# GREEN TRANSPORTATION INFRASTRUCTURE: CHALLENGES TO ACCESS AND IMPLEMENTATION

## HEARING

BEFORE THE

SUBCOMMITTEE ON TECHNOLOGY AND INNOVATION

COMMITTEE ON SCIENCE AND TECHNOLOGY

HOUSE OF REPRESENTATIVES

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# GREEN TRANSPORTATION INFRASTRUCTURE: CHALLENGES TO ACCESS AND IMPLEMENTATION

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**THURSDAY, MAY 10, 2007**

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON TECHNOLOGY AND INNOVATION,
COMMITTEE ON SCIENCE AND TECHNOLOGY,
*Washington, DC.*

The Subcommittee met, pursuant to call, at 2:30 p.m., in Room 2318 of the Rayburn House Office Building, Hon. David Wu [Chairman of the Subcommittee] presiding.

BART GORDON, TENNESSEE
CHAIRMAN

RALPH M. HALL, TEXAS
RANKING MEMBER

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The Subcommittee on Technology and Innovation

Hearing on:

***"Green Transportation Infrastructure: Challenges to Access and Implementation"***

2318 Rayburn House Office Building
Washington, D.C.

May 10, 2007
2:00 p.m.

WITNESS LIST

**Ms. Gloria Shepherd**
*Associate Administrator for Planning, Environment, and Realty*
*Federal Highway Administration*

**Mr. Benjamin Grumbles**
*Assistant Administrator for the Office of Water*
*Environmental Protection Agency*

**Mr. Sam Adams**
*Commissioner of Public Utilities*
*City of Portland*

**Mr. Dan Huffman**
*Managing Director for National Resources*
*National Ready Mixed Concrete Association*

**Mr. Hal Kassoff**
*Senior Vice President for Sustainable Development*
*Parsons Brinckerhoff*

HEARING CHARTER

# SUBCOMMITTEE ON TECHNOLOGY AND INNOVATION
# COMMITTEE ON SCIENCE AND TECHNOLOGY
# U.S. HOUSE OF REPRESENTATIVES

# Green Transportation Infrastructure: Challenges to Access and Implementation

THURSDAY, MAY 10, 2007
2:00 P.M.–4:00 P.M.
2318 RAYBURN HOUSE OFFICE BUILDING

**1. Purpose**

On Thursday, May 10, the Subcommittee on Technology and Innovation of the Committee on Science and Technology will hold a hearing to examine options for construction technologies and materials available for transportation infrastructure that contribute to stormwater management and control of non-point source water pollution. Federal and local government officials and industry representatives will also address barriers to widespread implementation of these technologies.

**2. Witnesses**

**Ms. Gloria Shepherd** is the Associate Administrator for Planning, Environment, and Realty at the Federal Highway Administration (FHWA) of the U.S. Department of Transportation (DOT).

**Mr. Benjamin Grumbles** is the Assistant Administrator for the Office of Water at the U.S. Environmental Protection Agency (EPA).

**Mr. Sam Adams** is the Commissioner of Public Utilities for the City of Portland, Oregon. His jurisdiction includes the Bureau of Environmental Services and the Office of Transportation.

**Mr. Dan Huffman** is the Managing Director for National Resources for the National Ready Mixed Concrete Association (NRMCA).

**Mr. Hal Kassoff** is the Senior Vice President for Sustainable Development at Parsons Brinckerhoff, a leading infrastructure engineering firm.

**3. Brief Overview**

- Transportation infrastructure such as roads and parking lots contribute to pollution of ground and surface water because they are impervious surfaces and collect a high concentration of contaminants. Stormwater washes pollutants off of hard surfaces and concentrates runoff into streams, lakes, and bays without filtration that could mitigate the effect of the contaminants. In addition, these hard surfaces concentrate rainfall during storms and empty the flow of water immediately via storm sewers intro streams, rivers, and lakes, unlike the slow, natural filtration when rain falls on undeveloped ground. The results—flooding, increased sedimentation and erosion, and pollution of ecosystems.
- Engineers have developed numerous technologies that can be incorporated into transportation infrastructure which contribute to controlling stormwater and mitigating non-point source water pollution. These green infrastructure technologies help absorb and filter excess runoff, rather than funneling runoff into large sewer pipes that empty directly into detention ponds or water treatment facilities, which can easily become overwhelmed during heavy rainfall.
- There has not been widespread implementation of green transportation infrastructure by governments or private industry. There are technical, social, and regulatory barriers to implementation which are being addressed to some extent by the Federal Government and private non-profit organizations, but additional efforts are necessary.

**4. Issues and Concerns**

**What future research is necessary, both in the area of technology development and testing and evaluation?** A common argument against the use of green transportation infrastructure by governments and private industry is the lack of data (or the lack of awareness of data) supporting the claims that these technologies control runoff and reduce non-point source pollution. Additional testing and evaluation as well as more robust public awareness campaigns could ease concerns that green infrastructure technologies are ineffective. Testing and evaluation should also cover the traditional criteria used to judge transportation infrastructure: safety, reliability, and cost. Currently, the EPA depends on outside groups for data collection, and as a result, data tends to be incomplete and only covers specific projects, not overall technology performance in a variety of settings. Because EPA uses performance-based standards to determine whether technologies effectively contribute to preventing water pollution, the lack of data makes it especially difficult to get approval to use new technology from some regional administrators.

The American Association of State Highway and Transportation Officials (AASHTO) maintains a database of all proposed research projects proposed by State departments of transportation in the field of environmental protection. The proposed research is intended to meet specific needs of transportation officials, and covers broad topics such as noise, energy, wildlife protection, and water management. In the area of stormwater management, states have proposed over 30 different research projects that would provide further data and feedback on the use of green transportation infrastructure. The results would be a valuable tool for helping convince State and local transportation officials and private industry of the effectiveness of these technologies. Unfortunately, research funding is limited, and many proposed projects are not carried out.

**How should a builder determine which type of green transportation infrastructure technology is most appropriate for their project? How should that technology be integrated into the overall stormwater management system?** One of the primary reasons builders resist incorporating green transportation infrastructure technologies into their design plans is the lack of understanding of the different options. Given that even EPA regional offices do not have universal expertise in this area, it is not surprising that builders are reluctant to invest time and effort in familiarizing themselves with green technologies. One of the most complicated aspects of planning designs that incorporate green infrastructure is determining the most appropriate technologies to use for a particular climate and built environment. A technology appropriate for a major urban center in the Northeast would likely not be effective for a more rural area in the desert Southwest. Additionally, these technologies do not operate independently, but are most effective when they are integrated into an overall stormwater management and sewer system. Since the technologies are relatively new, many builders do not have the expertise necessary to efficiently integrate the design into an existing water management system. EPA is working to educate designers and builders through the use of fact sheets on the various technologies, but additional efforts are necessary to facilitate broader implementation.

**What should the Federal Government do to facilitate adoption of green transportation infrastructure by State and local governments and private companies? How can federal agencies coordinate effectively to maximize use of green technologies?** Federal action on the issue of green transportation infrastructure has been generally limited to research and development, public awareness campaigns, and demonstration projects. While these efforts are laudable, the Federal Government could provide stronger incentives for using these types of technology. Federal agencies can also set a good example by using green infrastructure practices at their facilities around the country, thus demonstrating that these technologies are useful in many climates and settings around the country.

There are also federal funding sources that could be used to provide incentives for the use of green infrastructure. In March, the House passed H.R. 720, the *Water Quality Financing Act of 2007,* which authorized the use of EPA grant money—which previously had been limited to funding traditional stormwater management infrastructure such as sewer pipes—for green infrastructure. Federal funding for green transportation infrastructure elements both provides a financial incentive for their use by states and municipalities and indicates federal recognition of the technology's effectiveness.

Additionally, better coordination between federal agencies is necessary to allow new technologies into the marketplace without being impeded by federal regulations. Currently, some EPA regions do not allow the use of innovative technologies

in spite of work performed by other federal agencies, including FHWA, that demonstrates their effectiveness. Improving coordination between R&D agencies and regulatory agencies can help ensure that technology transfer is not hampered by outdated regulations.

**5. Background**

The information in this section is summarized from the National Cooperative Highway Research Program's 2006 report, *Evaluation of Best Management Practices for Highway Runoff Control.*

*Environmental Problems Associated With Runoff*

Changes in the amount of land covered by surfaces that are impervious to water, such as roads or parking lots, can have significant impacts on an area's natural hydrology, potentially resulting in flooding, pollution, or aquatic ecosystem destruction. Due to their impermeable nature, roads and parking lots decrease the amount of rainwater that will infiltrate into the ground, leading to an increase in the amount of rainwater that runs over the surface of the ground, referred to as "surface runoff." An area that is fully paved has on average of 15 to 20 times the amount of runoff as a completely undeveloped area. Thus, streams, rivers, lakes and other bodies of surface water receive a greater volume of runoff under developed conditions than they would under undeveloped conditions. They also receive the peak flow of this surface runoff much sooner than they would under natural conditions, where water would filter through slowly. These changes in volume and timing can degrade the physical characteristics of streams and rivers. Increases in erosion will widen channels, decrease the stability of banks, and widen flood plains. These changes affect the fish and other animals and plants. Additionally, these changes to the watershed can increase the possibility that a stream will experience reduced or intermittent flow during some times of the year, since there is less groundwater to recharge the stream and the flow of runoff into the stream is no longer gradual but instead very sharp. Thus, developed areas have a significant and far-ranging environmental impact.

Runoff from highways contributes to non-point source pollution—the type of non-localized pollution emission that is responsible for over 80 percent of the degradation of the Nation's surface water. Stormwater moves over agricultural land, lawns, urban areas, and other types of human land-use, washing chemicals like fertilizers, heavy metals, and harmful bacteria into surface water. Highway and other transportation installations are major contributors to this type of pollution. The most common contaminants in highway runoff are metals, inorganic salts, aromatic hydrocarbons (such as the carcinogenic chemical benzene) and suspended solids that accumulate on the road surface as a result of regular highway operations and maintenance activities.

*Runoff Mitigation Methods*

To be an effective tool in countering the negative impact of rainfall runoff, mitigation measures must reduce the speed and volume of flow and treat or reduce pollutants. Mitigation techniques rely on structural and non-structural best management practices (BMPs) to address these goals. Structural measures are installations like infiltration basins and trenches, detention and retention ponds, constructed wetlands, vegetated swales and filter strips, and filtration systems. Generally they are above ground and rely on passive methods to accomplish treatment goals. Some highly urbanized areas use underground, proprietary systems. Non-structural measures are designed to control runoff and pollution problems at their source; they include practices such as street sweeping and reductions in fertilizer applications.

Stormwater managers generally choose their treatment technique by evaluating the amount of land available, the cost of implementation and operation and maintenance of the technology, and the treatment objectives. Attenuation methods, or reducing the size of the peak runoff flow, can be accomplished by intercepting the rainfall with vegetation and avoiding overly efficient conveyance systems (such as large storm drains) and detention ponds. All of these serve the purpose of slowing the water as it travels to the ground or surface water. Reductions in stormwater volume can be accomplished with retention, infiltration and evapo-transpiration (the water lost through evaporation and plant processes).

Low-impact development is a comprehensive design strategy intended to maintain the natural hydrology of an area even after roads and other infrastructure are installed. It embodies the principles of conservation, minimization of impact, and maintenance of natural watershed hydrologic timing. Ideally, low impact development should be designed to replicate pre-development conditions as much as possible.

*Current Federal Programs*

While most of the decisions regarding implementation of green transportation infrastructure are made at the State and local level, there are federal programs addressing the issue of non-point source water pollution control in transportation infrastructure. The Green Highways Partnership (GHP) is the primary federal vehicle for encouraging the use of green transportation infrastructure by State and local governments and private industry. EPA and FHWA are the chief federal participants in the partnership, which includes an expanding list of State departments of transportation, trade organizations, municipal governments, and non-profit organizations. The Partnership's activities focus on planning and design, construction, and operations and maintenance of green transportation infrastructure, and include pilot projects that demonstrate cost-effective, environmentally-sound transportation infrastructure technologies that meet State performance requirements. GHP includes a specific program on watershed-driven stormwater management which includes the development of best practices and performance standards, and the collection of data and modeling results to better understand the benefits of green technologies.

FHWA, through the Surface Transportation Environment and Planning (STEP) Cooperative Research Program, also conducts research to improve air quality and climate, wetlands, and water quality and ecosystems as part of its environmental research initiative. Stormwater-control related projects include basic research into the contribution of impervious surfaces to runoff, and development of methods to rapidly assess the effects of highways on adjoining ecosystems.

Additional research projects are supported through the Transportation Research Board (TRB), a FHWA-funded arm of the National Research Council (NRC). As part of the National Cooperative Highway Research Program, TRB has sponsored evaluations of best management practices for highway runoff, long term data collections on the effect of highway construction on habitats, and other projects related to the effect of transportation infrastructure on non-point source water pollution. The EPA Office of Water participates in TRB committees, and assists in the translation of research results into usable manuals and guides for State and local agencies.

The EPA Office of Water also supports the use of green infrastructure through the National Menu of Storm Water Best Practices, a web-based database of stormwater management options for local authorities. EPA developed this database beginning in 2000. The database includes information and builder specifications for a variety of green transportation infrastructure technologies. The Office of Water has also begun cooperating with environmental non-profit organizations to promote the use of these practices among local governments. They provide additional support to State and local governments through the development of fact sheets that specify which technologies are suited to various environments around the country.

**6. Challenges to Implementation**

Though research has shown significant benefits in terms of stormwater management and control of non-point source water pollution, technologies such as bioswales and pervious pavement have not been adopted in many jurisdictions or by private entities. There are numerous barriers to full adoption of green infrastructure, including technical problems, regulatory challenges, and general industry resistance to changing practices.

*Technical Challenges*

The installation of green transportation infrastructure can be impeded by problems of high cost and availability of space for technologies. For measures that are installed directly on the roadway, unless new infrastructure is being constructed, there are high costs associated with removing old materials and installing new surfaces. Additionally, the disruption to traffic and business is extremely costly. In many urban areas, there is also not space on the roadside or around parking lots to install measures such as bio-swales, limiting local governments' choices of technology.

Various climates can also present unique challenges to implementation. In areas where very cold weather is common, technologies that retain water for slow filtration are susceptible to freezing. Freeze/thaw cycles can shorten the lifespan of infrastructure, as well as limiting its ability to effectively filter pollutants from runoff. Further research will help develop better guidelines as to which technologies are most appropriate for various climates.

*Regulatory Challenges*

Federal, State, and local government agencies have taken an active role in promoting the use of green transportation infrastructure, but paradoxically, those same entities have often erected regulatory barriers which prevent widespread implemen-

tation. On the federal level, the U.S. Environmental Protection Agency (EPA) has begun promoting the use of green infrastructure, including transportation infrastructure, through its Office of Water. In March 2007, Assistant Administrator Ben Grumbles released a memo to regional administrators encouraging the acceptance of green infrastructure to protect water quality (Appendix I). The EPA also recently signed an agreement with a number of environmental organizations to assist State and local governments in implementing green infrastructure projects.

However, though the Office of Water has been a strong advocate for green infrastructure projects, there are regulatory barriers internal to the EPA that prevent those projects from moving forward. Through the *Clean Water Act,* the National Pollutant Discharge Elimination System (NPDES) permit program gives EPA the authority to regulate sources of water that release pollutants into ground and surface water. The program is administered on a regional level, and regional administrators have discretion over defining a green infrastructure technology as a source of water that is covered by NPDES. If technologies such as pervious pavement or bio-swales, which filter runoff before it flows into the ground or surface water, are considered "point sources" that inject water directly into the ground. EPA regulations require permitting procedures that act as a significant disincentive to use these technologies.

For example, when the City of Portland was preparing its "Clean River Plan" for the Willamette River in 2000 and 2001, the city planners wanted to incorporate bio-swales as part of the runoff management plan. However, the EPA regional administrator was not familiar with research results which indicated that bio-swales effectively filtered pollutants from runoff, and required extensive permitting and monitoring systems under the NPDES authority, thus creating a financial disincentive for the use of bio-swales. Conversely, in other regions, EPA regional administrators have taken a leadership role, reducing the bureaucratic barriers to implementing projects using green infrastructure. The Office of Water's initiative has a goal of standardizing implementation procedures across the various regions.

State and local authorities can sometimes also be at fault in preventing implementation of green transportation infrastructure, but unlike federal laws that specifically disallow the use of green technologies without extensive permitting, State and local authorities tend to fail to explicitly allow their use. As a result, governments or private companies within the jurisdiction who propose the use of green transportation infrastructure are not given approval simply because the innovative technologies have not been previously considered by the regulating authority. The problem is then self-perpetuating, as these local governments block all potential demonstration projects, and then continue to deny builders on the basis that there have been no successful demonstration projects. Of course, many cities have acted as leaders in the green transportation infrastructure initiative, but the challenge remains to universalize its use across local jurisdictions.

*Social Challenges*

Finally, there are social challenges to widespread implementation of green transportation infrastructure. The transportation construction industry is highly decentralized, and stakeholders range from State governments to private developers. As a whole, the industry tends to be risk-averse, and hence reluctant to adopt technologies that may be considered experimental or unproven because of concerns about high cost, reliability, maintenance, or simply confusion about the best products to use. The slow adoption of these technologies has also led to a shortage of trained contractors who are able to properly design and install integrated systems, making implementation more difficult and costly.

Numerous companies, non-profits, and industry organizations have developed programs to specifically promote environmentally-friendly advances in construction techniques and technologies with varying levels of success. Market-driven techniques are most effective: demonstrating that green transportation infrastructure is attractive to consumers as part of a corporate citizenship initiative has been an effective means of encouraging implementation. For example, Turner Construction Company, one of the largest construction companies in the United States, recently worked with Wal-Mart to develop a "green supercenter" which incorporated green transportation elements such as bio-swales and pervious pavement as part of an overall sustainability initiative that was formulated to build community goodwill. The EPA and FHWA, through the Transportation Research Board (TRB), have also dedicated some resources towards training programs, but the scope of these programs is limited because of budgetary constraints.

Chairman WU. I call the Subcommittee to order. I would like to welcome everyone to this hearing on *Green Transportation Infrastructure: Challenges to Access and Implementation.*

The Committee has heard a lot of testimony over the last five months on high-tech methods to mitigate climate change. Today, I want to hear about simpler methods for protecting our lakes, rivers, and oceans. I have invited today's witnesses because they each give a unique perspective in the field of green transportation infrastructure.

Now, this is a term that is not necessarily well known outside of environmental circles. Simply put, green transportation infrastructure is the use of materials, methods, and methods for construction of roads, highways, and parking lots that minimize environmental impact. Today, we will hear about the materials and technologies that specifically contribute to the minimization of non-point source water pollution.

Runoff is a major contributor to water pollution, especially from roads and parking lots, which concentrate oil, gasoline, heavy metals, and other pollutants, which then flow unimpeded into our nation's waterways. For example, a one acre parking lot produces 16 times the runoff of a one acre meadow. In recent years, local governments and companies and private citizens have been working to develop simple, yet innovative solutions that integrate control of non-point source water pollution into the existing infrastructure. The results, a common sense, low cost, low maintenance system that reduces pollution, prevents flooding, protects ecosystems, and maintains a more natural hydrological environment.

I would like to thank our witnesses for testifying today. Our challenge today is not the development of new technologies. It is to get people to start using the technologies that we do have. I hope that at the end of this hearing, that we have learned a lot about technologies for controlling non-point source water pollution that can be integrated into transportation infrastructure. I am shortening my opening statement in the interests of adjusting to the flex of our Committee schedule and our Floor schedule, and I will submit my full statement into the record.

I would like to recognize my good colleague from Georgia, Dr. Gingrey, the Ranking Member of this committee, for his opening statement.

[The prepared statement of Chairman Wu follows:]

PREPARED STATEMENT OF CHAIRMAN DAVID WU

I would like to call the Subcommittee to order.

I want to welcome everyone to this morning's hearing on *Green Transportation Infrastructure: Challenges to Access and Implementation.* The Committee has heard a lot of testimony over the last five months on high-tech ways to mitigate climate change. Today I want to hear about simpler methods for protecting our lakes, rivers and oceans. I've invited today's witnesses because they each a unique perspective in the field of green transportation infrastructure. Now this is a term that is not necessarily well known outside of environmental circles. Simply put, green transportation infrastructure is the use of materials and methods for construction of roads, highways, and parking lots that minimize environmental impact. Today we will hear about the materials and technologies that specifically contribute to the minimization of non-point source water pollution.

Runoff is a major contributor to water pollution, especially from roads and parking lots which concentrate oil, gasoline, heavy metals, and other pollutants which then flow unimpeded into our nation's water. For example, a one-acre parking lot

produces 16 times the runoff of a one-acre meadow. In recent years, local governments, companies, and private citizens have been working to develop simple yet innovative solutions that integrate control of non-point source water pollution into the existing infrastructure. The results: a common sense, low cost, low maintenance system that reduces pollution, prevents flooding, protects ecosystems, and maintains a more natural hydrological environment.

On paper, these technologies look like no-brainers. So why don't we see them used more often? While there are technological issues and research that needs to be carried out to prove their effectiveness, the biggest impediments are State and federal regulations. Clean water is regulated by the Environmental Protection Agency on a regional basis, and some regional administrators, including in my home district of Portland, are not familiar with the benefits of using green infrastructure for filtering runoff. Because of they have discretion to approve or disapprove technologies, some of these administrators tend to rely on standard operating procedures and steer clear of innovative solutions. We'll hear this afternoon from Assistant Administrator Ben Grumbles of the EPA's Office of Water, who is taking the lead at his agency to educate the EPA regional administrators across the country about green infrastructure technologies. I hope to be able to work with Assistant Administrator Grumbles to promote the implementation of green transportation infrastructure projects across the country.

We also need to see better coordination among the federal agencies working on the R&D and regulatory aspects of green transportation infrastructure. Technology development must not happen in a vacuum. The DOT, EPA, universities, and other stakeholders must work together to make sure that technology fits into the current regulatory structure. Likewise, regulators must be flexible enough to evaluate technology according to its performance. In addition, the Federal Government should take the lead in training the private sector to insist on the use of green technologies for all new developments.

Thank you again to our witnesses for testifying today. Our challenge today is not to development new technologies. It's to get people to start using the technologies we've got. I hope at the end of this hearing that we've learned a lot about technologies for controlling non-point source water pollution that can be integrated into transportation infrastructure. I hope we also gain a better understanding of how to facilitate implementation of these technologies in the public and private sectors to better protect our nation's precious water. I'd now like to recognize my colleague, Ranking Member Gingrey, for an opening statement.

Mr. GINGREY. Mr. Chairman, thank you, and I thank the witnesses. I apologize to the witnesses. I had memorized my 18 page opening statement, and in the interest of time, my staff has redacted it so much now that I am going to have to read it, because it is a different statement. But thank you so much, Mr. Chairman, for having this important hearing.

Roads and highways let people in the smallest towns reach out to the largest cities. They let urban workers escape to more tranquil homes outside of the city, and they let mom and pop stores in Cedartown, Georgia, in my district, ship their wares easily, quickly, and affordably. In short, they form the fabric that keeps this country connected and competitive.

Unfortunately, roads and highways have also left an indelible mark on our environment. Today, I am looking forward to hearing our distinguished panel discuss how we can further reduce, maybe even negate environmental degradation associated with our transportation system. From reviewing your testimony, it appears that green or sustainable highway technologies could be a win-win for everyone involved. However, it is also clear that we are not quite there yet.

And I would like to close by, again, thanking you for coming before the Committee today to discuss this very, very important topic. I am looking forward to hearing your thoughts, and starting a dialogue with you on how we can improve our nation's environment and support our critical highway infrastructure.

And Mr. Chairman, I will yield back the balance of my time.

[The prepared statement of Mr. Gingrey follows:]

PREPARED STATEMENT OF REPRESENTATIVE PHIL GINGREY

Thank you Mr. Chairman and I want to also thank our panel of witnesses for taking the time to be with us here today.

Roads and highways have left an indelible mark on our nation's history and character, promoting an unprecedented freedom to travel, trade, and prosper. Indeed, the family car trip remains an icon of holiday festivities. . .along of course with the inevitable cries of, "Are we there yet?" from the back seat.

Our nation's transportation infrastructure not only allows the cross-country trek to Grandma's house, but also allows our local grocery stores to sell fruits and vegetables from across the state, across the country, and indeed also from across the world.

Roads and highways let people in the smallest towns reach out to the largest cities. They let urban workers escape to more tranquil homes outside the city. And they let a mom and pop store in Cedartown, GA ship their wares easily, quickly, and affordably. In short, they form the fabric that keeps this country connected and competitive.

Unfortunately, roads and highways have also left an indelible mark on our environment. Air and water quality can suffer from poorly designed or over-used roads as tailpipe emissions accumulate in the air—and oil, dust, and chemicals seep into the watershed. Road construction itself can damage ecosystems, clouding streams with dirt and debris or filling in wetlands that protect from flooding and provide precious habitat.

Over the years, local, State, and Federal governments have acted to contain these harms by requiring environmentally responsible planning and development and investing in cleaner and greener technologies and construction techniques.

Today, I'm looking forward to hearing our distinguished panel discuss how to further reduce, maybe even negate, environmental degradation associated with our transportation system. From reviewing your testimony, it appears that green or sustainable highway technologies could be a win-win for everyone involved. However, it's also clear that we're not quite there yet.

There are a few key points that I hope we can discuss today. First, your testimony points out that measures to improve highways must be tailored to that particular road, taking into account the local terrain and weather, the broader ecosystem and watershed, and the expected use of the road.

With all these variables at play, we can't just assume that particular green highway technologies or practices will be effective everywhere. So, do we currently have data that is robust enough to meet the needs of highway administrators and engineers in both Georgia and North Dakota? If not, do we have a research plan to help make these technologies viable?

Second, implementing these new technologies and practices will require close cooperation between large groups of stakeholders; contractors, highway and environmental administrators at the federal, State, and local level, as well as community residents.

Communicating and coordinating with a large and diverse group like this is challenging in any circumstance, and I'd like to hear the panel's thoughts on how green highway practices can be better disseminated across the country.

I'd like to close by again thanking you for coming before the Committee today to discuss this important topic. I'm looking forward to hearing your thoughts and starting a dialogue with you on how we can improve our nation's environment and support our critical highway infrastructure.

Mr. Chairman, I'll yield the balance of my time.

Chairman WU. Thank you very much, Dr. Gingrey. Our first witness is Ms. Gloria Shepherd, who is the Associate Administrator for Planning, Environment, and Realty at the Federal Highway Administration.

Let us see. We also have Mr. Ben Grumbles, who in addition to being the Assistant Administrator of the Office of Water at the Environmental Protection Agency is an alumni of the Science and Technology Committee staff. Welcome back.

I also have a special welcome for our next two witnesses, who both come from Oregon. City Commissioner Sam Adams was elect-

ed to the Portland City Council in 2005. He oversees the Office of Transportation and the Bureau of Environmental Services. He has taken the lead in developing a citywide green-streets policy, which requires green street development for all newly constructed or reconstructed roadways. Welcome, Sam.

Mr. Dan Huffman is the Managing Director for National Resources for the National Ready Mixed Concrete Association, and also comes from Portland, Oregon.

Our final witness is Mr. Hal Kassoff, who is a Senior Vice President at Parsons Brinckerhoff, a leading construction firm.

And with that, Ms. Shepherd, please proceed.

## Panel 1:

**STATEMENT OF MS. GLORIA M. SHEPHERD, ASSOCIATE ADMINISTRATOR, OFFICE OF PLANNING, ENVIRONMENT, AND REALTY, FEDERAL HIGHWAY ADMINISTRATION, U.S. DEPARTMENT OF TRANSPORTATION**

Ms. SHEPHERD. Chairman Wu, Ranking Member Gingrey, and Members of the Subcommittee, thank you for the opportunity to testify today about the Federal Highway Administration's efforts to advance environmentally sensitive transportation infrastructure.

I am pleased to have the opportunity to testify about ways in which FHWA is advancing a shift in the focus of the highway community from simply mitigating environmental impacts to proactively contributing to environmental enhancements. To fulfill this responsibility, we work closely with our partners at the federal, State, and local levels to provide coordinated national research, and to deliver research results through training, and technical assistance.

Minimizing damage from and mitigating negative impacts of transportation facilities on the human and natural environment are always significant considerations for every federal-aid funded highway project, from the initial planning and project development throughout the design, construction, operation, and maintenance stages. Our State partners are learning from experiences that introducing environmentally sound technologies and construction considerations early in the project development process can produce savings in costs and time, and can reduce future remediation expenses.

As more transportation environmental research is being undertaken by a diverse array of organizations, there is a growing need for organizational approaches to make the results more visible. FHWA participates in a variety of research coordination efforts, including the Surface Transportation Environment and Planning Cooperative Research Program, better known STEPCRP, our National Highway courses, our Local and Tribal Technical Assistance Programs, and through development of case studies to show case best practice and innovative techniques.

FHWA is also becoming an active participant in the Green Infrastructure Planning Workshops developed by a number of resource and regulatory agencies in cooperation with the Conservation Fund. We are a leading partner in the Mid-Atlantic Green Highway Partnership. FHWA is actively working with the interagency

teams of the Green Highway Partnerships in the area of stormwater runoff management, recycling, re-use of industrial by-product materials, and conservation and ecosystem management.

In our efforts to promote technologies that mitigate damage and impacts on environment from highway construction and operations, we have made the issue of managing highway stormwater runoff a particular focus. While highway runoffs may be a potential threat, there are a number of highly effective measures, structural and nonstructural, available to treat runoff before it actually reached any receiving waters.

Site-specific practices remain important treatment options, but we are increasingly focusing our practice and techniques that look at ecosystem level impacts. At selecting the most appropriate management practice, FHWA encourages states to study the amount of time, type of their highway runoff, and availability of land, and the physical characteristics on the site before designing any control strategies for a specific area.

One challenge that is facing us, as we work to expand acceptance in the use of environmentally sensitive technologies, is the lack of a sufficient track record illustrating the costs versus the benefits of various technologies. The business case has to be made that new transportation technologies can be utilized safely in an environmentally sensitive manner. Context-sensitive solutions that fully integrate safety into the project development process can assure both environmental and highway safety benefits.

When appropriately applied, green transportation technologies and practices, such as highway infrastructure to mitigate stormwater runoff, beneficial re-use of industrial byproduct materials, and context-sensitive solutions not only help to avoid or mitigate negative environmental impacts of highway constructions, but can produce safety enhancements and economic savings as well.

Mr. Chairman, Members, thank you for the opportunity to testify. I would be pleased to answer any questions that you may have.

[The prepared statement of Ms. Shepherd follows:]

PREPARED STATEMENT OF GLORIA M. SHEPHERD

Chairman Wu, Ranking Member Gingrey, and Members of the Subcommittee, thank you for the opportunity to testify today about the Federal Highway Administration's (FHWA) efforts to advance environmentally sensitive transportation infrastructure. FHWA is fostering a continued shift in the focus of the highway community from simply mitigating environmental impacts to actively contributing to environmental improvements. In fulfilling this responsibility, we work closely with our partners at the federal, State, and local levels to provide a coordinated national research agenda and deliver research results through training and technical assistance

Following the direction provided by the *National Environmental Policy Act* (NEPA), FHWA and the State departments of transportation (DOTs) have become proactive partners in the environmental area. The *Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users* (SAFETEA–LU) expanded the focus of environmental considerations from project development, construction, and operations, to the area of transportation planning. SAFETEA–LU also contains a number of provisions to improve coordination between transportation and resource agencies. Minimizing damage from, and mitigating negative impacts of, transportation facilities on the human and natural environments are always significant considerations for every federal-aid funded highway project, from the initial planning and design stages, through development and construction, to operation and maintenance.

Our State partners are learning from experience that introducing environmentally sound technologies and construction practices early in project development can produce savings in costs and in time to completion, and can reduce future remediation expenses. FHWA and its partners have made substantial contributions to the natural environment and to communities, through planning and programs that support context sensitive solutions, stormwater management, beneficial re-use of industrial byproducts materials, wetland banking, habitat restoration, historic preservation, air quality improvements, bicycle and pedestrian facilities, wildlife crossings, and public and tribal government involvement in transportation project development.

FHWA will continue to support these programs while it also works with State, local, and federal partners to conduct sound environmental reviews in a timely way. With prompt decision-making, we routinely reduce project cost escalation, ease congestion, and deliver the transportation and safety improvements that the American public expects.

**Research Programs for Environmentally Sound Practices and Technologies**

Working with its partners, FHWA supports a research and technology program that is focused on developing and implementing an environmentally sensitive transportation program.

*State Planning and Research (SP&R) Program.* Section 505 of title 23, United States Code, requires that states set aside two percent of the apportionments from the Interstate Maintenance, National Highway System, Surface Transportation, Highway Safety Improvement, Highway Bridge, Congestion Mitigation and Air Quality Improvement, and Equity Bonus programs for State planning and research activities. Of this amount, states must allocate 25 percent for research, development, and technology, unless the state certifies that transportation planning expenditures will require more than 75 percent of the amount set aside. In fiscal year 2006, the set aside amounted to almost $600 million and, thus, provided almost $150 million for the State Planning and Research (SP&R) Program. SP&R-funded activities involve researching new areas of knowledge, adapting findings to practical applications by developing new technologies, transferring the technologies, and training the users of the technologies.

The SP&R Program is intended to solve problems identified by the states. State DOTs are encouraged to establish research, development, and training programs that anticipate and address transportation concerns before they become critical problems. Each state must implement a program that ensures effective use of available SP&R funds on a statewide basis, and each state is permitted to tailor its program to meet local needs. High priority is given to applied research on State or regional problems, transfer of technology from researcher to user, and research for setting standards and specifications. Major research and development areas include infrastructure renewal (including pavement, structures, and asset management); activities relating to safety, operations, and management; environmental and real estate planning; and policy analysis and systems monitoring.

State DOTs have used SP&R funds for substantial research into regional stormwater issues and development of best management practices suitable for the particular issues in that locality or state. An example of ongoing research related to stormwater at the State level is an "Investigation of Stormwater Quality Improvements Utilizing Permeable Pavement and/or Porous Friction Courses," which is being sponsored by the Texas DOT using SP&R funds.

*Surface Transportation Environment and Planning Cooperative Research Program (STEP).* At the national level, FHWA currently administers environment and planning research funds under the STEP program created by SAFETEA–LU in section 5207. STEP is intended to improve understanding of the complex relationship between surface transportation, planning, and the environment. The program is authorized at $16.875 million per year for fiscal years 2006 through 2009.

Current initiatives propose research in areas related to planning, air quality, noise abatement, wetlands, vegetation management, wildlife connectivity, brownfields, and stormwater. Some specific stormwater initiatives are the International Storm Water Best Management Practices Database, Evaluation and Update of FHWA Pollutant Loadings Model for Highway Stormwater Runoff, and Synthesis on the Fate and Effects of Chloride from Road Salt Applied to Highways for Deicing. Other proposed research would examine tools such as Geographic Information Systems (GIS) and Global Positioning Systems (GPS) to better map important ecosystem features, including wildlife corridors and invasive plants, to improve our ability to recognize and address environmental concerns very early in the process of planning a project.

*Center for Environmental Excellence.* In section 5309, SAFETEA–LU authorizes $1.25 million per year for fiscal years 2006 through 2009 to establish a Center for Environmental Excellence to provide technical assistance, information sharing of best practices, and training in the use of tools and decision-making processes that can assist states in planning and delivering environmentally sound surface transportation projects. FHWA is currently reviewing proposals from universities and expects to announce the establishment of the new Center for Excellence shortly.

*Infrastructure Research and Technology.* FHWA's infrastructure research and technology programs also pursue initiatives with potential environmental benefits, including:

- Cantilever construction of bridges, which keeps construction equipment out of the waterway.
- Prefabricated technologies for construction and repair of infrastructure (bridges and pavements) and other accelerated construction technologies which reduce environmental impacts by (a) moving much of the construction process to controlled environments and (b) reducing the duration of damaging activities.
- "Warm mix" technology for asphalt paving which reduces the temperature at which asphalt paving materials are manufactured and placed, thereby reducing both emissions and fuel consumption. This technology also has the potential to increase the amount of recycled asphalt pavement that can be effectively used in the paving mixture.

FHWA promotes and supports the use of recycled materials in highway construction and, through our contractor, the Recycled Materials Resource Center, currently at the University of New Hampshire, we are making changes in the extent of use of several industrial by-product materials in highway construction. FHWA also has an active Recycling Team that works with the states, the Environmental Protection Agency (EPA), and industry to implement recycling technology.

Funding for these initiatives comes from several sources, including the Innovative Pavement Research and Deployment Program and the Innovative Bridge Research and Deployment Program. The Highways for LIFE program will also contribute to implementation of these technologies.

**Research Coordination, Training and Technical Assistance, and Partnerships**

*Coordination.* As more transportation and environmental research is being undertaken by a diverse array of organizations, there is a growing need for organized approaches that support well-crafted research agendas. FHWA hosts, funds, or participates in various research coordination efforts. FHWA's STEP program is a cooperative research program, and stakeholders were extensively engaged in defining the research agenda and identifying focus areas and projects. In addition to FHWA's STEP program, National and State-level research programs of particular interest to State DOT transportation and environmental practitioners include the Strategic Highway Research Program Two (SHRP–2) led by the Transportation Research Board (TRB); the National Cooperative Highway Research Program (NCHRP) research programs, including the 25–25 research initiative, which provides funding for quick turnaround research by American Association of State Highway and Transportation Officials' (AASHTO) Standing Committee on Environment; individual State DOTs' research programs, which increasingly include environmental components that are often conducted in coordination with university partners; and university research, particularly practitioner-oriented research conducted by University Transportation Centers around the Nation that receive funding authorized under SAFETEA–LU.

An additional key area of investment is the AASHTO Center for Environmental Excellence Transportation Environmental Research Ideas (TERI) Database. TERI is a dynamic tool that helps practitioners keep track of and prioritize constantly evolving transportation and environmental research needs.

*Training and Technical Assistance.* Important components of a coordinated research agenda are training and technical assistance. FHWA is working with our partners at all levels to share research results and promote environmentally sound practices.

The FHWA's National Highway Institute (NHI) has developed courses addressing environmental issues associated with infrastructure construction, operation, and maintenance, including a number of courses relating to water quality and runoff. Development of courses in these areas is coordinated with the appropriate federal agencies—most often EPA, the United States Army Corps of Engineers, and the United States Fish and Wildlife Service (USFWS)—and with representatives of

State DOTs. Courses include "Design and Implementation of Erosion and Sediment Control," "Water Quality Management of Highway Runoff, and "Managing Road Impacts on Stream Ecosystems: An Interdisciplinary Approach." Attached to this statement is a summary of research related to stormwater runoff, directly carried out, funded, or supported by FHWA, which provides additional information on these courses. (See Attachment—"Status of Current FHWA Water Quality Research.")

FHWA will be developing a NHI short course entitled "Environmental Factors of Construction and Maintenance." The course is intended to familiarize construction teams with environmental concerns to be addressed as part of construction and maintenance operations. The scope of work for the training has been prepared, and a request for proposals will be issued shortly. This is the latest of several courses developed and offered by FHWA's NHI relating to water quality and runoff. The Attachment also includes additional information on this course.

Technical assistance is also available through FHWA's Resource Center technical teams and through the Local Technical Assistance Program (LTAP) and Tribal Technical Assistance Program (TTAP). The latter two organizations represent 58 centers that work directly with local agencies to transfer technology and train practitioners at city, town, county, and tribal levels.

In addition, FHWA has developed case studies to showcase best practices or innovative techniques. Transportation enhancement funds have often been used for projects that improve the quality of highway stormwater runoff. The Sebago Lake-Route 35 Environmental Mitigation in Standish, Maine; the Santa Monica Urban Runoff Recycling Facility; and the Rock Creek Watershed Restoration, Montgomery County, Maryland, are three examples of such projects showcased on our transportation enhancements website.

We also showcase important water quality improvement projects or mitigation measures in our Environmental Excellence Awards Program and our Exemplary Ecosystem Initiatives. An example is the Berthoud Pass Mountain Access Project in Colorado. This project received the 2005 Environmental Excellence Award for Roadside Resource Management and Maintenance. Prior to this project, the sediment and de-icing materials needed for safety considerations on U.S. Highway 40, as it passed through the mountains in northwest Colorado, were pushed into the forest floor causing streams to fill up and clogging pipes. Now, when Colorado DOT maintenance crews plow the highway in the winter, snow and sand travel through a sophisticated system of culverts and ditches to collect in a strategically placed concrete storage basin. Once in the basins, the sand is allowed to settle out and clean water is released into the watershed below the highway. Colorado DOT crews then recover the sand from sloped access ramps, and the process begins again.

*Partnerships.* FHWA has actively supported a multi-agency effort to develop a non-prescriptive approach to making infrastructure more sensitive to wildlife and ecosystems through greater agency cooperative conservation. The collaborative ecosystem approach to transportation development is described in "Eco-Logical: an Ecosystem Approach to Developing Infrastructure Projects." FHWA currently has dedicated $1 million for grants to transportation agencies, local governments, non-governmental organizations, and others to advance pilot projects based on Eco-Logical and integrated planning principles. Integrated planning is a process for the collection, sharing, analysis, and presentation of data contained in agencies' plans—conservation, watershed, historic preservation, transportation, and others—to more comprehensively address the multiple needs of an area. The solicitation for these grants is expected to be posted at *http://www.grants.gov/* and several FHWA websites in the next few days.

National Partnerships are also being promoted through workshops on Linking Conservation and Transportation Planning and Project Development. Pilot workshops were held last year in Arizona, Colorado, and Arkansas. The workshop content is being updated and workshops will be offered again in fiscal year 2008. The purposes of the workshops are to (1) facilitate the exchange of ideas, concepts, and methods for better collaboration between transportation and conservation planning practitioners and (2) promote the sharing of conservation and transportation geospatial data, methodologies, and tools to advance planning, environmental stewardship, and streamlining goals. The primary audience for the training will be conservation and transportation planning and project review/development staffs at the federal, State, regional, and local levels.

FHWA is also becoming an active participant in the Green Infrastructure Planning Workshops developed by a number of resource and regulatory agencies in cooperation with the Conservation Fund. Green infrastructure relates to a strategic approach to conservation that promotes planning, protection, restoration, and long-term management that is proactive, systematic, holistic, multi-functional, and science-based. Green Infrastructure workshops approach transportation planning as

a way of promoting integrated planning principles. FHWA has provided funding support for Green Infrastructure Workshops held recently in Anchorage, Alaska, and Colorado Springs, Colorado.

FHWA has been a leading partner in the Mid-Atlantic Green Highways Partnership (GHP). The GHP is a public-private initiative that seeks to revolutionize the manner in which our nation's transportation infrastructure is planned and constructed. The GHP promotes integrated planning, regulatory flexibility, and market-based rewards. The GHP provides State DOTs an opportunity to highlight good environmental practices already underway and encourages additional innovations.

FHWA has contributed significant resources towards the partnership including staff time, monetary commitments, and technological expertise. Recently, FHWA and EPA co-founded a Green Highways Partnership grant for innovative watershed management projects within the Anacostia Watershed. The grant, announced on Earth Day 2006, awarded a total of $1 million to three different groups working on projects designed to protect and restore urban water resources through a holistic watershed approach to managing water quality. The grant supports Low Impact Development and restoration work in the Anacostia River watershed. This partnership represents significant leveraging of public, private, and non-profit resources, while playing a pivotal role in advancing environmental results; safe, sustainable transportation systems; and economic competitiveness in and around the Anacostia watershed in D.C. and Maryland.

Another recent event was a GHP workshop with Maryland that reviewed a project in the early Environmental Impact Statement stage to discuss stormwater management, conservation practices, and recycle/re-use of industrial byproducts, with a focus on what can then be used in the construction plans for the project.

In addition to work on stormwater runoff management, FHWA is collaborating with the multi-disciplinary, interagency teams of the GHP in the following areas:

*Recycling and Reuse.* Recycling of industrial byproducts and their re-use as materials for infrastructure construction can not only reduce a wide range of environmental impacts (conserve landfill, reduce water/air pollution, reduce greenhouse gases), but can also save energy, money, and conserve non-renewable resources. The GHP recycling and re-use team has a number of efforts underway, primarily to overcome informational barriers. After identifying and evaluating existing environmental regulations and construction/material specifications, the team will develop guidance documents for State and local agencies on the best methods and specifications for the use of industrial byproduct materials in road and bridge construction. The team will also produce a comprehensive toolkit that provides technical information and guidance to help DOTs and regulatory agencies overcome barriers.

Another GHP priority is to highlight existing State DOT projects that optimize the beneficial re-use of industrial byproducts. An example of a project that has been showcased through the GHP is the Tarrtown Bridge in Pennsylvania, where the Pennsylvania DOT used shredded tires as lightweight embankment fill on two bridge approaches. The project incorporated approximately 780,000 scrap tires, thereby easing the load on landfills.

In West Virginia, the State DOT is using recycled blast furnace slag as the aggregate of choice in the western part of the state for the majority of the asphalt surface course pavements. The effort results in a safer pavement due to the aggregate's non-polishing properties (higher friction number). Further, recycling blast furnace slag, when available locally, offers an economic advantage compared with using virgin limestone aggregate.

These are just two examples of the various industrial byproduct materials that FHWA is actively promoting for re-use in highway and bridge construction. As noted above, the Recycled Materials Resource Center mission is to conduct research to insure that the use of recycled materials does not have a negative impact on the environment and to provide technical information to State and local agencies on the proper re-use of the materials.

*Conservation and Ecosystem Management (principles and practices).* The conservation and ecosystem management team within the GHP focuses on bringing advances in mapping and data management together with various initiatives in conservation and ecosystem management to achieve greener highways. The data and regulatory managers are working to gain agreement on how to develop a set of tailored, core data-sets and maps that can be integrated at both the transportation project and planning levels. The maps will facilitate information sharing at the federal, State, metropolitan planning organization, and local levels, and will facilitate the integration of conservation and ecosystem management practices into land-use planning. Priority areas for conservation will emerge from the development of a regional ecosystem framework.

The Green Highways Partnership represents the next logical step in the evolution of EPA, FHWA, and Mid-Atlantic State DOT efforts in environmental streamlining and stewardship.

**Management of Highway Stormwater Runoff**

FHWA has made the issue of managing stormwater runoff a particular focus in its efforts to promote technologies that mitigate damage and impacts to the environment from highway construction and operation.

Highway stormwater runoff, as part of development and urbanization, is a potential source of a wide variety of possible pollutants to surrounding water bodies. Highway surfaces, along with adjoining areas, collect a variety of materials as a result of highway usage, maintenance, natural conditions, and pollution fallout. While highway runoff may be a potential threat to receiving waters, if handled properly the runoff does not have to be a serious problem.

There are a number of highly effective measures available to treat the runoff before it actually reaches any receiving waters. Site-specific practices remain important treatment options, but a changing management style has also embraced the practice of planning at the watershed and sub-basin scales. Best management practices are no longer driven only by water-quality criteria. We are not looking only at "end of the pipe" treatment technologies but, increasingly, are focusing on practices and techniques that look at ecosystem-level impacts and stressors, such as conserving ecosystems, maintaining natural drainage courses, and minimizing cleared and graded area.

FHWA researches and showcases the various best management practices for managing stormwater runoff from highway projects. These best management practices can generally be categorized as "structural" or "non-structural."

*Structural* best management practices consist of infiltration technologies, detention, retention, vegetative practices, filtering systems, and porous pavements. Structural best management practices operate by physically trapping runoff until contaminants settle out or are filtered through the underlying soils. They work through gravity settling the constituents, the infiltration of soluble nutrients through the soil or filters, or other biological and chemical processes.

Stormwater management innovations are underway throughout the mid-Atlantic region, where urbanized areas are particularly challenging. In 2004 in Washington, D.C., the District Department of Transportation installed a biocell for stormwater management at Benning Road Bridge. A biocell is composed of natural materials such as mulch, soil mix, and various types of vegetation. Rather than require an engineered structure like a weir or drainage pit, a biocell acts like a filtration trench, where the soil or natural drainage materials filter the water. A biocell can remove up to 90 percent of the suspended solids from stormwater. This project represented the first use of low-impact stormwater management technology by the District government.

The *non-structural* best management practices deal mainly with source controls such as land use planning, street sweeping, fertilizer application controls, reduced mowing, and litter removal from roads and roadside areas. These methods help reduce the initial concentration and accumulation of contaminants in the stormwater runoff. Non-structural controls can reduce the need for structural controls.

Many states, including Oregon, have implemented a requirement that any engineered stormwater facility, such as detention, treatment, pumping, or infiltration, must be accompanied by a site specific "Operation & Maintenance" manual. This manual is necessary to ensure the agreements and assumptions made during the water resources analysis conducted during the NEPA environmental review process are fulfilled for the life of the facility. The manual is provided to the people responsible for the long-term maintenance of the facility.

FHWA's promotion and technical support for more environmentally sensitive use of de-icing agents and chemicals, as well as abrasion use for winter road maintenance activities, is saving operating budgets and increasing roadway asset service life, with less impact on the roadside environment. We find a similar payoff for improvements in summer work managing the roadsides using improved herbicide and pesticide application and control.

In selecting the most appropriate best management practice, careful consideration must be given to the expected amount of runoff, the type and amount of contaminants, the availability of land, and the physical characteristics of the site. Some best management practices can operate in any weather conditions, while others cannot. Where there is limited space, certain of the structural practices may not be reasonable or feasible, while the non-structural practices can be implemented effectively anywhere.

FHWA encourages all states to study the quality of the highway runoff and its properties before implementing or designing any control treatment strategies for a specific area. Given that every watershed is different, a one-size fits all approach could result in spending funds for unnecessary or inappropriate treatment. We encourage early study by providing funding for mitigation of impacts associated with federal-aid highway projects, including stormwater control, technical assistance, training, and research assistance to State and local transportation staff.

See the Attachment to this statement for a status report on research, training, and publications related to stormwater runoff, being carried out, funded, or supported by FHWA.

**Obstacles to Implementation of Environmentally-Sensitive Technologies**

The permitting program under the *Clean Water Act,* regulating discharges to waters of the United States, addresses stormwater discharges associated with urban areas and certain industrial activities, and includes transportation facilities. Because of a lack of monitoring information, scientific analysis, and third-party evaluations, it may be difficult for new and innovative technologies to demonstrate significant water quality treatment to satisfy regulatory agencies. For example, the EPA's Environmental Technology Verification Program approves innovative treatment technologies through performance verification and dissemination of information. Some State regulatory agencies have similar programs. While these programs are beginning to test and approve innovative technologies in their region, many technologies are still being tested, thus the level of acceptance by the regulatory agency for meeting permitting requirements may be limited, even if the technology theoretically demonstrates the necessary ability to meet the requirements.

Lack of a sound track record regarding the costs versus the benefits of a particular technology also can be a problem. The business case has to be made for why a new technology is promising for both the environment and transportation. Life cycle information from existing infrastructure construction will help inform future decisions.

Of course safety and engineering considerations must always be balanced with environmental benefits. However, safety and environmentally sensitive technologies can be compatible. Context Sensitive Solutions that fully integrate safety into the project development process ensure that both the environment and highway safety benefit. For example, properly designed landscaping can ensure adequate sight distances for drivers, avoid deadly fixed object hazards, and maintain the ability of drivers and pedestrians to see each other. Water quality and highway safety can both be improved with gently sloping clear zones that allow errant motorists to regain control of their vehicles and reduce the risk of fixed-object crashes. These clear zones also allow highway runoff to be filtered or absorbed before entering waterways.

**Conclusion**

When appropriately applied, "green" transportation technologies and practices, such as use of highway infrastructure to mitigate stormwater runoff, beneficial reuse of industrial byproduct materials, and context sensitive solutions, not only yield significant benefits for avoiding or mitigating negative environmental impacts of highway construction, but can produce safety enhancements and economic savings as well. Ongoing research, transfer of technologies and best practices, and new partnerships are providing states and tribal governments more knowledge and tools to address such issues as stormwater runoff control. A heightened focus on integrated planning should help ensure that potential environmental impacts are identified and addressed early in the project development process.

Mr. Chairman, Members, thank you for this opportunity to testify. I will be pleased to answer any questions you may have.

**ATTACHMENT**

## Status of Current FHWA Water Quality Research

http://www.fhwa.dot.gov/environment/natural.htm

5/10/2007

### I. Research Projects

*Project:* **International Stormwater BMP Database**

*Contractor:* Wright Water Engineers, Inc., and GeoSyntec Consultants

*Purpose of Work:* Water Environment Research Foundation, American Society of Civil Engineers-Environmental and Water Resources Institute, United States Environmental Protection Agency, Federal Highway Administration and American Public Works Association have formed a coalition of organizations to fund and manage the International Stormwater Best Management Practices (BMP) Database. The work will consist of entering currently available and newly developed data sets, keeping the web site and database up to date, providing data analysis and developing protocols for integrating low impact development techniques into the database.

*Status:* The work is ongoing and the database is currently accessible through the web site at *http://www.bmpdatabase.org.*

*Project:* **Evaluation and Update of FHWA Pollutant Loadings Model for Highway Stormwater Runoff**

*Contractor:* U.S. Geological Survey, Reston, Virginia

*Purpose of Work:* The Federal Highway Administration and the U.S. Geological Survey are cooperating on a national project to evaluate the existing highway stormwater runoff model and update the model using new information and software. This work will incorporate the existing model in a new software platform, provide information on the probability distributions of: precipitation characteristics, highway-runoff-volumes, highway-runoff concentrations, upstream flow, upstream receiving-water concentrations, and structural best management practice performance. This information will be used to estimate the probability of concentration and loads in receiving waters downstream of the highway outfall and it will estimate the probability of the outfall exceeding water quality standards.

*Status:* The model is in preparation. Information on this project can be found at: *http://ma.water.usgs.gov/fhwa/,* along with the 1990 FHWA Pollutant Loadings Model for Highway Stormwater Runoff.

*Project:* **State Transportation Agency Strategies to Address NPDES Phase II Requirements, NCHRP 25–25(16)**

*Contractor:* Venner Consulting, GeoSyntec, and Parsons Brinckerhoff

*Purpose of Work:* The research will focus on determining how State transportation agencies have addressed compliance with National Pollutant Discharge Elimination System (NPDES) Phase II requirements. Research will be directed toward determining staffing and organizational structure throughout the entire agency to address NPDES Phase II compliance for construction activities as well as the stormwater management program as a regulated Municipal Separate Storm Sewer System (MS4).

*Status:* The final draft report was submitted in November 2006 and the consultant is addressing comments from the review panel. The final report should be published soon.

*Project:* **Water Quality Analyses for NEPA Documents: Selecting Appropriate Methodologies, NCHRP 25–25(35)**

*Contractor:* Parsons, Brinckerhoff, Quade & Douglas, Inc.

*Purpose of Work:* The *National Environmental Protection Act* (NEPA) requires that sponsors of transportation projects consider the impacts of those projects on water quality and water resources. There are numerous methodologies available to perform these analyses; however, there is little or no guidance on selecting the most effective analytical tool for the particular information being presented for NEPA documentation. Some methods developed by the EPA and FHWA may be more suited for detailed project level analysis and some better suited for planning level studies and watershed-based analyses. The objective of this study is to identify those

water quality analysis methodologies that are best suited for detailed project-level impact assessment for NEPA documents.

*Status:* The research started in December 2006, and will be concluded in the fall of 2007.

*Project:* **Quantifying the Components of Impervious Surfaces**

*Contractor:* U.S. Geological Survey

*Purpose of Work:* The purpose of this research is to determine, using existing land use, land cover, and impervious surface data, the individual contribution of the various components to impervious surfaces, to the overall storm water runoff issue. Preliminary results of this report for six case studies (Washington, Virginia, Nebraska, Iowa, Florida) shows that the percentage of impervious cover contributions from road surfaces in these studies varied between 20–35 percent. Generally roads were at 28 percent, buildings at 29 percent, and parking lots at 25 percent for total impervious areas in a watershed. As the watershed becomes more developed and the impervious surfaces increase, the contribution from the road surfaces decreases.

*Status:* Final report can be found on the web at: *http://pubs.usgs.gov/of/2007/1008/*.

*Project:* **Guidelines for the Selection of Snow and Ice Control Materials to Mitigate Environmental Impacts, NCHRP Project 6–16**

*Contractor:* Levelton Consultants, Ltd.

*Purpose of Work:* Every year considerable quantities of snow and ice control products are applied to highways. This application involves a balancing act of maintaining safety and applying what is needed without causing environmental impacts. This project is looking at a way to define the selection of winter maintenance materials based on their environmental impact. They will be looking at the most common chemical alternatives such as sodium chloride, magnesium chloride, calcium chloride, calcium magnesium acetate, potassium acetate, etc. This project will develop guidelines for selection of snow and ice control chemicals and abrasives, based on their constituents, performance, environmental impacts, cost, and site-specific conditions. Investigators will look at the environmental impacts of the effects on human health, aquatic life, flora and fauna, surface-water and groundwater quality, air quality, vehicles, and physical infrastructure including bridges, pavements, railway electronic signaling systems, and power distribution lines. In the past, transportation departments have focused on performance and cost under various weather conditions without evaluating their relative impacts on the environment.

*Status:* The final report is available upon request from NCHPR.

## II. State Planning and Research Funds

The *Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users* (SAFETEA–LU) requires that states set aside two percent of the apportionments they receive from the Interstate Maintenance, National Highway System, Surface Transportation, Highway Safety Improvement, Highway Bridge, Congestion Mitigation and Air Quality Improvement, and Equity Bonus programs for State planning and research activities. Of this amount, states must allocate 25 percent for research, development, and technology (RD&T), unless the state certifies and the Secretary accepts the certification, that transportation planning expenditures will require more than 75 percent of the earmarked amount. These activities involve research on new areas of knowledge; adapting findings to practical applications by developing new technologies; and the transfer of these technologies, including the process of dissemination, demonstration, training, and adoption of innovations by users.

The State Planning and Research (SP&R) Program is intended to address problems identified by the states. State Departments of Transportation are encouraged to develop, establish, and implement RD&T programs that anticipate and address transportation concerns before they become critical problems. Each state must develop, establish, and implement a program that ensures effective use of available SP&R funds for RD&T activities on a statewide basis, and each state is permitted to tailor its RD&T program to meet local needs. High priority is given to applied research on State or regional problems, transfer of technology from researcher to user, and research for setting standards and specifications. Major RD&T areas include infrastructure renewal (including pavement, structures, and asset management); activities relating to safety, operations, and management; environmental and real estate planning; and policy analysis and systems monitoring.

**III. Available Reports and Publications:**

**Evaluation of Best Management Practices for Highway Runoff Control, 2006, NCHRP Report 565, Project 25–20(1)**

This report focuses on improving the scientific and technical knowledge base for the selection of best management practices (BMP) through a better understanding of BMP performance and application. This report documents an extensive program of research on the characterization of BMPs and stormwater, and the influence of factors such as land use practice, hydraulic characteristics, regional factors, and performance evaluation. In addition to the report, a CD is affixed to the back cover containing three additional volumes and a spreadsheet model. The additional volumes are: User's Guide for BMP/LID Selection, Appendices to the User's Guide, and Low Impact Development Design Manual for Highway Runoff Control.

**Great Lakes Initiative—Stormwater Workshop Report**

The Great Lakes Regional Collaboration was initiated by Executive Order (EO) 13340, issued in May 2004. This EO acknowledged the national significance of the Great Lakes and created a unique partnership of key members from Federal, State, and local governments, tribes and others for the purpose of developing a strategic plan to restore and protect the Great Lakes ecosystem. EO 13340 set up a Federal Interagency Task Force and a Regional Working Group. On December 12, 2005, the Great Lakes Interagency Task Force met to reinforce and demonstrate commitment and collaborative efforts to promote further work and progress in the Great Lakes area. The task force identified existing federal programs that will support Great Lakes ecosystem restoration and developed a list of action items. From this meeting in December, the Federal Highway Administration committed to convene a gathering of Great Lakes State DOTs to collaborate, share information, build contacts, examine issues, and develop strategies for dealing with stormwater runoff in the Great Lakes region. The workshop was held in August 2006 and report was issued on the results of this workshop. Copy of the report can be requested by calling 202–366–4085.

**Eco-Logical (2006)**

Eco-Logical is a guide or process for a comprehensive management approach that federal, State, and local partners can use to get involved in infrastructure, planning, design, review, and the construction of projects to work more efficiently and effectively together. The process integrates infrastructure development with ecosystem management to advance project approvals with conservation and sustainable land development practices. The guide is available on-line at: *http://environment.fhwa.dot.gov/ecological/ecological.pdf.*

**Environmental Stewardship Practices, Policies, and Procedures for Road Construction and Maintenance (2005)**

This report developed a compendium of environmental stewardship practices, policies, and procedures in areas of construction and maintenance. This manual can be downloaded at: *http://www.environment.transportation.org/center/products_programs/environmental—stewardship.aspx.*

**Common Native Roadside Wildflowers (2005)**

This field guide highlights 100 native forbs and grasses commonly found on highway rights-of-way in Western America. All are native to the United States and do not include plants that have been naturalized.

**The Nature of Roadsides and the Tools to Work with It—2003**

This publication discusses the various tools available for right-of-way managers. Highway corridors crisscross our nation and the management of these acres of land is complicated by many uses: recovery zone for errant vehicles, utility lines, snow storage, open space, wetland mitigation, wildlife corridors, greenways, signage, and biodiversity. This publication discusses some of the methods and tools available to protect and manage the beauty and value of our roadside biota.

**The National Highway Runoff Data and Methodology Synthesis—2003**

**Volume I:** Technical Issues for Monitoring Highway Runoff and Urban Stormwater

**Volume II:** Project Documentation with CD based bibliographic database of reports

**Volume III:** Availability and Documentation of Published Information for Synthesis of Regional or National Highway Runoff Quality Data

This report evaluates the existing highway runoff quality data to determine if the quality and processes contributing to water quality constituents in highway runoff can be adequately characterized on a nationwide basis to fulfill the information needs of highway practitioners. Results are also available through the internet at: *http://ma.water.usgs.gov/FHWA/*.

**Common Roadside Wildflowers (2003)**

This field guide highlights 100 native forbs and grasses commonly found on highway rights-of-way and other natural areas across Eastern America. State Departments of Transportation are encouraging their use for many reasons: their natural beauty, adaptation to arid environments, usefulness to wildlife, addition to biodiversity and land health, ability to slow water runoff, and slope stabilization.

**Aquatic Ecology and Stream Restoration Video—Fall 2003**

This video showcases six stream restoration case studies from across the Nation and promotes the importance of restoring our streams after road construction. This project documents examples of a nationwide effort on stream restoration showing the appropriate designs and techniques for stream relocation, fish and wildlife habitat preservation, and methods to improve the water quality while providing safe, efficient roadways. The series of videos has been developed by North Carolina Department of Transportation for Federal Highway Administration and is now available and a copy can be obtained by calling 202–366–2054.

**Keeping It Simple—Easy Ways to Help Wildlife Along Roads (2003)**

This brochure highlights more than 100 simple, successful activities that help make roads more wildlife friendly, from all 50 states. These success stories are also available at our web site: *www.fhwa.dot.gov/environment/wildlifeprotection.* The web site allows users to search by State and by category, and it provides contact information for sending new "keeping it simple" success stories to be added to the site.

**Assessing the Impacts of Bridge Deck Runoff Contaminants in Receiving Waters—2002, NCHRP Report 474, Volume 1: Final Report, Volume 2: Practitioner's Handbook**

This report presents guidance for assessing and, if necessary, mitigating the impacts of bridge deck runoff. The final report includes findings of the literature review and a survey of highway agency practices, consultation and testing of sites. The second volume or practitioner's handbook presents the assessment process as a result of the final report.

**Wet Detention Pond Design for Highway Runoff Pollution Control**

The research developed a methodology for designing efficient wet detention ponds in the highway environment. The methodology included performance characteristics, design guidelines, conditions, limitations, and applications for use. A comparison was made between wet detention ponds and dry detention ponds in order to show the advantages and disadvantages of each system. The research is complete and the preliminary draft final report was submitted to the technical oversight panel for review. The unedited final report for NCHRP Project 25–12 as prepared by the University of Washington is available for loan by contacting NCHRP at *NCHRP@nas.edu.*

**Common Roadside Invasives (2002)**

This laminated field guide identifies common and showy roadside invasive grasses and forbs, all of which are on various State noxious weed lists. We provide this guide with the expectation that it will help roadside vegetation managers and maintenance personnel to identify and control invasive plants in their jurisdictions.

**Wildlife Habitat Connectivity Across European Highways—August 2002**

The Federal Highway Administration, American Association of State Highway and Transportation Officials, and the National Cooperative Highway Research Program sponsored an international technology scan to learn what actions are being taken in Europe to address habitat and wildlife issues. As a result of the trip, the team formed conclusions and recommendations for U.S. application in the areas of policy, communication, guidance manuals, and research. This publication is available from our Office of International Programs.

**Management of Runoff from Surface Transportation Facilities—Synthesis and Research Plan, 2001, NCHRP Web Document 37**

The final report has been posted at: *http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_w37.pdf.* The objectives of this research on the management of the quality and quantity of runoff waters from surface transportation facilities, was to (1) synthesize existing knowledge and practice into a form usable by practitioners; (2) develop a strategic research plan to address gaps in existing knowledge; and (3) recommend a system for continued exchange of information between practitioners and others interested in water-quality and runoff issues.

**Guidance Manual for Monitoring Highway Runoff Water Quality—June 2001**

The Federal Highway Administration contracted with URS Group, Inc., to conduct an evaluation of water quality monitoring equipment for measuring the constituents of highway stormwater runoff. Testing was done on the methodologies and use of these various monitoring and sampling equipment in the highway environment. The results are presented in this manual. This manual will assist State and local governments prepare highway stormwater monitoring programs based on monitoring goals. Guidance is provided to assist the user in not only selecting equipment, but also with highway stormwater runoff monitoring designs for a comprehensive plan. Recommendations and field evaluations are given for specific equipment and monitoring methods. The report provides recommendations on adaptations necessary for using available off-the-shelf equipment to improve the evaluation of stormwater runoff in the highway setting.

**Wetlands Data Reporting System—Spring 2001**

The FHWA has developed the Wetlands Accounting Database for collecting and analyzing wetland mitigation data. The database is designed to accumulate data about wetlands mitigation projects. It collects, correlates, and presents this data as useful and meaningful information. The CD-based software is available upon request.

**Case Histories of Wetland Restoration—December 2000**

This report highlights four wetland restoration projects from regionally different areas within the United States. These studies show that restoration can result in highly successful ecological communities that are similar in structure and function to the natural ones. The goals, objectives, and criteria for restoration should be established in relation to the water regime of the drainage basin and ecosystem in which they lie. The four projects in this publication offer some insight into what elements lead to a successful restoration project. There is no single path, but certain elements and themes emerge from the examination of these projects.

**Environmental Impact of Construction and Repair Materials on Surface and Ground Waters—NCHRP 25–9—June 2000**

The CD–ROM based report presents a validated methodology for assessing the environmental impact of highway construction and repair materials on surface and ground water under six general highway reference environments. This methodology includes: (1) a set of comprehensive bioassay protocols that directly measure the toxicity of leachates from highway construction and repair materials on two target organisms, the water flea, Daphnia magna, and the freshwater algae, Selenastrum capricornutum, and (2) the IMPACT model that can estimate the fate and transport of such leachates in typical highway environments. The IMPACT model is based on an extensive database of bioassay toxicity results for materials ranging from common construction and repair products to waste and recycled materials proposed for use in highway construction.

**Stormwater Management Practices in an Ultra-Urban Setting: Selection and Monitoring—May 2000**

This report focuses on design criteria and monitoring studies on stormwater best management practices (BMPs) implemented in ultra-urban settings. The report provides planning level review of the applicability and use of new and more traditional BMPs in ultra-urban areas. The report provides specific guidance for selecting and siting stormwater management technologies. Case studies are used to highlight various examples throughout the country that address ultra-urban considerations.

**Critter Crossings—Linking Habitats and Reducing Roadkill—February 2000**

This brochure describes the transportation impacts on wildlife and highlights projects and processes that help to reduce these impacts.

**Roadside Use of Native Plants—September 1999**

This publication is for use in making site specific decisions. The primer provides a holistic background information for decision-making. It addresses basic techniques for using native plants. The State-by-State section pulls together native, endangered, and noxious plant lists to aid in design and management. The manual includes definitions, bibliographies, and policy citations to clarify the use of native plants on roadsides.

**Evaluation and Management of Highway Runoff Water Quality—June 1996**

This manual synthesizes the results of past documentation and research on highway stormwater runoff into a single-volume user's manual on water quality impact assessment and mitigation. It presents available and appropriate impact prediction and mitigation tools for use during highway project planning and development activities.

**IV. Training Courses, Workshops, and Award Programs**

**Design and Implementation of Erosion and Sediment Control—NHI Course #142054**

This NHI course was developed as a joint effort between FHWA and the EPA Office of Water. The course reflects the Agencies' commitment to providing education and training on planning, design, implementation, enforcement, inspection, and maintenance strategies to control erosion and sediment on highway construction projects, as well as to ensure that regulatory issues are addressed accurately and uniformly. Each discipline involved in a highway construction project has a different set of priorities. The course offers participants opportunities for discussion and joint problem-solving, through which they will gain information about the roles and responsibilities of other team members.

**Water Quality Management of Highway Runoff—NHI Course #142047**

This NHI course, developed with EPA Office of Water, provides an overview of the basic water quality parameters and processes, along with the requirements and guidance on best management practices the transportation community can use in mitigating highway runoff impacts and protecting water quality. This course shares approaches and technologies for the water quality management of highway runoff, including the effective maintenance, inspection and evaluation of Best Management Practices (BMPs).

**Managing Road Impacts on Stream Ecosystems: An Interdisciplinary Approach—NHI Course #142048**

This NHI course will introduce and discuss the basic concepts related to the impacts that roadways have on streams and stream ecosystems. The course will be structured to first address the ecological and physical characteristics of stream ecosystems, discuss the impacts that roadways can have on those ecosystems, and then look at tools that the practitioner can use to help avoid and mitigate those effects. Through the use of case studies, discussion, and other techniques, the participants will be afforded an opportunity to use critical thinking to identify solutions and preventative measures related to the impacts of roads on streams and their riparian communities. The course will be available at the end of the fiscal year 2007.

**International Conference on Ecology and Transportation—May 20–25, 2007 in Little Rock, Arkansas**

Multi-disciplinary, interagency event conducted biennially to identify and share quality research applications and best management practices that address wildlife, habitat, and ecosystem issues related to the delivery of surface transportation systems.

**2007 Environmental Excellence Awards**

These awards have been designed to recognize outstanding transportation projects, processes, and people who incorporate environmental stewardship into the planning and project development processes using FHWA funding sources. The winners will be recognized at our International Conference on Ecology and Transportation in Little Rock, Arkansas on May 20–25, 2007.

**Exemplary Ecosystem Initiatives (EEI)**

Since 2002, FHWA has designated 43 Exemplary Ecosystem Initiatives in 31 States. An EEI is an initiative that sustains or restores natural systems and their

functions and values. EEIs are developed within a landscape context, using partnering and collaborative approaches and the best available science in ecosystem and habitat conservation. All EEIs are posted on FHWA's web site at: *http://www.fhwa.dot.gov/environment/ecosystems/index.htm.*

**Alternative Practices for Highway Stormwater Management (2006)**

This previously aired four-part webcast series, which can be accessed on the Web at any time, was presented by the Izaak Walton League and sponsored by FHWA. The sessions outline the latest techniques available to help transportation agencies save money, comply with water quality and water supply regulations, and improve water quality with context-sensitive stormwater management practices, including low impact development techniques. These techniques also can help highway department personnel manage stormwater quantity and quality while using existing rights of way and providing easy access for maintenance crews. Each session includes valuable background information and specific guidance on how to apply these principles for highway projects. The series also addresses barriers to using innovative stormwater management techniques and how to overcome those barriers. This series provides valuable information to design engineers, planners, regulators, students, maintenance supervisors, construction engineers, and consultants. To view the archived Webcast, go to: *http://itre.ncsu.edu/cte/TechTransfer/Teleconferences/iwla2006.asp.*

**Environmental Factors of Construction and Maintenance (Under Development)**

FHWA is developing a training course on how to mitigate environmental impacts during construction and maintenance projects. The course is intended to familiarize State and contractor construction personnel with environmental concerns that should be addressed as part of construction operations. These concerns include construction noise, construction dust, light pollution from nighttime operations, vibration, alkali runoff from concrete pour/sawcut, emissions from equipment exhaust, disruption of species habitat or migration/ESA commitments, damage to archaeological or cultural resources, Stormwater Pollution Prevention Plan (SWPPP)-maintenance activities, and hazardous materials. We expect the course to be available sometime next year.

BIOGRAPHY FOR GLORIA M. SHEPHERD

Gloria M. Shepherd is the Associate Administrator for Planning, Environment and Realty, U.S. Department of Transportation, Federal Highway Administration (FHWA). She previously held the position as Director of Planning for the FHWA. She joined FHWA in 1999 having served previously as the Staff Director for the Transportation Solutions Group, Maryland Department of Transportation (MDOT) and the Deputy Director of the Office of Planning and Preliminary Engineering Maryland State Highway Administration, MDOT. She was previously Chief of Staff for the Commissioner of the New York State's Department of Transportation (NYS DOT).

She earned her Masters of Law degree from Georgetown University, Doctor of Jurisprudence degree from Albany Law School, and her Doctor of Arts from the University at Albany (SUNY).

Chairman WU. Thank you very much, Ms. Shepherd. Mr. Grumbles, welcome to the Committee.

## STATEMENT OF MR. BENJAMIN H. GRUMBLES, ASSISTANT ADMINISTRATOR FOR WATER, U.S. ENVIRONMENTAL PROTECTION AGENCY

Mr. GRUMBLES. Thank you very much Mr. Chairman, Congressman Gingrey, Congressman Ehlers, Congressman Baird. It is great to be back before this committee.

It is an honor and it is an even greater opportunity to discuss and to promote green infrastructure, for transportation and for healthier watersheds, as the wave of the future for this country as we look at the water and the transportation challenges.

I, too, will be brief and summarize my testimony, but the major point here is that the U.S. EPA, in collaboration with other agencies, such as the Federal Highways and also governmental and nongovernmental partners, are advancing this concept of green infrastructure like never before, because we see, through technology, innovation, and collaboration, it is a sustainable way forward to also accelerate environmental progress.

This is a very important part of our four pillars of sustainability. When it comes to infrastructure, and that pillar of a watershed approach, the Administrator's objective is to change the way America views and values infrastructure. The objective is to not "just" emphasize the critical importance of it but also find environmentally sensitive approaches. That is why we are so excited about green infrastructure. And in the transportation arena in particular, we are very enthused about the Green Highways Partnership. EPA Region 3 and the Federal Highways and many partners have been involved over the past couple years in an innovative collaboration. In this collaboration we pursue technologies; porous pavements and concrete; practical and protective wetlands strategies; and ways to address one of the fundamental challenges and concerns to watersheds across the country, and that is stormwater runoff, stormwater contamination. So, we are very enthused about green highways and green infrastructure transportation methods.

I want to just emphasize that for us, as you pointed out in your statement, the term itself is not a rigid definition. For us, green infrastructure is systems or practices that use or mimic natural processes to focus on vegetation, infiltration, evapotranspiration, reclamation, and re-use of excess stormwater.

In this watershed, where we are right now in the Capitol, in the Chesapeake Bay watershed, we know that over the last ten years, population has increased seven percent, and the amount of impervious surface has increased 41 percent. We know that has adverse environmental impacts. We are committed to working together with you and other committees, with colleagues outside of government, and with agencies to advance green infrastructure concepts.

What I want to mention as well is that the Agency has entered into some significant memoranda and agreements. One of them, on April 9, the Administrator of EPA entered into an agreement with the Natural Resources Defense Council, the National Association of Clean Water Agencies, the Low Impact Development Center, and also, the Association of State and Interstate Water Pollution Control Administrators to advance green infrastructure concepts, to use rain gardens and green roofs, to protect wetlands, to come up with innovative approaches and different types of concrete that help reduce concerns about stormwater pollution. And we are committed to following through on that important effort.

I too have also signaled to the various EPA Regions that green infrastructure is a priority for the National Water Program, and so, we are going to be taking advantage of your leadership in having this hearing and moving forward with approaches, ways to reduce barriers. Sometimes the barriers may be due to local regulation. Sometimes it is just due to people not understanding that they can have healthier watersheds and transportation systems by using these innovative technologies.

One thing I did also want to point out, that a very important effort that has been critical to EPA's interests in and approach on working with others on green infrastructure is the NRDC rooftops to rivers report. One of the greatest challenges in this country, in addition to stormwater runoff from transportation systems, is sewer overflows and stormwater pollution. And so, this report provides green strategies for controlling stormwater and combined sewer overflows, and it identifies various areas in the country, including Portland, Oregon and other cities, that are showing leadership.

So, Mr. Chairman, I look forward to answering questions that you and your colleagues have and to working with you to promote green infrastructure transportation and healthier watersheds across the country.

[The prepared statement of Mr. Grumbles follows:]

PREPARED STATEMENT OF BENJAMIN H. GRUMBLES

**I. Introduction**

Mr. Chairman and Members of the Subcommittee, I am Benjamin Grumbles, Assistant Administrator for Water at the United States Environmental Protection Agency (EPA). Thank you for inviting me to discuss EPA's programs and initiatives on green infrastructure, clean water, and healthy watersheds. I believe that there are many opportunities for green infrastructure practices to be applied to protect water quality and enhance our communities. States and thousands of communities and transportation agencies across the Nation face difficult challenges in meeting stormwater and sewer overflow regulatory requirements. Green infrastructure provides tools for these communities to meet regulatory requirements and non-regulatory needs in the context of broader community goals. EPA believes green infrastructure has great potential to advance environmental protection and economic prosperity through technology, innovation, and collaboration.

**II. What Is Green Infrastructure, and How Does It Help Protect Water Quality?**

"Green Infrastructure" is a relatively new and flexible term, and it has been used by various speakers and writers in various contexts. Thus, to date, there is no universally established definition of the term. In addition, several other terms are often used interchangeably with, or as aspects of, "green infrastructure," such as "low impact development (LID)" and "conservation development." In my remarks today, as well as in my March 5, 2007, memorandum *[see Attachment A]* entitled, "Using Green Infrastructure to Protect Water Quality in Stormwater, CSO, Nonpoint Source and other Water Programs," I have intended the term "green infrastructure" to generally refer to systems and practices that use or mimic natural processes to infiltrate, evapotranspirate (the return of water to the atmosphere either through evaporation or by plants), or re-use stormwater on the site where it is generated.

Green infrastructure encompasses a large set of specific practices. Typical techniques include literally green practices such as green roofs, rain gardens, and bioswales. However, the term is also often used to include other technologies, such as permeable concrete or rain barrels, that similarly promote the onsite infiltration, evapotranspiration, or re-use of stormwater. At EPA, we promote all such onsite practices and technologies under the green infrastructure umbrella.

Green infrastructure practices protect water quality primarily in two ways. First, they reduce the amount of pollutants that run off a site and ultimately are discharged into adjacent waterbodies. Second, they reduce or eliminate the water that runs off the site. Traditional development practices cover large areas of the ground with impervious surfaces such as roads, driveways, and buildings. The Center for Watershed Protection ("CWP") has classified our nation's development patterns as "habitat for cars, habitat for people, and habitat for nature." Once such development occurs, rainwater cannot infiltrate into the ground, but rather runs offsite at levels that are much higher than would naturally occur. The collective force of all such rainwater scours streams, erodes stream banks, and thereby causes large quantities of sediment and other entrained pollutants to enter the waterbody each time it rains. Green infrastructure techniques are designed to reduce such runoff through

infiltration, evapo-transpiration and re-use, thereby helping to protect the receiving streams as well as replenish ground-water supplies.

EPA believes that green infrastructure approaches and practices can be a significant component of states' and cities' programs to reduce and control stormwater, combined sewer overflows, and nonpoint source pollution. They can be used by communities to help meet requirements of their stormwater permits under the National Pollutant Discharge Elimination System ("NPDES") permit program under the *Clean Water Act,* and similarly can play a significant role in the creation and implementation of long-term control plans ("LTCP") to reduce combined sewer overflows. Moreover, green infrastructure can play a critical role in the broader context of sustainable infrastructure by being integrated into comprehensive plans that simultaneously address communities' drinking water supply, wastewater management, stormwater management and recreational needs. The use of green infrastructure can help communities meet their overall water resource management goals and reduce the costs (or free up funding for other uses such as land purchases) of constructing and maintaining engineered infrastructure including pipes and treatment systems.

There are many green technologies that can help protect water quality, and no single set of practices can be identified as the best for all circumstances; approaches should be tailored to fit local circumstances. For example, in a very heavily developed downtown area, where space is at a premium, the placement of green roofs on the top of office buildings and residential high rises may be the most economical way to retain stormwater on site. A recent study of green roofs in Portland, Oregon demonstrated that, over a period of 18 months which included the wettest month on record, five different configurations of green roof types and thickness reduced the volume of runoff leaving the site 65 to 94 percent. On the other hand, in a suburban setting characterized by many single-family homes, rain gardens might provide a more cost-effective means to obtain similar results. Similarly, the problems presented and the solutions to be prescribed will differ greatly between Washington, D.C., and the arid Southwest. Thus the determination of the most appropriate technologies will depend on a number of site-specific factors, such as available space, soil characteristics, depth of the water table, and climatic factors.

**III. To What Extent Are States and Communities Already Implementing Green Infrastructure Projects?**

In the 1990's, several communities and nonprofit groups began promoting and demonstrating the effectiveness of green infrastructure techniques. In 2000, Prince George's County, MD, authored, and EPA published, two companion books, "LID Design Strategies" and "LID Hydrologic Analysis," which provided detailed guidance for local communities to install rain gardens and other LID techniques to reduce and control stormwater runoff. Since that time, throughout the country, numerous additional documents have been published, conferences and technical seminars held, and local ordinances modified or enacted, that promote the incorporation of green infrastructure into development practices. See, e.g., *www.epa.gov/nps/lid.*

A number of cities across the Nation are already investing heavily in green infrastructure in order to manage their stormwater and/or abate their combined sewer overflows. The list includes large cities such as Portland (OR), Seattle (WA), Chicago (IL), and Philadelphia (PA), and smaller jurisdictions such as Lexana (KS), Prince George's County (MD), Griffith (GA), Emoryville (CA), Warsaw and Stafford Counties (VA), and Huntersville (NC). This list is growing as I speak, with recent announcements, proposed and final ordinances, and policy changes having been made by the cities of Boston, Washington, D.C., and New York City, and by states such as California and New Jersey.

Many organizations are currently working cooperatively to improve our understanding of the costs and benefits of green infrastructure. Nonprofit groups such as the LID Center, Center for Neighborhood Technology, Casey Trees, CWP, and others have published studies that estimate the costs, cost savings, and/or water quality benefits associated with various LID technologies at particular sites. Detailed studies and demonstration projects are being implemented by leading universities around the country, federal agencies (e.g., the Department of Defense has published an LID Design Manual to be used at all DOD facilities and recently FHWA and EPA co-founded a Green Highways Partnership grant for innovative watershed management projects within the Anacostia Watershed) and State and local governments (e.g., through funding provided by EPA's Nonpoint Source Program under Section 319 of the *Clean Water Act*).

## IV. What is EPA Doing to Promote Increased Adoption of Green Infrastructure?

### A. Partnerships to Promote Green Infrastructure

On March 7, 2007, I issued a memorandum to all of EPA's Regional Administrators expressing my strong support for the increased development and use of green infrastructure in water program implementation. I listed the many benefits that green infrastructure provides, including cleaner water, enhanced water supplies, cleaner air, reduced urban temperatures, increased energy efficiency, community benefits, and cost savings. On April 19, 2007, EPA Administrator Stephen L. Johnson signed a "Green Infrastructure Statement of Intent" with representatives of the National Association of Clean Water Agencies, Natural Resources Defense Council ("NRDC"), LID Center, and Association of State and Interstate Water Pollution Control Administrators, that formalized a collaborative effort among the signatory organizations to promote the benefits of using green infrastructure in protecting drinking water supplies and public health, mitigating overflows from combined and separate sewers and reducing stormwater pollution, and to encourage the use of green infrastructure by cities and wastewater treatment plants as a prominent component of their programs. EPA will work to include green infrastructure components and water quality trading and watershed projects. EPA is working with these and other key groups to develop a multi-pronged green infrastructure strategy. See *www.epa.gov/npdes/greeninfrastructure.*

At the same time, EPA has partnered with numerous organizations in a variety of other forums to promote and understand the benefits of green infrastructure approaches and practices. We are working with non-governmental organizations and associations such as the American Institute of Architects to promote urban design and planning to protect and restore water resources. We are participating in an effort led by Ladybird Wildflower Center and the American Society of Landscape Architects to develop sustainability metrics to aid design and planning professionals in designing landscapes that are functional components of our water resource infrastructure. To promote green building, we are working with the U.S. Green Building Council, the Congress for the New Urbanism and NRDC to incorporate metrics for onsite infiltration, evapotranspiration and re-use into a new Leadership in Energy and Environmental Design for Neighborhood Development (LEED–ND) rating system. As another example, working with The Conservation Fund, EPA, and the U.S. Department of Agriculture Forest Service has sponsored training for diverse audiences and participated in stakeholder processes in the development of green infrastructure plans at different geographic scales. There are in fact many other cooperative initiatives, such as a Source Water Collaborative and a Sustainable Infrastructure Initiative, whereby EPA works actively with many partners to promote green infrastructure.

EPA has also funded and partnered with leading engineering and science organizations in the United States, and the Federal Highway Administration (FHWA), in the development of the International Stormwater Best Management Practices (BMP) Database. The database, available online at www.bmpdatabase.org, provides a public platform for sharing information on best management practices to manage stormwater, including LID practices.

### B. Overcoming Existing Barriers to Green Infrastructure

The future looks very bright for green infrastructure. However, we will need to overcome some long-standing barriers in order to expedite its progress. Pursuant to the April 19, 2007, agreement that Administrator Johnson co-signed with partnering groups, EPA and its partners have begun to work together to meet its objectives. These include components such as:

- Continuing research and development of green infrastructure management practices performance and effectiveness. This information is critical to increasing the rate of implementation of green infrastructure practices.
- Guidance, assistance and education on selecting and applying green infrastructure approaches.
- Regulatory guidance that provides direction to promote utilization of green infrastructure approaches in lieu of, or in combination with, gray infrastructure approaches. Such guidance could be issued in the context of stormwater permits, long-term control plans for combined sewer overflows, enforcement documents, and funding programs.
- Documentation of the multiple benefits and relative life cycle costs of green infrastructure approaches as compared to more traditional technologies.

- Publicizing, cataloging, and recognizing successful green infrastructure projects and approaches.

Interestingly, one of the most significant barriers to implementing green infrastructure is local regulation. Many local ordinances, written a generation or two ago, require wide streets, curbs, gutters and underground storm sewers, and expansive ratios for paved parking square footage. Others require detention ponds and in some cases retention ponds, without giving credit for onsite practices that infiltrate, evapotranspirate, or re-use stormwater. Useful books have been written about such local codes and provided guidance on how to change them. An example includes "Better Site Design: A Handbook for Changing Development Rules in Your Community" (CWP, 1988, funded in part by EPA. EPA intends to work with its partners to continue to provide information to municipalities, counties, states, and others that explains the many economic, social, and environmental advantages that they can achieve by using green infrastructure alternatives in appropriate circumstances.

### C. EPA Research Efforts Related to Green Infrastructure

The EPA Water Quality Research Program includes studies on the control of stormwater pollution, including the use of green infrastructure processes. Research specific to the transportation sector has included the ability of retention basins and constructed wetlands, such as are installed as part of highway drainage systems for flood control, to mitigate nutrients, sediment, metals, and bacteria. EPA has also begun an evaluation of the effectiveness of swales, commonly used as a drainage tool along roadways where transportation right-of-ways can provide space and infiltration systems.

EPA's research program has documented and modeled the performance of porous surfaces in controlling stormwater runoff. The research program is now installing and evaluating porous pavement parking and a modular block system. These projects will allow evaluation of changes in the technology over time. Demonstrations have also been undertaken to examine the ability of green roofs to reduce the effect of roof-top impervious area with respect to hydrology and selected stressors. EPA will continue to evaluate these and other low impact development technologies in the future.

EPA plans to publish a new study within the next few months that will examine about a dozen LID and green infrastructure projects. The vast majority of these projects have been found to cost less money than a more traditional hard infrastructure project would have cost. Cost savings often result from site design techniques such as narrower streets, smaller storm sewer pipes, and elimination or reduction of detention basins, which can more than offset the increased costs of adding some LID practices.

Consideration of additional factors, such as the energy savings achieved by green roofs or the increased sales value of a home with a rain garden and reduced imperviousness, could tip the cost-benefit balance even more in favor of green infrastructure.

## V. Green Infrastructure and Transportation

Transportation, ranging from super-highways to unpaved county roads, constitutes a significant component of our national infrastructure. As such, it presents similar opportunities for the incorporation of green infrastructure techniques, such as diverting flows onto medians and rights-of-way, where the flows may be evapotranspirated and/or infiltrated.

EPA cooperates with federal agencies (e.g., Department of Transportation, U.S. Department of Agriculture Forest Service, and Bureau of Land Management), the National Association of County Engineers, the National Association of Counties, the American Public Works Association, and State and local governments to promote environmentally sound LID designs and maintenance practices for low volume and rural roads. Working together, we have collectively developed a guidance manual, a website to promote environmentally sound maintenance practices for dirt and gravel roads *(http://www.ltapt2.org/resources/ruralresources.php)*, and, through DOT's Local Transportation Assistance Program (LTAP), a clearinghouse and electronic discussion list-serve focused on environmental considerations relating to low-volume roads. In addition, EPA staff actively participates in Transportation Research Board ("TRB") committees on low volume roads, ecology and transportation, and environmental analysis in transportation, and have worked with the Federal Highway Administration (FHWA) to develop training courses on water quality/stormwater management and erosion and sediment control for highway engineers and public works staff.

An essential aspect of any green infrastructure strategy is comprehensive planning. Watershed planning should be integrated with transportation planning and

other local and regional community planning efforts. EPA participated on a workgroup chaired by FHWA that wrote Eco-Logical: An Ecosystem Approach to Developing Infrastructure Projects. Eco-Logical emphasizes integrated planning approaches. EPA has worked with FHWA and groups such as the National Association of Regional Councils to promote integrated planning to protect water resources. Approaches such as Context Sensitive Solutions help communities plan the placement and design of transportation facilities that are safe and meet a community's transportation needs while preserving scenic, aesthetic, historic and environmental resources.

*A Transportation Model: The Green Highways Partnership*

EPA is very proud to be a primary sponsor of the Green Highways Partnership, a voluntary, public/private collaboration in the Mid-Atlantic region with an expansive list of partners from the environmental, transportation and industry sectors. Green Highways, like Green Infrastructure, is not a defined term of art. However, some characteristics of green highways are that they are:

- built with permeable materials that provide superior watershed-driven stormwater management, thus preventing metals and toxins from leaching into streams and rivers;
- constructed with recycled materials, thereby reducing landfill usage; and
- designed using cutting-edge technologies to protect critical habitats, waterways, and ecosystems from the adverse impacts and encroachment of highway infrastructure.

The Green Highways Partnership is demonstrating the opportunities that exist through integration of environmental and transportation planning, using the green infrastructure approach. Through concepts such as regulatory flexibility and market-based rewards, Green Highways seeks to incorporate environmental streamlining and stewardship into all aspects of the highway lifecycle. Green Highways looks for opportunities to design roadways using cutting-edge technologies, like those which support green infrastructure, including LID practices, to protect critical habitats, waterways, and ecosystems from the adverse impacts and encroachment of highway infrastructure; build roadways with permeable materials that provide superior watershed-driven stormwater management, thus preventing metals and toxins from leaching into streams and rivers; and construct roadways with recycled materials, thereby reducing landfill usage. The outcome is sustainable transportation infrastructure that is "beyond compliance" and leaves the environment and communities "better than before."

While examples and practices are occurring throughout the Mid-Atlantic region, the Partnership is actively engaged in several demonstrations in Maryland and DC. The U.S. Highway 301 Waldorf Transportation Improvements project is working towards becoming the Nation's first truly green highway by incorporating the principles of the Green Highways Partnership and green infrastructure in its earliest planning stages.

Through Green Highways, EPA has partnered with FHWA, State Departments of Transportation, and county planning organizations to map the natural resources in a geographic area and conduct green infrastructure assessments to inform and complement the comprehensive transportation plan. For example, the U.S. 301 Project team is working on updating the regional green infrastructure assessment to aid in decision-making at every level of the project: location, design, stormwater management, and mitigation. Similarly, the District of Columbia DOT has developed its own design standards to create an infrastructure to support the sustainable economic and environmental health of the region and the creation of livable communities. As an example, the District DOT has implemented a bioretention cell, which has reduced pollutant loads by more than 90 percent.

**Conclusion**

We have made and are continuing to make major investments in the implementation of programs and practices to protect and restore waters that are impacted or may be impacted by stormwater, urban runoff, and combined sewer overflows. Green infrastructure can be both a cost-effective and an environmentally preferable approach to reduce stormwater and other excess flows entering combined or separate sewer systems in combination with, or in lieu of, centralized hard infrastructure solutions. We will continue to work with this committee, our federal colleagues, and the many partners, stakeholders, and citizens who want to promote green infrastructure to achieve our water quality goals as well as to promote more livable communities. This concludes my prepared remarks; I would be happy to respond to any questions you may have.

**Attachment A:**

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

MAR 5 2007

OFFICE OF WATER

**MEMORANDUM**

**SUBJECT:** Using Green Infrastructure to Protect Water Quality in Stormwater, CSO, Nonpoint Source and other Water Programs

**FROM:** Benjamin H. Grumbles
Assistant Administrator

**TO:** EPA Regional Administrators

Green infrastructure can be both a cost effective and an environmentally preferable approach to reduce stormwater and other excess flows entering combined or separate sewer systems in combination with, or in lieu of, centralized hard infrastructure solutions. EPA Water Programs are in a pivotal position to exert leadership in the consistent and reliable implementation of green infrastructure approaches. This memo is to highlight opportunities for the Regions, States, and Headquarters efforts to increase the development and use of green infrastructure in water program implementation.

Several cities, searching for alternatives to traditional hardscape solutions to wet weather discharge problems, have initiated some green infrastructure approaches. The Natural Resources Defense Council (NRDC) has recently published a document with information and case studies on these efforts. I strongly support the use of green infrastructure approaches described in the NRDC report and I suggest you share the report with States and promote other tools for green infrastructure. *Rooftops to Rivers: Green strategies for controlling stormwater and combined sewer overflows* (NRDC, June 2006) is available at:
http://www.nrdc.org/water/pollution/rooftops/contents.asp

Green infrastructure approaches essentially infiltrate, evapotranspirate or reuse stormwater, with significant utilization of soils and vegetation rather than traditional hardscape collection, conveyance and storage structures. Common green infrastructure approaches include green roofs, trees and tree boxes, rain gardens, vegetated swales, pocket wetlands, infiltration planters, vegetated median strips, reforestation, and protection and enhancement of riparian buffers and floodplains. Green infrastructure can be used where soil and vegetation can be worked into the landscape. It is most effective when supplemented with other decentralized storage and infiltration approaches, such as the use of permeable pavement, and rain barrels and cisterns to capture and re-use rainfall for watering plants or flushing toilets. These approaches can be used to keep rainwater out of the sewer system to reduce sewer overflows and to reduce the amount of untreated stormwater discharging to surface waters. Green infrastructure

facilitates or mimics natural processes that also recharge groundwater, preserve baseflows, moderate temperature impacts, and protect hydrologic and hydraulic stability.

Green infrastructure has a number of benefits:

- *Cleaner Water* – Vegetation and green space reduce the amount of stormwater runoff and, in combined systems, the volume of combined sewer overflows.
- *Enhanced Water Supplies* – Most green infiltration approaches result in stormwater percolation through the soil to recharge the groundwater and the base flow for streams.
- *Cleaner Air* – Trees and vegetation improve air quality by filtering many airborne pollutants and can help reduce the amount of respiratory illness.
- *Reduced Urban Temperatures* – Summer city temperatures can average 10°F higher than nearby suburban temperatures. High temperatures are linked to higher ground level ozone concentrations. Vegetation creates shade, reduces the amount of heat absorbing materials and emits water vapor – all of which cool hot air.
- *Increased Energy Efficiency* – Green space helps lower ambient temperatures and helps shade and insulate buildings, decreasing energy needed for heating and cooling.
- *Community Benefits* – Trees and plants improve urban aesthetics and community livability by providing recreational and wildlife areas and can raise property values.
- *Cost Savings* - Green infrastructure may save capital costs on digging big tunnels and stormwater ponds, operations and maintenance expenses for treatment plants, pipes, and other hard infrastructure; energy costs for pumping water; and costs of wet weather treatment and of repairing stormwater and sewage pollution impacts, such as streambank restoration.

The Office of Water is working with a coalition of organizations, including the Natural Resources Defense Council, the National Association of Clean Water Agencies, and the Low Impact Development Center, to develop additional strategies for green infrastructure approaches to water quality challenges. As those strategies take shape, we will send you additional tools and information on implementing green infrastructure in our water programs.

I am pleased that EPA Regions and States are looking for opportunities to incorporate green infrastructure. We would be very interested in hearing about your efforts, and to the extent they can be applied elsewhere, assist in disseminating information and tools. If you have any questions, please contact me or have your staff call Jenny Molloy at (202) 564-1939 with any questions, comments, ideas or information on green infrastructure approaches.

cc: Water Division Directors
OW Office Directors

BIOGRAPHY FOR BENJAMIN H. GRUMBLES

Benjamin H. Grumbles was confirmed by the United States Senate on November 20, 2004, as Assistant Administrator for the Office of Water at the U.S. Environmental Protection Agency. Prior to being appointed Acting Assistant Administrator in December, 2003, Mr. Grumbles served as Deputy Assistant Administrator for Water and Acting Associate Administrator for Congressional and Intergovernmental Relations.

Before coming to EPA in 2002, Mr. Grumbles was Deputy Chief of Staff and Environmental Counsel for the Science Committee in the U.S. House of Representatives. For over fifteen years, he served in various capacities on the House Transportation and Infrastructure Committee staff, including Senior Counsel for the Water Re-

sources and Environment Subcommittee, and focused on programs and activities of the EPA and the Army Corps of Engineers.

From 1993 to 2004, he was an adjunct Professor of Law at the George Washington University Law School, teaching a course on the *Clean Water Act, Safe Drinking Water Act, Ocean Dumping Act,* and *Oil Pollution Act.*

His degrees include a B.A., Wake Forest University; J.D., Emory University; and LL.M. in Environmental Law, from the George Washington University Law School.

Ben was born and raised in Louisville, Kentucky. He currently lives in Arlington, Virginia, with his wife, Karen, and two children.

## DISCUSSION

Chairman WU. Thank you very much, Mr. Grumbles.

We have just been notified of a series of, a long series of votes, and I understand that one or more of the government witnesses may have to leave at 3:30, so I am going to seek unanimous consent to ask the first two witnesses questions. And hearing no objections, so ordered. Mr. Grumbles, I am going to confine myself to one or two questions, and then turn it over to my colleague, Dr. Gingrey.

I very much appreciate your memorandum written this March, supporting green streets and green efforts, and I want to ask you what other guidance can or does EPA Office of Water provide to its Regions, to communities interested in green transportation infrastructure development, and how does your Office collaborate with regional EPA offices?

Mr. GRUMBLES. Thank you, Mr. Chairman.

The National Water Program is excited about a couple opportunities in particular, one is what we are learning in the Mid-Atlantic on the Green Highways Program, this unique collaboration with Federal Highways and with other State and local government and private sector entities. We are looking to share with other EPA Regions through guidance or different materials. We are also very focused on working with our Enforcement and Compliance Assistance Office, as they look at communities that have sewer overflow challenges, or stormwater problems, and looking for opportunities to incorporate various practices that reflect a green infrastructure approach.

It is also very important to the National Water Program that it becomes an important component of our overall strategy on wetlands protection that gaining, not simply maintaining, wetlands in the United States is a critically important part of the infrastructure. And then, of course, as this committee knows and has focused on, the importance of technology and continuing to evaluate different technologies and approaches. It is important to us to work with our Research Office and with the private sector and other agencies to advance the science and improve the environmental results of so many of these exciting green infrastructure transportation technologies.

Chairman WU. Well, Mr. Grumbles, if there is anything that this Congress, this committee, or this subcommittee can do to assist you in a more uniform acceptance of a green streets approach across the Regions, we would be delighted to do that.

And with that, I would like to turn over time to my colleague, Dr. Gingrey, from Georgia.

Mr. GINGREY. Mr. Chairman, thank you, and in the interests of Mr. Grumbles' time, in particular, and also, I will ask Ms. Shepherd a question, and then, hopefully, we will get to hear from the other witnesses and question them as well.

My staff was briefing me on the hearing earlier today, and were telling me about some of the technologies and things that could be done. I have said well, gee, you know, I don't think that will work. And it was, Mr. Grumbles, in regard to the issue of regular maintenance of things like porous pavement, and taking care of the vegetation in the bioswales, you know.

And so, my question is, because I am concerned, and then, there is a recurring criticism of some of the green transportation practices, is the need for this regular maintenance, and I mentioned the vacuuming of porous pavement, or attending to the vegetation in the bio-swales. When you are reviewing technologies like this for potential inclusion into the best management practices, are O&M estimated by the EPA?

Do you look at these things and say, well, what will it cost to maintain it, and in fact, even if it is put in place, will the cooperation be there? I mean, if you have got to vacuum concrete once every couple of years, or dig out and replant the vegetation every five years, are State and local folks going to do that, and what is the cost to comply?

Mr. GRUMBLES. Your question is just right on target, about what are the practical aspects and ramifications of some of these emerging technologies, and I would just say a couple things.

One, EPA is focused on environmental results more than on particular technologies, and we don't, through our ETV program, certify particular technologies. We do evaluate them, and our goal is to get out the best information on various technologies and work with others and work at the grassroots level to give them the information, so that they can choose which technologies are the most effective and practical.

And you are exactly right that as communities, and as EPA, look at the range of options, because there is no one size fits all, it depends on the local circumstances and climate and geographic factors and community needs. It is important to give the biggest possible list and options and then provide information. You are right. Sometimes, as we move towards greater vegetated green approaches in some areas it may not be as practical given the terrain or the climate. But some of the experts who are on the panel, who have real hands-on experience about some of the different technologies, are informing us and everyone else.

Mr. GINGREY. Sure. Well, it is intriguing, and I have to say, I mean, the highway departments in the various states, and mine in particular, you know, they are concerned about repainting the lines, and making sure the shoulders are safe, and things like that. So, even if you put some of these things in place, you worry about the O&M.

Ms. Shepherd, the training and technology transfer. In the end, the implementation of these technologies is going to require the local developers and the planning boards to accept their use. It is kind of in the same line of reasoning that I had with Mr. Grumbles.

Ms. Shepherd, in your testimony, you mentioned two programs that provide training and technical assistance for individuals, the National Highway Institute and the Local Technical Assistance Program. How many individuals actually participate in these programs during the course of the year, and what are the two key differences in these programs?

Ms. SHEPHERD. The NHI, the National Highway Institute, is the training arm of the Federal Highway Administration. That particular part of the organization offers and develops training based on the specific subject matter discipline. So, in this area, it would be the environment and stormwater management specifically, and for your question, it would be related to things like O&M and all the things that are associated with stormwater management.

We are developing a course now on environmental considerations in the construction, meaning stormwater management, area. We work with the states to host, and the states are welcome to invite the local governments to participate in that training, so the states actually sponsor the training in connection with our National Highway Institute. And they are free, because the states are actually supporting the training. They are actually able to open up seats to that training to their local partners, their local governments within that state.

In addition, there is the Local Technical Assistance Program (LTAP). There are 58 in the country, and that includes Puerto Rico. There are multiple LTAPs in a number of states. And there are seven LTAPs throughout the country, mostly, obviously, located in the western part of the country. And a lot of them are through the university systems and some of them are through the State highway administrations.

Those programs are well attended, because what they do is they actually reach out to the locals, the grassroots organizations, the local State highway administrations and their transportation professionals. They find out what the needs of the specific areas are and try to gear training and technical assistance, technical deployment, based on what those local governments say their priorities are. So, it is very much a hands-on approach with the local governments.

Mr. GINGREY. Ms. Shepherd and Mr. Grumbles, thank you. I am sorry, Mr. Chairman. I took way beyond my five minutes, but I talk slow. It wasn't their fault.

Chairman WU. Now, we appreciate the gentility of the gentleman from Georgia, and we are down to about three minutes before the vote, but I understand that Dr. Ehlers has a question, and we would like to get this done before we take a potentially significant break.

Mr. EHLERS. Well, I am from Michigan. We don't talk much faster than Georgia, but I just very quickly want to make a point. I am on the Transportation Committee, too. When we did the last reauthorization, SAFETEA–LU, I was chairing this subcommittee, and we fought very, very hard to get more research money into the Department of Transportation. We did not succeed very well.

And I am wondering, since you are involved in this area, I found it totally absurd that we have a multi-billion dollar industry, so to speak. I don't know of any other multi-billion dollar industry in the

world that spends so little on research as the Department of Transportation does. Have things improved at all? Are you dedicating more funding to research or not?

Ms. SHEPHERD. What we do is, since you acknowledge that, though transportation research funds were not there, as they were, as they have been historically, what we have done is we have tried to do a lot more cooperative efforts with our partners, like the states or AASHTO, for example, the American Association of State Highway Transportation Officials.

As you know, sir, the states are required, through the State planning and research programs, that two percent of all the major categories in SAFETEA–LU are set aside for research. Furthermore, we passed that to the states. Of that money, the states have to set aside 25 percent of that money that can only be spent on research and development. So, what we do is we try to pool, albeit, our limited funding, with the states and their funds, to try to address their priority areas. We also try to work with the Transportation Research Board through their National Cooperative Highway Research Program and a number of other efforts.

So, what we have done is, because of the limitations, we have learned to reach out and try to pool funding together to address some of these major issues, by trying to increase the flexibilities for moving funding around, given the limited amount of research revenues. So, you are right. There is a significant shortage of funding that is dedicated to research, but we try to make the best use that we can of what we have.

Mr. EHLERS. Well, thank you for this slight bit of encouragement, and I am going to leave it up to you to raise the funds even more. Thank you very much.

Mr. GRUMBLES. Could I just add something?

Chairman WU. Well, Mr. Grumbles, perhaps we could take your additional comment in the record. We are somewhat under 30 seconds for this first of five votes, and I want to apologize to all the witnesses and the attendees. We will have to step away for however long it takes us to cast these five votes, and then we will reconvene.

The Committee is in recess.

[Whereupon, at 2:58 p.m., the Subcommittee was recessed, to reconvene at 3:48 p.m., the same day.]

Chairman WU. I want to thank the forbearance of the witnesses and the attendees, and at this point, I would like to recommence testimony, with Commissioner Sam Adams. Sam, please proceed.

## Panel 2:

### STATEMENT OF MR. SAM ADAMS, COMMISSIONER OF PUBLIC UTILITIES, CITY OF PORTLAND, OREGON

Mr. ADAMS. Thank you, Mr. Chair, and Ranking Member, and Committee Members, for the opportunity to share with you some of the lessons learned, and barriers that stand in the way, and uncertainties that stand in the way of further application in the City of Portland. And in talking to my colleagues in other cities and local governments across the United States, selectively, sort of the

challenges that they have told me, in terms of greater implementation of green transportation technology.

I also want to acknowledge your leadership on this issue, not only just here in Congress but also your willingness to go out with us, as Transportation Commissioner, and see the projects up close and personally. We are very grateful. Thank you for your leadership.

The City of Portland gets 37 inches of rain annually, and that translates into about 17 billion gallons of transportation-related stormwater runoff. In Oregon, Portland specifically, it rains many days of the year, but the number of inches, and the amount of stormwater produced by the transportation system, is commensurate with a lot of cities across the United States. Sometimes, it comes in thundershowers, sometimes in snow, but many cities across the United States have the challenge or opportunity to deal with stormwater.

In the City of Portland, starting in 1994, when we came under the jurisdiction of the State Department of Environmental Quality and the EPA for sewer overflow discharges into the Willamette River, we have been working very aggressively to do the research and development and the experimentation, and the proving of transportation-related green stormwater approaches. It really took a changing, not only just of technology, but really, of outlook, that up to that point, stormwater had largely been treated as a waste product or ignored. Stormwater was either piped directly in through the treated system, or directly into the river, which means if it hit the river, it was warm, it was dirty, and it was fast-moving. It was not the kind of stream inflows to the Willamette River, which is our major river, that we were looking for.

Instead, sort of trying to turn things around, and doing it in a way that could save money to local ratepayers. Instead, our goal was to get stormwater to percolate into the ground as much as possible. Thirty percent of our main river and most of our watersheds come up from below, and if the water comes up from below, it tends to be cool, clean, and it recharges the river in the most beneficial way.

A couple of examples of just pictures of the kinds of stormwater technologies that mimic, as you heard from Mr. Grumbles, that mimic the natural environment. This is a curb extension, all three of these examples are retrofits of the existing system in the City of Portland, in which we have 4,000 miles of streets and roads. That is a curb extension in a residential area. This is actually a sidewalk planter. That is in use in downtown Portland, taking a very narrow, a narrow part of the sidewalk in the street, and turning it into a functioning swale. And then, the third one is an example of pervious pavers. Your next witness is going to talk about pervious concretes. I don't want to steal any of his thunder, but we use that as well. These are pervious pavers in the parking strip.

In terms of what stands in the way of more application of these things, it has been touched upon, but it really is when, like me, when you are running a local government agency. In my case, I am responsible for transportation. As you mentioned, environmental services is a euphemism for the sewer agency. We don't have the luxury of taking risks that can come with unclear federal regula-

tions. In the City of Portland, we push further than most, but most cities won't do that. So, some of the barriers that we have faced, and that I hear from my colleagues around the country, is a lack of alignment of regulatory policies, with green infrastructure initiatives within EPA, and with the transportation agencies on the federal level.

There has been some positive forward motion, in terms of improving green technologies for inclusion into federally funded projects, but as detailed in my testimony, we feel like there is a long ways to go. Because there is a lack of federal standards, it means that a lot of the local governments simply will not choose to try to build the green stormwater facilities simply because they don't know what the rules of success are. Even though in the City of Portland, we are achieving between a 20 and 60 percent reduction in green stormwater facilities, than if we had tried to treat that same amount of stormwater through a traditional drainpipe method.

So, I appreciate the opportunity to testify. I look forward to questions and answers.

[The prepared statement of Mr. Adams follows:]

PREPARED STATEMENT OF SAM ADAMS

Chairman Wu, Members of the Subcommittee:

It's an honor to discuss with you the challenges and opportunities of green transportation technologies.

I am Sam Adams, a member of the City Council for the City of Portland, Oregon, and the Commissioner-in-Charge of Portland's Office of Transportation and Bureau of Environmental Services.

Portland is a city of 563,000 residents, inhabiting 145 square miles, spread over five watersheds at the confluence of the Columbia and Willamette Rivers. The City's transportation system consists of 4,000 miles of local streets and arterials. The sanitary sewer and stormwater utilities operate 2,400 miles of sanitary, stormwater and combined sewers, 9,000 stormwater sumps and two wastewater treatment plants.

Portland receives 37 inches of precipitation per year, producing 17 billion gallons of transportation-related stormwater runoff. Historically, we have treated this stormwater as a waste product: channeled to a sewer or piped directly to the Willamette River. This approach simultaneously deprived the river of clean, cool groundwater from below, while flooding it with warm and dirty surface runoff. We are committed to reverse this approach and begin to value stormwater runoff as an asset for watershed health. To that end, I am pleased to report that Portland is the first city in the Nation to adopt comprehensive green street policies to address the interrelated challenges of street design and stormwater management.

I appear before you today to provide the following recommendations on the ways the Federal Government can promote the further development and use of green transportation infrastructure:

1. Align Regulatory Policies with Green Initiatives.

I would like to recognize Representatives Ehlers and Honda of this Subcommittee, and Ben Grumbles of the Office of Water at the Environmental Protection Agency (EPA) for promoting green technologies at the federal level.

The Congressional *Statement of Support for Green Infrastructure* sends an important signal to Members of Congress about the need for a new approach to public works. And EPA's *Green Infrastructure Statement of Intent* establishes an important partnership with the National Association of Clean Water Agencies (NACWA) and Natural Resources Defense Council (NRDC) to expand the use of green technologies nationally.

Now that a national policy consensus is taking shape, it is time for EPA and other federal agencies to align their regulatory policies accordingly. Existing policies and rules must be reviewed and updated to reflect the green revolution that is occurring in the environmental sciences and civil engineering.

Portland is currently dealing with two issues where EPA's regulatory policies are frustrating our efforts to use green technologies:

- In 2001, Portland attempted to get regulatory approval for a comprehensive plan to eliminate combined sewer overflows (CSOs), advance our compliance with the *Endangered Species Act,* and improve watershed health. Our "Clean River Plan" called for integrated watershed planning, green technologies and multi-purpose infrastructure investments applied over a 20-year period. Unfortunately, our Plan failed to get support from the Oregon Department of Environmental Quality and EPA. In fact, EPA said our 2001 efforts were the root cause of enforcement actions that Portland is dealing with now six years later. Both agencies favored traditional engineered solutions that assured regulatory compliance within a tightly constrained timetable. Neither agency was willing to provide additional time for Portland to pursue more sustainable, cost effective and affordable strategies that also promoted comprehensive watershed health. Had Portland spent more time over the past several decades developing green technologies, we would have been able to reduce the size and expense of traditional technologies.
- Green technologies incorporate stormwater quality protections to produce discharges that are an asset to watershed health. These discharges more closely emulate the natural water cycle and provide multiple ecosystem benefits. EPA considers these treated discharges as a waste product and a potential risk to groundwater. This interpretation produces regulations that make it cumbersome, costly and risky to use surface infiltrating green technologies by requiring green technologies to be equipped with redundant filtering systems. The expanded use of green technologies will be significantly hindered if EPA does not revise its current policy on stormwater infiltrating through sumps and drywells. Municipalities and private developers will not take advantage of such technologies as flow-through planters and street swales that use specially designed landscaping to filter, detain and reduce stormwater runoff before it is discharged to a sewer, outfall or sump.

2. Incorporate Green Technologies into Federal Transportation Policies and Programs.

Federal and State highways traverse Portland, discharging about five billion gallons of stormwater runoff per year. These discharges contain heavy metals, solvents, chemicals, particulates, heat and other pollutants that find their way into our groundwater, rivers and streams. Investments in the upgrade, replacement and addition of new transportation infrastructure must include provisions for green transportation technologies. As with the EPA, we strongly recommend that the U.S. Department of Transportation and State transportation agencies adopt the use of green technologies wherever practical, and coordinate their stormwater management improvements with those of municipalities. In addition, federal and State agencies should be required to compensate municipalities for the costs of managing stormwater discharges from federal and State highways.

3. Support Research and Development of Green Technologies.

Developing new technologies is an expensive and risky business. A national program of innovative design and product development will help jump start the use of green transportation infrastructure, and promote the creation of green economies throughout the country. Such a program should be coordinated with EPA, National Association of Clean Water Agencies (NACWA), Natural Resource Defense Council (NRDC), State environmental agencies, universities and municipalities. A national technology development program fits nicely into EPA's *Green Infrastructure Statement of Intent* and the Congressional *Statement of Support for Green Infrastructure.*

4. Support Research on the Appropriate Placement and Performance of Green Technologies.

Developing new green technologies is not enough. Many states and municipalities are trying to determine which green technologies provide the most benefits given specific site characteristics and watershed conditions. Research on the performance of green technologies needs to become a national priority if we are serious about their effective use. Coincidentally, compliance with current *Clean Water Act* requirements for the application of stormwater best management practices (BMPs) to the maximum extent practicable (MEP) is also reliant on a solid demonstration of the effectiveness of those BMPs. As with technology development, research on "BMP effectiveness" must be coordinated with the EPA, NACWA, NRDC, State environmental agencies, universities and municipalities. The research must be sensitive to the regional variations of hydrology, climate, plant biology, soils and other factors that impact the effectiveness of green technologies. The research should include ongoing and statistically-significant monitoring to determine the long-term effective-

ness of green technologies. And the research must be transferable to and among the end users such as municipalities, State agencies, private developers, and EPA.

5. Support Research on the Costs and Benefits of Green Technologies.

It is difficult for policy-makers and the public to see the full costs of environmental degradation and the full value of green technologies to restore watershed health. As a society, we have not developed a comprehensive method of accounting for the full costs and benefits of stormwater management. We have not placed an economic value on stormwater that incorporates the full costs of old technologies and the full value of ecosystem benefits. If we are going to begin to make decisions in the best long-term interests of society and the planet, this must change. A national research program of economic research into the costs and benefits of different stormwater management technologies is an essential companion to research on BMP effectiveness. Solid economic analysis will support State and local efforts to develop fair, equitable and adequate funding mechanisms for public stormwater management, and provide the necessary basis for the development of new market-based initiatives.

6. Support the Development of Information Technologies and Systems Modeling.

Portland has spent more than a decade and millions of dollars developing geographical information systems (GIS), watershed characterization techniques and planning tools needed to make informed decisions about capital investments in stormwater and sanitary sewer infrastructure. Our systems are well tested and accurate at a localized level of planning. We developed these tools out of necessity, in support of our CSO response, in a watershed context. Soon we will add new tools to manage our capital assets and further inform our decisions about facilities maintenance and replacement. We have learned that such tools are indispensable to comprehensive and integrated watershed planning. Any national program to promote green technologies must include programs to deliver planning tools and training to municipalities and states.

These recommendations are offered based on nearly two decades of ground-breaking work on green technologies by the City of Portland. I believe Portland comes by its leadership position on green transportation honestly. After years of experimentation, we have embraced green technologies as a core value to manage stormwater runoff from all City streets. We have designed and installed award winning street planters, rain gardens and swales that integrate seamlessly into the urban landscape. These green technologies take pressure off our combined sewer system, soften the streetscape and infiltrate stormwater to recharge our streams and rivers. When coupled with trees and native vegetation, our green streets increase evapotranspiration and carbon sequestration, reduce the urban heat island effect, provide traffic calming, and add landscape amenities for adjacent private property. These benefits are not possible with traditional approaches to street drainage.

**Examples of Green Transportation Technologies**

Consider the following three examples of cost-effective and sustainable green transportation technologies:

- Portland has found very simple ways to turn traditional streets into green streets without spending substantial sums for planning, design and engineering. Simple street swales capture, filter and infiltrate stormwater runoff before it has a chance of getting into traditional combined or separated sewers. These swale are carved out of the existing street along the curb immediately upstream of a sewer inlet. Abutting property owners participated in the selection of native plants and help with simple maintenance.
- Portland has developed award-winning infiltration planters that collect and infiltrate street runoff within the tight dimensions of an urban streetscape. The planters are sunken below the level of the sidewalk and receive stormwater through grated curb cuts. Some designs allow stormwater to flow in and out of multiple planters during heavy rain events. Native vegetation and trees facilitate drainage and provide multiple ecosystem benefits.
- Porous pavement and pervious pavers offer another type of green technology that provides a way for stormwater to filter into soils rather than flow into sewers, streams and rivers. Portland uses both types of green paving depending on site conditions, land uses and traffic patterns. In the case of pervious pavers, Portland uses traditional asphalt paving for the heavily-used traveling lanes of neighborhood streets. Pervious pavers are concentrated in the parking areas where runoff can be captured and filtered into the ground. Spe-

cial soils are used to facilitate infiltration. The project takes stormwater runoff out of local combined sewers, and increases groundwater recharge for the benefit of local streets. The street design is very well received by local residents.

**Integrating Green and Traditional Technologies**

Portland's stormwater systems reflect the evolution of science, engineering and regulation over the City's 156-year life. For most of our history, we conveyed stormwater as quickly as possible to our streams and rivers without much thought about the consequences. As we developed into an urban center, we added combined sewers, separated stormwater sewers, sumps, and pollution reduction facilities. Today, we pursue comprehensive strategies that treat stormwater as an asset for watershed health. We incorporate natural functions into our infrastructure to complement, enhance and strengthen our watersheds. Portland will always have a complex and overlapping system of older sewers and newer green technologies. Our challenge and our opportunity are to align and integrate the older and newer technologies in ways and at locations that maximize their benefit to our watersheds.

**Lessons Learned**

In Portland, we have fundamentally redefined "technology" and "infrastructure" in order to capture the full potential of green streets and sustainable stormwater management. To do otherwise would have perpetuated our reliance on traditional infrastructure that is ineffective, unsustainable and works in opposition to natural systems.

Portland has moved beyond traditional transportation engineering principles to embrace a comprehensive and multi-disciplinary approach to infrastructure based on natural systems, soils, hydrologic function, biology, chemistry and plant sciences. We view stormwater as an asset rather than a liability. We look for opportunities to seamlessly integrate man-made structures into the urban landscape in ways that enhance and strengthen the natural functions of our watersheds.

As with any new technology or innovation, our early efforts required additional investments in research, planning and design. However, after more than a decade of experience, our recent green street projects are increasingly cost-effective. Our most recent pre-design for green street projects identify design and construction savings of 20 percent to 63 percent over traditional storm sewer systems. These savings are calculated without accounting for the value of improved air and water quality, increased natural habitat, and other ecosystem benefits.

**In Closing**

A transition from traditional to green technologies is unavoidable. We must hasten the change by expanding our definition of technology and infrastructure to integrate built and natural environments. Green technologies marry together science, engineering and design to construct green infrastructure that is seamless, sustainable and cost effective. We need a partnership with federal and State agencies, universities and others to affect a fundamental change to green transportation technologies. This subcommittee can take an important first step by giving careful consideration to my recommendations:

- Redefine Technology and Infrastructure
- Align Regulatory Policies with Green Initiatives
- Incorporate Green Technologies into Federal Transportation Policies and Programs
- Support Research and Development of Green Technologies
- Support Research on BMP Effectiveness and Performance Measures
- Support Research into the Economic Value of Stormwater Management
- Support the Development of Information Technologies and Systems Modeling

Thank you for your attention and interest. I will gladly entertain any questions.

BIOGRAPHY FOR SAM ADAMS

Sam Adams was elected to the Portland City Council in 2005. Commissioner Adams oversees the Office of Transportation and the Bureau of Environmental Services. Upon receiving the two assignments, he immediately seized upon the opportunity to develop a citywide greenstreets policy, which requires greenstreet development for all newly constructed or reconstructed roadways unless technically infeasible. The comprehensive greenstreets policy follows the city council passage of the

comprehensive Watershed Management Plan, the Nation's first citywide urban natural resource baseline and plan for sustainable resource management. Still not satisfied with his environmental leadership, Commissioner Adams has now directed the Bureau of Environmental Services to development a Green City Strategy, which aims to manage all the city's stormwater in a sustainable manner.

Portland's sustainable management initiatives are necessary to complement a federal court-mandated $1.4 billion investment in underground sewer infrastructure to mitigate combined sewer overflows.

Commissioner Adams is a strong advocate for the environment and has used his role at the City of Portland to pursue strong policies that reduce our impact on the naturescape and seek alternatives to traditional transportation and sewer infrastructures.

Prior to serving a City Commissioner, Sam Adams served as Chief of Staff to Mayor Vera Katz for 11 years. In the Mayor's office he helped lead projects to revitalize the Willamette River and expand light rail service to the Portland International Airport.

Commissioner Adams started his political career with Representative Peter De Fazio, who represents the Fourth District of Oregon. Sam Adams earned a Bachelor of Arts in Political Science from The University of Oregon.

Chairman WU. Thank you very much. Mr. Huffman, welcome to the Committee.

**STATEMENT OF MR. DANIEL J. HUFFMAN, MANAGING DIRECTOR, NATIONAL RESOURCES, NATIONAL READY MIXED CONCRETE ASSOCIATION**

Mr. HUFFMAN. Thank you. Good afternoon, Chairman Wu, and Ranking Member Gingrey, and Congressman Ehlers. Mr. Chairman, as a resident of your district, I am especially pleased to appear before you today to discuss the environmental benefits of pervious concrete pavements.

My testimony will provide a brief overview of the properties of pervious concrete, some real world applications, and industry efforts to enhance its broad utilization. Pervious concrete is a leading edge infiltration technology. Its limited use in the United States in pavement began about 25 years ago, and primarily, in Florida.

Pervious concrete can be a major element of low impact development, and could provide for substantial water harvesting. It already has been accepted by EPA as a recommended best management practice (BMP), and the U.S. Green Building Council's LEED Program allows the use of pervious concrete to contribute towards certification.

Pervious concrete is a performance engineered structural material used in the constituents of conventional Portland cement concrete, only with little or no sand in the mixture, allowing for a 15 to 30 percent air void factor. Taking advantage of the decreased density, pervious concrete is incredibly permeable while still able to provide a quality structural pavement. The use of pervious concrete pavement supports the many positives of infiltration technology, including both groundwater recharge and attempts to control increasing aquifer depletion.

Because a picture says a thousand words, I would like to provide some visualization. Represented on the left is a sample of pervious concrete, such as this one with me today. You can see the moisture falling onto the top of the pervious concrete, immediately passing through, and immediately coming out the bottom. The schematic on the right demonstrates how moisture falls onto a slab of pervious concrete, represented by the gray solid material on the top. The

moisture is filtered, as it moves through the concrete, and then passes through the granular base reservoir, where it is temporarily stored, before it is percolated into the subgrade, where in addition to providing groundwater recharge, it also provides substantial moisture to the root systems of surrounding vegetation as if no hardscape ever existed.

This is a Sam's Club Discount Store parking lot in Atlanta, Georgia. On your left, you can see moisture accumulated on the surface of conventional asphalt pavement immediately following a rain event. On the same site, the photo on the right shows the pervious concrete slab that was later constructed, and you can see the comparison at the same time. This is a parking lot of a Wal-Mart store in Denver, Colorado. In the background, you can see conventional asphalt during a rain event, with the expected standing water in many places, while in the foreground is a test section of pervious concrete, which appears to show no effects of moisture at all.

The Safeway grocery store on the left has a complete parking lot of pervious concrete, and is shown as it looked on April 11, 2005, the following morning after a 12 inch snowfall had closed the Denver airport. The parking lot was plowed the night before, and as soon as the sun appeared, most of the remaining moisture quickly melted, and passed through the pervious concrete. The photo on the right was taken at the same time, and represents the conventional pavement immediately across the street, which was later turned to ice when the sun went down. The temperatures dropped, and the moisture standing on the surface refroze.

This is the parking lot of Finley Field at the University of Tennessee at Chattanooga. The aerial view shows pervious concrete, the light stripes or strips that you see there, surrounded by conventional asphalt. This shows just one means of using pervious concrete for water harvesting, as the moisture trapped in the granular base system immediately beneath the pervious concrete is pumped over to the pinkish roof building on the left, which was converted into a cistern. From the cistern, the water is used to water all the vegetation of the surrounding areas of the parking lot and the nearby baseball field. This building was built, or the project was built about 12 years ago, and is still in very good condition.

And finally, this is a pervious concrete street in Portland, Oregon, which demonstrates the ability to use pervious concrete also on roadways. I took a look at the street just the other night, Mr. Chairman, and to me, it looked even better, as shown in this picture. I can declare it as what we would project to be a 20 to 30 year pavement. Here you can see pervious concrete being poured onto a slab, where concrete, the moisture is expected to infiltrate at a rate in excess of 200 inches per square foot per hour, which is typical of what we get with pervious concrete.

NRMCA recognizes that sustainable development and environmentally friendly pavement technologies are balancing human needs with the Earth's capacity to meet them. Concrete offers a wide range of capabilities to help achieve this balance. In particular, pervious concrete offers a compelling solution to the many stormwater challenges confronted by communities around the Nation. NRMCA is a lead participant in the development of guideline specifications for the design and use of pervious concrete through

its participation on the American Concrete Institute's Technical Committee focused on this technology. In addition, NRMCA sponsors a national program for the certification of concrete, pervious concrete contractors that is delivered regionally and locally, and resulting in 1,200 certifications in the last 18 months.

Mr. Chairman, this concludes my statement. I would be pleased to answer any questions you or any of the Members of the subcommittee may have.

[The prepared statement of Mr. Huffman follows:]

PREPARED STATEMENT OF DANIEL J. HUFFMAN

The National Ready Mixed Concrete Association (NRMCA) appreciates this opportunity to share its views on green transportation infrastructure technologies and the challenges that exist to incorporating these technologies into current infrastructure projects.

NRMCA is a national trade association representing producers of ready mixed concrete and those companies that provide materials, equipment, and support to the ready mixed concrete industry. Our association has been working vigorously over the past several years to promote the broader use of concrete materials as an environmentally friendly technology. These technologies exist within the realm of concrete materials being broadly produced today especially as it relates to concrete pavements. Pervious concrete pavement is just one of many forms of concrete that are especially beneficial for environmental transportation related applications. In addition, there is a vast range of highly significant environmental qualities that conventional concrete contributes to transportation and all other environmental applications depending upon the targeted goal (i.e., urban heat island mitigation, energy savings, use of re-cycled materials, etc.)

**GREEN PAVEMENT TECHNOLOGIES**

*Pervious Concrete*

Material known as *pervious concrete* is especially compelling as a leading edge green building technology. It was reportedly first used in Europe more than 100 years ago for non-pavement applications, its limited use in the United States in pavement began only 20–25 years ago and primarily in Florida. In addition to offering the opportunity to deploy a major element of Low Impact Development (LID) and even initiate substantial Water Harvesting, pervious concrete already has established acceptance by the U.S. Environmental Protection Agency (EPA) as a recommended Best Management Practice (BMP) means of stormwater management on a local basis. However, it has recently garnered much attention due to increasingly stringent *Clean Water Act* stormwater management guidelines and particularly in response to the National Pollution Discharge Elimination System (NPDES) Phase II Stormwater Program. Among other modifications, Phase II applied guidelines to commercial projects sites of one acre or more and combined with the increasing focus on LID have greatly stimulated interest in *infiltration technology,* which is essentially what pervious concrete provides.

Pervious concrete is a performance-engineered structural material using the usual constituents of conventional portland cement concrete, only with little or no sand in the mixture, allowing for a 15–30 percent air void factor. Taking advantage of the corresponding decreased density, pervious concrete is incredibly permeable while still able to provide a quality structural pavement. Instead of moisture (i.e., rain/snow melt) running off the surface horizontally, virtually all stormwater falling onto the pavement is immediately infiltrated directly through the pavement and eventually into the subgrade. In most places in the United States, placed immediately below the pavement is an even more porous aggregate base layer that functions as a stormwater reservoir accommodating all the precipitation necessary for a design storm event. The depth and volume of the aggregate base layer is calculated relative to the percolation rate of the native soils along with the expected rates of moisture that need to be infiltrated over time. Where there are poor percolating soils or other hydrology challenges, outfall designs and supplementary drainage may be required for which perforated piping systems and other devices exist. Pavement design thicknesses are adjusted to meet the necessary load bearing capability for a broad range of applications. Properly designed and placed pervious concrete usually results in a pavement that can pass water at a rate in excess of 200 inches of rain per hour thus exceeding the requirements of almost any design storm event. The use of pervious concrete supports the many positives of infiltration technology in-

cluding both groundwater recharge and attempts to control increasing aquifer depletion.

*Pervious Concrete—Benefits and Costs*

Pervious concrete provides many environmental and some cost benefits by reducing stormwater volume, limits the amount of pollutants being carried away by runoff into our waterways, lakes, and oceans. However, in addition to improving overall water quality by reducing the volume of runoff, pervious concrete performs effectively as a filter of the moisture it infiltrates. The complex matrix of aggregate, hardened cementitious paste, and air voids retains at least 80 percent of the pollutant solids. With the aid of naturally occurring microorganisms also within the matrix of the pavement, a substantial level of treatment of the retained solids takes place which are only further enhanced by exposure to the elements over time (varying temperature and sun, etc.) It is generally accepted that what pollutants do pass through the pervious concrete system (including the granular base layer) are further converted by native soils and the total affect on groundwater is *positive* in terms of *water quality* and level of *replenishment*.

Far and away the most common application of pervious concrete is for commercial parking lots. Also, its use in residential street applications is slowly growing as is that for major pedestrian areas of all types, and there is increasing interest even for the largest of retail shopping centers. Unlike so many other green building technologies that may come with increased cost, most major utilizations of pervious concrete technology, such as for commercial parking lots, benefit from a lowered first-cost of construction when considered on an overall project site basis. While hard cost data is often difficult to obtain, that relating to the experience of one residential housing developer is perhaps representative of how the optimization of pervious concrete can lower the first-cost of construction and also provide additional revenue through increased site optimization:

In 2006, owner/developer Craig Morrison of CMI Homes in Bellevue, WA, completed the construction of a 20 home residential subdivision in Sultan, WA, called Stratford Place. 100 percent of the subdivision's original general hardscape was built with pervious concrete—roadway, driveways, and sidewalks. CMI has provided cost data supporting the cost savings resulting from the conversion from a site estimate using conventional asphalt pavement and traditional on-site stormwater detention to one where pervious concrete was actually used. While the developer is rather detailed in his calculations showing a net savings overall of approximately $264,000, he could also have projected increased net revenue relating to the development of two additional home sites he was able to add resulting from the elimination of the traditional stormwater treatment system.

The CMI case demonstrates that progressive owners and developers see the use of a green technology like pervious concrete as a public relations opportunity and have been rewarded by some agencies in the permitting process for proposing and building with green technologies. NPDES Phase II regulations requiring the treatment of runoff prior to it leaving a site presents very attractive cost and site optimization dynamics to an owner who deploys pervious concrete. The site optimization dynamic is not always easy to quantify in financial terms but it is frequently perceived by some owners as highly valuable. The positive for pervious concrete in this respect is that it has the ability to provide a multi-functional facility that to a stormwater professional will function as stormwater treatment system yet to a facilities owner it is a parking lot.

Moreover, traditional stormwater management devices such as retention/detention ponds, swales, and similar devices are greatly lessened and in most cases totally eliminated where pervious concrete is deployed on a major scale. In some cases, pressures are so great on major big box retailers to be responsive to stormwater regulations yet with the perceived increasing lack of "good sites" in most major metropolitan areas they sometimes spend millions of dollars per major big box store to construct underground stormwater treatment systems to accommodate an acceptable minimum amount of on-site parking. With the optimization of pervious concrete, an owner could instead eliminate the conventional devices (which may consume 10–20 percent of a site) and maintain or expand the area of his parking lot, possibly increase the footprint of his building, or use the increased optimization for some other revenue generating or aesthetic purpose. The bottom line economics strongly suggest that it is usually less costly to build with pervious concrete on an overall site basis compared to all that relates to traditional stormwater device utilization. Indeed, the financial benefits of increased site optimization are potentially highly significant and for a high volume big box retailer could be paramount depending on other site location dynamics.

Pervious concrete also has a number of other important benefits. Like conventional concrete it is a "hard-riding" surface that provides less resistance and therefore greater fuel efficiency. Pervious concrete can have a substantial effect on sound mitigation. Much of the sound of tires rolling on pavement relates to the way air is compressed and released "as the rubber hits the road." The open graded surface of pervious concrete diminishes this sound effect as it does much to allow air not to become trapped beneath moving vehicle tires. Instead, air can move relatively easily within the upper layers of the pervious concrete void matrix thereby muffling any road noise. There is also strong evidence that in many places in the country subjected to snowfall, snowmelt actually leaves the surface of pervious concrete much faster than that of conventional pavement because the moisture has a place to go—directly down. This rapid removal of snowmelt greatly limits the likelihood of ice formation on pavement due to snowmelt refreezing when day time sun and ambient temperatures may convert snow to liquid but then subjects it to becoming ICE when night falls, temperatures drop and it refreezes.

*Pervious Concrete Contributes to Environmental Protection*

A largely untapped and potentially huge opportunity exists for society to HARVEST STORMWATER. This could especially be of interest in the very dry climates of the far west and other areas of the country with increasing pressure on the water supply. While the strategy focused on green roof technology to harvest stormwater is sound and getting a large amount of attention, we are barely scratching the surface on the potential to broadly harvest stormwater through the technology pervious concrete represents. The amount of hardscape that is non-roof material offers vast potential. Taking the example of many retail shopping centers, the surface area of on-grade parking is generally considered to be three to four times that of the buildings it is serving. Why not use pervious concrete to harvest water for gray water re-use? The technology to do that already exists and is relatively simple. 12 years ago at Finely Stadium, a sports venue at the University of Tennessee (Chattanooga), a parking lot was constructed using pervious concrete in all the parking spaces. The water passing through the pervious concrete into the granular base reservoir is piped to an existing site adjacent building that was modified to become a cistern. The water that otherwise would have been pollutant carrying runoff 12 years ago has been used instead as gray water for watering not only the vegetation directly on the site but also a nearby baseball field.

Other important environmental benefits supporting the use of pervious concrete include its potential to save energy. Like conventional concrete, portland cement and other supplementary cementitious materials are used in pervious concrete pavement and are much LIGHTER in color than the binder used by their respective petroleum based counterparts. Concrete is vastly superior in light reflectivity, increasingly evaluated by Solar Reflectance Index (SRI), so the amount of night illumination and its corresponding energy could be greatly reduced where some concrete pavements are deployed. Additionally, concrete's superior position as a pavement to enhance urban heat island mitigation is well documented by the EPA and other study groups. The decreased density of pervious concrete also has a positive effect on heat island dynamics because of the way it simply absorbs less heat in the first place, a quality that may not specifically relate only to its superior SRI. As it relates to temperature dynamics, and beyond that directed primarily at the cost of energy, the concern for stormwater runoff's *thermal pollution* is also benefited through the use of pervious concrete. Unlike other man-made pavements, pervious concrete does not share the heat retaining properties that contribute to thermal pollution Less than optimally controlled levels of stormwater runoff are known to increase the temperature of streams, rivers, lakes, and perhaps may have some effect on ocean temperatures. This thermal pollution of waterways negatively effects the survival of fish and various riparian life.

*Energy Savings & Urban Heat Island Mitigation*

While energy savings and urban heat island mitigation are clearly not technologies, due to their critical roles in the battle to combat global warming, concrete's great potential to benefit in that battle must be addressed. While in the context of pervious concrete, energy savings was briefly discussed; *conventional* concrete may be even more underutilized as a means of providing impressive energy savings. The Solar Reflectance Index (SRI) data supporting the benefit conventional concrete provides due to its potential to lessen the need for night illumination is only one aspect of energy savings.

**Table 1. Solar reflectance (albedo), Emittance, and Solar Reflective Index (SRI) of select material surfaces[1],[2],[3],[4]**

| Material surface | Solar Reflectance* | Emittance | SRI* |
|---|---|---|---|
| Black acrylic paint | 0.05 | 0.9 | 0 |
| New asphalt | 0.05 | 0.9 | 0 |
| Aged asphalt | 0.1 | 0.9 | 6 |
| "White" asphalt shingle | 0.21 | 0.91 | 21 |
| Aged concrete | 0.2 to 0.3 | 0.9 | 19 to 32 |
| New concrete (ordinary) | 0.35 to 0.45 | 0.9 | 38 to 52 |
| New white portland cement concrete | 0.7 to 0.8 | 0.9 | 86 to 100 |
| White acrylic paint | 0.8 | 0.9 | 100 |

(1) Levinson, Ronnen and Akbari, Hashem, "Effects of Composition and Exposure on the Solar Reflectance of Portland Cement Concrete," Lawrence Berkeley National Laboratory, Publication No. LBNL-48334, 2001, 39 pages.

(2) Pomerantz, M., Pon, B., and Akbari, H., "The Effect of Pavements' Temperatures on Air Temperatures in Large Cities," Lawrence Berkeley National Laboratory, Publication No. LBNL-43442, 2000, 20 pages.

(3) Berdahl, P. and Bretz, S, "Spectral Solar Reflectance of Various Roof Materials", *Cool Building and Paving Materials Workshop*, Gaithersburg, Maryland, July 1994 14 pages.

(4) Pomerantz, M., Akbari, H., Chang, S.C., Levinson, R., and Pon, B., "Examples of Cooler Reflective Streets for Urban Heat-Island Mitigation: Portland Cement Concrete and Chip Seals," Lawrence Berkeley National Laboratory, Publication No. LBNL-49283, 2002, 24 pages.

The U.S. Green Building Council's LEED green building rating system recognizes the value of the albedo or reflectivity dynamic and allows credit toward LEED certification relative to SRI capability. The differences in pavement materials in night lighting situations is even more pronounced in wet weather conditions when "dark wet roads" seem to absorb the light given off by vehicle headlights which are only compounded when "puddles" and pot holes also exist. At least one extensive study documents that a 35 percent reduction in the amount of lighting required is warranted where conventional concrete is used instead of the most commonly used pavement material. Another means of taking advantage of concrete's superior SRI would not save energy but would improve public safety. That is, allow for the use of concrete pavement's increased brightness while not eliminating the additional light poles required of the other type of pavement so as to provide better night driving conditions on roadways and parking lots, and to improve pedestrian safety through increased night visibility. The option also exists for improved security in high crime areas due to increased brightness. Possibly, the best option is to take advantage of concrete's reflectivity to seek the middle ground in *energy reduction* and *safety* consideration relative to the specific environment—the best of both worlds.

The energy savings issue and conventional concrete's superior SRI are also closely linked to urban heat island mitigation dynamics. Where higher SRI materials are used, they are holding and generating less heat which in warmer climates would result in a corresponding energy savings especially as it relates to air conditioning utilization. Where some major urban areas are thought to have ambient temperature increases of up to eight degrees F. due to heat island effects, the potentials to mitigate with the expanded utilization of concrete pavements presents significant impact potentials not only on the immediate amount of energy consumption but as it relates to the negative health effects of ozone and smog, etc.

## MEASURING ENVIRONMENTAL IMPACT

Answering the question of what makes a product environmentally friendly is difficult and complex. It is important that there is a predictable and reliable process for answering this question because both citizens and their elected representatives

are concerned about the environmental consequences of producing and using various materials and products and they are demanding "green" products. This is the result of a societal awareness that consumption of manufactured products have an effect on resources and the environment. These effects, which can be direct or indirect, occur at every stage in a product's life cycle—from the extraction of the raw materials from the ground through the processing, manufacturing, and transportation phases, ending with use and disposal or recycling. One methodology increasingly in use today is life cycle assessment (LCA), which attempts to quantify these direct and indirect effects of products and processes.

LCA has the potential to have a significant impact on determining the true "greenness" of a material. Standards organizations such as the American Society of Testing and Materials (ASTM) and the International Standards Organization (ISO) have worked to develop consistent LCA methods and procedures in order to quantify environmental impacts. Notwithstanding these efforts, LCA continues to receive both positive and negative comment on its utility as a process to evaluate environmental impact. Part of the difficulty rests in the inability to define a common methodology to determine the life cycle environmental cost of a material. Another difficulty lies in locating reliable data on the performance of the material and the associated maintenance costs that occur over time. Indeed, despite all the activity in standards organizations and elsewhere, there is still debate within the LCA practitioner community as to whether a scientific basis exists for applying impact assessment techniques to the data derived from an LCA process analysis. Nonetheless, many standards LCA processes demonstrate that concrete's thermal mass, combined with an optimal amount of insulation, saves energy over the life of a building, thus reducing energy consumption in the building sector which accounts over 40 percent of greenhouse gas emissions from fossil fuels. However, NRMCA is not aware of any rigorous applications of LCA pavements to concrete pavements, pervious or otherwise.

However, environmental friendliness can be reasonably well determined through analysis and some level of reliance on existing green building rating systems such as the U.S. Green Building Council's LEED rating system, the Green Building Initiative's Green Globes program, or by EPA's Energy Star system. As it relates to general building, it could be noted that the U.S. General Services Administration and the Department of Defense (among other federal entities) have produced statements perceived as favorable toward LEED in particular. The basic focus areas of the LEED, Green Globes, and similar programs seem to be much the same. There is consistent emphasis on "Sustainable Sites," "Water Efficiency," Energy and Atmosphere" and "Indoor Environmental Quality."

It an open question as to whether LEED, Green Globes, or Energy Star are really suited to meet the needs of green pavement technologies. In this respect, leading members of the green community have concluded that the answer to the question of what is environmentally friendly is most apparent when actual use is considered. In the case of pervious concrete among the reasons it can be considered environmentally friendly is because it provides an effective means of improving overall water quality, it offers substantial support to Low Impact Development, it is included among the EPA's Recommended Best Management Practices as an element of stormwater management on a local/regional basis, and green building rating systems such as LEED and Green Globes clearly allow it to contribute to the credits registered projects can accumulate for certification.

**BARRIERS TO BUILDING GREEN**

The barriers to the acceptance and utilization of both established and developing environmental technologies by private enterprise are many. While the improved public relations opportunities and other values associated with green building are increasingly of interest, off-setting the perceived increases in first costs are still greatly at issue. Owners and their consultants are frequently challenged in their awareness of green building technologies. While organizations like the EPA are working to educate designers and builders, the lack of understanding by various agencies and especially at the local and State levels does not encourage the process. It is not that agencies and regulators are so often taking a position that overtly denies the utilization of a technology like pervious concrete, or LID for that matter, it is more likely that their Best Management Practices (BMPs) just don't address such.

NRMCA has a National Accounts program which I direct on a national basis and includes a team of technical/promotional professionals who operate primarily from various regional bases and are focused accordingly. Our mission is to provide *technology transfer* relative to the use of concrete to the entities both public and private that have the opportunity to influence the selection of particular building materials.

Though primarily focused on private enterprise we attempt to cover the bases with federal agencies as well. Among the largest facilities owners we have established relationships with are the big box builders and the largest commercial developers otherwise, and a large number of consultant organizations to those builders and developers.

A challenge for us comes in the ability to gain acceptance of a technology like pervious concrete and other technologies such as insulating concrete wall systems that have the potential to save as much as 35 percent in the cost of heating/cooling a home. While regulations and codes that simply do not address pervious concrete technology are certainly barriers to acceptance, some of the challenge is simply "human." When presented with an unfamiliar LID technology, the difficulty that some people have with pervious concrete is not that it is LID, but that it is not an existing, established convention. The relatively simple concept of allowing moisture to fall to Earth, pass immediately through the filtration process pervious concrete provides and then infiltrated in most applications without additional conveyance and process is difficult for some to accept. That is not to say that there cannot be legitimate concerns about various soils related dynamics and other aspects of hydrology. However, numerous designers and acknowledged experts in the field such as Bruce Ferguson, Franklin Professor and former Director of the School of Environmental Design at the University of Georgia, and author of the book, *Porous Pavements,* suggests that it is usually within the capability of sound engineering and hydrological design professionals to overcome many of those perceived obstacles. Professor Ferguson goes on to say, "The observed, measured, documented, scientific fact is that properly designed, installed, and maintained pervious concrete is structurally durable and environmentally beneficial. Proven facts allow us to discard blindly uniform convention, and to select the most appropriate technology for each separate site-specific situation."

**FEDERAL INCENTIVES TO BUILD GREEN**

Federal support to innovative building technologies can come through a variety of means. States and local governments are proving that modest tax credits can stimulate market interest in green building practices by offsetting any additional up-front costs such as energy modeling and commissioning. Tax credits should be tied to green building technologies that deliver promised results and speed overall market transformation. Such tax credits should apply to both the commercial and residential markets.

Funding programs that are focused on increased awareness of existing data, most of which is highly supportive of the technology would not have to be very costly as perhaps the largest challenge is the awareness and acceptance of existing data. Empirical data already exists that is the result of research grants or was developed by a host of universities and other researchers across the country. Much of this data suffers from lack of circulation perhaps because it is generated primarily by private enterprise. The American Concrete Institute's Technical Committee—522—Pervious Concrete perhaps collates such data more than anyone else, but communication of this technology may not exist by any formal means to government agencies at any level. Federal funding to insure such data is transferred on an appropriate basis and broadly distributed would do much to move awareness of existing data forward.

Funds specifically earmarked for agency personnel to attend national, regional, and local programs that are increasingly available on specific innovative technologies like pervious concrete would also be highly beneficial. In the spring of 2006, a major national symposium on pervious concrete took place in Nashville, TN, was sponsored by NRMCA with a call for technical papers widely advertised. While the private sector sent people from all parts of the country attendance by agency personnel was limited. On an on-going basis, NRMCA sponsors regional seminars (10 or more in 2007) charging moderate prices and are presented by some of the top technologists in the industry. These would be excellent venue for agency officials to pick-up existing technology on pervious concrete.

Increased research grants and tax incentives for building that would deploy targeted new technologies would be of huge benefit. A positive model currently funded and under final development relates to the cooperative effort and partnership between EPA's Region III and NRMCA where strong leadership and support by Dominique Lueckenhoff, Associate Director for Water Quality, has led to a research grant for Villanova University to evaluate the water quality and other capabilities of competing porous pavement systems, in this case, pervious concrete and porous asphalt pavements. The grant funding has come from EPA and assistance from the RMC Research and Education Foundation.

Positive programs supportive of new technology also exist at the State and local level that would be highly worthy of federal support. One fine example of such re-

lates to Snohomish County, Washington's goal of implementing Low Impact Development. Snohomish County, WA, is one of a very few, and the first in the State of Washington to do so. Ref: Snohomish County Ordinance 06–044, adopted July, 2006. This ordinance creates staff leeway to approve methods which they determine to meet the County's storm water management goals, and provides incentives to developers who use LID methods and materials. These incentives are in the form of expedited permit processing, which results in real monetary incentive to the developer, who gets to shorten his development period, and get properties to market sooner. A technology like pervious concrete has a much better opportunity to be utilized in this environment and meets the environmental goals of a highly environmentally sensitive area such as the Puget Sound Area of Washington.

NRMCA appreciates the opportunity to present this statement for the record.

BIOGRAPHY FOR DANIEL J. HUFFMAN

Based in Portland, Oregon, Dan is the Managing Director of National Resources for the National Ready Mixed Concrete Assn. (NRMCA) a Silver Spring, MD, headquartered non-profit national trade association. For more than 25 years he has worked throughout the west and nationally with owners, designers, contractors, and concrete producers while employed by various concrete materials companies including those producing ready mixed concrete and aggregate, concrete paving, portland cement, fly ash pozzolan, and various admixtures for the modification of concrete.

Dan is a member of the American Concrete Institute's (ACI) Board Advisory Committee on Sustainable Development, and is a voting member of ACI's technical committees on "Pervious Concrete" and "Design & Construction with Insulating Concrete Forms." Most of Dan's focus is now on technology transfer relating to sustainable construction and the potential for advancement of "green building with concrete" technologies—and a national team of Resource Directors employed by NRMCA in every region of the country report to Dan.

Chairman WU. Thank you, Mr. Huffman. Mr. Kassoff, welcome to the Committee.

## STATEMENT OF MR. HAL KASSOFF, SENIOR VICE PRESIDENT FOR SUSTAINABLE DEVELOPMENT, PARSONS BRINCKERHOFF

Mr. KASSOFF. Thank you, Mr. Chairman, Members of the Subcommittee. My name is Hal Kassoff, with PB, Parsons Brinckerhoff, a global engineering consulting firm, and I also served for 12 years as State Highway Administrator in the State of Maryland. I very much appreciate the opportunity to be here.

Five years ago, while with PB, I was asked by a colleague, who was leading a company-wide sustainability initiative for buildings and transportation, whether I thought the case could be made for highways as a net contributor, rather than a net detractor, in terms of sustainable development. I took on the assignment, and began researching, writing, and speaking about what I called Sustainable Highways: Oxymoron or Opportunity.

I define sustainable highways as improvements which achieve better than before outcomes, not only for highway purposes, such as safety, mobility, and structural integrity, but also for broader environmental and societal goals.

While not as advanced in sustainable development as buildings, and not as inherently sustainable as public transportation, there are several underlying reasons why the concept of sustainable highways is an idea whose time has come. The first is that an increasingly demanding and politically active customer base, the people we serve, want improved transportation and a healthy environment. They are not willing to sacrifice one for the other.

Second is that over 90 percent of highway improvements are on existing, rather than new facilities, a radical change from the re-

cent era of interstate highway construction. This offers a unique opportunity to improve communities and the environment by virtue of a second generation of highway projects that must adhere to much more stringent requirements, such as for air quality, noise, wetlands, water quality, endangered species, historic preservation, just to name a few.

The third factor is that for the past seven or eight years, AASHTO, the American Association of State Highway and Transportation Officials, has advanced the concept of environmental stewardship, accepting responsibility for the environment as affected by transportation improvements. Perhaps even more importantly, seeking practical and affordable ways to enhance it. By actively approaching and promoting an approach to project development called context sensitive solutions, AASHTO provides the single most important tool to fulfill environmental stewardship and sustainability goals. And more recently, AASHTO initiated a process to define and advance a vision for sustainable transportation throughout this country, with the assistance of a national panel of professionals, which I had the privilege and honor of chairing.

A fourth factor is that sustainable highways makes good business and good economic sense from several perspectives. On a project level, they contribute to economic efficiency, since context sensitive and sustainable highway improvements are more likely to be supported and implemented much faster than less contextual and less sustainable alternatives, which are more likely to languish. Also, from a life cycle asset management perspective, investing in increased durability and preventive maintenance means lower life cycle costs, less consumption of nonrenewable resources, and reduced economic losses to shippers and travels, who are delayed less frequently by repairs and reconstruction. And let us not forget the role of highways in an ever expanding recycling industry, which is second to none.

There are many opportunities for sustainable highway practices, from the earliest phases of planning, where land use and conservation and transportation decisions can be better coordinated, as encouraged by SAFETEA-LU legislation, to technologies for fast track construction, managing traffic, and reducing impacts during and after construction. These opportunities are articulated in a series of tools, with which we were associated, including a compendium of environmental stewardship practices in construction and maintenance, and a 30-page highway sustainability checklist, which covers planning all the way to operations. These opportunities are underscored by the cooperative Green Highways Partnership that you have already heard about from EPA and Federal Highways.

Perhaps the greatest barrier to sustainable highways lies with motor vehicles that use these highways, and in particular, the carbon footprint and related air quality and climate change issues that arise. A sustainable highways concept that ignores motor vehicle issues represents just part of the puzzle.

The second barrier has to do with the land use decisions that can exploit and ultimately degrade highway service and the quality of life through strip development and sprawl, problems, by the way, that Portland, Oregon is noted for having overcome in your home district, and I congratulate Portland in that regard.

Finally, as a way to simultaneously induce, as well as measure sustainability outcomes in infrastructure, we can apply a framework known throughout the world of sustainable development. Mostly outside the United States, as the Triple Bottom Line, a framework to set targets, measure progress, and evaluate whether and to what extent the so-called better than before outcomes are indeed achieved as we pursue a robust economy, a healthy natural environment, and an enhanced quality of life, which we all certainly want. The Triple Bottom Line has the potential to offer incentives and inducements to public as well as private sector decision-makers to pursue sustainability strategies and initiatives without mandating the details of how to achieve these desired outcomes. I would strongly recommend research into the best ways to apply this Triple Bottom Line tool in the United States.

In sum, the goal of sustainable highways may, at first, sound like an oxymoron, but in reality, represents an opportunity whose time has come. Thank you.

[The prepared statement of Mr. Kassoff follows:]

PREPARED STATEMENT OF HAL KASSOFF

## Sustainable Highways: Oxymoron or Opportunity

Mr. Chairman and Members of the Committee, my name is Hal Kassoff. I am a Senior Vice President and Highway Market Leader with PB, a global infrastructure consulting firm with 200 offices worldwide. Thank you for the opportunity to share these thoughts with you today.

Five years ago I was asked by a colleague who was leading a company-wide sustainability initiative for buildings and transportation whether I thought the case could be made for highways as a net contributor rather than a net detractor in terms of sustainable development. I took on the assignment and began researching, writing and speaking about what I called "Sustainable Highways: Oxymoron or Opportunity."

I define sustainable highways as improvements which achieve "better than before" outcomes, not only for highway purposes such as safety, mobility and structural integrity, but also for broader environmental and societal goals.

While not as advanced in sustainable development as buildings, and not as inherently sustainable as public transportation, there are several underlying reasons why the concept of sustainable highways is an idea whose time has come.

1) The first is that an increasingly demanding and politically active customer base is expecting more of us. Our customers want improved transportation and a healthy environment. They are not willing to sacrifice one for the other.
2) Second is that over 90 percent of highway improvements are on existing rather than new facilities—a radical change from the recent era of Interstate highway construction. This offers a unique opportunity to improve communities and the environment by virtue of a second generation of highway projects that must adhere to more stringent requirements, such as for air quality, noise, wetlands, water quality, endangered species, and historic preservation, to name just a few.
3) The third factor is that for the past seven or eight years, AASHTO (the American Association of State Highway and Transportation Officials) has advanced the concept of environmental stewardship—accepting responsibility for the environment as affected by transportation improvements, and seeking practical and affordable ways to enhance it. By actively promoting an approach to project development called Context Sensitive Solutions, AASHTO provides the single most important tool to fulfill environmental stewardship and sustainability goals. And more recently, AASHTO initiated a process to define and advance a vision for sustainable transportation with the assistance of a diverse panel of professionals which I have had the honor of chairing.

4) A fourth factor is that sustainable highways make good business and economic sense from several perspectives. On a project level, they can contribute to economic efficiency in that context sensitive, sustainable highway improvements are more likely to be supported and implemented than less contextual and less sustainable alternatives which are more likely to languish in controversy. Also, from a life cycle asset management perspective, investing in increased durability and preventive maintenance means lower life cycle costs, consumption of fewer non-renewable resources, and reduced economic losses to shippers and travelers delayed by less frequent repair and reconstruction cycles. And, it should not be overlooked, the role of highways in an ever expanding recycling industry is becoming second to none.

Opportunities for sustainable highway practices abound, from the earliest phases of planning where land use, conservation, and transportation decisions can be better coordinated, as encouraged by SAFETEA–LU, to construction, maintenance and operations where new technologies for fast-track construction, managing traffic, reducing noise, controlling emissions, and suppressing dust offer an array of possibilities. These opportunities are articulated in a variety of tools such as the Compendium of Environmental Stewardship Practices in Construction and Maintenance to a 30-page highway sustainability checklist from planning to operations—in both of which I am proud to say PB, and I personally, have been involved.[1] They are evidenced by the cooperative Green Highways Partnership advanced by EPA and FHWA as well as several State DOTs.

Clearly the state-of-the-art is advancing at a rapid pace as demands for kinder and gentler infrastructure projects increasingly prevail.

Perhaps the greatest barrier to sustainable highways lies with the motor vehicles that use them and in particular, the carbon foot print and related air quality and climate change issues that arise. A sustainable highways concept that ignores motor vehicle issues represents just part of the puzzle.

A second barrier involves land use decisions that exploit and ultimately degrade highway service and quality of life through strip development and sprawl that discourage walking and use of alternative modes. Land use planning, zoning and utility location decisions must be made in conjunction with transportation to shape a more coherent and sustainable approach to growth.

Finally, as a way to simultaneously induce as well as measure sustainability outcomes we can apply a framework known throughout the world of sustainable development (mostly outside the United States) as the "Triple Bottom Line"—a framework to set targets, measure progress, and evaluate whether and to what extent better than before outcomes are indeed achieved as we pursue a robust economy, a healthy natural environment, and an enhanced quality of life. The triple bottom line has the potential to offer incentives and inducements to public as well as private sector decision-makers to pursue sustainability strategies and initiatives without mandating the details of how to achieve desired outcomes. I would strongly recommend research into the best ways to apply this tool in the United States.

In sum the goal of sustainable highways may at first sound like an oxymoron, but in reality represents an opportunity whose time has come.

## BIOGRAPHY FOR HAL KASSOFF

Hal Kassoff is a Senior Vice President with PB responsible for providing leadership in emerging highway-related practice areas. Mr. Kassoff has guided the development of a workshop on Sustainable Highways which he has delivered to clients and PB professionals worldwide. He also led the team that produced the NCHRP Compendium of Environmental Stewardship Practices in Construction and Maintenance, and was recognized by AASHTO with an award for developing a Highway Sustainability Checklist. Mr. Kassoff led a team that produced PB's reference guide for Concepts in Contextual Highway Design as well as a training seminar in Context Sensitive Solutions.

Prior to joining PB, Hal spent 25 years with the Maryland Department of Transportation, including six years as Director of Planning and Preliminary Engineering and 12 years as State Highway Administrator. During Hal's tenure, the Environ-

[1] The referenced compendium is a research report under the National Cooperative Highway Research Program (NCHRP 25–25 (4)) and can be found on the website of AASHTO's Center for Environmental Excellence at: *http://environment.transportation.org/environmental_issues/construct_maint_prac/compendium/manual/* The referenced checklist was developed by PB and recognized by AASHTO in its 2007 National Competition Award for Transportation Professionalism. The checklist may be accessed by contacting Hal Kassoff at *kassoff@pbworld.com*

mental Design Division was established and SHA was recognized for its aesthetic and environmentally sensitive bridges and highway designs.

Hal has been a frequent speaker and has published a number of articles on Context Sensitive Solutions and Sustainable Highways.

## DISCUSSION

Chairman WU. Thank you very much, Mr. Kassoff. Now comes the time for questions, and the Chair recognizes himself for five minutes.

Commissioner Adams, you mentioned that there are several challenges faced by the City of Portland in implementing its green streets initiative, and I would like you to line out, or lay out for us what some of those challenges are, how the green streets initiative would interact with existing stormwater management systems, and that if the green streets initiative could have been fully implemented, what the impact would have been on stormwater runoff, both in terms of costs and effectiveness.

Mr. ADAMS. Thank you, Mr. Chair, Members of the Committee. Starting in 1994, and for a series of years, including up to the last years that I have been Commissioner in charge of transportation and environmental services, we have sought partnerships with the EPA on a number of green stormwater-related projects, and indeed, we have achieved some of those partnerships with EPA. But I would personally characterize the partnerships as, the green transportation partnerships as, in addition to the normal requirements of the grey pipe solutions.

So, for instance, our sewer retrofit, which is a $1.4 billion digging up of the sewers, big pipes, and everything else, when we asked them to supplement some of that grey pipe solution for some green stormwater solutions, they said no, and in fact, used that as the impetus, one of the impetuses for a six year investigation of the City that is still open and ongoing today. So, there are parts of EPA that I find to be very interested in the partnerships around green stormwater, especially related to streets, and there are other parts of the Agency where we have experienced quite the opposite.

I understand the reluctance to put too much reliance on green stormwater solutions that don't have, you know, the stamp of approval of the EPA, but I would hope that the most recent good words that we have heard from the EPA on green stormwater would have happened sooner.

Chairman WU. Thank you. You referred in your testimony to an unclear regulatory environment, and that there might be a long series of steps, so that more municipalities or local jurisdictions would enact green streets approaches to stormwater. What are some of the steps that you think are necessary, and what are some of the clarifications, from a regulatory perspective, that you think are necessary to promote green technologies in stormwater treatment?

Mr. ADAMS. Thank you, Mr. Chair, Members of the Committee. I think one key issue is, to get to those standards, is to support a national program of research and development around green infrastructure technology and specifically around green transportation stormwater technologies. A national technology development program, I think, builds on the EPA's recent green infrastructure

statement of intent, and your Congressional statement of support for green infrastructure.

Local governments, again, need to know what the measures of success are. Mr. Grumbles talked about we are not going. The EPA is not going to dictate the solutions, but we need to know, you know, what the measures of success are, the results that they are looking for, and projects that we can then go after.

The other is that the specific green transportation stormwater tools for Portland should and will be different than the same tools in other parts of the United States that have different terrains, different climates, different weather patterns. So, as—if the EPA would help work with local governments and State governments to develop some standards and approaches, they need to, in my opinion, they need to do it based on the different kinds of terrains that exist in the United States.

The other is, as mentioned by my fellow witnesses up here, and this is to really put some rigor to the costs and benefits around the green transportation technology. We would welcome that. We are seeing savings, and there are parts of our city, like a lot of the cities around the United States, where the existing sewer infrastructure, the pipes are too small, or where there is new development, or an expansion of the city, where new pipes have to be laid. What we are experiencing is significant savings by not having to go in and put in bigger pipes, but implement green stormwater solutions, that keep the stormwaters out of the pipe; therefore, we don't have to dig them, and we realize significant savings in terms of where the city is expanding and not having to put the pipes in under the street in the first place to deal with that stormwater runoff from the streets saves money for everybody.

Again, we want to feel assured that what we are doing is going to meet with EPA's approval in the future. So, those standards, I think, are really key, and agreement among the Federal, State, and local governments around some cross benefit methodologies would be incredibly useful.

Chairman WU. Thank you, Commissioner. My time has expired, but at some point in the future, if there are records of, or estimates of what potential cost savings might be achieved, the Committee would be very, very interested in that information.

And with that, I turn to the Ranking Member, Dr. Gingrey.

Mr. GINGREY. Mr. Chairman, thank you. We touched on this a little bit before we had to break for votes, but this is, of course, extremely, extremely interesting testimony.

And I think my question before was, pertained to best management practices, depending on the environment, and where you are, and how much rainfall, but not just the total quantity per year. I am not really sure that Oregon gets that much more, maybe Georgia has average rainfall is closer to 50 inches per year. So, it is more, I think you said 37 for Oregon. But it comes in a different way. I am sure we get a lot more thunderstorms, and you get a lot more gentle, steady rain that everybody likes, and likes to hear at night, particularly, if you have got a tin roof on your house. But Florida and Georgia are a little bit different.

And so, I guess the point, and any one of the three of you can address this, because Mr. Huffman, obviously, is in the business,

and Mr. Kassoff, in his testimony, is very knowledgeable about this as well, different strokes for different folks, I guess is what I am talking about. I know we were recently in Hamburg, Germany, looking at all these windmills, and the discussion was well, you know, this is great, and this is the Germans talking, German scientists, in regard to renewable energy sources, and they said well, these windmills are great up here in Hamburg on the North Sea, but they wouldn't do a whole lot of good on the equator, whereas the solar panels would probably be very, very efficient on the equator, but those windmills wouldn't get you a lot of bang for the buck.

So, it is this issue of best management practices, depending on where you are, and clearly, one size will not fit all, and if the Federal Government, and our two previous witnesses, Ms. Shepherd and Mr. Grumbles, of course, of the EPA and the Federal Highway Department, the bureaucracy tends to want to try to squeeze a one size fits all mantra.

Talk about that for us a little bit, and how we can approach it, and Mr. Huffman in particular, the pervious concrete, I think, is very interesting, the pictures or the slides that you showed, extremely interesting, and how, what does that do to the strength of the concrete, you know, over the old, traditional, rock solid concrete with rebars and all that stuff, and I am looking at something I have never seen before. Maybe you could explain that to us, and whether or not that would be applicable, also, to asphalt surfaces.

Mr. HUFFMAN. Thank you, Ranking Member Gingrey, and Members of the Committee.

As it relates to concrete and the one size fits all, the bigger product area that is sometimes cast upon us relates to porous pavements generally, and within that, there is certainly a difference between pervious concrete and some other porous or pervious materials. For example, pervious concrete, like its counterpart on the asphalt side of the industry, takes large stone and sand from our conventional technologies of conventional concrete, that is also used with Portland cement binder, which provides a very rigid binding material. We take the sand out, and we create a void structure. The competing material, which is a petroleum-based product, which is frequently referred to by highway engineers as flexible pavement, uses asphalt as a binder. They have large rocks in their conventional product, and they also take the sand out, so basically, the products are much the same in terms of larger rocks and a binder, with little or no sand.

The benefits of concrete in that situation, especially, to be distinguished from a competing material, is that the rigid binder is ideally situated, or positioned, to allow for a voided product, with 15 to 30 percent void factors, and stays rigid. In respect to your question about strength, yes, it is true, as we take the voids out, and allow for decreased density, the product does lose some compressive strength. We compensate for that by increasing the depth of the structure, typically by about a 50 percent factor. So in a parking lot, for example, typically, a conventional concrete parking lot is four inches in thickness, and with pervious concrete, because of the decreased density, we increase the thickness to six inches. So, that is the way the technology works.

Mr. GINGREY. Is it cheaper, and I am not sure exactly how you measure it and how you price it, but is it more expensive, and I am assuming the answer is yes, to put in your product for the long-term benefit? A lot of times, you have got developers who are developing strip shopping centers and that sort of thing, and the cost is obviously a factor. Do you get resistance from that?

Mr. HUFFMAN. We get resistance because in first costs, certainly, the use of a product like pervious concrete, versus a conventional pavement material, is going to be somewhat higher. The offset, that it greatly advantages the environment and the concept of using this, is that because we will eliminate conventional stormwater detention on most applications, such as parking lots, we will actually save in the first costs of construction when we use a material like this. For that reason, many big box builders and major shopping mall developers, anybody building big parking lots, see this very favorably.

Mr. KASSOFF. Ranking Member Gingrey, I would like to address your point about the one size fits all issue, in terms of how the government might approach this issue of sustainability and sustainable highways.

First, I think we have all learned over the years that specifying outcomes, desired end results, and then, leaving flexibility to other parties, states, local governments, private industry, to figure out how to achieve those outcomes, works better than specifying detailed methods, because we are such a diverse country, and what works in one place doesn't necessarily work in another.

And then, extending that idea, and we have given an awful lot of thought to this idea, of whether you could legislate or regulate sustainability into effect. In the highway business, and I sense that you have some familiarity with how that works, you can call your commissioner, Former President of AASHTO by the way, and one of the leading transportation officials in the country.

The principle that has been established for the past 20 to 30 years under NEPA. NEPA is actually older than that, but what had evolved is this idea that when impacts are created by transportation facilities, the first order is try to avoid them, the second is to try to minimize them, and the third is with whatever impacts are minimally necessary, you must mitigate those impacts, which means a restoration idea. And it engenders an avoidance of harm, and then, a compensation for harm by trying to draw even through mitigation. What sustainability, and that, by the way, has found its way into regulation, and it is appropriate, if we—I like to use the term, if we create a mess, our obligation is to clean it up and fix it.

There are serious questions whether that approach alone will move us towards sustainability, especially since we have started with, as you pointed out, some damage to the environment, just by the works we have accomplished over the years. We are very proud of these works, but there have been these unavoidable impacts.

The sustainability idea, founded on environmental stewardship, which is better than before, transforms the mentality from avoiding a negatives approach into a create positives. And the create positives approach, I think, can come about through, more likely to come about through, a series of initiatives and steps that the Fed-

eral Government can take, other than regulation and hard legislation. It could be incentivized, for example. It can be recognized that as the Mid-Atlantic Region EPA Region has demonstrated through their green highways initiative, that through cooperation they are much more likely to achieve a faster turnaround and a better end result than by just riding the minimums.

So, I think what we are looking for is performance outcomes rather than methods. In the first instance, a level playing field for minimum requirements to avoid, minimize, mitigate, and then, an incentivization through articulation of principles and policies, right down to some form of recognition that by going the extra step, there are benefits to be achieved.

Mr. GINGREY. Thank you. Thank all of you.

Chairman WU. I would like to recognize Dr. Ehlers for five minutes.

Mr. EHLERS. Thank you, Mr. Chairman, and I have to say it really warms my heart to hear the testimony. Many years ago, when I was a county commissioner, I also chaired the County Board of Public Works, and tried to introduce the ideas of sustainability in a number of ways, met tremendous resistance, particularly from the engineers, who said you know, just another do-gooder trying to mess up our profession. Fortunately, I am a physicist, so I could tend to argue them down sometimes, but not all the time.

And also, Mr. Chairman, I have to note, since I am a scientist, I always try to correlate data I observe, and I have noticed something amazing about this committee. A very disproportionate number of the witnesses tend to come from Portland, Oregon.

Chairman WU. It is means as a forward thinking.

Mr. EHLERS. Yeah. I am having trouble—I haven't quite determined the correlation yet, but I will figure it out.

I just want to comment, the examples you have given are primarily from Portland, and Mr. Gingrey talked about Georgia and so forth, but what about the frozen North? Michigan has a particular problem, and I am from Michigan. We are even worse off than Minnesota and Wisconsin, which are to the west, because there, it freezes and it stays frozen for four months, and then thaws. In Michigan, it freezes and thaws every couple of weeks. We have an incredible amount of freeze-thaw cycle, which really weakens our systems, and leads to a lot of maintenance problems.

How does pervious material work in a constant freeze-thaw cycle? And in particular, if you have a roadway get a lot of water in, it freezes very hard at night, and may stay that way for several days, what does that do to the permeable surface, or the pervious surface, I should say? Any comments?

Mr. HUFFMAN. I definitely have a comment, Congressman Ehlers, and Members of the Committee, thank you.

The American Concrete Institute and other organizations have done extensive studies to determine the freeze-thaw durability of previous concrete, in particular, and we have mostly empirical data, but there are laboratories at universities across the country that are evaluating it also under laboratory conditions. And their findings are very supportive of its use for freeze-thaw durability climates.

I can assure you that before major big box builders went in to a city like Denver, which they claim to have more cycling than anybody in the country, but there are some other places that would make the same claim, they looked very carefully at this technology, and with their consultants, they determined that the data that we presented was sufficient, and it is being well proven in the field in a number of, in all applications that we know of, and after probably more than ten years at various locations around the country, we are not aware of any suspected deterioration anywhere due to freeze-thaw cycling with pervious concrete.

Mr. EHLERS. Up in Eastern Michigan?

Mr. HUFFMAN. I think on a very limited basis, that would be driveways and sidewalks and such, nothing that would be a well documented commercial application.

Mr. EHLERS. I would be very interested to see. Denver, in spite of the fact they claim everything, certainly has big swings in the freeze-thaw cycle, but they have far less frequent freeze-thaw cycles than the Upper Midwest does, so well, when you find some data, or you find some people in Michigan, I would be very interested, if you encounter that some time in the future.

Mr. HUFFMAN. Yes, sir.

Mr. EHLERS. With that, Mr. Chairman, I yield back.

Chairman WU. Thank you. Mr. Huffman, let me follow up on that research, or research and development question, and with respect to high traffic or high use areas. Are there further areas of research that are necessary before permeable pavements are used? The examples that you showed earlier are very impressive, but those tend to be in parking lot settings. What about high use environments like highways?

Mr. HUFFMAN. Yeah. You are absolutely right. There isn't yet enough data to support the use in highway applications, in particular. It is the speed of traffic, it is not necessarily the loads that are carried in terms of 18 wheelers and such. We have actually been able to handle those loads in parking lot applications well with pervious concrete. But more study is definitely required relative to highways.

Chairman WU. Thank you. And Mr. Huffman and Mr. Kassoff, are there some challenges in acceptance of this technology by buildings and, you know, the construction industry? Are there further steps that need to be taken, either in the public or private sector, for faster takedown of these technologies?

Mr. KASSOFF. The national organization that all of the State Departments of Transportation belong to, AASHTO, we have mentioned it several times, has a national testing program. Each state has its own laboratories, but they have a more efficient, integrated approach in recent years for industry to bring products for testing and evaluation, and I think as, again, we look for outcomes and we leave industry with flexibility, the need for those testing programs is even greater. The mechanisms are definitely there.

There is no question that more research into the hard technology is needed, as well as the application of the institutional framework of Triple Bottom Line that we mentioned earlier. But yes, that would all contribute to advancing sustainability in infrastructure more rapidly.

Mr. HUFFMAN. Chairman Wu, thank you. I would like to add that the major owners in private enterprise are generally supportive of this technology, and what happens is when they move down to the regional and local level, they very often are faced with regulators who just are not yet aware of the technology, in spite of the fact that it is an EPA best management practice for first-flush pollution mitigation, and the EPA is very supportive. Many of these agencies don't have BMPs relating to low impact development, much less pervious concrete, and as they transition in that direction, we will expect that they will find the means to become knowledgeable enough to be positively responsive.

Chairman WU. So, that local level of regulation is also very important in the takedown of this technology.

Mr. HUFFMAN. Absolutely, sir.

Mr. KASSOFF. And I would just add, that in addition to regulation, I think part of what Mr. Huffman is talking about, and I would second, is education. It is a broadening of the horizons of what is possible, so that the engineers that Congressman Ehlers encountered in the future are engineers who are seeking out these alternatives and have places to go for referents to find that they do work.

Chairman WU. Commissioner Adams, you showed me some residential developments, which were truly outstanding, and the thoughtfulness with which they planned out the disposition and the flows of groundwater. Some developers do that, some developers don't do that. What are some of the factors that go into that private sector developer decision, and what can we do to encourage more residential development that uses green street concepts?

Mr. ADAMS. Thank you Mr. Chair. I think we in the local level in Portland, as I touched on earlier, have been first doing our own research and development, so that we can prove to ourselves and the private sector that the green stormwater approach works, whether it is on the public right of way or on the private side.

We also regulate. We have a stormwater development manual that, for new construction, establishes that minimum amount of a minimum green stormwater approach to new development or major renovation of existing buildings. But then, we also try to—we don't like to rely just on regulations. Our preference is to be partners with the private sector, because it can be a win-win.

When a developer develops in a manner that takes existing stormwater off the system, that saves us money. In the short-term it saves us money because many of our pipes are 80, 90 years old, and therefore, inadequate or too small to handle the increased density of the City of Portland. We will also partner with developers by paying them a portion of the cost to do a green stormwater development or treatment of their parking lots and of the development that they are looking at, because we actually make it back in savings over a very defined and a pretty quick period of time.

So, in some ways we have actuarial sort of experience now with how much we can incent the private sector to do the right thing, and when we will get, when the ratepayers, the city's ratepayers for the sewer agency actually will get that benefit back.

Chairman WU. Thank you very much. Dr. Ehlers, further questions.

Mr. EHLERS. Just a follow up, and then, I think we will all be wrapped up here.

Mr. Kassoff, you have gotten off relatively free so far. I just wanted to pick your brain about, since you have a lot of background in State DOTs and AASHTO. I would like some idea from about, first of all, what kind of barriers do you run into when advocating these new approaches? Can you also tell the Committee about how these group efforts that we are talking about here play into the green highway R&D and implementation efforts?

Mr. KASSOFF. I think the principal barrier is one of lack of awareness and, in some cases, leadership. When we have leadership that says we are going to be green, and we are moving in the direction of sustainability, and we are going to challenge you, the engineers in our agency, to come up with different ways to achieve that, the juices start flowing. Actually, people move out of their comfort zone and create solutions.

And we have seen this in case after case. Oregon is a State that is a leader in this regard, as is Washington State, New York, and my home State of Maryland. So, it is very much a cultural and leadership type of issue. And it is a matter of comfort zone. It is a matter of where the central tendency is, as a physician, and you, as a physicist I should say, you understand that. If the central tendency is to just repeat what you have been doing in the past in your comfort zone, that is where you remain, but if the central tendency, because it is part of the organization's culture, is to experiment, to try to fulfill a broader purpose, such as sustainability outcomes, or green outcomes, then that is the way the engineers will want to move.

Engineers are problem-solvers, and I think they thrive on challenges. Just going back to the same old manuals and the same old practices, which don't achieve these new expectations, is not the height of engineering to most professionals.

Mr. EHLERS. My personal experience, most of the opposition came not so much from the engineers, once they understood what was happening to the field, but from local government leaders, who are afraid of headlines about this wonderful new project that came in 25 percent over budget, et cetera, and that is the big fear. And so, it tends to spread rather slowly, but the best thing is to have success, present papers at national conferences, the National Association of Counties, the Municipal League, et cetera, and that then convinces them.

I have no further questions, Mr. Chairman.

Chairman WU. Well, I thank you for that comment, and I am glad that Commissioner Adams has had a platform to talk about some local successes. Unless Dr. Gingrey comes back from the Floor in the next few minutes, or unless Dr. Ehlers has any further questions, I only have one further inquiry, and that is for Mr. Huffman and Mr. Kassoff.

What sources of federal support, if any, whether it is grants or technical assistance, or other forms, have been of assistance to you in developing green streets technology and permeable pavement technology, and how can we adjust those federal efforts to be best supportive? And Commissioner Adams, if you want to take a shot at that also, you are very welcome to.

Mr. HUFFMAN. I am not sure where I have seen the benefit directed directly from the funding, but what we do need, as Mr. Kassoff said earlier, is that it needs to focused on education, and the primary barrier is just that people don't understand. The regulators are not necessarily taking negative positions. They are just not aware of the technology, and so, the technology is unaddressed. So, for an owner making a proposal for a project, he sees it as a challenge to the permitting process to be allowed to use any new technology, and it is just easier not to submit.

Mr. KASSOFF. The Federal Highway Administration has a number of sources, and I have to say that in recent years, they have been in tune with this idea of environmental stewardship and context sensitive solutions, both of which are key components of what we are talking about here, green infrastructure.

On the research end, they have supported research into this area. On the educational end, they work with universities. They have the Council of University Transportation Centers that they offer grants to. We would like to see the universities picking up more on what we call context sensitive solutions. Civil engineering programs around the country have definitely moved in the green direction, since someone as old as I am went to civil engineering school. So that has been a positive development. But this idea of contextual design, that the one size does not fit all, and we have to achieve these sustainable outcomes by applying our most creative engineering tools, that is something that needs to be educated.

Finally, in the regular Federal Highway Program, the Federal Highway Administration, through initiatives like the Green Highway Partnership, is saying funding is available for this kind of thing. The Green Highways Partnership has adopted a pilot project, actually not 25 miles from where we are sitting. It happens to be U.S. 301 in Southern Maryland. It is a corridor in great need of some improvement and has now become the testbed for green highways and Green Highways Partnership to see if the State DOT, which in Maryland, has been extremely progressive. The EPA, which has been a leader in this regard, Federal Highways, who has put funding into this Green Highways Partnership and has been very supportive, and local governments, all in combination with the private sector, can make it work.

So, we are keeping our fingers crossed that we will have a successful outcome in that regard, but they have made their funding available, and of course, there is not sufficient funding overall to accomplish all of these objectives. That is for sure.

Chairman WU. Thank you, Mr. Kassoff, and Commissioner Adams, you may have the last word, if you so choose.

Mr. ADAMS. Thank you, Mr. Chair. Just to, I think, reiterate some points that were touched on in your opening comments, and that I sought to underscore in my testimony, and as well, has been mentioned by the other witnesses.

The effort at green transportation infrastructure has really been in a research and development phase, a piloting phase, and that has been very necessary. What I hope happens is that we go from there to the strategies and the investment to make it as a way of doing business. In terms of local governments, what they really

need to see from the federal regulators is very explicit green lights that this is not just okay to experiment with, but this is okay to begin to have as part of the way of doing business and managing the transportation system.

Chairman WU. Thank you very much, and I want to thank all the witnesses for your testimony, and also, for your forbearance with the interaction of the Committee schedule and the Floor schedule.

The record will remain open for additional statements from the Members and for questions and answers to any follow-up questions the Committee may ask of the witnesses.

The witnesses are excused, and the hearing is now adjourned.

[Whereupon, at 4:45 p.m., the Subcommittee was adjourned.]

# Appendix 1:

## Answers to Post-Hearing Questions

ANSWERS TO POST-HEARING QUESTIONS

*Responses by Gloria M. Shepherd, Associate Administrator, Office of Planning, Environment, and Realty, Federal Highway Administration, U.S. Department of Transportation*

**Questions submitted by Chairman David Wu**

*Q1. How does FHWA coordinate with the EPA to ensure that new technologies fit into the existing regulatory framework for stormwater management? Does FHWA provide testing and evaluation results that can be used to demonstrate a technology's compliance with EPA's performance-based standards? Do you coordinate with EPA to identify research needs and information gaps?*

*A1.* FHWA and EPA coordinate at the national level through initiatives, such as the International Best Management Practices (BMPs) Database, which contains carefully screened BMPs and information on the appropriate circumstances for their use. We are working with a coalition of organizations to fund and manage the database, providing data analysis, and developing protocols for integrating low impact development techniques into the database. The work is ongoing and the database is currently accessible at the web site: *http://www.bmpdatabase.org*.

At the State level, State departments of transportation (DOTs) coordinate with State water quality agencies, as well as EPA regional offices, to determine if newly developed technologies will meet regulatory standards. FHWA and the State DOT, in consultation with State and federal water quality regulators, determine if the technology will be appropriate for use in a highway setting. Safety and engineering considerations also help to determine whether a particular technology is appropriate for use on a project. For example, many current low-impact development technologies, such as rain gardens, may be appropriate for low volume residential streets, but cannot safely handle the requirements of stormwater removal for an urban highway.

FHWA coordinates research needs at the national level with EPA through professional organizations, such as the Transportation Research Board (TRB) and the National Cooperative Highway Research Program (NCHRP). There are several studies done through NCHRP that are coordinated with EPA. One report of such a study is "Evaluation and Best Management Practices for Highway Runoff Control, NCHRP 25–20(1)." This report focuses on improving the scientific and technical knowledge base for the selection of BMPs through a better understanding of BMP performance and application. It documents the extensive research on the characterization of stormwater BMPs and the factors that influence runoff, such as land use practice, hydraulic characteristics, regional factors, and performance evaluation. Another report is entitled "State Transportation Agency Strategies to Address NPDES Phase II Requirements, NCHRP 25–25(16)." This report looks at how State transportation departments are addressing compliance with National Pollutant Discharge Elimination System (NPDES) Phase II requirements. The research looked at staffing and organizational structure throughout the entire agency regarding NPDES Phase II compliance for construction activities, as well as the stormwater management program, as regulated under the Municipal Separate Stormwater Sewer System (MS4). The report also examines inspection systems and environmental management systems, as well as recent trends concerning enforcement and methods for achieving compliance.

We also coordinate our proposed research initiatives under the Surface Transportation Environment and Planning Cooperative Research Program (STEP) with other federal agencies, including EPA. Research comments from other federal agencies are given the highest priority in establishing our STEP research goals. FHWA is working with EPA on the Mid-Atlantic Green Highways Partnership and the Great Lakes Initiative, both of which have a stormwater research and technology component. FHWA also supports the work of the American Association of State Highway and Transportation Officials' (AASHTO) Transportation Environmental Research Ideas data base, which is a repository for ideas on needed environmental research. We are encouraging other federal agencies, including EPA, to contribute ideas to this data base.

Another way that we are coordinating with EPA is through the Eco-Logical grant. FHWA currently has an open solicitation that will provide $1,050,000 in grant funds to support pilot projects, which exemplify integrated planning and ecosystem-based approaches to developing transportation infrastructure. EPA will be participating in the technical review of the pilot project proposals, along with FHWA and representatives from other agencies that participated in writing the publication entitled *Eco-*

*Logical: An Ecosystem Approach to Developing Infrastructure Projects.* It is anticipated that this joint review will identify additional research gaps and will provide incentive for other agencies to join FHWA in funding future Eco-Logical grants.

*Q2. Of the State Planning and Research program funding, how much is spent specifically on green transportation infrastructure R&D? Does FHWA work with states to help them identify potential research opportunities in the field of green transportation infrastructure?*

*A2.* Section 505 of title 23, United States Code, requires that States set aside two percent of the apportionments they receive from the Interstate Maintenance, National Highway System, Surface Transportation, Highway Bridge, Congestion Mitigation and Air Quality Improvement, Highway Safety Improvement Program, and Equity Bonus programs for State planning and research (SP&R) activities. Of this amount, states must allocate 25 percent for research, development, and technology transfer activities relating to highway, public transportation, and intermodal transportation systems.

States select research projects to be funded with SP&R funds to address State and local needs. However, FHWA Division Office staffs have a continuing relationship with State research staffs and may provide advice and guidance as they develop the projects and carry out their research program. FHWA encourages States to use some of their SP&R funds to participate in national research efforts, such as Transportation Research Board (TRB) workshops. In addition, FHWA also has helped to bring States together to address regional research needs. The Mid-Atlantic Green Highways Partnership (GHP) is one example of such FHWA coordination.

State departments of transportation have used SP&R funds for substantial research into environmental issues, including regional stormwater issues and development of best management practices suitable for the particular issues in that locality or state. At least 20 states currently have active projects related to stormwater management. One example of ongoing research related to stormwater at the State level is an "Investigation of Stormwater Quality Improvements Utilizing Permeable Pavement and/or Porous Friction Courses," which is being sponsored by the Texas DOT using SP&R funds. The Wisconsin Department of Transportation is engaged in a cooperative research project with the U.S. Geological Survey to evaluate stormwater treatment devices. The Oregon Department of Transportation is funding a project to develop water quality monitoring methods or testing protocols for different types of water quality facilities. Also, the District of Columbia DOT is also conducting an evaluation of best practices for the reduction of transportation-related stormwater pollution in Washington, DC.

*Q3. In your testimony, you discussed FHWA's Infrastructure Research and Technology program, which supports R&D for innovative highway technologies. For those technologies considered "green," what criteria did you use to determine that the technology is environmentally friendly? How do life cycle environmental costs affect whether a technology is considered "green"? What do you consider to be included in life cycle costs? What are FHWA's plans for future research in this area?*

*A3.* FHWA characterizes infrastructure technologies as environmentally friendly, if the technology will mitigate environmental impacts or contribute to environmental improvements. For example, FHWA considers cantilever construction an environmentally friendly technology, because it can reduce the amount of ground, water, and river bed disturbance, as well as minimize noise, dust, and erosion. Cantilever construction also can reduce construction time, which minimizes the environmental impacts of a project.

Life cycle cost analysis compares the life cycle costs of two or more alternatives for a project, enabling the lowest overall cost alternative to be identified. Under life cycle cost analysis, selection of a design alternative is not based solely on the lowest initial costs, but also considers all the future costs (appropriately discounted) over the project's usable life. Generally, the costs associated with construction, rehabilitation, and maintenance activities of each alternative being compared are identified, monetized, and then discounted to their present value. Life cycle cost analysis typically does not affect whether a particular technology is considered green.

However, through the Highways for LIFE program, FHWA is seeking ways to build highways and bridges faster and safer (both design and construction), to improve quality, and to reduce costs. Decreasing the time a project takes to construct, while using environmentally sensitive methods and increasing the longevity of a section of highway or bridge, means there should be fewer adverse impacts to the environment resulting from construction or reconstruction work. In this way, FHWA is

promoting longer lasting technologies, which in turn can reduce environmental impacts. Currently, there are 10 projects funded under Highways for LIFE.

FHWA's infrastructure research and technology programs are examining a number of technologies with potential positive environmental benefits. For example, FHWA is studying numerous technologies to optimize pavement performance and improve the quality of system performance and surface characteristics that are likely to reduce adverse environmental impacts. This research includes innovative pavement technologies, long-term pavement performance, "warm mix" technologies, quieter pavement technology, and the use of recycled materials in pavement. We also are assessing prefabricated technologies and other accelerated construction technologies (such as cantilever construction), which reduce environmental impacts by moving much of the construction process to controlled environments and reducing the time of construction. Research on reducing the frequency and duration of construction work zones likely will have environmental benefits as well.

**Questions submitted by Representative Phil Gingrey**

*Q1. Can you describe FHWA's role in the Green Highway Partnership? How did your agency get involved in this activity and what do you expect your role to be in future years? Will FHWA request funding for this partnership beyond the current fiscal year?*

*A1.* FHWA is one of the original partners in the development of the Mid-Atlantic Green Highways Partnership, along with Region 3 of the EPA. FHWA provided the initial funding for the initiative. To date, we have dedicated $825,000 to this effort, along with staff participation in initial workshops and development of the concept. We also participate on the sub-teams of recycling and reuse, stormwater, and conservation planning. FHWA employees from both headquarters and Division Offices in the Mid-Atlantic region are engaged in the Green Highways Partnership.

In 2004, EPA Region 3 and FHWA's Maryland Division Office began discussions about hosting a regional forum on streamlining, stewardship, and watershed protection. These discussions resulted in June 2005 executive planning meeting in Philadelphia, PA, where 50 senior-level executives from the public and private sectors came together to define and establish a vision for Green Highways. The initial organizing efforts culminated with a Green Highways Forum held on November 8–10, 2005, in College Park, MD. The forum brought together several hundred federal, State, and local transportation and environmental officials, as well as professionals from the private sector and trade associations. A formal Green Highways Partnership resulted from the forum.

FHWA expects to continue its co-leadership role in the Mid-Atlantic Green Highways Partnership. Our goal is to evaluate if such a partnership can improve both environmental review and project timeframes. The ongoing Green Highways Partnership pilot project on Maryland 301 should provide us with more information to determine if better integrated planning, improved recycling and reuse, and the use of the most current technologies on a project can lead to the regulatory flexibility needed to make a partnership of this nature a benefit to the transportation community, as well as to the environment. If the Mid-Atlantic Green Highways Partnership provides such a benefit, our future role may be to work with EPA to extend the partnership to other regions.

FHWA intends to continue our financial and staff support of the Mid-Atlantic Green Highways Partnership in FY08 through the Surface Transportation Environment and Planning Cooperative Research Program (STEP).

*Q2. In his testimony, Mr. Kassoff urged federal officials to consider how they might promote a focus on improving environmental quality rather than mitigating potential damage. What incentives does FHWA have in place for projects to improve overall environmental quality rather than simply meet regulations meant to avoid harm?*

*A2.* Environmental considerations beyond regulatory requirements are reflected in transportation plans and projects based on the interests of the community, coordination with environmental groups and State and federal agencies, and input from the public. FHWA has made a significant investment in programs to promote integrated planning and context sensitive solutions to both avoid impacts to sensitive resources and to design transportation facilities that are compatible with the important resource and community needs in an area.

FHWA works to showcase important ecosystem-based mitigation and enhancement projects through initiatives such as the Exemplary Ecosystem Initiatives (EEI) program. FHWA currently has 43 designated EEIs, with a goal of 50 EEIs for 2007.

EEIs clearly demonstrate how an ecosystem approach (e.g., watershed-based mitigation) will generate benefits, such as greater predictability in transportation project timelines, ability to address multiple project impacts in a comprehensive manner, more effective habitat conservation, and elimination of temporal loss of wetland and riparian areas. To be designated as an EEI, the scope of the ecosystem initiative must be clear with respect to:

- the resources in question and the need for innovative solutions to preserve and enhance them;
- the overall goals, both from an ecosystem perspective and a highway perspective, that were met by the solution; and
- the methodology used to bring about the solution (e.g., effective use of stakeholder involvement, innovative partnerships, and funding mechanisms).

FHWA also sponsors the biennial Environmental Excellence Awards for ecosystem-based mitigation and conservation. Additionally, FHWA is funding the Eco-Logical pilot projects grant, the purpose of which is to support pilot projects that exemplify integrated planning and ecosystem-based approaches to developing transportation infrastructure.

ANSWERS TO POST-HEARING QUESTIONS

*Responses by Benjamin H. Grumbles, Assistant Administrator for Water, U.S. Environmental Protection Agency*

**Questions submitted by Chairman David Wu**

*Q1. How does EPA determine if a technology fits into the definition of green transportation infrastructure? How do life cycle environmental costs affect whether a technology is considered "green"? What do you consider to be included in the life cycle costs?*

*A1.* "Green Infrastructure" is a relatively new and flexible term, and has been used by various speakers and writers in various contexts. EPA has recently defined green infrastructure as a way to protect surface waters and drinking water supplies, reduce drinking water and stormwater treatment costs, reduce urban heat island impacts, and provide more sustainable water resource management.

Similarly, "green transportation infrastructure" is not yet a defined term of art. However, EPA's Green Highways Partnership has focused on projects that go beyond minimum standards set by environmental laws and regulations and integrates transportation functionality and ecological health to provide a net increase in environmental functions and values of a watershed, while improving upon sustainability for both the environment and transportation.

Green highways may employ a number of practices towards achieving this outcome, including the use of permeable, low-impact practices that provide high performance in reducing stormwater impacts, thus preventing stream bed scouring, erosion and sedimentation and toxic pollutant runoff into streams and rivers; construction with recycled materials, thereby reducing landfill usage; and design using cutting-edge technologies, such as wildlife corridors and strategic conservation to protect critical habitats and ecosystems from the encroachment of highway infrastructure.

At this time EPA is working with several organizations to improve our understanding of the costs and benefits of these technologies, including their operation and maintenance needs and constraints due to local ordinances and building codes. While some of this work is being conducted through research opportunities, EPA is also participating in data gathering and analysis through demonstration pilots and benchmarking studies with our State and local government, non-government, academic and industry partners. Some elements that are being examined include application, planning, production, operation, and maintenance costs for these technologies, as well as regulatory acceptance, market-based incentives and the benefits derived through cleaner water and air, reduction in energy consumption, and increased economic growth.

*Q2. How is data gathered on the effectiveness of particular transportation infrastructure technologies for protecting water quality or managing runoff? How does EPA use the data and information produced by the Federal Highway Administration to determine whether a technology is environmentally beneficial? What additional data is needed, and which organizations or agencies are best situated to perform additional testing and evaluation? How do these technologies contribute to the Administration's overall energy use reduction goals?*

*A2.* Much of the data EPA has regarding the effectiveness of green technologies and green infrastructure practices has been the result of research and intensive monitoring conducted by a variety of Federal, State and local government agencies, academic institutions, non-profit and industry organizations and citizens. The data that is collected, by the Federal Highway Administration (FHWA) and other entities, is shared publicly through various mechanisms, including the International Stormwater Best Management Practices Database and assorted publications. Through sharing information and data on best practices, EPA is promoting the use of green technologies, where appropriate, throughout the country.

EPA recognizes the importance of sound science in the decision-making process, including the decision to use green technologies. We are supporting a robust research program to study the efficacy of many green practices in varied settings. As indicated above, EPA is working with several entities to improve our understanding of the costs and benefits of these technologies. We believe that the information derived from this, and other independent research efforts, will demonstrate the energy savings achieved from green infrastructure projects such as green roofs and increased tree cover, therefore placing even greater emphasis on the use of these technologies. In addition, EPA believes there is great potential for green infrastructure

practices to reduce cooling costs and reduce pumping and treatment costs associated with managing stormwater. Still, there is always more that could be done and the role that other organizations can play in the development of this research is limitless.

In order to achieve successful outcomes in the evaluation, application, and understanding of green transportation infrastructure technologies, significant collaboration is needed to piece together aspects of a wide variety of regulations, procedures, procurement methods, and specification requirements. A functioning partnership is essential to develop a myriad of timely solutions, particularly given the need for broader outreach and awareness. A current focus of the Green Highways Partnership is to implement pilot projects that demonstrate the concepts of green transportation infrastructure practices visibly and tangibly. Pilot projects will inform and inspire the implementation of practices and products that are innovative, efficient, cost effective, and environmentally sound. The anticipated outcome of the pilots is to demonstrate sustainable solutions. Pilots also will serve to improve partnerships and research efforts, while broadening the body of knowledge on green transportation technologies.

**Ouestions submitted by Representative Phil Gingrey**

*Q1. Can you describe EPA's role in the Green Highway Partnership? How did your agency get involved in this activity and what do you expect your role to be in future years? Will EPA request funding for this partnership beyond the current fiscal year?*

*A1.* EPA is the primary sponsor of the Green Highways Partnership (GHP). The roots of the Green Highway Partnership run back to 2002, when the Federal Highway Administration (FHWA) named environmental stewardship and streamlining one of three "vital few" goals. This marked the beginning of a new era; substantial FHWA investments and improved coordination with EPA resulted in a wave of environmentally-focused programs and documents such as Context Sensitive Solutions, the Exemplary Ecosystem Initiative, and Ecological: An Ecosystem Approach to Developing Infrastructure Projects. Recognizing the need to consolidate the myriad of aspects involved in the "greening" of U.S. highways, EPA set out to forge a new and lasting partnership with FHWA and, thus, the Green Highways Partnership was formed.

Providing much of the leadership, conceptual design, organizational support, and vision for this multi-disciplinary effort, EPA is committed to progress in the development of green highways, not only in the Mid-Atlantic but in other regions across the Nation. EPA has committed over $1.4 million to this innovative program. The success of the Partnership, however, has not been the result of any one individual effort. EPA has combined its resources with that of our partners to leverage approximately $20 million dollars to reach the program's goal of "beyond compliance, better than before." Through EPA's green infrastructure and sustainable infrastructure strategies, we intend to continue focusing attention on greening our nation's highways. To this end, EPA will pursue all opportunities to support the advancement of this effort.

*Q2. In your testimony you emphasized the need for cooperation among academia, private industry, and the EPA Research Office to compile data regarding the efficacy of green technologies in various contexts. Does a coordinating mechanism currently exist to guide this research?*

*A2.* Certainly there is a need for cooperation among the numerous entities with a stake in implementing green technologies. Through the GHP, EPA has been working cooperatively with a variety of public and private entities, including FHWA, to ensure that our research efforts complement one another. While EPA will make its research priorities known through our website, many times we reach out to our partners to seek their counsel and coordinate our efforts. In turn, agencies and organizations, such as FHWA and the American Association of State Highway Officials, provide EPA with notice to submit proposals for environmental research ideas and opportunities to collaborate on research needs. Generally, with EPA, much of this activity is conducted via the web. However, through the network of Green Highways partners, we have expanded data and information gathering efforts through which to share and evaluate green technologies and their performance in supporting water quality improvements and other environmental benefits. This venue includes, but is not limited to the following: monthly and quarterly conference calls and meetings, design charrettes, workshops, conferences, newsletters and other published articles,

webcasts, web-based training, student-supported programs and internships (college/university), and jointly-funded studies.

*Q3. In his testimony, Mr. Adams asked federal regulators to provide "very explicit green lights that this is not just okay to experiment with, but this is okay to begin to have as part of the way of doing business." Your written testimony and the March 5th memo to the Regional Administrators assert EPA's acceptance of these approaches. Does the EPA plan further actions to increase awareness of green infrastructure approaches and there use?*

*A3.* EPA is providing clarification to regional offices and State NPDES programs that green infrastructure technologies, may, in the appropriate circumstances, be used in lieu of more traditional wastewater treatment collection and control technologies for meeting water quality objectives in permits and settlements. As with any regulatory program, the necessary accountability provisions will be needed (e.g., Do models or data reasonably predict that standards will be met? Are appropriate monitoring or evaluation provisions in place?).

In addition, EPA is developing model municipal separate storm sewer system (MS4) language that can be used to provide permitting authorities and permittees alternatives to traditional stormwater management measures. We are also documenting examples of permits, combined sewer overflow long-term control plans, and enforcement agreements that have included green infrastructure provisions. We are also drafting some general information on how the permitting and enforcement processes can more easily facilitate more wide-spread use of green infrastructure. EPA is actively encouraging all permitting and enforcement authorities to harness opportunities where green infrastructure approaches are appropriate and effective solutions to water quality issues.

*Q4. In his testimony, Mr. Kasoff urged federal officials to consider how they might promote a focus on improving environmental quality rather than mitigating potential damage. What incentives does EPA have for projects to improve overall environmental quality rather than simply meet regulations meant to avoid harm?*

*A4.* EPA agrees with Mr. Kasoff that we should strive not only to mitigate potential damage but also to improve environmental quality. As EPA Assistant Administrator Grumbles explained in his March 5, 2007, memorandum, "Using Green Infrastructure to Protect Water Quality in Stormwater, CSO, Non-point Source and Other Water Programs," green infrastructure provides many positive environmental and social benefits, including: cleaner water, enhanced water supplies (stormwater percolation through the soil to recharge the groundwater and the base flow for streams); cleaner air, reduced urban temperatures; increased energy efficiency; community livability and aesthetics; and cost savings. EPA supports local communities' efforts to achieve all of these goals.

EPA has a number of programs that focus on the promotion of low impact development (LID) and other community greening techniques that help local communities to develop and redevelop in a more environmentally sustainable manner. Using *Clean Water Act* Section 319 grants awarded by EPA, states have focused approximately $10 million on the implementation of projects including green roofs, rain gardens, and bioswales, as well as projects that protect and restore valued riparian and waterfront areas. Similar projects have been funded under the CWA's State Revolving Loan Fund. EPA's Brownfield's program has funded projects that incorporate green infrastructure into redevelopment activities that restore vitality to many urban neighborhoods.

We believe that our efforts to date are bearing fruit, as we see more and more communities around the U.S. working to integrate green infrastructure into their programs and policies, such as Chicago's commitment to greening the city with green roofs and other green practices, and Kansas City's commitment to create 10,000 rain gardens. In addition, many cities and states are adopting new regulations and policies that require that any new development or redevelopment to consider the use of green infrastructure as the first option in addressing stormwater that would result from the development.

EPA supports further acceleration of local communities' use of green infrastructure. On April 19, EPA Administrator Steve Johnson signed a commitment with a number of partnering organizations (including the Natural Resources Defense Council, the National Association of Clean Water Agencies, the Low Impact Development Center, and others) that expressed the signatories' mutual commitment to collaborate on efforts to encourage the use of green infrastructure. We are working together expeditiously to develop a joint agenda and to begin acting on various items, including developing a research agenda, providing guidance and tools that promote

the expanded use of green infrastructure, analyzing and publicizing the economic and other benefits of green development, and other action items. We look forward to continuing to expand the number of states and communities throughout the country that incorporate LID and other green approaches as critical and fundamental components of their development and redevelopment policies and programs.

Lastly, as we mentioned in our response to Question #2, although we are still in the data gathering phase with our Green Highways partners, we have used these collaborative research and demonstration pilot efforts to share and evaluate green technologies and their performance in supporting water quality improvements and other environmental benefits.

ANSWERS TO POST-HEARING QUESTIONS

*Responses by Sam Adams, Commissioner of Public Utilities, City of Portland, Oregon*

**Questions submitted by Chairman David Wu**

*Q1. How has the City of Portland used information on green transportation infrastructure technologies provided by federal agencies to assist in developing the Green Streets Initiative? As a city executive, what strategies would you recommend to the EPA and FHWA for making their work on green infrastructure more accessible to local government officials?*

*A1.* Portland hasn't had to rely on the assistance of federal agencies because the City's green transportation initiatives pre-dated federal efforts by several years. For example, our first parking lot swales were developed in the late 1980s. Our manual of stormwater technologies was first published in 1999. We have been developing and refining green transportation technologies continuously for more than a dozen years. We recognized, early on, that the City could employ natural systems to achieve multiple environmental goals at lower capital costs than traditional stormwater infrastructure. Since then, Portland has sought opportunities to green our infrastructure whenever practical. Early adoption of green technologies has been propelled by overlaying federal requirements to protect surface water and ground water resources, restore endangered fish populations and restore natural habitats.

We recommend that EPA and FHWA work with NACWA, NRDC, State and local stormwater and transportation agencies, academic institutions and private parties to develop regionally-sensitive guides to green transportation technologies. These guides would be indispensable to communities that are at the early stages of developing stormwater management plans to comply with the *Clean Water Act.* Wherever possible, EPA and FHWA should build on the extensive work of existing stormwater utilities, actively engage State and local partners in the development of stormwater guides, and develop extensive training programs to ensure local use of green transportation infrastructure.

*Q2. What are the estimated life cycle cost savings for the City of Portland if green transportation infrastructure is used citywide? What factors are included in this estimate?*

*A2.* We know that green transportation infrastructure can yield construction savings. We also know that green transportation technologies can be designed and constructed at savings of 20 percent to 63 percent when compared to traditional storm sewer solutions. Our most simple and efficient green street technology (curb extensions) appears to cost less than half of the cost of sewer separation projects in Portland combined sewer basin.

On the operations side, we expect to see additional savings in long-term maintenance costs as our experience increases. We will fully document the added value of green technologies as we improve our ability to measure and value ecosystem benefits, such as improved air and water quality, increased natural habitat, lower energy costs, increased carbon sequestration and reduced heat island effects.

*Q3. You recommend in your testimony that the Federal Government should support R&D for new green technologies. In your opinion, what are the most pressing research needs in the field of green transportation infrastructure? Should Federal R&D programs focus more strongly on technology development or testing and evaluation? How would the City of Portland use the results of the R&D you recommend?*

*A3.* As you are aware, green transportation infrastructure relies on natural processes to capture, treat, transport and dispose of stormwater runoff. Soils and plants are integral components of green technologies. While we are experienced in designing and constructing green facilities, we have much to learn about the interplay of soils and plants within these facilities.

We recommend that Federal R&D programs focus on documenting the natural functions of green technologies, specifically the performance of plants and soils under varied conditions, in varied combinations, to achieve varied stormwater management objectives. Investment must be made in both testing and development to ensure successful implementation of green transportation infrastructure. Research undertaken nationally will substantiate the impacts of slope, soil, depth to groundwater, and other factors that determine effectiveness. Robust monitoring and testing conducted over an extended period of time will allow cities to determine the most effective locations, conditions and compositions of each type of green technology and

provide meaningful performance information and guidance about effective maintenance regiments.

Portland invests limited rate-payer resources to test and monitor the effectiveness of our green technologies. However, our results are specific to the geology, geography and hydrology in Portland. While this information maybe indicative of how facilities can be useful, success will not be assured without performance information from a variety of conditions. Portland will benefit from national research that engages State and local stormwater agencies, academic institutions and private stakeholders. A broad-based approach to the research will produce more comprehensive evaluations and deepen our collective knowledge of green technologies. We recommend that all research findings be made readily available to all interested parties as the research unfolds.

**Question submitted by Representative Phil Gingrey**

*Q1. During your testimony, you asked federal regulators to provide "very explicit green lights that this is not just okay to experiment with, but this is okay to begin to have as part of the way of doing business." Mr. Grumbles' written testimony states, "EPA believes that green infrastructure approaches and practices can be a significant component of State's and cities' programs to reduce and control stormwater, combined sewer overflows, and non-point source pollution." This sentiment also appears in his March 5th memo to EPA regional administrators. What other actions do you suggest EPA take to meet your request?*

*A1.* We applaud Mr. Grumbles' commitment to green infrastructure and stand ready to work with the EPA to develop any policies that further the use of these green technologies. Mr. Grumbles has given life to a fundamental change in the way we think about stormwater, the way we manage the built and natural landscapes, and the way we regulate watershed health and water quality.

Portland's success in adopting and advancing green technologies depends on a fundamental rethinking of our laws, engineering principals, design standards, utility operations and public engagement. This rethinking must include EPA and extend to State and local governments. Without a close partnership with federal and State regulators, municipalities will not be able or willing to expend the time and resources to advance this initiative.

EPA's green infrastructure policies must be guided by measurable federal, State and local performance goals. EPA should encourage adaptive management to convert learning into continuous improvements, and renew its commitment to green technologies through the periodic refinement of laws and regulations to eliminate uncertainty and obstacles to progress. For optimum success of green technologies, commitment to these innovations must be expressed and memorialized in laws, intergovernmental agreements and permits that can be sustained across federal, State and local administrations.

ANSWERS TO POST-HEARING QUESTIONS

*Responses by Daniel J. Huffman, Managing Director, National Resources, National Ready Mixed Concrete Association*

**Questions submitted by Chairman David Wu**

*Q1. Please describe the type of maintenance pervious pavements require. With proper maintenance, how long will the pavement maintain optimal filtering performance? What are the effects on filtering if maintenance is not performed? At the end of the pavement's life cycle, can it be disposed of in a conventional manner?*

*A1.* Pervious concrete pavements are infiltration-based systems. Water passing through the pavement will carry with it varying degrees of soluble and insoluble pollutants and debris. Most of this debris will be deposited on or near the surface of the pavement. Optimal performance of pervious concrete requires that the void structure be maintained to provide sufficient infiltration of stormwater. The majority of pervious concrete pavements function well with little or no maintenance.

Maintenance of pervious concrete consists primarily of prevention of clogging of the void structure. This can be achieved by vacuum/sweeping or pressure washing the pavement. Independent studies have shown each of these procedures to be effective in restoring the infiltration capabilities of the pervious concrete to accommodate design storms. Research conducted by the Florida Concrete and Products Association, and reported in the American Concrete Institute's Committee 522, Pervious Concrete Report, quantifies the extent of contaminant infiltration in pervious concrete pavement systems. Five existing pervious concrete parking lots were examined in the study, and the level of contaminant infiltration was found to be in the range of 0.16 to 3.4 percent of the total void volume after eight years of service. Sweeping the surface of the pervious concrete immediately restored over 50 percent of the permeability of the clogged pavement.

A University of Central Florida (UCF), report titled *Construction and Maintenance of Pervious Concrete Pavement,* published in January, 2007 documents the findings of a study conducted on eight existing pervious concrete parking lots, ranging from six to 20 years of service. The sample lots were evaluated to determine the infiltration rates of pervious concrete systems that received relatively no maintenance. Infiltration rates were measured using an embedded single-ring infiltrometer developed specifically for testing pervious concrete in an in-situ state. In-situ infiltration rates ranged from 2.1 to 75.4 inches per hour, which indicates that sample lots though compromised, had retained functionality.

From the eight parking lots, a total of 30 pervious concrete cores were extracted and evaluated for infiltration rates after various rehabilitation techniques were performed to improve the infiltration capability of the concrete. The techniques were pressure washing, vacuum sweeping and a combination of the two methods. Researchers found that the three methods of maintenance investigated in this study typically resulted in a 200 percent or greater increase over the pre-treatment infiltration rates of the clogged pervious concrete cores. Thus, with respect to longevity, the UCF study indicates that even minimal maintenance will ensure long term pervious functionality.

Frequency of maintenance is, in part, a function of the site and the pavement design. The pervious concrete system should be designed such that washout from adjacent soil areas is not allowed to drain onto the pavement. Periodic visual inspection of the pavement can determine when cleaning is necessary. The typical maintenance schedule, as included in the Environmental Protection Agency's (EPA) Best Management Practices for Stormwater Management: Porous Pavements Facts Sheet, calls for monthly visual inspection of the pavement to ensure that it is clean of debris and that it sufficiently dewaters between storms; vacuum/sweep or pressure wash on an "as needed" basis; and annual inspection of the surface for deterioration or spalling. Average costs for maintenance of pervious concrete can range widely, dependent on the amount of sediment and debris that is allowed to collect on the pavement. Common practice, however, shows these costs to be minimal, in most cases limited to similar costs for sweeper/vacuum of conventional pavement. One option is to include maintenance planning as part of the original project cost, which typically represents a very small percentage of that cost.

In a 2003, the City of Olympia, Washington issued its *Report on Cleaning of Porous Concrete Sidewalk.* The sidewalk, installed in 1999, was 5.5 feet wide and 1,500 feet long and had maintenance performed for four years. The void structure was visibly clogged with debris from tree leaves and needles, and had moss growing in the most abundantly clogged areas. The city successfully used pressure washing to

clean out the debris in a mere 41 man-hours. Following the washing, the surface pores were visibly clean and open.

Pervious concrete, similar to conventional concrete, is manufactured using no hazardous materials. While the pervious concrete pavement system does filter certain chemicals, heavy metals, and other pollutants, these suspended solids occur within the filter bed and earthen sub-base below the actual pervious concrete. Therefore, pervious concrete that has reached the end of its life cycle can be recycled and/or disposed of by conventional means.

*Q2. What channels exist for industry to introduce green transportation technologies and show proof of concept to State and federal regulatory agencies? What actions should the Federal Government take to encourage both private development and private adoption of new technologies?*

*A2.* NRMCA believes that one of the ways it can support the introduction of green pavement technologies is through advancement of highly developed standards combined with a robust construction training programs. NRMCA, along with the Portland Cement Association (PCA), are active in the development of guideline specifications for the design and use of pervious concrete through participation in the American Concrete Institute (ACI) standard setting committees. Currently, NRMCA and PCA are working through ACI Committee 522 towards the revision of ACI 522R–06 which addresses pervious concrete construction and maintenance. NRMCA and PCA are also finalizing a document on design of pervious concrete pavements for structural and hydrological requirements that will include software to assist in design applications.

NRMCA is involved in a newly formed American Society for Testing and Materials (ASTM) subcommittee to develop standards for testing and evaluation of pervious concrete. An NRMCA staff member chairs this subcommittee. ASTM is an organization that develops consensus standards that are used globally for various materials and products. In addition, to enhance greater utilization of pervious technology, NRMCA has embarked on a national program for the certification of Pervious Concrete Contractors which has resulted in 1200 certifications in the last 18 months.

Moreover, in order to provide a practical response to the growing interest in pervious concrete pavements for stormwater management, the American Concrete Pavement Association (ACPA) has released a new publication, *"Stormwater Management with Pervious Concrete Pavement."* This user-friendly document details applications, considerations, limitations, and benefits of pervious concrete on stormwater management.

The concrete industry's training efforts have been complimented by the EPA, which has accepted pervious concrete as a recommended Best Management Practice (BMP) for stormwater management on a local and regional basis. However, due to a lack of understanding of the efficacy of the BMP, many State and local planners still have failed to fully utilize pervious concrete and some have actually excluded pervious pavements from their own BMPs. It is clear that this is a problem that needs to be addressed on a regional basis by means of further education on the part of both EPA and industry.

One vehicle for providing timely information about "state-of-the-art" technologies and for accelerating their development and use are public-private partnerships. One such partnership is the Mid-Atlantic Green Highways Partnership (GHP) of which NRMCA and ACPA are active members. The GHP has diverse members including the Industrial Resources Council, the Conservation Fund and the Pennsylvania Department of Environmental Protection. The GHP is grounded in a commitment to developing ecologically advanced infrastructure projects. GHP seeks to transform the manner in which the Nation's transportation infrastructure is planned and constructed through a blending of integrated planning, regulatory flexibility, and market-based rewards. Included in this effort is the goal of achieving broader utilization of green pavement technologies that will help support superior watershed-driven stormwater management. In this regard, the GHP provides a unique opportunity for industry to collaborate with Federal, State and local governments to introduce "state-of-the-art" technologies such as pervious concrete. In fact, the GHP has produced a cooperative partnership between EPA's Region III and NRMCA leading to a research grant for Villanova University to evaluate the water quality and other attributes of competing porous pavement systems. The grant has come from EPA with assistance from the RMC Research and Education Foundation and Villanova University.

One of the principal benefits of the GHP is that it allows for the front-loading of the environmental review process through demonstration projects that can demonstrate proof of concept. NRMCA believes that proof of concept must involve an in-

tegrated planning approach that provides for early stakeholder involvement prior to initiation of the *National Environmental Policy Act* process. In order to secure regulatory acceptance of the technology and to streamline the permitting process it is often necessary to front-load consultation and coordination with citizens and local government agencies in order to fully educate them about the benefits of using green pavement technologies as a tool to comply with various environmental requirements. As part of the GHP, NRMCA has recently made a commitment to participate in the U.S. 301 Waldorf Maryland Transportation Improvements Project that will provide a forum early in the environmental impact assessment stage to meet with regulators and train them on utilizing pervious concrete as an alternative for meeting low-impact development (LID) and stormwater management objectives. Similarly, NRMCA looks forward to working with EPA Region III and the FHWA as part of the Anacostia Restoration Project which supports LID and sustainable transportation systems in and around the Anacostia watershed in the District of Columbia and Maryland.

*Q3. What R&D, including testing and evaluation, is required to make pervious pavement more feasible for use in higher traffic areas, such as roads and highways? What are the costs and benefits of expanding the use of pervious pavement?*

*How difficult is it to get construction contractors to use green transportation infrastructure technologies? What additional education is necessary to encourage builders and architects to specify green technologies in their design plans? Is there a role for the Federal Government in educating builders, architects, and other engineers?*

*A3.* The federal tax code provides about $500 billion each year in incentives intended to encourage socially-valued activities, including homeownership, charitable contributions, health insurance, and education. NRMCA believes that adoption of green pavement technologies should be included as one of these socially-valued activities. By supporting new green technologies, the government can offer every American an opportunity to enjoy higher water quality and a better, more sustainable environment at lower costs.

One model for rewarding socially-valued activity is the *Energy Policy Act of 2005,* which offers consumers and businesses federal tax credits for purchasing fuel-efficient hybrid-electric vehicles and energy-efficient appliances and products. The benefits to the environment in terms of reduced air pollution of buying and driving a fuel-efficient vehicle and purchasing and installing energy efficient appliances and home improvement products are obvious. Consumers who purchase and install specific products such as energy efficient windows, insulation, doors, roofs and heating and cooling equipment in the home can receive a tax credit of up to $500 for eligible purchases. In the same manner, homeowners that install a pervious concrete driveway should be eligible for a proportionate tax credit for helping to reduce stormwater runoff. Also, businesses that employ pervious concrete pavement around buildings (walkways, courtyards, etc.) and parking areas and low volume roads in housing subdivisions should be eligible for tax credits on both new construction as well as improvements to existing properties.

Tax credits are generally a more valuable incentive than an equivalent tax deduction because a tax credit reduces tax dollar-for-dollar, while a deduction only removes a percentage of the tax that is owed. Yet, there are also beneficial models for tax deductions that have proven to be effective in environmental clean-up. One example is the Brownfields Tax Incentive that was passed as part of the *Taxpayer Relief Act of 1997.* Brownfields are properties where reuse is complicated by environmental contamination concerns. The incentive allows a taxpayer to fully deduct the costs of environmental cleanups in the year the costs were incurred rather being capitalized and spread over a period of years. Its purpose is to spur the cleanup and redevelopment of brownfields. A similar tax incentive should be afforded to developers who replace antiquated conventional stormwater management systems in industrial and residential properties with an LID approach that combines a hydrologically functional site design with pavement technologies like pervious concrete to compensate for land development impacts on hydrology and water quality.

Other examples of support for environmentally preferable products can be found in federal procurement policy. In 1983, EPA promulgated the first federal procurement guideline that required all federal and all State and local government agencies and contractors that use federal funds to implement a preference program favoring the purchase of cement and concrete containing fly ash. EPA published a summary of information pertaining to coal combustion products use in an environmental fact sheet, *Guideline for Purchasing Cement and Concrete Containing Fly Ash* (EPA530–SW–91–086, January 1992). In addition, Executive Order (E.O.) 12873, *Federal Ac-*

*quisition, Recycling, and Waste Prevention,* signed on October 20, 1993, directs federal agencies to develop affirmative procurement programs for environmentally preferable products. With respect to the cement and concrete containing fly-ash, E.O. 12873 requires that 100 percent of the purchases meet or exceed the EPA guideline standards unless written justification is provided that a product is not available competitively within a reasonable time frame, does not meet appropriate performance standards, or is only available at an unreasonable price. These same types of procurement requirements would be highly effective drivers of green pavement technologies in federally supported combined sewer overflow projects as well as in surface transportation projects that present stormwater management challenges.

Congress has also recognized the importance of using innovative technologies in water quality management, both in terms of funding research into possible new technologies and in demonstrating existing (but relatively new) technologies. In the 1977 *Clean Water Act* amendments, Congress established a three-year innovative and alternative technologies (known as "I/A") program. The I/A program helped successfully move technologies such as land treatment of wastewater, sludge composting and alternative collection systems from relative obscurity to widespread acceptance. For example, the I/A program documented successes and problems with ultraviolet disinfection. This method is now routinely accepted as an alternative to chlorination, especially where there are concerns about security or toxic effects of residual chlorine and chlorine byproducts. The program also demonstrated that I/A technologies can reduce costs while increasing environmental performance.

To further encourage research into innovative green pavement technology, it is critical that EPA establish both a research and development program and a demonstration grant program. The research program should be aimed at: (1) increasing the effectiveness and efficiency of water supply systems (including source water protection, stormwater reuse, and protection of the hydrology of wetlands, streams and sub-surface waters); (2) encouraging the use of innovative or alternative approaches relating to reduction of impervious surfaces; and (3) increasing the effectiveness of waste water systems through incorporation of impervious pavements, nonstructural alternatives, water efficiency, and methods of dispersing, reusing, reclaiming and recycling wastewater.

The demonstration grant program should target water quality management and enhancement by promoting innovations in technology and alternative approaches with the goal of reducing municipal costs of complying with the *Clean Water Act.* Communities selected for grants must describe a strategy by which the demonstration grants could achieve similar goals as (1) those mandated by the *Clean Water Act* (e.g., requirements of stormwater permits under the National Pollution Discharge Elimination System) or (2) those that could be achieved by traditional stormwater management methods. The Administrator should provide grants for water supply or water quality matters relating to urban or suburban population pressure; difficulties in water conservation and efficiency; non-point source pollution; sanitary or combined sewer overflows; or a lack of an alternative water supply.

Precedent for a recommended EPA demonstration grant programs that would support green pavement technologies can be found in the Surface Transportation Environment and Planning Cooperative Research Program (STEP), administered by the Federal Highway Administration (FHWA). The general objective of STEP, which was created by SAFETEA–LU in Section 5207, is to improve understanding through research of the complex relationship between surface transportation, planning and the environment. STEP is the sole source of SAFETEA–LU funds available to conduct FHWA research on planning and environmental issues. It has already addressed specific high utility stormwater initiatives including the International Stormwater Best Management Practices Database, Evaluation and Update of FHWA Pollutant Loadings Model for Highway Stormwater Runoff, and Synthesis on the Fate and Effects of Chloride from Road Salt Applied to Highways for Deicing.

Ultimately, to ensure that green pavement technologies are actually deployed, State and local planners and agencies responsible for administering of the Nation's water quality program have to have confidence that all proven technologies are fully available to them to meet the *Clean Water Act*'s goals and requirements. As such, it is recommended that Section 603(c) of the *Clean Water Act* be amended to identify that financial assistance is available from the State Revolving Loan Fund program for stormwater management projects, to include the use of pervious pavement technologies.

NRMCA appreciates the opportunity to answer questions submitted for the record by Members of the Subcommittee. If you need additional information, please feel free to contact Robert L. Sullivan, NRMCA's Senior Vice President of Government & Legal Affairs at (240) 485–1148 or at rsullivan@nrmca.org.

ANSWERS TO POST-HEARING QUESTIONS

*Responses by Hal Kassoff, Senior Vice President for Sustainable Development, Parsons Brinckerhoff*

**Questions submitted by Chairman David Wu**

*Q1. What State or federal regulations have affected your company's green infrastructure practices?*

*A1.* With transportation representing the largest part of our business, federal regulations relating to NEPA, Clean Water, Clean Air, Historic Preservation, Rare and Endangered Species, Storm Water Management, and Noise all have a profound impact on the projects that we work on for our clients. While each area has its own legislation and regulations, and this in and of itself can be problematic, the prevailing approach among them when it comes to the potential impacts associated with projects can perhaps best be described as "avoid, minimize, mitigate." This concept is reasonable as a regulatory foundation for achieving green infrastructure. A minimum bar must be set to protect our resources and that bar is, in essence, defined by those three words—first do no harm if that is possible, and if some degree of harm is unavoidable then the next rung on the ladder is to minimize that harm with all reasonable measures, as well as mitigate the harm by somehow replacing the functional value of what was lost—this could mean anything from wetland creation to enhancing an historic district. The "affect" of these regulations is to allow many projects to proceed but to do so in as green a manner is possible.

However, there is often even more that can be done if our mindset is advanced one more notch from avoid, minimize and mitigate harm to creating a positive (better than before) net outcome with respect to the natural, social and built environments. This simply means that in addition to meeting regulatory standards for avoiding, minimizing and mitigating harm, transportation and environmental resource professionals might seek outcomes in which at little or no additional cost, measures might be taken to improve upon the environmental footprint that pre-existed the project. Such opportunities most often arise from the fact that the vast majority of projects—certainly in the highway business—involve upgrading existing facilities, few of which were built to current standards of environmental protection.

The problem is that to do *more* than regulations require, by definition is impossible to regulate. So when we ask what can be done from a regulatory perspective to improve the likelihood of achieving "green infrastructure" the answer has to be nothing beyond the avoid, minimize and mitigate harm "standard" and then everything to encourage voluntary efforts to find reasonable and affordable ways to go beyond regulatory minimums as a normal matter of doing business—with the attendant benefits of an improved natural, social and built environment, and improved relationships and greater trust between project sponsors and resource regulators.

*Q2. In your opinion, what are the most pressing research needs in the field of green transportation infrastructure? Should federal R&D programs focus more strongly on technology development or testing and evaluation? How would Parsons Brinckerhoff use the results of that R&D?*

*A2.* A particularly pressing need involving research is to improve the ability of resource agencies to have access to and to apply the science, and a factual foundation, behind what are perceived, but are not in fact always proven to be, the real harmful effects of projects, as well as the real benefits of mitigation and enhancement measures. This point is perhaps best illustrated with a story about one of the most significant environmental challenges I had encountered in my 40 plus years in this business.

We had completed and received federal approval of the Environmental Impact Statement for a long-awaited highway project and after an additional two years to complete final design and acquire right-of-way, we were stopped in our tracks at the wetland permitting stage when federal resource agencies told us that notwithstanding the approved EIS, the project would not receive necessary wetland permits. The reason cited was that during the permit review stage it was determined that the wetland impacts were too severe and that design changes would be needed, even though they would delay the project by over a year and add $20 million in cost.

After engaging a renowned wetland expert to assess the situation we learned from him the good news was that the resource agencies were mistaken and were, in fact, reacting literally to surface appearances in attempting to protect a pristine looking wetland area that was actually created by poor drainage from an adjacent project.

The other somewhat ironic news we were given was that while the area the resource agencies wanted to protect could not be backed up by a factual analysis, there was indeed another area that had been dismissed as being of low value—again largely due to surface appearances—which had a very significant function as a wetland due to its sub-surface connection to important aquifers. So in the end we suffered the delay and most of the additional cost, but had the satisfaction of knowing that the harm we prevented was real.

Related to the need to get the information to practitioners and ensure that it is used, is the need for better information about what mitigation measures are most effective and which ones are marginal. Again, using wetlands as an example, how effective have the many thousands of very small, on site, difficult to maintain mitigation sites proven to be compared to some of the larger, off-site and even out-of-watershed measures, such as wetland banking.

Finally, is it possible to develop cross functional green infrastructure mitigation to address situations where the resource affected is not particularly scarce and replacing the loss would have marginal, if any benefit, but on the other hand another resource, which was perhaps not affected, is threatened. So instead of replacing five acres of wetland adjacent to a 50,000 acre wetland system would it be of greater value to use mitigation funding for upland habitat preservation in connection with an endangered mammal? What are the tradeoffs. How are they quantified? What are the institutional barriers and how can they be overcome?

**Questions submitted by Representative Phil Gingrey**

*Q1. Does current research successfully encapsulate the local environmental factors that affect Best Management Practices which are appropriate for different environments? Does for instance, the International Stormwater Best Management Practices Database include all of the relevant performance data? And if not, are the gaps known and being addressed by State or federal research programs?*

*A1.* While I am unable to respond to these questions I have asked members of our firm who might be able to address them to do so. (Their response follows.)

Many excellent studies have been conducted to evaluate the performance, pollutant removal efficiency and cost of various types of storm water BMPs. Of these research projects, however, only a few were specifically designed to study geographic variation. EPA has published some information regarding site specific BMP information, regional limitation and operation and maintenance burdens of these BMPs, but not in great and practical details sufficient to guide selection and installation. Cooperative research efforts such as the International Stormwater BMP Database project have done an excellent job in reaching out and collecting storm water BMP data. The sites contained in the database to date, however, are not yet geographically diverse. A large amount of data has come from a small number of states, such as California, Texas, and Florida. Not many BMP data represent the Northeast, Mid-Atlantic and Midwest. For the State of Maryland, for example, only two BMP data sets were presented despite the numerous storm water BMPs that have been applied in the past two decades. This poor geographic distribution of the data set makes study of the geographic variation in BMP performance statistically difficult.

Another gap in research is the type of BMPs being studied. For example, one can more readily find detention pond-based BMPs performance data, mainly due to its long history of implementation. One can also find many proprietary BMPs, such as hydrodynamic devices, on the Internet particularly due to commercial interests. By comparison, there is limited information and research related to low impact development (LID) BMP techniques such as bioretention, grass swales, and infiltration.

*Q2. What recommendations do you have for improving university awareness and education of green infrastructure practices?*

*A2.* Clearly our universities as well as our agencies and businesses that employ practitioners would benefit from greater cross fertilization of ideas—through internships among students, continuing education for practitioners, conferences, and the like. The notion of green infrastructure in the U.S. is still relatively new but interest in it is growing very rapidly. Certainly if Congress expressed its interest in and provided additional funding for research and educational programs centered upon green infrastructure (hopefully with earmarks), that would send a powerful message.

*Q3. How can federal agencies such as FHWA and EPA create incentives for projects to improve environmental quality rather than simply meet regulations to avoid harm?*

*A3.* The most important aspect of this question is the implied recognition that regulations will not succeed in going beyond the "avoid, minimize and mitigate harm" standard. Simply put, what we need is ensure success of the current Green Highways Partnership "experiment" in the Mid-Atlantic.

Transportation agencies which become convinced that a "better than before" environmental stewardship ethic is not only the right thing to do but yields practical benefits in gaining the trust and confidence of resource agencies will clearly move in that direction. Similar movement is needed among resource agencies to see that win-win outcomes are possible with their pro-active support and that a track record of poor relationships and frequent appeals means that they may not be working hard enough to find win-win solutions.

While doing more than meeting minimum requirements to improve the environment will not happen through legislation, programs to identify, recognize, celebrate and spread the word about green infrastructure successes in the U.S. and elsewhere can and should be defined.

# Appendix 2:

## Additional Material for the Record

STATEMENT OF THE INTERLOCKING CONCRETE PAVEMENT INSTITUTE

Mr. Chairman, my name is Randall G. Pence, Capitol Hill Advocates, Inc. I am pleased to offer testimony on behalf of ICPI, the Interlocking Concrete Pavement Institute with offices at 1444 I St., NW, Washington, DC 20005.

ICPI represents producers and installers of segmental interlocking concrete pavers in the United States, Canada and elsewhere. ICPI is the voice of the segmental interlocking concrete pavement industry and is the leader in efforts to develop the industry in the Americas through technological research, engineering, product development and innovation, marketing, government relations and public relations.

Segmental interlocking concrete pavements provide multiple benefits of interest in public policy. For the purposes of today's hearing, I will focus on the characteristics of paver surfaces as permeable interlocking concrete pavements (PICP).

PICP are comprised of a layer of concrete pavers placed in layers of small stones and separated by joints filled with even smaller stones. Permeable pavements provide tremendous stormwater runoff advantages. The concrete paving units are not permeable, but the joints between them, typically 5–10 mm wide, provide permeability. They allow water to percolate through the base materials to be absorbed in local soils rather than flow across non-pervious pavements, carrying surface pollutants to the Nation's rivers. Further, there is a filtration benefit as stormwater travels though the permeable pavements and the in situ soils.

PICPs are highly effective in providing infiltration, detention and treatment of storm water pollution. The base can be designed to filter, treat and slowly release water into a storm sewer or water course while providing a walking and driving surface. PICPs answer the call from municipal regulations to limit impervious covers and runoff into storm drains working at capacity, or when sites have limited space for detention ponds. The U.S. Environmental Protection Agency and several State agencies consider PICPs an infiltration Best Management Practice (BMP). An increasing number of cities, counties and states are incorporating them into land development and runoff standards, low-impact development guidelines and design manuals on stormwater control.

With proper design, material selection, construction and routine maintenance, PICP is a sustainable low-impact BMP used by landscape architects, architects, engineers, developers and public agency staff. PICPs have been widely used across Europe, especially Germany since the early 1990s. The paving products shown in the exhibit attached to this testimony demonstrate runoff reduction and improved water quality in a range of climates, soils, hydrological and regulatory environments.

As urbanization increases, so does the concentration of pavements, buildings and other impervious surfaces. These surfaces generate additional runoff and pollutants during rainstorms causing stream-bank erosion, as well as degenerating lakes and polluting sources of drinking water. Increased runoff also deprives groundwater from being recharged, decreasing the amount of available drinking water in many communities. Recreational opportunities from lakes, streams and rivers decline from the impacts of urban runoff. Commercial fishing productivity can decline in estuaries and bays thereby negatively impacting regional economies. In response to environmental and economic impacts from stormwater runoff, U.S. federal law mandates that states control water pollution in runoff through the National Pollutant Discharge Elimination System (NPDES). Among many things, the law requires that states and localities implement best management practices BMPs to control nonpoint source pollution in runoff from development. BMPs can include storage, filtration and infiltration land development practices. Infiltration practices capture runoff and rely on infiltration through soils, vegetation, or aggregates for the reduction of pollutants. Detention ponds are a common BMP example used to hold, infiltrate, and release stormwater. Infiltration trenches are another that reduce stormwater runoff and pollution, and replenish groundwater. All of these BMPs provide some treatment and reduction of runoff pollutants.

In preparation for this hearing, Subcommittee staff have asked ICPI to address these issues:

1. *What environmentally-friendly transportation infrastructure technologies are available to private developers? What are the costs and benefits associated with these technologies? How do these technologies contribute to environmental protection, including pollution control and energy efficiency?*
2. *How do you determine if a technology is environmentally-friendly? How do life cycle environmental costs affect whether a technology is considered "green"?*
3. *What are the barriers preventing widespread use of these technologies by private entities?*

*4. What actions can the Federal Government take to encourage use of these technologies by private entities?*

The first two questions may be attended in brief. Clearly, PICP are a prime example of an environmentally-friendly transportation infrastructure technology that is available to all developers—private, public, institutional, suitable at small and larger scales for residential, commercial, government, military construction and more. Costs vary by several factors including location, design complexity and more but PICP are cost-competitive with other paving surfaces. The environmental benefits are as set forth above in the introduction to PICP: effective stormwater management due to the permeable qualities of the product, improved water quality due to filtration and flood control. The energy efficiency benefits may not be a distinguishing factor.

In determining if a technology is environmentally friendly, we would suggest that a good test would be to assess whether a given technology tends to bring about environmental conditions more like the conditions that would exist if there were no development in the location in question. PICP meet this standard by providing a permeable surface that can provide substantial in situ absorption and infiltration as would be expected without development. Life cycle costing is always a factor for consideration, but finding a valid cost comparison for a life cycle analysis could be a challenge. For example, life cycle costs at a specific job site might be relatively easy to estimate in the long term, it might be more difficult to estimate the out-year costs of failing to implement green technologies because those costs could occur downstream of the job site.

Further, any life cycle cost analysis should address infrequent but potentially overwhelming catastrophic events that are more likely to occur downstream if innovative technologies are not supported upstream.

**Barriers and Solutions**

Questions 3 and 4 describe issues that could suggest remedial action to be supported by the Subcommittee and are best answered together.

The prime barriers to widespread adoption of green technologies in transportation, and other construction sectors as well, are initial construction costs and the general issue of local custom—that which is familiar and safe in the thinking of local architects, designers and engineers.

*A.* The construction industry is well known for intense pressures to build as quickly and as inexpensively as the legislative, regulatory and codes schemes will allow. Assuming that most environmentally friendly construction options that are not being widely used are not being used because they are not the least costly options for initial construction, the solution would seem to be for government to provide financial incentives for green construction. This could take the form of tax incentives such as targeted tax credits for using approved technologies. Perhaps accelerated depreciation would be attractive to private sector entities that would intend to build and own properties. It may well be the case that such tax incentives would be less expensive than the costs of catastrophic event responses in the future, but clearly, tax incentives would be costly and controversial for that reason, though ICPI would support the concept.

*B.* Another cost-related barrier is that associated with setting aside valuable land area for open space to provide infiltration of stormwater. Open areas can provide strong environmental benefits but carry large costs which are a prime impediment to their use. Innovative techniques like PICP can obviate this barrier if they can provide a dual use of the area, for example, meeting the needs for parking areas and simultaneously providing infiltration opportunity in the same space because the parking area is a permeable pavement. As Congress considers means to move green construction technologies to the mainstream, it should recognize and provide incentives for efficient use of the land that allow for development and good environmental impacts without relying solely on undeveloped open spaces, catch basins and other costly space-consumptive sole-use techniques. We should assume that those green technologies that have lower costs in terms of dedicated land set-asides will be more attractive to developers and face lesser barriers to adoption on this basis.

*C.* Perhaps the more pervasive barrier, and one which Congress might help surmount for small commitments of funding, is the vexing problem of attracting to deviate from prior practice and custom and to adopt new technologies. Local governments and local markets have the primary impact on codes, regulations and customs for construction. The construction industry tends to stay with what is safe, what is familiar, and what has been done before.

Congress can have positive impacts in overcoming this barrier by providing relatively modest funding for innovative technology research, engineering and demonstration projects to be conducted at the local level, helping develop local familiarity, local applications, local reference data, local experience and expertise. Recipients of federal grant funding for this purpose should be made available to State water pollution control agencies, interstate agencies, other public or nonprofit private agencies, institutions, organizations, and individuals. The purpose would be to conduct and promote the coordination and acceleration of, research, investigations, experiments, training, demonstrations, surveys, and studies relating to the causes, effects, extent, prevention, reduction, and elimination of pollution, with special emphasis on demonstrating uses of low-impact, decentralized stormwater control technologies and applications using permeable pavements, including interlocking concrete pavements, to prevent and control stormwater run-off at the source.

EPA has such a program in place. Unfortunately, it has not been funded consistently enough to reach critical mass with the construction community. ICPI would recommend that the Subcommittee support full funding for currently authorized EPA programs to award such grants. What is needed is more funding, especially to demonstrate the feasibility of technologies like PICP to local government authorities who determine which technologies are recognized at the local level as BMPs for stormwater management. This is crucial to widespread adoption of innovative new BMPs.

ICPI is urging the House Interior Appropriations Subcommittee to direct funding of $2 million in FY 2008 to fund grant programs authorized under 33 USC § 1254(B)(3) to research and demonstrate stormwater mitigation demonstration projects nationwide, many of which will include use of concrete paver technology. We urge this subcommittee to support funding for these EPA grant programs.

*D.* As part of its stormwater mandate, EPA maintains the most comprehensive database of BMPs in the world for the management and reduction of stormwater runoff. EPA uses the database to make policy decisions and impact grant funding for stormwater projects. But the database's impact goes far beyond EPA. Other agencies use the EPA database to make their stormwater design decisions. Private companies, designers, architects, and engineers across the world use the database.

The BMP database needs to be updated to reflect a substantial body of new BMP research. Yet, in the most recent fiscal years, funding for the *Clean Water Act*'s Section 104(b)(3) funds which EPA would use to conduct the update have been reduced and eliminated. The BMP update would significantly add to information regarding the use of concrete pavers and permeable pavement systems for stormwater mitigation.

Congress could jump-start the BMP update by restoring modest funding for both the BMP update and the grant program for to ensure that the construction and design communities worldwide could access the latest data for their stormwater mitigation strategies. Industries would offer new data that would focus on the stormwater potential of making routine use of permeable interlocking concrete pavers to capture important environment benefits.

ICPI is currently recommending to the House Interior Appropriations Subcommittee that is renew funding of up to $200,000 in FY 2008 for the CWA Section 104(b)(3) programs to conduct a major overhaul and update of the EPA stormwater BMP database, which is likely to include a substantial upgrade and enhancement of the data describing how concrete paver technology can be used very effectively to mitigate stormwater runoff. We recommend that this subcommittee support the recommendation.

*E.* It is noted in the hearing background documents that a regulatory barrier to widespread adoption of innovative technologies may be due to EPA regional offices taking different positions on whether permeable pavements that inject into the ground should be considered point sources subject to permitting under the NPDES. Clearly, Congress could act to remove this barrier by passing legislation to clearly define permeable pavements that inject into the ground are either not defined as point sources or are point sources exempt from permitting requirements under NPDES. EPA should be tasked to standardize regulatory responses among the regional offices with regard to permeable pavements.

Mr. Chairman, thank you for this opportunity to provide the views of ICPI. We look forward to working with you as the Subcommittee considers policy responses to enhance adoption of these technologies and would be happy to address the Subcommittee's questions.

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