Guidelines for Environmental Performance Measurements Final Report

NCHRP 25-25, Task 23

Requested by:

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Standing Committee on Environment

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1.0 Introduction

The objective of National Cooperative Highway Research Program (NCHRP) Project 25-25, Task 23 is to establish guidelines for the development and implementation of environmental performance measurements for state departments of transportation (DOT). Through an analysis of existing literature, practices, and research, practical procedures to integrate environmental measurements into agency practices and decision-making are identified and described.

Transportation agencies increasingly are utilizing performance-based management approaches to guide their planning, design, maintenance, operations, and contracting practices. These include the adoption of goals and objectives, performance standards, and monitoring of actual performance. Typically performance measures have been limited to a set of measures directly under the agency's control, such as capacity and pavement quality. Today's transportation decisions, though, are being made in a much broader and more collaborative context in which water quality, air quality, ecology, economic development, historic preservation, community quality of life, and other environmental considerations are being given increased importance. While transportation may have an important influence on outcomes in these areas, a variety of other factors also affect the degree to which these desired other objectives are achieved. Not only do these outcomes require more complex measures, but they also often overlap with efforts being undertaken by other agencies such as departments of natural resources. Nonetheless, transportation agencies are concluding that it is important to incorporate these broader indicators in their performance-based strategic management processes.

Provisions contained in the 2005 Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) continue this evolution in which environmental considerations are being more systematically incorporated throughout all aspects of transportation planning, project development, and operation. For example, Section 6001of SAFETEA-LU requires consultation with resource agencies as part of the process for preparing a long-range transportation plan. This consultation includes those agencies responsible for land use management, natural resources, environmental protection, and conservation and historic preservation. Section 6001 also requires a discussion as part of a long-range transportation plan of potential environmental mitigation activities. Environmental performance measurements will help to carry out these requirements.

This report, thus, examines the interface between two important characteristics of DOT professional practice: an increasing attention to environmental stewardship and performance-based strategic management. Although DOTs have been addressing environmental considerations for many years, environmental concerns are taking on even greater importance; the scope of environmental issues considered relevant to transportation is increasing; and the environmental focus is expanding from project-based assessments to the consideration of environmental issues in operations, maintenance, planning, and policy-level decisions. This project examined this shift in conjunction with the expansion of performance-based strategic management within DOTs. Over the past decade, agencies have adopted a more systematic approach to identifying the vision, goals, and performance measures to guide agency planning and decision-making. As environmental issues gain momentum, so does the need to identify performance measures that can connect agency goals with outcomes.

The product of this project is practice-oriented and includes a "library" of examples and possible environmental performance measures. Through an analysis and synthesis of current practices, the report provides an overall framework and guidance for the selection and implementation of environmental performance measures that can reflect different agency goals, organizational management structures, and data availability. The intent is to provide usable products for those interested in furthering the systematic consideration of environmental factors in agency planning, operations and management decision-making.

The report begins with a summary in Section 2.0 of the research approach and tasks undertaken. It then summarizes in Section 3.0 a base of work upon which this project builds and applicable principles of performance-based management. Section 4.0 assesses the existing literature in terms of its applicability, conclusiveness, and usefulness; summarizes the results of the Internet-based survey that was undertaken; and presents examples of environmental performance measurement practices that could be either adopted or adapted by others. Supporting information for Section 4.0 is provided in a series of appendices. The report concludes with recommended guidelines for use by state DOTs in furthering their development and implementation of environmental performance measurements.

Two overall findings emerge from the work performed. The first, as documented by the examples presented in Section 4.0, is that numerous initiatives exist both internationally and in this country that are directly related to aspects of environmental performance measurement. While these include the growing and broad interest in the concept of sustainability, they also include the use of environmental benefit agreements; green or environmentally sensitive design, construction, maintenance, and operations practices; and a growing library of environmental stewardship practices. These practices are immediately available for adoption or adaptation by other state DOTs and MPOs.

At the same, the practice of environmental performance measurement is not yet comprehensively developed or practiced, even within environmental resource agencies. Virtually all agencies would like to be doing more than they currently are, but are slowed by having to overcome a number of difficult challenges. Many environmental issues are difficult to quantify. Achieving an environmental objective is seldom within the complete control of a transportation agency, raising the question of what targets are appropriate and how to establish targets. Data may be difficult or costly to collect. Measures of environmental performance are affected by the actions of others; is it appropriate to measure and monitor something that is not fully under your control? There are important issues of geographic and temporal scale; what is appropriate for monitoring by a transportation agency?

The reconciliation of these apparent contradictions is that the results of this work indicate that despite these challenges, many agencies nonetheless are making important strides in their implementation of environmental performance measurements. These agencies recognize both the need and the opportunities that exist.

2.0 Approach

This project was accomplished by undertaking the following four activities:

- A review of domestic and international published literature and research in progress;
- A survey of state DOT environmental performance measurement practices;
- Interviews conducted with selected state DOTs, metropolitan planning organizations (MPO), and environmental resource agencies identified in the literature review, the survey, or otherwise known to be actively measuring and tracking environmental performance to evaluate trends and achieve established goals; and
- A synthesis of the resulting environmental performance measure information into examples and recommended implementation guidelines.

A number of studies have looked at how transportation agencies currently are adopting and implementing environmental performance measures throughout the United States and around the world. The purpose of the **literature review** was to conduct a critical analysis of this domestic as well as international literature, research in progress, and current practice with an emphasis on assessing the applicability, conclusiveness of the findings, and usefulness for the analytical needs defined by AASHTO for this project. Attention was given to identifying the state of the practice within the transportation community, determining how nontransportation organizations are using environmental performance measurements, and determining the direction in which environmental performance measurement practices are evolving. Consequently, information was gathered on the role of environment-related performance measures in state DOT and other natural resource agency efforts to foster environmental stewardship. As noted in Section 1.0, such stewardship is focusing not just on planning but also on construction, operations, and maintenance.

Although a literature review is an important source of information concerning the use of environment-related performance measurements, it was important for this project to also identify the most recent related activities in the United States. This was accomplished by conducting an **Internet-based survey** of the environmental and planning groups within state DOTs. The survey, a copy of which is provided as an appendix to this report, provided information on what DOTs are and are *not* doing. In addition, the survey allowed the identification of other aspects of performance measurement applications (e.g., organizational responsibility, perceived advantages and disadvantages, costs) that are not easily discerned in a literature review.

Based on the results of the literature review and the Internet survey, **interviews** then were conducted with approximately a dozen state DOTs in order to follow-up on specific issues, fill in information gaps, obtain more in-depth information, and also acquire examples of specific reports and applications. The results of these interviews are incorporated into the Section 4.0 Findings.

Interviews also were conducted with a small sample of environmental resource agencies to obtain their perspective on the use of environmental performance measurements. In addition,

there are several MPOs that have given considerable thought to environmental performance measures. Seven MPOs were contacted that have experience with such measures. Representative examples of these interview findings regarding current and emerging practices are presented as part of the Section 4.0 Findings.

The final portion of the project used the base of literature, survey, and interview information, together with previous work performed for NCHRP regarding the implementation of performance-based management approaches, to produce **guidelines** that could be used by state DOTs for the development and implementation of environmental-specific performance measurements. Consideration was given to determining which performance measurements are most feasible and useful from a strategic management perspective, the ease of data collection and tracking, and institutional factors that should be taken into consideration. Recognizing the diversity of current state DOT practices and preferences, the intent was to produce guidelines that were both consistent with broader performance-based management approaches and practice-oriented in that they would enable state DOTs and MPOs to immediately take steps to further their implementation and use of environmental performance measurements. At the same time, the guidelines are not prescriptive in that they encourage agencies to incrementally build upon their existing practices and preferences.

3.0 Background

3.1 Performance-Based Management

State DOTs are charged with the difficult task of planning, building, operating, and maintaining an efficient multimodal transportation network that serves a diverse community of users, while minimizing impacts on (and preferably enhancing) the environment. Although daunting, this charge has been met successfully by DOTs and international agencies through strategic management and performance monitoring. Performance-based planning has transitioned from an accountability tool that justifies dollars invested in the transportation system to an important foundation for transportation policy-making. Performance measures are a key mechanism employed to monitor DOT progress towards a set of goals. Defining a performance measure (or indicator) increases attention on a particular issue and integration into strategic management ("that which is measured, counts"). Traditionally, the most common performance measures are those relating to the condition or operational characteristics of transportation infrastructure, e.g., pavement and bridge condition, number of crashes, average speed, volume to capacity, transit ridership, etc. Environmental performance measures, in contrast, have not been as common, thus hindering the integration of environmental factors into agency decisions.

Today, successful delivery of transportation services and projects depends more on finding the right balance among potentially competing objectives supported by a diverse group of stakeholders as it does on traditional engineering skills. To achieve "win-win" solutions, state DOTs and MPOs need to be equipped to employ early, continuous, and effective analysis of information as part of their standard set of management practices and tools. Reliable and easy to understand information developed and presented in a collaborative style is proving key to making informed decisions that reflect systemwide concerns and inevitable tradeoffs among choices. Such approaches ultimately are vital in facilitating faster, lower cost, and more cost-effective processes for achieving environmental goals.

While a concise and coherent synthesis of existing environmental performance measurement cannot be found in either practice or the literature, work on this project could nonetheless build on a substantial and proven foundation of existing related research and practice:

- Guidelines for the development and tracking of transportation performance measures and the integration of these measures into transportation agency decision-making have become well-established in recent years.[1]

- As one means of measuring their performance, many transportation agencies have become much more "customer-oriented," using surveys, focus groups, and other market research

[1] *A Guidebook for Performance-Based Transportation Planning* (NCHRP 446); *Performance Measures and Targets for Transportation Asset Management* (NCHRP Project 20-60); *Effective Organization of Performance Measurement* (NCHRP Project 8-36, Task 47); *Guide to Effective Freeway Performance Measurement* (NCHRP Project 3-68); and *Cost-Effective Methods and Planning Procedures for Travel Time, Delay, and Reliability* (NCHRP Project 7-15).

techniques to measure and track customer satisfaction.[2] These efforts represent an important step in moving beyond travel time, congestion, cost, and other traditional transportation performance measures.

- An increasingly broad range of concerns are considered in all aspects of transportation decision-making today, including economic development, land use, and environmental quality. Environmental quality is included as one of the eight planning factors defined in the 2005 SAFETEA-LU surface transportation reauthorization to be considered in the development of transportation plans, programs, and projects. The objective is to, "protect and enhance the environment, promote energy conservation, improve the quality of life, and promote consistency between transportation improvements and state and local planned growth and economic development patterns."[3] The *Transportation and Community and System Preservation (TCSP) Program* established under the 1998 Transportation Equity Act for the 21st Century (TEA-21) represents an example of a transportation program that successfully integrates environmental, economic development, and traditional asset management objectives.[4]

- Environmental stewardship practices have been widely adopted by transportation organizations throughout the country, and at all levels of government. As described in more detail in Section 4.0, these include the practices of context sensitive solutions (CSS), context sensitive design (CSD), and "green highways." Utilizing these practices, agencies are finding that projects frequently can be developed in less time and with a lower cost, and at the same time are more environmentally friendly. Equally importantly, environmental stewardship is no longer viewed as exclusively or even primarily a transportation planning consideration. Environmental considerations are being given increased attention as part of transportation system planning, as well as in maintenance, operations, and construction practices.[5] Issues of biodiversity, wetland protection, historic preservation, open space, and environmental justice are routinely addressed within many transportation organizations today.

- Building on private sector experience, several state DOTs, including Maine, Massachusetts, Pennsylvania, and Maryland, have implemented Environmental Management Systems (EMS) to track performance of environmental permits and obligations. New York State DOT's Environmental Commitment and Obligations Package for Construction (ECOPAC) records and tracks environmental compliance of the agency's construction projects. Ensuring that environmental commitments are implemented in a timely manner represents one means of monitoring environmental performance.

- Transportation decisions today increasingly are made in a highly collaborative environment based on the development of a consensus rather than the exercise of an executive authority.

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[2] Cambridge Systematics, Inc. with Dr. Michael Meyer, *Peer Exchange Series on State and Metropolitan Transportation Planning Issues – Nontraditional Performance Measures*, NCHRP Project 8-36, Task 53(02), Washington, D.C., March 2006.

[3] *Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users* (SAFETEA-LU), 2005.

[4] Cambridge Systematics, Inc., *Transportation and Community and System Preservation Fifth Year Report,* Federal Highway Administration, Washington, D.C., 2005.

[5] Venner Consulting and Parsons Brinckerhoff, *Environmental Stewardship Practices, Procedures, and Policies for Highway Construction and Maintenance, ,* NCHRP Project 25-25, Task 04, September 2004, Washington, D.C.,

> The important environmental, economic development, community, and other factors are sufficiently broad that the requisite knowledge to understand these multiple considerations frequently extends well beyond the limits of any one organization. Consequently, collaborative working arrangements are necessary to make meaningful headway in solving problems. The Michigan Transportation Commission has adopted an explicit policy requiring, "a collaborative, interdisciplinary approach involving stakeholders for the development of a transportation facility that fits its physical setting and preserves scenic, aesthetic, historic, cultural, and environmental resources, while maintaining safety and mobility."[6]

These different trends and practices, both individually and collectively, represent a major evolution in the manner in which transportation agencies are being managed and transportation decisions made, with significant importance being given to the manner in which environmental considerations are integrated in all aspects of transportation management and decision-making. One also sees that the word "environment" is being broadly interpreted. Air quality concerns no longer are limited to pollutants covered by the National Ambient Air Quality Standards (NAAQS), but also include air toxics and greenhouse gases. The natural environment (be it wetland preservation or wild life), increasingly is being examined on a basis of ecosystems, especially in the development of transportation system plans. Energy and resource conservation are important issues at the state and local levels of government as well as at the Federal level with increased attention being given to vehicle fleet fuel economy and the introduction of vehicles powered by a range of alternative fuels. The effect of transportation on quality of life frequently is raised as an important issue, including public health, pedestrian-friendliness, and neighborhood character. The manner in which the development and management of transportation infrastructure affects particular groups of people increasingly is being addressed within a framework of assessing environmental justice.

3.2 Definitions and Principles

3.2.1 Performance versus Impact versus Indicator

The practice of strategic or performance-based management originated in the private sector as a way to both better serve customers and assess return on investment; in other words, "know where you are before you decide where to go." It was viewed as an improved way of providing accountability. These same principles of performance-based management are being adopted within the public sector to help answer the question, "How are we doing?"

The terms *performance measure*, *impact*, and *indicator* often are used interchangeably. The research literature, though, makes a subtle distinction among these terms. The primary objective of this project is to prepare guidelines for the development and implementation of environmental performance measures by state DOTs. Performance measures are established to indicate how a transportation system is performing in the context of specific goals and objectives. A regional goal may be improved air quality, with a supporting objective being a decrease in NO_X emissions. Environmental analyses commonly are oriented to demonstrating

[6] Mortel, Susan, Deputy Director, Bureau of Transportation Planning, Michigan Department of Transportation, *Collaboration – Success Stories from the Michigan Department of Transportation*, Lansing, Michigan, January 2006.

the degree to which a desired objective is or is not being achieved by a proposed action. Again for air quality, the impact measure of concern is commonly emissions, although these may not necessarily translate directly to improved levels of ambient air quality.

While a performance measure may be calculated or estimated, performance *measurement* programs commonly include monitoring of actual conditions to measure changes in performance over time and the degree to which established goals and objectives actually are being achieved in practice. MPOs and state DOTs increasingly are publishing indicator reports on a periodic basis. A commonly used indicator for air quality is the number of days that ambient air quality for a particular pollutant, e.g., ozone, exceeds the applicable National Ambient Air Quality Standard. An environmental measurement program should be viewed broadly, incorporating the monitoring of various indicators as well as performance measures associated with particular impacts.

3.2.2 Criteria for Selecting Performance Measures

The following criteria traditionally have been recommended for use in selecting performance measures:

- Simplicity;
- Objectivity;
- Availability of data and supporting analysis methods;
- Cost;
- Number; and
- Controllability.

The rationale for the majority of these criteria is easy to understand and not controversial. Performance measures should be easily understood by the public, elected and appointed officials, and agency staff; and thus simplicity is almost always better than complexity. Performance measures, to the maximum degree, should be objective or factually based, so the values can be easily agreed upon and not themselves subject to debate. This normally results in the use of quantitative as opposed to qualitative measures.

The availability of required supporting data and analysis methods is important; any performance measurement that cannot be implemented, no matter how desirable it may be, simply is not practical. Similarly, the associated cost of collecting and analyzing the desired data should be within available budget and resource limitations. Again certain performance measurement information may be desirable, but not within the resource abilities of an agency. It is important to note, though, that for many environmental performance measurements, a transportation agency can enter into a cooperative agreement with an environmental resource agency that results in the availability of additional personnel and budgetary resources.

Regarding the number of performance measures, the traditional guideline has been to keep the total number relatively small. Doing so facilitates easy communication as a large amount of information easily can overwhelm an interested party. Given the combination of the number of relevant policy areas combined with the number of potentially important environmental areas,

one way of overcoming a limitation in total number of performance measures is to utilize a hierarchical structure, thereby permitting more in-depth reporting in any one particular area; e.g., environmentally sensitive highway maintenance practices.

Of the listed criteria, controllability is the subject where the greatest change in thinking has occurred. The early and still a common approach was to measure only those aspects of performance that were directly and entirely, or at least primarily, under the control of the transportation agency. Thus, attention was given to measures such as pavement condition, snow and ice removal, and traffic level of service. The thinking was why track something that is not within your control to change.

The evidence from the literature, survey, and interviews, though, indicates that this traditional thinking is changing. Transportation agencies increasingly are looking at a broad range of nontraditional performance measures corresponding in scope to the eight planning factors defined in SAFETEA-LU. One definition of a nontraditional performance measure is one that while either largely or partially beyond the control of actions directly taken by a transportation agency, it is nonetheless still affected by the decisions made by a transportation agency.[7] Example categories of such performance measurements include customer satisfaction, economic development, environmental quality, energy and resource conservation, environmental justice, quality of life, freight transportation, security, and sustainability. The reasoning for this evolution is very straightforward. Transportation agencies increasingly are adopting a broader mission, acknowledging the impact that transportation impacts have on the economy, communities, and the environment. Transportation agencies have found that including performance measures that reflect the interests of partner agencies and stakeholders facilitates the effective participation of these groups in the development and management of transportation systems, and thus helps to achieve both a collaborative decision-making process and consensus support for the resulting decisions.

3.2.3 Types of Performance Measures

Performance measures commonly are classified as being either an *output* or an *outcome* measure, where output measures track activities that hopefully lead to desired outcomes. Output measures normally are easier to determine and track, more immediately understandable to agency decision-makers, and often under more direct control of agency actions. Monitoring ambient air quality represents an outcome or bottom-line effectiveness result of environmental quality initiatives. Output measures, in contrast, could be emissions from mobile sources, the number of vehicles undergoing a vehicle emissions inspection, or the number of organizations participating in a transportation demand management program. Each of these, in theory, will result in improved air quality, but this result is not necessarily guaranteed. The challenge, therefore, is to make sure that output measures are linked to desired outcomes in as direct a way as possible. Outputs can be viewed as the products or services delivered, rather than the outcomes or changes that are desired by the delivery of these products and services.

[7] Cambridge Systematics, Inc. with Dr. Michael Meyer, *Peer Exchange Series on State and Metropolitan Transportation Planning Issues; Nontraditional Performance Measures*, NCHRP Project 8-36, Task 53, Washington, D.C., March 2006.

An environmental measurement program normally will contain a mix of *output* and *outcome* measures. In developing a program of environmental performance measurements, an expanded typology of performance measure types also may prove useful. In addition to output and outcome measures, other types of performance measures can relate to:[8]

- *Input* measures tracking resources or expenditures, such as the number of trained environmental professionals on staff;
- *Process* or *workload* measures capturing the amount of work performed, such as the number of permits reviewed or granted;
- *Timeliness* measures, such as the length of time required to complete an environmental impact statement and the associated reviews; and
- *Productivity* and *efficiency* measures are a ratio or comparison of outputs to inputs, such as the number of environmental compliance inspections conducted per staff day.

As documented in the Section 4.0 Findings and the associated appendices, the research conducted for this project revealed examples of environmental performance measurements within each of these defined categories.

[8] Hatry, Harry P., *Performance Management: Getting Results,* Washington, D.C., Urban Institute Press, 1999, reprinted in Richard P. Nathan, editorial, *Quicker, Better, Cheaper? Managing Performance in American Government*, 2000.

4.0 Findings

Information documenting the current state of the practice was obtained from three sources: a review of performance measure and environmental literature, an Internet-based survey of state DOTs and selected other transportation organizations, and telephone interviews with staff in agencies either known or identified as having potentially transferable practices relating to environmental performance measurement. The objective was to identify examples of particular practices, to note trends in the implementation of environmental performance measurements, and characterize the overall framework of current practices.

- **Subsection 4.1, Literature Review,** documents the results of Task 1, an analysis of domestic and international literature, with additional information presented in Appendices A and B.

- **Subsection 4.2, Survey of Agency Practices,** summarizes the results of Task 3, the survey of State DOTs and MPOs, with the survey questions used for the Internet-based survey provided as Appendix C. The results of the survey of state and Federal resource agencies are documented as apart of Subsection 4.3.

- **Subsection 4.3, Examples of Current Practices,** describes the Task 3 identification and synthesis of current practices, based on the telephone interviews conducted using the guideline questions contained in Appendix D.

The conclusions and lessons learned from these respective information collection efforts are contained as a part of the beginning of Subsection 4.3 as well as in the individual subsections and practice examples. Guidelines for the development and implementation of environmental performance measures by transportation agencies, documenting the results of Task 6, are presented as Section 5 of this report.[9]

4.1 Literature Review

An annotated bibliography is provided as Appendix A, identifying and summarizing selected documents related to both performance measures in general and environmental performance measurement in particular. The body of literature relating to environmental performance measures offers a number of important observations and conclusions on the topic:

- The literature demonstrates that many states and Federal agencies (U.S. and abroad) are utilizing performance measures and indicators to meet environmental goals in relation to transportation planning, systems operation, and construction. This trend is increasing over time.

[9] Tasks 4, 5, and 7 of the project define interim and final reporting, the results of which are represented by this final report.

- The body of literature generally supports the use of performance measures for reasons such as the justification of funding, public relations, decision-making processes, and guidance of effective public policies.

- A number of studies also have documented the importance of an appropriate framework for successful implementation of performance measures, although existing descriptions of such a framework do not yet extend to fully address environmental performance measurements.

- There appears to be little or no work dedicated to the actual evaluation of current performance measurement programs (i.e., there is little to no measurement of the effectiveness of environmental performance measurement). The only measure of "success" utilized throughout the literature is the frequency of an approach or specific measure.

- Scan studies conclude that comparing performance measurement programs is limited by a lack of consistent definitions of terms such as: indicators, benchmarks, outputs, outcomes, etc. Agreement on the use of these terms could allow environmental performance measurement data to be aggregated on a regional or even national level.

- The literature illustrates the need for an established framework and interagency collaboration to ensure the success of an environmental performance measurement program. In particular, collaboration between state resource agencies and transportation agencies has been challenging, making data sharing and program implementation difficult.

- A lack of accurate and consistent data collection is a recurring theme throughout the literature.

The existing literature, for the most part, can be divided into two types of documents: practical how-to guides and best practices reviews. Most of the literature provides examples of programs; either domestic or international, or both. A number of reports in both categories also provide comprehensive lists of examples of specific performance measures that have been adopted by agencies. Together, the body of literature provides evidence of environmental performance measurement programs, and the tools, guidelines, and required factors that can lead to successful implementation. As noted above, the literature does not provide measured, quantifiable findings showing that performance measurement actually leads to the improvement of the environment. Since the practice is only a tool that enables decision-making with the outcome of an improved environment, it is difficult to isolate and evaluate the impacts of performance measurement alone.

Environmental performance measurement overlaps with a number of related topics. Thus, there is a substantial body of literature that relates to some aspect of environmental performance measurement. The project team reviewed a significant number of documents that focus specifically on performance measures for transportation agencies, a smaller number on the topic of sustainable transportation, and finally documents that directly address environmental performance measures for transportation.

The literature addressing transportation performance indicates that an increasing number of transportation agencies are engaging in this practice. With the recent focus on accountability, strategic planning, and performance-based resource allocation and decision-making, it is logical that performance measurement would take hold as a practice that enables these activities.

In addition, the use of indicators and "dashboards" are valuable for use in customer relations and outreach efforts. A number of international scans illustrate that these practices are even more prevalent abroad, and provide good case studies by documenting commonalities among the programs. This set of documents is useful for transportation agencies trying to develop a comprehensive performance measure program, providing both examples of these efforts and step-by-step how-to guides. These documents also provide a context for how an environmental performance measurement program can fit within a program that is tracking transportation planning, programming, and maintenance performance in a number of areas.

The term "sustainability" has become a catch-all phrase and thus the literature on the topic suffers from a lack of a consistent definition. A widely accepted definition is one stating that sustainable transportation is a system that meets the needs of today's population without jeopardizing the health of tomorrow's. From there, definitions can range from including purely basic environmental outcomes, to those including the economy, historic preservation, community development, quality of life, and more. The term is more widely accepted and utilized in Canada and Europe, but the concept is becoming more integrated in the United States, sometimes simply under the term "environment." The general literature reviewed for this project reveals that many agencies and professionals in the transportation field group things such as economic development and quality of life under the umbrella of the term "environment." For the purposes of this project, the literature on sustainability provides additional information.

Henrik Gudmundsson's article provides a useful discussion of this lack of definition, and reviews six programs that claim to be measuring sustainability. He argues that there should be a distinct difference between programs that measure sustainability and those that measure environmental impacts, in that sustainability measurements should be considering whether the current condition can be maintained in the long run.

Finally, the literature that specifically addresses environmental performance measures in transportation provides some useful insights. In general, this group of documents provides additional information about agencies currently using these strategies. In particular, there are two documents which offer especially unique insights. First, in 1996, the United States Environmental Protection Agency released a report called *Indicators of the Environmental Impacts of Transportation: Highway, Rail, Aviation, and Maritime Transport*. This report provides general background on indicators, identifies the range of environmental impacts on transportation, suggests related indicators, quantifies the impacts of transportation on a national level, and assesses the data gaps associated with the indicators. Although now ten years old, this report still represents a comprehensive document that provides information from the environmental perspective, and therefore provides particularly useful insight for transportation agencies

Another study worth noting is a Gallup report, published in 2004 for FHWA called *Implementing Performance Measurement in Environmental Streamlining*. The researchers interviewed officials from transportation and resource agencies who have participated in the environmental streamlining process. A follow-up survey was conducted and reported on in 2007. Though not specifically related to environmental performance measures, the responses nonetheless provide valuable insight. For example, the 2004 report finds that this practice has created the need for additional collaboration between the two agencies, that there are different

definitions of the word streamlining, and both transportation and environmental agencies note difficulties in working with their partner agency.[10]

4.2 Survey of Agency Practices

A web-based Internet survey was distributed to state department of transportation and metropolitan planning organization representatives asking about their agencies' use of environmental performance measures. The survey asked about current use, motivations for use, specific environmental areas that are being measured, the type of data used in measurement and reporting, the agency's overall experience, benefits, barriers, and other information associated with implementation and use of environmental performance measures. A copy of the survey text is included as Appendix C.

Thirteen agencies responded to the survey. Although the response rate was disappointingly low, the information still provides some useful insights. General trends found in the survey responses are noted here, with more specific agency-related information documented in the Section 4.3 examples.

Out of the 13 responses, four agencies stated that they are not using performance measures at all for planning or strategic management purposes, to track environmental areas or otherwise. Of these four, one agency reported that they are in the process of considering the use of performance measures in the update of their long-range transportation plan. Another said that, while they do not use them as a strategic planning tool, they do track important environmental factors in their work, and have implemented ways to analyze the effect of environmental coordination and streamlining efforts on the agency's mission. It is possible that other agencies would classify these efforts as performance measurement, and this may be an example of a difference in definition influencing an answer.

An additional four respondents reported that they are using performance measures in their planning and/or strategic management process, but are not using environmental performance measures. Of these four, three stated that they are in the process of implementing environmental measures into their long-range plans or other agency planning documents. The one agency that did not report this stated they have incorporated environmental measurement requirements in the past through their business plan development efforts.

This group of respondents listed a number of important barriers they have faced to implementation of environmental performance measurements. These include a lack of staffing and a lack of emphasis on performance measures in the strategic plan. One agency reported that they have struggled with determining which environmental trends can be directly attributed to their actions or actually have control over, and thus which are worth measuring for use in decision-making. Another respondent stressed their frustration with people's lack of understanding of

[10]These surveys also are being used to assess the implementation effectiveness of environmental provisions contained in the SAFETEA-LU surface transportation reauthorization legislation, as documented in H*ighways and Environment: Transportation Agencies Are Acting to Involve Others in Planning and Environmental Decisions*, U.S. Government Accountability Office, Washington, D.C., April 2008.

the usefulness of performance measurement efforts. This response illustrates the need for better evaluation of the effectiveness of environmental performance measurement programs to guide decisions that have a positive impact on the natural environment.

Five agencies (two MPOs and three DOTs) reported utilizing environmental performance measures for planning and/or strategic management. These agencies were asked to list their key motivations for employing environmental performance measures. Four out of the five agencies listed the ability to evaluate existing programs and projects, and to communicate the results of the programs and projects within the agency as being key motivations. The ability to establish a link between statewide goals and projects or programs, a method to easily communicate the results of programs and projects with the public, and the need to fulfill a legislative mandate were all mentioned twice. Other primary motivations included the ability to allocate resources across the agency, benchmarking, employee motivation and direction, problem solving, and a method to identify efficiencies.

Table 4.1 shows how the respondents' agencies have used specific categories of environmental performance measures. The numbers in each column represent the frequency with which the environmental issues were incorporated through performance measures in each of the five processes (respondents were allowed to select as many categories as were relevant). The answers are relatively well distributed among the issues and processes, suggesting that environmental performance measures are being used for a wide variety of purposes and in many ways. However, adding the total of answers in each individual column and row does indicate which practices are more common than others (again, keeping in mind that this is based on a very small sample size). Timeliness of the environmental process was selected 17 times among the five strategies, suggesting that this measure is useful for tracking the impact of a range of processes. Water quality, wetlands, air quality, and livable communities were all selected at least 10 times. With the exception of livable communities, these categories are relatively standard and easier to measure quantitatively than some of the others and may be the reason they have been implemented more frequently. Project development and design is the process most frequently cited as employing performance measures. Planning and strategic management also were selected as processes employing performance measurements on a range of topics.

The responding agencies provided a variety of responses regarding the performance measures that have been the most effective. One agency listed those measures they described as easily quantifiable, such as the number of projects reviewed, the amount of agency participation, the quality of responses, and the meeting of deadlines. Another noted that the most successful measures are those that are aligned with FHWA goals, thereby providing support and documentation for Federally established policies. Finally, one agency mentioned environmental justice as an area where performance measures have received tremendous attention.

The survey respondents cited the least effective performance measures as those that are either too subjective to measure or create data collection difficulties. One respondent stated that while the measurement process has been successful at engaging more stakeholders, the data quality is still insufficient to rely upon to make decisions.

Table 4.1 Uses of Environmental Performance Measurements

Environmental Issues	Strategic Management	Planning	Programming	Project Development and Design	Maintenance and Operations	Total
Ecosystem/Habitat Conservation	2	2	1	2	1	**8**
Water Quality	2	2	1	3	2	**10**
Wetlands	2	2	1	3	2	**10**
Stormwater Runoff	3	1	1	1	2	**8**
Energy Consumption/Efficiency		1				**1**
Hazardous Waste	1	2	1	3	2	**9**
Noise	1	3	1	3		**8**
Air Quality	2	3	2	3	1	**11**
Equity/Environmental Justice	2	2	2	2		**8**
Land Preservation	1	2		2		**5**
Livable Communities	2	3	2	2	1	**10**
Health	1					**1**
Historic Preservation	1	2		3	2	**8**
Timeliness of the Environmental Process	4	3	4	4	2	**17**
Aesthetics		1		2		**3**
Other: Agency Participation	1	1	1	1		**4**
Other: Major Environmental Issues	1	1	1	1		**4**
Total	**26**	**31**	**18**	**35**	**15**	

Agencies utilizing environmental performance measures most frequently cited three benefits: evaluation of existing programs and projects, communication within the agency, and establishing links with other agencies and their goals. Four out of five agencies indicated that their experience using environmental performance measures has been positive; one stated that it was mixed. Explanations for these positive experiences included gaining support from upper management and the ability to align environmental objectives with other agencies' missions and fostering interagency cooperation. This group most often cited their greatest barriers to be the data collection effort, the data quality once collected, and having insufficient resources.

Finally, the agencies were asked which environmental areas are likely to become more important in the coming years. Wetlands, storm water runoff, hazardous wastes, and land preservation were all selected three times. Water quality, livable communities, aesthetics, and equity/ environmental justice were all selected twice.

The survey findings confirm that the responding agencies are finding value in their currently implemented environmental performance measurement practice, particularly in areas where the outcomes can be stated in quantifiable results. The survey responses also suggest that this approach has the potential to be applied in a diverse range of processes, allowing agencies to link policies, goals, and vision statements. Finally, the survey indicates that as the link between transportation and the environmental gains greater concern and awareness, the practice of using environmental performance measures likely will become more common.

4.3 Examples of Current Practices

Representative examples of effective environmental performance measurement practices are summarized in this section. Emphasis is on the use of environmental performance measurements to help establish environmental goals, the process of developing environmental performance measurements, the steps taken to implement environmental performance measurements, the manner in which environmental performance measurements are tracked and evaluated, and the specific lessons learned.

- Examples of the work of **six state DOTs** are described in Subsections 4.3.1 to 4.3.6: Washington State, Oregon, Minnesota, Florida, California, and Maryland.

- The manner in which transportation-related environmental issues are tracked by a **state environmental agency**, the New Jersey Department of Environmental Protection, is described in Subsection 4.3.7.

- The environmental performance measurement work of two **metropolitan planning organizations** – the Denver Regional Council of Governments and the Houston-Galveston Area Council – is described in Subsection 4.3.8, illustrating the development of regional visions and supporting goals, objectives, and performance measures.

- The concept of **Green Highways** is demonstrated in Subsection 4.3.9 by examining the work being done in this area by the New York State DOT, FHWA, and EPA.

- Three emerging **environmental management approaches** – context sensitive solutions (CSS), the use of cooperative or community benefit agreements, and environmental information management systems (EIMS) – are described in Subsections 4.3.10, 4.3.11, and 4.3.12.

- To place these United States practices in a broader context, the final subsection, 4.3.13, presents an assessment of Transit New Zealand's integrated transport policy as an example of **international environmental performance measurement practices**.

Collectively, the presented examples support five broad conclusions or lessons learned. These conclusions form the basis for the environmental performance measurement implementation guidelines presented in Section 5.0.

- The use of environmental performance measurements has increased over time, in part because of an increased environmental sensitivity and in part as a result of the increased emphasis on performance-based management approaches.

- Examples of environmental performance measurement can be found across the full spectrum of transportation practice: planning, design, maintenance, operations, construction, and internal day-to-day agency management practices.

- Agencies also are utilizing the full classification of performance measurement types: outcome, output, productivity, and process.

- The development of ongoing programs of environmental performance measurements within transportation agencies can be characterized as occurring in incremental small steps and

even in a piecemeal manner rather than a comprehensive manner. The introduction of this practice has been neither quick nor easy, and none of the agency representatives with whom we spoke characterized their practices as being sufficiently comprehensive or at the level ultimately desired. While each of the described examples illustrates a beneficial and even a leading edge practice, a comprehensive framework for environmental performance measurement has not yet emerged that encompasses the full spectrum of potentially relevant agency practices.

- Implementation often proves to be more difficult than originally anticipated. As discussed in Section 3.0 and elaborated upon in Section 5.0, data, resource, institutional, and management considerations often prove to be larger and more difficult for environmental (and other nontraditional) performance measurements than for more traditional transportation performance measures. Leadership, staffing, and collaboration with corresponding resource agency personnel, for example, are proving to be especially important in achieving successful implementation of a program of environmental performance measurements.

4.3.1 Washington State Department of Transportation Gray Notebook

Introduction[11]

Washington State DOT (WSDOT) began its performance measurement initiative in the early 1990s at a time when there were few mechanisms for providing accountability in the agency and the DOT had a credibility problem with the state legislature. Washington State DOT's Secretary was hired specifically to bring greater accountability via use of performance measures. While performance measures are integrated throughout the agency, the Office of Strategic Assessment (OSA), which is in the Programming and Planning Division, takes the overall lead. This group is considered a "strike force" capable of working with participants throughout the entire organization.

Performance measures at WSDOT are viewed as a tool for achieving three core agency goals:

1. They are a *communications tool that* makes the agency's actions transparent to stakeholders.

2. They are a *management tool* that is particularly important in the areas of project delivery and system preservation for achieving WSDOT's philosophy of "what gets measured gets done." Funding packages passed by the legislature have increased pressure on Washington State DOT to deliver projects as efficiently as possible.

3. They are an *investment decision support tool*, particularly in the traditional areas of bridge and pavement management. Pavement provides a good example of how geographic region-driven formulas are being replaced by performance driven allocation of resources.

[11] Material in this section builds upon the results of two separate tasks conducted as part of the AASHTO SCOP NCHRP Project 8-36 as well as the extensive performance measure-related publications produced by the Washington State Department of Transportation. The previous NCHRP 8-36 work for AASHTO are Task 47, *Effective Organization of Performance Measurement*, and Task 53, *Peer Exchange Series on State and Metropolitan Transportation Planning Issues – Nontraditional Performance Measures*.

History

WSDOT's approach to performance-based management has evolved over time. While a major emphasis has been on traditional measures such as those involving system preservation and congestion, environmental issues also have been an important underlying theme right from the start.

- Based on recommendations made by a Growth Strategies Commission appointed by the Governor during the 1980s, the Washington State Legislature passed a Growth Management Act in 1990. This act has been characterized as "pay as you grow" planning where local governments must establish transportation levels of service, identify transportation deficiencies based on adopted land use plans, and determine local financial capacity to meet the adopted transportation standards.

- In 1990, WSDOT developed its first State Transportation Policy Plan, a comprehensive and coordinated multimodal planning process.

- A Programming and Prioritization Study (PAPS) was undertaken by the Washington Legislature's Transportation Committee and completed in 1993.[12] The study's recommendations included the development of a program tradeoff process that would give the State Transportation Commission the ability to review alternative highway programs and select the program that would provide the greatest overall benefit within available resources.

- A 1999 Update of the Washington Transportation Plan included a Vision of a future based on the goal of promoting livability throughout the State.[13] Twenty-three Vision Transportation Outcomes were organized in three major areas of societal goals: vibrant communities, sustainable environment, and vital economy. A set of more detailed performance measures then were defined that could be used to evaluate progress towards attaining this desired vision.

- Washington State's use of performance measures has included the adoption of benchmarks. In November 2000, the Governor appointed a Blue Ribbon Commission on Transportation that recommended 11 benchmarks for Washington State's transportation system and a set of additional benchmarks that should be considered for future implementation. In October 2001, the Washington Transportation Commission formed a benchmark Committee to guide the development of WSDOT benchmarks.[14]

- In January 2002, the Washington Legislature enacted legislation, ESHB 2304, "Establishment of Transportation Performance Measures," directing the Transportation Commission to develop benchmarks based on policy goals for operation, performance, and investment.

[12] *Program and Performance Monitoring*, prepared for the State of Washington Legislative Transportation Committee by Cambridge Systematics, Inc., April 1993.

[13] *WTP Phase II Update: Candidate Vision Transportation Outcome Statements, Performance Measures, and Congestion Relief Approach*, prepared for Washington State Department of Transportation by Cambridge Systematics, Inc., 1999.

[14] *Transportation Benchmarks Implementation Report*, Washington State Department of Transportation and Washington State Transportation Commission, August 2003.

One goal was to maintain per capita vehicle miles of travel at 2000 levels. Another goal was to increase the nonauto share of commuter trips within urban areas.

Measures, Markers, and Mileposts – The Gray Notebook

WSDOT's performance measure work is widely recognized for its *Measures, Markers, and Mileposts* report, commonly known as the *Gray Notebook.*[15] Named because of the color of the report's printed cover, the report provides quarterly, in-depth reports on agency and transportation system performance and forms the backbone of WSDOT's performance measurement activities.[16] The same information also is Internet accessible (http://www.wsdot.wa.gov/accountability). In addition to serving as an internal management and integration tool, an important purpose of the report is to keep the Washington State DOT accountable to the Governor, citizens, and legislators. The *Gray Notebook* uses a style of reporting referred to as "performance journalism" that combines quantitative reporting using charts and tables with narrative storytelling.[17] Twenty-eight separate environmental indicators are tracked, including diesel and particulate matter, wildlife crossings, compost use, fish passage barriers, herbicide usage trends, wetland mitigation and monitoring, and construction site erosion and runoff protection.

Data for the *Gray Notebook* are collected and maintained by program staff using existing information management systems. Data collection and analysis is not automated; rather it is provided to OSA in a variety of formats. There are no sophisticated IT systems used to collect data. At WSDOT, a heavy emphasis is placed on using the best possible data. This means that staff must be educated about the purpose of performance measurement. In addition, knowing that the Secretary is invested in the *Gray Notebook* and the entire performance measurement program means that data integrity is usually sound.

A first cut analysis of data is done by program staff. They discuss appropriate actions before numbers are put in the *Gray Notebook*. The extent to which OSA gets involved in helping program staff varies depending on the capability of program staff in different areas. Asset management measures (bridge and pavement condition, rest areas, transit inventory, etc.) are reported annually. Customer-driven measures, such as congestion and transit reliability are reported much more frequently, even daily in the area of congestion – but quarterly at a minimum.

There is a heavy emphasis on the quality of data presentation. OSA uses desktop publishing software "In-Design" (similar to PageMaker) and "Illustrator" (for graphics) to convey the Department's message.

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[15] *What is the Gray Notebook?*, Washington State Department of Transportation, January 2007.

[16] *Measures, Markers, and Mileposts, The Gray Notebook for the Quarter Ending September 30, 2006*, Washington State Department of Transportation.

[17] Washington State DOT's approach to performance reporting, while sharing many of the objectives, differs in form and style from "dashboard" performance reporting systems. The Virginia DOT, for example, has a seven-dial high-level dashboard consisting of indicators for engineering, construction, maintenance, operations, safety, finance, and the environment (www.dashboard.virginiadot.org). While the environmental indicator currently is limited to environmental compliance, the Virginia DOT dashboard is part of a larger Virginia Performs scorecard that includes air quality and other natural, historic, and cultural resources (www.vaperforms.virginia.gov).

The Environmental GIS Workbench

Environmental performance measurement and reporting are supported by an environmental GIS Workbench that has grown since its introduction in 1999 to include over 150 separate data layers.[18] The Environmental GIS Workbench is a custom GIS application built to help WSDOT staff access and utilize environmental or natural resource management data. WSDOT's Environmental Information Program works with appropriate Federal, state, and other agencies to maintain a collection of the best available data for statewide environmental analysis. The environmental workbench application is an ArcView extension that provides WSDOT staff with tools for displaying a wealth of environmental data themes.

Nontraditional Performance Measures[19]

Environmental goals, objectives, and performance measures have been incorporated right from the start in WSDOT's performance measurement work. Agency staff, though, has been asked to think outside the box and examine the use of environmental performance measures that generally are characterized as being nontraditional. Examples of existing environmental performance measurements include stream turbidity upstream and downstream from construction sites, acres of wetland mitigation and mitigation ratio, and the volume and percent of aluminum signs recycled. The concern with other measures of environmental performance that are sometimes used is that the measures, in reality, may be of questionable value, such as the number of meetings attended.

An example of a nontraditional environmental objective is to make every highway beautiful; measured, in part, by the amount of native plants planted within the right-of-way. The objective of gaining and keeping the public trust can be measured by the level of public satisfaction with a completed project. An objective of promoting public health through increased physical activity could be measured by the number and length of available pedestrian and bicycle paths. The objective of gaining overall environmental resources could be measured by monitoring greenhouse gas and diesel emissions trends for regions and projects, and also by doing a song bird inventory within one mile of the right-of-way.

The objective of achieving public trust also can be measured by the degree of understanding that is achieved after reading a NEPA EIS. In response, WSDOT is devoting a major effort to producing reader-friendly environmental documents – believing that the public as well as agency partners need to be able to easily understand proposed transportation projects and their associated environmental and transportation benefits, together with any consequences and proposed mitigation.

WSDOT also is working toward nontraditional performance measures by negotiating with environmental resource agencies concerning the manner in which project-level environmental reviews are conducted. WSDOT is seeking to break free from prescriptive site-specific requirements by asking environmental resource agencies to define what *outcome* they want to see from a project. Rather than having biologists tell WSDOT how a bridge should be

[18] http://www.wsdot.wa.gov/Environment/GIS/workbench.htm.

[19] *Wild Ideas for Measuring Performance – Some Thoughts from Eco-Geeks at the Washington State Department of Transportation*, presented at the summer meeting of the Transportation Research Board, Boston, Massachusetts, July 2005.

designed, WSDOT would prefer that the biologist tell the agency how the bridge should function both at completion and during construction; i.e., what protection measures they would like to see in place.

Environmental Management Systems

WSDOT's environmental performance measurement program is supported by use of an Environmental Management System (EMS).[20,21] While ISO 14001 standards generally are being followed, WSDOT does not intend to formally register as meeting the standard. They believe the majority of the benefits associated with implementing an EMS can be achieved without incurring the cost or burden of actual registration. The EMS initiative is building upon already strong systems that are designed to ensure compliance with environmental laws, such as their maintenance manual for water quality and habitat and their construction erosion and sediment control program. Fundamental blocks contained within the EMS include a description of legal and other requirements, written procedures instructing personnel how work is to be conducted, training, descriptions of roles and duties, mechanisms for inspections and monitoring, procedures for implementing corrective actions, and performance measurement against predetermined targets.

WSDOT's EMS is designed around a series of environmental management programs. These are building blocks applicable to specific organizational units or activities. Examples include construction, maintenance, operations, and materials testing.

A Commitment Tracking System and associated business practices are being implemented as part of WSDOT's EMS. The intent is to track environmental commitments from their inception (in project development) through design, construction, and completion or pass off for long-term maintenance. In undertaking this commitment tracking system, the objectives of WSDOT's EMS are to record in a single easily accessible database the environmental commitments that have been made and the specifics of these commitments, to ensure that these commitments are honored, to document the manner in which the commitments have been implemented, to use this information as a means for developing ways that similar commitments could be improved upon in the future, and, if applicable, ensure that these commitments are adequately maintained.

Conclusions

While bridge and pavement management are the two biggest areas of success in WSDOT's performance measurement program, environmental performance measurements are growing in importance. The presence of a strong and actively engaged leader has helped immeasurably in making the program successful.

Performance measurement is not necessarily applied across the board by WSDOT. Rather, the agency is looking to monitor and evaluate areas where they would like to do better and where they feel systems for data collection and reporting currently are not as strong as they could be,

[20] http://www.wsdot.wa.gov/Ennvironmemnt/EMS/.

[21] Environmental Management Systems are discussed in greater detail in Section 4.3.12.

including quality of projects, congestion (real-time data), effectiveness of investments, and project delivery.

Performance measures are added, dropped, or changed based on careful deliberation, and based primarily on their suitability for supporting communications and/or decisions. The *Gray Notebook* is reviewed quarterly at an internal meeting of senior WSDOT staff. Targets are used cautiously by WSDOT. Agency management emphasizes that performance measures are a tool, not a product, and that decisions are made based on a variety of factors, not just performance results.

In addition to considering new types of performance measure indicators such as ratios, WSDOT also has given attention to developing new analyses of program measurements and to displaying measurement data in different ways. Examples of new analyses are the examination of a history over time of certain indicators and to focus on important subsets of information rather than only programs or subprograms as a whole. Different ways of displaying or reporting monitored data include the examination of changes in performance in addition to absolute values and reporting, where applicable, a distribution of values.

4.3.2 Oregon Department of Transportation Benchmarks

Introduction

Oregon was one of the first states to adopt a systematic approach toward measuring the progress of state actions against adopted measures or indicators. In addition, Oregon has a long tradition of statewide planning and of state policies and planning rules that guide the planning and investment decisions of other agencies and units of government. In particular, this approach has been used to draw a closer linkage between land use and infrastructure development.

Performance Measure Framework

In 1989, the State adopted a statewide vision document entitled, *Oregon Shines*. Ninety possible benchmarks were established for state agencies to measure the progress of their actions in achieving the State's vision. Seven major categories of benchmarks were identified, including: economy, education, civic engagement, social support, public safety, community development, and environment. The Oregon DOT identified 11 of the overall 90 benchmarks that were affected in some way by DOT activities. Nineteen performance measures were defined that related to these benchmarks. An example of the benchmarks and the corresponding performance measures are shown in Table 4.2.

As can be seen in Table 4.2, the transportation-related environmental benchmarks that are monitored by ODOT are broad, including air quality, salmon recovery, and "alternatives to one-person commuting."

Table 4.2 Oregon Benchmarks and ODOT Performance Measures

Oregon Benchmark	ODOT Performance Measure
Increase Rural Jobs Net Job Growth	Jobs from Construction Spending
Premature Death	Fatalities Safe Drivers Impaired Driving Use of Safety Belts Large Truck Accidents Rail Crossing Incidents Derailment Incidents
Independent Seniors Disabled Employment	Special Transit Rides
Travel Delay	Travel Delay Alternatives to One-Person Commuting
Alternatives to One-Person Commuting	Passenger Rail Ridership Alternatives to One-Person Commuting
Vehicle-Miles Traveled	Passenger Rail Ridership Vehicle-Miles Traveled
Road Condition	Pavement Condition Bridge Condition
Air Quality	Travel Delay
Salmon Recovery	Fish Passage at State Culverts

Source: Oregon DOT, *Annual Performance Progress Report, FY 2004-2005*, Salem, Oregon, 2005.

In addition to the Oregon Benchmarks, the statewide transportation plan has been developed as an overarching policy document intended to provide guidance to the development of mode-specific plans and to inform investment decision-making. The latest plan, adopted in 2006, identified the goals and strategies that would provide the policy framework for ODOT activities. Six priority areas surfaced during the plan development process:

1. Maintain the existing transportation system to maximize the value of the assets;
2. Optimize system capacity and safety through information technology and other methods;
3. Integrate transportation, land use, economic development, and the environment;
4. Integrate the transportation system across jurisdictions, ownerships, and modes;
5. Create a sustainable funding plan for Oregon transportation; and
6. Invest strategically in capacity enhancements.

As can be seen in this list, environmental concerns were incorporated into an area that included the integration of transportation, land use, economic development, and the environment. The plan listed specific initiatives that could be taken by ODOT in this priority area, including:

- Encourage and support land use plans and policies to enhance overall transportation system efficiency and transportation choices, including planning for compact and mixed-use development in appropriate locations.

- Expand the use of and consistently apply context sensitive and sustainable solutions in transportation facility planning and design.

- Coordinate tribal, state, local, and regional planning to protect transportation facilities, corridors, and sites for their identified functions, and to facilitate community and economic development. With ODOT leadership, develop simulation tools to assist communities in evaluating transportation and land use proposals.

- Join the energy debate as an advocate for Oregon transportation to assure a reliable, diverse, and adequate fuel supply. Develop a contingency plan for dealing with fuel shortages.

The statewide transportation plan also identified seven goals that the DOT's program was aiming to achieve. Interestingly, one of the goals was defined as sustainability and was defined in the following way:

> "To provide a transportation system that meets present needs without compromising the ability of future generations to meet their needs from the joint perspective of environmental, economic, and community objectives. This system is consistent with, yet recognizes differences in, local and regional land use and economic development plans. It is efficient and offers choices among transportation modes. It distributes benefits and burdens fairly and is operated, maintained, and improved to be sensitive to both the natural and built environments."

One of the important consequences of this goal for the rest of the State is that the statewide transportation plan is to be used by other state agencies in guiding and coordinating transportation activities. In addition, cities and counties must prepare local transportation system plans that are consistent with the statewide plan.

In order to monitor the progress of transportation program actions that result from the transportation plan and ODOT strategic investment decision-making in general, ODOT has identified several key performance measures that are monitored on a periodic basis. As noted in the monitoring report, key performance measures are "those highest-level, most outcome-oriented performance measures that are used to report externally to the legislature and interested citizens." Key performance measures communicate in quantitative terms how well the agency is achieving its mission and goals. The goal of ODOT is to update the set of key performance measures on a quarterly basis and to present this information to executive team meetings for top management consideration. An example of the type of information that is produced is shown in Table 4.3 and Figure 4.1. Table 4.3 indicates the overall level of achievement of system performance from the perspective of the 22 identified performance measures. Figure 4.1 shows the information that is presented in the performance measurement progress report that relates most to environmental concerns.

Table 4.3 Summary Report of Progress on Key Performance Measures

Performance Target Achievement	Number of Measures
Total Number of Key Performance Measures (KPM)	22
Number of KPMs at or better than target for current reporting period	10
Number of KPMs not at target for current reporting period	11
Number of KPMs where an additional year of data is needed	1

Figure 4.1 Typical Information Presented in Performance Report for Environment-Related Measures

Description: Percent of Oregonians who commute to work during peak hours by means other than Single Occupancy Vehicles.

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Target								30%	30%	30%
Data	29%		27%		29%		31%			

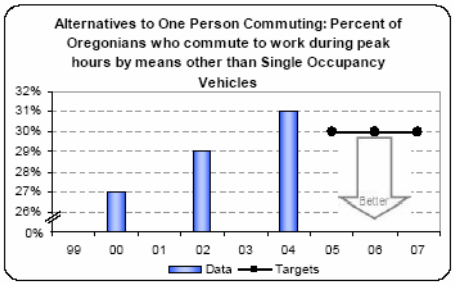
Data Source: Oregon Population Survey, Oregon Progress Board

Key Performance Measure Analysis

To what goal is this measure linked?

Oregon Benchmark #68: Reducing Travel Delay and #70: Promoting Alternatives to One-Person Commuting

ODOT Goal #2: Move People and Goods Efficiently



What does the measure demonstrate about the goal?

This measures the success of programs dedicated to offering alternatives to one-person commuting. Use of commuting alternatives contributes to the reduction of congestion.

What do the data reveal?

The proportion of Oregonians commuting during peak hours by means other than Single Occupancy Vehicle (SOV) is essentially at target level. However, it may not go much higher in the future. Efforts to reduce SOV commuting must take into account the fact that many people combine their commute with household trips to help balance the time demands of work, home, children and travel. Efforts to help people cope with congestion include helping to balance work and home responsibilities (e.g. flexible work hours, schedules and telecommuting options), reducing the transportation burden required for managing a household, and managing consumption.

Description of measure to be replaced: Percent of urban state highway miles with bike lanes and sidewalks.

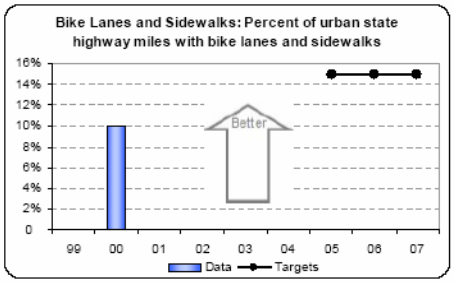
	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Target								15%	15%	15%
Data			10%							

Data Source: Bicycle/Pedestrian Program, ODOT

Key Performance Measure Analysis

To what goal(s) is this performance measure linked?

ODOT Goal #3: Provide a Transportation System that Supports Livability and Economic Prosperity in Oregon.



What do benchmark (or other high-level outcome) data say about Oregon relative to the goal(s)? What is the impact of your agency?

While there are no specific benchmarks related to bike lanes and sidewalks, these have been a priority for Oregonians for over 30 years. Oregon Revised Statute (ORS) 366.112 established an advisory committee and ORS 366.514 requires a minimum percentage of the highway fund be used for bicycle and pedestrian facilities on state highways. ODOT oversees both of these activities.

How does the performance measure demonstrate agency progress toward the goal?

ODOT's Bicycle/Pedestrian Program staff determined in 2003 that the measure, Percent of Urban State Highway Miles with Bike Lanes and Sidewalks, and its goal are not adequately reflective of the efforts of the program. This measure is misleading because it includes all highways regardless of need and assumes all should have both bike lanes and sidewalks. A replacement performance measure was proposed and approved by the 2005 Legislature. This new measure, Percent of Urban Roadside Miles with Bike/Pedestrian Facilities in Fair or Better Condition, will be a better indicator of progress made via this program as it is calculated based on the separate facilities and their condition.

Conclusions

Oregon's benchmarking process represents one of the most systematic efforts at developing statewide performance indicators for a variety of factors that are considered critical for the future of the State. Because of the State's institutional structure for requiring progress reporting against these benchmarks, the Oregon DOT has a record of monitoring the changes in key measures contributing to environmental quality in the State. In addition, the planning rules and policies that guide statewide and local transportation planning in the State promote consistency among different state agencies and between levels of government. Of some interest in the Oregon transportation case is the adoption of "sustainability" as one of the goals in the statewide transportation plan. However, besides the performance measures that have been identified for the *Oregon Benchmarks* effort, the only performance measurement associated with this goal is related to the degree to which specific design approaches and processes have occurred within the agency, such as the use of context sensitive solutions (CSS) approaches in project development.

Although the written description of the performance measurement framework for ODOT describes a process in which such measures guide budget decisions, program priorities, and planning efforts, it was not clear in this case study whether the environmental measures have yet had such an impact. It is evident, though, that measures relating to road and bridge condition were very important in agency decision-making.

The performance measurement approach toward environmental factors made an important distinction between outcome-oriented and output-oriented measurement. As noted, the outcome-oriented measures were aimed at a much higher decision-making level than those defined more on outputs. However, it is clear that for some undefined performance categories such as "sustainability," output measures may be the only way of showing any progress toward achieving this goal.

4.3.3 Minnesota Department of Transportation's Performance Measure Framework

Introduction

The Minnesota DOT (Mn/DOT) is known nationally for its performance-based planning and investment decision-making processes. Beginning in the 1990s with the passage of the Intermodal Surface Transportation Efficiency Act (ISTEA), Mn/DOT has been evolving toward a self-assessing organization, aimed at improving the services it provides to the citizens of the State. Part of this effort has been the identification of a set of policy and program outcomes that direct the agency's actions. Environmental performance indicators are part of these outcomes.

Performance Measure Framework

The process of developing a set of performance measures and of establishing a performance-oriented investment process that is accepted both internally as well as with the state legislature has been challenging. Over the past 10 years, this process has included extensive agency reviews of its own internal structure and of the location of decision accountability within the organization. Efforts have been made to bring outside perspectives into what the mission and strategic directions of Mn/DOT should be. In addition, Mn/DOT officials have aggressively

pursued best practice from other state DOTs and transportation agencies around the world in making its performance-based planning efforts a role model in the United States.

The performance-based strategic planning framework for Mn/DOT is based on three strategic directions and 10 policies that are aligned with these directions. The strategic directions include: safeguard what exists, make the network operate better, make Mn/DOT work better. Environmental performance is found in the last strategic direction under a policy called "protect the environment and respect community values." The outcomes associated with this policy include:

1. Minimize impacts to the natural and human environment when building, operating, and maintaining Mn/DOT's transportation system. Work with the Minnesota Pollution Control Agency, the lead agency, to achieve its mission to:

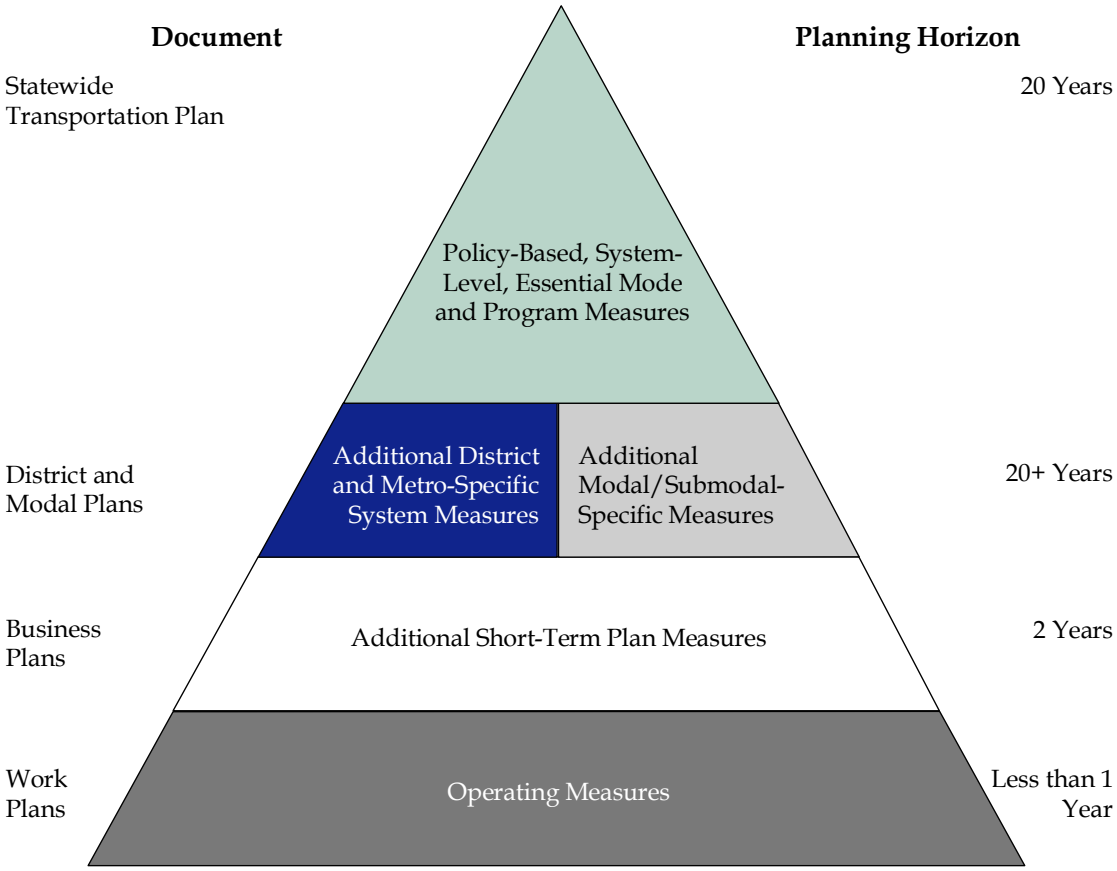
   - Ensure clean and clear air that protects human health and the environment; and

   - Maintain, restore, or improve the quality of Minnesota's waters.

2. Maintain, restore, or improve the quality of Minnesota's waters.

The use of performance measures in the context of Mn/DOT's planning framework is shown in Figure 4.2. As shown, performance measures are used to monitor operations, inform investment decisions at different levels of decision-making, and provide input into longer-term policy formulation. Interestingly, one of the performance measure areas that created a challenge to Mn/DOT officials was the environmental category. Although performance measures for pavement and bridge condition, which are the direct responsibility of Mn/DOT were fairly straight-forward, measuring environmental performance was not. In many cases, the outcomes identified above for the "protect the environment and respect community values" policy are not directly affected by Mn/DOT actions. For example, the quality of Minnesota's waters can be affected by many different factors, one of which will surely be road-related, but certainly not the only one.

Figure 4.2 Performance Measure Use in Mn/DOT



Source: Minnesota DOT, Statewide Transportation Plan, St. Paul, Minnesota, 2003.

To reflect the importance of monitoring key environmental conditions, and yet establishing the concept of transportation's often secondary or tertiary role in the ultimate outcome value, Mn/DOT makes a distinction between a "performance measure" and an "indicator." Performance measures are used for phenomena that the agency can directly affect, such as the condition of bridges. Indicators, however, are:

> "…like a performance measure, a set of consistent trend data reported over time that provides historical or predictive data. Indicators are employed because they address issues that potentially have broad impacts on society, the environment, and the department. Major changes in these indicators could severely affect Mn/DOT's ability to achieve its mission. Mn/DOT has included these measures because it believes that they are worth measuring and because their outcome can be directly or indirectly influenced by the department through funding participation, technical assistance, partnership formation, and public outreach and involvement activities."

The environmental performance indicators that have been chosen by Mn/DOT include the following.

Policy – Protect the Environment and Respect Community Values

Air Quality

1. Outdoor levels of ozone, nitrogen oxide, carbon monoxide, and particulate matter as a percent of the National Ambient Air Quality Standards.
2. Estimated carbon dioxide emissions from motor vehicles in Minnesota.
3. Percent of Mn/DOT fuel consumption defined as cleaner fuels.

Wetlands

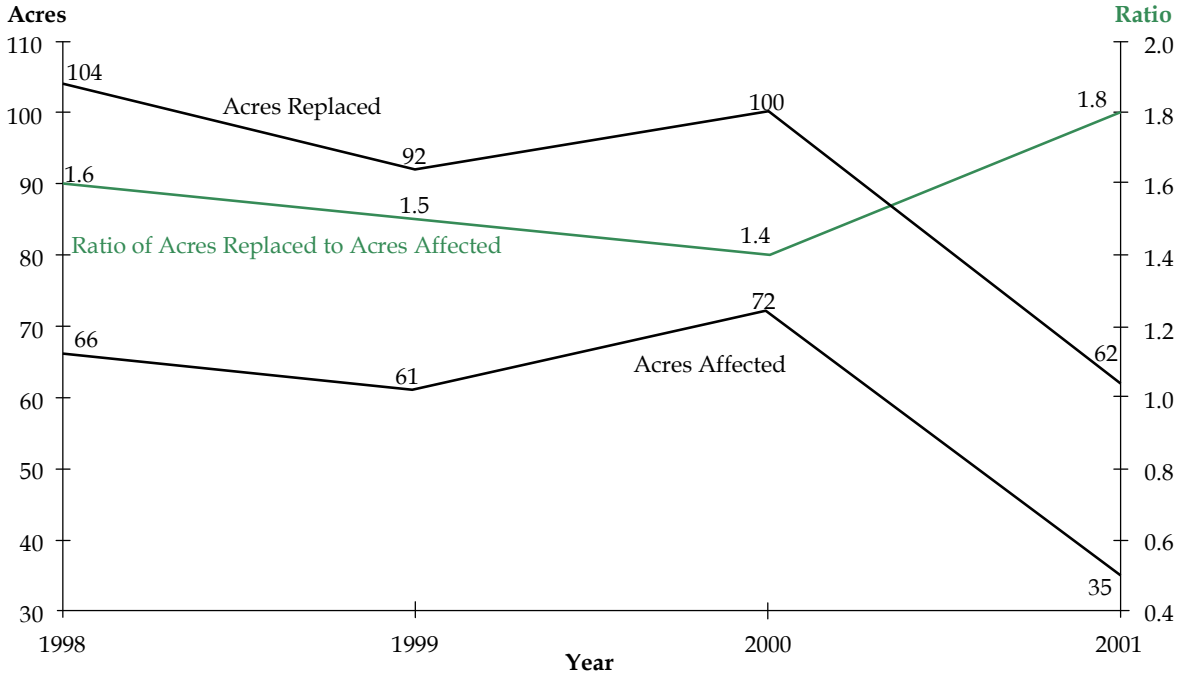
1. Percent of NPDES permits that have violations.
2. Ratio of acres replaced by Mn/DOT to acres of wetlands affected.
3. Percent of replaced wetlands where types are as planned.

Land Management

1. Number of acres replanted with native species.
2. Number of undeveloped acres converted to another land use.

Graphs and figures are used to show the trend of the indicators over time. Figure 4.3 is an example of such a figure, in this case for the number of wetland acres affected.

Figure 4.3 Monitoring of Wetland Acreage Affected, Minnesota DOT



Source: Minnesota Department of Transportation, *Target-Setting Framework, Performance Measures, Targets and Policy Guidance,* Chapter 6, Mn/DOT, St. Paul, Minnesota, 2003.

Conclusions

Minnesota DOT is an example of a state that has advanced beyond many others in the use of performance measures in planning and decision-making. Accordingly, Mn/DOT provides many lessons that other states can consider as they incorporate environmental performance measures into their planning and decision-making processes.

- Mn/DOT has explicitly recognized the difference between performance measures that they can directly affect and those (that is, indicators) that are important to monitor and that perhaps can be indirectly affected by Mn/DOT activities. Many of the environmental concerns fit into the "indicator" category.

- Unlike other states, Mn/DOT has identified a few selected environmental indicators that are considered important to the State (including carbon dioxide emissions). This approach is different from the practice of having numerous measures relating to virtually every possible type of environmental impact. The targeting on a few important indicators provides Mn/DOT leadership with a sense of what the important environmental issues are to the State, as well as an important benchmark to outside constituencies on how Mn/DOT is valuing environmental quality.

- The performance measure framework has taken some time to develop, and has required constant nurturing by Mn/DOT officials. Not only has the framework been subject to internal scrutiny, but a great deal of external communication and interaction has occurred with key stakeholders. In developing environmental indicators, for example, many discussions were held with state environmental agencies, environmental interest groups and with other interested parties. The limited number of environmental indicators, in some sense, represents a consensus of key groups in Minnesota of what Mn/DOT's role is in the environmental area.

- Varying levels of decision-making and accountability will use performance measures differently. Environmental indicators seem to be most relevant to the systems level of policy-making, although some such as the number of wetlands affected can be monitored at the district and subregional levels.

4.3.4 Florida Department of Transportation's Environmental Transportation Decision-Making Process

Introduction

Florida is one of the pioneering states in the development and use of general performance-based planning and a recognized leader in the use of environmental performance measures. The 2025 Florida Transportation Plan sets the long-range goals and objectives that guide investment decisions. An annual Short-Range Component of the 2025 Plan specifies how the goals and objectives are being measured and provides the policy framework for the department's budget and work program. Key performance measures are monitored monthly by the Department's Executive Board which has established procedures for the review, maintenance, and enhancement of all measures used by the department. Performance measures are an integral part of Florida's Strategic Intermodal System (SIS) which was established by law in 2003. SIS "represents a fundamental shift in the way Florida views the development of – and makes investments in – transportation facilities and services."

The ETDM Performance Management Plan

The Efficient Transportation Decision-Making (ETDM) process was established by the Florida Department of Transportation (FDOT) in response to Section 1309 of the Transportation Act for the 21st Century (TEA-21) to "improve transportation decision-making in a way that protects the human and the natural environment." ETDM links land use, transportation, and environmental resource planning in order to identify critical issues early on in the planning and development process in order to avoid delays and other potentially complicating issues throughout this process. It is designed to expedite the process, while providing decision-makers and planners with additional information at key points throughout project design and development. The ETDM program is viewed throughout the United States as one of the leading initiatives in environmental management.

Two points of intervention were created by the Florida DOT (FDOT) where agencies are able to provide input, using a range of measures and input functions prior to the initiation of significant engineering work: the Planning Screen and the Programming Screen. The Planning Screen occurs as cost-feasible plans are being developed. The Programming Screen occurs before projects are identified for the FDOT work program. The screening process occurs using the Environmental Screening Tool (EST), a software application that offers GIS mapping of over 350 environmental data layers and other data analysis functions.

To understand the impact of this approach, FDOT established a performance measures system, or ETDM Performance Management Plan, for the ETDM process. The Performance Management Plan is designed to continuously monitor program area performance, identify problems early, develop efficient and effective solutions, and recognize and promote successes. The goal of the Performance Management Plan is to create a more efficient and enhanced ETDM process.

FDOT began the ETDM performance measures project by creating a baseline database of existing transportation improvement projects. The database includes process information (such as permit review time and schedules met), and data pertaining to environmental conditions (such as wetlands removed and/or replaced, habitats created, noise, and air quality). This baseline database is compared with projects that go through the ETDM process to determine whether it is meeting its objectives of better decision-making for the human and natural environment.

FDOT's ETDM Performance Measures Task Work Group also established specific performance measures and stated that the performance measures should be continually monitored for effectiveness and streamlining. The Performance Management Plan has three main objectives, each supported by a set of activities, performance indicators (or measures), and targets. The three objectives are: Integrate ETDM into Project Delivery, Improve Interagency Coordination and Dispute Resolution, and Develop Environmental Stewardship through Protection of Environmental Resources. The activities, indicators, and targets are listed in Table 4.4.

The ETDM Performance Measures System has five components to provide detailed and extensive information on the effectiveness of the process. The first component is the baseline database of historical projects that enables analysis of the ETDM system in terms of time savings, cost savings, improved project delivery, and enhanced protection of environmental resources. The second components are the performance measures listed in Table 4.4. A summary page, or "Dashboard" screen designed to graphically look like the indicators on a vehicle's dashboard,

provides an overview of the process status in terms of project delivery, interagency coordination and dispute resolution, and protection of environmental resources through environmental stewardship. A color-coded system indicates how effectively the measure is working (i.e., a performance measurement of the performance measures): green indicates it is effective, yellow indicates potential problems, and red indicates that a problem exists with a specific measure. The third component is geographically based environmental data in GIS layers. The fourth component includes information gathered through Quarterly Reports, and the last component is the Annual Report. All of these sources of information and analysis are utilized to determine how effective the ETDM process is working to protect the human and natural environment.

Conclusions

The work by the Florida DOT is an example of a multiyear department initiative aimed at improving the manner in which environmental performance is measured and considered in agency decision-making. At the same time, the incorporation of these changes is incremental, with the results of ETDM being used as the basis for establishing continued future improvements. Importantly, measuring the effectiveness of the ETDM improvements provides the credibility both within the agency and with other agencies to demonstrate that ETDM is indeed accomplishing the intended objectives and that continued improvements are justified.

Under the former transportation planning process, Florida's permitting agencies would typically wait until the project was at 60 percent design before beginning the Project Development and Environment (PD&E) process. This resulted in a number of problems, including making the process long and drawn out, limiting the ability of project designers to consider community concerns, and identifying major issues after significant resources already had been dedicated to the project. All of these problems are significantly lessened as a result of ETDM. The evaluations demonstrate that the objective of improved environmental stewardship is being achieved, while simultaneously reducing costs and the length of the project development process.

Building upon the success of ETDM, FDOT currently is identifying opportunities to improve the manner in which transportation planning activities can be integrated with the NEPA process. The results of this work will result in new guidance and work scope language. Examples of the kinds of issues being investigated include the following:

- How can FDOT and the state's MPOs ensure that the findings of corridor planning studies are sufficient to serve as input for subsequent environmental analyses?
- What constitutes sufficient documentation during different types of planning studies regarding the affected environment, the alternatives considered, and environmental consequences?
- Can a threshold be established that is sufficient for eliminating certain alternatives during the planning process?
- What is the desirable and sufficient level of partner coordination during the planning process?
- How can mitigation strategies be identified in planning studies and carried forward into the NEPA process?

FDOT also is working in cooperation with the Florida Transportation Commission and other statewide, regional, and local partners, is undertaking a *Future Corridors Program* to plan and develop major statewide corridors that will serve anticipated population and economic growth within the state over the next 50 years.[22] The planning of these statewide corridors is not viewed as just a transportation issue; it is about the future quality of life of Florida residents, the sustainability of the state's environment, and the competitiveness of the state's economy. The future corridor planning effort would integrate, and be consistent with, land use, economic development, conservation, community, and transportation goals and objectives. In particular, the corridor planning effort would be coupled with responsible environmental stewardship, including protection of water resources, public and private conservation lands, and sensitive wetlands and ecosystems.

The envisioned future corridors planning process would consist of three stages of activity. Each stage would entail a screening and evaluation process that leads to decisions about whether a study area, alternative, project, or segment should move forward, wait for additional information, or potentially move no further. As the process progresses, a large number of concepts will be narrowed down to more specific routes and modes, which in turn will be narrowed into a smaller number of specific candidate projects. At the same time, the level of detail required to evaluate criteria will increase. A *concept study* would provide a high-level screening of conceptual alternatives that may help meet identified mobility or connectivity needs. The concept study also would create a framework for understanding the full range of possible impacts of alternative corridor improvements. Building upon information from the concept stage, a subsequent *feasibility study* would evaluate and build consensus around a more precise definition of the study area transportation needs and develop an action plan for meeting the identified needs, while simultaneously addressing key economic, environmental, and community issues and goals in the study area. Following the feasibility stage, FDOT's *ETDM/PD&E* processes would be used to conduct thorough analyses of the effects and impacts of alternative improvements in order to select the best options for implementation.

[22] Florida's *Future Corridors Action Plan*, prepared by the Florida Department of Transportation in cooperation with its Partners, December 29, 2006.

Table 4.4 Florida DOT ETDM Activities, Indicators, and Targets

Objectives	Activities	Performance Indicators (Measures)	Targets (Percent, Number, Score, Timeframe, etc.)
Integrate ETDM into Project Delivery	(1) Implement Planning Phase (projects moving into LRTP/Florida Intrastate Highway System (FIHS) Plans)	1(a) Percentage of major capacity transportation improvement projects screened	1(a) 90 percent
		1(b) Percentage of ETAT agencies participating who have signed Agency Agreements	1(b) 100 percent
		1 (c) Percentage of projects with potential dispute issue(s)	1(c) For reporting purposes only
		1(d) Percentage of projects concept and scope revised due to ETAT review	1(d) For reporting purposes only
		1(e) Percentage of Planning Summary Reports completed within 90 days	1(e) 90 percent
		1 f) Number of projects withdrawn due to ETAT review	1(f) For reporting purposes only
	(2) Implement Programming Phase (projects moving into FDOT Five-Year Work Plan)	2(a) Percentage of Major Capacity transportation improvement projects screened	2(a) 90 percent
		2(b) Percentage of ETAT agencies participating who have signed Agency Agreements	2(b) 100 percent
		2(c) Percentage of projects eligible for Work Program (i.e., No Dispute Issues)	2(c) 95 percent
		2(d) Percentage of Final Programming Summary Reports completed within 60 days	2(d) 90 percent
		2(e) Percentage of projects withdrawn due to ETAT review	2(e) For reporting purposes only
		2(f) Percentage of projects concept and scope revised due to ETAT review	2(f) For reporting purposes only
		2(g) Percentage and number of projects in formal dispute	2(g) Less than 1 percent

Table 4.4 Florida DOT ETDM Activities, Indicators, and Targets (continued)

Objectives	Activities	Performance Indicators (Measures)	Targets (Percent, Number, Score, Timeframe, etc.)
Integrate ETDM into project Delivery (continued)	(3) Implement Project Development Phase	3(a) Number of screened PD&Es (Project Development and Environment report) (based on focused scope of work) completed in FY 2006	3(a) At least 2 per district by July 2006
		3(b) Average duration of screened Categorical Exclusions	3(b) 12 months or less
		3(c) Percentage of screened PD&Es that obtain permits concurrent with Location and Design Concept Acceptance (LCDA)	3(c) 50 percent or more
		3(d) Percentage of screened PD&Es that meet proposed schedule	3(d) 90 percent
	(4) Identify Funding Requirements and Efficiencies	4(a) Compare traditional PD&E study	4(a) Cost savings of up to 20 percent
		4(b) Compare traditional PD&E schedule versus screened PD&E schedule	4(b) Cost savings of up to 25 percent
	(5) Develop Training	5(a) Publication of Annual Central Environmental Management Office (CEMO) Training Plan based on Incidental Take Permits (ITP)	5(a) By July 1 of each year
		5(b) Number and type of statewide workshops and conferences	5(b) At least 1 statewide workshop each year (CEMO and ETAT)
Improve Interagency Coordination and Dispute Resolution	(1) Implement Agency Dispute Resolution Process (DRP)	1(a) Percentage of ETAT that have a dispute and participate in a DRP	1(a) 100 percent participation
		1(b) Environmental issue that initiated dispute	1(b) For reporting purposes only
		1(c) Percentage of formal dispute resolutions completed within 120 days	1(c) 70 percent or more
	(2) Support Agency GIS database development	2(a) Provide technical support to ETAT agencies on GIS database development	2(a) Satisfaction surveys from ETAT agencies in FY 2006
		2(b) Ensure quality of the interactive ETDM database information	2(b) Annual review and acceptance of ETAT databases in FY 2006

Table 4.4 Florida DOT ETDM Activities, Indicators, and Targets (continued)

Objectives	Activities	Performance Indicators (Measures)	Targets (Percent, Number, Score, Timeframe, etc.)
Improve Interagency Coordination and Dispute Resolution (continued)	(3) Improve interagency communication and coordination via the Environmental Screening Tool (EST)	(3) Enhanced application of EST for functionality and communication	3(a) Annual survey of users on EST its application, innovation, and need for improvement
	(4) Development and signature of agency agreements and tribal agreements	4(a) Execution of agency agreements	4(a) 100 percent completion of all agency agreements by July 2005
		4(b) Reevaluate agency resource needs	4(b) Update agency agreements, as required, and support through budget request
	(5) Response/review timeframes for ETAT and FDOT	5(a) Percentage of ETAT reviews completed within 45 days	5(a) 90 percent
		5(b) Percentage of ETAT reviews requesting time extensions	5(b) 10 percent
		5(c) Percentage of ETAT reviews of environmental documents completed within 30 days	5(c) 90 percent
		5(d) Percentage of projects without Requests for Additional Information (RAI)	5(d) 50 percent

Table 4.4 Florida DOT ETDM Activities, Indicators, and Targets (continued)

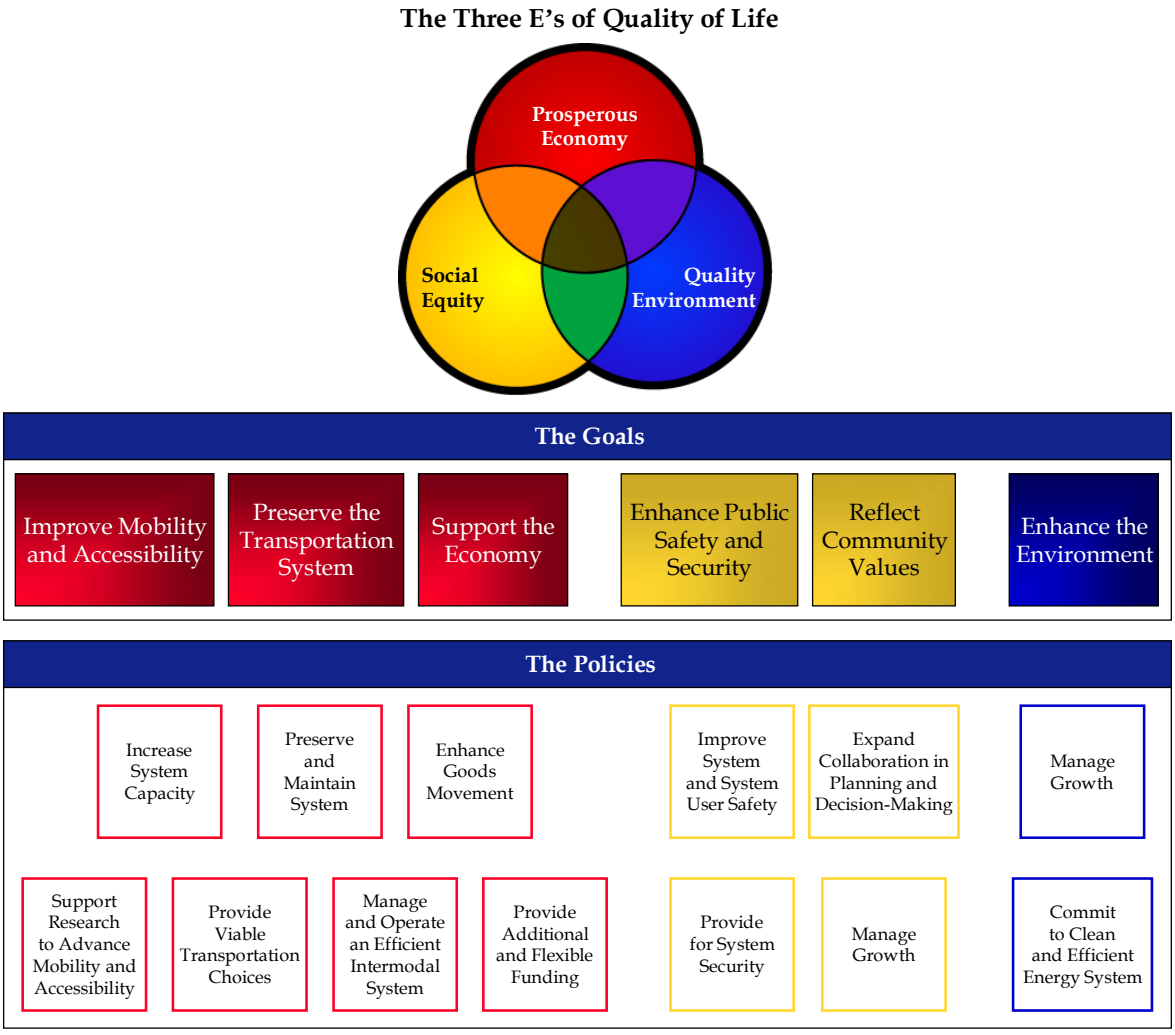
Objectives	Activities	Performance Indicators (Measures)	Targets (Percent, Number, Score, Timeframe, etc.)
Develop Environmental Stewardship through Protection of Environmental Resources	(1) Environmental Compliance	1(a) Commitment compliance	1(a) 100 percent
		1(b) Percentage of projects in construction that had a noncompliance citation	1(b) 5 percent
	(2) System Level Mitigation	2(a) Earlier regional mitigation planning	2(a) Resource agency reports annually on regional mitigation plans identifying projects considered
		2(b) Earlier regional acquisition	2(b) Resource agency reports annually on projects that have approved mitigation plans prior to project development
	(3) Protection of Natural Resources	3(a) Total number of wetlands impacted (acres)	3(a) Establish baseline
		3(b) Total number of wetlands mitigated (no net loss)	3(b) Establish baseline
		3(c) Total amount spent on mitigation	3(c) For reporting purposes only
		3(d) Total amount spent on Endangered Species Act (per unit)	3(d) For reporting purposes only
	(4) Protection of Cultural Resources	4(a) Total number of other findings of "effect" on which opinions are provided need SHPO input	4(a) Establish baseline
		4(b) Total number of MOAs signed	4(b) Establish baseline
		4(c) Total amount spent on mitigation	4(c) For reporting purposes only
	(5) Protection of the Physical Environment	5(a) Contamination	5(a) TBD
	(6) Protection of the Sociocultural Environment	6(a) Enhance customer and stakeholder relationships	6(a) Customer Satisfaction Survey (80 percent satisfied)

4.3.5 California Department of Transportation's Sustainability Framework

Introduction

The California Department of Transportation (Caltrans) has been one of the national leaders in considering performance measures in the context of a sustainability framework. In the late 1990s, Caltrans conducted a study that outlined the types of performance measures that could be used to monitor and inform investment decision-making at the state level. These performance measures, however, were targeted almost exclusively on transportation system performance, except for air quality which has been a critical issue in California for decades. The evolution of this initial performance measure framework has led Caltrans to the current construct, which is heavily based on sustainability. Figure 4.4, for example, shows the vision that was adopted in the 2025 California Transportation Plan (CTP). As shown, environmental quality is one of the three cornerstones of the sustainability framework guiding transportation investment in the State, along with a prosperous economy and social equity.

Figure 4.4 Caltrans' Sustainability Framework Guiding Transportation Policy



There are two aspects of California's approach toward the linkage between transportation and environment that merit attention for purposes of this assessment. The first is the consideration of environmental measures in the statewide planning effort and the second is a state program aimed at encouraging regional transportation planning agencies to consider more comprehensively a wide range of issues in the transportation planning process.

Caltrans' Performance Measure Framework

One of the results of the development of the statewide transportation plan in response to ISTEA was an interest in "developing a set of performance indicators and measures to assess the performance of California's multimodal transportation system, and to support informed transportation decisions by public officials, operators, service providers, and system users." A *Transportation System Performance Measures Report* (1998) was prepared by Caltrans that offered a blueprint for developing performance measures. The process for developing this original report included the participation of many different transportation stakeholders in both public agencies and private firms. In 2004, this initial effort was updated at the recommendation of a state transportation expert review panel consisting of representatives from a wide range of backgrounds.

At the same time as this update was happening, the California Environmental Protection Agency and the California Resources Agency published a list of environmental protection indicators for the State, whose purpose was to allow "objective, scientifically based tools for tracking changes in the environment." This effort identified 90 indicators relating to the environmental health of the State, and linked transportation system performance either directly or indirectly to about half. Direct transportation linkages were defined for:

- Air quality degradation due to tail pipe emissions;
- Poorer water quality resulting from leaking underground fuel tanks and stormwater runoff of paved surfaces;
- Waste management issues relating from over 31 million used tires being discarded each year;
- Global climate change caused by greenhouse gases produced from fossil fuel use;
- Human health issues resulting from air quality degradation, and traffic-related injuries and fatalities; and
- Ecosystem impacts due to loss or fragmentation of habitat and from animal injuries and fatalities.

Indirect linkages included:

- Pesticide and hazardous material spills resulting from roadway incidents or freight train derailment; and
- Provision of access to undeveloped land and farmland.

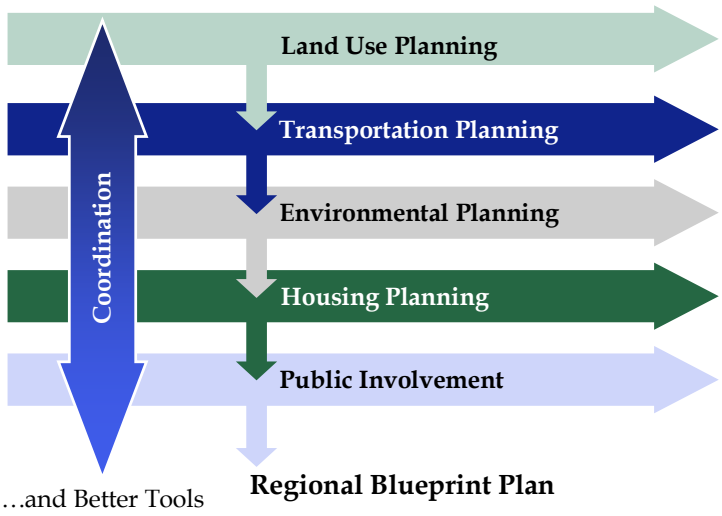
Caltrans is now in the process of developing a range of environmental indicators and measures that relate to the goals of the statewide transportation plan. To date, three measures have been

identified and included in the latest plan update: 1) days exceeding national/state air quality standards by region/air basin and statewide; 2) number of residential units exposed to transportation-generated noise exceeding standards; and 3) the ratio of fossil fuel use to passenger miles traveled. Additional measures are likely to be developed relating to greenhouse gases and ecological impacts, including those relating to water resources.

Regional Blueprint Plans and Performance Measures

California has established a program aimed at developing a broader planning perspective among the regional planning agencies in the State. The intent is to provide such agencies with funds to develop a regional "blueprint" plan that explicitly links land use, transportation, environmental, and housing plans. Figure 4.5, which comes from a Caltrans document describing the program, illustrates this relationship.

Figure 4.5 Linkage Among Transportation and Regional Issues in California's Blueprint Strategy



The program provides funds for regional collaborative decision-making and adoption of "blueprint" plans that will:

- Foster a more efficient land use pattern that: a) supports improved mobility and reduced dependency on single-occupant vehicle trips; b) accommodates an adequate supply of housing for all incomes; c) reduces impacts on valuable habitat, productive farmland, and air quality; d) increases resource use efficiency; and e) results in safe and vibrant neighborhoods;

- Provide consumers more housing and transportation choices;

- Improve California's economic competitiveness and quality of life;

- Reduce costs and time needed to deliver transportation projects through informed early public and resource agency involvement;

- Secure local government and community support, including that of underrepresented groups, to achieve the resulting comprehensive vision through including innovative computer models and public involvement activities; and

- Establish a process for public and stakeholder engagement that can be replicated to build awareness of and support for critical infrastructure and housing needs.

Interestingly, the program guidance stipulates that the blueprint planning process is to be performance-based, with one of the earliest steps being the identification of performance measures. As with the California statewide transportation plan, the most relevant transportation-related measures focused on transportation performance. Part of this recommended list included days exceeding national/state air quality standards by air basin and statewide, which was the same measure reported on in the statewide transportation plan. The guidance also recommends that additional measures be considered in the regional blueprint plans, including the following:

- Extent to which the region accommodates a sufficient housing supply to match their natural population increases and workforce needs for all income categories;

- Achieve the targets for reduction in emissions of greenhouse gases established for California by Governor's Executive Order S-3-05 on June 1, 2005;

- Reduction in number of vehicle miles traveled per household (reflects changes in land use that reduce single-occupancy vehicle travel);

- Reduction in acres of agricultural or greenfield lands converted to urban uses; and

- Increase in the proportion of residents using transit.

Conclusions

California represents a state that is much further along than most other states in considering a broad range of environmental performance measures that are part of an overarching sustainability framework. Several observations of this process merit discussion:

- The evolution toward a performance-based perspective in transportation planning has taken a long time, and in several ways is still not yet complete. The performance measures that have been explored in detail and incorporated into the statewide transportation plan are primarily for transportation system performance. The only exception to this is the air quality measure.

- The sustainability framework is one of the most innovative and interesting aspects of the California approach. It is intended to serve as a driving concept for developing a planning process that reflects the basic principles of sustainability. Adopting sustainability as an overarching vision for the transportation planning process has led to outreach efforts to include in transportation planning a range of environmental agencies and groups that traditionally have not participated in the process.

- Only relatively recently, and reflecting the environmental indicators developed by the state environmental protection agency, has progress been made on environmental measures outside of air quality. Again, this progress has occurred primarily in the traditional environmental measures – air quality, noise, and fuel consumption. Work now is underway to look at nontraditional measures, such as ecosystem health, contribution to global climate change, and human health.

- The development of the transportation performance measures was undertaken with substantive stakeholder input. In fact, it was a statewide advisory committee that produced a draft list of those measures that made most sense from a range of perspectives. It also was this external (to Caltrans) input that urged the State to broaden its measures to beyond just transportation.

- The State has attempted to influence other planning agencies through its blueprint program, which aims to broaden the linkage of transportation to other contextual issues. Many of the examples provided in the program material focused on identifying the sensitive environmental areas as a first step toward regional planning. Importantly, the basis for blueprint planning is to be the identification of performance measures, many of which relate to environmental indicators.

4.3.6 Maryland Department of Transportation Annual Attainment Report

Introduction

The Maryland Department of Transportation (MDOT) oversees five modal agencies: the Maryland Transit Administration, the Maryland Port Administration, the State Highway Administration, the Motor Vehicle Administration, and the Maryland Aviation Administration in addition to the Maryland Transportation Authority. MDOT has a legislative mandate to produce an "Annual Attainment Report on Transportation System and Performance" each year that utilizes specific measures to track the implementation of the Maryland Transportation Plan (MTP) and the Consolidated Transportation Program (CTP).[23] The MTP has four goals – efficiency, mobility, safety and security, and productivity and quality. Each of these four goals has associated annual performance measures, with one or more agencies tasked with monitoring. The Annual Attainment Report discusses why the specific measures are tracked, how situations have changed, and why they have changed. This model serves to link agency goals with transportation plans and actions through the accountability of each agency.

The Annual Attainment Report

Environmental issues are captured and tracked within the productivity and quality goal. This goal has three policy objectives: reduce project implementation time through process improvements, incorporate environmental stewardship into all projects and activities, and contain costs and leverage resources with business-like organization and innovative

[23] Maryland DOT 2006 Annual Attainment Report on Transportation System Performance: Implementing the Maryland Transportation Plan and Consolidated Transportation Program, http://www.e-mdot.com/Planning/Plans%20Programs%20Reports/Reports/Attainment%20Reports/2006%20Attainment%20Report.pdf.

approaches to funding and service delivery. MDOT is the designated monitoring agency to track the most directly related environmental performance measure: transportation-related emissions by region. The 2006 Annual Attainment Report cites a significant reduction in VOC and NO_x between 2002 and 2005 in the two major metro areas (Washington and Baltimore). The report also provides explanations for why the performance changed: integrated environmental stewardship as a component of planning, design, and operations of transportation projects and services; improved vehicle emissions on a national level; increased financial support for alternative modes of transportation; and implemented emissions-reduction strategies in nonattainment areas. In addition, the Annual Attainment Report provides some suggestions for future performance strategies: contribute to additional nonmobile emission reduction efforts and continue to invest in alternative transportation (e.g., Transportation Emission-Reduction Program).

State Highway Administration Environmental Objectives and Performance Measures

The Maryland State Highway Administration (SHA) has its own set of goal-related performance measures. The agency's business plan for 2004 to 2007 establishes six goals: improve highway safety in Maryland; improve mobility for customers; maintain a high-quality highway system; improve efficiencies in business processes; develop and maintain Maryland state highways in an environmentally responsible manner; and provide services and products to customers that meet or exceed their expectations.[24] Within each goal is a set of related objectives. Table 4.5 lists the objectives and measures established to track the goal relating to the environment.

[24]Maryland State Highway Administration Business Plan (FY 2004-2007), http://www.sha.state.md.us/aboutus/shabusinessetnl.

Table 4.5 Maryland State Highway Administration Environmental Objectives and Performance Measures

Environmental Objectives	Objective Description	Measure Description	Type
5.1 Environmental Commitments on Projects	Annually meet 100 percent of project-related environmental commitments	Number of environmental commitments (per year)	Input
		Percentage of commitments met annually	Outcome
5.2 Wetland and Stream Restoration	Create or restore 200 acres of wetlands and five miles of stream by June 30, 2010 to benefit watershed water quality	Number of wetland and stream restoration opportunities	Input
		Number of water quality-related watershed restoration projects	Output
		Acres of wetlands restored	Outcome
		Miles of streams restored	Outcome
5.3 Reduction of Invasive Species	Eliminate 25 percent of the Canada thistle on SHA rights-of-way by December 2006	Acres of Canada thistle on SHA rights-of-way	Input
		Funds available for thistle control	Input
		Acres of Canada thistle treated	Output
		Acres of Canada thistle eliminated each year	Outcome
		Percentage of Canada thistle eliminated on SHA rights-of-way	Outcome
5.4 National Pollutant Discharge Elimination System (NPDES)	Meet 100 percent of the NPDES Municipal Separate Storm Sewer System (MS4) Permit conditions annually in order to receive an "in compliance" rating from the Maryland Department of the Environment	Number of SHA's NPDES Permit Conditions	Input
		Number of activities and projects performed to meet permit requirements	Output
		Percentage of permit conditions met annually	Outcome
		MDE evaluation report rating on SHA's compliance with the NPDES MS4 Permit	
5.5 Stormwater Management (SWM) Facilities Function	By 2010, maintain functional adequacy of SHA Stormwater Facilities at 90 percent	Number of SWM facilities	Input
		Number of SHA SWM facilities requiring remediation, retrofit, and/or maintenance	Input
		Number of SWM facilities that have received remediation and major maintenance	Output
		Number of SWM facilities that have received routine maintenance	Output
		Number of SWM facilities that have received retrofits	Output
		Percent of SWM facilities rated as functionally adequate	Outcome

Table 4.5 Maryland State Highway Administration Environmental Objectives and Performance Measures (continued)

Environmental Objectives	Objective Description	Measure Description	Type
5.6 NPDES Compliance at SHA Shops	Meet 100 percent of the annual structural retrofits and operational practices at District Maintenance Facilities (known as "shops") required by SHA's Industrial Discharge NPDES permits	Number of retrofit needs identified in Pollution Prevention Plans for each shop	Input
		Number of operational practices identified in each maintenance shop	Output
		Number of maintenance personnel to receive pollution prevention training	Output
		Number of shop water quality improvements each year	Output
		Percentage of structural retrofits completed and operational practices implemented to meet NPDES industrial discharge conditions annually	Outcome
5.7 Erosion and Sediment Control Compliance	Annually achieve an in compliance rating from MDE for Maryland erosion/sediment control requirements on all SHA construction projects and maintenance activities	Number of SHA construction projects and maintenance activities	Input
		Number of inspections performed	Output
		Number of personnel trained in inspection and design	Output
		Percentage of compliance on erosion/sediment control ratings	Outcome
5.8 Environmental Stewardship Program	Implement in SHA Environmental Stewardship Program involving all offices and districts by the end of 2004	Number of current SHA environmental initiatives and processes	Input
		Number of implemented strategic environmental activities and initiatives	Output
		Number of offices implementing environmental stewardship activities	Output
		Percentage of SHA offices implementing environmental stewardship program elements	Outcome
5.9 Historic Bridge Preservation	Maintain the "Priority Level" historic bridges on the SHA Highway Network so that their preservation is not in jeopardy (have an overall condition rating of 5 or better).	Number of "Priority Level" historic bridges along the SHA Highway Network at the beginning of the calendar year	Input
		Percentage of "Priority Level" historic bridges along the SHA Highway Network at the beginning of the calendar year with an overall condition rating of five or better	Input
		Number of "Priority Level" historic bridges along the SHA Highway Network that had significant maintenance and/or rehabilitation work performed during the calendar year	Output
		Percentage of "Priority Level" historic bridges along the SHA Highway Network at the end of a calendar year with an overall condition rating of five or better	Outcome

Each year, SHA releases an Annual Report detailing the Business Plan performance results and other accomplishments. The document reports on specific performance measures, describes steps taken to reach goals, and how they did specifically in the areas of stewardship of historic and archaeological resources, the human environment, and the natural environment.

Conclusions

Maryland represents an example of a state where performance measures, including environmental performance measurements, are coordinated by multiple agencies within the multimodal state DOT. An Annual Attainment Report is a key documentation and reporting element. Performance measures are quantified and structured by goal, objective, and type.

4.3.7 New Jersey Department of Environmental Protection State of the Environment

Introduction

State resource agencies logically play a clear role in the measurement of environmental performance agencies. Therefore, many state DOTs interested in getting more directly involved in monitoring the environmental impacts of their programs may benefit easily from the work that their department of environmental protection already is doing. The New Jersey Department of Environmental Protection (NJ DEP) is an example of a state resource agency that actively tracks measures, including those directly linked to transportation.

NJ DEP's responsibility is to protect the natural environment and those aspects of human health directly related to environmental factors. The agency uses periodic assessments of environmental conditions to determine the effectiveness of current efforts, and guide the focus of future efforts. The agency publishes periodic *State of the Environment* reports that track a variety of environmental conditions which, together, provide a picture of the State's health. New Jersey's *Environment Trends 200:* includes 45 chapters, each one describing a specific area where NJ DEP has focused.[25] Of these 45 trends, NJ DEP links them to seven impact areas. Table 4.6 provides a sample of 5 of the 45 trends that relate to transportation and their designated impact areas.

[25] New Jersey Department of Environmental Protection, *Environmental Trends 2005*, http://www.state.nj.us/dep/dsr/trends2005/.

Table 4.6 New Jersey DEP Monitored Transportation-Related Performance Measures

Trend Chapter Title	Water	Air	Land Use	Regional/ Global Issues	Public Health	Pollution Prevention/ Solid Waste	Wildlife
Air Toxics		●		●	●	●	
Energy Use and Renewable Energy Sources		●	●				
Greenhouse Gas Emissions		●	●	●			
NO_x and VOCs		●	●		●		
Vehicle Miles Traveled		●	●	●			

Transportation Indicators

NJ DEP gathers travel volume data from the New Jersey DOT to track vehicle miles of travel (VMT). In the VMT Chapter of the 2005 Trends report, NJ DEP states: "vehicle use in New Jersey is an indirect indicator of vehicle emissions, so reviewing this data may help determine whether increases in miles driven interferes with attaining the State's ozone standards." The chapter notes that while VMT is a good indicator for vehicle emissions, the number of vehicle trips would be preferable due to the fact that emissions from a car are much greater for the first few minutes after it has started up. The VMT data indicates that the demand for travel is increasing at a much faster rate than new capacity is being built. The report suggests that more road miles are not the solution, but instead alternatives to vehicle travel is the best way to address the problem and makes reference to the use of smart growth as a management strategy.

Another transportation-related trend tracked by NJ DEP is the amount of VOCs and NO_x that are released into the air. The chapter outlining this trend notes that on-road mobile sources (e.g., cars, trucks, and buses) are one of the four main sources of these emissions. In 1996, on-road mobile sources were the largest contributor, but there has actually been a relatively significant reduction in this form of pollution from vehicles since that time. However, it continues to be the second largest contributor. The chapter notes that NJ EPA has adopted some regulations to address this issue. Related to transportation, these include the requirement that all gasoline storage containers sold in New Jersey be designed to minimize emissions of air pollutants, and that requirements for lower sulfur levels in fuels are recently or soon to be in effect.

According to NJ DEP representatives, their agency does not work directly with NJDOT on this performance monitoring project. NJDOT provides them with the VMT data, and they use it for reporting purposes. However, the State recently has begun work on the New Jersey Energy Master Plan.[26] The State has assembled an Energy Master Plan Committee, which includes top leadership from nine state departments: agriculture, community affairs, environmental

[26]New Jersey Energy Master Plan, http://nj.gov/emp/.

protection, health and senior services, children and families, human services, public advocate, transportation, and the treasury.

As of October 2006, the committee had drawn up a draft plan of goals, objectives, and performance measures. The goals of the plan focus on energy security, economic growth, and environmental impact. Objectives associated with each goal are meant to establish quantifiable measurements to achieve goals by 2020. While some of the objectives associated with the other goals do cite specific, quantitative goals, those associated with environmental impact and protection are more general. The draft document provides a general policy recommendation that "strategies pursued in meeting energy resource management and economic growth and development objectives should be evaluated in the context of the impact of these strategies on achieving national air ambient quality requirements, achieving long-term reductions in greenhouse gas emissions, and improving air quality." Specifically listed under air quality is the recommendation that special attention should be paid to NO_x and VOCs, especially on the hottest days of the year. The greenhouse gas emissions objective notes that all project alternatives should be viewed in the context of emission reduction. The water quality indicator mentions the reduction of mercury levels in water resources and fish as the indicator.

Conclusions

The environmental performance measurement work of the NJDEP illustrates the wide range of environmental issues that are of interest to environmental resource agencies; the increased attention being given to climate change as an environmental concern; and the linkages between transportation, development, and environmental quality. Importantly, NJDEP's work also illustrates the potential benefits that can be achieved through the partnering of transportation and environmental resource agencies, thereby opening up opportunities to leverage each other's resources and skills.

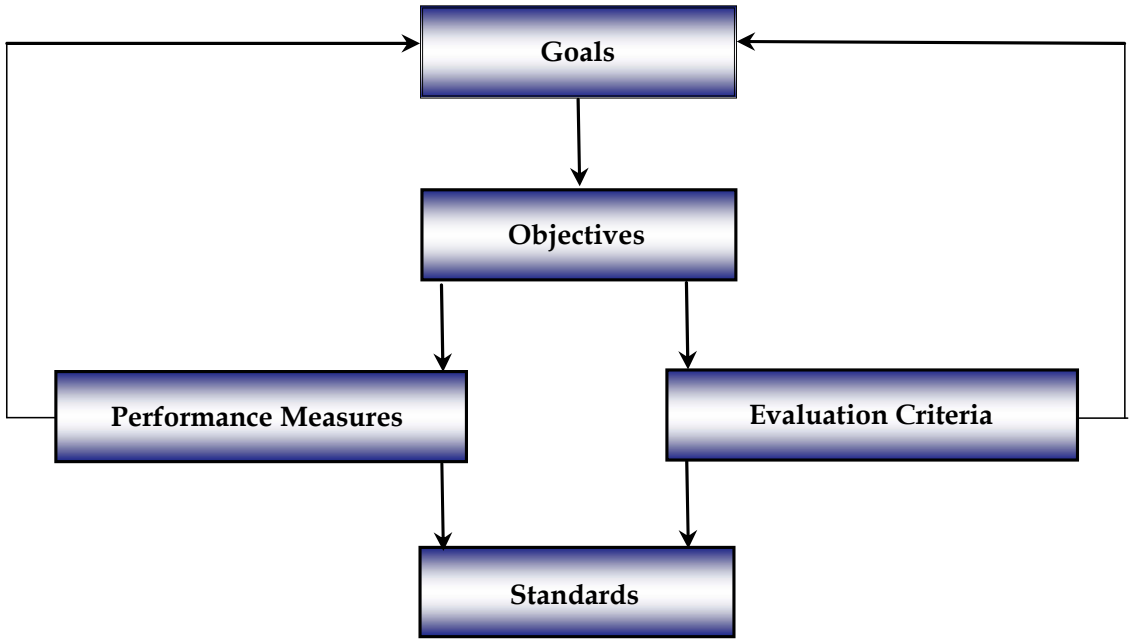
4.3.8 Metropolitan Planning Organizations – Creating a Vision, Goals, Objectives, and Performance Measures

Introduction

The urban area transportation planning process, as well as the parallel statewide planning process, has evolved considerably over the years and is very different today than it was in the 1950s and 1960s. An important element of this evolution has been the increased attention given to a broad range of environmental considerations. The primary objective of the transportation planning process often was characterized as identifying the need for new and expanded highway capacity and then developing solutions to meet these needs.

Transportation agencies, as illustrated by the previous examples, have today adopted a broader mission in which economic development, environmental stewardship, and other broader goals also are seen as being important in driving transportation decisions. Metropolitan Planning organizations (MPO) increasingly are undertaking scenario planning as a means of developing a practical, achievable vision for a region. This vision, in turn, is then translated into a set of goals, objectives, and performance measures, with standards established for at least some of these performance measures (Figure 4.6). Ideally, the achievement of these performance measures is then measured through the periodic monitoring of a set of indicators.

Figure 4.6 Translating a Vision into Performance Measurements and Standards



Visions are very broad and generally describe a set of desired future characteristics. In order to guide the planning process, vision statements must be made more specific. This is done through the definition of goals and objectives. Goals and objectives are important because they relate directly to the identification of performance measures for system monitoring, and hence obtaining some idea if goals are being achieved, and to the definition of evaluation criteria that are used to assess the degree to which proposed actions meet specific objectives. Standards can be used to specify a specific level of performance. For example, a community wants fatality rates to be below a certain threshold.

As a state example, the mission of the Mississippi DOT is, "to provide a safe intermodal transportation network that is planned, designed, constructed, and maintained in an effective, cost-efficient, and environmentally sensitive manner."[27] Environmental stewardship is defined as one of seven associated goals, "to ensure that transportation system development is sensitive to human and natural environment concerns." Indicators or performance measures become more specific, and often more quantifiable. For example, the Sacramento Area Council of Governments (SACOG) uses as an indicator the percent of growth in both housing and jobs that are within 2.5 miles of transit service.[28] Another indicator utilized for the Sacramento urban area is the additional square miles of land that becomes urbanized. These are performance measures that are used in addition to more traditional measures such as cost, congestion, and accessibility.

[27]http://www.mmdot.state.ms.us.

[28]http://www.sacog.org.

The work of the Houston-Galveston Area Council (H-GAC) and the Denver Regional Council of Governments (DRCOG) serve as illustrative examples of the manner in which environmental performance measurements are being incorporated into their planning and agency decision-making. While these are both larger organizations with a corresponding larger set of resources that they can call upon, their approaches may nonetheless still be applicable as examples of evolving practice for midsized and smaller transportation planning organizations.

Houston-Galveston Area Council

H-GAC is the regional council of governments for the Houston and Galveston metropolitan area of Texas. As such, they have broader responsibilities than a MPO and, accordingly, have adopted a broader set of goals, objectives, and performance indicators covering, in part, social services, solid waste, water quality and clean rivers, wetlands conservation, economic development, criminal justice, and cooperative purchasing. With respect to transportation, indicators have been selected that are broader than those that are directly related to vehicle miles of travel. These include the amount of open space, the total amount of land developed, the amount of development that occurs in flood plain areas, and the utilization of transit. These indicators, thus, are more directly related to identifying trends and patterns in which land use is changing than directly tied to the area's transportation system. An *Air Quality Reference Guide* is published annually that tracks the number of days each year that the eight-hour National Ambient Air Quality Standard (NAAQS) for ozone is exceeded. Quality of life is assessed in a qualitative manner by asking people in focus groups and surveys the aspects of their community that they particularly value.

H-GAC currently is completing a regional visioning process, which will then be used as the basis for the development of a new long-range regional transportation plan. This current round of visioning and planning has been undertaken with an extensive program of outreach and public involvement activities, and is being guided by the principles of scenario planning in which possible future scenario outcomes are identified and described through a set of indicators as a means of determining those outcomes that are more desirable than others. Almost all of their scenarios outperform a regional future that is based on a simple trend line projection. The end result will be a new comprehensive master plan for use in guiding overall regional growth.

This broader approach to transportation planning represents a change for H-GAC, but one that is meeting with the support and encouragement of local, private, and state participants. Changes are being introduced gradually and incrementally. The agency fully recognizes that they may be able to only influence and guide future development patterns, rather than directly controlling them. In introducing a broader set of community and environmental measures, H-GAC is being intentionally cautious and points out that it may take two or three planning cycles before they make the kind of advances they ultimately would like to achieve.

Denver Regional Council of Governments

The Denver Regional Council of Governments (DRCOG) is similar to H-GAC in that they are incrementally broadening their performance measures from the traditional focus on congestion to also introduce and consider a series of environmental performance measurements. Like the Houston-Galveston region, important consideration in the Denver area is being given to the location of anticipated future development, placing an emphasis on growth within already established activity centers in contrast to a continuation of existing trends of urban sprawl.

Towards this end, DRCOG developed a *Metro Vision 2030 Plan* that has now been adopted and also is using and publishing a series of regional performance measures and indicators. While these indicators are not yet fully incorporated into the transportation decision-making process, the intent is to periodically update and communicate this information so that over time this monitoring information becomes better understood and more effectively considered in all aspects of regional and local decision-making. The initial effort, thus, is viewed as "setting the stage for later efforts."

The 2030 Metro Vision is an integrated long-range plan to manage growth within the Denver metropolitan area. In addition to patterns of growth and development, the vision plan also covers transportation and environmental quality. The challenges addressed include traffic congestion that can impede economic development and job creation; concerns about air quality, water quality, and water supply; the manner in which desired new facilities and services will be paid for; and the desire to preserve open space for current and future generations.

Four broad areas of environmental quality are covered: parks and open space, water quality, air quality, and noise. Within each of these areas, specific policies are articulated, issues and challenges are described, and a plan is presented. The open space element, for example, covers the role of open space in the growth and development of the Denver region, who is responsible for open space, and the different types of open space. The open space element also describes how much open space currently exists, the minimum desired amount of open space in the future, the tools that are available to protect open space, and a set of actions to be taken to achieve the agreed upon objectives.

The April 2005 *Measuring Progress* report represents the first attempt by DRCOG to develop and publish a regional set of performance measures and indicators. As such, the report documents a base line condition against which updated information can be compared. Environmental areas covered are air quality, water quality, water supply and demand, wastewater capacity, parks and open space per capita, amount of protected regional open space preservation focus areas, and the regional biodiversity of species and significant natural communities. Within each area, a goal is defined, a policy is described, performance measures are identified and displayed, conclusions are drawn, and action steps are identified. For example, the number of acres of parks and open space per 1,000 population increased from 90 in 1997 to 120 in the year 2000. The current square miles of protected river corridors and canyons is roughly 20 compared to a goal of 60.

Social indicators also are identified in the Metro Vision for health (measured by a composite health index and the percent of residents who exercise vigorously) and community life (measured by crime levels, parks and recreational spending, cultural spending, and voter participation).

Each topic area is then scored in terms of whether it is moving in a direction consistent with Metro Vision goals, moving downward or away from Metro Vision goals, or sideways meaning that no major trend can be determined from the information available.

Like Houston-Galveston, DRCOG's environmental and community performance measure work is viewed as an ongoing effort in which updated versions will be continuously refined. The initial set of performance measures were largely limited to issues addressed in the existing regional plan. This same constraint, though, may not apply for the updated monitoring. Also,

while the initial set of benchmarking indicators were well received and viewed with considerable interest, they have not yet been directly utilized to drive the region's transportation decisions. The intent, though, is that the content of 2035 updated regional transportation plan will be based on an evaluation that is much more directly tied to this evolving set of regional performance measures and indicators.

Conclusions

An examination of the usage of environmental performance measurements by MPOs illustrates the following lessons:

- The orientation of both H-GAC and DRCOG is to development, quality, and vitality of their respective regions, broadly defined. Performance objectives include, but are not limited to those that are directly related to transportation.

- Visioning and scenario planning increasingly are being used to establish the foundation for regional planning, with the results used to define goals, objectives, and performance measures. Monitoring of these performance measurements is used to examine trends in performance as well as the relationship to a desired threshold.

- When examined from a regional perspective, a broad range of environmental issues are of interest, especially those that are influenced by the relationship between transportation investment and land development.

- Public outreach and agency involvement are important in defining, and gaining acceptance for, environmental goals, objectives, and performance measures. Further, it is important that environmental performance measurements be communicated in a manner that can be easily understood by non-transportation professionals.

- The reporting of environmental performance often represents an important early implementation step. It is important, though, that this information also be used in guiding transportation management and investment decisions.

4.3.9 Green Highways

Introduction

The U.S. Federal Highway Administration (FHWA), U.S. Environmental Protection Agency (EPA), the Maryland State Highway Administration, the National Asphalt Pavement Association, the American Concrete Pavement Association, and several other organizations have established a Green Highways Partnership (GHP) with the objective of minimizing the impacts of transportation projects on the environment.[29] In many ways, the program is patterned after the Green Building program, but without the associated certification. The emphasis of the program is on the implementation of Best Management Practices (BMP), especially with respect to watershed-driven storm water management, recycling and reuse, and

[29]http://www.greenhighways.org.

conservation and ecosystem management.[30] The rationale for this focus is simple; the vast majority of transportation facilities already are built, and it is important that these existing facilities and systems be operated and maintained in as environmentally responsible a way as possible.[31]

Key concepts underlying the Green Highways initiative are partnerships, recognition, and training. Green Highways is viewed as a voluntary, non-regulatory collaboration of private and public partners at both the state and Federal level in which transportation agencies, resource agencies, contractors, industry, trade associations, academic institutions, and nongovernmental organizations work together to identify opportunities that will result in an increase in environmentally friendly transportation systems. These opportunities may involve joint funding, technology transfer, collaboration, and joint research. Leaders are recognized and rewarded for their good practices, thereby encouraging others to adopt similar practices. Similarly, incorporating BMPs into training and education programs for public and private sector staff also serves to further implementation. Gary McVoy of the New York State DOT has characterized this approach in a very simple manner, "Just by getting more people adapting known good practices will result in things getting better." Shari Schaftlein of FHWA has described the GHP as, "seeking to eradicate the traditional disconnect between the transportation and environmental communities through communication and cooperation, which will allow for a mutually beneficial relationship."

The concept of Green Highways is broader in scope than planning, covering project development and design, pavements and materials, right-of-way treatment, and construction as well as operations and maintenance.[32] A similar Sustainable Roads program undertaken by the European Union Road Federation is based on the notion of "Cleaner Road Transport for All" and includes optimizing route planning through environmental impact analyses, use of recycled and environment-friendly construction material, mitigating habitat fragmentation, avoiding water pollution, making the most of Intelligent Transportation Systems (ITS), and quieter roads.[33] The connection of Green Highway BMPs to environmental performance measures is direct and easy. BMPs can be documented and adopted as agency policy. The extent to which these practices are then implemented simply can be monitored as a measure of agency output.

While the Green Highways Program places an emphasis on implementation of Best Management Practices, the program also is viewed as an umbrella for a broader range of activities having the objective of improving environmental stewardship within the

[30] *Paving the Way to Cleaner, Greener Highways*, the Mid-Atlantic Green Highways Initiative, January 2006.

[31] Schaftlein, Shari, *Going Green with U.S. Highways,* Research and Technology Transporter, U. S. Federal Highway Administration, Washington, D.C., March 2006.

[32] An extensive set of examples demonstrating the multiple environmental and societal benefits that can result from transportation is contained in *Taking the High Road, The Environmental and Social Contributions of America's Highway Programs*, American Association of State Highway and Transportation Officials, Washington, D.C., 2007. Subject areas covered include historic preservation, recycling, air quality, community design, wetlands and water quality, wildlife preservation, and vegetation.

[33] *Sustainable Roads,* Discussion Paper, European Union Road Federation and the Brussels Programme Centre of the International Road Federation, April 2007.

transportation community. These broader activities include context sensitive solutions and context sensitive design (Cf. Section 4.3.10), NEPA project management and analysis practices, smart growth, education and training, and enhanced partnerships.

The following subsections describe three examples of the introduction of "green" practices: New York State DOT's highway maintenance procedures, EPA's Green Communities initiative, and FHWA's use of focus groups and customer surveys to measure the success of their environmental streamlining initiative.

New York State DOT's Environmental Stewardship Practices for Highway Maintenance

New York State DOT's highway maintenance practices illustrate how Green Highway Best Management Practices can be systematically introduced into the standard operating procedures of a transportation organization. Building on the results of NCHRP Project 25-25(4), success is determined by measuring the number of identified BMPs that have been applied and the number of geographic areas or locations where they have been applied.

The purpose of NCHRP Project 25-25(4) was to develop a compendium of *Environmental Stewardship Practices, Procedures, and Policies for Highway Construction and Maintenance*.[34] The resulting detailed compendium is in excess of 700 pages long and covers construction, pavement, materials, recycling, maintenance facilities, bridges, winter operations (salt, sand, and chemicals), and roadside vegetation. Examples of specific topics where BMPs are described are culverts and fish passage, stream restoration and bioengineering, drainage ditches and swales, and designing to reduce snow, ice, and chemical accumulation.

The New York State DOT has adopted the 25-25(4) compendium as a guide and is working to increase the use of the described practices. Maintenance crews review the compendium, then travel their assigned road segments using one-page summaries of applicable BMPs to identify potentially useful practices and specific spots or areas where these practices could be applied, and then implement the identified practices in as many areas as practically possible. In addition to simple counts of opportunities identified and actions taken, the environmental performance also is measured as the percentage of the opportunities identified where the improved environmental stewardship opportunities are actually implemented with the State's GIS capabilities used to display specific locations and areas.

The New York State DOT is giving particular attention to vegetation management as well as to overall roadside management and maintenance. This is in recognition that multiple factors need to be taken into considerations in making right-of-way management decisions. These include visual quality, safety, and plant and animal ecology. Vegetation is desired that can resist the invasion of woody plants, is aesthetically pleasing, provides food and cover for wildlife, and can be economically established and maintained. The New York State DOT follows a six-step approach for Integrated Vegetation Management (IVM): 1) understand pest and ecosystem dynamics; 2) set management objectives and tolerance levels; 3) compile treatment options; 4) account for economic and environmental effects of treatments; 5) develop

[34] Venner Consulting and Parsons Brinckerhoff, *Environmental Stewardship Practices, Procedures, and Policies for Highway Construction and Maintenance*, National Cooperative Highway Research Program Project 25-25(4), Washington, D.C., September 2004.

site-specific treatment plans; and 6) monitor outcomes and revise and adapt management plans. The second and sixth of these steps are directly related to environmental performance measurement. Well-defined threshold and tolerance levels are a critical element and are useful in communicating with various stakeholders. These then are supported by a monitoring of actual outcomes. Specific vegetation management practices relate to inventorying rare species and sensitive resources within the highway right-of-way, mowing practices, controlled burning, and noxious weed management.

U.S. Environmental Protection Agency Environmental Indicators

The U.S. Environmental Protection Agency (EPA) has several environmental indicator initiatives and monitors numerous specific indicators. This information can be accessed via an overall indicators gateway web site.[35] These projects provide information on environmental conditions and trends over a range of geographic scales and time periods. The gateway web site provides summaries of the indicator projects and links to the related reports and web sites developed by each project. These summaries can be searched by geographic location, keyword, and topic. Two EPA programs are particularly related to transportation and Green Highways. These are the agency's Green Communites Program and the *Report on the Environment*. On June 17, 2008, the White House issued a directive to multiple Federal agencies to develop and report on environmental indicators. These indicators are to be "a set of high quality, science-based statistical measures of selected conditions of our environment and natural resources." This new program is similar, but broader than EPA's *Report on the Environment*.

EPA's Green Communities Program

The U.S. EPA established the Green Communities Program to help local communities transition towards sustainability by providing access to tools and information.[36] The specific goals of the Green Communities Program are to:

- Promote innovative tools that encourage successful community-based environmental protection and sustainable community development;
- Establish partnerships with other organizations and agencies to help build community capacity and knowledge in order to create more livable communities; and
- Provide technical assistance and training through a Green Communities Assistance Tool Kit, workshops, and a network of Green Communities throughout the country.

Indicators, or performance measures, are an integral component of EPA's *Green Communities Assistance Tool Kit.* Example indicators are defined in three separate domain areas, proposed as pillars of sustainable development: environmental, economic, and social. Goal-based indicators then are defined within each of these three domain areas. Transportation-related performance measures that can be monitored include vehicle miles of travel, acres of impervious surface, percentage of population within walking distance of public transportation, and hospitalization for asthma per 10,000 residents.

[35] http://www.epa.gov/igateway/index.html.

[36] http://www.epa.gov/greenkit.

EPA's web-based toolkit for Green Communities is organized around a five-step planning approach: 1) where are we now?; 2) where are we going?; 3) where do we want to be?; 4) how do we get there?; and 5) let's go! Viewed from a performance measurement perspective, the second step involves the monitoring of key indicators and the third step is focussed on the establishement of a time-phased vision and associated goals and objectives.

EPA's Report on the Environment

EPA, in 2001, undertook the development of a reliable set of indicators of air, water, land, and related environmental conditions. The most resent edition was published in May 2008.[37] The report consists of separate chapters covering air, water, land, human helath, and ecological conditions. Further, the report is organizaed to address 26 priority questions. The selected indicators satisfy six criteria. These include usefull, objective, transparency, reproducible, availability of data, and comparable across time and space. In addition to national reporting, data for 23 indicators are broken out on a regional basis. Similar information could be monitored and reported on a statewide or even a metropolitan area basis.

Within the Air chapter, three priority questions are defined. One of these is, "What are the trends in outdoor air quality and their effects on human health and the ennvironment?" Twenty-three separate indicators then are examined to respond to this question, including ozone levels and air toxic emissions.

Five priority questions are defined in the Land chapter. One of these is, "What are the trends in land use and their effects on human health and the environment?" Urbanization and population change are associated indicators.

EPA's indicators work points out how different environmental performance measurement initiatives can be designed to support and complement one another. Green Highways, Green Communities, and the Report on the Environment each play an important individual role. More over, they examine environmental indicators at a progressively higher level. Finally, they provide scienticially based examples of environmental performance measurements that can be utilized and built upon by State agencies and MPOs in implementing similar but more localized environmental performance measurement initiatives.

U.S. Federal Highway Administration Performance Measurement for Environmental Streamlining

The U.S. Federal Highway Administration (FHWA) implemented a performance measurement program to evaluate the effectiveness of the agency's environmental streamlining program, including both qualitative and quantitative components.[38] Similar programs could be implemented by state DOTs and MPOs to assess achievement of their environmental goals and objectives.

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[37] *EPA's 2008 Report on the Environment*, U.S. Environmental protection Agency, Washington, D.C., May 2008, EPA/600/R-07/045F. It is supported by a May 2007 Draft *EPA's 2007Report on the Environment – Science Report* written for environmental professionals.

[38] The Gallup Organization, *Implementing Performance Measurement in Environmental Streamlining*, prepared for U.S. Federal Highway Administration, Washington, D.C., January 2004.

Focus groups were first conducted in six nationally distributed cities. The objectives of the focus groups were to obtain qualitative insights regarding environmental streamlining and to help design a survey questionnaire. The survey then was administered focussing on the quality of organizational relationships, communication, timeliness, and performance. The questions were directed at both managers and staff with the objective of measuring, for example, the nature of the relationships with counterpart organizations and the performance of counterpart organizations on recently completed transportation projects. Beginning with a baseline measure of stakeholder perceptions, a second survey then assessed progress in achieving desired performance characteristics and reported these results in the form of a scorecard.[39]

This same basic approach to market research could be applied at state and local levels of government to monitor performance of Green Highway practices. For example, one or more focus groups could be convened of agency partners and a sample of "customers." The focus of the discussion could be on the effeectiveness of one or more specific environmental initiatives, broader environmental performance, or on the degree to which environmental documentation is meeting agency and public needs. In a similar manner, surveys could be conducted of a stratified sample of the public in order to better assess their perception of environmental performance.

Conclusions

Three aspects of Green Highways differentiate it from other environmental performance measurement intiatives. The first is the focus on Best Management Practices, and thus on agency outputs rather than on actual environmental outcomes. The rationale is that these management practices are known to result in environmental benefits. Further, since output measures generally are far easier to measure than outcomes, it is easier and just as effective to measure well-defined and directly observable outputs.

Second, the Green Highways Program is aimed at creating communities of practice and a "movement" that results in an ever-growing momentum for stewardship of the environment. By preparing and promoting tool kits and compendiums of good practice, it is explicitly designed to get lots of people doing lots of inherently good things. At the same time, the intent is to monitor and measure the degree to which specific environmental practices are implemented both geographically and within individual business units.

Third, while the Green Highways umbrella is defined as being extremely broad, there is at the same time a focus both on construction and maintenance practices and on very specific practices and procedures. Thus, context sensitive solutions is viewed as being a planning and design-oriented "on-ramp" to a Green Highway. At the same time, wildlife management in the form of passageways to cross a highway right-of-way and the recycling of pavement materials also are seen as equally important aspects of the Green Highways Program.

[39]The Gallup Organization, *FHWA Survey of Transportation Agencies, Ratings Processes with Resource Agencies*, prepared for the U.S. Federal Highway Administration, Washington, D.C., September 2007.

4.3.10 Context Sensitive Solutions

Introduction

The practice of Context Sensitive Solutions (CSS) is viewed by many as a key practice that simultaneously contributes to achieving objectives of environmental stewardship and increased environmental streamlining. CSS has evolved from and is a broadening of Context Sensitive Design (CSD) and initially was referred to as, "Thinking Beyond the Pavement." Monitoring and measuring the success of CSS implementation, therefore, represents an example of a "process" approach to environmental performance measurement.

Description

CSS is defined as a collaborative, interdisciplinary approach to transportation planning and project development that involves all stakeholders that recognizes the interdependencies of transportation, economic, and environmental considerations and results in a balance of transportation objectives with objectives for the economy, the natural environment, and the human environment. Incorporating CSS principles throughout a transportation planning and programming process can provide an improved understanding of community context and community values. CSS also provides a means for achieving early cooperation, coordination, and consensus-building among key transportation, economic development, environmental agencies, and communities. Success factors to achieving effective CSS include knowing the potentially affected communities and the associated stakeholders, starting with a definition of the problem rather than a solution, gathering information early, and then sharing this information. Measuring the degree to which these success factors are being achieved represents one approach to determining the effectiveness of an organization's CSS practices.

North Carolina State University's Center for Transportation and Environment conducted a post training survey to assess the degree to which CSS practices are being incorporated into day-to-day planning and design activities.[40] The performance measures they examined can be considered as "output" or "process" measures and include how often elements of CSS are utilized in performing a person's job; the importance of individual CSS principles, such as working with stakeholders, in conducting daily work activities; the availability of funding, staffing, time, information, training, and supervisory resources; an increase in public acceptance; a reduction in the number of legal challenges; a decrease in the number of "redo" loops; and a reduction is project completion time.

Since multidisciplinary teams are important to the success of CSS, another environmental measurement approach to assessing the effectiveness of CSS is to monitor the success of multidisciplinary planning and design teams.[41] A review of research literature and agency practice materials unfortunately did not yield specific measurements of multidisciplinary team performance during project planning and development. A number of states, however, have

[40] Lane, Leigh with Brian Byfield and Ann Hartell, *Integrating Context Sensitive Solutions in Day-to-Day Activities: Information from a Post Training Survey*, North Carolina State University, August 2006, Raleigh, North Carolina.

[41] Center for Transportation and the Environment, *Multidisciplinary Teams in Context Sensitive Solutions,* Draft Final Report for NCHRP Project 20-5, Synthesis Topic 37-01, North Carolina State University, June 2006.

conducted post-project debriefings, critiques, and "lessons learned" to assess successes and shortcomings. Systematically conducting such assessments over a period of time yields insights regarding the manner in which multidisciplinary teams are organized and trained, the degree to which multidisciplinary planning and CSS approaches are being mainstreamed, and common barriers that are being encountered. Conducting these assessments repeatedly over a period of time enables an assessment in the change in agency performance over time.

A broader examination of applicable CSS performance measures was taken in NCHRP Project 20-24(30).[42] A CSS measurement program framework is defined in which a balance of process and organization-level performance measures is recommended. Examples of process-level performance measures are the presence of a public involvement plan, presence of a linkage of problems, opportunities, and needs to the evaluation of alternatives, the degree of consistency with local plans that is achieved, tracking the implementation of project commitments, and assessing the degree to which consensus was achieved. Examples of organization-wide CSS performance measures are the quantity and quality of training, the degree to which policies and design manuals have been changed, surveys of key stakeholders, and tracking the time required for project completion.

Conclusions

CSS practices increasingly are being introduced throughout the country in the planning and development of transportation practices. Indeed, CSS represents one of the most significant emerging environmental practices. The degree to which the practices and principles of CSS are implemented within an agency, therefore, represents an important environmental performance measurement. In addition, individual aspects of CSS can be monitored, including such things as the degree of stakeholder consultation and involvement, the degree of consistency between transportation and local land use plans, project completion time, the number of "redo" loops, and the number of legal challenges. Intended benefits of CSS also can be monitored, such as improved community satisfaction, benefits to the natural and human ennvironment, improved walkability and bikeability, and improved community quality of life.

4.3.11 Cooperative Agreements

Introduction

A Cooperative or Community Benefit Agreement (CBA) is a legally binding agreement between a transportation agency or developer and one or more potentially affected community and environmental groups whereby the transportation agency agrees to implement a set of environmental mitigation and enhancement actions and the coalition of community and environmental groups agree not to bring any legal action that is aimed at delaying or stopping the project. In an environmental performance measurement framework, emphasis then is given to monitoring implementation of the actions contained in this agreement, e.g., output measures, rather than monitoring actual ambient environmental conditions, e.g., outcome measures. Performance monitoring, thus, becomes considerably easier.

[42] TransTech Management, Inc. with Oldham Historic Properties, Inc. and Parsons Brinckerhoff Quade & Douglas, Inc., *Performance Measures for Context Sensitive Solutions – A Guidebook for State DOTs*, NCHRP Web-Only Document 69, Transportation Research Board, Washington, D.C., October 2004.

Cooperative or Community Benefit Agreements are most likely to be applicable for very large or very complex projects, rather than on a routine basis for all projects. As stated by a representative of one environmental organization, "Only about five percent of transportation projects are really difficult and require this kind of careful attention. Eighty percent of the projects don't require any 'out of the box' thinking, and the remaining 15 percent only require some thought."

Examples

Two recent examples of Community Benefit Agreements are for the expansion of the Los Angeles International Airport (LAX) and the San Pedro Bay Ports Clean Air Action Plan. The Los Angeles International Airport Master Plan Program Cooperative Agreement was signed in September, 2004 between the Los Angeles World Airports and the LAX Coalition for Economic, Environmental, and Educational Justice, a coalition of more than 20 community and environmental groups, labor unions, and school districts. It is a legally binding agreement requiring the implementation of an agreed upon set of mitigation measures as part of the planned 10- to 15-year LAX modernization and expansion program. In return, the coalition groups agreed not to legally challenge the project. The estimated cost of the mitigation measures is $500 million compared to an estimated cost of $9-12 billion for the airport modernization. The agreed upon measures include soundproofing for homes and schools, emission reductions for both on- and off-road diesel powered vehicles, and improved access by the public to information concerning the expansion of LAX. The agreement contains provisions for enforcement, including a 60-day right to cure, mediation, remedies, and binding arbitration. Environmental justice issues were seen as being especially important as 81 percent of impacted census tracts are minority, 57 percent are considered low-income, and 23 percent of the impacted population lives below the poverty level.[43]

The San Pedro Bay Ports Clean Air Action Plan is similar in objective to the Los Angeles International Airport Community Benefits Agreement in that a series of impact mitigation activities are agreed upon in connection with a proposed major expansion of intermodal freight port facilities.[44] The Ports of Long Beach and Los Angeles are the two busiest container seaports in the United States, moving more than $260 billion a year in trade. Also, like LAX, issues of environmental justice were an important motivating consideration. To support a significant expansion of these two ports to handle the projected continued rapid growth in movement of international freight, the Ports of Long Beach and Los Angeles worked in cooperation with the South Coast Air Quality Management District, the California Air Resources Board, and the U.S. Environmental Protection Agency on the development of the San Pedro Bay Clean Air Action Plan. Under the Plan, investments will be made by the ports, the local air district, the state, and port-related industry to cut particulate matter (PM) pollution from all port-related sources by at least 47 percent within the next five years. Nitrogen oxide (NO_x) emissions will be reduced by more than 45 percent, and emissions of sulfur oxides (SO_x) will be reduced by at least 52 percent. The agreed upon measures will reduce emissions from ships, trucks, trains, terminal cargo-handling equipment, and harbor craft. The Action Plan also establishes uniform air quality standards at three key levels: San Pedro Bay, project-, and

[43] Final EIR/EIA as reported by Jerilyn Lopez Mendoza of Environmental Defense to the 2005-2006 ENO Transportation Foundation symposium on *Efficient Goods Movement and the Environment*.

[44] http://www.polb.com/environment/air_quality/clean_air_action_plan.asp.

source-specific performance. Existing diesel trucks will be replaced with either clean or retrofitted vehicles. Major container and cruise ship terminals will be equipped with shore-side electricity so that vessels do not have to be diesel-powered while at berth. Switching locomotives operating at the ports will meet the most stringent U.S. EPA standards for new locomotives and will automatically shut off to prevent extensive idling.

Conclusions

Community benefit agreements are not new, but there is a renewed interest in their application for large complex projects. These agreements can be cross-cutting in terms of their transportation modal coverage, as evidenced by the San Pedro Bay Ports agreement. They also can be cross-cutting in terms of the range of environmental issues addressed, with a particular focus on the communities and neighborhoods that may be most heavily impacted by an expansion program. Environmental considerations, though, are addressed in the context of a broader set of objectives and performance measures, especially job creation. The agreements also commonly involve multiple government jurisdictions, often working in partnership with the private sector. Community benefit agreements also are consistent with the principles of Context Sensitive Solutions and Context Sensitive Design, practices that are becoming increasingly common within state DOTs. Community benefit agreements also are seen as being consistent with the principles of good asset management, where the investment and management decisions in question are viewed within the broader context of the development, operation, and management of a multimodal transportation system.

Viewed in the context of performance measurement, community benefit agreements help to focus resources on those issues that are of the highest priority of importance. Rather than just meeting a minimum standard, attention can be given to those areas where a higher environmental standard may be desirable, thereby providing environmental benefits rather than just environmental mitigation. Community benefit agreements also can be seen as being consistent with the movement towards performance-based contracting, in that a set of actions are agreed upon whose implementation then can be monitored.

From project, legal, and cost perspectives, community benefit agreements are seen as being mutually beneficial. Projects can be developed in less time and without the continued fear of legal challenge. These agreements build upon existing Federal and state law, such as the National Environmental Policy Act and, in the case of the two described examples, the California Environmental Quality Act. At the same time, a community benefit agreement becomes a legally binding agreement and, therefore, extends beyond the provision of existing statutes. Total project costs may be higher, but this increment may be lower than the cost that would be associated with delay. Community understanding and support are obtained, and environmental benefits are achieved.

The development of a community benefit agreement is a process of negotiation. The range of relevant interests and stakeholders need to be identified and engaged in this collaborative process. Common goals should be identified and agreed upon, including accountability and the availability of information. Building upon this dialog and shared goals, an agreement than can be negotiated, including provisions for monitoring, representation, and remedies.

4.3.12 Environmental Information Management Systems

Introduction

The use of environmental management systems (EMS) is becoming a common tool closely associated with the practice of environmental performance measurement. As defined by the International Standards Organization, an EMS is "the part of the overall management system that includes organizational structure, planning activities, responsibilities, practices, procedures, processes, and resources for developing, implementing, achieving, reviewing, and maintaining the environmental policy." Using this broad definition, it could be noted that all transportation agencies with adopted environmental policies are engaged in utilizing an EMS, but full implementation of an EMS includes the implementation and tracking of environmental performance measures.

Examples

NCHRP Project 25-23(2), *Software for an Environmental Information Management and Decision Support System*, provides an overview of best practices and current activity in this field.[45] The research conducted for the report revealed that nearly every U.S. transportation agency (and many MPOs) has undertaken some activities to improve environmental management, indicating the growing importance of effective environmental decision-making. The increased attention given to environmental factors in the TEA-21, ISTEA, and SAFETEA-LU reauthorization bills; advancements in technology that facilitate the use of environmental data and systems-level planning; an increasing appreciation among transportation practitioners of the complex interactions between transportation infrastructure and ecological systems; and growing public awareness about environmental stewardship are all factors contributing to this trend.

Through a scan of state activities, NCHRP 25-23(2) found that GIS and overlay mapping of environmental conditions is the most commonly used tool to evaluate project alternatives and associated impacts. Data trend analysis, socioeconomic/community impact assessment methods, public or expert surveys, focus groups, and air quality impact models also are common. Florida's ETDM process (see Section 4.3.4) was found to be one of the most advanced systems to effectively screen and manage transportation development projects.

As of 2002, 20 state DOTs reported systems for tracking environmental mitigation commitments. Many of these are simply the procedure of attaching copies of the commitments to the plans, but more sophisticated systems are under development in many states, as illustrated by the Washington State DOT work described in Section 4.3.1. The integration of personal handheld computers in the field, wireless data transfer, and precision GPS location information are facilitating more extensive collection of environmental information in the field. Metrics like the number of commitments met per year by a DOT can easily be translated into a performance measure.

[45] Cambridge Systematics, Inc. with Parsons Brinckerhoff Quade and Douglas, Inc. and Venner Consulting, Inc., NCHRP Project 25-23(2), Research Results Digest 317, *Software for an Environmental Information Management and Decision Support System,* NCHRP Web-Only Document103, *Final Report and Users Guide for an Environmental Information Management and Decision Support System,* Washington, D.C., March 2007.

Conclusions

The review of current systems conducted for NCHRP 25-23(2) was conducted to inform the subsequent development of a prototype environmental information management system (EIMS). The prototype is one example of a software system that can support environmental management for transportation and planning agencies and is based on use of a web-based user interface, relational database, and map interface. The system supports four functionalities: long-term planning, project development, asset definition, commitment tracking, and requirements/best practices.

4.3.13 Transit New Zealand's Integrated Transport Policy

Introduction

Important transportation performance-based management initiatives are occurring internationally, including Australia, Canada, Japan, and New Zealand. New Zealand is recognized as a leader in the priority being given to environmental preservation, with national laws requiring that infrastructure decisions be made within a broader context of sustainability. Transit New Zealand, the agency responsible for national transportation, is an example of an organization that has developed an integrated approach toward performance-based planning and decision-making that includes environmental performance measurements as an integral part. This approach has evolved over many years, influenced by the applicable national legislation as well as by evolving standards of environmental practice. Consistent performance measures are found in documents ranging from Transit New Zealand's corporate strategic plan to performance specifications in private service contracts.

Performance Measure Framework

Figure 4.7 shows the general framework for the policy directions that guide transportation investment policies in New Zealand. One of the most important documents for identifying which system performance indicators are considered most important is an organizational "Statement of Intent." A public finance law in 1989 required all government agencies to prepare a document that provided information on a range of corporate management factors, including performance targets, objectives, and scope of activities. Thus, for example, the Ministry of Transport's Statement of Intent states that,

> "Sustainable Transport is the Ministry's vision. As the government's principal transport advisor, we will continue to identify solutions with longer-term benefits. Decisions will be based not only on monetary costs and benefits, but also will take into account the social, regional, economic, health, and environmental impacts of all projects."

The Statement of Intent for Transit New Zealand provides a more detailed set of performance measures that relates to the goals established in the strategic plan. The environmental performance measures that have been included in this document and monitored during each annual update of the Statement are found in Table 4.7. These performance measures are considered by the highest management level in Transit New Zealand. The agency also has developed an Environmental Plan that provides much more detail on the types of actions and policies that will be adopted by Transit New Zealand in relation to its adopted environmental policy. As illustrated by the following eleven examples, each of the environmental impact categories has its own set of performance measures.

Noise

1. Number of properties benefiting from the noise retrofit program where design traffic noise levels drop by 6dBA or more.
2. Percentage of urban state highways with noise-sensitive receivers with a speed environment of 70km/h or greater where traffic noise is treated by designed solutions.

Air Quality

1. Tons of carbon dioxide generated by vehicle use.
2. Total amount of carbon monoxide and nitrogen dioxide attributed to vehicles.
3. Percentage of new major projects that model air emissions during design.

Figure 4.7 Transportation Policy Framework in New Zealand

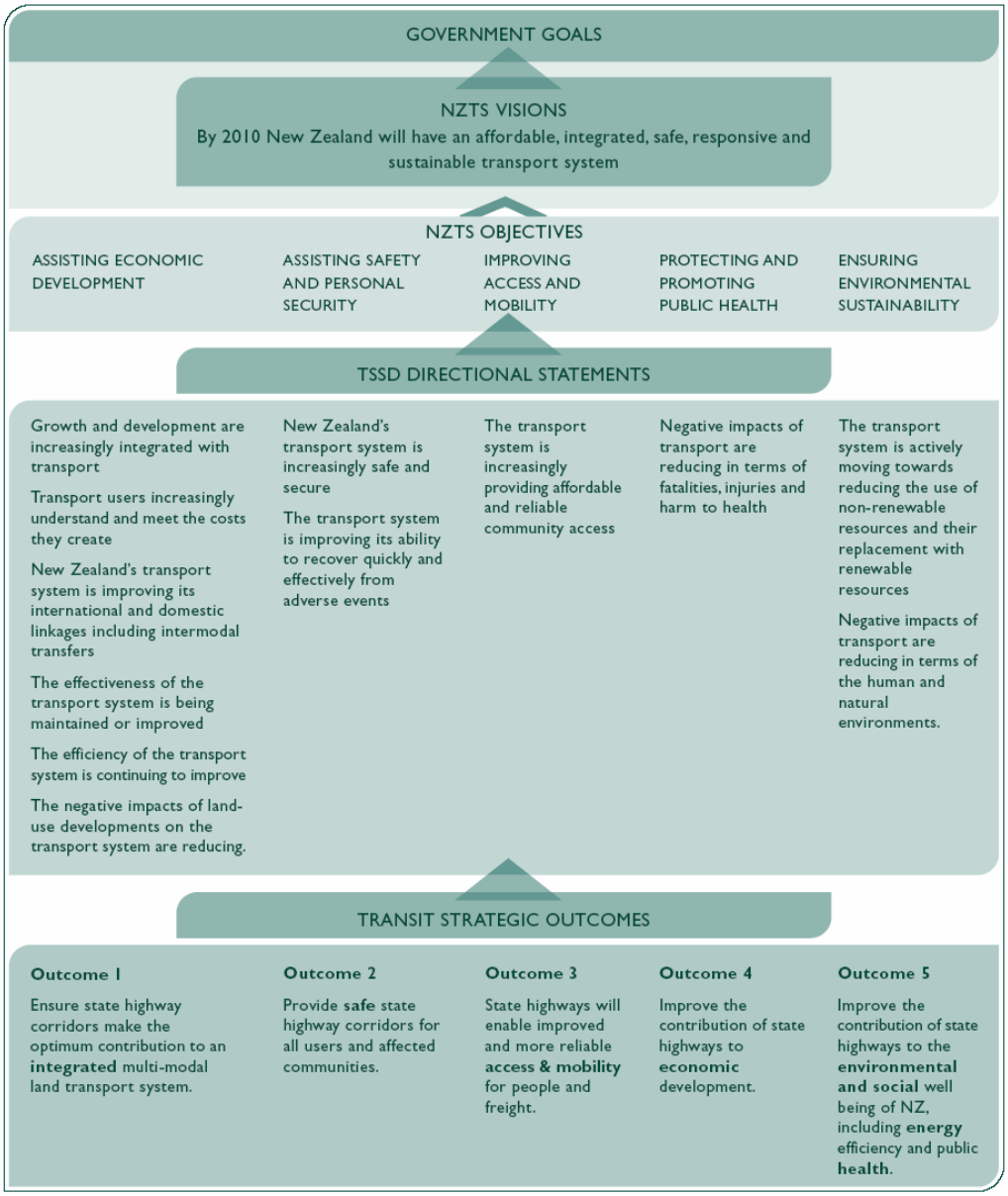

Table 4.7 Environmental Performance Measures, Transit New Zealand

Performance Measure	Target
The change in the degree of alignment between the state highway network plan and macro planning of land use, demand management, network and corridors as a result of collaboration with local authorities and other transport sector members.	Increasing Transit's contribution to transport sector objectives by achieving 85 percent alignment between Transit's 10-year State Highway Forecast and regional land transport strategies, regional and local growth strategies, and long-term council and community plans (by 2010).
Vehicle emissions (total amount of nitrogen dioxide, particulate matter, carbon monoxide, and carbon dioxide to be reduced as the consequence of improved traffic flows in key urban areas	The reduction in vehicle emissions (NO_x, PM_{10}, CO, CO_2) form actively optimizing traffic flows and working in collaboration with others in the sector to reduce congestion in key urban areas.
The reduction in energy use and reduction in nonrecycled wastage from Transit offices as a direct result of improved staff education and awareness of the issues.	Reducing energy use by three percent per m^2 of office space over the previous 12-month period, and reducing the nonrecycled wastage from Transit offices by five percent per staff member in the period 2006/2007, compared with the previous year's waste sort results, by making staff more aware of energy and resource issues and providing facilities to allow recycling to take place.
The change in the proportion of state highways in urban areas with a speed environment greater than 70 kph where designed solutions, such as quiet road surfaces and noise barriers, are installed to protect adjacent noise-sensitive areas.	Increasing the proportion of noise sensitive areas, adjacent to urban state highways with a speed environment of greater than 70 kph, which are protected by the use of designed solutions. The proportion of Auckland carriageways treated with designed solutions is in the range of 40 to 50 percent.
The change in the proportion of the network where designed water treatment solutions, such as both natural and mechanical water-filtering systems, are used to control the potential negative impacts of rain washing vehicle and pavement contaminants from the road into sensitive environmental areas.	Increasing the proportion of the network with sensitive environments, where potential water pollution, as the result of rain washing vehicle and pavement contaminants from the road, is controlled by designed solutions, such as both natural and mechanical water-filtering systems. This proportion currently is in the range of 20 to 30 percent in the Auckland area.

Source: Transit New Zealand, *Statement of Intent*, 2006/2007-2008/2009, Wellington, New Zealand, 2006.

Water Resources

- Percentage of consent conditions and regional plan standards (where applicable) that regional council monitoring show as demonstrating full compliance.
- Percentage of kilometers of state highway impacting on sensitive receiving environments that have designed road run-off treatment mechanisms in place.
- Reduction in total number of sensitive receiving environments adversely affected by state highway run-off.
- Number of stock and camper van effluent sites established.
- Additional hectares treated as a result of partnerships with local authorities or landowners/ developers.

Resource Efficiency

- Kilowatt hours of electricity used in Transit offices per square meter of occupied floor space.
- Kilograms of waste disposed to landfills from office operations per full-time equivalent staff.
- Percentage of state highway corridors with corridor-specific waste reduction and resource and energy efficiency targets set, achieved, and reported.
- Number of contracts incorporating waste reduction and resource and energy efficiency practices in their methodology.

Cultural Resources

- Number of New Zealand Historic Places Trust registered sites, heritage sites and trees recorded in operative and proposed district plans and archaeological sites affected by state highway activities.
- Number of complete Statement of Identified Maori Interest (SIMI) database entries.

Visual Quality

- Percentage of road user satisfaction survey respondents who indicate they are "satisfied," or better, with state highway landscapes.
- Square meters of existing state highway verges benefiting from new landscape treatments.
- Square meters of existing state highway verges benefiting from the Adopt-a-Highway program.
- Percentage of audited maintenance contracts that comply with vegetation and litter management requirements.

Ecological Resources

- Number of ecological resource areas identified on the GIS database.
- Percentage of audited maintenance contracts that comply with vegetation management requirements.

Vibration

- Number of vibration complaints received and addressed to the satisfaction of the complainant.

Land Use Planning

- Cumulative number of 'no complaint' instruments secured as a result of Transit requirements.

Contractual Processes

- Percentage of Transit staff who have attended environmental training in the last two years.
- Number of consultants and contractor organizations attending Transit's Environmental Plan briefings in the last three years.

Environmental Assessment

- Robust prioritization based on actual environmental effects enabled for noise and road run-off.
- Use of the environmental database by project managers and asset managers.

Information on each of these environmental categories is provided during annual updates of Environmental Plan progress.

Conclusions

New Zealand, most importantly, represents a country with a long history of being at the forefront of environmental preservation worldwide. As such, Transit New Zealand illustrates the longer term results that are possible by a transportation agency's taking a sustained approach toward environmental performance measures. National laws have been passed that require all infrastructure areas to be considered within a much broader sustainability construct. In particular, the national government is developing overall strategies for global warming and the implications on the provision of government services in the country. In addition, there is a long heritage of the use of performance measurement and government accountability in New Zealand. Transit New Zealand, for example, is always pointed to as a world leader in the use of performance-based planning and decision-making for transportation decisions. Thus, the evolution of Transit New Zealand's performance measurement framework to include environmental performance measures has not created great consternation nor major concern among transportation officials.

The existence of a Transit New Zealand Environmental Plan, which included its own set of performance measures, certainly helped the agency define which measures deserved attention at the highest levels of government. The agency did experience some uncertainty about environmental performance measures after the national legislature passed a law requiring Transit New Zealand to show how it was contributing to a sustainable future for New Zealand. The major question was what does sustainable mean in the context of annual performance measurement? As can be seen in the most recent Statement of Intent, this has been interpreted as meaning not only the relationship between transportation system performance and ensuing environmental impacts (such as on noise and air quality), but also in the longer term looking at the compatibility between national transport investment plans and regional/local development and land use plans.

5.0 Implementation

5.1 Achieving Effective Implementation

Two seemingly contradictory general findings emerge from the work performed. The first, as introduced in Section 1.0 and supported by the Section 4.0 findings, is that numerous initiatives exist both in this country and internationally that are directly related to aspects of environmental performance measurement. These include green or environmentally sensitive design, construction, maintenance, and operations practices; the implementation of environmental management systems; a growing library of environmental stewardship practices; the practices of context sensitive solutions (CSS) and context sensitive design (CSD); the use of environmental benefit agreements; and the application of geographic information systems and use of aerial data collection; as well as the growing and broad interest in the concept of sustainability. Elements of these practices are immediately available for adoption or adaptation by other state DOTs and MPOs. Further, as documented in the appendix to this report, a large variety of environmental performance measures have been successfully used.

At the same time, the practice of environmental performance measurement is not yet comprehensively developed or practiced within state DOTs. Many of the agencies surveyed and interviewed were reluctant to put themselves forward as representing, "good practice," saying that they know they are not doing as much as they would like to be doing. Other organizations responded that they just were not doing very much interesting work related to the measurement of environmental performance.

As a result, virtually all agencies would like to be doing more than they currently are, but are slowed by having to overcome a number of difficult challenges. Many environmental issues are difficult to quantify. Achieving an environmental objective is seldom within the complete control of a transportation agency, raising the question of what targets are appropriate and how to establish targets. Data may be difficult or costly to collect. Measures of environmental performance are affected by the actions of others; is it appropriate to measure and monitor something that is not fully under an agency's control? There are important issues of geographic and temporal scale; what is appropriate for monitoring by a transportation agency? As a result, the implementation of approaches to environmental performance measurement and management often take longer to develop and implement than initially thought.

The reconciliation of these apparent contradictions is that the results of this work indicate that despite these challenges, many agencies nonetheless are making important strides in their implementation of environmental performance measurements. These agencies recognize both the need and the opportunities that exist. For environmental performance measurement programs in particular, the manner in which these programs are designed, implemented, and managed is especially critical to the success achieved. Two previous NCHRP projects have developed guidelines for the implementation of performance measures. The results are

contained in NCHRP Report 446, *A Guidebook for Performance-Based Transportation Planning*[46], and the final report for Task 47 of NCHRP Project 8-36, *Effective Organization of Performance Management*[47]. In addition, implementation issues were discussed as part of the *Third International Conference on Performance Management* held in September 2007.[48] As elaborated upon in this section, the implementation-related findings from this environmental performance measurement project are consistent with the previous and broader NCHRP work, and also the September 2007 conference.

The following are basic guidelines or principles:

- Build upon existing and emerging practices, as elaborated upon in Section 5.2. Start simple, and then gradually move towards more advanced approaches.

- Utilize an incremental or time-phased approach to implementation, but one that is guided by trends and longer-term goals.

- Recognize that "one size that does fit all." As documented in Section 4.0, each State and MPO is different. An approach that may be appropriate in one institutional setting may not be appropriate in another.

- Especially in the area of environmental performance measurements, work with partners and stakeholders. An interdisciplinary working group is essential.

- Follow the principles for sustainable transportation, as summarized in Section 5.3. Environmental performance measurements should be introduced throughout all phases of an organization's management practices, including maintenance, operations, construction, planning, and project development. Further, performance measurements should include economic, the natural environment, communities, and the human or social environment.

- An environmental performance measurement program should be developed and implemented as part of a larger agencywide performance measurement program rather than as an independent initiative. Expand existing performance-based management approaches to include environmental considerations if this inclusion does not already exist. Similarly, if an environmental performance management initiative already exists but it is independent of an agency's performance-based management program, then the two initiatives should be coordinated and integrated. The approaches taken for various types of environmental performance measurements should be consistent with those for other types of performance measures.

[46] Cambridge Systematics, Inc. *A Guidebook for Performance-Based Transportation Planning*, National Cooperative Highway Research Program Report 446, Washington, D.C., 2000.

[47] Cambridge Systematics, Inc. *Effective Organization of Performance Measurement*, Final Report for National Cooperative Highway Research Program Project 8-36 Task 47, Washington, D.C., February 2006.

[48] Transportation Research Board, Third International Conference on Performance Measurement, Beckman Conference Center, Newport Beach, California, September 9-12, 2007. http://ww.trb.org/conferences/2007/PM/Agenda.pdf.

- Build upon existing implementation practices as documented in this report and in previous NCHRP publications as summarized in Sections 5.4 and 5.5.

5.2 Emerging Environmental Performance Measurement Practices

Emerging environmental management practices can serve as the basis for implementing a longer-term environmental performance measurement goals. An examination of environmental resource agency management practices indicates that advances in each of the following three areas are resulting in important advances in environmental performance measurement: environmental management systems; geographic mapping, tracking, and analysis; and adaptive resource management. While these practices are just beginning to be introduced within transportation agencies, each provides an important indication of the way that environmental performance measurement is likely to be conducted in the future.

5.2.1 Environmental Management Systems

The use of an Environmental Information Management System (EIMS) is described in Section 4.3.12. An EIMS, though sometimes viewed as a stand alone computer system, should be viewed as only one component of an agency's broader Environmental Management System (EMS). As indicated in Section 4.0, an EIMS generally is tailored to support the business process of a transportation agency, including areas such as supporting the NEPA process, commitment tracking, and public involvement. An EIMS, in addition, normally is designed for integration with an agency's other computerized database systems.

An EMS, in contrast, is far broader in scope and management ambition, and most frequently is designed and developed in compliance with the ISO 14000 standards promulgated by the Geneva-based International Organization for Standards (ISO). An EMS is defined by ISO 14001 as that part of an overall management system that includes organizational structure, planning activities, management and technical responsibilities, practices, procedures, processes, and resources for developing, implementing, achieving, reviewing, and maintaining an environmental policy. The U.S. EPA further defines an EMS as the set of processes and practices that enable an organization to reduce its negative environmental impacts and increase its operating efficiency.

ISO 14001 commonly is referred to as a "plan, do, check, act" management approach; i.e., environmental performance measurement. Under ISO 14001, an EMS provides for establishing an environmental policy, determining environmental impacts, establishing environmental objectives and measurable targets, implementation of programs to achieve these objectives and targets, monitoring to determine the degree to which these targets actually are being achieved, development of corrective actions where necessary, and management review. This approach to environmental management already is becoming increasingly common within the transportation profession.

5.2.2 Geographic Mapping, Tracking, and Analysis

A variety of technology-based approaches are being examined and implemented that have the potential to improve the consideration of environmental issues in transportation decisions.[49] Two closely related technology options are the use of geographic information systems (GIS) to both visually and analytically track how environmental conditions change over time and the use of integrated aerial data collection methodologies.

The U.S. Long-Term Ecological Research program (LTER) represents one example to temporally analyze environmental conditions.[50] The underlying goal of LTER is to improve the understanding of a diverse array of ecosystems at multiple spatial and temporal scales. LTER's mission is defined as, "To provide the scientific community, policy-makers, and society with the knowledge and predictive understanding necessary to conserve, protect, and manage the nation's ecosystems, their biodiversity, and the services they provide." Funded by the National Science Foundation (NSF), spatial databases are being developed for 24 separate sites located throughout the United States where data are collected and monitored on a long-term basis, thereby leading to an improved understanding of temporal changes in environmental conditions. While many of the LTER sites can be characterized as pristine and not directly influenced by urban conditions, the Central Arizona-Phoenix (CAP) is one of two LTER sites specifically designed to study ecology of urban systems. Phoenix and central Arizona is described as, "an arid land ecosystem profoundly influenced, even defined, by the presence of humans." Biological, physical, and social scientists from Arizona State University are working in cooperation with local partners to study the structure and function of the urban ecosystem, assess the effects of urban development on the Sonoran Desert, and understand the impact of ecological conditions on urban development. Sampling locations are randomly selected and include the Sky Harbor International Airport, the top of an eight-story parking garage, and the median of a freeway.

Integrated aerial data collection is used to collect spatial data from multiple sources to produce an information-rich set of databases for a particular area that can be combined with existing GIS data layers for use in environmental analyses. Integrated aerial data collection can include multispectral satellite imagery, color infrared and black and white digital orthorectified imagery, light detection and ranging (LIDAR) data, and hyper-spectral image data.

The National Consortium on Remote Sensing in Transportation-Environment Assessment (NCRST-E) is a multiyear effort sponsored by the U.S. DOT's Research and Innovative Technology Administration (RITA) that is based at the Mississippi State University's Remote-Sensing Technology Center (RSTC). The objective of this work is, "to apply remote sensing technology to estimate surface properties and classify land use and land cover change at multiple spatial resolutions to determine growth trends in response to, and environmental and socioeconomic effects of, transportation development."

[49] Descriptions of these technologies are contained in NCHRP Research Results Digest 304, *Technologies to Improve Consideration of Environmental Concerns in Transportation Decisions*, prepared by CH2M Hill as part of NCHRP Project 25-22(02), Washington, D.C., June 2006.

[50] http://www.lternet.edu.

Land use and land cover information is being developed over time for existing transportation corridors in selected Mississippi study areas, with particular attention on assessing the impacts of transportation projects on inland and coastal waterways. The hope is that these measurements will result in more accurate estimates of environmental impacts and replace the need to rely on the use of secondary data sources. Related applications have been developed with state DOTs in North Carolina, Iowa, Alabama, Virginia, and Washington.

5.2.3 Adaptive Resource Management

Considerable attention and effort has been given by both state and Federal transportation agencies in recent years to the way in which the NEPA environmental impact Statement (EIS) process is managed. These include Section 1309 of the Transportation Equity Act for the Twenty-First Century (TEA-21) and Executive Order 13274, Environmental Stewardship and Transportation Infrastructure Project Reviews. In addition, the Council on Environmental Quality (CEQ) has undertaken its own NEPA modernizing efforts. Adaptive resource management is one approach that has received attention from CEQ.[51]

"Adaptive resource management" is a performance measurement management approach that has been used since the late 1970s for the management of ecosystems that is now being extended to other environmental systems. CEQ recognizes that environmental protection afforded by the "predict, mitigate, and implement" environmental management model now in wide use today depends on the accuracy of the predicted impacts and expected results of any mitigation. This "one-time" approach does not account for any unanticipated conditions, inaccurate predictions, or subsequent information. To address these issues, adaptive management adds "monitor and adapt."

Adaptive resource management is fully consistent with the principles of using performance measures for accomplishing agreed upon goals and objectives and ISO 14001 environmental management systems. It is defined as, "a structured, iterative process of optimal decision-making in the face of uncertainty, with an aim to reducing uncertainty over time via system monitoring. In this way, decision-making simultaneously maximizes one or more resource objectives and, either passively or actively, accrues information needed to improve future management."

According to the CEQ, "integrating adaptive management and the NEPA process gives agencies a tool that provides them with flexibility to address unanticipated results of project implementation and to adjust decision for practical reasons." Implementation of an adaptive environmental management strategy includes:

- The ability to establish clear monitoring objectives;
- Agreement on the impact thresholds to be monitored;
- The existence of a baseline or the ability to develop a baseline for the resources to be monitored;
- The ability to see the effects within an appropriate timeframe after the action is taken;

[51] Council on Environmental Quality, *The National Environmental Policy Act: a Study of its Effectiveness After Twenty-five Years,* Washington, D.C., 1997.

- The technical capabilities of the procedures and equipment used to identify and measure changes in the affected resources and the ability to analyze the changes; and

- The resources needed to perform the monitoring and respond to the results.

The settlement agreement entered into between the FHWA and the Sierra Club in connection with the expansion of U.S. 95 in Las Vegas illustrates a transportation application of adaptive resource management. The issue of air toxics was a primary concern raised by the Sierra Club in its legal challenge to U.S. 95 in Las Vegas. *(Sierra Club v. Mineta,* D. Nev., No. CV-S-02-0578-PMP-RJJ, settlement announced June 27, 2005).

The U.S. 95 widening project proposed to increase the highway from six lanes to 10 lanes, in response to estimates that by 2015, absent improvements, peak hour traffic volume was expected to equal or exceed capacity on more than 100 miles of roadway in the Northwest Region of the Las Vegas Valley. The Sierra Club had challenged the sufficiency of the environmental impact statement, maintaining the EIS did not adequately identify and study the project's impacts, including adverse health effects from increased motor vehicle emissions. The U.S. District Court for the District of Nevada ruled in favor of FHWA, but the Sierra Club appealed this ruling and the U.S. Court of Appeals for the Ninth Circuit issued a stay on construction of the highway project pending the outcome of the appeal.

In a June 27, 2005 settlement, FHWA and the Nevada Department of Transportation agreed to install air pollution monitoring and filtration systems at three schools adjacent to U.S. 95, relocate portable school buildings and playgrounds, help redesign a nearby high school to minimize exposures, and retrofit diesel school buses to reduce emissions. FHWA also agreed determine the levels and behavior of toxic air pollution from motor vehicles. The results of the studies could have implications for addressing toxic air emissions from highways nationwide.

5.3 Moving Towards Sustainable Transportation

The 1987 report of the World Commission on Environment and Development, widely referred to as the Brundtland Report, defined sustainable development as, "development that meets the needs of the present without compromising the ability of future generations to meet their own needs." The tracking of indicators of sustainable development, along with the implementation of sustainable development practices, gradually has been introduced in countries such as New Zealand, Australia, the United Kingdom, and Denmark. The concept of sustainability, though, has been less commonly discussed in the United States. That, however, is changing and considerations of sustainability have become an important element of transportation management. The release of the series of 2007 reports by the Intergovernmental Panel on Climate Change (IPCC) was a major factor in contributing to this change. Considerations of congestion, expanded capacity, and development practices, though, also were an important contributor.

In a report submitted to the National Surface Transportation Policy and Revenue Study Commission in July 2007, the American Association of State Highway and Transportation Officials (AASHTO), working with other transportation industry groups, concluded that "new thinking" was required if transportation was going to be successful in addressing issues of global economic competition, metropolitan congestion, and global climate change. The

Transportation Vision and Strategy for the 21st Century includes sustainable transportation as one of its core recommendations.[52,53] Programs of environmental performance measurement developed and implemented by State DOTs and MPOs, therefore, should be consistent with achieving sustainable transportation practices, and thereby recognizing and promoting the positive environmental benefits that can result from well-designed transportation programs and projects. These kinds of changes in environmental monitoring, reporting, and decision-making help to elevate transportation environmental performance from what at times has been a "second tier" issue.

The AASHTO sustainability recommendations cover five areas, including climate change and the coordination of land use and transportation and affecting both the development and the delivery of transportation projects and services. The objective is to achieve "better than before" outcomes in which the natural, social, and built environments are improved concurrently with the implementation of transportation improvements. Central to achieving the defined sustainability goals is adoption of a "triple bottom line" policy making and performance assessment tool in which environmental, social, and economic objectives and outcomes are monitored as a "yardstick for evaluating the sustainability of surface transportation system policies and performance."

The work of Henrik Gudmundsson of the Danish Transport Research Institute can be examined as an example of research performed on sustainable transport performance indicators.[54,55] Consistent with the findings of this NCHRP research, Gudmundsson concludes that, "there is not one uniform approach and not one general application – the function of sustainable transport indicators will be highly dependent on specific context, and can serve different users with different priorities and concerns." Gudmundsson recommends an indicator pyramid consisting of 5-10 headline indicators for use by decision-makers and the public, 20-200 indicators of medium aggregation for use by policy makers and analysts, and basic data and statistics for use by scientists and engineers. Suggested indicators are characterized in a two-dimensional matrix in which environmental, economic, social, and institutional indicators are examined for both present and future generations. Examining the continued viability of natural life-support systems is an example of looking into the future, with the objective being to reduce the pressure on natural life support systems, including climate change. Gudmundsson recommends that indicators be of adequate scope; for example, examining human as well as ecosystem time scales. In addressing success factors for indicators, Gudmundsson emphasizes the importance of choosing indicators that can be easily and directly linked to decision-making.

While Gudmundsson concludes that it is difficult to define sustainable transport in the absolute, the desire for transportation to be more sustainable will not go away. Therefore,

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[52] U.S. Department of Transportation, National Surface Transportation Policy and Revenue Study Commission, Washington, D.C., July 26, 2007.

[53] American Association of State Highway and Transportation Officials, *Transportation Vision and Strategy for the 21st century Summit,* Report of the Sustainable Transportation Panel, March 1-2, 2007.

[54] Gudmundsson, Henrik, *Sustainable Transport and Performance Indicators,* Issues in Environmental Science and Technology, No. 20, Transport and the Environment, 2004.

[55] Gudmundsson, Henrik, *Sustainable Transport and the Role of Performance Indicators*, Paper presented at the Third International Conference on Performance Measurement, Transportation Research Board, September 9-12, 2007.

while establishing targets may help, it is more important to use environmental performance measurements to examine directions of change; i.e., will a particular decision make matters better or worse?

5.4 Management Attributes of Successful Performance Measure Programs

It is important, as indicated in Section 5.1, that an environmental performance measurement program be developed and implemented as an integral component of a broader performance-based management framework rather than on a stand alone basis. Task 47 of NCHRP Project 8-36 examined *how* a performance measurement program should be organized, in contrast to the *types* of performance measures that might be employed.[56] The results were based an examination of performance measurement programs implemented in 12 state DOTs and MPOs. As confirmed by the work performed for this current environmental performance measurement project, the following are recommended as key management attributes that help position a performance measurement program for success. More in-depth discussions of individual points are provided as part of the Task 47 final report.

- **Start with Easy Actions –** The majority of successful performance measurement programs have started with modest, easily implementable actions. These initial steps then are used to build momentum for more comprehensive and far-reaching steps.

- **Top-Level Leadership –** Commitment to performance measurement from a CEO-level leader fosters broad employee support. If an organization's leader promotes the use of performance data for decision-making, resource allocation, and/or guiding agency direction, the performance measurement program is more likely to receive support from within the organization.

- **Career/Senior Management Leaders –** Championship of performance measures by career-level managers helps institutionalize a performance measurement program. These champions provide day-to-day leadership and continuity that helps sustain performance monitoring on an organization's agenda, even when changes in executive-level administration occur.

- **Performance Measurement Culture and Employee Accountability –** Creating a culture where performance measurement and the setting of performance targets are accepted helps motivate employees to participate and strengthens program continuity over time. Ownership and employee buy-in are fostered when staff has an expectation that measurement reports will be regularly reviewed and acted upon by top-level management. A consistent and stable program can improve the value of an agency's performance measurement program over time and creates an expectation that performance measurement is becoming a part of an agency's operation, and not simply a short-term initiative.

[56] Cambridge Systematics, Inc. *Effective Organization of Performance Measurement*, Final Report for National Cooperative Highway Research Program Project 8-36 Task 47, Washington, D.C., February 2006.

- **Link Measures with Actions –** The review of performance measure results should be linked to decision-making processes that allow appropriate responses to be taken, including resource allocation decisions, to address issues identified during the monitoring and review process.

- **Decentralized Responsibility –** Establishing widespread responsibility for performance measurement data collection, management, and analysis is likely to result in the greatest impact. The key is to identify effective participants across an agency, engage knowledgeable staff, and develop reporting mechanisms that expand responsibility for the program beyond a small number of centralized staff.

- **Cyclical Reporting on Performance –** Cyclical reporting, especially external reporting to customers and partner environmental organizations, is likely to increase agency accountability for decision-making and delivery. Agency reports on key performance indicators establish expectations among legislators and other key decision-makers for continued performance-based decision-making that support program stability over time. Clear regularly scheduled reports also provide a consistent discussion document when addressing resource needs.

Many DOT performance measurement practitioners credit committed leadership among the highest echelons of executive management as a defining factor in the success of their agencies' performance measurement initiatives. This applies to environmental as well as to broader performance measurement programs. An effective performance measurement program, however, can still struggle to survive inevitable changes among top-level administrators or swings in agencywide policy priorities. The leadership solutions that many transportation organizations having successful performance measurement programs have found to be effective blend high-level leadership from an executive office/CEO-type figure with support from one or more career status senior-level managers who act as performance measurement champions.

State DOTs engaged in performance measurement typically employ a small performance measurement unit or office that brings focus to overall agency activities. The weaknesses of concentrating performance measurement functions and responsibilities in a single office, however, include a perception among other agency staff that performance is the responsibility of others, is not relevant to their own group, or is simply for the purposes of evaluation. Dispersing performance measurement activities to those with the greatest expertise and familiarity with the data, therefore, is a necessity for building a successful performance measurement program.

A centralized group can oversee performance measures and provide necessary technical support, but basic responsibility for data collection and initial analysis can be decentralized to an array of individual "measure owners" who are considered closest to the data. This is especially the case with environmental performance measurement programs given the wide breadth and associated highly technical nature of relevant environmental considerations. Decision-making elements are decentralized and those responsible for managing the data collection efforts understand how it is used. In such systems, those responsible for data collection and analysis have greater incentive to promote data accuracy, analyze information based on their own expertise, and identify appropriate actions to address performance.

Successful performance measurement programs usually feature a direct connection between performance results and some element of action. A key means to improving buy-in from employees and partner organizations is to establish some sort of action that is directly linked to performance. "Actions" can take many forms, from face-to-face management meetings where performance results are reported, to business plans structured around strategies to address performance deficiencies, to programming and funding allocation decisions based on current or projected performance. Success is not necessarily determined by the action itself, but by the presence of "action" as a step in the performance measurement process.

Finally, many agencies cite staffing levels and resource constraints as challenges to establishing expanded environmental performance measurement practices. Given the challenge of tight budgets for many transportation organizations, performance measurement practices should be integrated to the maximum extent possible into existing business management processes. Examples include adding a performance reporting element to existing quarterly meetings between districts and including environmental performance elements to the annual business planning process. The significance of performance measurement programs becomes clearer when they can be linked to compelling priority objectives or initiatives within an organization. Integrating environmental performance measurement into existing agency management practices, therefore, contributes to the important objective of integrating environmental measurement into the mainstream of agency operations.

5.5 Achieving Success

The design, development, and implementation of comprehensive environmental performance measurements, as evidenced from the findings of this project, should be viewed as a long-term management initiative. Indeed, most agencies have implemented environmental performance measurements incrementally over some period of time. While some successful environmental performance measurement implementation efforts can be characterized as being piecemeal, attempting to accomplish a few high-priority objectives, it is still valuable to have an overall work plan in mind that can be used to provide overall guidance. Based on the work performed for this project, the desirable management attributes described in Section 5.4, and the performance measurement development process described in Chapter 3 of NCHRP Report 446 the following are suggested steps for the development and implementation of environmental performance measurements:[57]

- **Getting Started –** Obtain high-level management endorsement that it is in the agency's best overall interest to monitor environmental performance through a measurement program. Such a measurement program fosters coordination of transportation and environmental resource decision-making and development of collaborative decision-making with environmental resource agencies. Assemble the necessary organizational resources, including designation of a project manager and supporting agency staff.

[57] Expanded discussions of these steps are contained in NCHRP Report 446, *A Guidebook for Performance-Based Transportation Planning*, prepared by Cambridge Systematics, Inc. for the National Cooperative Highway Research Program, Washington, D.C., 2000.

- **Select, Prioritize, and Schedule Applications –** Consider maintenance, construction, and operations as well as planning and design. Performance measures often are viewed as a planning initiative. Performance-based management practices, though, really cross-cut across all aspects of an agency's operation, with significant environmental benefits being easily accomplishable in maintenance, construction, and operations practices. The challenge is to prioritize these opportunities in terms of their relative benefits and costs.

- **Develop an Interagency Working Group –** Identify target stakeholder audiences and partner agencies for environmental performance measurements, including the purposes and uses these organizations or groups have for particular environmental performance measurements. Measure and obtain information in a form that will meet the needs of these stakeholder groups.

- **Develop Goals and Objectives –** Have overall multiyear goals in mind for an environmental performance measurement program, but begin with small steps and proceed incrementally. Adopt environmental goals and objectives; incorporate environmental measures in evaluation criteria for prioritizing projects and periodically review the weight given to these measures; adopt environmental performance standards; monitor environmental performance measurements. Most successful performance measurement programs start small and grow by learning from experience and building support. Early success enables gradual expansion of environmental performance measurement within an agency.

- **Develop Performance Measures –** Utilize a mix of different performance measure types. While outcome measures in many ways are the most desirable, they also can be more costly to obtain and also more difficult to directly relate to actions of a transportation agency. A mix of output (e.g., permitting, time), process, and productivity measures, therefore, can be important supplements to outcome-defined measures. Use indirect as well as direct measures; for example, the number and type of walking trips can be used as an indirect indicator of physical activity and health.

- **Design a Reporting System –** Develop a hierarchy of environmental performance indicators to meet the needs from top agency management down through individual operating units. A hierarchy of three or four levels of environmental performance measurements can be defined, as illustrated in Appendix B, that facilitates examination of more detailed or in-depth environmental measurements; e.g., water quality, air quality. The top level may be of interest primarily to upper management and for public information purposes, and include ambient air quality levels and amounts of mobile source emissions. Midlevel measures for air quality should be designed to meet the needs of midmanagement personnel and relate more to the specific manner that transportation factors may be contributing to air quality problems. The lowest-level measures should assist managers of individual programs; for example, a measurement of the number of truck stops that have been electrified. Keep the number of environmental performance measurement indicators at any one level to as small a number as possible so as to improve the manageability of the resulting information. The desire is not to measure everything possible, but to improve an agency's environmental performance.

- **Identify Data Sources –** Examine the environmental data that currently are collected by the DOT, MPOs, and partner environmental resource agencies and assess the potential of these

data to support the measurement and monitoring of desired environmental goals and objectives. It is important, though, to identify and measure what is important rather than to have environmental performance monitoring be constrained by limitations associated current data sources. The intent is to manage underlying causal factors and not just the data measurement process. At the same time, it is likely that not all desirable data will be available. As discussed in NCHRP Report 446, some agencies have addressed this gap by incrementally adopting more challenging performance measures as the agency becomes able to implement the necessary additional data collection, synthesis, and analysis tools. Thus, data increasingly are being viewed as an asset, equivalent in importance to pavement, bridges, drainage facilities, and other physical infrastructure. The suggested data strategy is to begin by identifying the "ideal" measures that relate to a particular environmental goal, then work backward to interim and surrogate measures that can be developed using more readily available data. Such an approach enables a balancing of data needs and costs.

- **Identify Analytical Tools –** A variety of analytical tools can be used to analyze and synthesize environmental performance measurements. As described in Section 5.2, these include environmental information management systems as well as geographic information and related geospatial analysis systems. They also can include specialized impact analysis tools such as an air quality dispersion model. Analytical tools also permit environmental data to be examined in conjunction with population, socioeconomic, and other community data to gain an improved understanding of equity considerations and the manner in which specific environmental justice populations are affected over time by transportation systems. Thus in selecting environmental performance measures and making the associated data decisions (Step 7), it also is useful to examine both existing and potential new analytical methodologies that could be used to support an environmental measurement program.

- **Report Results –** The reporting of results, consistent with Step 6, should be viewed from a communications rather than a technical perspective. Information should be communicated in a manner that will facilitate an easy understanding of important trends and indicators by the full range of different interests. Emphasis should be given to utilizing rapidly emerging visualization techniques including mapping as well as graphs and other charts. In today's electronic world, information can be placed on Internet and Intranet sites, thereby making environmental performance measurement results more rapidly and broadly available. Over time, periodically review adjust, and expand the adopted environmental performance measurements. For example, an agency may choose to start with issues such as ecology, water quality, and air quality, but then introduce emerging issues such as climate change and health.

Appendix A

Transportation Performance Measurement Literature

A. Transportation Performance Measurement Literature

National Cooperative Highway Research Program Report 446: A Guidebook for Performance-Based Transportation Planning, Transportation Research Board, (2000).

- This guidebook provides transportation agencies, planners, and practitioners with a description of the tools and processes necessary to integrate performance measures into the multimodal transportation decision-making process. The report explains the underlying rationale for employing performance measures, provides examples from around the country, and offers a "Performance Measures Library" listing measures currently in use. This library is organized by performance measure topic area, with subtopics associated with each area. Two topic areas, Quality of Life, and Environmental and Resource Conservation, include performance measures relating to the environment.

Bremmer, Daniela, Keith C. Cotton, and Brooke Hamilton, *Emerging Performance Measurement Responses to Changing Political Pressures at State DOTs: A Practitioners Perspective.* TRB 2005 Annual Meeting.

- This paper highlights trends in the development and use of performance measures by state DOTs. The authors identify the factors that motivate the development of a performance measure system, and influence the type of response by state DOTs. The trends inform a set of recommendations for transportation agencies interested in taking their performance measures systems to the next level.

Meyer, Michael D., *Use of Performance Measures for Surface Transportation in Different Institutional and Cultural Contexts: The Case of Australia, Japan and New Zealand.* TRB 2005 Annual Meeting.

- This paper documents the use of performance measures by transportation agencies in Australia, Japan, and New Zealand. It compares the organizational structures, the actual performance measures in place, and aspects of their use in the planning process among the three countries. The author identifies common characteristics of performance measure programs in each country, and suggests that these commonalities could be used to inform the adoption of performance measurements elsewhere.

National Cooperative Highway Research Program, *Strategic Performance Measures for State Departments of Transportation: A Handbook for CEOs and Executives.* Project No. 20-24(20), June 2003.

- This report provides guidance on linking strategic planning and performance measures through the use of strategic performance measures. The document outlines how one informs the other, and provides the basic building blocks for creating and implementing a strategic performance measurement program. Specific agency examples are cited throughout the report. Specific to environmental performance measures, the document notes that agencies differ in the area where they focus on the environment; some focus on

the effectiveness and efficiency of the environmental process, some focus on outcomes or outputs, and others consider environmental factors to be part of a commitment to customer satisfaction. The report includes an appendix listing strategic performance measures adopted by Florida, Kentucky, Louisiana, Maryland, Minnesota, New Mexico, Pennsylvania, and Washington.

National Cooperative Highway Research Program. *Managing Change in State Departments of Transportation. Scan 1 of 8: Innovations in Strategic Leadership and Measurement for State DOTs.* Web Document 39 (Project SP20-24[14]). October 2001.

- This report is one of eight in a series investigating the ways that state DOTs are using strategic management strategies to deal with change. Based on a survey, the report documents some general trends used by state DOTs to use performance measurement for the purpose of strategic management. The report provides specific examples of DOTs using performance measurements in the three distinct areas of measurement systems as measurement tools, scorecards and dashboards, and measuring outcomes.

International Technology Exchange Program. *Transportation Performance Measures in Australia, Canada, Japan, and New Zealand.* December 2004.

- An international scan was conducted to explore the ways in which performance measurement is being used in transportation planning and decision-making in different countries. The scan included Australia, Canada, Japan, and New Zealand. From the information collected, the team identified 23 observations that would be of particular interest to transportation officials in the United States. In addition, the report includes 14 lessons learned and 10 implementation strategies and recommendations. Specifically related to the environment, the team found that while all of the sites were aware of the importance of monitoring environmental impacts, they were all struggling to identify effective areawide measures.

Transit Cooperative Research Program. *TCRP Report 88: A Guidebook for Developing a Transit Performance-Management System.* 2003.

- This report provides a step-by-step approach for integrating a performance-based management system into transit operations and regional decision-making processes. It includes traditional and nontraditional performance measures and indicators that relate to customer-oriented and community issues. Included in the transit performance measures menu are four topics related to the environment: noise impact, resource consumption impact, environmental impact, and energy consumption. Each topic is accompanied by examples of specific performance measures that could be adopted to monitor these areas.

Poister, Theodore H. *Performance Measurement in Transportation: State of the Practice.* Andrew Young School of Policy Studies, Georgia State University.

- This paper documents recent trends in the development and implementation of performance measures by transportation agencies. It addresses environmental and economic impact specifically, and provides a few examples of states that have adopted such measures. The paper summarizes recent trends and continuing challenges, including a list of specific issues that need to be addressed.

National Cooperative Highway Research Project. *Peer Exchange Series on State and Metropolitan Transportation Planning Issues. Meeting 2: Nontraditional Performance Measures.*

- As part of a series of peer exchanges on state and metropolitan transportation planning issues, this report summarizes a facilitated discussion by state DOT, MPO, and transit officials about their use of nontraditional performance measures. The report provides an overview of performance-based planning and nontraditional performance measures (listing environmental justice, environmental quality, and sustainability as three separate functional areas).

Sustainability Literature

Litman, Todd. *Practical Indicators for Sustainable Transportation Planning.* Victoria Transport Policy Institute. TRB 2005.

- In this paper, Litman looks at sustainability as incorporating economic, social, and environmental factors. With these areas in mind, the paper documents a range of performance measures addressing sustainability and the relevant data. It reviews traditional transportation goals, objectives and indicators, and then provides a list of specific sustainability indicators.

United States Department of Transportation, Federal Highway Administration. *Sustainable Transportation Practices in Europe.* November 2001.

- This report documents the findings of a scan tour of Sweden, Germany, the Netherlands, and Scotland. The tour was conducted to gather information on how other countries are dealing with transportation in relation to sustainability. The study found six general policies and practices present in each of the country's efforts, one of which was performance measures. The report includes specific examples from each of the countries with specific highlights of their programs.

Gudmundsson, Henrik. *Making Concepts Matter: Sustainable Mobility and Indicator Systems in Transport Policy.* UNESCO, 2003.

- This report studies six existing sustainability indicator programs to determine whether their policy applications effectively capture and promote the concept of sustainable mobility. The study reviews the use of indicators and the concept of sustainability. The author makes a distinction between sustainability and environmental indicators. The report concludes that each of the programs reviewed are strong on measuring themes such as emissions or energy, but are less successful in operationalizing impacts on things such as the ecosystem and human health. Finally, the authors used their findings to provide a list of criteria necessary to build the optimal sustainable indicators system.

Hall, Ralph P. *Understanding and Applying the Concept of Sustainable Development to Transportation Planning and Decision-Making in the U.S.* Submitted to the Massachusetts Institute of Technology to fulfill the requirements of a degree of Doctor of Philosophy in Technology, Management, and Policy, 2006.

- This paper identifies techniques and strategies that have not yet been utilized in a systematic way to promote sustainable development and sustainable transportation. Specifically, the research examines the role of indicators in measuring sustainable transportation. It specifies important components of sustainability indicators, noting that the outcome may be different than for a traditional environmental performance measure. For example, there are multiple ways to improve air quality, but not all methods would necessarily reduce congestion or take other steps toward achieving sustainability.

Specific to Transportation and the Environment

Ministry of Environment and Energy National Environmental Research Institute, *Indicators and Performance Measures for Transportation, Environment and Sustainability in North America,* Research Notes No. 148 (June 2001).

- This report is a summary of a scan conducted in the United States and Canada to understand how performance measures are being used in the areas of transportation and the environment. The report documents how performance planning requirements are working, how effective performance measures are at integrating the environment into transportation planning decisions, and the types of indicators that are in place. The researchers compared efforts in the two countries, and at the state and Federal levels. The report also comments on the concept of sustainability, and how it has been integrated in the two countries.

Venner, Marie. *Measuring Environmental Performance at State Transportation Agencies.* Transportation Research Record 1859, Paper No. 03-4485. Transportation Research Board, 2004.

- This paper reviews some of the traditional ways that transportation agencies have been using performance measures to measure their programs. It then describes how these techniques can be applied to monitoring the environmental impact of their decisions. The paper specifically highlights the challenges associated with implementing and utilizing environmental performance measures. Examples of specific state programs are highlighted throughout the paper.

United States Environmental Protection Agency. *Indicators of the Environmental Impacts of Transportation: Highway, Rail, Aviation, and Maritime Transport.* EPA 230-R-96-009. October 1996.

- This report is the product of an effort by the EPA to develop environmental indicators for the transportation sector. The report provides the framework for the indicators, identifies the environmental impacts of transportation, develops indicators, quantifies the environmental impacts of transportation at the national level, and identifies data gaps. The report looks at four primary modes of transportation (highway, rail, aviation, and maritime), and looks at environmental impacts in three areas: air; water; and land resources. The study considers the impacts of transportation for the entire "life cycle," from infrastructure construction to disposal of vehicles. An updated version of this report was released in 1999.

The Gallup Organization for the Federal Highway Administration. *Implementing Performance Measurement in Environmental Streamlining.* January 2004.

- This study was commissioned by the FHWA to measure the performance of agencies involved in environmental streamlining, and therefore determine the areas in need of improvement. The study was conducted using both qualitative and quantitative measures to look at how the system is functioning. The report provides interesting insight on some of the difficulties that transportation and resource agencies face in trying to collaborate, thereby highlighting key barriers in the effort to measure environmental performance.

National Cooperative Highway Research Program. *Report 481: Environmental Information Management and Decision Support System – Implementation Handbook.* Transportation Research Board, 2003.

- This guidebook describes an environmental-based decision support system framework that can be applied to transportation planning, programming, project development, operations, and maintenance decision-making. The document provides step-by-step instructions for implementation of an Environmental Information Management and Decision Support system.

Appendix B

Typology of Environmental Performance Measures

B. Typology of Environmental Performance Measures

Table B.1 Typology of Environmental Performance Measures

Environmental Category	Performance Measure	Agency Using Measure	Source Document
Human Impacts			
Air Quality	Metric tons (in millions) of carbon equivalent emissions from transportation sources	Ministry of Environment and Energy National Environmental Research Institute	U.S. DOT
	Change in Criteria Pollutant Emissions compared to Vehicle Travel	Ministry of Environment and Energy National Environmental Research Institute	U.S. EPA
	Criteria Pollutant Emissions from Transportation Vehicle and Equipment Manufacturing (car, rail, aircraft, etc.) (percentage of total)	Ministry of Environment and Energy National Environmental Research Institute	U.S. EPA
	Criteria Pollutant Emissions from Airport Service Vehicles	Ministry of Environment and Energy National Environmental Research Institute	U.S. EPA
	Quantity of CO, NO_2, PM-10, TP, SO_2, VOC released to air	EPA: Indicators of the Environmental Impacts of Transportation	U.S. EPA
	Cases of chronic respiratory illness, cancer, headaches, respiratory restricted activity days, and premature deaths due to motor vehicle pollution	EPA: Indicators of the Environmental Impacts of Transportation	U.S. EPA
	Quantity of CFCs consumed in autos	EPA: Indicators of the Environmental Impacts of Transportation	U.S. EPA
	VOC Emissions from Solvent Utilization in Surface Coating for Autos and Light Trucks	Ministry of Environment and Energy National Environmental Research Institute	U.S. EPA
	VOC Emissions from Service Stations	Ministry of Environment and Energy National Environmental Research Institute	U.S. EPA
	Fuel consumption resulting from aviation travel	EPA: Indicators of the Environmental Impacts of Transportation	U.S. EPA
	Share of CO2 Emissions from Transportation	Ministry of Environment and Energy National Environmental Research Institute	U.S. EPA

Table B.1 Typology of Environmental Performance Measures (continued)

Environmental Category	Performance Measure	Agency Using Measure	Source Document
Human Impacts (continued)			
Air Quality (continued)	Full Fuel Cycle CO_2-equivilant Emissions for Light-duty Motor Vehicles (grams per mile)	Ministry of Environment and Energy National Environmental Research Institute	U.S. EPA
	Estimated U.S. Emissions of CFC-12 and HFC-134a (all sources not only transportation)	Ministry of Environment and Energy National Environmental Research Institute	U.S. EPA
	Greenhouse gas emissions for all transport	Litman (2004)	Sustainable Transportation Performance Indicators (STPI) project by the Centre for Sustainable Transport
	Ambient air quality	Litman (2004)	Sustainable Transportation Performance Indicators (STPI) project by the Centre for Sustainable Transport
	Per capita emissions of "conventional" air pollutants (CO, VOC, NO_x, particulates, etc.)	Litman (2004)	Litman's Compiled Indicators
	Transportation-related emissions by region	Tennessee Long-Range Transportation Plan	Tennessee DOT
	Increase-decrease in air quality pollutants in major transit corridors	Tennessee Long-Range Transportation Plan	Tennessee DOT
	Reduced greenhouse gas emissions and other air pollutants from transportation sources	International Technology Exchange Program	Transport Canada
	Reduction in CO_2 emissions	International Technology Exchange Program	Japanese Government
	Percent of NO_2 environmental goal achievement	International Technology Exchange Program	Japanese Government
	Percent of suspended particulate matter goal achievement	International Technology Exchange Program	Japanese Government
	Transport emissions of greenhouse gases by mode and by type of gas	Operationalising Sustainable Transport and Mobility: The System Diagram and Indicators	SUMMA

Table B.1 Typology of Environmental Performance Measures (continued)

Environmental Category	Performance Measure	Agency Using Measure	Source Document
Human Impacts (continued)			
Air Quality (continued)	Greenhouse gas emissions from vehicle and parts manufacture, and transport maintenance by mode and by gas	Operationalising Sustainable Transport and Mobility: The System Diagram and Indicators	SUMMA
	Transport emissions of air pollutants by mode and by type of pollutant	Operationalising Sustainable Transport and Mobility: The System Diagram and Indicators	SUMMA
	emissions of air pollutants from vehicle and parts manufacture, and transport maintenance by mode and by type of pollutant	Operationalising Sustainable Transport and Mobility: The System Diagram and Indicators	SUMMA
	Amount of pollutants released at transport accidents by type of pollutant and by mode	Operationalising Sustainable Transport and Mobility: The System Diagram and Indicators	SUMMA
	Tons (in millions) of mobile source emissions from on-road motor vehicles	Ministry of Environment and Energy National Environmental Research Institute	U.S. DOT
	Index of emissions of air pollutants from road transport	Litman (2004)	Sustainable Transportation Performance Indicators (STPI) project by the Centre for Sustainable Transport
	Per capita fossil fuels consumption, and emissions of CO2 and other climate change emissions	Litman (2004)	Litman's Compiled Indicators
	Mobile Source Contribution to Hazardous Air Pollution Inventories	Ministry of Environment and Energy National Environmental Research Institute	U.S. EPA

Table B.1 Typology of Environmental Performance Measures (continued)

Environmental Category	Performance Measure	Agency Using Measure	Source Document
Human Impacts (continued)			
Community Impacts/ Quality of Life; Civil Rights; Environmental Justice	Percent urban population living within one mile of transit stop with service of 15 minutes or less	Ministry of Environment and Energy National Environmental Research Institute	U.S. DOT
	Environmental justice cases that remain unresolved over one year	Ministry of Environment and Energy National Environmental Research Institute	U.S. DOT
	A community that is engaged and well informed	International Technology Exchange Program	Transport Canada
	Increased public awareness of the environmental impact of transportation activities	International Technology Exchange Program	Transport Canada
	Triple bottom line reporting measures for assets – social, environmental, and economic	International Technology Exchange Program	Transit New Zealand
	Amount of funding for environmental or community restoration from rail impacts	Tennessee Long-Range Transportation Plan	Tennessee DOT
Land Use/ Consumption	Land Area Occupied by Roadways	Ministry of Environment and Energy National Environmental Research Institute	U.S. EPA
	Cumulative land area covered by surface rail track	EPA: Indicators of the Environmental Impacts of Transportation	U.S. EPA
	New land area taken for track	EPA: Indicators of the Environmental Impacts of Transportation	U.S. EPA
	Track mileage constructed and abandoned	EPA: Indicators of the Environmental Impacts of Transportation	U.S. EPA
	Number of airports constructed	EPA: Indicators of the Environmental Impacts of Transportation	U.S. EPA
	Length of runways constructed	EPA: Indicators of the Environmental Impacts of Transportation	U.S. EPA
	Cumulative number of airports	EPA: Indicators of the Environmental Impacts of Transportation	U.S. EPA

Table B.1 Typology of Environmental Performance Measures (continued)

Environmental Category	Performance Measure	Agency Using Measure	Source Document
Human Impacts (continued)			
Land Use/ Consumption (continued)	Number of U.S. ports and marinas	EPA: Indicators of the Environmental Impacts of Transportation	U.S. EPA
	Disposal/Use of Material Dredged by U.S. Army Corp of Engineers	Ministry of Environment and Energy National Environmental Research Institute	U.S. EPA
	Land use for transport	Litman (2004)	Sustainable Transportation Performance Indicators (STPI) project by the Centre for Sustainable Transport
	Per capita land devoted to transportation facilities	Litman (2004)	Litman's Compiled Indicators
	Number of shared use trails along major state natural and manmade corridors	Tennessee Long-Range Transportation Plan	Tennessee DOT
	Land take by transport infrastructure by mode and as percent of country surface area	Operationalising Sustainable Transport and Mobility: The System Diagram and Indicators	SUMMA

Table B.1 Typology of Environmental Performance Measures (continued)

Environmental Category	Performance Measure	Agency Using Measure	Source Document
Human Impacts (continued)			
Public Health/ Safety	Index of incidence of road injuries and fatalities	Litman (2004)	Sustainable Transportation Performance Indicators (STPI) project by the Centre for Sustainable Transport
	Effects on human health	Litman (2004)	Sustainable Transportation Performance Indicators (STPI) project by the Centre for Sustainable Transport
	Reduced accident rate	International Technology Exchange Program	Transport Canada
	Increased compliance rate	International Technology Exchange Program	Transport Canada
	Reduced security risks	International Technology Exchange Program	Transport Canada
	High public confidence in travel	International Technology Exchange Program	Transport Canada
	Stakeholder understanding of safety benefits and issues	International Technology Exchange Program	Transport Canada

Table B.1 Typology of Environmental Performance Measures (continued)

Environmental Category	Performance Measure	Agency Using Measure	Source Document
Natural Environment Impacts			
Noise	Number of people (in thousands) in U.S. exposed to significant noise levels	Ministry of Environment and Energy National Environmental Research Institute	U.S. DOT
	Percent of U.S. Population Exposed to Different Levels of Transportation Noise	Ministry of Environment and Energy National Environmental Research Institute	U.S. EPA
	Length of Noise Barriers Constructed (miles) and Cost	Ministry of Environment and Energy National Environmental Research Institute	U.S. EPA
	Population Exposed to 65 DNL at 30 Busiest Airports	Ministry of Environment and Energy National Environmental Research Institute	U.S. EPA
	Typical noise emissions levels by vehicle type and road type	EPA: Indicators of the Environmental Impacts of Transportation	U.S. EPA
	Typical noise emissions levels for trains	EPA: Indicators of the Environmental Impacts of Transportation	U.S. EPA
	Typical noise emissions levels by aircraft type during takeoff and landing	EPA: Indicators of the Environmental Impacts of Transportation	U.S. EPA
	Portion of population exposed to high levels of traffic noise	Litman (2004)	Litman's Compiled Indicators
	Percent of compliance on nighttime noise standards	International Technology Exchange Program	Japanese Government
	Amount of population exposed to levels of noise affecting well-being; Amount of population exposed to detrimental levels of noise	Operationalising Sustainable Transport and Mobility: The System Diagram and Indicators	SUMMA
	Total population within DNL65 noise contour		

Table B.1 Typology of Environmental Performance Measures (continued)

Environmental Category	Performance Measure	Agency Using Measure	Source Document
Natural Environment Impact (continued)			
Ecology (Natural Resources, Plants, Wildlife)	Acres of wetlands replaced for every acre affected by Federal-aid Highway projects	Ministry of Environment and Energy National Environmental Research Institute	U.S. DOT
	Compliance rate with Federal fisheries regulation	Ministry of Environment and Energy National Environmental Research Institute	U.S. DOT
	Percentage of roads that are paved	EPA: Indicators of the Environmental Impacts of Transportation	U.S. EPA
	Wetland Losses and Creation Associated with Federal Aid Highway Program	Ministry of Environment and Energy National Environmental Research Institute	U.S. EPA
	Number of Animal Collisions with Motor Vehicles reported	Ministry of Environment and Energy National Environmental Research Institute	U.S. EPA
	Approximate number of animals killed (resulting from all modes of travel: roadway, air, rail, water)	EPA: Indicators of the Environmental Impacts of Transportation	U.S. EPA
	States reporting disposal of dredged material as a source of direct wetlands losses	EPA: Indicators of the Environmental Impacts of Transportation	U.S. EPA
	Quantity of dredged material disposed at various sites (ocean, coastal waters) and used for various purposes (wetlands creation)	EPA: Indicators of the Environmental Impacts of Transportation	U.S. EPA
	Number of non-native species introduced	EPA: Indicators of the Environmental Impacts of Transportation	U.S. EPA
	Proximity of infrastructure to sensitive areas and ecosystem fragmentation	Litman (2004)	Sustainable Transportation Performance Indicators (STPI) project by the Centre for Sustainable Transport
	Effects on ecosystem health	Litman (2004)	Sustainable Transportation Performance Indicators (STPI) project by the Centre for Sustainable Transport

Table B.1 Typology of Environmental Performance Measures (continued)

Environmental Category	Performance Measure	Agency Using Measure	Source Document
Natural Environment Impact (continued)			
Ecology (Natural Resources, Plants, Wildlife) (continued)	Preservation of high-quality wildlife habitat (wetlands, old-growth forests, etc.)	Litman (2004)	Litman's Compiled Indicators
	Average size of roadless wildlife preserves	Litman (2004)	Litman's Compiled Indicators
	Designated nature areas in the proximity (unit to be defined) of transport infrastructure in total and by mode	Operationalising Sustainable Transport and Mobility: The System Diagram and Indicators	SUMMA
	Amount of lighted transport infrastructure	Operationalising Sustainable Transport and Mobility: The System Diagram and Indicators	SUMMA
	Number of collisions with animals by mode	Operationalising Sustainable Transport and Mobility: The System Diagram and Indicators	SUMMA
	Number of non-native species introduced by marine transport and in transport infrastructure construction	Operationalising Sustainable Transport and Mobility: The System Diagram and Indicators	SUMMA
	Amount of dredging at ports, waterways, etc. by type of dredged area	Operationalising Sustainable Transport and Mobility: The System Diagram and Indicators	SUMMA

Table B.1 Typology of Environmental Performance Measures (continued)

Environmental Category	Performance Measure	Agency Using Measure	Source Document
Natural Environment Impact (continued)			
Ecology (Natural Resources, Plants, Wildlife) (continued)		U.S. EPA	
	Percent of surface waters degraded from land development projects (not just highways)	EPA: Indicators of the Environmental Impacts of Transportation	U.S. EPA
	Changes in surrounding water quality conditions near typical construction site	EPA: Indicators of the Environmental Impacts of Transportation	U.S. EPA
	States reporting contamination problems at maintenance facilities	EPA: Indicators of the Environmental Impacts of Transportation	U.S. EPA
	Acres sprayed with herbicide	EPA: Indicators of the Environmental Impacts of Transportation	U.S. EPA
	Energy used in construction	EPA: Indicators of the Environmental Impacts of Transportation	U.S. EPA
	Amount of solid raw materials used in building transport infrastructure	Operationalising Sustainable Transport and Mobility: The System Diagram and Indicators	SUMMA
	Amount of solid raw materials used in vehicle manufacture	Operationalising Sustainable Transport and Mobility: The System Diagram and Indicators	SUMMA
	Losses of designated and nondesignated nature areas due to construction of transport infrastructure by mode	Operationalising Sustainable Transport and Mobility: The System Diagram and Indicators	SUMMA
	Amount of wastewater produced in transport manufacturing industries or service infrastructures not treated in wastewater treatment plants	Operationalising Sustainable Transport and Mobility: The System Diagram and Indicators	SUMMA

Table B.1 Typology of Environmental Performance Measures (continued)

Environmental Category	Performance Measure	Agency Using Measure	Source Document
Natural Environment Impact (continued)			
Energy/Fuel Usage	Transportation-related petroleum consumption (in quadrillion BTUs) per trillion dollars of Real Gross Domestic Product	Ministry of Environment and Energy National Environmental Research Institute	U.S. DOT
	Use of fossil fuel energy for all transport	Litman (2004)	Sustainable Transportation Performance Indicators (STPI) project by the Centre for Sustainable Transport
	Resource efficiency	Often available but not standardized	Litman (2004)
	Increase the use of more energy-efficient vehicles	International Technology Exchange Program	Transport Canada
	Final energy consumption in transport by mode and energy sources	Operationalising Sustainable Transport and Mobility: The System Diagram and Indicators	SUMMA
	Share of final energy consumption in transport produced from renewable energy sources	Operationalising Sustainable Transport and Mobility: The System Diagram and Indicators	SUMMA
Hazardous/ Toxic Waste	Gallons of oil spilled per million gallon shipped by maritime sources	Ministry of Environment and Energy National Environmental Research Institute	U.S. DOT
	Tons of hazardous liquid materials spilled per million ton miles shipped	Ministry of Environment and Energy National Environmental Research Institute	U.S. DOT
	Gallons of hazardous liquid materials spilled (nonpipeline) per serious transportation incident	Ministry of Environment and Energy National Environmental Research Institute	U.S. DOT
	Percent DOT facilities categorized as No Further Remedial Action Planned under Superfund Act	Ministry of Environment and Energy National Environmental Research Institute	U.S. DOT
	Quantity of used motor oil improperly disposed	EPA: Indicators of the Environmental Impacts of Transportation	U.S. EPA
	Type and quantity of material reported released during transport	EPA: Indicators of the Environmental Impacts of Transportation	U.S. EPA
	Number of Hazardous Materials Incidents	Ministry of Environment and Energy National Environmental Research Institute	U.S. EPA

Table B.1 Typology of Environmental Performance Measures (continued)

Environmental Category	Performance Measure	Agency Using Measure	Source Document
Natural Environment Impact (continued)			
Hazardous/ Toxic Waste (continued)	Number of Motor Vehicles Scrapped Annually	Ministry of Environment and Energy National Environmental Research Institute	U.S. EPA
	Disposition of Scrap Tires	Ministry of Environment and Energy National Environmental Research Institute	U.S. EPA
	Lead Acid Batteries in Municipal Solid Waste Streams	Ministry of Environment and Energy National Environmental Research Institute	U.S. EPA
	Estimated Annual Garbage Generation by U.S. Maritime Sectors	Ministry of Environment and Energy National Environmental Research Institute	U.S. EPA
	Quantity of new aircraft ordered to replace those disposed	EPA: Indicators of the Environmental Impacts of Transportation	U.S. EPA
	Quantity of new rail cars installed to replace those disposed	EPA: Indicators of the Environmental Impacts of Transportation	U.S. EPA
	Quantity of garbage generated by the maritime sector (amount disposed in sea is unknown)	EPA: Indicators of the Environmental Impacts of Transportation	U.S. EPA
	Waste from road transport	Litman (2004)	Sustainable Transportation Performance Indicators (STPI) project by the Centre for Sustainable Transport
	Five-year average of chemical spills	Tennessee Long-Range Transportation Plan	Tennessee DOT
	Amount of pollutants released at transport accidents by type of pollutant and by mode	Operationalising Sustainable Transport and Mobility: The System Diagram and Indicators	SUMMA
	Amount of wastewater discharged into the seat from ships and boats; Amount of waste discharged into the sea from ships and boats	Operationalising Sustainable Transport and Mobility: The System Diagram and Indicators	SUMMA
	Total amount of nonrecycled waste generated by transport mode and by type of waste	Operationalising Sustainable Transport and Mobility: The System Diagram and Indicators	SUMMA

Table B.1 Typology of Environmental Performance Measures (continued)

Environmental Category	Performance Measure	Agency Using Measure	Source Document
Natural Environment Impact (continued)			
Water Quality	Highway Salt Sales	Ministry of Environment and Energy National Environmental Research Institute	U.S. EPA
	States reporting degraded wetlands integrity due to salinity	EPA: Indicators of the Environmental Impacts of Transportation	U.S. EPA
	Percentage of transit agencies that wash bus fleets daily	EPA: Indicators of the Environmental Impacts of Transportation	U.S. EPA
	States reporting road salting as a significant source of ground water contamination	EPA: Indicators of the Environmental Impacts of Transportation	U.S. EPA
	Quantity of road salt used	EPA: Indicators of the Environmental Impacts of Transportation	U.S. EPA
	River miles, lakes, and ocean shore miles impaired by urban runoff (not just highways)	EPA: Indicators of the Environmental Impacts of Transportation	U.S. EPA
	Average pollutant concentrations of various metals, suspended solids, and toxic organics in road runoff	EPA: Indicators of the Environmental Impacts of Transportation	U.S. EPA
	Quantity of oil and grease loading via road runoff	EPA: Indicators of the Environmental Impacts of Transportation	U.S. EPA
	Number of Fuel Spills and Total Volume of Fuel Discharged Annually	Ministry of Environment and Energy National Environmental Research Institute	U.S. EPA
	Percentage of urea (deicing compound) discharged directly to surface waters	Ministry of Environment and Energy National Environmental Research Institute	U.S. EPA
	Quantity of deicing agents used	Ministry of Environment and Energy National Environmental Research Institute	U.S. EPA
	Quantity of oil and other hazardous wastes spilled in U.S. waters during water transport	EPA: Indicators of the Environmental Impacts of Transportation	U.S. EPA

Table B.1 Typology of Environmental Performance Measures (continued)

Environmental Category	Performance Measure	Agency Using Measure	Source Document
Natural Environment Impact (continued)			
Water Quality (continued)	Percentage of shellfish waters reported contaminated due to sewage dumping	EPA: Indicators of the Environmental Impacts of Transportation	U.S. EPA
	Percentage of commercial vessels with on-board sanitation devices	EPA: Indicators of the Environmental Impacts of Transportation	U.S. EPA
	Discharges into water	Litman (2004)	Sustainable Transportation Performance Indicators (STPI) project by the Centre for Sustainable Transport
	Per capita vehicle fluid losses	Litman (2004)	Litman's Compiled Indicators

Appendix C

Internet-Based Survey Questions

C. Internet-Based Survey Questions

Guidelines for Environment Performance Measurement

Please fill out the information below as completely as possible. When you have completed the form, click the Submit button at the bottom of the page to submit your survey. If you would like to reset the information on the survey and start over, click the Reset button at the bottom of the form.

Part 1 – Contact Information and Preliminary Questions

1. Contact Information

   Agency name*
   Agency Address*
   Respondent Name*
   Respondent Title*
   Respondent Telephone*
   Respondent E-mail*

Note: Fields marked with an * are required fields.

2. Are performance measures currently being used by your agency for the purposes of planning and/or strategic management?

   Yes No

   If you answered "No," skip to Part 4, Question 16.

3. Are any of the performance measures that your agency uses related to environmental issues or stewardship?

   Yes No

   If you answered "No," skip to Part 4, Question 16.

Part 2 – Current Use of Environmental Performance Measures

4. What are the key motivations for utilizing environmental performance measures for strategic planning and program management?

   Please rate each motivation using the following scale: 1 = Primary, 2 = Secondary, 3 = Not Applicable/None.

   Key Motivations Rating

a) Fulfill legislative mandate 1 2 3
b) Establish a link between statewide goals and projects/programs 1 2 3
c) Evaluate existing programs/projects 1 2 3
d) Communicate results of programs/projects within the agency 1 2 3
e) Communicate results of programs/projects with the public 1 2 3
f) Prioritize and select programs and projects 1 2 3
g) Allocate resources across the agency 1 2 3
h) Tradeoff analysis 1 2 3
i) Benchmarking (over time or with peer agencies) 1 2 3
j) Employee motivation and direction 1 2 3

Other (please specify):

5. Performance measures can be used at the highest level of agency decision-making for strategic management purposes, as well as for program management at division or bureau levels. Please indicate where environmental issues are included, if at all, in your performance measurement for specific management purposes.

   Check all boxes that apply for each environmental issue.

   Environmental Issues: Strategic Management; Planning; Programming; Project Development; and Design, Maintenance, and Operations

   a) Ecosystem/habitat conservation
   b) Water quality
   c) Wetlands
   d) Storm water runoff
   e) Energy consumption/efficiency
   f) Hazardous waste
   g) Noise
   h) Air quality
   i) Equity/environmental justice
   j) Land preservation
   k) Livable communities
   l) Health
   m) Historic preservation
   n) Timeliness of environmental process
   o) Aesthetics

   Other:

6. For this project, we are particularly interested in environmental performance measures that are considered as part of an agency's ongoing performance-based strategic management process. Please list all environmental performance measures that your agency currently is utilizing for this purpose in the left-hand column.

   For each measure you list, select the most appropriate choices from the corresponding dropdown boxes. If more then 10 environmental performance measures are used, additional measures can be described in the attached Word document. Related documents also may be sent to Ginna Smith at vsmith@camsys.com.

Performance Measure Type of Measure Type of Data Frequency of Reporting

1. Quantitative Qualitative Both Universal Sample Modeled Other
   Monthly Quarterly Biannually Annually More than Annually
2. Quantitative Qualitative Both Universal Sample Modeled Other
   Monthly Quarterly Biannually Annually More than Annually
3. Quantitative Qualitative Both Universal Sample Modeled Other
   Monthly Quarterly Biannually Annually More than Annually
4. Quantitative Qualitative Both Universal Sample Modeled Other
   Monthly Quarterly Biannually Annually More than Annually
5. Quantitative Qualitative Both Universal Sample Modeled Other
   Monthly Quarterly Biannually Annually More than Annually
6. Quantitative Qualitative Both Universal Sample Modeled Other
   Monthly Quarterly Biannually Annually More than Annually
7. Quantitative Qualitative Both Universal Sample Modeled Other
   Monthly Quarterly Biannually Annually More than Annually
8. Quantitative Qualitative Both Universal Sample Modeled Other
   Monthly Quarterly Biannually Annually More than Annually
9. Quantitative Qualitative Both Universal Sample Modeled Other
   Monthly Quarterly Biannually Annually More than Annually
10. Quantitative Qualitative Both Universal Sample Modeled Other
    Monthly Quarterly Biannually Annually More than Annually

Check if you also are sending information.

7. Which of the environmental performance measures listed in Question 6 have proven to be the most effective in terms of supporting agency decision-making, and why?

8. Which of the environmental performance measures listed in Question 6 have proven to be the least effective in terms of measuring environmental conditions and quality, and why?

9. What benefits have resulted from the use of these environmental performance measurements?

   Please check all that apply.

   Fulfills legislative mandate
   Establishes links between statewide goals and projects/programs
   Evaluates existing programs/projects
   Communicates results of programs/projects within the agency
   Communicates results of programs/projects with the public
   Prioritizes and selects programs and projects
   Allocates resources across the agency
   Tradeoff analysis
   Benchmarking (over time or with peer agencies)
   Employee motivation and direction
   Other:

10. Has your agency utilized performance measurement in an effort to streamline the process surrounding environmental impact statements for major construction projects?

    Yes No Not Sure

11. Which of the environmental performance measures listed in Question 6 are tied to the goals and objectives of state resource agencies, and what are the associated agencies?

12. What has been your agency's overall experience resulting from the introduction and use of environmental performance measurements?

    Very Positive, Positive, Mixed, Not Successful

    Briefly describe why your agency's overall experience was such.

Part 3 – Future Use of Environmental Performance Measures

13. What are the problems or barriers your agency has faced to using environmental performance measurements?

    Please rate the size of each problem or barrier.

    Problem or Barrier Rating

    a) Data collection effort required:
    No Problem/Small Problem/Medium Problem/Large Problem

    b) Data quality/consistency:
    No Problem/Small Problem/Medium Problem/Large Problem

    c) Conflicting agency goals:
    No Problem/Small Problem/Medium Problem/Large Problem

    d) Lack of connection to agency goals:
    No Problem/Small Problem/Medium Problem/Large Problem

    e) Lack of consensus on best measures:
    No Problem/Small Problem/Medium Problem/Large Problem

    f) Lack of support within the agency:
    No Problem/Small Problem/Medium Problem/Large Problem

    g) Measured elements largely outside agency control:
    No Problem/Small Problem/Medium Problem/Large Problem

    h) Insufficient resources:
    No Problem/Small Problem/Medium Problem/Large Problem

    Others (please specify):
    No Problem/Small Problem/Medium Problem/Large Problem

14. Are there measures of environmental performance currently under consideration to be added to the list in Question 6? If so, what are they and why are they being considered?

    Are there measures of environmental performance currently under consideration to be subtracted from the list in Question 6? If so, what are they and what are the reasons for elimination?

15. With respect to using performance measures in agency decision-making, how would you rate the importance of the following environmental factors as they may change over the next 10 years?

    Please rate each of the environmental factors below.

    Environmental Factors Rating

    a) Ecosystem/habitat conservation:
       More Importance/Same Importance (as today)/Less Importance
    b) Water quality:
       More Importance/Same Importance (as today)/Less Importance
    c) Wetlands More:
       More Importance/Same Importance (as today)/Less Importance
    d) Stormwater runoff:
       More Importance/Same Importance (as today)/Less Importance
    e) Hazardous wastes:
       More Importance/Same Importance (as today)/Less Importance
    f) Noise:
       More Importance/Same Importance (as today)/Less Importance
    g) Air quality:
       More Importance/Same Importance (as today)/Less Importance
    h) Equity/Environmental justice:
       More Importance/Same Importance (as today)/Less Importance
    i) Land preservation:
       More Importance/Same Importance (as today)/Less Importance
    j) Livable Communities:
       More Importance/Same Importance (as today)/Less Importance
    k) Health:
       More Importance/Same Importance (as today)/Less Importance
    l) Historic preservation:
       More Importance/Same Importance (as today)/Less Importance
    m) Timeliness of environmental process:
       More Importance/Same Importance (as today)/Less Importance
    n) Aesthetics:
       More Importance/Same Importance (as today)/Less Importance

    Others (please specify):
       More Importance/Same Importance (as today)/Less Importance

Please skip to Part 5, Question 18.

Part 4 – DOTs that Currently are Not Using Environmental Performance Measures

16. Has consideration been given to implementing environmental performance measures? Why or why not?

17. What barriers exist to implementing and utilizing environmental performance measures?

Please continue to Part 5, Question 19.

Part 5 – Follow-Up Contacts

18. What other groups or agencies would be useful to contact for further information on this topic? Please provide a contact name, if possible.

    a. Within the state DOT?

    b. In state resource agencies?

    c. MPOs?

19. Would you be willing to be contacted for further information about your agency's development and use of environmental performance measures?

    Yes No

When you have completed the form, click the Submit button below to submit your survey.

Appendix D

Telephone Interview Guide

D. Telephone Interview Guide

Guidelines for Environment Performance Measurement

Part 1 – Screening Questions

1. Are performance measures currently being used by your agency for the purposes of planning and/or strategic management?
   Yes No
   (If answer is "No," skip to Part 4, Question 16.)

2. Are any of the performance measures that your agency uses related to environmental issues or stewardship?
   Yes No
   (If answer is "No," skip to Part 4, Question 16.)

Part 2 – Current Use of Environmental Performance Measures

3. What are the key motivations for utilizing environmental performance measures for strategic planning and program management?
   (Use list below as talking points/suggestions, if needed.)

   a) Fulfill legislative mandate
   b) Establish a link between statewide goals and projects/programs
   c) Evaluate existing programs/projects
   d) Communicate results of programs/projects within the agency
   e) Communicate results of programs/projects with the public
   f) Prioritize and select programs and projects
   g) Allocate resources across the agency
   h) Tradeoff analysis
   i) Benchmarking (over time or with peer agencies)
   j) Employee motivation and direction

4. For what strategic management or program management purposes are performance measures used?

Follow-up question if needed:

Specifically, are any of the following environmental concerns tied into your Strategic Management, Planning, Programming, Project Development, or Design Maintenance and Operations?

   a) Ecosystem/habitat conservation
   b) Water quality

c) Wetlands
d) Stormwater runoff
e) Energy consumption/efficiency
f) Hazardous waste
g) Noise
h) Air quality
i) Equity/environmental justice
j) Land preservation
k) Livable communities
l) Health
m) Historic preservation
n) Timeliness of environmental process
o) Aesthetics

5. What environmental performance measures is your agency currently utilizing for ongoing performance-based strategic management?

6. Which of these environmental performance measures have proven to be the most effective in terms of supporting agency decision-making, and why?

7. Which of these environmental performance measures have proven to be the least effective in terms of measuring environmental conditions and quality, and why?

8. What benefits have resulted from the use of these environmental performance measurements?
(Use list below as talking points/suggestions, if needed.)

a) Fulfills legislative mandate
b) Establishes links between statewide goals and projects/programs
c) Evaluates existing programs/projects
d) Communicates results of programs/projects within the agency
e) Communicates results of programs/projects with the public
f) Prioritizes and selects programs and projects
g) Allocates resources across the agency
h) Tradeoff analysis
i) Benchmarking (over time or with peer agencies)
j) Employee motivation and direction

9. Has your agency utilized performance measurement in an effort to streamline the process surrounding environmental impact statements for major construction projects?

For State DOTs and MPOs only:

10. Which of the environmental performance measures that your agency is using are tied to the goals and objectives of state resource agencies, and what are the associated agencies?

11. What has been your agency's overall experience resulting from the introduction and use of environmental performance measurements?

Part 3 – Future Use of Environmental Performance Measures

12. What are the problems or barriers your agency has faced to using environmental performance measurements?

    (Use list below as talking points/suggestions, if needed.)

    a) Data collection effort required
    b) Data quality/consistency
    c) Conflicting agency goals
    d) Lack of connection to agency goals
    e) Lack of consensus on best measures
    f) Lack of support within the agency
    g) Measured elements largely outside agency control
    h) Insufficient resources

13. Are there measures of environmental performance currently under consideration to be added by your agency? If so, what are they and why are they being considered?

14. Are there measures of environmental performance currently under consideration to be subtracted by your agency? If so, what are they and what are the reasons for elimination?

15. With respect to using performance measures in agency decision-making, how do you think environmental factors are likely to change in importance over the next 10 years?

    (Use list below as talking points/suggestions, if needed.)

    a) Ecosystem/habitat conservation
    b) Water quality
    c) Wetlands
    d) Stormwater runoff
    e) Hazardous wastes
    f) Noise
    g) Air quality
    h) Equity/environmental justice
    i) Land preservation
    j) Livable communities
    k) Health
    l) Historic preservation
    m) Timeliness of environmental process
    n) Aesthetics

Please skip to Part 5, Question 18.

Part 4 – Agencies that currently are not using Environmental Performance Measures

16. Has consideration been given to implementing environmental performance measures? Why or why not?

17. What barriers exist to implementing and utilizing environmental performance measures?

Part 5 – Guidance Document

18. The final product of this effort will be a guidance document for agencies thinking about using (or improving their use of) environmental performance measures. If you were considering initiating or changing your agency's use of environmental performance measures, what type of information would you find useful? What information would you share with others who are looking to do this?

Part 6 – Follow-Up Contacts

19. What other groups or agencies would be useful to contact for further information on this topic? Please provide a contact name, if possible.

    a. Within the state DOT?

    b. In state resource agencies?

    c. MPOs?