Implementation of the Quality Management Plan for the Collection of Interstate Pavement Condition Data

By

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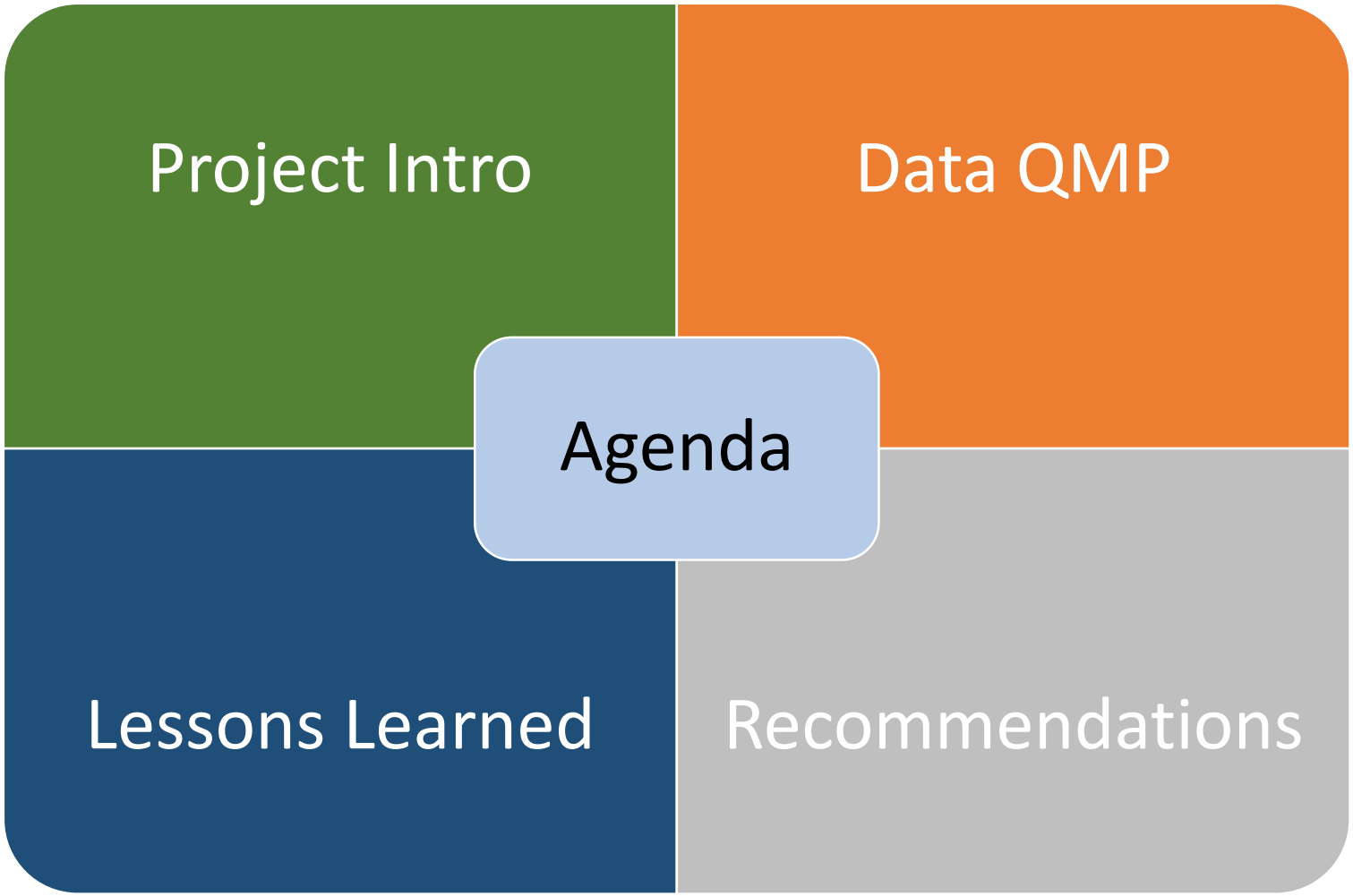
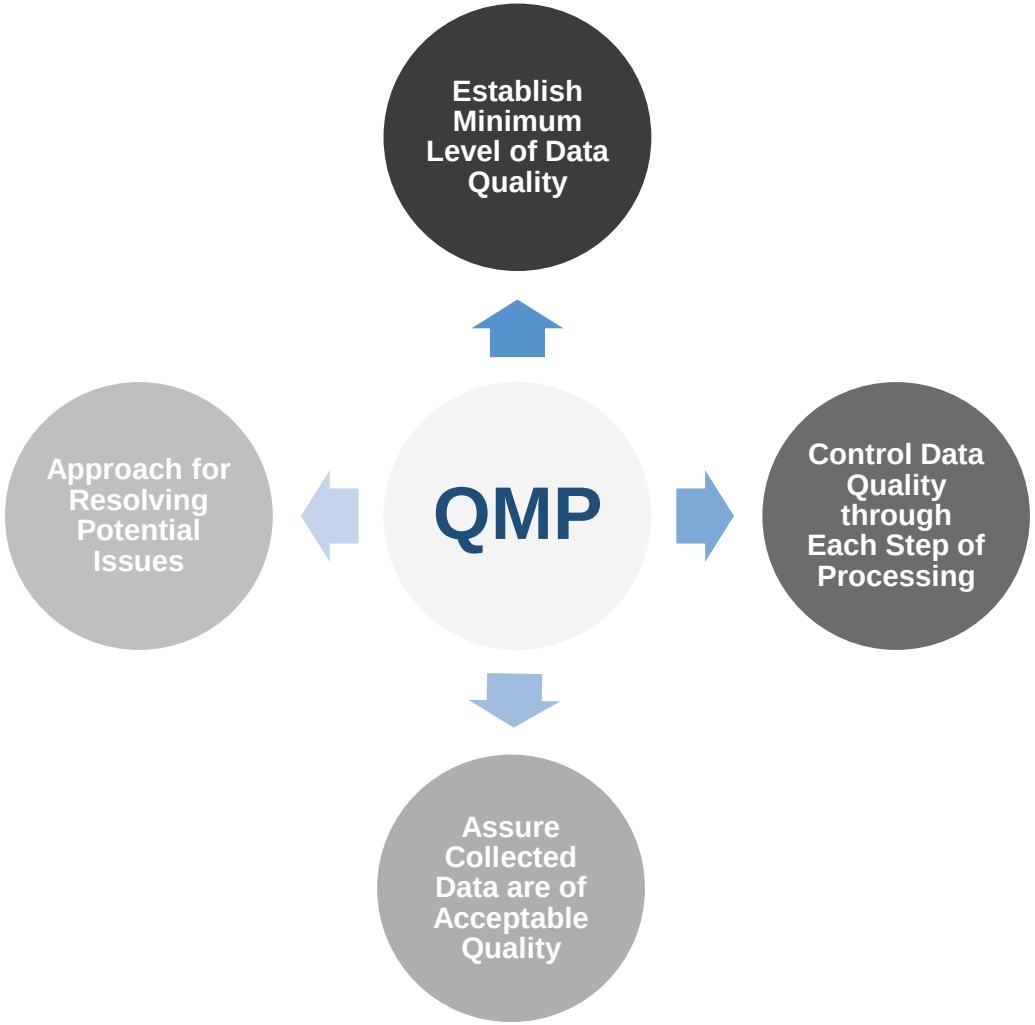

Project Intro
Data QMP
Agenda
Lessons Learned
Recommendations

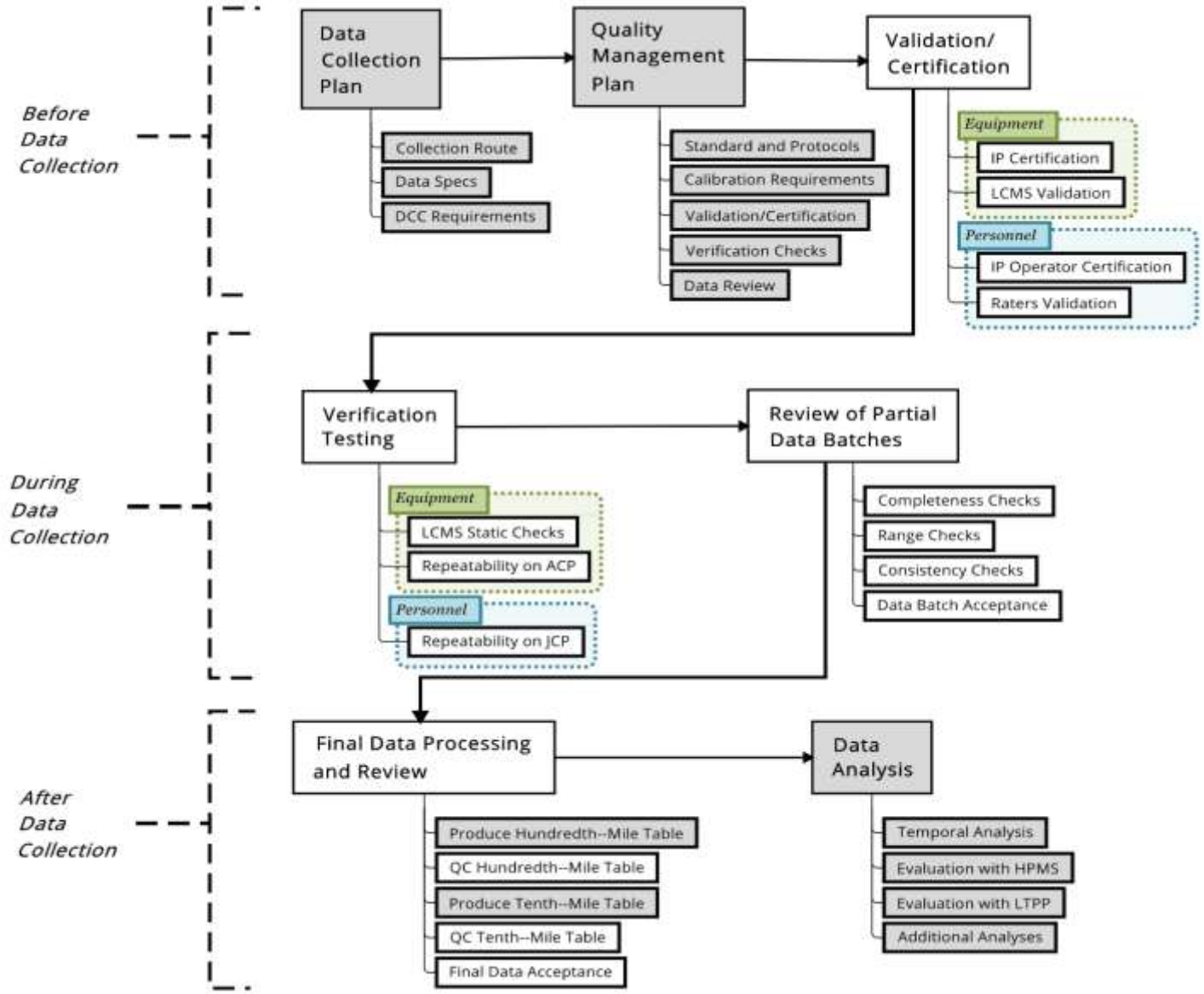
Introduction

- FHWA Project - “Interstate Highway Pavement Sampling”
- Project Data Collection
  - ➢ Collection of ~7,500 miles of Interstate Highway
  - ➢ Using an automated measurement system
    - International Roughness Index (IRI)
    - Rutting
    - Cracking Percent
    - Faulting
  - ➢ Develop and implement QMP to comply with FHWA regulations

Project Data QMP



Project QMP Components



Project QMP Definitions – Pre-production

Calibration	Certification	Validation
• Compare against known standard • May require adjustment factor	• Review by party other than DCC • Check accuracy and precision of equipment or personnel	• Review by party other than DCC • Compare against reference measurements

Project QMP Definitions - Production

Verification	Quality Control	Quality Assurance
• Check if equipment is functioning as intended	• Actions to measure quality of the data	• Assure data collection processes followed

Standards and Protocols

- IRI
  - Equipment – AASHTO M328-14
  - Data collection – AASHTO R57-14
  - Calculation of IRI – AASHTO R43-13
  - Certification of equipment – AASHTO R56-14
- Rutting
  - Data collection – AASHTO PP70-14
  - Rut depth calculation – AASHTO PP69-14, with modifications specified in HPMS Field Manual

Standards and Protocols

- Cracking Percent
  - Collection of images – AASHTO PP68-14
  - Identification of cracking on images – AASHTO PP67-16
  - Quantification of percent cracking – HPMS Field Manual, 2016
- Faulting
  - Data collection – LCMS sensors
  - Calculation – AASHTO R36-13

Certification & Validation Testing

- Field Testing
  - Minnesota Road Research Facility
  - ~500-ft long ACP and JCP sections
  - Selected different sections to cover “low” and “high” distress values

➢ Certification of Inertial Profiler (IP)

- Conducted by MnROAD personnel
- Data was collected at two speeds – 30 mph and 55 mph
- Tested on one asphalt-surfaced section and one concrete-surfaced section
- Reference roughness data – SurPro
- Reference device calibrated just before testing
- Acceptance Criteria - AASHTO R56-14
  - Accuracy - within 5% of reference data with 95% CL
  - Precision - repeated profiles within 5% with 95% CL

SurPro data collection,

➢ Error resolution

- DCC not allowed to collect data until passing MnROAD certification test

➢ Validation of LCMS Equipment - Rutting

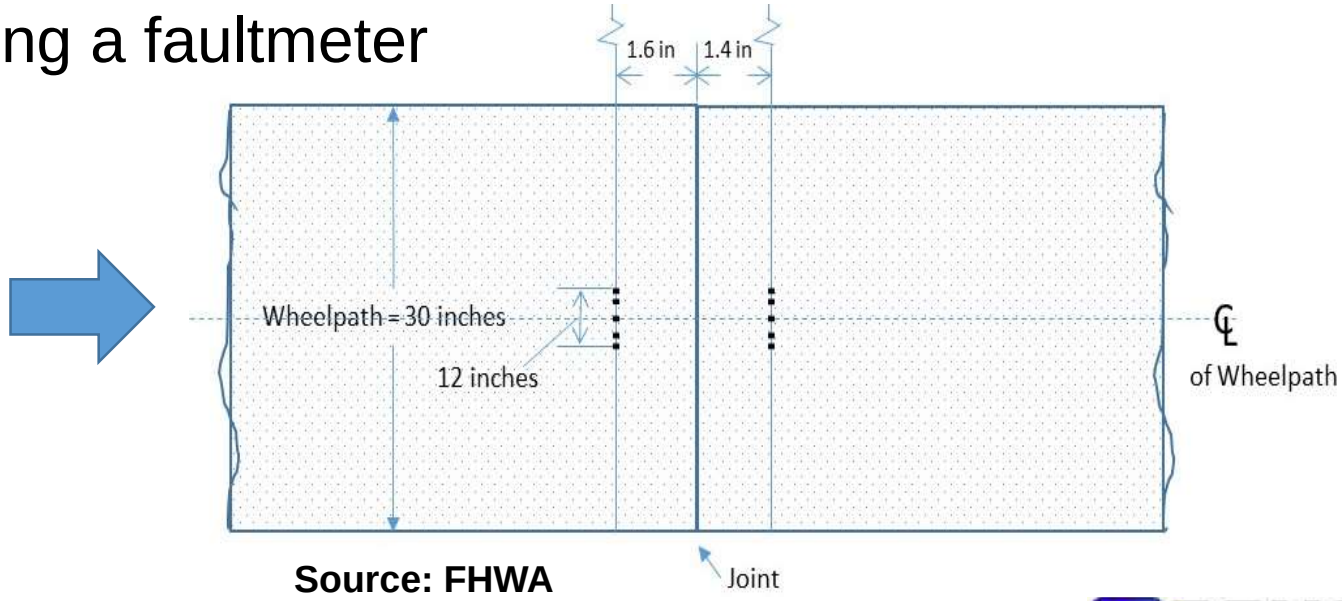
- 10 test locations with rut depth from 0.25 to 2 in.
- 10 repeated measurements at each test location
- Reference rutting data
  - MnROAD Automated Laser Profile System
  - Rut depth based on AASHTO PP 69-14

ALPS data collection,
Source: FHWA

➢ Validation of LCMS Equipment - Faulting

- 10 Joints with faulting from 0.0 to 0.4 in.
- Data collection based on AASHTO R36
- 10 repeated measurements at each location
- Reference data collected using a faultmeter

Location of validation faulting measurements



Source: FHWA

➢ Validation of Cracking Percent on ACP

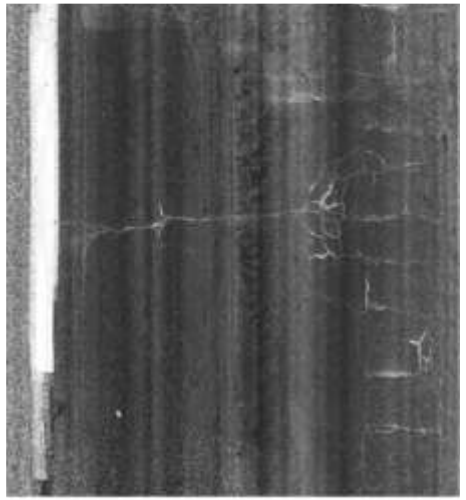
- Two ACP sections
- DCC cracking percent collected using automated approach
  - Section 1 – at 55 mph
  - Section 2 – at 50 mph (slower speed due to proximity of a curve)

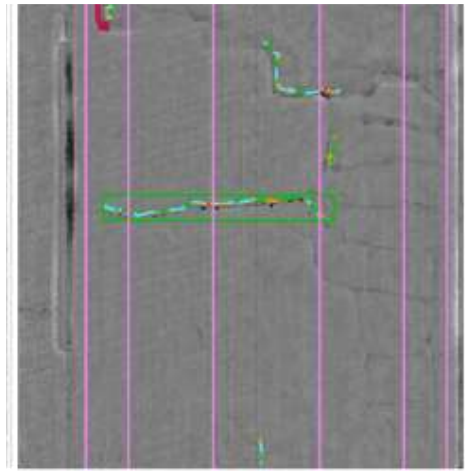
- Reference cracking percent data
  - Visual assessment of pavement images collected by DCC

Overview of one of the sections, Source: FHWA

➢ Validation of Distress DCC Raters

- Selected sections
  - Two JCP sections on MnROAD facility
  - Four CRCP sections from images collected for Interstate Pavement Condition Sampling project, FHWA 2015
- Visual inspection of DCC images by raters
  - Percent cracking on JCP sections
  - Number of slabs identified on JCP sections
  - Percent cracking on CRCP sections
- Reference values
  - Consensus survey by two experts in distress identification



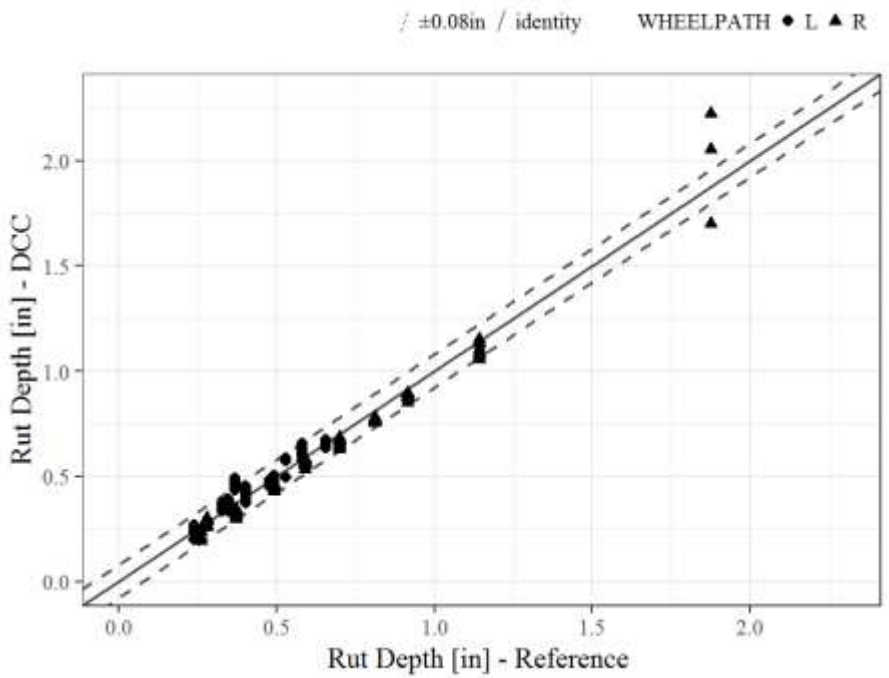


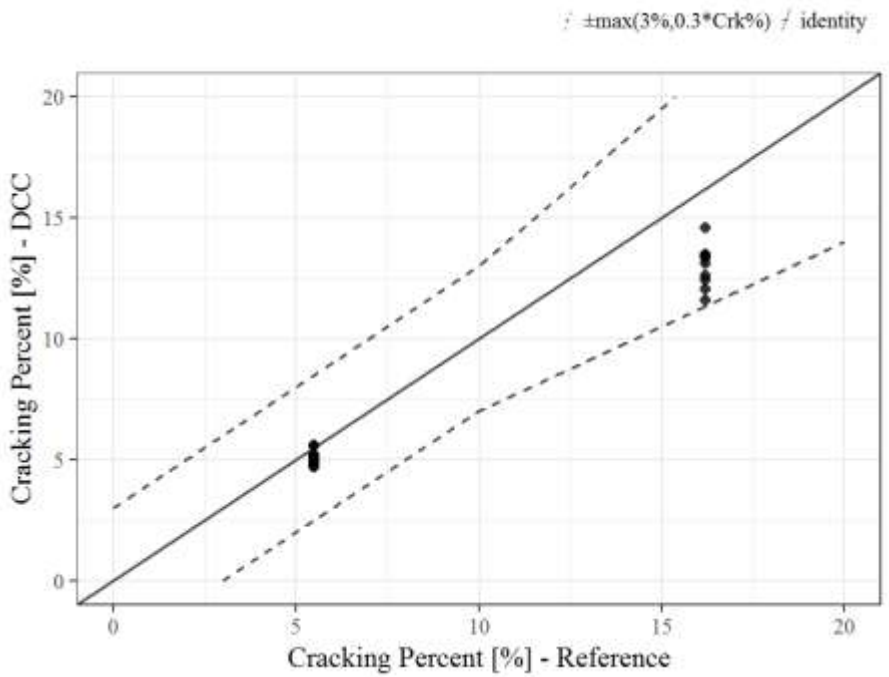
Example of surface images

Validation – Project QMP Acceptance Criteria

Data Metric	Accuracy	Precision
Rutting	• **±0.08** in.	• **±0.08** in. of mean with a 90% CL
Faulting	• **±0.05** in.	• Standard deviation of values not to exceed **15%** of mean value if the mean is greater than 0.1 in. • Otherwise, not to exceed 0.03 in.
Cracking Percent	• ACP: Highest of **±30%, or ±3** • JCP and CRCP: Highest of **±15%** or **±3** • ± 2 joints for any of the 500-ft long JCP sections	• ACP: within **±30%** of mean with a 90% CL if mean is greater than 5%, otherwise, the standard deviation must be less than 1.5%. • JCP and CRCP: within **±15%** of mean with a 90% CL if mean is greater than 5%, otherwise, the standard deviation must be less than 1.5%.

Validation – Project QMP Acceptance Criteria





➢ Error Resolution

- DCC re-process the measurements (blind reference values) if one or more of the acceptance criteria are not met
- DCC not allowed to collect data until passing all validation tests

Equipment Verification

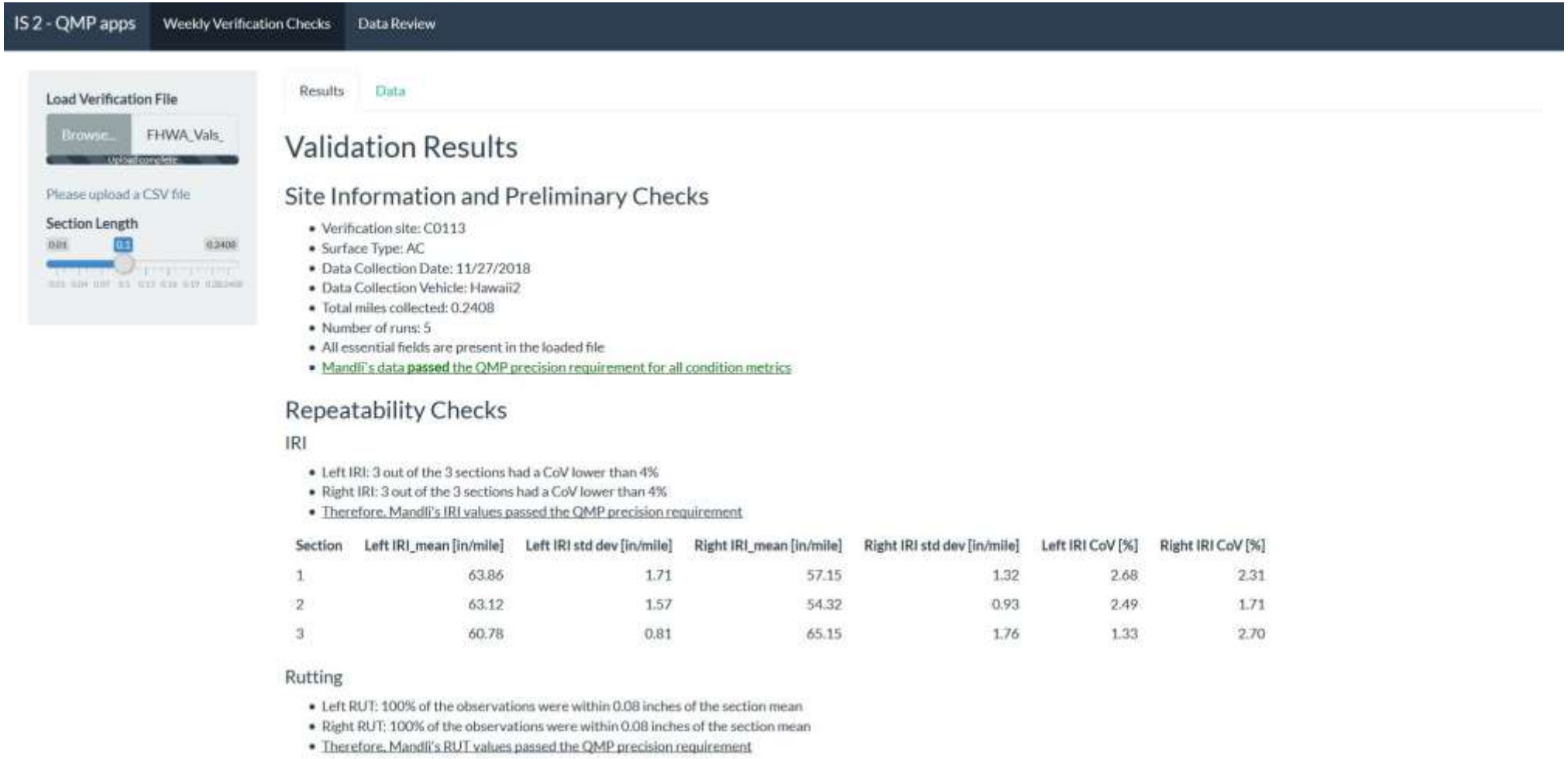
- Distress measurement repeatability
- LCMS static checks

Verification – Distress Measurement Repeatability

- On a weekly basis during data collection
- Verification sites near to the data collection route
- Five runs for all condition metrics on each section
- Pass if meets following criteria

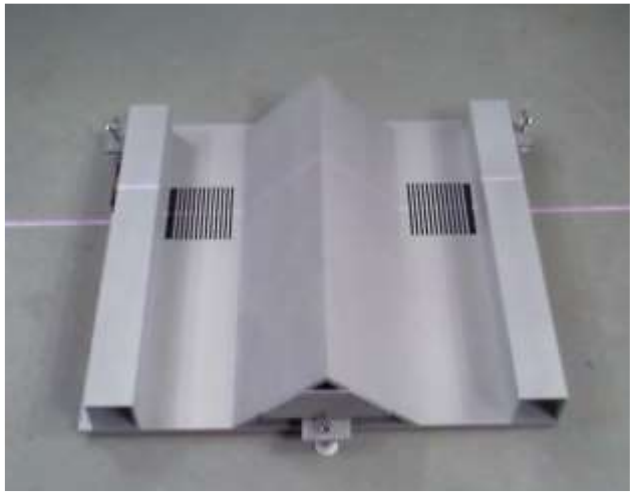
  - Verification acceptance criteria for percent cracking, rut depth, and faulting similar to validation acceptance criteria.
  - Coefficient of variation of IRI measurements less than or equal to 4.0%.

Automated Verification Checks – Web-based Tool



Verification – LCMS Static Checks

- Goal was to evaluates the laser's noise level and focus quality
- Used the calibration board
- Performed in the presence of project team
  - Within first 2 weeks of data collection
  - Between 50% and 75% of data collection



Calibration board
Source: FHWA

Verification – Error Resolution

- If the acceptance criteria are not met
  - DCC stop data collection
  - DCC resume data collection after re-evaluating measurement system and passing acceptance criteria
  - DCC re-process the affected measurements collected after latest successful verification test

Review of Partial DCC Data

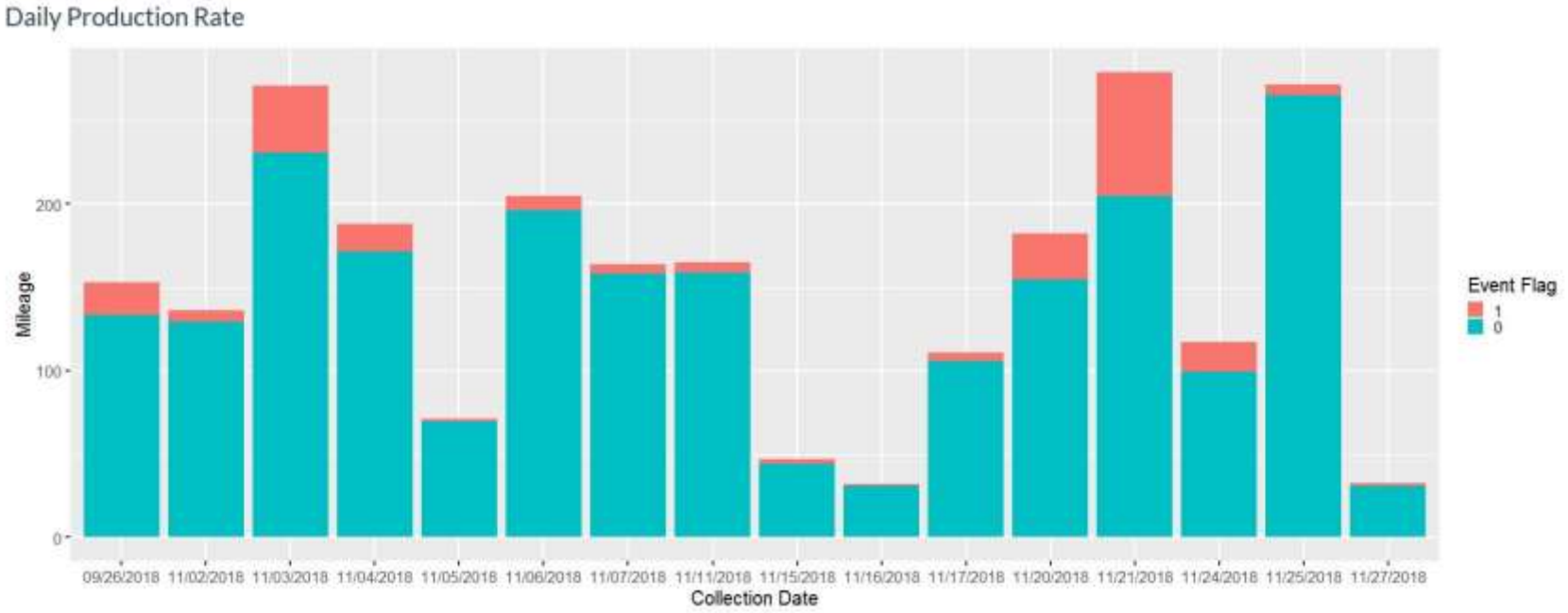
- Completeness checks, for example
  - Percentage of missing condition metrics and inventory data
  - Faulting only for JCPC and rutting only for ACP

- Validity Checks, for example
  - IRI – 40 to 250 in/mile
  - Percent cracking – 0 to 60 percent for surface type 2, and 0 to 100 percent for surface type 3 or 5

- Data consistency checks, for example
  - Difference in IRI between wheelpaths < 50 in/mile
  - Difference in Rut Depth between wheelpaths < 0.25 inch

Review of Partial DCC Data

- Automated review of partial data batches through a web-based tool



Show 30 entries Search:

Collection_Date	Reported	Reported_noEvent	Reported_Event
Overall Means	151.59	136.39	15.20
09/26/2018	152.61	133.30	19.31
11/02/2018	136.06	129.40	6.66
11/03/2018	271.05	230.79	40.25

Lessons and Recommendations

- QMP for collection of ~7,500 miles was discussed and approved by FHWA within context of project
- Certification procedures are available for Inertial profilers. Similar procedures are needed for certification of collection of percent cracking, rut depth, and faulting
- Routine review of equipment operations throughout the data collection process is important to maintaining quality data collection

Lessons and Recommendations

- Data must be reviewed as it is being collected to minimize mileage for recollection or reprocessing
- Independent checks throughout all stages of data collection is key for the success of the pavement data QMP

Thank you