



Alaska Department of Transportation & Public Facilities

Mat and Joint Compaction Incentives via PaveScan Data
Rich Giessel

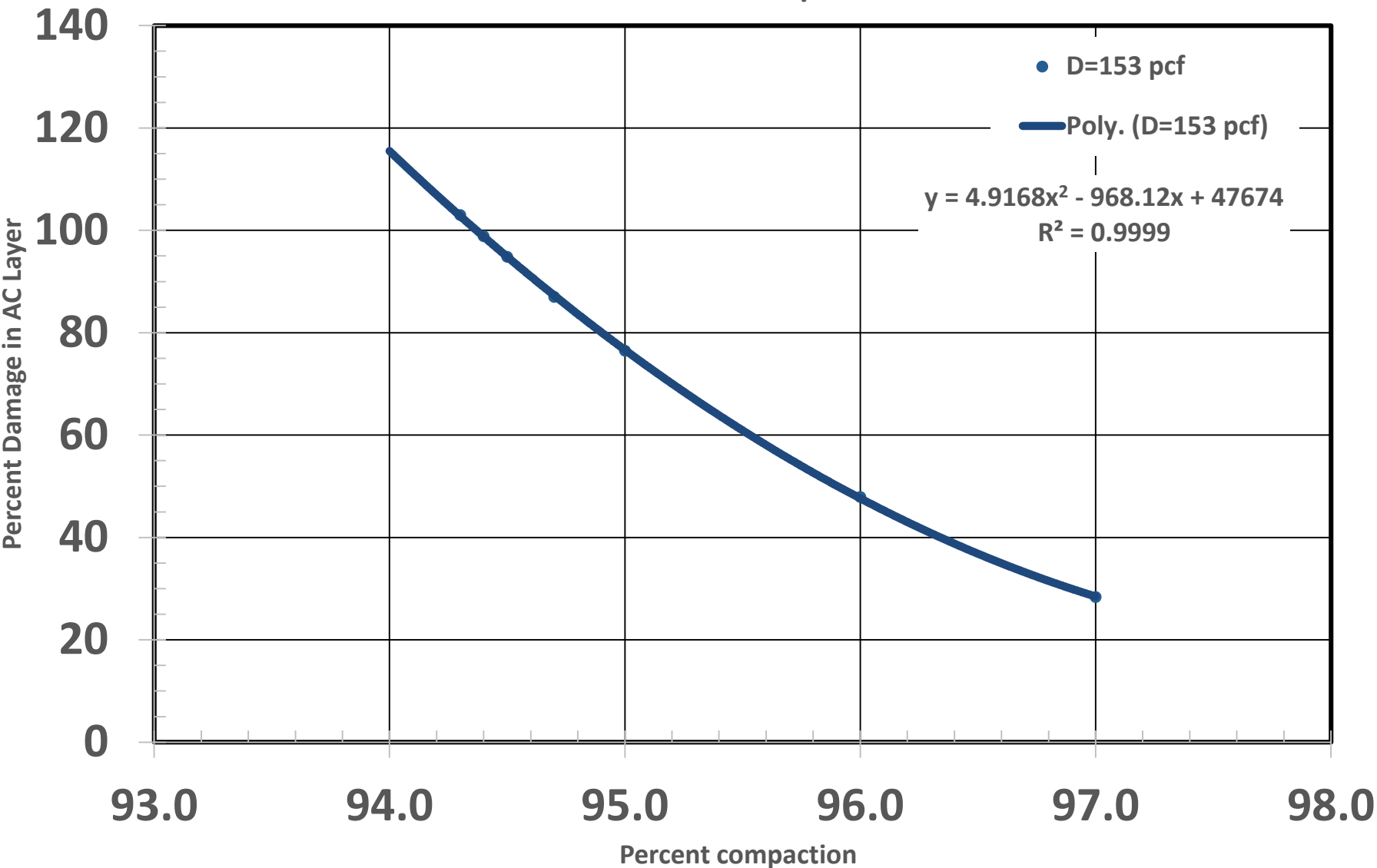
TRB DPS User Group: January 15, 2020



1. Mat Compaction Incentives Why?

% Damage vs % Compaction

AC with 5.5% asphalt content



Q: What Changes?

A: Compaction Acceptance Method

The main specification change for implementation of this technology is substituting Percent Conforming (PC) for Percent Within Limits (PWL) in the Density Pay Factor.

400,000 density readings replace **10**
drilled cores

Global Change: Use PaveScan Data

Use Percent Conforming (PC)
instead of
Percent Within Limits (PWL)
in the Density Pay Factor.

Alaska Mat Density Pay Factor
= $0.55 + PC/200$

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100% Conforming gives a
1.05 Pay Factor

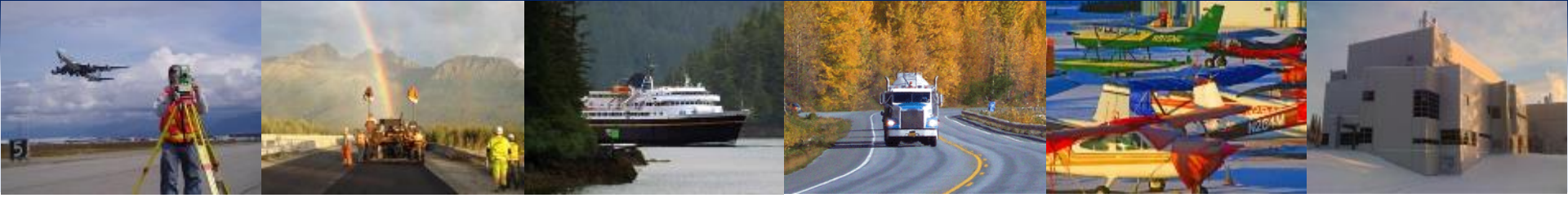
Should <80% Conforming Trigger
Remediation?

< 50% Percent Conforming Triggers R&R

What PC should trigger repair with Sand or Fog Seal?

- Perhaps from PC = 50% to 70%, PF = 0.80 to 0.90?

<u>% Conforming</u>	<u>Grade</u>	<u>Pay Factor</u>
PC = 90-100	A	PF = 1.00-1.05
PC = 80-90	B	PF = 0.95-1.00
PC = 70-80	C	PF = 0.90-0.95
PC = 60-70	D	PF = 0.85-0.90
PC = 50-60	F	PF = 0.80-0.85
PC < 50		Remove & Replace



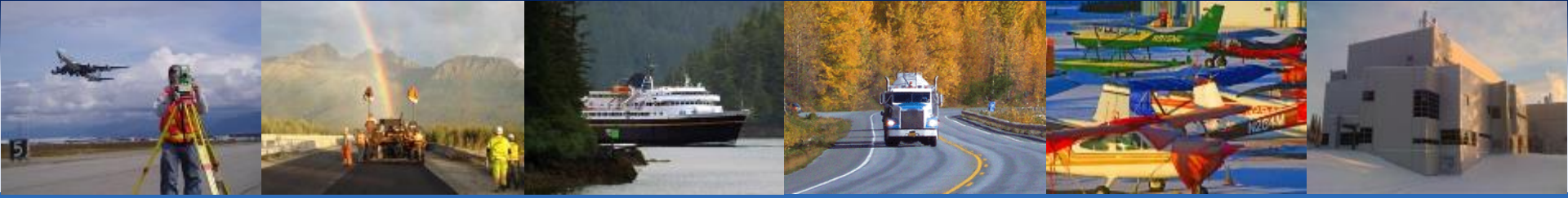
Should defect size trigger repair?

Current programming allows PaveScan Operator to Select defect size and compaction threshold for identification and mapping of both linear and area defects.

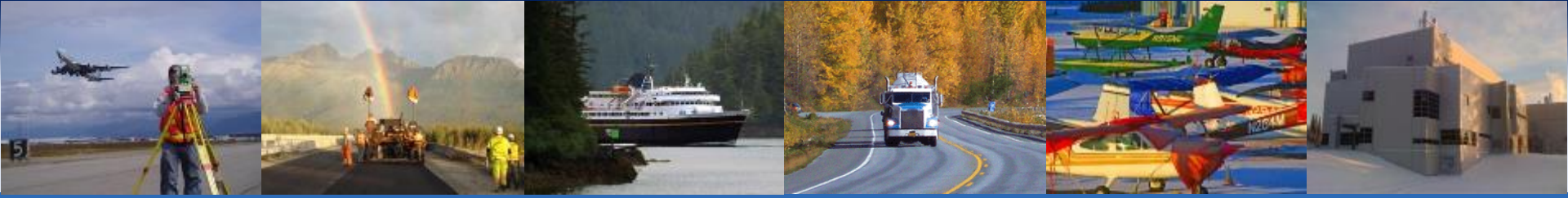
What size low-compaction area should trigger mat repair?

What size area should trigger repair?
(Currently using 8 ft²)

What % compaction should trigger repair?
(Currently using <92%)



Pay Factor Increases w/
>Compaction & >PC



- Incentive goes up with higher % **Compaction**

Compaction Factor (A):

$$A = \text{IF}(D < 92, 1.0, \text{MIN}(1.0 + (D - 92) / 100, 1.04))$$

where: D = Ave % Compaction/Station

92% Compaction = 1.00

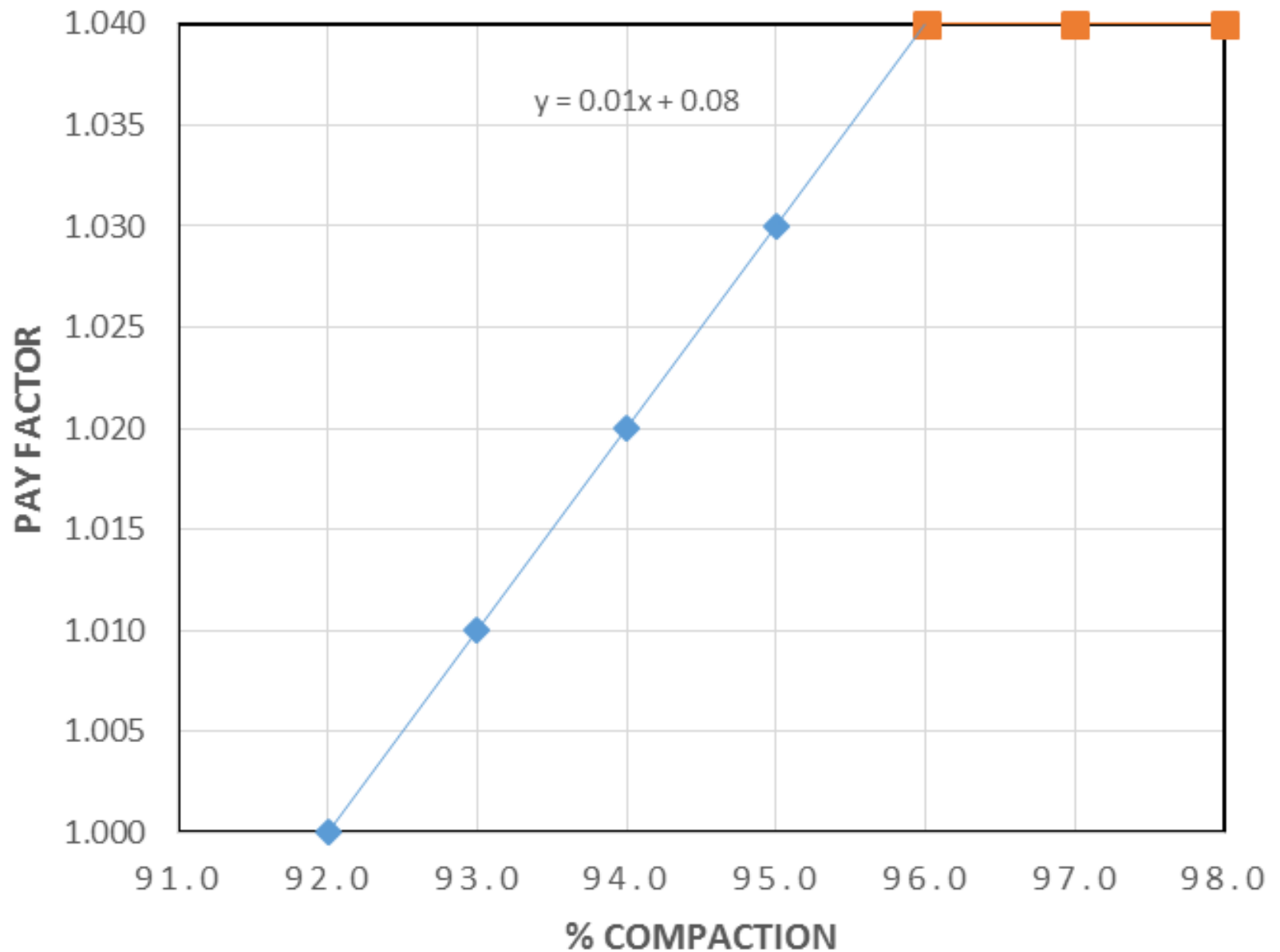
93% Compaction = 1.01

94% Compaction = 1.02

95% Compaction = 1.03

96% Compaction = **1.04**

COMPACTION FACTOR (A)





- Incentive goes up with higher % Conforming

% Conformance Factor (B):

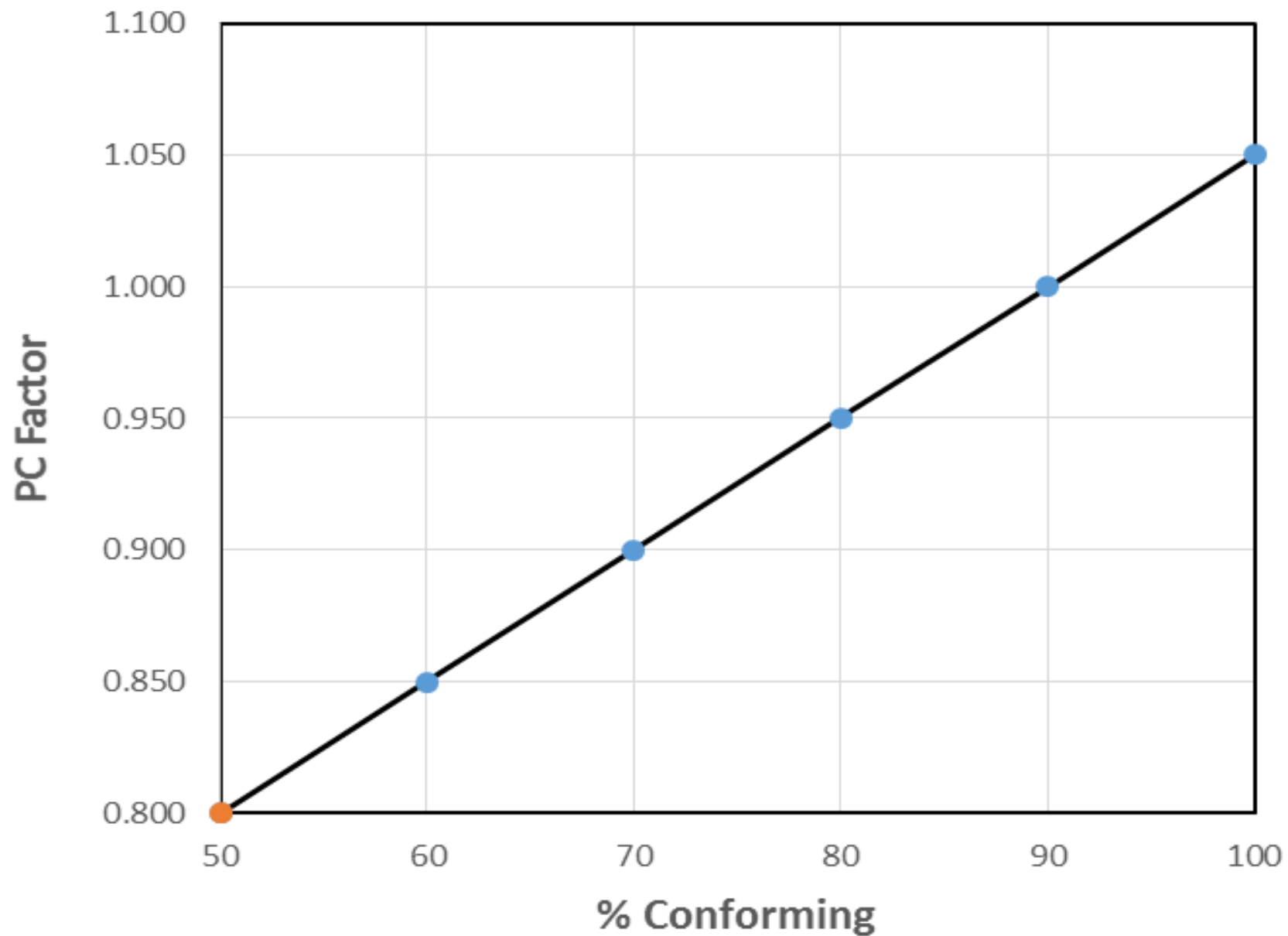
$$B = \text{IF}(PC < 50, 0, \text{MIN}(0.55 + PC/200, 1.05))$$

where: PC = Percent Conforming/Station

If PC = 100 then Pay Factor =

$$0.55 + (100)/200 = \mathbf{1.05}$$

% Conforming Factor (B)



Pay Factor (PF) = $A \times B$

Maximum Pay Factor: $1.04 \times 1.05 = \mathbf{1.092}$

R&R Threshold same as with
PWL < 50%

Suggest requiring Sand Seal at
PC < 80% Conformance/Station

Agency Mat Compaction Parameters:

	Maximum Pay Factor:	1.092
	Minimum Compaction level:	92
	Target Compaction level:	96
	Minimum % Conformance level:	90
	Target % Conformance level:	100
<80% Conforming = Sand Seal Required		

Example Compaction Data

Collected: 6-6-2017		(D)	A	(PC)	B	JB=AxB
	Segment	% Comp.	Compaction	Percent	PF	Mat Pay
Station	Length (ft)	Average	Bonus	Conforming	Pay Factor	Factor
1227	100	97.9	1.04000	100.0	1.05000	1.09200
1228	100	95.3	1.03328	99.8	1.04900	1.08391
1229	100	96.1	1.04000	100.0	1.05000	1.09200
1230	100	95.2	1.03232	99.7	1.04850	1.08239
1231	100	95.2	1.03174	99.2	1.04600	1.07920
1232	100	95.5	1.03470	99.6	1.04800	1.08437
1233	100	95.5	1.03496	99.9	1.04950	1.08619
1234	100	96.4	1.04000	98.2	1.04095	1.08259
1235	100	95.3	1.03346	96.4	1.03205	1.06658
1236	100	95.6	1.03584	99.2	1.04600	1.08349
1237	100	95.1	1.03120	98.5	1.04255	1.07508
1238	100	94.5	1.02514	97.0	1.03505	1.06107

Example Defect Data

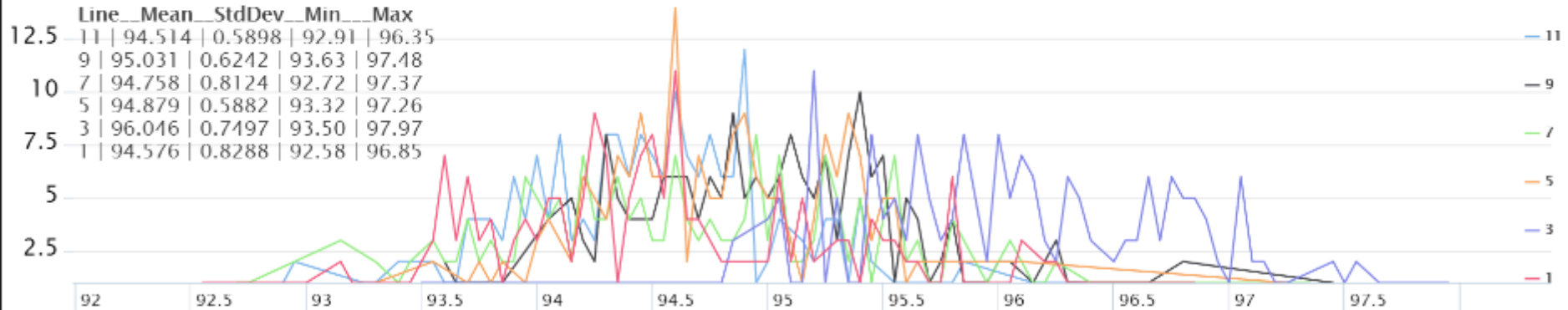
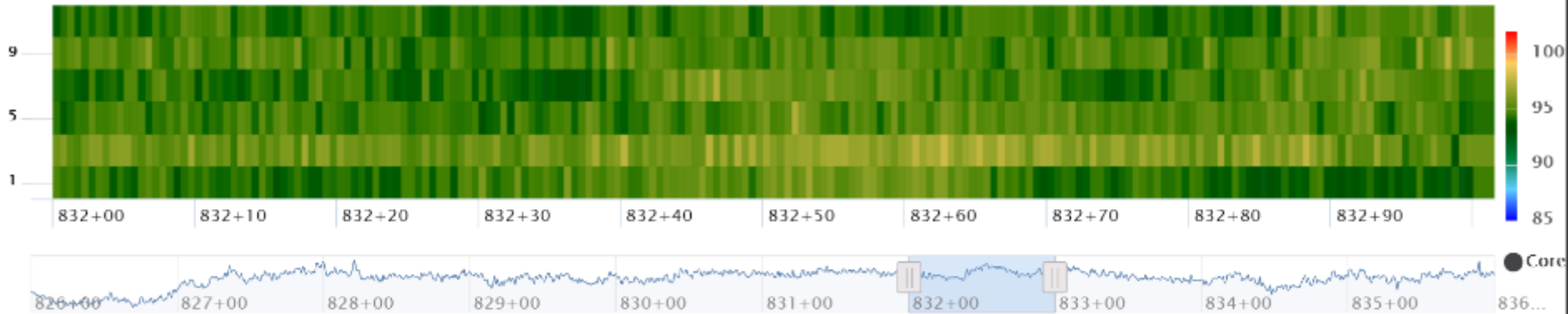
Area Defect Locations:					
Starting Station	Start Distance (ft)	Ending Station	End Distance (ft)	Start Offset (ft)	End Offset (ft)
1268	90.75	1270	27.25	2	6
1326	76.75	1327	0.25	2	6
1268	83.75	1268	87.75	4	2
1326	65.75	1326	74.75	4	2
1239	33.75	1239	38.25	2	6
1269	36.25	1269	39.75	2	6
1311	51.25	1311	53.25	2	6
1326	71.75	1326	76.25	2	6
1235	55.25	1235	62.75	6	4
1243	77.75	1243	84.75	6	4

Good Compaction - Station 832

Heatmap + Histogram

Heatmap + Linechart

Linechart + Histogram



Home icon
Main Menu

Bar chart icon
Statistics

Globe icon
Core Locations

Export icon
Export

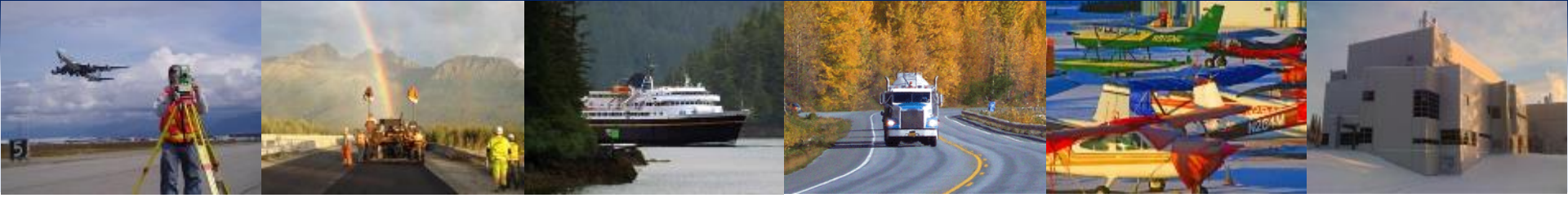
List icon
Display Options

Back icon
Back



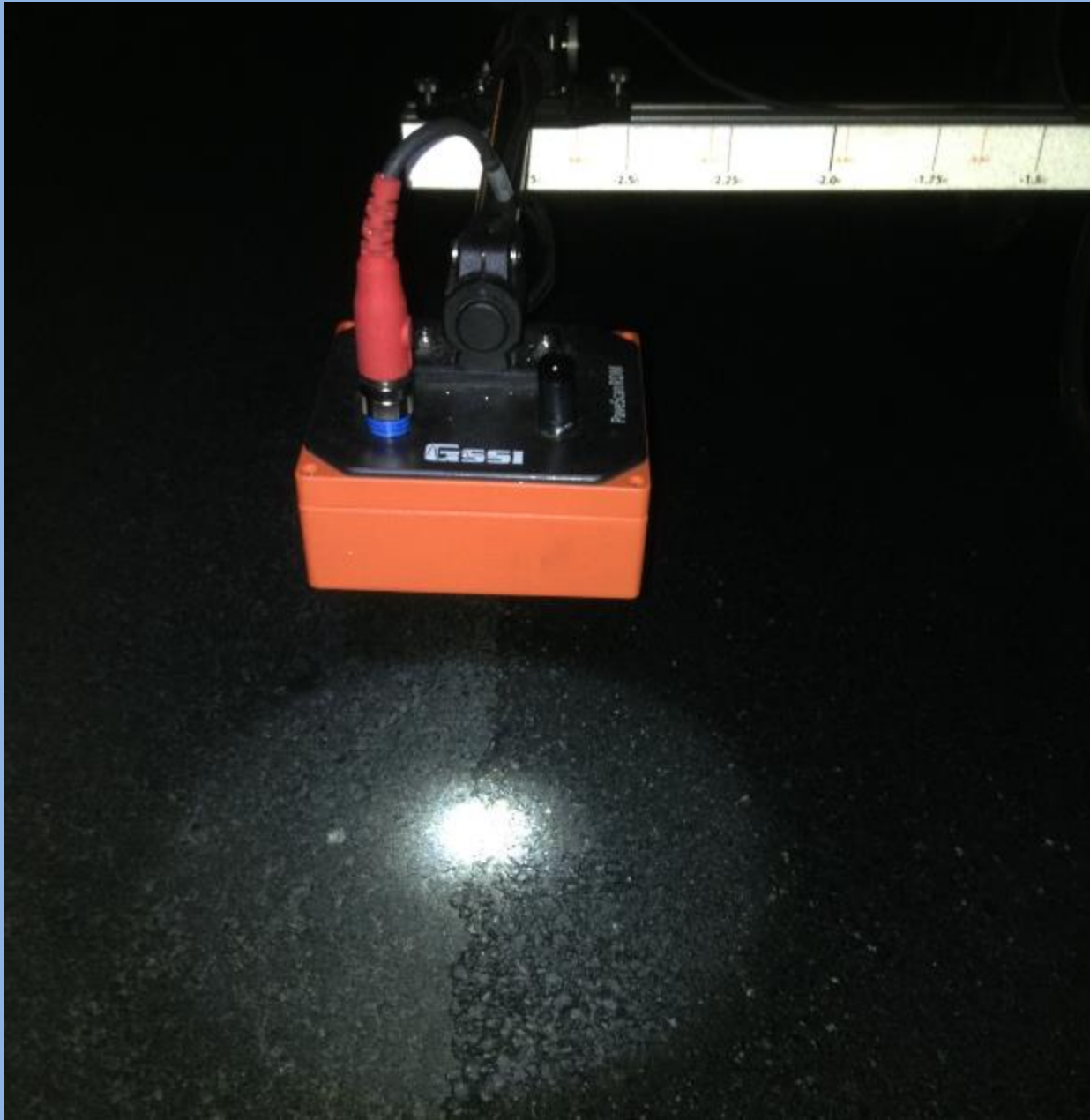
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Any Questions on Mat
Compaction Incentives?



2. Joint Compaction Incentives

Keeping Antenna Centered on Joint



Longitudinal Joint Bonus determined by ...

A. Compaction Level

B. % Conforming

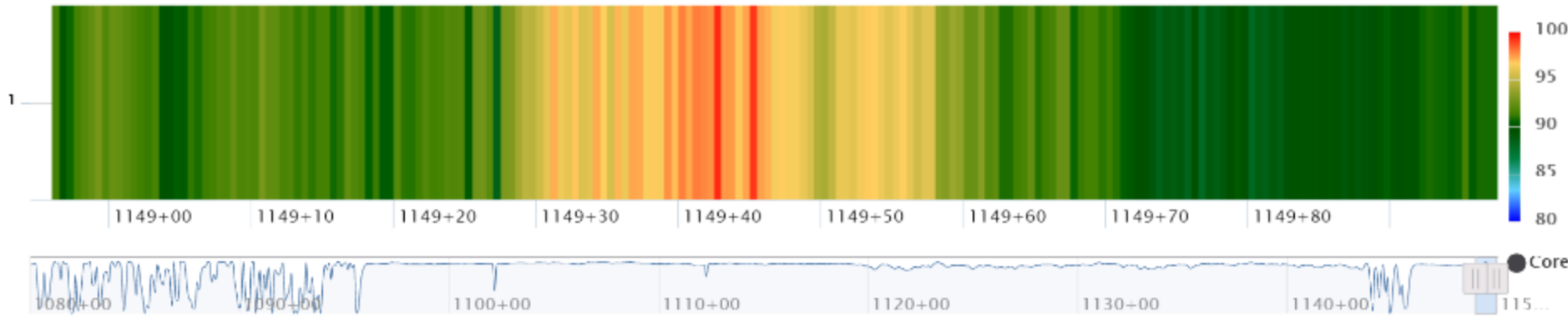
C. Both A & B

Joint Compaction Station 1149

Heatmap + Histogram

Heatmap + Linechart

Linechart + Histogram



 Main Menu

 Statistics

 Core Locations

 Export

 Display Options

 Back

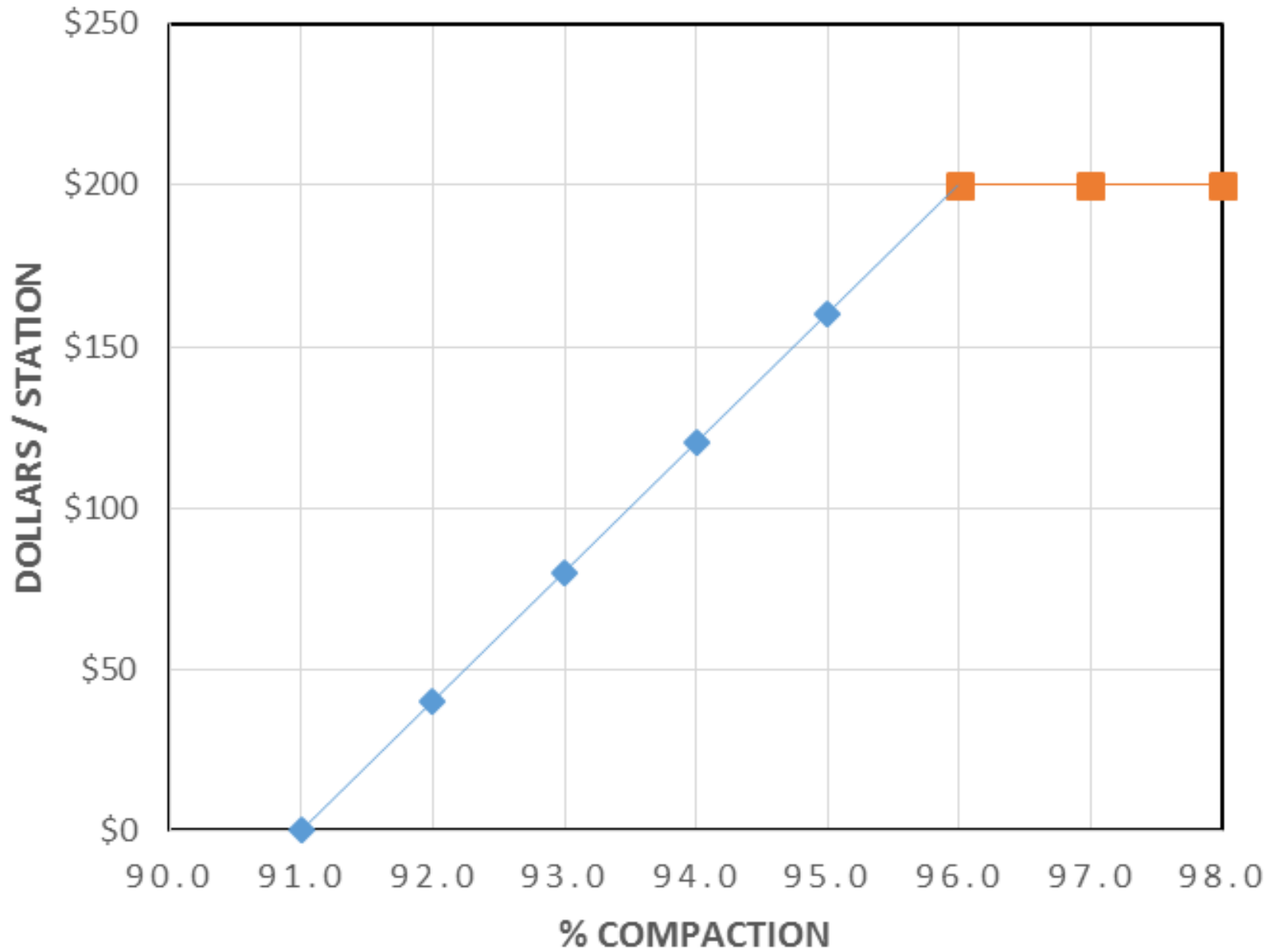
Incentive / Disincentive Rewards Compaction Level & Consistency

Compaction Factor (A): $A = \text{IF}(D < 91, 0, \text{MIN}(40 * (D - 91), 200))$

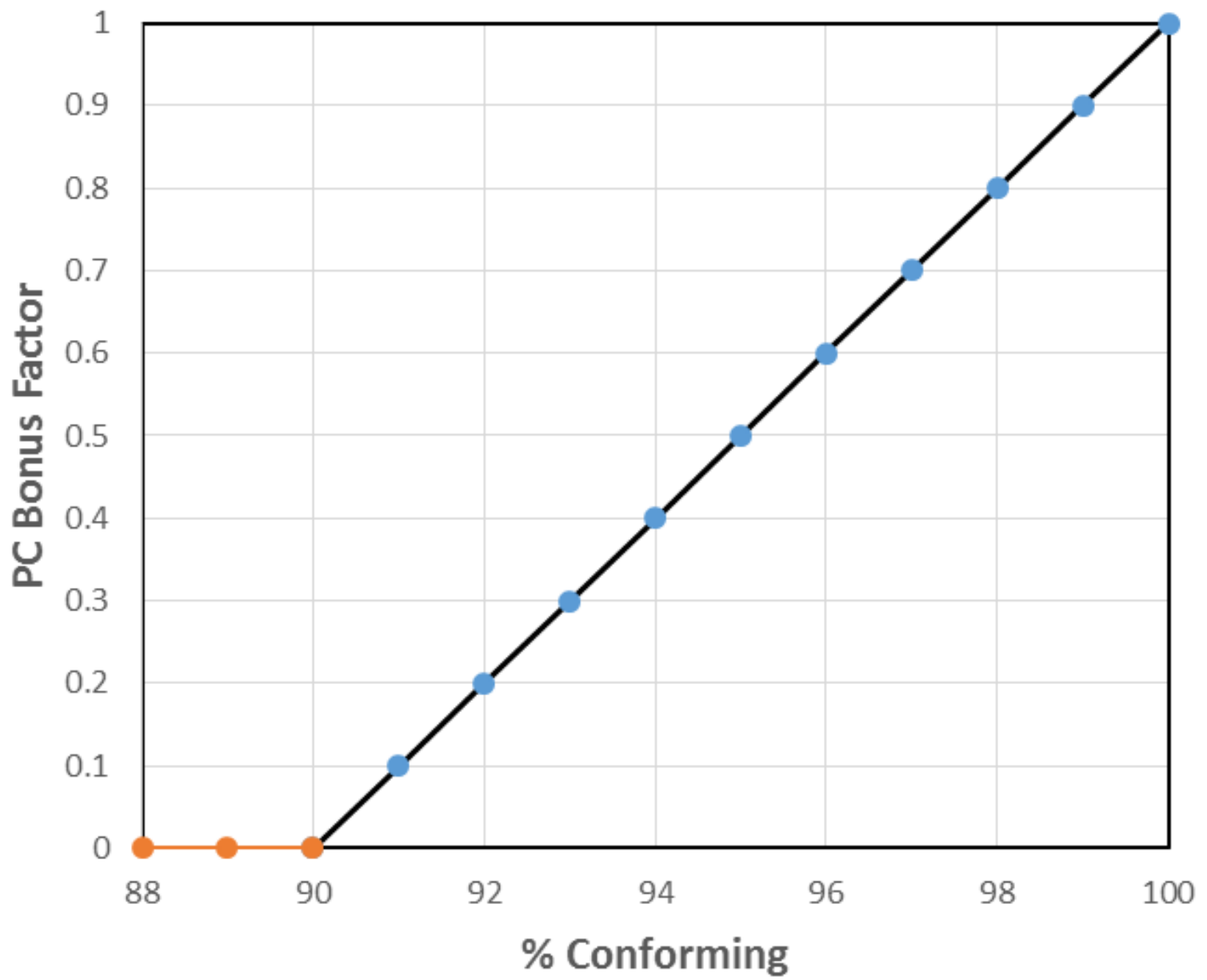
% Conforming Factor (B): $B = \text{MAX}(10 * (PC - 90), 0)$

Joint Bonus (JB): $JB = A * B$

COMPACTION FACTOR



% Conformance Factor



		Joint Bonus = AxB		
Example:		Enter Data		
		Below		
Ave. compaction =	96	A =	200	
% Conforming =	98	B =	0.8	
	JB (Joint Bonus in \$ / Station) =		\$ 160	

Longitudinal Joints in Asphalt Paving				Agency Joint Incentive / Disincentive Parameters:						
Project:	GHHE-HMA-SB-L2-12R-24R			Maximum Joint Bonus / 100 feet:	\$200					
Segment Stations:	1096-1227			Minimum Compaction level:	91					
PaveScan Project Joint Settings:				Target Compaction level:	96					
Measurement Output Interval (ft):	0.5			Minimum % Conformance level:	90					
Measurement Moving Average (ft):	0.5			Target % Conformance level:	100					
Defect Threshold Value:	91			<90% Conforming = Joint Sealant Required						
Defect Linear Distance Threshold (ft):	4			Agency Equations derived from parameters listed above:						
Calculations from PaveScan Data & Agency Parameters:										
Compaction Pay Factor (A):		A=IF(D<91,0,MIN(40*(D-91),200))				where: D=Ave % Compaction/Station				
PC Pay Factor (B):		B=MAX(0.1*(PC-90),0)				where: PC=Percent Conforming/Station				
Joint Bonus (JB):		JB=AxB								
Collected: 6-8-2017	(D)	A	(PC)	B	JB=AxB					
Station	Segment Length (ft)	% Comp. Average	Compaction Pay Factor	Percent Conforming	PC Pay Factor	Joint Bonus	Sealant Required?	% Compaction (Gmb/Gmm)		
								Average	Minimum	Maximum
1096	100	94.9	154	100.0	1.000	\$154	-	94.86	93.38	97.39
1097	100	95.9	195	100.0	1.000	\$195	-	95.88	93.17	98.23
1098	100	93.9	116	100.0	1.000	\$116	-	93.89	91.97	95.97
1099	100	94.3	133	100.0	1.000	\$133	-	94.32	91.97	96.33
1100	100	95.5	180	100.0	1.000	\$180	-	95.5	94.15	97.11
1101	100	95.0	158	100.0	1.000	\$158	-	94.95	92.59	97.06
1102	100	94.6	144	100.0	1.000	\$144	-	94.59	92.95	97.99
1103	100	96.2	200	100.0	1.000	\$200	-	96.17	94.58	97.5
1104	100	96.4	200	100.0	1.000	\$200	-	96.42	93.45	98.1

Glenn Highway, Hiland to Eklutna - Hypothetical Joint Incentive

Using Continuous-Full-Coverage (CFC) data for Calculation of Longitudinal Joint Bonus

800 Stations (15.15 miles) of PaveScan Data analyzed for this example.

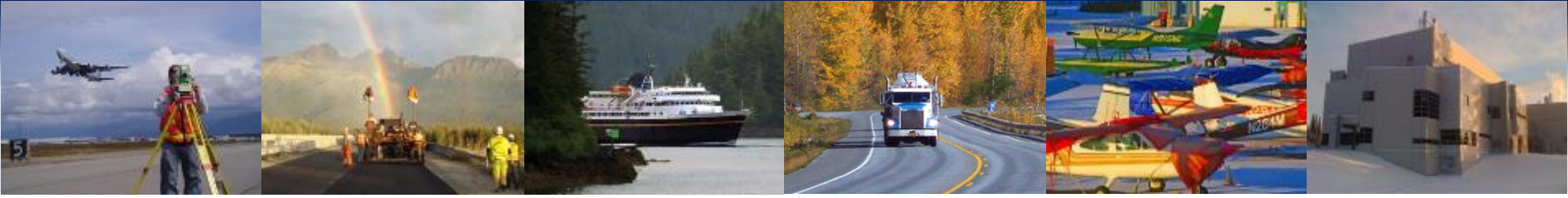
Stations 1326-1227				June 6, 2017	
Stations in this analysis:		100	84.8	Bonus:	\$3,823
Linear feet of Longitudinal Joint:		10,000	Average %	Max Possible:	\$20,000
Compaction readings:		20,000	Conforming	% of Max:	19.1%
		Number of stations receiving bonus payments:)			46
		Number of stations requiring joint sealant:(54
Stations 1227-1096				June 8, 2017	
Stations in this analysis:		132	68.7	Bonus:	\$6,979
Linear feet of Longitudinal Joint:		13,200	Average %	Max Possible:	\$26,400
Compaction readings:		26,400	Conforming	% of Max:	26.4%
		Number of stations receiving bonus payments:)			51
		Number of stations requiring joint sealant:(81

Stations 1096-956			June 9, 2017	
Stations in this analysis:	140	84.5	Bonus:	\$11,649
Linear feet of Longitudinal Joint:	14,000	Ave. Percent	Max Possible:	\$28,000
Compaction readings:	28,000	Conforming	% of Max:	41.6%
Number of stations receiving bonus payments:)				84
Number of stations requiring joint sealant:(56

Stations 955-528			June 10-15, 2017	
Stations in this analysis:	428	79.4	Bonus:	\$31,812
Linear feet of Longitudinal Joint:	42,800	Ave. Percent	Max Possible:	\$85,600
Compaction readings:	85,600	Conforming	% of Max:	37.2%
Number of stations receiving bonus payments:)				215
Number of stations requiring joint sealant:(213

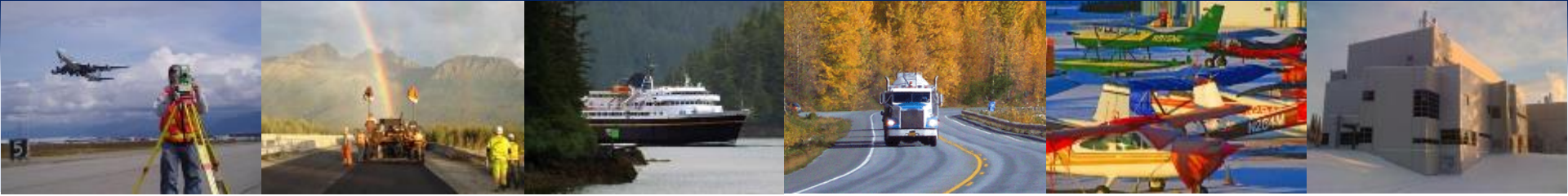
Southbound Joint Bonus Totals:

Stations 1326-528			June 6-15, 2017	
Stations in this analysis:	800	79.2	Bonus:	\$54,262
Linear feet of Longitudinal Joint:	80,000	Average %	Max Possible:	\$160,000
Compaction readings:	160,000	Conforming	% of Max:	33.9%
Number of stations receiving bonus payments:)				396
Number of stations requiring joint sealant:(404



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Any Questions on Joint
Compaction Incentives?



3. Perfecting Longitudinal Joints

Cost of Cutting vs. Joint Heater

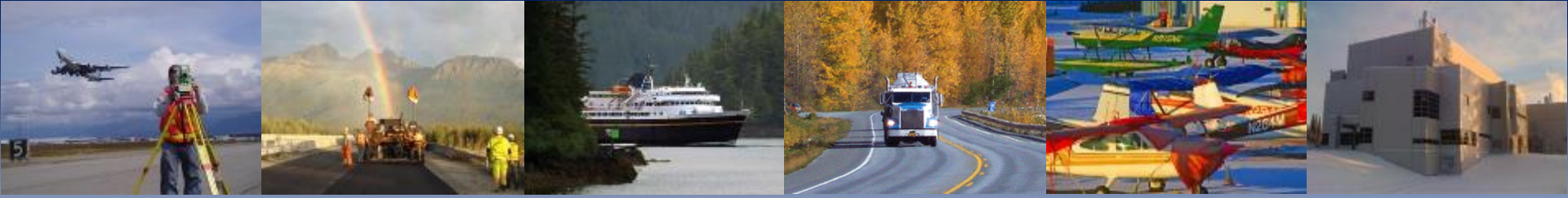
EQUIPMENT AND COST TO RUN



- Heat Design Equipment: JMH 500-PA 500,000 BTU Joint Heater
- Runs off liquid propane – 1 to 2 tanks per shift in Petersburg (low setting)

Cost Comparison per meter Cutting/Milling vs. Joint Heater

Cutting	Cutting	Joint Heater
Labor plus Joint Adhesive	Waste Asphalt (Agency)	Propane
\$2.79	\$2.95	\$0.39



Notch Wedge Joint

- Superior Joint and **NO** wasted asphalt

479-8146



WILLOW  **DESIGNS**
Innovative Paving Products

Made in America
717-919-9828

CAT 3-60



Made in America

**WILLOW
DESIGNS**
Innovative Paving Products
East Northport, PA

LEFT SIDE PULL







Notch Wedge Joint – Bottom Lift

- Notch 40% of compacted mat thickness
- Edge (thinnest part of wedge) no less than Max Nominal Aggregate size
- Compact wedge w notch wedge pneumatic roller
- Adjust Roller to cut the mainline mat by $\frac{1}{2}$ " to $1 \frac{1}{2}$ "
- Roll first pass about 12" to 15" from joint
- On second roller pass shift over to just compact the section skipped on the first pass







Made in America

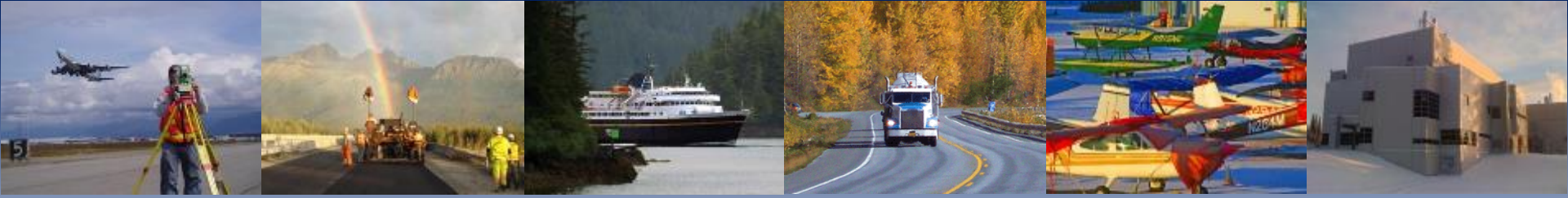
**WILLOW
DESIGNS**

Innovative Paving Products

East Berlin, PA

LEFT SIDE PULL





Notch Wedge Joint – Top Lift

- Apply tack coat on notch and wedge of joint
- Use Joint heater with top lift to ensure:
 1. Full-depth joint compaction
 2. Excellent joint fusion



Notch Wedge Joint – Top Lift

- Use 0.5” to 2” lap with edge gate
- Match height on the joint
- Roll first pass about 12” to 15” from joint
- Roll second pass with about 6” lap onto cold side





QUESTIONS?

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