Greening the Road: Using Green Rating Systems to Evaluate Your Transportation Project

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Agenda

• How Do We Define “Green”?  
• Sustainability —Objectives & Challenges  
• Sustainability —Planning & Management  
• Sustainable Solutions (e.g., porous asphalt, pervious pavement, etc.)  
• How Do We Evaluate “Green”? (e.g., INVEST, Greenroads, etc.)  
• Questions
Introduction

• Public agencies strive to be fiscally, socially, and environmentally responsible

• As a custodian of public investment, they strive to incorporate sustainability in their operations
How Do We Define “Green”?  

*Sustainable Development*  
*LEED*  

**Alternative Fuel Vehicles**  
*Recycling*  

**Platinum Points**  
*Cost-Recovery*  
*Green Roofs*  

**Global Warming**  
*ISO 14001*  
*U.S. E.O. 13423*  

**Environmental Management System**  
**Best Management Practices**  
*Economic Survival*  

**Long-term planning**  
*Balance*  
*Guidance*  

**Holistic Resource Management**  
*Life Cycle Cost Management*  
*Environmental Stewardship*
Sustainability Process

• Agencies cannot wait until construction begins to start discussing sustainable practices

• Planners, engineers, and construction experts are needed to promote sustainable construction practices

• Incorporate all facets of the roadway operations from service delivery to infrastructure renewal

• Agencies must ensure compliance with all federal, state, and local regulations
Why Be Sustainable?

• Take responsibility for the impact of roadway operations
• Reduction of greenhouse gas emissions
• Optimize the investment in renewable infrastructure
• Increase business value
Sustainability Objectives

- Water conservation for operations and construction activities
- Use of environmentally “friendly” products
- Recycling and source reduction efforts at all facilities and construction operations
- Reduce energy usage and increase use of green power
Sustainability Objectives

• Incorporate sustainable planning, design, and construction practices

• Reduce emissions from all operations including stationary and mobile sources

• Promote sustainability awareness

• Integrate sustainable practices into policies and business processes
The Problem.....

• Agencies regularly face decisions on how best to execute a transportation improvement project
  
  o How do we make the project economically viable?
  
  o How do we strike an acceptable balance between economic, environmental, and social concerns?
  
  o Focusing on only one area (e.g., environmental sustainability) can result in a project that is not economically viable or minimizes benefits.

• The key is to develop a process that optimizes each element to maximum extent possible
How Can We Do This?

- Reducing Energy Requirements — warm-mix asphalt instead of conventional hot-mix asphalt
- Reducing the Need for Raw Materials — reuse of in-situ materials instead of new premium-select materials
- Using Green Building Technology — heating and air conditioning, green roofs, etc.
- Capturing and Reusing Water for Irrigation
How Can We Do This?

- Using Low-Energy Lighting
- Using Roundabouts for Traffic Flow Control (instead of lighting)
- Minimizing Construction Waste — rubblize and overlay instead of remove and replace; reuse of building waste
- Minimize the Impact of Construction — reduced size of staging areas, noise, etc.
Setting the Path

• Establish sustainability guidelines and practices for waste reduction, fleet, building, and utility services such as water and wastewater, energy, and fuel use

• Reduce use of non-renewable resources

• Complete sustainability reviews

• Join sustainability forums such as the Urban Sustainability Forum, ITS America, World Road Association, ASCE, etc.

Roadway agencies are in need of a better understanding of the benefits of sustainable projects and a process for evaluating sustainability options and incorporating them into projects.
Current Status

• There is a reasonably good understanding of what constitutes sustainable design and construction

• Benefits of noise mitigation, light emissions, indoor air quality, wildlife, and habitat conservation are difficult to quantify

• How far back in the process (or forward) do we go to judge the sustainability benefits of one product over another?

• NCHRP Report 708 – Sustainability Performance Measures for State Departments of Transportation

What Resources Are Available?
Other Available Tools

- ASCE Institute for Sustainable Infrastructure (envision™) system
- LEED, (U.S. and Canadian Green Building Councils)
- Canadian Construction Association Guidelines
- Washington State’s Greenroads Guide
- New York State’s GreenLITES System
- Ontario Ministry of Transportation’s GreenPave
- Transportation Association of Canada’s Guide for Greener Roads
- FHWA Sustainable Highways Self-Evaluation Tool
- FHWA Green Procurement Guide
- Saga Sustainability Database
- Dutch Dubocalc Sustainability Evaluation System
Sustainability Planning Process

Phase 1
- Conduct Sustainability Baseline Assessment
- Establish Sustainability Goals & Objectives
- Identify Candidate Sustainability Initiatives
- Evaluate Candidate Initiatives

Phase 2
- Develop Sustainability Performance Targets
- Develop Implementation & Monitoring Program
- Prepare Sustainability Management Plan
- Annual Sustainability Report Card Outline
Sustainability Management Approach

- Formally designate a “sustainability champion”
- Schedule regular sustainability coordination meetings
- Revisit the Agency’s goals and performance
Use or Develop Decision Models

Element

- Project/Process Screening
- Detailed Impact Analysis
- Benefit/Cost Analysis

Output

- Warrant for Further Consideration
- Environmental Value Index
- Prioritization
Pervious, Porous & Permeable Pavements

Pavement systems designed to permit the infiltration of surface water
Permeable Pavements – A Green Solution

- In percolating soils, increases infiltration
- Reduces stormwater volume/peak flows
- Reduces stormwater pollutant load
- Decreases downstream erosion
Features of Permeable Pavements

PAVERS
- ASTM No. 8 Aggregate

BASE LAYER(S)
- ASTM No. 57 Aggregate

JOINT

SUB-BASE LAYER
- ASTM No. 2 Aggregate

BEDDING

RAIN WATER INFILTRATION

SUBGRADE

80 mm (3 1/8 in)
20-30 mm (3/4 to 1 ¼ in)
100 mm (4 in)
min.
150 mm (6 in)
Porous Asphalt

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Pervious Concrete
Permeable Interlocking Concrete Pavers
Waste and Byproducts

- **Use of Waste Products**
  - Fly ash as supplementary cement replacement
  - Limestone cement
  - Polymers or ground rubber in asphalt binders
Green Initiatives

• Waste Building Products
  - Recycled crushed concrete
  - Other building demolition materials such as wallboard
Green Initiatives

• Recycled Asphalt Mixes
  o Reduced virgin aggregate use
  o Decreased trucking costs
  o Accelerated load test screening

Recycled Shingles

Load Test Screening
Warm-Mix Asphalt

- **WMA reduces production and placement temperatures**
  - Reducing Energy Usage
  - Reducing Emissions
  - Reducing Worker Exposure

- **Placement**
  - Longer Hauls and Lower Temperatures

- **Production**
  - Wax-Like Products
    - Sasobit, Asphaltan B, Fatty Acid Amides
  - Foaming Processes
    - Aspha-min Zeolite, Low-Energy Asphalt, WAM Foam
  - Emulsion Base
    - Evotherm
  - Other Additional Technologies
Warm-Mix Asphalt

- Reduce Energy Usage
  - Trucking
  - Processing
  - Production (Warm-Mix)

Temp = 245°F
In-Place Recycling Techniques

- **Hot In-Place Recycling**
  - 100 percent reuse of existing pavement
  - Substantial savings on truck and fuel costs
In-Place Recycling Techniques

- FDR and CIREAM
  - Pulverization of existing pavement
  - In-situ stabilization
  - Emulsion, foamed asphalt, cement, etc.

![Image of In-Place Recycling Techniques](image-url)
Roundabouts

- Advantages
  - Continuous traffic flow (saving fuel and greenhouse gases)
  - No moving parts (low maintenance)
  - Little to no energy use
Long Life – Perpetual Pavements
Other Interesting Techniques
How Do We Evaluate Green?
envisio\textsuperscript{TM} Sustainability Rating System

• Product of the ASCE Institute for Sustainable Infrastructure
• Web-based, currently in test stage
• Sponsored by:

• Performance-based (outcomes) rather than prescriptive
• Scalable for size and complexity of projects (4 Levels)
• Adaptable for specific needs and circumstances
• Provides for self-assessment as well as independent verification
• Suitable for all infrastructure (e.g., roads, water, electrical, etc.)
Welcome!

Pilot Test Version of INVEST, the FHWA Sustainable Highways Self-Evaluation Tool

This website represents a significant revision of the FHWA Sustainable Highways Self-Evaluation Tool that was released as a Beta Version in the Fall of 2010. Called the "Infrastructure Voluntary Evaluation Sustainability Tool", INVEST is a practical, web-based, collection of best practices that allow states to integrate sustainability into their transportation projects. The use of the tool is voluntary and can be used by states or other project sponsors to measure the sustainability of their projects.
INVEST Highlights

• Currently in Pilot/Test Stage – Full Version Imminent
• Two-tiered Structure
• Basic Scorecard
  o Small reconstruction and bridge replacement projects
  o Preservation projects for extending asset life
  o Restoration projects for restoring pavement condition and ride
• Extended Scorecard
  o New construction
  o Major reconstruction
PD-8: Habitat Restoration

Goal
Offset the loss and alteration of natural (stream and terrestrial) habitat caused by road construction. Restore and protect natural habitat beyond regulatory requirements.

Requirements
3 Points: Either of the requirements below must be met for points. The points can be obtained through project-specific mitigation or through the use of banking.

Requirement 1: For projects required to mitigate habitat impacts through restorative practices.
- Implement a restoration/preservation approach that restores and/or preserves more area by at least an additional 5 percent beyond what is required by law or regulation, such that the total area of restored and/or preserved habitat equals 105 percent of total required mitigation area.
**PD-12: Create Renewable Energy**

**Goal**
Offset total operational energy use through autonomous renewable energy sources.

**Requirements**
1-6 Points. Compute the energy requirements for all permanently-installed electrical components on the project. Provide operational energy for the project’s electrified components using autonomous, on-site, renewable energy sources. Points are awarded based on the percentage of the total lifetime energy provided by renewable sources as follows:

- 1 point: 20%
- 2 points: 40%
- 3 points: 60%
- 4 points: 80%
- 5 points: 100%
- 6 points: 110%

**INVEST Scoring Sheets**
TAC Guide for Greener Roads

LIFECYCLE ASSESSMENT

This is one of a number of Canadian Guide for Greener Roads (CGGR) practices. Each practice is a general outline of a topic for people interested in being part of the “sustainability conversation” for roads. Applicable jurisdictional requirements, technical standards and guidance documents, and professional advice should be consulted when considering the information provided. CGGR Practices are support the Sustainability Objectives defined in the CGGR User Guide. Other CGGR Practices can be found using the hyperlinks in this practice or via the interactive selection tool found here: CGGR Practice Selection Tool.

WHAT IS LIFECYCLE ASSESSMENT (LCA)?

Life Cycle Assessment (LCA) (or Analysis) is a method, which quantifies the environmental impacts (or burdens) associated with the delivery of a particular service or product, including a road. The life cycle of the road consists of three distinct phases: construction, use, and end-of-life. The construction phase consists of the production of raw materials, site preparation activities, the transportation of raw materials to the site and their placement. The use phase encompasses all activities related to the use of the road over a defined lifespan. These activities include all material and energy consumed for maintenance purposes. The end-of-life phase deals with the eventual demolishing of the road, and includes the transportation of waste to recycling operations or landfills.
# TAC Guide for Greener Roads

<table>
<thead>
<tr>
<th>CGGR OBJECTIVES</th>
<th>GOALS AND BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goals</td>
<td></td>
</tr>
<tr>
<td>11. Increase Lifecycle Efficiency</td>
<td>Thus LCA will give a clear and unambiguous account of the environmental impacts of the product under study and will allow the system to be analysed on a clear and consistent basis.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Potential Benefits</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Reduce Virgin Materials Use</td>
<td>Quantify materials use in relation to each life cycle stage and/or major contributing process.</td>
</tr>
<tr>
<td>2. Optimize Waste Stream</td>
<td>Quantify waste in relation to each life cycle stage and/or major contributing process.</td>
</tr>
<tr>
<td>3. Reduce Energy Use</td>
<td>Quantify energy use in relation to each life cycle stage and/or major contributing process.</td>
</tr>
<tr>
<td>4. Reduce Emissions to Air</td>
<td>Quantify environmental releases to air, water, and land in relation to each life cycle stage and/or major contributing process.</td>
</tr>
<tr>
<td>5. Maintain or Improve Hydrologic Regime Characteristics</td>
<td>Quantify environmental releases to air, water, and land in relation to each life cycle stage and/or major contributing process.</td>
</tr>
</tbody>
</table>
WHAT ARE THE BARRIERS & ISSUES?

The following are some common barriers and issues for implementing this practice. This is not an exhaustive list and will vary depending on the nature of your road project. Not all of these issues may apply on a specific road project. As well, other issues and barriers may be applied to the project.

Data:

- Comprehensive LCAs require significant amount of data. As such, detailed attention is needed to both data quality and management.
- Wherever possible, data should be collected for the project (i.e., primary data).
- Secondary data choices should be based on realistic project-based information, and care should be taken to ensure that the secondary data source properly reflects regional or national conditions.
- Any uncertainties or assumptions made in the LCA must be clearly specified or documented (per the ISO standards). Additionally, any substitutions or generic data used must be explicitly stated.

Costs:

- Data management can require significant manpower, be time consuming, and be of high cost, especially in more comprehensive LCAs.
- Using professional lifecycle assessors may add significant cost to design of the project.
WHO DO I TALK TO?

Cross-functional teams are used in road projects. The following list of expertise need to be inclusively engaged to evaluate the use of this practice on a particular project. Titles may vary by jurisdiction and/or agency.

- Environmental Engineering
- Bridge Engineering
- Drainage and Hydrology Engineering
- Electrical and Lighting Engineering
- Pavement Engineering
- Traffic Engineering
EXAMPLE 1: COMPREHENSIVE LCA APPROACH (STRIPPLE, 2001)

Stripple (2001) began an ISO-LCA of the construction, maintenance and operation over a 40 year period of 1 lane-km of road, 13 meters in width using low emission diesel engines vehicles for construction and maintenance. The study compared three pavement options:

- paved with hot-mix asphalt
- paved with cold-mix asphalt
- paved with concrete

While the impact assessment and interpretation steps were not completed, the study provides an example of what should be considered in a comprehensive roadway lifecycle inventory analysis and impact assessment based on an ISO-LCA model. The following is a list of unit processes (and equipment) that were considered for the inventory analysis is:
TAC Guide for Greener Roads

**RELATION TO OTHER PRACTICES**

This practice may have a positive (even synergistic) relationship with other practices in this Guide. It may also, by its nature, make it more difficult to implement some practices. These relationships are listed below.

<table>
<thead>
<tr>
<th>PRACTICE</th>
<th>RELATIONSHIP</th>
<th>RATIONALE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green Procurement</td>
<td>✓</td>
<td>LCA allows for comparison of products and systems to support designer/engineer decision making.</td>
</tr>
<tr>
<td>Energy Efficiency – Lighting</td>
<td>✓</td>
<td>LCA allows for comparison of energy use and cost for lighting fixtures.</td>
</tr>
<tr>
<td>Long-Life Pavements</td>
<td>✓</td>
<td>LCA allows for comparison on environmental impacts of different pavements throughout their lifespans.</td>
</tr>
<tr>
<td>Greenhouse Gas Inventories</td>
<td>✓</td>
<td>Some LCA are scoped to GHG emissions.</td>
</tr>
</tbody>
</table>
# TAC Guide for Greener Roads

## RESOURCES & REFERENCES

### RESOURCES

- Birgisdóttir (2005), Christensen and Birgisdóttir (2006), Birgisdóttir et al. (2007) describe the development of the Danish ROAD-RES software tool for that incorporates municipal solid waste incinerator residues in pavement LCAs.
Greenroads

- Third-party rating system for roads projects
- Developed by the University of Washington and CH2mHill
- Awards-based rating system
- Captures aspects of sustainability for road design and construction
- Points are assigned based on their ‘impact’ on sustainability
- Designed to be simple to use
- Can be used for self evaluation or certification through independent third party
List of Credits

• Project Requirements (mandatory)
  o Environmental
  o Life-cycle cost, etc.

• Environment and Water (21 points)
  o Runoff flow control
  o Site vegetation, etc.

• Access and Equity (30 points)
  o Traffic emissions
  o Scenic views, etc.

• Construction Activities (14 points)
  o Site recycling plan
  o Paving emissions reduction, etc.
List of Credits (continued)

- Materials and Resource Management (23 points)
  - Pavement reuse
  - Regional materials, etc.

- Pavement Technologies (20 points)
  - Long-life pavement
  - Warm-Mix asphalt, etc.

- Custom Credits (up to 10 points)
  - 2 custom-design categories available

Total Available Credits = 118
**Credit Requirement Sheets**

**RUNOFF QUALITY**

**GOAL**
Improve water quality of stormwater runoff leaving the roadway Right-of-Way (ROW).

**CREDIT REQUIREMENTS**

1. Develop a stormwater management plan for the site using stormwater best management practices (BMPs) for water quality treatment. Explicitly state the goals of this plan and how performance will be measured.
2. Use low-impact development (LID) BMPs to the maximum extent feasible as determined in Project Requirement PR-8 by a licensed professional.
3. Compute the 90th percentile average annual rainfall event post-construction runoff volumes ($V_{total}$) for two areas as follows:
   - $V_{runoff}$: the total pollution generating surface (PGS) area of the project ROW
   - $V_{run-on}$: The total PGS area outside the ROW that may generate untreated stormwater which runs into the ROW BMPs, if any.
   - $V_{total} = V_{runoff} + V_{run-on}$
   - $V_{treated} = V_{runoff-treated} + V_{run-on-treated}$
   - % of Total Post-Construction Runoff Volume Treated = $V_{treated}/V_{total} \times 100$
   - Compute a weighted average of volumes treated for the total volume managed in the project where more than one BMP is used.
4. Provide treatment for a desired percentage of the total computed runoff volume for either of the areas noted in Table EW-3.1. List the types, manufacturers, treatment levels, and total volumes treated in BMPs.

**RELATED CREDITS**
- PR-8 Low Impact Development
- PR-10 Site Maintenance Plan
- EW-2 Runoff Flow Control
- EW-4 Stormwater Cost Analysis
- EW-5 Site Vegetation

**SUSTAINABILITY COMPONENTS**
Credit Requirement Sheets

5. Demonstrate that the planned BMPs meet the following quality criteria:
   - BMPs reduce sediment loads to **total suspended solids (TSS) concentrations of 25 mg/L or less**, as an indicator of overall treatment level. See Table EW-3.2.
   - BMPs **conform to all applicable minimum water quality standards** for all effluent leaving the ROW set by the governing jurisdiction for contaminants, such as heavy metals, hydrocarbons, pathogens, water temperature and turbidity. State the minimum requirements, including critical erosive flow criteria, and provide referenced document or policy.

<table>
<thead>
<tr>
<th>Type of Runoff Volume</th>
<th>Volume Treated</th>
<th>Treatment Level</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pollution generating</td>
<td>80%</td>
<td>Basic</td>
<td>-</td>
</tr>
<tr>
<td>surfaces (PGS) from</td>
<td></td>
<td>Basic &amp; Enhanced</td>
<td>-</td>
</tr>
<tr>
<td>within the project ROW</td>
<td></td>
<td>Basic, Enhanced &amp; Oil</td>
<td>1</td>
</tr>
<tr>
<td>only (runoff)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>90%</td>
<td></td>
<td>Basic</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Basic &amp; Enhanced</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Basic, Enhanced &amp; Oil</td>
<td>2</td>
</tr>
<tr>
<td>Pollution generating</td>
<td>80%</td>
<td>Basic</td>
<td>-</td>
</tr>
<tr>
<td>surfaces (PGS) from</td>
<td></td>
<td>Basic &amp; Enhanced</td>
<td>1</td>
</tr>
<tr>
<td>within the project ROW</td>
<td></td>
<td>Basic, Enhanced &amp; Oil</td>
<td>2</td>
</tr>
<tr>
<td>and from outside areas</td>
<td>90%</td>
<td>Basic</td>
<td>1</td>
</tr>
<tr>
<td>(run-on and runoff)</td>
<td></td>
<td>Basic &amp; Enhanced</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Basic, Enhanced &amp; Oil</td>
<td>3</td>
</tr>
</tbody>
</table>
Achievement Levels for Greenroads

- **Green Road certified**
  - 19-25 credits
- **Green Road certified SILVER**
  - 26-31 credits
- **Green Road certified GOLD**
  - 32-37 credits
- **Green Road certified EVERGREEN**
  - 38+ credits
Worked Example – Ontario GreenPave

**Category**

**Pavement Technologies**
- Long-Life Pavement Design: 3 Points
- Permeable Pavement: 2 Points
- Noise Mitigation: 2 Points
- Cool Pavements: 2 Points

**Material & Resources**
- Recycled Content: 5 Points
- Undisturbed Pavement Structure: 2 Points
- Local Materials: 2 Points
- Construction Quality: 2 Points

**Energy & Atmosphere**
- Reduced Energy Consumption: 3 Points
- GHG Emissions Reduction: 3 Points
- Pavement Smoothness: 1 Point
- Pollution Reduction: 1 Point

**Innovations & Design Process**
- Innovation in Design: 2 Points
- Exemplary Process: 2 Points

*Points:
- Pavement Technologies: 9 Points
- Material & Resources: 11 Points
- Energy & Atmosphere: 8 Points
- Innovations & Design Process: 4 Points*
Alternatives

• Alternative 1
  o Pulverize existing pavement and place new base and asphalt layers
  o High smoothness to ensure longer life
  o 20% recycled content in binder asphalt, 50% recycled subbase
  o Future use of microsurfacing to extend pavement life
  o Permeable pavements for parking areas

• Alternative 2
  o Pulverize, recycle in place using expanded asphalt stabilization
  o Reduction in asphalt layer thickness (due to stabilization of granular materials)
  o 20% recycled asphalt, 100% recycled base, 50% recycled subbase
  o Future use of microsurfacing to extend pavement life
  o Permeable pavements for parking areas
  o Quiet pavement
  o All excess materials used onsite and proactive construction traffic planning
  o Lower life-cycle cost
<table>
<thead>
<tr>
<th>Pavement Technology (PT) - Max 9 Points</th>
<th>PT-1 Score = 0.0</th>
<th>PT-2 Score = 1.0</th>
<th>PT-3 Score = 1.0</th>
<th>PT-4 Score = 1.0</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PT - 1: Long-Life Pavement (3 Points)</strong></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Is this Pavement Structure:</td>
<td>Rigid Pavement</td>
<td>Yes/No</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Composite Pavement</td>
<td>Yes/No</td>
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<tr>
<td></td>
<td>Perpetual Asphalt Pavement</td>
<td>Yes/No</td>
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<tr>
<td></td>
<td>Deep Strength Asphalt Pavement*</td>
<td>Yes/No</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>PT - 2: Permeable Pavement (1 Point)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Are permeable pavements used in:</td>
<td>Parking Areas or</td>
<td>Yes/No</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Roadside Drainage or</td>
<td>Yes/No</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Both</td>
<td>Yes/No</td>
<td></td>
<td></td>
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<tr>
<td><strong>PT - 3: Noise Mitigation (1-2 Points)</strong></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Surface Course is:</td>
<td>Asphalt</td>
<td>Yes/No</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>SuperPave</td>
<td>Yes/No</td>
<td></td>
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<tr>
<td></td>
<td>Stone Mastic Asphalt</td>
<td>Yes/No</td>
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<td></td>
<td>HMA w/ Rubber Mod AC</td>
<td>Yes/No</td>
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<tr>
<td></td>
<td>Quiet Pavement</td>
<td>Yes/No</td>
<td></td>
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<tr>
<td></td>
<td>Concrete</td>
<td>Yes/No</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>w/ Longitudinal Tining</td>
<td>Yes/No</td>
<td></td>
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<tr>
<td></td>
<td>w/ Diamond Grinding</td>
<td>Yes/No</td>
<td></td>
<td></td>
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<tr>
<td><strong>PT - 4: Cool Pavement (1-2 Points)</strong></td>
<td></td>
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<tr>
<td>Surface Course</td>
<td>Asphalt</td>
<td>Yes/No</td>
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<tr>
<td></td>
<td>Porous Asphalt</td>
<td>Yes/No</td>
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<tr>
<td></td>
<td>Quiet Pavement</td>
<td>Yes/No</td>
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<td></td>
<td>Concrete</td>
<td>Yes/No</td>
<td></td>
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<tr>
<td></td>
<td>Conventional</td>
<td>Yes/No</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
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<td>Yes/No</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>Yes/No</td>
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<tr>
<td></td>
<td>Permeable Pavers</td>
<td>Yes/No</td>
<td></td>
<td></td>
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<tr>
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<td>Pervious Concrete</td>
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### Materials & Resources (MR) - Max 11 Points

<table>
<thead>
<tr>
<th>New Layer Type / Treatment</th>
<th>Descriptions</th>
<th>Thickness (mm)</th>
<th>% of RAP, SCM, or RM</th>
<th>% of CR, RST, or Recycled Water</th>
<th>Point</th>
<th>Thickness x Point</th>
<th>% Aggregates (by mass) Transported within 100 km</th>
<th>Aggregates (w.r.t. thickness, mm) Transported within 100 km</th>
<th>Assigned Point from CA</th>
<th>Assigned Point from QAO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Layer 1</td>
<td>Surface</td>
<td>Superpave</td>
<td>40</td>
<td>0%</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Layer 2</td>
<td>Binder</td>
<td>Superpave</td>
<td>100</td>
<td>20%</td>
<td>1</td>
<td>100</td>
<td>100%</td>
<td>100</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Layer 3</td>
<td>Base</td>
<td>Virgin</td>
<td>150</td>
<td>0%</td>
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<td>0</td>
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<td>0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
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<td>Subbase</td>
<td>Recycled</td>
<td>300</td>
<td>50%</td>
<td>2</td>
<td>600</td>
<td>100%</td>
<td>300</td>
<td>2</td>
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</tr>
<tr>
<td>Layer 5</td>
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<tr>
<td><strong>Total Thickness</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>590</strong></td>
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<tr>
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<td><strong>MR-4 Score =</strong></td>
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<td></td>
<td><strong>1.3</strong></td>
<td></td>
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</tbody>
</table>

### MR - 2: Undisturbed Pavement Structure (1-2 Points)

**Does the rehabilitation technique involve:**
- Concrete Overlay
- HMA Overlay, Chip seals
- Slurry Seals, Microsurfacing

**Does the rehabilitation maintain the existing pavement structure?**
If yes, complete the fields below:

- **Existing Pavement Structure, \( t_{existing} = \)**
- **Existing Structure will be processed or removed, \( t_{processed} = \)**
- **Existing Structure will be undisturbed or unprocessed, \( t_{undisturbed} = \)**
- **Additional Thickness will be placed on undisturbed structure, \( t_{place} = \)**
- **New Pavement Structure, \( t_{new} = \)**
- **Reuse Pavement, \( R = t_{undisturbed} / t_{new} (\%) = \)**

**MR-2 Score =**

**Legend:**
- CA = Contract Administrator
- CR = Crumb Rubber
- QAO = Quality Assurance Officer
- RAP = Reclaimed Asphalt Pavement
- Recycled Water = Treated Wash Water or Slurry Water
- RM = Recycled Material
- RST = Roof Shingle Tab
- SCM = Supplementary Cement Material
### Energy & Atmosphere (EA) - Max 8 Points

<table>
<thead>
<tr>
<th>New Layer Type/Treatment</th>
<th>Description</th>
<th>Thickness (mm)</th>
<th>% of RAP, SCM, or RM</th>
<th>% of CR, RST, or Recycled Water</th>
<th>Point</th>
<th>Thickness x Point</th>
<th>Point</th>
<th>Thickness x Point</th>
</tr>
</thead>
<tbody>
<tr>
<td>Layer 1</td>
<td>Surface</td>
<td>40</td>
<td>0%</td>
<td>0%</td>
<td>2</td>
<td>80</td>
<td>2</td>
<td>80</td>
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<tr>
<td>Layer 2</td>
<td>Binder</td>
<td>100</td>
<td>20%</td>
<td>0%</td>
<td>1</td>
<td>100</td>
<td>1</td>
<td>100</td>
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<tr>
<td>Layer 3</td>
<td>Base</td>
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<td>1</td>
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<td>Layer 4</td>
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<td>50%</td>
<td>600</td>
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<td>2</td>
<td>600</td>
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<tr>
<td>Layer 5</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Layer 6</td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total Thickness</strong></td>
<td></td>
<td><strong>590</strong></td>
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<td></td>
<td></td>
<td><strong>930</strong></td>
<td></td>
<td><strong>930</strong></td>
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</tbody>
</table>

**EA-1 Score = 1.6**  
**EA-2 Score = 1.6**

### EA - 3: Pavement Smoothness (1 Point)

**What type of the surface course?**

**Answer:** Superpave

**If Asphalt Surface, what is the IRI value?**

**Answer:** 1.2

**EA-3 Score =**

### EA - 4: Pollution Reduction (1 Point)

**What is the percentage of Construction Equipment/Vehicles with Emission Reduction Exhaust Retrofit or Fuel Efficient Technology?**

- **Diesel Retrofit (%) =** 0
- **Fuel Efficient Technology (%) =** 0

**EA-4 Score =**
### Innovation and Design Process (I) - Max 4 Points

#### I-1: Innovation in Design (1-2 Points)

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any Innovation in Design?</td>
<td>No</td>
</tr>
</tbody>
</table>

If Yes, what they are?

- **Innovation 1:**
- **Innovation 2:**

I-1 Score =

#### I-2: Exemplary Process (1-2 Points)

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any Exemplary Process?</td>
<td>No</td>
</tr>
</tbody>
</table>

If Yes, what they are?

- **Exemplary Process 1:**
- **Exemplary Process 2:**

I-2 Score =
Greening the Road: Using Green Rating Systems to Evaluate Your Transportation Project


### New Layer Type/Treatment Descriptions

| Layer 1 | Surface | Superpave | 60 | 0 | 0 | 1 | 1 |
| Layer 2 | Binder | 1 | 1 | 1 |
| Layer 3 | Base | Expanded Asphalt Stabilized | 150 | 100% | 100% | 4 | 600 | 100% | 150 | 2 | 2 |
| Layer 4 | Subbase | Recycled | 300 | 50% | 550 | 2 | 600 | 100% | 300 | 2 | 2 |
| Layer 5 |  |  |  |  |  |  |  |  |  |  |  |
| Layer 6 |  |  |  |  |  |  |  |  |  |  |  |

**Total Thickness = 510 mm**

**MR-1 Score** = 2.4

**MR-4 Score** = 1.3

**MR-2 Score** = 1.0

**MR-3 Score** = 2.0

### MR - 2: Undisturbed Pavement Structure (1-2 Points)

Does the rehabilitation technique involve:
- Concrete Overlay
- HMA Overlay, Chip seals
- Slurry Seals, Microsurfacing

Yes / No

**Yes**

Does the rehabilitation maintain the existing pavement structure?
If yes, complete the fields below:

| Existing Pavement Structure, texisting = | 590 |
| Incoming Structure will be processed or removed, tprocessed = | 40 |
| Minus |
| Existing Structure will be undisturbed or unprocessed, tundisturbed = | 550 |
| Plus |
| Additional Thickness will be placed on undisturbed structure, tplace = | 510 |
| New Pavement Structure, tnew = | 1060 |

**Reuse Pavement, R = tundisturbed/tnew (%) =** 51.9%

MR-2 Score = 1.0

### MR - 3: Local Materials (1-2 Points)

**Total Aggregates Transported within 100 km (%) = 88%**

### MR - 4: Construction Quality (1-2 Points)

Legend:
- CA = Contract Administrator
- CR = Crumb Rubber
- QAO = Quality Assurance Officer
- RAP = Reclaimed Asphalt Pavement
- Recycled Water = Treated Wash Water or Slurry Water
- RM = Recycled Material
- RST = Roof Shingle Tab
- SCM = Supplementary Cement Material
<table>
<thead>
<tr>
<th>New Layer Type/Treatment</th>
<th>Description</th>
<th>Thickness (mm)</th>
<th>% of RAP, SCM, or RM</th>
<th>% of CR, RST, or Recycled Water</th>
<th>Thickness x Point</th>
<th>Point</th>
<th>Thickness x Point</th>
<th>Point</th>
<th>Sum =</th>
</tr>
</thead>
<tbody>
<tr>
<td>Layer 1</td>
<td>Surface</td>
<td>Superpave</td>
<td>60</td>
<td>-</td>
<td>2</td>
<td>120</td>
<td>2</td>
<td>120</td>
<td>870</td>
</tr>
<tr>
<td>Layer 2</td>
<td>Binder</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Layer 3</td>
<td>Base</td>
<td>Expanded Asphalt Stabilized</td>
<td>150</td>
<td>100%</td>
<td>100%</td>
<td>1</td>
<td>150</td>
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<td>150</td>
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<tr>
<td>Layer 4</td>
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<td>50%</td>
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<td>600</td>
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<td>600</td>
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<tr>
<td>Layer 5</td>
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<td></td>
</tr>
<tr>
<td>Total Thickness</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>870</td>
</tr>
</tbody>
</table>

**EA - 1: Reduced Energy Consumption (1-3 Points)**

EA-1 Score = 1.7

**EA - 2: GHG Emission Reduction (1-3 Points)**

EA-2 Score = 1.7

**EA - 3: Pavement Smoothness (1 Point)**

What type of the surface course?

Answer: Superpave

If Asphalt Surface, what is the IRI value?

Answer: 0.8

EA-3 Score = 1.0

**EA - 4: Pollution Reduction (1 Point)**

What is the percentage of Construction Equipment/Vehicles with Emission Reduction Exhaust Retrofit or Fuel Efficient Technology?

- Diesel Retrofit (%) =
- Fuel Efficient Technology (%) =

EA-4 Score =
### Innovation and Design Process (I) - Max 4 Points

#### I-1: Innovation in Design (1-2 Points)

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any Innovation in Design?</td>
<td>Yes</td>
</tr>
</tbody>
</table>

**Innovation 1:** All excess materials are recycled and reused on-site.

**Innovation 2:**

**I-1 Score = 1.0**

#### I-2: Exemplary Process (1-2 Points)

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any Exemplary Process?</td>
<td>Yes</td>
</tr>
</tbody>
</table>

**Exemplary Process 1:** Proactive construction traffic planning and construction timing to ensure consistent free flow of traffic.

**Exemplary Process 2:**

**I-2 Score = 2.0**
### GreenPave Category

<table>
<thead>
<tr>
<th>Maximum Point</th>
<th>GreenPave Category</th>
<th>Option 1</th>
<th>Option 2</th>
<th>Option 3</th>
<th>Option 4</th>
<th>Option 5</th>
<th>Option 6</th>
<th>Option 7</th>
<th>Option 8</th>
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<tr>
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</tr>
</tbody>
</table>

**Green Pave Rating:**
- BRONZE
- SILVER
- NOT CERTIFIED
- NOT CERTIFIED
- NOT CERTIFIED
- NOT CERTIFIED

Bronze 10-15 points  Silver 15-20 points  Gold 20-32 points

**Life Cycle Cost:**
- $340,000
- $285,000

**Comments:**

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Greening the Road: Using Green Rating Systems to Evaluate Your Transportation Project  •  David Hein, P. Eng., Applied Research Associates
Challenges and Lessons Learned

- Sustainable design, construction, and maintenance practices can save money and improve our environmental stewardship
- Many ways to travel the path
  - Engage senior management early
  - Implement a sustainability awards program
  - Track and report sustainable activities
  - Publish an agency-wide sustainability report
  - Design long-life pavements
  - Optimize maintenance and rehabilitation
  - Maximize the use of recycled products
  - Use high-solar-reflectance pavements
  - Integrate pavement design and construction with stormwater management
  - Use fewer, but higher quality materials
Greening the Road: Using Green Rating Systems to Evaluate Your Transportation Project

David Hein, P. Eng.

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