Performance of Interstate Edge Drains in Arkansas

Gary M. Bennett, PE
Civil Engineer IV
Planning & Research Division
Research Section

Background/History

- One belief is that pavement drainage is beneficial to pavement performance
- Prior research supports and contradicts this statement
- Excessive water can accelerate pavement distress
  - Subsurface drainage combats detrimental effects of water on pavements
- However…

Background/History

- The Guide for Mechanistic-Empirical Design of New and Rehabilitated Pavements states:
  - “The current state of the art in such that conclusive remarks regarding the effectiveness of pavement subsurface drainage or the need for subsurface drainage are not possible”

Background/History

- Reasons why subsurface drainage systems do not perform:
  - Inadequate Design
  - Improper Construction
  - Inadequate Maintenance
- And...
  - Location
  - Used on a pavement where it is not necessarily needed

NCHRP Project 1-34

- Conducted between 1995 and 1998
- Evaluated effectiveness of subsurface drainage systems
- Small data set
- No LTPP data included
- Did not assess the functionality of drainage systems

NCHRP Project 1-34B

- Completed in 1999
- Evaluated both PCC and ACHM pavements on LTPP sites

NCHRP Project 1-34C

- Completed in 2003
- Analysis of data collected in 1-34B

Long Term Pavement Performance Program (LTPP)

- SPS-1
  - ACHM Pavements
    - 3 Undrained Sections
      - Dense Graded
      - Asphalt Treated Base
      - Asphlat Treated Base over Dense Aggregate
    - 2 Drained Sections
      - Permeable Asphalt Treated Base over Aggregate
      - Asphalt Treated Base over Permeable Asphalt Treated Base

Long Term Pavement Performance Program (LTPP)

- SPS-2
  - PCC Pavement Sections
    - 2 Undrained
      - Dense Graded Aggergate
      - Lean Concrete Base
    - 1 Drained
      - Permeable Asphalt Treated Base

SPS-1 Locations

Figure 1. SPS-1 (flexible pavement) sites.

SPS-2 Locations

Figure 2. SPS-2 (rigid pavement) sites.

NCHRP Report 583

- Published in 2007
- Research Objectives
  - Resolve discrepancies between as designed and as built drainage designs of SPS-1 and SPS-2 studies
  - Develop method for quantitative testing of edge drains
  - Report on effective of subsurface drainage on performance on ACHM and PCC pavements

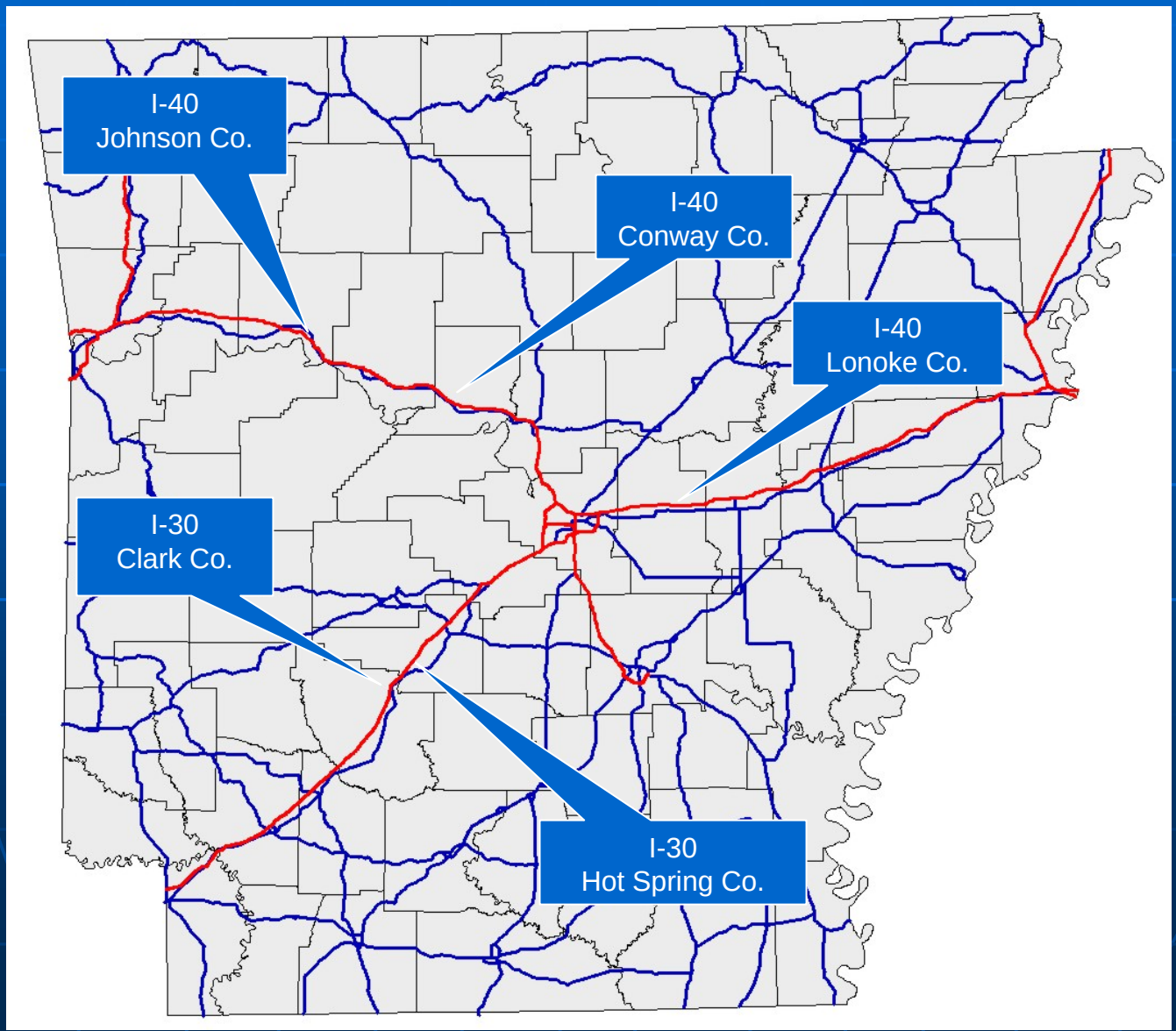
NCHRP 583 Recommendations & Conclusions

- Pavements built today are less vulnerable to excessive moisture
- Best performing pavements on SPS-1 (ACHM) had stiff base courses
- Best performing pavements on SPS-2 (PCC) had bases that were neither too stiff nor too weak
- Recommendations
  - Use climate data to determine sites with excessive moisture
  - Identify areas with subgrade soils with poor drainage characteristics
  - Consider subsurface drains at sites with wet climates and/or poorly draining subgrade soils

Arkansas Data

- Monitor performance of rehabilitated interstate pavements with edge drains
  - Maintained
  - Not Maintained
- Monitoring included
  - Site Visits
  - Video Inspection
  - FWD
  - Rut Measurements
  - LWP
  - ARAN (IRI & Rutting)
- Flow and rain gauges installed at monitoring sites on I-30 WB in Hot Spring County

Locations


I-40
Johnson Co.
I-40
Conway Co.
I-40
Lonoke Co.
I-30
Clark Co.
I-30
Hot Spring Co.

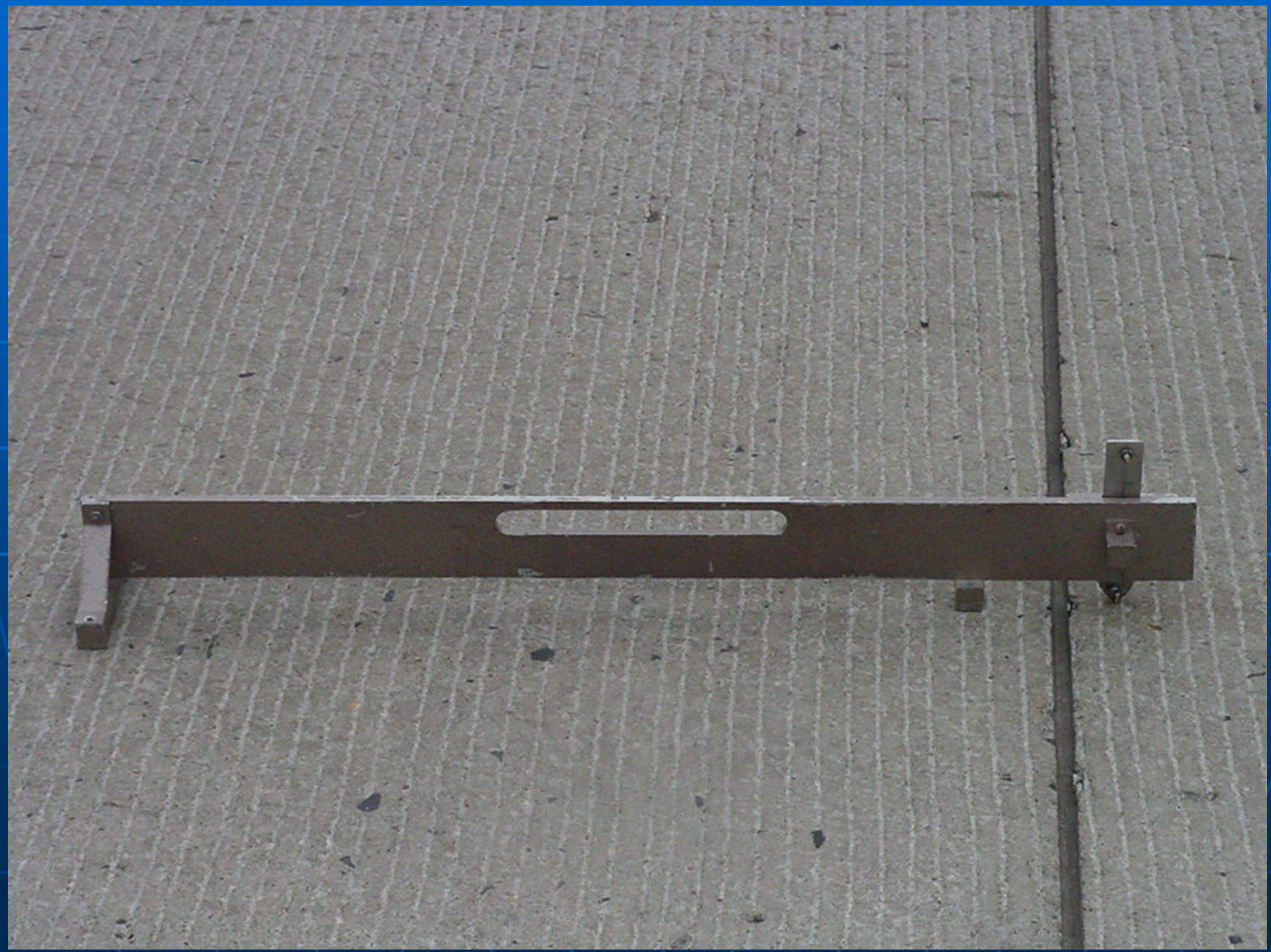
Site Visits


Dynatest
Falling Weight Deflectometer
4023
2509
Lightweight

Site Visits

Site Visits

Site Visits



Site Visits

Site Visits

Site Visits


FOOTAGE
DISPLAY
BLACK
CLEAR
JVC
VOLUME
PHASE
CHROMA
BRIGHT
CONTRAST
POWER
AUX
CAUTION:
MAINLINE
TRIP SELECTOR
MINI
CAMERA
LIGHTS
CAM LTS TRAC 12V
TEST METER
NO VCR

Site Visits

Site Visits

Site Visits

Drain Outlet Before Maintenance

Log Mile 88.98
April 2004

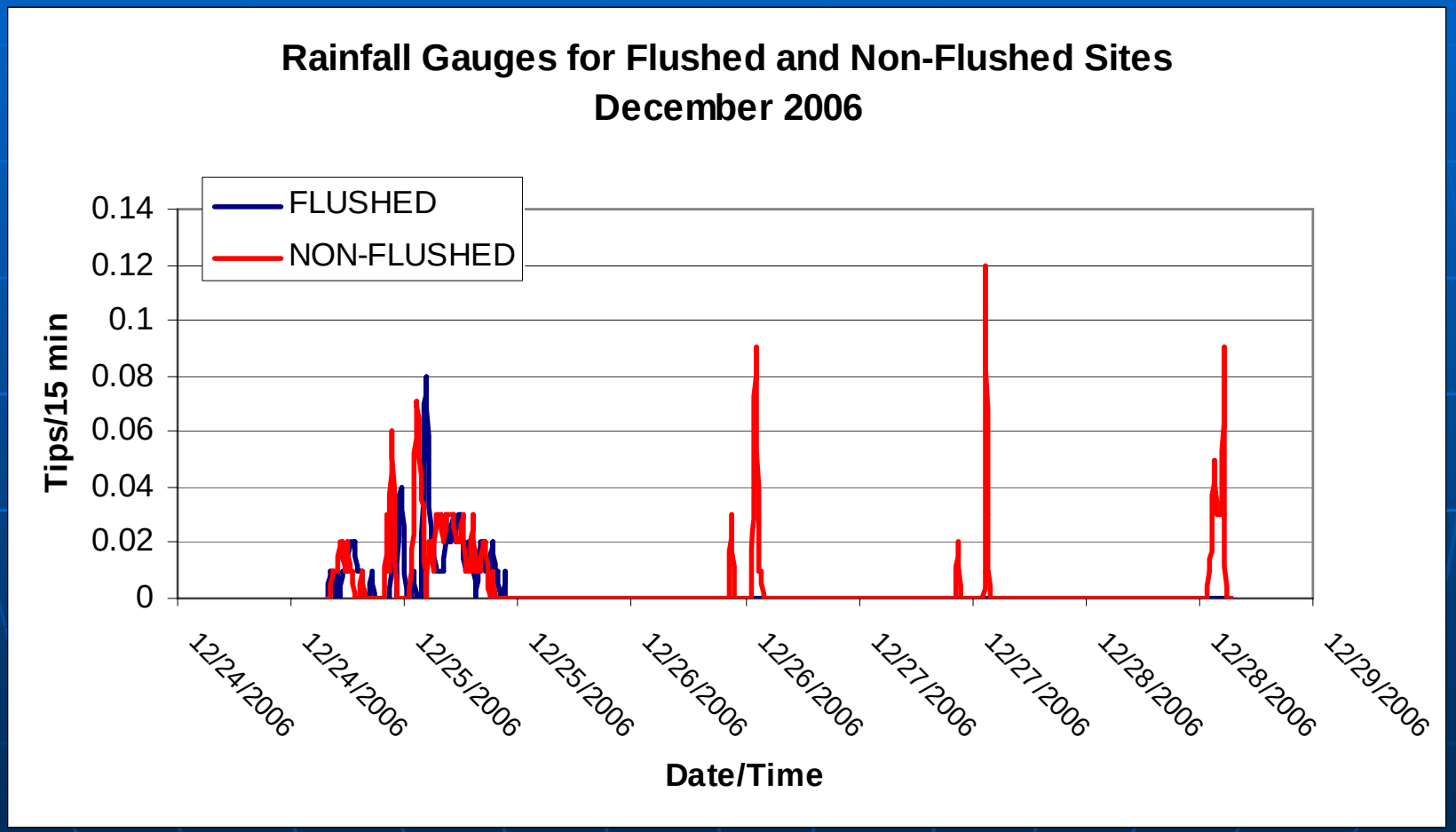
Maintained Drain Outlet

Drain Outlet Not Maintained

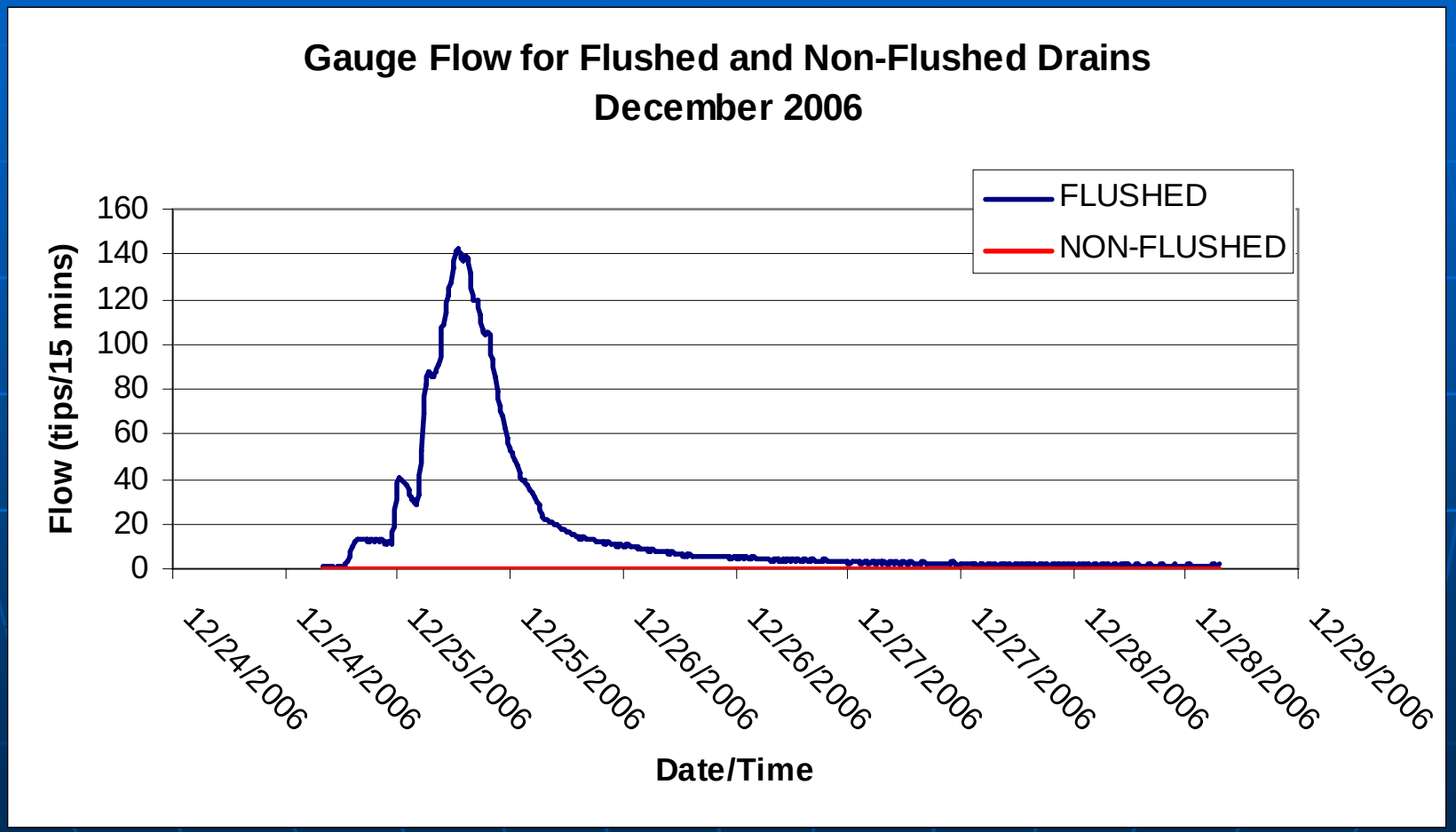
Flow Monitoring

- Rainfall and flow tipping bucket gauges
- Maintained and non-maintained section
- How does maintenance effect
  - Long term drain performance
  - Long term pavement performance

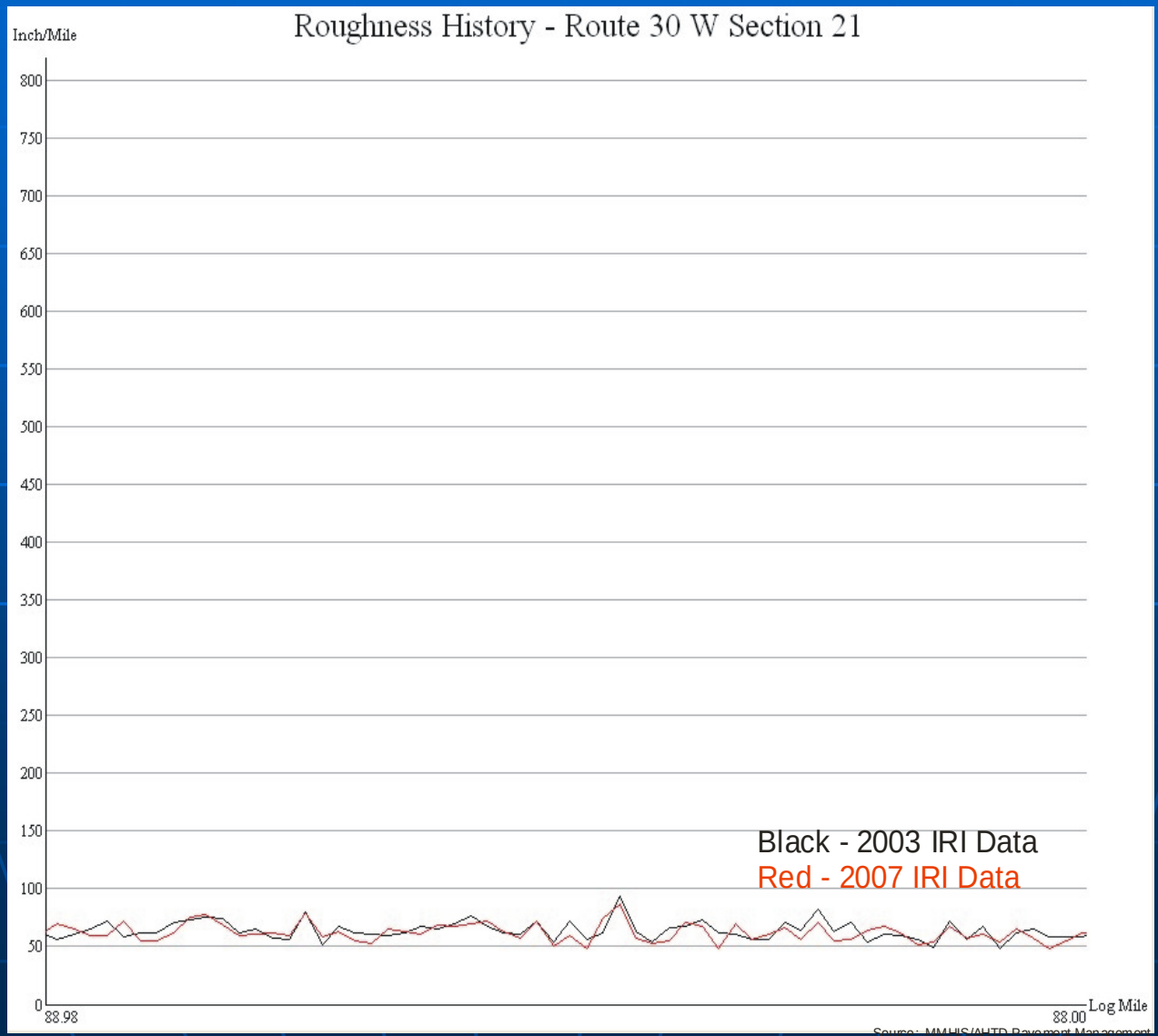
Rainfall Event



Gauge Flow

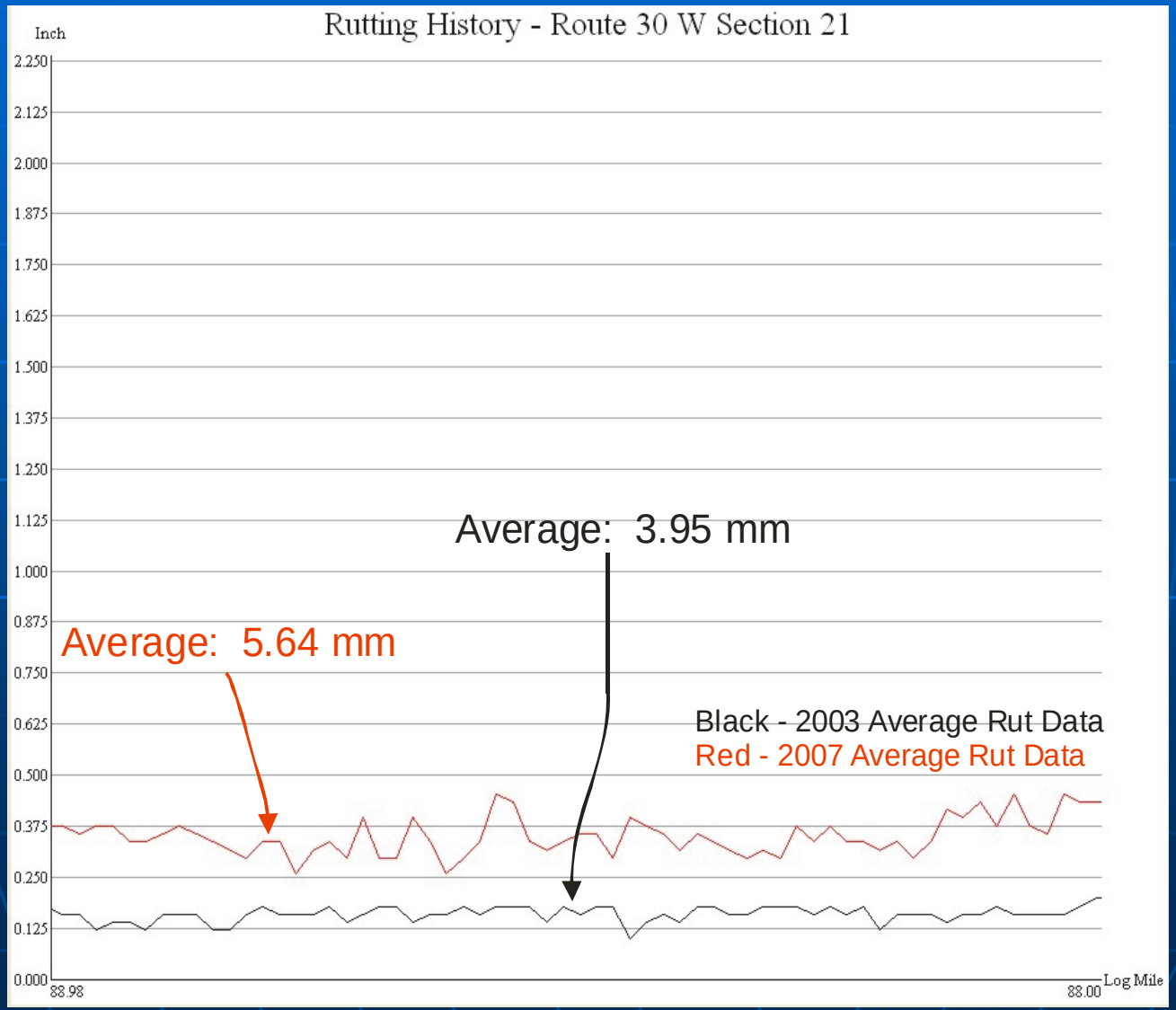

Gauge Flow for Flushed and Non-Flushed Drains
December 2006
FLUSHED
NON-FLUSHED
Flow (tips/15 mins)
160
140
120
100
80
60
40
20
0
12/24/2006
12/24/2006
12/25/2006
12/25/2006
12/26/2006
12/26/2006
12/27/2006
12/27/2006
12/28/2006
12/28/2006
12/29/2006
Date/Time

IRI for Flushed Section



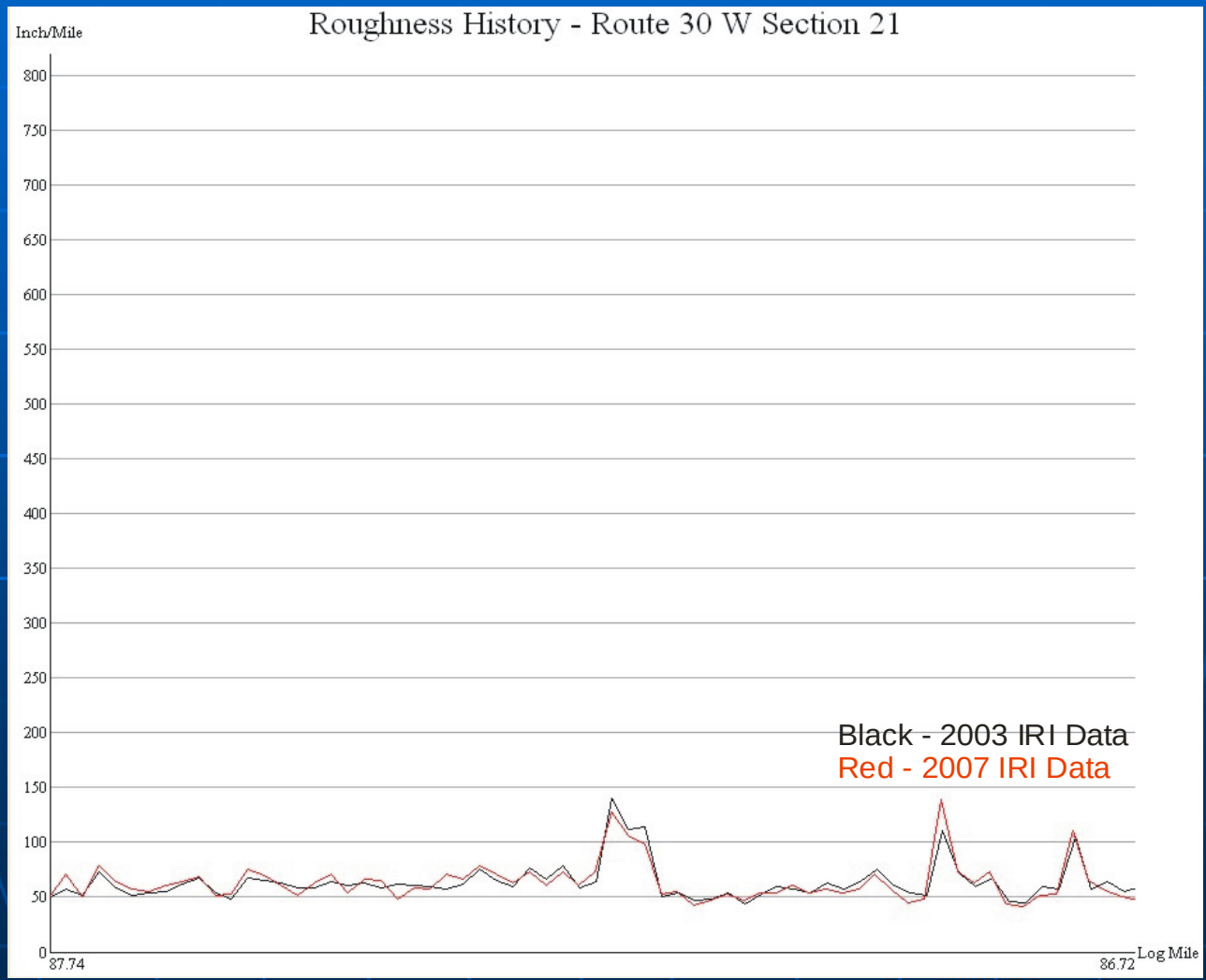
Source: AHTD Pavement Management/MMHIS

Rutting for Flushed Section



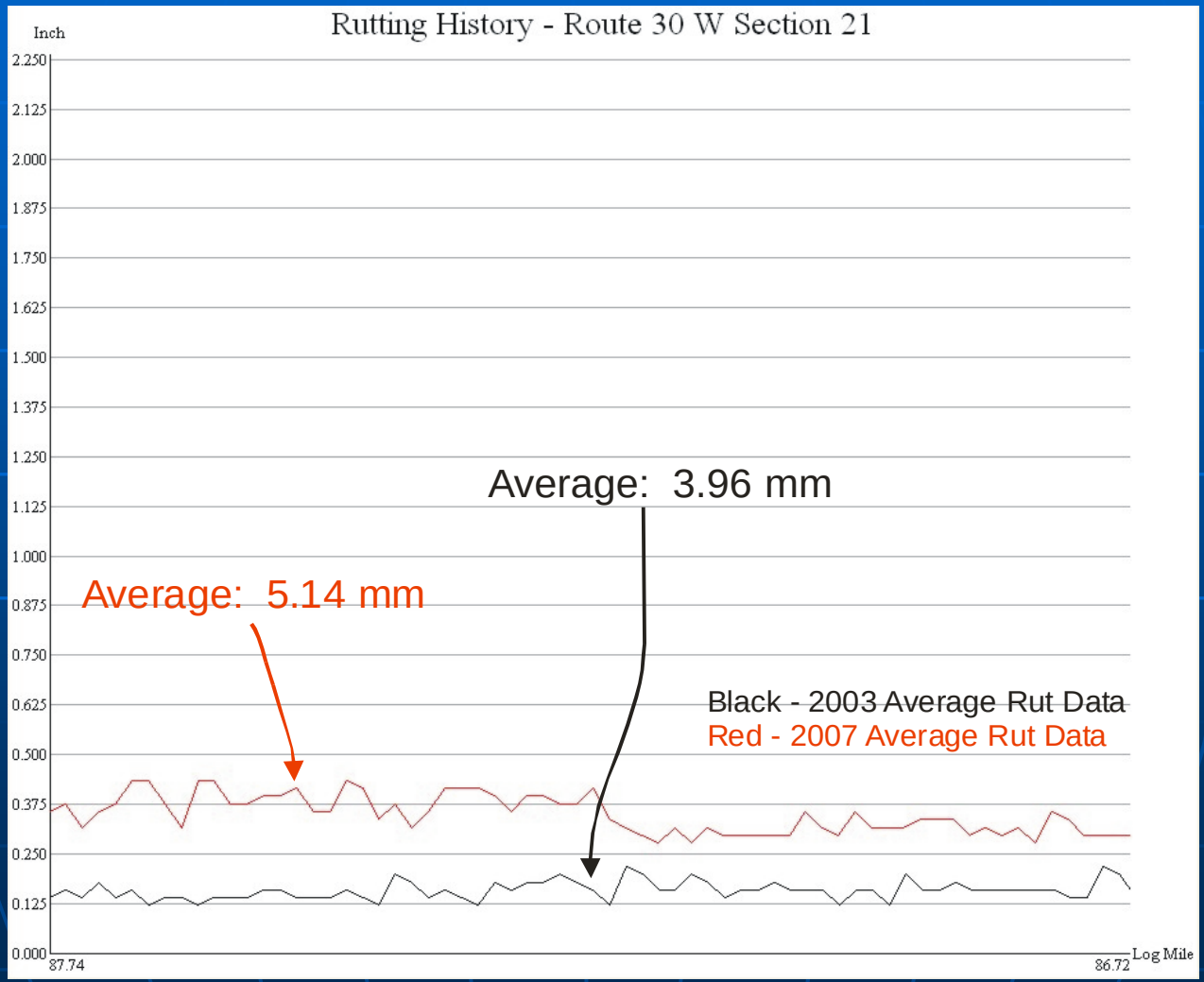
Source: AHTD Pavement Management/MMHIS

IRI for Non-Flushed Section



Source: AHTD Pavement Management/MMHIS

Rutting for Non-Flushed Section



Source: AHTD Pavement Management/MMHIS

Summary of Pavement Performance

	Flushed			*Not Flushed*		
	2003	***2007***	***%Change***	***2003***	***2007***	***%Change***
IRI (in/mi)	57.6	61.07	6.0	62.9	63.7	1.3
Rutting (in)	0.15	0.2	33.3	0.15	0.2	33.3

Summary

- Arkansas results tend to correlate with NCHRP results...so far
- More data/history could support or contradict NCHRP recommendations
- Edge drains (if installed) should be maintained
- Monitoring of pavement and drain performance should continue

Questions?