10 Year Performance of FDR with Foamed Asphalt Stabilization

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Outline

- Background
- Advantages of Full Depth Reclamation (FDR) with expanded asphalt (EA)
- Hwy 17, Wawa project
- 10 Year Performance
- Observations and Conclusions

Background

- MTO constructed its first full depth reclamation with expanded (foamed) asphalt stabilization project on the Trans Canada Highway (Highway 17) north of Sault Ste. Marie in the summer of **2001**.
- This presentation highlights the results of **10 years** of performance monitoring.

Project Location

- Highway 17 within the boundaries of Lake Superior Provincial Park.
- Project length 22.5 km.

Why Use Expanded Asphalt Stabilization?

- Need to conserve natural resources
  - No aggregate extraction within park boundaries
  - EAS strengthens the granular base, saves a lift of hot mix asphalt
- In place process reduces transportation of materials
  - Trucking, energy and emissions reduced
- Previous challenging experience in the local area with CIR
  - Moisture-related concerns in cool, damp, foggy microclimate

Existing Pavement Condition

- Originally constructed in 1959 and resurfaced in 1981
- In 2001 the pavement structure consisted of 80mm HMA, 100mm granular base and 530mm of granular subbase.
- PCI of 49 out of 100, poorly performing
- 2010 AADT = 2500 with 28% trucks
- 20 year design ESAL = 2.8 million

Pavement Design

- In-place full depth reclamation of the existing HMA and granular base to a depth of 200 mm (50:50 blend, max size 26.5 mm).
- Stabilize reclaimed material by adding 2.8-3.0% expanded (foamed) asphalt:
  - In this process, a small amount of cold water is added to hot asphalt cement causing it to rapidly expand (foam).
- Grading/placing and compacting
- 80 mm HMA overlay following min. 2 day cure

Construction: August 2001


13007


AUG 13 2001


AUG 13 20


AUG 13 2001


Crossfall
correction

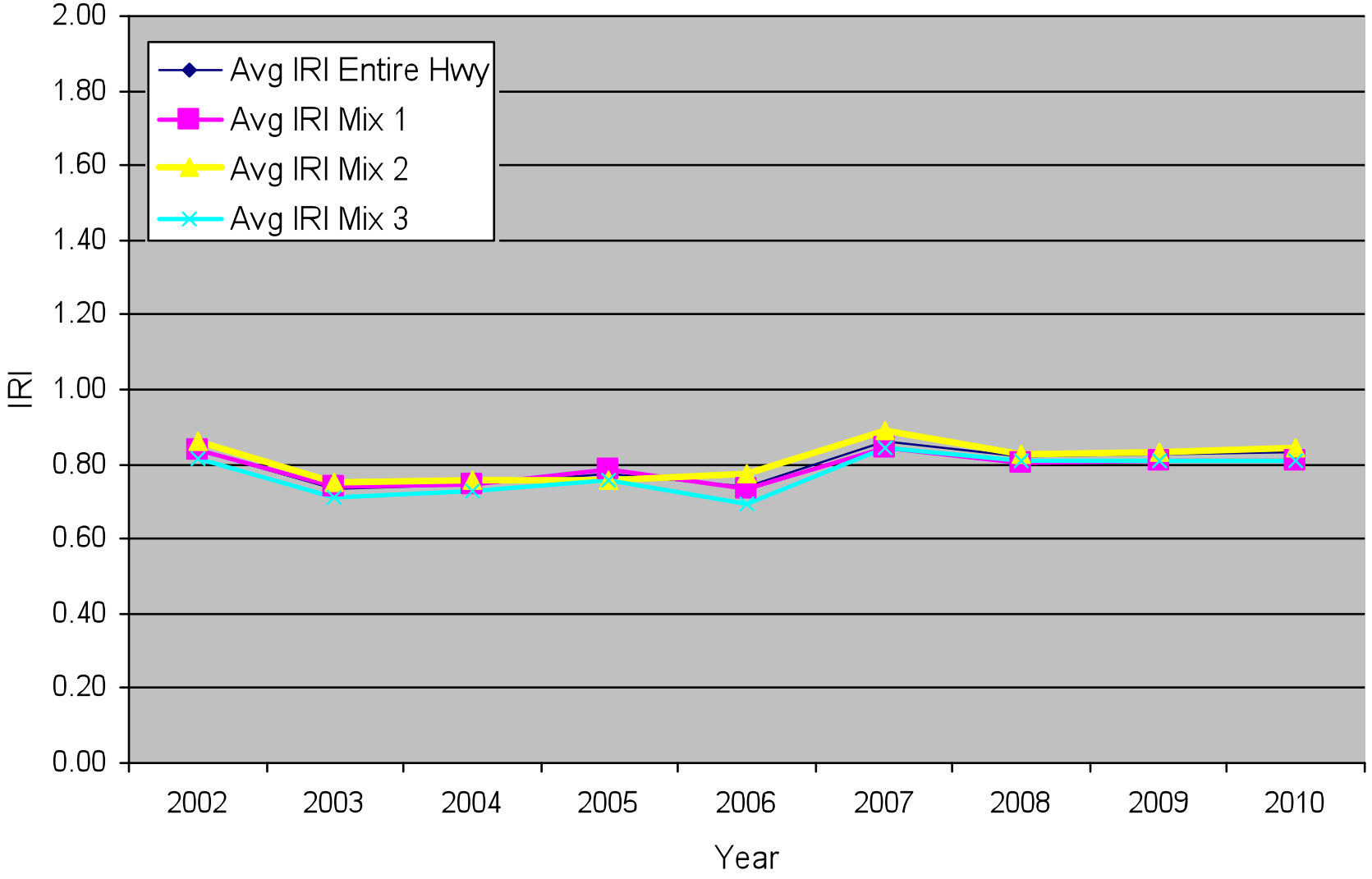
Long Term Performance

ARAN Monitoring

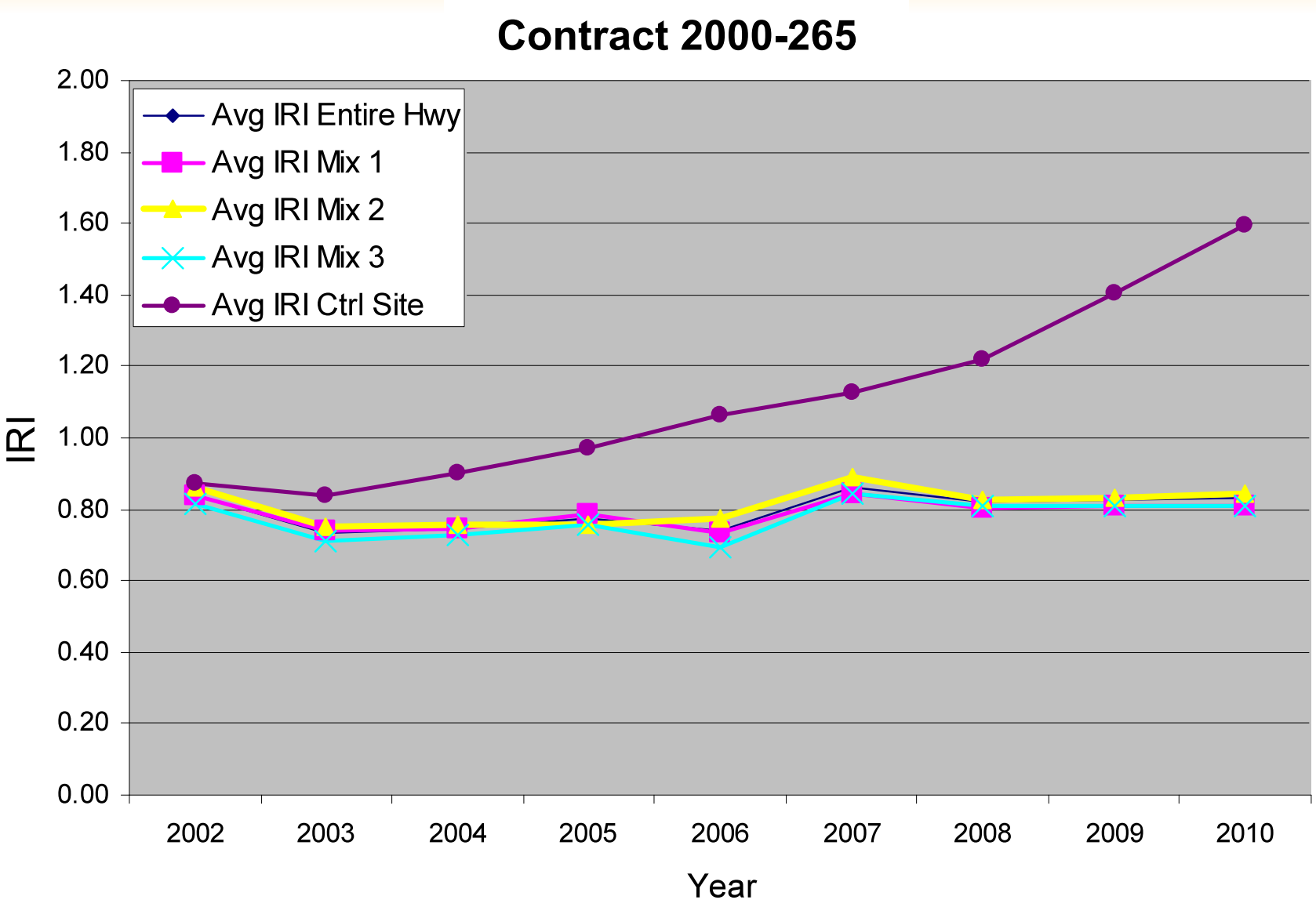
To monitor pavement performance, MTO carried out annual ARAN testing:

- Roughness (IRI) and rutting surveys
- Visual distress data collection (DMI)
- IRI & DMI used to calculate Pavement Condition Index (PCI)

IRI Comparison of Expanded Asphalt Various Mixes
Contract 2000-265



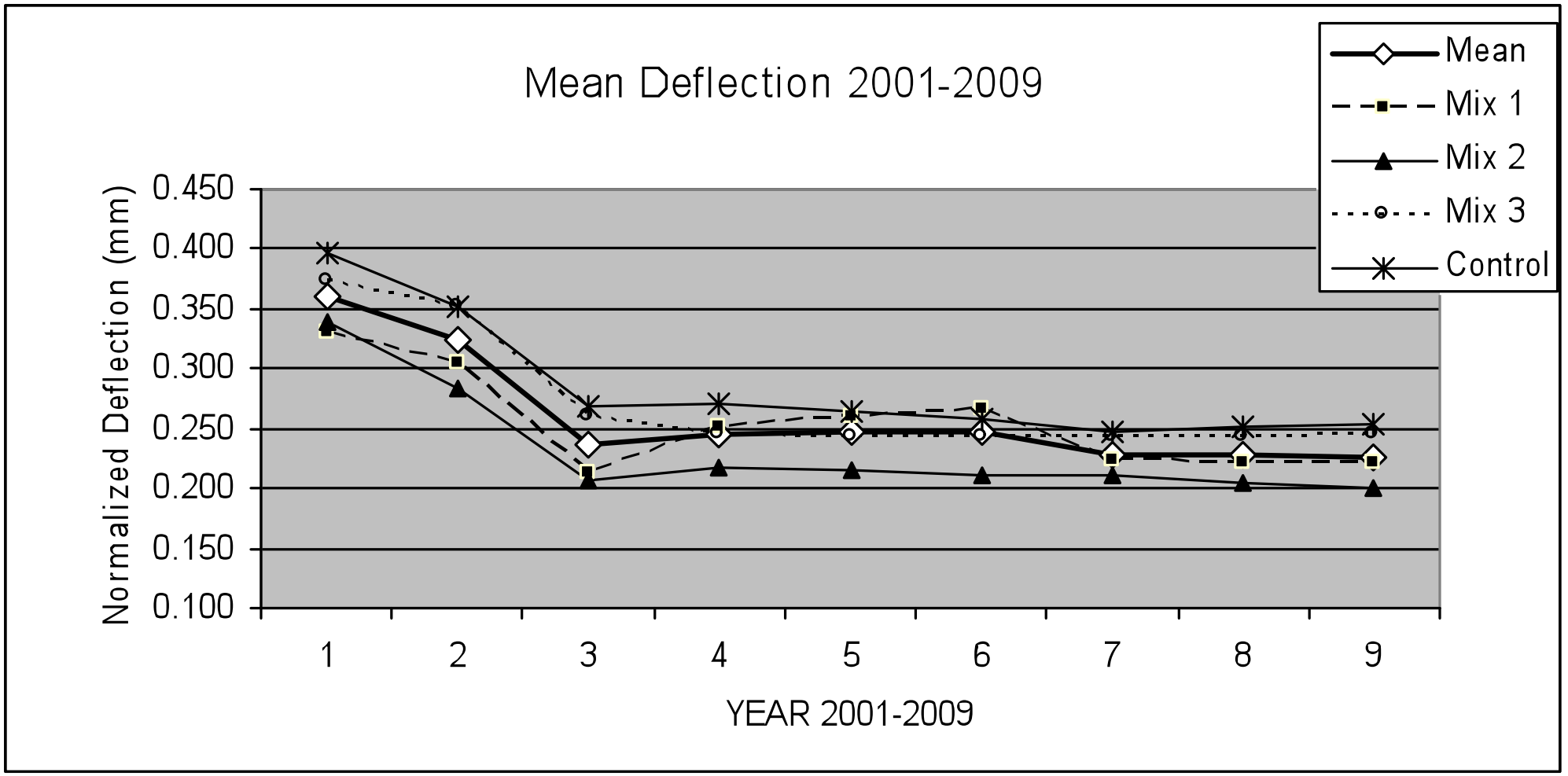
IRI Comparison of Expanded Asphalt Various Mixes

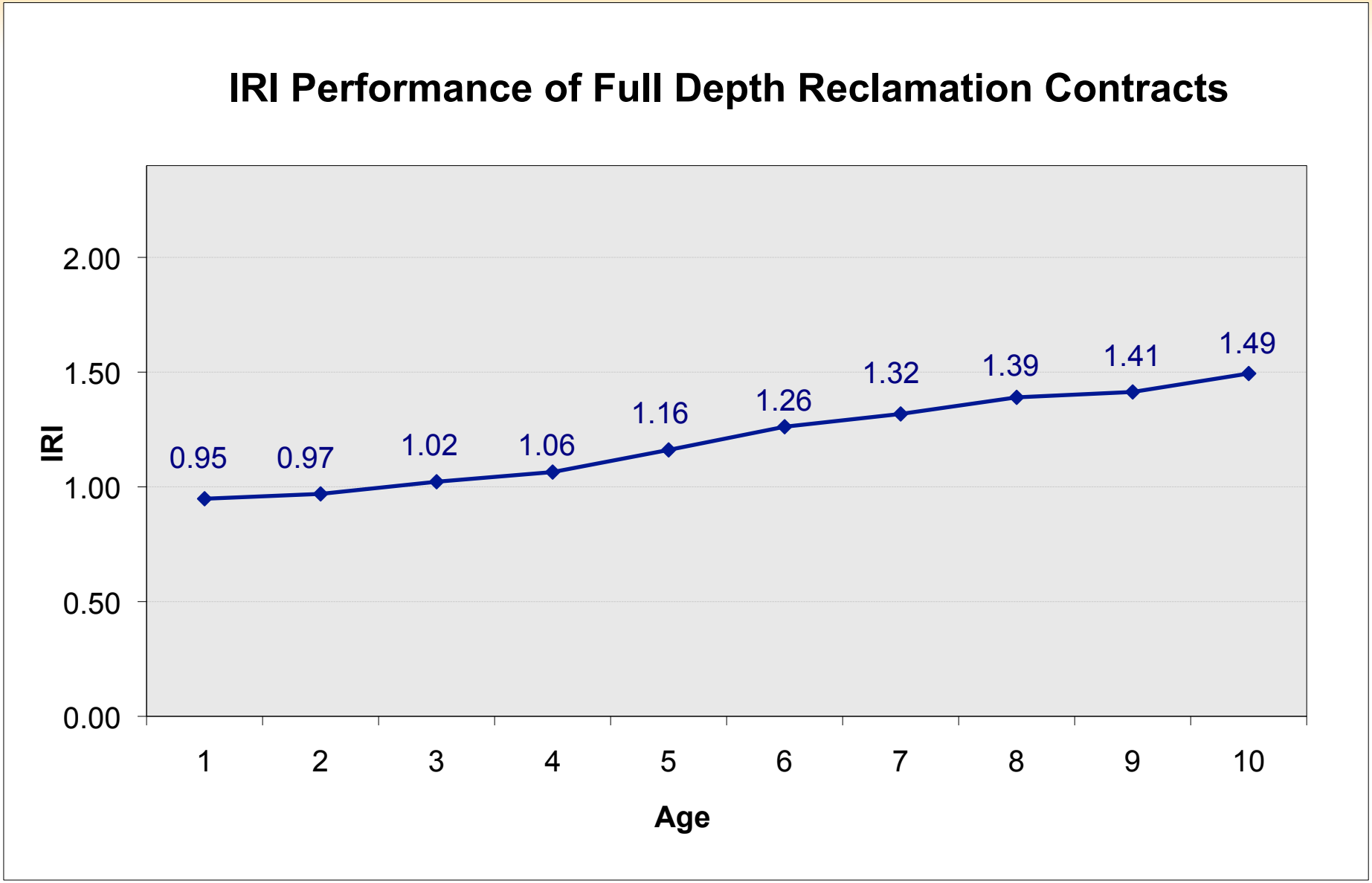


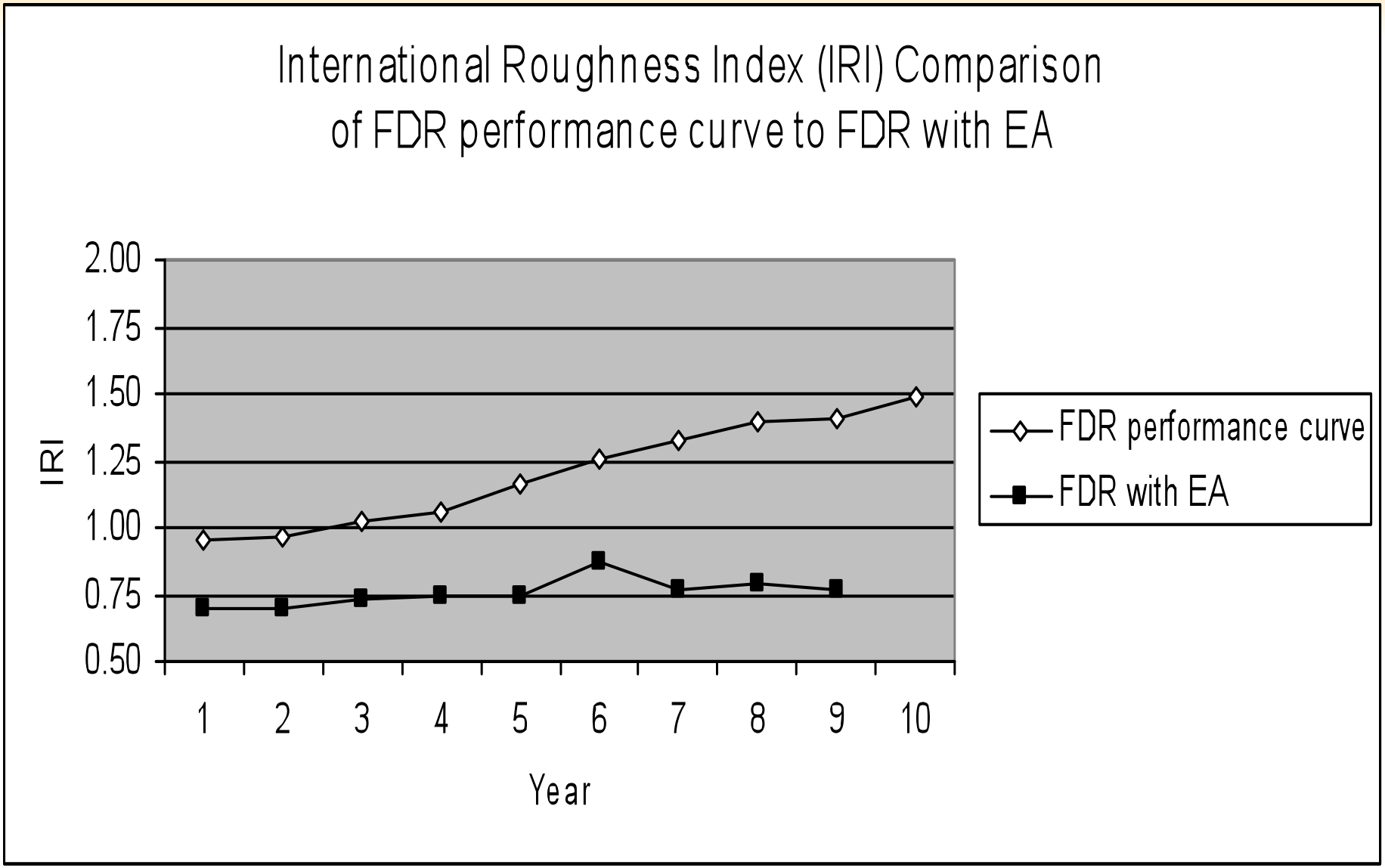
Falling Weight Deflectometer Testing

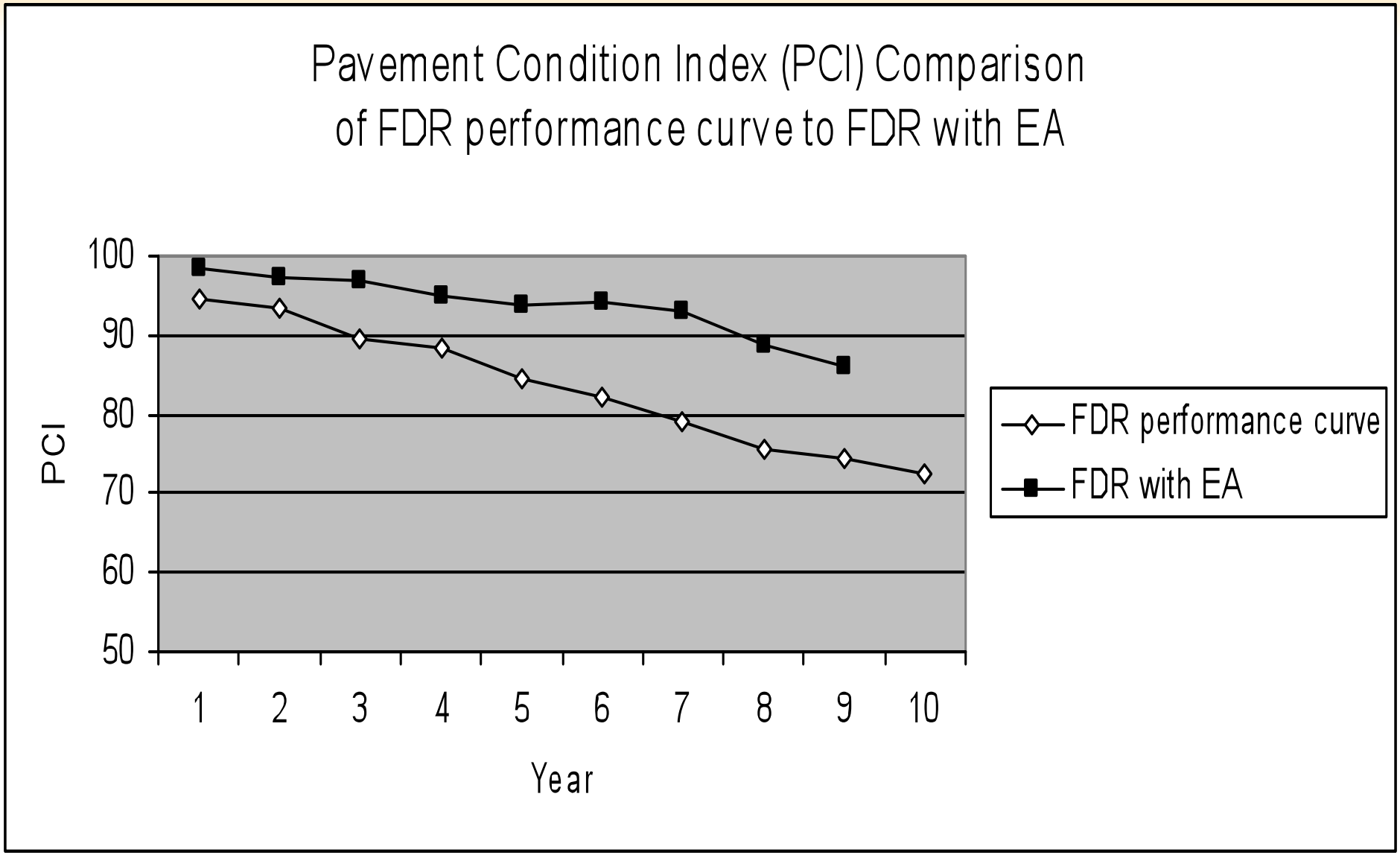
- To measure pavement structural strength, FWD measurements were taken from 2002-2009.
- Over the 9 years, the EA section with corrective aggregate was determined to be the stiffest section with the lowest mean deflection.
- The control section was the least stiff section with the highest mean deflection.
- In 2009, the average normalized deflection obtained from the EAS sections was 0.22 mm, while the average normalized deflection obtained from the 300 m control section was 0.25 mm.
- The backcalculated resilient moduli for the HMA layer was 2672 MPa.
- The backcalculated resilient moduli for the expanded asphalt sections was 1401MPa.

Falling Weight Deflectometer Results

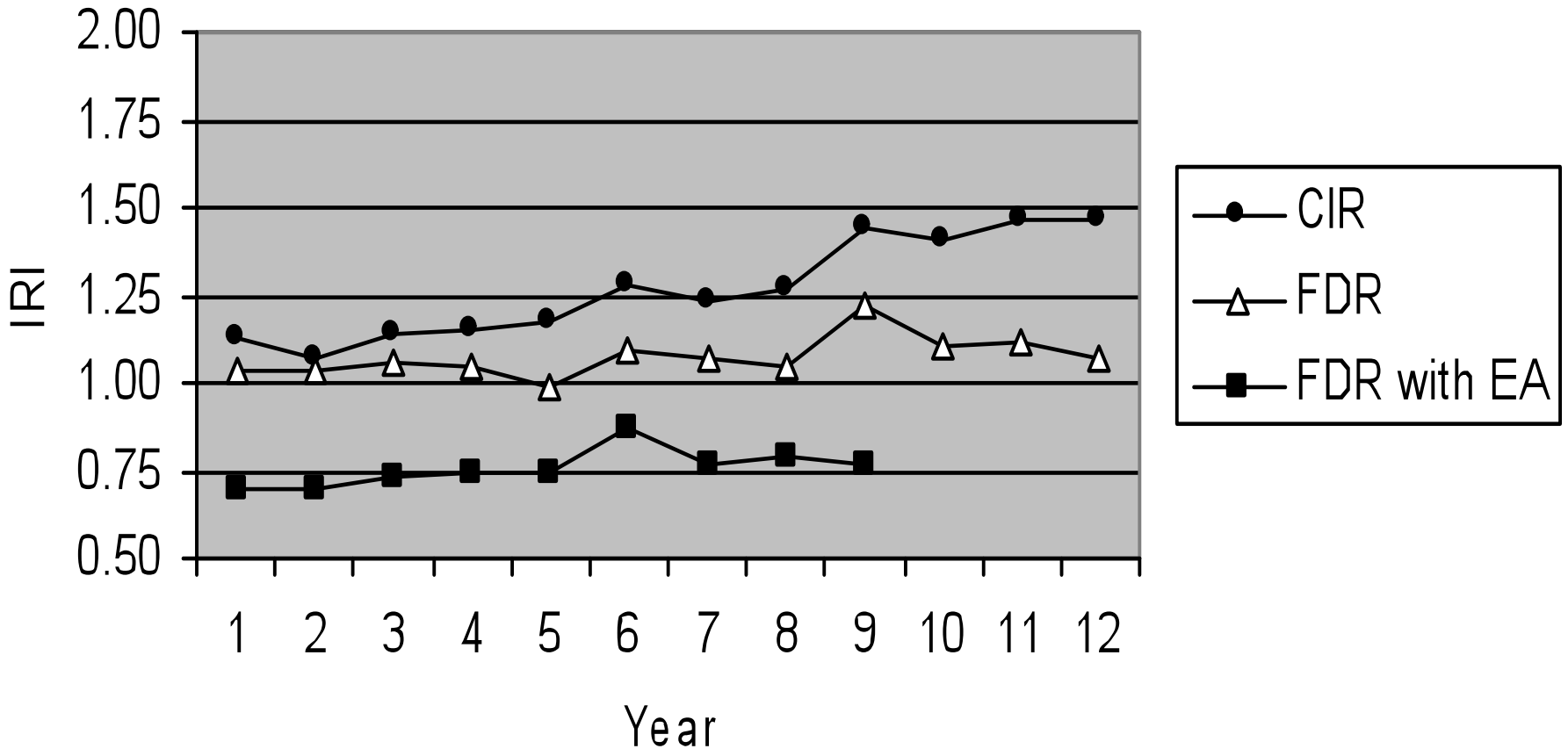


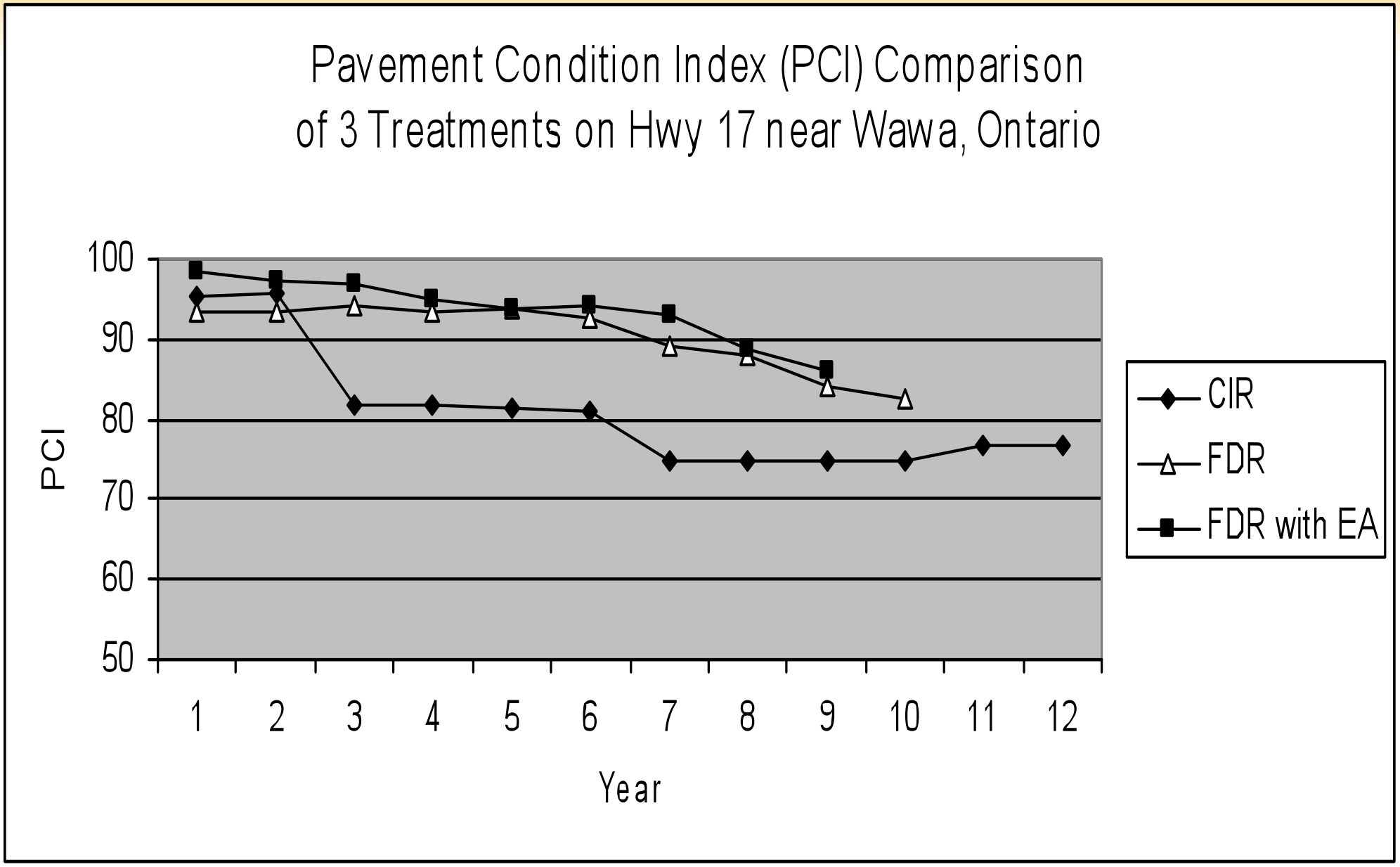

IRI Performance of Full Depth Reclamation Contracts
IRI
2.00
1.50
1.00
0.50
0.00
0.95
0.97
1.02
1.06
1.16
1.26
1.32
1.39
1.41
1.49
1
2
3
4
5
6
7
8
9
10
Age


International Roughness Index (IRI) Comparison
of FDR performance curve to FDR with EA
IRI
2.00
1.75
1.50
1.25
1.00
0.75
0.50
1
2
3
4
5
6
7
8
9
10
Year
FDR performance curve
FDR with EA


Pavement Condition Index (PCI) Comparison
of FDR performance curve to FDR with EA
PCI
100
90
80
70
60
50
1
2
3
4
5
6
7
8
9
10
Year
FDR performance curve
FDR with EA

International Roughness Index (IRI) Comparison of 3 Treatments on Hwy 17 near Wawa, Ontario




Pavement Condition Index (PCI) Comparison
of 3 Treatments on Hwy 17 near Wawa, Ontario
PCI
100
90
80
70
60
50
1
2
3
4
5
6
7
8
9
10
11
12
Year
CIR
FDR
FDR with EA

Observations

- Expanded asphalt stabilization on Highway 17 resulted in a smooth, hard, uniform surface suitable for temporary traffic and provided an excellent platform for HMA paving operations.
- Once start-up issues were addressed, the EAS field operations progressed in a continuous and efficient manner, typically progressing at 1.2 km of 2-lane roadway per day.

Conclusions

- Results of ARAN surveys carried out in the years following construction found that the pavement has remained smooth (IRI<1) and in good condition (PCI>85) after 10 years in service.
- The three different EA mix designs, two with corrective aggregate and one without, performed similarly over the 10 year period.
- A control section of FDR with 80 mm HMA overlay started off with similar performance but deteriorated at a much faster rate.

Conclusions

- Performance of the EAS project was compared to MTO's established IRI and PCI performance curves for FDR with HMA overlay - *the FDR with EAS is outperforming the average FDR project both in terms of roughness (IRI) and pavement condition (PCI).*
- Results also indicate that the EAS with a two lift HMA overlay rehabilitation strategy performed better than adjacent CIR and FDR projects.

Conclusions

- Expanded asphalt stabilization provides an acceptable in-place recycling rehabilitation strategy that conserves natural resources and provides an economic and sustainable alternative to conventional full depth reclamation with HMA overlay, particularly in areas where aggregates are in short supply.

Thank you!

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