



Asphalt Rubber

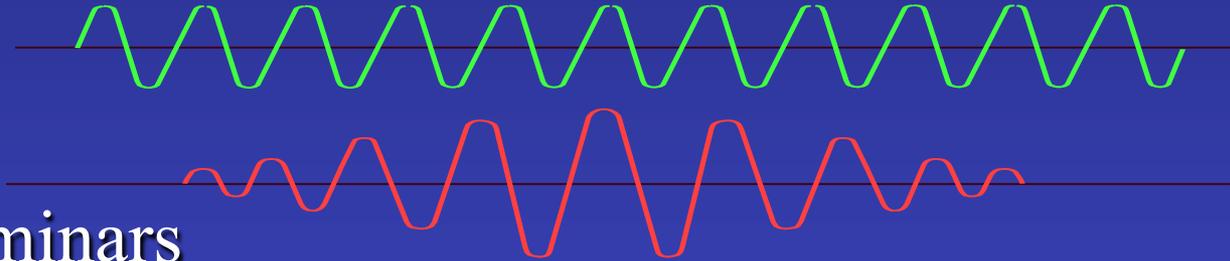
Theron Roschen, PE

Quincy Engineering

With assistance from:

The California Department of Resources Recycling and Recovery
(CalRecycle)

NO COST TECHNOLOGY TRANSFER THROUGH



- Seminars
- Field Assistance
- Technical Reviews
- Guidelines
- Grant Assistance

Why should an agency choose asphalt rubber strategies?



- Has a long term performance history (over 35 years)
- Allows for 2% higher binder contents in mixes
- Greater film thickness improved durability and longer life
- Higher viscosity (Rut resistant)
- Higher softening point

Why choose asphalt rubber?



- Less maintenance
- Resistance to reflective cracking
- Established life cycle cost-effectiveness
- Can be used in reduced thickness
- Proven alternative to costly reconstruction
- Quieter pavements (4dB 6-year study)

California Scrap Tire Overview

- ❖ Generates 30 – 33 million scrap tires/year
- ❖ \$1.75 per tire collected for CalRecycle (Grants)
- ❖ Tires in stockpiles





Asphalt-Rubber as defined by ASTM D8-88

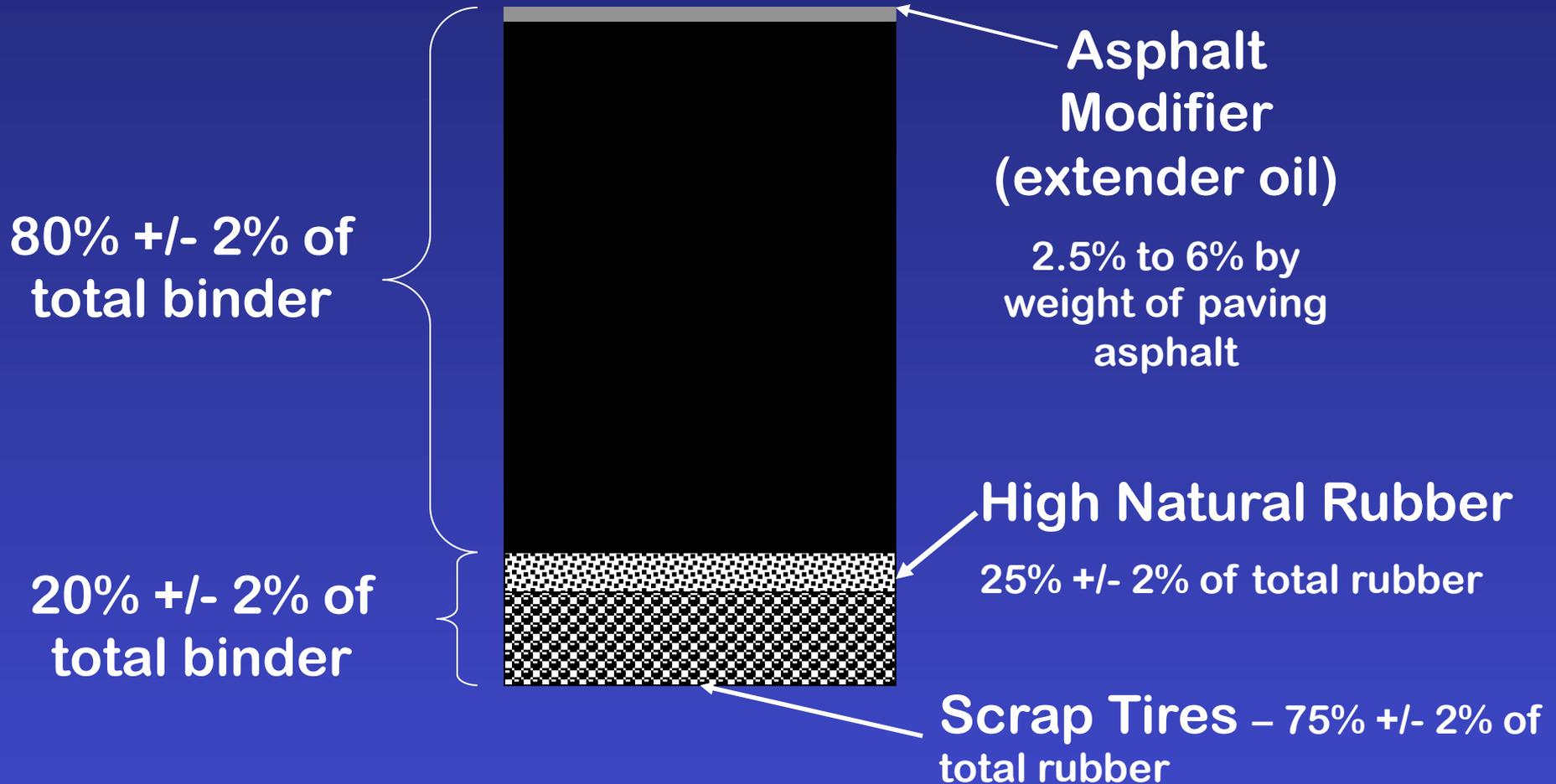
“Asphalt-Rubber is a blend of asphalt cement, reclaimed tire rubber and certain additives, in which the rubber component is at least 15% by weight of the total blend and has reacted in the hot asphalt cement sufficiently to cause swelling of the rubber particles.”



Type 1 Asphalt-Rubber Binder - Paving grade asphalt and reclaimed vulcanized rubber.

Type 2 Asphalt-Rubber Binder - Paving grade asphalt, extender oil, high natural and reclaimed vulcanized rubber.

Terminal Blend - Paving grade asphalt, polymers, and reclaimed vulcanized rubber digested into asphalt at the refinery



Greenbook Type II Asphalt Rubber

Terminal Blend Tire Rubber Asphalt

- ⦿ Modified binder that contains recycled tire rubber
- ⦿ Manufacture that completely digests tire rubber particles into an asphalt binder
- ⦿ Refined for approximately 16 hours, under great pressure and temperature
- ⦿ Non proprietary product
- ⦿ Meets existing PG grading system
- ⦿ Material comes ready to use upon arrival
- ⦿ Polymers may be added
- ⦿ Meets CalRecycle Grants

Viscosity is what defines Asphalt-Rubber Binder

Asphalt-Rubber
1,500 to 2,500
Centipoises At 375°
Extremely Viscous

Rubberized Asphalt
Terminal Blend
300 to 600
Centipoises At 325°

Granulation 2 Inch Chips Reduced to $\frac{3}{4}$ Inch While Separating Steel



Granulation $\frac{3}{4}$ Inch Reduced to $\frac{3}{8}$ Inch While Separating Fabric and Steel



Finish Product and Bagging



2,000 recycled tires per lane mile for a 2-inch overlay

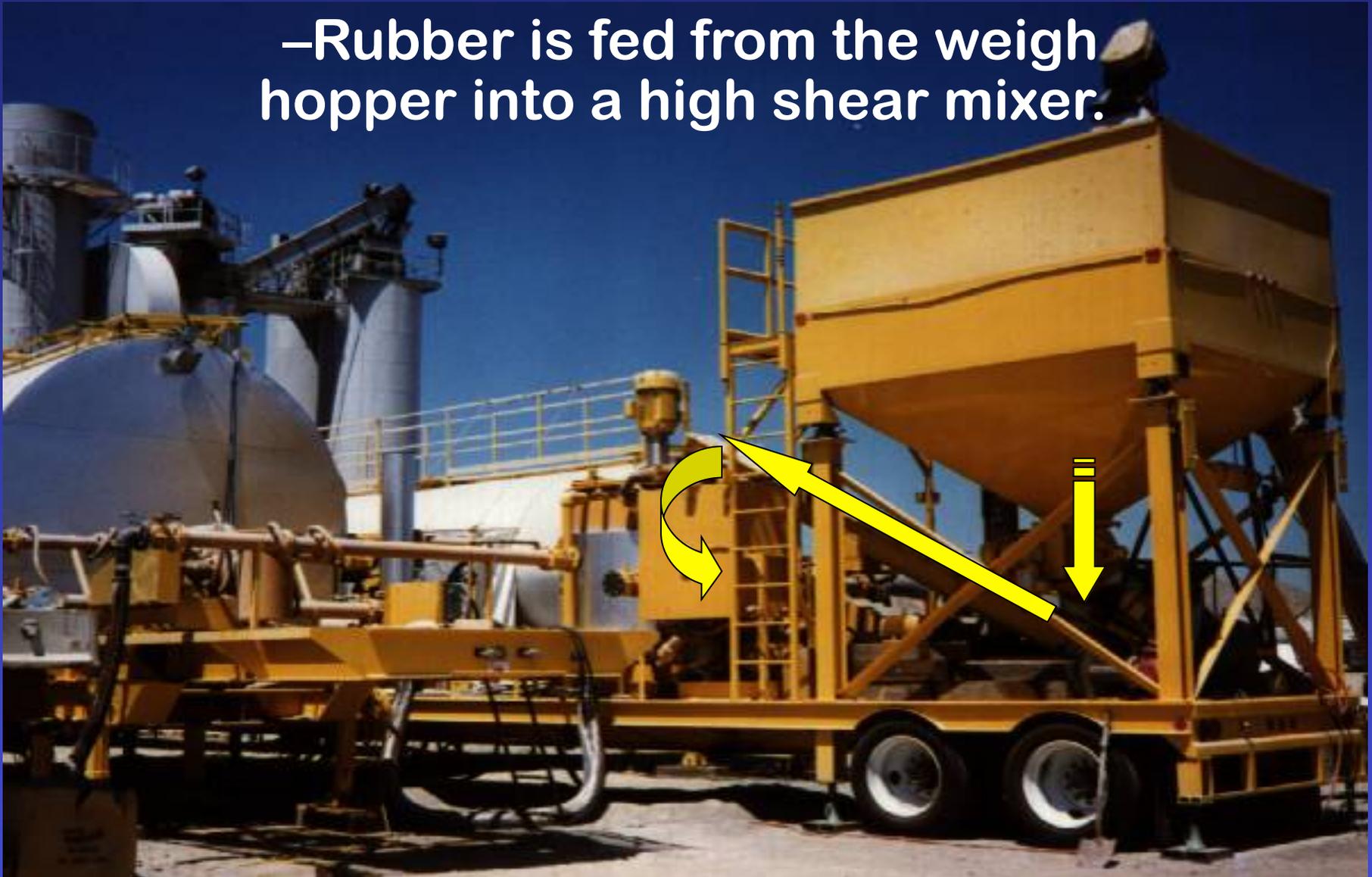
2.4 tires per ton



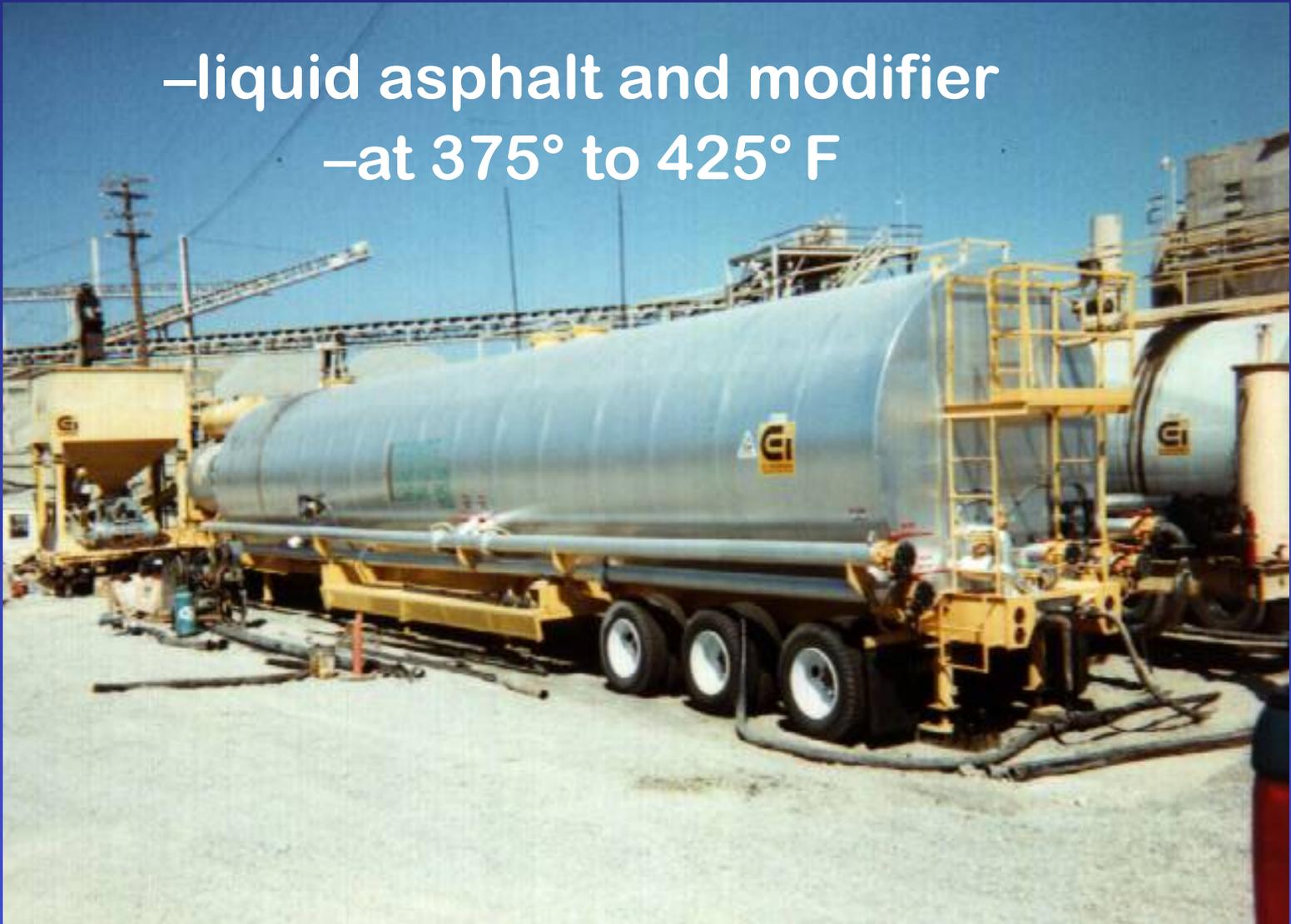
Ground tire rubber in 2,000 pound “Supersacks”



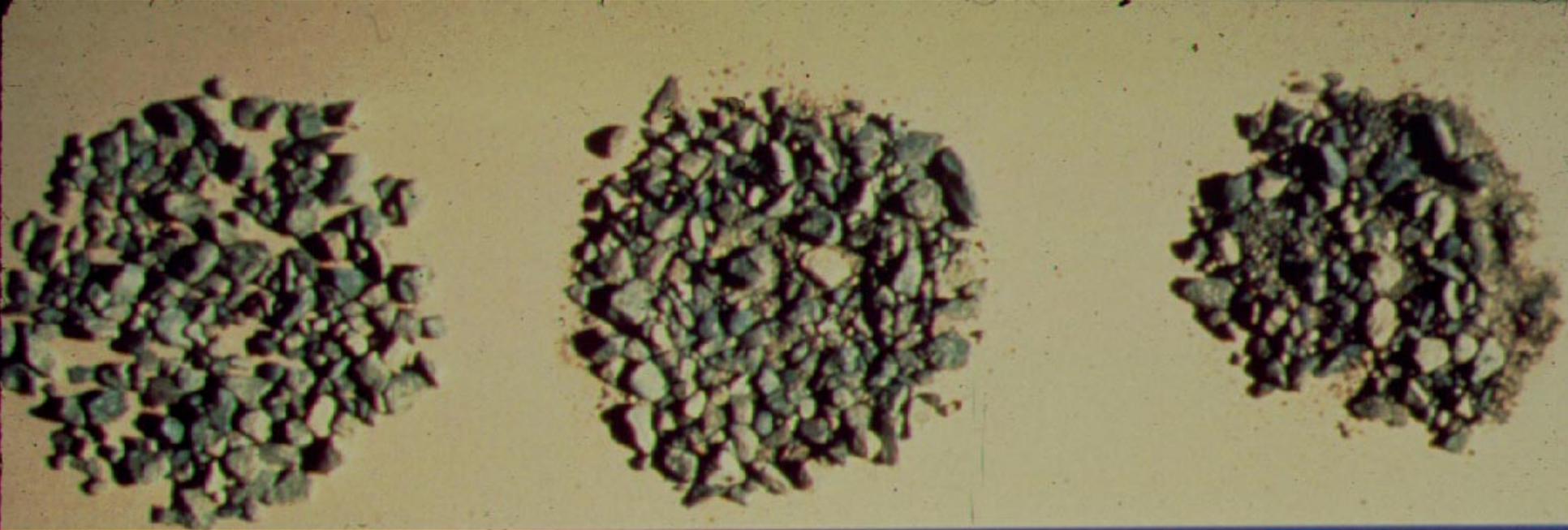
–Rubber is fed from the weigh hopper into a high shear mixer.



–liquid asphalt and modifier
–at 375° to 425° F



Aggregate Gradation Comparison



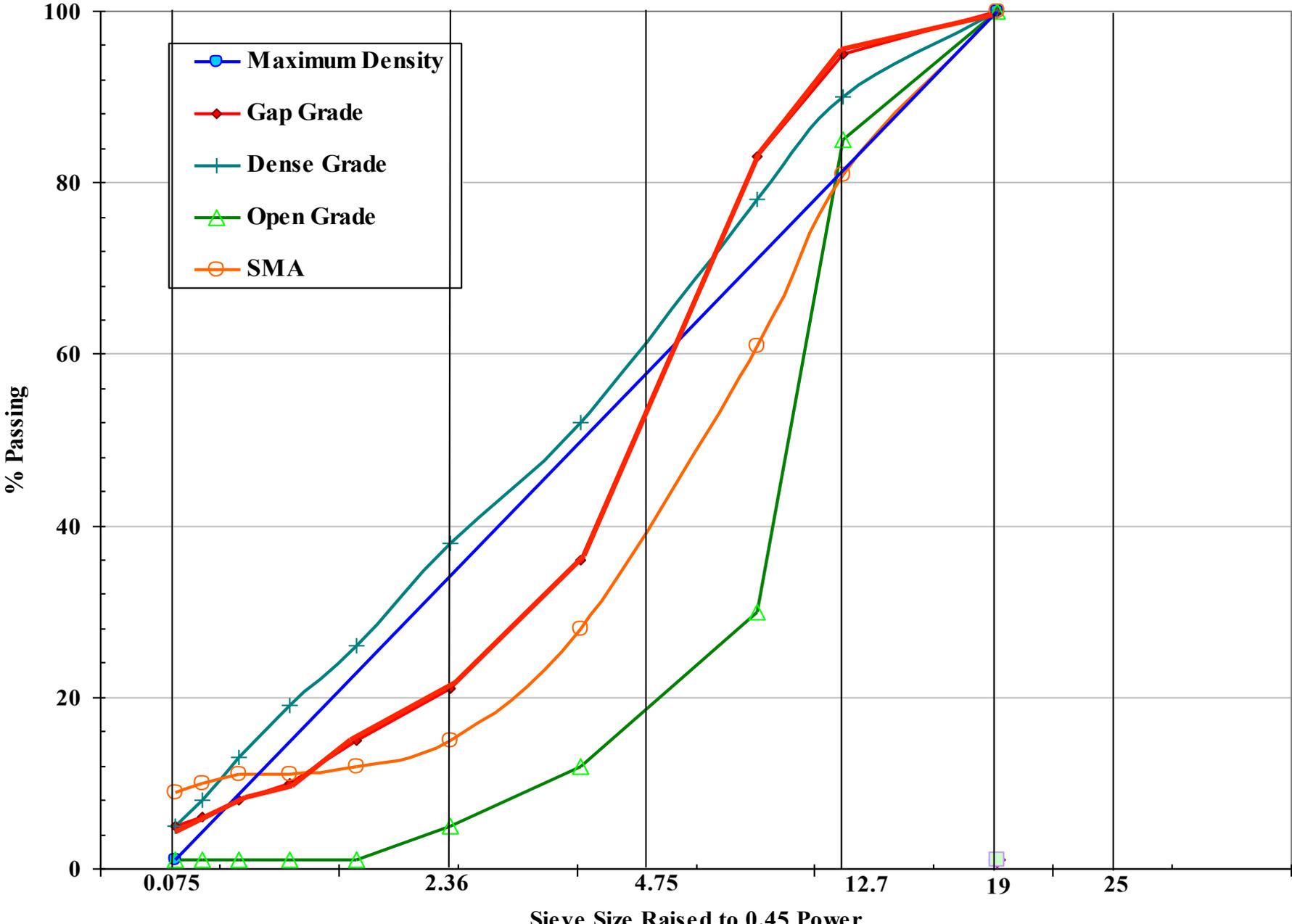
Open Graded

Gap Graded

Dense Graded



Composite Power 45 Chart



Cost Factors



- When AR is in production the plant can not make conventional
- Haul distance and ambient temperatures
- Traffic control for cooling time

Contractor's Cost Issues



- Small Projects = LARGE UNIT COSTS!!
 - Expensive move-in
 - Fixed daily costs
- Agencies can save \$\$ with coordination/procurement
- Rubber Plant may limit Production Rate
- Bidding in the Winter will allow efficient scheduling for the upcoming season
- Be flexible

Design of Asphalt Rubber Pavements

- Uses a deflection based design method
- Up to 50 % reduction in thickness compared to conventional AC design thickness to retard reflective cracking
- Over 1000 reduced thickness projects



Heavy Vehicle Simulator – UC Davis



Heavy Vehicle Simulator – UC Davis

Performance

Repetitions	Wheel Load	AC Overlay Section (3")	ARHM-GG Section (1.5")	ARHM-GG Section (1")
0-100,000	40kN	Fine cracks at 100,000	—	—
100,000 to 175,000	40kN	Block cracks at 175,000	—	—
Wheel load Changed to 80 kN				
175,000 to 200,000	80kN	Completely cracked	—	Fine cracks
200,000 to 237,000	80kN	Test stopped	—	Completely cracked
Surface Temperature Reduced to -5 C				
237,000 to 250,000	80kN	Test stopped	1/2 of section cracked	Test stopped



3" Conv. AC



1 1/2" ARHM

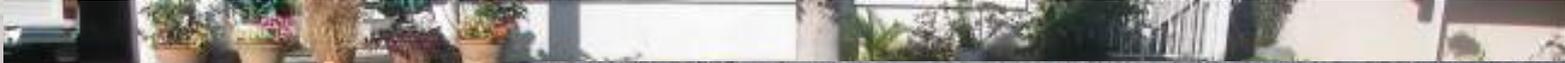


1" ARHM

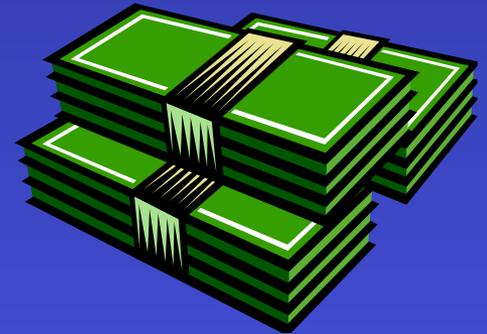
Performance in Indio, CA



11/06/2002



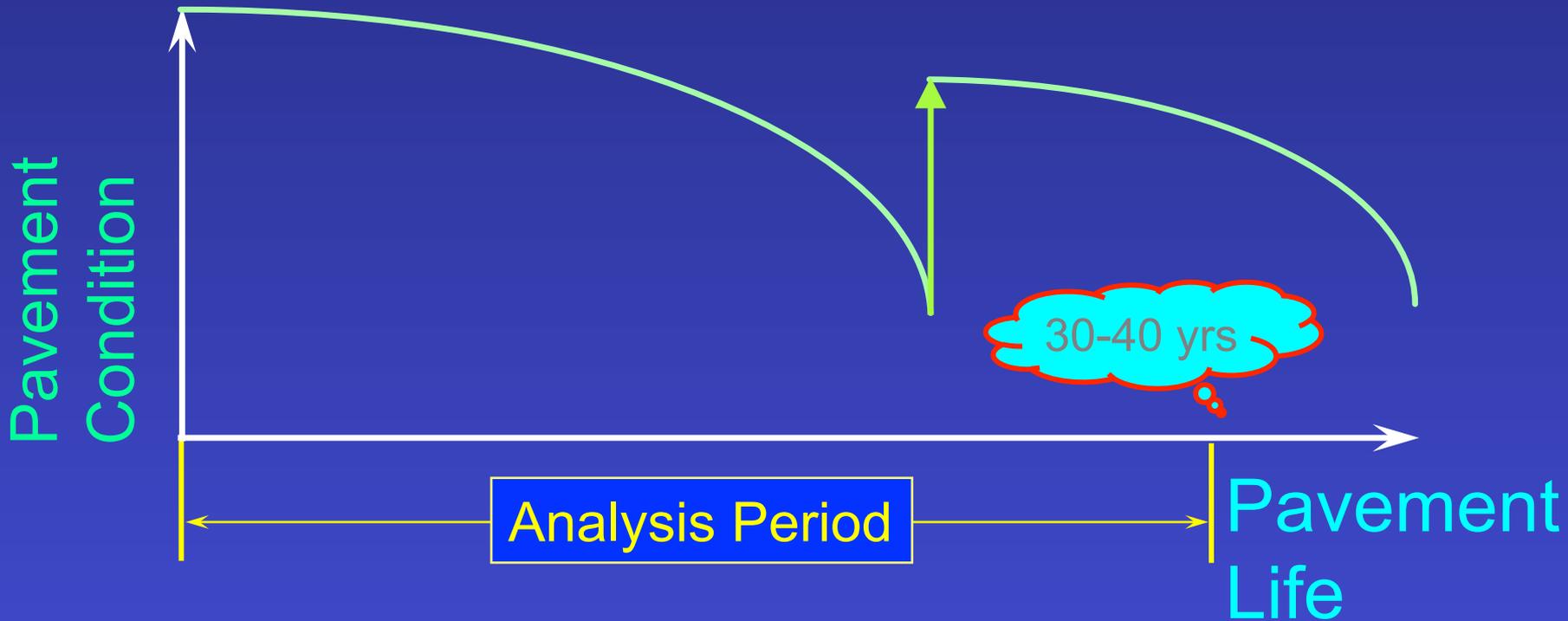
Cost Effectiveness of AR and Life Cycle Analysis UNR & Oregon State



LCCA Process

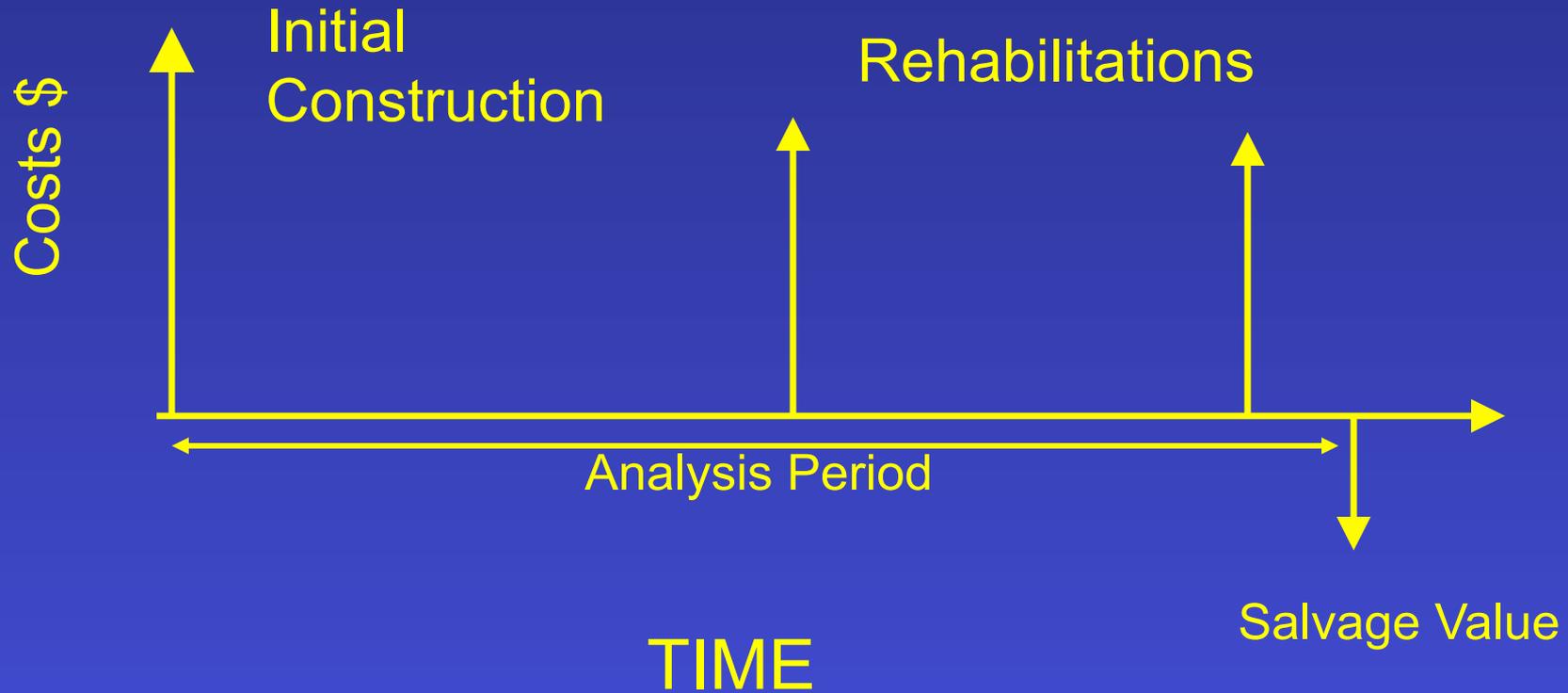
- Establish strategies for analysis period
- Establish M&R activity timing
- Estimate agency costs
- Estimate user and non-user costs
- Develop expenditure streams
- Compute net-present value
- Analyze results

Analysis Period



Include at least one Rehab.

Typical Expenditure Stream



Net Present Value



Results - Deterministic Approach

Scenario	Present Worth (\$/yd)	
	<u>Total</u>	<u>Savings w/ AR</u>
Preservation - Chip Seal		
Conventional	18.39	
AR	15.87	2.52
Preservation - Thin HMA		
Conventional	20.69	
AR	17.33	3.36
Structural Overlay		
Conventional	21.97	
AR	14.63	7.34

Results - Probabilistic Model

<u>Scenario</u>	<u>Percentage of times savings result using AR</u>
Preservation - chip seal	86
Preservation - thin HMA	82
Structural Overlay	86

Chico State – Caltrans Update

District	Deterministic Results – Percent Saving	Probabilistic Results – Average Percent Savings
2	3%	3%
3	6%	5%
4	20%	18%
5	36%	36%
6	28%	27%
7	21%	20%
8	29%	28%
10	35%	35%
11	20%	19%
12	36%	34%

Video

Best Practices



Viscometer Testing

- Test @ 350° F
- Stir binder
- Read peak viscosity
- Average 3 readings



Process Control @ Plant

- Check plant certification
- Samples
 - Paving asphalt
 - Crumb rubber
 - AR binder
 - Aggregate
- Certificates of Compliance
- Temperatures

Temp of ARHM-GG

**SHOULD
MINIMUM
315 F LEA
PLAN**



HEAT

- Virgin Asphalt Temp: >375° F
- Reaction Temperature: 375°- 425° F
- Mix Temp @ Plant: 315°- 325° F
- 1st Breakdown: >280° F
- All compaction: >250° F
- Ambient/Surface Temp: >55° F

Multicool



MultiCool 3.0 - Multilayer Pavement Cooling Program

File View Help



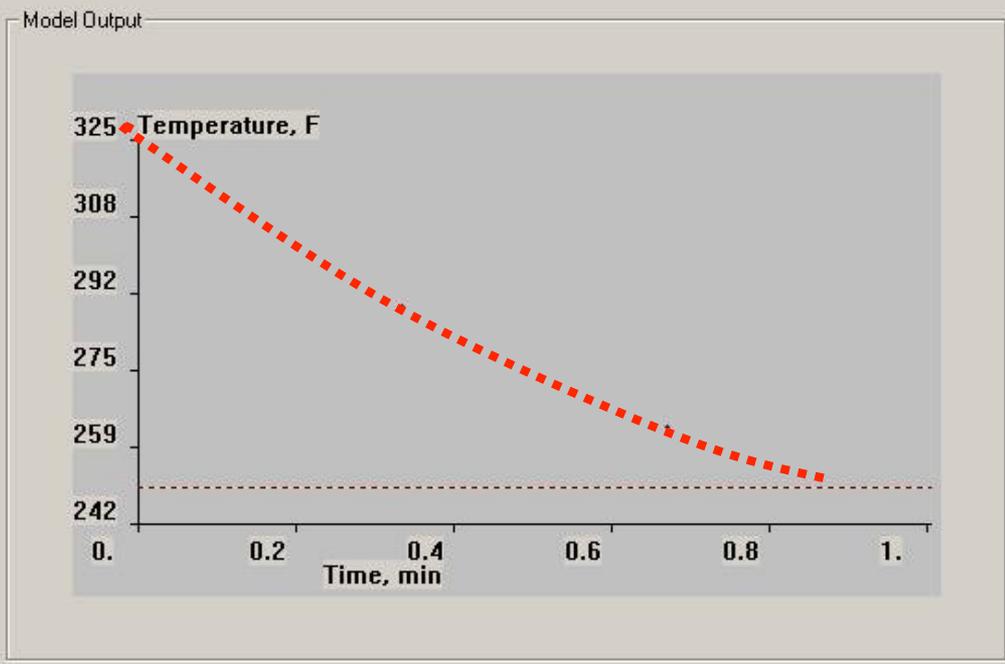
Start Time
(24-hour clock)
Hour: 13
Minutes: 45
DATE
Month: 5
Day: 3
Year: 2010

Environmental Conditions
Ambient Air Temp: 50 F
Average Wind Speed: 15 mph
Sky Conditions: Overcast
Latitude (Deg North): 38
Update to Current Time

Existing Surface
Material Type: AC
State of Moisture: [dropdown]
Moisture Content: [dropdown]
Surface Temp.: 50 F

Mix Specifications
Number of Lifts: 1
Lift Number: 1
Next Lift
Mix Type: SMA
PG Grade: 76 -22
Lift Thickness: 0.5 in.
Delivery Temp: 325 F
Stop Temp: 250 F

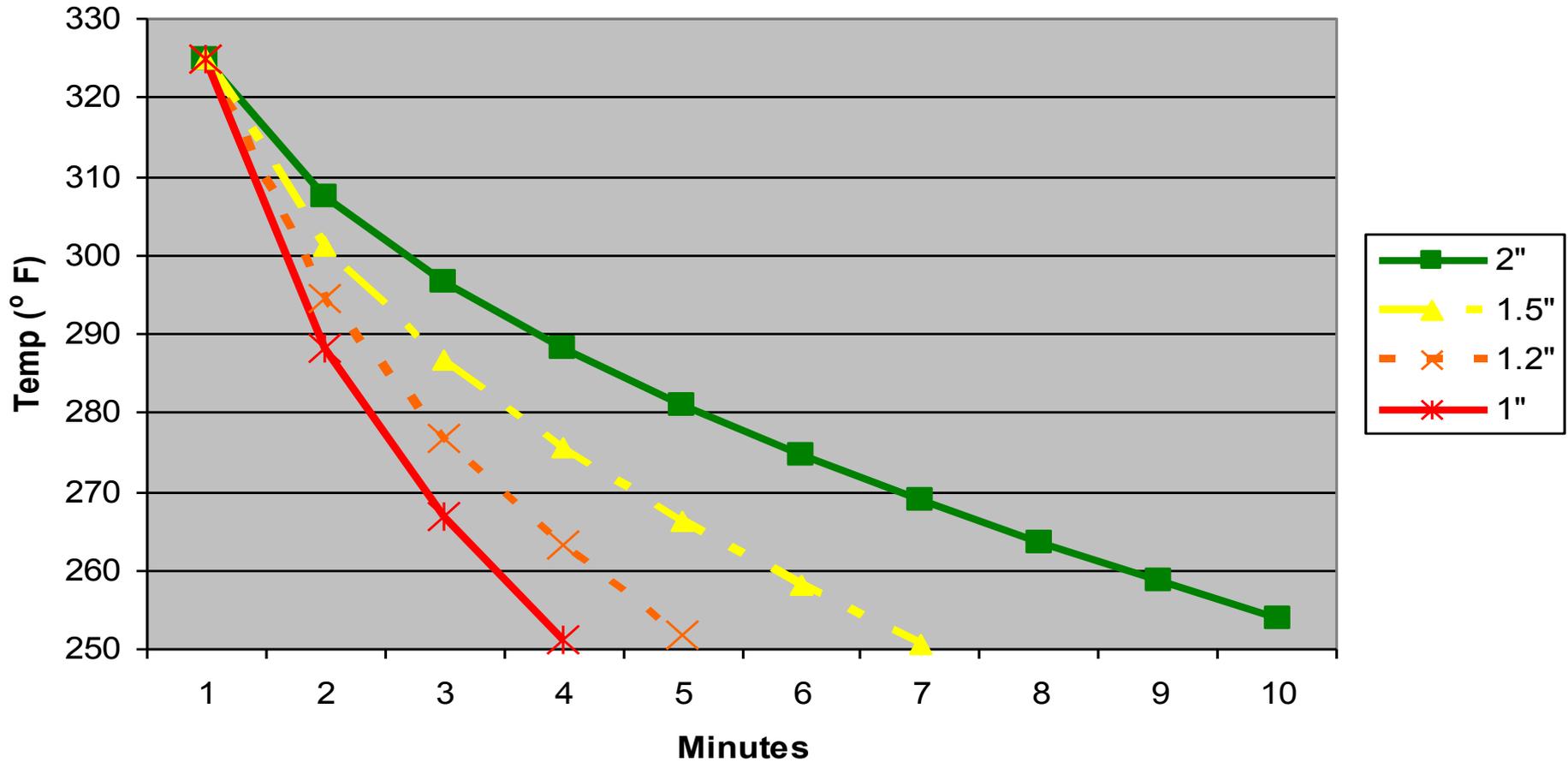
Units: SI English
Calculate
Export Formatted Data



Tabular Output Graphical Output

50°, 15 mph wind, 1/2" – less than a minute

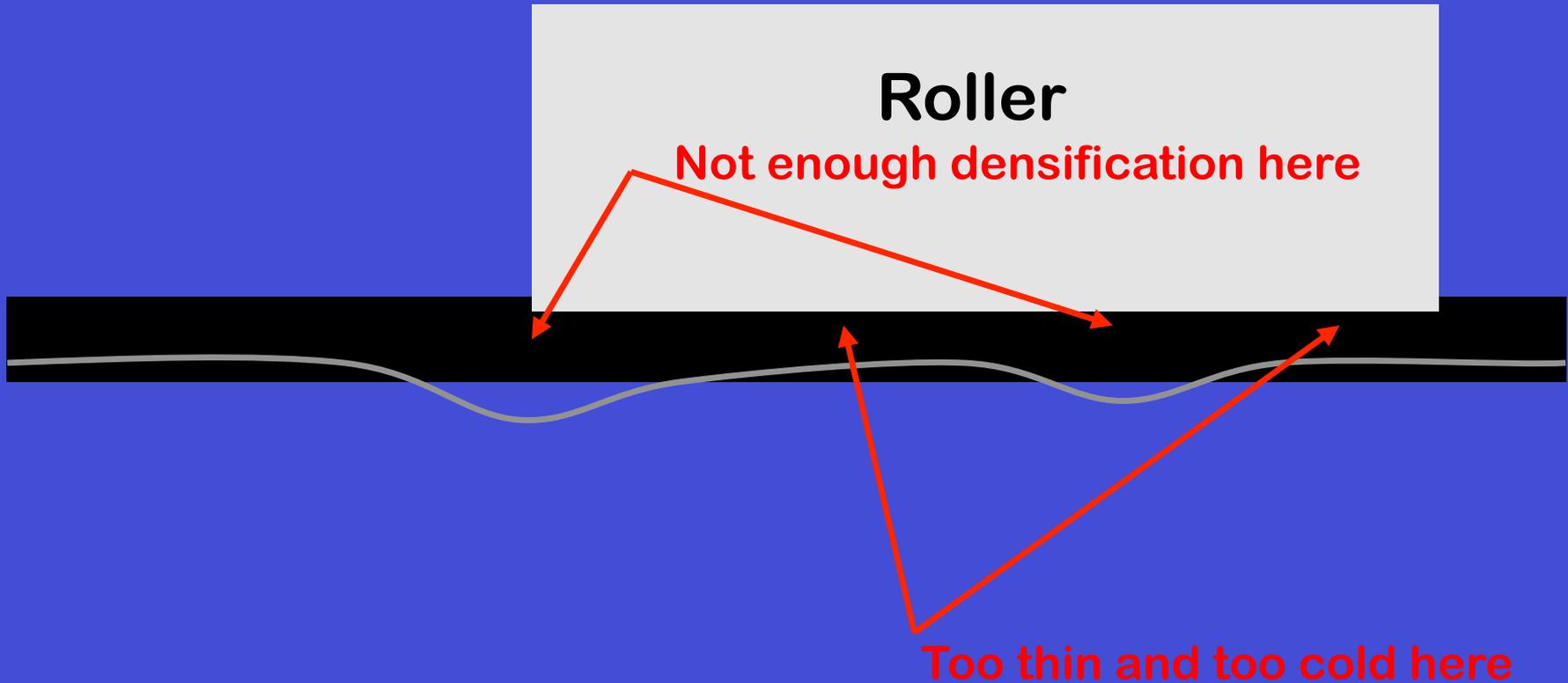
65° Ambient & Surface, 5 mph wind



But it's not just cooling



But it's not just cooling



and Quantifies Results



Measure what you can

- Binder content
- Gradation
- Rice with Pay Clause
- Stability





The Box Test

8 11 '03

Or the Comb Test



8 11 03

INSPECTION AT THE JOB SITE PRIOR TO PAVING

- Pre-Construction Meeting:
 - ✓ Approved mix design
 - ✓ Surface preparation
 - ✓ Delivery method
 - ✓ Rate of delivery
 - ✓ Equipment in good working order
 - ✓ Number and type of rollers
 - ✓ Acceptance Testing
 - ✓ Other Issues (Refer to A-R Design Guide)
- Ambient and surface temperatures (>55° F)

Surface Preparation

- Cracks filled way in advance?
- R & R obvious subgrade failures
- Leveling course
- Remove thermoplastic markings
- Mill conforms at curb and end match
- Sweep / power wash

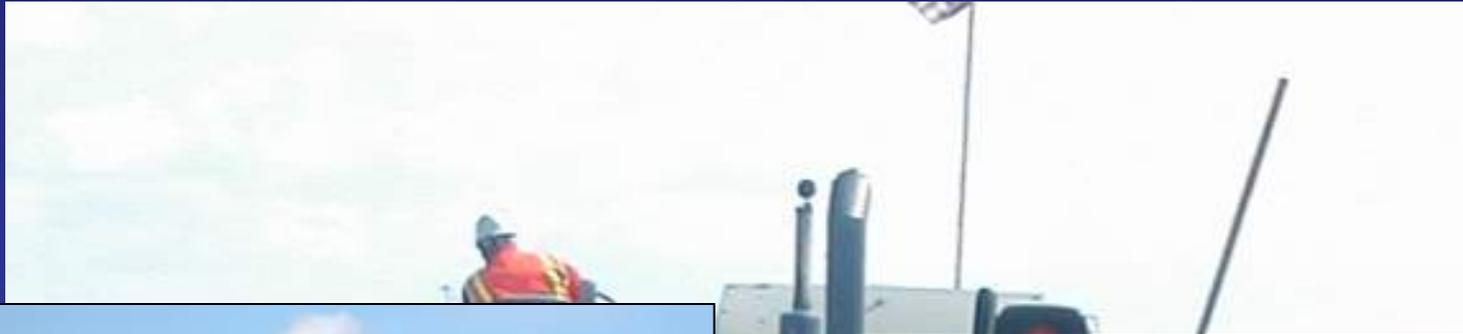




Surface Preparation

- Clean & Dry
- Tack
 - Uniformly applied
 - No more than necessary
 - Emulsions must “break” before paving
 - Why use SS tack?





A-R Paving is done with conventional paving techniques.

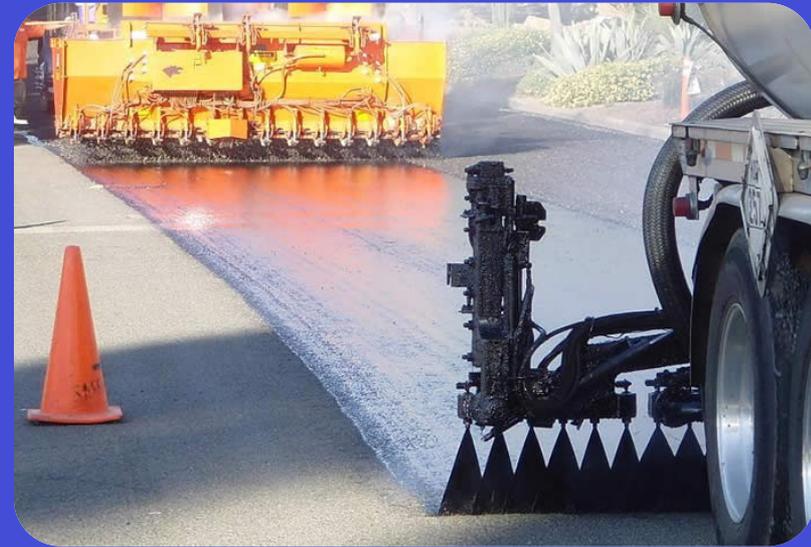
Chip Seals With Asphalt Rubber





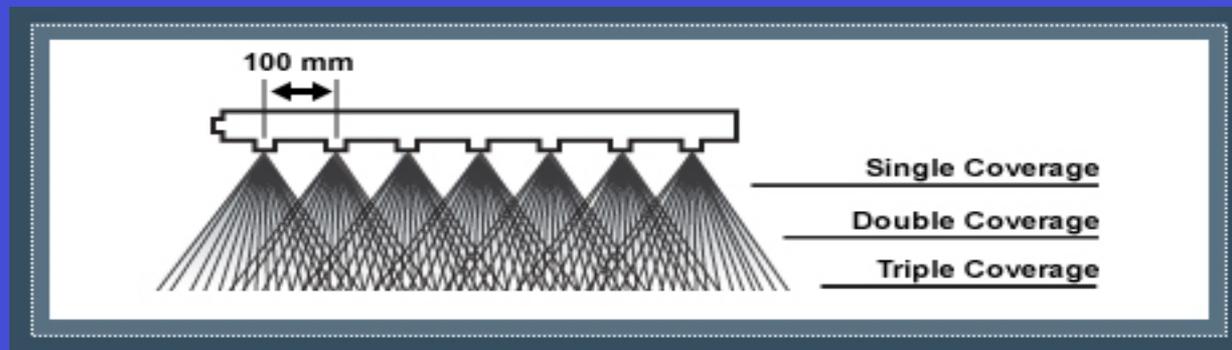
Application

- Spray @
 - 375° F to 400° F
 - 0.60 to 0.65 gallons/SY



Application

- Building paper at joints
- Maximum 12" overlap for longitudinal joints
- Adjust bar height, tip size, and tip orientation to achieve uniform coverage



Aggregate

- 3/8" and 1/4"
- Precoated w/ 0.5 to 1.0% PG binder
- Supplied to project at 225° F to 325° F
- 3/8" @ 28-34 lbs/SY
- Apply IMMEDIATELY!

– (Hot Pre-Coated Aggregate)



Rollers

- **Minimum of 3 pneumatic**
 - 3,000 lbs/wheel minimum
 - 90 psi minimum, or foam-filled
- **1 steel drum**



Set & Cure Time

- No traffic of any kind for at least 15 minutes
- Open to traffic for at least 30 minutes
- Keep speeds below 10 mph
- Sweep 1 hour and next day
- Stripe 2 days





-Double Chip Seal Two Layer System

Manual
Number

2006-34



Minnesota Seal Coat Handbook 2006

Revised 2006



ASPHALT RUBBER USAGE GUIDE



Prepared by

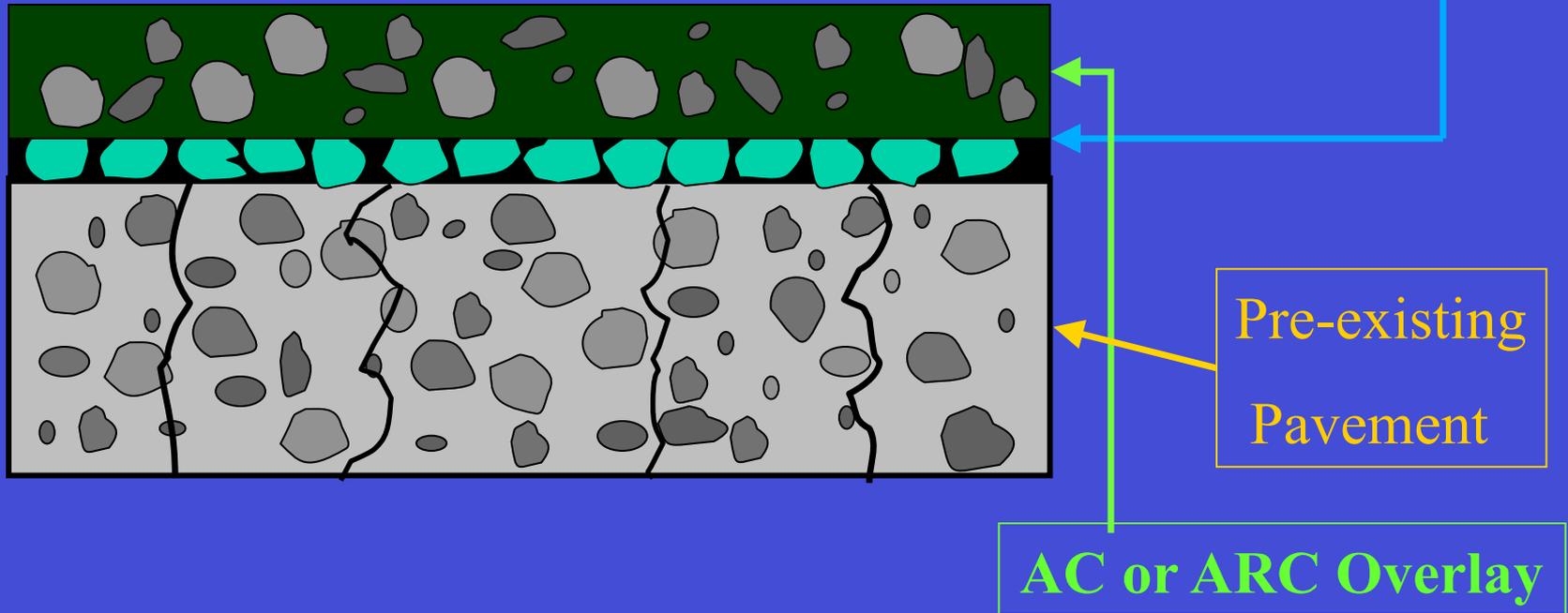
State of California Department of Transportation
Materials Engineering and Testing Services
Office of Flexible Pavement Materials
5900 Folsom Blvd
Sacramento, California 95819

Revised September 30, 2006

Cul-de-sacs are tough

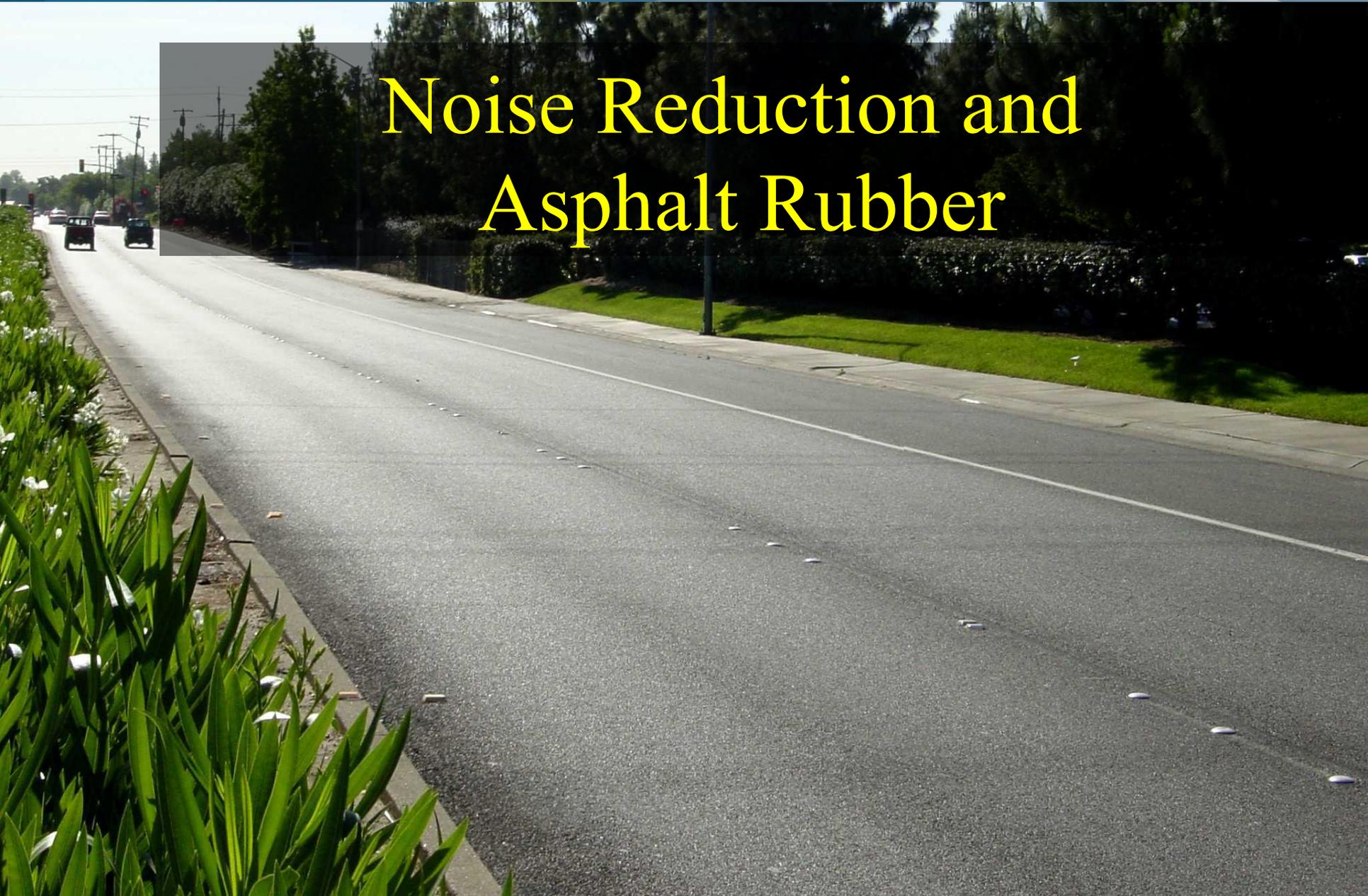


SAMI - Stress Absorbing Membrane Interlayer



Also known as a Two Layer System

Noise Reduction and Asphalt Rubber



- Vehicle-generated noise comes from:
 - engine,
 - exhaust system,
 - aerodynamic noise
 - tire noise.
- Power train noise**
- External factors**
- For ≥ 30 mph, pavement/tire noise dominates.

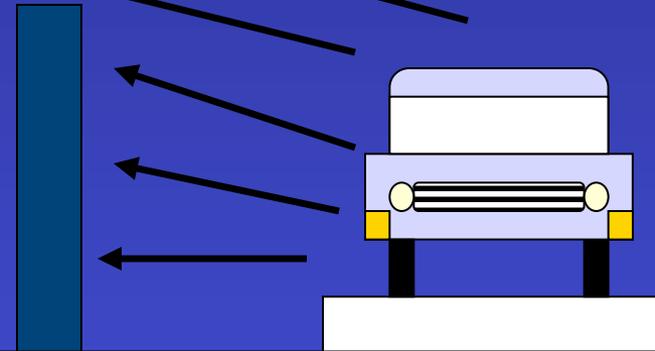


Walls

Effective only for those in line-of-sight.

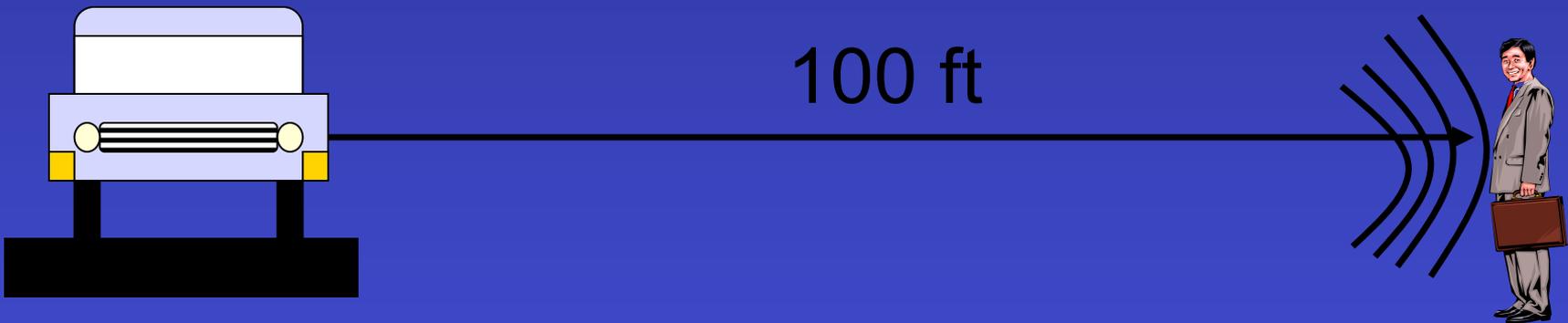


Do not reduce noise at source.



A reduction of 3 dB(A) is like doubling the distance from the noise, reducing traffic volume by 50%, or reducing traffic speed by 25%

$$67 \text{ dB(A)} - 3 \text{ dB(A)} = 64 \text{ dB(A)}$$

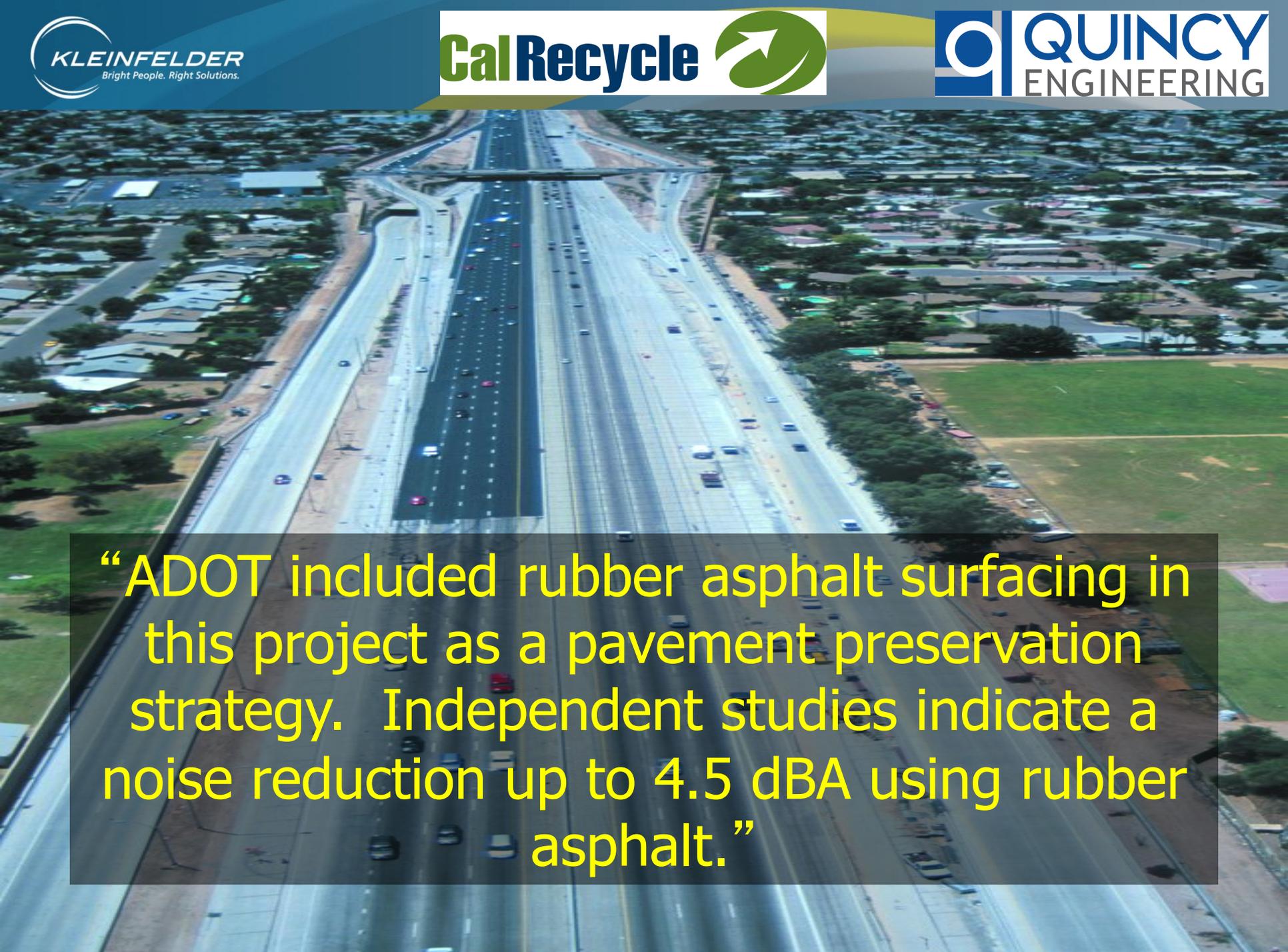


6-year Noise Study

Reduction compared to pre-overlay condition

Alta Arden	AR	1 month	-6dB
		16 months	-5dB
		6 years	-5dB
Antelope*	AR	6 months	-4dB
		5 years	-3dB
Bond	CA	1 month	-2dB
		4 year	0dB

* (speed increase)



“ADOT included rubber asphalt surfacing in this project as a pavement preservation strategy. Independent studies indicate a noise reduction up to 4.5 dBA using rubber asphalt.”



Rubberized Asphalt Concrete Cooperative Purchasing Program (RCPP)

RCPP PILOT GOAL

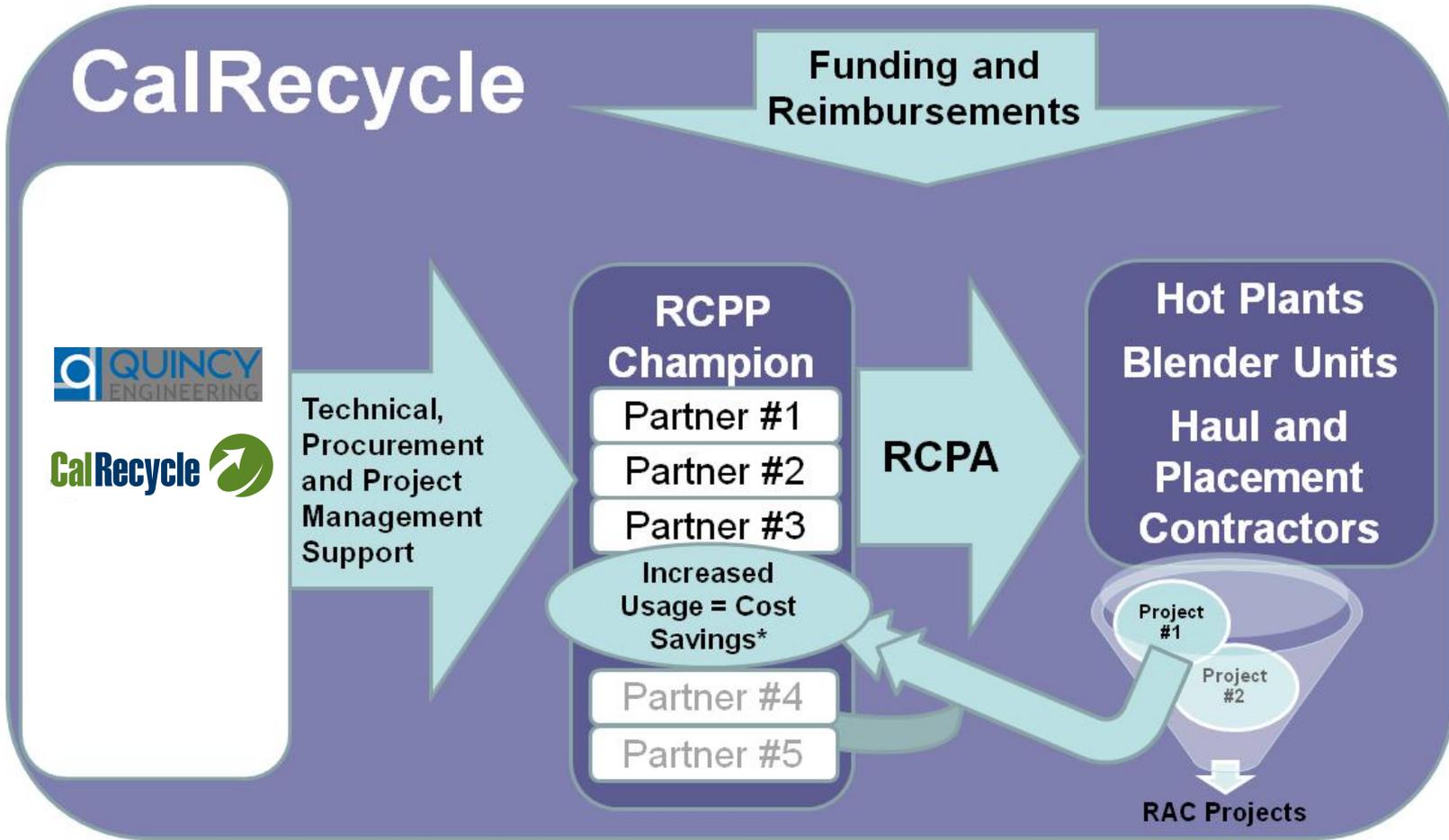
*Leverage RAC Champions' experience
and their relationships with neighboring
jurisdictions to increase and sustain
RAC usage.*

New Program, But Not a New Concept

- Sacramento County Implemented a RCPP
- Net RAC savings was 15%
- Introduced new bidders
- Eliminated Project Delays due to Unavailability of the Mobil Blender Units



RCCP Overview

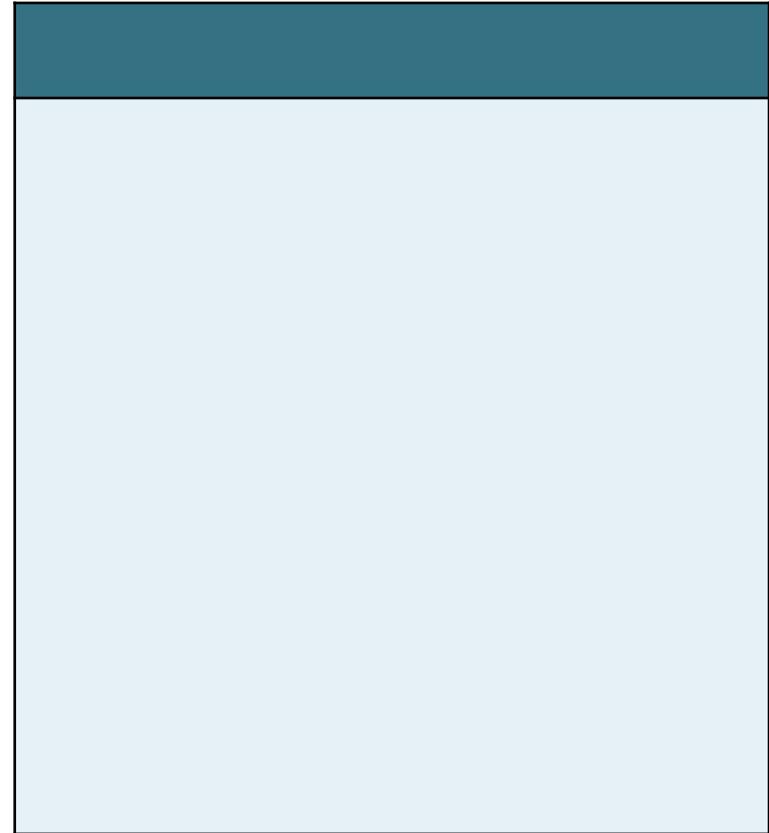
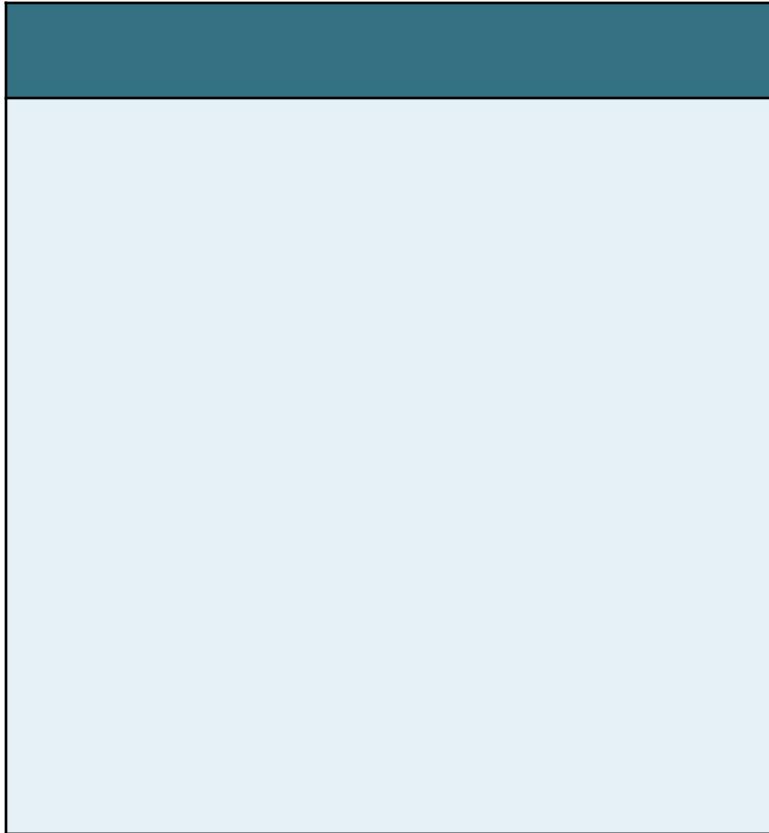


What are the benefits?

- Shared Economies of Scale with lowers RAC costs through increased competition and competitive pricing
- Facilitates jurisdictions with smaller tonnages into RAC bidding
- Allows past RAC grant recipients that are now ineligible and targets support for non-grant recipients
- Communicates positive regional partnerships
- Eliminates Blender Unit mobilization costs, lower costs for underserved jurisdictions
- Opens the current producer/contractor bidding paradigm
- Creates better opportunities for disadvantaged contractors
- No costs services and CalRecycle reimbursements



Quals: Experienced RAC Champion





- *Theron Roschen, PE*
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