Track Status Report

	Track 1	Objectives	Benefits
	Mix Design Priority Track <u>Track Coordinator</u> Peter Taylor	1. Develop a concrete lab of the future. 2. Develop the tools necessary to predict the compatibility and effectiveness of concrete mix constituents. 3. Detect potential construction problems early and correct them on the fly. 4. Detect potential long-term durability problems more effectively during the mix design and quality control processes. 5. Improve the ability to predict concrete mix properties and their relationship to slab behavior and performance (e.g., shrinkage, joint opening, and curing). 6. Identify and use innovative, nontraditional materials.	Innovative concrete mix material selections and mix design procedures will produce economical, compatible, and optimized concrete mixes integrated into both concrete pavement structural design and construction control.

Status: 9-11-07
Executive Committee accepted this Track as a priority.
A Summit was held in October 2006, in cooperation with the Center and FHWA. This led to a reemphasis of the need for the Track.

The CP Road Map Admin Team, in cooperation with MCC, ACPA, PCA, and FHWA developed and presented an initial slate of projects to MCC participants in March 2007. A pooled fund project is proposed to handle these projects. The Team has prepared an extensive program for the MCC meeting in September 2007 to present progress and solicit more support for the pooled fund.

The six priorities projects include:
1. Design and Control of Concrete Pavement Mixtures
2. Mixture Testing and Analysis
3. Evaluation of Emerging Lab Tests
4. Modeling and Software Improvements
5. Field Evaluation, Coordination, Training & Outreach
6. Framework of Mixture Design System and Integration

Estimated Implementation Cost: $2.1 million
CP Tech Center: $525,000
FHWA: $525,000
Industry: $525,000
States: $525,000

Track Leadership: Leif Wathne, ACPA; John Staton, MDOT and MMC; Rick Meininger, FHWA

Track Status Report

	Track 2	Objectives	Benefits
	Performance-based Design Guide for New and Rehabilitated Concrete Priority Track <u>Track Coordinators</u> Dale Harrington/ Jagannath Mallela	1. Develop viable (e.g., reliable, economical, constructible, and maintainable) concrete pavement options for all classes of streets, low-volume roads, highways, and special applications. 2. Improve concrete pavement design by maximizing the use of fundamental mechanistic relationships. 3. Integrate pavement designs with materials, construction, traffic loading, and climate. 4. Develop functional design manual (noise, spray, aesthetics, friction, texture, illumination). 5. Design preservation and rehabilitation treatments and strategies using mechanistic-based designs.	Mechanistic-based concrete pavement designs will be reliable, economical, constructible, and maintainable throughout their design life and meet or exceed the multiple needs of the traveling public, taxpayers, and the owning highway agencies. The advanced technology developed under this track will increase concrete pavement reliability and durability (with fewer early failures and lane closures) and help develop cost-effective pavement design and rehabilitation.

Status 9-11-07:
Executive Committee accepted this Track as a priority.

Ongoing Work Related to the Design Guide Track:

Fueled by the interest generated by the Mechanistic Empirical Pavement Design Guide (MEPDG), a tremendous amount of work is currently ongoing related to rigid pavement design which falls under the various subtracks of the Performance Based Design Track of the CP Road Map. Specifically, federal or state agency sponsored work is ongoing in 17 of the 21 subtracks of the Design Guide Track.

Not surprisingly, spurred by the recent positive ballot received by the MEPDG from the AASHTO subcommittees on Materials and Design to make it an AASHTO Interim Pavement Design Guide, there has been a wealth of activity related to the Design Guide. This work is related to subtrack DG 5.1 on MEPDG implementation. Some of the projects go across multiple tracks, e.g., Mix Design. In addition, several industry sponsored and FHWA sponsored training activities related to the MEPDG are ongoing.

Track Leadership: Historically, the AASHTO Joint Technical Committee on Pavements (JTCP) – provides direct link to key decision makers in State agencies. However, TRB Design Section Representative and Committee Chair on Rigid Pavement Design – provides a ready link to practitioners and researchers. There is the consortium of State agencies who are large users of concrete pavements, e.g., Midwestern States, Texas, and California. The North-Central States ME PDG User Group will be a good start for this purpose—provides a link to active. Industry—provides a link to contractors and consultants who deal with concrete pavements on a daily basis and know the practical issues related to cost, construction, performance, etc. Academia—provides a link to the community performing basic research. It is suggested that representatives from each of these groups come together to 1) assess where we are and 2) define the next few projects that should be undertaken to meet the objectives of the Track. The key is to gain support from the JTCP first.

Two projects that might be offered to the track that are worth of consideration are:

1. Develop an integrated concrete materials modeling and design/analysis tool
2. Develop improved JPCP Deterioration models

Track Status Report				
	Track 3	Objectives	Benefits
	High-Speed Nondestructive Testing and Intelligent Construction Systems Priority Track Track Coordinator Ted Ferragut	1. Perform NDT quality control tests and procedures that use continuous and real-time sampling to monitor performance-related concrete mix properties and reduce the number of human inspectors. 2. Improve construction operations by providing continuous and rapid feedback to make changes on the fly. 3. Integrate data collection with materials management and pavement management systems to solve future problems and evaluate performance.	High-speed nondestructive quality control can continuously monitor pavement properties during construction to provide rapid feedback. As a result, on-the-fly adjustments can ensure a high-quality finished product that meets performance specifications

Status 9-11-07:

Executive Committee accepted this Track as a priority.

TRB Committee AFD50 has agreed to lead the track, based on a vote at their mid-year meeting in June 2007.

The CP Admin Team recommends a Track Summit to be held in late 2007 – early 2008, similar to the Summits held for Mix and Noise.

Track Leadership: Track leaders have not been identified as yet, but the Team would like to propose Ron Guntert as co-chair from the industry side. One DOT person that also sits on AFH50 should be identified.

<table>
<tr><th colspan="4">Track Status Report</th></tr>
<tr><th></th><th>Track 4</th><th>Objectives</th><th>Benefits</th></tr>
<tr><td></td><td>Surface Characteristics

Priority Track

<u>Track Coordinator</u>
Paul Wiegand</td><td>1. Identify the links between pavement surface characteristics and human response.

2. Develop relationships between surface texture, pavement material properties, and pavement surface characteristics. Relate pavement surface characteristics relate to each other.

3. Link design, materials, construction, maintenance, climate, and traffic to both initial values and changes in texture and the various pavement surface characteristics.

4. Optimize the nominal concrete pavement textures used today to meet site-specific conditions. Identify promising pavement surfaces beyond what is commonly used today in the USA.

5. Develop measurement and analysis techniques to better characterize texture and the various pavement surface characteristics.</td><td>A better understanding of concrete pavement surface characteristics will provide the traveling public with concrete pavement surfaces that meet or exceed predetermined requirements for friction/safety, tire-pavement noise, smoothness, splash and spray, light reflection, rolling resistance, and durability (longevity).</td></tr>
<tr><td colspan="4">Status 9-11-07:

Executive Committee accepted this Track as a priority.

ISU, FHWA, ACPA, and pooled fund states have developed a comprehensive program related to noise. An updated Strategic Plan (Track Framework) was also developed under prior work. Major efforts should look at splash / spray issues as well as ways to integrate all functional properties. The major emphasis need to look at the interrelationship of all functional characteristics in hopes of optimizing the right solution for specific situations.

Track Leadership: A first cut of Track Team members has been developed in advance of a Track meeting later this year. Chairs will be determined at that time.</td></tr>
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<tr><th colspan="4">Track Status Report</th></tr>
<tr><th></th><th>Track 5</th><th>Objectives</th><th>Benefits</th></tr>
<tr><td></td><td>Concrete Pavement Equipment Automation and Advancements

Deferred Track</td><td>1. Develop batching equipment that will produce better quality concrete mixes by optimizing the materials used and allowing for rapid adjustment of mix proportions.

2. Improve paving techniques and equipment to produce higher quality concrete pavements, while optimizing material usage and reducing construction time and processes.

3. Improve techniques for curing, texturing, and jointing concrete pavements, while allowing pavements to be opened to traffic quicker.

4. Improve equipment and techniques for expedited subbase stabilization and subdrain installation.

5. Develop equipment for rapid in-place reconstruction of concrete pavements using existing/recycled materials.

6. Improve and automate techniques and equipment for rapid concrete pavement restoration.

7. Introduce contractors and owner-agencies to new advanced equipment and provide assistance for purchasing such equipment.</td><td>Concrete paving process improvements and equipment advancements will expedite and automate PCC pavement rehabilitation and construction, resulting in high-quality concrete pavements, reduced waste, and safer working environments.</td></tr>
<tr><td colspan="4">Status 9-11-07:

The members of the project team met with a large paving manufacturer to obtain an understanding of equipment technology needs. That discussion should lead to developing a management approach that can be finalized under Task Order #2.</td></tr>
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Track Status Report			
	Track 6	Objectives	Benefits
	Innovative Concrete Pavement Joint Design, Materials, and Construction Deferred Track	1. Identify new and innovative alternatives to handling the forming, opening/closing, load transfer, and sealing for transverse and longitudinal concrete pavement joints. 2. Identify criteria for the design, materials, and construction of exceptionally long-lasting joints (e.g., more than 50 years). Also see track 8 (Long Life Concrete Pavements). 3. Determine optimum joint design for concrete overlays. 4. Determine optimum joint design for low-volume, long-life pavements. 5. Develop an advanced, high-speed computational model for joint condition analysis that can joint improve design, materials, and construction. 6. Develop fully and field test to determine the cost effectiveness, reliability, and durability of promising new and innovative joint designs. 7. Develop and validate rapid methodology for evaluating existing joint conditions so that joints can be preserved and repaired.	This track will identify, develop, and test new and innovative joint concepts for concrete pavements that are more cost-effective, reliable, and durable than current alternatives.
Status 9-11-07:			

Track Status Report

	Track 7	Objectives	Benefits
	High-Speed Concrete Pavement Rehabilitation and Construction Subject Matter Priority <u>Track Coordinator</u> Dale Harrington	1. Develop planning and simulation tools that allow contractors, designers, and owner-agencies to identify potential problems before construction begins as well as the most efficient processes. 2. Explore and refine precast and modular pavement technology for new construction, rehabilitation, and maintenance. 3. Refine fast-track construction technologies and techniques and synthesize them into best practice guidelines for contractors, designers, and owner-agencies. 4. Provide the means for all contractors, designers, and owner-agencies to learn about new high-speed construction and rehabilitation products and technologies.	This track will explore new and existing products and technologies that facilitate high-speed rehabilitation and construction of PCC pavements.

Status 9-11-07: Some of the work for item 2 is underway under the SHRP II program. ISU, FHWA, and ACPA are cooperating on concrete overlays and concrete pavement preservation & rehabilitation.

<u>Overlays</u>

1. The CP Tech Center and ACPA under the guidance of a national technical advisory committee developed and published a 28-page *Guide to Overlay Solutions* in January 2007. The 2nd Edition of the Guide, renamed *Guide to Concrete Overlay Solutions for Resurfacing and Rehabilitation of Existing Pavements* will begin September 4, 2007. The 2nd edition will include changes to the terminology, and will add a section on expedited construction and corresponding traffic control along with model specifications.
2. A multi-state concrete overlay construction program is being developed across the country by FHWA, ACPA and the CP Tech Center. This 8 state program will teach, demonstrate and document the concept and benefits of a concrete overlay in various applications. Expert teams will share their knowledge, experiences, and shepherd the regionally selected states during the selection, design, and construction of concrete overlay projects in their regions. The project will provide real-world lesions learned from the multi-state projects. In addition FHWA has formed an Overlay Task Force under the CPTP Program to help states with state DOT training on overlays.
3. It is proposed that FHWA, ACPA and the CP Tech Center in 2008/2009 will develop a comprehensive concrete overlay design and construction manual based on the current best practices and lessons learned form the eight state projects.

<u>Preservation & Rehabilitation</u>

FHWA and the CP Tech Center along with the concrete Pavement Preservation Technical Oversight Committee is developing a 1.5-day workshop on Preservation & Rehabilitation. The materials will be developed using current research products and state-of-practice and state-of-art maintenance/rehabilitation techniques. The learning objectives of the workshop include: Evaluating the condition of existing concrete pavements, selecting the appropriate category based on the evaluation, selecting the cost-effective and timely techniques with that category and determining the materials and construction procedures of each technique that will provide the optimal combination of extended pavement service life and cost.

Recommendation 1: Right now Track 7 is not a priority track. The administrative support group recommends that we focus instead on elements of track 7: specifically, those elements (described on page 412 of Volume II of the Road Map) in the cross-referenced topic table, Maintenance and Rehabilitation, with emphasis on high-speed.

Recommendation 2. It is suggested that the CP Executive Committee support a cooperative effort with SHRP II to oversee work related to these elements.

Estimated cost 3-year effort: $950,000

Track Status Report

	Track 8	Objectives	Benefits
	Long-Life Concrete Pavements (Priority Track) <u>Track Coordinator</u> Tom Cackler	1. Develop clear and detailed definitions of long-life pavements, including information about warrants, required maintenance, a range of low- to high-traffic roadways, and other information. 2. Identify pavement strategies (design, foundation, restoration, and rehabilitation) for long life. 3. Identify design and foundation features that are likely to result in long-life concrete pavements 4. Identify restoration treatments for preserving long-life concrete pavements 5. Identify concrete and other material tests and requirements for long-life pavements 6. Identify QC/QA procedures that will ensure quality long-life pavement construction 7. Construct test highways of the most promising concrete pavement types that include design features, foundations, materials, construction QC/QA, and preservation treatments that will ensure long-life concrete pavements.	The problem statements in this track will identify both conventional and innovative pavement types, design features, foundations, materials, construction quality control/quality assurance (QC/QA), and preservation treatments that will reliably provide long service life (e.g., more than 40 years).

Status 9-11-07:

Executive Committee accepted this Track as a priority.

The FHWA is very active in this area, with work in both the Highways for Life Program and the Long Life Pavement Scan Implementation Plan underway. It is not clear as to how FHWA intends to manage this topic, with committees or expert task groups.

Efforts so far have focused on the two-lift aspects only.

The Track could benefit from additional focus on a clearer definition of long life pavements.

It is also not clear as to one long term goals could be attained in the track.

Track Leadership: FHWA is the logical leader in this area. The LLCP Scan suggested several major initiatives in this area as well, It is suggested that the Track scope of work be revisited by a small study group,

Track Status Report

	Track 9	Objectives	Benefits
	Concrete Pavement Accelerated and Long-Term Data Collection Deferred Track	1. Identify performance data needs for calibrating and validating performance models for jointed plain concrete, continuously reinforced concrete pavements, and other types of concrete pavements. 2. Develop an ATF and full-scale test road program for collecting materials, design, traffic, climate, and performance data from existing and future experimental pavements. 3. Establish reliable experimental testing programs along with testing protocols for ATF and test road programs that include durability testing for materials and design. 4. Collect and analyze relevant test database programs that support the CP Road Map.	The research in this track will collect, manage, and analyze concrete pavement performance data that will support the CP Road Map.

Status 9-11-07:

This track focuses on two parts. The first is to address the collection and storage of pavement data related to concrete pavements so as to continue the LTPP-type mission. The second is to conduct research into ways that ATF could be used to test concrete pavements. To date, little has been done on this at the 10 or so facilities in the U.S., although there is a group called the CAPT group that meets twice a year. ATF facilities need designs that ‘fail’ within reasonable time frame. Unfortunately, concrete pavements do not, under current state-of-the-art, lend themselves to that type of design and testing.

The FHWA’s LTPP program would be a logical place to address this effort, but they are not into expanding their current program.

Recommendation: No action at this time.
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Track Status Report

	Track 10	Objectives	Benefits
	Concrete Pavement Performance Deferred Track	1. Develop ways to collect real-time data on concrete pavement conditions, including surface characteristics (friction, noise, distress, smoothness, others), climate parameters (temperature and moisture), traffic loading, moisture sensors beneath the slab, and structural factors using a combination of embedded electronics, high-speed assessment equipment, traffic measurement devices, and performance prediction equations. 2. Determine concrete pavement condition using a new generation of equipment that addresses structural support, smoothness, friction, noise, moisture beneath the slab, drainage, and other factors. 3. Loop concrete pavement performance data back to agency maintenance, planning, traffic, design, materials, and construction units using improved management systems. This feedback will allow the required concrete pavement surface and structural improvements to be scheduled cost-effectively and the pavement technology to be improved quickly. 4. Plan and schedule concrete pavement preservation and maintenance activities based on feedback condition and performance data to minimize lane closures and congestion. 5. Optimize the volume, type, and flow characteristics of traffic through long-lasting traffic monitoring sensors embedded in the pavement.	The research in this track will provide the traveling public with excellent concrete pavement surface characteristics and minimal lane closures for maintenance or rehabilitation over the design life.
Status 9-11-07:			

Track Status Report

	Track 11	Objectives	Benefits
	Concrete Pavement Business Systems and Economics Priority Track <u>Track Coordinator</u> Tom Cackler	1. Understand more clearly the economics of concrete pavements, fix alternatives, and the cost implications of engineering improvements as they relate to pavement performance. 2. Determine the best combination of concrete pavement solutions (mix-of-fixes) that balances funds, traffic impact, and network efficiency. 3. Develop an array of alternate contracting techniques that enhance the procurement of concrete pavements with a clear determination of risk between the owner and the contractor. 4. Develop optimum technology transfer, training, and outreach for the entire concrete paving workforce that the new generation of efficient, targeted, high-quality, cross-disciplined, and available-on-demand pavements will require.	The research in this track will clarify the relationship between concrete pavements and economic issues, capital availability, risk and risk transfer, and alternative contracting.

Status 9-11-07:

Executive Committee accepted this Track as a priority. Additionally, the Executive Committee was designated in the CP Road Map as the Track Leader to address the Track objectives..

Three major areas are important in this track:

- CP Road Map Administration
- Concrete Pavement Economic Studies
- Innovative Technology Transfer Programs

The Administration will be discussed at this meeting. The Executive Committee may want to sponsor several cost-related projects, such as comprehensive LLC analysis and alternative bids.

An Innovative Technology Transfer Program was one of the more highly recommended projects that would find creative ways to close the gap between research and adoption as well as the ability to improve training of the work force.

<table>
<tr><th colspan="4">Track Status Report</th></tr>
<tr><th></th><th>Track 12</th><th>Objectives</th><th>Benefits</th></tr>
<tr><td></td><td>Advanced Concrete Pavement Materials

Subject Matter Priority</td><td>1. Improve pavement durability and long-term performance to extend pavement life further than conventional materials.

2. Improve the construction process by reducing material requirements, labor requirements, or construction time.

3. Reduce waste through pavement reclamation.</td><td>New materials will be evaluated and existing materials will be refined to improve concrete pavement performance, enhance construction, and lessen environmental impact.</td></tr>
<tr><td colspan="4">Status 9-11-07:
TOM INSERT NANOTECHNOLOGY There are 3 other programs that have the potential to significantly address track 12 objectives. 1) A nanotechnology initiative for cement and concrete through the NSF, 2) FHWA’s Advanced Research program , and 3) and coordination with the Recycled Materails Resourse Center (RMRC). It is recommended that the Executive Committee focus on other tracks until the potential for address track 12 objectives through these other programs can be clarified.</td></tr>
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Track Status Report

	Track	Objectives	Benefits
	Environmental *(proposed)*	*Environment is not a track, but could be developed into one. It would combine elements of many of the above Tracks. In the original CP Road Map, a table was developed that identified 16 projects that were substantially environmentally based. See page 414 of Volume II.* *The Track could be divided into four sub modules: Design, Materials, Construction, and Performance Measurements/Economics.*	*New materials, construction processes, designs would improve concrete pavements as environmentally friendly and sustainable.*

Status:
In the development of the CP Road Map Many participants in the brainstorming events were disappointed not to see a research track dealing specifically with environmental issues.

In addition, the Original discussion by the Executive Board raised the potential of the environmental projects to be elevated to a separate track since the inclusion of environmental projects within the other tracks could reduce the overall importance of the environmental projects. With the increasing emphasis on environmental elements and sustainability, some people are concerned that not developing a separate track will delay important research activities in this area. The other alternative to a separate track is to include the environmental/sustainability projects in the other tracks. The Executive Committee could direct that the environmental/sustainable projects be given a high priority within each of those tracks.

The committee may want to work with existing programs that address environmental issues. The Environmental Council of Concrete Organizations, for example, could be more mainstreamed with the highway community. These and similar organizations should be examined thoroughly for scope of work, research funding, training, etc., that could be pulled into the CP Road Map.

The first activity of the leadership group for each track is to develop a framework for that track. That framework can include priority environmental projects pertinent to that track per the direction of the Executive Committee. For instance, use of recycled materials in PCC mixes is noted in Track 1, Mix Design, MD 1.5. If that project was pulled out and placed in an environmental track; it would have a lower priority than leaving it in the Mix Design Track.

Recommendations:

- Because of the limited time and allocation of resources to the priority tracks identified in the first Task Order and the broad range of environmental/sustainability projects identified in the Roadmap, it is felt that it would be best to integrate the important environmental projects into the priority tracks of the Roadmap. With that integration and direction from the Executive Committee, they will move to a higher priority quicker than if a separate track was created that wasn't as high a priority.
- Because the CP Roadmap is a dynamic process, changes in emphasis can be made by the Executive Committee as more of a focus is placed on environmental/sustainable issues and as funding for this type of project increases. To further enhance the priority of activities on the environmental /sustainability projects by asking the Advisory Board of the National Concrete Pavement Technology Center to add this topic to the Center's priorities.
- It is also recommended to follow-up on improving the visibility of the projects, as well as the promotion of any appropriate findings.

Environmental Concrete Pavement Advancements

Problem Statement	Estimated Cost	Products	Benefits
MD 3.5. Functional PCC Pavement Models Adaptation (see Track 1)	$250k–$500k	Thoroughly documented models, also in computerized form, that can be used to predict the functional performance (e.g., smoothness) of a concrete pavement as a function of mix properties.	Functional models predicting the linkage between concrete pavement function (e.g., smoothness, safety, noise) and mix properties in the mix design system; supplements for other ongoing efforts to develop these models.
ND 2.11: Pavement-Tire Noise Sensing (see Track 3)	$500k–$1M	Equipment for predicting pavement noise characteristics during construction.	Prediction of pavement-tire noise potential during construction, allowing surface textures to be corrected while the concrete is still plastic and on-the-fly adjustments to the surface texturing process to meet the pavement-tire noise restrictions; as-constructed pavements that meet stringent pavement-tire noise restrictions without the need for additional noise mitigation.
EA 5.1. High-Speed, In-Situ PCC Pavement Breakup, Removal, and Processing (see Track 5)	$2M–$5M	Equipment for high-speed, one-pass, in-situ breaking up, removing, and processing PCC pavement.	Equipment that will permit old concrete pavement to be broken up, removed, and processed in place, allowing the concrete material to be recycled into base material or new concrete and significantly reducing or even eliminating waste material.
EA 5.2. Recycled Concrete Processing/Improvement (see Track 5)	$1M–$2M	Equipment and recommendations for separating crushed concrete into usable materials.	Equipment that will properly separate crushed concrete into materials that can be used for new concrete, minimizing or eliminating waste from reconstructed concrete pavements.
RC 2.5. Precast Quiet Pavement Surfaces (see Track 7)	$500k–$1M	Recommendations for noise reducing techniques for precast concrete pavement surfaces.	Exploration of noise reducing techniques that may not be viable for conventional concrete pavements but that can be incorporated into precast concrete pavements.
LL 1.1. *Identifying Long-Life Concrete Pavement Types, Design Features, Foundations, and Rehabilitation/Maintenance Strategies (see Track 8)*	$800k–$1.2M	Feasible pavement strategies and promising features for providing long life for each type of concrete pavement selected; case studies of past long-life concrete pavements.	Feasible pavement strategies for providing long life that will provide input throughout track 8 (Long-Life Concrete Pavements).
BE 2.1. Achieving Sustainability with Concrete Pavements (see Track 11)	$500k–$750k	Macro-analysis of whole-life factors related to concrete pavements.	A study of the broader issues associated with cement, aggregate, construction, rehabilitation, and concrete pavement salvaging that allows policy makers and engineers to examine the full societal value of concrete pavements and recommend improvements.
BE 5.1. The Impact of Concrete Pavement Reflectance, Absorption, and Emittance on the Urban Heat Island Effect (see Track 11)	$250k–$500k	A report detailing the impact that the reflectance of various concrete pavement types has on the heat island effect.	An examination of existing efforts to understand and reduce the heat island effect in order to determine their applicability to concrete pavements and help determine the impact of concrete pavements on the heat island effect, as well as the costs associated with reducing the effect.

Problem Statement	Estimated Cost	Products	Benefits
AM 3.1. Cement Containing Titanium Dioxide (see Track 12)	$100k–$250k	Recommendations for the use of cement containing titanium dioxide in concrete paving mixes.	Concrete pavements containing titanium dioxide that can potentially remove certain volatile organic compounds from the air, helping to reduce air pollution in urban areas.
AM 3.2. Sulfur Concrete (see Track 12)	$100k–$250k	Recommendations for the use of sulfur concrete in paving applications.	Sulfur concrete that consists of 100 percent recycled material, made from byproducts of electricity production and petroleum refinement; a dense, acid resistant material that may have applications for concrete paving.
AM 3.3. Increased Percentages of Reclaimed Asphalt Pavement as an Aggregate for Concrete Paving Mixtures (see Track 12)	$1M–$2M	Recommendations for using RAP as an aggregate for concrete paving mixes.	RAP in concrete paving mixes, reducing the amount of RAP that must be disposed of, as well as reducing the demand for virgin aggregate for concrete pavements.
AM 3.4. Mix Design Considerations with Recycled Concrete Aggregate (see Track 12)	$1M–$2M	Recommendations for using recycled concrete as aggregate in new pavement construction.	Recycled concrete for aggregate in new concrete pavements, reducing the amount of reclaimed concrete pavement that must be disposed of, as well as the demand for virgin aggregate in concrete pavements.
AM 3.5. Acceptance Criteria for Using Recycled Aggregate (see Track 12)	$500k–$1M	Recommendations for acceptance criteria and test procedures for recycled aggregate and concrete made with recycled aggregate.	Established acceptance criteria and test procedures for recycled aggregate in new concrete pavements to promote the use of recycled aggregates, thereby reducing the demand for virgin aggregate for new construction.
AM 3.6. Waste Materials in Concrete Mixes (see Track 12)	$1M-2M	Recommendations (proportions and limits) for the use of waste materials in concrete paving mixes.	Use of waste materials in concrete mixes, reducing the amount of waste materials and the demand for cement (which must be produced), while producing a better concrete mix.
AM 3.7. Ecocement for Concrete Mixes (see Track 12)	$100k-250k	Recommendations for the production and use of Ecocement in the United States.	Ecocement that is produced during the incineration of solid waste and sewage sludge, reducing the amount of waste, while reducing the amount of cement required for concrete paving mixes, resulting in a faster setting concrete mix.
AM 3.8. Polymer Concrete Made from Recycled Plastic Bottles (see Track 12)	$100k-250k	Recommendations for using polymer concrete for paving applications.	Polymer concrete that results in a more durable pavement or pavement overlay, making use of recycled plastic bottles and reducing the demand on landfills.