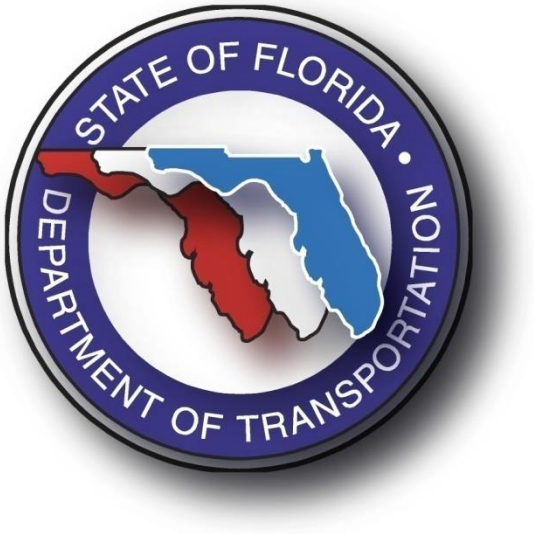
FDOT's Experience with Warm Mix Asphalt



Matt Corrigan (FHWA)
for
James A. Musselman, P.E.
State Bituminous Materials Engineer
Florida Department of Transportation

Florida's Highways

- Roadway System in Florida
  - 121,759 centerline miles of public roads
- State Highway System
  - 12,076 centerline miles
  - FDOT maintained
  - 10% of entire system
- Local Agencies:
  - 107,455 centerline miles

Florida's Highways

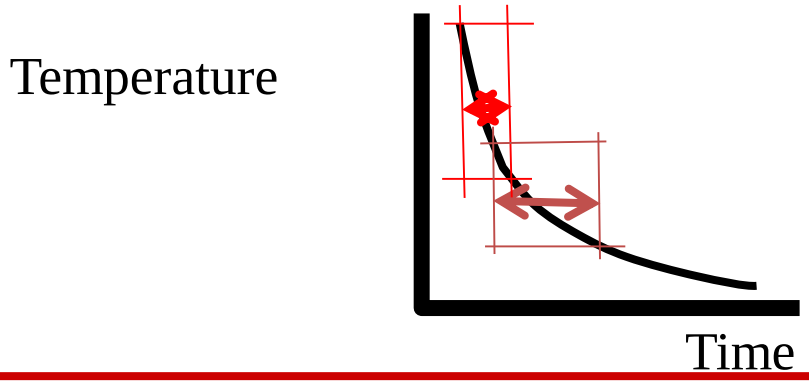
- State Highway System
  - State Roads, US & Interstate Highways:
  - 43,212 lane miles of roadway
  - 97.6% Asphalt
  - Carries more than 54% of all traffic in state
- 12.4 million tons of asphalt produced statewide
  - 4.9 million tons produced for FDOT
  - 39% of total statewide asphalt produced

Asphalt in Florida

	In-State	Out-of-State
Asphalt Contractors	44	2
Asphalt Plants	105	2
Asphalt Plants w/WMA	26	0

Benefits of Warm Mix (FDOT Perspective)

- Less aging of the asphalt binder
- Less emissions/fumes
- Easier to obtain density:
  - Able to pave in cooler weather due to slower cooling rate in working range
  - Increased Time Available for Compaction



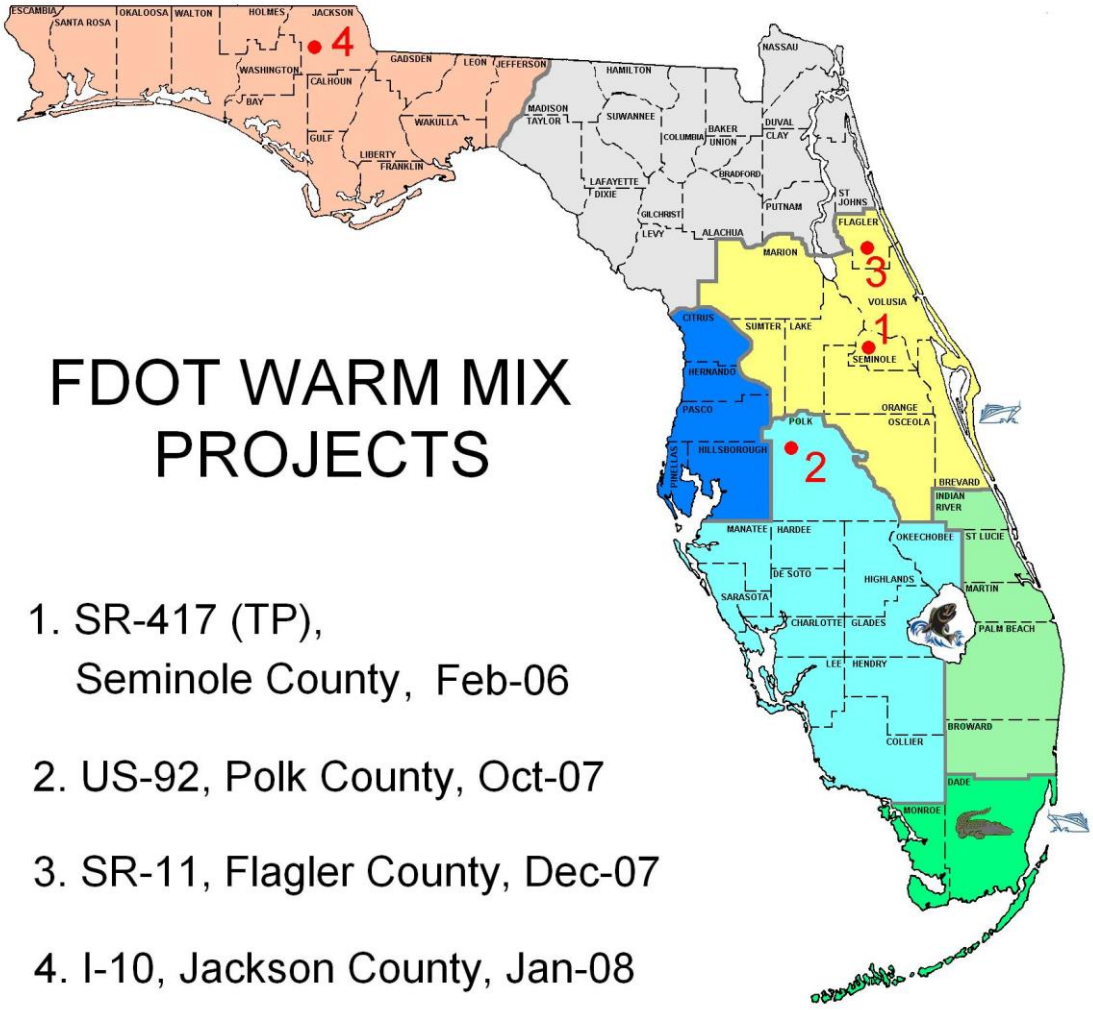
Initial Concerns with Warm Mix Asphalt

- Possibility of premature rutting
  - May require longer cure times
- Testing issues with highly absorptive aggregates
- Moisture susceptibility issues
- Impact of high RAP contents

History of WMA in Florida

- Pilot Projects:
  - February 2006: SR-417, Seminole County
    - Aspha-Min (Zeolite)
    - Open graded friction course
  - October 2007 – US-92, Polk County
    - Evotherm DAT
  - December 2007 – SR-11, Flagler County
    - Astec Double Barrel Green System
  - January 2008 – I-10, Jackson County
    - Astec Double Barrel Green System

Pilot Projects

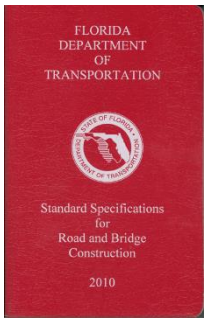


FDOT WARM MIX PROJECTS

1. SR-417 (TP),
   Seminole County, Feb-06
2. US-92, Polk County, Oct-07
3. SR-11, Flagler County, Dec-07
4. I-10, Jackson County, Jan-08

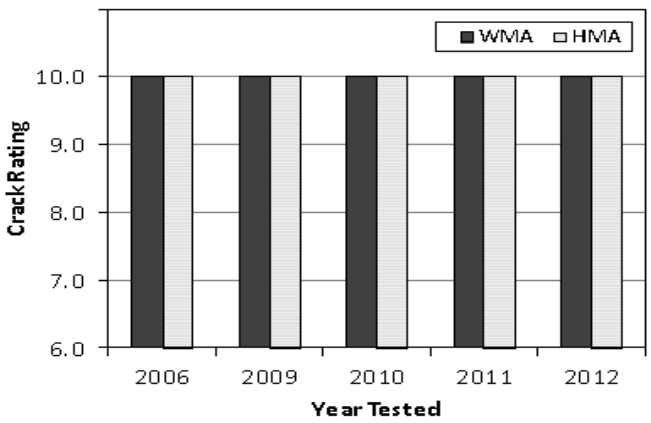
History of WMA in Florida

- Pilot Projects:
  - No constructability or testing issues were encountered
  - Performance tests looked good:
    - Superpave IDT (Energy Ratio and Fracture Energy) - Cracking
    - APA – Rutting
    - AASHTO T 283 –Moisture Susceptibility
  - Short-term pavement performance was good
- Adopted as Standard Specification January 2010
  - Contractor's Option

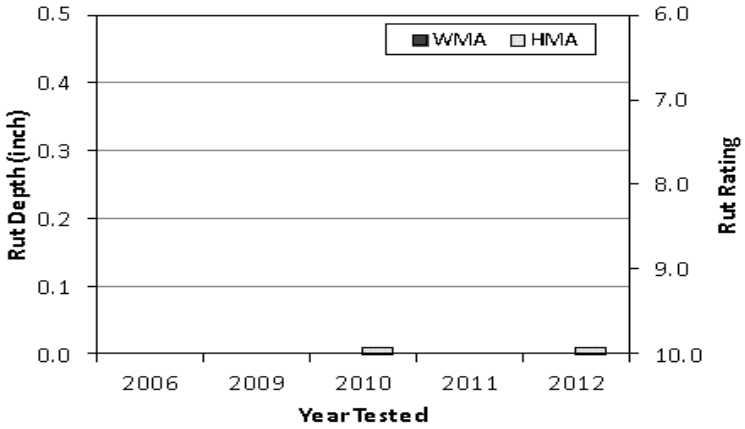


SR-417 Performance

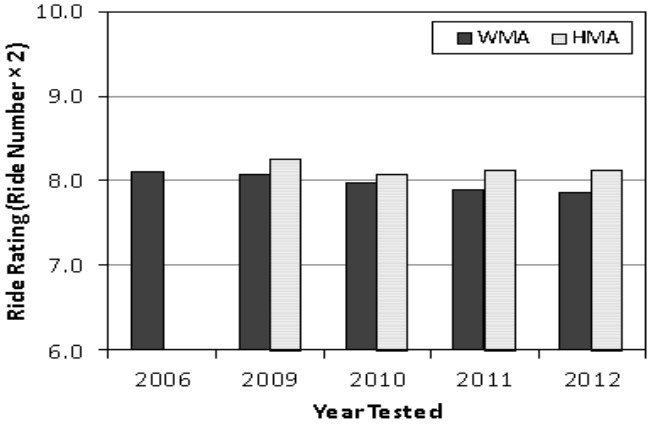
OGFC (Aspha-Min)



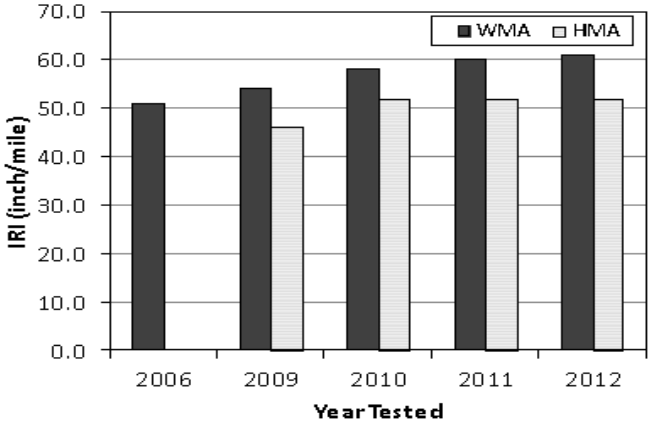
(a) Crack Rating



(b) Rut Rating



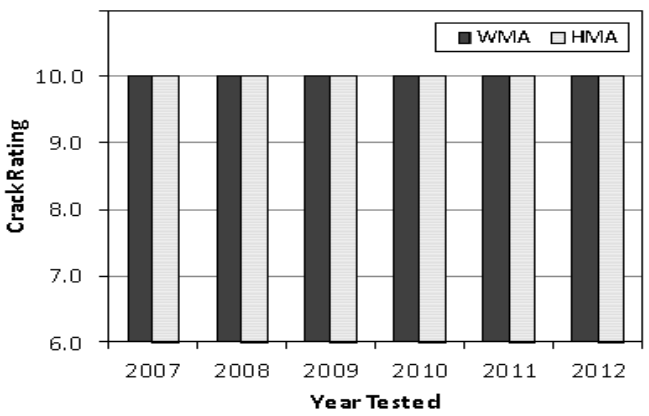
(c) Ride Rating



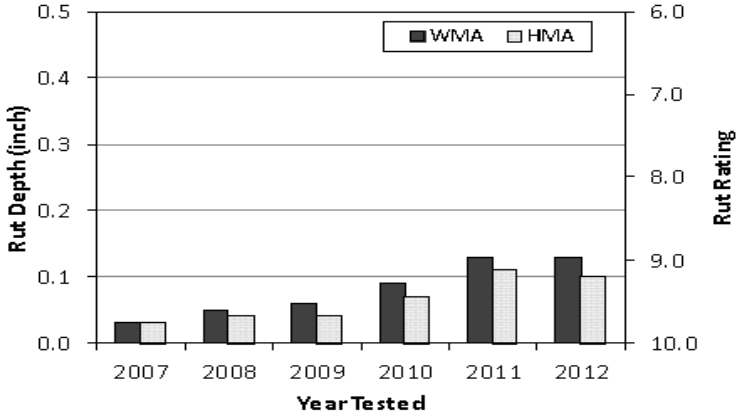
(d) IRI

US-92 Performance

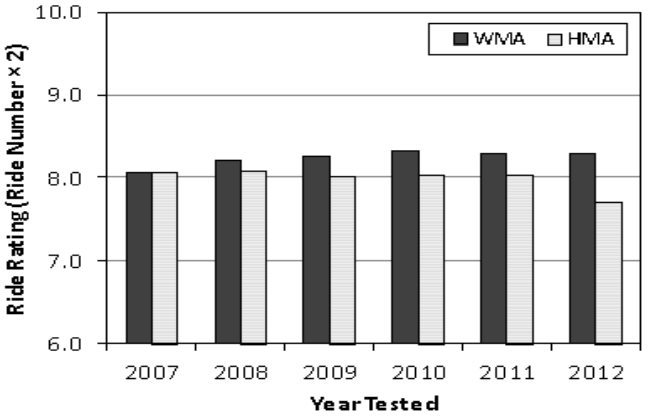
12.5 mm mix w/ Evotherm DAT



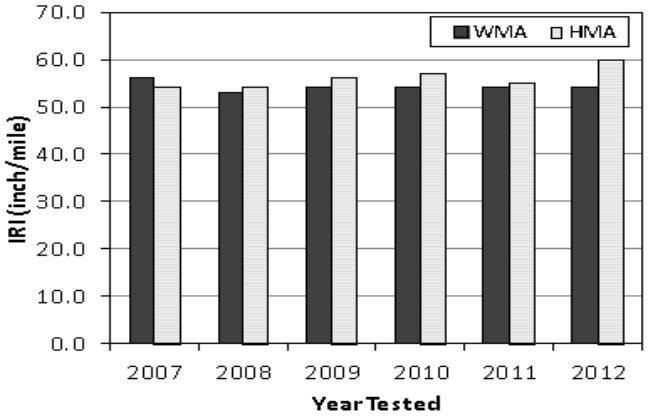
(a) Crack Rating



(b) Rut Rating



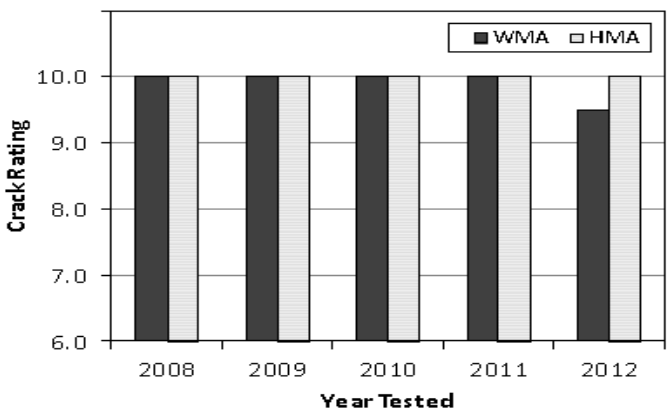
(c) Ride Rating



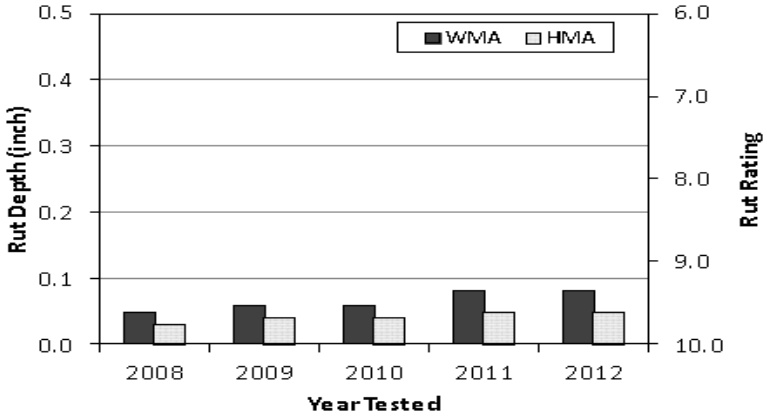
(d) IRI

SR-11 Performance

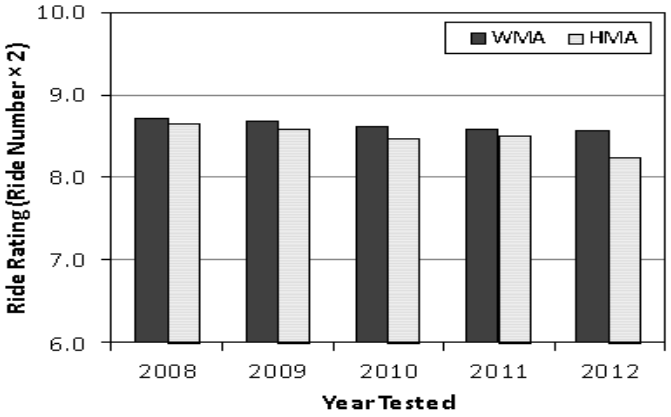
12.5 mm mix – Astec DBG



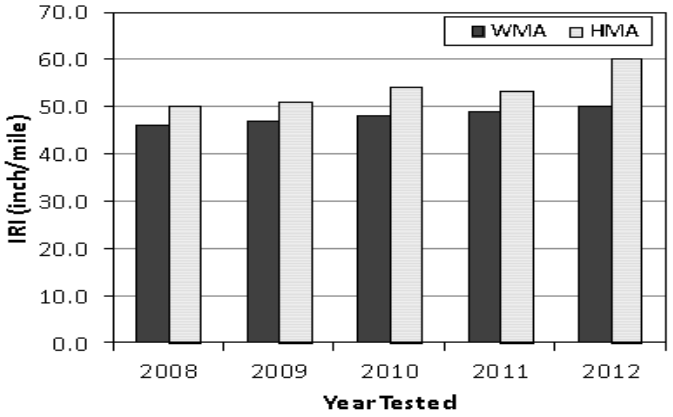
(a) Crack Rating



(b) Rut Rating



(c) Ride Rating



(d) IRI

FDOT Approved WMA Products/Processes

Process/Product	Number of Projects
Astec - Double Barrel Green	51
Meeker - Aqua Foam System	16
Terex - Warm Mix Asphalt System	10
MWV - Evotherm (DAT & M1)	6
Gencor - Ultra Foam	5
EUROVIA - Aspha-min	1
AESCO / Madsen - Eco-Foam II	1
Road Science - Cecabase RT 945	1

Temperature Data

	Plant	Road
Average HMA Temps:	311°F	309°F
Average WMA Temps:	272°F	270°F
Average Temperature Difference:	39°F	39 °F

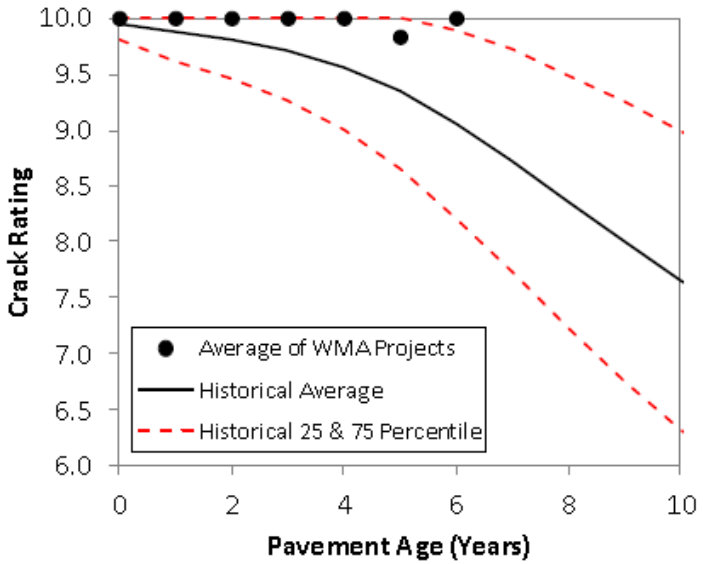
Construction Variability Analysis

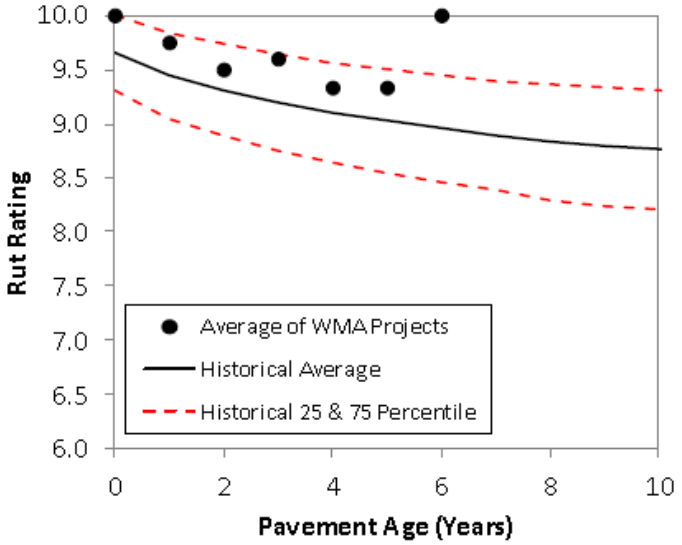
- Examined difference in standard deviations of QC test results for WMA and HMA.
  - Within the same project
  - Across projects
- 11 projects, 12 mixture types (3 OGFC mixtures, 9 - 12.5 mm mixtures
- No differences were seen between HMA and WMA variability.

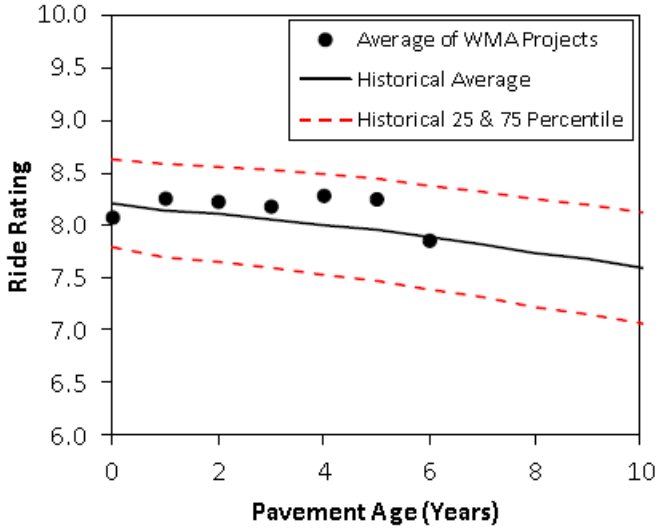
Comparison Performance

- Compared historical performance of all FDOT HMA projects over the last 35 years.
- Six WMA projects constructed between 2006 and 2010
  - 2 - 6 years old at time of analysis
- A different warm mix technology/product was used for each project.
- Performance of WMA appears comparable to HMA.

Comparison Performance







FDOT WMA Projects

Year	Number of Projects Constructed	Tonnage
2006	1	730
2007	2	7,856
2008	2	15,165
2009	15	191,030
2010	20	223,093
2011	23	280,025
2012	18	128,509
2013	8	130,240
Totals	**89**	**976,648**

Asphalt Quantities (FY 12/13)

- 12.4 million tons of asphalt produced *statewide*
- 4.9 million tons produced for FDOT
  - 39% of total statewide asphalt produced
- 141,000 tons WMA for FDOT
  - 2.8% of FDOT total

Why Not More WMA?

- Local government adoption is slow
- Down Economy ($$)
  - Initial investment
  - Increased risk to the contractor
  - Increased cost per ton of mix (i.e. chemical additives) affects the bids on an already competitive market.
- No contractor to champion warm mix

~~Initial~~ *Current* Concerns with Warm Mix Asphalt

- Possibility of premature rutting - None
- Testing issues with highly absorptive aggregates - None
- Moisture susceptibility issues – None so far
- Impact of high RAP contents - Uncertain

Observations/Conclusions

- Successful implementation
  - Slow, but successful
- Performance equivalent to HMA
- Beneficial to the environment and worker
- Long term performance history unknown
- Contractor option starting January 2010.
- The market will drive the process.