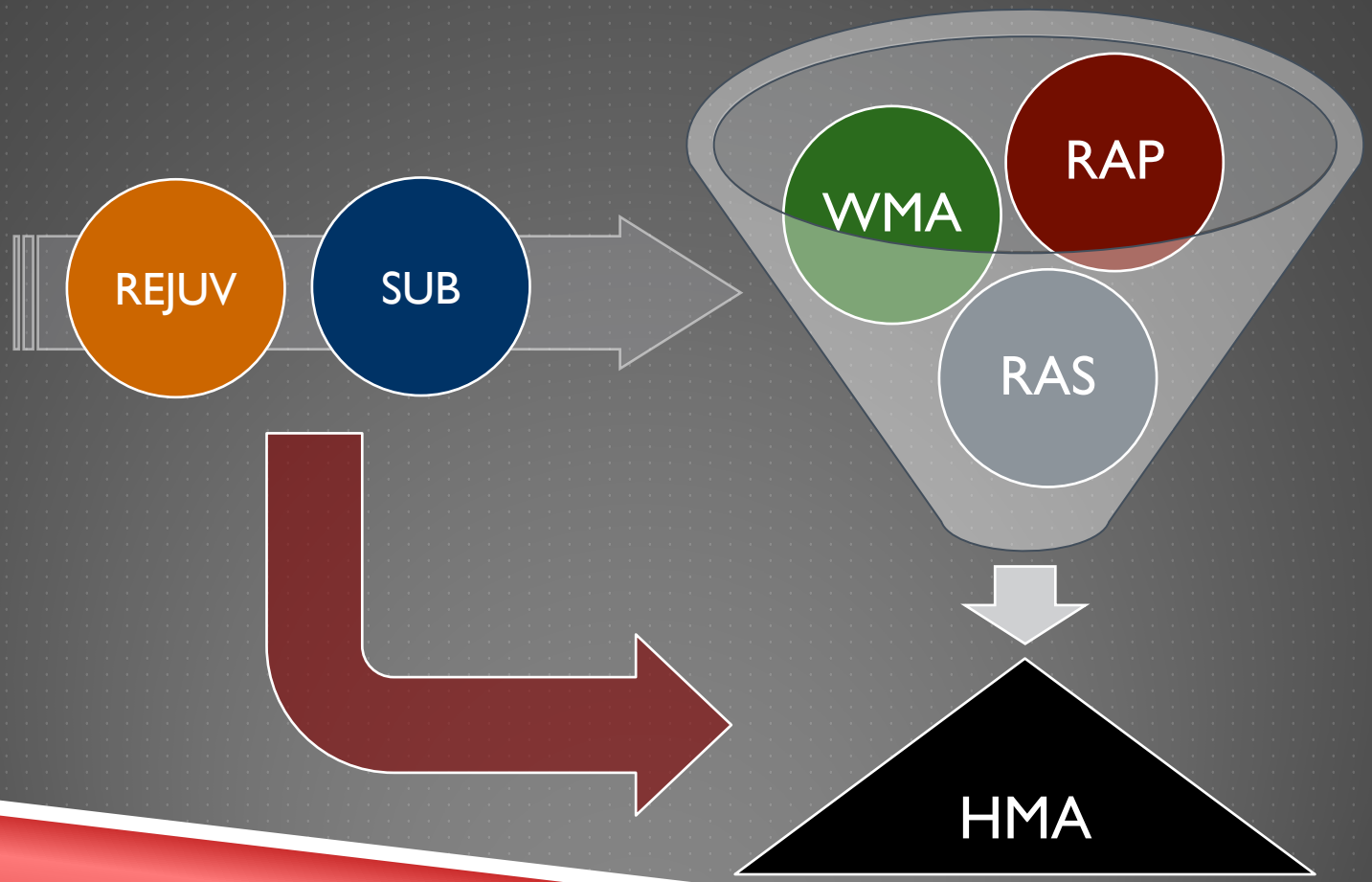
RESEARCH PROJECT 0-6738

Performance Studies and Future Directions for Mixes Containing RAP and RAS (and WMA)

OUTLINE

- Focus of the Project
- Recycled Materials Tables
- Recycled Materials Blending Program
- Specification Changes

PROJECT FOCUS



RECYCLED MATERIALS TABLES

from Special Specifications

3267 & 3268 DENSE GRADED

Mixture Description & Location	Maximum Ratio of Recycled Binder to Total Binder (%)	Maximum Allowable Weight % (Percent by Weight of Total Mixture)		
		Unfractionated RAP	Fractionated RAP	RAS
Surface	20 (30[1])	10	20	5
Intermediate	20 (35[1])	10	30	5
Base	20 (40[1])	10	40	5

1. Allowed when using WMA or softer low temperature binder grade.

Recycled Materials Blending Program - Dense Graded Mixes

Enter Fields Highlighted In Blue

Mixture Information

% Asphalt from JMF	5.0
Layer	Surface
Binder Grade	PG 70

Virgin Material Costs

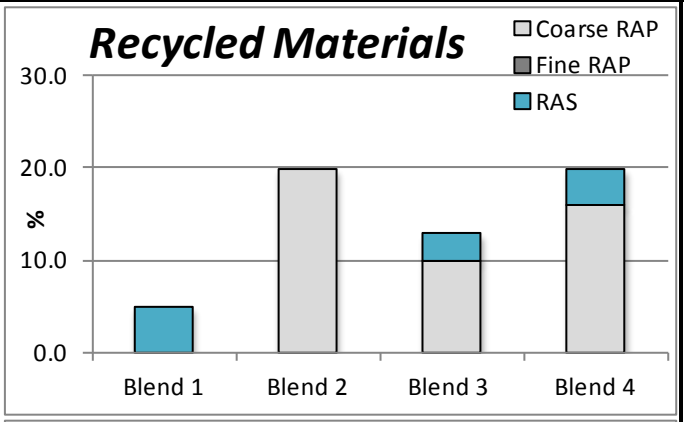
	$ / Ton
Aggregate	12.00
PG 76	736.00
PG 70	688.00
PG 64	584.00
Other	642.00
Price / Ton of Mix	$ 45.80

Recycled Material Costs

		$ / Ton	% Asphalt
1)	Coarse RAP	15.00	4.0
2)	Fine RAP	20.00	6.0
3)	RAS	25.00	20.0

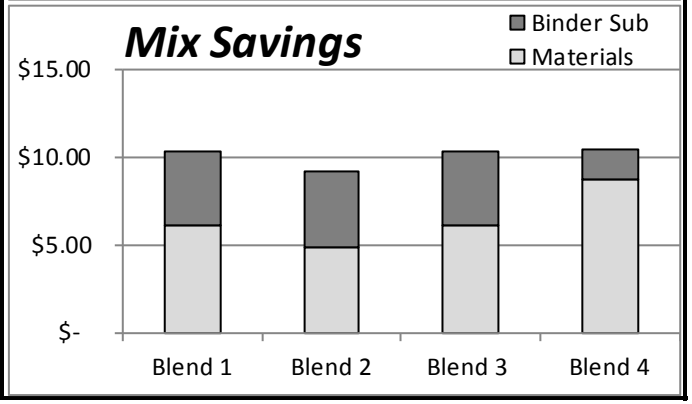
Blends

	Virgin	Blend 1	Blend 2	Blend 3	Blend 4
Binder Grade	PG 70	PG 64	PG 64	PG 64	Other
% Coarse RAP	0.0		20.0	10.0	16.0
% Fine RAP	0.0				
% RAS	0.0	5.0	0.0	3.0	4.0
% Recyled Material Limit	**20**				
% Recycled Binder	0.0	20.0	16.0	20.0	28.8
% Recycled Binder Limit	**30**				



Economics (Mix Savings)

	Virgin	Blend 1	Blend 2	Blend 3	Blend 4
Recycle Material Savings	$ -	$ 6.11	$ 4.81	$ 6.07	$ 8.73
Binder Substitution Savings	$ -	$ 4.16	$ 4.37	$ 4.16	$ 1.64
Total Savings	$ -	$ 10.27	$ 9.18	$ 10.23	$ 10.37
Adjusted Price/Ton	$ 45.80	$ 35.53	$ 36.62	$ 35.57	$ 35.43



Economics (Value of Recycled Material)

(Replacement Value - Cost)

Coarse RAP	$ 24.04
Fine RAP	$ 32.56
RAS	$ 122.20

3269 PFC

Mixture Description & Location	Maximum Ratio of Recycled Binder to Total Binder (%)	Maximum Allowable Weight % (Percent by Weight of Total Mixture)		
		Unfractionated RAP	Fractionated RAP	RAS
Surface	15	0	10	5

Recycled Materials Blending Program - PFC

Enter Fields Highlighted In Green

Surface Mixture Information

	% Asphalt from JMF
PG 76	6.3
AR	8.4

Virgin Material Costs

	$ / Ton
Aggregate	12.00
PG 76	736.00
AR	725.00

	Price / Ton of Mix
PG 76	$ 57.61
AR	$ 71.89

Recycled Material Costs

		$ / Ton	% Asphalt
1)	Coarse RAP	15.00	4.0
2)	Fine RAP	20.00	6.0
3)	RAS	25.00	20.0

Blends

	Virgin	Blend 1	Blend 2	Blend 3	Blend 4
Binder	AR	PG 76	PG 76	AR	AR
% Coarse RAP	0.0		7.0		10.0
% Fine RAP	0.0				
% RAS	0.0	4.0	3.0	4.0	
% Recyled Material Limit	**10**				
% Recycled Binder	0.0	12.7	14.0	9.5	4.8
% Recycled Binder Limit	**15**				

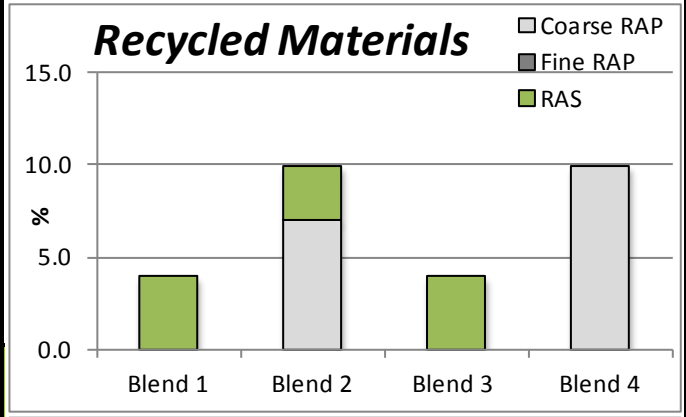
Economics (Mix Savings)

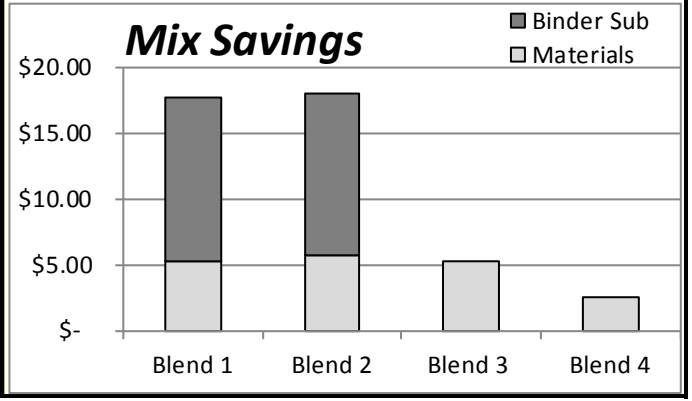
	Virgin	Blend 1	Blend 2	Blend 3	Blend 4
Recycle Material Savings	$ -	$ 5.18	$ 5.67	$ 5.18	$ 2.55
Binder Savings	$ -	$ 12.47	$ 12.29	$ -	$ -
Total Savings	$ -	$ 17.65	$ 17.96	$ 5.18	$ 2.55
Adjusted Price/Ton	$ 71.89	$ 54.24	$ 53.93	$ 66.71	$ 69.34

Economics (Value of Recycled Material)

(Replacement Value - Cost)

Coarse RAP	$ 25.52
Fine RAP	$ 34.78
RAS	$ 129.60





3270 SUPERPAVE

Mixture Description & Location	Maximum Ratio of Recycled Binder to Total Binder (%)	Maximum Allowable Weight % (Percent by Weight of Total Mixture)		
		Unfractionated RAP	Fractionated RAP	RAS
Surface	20 (30[1])	10	20	5
Intermediate	20 (35[1])	10	25	5
Base	20 (40[1])	10	30	5

1. Allowed when using WMA or softer low temperature binder grade.

Recycled Materials Blending Program - Superpave

Enter Fields Highlighted In Orange

Mixture Information

% Asphalt from JMF	5.5
Layer	Surface
Binder Grade	PG 70

Virgin Material Costs

	$ / Ton
Aggregate	12.00
PG 76	736.00
PG 70	688.00
PG 64	584.00
Other	642.00
Price / Ton of Mix	$ 49.18

Recycled Material Costs

		$ / Ton	% Asphalt
1)	Coarse RAP	15.00	4.0
2)	Fine RAP	20.00	6.0
3)	RAS	25.00	20.0

Blends

	Virgin	Blend 1	Blend 2	Blend 3	Blend 4
Binder Grade	PG 70	PG 70	PG 64	PG 64	Other
% Coarse RAP	0.0		20.0	10.0	15.0
% Fine RAP	0.0				
% RAS	0.0	5.0		3.0	5.0
% Recyled Material Limit	**20**				
% Recycled Binder	0.0	18.2	14.5	18.2	29.1
% Recycled Binder Limit	**30**				

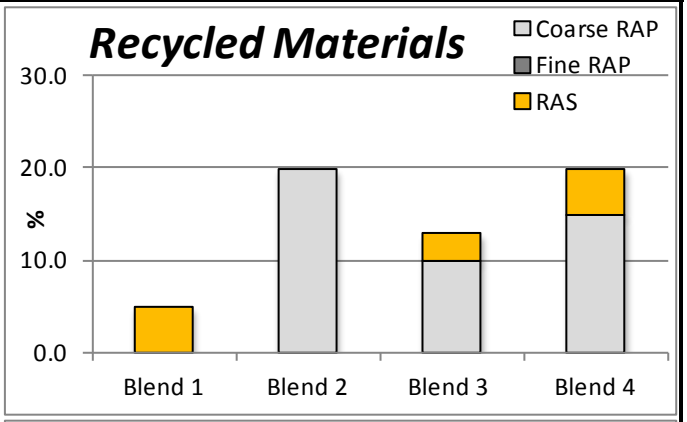
Economics (Mix Savings)

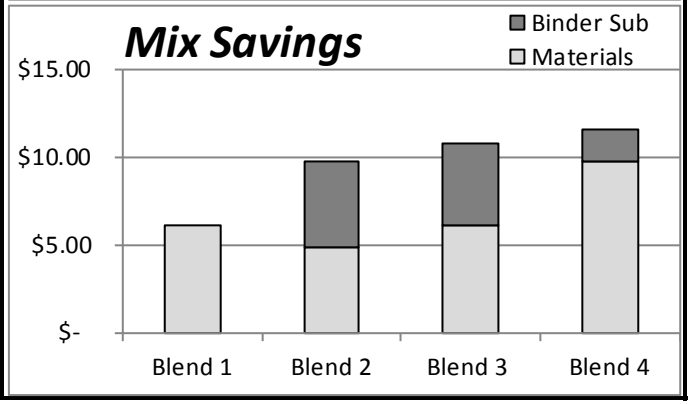
	Virgin	Blend 1	Blend 2	Blend 3	Blend 4
Recycle Material Savings	$ -	$ 6.11	$ 4.81	$ 6.07	$ 9.72
Binder Substitution Savings	$ -	$ -	$ 4.89	$ 4.68	$ 1.79
Total Savings	$ -	$ 6.11	$ 9.70	$ 10.75	$ 11.51
Adjusted Price/Ton	$ 49.18	$ 43.07	$ 39.48	$ 38.43	$ 37.67

Economics (Value of Recycled Material)

(Replacement Value - Cost)

Coarse RAP	$ 24.04
Fine RAP	$ 32.56
RAS	$ 122.20





3271 SMA

Mixture Description & Location	Maximum Ratio of Recycled Binder to Total Binder (%)	Maximum Allowable Weight % (Percent by Weight of Total Mixture)		
		Unfractionated RAP	Fractionated RAP	RAS
Surface	15	0	15	5
Non-surface	20	0	20	5

Recycled Materials Blending Program - SMA

Enter Fields Highlighted In Purple

Surface Mixture Information

	% Asphalt from JMF
PG 76	6.1
AR	8.0
Layer	Surface

Virgin Material Costs

	$ / Ton
Aggregate	12.00
PG 76	736.00
AR	725.00

	Price / Ton of Mix
PG 76	$ 56.16
AR	$ 69.04

Recycled Material Costs

		$ / Ton	% Asphalt
1)	Coarse RAP	15.00	4.0
2)	Fine RAP	20.00	6.0
3)	RAS	25.00	20.0

Blends

	Virgin	Blend 1	Blend 2	Blend 3	Blend 4
Binder	AR	AR	AR	PG 76	PG 76
% Coarse RAP	0.0	15.0	10.0	15.0	7.0
% Fine RAP	0.0				
% RAS	0.0		4.0		3.0
% Recyled Material Limit	**15**				
% Recycled Binder	0.0	7.5	15.0	9.8	14.4
% Recycled Binder Limit	**15**				

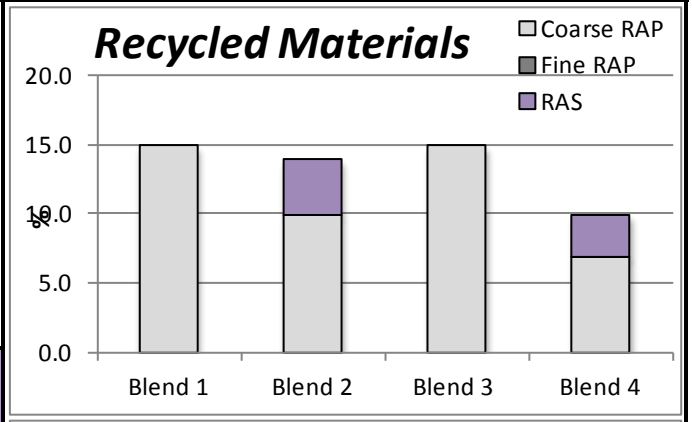
Economics (Mix Savings)

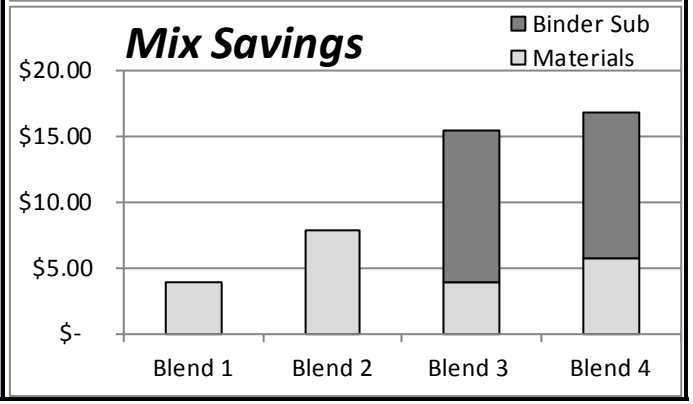
	Virgin	Blend 1	Blend 2	Blend 3	Blend 4
Recycle Material Savings	$ -	$ 3.83	$ 7.74	$ 3.83	$ 5.67
Binder Savings	$ -	$ -	$ -	$ 11.61	$ 11.02
Total Savings	$ -	$ 3.83	$ 7.74	$ 15.44	$ 16.69
Adjusted Price/Ton	$ 69.04	$ 65.21	$ 61.30	$ 53.60	$ 52.35

Economics (Value of Recycled Material)

(Replacement Value - Cost)

Coarse RAP	$ 25.52
Fine RAP	$ 34.78
RAS	$ 129.60





SPECIFICATION CHANGES

REGARDING RAS & RAP

- Add sand meeting the requirements of Table 1 and Table 2 or fine RAP to RAS stockpiles if needed to keep the processed material workable. For any stockpile that contains RAS, the entire stockpile will be considered a RAS stockpile and be limited to no more than 5.0% of the HMA mixture in accordance with Table 4.

SPECIFICATION CHANGES

REGARDING RAS & RAP

- During HMA production, use a separate cold feed bin for each stockpile of RAP and RAS.

SPECIFICATION CHANGES

REGARDING RAS & RAP

- When RAP or RAS is used, calculate and ensure that the ratio of the recycled asphalt binder to total binder does not exceed the percentages shown in Table 5 during mixture design and HMA production.

SPECIFICATION CHANGES

REGARDING RAS & RAP

- **JMF Adjustments.** If necessary, adjust the JMF before beginning a new lot. The adjusted JMF must:
  - Be provided to the Engineer in writing before the start of a new lot.
  - Be numbered in sequence to the previous JMF.
  - Meet the mixture requirements in Table 4 and Table 5.
  - Meet the master gradation limits shown in Table 6.
  - Be within the operational tolerances of JMF2 listed in Table 9.

QUESTIONS?