

SCOE Strategic Plan and Research Plan

Requested by:

American Association of State Highway
and Transportation Officials (AASHTO)

Standing Committee on the Environment

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SCOE Strategic Plan

June 2015

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Introduction and Background

The American Association of State Highway and Transportation Officials (AASHTO) has many committees focused on specific topics of interest to state Departments of Transportation (DOTs), herein referred to as “members”. The Standing Committee on Environment (SCOE) covers four primary areas of environmental interest: air quality, climate change, and energy (AQCCE); communities and cultural concerns (CCC); environmental process (EP); and natural resources (NR).

As first developed in its 2003 Strategic Plan, the vision of SCOE is to assist members in delivering “a national, regional and local intermodal transportation system that is safe, economical, efficient, environmentally sound, and aesthetically and culturally sensitive.” This vision was accompanied by SCOE’s mission, goals, and strategies to achieve those goals. Although no formal updates have been made to the 2003 Strategic Plan, SCOE revisited its plan proposing an updated mission and goals in 2011.

In 2015, the vision and mission of SCOE, while faced with new challenges, has not changed significantly. A number of environmental topics, concerns, and responsibilities have arisen over the past decade at both the national and state levels with profound impacts on members. These topics include but are not limited to: streamlining project delivery, climate change and adaptation to extreme weather, environmental justice, asset management, health assessments, and public-private partnerships. Performance metrics have also become a recent focus resulting from the passage of the Moving Ahead for Progress in the 21st Century Act (MAP-21).

Multimodal and intermodal issues, along with programmatic approaches to transportation impacts, resources, and corridors, have also become increasingly important as the nation’s highway system becomes increasingly built out and subject to matters of service, safety, and efficiency. As the industry’s leader for members on environmental topics, SCOE continues to face these evolving issues and is challenged to provide the policy and technical support needed by members in an environment of dwindling financial resources and changing requirements, including those under the latest surface transportation reauthorization bill, MAP-21.

To address these new and evolving issues, in 2014/2015, SCOE, with the support of the National Cooperative Highway Research Program (NCHRP), revisited and updated its strategic plan and research plan to reflect the current and future environmental priorities of the members. The effort involved extensive data gathering through interviews with committee and subcommittee members and a series of surveys to identify priorities and needs at the committee level and in the four environmental areas of interest.

This resulting Strategic Plan retains the high level goals and objectives for the SCOE Full Committee, while outlining goals and objectives for each of the four subcommittees to increase the capacity of members to efficiently and reliably deliver environmentally sound transportation projects, programs and services; and, to create the knowledge foundation for examining current and future environmental issues. A current list of the environmental research topics identified for each of the subcommittees is shown in the table on the following page.

SCOE Subcommittee Research Topics

	Subcommittees			
	AQCCE	CCC	EP	NR
4(f)		●	●	
Air Quality	●			
Alternative Transportation Funding	●	●	●	●
Asset Management	●	●	●	●
Climate Change/Adaptation to Extreme Weather	●		●	●
Construction and Maintenance Practices	●		●	●
Context Sensitive Solutions	●	●	●	●
Energy	●			
Environmental Considerations in Transportation Planning	●	●	●	●
Environmental Enhancements			●	
Environmental Justice	●	●	●	
Environmental Management Systems			●	
Geographic Information Systems	●	●	●	●
Health Assessments		●	●	
Historic Preservation/Cultural Resources		●		
Indirect Effects/Cumulative Impacts	●		●	●
Invasive Species/Vegetation Management				●
Land Use	●	●	●	
MAP-21	●	●	●	●
NEPA Process			●	
Noise		●	●	●
Programmatic Agreements/Approaches	●	●	●	●
Project Delivery/Streamlining	●	●	●	●
Risk Management	●	●	●	●
Sustainability	●		●	
Tribal Consultation		●		
Waste Management/Recycling/Brownfields			●	●
Water Quality/Wetlands				●
Wildlife & Ecosystems				●

The research topics presented in the table are a compilation from sources such as the Transportation Environmental Research Ideas (TERI) database, the SCOE survey effort, and member input. The list of topics is not intended to be all encompassing, but rather the table represents the primary subcommittee issues/topics. As shown in the table, environmental research topics often require the involvement and input from more than one subcommittee. The Strategic Plan establishes a framework for SCOE to address all of the research topics, including those topics that cut across multiple subcommittees and environmental issues.

NCHRP 25-25 (95) SCOE Strategic Plan and Research Plan

Referenced within the goals and objectives for each of the four subcommittees is a Research Road Map. The purpose of the Research Road Map is to present research directions for each subcommittee, as well as specific research plans for Storm Water and Adaptation to Extreme Weather. The research directions outlined are based on the results of the survey conducted of subcommittee members, as well as an assessment of research that has occurred and is on-going on the subject topics. Although these topics are characterized as research, they might also represent topics for discussion, guide book development, workshops, agenda items, etc.

Each Research Road Map includes potential topic areas grouped around seven general subject areas or research categories that are critical to the goals of the individual subcommittee, including:

- Policy Analysis and Decision-making
- Environmental Planning and Process Requirements
- Environmental Impacts and Consequences
- Analysis Tools
- Strategies and Best Practices
- Implementation Challenges
- Emerging Issues

The research topic areas provide examples of specific research topics of interest to the subcommittee for each subject or research category. They are not intended to dictate which topics are to be selected for research/funding, nor are they to be the only ideas that may be funded, or in any way exclude new ideas received in the annual TERI database update process from being considered for funding. Rather, the topics are provided to serve as a framework of ideas of interest to SCOE and the individual subcommittees that can be revised as needed over time. Research Road Maps may also be used to assess what research is needed to support policy positions.

In order to remain relevant, the Research Road Map must be updated on a regular basis, e.g., in conjunction with the annual “Call for Research Ideas” (TERI database update process). Updates may be initiated as needed and led by the Subcommittee Chair (and Vice-Chair as applicable), Research Task Force representative and/or AASHTO staff for the Subcommittee. They may also be initiated at the request of one or more members of SCOE or its Subcommittees.

The goals and objectives for each subcommittee, along with the Research Road Map, are intended to provide a context for each subcommittee to annually:

- Identify and prioritize environmental issues/concerns;
- Provide input into the SCOE work plan;
- Establish a process (e.g., regular conference calls and/or webinars) to monitor progress and annually assess the subcommittees’ accomplishments;
- Assess critical and emerging issues; and
- Coordinate with other transportation associations, federal regulatory agencies, United States Department of Transportation (USDOT), Transportation Research Board (TRB), and other AASHTO committees to share perspectives and seek solutions to existing and emerging challenges, regulations, and practices.

SCOE’s Vision, Mission, and Goals (Full Committee)

Vision Statement

To assist members in delivering a national, regional and local intermodal transportation system that is safe, resilient, economical, efficient, environmentally sound, and aesthetically and culturally sensitive.

Mission Statement

The AASHTO Standing Committee on Environment (SCOE) provides policy and technical support to the AASHTO Board of Directors and members to increase their capacity to efficiently and reliably deliver environmentally sound transportation projects, programs and services.

SCOE Goals and Objectives

The following are the goals and objectives, in support of the SCOE Vision and Mission.

SCOE Goal 1: Provide technical and policy support to AASHTO Board of Directors, members, and other AASHTO Committees as appropriate.

SCOE Objective 1.1: Serve as a mechanism for members to provide input on federal legislation, regulation, guidance and other policy arenas.

SCOE Objective 1.2: Monitor and actively participate in the development and consistent application of environmental laws, regulations, and guidance.

SCOE Objective 1.3: Collaborate with other AASHTO committees, federal regulatory agencies, USDOT, TRB, and other associations to share perspectives and seek solutions to existing and emerging challenges faced by the members.

SCOE Goal 2: Increase the capacity of members to efficiently and reliably deliver environmentally sound transportation projects, programs and services.

SCOE Objective 2.1: Support the goals and guide/support the work of the Center for Environmental Excellence by AASHTO, the Environmental Technical Assistance Program (ETAP), and the Resilient and Sustainable Transportation Systems (RSTS) Technical Assistance Program.

SCOE Objective 2.2: Annually assess emerging environmental issues that will pose challenges for project delivery, and prioritize them for action.

SCOE Objective 2.3: Advance transportation project delivery by working with members to encourage innovation and develop strategies for increasing the efficiency of project delivery processes.

SCOE Goal 3: Create the knowledge foundation on which to base state of the art impact analysis and mitigation planning, for current and future environmental issues.

SCOE Objective 3.1: In accordance with the current Subcommittee Research Road Maps, identify and prioritize environmental/transportation research and support priority research selection and funding.

Subcommittee Goals, Objectives, and Research Needs

Air Quality, Climate Change, and Energy (AQCE)

AQCE Goal 1: Provide policy support to SCOE and members related to air quality, climate change and energy.

AQCE Objective 1.1: Serve as a mechanism for members to review and comment on national legislation, regulation and guidance, coordinating with other AASHTO subcommittees and other organizations as appropriate.

AQCE Goal 2: Increase the capacity of members to efficiently and reliably deliver environmentally sound transportation projects, programs and services relating to air quality, climate change, and energy.

AQCE Objective 2.1: Proactively participate in national discussions regarding the contributions to improving air quality and reducing GHG emissions made and energy used by the transportation sector.

AQCE Objective 2.2: Coordinate with other transportation associations, federal regulatory agencies, USDOT, TRB, and other AASHTO committees to share perspectives and seek solutions to existing and emerging challenges, regulations, and practices.

AQCE Objective 2.3: Annually assess emerging issues and prepare recommendations for SCOE Committee work plan.

AQCE Goal 3: Create the knowledge foundation for examining current and future environmental issues.

AQCE Objective 3.1: Identify and prioritize air quality, climate change and energy research and support priority research selection and funding, making use of and updating the Research Road Map as appropriate.

AQCE Objective 3.2: Conduct regular conference calls and/or webinars to conduct the business of the subcommittee and discuss emerging issues as deemed appropriate by the subcommittee. Discuss subcommittee accomplishments at the SCOE Annual Meeting.

The AQCE Research Road Map can be found in Appendix A and the Research Road Map for Extreme Weather Events can be found in Appendix B.

Subcommittee Goals, Objectives, and Research Needs

Communities and Cultural Concerns (CCC)

- CCC Goal 1:** Provide policy support to SCOE and members related to communities and cultural concerns.
- CCC Objective 1.1: Serve as a mechanism for members to review and comment on national legislation, regulation and guidance, coordinating with other AASHTO subcommittees and other organizations as appropriate.
- CCC Goal 2:** Increase the capacity of members to efficiently and reliably deliver environmentally sound transportation projects, programs and services relating to communities and cultural concerns.
- CCC Objective 2.1: Focus the committee’s efforts to emerging issues and technologies of particular importance to members. These may include communities and cultural resources issues such as: technological innovation, emergent public engagement strategies, cultural landscapes, and asset management (e.g., historic bridges) planning.
- CCC Objective 2.2: Sustain and diversify membership, beyond historians and archaeologists, on the communities and cultural concerns subcommittee.
- CCC Objective 2.3: Coordinate with other transportation associations, federal regulatory agencies, USDOT, TRB, and other AASHTO committees to share perspectives and seek solutions to existing and emerging challenges, regulations, and practices.
- CCC Objective 2.4: Annually assess emerging issues and prepare recommendations for SCOE Committee work plan.
- CCC Goal 3:** Create the knowledge foundation for examining current and future environmental issues.
- CCC Objective 3.1: Identify and prioritize communities and cultural concerns research and support priority research selection and funding, making use of and updating the Research Road Map as appropriate.
- CCC Objective 3.2: Conduct regular conference calls and/or webinars to conduct the business of the subcommittee and discuss emerging issues as deemed appropriate by the subcommittee. Discuss subcommittee accomplishments at the SCOE Annual Meeting.

The CCC Research Road Map can be found in Appendix C.

Subcommittee Goals, Objectives, and Research Needs

Environmental Process (EP)

EP Goal 1: Provide policy support to SCOE and members related to environmental process.

EP Objective 1.1: Serve as a mechanism for members to review and comment on national legislation, regulation and guidance, coordinating with other AASHTO subcommittees and other organizations as appropriate.

EP Goal 2: Increase the capacity of members to efficiently and reliably deliver environmentally sound transportation projects, programs and services relating to the environmental process.

EP Objective 2.1: Assist members to improve the project development process by integrating environmental requirements and considerations into the various phases of project delivery.

EP Objective 2.2: Assist members in gaining knowledge regarding environmental issues through education, training, and sharing of information among the states.

EP Objective 2.3: Coordinate with other transportation associations, federal regulatory agencies, USDOT, TRB, and other AASHTO committees to share perspectives and seek solutions to existing and emerging challenges, regulations, and practices.

EP Objective 2.4: Annually assess emerging issues and prepare recommendations for SCOE Committee work plan.

EP Goal 3: Create the knowledge foundation for examining current and future environmental issues.

EP Objective 3.1: Identify and prioritize environmental process research and support priority research selection and funding, making use of and updating the Research Road Map as appropriate.

EP Objective 3.2: Conduct regular conference calls and/or webinars to conduct the business of the subcommittee and discuss emerging issues as deemed appropriate by the subcommittee. Discuss subcommittee accomplishments at the SCOE Annual Meeting.

The EP Research Road Map can be found in Appendix D.

Subcommittee Goals, Objectives, and Research Needs

Natural Resources (NR)

- NR Goal 1:** Provide policy support to SCOE and members related to natural resources.
- NR Objective 1.1: Serve as a mechanism for members to review and comment on national legislation, regulation and guidance, coordinating with other AASHTO subcommittees and other organizations as appropriate.
- NR Goal 2:** Increase the capacity of members to efficiently and reliably deliver environmentally sound transportation projects, programs and services relating to natural resources.
- NR Objective 2.1: Target, on an annual basis, the committee’s efforts to emerging issues, operating activities, and technologies of particular importance to members. These may include natural resource issues such as: storm water runoff and nonpoint source pollution, endangered species, vegetation management, landscape connectivity, watershed management, and migratory birds.
- NR Objective 2.2: Disseminate successful strategies, lessons learned, techniques and technologies for addressing DOT Natural Resources issues, requirements, and goals.
- NR Objective 2.3: Coordinate with other transportation associations, federal regulatory agencies, USDOT, TRB, and other AASHTO committees to share perspectives and seek solutions to existing and emerging challenges, regulations, and practices.
- NR Objective 2.4: Annually assess emerging issues and prepare recommendations for SCOE Committee work plan.
- NR Goal 3:** Create the knowledge foundation on which to base state of the art impact analysis and mitigation planning, for current and future environmental issues.
- NR Objective 3.1: Identify and prioritize natural resources research and support priority research selection and funding, making use of and updating the Research Road Map as appropriate.
- NR Objective 3.2: Coordinate with other AASHTO committees (e.g., Technical Committee on Hydrology and Hydraulics) and TRB committees (e.g., Hydrology, Hydraulics and Water Quality, Ecology and Transportation) to create synergy around common research ideas to increase funding opportunities.
- NR Objective 3.3: Conduct regular conference calls and/or webinars to conduct the business of the subcommittee and discuss emerging issues as deemed appropriate by the subcommittee. Discuss subcommittee accomplishments at the SCOE Annual Meeting.

The NR Research Road Map can be found in Appendix E and the Research Road Map for Stormwater can be found in Appendix F.

Appendices

Appendix A – Research Road Map for the Subcommittee on Air Quality, Climate Change, and Energy

Appendix B – Research Road Map for Extreme Weather Events

Appendix C – Research Road Map for the Subcommittee on Communities and Cultural Concerns

Appendix D – Research Road Map for the Subcommittee on Environmental Process

Appendix E – Research Road Map for the Subcommittee on Natural Resources

Appendix F – Research Road Map for Stormwater

Introduction

The purpose of this Research Road Map is to present research directions for the Standing Committee on the Environment (SCOE) Air Quality, Climate Change and Energy (AQCCCE) Subcommittee, which is focused on specific topics of interest to state Departments of Transportation DOTs, herein referred to as “members”. The research directions outlined are based on the results of a survey conducted of SCOE and AQCCCE Subcommittee members, and an assessment of recent and ongoing research on the subject topics. The topics of air quality, climate change and energy have received considerable attention from the research community for many years and thus future SCOE-sponsored research should reflect and complement this preceding research, as well as the work that is currently being conducted by others.

Research Road Map

The Research Road Map includes potential topic areas, grouped around seven subject areas or research categories that are depicted in **Figure 1**.

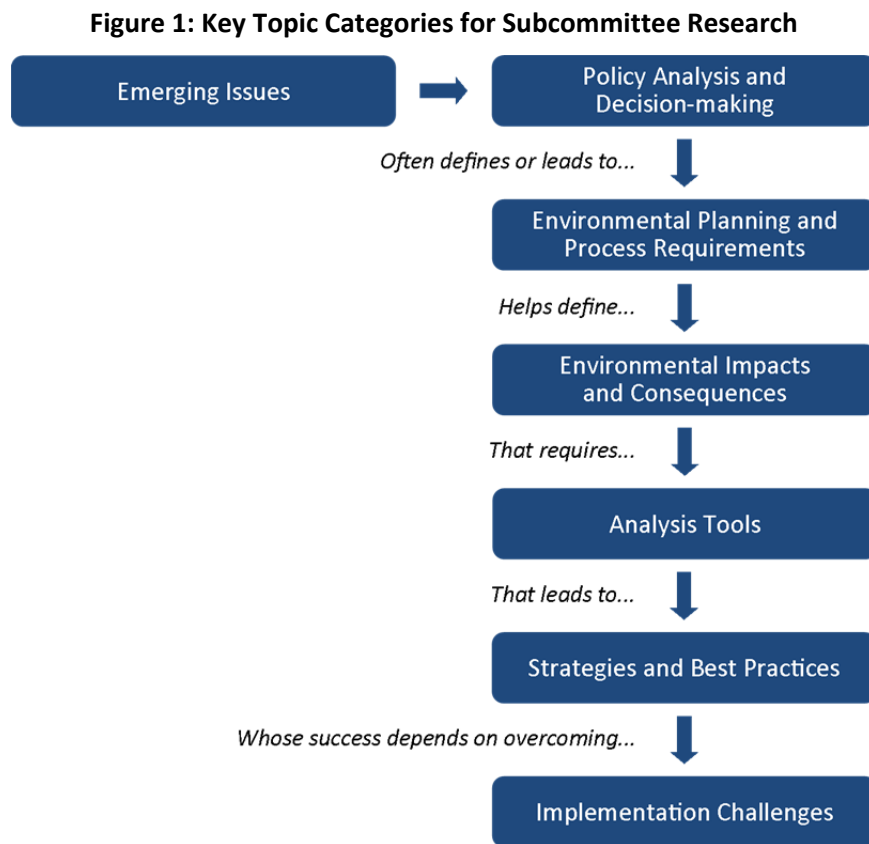


Figure 1 shows how the seven subject areas are connected to different phases of each topic area which are critical to the goals of the Air Quality, Climate Change and Energy Subcommittee. For example, emerging issues might focus on those topic areas where very little thought has been given to the implications of a particular issue and its effect on the transportation community. Or, members may have faced a particular issue for some time but one of the key challenges is inadequate tools or databases to analyze the impacts of said issue. Or, members might have appropriate analysis tools and data, but the key challenges are found in overcoming critical barriers to implementing the recommended strategies. A key observation from **Figure 1** as it relates to the Subcommittee’s research agenda is that research topics can focus on a range of issues that might be of concern to members.

Updates to the Research Road Map

To remain relevant, this Research Road Map requires regular updates. The process is as follows:

1. An annual update will occur in conjunction with the AQCCE Subcommittee chair's notice for the annual "Call for Research" Transportation and Environmental Research Ideas (TERI database).
2. Other updates may be requested by any SCOE or AQCCE Subcommittee member.
3. All updates will be coordinated by the AQCCE Subcommittee Research Coordinator.
4. AQCCE Subcommittee members will have the opportunity to review and comment on updates.
5. The consensus Research Road Map will be posted on the TERI database.
6. AQCCE Subcommittee members and others will be invited to develop research proposals linked to the Research Road Map entries.
7. The AQCCE Subcommittee will consult the Research Road Map during development of the annual NCHRP research program and response to calls for research suggestions from FHWA and others.

Potential Research Topics

The identification of research topics for Subcommittee sponsorship should reflect the importance of a topic to members, the level to which the research will add understanding or capability to members' technical analysis, the degree to which the research will not overlap with what others are doing on that topic, and additional input, improvements to streamlining and/or cost-effectiveness of technical analyses, or environmental clearance processes, and other considerations (e.g. regulatory) as appropriate. With respect to identifying research topics that best fit into the Research Road Map, the potential research topics, include the results from a survey of the full SCOE membership that identified the following research topics (out of 30) ranked by level of support:

- Climate change (4th)
- Air quality (8th)
- Emissions analysis conformity (16th)*
- Greenhouse gas emissions (21st)
- Congestion Mitigation and Air Quality Improvement program (22nd)*
- Energy (26th)

**Note: Asterisk (*) indicates cross-cutting topic and is also identified in at least one other subcommittee.*

The research topic areas presented below provide examples of specific topics of interest to the AQCCE Subcommittee for each subject or research category. They are not intended to be the only ideas that may be funded, or in any way exclude new ideas received in the annual TERI database update process from being considered for funding. Rather, the topics are provided to serve as a framework of ideas of interest to SCOE and the AQCCE Subcommittee that can be revised as needed.

The topics identified by the survey as well as other research topics that were identified through discussions with member officials are summarized below under each of the topic categories (a topic was listed from the survey if it received votes of "medium" or "high" priority). Topics may be presented as a research question, though they might also represent topics for discussion, guide book development, workshops, agenda items, etc. The current topics of interest to the AQCCE Subcommittee reflect its ongoing interest in: regulatory issues, streamlining and modeling and related improvements.

NCHRP 25-25 (95) SCOE Strategic Plan and Research Plan

Appendix A - Research Road Map for the Subcommittee on Air Quality, Climate Change, and Energy

Policy Analysis and Decision-making

This category includes research to better understand the underlying factors associated with specific environmental policies. It also includes emphasis on how these factors can be considered within the State DOT decision-making processes.

- Pending transportation authorization related to conformity, NEPA, model improvement programs, and consultation requirements for regulations, guidance, policies and model updates.
- Can conformity be streamlined (e.g. project revisions that make on de minimus changes to total regional VMT), especially if a large number of areas are designated nonattainment with revised NAAQS?
- What are the continuing effects of conformity on transportation planning and decision-making?
- Will there be a need for research to facilitate the implementation of the pending federal CEQ guidance for considering greenhouse gas emissions for transportation? For example, how should greenhouse gas (GHG) emissions (and appropriate modeling efforts) be considered in long range transportation planning?
- To what extent is there a role for environmental performance measures as part of the transportation planning process (relating to air quality, climate change and energy)?

Environmental Planning and Process Requirements

This category includes research on how the process of considering transportation-related impacts can better consider environmental concerns. It also covers improved understanding of how existing or new process requirements can fit into state transportation and environmental planning efforts and improving collaborative efforts in environmental analysis. Streamlining environmental clearances processes is a key consideration.

- What areas or elements of the air quality clearance process can be facilitated or streamlined with a programmatic agreement (or categorical finding) or a template that state DOTs can customize for application in their respective jurisdictions? Possible examples:
 - A template for a categorical finding or programmatic agreement for particulate matter (PM).
 - What are the best reference cases for project level air quality quantitative analyses and modeling?
 - Templates for a programmatic agreement for mobile source air toxics (MSATs) to address topics not addressed in the guidance (e.g. combining regional modeling exercises for several projects being assessed concurrently, establishing higher MSAT thresholds based on local modeling inputs, etc.).
 - A template for state DOTs to apply for purposes of documenting CMAQ programmatic eligibility.
 - Pilot studies for implementing any & all new templates for programmatic agreements.
- To what extent can (or should) air quality, climate change/extreme weather and energy concerns be incorporated into sustainability or other environmental rating systems?
- Data Management and Quality Control: Would an online data repository (DR), aka “big data,” for project-level air quality analyses help project sponsors and modelers more efficiently and reliability conducts analyses and streamline the overall environmental clearances process? An

NCHRP 25-25 (95) SCOE Strategic Plan and Research Plan

Appendix A - Research Road Map for the Subcommittee on Air Quality, Climate Change, and Energy

ODR could for example contain project-level modeling inputs (by county) based on MOVES input files originally developed for regional conformity and/or the national emissions inventory. Similarly, typical modeling inputs could be developed and housed in the ODR for dispersion models.

Environmental Impacts and Consequences

This category focuses on research on the community and transportation system consequences of environmental impacts. Focus could be on sole impacts or cumulative impacts over time.

- What are good examples of assessments of indirect effects and cumulative impacts for project-level air quality analyses for various types of highway, transit and inter-modal projects?
- What PEL can be made for health in transportation planning related to air quality?
- What are the impacts of Congestion Mitigation and Air Quality Improvement (CMAQ) Program PM2.5 set-asides on other pollutants?

Analysis Tools

This category covers research on models and tools that can be used to analyze and assess environmental impacts. It also includes examining the sources and use of data as part of the analysis process.

- Modeling Improvements: What research would be needed to support the implementation of the recommendations from the landmark 2007 NRC report "[Models in Environmental Regulatory Decision Making](#)"? While the ultimate goal is the establishment of ongoing model improvement programs for EPA emission and dispersion models that include critically-needed model validation processes for typical transportation projects, appropriate treatment of uncertainty, and ongoing consultation and coordination with transportation agencies that are required to use those models, the first step may be a basic assessment of the current state of the art in reference to or following the concepts presented in the NRC report.
- Streamlining (Modeling Efficiency):
 - How can the data requirements for air quality analysis be made more efficient?
 - How can the data needs for GHG modeling be made more efficient?
- Accuracy and Uncertainty (Model Evaluation):
 - How best to quantify the contribution of roadway sources to near road air quality?
 - How best to characterize the accuracy and uncertainty associated with dispersion models? Studies that compare model predictions to near road ambient concentration data for various typical transportation facilities and configurations would serve this purpose.
 - How best to characterize the accuracy and uncertainty of the overall modeling chain (traffic, emissions and dispersion, including estimates of background concentrations)?
 - As more stringent emission and fuel quality standards result in ongoing reductions in overall modeled emissions, emissions from specific sources (such as brake and tire wear, and cold starts) may become relatively larger or more important.
 - What sources are becoming (or may be expected to become) more important over time?
 - How accurate are modeled emissions for brake and tire wear and cold starts, and how can they be improved?

NCHRP 25-25 (95) SCOE Strategic Plan and Research Plan

Appendix A - Research Road Map for the Subcommittee on Air Quality, Climate Change, and Energy

- Traffic and Activity:
 - What data are available from ITS and operations databases that may help improve traffic inputs for project-level air quality analyses as well as regional analyses? What is the best way to conduct data-mining in order to access and process these data for modeling purposes?
 - What data is available to better characterize driving cycles and operating mode distributions for typical highway, transit and inter-modal projects and potentially significantly improve the accuracy of PM analyses and help clear projects for air quality?
 - Are there limitations in data for driving cycles for higher road grades that might effectively limit the application of the emission model? Note the degree to which this effect may occur may vary by pollutant and vehicle (source) type.
 - How can microsimulation and/or HCM approaches be improved to better characterize traffic and activity for project-level air quality analyses? How can their application for project-level air quality analyses be facilitated and streamlined?
- Climate Change:
 - How does one conduct a credible greenhouse gas emissions reduction and climate resilience benefit/cost analysis?
 - Does currently available guidance address the states' needs for risk assessment of infrastructure vulnerable to extreme weather events and sea rise? What additional tools and training are necessary?
 - What tools and best practices are being used by state and local agencies that provide a comprehensive decision making process for investment in sustainable transportation corridors and systems? What air quality, climate change and/or energy information is needed in order for states to be able to demonstrate desired performance based outcomes?
 - Does currently available guidance address the states' needs for risk assessment of infrastructure vulnerable to extreme weather events and sea rise? What additional tools and training are necessary?
- What tools and best practices are being used by state and local agencies that provide a comprehensive decision making process for investment in sustainable transportation corridors and systems? What air quality, climate change and/or energy information is needed in order for states to be able to demonstrate desired performance based outcomes?

Strategies and Best Practices

This category covers research on the effectiveness of different strategies to mitigate or adapt community and transportation system impacts. It includes identifying current State DOT best practices as well as making recommendations for or developing new strategies.

- What are best practices for PM_{2.5} hot spot analysis screening tools for use in interagency consultation?
- Are there states that have successfully implemented renewable energy investments or partnerships and what is the opportunity for others? What is the process by which a State DOT would assess the appropriateness and value of establishing renewable energy technologies in highway rights-of-way?
- What are the best practices being utilized within states among MPOs, transit providers, State and Local DOTs and the private sector in providing integrated transportation solutions within corridors to reduce greenhouse gas emissions?

NCHRP 25-25 (95) SCOE Strategic Plan and Research Plan

Appendix A - Research Road Map for the Subcommittee on Air Quality, Climate Change, and Energy

Implementation Challenges

This category focuses on research on the barriers and opportunities to implement environmental policy, planning requirements and mitigation strategies.

- How can the data requirements for air quality and GHG analysis be made more efficient?
- Are there barriers within federal transportation policies and funds that inhibit the investment in the solutions that demonstrate the greatest benefit/cost from the perspective of air quality, climate change and/or energy?
- Are there gaps in existing policy that are barriers to conducting air quality analyses efficiently?

Emerging Issues

This category covers research on new and emerging environmental issues that will affect state DOTs in the near future.

- What are the implications of alternatively fueled vehicles to state DOTs? Are there better ways to account for the number, activity and emissions of alternative fuel and advanced technology vehicles in forecasting?
- How are states planning for and considering funding/financing options for providing electric vehicle charging stations within or along transportation corridors? What partnerships are forming or available with other agencies or the private sector to facilitate this infrastructure?
- What are implications of NAAQS revisions? How can health impact assessments (HIA) be used to address topics on health/children's health and near-road mitigation?

Introduction

The purpose of this Research Road Map is to present research directions for the Standing Committee on the Environment (SCOE) Air Quality, Climate Change and Energy (AQCCCE) Subcommittee, which is focused on specific topics of interest to state Departments of Transportation DOTs, herein referred to as “members”, specific to extreme weather events. This Extreme Weather Events Research Road Map may include other issues of concern to SCOE and also includes issues of concern to other AASHTO committees and subcommittees. As such, it is anticipated that the Extreme Weather Research Road Map will overlap with other SCOE Subcommittees’ Research Road Maps, the Stormwater Research Road Map, and joint work with other AASHTO groups. This overlap was expected due to the complex relationship between natural cycles (which include extreme weather events); human activity; air, biotic, and aquatic ecosystem quality; water quality and quantity; and human health.

The research directions outlined are based on the results of a survey conducted of SCOE members, as well as an assessment of existing and ongoing extreme weather events research that has occurred and is on-going on the subject topics. The topic of extreme weather events has received some attention from the research community in recent years, but very little has been published in archival journals or research reports. Future SCOE-sponsored research should address gaps, reflect, complement, and build upon preceding research, as well as the work that is currently being conducted by others.

Research Road Map

The Extreme Weather Events Research Road Map includes potential topic areas, grouped around seven subject areas or research categories that are depicted in **Figure 1**.

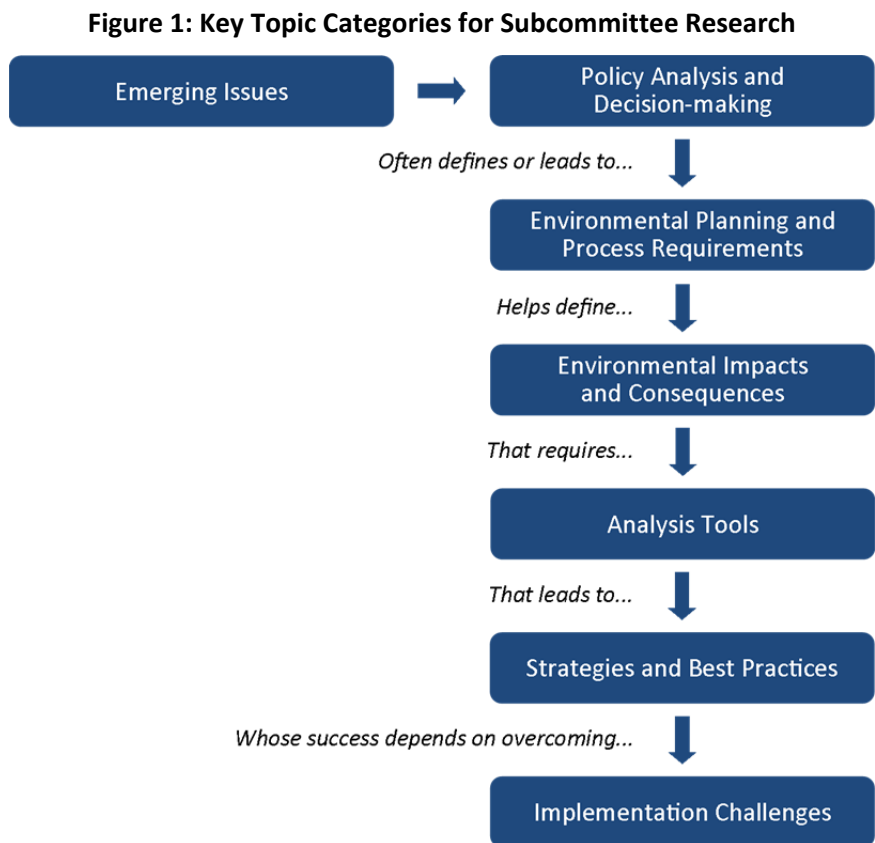


Figure 1 shows how the seven subject areas are connected to different phases of each topic area. For example, emerging issues might focus on those topic areas where very little thought has been given to the implications of a particular issue and its effect on the transportation community. Or, members may have faced a particular issue for some time but one of the key challenges is inadequate tools or databases to analyze the impacts of that issue. Or, members might have appropriate analysis tools and data, but the key challenges are found in overcoming critical barriers to implementing the recommended strategies. A key observation from **Figure 1** as it relates to the extreme weather event research agenda is that research topics can focus on a range of issues that might be of concern to members.

Updates to the Research Road Map

To remain relevant, this Research Road Map requires regular updates. The process is as follows:

1. An annual update will occur in conjunction with the AQCCE Subcommittee chair's notice for the annual "Call for Research" Transportation and Environmental Research Ideas (TERI database).
2. Other updates may be requested by any SCOE or AQCCE Subcommittee member.
3. All updates will be coordinated by the AQCCE Subcommittee Research Coordinator.
4. AQCCE Subcommittee members will have the opportunity to review and comment on updates.
5. The consensus Research Road Map will be posted on the TERI database.
6. AQCCE Subcommittee members and others will be invited to develop research proposals linked to the Research Road Map entries.
7. The AQCCE Subcommittee will consult the Research Road Map during development of the annual NCHRP research program and response to calls for research suggestions from FHWA and others.

Potential Research Topics

The identification of research topics for Subcommittee sponsorship should reflect the importance of a topic to members, the level to which the research will add understanding or capability to members' technical analysis, the degree to which the research will not overlap with what others are doing on that topic, and additional input, improvements to streamlining and/or cost-effectiveness of technical analyses, or environmental clearance processes, and other considerations (e.g. regulatory) as appropriate.

With respect to the importance of extreme weather events research, a survey of the full SCOE membership ranked climate change/extreme weather events as the fourth most important out of 30 potential research topics. There is clearly a great deal of interest in supporting more research attention on those issues surrounding extreme weather events.

The research topic areas presented below provide examples of specific topics of interest to the AQCCE Subcommittee for each subject or research category. They are not intended to be the only ideas that may be funded, or in any way exclude new ideas received in the annual TERI database update process from being considered for funding. Rather, the topics are provided to serve as a framework of ideas of interest to SCOE and the AQCCE Subcommittee that can be revised as needed.

Policy Analysis and Decision-making

This category includes research to better understand the underlying needs associated with specific environmental policies. It also includes emphasis on how these needs can be considered within the state DOT decision-making processes.

- What are the information needs for decision-makers and policy-makers in establishing policies and protocols related to preparing for and responding to extreme weather events?
- What are best case examples of state DOT organizational decision-making models for responding to extreme weather events?
- What are recommended practices for state DOT/federal agency coordination in response to extreme weather events?

Environmental Planning and Process Requirements

This category includes research on how the process of assessing transportation-related impacts can better consider environmental concerns. It also covers improved understanding of how existing or new process requirements can fit into state transportation and environmental planning efforts and improve collaborative efforts in environmental analysis.

- What are the demonstrated savings for state DOTs using programmatic agreements/approaches and contracts with private contractors for responding to extreme weather events? How can these best practices and lessons learned be disseminated among the state DOTs for use in other planning and collaboration efforts?
- How should potential changes in climate change, extreme weather frequency and magnitudes be addressed, if at all, during project development, construction and maintenance?
- How can system resiliency in response to extreme weather events be incorporated into regional or statewide planning?
- What are best practices and ultimately, recommended strategies for state DOTs in providing information to facilitate other agencies' (USDOT modal agencies and FEMA) decisions relating to disaster response approvals?

Environmental Impacts and Consequences

This research category focuses on the community and transportation system consequences of environmental impacts. Focus could be on sole impacts or cumulative impacts over time.

- What has been the experience of state DOTs in the type of damage caused by extreme weather events, both short term and long term?
- What types of design and operations strategies can state DOTs use to mitigate or avoid potential consequences?
- What techniques have been used to predict the impact that extreme weather events will have on transportation? How accurate have these techniques been in predicting impacts?

Analysis Tools

This category covers research on models and tools that can be used to analyze and assess environmental impacts. It also includes examining the sources and use of data as part of the analysis process.

- How do current design and analysis models consider uncertainty and risks associated with extreme weather events? Are changes necessary? If so, what changes?
- What types of tools are available to assess the vulnerability of different transportation assets to extreme weather events?
- How does one prioritize mitigation and avoidance strategies across all of the assets for which a state DOT is responsible?
- How do we better link meteorological forecasting and climate change projections to potential system impacts?

Strategies and Best Practices

This category covers research on the effectiveness of different strategies to mitigate or adapt to community and transportation system impacts. It also includes examining state DOT best practices.

- What are best practices in the operations and maintenance responses to extreme weather events?
- How can Road Weather Information Systems (RWIS) be used for real-time responses to extreme weather events?
- What are best practices in preparing for extreme weather events?
- What are best practices on establishing risk levels and choosing the most robust strategies given uncertainty and the probabilistic nature of extreme event planning?
- What is best practice in establishing formal processes for recovering from an extreme weather event?
- What have been important lessons learned and guidance on evacuation planning?

Implementation Challenges

This research category focuses on the barriers and opportunities to implement environmental policy, planning requirements and mitigation strategies.

- What are best practices and approaches to streamline the response to extreme weather events?
- What are best practices for developing needed information technology systems and databases that can be used to manage state DOT responses to extreme weather events?
- What have been some of the institutional challenges associated with extreme weather preparation and response? What strategies are most effective in meeting these challenges?

Emerging Issues

This category covers research on new and emerging environmental issues that will affect state DOTs in the near future.

- How can “intelligent” infrastructure be used to minimize the impacts of extreme weather events on the transportation system?
- How can a transportation agency incorporate extreme weather concerns into performance-based planning and programming?

Introduction

The purpose of this Research Road Map is to present research directions for the Standing Committee on the Environment (SCOE) Communities and Cultural Concerns (CCC) Subcommittee, which is focused on specific topics of interest to state Departments of Transportation DOTs, herein referred to as “members”. The research directions outlined are based on the results of a survey conducted of SCOE and CCC Subcommittee members, as well as an assessment of research that has occurred and is on-going on the subject topics. The topics of community and cultural concerns have received some attention from the research community for many years. Future SCOE-sponsored research should reflect and complement this preceding research, as well as the work that is currently being conducted by others.

Research Road Map

The Research Road Map includes potential topic areas, grouped around seven subject areas or research categories that are depicted in **Figure 1**.

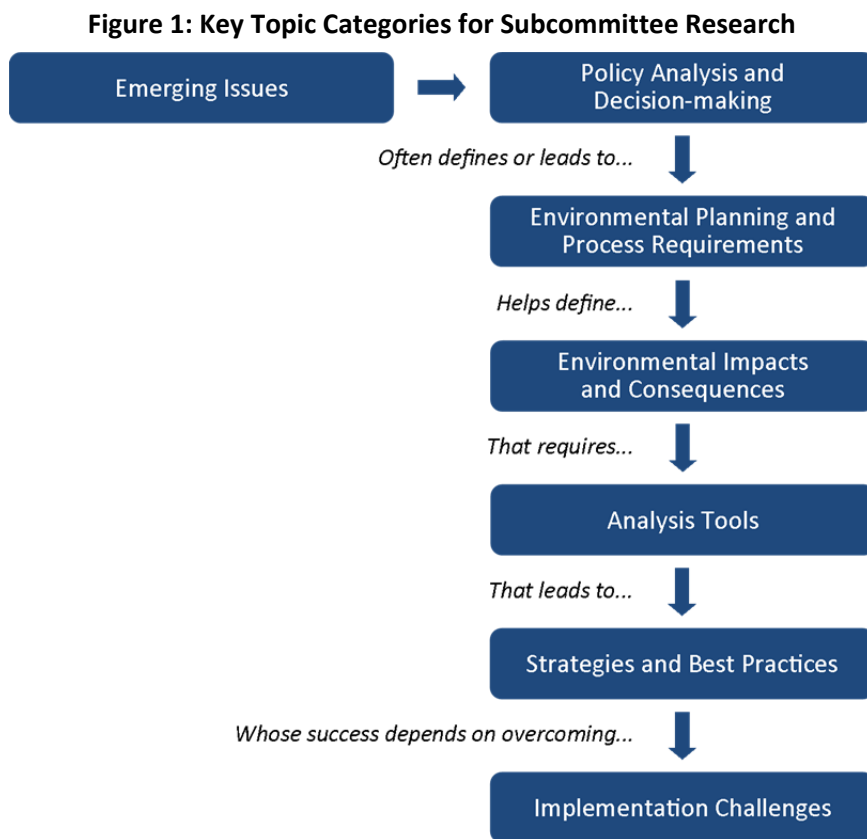


Figure 1 shows how the seven subject areas are connected to different phases of each topic area which are critical to the goals of the CCC Subcommittee. For example, emerging issues might focus on those topic areas where very little thought has been given to the implications of a particular issue and its effect on the transportation community. Or, members may have faced a particular issue for some time but one of the key challenges is inadequate tools or databases to analyze the impacts of said issue. Or, state members might have appropriate analysis tools and data, but the key challenges are found in overcoming critical barriers to implementing the recommended strategies. A key observation from **Figure 1** as it relates to the Subcommittee’s research agenda is that research topics can focus on a range of issues that might be of concern to members.

Updates to the Research Road Map

To remain relevant, this Research Road Map requires regular updates. The process is as follows:

1. An annual update will occur in conjunction with the CCC Subcommittee chair's notice for the annual "Call for Research" Transportation and Environmental Research Ideas (TERI database).
2. Other updates may be requested by any SCOE or CCC Subcommittee member.
3. All updates will be coordinated by the CCC Subcommittee Research Coordinator.
4. CCC Subcommittee members will have the opportunity to review and comment on updates.
5. The consensus Research Road Map will be posted on the TERI database.
6. CCC Subcommittee members and others will be invited to develop research proposals linked to the Research Road Map entries.
7. The CCC Subcommittee will consult the Research Road Map during development of the annual NCHRP research program and response to calls for research suggestions from FHWA and others.

Potential Research Topics

The identification of research topics for Subcommittee sponsorship should reflect the importance of a topic to members, the level to which the research will add understanding or capability to members' technical analysis, the degree to which the research will not overlap with what others are doing on that topic, and additional input, improvements to streamlining and/or cost-effectiveness of technical analyses, or environmental clearance processes, and other considerations (e.g. regulatory) as appropriate.

With respect to identifying research topics that best fit into the Research Road Map, the potential research topics, include the results from a survey of the full SCOE membership that identified the following research topics (out of 30) ranked by level of support:

- Historic/archaeological/cultural (10th)
- Section 106 (12th)*
- Social and economic (13th)
- Environmental justice (15th)
- Land use (tied for 18st)
- Public health and active living (tied for 18th)
- Community disruption (24th)
- Livability (28th)

**Note: Asterisk (*) indicates cross-cutting topic and is also identified in at least one other subcommittee.*

The research topic areas presented below provide examples of specific topics of interest to the CCC Subcommittee for each subject or research category. They are not intended to be the only ideas that may be funded, or in any way exclude new ideas received in the annual TERI database update process from being considered for funding. Rather, the topics are provided to serve as a framework of ideas of interest to SCOE and the CCC Subcommittee that can be revised as needed.

NCHRP 25-25 (95) SCOE Strategic Plan and Research Plan

Appendix C – Research Road Map for the Subcommittee on Communities and Cultural Concerns

The topics identified by the survey as well as other research topics that were identified through discussions with member officials are summarized below under each of the topic categories (a topic was listed from the survey if it received votes of “medium” or “high” priority). Topics may be presented as a research question, though they might also represent topics for discussion, guide book development, workshops, agenda items, etc. The current topics of interest to the CCC Subcommittee reflect its ongoing interest in: regulatory issues, streamlining and modeling and related improvements.

Policy Analysis and Decision-making

This category includes research to better understand the underlying factors associated with specific environmental policies. It also includes emphasis on how these factors can be considered within the State DOT decision-making processes.

- How successful have the *de minimis* provisions been in streamlining the consideration of historic properties under Section 4(f)?
- How does a state provide a more balanced approach to 4(f) alternatives analysis per the latest FHWA guidance?

Environmental Planning and Process Requirements

This category includes research on how the process of considering transportation-related impacts can better consider environmental concerns. It also covers improved understanding of how existing or new process requirements can fit into state transportation and environmental planning efforts and improving collaborative efforts in environmental analysis.

- What are the documented benefits of state DOT and resource agency programmatic agreements/approaches?
- What is the documented value added and the efficiencies gained from upfront environmental planning during regional or statewide planning?
- What are the long term benefits and disadvantages of resource agency partnerships that support staff positions?
- How can the reliability of predictive modeling for the identification of archeological properties be enhanced?
- How can we better plan pedestrian facilities or use bike/pedestrian modes to connect to other transportation modes?
- How can we strengthen the integration or coordination with NCSHPO and other national preservation agencies into our environmental planning process?

Environmental Impacts and Consequences

This category focuses on research on the community and transportation system consequences of environmental impacts. Focus could be on sole impacts or cumulative impacts over time.

- How can more reliable models be developed for analyzing the secondary impacts resulting from induced growth?
- How can we improve the treatment of impacts to archeological properties associated with lands selected for use as borrow/fill?
- How can sustainability (environmental, social, economic) impacts be considered by state DOTs?

NCHRP 25-25 (95) SCOE Strategic Plan and Research Plan

Appendix C – Research Road Map for the Subcommittee on Communities and Cultural Concerns

Analysis Tools

This category covers research on models and tools that can be used to analyze and assess environmental impacts. It also includes examining the sources and use of data as part of the analysis process.

- What tools and best practices are being used by state and local agencies that provide a comprehensive decision making process for investment in sustainable transportation corridors and systems? What community and cultural impact information is needed in order for states to be able to demonstrate desired performance based outcomes?
- How can we identify the benefits and costs of promoting off-site preservation strategies to mutually benefit both highway planning needs and preservation values in lieu of carrying out archeological excavations of marginal value?
- What are good examples of using GIS for analysis and assessment of community and cultural impacts?
- What are good examples of generating better visual impacts analysis?
- How can social media and technologies be used as part of public/community involvement efforts in environmental issues and communicating the benefits of DOT efforts?

Strategies and Best Practices

This category covers research on the effectiveness of different strategies to mitigate or adapt community and transportation system impacts. It also includes examining State DOT best practices.

- What are examples of successful context sensitive designs in mitigating highway improvement impacts in historic districts?
- Can successful, creative practices under Section 106 be applied more broadly to address other project-driven environmental impacts?
- What are best practices in identifying environmental justice issues and engaging the affected community in reaching successful outcomes?
- Can successful consultation practices with tribes be applied to improve outreach to more traditional community groups and organizations?
- How are states handling historic bridge mitigation in their Historic Bridge Programmatic Agreements? What works and does not work and why?

Implementation Challenges

This category focuses on research on the barriers and opportunities to implement environmental policy, planning requirements and mitigation strategies.

- What are the most common barriers in accelerated project delivery, and to what extent do community and cultural impact requirements contribute to them?
- What has been the experience of excluding the Interstate Highway System from Section 106 requirements?
- State DOTs have many years of experience working with SHPO's in applying the National Register criteria to evaluate historic properties. Evaluation of what type of properties has been the most problematic? Are programmatic understandings needed with the National Park Service in how the criteria should be applied in the context of transportation planning? Are changes to the criteria warranted?
- What are best practices and approaches to streamline the environmental process with respect to community and cultural issues?

Emerging issues

This category focuses on research on the barriers and opportunities to implement environmental policy, planning requirements and mitigation strategies.

- None identified.

Introduction

The purpose of this Research Road Map is to present research directions for the Standing Committee on the Environment (SCOE) Environmental Process (EP) Subcommittee, which is focused on specific topics of interest to state Departments of Transportation DOTs, herein referred to as “members”. The research directions outlined are based on the results of a survey conducted of SCOE and EP Subcommittee members, and an assessment of recent and ongoing research on the subject topics. The topic of environmental process has received some attention from the research community for many years, although not as much as other topical areas in SCOE and thus future SCOE-sponsored research should reflect and complement this preceding research, as well as the work that is currently being conducted by others.

Research Road Map

The Research Road Map includes potential topic areas, grouped around seven subject areas or research categories that are depicted in **Figure 1**.

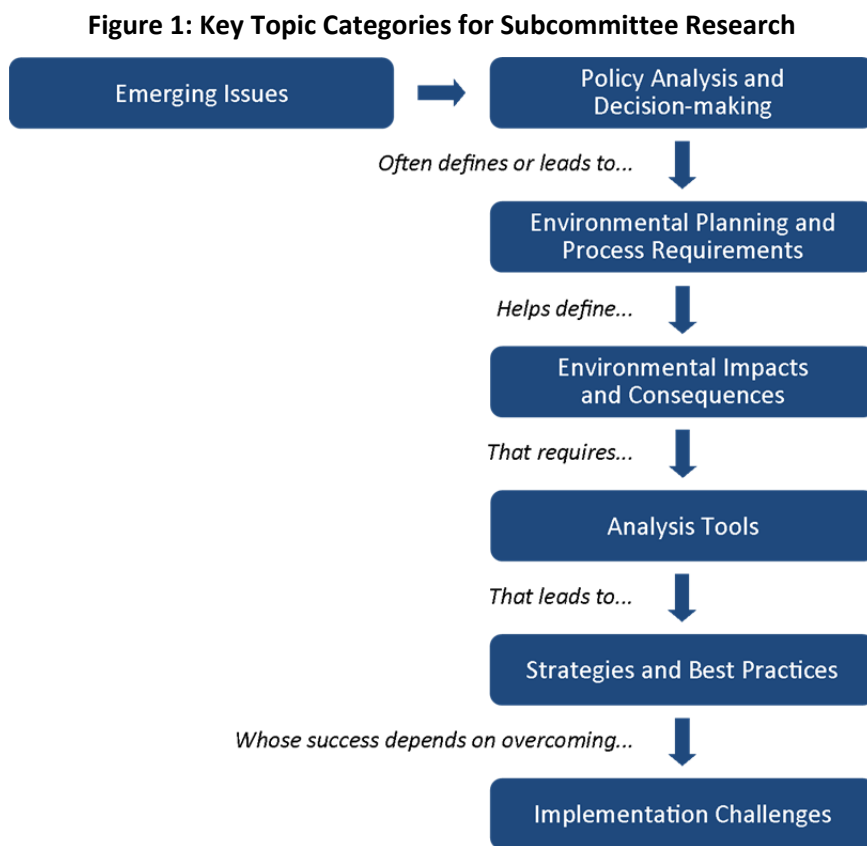


Figure 1 shows how the seven subject areas are connected to different phases of each topic area which are critical to the goals of the EP Subcommittee. For example, emerging issues might focus on those topic areas where very little thought has been given to the implications of a particular issue and its effect on the transportation community. Or, members may have faced a particular issue for some time but one of the key challenges is inadequate tools or databases to analyze the impacts of said issue. Or, members might have appropriate analysis tools and data, but the key challenges are found in overcoming critical barriers to implementing the recommended strategies. A key observation from **Figure 1** as it relates to the Subcommittee’s research agenda is that research topics can focus on a range of issues that might be of concern to members.

Updates to the Research Road Map

To remain relevant, this Research Road Map requires regular updates. The process is as follows:

1. An annual update will occur in conjunction with the EP Subcommittee chair's notice for the annual "Call for Research" Transportation and Environmental Research Ideas (TERI database).
2. Other updates may be requested by any SCOE or EP Subcommittee member.
3. All updates will be coordinated by the EP Subcommittee Research Coordinator.
4. EP Subcommittee members will have the opportunity to review and comment on updates.
5. The consensus Research Road Map will be posted on the TERI database.
6. EP Subcommittee members and others will be invited to develop research proposals linked to the Research Road Map entries.
7. The EP Subcommittee will consult the Research Road Map during development of the annual NCHRP research program and response to calls for research suggestions from FHWA and others.

Potential Research Topics

The identification of research topics for Subcommittee sponsorship should reflect the importance of a topic to members, the level to which the research will add understanding or capability to members' technical analysis, the degree to which the research will not overlap with what others are doing on that topic, and additional input, improvements to streamlining and/or cost-effectiveness of technical analyses, or environmental clearance processes, and other considerations (e.g. regulatory) as appropriate.

With respect to identifying Subcommittee research topics that best fit into the Research Road Map, the potential research topics, include the results from a survey of the full SCOE membership that identified the following research topics (out of 30) ranked by level of support:

- Accelerating project delivery (1st)
- MAP-21 environmental provisions (11th)
- Section 106 (12th)
- Section 4(f)(14th)
- Conformity (16th)
- CMAQ (18th)

**Note: Asterisk (*) indicates cross-cutting topic and is also identified in at least one other subcommittee.*

The research topic areas presented below provide examples of specific topics of interest to the EP Subcommittee for each subject or research category. They are not intended to be the only ideas that may be funded, or in any way exclude new ideas received in the annual TERI database update process from being considered for funding. Rather, the topics are provided to serve as a framework of ideas of interest to SCOE and the EP Subcommittee that can be revised as needed.

NCHRP 25-25 (95) SCOE Strategic Plan and Research Plan

Appendix D – Research Road Map for the Subcommittee on Environmental Process

The topics identified by the survey as well as other research topics that were identified through discussions with member officials are summarized below under each of the topic categories (a topic was listed from the survey if it received votes of “medium” or “high” priority). Topics may be presented as a research question, though they might also represent topics for discussion, guide book development, workshops, agenda items, etc. The current topics of interest to the EP Subcommittee reflect its ongoing interest in: regulatory issues, streamlining and modeling and related improvements.

Policy Analysis and Decision-making

This category includes research to better understand the underlying factors associated with specific environmental policies. It also includes emphasis on how these factors can be considered within the State DOT decision-making processes.

- How should sustainability (environmental, social, economic) concerns be considered by state DOTs in statewide planning and programming?
- How to improve project development through value-added public participation?
- How can the NEPA process be more streamlined?
- What are best practices for establishing MOUs or other mechanisms for collaborative action?
- What are some guidelines for preparing high-quality NEPA documents?
- How can alternative uses of ROW for power generation, carbon sequestration, wetlands mitigation, water quality, etc. be facilitated?
- What has been the effect of brownfield sites on the NEPA decision making process?
- What has been the impact of impacted soil and groundwater on the NEPA decision-making process?

Environmental Planning and Process Requirements

This category includes research on how the process of considering transportation-related impacts can better consider environmental concerns. It also covers improved understanding of how existing or new process requirements can fit into state transportation and environmental planning efforts and improving collaborative efforts in environmental analysis.

- What are documented time savings for state DOTs and resource agencies in using programmatic agreements/approaches? What are the long term benefits and disadvantages of resource agency partnerships that support staff positions?
- How can a “no-net-loss strategy” be used for handling resource impacts?
- What strategies are most effective in linking planning and the NEPA process?
- What has been the impact of the new categorical exclusions under MAP-21?
- How can extreme weather and climate change risks be incorporated into environmental processes?
- What are best practice tools for cumulative impact analysis?
- How can we strengthen the coordination with environmental agencies into a State DOT’s environmental planning process?

Environmental Impacts and Consequences

This category focuses on research on the community and transportation system consequences of environmental impacts. Focus could be on sole impacts or cumulative impacts over time.

- How can more reliable models be developed for analyzing the secondary impacts resulting from induced growth?
- How can we improve the treatment of impacts to archeological properties associated with lands selected for use as borrow/fill?
- How can sustainability (environmental, social, economic) impacts be considered by state DOTs?

Analysis Tools

This category covers research on models and tools that can be used to analyze and assess environmental impacts. It also includes examining the sources and use of data as part of the analysis process.

- What has been State experience in using FHWA's E-NEPA system?
- What is the current state of practice and future directions for environmental management systems in light of technology advancements?
- What does a Sustainability Management System look like? How can fully integrated sustainability planning that includes economic, social and environmental impacts together be developed as part of the environmental process?

Strategies and Best Practices

This category covers research on the effectiveness of different strategies to mitigate or adapt community and transportation system impacts. It also includes examining State DOT best practices.

- How can States transfer NEPA process best practice, lessons learned, programmatic agreements, etc.?
- What are best practices for tracking/implementing environmental commitments?
- What is best practice for NEPA reevaluations?
- What are best practices for categorical exclusion documentation?
- What are best practices in using social media and technologies as part of public/community involvement efforts?

Implementation Challenges

This category focuses on research on the barriers and opportunities to implement environmental policy, planning requirements and mitigation strategies.

- What are best practices for advance acquisition under MAP-21?
- How can accelerated decision-making under MAP-21 be best implemented?
- What are best practices and approaches for multi-modal/intermodal environmental process improvements?
- What are the barriers to using recycled materials in transportation infrastructure, including potential environmental impacts, engineering properties, regulatory complexities and perception problems?

Emerging Issues

This category focuses on research on the barriers and opportunities to implement environmental policy, planning requirements and mitigation strategies.

- How can clean fill issues be coordinated with regulatory agencies to facilitate reuse of minimally contaminated fill materials with minimal regulatory requirements?

Introduction

The purpose of this Research Road Map is to present research directions for the Standing Committee on the Environment (SCOE) Natural Resources (NR) Subcommittee, which is focused on specific topics of interest to state Departments of Transportation DOTs, herein referred to as “members”. The research directions outlined are based on the results of a survey conducted of SCOE and NR Subcommittee members, and an assessment of recent and ongoing research on the subject topics. The topic of natural resources has received considerable attention from the research community for many years and thus future SCOE-sponsored research should reflect and complement this preceding research, as well as the work that is currently being conducted by others.

Research Road Map

The Research Road Map includes potential topic areas, grouped around seven subject areas or research categories that are depicted in **Figure 1**.

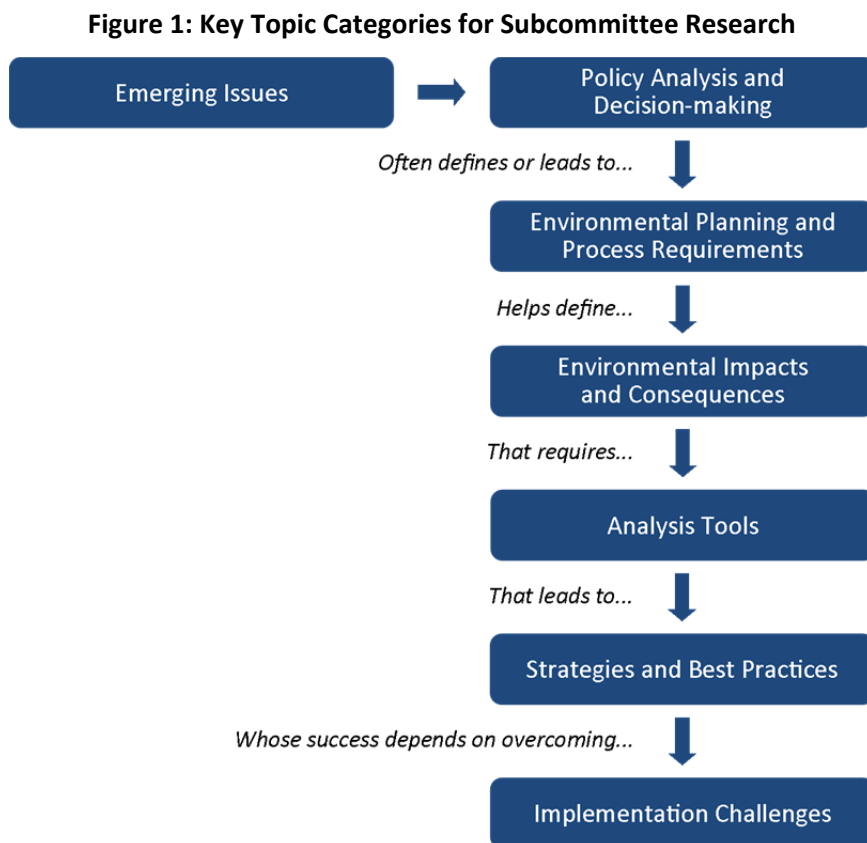


Figure 1 shows how the seven subject areas are connected to different phases of each topic area which are critical to the goals of the NR Subcommittee. For example, emerging issues might focus on those topic areas where very little thought has been given to the implications of a particular issue and its effect on the transportation community. Or, members may have faced a particular issue for some time but one of the key challenges is inadequate tools or databases to analyze the impacts of said issue. Or, members might have appropriate analysis tools and data, but the key challenges are found in overcoming critical barriers to implementing the recommended strategies. A key observation from **Figure 1** as it relates to the NR Subcommittee’s research agenda is that research topics can focus on a range of issues that might be of concern to members.

Updates to the Research Road Map

To remain relevant, this Research Road Map requires regular updates. The process is as follows:

1. An annual update will occur in conjunction with the NR Subcommittee chair’s notice for the annual “Call for Research” Transportation and Environmental Research Ideas (TERI database).
2. Other updates may be requested by any SCOE or NR Subcommittee member.
3. All updates will be coordinated by the NR Subcommittee Research Coordinator.
4. NR Subcommittee members will have the opportunity to review and comment on updates.
5. The consensus Research Road Map will be posted on the TERI database.
6. NR Subcommittee members and others will be invited to develop research proposals linked to the Research Road Map entries.
7. The NR Subcommittee will consult the Research Road Map during development of the annual NCHRP research program and response to calls for research suggestions from FHWA and others.

Potential Research Topics

The identification of research topics for Subcommittee sponsorship should reflect the importance of a topic to members, the level to which the research will add understanding or capability to members’ technical analysis, the degree to which the research will not overlap with what others are doing on that topic, and additional input, improvements to streamlining and/or cost-effectiveness of technical analyses, or environmental clearance processes, and other considerations (e.g. regulatory) as appropriate.

With respect to identifying NR Subcommittee research topics that best fit into the Research Road Map, the potential research topics, include the results from a survey of the full SCOE membership that identified the following natural resource research topics (out of 30) ranked by level of support:

- Water quality (2nd)
- TMDLs (3rd)
- Climate Change / Extreme Weather Events (4th)*
- Streams (5th)
- Ecology (6th)
- Protected species (7th)
- Wetlands (9th)
- Section 4(f) (14th)*
- Vibration (tied for 18th)*
- Energy (26th)*
- Coastal zone management (27th)
- Noise (28th)*

**Note: Asterisk (*) indicates cross-cutting topic and is also identified in at least one other subcommittee.*

The research topic areas presented below provide examples of specific topics of interest to the NR Subcommittee for each subject or research category. They are not intended to be the only ideas that may be funded, or in any way exclude new ideas received in the annual TERI database update process from being considered for funding. Rather, the topics are provided to serve as a framework of ideas of interest to SCOE and the NR Subcommittee that can be revised as needed.

NCHRP 25-25 (95) SCOE Strategic Plan and Research Plan

Appendix E – Research Road Map for the Subcommittee on Natural Resources

The topics identified by the survey as well as other research topics that were identified through discussions with member officials are summarized below under each of the topic categories (a topic was listed from the survey if it received votes of “medium” or “high” priority). Topics may be presented as a research question, though they might also represent topics for discussion, guide book development, workshops, agenda items, etc. The current topics of interest to the NR Subcommittee reflect its ongoing interest in: regulatory issues, streamlining and modeling and related improvements.

Policy Analysis and Decision-making

This category includes research to better understand the underlying factors associated with specific environmental policies. It also includes emphasis on how these factors can be considered within the state DOT decision-making processes.

- What are the information needs for decision-makers, policy-makers and regulators that need to be addressed regarding the application of Road Deicers and the realities of needing their use but considering their effect on surface water quality, ground water, aquatic species, etc.?
- What legal and/or policy issues need to be addressed in order to allow for the possibility of using programmatic agreements for mitigating impacts under Section 7 of the ESA using an existing Section 10 Habitat Conservation Plans in order to add value and achieve efficiencies? (NCHRP 20-06/Topic 22-01 is anticipated)
- What are agencies’ (USDOT modal agencies, USFWS, USEPA, USACE, State Parks and Wildlife Departments, State Departments of Environmental Protection) policies and approaches to risks and uncertainty in making decisions and issuing permits and other approvals?
- How can local and state DOT policy be considered or adapted for adjacent land relative to flooding air quality (dust, particulate), and wildlife connectivity?
- How can the Section 7 consultation policies and decision-making processes for transportation projects be improved (including for listed bats)?
- How can in-lieu fees, banking, pollutant trading, and restoration policies and decision-making be further clarified for those options to take precedence over on-site mitigation?

Environmental Planning and Process Requirements

This category includes research on how the process of considering transportation-related impacts can better consider environmental concerns. It also covers improved understanding of how existing or new process requirements can fit into state transportation and environmental planning efforts and improving collaborative efforts in environmental analysis.

- What are the demonstrated time savings for state DOTs and resource agencies in using NR-type programmatic agreements/approaches? How can these best practices and lessons learned be disseminated among the state DOTs for use in other planning and collaboration efforts?
- What processes, procedures, and agreements exist or are needed to address new species listings during critical phases in project development, construction and maintenance?
- What value added and efficiencies have been or can be realized by considering NR issues during regional or statewide planning?
- What are best practices and ultimately, recommended strategies for state DOTs in providing information to facilitate other agencies’ (USDOT modal agencies, USFWS, USEPA, and USCOE) decision relating to permits and other approvals considering predictability, severity and uncertainty?

NCHRP 25-25 (95) SCOE Strategic Plan and Research Plan

Appendix E – Research Road Map for the Subcommittee on Natural Resources

- How can a “no-net loss” strategy be used for solving resource impacts?
- What are the long term advantages and disadvantages from resource agency partnerships and how do these partnerships advance other efforts?

Environmental Impacts and Consequences

This category focuses on research on the community and transportation system consequences of environmental impacts. Focus could be on sole impacts or cumulative impacts over time.

- What are the top 10 state DOT practices that have positively affected natural resources and what information can be used to demonstrate and communicate the message?
- How do sustainability (environmental, social, economic) impact assessments apply to state DOTs and how could these assessments improve environmental performance?
- How accurate have past techniques been in predicting secondary impacts resulting from induced growth?
- What are the environmental benefits, or lack thereof, of mitigation programs? (Mitigation success is usually determined by permit conditions – a program level look at the benefits, or lack thereof, of mitigation strategies could inform changes in how DOTs approach environmental efforts.)

Analysis Tools

This category covers research on models and tools that can be used to analyze and assess environmental impacts. It also includes examining the sources and use of data as part of the analysis process.

- What are best practices for water quality monitoring programs for state DOTs that provide data that can be used to assess the impacts on aquatic species and incorporated into state DOT MS4 storm water monitoring programs?
- What are the characteristics of effective species databases and user ratings that make online species databases most useful to users and how can these best practices be transferred to owners and developers of these databases?
- What are best practices for species distribution modeling? How can one incorporate Western Governors’ Critical Habitat Assessment Tool (WGA CHAT), state wildlife agency datasets, and other federal agency datasets into a tool like Eco-Plan so that these datasets are easily available to state DOTs?
- How can one model large scale wildlife connectivity data, especially across state boundaries? How can BLM and USFS datasets, modeling efforts such as by The Nature Conservancy, WGA CHAT, and NatureServe be used to develop such a model?
- What model or tool can be used to assess the value, if any, in state DOTs incorporating uncertainty and risk management into environmental analysis?
- What are best practices in using GIS for analysis and assessment of environmental impacts and what state DOT environmental programs already use these best practices or would benefit from using these practices?

Strategies and Best Practices

This category covers research on the effectiveness of different strategies to mitigate or adapt community and transportation system impacts. It also includes examining state DOT best practices.

- What are best practices in the maintenance of porous pavements considering long-term performance and life-cycle costs, and routine maintenance requirements as well as maintaining environmental benefits (e.g., noise and water quality)?
- What is best practice for mitigation within the right-of-way and reducing risks to state DOTs? What are some effective risk management strategies?
- What are best management practices for addressing the Migratory Bird Convention Act (Canada)/Migratory Bird Treaty Act (US) and its effect on roadway and bridge construction and rehabilitation?
- What are best practices in habitat connectivity for small mammals (current practice, sizing, benefit/cost for resizing, and monitoring)?
- What are best practices among state DOTs, MPOs, LPAs, and NGOs regarding bat management strategies—effectiveness and general cost-benefit analysis including maintenance implications and costs?
- What are best practices in stream restoration in lieu of storm water management practices to achieve pollutant reduction and to meet various regulatory requirements (e.g., Section 404, Section 7, MS4)?
- What is best practice in using social media and technologies as part of public/community involvement efforts in environmental issues and communicating the benefits of a state DOT's environmental work?
- What are the best practices by state DOTs in using electronic project scoping, electronic CE development, electronic environmental management and/or other electronic information and documentation systems? How can these best practices for electronic information management be transferred throughout the agency to reduce duplication of effort?

Implementation Challenges

This category focuses on research on the barriers and opportunities to implement environmental policy, planning requirements and mitigation strategies.

- What are best practices and approaches to streamline the environmental process and that can be applied to overcome identified challenges and barriers?
- What are best practices for developing needed information technology systems and databases?
- What are the key organizational resources and structures needed to provide a strong environmental capability in natural resources assessment—staff, agency structure, funding, tools, partnering, and technical guidance?
- How can a business case (data sources, formats, etc.) be made to address implementation challenges?
- What approach can the NR Subcommittee undertake to capture research needs identified in relevant research in order for the Subcommittee to evaluate for possible inclusion into the NR research road map?
- What NR completed research would benefit from further research for conversion into practical user's guidance documents?
- What approach can the NR Subcommittee undertake to maintain developed user guidance documents current?

Emerging Issues

This category focuses on research on the barriers and opportunities to implement environmental policy, planning requirements and mitigation strategies.

- How can clean fill issues be coordinated with regulatory agencies to facilitate reuse of minimally contaminated fill materials with minimal regulatory requirements?
- What are the impacts on the environmental process of alternative funding strategies (e.g., Public Private Partnership [P3] involvement in plan/design/build/operate/maintain/finance)?
- What are successful models/examples/lessons learned/best practices for the environmental process in different P3 approaches?
- What are best practice in collaborative project development teams (scoping, programming, design, environmental, construction, maintenance)?
- How can vehicle miles traveled (VMT) be used as a tool for transportation planning and decision-making to evaluate environmental benefits?
- How can tribal concerns with natural resources be addressed in the environmental review process? Are new methods of tribal coordination needed to solicit this information?

Introduction

The purpose of this Research Road Map is to present research directions for the Standing Committee on the Environment (SCOE) Subcommittee on Natural Resources (NR) Subcommittee, which is focused on specific topics of interest to state Departments of Transportation, herein referred to as “members”, specific to stormwater. This Stormwater Research Road Map may include other issues of concern to SCOE and also includes issues of concern to other AASHTO committees and subcommittees. As such, it is anticipated that the Stormwater Research Road Map will overlap with other SCOE subcommittees’ research roadmaps, including the Extreme Weather Events Research Road Map and the separate research road map for other natural resource issues of concern. This overlap was expected due to the complex relationship between natural cycles (which include stormwater events); human activity; air, biotic, and aquatic ecosystem quality; water quality and quantity; and, human health.

The research directions outlined are based on the results of discussions with certain NR Subcommittee members; a survey conducted of all SCOE Subcommittee members; an assessment of existing and ongoing stormwater-related research; and a review of information that was reviewed from the Center for Environmental Excellence by AASHTO (Center) Stormwater Management Community of Practice (CoP). Stormwater has received considerable attention from members, the NR Subcommittee, TRB and the research community for many years. Future SCOE-sponsored research should address gaps, reflect, complement, and build-on preceding research, as well as the work that is currently being conducted by others.

Research Road Map

The Research Road Map includes potential topic areas, grouped around seven subject areas or research categories that are depicted in **Figure 1**.

Figure 1: Key Topic Categories for Subcommittee Research

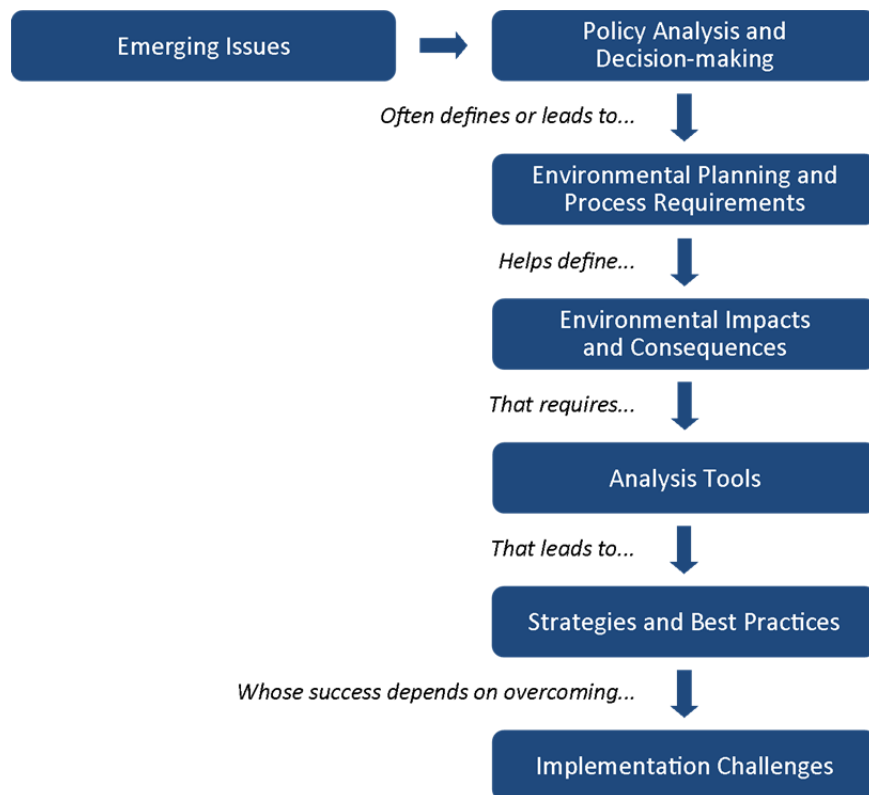


Figure 1 shows how the seven topic areas are connected to different phases of each topic area. For example, emerging issues might focus on those topic areas where very little thought has been given to the implications of a particular issue and its effect on the transportation community. Or, members may have faced a particular issue for some time but one of the key challenges is inadequate tools or databases to analyze the impacts of that issue. Or, members might have appropriate analysis tools and data, but the key challenges are found in overcoming critical barriers to implementing the recommended strategies. A key observation from **Figure 1** as it relates to stormwater issues and the NR Subcommittee’s and Stormwater Management CoP research agendas is that stormwater is fraught with embedded emerging issues that affect member’s “mature” stormwater practices. As such, stormwater management and related research will need to respond quickly to changing requirements and other issues.

Updates to the Research Road Map

To remain relevant, this Research Road Map requires regular updates. The process is as follows:

1. An annual update will occur in conjunction with the NR Subcommittee chair’s notice for the annual “Call for Research” Transportation and Environmental Research Ideas (TERI database).
2. Other updates may be requested by any SCOE or NR Subcommittee member.
3. All updates will be coordinated by the NR Subcommittee Research Coordinator.
4. NR Subcommittee members will have the opportunity to review and comment on updates.
5. The consensus Research Road Map will be posted on the TERI database.
6. NR Subcommittee members and others will be invited to develop research proposals linked to the Research Road Map entries.
7. The NR Subcommittee will consult the Research Road Map during development of the annual NCHRP research program and response to calls for research suggestions from FHWA and others.

Potential Research Topics

The identification of research topics for Subcommittee sponsorship should reflect the importance of a topic to members, the level to which the research will add understanding or capability to members’ technical analysis, the degree to which the research will not overlap with what others are doing on that topic, and additional input, improvements to streamlining and/or cost-effectiveness of technical analyses, or environmental clearance processes, and other considerations (e.g. regulatory) as appropriate.

With respect to the importance of stormwater research, a survey of the full SCOE membership ranked the water quality and total maximum daily loads (TMDLs) topics as the second and third (respectively) most important topics out of 30 potential research topics. There is clearly a great deal of interest in supporting more research attention on those issues surrounding stormwater.

The stormwater research topic areas presented below provide examples of specific topics of interest to the NR Subcommittee for each subject or research category. They are not intended to be the only ideas that may be funded, or in any way exclude new ideas received in the annual TERI database update process from being considered for funding. Rather, the topics are provided to serve as a framework of ideas of interest to SCOE and the NR Subcommittee that can be revised as needed.

The topics identified by the survey as well as other research topics that were identified through discussions with member officials are summarized below under each of the topic categories (a topic was listed from the survey if it received votes of “medium” or “high” priority). Information developed as part of the Stormwater

NCHRP 25-25 (95) SCOE Strategic Plan and Research Plan

Appendix F – Research Road Map for Stormwater

Management CoP was also reviewed. This review included the information posted on the Center website regarding the Stormwater Management CoP and reports including:

- *Stormwater State-of-the-Practice Report: Source Control, May 2011*
- *EPA Post-Construction Stormwater Control Rulemaking CoP State-of-the-Practice Report, March 2010*
- *TMDL CoP State-of-the-Practice Report, March 2010*
- *Effluent Limitation's Guidelines CoP State-of-the-Practice Report, March 2010*
- *Stormwater Management CoP State-of-the-Practice Report, June 2009.*

A review of the proceedings from the July 2014 National Stormwater Practitioners Meeting highlighted discussion topics, concerns and information associated with:

- Audits by federal and state regulators;
- Construction contract administration;
- Asset/data management and tracking;
- Research findings and tools;
- Maintenance; and
- TMDL implementation and the watershed approach.

The key findings from the proceedings played a critical role in helping to identify and refine research areas. The following is a summary of the key factors that influenced the Stormwater Research Road Map:

- The survey of the NR Subcommittee members showed strong support for a Subcommittee goal of “identifying and prioritizing research priorities and supporting their selection and funding” (average rating of 4.73 out of 5.0);
- The research-oriented questions on the survey focused on both existing and new areas of research interests;
- The research topics identified by the survey that either directly or indirectly pertained to stormwater;
- Research topics that were identified through the review of information reflected in the Stormwater Management CoP; and
- Review of past stormwater related research.

The NR Subcommittee identified areas to research that overlap and either directly address or can be used to address stormwater issues. Topics may be presented as a research question, though they might also represent topics for discussion, guide book development, workshops, agenda items, etc. The current topics of interest to the NR Subcommittee reflect its ongoing interest in: stormwater.

Policy Analysis and Decision-making

This category includes research to better understand the underlying factors associated with specific environmental policies. It also includes emphasis on how these factors can be considered within the state DOT decision-making processes.

- What are the potential implications to state DOTs as MS4 operators, as a result of EPA rulemaking in the area of NPDES and Waters of the United States? (“Definition of ‘Waters of the United States’ Under the Clean Water Act,” published at 79 Federal Register 22,188 (April 21, 2014) (“Proposed Rule”). There are past court decisions and existing guidance on Waters of the U.S. It seems that the MS4 community needs more certainty regarding the interplay between Sections 402 and 404 of the Clean Water Act, i.e., NPDES and 404 permits. What would be the impact to state DOTs if MS4 (including component parts such as ditches, etc.) are somehow considered jurisdictional Waters of the U. S.? A 25-25(52) study completed in 2009 gave the perspective that ditches should not be considered jurisdictional.)
- What are the potential implications to state DOTs as a result of trends in stormwater management regulatory practices (regulating and reducing flow; performance requirements in permits; second generation permits regulating discharges into waters under a TMDL, which includes tighter water quality limits or may have impervious surface retrofit requirements; and, development of standards incorporating on-site retention requirements)?
- What information does FHWA need in developing a nationwide performance measure(s) for stormwater?
- What are the implications for state DOT stormwater management programs when EPA is considering that highway runoff discharges constitute a release of hazardous substances and a source of contaminated water body sediments, per CERCLA?
- What are the information needs for decision-makers, policy-makers and regulators that need to be addressed regarding the application of road salts and the realities of needing its use, but considering its effect on MS4 permit requirements, water quality and quantity, aquatic species, etc.? (In the Northeast, it is not unusual for highway runoff to cause exceedances of chloride water quality standards (e.g., where an intermittent stream (receiving water) runs next to a multi-lane highway). DOTs/regulators need practical measures in terms of policies and design options to address these occasional impairments. Considerable research has been done on winter operations, salt, sand and chemical management. (Included in other portions of this research road map are further research questions that need to be addressed.)
- What are some local and state DOT existing policies and realistic future policy options in managing and regulating volume and discharge into state DOT right-of-way? Would monitoring inflow and outflow of off-site stormwater into the right-of-way be cost-effective and provide the needed information to influence policy and regulatory changes?
- What information needs to be supplied to EPA and State Departments of Environmental Quality for the assignment of TMDLs to the original discharger of polluted off-site source stormwater rather than to the state DOT as the MS4 permit holder?
- What are some mechanisms available to state DOTs, to influence policies and decision-making regarding TMDL development?
- What are the best practices and challenges in documenting emergencies resulting from extreme weather events that may lead to issues with BMPs (e.g., BMP (re)design approach, revised design standards, BMP failure, non-compliance, enforcement, etc.)?

- What policy decisions (internal and external to state DOTs), if any, need to be modified to allow for in-lieu fee, banking, restoration, regional BMPs (i.e., off-site and out-of-kind mitigation) and other types of regional mitigation for more effective stormwater management?
- What information is needed by state DOT policy and decision-makers to resolve problems regarding resources (human) needed to collect surface water samples to satisfy TMDLs for *E. coli*, other assigned TMDLs and for overall MS4 compliance?

Environmental Planning and Process Requirements

This category includes research on how the process of considering transportation-related impacts can better consider environmental concerns. It also covers understanding of how existing or new process requirements can fit into state transportation and environmental planning efforts and improving collaborative efforts in environmental analysis.

- What practical processes are needed to identify effective BMPs, reduce long-term operation and maintenance costs, increase project life span, reduce capital costs for retrofit projects, and to assess if the overall process is working?
- Are there situations where the same amount of effort/funds used by state DOTs to meet TMDL requirements could be used for greater benefit elsewhere in a watershed?
- What should be the process framework for selecting effective BMPs to address assigned TMDLs?
- What laws, rules, regulations, processes, procedures and agreements are needed to more efficiently and effectively regulate stormwater, water quality and quantity, and endangered species? (The intent is to eliminate duplication and conflicts in regulatory approaches and to achieve added value through efficiencies and coordinated efforts.)
- What are the long-term advantages and disadvantages from current partnerships and how can these current or new partnerships be used to improve and positively advance state DOT stormwater programs?
- What is the current status and what is the needed framework for stormwater quality banking (e.g., stream restoration, leveraging wetlands for hydromodification, other flow control activities, etc.) and trading?
- What are the appropriate application rates for anti-icing and deicing, effectiveness of incentive programs, effective use of hot water, and innovative use of roadside vegetation and efficiency of reactive strategies in cold regions?
- What credit programs are available for source control and what are the requirements for being included and trading?

Environmental Impacts and Consequences

This category focuses on research on the community and transportation system consequences of environmental impacts. Focus could be on sole impacts or cumulative impacts over time.

- How effective are the six minimum control measures as implemented by the state DOTs? How appropriate are the six measures for state DOTs (as opposed to municipalities)?
- How have state DOT stormwater management programs positively affected NR?
- How effective is off-site mitigation (in-lieu fee, banking, regional BMPs, etc.) versus on-site strategies under watershed – and entity – based permitting for MS4 permits and what combination results in overall better outcomes?

- What model and tools can be used to evaluate impacts and mitigation for water quality, stormwater and endangered species that could be used to inform better outcomes and a coordinated and effective decision-making and permitting by the regulatory agencies?
- What factors need to be considered in BMP evaluation, selection, design, performance and maintenance as related to impacts and mitigation for endangered species, habitat connectivity, temperature, water quality, and water quantity?
- What are the environmental costs/benefits for state DOT implementation of plans to comply with TMDLs?
- What are the benefits and risks of using liquids for anti-icing and deicing, impacts and implications of removing impaired roadside vegetation, cost-effectiveness and environmental impacts of agro-based deicers, fate and transport of pollutants?
- What do field investigations reflect regarding the use of mobile salinity sensors, salt-tolerant vegetation, and the correlation of the chloride loading in adjacent soils with deicer usage and the effectiveness of salt management plans?
- What do water quality monitoring results indicate regarding the effectiveness of roadway BMPs not traditionally credited (e.g., vegetated filter strips, open graded friction course, tree buffers, etc.)?
- How effective are the different vegetation types within existing rights-of-way as BMPs for pollutant reduction; and, what specific vegetation types are needed for pollutant reduction by climate region?

Analysis Tools

This category covers research on models and tools that can be used to analyze and assess environmental impacts. It also includes examining the sources and use of data as part of the analysis process.

- What are best practices in stormwater monitoring programs (evaluate pollution in stormwater runoff and evaluate effectiveness of controls) and what are the recommended models for state DOT stormwater monitoring programs to successfully meet their individual existing and evolving MS4 requirements? (The intent is to design and implement effective, realistic and reasonable stormwater monitoring programs that provide actionable information and support compliance with MS4 requirements. The research should also consider that the resulting information will be used to guide conversations with regulators regarding monitoring.)
- Is there a need to develop a flexible tool/decision support system that considers climatic and other region and site specific considerations for evaluating and selecting mitigation (banking, etc.) and BMPs (e.g. performance; location; single, train or regional BMP; construction; maintenance; life-cycle cost; etc. and organized by climatic regions)? What modeling and/or tools are needed to analyze TMDLs and establish proper Waste Load Allocation (WLA) to state DOTs and others and to determine the extent of that WLA? (The goal is to assign responsibility to the original dischargers rather than to MS4 owners/operators.)
- What models and/or tools are needed for watershed planning and TMDL implementation?
- What modeling and/or other tools are needed to evaluate regional BMPs/mitigation and on-site BMPs/mitigation approaches?
- What models, tools and technologies need to be identified, developed and implemented or better integrated into state DOT stormwater programs? (GIS, drones, smart systems, etc.)
- Are there consistent and scientifically supportable criteria for determining when hydrologic mitigation is appropriate and necessary, as well as guidance for designing hydromodification controls? (Research could include evaluating existing criteria and rationale, methods [e.g., stream restoration, leveraging

wetlands, etc.], recommending criteria by climatic region and geomorphology and developing design guidance.)

- What is the status of technology performance such as anti-icing pavement, better chemical products and improved thermal road mapping?
- Would contract administration templates to evaluate contractors and to communicate performance requirements in contracts involved in stormwater monitoring and/or maintenance be useful?
- Would contract administration templates for transferring responsibilities associated with stormwater, to design-bid-build, design-build and Public/Private Partnerships (P3s) be useful?
- Would a handbook based on lessons learned be useful to guide conversations for establishing or revising a Transportation Separate Storm Sewer System (TS4) program? What tools exist for identifying and prioritizing retrofit projects?
- What is the recommended monitoring program (protocols, procedures, locations, schedule, training, implementation, etc.) for state DOTs for illicit discharge detection and elimination?

Strategies and Best Practices

This category covers research on the effectiveness of different strategies to mitigate or adapt community and transportation system impacts. It also includes examining best practices of state DOTs.

- What are best practices in TMDL assignment, TMDL partnerships for management and BMP approaches for addressing assigned TMDLs?
- What are best practices in preparing for audits (understanding MS4 permit requirements, preparations, and lessons learned?)
- What are best practices to integrate funding constraints into state DOT stormwater management programs?
- What are best practices in funding projects regionally – regional BMPs and associated new development, redevelopment and retrofit projects or programs?
- What are best practices and strategies for improving construction and maintenance contract administration as related to stormwater?
- What are best practices and strategies for contract provisions in P3 agreements as related to stormwater?
- What are best practices in assigning roles and responsibilities to internal and external parties in monitoring programs and BMP maintenance to maintain effectiveness under state DOT stormwater programs?
- What are best practices and strategies for state DOT good housekeeping and other activities (of concern to stormwater, state DOT MS4 permit and other compliance) occurring on state DOT owned facilities such as Headquarters, district and maintenance offices and other buildings and yards and right-of-way?
- What are best practices and strategies to improve stormwater permit compliance with respect to maintenance practices and activities, including best management practice (BMP) inspection, tracking, and reporting concepts, winter storm management-related procedures with considerations to the region's environment? (guidance, training, etc.)
- What are best practices and strategies to incorporate stormwater features inventories into (and be components of) corporate asset management databases and systems?
- What are best practices in improving and/or implementing asset/data management, tracking and response as related to state DOT stormwater programs? (Reason for collecting data; type and quantity

of data to collect; use of funding systems; use of technological tools; the need for actionable, meaningful data that the state DOT can actually use; how to determine what an asset consists of; and, the level of data to collect).

- What are best management practices for porous pavements considering long-term performance, life-cycle costs, pavement longevity, routine maintenance requirements and maintaining environmental benefits (mostly to purify stormwater)?
- What are the best practices and recommended strategies for BMP maintenance techniques and schedules to achieve stormwater BMP performance requirements, based on certain parameters (e.g., road type, sanding practices, climate areas, etc.)?
- What are realistic and best practices in managing stormwater volume by state DOTs?
- What are innovative practices in mitigating (banking, BMPs, etc.) for stormwater impacts, with and without other environmental impacts? What are best practices in stream restoration in lieu of more traditional stormwater management practices to meet regulatory requirements and to achieve pollutant reduction requirements?
- What stream restoration and leveraging of wetlands (for hydromodification) practices can be used to meet regulatory pollutant reduction and volume requirements?
- What are strategies to get stream restoration and leveraging of wetlands practices accepted by regulatory agencies as a mitigation for stormwater impacts?
- What are best practices in using social media and technologies as part of the Public Education and Outreach/Public Participation/Public Involvement minimum control measures?
- Have the results for BMPs in roadway settings been consolidated and reflected in the International BMP database?

Implementation Challenges

This category focuses on research on the barriers and opportunities to implement environmental policy, planning requirements and mitigation strategies.

- What is the status of TS4 permit development?
- What have been the challenges and strategies used by state DOTs to implement their MS4 permit, and what needs have been identified?
- What are the models or data or both that will help prioritize and allocate limited funding for retrofits?
- What are source control options that may be appropriate for some traditional pollutants of concern specific to state DOT activities and third party activities? (Third party information will inform state DOT outreach, communication, coordination, collaboration and cooperation.)
- What is needed for a more rigorous science-based TMDL development process and to demonstrate the fact that state DOTs are often minimal contributors to many TMDLs?
- What are the best practices, strategies, challenges and needs for TMDL implementation and watershed permitting?
- What are the options, challenges and opportunities for mitigation (in-lieu fees, banking, regional BMPs, etc.) under watershed based permitting?
- What are the opportunities and challenges for new development; redevelopment and retrofit projects under watershed based permitting?

NCHRP 25-25 (95) SCOE Strategic Plan and Research Plan

Appendix F – Research Road Map for Stormwater

- What partnerships exist or need to be formed to develop stormwater management success for existing and evolving MS4 permits and for the watershed scale level?
- What are the best practices and challenges for incorporating BMPs in the state DOT right-of-way?
- What are the geographic factors that negatively affect BMP effectiveness?
- What challenges and opportunities exist in current state DOT stormwater monitoring programs for adaptive management considering the six minimum control measures, Construction General Permit (CGP), endangered species and Section 404 requirements?
- What is being reported in MS4 Annual Reports and how are the regulators and state DOTs responding?
- What are best practices and opportunities in addressing construction and maintenance activity compliance (erosion and sediment control, good housekeeping, etc.) in response to State DOT or regulatory audits?
- What are the challenges, future opportunities and current realistic opportunities for volume reduction by state DOTs?
- What are the challenges and opportunities to state DOTs in not allowing bats to roost under bridges or in culverts due to water quality concerns?
- What are best practices in addressing the Migratory Bird Convention Action (Canada)/Migratory Bird Treaty Act (U.S.) as it relates to state DOT stormwater programs?
- What are the issues and methods of disposing or reusing BMP and drainage system (e.g., catch basin) generated waste?
- Why and how can compost be used in stormwater management as a permanent BMP?
- What are the best practices and challenges in capturing emergencies that may lead to issues with BMPs? (Emergencies resulting from extreme weather events, etc.)
- What are the key organizational resources and structures needed to provide a strong capability for stormwater program development, implementation and management—staff, agency structure, funding, tools, partnering and technical guidance?
- How can a business case be made to address implementation challenges?
- What are the opportunities for better capturing research gaps routinely identified in existing and ongoing stormwater related research?
- What are the gaps in training, practical guidance documents and tools to better position state DOTs to respond to changes and incorporate necessary changes into their stormwater management programs.
- What completed stormwater research would benefit from further research for conversion into practical user's guidance documents?
- What are the best mechanisms for keeping any developed stormwater training, practical guidance documents and tools updated?
- What are the opportunities and challenges in providing the human resources needed for the growing industry of water resources, environmental planning and design?
- What are the best practices and opportunities in the use of devices and technology for all areas of stormwater management? (drones, GIS, smart systems, etc.)
- What are the opportunities and challenges in implementing source controls external to the control of state DOTs?

NCHRP 25-25 (95) SCOE Strategic Plan and Research Plan

Appendix F – Research Road Map for Stormwater

- What are the opportunities and challenges in implementing the Watershed Resource Registry? What is needed to implement the Watershed Resource Registry for use in watershed planning and permitting and ultimately as part of stormwater management programs?

Emerging Issues

This category covers research on new and emerging environmental issues that will affect state DOTs in the near future.

- What are the potential implications to state DOT MS4 permits and stormwater programs as a result of national and state proposed laws, rules, etc.?
- What are the potential implications to state DOTs as a result of trends in stormwater management regulatory practices (regulating and reducing flow; performance requirements in permits; use of surrogates in TMDL development, second generation permits regulating discharges into waters with a TMDL, which includes tighter water quality limits or may have impervious surface retrofit requirements; and, development of standards incorporating on-site retention requirements)?
- What are the implications to state DOTs as a result of lawsuits filed against EPA, other regulators and MS4 operators?
- What are the opportunities and challenges in new technology for stormwater management?
- What adaptations for stormwater BMP evaluation, location, selection and design are needed to address extreme weather events?
- What is needed to evaluate stormwater investments by state DOTs being overwhelmed by precipitation impacts that are beyond those anticipated by past stormwater management programs?
- What data and modeling tools are needed to assist state DOTs in supporting their future stormwater programs and approaches considering extreme weather events?
- What are examples, opportunities and challenges for P3 involvement in stormwater management?
- What are examples of collaborative project development teams in the area of stormwater to include project planning, BMP evaluation, selection and design, that factor in construction and maintenance considerations?
- What are the evolving threats and risks to state DOTs as MS4 owners/operators and to their stormwater management programs?