9th International Conference on MANAGING PAVEMENT ASSETS (ICMPA9)

Measuring Pavement Condition Data for a Long-term Pavement Performance Study on New Zealand Roads.

D Brown

AASHTO THE VOICE OF TRANSPORTATION

VirginiaTech Transportation Institute

TRB

U.S. Department of Transportation Federal Highway Administration

WORLD ROAD ASSOCIATION MONDIALE DE LA ROUTE 1909-2009 AIPCR PIARC

VDOT Virginia Department of Transportation

Measuring Pavement Condition Data for a Long-term Pavement Performance Study

- **Background**
- **Measurement Requirements**
- **Equipment**
  - Roughness
  - Rutting
  - Texture
  - Condition
- **Calibration and Validation**
  - Roughness
  - Rutting
  - Texture
  - Condition
- **Results**
- **Summary**

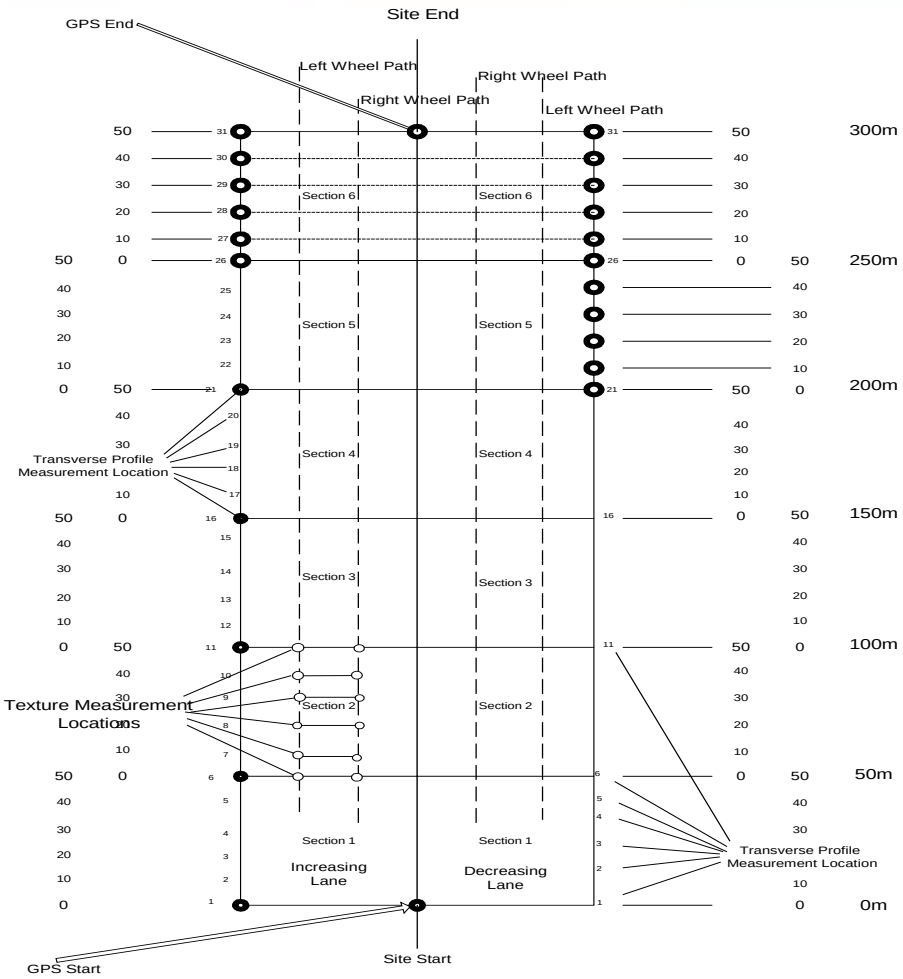
Background

- Project inception 2001
  - 2001 63 sites established on State Highways
  - 2003 Parallel Local Authority Project, 81 sites
  - 2009 Contracts combined
  - 2015 Data collection completed on 145 sites.
- Project Design
  - Appropriate Methodology
    - Surveyor Bias
    - Climate
    - Equipment - Measurement Procedures
  - Manual Type Data Collection and Site Establishment
  - Class1 Type Measuring Equipment
  - Measurement Location
  - Visual Inspection

Measurement Details

- Sites
  - 300m long
  - 2 lanes
  - Divided into 12 - 50m Subsections;
- Measurements
  - Roughness - ARRB Walking Profiler
  - Rutting - Transverse Profile Beam (R&D)
  - Texture - NZTA's Stationary Laser Profiler
  - Surface Distress - Visual Inspection
- Data Processing/QA

Measurement Details



Measurement Details

New Zealand Roads: Predominantly Chipseal

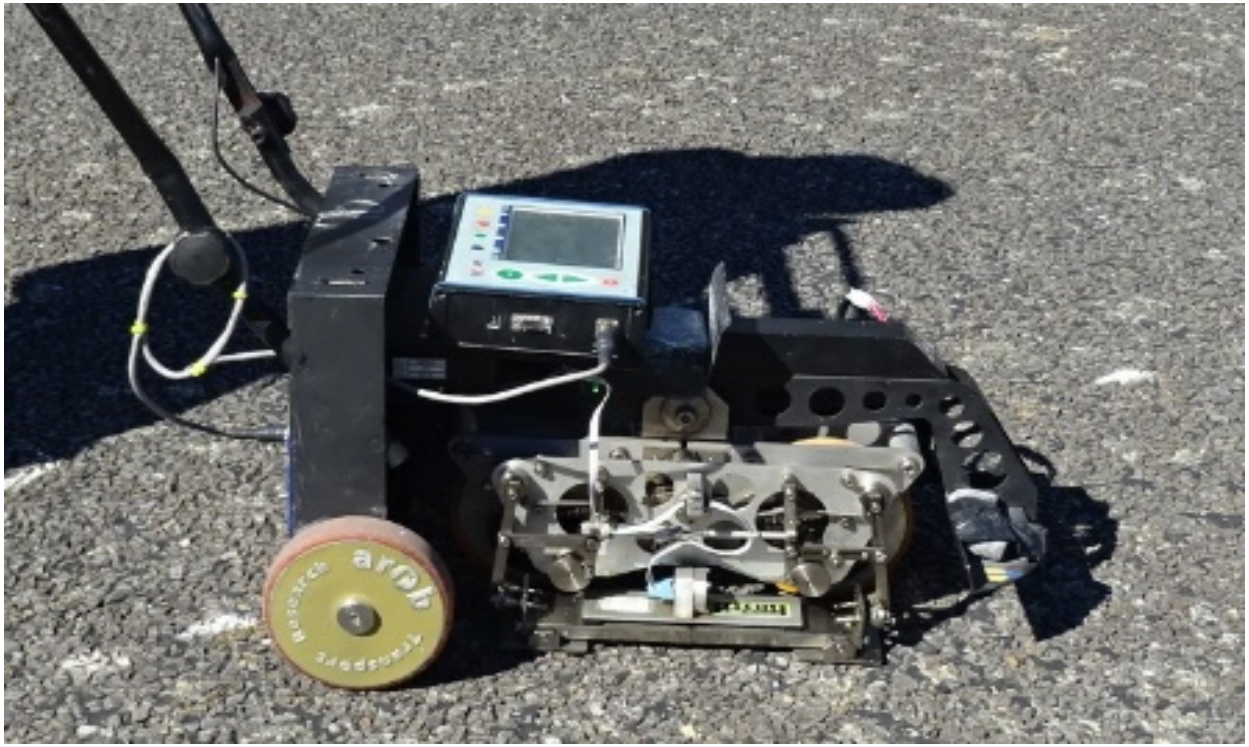
- The LTPP Program Included:
  - Asphalt – Motorways and High volume roads
  - Surface Treatment -
    - Grade3 Large aggregate ≈20mm
    - Grade 6 Small Aggregate ≈ 6mm
    - Grade 3/5 Large Aggregate locked with a small aggregate
- Equipment
  - Able to measure on these road types and not be adversely affected by changes in condition and network features such as grade & curvature
  - Flexible – able to cope with change in measurement requirements.
- Sites
  - Permanent marking and setup to ensure repeatable measurements in following years are taken at the same locations

Measurement Details

Measurement Details

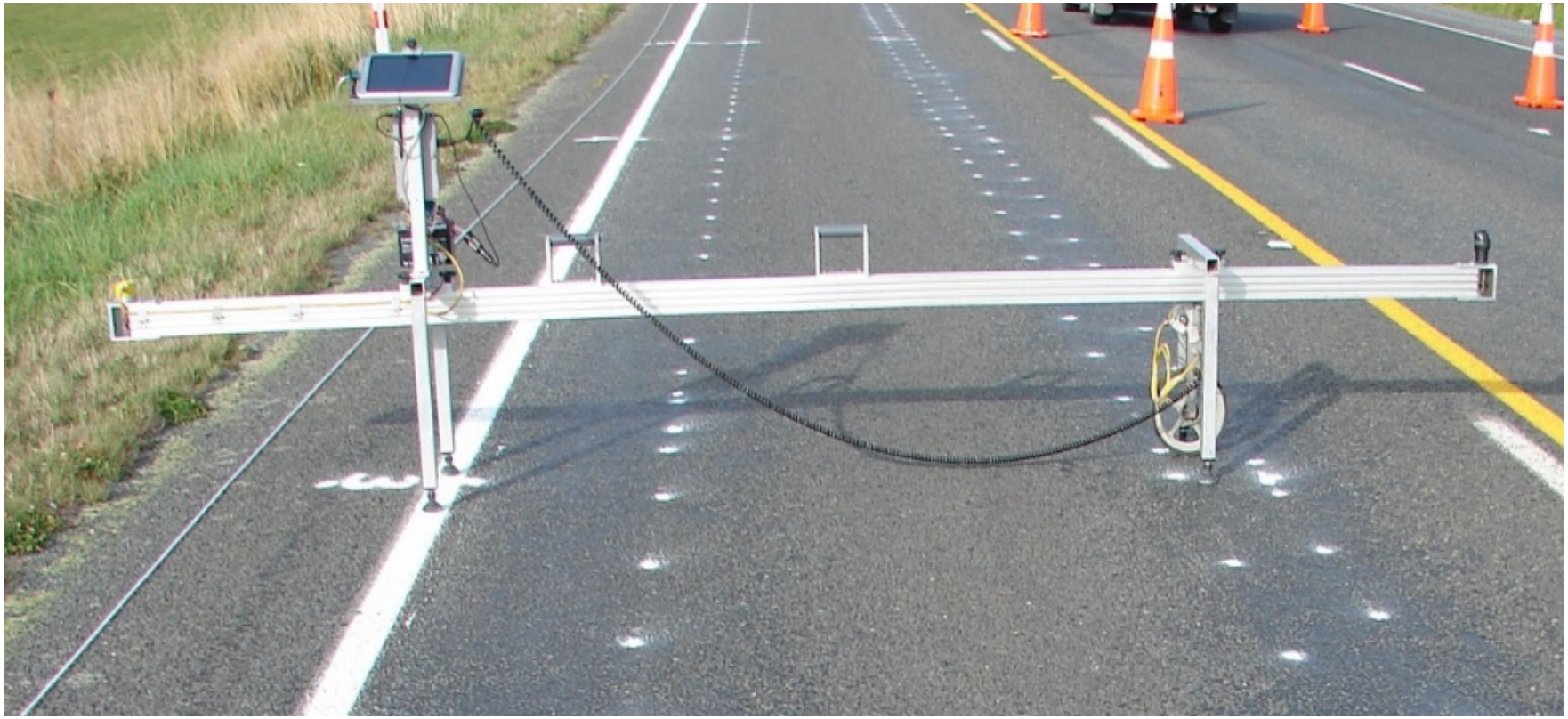
Equipment

Roughness - ARRB Walking Profiler



Equipment

Rutting – Transverse Profile Beam



Equipment

Texture - Stationary Laser Profilometer

Equipment

Visual Condition Inspection

Code	Description of Distress
A1	Active Aggregate Loss
A2	Stable Aggregate Loss
D	Delamination
M	Mechanical Damage
F1	Flushing (Some spots)
F2	Flushing (Clearly Defined Area)
F3	Flushing (No Texture)
LEN	Longitudinal Edge Cracks Narrow
LEW	Longitudinal Edge Cracks Wide
LES	Longitudinal Edge Cracks Sealed
LWN	Longitudinal Wheel Cracks Narrow
LWW	Longitudinal Wheel Cracks Wide
LWS	Longitudinal Wheel Cracks Sealed
LIN	Longitudinal Irregular Cracks Narrow
LIW	Longitudinal Irregular Cracks Wide
LIS	Longitudinal Irregular Cracks Sealed

Code	Description of Distress
TCN	Transverse Cracks Narrow
TCW	Transverse Cracks Wide
TCS	Transverse Cracks Sealed
AGN1	Alligator Cracks Narrow (In Wheel path)
AGW1	Alligator Cracks Wide (In Wheel path)
AGS1	Alligator Cracks Sealed (In Wheel path)
AGN2	Alligator Cracks Narrow (Outside Wheel path)
AGW2	Alligator Cracks Wide (Outside Wheel path)
AGS2	Alligator Cracks Sealed (Outside Wheel path)
PCN	Parabolic cracking Narrow
PCW	Parabolic cracking Wide
PCS	Parabolic cracking Sealed
SP	Surface Patch (Area)
StP	Structural Patch (Area)
P	Pothole (Number, Length, Width, and Depth)
E	Edge Distress (Length Width and Depth)
S	Shoving

Equipment

Visual Condition Inspection

Date	Sub Sect	Dist St	Dist End	Dist Width	Dist Depth	Distress	Comments
26-Sep-14	5	7	14			lwn	lwp
26-Sep-14	5	8	11.3	400		sp	edgeline
26-Sep-14	5	19	50	500		f2	rwp
26-Sep-14	5	41.7	42	20	10	m	btwp
26-Sep-14	6	0	18	600		f2	rwp
26-Sep-14	6	0	8	1000		f2	lwp
26-Sep-14	6	7.7	8	300		agn2	btwp
26-Sep-14	6	8	9.5			lwn	lwp
26-Sep-14	6	8.1	10	1000		sp	lwp
26-Sep-14	6	9.4	9.6	100		agn1	lwp

Calibration and Validation

Project Contract defined data collection specifications

- More stringent procedures were developed to ensure greater data quality.
- Calibrate to an International Standard
- Retain and use data from previous equipment calibration and validation exercise.
- Undertake a detailed validation exercise that demonstrates compliance to defined specs and tests
  - procedures
  - equipment
  - personnel
  - process

Validation & Repeatability

100m Roughness Validation Site 1

Crowther Rd WP020, 024, 073 September 2014										
Loc	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6	Mean	Std Dev	Cf Var	Std Err.
WP020										
100	3.31	3.13	3.27	3.23	3.22	3.22	3.23	0.060	0.003	0.025
200	2.83	2.90	2.88	2.88	2.90	2.85	2.87	0.028	0.001	0.011
300	2.15	2.20	2.15	2.07	2.25	2.10	2.15	0.065	0.003	0.027
WP024										
100	3.29	3.20	3.31	3.23	3.22	3.15	3.23	0.059	0.003	0.024
200	2.82	2.95	2.90	2.87	2.87	2.88	2.88	0.043	0.002	0.017
300	2.15	2.17	2.19	2.12	2.12	2.09	2.14	0.037	0.001	0.015
WP073										
100	3.16	3.25	3.22	3.20	3.14	3.41	3.23	0.097	0.007	0.039
200	2.80	2.79	2.86	2.88	2.86	2.93	2.85	0.052	0.002	0.021
300	2.22	2.19	2.23	2.21	2.18	2.13	2.19	0.036	0.001	0.015

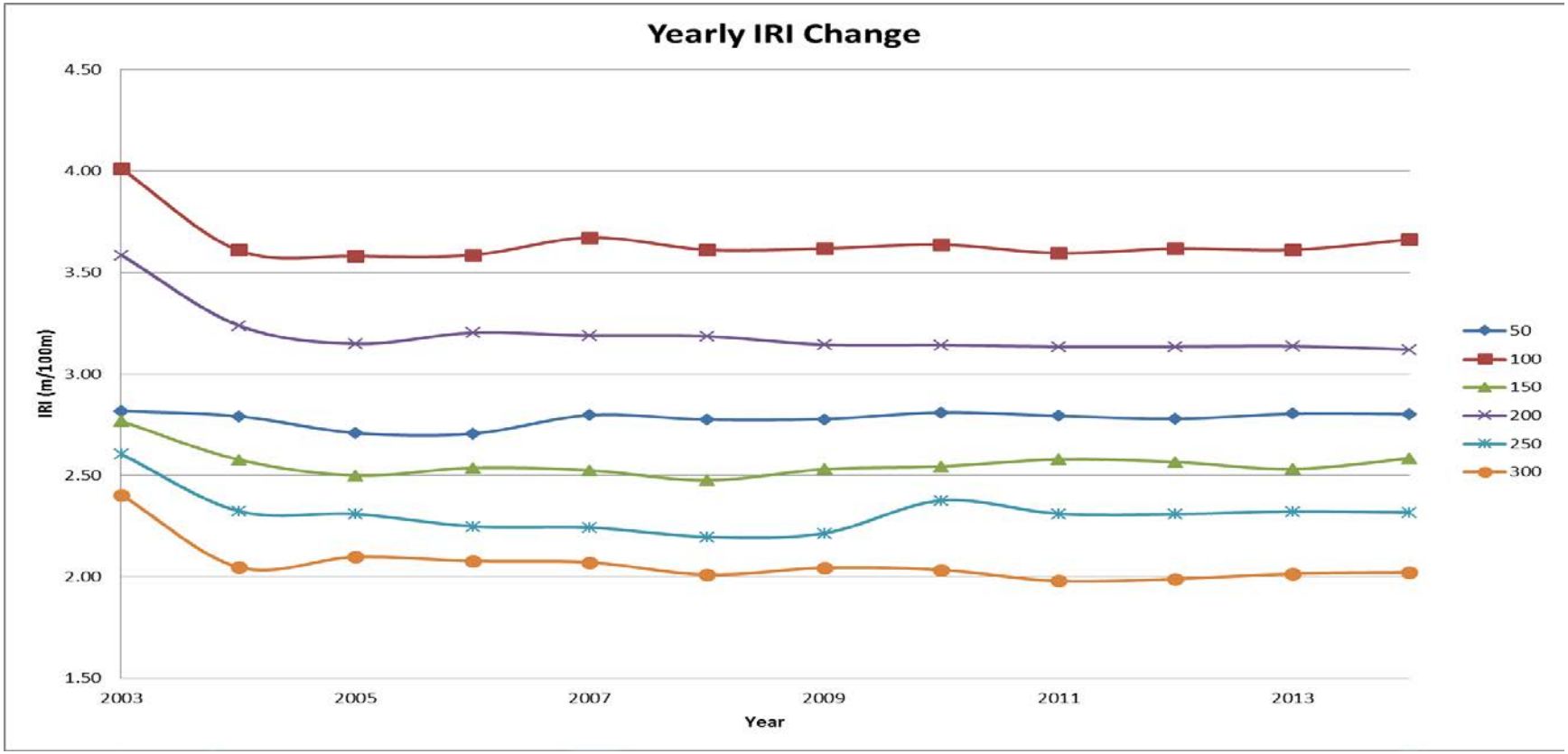
Validation & Repeatability

50m Roughness Validation Site 1

Crowther Rd 2015 WP024					2014 Data		
Distance	Run 1	Run 2	Run 3	Mean1-3	Mean	Up/Lmt	Lw/Lmt
50	2.87	2.69	2.80	2.79	2.80	3.22	2.38
100	3.59	3.66	3.63	3.63	3.66	4.21	3.11
150	2.65	2.63	2.69	2.66	2.59	2.98	2.20
200	3.17	3.15	3.16	3.16	3.15	3.62	2.67
250	2.20	2.51	2.44	2.38	2.30	2.64	1.95
300	2.09	2.00	2.01	2.03	2.00	2.30	1.70
Distance	Run 4	Run 5	Run 6	Mean 4-6	Mean	Up/Lmt	Lw/Lmt
50	2.76	2.79	2.77	2.77	2.80	3.22	2.38
100	3.65	3.62	3.77	3.68	3.66	4.21	3.11
150	2.66	2.68	2.71	2.68	2.59	2.98	2.20
200	3.18	3.15	3.10	3.14	3.15	3.62	2.67
250	2.29	2.43	2.29	2.34	2.30	2.64	1.95
300	1.98	2.07	1.99	2.01	2.00	2.30	1.70

Validation & Repeatability

50m Roughness 2003 to 2014



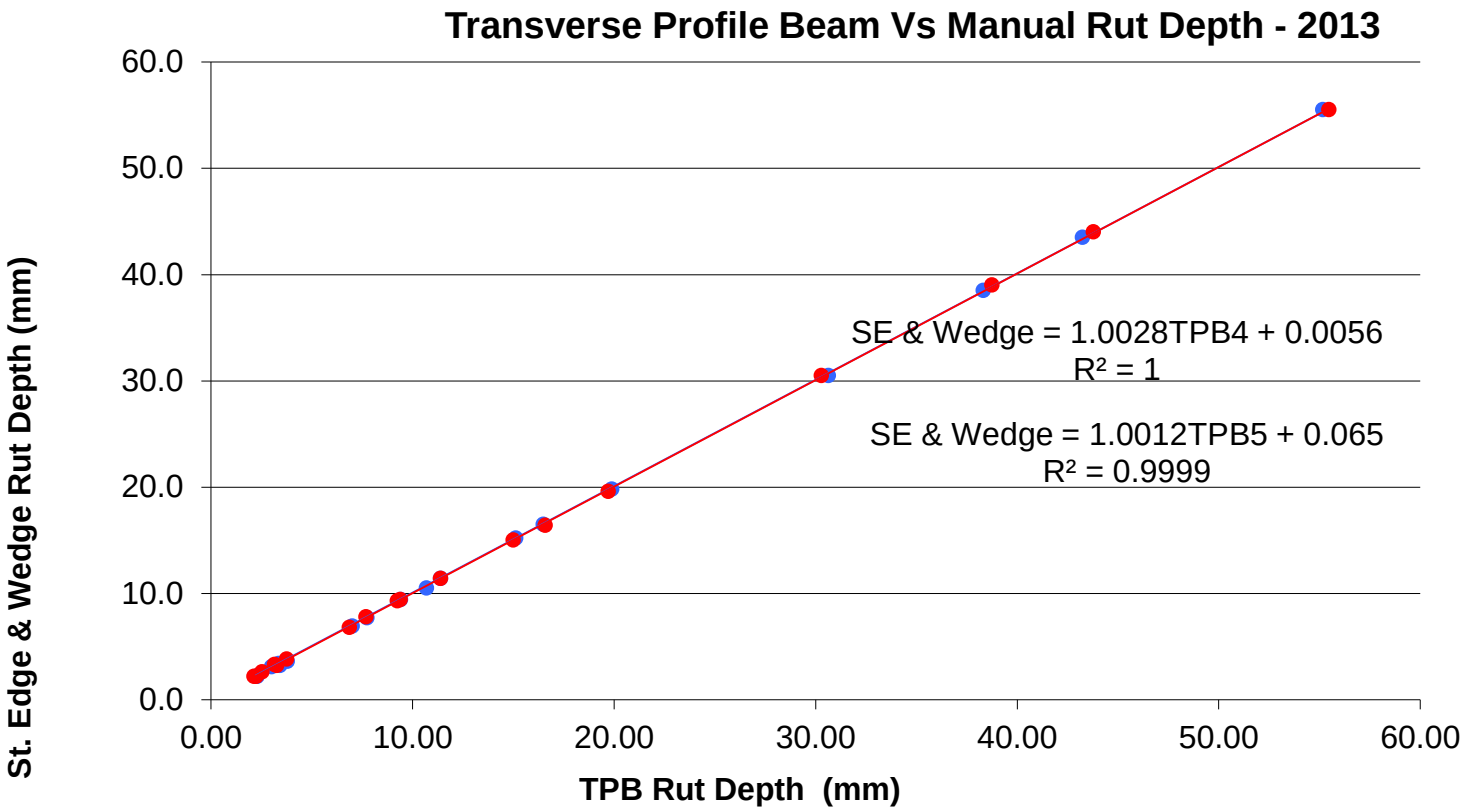
Validation and Repeatability

Rutting Validation Site 3

Moores Valley Rd Site 3								
Run No.	Left Rut	Mean	STD Dev	Std Error	Right Rut	Mean	STD Dev	Std Error
1	29.95				8.67			
	29.60	29.77	0.25	0.17	8.54	8.61	0.10	0.07
2	29.83				8.64			
	29.42	29.70	0.23	0.12	8.68	8.63	0.07	0.03
3	29.88				8.56			
	29.74	29.74	0.20	0.08	8.65	8.62	0.06	0.02
4	29.86				8.64			
	29.50	29.72	0.19	0.07	8.67	8.63	0.05	0.02
5	29.88				8.65			
	29.14	29.68	0.26	0.08	8.75	8.64	0.06	0.02

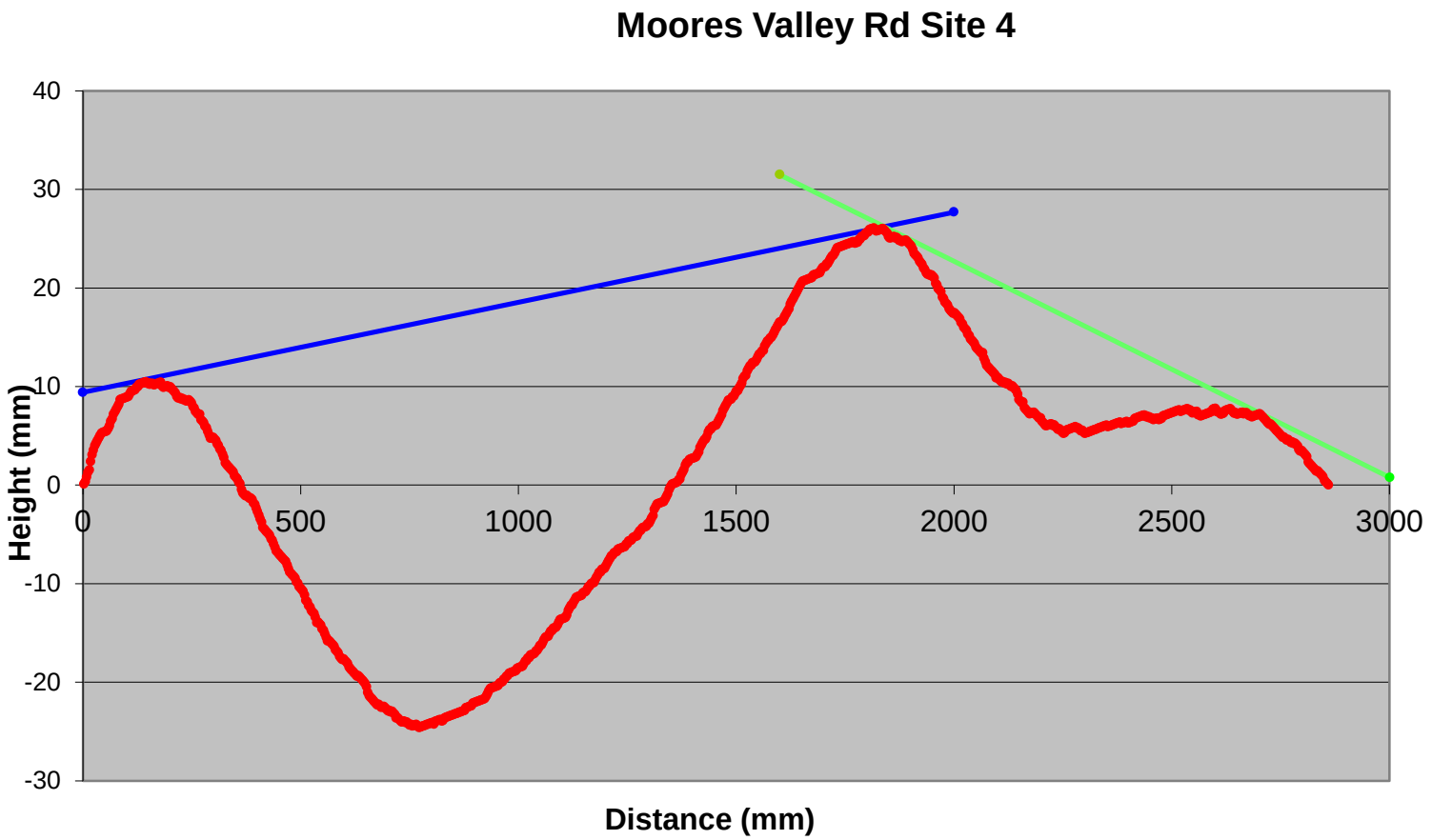
Validation & Repeatability

Straight Edge and Wedge vs TPB



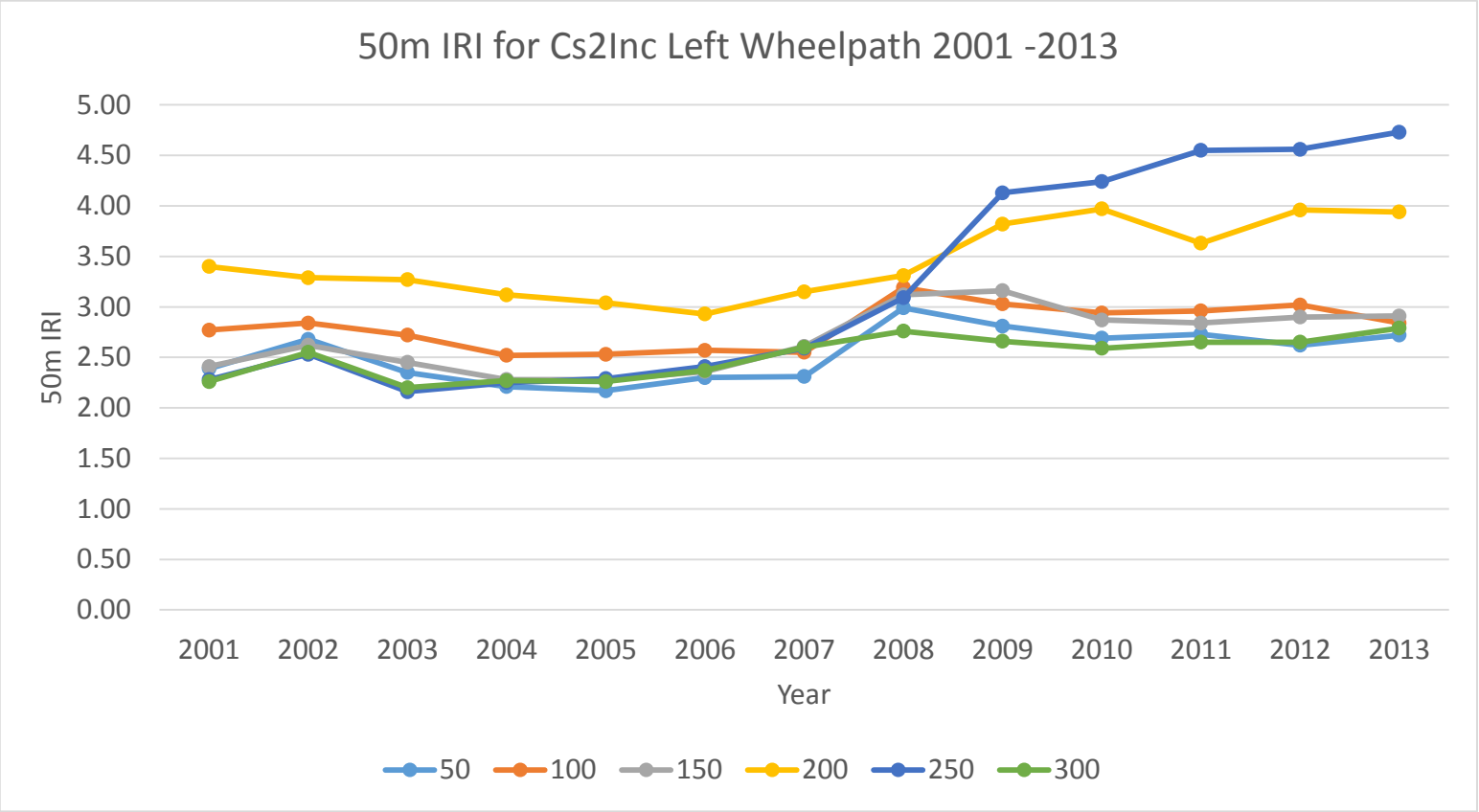
Validation & Repeatability

Typical Transverse Profile



Results

Roughness G3 Surface Treatment 2001 to 2013

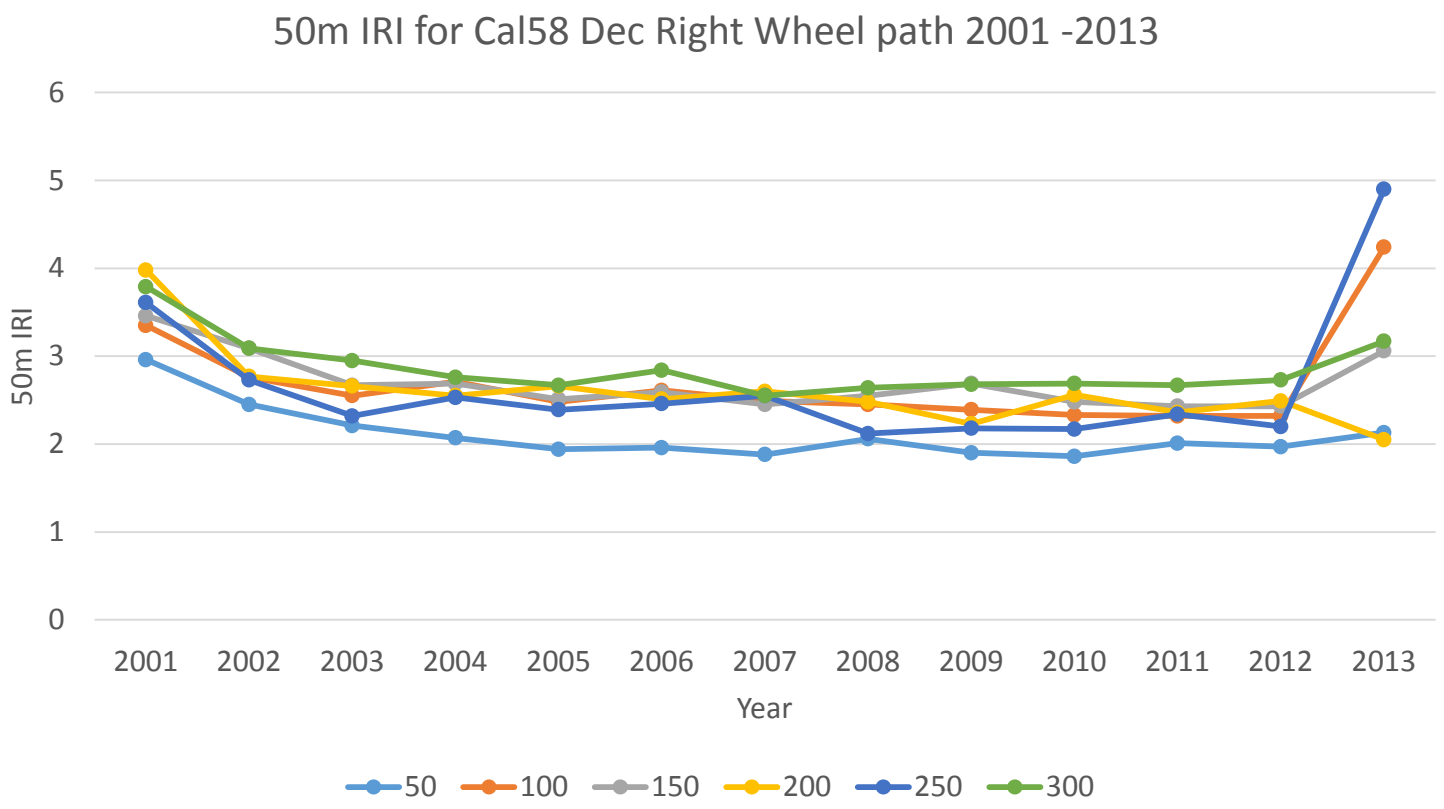


Results

Roughness Grade 3 Surface Treatment

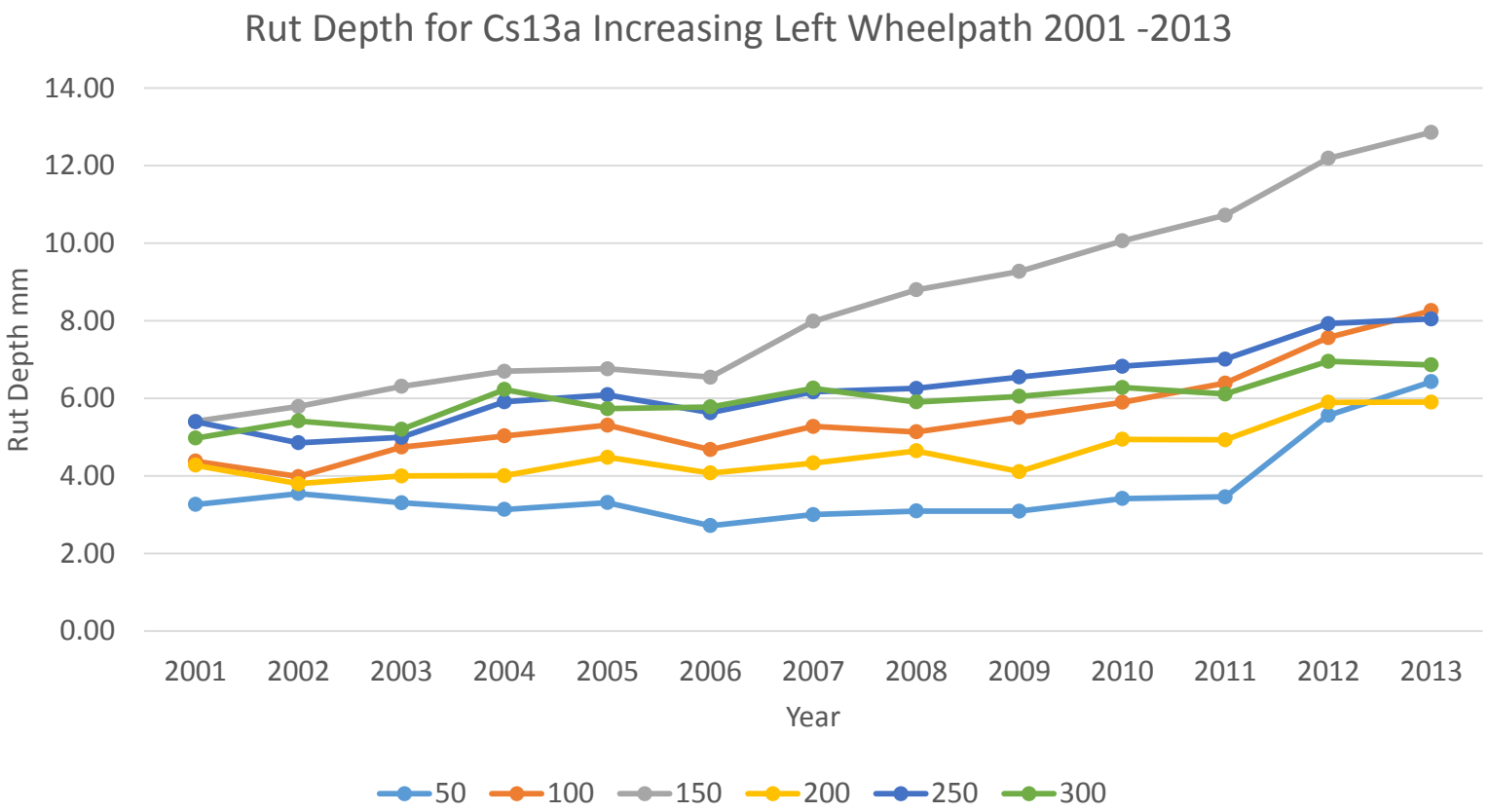
Results

Roughness G3/5 Surface Treatment



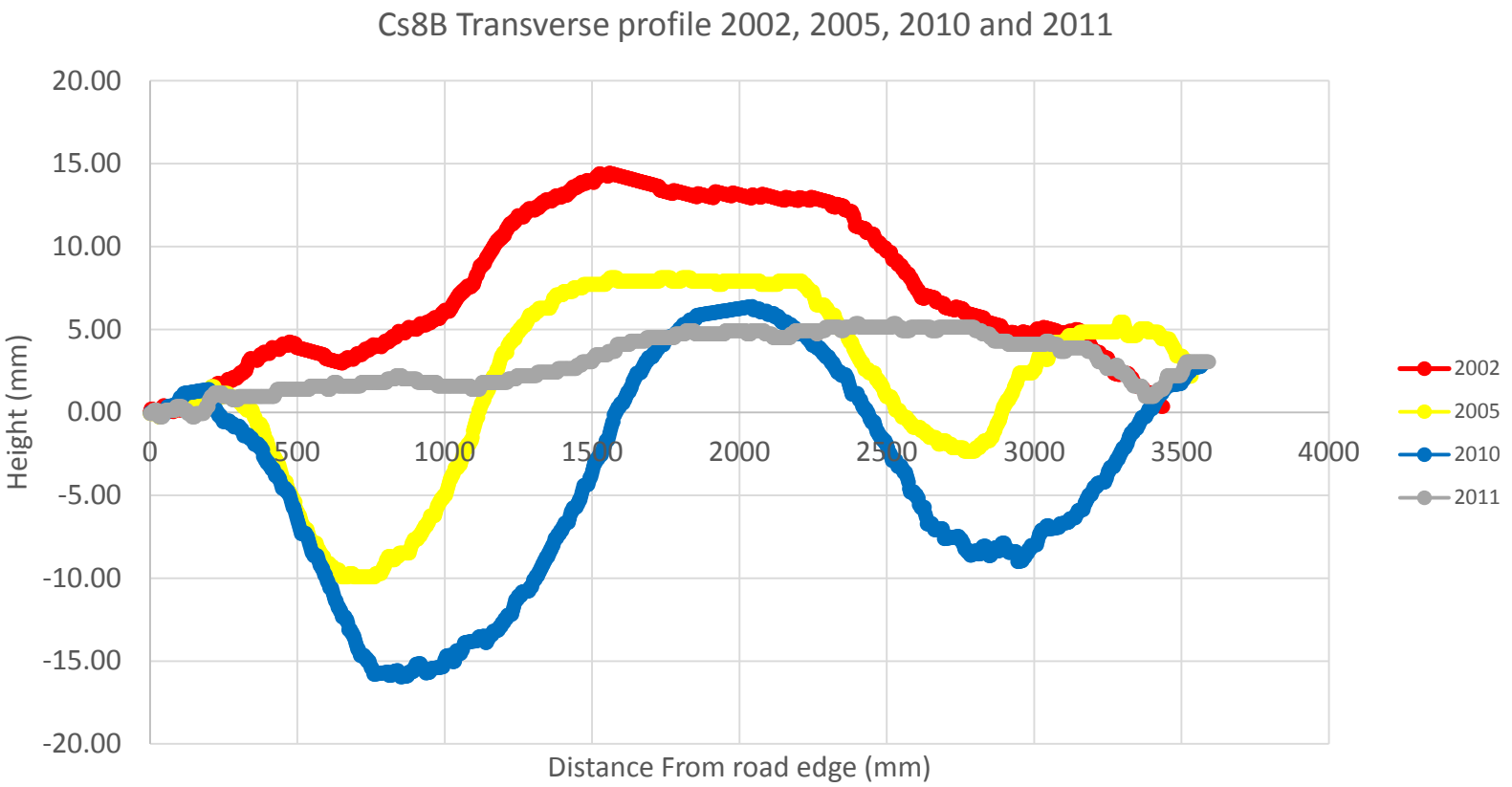
Results

Rutting Development 2001 to 2013



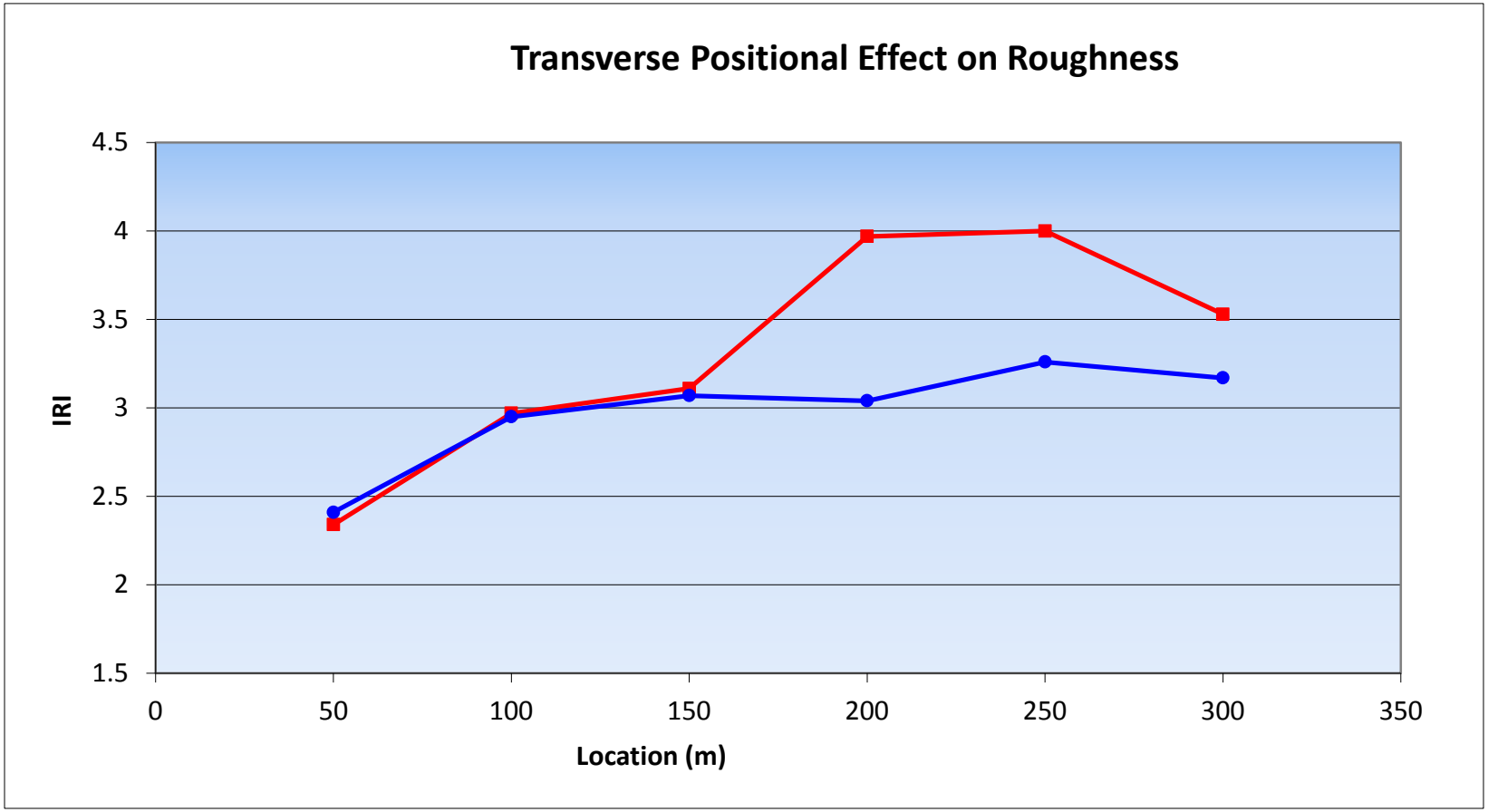
Results

Measurement Location - Rutting



Results

Measurement Location - Roughness



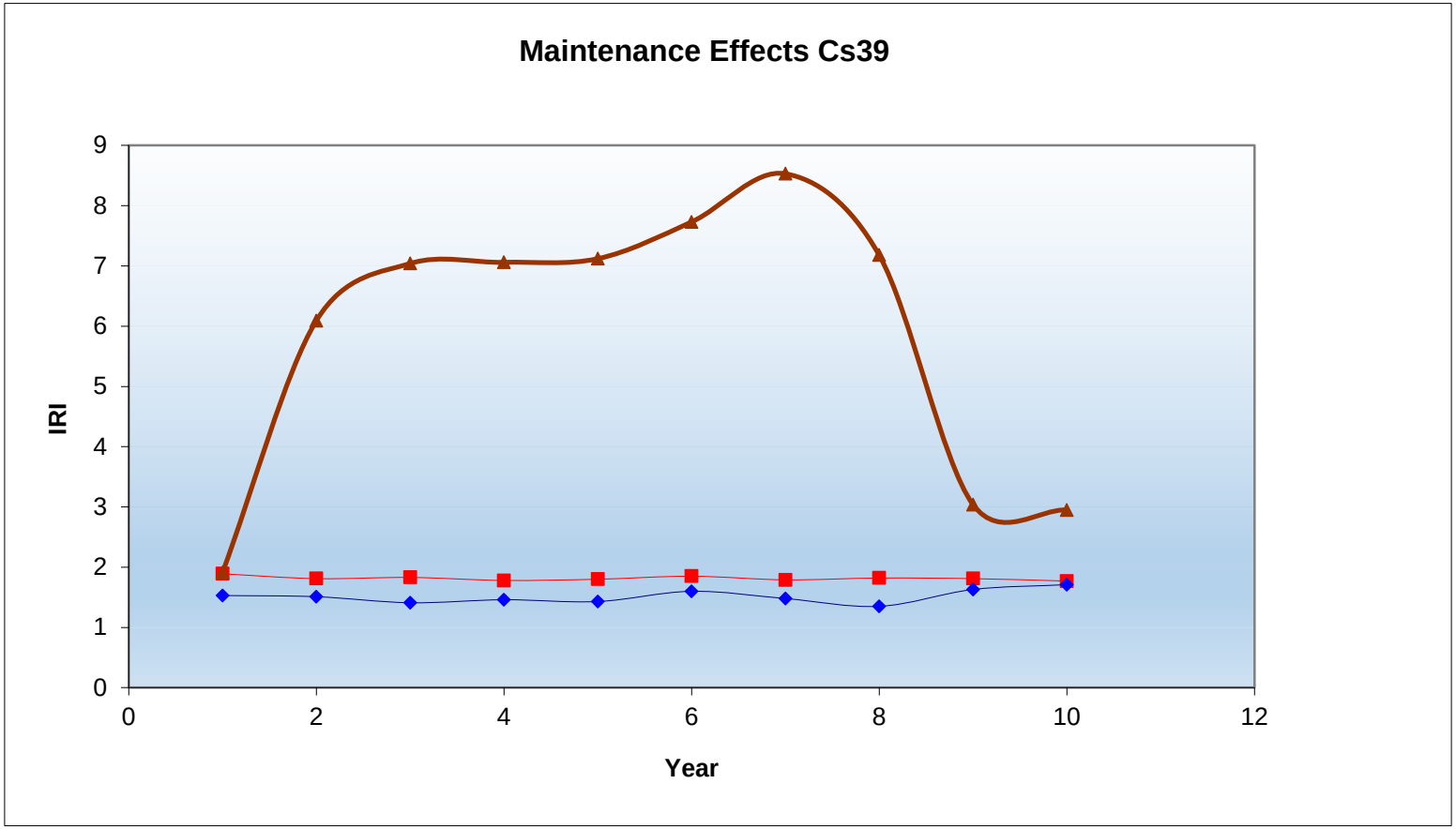
Results

Measurement Location - Wheelpath Separation

Wheelpath Separation	No. of Sites	No of Heavy Vehicle Sites
1400	5	0
1500	25	2
1600	25	4
1700	15	5
1800	8	4
1900	4	4

Results

Maintenance - Roughness



Summary

- **Site Establishment**
- **Traffic Management**
- **Equipment**
  - **Select suitable Equipment**
  - **Retain Backup**
  - **Operate Multiple Equipment- cross checking**
- **Calibration and Validation**
  - **Calibrate to an International Standard**
  - **Develop Validation procedures that test the equipment for all expected conditions**
- **Data Collection**
  - **Develop and document robust data collection procedures**
  - **Follow same procedures each year- photograph distress**
- **Results**
  - **Check data – Check data as it is collected**
  - **Data Processing - use automated software to minimise human error**
  - **Quality Control – follow well defined QA procedures**