

Mobile Survey Survey Grade Validation

Executive Brief

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Phoenix Scientific Inc.

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Pavement Profile Scanner (PPS)

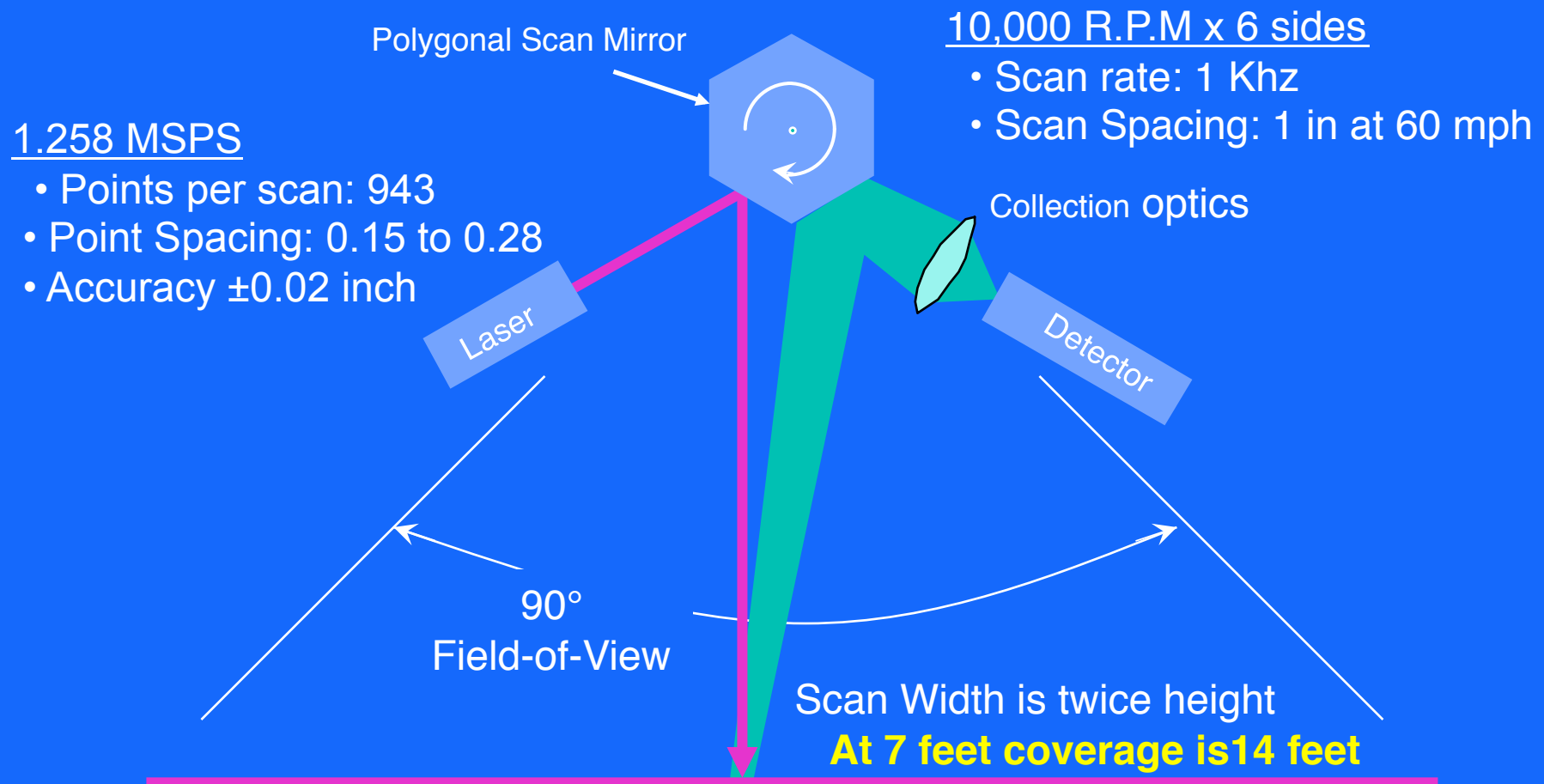


- Fast
- Accurate
- Available

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PPS – Pavement Profile Scanner



Applications

- Rolling Wheel Deflection
 - ◆ Technology Driver
- Rut and Ride
 - ◆ Rut Bar Replacement (IRI)
 - ◆ Texture, Distress Correlation, Shoulder
- Mobile Mapping
 - ◆ Precision DTM
 - ◆ Road Design, Vehicle Dynamics

Development Prototypes for RWD

USACE-WES SBIR funded development.

PSI Patented RWD



Rutting for LTPP



Westrack 1997

Roll-by Deflection Demonstrated

FHWA(ARA) SBIR – Rolling Wheel Deflectometer (RWD)

Ohio 1999



Single Scanner Used



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Road Condition Testing Units

In-service since October 2002



Mandli Communications, USA



British Hwys Agency (TRL Ltd.)

760.471.5396

Pavement Profile Scanner
PPS-2002



PSI
Test
Vehicle

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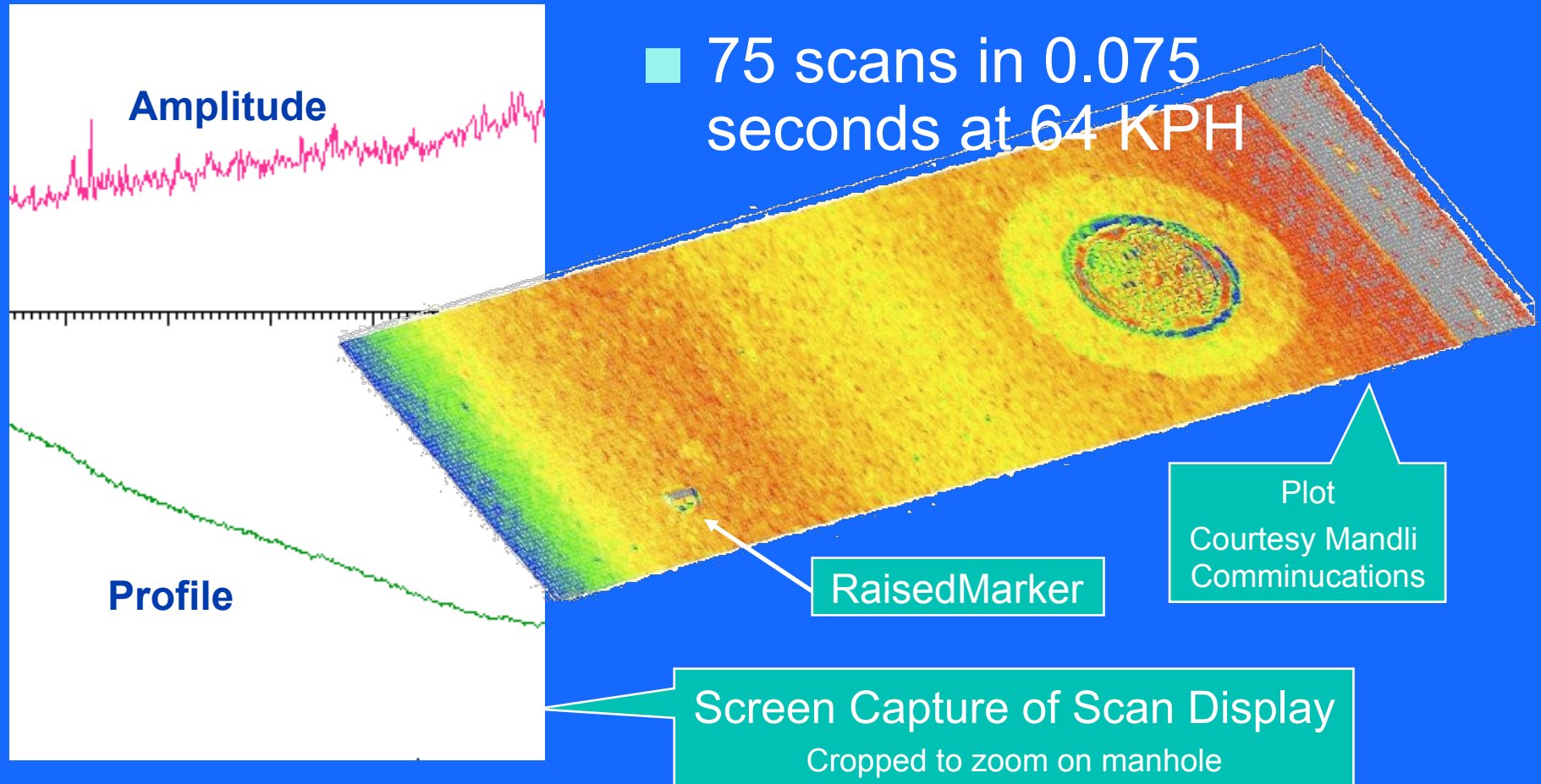
PASCO Road Corporation, Japan

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Manhole Sequence



Screen Capture

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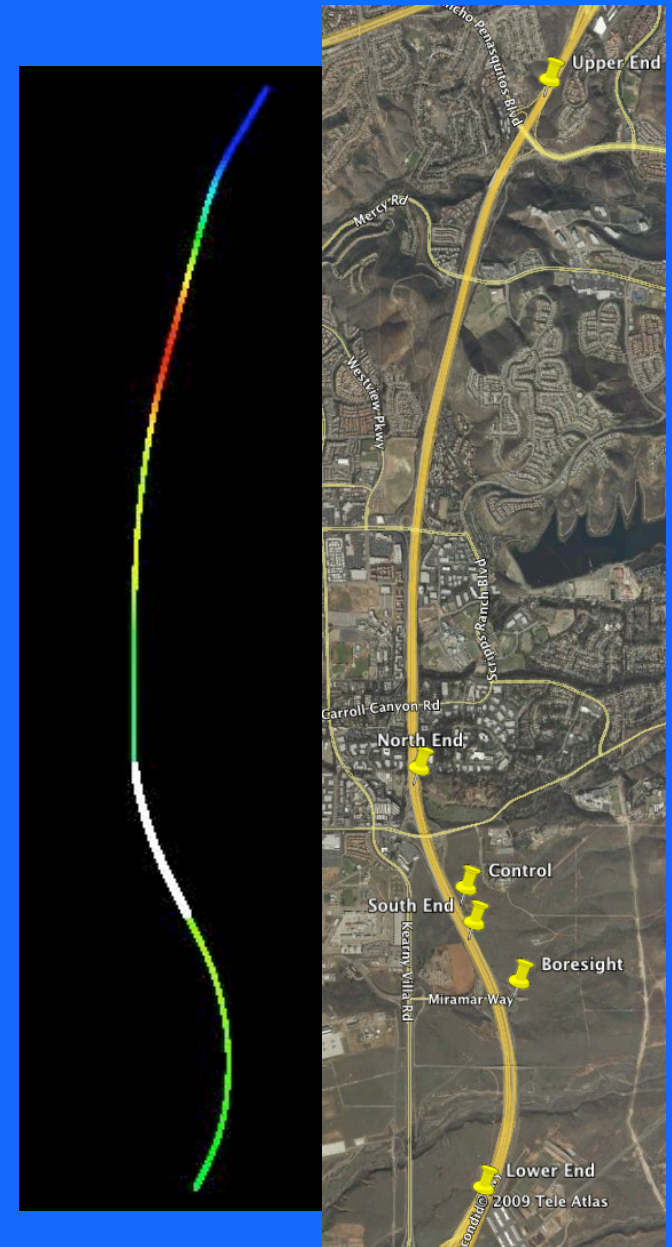
2005 – Initiated Road Survey

- Road Reproduction for Ride Testing (BMW)
- LA Area (405)
- Impossible to close road
- Fine Grain DTM
 - ◆ Joints
 - ◆ Faults
 - ◆ Slab angles
 - ◆ Distress



I15 Project Overview

- Dave Olander
District 11 Survey
- Reversible HOV Lanes
- 6 mile loop
- 0.9 mile (1.4 Km)
Length surveyed by
Caltrans District 11



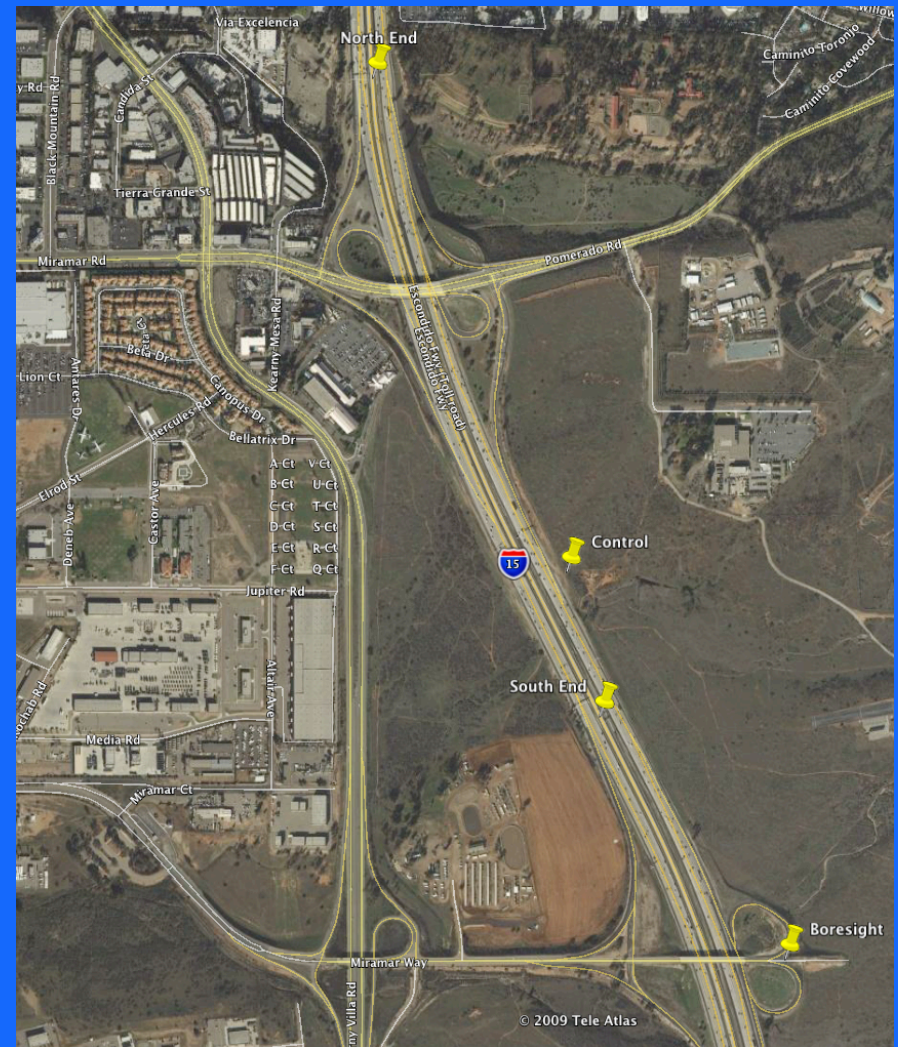
Surveyed Test Section

Two HOV Lanes

- ◆ 0.9 miles (1.4 Km)
- ◆ Overpass provides GPS outage

■ Extensive Controls

- ◆ Surveyed during midday direction reversal
- ◆ 1,700 points
- ◆ Cross section every 5 meters
- ◆ 5-10 points per cross section



I-15 Survey Control



- Permanent Control
 - ◆ Used for conventional and mobile survey

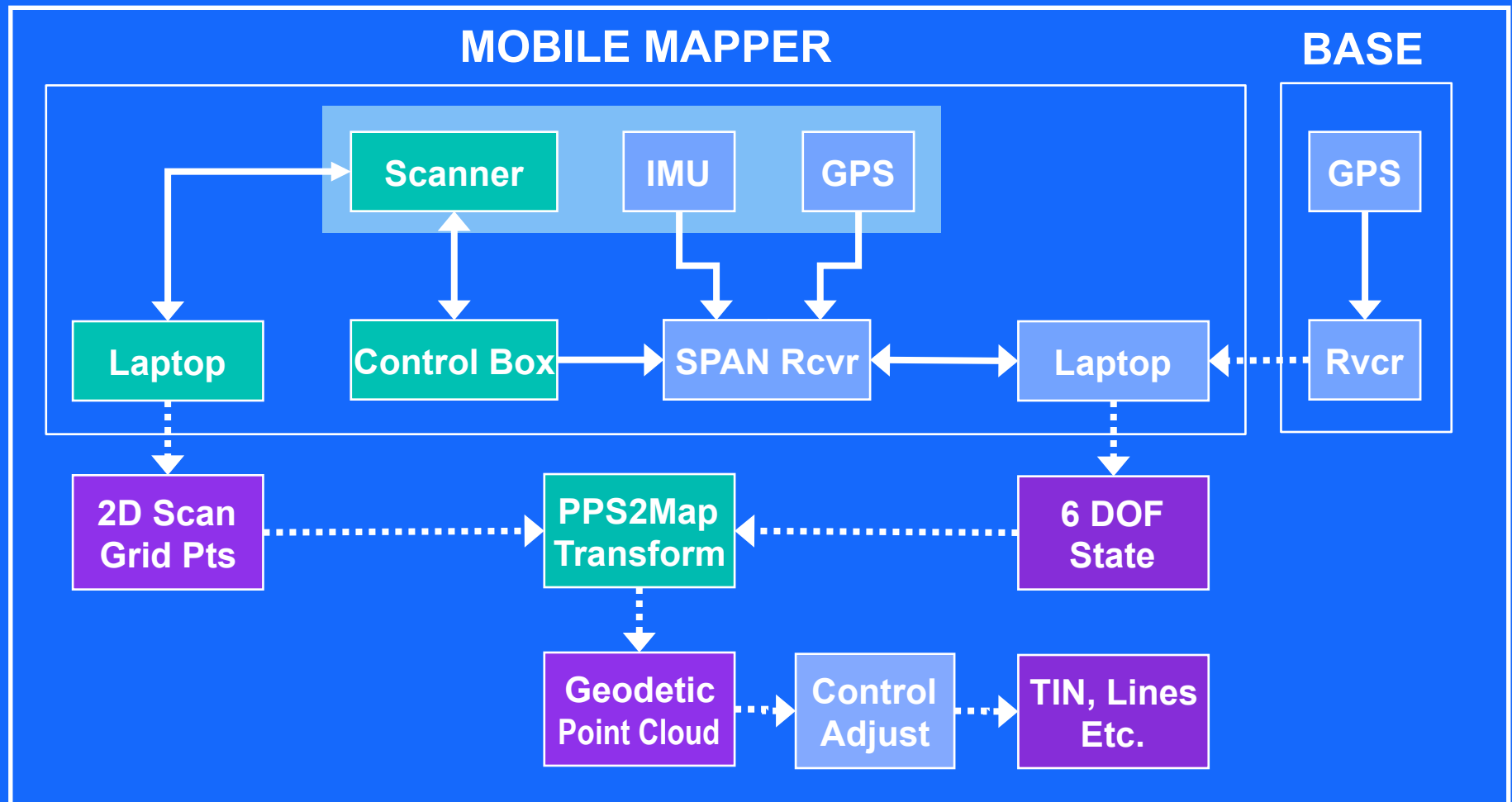
Tinned and Jointed PCC



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Survey System Diagram



Data Processing

■ Raw Scanner Data

- ◆ 1 scan per inch – 944 points per scan

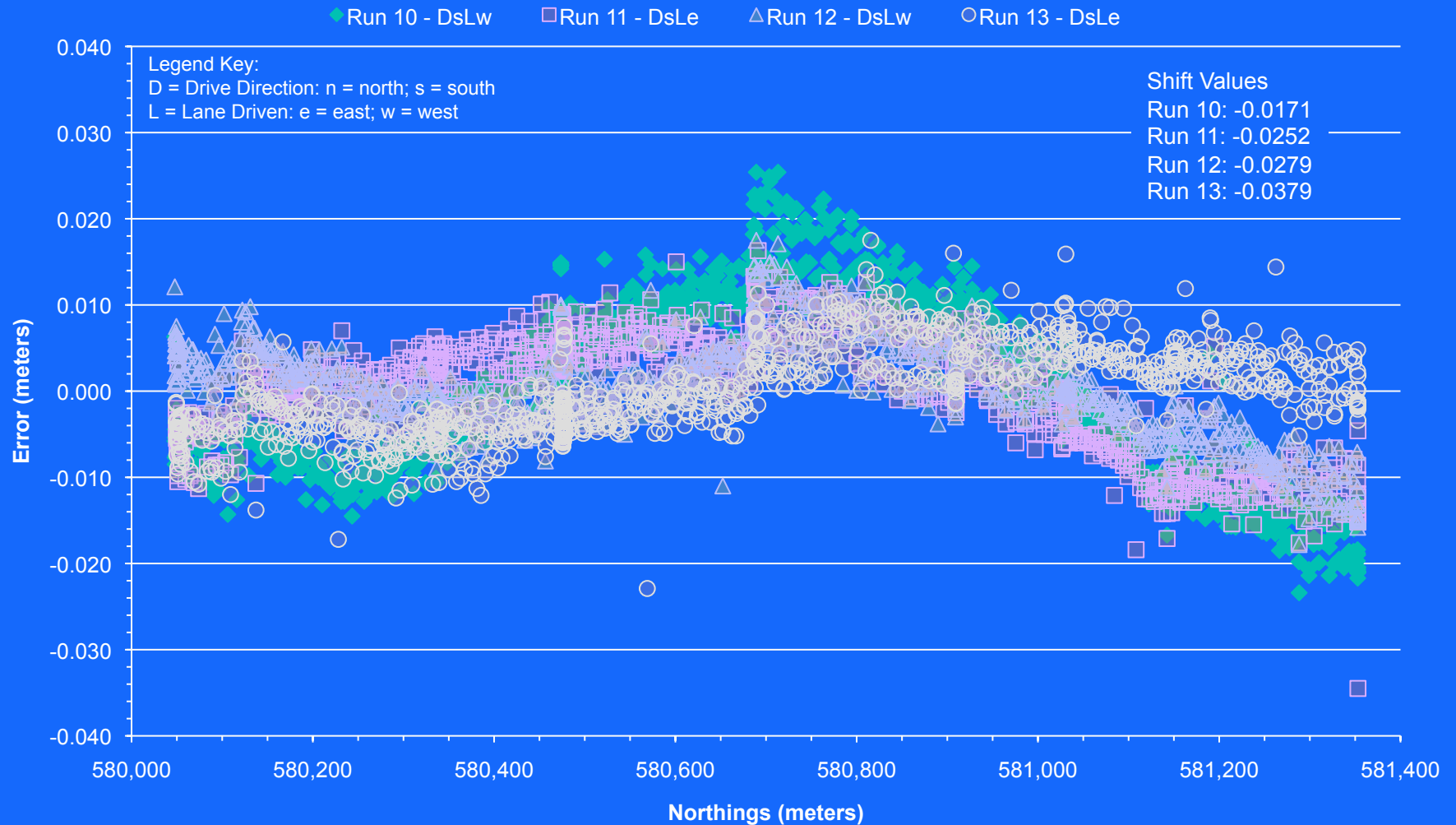
■ LAS Files Analyzed

- ◆ 1 scan per 6 inches – 32 points per scan

■ Quantity of Data Analyzed

- ◆ Reduced to 95% of raw (bin averaging)
- ◆ 2 Million Points per Run – 16 Million Total

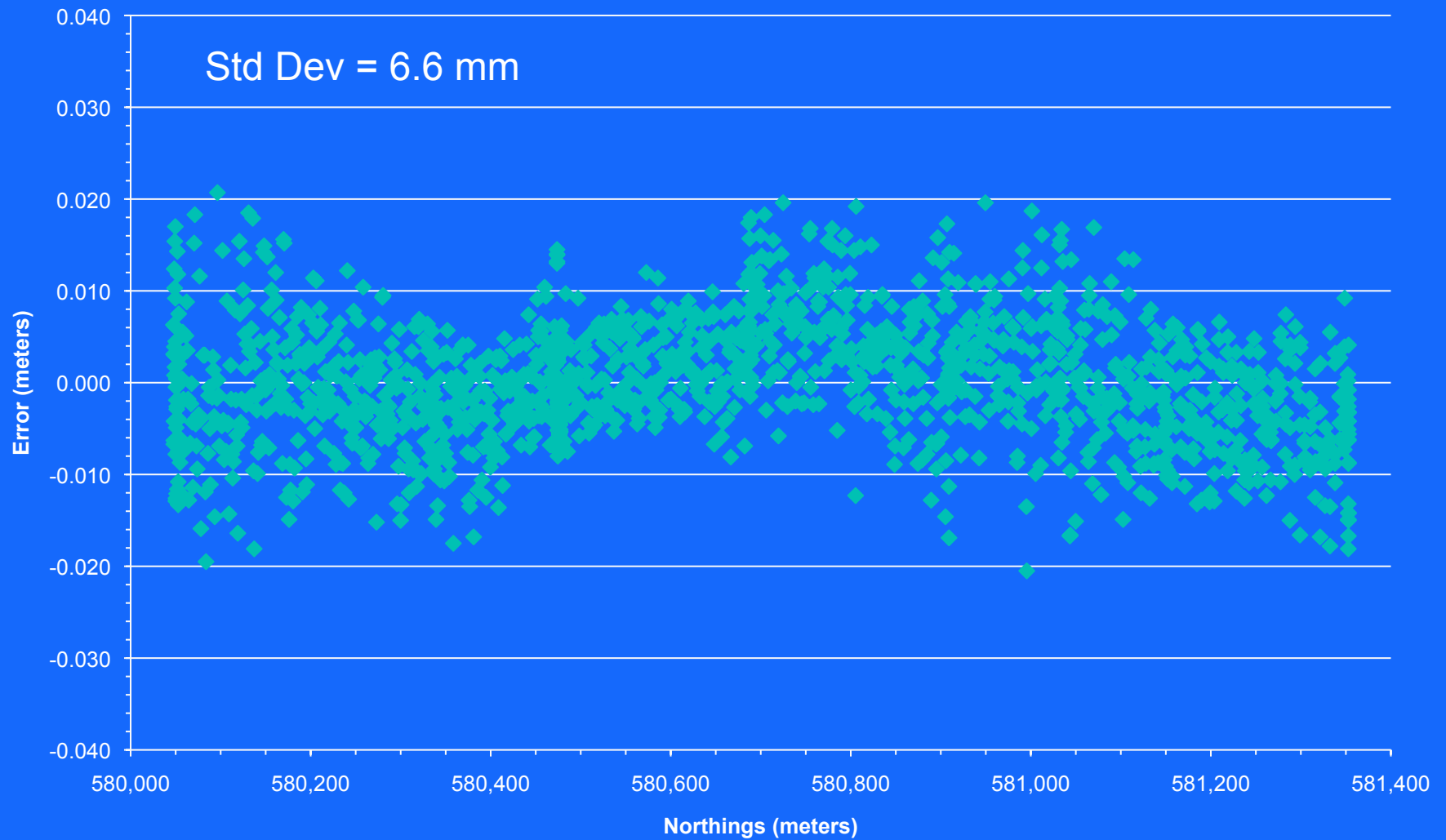
Runs Driving South



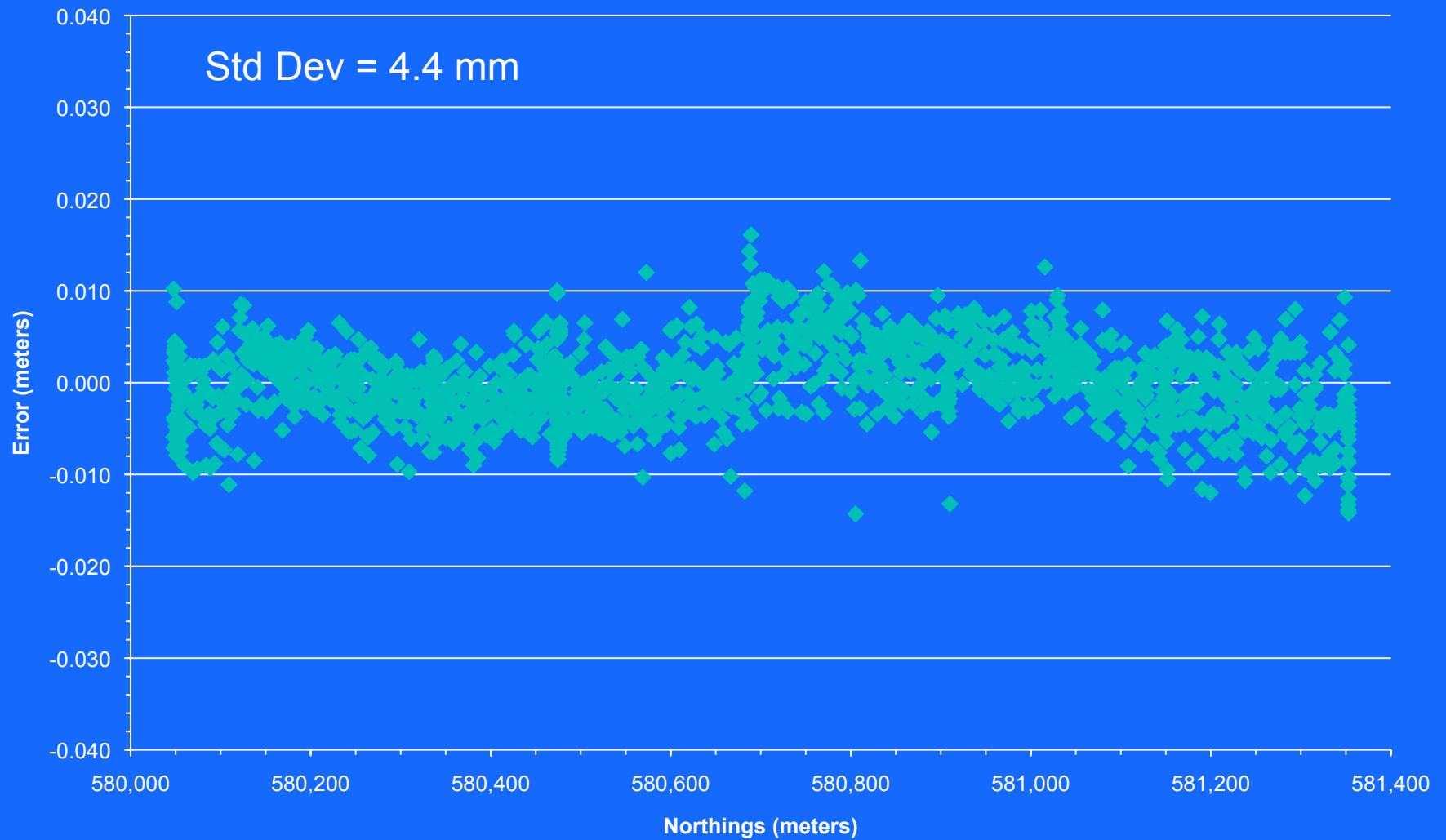
Runs Driving North



All Runs



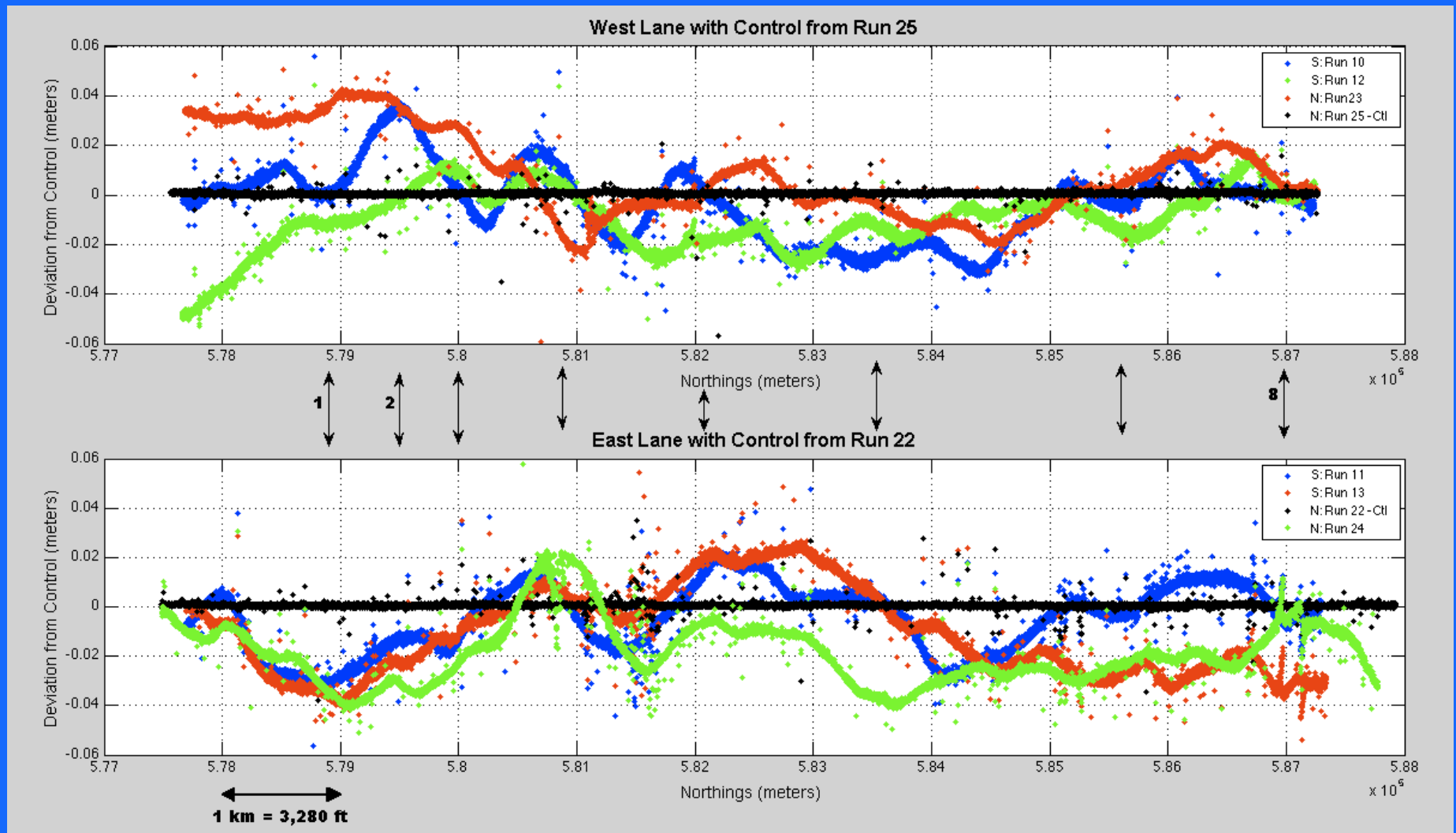
Best 5 of 8 Runs (11-13, 22, 25)



Full Length Analysis

- Selected best run in each lane: 22 and 25
- Reprocessed and edited to create Control
 - ◆ 7 points per scan:
 - 0, ± 0.5 , ± 1.0 and ± 1.5 meters
 - 0, ± 1.6 , ± 3.2 and ± 4.9 feet
 - ◆ 1 scan per 5 meters (16 feet)
- Quantity of Control Points
 - ◆ 13,860 Control Points per 6 miles per lane

Full Length Results - Relative to Best Run



Conclusions

- Mobile survey can attain survey grade
- PSI PPS Scanner exceeds requirements
- Navigation and GPS specifically is driver
- Control and QC
 - ◆ Periodic control in one or both shoulder adequate for correcting GPS
 - ◆ Control Points double as QC
 - ◆ Current tools support post-processing

Acknowledgements

Caltrans

- Dave Olander – District 11
 - ◆ Vision and drive
 - ◆ Invaluable Control Survey
- Kevin Akin – HG
 - ◆ Analytical Collaboration on original test

Merrick

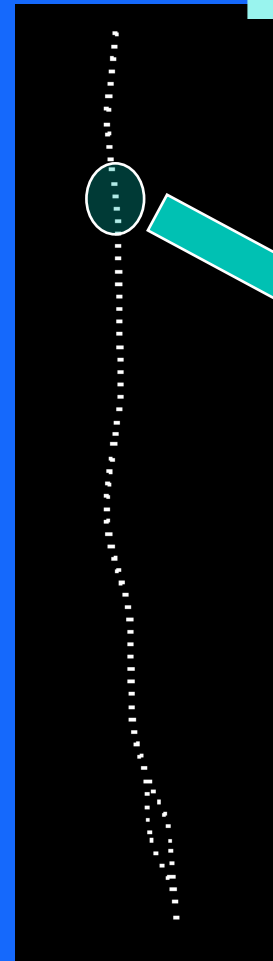
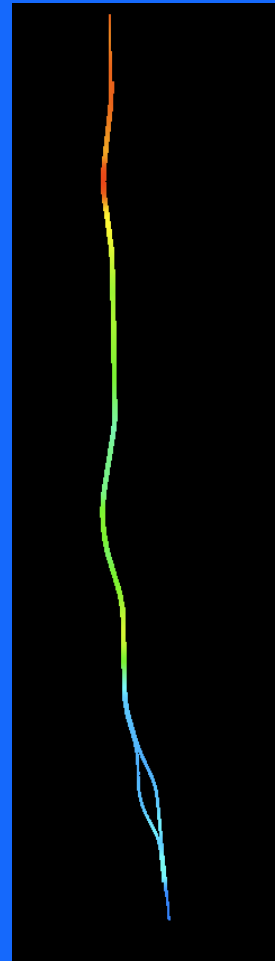
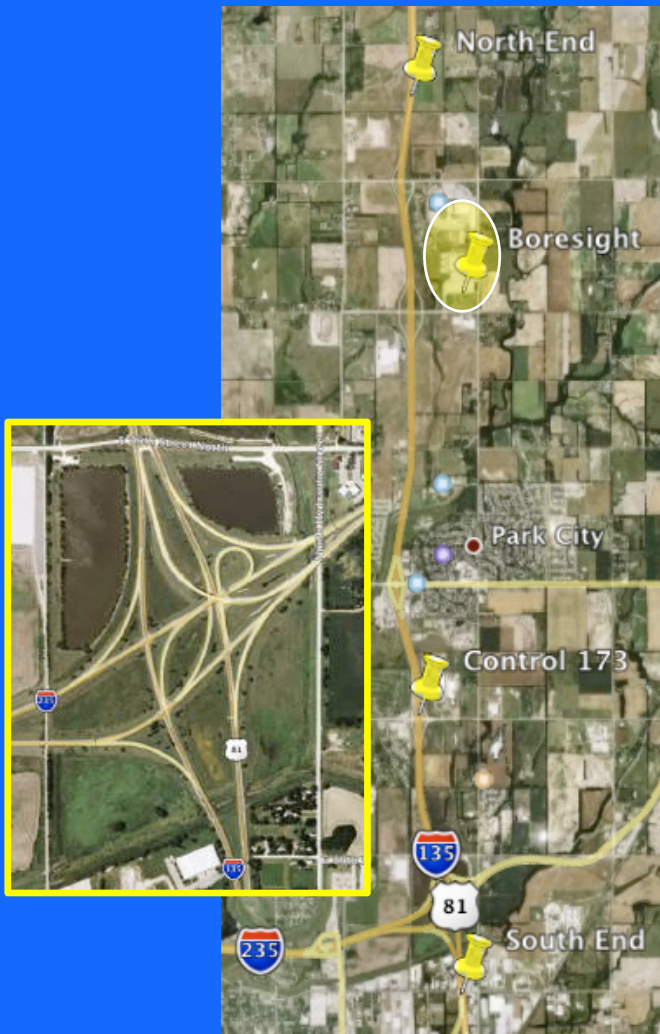
- LAS File Export Format Test
- MARS Software
 - ◆ Visualization
 - ◆ Error Calculations
 - ◆ Efficient Corrections
 - ◆ Translation to 2D

KDOT I-135 Project – August 2007

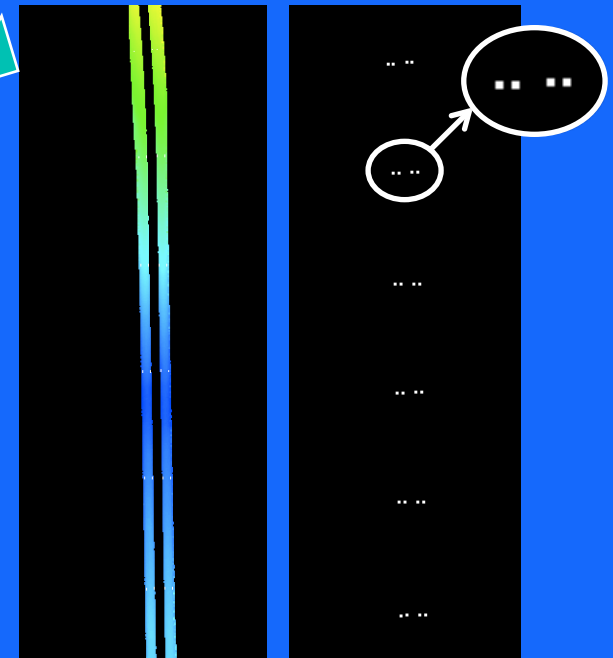
- Kansas DOT
 - ◆ 6.8 miles
 - ◆ 7 overpasses
 - ◆ 3/4 lanes + shoulders
 - ◆ Gore areas



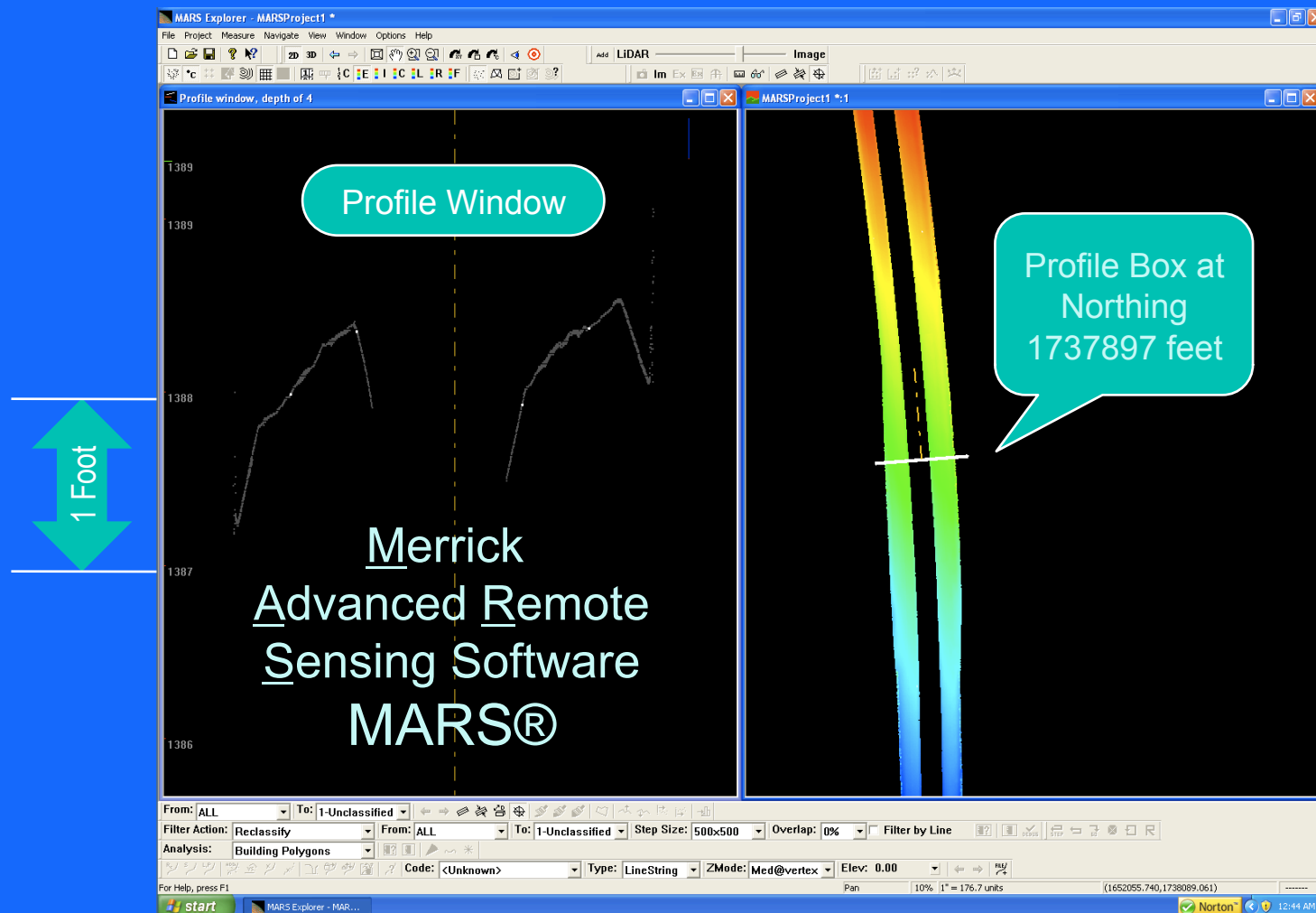
I-135 Project Control



- 280 points
 - ◆ Inner & outer shoulders
 - ◆ North & South bound
 - ◆ Every 500 feet



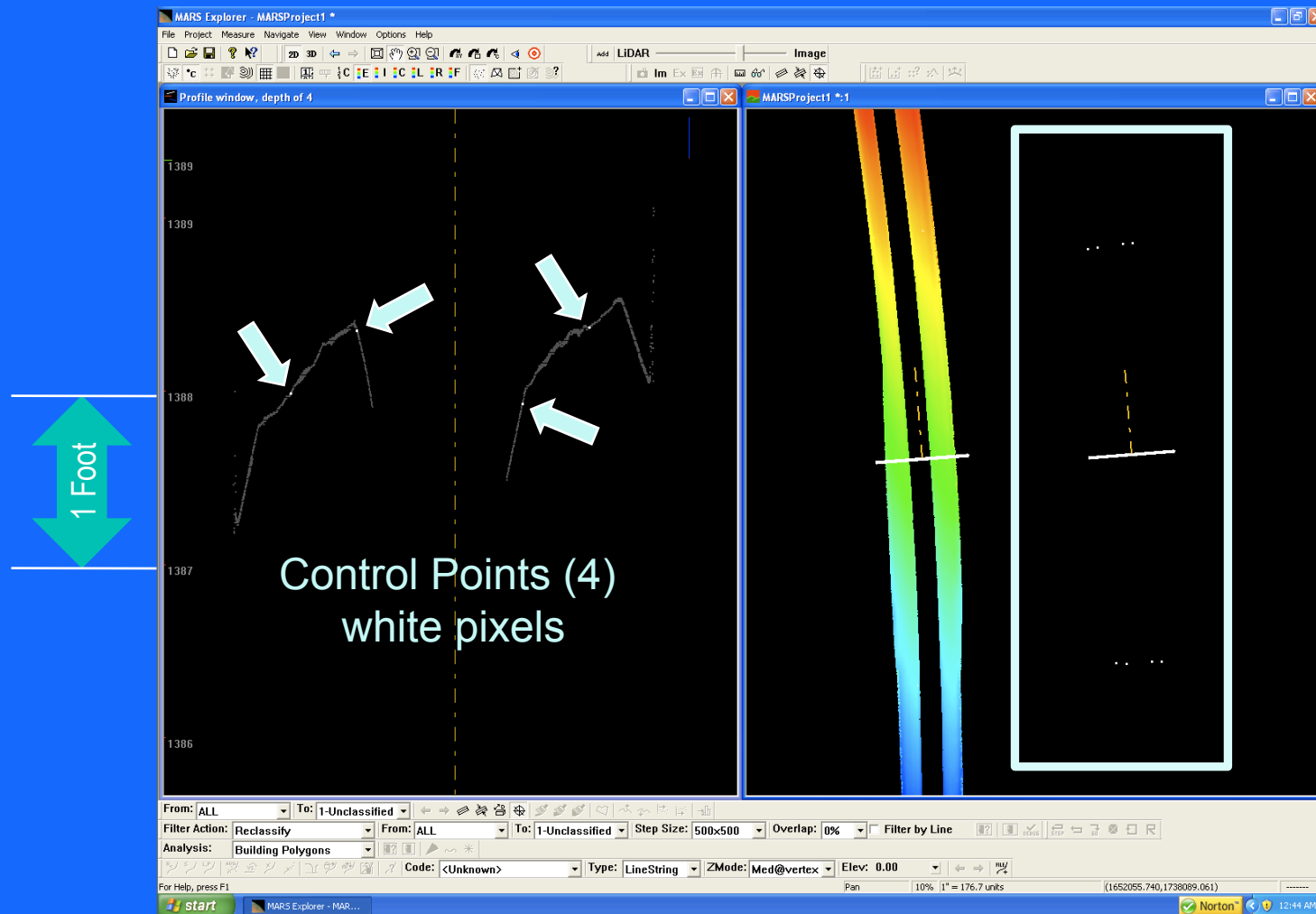
Aerial Lidar Software



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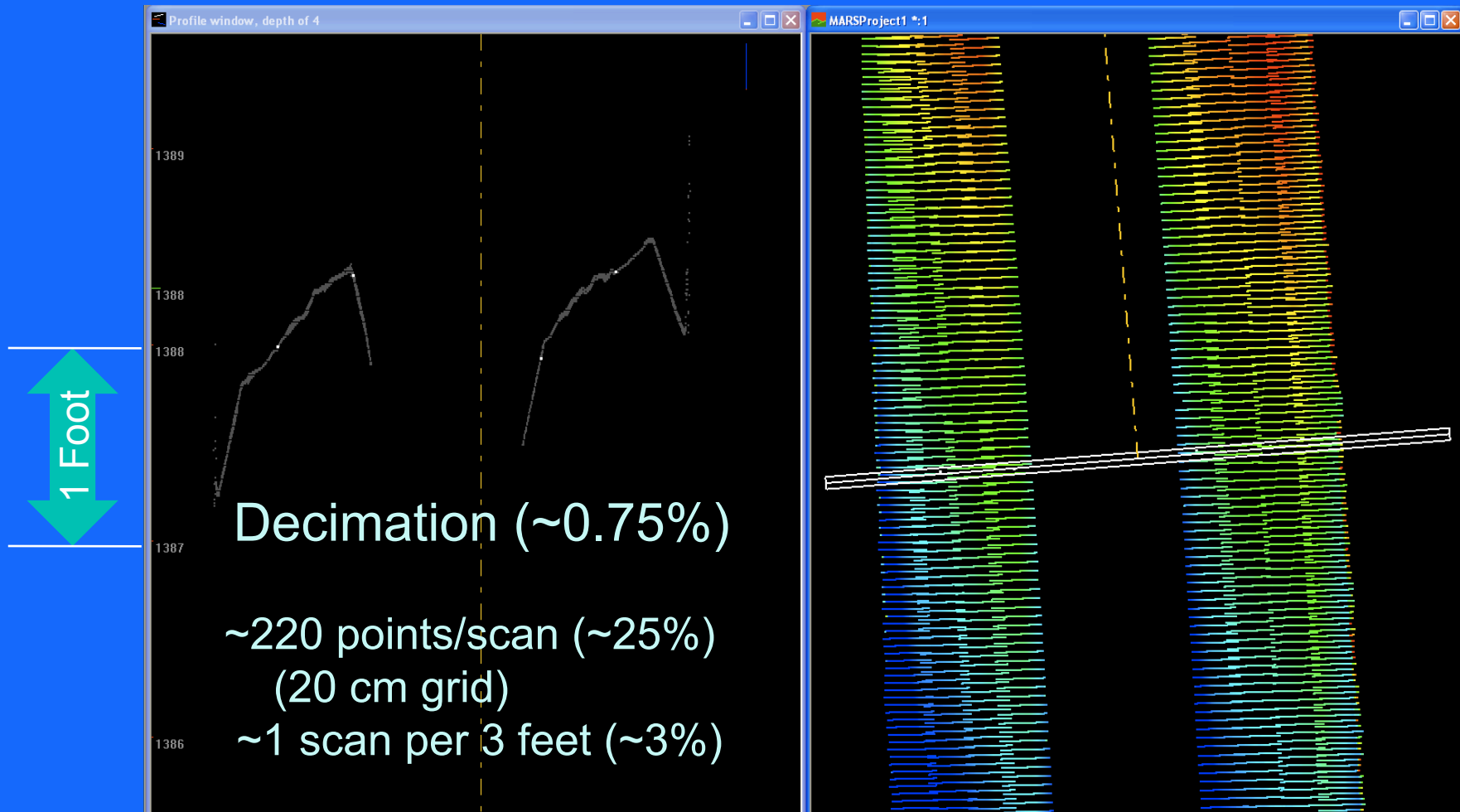
Control with Point Cloud Hidden



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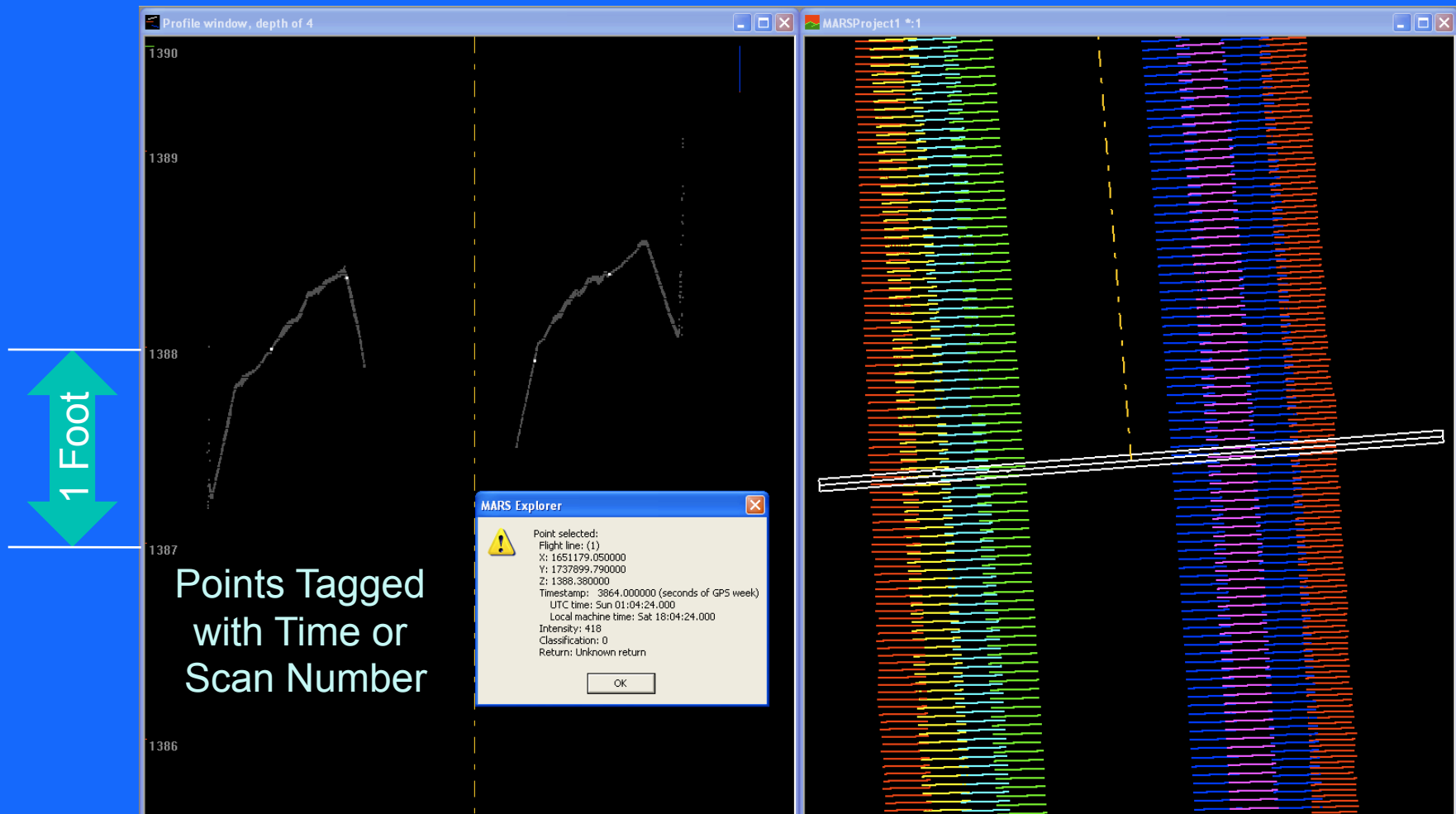
Scan Inspection



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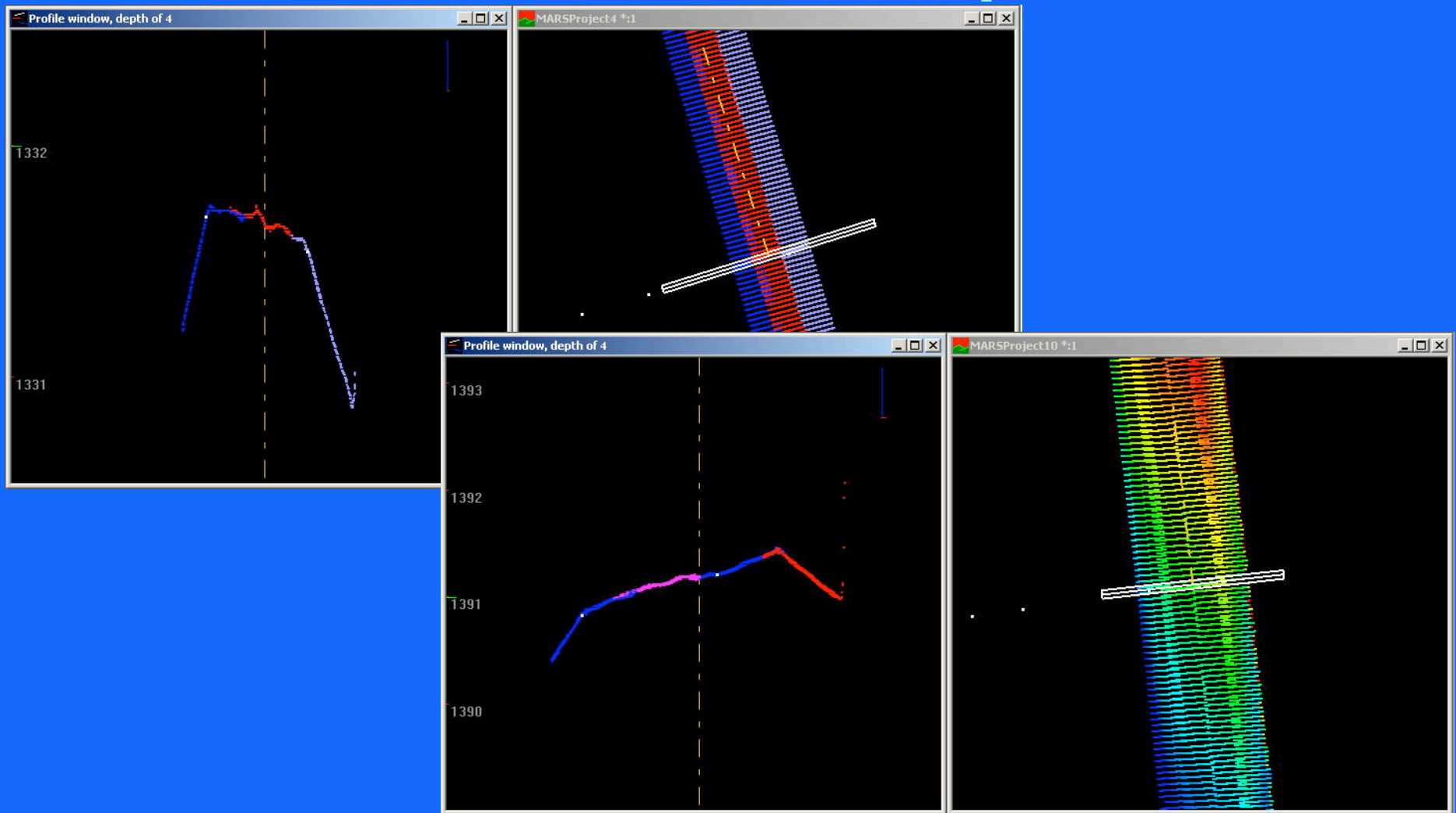
Color Coded Runs



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3 and 4 Lane Samples



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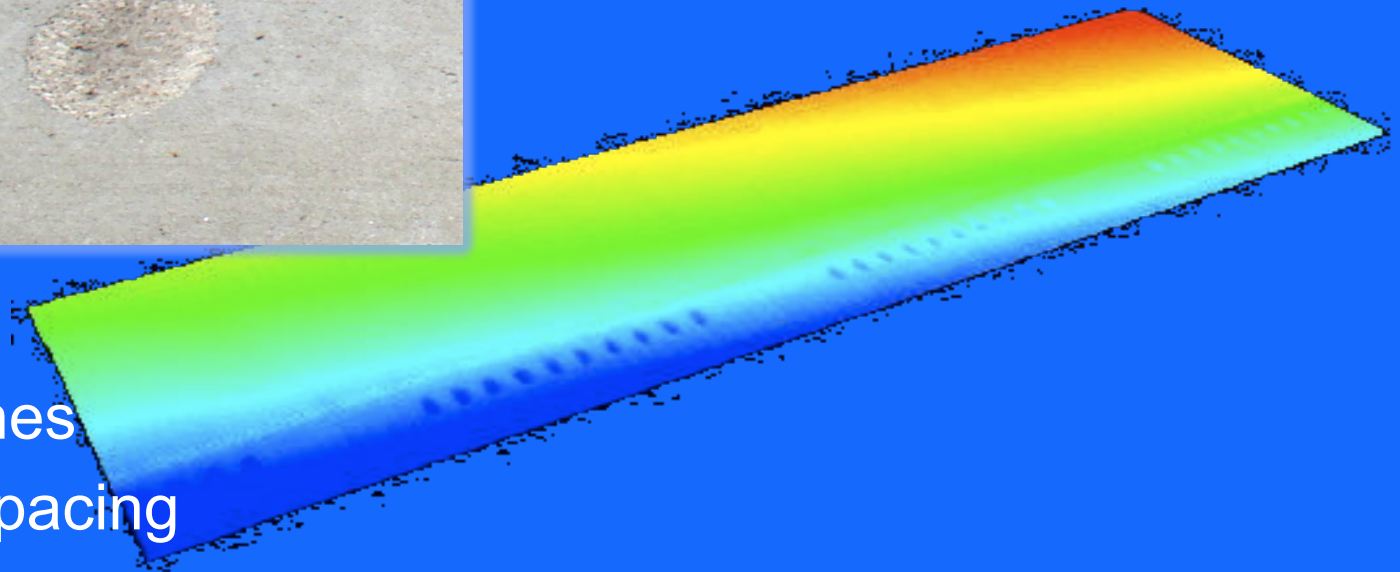
Full Resolution Example

Recessed Rumble Strip

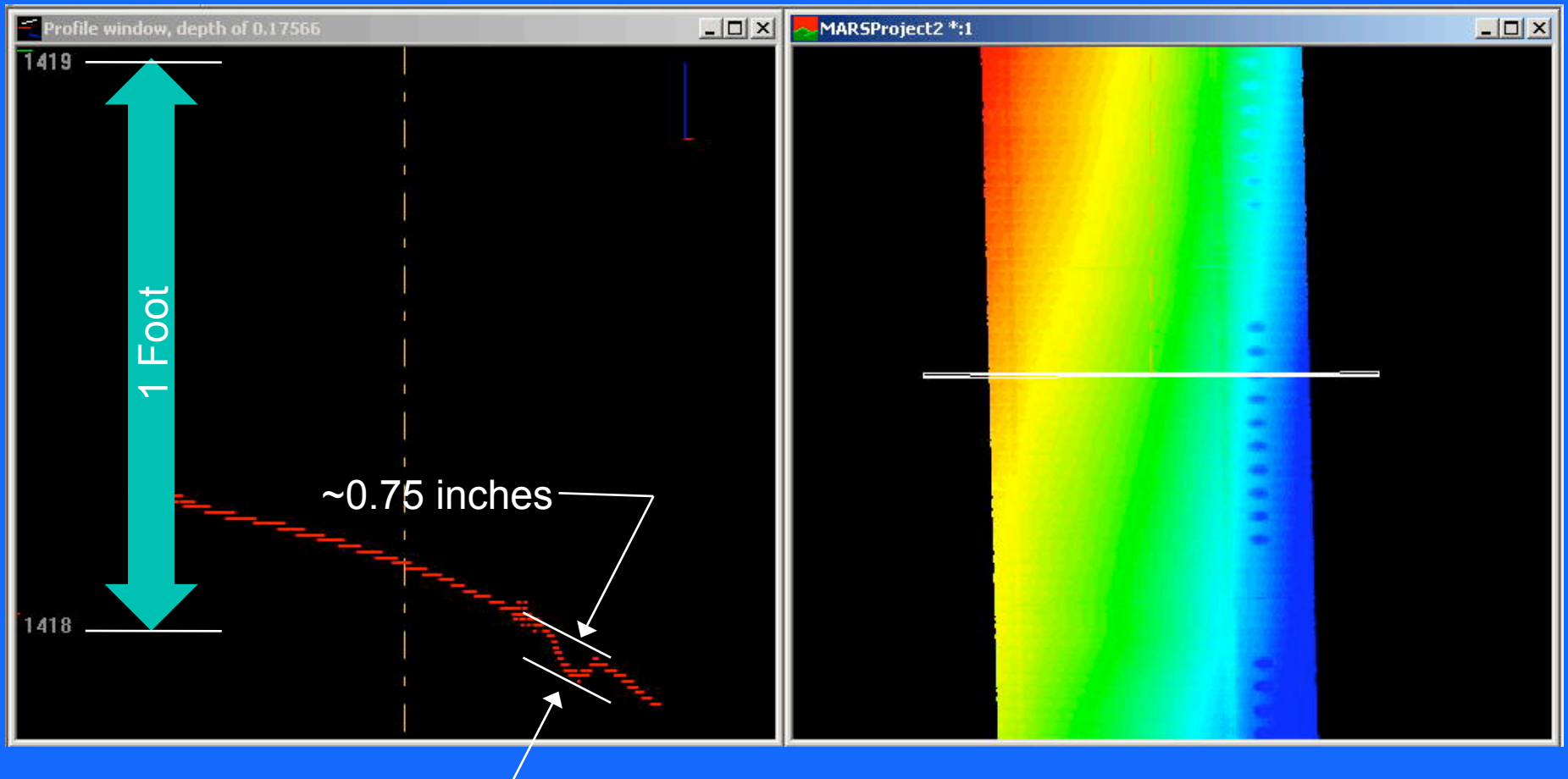


- One Run
 - ◆ Straddling Shoulder

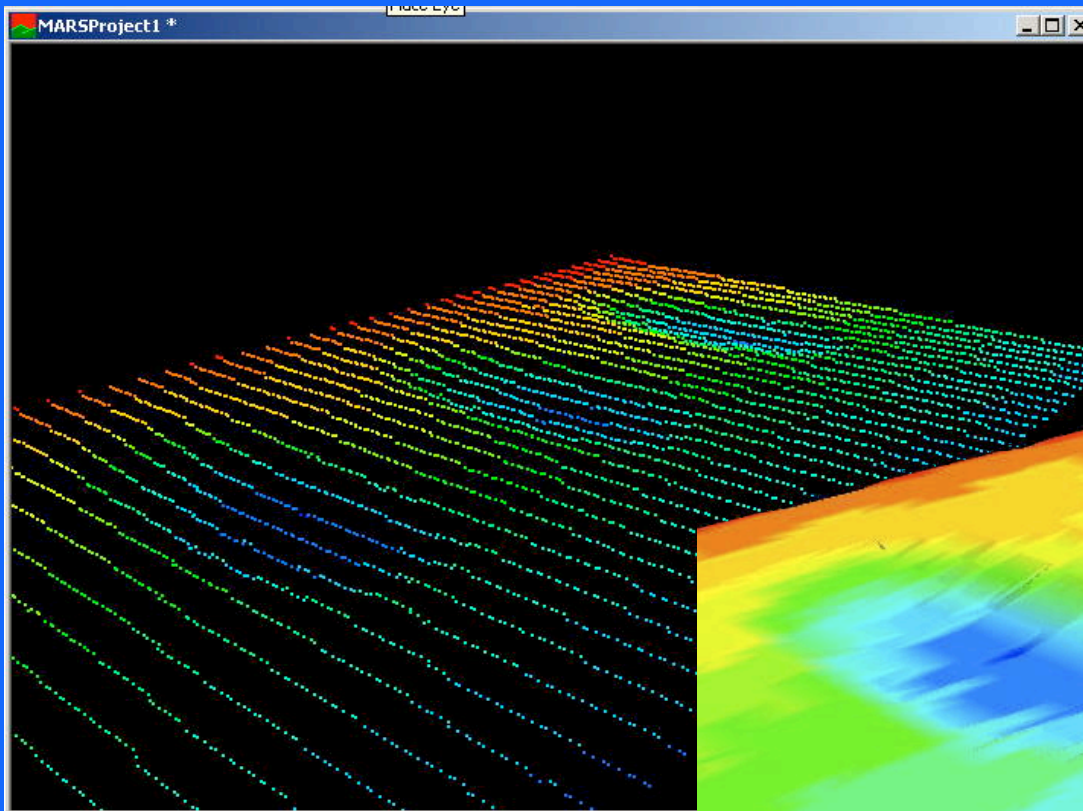
- Divots
 - ◆ ~ 6x12 inches
 - ◆ ~ 10 inch spacing



Rumble Strip Cross section



Rumble Strip Topology



■ Full Resolution

- ◆ Every Scan ($\sim 1/\text{in.}$)
- ◆ Every Point (av 0.2 in.)

