Washington State Department of Transportation

Transportation Asset Management Feasibility Study

June 2009

DYE MANAGEMENT GROUP, INC.

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Executive Summary

The Washington State Department of Transportation (WSDOT) is a very large enterprise with a biennial budget of over $5.7 billion dollars; 7,800 employees; 18,500 lane miles of roads; 3,500 bridges; and the largest ferry system in North America. As such, WSDOT executive management, the Governor, and the Washington State Legislature need comprehensive, accurate, and timely data to manage by and set policy. This information is required to enhance traveler safety, safeguard taxpayer investment in the state's transportation system, deliver projects on time and on budget, optimize mobility, and exercise proper stewardship over resources.

WSDOT's core enterprise asset management, financial, program and project management systems, known collectively as the "Critical Applications," are wholly inadequate to provide this information. Because of these deficiencies, the Washington State Legislature directed the department during the 2007-2009 Biennium to prepare a detailed plan for replacing these systems. WSDOT performed this planning effort in collaboration with the Office of Financial Management (OFM) and the Department of Information Services (DIS) who participated on the project steering committee. WSDOT engaged Dye Management Group, Inc. to assist the department with this study.

One of the application components identified during the Critical Applications Implementation Feasibility Study is a Transportation Asset Management solution. During the development of the Critical Applications Replacement Program implementation plan, WSDOT identified the implementation of this Transportation Asset Management solution as being a high priority and thus a candidate for earlier implementation within the overall Critical Applications Replacement Program. Because of WSDOT's interest in having some or all of the Transportation Asset Management component be one of the earlier projects initiated within the Critical Applications Replacement Program, WSDOT decided to complete a detailed feasibility study for this component as an extension of the Critical Applications Implementation Feasibility study. This is the final report of the Transportation Asset Management Feasibility Study.

A. Project Scope

The proposed Transportation Asset Management component of the Critical Applications Replacement Program will contain roadway asset inventory, traffic analysis, crash analysis, and location referencing capabilities. This function is intended, at a minimum, to replace the capabilities of the current Transportation Information Planning and Support System (TRIPS), which is one of the fourteen Critical Applications. It will also position the agency with the capability to potentially replace a number of other standalone asset management applications maintained across WSDOT and over time develop a comprehensive, integrated asset management system.

Depending on the final approved budget for this effort, some additional asset classes and asset types beyond those currently included within the scope of TRIPS may be able

to be included within the scope of this effort. A final determination of the specific scope will be made during the future requirements definition phase. Because of the enterprise wide nature of this effort, representatives from a number of other functional areas within WSDOT will need to be involved in the future requirements gathering effort.

B. Problem Statement

The study team conducted a number of business interviews with managers and staff in the Transportation Data Office (TDO) and in various business units across WSDOT that utilize data provided by the TDO. One of the goals of the interviews was to identify problems with the existing business processes and the applications which support these processes. Some of the problems noted by stakeholders included:

- **Potential for delays and quality issues in providing information to stakeholders** - There is a significant potential for delays in providing information to the Washington State Legislature, other stakeholders, or the public. This is a result of the difficulty and length of time required to obtain information from the current systems. In addition, because these systems do not easily talk to each other, there is the potential for multiple answers or versions of the truth depending on which systems are used to obtain the information.

- **Lack of critical functionality needed to deliver programs** - Much information about asset inventory and asset conditions, relevant to planning, programming, and project management requires research in multiple systems or is not readily available in any WSDOT system.

- **Asset inventory is stored in multiple systems, impacting the department's ability to manage assets from an enterprise perspective** – Asset inventory and condition information is currently stored in multiple systems, including TRIPS. As a result, comprehensive access to this information for planning and accountability and performance reporting is very difficult. This limits the department's ability to implement an enterprise asset management business model.

- **Lack of support for geospatial referencing** - Locating assets or events on the transportation network is more difficult as a result of a lack of geospatial referencing capability in the current TRIPS Linear Referencing system. This complicates providing a range of management information to users based on geographic parameters including financial information by political or jurisdictional boundaries. It also creates the potential for incorrect assignment of project expenditures and taxes to jurisdictions and programs.

- **Potential for incomplete or inaccurate reporting or analysis –** There are data currency issues resulting from an inability to dynamically update traffic and collision data used for analysis. Traffic and collision data is entered into TRIPS as information is available from the Collision Location and Analysis System (CLAS) or from traffic recorders or traffic studies. However, this data is not automatically updated in other

downstream WSDOT systems that use this data for reporting and analysis, resulting in potentially conflicting information being provided to stakeholders or incorrect analysis being performed.

- **Potential difficulties in complying with future changes in regulatory requirements** – The ability of TRIPS to store additional roadway feature and characteristic inventory data and traffic count locations and new elements is severely limited by the capacity and constraints of the underlying database management system and the 20-year old design of the system. Changing federal standards and expectations of policy makers at the state level are requiring use of enhanced data in analysis and justification for funding requests. As a result, some asset inventory data is stored in shadow systems or data marts. This data may become out of sync with TRIPS. It also increases the complexity of WSDOT's systems environment, complicates information gathering, and increases the overall cost to maintain these systems.

- **Increased business risk due to an old system that is increasingly difficult to enhance and maintain** - The current TRIPS system was developed using mainframe computer languages. For the most part, only mandated changes are made in order to maintain system stability. Often unintended consequences have occurred when changes are made to the current application.

- **Increased operating costs as a result of supporting a number of duplicate systems** - Because of limitations in the existing TRIPS application, other systems have been developed both by WSDOT's Office of Information Technology (OIT), TDO, and various business units. These standalone applications substantially increase the cost of maintaining WSDOT's information technology portfolio.

C. Proposed Solution

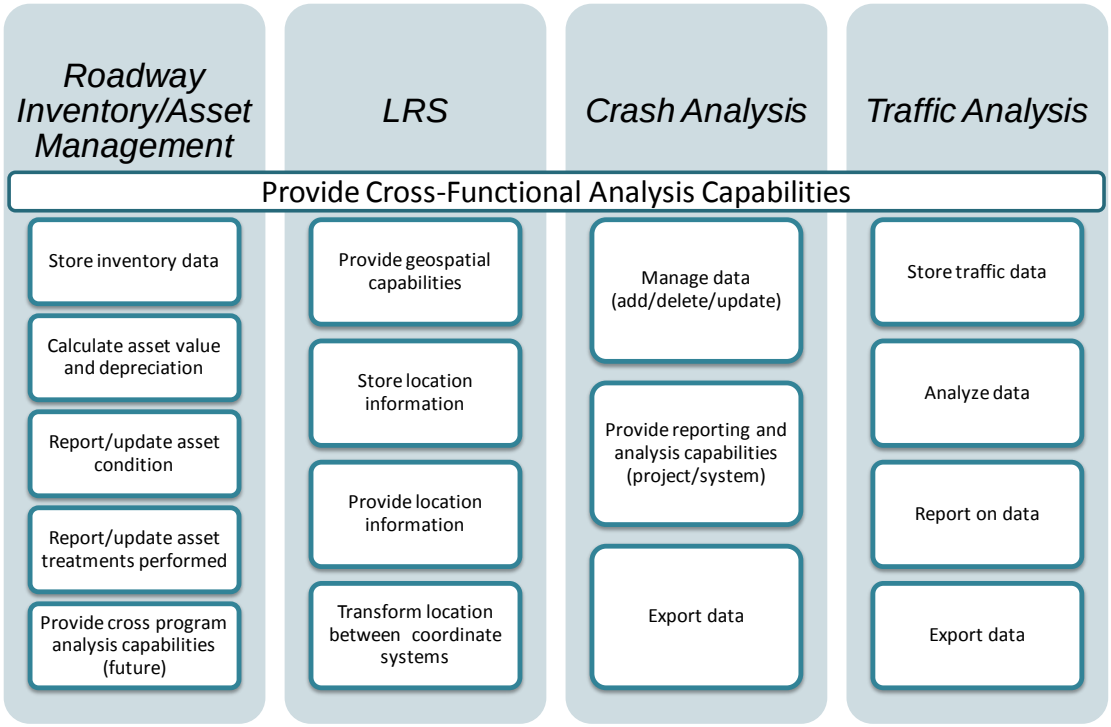
The Transportation Asset Management application component of the Critical Applications Replacement Program will provide the capability to develop an integrated inventory of the assets on WSDOT's transportation network. It will also include a set of robust analysis tools that will support needs identification and other analysis utilizing data in the asset inventory, in conjunction with other information such as condition data, crash records, and traffic counts.

The functionality of this solution includes four distinct sub-components:

- Asset inventory
- Location referencing system
- Crash analysis tools
- Traffic analysis tools

Exhibit ES-1 on the page below depicts, at a high level, the core functionality to be provided by the Transportation Asset Management solution. Each of these sub-components is then briefly described.

Exhibit ES-1: Transportation Asset Management Solution Functionality



1. Asset Inventory

The Asset Inventory function will provide the capability to have a complete, detailed inventory of the linear and point assets existing on the WSDOT transportation network. Initially, this function will replace the Roadway Inventory application currently contained in TRIPS. In addition, other asset classes and types may also be able to be brought into this application as part of the initial establishment of the asset inventory function. This would likely include the other inventory databases under development or maintained by TDO such as the roadside features database. The specific asset classes/types will be finalized in the requirements definition phase of the project. The implementation of this asset inventory capability will allow, over time, for the decommissioning of a number of other standalone asset inventory databases.

The Asset Inventory application will also provide WSDOT with the capability to store condition history for an asset and track construction and major maintenance activities. Likewise, the Asset Inventory application will have a number of analytical capabilities including performance-based budgeting based on the work required to move from the average current condition for an asset type to the targeted level of service for an asset type and lifecycle cost modeling, needs identification, trade-off analysis, and project

prioritization within an asset class. Implementation of these capabilities will require additional policy decisions by WSDOT executive management and the involvement of other asset owners and functional specialty areas in the future requirements gathering and system implementation efforts.

2. Location Referencing System

The Location Referencing System is a service module that will provide location reference and location validation capabilities to other WSDOT applications. Highlights of the capabilities of this solution include supporting creation and maintenance of line work (roadway geometry) both dynamically and in a batch mode; supporting multiple location reference methods including geospatial referencing and WSDOT's existing county, route, and milepost referencing scheme; providing translation and transformation between multiple location reference methods; providing translation back and forth between single-line representation and dual-line representation of the transportation network and allowing for locating data on both representations; and providing the ability to determine various jurisdictions for any particular location such as federal and state political boundaries or the boundaries of cities and counties.

3. Crash Analysis Tools

The Crash Analysis subcomponent consists of a set of analytical tools to allow WSDOT to identify safety needs by integrating data available in the Asset Inventory application and the existing Collision Location Analysis System (CLAS). This includes support for identification of high crash locations by various criteria; spatially displaying results sets from various ad-hoc queries by integrating with WSDOT's GIS Workbench; allowing users to dynamically create collision diagrams for crashes identified by the analysis tools using either pre-defined or user-defined schematics; supporting drill-down to the actual crash report data in CLAS and providing web-based access to the crash analysis capabilities for authorized WSDOT partners such as metropolitan planning organizations (MPOs) and county engineers.

4. Traffic Analysis Tools

This is a set of tools that facilitates performing traffic demand analysis by integrating asset information with traffic data collected by WSDOT. The Traffic Analysis toolset will support analysis of data collected from permanent and short-term data collection sites; allow analysis of the WSDOT transportation network by a variety of factors including count locations, roadway volumes, speed, vehicle classification, length classification, and weight; support reporting required by the Federal Highway Administration's (FHWA) Highway Performance Management System (HPMS); and support publication and web-based access to traffic data and analysis capabilities for authorized partners

D. Alternative Implementation Approaches Evaluated

Dye Management Group, Inc. in conjunction with the Transportation Asset Management Feasibility Study Work Group identified three alternative approaches for implementing a new Transportation Asset Management solution. The three alternatives involve a combination of custom or best of breed components[1] to meet the requirements for various functional components.

Based on market research, it was determined that the Asset Inventory and Location Referencing System functions could potentially be provided by either a custom or best of breed solution. The specific approach varies by alternative.

Likewise, based on market research, it is anticipated that the Crash Analysis solution will be met by the integration of one or more best of breed software tools, with some custom development required. In addition, it is anticipated that the Traffic Analysis component will be provided by a best of breed software solution. These approaches are consistent across the three alternatives evaluated.

The three implementation alternatives analyzed included:

Alternative 1: Custom developed Asset Inventory and Location Referencing; best of breed Crash Analysis tools with custom extensions; and a best of breed Traffic Analysis solution

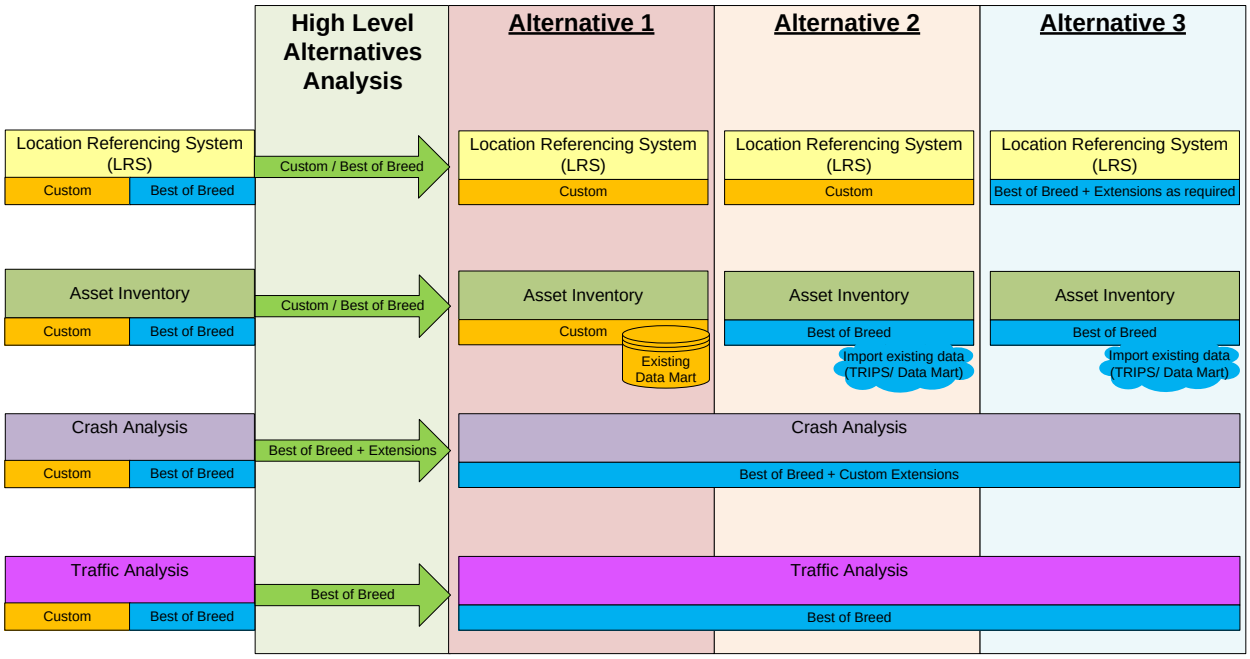
Alternative 2: Best of breed Asset Inventory; custom developed Location Referencing; best of breed Crash Analysis tools with custom extensions; and a best of breed Traffic Analysis solution

Alternative 3: Best of breed Asset Inventory and Location Referencing tools; best of breed Crash Analysis tools with custom extensions; and a best of breed Traffic Analysis solution

Exhibit ES-2 provides an overview of the alternatives listed above.

[1] Best of breed software is a commercially available software solution which is designed to support one specific business function or a very limited set of business functions. This is in contrast to enterprise resource planning or ERP solutions which is an integrated software suite supporting most of an organization's core business functions

Exhibit ES-2: Alternatives Considered for Providing Transportation Asset Inventory Functionality



E. Recommended Approach for Proceeding and Rationale

The study team recommends proceeding forward under Alternative 2 with a best of breed Asset Inventory solution and a custom developed Location Referencing System. The rationale for this recommendation includes:

- A best of breed Asset Inventory solution is required to provide WSDOT with the type of robust asset management tools and capabilities needed to support implementation of an enterprise wide asset management program consistent with evolving national best practices. To custom develop this full range of capabilities would be cost prohibitive and high risk.

- It is unclear that the existing best of breed Location Referencing System offerings meet all or most of WSDOT's requirements without requiring extensive customizations.

However, it is also recommended that the Request for Proposals (RFP) to select a systems integrator and a set of solutions proposed by the integrator allow the vendors flexibility to propose either a best of breed solution with custom extensions or a custom solution for the Location Referencing System component. This approach allows a vendor to propose a best of breed solution with appropriate custom program extensions, if the vendor believes this is the most appropriate approach to fully meet WSDOT's requirements. This approach also recognizes that while best of breed Location Referencing solutions do not yet fully meet WSDOT requirements, vendor solution

offerings in this area are continuing to expand and one or more best of breed solutions may support all or most of WSDOT's requirements by the summer/fall of 2011.

F. Proposed Project Schedule

The study team analyzed several alternative project schedules, including deployment of the Transportation Asset Management solution as a single project effort and in multiple project phases to better align with budgetary constraints.

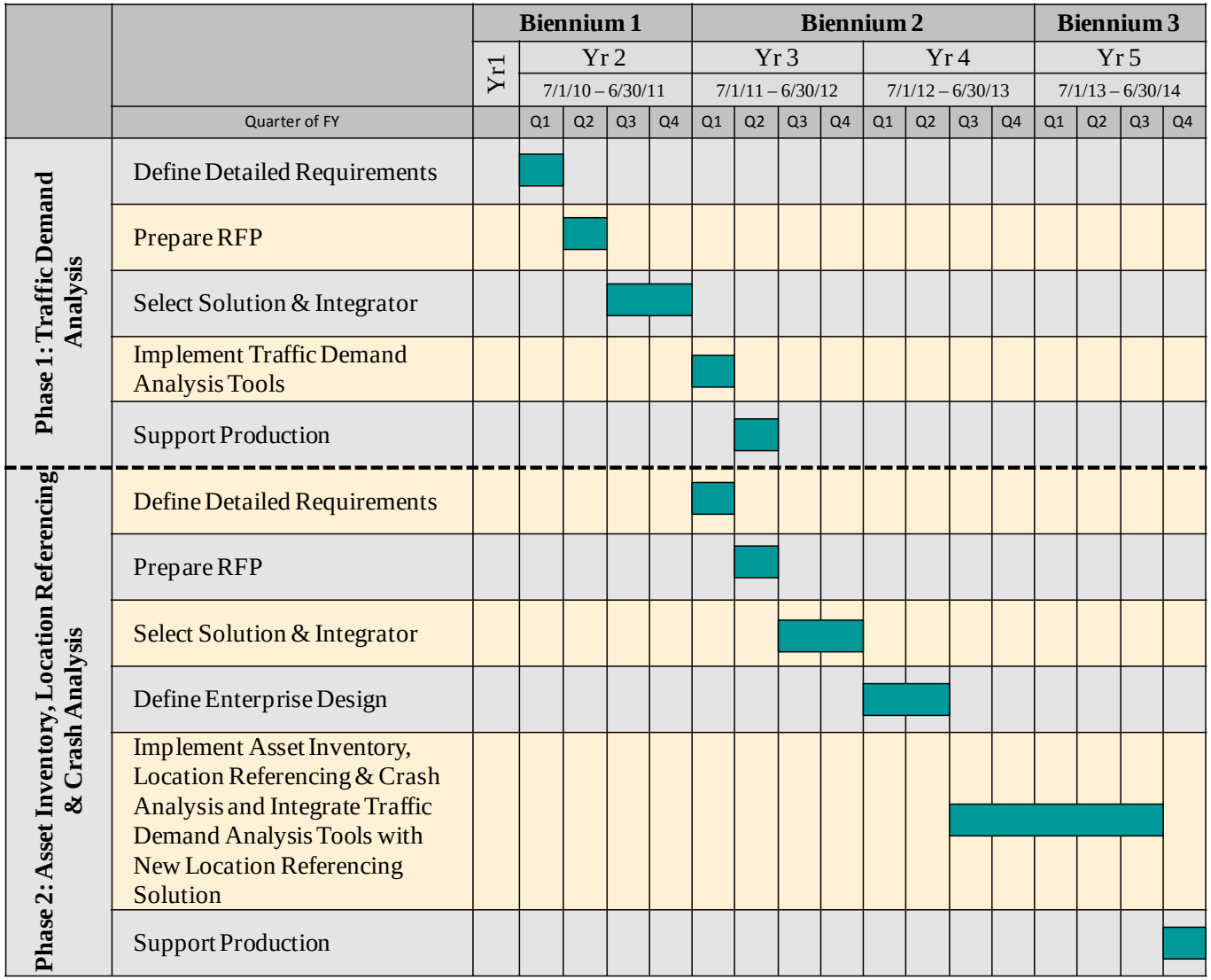
Exhibit ES-3 on the next page outlines the timeline and sequencing of the recommended multi-project phased approach. This approach has been incorporated into the overall Critical Applications Replacement Program work plan presented to the Washington State Legislature on June 30, 2009.

Under this approach, Phase I would include the selection and implementation of the Traffic Analysis solution. Acquisition phase activities including defining detailed requirements for the Traffic Analysis software and preparing the RFP would be performed by internal WSDOT resources beginning July 2010. Software and integrator selection would be completed and the Implementation phase initiated in July 2011, with a go-live in late fall 2011.

Phase II would include implementation of the Asset Inventory, Location Referencing System and Crash Analysis components. This project would be initiated in July 2011. Acquisition phase activities including defining detailed requirements, preparing RFPs and selecting the systems integrator and software solutions would occur between July 2011 and June 2012, with assistance from a consultant. Implementation Phase activities would be initiated in July 2012, with a go-live in the spring of 2014.

The advantage of this multi-project approach is that implementation can begin on the smaller Traffic Analysis component while funding is being secured for the larger effort. This approach is feasible since the Traffic Analysis component is fairly modular, with limited integration to other system components. Thus, limited re-work will be required to integrate the Traffic Analysis module with the new Location Referencing System and Asset Inventory components when these elements are completed in the second phase of work.

Exhibit ES-3: Proposed Schedule for Transportation Asset Management Solution under a Multi-Phase Deployment Approach



G. Business Case of the Proposed Investment

The estimated cost of the Transportation Asset Management solution is $18.1 million on a pay as you go basis and $21.6 million if most eligible expenses are financed through the sale of Certificates of Participation (COP).

While the Transportation Asset Management application does not have a positive return on investment over the ten year period analyzed for the cost benefit analysis, the new Transportation Asset Management application will provide a number of key benefits to WSDOT including:

- Better and more informed project programming decisions through enhanced needs identification, project scoping, project prioritization and selection tools. This will provide WSDOT the opportunity to fund additional projects within the WSDOT transportation program through reducing the cost of program delivery by improved project scoping and selection processes. This is a result of projects being programmed with more cost effective solutions to meet the identified needs, better cost estimates and risk identification. This benefit will be partially provided by the enhanced Asset Inventory and the more robust Crash Analysis and Traffic Analysis tools, in combination with enhanced needs identification and project scoping tools to be included in the proposed enterprise resource planning (ERP) application as part of the overall Critical Applications Replacement program.

- Improved lifecycle asset cost management through enhanced asset management tools and implementation of an enterprise asset management business model. These improved tools will provide WSDOT with a better understanding of the current conditions of assets and the ability to make more effective replace/maintain decisions. This will help redirect both capital budget and maintenance budget dollars to highest priority needs, resulting in the ability to perform more work within the existing WSDOT preservation and maintenance budgets.

- Enhanced automation which reduces TDO data entry efforts and the potential for errors and associated error correction efforts.

- Improved access to information, reducing the staff effort to perform research and improving the quality of the information available for management and policy maker decision making.

- Reduced information technology costs resulting from decommissioning the mainframe when TRIPS and other Critical Applications are replaced.

- A simplified information technology environment resulting from the elimination of a number of standalone asset management and related systems.

- Reduction in tort claims due to improved project selection mechanisms, which will allow WSDOT to better concentrate efforts on road segments with significant safety

related issues. This will provide an opportunity to reduce the cost of tort claims and attorneys fees paid each year.

- Ability to more effectively communicate with the public, policy makers and internal stakeholders through more timely and accurate information including more timely FHWA traffic reporting, more accurate information on roadside features such as fish barriers and culverts and more detailed roadway inventory reporting capabilities.
- Improved partner self-service capabilities which will allow WSDOT to reduce data entry and maintenance costs and provide easier and timely access to information for partners.
- Enhanced ability to locate assets and events as a result of a more robust Location Referencing System.
- Improved constituent trust through performance reporting using before and after data associated with project and mitigation actions.
- More accurate jurisdictional boundaries, which will increase the accuracy of tax reporting to individual jurisdictions concerning construction work performed within their boundaries.
- Elimination of the business risk of not being able to maintain the TRIPS application.
- Positioning the department to be better able to respond to future changes including:
  - Changes in WSDOT business practices, such as the addition of tolling to roadways and bridges
  - New FHWA data capture requirements, including requirements for a geospatial data model of local roads
  - Ability to integrate evolving asset management best practices such as cross-program trade-off analysis

I. Introduction

This deliverable represents the final packaging and publication of the Transportation Asset Management Feasibility Study Report, which has been developed as part of the Critical Applications Implementation Feasibility Study effort. It is intended that this report will provide WSDOT with the information needed to move the Transportation Asset Management component of the Critical Applications Replacement Program forward to the next steps. These next steps are the definition of detailed requirements and the development of one or more Requests for Proposal (RFP) for the selection of best of breed software solutions and system integration services to develop required custom components and implement these selected solutions.

1. The remainder of this document is organized as follows:

Section II: Background and Needs Assessment – This section presents an overview of the Transportation Asset Management Feasibility Study project including project background, an overview of WSDOT's Critical Applications Implementation Feasibility Study of which this study is a part, and an overview of WSDOT's business environment and existing processes in the context of roadway inventory/asset inventory, location referencing, traffic, and crash analysis. This section also describes the objectives for and approach to performing the feasibility study.

Section III: Objectives – This section will discuss the primary objectives of implementing a Transportation Asset Management solution including the problems to be solved, opportunities to be gained and anticipated service delivery enhancements.

Section IV: Impacts – This section will identify and describe which stakeholders are impacted by the proposed technology investment in a new Transportation Asset Management solution.

Section V: Organizational Effects – This section describes the potential organizational impacts of the proposed investment for WSDOT such as changes in business processes, anticipated training needs, changes in job content or roles and responsibilities, and the impact on organizational structure.

Section VI: Proposed Solution – This section describes the core elements of the proposed Transportation Asset Management solution that will meet the identified project objectives.

Section VII: Alternative Solutions Considered – This section describes the three alternatives that have been evaluated as potential approaches for implementing a new Transportation Asset Management application.

Section VIII. Conformity with Agency IT Portfolio – This section will outline how the implementation of the proposed Transportation Asset Management solution is

consistent with WSDOT's strategic objectives and business drivers and overall information technology direction.

Section IX: Project Management and Organization – This section defines the recommended project management and organization structure for the Transportation Asset Management project including the proposed governance structure and the key roles and responsibilities of various stakeholders.

Section X: Estimated Timeframe and Work Plan – This section outlines the proposed project schedule and work plan for the Transportation Asset Management solution with key milestones and decision points. It includes the estimated timeframe by project phase through implementation, a description of the major tasks and activities to be accomplished in each phase, and the anticipated external and internal resource requirements for each phase.

Section XI: Cost Benefit Analysis – This section presents the cost benefit analysis for the recommended alternative and the two other alternatives evaluated by the team.

Section XII: Risk Management – This section will identify potential risks in the implementation of the proposed approach and the manner in which these risks can be managed.

Section XIII: Anticipated Shelf-Life of Analysis and Recommendations – Because of uncertainties about the project funding strategy, this section provides various parameters on the shelf-life of this feasibility study report and outlines several items for WSDOT consideration at the time the implementation project is actually initiated.

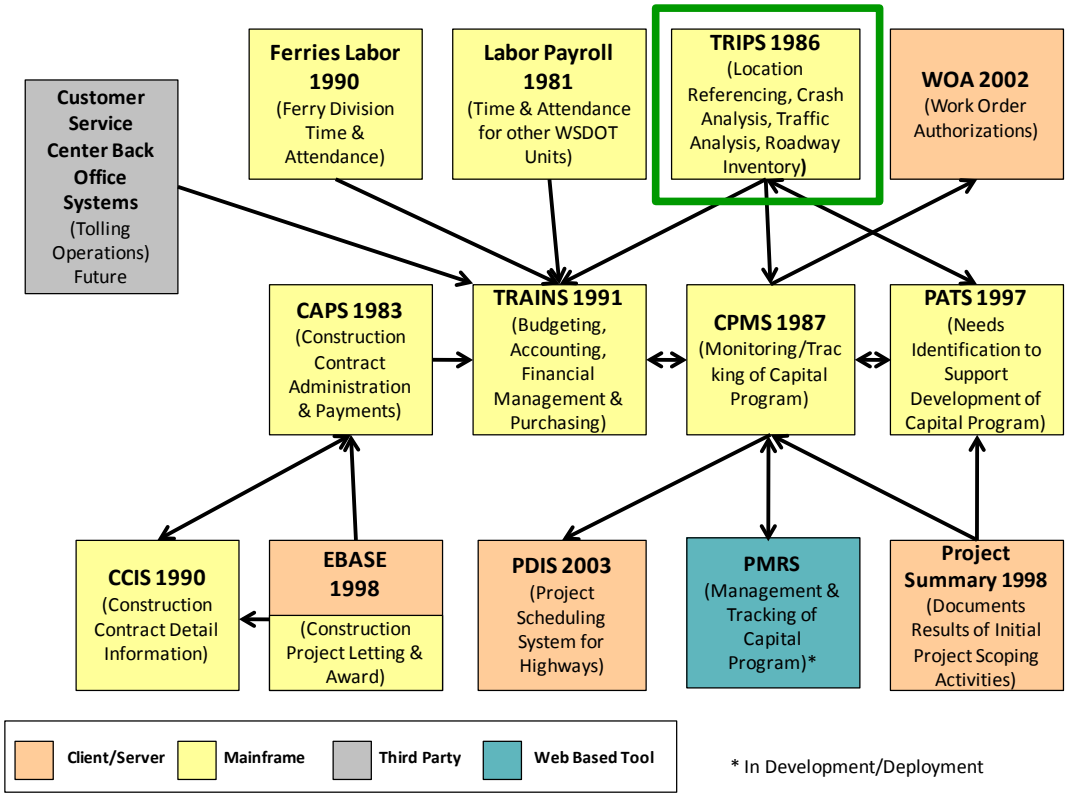
II. Background and Needs Assessment

This section presents an overview of the Transportation Asset Management feasibility study project including project background, an overview of the Washington Department of Transportation's (WSDOT) Critical Applications Replacement Implementation Feasibility Study of which this study is a part, and an overview of WSDOT's business environment and existing processes in the context of roadway inventory/asset inventory, location referencing, traffic, and crash analysis. This section also describes the objectives for and approach to performing the feasibility study.

A. Project Background

WSDOT's "Critical Applications" consist of fourteen systems that constitute the department's primary asset management, financial management, timekeeping, program management and project management systems. These systems are depicted in Exhibit II-1. The Transportation Information Planning and Support System or TRIPS, which will be replaced by the solution proposed in this feasibility study, is outlined with a green box.

Exhibit II-1: Washington Department of Transportation Critical Applications



From a functional perspective, these systems perform a range of business functions for the department. These functions include needs identification and project prioritization,

development and monitoring of the department's capital construction program, asset management, project management, procurement, management of the revenue cycle, and financial reporting and general ledger.

The TRIPS application performs several asset management or related functions. It manages current and historical data about WSDOT's roadway network, traffic volumes and classifications, collisions, and collision severity. It also includes a Roadway Inventory component and a location referencing system that is utilized by a number of other systems across the department.

Most of the Critical Applications have a number of functional and technical gaps that impact their ability to fully meet WSDOT's business requirements including:

- There is a significant potential for delays in providing information to the Washington State Legislature, other stakeholders, or the public. This is a result of the difficulty and length of time required to obtain information from the current systems. Likewise, there is the potential for multiple answers or versions of the truth depending on which systems are used to obtain the information.

- These systems do not provide WSDOT with the information needed by managers to effectively deliver the department's programs. This includes an inability to easily identify the real cost of projects or operations and difficulty in measuring actual outcomes against management objectives.

- The current system environment is highly manual with numerous standalone applications to meet gaps in the functionality provided by the Critical Applications.

- A number of the older Critical Applications, including TRIPS, are complex, fragile, and require constant monitoring by WSDOT staff. For the most part, only mandated changes are made in order to maintain system stability. Often, unintended consequences have occurred when changes are made to the current applications.

- Because of limitations in the Critical Applications, numerous standalone systems have been developed both by WSDOT's Office of Information Technology (OIT) and by various business units. These standalone applications substantially increase the cost of maintaining WSDOT's information technology portfolio.

- There is diminishing expertise within WSDOT on a number of these applications. Thus, there is the potential for system failure if existing resources cannot keep up with the demands for application changes or if they are not available to perform necessary production support activities.

Taken together, these issues result in increased operating costs and substantial business risk for WSDOT.

1. 2005-2007 Critical Applications Assessment

In response to the types of issues identified above, the Washington State Legislature, in a budget provision for the 2005-2007 Biennium, directed WSDOT to conduct a "financial and capital project system needs assessment for future automation development and enhancements." This Critical Applications Modernization and Integration Strategy project or the "Critical Applications Assessment" as it is commonly called was completed in early 2006. It addressed both the business and technical needs of WSDOT's asset management, financial, and capital project systems.

The goal of the Critical Applications Assessment process was to determine whether or not the Critical Applications were supporting WSDOT's business needs. The team conducted a gap analysis where the business requirements were compared to the system functionality. The Critical Applications Assessment effort identified a number of issues with the systems and based on the results of the gap analysis, WSDOT identified several potential high-level alternatives/strategies for addressing the issues with the Critical Applications:

- Do nothing – retaining the existing Critical Applications
- Modify/extend through additional customizations some or all of the existing mainframe applications
- Develop an action plan for replacing the Critical Applications

The alternatives were then evaluated to determine the most advantageous functional, technical, and financial approach for WSDOT to replace its Critical Applications. Based on this analysis, the Critical Applications Assessment team made the following recommendations:

- The existing systems have to be retooled and need to incorporate WSDOT's required geographic and location referencing capabilities
- There is limited potential for WSDOT to save, reuse, or extend the existing Critical Applications

The Critical Applications Assessment team did not focus on the "do nothing" option because WSDOT relies on these systems to support its business operations and the system shortcomings were putting the business at risk. Likewise, while the assessment team felt that partial replacement of systems could deliver some benefits, it was concluded that unless WSDOT replaced all of the Critical Applications, it would incur increasing maintenance costs while achieving decreased return in the value of these systems over time.

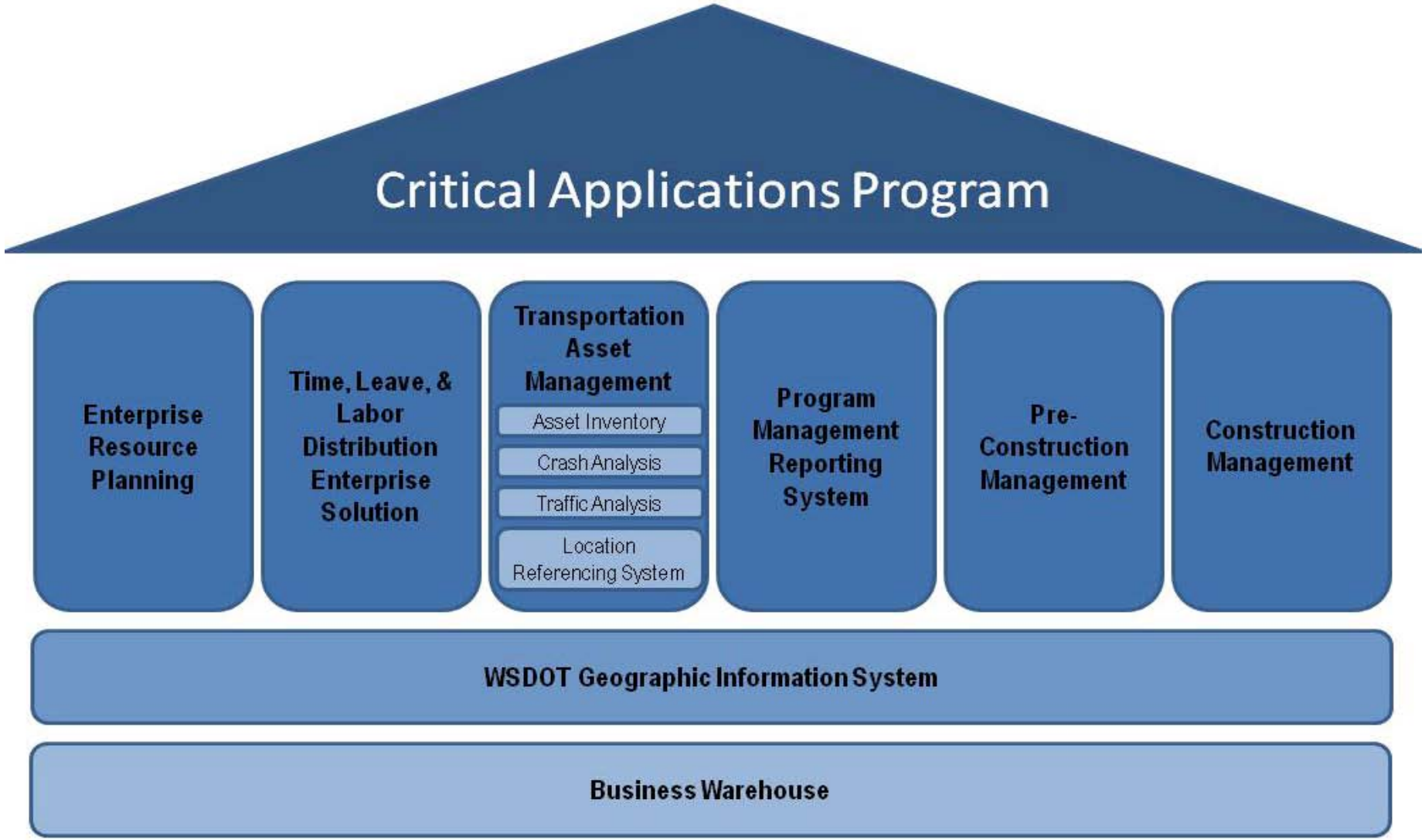
2. 2007-2009 Critical Applications Implementation Feasibility Study

Based on the recommendations of the Critical Applications Assessment, WSDOT requested funding to develop a detailed plan for replacing these systems. The Washington State Legislature included funding for this Critical Applications Implementation Feasibility Study effort in the 2007-2009 biennium budget and directed WSDOT to submit a report to the Washington State Legislature by June 30, 2009 detailing this plan.

WSDOT initiated this project in the fall of 2007. The Office of Financial Management (OFM) and the Department of Information Services (DIS) collaborated with WSDOT in this effort through representation on the project steering committee. The results of this effort are an implementation plan for a program of related projects known as the Critical Applications Replacement Program.

One of the work products of this planning effort is a conceptual architecture for the Critical Applications Replacement Program. Exhibit II-2 depicts this architecture.

Exhibit II-2: Proposed Critical Applications Replacement Program Conceptual Architecture



The proposed Critical Applications Replacement Program conceptual architecture includes an application layer, consisting of an integrated suite of software modules by a single vendor known as an Enterprise Resource Planning or ERP application and a number of other related components. For the most part, these related application components will be provided by commercially available best of breed software solutions that address elements of WSDOT's requirements that are not typically supported by an ERP software suite.

The components in the application layer utilize and work with the existing WSDOT Geographic Information System (GIS) and the department's GIS Workbench to support spatially displaying information. The components of the application layer also integrate with the Business Warehouse layer to provide management reporting and analysis capabilities.

3. Transportation Asset Management Solution

One of the application components in this proposed systems vision is Transportation Asset Management. This function is intended, at a minimum, to replace the capabilities of the current TRIPS application. It will also provide WSDOT with the capability to replace a number of other standalone asset management applications maintained across WSDOT. Appendix B provides a partial list of these opportunities for replacing systems through the implementation of the Transportation Asset Management initiative. The systems identified in Appendix B will need to be further validated in the future requirements definition phase. This effort will require the involvement of additional asset owners and other functional areas across WSDOT to make final decisions on the specific scope of the Transportation Asset Management solution.

The proposed Transportation Asset Management component of the Critical Applications Replacement Program will contain asset inventory, traffic analysis, crash analysis, and location referencing capabilities. This Location Referencing System will act as a service utility for all of the other components of the Critical Applications Replacement Program by facilitating the ability to store or locate data geospatially.

During the development of the Critical Applications Replacement Program implementation plan, WSDOT identified the implementation of this Transportation Asset Management solution as being a high priority and thus a candidate for earlier implementation within the overall Critical Applications Replacement Program. Some of the reasons the Transportation Asset Management component was identified as a high priority include:

- The functionality to be provided in the Transportation Asset Management component is WSDOT specific and would not be addressed in the OFM Roadmap project for statewide financial systems or any other enterprise solution.

- The Location Referencing System will serve as a service utility for all components in the Critical Applications Replacement Program to facilitate the ability to store or

locate data geospatially. Thus, it would be beneficial to have this module available for other system components to use during testing and development.

- Some of the elements of the Transportation Asset Management component are modular or independent enough from other program components that these elements can be implemented earlier with limited re-work required when other system components are added later.

Because of WSDOT's interest in having some or all of the Transportation Asset Management components be one of the earlier projects initiated within the Critical Applications Replacement Program, WSDOT decided to complete a detailed feasibility study for this component as an extension of the Critical Applications Implementation Feasibility Study.

WSDOT formed a work group of Transportation Data Office (TDO) and OIT staff to provide guidance and direction to the Transportation Asset Management Feasibility Study. Dye Management Group, Inc., WSDOT's consultant for the overall Critical Applications Implementation Feasibility study, was engaged to perform the TRIPS Replacement Feasibility Study. This report documents the findings of this study.

B. Business Environment

WSDOT is responsible for ensuring the safe and efficient movement of people and goods throughout the state of Washington. As part of carrying out this mission, WSDOT is responsible for the planning, design, construction, maintenance, and operation of the state's transportation system. This includes both the state highway network and the operation of the Washington State Ferries, the largest ferry system in the United States and the largest ferry system in the world based on vehicles carried. WSDOT executes its mission through a number of divisions, some based at headquarters in Olympia and others based in its six regional headquarters across the state, or field offices maintained within each region or in the multiple operating locations maintained by the WSDOT Ferry Division.

To carry out its mission, WSDOT executive management and other stakeholders need comprehensive, accurate, and timely data to manage by and set policy. This information is required to enhance traveler safety, safeguard taxpayer investment in the state's transportation system, deliver projects on time and on budget, optimize mobility, and exercise proper stewardship over resources.

1. Transportation Data Office (TDO)

WSDOT's TDO plays an important role in collecting, storing, and disseminating much of this information. Specifically, TDO is responsible for providing WSDOT headquarters and regional staff with information about the state's transportation network to support a variety of analysis activities. These activities include:

- Supporting needs identification as part of identifying and prioritizing candidate transportation projects
- Maintaining an accurate inventory of assets on the transportation network
- Monitoring the condition of assets against target levels of service
- Identifying high crash locations and other safety issues and establishing a range of potential solutions to address the issues identified
- Identifying current or potential congestion areas on the transportation network and identifying possible solutions to improve the flow of traffic

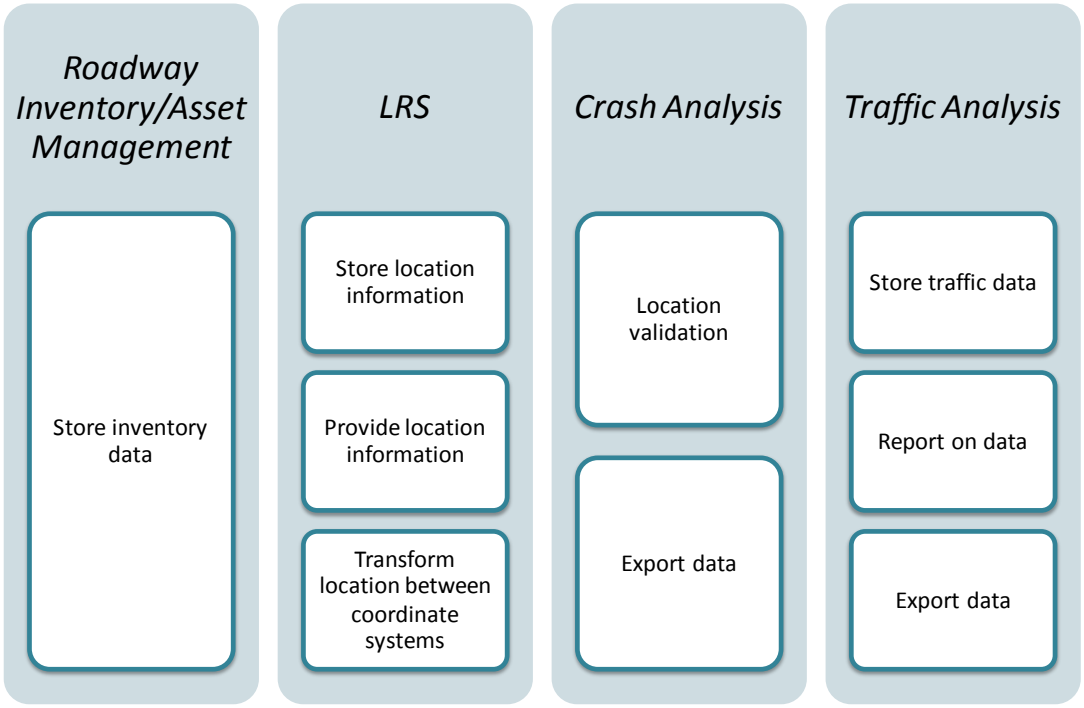
2. Scope of Current TRIPS Application

TDO utilizes the existing TRIPS application in support of its information delivery mission for the department. TDO uses TRIPS to provide location referencing of assets and events, manage the current and historical roadway network data, maintain traffic volumes and classifications, and maintain collisions and collision severity. The TRIPS system has four distinct modules:

- **Roadway Inventory** - allows WSDOT to maintain an inventory of all roadway assets (pavement, guardrails, etc.)
- **Linear Referencing (LRS)** - provides the capability to store the location of various transportation assets in the system and facilitate the display of this location on a map
- **Crash Analysis** - allows WSDOT to conduct an analysis of traffic collisions to help determine roadway deficiencies and improvements needed to reduce traffic collisions, fatalities, and serious injuries
- **Traffic Demand Analysis** - allows collection of traffic data that is then used to identify potential congestion issues on various sections of the transportation network and determine possible improvement opportunities to reduce congestion

Exhibit II-3 below presents the primary functions of all four TRIPS modules.

Exhibit II-3 – Functionality of Current TRIPS Application



The business function of each of these modules of TRIPS is described in further detail below.

Roadway Inventory

The Roadway Inventory module stores all roadway and feature information and locations. Locations are stored using the Linear Referencing System in this module. This includes all road segments and roadway inventory items associated with these segments. The Roadway Inventory module contains a long history of roadway feature information and locations.

Linear Referencing System

The Linear Referencing System module of TRIPS is a method for locating data at a measured distance along a particular highway from its beginning. This Linear Referencing System can locate both point features such as intersections and linear features like guardrails, and events such as collisions. The Linear Referencing system allows WSDOT to map all existing transportation assets (highways, guardrails, etc.).

Crash Analysis

Using standard collision report forms, collision data is reported for every vehicle collision that occurs on both state and local roadways. The Collision Location and Analysis System (CLAS) captures data from these crash reports by imaging and data entry. Collision location information entered into CLAS by staff is specifically compared

against the Linear Referencing System associated with TRIPS to ensure collision location validity. After Quality Assurance measures are applied to collision records within CLAS, the finalized records are transferred to TRIPS and the Collision data mart to facilitate crash analysis by WSDOT engineering staff. Thereafter data can then be made available from the Collision data mart for other analysis tools such as WSDOT's Geographic Information System (GIS) Workbench. While both the Collision data mart and the GIS Workbench allow WSDOT engineering staff the opportunity to perform more detailed analysis than what can be performed within TRIPS, neither of these applications have the robust set of crash analysis capabilities which are consistent with both user requirements and industry best practices in this area.

Collision data is a key data source used to determine roadway deficiencies and required safety related improvements. Planners, program managers, and researchers all use collision data through the GIS Workbench and the Collision data mart for analysis and programming.

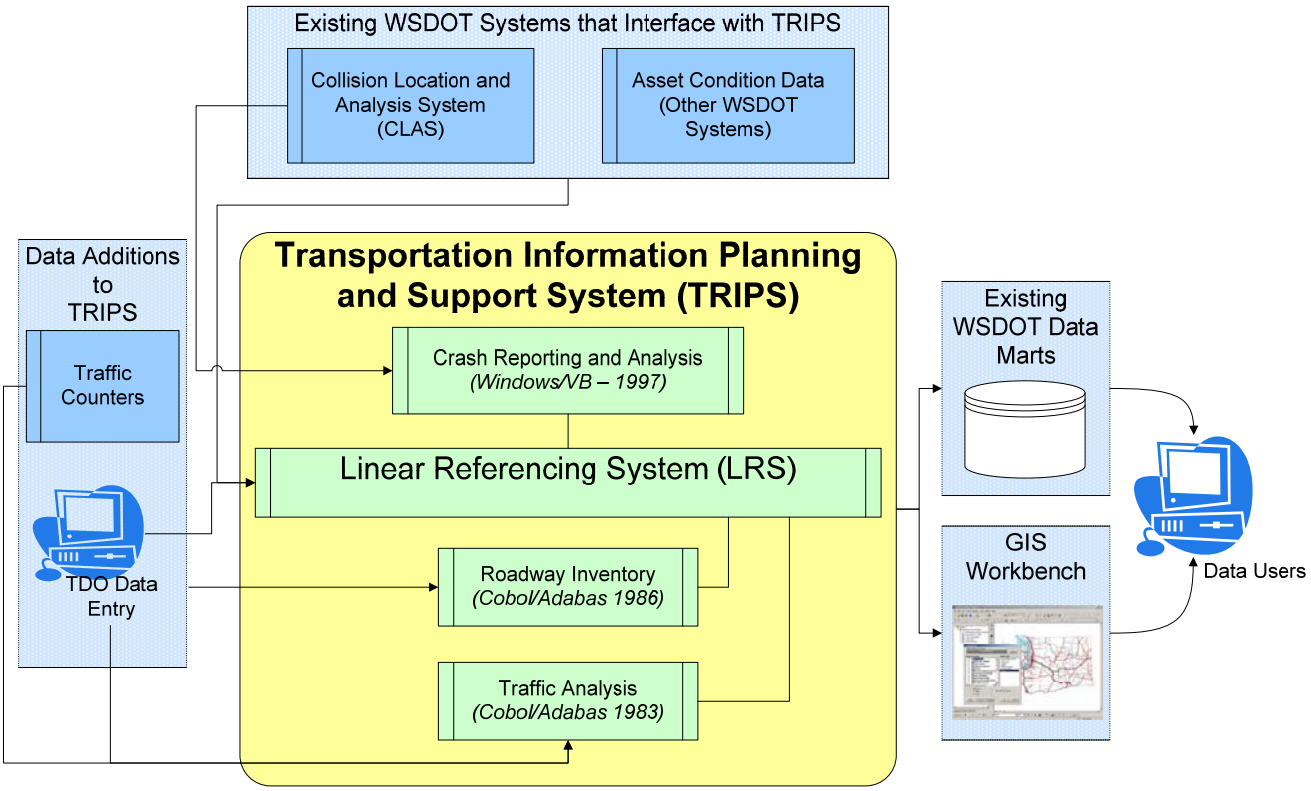
Traffic Demand Analysis

The Traffic Demand Analysis module stores traffic data collected by TDO. This data includes traffic volume, vehicle classification, speed, and weight data. The current module allows reporting on the data and exporting of the data to other programs for detailed analysis, but does not allow detailed traffic demand analysis.

Exhibit II-4 below provides an overview of the TRIPS application and the systems that interface with TRIPS. TDO staff maintains the roadway geometry that underlies the Linear Referencing system on-line. Traffic data is populated through either transfer of data from traffic counters or data entry by TDO staff. Crash data is primarily interfaced from the Collision, Location, and Analysis System. Asset inventory and asset condition information is transferred from data collectors or entered on-line by TDO staff.

Users typically access TRIPS data through either one of several existing WSDOT data marts or the WSDOT GIS Workbench.

Exhibit II-4: Conceptual Overview of Existing TRIPS Application



3. Users of the Current TRIPS System

A number of functional areas within WSDOT are customers of information maintained within TRIPS including environmental, design, maintenance, pavement management, program management, traffic, TDO, and transportation planning. These users access TRIPS data either through TRIPS directly or more likely through the TRIPS or Collision data marts or the GIS Workbench applications. Examples of the range of users of TRIPS information and how these users leverage TRIPS information to perform their business activities include:

- **Environmental** - WSDOT Environmental staff utilize asset inventory information in TRIPS and the Linear Referencing System to map roadway assets in conjunction with wetlands or other environmentally sensitive areas. WSDOT Environmental staff also uses traffic information for air quality and noise studies. This information allows WSDOT Environmental staff to identify environmental risk factors associated with proposed construction or maintenance activities.

- **Pavement Management** - This WSDOT headquarters business unit uses traffic and roadway inventory data in conjunction with other pavement management tools to

evaluate the current condition and location of roadways to identify segments on the transportation network that are candidates for future pavement preservation projects.

- **Maintenance** - Maintenance staff in the WSDOT regions use TRIPS to obtain asset location and traffic information, and in some cases, the condition of the assets.

- **Traffic** – The traffic section uses TRIPS to obtain crash as well as traffic data. It is also used to analyze the data to evaluate safety and congestion related issues throughout the roadway network and suggest future safety improvement and congestion relief projects.

- **Transportation Data Office** – TDO staff maintains the data within TRIPS. They also utilize data within TRIPS to respond to a range of information requests from WSDOT management, policy makers, and other stakeholders.

- **Transportation Planning** - Planning staff in each WSDOT region obtain safety and traffic and roadway data from TRIPS to perform needs identification and evaluate and prioritize various potential transportation projects including both safety and congestion related projects.

In addition, the Linear Referencing System is used by multiple business units and various WSDOT computer applications to obtain location information.

C. Overview of Transportation Asset Management Feasibility Study

This subsection briefly describes the objectives for the Transportation Asset Management Feasibility Study; a set of guiding principles to provide general direction to the project effort; the approach utilized by the study team to meet the project objectives; and the project governance structure for this study.

1. Project Objectives

The objectives for the Transportation Asset Management Feasibility Study are as follows:

- Evaluate potential alternatives for implementing a Transportation Asset Management solution as part of the Critical Applications Replacement Program, including analysis of the relative merits, cost, benefits, and risks of each alternative.

- Establish a recommended approach for moving forward with the implementation of a Transportation Asset Management solution and the rationale for this recommendation.

- Provide a work plan, cost benefit analysis, and risk assessment for the recommended alternative.

- Prepare a feasibility study report that is intended for submission to the Washington State Information Services Board (ISB) when a funding source(s) is identified.

2. Guiding Principles

To help provide direction in achieving the project objectives, the study team worked with WSDOT executive management, the Critical Applications Implementation Feasibility Study steering committee, and the Transportation Asset Management Feasibility Study Work Group to establish a set of guiding principles to utilize in defining and evaluating potential solution alternatives and approaches. These guiding principles included:

- Utilize commercially available best of breed software solutions as the first choice to meet business requirements. Using best of breed solutions should reduce the cost and risk of implementing the new systems, as well as the cost to maintain and operate these systems in the future.

- Utilize an integrated software suite versus separate best of breed solutions whenever possible to meet requirements.

- Change business processes first whenever possible to adapt to the capabilities of the best of breed solutions.

- Develop customizations only where absolutely required due to gaps in the capabilities of the best of breed solutions or very specific legal, statutory, or regulatory requirements. Customizations should require a specific business case and program steering committee approval. Limiting customizations reduces the cost and risk of the development effort. It also simplifies and reduces the cost of future software upgrades, thus reducing the total lifecycle cost to own and maintain the system.

- Implement solutions that are consistent with WSDOT's and the state's technology direction to the extent possible.

3. Project Approach

Exhibit II-5 outlines the project approach utilized to conduct the Transportation Asset Management Feasibility Study. This approach consisted of three primary stages:

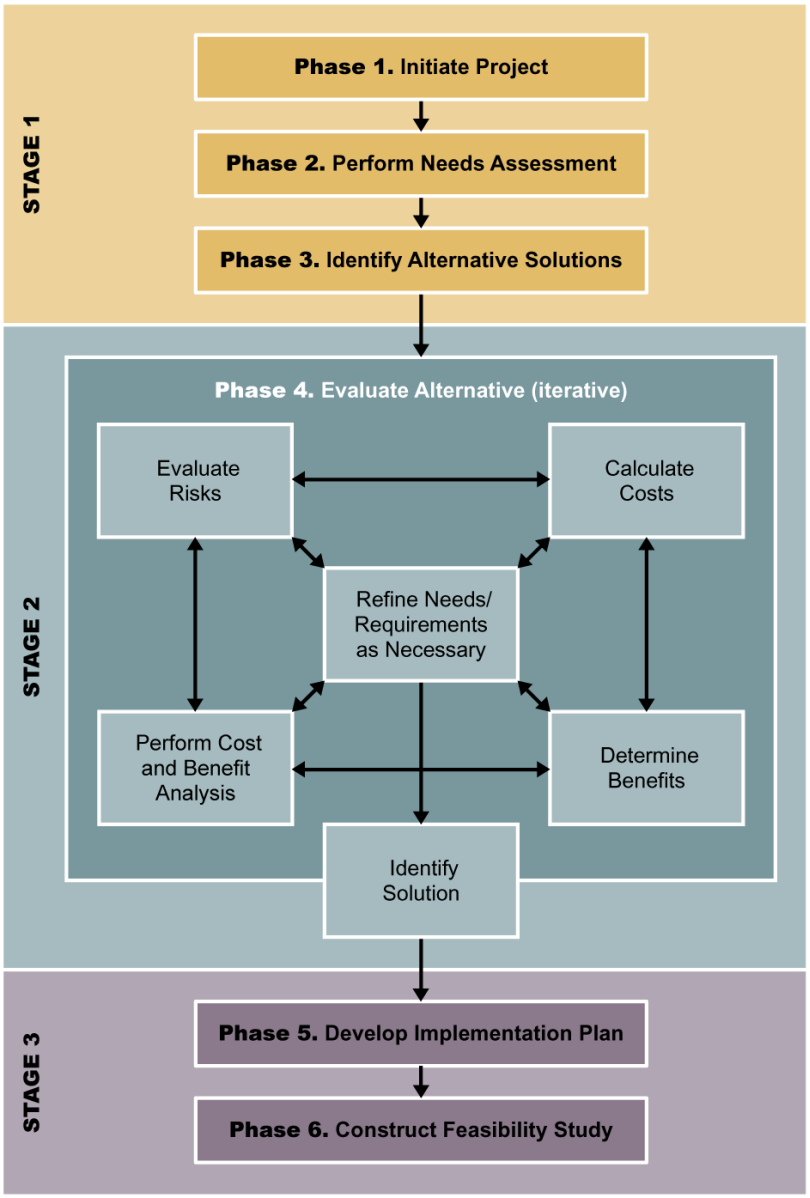
- Stage 1: Identify needs and solutions

- Stage 2: Develop and evaluate alternatives

- Stage 3: Construct an implementation plan and feasibility study

Each of these stages is described briefly below.

Exhibit II-5: Transportation Asset Management Feasibility Study Approach



1. Stage 1: Identify needs and solutions

During this first stage, the feasibility study team identified WSDOT's needs by defining high level business and technical requirements; identified potential solutions available in the market place; and conducted vendor demonstrations of a representative set of potential solutions.

Based on a review of WSDOT's business processes, industry best practices, and the consulting team's knowledgebase of systems requirements from work with other state transportation agencies, the study team developed draft business requirements for each

of the four functional areas within the project scope. These draft requirements were then provided to various WSDOT staff for review. A set of workshops was then conducted in each functional area to review, validate, and update the draft requirements.

The study team also conducted a set of stakeholder interviews to identify business drivers for TDO customers and confirm these system requirements. The team conducted thirty interviews with staff from headquarters and various WSDOT regions, representing nine different WSDOT business functions that utilize TRIPS data. The team also interviewed a representative from one of the state's metropolitan planning organizations. Appendix A contains a summary of the stakeholders interviewed and a copy of the interview questionnaire.

The study team developed a baseline set of application architecture and technical architecture requirements as part of the overall Critical Applications Implementation Feasibility Study. These requirements were first developed by the team as a draft and then validated and updated based on input from various WSDOT OIT staff.

Based on the business and technical requirements, the study team identified a number of commercially available best of breed solutions that provide some elements of the required functionality. In conjunction with the Critical Applications Implementation Feasibility Study Project Steering Committee and the Transportation Asset Management Feasibility Study Work Group, the team then identified a subset of these solutions to invite for demonstrations beginning November 2008 through January 2009. Seven different vendor demonstrations were conducted as part of the TRIPS Feasibility Study including:

- Three (3) demonstrations of transportation asset management solutions
- Two (2) demonstrations of specific solutions for location referencing
- One demonstration of a crash analysis solution
- One demonstration of a traffic analysis solution

2. Stage 2: Develop and evaluate alternatives

In this second stage, the study team identified a number of potential alternative solutions for moving forward with the Transportation Asset Management application.

Initial analysis was performed on these alternatives and iterative discussions were conducted with the work group, the steering committee, and WSDOT executive management. Based on this initial analysis, adjustments in the list of potential alternatives were made to arrive at the three alternatives for implementing the Transportation Asset Management component of the Critical Applications Replacement Program that were fully analyzed and are presented in this report. These three alternatives were then analyzed in detail based on a variety of factors and a preliminary

recommendation established. This detailed analysis and recommendation was then presented and validated with the work group, project steering committee, and WSDOT executive management.

3. Stage 3: Construct an implementation plan and feasibility study

During the third stage, an implementation plan and a high level business case was developed for the recommended alternative. This feasibility study report was then created in draft form and reviewed with project stakeholders. The final report was then published in a form suitable for submission to the ISB when a funding source(s) for the proposed investment in the new Transportation Asset Management application was identified.

4. Project Governance

A project governance structure was established to guide the Critical Applications Implementation Feasibility Study effort with an executive sponsor, project executive, and a project steering committee with representation from across WSDOT and from key stakeholders outside the department. A project executive and a work group of stakeholders from TDO and OIT was also identified to specifically guide the Transportation Asset Management Feasibility Study effort, under the overall guidance and direction of the Critical Applications Implementation Feasibility Study Project Sponsor and Project Steering Committee.

Mr. Bill Ford, Assistant Secretary for Administration was the Executive Sponsor for the overall Critical Applications Implementation Feasibility Study and Mr. Grant Rodeheaver, Director of the Office of Information Technology was the Project Executive for this overall effort. Mr. Jon Bauer, General Manager of the Transportation Data Office was the Project Sponsor/Project Executive for the Transportation Asset Management Feasibility Study portion of the project effort. Mr. Noel Morgan of OIT was the WSDOT Project Manager. Ms. Kristi Hubble of OIT was the WSDOT Lead Analyst and day-to-day point of contact with the consultant project team.

Exhibit II-6 provides a list of the Critical Applications Implementation Feasibility Study Project Steering Committee members. Exhibit II-7 provides a list of the members of the Transportation Asset Management Feasibility Study Work Group.

Exhibit II-6: Critical Applications Implementation Feasibility Study Project Steering Committee

Steering Committee Member	Organization/Title
Washington State Department of Transportation	
Bill Ford	Assistant Secretary, Administration
Jon Bauer	General Manager, Transportation Data Office
John Broome	Director, Administrative Services
Bob Covington	Director, Division of Accounting and Financial Services
Jeff Carpenter	Director, Project Control and Reporting
Cindy Kay	Financial Systems Manager, Division of Accounting and Financial Services
Noel Morgan	Enterprise Implementation Manager, Office of Information Technology
Grant Rodeheaver	Director, Office of Information Technology
Brian Smith	Director, Strategic Planning and Programming
Tim Smith	Director, Terminal Engineering, Ferries Division
Doug Vaughn	Director, Budget and Financial Analysis
John Wynands	Assistant Region Administrator, Olympic Region
Office of Financial Management	
Sadie Hawkins	Senior Assistant Director of Accounting
Department of Information Services	
Tom Parma	Management Consultant, Management and Oversight of Strategic Technologies

Exhibit II-7: Transportation Asset Management Feasibility Study Work Group

Work Group Member	Organization/Title
Washington State Department of Transportation	
Jon Bauer	General Manager, Transportation Data Office
Dave Bushnell	Travel Analysis Manager, Transportation Data Office
John Dunn	Collision Data and Analysis Branch Manager, Transportation Data Office
Mark Finch	Roadway Systems Branch Manager, Transportation Data Office
Kristi Hubble	Project Lead, Office of Information Technology
Nadine Jobe	Data Integration Branch Manager, Transportation Data Office
John Rosen	Highway Usage Branch Manager, Transportation Data Office

III. Objectives

This section outlines a number of key business challenges related to the existing TRIPS application. It then outlines a number of targeted service delivery enhancements expected from the proposed Transportation Asset Management solution to address the business challenges. Finally, this section summarizes a number of benefits anticipated from the implementation of the new Transportation Asset Management solution.

A. Current Business Challenges

The study team conducted a number of business interviews with managers and staff in TDO and in various business units across WSDOT. One of the goals of these interviews was to identify problems with the existing TRIPS application and/or the business processes supported by the TRIPS application. Some of the problems noted by stakeholders included:

1. Potential for delays and quality issues in providing information to stakeholders

There is a significant potential for loss of credibility with the Washington State Legislature, other stakeholders, or the public. This is a result of the difficulty and length of time required to obtain information from the current systems. In addition, because these systems do not easily talk to each other, there is the potential for multiple answers or versions of the truth depending on which systems are used to obtain the information.

2. Lack of critical functionality needed to deliver programs

Much of the information about asset inventory and asset conditions, relevant to planning, programming, and project management, requires research in multiple systems or is not readily available in any WSDOT system.

3. Lack of support for geospatial referencing

Locating assets or events on the transportation network is more difficult due to the lack of geospatial referencing capability in the current Linear Referencing system. This complicates providing a range of management information to users based on geographic parameters.

The current TRIPS application uses a Linear Referencing system based on Distance Measuring Instrument (DMI) through Accumulated Route Mileage (ARM)/State Route Milepost (SRMP) to describe locations. This approach creates a number of issues including:

- Divided highways are incompatible with the ARM/SRMP directional dependent and single roadway orientation

- ARM/SRMP is incompatible with the geographic positioning system (GPS) based measurements, which follow national standards and are used by most of WSDOT, other agencies and jurisdictions to link condition, context, feature and other data to specific roadway locations

These limitations can result in incorrect assignment of project expenditures and taxes to jurisdictions and programs, potential miscommunication with engineers and construction contractors resulting in costly rework, and inaccurate results from research studies. Traffic and collision data also cannot be stored efficiently due to these Linear Referencing system limitations.

4. Data currency issues resulting from an inability to dynamically update traffic and collision data

Traffic and collision data is entered into TRIPS as information is available from the Collision Location Analysis System and from traffic recorders or traffic studies. However, this data is not automatically or immediately updated in other downstream WSDOT systems that use this data. Updates to these systems are performed on a periodic basis. Thus, since most WSDOT stakeholders use existing data marts or download data sets from these data marts to perform analysis, the information available to these stakeholders is not always up-to-date, and may result in errors. For example, when a road is re-aligned and collisions are recorded on this new alignment, these collisions may appear to a user as actually occurring somewhere off the roadway. Interfacing on a more real-time basis with the current TRIPS application to improve data currency would be costly and difficult. This leads users of roadway location information to either rely on older data or to develop other systems to support their analysis requirements.

5. Limited capacity to store roadway features and data due to outdated technical architecture

TRIPS ability to store expanding roadway feature and characteristic inventory data is severely limited by the capacity and constraints of the underlying database management system and the 20-year old system design. Changes in federal standards and the expectations of state policy-makers are requiring use of enhanced data in analysis and justification for funding requests. As a result, some asset inventory data is stored in shadow systems or data marts, and may become out of sync with TRIPS. Reconciliation, synchronization, and extraction of data from many incompatible sources to meet data requests is very time consuming, costly, and can result in incomplete and inaccurate data. This also limits the historical analysis of changes in traffic and safety observations.

6. Asset inventory data is stored in multiple systems

Asset inventory data is currently stored in multiple systems, including TRIPS. These include systems for storing data on bridges, culverts, rest areas, and traffic systems, among others. Some of the data is stored in sophisticated systems with a database at the backend, while other data is stored in simple spreadsheets. Comprehensive access to this information for planning, accountability, and performance reporting is very difficult, resulting in inefficiencies.

7. Increased business risk due to an old system that is increasingly difficult to enhance and maintain

The current TRIPS system was developed using mainframe computer languages. For the most part, only mandated changes are made in order to maintain system stability. Often unintended consequences have occurred when changes are made to the current applications.

As a result of the inability to easily make system changes, workarounds are necessary to keep pace with changing rules and procedures. The data is exported into data marts to be analyzed, which creates extra work. It also requires use of other programs for analysis. In addition, there is diminishing expertise within WSDOT in the mainframe computer languages used to build and maintain TRIPS. Most programmers knowledgeable in these mainframe languages are retiring or have updated their skills to more modern computer languages; thus, there is the potential for system failure if existing resources cannot keep up with the demands for application changes or if they are not available to perform necessary production support activities.

8. Increased operating costs as a result of supporting a number of duplicate systems

Because of limitations in the existing TRIPS application, other systems have been developed by OIT, TDO, and various business units. These standalone applications substantially increase the cost of maintaining WSDOT's information technology portfolio. These standalone applications also create a number of duplicate data entry processes, significantly complicate management reporting, and in some cases divert business unit staff from program activities.

B. Anticipated Service Delivery Enhancements

To address these various business challenges, the study team established a set of targeted service delivery enhancements for the new Transportation Asset Management solution. These anticipated service delivery enhancements include:

- **Improve efficiency by having a single source of information and providing the capability to conduct cross-functional analysis to make better decisions**

This objective involves implementing a new system that will store information about multiple asset types, as well as traffic and crash data. All information will be internally linked through a common Location Referencing System. This will provide users a single, integrated system (that may be comprised of multiple best of breed solutions working together) to obtain and analyze information. The ability to obtain and analyze information cross-functionally will allow WSDOT to conduct detailed analysis, leading to better decision making.

- **Provide capability to perform more effective asset lifecycle management**

The new Transportation Asset Management Solution will provide WSDOT with the capability of capturing the history of the condition of each asset and comparing current or historical conditions against levels of service for various organizational units within WSDOT. It will also provide the capability of capturing treatments performed on each asset, utilizing performance-based budgeting capabilities to identify the level of work required to move from the average current condition for an asset type to the targeted level of service for an asset type and lifecycle cost modeling, needs identification, trade-off analysis, and project prioritization tools. Implementation of these capabilities will require policy decisions by executive management and extensive involvement by a number of asset owners and other functional specialty areas as well as additional funding and work to define requirements and implement.

- **Provide geospatial reporting capabilities and the ability to access and report single-line representation and dual-line representation based upon directional flow**

The Transportation Asset Management application will support geospatial identification and reporting capabilities. This will allow WSDOT to reduce redundant and inefficient efforts to plot and analyze data. These capabilities will also be provided to other applications for location identification, validation, and translation as required using service oriented architecture.

- **Reduce rework and data unknowns in system**

Implementation of the new Transportation Asset Management application will allow WSDOT to store and retrieve data more efficiently, thus reducing rework in data retrieval. All system users will be able to retrieve data from the same data sources, ensuring that a consistent “answer” is provided every time.

- **Lower operating, maintenance, and upgrade costs**

The new Transportation Asset Management solution will utilize best of breed software applications developed in more current technologies. These applications should cost less to operate, maintain, and upgrade since the system will be built on a more robust architecture. This should also make these solutions more flexible to adapt to WSDOT’s changing business needs. Likewise, the best of breed vendors should be providing

enhancements to their software solutions which address changes in industry practices. These changes will not only be required by WSDOT, but also by the other state departments of transportation in the installed base of the best of breed software vendors.

- **Reduce data errors in the system**

The Transportation Asset Management solution will provide a central location to enter data and provide better data validation capabilities. This will help WSDOT reduce data entry errors. Also, since all users will utilize the same database to obtain information, data used to generate reports by different sections will be consistent, providing more accurate information to stakeholders for analysis.

- **Provide better traffic data analysis capabilities in the system**

The Transportation Asset Management solution will allow WSDOT to provide better traffic data analysis capabilities. One example is the ability to create before and after studies and link to traffic count and text/jpeg files of specific vehicle supporting studies.

- **Provide more robust crash analysis capabilities in the system**

The new Transportation Asset Management application will provide WSDOT with enhanced crash analysis capabilities for identifying high crash locations and developing a range of potential solutions to address the identified issues.

- **Eliminate redundant or duplicate systems**

The Transportation Asset Management component will provide its required capabilities in a toolset with a minimum number of components. This Transportation Asset Management component should allow for decommissioning of a number of standalone asset inventory and related systems across the department (contingent on executive management direction to move towards a total asset management system and buy-in from various stakeholders to decommission a number of the existing standalone systems).

C. Anticipated Benefits

Implementation of the new Transportation Asset Management application is expected to yield a number of benefits for WSDOT. These benefits have been categorized below by quantitative benefits that will be used as part of the calculation of the cost benefit analysis in Section XI and other qualitative benefits for which it is not possible to specifically quantify the value of the anticipated benefit stream.

1. Quantitative Benefits

The primary quantitative benefits include the following:

- Better and more informed project programming decisions through enhanced needs identification, project scoping, project prioritization and selection tools. This will provide WSDOT the opportunity to fund additional projects within the WSDOT transportation program through reducing the cost of program delivery by improved project scoping and selection processes. This is a result of projects being programmed with more cost effective solutions to meet the identified needs, better cost estimates and risk identification. This benefit will be partially provided by the enhanced Asset Inventory and analysis tools, more robust Crash Analysis tools and enhanced Traffic Analysis tools, in combination with enhanced needs identification and project scoping tools to be included in the proposed ERP application as part of the overall Critical Applications Replacement Program.

- Improved lifecycle asset cost management through enhanced asset management tools and implementation of an enterprise asset management business model. The improved tools will provide WSDOT with a better understanding of the current conditions of assets and the ability to make more effective replace/maintain decisions. This will help redirect both capital budget and maintenance budget dollars to highest priority needs, resulting in the ability to perform more work within the existing WSDOT preservation and maintenance budgets.

- Enhanced automation which reduces TDO data entry efforts and the potential for errors and associated error correction efforts. Examples include:

  - Automation of the currently manual HPMS/functional classification processes and basing this process on actual geometric and jurisdictional changes.

  - Efficiencies in the Traffic Branch due to automated scheduling, less paper work and the ability to use multiple equipment formats

  - Enhanced automation, which allows Traffic staff to focus on estimation and analysis resulting in better quality and more complete data

  - Reduced effort to maintain the roadway geometry underlying the Location Referencing System

- Improved access to information, reducing the staff effort to perform research and improving the quality of the information available for management and policy maker decision making. This will allow WSDOT to redirect staff time across the department into additional analytical and other higher value activities. This benefit will be provided by replacing TRIPS and other standalone asset inventory applications with a single asset inventory application, by more robust analysis tools and by providing select partners some access to these tools and data.

- Decommissioning of the WSDOT mainframe after replacing TRIPS and the other Critical Applications will allow WSDOT the opportunity to redirect costs spent to operate the mainframe to other information technology applications. The replacement of TRIPS provides a part of this benefit stream.

- A simplified IT environment resulting from the elimination of a number of standalone asset management and related systems. This will allow WSDOT to redirect information technology staff time to increase the level of service provided for other line of business information technology systems.

- Reduction in tort claims due to improved project selection mechanism, which will allow WSDOT to better concentrate efforts on road segments with the most significant safety related issues. This will provide an opportunity to reduce the cost of tort claims and attorneys fees paid each year.

2. Qualitative Benefits

Additional benefits expected from the implementation of the Transportation Asset Management solution include:

- Ability to more effectively communicate with the public, policy makers, and internal stakeholders. The new system will allow WSDOT to provide crash reports, traffic reports, as well as other information faster and more precisely to internal and external stakeholders.

- Improved partner self-service capabilities will allow WSDOT to reduce data entry and maintenance costs and to provide easier and timelier access to information for partners. These will be achieved in multiple areas of work. For example:

  - Traffic data can be provided to counties/MPOs using a self-service portal, reducing the need for the counties/MPOs to contact WSDOT staff and have them create and mail a data extract/report. This will result in fewer customer service calls for TDO staff.

  - Select crash data can be provided to MPOs, county engineers, city engineers and other authorized partners such as alcohol task forces and other safety grant recipients via a self-service portal. This will also result in fewer customer service requests to TDO staff.

  - Stored HPMS/Functional Classification data (such as shape files) will be more accessible to outside agencies for use in comparing and updating their representations of this data.

- Enhanced ability to locate assets and events as a result of a more robust Location Referencing System including:

  - A routable network could improve public safety

  - Horizontal/vertical information collected and stored for decreasing direction will provide information for curve advisories

  - The potential for reduced department liability for environmental infringement as a result of more accurate location data

- Availability of more timely and accurate information including:
  - More timely FHWA traffic reporting, allowing WSDOT to meet established deadlines
  - More timely traffic information available for communications offices and WSDOT executives
  - Expanded reporting capabilities will allow capture of traffic speed and weight data to meet new FHWA reporting requirements
  - Automated reports and graphs can be used to compare and complete quality assurance on HPMS/functional classification data
  - Ability to analyze and perform quality assurance on HPMS and functional classification data geospatially
  - More accurate information on roadside features such as fish barriers and culverts
  - More detailed roadway inventory reporting capabilities
  - Better data to react to climate change issues such as sea level rise
  - Ability to answer more specific questions
- Improved constituent trust through performance reporting using before and after data associated with project and mitigation actions, for example related to mobility studies.
- More accurate jurisdictional boundaries increases the accuracy of tax reporting to individual jurisdictions for construction work performed within the boundaries of each jurisdiction.
- Elimination of business risk of not being able to maintain TRIPS.
- Better positioned to be able to respond to future changes including:
  - Changes in WSDOT business practices, such as the addition of tolling to roadways and bridges
  - New FHWA data capture requirements, including requirements for a geospatial data model of local roads
  - Ability to integrate evolving asset management best practices such as cross-program trade-off analysis

IV. Impacts

This section identifies and describes the range of stakeholders in WSDOT who will be impacted by the proposed technology investment in a new Transportation Asset Management solution.

A. Summary of Stakeholder Impacts

This subsection summarizes the specific impacts the new Transportation Asset Management solution will have on different types of stakeholders. The impacts on the various stakeholders will be principally driven through the following major business changes:

- Implementation of an asset management business model
- Reduced data management effort
- Partner self-service capabilities
- Data analysis and reporting using a single set of applications and tools

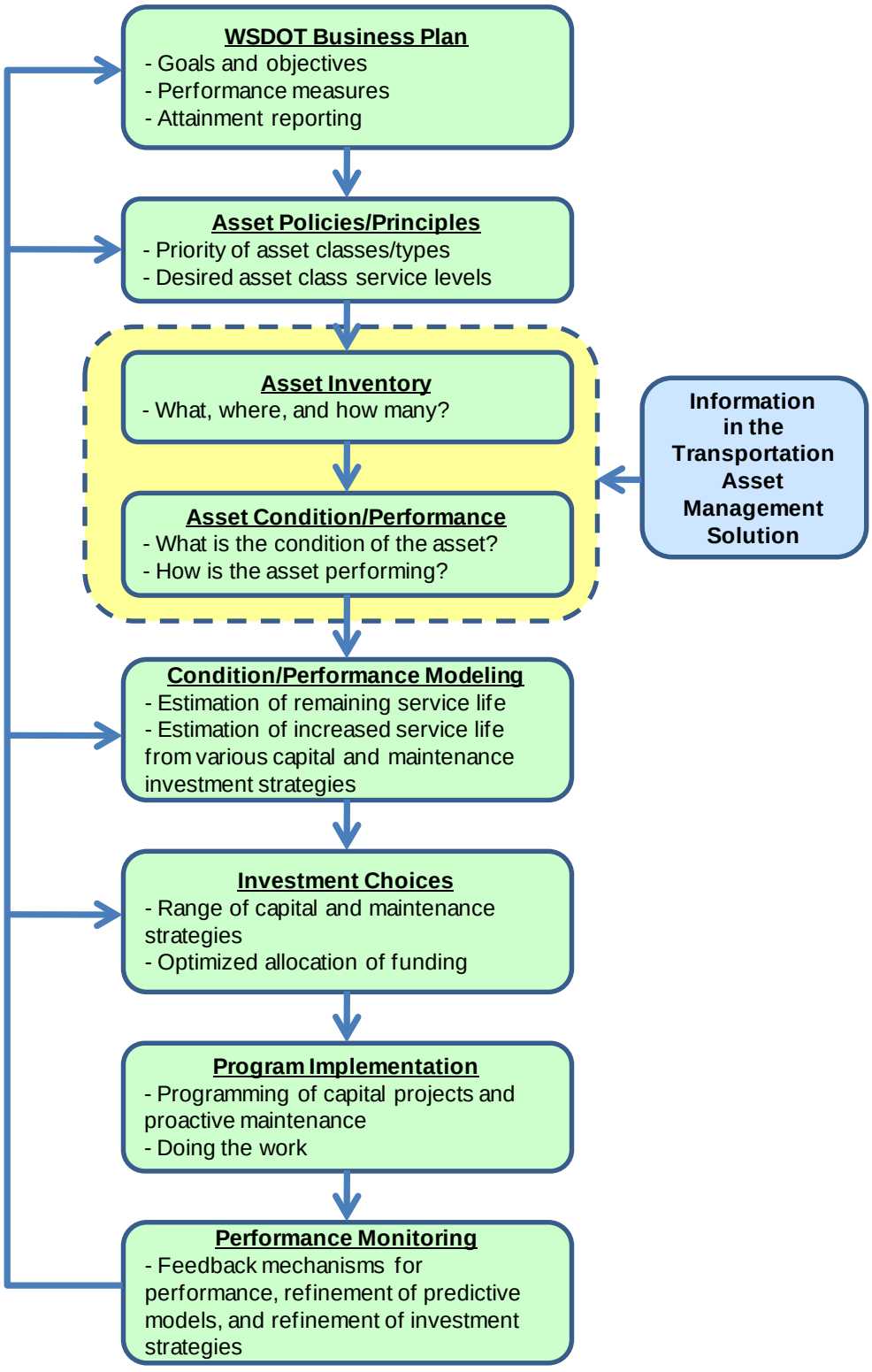
Each of these business changes is outlined below:

1. Implementation of an Asset Management Business Model

The Transportation Asset Management solution will support a more holistic approach to asset management within WSDOT by providing a centralized repository for the acquisition, management, and disbursal of inventory data relevant to the ongoing management of assets on the state's transportation network. In addition to a basic inventory of assets, the Transportation Asset Management solution will provide WSDOT with the capability to collect and maintain a description of the asset, its critical attributes, and a "condition" rating that is applied for each asset.

Exhibit IV-1 below illustrates the core components of applying an asset management approach to managing transportation infrastructure.

Exhibit IV-1: Overview of Asset Management Business Model



This enterprise asset management business model consists of the following main steps:

- Establishing overall goals and objectives for WSDOT from an asset management and program perspective at the agency level
- Setting target levels of service for each asset type based on the overall WSDOT goals and objectives
- Establishing an integrated asset inventory and maintaining the currency of this inventory over time
- Determining the condition of this asset inventory through regular condition assessment processes (the approach would be variable by asset type)
- Estimating remaining service levels for individual assets based on different maintenance or replacement strategies
- Performing analysis on various levels of investment both within the same asset type and across various asset classes/types
- Programming capital project efforts and initiating the projects or performing appropriate maintenance strategies based on this investment planning
- Measuring outcomes and refining strategies as appropriate based on actual outcomes

This type of enterprise asset management approach will result in:

Lower long-term costs for infrastructure preservation – The Transportation Asset Management solution will provide WSDOT managers with the ability to better plan for and program preventive maintenance; thus reducing total lifecycle costs to maintain assets in the transportation network.

Improved performance and service to customers – The Transportation Asset Management solution will provide the ability to record levels of service for asset condition; develop budgets and allocate resources to achieve these service levels and then measure the agency's performance in meeting the target levels of service.

Improved cost-effectiveness and use of available resources – The Transportation Asset Management solution will provide WSDOT managers with the ability to more easily perform trade-off analysis between levels of investments in maintaining specific asset types and/or specific assets within an asset type**.**

A strategic focus on performance and outcomes – The Transportation Asset Management solution is designed to facilitate and support performance measurement processes and the monitoring of performance against specific outcomes or target levels of service.

Improved credibility and accountability for decisions – The Transportation Asset Management solution will help to provide the capability to more easily monitor the results (outcomes) obtained from various investment decisions. It can also help to justify requests for additional funding for various activities based on the outcomes which can be achieved based on any additional investment.

2. Reduced data management effort

The new Transportation Asset Management application will reduce the effort required to maintain and manage the underlying asset, traffic and collision data. TDO users who enter and maintain location information and traffic information will be presented with a new, more user-friendly interface to enter data that will be more streamlined, reducing the time required to perform any required data entry. While the new application will not replace the Collision Location and Analysis System which is used to collect collision data, the data will be imported from this system and validated in the new Transportation Asset Management application faster and more accurately. Asset location and condition data will also typically be interfaced into the system directly. Much of this information will be collected by Highway Maintenance staff in the regions using GPS-based field data collection units.

These improvements in the data entry capabilities of the new Transportation Asset Management solution will allow WSDOT to redirect some TDO staff time currently spent on data maintenance and data management activities to analysis and reporting activities.

3. Partner self-service capabilities

Counties and metropolitan planning organizations (MPOs) regularly request information from WSDOT regarding traffic volumes, collisions, maintenance and preservation work that was recently conducted, or construction or major maintenance work that is planned in the future. Currently many of these data requests have to be manually addressed by WSDOT staff using data marts to gather and summarize this information since the counties or MPOs do not have access to this information. With the new Transportation Asset Management solution, counties, MPOs and other authorized stakeholders will be able to request data and utilize many of the capabilities of the analysis tools through a web-based interface. This will reduce the time required by WSDOT staff to answer data requests, allowing a part of this time to be redirected to other analysis activities.

The data available will also be more granular, providing information, for example, on traffic peak hour counts, truck percentages per lane, and non-recurring congestion data. It should be noted that some data requests will still need to be validated and approved by WSDOT before release, and thus may still require some TDO involvement, albeit at a reduced level of effort.

4. Data analysis and reporting using a single set of applications and tools

WSDOT's Transportation Planning, Design, and Program Management functions, among others, also request information regarding asset inventory, asset locations, asset conditions, traffic patterns, and vehicle collisions. The Transportation Asset Management application will allow users to directly conduct data analysis in the system, eliminating the need for data exports into various data marts and other offline systems to utilize analysis tools. This will not only speed up analysis efforts, but ensure that the latest data is being used for analysis and that a common set of applications and tools is being utilized by all stakeholders to perform various analysis and reporting activities. The new Transportation Asset Management application will also allow users from these disciplines and other WSDOT sections to obtain consistent and accurate information faster than is currently possible.

B. Inventory of Anticipated Stakeholder Impacts

Exhibit IV-2 provides an inventory of the anticipated stakeholder impacts which have been identified to date.

Exhibit IV-2: TRIPS Stakeholder Impacts by Stakeholder Type

Stakeholder Group	Anticipated Impacts
Engineering Staff at WSDOT Headquarters	• Opportunity to implement an enterprise asset management business model including enhanced trade-off analysis and investment planning for various asset types • Availability of additional information for use in analysis • Need for some users to learn how to use the new asset inventory solution and the traffic and crash analysis tool • There will be limited impact for many users in terms of how they obtain data since they will continue to utilize the GIS workbench as a primary source or method of accessing data, however, more data will be available • Some users will access the new Transportation Asset Management solution directly including Maintenance, Bridge and Pavement Management among others • Some users will utilize the enhanced crash reporting analysis tools or the traffic demand analysis tools. This includes the State Traffic Engineering section, staff in the Design office and Traffic Services in Local Programs

Stakeholder Group	Anticipated Impacts
Engineering Staff at WSDOT Regional Offices	• Opportunity to implement an enterprise asset business model including enhanced trade-off analysis and investment planning for various asset types • Availability of additional information for use in analysis • Limited impact for some users in terms of how they obtain data since they will continue to utilize the GIS workbench as a primary source • Need for some users to learn how to use the new asset inventory solution and the traffic and crash analysis tools • Some users will access the new Transportation Asset Management solution directly such as Maintenance, Planning Program Management and the region management team • Some users will utilize the enhanced crash reporting analysis tools or the traffic demand analysis tools including Planning, Program Management and Traffic
Transportation Data Office	• Reduced manual effort to maintain data currency and integrity • Simplified effort to maintain roadway geometry and traffic information • Ability to maintain geometry dynamically in the new Location Referencing System • Reduced manual effort to complete information requests due to fewer systems, with a more integrated database and more robust analysis tools • Reduced complexity to maintain existing systems due to consolidation of multiple existing applications into a single Asset Inventory application • New Asset Inventory, Crash Analysis, Traffic Analysis and Location Referencing System tools for staff to be trained on and become familiar with
Metropolitan Planning Organization (MPO) staff	• Web-based access to some Asset Inventory, Traffic Analysis and Crash Analysis tools for data related to the transportation network within their planning boundaries • Opportunity to apply enhanced asset management tools in planning and decision-making processes
County engineering staff	• Web-based access to Asset Inventory information and Traffic Analysis and Crash Analysis tools for data related to the transportation network within their planning boundaries • Opportunity to apply enhanced asset management tools in planning and decision-making processes
Staff of other WSDOT partners	• Potential web-based access to Asset Inventory information and Traffic Analysis and Crash Analysis tools for data related to the transportation network within their planning boundaries or scope of responsibility • Opportunity to apply enhanced asset management tools in planning and decision-making processes

Stakeholder Group	Anticipated Impacts
WSDOT Information Technology Staff	• Reduced complexity to maintain systems due to consolidation of multiple existing applications into a single Asset Inventory application • Need to learn new applications/tools and potentially new technologies on which various best of breed software applications are based • Potential need to develop or contract for knowledge of the Oracle database management system, as this system is used by many of the best of breed solutions under consideration instead of Microsoft SQL Server (WSDOT's standard database management system)

V. Organizational Effects

This section documents the potential organizational effects on WSDOT and other agencies of the proposed technology investment in the Transportation Asset Management application. These anticipated organizational effects have been categorized by the following:

- Changes in business processes, job content, roles, and responsibilities
- Anticipated training needs
- Impact on organizational structure

Each of these types of anticipated organizational effects is described in further detail below.

A. Changes in Business Processes

As outlined in Section IV, Impacts, the implementation of the Transportation Asset Management solution will provide WSDOT with the tools to implement an enterprise asset management business model. In addition, various WSDOT stakeholders who currently obtain traffic and crash data through data marts and analyze data using offline analysis tools will be able to access data directly in the Asset Inventory application and utilize the new analysis tools.

Likewise, TDO staff currently performs a significant amount of information collection and analysis. This information gathering will generally take less time because the information will be easier to access. Some partners, such as MPO staff or county engineering staff, will also be given access to selected data and analysis tools via the Web, allowing partner agency staff the ability to perform some analysis on their own.

B. Anticipated Training Needs

The implementation of the Transportation Asset Management solution will require extensive communications for a number of engineering employees in WSDOT headquarters and the regions and focused training for specific groups. The systems integrator and best of breed software vendors will provide training materials for the system, but the WSDOT project team will need to modify and enhance these materials to incorporate WSDOT specific business processes and procedures.

The training plan should be a part of an organizational change management plan that includes structured, sequenced communications throughout the project lifecycle.

Exhibit V-1 provides a summary of the recommended types of training that should be rolled out and to whom.

Exhibit V-1: Suggested Transportation Asset Management Solution Training by Stakeholder Group

Business Process and/or System Procedure	Design	Environmental	External Partners	HQ and Regional Maintenance	HQ and Regional Mgrs	OIT	Pavement Management	Planning	Program Management	TDO	Traffic
Asset Inventory application	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓
Asset Inventory analysis tools (performance budgeting, lifecycle cost modeling, etc.)			✓	✓	✓		✓	✓	✓	✓	✓
Management reporting capabilities of Asset Inventory application	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓
Maintaining the Asset Inventory such as managing the underlying metadata, etc.										✓	
Crash Analysis tools	✓		✓					✓		✓	✓
Traffic Analysis tools	✓	✓	✓	✓			✓	✓	✓	✓	✓
Technical support for Asset Inventory, Traffic Analysis and Crash Analysis						✓					

C. Impact on Organizational Structure

The implementation of the new Transportation Asset Management solution is anticipated to have several impacts on WSDOT's organizational structure. These impacts include:

- Redirecting some of the time of WSDOT information technology or business unit staff currently supporting various asset management systems to supporting other critical line of business systems or other program specific activities.

- Redirecting some of the time of TDO staff or other program staff currently spent responding to information requests to other analysis or program specific activities as a result of easier access to information, better analysis tools and providing WSDOT partners with some access to asset, traffic and crash information and tools.

VI. Proposed Solution

This section describes the primary elements of the proposed Transportation Asset Management solution.

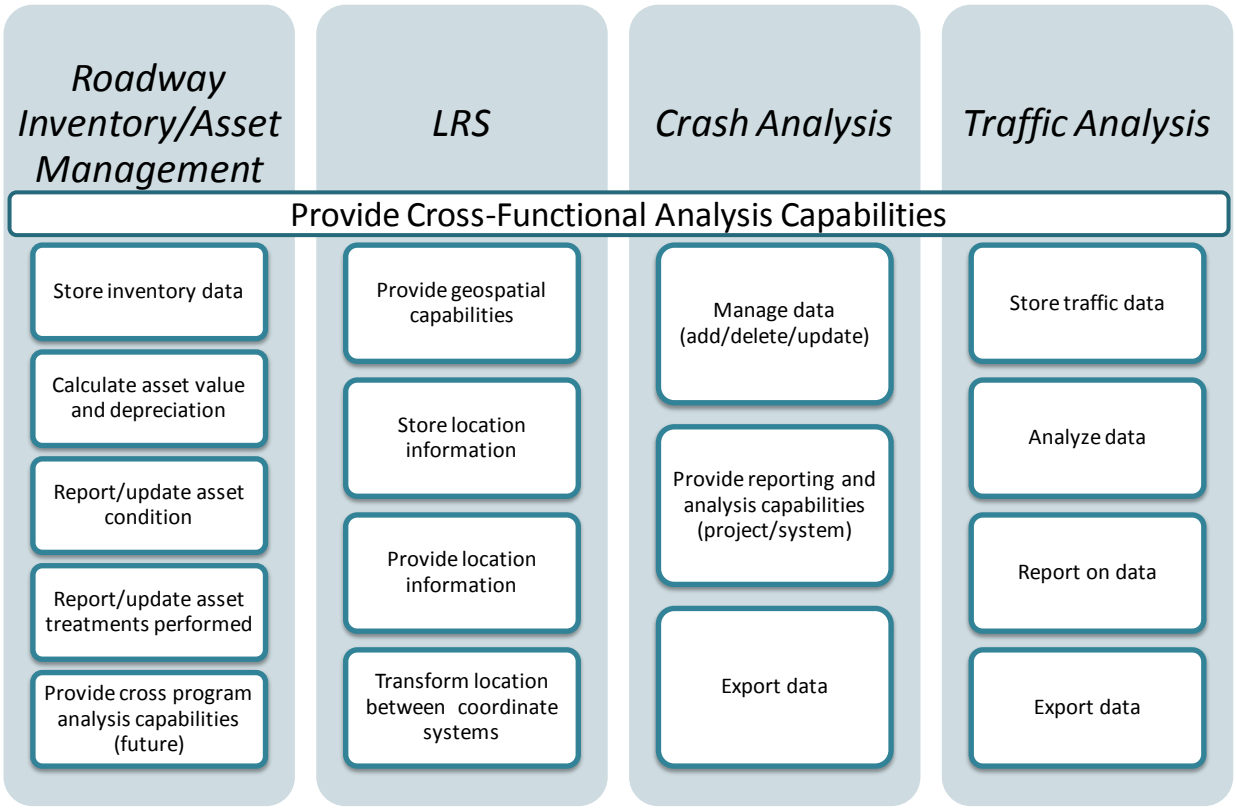
The Transportation Asset Management application component of the Critical Applications Replacement Program provides an integrated inventory of the assets on WSDOT's transportation network. It also includes a set of robust analysis tools that support needs identification and other analysis utilizing data in the asset inventory, in conjunction with other information such as condition data, crash records, and traffic counts.

The functionality of this solution includes four distinct sub-components:

- Asset Inventory
- Location Referencing System
- Crash Analysis tools
- Traffic Analysis tools

Exhibit VI-1 depicts, at a high level, the core functionality to be provided by the Transportation Asset Management solution. Each of these sub-components is then briefly described. Appendix C includes the high level requirements for each function developed during the feasibility study.

Exhibit VI-1 – Transportation Asset Management Solution Functionality



A. Asset Inventory

The Asset Inventory function includes a complete, detailed inventory of the linear and point assets existing on the WSDOT transportation network. This function will replace the Roadway Inventory application currently in TRIPS, as well as allow for the decommissioning of a number of other standalone asset inventory databases. This Asset Inventory application will store inventory and attribute information on a range of asset types including but not limited to:

- Barriers
- Culverts
- Detectors
- Guardrails
- Mitigation sites
- Pavement markings and treatments
- Roadside features
- Roadway lighting

- Signs
- Signals
- Supports and structures for signs, signals, and lighting

The Asset Inventory function will also provide the following capabilities:

- Support for locating assets via multiple geo-referencing strategies
- A means of capturing the history of the conditions of each asset and of creating management reports comparing current or historical conditions against levels of service for various organizational units within WSDOT
- A means of capturing treatments performed on each asset and integrating with/updating condition data based on treatments performed
- Support for integrating with data capture tools to maintain a current asset inventory and condition history
- Performance-based budgeting capabilities based on the work required to move from the average current condition for an asset type to the targeted level of service for an asset type
- Lifecycle cost modeling, needs identification, trade-off analysis, and project prioritization within an asset class
- Construction history for an asset
- Major maintenance history for an asset

In addition, while not specifically included in the scope of the Critical Applications Implementation Feasibility Study effort, this function could also be extended, at a moderate incremental cost, to provide support for a new highway maintenance management system that was recommended by the 2007 WSDOT Administrative and Overhead Performance Audit. Best of breed solutions available in the market place to perform the asset management functions in the scope of the Critical Applications Replacement Program also typically provide the planning, scheduling, and work order management functionality needed to support WSDOT's highway maintenance operations. Colorado, Louisiana, North Carolina, Pennsylvania, and Wyoming have all chosen to address their needs for a highway maintenance management system in parallel with their ERP and/or Transportation Asset Management applications using a combination of the ERP and Transportation Asset Management software solutions to perform this function.

B. Location Referencing System

The Location Referencing System is a service module that will provide location reference and location validation capabilities to the ERP and other WSDOT applications. Some of the key requirements of this module include:

- Allow WSDOT staff to create and maintain line work (roadway geometry) both dynamically and in a batch mode
- Support multiple location reference methods including geospatial referencing and WSDOT's existing county, route, and milepost referencing scheme
- Support translation and transformation between multiple location reference methods
- Translate back and forth between single-line representation and dual-line representation of the transportation network and allow for locating data on both representations
- Provide the ability to determine various jurisdictions for any particular location such as federal and state political boundaries, city, county, etc.
- Incorporate temporal location references that support obtaining a view of the transportation network at a snapshot point in the past including locations, names, and descriptions
- Support temporal topology such as reversible lanes or other items that change based on time of day

C. Crash Analysis Tools

The Crash Analysis subcomponent consists of a set of analytical tools to allow WSDOT to identify safety needs by integrating data available in the Asset Inventory application and the existing Collision Location Analysis System. Key requirements for the crash analysis function include:

- Support identification of high crash locations by various criteria including:
  - All accidents in a given time period
  - Types of accidents (car, motorcycle, truck, pedestrian, bicycle, etc.)
  - Severity
  - Other user defined criteria
- Spatially display results sets from ad-hoc queries by integrating with WSDOT's GIS Workbench
- Allow a user to dynamically create collision diagrams for crashes identified by the analysis tools using either pre-defined or user-defined schematics
- Support drill-down to the actual crash report data in the Collision Location Analysis System and display available information in the crash report based on user security

- Aggregate, classify, and support publication of crash data by various criteria for distribution to authorized partners

- Provide web-based access to the Crash Analysis capabilities for authorized partners

D. Traffic Analysis Tools

This is a set of tools that facilitates performing traffic demand analysis by integrating asset information with traffic data collected by WSDOT. Traffic data is typically collected by WSDOT using one of two methods. Permanent data collection sites obtain traffic data through imbedding sensors in the roadway and connecting them to specialized computers that continuously capture traffic data. Short-term collection sites are temporary data collection efforts such as tallies of visually observed vehicles or counts obtained through the temporary installation of traffic data collection equipment. The traffic information obtained through these data collection processes such as traffic volume, vehicle classification, speed, and weight data is then integrated with asset inventory information through the Location Referencing System and stored for analysis.

The Traffic Analysis toolset implemented as part of the Transportation Asset Management solution will:

- Maintain inventory and attribute information about both permanent and short-term data collection sites

- Support analysis of data collected from permanent and short-term data collection sites

- Allow analysis of the WSDOT transportation network by a variety of factors including roadway volumes, speed, vehicle classification, length classification, and weight

- Support reporting required by the Federal Highway Administration's (FHWA) Highway Performance Management System (HPMS)

- Support publishing of traffic data to partner agencies

- Support access to traffic analysis capabilities for authorized partners

VII. Alternative Solutions Considered

This section describes the three alternatives that have been evaluated as potential approaches for implementing a new Transportation Asset Management application. It provides a description of the three alternatives, outlines the evaluation criteria used to assess the degree of fit of each alternative, and provides a summary of the analysis conducted. It then documents the team's recommendation to proceed under Alternative 2 and the rationale for this recommendation.

A. Summary of Alternatives Analyzed

Dye Management Group, Inc. in conjunction with the Transportation Asset Management Feasibility Study Work Group identified three alternative approaches for implementing a new Transportation Asset Management solution. The three alternatives involve a combination of custom developed or best of breed components to meet the requirements for various business functions.

Based on market research, the Roadway Inventory/Asset Inventory and Location Referencing System functions could be met by either a custom developed or best of breed solution. The specific approach varies by alternative.

Likewise, based on market research, it is anticipated that the Crash Analysis solution will be met by the integration of one or more best of breed software tools, with some custom development required. In addition, it is anticipated that the Traffic Analysis component will be provided by a best of breed software solution. These approaches are consistent across the three alternatives evaluated.

A brief summary of the three alternatives are presented below:

Alternative 1: Custom developed Asset Inventory and Location Referencing System; best of breed Crash Analysis tools with custom extensions; and a best of breed Traffic Analysis solution

The scope of Alternative 1 includes:

- Designing and developing a custom Asset Inventory application and Linear Referencing System. Under this scenario, existing WSDOT TRIPS data marts would be retained for data retrieval, analysis and reporting.

- Utilizing one or more best of breed solutions with custom extensions for Crash Analysis

- Utilizing a best of breed solution for Traffic Analysis

Alternative 2: Best of breed Asset Inventory; custom developed Location Referencing System; best of breed Crash Analysis tools with custom extensions; and a best of breed Traffic Analysis solution

The scope of Alternative 2 includes:

- Designing and developing a custom Linear Referencing system
- Implementing a best of breed Asset Inventory solution
- Converting data from existing TRIPS data marts into the new Asset Inventory application and decommissioning the current data marts
- Utilizing one or more best of breed solutions with custom extensions for Crash Analysis
- Utilizing a best of breed solution for Traffic Analysis

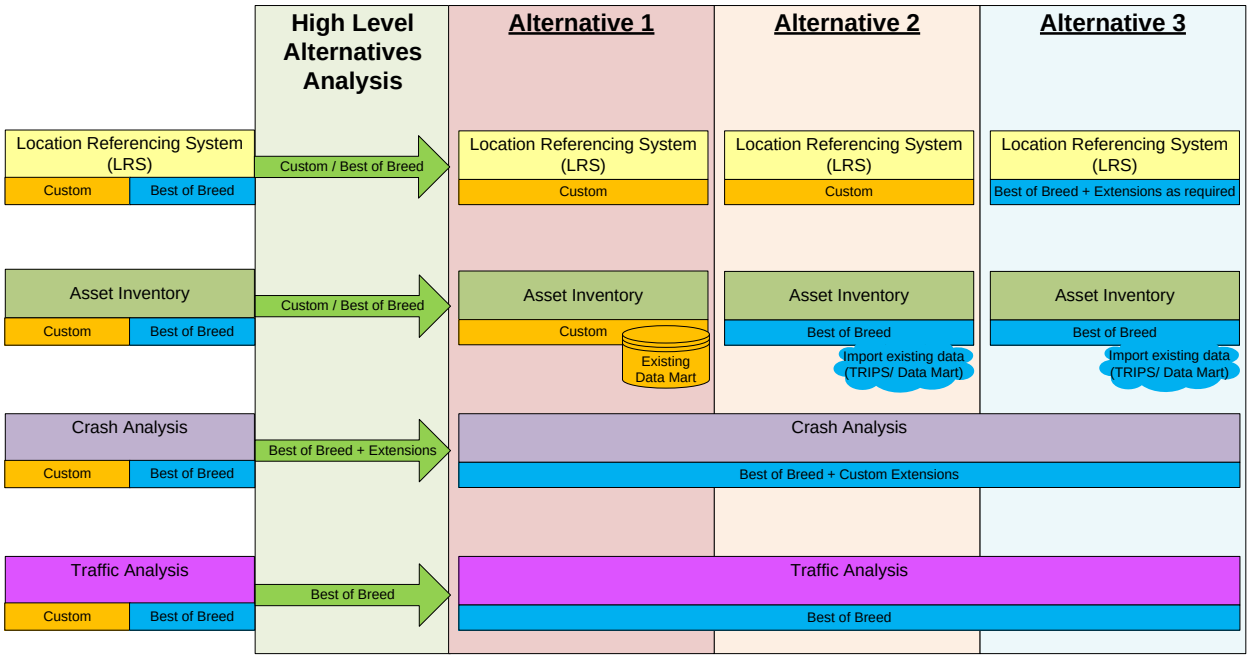
Alternative 3: Best of breed Asset Inventory and Location Referencing System tools; best of breed Crash Analysis tools with custom extensions; and a best of breed Traffic Analysis solution

The scope of Alternative 3 includes:

- Implementing a best of breed Asset Management solution to provide an integrated solution for both Asset Inventory and Location Referencing System capabilities
- Designing and developing any custom extensions (if required) to provide the full range of Asset Inventory and Location Referencing System functionality
- Importing data from existing TRIPS data marts into the new Asset Management application and decommissioning these data marts
- Utilizing one or more best of breed solutions with custom extensions for Crash Analysis
- Utilizing a best of breed solution for Traffic Analysis

Exhibit VII-1 provides an overview of the alternatives listed above.

Exhibit VII-1: Alternatives Considered for Providing Transportation Asset Inventory Functionality



B. Description of Alternative 1

Alternative 1 includes a custom developed Location Referencing System and Asset Inventory application, a set of best of breed tools with custom extensions/development for Crash Analysis and a best of breed solution for Traffic Analysis. This alternative provides WSDOT with the flexibility of custom developing and tailoring specifically to WSDOT's requirements the Location Referencing System and Asset Inventory application that would replace two of TRIPS' current functions.

In terms of Asset Inventory, significant custom development would be required if WSDOT sought to not only replace the roadway inventory functionality in TRIPS, but to also develop the capabilities required to replace other asset inventory systems, and to develop many of the analysis tools which are considered state of the practice for asset management in state departments of transportation.

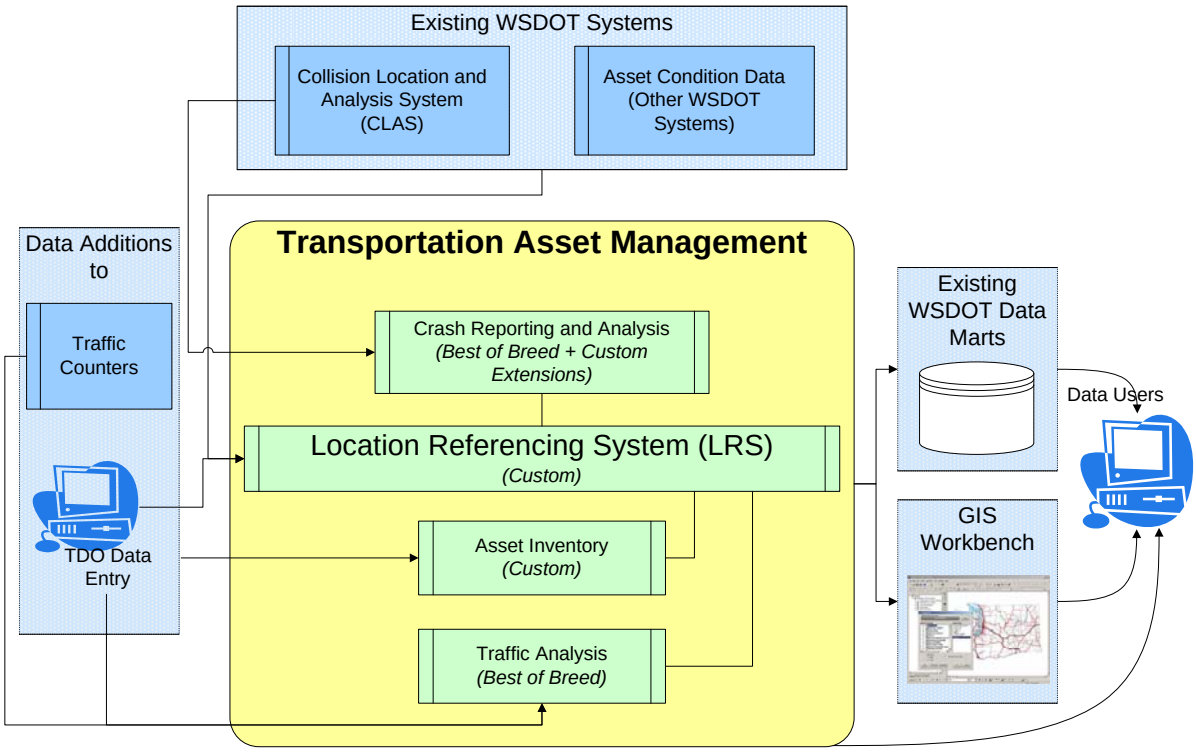
Under Alternative 1, the existing TRIPS data marts will still be utilized to provide users with data for management reporting and analysis.

Exhibit VII-2 below shows a conceptual diagram of Alternative 1. Under this alternative, roadway inventory data and other asset data is maintained on-line or through uploads from data collectors. Traffic data is imported from traffic counters or through data entry. The roadway geometry for the Location Referencing System is maintained on-line and then updated dynamically throughout the system. The location identification and translation component is a service module accessible by all other WSDOT applications.

Crash data is imported and/or dynamically accessed from the Collision Location and Analysis System.

In terms of management reporting and analysis, asset management data will be extracted into existing data marts and/or accessed through the GIS Workbench, as well as directly from the Transportation Asset Management solution. This is similar to how TRIPS data is accessed today for management reporting and analysis.

Exhibit VII-2: Alternative 1 Conceptual Architecture



C. Description of Alternative 2

This alternative provides WSDOT with the flexibility of custom developing the Location Referencing System while purchasing a best of breed Asset Inventory product. This best of breed Asset Inventory product will not only replace the Roadway Inventory application in the existing TRIPS, but it will also allow consolidation of a number of standalone asset inventory type applications into a single solution. This tool will provide a range of state of the practice asset management analysis, modeling and reporting capabilities, and the platform to implement other modeling capabilities such as cross-functional trade-off analysis between asset types as the selected vendor integrates these evolving concepts into their solution set. The solution suggested for Crash Analysis and Traffic Analysis is the same as Alternative 1.

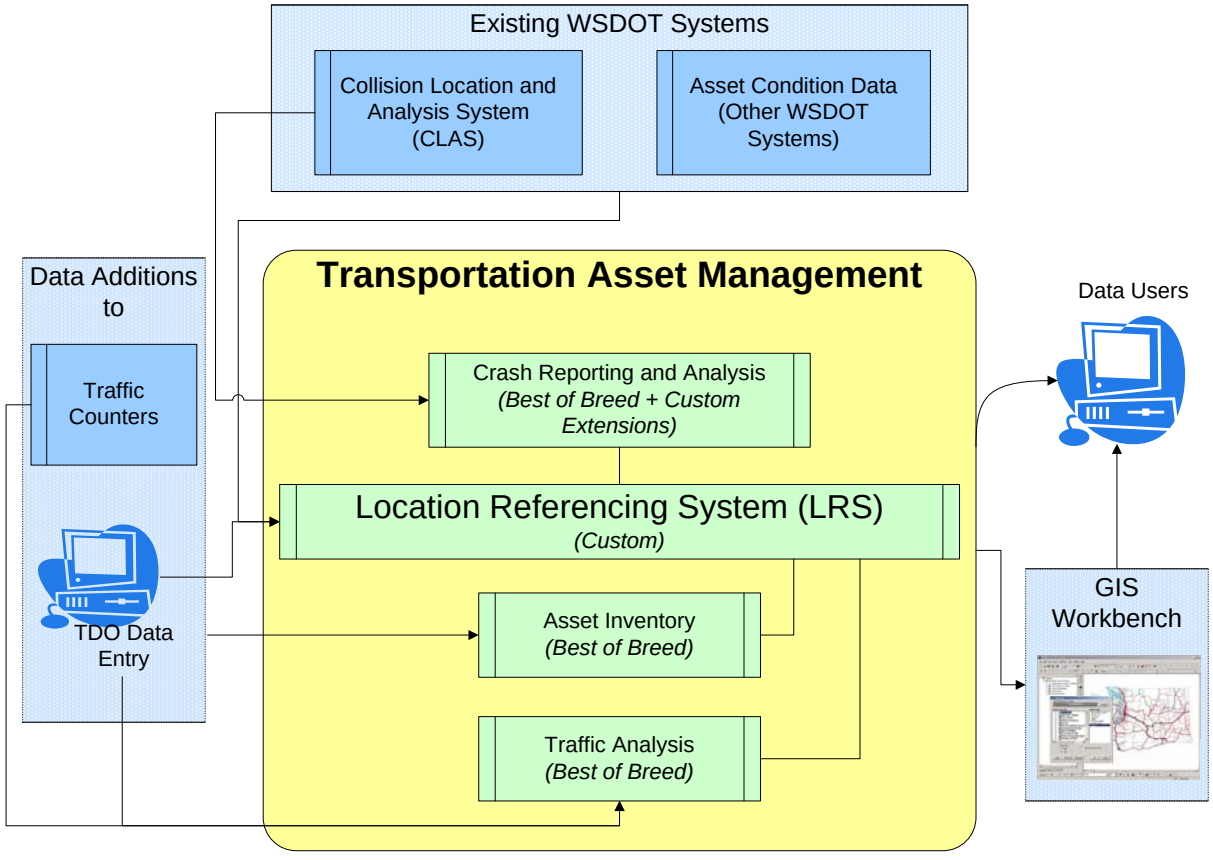
In terms of management reporting and analysis, it is assumed under this alternative that the existing data marts will be replaced by the reporting and analysis tools in the best of

breed Asset Inventory solution or by the Crash Analysis and Traffic Analysis tools, as well as potentially by SAP Business Information Warehouse which will provide the Business Warehouse layer of the Critical Applications Replacement Program.

Exhibit VII-3 below shows a conceptual diagram of Alternative 2. Under this alternative, a range of asset inventory data is maintained on-line or through uploads from data collectors. Traffic data is imported from traffic counters or through data entry. The roadway geometry for the Location Referencing System is maintained on-line and then updated dynamically throughout the system. The location identification and translation component is a service module accessible by all other WSDOT applications. Crash data is imported and/or dynamically accessed from the Collision Location and Analysis System.

To support management reporting and analysis, asset management data will be obtained by users directly from the Transportation Asset Management solution or accessed through the GIS Workbench.

Exhibit VII-3: Alternative 2 Conceptual Architecture



D. Description of Alternative 3

This alternative includes implementation of an integrated best of breed asset management solution that has Asset Inventory and Location Referencing System

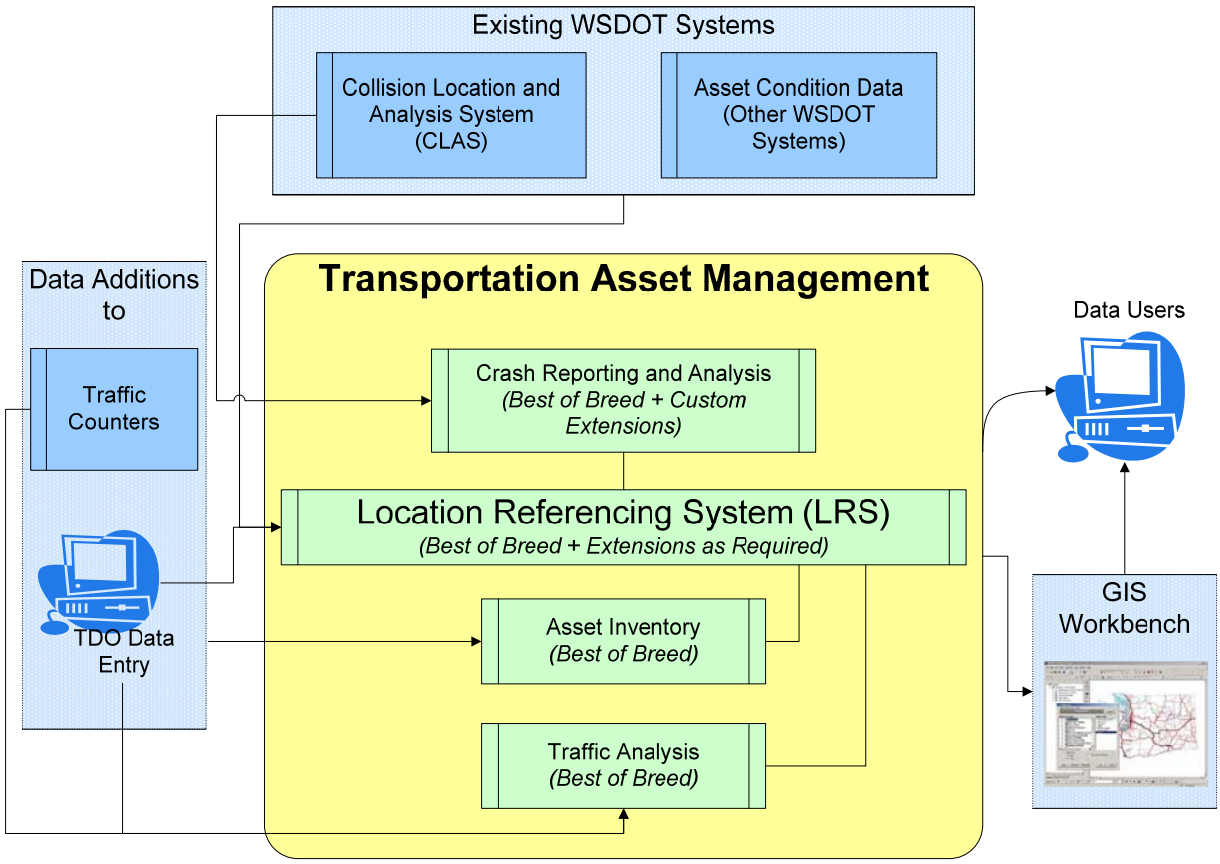
capabilities. The best of breed asset management solution, as in Alternative 2, will not only replace the Roadway Inventory application in the existing TRIPS, but it will also allow consolidation of a number of standalone asset inventory type applications into a single solution. This tool will provide a range of state of the practice asset management analysis, modeling and reporting capabilities, and the platform to implement other modeling capabilities such as cross-functional trade-off analysis between asset types as the selected vendor integrates these evolving concepts into their solution set. The solution suggested for Crash Analysis and Traffic Analysis is the same as in Alternatives 1 and 2.

In terms of management reporting and analysis, it is assumed under this alternative that the existing data marts, as is the case in Alternative 2, will be replaced by the reporting and analysis tools in the best of breed asset management solution, as well as potentially by SAP Business Information Warehouse which will provide the Business Warehouse layer of the Critical Applications Replacement Program.

Exhibit VII-4 below shows a conceptual diagram of Alternative 3. Under this alternative, a range of asset inventory data is maintained on-line or through uploads from data collectors. Traffic data is imported from traffic counters or through data entry. The roadway geometry for the Location Referencing System is maintained on-line and then updated dynamically throughout the system. The location identification and translation component is a service module accessible by all other WSDOT applications. Crash data is imported and/or dynamically accessed from the Collision Location and Analysis System.

To support management reporting and analysis, asset management data will be obtained by users directly from the Transportation Asset Management solution or accessed through the GIS Workbench.

Exhibit VII-4: Conceptual Architecture for Alternative 3



E. Evaluation Criteria

Each of the three alternatives for the Transportation Asset Management solution was analyzed against a set of evaluation criteria agreed to by the Transportation Asset Management Work Group. Each of the evaluation criteria are described briefly below.

- **Degree of fit with WSDOT business requirements** – This criterion refers to the extent to which an alternative meets WSDOT's business requirements based on the as developed functionality in the best of breed software solution and does not require significant customizations.

- **Degree of fit with state/agency strategic business direction** – This criterion refers to the extent to which the alternative is aligned with State of Washington and WSDOT business objectives and strategic plans.

- **Cost to develop** – This criterion is based on the cost to configure and implement each of the alternatives and includes, among other items, the cost of software licenses, software maintenance during the project period, the development of any custom programs, custom program extensions or interfaces required, hardware and

operating system software, the systems integrator and the state resources on the project team.

- **Lifecycle costs/total cost of ownershi**p – This criterion is based on a comparison of the cost of supporting the system over its lifecycle. For purposes of this analysis, the cost of ownership is being analyzed from July 1, 2010 (program initiation for the Transportation Asset Management components) through June 30, 2020. This includes the cost for internal staff to support the system, ongoing end user licenses, one software upgrade cycle for each best of breed component and a refresh of the hardware environment.

- **Degree of risk** – This criterion is based upon the relative degree of risk of each alternative, including the risk associated with the development approach (extent of customization required) and operational risk factors such as potential issues with upgrading best of breed solutions or maintaining custom software.

- **Consistency with the state/WSDOT information technology (IT) direction** – This criterion refers to the extent to which an alternative will fit with the state and WSDOT information technology standards and direction. Aspects to be considered under this criterion include customer service capability, system sustainability, process efficiencies, security, development platform, database management software, system integration, and reduction of redundant agency or shadow systems, among others.

- **Speed of implementation** – This criterion refers to the expected duration of the initial implementation project from the procurement through go-live, and with a period of post go-live support.

- **Long-term support considerations** – This criterion is designed to address the degree of ease in which an alternative can be supported by WSDOT following initial implementation. Factors to be considered under this criterion include whether WSDOT will be dependent on a third party for software upgrades, the ease of completing and implementing these upgrades, and the type and number of staff and skills required for WSDOT to maintain the application internally.

F. Comparison of Alternatives

This subsection provides a brief comparison of the three Transportation Asset Management alternatives against the evaluation criteria.

1. Degree of fit with WSDOT business requirements

Alternative 1 requires customization to meet Location Referencing System requirements. Alternative 1 also requires customization to meet Asset Inventory requirements. This will involve substantial custom development if WSDOT is to not only replace the Roadway Inventory application in TRIPS, but also other asset inventory

systems and develop the various analytical capabilities that are available in best of breed applications to support an enterprise asset management approach.

Alternative 2 also requires customization to meet Location Referencing System requirements, but all other requirements can be met with best of breed solutions.

Alternative 3 utilizes all best of breed solutions. However, it is not clear that a best of breed Location Referencing System solution can currently meet all or most of WSDOT's requirements. A significant number of fairly complex custom extensions will likely be required to meet all of WSDOT's requirements.

2. Degree of fit with state/agency strategic business direction

Alternative 2 and Alternative 3 facilitate implementation of an enterprise asset management strategy for WSDOT. Alternative 1 is somewhat limited in its ability to do this as the asset inventory component is really only a replacement for the functionality in the existing TRIPS application, unless significant custom development is undertaken.

3. Cost to develop

The estimated cost to develop includes acquisition of best of breed software, hardware, system integration services including any custom development, state staff costs, the Requirements and RFP Consultant, the Quality Assurance and Independent Verification and Validation Consultant and training for WSDOT staff assigned to the project. No facilities related costs were included as it is assumed WSDOT will utilize existing facilities to house the project team.

The estimated cost to develop Alternative 1 is $18.6 million under a pay as you go approach and $22.2 million if eligible costs are financed. The cost to develop Alternative 2 is estimated at $18.1 million on a pay as you go basis and $21.6 million if eligible costs are financed. The cost to develop Alternative 3 is $18.2 million on a pay as you go basis and $21.7 million if eligible costs are financed.

4. Total cost of ownership

The total cost of ownership includes the initial development costs and the ongoing cost to operate and maintain the system. For purposes of this analysis, the study team analyzed a ten year period beginning with the initiation of the project. Exhibit VII-5 outlines the cost to develop if eligible costs are financed, the cost to maintain/operate, and the total cost of ownership for each alternative.

Exhibit VII-5: Cost Summary for Each Alternative

Alternative	Cost to Develop If Eligible Costs Are Financed (millions)	Cost to Maintain and Operate through Year 10 (millions)	Total Cost of Ownership Financed (millions)
1	$22.2	$9.1	$31.3
2	$21.6	$9.6	$31.2
3	$21.7	$9.8	$31.5

5. Degree of risk

Alternative 1 has more significant development risk based on custom development of the Asset Inventory and Location Referencing System components. Alternative 1 also has more significant operational risk due to the need to support two custom applications and because of the potential for inadvertent impact to existing data marts. Likewise, Alternative 1 also has additional operational risk for the business as significant custom development is required in order to provide for decommissioning various existing asset inventory applications and developing the analysis tools required to position WSDOT to implement an enterprise asset management program.

Alternative 2 also has additional development risk because of the custom development of the Location Referencing System component. It also has some additional operational risk as a result of the need to support this custom module. Alternative 2, unlike Alternative 1, reduces operational risk for the business by facilitating the simplification of the information technology environment and the implementation of an enterprise asset management program.

Alternative 3 also presents some additional development and operational risk since it appears significant custom extensions are required to meet all Location Referencing System requirements.

6. Consistency with the state/agency IT direction

Alternative 1 and Alternative 2 would likely utilize Microsoft SQL Server, WSDOT's standard database management system, for the custom components. The best of breed solutions under each alternative would likely be Oracle-based, as this is the standard database management system platform for most best of breed software vendors focused on the state transportation marketplace. This would mean more non-standard applications from a database perspective under Alternative 2, and all components being non-standard from a database perspective under Alternative 3.

The three alternatives are otherwise fairly consistent with WSDOT information technology direction, including support for service oriented architecture. As an example, all three alternatives would implement the location validation and translation capability of the location referencing system as a service module, which could be utilized by any WSDOT application.

7. Speed of implementation

All three implementation approaches have similar timelines of approximately 36 months from project initiation to the implementation of all four components.

8. Long-term support considerations

Alternative 1 and Alternative 2 involve supporting custom solutions. This requires skilled development staff. It could also limit WSDOT's ability to upgrade and enhance the application.

Alternative 3 requires supporting significant custom extensions to the Location Referencing System best of breed solution. Also, Alternative 3 does make WSDOT more dependent on the solution vendor providing the integrated Asset Inventory and Location Referencing System components.

Exhibit VII-6 outlines a comparison of the three alternatives against the evaluation criteria. The rating is from 0 to 5 with 0 being the least optimal to 5 being the most optimal.

Exhibit VII-6: Comparison of Transportation Asset Management Alternatives against Evaluation Criteria

Evaluation Criteria	Alternative 1	Alternative 2	Alternative 3
Degree of fit with WSDOT business requirements	2	4	3
Consistency with agency and/or state business strategic direction	3	4	4
Cost to develop	2	4	4
Total cost of ownership	4	4	3
Degree of risk	2	3	3
Consistency with agency and/or state IT direction	3	3	3
Speed of Implementation	4	4	4
Long-term support considerations	2	3	4
Total Rating	**22**	**29**	**28**

G. Recommended Approach

The study team recommends proceeding forward under Alternative 2 with a best of breed Asset Inventory solution and a custom Location Referencing System. The rationale for this recommendation includes:

- A best of breed Asset Inventory solution is required to provide WSDOT with the type of robust asset management tools and capabilities needed to support implementation of an enterprise wide asset management program consistent with evolving national best practices. It would be cost prohibitive to custom develop this full range of capabilities.

- It is unclear that the existing best of breed Location Referencing System offerings meet all or most of WSDOT's requirements without requiring extensive customizations.

While a custom Location Referencing System is being used as the basis for establishing effort estimates and the project budget, it is also recommended that the RFP to select a systems integrator and a set of solutions proposed by the integrator allow the vendors flexibility to propose either a best of breed solution with custom extensions or a custom solution for the Location Referencing System component. This approach will allow a vendor to propose a best of breed solution with appropriate custom program extensions,

if the vendor believes this is the most appropriate approach to fully meet WSDOT's requirements. This approach also recognizes that while best of breed Location Referencing Systems do not yet fully meet WSDOT requirements, vendor solution offerings in this area are continuing to expand and that one or more best of breed solutions may support all or most of WSDOT's requirements by the summer/fall of 2011.

VIII. Conformity with Agency IT Portfolio

This section outlines how the recommended alternative for the proposed Transportation Asset Management solution is consistent with WSDOT's strategic objectives and business drivers and overall information technology direction.

A. Consistency with WSDOT Information Technology Direction

The recommended Transportation Asset Management solution is generally consistent with WSDOT's strategic objectives, business drivers and its overall information technology direction. Examples include:

- **The recommended solution simplifies WSDOT's information technology environment through consolidation of several applications into a common, integrated solution**

For example, the proposed Transportation Asset Management solution will allow consolidation of the existing Roadway Inventory application in TRIPS and several other standalone asset management inventory applications (roadside features, culverts, etc.) into a common solution. Another example is the consolidation of the current traffic analysis functionality in TRIPS and several standalone traffic applications into a single application.

- **The recommended solution supports the concept of a service oriented architecture**

The proposed Location Referencing System component of the Transportation Asset Management solution will provide location identification, validation, translation and transformation services to other elements of the Transportation Asset Management solution, other planned applications such as the proposed ERP, Preconstruction and Construction Management applications and other existing WSDOT applications. This will expedite development of new application components and reduce the cost of future system maintenance.

B. Limited Data Warehouse Capabilities in Best of Breed Solutions

In the current environment, WSDOT has developed several data marts to support management reporting and analysis of asset, traffic, and crash data. The primary reason for the implementation of these data marts is the difficulty in accessing information directly from TRIPS and other transaction systems.

The best of breed asset inventory/asset management solutions the team reviewed during the market research activities do not currently include data warehousing tools or pre-built integration with any data warehousing solutions. Other state departments of transportation using these best of breed vendors perform analysis and reporting directly in the best of breed solution. Vendors reported that the lack of a data warehouse capability has not been an issue for any existing customers, primarily because these

applications contain data that is relatively static and these applications are not heavy transaction systems.

Performing data analysis and reporting directly in the system of record will be a change from the current WSDOT information technology direction. However, based on the discussions with best of breed vendors, this does not appear to be a significant performance issue. In addition, some of these best of breed vendors indicated that either data warehousing capabilities or pre-built integration with other data warehousing tools would likely be added to their solutions in a future product release. Thus, this may be less of an issue at the time the software solutions are actually selected.

Likewise, as an alternative approach, WSDOT could also consider integrating the Transportation Asset Management solution with the Business Warehouse functionality of the Critical Applications Replacement Program. The Business Warehouse component is expected to be provided by SAP's Business Information Warehouse, which has pre-built integration with the SAP ERP application suite. The integration with the Transportation Asset Management solution would need to be developed, unless a best of breed transportation asset management vendor incorporates integration with SAP Business Information Warehouse into its product set.

C. Potential Need to Support Oracle Database Management System

The recommended approach does present one other challenge in terms of consistency with WSDOT's standard for database management systems. WSDOT has standardized on Microsoft SQL Server. However, most of the best of breed applications evaluated by the study team utilize Oracle as its database management system. Vendors focused on transportation solutions have generally developed on an Oracle platform since this is the database management system utilized by most state departments of transportation.

This will require WSDOT to either ask vendors to re-platform their applications or adopt a strategy for supporting a second database management system. Re-platforming applications will increase the cost of the project. It will also increase the risk of the project. Instead of implementing proven technology, WSDOT will be the first client to implement the SQL Server version of the product. It also increases the on-going operational risk as vendors will typically develop future product releases on their primary platform (Oracle) first.

WSDOT has several alternatives for supporting the Oracle database management system. Each of these alternatives should be further evaluated as part of the Planning and Acquisition phase of the Transportation Asset Management project. This includes:

- Engaging a third party vendor or a central services agency with Oracle expertise to host the application
- Contracting for Oracle database administration support on an as needed basis
- Developing Oracle database management skills internally

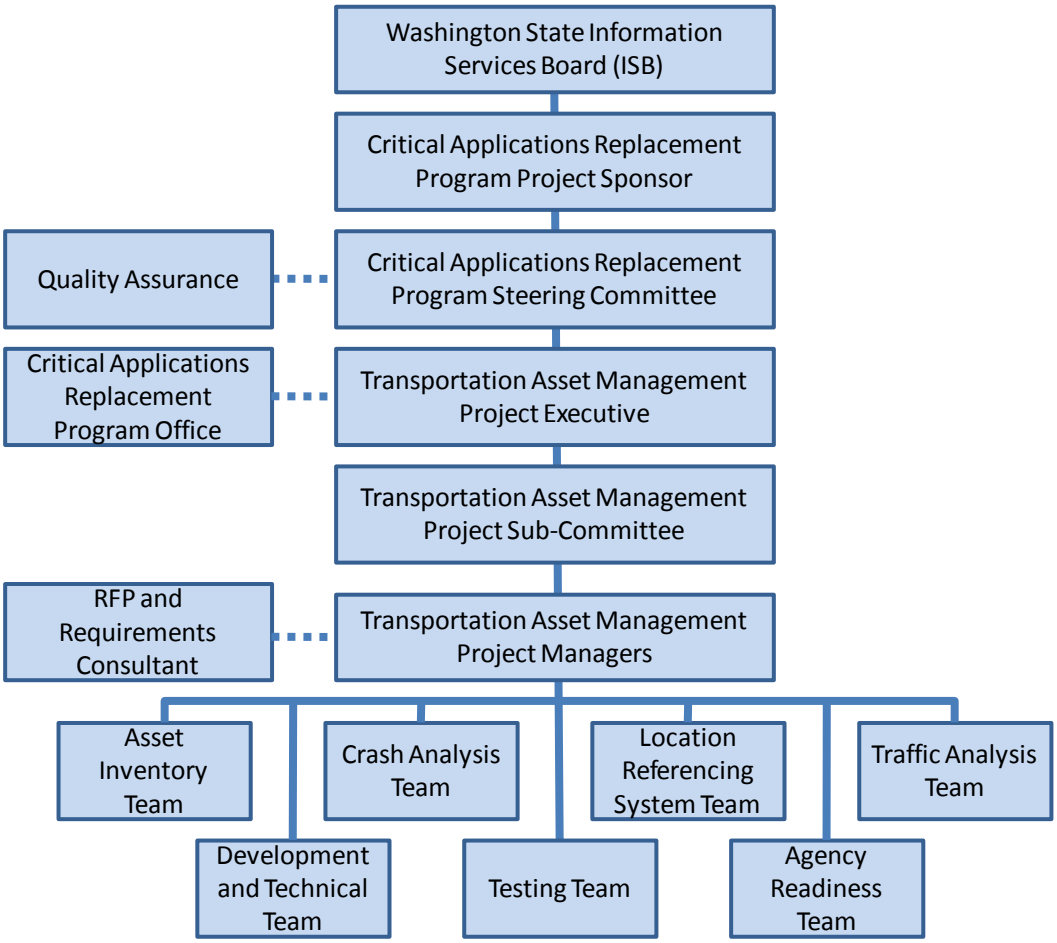
IX. Project Management and Organization

This section defines the recommended governance structure for the envisioned Transportation Asset Management implementation project and outlines the key roles and responsibilities of various project stakeholders including OIT, TDO, other WSDOT stakeholders, and software vendors/systems integrators. This section also outlines suggested project decision-making processes and recommended procurement and quality assurance strategies for the project.

A. Proposed Project Organization

Exhibit IX-1 outlines the proposed project organization for the Transportation Asset Management project. Each of the components of the proposed project organization is then described in further detail below.

Exhibit IX-1: Proposed Transportation Asset Management Project Organization



1. Washington State Information Services Board (ISB)

The ISB is responsible for initially authorizing the Transportation Asset Management project, periodically receiving and reviewing project progress reports, and then authorizing the project to proceed at periodic milestones or "gates" throughout the project lifecycle.

2. Critical Applications Replacement Program Project Sponsor

The Critical Applications Replacement Program Project Sponsor is a member of the WSDOT executive management team with overall responsibility and accountability for the completion of the Critical Applications Replacement Program. The project sponsor chairs the program steering committee and is responsible for policy direction and issue resolution requiring escalation to executive management.

3. Critical Applications Replacement Program Steering Committee

The Critical Applications Replacement Program Steering Committee has overall responsibility within WSDOT for the replacement of the Critical Applications, of which the Transportation Asset Management project is a part. The Critical Applications Replacement Program Steering Committee is a multi-disciplinary group of WSDOT management responsible for providing overall guidance and direction to the program and ensuring that each of the projects within the program are coordinated in their efforts.

4. Critical Applications Replacement Program Office

The Critical Applications Replacement Program Office is responsible for the day-to-day management and execution of the Critical Applications Replacement Program, including monitoring the scope, schedule, and budget of the overall program and the individual project components. This program office is also responsible for ensuring coordination between the individual project team efforts and for tracking and facilitating any issue resolution across project teams.

5. Transportation Asset Management Project Executive

The Transportation Asset Management Project Executive has responsibility for providing guidance and direction to the Transportation Asset Management project team within the approved scope, schedule, and budget for the project. It is anticipated that this individual will be the General Manager of the Transportation Data Office.

6. Transportation Asset Management Project Sub-Committee

The Transportation Asset Management Project Sub-Committee is responsible for providing overall guidance and direction to the project team within the approved scope of the project effort. The Transportation Asset Management Project Sub-Committee will

consist of representatives of the various stakeholder groups impacted by the implementation of the Transportation Asset Management solution. It should consist of a mix of headquarters and regional staff. It should also include one or two representatives of external partners, potentially one representative from an MPO, and one representative from a county engineer's office.

Given the opportunity to utilize this project effort as the framework for implementing a total transportation asset management, it is critical that key asset owners and a range of functional specialty areas within WSDOT, as well as external stakeholders, be represented on the Transportation Asset Management project sub-committee.

7. Quality Assurance

It is envisioned that a third party will be contracted to perform quality assurance and independent verification and validation (IV & V) services for the Transportation Asset Management implementation. This quality assurance consultant will report to the Transportation Asset Management Project Executive, as well as the Critical Applications Replacement Program Sponsor and Critical Applications Program Steering Committee.

8. Transportation Asset Management Project Managers

The Transportation Asset Management Project Managers will be responsible for the day-to-day management of the Transportation Asset Management implementation project. This group will consist of the WSDOT project manager, the business project manager from TDO, and the selected systems integrator's project manager. It is assumed that the WSDOT project manager will be a contracted resource, with extensive experience in asset management and analysis tools for a state department of transportation or a very large city or county engineering organization.

9. RFP and Requirements Consultant

It is anticipated that a consultant will be retained to assist WSDOT with the preparation of detailed requirements, the RFP document(s), and the procurement process for the Asset Inventory, Crash Analysis, and Location Reference System components. It is assumed the detailed requirements and the RFP for the Traffic Analysis component will be developed internally since the scope of this application component is smaller, can be met almost entirely by a best of breed solution and WSDOT has internal resources with a strong understanding of the functional requirements in this area.

10. Asset Inventory Team

The Asset Inventory team will have responsibility for defining and documenting business processes, configuring the selected Asset Inventory application, and defining detail specifications for any custom program extensions to support the business processes and the defined system requirements. This team will also be responsible for planning for and testing the Asset Inventory system application components and supporting the

deployment of the application. The Asset Inventory team will consist of staff from WSDOT and the selected integrator working in collaboration. The integrator will provide staff experienced in the set-up and configuration of the selected Asset Inventory best of breed application. WSDOT will assign staff familiar with the department's business processes.

11. Crash Analysis Team

The Crash Analysis team will have responsibility for defining and documenting business processes, configuring the selected Crash Analysis application to support these business processes and the defined system requirements, developing functional specifications for any required extensions, planning for and testing the Crash Analysis application components, and supporting the deployment of the application. The Crash Analysis team will consist of staff from WSDOT and the selected integrator working in collaboration. The integrator will provide staff experienced in the set-up and configuration of the selected Crash Analysis best of breed components. WSDOT will assign staff familiar with the agency's business processes.

12. Location Referencing System Team

The Location Referencing System team will have responsibility for defining and documenting business processes, configuring the selected Location Referencing System (if it is a best of breed application), and/or defining detail specifications for a custom solution or custom program extensions to the best of breed to support the business processes and the defined system requirements. This team will also be responsible for planning for and testing the Location Referencing System application components and supporting the deployment of the application. The Location Referencing System team will consist of staff from WSDOT and the selected integrator working in collaboration. The integrator will provide staff experienced in the set-up and configuration of the selected Location Referencing System best of breed application or staff familiar with the custom development of a Location Referencing System solution. WSDOT will assign staff familiar with the agency's business processes.

13. Traffic Analysis Team

The Traffic Analysis team will have responsibility for defining and documenting business processes, configuring the selected Traffic Analysis application to support these business processes and the defined system requirements, developing functional specifications for any required extensions, planning for and testing the Traffic Analysis application components, and supporting the deployment of the application. The Traffic Analysis team will consist of staff from WSDOT and the selected integrator working in collaboration. The integrator will provide staff experienced in the set-up and configuration of the selected Traffic Analysis application. WSDOT will assign staff familiar with department business processes.

14. Development and Technical Team

The Development and Technical team will be responsible for developing any required program extensions, interfaces, and conversion programs. It will also be responsible for establishing required technical infrastructure, installing the best of breed software components, and installing other required operating system and database management software.

This team will be staffed jointly by WSDOT and the systems integrator(s). The systems integrator will provide designers and developers familiar with the development of Location Referencing System applications using the tools proposed by the integrator. These designers and developers will also have experience with designing and developing custom extensions for the proposed best of breed solutions. WSDOT will provide programmers familiar with the existing TRIPS application to perform data conversion activities, as well as development staff familiar with any other line of business systems that the new Transportation Asset Management solution will integrate with.

The systems integrator will also provide database administrator and technical specialist resources. These resources will work collaboratively with OIT database administrator and technical support resources that will assist on the project on an as-needed basis.

15. Testing Team

The Testing team will be responsible for coordinating all Transportation Asset Management testing efforts. This team will consist of WSDOT staff, working in collaboration with the team of the selected systems integrator. The responsibilities of this team will include establishing standards and providing period quality control and oversight of the unit testing performed by the selected systems integrator of custom development and custom program extensions, interfaces and conversions; providing guidance to the system testing effort and monitoring the progress and quality of this testing effort; and planning for and managing execution of WSDOT's user acceptance testing effort.

16. Agency Readiness Team

The Agency Readiness team is responsible for managing the organizational change aspects of the Transportation Asset Management project. This includes ensuring WSDOT is prepared for and ready to accept the system for production operations and leading the deployment efforts. This team will be staffed jointly by WSDOT and the selected systems integrator. From the WSDOT perspective, it will include an overall Agency Readiness team lead and a number of other WSDOT staff who will be engaged on a part-time basis during the project as change agents and system champions. It will also include some WSDOT staff assigned on a full-time basis during the later stages of the Implementation phase to assist with the training effort.

B. Project Roles and Responsibilities

This subsection outlines various project roles and responsibilities for the Transportation Asset Management project. These roles and responsibilities are shown in the form of a Responsible, Accountable, Consulted, Informed, or RACI chart. Exhibit IX-2 outlines anticipated roles and responsibilities during the Planning and Acquisition phase of the project. Exhibit IX-3 outlines anticipated roles and responsibilities during the Implementation phase of the project. The codes for each task/activity reflect the nature of the function's responsibility for that task as follows:

- **R:** Responsible for/Manages the Process
- **A:** Accountable Member (Assigned)
- **V:** Verifies Deliverables (Usually also a "C")
- **C:** Needs to be Consulted (Valuable Input)
- **I:** Informed of Process (Stakeholders)
- **S:** Sign-Off (For Final Delivery, Sponsor)

Exhibit IX-2 – Transportation Asset Management Project RACI Chart for Planning and Acquisition Phase

Project Roles ⇨ Project Tasks, Activities, and Deliverables ⇩	Project Executive and Sub-Committee	Project Office	WSDOT Functional Analysts and Subject Matter Experts	System Requirements and RFP Consultant	Quality Assurance and/or IV & V
Initiate Project					
Update and Finalize Project Charter	C/V	A/R	C/V		
Confirm Sourcing Strategy	C/V	A/R	C/V		
Develop Initial Work Plan	C/V	A/R	C/V		
Select Independent, Validation & Verification (IV & V) Vendor	C/V	A/R	C/V		

Project Roles ⇨ Project Tasks, Activities, and Deliverables ⇩	Project Executive and Sub-Committee	Project Office	WSDOT Functional Analysts and Subject Matter Experts	System Requirements and RFP Consultant	Quality Assurance and/or IV & V
Select System Requirements and RFP Consultant	C/V	A/R	C/V		
Prepare Detailed System Requirements					
Define detail system requirements	C/V	A/C	A/R	A/R	I
Review detailed requirements with stakeholders	C/V	A/C	A/R	A/R	
Update systems requirements if required				A/R	
Prepare RFP					
Develop RFP	C/V	-	C/V	A/R	I
Finalize and Release RFP	C/V	A/R		C	
Select Software/Integrator					
Conduct Pre-Bid Conference	C/V	A/R		C	
Respond to Vendor Questions		A/R	C/V	A/R	
Develop Demonstration Strips		A/R	C/V	A/R	I
Evaluate Vendor Proposals	C/V	A/R	A/R	C	I
Select Vendor	C/V	A/R	C		I
Finalize Vendor Contract	C/V	A/R			I

Exhibit IX-3 – Transportation Asset Management Project RACI Chart for Implementation Phase

Project Roles ⇨ Project Tasks, Activities, and Deliverables ⇩	Project Sponsors and Steering Committee	Program Office	Staff from Other State Agencies	Time and Leave Team	Labor Distribution Team	Development and Technical Team	Testing Team	Agency Readiness Team	Quality Assurance and/or IV & V
Perform Enterprise Design									
Finalize Project Work Plan		A/R		C	C	C	C		I
Application / System Design	C/V	C/V	C	A/R	A/R	C/I	C/I		I
Develop and Test Solution									
Configure Selected Best of Breed Solutions	C/V	C/V	C	A/R	A/R	C/I	I		I
Develop Location Referencing System Components		C/V	C	A/R	C	C/I	I		I
Develop Required Extensions to Best of Breed Software	C/V	C/V		C/V	C	A/R	I		I
Perform Change / Configuration Management	C/V	A/R		C	C	A/R	A/R		
Design and Develop Any System Interfaces		A/C		C/V	C/V	A/R	I		I
Perform Data Conversion Planning	I	R		A/R	A/R	A/R	I		I
Design and Develop Data Conversion Routines	I	A/C		C/V	C/V	A/R	I		I
Perform Required Data Cleanup	I	A/C		A/R	A/R	C			I
Perform Manual Data Conversions	I	A/R		A/R	A/R	C			I
Prepare and Conduct System Testing	I	A/R			A/R	A/R	A/R		I

Project Roles ⇨ Project Tasks, Activities, and Deliverables ⇩	Project Sponsors and Steering Committee	Program Office	Staff from Other State Agencies	Time and Leave Team	Labor Distribution Team	Development and Technical Team	Testing Team	Agency Readiness Team	Quality Assurance and/or IV & V
Prepare for and Conduct User Acceptance Testing (UAT)	C/V	A/R		A/R	A/R	A/C	A/R		I
Develop Training Materials	I	A/C		C	C			A/R	I
Conduct Train-the-Trainer Sessions	I	A/C		C	C			A/R	
Conduct End-User Training Sessions	I	A/C						A/R	
Conduct Technical Training		A/C				A/R	A/C	A/R	
Deploy/ Implement Solution									
Establish Production Environment	I	A/C		C	C	A/R	C	A/R	
Perform Production Cut-Over	I	A/R		A/R	A/R	A/R		A/R	I
Provide Production Support									
Manage/Troubleshoot Operations	I	A/C		A/R	A/R	A/R	C/I	C/I	I
Provide End User Support		A/C		A/R	A/R	A/R		A/R	
Manage Project									
Validation of Deliverables	C/V	V							C/V
Program Management	C/V	A/R							
Project Status Reporting	C/V	A/R							
Project Closure/Signoff	S	C		C	C	C	C	C	C/I

C. Issue Resolution and Other Project Decision Making Processes

Issue resolution and other decision-making processes will flow upward through the project organization. The co-team leads from WSDOT and the selected systems integrator will be responsible for resolving issues within their individual teams.

Issues which cannot be resolved by the co-team leads or issues that require coordination across multiple teams will be raised to the project managers during regular project status meetings and/or on an expedited basis if required. The project managers will attempt to address these issues.

Issues which involve coordination between the Transportation Asset Management team and other Critical Application Replacement Program teams will be raised to the Critical Applications Program Office for resolution. An example would be a need for a change to the location translation capability to support a requirement for the ERP application.

Issues which either the project managers or the Critical Applications Program Office believes require management input and direction because they affect policy and/or project scope, schedule, budget or other factors will be discussed with the Transportation Asset Management Project Executive and elevated to the Transportation Asset Management Project Sub-committee and, if required, to the Critical Applications Replacement Program Steering Committee. If issues require immediate resolution and cannot wait until the next meetings of these committees, the Transportation Asset Management Project Executive may choose to resolve the issue and/or informally poll project sub-committee members for input prior to making a decision.

Issues which materially affect the scope of the project or impact the schedule and budget of this project will also require approval of the Critical Applications Replacement Program Steering Committee and the Critical Applications Replacement Program Project Sponsor.

D. Procurement Strategies

The following procurement strategies are recommended for the Transportation Asset Management project.

1. Project Management

WSDOT should contract for an experienced program manager/project manager with extensive experience implementing asset management, analysis tools, or other engineering management systems for state departments of transportation. This resource could be procured through a separate RFP, through one of the existing information technology master services contracts or possibly through seeking to hire a temporary employee on a term basis.

2. System Requirements and RFP Consultant

WSDOT should contract with a consulting firm to assist with the definition of detailed requirements, preparation of the RFP and facilitation of the software and integrator selection process. The one exception is the Traffic Analysis component (if procured separately) where, due to the smaller size of the project effort and WSDOT's knowledge of the requirements, this activity could be performed internally.

This consultant must be experienced in preparing RFPs and assisting state transportation agencies or large county and city engineering organizations to procure and select asset management software, analysis tools and other engineering management systems. This consultant could be procured through a separate RFP or through an existing state information technology master contract.

3. Quality Assurance and Independent Verification and Validation

WSDOT should contract with a consulting firm to provide quality assurance and independent verification, and validation (IV & V) services. The selected consultant must be experienced in performing these types of services for the implementation of best of breed and custom development projects for state agencies. This consultant could be procured through a separate RFP or through an existing state information technology master contract.

4. Best of Breed Software and Systems Integrator

WSDOT should develop a single RFP for selecting the Transportation Asset Management best of breed software solutions for Asset Inventory, Traffic Analysis and Crash Analysis; the best of breed or custom solution for the Location Referencing System; and the systems integrator to deploy the Transportation Asset Management solution application. It is recommended that this acquisition be done in a single RFP process versus selecting the best of breed software and then procuring the systems integrator. The rationale for this recommendation includes:

- WSDOT will have a single prime vendor with full ownership and responsibility for the successful implementation of the Transportation Asset Management solution.

- WSDOT will save time by eliminating an additional three to six months that would be required for a second procurement step, thus allowing the implementation effort to begin sooner.

The RFP to select a systems integrator and a set of solutions proposed by the integrator will specify best of breed solutions for the Asset Inventory and Traffic Analysis components, and a best of breed solution for the Crash Analysis component, with custom extensions as required. The RFP will indicate a preference for a best of breed solution for the Location Referencing System, but allow the vendors flexibility to propose either a best of breed solution with custom extensions or a custom solution for this component. This approach is based on concerns that best of breed offerings do not yet fully meet WSDOT requirements, but recognizes that vendor offerings in this area are continuing to expand and that one or more best of breed solutions may support all or most of WSDOT's requirements by the summer/fall of 2011.

5. Coordination with the Critical Applications Program and Other Considerations

Because it is assumed this project will be performed in relative parallel with the ERP project, WSDOT may choose to release one integrated RFP. Both Louisiana (for a statewide solution including the department of transportation) and the Wyoming Department of Transportation included ERP and asset management capabilities in a single, integrated RFP for software and services. WSDOT could also procure requirements and RFP support and quality assurance and independent verification and validation services for this effort and other Critical Applications Replacement Program requirements in single RFPs for each type of service for the entire program.

If the Transportation Asset Management solution is deployed in multiple phases, one or more RFPs for software solutions and integration services may be required. One scenario is a separate RFP for the Traffic Analysis software and implementation services and a second RFP for the remaining solution components and integration services.

X. Estimated Timeframe and Work Plan

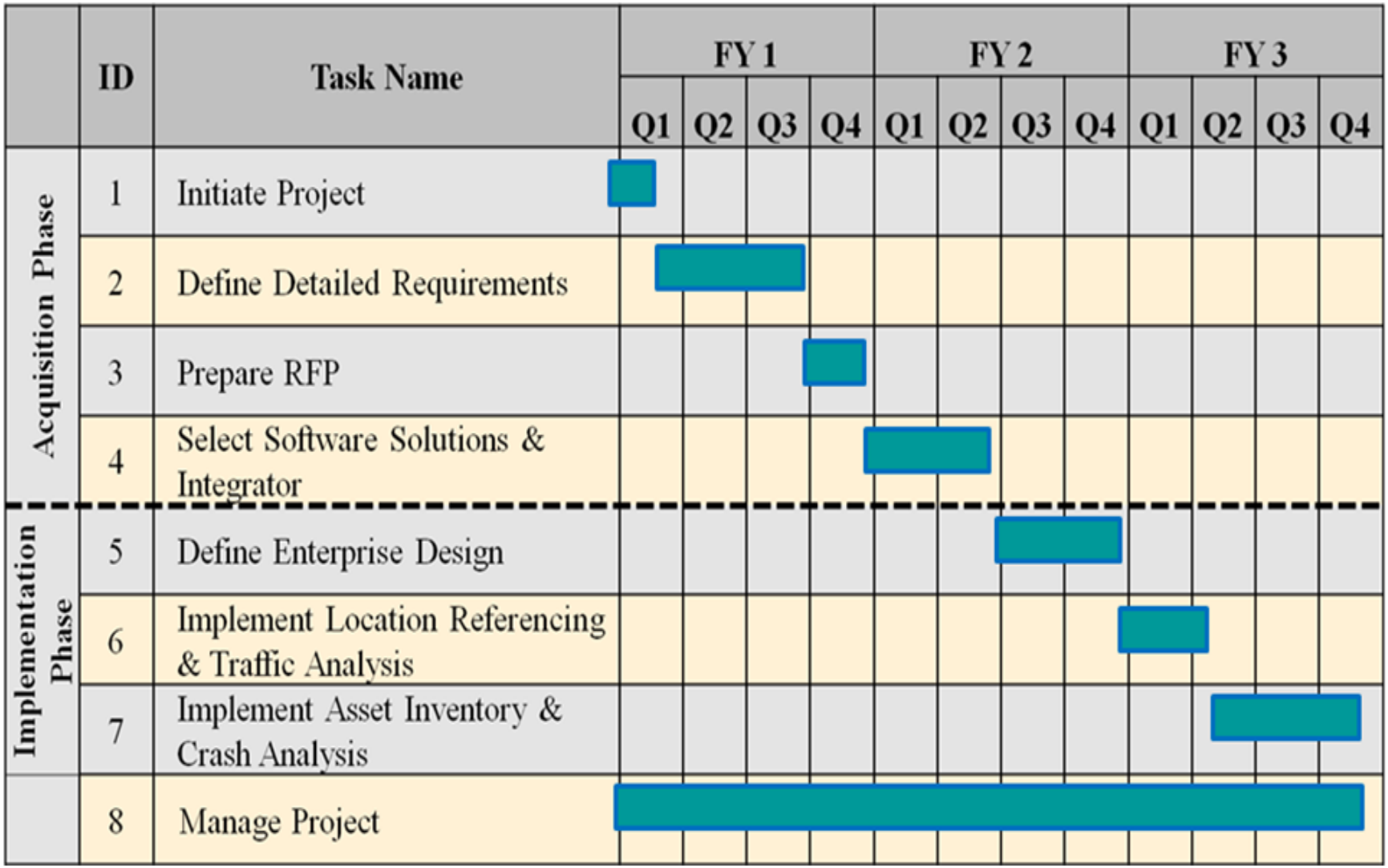
This section outlines the proposed project schedule and work plan with key milestones and decision points. For planning purposes, two proposed timelines have been provided. The first illustrates the preferred approach which involves a single acquisition process, followed by a common enterprise design and then deployment of the four components of the Transportation Asset Management solution. The second proposed timeline divides the project into two phases based on budget considerations to allow work on the Traffic Analysis software solution to begin earlier, with work on the other three components beginning approximately one year later.

A. Single, Integrated Implementation Project Approach

Exhibit X-1 outlines the timeline and sequencing of the major activities of a single, integrated deployment effort for the Transportation Asset Management solution. This approach involves completion of detailed requirements definition for all four solution components, followed by a single RFP process to select a systems integrator and solution components. Enterprise Design is then performed for the integrated Transportation Asset Management solution. The Implementation phase is then initiated for various components, with the implementation activities slightly staggered. However, because Enterprise Design was completed first for all components, the solution is being built to a common design, even if the Implementation phases for each solution component are slightly staggered.

The proposed schedule under this approach is anticipated to last approximately 36 months. This elapsed duration includes program initiation, procurement activities, enterprise design, development, testing, deployment/implementation and three months of production support by the selected systems integrator and the assigned state project team members. Because no funding source has been identified at the time of the preparation of this feasibility study, no specific start date is shown for this proposed schedule. Thus, the project plan will need to be adjusted once a funding source(s) has been identified and a specific start for the project established.

Exhibit X-1: Proposed Schedule for Transportation Asset Management Solution under a Single, Integrated Implementation Effort



The project work plan under this approach consists of two phases:

- **Planning and Acquisition** - This phase includes activities 1-4 above: the formal initiation of the project; detailed requirements definition; the preparation of the RFP to select best of breed solutions to meet requirements and a systems integrator; and the selection of the best of breed solutions and the systems integrator.

- **Implementation** – This phase includes activities 5-7 above: the enterprise design of the Transportation Asset Management application, the development and unit testing of required custom program extensions and interfaces, the system testing and user acceptance testing of the application, user training and other agency organizational change management and readiness activities, the planning for and executing of the cut-over of the new application and a period of production support following cut-over.

The remainder of this subsection provides a brief description of the primary tasks which will be performed in each project phase.

1. Planning Phase

The Planning Phase consists of the following tasks:

- Initiate Project
- Define Detailed Requirements
- Prepare RFP
- Select Software Solutions and Systems Integrator

Each of these tasks is described in further detail below.

Initiate Project

This task involves establishing the project management structure, finalizing and implementing the governance structure, finalizing and obtaining approval of the project charter and identifying the various state project team members, and developing the project management plan. An initial work plan for the entire project will also be developed in this phase at a somewhat higher level of detail. This work plan will then be adjusted once the systems integrator has been selected. A more detailed work plan will also be established for the acquisition activities leading to the selection of a software solutions and a systems integrator.

This task will also include procurement activities required to select a consultant to assist with the RFP process and systems integrator/software solution selection, select the quality assurance consultant and select the contract state program manager. In addition, it will include the development of an initial organizational change management

plan to guide organizational change management and other deployment activities to prepare WSDOT for deployment of the new Transportation Asset Management solution.

This task will begin immediately upon identification of a funding strategy for the project and ISB approval to proceed with the project. Some activities in this phase such as preparing the work plan and the draft procurement vehicles to select the program manager, RFP consultant, and quality assurance consultant may be able to be performed earlier by state staff funded through existing operating budgets.

Define Detailed Requirements

This task involves conducting detailed requirements definition by engaging with various project stakeholders. The objective of this task will be to carry the requirements developed during the feasibility study phase to a lower level of detail for each of the four functional areas.

Based on the additional requirements gathering work, the project team will make any updates which may be required to the functional requirements. As is the case with the Initiate Project task, some activities in this task may be able to be performed earlier than shown in the schedule by state staff funded through existing operating budgets.

Prepare RFP

This task includes the activities required to prepare RFP documents and publish them to the vendor community. During this task, the RFP Consultant will develop the functional and technical scope of work elements for an RFP to select best of breed applications for Asset Inventory, Traffic Analysis and Crash Analysis, and a best of breed or custom solution for the Location Referencing System and a systems integrator. The project team will then work with agency procurement staff to finalize and publish the RFP.

Select Software Solutions and Systems Integrator

In this task, the state team, with assistance from the RFP consultant, will evaluate vendor proposals and select a systems integrator and software solution. The team will first evaluate vendor proposals and develop a short list for further evaluation, if required. The team will conduct vendor demonstrations and perform reference checks as appropriate, identify the finalists, conduct competitive negotiations with the finalists and select and contract with an integrator to implement the application.

2. Implementation Phase

The Implementation phase will consist of a common Enterprise Design, followed by two separate deployment sub-phases. Each of the deployment sub-phases will consist of the same set of tasks including:

- Develop and Test Solution

- Deploy/Implement Solution
- Provide Production Support

Each of these tasks is described below.

Perform Enterprise Design

The Enterprise Design task begins with the initiation of the solution implementation effort, including the on-boarding of the systems integrator, and confirming project understanding for both the state team and the systems integrator.

In this task, the selected systems integrator will establish an initial configuration of the application software components based on the detailed requirements matrix. The systems integrator and members of the state team will then lead a series of workshops with stakeholders to demonstrate and validate the software configuration for each component of the solution. Required changes to the software configuration will be identified and made. In addition, any gaps in the software configuration requiring customization effort will be confirmed and further analyzed.

Based on the enterprise design efforts, the systems integrator and the state team will develop an inventory of required customizations, interfaces, and data loads. The systems integrator will also work with state functional team members to develop screen and report layouts for any required customizations. The results of the system design will then be documented and published in a System Design document.

This task also includes the creation of a data conversion plan that details the specific activities associated with initial data migration from existing systems to the new applications. This will include importing data from current data marts. This plan serves as the basis for the design and development of required data conversion programs in the later phases.

Likewise, this task includes updating and finalization of the organizational change management plan based on the system design. This plan will then guide communications, training and deployment activities for the remainder of the project.

Develop and Test Solution

Develop and Test Solution involves the tasks associated with preparing the software solutions for installation via application development and configuration activities. This includes the detail design, programming, and unit testing of required customizations, interfaces and initial data loads.

The Develop and Test Solution task also includes a set of structured testing activities to ensure the designed systems meet all defined functional requirements. This includes planning and conducting system testing activities in which the system is tested as an

integrated application following scripts modeled on typical business scenarios. It also includes planning and conducting user acceptance testing activities in which the state team and other extended stakeholders validate that the application meets the defined functional requirements and is ready for production operation.

Deploy/Implement Solution

The Deploy/Implement Solution task involves preparing user training materials, conducting end-user training, conducting manual data conversion activities and deploying the accepted application into a production environment.

The systems integrator will be responsible for developing the training plan, preparing custom training materials, and leading the initial pilot training courses for the solution. WSDOT staff will then perform the remainder of the training with support from the systems integrator. As part of the training effort, the systems integrator, with assistance from the state team, will modify the standard training materials for the selected best of breed products to reflect WSDOT business scenarios and data. This customized training material will then be utilized to perform the training.

The systems integrator and the WSDOT technical support and database administrators will be jointly responsible for establishing the training environment, with the systems integrator configuring the application environments to be used for training.

A detail cut-over plan will be developed to delineate the steps for moving the user acceptance tested application from the user acceptance testing environment to the production environment. This cut-over plan will outline the tasks associated with the production cut-over for the new system, including the resources required and associated timeframes, the order in which the activities will occur, and a contingency or fallback plan in the event that the cut-over is not successful. This activity will be prepared by the selected systems integrator with support from all project resources.

The activities associated with the migration of the application to production include both the application environment moving from the user acceptance testing environment into production, as well as a migration of the underlying data and system interfaces going live as part of the same exercise. This would include any required manual conversion activities.

Due to the number of activities involved in the production migration phase, best practices state that any data that is considered “static” should be moved prior to the actual cut-over weekend. Static data is generally defined as data that is not updated on a regularly-scheduled (i.e. daily, weekly) basis. For the Transportation Asset Management application, this would include the asset data showing location and condition of all assets and all historical traffic and crash data. The remaining data is then converted during the cut-over weekend.

The following activities will be required for migration of the new Transportation Asset Management solution to production:

- Establish production hardware and software environments
- Configure the best of breed software solutions in the production environment
- Install/migrate custom programs
- Convert master data
- Convert operational data
- Perform manual conversions
- Initiate production

Provide Production Support

The effort and cost estimates prepared for this feasibility study included three months of post production support. This task includes providing end-user support, documenting and resolving application issues, making any necessary software configuration changes and making any necessary changes to custom program extensions or interfaces. This task also includes a structured transition of responsibility for the system from the systems integrator to WSDOT.

3. Manage Project

This task includes all of the ongoing tasks required to manage execution of the project effort. During the Planning and Acquisition phase, this is a joint activity between WSDOT's Project Manager, WSDOT's Business Lead and the Requirements and RFP consultant. During the Implementation phase, this is a joint activity between WSDOT's Project Manager, WSDOT's Business Lead, and the systems integrator's Project Manager. In addition, the activities of the selected quality assurance and independent verification and validation consultant are included as part of the Manage Project task. Activities in this task include:

- Monitor and update project work plan
- Monitor and update project management plan
- Monitor and update project issues log
- Monitor and update risk management plan
- Perform on-going quality assurance reviews

- Perform independent verification and validation reviews as appropriate
- Prepare monthly progress reports
- Conduct bi-weekly Project Management meetings
- Conduct periodic steering committee meetings

B. Multi-Project Implementation Approach

To provide flexibility based on available budgets, the team also developed a multi-project implementation strategy for the Transportation Asset Management solution. This multi-project approach involves implementing the Traffic Analysis component in a separate first project phase and the other components in a second phase. The advantage of this approach is that implementation can begin on the smaller Traffic Analysis component, while funding is being secured for the larger effort. This approach is feasible since the Traffic Analysis component is fairly modular, with limited integration to other system components. Thus, some re-work will be required to integrate the Traffic Analysis module with the new Location Referencing System and Asset Inventory components when these elements are completed in the second phase of work.

Exhibit X-2 outlines the timeline and sequencing of this multi-project phased approach.

This approach has been incorporated into the overall Critical Applications Replacement Program work plan presented to the Washington State Legislature. Under the proposed Critical Applications Replacement Program work plan, Phase I would begin in July 2010 with Acquisition phase activities including defining detailed requirements for the Traffic Analysis software, preparing the RFP and selecting the solution vendor. This work would be performed by internal WSDOT resources. The Implementation phase would be initiated in July 2011, with a go-live in the fall of 2011.

Phase II would be initiated beginning in July 2011. Acquisition phase activities including defining detailed requirements, preparing RFPs and selecting the systems integrator and best of breed software solutions would occur between July 2011 and June 2012, with assistance from a Requirements and RFP consultant. Implementation Phase activities would be initiated in July 2012, with a go-live in the spring of 2014.

Exhibit X-3 illustrates the proposed overall Critical Applications Replacement Program schedule and the relative timeline for the two phases of the Transportation Asset Management solution within this overall program work plan.

Exhibit X-2: Proposed Schedule for Transportation Asset Management Solution under a Multi-Project Deployment Approach

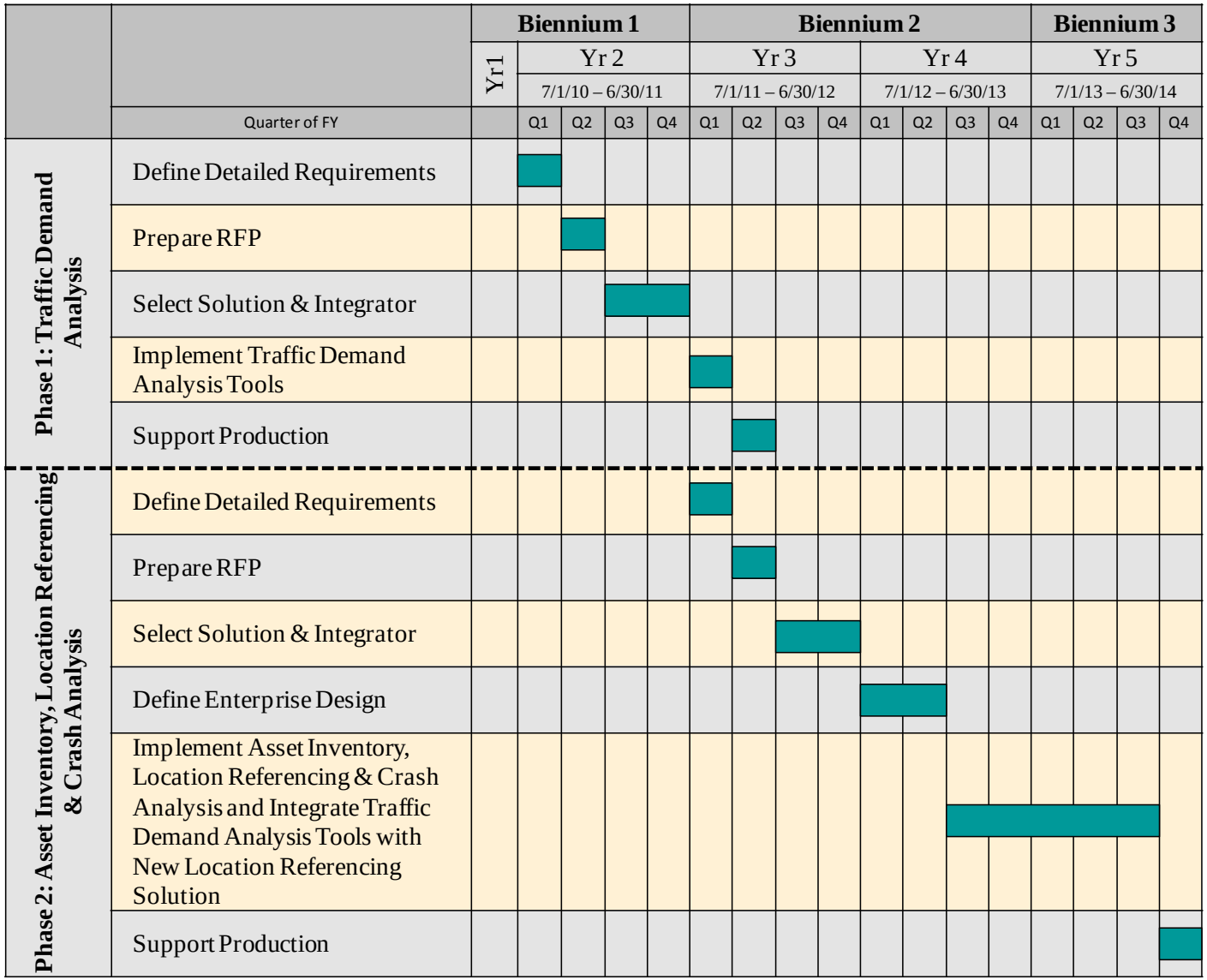
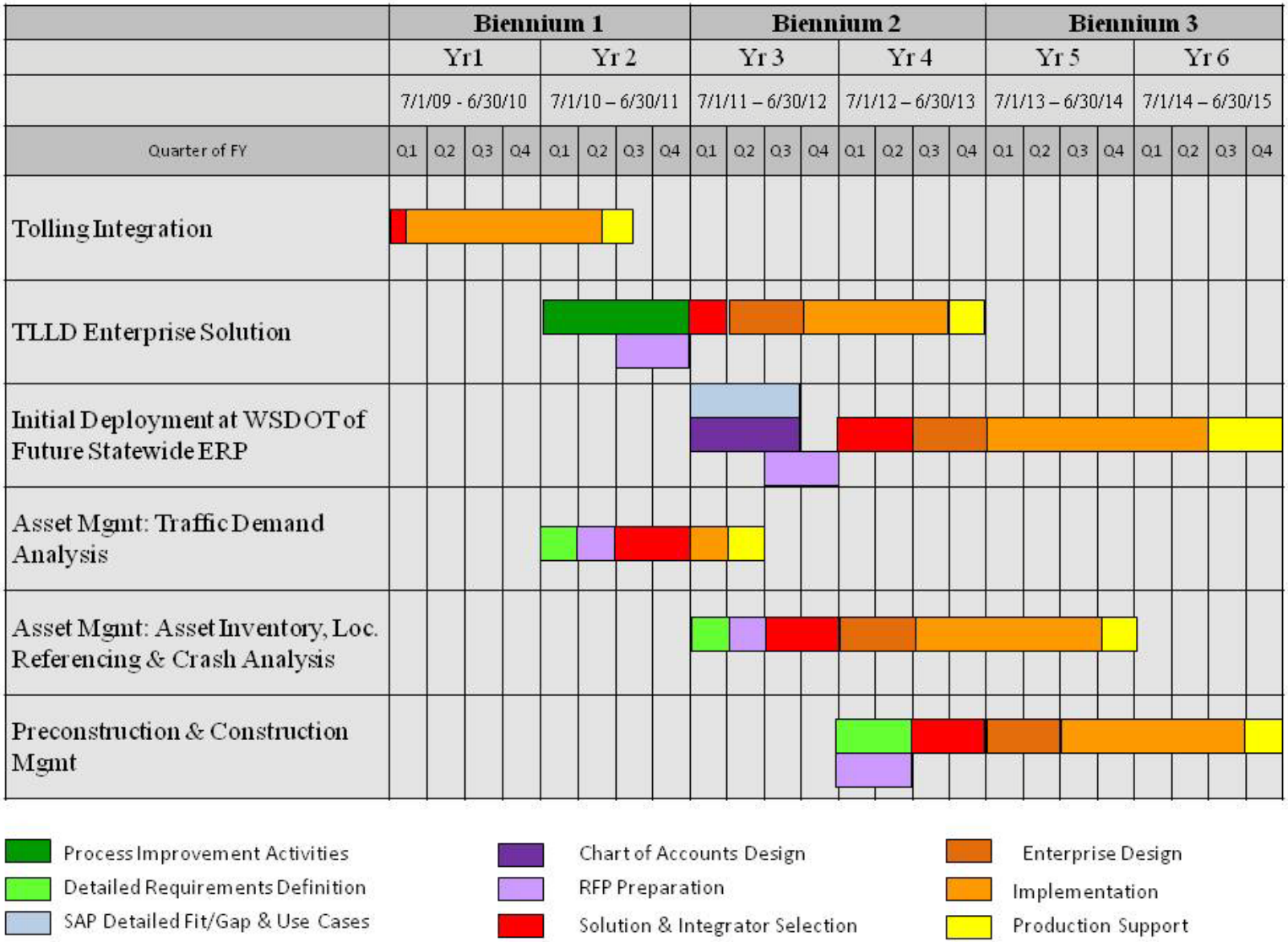


Exhibit X-3: Proposed Schedule for Critical Applications Replacement Program Illustrating the Suggested Timeline for Implementing the Two Phases of the Transportation Asset Management Solution



C. Project Staffing

The Transportation Asset Management solution project effort will require the following types of resources

- A contracted Program Manager/Project Manager with extensive experience implementing asset management and other engineering management systems in state transportation agencies or similar, complex organizations.

- A consulting firm to assist with finalizing the detailed requirements, preparing the request for proposal (RFP) and facilitating the software selection process that has substantial experience in preparing RFPs and assisting state transportation agencies and other similar organizations to procure and select asset management and other engineering management software solutions.

- A consulting firm to provide quality assurance and independent, verification and validation services that has significant experience in performing these types of services for the implementation of best of breed software solutions for state departments of transportation and other state agencies.

- A systems integrator or systems integrator team with experience implementing their proposed best of breed solution set and experience with custom developing Location Referencing Systems (if a custom approach is proposed by the systems integrator). The types of resources that will be required from the systems integrator include:

  - Project management

  - Functional consultants to configure best of breed modules

  - Technical Lead to oversee any software development and the technical infrastructure

  - Database administrator(s) experienced with the proposed best of breed solutions

  - Designers and developers to design, code and unit test any custom components, any required custom program extensions to best of breed solutions, interfaces with existing systems and data conversions routines

- State staff including:

  - WSDOT Business Lead

  - WSDOT subject matter experts with experience in asset inventory, traffic analysis, crash analysis and location referencing

  - Additional extended WSDOT stakeholders in each of the four business functions on an as needed basis

- Technical Lead to work with the systems integrator and assume ownership for the custom components of the solution and the technical infrastructure following implementation

- Database Administrator(s)

- Developers familiar with the existing WSDOT systems to code/test data conversion export programs

- Developers familiar with existing WSDOT line of business systems to code imports to or extracts from these systems for required interfaces

- Developers familiar with the SAP ERP application to code/test use of the location referencing service module (this skill set could possibly be provided by the ERP systems integrator)

- Test Lead and testers to plan and perform system testing and lead user acceptance testing

- Agency Readiness Lead to guide organizational change management and other activities to plan and support deployment

- Additional staff as needed to support organizational change management and agency readiness activities such as training

- WSDOT user champions on a part-time basis

XI. Cost Benefit Analysis

This section outlines the cost benefit analysis for the Transportation Asset Management project. It outlines the assumptions used to prepare the cost estimate for each alternative and the assumptions about the anticipated quantifiable benefit streams from the project. A summary of the return on investment analysis for each alternative is then presented. The detailed cost benefit analysis for each alternative following the DIS templates is provided in Appendices D-F.

A. Cost Estimate Assumptions

The following assumptions were utilized to develop the cost estimates for the three alternatives for proceeding with the Transportation Asset Management project. Unless specifically noted, assumptions apply to all three of the alternatives evaluated.

1. Project Scope

The scope of the project for cost estimating purposes was assumed to include the following elements:

- Implementation of Location Referencing System, Traffic Analysis and Crash Analysis components
- Implementation of the Asset Inventory capabilities to provide the framework for WSDOT to establish an enterprise asset management program
- Migration at a minimum of the roadway inventory data currently housed in TRIPS into the Asset Inventory application
- Migration of some additional asset data beyond the roadway inventory data into the new Asset Inventory application to the extent this can be accomplished under the approved project budget. The specific asset types/classes beyond those currently in TRIPS will need to be established during the requirements definition phase. Likely candidates would include:
  - Asset data in other databases under development or maintained by TDO such as the culvert and roadside features inventory
  - Several asset classes/types for which the asset owners have requests pending for new systems
  - Mature asset classes/types whose data is currently stored in existing systems, resulting in reduced effort, cost and risk associated with data collection, data clean-up and data conversion

Migration of other asset classes/asset types not converted to the Asset Inventory application initially would occur over time as an on-going operational activity of the department. The cost for this migration of additional asset classes/types would represent an additional cost not included in the proposed project budget for the Transportation Asset Management solution.

2. Best of Breed Software

Assumptions related to commercial off the shelf solution (COTS) software include the following:

- A total cost of $150,000 was included in all three alternatives for the cost of acquiring best of breed Traffic Analysis software. This cost estimate was based on market research.

- A total cost of $200,000 was included in all three alternatives for the cost of acquiring best of breed Crash Analysis software. This cost estimate was based on market research.

- An estimated $750,000 was included in Alternative 2 for the cost of a best of breed Asset Inventory solution; a total cost of $950,000 was included in Alternative 3 for the cost of acquiring an integrated best of breed Asset Inventory and Location Referencing System solution. This cost estimate was developed through market research activities.

- In all three alternatives, the timing of the software acquisition cost was divided between the start-up of implementation activities where approximately 20% of the licenses are acquired and just prior to the deployment of the Transportation Asset Management application where the larger proportion of the licenses are acquired. This allows the state to better manage its cash flow and avoid paying maintenance on licenses it is not going to utilize during the development period. However, this approach will be subject to negotiation with each software vendor.

- Software licensing costs of 22% of the acquisition price are included in the cost estimate beginning in the year following the acquisition of the software. These costs are escalated 5% annually.

3. Hardware, Operating System Software, and Database Licenses

Assumptions in the cost estimates related to hardware, operating system software, and database licenses include the following:

- The cost of a new development instance and a new production instance was included in the cost of each alternative. This included hardware, operating system software, and Oracle and/or SQL Server database licenses.

- The development instance was assumed to be acquired at the start of the Implementation phase and the production instance just prior to deployment of the Transportation Asset Management application.

- Maintenance for the hardware, operating system software and database licenses was included at 20% of the acquisition price, beginning in the year following acquisition. These costs are escalated 5% annually.

- A total cost of $80,000 was included in the cost estimate for each alternative to support establishment of a disaster recovery environment. It is assumed that this environment is shared with other applications.

- A total cost of $800,000 was included in the estimate in Year 8 of the analysis period for a hardware refresh.

4. Systems Integration and Other Professional Services

Assumptions related to systems integration and other professional services costs include the following:

- A multi-project implementation approach was assumed with Traffic Analysis implemented in the first project and Asset Inventory, Location Referencing System and Crash Analysis implemented in the second project effort. This project schedule is discussed in Section IX.B.

- A total cost of $175,000 was included for the cost of a consultant to develop detailed system requirements, prepare the RFP, and facilitate the selection process for the Asset Inventory, Crash Analysis, and Location Referencing system components in the second project effort. It is assumed requirements are developed internally for the Traffic Analysis project.

- Costs were also included for a contracted state program manager and a quality assurance and independent, verification and validation consultant for the Asset Inventory, Crash Analysis, and Location Referencing system components. These costs were not included for the smaller Traffic Analysis project.

- Systems integrator costs were established based on the estimated level of effort for each alternative and competitive rates for the skill sets needed in each alternative.

- State staff was included in the cost estimate for each alternative at the levels of participation required for each alternative. The cost of state staff was determined by using either the current state information technology or engineering salary scales, escalated by 5% annually. No costs were included for assisting business units with replacing staff members assigned to the project team since it is assumed the person's current position is already in the business unit's budget.

- The cost of one software upgrade in Years 7 and 8 is included in the cost of each alternative. The actual costs of this upgrade vary by alternative based on the extent of customizations and the mix of internal and external resources required to perform the work.

5. Other Costs

Other cost assumptions include:

- Debt service cost was estimated based on utilizing ten year certificates of participation (COP) at 6.25% interest. It assumes the sale of COP's each year during the Implementation phase of the project for eligible expenses to be incurred during that year.
- No costs were included for facilities for the Implementation phase of the project. It is assumed project staff can be accommodated in existing WSDOT facilities.
- A total of $50,000 was included for WSDOT and other state staff assigned to the project to attend training on the various best of breed modules. A total of $10,000 was allocated to the Traffic Analysis software and the balance to the other components.

B. Benefit Stream Assumptions

The primary quantitative benefits include the following:

- Better and more informed project programming decisions through enhanced needs identification, project scoping, project prioritization and selection tools. This will provide WSDOT the opportunity to fund additional projects within the WSDOT transportation program through reducing the cost of program delivery by improved project scoping and selection processes. This is a result of projects being programmed with more cost effective solutions to meet the identified needs, better cost estimates and risk identification. This benefit will be partially provided by the enhanced Asset Inventory and analysis tools, more robust Crash Analysis tools and enhanced Traffic Analysis tools, in combination with enhanced needs identification and project scoping tools to be included in the proposed ERP application as part of the overall Critical Applications Replacement Program.

- Improved lifecycle asset cost management through enhanced asset management tools and implementation of an enterprise asset management business model. The improved tools will provide WSDOT with a better understanding of the current conditions of assets and the ability to make more effective replace/maintain decisions. This will help redirect both capital budget and maintenance budget dollars to highest priority needs, resulting in the ability to perform more work within the existing WSDOT preservation and maintenance budgets.

- Enhanced automation which reduces TDO data entry efforts and the potential for errors and associated error correction efforts.

- Improved access to information, reducing the staff effort to perform research and improving the quality of the information available for management and policy maker decision making. This will allow WSDOT to redirect staff time across the department into additional analytical and other higher value activities. This benefit will be provided by replacing TRIPS and other standalone asset inventory applications with a single asset inventory application, by more robust analysis tools and by providing select partners some access to these tools and data.

- Decommissioning of the WSDOT mainframe after replacing TRIPS and the other Critical Applications will allow WSDOT the opportunity to redirect costs spent to operate the mainframe to other information technology applications. The replacement of TRIPS provides a part of this benefit stream.

- A simplified IT environment resulting from the elimination of a number of standalone asset management and related systems. This will allow WSDOT to redirect information technology staff time to increase the level of service provided for other line of business information technology systems.

- Reduction in tort claims due to improved project selection mechanism, which will allow WSDOT to better concentrate efforts on road segments with the most significant safety related issues. This will provide an opportunity to reduce the cost of tort claims and attorneys fees paid each year.

Exhibit XI-1 outlines the assumptions used to determine the anticipated benefit streams for each of these quantified benefits. This exhibit explains the basis for estimating each anticipated benefit stream and the approach assumed for phasing-in the benefit stream following go-live of the second Transportation Asset Management project phase.

Exhibit XI-1: Inventory of Quantifiable Benefits and Assumptions

Anticipated Benefit	Projected Benefit Stream	Estimating Methodology	Estimated Annual Benefit	Phase-In Assumption for Benefit Stream
Better and more informed project programming decisions through enhanced needs identification, project scoping, project prioritization and selection tools	Opportunity to fund additional projects within the WSDOT transportation program by reducing the cost of program delivery through improved project scoping and selection processes that result in projects being programmed with more cost effective solutions to meet the identified needs, better cost estimates and risk identification	½% of an average $800 million annual construction program; 20% of this savings attributable to Transportation Asset Management and the remainder to the proposed ERP solution	20% of $4,000,000 estimated annual savings or $800,000 per year	0% first year after go-live; 20% second year after go-live; 50% third year after go-live; 70% fourth year after go-live and 100% thereafter
Improved lifecycle asset cost management through enhanced asset management tools including lifecycle cost modeling, needs identification, trade-off analysis, and performance-based budgeting capabilities	Opportunity to redirect maintenance budget dollars to highest priority needs through a better understanding of the current conditions of assets and the ability to more effectively make replace/maintain decisions	½% of WSDOT's annual $400 million highway maintenance program; 50% of this attributable to Transportation Asset Management and 50% of this attributable to the proposed ERP solution	50% of $2,000,000 estimated annual savings or $1,000,000 per year	0% first year after go-live; 20% second year after go-live; 50% third year after go-live; 70% fourth year after go-live and 100% thereafter
Redirection of staff currently performing manual data entry, data validation and correction to analysis activities Enhanced automation which reduces TDO data entry efforts and the potential for errors and associated error correction efforts	Enhanced automation reduces TDO data entry efforts and the potential for errors and associated error correction efforts allowing redirection of staff time to other activities	0.5 FTE at an average fully loaded salary of $95,000, escalated 2% per year	$76,500 per year	50% first year after go-live and 100% thereafter

Anticipated Benefit	Projected Benefit Stream	Estimating Methodology	Estimated Annual Benefit	Phase-In Assumption for Benefit Stream
Redirection of some staff time currently in TDO and various business units performing research and analysis activities into other program specific work	Improved access to information reduces the staff effort to perform research and improving the quality of the information available for management and policy maker decision making. This will allow WSDOT to redirect staff time across the department into additional analytical and other higher value activities. This benefit will be provided by replacing TRIPS and other standalone asset inventory applications with a single asset inventory application, by more robust analysis tools and by providing select partners some access to these tools and data	0.5 FTE at an average fully loaded salary of $95,000, escalated 2% per year	$83,000 per year	50% first year after go-live and 100% thereafter
Decommissioning of the WSDOT mainframe after replacing TRIPS and the other Critical Applications will allow WSDOT the opportunity to redirect costs spent to operate the mainframe to other information technology applications. The replacement of TRIPS provides a part of this benefit stream.	The elimination of the WSDOT mainframe after replacing TRIPS and the other Critical Applications will allow WSDOT the opportunity to redirect costs spent to operate the mainframe to other information technology applications. The replacement of TRIPS provides a part of this benefit stream.	$4.5 million annual cost, 10% attributable to TRIPS or $450,000 escalated at 2% per year	$450,000 per year	50% first year and 100% thereafter
Redirection of cost currently spent maintaining various asset management applications	A simplified IT environment resulting from the elimination of TRIPS and a number of standalone asset management and related systems. This will allow WSDOT to redirect information technology staff time to increase the level of service provided for other line of business information technology systems.	1.5 FTEs at an average loaded salary of $94,500, escalated 2% per year	$141,750 per year	50% first year and 100% thereafter

Anticipated Benefit	Projected Benefit Stream	Estimating Methodology	Estimated Annual Benefit	Phase-In Assumption for Benefit Stream
Cost avoidance in tort claim payments and attorneys fees	Reduction in tort claims due to improved project selection mechanism, which will allow WSDOT to better concentrate efforts on road segments with the most significant safety related issues. This will provide an opportunity to reduce the cost of tort claims and attorneys fees paid each year.	5% savings in average $4.9 million in claims and $2.0 million in attorney fees paid over the last three fiscal years	$345,000 per year	0% first year after go-live; 20% second year after go-live; 50% third year after go-live; 70% fourth year after go-live and 100% thereafter

In addition to these quantifiable benefits, there are also a number of intangible benefits associated with the Transportation Asset Management solution. These intangible benefits are outlined in Section III.C.2.

C. Summary of Return on Investment

Exhibit XI-2 outlines the anticipated return on investment for each of the three alternatives. This cost benefit analysis analyzed the development and operational costs and anticipated benefits for a period of ten years from project initiation.

Exhibit XI-2: Anticipated Return on Investment for Alternatives Analyzed

Element	Alternative 1	Alternative 2	Alternative 3
Cost to Develop – Pay as You Go	$18.6 million	$18.1 million	$18.2 million
Cost to Develop – Financed	$22.2 million	$21.6 million	$21.7 million
Total Cost of Ownership through June 30, 2020 – Pay as You Go	$27.7 million	$27.7million	$28.0 million
Total Cost of Ownership through 30, 2020 - Financed	$31.3 million	$31.2 million	$31.5 million
Net Payback - Pay As You Go	($15.9 million)	($15.9 million)	($16.2 million)

D. Cost Benefit Analysis – Alternative 1

This subsection provides a summary of the cost benefit analysis for Alternative 1 assuming a pay as you go approach. Exhibit XI-3 outlines the estimated cost to develop Alternative 1. Exhibit XI-4 outlines the cost of ownership for Alternative 1 over a ten year period. Exhibit XI-5 depicts the estimated payback for Alternative 1 on a pay as you go basis over a ten year period.

The DIS cost benefit analysis forms for Alternative 1 are included in Appendix D.

Exhibit XI-3: Alternative 1 – Summary of Development Costs (Pay as You Go)

	Total	Year 1	Year 2	Year 3	Year 4
Implementation Services	$ 8,270,961	$ -	$ 270,342	$ 3,825,995	$4,174,624
RFP Preparation and Procurement Support	$ 175,000	$ -	$ 175,000	$ -	$ -
Program Management	$ 612,480	$ -	$ 105,600	$ 253,440	$ 253,440
Quality Assurance	$ 479,820	$ -	$ 66,000	$ 211,200	$ 202,620
Software Licenses and Maintenance	$ 358,800	$ -	$ 150,000	$ 40,000	$ 168,800
Technical Infrastructure (Hardware, OS, DB Licenses, etc.)	$ 690,000	$ -	$ 300,000	$ 50,000	$ 340,000
Facilities for Project Team	$ -	$ -	$ -	$ -	$ -
Training for State Staff	$ 50,000	$ -	$ 10,000	$ 40,000	$ -
End User Training	$ 480,010	$ -	$ 42,550	$ -	$ 437,460
Data Processing Costs	$ 200,000	$ -	$ -	$ 50,000	$ 150,000
Subtotal: External Costs	**$ 11,317,071**	**$ -**	**$ 1,119,492**	**$ 4,470,635**	**$5,726,944**
Salaries and Benefits of State Employees Assigned to Project	$ 4,169,103	$ 34,332	$ 413,630	$ 1,874,315	$1,846,826
Subtotal: Estimated Project Costs Less Contingency	**$ 15,486,173**	**$ 34,332**	**$ 1,533,122**	**$ 6,344,950**	**$7,573,769**
Contingency at 20%	$ 3,097,235	$ 6,866	$ 306,624	$ 1,268,990	$1,514,754
Total Estimated Project Cost:	**$ 18,583,408**	**$41,198**	**$ 1,839,747**	**$ 7,613,940**	**$9,088,523**

Exhibit XI-4: Alternative 1 - Estimated Total Cost of Ownership (Pay as You Go)

	Total	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Software Acquisition	$ 350,000	$ -	$ 150,000	$ 40,000	$160,000	$ -	$ -	$ -	$ -	$ -	$ -
Ongoing Software Licensing	$ 626,198	$ -	$ -	$ 33,000	$ 43,450	$80,823	$ 84,864	$ 89,107	$ 93,562	$ 98,240	$ 103,152
Hardware Acquisition	$1,455,000	$ -	$ 300,000	$ 50,000	$330,000	$ -	$ -	$ -	$ 775,000	$ -	$ -
Hardware Maintenance	$1,161,648	$ -	$ -	$ 60,000	$ 73,000	$142,650	$ 149,783	$ 157,272	$ 165,135	$ 201,858	$ 211,951
Implementation Services											
System Requirements and RFP Consultant	$ 175,000	$ -	$ 175,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Implementation Vendor	$8,270,961	$ -	$ 270,342	$3,825,995	$4,174,624	$ -	$ -	$ -	$ -	$ -	$ -
Program Mgmt Support	$ 612,480	$ -	$ 105,600	$ 253,440	$ 253,440	$ -	$ -	$ -	$ -	$ -	$ -
Quality Assurance	$ 479,820	$ -	$ 66,000	$ 211,200	$ 202,620	$ -	$ -	$ -	$ -	$ -	$ -
Facilities for Project Team	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Training for State Team Members	$ 50,000	$ -	$ 10,000	$ 40,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -
End User Training	$ 480,010		$ 42,550		$ 437,460						
Internal Transportation Asset Management Core Team Base Pay & Benefits	$4,169,103	$ 34,332	$413,630	$1,874,315	$1,846,826	$ -	$ -	$ -	$ -	$ -	$ -
Data Processing Services	$1,692,364	$ -	$ 20,000	$ 92,000	$ 194,100	$203,805	$ 213,995	$ 224,695	$ 235,930	$ 247,726	$ 260,113
Ongoing System Maintenance - Base Pay and Benefits	$3,864,088	$ -	$ 31,388	$ 57,615	$ 60,496	$571,988	$ 568,731	$ 597,168	$ 627,026	$ 658,378	$ 691,297
Software Upgrade	$1,215,720	$ -	$ -	$ -	$ -	$ -	$ -	$1,215,720	$ -	$ -	$ -
Other Operational Expenses	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Subtotal: Cost of Ownership	$24,602,391	$ 34,332	$1,584,510	$6,537,565	$7,776,015	$999,266	$1,017,373	$2,283,962	$1,896,654	$1,206,202	$ 1,266,512
Contingency @ 20% for Project Costs	$ 3,097,235	$ 6,866	$ 306,624	$1,268,990	$1,514,754	$ -	$ -	$ -	$ -	$ -	$ -
Total Estimated Cost of Ownership - State	$27,699,625	$ 41,198	$1,891,135	$7,806,555	$9,290,769	$999,266	$1,017,373	$2,283,962	$1,896,654	$1,206,202	$ 1,266,512

Exhibit XI-5: Alternative 1 – Estimated Payback (Pay as You Go)

	Total	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Estimated Annual Costs Including Project Contingency	$27,699,625	$41,198	$1,891,135	$7,806,555	$9,290,769	$999,266	$1,017,373	$2,283,962	$1,896,654	$1,206,202	$1,266,512
Anticipated Annual Benefit Streams	$11,760,832	$ -	$ -	$ -	$ -	$590,250	$1,174,110	$1,832,512	$2,276,712	$2,935,717	$2,951,531
Net Payback	($15,938,793)	($41,198)	($1,891,135)	($7,806,555)	($9,290,769)	($409,016)	$156,737	($451,449)	$380,059	$1,729,515	$1,685,019
Cumulative Payback		($41,198)	($1,932,333)	($9,738,888)	($19,029,657)	($19,438,673)	($19,281,936)	($19,733,385)	($19,353,326)	($17,623,812)	($15,938,793)

E. Cost Benefit Analysis – Alternative 2

This subsection provides a summary of the cost benefit analysis for Alternative 2 assuming a pay as you go approach. Exhibit XI-6 outlines the estimated cost to develop Alternative 2. Exhibit XI-7 outlines the cost of ownership for Alternative 2 over a ten year period. Exhibit XI-8 depicts the estimated payback for Alternative 2 over a ten year period. The DIS cost benefit analysis forms for Alternative 2 are included in Appendix E.

Exhibit XI-6: Alternative 2 – Summary of Development Costs (Pay as You Go)

	Total	Year 1	Year 2	Year 3	Year 4
Implementation Services	$7,105,401	$0	$270,342	$3,436,145	$3,398,914
RFP Preparation and Procurement Support	$175,000	0	175,000	0	0
Program Management	$612,480	0	105,600	253,440	253,440
Quality Assurance	$479,820	0	66,000	211,200	202,620
Software Licenses and Maintenance	$1,141,800	0	150,000	190,000	801,800
Technical Infrastructure (Hardware, OS, DB Licenses, etc.)	$690,000	0	300,000	50,000	340,000
Facilities for Project Team	$0	0	0	0	0
Training for State Staff	$50,000	0	10,000	40,000	0
End User Training	$480,010	0	42,550	0	437,460
Data Processing Costs	$200,000	0	0	50,000	150,000
Subtotal: External Costs	**$10,934,511**	**$0**	**$1,119,492**	**$4,230,785**	**$5,584,234**
Salaries and Benefits of State Employees Assigned to Project	4,169,103	34,332	413,630	1,874,315	1,846,826
Subtotal: Estimated Project Costs Less Contingency	**$15,103,613**	**$34,332**	**$1,533,122**	**$6,105,100**	**$7,431,059**
Contingency at 20%	3,020,723	6,866	306,624	1,221,020	1,486,212
Total Estimated Project Cost:	**$18,124,336**	**$41,198**	**$1,839,747**	**$7,326,120**	**$8,917,271**

Exhibit XI-7: Alternative 2 – Estimated Total Cost of Ownership (Pay as You Go)

	Total	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Software Acquisition	$ 1,100,000	$ -	$ 150,000	$ 190,000	$ 760,000	$ -	$ -	$ -	$ -	$ -	$ -
Ongoing Software Licensing	$ 1,792,736	$ -	$ -	$ 33,000	$ 76,450	$ 247,473	$ 259,846	$ 272,838	$ 286,480	$ 300,804	$ 315,845
Hardware Acquisition	$ 1,455,000	$ -	$ 300,000	$ 50,000	$ 330,000	$ -	$ -	$ -	$ 775,000	$ -	$ -
Hardware Maintenance	$ 1,161,648	$ -	$ -	$ 60,000	$ 73,000	$ 142,650	$ 149,783	$ 157,272	$ 165,135	$ 201,858	$ 211,951
Implementation Services											
System Requirements and RFP Consultant	$ 175,000	$ -	$175,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Implementation Vendor	$ 7,105,401	$ -	$270,342	$3,436,145	$3,398,914	$0	$0	$0	$0	$0	$0
Program Mgmt Support	$ 612,480	$ -	$105,600	$253,440	$ 253,440	$ -	$ -	$ -	$ -	$ -	$ -
Quality Assurance	$ 479,820	$ -	$ 66,000	$ 211,200	$ 202,620	$ -	$ -	$ -	$ -	$ -	$ -
Facilities for Project Team	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Training for State Team Members	$ 50,000	$ -	$ 10,000	$ 40,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -
End User Training	$ 480,010		$42,550		$437,460						
Internal Transportation Asset Management Core Team Base Pay & Benefits	$ 4,169,103	$ 34,332	$ 413,630	$1,874,315	$1,846,826	$ -	$ -	$ -	$ -	$ -	$ -
Data Processing Services	$ 1,692,364	$ -	$ 20,000	$ 92,000	$ 194,100	$ 203,805	$ 213,995	$ 224,695	$ 235,930	$ 247,726	$ 260,113
Ongoing System Maintenance - Base Pay and Benefits	$ 3,190,855	$ -	$ 31,388	$ 57,615	$ 60,496	$ 473,011	$ 464,806	$ 488,046	$ 512,448	$ 538,071	$ 564,974
Software Upgrade	$ 1,215,720	$ -	$ -	$ -	$ -	$ -	$ -	$1,215,720	$ -	$ -	$ -
Other Operational Expenses	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Subtotal: Cost of Ownership	$24,680,137	$ 34,332	$1,584,510	$6,297,715	$7,633,305	$1,066,939	$1,088,430	$2,358,571	$1,974,994	$1,288,459	$1,352,882
Contingency @ 20% for Project Costs	$ 3,020,723	$ 6,866	$ 306,624	$1,221,020	$1,486,212	$ -	$ -	$ -	$ -	$ -	$ -
Total Estimated Cost of Ownership - State	$27,700,859	$ 41,198	$1,891,135	$7,518,735	$9,119,517	$1,066,939	$1,088,430	$2,358,571	$1,974,994	$1,288,459	$1,352,882

Exhibit XI-8: Alternative 2 – Estimated Payback (Pay as You Go)

	Total	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Estimated Annual Costs Including Project Contingency	$27,700,859	$41,198	$1,891,135	$7,518,735	$9,119,517	$1,066,939	$1,088,430	$2,358,571	$1,974,994	$1,288,459	$1,352,882
Anticipated Annual Benefit Streams	$11,760,832	$0	$0	0	0	590,250	1,174,110	1,832,512	2,276,712	2,935,717	2,951,531
Net Payback	($15,940,027)	($41,198)	($1,891,135)	($7,518,735)	($9,119,517)	($476,689)	$85,680	($526,059)	$301,719	$1,647,258	$1,598,649
Cumulative Payback		($41,198)	($1,932,333)	($9,451,068)	($18,570,585)	($19,047,274)	($18,961,594)	($19,487,653)	($19,185,934)	($17,538,676)	($15,940,027)

F. Cost Benefit Analysis – Alternative 3

This subsection provides a summary of the cost benefit analysis for Alternative 3 assuming a pay as you go approach. Exhibit XI-9 outlines the estimated cost to develop Alternative 3. Exhibit XI-10 outlines the cost of ownership for Alternative 3 over a ten year period. Exhibit XI-11 depicts the estimated payback for Alternative 3 over a ten year period. The DIS cost benefit analysis forms for Alternative 3 are included in Appendix F.

Exhibit XI-9: Alternative 3 – Summary of Development Costs (Pay as You Go)

	Total	Year 1	Year 2	Year 3	Year 4
Implementation Services	$7,000,701	$0	$270,342	$3,401,645	$3,328,714
RFP Preparation and Procurement Support	$175,000	0	175,000	0	0
Program Management	$612,480	0	105,600	253,440	253,440
Quality Assurance	$479,820	0	66,000	211,200	202,620
Software Licenses and Maintenance	$1,313,800	0	150,000	290,000	873,800
Technical Infrastructure (Hardware, OS, DB Licenses, etc.)	$690,000	0	300,000	50,000	340,000
Facilities for Project Team	$0	0	0	0	0
Training for State Staff	$50,000	0	10,000	40,000	0
End User Training	$480,010	0	42,550	0	437,460
Data Processing Costs	$200,000	0	0	50,000	150,000
Subtotal: External Costs	**$11,001,811**	**$0**	**$1,119,492**	**$4,296,285**	**$5,586,034**
Salaries and Benefits of State Employees Assigned to Project	4,169,103	34,332	413,630	1,874,315	1,846,826
Subtotal: Estimated Project Costs Less Contingency	**$15,170,913**	**$34,332**	**$1,533,122**	**$6,170,600**	**$7,432,859**
Contingency at 20%	3,034,183	6,866	306,624	1,234,120	1,486,572
Total Estimated Project Cost:	**$18,205,096**	**$41,198**	**$1,839,747**	**$7,404,720**	**$8,919,431**

Exhibit XI-10: Alternative 3 – Estimated Total Cost of Ownership (Pay as You Go)

	Total	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Software Acquisition	$ 1,250,000	$ -	$ 150,000	$ 290,000	$ 810,000	$ -	$ -	$ -	$ -	$ -	$ -
Ongoing Software Licensing	$ 2,046,682	$ -	$ -	$ 33,000	$ 98,450	$ 281,573	$ 295,651	$ 310,434	$ 325,955	$ 342,253	$ 359,366
Hardware Acquisition	$ 1,455,000	$ -	$ 300,000	$ 50,000	$ 330,000	$ -	$ -	$ -	$ 775,000	$ -	$ -
Hardware Maintenance	$ 1,161,648	$ -	$ -	$ 60,000	$ 73,000	$ 142,650	$ 149,783	$ 157,272	$ 165,135	$ 201,858	$ 211,951
Implementation Services											
System Requirements and RFP Consultant	$ 175,000	$ -	$175,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Implementation Vendor	$ 7,000,701	$ -	$270,342	$3,401,645	$3,328,714	$0	$0	$0	$0	$0	$0
Program Mgmt Support	$ 612,480	$ -	$105,600	$253,440	$ 253,440	$ -	$ -	$ -	$ -	$ -	$ -
Quality Assurance	$ 479,820	$ -	$ 66,000	$ 211,200	$ 202,620	$ -	$ -	$ -	$ -	$ -	$ -
Facilities for Project Team	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Training for State Team Members	$ 50,000	$ -	$ 10,000	$ 40,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -
End User Training	$ 480,010		$42,550		$437,460						
Internal Transportation Asset Management Core Team Base Pay & Benefits	$ 4,169,103	$ 34,332	$ 413,630	$1,874,315	$1,846,826	$ -	$ -	$ -	$ -	$ -	$ -
Data Processing Services	$ 1,692,364	$ -	$ 20,000	$ 92,000	$ 194,100	$ 203,805	$ 213,995	$ 224,695	$ 235,930	$ 247,726	$ 260,113
Ongoing System Maintenance - Base Pay and Benefits	$ 3,190,855	$ -	$ 31,388	$ 57,615	$ 60,496	$ 473,011	$ 464,806	$ 488,046	$ 512,448	$ 538,071	$ 564,974
Software Upgrade	$ 1,215,720	$ -	$ -	$ -	$ -	$ -	$ -	$1,215,720	$ -	$ -	$ -
Other Operational Expenses	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Subtotal: Cost of Ownership	$24,979,382	$ 34,332	$1,584,510	$6,363,215	$7,635,105	$1,101,039	$1,124,235	$2,396,166	$2,014,469	$1,329,908	$1,396,403
Contingency @ 20% for Project Costs	$ 3,034,183	$ 6,866	$ 306,624	$1,234,120	$1,486,572	$ -	$ -	$ -	$ -	$ -	$ -
Total Estimated Cost of Ownership - State	$28,013,565	$ 41,198	$1,891,135	$7,597,335	$9,121,677	$1,101,039	$1,124,235	$2,396,166	$2,014,469	$1,329,908	$1,396,403

Exhibit XI-11: Alternative 3 – Estimated Payback (Pay as You Go)

	Total	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Estimated Annual Costs Including Project Contingency	$28,013,565	$41,198	$1,891,135	$7,597,335	$9,121,677	$1,101,039	$1,124,235	$2,396,166	$2,014,469	$1,329,908	$1,396,403
Anticipated Annual Benefit Streams	$11,760,832	$0	$0	0	0	590,250	1,174,110	1,832,512	2,276,712	2,935,717	2,951,531
Net Payback	($16,252,732)	($41,198)	($1,891,135)	-$7,597,335	-$9,121,677	-$510,789	$49,875	-$563,654	$262,244	$1,605,809	$1,555,128
Cumulative Payback		($41,198)	($1,932,333)	($9,529,668)	($18,651,345)	($19,162,134)	($19,112,259)	($19,675,913)	($19,413,669)	($17,807,860)	($16,252,732)

G. Cash Flow Analysis for Preferred Alternative 2

This subsection provides a summary of the anticipated cash flow for preferred Alternative 2 if the state chose to finance eligible expenses. For planning purposes, the study team assumed three sales of Certificates of Participation with a 10 year term, monthly payments, and a 6.25% interest rate. One sale was in Year 2 and one sale was in Year 3 and one sale in Year 4 for the eligible expenses in those years. Exhibit XI-12 depicts the cash flow requirements over the period of the bonds.

Exhibit XI-12: Alternative 2 – Cash Flow Analysis If Financed

			Total	Total	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
					7/1/2010	7/1/2011	7/1/2012	7/1/2013	7/1/2014	7/1/2015
Project Costs Not Financed				$8,094,835	$41,198	$947,805	$3,185,335	$3,920,497	0	0
Principal and Interest - External Services	Borrowed Amt	Payment								
Bond Sale 1 - Year 2	891,942	10,015	1,201,768		0	120,177	120,177	120,177	120,177	120,177
Bond Sale 2 - Year 3	4,140,785	46,493	5,579,132			0	557,913	557,913	557,913	557,913
Bond Sale 3 - Year 4	4,996,774	56,104	6,732,458				0	673,246	673,246	673,246
Subtotal: Debt Service				$13,513,358	$0	$120,177	$678,090	$1,351,336	$1,351,336	$1,351,336
Total Project Cost				$21,608,194	$41,198	$1,067,982	$3,863,425	$5,271,833	$1,351,336	$1,351,336

			Total	Total	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13
					7/1/2016	7/1/2017	7/1/2018	7/1/2019	7/1/2020	7/1/2021	7/1/2022
Project Costs Not Financed				$8,094,835	0	0	0	0	0	0	0
Principal and Interest - External Services	Borrowed Amt	Payment									
Bond Sale 1 - Year 2	891,942	10,015	1,201,768		120,177	120,177	120,177	120,177	120,177	0	0
Bond Sale 2 - Year 3	4,140,785	46,493	5,579,132		557,913	557,913	557,913	557,913	557,913	557,913	0
Bond Sale 3 - Year 4	4,996,774	56,104	6,732,458		673,246	673,246	673,246	673,246	673,246	673,246	673,246
Subtotal: Debt Service				$13,513,358	$1,351,336	$1,351,336	$1,351,336	$1,351,336	$1,351,336	$1,231,159	$673,246
Total Project Cost				$21,608,194	$1,351,336	$1,351,336	$1,351,336	$1,351,336	$1,351,336	$1,231,159	$673,246

XII. Risk Management

This section identifies potential organizational and technical risks to project success, establishes the probability of these risks occurring, and delineates potential mitigation strategies to address these risks. This risk assessment is performed first at the detailed level and then summarized following DIS' Portfolio-based Severity and Risk matrix. Based on this risk assessment, the recommended quality assurance strategy for the project is then detailed.

A. Risk Management Objectives

The objectives of project risk management are to decrease the probability and impact of events adverse to the project. Risk management begins during project planning and continues throughout the lifecycle of the project. Any assumptions made in the development of a plan, schedule, or resource allocation should be considered for documentation as a risk. Factors external to the project may also have an impact on the team's ability to deliver, and should be included.[2]

B. Risk Management Process

The following steps have been utilized to identify, assess impact, and define mitigation strategies for the Transportation Asset Management project.

- **Risk Identification** - This is the process of identifying risks that could affect the project and their characteristics. For the Transportation Asset Management project, several techniques were utilized to identify potential risks including the experience of the consultant team, informal discussions with the Transportation Asset Management Work Group, and discussions with various project stakeholders. Each identified risk was then documented in a risk log. For each risk that was identified, the team classified the risk as either business, organizational, or technical. The risk is also classified as internal (under the control of WSDOT or the project team) or external (the result of factors over which the project has limited to no control).

- **Risk Analysis and Prioritization** - For each risk that was identified, the team then assessed the probability of occurrence using a standard probability scale (from 0.1 to 1.0) and the level of impact using a standard impact assessment matrix (from 1 to 10 based on team member judgment) in the event that the risk does occur. The product of probability and the impact yielded the risk score that will help to determine risk planning. Risks that have a risk score of 6.0 or higher are considered "High" risk, those with a risk score between 2.5 and 6.0 are considered "Medium" risk, and those with a risk score less than 2.5 are considered "Low" risk.

- **Risk Planning** - This step involved identifying an owner of the risk and devising a risk response plan for handling each of the high-priority risks identified in risk

[2] Partially adapted from A Guide to the Project Management Body of Knowledge (**PMBOK**® Guide) Fourth Edition

analysis and prioritization. During the feasibility study, this activity primarily involved iterative discussion with the Transportation Asset Management Work Group. Going forward, it is expected that this will be an on-going process involving the Critical Applications Replacement Program Office, the Transportation Asset Management Project Executive, the Transportation Asset Management project sub-committee, the Transportation Asset Management project managers, and project team members. Guidance may also be received from the quality assurance consultant.

- **Risk Control and Monitoring** - This step includes executing the appropriate risk response plan during the project lifecycle to reduce the probability of a risk occurring or to mitigate its impact should it occur. This includes monitoring the progress in handling all risks that have occurred and continuing to identify and assess new risks that may emerge throughout the project.

For purposes of the feasibility study, the risks have been categorized into either business/organizational risks or technical risks. Each of these risk categories is described below and the various risks identified in each category are inventoried, prioritized, and appropriate risk response strategies identified.

C. Business/Organizational Risks

This subsection identifies business and organizational risks associated with the proposed Transportation Asset Management project. The impact of any identified risks is assessed and potential risk response strategies are defined for each of these risks. Business risks include those risks that impact the existing WSDOT business operations. For example, risks in this category could include items such as the need to change existing processes and procedures, the need for organizational change management, and the need to implement standardized processes.

Organizational risks relate to the impact of the project on WSDOT's organization and the organization of other partners such as MPOs involved in the project. Issues that should be considered in this regard include items such as:

- Level of executive and staff support for the change being proposed
- Agency's demonstrated ability to manage projects of this size and complexity
- Skills and experience available to implement this approach
- Agency's ability to manage internal and external (contractor) staff
- Number of users impacted
- Level of training that might be required
- Length of time WSDOT has to complete the project or implement an alternative

Exhibit XII-1 highlights the high and medium business and organizational risks identified to date for the Transportation Asset Management project. The risk score for the items rated as high risk are highlighted in red and the risk score for the items rated as medium risk are highlighted in yellow.

Exhibit XII-1: Risk Register Log for Business and Organizational Risks

Risk ID	Risk Description	Risk Classification Internal External	Proba-bility 0.1 – 1.0	Impact 1 - 10	Risk Score (PxI)	Risk Owner	Response (Accept / Avoid / Mitigate / etc.)	Risk Response Strategy and Notes
ORG01	A change in WSDOT priorities may cause a delay in obtaining funding for implementation phase	External	0.7	10	7.0	Program Steering Committee and Project Sub-committee	Avoid & Accept	• Active engagement with stakeholders and policy makers to obtain approval • Revisit budgets at each steering committee meeting; economic factors should be on agenda for discussion where appropriate. • Adjust project schedule as necessary based on timing of funding • Identify activities that could continue in the interim (process analysis, etc.) to maintain momentum
ORG02	Less funding than requested is approved for the implementation phase	External	0.7	10	7.0	Program Steering Committee and Project Sub-Committee	Avoid & Accept	• Active engagement with stakeholders and policymakers to obtain approval • Revisit budgets at each steering committee meeting; economic factors should be on agenda for discussion where appropriate. • Adjustments in scope and/or project schedule as necessary based on timing of funding
BUS01	Specialized requirements or significant gaps identified	External	0.7	8	5.6	Project Sub-committee and Project Managers	Avoid and Mitigate	• Assess potential for modifying business processes slightly • Assess need for additional best of breed software and/or minor customizations • Consider custom solution for some elements (location referencing system)

Risk ID	Risk Description	Risk Classification Internal External	Proba-bility 0.1 – 1.0	Impact 1 - 10	Risk Score (PxI)	Risk Owner	Response (Accept / Avoid / Mitigate / etc.)	Risk Response Strategy and Notes
BUS02	Potential that WSDOT stakeholders will not be able to agree on the best of breed solution(s) that best fits the need of WSDOT due to different priorities in various business units	Internal	0.5	10	5.0	Project Sub-committee	Avoid	• The extended stakeholder team should work together on developing detailed requirements • Vendor demos during the Acquisition Planning phase prior to the formal RFP to try to identify potential differences in requirements and/or expectations early on • Careful attention to evaluation factors to ensure weighting is consistent with WSDOT business priorities
BUS03	Desired business benefits not achieved	Internal	0.5	10	5.0	Project Sub-committee and Project Managers	Avoid	• Adhere to requirements, involve stakeholders and tie scope decisions to performance measures to ensure success • Need to keep the list of business benefits clear, and set a tolerance level for each
ORG03	Change in overall Critical Applications Program or other projects within the program creates changes to Transportation Asset Management scope, project costs and timeline	External	0.5	10	5.0	Program Steering Committee and Project Sub-Committee	Mitigate & Accept	• Adjust project scope/timelines based on any program level changes and the impact of these changes on Transportation Asset Management as a related project. • In making adjustments, minimize additional costs to Transportation Asset Management and keep focus to extent possible on implementing highest payback areas first in any project plan revisions

Risk ID	Risk Description	Risk Classification Internal External	Proba-bility 0.1 – 1.0	Impact 1 - 10	Risk Score (PxI)	Risk Owner	Response (Accept / Avoid / Mitigate / etc.)	Risk Response Strategy and Notes
ORG04	Staff not being able to participate in workshops or review deliverables within schedule	Internal	0.6	8	4.8	Project Managers	Mitigate	• Project approach that leverages best practices as a starting point for discussions to better leverage staff time • Proactive identification of resource constraints by project managers and timely escalation as appropriate • Potential re-assignment of some responsibilities of key extended team members • Reprioritization of some activities assigned to extended team members
ORG05	Changes in agency executive management can impact project	External	.5	9	4.5	Program Steering Committee and Project Sub-Committee	Mitigate & Accept	• Immediately brief new management on project objectives and status • Engage existing Program Steering Committee and Project Sub-Committee members to assist in presenting project benefits to new management team members

D. Technical Risks

This subsection identifies technical risks with the proposed Transportation Asset Management project, assesses the impact of these risks, and delineates potential risk response strategies for each of these risks.

Examples of risk include the system implementation effort itself, the need to integrate or interface with other systems, the need to implement new technology infrastructure, the technical skill sets required for the new system, and any skill set gap with current staff and other similar items.

Exhibit XII-2 highlights the high and medium technical risks identified to date for the Transportation Asset Management project. The risk score for the items rated as high risk are highlighted in red and the risk score for the items rated as medium risk are highlighted in yellow.

Exhibit XII-2: Risk Register Log for Technical Risks

Risk ID	Risk Description	Risk Classification Internal External	Probability 0.1 – 1.0	Impact 1 - 10	Risk Score (PxI)	Risk Owner	Response *(Accept / Avoid / Mitigate / etc.)*	Risk Response Strategy and Notes
TEC01	Need to support Oracle database management system within WSDOT as most of the candidate best of breed systems utilize this DBMS	Internal	1.0	10	10.0	Program Office, OIT Management	Mitigate	• Identify strategy for addressing Oracle support (hosting of application, contracted database administrator, training for WSDOT staff) early in project
TEC02	Availability of WSDOT resources (business and technical) to support implementation and/or understanding the "ownership" for providing support	Internal	.8	9	7.2	Project Executive, Project Managers	Avoid	• Detailed estimates of resource requirements as early as possible as part of pre-implementation planning • Develop an implementation strategy and work plan that is in sync with availability of state resources • Obtain specific commitment of resources from all agency management prior to start of implementation
TEC03	Complexity of integrating with other existing WSDOT applications	Internal	0.7	9	6.3	Project Managers and Technical Lead	Avoid	• Develop interface strategy that utilizes same layout and format used today for downstream systems • Early engagement of business and IT owners of these other systems
TEC04	Complexity of integrating with other components of Critical Applications Replacement Program (SAP ERP, etc.)	Internal	0.7	9	6.3	Program Office, Transportation Asset Management Project Managers	Avoid	• Early engagement of business and IT owners of these other systems • Ongoing coordination through Program Office • Potential for selecting a single integrator responsible for most program components

Risk ID	Risk Description	Risk Classification Internal External	Probability 0.1 – 1.0	Impact 1 - 10	Risk Score (PxI)	Risk Owner	Response *(Accept / Avoid / Mitigate / etc.)*	Risk Response Strategy and Notes
TEC05	Inadvertent impact on users who currently access TRIPS access through data marts or GIS Workbench	Internal	0.5	9	5.4	Project Managers	Avoid & Mitigate	• Conduct impact assessment of Transportation Asset Management on other existing WSDOT applications • Establish integration strategies which minimize impact on other systems • Incorporate changes in existing systems to user training
TEC06	Less skilled resources than expected provided by selected systems integrator	External	0.6	9	5.4	Program Office and Project Managers	Avoid	• Require WSDOT approval of project staff • Include in contract protections such as process for removing staff • Use of performance bond or other incentives/disincentives to ensure vendor performance within agreed-to schedule
TEC07	Changes in requirements during implementation	Internal	1.0	5	5.0	Project Managers	Avoid & Mitigate	• Involvement by stakeholders in developing initial requirements • Formal sign-off by Project Subcommittee on requirements • Well defined scope change process including Project Subcommittee, Program Office and Program Steering Committee approval
TEC08	Vendor proposals exceed cost estimate	External	0.5	10	5.0	Program Office, Project Subcommittee, Project Managers	Mitigate	• Detailed estimates to the extent possible during development of the business case • Conducting of vendor software demos to assess the fit of vendor solutions with agency requirements • Key gaps and their impacts to be identified as early as possible • Benchmarking of costs incurred by other states or agencies who have recently implemented asset mgmt solutions

Risk ID	Risk Description	Risk Classification Internal External	Probability 0.1 – 1.0	Impact 1 - 10	Risk Score (PxI)	Risk Owner	Response *(Accept / Avoid / Mitigate / etc.)*	Risk Response Strategy and Notes
TEC09	Lack of IT (programming or configuration) experience with selected software solutions	Internal	0.5	9	4.5	Program Office, Project Managers and Technical Lead	Mitigate	• Detailed technical training plan that is initiated upon software selection • Inclusion of maintenance option within systems integrator agreement to allow for application support or hosting for some period of time following implementation • Joint planning for application and technical support with other agencies
TEC10	Project scope too large or complex and/or implementation inadequately planned	Internal	0.5	9	4.5	Project Subcommittee, Project Managers	Avoid	• Scope defined to initially replacing business functionality provided by TRIPS and related standalone asset inventory systems • Scope linked to business benefits • Careful review by Project Subcommittee Committee of requirements and implementation plan before approving implementation go-ahead • Develop scope change process that requires demonstrated link to targeted business benefits and Project Subcommittee, Program Office and Program Steering Committee approval of any proposed scope changes
TEC11	Delay in implementation of another Critical Applications Program component could impact stakeholder in the Transportation Asset Management component	External	0.5	9	4.5	Program Office and Project Sub-Committee	Avoid	• Establish reasonable schedule for various program components including schedule contingency • Plan for multiple implementation teams to allow for balance of deployment work on various program components and production support of components already deployed

E. Evaluation of Project Risk against DIS' Portfolio-based Severity and Risk Matrix

The detailed risk assessment planning outlined in the prior subsection was then used as the basis for completing the DIS Portfolio-based Severity and Risk Matrix. The DIS process evaluates proposed information technology investments on both severity factors related to the impact of project on various stakeholders and on project risk factors.

Based on the DIS Severity and Risk Matrix, the Transportation Asset Management implementation has an overall Level 2 rating based on a medium severity rating and a high risk rating. Exhibit XII-3 summarizes the basis for this rating.

Exhibit XII-3: Overall Transportation Asset Management Project Risk and Severity Rating

High Severity	***Level 2***	***Level 2***	***Level 3***
Medium Severity	***Level 1***	***Level 2***	***Level 2***
Low Severity	***Level 1***	***Level 1***	***Level 1***
	Low Risk	***Medium Risk***	***High Risk***

Please note that the overall rating could be adjusted to a Level 3 if the project is given the same rating as the overall Critical Applications Replacement Program with which it is a part. Likewise, if the traffic demand analysis solution is implemented as a separate, initial phase, the initial phase of the project is likely an overall Level 1 since it is using proven best of breed software and impacts a smaller group of users.

The evaluation of the Transportation Asset Management project against the DIS severity criteria and risk criteria is outlined below.

1. Evaluation of Transportation Asset Management Project against the DIS Severity Criteria

The severity matrix assesses the proposed project's impact on citizens and state operations, its visibility to stakeholders, and the consequences of project failure. Exhibit XII-4 summarizes the evaluation of the Transportation Asset Management project against the DIS severity criteria.

Exhibit XII-4: Evaluation of Transportation Asset Management against DIS Severity Criteria

	Categories			
Levels	**Impact on Clients**	**Visibility**	**Impact on State Operations**	**Failure or Nil Consequences**
Project Rating	**Medium**	**Medium**	**Medium**	**Medium**
High	• Direct contact with citizens, political subdivisions, and service providers – including benefits payments and transactions.	• Highly visible to public, trading partners, political subdivisions and Legislature. • Likely subject to hearings. • System processes sensitive / confidential data (e.g. medical, SSN, credit card #'s).	• Statewide or multiple agency involvement / impact. • Initial mainframe acquisitions or network acquisitions.	• Inability to meet legislative mandate or agency mission. • Loss of significant federal funding.
Medium	• Indirect impacts on citizens through management systems that support decisions that are viewed as important by the public. • Access by citizens for information and research purposes.	• Some visibility to the Legislature, trading partners, or public the system / program supports. • May be subject to legislative hearing.	• Multiple divisions or programs within agency.	• Potential failure of aging systems.
Low	• Agency operations only.	• Internal agency only.	• Single division. • Improve or expand existing networks or mainframes with similar technology.	• Loss of opportunity for improved service delivery or efficiency. • Failure to resolve customer service complaints or requests.

2. Evaluation of Transportation Asset Management Project against the DIS Risk Matrix

The risk matrix measures the impact of the project on the organization, the effort needed to complete the project, the stability of the proposed technology, and agency preparedness. Exhibit XII-5 presents the evaluation of the Transportation Asset Management project against the DIS risk criteria.

Exhibit XII-5: Evaluation of Transportation Asset Management against DIS Risk Criteria

	Categories			
Levels	**Functional Impact on Business Processes or Rules**	**Development Effort & Resources**	**Technology**	**Capability & Management**
ProjectRating	**High**	**High**	**High**	**Low**
High	• Significant change to business rules. • ***Replacement of a mission critical system.*** • Multiple organizations involved. • Requires extensive and substantial job training for work groups.	• Over $5 million. • Development and implementation exceeds 24 months.* • Requires a second decision package. * Clock starts after feasibility study or project approval and release of funding.	• Emerging. • Unproven. • Two or more of the following are new for agency technology staff or integrator, or are new to the agency architecture: programming language; operating systems; database products; development tools; data communications technology. • Requires PKI certificate. • Complex architecture – greater than 2 tier.	• Minimal executive sponsorship. • Agency uses ad-hoc processes. • Agency and/or vendor track record suggests inability to mitigate risk on project requiring a given level of development effort.

	Categories			
Levels	**Functional Impact on Business Processes or Rules**	**Development Effort & Resources**	**Technology**	**Capability & Management**
ProjectRating	**High**	**High**	**High**	**Low**
Medium	• Moderate change to business rules. • Major enhancement or moderate change of mission critical system. • Medium complexity business process(es). • Requires moderate job training.	• Under $5 million but over agency delegated authority. • 12 to 24 months for development and implementation. ***** ***** Clock starts after feasibility study or project approval and release of funding.	• New in agency with 3rd party expertise and knowledge transfer. • One of the technologies listed above is new for agency development staff.	• Executive sponsor knowledgeable but not actively engaged. • Systems integrator under contract with agency technical participation. • Agency and/or vendor record indicates good level of success but without the structure for repeatability.
Low	• Insignificant or no change to business rules. • Low complexity business process (es). • Some job training could be required.	• Within agency delegated authority. • Under 12 months for development and implementation.***** ***** Clock starts after feasibility study or project approval and release of funding.	• Standard, proven agency technology.	• Strong executive sponsorship. • Agency and vendor have strong ability to mitigate risk on a development project. • Project staff uses documented and repeatable processes for tracking status, problems, and change. • Agency or vendor is CMM Level 3 equivalent or above.

F. Quality Assurance Strategy

While it is rated a Level 2 overall, funding for an external quality assurance consultant has been included in the project budget. This consultant will perform quality assurance and independent, verification and validation activities.

The use of external quality assurance is primarily due to the fact that this project is part of an overall program, which, at the program level, is of the size, complexity, and risk that it requires external quality assurance. External quality assurance would not be required for the implementation of the Traffic Analysis software, if it is implemented as an initial separate phase. The Traffic Analysis software is a proven best of breed solution which impacts a very small number of WSDOT users.

In addition to external quality assurance, active involvement by DIS Management and Oversight of Strategic Technologies (MOST) staff in the Transportation Asset Management Project Sub-committee, as well as the overall Critical Applications Program Steering Committee is recommended. WSDOT should also provide copies of the project status report and other key project management documents to the assigned MOST staff member.

WSDOT will also develop appropriate project management documentation. This should include a project management plan, quality management, risk management plan, and organizational change management plan. WSDOT will also include this project in its Information Technology portfolio.

XIII. Anticipated Shelf-life of Analysis and Recommendations

Because there is some uncertainty around the funding strategy for the Transportation Asset Management solution as a result of current budget constraints, WSDOT management and the Transportation Asset Management Work Group were concerned about the anticipated shelf-life of this feasibility study report.

The feasibility study team evaluated this issue as part of its work. Based on stakeholder interviews, market research and the experience of the study team, the following considerations are offered in this regard:

- Asset management capabilities are likely to continue to expand with additional analytical capabilities being incorporated into best of breed solutions. Examples are analysis tools which evaluate investments on a cross-program basis.
- Additional and more sophisticated methodologies and analysis approaches are likely to be incorporated into crash analysis tools as results from on-going research is incorporated into best of breed solution offerings.
- Stakeholder expectations in terms of overall system capabilities are likely to increase over the next several years. One example is in the area of spatial integration of system functions and spatial display of system results as users become more accustomed to these types of capabilities in all different kinds of computer applications as a result of readily available commercial technologies such as Google Maps.
- Best of breed asset management vendors are likely to integrate more sophisticated data warehousing features into their products and/or integrate their products with market leading data warehousing technologies.
- The capabilities of best of breed Location Referencing System solutions are likely to continue to expand and will cover more of the functionality required by WSDOT.

Based on these anticipated trends, it is likely, due to the recommendation to utilize best of breed software solutions, that the findings and recommendations in this report should remain current for several years. One exception could be the selection of Alternative 2 (custom Location Referencing System) as the capabilities of best of breed solutions continue to mature. One mitigation strategy in this regard is the additional recommendation to allow vendors to propose either a custom solution or a best of breed solution with custom program extensions to meet Location Referencing System requirements. In addition, the project team can re-evaluate the capabilities of best of breed Location Referencing System tools as part of developing detailed requirements and adjust the requirements in the future RFP to specify a best of breed solution should WSDOT have greater confidence at that time in the capabilities of best of breed applications.

Appendix A – Stakeholder Interviews

Exhibit A-1 provides a summary of stakeholders interviewed by region and functional area. This is followed by a copy of the interview questionnaire utilized to conduct the interviews.

Exhibit A-1: Summary of Stakeholders Interviewed

Unit &Function	Str. Plng	Planning	Program Mgr	Design	Traffic	Maint	Env	Pavement Mgmt	GIS	Totals
HQ	1			1	1		2	1	1	**7**
Urban Corridors		1								**1**
Olympic Region		3	1		1					**5**
Southwest Region		2	1							**3**
Northwest Region		1	2		1	1				**5**
South Central Region		2			1					**3**
North Central Region		1			1					**2**
Eastern Region		1			1					**2**
MPOs		2								**2**
Totals	**1**	**13**	**4**	**1**	**6**	**1**	**2**	**1**	**1**	**30**

Washington State Department of Transportation

Exhibit A-2: Stakeholder Interview Questionnaire

TRIPS Replacement Feasibility Study
Stakeholder Interview Questions

Background

As a part of the Critical Applications Replacement Program, the Department has asked Dye Management Group, Inc. to complete a feasibility study specifically addressing the replacement of the current Transportation Information Planning and Support System (TRIPS). The feasibility study will identify potential alternatives for replacing TRIPS, examine the alternatives against several different evaluation criteria (typically including ability to meet needs and objectives, cost, and risk, for example), and document an implementation plan for the recommended alternative.

The scope of the TRIPS replacement includes a new Linear Referencing system; Roadway Inventory system; traffic data management system, and enhanced collision reporting and analysis functionality. Most business users access TRIPS data though the TDO datamarts and/or the GIS workbench. The accuracy and timeliness of data in these systems is a function of TRIPS and they will also experience change as a result of TRIPS replacement. In order to clarify and evaluate various alternatives for replacing TRIPS, we need your input to:

- Ensure understanding of how the TRIPS replacement project will support the Department's strategic business objectives and priorities
- Obtain input on key business drivers and desired outcomes from the transportation asset and location management and transportation data analysis business functions
- Identify business risks associated with the TRIPS replacement effort
- Document critical business success factors for the project

Interview Questionnaire

In preparation for our meeting, we ask you to consider the following questions:

1. What are your primary areas of responsibility?

2. How does your organization's mission support the strategic business objectives of the Department?

3. In addition to Department objectives, what are your organization's specific business goals and business drivers?

4. How does the availability of timely and accurate location information about highway assets and events support your ability to meet Departmental or business unit objectives and priorities? These assets and events include items such as; the number and width of lanes, shoulders, the location of intersections and jurisdictional boundaries, the amount and makeup of traffic and areas of congestion, collision locations, and the ability to analyze assets and events in relation to the highway.

5. Are there specific limitations to the location, asset, and event information that TRIPS provides that impact your ability to meet your business objectives and priorities, also considering the TDO datamarts and GIS workbench as part of the overall process?

6. How important is the accuracy of the highway centerline location and milepost reference to your ability to locate assets and events that your business unit collects and uses in order to meet Departmental or business unit objectives and priorities?

7. What potential benefits would the Department and other stakeholders derive from the availability of more timely, accurate location, asset, and event information?

8. What risks would your organization anticipate from the TRIPS replacement effort and associated impacts to the datamarts and GIS Workbench? Do you have suggestions for mitigating these risks?

9. What are the key success factors for the TRIPS replacement effort for you and your staff?

10. What other individuals would you suggest we talk to both within and outside the department as part of preparing the final report?

Appendix B – Partial List of WSDOT Systems That May Be Candidates for Decommissioning

Exhibit B-1 provides a partial list of existing WSDOT systems that may be able to be decommissioned based on the implementation of the Transportation Asset Management solution of the Critical Applications Replacement Program. This list is not intended to be a complete list of systems to be decommissioned. This list is a compilation of systems identified by the feasibility study team through its work.

This list has not been fully validated by WSDOT business owners. Thus, it should be viewed as simply a list of potential opportunities that will require significant additional analysis and discussions with a range of WSDOT business units and other stakeholders during the future requirements definition phase. There are likely other systems, potentially a number of which are maintained in business units, that should also be on this list. Likewise, additional analysis of each system will be required as part of implementation planning and enterprise design activities to confirm the system could be decommissioned and to ensure that the business functions performed by these systems are supported by the new Transportation Asset Management solution.

Exhibit B-1: Partial List of WSDOT Systems That May Be Candidates for Decommissioning As Result of the Critical Applications Replacement Program

System Acronym	System Title	System Function	Potential Solution
ArmCalc	ArmCalc	Convert state route milepost to ARM and ARM to state route milepost. Also validates SRMP to ARM and ARM to SRMP. Common module for PC systems. Also includes web services.	New Location Referencing System
Bridge Engineering Information System	Bridge Information Engineering System	Provides access to inventory data, plans, rating reports, inspection reports, photographs, and related files for bridge structures in the WSDOT inventory	Potential to replace with Transportation Asset Inventory application
CARS	Condition Acquisition and Reporting System	Supports input and sharing of information about traffic, incidents, construction, closures, and other activity on the roadway	Potential to replace with Transportation Asset Inventory application
CARSQA	CarsQA	Process collision reports for upload and processing by Mainframe	Transportation Asset Management solution and Crash Analysis tools
Collision Data Mart	Collision Data Mart	Transportation Data Office collision information	Transportation Asset Inventory and Crash Analysis tools
COPIS	CADD and Ortho Photo Information System	Tracking catalog for CADD and Ortho-Photo Management images and diagrams for highway projects	Transportation Asset Inventory
CTS	Commitment Tracking System	Enter and track environmental commitments.	Transportation Asset Inventory
Culvert Database		Tracks condition history and maintenance on culverts	Transportation Asset Inventory
HPMS	Highway Performance Monitoring System Web Application	Annual data collection for reporting to FHWA	Transportation Asset Inventory and Traffic Analysis
Illegal Sign Inventory	Illegal Sign Inventory	TDO application used to track advertising signs that have not been permitted or that do not meet IAW RCW standards	Transportation Asset Inventory
Locator Log	Locator Log	Provides means for inventorying roadway items.	Transportation Asset Inventory and Location Referencing System
MainWim, VolCheck, Dirsel	TDO Traffic	A collection of applications for collecting, tracking, and maintaining traffic count data	Traffic Analysis
Module Counts	Module Counts	Reformats outputs from GK serial data	Traffic Analysis

System Acronym	System Title	System Function	Potential Solution
		ports for upload and processing	
NW REGION CHECKER		This program is used to check NW Region loop data plus reformat to report missing data + run a macro	Traffic Analysis
Outdoor Advertising Inventory and Permitting System	Outdoor Advertising Inventory and Permitting System	Inventory, track, and issue outdoor advertising sign permits for use along state routes.	Transportation Asset Inventory (potential)
RAMPS	Road Access Management Permit System	Manage access to state highway system not in centrally incorporated area	Transportation Asset Inventory
RFIP	Roadway Features Inventory Program	Gather roadside features - GPS based	Transportation Asset Inventory
Roadway Data Mart	Roadway Data Mart		Transportation Asset Management Inventory & Business Warehouse
RTIS	Radio Towers Information System	Secure inventory of government radio tower infrastructure with GIS interface	Transportation Asset Inventory
Safety Management	Safety Management	Tracks safety incidents	Transportation Asset Inventory and Crash Analysis Tools
School Bus Stop Inventory	School Bus Stop Inventory	TDO application used to track school bus stop zones on roads and highways maintained by WSDOT	Transportation Asset Inventory
Short Count	Manual Counts	Process traffic counts collected by individuals for upload and processing	Traffic Analysis
SignSpec	Sign Specification and Cost Estimation	Documents sign removal, installation, and relocation information for highway construction projects that are included in the set of standard plans	Transportation Asset Inventory and Construction Management component of Critical Applications Replacement Program
SIMMS	Signal Maintenance Management System	Supports management of work and inventory by Signal Maintenance department. Used to enter work reports, print timesheets, and maintain location control records for signals inventory.	Transportation Asset Inventory (potential with work order module)
SMARTS	Safety Management Accident Review Tracking System	Supports review of high accident locations, high accident corridors, and pedestrian accident locations by NW Safety Management Group	Transportation Asset Inventory and Crash Analysis

System Acronym	System Title	System Function	Potential Solution
SSOS	Sign Shop Order System	Used to order highway signs for the sign shop	Transportation Asset Inventory and ERP component of Critical Applications Replacement Program
Survey	Survey Monument Database	Tracks the location, status, and history of survey monuments for state highways	Transportation Asset Inventory and Location Referencing System
SWD	Stormwater Inventory System	Used to meet federal, state, and local regulations related to controlling contaminated storm water runoff and reducing storm water flows	Transportation Asset Inventory
TARIS	Traffic Accident and Roadway Information System	Database of traffic, roadway, and collision data	Transportation Asset Inventory and Crash Analysis tools
TARTS	Transportation Asset Reporting and Tracking System	Reports on depreciation of department assets. Compiles value and depreciation for reporting to SARS	ERP and Transportation Asset Management
TRACTS	Traffic Action Tracking System	Stores critical traffic project data	Traffic Analysis
Traffic Accidents	Traffic Accidents	Process and track accident information	Crash Analysis
Traffic Data Mart	Traffic Data Mart		Traffic Analysis, Transportation Asset Inventory, Business Warehouse
TRIPS	Transportation Information Planning and Support System	Maintains and processes current and historical data about the WSDOT roadway network, traffic volumes and classifications, collisions and collision severity	Transportation Asset Management (all components)
TSMS	Traffic Sign Management System	Inventories all signs installed by WSDOT on various state and inter-state routes	Transportation Asset Inventory
UFP	Utility Franchise Permits	Allows entry, edit, and view of utilities, franchise, and permit information	Transportation Asset Inventory
USMS	Unstable Slopes Management System	Allows entry and storage of slope information, ratings, and cost estimates	Transportation Asset Inventory
WSBIS	Washington State Bridge Inventory System	Integrated bridge inventory system	Transportation Asset Inventory

Appendix C – High-Level Functional Requirements

This appendix provides the high-level functional requirements for each application component which were developed through workshops with the Transportation Asset Management Work Group during the feasibility study process.

Exhibit C-1 provides the requirements for Roadway/Asset Inventory and Exhibit C-2 provides the requirements for the Location Referencing System. Exhibit C-3 provides the requirements for Traffic Analysis. Exhibit C-4 provides the requirements for Crash Analysis.

It is envisioned that additional detail requirements gathering would be completed during the Planning and Acquisition phase for each application component prior to the development of an RFP. As an example, the requirements for Roadway Inventory/Asset Inventory focus on replacing or extending capabilities in the current TRIPS application. Additional requirements will need to be added to cover the capabilities in other standalone asset inventory applications listed in Appendix B, as well as analysis and modeling capabilities.

Exhibit C-1: Initial High-Level Requirements for Asset Inventory/Roadway Inventory

Function	Sub Function	Req #	Functional Requirement	Priority
Data Collection	Identify & Receive Info from WSDOT & External Sources	IRI 1.0	Provide the ability to access and/or receive information from internal and external systems based on end user defined selection criteria (e.g. census data, open to traffic data from Construction, etc)	High
Data Collection	Extract Jurisdictional Info from Maps	EJI 1.0	Provide the ability to access and extract jurisdictional information from maps and other sources	High
Manage Data	Create, Validate, Translate & Maintain Data	CVTM 1.0	Provide the ability to translate geographic addressing data for roadway fixed object/off-road features and structures to SRMP and ARM values based on contract location information (station number)	High
Manage Data	Create, Validate, Translate & Maintain Data	CVTM 2.0	Provide the ability to add, delete, modify, store and retrieve roadside feature data types and attributes including geometric and location information based on information from state awarded or developer contracts, utility agreements and WSDOT staff (e.g. signs, guardrails, rest areas, etc)	High
Manage Data	Create, Validate, Translate & Maintain Data	CVTM 3.0	Provide the ability to add, delete, modify, store and retrieve roadway structure data types and attributes including geometric and location information based on information from state awarded or developer contracts, utility agreements and WSDOT staff (e.g. bridges, intersections, railroad crossings, etc)	High
Manage Data	Create, Validate, Translate & Maintain Data	CVTM 4.0	Provide the ability to add, delete, modify, store and retrieve roadway control section information	High
Manage Data	Create, Validate, Translate & Maintain Data	CVTM 5.0	Provide the ability to add, maintain, store and retrieve new roadway data types and attributes including geometric and location information based on recommendations by MMIRE	High

Function	Sub Function	Req #	Functional Requirement	Priority
Manage Data	Create, Validate, Translate & Maintain Data	CVTM 6.0	Provide the ability to translate/map between TRIPS naming conventions and the new Linear Referencing naming conventions	High
Manage Data	Archive Data	AD 1.0	Provide the ability to store and retrieve temporal snap shops of historical roadway data	High
Manage Data	Archive Data	AD 2.0	Provide the ability to archive roadway data based on user defined time period and parameters	High
Reporting	Produce Roadway Reports	PRR 1.0	Provide the ability to produce predefined and ad hoc reports based upon user configurable parameters and WSDOT layout (e.g.: state highway log, roadway classification log, road life report, horizontal/vertical alignment, Lane Miles by Type, etc)	High
Reporting	Provide Info to Internal/External Systems	PIIE 1.0	Provide the ability to create extracts of roadway data for other WSDOT users (including GIS users and field video crews) based on end user defined parameters (e.g. inside lane data, etc)	High
Reporting	Provide Info to Internal/External Systems	PIIE 2.0	Support the ability for other WSDOT systems to access and extract roadway data	High
Reporting	Respond to Internal/External Requests for Info	RIER 1.0	Provide the ability to record, assign, and track customer data requests (include public disclosure)	Medium
General Data & Other Requirements		GDR 1.0	Provide the ability to select and export roadway data to data marts based on end user defined parameters	High
General Data & Other Requirements		GDR 2.0	Support the conversion of legacy transactional and data mart information	High
General Data & Other Requirements		GDR 3.0	Provide the ability to access and report single-line representation and dual-line representation based upon directional flow (increasing or decreasing)	High

Exhibit C-2: Initial High-Level Requirements for Location Referencing System

Function	Sub Function	Req #	Functional Requirement	Priority
Manage Transportation Network	Create & Maintain Line Work	CML 1.0	Provide the ability to collect and update geographic coordinates to produce multi line work	High
Manage Transportation Network	Create & Maintain Line Work	CML 2.0	Provide the ability to collect and update geographic coordinates to produce single line work	High
Manage Transportation Network	Create & Maintain Line Work	CML 3.0	Provide the ability to import raw coordinate data from data collection devices	High
Manage Transportation Network	Create & Maintain Line Work	CML 4.0	Provide the ability to manipulate coordinate data to finalize line work	High
Manage Transportation Network	Create & Maintain Line Work	CML 5.0	Provide the ability to update line work (e.g. realignments, improve data, etc)	High
Manage Transportation Network	Create & Maintain Line Work	CML 6.0	Provide the ability to be able to create and maintain a routable network	Medium
Manage Transportation Network	Create & Maintain Line Work	CML 7.0	Provide the ability to maintain the naming and Linear Referencing system attributes and their relationships that apply to the lines of work	High
Manage Transportation Network	Create & Maintain Line Work	CML 8.0	Support the merging of local road data, including naming conventions and attributes, with other transportation data into the proposed WSDOT Multi Modal Transportation System Inventory (e.g. aviation, bike paths, ferries, etc)	Medium
Manage Transportation Network	Create & Maintain Line Work	CML 9.0	Support the merging of local road data to create a seamless transportation road network including naming conventions and attributes	High
Manage Transportation Network	Create & Maintain Line Work	CML 10.0	Provide the ability to perform dynamic segmentation	High
Manage Transportation Network	Create & Maintain Naming Conventions	CMN 1.0	Provide the ability to translate/map between TRIPS naming convention and the new LRS naming conventions	High

Function	Sub Function	Req #	Functional Requirement	Priority
Manage Transportation Network	Create, Validate & Maintain Data	CVM 1.0	Provide the ability to uniquely identify and update the location of a feature or event, using various location referencing services	High
Manage Transportation Network	Create, Validate & Maintain Data	CVM 2.0	Provide the ability to capture and maintain anchor points	High
Provide Location Services	Provide Location Information Including Transformation	PLIT 1.0	Provide the ability to identify compass direction of the highway (general direction, at segment length and compass direction in degrees)(ELC - Enterprise Location Class is the data source)	High
Provide Location Services	Provide Location Information Including Transformation	PLIT 2.0	Provide the ability to translate between different location referencing methods (x, y coordinates to/from state route milepost; addressing; stationing; etc)	High
Provide Location Services	Provide Location Information Including Transformation	PLIT 3.0	Provide the ability to translate back and forth between single-line representation and dual-line representation and locating data on both representations	High
Provide Location Services	Provide Location Information Including Transformation	PLIT 4.0	Provide the ability to convert a TRIPS SRMP or ARM value to/from a GPSLRS ARM using anchor points	High
Provide Location Services	Provide Location Information Including Transformation	PLIT 5.0	Provide the ability to control the display properties for features and items based on functional needs controlled by data of highest resolution (e.g. a bridge or intersection as a point, line or polygon)	High
Provide Location Services	Provide Location Information Including Transformation	PLIT 6.0	Provide the ability to capture and maintain feature level metadata (accuracy/error with data)	High
Provide Location Services	Provide Location Information Including Transformation	PLIT 7.0	Provide the ability to add metadata report to guide general data use	High

Function	Sub Function	Req #	Functional Requirement	Priority
Provide Location Services	Provide Jurisdictional Location Information	PJL 1.0	Provide the ability to determine various jurisdictions for any particular location such as Federal and State FC, R/U, city #, county #, district	High
Provide Location Services	Provide Temporal Information	PTI 1.0	Provide the ability to obtain a temporal view of the transportation network, including locations, names, and descriptions	High
Provide Location Services	Provide Temporal Information	PTI 2.0	Provide the ability to support Temporal Topology (just-in-time logistics) such as reversible lanes or other items that change based on time of day	Medium
Provide Location Services	Realignment Updates	RU 1.0	Provide the ability to update location information both dynamically and batch	High
Provide Location Services	Support Maintenance Agreements	SMA 1.0	Support the ability to maintain an administrative region for maintenance agreements or other purposes (e.g. determine what administrative and/or geographic area a point or points of interest may fall in (for example legislative district, county, city, WSDOT region, maintenance agreements between regions and with neighboring jurisdictions including other states and Canada, Indian reservation, school district, etc)	Medium

Exhibit C-3: Initial High-Level Requirements for Traffic Analysis

Function	Sub Function	Req #	Functional Requirement	Priority
Highway Usage Data Collection	Install, Poll, Manage & Maintain ATR & Short Count Sites	IPMM 1.0	Provide the ability to manage and maintain ATR (Automated Traffic Recorder)	High
Highway Usage Data Collection	Install, Poll, Manage & Maintain ATR & Short Count Sites	IPMM 2.0	Provide the ability to maintain site history (installation and maintenance)	High
Highway Usage Data Collection	Install, Poll, Manage & Maintain ATR & Short Count Sites	IPMM 3.0	Provide the ability to link site history to as-built designs and pictures, etc	High
Highway Usage Data Collection	Install, Poll, Manage & Maintain ATR & Short Count Sites	IPMM 4.0	Provide the ability to schedule maintenance and installations for ATR and scheduling for short counts	High
Highway Usage Data Collection	Install, Poll, Manage & Maintain ATR & Short Count Sites	IPMM 5.0	Provide the ability to store targeted location sites for short count on a time cycle and track actual counts accomplished (include geospatial mapping capabilities)	High
Highway Usage Data Collection	Install, Poll, Manage & Maintain ATR & Short Count Sites	IPMM 6.0	Provide the ability for the schedule to link scanned documents of short site placement history	Medium
Highway Usage Data Collection	Install, Poll, Manage & Maintain ATR & Short Count Sites	IPMM 7.0	Provide the ability to collect, merge, edit, validate, and store data from short count and ATR sites	High
Highway Usage Data Collection	Install, Poll, Manage & Maintain ATR & Short Count Sites	IPMM 8.0	Provide the ability to collect traffic information from various traffic collection equipment (including different file types, formats, types of data based on source) and manage changes over time by end users	High
Highway Usage Data Collection	Install, Poll, Manage & Maintain ATR & Short Count Sites	IPMM 9.0	Provide the ability to track and manage special count requests and link to work orders	Low

Function	Sub Function	Req #	Functional Requirement	Priority
Highway Usage Data Collection	Identify & Receive Data from Other Sources	IPMM 10.0	Provide the ability to automatically gather and input information from other sources (e.g.: on WA State Ferry ridership from toll collection data, Oregon, etc)	Medium
Highway Usage Data Management	Format, Validate, Edit & Merge Data	FVEM 1.0	Provide the ability to uniquely identify and update a count by location (linear, geospatial), temporal, count id (descriptor), and channel (equipment)	High
Highway Usage Data Management	Format, Validate, Edit & Merge Data	FVEM 2.0	Provide the ability to apply user defined and user maintained site specific and count type validity checks	High
Highway Usage Data Management	Format, Validate, Edit & Merge Data	FVEM 3.0	Provide the ability to flag, accept, reject, suspend, restore identified anomalies (from the validity checks or user discretion)	High
Highway Usage Data Management	Format, Validate, Edit & Merge Data	FVEM 4.0	Provide the ability to capture and store traffic count data including volume, class, speed, weight by vehicle based on user defined parameters for collection equipment and count type	High
Highway Usage Data Management	Format, Validate, Edit & Merge Data	FVEM 5.0	Provide the ability to capture and store both begin and end dates for traffic count data	High
Highway Usage Data Management	Format, Validate, Edit & Merge Data	FVEM 6.0	Provide the ability to capture and store various kinds of class data (e.g.: length, axle)	High
Highway Usage Data Management	Format, Validate, Edit & Merge Data	FVEM 7.0	Provide the ability to capture and store at n-bin level and roll to standard summary bin levels (e.g.: 4 or 13)	High
Highway Usage Data Management	Format, Validate, Edit & Merge Data	FVEM 8.0	Provide the ability to capture and store gap and headway data	High
Highway Usage Data Management	Format, Validate, Edit & Merge Data	FVEM 9.0	Provide the ability to capture, calculate and store occupancy data based on time based counts (count/studies)	High
Highway Usage Data Management	Format, Validate, Edit & Merge Data	FVEM 10.0	Provide the ability to record, update and associate metadata (for example counts, studies, sites, events, history, etc)	High

Function	Sub Function	Req #	Functional Requirement	Priority
Highway Usage Data Management	Format, Validate, Edit & Merge Data	FVEM 11.0	Provide the ability to automatically reformat traffic data and summary information into FHWA standards (that change over time)	High
Highway Usage Data Management	Format, Validate, Edit & Merge Data	FVEM 12.0	Provide the ability to automatically identify all traffic data records impacted by roadway realignment or closure, based on information from the LRS (Linear Referencing System), separately flagging records within the realignment or closure and impacted by them	High
Highway Usage Data Management	Format, Validate, Edit & Merge Data	FVEM 13.0	Provide the ability to automatically update records impacted by the realignment or closure	High
Highway Usage Data Management	Format, Validate, Edit & Merge Data	FVEM 14.0	Provide the ability for end user review and update of records within the realignment or closure area	Medium
Highway Usage Data Management	Format, Validate, Edit & Merge Data	FVEM 15.0	Provide the ability to automatically update records based on a change in the route name	High
Highway Usage Data Management	Format, Validate, Edit & Merge Data	FVEM 16.0	Provide the ability to automatically poll ATR and flag and report if data is incomplete	High
Highway Usage Data Management	Format, Validate, Edit & Merge Data	FVEM 17.0	Provide the ability to manually update records based upon user defined parameters	High
Highway Usage Data Management	Format, Validate, Edit & Merge Data	FVEM 18.0	Provide the ability to add user defined validity rules	High
Highway Usage Data Management	Format, Validate, Edit & Merge Data	FVEM 19.0	Provide the ability to gather and store geospatial location information for ATR and short counts	High
Highway Usage Data Management	Format, Validate, Edit & Merge Data	FVEM 20.0	Provide the ability to associate a count to a roadway segment at a point in time and over time	High
Highway Usage Data Management	Format, Validate, Edit & Merge Data	FVEM 21.0	Provide the ability to define and maintain roadway sections/segments with factor source assignment	High
Highway Usage Data Management	Format, Validate, Edit & Merge Data	FVEM 22.0	Provide the ability to associate linear or geospatial location information for counts with information on directional flow (derived from Roadway Inventory system) and use in user defined calculations and reporting	High

Function	Sub Function	Req #	Functional Requirement	Priority
Highway Usage Data Management	Format, Validate, Edit & Merge Data	FVEM 23.0	Provide the ability to create before and after studies and link to traffic count and text/jpeg of specific vehicle supporting studies	High
Highway Usage Data Management	Extrapolate & Store Statistics	ESS 1.0	Provide the ability to calculate and store factors for sites, groups of sites and combinations thereof	High
Highway Usage Data Management	Extrapolate & Store Statistics	ESS 2.0	Provide the ability to generate and store factors based on ATR data (e.g.: axle, day of week, etc) and apply to short count traffic records based upon user defined parameters (e.g.: on the vehicle or temporal or on calculation algorithm)	High
Highway Usage Data Management	Extrapolate & Store Statistics	ESS 3.0	Provide the ability to store statistical records created from ATR and short count data (e.g.: average weekday counts, etc) using AASHTO and FHWA guidelines	High
Highway Usage Data Management	Extrapolate & Store Statistics	ESS 4.0	Provide the ability to update generated and statistical records with a complete audit trail and an indicator that the records have been modified (add comments to records)	High
Highway Usage Data Management	Extrapolate & Store Statistics	ESS 5.0	Provide the ability to generate turning movement schematics for intersections based on manual counts and template diagrams of typical intersections	High
Highway Usage Data Management	Extrapolate & Store Statistics	ESS 6.0	Provide the ability to capture, store, maintain and retrieve schematics, sketches, pictures, Excel templates and Visio diagrams including a link to the data records they are associated with (short and ATR counts)	High
Highway Usage Data Management	Extrapolate & Store Statistics	ESS 7.0	Provide the ability to estimate volumes for uncounted mainline locations from counted mainline and ramp location data within a user defined area (linear) based on Traffic Monitoring Guide procedures (factors could differ within segment by specific location)	High
Highway Usage Data Management	Extrapolate & Store Statistics	ESS 8.0	Provide the ability to aggregate data to user specified granularity	High

Function	Sub Function	Req #	Functional Requirement	Priority
Highway Usage Data Management	Extrapolate & Store Statistics	ESS 9.0	Provide the ability to automatically calculate and store short-count AADTs (Annual Average Daily Traffic) using previous year and current year factors based on request date and factor availability labeling calculations with factor source	High
Highway Usage Data Management	Extrapolate & Store Statistics	ESS 10.0	Provide the ability to create and store an annual summary record for each ATR Site	High
Highway Usage Data Management	Extrapolate & Store Statistics	ESS 11.0	Provide the ability to create current year traffic record from one or more count records for a particular location or growth factor from the prior year's traffic record, linking the annual record to source data and allowing for descriptive metadata	High
Highway Usage Data Management	Analyze, Update & Archive Data	AUA 1.0	Provide the graphing capabilities for the purpose of identifying data anomalies	High
Highway Usage Data Management	Analyze, Update & Archive Data	AUA 2.0	Provide the ability to archive sections/segments with factor source assignment by year	High
Highway Usage Data Management	Analyze, Update & Archive Data	AUA 3.0	Provide the ability to automatically determine sections for best available annual traffic data based on roadway inventory data and current year traffic summary record count locations and user defined algorithm	High
Highway Usage Data Management	Analyze, Update & Archive Data	AUA 4.0	Provide the ability to generate best available annual traffic data by roadway sections defined (in the requirement above) based on user defined algorithm (Miletraf)	High
Highway Usage Data Access and Reporting	Report Traffic Levels	RTL 1.0	Provide the ability to create the annual traffic report per WSDOT layout that may include geospatial components	High
Highway Usage Data Access and Reporting	Report Traffic Levels	RTL 2.0	Provide the ability to generate numerous predefined/ad hoc reports (such as tabular data reports) and schematics based upon user configurable parameters to meet federal, state, public and internal user needs	High

Function	Sub Function	Req #	Functional Requirement	Priority
Highway Usage Data Access and Reporting	Respond to Internal/External Customer Requests	RCR 1.0	Provide the ability to record, assign, and track customer data requests (include public disclosure)	Medium
Highway Usage Data Access and Reporting	Respond to Internal/External Customer Requests	RCR 2.0	Provide the ability for customers to retrieve non state highway count results, associated documentation based on jurisdictional linear or geospatial location and count identifier	Medium
Highway Usage Data Access and Reporting	Respond to Internal/External Customer Requests	RCR 3.0	Provide the ability for customers to retrieve state highway count results, associated documentation based on linear or geospatial location and count identifier	High
Highway Usage Data Access and Reporting	Provide Traffic Information to Other Systems	PTI 1.0	Provide the ability to automatically schedule various extracts	High
Highway Usage Data Access and Reporting	Provide Traffic Information to Other Systems	PTI 2.0	Support the ability for other WSDOT systems to extract finalized traffic data (e.g.: pavement management system, GIS workbench, HPMS, etc)	High
Highway Usage Data Access and Reporting	Provide Traffic Information to Other Systems	PTI 3.0	Provide the ability to create extracts for SHRP, FHWA, HSIS based on end user defined parameters (e.g.: class, weight, site description, volume)	High
Highway Usage General Requirements	General Data & Other Requirements	GDR 1.0	Provide the ability to restrict access to non-finalized records based on user defined role based security	High
Highway Usage General Requirements	General Data & Other Requirements	GDR 2.0	Provide the ability to access certain records based on user defined parameters (could include who the audience is)	High
Highway Usage General Requirements	General Data & Other Requirements	GDR 3.0	Provide the ability for automated workflow based on end user defined criteria for analysis, review, and approval of traffic count processing from ATR and short count sites	High
Highway Usage Data Management	General Data & Other Requirements	GDR 4.0	Provide the ability to translate/map between TRIPS naming conventions and the New Linear Referencing naming conventions	High
Highway Usage General Requirements	General Data & Other Requirements	GDR 5.0	Provide the ability to select and export roadway data to data marts based on end user defined	High

Function	Sub Function	Req #	Functional Requirement	Priority
			parameters	
Highway Usage General Requirements	General Data & Other Requirements	GDR 6.0	Support the conversion of legacy transactional and data mart information	High
Highway Usage General Requirements	General Data & Other Requirements	GDR 7.0	Provide the ability to capture, store, analyze, update and report both single line representation and dual line representation traffic data	High
Highway Usage General Requirements	General Data & Other Requirements	GDR 8.0	Provide the ability link traffic way data for the same or similar locations	High
Travel Analysis	Data Collection	DC 1.0	Provide the ability to access and extract state highway location, geometric and attribute data from Roadway Inventory based on end user defined selection criteria	High
Travel Analysis	Data Collection	DC 2.0	Provide the ability to access and extract state highway traffic data from Highway Usage based on end user defined selection criteria	High
Travel Analysis	Data Collection	DC 3.0	Provide the ability to access and extract data from Collision based on end user defined selection criteria	High
Travel Analysis	Data Collection	DC 4.0	Provide the ability to receive or enter (via web, e-mail, datasets), edit against end user defined business rules, quality analyze and process or flag traffic and geometric data from counties, municipalities and WSDOT regional offices for state highways and other roadways	High
Travel Analysis	Data Collection	DC 5.0	Provide the ability to receive pavement condition data (from the WSDOT Materials Lab)	High
Travel Analysis	Data Collection	DC 6.0	Provide the ability to capture and store travel time data collected from automatic license plate reader cameras	High
Travel Analysis	Data Collection	DC 7.0	Provide the ability to retrieve or receive location information from the LRS (Linear Referencing System)	High
Travel Analysis	Data Management	DM 1.0	Provide the ability to annually archive various information files	High

Function	Sub Function	Req #	Functional Requirement	Priority
Travel Analysis	Data Management	DM 2.0	Provide the ability to review and update functional classification for various locations (state and local) and provide appropriate updates for all related systems	High
Travel Analysis	Data Management	DM 3.0	Provide the ability to review and update HPMS section limits (Roadway geometrics records) for state routes	High
Travel Analysis	Data Management	DM 4.0	Provide the ability to define highway segments dynamically and gather usage and geometric attributes for those segments simultaneously	High
Travel Analysis	Data Analysis	DA 1.0	Provide the ability to calculate averages of directional hourly volumes of two-axle volume traffic counts for state routes	High
Travel Analysis	Data Analysis	DA 2.0	Provide the ability to calculate daily directional hourly volumes of classification (vehicle classification) traffic counts for state routes	High
Travel Analysis	Data Analysis	DA 3.0	Provide the ability to determine segments for review based on usage and traffic statistics	High
Travel Analysis	Data Analysis	DA 4.0	Provide the ability to create an algorithm that examines the consistency of data by segment or across time periods or based on sampling (for example)	High
Travel Analysis	Data Analysis	DA 5.0	Provide the ability to create statistically valid samples based on geometric and usage data for roadways	High
Travel Analysis	Data Analysis	DA 6.0	Provide the ability to extract information to industry specific modeling tools and Excel spreadsheets (VISSIM, SYNCRO, etc)	High
Travel Analysis	Data Analysis	DA 7.0	Provide the ability to create before and after studies and link to traffic count and text/jpeg of specific vehicle supporting studies	High
Travel Analysis	Reporting	RP 1.0	Provide the ability to create predefined and ad hoc reports based upon user configurable parameters (e.g.: Freight and Goods)	High

Function	Sub Function	Req #	Functional Requirement	Priority
Travel Analysis	Reporting	RP 2.0	Provide geospatial reporting capabilities (includes FHWA mandated)	High
Travel Analysis	General Data & Other Requirements	GDR 1.0	Provide the ability to access and report single-line representation and dual-line representation	High
Travel Analysis	General Data & Other Requirements	GDR 2.0	Support the conversion of legacy transactional and data mart information	High
Travel Analysis	General Data & Other Requirements	GDR 3.0	Provide the ability to translate/map between TRIPS naming conventions and the new Linear Referencing naming conventions	High
Travel Analysis	General Data & Other Requirements	GDR 4.0	Provide the ability to select and export roadway data to data marts based on end user defined parameters	High

Exhibit C-4: Initial High-Level Requirements for Crash Analysis

Function	Sub Function	Req #	Functional Requirement	Priority
Collect & Process Data	Collect Collision Reports	CCR 1.0	Provide the ability to receive or enter collision information in various formats including electronic and paper (police and citizen reports, etc)	High
Collect & Process Data	Image, Index & Load Collision Data	IIL 1.0	Provide the ability to scan, index and store collision reports	High
Collect & Process Data	Image, Index & Load Collision Data	IIL 2.0	Provide the ability to receive collision location data from a user defined electronic location coding tool (currently in development)	High
Collect & Process Data	Image, Index & Load Collision Data	IIL 3.0	Provide the ability to route collision reports to designated WSDOT employees for quality analysis and location coding based upon user defined rules (Data Analysis, Quality Assurance)	High
Manage Data	Store Data	SD 1.0	Support the transfer of historical collision records (prior to 2002) from TRIPS into CLAS	High
Manage Data	Provide Jurisdiction Info	PJI 1.0	Provide the ability to add, delete, modify and store state route collision data (including state, county and city jurisdictional information)	High
Manage Data	Update Locator Log Data	ULL 1.0	Provide the ability to access roadway information and add, delete, modify and store business access information for updating Locator Log (private businesses, public services that exist along the state route)	High
Manage Data	Modify SR Location Information	MSRL 1.0	Provide the ability to receive automatic updates of state route location information (from the LRS) based upon roadway realignments	High
Manage Data	Modify SR Location Information	MSRL 2.0	Provide the ability to receive automatic updates of additional location data (from the LRS) including functional class, urban/rural codes, WSDOT regions, city and county numbers, etc.	High
Manage Data	Modify SR Location Information	MSRL 3.0	Provide the ability to automatically flag and update collision records for suspension and notify designated WSDOT employees when manual realignment updates are required.	High

Function	Sub Function	Req #	Functional Requirement	Priority
Manage Data	Modify SR Location Information	MSRL 4.0	Provide the ability to flag and archive historical collision records based upon realignment information	High
Provide & Report Collision Information	Analyze Data	AD 1.0	Provide the ability to export collision data to a user defined statistical analysis tool (e.g. SAS)	High
Provide & Report Collision Information	Analyze Data	AD 2.0	Provide the ability to export collision data to a user defined collision diagramming tool (e.g. Intersection Magic)	High
Provide & Report Collision Information	Analyze Data	AD 3.0	Provide the ability to export collision data to a user defined geospatial tool	High
Provide & Report Collision Information	Analyze Data	AD 4.0	Provide the ability to access and extract data from other WSDOT and legacy systems (e.g. roadway, traffic, etc), link to collision data and store results	High
Provide & Report Collision Information	Analyze Data	AD 5.0	Provide the ability to store and modify formulas to perform safety analysis	High
Provide & Report Collision Information	Analyze Data	AD 6.0	Provide the ability to store statistical results (e.g. raw data, reports, etc)	High
Provide & Report Collision Information	Analyze Data	AD 7.0	Provide the ability to access and extract formulas from external sites (e.g. federal, state, etc.)	Low
Provide & Report Collision Information	Produce Reports & Data Extracts	PRDE 1.0	Provide the ability to generate predefined and ad hoc reports based upon user configurable parameters to meet federal, state, public and internal user needs	High
Provide & Report Collision Information	Produce Reports & Data Extracts	PRDE 2.0	Provide the ability to record, assign, and track customer data requests (include public disclosure)	Medium
Provide & Report Collision Information	Provide Information to Other Systems	PIOS 1.0	Support the ability for other WSDOT systems to access and extract collision data	High
Provide & Report Collision Information	Provide Information to Other Systems	PIOS 2.0	Provide the ability to automatically schedule various extracts	High
Provide & Report Collision Information	Provide Information to Other Systems	PIOS 3.0	Provide the ability to select and export collision data to data marts based on end user defined parameters	High
General Data & Other		GDR 1.0	Support the conversion of legacy transactional and data mart	High

Function	Sub Function	Req #	Functional Requirement	Priority
Requirements			information	
General Data & Other Requirements		GDR 2.0	Provide the ability to access and report single-line representation and dual-line representation	High

Appendix D – Alternative 1 Cost Benefit Analysis

Appendix D provides the completed DIS Forms 1, 3, 4, and 5 for the cost benefit analysis for Alternative 1 under a pay as you go scenario.

Form 1: Summary Cost Benefit and Cash Flow Analysis

	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	GRAND TOTAL
TOTAL OUTFLOWS	(621,622)	872,887	5,855,111	6,642,452	289,240	320,749	1,573,405	1,171,886	466,939	482,586	17,053,632
TOTAL INFLOWS	0	0	0	0	590,250	1,174,110	1,832,512	2,276,712	2,935,717	2,951,531	11,760,832
NET CASH FLOW	621,622	(872,887)	(5,855,111)	(6,642,452)	301,010	853,361	259,107	1,104,827	2,468,778	2,468,945	
INCREMENTAL NPV	NA	(188,159)	(5,069,603)	(10,281,702)	(10,059,403)	(9,466,260)	(9,296,757)	(8,616,517)	(7,185,906)	(5,839,357)	
Cumulative Costs	NA	251,265	6,106,376	12,748,828	13,038,067	13,358,816	14,932,221	16,104,107	16,571,046	17,053,632	
Cumulative Benefits	NA	0	0	0	590,250	1,764,360	3,596,872	5,873,585	8,809,301	11,760,832	

Cost of Capital	Breakeven Period - yrs.* Non-Discounted	Discounted	NPV $	IRR %
6.25%			(5,839,357)	322.26%

* - "Non-Discounted" represents breakeven period for cumulative costs and benefits (no consideration of time value of money).

* - "Discounted" considers effect of time value of money through incremental Net Present Value.

Form 3: Summary Operations Incremental Cost of Project

		FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	GRAND TOTAL
OPERATIONS INCREMENTAL COSTS OF PROJECT (Per Form 4 - Column C)												
Salaries and Wages	(A)	(146,622)	260,445	1,743,666	1,715,292	376,118	368,944	393,384	419,167	446,361	475,040	6,051,795
Employee Benefits	(B)	0	0	0	0	0	0	0	0	0	0	0
Personal Service Contracts	(CA)	0	616,942	4,290,635	4,630,684	0	0	0	0	0	0	9,538,261
Communications	(EB)	0	0	0	0	0	0	0	0	0	0	0
Hardware Rent/Lease	(ED)	0	0	0	0	0	0	0	0	0	0	0
Hardware Maintenance	(EE)	(450,000)	(459,000)	(408,180)	(404,544)	(344,444)	(347,054)	(349,501)	(351,773)	(325,389)	(325,841)	(3,765,727)
Software Rent/Lease	(ED)	0	0	0	0	0	0	0	0	0	0	0
Software Maintenance & Upgrade	(EE)	0	0	33,000	43,450	80,823	84,864	1,304,827	93,562	98,240	103,152	1,841,918
DP Goods/Services	(EL)	0	20,000	92,000	194,100	203,805	213,995	224,695	235,930	247,726	260,113	1,692,364
Goods/Services Not Listed	(E)	(25,000)	(25,500)	(26,010)	(26,530)	(27,061)	0	0	0	0	(29,877)	(159,978)
Travel	(G)	0	0	0	0	0	0	0	0	0	0	0
Hardware Purchase Capitalized	(JC)	0	300,000	50,000	330,000	0	0	0	775,000	0	0	1,455,000
Software Purchase Capitalized	(JC)	0	150,000	40,000	160,000	0	0	0	0	0	0	350,000
Hardware Purchase - Non. Cap	(KA)	0	0	0	0	0	0	0	0	0	0	0
Software Purchase - Non. Cap	(KA)	0	0	0	0	0	0	0	0	0	0	0
Hardware Lease/Purchase	(P)	0	0	0	0	0	0	0	0	0	0	0
Software Lease/Purchase	(P)	0	0	0	0	0	0	0	0	0	0	0
Other (specify)	( )	0	10,000	40,000	0	0	0	0	0	0	0	50,000
TOTAL OPERATIONS		(621,622)	872,887	5,855,111	6,642,452	289,240	320,749	1,573,405	1,171,886	466,939	482,586	17,053,632
TOTAL OUTFLOWS		(621,622)	872,887	5,855,111	6,642,452	289,240	320,749	1,573,405	1,171,886	466,939	482,586	17,053,632
CUMULATIVE COSTS			251,265	6,106,376	12,748,828	13,038,067	13,358,816	14,932,221	16,104,107	16,571,046	17,053,632	

(1) Total Outflows the sum of Fiscal Total Operations and Total Development from Form2.
(2) Total Outflows carried to Form1

Form 4: Current versus Proposed Method Operations Cost

		FY 2010			FY 2011			FY 2012			FY 2013			FY 2014		
OPERATIONS COSTS	Obj. Codes	(a) Current	(b) Project	(c) = (b)-(a) Incremental Effect of Project (to summary)	(a) Current	(b) Project	(c) = (b)-(a) Incremental Effect of Project (to summary)	(a) Current	(b) Project	(c) = (b)-(a) Incremental Effect of Project (to summary)	(a) Current	(b) Project	(c) = (b)-(a) Incremental Effect of Project (to summary)	(a) Current	(b) Project	(c) = (b)-(a) Incremental Effect of Project (to summary)
Salaries and Wages (Implementation and Ongoing Support)	(A)	180,954	34,332	(146,622)	184,573	445,018	260,445	188,265	1,931,930	1,743,666	192,030	1,907,322	1,715,292	195,870	571,988	376,118
Employee Benefits (included in salaries & wages)	(B)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Personal Service Contracts (implementation vendor)	(CA)	0	0	0	0	616,942	616,942	0	4,290,635	4,290,635	0	4,630,684	4,630,684	0	0	0
Communications	(EB)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hardware Rent/Lease	(ED)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hardware Maintenance	(EE)	450,000	0	(450,000)	459,000	0	(459,000)	468,180	60,000	(408,180)	477,544	73,000	(404,544)	487,094	142,650	(344,444)
Software Rent/Lease	(ED)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Software Maintenance & Upgrade (ongoing licensing)	(EE)	0	0	0	0	0	0	0	33,000	33,000	0	43,450	43,450	0	80,823	80,823
DIS Goods/Services -- Centralized Data Processing Costs	(EL)	0	0	0	0	20,000	20,000	0	92,000	92,000	0	194,100	194,100	0	203,805	203,805
Goods/Services Not Listed	(E)	25,000	0	(25,000)	25,500	0	(25,500)	26,010	0	(26,010)	26,530	0	(26,530)	27,061	0	(27,061)
Travel	(G)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hardware Purchase Capitalized	(JC)	0	0	0	0	300,000	300,000	0	50,000	50,000	0	330,000	330,000	0	0	0
Software Purchase Capitalized (s/w acquisition)	(JC)	0	0	0	0	150,000	150,000	0	40,000	40,000	0	160,000	160,000	0	0	0
Hardware Purchase - Non. Cap	(KA)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Software Purchase - Non. Cap	(KA)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hardware Lease/Purchase	(P)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Software Lease/Purchase	(P)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other (specify) Facilities for training & project team)	( )	0	0	0	0	10,000	10,000	0	40,000	40,000	0	0	0	0	0	0
TOTAL OPERATION COSTS		655,954	34,332	(621,622)	669,073	1,541,960	872,887	682,455	6,537,565	5,855,111	696,104	7,338,555	6,642,452	710,026	999,266	289,240
FTE'S				0			0			0			0			0

Form 4: Current versus Proposed Method Operations Cost (continued)

		FY 2015			FY 2016			FY 2017			FY 2018			FY 2019		
OPERATIONS COSTS	Obj. Codes	(a) Current	(b) Project	(c) = (b)-(a) Incremental Effect of Project (to summary)	(a) Current	(b) Project	(c) = (b)-(a) Incremental Effect of Project (to summary)	(a) Current	(b) Project	(c) = (b)-(a) Incremental Effect of Project (to summary)	(a) Current	(b) Project	(c) = (b)-(a) Incremental Effect of Project (to summary)	(a) Current	(b) Project	(c) = (b)-(a) Incremental Effect of Project (to summary)
Salaries and Wages	(A)	199,788	568,731	368,944	203,784	597,168	393,384	207,859	627,026	419,167	212,016	658,378	446,361	216,257	691,297	475,040
Employee Benefits (included in salaries & wages)	(B)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Personal Service Contracts (implementation vendor)	(CA)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Communications	(EB)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hardware Rent/Lease	(ED)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hardware Maintenance	(EE)	496,836	149,783	(347,054)	506,773	157,272	(349,501)	516,909	165,135	(351,773)	527,247	201,858	(325,389)	537,792	211,951	(325,841)
Software Rent/Lease	(ED)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Software Maintenance & Upgrade (ongoing licensing)	(EE)	0	84,864	84,864	0	1,304,827	1,304,827	0	93,562	93,562	0	98,240	98,240	0	103,152	103,152
DIS Goods/Services -- Centralized Data Processing Costs	(EL)	0	213,995	213,995	0	224,695	224,695	0	235,930	235,930	0	247,726	247,726	0	260,113	260,113
Goods/Services Not Listed	(E)	27,602	0	0	28,154	o	0	28,717	0	0	29,291	0	0	29,877	0	(29,877)
Travel	(G)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hardware Purchase Capitalized	(JC)	0	0	0	0	0	0	0	775,000	775,000	0	0	0	0	0	0
Software Purchase Capitalized (s/w acquisition)	(JC)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hardware Purchase - Non. Cap	(KA)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Software Purchase - Non. Cap	(KA)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hardware Lease/Purchase	(P)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Software Lease/Purchase	(P)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other (specify) Facilities for training & project team)	( )	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL OPERATION COSTS		724,226	1,017,373	320,749	738,711	2,283,962	1,573,405	753,485	1,896,654	1,171,886	768,555	1,206,202	466,939	783,926	1,266,512	482,586
FTE'S				0			0			0			0			0
(1) FY__ Column (c) for each Cost Code carried to Form3																

Form 5: Benefits Cash Flow Analysis

TANGIBLE BENEFITS	OFM Object Codes	BENEFITS FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	TOTAL
Hard $												
Revenues (specify)	(revenue codes)	0	0	0	0	0	0					0
Reimbursements (specify)	(object codes)	0	0	0	0	0	0					0
Cost Reduction (specify) (1)	(object codes)	0	0	0	0	0	0					0
Elimination of mainframe		0	0	0	0	450,000	459,000	468,180	477,544	487,094	496,836	2,838,654
Other (specify)	(object codes)	0	0	0	0	0	0					0
Soft $												0
Cost Avoidance (specify)	(object codes)	0	0	0	0	0	0					0
Improved project scoping						0	160,000	400,000	560,000	800,000	800,000	2,720,000
Lifecycle asset management						0	200,000	500,000	700,000	1,000,000	1,000,000	
Redirect staff due to automation						24,225	49,419	50,407	51,416	52,444	53,493	281,403
Redirect staff due to reduced research effort						24,225	49,419	50,407	51,416	52,444	53,493	281,403
Redirect IT resources						91,800	187,272	191,017	194,838	198,735	202,709	1,066,371
Reduce tort claims						0	69,000	172,500	241,500	345,000	345,000	1,173,000
TOTAL INFLOWS		0	0	0	0	590,250	1,174,110	1,832,512	2,276,712	2,935,717	2,951,531	8,360,832
CUMULATIVE BENEFITS			0	0	0	590,250	1,764,360	3,596,872	5,873,585	8,809,301	11,760,832	

(1) Reflect all Cost Reduction Benefits except Operations reductions (which are reflected in Cost of Operations).
(2) Total Inflows carries to Form1

Appendix E – Alternative 2 Cost Benefit Analysis

Appendix E provides the completed DIS Forms 1, 3, 4, and 5 for the cost benefit analysis for Alternative 2 under a pay as you go scenario.

Form 1: Summary Cost Benefit and Cash Flow Analysis

	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	GRAND TOTAL
TOTAL OUTFLOWS	(621,622)	872,887	5,615,261	6,499,742	356,913	391,805	1,648,014	1,250,226	549,196	562,596	17,125,018
TOTAL INFLOWS	0	0	0	0	590,250	1,174,110	1,832,512	2,276,712	2,935,717	2,951,531	11,760,832
NET CASH FLOW	621,622	(872,887)	(5,615,261)	(6,499,742)	233,337	782,305	184,498	1,026,487	2,386,521	2,388,935	
INCREMENTAL NPV	NA	(188,159)	(4,869,638)	(9,969,758)	(9,797,436)	(9,253,683)	(9,132,988)	(8,500,981)	(7,118,036)	(5,815,125)	
Cumulative Costs	NA	251,265	5,866,526	12,366,268	12,723,180	13,114,986	14,763,000	16,013,226	16,562,422	17,125,018	
Cumulative Benefits	NA	0	0	0	590,250	1,764,360	3,596,872	5,873,585	8,809,301	11,760,832	

Cost of Capital	Breakeven Period - yrs.* Non-Discounted	Discounted	NPV $	IRR %
6.25%			(5,815,125)	#DIV/0!

* - "Non-Discounted" represents breakeven period for cumulative costs and benefits (no consideration of time value of money).

* - "Discounted" considers effect of time value of money through incremental Net Present Value.

Form 3: Summary Operations Incremental Cost of Project

		FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	GRAND TOTAL
OPERATIONS INCREMENTAL COSTS OF PROJECT (Per Form 4 - Column C)												
Salaries and Wages	(A)	(146,622)	260,445	1,743,666	1,715,292	277,141	265,018	284,262	304,589	326,054	342,357	5,372,202
Employee Benefits	(B)	0	0	0	0	0	0	0	0	0	0	0
Personal Service Contracts	(CA)	0	616,942	3,900,785	3,854,974	0	0	0	0	0	0	8,372,701
Communications	(EB)	0	0	0	0	0	0	0	0	0	0	0
Hardware Rent/Lease	(ED)	0	0	0	0	0	0	0	0	0	0	0
Hardware Maintenance	(EE)	(450,000)	(459,000)	(408,180)	(404,544)	(344,444)	(347,054)	(349,501)	(351,773)	(325,389)	(325,841)	(3,765,727)
Software Rent/Lease	(ED)	0	0	0	0	0	0	0	0	0	0	0
Software Maintenance & Upgrade	(EE)	0	0	33,000	76,450	247,473	259,846	1,488,558	286,480	300,804	315,845	3,008,456
DP Goods/Services	(EL)	0	20,000	92,000	194,100	203,805	213,995	224,695	235,930	247,726	260,113	1,692,364
Goods/Services Not Listed	(E)	(25,000)	(25,500)	(26,010)	(26,530)	(27,061)	0	0	0	0	(29,877)	(159,978)
Travel	(G)	0	0	0	0	0	0	0	0	0	0	0
Hardware Purchase Capitalized	(JC)	0	300,000	50,000	330,000	0	0	0	775,000	0	0	1,455,000
Software Purchase Capitalized	(JC)	0	150,000	190,000	760,000	0	0	0	0	0	0	1,100,000
Hardware Purchase - Non. Cap	(KA)	0	0	0	0	0	0	0	0	0	0	0
Software Purchase - Non. Cap	(KA)	0	0	0	0	0	0	0	0	0	0	0
Hardware Lease/Purchase	(P)	0	0	0	0	0	0	0	0	0	0	0
Software Lease/Purchase	(P)	0	0	0	0	0	0	0	0	0	0	0
Other (specify)	( )	0	10,000	40,000	0	0	0	0	0	0	0	50,000
TOTAL OPERATIONS		(621,622)	872,887	5,615,261	6,499,742	356,913	391,805	1,648,014	1,250,226	549,196	562,596	17,125,018
TOTAL OUTFLOWS		(621,622)	872,887	5,615,261	6,499,742	356,913	391,805	1,648,014	1,250,226	549,196	562,596	17,125,018
CUMULATIVE COSTS			251,265	5,866,526	12,366,268	12,723,180	13,114,986	14,763,000	16,013,226	16,562,422	17,125,018	

(1) Total Outflows the sum of Fiscal Total Operations and Total Development from Form2.
(2) Total Outflows carried to Form1

Form 4: Current versus Proposed Method Operations Costs

		FY 2010			FY 2011			FY 2012			FY 2013			FY 2014		
OPERATIONS COSTS	Obj. Codes	(a) Current	(b) Project	(c) = (b)-(a) Incremental Effect of Project (to summary)	(a) Current	(b) Project	(c) = (b)-(a) Incremental Effect of Project (to summary)	(a) Current	(b) Project	(c) = (b)-(a) Incremental Effect of Project (to summary)	(a) Current	(b) Project	(c) = (b)-(a) Incremental Effect of Project (to summary)	(a) Current	(b) Project	(c) = (b)-(a) Incremental Effect of Project (to summary)
Salaries and Wages (Implementation and Ongoing Support)	(A)	180,954	34,332	(146,622)	184,573	445,018	260,445	188,265	1,931,930	1,743,666	192,030	1,907,322	1,715,292	195,870	473,011	277,141
Employee Benefits (included in salaries & wages)	(B)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Personal Service Contracts (implementation vendor)	(CA)	0	0	0	0	616,942	616,942	0	3,900,785	3,900,785	0	3,854,974	3,854,974	0	0	0
Communications	(EB)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hardware Rent/Lease	(ED)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hardware Maintenance	(EE)	450,000	0	(450,000)	459,000	0	(459,000)	468,180	60,000	(408,180)	477,544	73,000	(404,544)	487,094	142,650	(344,444)
Software Rent/Lease	(ED)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Software Maintenance & Upgrade (ongoing licensing)	(EE)	0	0	0	0	0	0	0	33,000	33,000	0	76,450	76,450	0	247,473	247,473
DIS Goods/Services - - Centralized Data Processing Costs	(EL)	0	0	0	0	20,000	20,000	0	92,000	92,000	0	194,100	194,100	0	203,805	203,805
Goods/Services Not Listed	(E)	25,000	0	(25,000)	25,500	0	(25,500)	26,010	0	(26,010)	26,530	0	(26,530)	27,061	0	(27,061)
Travel	(G)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hardware Purchase Capitalized	(JC)	0	0	0	0	300,000	300,000	0	50,000	50,000	0	330,000	330,000	0	0	0
Software Purchase Capitalized (s/w acquisition)	(JC)	0	0	0	0	150,000	150,000	0	190,000	190,000	0	760,000	760,000	0	0	0
Hardware Purchase - Non. Cap	(KA)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Software Purchase - Non. Cap	(KA)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hardware Lease/Purchase	(P)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Software Lease/Purchase	(P)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other (specify) Facilities for training & project team)	( )	0	0	0	0	10,000	10,000	0	40,000	40,000	0	0	0	0	0	0
TOTAL OPERATION COSTS		655,954	34,332	(621,622)	669,073	1,541,960	872,887	682,455	6,297,715	5,615,261	696,104	7,195,845	6,499,742	710,026	1,066,939	356,913
FTE'S				0			0			0			0			0

Form 4: Current versus Proposed Method Operations Costs (continued)

		FY 2015			FY 2016			FY 2017			FY 2018			FY 2019		
OPERATIONS COSTS	Obj. Codes	(a) Current	(b) Project	(c) = (b)-(a) Incremental Effect of Project (to summary)	(a) Current	(b) Project	(c) = (b)-(a) Incremental Effect of Project (to summary)	(a) Current	(b) Project	(c) = (b)-(a) Incremental Effect of Project (to summary)	(a) Current	(b) Project	(c) = (b)-(a) Incremental Effect of Project (to summary)	(a) Current	(b) Project	(c) = (b)-(a) Incremental Effect of Project (to summary)
Salaries and Wages	(A)	199,788	464,806	265,018	203,784	488,046	284,262	207,859	512,448	304,589	212,016	538,071	326,054	222,617	564,974	342,357
Employee Benefits (included in salaries & wages)	(B)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Personal Service Contracts (implementation vendor)	(CA)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Communications	(EB)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hardware Rent/Lease	(ED)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hardware Maintenance	(EE)	496,836	149,783	(347,054)	506,773	157,272	(349,501)	516,909	165,135	(351,773)	527,247	201,858	(325,389)	537,792	211,951	(325,841)
Software Rent/Lease	(ED)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Software Maintenance & Upgrade (ongoing licensing)	(EE)	0	259,846	259,846	0	1,488,558	1,488,558	0	286,480	286,480	0	300,804	300,804	0	315,845	315,845
DIS Goods/Services -- Centralized Data Processing Costs	(EL)	0	213,995	213,995	0	224,695	224,695	0	235,930	235,930	0	247,726	247,726	0	260,113	260,113
Goods/Services Not Listed	(E)	27,602	0	0	28,154	o	0	28,717	0	0	29,291	0	0	29,877	0	(29,877)
Travel	(G)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hardware Purchase Capitalized	(JC)	0	0	0	0	0	0	0	775,000	775,000	0	0	0	0	0	0
Software Purchase Capitalized (s/w acquisition)	(JC)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hardware Purchase - Non. Cap	(KA)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Software Purchase - Non. Cap	(KA)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hardware Lease/Purchase	(P)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Software Lease/Purchase	(P)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other (specify) Facilities for training & project team)	( )	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL OPERATION COSTS		724,226	1,088,430	391,805	738,711	2,358,571	1,648,014	753,485	1,974,994	1,250,226	768,555	1,288,459	549,196	790,286	1,352,882	562,596
FTE'S				0			0			0			0			0

(1) FY__ Column (c) for each Cost Code carried to Form3

Form 5: Benefits Cash Flow Analysis

TANGIBLE BENEFITS	OFM Object Codes	BENEFITS FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	TOTAL
Hard $												
Revenues (specify)	(revenue codes)	0	0	0	0	0	0					0
Reimbursements (specify)	(object codes)	0	0	0	0	0	0					0
Cost Reduction (specify) (1)	(object codes)	0	0	0	0	0	0					0
Elimination of mainframe		0	0	0	0	450,000	459,000	468,180	477,544	487,094	496,836	2,838,654
Other (specify)	(object codes)	0	0	0	0	0	0					0
Soft $												0
Cost Avoidance (specify)	(object codes)	0	0	0	0	0	0					0
Improved project scoping						0	160,000	400,000	560,000	800,000	800,000	2,720,000
Lifecycle asset management						0	200,000	500,000	700,000	1,000,000	1,000,000	3,400,000
Redirect staff due to automation						24,225	49,419	50,407	51,416	52,444	53,493	281,403
Redirect staff due to reduced research effort						24,225	49,419	50,407	51,416	52,444	53,493	281,403
Redirect IT resources						91,800	187,272	191,017	194,838	198,735	202,709	1,066,371
Reduce tort claims						0	69,000	172,500	241,500	345,000	345,000	1,173,000
Other (specify)	(object codes)	0	0	0	0	0	0					0
TOTAL INFLOWS		0	0	0	0	590,250	1,174,110	1,832,512	2,276,712	2,935,717	2,951,531	11,760,832
CUMULATIVE BENEFITS			0	0	0	590,250	1,764,360	3,596,872	5,873,585	8,809,301	11,760,832	

(1) Reflect all Cost Reduction Benefits except Operations reductions (which are reflected in Cost of Operations).

(2) Total Inflows carries to Form1

Appendix F – Alternative 3 Cost Benefit Analysis

Appendix F provides the completed DIS Forms 1, 3, 4 and 5 for the cost benefit analysis for Alternative 3 under a pay as you go scenario.

Form 1: Summary Cost Benefit and Cash Flow Analysis

	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	GRAND TOTAL
TOTAL OUTFLOWS	(621,622)	872,887	5,680,761	6,501,542	391,013	427,610	1,685,610	1,289,701	590,645	612,477	17,430,623
TOTAL INFLOWS	0	0	0	0	590,250	1,174,110	1,832,512	2,276,712	2,935,717	2,951,531	11,760,832
NET CASH FLOW	621,622	(872,887)	(5,680,761)	(6,501,542)	199,237	746,500	146,903	987,012	2,345,072	2,339,054	
INCREMENTAL NPV	NA	(188,159)	(4,924,246)	(10,025,778)	(9,878,640)	(9,359,773)	(9,263,672)	(8,655,970)	(7,297,044)	(6,021,337)	
Cumulative Costs	NA	251,265	5,932,026	12,433,568	12,824,580	13,252,191	14,937,800	16,227,501	16,818,146	17,430,623	
Cumulative Benefits	NA	0	0	0	590,250	1,764,360	3,596,872	5,873,585	8,809,301	11,760,832	

Cost of Capital	Breakeven Period - yrs.* Non-Discounted	Discounted	NPV $	IRR %
6.25%			(6,021,337)	#NUM!

* - "Non-Discounted" represents breakeven period for cumulative costs and benefits (no consideration of time value of money).
* - "Discounted" considers effect of time value of money through incremental Net Present Value.

Form 3: Summary Operations Incremental Cost of Project

		FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	GRAND TOTAL
OPERATIONS INCREMENTAL COSTS OF PROJECT (Per Form 4 - Column C)												
Salaries and Wages	(A)	(146,622)	260,445	1,743,666	1,715,292	277,141	265,018	284,262	304,589	326,054	348,717	5,378,562
Employee Benefits	(B)	0	0	0	0	0	0	0	0	0	0	0
Personal Service Contracts	(CA)	0	616,942	3,866,285	3,784,774	0	0	0	0	0	0	8,268,001
Communications	(EB)	0	0	0	0	0	0	0	0	0	0	0
Hardware Rent/Lease	(ED)	0	0	0	0	0	0	0	0	0	0	0
Hardware Maintenance	(EE)	(450,000)	(459,000)	(408,180)	(404,544)	(344,444)	(347,054)	(349,501)	(351,773)	(325,389)	(325,841)	(3,765,727)
Software Rent/Lease	(ED)	0	0	0	0	0	0	0	0	0	0	0
Software Maintenance & Upgrade	(EE)	0	0	33,000	98,450	281,573	295,651	1,526,154	325,955	342,253	359,366	3,262,402
DP Goods/Services	(EL)	0	20,000	92,000	194,100	203,805	213,995	224,695	235,930	247,726	260,113	1,692,364
Goods/Services Not Listed	(E)	(25,000)	(25,500)	(26,010)	(26,530)	(27,061)	0	0	0	0	(29,877)	(159,978)
Travel	(G)	0	0	0	0	0	0	0	0	0	0	0
Hardware Purchase Capitalized	(JC)	0	300,000	50,000	330,000	0	0	0	775,000	0	0	1,455,000
Software Purchase Capitalized	(JC)	0	150,000	290,000	810,000	0	0	0	0	0	0	1,250,000
Hardware Purchase - Non. Cap	(KA)	0	0	0	0	0	0	0	0	0	0	0
Software Purchase - Non. Cap	(KA)	0	0	0	0	0	0	0	0	0	0	0
Hardware Lease/Purchase	(P)	0	0	0	0	0	0	0	0	0	0	0
Software Lease/Purchase	(P)	0	0	0	0	0	0	0	0	0	0	0
Other (specify)	( )	0	10,000	40,000	0	0	0	0	0	0	0	50,000
TOTAL OPERATIONS		(621,622)	872,887	5,680,761	6,501,542	391,013	427,610	1,685,610	1,289,701	590,645	612,477	17,430,623
TOTAL OUTFLOWS		(621,622)	872,887	5,680,761	6,501,542	391,013	427,610	1,685,610	1,289,701	590,645	612,477	17,430,623
CUMULATIVE COSTS			251,265	5,932,026	12,433,568	12,824,580	13,252,191	14,937,800	16,227,501	16,818,146	17,430,623	

(1) Total Outflows the sum of Fiscal Total Operations and Total Development from Form2.
(2) Total Outflows carried to Form1

Form 4: Current versus Proposed Method Operations Costs

		FY 2010			FY 2011			FY 2012			FY 2013			FY 2014		
OPERATIONS COSTS	Obj. Codes	(a) Current	(b) Project	(c) = (b)-(a) Incremental Effect of Project (to summary)	(a) Current	(b) Project	(c) = (b)-(a) Incremental Effect of Project (to summary)	(a) Current	(b) Project	(c) = (b)-(a) Incremental Effect of Project (to summary)	(a) Current	(b) Project	(c) = (b)-(a) Incremental Effect of Project (to summary)	(a) Current	(b) Project	(c) = (b)-(a) Incremental Effect of Project (to summary)
Salaries and Wages (Implementation and Ongoing Support)	(A)	180,954	34,332	(146,622)	184,573	445,018	260,445	188,265	1,931,930	1,743,666	192,030	1,907,322	1,715,292	195,870	473,011	277,141
Employee Benefits (included in salaries & wages)	(B)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Personal Service Contracts (implementation vendor)	(CA)	0	0	0	0	616,942	616,942	0	3,866,285	3,866,285	0	3,784,774	3,784,774	0	0	0
Communications	(EB)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hardware Rent/Lease	(ED)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hardware Maintenance	(EE)	450,000	0	(450,000)	459,000	0	(459,000)	468,180	60,000	(408,180)	477,544	73,000	(404,544)	487,094	142,650	(344,444)
Software Rent/Lease	(ED)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Software Maintenance & Upgrade (ongoing licensing)	(EE)	0	0	0	0	0	0	0	33,000	33,000	0	98,450	98,450	0	281,573	281,573
DIS Goods/Services -- Centralized Data Processing Costs	(EL)	0	0	0	0	20,000	20,000	0	92,000	92,000	0	194,100	194,100	0	203,805	203,805
Goods/Services Not Listed	(E)	25,000	0	(25,000)	25,500	0	(25,500)	26,010	0	(26,010)	26,530	0	(26,530)	27,061	0	(27,061)
Travel	(G)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hardware Purchase Capitalized	(JC)	0	0	0	0	300,000	300,000	0	50,000	50,000	0	330,000	330,000	0	0	0
Software Purchase Capitalized (s/w acquisition)	(JC)	0	0	0	0	150,000	150,000	0	290,000	290,000	0	810,000	810,000	0	0	0
Hardware Purchase - Non. Cap	(KA)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Software Purchase - Non. Cap	(KA)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hardware Lease/Purchase	(P)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Software Lease/Purchase	(P)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other (specify) Facilities for training & project team)	( )	0	0	0	0	10,000	10,000	0	40,000	40,000	0	0	0	0	0	0
TOTAL OPERATION COSTS		655,954	34,332	(621,622)	669,073	1,541,960	872,887	682,455	6,363,215	5,680,761	696,104	7,197,645	6,501,542	710,026	1,101,039	391,013
FTE'S				0			0			0			0			0

Form 4: Current versus Proposed Method Operations Costs (continued)

		FY 2015			FY 2016			FY 2017			FY 2018			FY 2019		
OPERATIONS COSTS	Obj. Codes	(a) Current	(b) Project	(c) = (b)-(a) Incremental Effect of Project (to summary)	(a) Current	(b) Project	(c) = (b)-(a) Incremental Effect of Project (to summary)	(a) Current	(b) Project	(c) = (b)-(a) Incremental Effect of Project (to summary)	(a) Current	(b) Project	(c) = (b)-(a) Incremental Effect of Project (to summary)	(a) Current	(b) Project	(c) = (b)-(a) Incremental Effect of Project (to summary)
Salaries and Wages	(A)	199,788	464,806	265,018	203,784	488,046	284,262	207,859	512,448	304,589	212,016	538,071	326,054	216,257	564,974	348,717
Employee Benefits (included in salaries & wages)	(B)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Personal Service Contracts (implementation vendor)	(CA)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Communications	(EB)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hardware Rent/Lease	(ED)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hardware Maintenance	(EE)	496,836	149,783	(347,054)	506,773	157,272	(349,501)	516,909	165,135	(351,773)	527,247	201,858	(325,389)	537,792	211,951	(325,841)
Software Rent/Lease	(ED)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Software Maintenance & Upgrade (ongoing licensing)	(EE)	0	295,651	295,651	0	1,526,154	1,526,154	0	325,955	325,955	0	342,253	342,253	0	359,366	359,366
DIS Goods/Services -- Centralized Data Processing Costs	(EL)	0	213,995	213,995	0	224,695	224,695	0	235,930	235,930	0	247,726	247,726	0	260,113	260,113
Goods/Services Not Listed	(E)	27,602	0	0	28,154	o	0	28,717	0	0	29,291	0	0	29,877	0	(29,877)
Travel	(G)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hardware Purchase Capitalized	(JC)	0	0	0	0	0	0	0	775,000	775,000	0	0	0	0	0	0
Software Purchase Capitalized (s/w acquisition)	(JC)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hardware Purchase - Non. Cap	(KA)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Software Purchase - Non. Cap	(KA)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hardware Lease/Purchase	(P)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Software Lease/Purchase	(P)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other (specify) Facilities for training & project team)	( )	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL OPERATION COSTS		724,226	1,124,235	427,610	738,711	2,396,166	1,685,610	753,485	2,014,469	1,289,701	768,555	1,329,908	590,645	783,926	1,396,403	612,477
FTE'S				0			0			0			0			0

(1) FY__ Column (c) for each Cost Code carried to Form3

Form 5: Benefits Cash Flow Analysis

		BENEFITS										
TANGIBLE BENEFITS	OFM Object Codes	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	TOTAL
Hard $												
Revenues (specify)	(revenue codes)	0	0	0	0	0	0					0
Reimbursements (specify)	(object codes)	0	0	0	0	0	0					0
Cost Reduction (specify) (1)	(object codes)	0	0	0	0	0	0					0
Elimination of mainframe		0	0	0	0	450,000	459,000	468,180	477,544	487,094	496,836	2,838,654
Other (specify)	(object codes)	0	0	0	0	0	0					0
Soft $												0
Cost Avoidance (specify)	(object codes)	0	0	0	0	0	0					0
Improved project scoping						0	160,000	400,000	560,000	800,000	800,000	2,720,000
Lifecycle asset management						0	200,000	500,000	700,000	1,000,000	1,000,000	3,400,000
Redirect staff due to automation						24,225	49,419	50,407	51,416	52,444	53,493	281,403
Redirect staff due to reduced research effort						24,225	49,419	50,407	51,416	52,444	53,493	281,403
Redirect IT resources						91,800	187,272	191,017	194,838	198,735	202,709	1,066,371
Reduce tort claims						0	69,000	172,500	241,500	345,000	345,000	1,173,000
Other (specify)	(object codes)	0	0	0	0	0	0					0
TOTAL INFLOWS		0	0	0	0	590,250	1,174,110	1,832,512	2,276,712	2,935,717	2,951,531	11,760,832
CUMULATIVE BENEFITS			0	0	0	590,250	1,764,360	3,596,872	5,873,585	8,809,301	11,760,832	

(1) Reflect all Cost Reduction Benefits except Operations reductions (which are reflected in Cost of Operations).
(2) Total Inflows carries to Form1

Transportation Asset Management
Feasibility Study

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