

**VTrans Asset Management
Vision and Work Plan**

**final
report**

prepared for

Vermont Agency of Transportation

prepared by

Cambridge Systematics, Inc.

January 15, 2002

final report

VTrans Asset Management Vision and Work Plan

prepared for

Vermont Agency of Transportation

prepared by

Cambridge Systematics, Inc.
150 CambridgePark Drive, Suite 4000
Cambridge, Massachusetts 02140

January 15, 2002

Table of Contents

Executive Summary	ES-1
1.0 Introduction	1-1
1.1 Study Background, Objectives, and Tasks.....	1-1
1.2 Report Organization	1-2
1.3 Transportation Asset Management Overview.....	1-3
2.0 State-of-Practice Review	2-1
2.1 Current VTrans Asset Management Practices	2-1
2.2 Current Legislative Compliance Capabilities	2-15
2.3 Summary of Findings	2-17
3.0 Asset Management Vision and Goals	3-1
3.1 Asset Management Vision Statement.....	3-1
3.2 Asset Management Goals.....	3-1
3.3 Benefits of Asset Management	3-1
4.0 Asset Management Work Plan	4-1
4.1 Asset Management Initiatives	4-1
4.2 Section 24 Compliance.....	4-6
4.3 Section 25 Compliance.....	4-13
4.4 Schedule and Cost Summary	4-17
Glossary and Abbreviations	GL-1
Appendix A - Sample Reports	A-1

List of Tables

2.1	Policy Goals and Objectives.....	2-2
2.2	Planning and Programming.....	2-5
2.3	Program Delivery	2-9
2.4	Information and Analysis.....	2-11
2.5	Summary of Legislative Compliance Status.....	2-15
4.1	Section 24 Sources of Information and Work Requirements.....	4-7
4.2	Section 25 Work Requirements.....	4-14
4.3	Asset Management Initiate Preliminary Cost Estimates	4-17

List of Figures

1.1	Transportation Asset Management Framework.....	1-8
2.1	VTrans Program Funding Tools.....	2-19
4.1	Asset Management Initiative Schedule.....	4-17
A.1	Sample Pavement Report – Inventory	A-2
A.2	Sample Pavement Report – Inventory Totals by Class	A-2
A.3	Sample Pavement Report – Cost to Achieve a Target Condition.....	A-3
A.4	Sample Maintained Features Report – Inventory	A-4
A.5	Sample Rail Bridge Report – Inventory, Condition, and Cost to Achieve a Target Condition.....	A-5
A.6	Sample Facility Report – Inventory	A-6

Executive Summary

Asset management is a strategic approach to managing transportation infrastructure assets. It focuses on an agency's business processes for resource allocation and utilization, with the objective of better decision-making based upon quality information and well-defined objectives. A key driver of asset management within the Vermont Agency of Transportation (VTrans) is Sections 24 and 25 of Act No. 488 recently passed by the General Assembly of Vermont (Sections 24 and 25). In response, VTrans conducted this study to document a vision for asset management at VTrans and develop an asset management work plan.

The first step of the project was to assess VTrans' current state of practice in asset management. In brief, VTrans has many of the necessary components of a sound asset management program that can both meet the requirements of Sections 24 and 25 and provide the agency with an effective, strategic approach to making wise infrastructure investments with limited resources. Examples of asset management elements in place include: established policy guidance, strong multimodal elements, clear customer-orientation, significant IT advancements, and data and systems required to meet several of the legislative requirements.

The review also identified several opportunities to strengthen VTrans' asset management capabilities and processes. Examples include: improve policy alignment, enhance performance measures, clarify budgeting process, enhance performance-based project development, improve analytical capabilities, and improve and standardize GIS capabilities.

Section 4.0 presents a work plan for implementing asset management at VTrans. The plan is based on the findings of the state-of-the-practice review, the results of an asset management working session, and Cambridge Systematics' knowledge of other state DOT practices. The plan identifies key steps, a timeframe, and an estimated budget for the following five initiatives:

- **Initiative 1** - Establish a lead role for asset management at VTrans and form asset management steering and technical committees to coordinate future efforts.
- **Initiative 2** - Incorporate asset management principles into the current performance measure initiative.
- **Initiative 3** - Institute a phased approach to legislative compliance - initially use current data and systems, and improve the asset management report annually as new capabilities are developed.

- **Initiative 4** - Move towards a more performance-based approach to planning and programming.
- **Initiative 5** - Develop a comprehensive IT strategy that will ensure that the data and analytical needs of the agency are met effectively.

1.0 Introduction

■ 1.1 Study Background, Objectives, and Tasks

The General Assembly of Vermont recently passed Sections 24 and 25 of Act No. 64, requiring the Vermont Agency of Transportation (VTrans) to submit information on its assets to the House and Senate Committees on Transportation. These sections read as follows:

Sec. 24. 19 V.S.A. § 10k is added to read:

§ 10k. STATEMENT OF POLICY; ASSET MANAGEMENT

The agency shall develop an asset management plan which is a systematic goal and performance-driven management and decision-making process of operating, maintaining and upgrading transportation assets cost-effectively. At a minimum, the asset management system shall:

- (1) list all of the infrastructure assets and their condition, including, but not limited to, pavements, structures, and facilities;
- (2) list other assets and their condition, including, but not limited to, construction and maintenance equipment, vehicles, real estate, materials, corporate data and information, and ground and water transportation facilities and equipment;
- (3) include deterioration rates for infrastructure assets; and
- (4) determine, long-term, the annual funds necessary to fund infrastructure maintenance at the recommended performance level.

Sec. 25. INFRASTRUCTURE ASSETS CONSTRUCTED WITHIN THE LAST 10 YEARS; MANAGEMENT PLAN

(a) The agency of transportation shall review all transportation infrastructure assets that have been constructed within the last 10 years and develop an asset management plan for those assets. The plan shall include, but not be limited to:

- (1) the costs associated with implementing the plan;
- (2) the activities to be undertaken under the plan; and
- (3) the comparative cost differential between maintaining the infrastructure, utilizing a preventive maintenance program versus deferring those maintenance costs.

(b) The asset management plan shall be presented to the house and senate committees on transportation no later than January 15, 2002.

In response to this legislation, VTrans engaged Cambridge Systematics, Inc. in October 2001 to conduct a study, entitled *Vermont Asset Management Vision and Work Plan*. The objectives of this study are to document a vision for asset management at VTrans and to develop an asset management work plan. The study comprises five major tasks:

- **Task 1. Review of Other State's Systems.** Review current asset management practices by other State departments of transportation (DOTs) and identify elements applicable to VTrans.
- **Task 2. Data Gathering and Preliminary Recommendations.** Obtain an understanding of existing and planned asset management elements at VTrans, and develop preliminary recommendations. As part of this task, key members of VTrans management were interviewed to elicit management's perspectives on asset management and compliance with the Sections 24 and 25.
- **Task 3. Presentation to Key Managers and Staff.** Present preliminary findings and recommendations to key staff in a half-day working session and facilitate an open forum for discussion.
- **Task 4. Asset Management Vision and Work Plan.** Finalize the vision and work plan.
- **Task 5. Final Presentations.** Communicate VTrans' asset management vision and work plan to key VTrans staff and to the Vermont House and Senate Committees on Transportation.

■ 1.2 Report Organization

This report responds to Task 2 described above.

- The remaining section of **Section 1.0** introduces the topic of transportation asset management. This material was developed by Cambridge Systematics through National Cooperative Highway Research Program (NCHRP) Project 20-24(11), *Asset Management Guidance for Transportation Agencies*.
- **Section 2.0** summarizes current asset management practice at VTrans using two benchmarks: the state-of-the-art in asset management developed in NCHRP 20-24(11) and the requirements of Sections 24 and 25.
- **Section 3.0** establishes a vision of asset management at VTrans and a set of goals for its implementation, and identifies the outcomes and benefits of implementing an asset management system at VTrans.
- **Section 4.0** recommends an asset management work plan with practical implementation steps that support the vision and goals.

■ 1.3 Transportation Asset Management Overview

This section provides an overview of transportation asset management. The overview has been adopted from material developed by this study team in NCHRP 20-24(11).

Transportation agencies manage a wide range of assets to meet public, agency, and legislative expectations. Physical transportation infrastructure is one type of asset. Others include an agency's human resources, financial capacity, equipment and vehicle fleets, materials stocks, real estate, and corporate data and information. The overall management framework presented below is flexible enough to be adapted and refined for use with, respectively, each type of asset above. However, this study focuses on the particular set of assets that constitutes VTrans' **physical transportation infrastructure**. Other assets can be viewed in this context as resources that are allocated and utilized in managing the physical transportation infrastructure.

Elements of Good Practice

Elements of good practice elaborate upon the definition of asset management. These elements reflect the concept that transportation asset management should not be considered as a separate new program or initiative, overlaid upon existing procedures and in competition with other items on a department's agenda. Rather, it represents a way of doing business - a perspective that VTrans can adopt in looking at its current procedures and seeing how better decisions on physical infrastructure management can be made with better information. In this view, the principles of good asset management can be visualized as affecting, simultaneously, the philosophy, processes, and technical tools that underlie VTrans' decisions and uses of information.

Asset Management Is a Philosophy

Asset management represents an approach to managing infrastructure that is strategic and proactive, and places a premium on good information in all aspects and in all departmental units.

- **Asset management is holistic.** It entails a comprehensive view across a range of assets. It encourages consideration of a full range of options to meet problems or needs. Tradeoffs are explicitly considered among programs, modes, or strategies.
- **Asset management as a philosophy may be applied broadly to virtually all functional areas of an organization or targeted to particular areas.** Increasingly, asset management is being seen as a comprehensive approach that may be successfully applied at virtually all levels and across virtually all functions of an infrastructure-based organization. However, in its evolution, asset management may also be focused on particular areas of emphasis, such as system preservation or, alternately, system expansion and operations. This need for adaptability in responding to the current

policy objectives and priorities of different agencies explains why the term “transportation asset management” is often interpreted differently. It also explains why asset management is simultaneously powerful, rigorous, yet flexible.

- **Asset management is driven by policy goals and objectives based upon performance.** Strategies are analyzed in terms of objective assessments of costs, benefits, and other impacts on the transportation system and levels of service provided to transportation users.
- **Asset management takes a long-term view of infrastructure performance and cost.** The benefits of different actions are assessed throughout the infrastructure service life, applying economic as well as technical criteria.
- **Asset management is proactive.** An agency has the latitude to make decisions based on merit. Preventive strategies are encouraged where they are cost effective.
- **Asset management policy is influenced and informed by good information.** This information describes current and projected system condition and performance that would result from different policies or strategies. It also encompasses user perceptions of system condition and performance, as obtained through surveys or focus groups.
- **Asset management is explicit and visible, and serves to clarify and communicate the process and outcomes of resource allocation and program delivery.** Asset management, by virtue of its rational and objective qualities, demystifies and fosters confidence in those decision processes that influence the allocation and utilization of scarce resources. In doing so, asset management fosters increased stakeholder participation, buy-in, and adherence to adopted strategies and decisions.
- **Viewed as “a way of doing business,” asset management is pervasive, affecting the business practices of every organizational element involved in the functions to which it is applied.**

Asset Management Is a Process

Principles of good asset management can suggest ways in which an agency’s business processes and its organizational roles and responsibilities can be strengthened. These process improvements can occur in those activities prior to budget approval – i.e., planning and program development – and in the program delivery and system performance monitoring phases subsequent to budget approval. Major principles governing process improvements are listed below.

- **Investment choices and decisions on allocating and applying resources are policy- and performance-driven.** Procedures to reach these decisions are consistent with objective information and criteria based on merit. Performance measures consistent with policy goals and objectives are established for management review of both system performance and program delivery.

- **Investment choices and decisions on allocating resources are based upon explicit tradeoffs among modes, programs, or strategies.** Tradeoffs assess the impacts of more or less investment in a mode, program, or strategy, and help to craft final recommendations on how resources will be allocated across competing needs. Managers also understand the implicit tradeoffs in their programs and budgets, and the consequences thereof.
- **Asset management entails the translation of policies and plans into optimized investment strategies, and the translation of investment strategies into optimized program delivery.** The essence of asset management involves a combination of resource allocation decisions and program delivery strategies that are optimized in relation to specific policy-driven criteria.
- **Organizational roles and responsibilities regarding asset management are developed to encourage more strategic and integrated approaches.** While strong vertical organizational units may exist to maintain core expertise, managed business processes and decisions involve wider participation, as noted below.
- **Asset management is interdisciplinary.** Decisions on investment choices and resource allocation are based upon expertise and judgment from several quarters of an agency.
- **Asset management requires effective communication within and outside the agency.** Within the agency, strong communication channels are needed both vertically and horizontally. External communications need to inform policy-makers and other stakeholders of the status of transportation assets and recommended policies and their benefits.
- **The agency strives for more effective program delivery.** The agency explores innovative methods to deliver the range of projects and services required. All available methods are considered, including use of departmental employees, intergovernmental agreements, outsourcing or managed competition, and privatization.

Asset Management Is a Set of Technical Tools

Effective management systems and complete, current, and accurate information on transportation infrastructure are practical necessities in meeting the policy and process requirements of asset management. Good asset management implies a systematic, integrated approach to project selection, analysis of tradeoffs, and program and budget decisions. It also implies that the right information be available to the right levels of management at the right times. The principles below support the availability and application of better information to make better decisions in asset management.

- **Complete, current, and accurate information** on transportation infrastructure assets, including descriptions, location, usage, unique or specialized characteristics, functional and other classification, and data needed for management systems as discussed below.

- **An appropriate suite of management systems and databases** informs the agency of the status, trends, and needs regarding its infrastructure assets. Typical capabilities of these systems include the following:
 - Organization of information within databases describing infrastructure inventory, condition, and performance;
 - Analytic models that predict the rate of future change in condition or performance, enabling the agency to forecast future infrastructure needs;
 - Decision rules or procedures for applying treatments or actions to maintain, rehabilitate, replace, or expand transportation infrastructure, with analytic models of resulting costs, benefits, and other impacts; and
 - Reports tailored to different organizational levels of management, including senior and executive levels, as well as for public distribution.
- **Information on system performance** in terms of both proposed targets and values actually achieved in the field. These data may be obtained in a number of ways:
 - Periodic surveys and assessments of system condition or levels of service;
 - Customer surveys of satisfaction with system condition and agency performance; and
 - Incorporation of performance measures and associated backup information within management systems.
- **Specialized technical applications** that support an agency’s asset management procedures. These will vary by agency, but may include advances such as use of geographic information systems (GIS) as a system/data integration platform, economic analysis applications (e.g., generalized life-cycle benefit-cost procedure), and other decision-support tools.
- **Applications that assist in program and service delivery**, including financial applications (e.g., to compute “total” or “true” cost of agency and contracted services), and management systems for construction project pipeline and construction delivery.

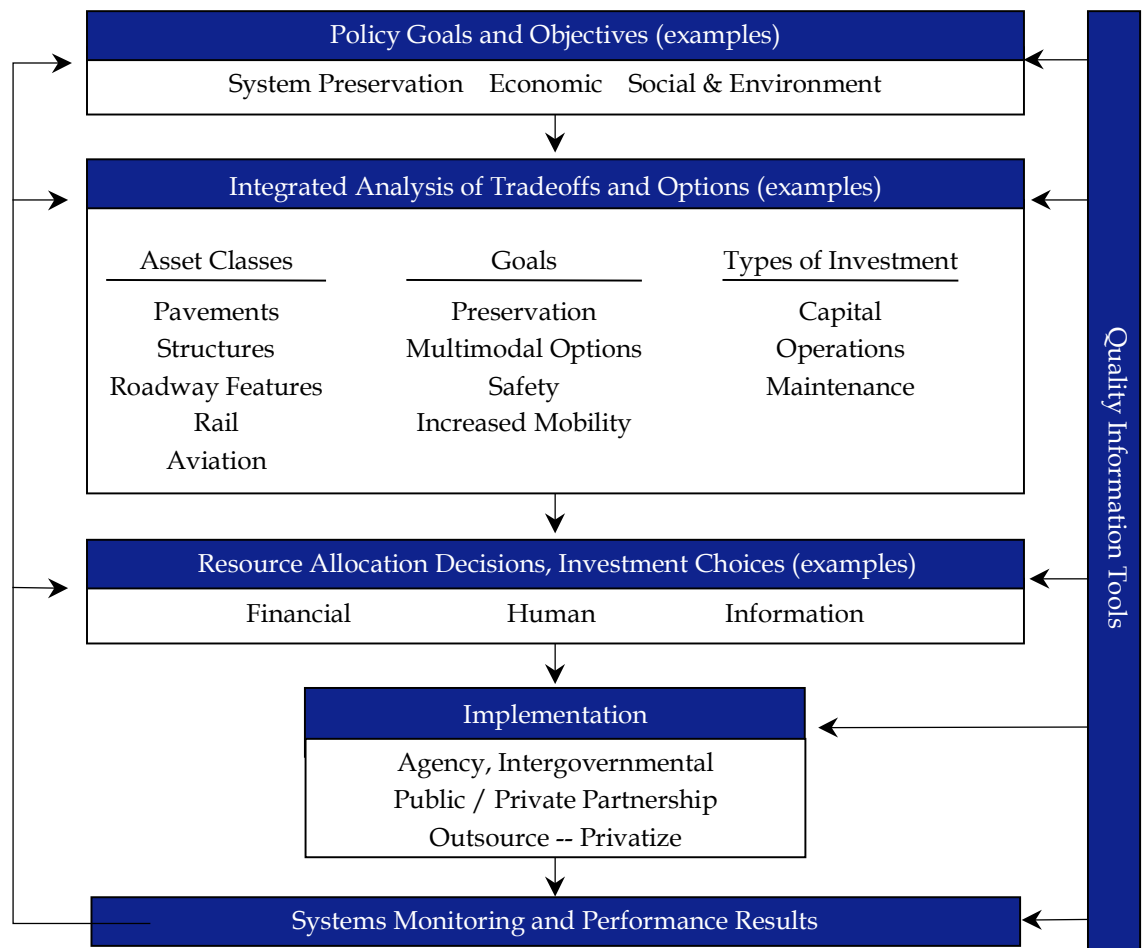
A Resource Allocation and Utilization Process

Asset management is, at its core, a process of resource allocation and utilization. Resources in this context are interpreted broadly, encompassing financial, human, information, material, and equipment inputs to the management of the physical transportation infrastructure. The process of assigning or distributing these resources and applying them to the agency’s mission is likewise interpreted broadly, encompassing not only the traditionally understood functions in planning, program development, and budget approval, but also program delivery, system monitoring, data analysis, and input to policy formulation.

Figure 1.1 illustrates a strategic, integrated, systematic, and interdisciplinary approach to asset management for physical transportation infrastructure. The approach is cast as a resource allocation and utilization process. The entries in Figure 1.1 are examples, defined broadly and comprehensively to provide a “benchmark” as to how the process could work in a general case. VTrans may tailor and adjust this benchmark example to its specific situations and perspectives on asset management. Note that the blocks in Figure 1.1 are general stages in the process; each block may comprise a number of individual processes and specific procedures, involving several organizational units, and the sequence in which they are performed may be more complicated than that implied in Figure 1.1. With this qualification, a discussion of each stage in the example follows.

- **Policy Goals and Objectives.** The process is driven by stated policy goals and objectives. “Goals” are general statements that define priority areas. “Objectives” are actual quantifiable targets that can be used when analyzing alternatives and performing tradeoffs. For example, if enhanced safety is a goal, decreasing accidents by 10 percent over the next two years may be an objective to support that goal.
- **Integrated Analysis of Options and Tradeoffs.** Several processes and procedures associated with an agency’s planning and programming functions may be conducted at this stage. Among these are the following, as examples: to identify problems and needs within the context of policy objectives, assess available resources and set realistic targets, explore alternatives to address problems and needs within financial constraints, develop information on the technical characteristics, costs, and impacts of proposed approaches, define candidate projects or service levels, analyze their benefits, costs and other impacts, rank or prioritize candidates, and evaluate tradeoffs. These analyses are performed with a wide vision of available alternatives and potential tradeoffs in investment across, for example, modes, classes of physical infrastructure assets, and types of investments (e.g., capital improvements, operations, and maintenance). Figure 1.1 suggests a range of asset classes, policy objectives, and types of investments as examples. VTrans may tailor these elements to its specific vision of transportation asset management.
- **Decisions on Applying Resources, Investment Choices.** Based upon the analyses above, decisions can be made on recommended capital projects and levels of service for maintenance and operations (M&O) activities. Program approval finalizes these allocations of resources. Financial, human, and information resources are shown as examples in Figure 1.1; other resources (e.g., real estate, equipment and materials) are also included as appropriate.
- **Implementation.** With an approved allocation of resources, asset management programs can be implemented. All available options to deliver program projects and services are considered (e.g., in-house, outsourcing, intergovernmental agreements, etc.). Figure 1.1 illustrates example delivery methods, but others may also be included.

Figure 1.1 Transportation Asset Management Framework



- System Monitoring and Performance Results.** Since program implementation is a continual process, monitoring of system performance must be done periodically. The resulting information is used to inform and update other stages of the overall process, as illustrated in Figure 1.1. For example, trends in the condition or performance of the physical infrastructure may influence future policy formulation, or the priorities given to particular programs, projects, or services in resource allocation. Observed impacts of work zones may influence future decisions on methods and timing of program delivery.
- Quality Information.** Systems of physical transportation infrastructure are extensive, and the information to describe their inventory, condition, characteristics, performance, costs, and impacts is voluminous. Developing, maintaining, and updating the management systems and data that are needed to describe the asset classes and to support the functions and decisions illustrated in Figure 1.1 is a continuing task. Ensuring that quality information can be provided to all

organizational levels in a timely, accurate, and meaningful way to assist them in fulfilling their asset management responsibilities is likewise important to the process.

In expressing resource allocation and utilization in a strategic, integrated, and systematic way, Figure 1.1 suggests a number of “best practices”:

- **The approach is policy-driven.** Applicable policies include those embodying system performance goals, and broader policies with important transportation implications, such as those specifying economic development or social or environmental initiatives. Other elements of resource allocation – e.g., planning criteria, prioritization factors, system performance measures – are consistent with these policy goals.
- **The analysis of options and tradeoffs is strategic, interdisciplinary, and integrated.** It encompasses a number of modes and their associated infrastructure, rather than focusing on individual classes of assets. Policy goals and objectives are explicitly considered in identifying modal, programming, or technological options to meet transportation needs. Tradeoffs among modes, programs, and technologies are conducted to seek the best performance at the lowest life-cycle cost. Quality information is applied throughout these processes.
- **Programs, projects, and services are delivered in the most effective way available.** Options for delivery are continually evaluated in terms of the agency’s own labor, financial, and information resources, and those of other providers in the public or private sectors.
- **Decisions at each step are based upon quality information.** The various steps in Figure 1.1 – policy formulation, establishment of goals and targets, and program planning, development, and delivery – are based upon current, complete, and accurate information on system condition, performance, and forecasted trends. Management systems and supplementary analytic tools (e.g., for benefit-cost analyses or tradeoff analyses) are applied to these decisions, not as “black-box” solutions, but rather as aids to managers and executives in diagnosing problems and identifying the most effective projects and services. Value is placed on the capabilities and resources to provide this quality information.
- The information base for asset management is continually renewed, with feedback for updates and improvement. Working upward from the bottom in Figure 1.1 to consider the several feedback loops shown:
 - **Program delivery monitoring** documents whether projects and services have been delivered on time and budget, and identifies causes of problems that may require remedy;
 - **System performance monitoring** quantifies the results of past investment decisions, establishes baselines for future decisions, and identifies updates needed in project selection criteria;

- **System and customer surveys** update information on current asset inventory, condition, and performance, and the cost and effectiveness of project treatments and service delivery methods for use in future analyses; and

Performance trends and comparisons to targets provide information on the status of program accomplishments, needed adjustments (either in areas of program emphasis, or in the target goals and objectives), and a basis for future policy formulation.

2.0 State-of-Practice Review

Section 2.0 assesses VTrans' current asset management practices against two benchmarks. Section 2.1 evaluates VTrans' state-of-practice as compared to the state-of-the-art in asset management documented by the study team in NCHRP Project 20-24(11). Section 2.2 summarizes VTrans' current capability to comply with Sections 24 and 25.

■ 2.1 Current VTrans Asset Management Practices

Tables 2.1 through 2.4 present VTrans state of the practice as compared to the state-of-the-art in asset management documented in NCHRP 20-24(11). These benchmarks were developed based on the results of asset management surveys and workshops, a review of current literature, visits to several state DOTs, and a synthesis of industry best practices. The tables represent four “matrices” that organize key concepts, principles, and state-of-the-art techniques. These matrices lay out a range of options in improved asset management and identify “ideal” practices to which VTrans can strive. They address the full range of DOT infrastructure management activities, and are described by the following questions:

- **Policy Goals and Objectives** - Does policy guidance encourage and provide incentives for good asset management?
- **Planning and Programming** - Do resource allocation decisions reflect good practice in asset management?
- **Program Delivery** - Do oversight techniques and follow-through reflect industry good practice?
- **Information and Analysis** - Do information resources effectively support asset management policy and decisions?

The information in each matrix has been organized in four columns:

- The first column identifies the most important basic characteristics of good asset management practice applicable to U.S. transportation agencies. These have been kept to a small number in each matrix to focus on the most important.
- The second column lists specific evaluation criteria by which these characteristics can be evaluated. They identify the likely places to look in determining whether the policy guidance, management procedures, and decision culture that drive investment choices and program delivery conform to the characteristics of good asset management.
- The third column describes the current state-of-the-art for each criterion.
- The fourth column describes the situation at VTrans in each of the key areas of asset management. These descriptions have been derived from interviews with key VTrans personnel and a review of VTrans literature.

Table 2.1 Policy Goals and Objectives
Does Policy Guidance Encourage Good Asset Management?

Characteristics	Criteria	Benchmark - State-of-the-Art	VTrans State of Practice
<p>1. Policy goals and objectives reflect a holistic, long-term view of asset performance and cost.</p>	<p>Defined goals and objectives</p>	<p>Goals and objectives are comprehensive, integrated with other statewide policy objectives, and supported by quantitative and measurable performance measures or criteria.</p>	<p>VTrans has taken important initial steps to define goals, objectives and performance measures. These steps reflect a recognition of the importance of a performance-driven, outcome-based approach to planning and resource allocation. Work is currently ongoing to establish a refined set of performance measures to reflect key outcome areas. Because work on development of a performance framework has been evolving, existing long-range plans, policy plans budget documents and procedures manuals (e.g., the Pavement Management Manual) do not always reflect a consistent view of policies and desired outcomes.</p>
	<p>Asset Management is a key catalyst for decision and action</p>	<p>Principles of good asset management are articulated in an agency business plan and clearly recognized throughout the agency as the driving force for resource allocation and utilization.</p>	
	<p>Life-cycle perspective</p>	<p>Goals and objectives embody the perspective of life-cycle economic analyses of asset performance and cost, and encourage strategies with long-term benefits.</p>	<p>The defined outcome area of Investment Benefit supports the encouragement of lowest life-cycle cost strategies. However, current performance measures are based on condition distributions and don't explicitly encourage least life-cycle cost strategies.</p> <p>Project development and evaluation efforts in the pavement and bridge areas have clearly recognized the importance of preventive maintenance. However, some policy statements emphasize a "worst-first" or equity-based project selection method. For example, the 1992 Interim Policy on Resurfacing states that priority be given to the most distressed areas. The Pavement Management Manual section 3.2.2 titled Program Development Goals states the goal: "Strive for a uniform system condition but recognize the importance of equitable geographic distribution of projects."</p>

Table 2.1 Policy Goals and Objectives (continued)
Does Policy Guidance Encourage Good Asset Management?

Characteristics	Criteria	Benchmark - State-of-the-Art	VTrans State of Practice
2. Goals and objectives embody the public interest in good stewardship of transportation assets.	Recognition of asset condition, performance, and public acceptance in policy formulation	This recognition entails the following characteristics: <ul style="list-style-type: none"> • Policy goals and objectives encourage a business-model, customer-oriented approach to asset management. • Reliable information on asset condition and public perceptions thereof is accounted for in updating policy objectives. 	VTrans has developed a mission statement and a set of emphasis areas that reflect the public’s priority issues, based on extensive customer surveys. The Transportation Planning Initiative is a successful vehicle for public involvement. VTrans FY2002 Budget Strategic Overview took some positive initial steps toward comparison of targets to actual performance. VTrans’ Pavement Management Annual Report includes effective graphics showing current and projected system performance. The Pavement Management Manual states objectives in terms of percent of vehicle miles traveled (VMT) by condition class, but VMT-based targets are not noted in other documents, and VMT-based statistics for actual pavement condition are not published.
	Public reporting and accountability	Reported system performance is measured against policy goals and objectives.	
3. Policy formulation allows the agency latitude in arriving at performance-driven decisions on resource allocation.	Political process	Political decisions on resource allocation among modes or programs are strongly influenced by objective information on expected performance.	VTrans is moving towards a more outcome-based presentation of the annual budget document. Development of the Rail Capital Investment Policy Plan, and the future Highway Policy Plan will provide substantive information on needs and relationships between investments and outcomes. Resource allocations among programs are not based on any formal analysis of budget level versus expected performance.
	Agency decision-making	The agency makes resource allocation decisions among programs and across geographic regions based on expected performance rather than by historical splits or formulas that do not correlate with an objective indication of system condition.	

Table 2.1 Policy Goals and Objectives (continued)
Does Policy Guidance Encourage Good Asset Management?

Characteristics	Criteria	Benchmark - State-of-the-Art	VTrans State of Practice
<p>4. The agency proactively helps to formulate effective asset management policy.</p>	<p>Engagement with policy-makers</p>	<p>The agency actively engages with political leaders and other policy-makers to define expectations of system performance, frame alternative approaches, and outline the consequences of decisions and courses of action relative to these expectations.</p>	<p>VTrans works with policy-makers during the budget process, sharing information on specific transportation problems and projects.</p> <p>The annual pavement management report presents projections of pavement condition assuming current funding levels.</p>
	<p>Provision of information</p>	<p>The agency’s asset management systems are designed and applied to yield meaningful information on policy choices and consequences.</p>	<p>A systemwide view of needs and performance under different budget scenarios is not currently presented to policy-makers.</p> <p>VTrans’ asset management systems are used to identify projects. The pavement and bridge management systems have the capabilities to assess the performance impacts of different budget levels, but are not used extensively for this purpose.</p>

Table 2.2 Planning and Programming

Do Resource Allocation Decisions Reflect Good Practice in Asset Management?

Characteristics	Criteria	Benchmark - State-of-the-Art	VTrans State of Practice
<p>1. Planning and programming procedures and criteria are consistent and reinforce policy goals and objectives.</p>	<p>Fiscally responsible planning</p>	<p>Development of statewide long-range plans can be demonstrated to be consistent with policy goals and objectives and with realistic projections of future revenue.</p>	<p>The long-range plan is consistent with policy goals and contains a thorough analysis of revenue trends and projections.</p>
	<p>Program prioritization</p>	<p>Funding allocation and project prioritization criteria are consistent with and support the state’s and the agency’s policy goals and objectives.</p>	<p>Programming procedures that support policy goals and objectives have been developed for selection of projects within the rail, aviation, pavement and bridge program categories. The pavement management system is used to produce a list of candidate projects based on a benefit/cost analysis. Level of improvement (LOI) policies are applied that recommend more extensive treatments on facilities with higher functional classifications and traffic levels.</p>
	<p>Updates and revisions</p>	<p>Updates and revisions to the planning and program development process are performed regularly to reflect changes affecting asset management priorities in the arenas of:</p> <ul style="list-style-type: none"> • Policy (e.g., preserving existing investments, economic development), • Technology (e.g., new design procedures or materials), or • Emerging issues (e.g., updated environmental regulations; identification of potentially catastrophic risks to asset condition or performance). 	<p>VTrans’ long-range plan is updated every five years. The Project Development Division is responsible for coordinating the programming process. There is no formal revision schedule for updating the programming process.</p>

Table 2.2 Planning and Programming (continued)
Do Resource Allocation Decisions Reflect Good Practice in Asset Management?

Characteristics	Criteria	Benchmark - State-of-the-Art	VTrans State of Practice
2. Planning and program development consider a range of alternatives in addressing system deficiencies.	Planning alternatives	Long-range planning identifies and evaluates a range of program alternatives and, as appropriate, modal alternatives to meet present and future deficiencies.	VTrans' long-range plan evaluates program alternatives at a general level. In addition, a recent freight study provides a more detailed evaluation of modal alternatives to meet the freight needs throughout Vermont.
	Project scope, cost, benefits, impact on performance	Program development, guided by adopted plans, formulates projects of appropriate scope and develops realistic estimates of their costs, benefits, and impacts on system performance.	VTrans' project development process for Federal-aid projects calls for consideration of alternatives including maintenance, rehabilitation, and a "no-build" option as part of the scoping process.

Table 2.2 Planning and Programming (continued)

Do Resource Allocation Decisions Reflect Good Practice in Asset Management?

Characteristics	Criteria	Benchmark - State-of-the-Art	VTrans State of Practice
<p>3. Performance-based concepts guide planning, program development, and system monitoring.</p>	<p>Performance-based budgeting</p>	<p>Recommended programs and budgets are tied to performance budgeting concepts entailing:</p> <ul style="list-style-type: none"> • Structuring of costs by activity, and • Relationships of costs to levels of service or performance measures 	<p>The FY 02 Budget documents program objectives, outputs, and current and projected performance and policy objectives. Target performance levels are presented for each program category and compared to current year performance.</p> <p>The amount of funding allocated to each program category is not explicitly linked to specific performance targets. Historical data indicates a high degree of instability in funding levels to specific program categories from year to year.</p> <p>The relationship between cost and performance is not currently available to decision-makers during the budgeting process.</p> <p>Information on the resources required to maintain existing assets at target performance levels and at least life-cycle cost is available for pavement and for railroads, but this information does not appear to have a strong influence on programming decisions.</p> <p>VTrans' system monitoring approach is being updated via the current performance measure initiative</p>
	<p>Benchmark achievement</p>	<p>The planning and programming process indicates (or “defines”) the resources required to maintain existing assets at target performance levels and at least life-cycle cost.</p>	
	<p>System monitoring</p>	<p>Performance measures or levels of service are defined and regularly applied to quantify the impacts of program decisions and actions and to provide feedback for future planning and program priorities.</p>	
	<p>Reporting</p>	<p>Progress toward stated programmatic system performance targets is measured and reported regularly.</p>	

Table 2.2 Planning and Programming (continued)
Do Resource Allocation Decisions Reflect Good Practice in Asset Management?

Characteristics	Criteria	Benchmark - State-of-the-Art	VTrans State of Practice
4. Resource allocations and program tradeoffs are based on relative merit and an understanding of comparative costs and consequences.	Program building	Organization of projects within programs (program building) results from statewide competition among projects based on objective criteria.	Objective criteria (both quantitative and qualitative) generally consistent with policy guidance are used to select projects within each program area. Program tradeoffs are based on informed judgment and negotiation. Formal, quantitative tradeoff analysis across program categories is not currently done. Performance measures are available for decision-makers, but information on the implications of more or less resources available to different categories is not generally estimated or communicated.
	Consistency	Projects being designed and built respond to, and are consistent with, overall policy guidance for system performance.	
	Program tradeoffs	Tradeoffs between programs (e.g., Preservation versus Improvement) are based upon analyses of life-cycle benefits and costs, rather than arbitrary formulas or historical splits	
	Communication	The implications of more or less resources allocated to each program are clearly communicated in terms of selected performance measures.	

Table 2.3 Program Delivery
Do Oversight Techniques and Follow-Through Reflect Good Industry Practices?

Characteristics	Criteria	Benchmark - State-of-the-Art	VTrans State of Practice
<p>1. The agency considers all available methods of program delivery.</p>	<p>Cost tracking</p>	<p>The agency knows its costs for delivering its programs and services (e.g., by activity, bid item, or resource class).</p>	<p>Cost data in various systems (Maintenance Activity Tracking System (MATS), State Transportation Accounting and Reporting System (STARS), Vermont Integrated System for Information and Organizational Needs (VISION), etc.) allows tracking of program expenditures at the detailed bid item and activity level. This detailed cost information does not easily lend itself to the derivation of unit cost factors required by pavement and bridge management systems, or for aggregate-level analysis of program output versus cost relationships.</p> <p>VTrans makes limited use of delivery options (e.g., approx. 5% of maintenance work is outsourced). A federally mandated threshold of \$50 million for design-build contracts prohibits VTrans from considering this option, because VTrans has no contracts of this size.</p>
	<p>Options for delivery</p>	<p>The agency periodically evaluates its options for delivering programs and services: e.g., agency employees, intergovernmental agreements, partnering, outsourcing, managed competition.</p>	
<p>2. The agency tracks program outputs and outcomes.</p>	<p>Feedback mechanism</p>	<p>The agency has the ability to easily track actual project and service delivery against the program plan so that adjustments can be made.</p>	<p>VTrans uses a construction management system to track schedules and budgets.</p> <p>A formal change order process has been documented. Procedures vary depending on the severity of the change.</p>
	<p>Change process</p>	<p>A formal program change process exists to make needed adjustments in cost, schedule, and scope; document causes; and reallocate funds.</p>	

Table 2.3 Program Delivery (continued)

Do Oversight Techniques and Follow-Through Reflect Good Industry Practices?

Characteristics	Criteria	Benchmark - State-of-the-Art	VTrans State of Practice
3. Reports on program delivery accomplishments are communicated and applied.	Internal	Department executives and program managers are regularly informed of progress; a well-understood mechanism exists to make needed adjustments.	The Budget office produces a monthly status report that shows how projects within a program are performing. Appropriation reports (rolled up financial reports) are produced for executives that show at a gross level if the agency is on track for spending money. Meetings between the Budget office and program delivery units occur regularly/as needed to monitor progress. Project status reports are available on the VTrans web page.
	External	Policy-makers and key stakeholders are kept informed of program status and adjustments.	
4. The approved program is delivered efficiently and effectively.	Delivery measures	Measures are defined and tracked to gauge successful program delivery in terms of schedule, cost, and scope.	Program managers provide quarterly project reviews and update program status information. There does not appear to be any established process or mechanism for review and revision of delivery approaches.
	Change management	The agency has a process to review and revise delivery approaches if improvement is needed.	

Table 2.4 Information and Analysis

Do Information Resources Effectively Support Asset Management Policies and Decisions?

Characteristics	Criteria	Benchmark - State-of-the-Art	VTrans State of Practice
<p>1. The agency maintains high-quality information needed to support asset management.</p>	<p>Asset Inventory</p>	<p>The agency maintains an inventory of assets that is a complete, accurate, and current description of infrastructure for which the agency is responsible or in which it has a statewide transportation interest.</p>	<p>Inventory and condition data is available for VTrans’ major infrastructure asset classes.</p> <p>The Transportation Planning Initiative (TPI) established in 1992 is a well-defined process for ensuring public involvement in development of plans and projects. The recent long-range plan update process included an extensive set of public involvement activities to elicit opinions on key transportation issues, including an opinion survey of 1,200 Vermonters, and meetings with planning commissions. Customer opinion survey information is not currently used on a regular basis to track performance.</p> <p>Actual costs and accomplishments are tracked at the program category level (e.g., paving, structures). In addition, an agency-wide average unit price list is available which reflects actual bid information, providing price ranges by bid item, and graphs of quantities versus price that support project-level cost estimation.</p> <p>Current cost and accomplishment tracking systems do not provide significant support for planning-level cost estimation.</p>
	<p>Asset Condition</p>	<p>Asset condition data are updated on a periodic schedule sufficient to meet regulatory requirements (e.g., bridge inspection data) and to provide timely and accurate information on status and performance.</p>	
	<p>Customer Perceptions</p>	<p>Information on customer perceptions is updated regularly through surveys, focus groups, complaint tracking, or other means, to gauge public perception of asset condition and agency performance, and to respond thereto.</p>	
	<p>Program outputs</p>	<p>Information on actual costs and accomplishments by project, asset category, work type, and location are maintained in a form that can be utilized to track actual cost versus performance and improve cost estimation techniques.</p>	

Table 2.4 Information and Analysis (continued)

Do Information Resources Effectively Support Asset Management Policies and Decisions?

Characteristics	Criteria	Benchmark - State-of-the-Art	VTrans State of Practice
2. Agency collects and updates asset management data in a cost effective manner.	Data collection technology	The agency applies the appropriate mix of data collection technology (e.g., visual, automated, remote sensing) to provide cost-effective coverage needed to maintain the quality information base discussed above.	VTrans uses an efficient combination of methods to collect asset inventory and condition data (e.g., manual inspections, video logging, Automatic Road Analyzer (ARAN)). Data collection is performed in accordance with federal guidelines (e.g., Federal Aviation Administration (FAA), Highway Performance Monitoring System (HPMS), National Bridge Inventory (NBI), etc.)
	Sampling methodology	The sampling methodology is demonstrated to be appropriate in terms of network coverage, sample size, and frequency, and in the training and team assignments needed to ensure objectivity, consistency, and repeatability.	

Table 2.4 Information and Analysis (continued)

Do Information Resources Effectively Support Asset Management Policies and Decisions?

Characteristics	Criteria	Benchmark - State-of-the-Art	VTrans State of Practice
<p>3. Information is automated and on platforms accessible to those needing it - relates to both databases and systems.</p>	<p>System technology and integration</p>	<p>The agency's single-asset management systems and databases have been updated and integrated to enable consistent information on all asset categories to be accessible to multiple applications, and to provide managers at various organizational levels the information and tools needed for effective asset management.</p>	<p>VTrans management systems are partially integrated (e.g., MATS downloads bridge and pavement data from the data warehouse, and the STARS financial system is connected to the Preconstruction Project Management System (PPMS)). Output from the management systems is not available to decision-makers throughout the agency on an immediate basis for ad-hoc queries and reports.</p> <p>IT requirements for future systems and system updates are determined on a case by case basis to reflect specific tactical needs. No standards are available.</p> <p>Although VTrans maintains two linear referencing systems, integrating the data from existing management systems is performed on an as-needed basis and is very labor intensive. A current initiative to develop a geographic information system (GIS)-based route log system will enhance and extend VTrans' GIS capabilities.</p>
	<p>Data administration</p>	<p>Information requirements and/or standards for asset management are in place to ensure that future system and database development efforts within the agency will integrate with existing systems and meet asset management information and analysis improvement needs.</p>	
	<p>Geo-referencing</p>	<p>Systems and information are based upon a common geographic referencing system and a common map-based interface for analysis, display, and reporting.</p>	

Table 2.4 Information and Analysis (continued)

Do Information Resources Effectively Support Asset Management Policies and Decisions?

Characteristics	Criteria	Benchmark – State-of-the-Art	VTrans State of Practice
4. Effective Decision-Support Tools are available for Asset Management	Strategy Analysis	The agency has decision-support tools that facilitate exploration of capital versus maintenance tradeoffs for different asset classes.	VTrans has the capabilities to explore capital versus maintenance tradeoffs for pavements and bridges.
	Project Analysis	The agency has tools that support consistent analysis of project costs and impacts, using a life-cycle cost perspective.	VTrans’ bridge management system (BMS) and pavement management system (PMS) are capable of analyzing projects on the basis of life-cycle costs and benefits.
	Program Analysis	The agency has tools, which provide an understanding of the system performance implications of a proposed program of projects.	VTrans’ BMS and PMS are capable of analyzing the impacts of alternative programs on system performance.
	Program Tradeoff Analysis	The agency has tools to help explore the system performance implications of different levels or mixes of investments across program categories or subcategories.	No management systems exist for other asset classes (e.g., rail and transit). No tools exist to perform tradeoffs across program categories.
5. Financial value of assets.	Conformity with Government Accounting Standards Board (GASB) Statement 34	The agency reports the value and condition of its transportation capital assets in a manner that conforms to the modified approach specified in GASB standards.	VTrans is using the depreciation method to comply with GASB 34.
	Information support for condition and financial reporting	Information on asset condition and the level of expenditure needed to meet target condition is available from the agency’s asset management systems.	The BMS and PMS are capable of generating information on the level of expenditure needed to meet target condition levels.

■ 2.2 Current Legislative Compliance Capabilities

Table 2.5 summarizes VTrans’ current capability to comply with Sections 24 and 25 for each of the following asset categories:

Table 2.5 Summary of Legislative Compliance Status

Asset Category	Section 24			Section 25			
	Inventory	Condition	Deterioration Rates	Funds for Target Condition	Required Activities	Activity Cost Data	Maint. Strategy Costs
Infrastructure Assets							
Roadways							
Pavement	■	■	■	■	■	■	■
Maint. features	■	□	□	□	■	■	□
Highway structures	■	■	■	□	■	□	□
Railroad							
Rails	■	■	-	■	■	■	-
Bridges	■	■	-	■	■	■	-
Crossings	■	■	-	■	■	■	-
Aviation							
Pavements	■	■	■	■	■	■	■
Other assets	■	■	■	□	■	■	□
Rail trails	■	□	□	□	■	■	□
Facilities	■	□	□	□	■	■	□
Other Assets							
Vehicles and equip.	■	■					
Land	-	NA					
Stockpiles	■	NA					

Legend

■ = Current □ = Planned - = Potential NA = Not applicable = Not required

Roadways

- Pavements
- Maintained roadway features – includes all roadway components other than pavement or structures that VTrans maintains (e.g., shoulders, guardrails, delineators, mile markers, fences, drainage facilities, traffic signs, signals, lights, etc.)

Highway structures

Railroad

- Rails
- Bridges
- Rail crossings

Aviation

- Pavements – runways, parking lots, taxi ways, etc.
- Other assets – navigational aides, beacons, lights, etc. (aviation buildings are included in the Facilities category)

Rail trails

Facilities – garages, sheds, aviation buildings, etc.

Vehicles and equipment

Land – right-of-way

Stockpiles – salt, sand, culverts, plow blades, guard rail (these five items constitute 95 percent of VTrans material stockpiles)

The table categorizes each of the requirements into one of four classifications:

- **Current** refers to those requirements with which VTrans can readily comply, with little additional work or resources.
- **Planned** refers to those requirements that match capabilities currently proposed by VTrans.
- **Potential** refers to those requirements that do not correlate to current or planned capabilities. Recommendations for filling these gaps are addressed in Section 4.0.
- **Not applicable** refers to legislative requirements that are not meaningful for an asset category.

■ 2.3 Summary of Findings

Key Asset Management Elements in Place

VTrans has put into place many of the necessary components of a sound asset management program that can both meet the requirements of Sections 24 and 25 of Act 64, and provide the agency with an effective, strategic approach to making wise infrastructure investments with limited resources. Key asset management elements currently in place or in progress include:

- Completion of a long-range plan to set policy direction and provide guidance for transportation planning, project development, operations and maintenance.
- Preliminary establishment of a consistent set of policy goals and performance measures, used to set direction for planning and program development. Refinement of performance measures is currently underway. This process of refinement is a necessary precursor to the establishment of a performance-based budgeting approach.
- Development of policy plans for aviation, rail, pedestrian/bicycle, and public transportation to examine current and future needs and establish specific modal policy directions and general direction for investment.
- Development of modal capital investment plans for aviation and rail, which establish mechanisms to identify, prioritize and fund transportation projects in these areas based on objective criteria reflecting established policy.
- Establishment of a strong customer orientation, through organizational changes (creation of project managers to provide single points of contact), community outreach activities in conjunction with the Transportation Planning Initiative (TPI), and conduct of public opinion surveys as part of Long-Range Plan development and update activities in 1995 and 2000.
- Full implementation and use of a state-of-the-art pavement management system, and collection of the data necessary to complete implementation of a state-of-the-art bridge management system.
- Use of maintenance management, pre-construction project management, and construction management systems to plan and monitor work. An upgrade to the maintenance management system is currently planned to facilitate planning for future maintenance needs and analyzing relationships between performance and funding levels.

Opportunities for Improvement

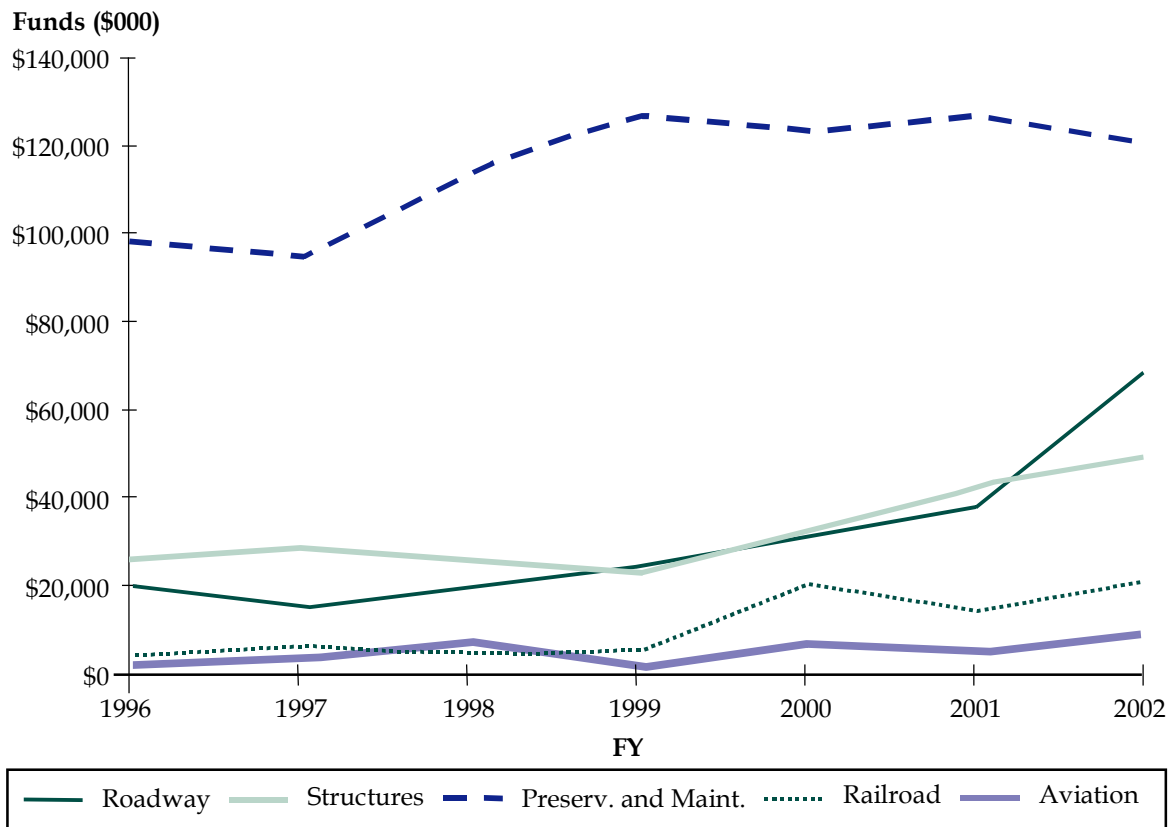
The current practice review also identified several opportunities to strengthen VTrans' asset management capabilities and processes. These findings provide the foundation for the asset management work plan presented in Section 4.0.

Policy and Performance Framework

- Continue refinement of the performance measures initiative, with attention to ensuring that a life-cycle perspective is considered in development and prioritization of asset preservation projects. Consider incorporation of regular customer survey information into the performance measurement effort.
- Improve integration of transit into overall resource allocation process.
- Work towards improved consistency with respect to objectives and performance criteria in current active budgeting, planning, policy and procedures documents.
- Ensure that future policy plans and initiatives are consistent with asset management principles.

Programming and Project Development Processes

- Clarify current resource allocation process.
- Review the extent to which asset preservation projects are being selected based on “worst first” and equity-based criteria, and assess the need/desirability of establishing stronger guidelines to encourage project selections based on life-cycle benefit/cost.
- Figure 2.1 indicates a significant degree of instability in funding levels for various program categories. Review the implications and impacts of this funding environment.
- Implement the capability to present alternative budget scenarios and their impacts on performance for each program category, in a consistent format. Develop summary reports showing this information in an effective manner suited to review by customers and policy-makers. In the longer term, develop the capability to make cross-program tradeoffs by viewing consolidated performance impacts of different budget allocations.
- Strengthen processes and procedures to support coordinated project programming and development across functional areas – to strengthen intermodal connections, encourage consideration of modal alternatives (where appropriate) and ensure that projects are developed to address multiple types of needs which may exist in a given location.
- Increase the use of existing management systems and data to support decision-making throughout current planning, programming, and delivery processes.

Figure 2.1 VTrans Program Funding Trends

Investigate the potential cost savings from consideration of alternative project delivery methods (e.g., outsourcing various maintenance activities).

- Investigate the need to realign the TPI process with asset management initiatives.

Information and Analysis

- Establish a consistent set of requirements for all asset management systems so that the results of these systems can be consolidated into an overall asset management reports including: inventory listings, condition summaries, comparison of conditions to targets, listing of proposed projects by location, type and status, estimates of funds required to meet condition targets, mix of preventive maintenance versus major rehabilitation/replacements.
- Based on these requirements, fill in gaps in VTrans' IT infrastructure.
- Continue to improve consistency of geographic referencing across asset databases in order to provide a convenient, widely accessible, automated capability to display

information about all asset classes (including location, classification, condition, needs, and planned/recommended projects) on a single map.

- Reinforce existing GIS and data warehouse efforts by aligning them with asset management initiatives.
- Investigate improvements to cost tracking methods in order to provide accurate planing-level unit cost information needed for scenario analysis. If VTrans has all required cost data, it may need to improve on the reporting of this information.

Legislative Compliance

As illustrated in Table 2.5 above, VTrans currently has the data and system capabilities required to meet several of the legislative requirements. For several of the remaining requirements, VTrans has plans to develop the capabilities. Despite this progress, two key challenges exist in the area of legislative compliance:

- Compilation and integration of existing data.
- Coordination of current and future management system initiatives with this effort. Several management system enhancements are planned throughout the agency. Care should be taken that these initiatives support VTrans' efforts to produce an asset management report that complies with Sections 24 and 25.

3.0 Asset Management Vision

Section 3.0 presents a vision for transportation asset management at VTrans, a set of goals to guide its implementation, and a discussion of the outcomes and benefits of asset management. The vision and goals build upon VTrans' development of several current concepts and methods that have been described in Section 2.0 and on the principles of asset management presented in Section 1.0.

■ 3.1 Asset Management Vision Statement

Transportation asset management at VTrans is a strategic approach to managing transportation infrastructure. It enables VTrans to improve how it conducts its business, how it reaches decisions, and how it leverages available data and IT capabilities. Asset management establishes common linkages between VTrans' asset classes in planning, program development, and program delivery.

■ 3.2 Asset Management Goals

The goals of asset management at VTrans are as follows:

- Operate, maintain, and/or upgrade infrastructure assets with appropriate performance and cost effectiveness;
- Deliver to VTrans' customers the best value for the dollar spent; and
- Enhance VTrans' accountability and credibility.

■ 3.3 Benefits of Asset Management

Developing a comprehensive asset management system at VTrans' will lead to the following outcomes and *benefits*:

- Enhanced planning, programming, and budgeting guidelines that will align investment decisions throughout VTrans with agency policies and focus areas - *increased quality of services*;
- Reports identifying 1) current and accurate asset inventory information in terms of effective performance measures; 2) target levels for asset condition compared to actual condition; and 3) estimated funds to maintain the target condition compared to actual costs - *improved accountability*;
- Standardized and ad hoc management system and GIS reports required to support planning, programming, and budgeting decisions - *defensible decisions and increased credibility*;
- Analytical methodologies and tools required to analyze the life-cycle costs and benefits of capital and maintenance projects, and to evaluate projects across modes and programs - *increased cost-effectiveness*;
- Suite of IT tools that generates consistent strategic information across asset types that is consistent with tactical information - *enhanced vertical integration; and*
- A set of department-wide organizing principles for existing and planned initiatives - *improved horizontally alignment*.

4.0 Asset Management Work Plan

Section 4.0 presents an asset management work plan for VTrans. The plan is based on the findings of the state-of-the-practice review presented in Section 2.0, the results of an asset management working session, and Cambridge Systematics' knowledge of other state DOT practices. It identifies practical implementation steps that support the vision and goals defined above. The plan also includes a timetable, a discussion of implementation issues, and a preliminary cost estimate for each activity.

Implementing the work plan will require a mixture of indirect and direct costs. Indirect costs cover the resources required for current VTrans staff to perform work and to bring their current processes and mindsets into alignment with the asset management principles presented in Section 1.0. Direct costs cover the resources required to engage consultants. Consultants may be brought in to add expertise or to address workload constraints within VTrans. Determining the "correct" mix of in-house and contracted work will be the responsibility of the asset management steering committee discussed in Initiative 1 below. This work plan represents one implementation scenario, which combines both internal and outsourced work. For the majority of the initiatives, the plan provides a preliminary cost estimate associated with engaging a consultant – indirect costs have not been estimated. The plan identifies two initiatives for which the implementation costs consist entirely of indirect expenses (i.e., no consulting work is required). The final cost of implementing the work plan will decrease if VTrans performs more work in-house and increase if consultants are relied upon more heavily.

The work plan makes no presumption of the relative priority of this initiative with respect to other projects at VTrans. Rather, the plan presents activities, timeframes, and budgets as if the implementation of asset management at VTrans has received executive and legislative support and full financial backing.

■ 4.1 Asset Management Initiatives

Initiative 1. Establish asset management coordination

Description: The lead role at VTrans for asset management coordination will be assigned to the Policy and Planning Division. An individual with identified support resources will be given the charge to lead this assignment. Establishing "ownership" will provide clear accountability for asset management and ensure that efforts throughout VTrans are coordinated and performed in a logical sequence. Specifically, the "owner" will be charged with responsibility for:

- Conveying the asset management initiative to all VTrans employees and “partners.”
- Implementing the asset management work plan. This will include assisting each of the divisions charged with mobilizing the resources necessary to carry out the initiatives as well as monitoring and providing assistance as necessary throughout the implementation process.
- Forming asset management steering and technical committees made up of representatives from various sections and divisions. These committees will coordinate asset management initiatives throughout VTrans.
- Providing material for ongoing communication regarding asset management implementation at VTrans to all employees and the Legislature and the Governor’s Office. This will include the development of the asset management report for the House and Senate Committees on Transportation.

Key Steps:

- Assign coordination “ownership” to an individual and identify the resources available for this effort.
- Form asset management steering committees.
- Provide ongoing communication regarding asset management implementation.

Timing: “Ownership” will be assigned before work begins on any of the other initiatives.

Preliminary Cost Estimate: Indirect costs only

Initiative 2. Incorporate asset management principles into current performance measure effort

Description: Asset management principles will be incorporated into the current performance measure initiative. Issues to be considered include:

- Improved consistency between policy objectives and performance criteria.
- Determine performance measures for assets that can be tracked, predicted, and reported by the management systems used for them.
- Include life-cycle perspective of costs and benefits in the asset management performance measures.
- Incorporate customer survey information and user benefits into the performance measures.

Key Steps:

- Provide consultant assistance to the performance measures effort for the development of measures that support asset management.
- Survey asset management performance measures used by other State DOTs.
- Develop a framework for asset management performance measures.
- Conduct an asset management performance measures workshop.
- Identify an extensive list of candidate measures.
- Prioritize performance measures based on the pro's and con's of using each measure as well as the data collection and maintenance implication of each measure.
- Select a balanced set of asset management performance measures.
- Initiate efforts to collect new data such as customer perceptions and preferences.

Timing: This activity will be complete within three months.

Implementation: The asset management “owner” will work with the performance measure steering committee to coordinate this activity.

Preliminary Cost Estimate: \$50 to 75K

Initiative 3. Legislative compliance

Description: VTrans will institute a phased approach to legislative compliance. Based on the current capabilities identified in Table 2.5, individual divisions will be asked to produce sections of the report (Tables 4.1 and 4.2 identify sources of information to meet the requirements of Sections 24 and 25 by asset category, and Appendix A includes examples of VTrans’ current reporting capabilities.) This information will then be compiled into a single report and submitted to the House and Senate Committees on Transportation. After the initial report is submitted, a process to update it regularly will be institutionalized. Future updates will take advantage of new data and system capabilities as they become available (Tables 4.1 and 4.2 identify future work activities by asset category).

Key Steps:

- Make assignments to each of the rows in Tables 4.1 and 4.2.
- Develop a timeline for completing each of the activities described in Tables 4.1 and 4.2.
- Integrate activities described in Tables 4.1 and 4.2 into the other asset management initiatives where appropriate.
- Initiate new activities for completing assignments where necessary.

Timing: The initial management report will be submitted within the next nine months and be updated annually.

Implementation: This activity will require significant coordination and contributions from all divisions across VTrans. The asset management steering and technical committees will play a major role in completing this initiative in a timely manner.

Preliminary Cost Estimate: Indirect costs only

Initiative 4. Enhance performance-based planning and programming

Description: The objective of this initiative is to encourage a more performance-based approach to the overall planning and programming functions at VTrans. In this context, “planning and programming” refers to an agency-wide process rather than a project-specific process. To meet this objective, VTrans will complete the following activities:

- Establish strengthened project evaluation criteria that are consistent with VTrans’ policies and performance measures and are based on life-cycle benefit/cost.
- Develop guidelines that assist VTrans with making decisions on when a facility should be considered for replacement, rehabilitation, and preventive maintenance. For example, when should a particular section of roadway be replaced rather than maintained? Currently, VTrans answers these questions based on pavement deterioration models from the PMS, safety concerns, congestion issues, etc. However, VTrans will develop a method to consider multiple factors simultaneously.
- Communicate the need for stability in funding levels for specific program categories to policy-makers. Funding stability would enable VTrans’ to have a longer-term outlook in its planning and programming processes by developing accurate projections of future resources.
- Develop processes and procedures that support coordinated project programming and development across functional areas – to strengthen intermodal connections, encourage consideration of modal alternatives (where appropriate) and ensure that projects are developed to address multiple types of needs which may exist in a given location.
- Develop processes and procedures for improving cross-program resource allocation decisions, including prioritization methods.

Key Steps:

Initiate a new project with a cross-division project team.

Develop a detailed scope for this project. Scope items will include:

- Workshops for brainstorming, consensus building, and determining priorities
- Case studies of model DOT’s

- Prioritization methods and tools
- Guidelines and/or manual for performance-based planning and programming

Timing: These activities will begin within three months and take 15 months to complete.

Implementation: The proposed highway policy plan presents an opportunity to perform the above activities for VTrans’ two major asset categories – highways and bridges. The scope of the proposed highway policy plan project will be reviewed with respect to the items described above so that opportunities for combining the two initiatives may be identified.

Preliminary Cost Estimate: \$200 to 250K

Initiative 5. Develop comprehensive IT strategy

Description: VTrans will define the data and analytical capabilities required at all levels of the agency to support asset management practices. The final product of this initiative will be an IT strategic plan that will ensure that these needs are met in the most effective possible way. The plan will focus on maximizing the use of VTrans’ current data and analytical capabilities.

Key Steps:

- Document the current overall planning, programming, and budget processes at VTrans, and the types of information and analysis used in these processes.
- Develop a set of “use case” scenarios for how these processes would be assisted by additional data or computerized tools.
- Review current and planned databases to identify gaps, areas of improvement, and opportunities for integration.
- Compile a list of data and analysis requirements and identify which requirements are not currently addressed by current or planned systems.
- Establish a consistent set of requirements for all asset management systems so that their results can be consolidated (e.g., inventory listings, condition summaries, comparison of conditions to targets, listing of proposed projects by location, type and status, estimates of funds required to meet condition targets, mix of preventive maintenance versus major rehabilitation/replacements, linear referencing system (LRS) requirements).
- Reinforce existing GIS and data warehouse efforts by documenting their criticality for asset management implementation as platforms for data integration.
- Build a formal logical data model and system architecture to support asset management needs in a comprehensive fashion.

Timing: This initiative will begin in six months and take 12 months to complete. This timeframe will enable the results of the performance measure initiative and the highway policy plan project to be incorporated into VTrans' overall IT strategy.

Implementation: This activity may be implemented in phases (e.g., Phase I - data and system inventory, Phase II - needs identification, and Phase III - gap analysis and plan development).

Preliminary Cost Estimate: \$150 to 200K

■ 4.2 Section 24 Compliance

Table 4.1 summarizes items required to comply with Section 24 for each asset category. The table identifies current sources of inventory data, measures with which to report asset condition, sources of condition data, sources of deterioration rates, sources of information on the funds required to obtain a specified condition target, and a summary of work requirements.

Table 4.1 Section 24 Sources of Information and Work Requirements

Asset Category	Source(s) of Inventory Data	Condition Measure(s)	Source(s) of Condition Data	Source(s) of Deterioration Rates	Funds for Target Condition	Work Requirements
INFRASTRUCTURE ASSETS						
Roadways						
Pavement	<ul style="list-style-type: none"> • dTIMS CT • Data from data warehouse is planned 	<ul style="list-style-type: none"> • Current rating system (good, fair, acceptable, poor) • Other indicators under review 	<ul style="list-style-type: none"> • dTIMS CT (raw detailed data) • Average data for reporting purposes will be included in data warehouse 	<ul style="list-style-type: none"> • dTIMS CT • New models currently under review and development 	<ul style="list-style-type: none"> • dTIMS CT • New models currently under review and development 	<ul style="list-style-type: none"> • Compile series of reports using dTIMS CT • Continue enhancement of dTIMS CT models • Continue plans to make data available in data warehouse

Table 4.1 Section 24 Sources of Information and Work Requirements (continued)

Asset Category	Source(s) of Inventory Data	Condition Measure(s)	Source(s) of Condition Data	Source(s) of Deterioration Rates	Funds for Target Condition	Work Requirements
Maint. Features	<ul style="list-style-type: none"> Maintenance Activity Tracking System (MATS) 	<ul style="list-style-type: none"> Condition rating system is under development (good, fair, poor) 	<ul style="list-style-type: none"> None available Plans exist to store this data in MATS 	<ul style="list-style-type: none"> None available Plans exist to store deterioration models in MATS Potential to use dTIMS CT for model analysis 	<ul style="list-style-type: none"> None available Plans exist to upgrade MATS with this capability Potential to use dTIMS CT for this analysis 	<ul style="list-style-type: none"> Compile inventory report using MATS Continue development of a condition rating system Continue plans to collect condition data Investigate modeling options - e.g., continuing MATS upgrades; using dTIMS CT Make data available in data warehouse
Highway structures	<ul style="list-style-type: none"> Bridge Access database Pontis 	<ul style="list-style-type: none"> Bridge sufficiency rating 	<ul style="list-style-type: none"> Bridge Access database Pontis 	<ul style="list-style-type: none"> Pontis 	<ul style="list-style-type: none"> Pontis 	<ul style="list-style-type: none"> Standardize element-level condition data Update activity cost data Compile inventory and condition reports using Pontis Make data available in data warehouse

Table 4.1 Section 24 Sources of Information and Work Requirements (continued)

Asset Category	Source(s) of Inventory Data	Condition Measure(s)	Source(s) of Condition Data	Source(s) of Deterioration Rates	Funds for Target Condition	Work Requirements
Railroad						
Rails	<ul style="list-style-type: none"> Five-Year State Railroad Capital Development Plan (1997) 	<ul style="list-style-type: none"> Ratings proposed in Rail Capital Investment Plan (2001) (combines FRA class and weight limits) 	<ul style="list-style-type: none"> Railroad Capital Plan 	<ul style="list-style-type: none"> None available 	<ul style="list-style-type: none"> Railroad Capital Plan 	<ul style="list-style-type: none"> Compile series of reports using information using the Railroad Capital Plan Update inventory data Update condition data Investigate modeling options - e.g., reviewing current models and practices used by other rail operators; develop simple models manually Make data available in data warehouse
Rail Bridges	<ul style="list-style-type: none"> Rail Div. Excel file 	<ul style="list-style-type: none"> Current ratings (1-10) 	<ul style="list-style-type: none"> Rail Div. Excel file 	<ul style="list-style-type: none"> None available 	<ul style="list-style-type: none"> Rail Div. Excel file 	<ul style="list-style-type: none"> Compile series of reports using current Rail Div. Excel spreadsheet Investigate modeling options - e.g., using Pontis; developing simple models manually Make data available in data warehouse

Table 4.1 Section 24 Sources of Information and Work Requirements (continued)

Asset Category	Source(s) of Inventory Data	Condition Measure(s)	Source(s) of Condition Data	Source(s) of Deterioration Rates	Funds for Target Condition	Work Requirements
Crossings	<ul style="list-style-type: none"> Rail Div. Excel file and Rail Capital Investment Policy Plan (2001) 	<ul style="list-style-type: none"> Current ratings (0-100) 	<ul style="list-style-type: none"> Rail Div. Excel file and Rail Policy Plan 	<ul style="list-style-type: none"> None available 	<ul style="list-style-type: none"> Rail Div. Excel file and Rail Policy Plan 	<ul style="list-style-type: none"> Compile series of reports using current Rail Div. Excel spreadsheet and Rail Policy Plan Investigate modeling options - e.g., reviewing current models and practices used by other rail operators; developing simple models manually Make data available in data warehouse
Aviation						
Pavement	<ul style="list-style-type: none"> Micro PAVER PMS 	<ul style="list-style-type: none"> Pavement condition index (PCI) 	<ul style="list-style-type: none"> Micro PAVER 	<ul style="list-style-type: none"> Micro PAVER 	<ul style="list-style-type: none"> Pavements - Micro PAVER 	<ul style="list-style-type: none"> Compile series of reports using Micro PAVER Make data available in data warehouse
Other Assets	<ul style="list-style-type: none"> Airport master plans, Airport Information Management System (AIMS) 	<ul style="list-style-type: none"> Applicable FAA ratings 	<ul style="list-style-type: none"> Airport master plans, AIMS, Airport Capital Facility Program 	<ul style="list-style-type: none"> None exist 	<ul style="list-style-type: none"> Airport Capital Facility Program, AIMS 	<ul style="list-style-type: none"> Compile series of reports using AIMS, airport master plans, and Airport Capital Facility Program Investigate modeling options - e.g., using dTIMS CS; developing simple models manually Make data available in data warehouse

Table 4.1 Section 24 Sources of Information and Work Requirements (continued)

Asset Category	Source(s) of Inventory Data	Condition Measure(s)	Source(s) of Condition Data	Source(s) of Deterioration Rates	Funds for Target Condition	Work Requirements
Rail trails	<ul style="list-style-type: none"> MATS, project plans 	<ul style="list-style-type: none"> Condition rating system under development (good, fair, poor) 	<ul style="list-style-type: none"> None available Plans exist to store this data in MATS 	<ul style="list-style-type: none"> None available Plans exist to store deterioration models in MATS 	<ul style="list-style-type: none"> None available Plans exist to upgrade MATS with this capability 	<ul style="list-style-type: none"> Compile inventory report using MATS Continue development of a condition rating system Continue plans to collect condition data Investigate modeling options – e.g., continuing MATS upgrades; using the modeling capabilities dTIMS CT Make data available in data warehouse
Facilities	<ul style="list-style-type: none"> Buildings book (2001) and facility database 	<ul style="list-style-type: none"> Facility rating now under development 	<ul style="list-style-type: none"> None available; eventually facility management system 	<ul style="list-style-type: none"> None available; eventually facility management system 	<ul style="list-style-type: none"> None available; eventually facility management system 	<ul style="list-style-type: none"> Compile inventory report using the facility database Finalize building rating system Collect condition data Continue facility management system effort, include capability to analyze relationship between budget and condition Make data available in data warehouse

Table 4.1 Section 24 Sources of Information and Work Requirements (continued)

Asset Category	Source(s) of Inventory Data	Condition Measure(s)	Source(s) of Condition Data	Source(s) of Deterioration Rates	Funds for Target Condition	Work Requirements
OTHER ASSETS						
Vehicles and Equipment	<ul style="list-style-type: none"> Maintenance Control and Management System (MCMS) 	<ul style="list-style-type: none"> Condition measure currently tracked by MCMS 	<ul style="list-style-type: none"> MCMS 	<ul style="list-style-type: none"> Not Required 	<ul style="list-style-type: none"> Not Required 	<ul style="list-style-type: none"> Generate current inventory and condition report using MCMS Make data available in data warehouse
Land	<ul style="list-style-type: none"> Technical Services Division records 	<ul style="list-style-type: none"> Not applicable 	<ul style="list-style-type: none"> Not applicable 	<ul style="list-style-type: none"> Not required 	<ul style="list-style-type: none"> Not required 	<ul style="list-style-type: none"> Generate inventory report by estimating acreage based on standard ROW widths Make data available in data warehouse
Stockpiles	<ul style="list-style-type: none"> MATS stores inventory data for the 5 materials identified in Section 2.2 	<ul style="list-style-type: none"> Not Applicable 	<ul style="list-style-type: none"> Not applicable 	<ul style="list-style-type: none"> Not required 	<ul style="list-style-type: none"> Not required 	<ul style="list-style-type: none"> Generate current inventory report for the materials identified in Section 2.2 using MATS Make data available in data warehouse

■ 4.3 Section 25 Compliance

Table 4.2 summarizes items required to comply with Section 25 for each infrastructure asset category. The table identifies required work items to develop a list of required activities and their associated costs, and to compare the cost of a preventative maintenance strategy to the cost a deferred maintenance strategy.

Table 4.2 Section 25 Work Requirements

Infrastructure Asset Category	List of Required Activities and their Associated Costs	Cost Comparisons between Preventive and Deferred Maintenance Strategies
Roadways		
Pavements	<ul style="list-style-type: none"> Use current dTIMS capabilities to develop pavement component of the asset management report 	<ul style="list-style-type: none"> Use current dTIMS capabilities to determine cost differential between a preventive maintenance and deferred maintenance strategy
Maint. Features	<ul style="list-style-type: none"> Use current MATS capabilities to develop roadway features component 	<ul style="list-style-type: none"> Near term - Perform this analysis “manually” based on current MATS data Long term - Include scenario analysis capabilities in the scope of the current MATS enhancement initiative (5-year timeframe)
Highway structures		
	<ul style="list-style-type: none"> Fully implement Pontis Use current Pontis capabilities to develop highway structures component 	<ul style="list-style-type: none"> Use current Pontis capabilities to determine cost differential between a preventive maintenance and deferred maintenance strategy

Table 4.2 Section 25 Work Requirements (continued)

Infrastructure Asset Category	List of Required Activities and their Associated Costs	Cost Comparisons between Preventive and Deferred Maintenance Strategies
Railroad		
Rails	<ul style="list-style-type: none"> Near term – Update Rail Capital Development Plan, following the policies developed in the Rail Policy Guide, to determine list of activities and costs for Rails Mid term – Investigate options for a rail crossing management system (e.g., develop new system or use MATS capabilities) 	<ul style="list-style-type: none"> Near term – Develop comparison of maintenance strategies manually Mid term – Include scenario analysis capability in rail management system
Bridges	<ul style="list-style-type: none"> Near term – Use current Excel file to develop rail bridge component Mid term – Investigate options for a rail bridge management system (e.g., develop new system or modify Pontis) 	<ul style="list-style-type: none"> Near term – Develop comparison of maintenance strategies manually Mid term – Include scenario analysis capability in rail bridge management system
Crossings	<ul style="list-style-type: none"> Near term – Use current Excel file and Rail Policy Plan to develop rail bridge component Mid term – Investigate options for a rail crossing management system (e.g., develop new system or use MATS capabilities) 	<ul style="list-style-type: none"> Near term – Develop comparison of maintenance strategies manually Mid term – Include scenario analysis capability in rail crossing management system
Aviation		
Pavements	<ul style="list-style-type: none"> Use current capabilities of Micro PAVER PMS 	<ul style="list-style-type: none"> Use current Micro PAVER PMS capabilities
Other Assets	<ul style="list-style-type: none"> Use the current Airport Capital Facility Program as the initial aviation component of the asset management report Use current AIMS capabilities for future updates 	<ul style="list-style-type: none"> Develop simple procedure to assess maintenance scenarios for assets other than pavements

Table 4.2 Section 25 Work Requirements (continued)

Infrastructure Asset Category	List of Required Activities and their Associated Costs	Cost Comparisons between Preventive and Deferred Maintenance Strategies
Rail Trails	<ul style="list-style-type: none"> Use current MATS capabilities to develop rail trails component of the asset management report 	<ul style="list-style-type: none"> Near term - Perform this analysis “manually” based on current MATS data Long term - Include scenario analysis capabilities in the scope of the current MATS enhancement initiative (5-year timeframe)
Facilities	<ul style="list-style-type: none"> Use current facility management system to develop the facilities component of the asset management report 	<ul style="list-style-type: none"> Initially, perform this analysis “manually” based on current facility data Develop capability to perform this analyses automatically as part of the current facility management system effort

■ 4.4 Schedule and Cost Summary

Figure 4.1 and Table 4.3 summarize the overall schedule and preliminary cost estimates for the asset management work plan presented above.

Figure 4.1 Asset Management Initiative Schedule

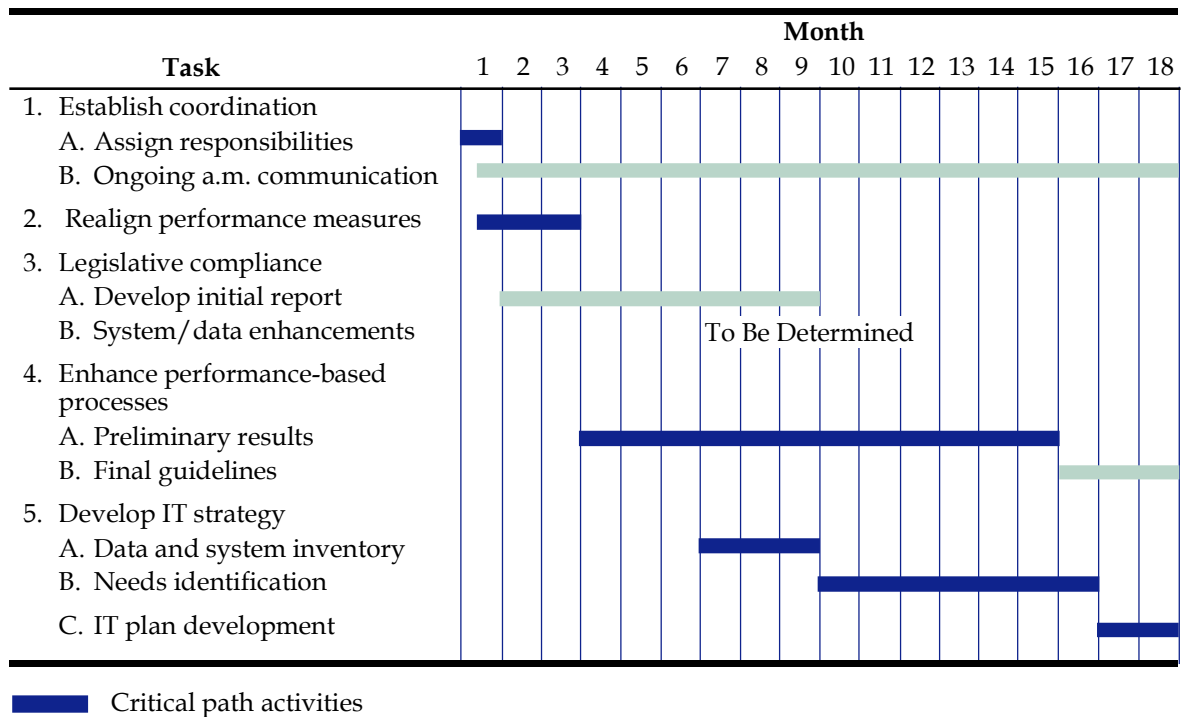


Table 4.3 Asset Management Initiate Preliminary Cost Estimates

#	Description	Preliminary Estimated Cost
1.	Establish coordination	Indirect only
2.	Realign performance measures	\$50-75K
3.	Legislative compliance	Indirect only
4.	Enhance performance-based processes	\$200-250K
5.	Develop IT strategy	\$150-200K

Glossary and Abbreviations

AIMS – Airport Information Management System – current VTrans management systems used to identify and prioritize aviation projects

ARAN – Automatic Road Analyzer – vehicle used to collect pavement condition data

BMS – Generic term for a bridge management system

DOT – Department of transportation

dTIMS – Current VTrans management systems for pavements

FAA – Federal Aviation Administration

FMS – Generic term for a financial management system

FRA – Federal Railroad Administration

GASB – Government Accounting Standards Board – non-governmental organization that sets standards for financial statements for state and local governments

GASB Statement 34 – New GASB requirements for state and local government annual financial reports that include asset depreciation, as well as expenditures and resources

GIS – Geographic information system

HPMS – Highway performance monitoring system

IT – Information technology

LOI – Level of improvement – system by VTrans to classify roadways into investment categories

LRS – Linear referencing system

MATS – Maintenance Activity Tracking System – current VTrans management systems for tracking maintenance activities

MCMS – Maintenance Control and Management System – current VTrans management systems for tracking vehicle and equipment data

Micro PAVER PMS – Current pavement management system used to manage pavements at VTrans' airports

MMS – Generic term for a maintenance management system

NBI – National Bridge Inventory

NCHRP – National Cooperative Highway Research Program

PCI – Pavement Condition Index – current measure used to quantify the condition of VTrans’ aviation pavements

PPMS – Preconstruction Project Management System – current VTrans system used to track projects until construction begins

Pontis – Current VTrans management system for bridges, culverts and miscellaneous structures

ROW – Right-of-way

STARS – State Transportation Accounting and Reporting System – Current VTrans financial management system

TPI – Transportation Planning Initiative

VISION – Vermont Integrated System for Information and Organizational Needs – statewide financial management system

VMT – Vehicle Miles Traveled – current VTrans traffic measurement

VTrans – Vermont Agency of Transportation

Appendix A

Sample Reports

Sample Reports

The following figures represent a sample of VTrans' current capabilities to comply with Section 24 and 25 requirements. The figures do not represent a current snapshot of an entire asset network. Rather, they are intended to illustrate the types of data currently available. Full reports of this nature will be generated as part of Initiative 3.

Figure A.1 Sample Pavement Report - Inventory

Road	Length	From	To	Name	Direction	Type	Exit Number	Divided
A0051N 00	1.282	0.000	1.282	ALT US5	NB	Section 1		
A0051NA01	0.038	0.000	0.038	ALT US5	NB	Approach		
A0052N 00	1.283	0.000	1.283	ALT US5	NB	Section 2		
B0040EA01	0.061	0.000	0.061	BR US4	EB	Approach		
B0040W 00	0.425	0.000	0.425	BR US4	WB	Mainline		Divided
B0040WA01	0.061	0.000	0.061	BR US4	WB	Approach		
B0040WJ01	0.195	0.000	0.195	BR US4	WB	Jughandle		
I0890N 00	130.254	0.000	130.254	I89	NB	Mainline		Divided
I0890NR01A	0.232	0.000	0.232	I89	NB	Ramp A	exit 1	
I0890NR04B	0.317	0.000	0.317	I89	NB	Ramp B	exit 4	
Total Length	134.148							

Figure A.2 Sample Pavement Report - Inventory Totals by Class

Class	NHS	NON-NHS	Total
State	374.34	1,992.48	2,366.82
Class 1	25.64	109.12	134.76
Interstate	698.29	0.00	698.29
Total	1,098.27	2,101.59	3,199.86

Notes: Table represents linear miles. Each direction of sections of divided highway is stored and analyzed as a separate road.

Figure A.3 Sample Pavement Report - Cost to Achieve a Target Condition

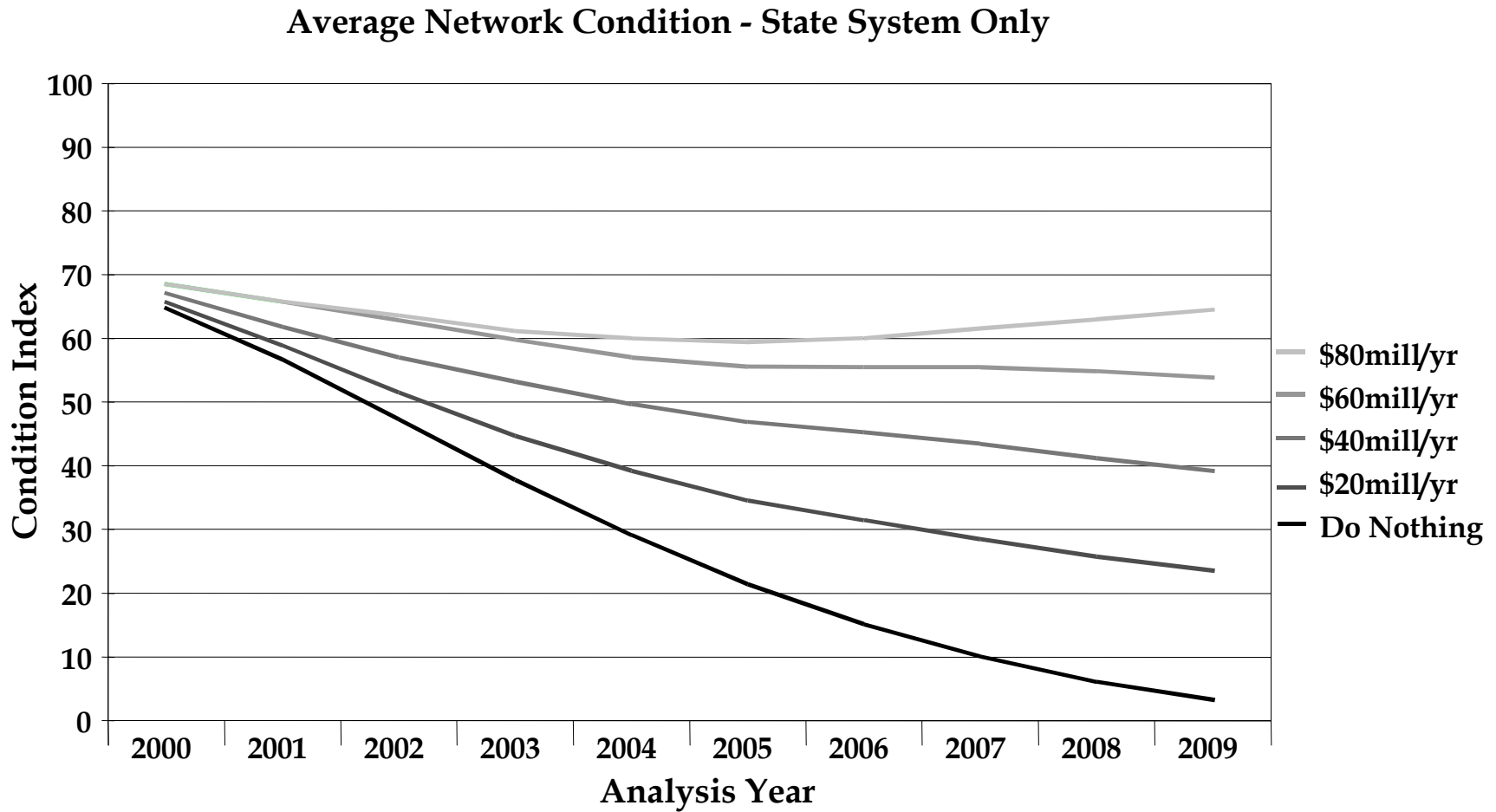


Figure A.4 Sample Maintained Features Report - Inventory

Feature	Unit of Measure	Total Inventory (for 1 regional garage)
Gravel surface	lane miles	0
Gravel shoulders	shoulder miles	168
Paved Shoulders	shoulder miles	168
Guardrail	linear feet	112,500
Delineators	linear feet	2,000
Mile marker plaques	items	0
Bedding area	square yards	9,000
Fence	miles	12
Culverts	culverts	1,500
Ditches	miles	75
Snow fence	linear feet	340
Marking signs	sites	20
Traffic signs	signs	2,457
Signals	signals	56
Roadway lights	lights	0
OBDS signs	sings	178
Plaques	plaques	0
Illegal signs	signs	45
Travel directional signs	signs	33

Figure A.5 Sample Rail Bridge Report - Inventory, Condition, and Cost to Achieve a Target Condition

Inventory and Condition Rating								Cost to Achieve Target Rating (\$000s)			
Railroad	Bridge	Mile Post	Year Built	Length	Type	Town	Rating	Immediate	Short Term	Long Term	Rehab
gmrr	136	27.46	1895	290	deck truss	Ludlow	2	0	225	100	5,000
gmrr	137	27.99	1965	97.83	I-beam	Ludlow	8	2,500	2	15	1,400
gmrr	137.5	29.00	1916	7.33	stone arch	Ludlow	3	0	102	0	1,100
gmrr	139	29.86	1919	15	conc. slab	Ludlow	4	0	15	40	360
gmrr	114	11.00	1899	117.17	thru truss	Chester	3	0	311	3	0
gmrr	116	11.40	1922	15.58	conc. slab	Chester	3	0	80	0	0
gmrr	120	16.10	1922	15.17	conc. slab	Chester	4	0	150	0	225
wcrr	10	8.44	1908	95.12	thru plate	Barre	5	0	55	30	0
wcrr	nd	8.50	1910	31.16	deck plate	Barre	4	0	32	28	0
Totals								2,500	972	216	8,085

Figure A.6 Sample Facility Report - Inventory

Site ID	Bld ID	Bld #	Use	Bays	Constructed	Front	Side	Height	Deprec value	Replace value	Appraise date
1-Ben	09099	4	salt shed 1	0	1991	40	84	10	\$87,600	\$97,210	6/13/2001
1-Ben	09100	5	salt shed 2	0	1991	40	84	10	\$87,600	\$93,920	6/13/2001
1-Ben	09102	2	bridge shop	2	1954	40	40	3	\$29,090	\$72,660	6/13/2001
1-Ben	09103	3	storage shed A	4	1999				\$55,211	\$60,671	6/13/2001
1-Ben	09101	1	district office	0	1965	70	70	0	\$540,560	\$900,930	6/13/2001
1-Ben	09104	6	storage shed B	0	1968	24	14	0	\$2,940	\$3,000	6/13/2001
1-Dor	09164	1	garage	6	1991	122	44		\$222,200	\$251,040	6/13/2001
1-Dor	09167	2	salt shed	0	1984	50	64		\$73,500	\$75,000	6/13/2001
1-Dor	09165	3	sand shed 1	0	1991				\$73,500	\$75,000	6/13/2001
1-Dor	09166	4	sand shed 2	0	1991				\$73,500	\$75,000	6/13/2001
1-Dor	09115	5	sand shed 3	0	1991				\$73,500	\$75,000	6/13/2001