AASHTO DARWin Task Force Development of DARWin-ME
Presentation Outline

- DARWin Task Force
- Current software status
- Development of DARWin-ME
- Future enhancements/modules, etc.
DARWin Task Force Members

- Linda Pierce (Chair), Washington
- Michael Pologruto, Vermont
- Trenton Clark, Virginia
- Andrew Johnson, South Carolina

Three new members:
- Imad Basheer, California
- Laura Fenley, Wisconsin
- Julian Bendana, New York

FHWA Liaison: Chris Wagner
Current Software

- DARWin 3.1 is the latest software version of the 1993 edition of the AASHTO Guide for Design of Pavement Structures
- AASHTO Contractor
- Sunset planned for 12 months following release of DARWin-ME
DARWin-ME Development

- DARWin TF meeting in July 2007 to move forward
- ARA presentation on software
- Transfer of intellectual property rights from NCHRP to AASHTO
  - Issues related to continuing work
  - Help files (December 2007)
DARWin-ME Development

- Condition of Source Code (research grade software)
  - Lack of documentation
  - Multiple programming languages
  - Documentation not in English
  - No overall system design document

- Solution: ARA proposal to develop software design document
  - Major components and how they work together
  - Descriptions of functionality, inputs, outputs, programming languages, and interfaces
DARWin-ME Development

- Independent Source Code Review
- Potential source code documentation by ARA
- List of enhancements for DARWin-ME
  - Reviewed by DARWin Task Force, Lead States Group, and Panel 1-40

- Request for Information (RFI)
  - Statement of Qualifications
  - Non-binding cost estimates
  - Identification of potential software development firms
DARWin-ME Project Solicitation

Project Solicitation Proposal Package

- Combine resources to develop/enhance software
- Provides business case for supporting DARWin-ME production software effort
- Funding commitments
- Cost for DARWin-ME will be based on:
  - Items identified by DARWin Task Force
  - Independent source code review
  - Joint Technical Committee on Pavements (JTCoP) input
- At least 10-12 agencies required to proceed
Based on successful project solicitation:
- Appoint new DARWin-ME Task Force (5-7 members)
- Develop and issue Request for Proposals (RFP) to RFI respondents
- Select software development contractor
- Begin development (15-18 month development cycle)
DARWin-ME Funding

- Existing DARWin TF Funding and new development grant funds from AASHTO Capitalization Fund contribution:
  - System Design Document by ARA
  - Independent Source Code Review
  - Potential source code documentation
  - Request for Information (RFI)
  - Project Solicitation Proposal
  - Likely $100K+ commitment by AASHTO
Commitments through Project Solicitation contribution:
- Request for Proposal (RFP)
- Development of Production Grade Software of DARWin-ME

Potential sources of funding
- DARWin Task Force request to FHWA
- Non-matching SP&R Funds
- Split of funding over two fiscal years potentially
Schedule is dependent on successful balloting of MEPDG and may be modified as necessary

- **Fall 2007**
  - Sign intellectual property agreement with TRB
  - ARA system design document

- **Winter 2007/2008**
  - Contract to review source code
    - Identify if modifications are needed for making software modular
    - Interface with third party software
DARWin ME Timeline (cont.)

- Spring 2008
  - Results of independent review and issue Request for Information (RFI)
- Summer 2008
  - Issue project solicitation proposal package for funding commitments
- Fall 2008
  - Develop and issue Request for Proposals (RFP)
- Winter 2008/2009
  - Select contractor
  - Commence development shortly thereafter (15-18 month cycle)
Opportunity for Enhancements

- Upon successful release of DARWin-ME
  - All member agency licensees will have the opportunity to obtain source code
  - Agreements with AASHTO will apply
  - Allows for state enhancement with the intent that it will be shared with AASHTO

- JTCoP intent
  - One version of DARWin-ME
DARWin-ME User’s Group

- Composed of all DARWin-ME licensee’s
- Annual meetings
  - Discuss software functionality
  - Discuss needed enhancements
  - Trouble shoot
  - Networking
- DARWin Task Force members will be members of user group (back-to-back meetings)
  - Direct link for developing and prioritizing software enhancements
Planning and Delivering the Pavement & Materials Program

FHWA Strategic Planning Efforts
Pavement & Materials Program

Process to Deliver National Pavement Network That Is:

– Safe
– Cost Effective
– Long Lasting
– Effectively Maintained

Develop Plan

FHWA Pavement and Materials Program

Deliver Results
Planning – Strategic Alignment

DOT
Outcomes

FHWA
National Objectives
Strategies

UNITS
Actions/Activities

Pav & Mat
Strag. Plan

Pav & Mat
Strag. Plan
Need for Plan

Federal Highway Bill

- States
  - STIP
  - Preservation
  - Research
  - Planning

Maximize National Pavement Network Condition

Must be Effective!

- Programs
- R&T Development
- Tech Transfer

FHWA

Funding

FHWA Stewardship, Partnership & Oversight

States

Industry

Universities
Program Focus Areas

- Pavement Design and Analysis
- Materials and Construction Technology
- Pavement Management and Preservation
- Pavement Surface Characteristics
- Materials and Construction Quality Assurance
- Environmental Stewardship
Overview of the P&M Planning Process

- Assess Needs
- Set Expectations
- Develop Plan
- Program Work
- Deliver Program
- Assess Progress

FALCON Teams
FHWA Units
Pavement Forum
TRB Committee
Planning the Program

- **Assessments** *(Where are we now?)*
  - Assessment of current state, gaps and needs.

- **Strategic Plan** *(Where do we want to go?)*
  - Multi-Year document including NPO’s, NPM’s, Targets, Strategies for each of the six Focus Areas

- **Work Activities** *(How are we going to get there?)*
  - Maintain multi-year plan of activities that are desired to be completed in order to meet Focus Area Objectives
  - Activities are requested to be funded annually

- **Pavement & Materials FY Funding Allocation Plan**
  - FY Funding allocated to each Focus Area and FHWA Unit
Delivering the Program

- **FHWA Execution Plan** (*Who is responsible?*)
  - Each team will maintain a listing of activities that are funded and/or planned to be worked on in a given FY. List includes responsible leads within FHWA to complete work.

- **Work Delivery** (*Is the work getting done?*)
  - Each team will monitor the delivery of work to complete the Execution Plan.

- **Progress Reports** (*Are we delivering the program?*)
  - Each team is required to report progress including planned vs. actual work accomplished on a semi-annual basis, as a minimum.

- **Annual Performance Report** (*Is the program effective?*)
  - Each team will develop an annual report indicating the effectiveness of the efforts in the Focus Area
Challenges – Establishing National Objectives

• Example 1 – Outcome Measure
  – Percentage of VMT traveling on NHS pavements exhibiting “Good” ride quality
    • What is the right target?
    • How can we (FHWA and States) rally around a national performance objective?

• Example 2 - Assessment
  – The extent to which highway agencies utilize efficient and effective construction and materials quality assurance programs.
    • How can an assessment be conducted effectively and routinely?

• Example 3 – Implementation
  – The percentage of states that have inertial profiler based ride specifications.
    • States may be effectively achieving outcome without need to implement specific technology
Working with AASHTO

• Subcommittee on Performance Measures and Benchmarking
  – Have established approach to assess emphasis areas
  – Voluntary state participation
  – Third party evaluation of data
  – Anonymous reporting of results
  – Identify Best Practices

• Current Efforts
  – Completed “On-Time, On-Budget Project Delivery”
  – Currently working on assessment of smoothness
Green Highway Partnership

An Overview

Joint Technical Committee on Pavements

September 20, 2007

Seattle, WA
The Green Highways Partnership (GHP) is a voluntary, public/private initiative that is revolutionizing our nation's transportation infrastructure. Through concepts such as integrated planning, regulatory flexibility, and market-based rewards, GHP seeks to incorporate environmental streamlining and stewardship into all aspects of the highway lifecycle.
• 2002 – FHWA Established Environmental Stewardship/Streamlining as Vital Few Goal
• FHWA invested in many environmentally focused programs
• FHWA & EPA Region 3 held planning charette in 2002 forming Green Highway Partnership
• Themes
  – Watershed-Driven Storm Water Management
  – Re-use/Recycling
  – Conservation & Ecosystem Protection
Green Highways Partnership

Government

Contractors

Public Organizations

Private Companies

Education

Materials Industry

Trade Organizations
Partnerships • Recognition • Opportunities

• GHP uniquely integrates
  – Federal/State Transportation/Resource Agencies
  – Contractors
  – Materials Industry
  – Trade Associations
  – Academic Institutions
  – Non-Governmental Organizations

• The key is ACTIVE PARTICIPATION by all partners
Partnerships • Recognition • Opportunities

• Recognition/Awards Program
  – Recognize projects that promote the GHP ideal of “better than before”

• Market Based Approaches
  – Promote cost savings associated with improving the environment
  – Provide regulatory incentives to partners
Partnerships • Recognition • Opportunities

• Promote “leading edge” pilot projects
  – Increases visibility of creative solutions
  – Inspires others to pursue green choices
  – Strengthen cooperation and partnerships

• Examples
  – Anacostia Watershed Grants
  – Villanova Porous Pavement Study
Green Highways On-Ramps

The "ON RAMPS" TO A GREEN HIGHWAY

- Recycling
- Maintenance & Operations
- Materials
- Stewardship
- NEPA
- CSS
- Smart Growth
- Planning
- Education

~ THE GREEN HIGHWAY ~
"Meeting transportation requirements and applying environmental stewardship so both are better than before"
### Green Highways Characteristics

| - Provides net increase in environmental functions and values of the watershed |
| - Goes beyond minimum standards set forth by environmental laws and regulations |
| - Identifies and protects important historical and cultural landmarks |
| - Maps all resources in the area in order to identify, avoid, and protect critical resource areas |
| - Uses innovative, natural methods to reduce imperviousness, and cleanse all runoff within the project area |
| - Maximizes use of existing transportation infrastructure, provides multi-modal transportation opportunities, and promotes ride-sharing / public transportation |
| - Uses recycled materials to eliminate waste and reduce the energy required to build the highway |
| - Links regional transportation plans with local landuse through partnerships |
| - Controls populations of invasive species, and promotes the growth of native species |
| - Incorporates post project monitoring to ensure environmental results |
| - Protects the hydrology of wetlands and streams channels through restoration of natural drainage paths |
| - Results in a suite of targeted environmental outcomes based upon local environmental needs |
| - Reduces disruptions to ecological processes by promoting wildlife corridors and passages in areas identified through wildlife conservation plans |
| - Encourages smart growth by integrating and guiding future growth and capacity building with ecological constraints |
Features of a Green Highway

1 – Bioretention Swale
2 – Porous Pavement Shoulder
3 – Recycled Pavement
4 – Preserved Forest Buffer
5 – Restored Wetlands
6 – Stream Restoration
7 – Wildlife Crossing
8 – Soil Amendments
Re-Use/Recycling

• Use of Industrial Byproducts
• Use of Solid Waste
• Use of Highway Materials
• Use of Dredge Spoils
• Engineering Properties
• Applications for Use
• Incentives to Utilize Materials
• Recycled Materials Resource Center
HPMS Reassessment
Need for Pavement Data

Presentation to the AASHTO
Joint Technical Committee on Pavements
September 19, 2007
Seattle, Washington
Need for Additional Data

- Improve HERS predictions
- Better estimate of national pavement needs
- Improve cost estimates provided within Conditions and Performance Report
- More complete assessment of NHS network condition
- Desire to calculate remaining service life (RSL)
Approach to Make Improvements

- Evaluated typical state PMS data elements
- Introduced additional performance indicators to more completely represent network health
- Utilized performance models developed for MEPDG as starting point
- Developed RSL concept to drive HERS
- Utilized LTPP data to refine models
- Formed national Pavement Steering Committee
Effort to Date

- Develop white papers on need for additional data and use of data
- Held 5 webinars
- Held 2 workshops
- Conducted national PMS survey
- Developed new models based on MEPDG
- Developed methodology to use models within HERS
- Developed draft report documenting HPMS data changes
Model Development

- Conducted sensitivity analysis using MEPDG and LTPP data to identify model inputs that had the greatest impact on performance prediction
- Identified PMS data that could be provided by states that were critical to fuel the new models
- Developed simplified versions of the MEPDG models based on data that would be provided through HPMS
Need for Models

- Predicted Condition (driven by models)
- Actual Condition (agency reported)
- Adjusted Model
- Model

Time

Condition
Performance Models

Rigid Pavements

- **Cracking**
  - Percent of slabs with transverse cracks, %
  - \( f(\text{age, inventory, traffic, PCC properties, climate}) \)

- **Faulting**
  - Mean transverse faulting, inches
  - \( f(\text{inventory, traffic, climate, dowels}) \)

- **Spalling (estimated only)**
  - Percentage joints spalled, %
  - \( f(\text{age, inventory, PCC properties, climate}) \)

- **IRI**
  - Average IRI, in/mile
  - \( f(\text{age, climate, inventory, Initial IRI, cracking, spalling, faulting}) \)
Performance Models

Flexible Pavements

• Alligator Cracking
  – Percent of area with alligator cracking, %
  – f(inventory, traffic, material properties)

• Transverse Cracking
  – Number of transverse cracks/mile, cracks/mile
  – f(inventory, asphalt properties, climate)

• Rutting
  – Mean rut depth, inches
  – f(inventory, traffic, material properties, climate)

• IRI
  – Average IRI, in/mile
  – f(age, climate, inventory, Initial IRI, alligator cracking, transverse cracking, rutting)
Performance Models

Composite Pavements

• Reflection Cracking
  – Percent of joints/cracks reflected, %
  – f(age, inventory, load transfer)

• IRI
  – Average IRI, in/mile
  – f(age, climate, inventory, Initial IRI, alligator cracking, transverse cracking, rutting)
Data Inputs to Models

Performance Data
- Rutting
- Faulting
- Slab Cracking
- Fatigue Cracking
- Collection Year Dates
  - Year of Last Resurface
  - Year of Last Construction
  - Year of Surface Improvement

Inventory Data
- Pavement Type
- Last Overlay Thickness
- Asphalt Thickness
- Concrete Thickness
- Base Thickness
- Base Type
- Soil Type
- Binder Type
- Dowel Bars (Y/N)
- Joint Spacing
Calculation of RSL

Initial Construction or Reconstruction

Current Age

First Major Rehab

Adjusted New Empirical Models

Terminal Distress/IRI

Current Distress/IRI Level

RL
Identifying Critical RSL

- Faulting
- Spalling
- Cracking
- IRI
Use of New Data

- New data will not be reported in Highway Statistics

- Used within Conditions and Performance Report
  - Only national aggregate results – not results by state
  - Present condition of national pavement network
  - Use HERS to estimate funding needs to maintain and improve pavement network – driven by RSL

- Used by FHWA and AASHTO to monitor network health

- Possibly use to set national performance targets
Questions?
Renewal Program Overview

Pavement Research
To develop a consistent, systematic approach to performing highway renewal that:

- is rapid
- causes minimum disruption
- produces long-lived facilities
## RENEWAL PLAN

<table>
<thead>
<tr>
<th>Priority</th>
<th>Renewal Research Projects</th>
<th>Total budget (x1,000)</th>
<th>Project duration (months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>In progress</td>
<td>1. R01. Encouraging Innovation in Locating and Characterizing Underground Utilities</td>
<td>$5,000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. R06. A Plan for Developing High-Speed, Nondestructive Testing Procedures for Both Design Evaluation and Construction Inspection</td>
<td>$5,000</td>
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<td></td>
<td>3. R07. Performance Specifications for Rapid Highway Renewal</td>
<td>$3,000</td>
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<td></td>
<td>4. R15. Strategies for Integrating Utility and Transportation Agency Priorities In Renewal projects</td>
<td>$1,000</td>
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<td>8. R19. Durable Bridges for Service Life beyond 100 Years</td>
<td>$3,000</td>
<td>48</td>
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<td></td>
<td>9. R04. Innovative Bridge Designs for Rapid Renewal</td>
<td>$2,000</td>
<td>48</td>
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<td>Summer '07</td>
<td>10. R16. Railroad-DOT Institutional Mitigation Strategies</td>
<td>$400</td>
<td>18</td>
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<td></td>
<td>12. R05. Modular Pavement Technology</td>
<td>$1,000</td>
<td>36</td>
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<td></td>
<td>13. R23. Using Existing Pavement in Place and Achieving Long Life</td>
<td>$1,000</td>
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<tr>
<td></td>
<td><strong>Total Budget</strong></td>
<td><strong>$28,900</strong></td>
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<tr>
<td>Contingent</td>
<td>14. R03. Identifying and Reducing Worker, Inspector and Manager Fatigue</td>
<td>$1,000</td>
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<td>15. R10. Innovative Project Management Strategies for Large, Complex Projects</td>
<td>$750</td>
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<td>16. R11. Strategic Approaches at the Corridor and Network Level to Minimize Disruption</td>
<td>$500</td>
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</table>
## Renewal Projects

### Projects Related to Pavement

<table>
<thead>
<tr>
<th>Rapid Approaches Projects</th>
<th>Minimize Disruption Projects</th>
<th>Long-Lived Facilities Projects</th>
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</thead>
<tbody>
<tr>
<td>Improvement and Rapid Embankment</td>
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<td>R23. Using Existing In Place Pavement</td>
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<tr>
<td>Construction Technology</td>
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<td>Traffic Volume Roadways</td>
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<tr>
<td>R06. Modular Pavement</td>
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<tr>
<td>R08. High-Speed NDT</td>
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<td>R07. Performance Specifications</td>
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<tr>
<td>R09. Risk Manual for Rapid Contracts</td>
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</tbody>
</table>
R05. Modular Pavement Technology

Advertised on July 2007 – proposals due Sept. 18

- **Objectives:**
  - Place pavement in exceptionally short construction windows of less than eight hours.
  - Improve pavement quality control through use of pre-cast and modular technologies.
  - Develop design protocols for modular pavement renewal systems.
  - Perform accelerated testing.
  - Develop detailed operation guidelines

- **Budget:** $1,000,000

- **Duration:** 3 years
R21. Composite Pavement Systems

*Advertised on March 2007 – under contract negotiations*

- **Objectives:**
  - Develop performance models and design procedures for long-lasting, easily maintained new composite pavements.
  - Investigate the behavior and critical performance parameters of composite pavements.
  - Develop material requirements for all layers of the composite pavement, including the subgrade.
  - Recommend construction and quality control procedures.
  - Develop a long-term evaluation program to provide for future refinements of the design procedures and models.
- **Budget:** $4,000,000
- **Duration:** 4 years
R23. Using Existing Pavement in Place and Achieving Long Life

Advertised on July 2007 – proposals due Sept.18

- **Objectives:**
  - Develop detailed criteria on when an existing pavement can be used in place, with or without significant modification.
  - Evaluate impact to future rehabilitation projects.
  - Determine best ways to construct these types of pavements in a high-speed environment.
  - Evaluate new design procedures currently under development.
  - Explore ways to minimize reflective cracking.
  - Focus on rubblizing, crack and seat, white topping- bonded and unbonded
  - Evaluation of pavement design options in the bidding process

- **Budget:** $1,000,000
- **Duration:** 3 years
R26. Preservation Approaches for High Traffic Volume Roadways

Advertised on July 2007 – proposals due Sept. 18

• Objectives:
  – Conduct a synthesis-type review on current preservation approaches
  – Identify preservation strategies and products that are usable on high traffic volume roadways.
  – Develop documentation on the benefit/cost of various treatments. One purpose of the benefit/cost evaluation is to help determining when it is too late to apply a preservation approach.
  – Identify potential opportunities for further development of preservation treatments

• **Budget**: $250,000

• **Duration**: 18 months
Objective: To develop alternative methods to facilitate rapid roadway and embankment construction with improved long-term performance. The project will focus on three elements:

– Construction of new embankments and roadways over unstable soils
– Rapid widening of existing embankments and roadways
– Stabilization of the pavement working platform.

Budget: $3,000,000

Duration: 4 years
R06. Plan for Developing High-Speed NDT Procedures for Design Evaluation and Construction Inspection

On-going project - Contract with Texas A&M

• Objectives:
  – Develop a process to identify existing or, if necessary, to develop new and quickly implementable technologies for rapid NDT of in situ conditions
  – Develop AASHTO-format test procedures for rapid design evaluation and construction inspection

• Budget: $5,000,000 total
  – $350,000 (ongoing “parent” project)

• Duration: 12 month (ongoing “parent” project)
R07. Performance Specifications for Rapid Highway Renewal

*On-going project - Contract with Trauner Consulting Services*

- **Objectives:**
  - Reduce the completion time of renewal projects while maintaining or improving quality.
  - Develop different specifications that can be used effectively in various contracting scenarios and develop recommendations on the transition to the use of these specifications.
  - Quantify relative shared risk between project owners and contractors and between contractors and subcontractors through the use of warranties and guarantees.

- **Budget:** $3,000,000
- **Duration:** 5 years
Thank You

www.trb.org/shrp2
Backup slides
## Projects In-Progress

<table>
<thead>
<tr>
<th>Renewal Research Projects</th>
<th>Total budget (x1,000)</th>
<th>Ongoing Phase Budget</th>
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<tbody>
<tr>
<td><strong>R01.</strong> Encouraging Innovation in <strong>Locating and Characterizing Underground Utilities</strong></td>
<td>$5,000</td>
<td><strong>$300K</strong> Louisiana Tech</td>
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<td><strong>R06.</strong> A Plan for Developing <strong>High-Speed Nondestructive Testing</strong> Procedures for Both Design Evaluation and Construction Inspection</td>
<td>$5,000</td>
<td><strong>$350K</strong> TTI</td>
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<td><strong>R07.</strong> <strong>Performance Specifications</strong> for Rapid Highway Renewal</td>
<td>$3,000</td>
<td>Trauner</td>
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<td><strong>R15.</strong> Strategies for Integrating Utility and Transportation Agency Priorities in Renewal Projects</td>
<td>$1,000</td>
<td><strong>$250K</strong> ICF</td>
</tr>
</tbody>
</table>

**ETGs committed a portion of available funds for Phase 1 – $900K out of $14,000K**
# Advertised on March 2007

<table>
<thead>
<tr>
<th>2007 Priority</th>
<th>Renewal Research Projects</th>
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<tbody>
<tr>
<td>1</td>
<td>R09. Risk Manual for Rapid Renewal Contracts</td>
<td>$250</td>
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<td>2</td>
<td>R21. Composite Pavement Systems</td>
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<td>3</td>
<td>R02. Geotechnical Solutions for Soil Improvement, Rapid Embankment Construction and Stabilization of the Pavement Working Platform</td>
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<td>4</td>
<td>R19. Bridges for Service Life beyond 100 Years</td>
<td>$3,000</td>
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<td></td>
<td><em>(To be re-advertised in July ’07 and March ’08 as two separate projects)</em></td>
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<td>5</td>
<td>R04. Innovative Bridge Designs for Rapid Renewal</td>
<td>$2,000</td>
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<td>4</td>
<td>R19-A. Bridges for Service Life beyond 100 Years: Innovative Systems, Subsystems, and Components</td>
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<td>6</td>
<td>R16. Railroad-DOT Institutional Mitigation Strategies</td>
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<td>R26. Preservation Approaches for High Traffic Volume Roadways</td>
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