



# RUTGERS

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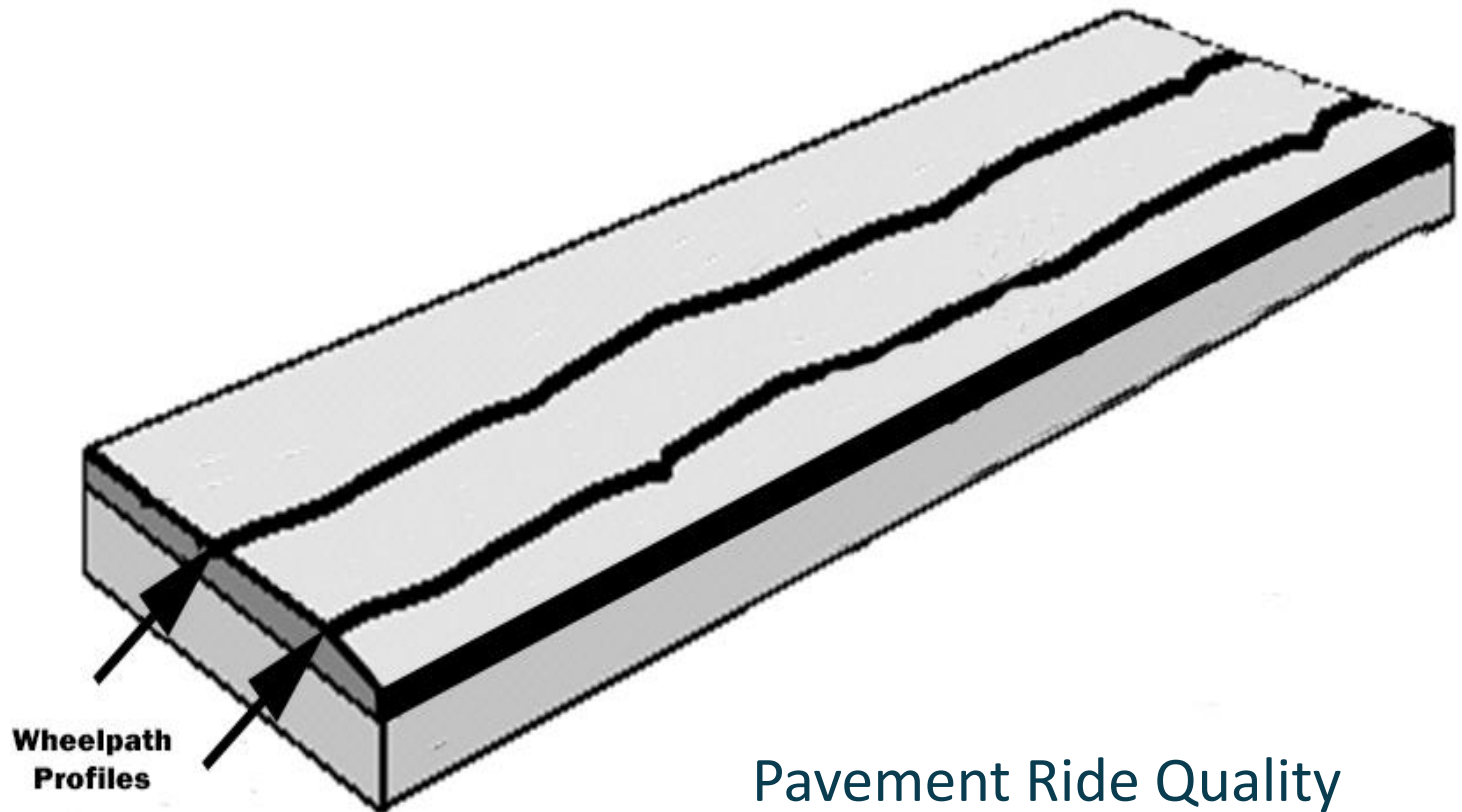
A U.S. Department of Transportation  
University Transportation Center

**Rational Method for  
Developing Ride Quality Pay  
Adjustments from PMS IRI  
Data**

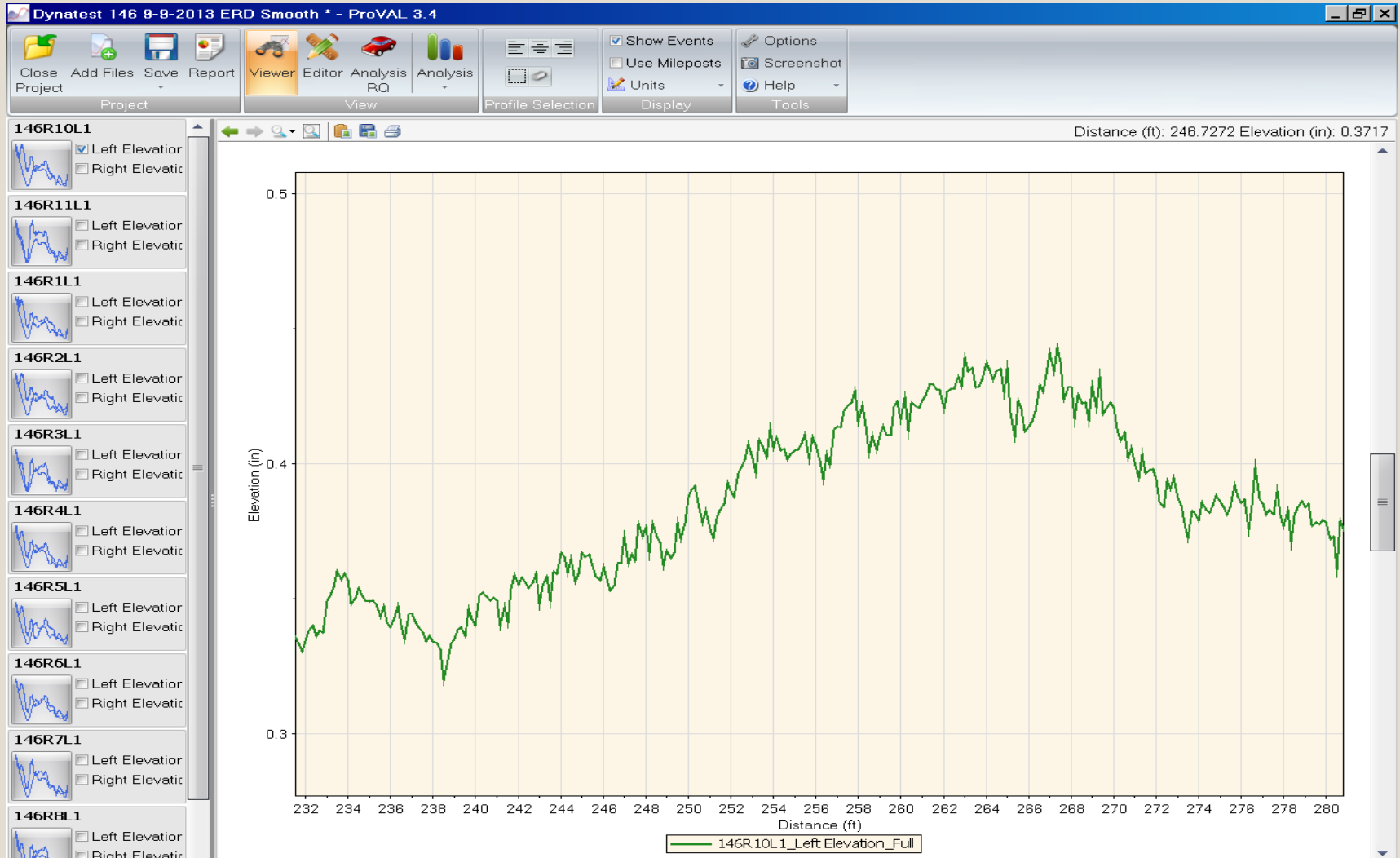
Pavement Resource Program (PRP)

# Wheel Track Profile

Longitudinal Slices of the Pavement Surface

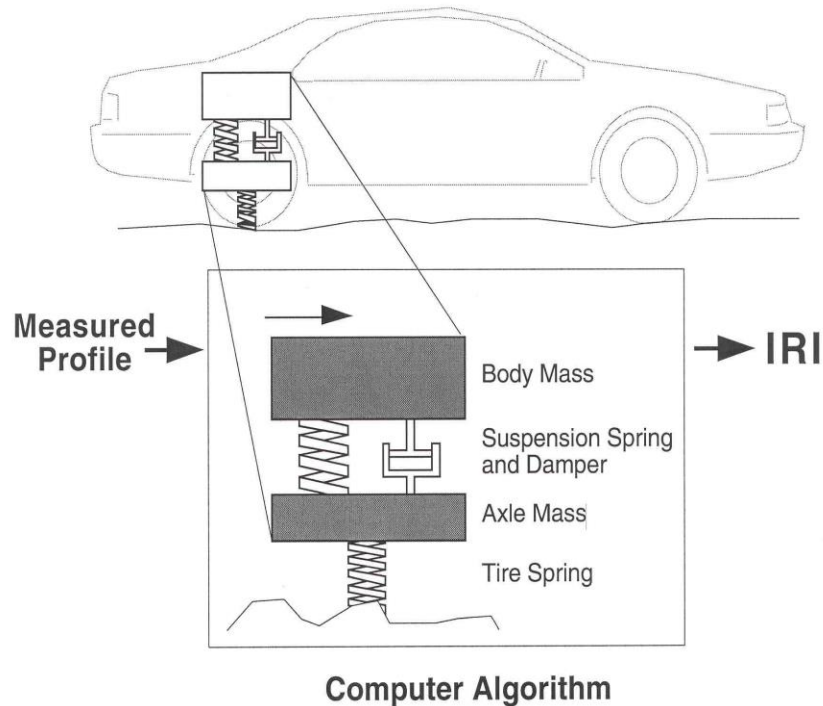


# Pavement Profile



# Pavement Ride Quality Index

## Quarter-Car Simulator



## International Roughness Index

IRI in in/mile

ProVAL 3.4

IRI is a summary of the vertical movement of a vehicle caused by the pavement profile over a given distance.

# ***Portable Profilers***

## **Dynatest Portable Profile**

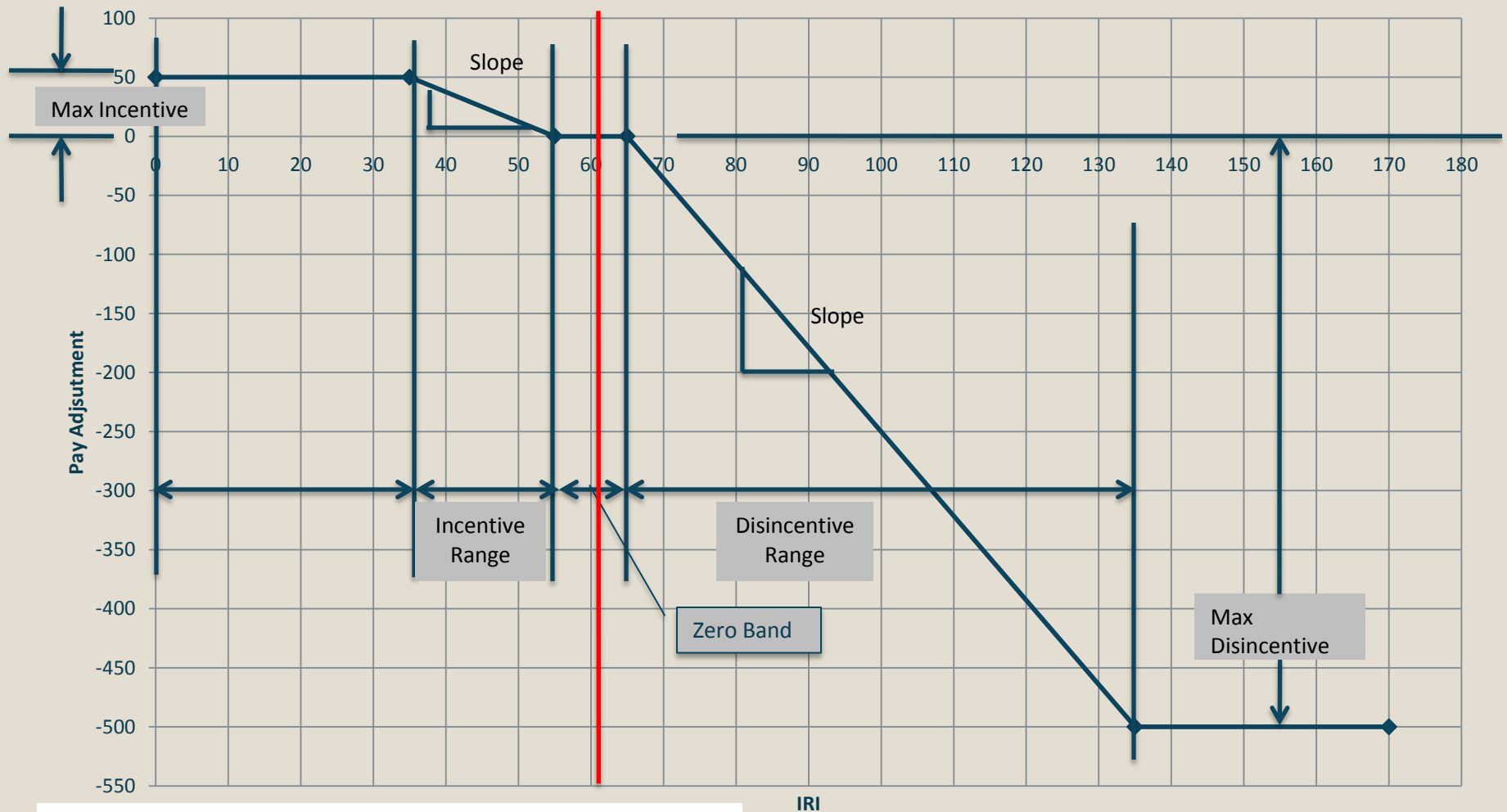


# *Background*

- Current ride quality specification was developed for construction pavement lots equal to a day's production.
- Pavement sublots of 0.01 mile (52.8 feet) in each lane are used to assess the smoothness acceptance.
- The current specification includes an incentive (bonus) range, a zero-pay adjustment range and a disincentive (penalty) range.
- The target IRI for the project is based on the pre-construction pavement IRI levels, impediments such as manholes, inlets, and intersections, and the number of construction opportunities (milling, and pavement layers) the contractor has to achieve acceptable ride quality.

# Current Ride Quality Specification

## Current Pay Adjustment



target IRI of 60 inches per mile

# *Current Ride Quality Specification*

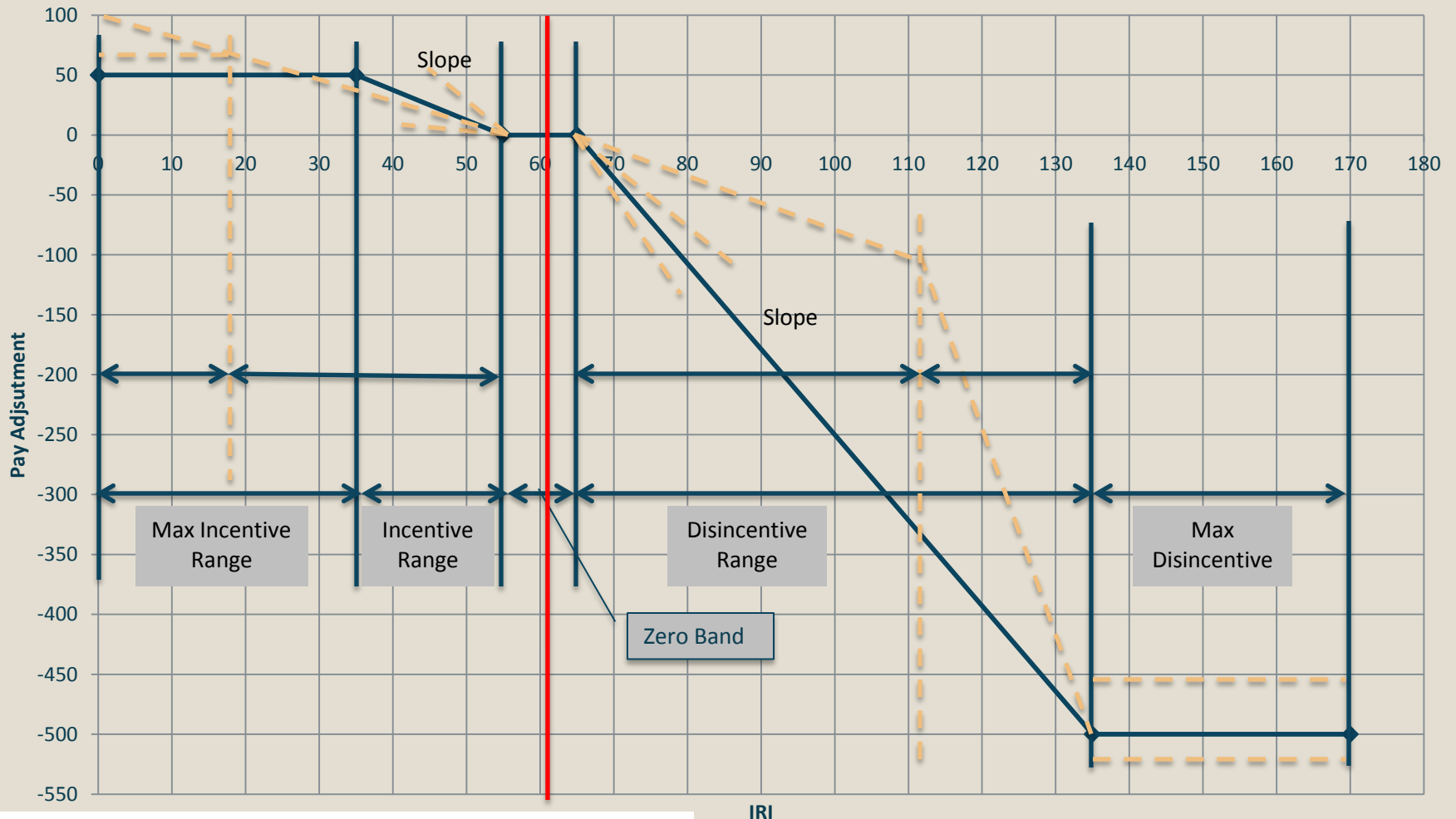
Maximum Incentive Pay Adjustment Level	For $IRI < 35$ , $PA = \$50 *$
Incentive Slope	For $IRI \geq 35$ and $< 55$ , $PA = 55 - IRI * 2.5$
Zero-Pay Adjustment	For $IRI \geq 55$ and $\leq 65$ , $PA = \$0$
Disincentive Slope	For $IRI > 65$ and $\leq 135$ , $PA = (135 - IRI) * (-7.142857)$
Maximum Disincentive Pay Adjustment Level	For $IRI > 135$ , $PA = -\$500$

\* Pavement sublots of 0.01 mile (52.8 feet)



# Current Ride Quality Specification

## Current Pay Adjustment



target IRI of 60 inches per mile

Which adjustment is "BEST"?

# *Research Objectives*

- Developed a rational and defensible methodology for pay adjustment specifications for ride quality assessment on new or rehabilitated pavement surfaces.
- Methodology based on actual IRI data from the NJDOT's Pavement Management System and actual project construction costs.
- Methodology provides basis for pay adjustments for project incentive (bonus), disincentive (penalty) and zero-incentives.

# *Questions Needing Answers*

- What is the pavement IRI failure level? **170 in/mi**
- How long does a pavement treatment last when constructed at the Target IRI level?
- How long does a pavement treatment last when constructed at an IRI level that is smoother or rougher than the project target IRI level?
- What is the basis for a pay incentive and disincentive for the ride quality pay factor?

# ***PMS Database and Construction Records***

- Mill 2 inches overlay 2 inches treatment
- Initial construction IRI data from the PMS for projects from 1999 to present
- Dataset of 0.1 mile sections was subdivided into groups that have initial IRI ranging from 30 to 130 inches per mile in ten unit increments, (e.g., 30 to 40, 40 to 50, etc.).
- Annual data for these sections were used to determine the change in IRI over the years since the pavement was initially constructed

## Summary of the Average IRI Values for Each IRI Range and Age

Age	30-40	40-50	50-60	60-70	70-80	80-90	90-100	100-110	110-120	120-130	130-140
2	37	45	54	65	74	84	95	104	114	124	130
3	38	48	59	71	78	89	97	109	117	131	128
4	40	49	58	75	81	93	101	111	121	131	134
5	52	59	62	77	87	95	104	115	124	134	132
6	49	58	65	81	87	97	104	115	125	137	145
7	59	64	69	76	88	99	104	117	127	133	147
8	No Data		71	91	100	104	110	120	131	139	161
9	No Data			70	95	104	109	125	138	148	160
10	No Data			78	95	102	112	127	134	148	183
11	No Data				97	107	113	137	141	151	156
12	No Data				102	107	123	146	153	174	169

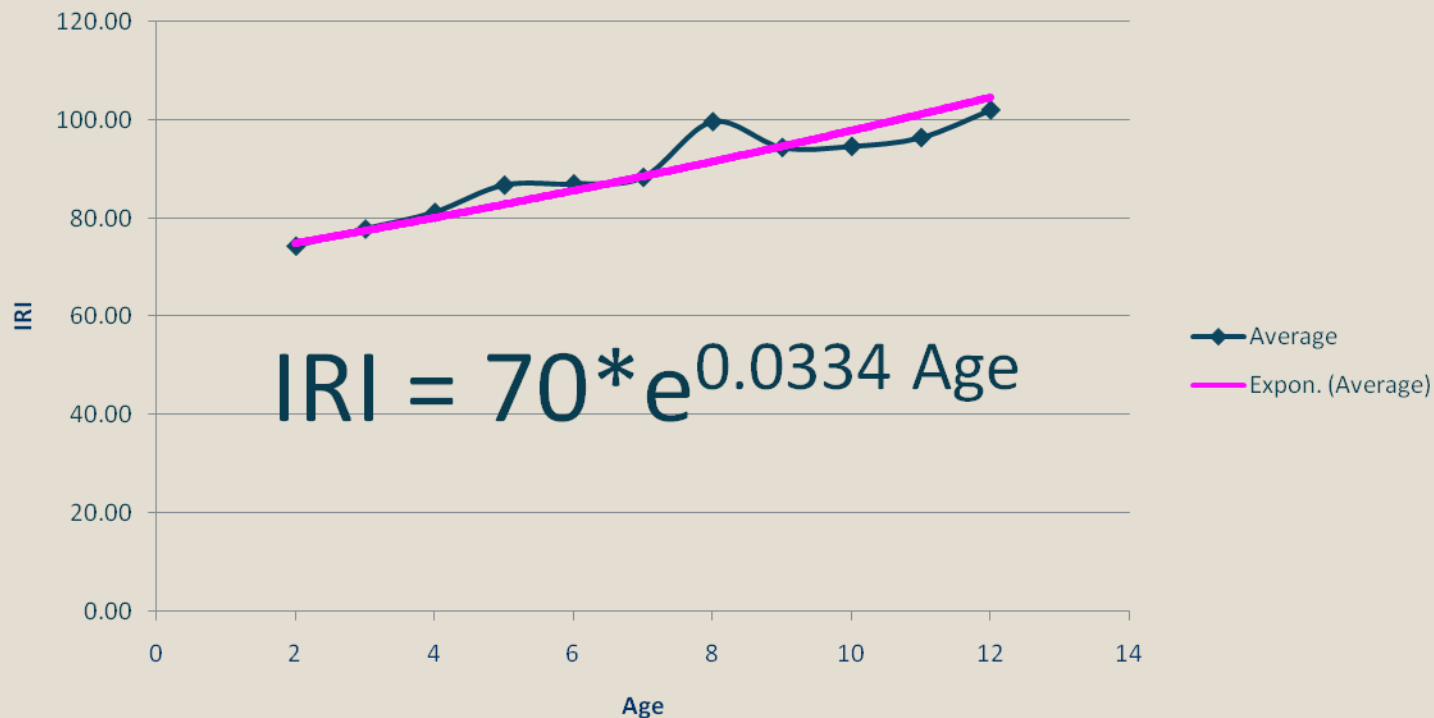
# Average Change in IRI over time

For each range of Initial IRI values:

Initial IRI of 70-80

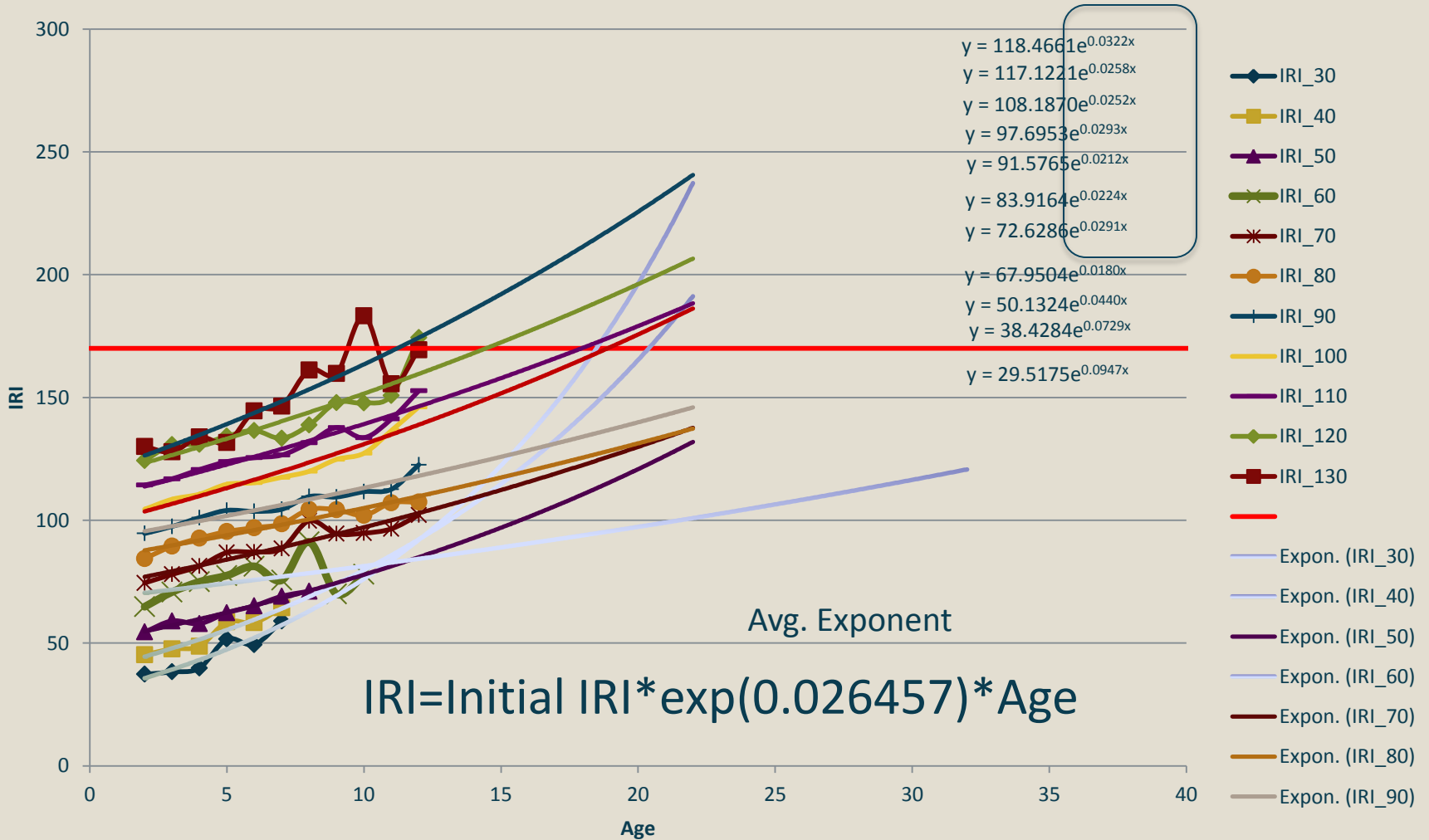
Age	2	3	4	5	6	7	8	9	10	11	12
Avg IRI	74	78	81	86	87	88	99	94	95	96	102

Change in IRI Over Time



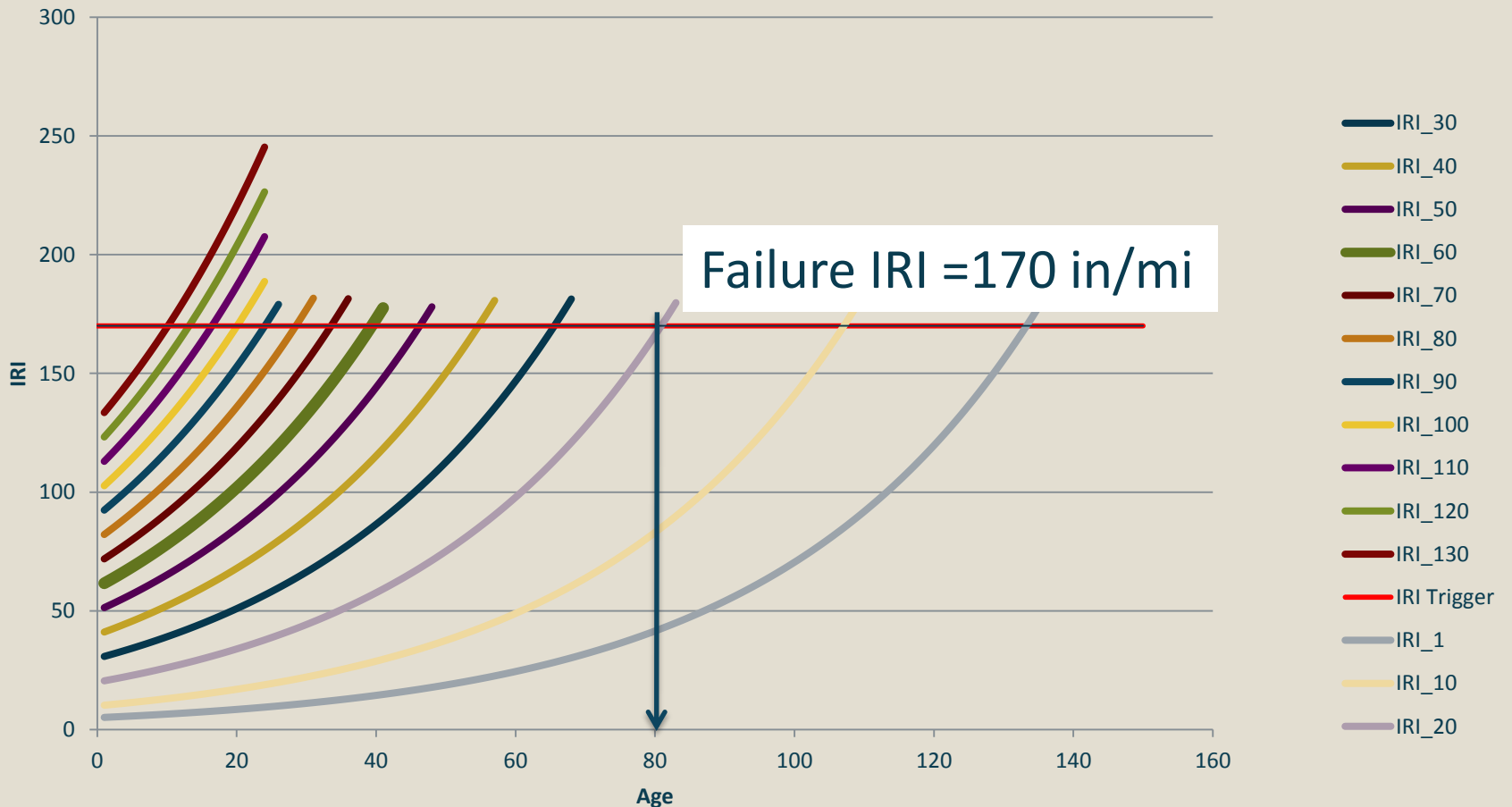
# IRI Performance Based on Initial IRI

IRI Performance Based on Initial IRI



# Normalized Curves for Each Initial IRI

Predicted IRI based on Initial IRI



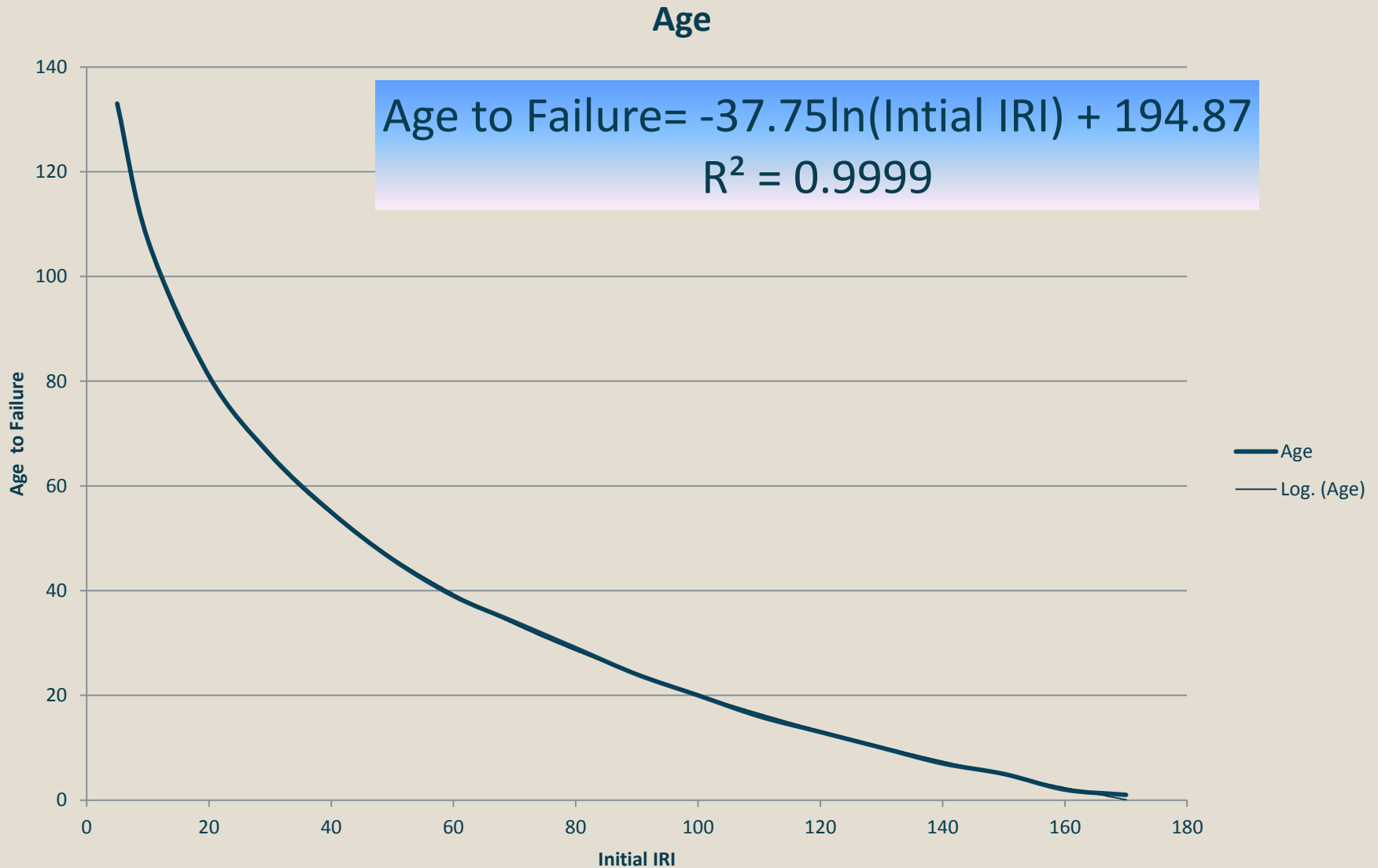


# Normalized IRI Based on Initial IRI

Age	Target	TARGET IRI										
	60	70	80	90	100	110	120	130	140	150	160	170
1	62	72	82	92	103	113	123	133	144	154	164	175
2	63	74	84	95	105	116	127	137	148	158	169	179
3	65	76	87	97	108	119	130	141	152	162	173	184
4	67	78	89	100	111	122	133	145	156	167	178	189
5	68	80	91	103	114	126	137	148	160	171	183	194
6	70	82	94	105	117	129	141	152	164	176	188	199
7	72	84	96	108	120	132	144	156	168	181	193	205
8	74	87	99	111	124	136	148	161	173	185	198	210
9	76	89	102	114	127	140	152	165	178	190	203	216
10	78	91	104	117	130	143	156	169	182	195	208	221
11	80	94	107	120	134	147	161	174	187	201	214	227
12	82	96	110	124	137	151	165	179	192	206	220	234
13	85	99	113	127	141	155	169	183	197	212	226	240
14	87	101	116	130	145	159	174	188	203	217	232	246
15	89	104	119	134	149	164	178	193	208	223	238	253

Continued to 150 years of Age

# Initial IRI vs. Age to Failure Relationship



# Payment Adjustment Relationship Development

For each sublots of 0.01 mile sections (52.8 foot)

## *Treatment Cost*

Treatment Type	Total Project Cost		Total Project Cost
	Per Sq Yd	Per Lane Mile	per Sublot
Minor Asphalt Rehab	<b>\$30.52</b>	<b>\$214,861</b>	<b>\$2,148.61</b>

*Cost per Age to Failure =*

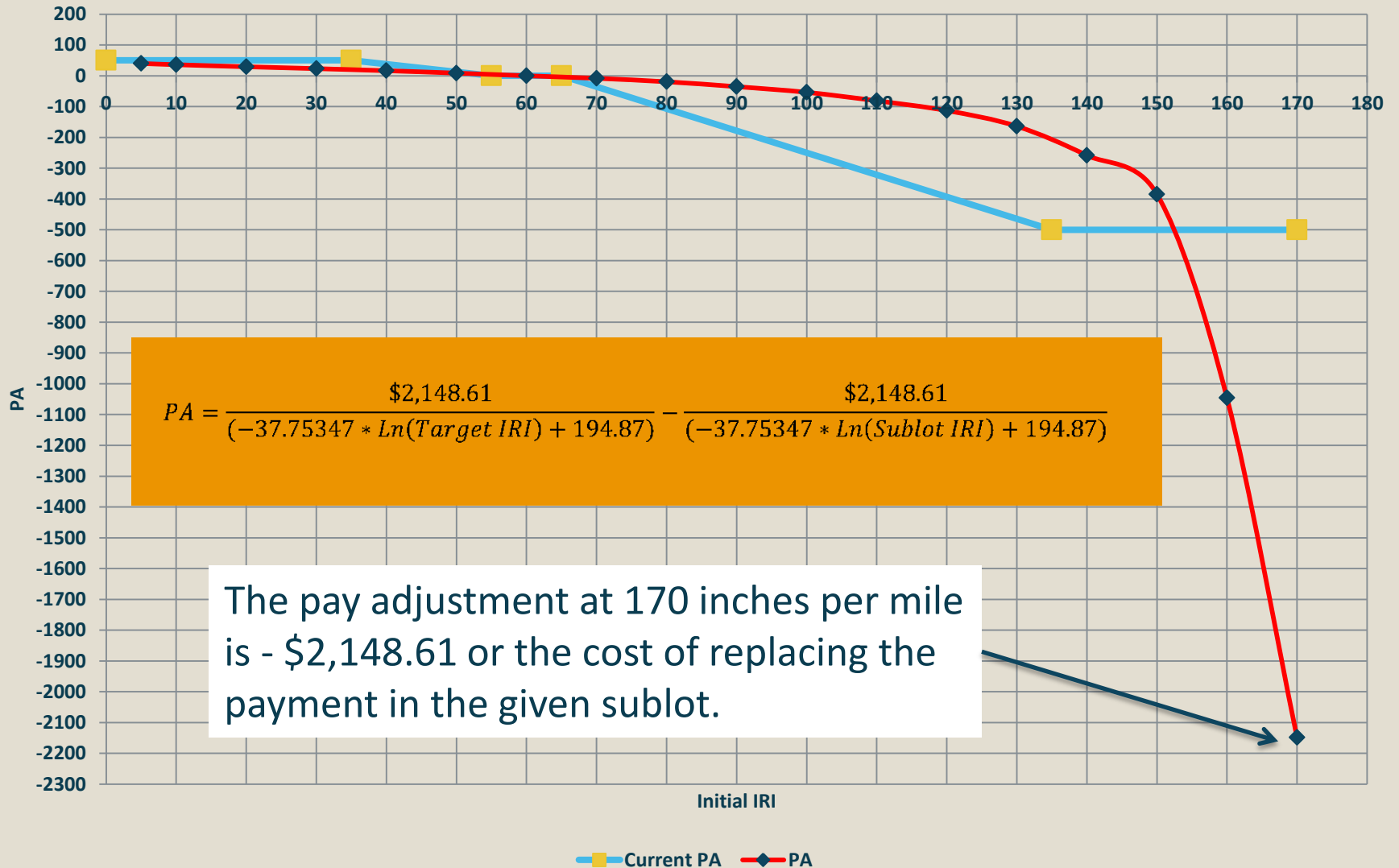
$$\frac{\underline{\$2,148.61}}{\text{Age to Failure}}$$

## *Cost per Age and Pay Adjustment Determination*

Sublot IRI	IRI_40	IRI_60*	IRI_80
Age to Failure	54.71	39.4	28.55
Cost/year	= $\$2148.61/54.71$ \$39.27	\$54.52	= $\$2148.61/28.55$ \$75.26
Pay Adjustment	= $\$54.52-\$39.27$ \$15.25	\$0.00	= $\$54.52-\$75.26$ -\$20.74

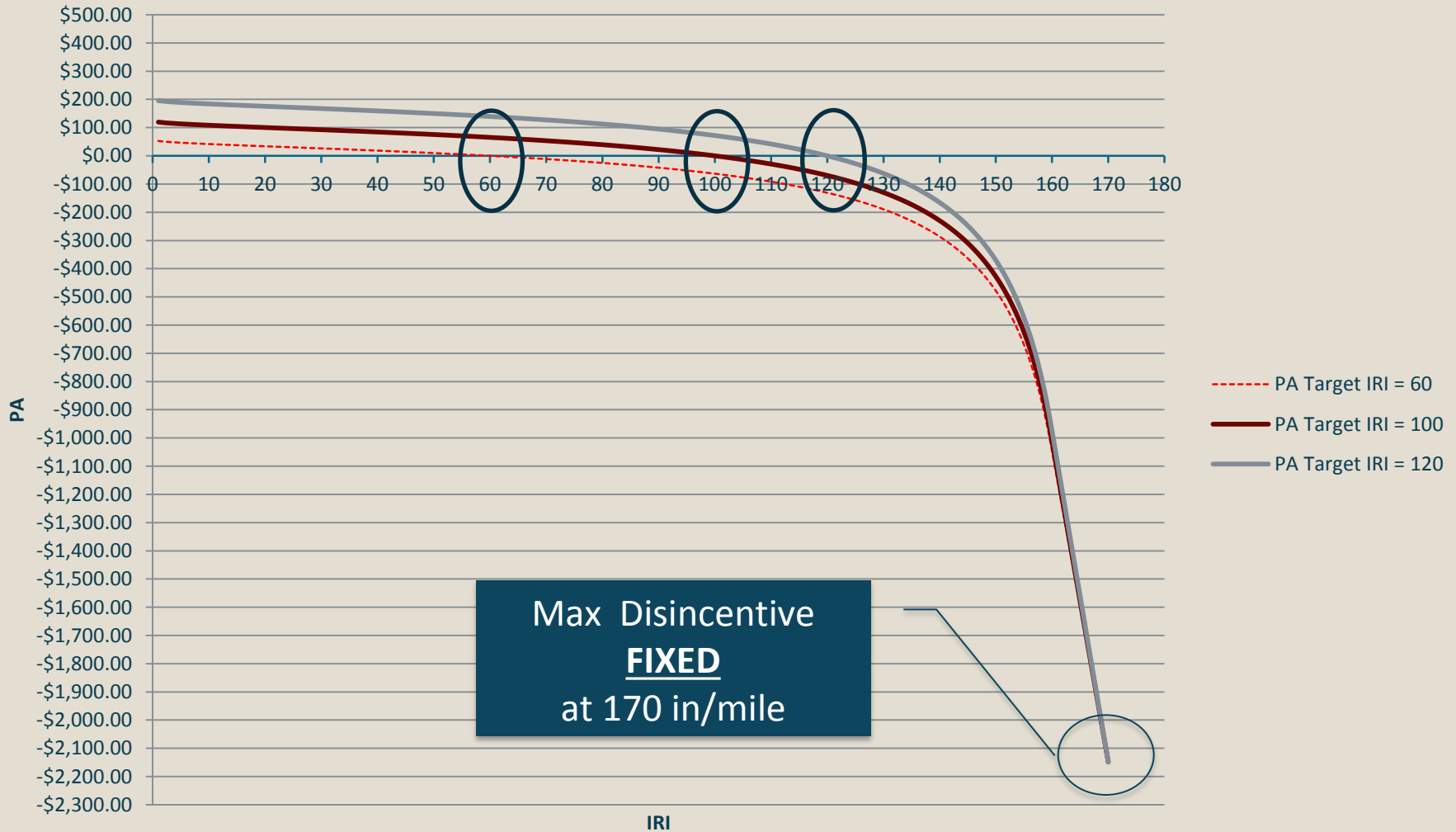
\*Project Target IRI is 60 inches per mile

# Comparison Between the Current RQ specification and the New Rational RQ PA Approach



# Adjustment of PA Curve based on Target IRI

## PA based on Target IRI



# *Questions?*

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