

#### Introduction to Cold In-Place Recycling & how it can help reduce Greenhouse Gas Emissions



#### MEA Workshop 2019 Chris Thompson, CET



# Why am I here today?

- To show how MEA members can get better roads, while being green and saving green (\$\$)
- Cold In-Place Recycling (CIPR) has been successfully used for Road Rehabilitations in Ontario for 20+ years!
- CIPR Process still seems "new" to some Municipal Owners, designers, inspectors
- Highlight the Environmental Benefits of CIPR



• Thanks to Amanda and the MEA Workshop organizing committee







- Asphalt Recycling & Reclaiming Association
- Founded in 1976
- Members in Canada, USA, Brazil, UAE, South Africa
- 1. Promote recycling of existing roadways
- 2. Preserve limited natural resources
- 3. Reduce costs
- Education & partnering with industry & agencies (like you)
- Partners with PPRA Pavement Preservation
  & Recycling Alliance

## **Presentation Outline**

- Definitions of Cold In-Place Recycling -CIPR
- History of CIPR in Ontario
- Benefits of using CIPR
- Candidate Selection When/Where to use
- What Specifications are used
- Over 20 Years of Recycling in Ontario
- Jobsite Challenges & Solutions



### Definitions for Cold In-Place Recycling

CIR / CIREAM	FDREAS	
Partial Depth	FULL Depth	
Existing <b>HMA</b> is reclaimed, sized, treated with new binder, placed, compacted	Existing <b>HMA</b> and existing and/or new granular	
1 stage	1 or 2 stage	
In-place or central plant	In-place	
Functional distresses	Structural distresses	
Longitudinal, transverse, block 5 cracks	Load-related cracks, rutting, geometry	

# **CIPR** Construction Equipment





## History and Use of CIPR in Ontario

- Ontario and generally across Canada
  - Equipment for Pulverizing/FDR became available in early 1980's with bituminous stabilization following shortly thereafter
  - Paver Laid CIPR was introduced to Ontario in 1989
  - FDR with Expanded Asphalt stabilization 1998

Annually there are over 50 Ontario Municipalities tendering Cold In-Place Recycling as part of their Road Rehabilitation program, including MTO, Grey, Bruce and Simcoe County's and many other municipality's here today.

In Ontario 2.5 – 4 million square meters (360-570 2 lane km)are completed each year



## MTO CIPR Quantities





### MTO FDR and FDREAS Quantities





# Benefits of Cold In-Place Recycling

- Cost effective
  - -25% 50% savings are achievable
- Performance
  - Flexibility mitigates & reflective cracking



### • Environmentally Sustainable

Less energy use resulting in
 Reduced Greenhouse Gas Emissions
 compared to traditional rehabilitation



### What are the Cost Savings!

- Cost effectiveness
  - The existing In-Place materials are 100 % recycled
  - -5" HMA @ \$100 / tonne
  - -6" Gran A @ \$20 / tonne
  - -7 m wide



- Recycled pavements are produced with minimal new materials, i.e. small amount of new AC
- Up to 60% cost savings have been documented on municipal projects
  - 25% 50% is typical for Ontario



# **CIPR** Performance

- Increased flexibility compared to hot mix
  - Non continuous binder film on coarse aggregate
  - Increased air voids (typ. 9 14%, versus 3 5% for HMA)
- Retains characteristics of virgin aggregate with significantly more strength
- Produces a stable, smooth base to Pave over
  <u>- MITIGATES REFLECTIVE CRACKING -</u>





Long term Smoothness Performance of CIPR versus Mill and Pave



### **CIPR** Performance

#### **Rankin named paver** of the year by MTO by STEVE PECAR

There are a few reasons why being named paver of the year for 2016 is a big deal for Rankin Construction Inc. The award, presented by the Ontario Ministry of Transportation at the recent Ontario Road Builders' Association conference held in Toronto. was presented to Rankin in recognition of the company's work on contract 2015-2022 for Highway 3 between Fort Erie and Port Colborne.

"Rankin produced a superior pavement using a high friction surface course material throughout the contract," explains Bob Nichols, Senior Media Liaison Officer with MTO, on why Rankin was chosen for the award. "While echelon paving was not specified in the contract, they chose to pave in echelon whenever they could to greatly reduce the number of cold joints throughout the contract. Along with excellent adherence to acceptance requirements, Rankin was able to achieve an exceptional final product."

"It's great news and something we are very excited about," says Rankin president Brian Rankin, "It really means a lot to all of us." The award is an acknowledgement of the culmination of all the projects the St. Catharines-based company has worked on since its inception in 1978. It's doubly appreciated because the highway project was one that hit close to home.

According to Rankin, the 20 km stretch the project that took about four of Highway 3 is right in the company's own backyard, with several of the crew being natives of Fort Erie. "For many, it was something personal, because they would work on that road and use it to get home at night," he says.

On a more personal level, it is a tribute to a long-time employee who died last year, but whose stamp is emblazoned on the company. "You could say that Joe Defrias put us on OFTHE YEAR PAVER OF THE the map," says Rankin of Defrias, a

that highway were those who learned from Joe through his experience and dedication and the way he ran job sites. He is still very much part of who we are." That tradition continues through family as Defrias' sons and grandsons now work for the company.

Rankin says the goal from day one was to do a quality job, and to do that, a team effort was required. Everyone worked hard together for months to complete starting last May. The work consisted of resurfacing the stretch of road that included grading, drainage, culvert replacement and hot mix paving.

Quantities used were 100,000 m<sup>2</sup> partial depth asphalt milled; 250,000 m<sup>2</sup> CIREAM cold-in-place recycled expanded asphalt mix; 10,000 tonnes SP19 base asphalt; and 50,000 tonnes SP12.5FC1 surface course asphalt. »

#### 2016 MTO project

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## Hwy 6, CIPR after 8 years 3



## Shave & Pave after 6 years 3



## It <u>CAN</u> be easy to be GREEN!

- Conserves natural resources (agg. & AC)
- Quarrying and haulage of new aggregates is eliminated (or significantly reduced)
- Shorter construction durations minimizes delays, user & traffic disruption and congestion
- Heating of materials is not required thereby reducing energy consumption and GHG
  - Reduction of  $CO_2$ ,  $SO_2$ , &  $NO_x > 50\%$  compared to mill and pave
- 40% 80% less GHG emissions (Can be quantified)
- Well suited to assist Municipalities reduce GHG



TAC 2007 MTO, and TAC 2010 AMEC papers on CIR GHG

Source: PPRA 2015 Niagara Falls, presentation by U. Maryland Prof Charles Schwartz

## CIPR - Environmental Benefits



## **CIPR** Candidate Selection

	Attribute	Partial Depth	Full Depth
	Description	(CIREAM)	(FDREAS)
	Typical Treatment Depth	75-110 mm (≥ 70% of HMA)	150 mm
	Existing Hot Mix Asphalt Depth	> 100 mm	< 150 mm May require pre- milling
Typica	Typical Materials	100 % RAP	RAP & Granular
Ree	Reclaimed		blend
	Typical Overlay	Hot Mix Asphalt,	Hot Mix Asphalt,
	Treatment	Chip Seals	Chip Seals
	Attributes of Existing Pavement	<b>Structurally sound,</b> badly cracked, decent long. and trans. profile	Requires structural improvement, distorted, heterogeneous <sub>19</sub>

### Candidate Selection

Attribute	Partial Depth (CIR)	Full Depth (FDREAS)
Typical Cross Sections	Urban, Rural, Freeway	
Typical binder injection rate	1.0 – 1.5% AC	100% agg: +/- 3.5 % AC; 50:50 RAP:Gran blend: +/-2.8% AC
Typical Additives	Portland Cement or hydrated lime with CSS-1h	Portland Cement, Hydrated Lime, Fly Ash, Anti-Strip, WMA
Performance Measures	Helps mitigate reflective cracking, improves smoothness and profile	Eliminates distresses, increases structural capacity, & restores profile



# CIPR - Partial Depth Candidates



Good Cross-section Sufficient Asphalt Depth **Adequate Drainage** 

Good base / sub-base



# Full Depth Candidates



Some projects may require base repair and drainage improvements

Distorted, severe rutting

Severe cracking



### Pavement Analysis Prior to Tender!

- Historic info
  - -Previous contracts / repairs / materials
- Field inspection
  - Structural adequacy & drainage
  - Type and severity of distresses (ARAN)
  - Cross fall, smoothness, width
- Coring and lab analysis of existing materials, incl. info-only Mix Design
- Structural assessment
- Pavement design

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# Current Specifications being used

- OPSS.MUNI 331 Nov. 2016 FDREAS
- OPSS.MUNI 333 Nov. 2015 CIR
- OPSS.MUNI 335 Nov. 2016 CIREAM

<u>Covers</u>

- Mix Design Requirements
- Materials, min binder required, Equipment
- Corrective aggregate and active fillers are permitted
- Operational Constraints: date, temperature (ref. CA)
- Specs cover gradation, compaction, surface appearance
- Often amended with Special Provisions to suit local conditions and past experience
- NEW: MTO SP-027 & Field Guide



# Field Guide



For the Acceptance of

Cold In-place Recycling Processes



Pavements and Poundations Section Materials Engineering and Research Office Ministry of Transportation Ontario MARCH 2016

> 155N 578-1-4606-5577-5 (Print 155N 578-1-4606-5578-6 (POP

 Developed in 2016 to uniformly implement acceptance procedures for Cold In-Place Recycling Processes based on latest SP's

Covers;

- Sampling methods and procedures,
- Equipment used,
- Construction surface
  prep, constraints & Traffic
  Control

INNOVATORS IN ROAD RECY

### Simcoe County Rd 42, pre & post CIPR



### Town of Innisfil 7<sup>th</sup> Line, 2009 project

7<sup>th</sup> Line, Pulverized, added 150 mm RAP, CIPR and SST in 2009. Photos from May 2017, after 8 winters

### CIPR: Hwy 7 (W of Perth) Rehabed in 2003



# MTO Project Hwy 400, Port Severn

2015 Project, had avg. of 140 mm of HMA 90 mm CIPR with 1.1 % new binder + 1 % Portland cement



# Grey/Simcoe County Road 31

#### 2015 FDREAS Project, Pre-Pulverize (50/50 blend), shift CL High truck volume near aggregate pits





From this municipal owned RAP pile

ROTO-MILL submitted a proposal to the Municipality of South Bruce to use their existing RAP pile

100 mm of CIPR RAP = 85 mm of Hot Mix

Environmental Benefits -Reuse of 10,000 tonnes of municipal RAP



# Jobsite Challenges/Solutions

- Crack sealant
- Crossfall correction (pre-mill vs fix vs follow existing)
- Early / late season work, temperature, day / night
- Closure length

- Cut deeper & place wider
- Incorporating shoulder materials
- Variability / quality of in-place materials
- Breakthru into granular below
- Pulverizing depths / blend ratios
- Joints mid-job

- Re-processing area (when, how much, risk, warranty)
- Turning lanes / tapers

- Effects of cement (placing, testing, curing, sample delivery, fines)
  - Mat appearance (SP-027)
  - Open to traffic too early / pilot slow
  - Cut slabs (eg after rain)
  - Effects of mat open for long time to traffic



### **Crossfall Correction**



Follow existing, +/- 2 % ? Pre-mill is an effective way to correct. Max 0.5% crossfall correction possible with CIPR process





# Early / Late Season Work

- Sudden rainstorms watch forecast
  - Emulsion and foam mixes with cement cure quicker
- Cool overnight  $\rightarrow$  may Ravel (could use Fog Seal)
- CA approval needed for CIPR after Sept 1
- No CIPR when colder than 10°C



# Closure Length

- Recycling train is a moving closure
- Train travels against traffic so no standing traffic on fresh mat, but may need to extend closure per mat properties
- Traffic allowed on mat after rolling with no temperature restrictions - typically 2 -3 hours

**Special Provision** 

#### **MAINTENANCE OF TRAFFIC**

Operations shall be scheduled on Highway 144 such that one lane of traffic in each direction, is restored to its original location prior to the end of each day's work, excluding lane closures at temporary traffic signal locations.

#### SINGLE LANE CLOSURES

A maximum of five (5) daytime single lane closures not exceeding 500 m each will be permitted within the contract limits. Each closure shall be separated by at least 500 m from any other single lane closure. These five (5) closure locations are in addition to any lane closures at temporary traffic signal locations.

Where operations require lane closures exceeding 500 m, the total number of lane closures shall be reduced to three (3), excluding lane closures at temporary traffic signal locations. No individual lane closure shall exceed 1500 m and at least one of the lane closures shall not exceed 500 m. Each of these closures shall have a separation of at least 1500 m from any other single lane closure.

### Pilot vehicle with Lane Closure



# **Construction - Lane Widening**



Pre-mill ahead of Recycling Train to accommodate PPS (Cycling Lanes)

➢Pave wider

- Base same width as final surface
- ≻Eliminate crack along shoulder
   ≻Triple win ☺



# Heavy weight on your shoulders...

#### Existing shoulders not recycled = 🙁 Difficult to match profile & creates bathtub



# **Pulverizing Depth on FDREAS**

- Ex. below shows 300 mm FDR, then 150 mm EAS
- Pad foot roller needed to compact
- Would likely pulverize full width, but only stabilize thru lanes



# Conclusions

- CIPR has long history of good success and performance across Ontario
- Should be top-of-mind option for road rehab
- Benefits: Cost, performance, environmental
- Proper candidate selection & pre-engineering
- Construction best practices, realistic specs
- Huge potential for increased use on municipal roads, high and low volume roads
- Large knowledge base & numerous resources



# Summary of Presentation

Long-term

not a fluke

**Right road** 

No reason NOT

to consider & use

P Recycling

**Realistic specs** 

Well constructed

performance is

good

- Definitions
- History
- Benefits Price, performance & Environmentally Friendly, Reduce GHG's
- Candidate Selection
- Specifications and SP's
- Over 20 Years of successful Recycling projects in Ontario
- Jobsite Challenges
  O
  and Solutions

### Available Resources for MEA members

- Asphalt Recycling and Reclaiming Association's (ARRA) Basic Asphalt Recycling Manual (BARM 2)
- OPSS, both MUNI. & PROV. and S.P.'s
- NCHRP Project 20-5 Synthesis Topic 40-13 on Inplace Recycling
- Wirtgen Cold Recycling Manual On-Line
- Local county's, neighbouring municipalities and MTO Region experience
- Roadresource.org website by PPRA
- MTO has GREENPAVE, Green Pavement Design Rating System
- Various research papers
- Contractors can answer questions





#### Thank You

### QUESTIONS??

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