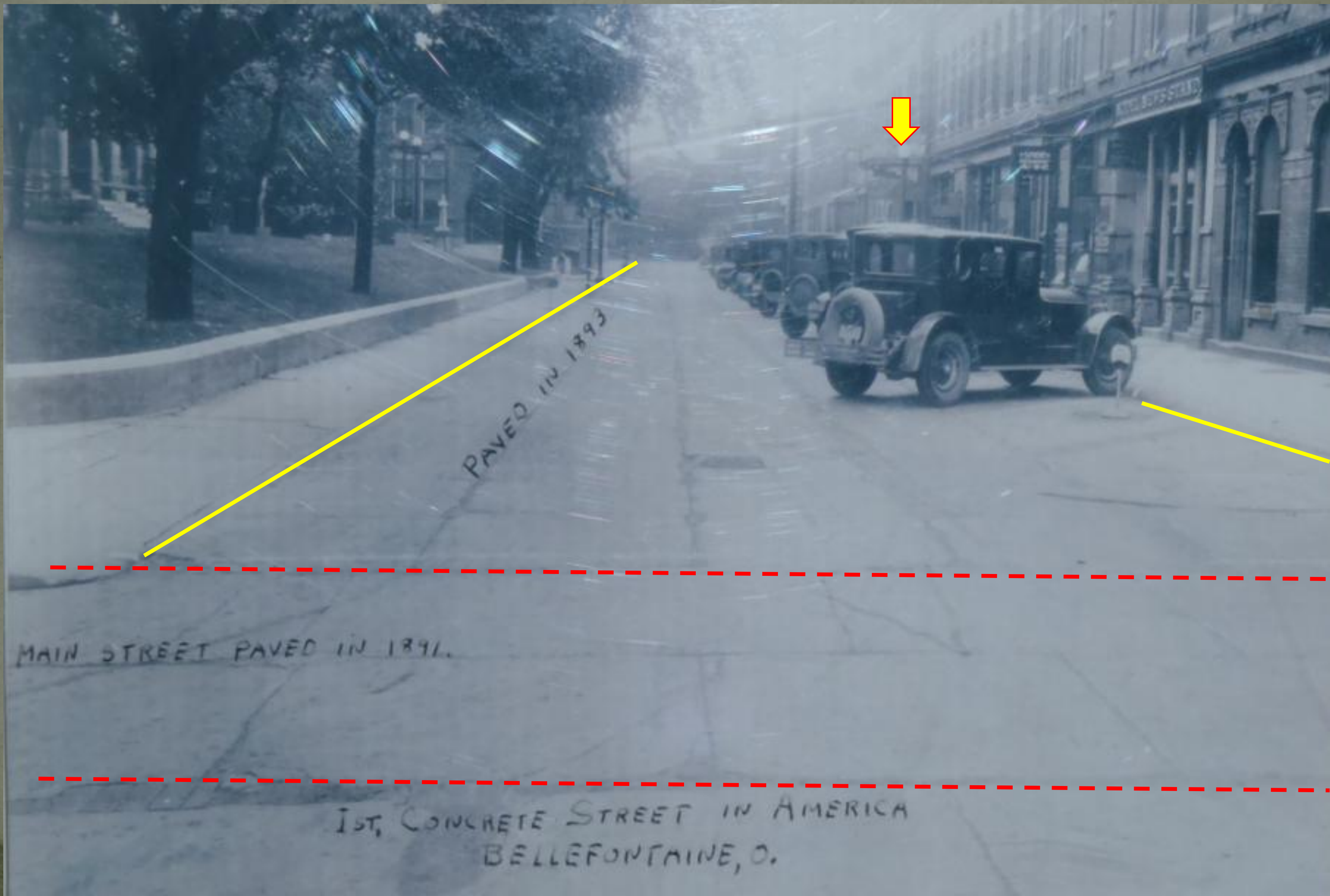
The LTPP SPS-2 Experiment **The Nations Largest Concrete Research Effort**

Larry Scofield, P.E.
International Grooving and Grinding Association

Bellefontaine, Ohio 1925



Bellefontaine, Ohio 2012

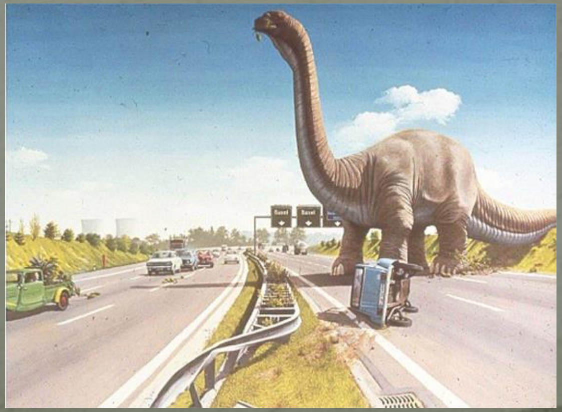
120 Years Old

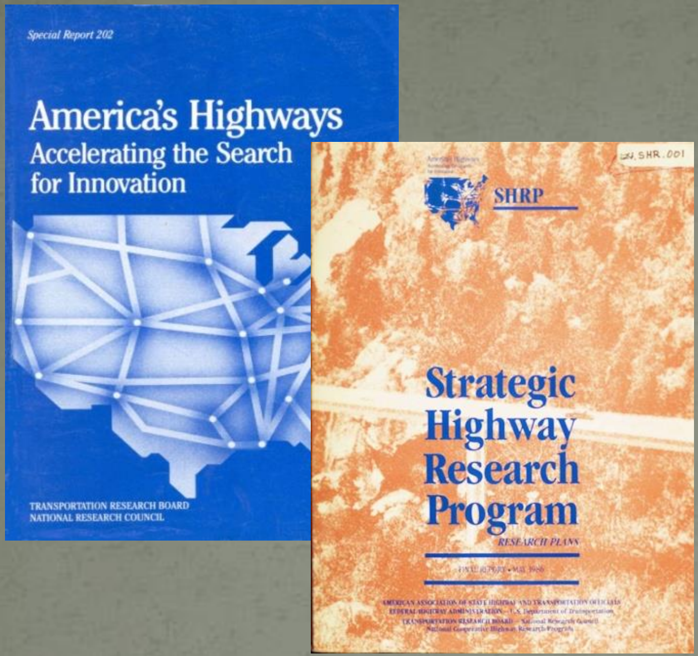
In the Beginning: SHRP (1987-1993)

- Strategic Highway Research Effort ($150M):
  - It was a five-year $150 million research program managed by TRB and funded by a set-aside of state-apportioned federal aid highway funds
  - The program was carefully developed and defined as; "A time-specific, concentrated, short-term and results oriented research effort aimed at closing specific technological gaps that have impeded the effective advancement of the highway program."
  - The goal was to deliver practical results for use by transportation agencies within five years.

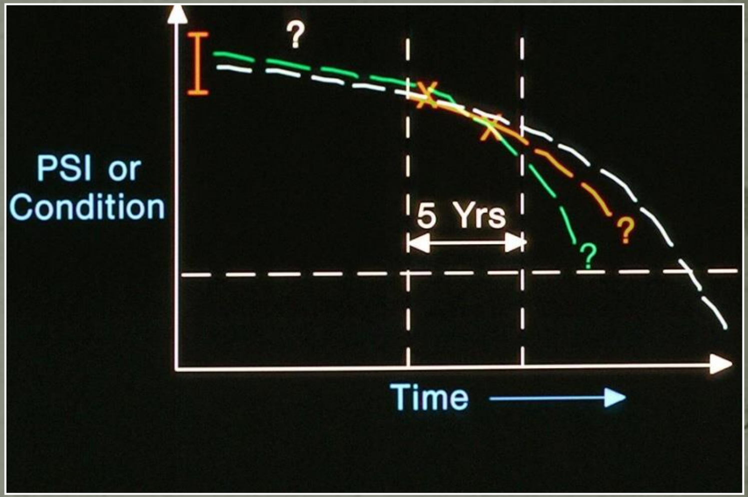
SHRP Program Areas (5 Year Effort)

- Asphalt
- Long Term Pavement Performance (LTTP) ($50M)(20 yr)
- Concrete and Structures
- Winter Maintenance
- Highway Operations





LTPP's GOAL is…



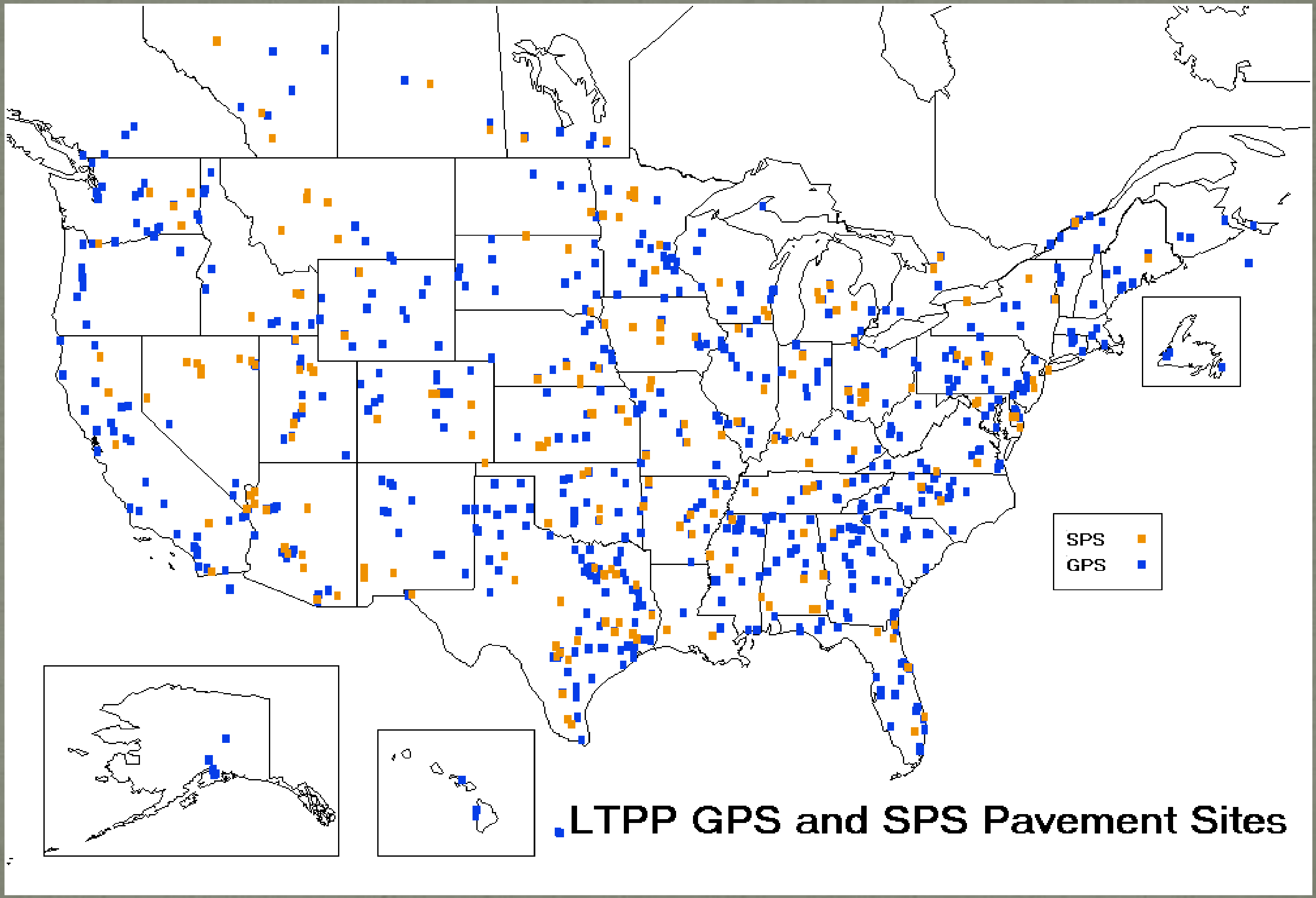
to provide answers to

HOW and ***WHY***

pavements perform as they do!

Long Term Pavement Performance (LTPP)

GPS and SPS Test Sections



LTPP SPS Program Areas

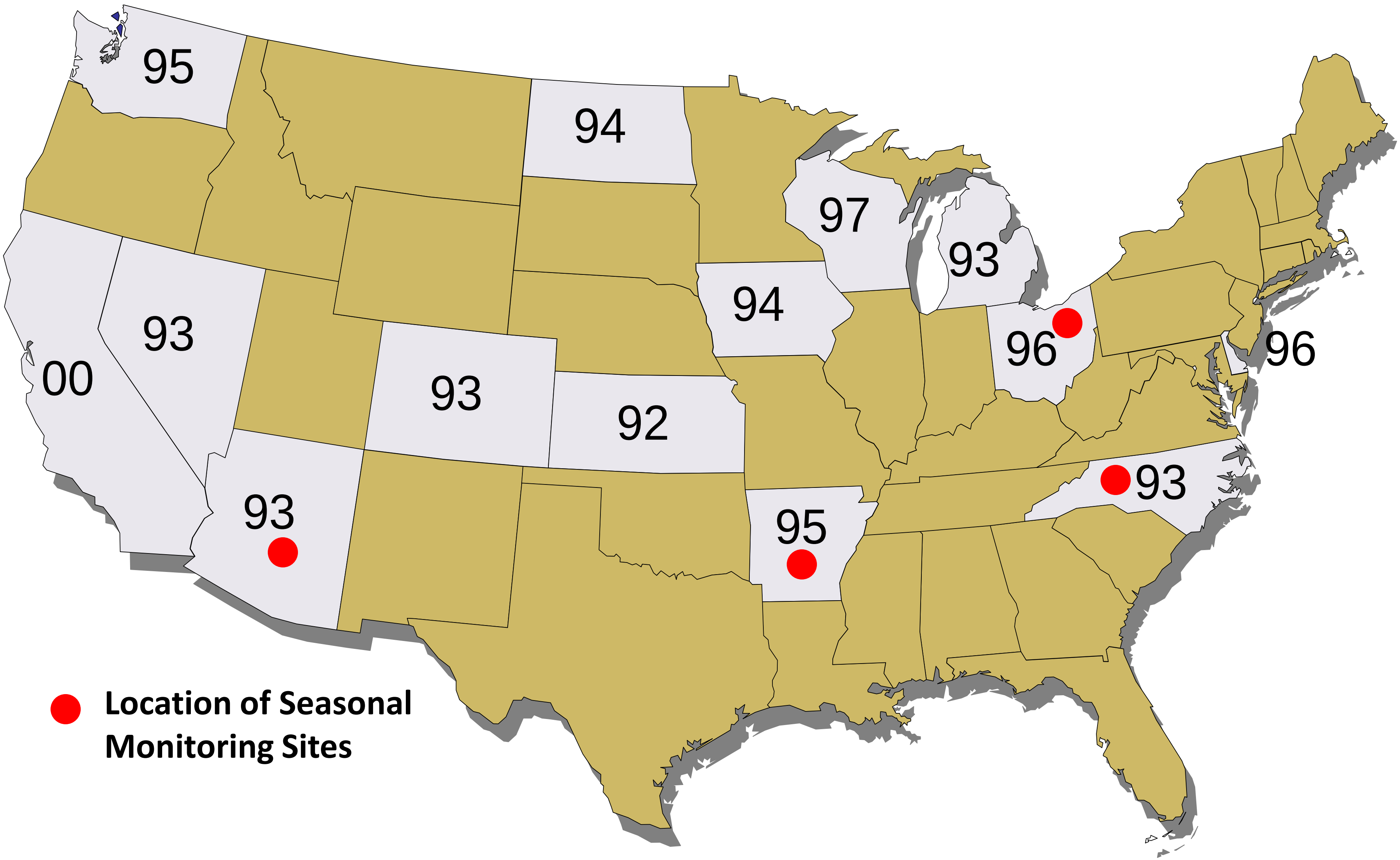
- SPS-1: Structural Factors for AC Pavements
- **SPS-2: Structural Factors for Concrete Pavements**
- SPS-3: Preventive Maintenance for AC Pavements
- SPS-4: Preventive Maintenance for Concrete Pavements
- SPS-5: Rehabilitation of AC Pavements
- SPS-6 Rehabilitation of Concrete Pavements
- SPS-7: Bonded Concrete Overlays
- SPS-8: Study of Environmental Factors

Designed to Evaluate Relative Influence of 5 Design Factors and 3 Site Factors on Long Term Performance

- Concrete Thickness (8” & 11”)
- Base Type (LCB, DGA, PATB, PATB/DGA)
- Flexural Strength (550 & 900)
- Lane Width (12’ & 14’)
- Drainage (with and without)

- Site Factors
  - Temperature
  - Precipitation
  - Subgrade

Location of SPS-2 Test Sites



Similar SPS-2 Experiments Nationally

Arizona (93)

1	2	3	Drainage		
			No		Yes
			Base Type		
			AGG	LCB	PATB
8	550	12	201	205	209
		14	213	217	221
	900	12	214	218	222
		14	202	206	210
11	550	12	215	219	223
		14	203	207	211
	900	12	204	208	212
		14	216	220	224

Arkansas (95)

1	2	3	Drainage		
			No		Yes
			Base Type		
			AGG	LCB	PATB
8	550	12	201	205	209
		14	213	217	221
	900	12	214	218	222
		14	202	206	210
11	550	12	215	219	223
		14	203	207	211
	900	12	204	208	212
		14	216	220	224

California (2000)

1	2	3	Drainage		
			No		Yes
			Base Type		
			AGG	LCB	PATB
8	550	12	201	205	209
		14	213	217	221
	900	12	214	218	222
		14	202	206	210
11	550	12	215	219	223
		14	203	207	211
	900	12	204	208	212
		14	216	220	224

Colorado (93)

1	2	3	Drainage		
			No		Yes
			Base Type		
			AGG	LCB	PATB
8	550	12	201	205	209
		14	213	217	221
	900	12	214	218	222
		14	202	206	210
11	550	12	215	219	223
		14	203	207	211
	900	12	204	208	212
		14	216	220	224

Delaware (96)

1	2	3	Drainage		
			No		Yes
			Base Type		
			AGG	LCB	PATB
8	550	12	201	205	209
		14	213	217	221
	900	12	214	218	222
		14	202	206	210
11	550	12	215	219	223
		14	203	207	211
	900	12	204	208	212
		14	216	220	224

Iowa (94)

1	2	3	Drainage		
			No		Yes
			Base Type		
			AGG	LCB	PATB
8	550	12	201	205	209
		14	213	217	221
	900	12	214	218	222
		14	202	206	210
11	550	12	215	219	223
		14	203	207	211
	900	12	204	208	212
		14	216	220	224

Kansas (92)

1	2	3	Drainage		
			No		Yes
			Base Type		
			AGG	LCB	PATB
8	550	12	201	205	209
		14	213	217	221
	900	12	214	218	222
		14	202	206	210
11	550	12	215	219	223
		14	203	207	211
	900	12	204	208	212
		14	216	220	224

Michican (93)

1	2	3	Drainage		
			No		Yes
			Base Type		
			AGG	LCB	PATB
8	550	12	201	205	209
		14	213	217	221
	900	12	214	218	222
		14	202	206	210
11	550	12	215	219	223
		14	203	207	211
	900	12	204	208	212
		14	216	220	224

North Carolina (93)

1	2	3	Drainage		
			No		Yes
			Base Type		
			AGG	LCB	PATB
8	550	12	201	205	209
		14	213	217	221
	900	12	214	218	222
		14	202	206	210
11	550	12	215	219	223
		14	203	207	211
	900	12	204	208	212
		14	216	220	224

North Dakota (94)

1	2	3	Drainage		
			No		Yes
			Base Type		
			AGG	LCB	PATB
8	550	12	201	205	209
		14	213	217	221
	900	12	214	218	222
		14	202	206	210
11	550	12	215	219	223
		14	203	207	211
	900	12	204	208	212
		14	216	220	224

Ohio (96)

1	2	3	Drainage		
			No		Yes
			Base Type		
			AGG	LCB	PATB
8	550	12	201	205	209
		14	213	217	221
	900	12	214	218	222
		14	202	206	210
11	550	12	215	219	223
		14	203	207	211
	900	12	204	208	212
		14	216	220	224

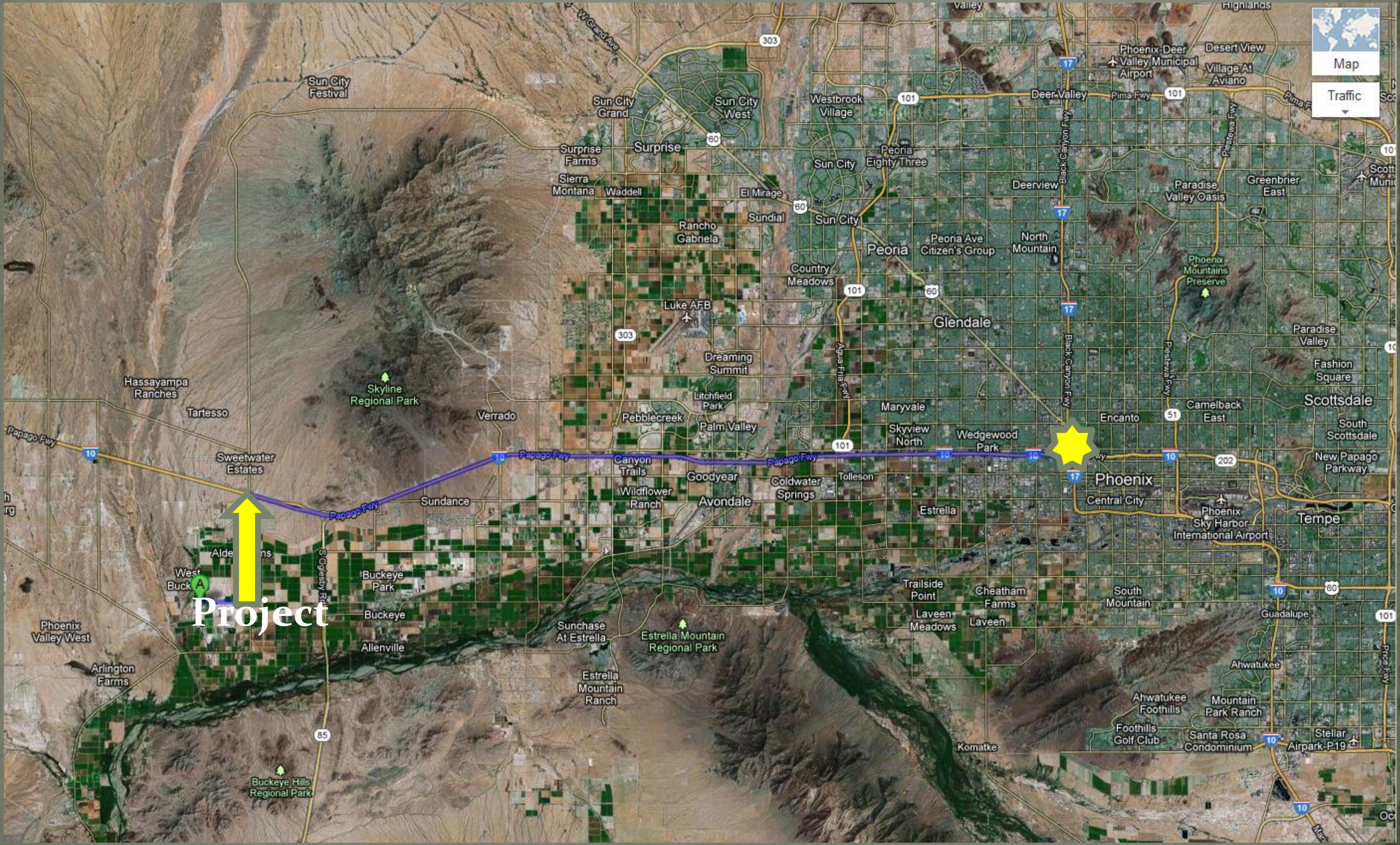
Washington (95)

1	2	3	Drainage		
			No		Yes
			Base Type		
			AGG	LCB	PATB
8	550	12	201	205	209
		14	213	217	221
	900	12	214	218	222
		14	202	206	210
11	550	12	215	219	223
		14	203	207	211
	900	12	204	208	212
		14	216	220	224

Wisconsin (97)

1	2	3	Drainage		
			No		Yes
			Base Type		
			AGG	LCB	PATB
8	550	12	201	205	209
		14	213	217	221
	900	12	214	218	222
		14	202	206	210
11	550	12	215	219	223
		14	203	207	211
	900	12	204	208	212
		14	216	220	224

The Arizona SPS-2 Experiment



Google Earth Image of Test Sections

Design Features On ADOT SPS-2

- **21** Test Sections
- PCCP Thickness (8, 11, **12.5**)
- Base Type (AB, PATB, LCB, PATB/AB, **AC**)
- Drained and UnDrained Base
- Lane Width (12 ft 14 ft)
- Doweled and **UnDoweled**

LTPP Design Feature

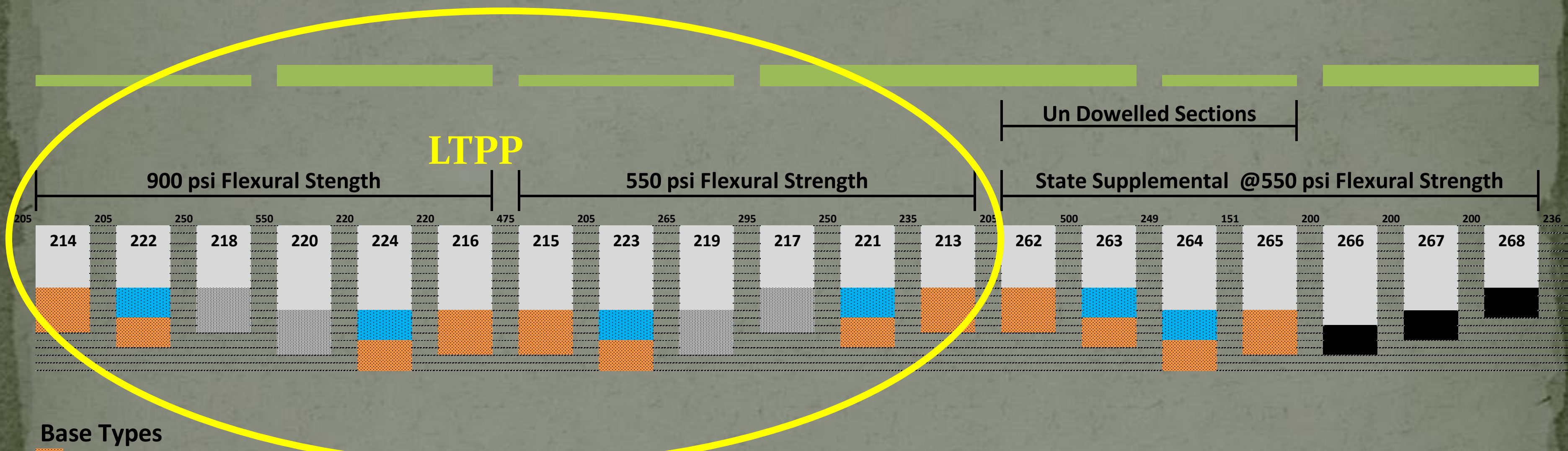
ADOT Design Feature

ADOT Test Section Investment

1.5 M **2.4 M**

1993 **2013**

Test Section Layout



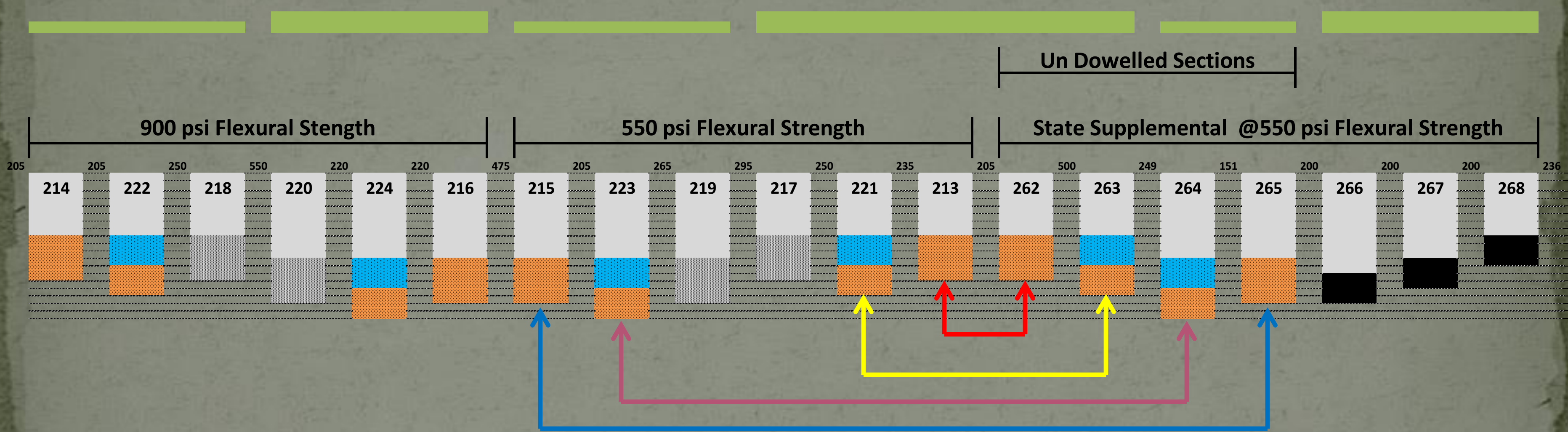
Base Types

- Dense Graded Aggregate Base (4" & 6")
- Permeable Bituminous Treated Base (4") Note: These are the only Sections with Edge Drains
- Lean Concrete Base (6")
- Bituminous Treated Base (4")

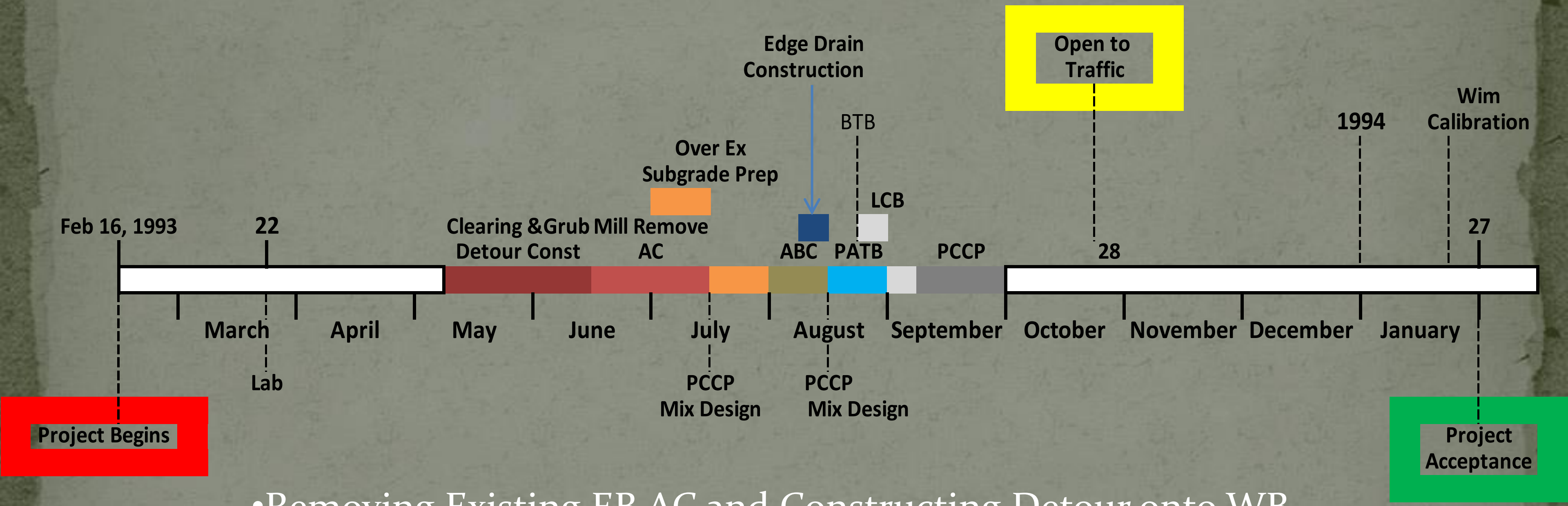
Shoulder Types

- 12 ft Shoulder Width
- 14 ft Shoulder Width

Comparison of Doweled to Undoweled

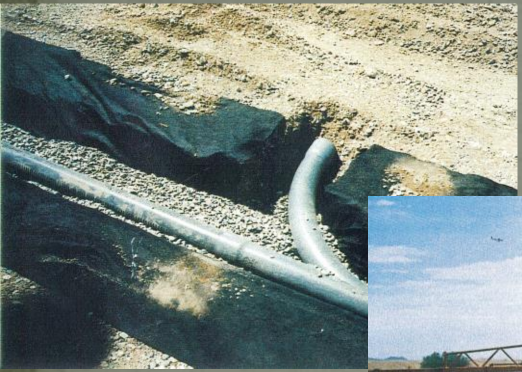


Project Construction Timeline (6 - 9 months)

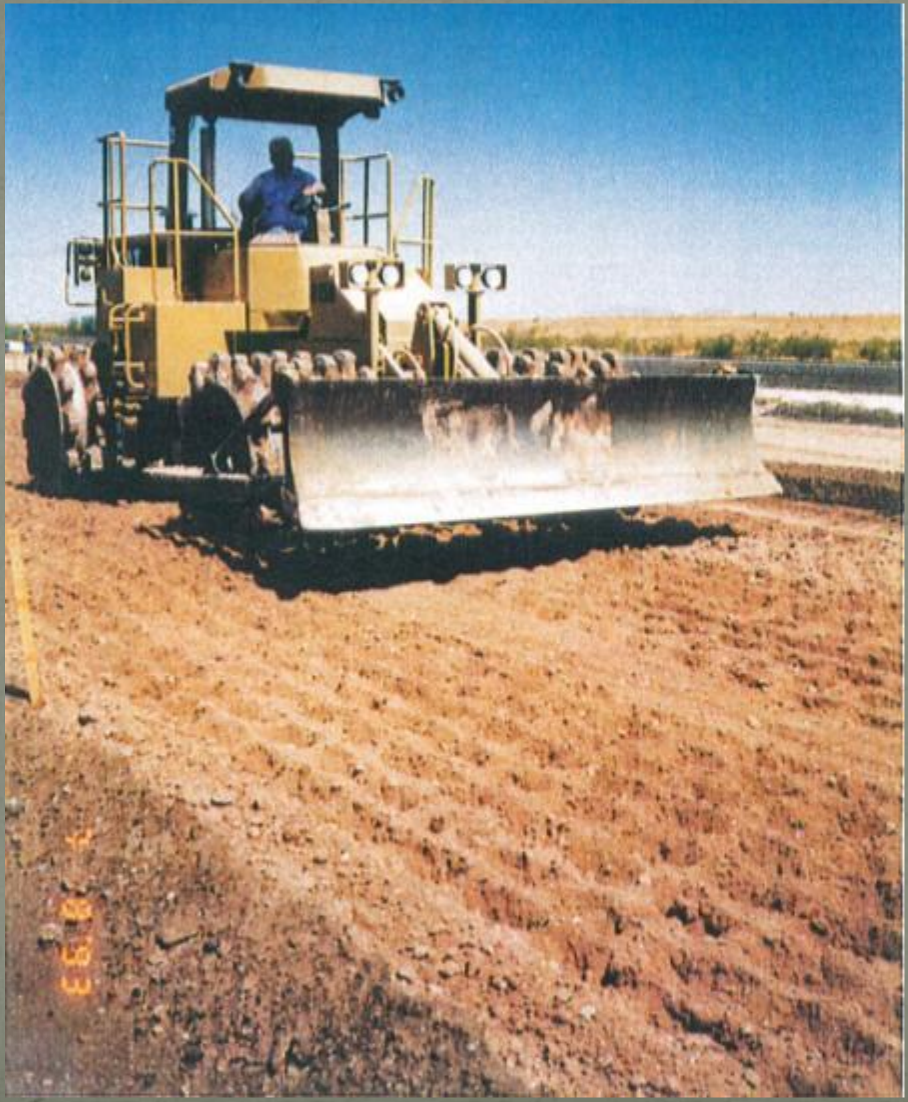


- •Removing Existing EB AC and Constructing Detour onto WB
- •Over Excavating Existing Subgrade 1 ft and Recompacting
- •Constructing Edge Drains
- •Constructing Aggregate Base, Lean Concrete Base, and Permeable Base
- •Constructing 8”, 11” and 12.5” Thick PCCP
- •Constructing 550 and 900 psi Flexural Strength PCCP
- •Constructed Doweled and Undoweled PCCP

Arizona I-10 EB SPS-2 Construction



Subgrade Compaction



Edge Drain Outlet

Subgrade/Base Trimming

PATB Compaction

Coarse Agg.	
Sieve Size	**% Pass**
1	100
3/4	87
1/2	62
3/8	33
No.4	3

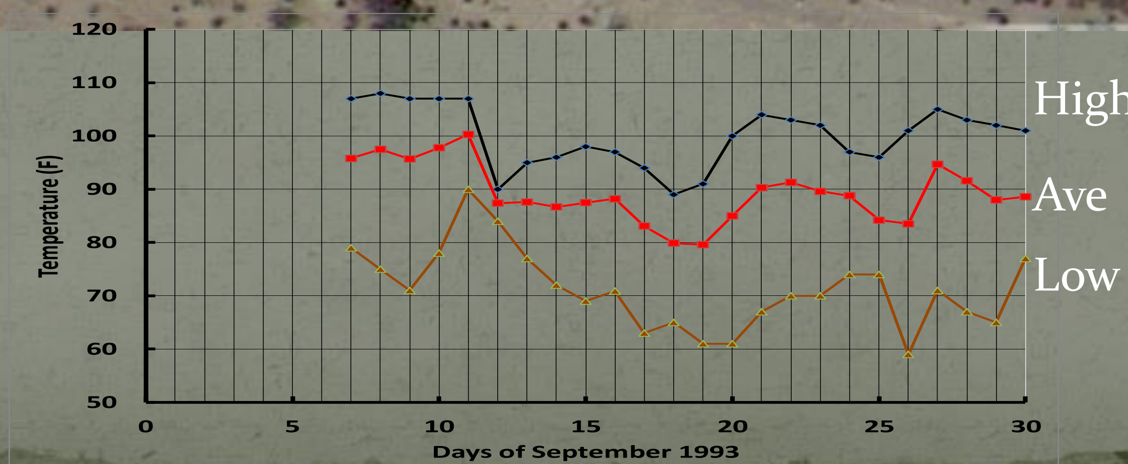
Fine Agg.	
Sieve Size	**% Pass**
No. 8	2
No. 10	0

Mix temp= 225 F
Compaction= 170 – 150 F

Lean Concrete Base

PCCP Paving

- Night Paving September 1993
- Three Mixes Used (1" & 1.5")
- All LTPP Sections Doweled



LTPP Concrete Mix Designs

LTPP 550 Mix Design

Material	%	Type	Weight	Misc.
Cement		Type II	400	
Fly Ash		Cholla	100	Class F
Water			232	.47 w/c
Fine Agg		ASTM	1285	
Coarse Agg		1"	1939	#57 Pioneer
		Unit Weight	147 pcf	
Water Reducer		WRDA-82		25 oz/cy
Air Entraining		Daravair-m		2 oz/cy

LTPP 900 Mix Design

Material	%	Type	Weight	Misc.
Cement		Type II	811	
Water			292	0.36
Fine Agg	40	ASTM	1207	
Coarse Agg	60	1"	1826	#57 Pioneer
		Unit Weight	153	
Water Reducer		WRDA-82		40 oz/cy
Air Entraining		Daravair-m		

Testing

Sample Type	Number of Samples	Sampling Year(s)
4" Core	262	1993, 1994, 2005
6" Core	0	N/A
12" Core	15	2005
Bulk (Subgrade)	28	1993, 2005
Bulk (Granular Base)	14	1993, 2005
Bulk (Treated Base)	10	1993
Beam (PCC)	45	1993
Cylinder (PCC)	72	1993
Cylinder (LCB)	18	1993

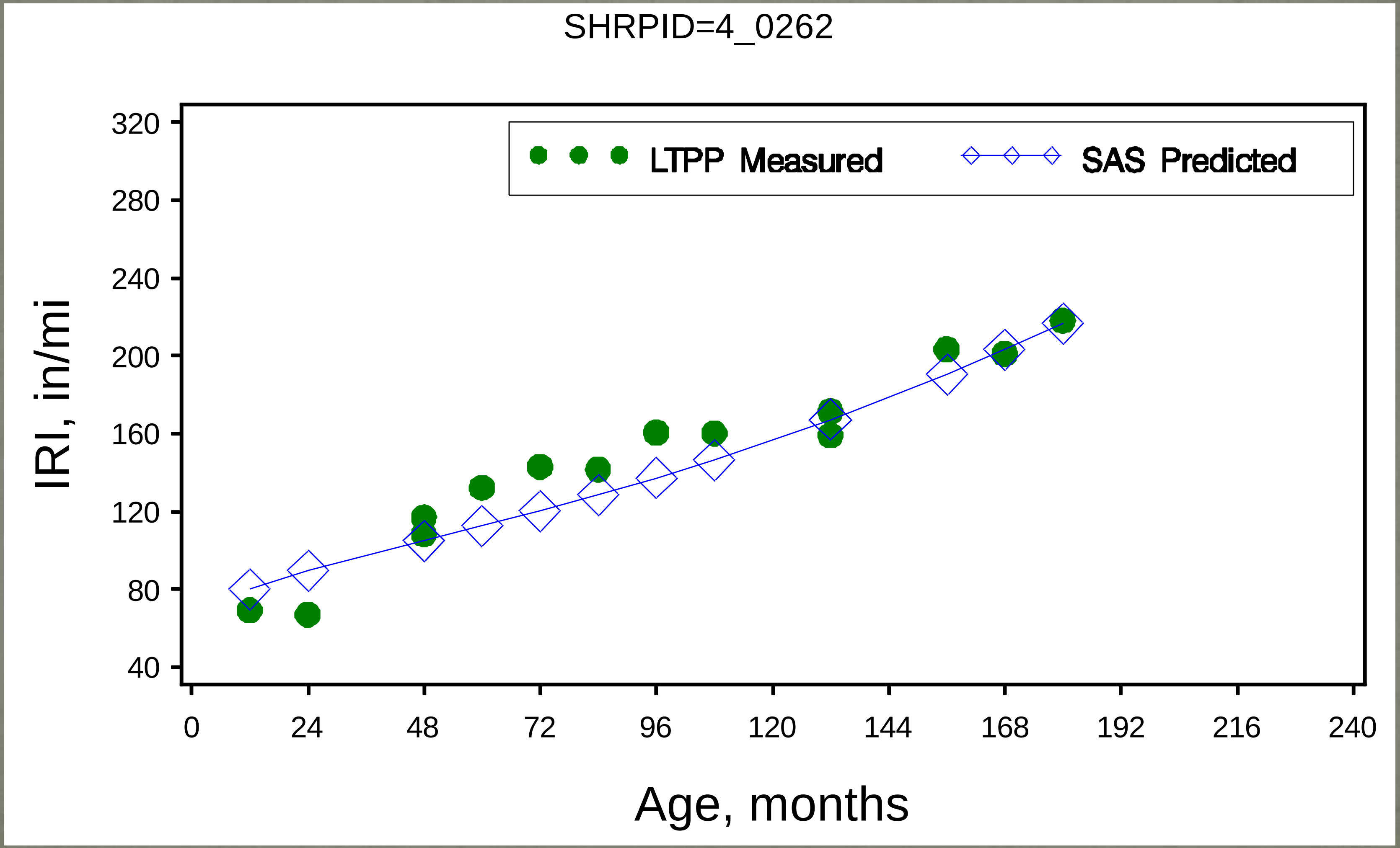
Lessons Learned from National Experiment

- 20 Year Report Due Out Early Next Year
- Base Type Effects Resulting Distresses
- Widened Slab Improves Performance (13ft)
- Longitudinal Cracking Influenced by Base Type and thickness
- Thicker Slabs Resulted in More Initial Roughness than Thinner Slabs
- Sections with Drainage Exhibited Less Roughness Development than Sections Without Drainage
- 900 psi Sections Exhibited Map Cracking
- Most Distress Exhibited on Sections with LCB Base

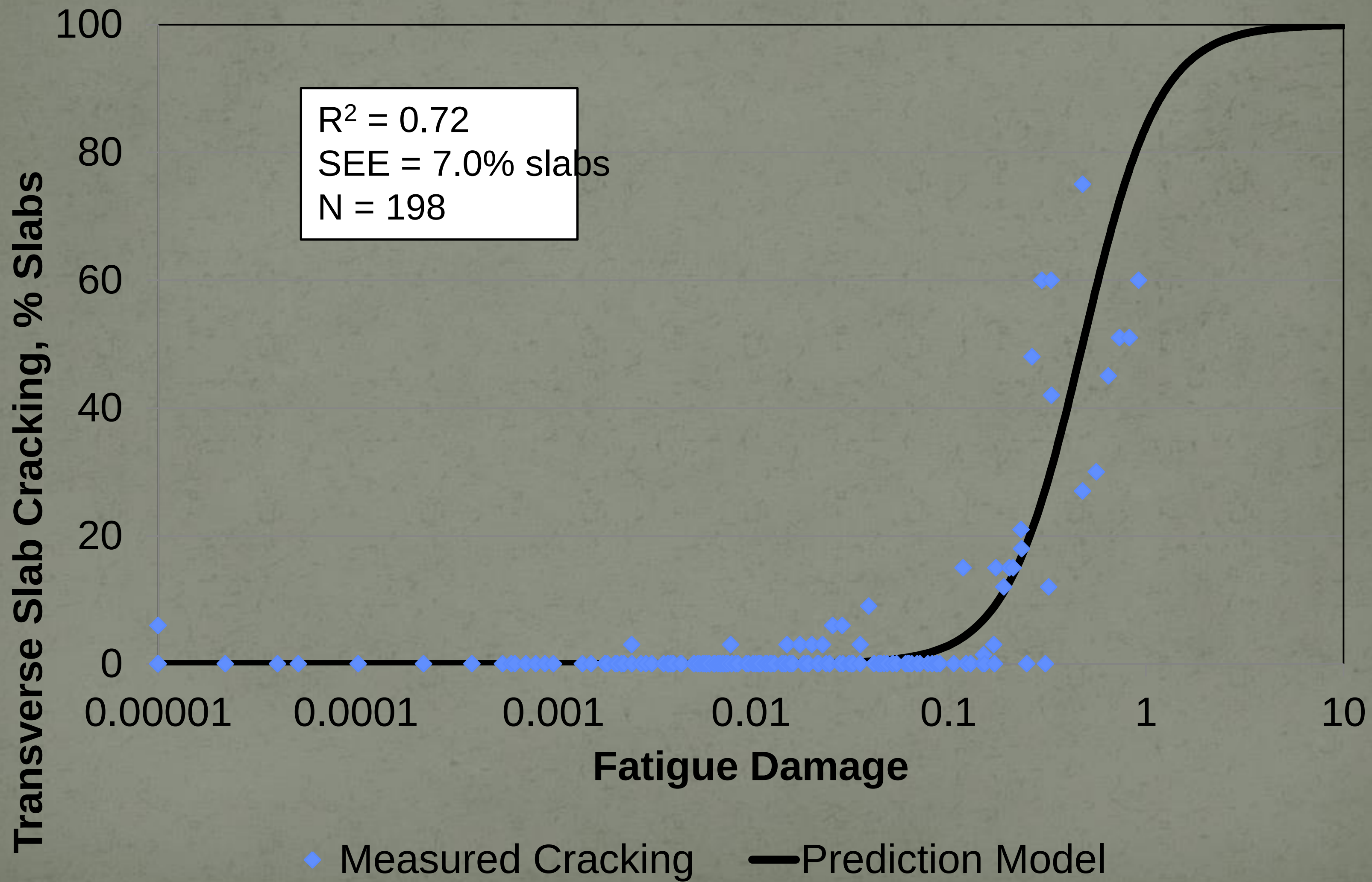
Process of Local Calibration

- ***Verification*** — the process of checking whether the MEDesign ***"National"*** models works as intended in Arizona.
- ***Calibration*** — If not, then changing MEDesign model ***"National coefficients"*** to ***"AZ local coefficients"*** that make distress & IRI predictions match AZ field measurements
- ***Validation*** — the process of checking that the ME Design ***"local Arizona"*** models works as intended in Arizona (independent data)

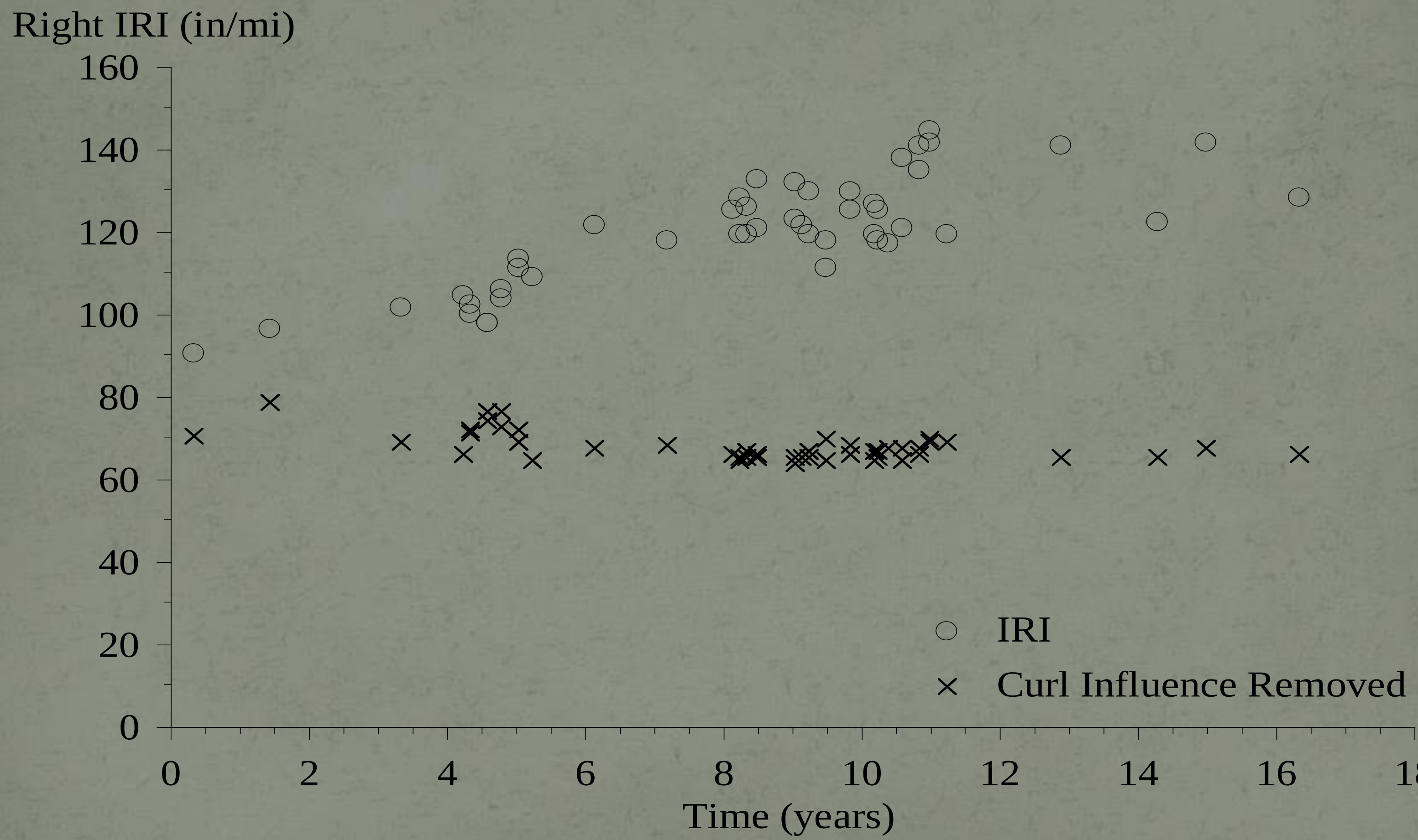
Example of Measured & Predicted IRI (LTPP 262)



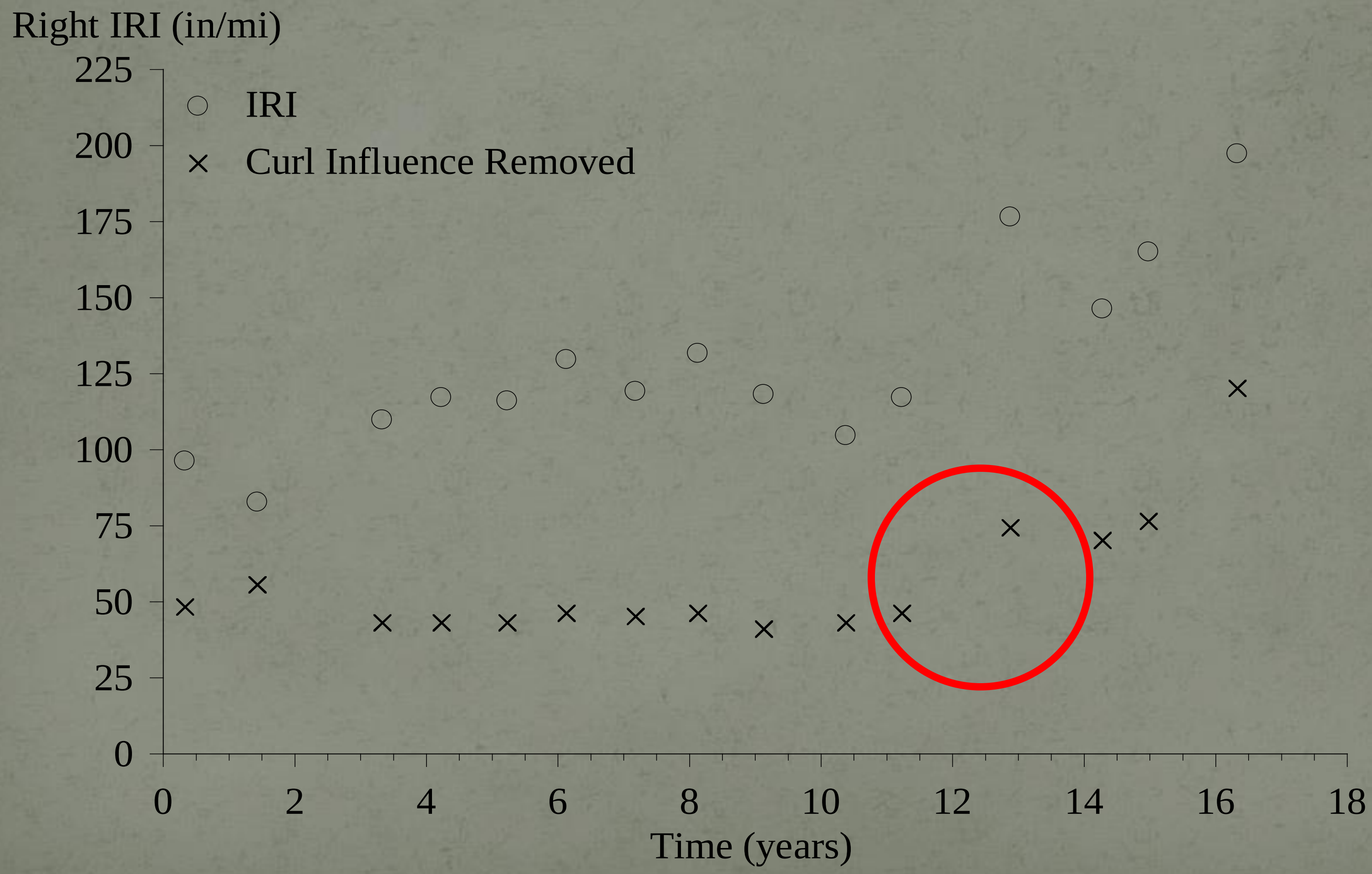
AZ Slab Cracking Vs Fatigue Damage



Curl and Warp Study- 11" PCCP (215)



Curl and Warp Study- 8” PCCP (213)

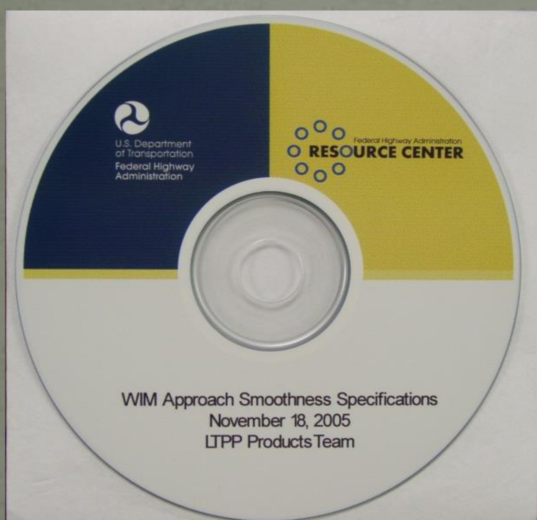


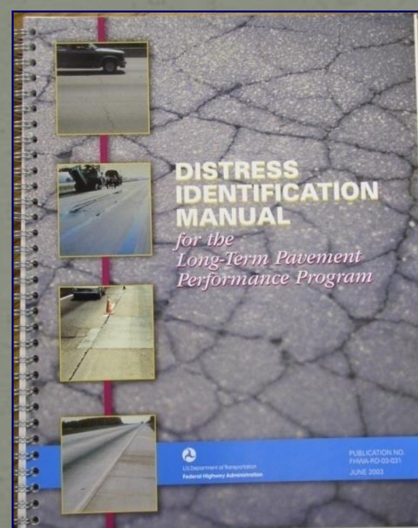
20 Year Old Silicone Sealed Joint

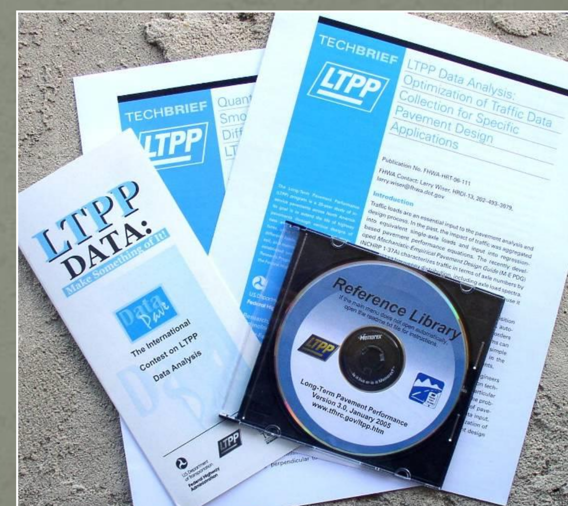
Shoulder Separation

LTPP Benefits

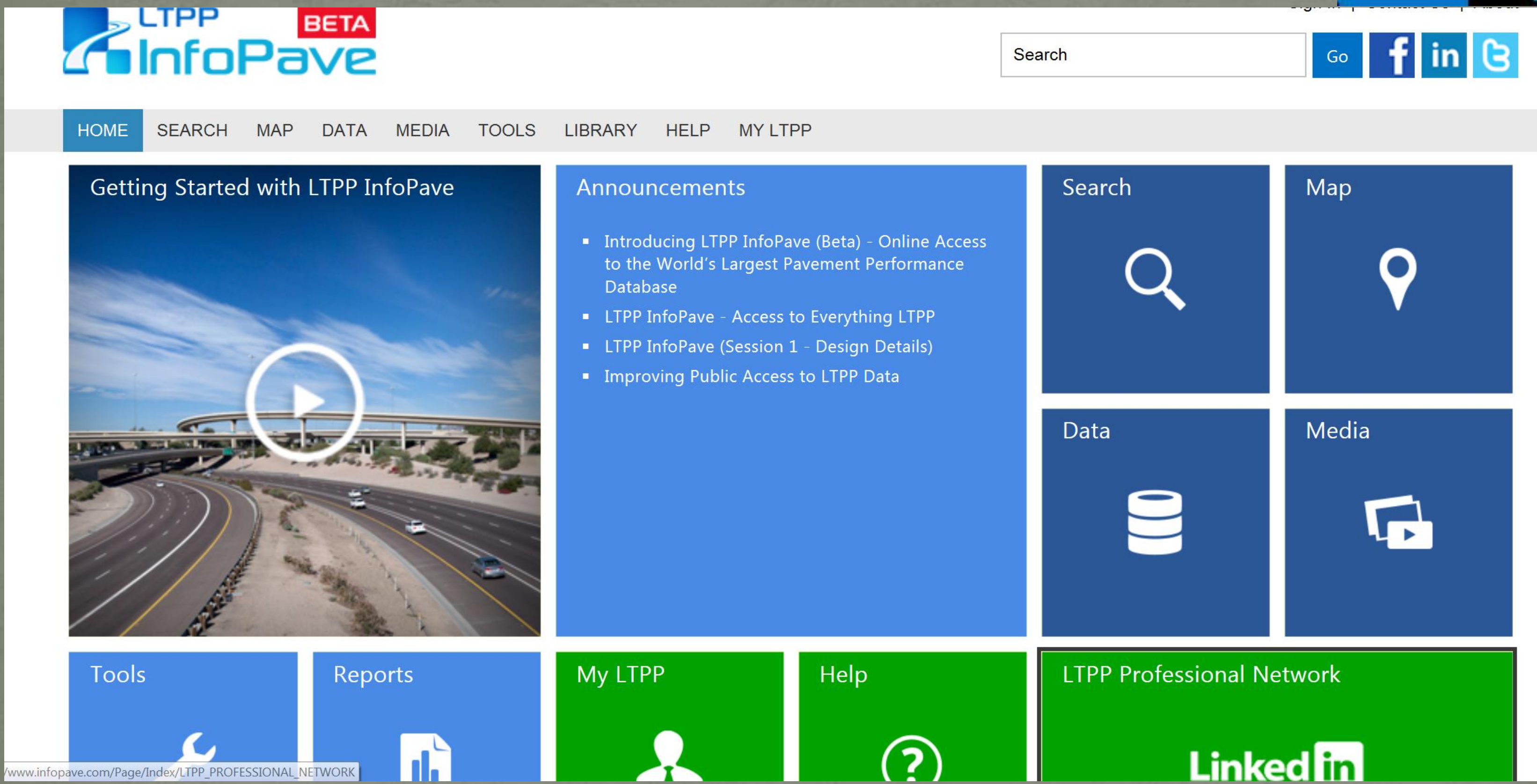
The LTPP program has generated a wide range of benefits all across the pavement engineering and performance spectrum.







InfoPave


LTPP
BETA
InfoPave
Search
Go
HOME
SEARCH
MAP
DATA
MEDIA
TOOLS
LIBRARY
HELP
MY LTPP
Getting Started with LTPP InfoPave
Announcements
Introducing LTPP InfoPave (Beta) - Online Access to the World's Largest Pavement Performance Database
LTPP InfoPave - Access to Everything LTPP
LTPP InfoPave (Session 1 - Design Details)
Improving Public Access to LTPP Data
Search
Map
Data
Media
Tools
Reports
My LTPP
Help
LTPP Professional Network
www.infopave.com/Page/Index/LTPP_PROFESSIONAL_NETWORK


Thank You
Questions?