# WHO IS PATHWAY SERVICES INC.?

- *LARGEST VENDOR* OF ITS KIND IN THE U.S.A
- *45* PATHRUNNERS IN FLEET *(LARGEST FULL SERVICE FLEET IN THE WORLD)*
    INCLUDING PAVEMENT CONDITION, FRICTION, & LiDAR EQUIPMENT
- MORE THAN *7M Miles/11.2M Kilometers* COLLECTED TO DATE
- *30+* CURRENT STATEWIDE AND INTERNATIONAL CONTRACTS
    DATA COLLECTION SERVICES and EQUIPMENT
- *SELECTED BY FHWA* FOR EQUIPMENT AND SERVICES
- *500,000+* ANNUALLY COLLECTED MILES BY PATHRUNNERS
    INCLUDING ON-SYSTEM, OFF-SYSTEM, LOCALS, RAMPS, TOLLS
- INDUSTRY RECOGNIZED *ADVANCED GIS CAPABILITIES*

PAST AND PRESENT CLIENTS
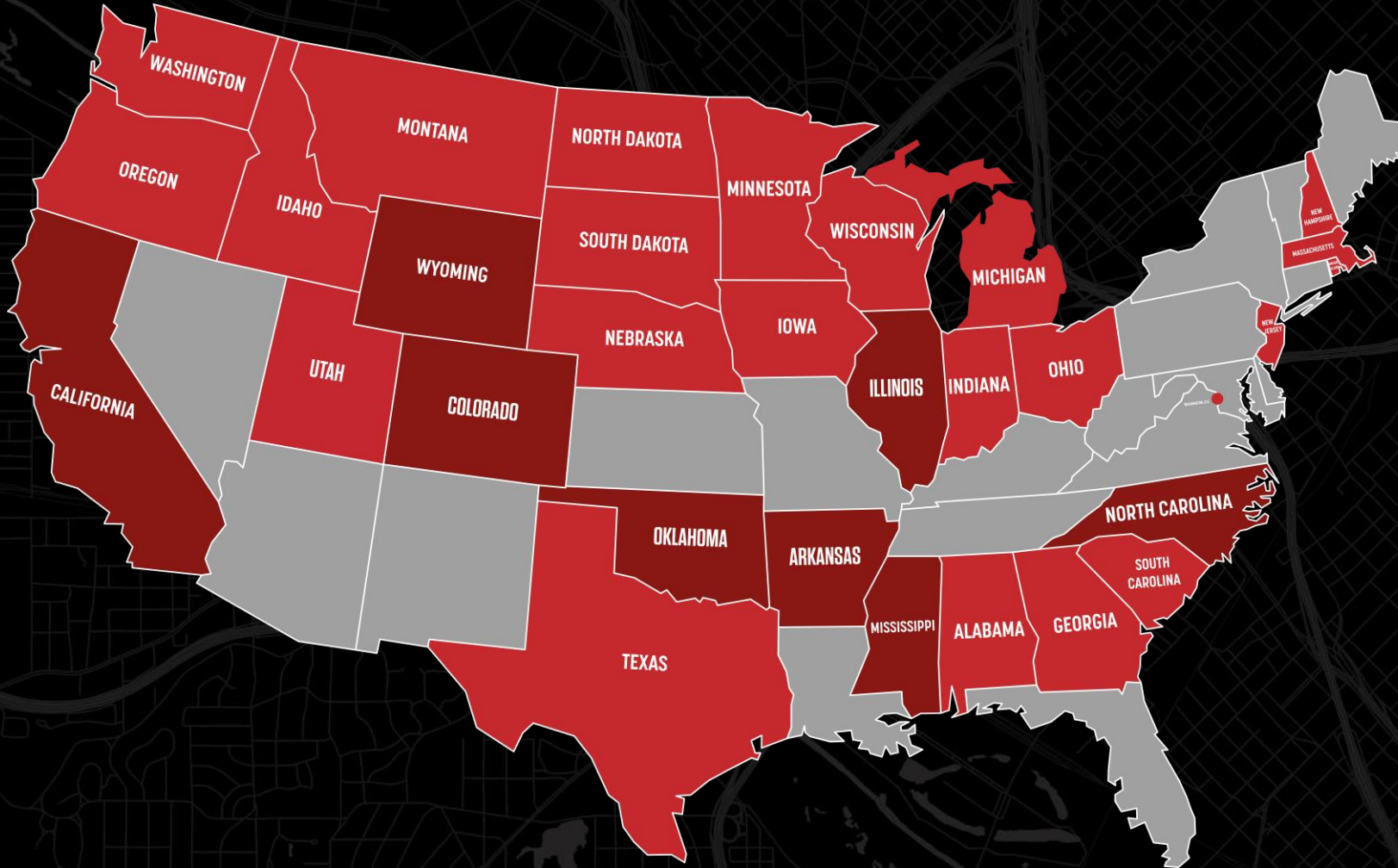
INCLUDING PUERTO RICO, INDIA, CHINA and MEXICO

IRI...

- Legacy method for "snapshot" road condition assessment
  - Provides a "flagging tool" to identify potential problems
- Networks are predominantly measured with Inertial Style Profilers (Single Laser/Single Accelerometer)

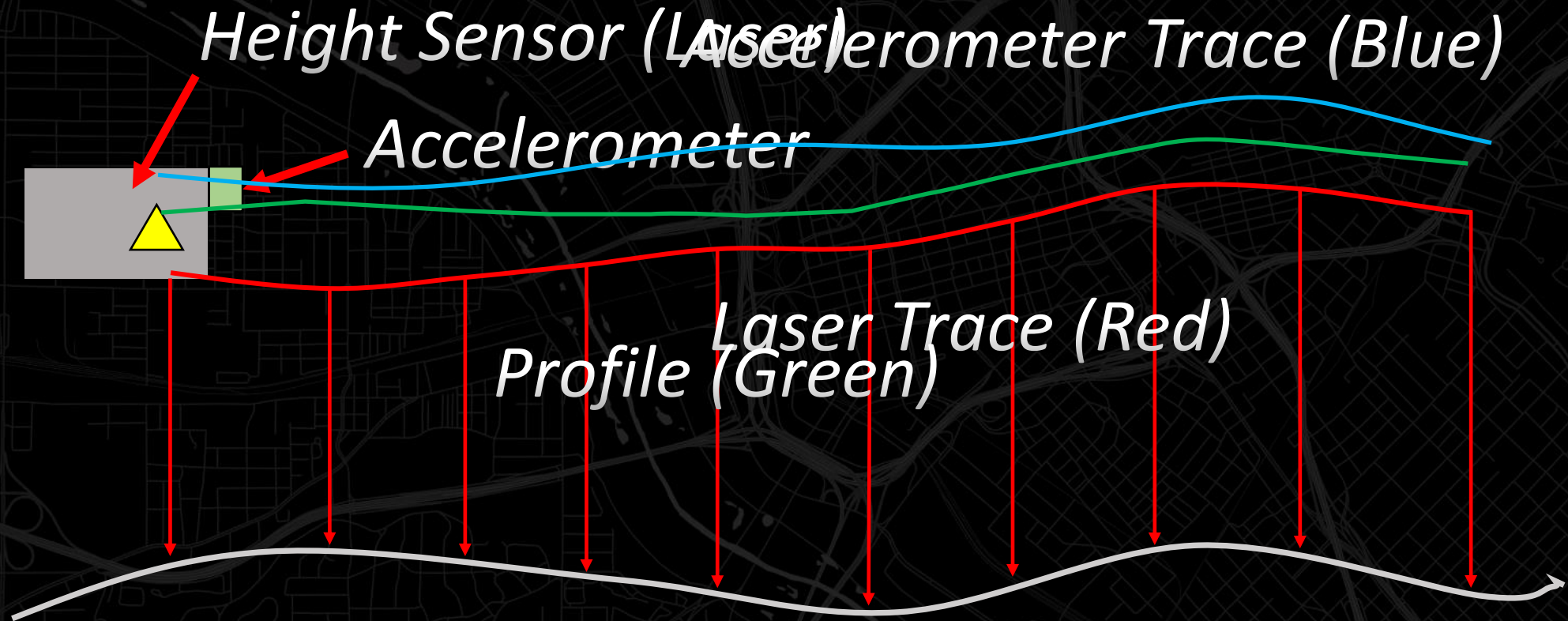**Traditional South Dakota Style Profiler**

- IRI- Arguably one of the fastest measurement methods for initial road condition assessment
- Cost Effective
- Requires little interpretation
- Simple*

Traditional IRI Measurement

Height Sensor (Laser)
Accelerometer Trace (Blue)
Accelerometer
Laser Trace (Red)
Profile (Green)

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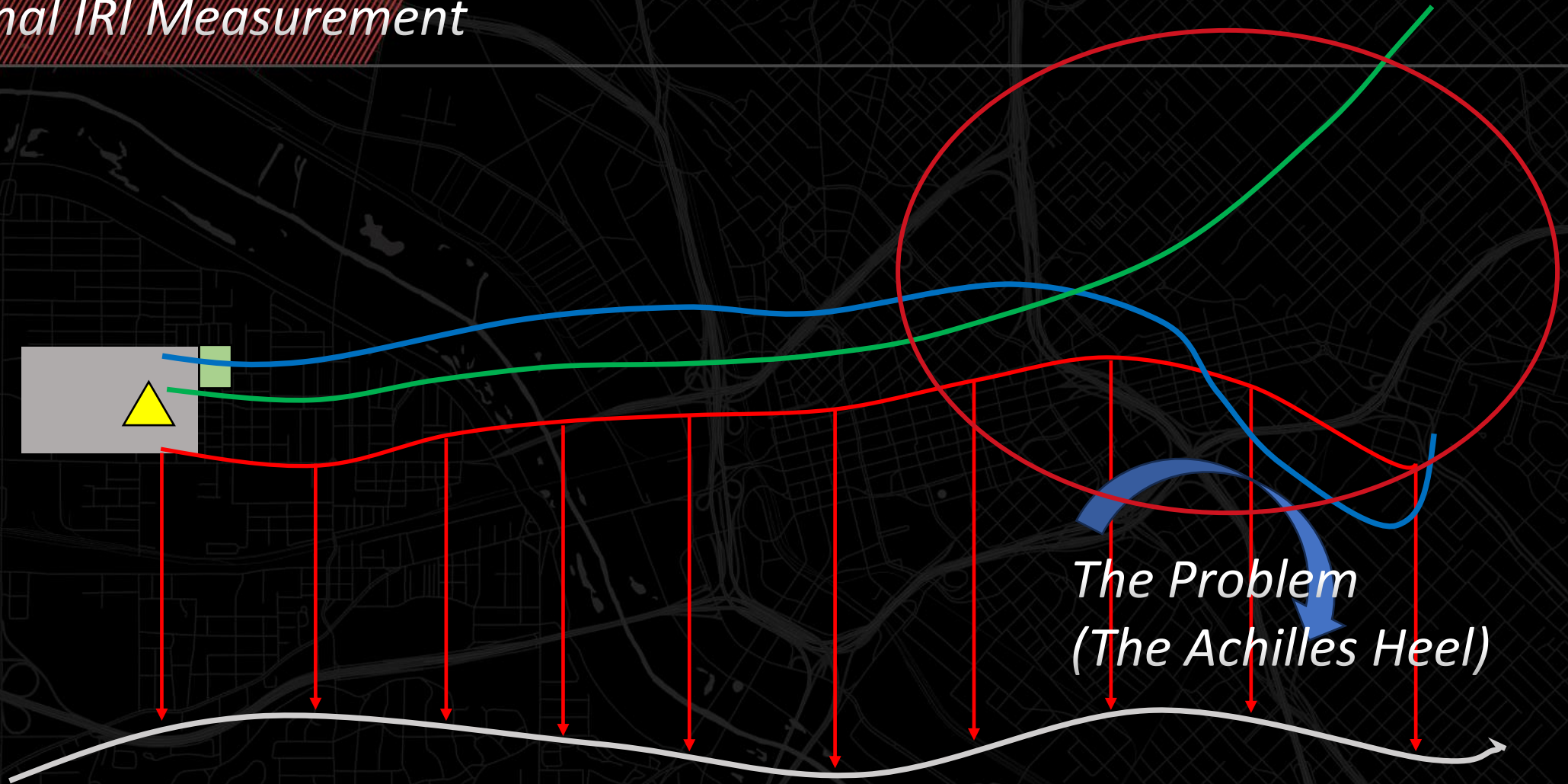*But... what about when...*

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The Problem(s)

- *Stopping*
- *Accelerating*
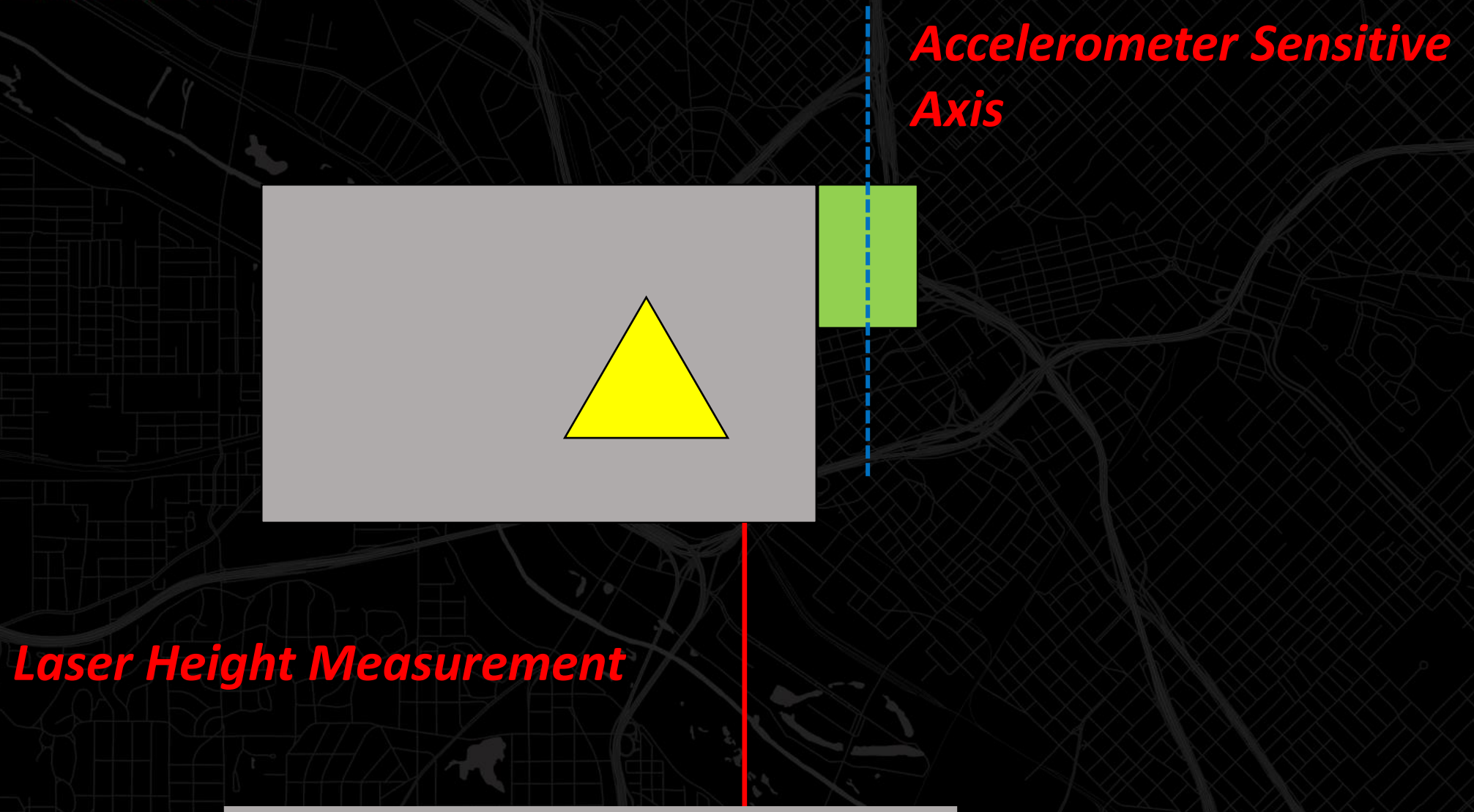- *Merging/Yielding*
- *Slow moving traffic*
- *Stop and go traffic*
- *Turns*

Achilles Heel- a weakness, in spite of overall strength, which can lead to the downfall of something.

Traditional IRI Measurement

The Problem
(The Achilles Heel)

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Accelerometer Sensitive Axis

Laser Height Measurement

Compounding problem of varying laser height measurements with substantially less accurate vertical compensation results in increased IRI response that is wrong.
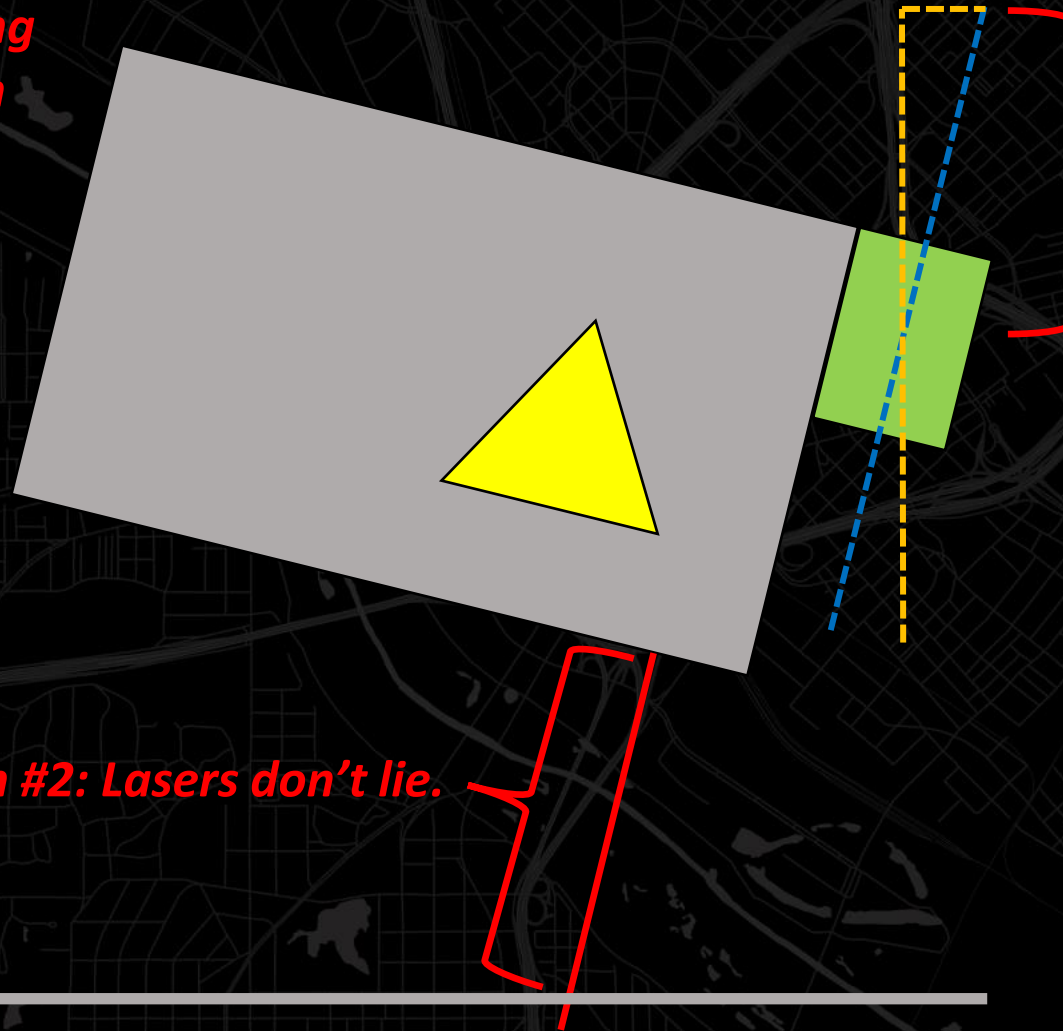
Problem #1: Accelerometer becomes exponentially less accurate. (It turns out vertical accelerometers like to be kept vertical!)

Problem #2: Lasers don't lie.

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- *Low Speed vs High Speed Profilers– One or the other*
- *Urban environments limit travel speed*
- *Difficult to collect data in dynamic traffic patterns (turns, ramps, roundabouts, merge lanes, etc…)*
- *You could be missing over half your network due to these circumstances.*
- *Why spend time collecting data you don't trust?*

Average Speed

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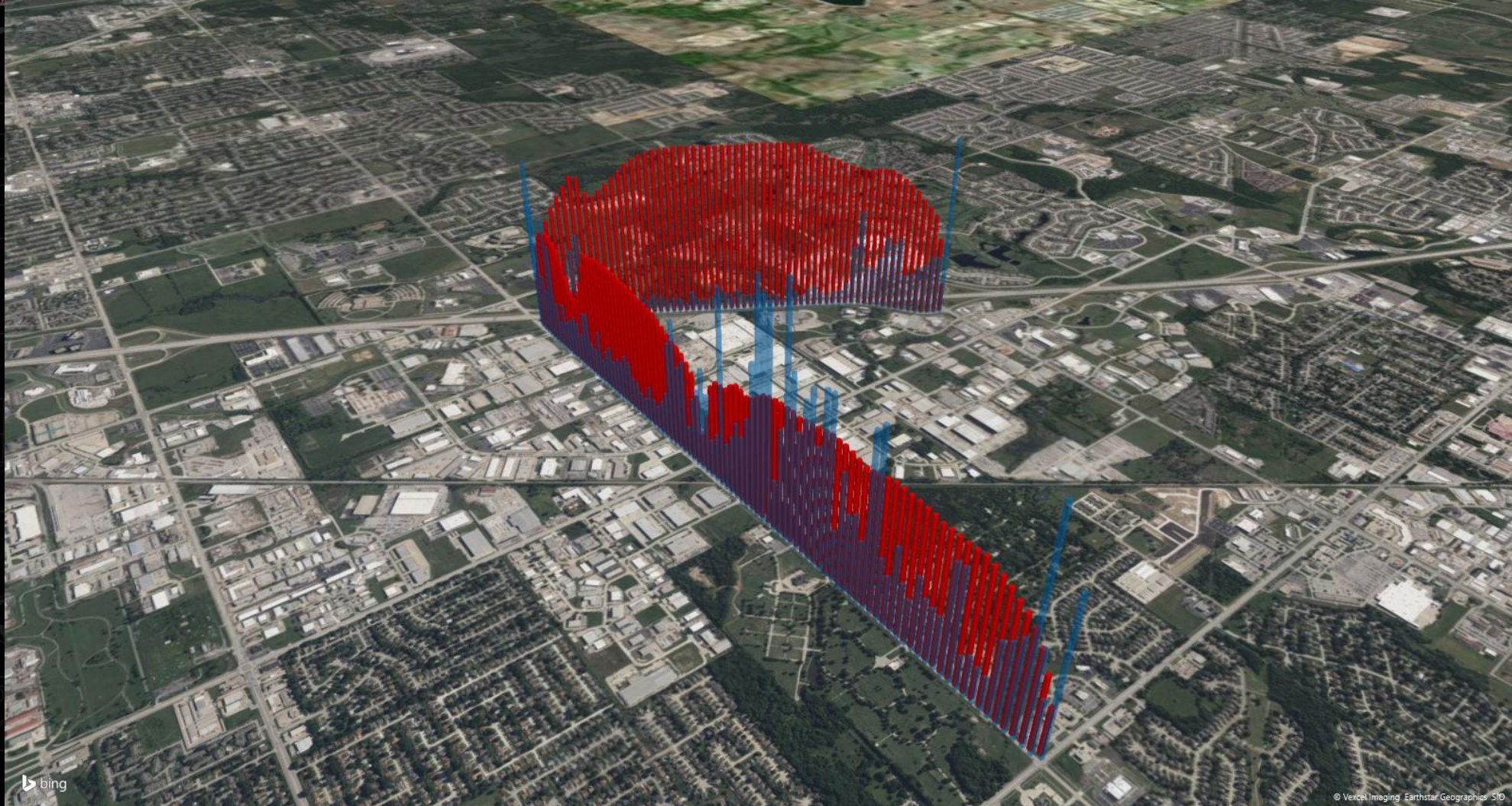
Average Speed (Red) with traditional IRI (100ft interval) (Blue)
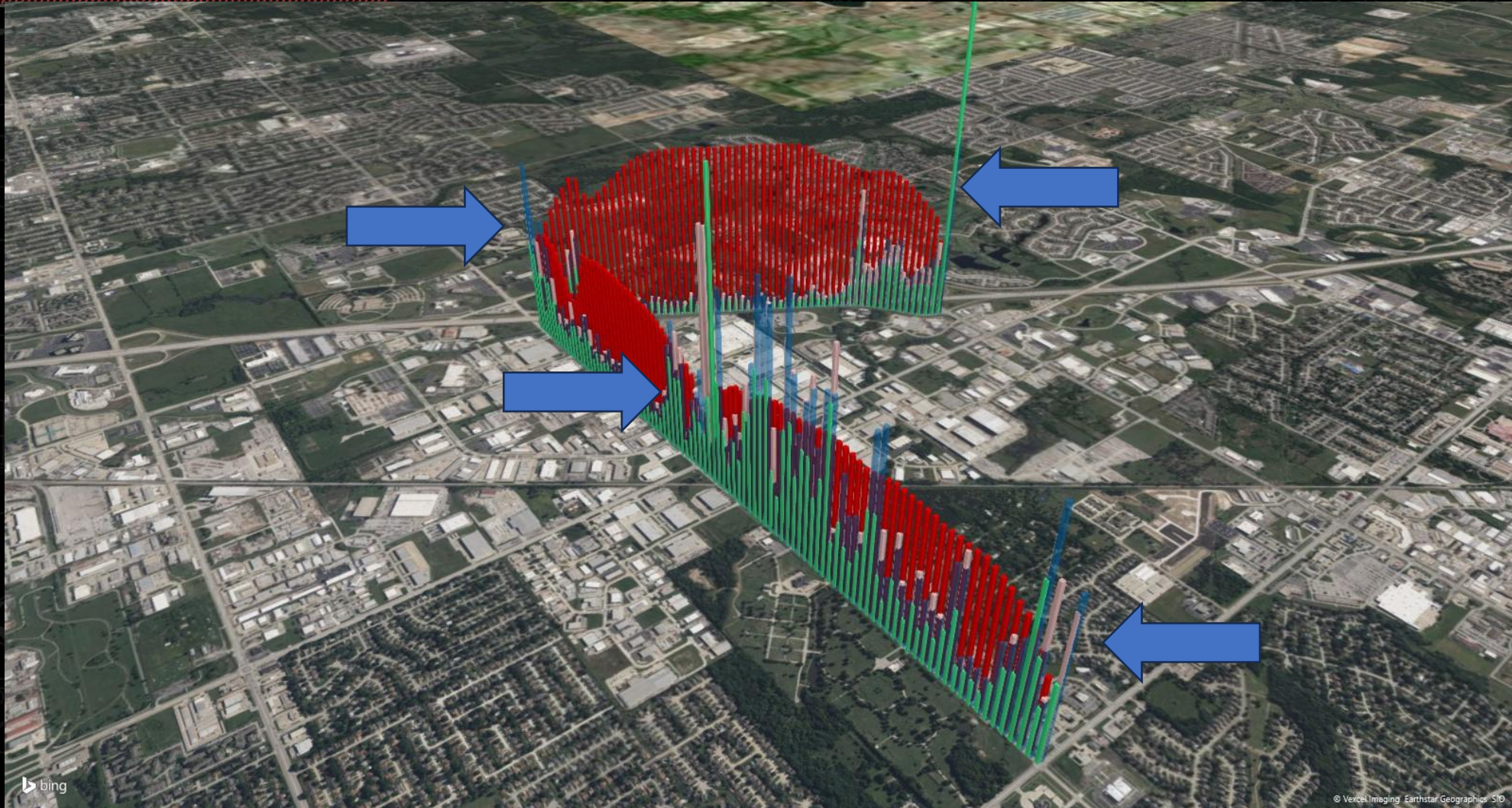
Average Speed (MPH) with traditional IRI x4 runs (100ft interval)
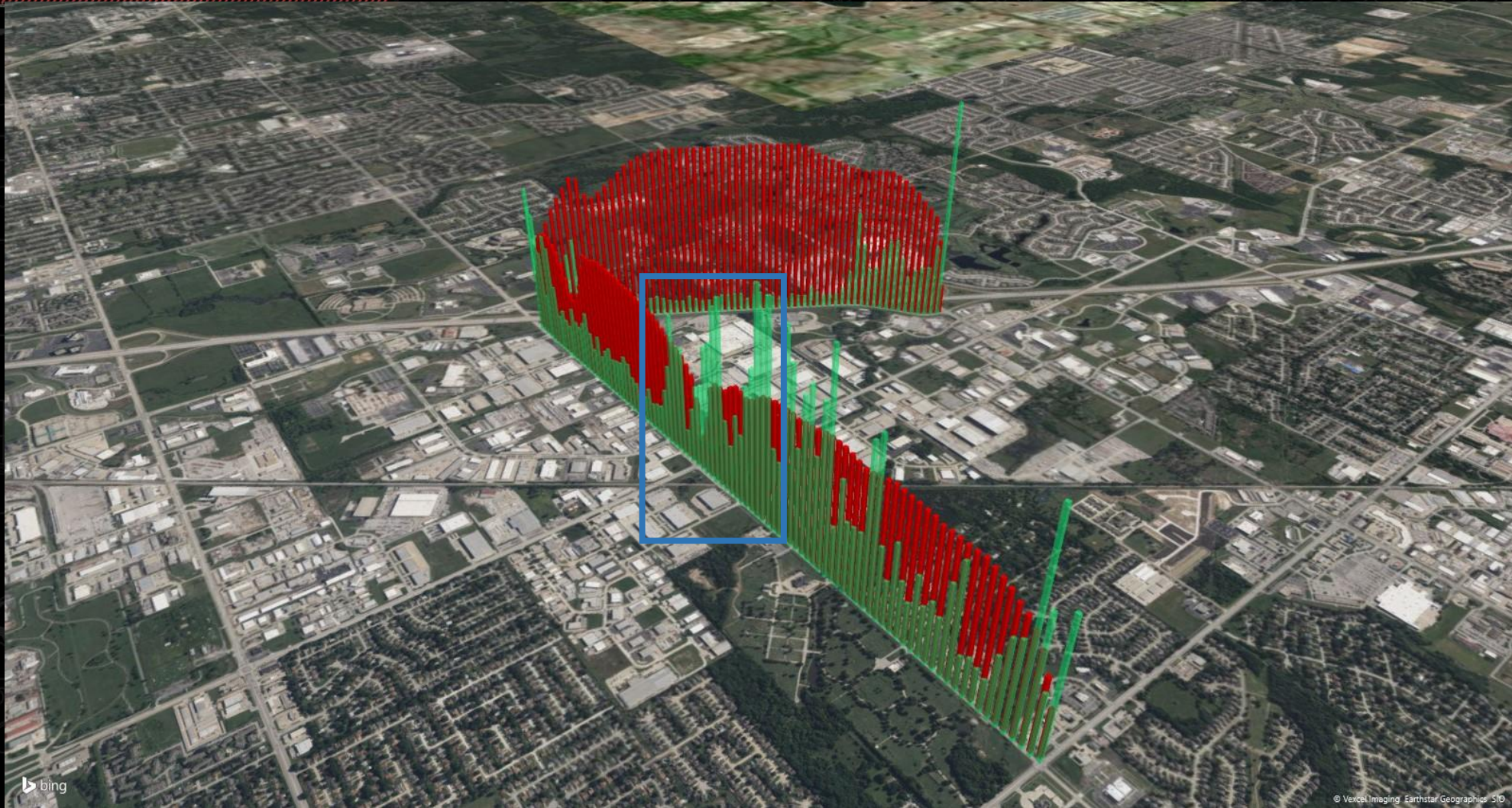
Average Speed (MPH) with traditional IRI Average (100ft interval)
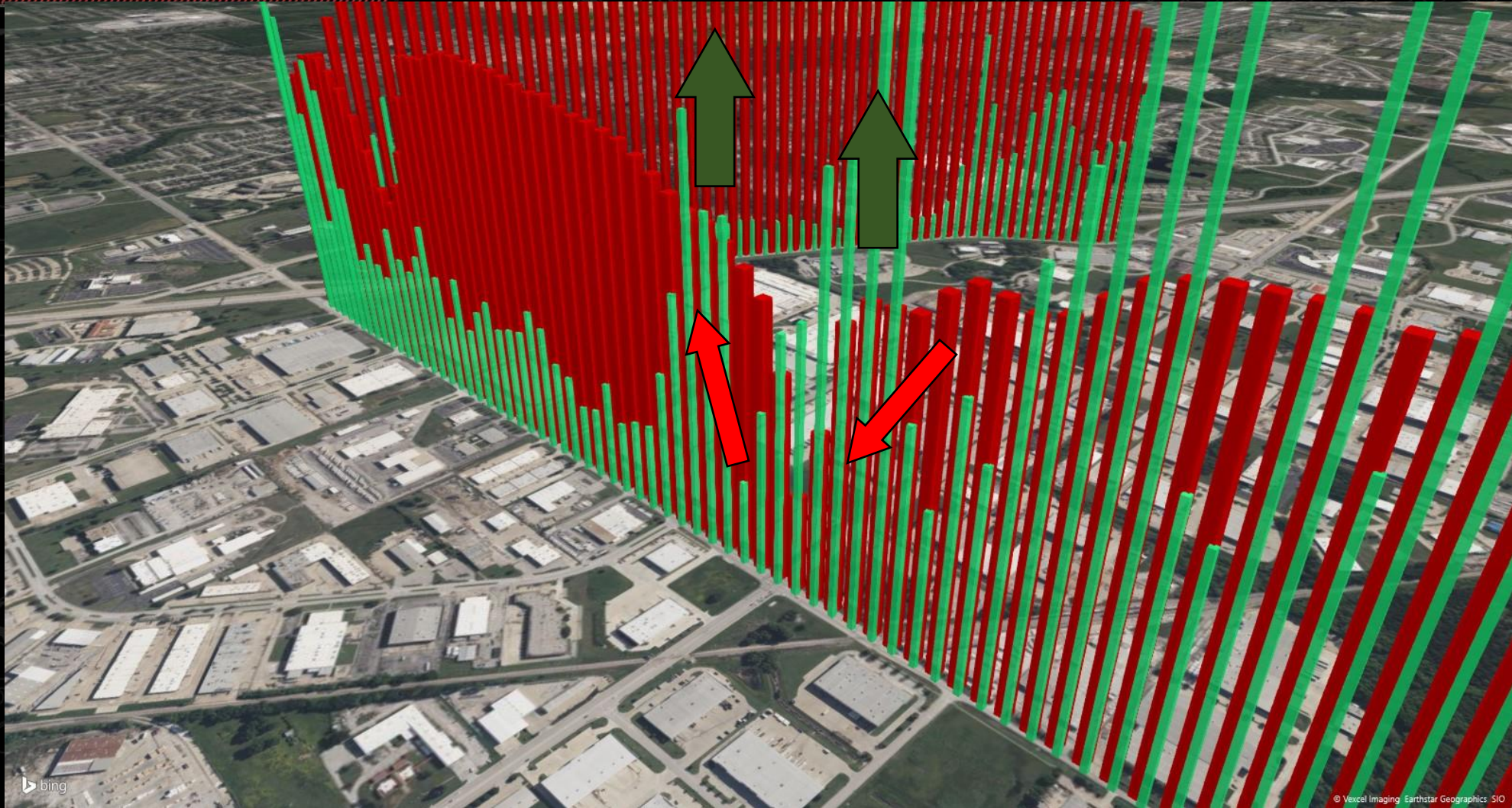
As speed goes down and up, traditional IRI goes up

Solution(s)?

- *How do we overcome the compromised data?*
- *Why is this important?*
  - *Large amount of compromised data in areas of high interest*
    - *Intersections*
    - *Ramps/merge lanes*
    - *High volume roads*
  - *These areas are subject to more failure due to traffic patterns*

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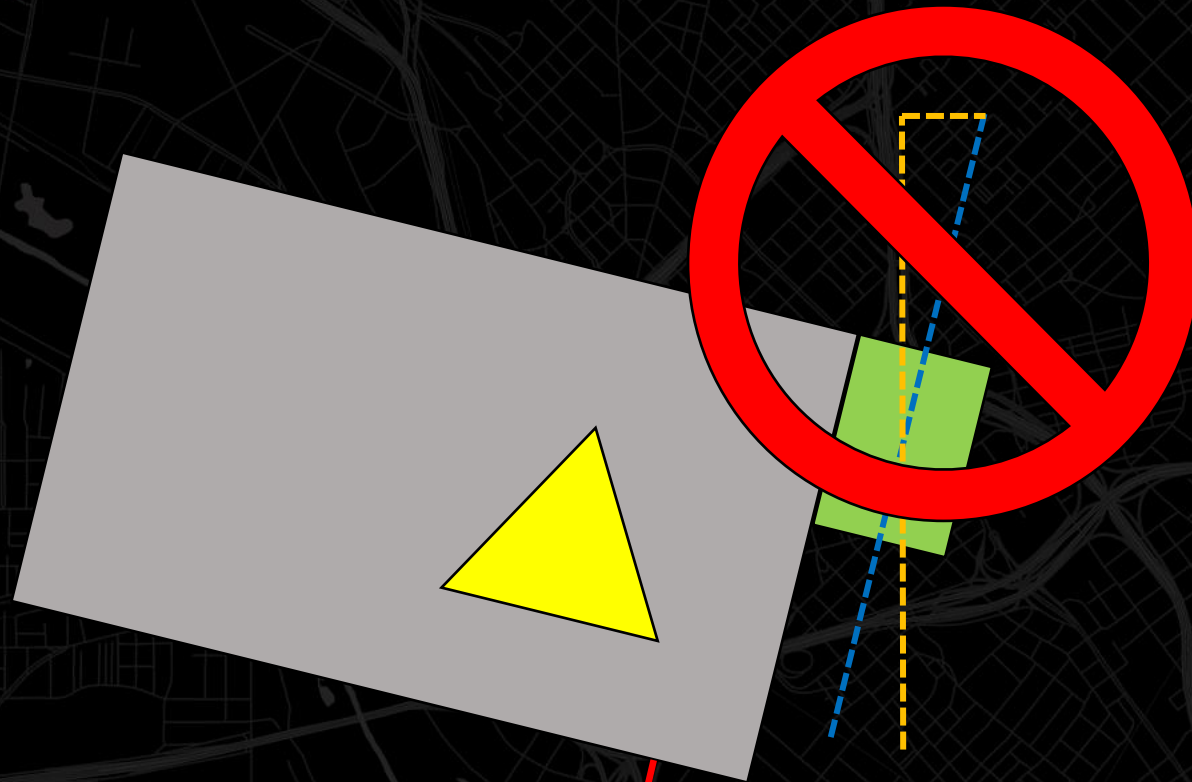
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The tests...
AASHTO R56 (US Standard)

Fixed speed @ 30MPH/48.5KPH, 1000Ft/305M

RWP 30MPH/48KPH

Legend: County_Line_NB_RWP_09152023_RElevation | Inertial_Profiler_109_30mph_001_RElev. | Inertial_Profiler_109_30mph_002_RElev. | Inertial_Profiler_109_30mph_003_RElev.

Statistic	Repeatability - Left	Repeatability - Right	Accuracy - Left	Accuracy - Right
Comparison Count	3	3	3	3
% Passing	100.00	100.00	100.00	100.00
Mean	98.64	98.35	92.09	94.87
Minimum	98.20	97.66	91.08	94.00
Maximum	99.39	98.96	92.84	95.88
Standard Deviation	0.7	0.7	0.9	0.9
Grade	Passed	Passed	Passed	Passed

Accuracy			Repeatability - Left Correlations (%)			Repeatability - Left Offsets (ft)			Repeatability - Right Correlations (%)			Repeatability - Right Offsets (ft)		
Run	Left	Right	Run	2	3	Run	2	3	Run	2	3	Run	2	3
1	91.08	94.00	1	98.32	98.20	1	0.1	0.1	1	98.96	97.66	1	0.1	0.2
2	92.36	94.74	2		99.39	2		0.1	2		98.43	2		0.1
3	92.84	95.88												

Inertial profiler (x3 runs) 1000 Ft, fixed speed

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Profilograph Simulation and Profiler Certification Results (ProVAL)

RWP 30MPH/48KPH
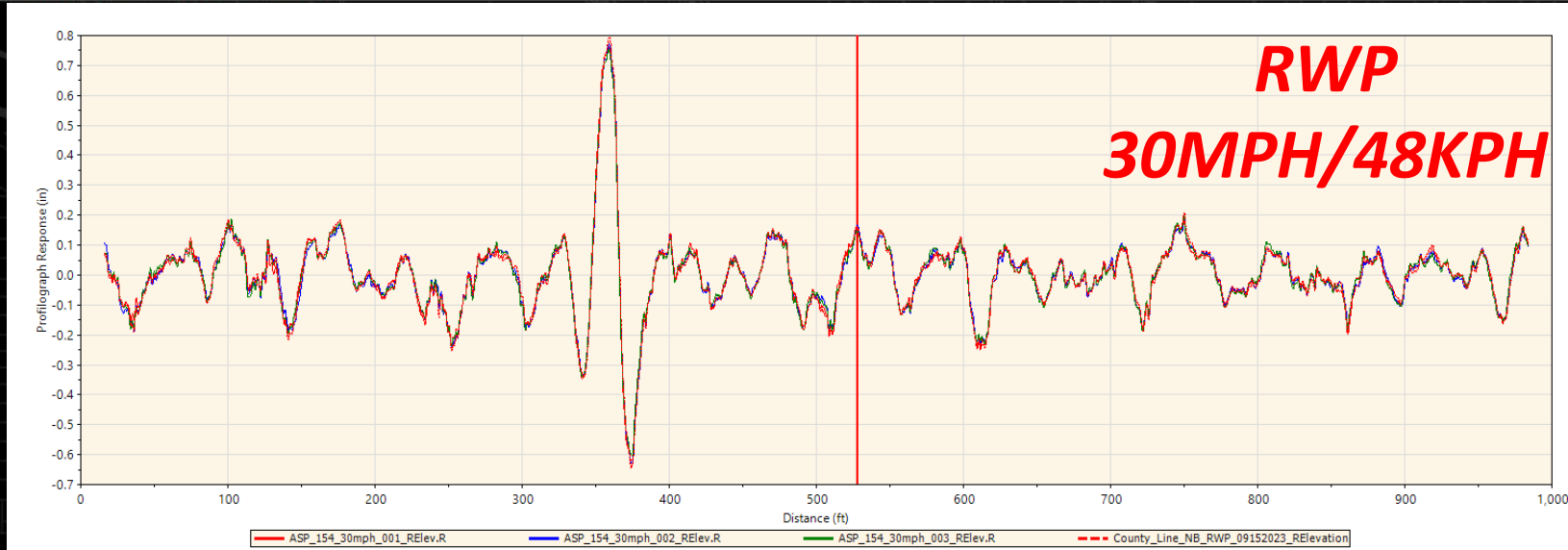
Statistic	Repeatability - Left	Repeatability - Right	Accuracy - Left	Accuracy - Right
Comparison Count	3	3	3	3
% Passing	100.00	100.00	100.00	100.00
Mean	97.82	98.02	93.74	97.87
Minimum	97.55	97.85	93.66	97.28
Maximum	98.04	98.26	93.84	98.26
Standard Deviation	0.2	0.2	0.1	0.5
Grade	Passed	Passed	Passed	Passed

Accuracy			Repeatability - Left Correlations (%)			Repeatability - Left Offsets (ft)			Repeatability - Right Correlations (%)			Repeatability - Right Offsets (ft)		
Run	Left	Right	Run	2	3	Run	2	3	Run	2	3	Run	2	3
1	93.66	98.06	1	97.55	98.04	1	0.3	0.3	1	98.26	97.94	1	0.0	0.3
2	93.84	98.26	2		97.87	2		0.0	2		97.85	2		0.3
3	93.73	97.28												

ASP (x3 runs) 1000 Ft, fixed speed

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Fixed speed @ 3MPH/4.8KPH, 1000Ft/305M
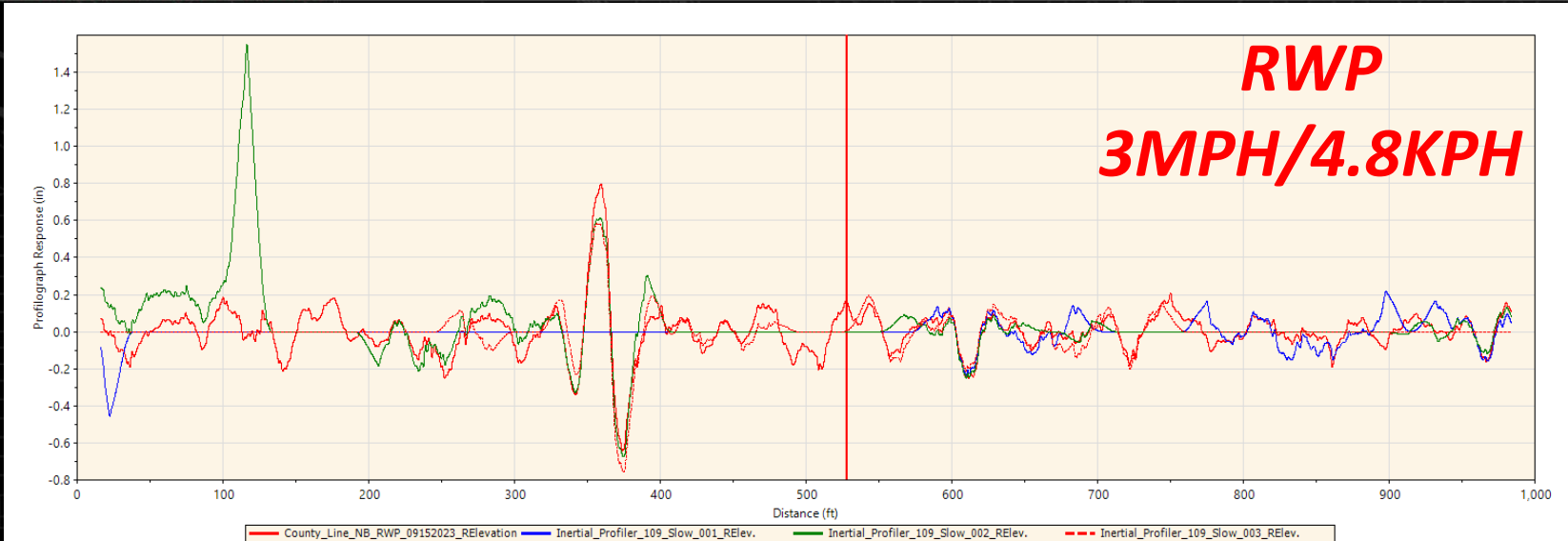
RWP 3MPH/4.8KPH

Statistic	Repeatability - Left	Repeatability - Right	Accuracy - Left	Accuracy - Right
Comparison Count	3	3	3	3
% Passing	0.00	0.00	0.00	0.00
Mean	2.53	19.46	22.09	42.90
Minimum	-8.33	7.58	13.22	16.70
Maximum	11.13	40.58	31.33	58.05
Standard Deviation	9.9	18.3	9.1	22.8
Grade	Failed	Failed	Failed	Failed

Accuracy				Repeatability - Left Correlations (%)				Repeatability - Left Offsets (ft)				Repeatability - Right Correlations (%)				Repeatability - Right Offsets (ft)		
Run	Left	Right		Run	2	3		Run	2	3		Run	2	3		Run	2	3
1	13.22	16.70		1	-8.33	4.80		1	5.1	0.0		1	7.58	10.22		1	0.0	-0.1
2	21.73	53.95		2		11.13		2		0.1		2		40.58		2		0.0
3	31.33	58.05																

Inertial profiler (x3 runs) 1000 Ft, fixed speed

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Profilograph Simulation and Profiler Certification Results (ProVAL)

RWP 3MPH/4.8KPH

Statistic	Repeatability - Left	Repeatability - Right	Accuracy - Left	Accuracy - Right
Comparison Count	3	3	3	3
% Passing	100.00	100.00	100.00	100.00
Mean	96.82	97.57	94.57	95.80
Minimum	96.22	97.05	93.39	93.97
Maximum	97.52	97.86	95.34	97.18
Standard Deviation	0.7	0.5	1.0	1.7
Grade	Passed	Passed	Passed	Passed

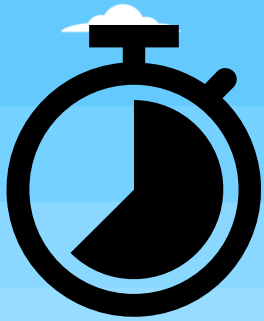| Accuracy			Repeatability - Left Correlations (%)			Repeatability - Left Offsets (ft)			Repeatability - Right Correlations (%)			Repeatability - Right Offsets (ft)		
Run	Left	Right	Run	2	3	Run	2	3	Run	2	3	Run	2	3
1	94.97	96.25	1	97.52	96.71	1	0.0	0.0	1	97.86	97.80	1	0.0	0.0
2	95.34	97.18	2		96.22	2		0.3	2		97.05	2		0.0
3	93.39	93.97												

ASP (x3 runs) 1000 Ft, fixed speed

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Enter site at 30MPH/48.5KPH, stop abruptly, then accel., 1000Ft/305M

Stop for 60 Seconds...

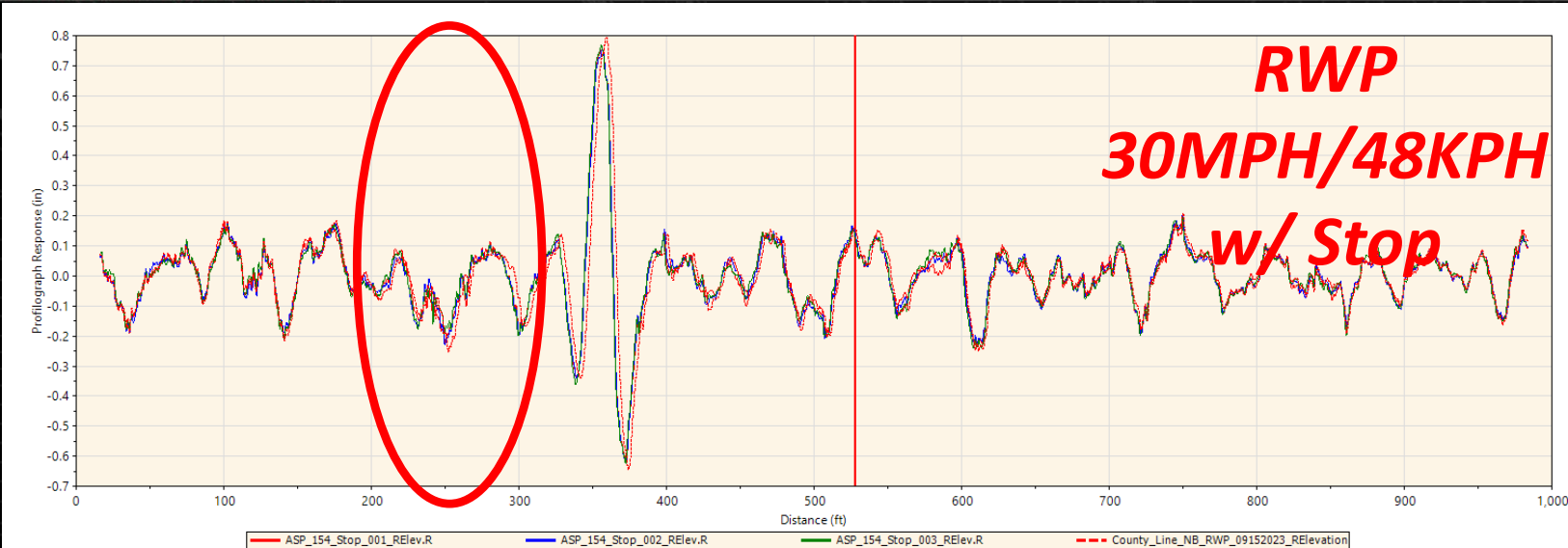# *Profilograph Simulation and Profiler Certification Results (ProVAL)*
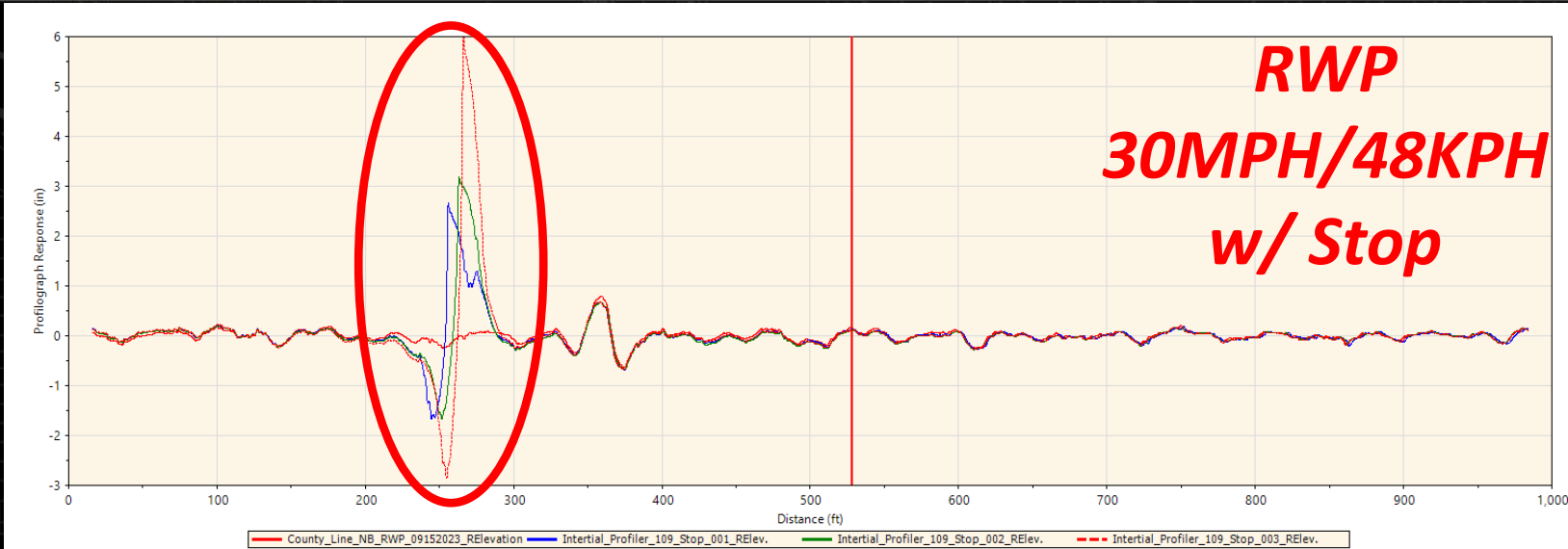
RWP 30MPH/48KPH w/ Stop

Statistic	Repeatability - Left	Repeatability - Right	Accuracy - Left	Accuracy - Right
Comparison Count	3	3	3	3
% Passing	0.00	0.00	0.00	0.00
Mean	44.04	39.25	6.26	9.60
Minimum	17.46	15.70	5.18	3.99
Maximum	69.81	52.98	7.96	14.73
Standard Deviation	26.2	20.5	1.5	5.4
Grade	Failed	Failed	Failed	Failed

Accuracy			Repeatability - Left Correlations (%)			Repeatability - Left Offsets (ft)			Repeatability - Right Correlations (%)			Repeatability - Right Offsets (ft)		
Run	Left	Right	Run	2	3	Run	2	3	Run	2	3	Run	2	3
1	5.18	10.09	1	44.84	17.46	1	-5.0	-2.9	1	49.06	15.70	1	-5.0	-2.9
2	7.96	14.73	2		69.81	2		-2.9	2		52.98	2		-3.0
3	5.64	3.99												

Inertial profiler (x3 runs) 1000 Ft

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RWP 30MPH/48KPH w/ Stop

Statistic	Repeatability - Left	Repeatability - Right	Accuracy - Left	Accuracy - Right
Comparison Count	3	3	3	3
% Passing	100.00	100.00	0.00	0.00
Mean	93.19	96.27	77.13	83.95
Minimum	92.62	95.09	73.98	81.81
Maximum	93.70	97.75	78.78	85.54
Standard Deviation	0.5	1.4	2.7	1.9
Grade	Passed	Passed	Failed	Failed

Accuracy			Repeatability - Left Correlations (%)			Repeatability - Left Offsets (ft)			Repeatability - Right Correlations (%)			Repeatability - Right Offsets (ft)		
Run	Left	Right	Run	2	3	Run	2	3	Run	2	3	Run	2	3
1	**78.78**	**81.81**	1	93.70	92.62	1	-0.2	-0.2	1	95.97	95.09	1	-0.2	-0.2
2	**78.62**	**85.54**	2		93.26	2		0.0	2		97.75	2		0.0
3	**73.98**	**84.51**												

ASP (x3 runs) 1000 Ft
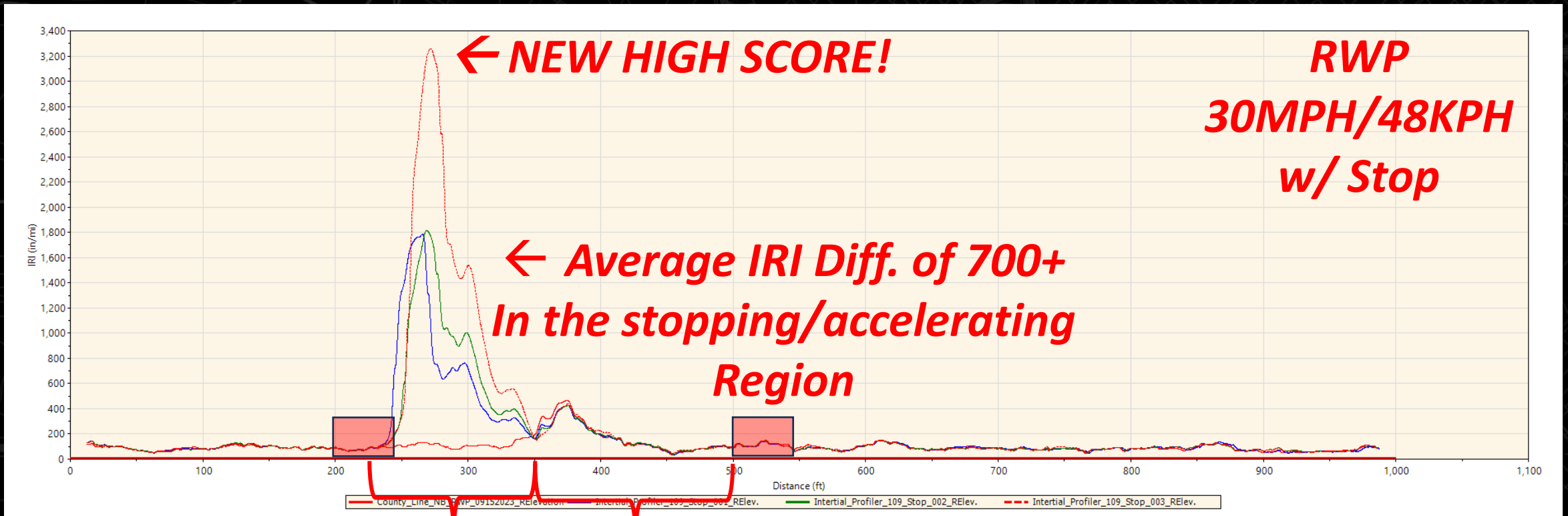
Ride Quality Analysis (Continuous, 25ft Interval)(ProVAL)

← **NEW HIGH SCORE!**

← **Average IRI Diff. of 700+
In the stopping/accelerating
Region**

**RWP
30MPH/48KPH
w/ Stop**

Stopping   Accelerating

Inertial profiler (x3 runs) 1000 Ft

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Ride Quality Analysis (Continuous, 25ft Interval)(ProVAL)

RWP
30MPH/48KPH
w/ Stop

Average IRI Diff. of ~15
In the stopping/accelerating
Region
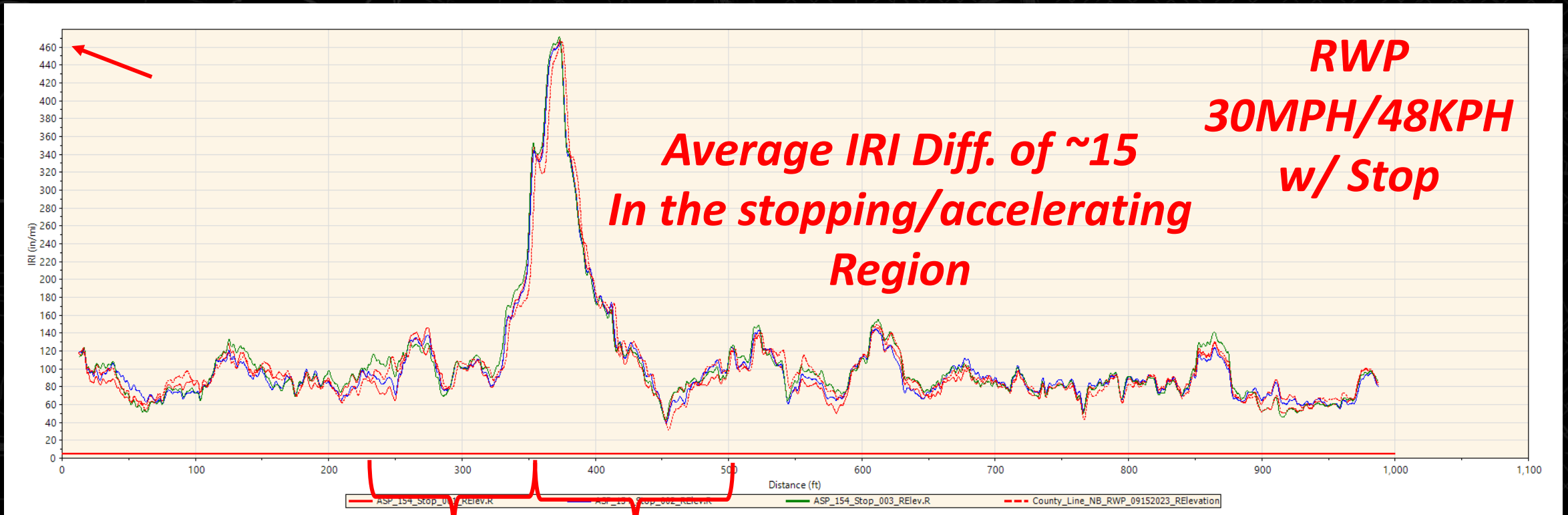
Stopping   Accelerating

ASP (x3 runs) 1000 Ft

Ride Quality Analysis (Continuous, 25ft Interval)(ProVAL)
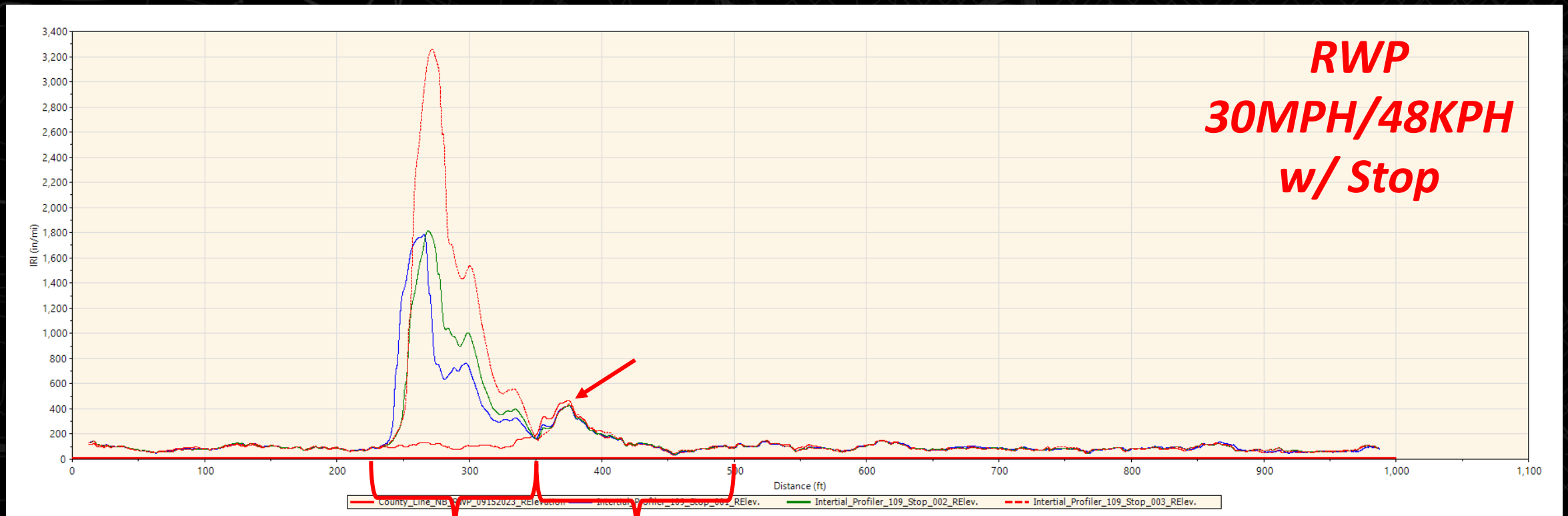
RWP 30MPH/48KPH w/ Stop

Stopping   Accelerating
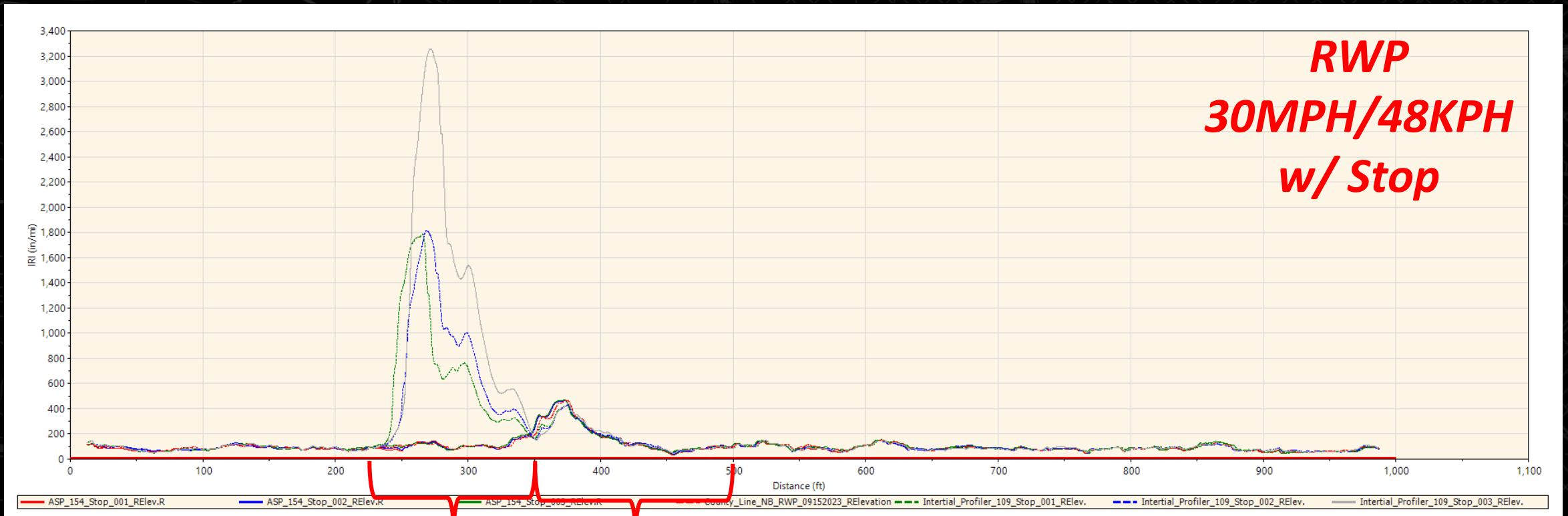
Inertial profiler (x3 runs) 1000 Ft

Ride Quality Analysis (Continuous, 25ft Interval)(ProVAL)

RWP 30MPH/48KPH w/ Stop

Stopping   Accelerating

ASP and Inertial Profiler (x6 runs) 1000 Ft, 30mph w/ abrupt stop (100 ft)

The work continues...

- Standardized testing and proving ground (AASHTO R56, USA)
- How to validate ground truth data
  - New data will introduce new questions:
    - How do we use this data?
    - How can we trust the data?
- Tests for turning (Large vs Small Radius)
- Don't get lost in the details (i.e. IRI 30 vs IRI 500)

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Conclusion:

Pathway Services Inc. All Speed Profiler can measure IRI in conditions previously known to have invalid data, opening the door for better measurement methods and better network condition accuracy.

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Questions?

(Please visit our booth for more information)

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