Summary & Problem Statements

FOCUS GROUP ON ENVIRONMENTAL RESEARCH & TECHNOLOGY TRANSFER NEEDS RELATED TO TRANSPORTATION

August 2004

IOWA STATE UNIVERSITY

CTRE
Center for Transportation Research and Education

Focus Group on Environmental Research and Technology Transfer Needs Related to Transportation

Summary and Problem Statements

August 2004

Center for Transportation Research and Education
2901 S. Loop Drive, Suite 3100
Ames, IA 50010-8632
515-294-9480
515-294-0467 (fax)
www.ctre.iastate.edu/

IOWA STATE UNIVERSITY

CTRE's mission is to develop and implement innovative methods, materials, and technologies for improving transportation efficiency, safety, and reliability while improving the learning environment of students, faculty, and staff in transportation-related fields.

Table of Contents

Introduction

A brainstorming focus group for transportation-related environmental issues was held at the Center for Transportation Research and Education (CTRE) on Monday, May 3, 2004. The purpose of the focus group was to generate problem statements covering environmental research and technology transfer issues associated with transportation that are needed from a practitioner's standpoint. The expected outcome of the meeting was to produce problem statements focusing on significant issues for those interested in transportation-related environmental issues in Iowa. The Iowa Department of Transportation (Iowa DOT), Iowa Department of Natural Resources (Iowa DNR), Iowa State University Department of Civil, Construction, and Environmental Engineering (CCEE), and CTRE were represented. Attendees broke into groups representing the following three topic areas according to attendee interest:

- Air Quality/Energy/Alternative Fuels
- Corridor Planning
- Water Quality

Each group brainstormed and listed ideas and then formulated the ideas into 16 initiatives. Then each group voted to select the initiatives and developed them into written research problem statements.

The research topics and participants are summarized below. Research problem statements are attached. Note that both the corridor planning and water quality group identified evaluation of wetland mitigation as an important topic.

The Air Quality/Energy/Alternative Fuels group developed 7 initiatives:

1. Engineering E-85 and Biodiesel Infrastructure Development
2. Educating Consumer about Alternative Fuel Options
3. Developing Alternative Fuels from Waste
4. Creating Viable Recycled Material for Highway Construction
5. Implementing Beneficial Use of Bio-Solids in Highway Systems
6. Reusing Power plant/Wastewater Treatment Residuals
7. Characterizing On-Road Mobile Source Emissions in Iowa

The Corridor Planning group generated 4 initiatives:

1. Developing a Statewide Resource Database Accessible to All Levels of Government
2. Developing a Business Case for Environmentally Friendly Transportation Enhancements
3. Utilizing of Interchanges on Freeway/Expressway Facilities
4. Analyzing the Benefit-Cost of Wetlands Mitigation

The Water Quality group generated 5 initiatives:

1. Systematic Study of the Effects of Transportation on Water Quality by Type of Impact and Scale of Watershed
2. Effectiveness of Best Management Practices

3. Effectiveness of Wetland Mitigation
4. Shared Use of Remote Sensing Data for System Level Quality Management
5. Iowa Example of an Exemplary Ecosystem

Jim Rost, Director of the Iowa DOT Office of Location and Environment, welcomed the group and emphasized the importance of a sound knowledge base that can only be provided by research. The following are the attendees grouped by the break out session in which they participated:

I. Air Quality/Energy/Alternative Fuels
Randy Boeckenstedt, Transportation Research Specialist, ISU/CTRE
Chad Daniel, Regional Scale Modeling Coordinator for Air Quality, Iowa DNR
Shauna Hallmark, Assistant Professor, ISU/CCEE/CTRE
Hans van Leeuwen, Professor, ISU/CCEE
Jennifer Moehlmann, Program Planner for Energy and Waste Management, Iowa DNR
Radhey Sharma, Assistant Professor, ISU/CCEE
Shihwu Sung, Associate Professor, ISU/CCEE

II. Corridor Planning
Mark Dunn, Research Engineer for Materials Inspection, Iowa DOT
Tim Ellis, Associate Professor, ISU/CCEE
Tom Kane, Executive Director, Des Moines Area MPO
Mark Kerper, Assistant Office Director for Location and Environment, Iowa DOT
Dennis Kroeger, Transportation Research Specialist, ISU/CTRE
Judy MacDonald, Cultural Resource Specialist for Location and Environment, Iowa DOT
Mark Masteller, Roadside Development Specialist, Iowa DOT
Kelly Strong, Associate Professor, ISU/CCEE

III. Water Quality
Ubbo Agena, Program Manager for Non-Point Source, Iowa DNR
Steve Andrle, CTRE Director, ISU/CTRE
Roy Gu, Associate Professor, ISU/CCEE
Mike LaPietra, Environment Realty Manager, FHWA
Donna Lutz, Assistant Scientist, ISU/CCEE
Scott Marler, Environment Specialist, Iowa DOT
Se Kee Ong, Associate Professor, ISU/CCEE
Mary Skopec, Section Supervisor for Water Monitoring, Iowa DNR

It should be noted that the following research problem statements represent the issues faced by the participants in their jobs, or that have been brought to their attention. The issues are real, but full or partial solutions may exist. There is an enormous amount of literature on environmental issues associated with transportation. Literature searches on each topic have not been conducted to refine the problem statements. If a research team is interested in pursuing one of these topics, we suggest that a literature search of completed and ongoing research be conducted and that the scope be further defined in light of this background. For more information, contact Stephen Andrle, andrle@iastate.edu, 515-294-8103, or Shauna Hallmark, shallmark@iastate.edu, 515-294-8103.

I. Air Quality/Energy/Alternative Fuels Research Problem Statements

Engineering E-85 and Biodiesel Infrastructure Development

Group Name: Air Quality/Energy/Alternative Fuels

Facilitator Name: Jennifer Moehlmann

Date: May 3, 2004

Initiative Team Members:
Randy Boeckenstedt, Transportation Research Specialist, ISU/CTRE
Chad Daniel, Regional Scale Modeling Coordinator for Air Quality, Iowa DNR
Shauna Hallmark, Assistant Professor, ISU/CCEE/CTRE
Hans van Leeuwen, Professor, ISU/CCEE
Jennifer Moehlmann, Program Planner for Energy and Waste Management, Iowa DNR
Radhey Sharma, Assistant Professor, ISU/CCEE
Shihwu Sung, Associate Professor, ISU/CCEE

Background and Problem Statement
The current siting of E-85 and biodiesel stations is somewhat haphazard and may not result in optimal utilization. Currently there are 11 retail and 7 state E-85 refueling sites in Iowa; biodiesel blends are mainly only available in bulk. Currently there are 11 retail and 7 state E-85 and biodiesel refueling sites available, mostly from jobbers. To better utilize existing resources and encourage more optimal use of E-85 and biodiesel, there is a need to identify the best spots for installing new refueling sites and/or how to open state sites to privately owned vehicles (tax, liability, etc.).

Research Objectives
To better utilize existing stations and optimally locate new refueling sites in order to encourage increased use of E-85 and biodiesel the research would accomplish the following:

- Determine the optimum vehicle concentration to guide location of viable new refueling sites
- Identify and spatially locate potential E-85 and biodiesel customers
- Spatially analyze existing and future relationships between customer base and infrastructure providing E-85 and biodiesel
- Determine where future facilities should be located
- Promote availability of E-85 (flexible fuel vehicles)
- Determine number and location of sites to establish a refueling network
- Prioritize sites for implementation
- Estimate performance (number of gallons sold, etc) to make site economical
- Forecast future use of E-85 and biodiesel

Resource Needs and Time Frame
Possible project for DOE Clean Cities if Iowa is selected; CMAQ, in-kind DOT, Iowa DNR

Intended Users (IHRB, County, City, State, Pool Fund)
Retail refueling stations, fleets, vehicle owners

Implementation
Iowa DNR, Iowa DOT, Iowa DAS, Iowa Corn Promotion Board, Iowa Soybean Promotion, Board, Iowa Renewable Fuels Association, biodiesel producers, petroleum marketers and convenience stores, petroleum pipelines and terminals

Educating the Consumer about Alternative Fuel Options

Group Name: Air Quality/Energy/Alternative Fuels

Facilitator Name: Shauna Hallmark

Date: May 3, 2004

Initiative Team Members:
Randy Boeckenstedt, Transportation Research Specialist, ISU/CTRE
Chad Daniel, Regional Scale Modeling Coordinator for Air Quality, Iowa DNR
Shauna Hallmark, Assistant Professor, ISU/CCEE/CTRE
Hans van Leeuwen, Professor, ISU/CCEE
Jennifer Moehlmann, Program Planner for Energy and Waste Management, Iowa DNR
Radhey Sharma, Assistant Professor, ISU/CCEE
Shihwu Sung, Associate Professor, ISU/CCEE

Background and Problem Statement
There is a lack of understanding about the availability of alternative fuels (AF), such as ethanol-85 (E-85), and the capability of private vehicles to use AF. For instance, a number of consumers are not aware that their vehicle can use E-85 and consequently may not take advantage of AF. Even when consumers are aware of vehicle capabilities, they are not always aware of where they can obtain AF, air quality benefits, and economic benefits. Additionally they may have concerns about using fuel that they are not familiar with and may be reluctant to try AF.

Research Objectives
To better educate the public about the availability and viability of E-85, or other alternative fuels, as a fuel source, the research would accomplish the following:

- Spatially analyze distribution facilities along with customer base
- Determine where to target public service campaigns
- Summarize information on vehicle wear, types of vehicles that can use E-85 or biodiesel to provide promotional material to the public
- Summarize research on economic and AQ benefits of alternative fuels to promote use

- Look at potential sources of distribution of educational material such as rest stops, webpage, billboards, radio, TV
- Look at strategies to promote use such as waivers
- Look at research on types of bio-diesel and suggest blends.

Resource Needs and Time Frame
Personnel, data including vehicle fleet information, motor vehicle records to locate vehicles, and location of alternative fuel stations

Intended Users (IHRB, County, City, State, Pool Fund)
Iowa DOT, Iowa DNR, private citizens

Other Outside Parties
Corn promotion board, soybean board

Developing Alternative Fuels from Waste

Group Name: Air Quality/Energy/Alternative Fuels

Facilitator Name: Randy Boeckenstedt

Date: May 3, 2004

Initiative Team Members:
Randy Boeckenstedt, Transportation Research Specialist, ISU/CTRE
Chad Daniel, Regional Scale Modeling Coordinator for Air Quality, Iowa DNR
Shauna Hallmark, Assistant Professor, ISU/CCEE/CTRE
Hans van Leeuwen, Professor, ISU/CCEE
Jennifer Moehlmann, Program Planner for Energy and Waste Management, Iowa DNR
Radhey Sharma, Assistant Professor, ISU/CCEE
Shihwu Sung, Associate Professor, ISU/CCEE

Background and Problem Statement
More research is needed on the ability to collect and convert waste materials to fuels.

Research Objectives
The research objective would be to evaluate collection and conversion of waste material sources, conversion methods, and distribution requirements for practical integration as biodiesel or celluosic ethanol supplements to petroleum feedstock. The research would accomplish the following:

- Identify and catalogue currently experimental, near-term, or existing commercial methods
- Identify and map locations and volumes of potential feedstock in Iowa
- Identify fuel output volumes by major terminal

- Balance supply/demand potential
- Evaluate conversion requirements and road tax implications

Resource Needs and Time Frame
Personnel (would be mostly literature review), data

Intended Users (IHRB, County, City, State, Pool Fund)
Counties, cities, state, waste managers

Implementation
Current ethanol/biodiesel producers

Other Outside Parties
DOE, EPA, farm groups

Creating Viable Recycled Material for Highway Construction

Group Name: Air Quality/Energy/Alternative Fuels

Facilitator Name: Radhey Sharma

Date: May 3, 2004

Initiative Team Members:
Randy Boeckenstedt, Transportation Research Specialist, ISU/CTRE
Chad Daniel, Regional Scale Modeling Coordinator for Air Quality, Iowa DNR
Shauna Hallmark, Assistant Professor, ISU/CCEE/CTRE
Hans van Leeuwen, Professor, ISU/CCEE
Jennifer Moehlmann, Program Planner for Energy and Waste Management, Iowa DNR
Radhey Sharma, Assistant Professor, ISU/CCEE
Shihwu Sung, Associate Professor, ISU/CCEE

Background and Problem Statement
This research will evaluate the use of viable waste material for recycling into material for highway construction.

Research Objectives
The research objective is to evaluate the use of viable waste material for different types of highway materials. The research would accomplish the following:

- Identify beneficial use of waste materials
- Identify quantities of waste materials, such as tires, and current recycling uses
- Evaluate the technical aspects of recycling, such as strength and volumetric stability with reference to highway construction materials

- Evaluate the cost effectiveness of using recycled materials as compared to conventional materials
- Explore the mechanical behavior of blended materials for highway construction in terms of shear strength, stiffness, and volumetric stability
- Evaluate existing standards for roadway construction materials
- Investigate the viability of blended materials in construction processes
- Demonstrate use in pilot project

Resource Needs and Time Frame
Personnel, testing equipment, data

Intended Users (IHRB, County, City, State, Pool Fund)
Iowa Highway Research Board (IHRB), counties, cities, state, waste managers

Implementation
ISU/CTRE

Implementing Beneficial Use of Bio-Solids in Highway Systems

Group Name: Air Quality/Energy/Alternative Fuels

Facilitator Name: Shihwu Sung

Date: May 3, 2004

Initiative Team Members:
Randy Boeckenstedt, Transportation Research Specialist, ISU/CTRE
Chad Daniel, Regional Scale Modeling Coordinator for Air Quality, Iowa DNR
Shauna Hallmark, Assistant Professor, ISU/CCEE/CTRE
Hans van Leeuwen, Professor, ISU/CCEE
Jennifer Moehlmann, Program Planner for Energy and Waste Management, Iowa DNR
Radhey Sharma, Assistant Professor, ISU/CCEE
Shihwu Sung, Associate Professor, ISU/CCEE

Background and Problem Statement
Bio-solid and composting material generation from waste treatment facilities (such as municipalities or animal confinement) is significant. This material may be recyclable into nutrient-rich biosolids for plant growth along highways but the viability is unknown.

Research Objectives
The research objective is to demonstrate the application of biosolids along highways or rest areas as organic fertilizer or soil conditioner. It could also provide the benefit of erosion control. The research would document the environmental benefits of using biosolids including nutrient conservations, silt control, and aesthetics.

Resource Needs and Time Frame
Would require several growing seasons for demonstration, personnel, data

Intended Users (IHRB, County, City, State, Pool Fund)
IOWA DOT and biosolid generators: municipality wastewater treatments plants, animal waste handling facilities, and animal production facilities

Implementation
ISU/CTRE

Reusing Power Plant/Wastewater Treatment Residuals

Group Name: Air Quality/Energy/Alternative Fuels

Facilitator Name: Hans van Leeuwen

Date: May 3, 2004

Initiative Team Members:
Randy Boeckenstedt, Transportation Research Specialist, ISU/CTRE
Chad Daniel, Regional Scale Modeling Coordinator for Air Quality, Iowa DNR
Shauna Hallmark, Assistant Professor, ISU/CCEE/CTRE
Hans van Leeuwen, Professor, ISU/CCEE
Jennifer Moehlmann, Program Planner for Energy and Waste Management, Iowa DNR
Radhey Sharma, Assistant Professor, ISU/CCEE
Shihwu Sung, Associate Professor, ISU/CCEE

Background and Problem Statement
Power plants and drinking water treatment plants produce millions of tons of residuals every year. Some reuse already takes place, such as fly ash in concrete roads or lime sludge in agriculture, but most of the wastes are stockpiled. This presents a problem in disposal, but also an opportunity to create materials for reuse in road construction, road dust control (unpaved), and in air pollution control.

Research Objectives
The research objective is to demonstrate the use of power plant or wastewater treatment residuals in road construction, dust control, or air pollution control. To accomplish this research would complete the following:

- Carry out a demonstration project in creating embankments from lime sludge, fly-ash, and bottom mixtures on highways
- Develop subbase construction materials
- Demonstrate use of fines (fly ash, lime sludge) on unpaved roads to limit dust generation
- Demonstrate use of lime sludge in SO_2 control at power plants

- Demonstrate use of lime sludge with organic acids from animal wastes to create deicing compounds (e.g. CMA)
- Address concerns that NO_x and SO_x control measures at power plans degrade fly-ash quality limiting re-use (switch grass co-firing effects on fly ash)

Resource Needs and Time Frame
Cooperation of county/city engineers for limited full-scale trials, personnel.
Duration: Several projects over 1–2 years

Intended Users (IHRB, County, City, State, Pool Fund)
Iowa DOT, regional/federal transportation agencies, DOE, EPA, Iowa DNR, electric power research institute, power plants, Edison Electric Institute, road users

Characterizing On-Road Mobile Source Emissions in Iowa

Group Name: **Air Quality/Energy/Alternative Fuels**

Facilitator Name: Chad Daniel

Date: May 3, 2004

Initiative Team Members:
Randy Boeckenstedt, Transportation Research Specialist, ISU/CTRE
Chad Daniel, Regional Scale Modeling Coordinator for Air Quality, Iowa DNR
Shauna Hallmark, Assistant Professor, ISU/CCEE/CTRE
Hans van Leeuwen, Professor, ISU/CCEE
Jennifer Moehlmann, Program Planner for Energy and Waste Management, Iowa DNR
Radhey Sharma, Assistant Professor, ISU/CCEE
Shihwu Sung, Associate Professor, ISU/CCEE

Background and Problem Statement
Accurate estimates of air pollutant emissions from on-road mobile vehicles are necessary for accurate studies of local, regional, and multistate air quality issues. Currently data available concerning vehicle fleet mix, VMT distribution, average speeds, fuel characterization, and other input data to emission factor models are not readily available for Iowa. Emission factor models output is highly correlated to these variables. National default values are available but may not reflect local conditions. Additionally, the different missions of the Iowa DOT and Iowa DNR have resulted in data disconnects which impede air quality studies as the agencies have different uses and classification standards for available data.

Research Objectives
The research objective is to improve data inputs to on-road mobile source emissions models. To accomplish this, the research would complete the following:

- Establish data needs for emission estimation models
- Identify public/private sources of data
- Review and AQ/AQ data sources, data/IT systems, records, etc.
- Establish/determine accurate Iowa specific inputs
- Develop emission estimates (county level) and recommend improved data structures

Resource Needs and Time Frame
- Iowa DNR and Iowa DOT, research group staff
- In-kind funding, outside coordination
- Data including vehicle fleet data, VMT data, speed data

Intended Users (IHRB, County, City, State, Pool Fund)
Local, regional/federal transportation agencies, Iowa DOT through CMAQ, Iowa DNR, MPOs, USEPA, consulting firms

Implementation
Iowa DOT, Iowa DNR, public/private research groups

Other Outside Parties
Fuels associations, renewable processors, largely regulated point sources (the usual targets for reduction programs).

II. Corridor Planning Research Problem Statements

Developing a Statewide Resource Database Accessible to All Levels of Government

Group Name: Corridor Planning

Facilitator Name: Mark Kerper

Date: May 3, 2004

Initiative Team Members:
Mark Dunn, Research Engineer for Materials Inspection, Iowa DOT
Tim Ellis, Associate Professor, ISU/CCEE
Tom Kane, Executive Director, Des Moines Area MPO
Mark Kerper, Assistant Office Director for Location and Environment, Iowa DOT
Dennis Kroeger, Transportation Research Specialist, ISU/CTRE
Judy MacDonald, Cultural Resource Specialist for Location and Environment, Iowa DOT
Mark Masteller, Roadside Development Specialist, Iowa DOT
Kelly Strong, Associate Professor, ISU/CCEE

Background and Problem Statement
Access to data is critical to the planning process. When planning roadway projects, surveying areas to determine environmental sensitivity, historical significance, or projected wetlands is a time consuming process. Many areas have previously been surveyed and cataloged for other projects, and those data have been stored in various formats at different agencies. If planners and engineers have access to those data, time and money could be saved and the planning process could be enhanced.

Research Objectives
The objective of this research is to develop a comprehensive database; utilizing all environmental, transportation, and planning data available from the federal, state, and local agencies. These agencies include, but are not limited to: Iowa Department of Natural Resources, Iowa Department of Transportation, Iowa Office of State Archeologist, Iowa Office of State Historical Preservation, US Army Corps of Engineers, US Geological Service, US Department of Interior, and others that may be identified. The research will incorporate these databases into a comprehensive database in a geographical information systems (GIS) platform that is accessible by all levels of government and can use in their planning functions. The project will map the state, and standardize the data so that all can use them.

Resource Needs and Time Frame
This research will take a two-phased approach:

Phase 1:	1. Determine and inventory the databases
(12 months)	2. Determine compatibility of data
	3. Determine any lapses in database
	4. Identify and inventory any confidentiality of data sources

Phase 2: (18 months) Develop statewide database

Anticipated funding level: $100,000

Intended Users (IHRB, County, City, State, Pool Fund)
All levels of government, city, county, state

Implementation
Include people/organizations that should be considered for implementing the research.

Developing a Business Case for Environmentally Friendly Transportation Enhancements

Group Name: Corridor Planning

Facilitator Name: Mark Kerper

Date: May 3, 2004

Initiative Team Members:
Mark Dunn, Research Engineer for Materials Inspection, Iowa DOT
Tim Ellis, Associate Professor, ISU/CCEE
Tom Kane, Executive Director, Des Moines Area MPO
Mark Kerper, Assistant Office Director for Location and Environment, Iowa DOT
Dennis Kroeger, Transportation Research Specialist, ISU/CTRE
Judy MacDonald, Cultural Resource Specialist for Location and Environment, Iowa DOT
Mark Masteller, Roadside Development Specialist, Iowa DOT
Kelly Strong, Associate Professor, ISU/CCEE

Background and Problem Statement
During the past few years, many construction projects have included enhancements and beautification improvements as part of the overall project. These projects have included biking and hiking trails, aesthetically pleasing rest areas, and bridges. While these projects have been generally met with favorable public opinion, the benefits of the enhancements have not been quantified, in terms of benefit-costs or environmental impact.

Research Objectives
The objective of this research is to develop a business case for environmentally friendly transportation enhancements. These enhancements could be improvements such as gateways, biking and hiking trails, and flowers and shrubberies. These types of improvements are usually considered “quality of life” enhancements, but they have environmental aspects as well. This

research will develop criteria to quantify these enhancements, in terms of environmental impacts, safety, outreach, and economic benefit.

Resource Needs and Time Frame
Duration: 18 months
Anticipated level of funding: $100,000

Intended Users (IHRB, County, City, State, Pool Fund)
IHRB, City, Counties, and State will benefit from this research.

Utilization of Interchanges on Freeway/Expressway Facilities

Group Name: Corridor Planning

Facilitator Name: Mark Kerper

Date: May 3, 2004

Initiative Team Members:
Mark Dunn, Research Engineer for Materials Inspection, Iowa DOT
Tim Ellis, Associate Professor, ISU/CCEE
Tom Kane, Executive Director, Des Moines Area MPO
Mark Kerper, Assistant Office Director for Location and Environment, Iowa DOT
Dennis Kroeger, Transportation Research Specialist, ISU/CTRE
Judy MacDonald, Cultural Resource Specialist for Location and Environment, Iowa DOT
Mark Masteller, Roadside Development Specialist, Iowa DOT
Kelly Strong, Associate Professor, ISU/CCEE

Background and Problem Statement
Experience has shown that development which occurs near at-grade intersections on four-lane highways can result in operational and safety problems over time. Interchanges are an ideal method to provide access to these facilities, but are considerably more expensive and should only be considered where warranted. These facilities are also more land-use intensive. There is a need to develop criteria to assists designers and planners in determining where interchanges should be built.

Research Objectives
The objective of this research is twofold:

1. Inventory criteria from other state departments of transportation as to what they use to justify/warrant interchanges.
2. Develop criteria and/or recommendation for use by Iowa DOT.

Resource Needs and Time Frame
Duration: 12 Months

Analyzing the Benefit-Cost of Wetlands Mitigation

Group Name: Corridor Planning

Facilitator Name: Mark Kerper

Date: May 3, 2004

Initiative Team Members:
Mark Dunn, Research Engineer for Materials Inspection, Iowa DOT
Tim Ellis, Associate Professor, ISU/CCEE
Tom Kane, Executive Director, Des Moines Area MPO
Mark Kerper, Assistant Office Director for Location and Environment, Iowa DOT
Dennis Kroeger, Transportation Research Specialist, ISU/CTRE
Judy MacDonald, Cultural Resource Specialist for Location and Environment, Iowa DOT
Mark Masteller, Roadside Development Specialist, Iowa DOT
Kelly Strong, Associate Professor, ISU/CCEE

Background and Problem Statement
The management of wetlands mitigation is important to corridor construction. However, the benefits of mitigating wetlands impacts have not been substantially quantified. Current benefit-cost models have been tied strictly to measured economic benefits. This research will investigate other models, such as “dialogue based” risk management that can be implemented here.

Research Objectives
The objective of this research is to establish methods to quantify benefits of wetlands mitigation and determine methods to measure function, value, successes, and failures. The research will also develop a best practices guide for wetlands mitigation for use in construction projects.

Resource Needs and Time Frame
Duration: 18 months
Anticipated Funding: $75,000

III. Water Quality Research Problem Statements

Systematic Study of the Effects of Transportation on Water Quality by Type of Impact and Scale of Watershed

Group Name: Water Quality

Facilitator: Steve Andrle

Date: May 3, 2004

Initiative Team Members:
Ubbo Agena, Program Manager for Non-Point Source, Iowa DNR
Steve Andrle, CTRE Director, ISU/CTRE
Roy Gu, Associate Professor, ISU/CCEE
Mike LaPietra, Environment Realty Manager, FHWA
Donna Lutz, Assistant Scientist, ISU/CCEE
Scott Marler, Environment Specialist, Iowa DOT
Se Kee Ong, Associate Professor, ISU/CCEE
Mary Skopec, Section Supervisor for Water Monitoring, Iowa DNR

Background and Problem Statement
Research and data on the effects of transportation on the environment are a piecemeal collection of results that often lack context, so analysts do not have a complete picture or the tools necessary to assess impacts. The piecemeal nature of the literature is related to the multidimensional nature of the problem. Construction period impacts must be distinguished from the use period. The roads involved must be classified—at least rural primary, rural secondary, and urban. The scale of the drainage basin must be considered. The type of pollution must be considered. The hydrology is vital, i.e., how fast does runoff reach affected waters. Finally the duration of impact must be considered.

A simple case illustrates the situation. Road snow was pushed near a stream in Iowa that contains trout, causing a short-term spike in salinity that affected the fish population. Similarly, summer parking lot runoff to the same stream can cause a 10-degree short-term rise in water temperature that is enough to produce a fish kill. These effects would not necessarily have been measurable or significant at a larger scale or on a less sensitive environment.

The problem is so complex that a long-term plan needs to be carried out by many parties to improve the science. It is very difficult to assess the value of mitigating actions if the effect of transportation on the environment is not clear in the first place.

The problem to be addressed by this research is to develop a typology of impacts, prioritize the severity and scale of each type of impact in Iowa, and set about measuring the effects in a systematic manner.

Research Objectives
The overall objective of this research is to assess the water quality and hydrology impacts of highway transportation on water quality for the primary system, county, urban environments.

- Develop a typology of the effects of highway transportation on water quality, considering:
    - Construction period
    - Use period
    - Road classification
    - Type of pollutant
    - Water temperature
    - Size of the drainage basin
    - Duration of impact
- Identify the numeric and narrative water quality criteria that are applicable in Iowa pertaining to highway transportation impacts.
- Design field monitoring tests that provide data on the situations that have the biggest impact in Iowa. (Include a road ditch scenario.)
- Monitor the following items in the field tests:
    - Salinity
    - Biological Oxygen Demand (BOD)
    - Total Organic Carbon (TOC)
    - Sediment
    - Biological assessment
    - Nutrients – nitrates, phosphorus
    - Temperature
    - Salts
- Monitor sites for 5 years, recording target pollutant(s) and road weather
- Put data in context (e.g., weather, road VMT, distance from road, type of watershed) so it can become part of a modeling process. Report on the concentration, and duration of both particulates and dissolved pollutants

Resource Needs and Time Frame
At least 10 years and $2 million

Intended Users
Designers and evaluators of mitigation strategies—public agencies and private companies

Implementation
These data would improve the science of pollution mitigation in Iowa. The data will be incorporated into modes and will theoretically result in actually achieving the desired mitigating effect.

The Effectiveness of Water Quality Best Management Practices (BMPs)

Group Name: Water Quality

Facilitator Name: Steve Andrle

Date: May 3, 2004

Initiative Team Members:
Ubbo Agena, Program Manager for Non-Point Source, Iowa DNR
Steve Andrle, CTRE Director, ISU/CTRE
Roy Gu, Associate Professor, ISU/CCEE
Mike LaPietra, Environment Realty Manager, FHWA
Donna Lutz, Assistant Scientist, ISU/CCEE
Scott Marler, Environment Specialist, Iowa DOT
Se Kee Ong, Associate Professor, ISU/CCEE
Mary Skopec, Section Supervisor for Water Monitoring, Iowa DNR

Background and Problem Statement
BMPs in general strive to reduce the quantity of runoff and increase the time it takes runoff to reach a body of water. However, information on the effectiveness of BMPs is piecemeal and unfocused. There are few scientific studies that that really examine the performance of BMPs. The goal of this research effort is to be in a position to respond to 2006 Iowa DNR criteria on a drainage basin basis.

Research Objectives
- Synthesize the BMPs recommended in the literature and design guidelines.
- Develop methods to test their effectiveness with respect to a drainage basin.
- Examine the effectiveness of transportation-related BMPs on a number of pollutants. Develop improved BMPs based on the evaluation. As a special case, assess the benefits of pervious pavers in Iowa.
- Incorporate the improved BMPs in design manuals, like SUDAS and the Iowa DOT Specifications for Highway Construction

Resource Needs and Time Frame
Two years and $200,000

Product
Improved design manuals

Effectiveness of Wetland Mitigation

Group Name: Water Quality

Facilitator Name: Steve Andrle

Date: May 3, 2004

Initiative Team Members:
Ubbo Agena, Program Manager for Non-Point Source, Iowa DNR
Steve Andrle, CTRE Director, ISU/CTRE
Roy Gu, Associate Professor, ISU/CCEE
Mike LaPietra, Environment Realty Manager, FHWA
Donna Lutz, Assistant Scientist, ISU/CCEE
Scott Marler, Environment Specialist, Iowa DOT
Se Kee Ong, Associate Professor, ISU/CCEE
Mary Skopec, Section Supervisor for Water Monitoring, Iowa DNR

Background and Problem Statement
In 2000, the National Academy of Sciences issued NCHRP Report 302, critical of wetland mitigation practices. How effective are wetlands at mitigating the effects of highways? Among the questions raised are:

- How long can a wetland be effective as a nutrient sink? Much of the evaluative research only includes data on the early life of newly-created wetlands. Do wetlands reach an equilibrium after which they no longer effective?
- How are wetlands linked? Does a new wetland serve the same function as the one replaced? The issue may be more complicated than replacing acre for acre or even at multiples of the damaged wetland acreage.
- Should mitigate efforts be "pooled" offsite to get greater impact? Site-for-site mitigation may have only marginal benefit, while a larger wetland or system of wetlands may have a disproportionately greater benefit
- What is the impact on wildlife travel and migration?

If the effect of a highway is known, successful mitigation efforts can be planned. However, we really don't know if wetland mitigation is replacing the function of impacted wetlands. We don't know because we lack tools for a system-wide functional assessment. We have site tools, but lack system tools. A suite of chemical and biological assessment tools is needed to measure system-wide impacts.

Research Objectives
The objectives of this research are as follows:

- Develop procedures to link the wetland mitigation actions to the road site
- Develop methods to evaluate effectiveness of wetland mitigation activities on a watershed basis

- Develop procedures and tests to measure the rate that carbon cycles through the wetland system.
- Develop procedures to monitor the impact on wildlife travel

Resource Need and Time Frame
The difficulty of attaining these objectives is not clear. The prospectus requires additional input from the scientific community.

Intended Users
Agencies charged with mitigating the effects of highway construction and operation are the intended users

Implementation
Based on the findings, guidelines for wetland mitigation would be revised, ensuring that future wetland construction or mitigation will incorporate the research results.

Shared Use of Remote Sensing Data for System Level Quality Management

Group Name: Water Quality

Facilitator Name: Steve Andrle

Date: May 3, 2004

Initiative Team Members:
Ubbo Agena, Program Manager for Non-Point Source, Iowa DNR
Steve Andrle, CTRE Director, ISU/CTRE
Roy Gu, Associate Professor, ISU/CCEE
Mike LaPietra, Environment Realty Manager, FHWA
Donna Lutz, Assistant Scientist, ISU/CCEE
Scott Marler, Environment Specialist, Iowa DOT
Se Kee Ong, Associate Professor, ISU/CCEE
Mary Skopec, Section Supervisor for Water Monitoring, Iowa DNR

Background and Problem Statement
Technologies like light detecting and ranging (LIDAR) and aerial spectral analysis can provide valuable planning data for water quality management. For instance, in flat country, watershed boundaries should be defined with a six-inch level of accuracy. A joint project, perhaps with the Iowa Department of Transportation, to map the entire state with airborne LIDAR would be very beneficial in defining watersheds, measuring impacts of new retention structures, and in assessing watershed impacts from highways. LIDAR is well suited to broad area surveys, and is less expensive than photogrammetry. Traditional surveying is feasible only for actual projects.

Research Objectives
The objective of this research is to use LIDAR to create an elevation map of the entire state.

Resources Needed and Time Frame
This would require approximately five years and $5 million. It may be possible to reduce this expense, because elevations should be available for roads. It may be possible to piece together some existing information to reduce the cost.

Intended Users
State agencies that are engaged in activities that impact water quality

Implementation
A lead agency, probably the Iowa DNR or the Iowa DOT, would contract for LIDAR mapping services and make the results available. Joint funding is anticipated.

Iowa Example of an Exemplary Ecosystem

Group Name: Water Quality

Facilitator Name: Steve Andrle

Date: May 3, 2004

Initiative Team Members:
Ubbo Agena, Program Manager for Non-Point Source, Iowa DNR
Steve Andrle, CTRE Director, ISU/CTRE
Roy Gu, Associate Professor, ISU/CCEE
Mike LaPietra, Environment Realty Manager, FHWA
Donna Lutz, Assistant Scientist, ISU/CCEE
Scott Marler, Environment Specialist, Iowa DOT
Se Kee Ong, Associate Professor, ISU/CCEE
Mary Skopec, Section Supervisor for Water Monitoring, Iowa DNR

Background and Problem Statement
Exemplary ecosystems are examples of low-impact development. The principles of low-impact development are known, but models are needed to demonstrate how many techniques can be implemented together for maximum impact. Developing design manuals and constructing demonstration projects would accelerate adoption of these techniques by the private sector and public agencies. The design guidelines and demonstrations should include roadways, runoff control, and parking lot hydrology. The effectiveness of pervious pavers on Iowa soils should be evaluated as part of the project.

Research Objectives
Develop an exemplary ecosystems design manual that addresses urban, suburban, and rural cases. The manual should address mitigating the water quality impacts of roads and site

development. The project should build on work already done by the Iowa DNR and the Iowa Statewide Urban Design and Standards Manuals (SUDAS).

Resource Needs and Time Frame
The design manual component is estimated at two years and $300,000. The demonstrations components would have to be negotiated with site developers and road builders through a long-term demonstration program.

Intended Users
The intended users are site developers and road builders.

Implementation
The beneficiary agencies would need to fund this effort and hire a consultant to prepare the manuals. Then the agencies would develop a demonstration policy based on the guidelines.