

Partial Depth Recycling

Dennis McElroy – Pavement Recycling Group Manager (Construction Division)





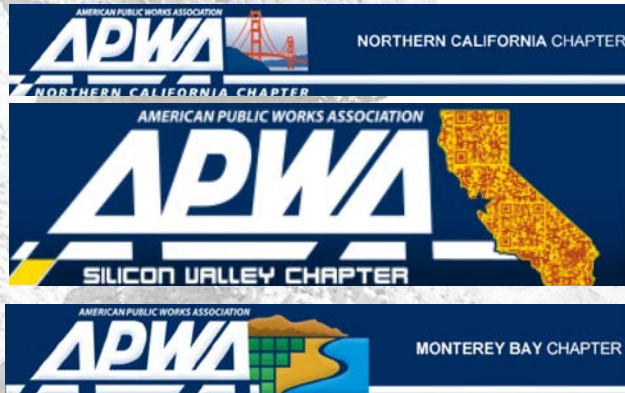
Agenda:

- **Industry associations**
- **Aggregate resources in Ca**
- **In-Place Recycling terminology update**
- **Where PDR and FDR fall in the pavement deterioration curve and when PDR is a good option**
- **Equipment and binders used in the industry**
- **Example project in San Jose**
- **PDR Cross section details showing different examples of how this process has been used.**

Partial Depth Recycling & Full Depth Recycling are not HMA or AB. They have their own material properties, performance characteristics and design features.

Please reach out to industry for assistance on project selection and design.





Why Are We Here?

- Potential cost saving techniques, that may save valuable taxpayer dollars.
- In-place recycling techniques to use the material that we already paid for
- Something to think about:
 - Binder and aggregates are a non-renewable resource. When they are gone they are gone. As scarcity increases then cost increases. Where will the additional funding come from?



Map Sheet 52 (2018) Aggregate Sustainability in California



CALIFORNIA GEOLOGICAL SURVEY
Department of Conservation

AGGREGATE STUDY AREA ¹	50-Year Demand (million tons)	Permitted Aggregate Reserves (million tons)	Permitted Aggregate Reserves Compared to 50-Year Demand (percent)	Projected Years Remaining
Bakersfield P-C Region	338	1,708	505	More than 50
Barstow-Victorville P-C Region	163	117	72	31 to 40
Claremont-Upland P-C Region	202	90	45	21 to 30
El Dorado County	82	15	18	11 to 20
Fresno P-C Region	305	556	182	More than 50
Glenn County	41	22	54	21 to 30
Merced County	154	61	40	21 to 30
Monterey Bay P-C Region	333	297	89	41 to 50
Nevada County	41	52	127	More than 50
North San Francisco Bay P-C Region	492	263	53	21 to 30
Palmdale P-C Region	569	163	29	11 to 20
Palm Springs P-C Region	238	163	68	31 to 40
Placer County	188	387	206	More than 50
Sacramento County	724	327	45	21 to 30
Sacramento-Fairfield P-C Region	295	109	37	21 to 30
San Bernardino P-C Region	939	156	17	11 to 20
San Fernando Valley/ Saugus-Newhall²	387	17	4	10 or fewer
San Gabriel Valley P-C Region	751	297	40	21 to 30
San Luis Obispo-Santa Barbara P-C Region	226	58	26	11 to 20
Shasta County	82	49	60	31 to 40
South San Francisco Bay P-C Region	1,320	506	38	21 to 30
Stanislaus County	160	39	24	11 to 20
Stockton-Lodi P-C Region	409	203	50	21 to 30
Tehama County	49	30	61	31 to 40
Temescal Valley-Orange County ²	1,079	862	80	41 to 50
Tulare County	130	53	41	21 to 30
Ventura County ²	241	84	35	11 to 20
Western San Diego County P-C Region	763	265	35	11 to 20
Yuba City-Marysville P-C Region	344	679	197	More than 50
Total	11,045	7,628	69	

How do we overcome these challenges?

- ✓ Learn from each other
- ✓ Look for ways to re-use the aggregate whenever possible
 - ✓ Realize we all have a shared responsibility in the determining the future of our aggregate reserves

Why Recycle?

- ✓ Proven technology with a range of strategies to suit most rehabilitation challenges
- ✓ More sustainable if designed and constructed correctly
- ✓ Uses all existing, paid for materials
- ✓ Requires limited new materials
- ✓ Minimizes trucking operations
- ✓ Shorter construction time, less traffic disruption
- ✓ Cost effective / lower life-cycle cost
- ✓ Removes distresses instead of covering them
- ✓ Selected strategies enhance structural capacity
- ✓ Extended pavement life
- ✓ Recycled roads can be recycled again
- ✓ Specifications / nSSPs are already in place
- ✓ Experienced contractors are already working in California



Terminology – UCPRC Expected Update

In-place recycling has evolved over time and consequently there are inconsistencies in the terminology within Caltrans and the industry.

A reset is suggested to standardize going forward and to prevent confusion:

IPR: general term for all types of in-place recycling

CIR: general term for all types of cold in-place recycling

PDR: partial-depth recycling (confined to asphalt concrete layers)

- New merged NSSP that includes both foam and emulsions.

FDR: full-depth recycling (asphalt concrete and underlying layers)

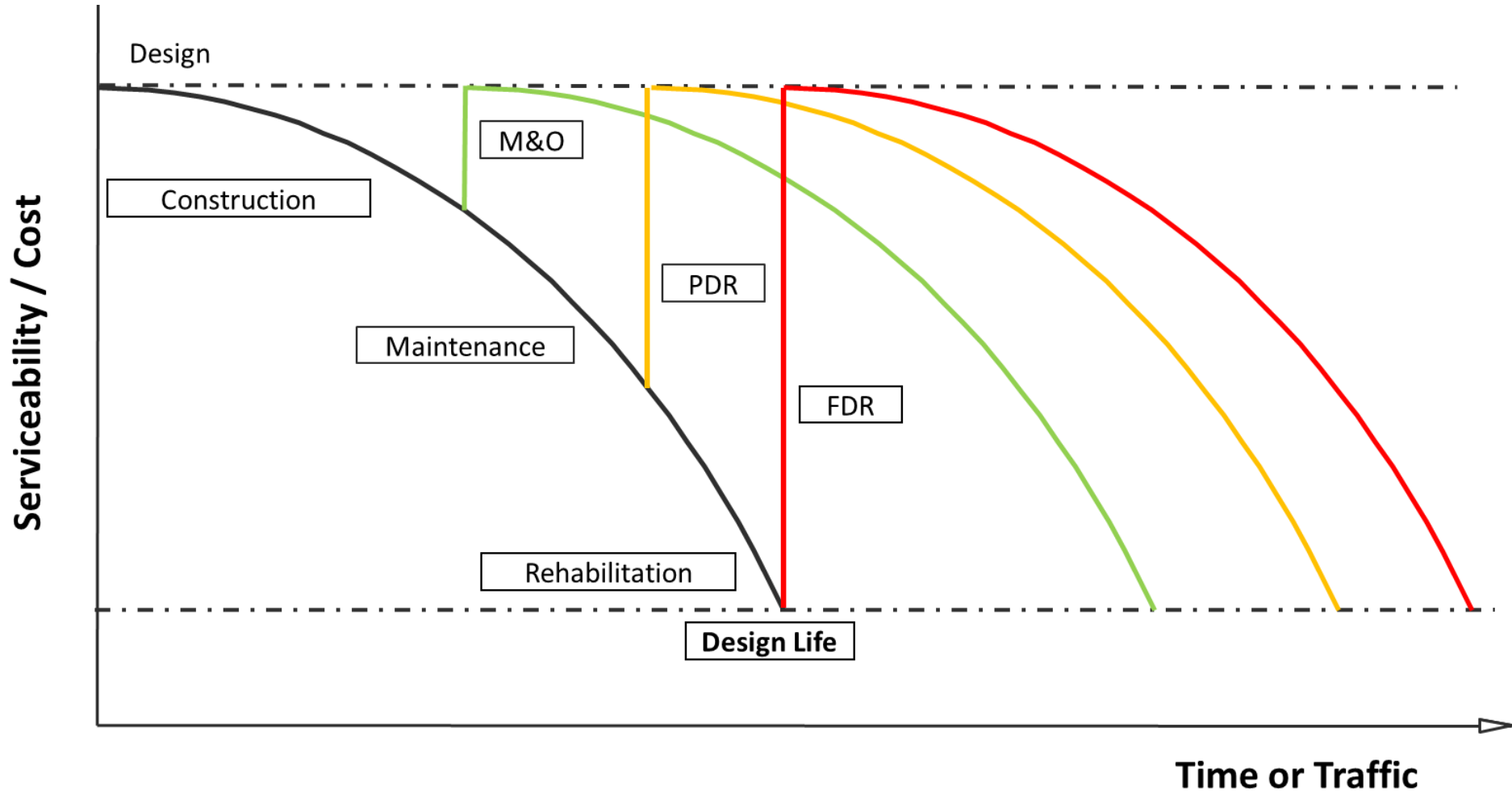
CCPR: cold central plant recycling (can be partial- or full-depth)

FA: foamed asphalt (e.g., PDR-FA)

EA: emulsified asphalt

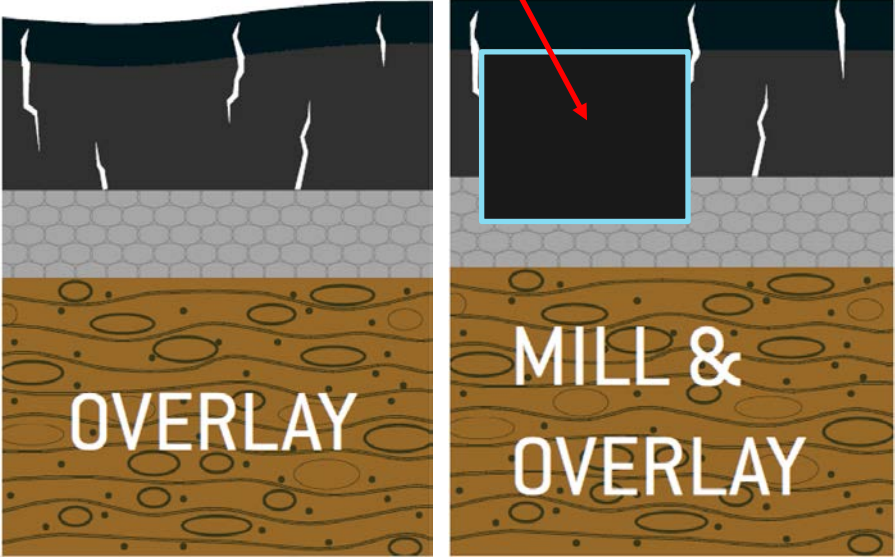
PC: portland cement

Recycling Options in the Pavement Life-Cycle



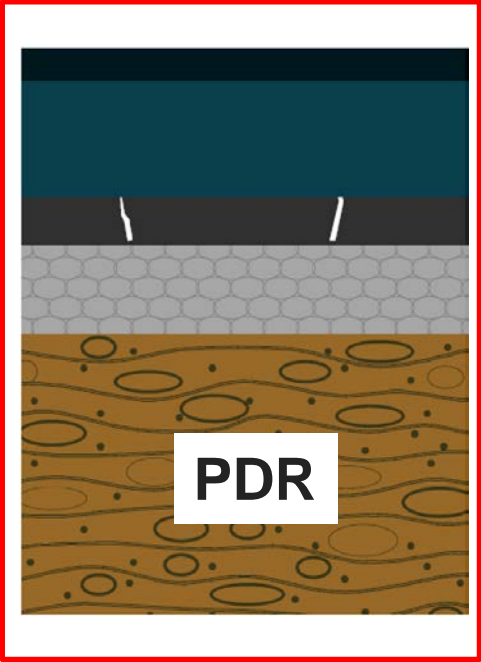
Examples

Digouts Before O/L



Top Down

3" – 6" Recycle Depth



Bottom Up

6" – 18" Recycle Depth



Top-Down Distresses in AC Layers

- Top-down distresses in top 0.2 ft. of AC
 - Mill and overlay



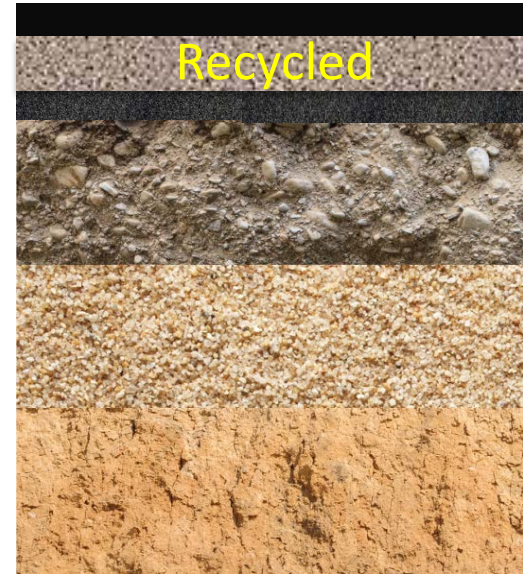
Top-Down Distresses in AC Layers

- Top-down distresses in top 0.5 to 1.0+ ft. of AC layers
 - Use PDR with foamed asphalt or emulsified asphalt (PDR-FA or PDR-EA)
 - Disclaimer: PDR and bottom up, load associated cracking don't work well together.



Top-Down Distresses in AC Layers

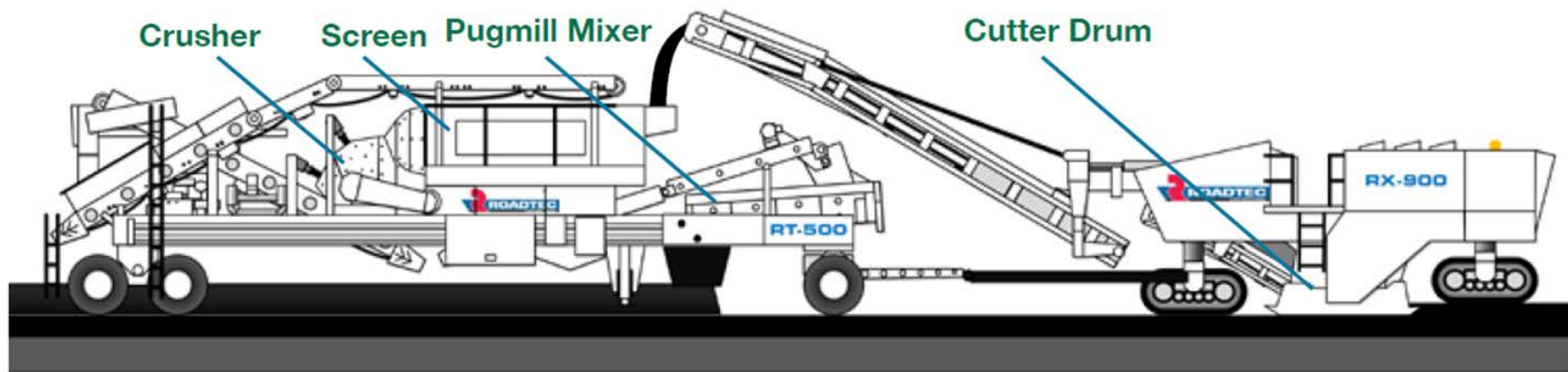
- Use PDR with foamed asphalt or emulsified asphalt



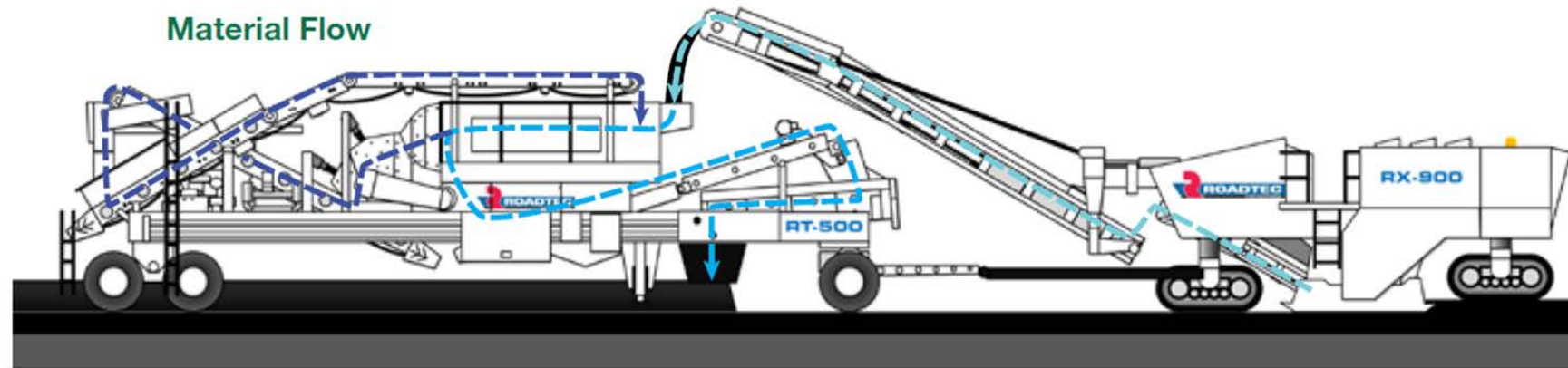
PDR Equipment Types and Construction

Multi Unit Recycler

Direction of Travel



Material Flow





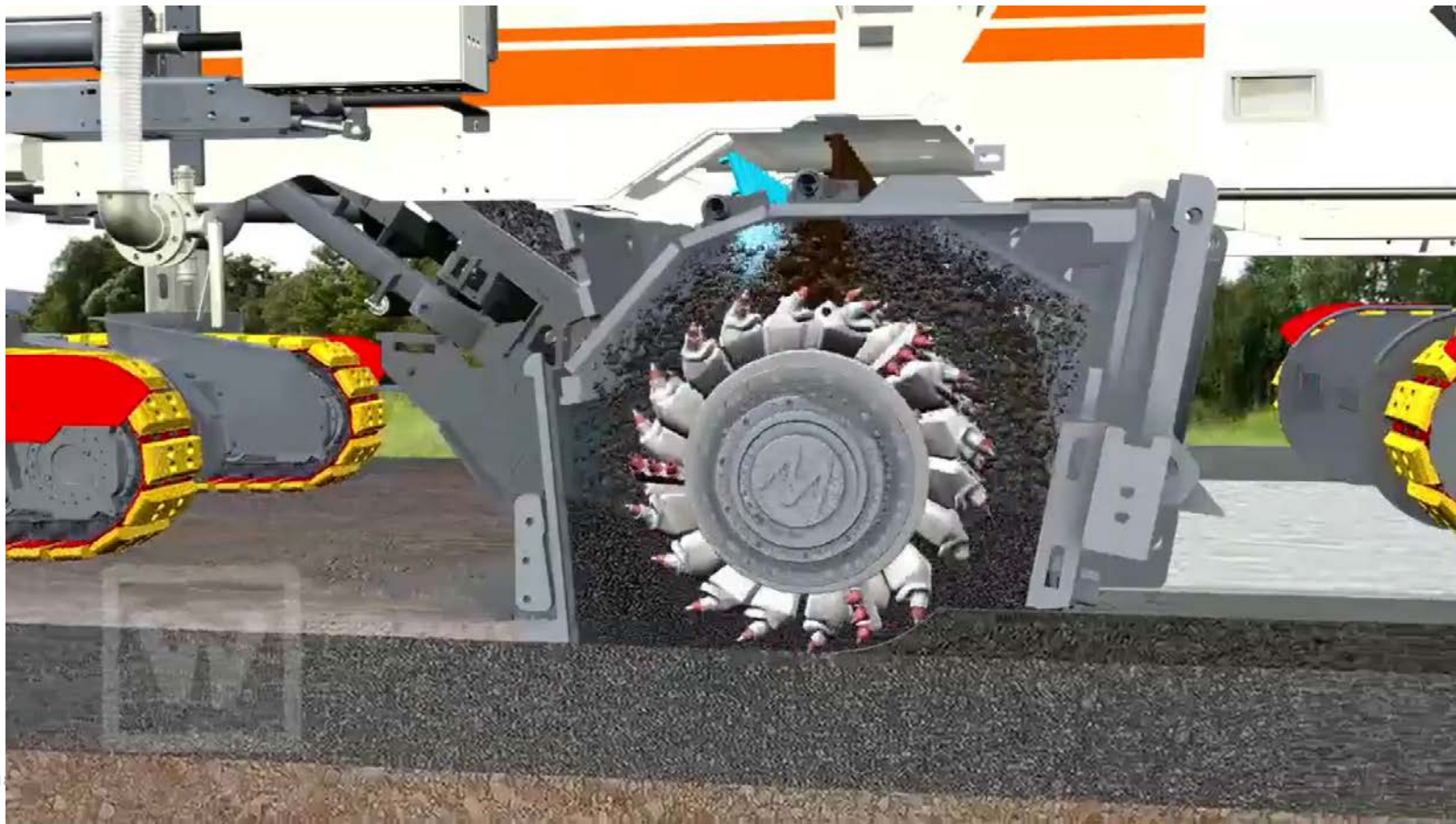
Caltrans Spec: 30 - 6



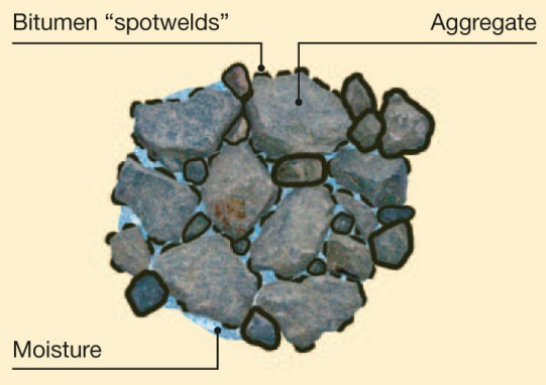
- Windrow of PDR material to paving machine

Single Unit Recycler

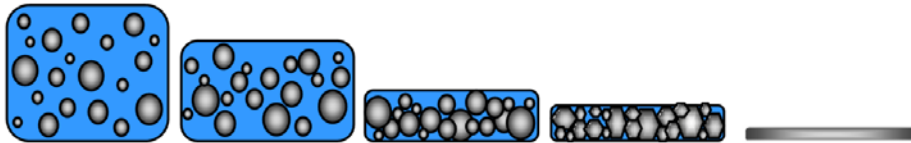
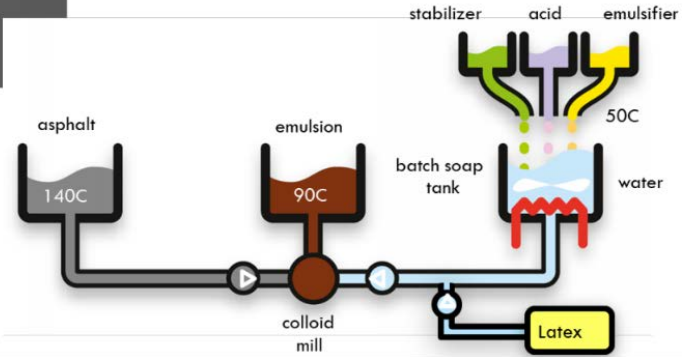
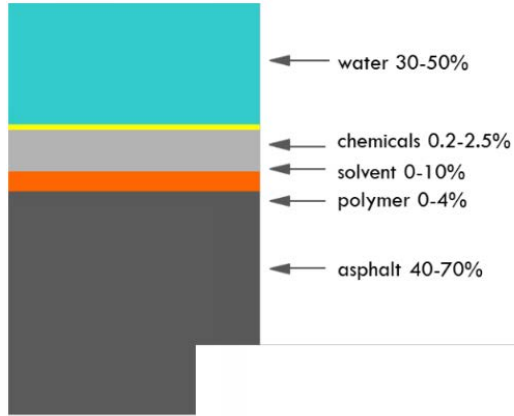
Partial Depth Recycling



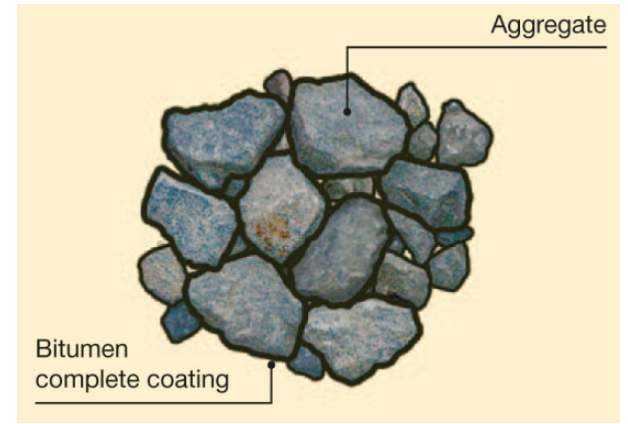
Foamed Asphalt PDR - Video



Emulsions - PDR



Evaporation of water



Urban Partial Depth Recycling



Dennis McElroy dmcelroy@graniterock.com
Ed Schwartz eschwartz@graniterock.com



Finished PDR Surface Example – Nieman Blvd San Jose CA - 2019



Example: Monterey Rd., San Jose 2012



Project Size

- 638,040 Sf

Conventional R&R

- 3" Mill
- 6" Digouts
- 3" Leveling Course / R-HMA Overlay

Total: \$2,540,470.00

Cold In-Place Recycling

- 2" Wedge Cut
- 4" PDR – Foam
- 2" RHMA Overlay

Total: \$2,122,400.00

NET SAVINGS: 16% or \$418,070.00



Monterey Rd., San Jose

- Existing Pavement Conditions

- Alligator Cracked Surface
- Years of patching
- Raveling/Potholes
- Aged Oxidized Pavement
- Type II Slurry Seal



- Benefits

- Elimination of costs for 780 truckloads of importing and off haul costs of over 15,600 tons of aggregates to and from landfill and/or asphalt plant or quarry.
- Conventional R&R method would have taken approximately 18 days, whereas the PDR method took only 9 days.



Savings

- **Economic:**
 - Conservation of Energy
 - Emissions Reduction
 - Aggregate Reduction
 - Dump Site/Off Haul Reduction
 - Trucking reduction
 - Faster production times



Combined translates into an average cost savings of 15% - 30%

Monterey Rd., San Jose

Skid Marks on final CIR
Surface – No Raveling



Monterey Rd., San Jose 6/24/2018



Monterey Rd.,
San Jose
11/4/2019



City of Pleasanton 2017



Pleasanton Contd. (see traffic handling)

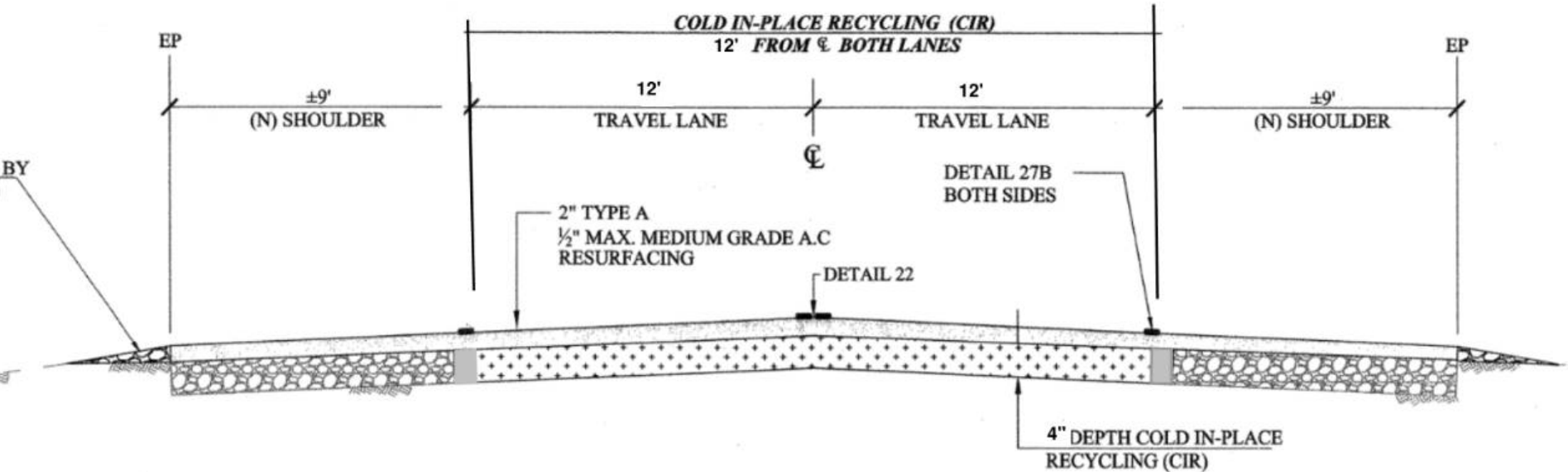


City of Santa Cruz 2017



PDR Cross Section Detail Examples

Typical Cross Section Detail – PDR (2 Lane Road, ETW to ETW)



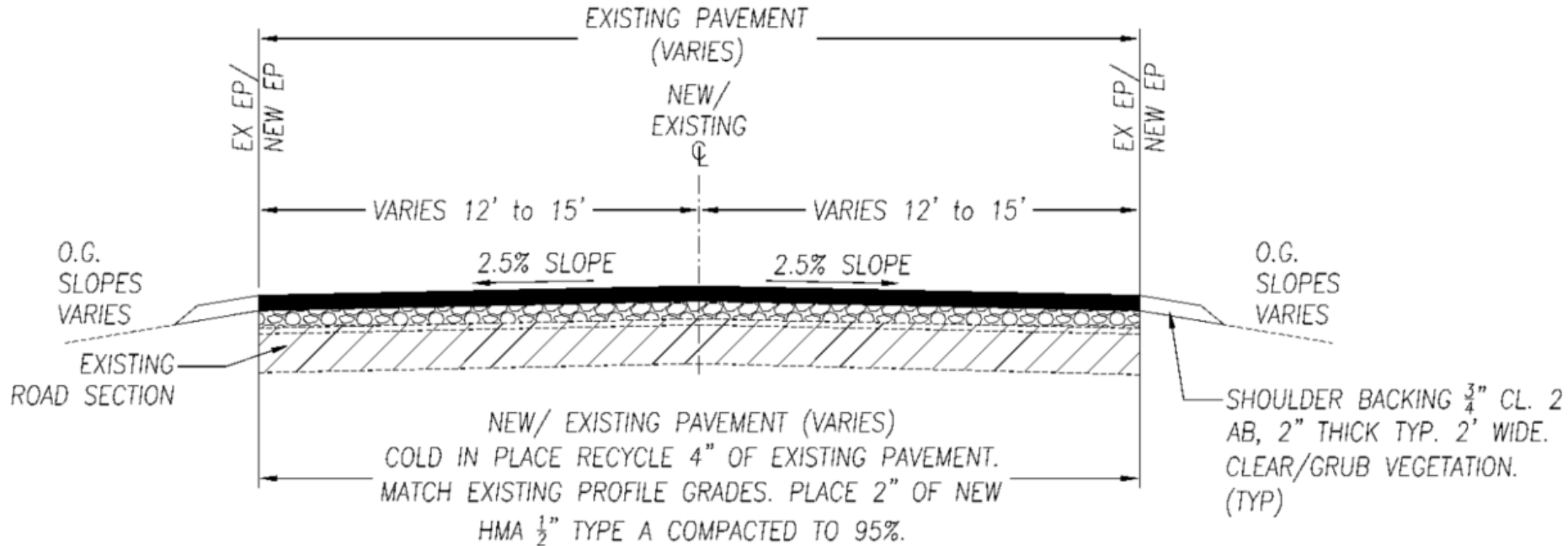
Typical Cross Section Contd. Marin County 2015



Typical Cross Section Contd. Arterial – San Jose 2019



Typical Cross Section Detail – PDR (2 Lane Road, EP to EP)

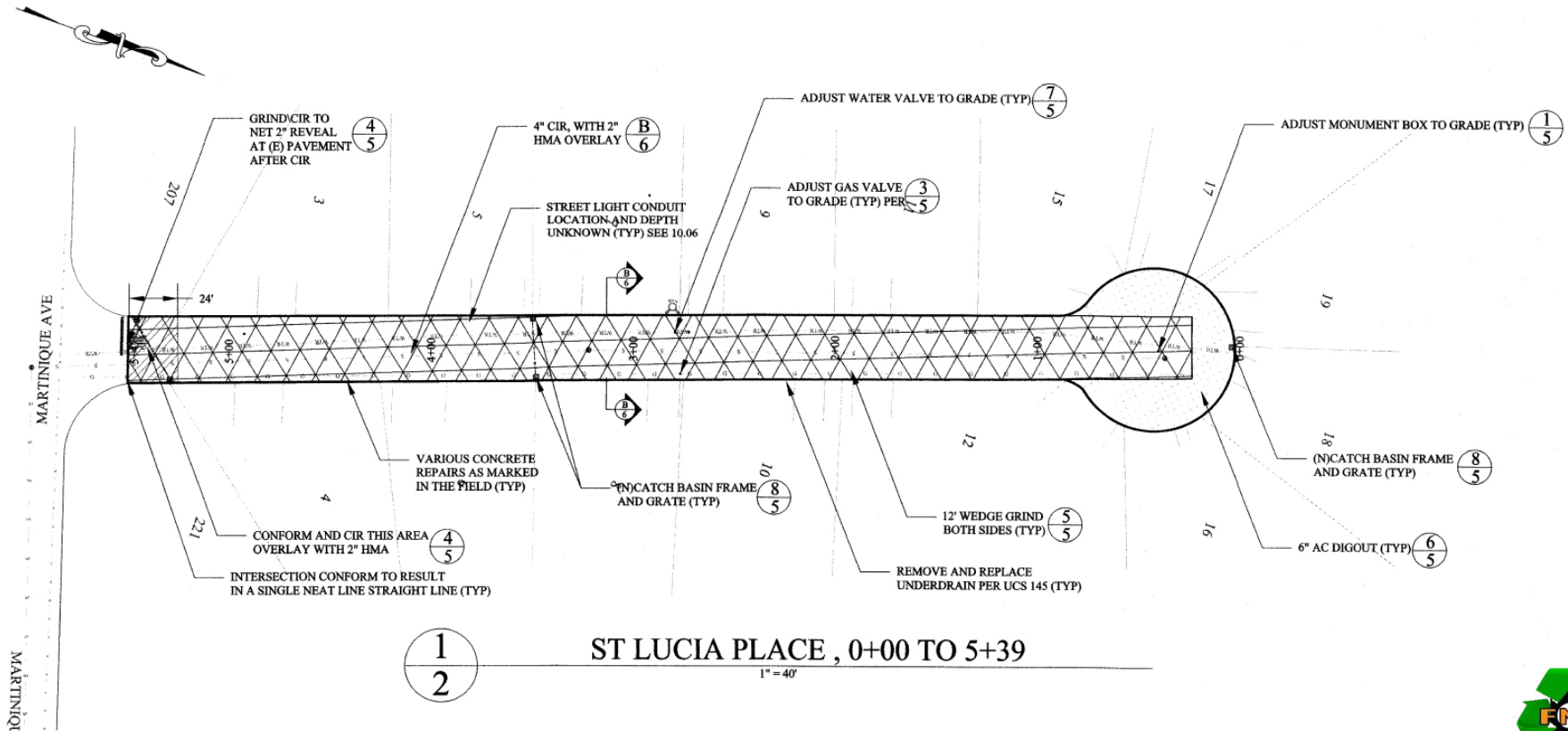


TYPICAL COLD IN PLACE RECYCLE CR 22 CROSS SECTION

SCALE: NTS



Cul De Sac Example - PDR



Cul De Sac Example - Marin County 2017



Paved exterior of cul de sac

Cul De Sac Example - CIR

AC Paving was left 2" low along lip of gutter. NO milling required later.



Paved exterior of cul de sac

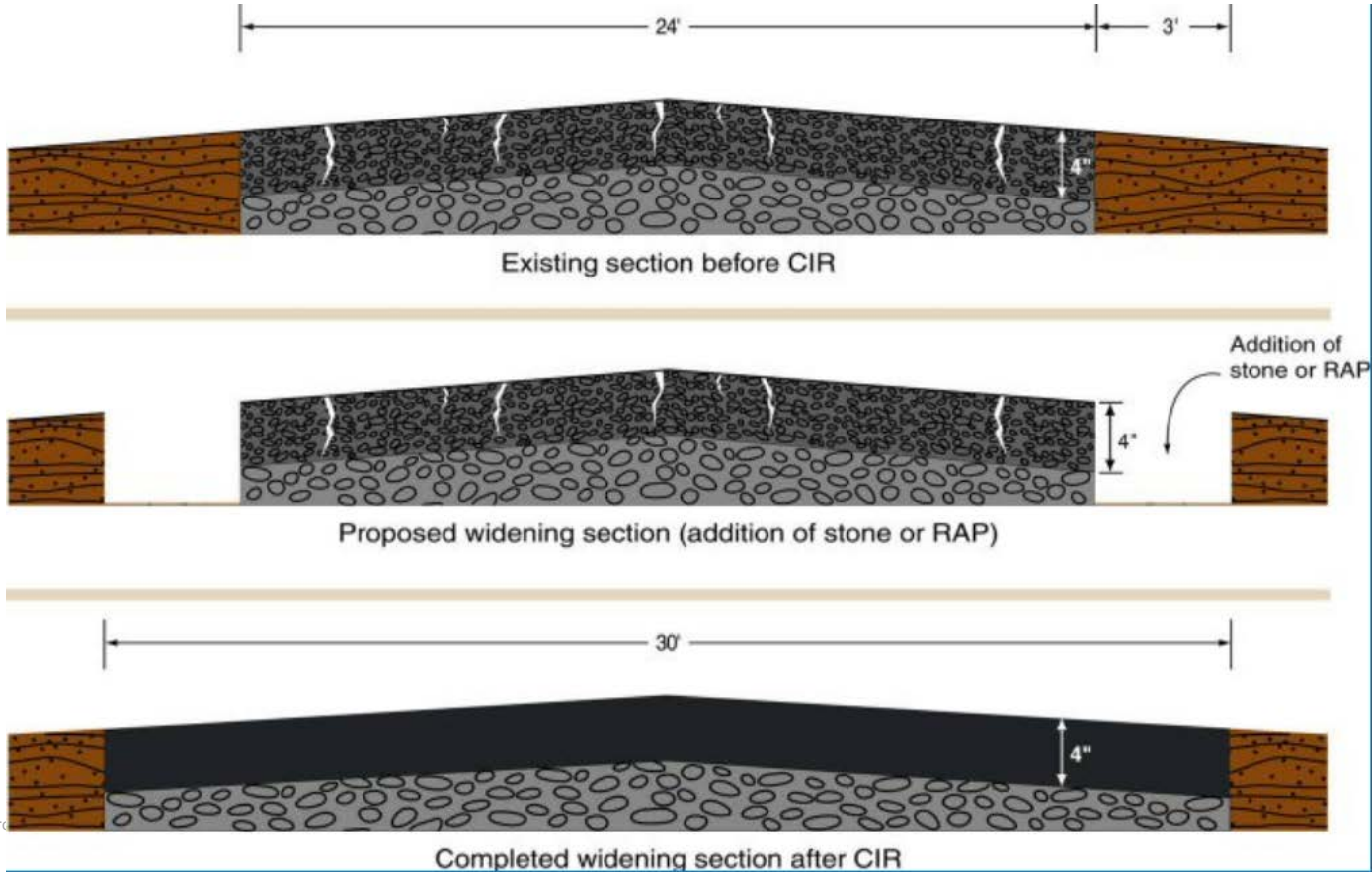


CIR Ties into new paved exterior of the cul de sac
And directly to the lip of gutter.

Point Reyes Petaluma Road – Marin County 2015 Shoulder Widening with CIR

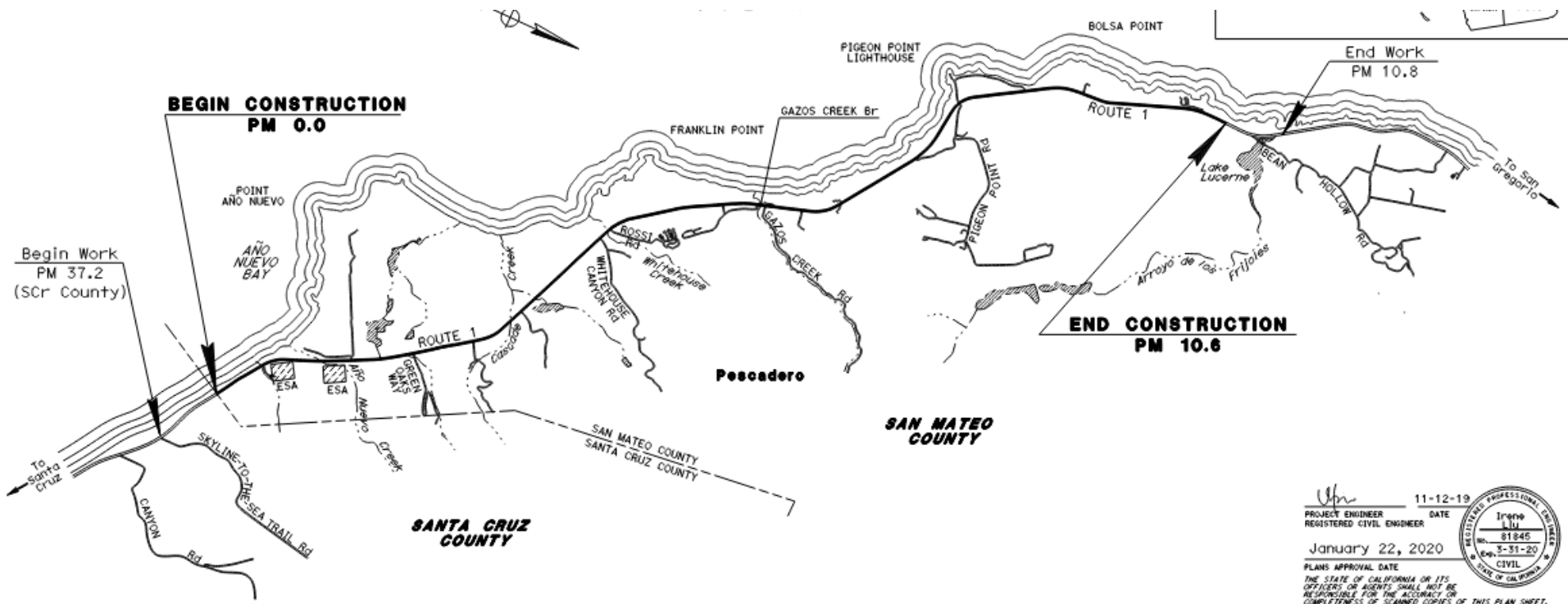


Shoulder Widening with CIR



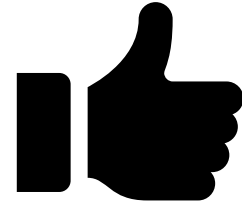
Caltrans District 4: PDR on SM1 (10.6 Miles)

- 182,000 SY of 3" deep PDR-FA (Foamed Asphalt)



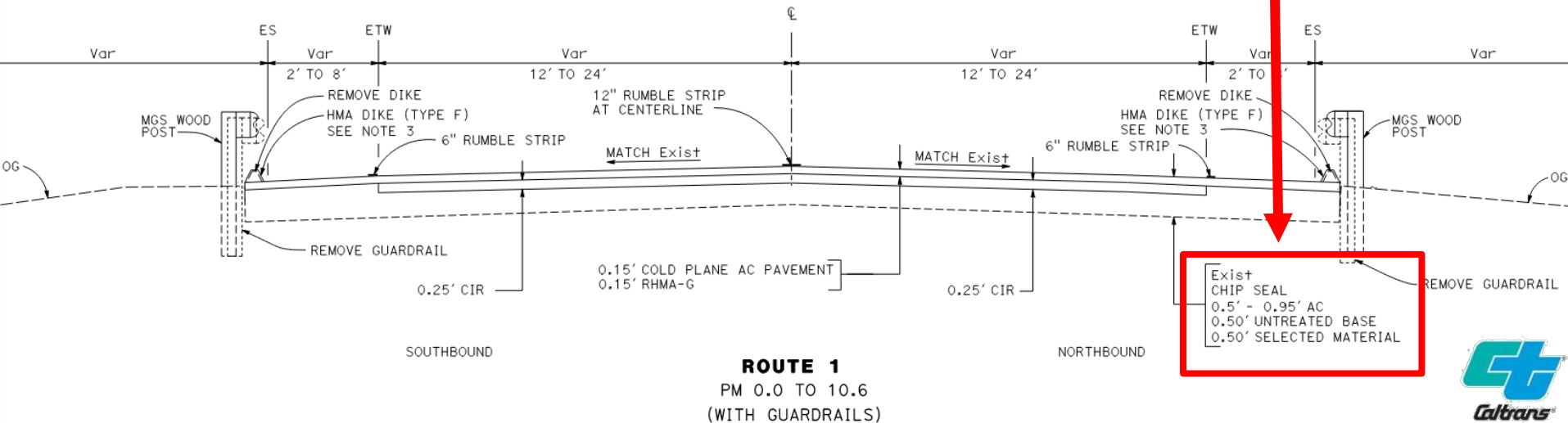
SUMMARY OF ROADWAY QUANTITIES

POST MILE	DIRECTION	COLD PLANE AC PAVEMENT	RUBBERIZED HOT MIX ASPHALT (GAP GRADED)	TACK COAT
		SQYD	TON	
0.0 TO 4.2	NB	52,779	5,344	19.8
0.0 TO 4.2	SB	52,811	5,347	19.8
4.3 TO 5.7	NB	21,477	2,175	8.1
4.3 TO 5.7	SB	22,983	2,327	8.6
5.8 TO 10.6	NB	64,637	6,544	24.2
5.8 TO 10.6	SB	66,013	6,684	24.8
TOTAL		280,700	28,421	105.3



COLD IN-PLACE RECYCLING

POST MILE	COLD IN-PLACE RECYCLING (FOAMED ASPHALT)	CEMENT (COLD IN-PLACE RECYCLING)	ASPHALT (COLD IN-PLACE RECYCLING)	ASPHALTIC EMULSION (COLD IN-PLACE RECYCLING)	SAND COVER (COLD IN-PLACE RECYCLING)
	SQYD	TON	TON	TON	TON
0.0 TO 10.6	181,201	285.4	713.5	112.3	181.2
TOTAL	181,201	285.4	713.5	112.3	181.2



Exist
CHIP SEAL
0.5' - 0.95' AC
0.50' UNTREATED BASE
0.50' SELECTED MATERIAL





New O/L being Installed

**Milled Shoulder, Conform
Temp Ramps pulled prior
to O/L**

**Finished PDR Surface (Traveled Way Only) Prior to O/L
(During Construction)**

Recap

Pavement rehabilitation techniques to be used in lieu of traditional remove and replace strategies.

- Partial Depth Recycling
- Full Depth Recycling

Resources:

CNCA

- FDR Guidebook online
- Value Engineering support, design recommendations, training, etc.

Graniterock

RSA of CA

www.Roadresource.org

© 2018 Graniterock and/or its affiliates. All rights reserved.

- PDR & FDR materials can be used in a variety of different scenarios
- Road Construction with Sustainability in mind, think about aggregate re-use. Not only IPR but High RAP HMA Mixes too.
- User friendly approach to construction.
 - Shortens the overall project schedule and exposure for the travelling public.
- Reduces project cost when implemented under the correct circumstances and applies to apples comparison.

Questions?



Graniterock®

Dennis McElroy
dmcelroy@graniterock.com
408-639-8063