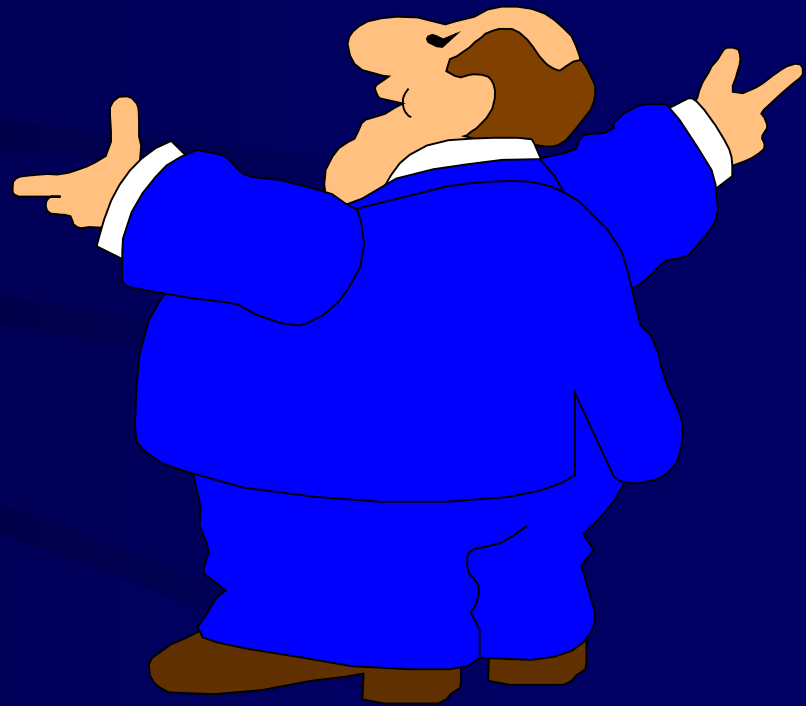


Recycling of Pavement Materials



Recycled Materials



- Reclaimed Asphalt Pavements (RAP)
- Recycled Asphalt Shingles (RAS)
- Recycling of concrete pavement is limited

Advantages of AC Recycling

- Economy – >25% savings in cost of material
- Energy saving - manufacturing & transportation
- Environment
 - reduces amount of new materials
 - solves problem of discarding old materials
- Eliminates problem of reconstruction of utilities, curbs & gutters associated with overlays
- Maintains bridge & tunnel clearances

RAP

- RAP generally does not have the properties required for quality asphalt concrete
- Virgin aggregate and asphalt are typically added to correct deficiencies in the RAP
- Variability in central plant recycling
 - RAP might be collected from several projects into a single stockpile.



Recycling

Central Plant

In-Place

**Hot
(HCPR)**

**Cold
(CCPR)**

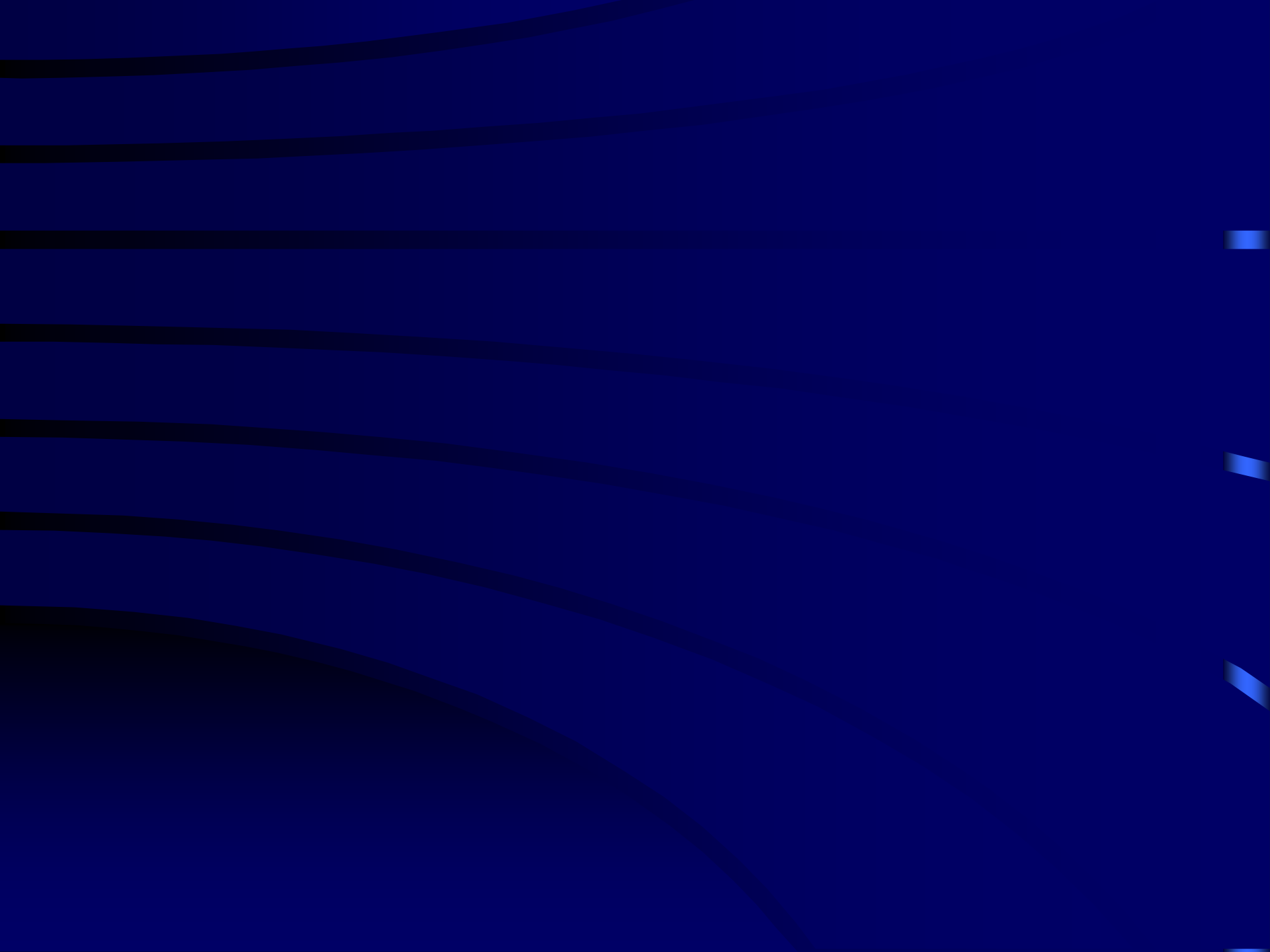
**Hot
(HIPR)**

**Cold
(CIPR)**

Partial Depth

Full Depth

Central Plant Recycling



In-Place Recycling

Pavement Maintenance & Rehabilitation Workshop

In-Place Recycling

Phoenix, AZ

March 30, 2023

Presented by Todd Gonser

Asphalt Pavement Recycling

- ▶ What is In-Place Recycling?
- ▶ Preventive Maintenance Concept
- ▶ Full Depth Reclamation (FDR)
- ▶ Cold-In-Place Recycling (CIPR)
- ▶ Hot-In-Place Recycling (HIPR)

What is In-Place Recycling?

- ▶ Pavement Recycling is an on-site (or nearby), in-place method that rehabilitates deteriorated asphalt pavements and minimizes the use of new materials.

The Need is Everywhere

Shrinking Budgets +

Dwindling Resources +

Quest for Sustainable Technologies +

Demand by Public for Safe, Quality Pavements

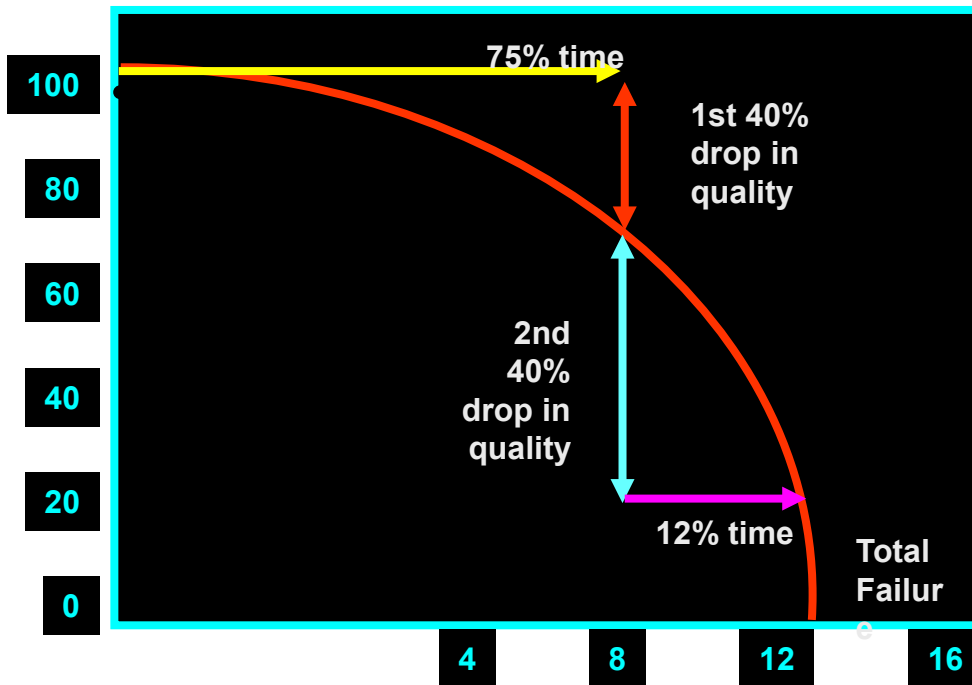
=

Need for Alternative Methods



Preventive Maintenance

Pavement Condition



Years (Time Varies for each Road Section)

Each \$1 spent during the first 40% drop in quality will cost \$4-5 if delayed until pavement loses 80% of its original quality.

Full Depth Reclamation



Full Depth Reclamation

- ▶ An engineered pavement recycling process in which existing pavement materials are incorporated into a structural pavement section through the pulverization and/or soil stabilization process.

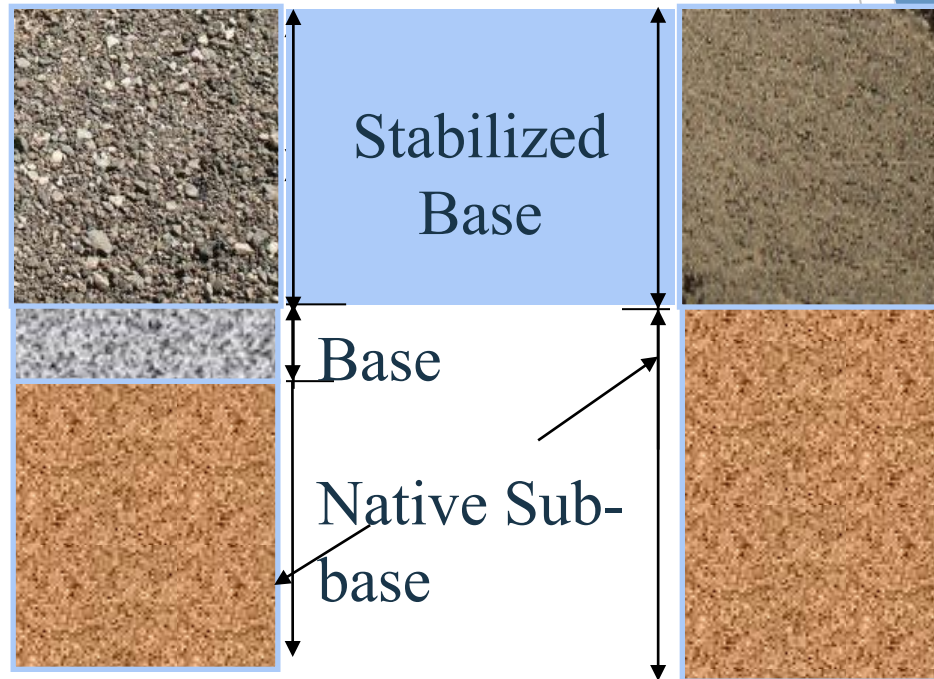


Full Depth Reclamation

- ▶ Typical depth of 6 to 12” (Most of today’s pulverizers can achieve 16 to 18” in depth).
- ▶ Additives used are cement, lime slurry, emulsion, and foamed asphalt.
- ▶ Surface Treatments range from a Chip seal to HMA overlay.



Full Depth Reclamation



Improves existing materials in-place to provide greater structural support and reduction of imported material.

FDR Construction Sequence



1. Pulverization Pass



2. Initial Shaping



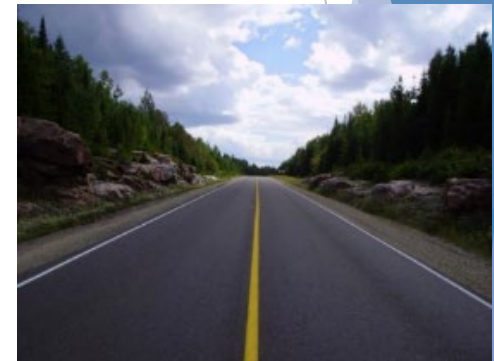
3. Mixing Pass



4. Compaction



5. Final Grading



6. Wearing Surface

Benefits of FDR

- ▶ Recycles existing materials and minimizes cost versus Export/Import with savings of 30 to 50%
- ▶ Time savings of up to 50%
- ▶ Reduces Carbon Footprint - Trucking 40:1
- ▶ Minimizes Distress on Existing Roadway Infrastructure
- ▶ All weather access.....reduced schedule impacts
- ▶ Increases Structural Number Without Excavation
 - ▶ Significant Increases in R Value and Strength
 - ▶ Coefficients = 0.23 to 0.28

Cold-In-Place Recycling

- ▶ CIR is a pavement maintenance/rehabilitation technique that involves the processing and treatment of the existing asphalt pavement with a bituminous recycling agent (emulsified asphalt or foamed asphalt) and additives, as required, such as lime, cement, or corrective aggregate.

CIR Construction Process

- ▶ Existing asphalt is milled to a specified depth - usually 3-4”.
- ▶ Milled material is conveyed to screen deck.
- ▶ Oversized material is sent to crusher.
- ▶ 100% of material passes top size requirement (1 1/4” minus).
- ▶ Processed material is sent to pugmill.
- ▶ As material is conveyed to pugmill, it crosses over belt scale.
- ▶ Electronic signal tells the “brain” how much material is entering pugmill and injects proper amount of additive.

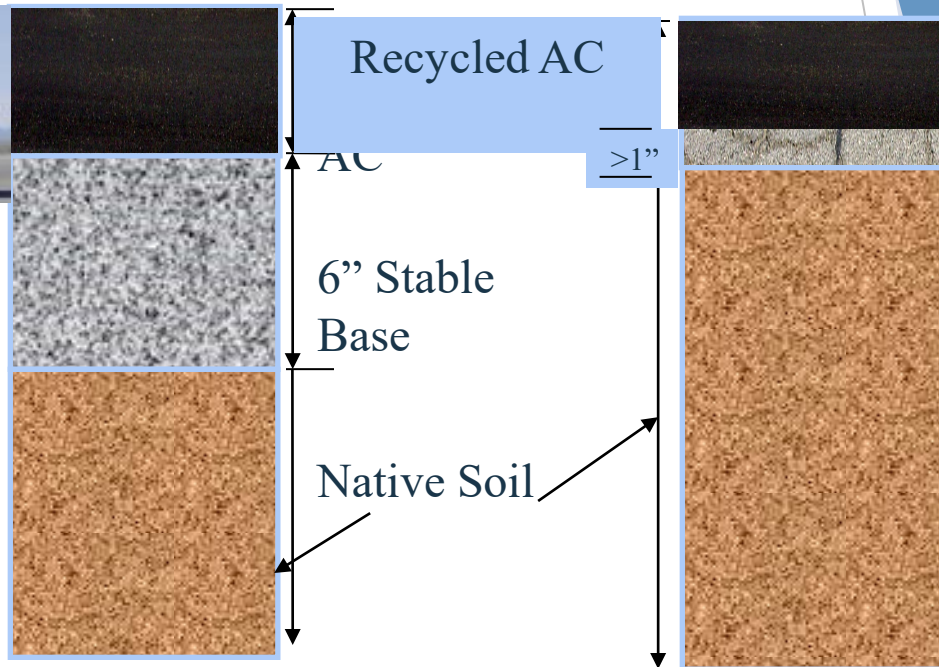


CIR Laydown

- ▶ Once the material is mixed in pugmill, it is deposited in a windrow.
- ▶ The windrow elevator picks up the windrow and deposits it in the paver hopper.
- ▶ Once the material is laid, compaction of the mat commences within 30 minutes or so depending on weather conditions and curing process.



Cold In-place Recycling



Recycle AC to:

- Stable Base
- Within 1" of less Supportive Material

CIR Project Selection

- ▶ The CIR process is not suited to address structural failures of the pavement such as structural rutting, severe fatigue cracking or base/subgrade instability.
- ▶ CIR is meant to treat non-load associated distresses and most structural distresses that occur in the top 2-5+ inches of the pavement structure
- ▶ CIR is an excellent treatment to mitigate transverse or reflective cracking.

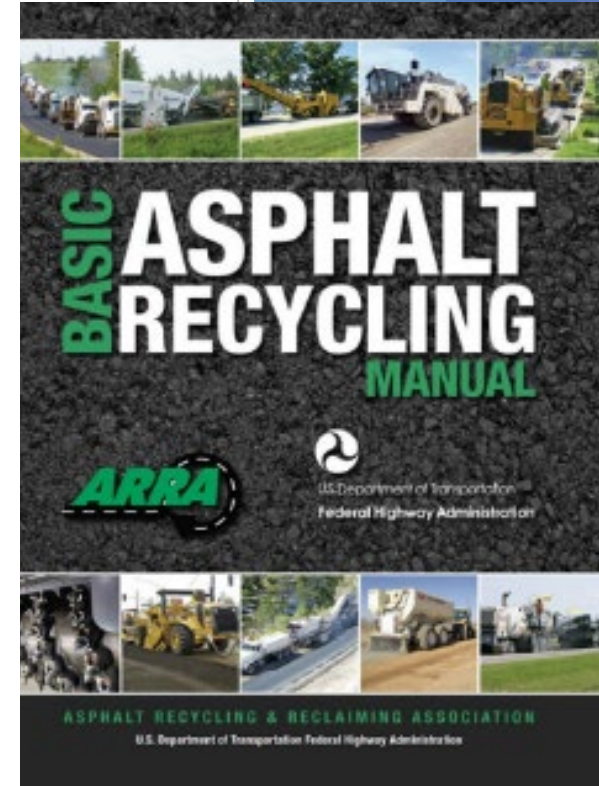
CR Applicability (Table 10-1)

Table 10-1: CR Applicability

Condition		CR Applicability
Surface Defects	Raveling	Yes
	Pot Holes	Yes
	Bleeding	Yes
	Skid Resistance	Yes
Deformations	Shoulder Drop Off	No
	Rutting - Wear	Yes
	Rutting - Mix Instability	Possible, see note a
	Rutting - Deep Structural	Possible, see note b
	Corrugations	Yes
	Shoving	Possible, see note a
Load Associated Cracking	Fatigue - Bottom Up	Possible, see note c
	Fatigue - Top Down	Possible, see note c
	Edge	Possible, see note d
	Slippage	Possible, see note e
Non-load Associated Cracking	Block	Yes
	Longitudinal	Yes
	Transverse	Yes
	Reflective	Yes
Combined Cracking	Joint Reflective	Possible, see note f
	Discontinuity	Yes
Base/Subgrade Deficiencies	Swells, Bumps, Sags Depressions	Possible, see note g
Roughness	Ride Quality	Yes
Other Criteria	All Levels of Traffic	Yes, see note h
	Rural	Yes
	Urban	Yes, see note i
	Stripping	Possible, see note a
	Poor Drainage	No, see note j

www.roadresource.org

Treatment Toolbox/Treatment Resource Center/CIR
or CCPR/Pre-Construction/Site Selection



Hot In-Place Recycling

- ▶ HIR may be performed as either a single pass (one phase) operation that monolithically recombines the restored pavement with virgin material, or as a two pass procedure, where the restored material is recompact and the application of the new wearing surface then follows.

Hot In-Place Recycling

The following improvements are dependent on the type of HIR method used (there are 3 types)

- ▶ Can treat surface to a depth of $\frac{3}{4}$ inch up to 3 inches
- ▶ Can add additional AC binder/modifiers/Recycling agent
- ▶ Can add additional hot mix asphalt/virgin aggregate

Types of HIR

- ▶ Scarification
- ▶ Remixing
- ▶ Repaving



Hot In-Place Recycling

- ▶ HIR uses heat to soften the existing asphalt pavement
- ▶ Scarifies the heated, softened pavement
- ▶ Add rejuvenating agent and additives (if desired)
- ▶ Mix and place rejuvenated mix
- ▶ Compact pavement in one continuous process.
- ▶ Usually requires surface course



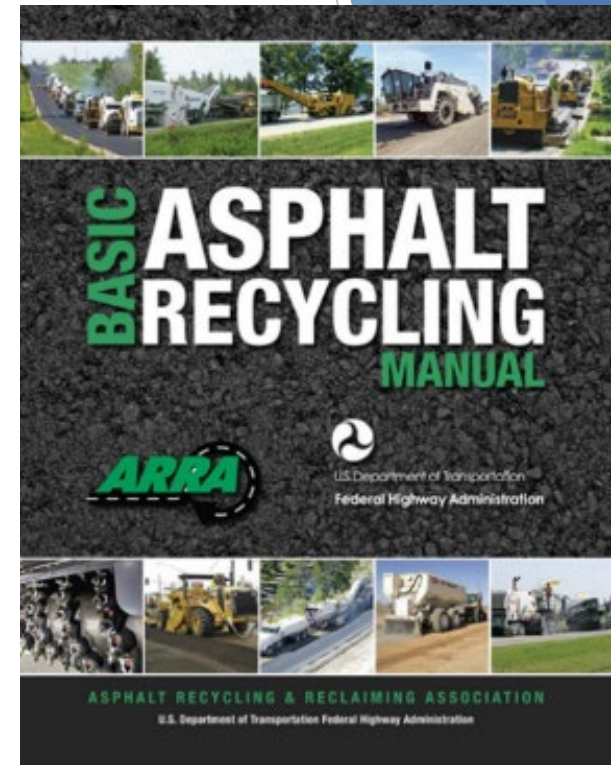
HIR Project Selection

- ▶ HIR is most effective as a maintenance/ minor rehabilitation process
- ▶ HIR treats distress in the upper 1-2 inches of the existing pavement
- ▶ HIR is not meant to address structural failures of a pavement
- ▶ Not all processes treat all distresses equally
- ▶ HIR can be used almost anywhere you would consider using mill and fill or a leveling course with an HMA overlay

HIR Applicability (Table 6-1)

Table 6-1: HIR Applicability

Condition		Surface Recycling	Remixing	Repaving
Surface Defects	Raveling	Yes	Yes	Yes
	Pot Holes	Yes	Yes	Yes
	Bleeding	No	Possible, see note a	Possible, see note b
	Skid Resistance	No	Possible, see note a	Yes
Deformations	Shoulder Drop Off	No	No	No
	Rutting - Wear	Yes	Yes	Yes
	Rutting - Mix Instability	No	Possible, see note a & c	Possible, see note d
	Rutting - Deep Structural	No	No	No
	Corrugations	Yes	Yes	Yes
	Shoving	No	Possible, see note a & c	Possible, see note d
Load Associated Cracking	Fatigue - Bottom Up	No	No	No
	Fatigue - Top Down	Possible, see note e	Possible, see note e	Possible, see note e
	Edge	Possible, see note b & f	Possible, see note b & f	Possible, see note b & f
	Slippage	Possible, see note g	Possible, see note g	Possible, see note g
Non-load Associated Cracking	Block	Yes	Yes	Yes
	Longitudinal	Yes	Yes	Yes
	Transverse	Yes, see note d	Yes, see note d	Yes, see note d
	Reflective	Yes, see note d	Yes, see note d	Yes, see note d
Combined Cracking	Joint Reflection	Possible, see note b	Possible, see note b	Possible, see note b
	Discontinuity	Possible, see note b	Possible, see note b	Possible, see note b
Base/Subgrade Deficiencies	Swells, Bumps, Sags Depressions	Unlikely, see note b	Unlikely, see note b	Unlikely, see note b
Roughness	Ride Quality	Yes	Yes	Yes
Other Criteria	All Levels of Traffic	Yes, see note h	Yes, see note h	Yes, see note h
	Rural	Yes	Yes	Yes
	Urban	Yes, see note i	Yes, see note i	Yes, see note i
	Stripping	Possible, see note c & d	Possible, see note c & d	Possible, see note c & d
	Poor Drainage	No, see note j	No, see note j	No, see note j



www.roadresource.org

Treatment Toolbox/Treatment Resource Center/HIR/Pre-Construction/Site Selection

Repaving

Combines the Scarification or Remixing process with the placement of a simultaneous or integral overlay of new HMA while the temperature of the recycled layer is 200° F minimum.
(Recycle depth 1"-2")



Repaving



Repaving



Repaving



Repaving



Repaving



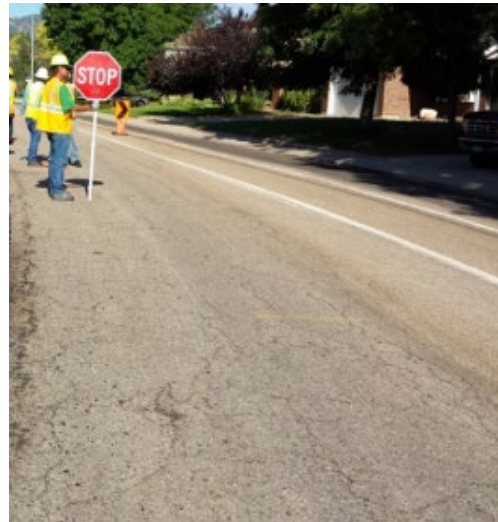
Repaving







HIR & CIR Will Not Fix Base, Subgrade or Drainage Problems



If these are isolated, repair prior to treatment. If not, consider FDR.

Minor fatigue cracking generally ok

In-Place Recycling is Sustainable & Cost Effective

- ▶ Reuses 90-100% of existing materials, in-place
- ▶ Costs 20-50% less than traditional methods
- ▶ Produces up to 90% less greenhouse gasses
- ▶ Reduces user delays (20 to 40% faster construction)
- ▶ Proven Performance

Questions?

Todd Gonser

tgonser@cutlerrepaving.com

(970)381-5907