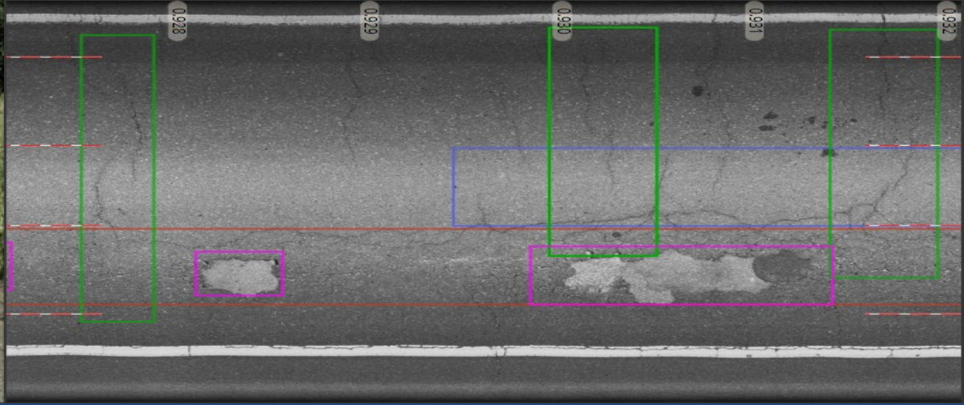


ODOT's Automated Pavement Condition Survey Practices

Northwest Transportation Conference
Rick Villarreal, P.E.
Pavement Specialist
March 5, 2024

Background & Survey Types

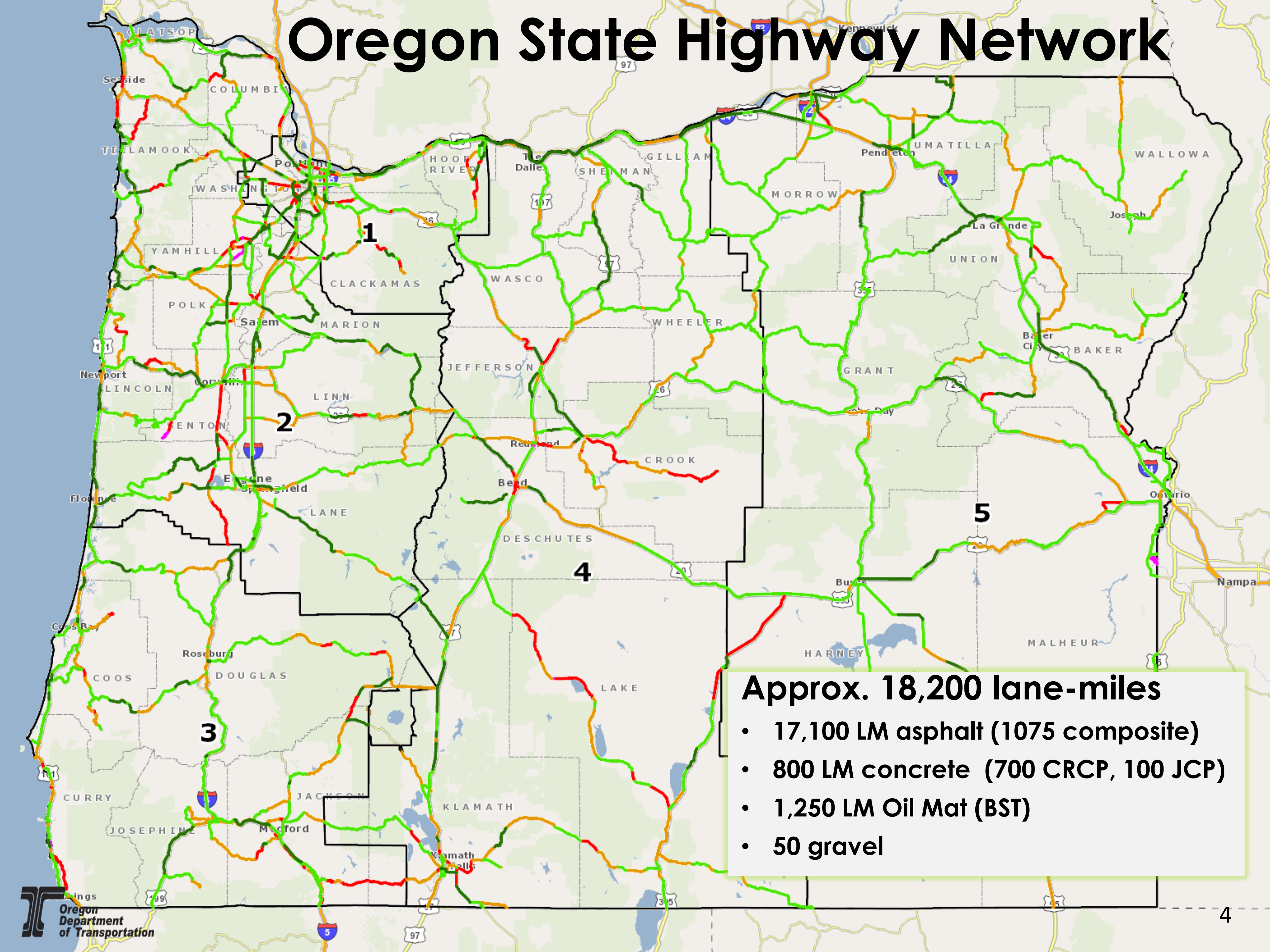
Standards, Requirements, & Performance Measures

Data Collection Vehicle Equipment

Viewer Interface

Background & Survey Types

Oregon State Highway Network



Approx. 18,200 lane-miles

- 17,100 LM asphalt (1075 composite)
- 800 LM concrete (700 CRCP, 100 JCP)
- 1,250 LM Oil Mat (BST)
- 50 gravel

Oregon Department of Transportation

Condition Survey Types – Two Methods

Manual/Windshield

Automated

Manual Surveys

- Windshield (GFP) Survey – travel lane viewed through the windshield.
- Two-person teams visually assess pavement conditions.
- Data is recorded by hand on paper forms.
- Focus on State highways not on the National Highway System (NHS).
- Pavement Section-Level estimates of certain distresses and overall condition.

Manual Surveys

	GFP Score	Stability	Structural Weakness	Fatigue	Transverse/ Block	Patching	Ride Qualities	Deformation and Rutting	Comment
Very Good	100, 99, 98, 97, 96	Stable	None	None	None	None	Excellent	Rut depth less than ¼"	Nothing would improve this road
Good	95, 90, 85, 80	Stable	None evident	Generally hairline and hard to detect	Minor amounts may be present	Minor amounts may be present	Very good	Deformation minor, rut less than ½"	May have dry or light colored appearance
Fair	75, 70, 65, 60, 55, 50	Generally stable	Minor areas evident	Easier to detect by low severity	May have widespread low and/or intermittent high severity	May be patched, but not excessively (i.e. less than 100%)	Good to acceptable	Deformation more easily noticed, rut less than ¾"	Typ. treatment needed: Low vol.: chip seal High vol.: 2" resurface
Poor	45, 40, 35, 30, 25	Areas of instability	Marked evidence of structural deficiency	Large crack patterns (alligatoring) present	May have widespread moderate and/or intermittent high severity	Heavy and numerous	Acceptable to poor	Deformation very noticeable, rut ¾" or greater if present	Typ. treatment needed: Low vol.: 2" resurface High vol.: >2" resurface
Very Poor	20, 15, 10, 5	Numerous areas of instability	Majority showing structural deficiency	Intermittent to extensive high severity	Extensive high severity	Intermittent to extensive high severity	Unacceptable, should slow down		Typ. treatment needed: Low vol.: >2" resurface High vol.: heavy rehab or reconstruction

2022 GFP PAVEMENT CONDITION FORMS - CALIBRATION LOOP

ROUTE	DIR	HWY	RW	MT	OV	BEG MP	END MP	SECTION	LENGTH	AGE	PAVEMENT TYPE	BOUNDARY ADJUSTED
US 20	E	016	1			11.71	12.70	GORE DR - RXR X-ING	0.99	14	C-MIX DGAC THK	
US 20	E	016	1			12.70	13.60	RXR X-ING - ELMORE ST (EB)	0.90	9	C-MIX MAINT THIN ON CTB	
US 20	W	016	2			12.93	13.21	MAIN ST - E VINE ST (WB)	0.28	9	C-MIX MAINT THIN INLY A	
US 20	W	016	2			13.21	13.39	E VINE ST - E GRANT ST (WB)	0.18	82	JCP JCP	
US 20	W	016	2			13.39	13.73	MAIN ST - ELMORE ST (WB)	0.34	9	C-MIX MAINT THIN ON CTB	

DISTRESS (each section): FATIGUE L M H 0 1 5 10 25 50 75 100 %length; T-CRK L M H ____ #/0.1 mi; PATCH L M H 0 1 5 10 25 50 75 100 %area; RAVEL L M H S I E; BLEEDING >5% Y; POTHOLES S or D S I E

SECTION	FATIGUE 20	T-CRK 20	PATCH 20
GORE DR - RXR X-ING	18%	0	0%
RXR X-ING - ELMORE ST (EB)	38%	14	0%
MAIN ST - E VINE ST (WB)	54%	18	0%
E VINE ST - E GRANT ST (WB)	58%		0%
MAIN ST - ELMORE ST (WB)	20%	10	0%

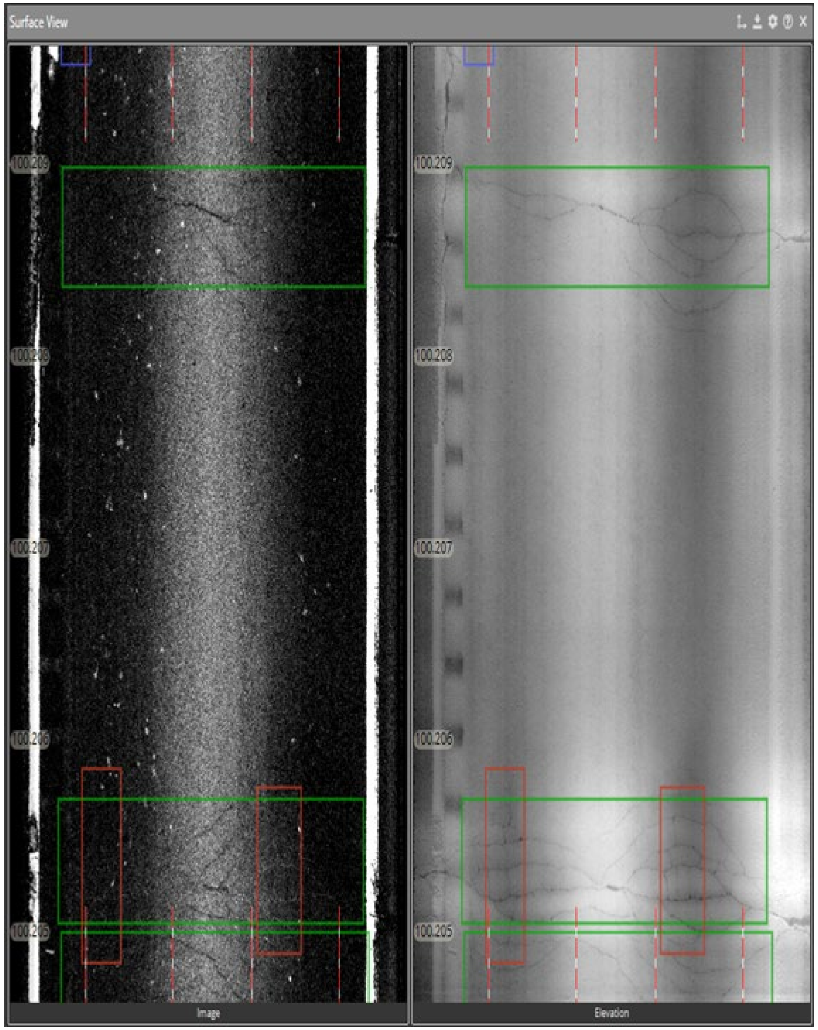
RATING

SECTION		14	16	18	20	2022
GORE DR - RXR X-ING	OVERALL	89	82	75	69	____
	IRI	74	75	77	89	GD FR PR
	RUT	0.2	0.2	0.2	0.2	____ in.
RXR X-ING - ELMORE ST (EB)	OVERALL	90	83	59	44	____
	IRI	132	128	113	125	GD FR PR
	RUT	0.1	0.1	0.1	0.2	____ in.
MAIN ST - E VINE ST (WB)	OVERALL	98	81	49	32	____
	IRI	136	112	148	125	GD FR PR
	RUT	0.1	0.1	0.2	0.2	____ in.
E VINE ST - E GRANT ST (WB)	OVERALL	35	18	18	18	____
	IRI	212	274	278	287	GD FR PR
	RUT	0.2	0.2	0.3	0.3	____ in.
MAIN ST - ELMORE ST (WB)	OVERALL	98	90	64	47	____
	IRI	105	119	130	123	GD FR PR
	RUT	0.1	0.1	0.2	0.2	____ in.

RW (Roadway ID): 1 = Add Roadbed, 2 = Non-Add Roadbed
MT (Mileage Type): T = Temporary Mileage, Y = Spur Mileage, Z = Overlap Mileage
For JCP: Enter faulting in the rut data box & for Fatigue circle % of cracked slabs rather than % length.
S = Sporadic I = Intermittent E = Extensive

Page 1

Automated Surveys



- Data is collected by imaging or noncontact sensor equipment.
- The types of pavement condition data collected are surface characteristics and distress.
- Systems capture all pavement data in a single pass at highway speed.
- Data is processed using automated or semi-automated methods.
- Data is reported by 0.10-mile segment.

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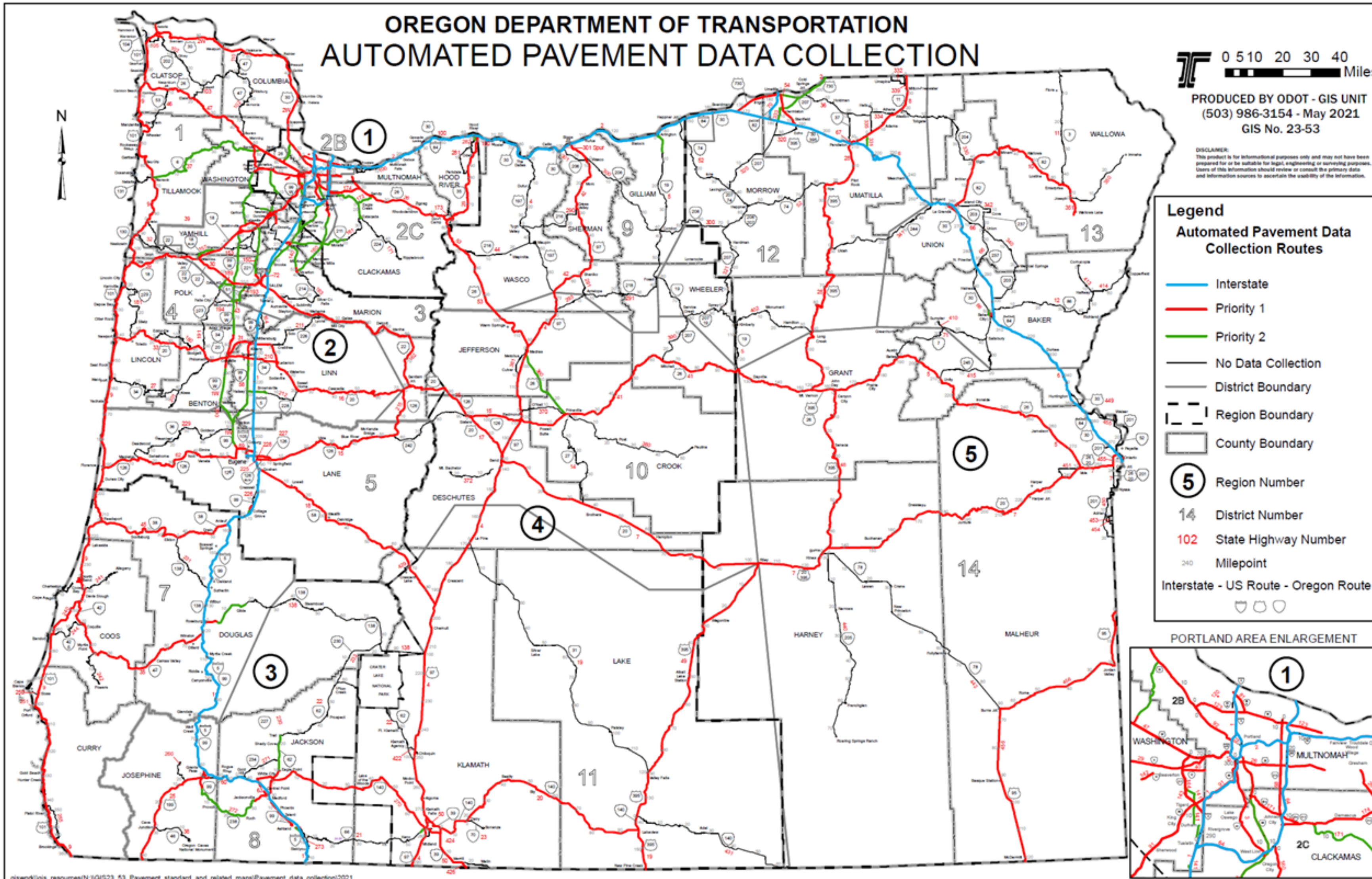
Which Routes are Rated and How?



Standards, Requirements, & Performance Measures

MAP-21 and FAST ACT Requirements

- 0.10-mile uniform pavement data collection and reporting on the National Highway System (NHS).
- Pavement Data Quality Management Plan to be developed and followed for the collection and processing of all data collection used for evaluating pavement performance.

PM2 Pavement Performance Measures	
Interstate System	Non-Interstate NHS
% of lane-miles in Good condition	% of lane-miles in Good condition
% of lane-miles in Poor condition	% of lane-miles in Poor condition

Oregon Department of Transportation

ODOT – DQMP

Data Quality Management Plan
for Pavement Condition
National Highway Performance Program

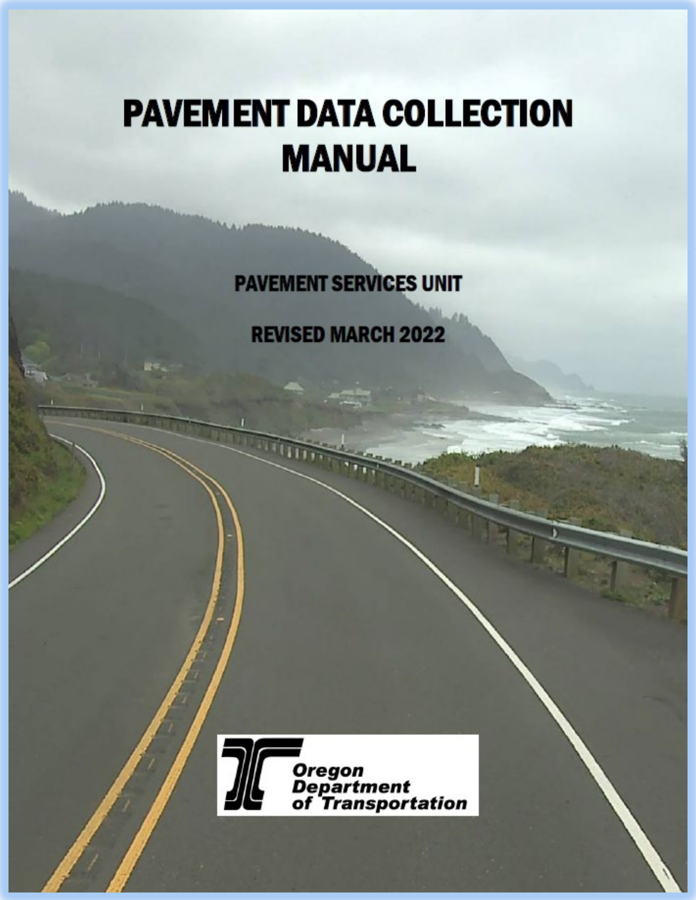
Oregon Department of Transportation
Pavement Services Unit

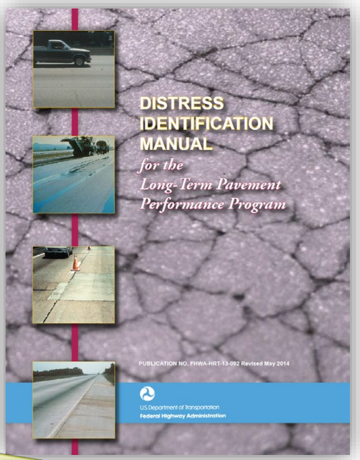
Version 1.3
February 26, 2024

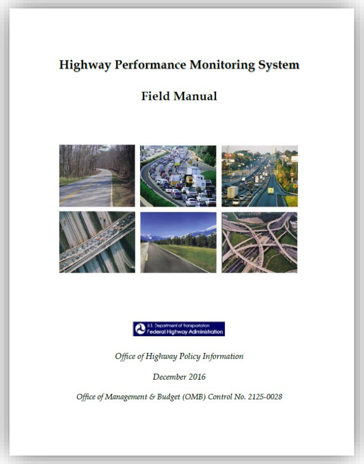
Section 1. Introduction	Describes new federal legislation mandating the program, minimum program requirements, and scope of ODOT's program.
Section 2. Deliverables, Protocols, and Quality Standards	Lists the data collection elements subject to the DQMP, protocols used to collect the data, and quality requirements for the data, as defined by the *HPMS Field Manual* requirements and ODOT's pavement management system (PMS) needs. Evaluates data against these criteria for acceptance.
Section 3. Quality Control	Describes the QC activities to be conducted before, during, and after data collection to verify data are of acceptable quality and are complete and correct.
Section 4. Acceptance	Outlines the acceptance processes and criteria that will be used to determine if data is fit for use. Includes data sampling, review, and checking processes, and error resolution procedures for data not meeting criteria.
Section 5. Roles and Responsibilities	Identifies the quality-related responsibilities of the data collection team, including Agency and Data Collection Contractor members.
Section 6. Tracking and Reporting	Outlines the documentation expected for QM activities, and format for QM logging, tracking and reporting.

ODOT. (2024). Data Quality Management Plan.
pavement_data_QM_plan.pdf (oregon.gov)

Data Collection Manuals







ODOT. (2022). Pavement Data Collection Manual.
http://www.oregon.gov/ODOT/Construction/Documents/pavement_data_collection_manual.pdf

HPMS Requirements

- Collection Cycle:
  - Interstate – Annually
  - Non-Interstate NHS – Biennially
  - Non-NHS – Biennially

- Pavement Data Items:
  - IRI
  - Cracking Percent
  - Rutting
  - Faulting
  - Present Serviceability Rating (PSR)

Oregon Department of Transportation

Deliverables, Protocols, & Quality Standards

Table 2. Deliverables, Protocols, and Quality Standards

Deliverable	Protocols	Resolution	Accuracy	Repeatability
IRI (left, right, and average)	ODOT *Pavement Data Collection Manual* AASHTO R 43-13[1] AASHTO R 56-14[1] AASHTO R 57-14[1] AASHTO M 328-14[1]	1 inch/mile	ProVAL cross correlation accuracy score ≥ 0.90 (5 repeat runs) compared to ODOT Surpro	ProVAL cross correlation repeatability score ≥ 0.92 (5 repeat runs)
Rut depth (left, right, average, and maximum)	AASHTO R 88-18[1] AASHTO R 87-18[1] AASHTO R 48-10[1]	0.01 inch	± 0.10 inch compared to ODOT survey	± 0.05 inch run to run (3 repeat runs)
Joint faulting (JPCP)	AASHTO R 36-13[1]	0.01 inch	± 0.06 inch compared to ODOT survey	± 0.06 inch (3 repeat runs)
Fatigue cracking (ACP)	ODOT *Pavement Data Collection Manual* AASHTO R85-18[1] AASHTO R 86-18[1]	N/A	Length ± 20 percent compared to ODOT values (by severity level)	N/A
Longitudinal cracking (all pavement types)	ODOT *Pavement Data Collection Manual* AASHTO R 85-18[1] AASHTO R 86-18[1]	N/A	Length ± 20 percent compared to ODOT values	N/A
Transverse cracking and potholes (ACP)	ODOT *Pavement Data Collection Manual*	N/A	Count ± 3 compared to ODOT values, and zero when ODOT is zero	N/A
Corner breaks, shattered slabs, no. slabs, and no. cracked slabs (JPCP)	ODOT *Pavement Data Collection Manual*	N/A	Count ± 3 compared to ODOT values, and zero when ODOT is zero	N/A
Punchouts (CRCP)	ODOT *Pavement Data Collection Manual*	N/A	Count ± 3 compared to ODOT values, and zero when ODOT is zero	N/A
Patching (all pavement types)	ODOT *Pavement Data Collection Manual*	N/A	Area ± 20 percent compared to ODOT values	N/A
Milepoint	N/A	0.005 mile	± 0.03 mile of actual location shown in ODOT straight line logs	N/A
Forward view images	N/A	1920 x 1080, Signs legible, proper exposure and color balance	N/A	N/A
Pavement images	AASHTO R 86-18	Visible 0.08-inch wide crack, 13-foot minimum width	N/A	N/A

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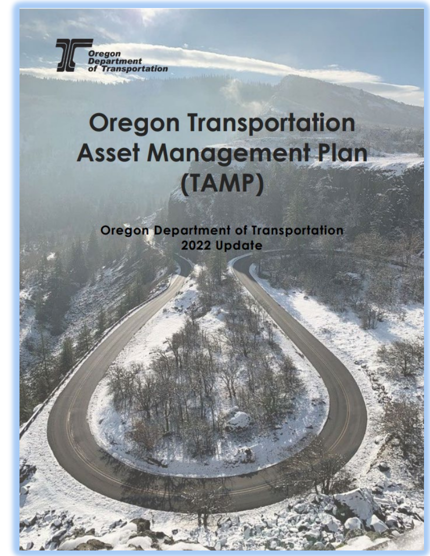
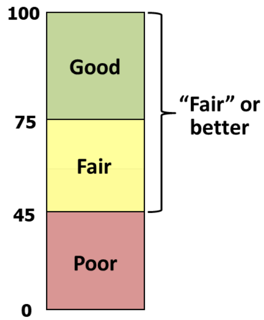
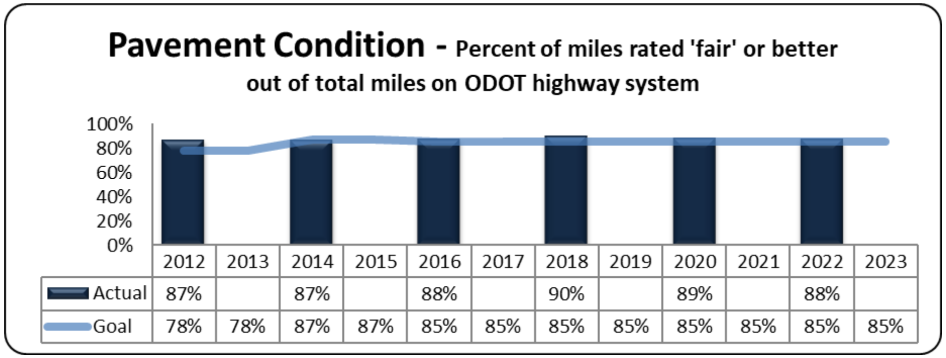
Performance Measures

TAMP



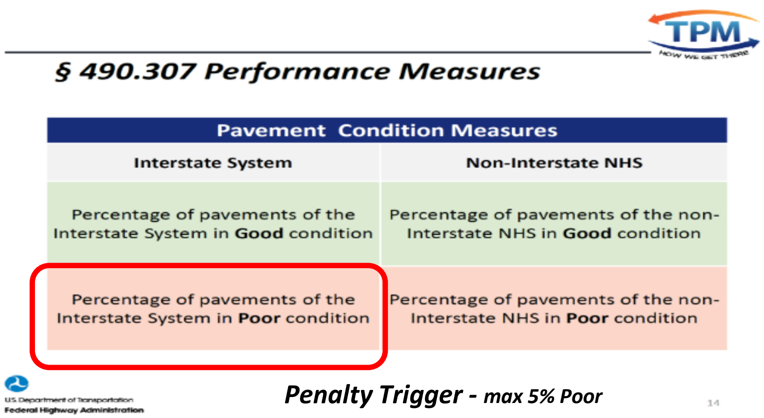
Legislative KPM





	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Actual	87%		87%		88%		90%		89%		88%	
Goal	78%	78%	87%	87%	85%	85%	85%	85%	85%	85%	85%	85%

Federal Measures



TPM
HOW WE GET THERE

§ 490.307 Performance Measures

Pavement Condition Measures	
Interstate System	**Non-Interstate NHS**
Percentage of pavements of the Interstate System in **Good** condition	Percentage of pavements of the non-Interstate NHS in **Good** condition
Percentage of pavements of the Interstate System in **Poor** condition	Percentage of pavements of the non-Interstate NHS in **Poor** condition

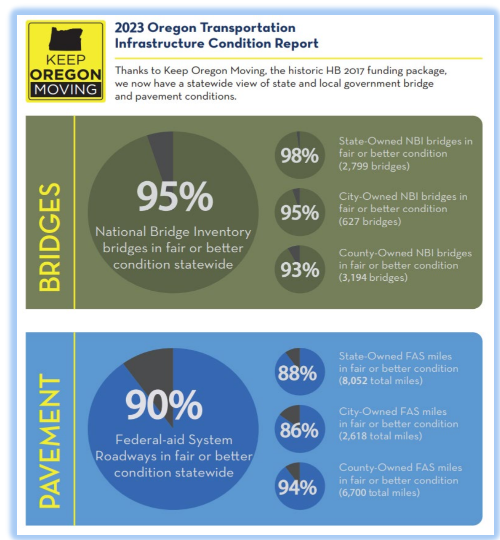
U.S. Department of Transportation
Federal Highway Administration

Penalty Trigger* - *max 5% Poor

14

Keep Oregon Moving

(HB2017)



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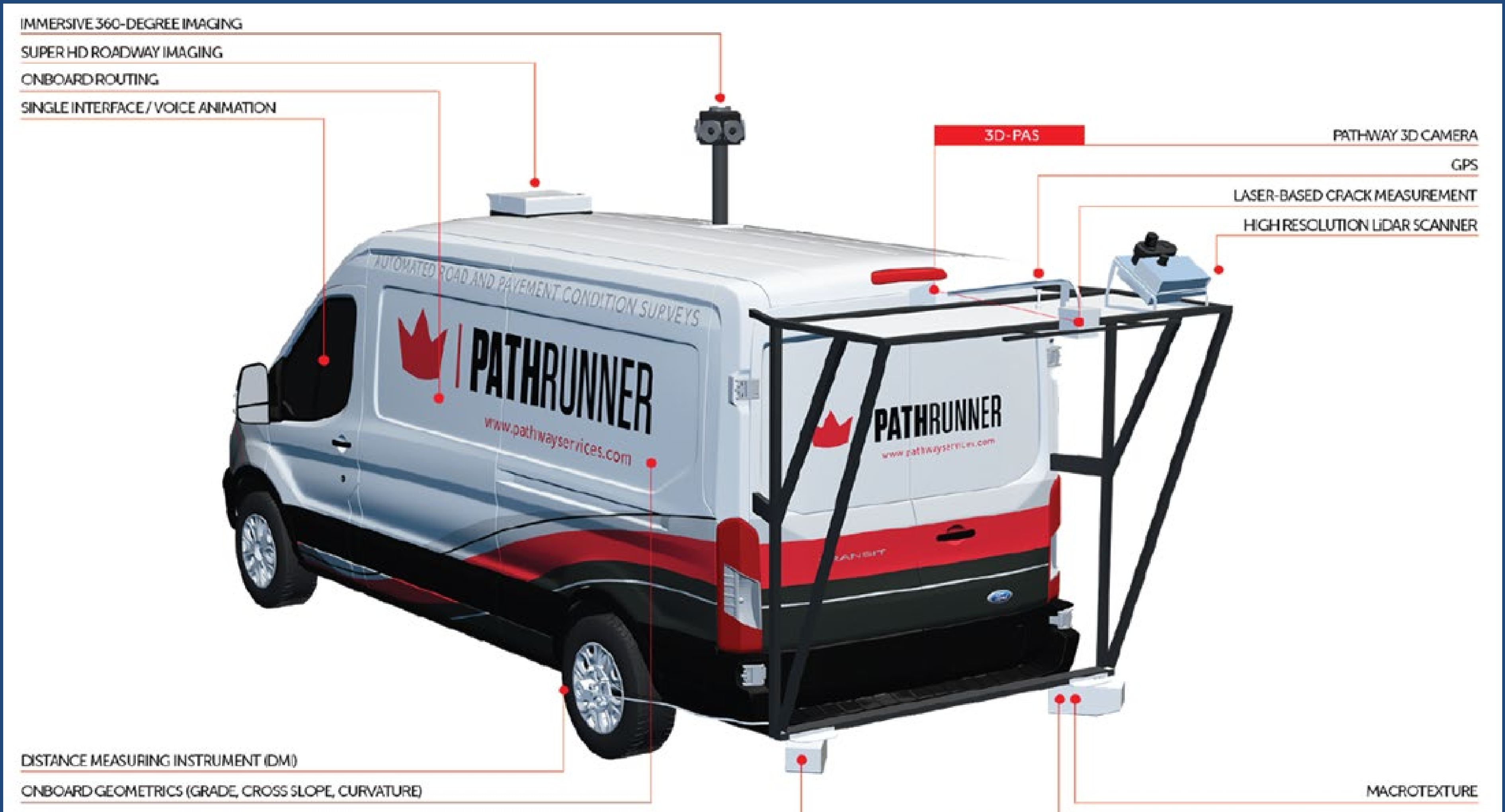
Data Collection Vehicle Equipment



Pathway Pathrunner

Subsystems - Location

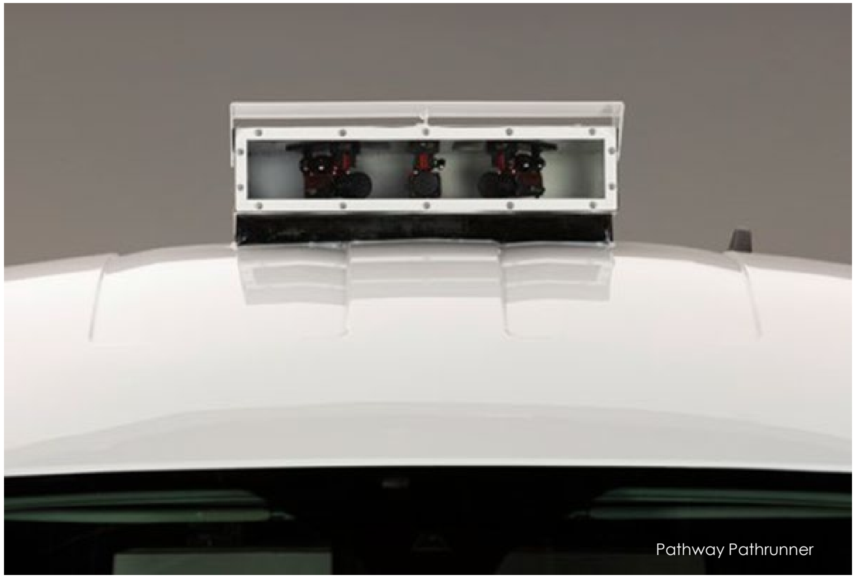

Pathway Pathrunner


Fugro Roadware

Global Positioning System (GPS)

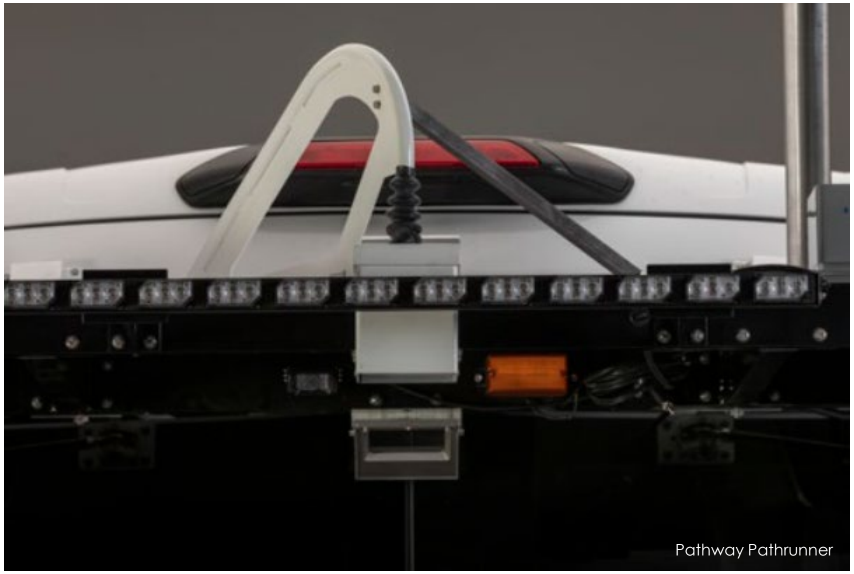
- Real-time location coordinates
- Integrated with DMI, Inertial Reference System

Subsystems – Image Collection



HD Videolog 3 Camera Array

- High-resolution CCD cameras
- Wide angle lenses capturing 120° panoramic view
- Built-in lens control feature
- Able to capture an image every 26.4 feet ~ 200 images per mile
- Essential for verification/identification of pavement distress



3D Pavement Analysis Subsystem (PAS) Laser and Camera Configuration

- High quality downward pavement surface images
- Mounted in rear of Pathrunner to remove blemishes
- Eliminates cropping and stitching from multiple cameras

Subsystems – Sensor and Distress

Pathway Pathrunner

High-Speed Inertial Profiler

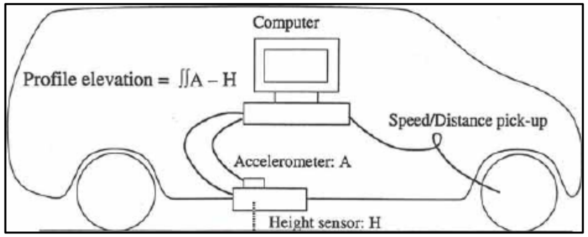
- Wide-line footprint laser to measure roughness - (approximately 4 inches)
- Wide-line footprint provides more data points then single and multi-point systems
- 3rd-party certified by TTI, MnDOT, NCAT, etc.

Laser Crack Measurement System (LCMS) / 3D-PAS

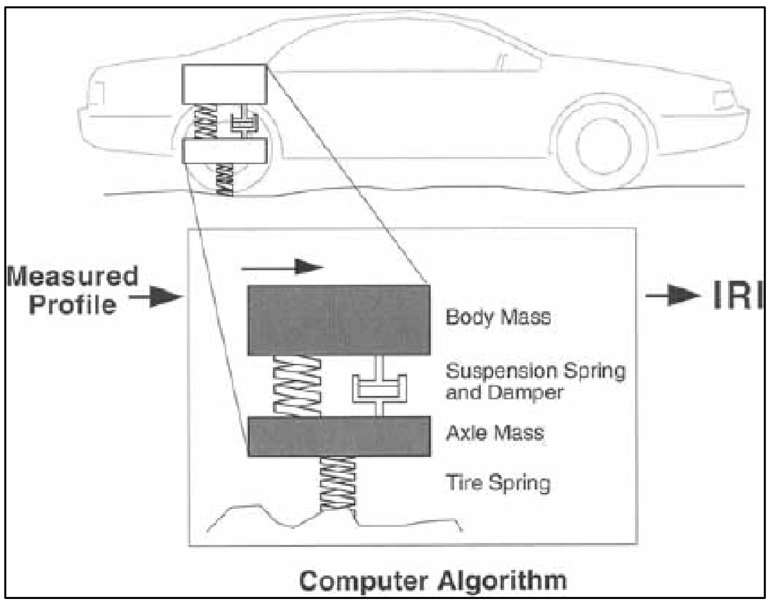
- Complete transverse profile (rutting)
- Crack, potholes, patches, joints (length, width, quantity)
- Faulting

Inertial Profiler

Components



Computing IRI – Quarter Car Model



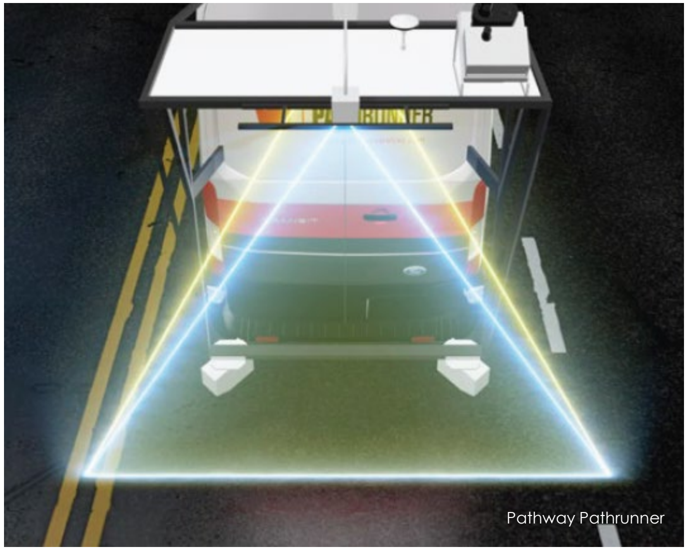
FHWA. (2005). Achieving A High Level of Smoothness in Concrete Pavements Without Sacrificing Long-Term Performance. FHWA-HRT-05-068.

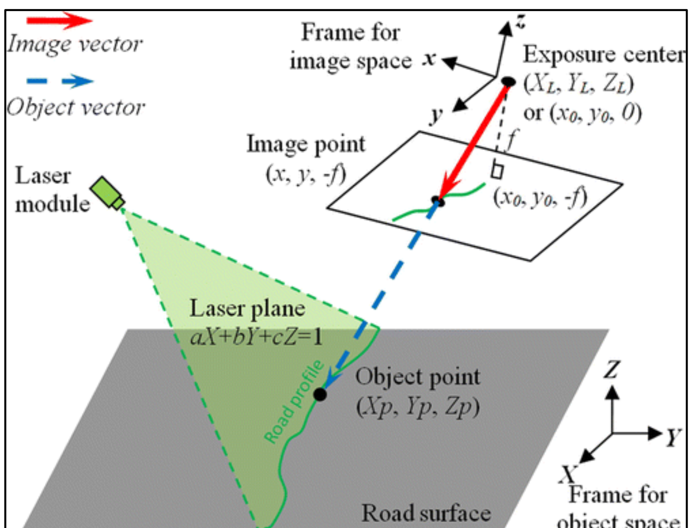
- **Height sensor – vertical distance**
- **Accelerometer - acceleration to compute inertial reference value.**

Pathway Pathrunner

Oregon Department of Transportation

LCMS – 3D PAS





- **2-D images and 3-D profiles (intensity and elevation).**
- **Sensors measure thousands of data points across a lane.**
- **Highway speed collection – thousands of profiles captured per second.**
- **Distresses are extracted from profiles.**

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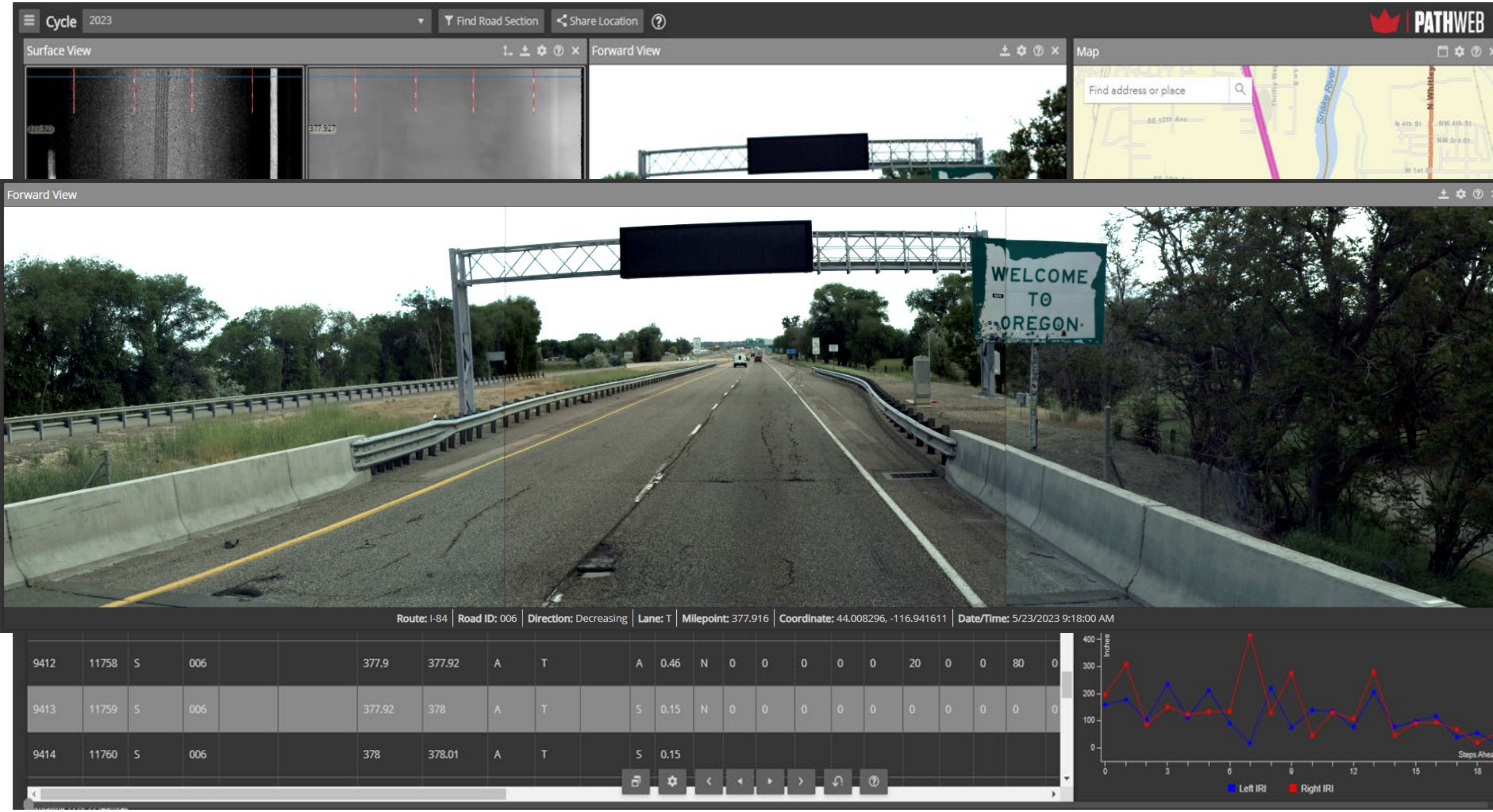
Han, J. Y., Chen, A., & Lin, Y. T. (2015). Image-based approach for road profile analyses. Journal of Surveying Engineering, 142(1), 06015003.

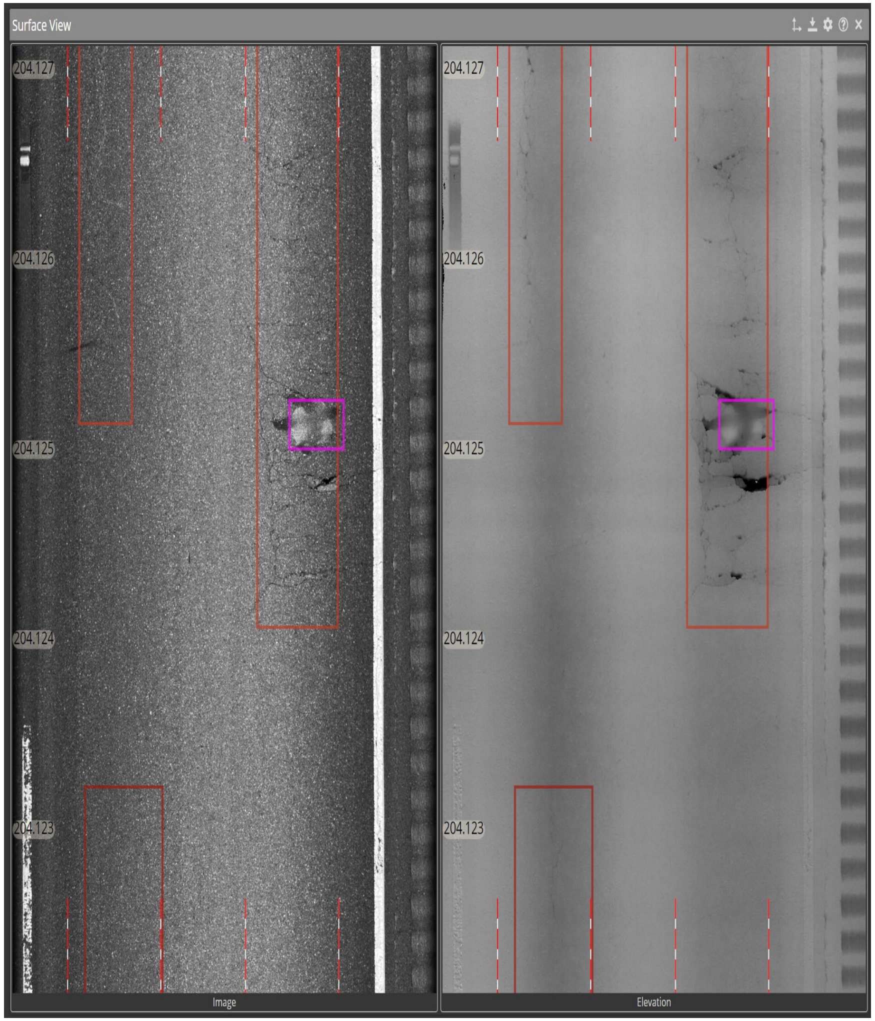
Viewer Interface

PATHWEB

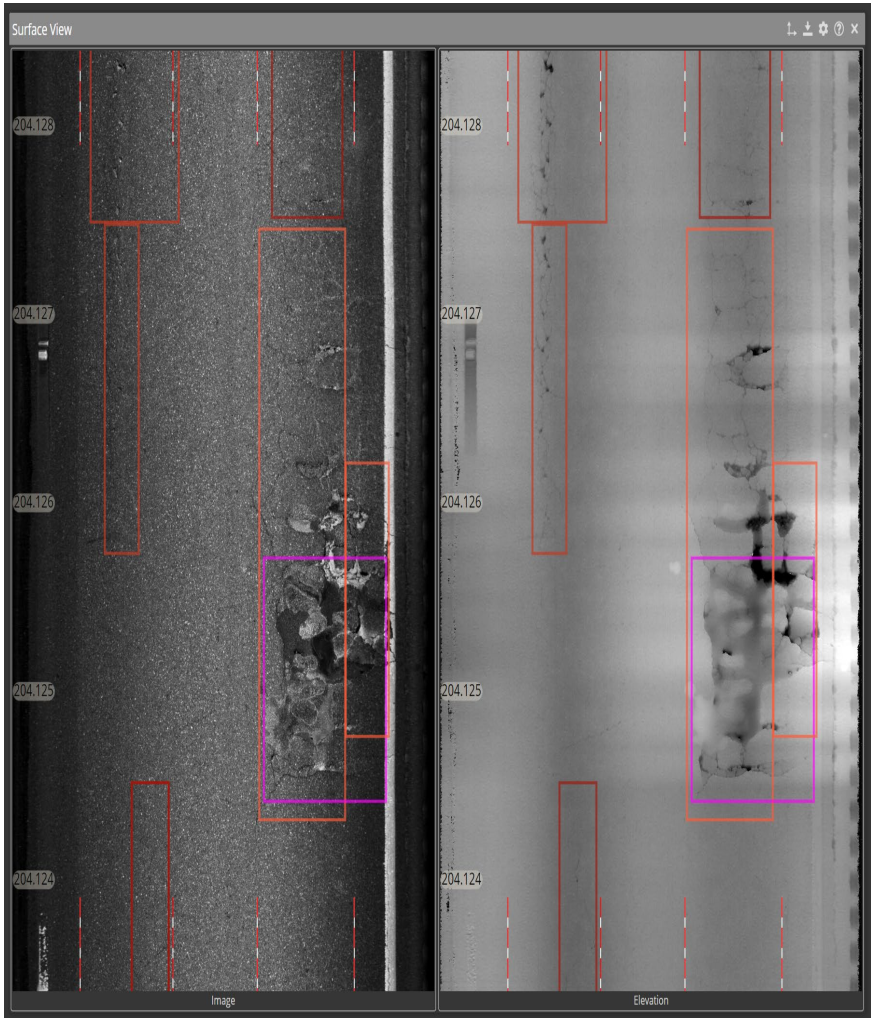


Cycle
2023
Find Road Section
Share Location
PATHWEB
Surface View
377.927
Forward View
Map
Find address or place
Snake River
Forward View
WELCOME TO OREGON
Route: I-84 | Road ID: 006 | Direction: Decreasing | Lane: T | Milepoint: 377.916 | Coordinate: 44.008296, -116.941611 | Date/Time: 5/23/2023 9:18:00 AM
9412 11758 S 006 377.9 377.92 A T A 0.46 N 0 0 0 0 0 20 0 0 80 0
9413 11759 S 006 377.92 378 A T S 0.15 N 0 0 0 0 0 0 0 0 0 0
9414 11760 S 006 378 378.01 A T S 0.15
Inches
400
300
200
100
0
Steps Ahead
0 3 6 9 12 15 18
Left IRI
Right IRI

Downward Pavement Image Comparison



2022

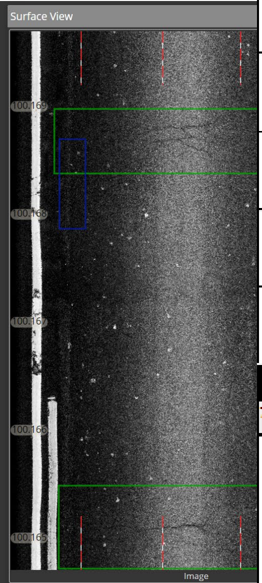


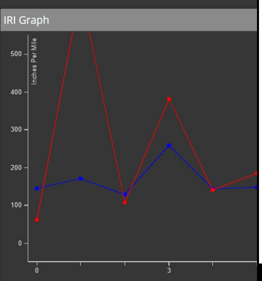
2023

Oregon Department of Transportation

Rutting

IRI t



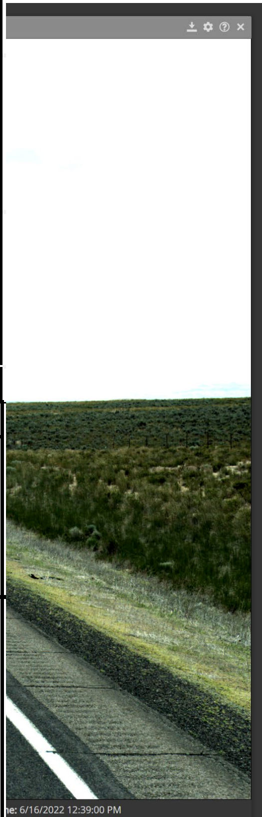


CONSTRUCTION HISTORY

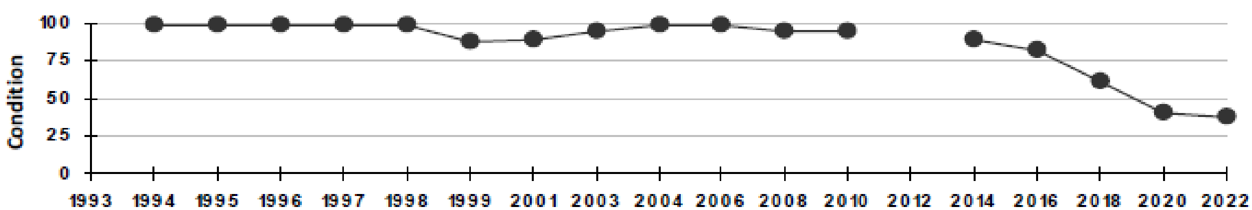
YEAR	BMP	EMP	KEY	CONTRACT	V-FILE	PROJECT NAME	LYR1	LYR2	LYR3	CPPR	BASE	SUB
	Comment						*LYR1 Mix Info:* / *Asphalt*	*Mix Level*	*Mix Type Producer*		*RAP/RAS*	*Warm Mix Lab #*
2012	66.18	121.35	K16603	C14403	44V-104	US95: IDAHO STATE LINE - NEVADA STATE LINE SEC.	PC					
2004	98.65	121.36	-	B24065	37V-095	District 14 2004 Chip Seal Sec	CS					
	dry key chip seal											
1993	98.65	121.36	K05611	C11264	24V-121	M.P. 98.65-MCDERMITT SEC.	3 EA	3 R		3		
1969	94.00	105.36	-	C07226	09V-361	Blue Mtn. Pass-Jackson Cr. Sec.	1.5 B	2 B	4 PB		8.5 PA	
	ovly & widen from 20' to 32'											
1954	94.23	104.49	-	-	04V-499	Blue Mtn. Pass Sec	1.5 B	1.5 B				
	MP's adjusted to todays MP's											
1935	99.19	104.37	-	-	01V-014	Blue Mountain Pass - Jackson Cr. Sec.	0.38 Z				1 AG	3 AG

CONDITION HISTORY

	76	78	80	82	84	86	88	90	92	93	94	95	96	97	98	99	01	03	04	06	08	10	12	14	16	18	20	22	24
	4	4	3	4	4	3	4	4	4	9	1	1	1	1	1	2	2	2	1	1	2	2	9	2	2	3	4	4	
COND:											98	99	99	99	99	88	89	94	99	98	95	95		89	82	61	40	38	
RUT:												0.10		0.10		0.05	0.10	0.15	0.10	0.10	0.15	0.16	0.16	0.20	0.23	0.22	0.24	0.35	
IRI:												104		103		103	102	100	107	106	96	92	96	105	115	139	189	235	
%Fatigue:											0%	0%	0%	0%	0%	0%	0%	0%	0%	0%		0%		0%	0%	1%	2%	6%	
%fat-mh:																											1%	4%	
%L-Crk:																													
#T-Crk:											0	0	0	0	0	0	0	0	0	0		1		5	11	18	24	26	
#tcrk-mh:																										7	15	21	
%Patch:											0%	0%	0%	0%	0%	17%	15%	6%	0%	0%		0%		0%	0%	0%	0%	0%	
#Pot or #Pun/mi:																													
Rav:																													

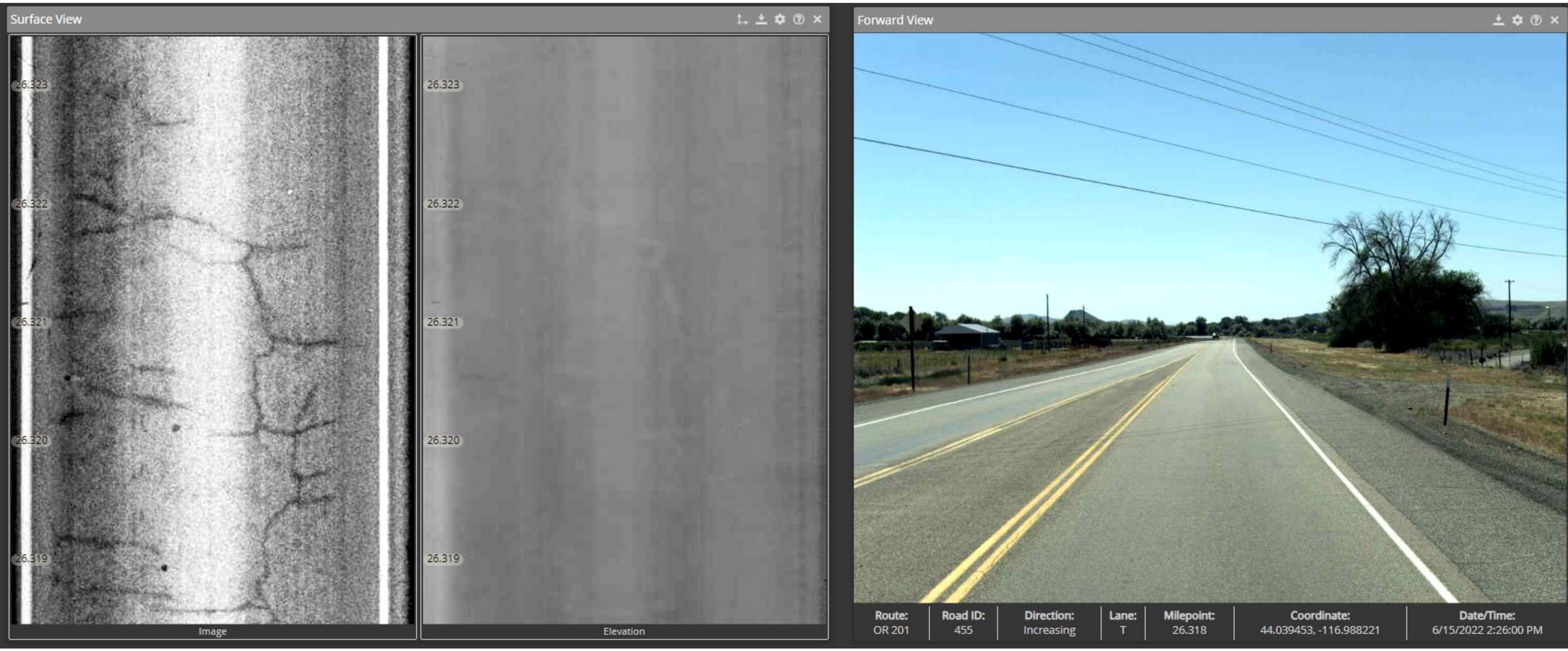


CONDITION GRAPH



Oregon Department of Transportation

Track Treatment Performance



Helping Maintenance in Selecting Appropriate Preventive Treatment Projects

Photo provided by Pathway Services