Rural Traveler Information Phase 1:

Rural Traveler Information Needs Assessment and Pilot Study

Final Report

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EXECUTIVE SUMMARY

Real-time traveler information services have thrived in two primary contexts: urban-focused systems and regional systems. Urban systems, strengthened by an extensive sensing and technology infrastructure, are able to offer significant volumes of information, updated at regular frequencies. Regional systems offer information over a larger geographic area, and can therefore more readily serve travelers on less regular trips, such as recreational or longer distance travel. However, these systems generally provide information on specific areas or highway segments, meaning that prospective travelers may need to consult multiple links to determine the travel conditions they will experience, and make a prudent decision regarding when to leave, which route to take, and how to prepare for the trip.

The objective of this project was to put a variety of route-oriented real-time and near real-time information together in a single web-based location in a user-friendly format that does not stop at jurisdictional boundary lines (state, district or county lines, for example). This would allow travelers making a trip in or through rural areas to have current travel information on a route-specific basis and across a wide geographic area, customized for a specific origin and destination, which will help them to make their trip more safely and with a minimum of delay. This project focused on a limited geographic area -Caltrans District 1 and District 2, and Oregon - to provide a proof-of-concept of this approach. While this scale of implementation will yield some direct benefits for the selected area, researchers believe that the principal value of this effort is in demonstrating the feasibility and attractiveness of a One-Stop Shop website for real-time route-specific traveler information for rural areas. This report presents the results of work culminating in the development of a prototype website. Project tasks included a review of practice, compilation of concept of operations and website requirements documents, and development of the prototype website.

Based on the information identified during the course of the review of practice, no work had been performed that provided users with all available traveler information in one location *and* the ability to specify an origin/destination without regard to jurisdictional boundaries or political subdivisions and receive all available information for the route(s) they would travel. While some states did provide all of their available information in one location, users were still required to identify their route(s) of interest in order to obtain all available information and were limited to travel within the state. No state had taken the final step of developing a website that provides route-specific information. As a result, research and development related to such a website was clearly needed.

The high-level concept of operations for the One-Stop Shop prototype specified that the website should provide users with a mechanism to specify their origin and destination, which would link them to a map displaying recommended routing as well as all available traveler information. This would eliminate the need for users to identify their routing and seek available data for their trip through the traditional, manual approach. Based on the concept of operations, the research team established requirements to guide the development of the One-Stop Shop website. Requirements translated the system concept/concept of operations into a series of statements describing what the system should do to accomplish its intended function. The requirements topics applicable to this work included functional, performance, interface, data, and enabling aspects of the website.

The research team developed the prototype One-Stop Shop using various data elements from sources within Caltrans and the Oregon Department of Transportation, as well as from other

agencies such as the California Highway Patrol that provide wide coverage in the rural areas of Caltrans District 1 and District 2, and Oregon. The user interface created for the prototype was a web-based map built using Google Maps. Custom markers (icons) presented point-based information such as commercial vehicle enforcement sites, CCTV camera images, incident and construction locations, and dynamic sign messages in their appropriate locations. Raster graphics were superimposed on the map to represent data such as forecast conditions over the region of interest. The system incorporated a route planner, which allowed the user to select a route via Google Maps; it then displayed an elevation profile of the route along with select data layers including forecast information. The system used Dynamic HTML, Javascript and general AJAX (asynchronous JavaScript and XML) capability to retrieve and display data on the map, and for periodic updates of the displayed data. This display was accomplished with Dynamic HTML, CSS, Javascript and Flash.

When first accessing the One-Stop Shop website, a user sees a view of the region which displays a series of icons related to DOT field elements, including CCTV camera images, CMS messages, incident and construction locations, RWIS station sites, and chain requirements (during winter weather). In addition to the default information presented, the user may toggle on or off additional data streams. These streams include current and forecast weather for the region, and the location of mountain passes, vista (scenic) points, rest areas and truck scales (commercial vehicle sites). When a user selects any of the active icons on the display, the site-specific information associated with the icon is presented.

Finally, users are presented with a mechanism to enter their origin and destination for custom route mapping. When selected, this feature provides users with an overview of their route, the selected elements of interest on that route, and map points indicating the specified origin and destination. The user also is provided with an option to generate a route profile. When selected, this feature displays forecasted weather for the displayed area and a profile (elevation and distance) of the route. This ability to specify a route in order to identify and view information along it and display its profile represents a significant departure from the approach presented by currently available DOT traveler information websites.

1. INTRODUCTION

Transportation challenges within urban areas often attract significant attention, because the scale and location of these challenges affect large numbers of Americans on a daily basis. With the emphasis on urban areas, the transportation needs of rural areas are often ignored. It is often assumed that solutions to urban transportation challenges can be implemented in rural areas. This is typically not the case, as the unique characteristics of rural transportation preclude the application of urban solutions.

The use of real-time traveler information represents one class of solutions to address mobility and safety challenges. Significant improvements in sensing, communications and computational technology over the last fifteen years have resulted in the proliferation of information regarding the performance of the transportation system. With rapidly increasing construction costs and the difficulties associated with adding capacity, state transportation agencies have increasingly adopted an "operations" approach to their highway networks, focusing on improving the use of existing assets. The real-time information capability offered by new technologies can help agencies to manage the system more efficiently. In addition, this information can help travelers to make more informed decisions to minimize their delay and enhance their safety.

Real-time traveler information services have thrived in two primary contexts: urban-focused systems and regional systems. Urban systems, strengthened by an extensive sensing and technology infrastructure, are able to offer significant volumes of information, updated at regular frequencies. These systems focus on shorter-distance trips within metropolitan areas, primarily during peak travel periods associated with work commute trips. Regional systems offer information over a larger geographic area, and can therefore more readily serve travelers on less regular trips, such as recreational or longer distance travel. However, these systems generally provide information on specific areas or highway segments within a specific jurisdiction, meaning that prospective travelers may need to consult dozens of links to determine the travel conditions they will experience, and make a prudent decision regarding when to leave, which route to take, and how to prepare for the trip.

Neither urban systems nor regional systems efficiently serve the rural traveler, whose trip may span a great distance between and/or through urban areas. In addition, these types of systems are typically designed to conform to specific jurisdictional lines, whereas rural trips typically span multiple jurisdictions. While many rural agencies and districts have sought to provide traveler information, there is considerable variation in the level of information provided and how to access it.

In terms of transportation funding and political support, rural travel needs generally rate as lower priorities than those of urban travelers. However, California's rural travel needs merit consideration for a variety of reasons. First, 19 percent of vehicle–miles traveled in California are on rural highways (1), even though less than 6 percent of California residents live in areas classified by the U.S. Census Bureau as rural (2). Second, movement of goods is primarily interurban and requires accurate real-time traveler information to ensure timely delivery of freight to markets and factories. Third, the lack of alternative routes in rural areas means that motorists may experience delays of hours or even days during catastrophic events, which can have significant mobility (and even health and safety) implications.

To address these challenges, this document discusses work undertaken to develop a One-Stop Shop for rural traveler information. At a high level, this will be a web-based platform that will provide route-specific, real-time, highway-based traveler information based on an origin and destination specified by the user.

1.1. Background

Caltrans has shown an interest in improving traveler information for drivers on all of California's highways, including those in rural areas. For example, the rural California/Oregon Advanced Transportation Systems (COATS) project has focused on investigating technological applications for addressing the unique transportation challenges present in the rural regions of Northern California and Southern Oregon. The project's boundaries spanned two states, multiple maintenance districts within each state, and involved dozens of agencies.

The project's first phase, initiated in 1998, placed significant importance on understanding traveler needs. WTI conducted traveler information needs surveys at nearly two dozen rest areas in southern Oregon and northern California, and conducted outreach to dozens of agencies. The results of the project, completed in 2001, included early-winner demonstrations of intelligent transportation systems (ITS) in rural areas, as well as an ITS strategic deployment plan to improve traveler information in rural areas.

The initial COATS effort was followed by COATS Showcase, a demonstration and evaluation effort funded by Caltrans and WTI, which ran from 2000–2005. This was followed by COATS Phase 3, which focused on further demonstration of ITS as well as technology transfer. All phases of the COATS project have included efforts to improve traveler information, especially across jurisdictional boundaries. As a result, there have been several successful deployments of innovative ITS technologies and traveler information system enhancements in the region.

A specific effort within COATS Phase 3, called Rural Integrated Corridor Management (ICM), also dovetailed effectively with the research of this project. The rural ICM project sought to develop a pilot mechanism to employ integrated corridor management on a rural highway. The test corridor included two primary routes connecting Eugene, Oregon, and Weed, California: Interstate 5, and Oregon 58/US Route 97. To facilitate corridor management, a data platform was established to strengthen center-to-center communications. This data platform provided a location where data could be stored and read on a real-time basis, with common data formats for ready use by different agencies. This data platform has established a framework for the One-Stop Shop, and has also gathered some of the data that will be conveyed to travelers.

1.2. Project Motivation

Two of Caltrans' overarching goals include (3):

- Safety: Provide the safest transportation system in the nation for users and workers
- Mobility: Maximize transportation system performance and accessibility

Real-time traveler information is a valuable tool in maintaining and enhancing both traveler safety and mobility, even in rural areas. From a safety perspective, it is important for rural travelers to know about potential challenges that may impact their trip, including snow, ice, high winds, fires and other hazards. These same challenges also degrade mobility, along with other events such as vehicle crashes and work zones. While such information may currently be

available through a variety of sources, the type, quality, and timeliness of data is not consistent. In addition, the information is generally scattered over numerous web-based (and sometimes non web-based) sources or provided by different agencies/jurisdictions, meaning travelers must spend significant amounts of time searching for and assembling updates before making a trip. As a result of the effort involved, many rural travelers do not seek out any or all of the information they need. This may result in increased delays and degraded safety for the traveler.

The objective of this project, therefore, is to put a variety of real-time and near real-time information together in a single web-based location in a user-friendly format. This will allow travelers making a trip in or through rural areas to have current travel information on a route-specific basis, customized for a specific origin and destination, which will help them to make their trip more safely and with a minimum of delay. To date, no agency has put a variety of route-oriented real-time and near real-time information together in a single web-based location in a user-friendly format that does not stop at jurisdictional boundary lines (state, district or county lines, for example). While some states provide all of their available information in one location, that information conforms to jurisdictional boundaries and does not cross state borders to a significant extent or provide a mechanism to identify information by a specific routing.

This research is focused on a limited geographic area - Caltrans District 1, District 2 and Oregon - to provide a proof-of-concept of this approach. While this scale of implementation will yield some direct benefits for the selected area, the researchers believe that the principal value of this effort is in demonstrating the feasibility and attractiveness of a One-Stop Shop for real-time route-specific traveler information for rural areas. The proof-of-concept will be designed in a scalable fashion, so that the concept may be expanded to other routes and states. Ultimately, as larger geographic areas are covered, this could become an umbrella traveler information website, which could be used as a primary point of reference for longer distance trips, with travelers interested in shorter trips looking at other websites for information. This could revolutionize traveler information, improving safety and mobility for all highway system users.

1.3. Project Tasks

As proposed, the One-Stop Shop project consisted of six tasks (not including Project Management). These included:

- *Task 1: Attend COATS Steering Committee Meeting*, to effectively coordinate efforts with the COATS project. This work was completed in November of 2008;
- *Task 2: Assess Traveler Needs*, which includes a literature review, an examination of traveler information web sites, and traveler surveys. In this report, the results of this task are referred to as Review of Practice;
- *Task 3: Develop Concept of Operations Document*, which provides a high-level, user-oriented perspective on how the One-Stop Shop will work;
- *Task 4: Develop Requirements Document*, which translates the concept of operations document into a series of statements describing what the system shall do;
- *Task 5: Develop Prototype Information Delivery Mechanism*, to gain feedback from the technical panel; and
- *Task 6: Submit Final Report*, which includes print and electronic deliverables, as well as a workshop presentation.

During the course of completing this project, a slight change was made to its scope. This included a scaling-back of Task 2, with the exclusion of traveler surveys. Instead, it was determined that a prototype website should be developed to display a proof-of-concept to travelers for evaluation and comment during a future phase of the project. Although not completed during the course of this project, a series of traveler survey questions have been developed for use in evaluations conducted in future project phases. These questions are presented in Appendix A.

1.4. Report Overview

This report is organized into six chapters. Chapter One provides an introduction and background on the problem of interest. Chapter Two provides a review of practice related to the provision of traveler information, both from a research perspective as well as the current practices of transportation agencies. Chapter Three provides an overview of the concept of operations developed during the project, while Chapter Four presents a high-level overview of the website requirements. Chapter Five discusses the development of the prototype website and provides an overview of its functions. Chapter Six discusses the conclusions drawn from the project, as well as the challenges encountered and recommendations for future work.

2. REVIEW OF PRACTICE

Before undertaking the development of the prototype one-stop shop, the research team conducted a review of current practice. The objectives were to determine the availability of any published reports or documents regarding the present and future provision of comprehensive web-based traveler information (literature review), as well to evaluate state department of transportation traveler information websites. The information compiled by this review was presented in a stand-alone technical memorandum, titled *Rural Traveler Information Needs Assessment and Pilot Study: Assessment of State Traveler Information* (4). Significant information discussed in that document is summarized in the following sections of this chapter.

2.1. Literature Review

The literature review performed for this project focused on aspects related to web-based traveler information. It was found that the body of published information (papers, reports, etc.) related to this subject was somewhat limited. The primary focus of the literature review was on past work related to the provision of information via the Internet. In addition, potential uses for web-based traveler information and lessons learned were evaluated. The primary conclusion that was drawn from the literature review (and the survey of state practices that follows later) was that no website existed (in early 2009 when the review was completed) that provided a single, one stop location at which to obtain all available traveler information for a specific route.

2.1.1. Traveler Information Website Development

Seymour and Miller noted that there was no commonly accepted standard for posting information concerning travel times, incidents, traffic volumes, video images or other traffic management center (TMC) content on the Internet at the time of their work (2006)[1] (5). The result was that the opportunity to provide such information via personal computers and mobile devices was lost. The authors discussed one approach to remedy this shortcoming, specifically the Dallas Transportation Management Center's (DalTrans) website effort that utilized an embedded Google map to provide traveler information. The web site provided information including roadway segment speeds, camera images, incident information, light rail locations and satellite imagery (1).

Wu and Wang noted that web-based mapping technologies employed in providing traveler information often focus on freeway segments, neglecting arterials and urban streets (6). To address this, the authors developed a Google maps based platform to provide arterial traveler information and to facilitate analysis activities (performance of urban streets, identification of bottlenecks). The platform made use of open source software for online data archiving.

[1] While Seymour and Miller indicated that no accepted standard existed at the time of their work, this was not necessarily the case. The Traffic Management Data Dictionary (TMDD) standard has been in existence since 2005. Oregon's TripCheck has been using the TMDD XML standard for at least 5 years, which also contradicts the finding of Seymour and Miller.

2.1.2. Web-based Traveler Information Uses

The Federal Highway Administration published a brochure providing an overview of Advanced Traveler Information Systems (ATIS) that included summaries of studies of customer satisfaction and use of these systems, including websites (7). Topics discussed included the use of traveler information in managing commuter travel and demand, lessons learned from past experiences, and future directions for traveler information. Additionally, the report discussed how traveler information can influence the choices that commuters make, including the influence of the time(s) a trip is made, the route(s) chosen, and the mode employed (7).

Ramachandran and Al-Deek identified ATIS as a possible solution to reduce traffic congestion on freeways. This would be accomplished through the provision of pre-trip planning information and route choices to transport system users through the development of an Internet based spatial data warehousing approach (8). Their work demonstrated how various technologies could be integrated, including Geographic Information Systems (GIS), Database Management Systems (DBMS), multimedia applications, and the Internet to provide a user-friendly traveler information website (8). The application developed for the research provided current traffic conditions, predicted travel-time, and provided CCTV images, DMS messages, construction reports, and evacuation information (8).

Fayish and Jovanis studied web-based delivery of roadway weather information to travelers in Pennsylvania (9). The research surveyed 98 travelers to evaluate the effectiveness of the presentation of roadway and weather information on the Internet. The authors concluded that the most important aspect for users was to minimize the amount of time spent searching for information. Clear presentation and easy access to features also played an important role in user satisfaction.

2.1.3. Lessons Learned

Petrella and Lapin performed a comparative analysis of customer response to online traffic information in the Los Angeles and Seattle regions through an online survey (10). Results found that users of online traveler information were similar between both regions, with a tendency to be males, well-educated, upper income, employed, 26-45 years of age and technologically savvy. Location did play a role in expectations, however. Seattle users indicated that online traveler information would save them time and reduce stress. Greater congestion and volatility in Los Angeles increased customer demand for up-to-the minute information and undermined customers' expectation that any information service can provide much relief (10).

Youngbin, Khattak and Raw examined how ATIS systems could affect the behavioral habits of travelers (11). The study focused on the lessons learned by TravInfo, an ATIS located in the San Francisco Bay Area. The researchers examined evidence from several behavioral surveys conducted in the San Francisco Bay Area between 1995 and 1999, finding that two-thirds of respondents used a variety of information sources to obtain travel information during the pre-trip as well as en-route stages.

2.2. Traveler Information Website Review

The researchers visited the websites of all state Department's of Transportation (DOTs) during late 2008 and early 2009 to determine what information was being provided to travelers and how it was presented. They observed a great variation in the information provided by DOTs. Some

states provided comprehensive information in one location, while other states employed a scattered approach, where information was provided on multiple websites by category (for example weather). Website data elements were identified by ten categories, which included:

- Road Weather Information System (RWIS);
- Closed circuit television cameras (CCTV);
- Message signs – Dynamic Message Sign (DMS) or Changeable Message Sign (CMS);
- Current road conditions;
- Incident location and type;
- General information –rest area locations, emergency services, etc.;
- Supplemental text to map-based data;
- Single website with information provided on one webpage;
- Traffic Speed Sensors; and
- Map Interface.

Based on the review of state websites and the number of states that presented a specific item of interest, a ranked list of state emphasis was compiled, which is presented in Table 2-1.

Table 2-1: Ranked state activities based on information streams provided

Rank	Feature	Description	Number of States
1	Map Interface	Provision of a map-based display of traveler informaiton	46
2	Supplemental Text	Provision of descriptive text (displayed either as a pop-up balloon or on a separate webpage) to describe conditions (weather, construction, etc.)	45
3	CCTV	Closed Circuit Television images (static or streaming)	42
4	Incidents	Display of location/information on incidents (ex. accidents)	40
5	Current Road Conditions	Current condition of roadway during weather events	37
6	RWIS	Road Weather Information Systems data (displayed either as a pop-up balloon or on a separate webpage)	25
7	Traffic Speed Sensors	Provision of speed-data from sensor locations along a route	18
8	Single Website	Provision of all available travewler information in one website	16
9	Dynamic Message Signs	Provision of current messages posted to DMS	12
9	General Info	Provision of additional information of interest to travelers (ex. rest area locations)	12

The review found that the majority of states presented web-based traveler information through some type of map interface. The interface employed a customized format or a mapping tool from Google or Microsoft. Similarly, a majority of states also provided text to supplement the

map-based information displayed. This supplemental text was primarily descriptive information displayed in a tabular format.

CCTV, incident locations, and current road conditions were also common data streams provided by states. Most states provided these features in a map-based format, although in some instances (incidents, road conditions), information could be provided in a textual format. As one would expect, a majority of the camera images cover urban areas, although some states did provide rural CCTV coverage. Given the nature of incident information (i.e. it can occur anywhere at any time), statewide coverage was provided by most of the websites visited. Current road condition information, which was also primarily map-based, had differing levels of coverage. This likely stemmed from the location of data sources (RWIS) and level of reporting during an event (i.e. how often plow drivers report segment condition).

States provided the remaining feature items on a sporadic basis. Half of all states provided information produced from RWIS sites on their traveler information websites. Only 18 states provided information from traffic speed sensors, and the coverage was primarily for urban areas only. Even fewer states provided the text of displayed DMS messages. Finally, only a limited set of states provided general traveler information such as rest area locations in any format.

Only 16 states provided all available traveler information in one central location; most require a user to visit subpages within the main traveler information website. Consequently, the majority of states have not pursued the opportunity to create a One-Stop Shop (or similar format) for traveler information. Instead, the user is often required to navigate multiple pages (and occasionally, websites) to find specific information that may be of interest to them.

2.3. Summary

Based on the information identified during the course of the review of practice, no work has put a variety of route-oriented real-time and near real-time information together in a single web-based location in a user-friendly format that does not stop at jurisdictional boundary lines (state, district or county lines, for example). This would allow travelers making a trip in or through rural areas to have current travel information on a route-specific basis and across a wide geographic area, customized for a specific origin and destination, which will help them to make their trip more safely and with a minimum of delay While some states did provide all of their available information in one location, that information conformed to jurisdictional boundaries and did not provide a mechanism to identify information by a specific routing. Consequently, users needed to identify their route(s) of interest in order to obtain all available information, and that was limited to information specific only to a single jurisdiction. No state had taken the final step of developing a website that provided route-specific information, let alone one which provided data from across neighboring state borders. As a result, research and development related to such a website was clearly needed.

3. CONCEPT OF OPERATIONS

The initial step in creating the prototype One-Stop Shop was the development of a concept of operations document. This concept of operations provided a high-level, user-oriented perspective on how the One-Stop Shop would work. It served as an important guidance document, because it assisted the research team in prioritizing which data elements were most important to include, and how the user interface should be structured to maximize user convenience.

Typically, a survey of potential users would be conducted prior to the development of a concept of operations. However, given the nature of the proposed One-Stop Shop and its shift from the traditional format of web-based traveler information, the research team decided it would be more advantageous to develop a prototype website first. By presenting users with a prototype that they could actually test and evaluate, researchers believed that they would obtain more useful feedback on modifications and improvements. Therefore, the concept of operations for this project was based on knowledge obtained with respect to users and data streams from projects such as COATS Phase 3 (12).

3.1. Users

In order to develop a concept of operations for the One-Stop Shop, researchers needed to understand who would be using the website and how they would be accessing it. The following sections provide an overview of the primary anticipated users of the One-Stop Shop. As the One-Stop Shop moves from a prototype to a more wide-scale deployment, new groups of users may emerge.

3.1.1. Long-Distance Travelers

The primary user group for the One-Stop Shop is long-distance travelers seeking real-time and near real-time information on weather, road conditions, and incidents. Specifically, this group includes motorists making journeys over a relatively substantial distance (as opposed to local travel between towns). Note that this group does not include goods movement operators (truck drivers) as their traveler information needs are different.

Long-distance travelers include users who have employed a route before, or who are using a route for the first time (vacationers, business travelers, etc.). The information required by this group varies, but typically includes the need for timely roadway conditions (construction activities, incidents, closures, chain requirements, etc.), weather (current and forecast), and the location of rest areas and services. In addition, imagery from CCTV cameras could also be of use to such travelers, as it provides a preliminary visual indication of what an area looks like (particularly with respect to weather).

This group of travelers is expected to access web-based traveler information both before their trip, as well as during their trip. Information accessed before the trip would be obtained for the purposes of planning the journey (route planning, familiarization, etc.). Information accessed during the trip (either before beginning travel for that day or while traveling), would be used for obtaining more up-to-date information regarding a present or upcoming travel segment. Information accessed during the trip would be obtained through the use of smartphones, wireless web access at rest areas, and similar sources.

To address the needs of this user group, it was determined that the One-Stop Shop prototype would provide all available information from Caltrans District 1 and District 2, and Oregon[2], including:

- Planned and active closures,
- Incidents,
- CCTV imagery,
- Changeable Message Sign text,
- Chain requirements,
- Weather conditions,
- Vista points, and
- Route profiles/summits.

3.1.2. Local Travelers

Local travelers are those motorists whose trips are likely to be a shorter distance, typically between towns within a rural area. While their trips are characterized as local, the nature of such trips in this region is similar to long distance trips. In a rural environment, particularly in some areas of Caltrans District 1, District 2 and Oregon, trips between towns can exceed 20 miles or more. The corresponding routes cross mountain passes and other roadway segments where conditions can vary greatly.

These local travelers may need only a limited amount and range of information, such as planned and active closures, incidents, weather, and chain requirements. CCTV imagery could also be useful to them. The experience of Caltrans District 2 indicated that CCTV was well utilized by travelers when inclement weather was a concern.

In general, this group is more familiar with the area and thus less concerned with route-planning. Rather, these travelers who use the One-Stop Shop would be more interested in learning what they would face during their trip, such as construction zones, road incidents, and weather/roadway conditions. Such information could be used to determine whether to take a trip and/or whether an alternate route should be used. Weather is a particular concern during winter months, as many of the short-distance trips in the targeted rural areas pass through varying terrain where roadway conditions can differ significantly over even a short distance. Providing near real-time, reliable information in such cases would enhance safety for local travelers.

To address the needs of this user group, the team determined that the One-Stop Shop prototype would provide all available information from Caltrans District 1 and District 2, and Oregon, including:

- Planned and active closures,
- Incidents,

[2] Note that Oregon data was provided for the entire state, as such coverage was available via the TripCheck portal.

- CCTV imagery,
- Changeable Message Sign text,
- Chain requirements,
- Weather conditions, and
- Route profiles/summits.

3.1.3. Goods Movement

The goods movement industry relies on truck drivers, company dispatchers, and other parties who may provide drivers with routing for a particular shipment. This group is focused on the efficient routing of goods in transit, ensuring a timely delivery. Goods movement trips are typically long distance, although short trips may also be common, and timeliness is the primary concern.

While the goods movement industry is composed of primarily long-distance travelers (truck drivers), the information needs of this group differs from other long-distance travelers (vacationers, etc.). This group is primarily concerned with information necessary to avoid delays. Information is needed by this group both pre-trip and during the trip. Pre-trip information would inform route planning and help in understanding the general conditions that may be encountered (e.g., construction zones). In addition, the location of rest areas and inspection facilities would also be employed in planning a trip. These users would also be interested in obtaining all of these types of information during their trip for updates on conditions that may be encountered along particular trip segments. Pre-trip information would be obtained through traditional means (Internet access from a personal computer or company workstation), while information accessed during the trip would be obtained through the use of smartphones, wireless web access at rest areas, and similar sources.

To address the needs of this user group, the team determined that the One-Stop Shop prototype would provide all available information from Caltrans District 1 and District 2, and Oregon, including:

- Planned and active closures,
- Incidents,
- CCTV imagery,
- Changeable Message Sign text,
- Chain requirements,
- Weather conditions,
- Route profiles/summits, and
- General information:
    - Safety rest areas,
    - Commercial vehicle enforcement facilities.

3.1.4. DOT Personnel

The project team also identified DOT personnel from management, operations and maintenance divisions as potential users of the One-Stop Shop website. These personnel are responsible for managing traffic and maintaining roadways. In this capacity, they also represent the foremost providers of data to support the One-Stop Shop. Through their various roadway duties, this group will provide timely data, such as Changeable Message Sign (CMS) messages or chain control status, for the various electronic databases that will ultimately serve as inputs to the One-Stop Shop website. However, in the course of their responsibilities, this group may also employ the data provided by the One-Stop Shop.

Anticipated data needs for these users are centered upon information that could assist with their typical responsibilities of management, operations and maintenance. This information includes planned and active closures, incidents, weather, chain requirements and CCTV imagery. All of these elements are items that frequently change and need to be continually tracked. This user group is expected to access information from office workstations, as well as from the field using an aircard, smartphones, and other available means.

3.2. Data Elements and Sources

Several unique data elements were available for inclusion and display in the prototype One-Stop Shop. Data streams and their sources recommended for use in the prototype One-Stop Shop are described in Table 3-1.

Table 3-1: Data elements, description and sources

			Meets data needs of:			
Data Item	**Description**	**Source**	**Long Distance**	**Short Distance**	**Goods Movement**	**DOT Personnel**
CMS messages	Text of currently displayed CMS messages	Caltrans DRI (1), ODOT TripCheck	X	X	X	X
CCTV images	Recent images from CCTV cameras	Commercial Wholesale Web Portal (links), Caltrans District 2, ODOT TripCheck	X	X	X	X
RWIS	Road weather information system data	Commercial Wholesale Web Portal (links), ODOT TripCheck	X	X	X	X
Chain requirements	Current chain requirements for specific vehicles	Caltrans District 2 (2), ODOT TripCheck	X	X	X	X
Planned and active closures	Current road construction, maintenance and similar activities	Commercial Wholesale Web Portal (links), ODOT TripCheck	X	X	X	X
Incidents	Currernt CHP-reported crashes	California Highway Patrol, ODOT TripCheck	X	X	X	X
Weather	Current and forcasted weather conditions	WeatherShare (3)	X	X	X	X
Safety roadside rest areas	Location of highway rest areas	Caltrans Office of GIS	X		X	X
Vista Points	Points of interest to travelers	Caltrans Office of GIS	X			X
Commercial vehicle enforecement sites	Locations of commercial enforcement facilities	Caltrans Office of GIS			X	X
Summits	Location of summits along state highways	Caltrans Office of GIS	X		X	X

(1) District 1 messages not employed during this phase of work

(2) District 1 chain requirements not available

(3) WeatherShare is a weather information repository developed by the Western Transportation Institute for Caltrans

As the table indicates, data for the One-Stop Shop prototype was acquired from a variety of sources. Most information was acquired from Caltrans and ODOT sources, although some specific streams (incidents, weather), came from outside sources.

While this list was not comprehensive, it met the various needs of the different user groups previously discussed. In most cases, each data element fulfilled the needs of multiple groups. In only limited cases was a specific data item targeted to the needs of only one group (vista points, commercial enforcement sites).

Overall, the data presented in the table extended beyond that traditionally offered by DOT traveler information websites. Certainly the approach to presenting this data is a departure from the norm (route-specific as opposed to everything at once). In presenting only route-specific information, the provision of comprehensive data to travelers would be enhanced, as data from other routes that were not of interest could receive less focus.

Of note, the location of commercial services (gas stations, hotels, restaurants, etc.) was not included in the data stream. This was deliberate, as the One-Stop Shop prototype has been funded by the state of California via Caltrans, and the potential for commercialization or the

view of favoritism must be avoided. Secondly, commercial business information may change without notice, increasing the potential for presenting outdated information. As the objective of the One-Stop Shop is to provide accurate, timely and reliable information, data that could not be reliably updated was excluded.

3.3. Website Functions

The objective of the One-Stop Shop prototype was to move from an approach where users were required to search a website or multiple websites to identify traveler information of relevance to their trip. Instead, One-Stop Shop users would enter their origin and destination and be presented with all available information for their specific route. The following paragraphs provide a high-level discussion and description of the anticipated functions of the prototype One-Stop Shop website. A more in-depth overview of functions is provided in the following chapter.

When initially entering the website, the users would see a region-wide viewing pane presenting traveler information. They would also have the capability to enter an origin and destination to obtain route specific information. For the purpose of simplification, origin and destination refers simply to the communities that the traveler wishes to travel between. For example, an origin might be Redding and a destination may be Yreka. Upon entering this information, the website would access Google's algorithm to generate the best route between these two points. Google Maps was used for prototype development to simplify mapping and routing tasks.

Using the Google-generated route as a reference, the website would focus on relevant information pertaining to that route. This information, along with a map of the designated route, would then be displayed on the primary pane of the webpage. A secondary pane along the bottom of the webpage would present the route in elevation profile and associated weather information.

Initially, users were presented with a Google map containing icons representing all available information for the region. Users would also have the option to toggle specific data icons/streams on and off, viewing only the information of interest to them. For example, if current weather was of interest, that data feed could be selected, with other feeds toggled off.

In addition to the route generated by Google's algorithm, the user had the option to choose other routes using nearby roadways through Google's route dragging feature. While customizing their routing, they would still be able to obtain available traveler information for their new route. When a new route was specified, information feeds would focus on the newly selected route.

3.4. Summary

This chapter has presented the high-level concept of operations for the One-Stop Shop prototype developed by this research. In short, users would be able to specify their origin and destination and view a map displaying the preferred routing as well as all available traveler information. This would eliminate the need for users to identify their routing first and then seek available data for their trip through the traditional, manual approach.

The research team was able to develop a prototype One-Stop Shop, based on this concept of operations, using various data elements from sources within Caltrans and ODOT, as well as from other agencies such as the California Highway Patrol that provide wide coverage in the rural areas of Caltrans District 1 and District 2, and Oregon. This prototype would take an origin and

destination as specified by a user and provide a preferred routing along with all available traveler information for that route. This information would be the most up-to-date available, with the website itself checking for updates from the data sources at regular intervals.

4. REQUIREMENTS

This chapter lists the requirements associated with the One-Stop Shop website prototype. Requirements translate the system concept/concept of operations into a series of statements describing what the system shall do and how it will accomplish its intended function. In this section of the document, the prototype is simply referred to as "the website" or "the interface" for simplicity and to minimize redundancy. Definitions that may be used throughout this chapter are presented in Table 4-1.

Table 4-1: Definitions employed in Chapter 4

Term	Definition
Changeable Message Sign (CMS)	Caltrans' current term for a dynamic message sign
CCTV	Closed circuit television
CMS	See changeable message sign
DMS	Dynamic Message Sign
GIS	Geographic Information Systems
HAR	Highway Advisory Radio
ICM	Integrated Corridor Management
Interface	Alternative name for the website that will display One-Stop Shop data
RWIS	Road Weather Information System
Variable Message Sign (VMS)	ODOT's current term for the broad class of electronic signs including VMS, blank out signs, and drum signs. VMS is a subset of DMS' that have variable text.

The Systems Engineering Guidebook for ITS (13) divides requirements into seven categories: functional, performance, interface, data, non-functional, enabling, and constraints. Together, these requirements are used to define what the system should do, how well it is to perform, and under what conditions or constraints. However, some of these aspects do not apply to this proposed website. As a result, only requirements pertaining to functional, performance, interface, data, and enabling aspects are discussed here. In defining the requirements for the website, the research team recognized that it is a challenge to specify requirements for a system that has never been developed, which corresponds to a concept that is still in its infancy. In the case of this work, it was a challenge to define requirements that pertained to the development of a website whose functions and intent were well-defined, but whose layout and appearance were had not yet been envisioned. Note that for the sake of brevity, the requirements presented in this chapter only touch upon major points; readers interested in further details are encouraged to review the specific requirements document developed for this project (14).

4.1. Functional Requirements

The functional requirements describe what the website is supposed to do. As described in Chapter 3, there are four groups of users who will use the website: local and long distance travelers, the goods movement industry, and DOT traffic management/operations/maintenance personnel. The function of the prototype website was to provide travelers in rural northern California with comprehensive, real-time data that can be employed in planning their trip. This

information would consist of both traditional information (routing, imagery, weather, etc.), as well as points of interest and other route-specific information (elevations, rest areas, etc.).

4.2. Data Set

The central feature of the One-Stop Shop is its service as a traveler information data source. As such, the requirements related to the data that the website acquires, stores, manages and disseminates are a central aspect of the Requirements document. For the sake of brevity, only specific points related to the datasets are presented here; further details are presented in the requirements document developed for this project (14). The data requirements developed for the website are presented in the following subsections.

4.2.1. DMS Data

- DMS message data shall be supplied from Caltrans via a delimited text file.
- DMS data from ODOT shall be provided via the TripCheck Portal.

4.2.2. CCTV Images

- Links to CCTV data shall be supplied from Caltrans via the Commercial Wholesale Web Portal (CWWP) and the District 2 website.
- CCTV data from ODOT shall be provided via the TripCheck Portal.

4.2.3. RWIS

- Links to RWIS data shall be supplied from Caltrans via the Commercial Wholesale Web Portal.
- RWIS data from ODOT shall be provided via the TripCheck Portal.

4.2.4. Chain Requirements

- Chain control information shall be supplied from Caltrans via District 2's chain control text file, available on the District's website.
- Chain control data from ODOT shall be provided via the TripCheck Portal.

4.2.5. Planned and Active Lane Closures

- Links to planned and active lane closure data shall be supplied from Caltrans via the Commercial Wholesale Web Portal.
- Planned and active lane closure data from ODOT shall be provided via the TripCheck Portal.

4.2.6. Incident Data

- Incident data shall be supplied by CHP via an xml file.
- Incident data from ODOT shall be provided via the TripCheck Portal.

4.2.7. WeatherShare

- WeatherShare data shall be acquired from the Western Transportation Institute directly.

- Comparable weather data for Oregon shall be acquired and disseminated when available.

4.2.8. Safety Roadside Rest Areas

- Safety roadside rest area data shall be acquired and disseminated from Caltrans' Office of GIS as a point file.
- Comparable data on location of safety roadside rest areas shall be acquired and disseminated for southern Oregon when available.

4.2.9. Features of Interest

- The location of vista points and points of interest shall be acquired and disseminated from Caltrans' Office of GIS as point files.

4.2.10. Commercial Vehicle Enforcement Facilities

- The location of commercial vehicle enforcement facilities shall be acquired and disseminated from Caltrans' Office of GIS as a point file.
- Comparable data on location of commercial vehicle enforcement facilities shall be acquired and disseminated for southern Oregon when available.

4.2.11. Summit Locations

- The location of state highway system summits shall be acquired and disseminated from Caltrans' Office of GIS as a point file.
- Comparable data on location of state highway system summits shall be acquired and disseminated for southern Oregon when available.

4.2.12. Additional Data Elements

- Additional data elements may be added to the website either during the development of the prototype or at a future date if deemed beneficial by Caltrans personnel.

4.2.13. Future Data

- The website shall be designed such that it can incorporate additional data in the future, such as Traffic Monitoring Station (TMS) data.

4.3. Performance

Performance requirements refer to measurable system capabilities. This section includes a discussion of the updating and delivery frequency requirements for the website.

4.3.1. Updating and Delivery Frequency

- The website shall check for new data to pull in from sources as it is updated by sources.
    - The frequency of checks made by the website shall be five minute intervals.

    - The data source providers shall maintain their traditional updating frequencies for their respective data feeds (i.e. the website shall not require changes to current procedures on the part of data providers).
- The website shall pull data from specified sources; no data source/provider shall push data to the website.
- The website shall be designed such that agencies may pull data from it via the interface, through re-formatted text feeds (XML) rather than the website pushing data to users.
- The website shall only serve as a dissemination platform for travel information, not a data entry mechanism.
- The website shall display only the data most recently acquired during data source scans.

4.3.2. Quality Control

- The website shall not serve as a quality control monitor for the data supplied by agencies.
- Quality control activities with respect to the website shall consist solely of checks made to ensure fixed data sources (CCTV, chain control, rest areas, etc.) are displayed in the correct geographic location.

4.4. Interface

Interface requirements describe a system's hardware and software interfaces; i.e. how a system is supposed to interact with other systems. For this project, the interaction between the website and other systems is limited to the acquisition and dissemination of data. Therefore, the requirements in this section focus on these aspects of the website interface.

4.4.1. General

- The website shall be available via commonly available web browser software running on a desktop or laptop PC platform.
- The website shall be housed on a server.
- The website shall pull in data from specific sources and provide that data to user groups via web-based protocols.
- The website shall employ a database to support route queries and general data storage.
- A throttle shall be considered in future discussions that would limit the number of times per minute a user may update their interface data.
- The website may also make available reformatted data files for use by other systems.
- Additional general operating requirements shall be discussed and finalized on an as-needed basis.

4.4.2. Data Format and Standards

- The website shall be capable of reading all data formats of the supplying agencies.
- If deemed necessary, the website shall be capable of reformatting data to serve as a data provider to other established systems.

- The website shall publish data in a format to be determined as the research progresses.
- The website shall also make available raw data files for use by systems aside from the interface in their original (provider) format.

4.4.3. Interface Display

- The website display shall be map based.
- The website shall only display information specific to the Google-generated route as specified by the user's beginning and ending points.
- The website display shall consist of an initial viewing pane that presents the region overall.
- Once the user enters a beginning and ending point for a trip, two viewing panes will be displayed.
    - The primary viewing pane shall contain a Google map with data icons displaying all available information of interest to travelers excluding a route elevation profile and weather conditions.
    - A second viewing pane shall display the route in profile, including elevations, summits, and weather conditions.
- The website shall allow users to view all data icons at once or selectively.
- The website shall be designed such that it is clear to the user that a data element is missing or unavailable.

4.4.4. Control

- The website shall require some interaction on the part of the user (i.e. entering the beginning and ending points for a trip and dragging the Google-generated route to a different path if desired).
- The website shall allow users to select specific layers of information of interest.

4.5. Enabling

The final section of this chapter presents the enabling requirements for the website. Enabling requirements relate to aspects of the website that enable it to function properly and fulfill its purpose.

4.5.1. Software

- The website shall require no specialized, third-party software to acquire, reformat or disseminate the available information previously detailed.

4.5.2. Installation Design

- The website shall operate in a standard web browser and be designed such that access may be accomplished by the user via a website link.

4.5.3. Website Server

- The initial location of the clearinghouse server shall be determined by the Western Transportation Institute.
- The website shall be maintained by the Western Transportation Institute.

4.5.4. Documentation

- Brief documentation pertaining to the development and coding of the website shall be compiled by the Western Transportation Institute.
- The website shall include a "Help" link to assist the user through use of the website.

4.6. Summary

This chapter has presented a high-level overview of the requirements that were established to guide the development of the One-Stop Shop website. Requirements translate the system concept/concept of operations into a series of statements describing what the system shall do to accomplish its intended function. The information provided was a condensed version of the full requirements developed and presented the reader with an overview of the different aspects of system requirements that were considered in developing the prototype website. The requirements topics applicable to this work included functional, performance, interface, data, and enabling aspects of the website. The information selected for inclusion in this chapter illustrates the major instructions and specifications that were laid out to guide website development.

5. PROTOTYPE WEBSITE

Once the research team finalized the requirements document, work began on development of the data-sharing platform. The data-sharing platform in this project was a website that integrated and presented different data streams of interest to users. The data came from existing agency databases; agencies populated the databases with the information of interest as part of their normal operations, while the website pulled this data in and disseminated it to users. In this manner, the website presented a number of different data elements both at a region-wide level and at a focused, route-specific level based on an origin and destination entered by the user. The website was developed to pull data in from agency web or ftp sites at a high frequency (depending on the dataset, this frequency may be as often as every five minutes) and presented it to users in a manner which differed from existing DOT traveler information websites. During this initial proof-of-concept stage, local (northern) and statewide data elements from California (based on availability) and Oregon (statewide) have been initially incorporated into the prototype website. As the system proves itself, data from other geographic areas and agencies may be added. The addition of such data is the intention of future project phases.

5.1. Interface Environment

As indicated throughout this report, the user interface was a web-based map built using Google Maps. Custom markers (icons) presented point-based information such as commercial vehicle enforcement sites, CCTV camera images, incident and construction locations, and dynamic sign messages in their appropriate locations. Raster graphics were superimposed on the map to represent data such as forecast conditions over the region of interest. The system incorporated a route planner, which allowed the user to select a route via Google Maps routing capability and display an elevation profile of the route along with select data layers including forecast information. The system architecture is presented in Figure 5-1.

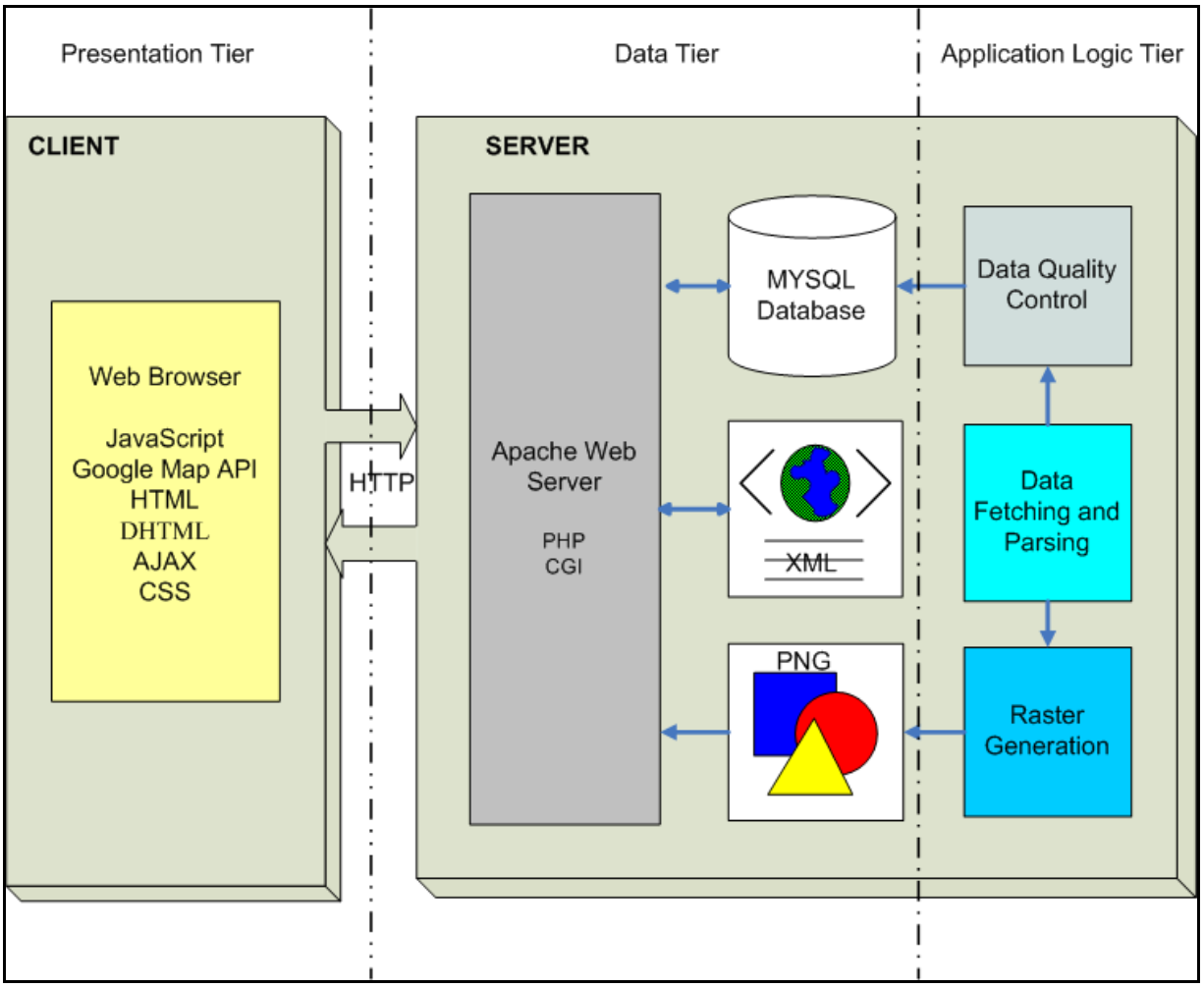

Figure 5-1: One-Stop Shop system architecture

Dynamic HTML, Javascript and general AJAX (asynchronous JavaScript and XML) capability were used to retrieve and display data on the map, and for periodic updates of the displayed data. This display was accomplished with Dynamic HTML, CSS, Javascript and Flash. The website operates on a standard (Debian) Linux platform running the Apache web server, MySQL database and scripting languages including Perl, PHP and Python.

A standard, existing hardware platform was used. The system was designed, however, to support prospective migration to another platform, perhaps housed by a service provider or even offered as part of a cloud-based service such as the Amazon Elastic Computer Cloud (EC2) or similar service. The Linux-based software platform facilitated this aspect of the design. The server used to host this project had the following configuration: Dell PowerEdge 2900 III server, with Dual Quad Core Intel® Xeon®X5450 3.0GHz, 300 GB x 2 RAID hard drive, and 16 GB memory.

5.2. Website Functions

As developed, the prototype website was designed to perform a number of different functions related to the provision of traveler information. An in-depth discussion of each function is beyond the scope of this document; however, a high-level overview of the various features of the website is provided in the following sections. This overview is intended to provide a summary

of the website's capabilities. The reader is encouraged to visit the prototype website at http://oss.weathershare.org/ to experience firsthand the various features and capabilities that it offers.

5.2.1. Initial View

When first accessing the One-Stop Shop prototype, a viewer is presented with a view of the region, as illustrated in Figure 5-2. As the figure indicates, the initial view of the region presents the user with a series of icons related to DOT field elements, including CCTV camera images, CMS messages, incident and construction locations, RWIS station sites, and chain requirements (during winter weather). Note that CMS signs that have a message posted are displayed with a yellow border and text, while inactive signs are displayed with grey features. In addition to the default information presented, the user may toggle on or off additional data streams. These streams include current and forecast weather for the region, and the location of mountain passes, vista (scenic) points, rest areas and truck scales (commercial vehicle sites). The user is also presented with a mechanism to enter origin and destination information for custom route mapping. When any of the active icons on the display is selected, the site-specific information associated with it will be presented. Finally, similar to traditional Google Maps displays, the user can also select a traditional map background, a satellite image, a hybrid image (map and satellite image) or a terrain display.

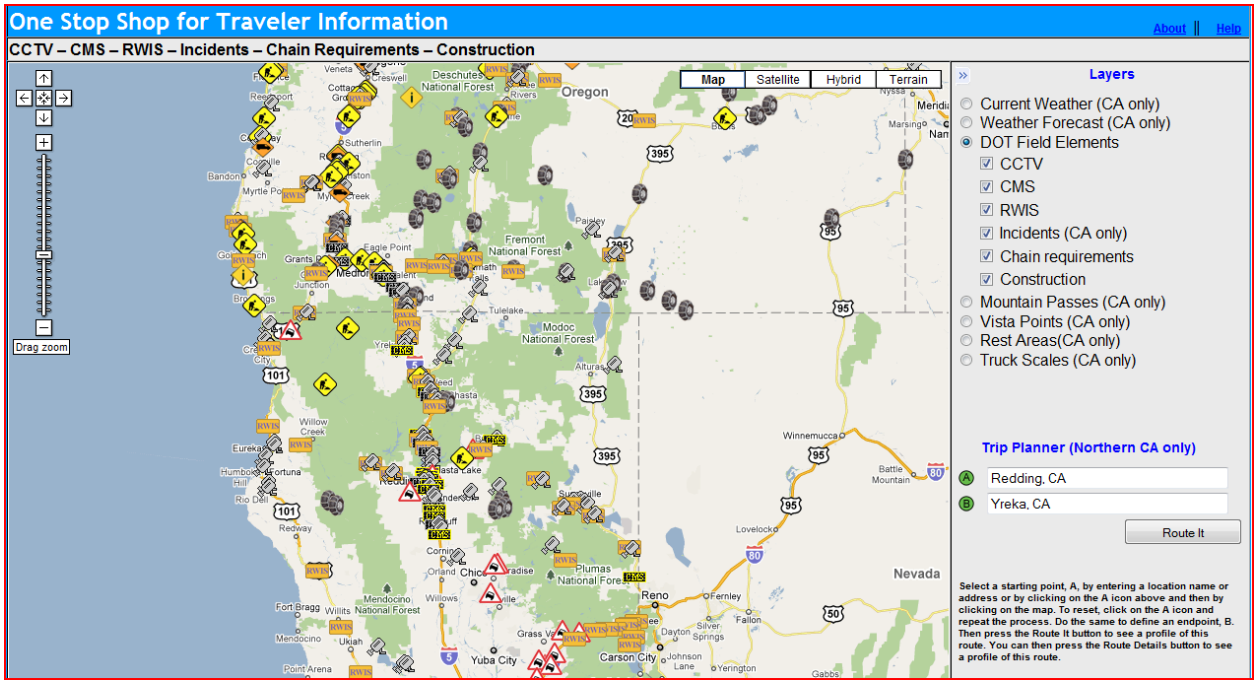

Figure 5-2: One-Stop Shop initial view

Perhaps the information of greatest interest to most One-Stop Shop users is current and forecasted weather. Figure 5-3 presents an example of one type of weather view that can be displayed by the website: current temperature. When the temperature icon is selected, various weather data from the weather station is presented to the user. In addition to current temperature, a number of other current conditions can be selected by the user for display through the use of a drop down menu. This information includes wind speed and direction, hourly precipitation, 24-hour precipitation, humidity, and National Weather Service observed 24-hour precipitation. Note that the information presented by the prototype is provided by WeatherShare[3]. As a result, current and forecast weather information is available only for California at this time. Regardless, the availability of current weather information should be of great interest and utility to users in planning their trip, as it provides a picture of present conditions along roadways throughout the region.

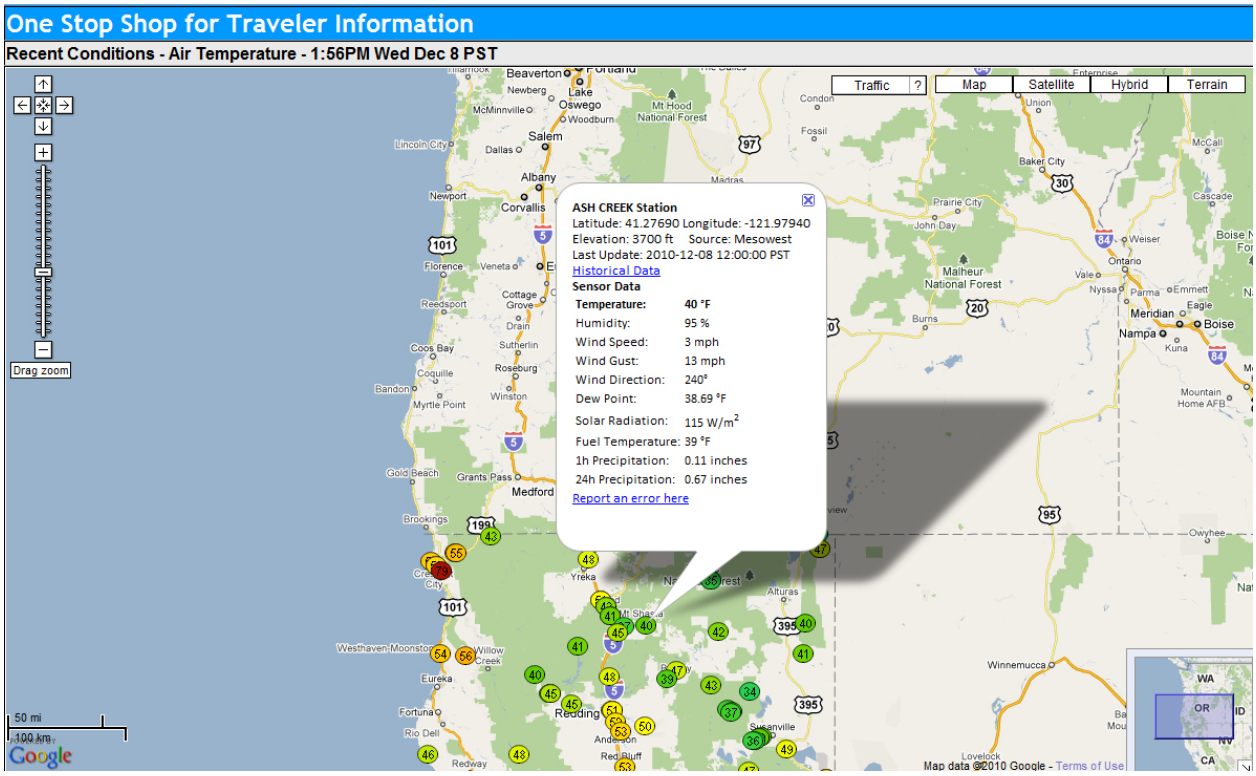

Figure 5-3: One-Stop Shop current weather display

[3] WeatherShare is not a primary source of weather data. Rather, it aggregates weather data from a number of different primary sources and provides that information in a single, consistent interface.

Figure 5-4 presents one layer of the weather forecast that can be displayed by the website: forecasted humidity. When the humidity icon is selected, various parameters from the weather station are presented to the user. In addition to humidity, available forecasted data includes air temperature, wind speed, wind gust speed, sky cover, 12-hour probability of precipitation, 6-hour amount of precipitation, snow, and general weather conditions (rain, mix, snow). The forecasted weather conditions are provided for the next 24-hours in three hour increments. These weather forecasts may be the most useful information provided to One-Stop Shop users, as they provide a picture of conditions that are likely to occur during the course of their trip.

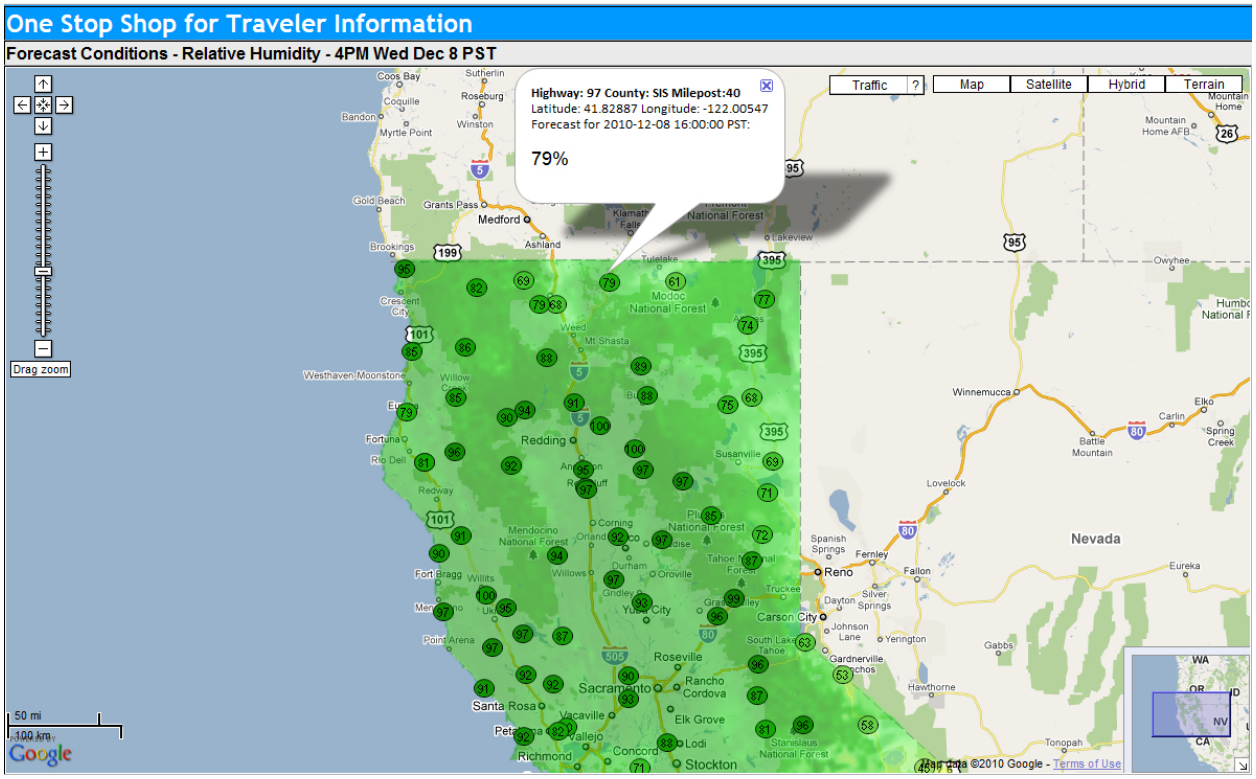

Figure 5-4: One-Stop Shop forecasted weather display

Users can access additional point specific information by clicking on the various icons displayed. For example, Figure 5-5 presents the display generated when a user selects an active CMS sign. As this figure illustrates, the user was presented with the exact text message that was being displayed by the sign at the moment the user was on the website. This message may pertain to weather conditions, chain requirements (as shown), construction, or other information of interest to motorists. Depending on the scenario, the information presented by CMS signs may alert travelers to conditions that they might have otherwise been unaware of until they encountered them en route.

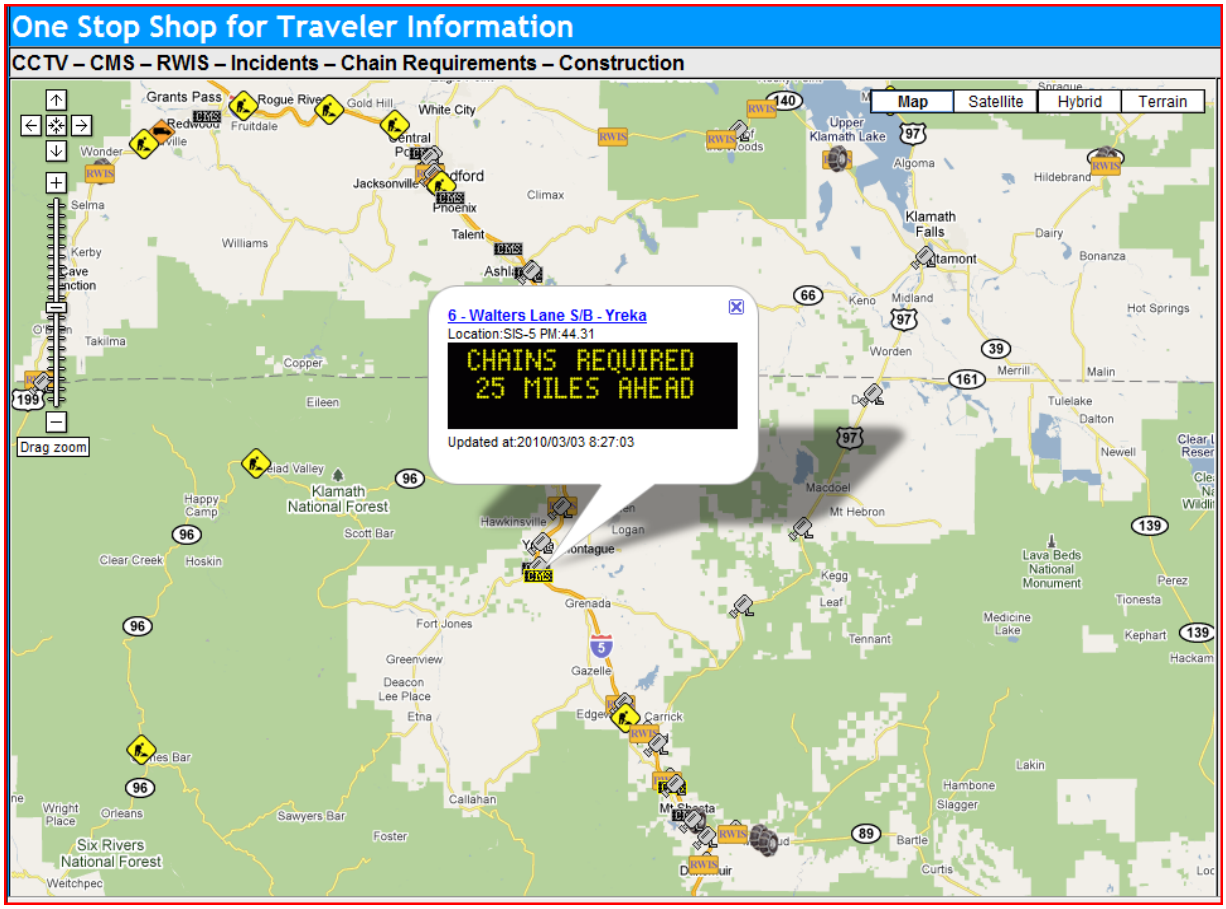

Figure 5-5: One-Stop Shop CMS message display

Figure 5-6 presents an example of the information displayed when viewers select a chain control icon. Note that chain control icons will only display data in the One-Stop Shop prototype when weather conditions warrant their use in the field (i.e. during the winter). As this figure indicates, the chain control that was active when this graphic was captured required motorists to have tire chains or traction tires on their vehicle in order to travel this particular route (I-5 over Siskiyou Pass). Such information is of great use to travelers pre-trip, as they will be informed of the conditions that await them along their route. This would alert them to carry the appropriate equipment, identify an alternative route with less restrictions, or postpone their trip until conditions improve.

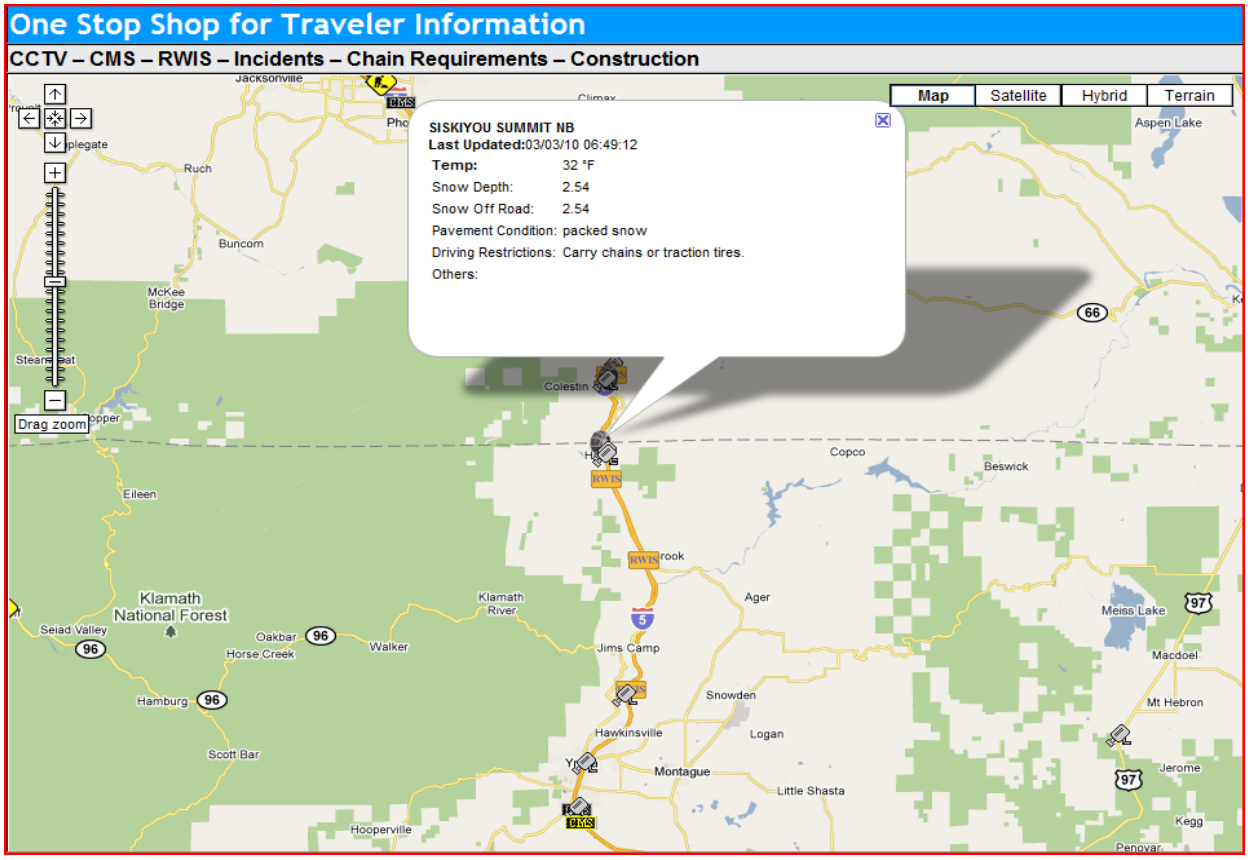

Figure 5-6: One-Stop Shop chain requirement display

Figure 5-7 presents the image display a user will see when selecting a CCTV camera site. This image, which was obtained at the same time as the previous chain control information, indicates that the weather and roadway conditions along that particular highway segment were quite poor. The CCTV image for this area would visually confirm to the user that conditions warranted chains or traction ties.

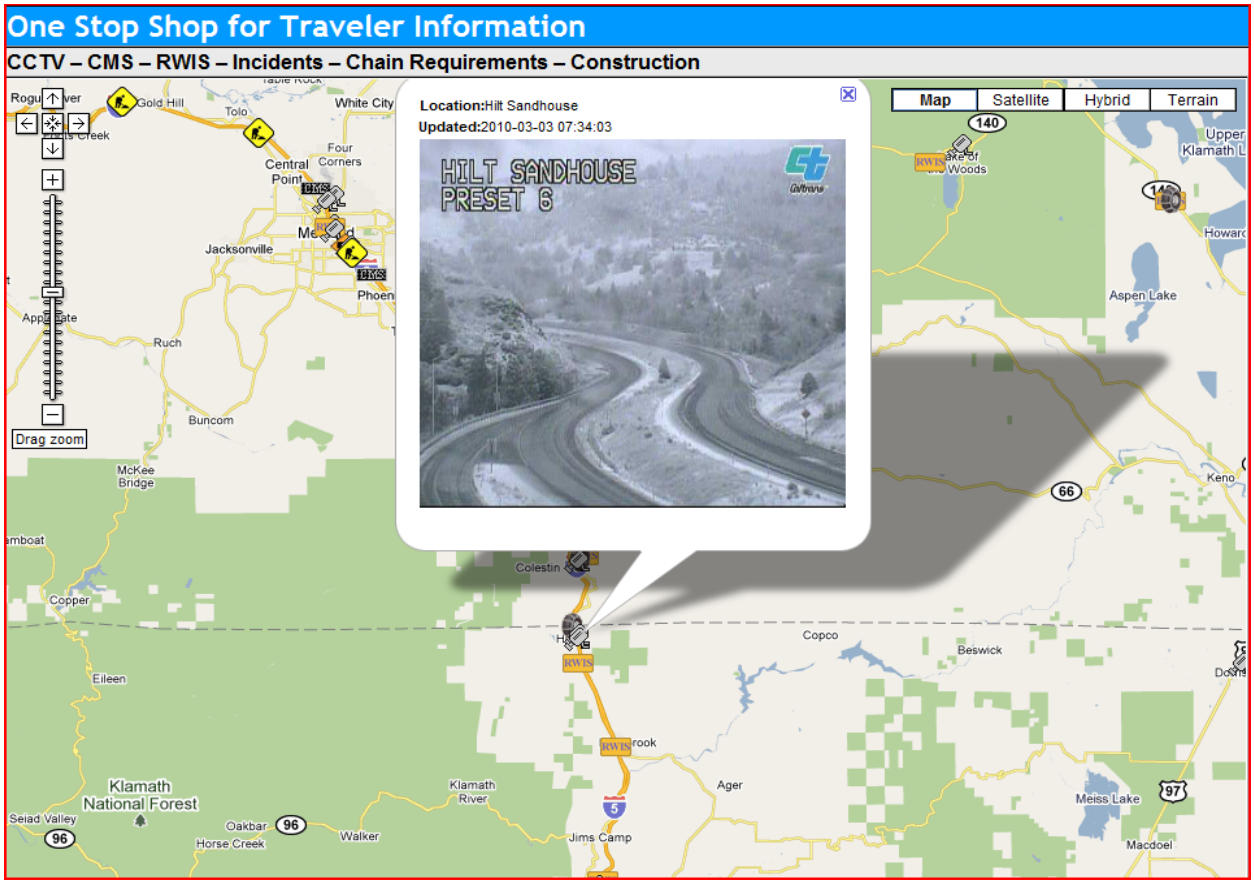

Figure 5-7: One-Stop Shop CCTV image display

Figure 5-8 presents the information a user would see when selecting an RWIS station. While RWIS data is likely to be of use primarily to DOT personnel, it may also be of interest to travelers who wish to see point conditions along a route. In addition to current conditions (temperature, dew point, humidity, etc.), pavement conditions are also available to the user. This information provides an indication of the conditions found on the roadway at that specific point (ex. dry, wet, icy, etc.). Finally, historical data can also be obtained through the RWIS icon, which may be of use to DOT personnel.

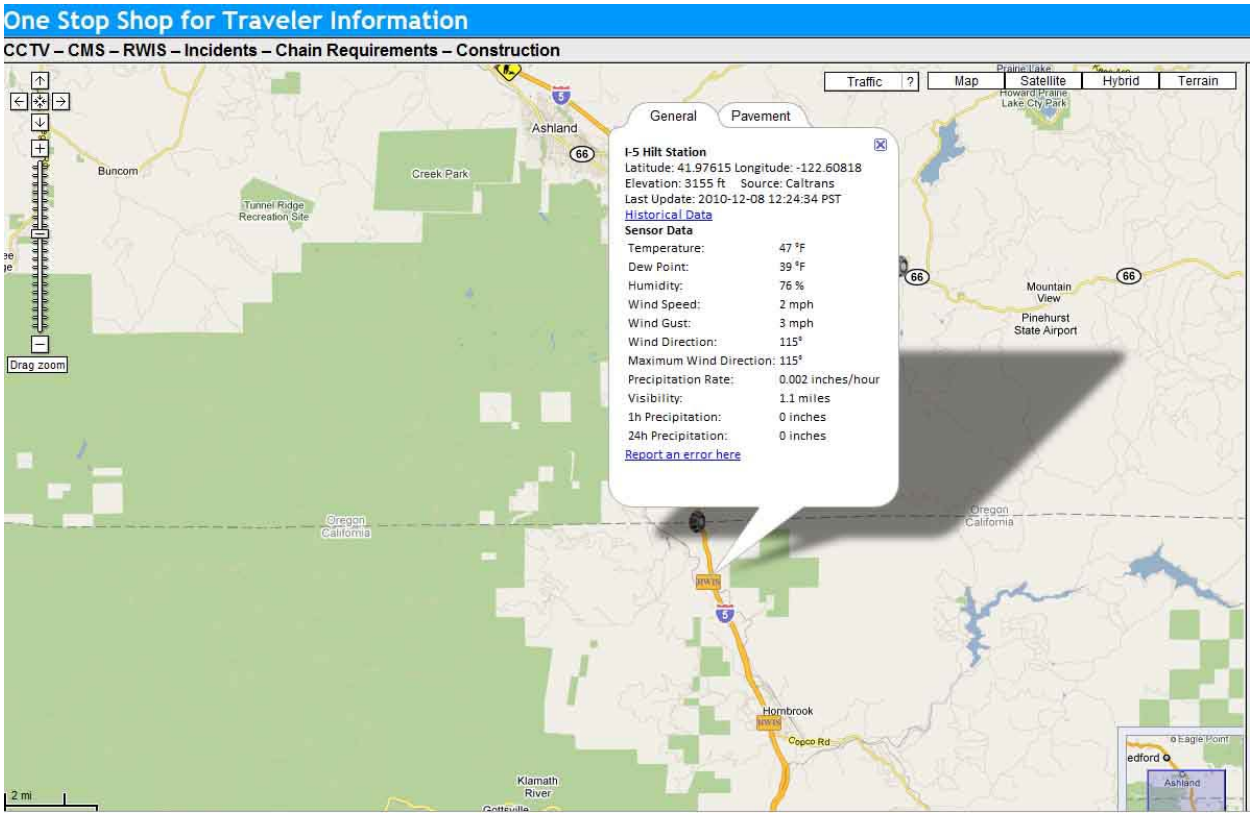

Figure 5-8: One-Stop Shop RWIS data display

Figure 5-9 presents the construction icon information display. Information provided by this display includes the start and end point of the construction zone, as well as the date of activities, the type of closure, the type of work, and the expected time delay that may be encountered. This information alerts travelers to the location and impact of construction activities along their route.

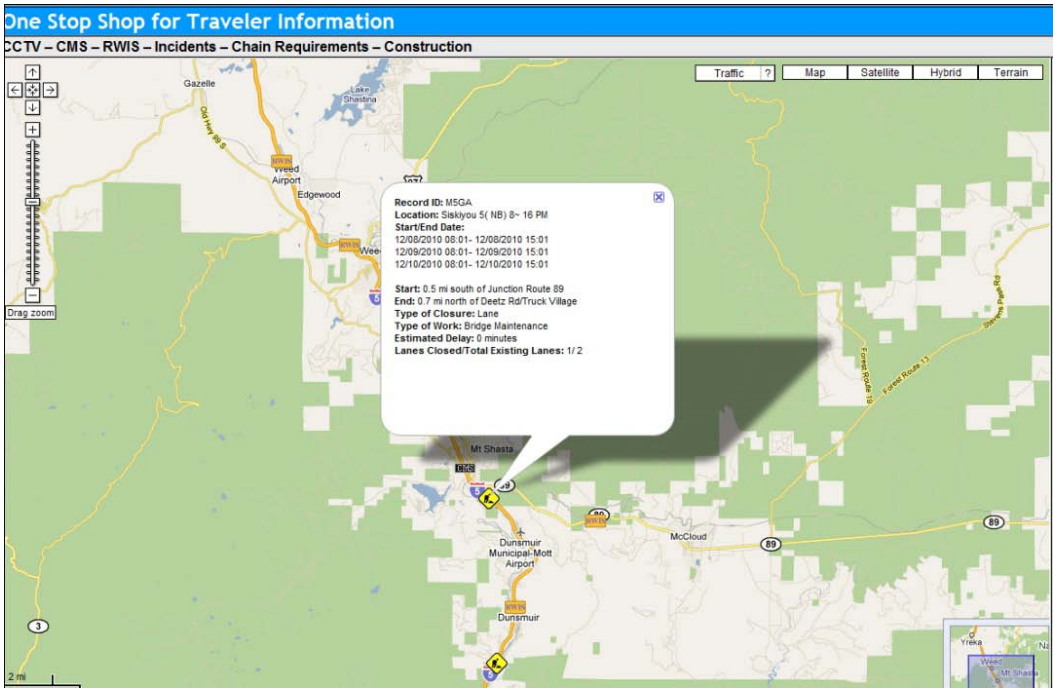

Figure 5-9: One-Stop Shop construction data display

Figure 5-10 through Figure 5-13 present the data displayed when the mountain summit, vista point, rest area and truck scale icons are selected, respectively. Mountain summit information includes route, post mile and elevation. Vista point information includes county, route and post mile. Rest area information includes route, post mile and facilities available. Finally, truck scales information includes route, post mile, direction of roadway served, and the class of the site. The information provided by these different icons has varying utility to the different website user groups. Note that, unlike the DOT field element data, the information for these sites is primarily static and will rarely change.

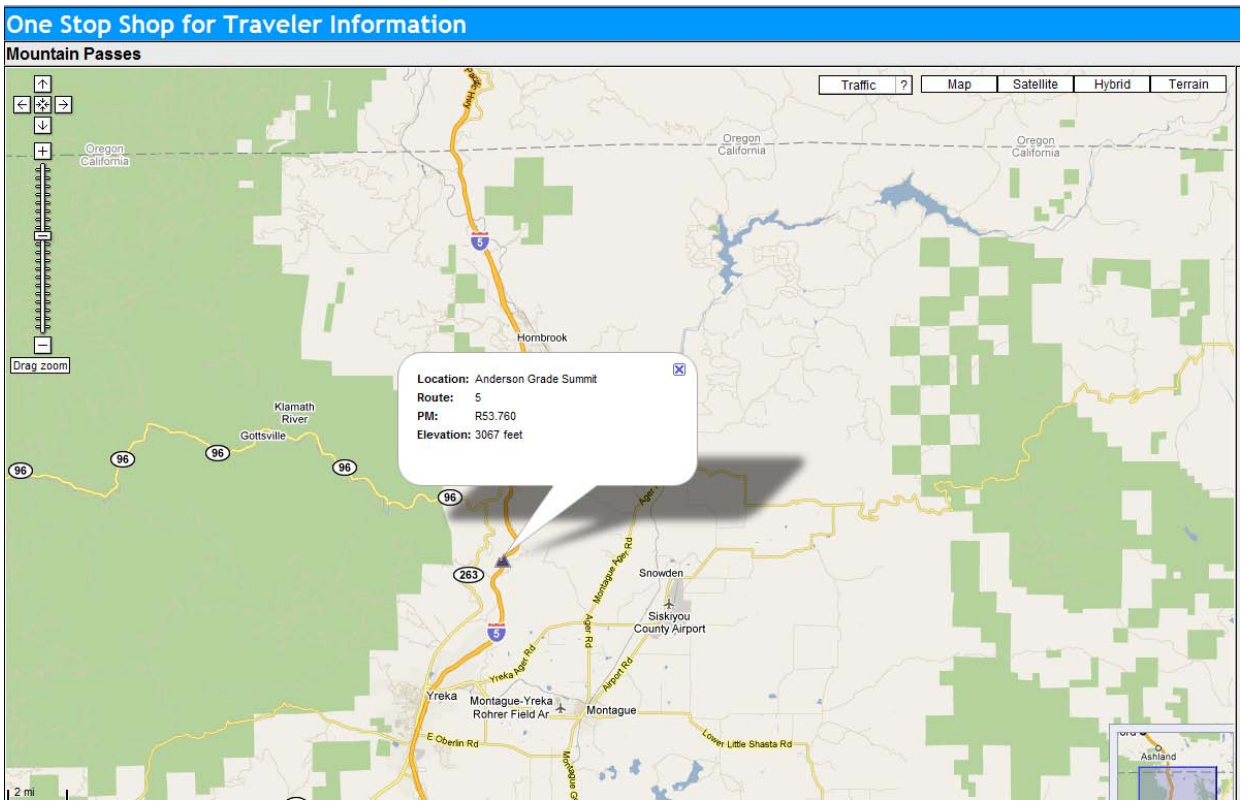

Figure 5-10: One-Stop Shop mountain pass data display

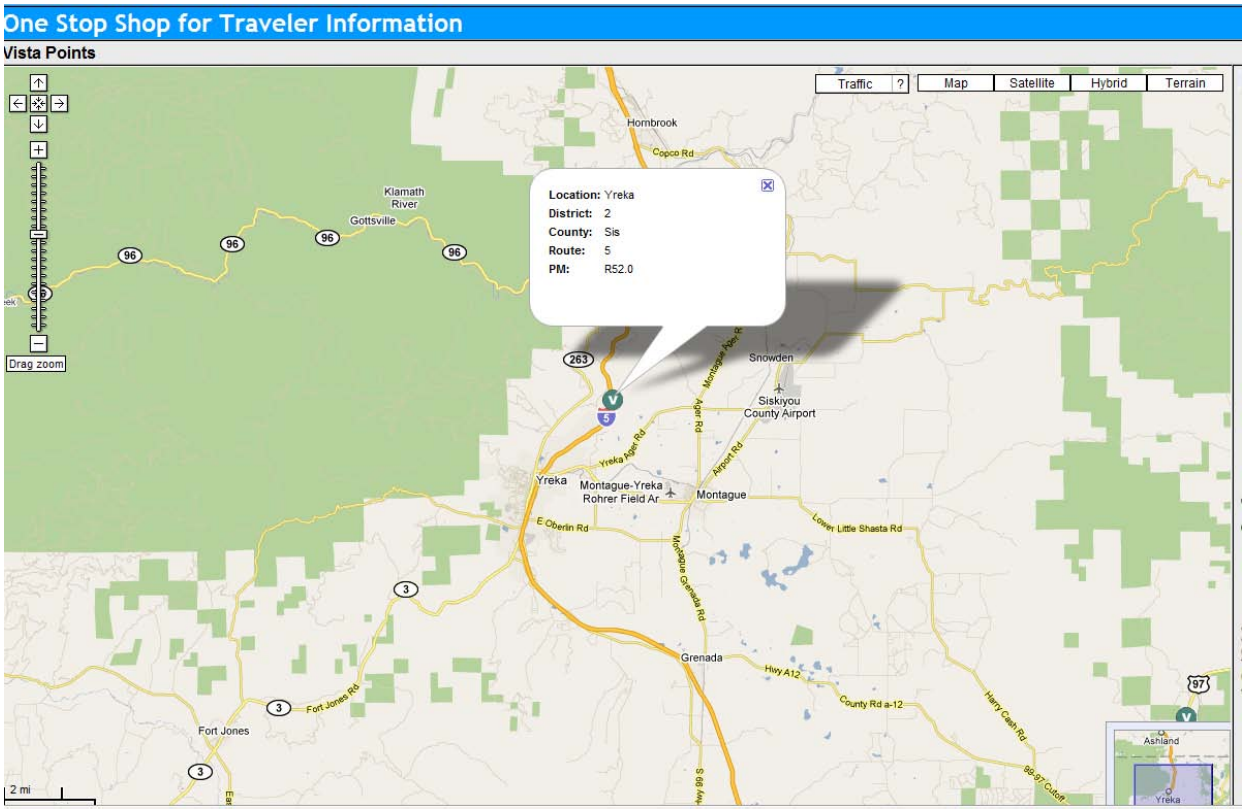

Figure 5-11: One-Stop Shop vista point data display

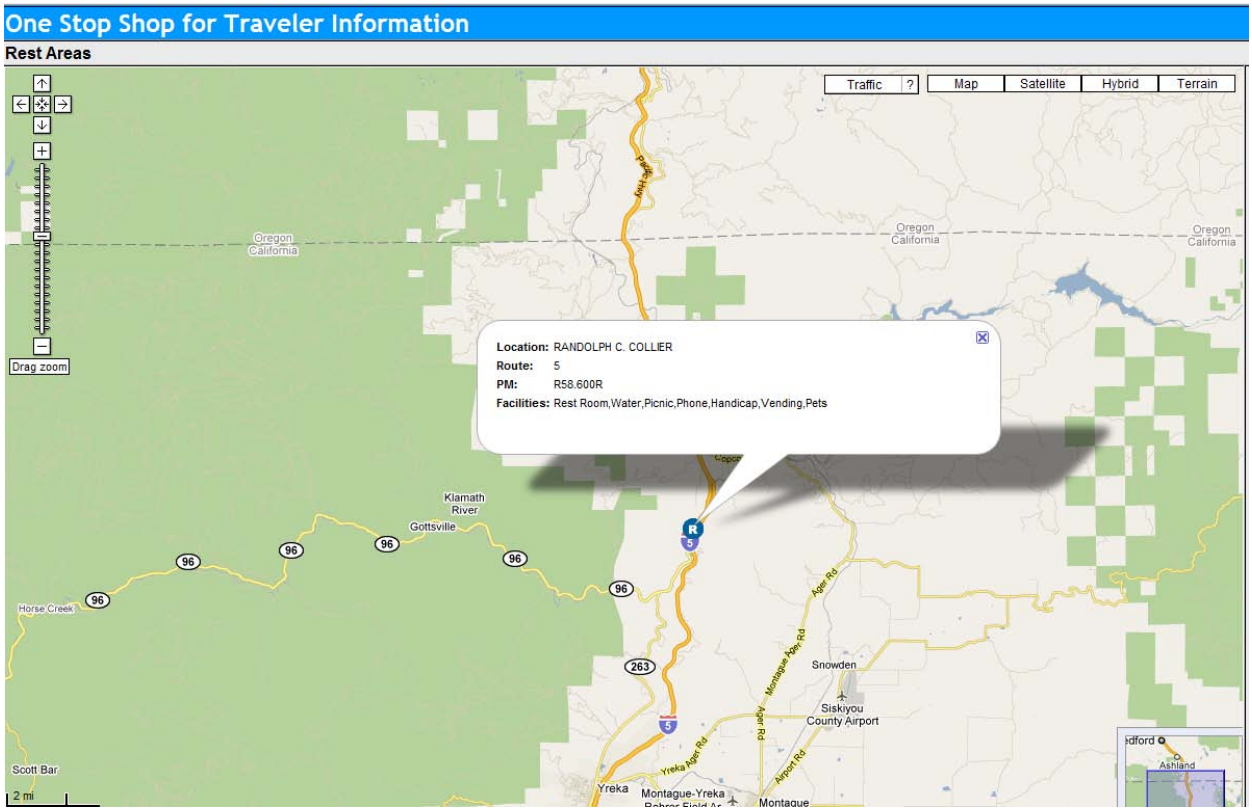

Figure 5-12: One-Stop Shop rest area data display

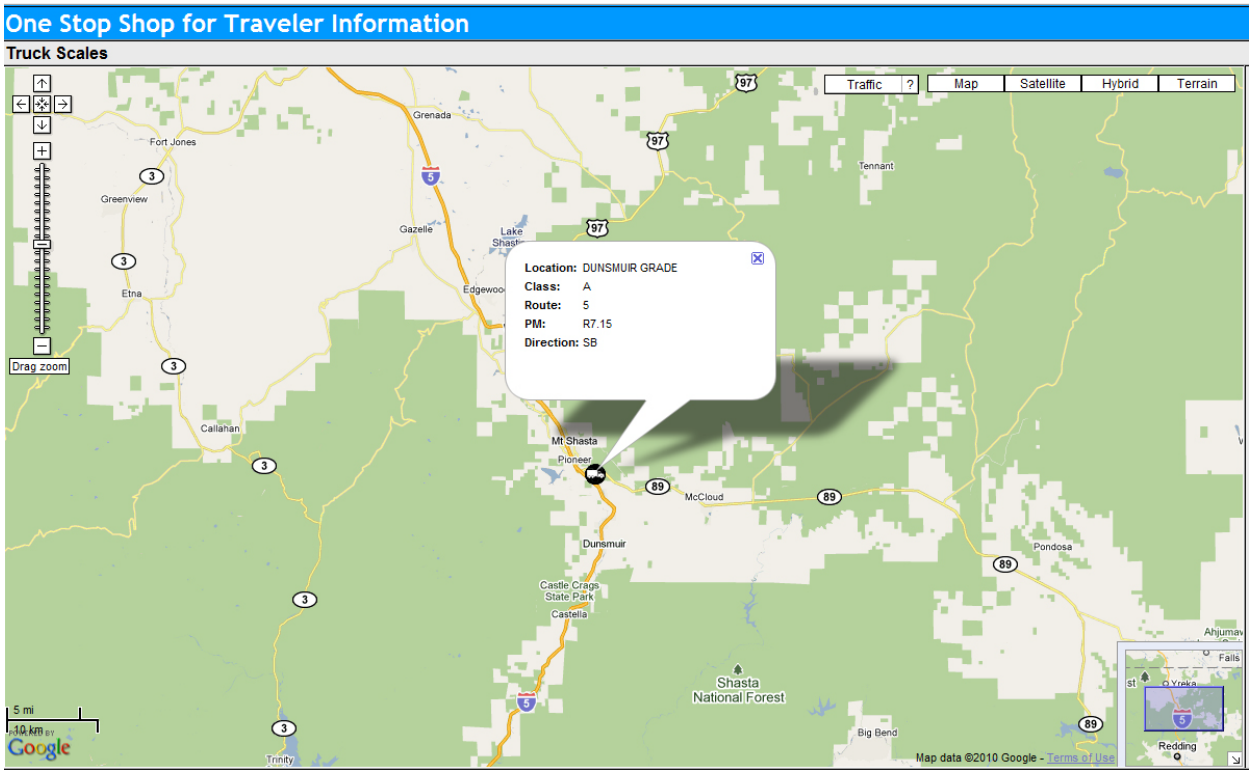

Figure 5-13: One-Stop Shop truck scale data display

5.2.2. Route Planner

The motivating factor behind this project was the provision of route-specific information to users based on their origin and destination. Consequently, it is useful to discuss the display of information provided to the user when the route planner feature is employed. For the purposes of this discussion, the route displayed will use Redding, California as the origin and Yreka, California as the destination. Note that in its present prototype form, the route planner function is only available for origins and destinations in northern California (Caltrans Districts 1 and 2).

When users specify their origin and destination and select the "Route It" button, they are presented with an outline of their route, all of elements available along that route and in the map view, and map points indicating the specified origin and destination. The data streams available for viewing are the same as those already discussed in the previous section. The only difference is that the icons now presented to users focus primarily on their specific route as opposed to a regional display. This view is presented in Figure 5-14.

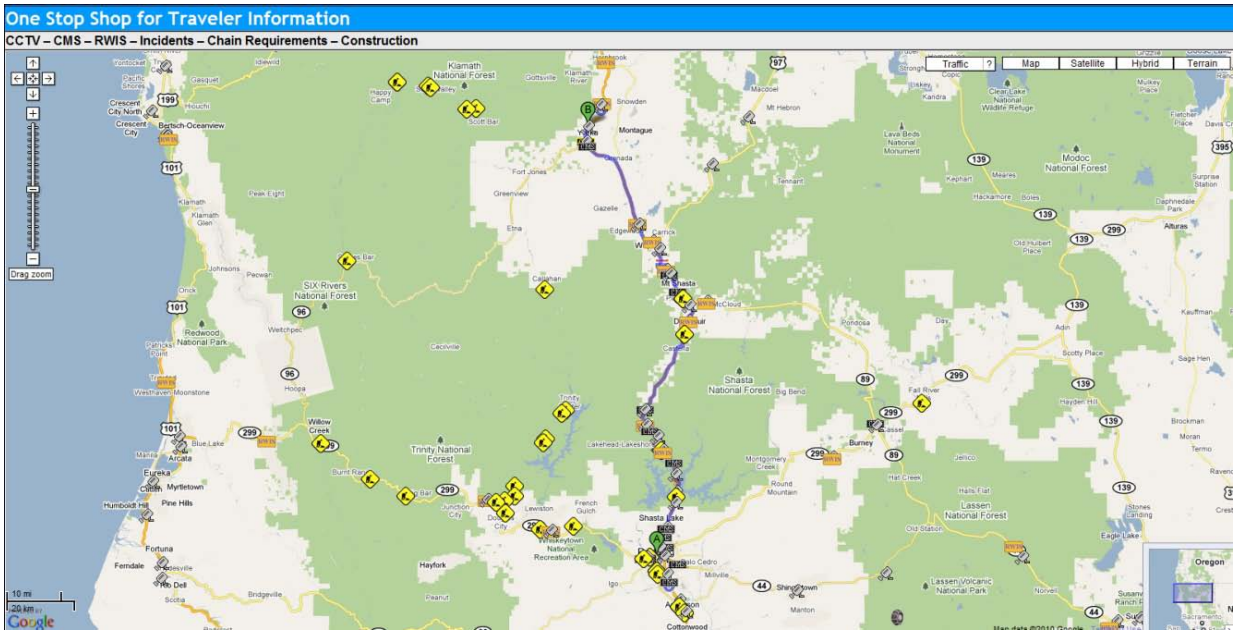

Figure 5-14: Route-specific map

When the "Route It" button is selected, it enables the "Route Details" feature. When selected, this new button displays forecasted weather for the area and a profile of the route (elevation, distance and predicted weather at each point along the route). The route profile feature is shown in Figure 5-15. The weather information displayed can be changed by the drop down menu to feature air temperature, wind speed, wind gust speed, sky cover, 12-hour probability of precipitation, 6-hour amount of precipitation or snow forecasted over the next 24-hours (at three hour increments).

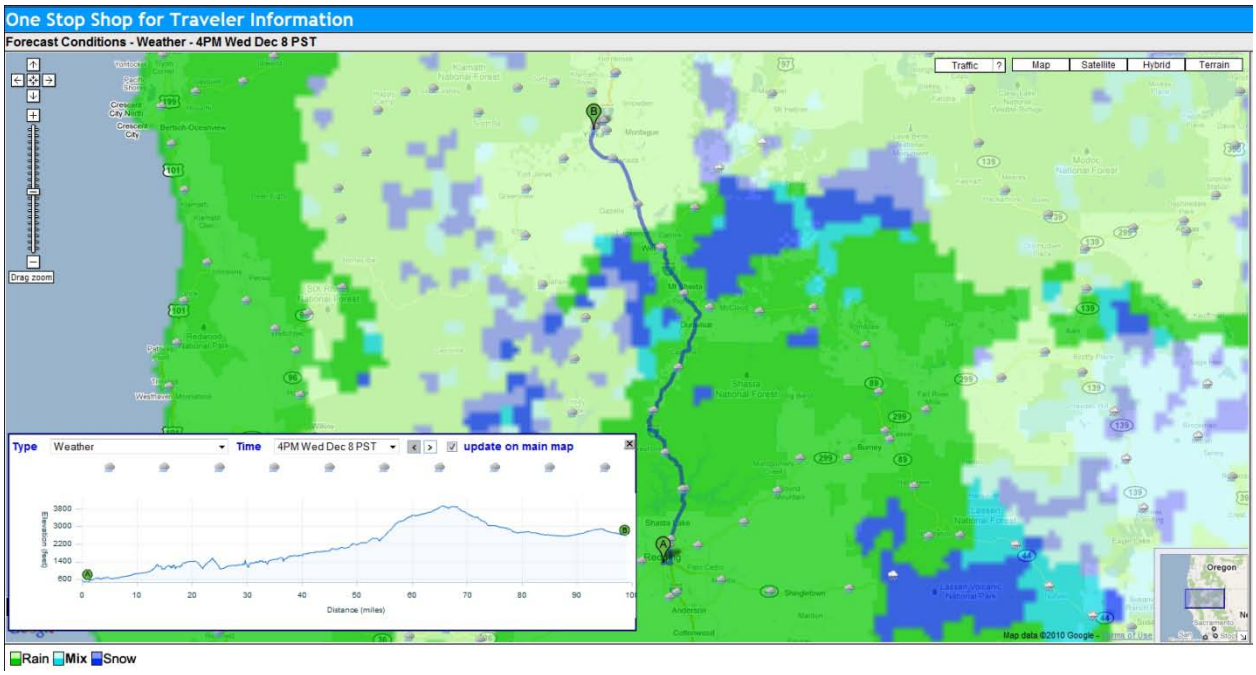

Figure 5-15: Route profile display

Aside from providing a more focused view of the route, as well as a route profile, the information presented when a user selects an icon displayed on the screen is consistent with the examples discussed in the previous section. Similar to traditional Google Maps displays, the user can once again select a display that shows a traditional map background, a satellite image, a hybrid image (map and satellite image), or terrain.

5.3. Summary

This chapter has provided an overview of the website coding environment and the functions of the prototype One-Stop Shop website. The user interface developed in this project was a web-based map built using Google Maps. Custom markers (icons) present point-based information such as commercial vehicle enforcement sites, CCTV camera images, incident and construction locations, and dynamic sign messages in their appropriate locations. Raster graphics are superimposed on the map to represent data such as forecast conditions over the region of interest. The system incorporates a route planner, which allows the user to select a route via Google Maps routing capability and display an elevation profile of the route along with select data layers including forecast information. Dynamic HTML, Javascript and general AJAX (asynchronous JavaScript and XML) capability is used to retrieve and display data on the map, and for periodic updates of the displayed data. This display is accomplished with Dynamic HTML, CSS, Javascript and Flash.

When first accessing the One-Stop Shop website, a viewer is presented with a view of the region showing a series of icons related to DOT field elements, including CCTV camera images, CMS messages, incident and construction locations, RWIS station sites, and chain requirements (during winter weather). In addition to the default information presented, the user may toggle on or off additional data streams. These streams include current and forecast weather for the region, and the location of mountain passes, vista (scenic) points, rest areas and truck scales (commercial vehicle sites). When a viewer selects an active icon on the display, the site-specific information associated with it will be presented.

Finally, the user is presented with a mechanism to enter origin and destination information for custom route mapping. When selected, this feature provides the user with an overview of the route, the selected elements of interest on that route, and map points indicating the specified origin and destination. The user can also select an option to generate a route profile. This feature displays forecasted weather for the selected area and a profile (elevation and distance) of the route. This ability to specify a destination, view traveler information and forecast weather for the entire route represents a significant departure from the approach presented by DOT traveler information websites at the present time.

6. CONCLUSIONS AND RECOMMENDATIONS

Real-time traveler information services have thrived in two primary contexts: urban-focused systems and regional systems. Urban systems, strengthened by an extensive sensing and technology infrastructure, are able to offer significant volumes of information, updated at regular frequencies. Regional systems offer information over a larger geographic area, and can therefore more readily serve travelers on less regular trips, such as recreational or longer distance travel. However, these systems generally provide information on specific areas or highway segments, meaning that prospective travelers may need to consult dozens of links to determine the travel conditions they will experience, before they make a prudent decision regarding when to leave, which route to take, and how to prepare for the trip.

The objective of this project was to put a variety of route-oriented real-time and near real-time information together in a single web-based location in a user-friendly format that does not stop at jurisdictional boundary lines (state, district or county lines, for example). This would allow travelers making a trip in or through rural areas to have current travel information on a route-specific basis and across a wide geographic area, customized for a specific origin and destination, which will help them to make their trip more safely and with a minimum of delay. This project focused on a limited geographic area -Caltrans District 1, District 2 and Oregon - to provide a proof-of-concept of this approach. While this scale of implementation will yield some direct benefits for the selected area, researchers believe that the principal value of this effort is in demonstrating the feasibility and attractiveness of a One-Stop Shop for real-time route-specific traveler information for rural areas.

6.1. Conclusions

This project has developed a prototype website that provides various traveler information items in one location on a route-specific basis. The One Stop Shop that was developed addresses a present shortcoming in traveler information provision that was confirmed by a review of current state practices completed during this project. That review of practice found that no work had been performed that provided a user with all available traveler information in one location *and* the ability to specify an origin/destination to receive all available information for the planned route(s). The review also confirmed that the current provision of traveler information is confined by jurisdictional boundaries (state, county, district borders). Consequently, the opportunity to provide travelers with comprehensive information for a specific route based on a trip origin and destination and across state and jurisdictional boundaries remained unmet. The provision of data across jurisdictional boundaries takes on added importance for rural trips which often entail long distances.

In developing the One Stop Shop prototype, the researchers completed a number of specific tasks. This included the development of concept of operations and requirements documents. The concept of operations established that the One Stop Shop website would allow users to specify their origin and destination and display a map of the preferred routing as well as all available traveler information along that route. The requirements document described what the website should do to accomplish its intended function.

Following the concept of operations and requirements documents, the researchers developed the prototype One Stop Shop website. The completed prototype is a web-based map built using Google Maps. Custom markers (icons) present point-based information such as commercial

vehicle enforcement sites, CCTV camera images, incident and construction locations, and dynamic sign messages in their appropriate locations. Raster graphics are superimposed on the map to represent data such as forecast conditions over the region of interest. The system incorporates a route planner, which allows the user to select a route via Google Maps routing capability and display an elevation profile of the route along with select data layers including forecast information.

Based on the work completed during this project, it was demonstrated through the prototype that the concept of providing travelers with comprehensive information for a specific route based on a trip origin and destination and across state and jurisdictional boundaries. The prototype website provides travelers in rural areas have a comprehensive source of information available to them for the planning of their trip. The availability of this information in one location will save travelers time in planning their trip, as well as will help make that trip more safely and with a minimum of delay.

6.2. Challenges

The primary challenge encountered by the researchers related to data accuracy. In most cases, these issues were minor (i.e., raw data formatting) and were addressed with little difficulty. In a few cases, the issues were more problematic and required extensive investigation and resolution. For example, the team encountered difficulties with the CMS message feeds for Oregon. In many instances, the geospatial location of these sign locations was incorrect when presented in Google Maps and had to be reconciled by the researchers. They identified the issue during quality control checks, which allowed them to determine the cause and a course of action. This problem was ultimately addressed through the use of an ODOT GIS file that contained the correct location coordinates, which made it possible to manually correct these offsets.

A second issue stemmed from data availability and format. The primary example of this was the California Highway Patrol incident file. Information about ongoing incidents (namely crashes) was available for the entire state, but it was presented in a non-spatial format that could not easily be imported and displayed. Consequently, the researchers had to develop an approach to transition this data from a non-spatial format to the one which presents incident data on the prototype website based on route and milepost information.

The performance of the prototype website has been a challenge, mainly because a database was not employed for archiving data due to the limited project budget available. This results in a slower loading time. This is not presently a concern, as the website is an unadvertised prototype. However, should more users become aware of the website and attempt to use it simultaneously, there will be an impact on performance.

The documentation available for each of the data elements employed in the prototype was limited in some cases. For example, Caltrans provided the chain control file in text format with no documentation of what each column heading represented. This presented a challenge in tracking down the necessary definitions and determining how to best format and present the data. This may be an issue when data from other areas of California is included in future development versions of the One-Stop Shop website.

Finally, the potential exists for agencies to change aspects of data elements included on the One-Stop Shop page without warning. The data elements provided by these agencies via different data streams are being provided with a “buyer beware” understanding. However, that means that

data formats and even locations can change at any time, and some of the route information displayed will be inaccurate While Caltrans' Commercial Wholesale Web Portal and Oregon's TripCheck do send alerts to users when updates or revisions are planned, some of the data streams employed in the prototype One-Stop Shop are not coming from these sources (e.g., DMS messages in California). This is an issue that must be kept in mind when maintaining not only the present version of the One-Stop Shop website, but also any future versions, specifically those that are deployed for public use.

6.3. Recommendations and Future Work

The primary recommendation of this work is that additional One-Stop Shop website development is necessary through future project phases. The purpose of this initial prototype was to demonstrate the overall One-Stop Shop concept and to build a foundation for the overall website with respect to appearance, content and function. Based on this initial foundation, the work of future phases should center on refinement of that prototype, the addition of new data streams (both for elements already included in the original prototype, as well as those that may become available), and the presentation and evaluation of the interface by various user groups. In addition to expanded geographic coverage, emphasis should be placed on optimization of code to support a greater number of simultaneous users. Finally, mechanisms such as Google Analytics should be incorporated into the site to further examine use and usability of the site.

Tools such as Google Analytics would be used in future project phases to analyze the use and usability of the revised prototype, including navigation paths and information selection. During the initial project phase of One-Stop Shop, no analysis has been conducted to document and compare actual use of the data layers. For instance, when the application starts, the DOT Field Elements data layer is displayed by default, with all types of field elements displayed. System developers do not yet know which of the sublayers are most frequently viewed or whether users navigate immediately to other layers such as current or forecast weather. Therefore, the goal of use and usability analysis would be to facilitate collection of data to answer such questions and to determine possible modifications that enable users to more easily access the content in which they are most interested.

As the One-Stop Shop is likely to be of interest and utility to travelers throughout the U.S., future work should examine the necessary steps for expanding the One-Stop Shop prototype beyond California. This would include determining which adjacent states the system might be expanded to include; the availability, format and updating frequency of their datasets; and an estimation of the level of effort that may be required to carry out such an expansion from a development and coding perspective. These activities would create the blueprint for the expansion of One-Stop Shop in future phases.

Finally, during a future project phase, it would be beneficial to obtain feedback from users regarding the One-Stop Shop website. Specifically of interest to this work would be feedback on the website from users who have planned a trip through a rural region of California. Such a prospective survey was briefly developed during the course of this project and is presented in Appendix A. Questions should focus on website aspects such as utility to the traveler, performance, whether it met their needs/expectations, whether the data provided was sufficient and timely, and if not, what other data should be added, and general feedback and impressions related to the website. It is recognized from experience that soliciting the participation of the general public in completing such a survey will be a challenge. Therefore, approaches to

obtaining a representative sample of user input and feedback will need to be carefully considered.

7. APPENDIX A: POTENTIAL SURVEY QUESTIONS

This appendix presents a series of survey questions that have been developed during the course of the project, which can be employed in future phases of work to obtain feedback from end users. Changes to the original project scope and tasks eliminated the user survey that was originally proposed.

1. How often do you visit the One Stop Shop (OSS) website for information?

- ☐ First time visitor
- ☐ Website is open all the time
- ☐ Hourly
- ☐ Daily
- ☐ Weekly
- ☐ Monthly
- ☐ Other (please specify): _____

2. When/why do you use the information? (check all that are applicable)

- ☐ Trip planning
- ☐ Under changing conditions only
- ☐ During incident conditions (storm/fire etc)
- ☐ Daytime hours
- ☐ Nighttime hours
- ☐ Other (please specify): _____

3. Now we would like you to rate the usefulness of the data on the OSS website that you have *used* at least once. For each feature that you have *not* used, please indicate whether you were aware of this feature before taking this survey (Please make a single selection for each data element.)

Current Weather	Use Feature			Don't Use Feature	
	Very Useful	Somewhat Useful	Not Very Useful	Aware of it	Not Aware of it
a. Air temperature	☐	☐	☐	☐	☐
b. Wind speed	☐	☐	☐	☐	☐
c. Hourly precipitation	☐	☐	☐	☐	☐
d. 24-hour precipitation	☐	☐	☐	☐	☐
e. Humidity	☐	☐	☐	☐	☐
f. Nt'l Weather Service Observed 24-hour precipitation	☐	☐	☐	☐	☐

Weather Forecast	Use Feature			Don't Use Feature	
	Very Useful	Somewhat Useful	Not Very Useful	Aware of it	Not Aware of it
a. Air Temperature	☐	☐	☐	☐	☐
b. Wind speed and direction	☐	☐	☐	☐	☐
c. Wind Gust Speed and direction	☐	☐	☐	☐	☐
d. Humidity	☐	☐	☐	☐	☐
e. Sky cover	☐	☐	☐	☐	☐
f. 12-hour Probability of Precipitation	☐	☐	☐	☐	☐
g. 6-hour Amount of Precipitation	☐	☐	☐	☐	☐
h. Snow	☐	☐	☐	☐	☐
i. Weather	☐	☐	☐	☐	☐

DOT Field Elements	Use Feature			Don't Use Feature	
	Very Useful	**Somewhat Useful**	**Not Very Useful**	**Aware of it**	**Not Aware of it**
a. CCTV images	☐	☐	☐	☐	☐
b. Message Sign Text	☐	☐	☐	☐	☐
c. Road Weather Information Stations	☐	☐	☐	☐	☐
d. Incidents	☐	☐	☐	☐	☐
e. Chain requirements	☐	☐	☐	☐	☐
f. Construction	☐	☐	☐	☐	☐

Additional Data Elements	Use Feature			Don't Use Feature	
	Very Useful	**Somewhat Useful**	**Not Very Useful**	**Aware of it**	**Not Aware of it**
a. Mountain passes	☐	☐	☐	☐	☐
b. Vista points	☐	☐	☐	☐	☐
c. Rest areas	☐	☐	☐	☐	☐
d. Truck scales	☐	☐	☐	☐	☐
e. Route details	☐	☐	☐	☐	☐

4. Now we would like you to rate the usefulness of the *features* on the Website that you have *used* at least once. For each feature that you have *not* used, please indicate whether you were aware of this feature before taking this survey (Please make a single selection for each feature.)

	Use Feature			**Don't Use Feature**	
	Very Useful	**Somewhat Useful**	**Not Very Useful**	**Aware of it**	**Not Aware of it**
a. Google Map display & zoom function	☐	☐	☐	☐	☐
b. Trip planner	☐	☐	☐	☐	☐
c. Current weather	☐	☐	☐	☐	☐
d. Weather forecast	☐	☐	☐	☐	☐
e. Field device data	☐	☐	☐	☐	☐
f. Mountain passes	☐	☐	☐	☐	☐
g. Vista points	☐	☐	☐	☐	☐
h. Rest areas	☐	☐	☐	☐	☐
i. Truck scales	☐	☐	☐	☐	☐
j. Route details	☐	☐	☐	☐	☐

5. Based on your experience using the Website, please evaluate the site in terms of the following aspects – indicate your level of agreement with these statements:

	Strongly Agree	**Somewhat Agree**	**Neither Agree nor Disagree**	**Somewhat Disagree**	**Strongly Disagree**
a. The site is well organized and user friendly	☐	☐	☐	☐	☐
b. The site presents the right amount of information	☐	☐	☐	☐	☐
c. I would like to see additional information added	☐	☐	☐	☐	☐
d. I would like to see less information presented	☐	☐	☐	☐	☐
e. Information should be presented in a different format than the current one.	☐	☐	☐	☐	☐
f. I find the information presented timely and useful	☐	☐	☐	☐	☐

6. What additional information, if any, would you like to have, which is not available currently at this site? (Please specify the type, format, frequency of updating, accuracy, if applicable)

_____

_____

_____

_____

_____

7. What are the chief benefits of this website to you in the context of your current usage? Please be as specific as possible.

8. Please also indicate in your own words how this website could be improved to better meet your needs. Consider information content, ease of use of the site, ability to understand what is presented and anything else that could make this site better. Be as specific as you can.

Thank you!

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