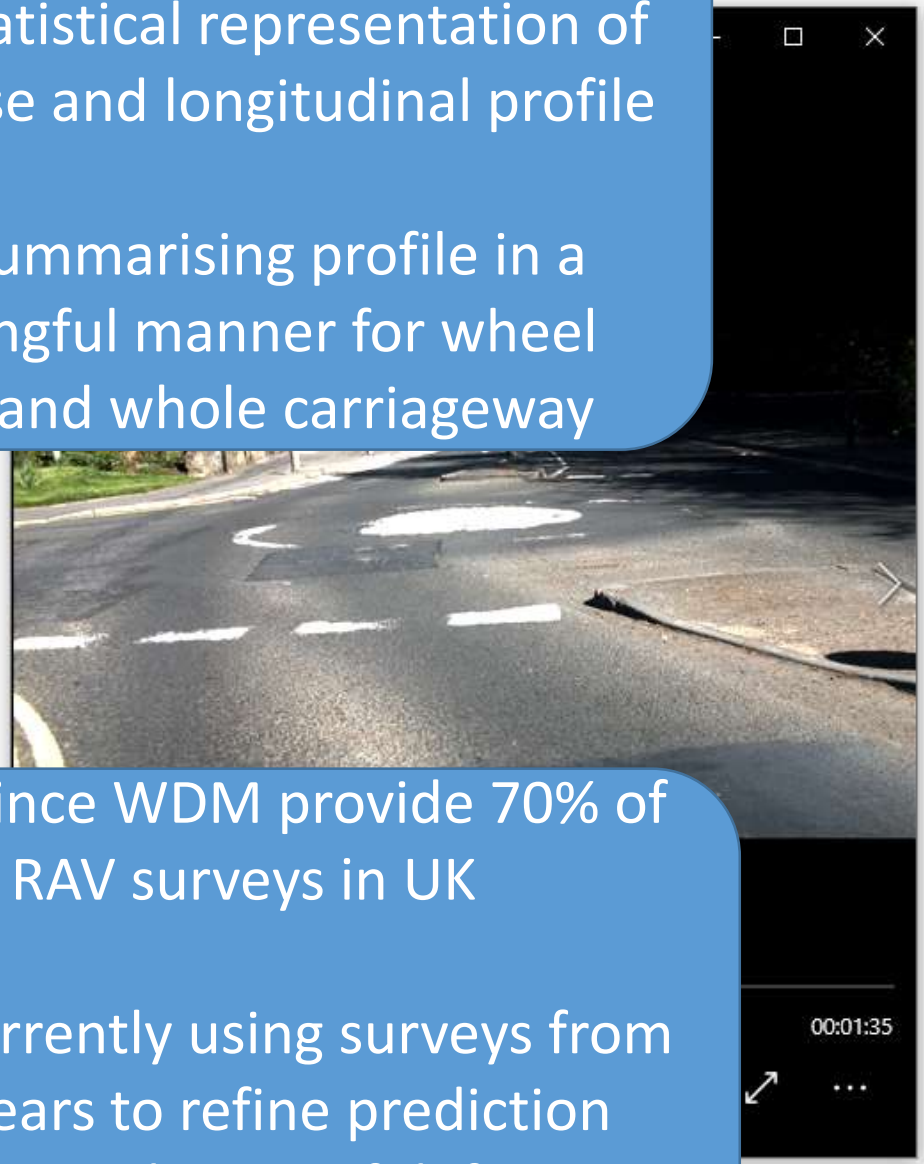
Stage 1 research:
RHS – statistical representation of transverse and longitudinal profile

LHS: summarising profile in a meaningful manner for wheel tracks and whole carriageway





Stage 2: since WDM provide 70% of all RAV surveys in UK

We are currently using surveys from many years to refine prediction models in advance of defects becoming visible

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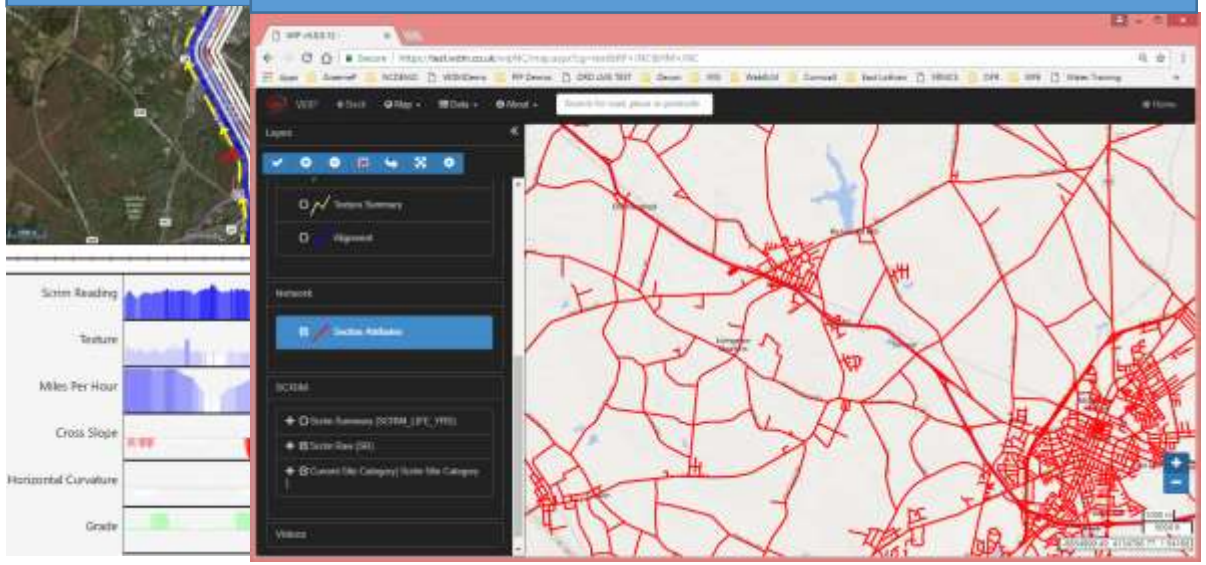
Survey data needs to quickly be available in your PMS

GPS

Data Validation/Quality System

GPS fitting to Road Network Centreline and lane



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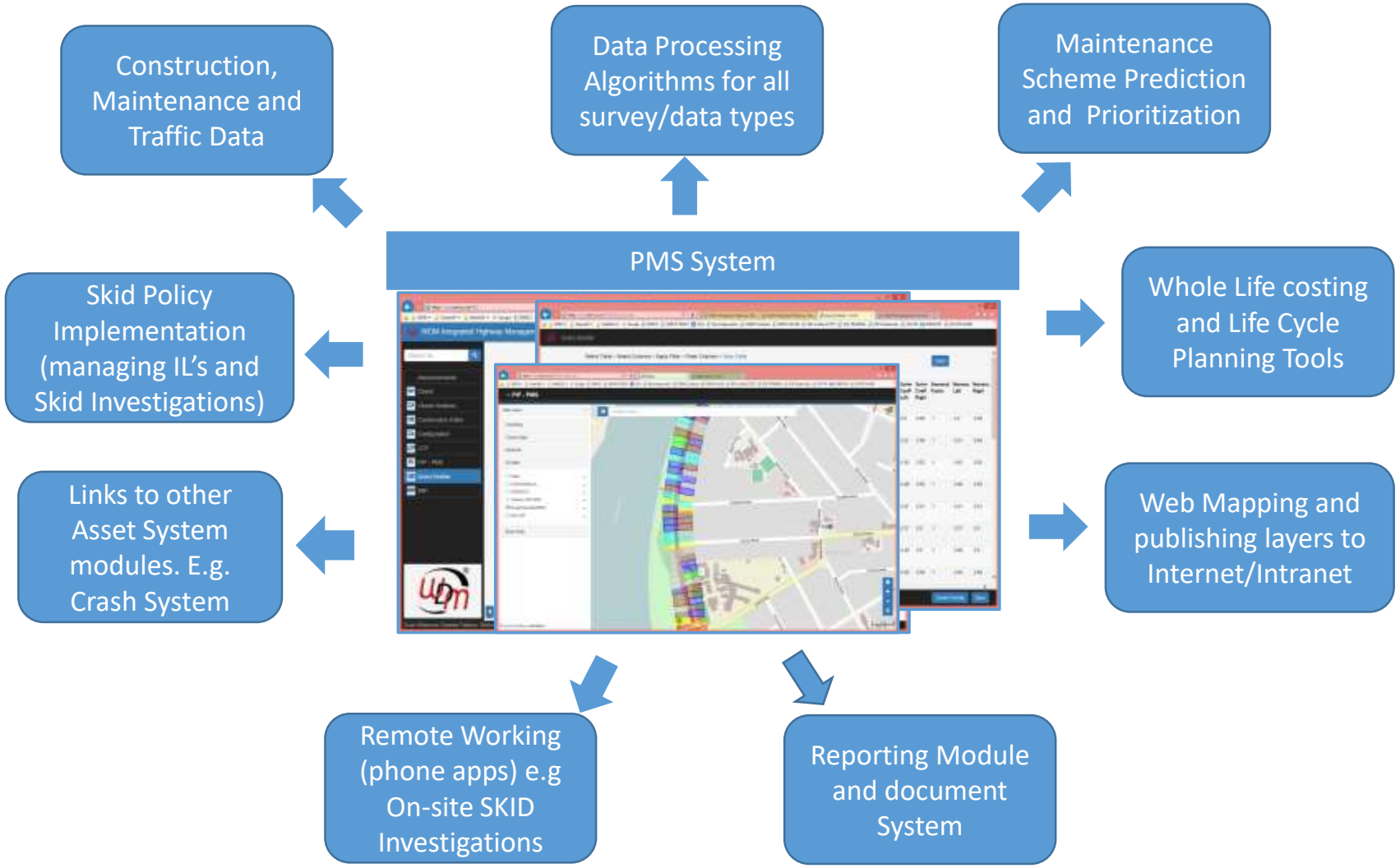
Pavement Management System (PMS)…

Key functions required to facilitate managing these “Big Data” sets



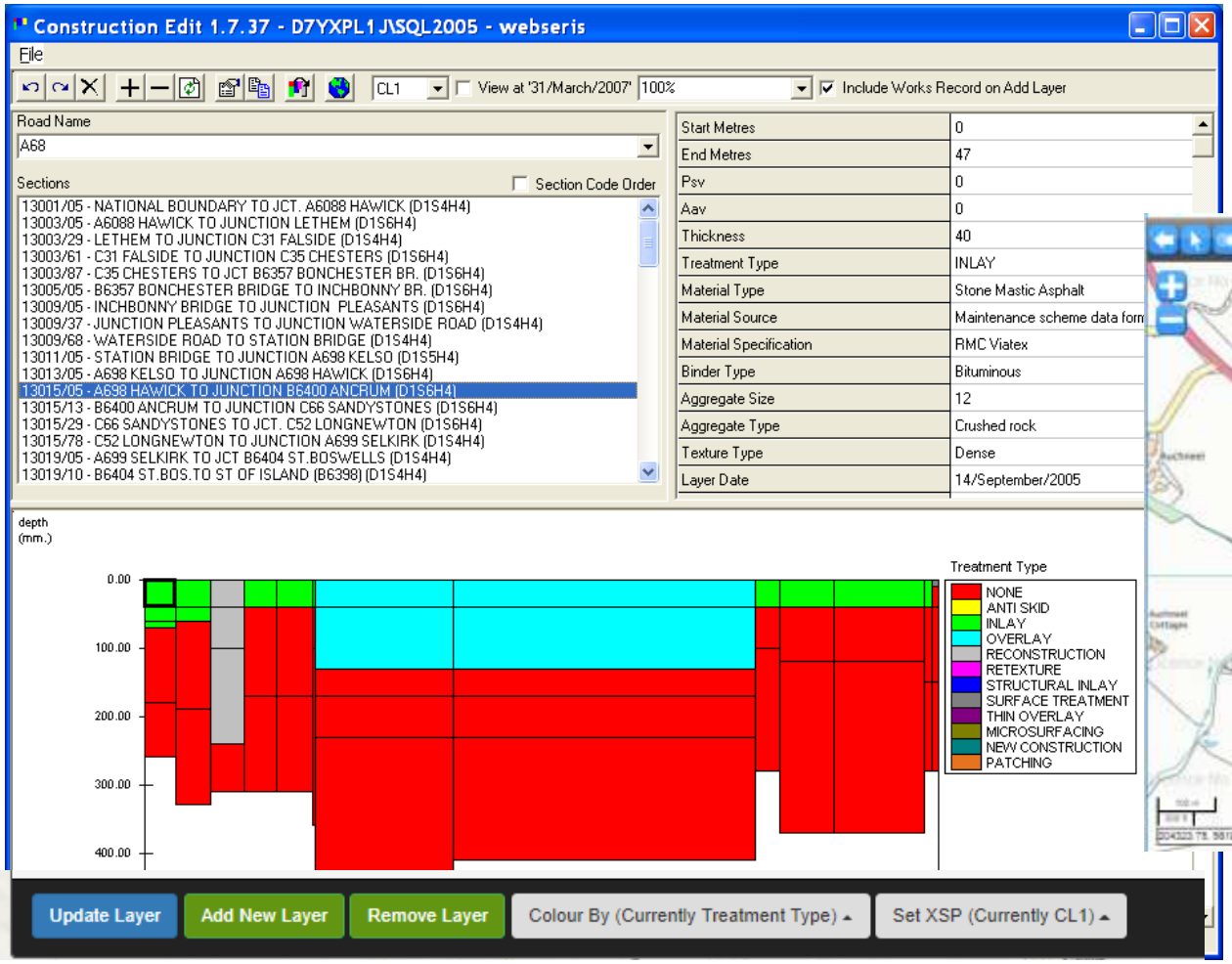
Integrated Mapping/GIS tools…

Easy access to all datasets both summary and detailed

PMS – construction/maintenance database…

This allows you to maintain a history of all treatments, material specifications, contractors, aggregate source etc. Useful for monitoring performance of treatments etc.

PMS also needs management systems for Traffic statistics and Maintenance Policy.



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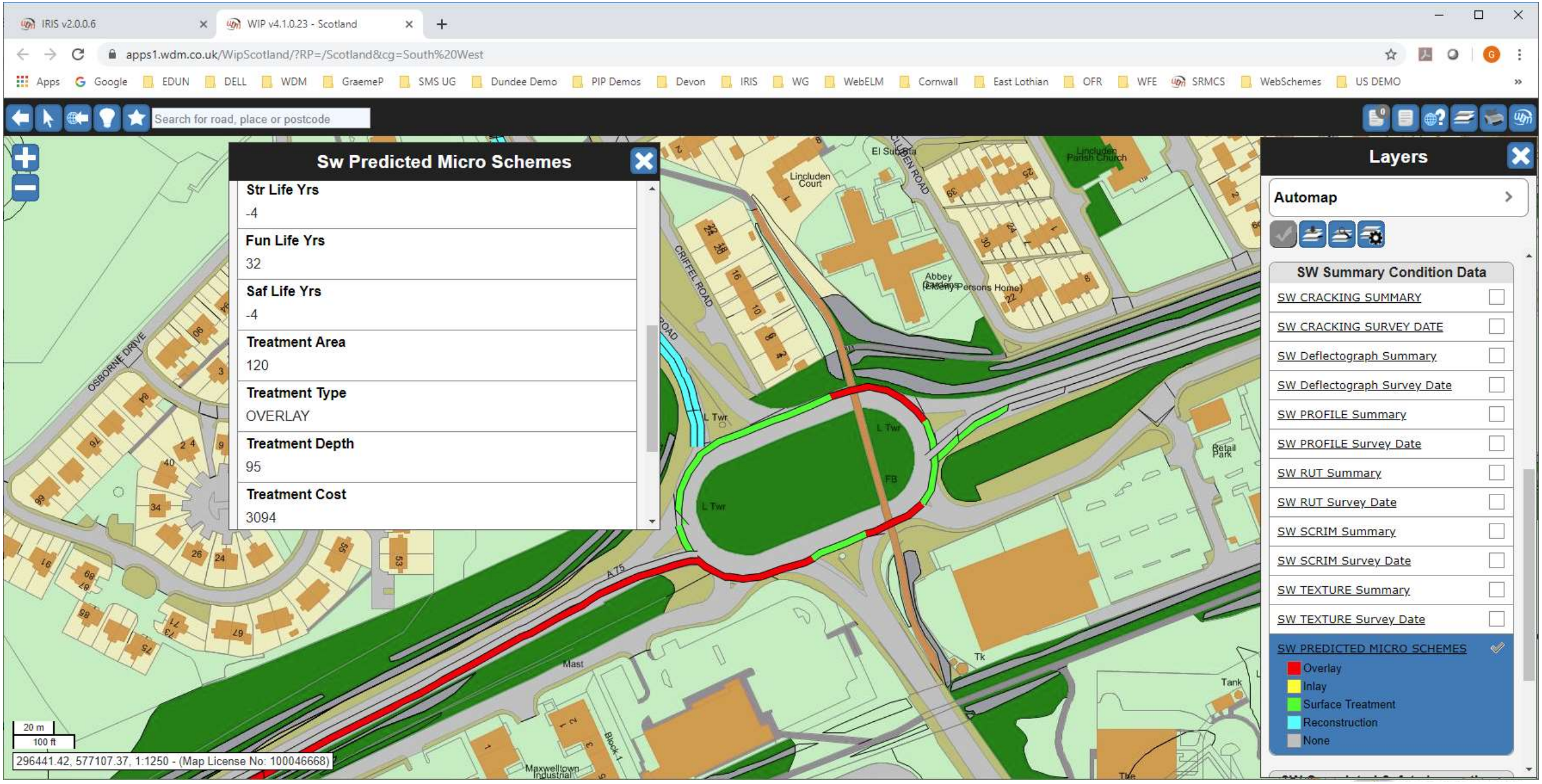
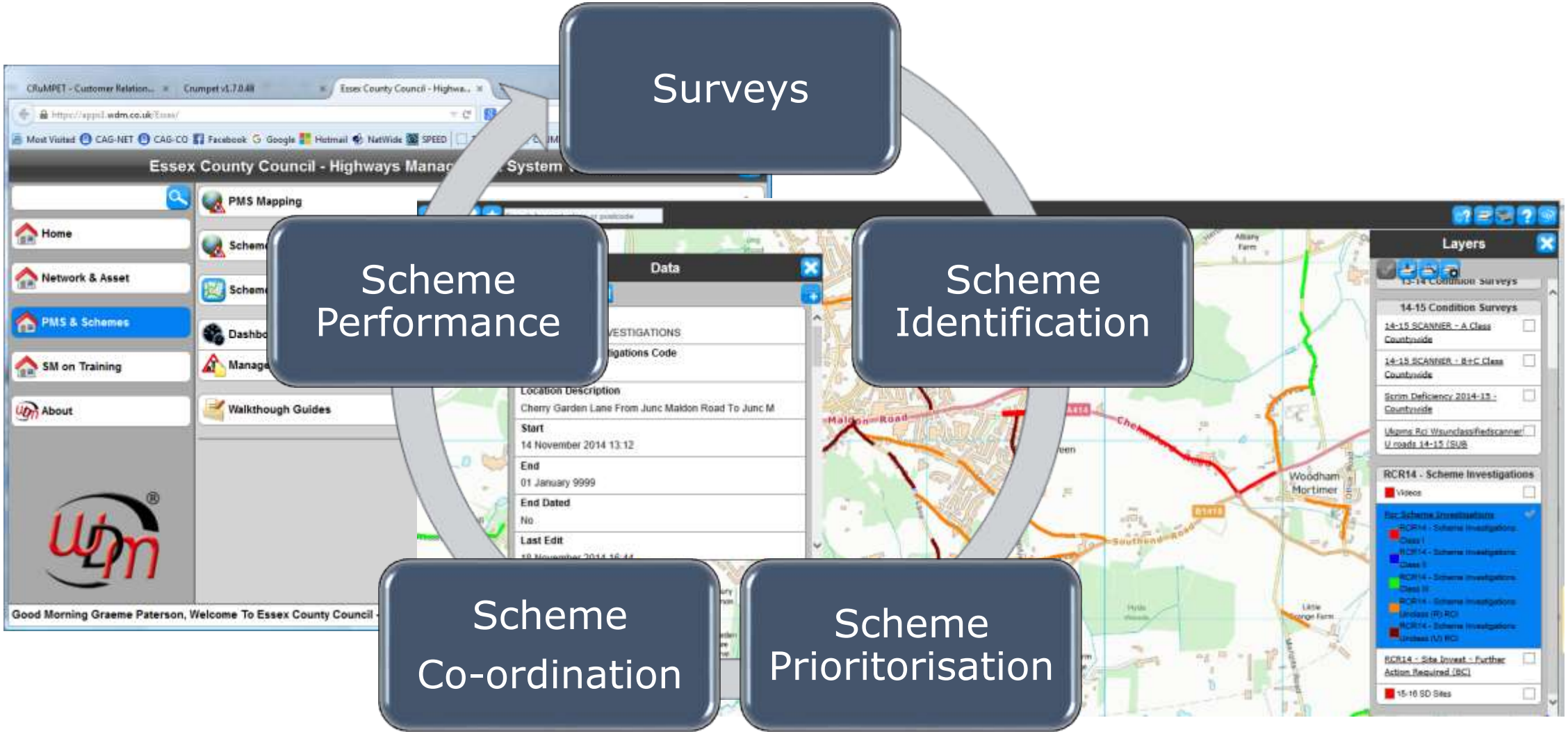
PMS Processing…merges all datasets together to produce useful outputs.



PMS Processing…Maintenance Scheme Management

… from inception to completion



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PMS Processing - Whole Life Costing and Life Cycle Planning models based on “real” proposed maintenance Schemes and programs

This both calculates costs to meet the desired Maintenance Policy but also allows testing of various actual budgets to gauge their effect on network condition.

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Continuous Friction Measurement and PMS

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Continuous Friction measurement…e.g. WDM US SCRIM®…

US SCRIM built for FHWA in 2015 and operated by Virginia Tech. (LHS in background)

Measures SCRIM Coefficient, Texture (MPD), Horizontal Curvature, Grade, Cross Slope and Video

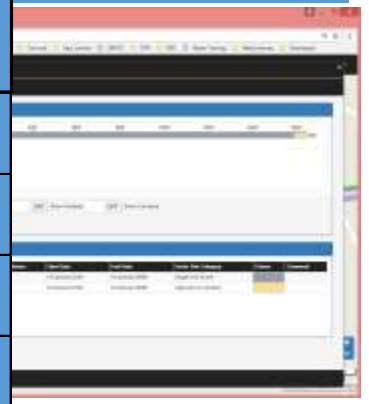
Second SCRIM in US this year operated by WDM - extra functionality over US SCRIM1: Longitudinal profile (IRI)

UK Government Skid Policy Implementation (HD28) using SCRIM (for routine testing)….

PMS is used to manage the processing of Continuous Friction data alongside Crashes, Texture and Friction Demand I.L's to determine where treatments need to be undertaken.

Manage Survey Routes, Survey, Data Fitting, SCRIM vs Crash Ca

Setting Investigatory Levels and t of Reviews



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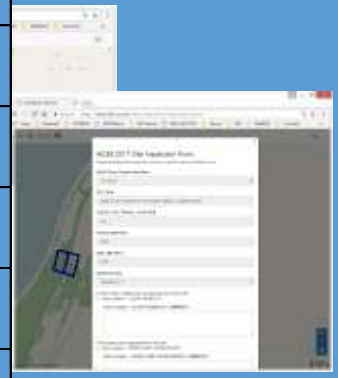
pp for Secondary site (online/offline)



Investigatory Levels (US)

Road classification definitions		Investigatory level (31 or 50 mph)							
		0.30	0.35	0.40	0.45	0.50	0.55	0.60	0.65
A	Interstate highways								
B	Divided highways w/o intersections, grade, etc.								
C	Two lane road w/o intersections, grade, etc.								
Q	Intersection (& roundabouts)								
K	Pedestrian crossings and other high risk areas								
R	Roundabout								
G1	Slope 5-10%, longer than 160 feet								
G2	Slope >10% longer than 160 feet								
S1	Curve radius < 1600 feet - divided roads								
S2	Curve radius < 1600 feet - two lane roads								

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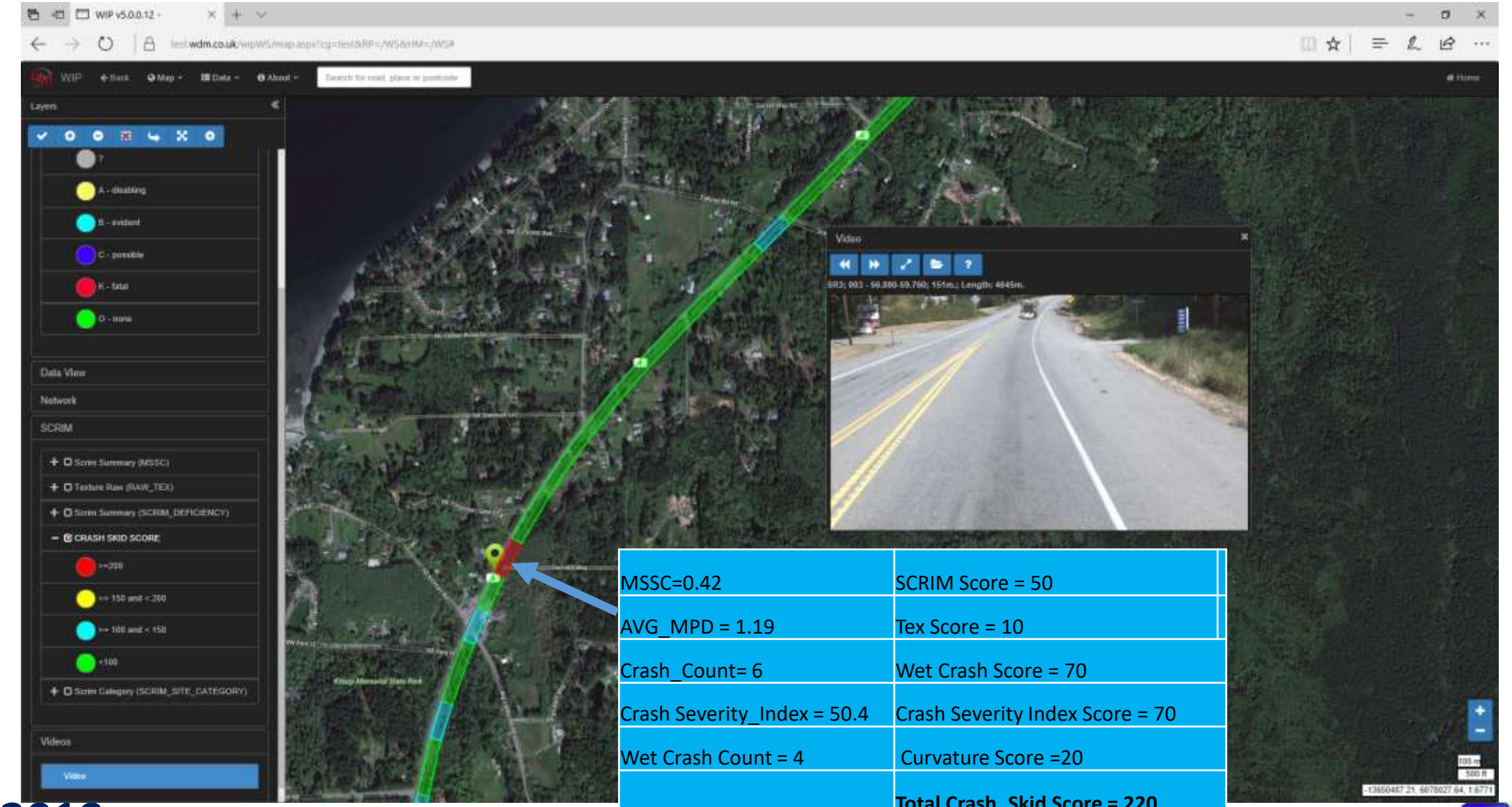
Crash Skid Scores (in the absence of Friction Demand categories)



MSSC=0.42	SCRIM Score = 50
AVG_MPD = 1.19	Tex Score = 10
Crash_Count= 6	Wet Crash Score = 70
Crash Severity_Index = 50.4	Crash Severity Index Score = 70
Wet Crash Count = 4	Curvature Score =20
	Total Crash_Skid Score = 220

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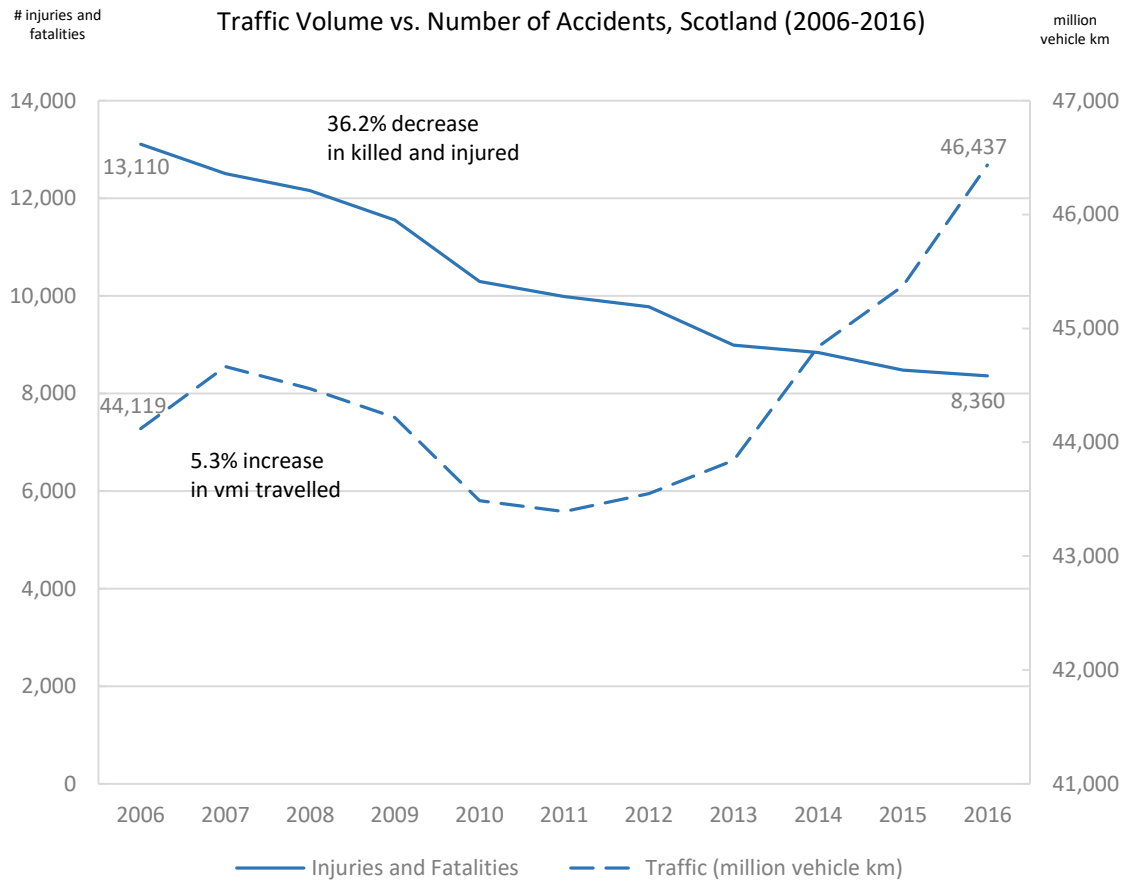
Road deaths have dropped in the UK despite similar increases in traffic and vehicle registrations as the US



Compared with the U.S., Scotland had an identical 5.3% increase in vehicle miles travelled and a 14% increase in number of vehicle registrations, but a 36.2% decline in injuries and fatalities.

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Scottish Transport Statistics, No 36, 2017 Edition

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