Sustainability In Asphalt Pavements

Southwest Ohio Asphalt Pavement Technical Seminar

November 29, 2012

Sustainable Concepts

- Sustainable Technologies Should Be:
  - Economical
  - Resource-responsible
  - Long-life Solutions
  - Environmentally Sound
  - Increase Performance and Value
- 3R's: Reduce, Recycle, Re-use

3R's: Reduce

- Asphalt Pavements Reduce Demand on Virgin Raw Materials:
  - Reclaimed Asphalt Pavement (RAP)
  - Reclaimed Asphalt Shingles (RAS)
  - Ground Tire Rubber (GTR)
  - Perpetual Pavement Design for Long-life Performance.
- Reduce Energy Consumption with Warm Mix (WMA) Asphalt

3R's: Recycle

- **Asphalt Pavement:** Use of RAP Reuses & Rejuvenates Old Asphalt Pavement and Avoids Placing Hundreds of Thousands of Tons of Waste Material Annually in Landfills.
- **Shingles:** Tear-offs from Old Roofs or Manufacturer Waste Used as a Component of Asphalt Pavements.
- **Scrap Tires:** Formerly Destined for Landfills Incorporated into Asphalt Pavements Improving Binder Properties and Material Performance.

Recycling Rates by Category

- 64% Scrap Steel
- 60% Aluminum Cans
- 56% Newspapers
- 37% Plastic Soft Drink Bottles
- 31% Glass Beverage Containers
- 23% Magazines
- **90% Asphalt Pavements**

3R's: Reuse

- Asphalt Pavements are 100% Reusable & Do Not Require Removal & Disposal Costs.
- Can be Incorporated Entirely Into New Asphalt Pavements.

Sustainable Attributes of Asphalt Pavements

- Reclaimed Asphalt Pavement (RAP)
- Reclaimed Asphalt Shingles (RAS)
- Ground Tire Rubber
- Bio-Derived Binder Extenders
- Warm Mix Asphalt
- Porous Pavements
- Perpetual Pavement
- Smoothness
- Low Carbon Footprint

Reclaimed Asphalt Pavement (RAP)

- Asphalt is the Most Recycled Material in America Saving More Than $300 Million Annually.
- 73 Million Tons Reused Annually.
  - Nearly twice as much as paper, glass, aluminum & plastics combined.
- RAP in Landfills:
  - Less Than 10% nationally.
  - Less Than 1% in Ohio.

RAP Usage in Ohio

- Ohio one of Top 7 states for Reported Average RAP Usage.
- Summary of RAP Usage in Ohio:
  - On Average Each Ton of Asphalt is Comprised of 24% RAP;
  - Approximately 3.4 Million Tons of RAP Used Annually;
  - Estimated Value of $170 million.

NCAT Reclaimed Asphalt Pavement Publication

- Developed by NCAT & FHWA Recycled Asphalt Pavement Expert Task Group
- Overview of the economic, performance and environmental benefits of RAP
- Available at: www.morerap.us

Reclaimed Asphalt Shingles

- Reclaimed Asphalt Shingles (RAS) is generally of two origins:
  - Manufacturing Waste
  - Roofing Tear-offs

RAS: Background

- 10 Million Tons of Asphalt Shingles Annually Enter Waste Stream
  - 1 Million Tons Manufacturer Waste
  - 9 Million Tons Tear-offs
- 3rd Largest Construction Material Waste

Why use Shingles?

- Economic Benefit
  - Considerable Cost Savings Per Ton of HMA
- Ease of Recycling
  - Shingles Composed of Materials Routinely Used in HMA
- Process Can be Engineered to Provide Asphalt Pavements with Equivalent or Superior Performance.

Ground Tire Rubber (GTR)

- Two Main GTR Applications:
  - Dry Process: Aggregate Replacement
    - Granulated/Ground Rubber is Added with Aggregate During Mixture Process.
    - Substitute for 1%-3% of Aggregate.
  - Wet Process: Asphalt Rubber (AR)
    - Crumb Rubber is Added to Liquid Asphalt before Mixing at Asphalt Plant.
    - Asphalt Cement Modifier.

GTR Environmental Benefits

- Two-Inch thick Overlay of GTR Asphalt Pavement Will Utilize Approximately 2,000 Tires Per Lane Mile.
- Approximately 10 Million Tires are Annually Recycled in Paving Applications.

NCAT Test Track GTR Research

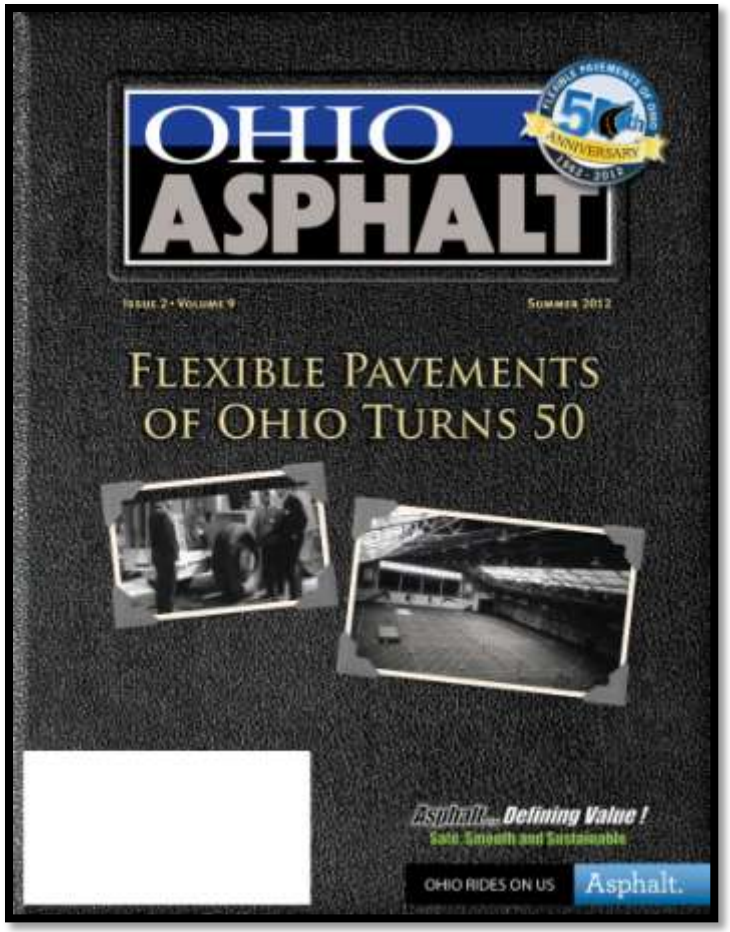
- NCAT Research on Viability of GTR as Alternate Binder Modifier for Styrene-Butadiene-Styrene (SBS) in Interstate Surface Mixes.

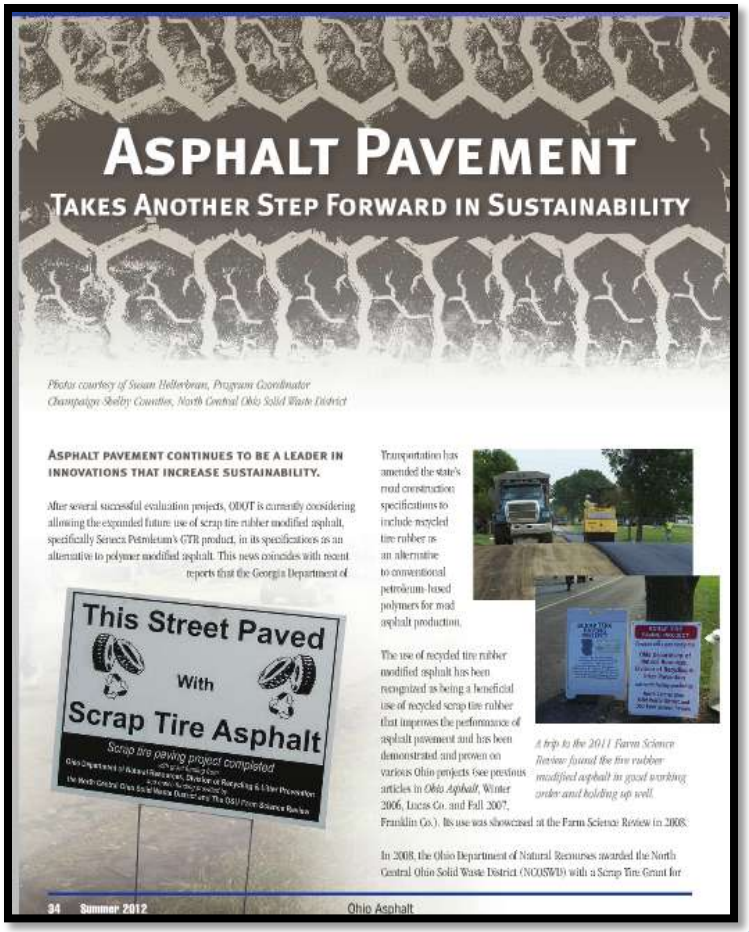
- Constructed Two Test Sections and Monitored Results for Two Years (2009-2011).

Preliminary Research Conclusions

- No Significant Rutting or Cracking.
- GTR Demonstrated Equivalent or Better Performance Compared to SBS Modified Mixture.
- GTR Can be Used as a Polymer Substitute Without Sacrificing Asphalt Mix Performance.

Ohio Asphalt: Summer 2012





ASPHALT PAVEMENT
TAKES ANOTHER STEP FORWARD IN SUSTAINABILITY

Photos courtesy of Susan Hellerbrand, Program Coordinator Champaign Shelby Counties, North Central Ohio Solid Waste District

ASPHALT PAVEMENT CONTINUES TO BE A LEADER IN INNOVATIONS THAT INCREASE SUSTAINABILITY.

After several successful evaluation projects, ODOT is currently considering allowing the expanded future use of scrap tire rubber modified asphalt, specifically Seneca Petroleum's GTR product, in its specifications as an alternative to polymer modified asphalt. This news coincides with recent reports that the Georgia Department of Transportation has amended the state's road construction specifications to include recycled tire rubber as an alternative to conventional petroleum-based polymers for road asphalt production.

A trip to the 2011 Farm Science Review found the tire rubber modified asphalt in good working order and holding up well.

The use of recycled tire rubber modified asphalt has been recognized as being a beneficial use of recycled scrap tire rubber that improves the performance of asphalt pavement and has been demonstrated and proven on various Ohio projects (see previous articles in *Ohio Asphalt*, Winter 2006, Lucas Co. and Fall 2007, Franklin Co.). Its use was showcased at the Farm Science Review in 2008.

In 2008, the Ohio Department of Natural Resources awarded the North Central Ohio Solid Waste District (NCOSWD) with a Scrap Tire Grant for

Bio-Derived Binder Extenders

- Vegetable Oil Formulations (Soybean, Corn, Sunflower & Canola) in Development as Possible Asphalt Binder Modifiers & Extenders.
- Nu-Vention Solutions, Inc.
  - Ohio Company
  - BR2: Swine Manure Based Bio-oil to Extend & Improve Asphalt Binder.

Warm Mix Asphalt (WMA)

- General Term for Technologies That Allow Reduced Asphalt Production & Placement Temperatures.
- Reductions of 50° to 100° Fahrenheit

Warm Mix Asphalt (WMA)

Reduced Mixing Temperatures (50º-100º F)

Temp = 320º F

Temp = 245º F

Advantages of WMA (Plant)

- Improves Air Quality Emissions
- Reduces Energy Consumption & Mix Production Cost
- Facilitates the Use of RAP
- Reduced “Carbon Footprint”

Advantages of WMA (Placement)

- Improves Worker Environment
  - Reduced Exposure to Fumes/Smoke
- Cool Weather Paving
  - Extends the Paving Season
- Improved Workability
  - Compaction Aid for “Stiff” Mixes

WMA Technologies

- Additives:
  - Zeolite
  - Sasobit
- Modified Binder:
  - Evotherm
- Foaming
  - Simple and Effective
  - All Manufacturers

WMA in Ohio

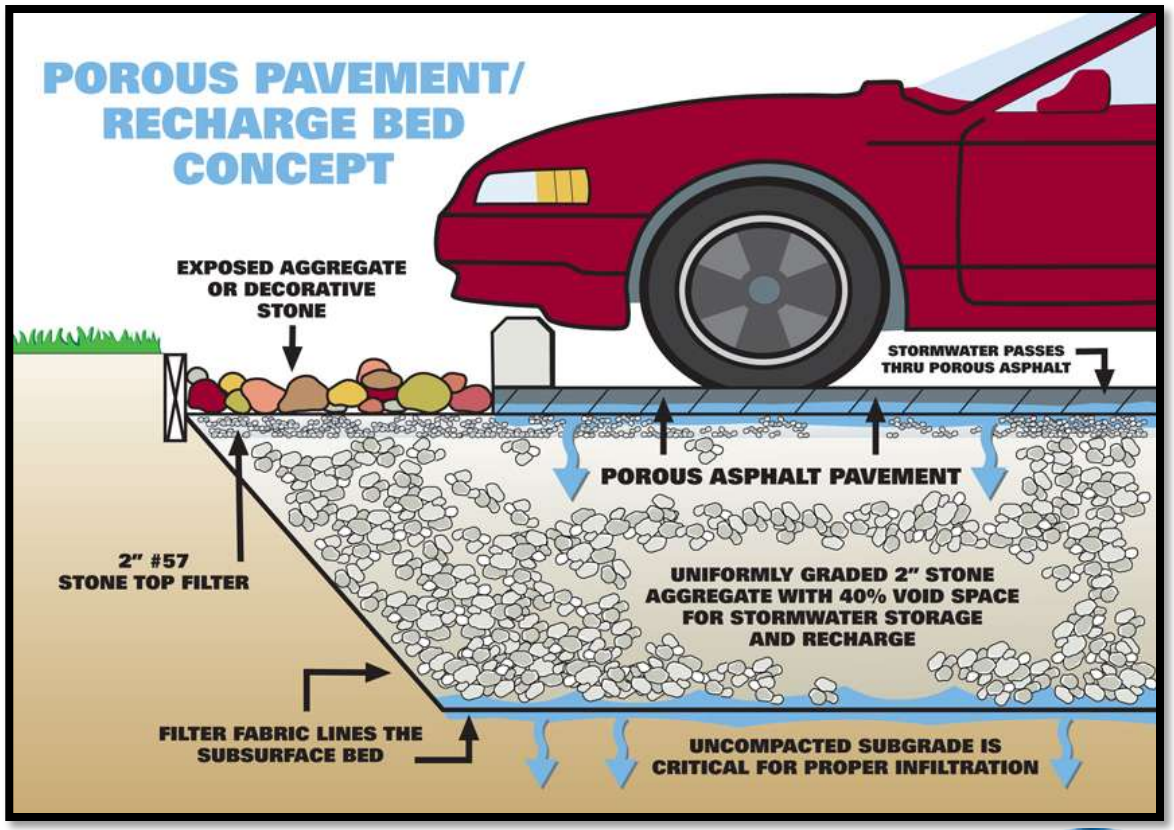
- In 2006: ODOT Began Lab Investigations & Field Trials of WMA.
- In 2008: Use Permissive Under ODOT Specs.
- 2011: 78 out of 151 Asphalt Plants Possess the Capability to Produce WMA

Warm Mix Asphalt in Ohio

Ohio DOT WMA Usage			
Year	Total Tons	WMA Tons	Percent WMA
2006	4,173,618	0	0
2007	4,677,966	0	0
2008	5,130,600	10,430	.2%
2009	4,953,472	148,576	3%
2010	3,573,764	1,071,994	30%
2011	5,000,000	2,800,000	56%

Porous Asphalt

Pavement Structure with Permeable Surface that Permits Stormwater to Pass Through Surface for Infiltration and/or Storage in the underlying layer.



Why Porous Asphalt Pavements?

- Environmental Benefits:
  - Limits Quantity & Improves Quality of Stormwater;
  - Recharges Groundwater;
  - Reduces Amount of Impervious Surfaces.
- Economic Benefits:
  - Reduces/Eliminates Conventional Stormwater Control Facilities & Maximizes Developable Space;
  - Stormwater Regulations & Taxable Outflow.

Pavement Longevity

- Walden Pond State Reservation, Concord, MA.
- Porous Pavement Parking Lot Installed in 1977.
- Still in Use Today.

Other Porous Asphalt Applications: Buckeye Varsity Field The Ohio State University

- 500-seat Field Hockey Stadium
  - Opened 2010.
- Field Construction:
  - Porous Asphalt Base
  - 3/8” Closed-cell Foam Intermediate Layer
  - Astroturf Surface.

ODNR Rainwater & Land Development Manual

- Design, Construction & Maintenance Guidance for Permeable Paving Materials
- Available for Purchase from ODNR or On-line at: http://www.dnr.state.oh.us/tabid/9186/default.aspx

APA Cleaner Water with Asphalt Pavements

- Written as a Single Source, Scientifically Documented Resource.
- Focuses on the Benefits of Asphalt Pavements for Improved Water Quality, Stormwater Management & the Reduction of Roadside Pollution.
- Available at: www.asphaltroads.org

Perpetual Pavements

Perpetual Pavement Design

- Full-depth Asphalt Pavement Designed To Eliminate Structural Distresses:
  - Bottom Up Fatigue Cracking
  - Structural Rutting
- All Distresses Can be Quickly Remedied from Surface.
- Result in a Structure with ‘Perpetual’ or ‘Long Life’ Performance.

Advantages of Perpetual Pavements

- Efficient Design – No Overdesign
- Avoid Need for Reconstruction or Rehabilitation
- Reduce Life Cycle Cost
- Reduce Energy Consumption
- Reduce Use of Virgin Materials
- Ease of Maintenance
  - Maintenance Primarily Consists of Crack Filling & Minor Resurfacing
  - Night Construction
  - Maintenance of Traffic is Easier

Perpetual Pavements in Ohio

- No Full-depth Asphalt Pavement on Ohio's Interstate System has ever Required Replacement.
  - Earliest Constructed in the Late 1950's.
- Active Research Projects on 3 Major Highways in Ohio
  - I-77 (Stark Co.)
  - U.S. Route 30 (Wayne Co.)
  - U.S. Route 23 (Delaware Co.)
- FPO Study, "Economic Evaluation of Ohio's Flexible and Rigid Interstate Pavements" Available at: www.flexiblepavements.org

APA Perpetual Pavement Awards

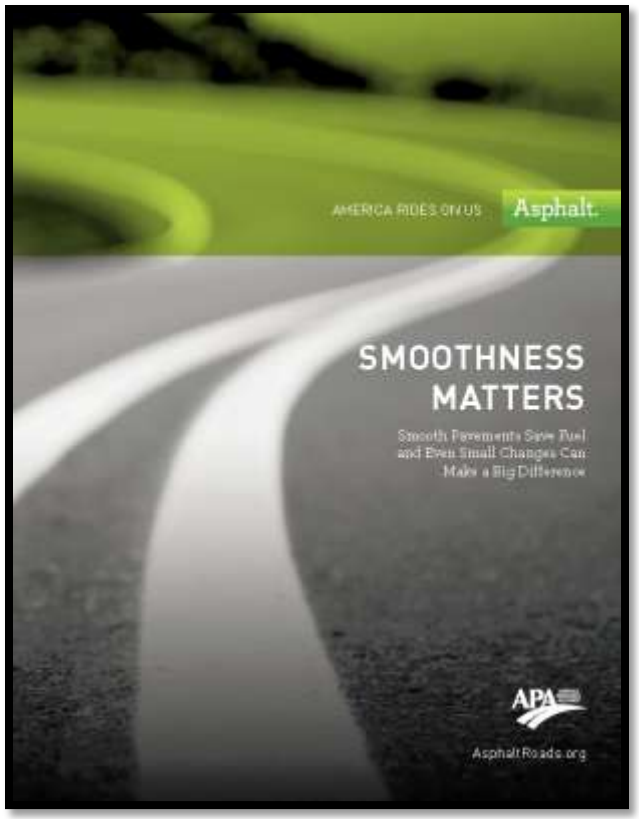
- National Award for Asphalt Pavements:
  - At Least 35 Years Old.
  - No Structural Failures.
  - 13 Year Average Resurfacing Interval.
- 80 Pavements Have Received Perpetual Pavement Awards Since 2001.
  - 3 in Ohio.

Smoothness in Sustainable Pavement Construction

- Asphalt Pavements are Consistently Smoother Than Other Pavements.
  - Smoother When First Constructed.
  - Smoother Over Life of the Surface.
- Smoothness is Restored with Resurfacing.
- Studies show Smoothness Has Sizeable Impact on Vehicle Energy Use.
- Asphalt is the Smoothest Type of Pavement as Validated by Ohio Department of Transportation Measurements of Asphalt & Concrete Pavements.

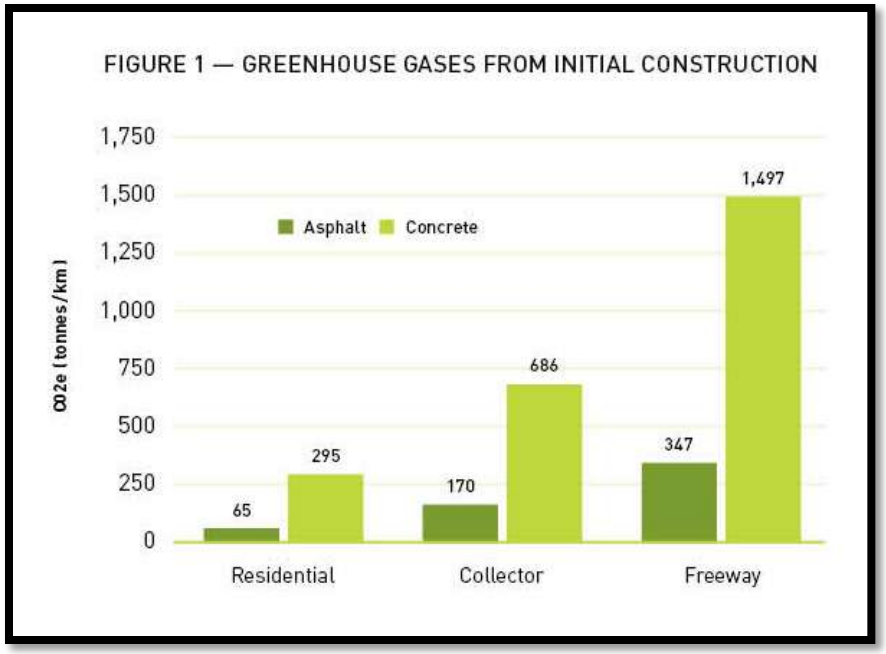
APA Smoothness Matters

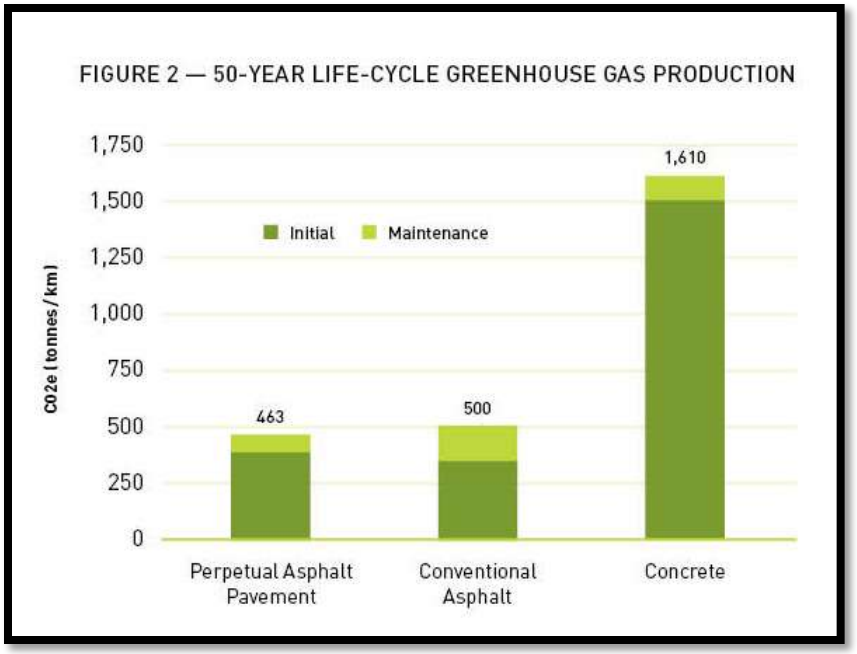
- Vehicle Fuel Efficiency Improves When Rolling Resistance is Reduced.
- Improving Smoothness is the Greatest Factor in Reducing Rolling Resistance.
- Available as a Free Download at: www.asphaltroads.org



Carbon Footprint

- What is Carbon Footprint?
  - Total amount of Greenhouse Gas Emissions Caused Directly & Indirectly by a . . . product [or material].” Usually expressed in Carbon Dioxide “equivalents” (CO2e).
- Carbon Footprint of Pavements Includes:
  - Raw Materials Extraction & Processing
  - Pavement Manufacturing
  - Pavement Transportation & Placement
  - Pavement Maintenance
- Sustainable Asphalt Technologies that Offset Greenhouse Gas Production:
  - RAP Reduces Acquisition of Virgin Raw Materials
  - WMA Reduces Energy Requirements & CO2

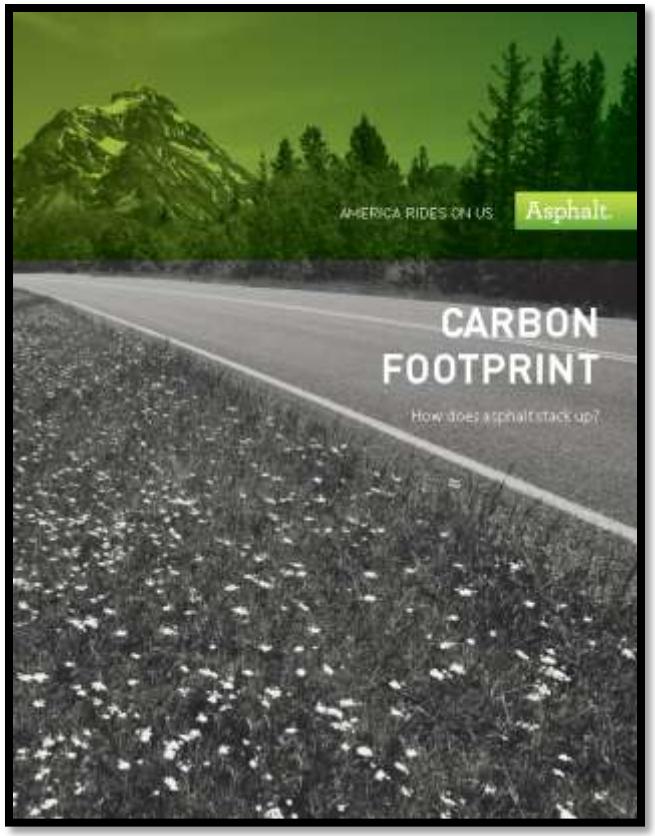




Carbon Footprint of Asphalt Pavements Are Less than 30% of Equivalent Portland Cement Concrete Pavements.

APA Carbon Footprint

- Examines Greenhouse Gas Production of Asphalt & Concrete Pavements.
- Analysis Demonstrates Asphalt has the Lowest Carbon Footprint for Roadway Construction.
  - Initial Construction & 50-year Life Cycle.
- Available as a Free Download at: www.asphaltroads.org



Asphalt Pavements in Sustainable Rating Systems

Leadership in Energy in Environmental Design (LEED)

- Developed by the U.S. Green Building Council, LEED is the Nationally Accepted Benchmark for the Design, Construction & Operation of High Performance Green Buildings.
- LEED Promotes a Whole-building Approach to Sustainability by Recognizing Performance in the Six Categories: Sustainable Sites, Water Efficiency, Energy and Atmosphere, Materials and Resources, Indoor Environmental Quality & Innovation & Design.

How Asphalt Earns LEED Credits

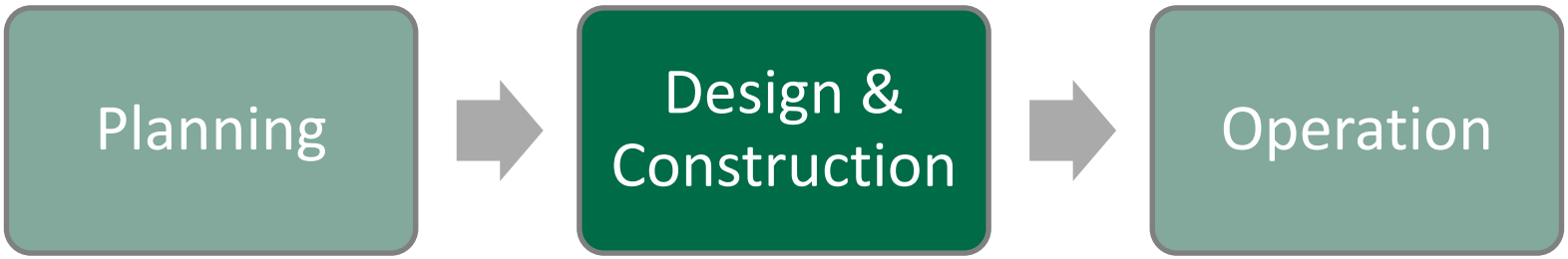
- Sustainable Sites
  - Porous Asphalt to Control Quantity & Improve Quality of Stormwater Runoff.
  - Open-graded Pavements or Reflective Surface to Mitigate Urban Heat Island
- Materials and Resources
  - RAP & RAS
  - Recycling Existing Pavements or Asphalt Shingles in Renovation Projects.
- Innovation & Design
  - Warm Mix Asphalt (Reduced Emissions & Fuel Savings)
  - High-RAP Pavements (20% or Higher)

NAPA Asphalt Pavements and the LEED Green Building System

- Outlines the Technologies Which Asphalt Pavements Contribute to LEED credits.
- Includes a scorecard that can use as a guide to earning LEED credits for asphalt pavements.
- Available for purchase from the NAPA Bookstore at: www.hotmix.org

Greenroads

- LEED-like Rating System for Roadway Design & Construction.
- Greenroads Quantify the Sustainable Attributes of a Roadway Project.



Greenroads Requirements

- 11 Mandatory Requirements that all projects must meet.
- 118 types of Voluntary Credits with varying credit values covering 38 different types of sustainable design and construction approaches.
- A minimum of 32 Voluntary Credits are required.

Mandatory Credit Requirements

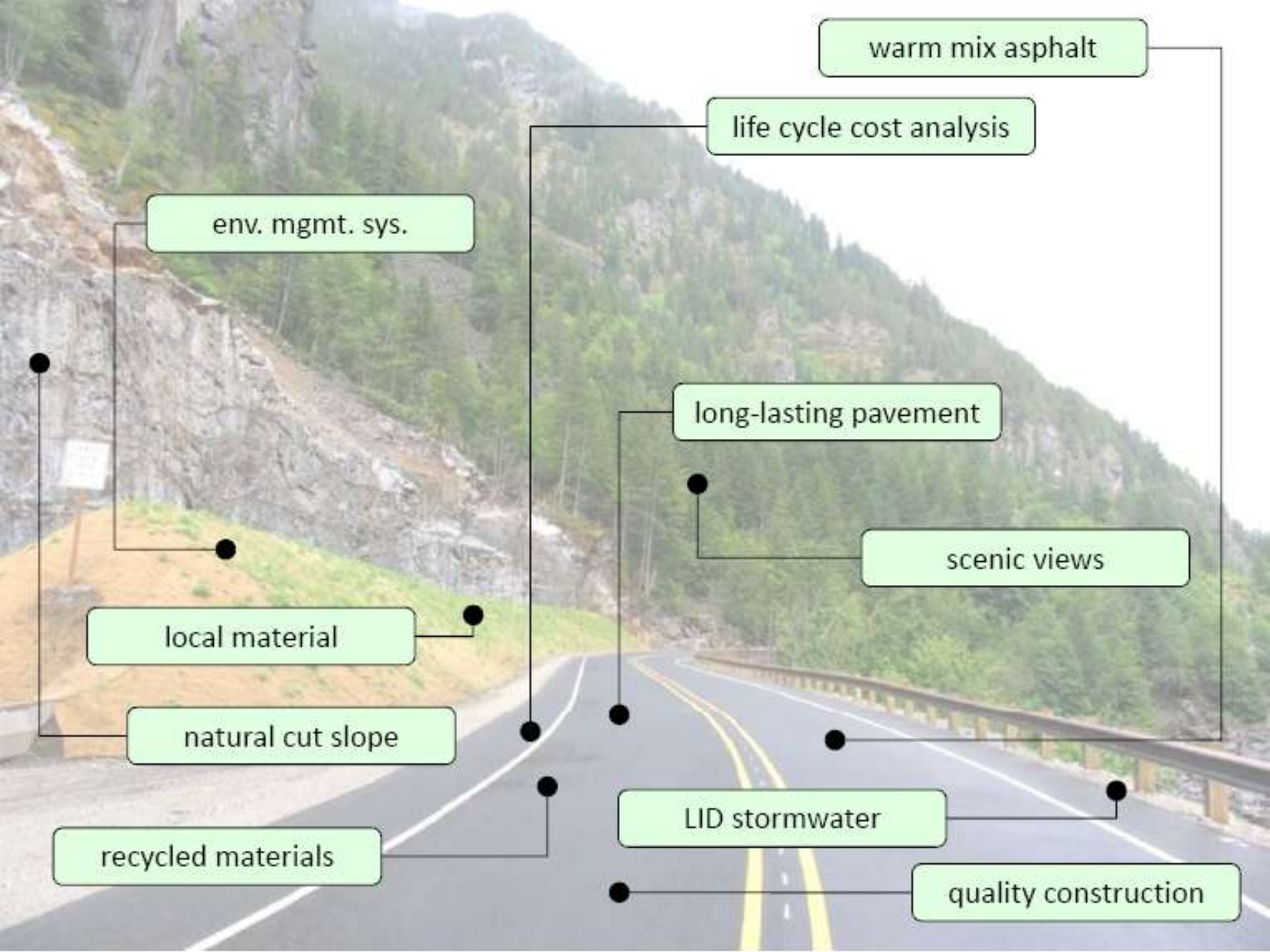
Requirement		Description
PR-1	Environmental Review Process	Complete and environmental review process
PR-2	Life Cycle Cost Analysis (LCCA)	Perform LCCA for pavement section
PR-3	Life Cycle Inventory (LCI)	Perform LCI of pavement section with computer tool
PR-4	Quality Control Plan	Have a formal contractor quality control plan
PR-5	Noise Mitigation Plan	Have a construction noise mitigation plan
PR-6	Waste Management Plan	Have a formal plan to divert C&D waste from landfill
PR-7	Pollution Prevention Plan	Have a TESC/SWPPP
PR-8	Low-Impact Development (LID)	Feasibility study for LID stormwater management
PR-9	Pavement Mgmt. System	Have a pavement management system
PR-10	Site Maintenance Plan	Have a site maintenance plan
PR-11	Educational Outreach	Publicize sustainability information for project

Voluntary Credit Requirements

Voluntary Credits		
EW Environment & Water	Stormwater, habitat, vegetation	21
AE Access & Equity	Modal access, culture, aesthetics, safety	30
CA Construction Activities	Construction equipment, processes, quality	14
MR Materials & Resources	Material extraction, processing, transport	23
PT Pavement Technology	Pavement design, material use, function	20
	Total Voluntary Credit Points	108

CC Custom Credits	Write your own credit for approval	10

Total Points **118**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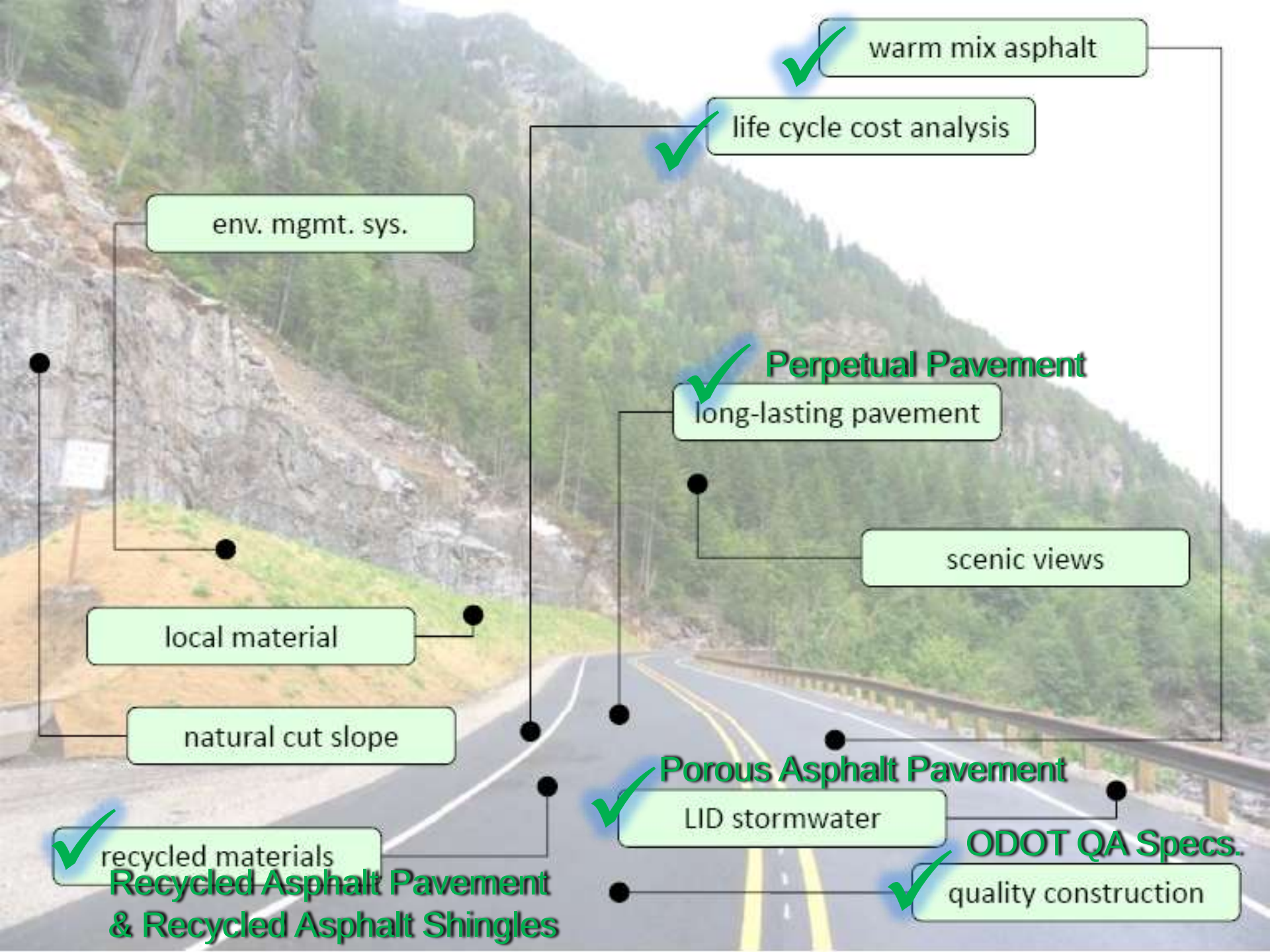
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Recycled Asphalt Pavement
& Recycled Asphalt Shingles

2010 Street Reconstruction Program
City of Upper Arlington, OH

- Construction & Materials Points Obtained through Use of:
  - WMA
  - RAP
  - Full-depth Reclamation
- Greenroads Pilot Project

Cheney Stadium Project
City of Tacoma

- Points Obtained through Use of:
  - Porous Asphalt Roadway & Parking Lot
- Achieved Greenroads Silver Certification

Questions?