FHWA's Recycled Materials Resource Center (RMRC): Helping to Create a Sustainable Roadway Infrastructure

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University of Washington
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Recycled Materials Resource Center

www.recycledmaterials.org

What is the RMRC?

University-FHWA collaborative on using recycled materials for sustainable roadway infrastructure:

- University of New Hampshire
- University of Wisconsin-Madison
- University of Washington

-Support also provided by USEPA and Pool Fund comprised of Alabama, Georgia, Indiana, New Hampshire, New York, North Carolina, Wisconsin

-Other states welcome to join. Interested states please contact: Steve.Mueller@fhwa.dot.gov

Who is the RMRC?

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What is the Purpose of the RMRC?

- Promote the safe and wise use of recycled materials in construction of transportation infrastructure through education, technology transfer, and applied research.

- Wise … ensure that the recycled material is suitable for the highway environment and provide procedures for appropriate use.

- Safe …. ensure that material will not have an adverse impact on the environment or users.

Two Byproducts → Use Product


RPM + High Carbon Fly Ash

= high modulus and durable base

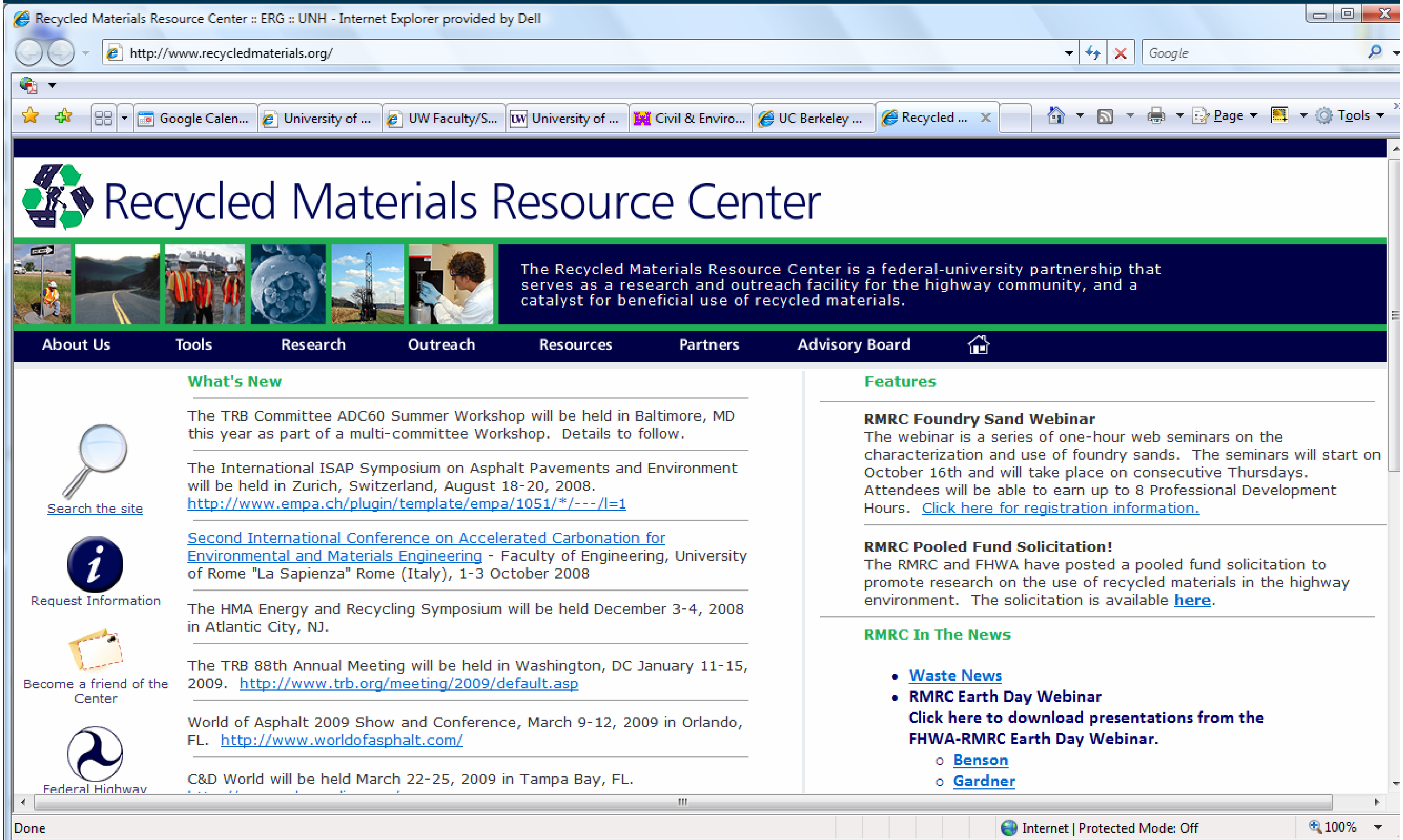
What does the RMRC do?

- Provide clearinghouse for technical information (see www.recycledmaterials.org)

- Provide continuing education/technical training on using recycled materials in roadway construction.
  - face-to-face workshops
  - webinars (coming October 2008!)
  - managed by UW-Madison EPD

-Applied research and development to turn concepts into field applications.

RMRC Website – Resource Center



THE UNIVERSITY of WISCONSIN MADISON

New Webinar!

Foundry Sand Recycling Forum

RMRC

Using Foundry Sand in Transportation and Civil Infrastructure Applications

Online Workshop: October 16–November 20, 2008

Six one-hour interactive Web sessions on consecutive Thursdays

9:00 a.m. Pacific Time; 10:00 Mountain; 11:00 Central; 12:00 Eastern

Earn up to

ACCEPTED NATIONWIDE 8 Professional Development Hours

Federal Highway Administration

Discover the Benefits of Foundry Sand Use in Specific Infrastructure Applications

Foundry sand is a manufactured structural sand used as a molding medium in the metalcasting process. U.S. foundries recycle sand internally but must discard millions of tons of unusable sand annually. This discarded sand then becomes locally available aggregate resources.

This online workshop will focus on using foundry sand in specific infrastructure applications, including:

- Hot mix asphalt
- Controlled low strength material
- Bases and subgrades
- Structural fills, embankments, and retaining structures

For each application the instructors will discuss civil engineering issues such as index properties, design guidelines, testing requirements, and specifications, along with case studies and environmental assessments.

Who Should Attend

- ☑ Design engineers
- ☑ Geotechnical/Soils Engineers
- ☑ Regulatory review professionals
- ☑ Contracting service personnel
- ☑ Construction contractors
- ☑ Public sector professionals
- ☑ Dam owners
- ☑ Biologists
- ☑ Planners

How to Enroll

http://epd.engr.wisc.edu/webK479

Click on the "Enroll Now" button and complete the form.

Webinar Session Topics

October 16, 2008
Characterizing Engineering Properties of Foundry Sands
- Characterizing engineering behavior—do foundry sands behave like sand?
- Measuring properties for embankments, structural fill, and backfill
- Measuring properties for pavement design

Dr. Craig H. Benson

October 23, 2008
Designing Hot Mix Asphalt with Foundry Sand
- Creating mix designs
- Controlling the mix at the plant
- Constructing HMA with foundry sand

Dr. Hussain U. Bahia

October 30, 2008
Designing Controlled Low Strength Material (Flowable Fill) with Foundry Sand
- Engineering CLSM with foundry sand
- Ensuring adequate set time and final strength
- Constructing with CLSM containing foundry sand

Dr. Tuncer B. Edil

November 6, 2008
Designing Pavements Using Foundry Sand in Base and Subbase
- Defining engineering properties for pavement design
- Evaluating pavements constructed with foundry sand bases and subbase
- Constructing with foundry sand as base or subbase

Dr. Tuncer B. Edil

November 13, 2008
Using Foundry Sand for Embankments, Retaining Structures, and Structural Fill
- Determining the shear strength for design
- Characterizing interaction with geosynthetics
- Evaluating drainage and raveling

Dr. Craig H. Benson

November 20, 2008
Evaluating Environmental Suitability of Foundry Sands for Infrastructure Construction
- Selecting the approach testing methods
- Demonstrating environmental acceptability for your project
- Negotiating environmental permitting

Dr. Craig H. Benson

Webinars

- Interactive sessions that provide practical training and PDHs.
- Coal combustion products (fly ash, bottom ash, FGD residual).
- RAP and RCA
- http://epd.engr.wisc.edu/webK479

Applied Research

Focus on both mechanical and environmental aspects …. information *and* tools for the roadway designer, the contractor, and the environmental compliance officer.

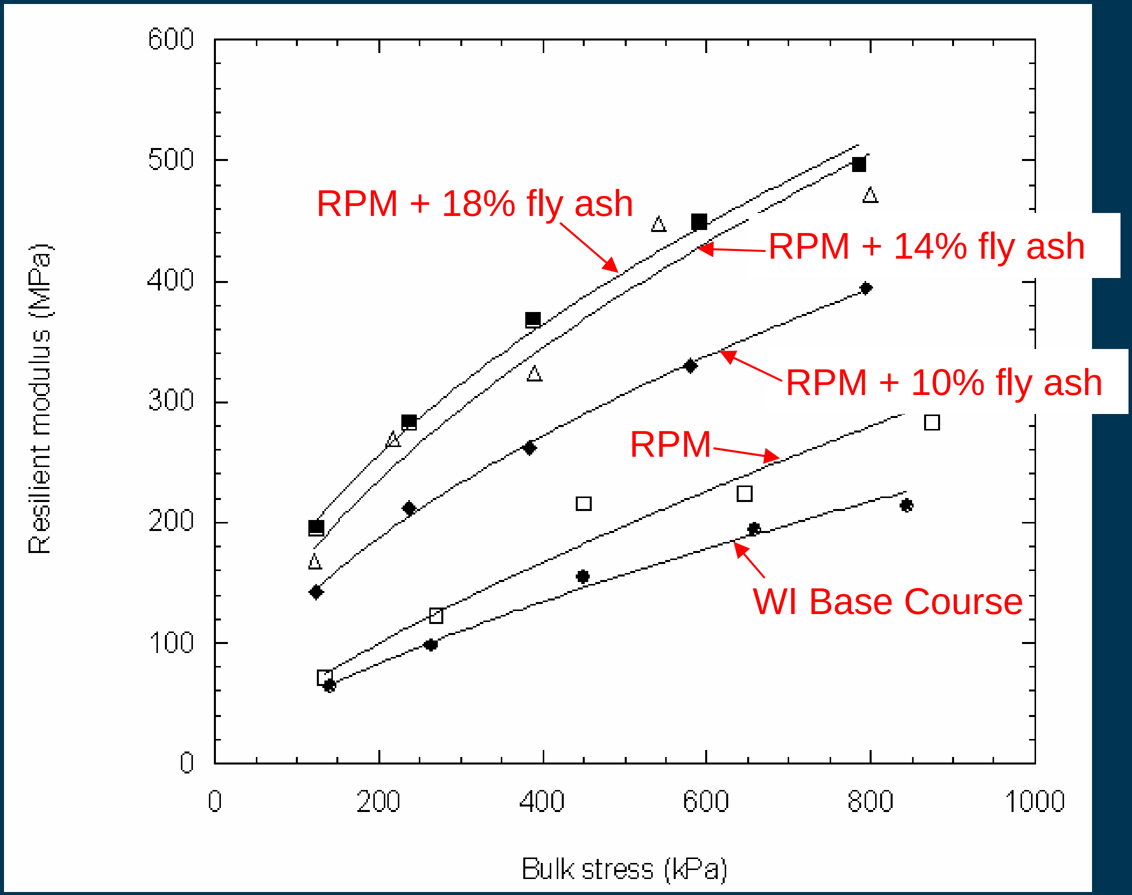
Provide designer with methodology to use recycled materials in place of conventional materials. For example, developing method for MnDOT to design low volume roads with recycled pavement material (RPM). Validated with full-scale test sections.

Computer tools: PaLate for life cycle assessment and WiscLEACH for environmental suitability.

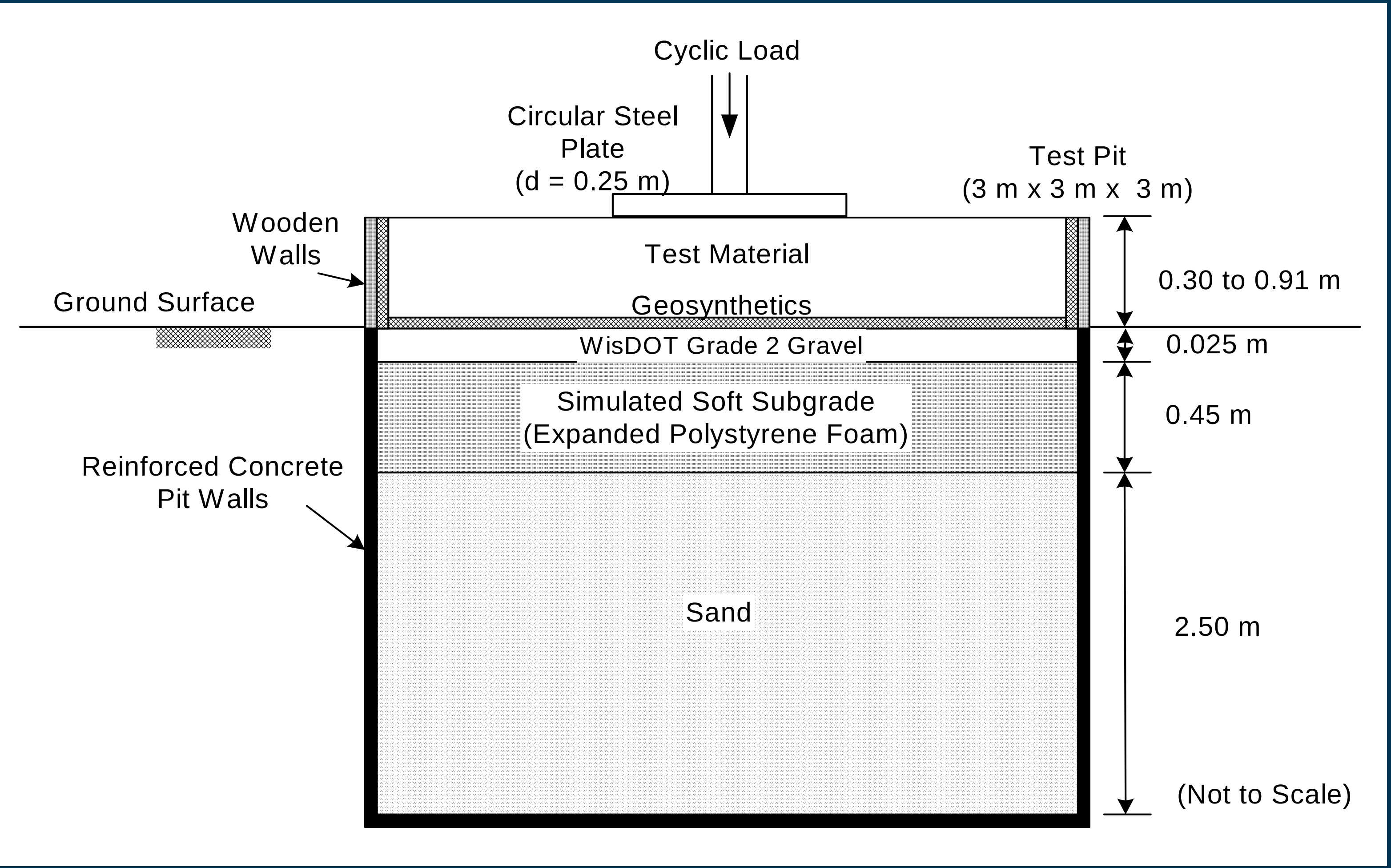
Applied Research

Conduct applied research at bench-scale, prototype scale, and field scale

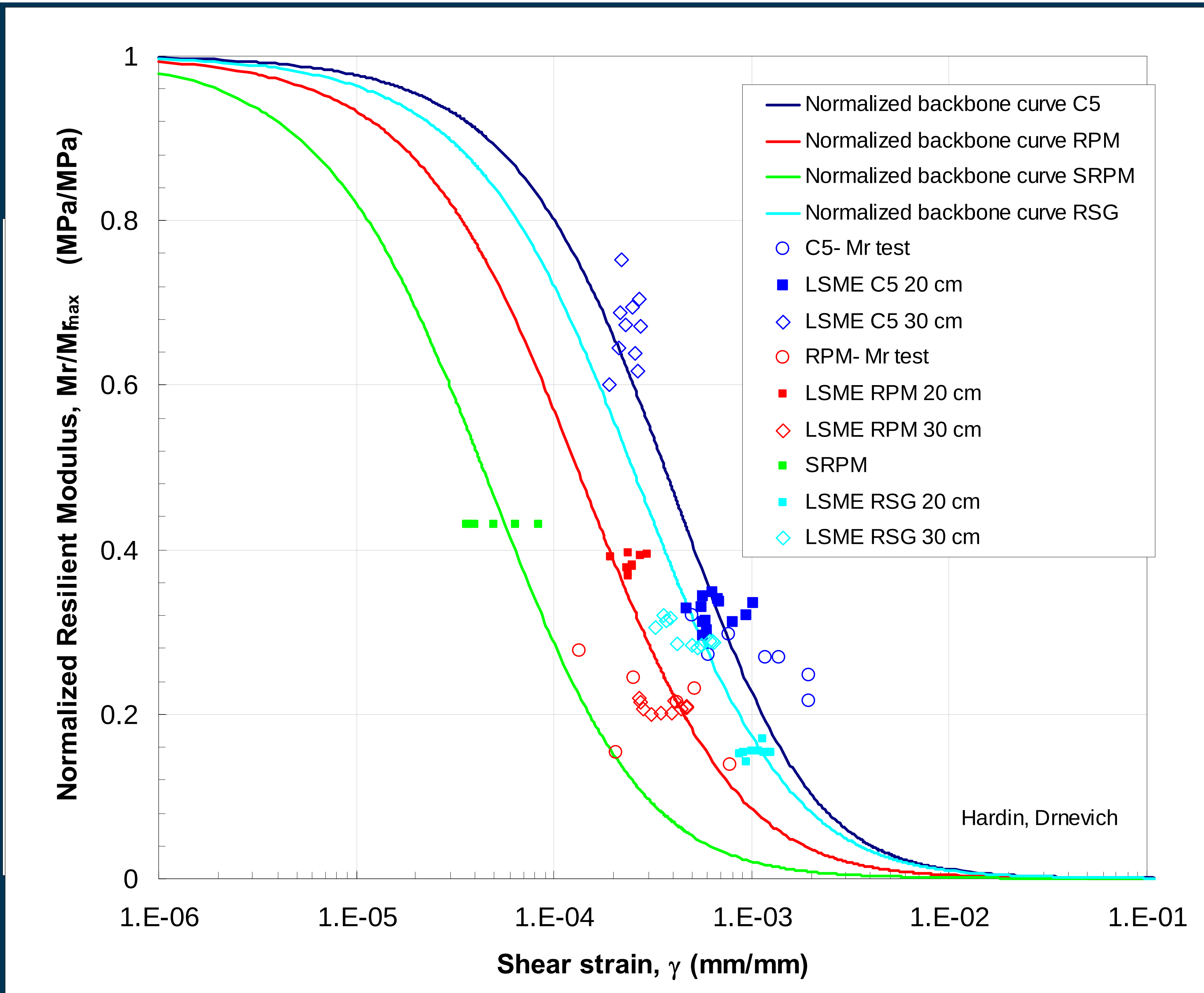
Bench-Scale Resilient Modulus Test



Applied Research – Prototype Scale



LSME Prototype Pavement Test Facility


Normalized Resilient Modulus, Mr/Mrmax (MPa/MPa)
1
0.8
0.6
0.4
0.2
0
1.E-06
1.E-05
1.E-04
1.E-03
1.E-02
1.E-01
Shear strain, γ (mm/mm)
Normalized backbone curve C5
Normalized backbone curve RPM
Normalized backbone curve SRPM
Normalized backbone curve RSG
C5- Mr test
LSME C5 20 cm
LSME C5 30 cm
RPM- Mr test
LSME RPM 20 cm
LSME RPM 30 cm
SRPM
LSME RSG 20 cm
LSME RSG 30 cm
Hardin, Drnevich

Applied Research – Field Scale

A. Spreading Fly Ash

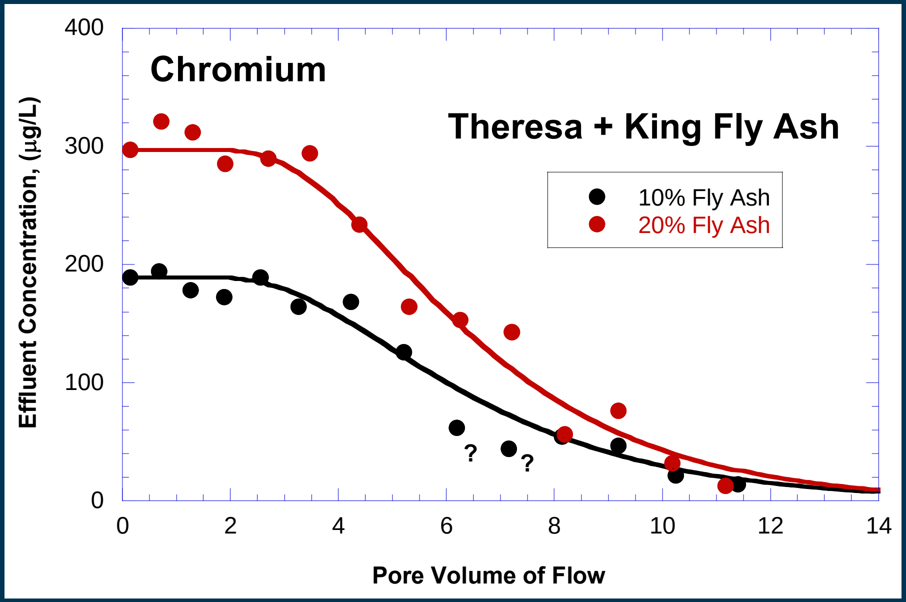
B. Fly Ash Mixing

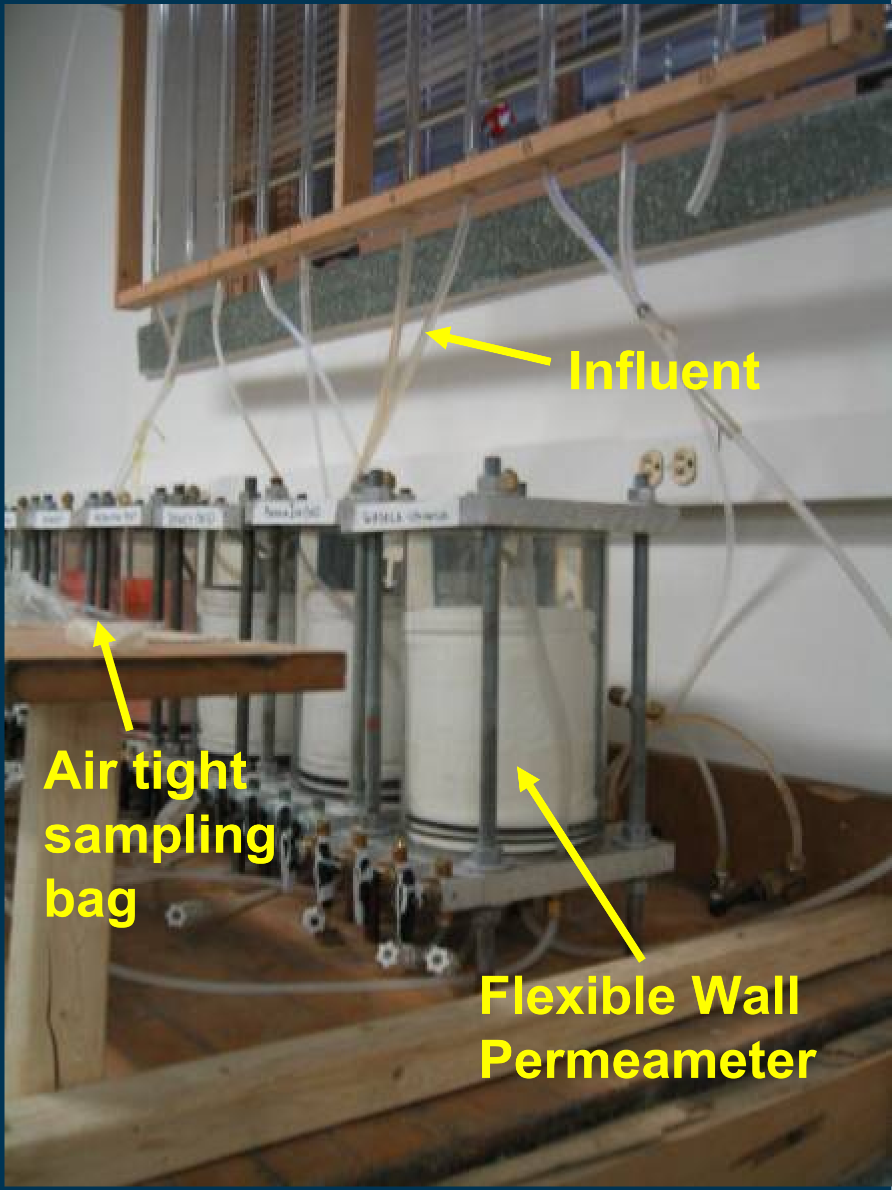
C. Grading

D. Compaction

Laboratory Column Leach Tests

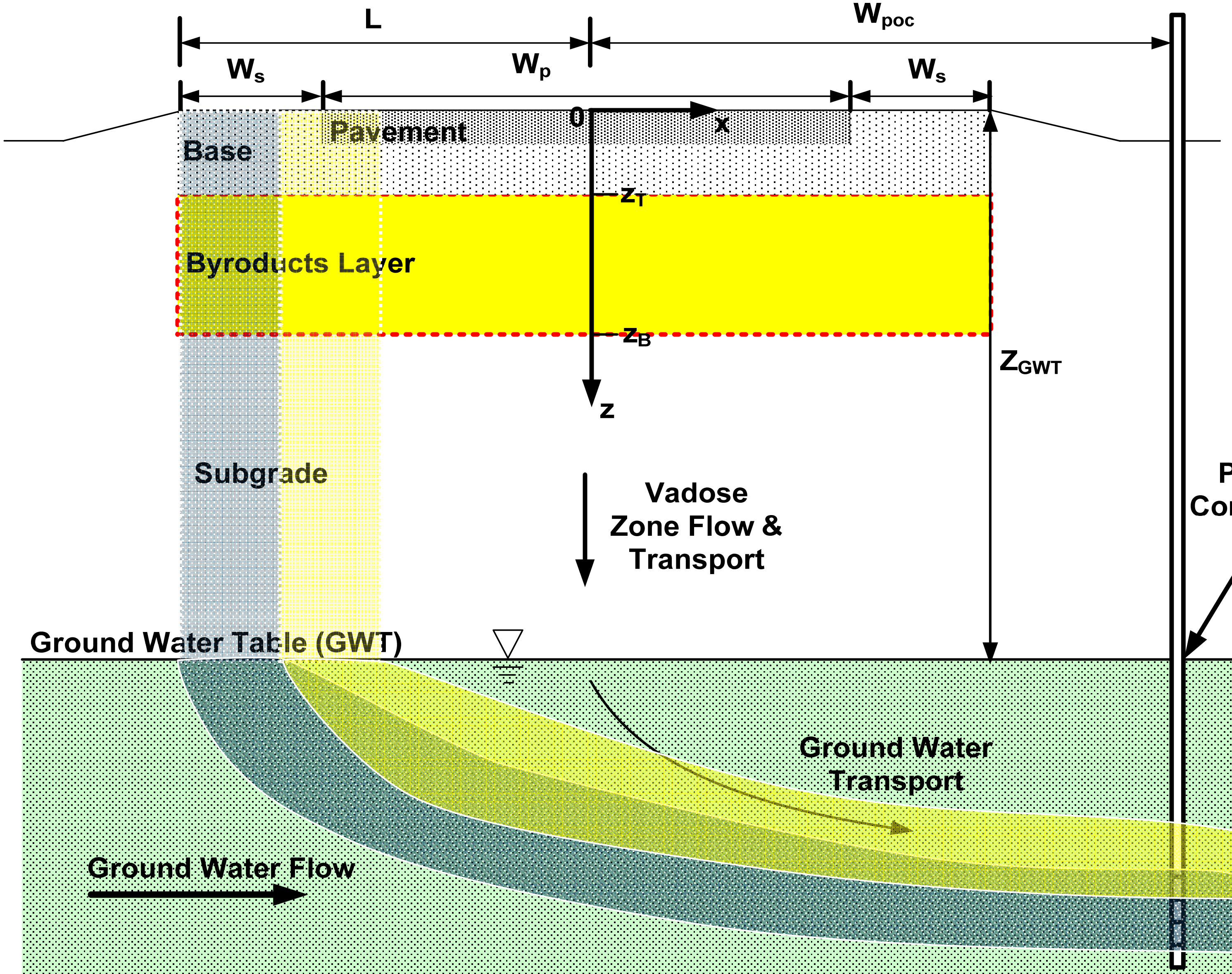
SRPM sample from field site. Analysis for elements: Sb, As, Ba, Be, B, Ca, Cd, Cr, Co, Cu, Pb, Mn, Hg, Mo, Ni, Se, Ag, Sr, Tl, Sn, V, Zn






Geomembrane installation
Sump welding
Drainage layer installation
Collection tank installation

WiscLEACH Model



Case Histories and Field Demonstrations

- Well documented case histories and field demonstrations answer severall of the fundamental questions of concern to the designer. High value to the community.
- Undocumented case histories add to body of experience, but lesser value. Do not answer most fundamental questions. Exception: demonstrates that project was completed and designer was not fired!

Case Histories

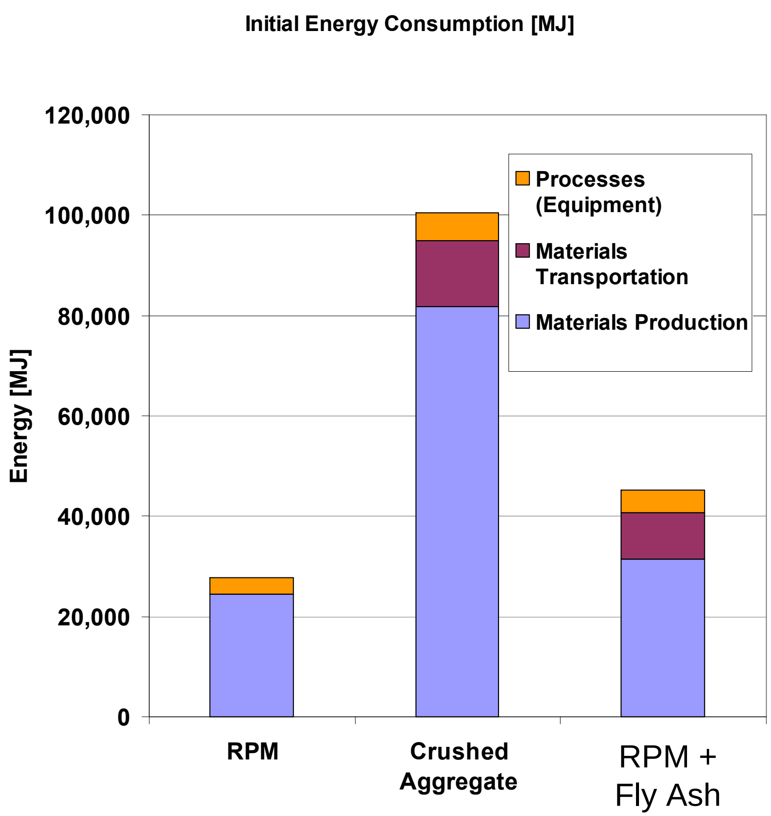
What elements are necessary for a well-documented case history?

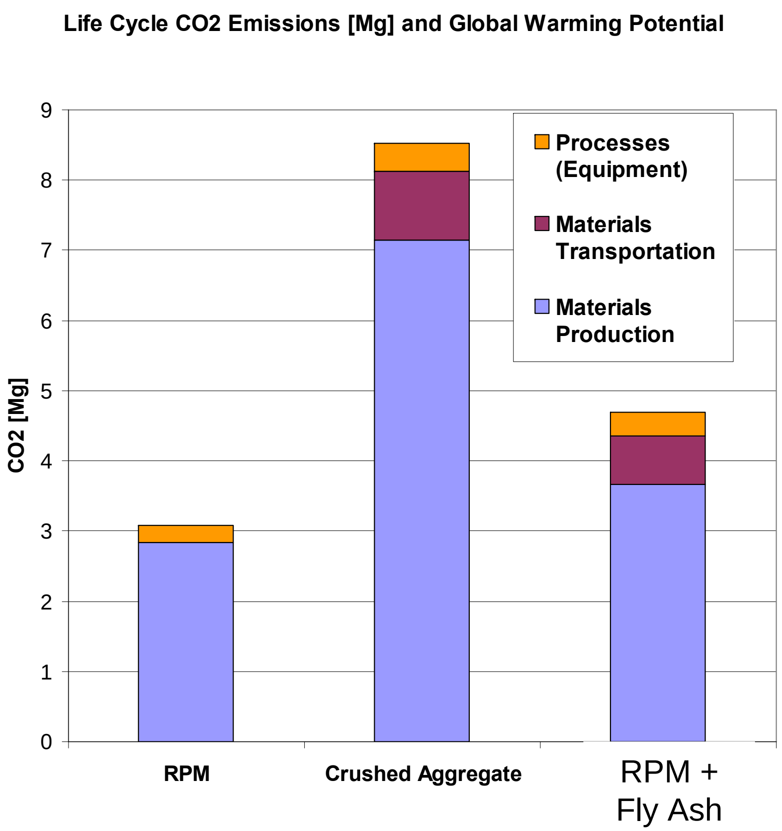
•A roadway that is *designed* and *constructed* with recycled materials.

•Field *documentation* that the engineering behavior of the recycled materials are behaving as anticipated during design. Measurements!

•Field documentation that the structure exhibits *comparable durability* as conventional construction. Measurements!

Life Cycle Analysis – Cost, Energy, Environment





MnROAD Test Sections with RPM & Fly Ash

Applied Research

Coal combustion products:

- Subgrade stabilization
- Base stabilization
- Structural fill

Foundry products:

- Subbase
- Base admixtures
- Surface coarse admixture
- HMA

Applied Research

Recycled Asphalt and Concrete Pavements (RAP, RCA), Recycled Pavement Material (RPM)

- Base course
- HMA
- Structural fill
- Impact of stabilizers (fly ash, CKD, cement).

Recycled Asphalt Shingles (RAS)

- Subbase
- Structural Fill
- HMA
- Remnants vs. Tear Offs

Applied Research

Materials Logistics and Support

- Mapping systems to relate sources to project sites
- Guidance documents on material applications

Life Cycle Analysis

- Capital and O&M costs
- Energy costs
- Environmental costs
- Tools to permit an integrated evaluation of alternatives.

Use the RMRC as a Resource

- We are here to help you!

- Contact us with your questions, resource needs, or opportunities:

Craig H. Benson: chbenson@u.washington.edu
Kevin H. Gardner: kevin.gardner@unh.edu

- Participate in the RMRC pool fund and drive the applied research program to address the needs in **your** state.

www.recycledmaterials.org