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Evaluation of the Idaho Transportation Department Integrated Road-Weather Information System

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Table of Contents

Table of Contents (Continued)

List of Appendices

Table of Contents (Continued)

Page

List of Tables

List of Figures

Acronym List

AADT	Annual Average Daily Traffic
CVO	Commercial Vehicle Operator
DOT	Department of Transportation
ESS	Environmental Sensor Station
FHWA	Federal Highway Administration
GIS	Geographic Information System
IP	Internet Protocol
IT	Information Technology
ITA	Idaho Trucking Association
ITD	Idaho Transportation Department
ITS	Intelligent Transportation System
JPO	Joint Program Office
MDSS	Maintenance Decision Support System
NCDC	National Climatic Data Center
NOAA	National Oceanic Atmospheric Administration
NWS	National Weather Service
RWIDS	Road-Weather Integrated Data System
RWIS	Road-Weather Information System
SQL	Structured Query Language
TAZ	Transportation Analysis Zones
URL	Universal Resource Locator
USDOT	United States Department of Transportation
VMT	Vehicle Miles Traveled
WAN	Wide Area Network
XML	Extensible Markup Language

Executive Summary

Introduction

This report presents the results of the Federal Highway Administration (FHWA) evaluation of the Idaho Transportation Department's (ITD) integration of their Road-Weather Information System (RWIS). The ITD RWIS project received approximately $396,400 in funding through the FHWA Intelligent Transportation System (ITS) Integration Program.

The ITD RWIS project was selected for evaluation because it held significant potential to generate lessons learned and other findings that would be useful to other RWIS operators and those planning for such systems. In particular, this project offered an opportunity to study the potential benefits and impacts on public travel and state highway maintenance practice associated with the integration of ITD RWIS data with non-transportation weather data, and the improved information access. The findings of this evaluation could provide useful insights to USDOT's ongoing Clarus initiative which intends to *"demonstrate an integrated road weather observation network and data management system to reduce the effect of adverse weather on all road users and operators."* Clarus—the Nationwide Surface Transportation Weather Observing and Forecasting System—aims to leverage state investments in Environmental Sensor Stations (ESS) to minimize weather impacts on safety, mobility and productivity.

The RWIS integration project was intended to solve the following four major problems faced by the ITD:

1. **Lack of a Consolidated, Internet-Accessible ITD RWIS User Interface –** Data from two different brands of ITD RWIS were accessed separately via two different proprietary user interfaces. Data from the two different systems were in different formats. Many ITD field maintenance sheds did not have convenient access to the data (dial-up connections were used).
2. **Inability to Integrate Various Brands of Environmental Sensor Stations (ESS) into a Single RWIS** – ITD operated two separate RWIS, one for each brand of ESS. (ESS, which are also known as weather stations and RWIS stations, are the field components of an RWIS.) It was not possible to integrate information from the different brands of ESS and therefore ITD felt confined to one of the two existing ESS brands when expanding coverage.
3. **Lack of Public Access to RWIS Information** – Public information on weather and road conditions was limited to the ITD "Road Report" phone line and website (http://164.165.237.41/apps/roadreport/), which did not include RWIS information.
4. **Inadequate ESS Coverage** – ITD operated about 34 RWIS sensors statewide and there were many critical gaps in coverage.

The RWIS Integration project addressed these problems by establishing a single RWIS user interface and data format, integrating data from existing brands of ESS and weather information from other sources (such as the National Weather Service) and capable of incorporating data from additional ESS; establishing a new public RWIS webpage as part of the existing ITD Road

Report traveler information website; and integrating, via a weather data sharing consortium, data from a large number of ESS operated by other organizations within Idaho and in bordering states. In addition to solving the four major problems noted above, the ITD Project Manager intended that the improved access to data would increase the utilization of RWIS in winter maintenance decision-making on the part of ITD maintenance personnel.

Evaluation Process

The evaluation of the ITD RWIS integration project employed a before-and-after study approach. The before (pre-deployment) data was collected and analyzed in 2001 and 2002. The RWIS project became operational in November 2002. Collection of after (post-deployment) data focused on the second winter season of operation from October 2003 through May 2004. The post-deployment evaluation was delayed one year in order to allow ITD maintenance personnel to be trained and to gain experiences with the integrated system.

The evaluation included the following analyses which evaluated each of the major components of the ITD RWIS Integration project:

- Interviews with ITD maintenance personnel and other ITD personnel associated with the project.
- Website utilization by travelers and ITD maintenance personnel.
- Accident and winter maintenance resource utilization impacts which could result from any improvements in winter maintenance practices associated with the project.
- Survey of public website users.
- Interviews with commercial vehicle operators

Findings

Evaluation findings are summarized below in three major areas: Road-Weather Integrated Data System (RWIDS) as an ITD maintenance information resource; RWIDS as a traveler information resource; and RWIDS as a data integration platform); etc.

RWIDS as an ITD Maintenance Information Resource

- **RWIDS represents an important evolutionary, but not a revolutionary, advance for ITD winter maintenance decision-making.** The RWIDS project has been very successful in its objective of making available a much more convenient, consolidated source of ITD RWIS data, and a vast wealth of additional weather data, to ITD maintenance personnel. Personnel with good access to the Internet in areas where RWIDS coverage is good find the site very useful. However, even the RWIDS proponents view it as "just another tool in the tool box" that has incrementally enhanced their decision making, rather than as a revolutionary improvement.

- **The usefulness of the current version of RWIDS varies widely for ITD maintenance personnel throughout the state, and can be enhanced.** The system is much less useful in

areas with few or no ESS, and there are still significant portions of the state with no stations. Other factors that impact the utility of RWIDS include lack of high-speed Internet access in many areas; scarcity of maintenance shed personal computers in some areas; little to no prior experience using Internet weather information and particularly ESS data in maintenance decision-making. To some extent this last factor is related to the variation across Foreman Areas and Districts in overall attitudes toward technology and new practices.

- **ITD maintenance personnel are generally comfortable synthesizing discrete weather data to draw conclusions and make decisions.** Most ITD maintenance personnel that were interviewed expressed little interest in expert systems for maintenance decision support. They don't feel that the technology is sufficiently sophisticated to effectively deal with what they perceive as a very complex and changing decision-making context. They also expressed concerns that ESS coverage and reliability are not sufficient to support such systems now or in the foreseeable future. It was clear that the interviewees tend to associate more synthesized information and suggested actions with an "automated" system. Therefore, their distrust of decision support does not necessarily imply that they would be likely to reject more synthesized information. In fact, several maintenance personnel cited the synthesized weather summaries prepared by NWS employees as among the most useful type of weather information to help coordinate shift changes.

- **Most ITD maintenance personnel are interested in a wide range of data, but are most interested in the same basic information popular with the public: cameras and basic current and forecasted weather information.**

- **RWIDS might not generate quantifiable improvements in roadway safety or the utilization of ITD winter maintenance resources.** There was no statistically significant change in statewide winter weather-related accident rates during the one-year period after implementation of RWIDS. The absence of measurable, traceable improvements in safety is not unexpected given the many exogenous factors; the modest, incremental improvement in decision-making associated with RWIDS; the fact that not all maintenance personnel utilize RWIDS; and the inherently conservative and relatively inelastic nature of many ITS winter maintenance resource commitment decisions.

- **Although demonstrable safety improvements are lacking, travelers perceive that their safety is enhanced through the use of the RWIDS webpage.** Eighty percent of on-line survey respondents who used RWIDS agreed that the information helped them better prepare for road-weather conditions and 76 percent of the respondents indicated that the information helped them drive more carefully.

RWIDS as a Traveler Information Resource

- **The addition of the RWIDS webpage accounts for a sizable percentage of the overall increase in Road Report website utilization.** Utilization of the Road Report website in general has risen consistently and dramatically in the year following implementation of the RWIDS webpage (169%). About half (47%) of the new user sessions included RWIDS

viewing. Further, 85 percent of all sessions that included RWIDS viewing featured *only* viewing of RWIDS content. A full 25 percent of post-RWIDS Road Report sessions feature viewing of only RWIDS information.

- **The traditional Road Report information, fed by ITD maintenance foremen reports, is not "replaced" by the RWIDS website.** Although "RWIDS-only" user sessions account for a significant portion of the overall growth in Road Report website utilization (about 47%), most of the growth, and most of the total current utilization is for traditional Road Report information (the road closure and conditions information provided by maintenance foremen).

- **RWIDS has probably not reached its full potential as a public information resource, since it has not been marketed or integrated.** The ITD has not marketed the RWIDS webpage. Although significant levels of usage have occurred as result of users happening across the new webpage, and presumably through some word-of-mouth, it seems likely that marketing could significantly increase usage. Also, since it is clear that users still value—and separately consult—the traditional Road Report closure and condition information, that overall Road Report usage might be further enhanced if the RWIDS information was integrated with the traditional information.

- **Public RWIDS users, including commercial vehicle operators, are most interested in camera images and basic current and forecasted weather information.**

RWIDS as a Data Integration Platform

- **RWIDS has successfully leveraged a wealth of data from other organization's ESS.** The RWIDS webpage provides access to approximately 120 ESS operated by other organizations, including other state department of transportation ESS. Most maintenance personnel find these other stations useful, although they prefer ITD operated ESS.

- **Other organization's ESS supplement but do not necessarily replace ITD ESS.** Data from other organizations' stations provide a low-cost means to greatly enhance data coverage. However, even in the case of Idaho which acquired access to a large number of such stations, such stations do not necessarily address all, or even the most critical (hot spot), data coverage gaps. Further, although they provide some value, other organizations' stations do not provide a standard, full compliment of information. For example, very few non-transportation department stations provide pavement data. Non-transportation agency stations are typically not ideally sited to support roadway maintenance-related data collection. Finally, other organizations may not maintain their stations at levels needed to support public traveler or highway maintenance information needs.

- **RWIDS has allowed ITD to pursue more cost-competitive ESS procurements.** Since completion of the RWIDS data platform, two sets of new ITD ESS have been successfully integrated into the system. The project has allowed the ITD to select from among a wider, more cost-competitive range of offerings and thereby significantly reducing the costs of new stations. The ITD estimates that the cost to deploy four sites using one of the two new

brands of stations is about 12 percent lower than the bid submitted by the primary "incumbent" RWIS vendor. In that particular procurement, the flexibility provided by RWIDS resulted in a savings of about $30,000, or about $7,500 per site.

Recommendations

- **Continue to fill gaps in ESS coverage.** Other organizations' ESS do not include pavement data and are often not positioned to effectively meet ITD RWIS needs. It is recommended that ITD pursue plans to implement additional ITD ESS and to evaluate adding pavement sensors to key ESS operated by other organizations.

- **Improve the reliability of ESS.** A number of maintenance employees identified reliability as a concern and significant limitation on RWIS benefits. It is recommended that the ITD continue to work to improve the reliability of stations, including adding their own ESS in key locations where other organizations' ESS are not sufficiently reliable.

- **"Level the playing field" statewide with respect to personal computers and Internet access.** Even more fundamental to the use and usefulness of RWIDS than ESS coverage is that maintenance sheds have personal computers and Internet access; preferably high-speed access. It is strongly recommended that ongoing ITD efforts in this area continue and be accelerated if possible.

- **Continue, and accelerate if possible, implementation of personal computers and high-speed Internet access at all maintenance sheds.**

- **Provide additional, focused training to ITD maintenance personnel.** Most maintenance personnel desired more training, especially hands-on training, with computers at each training station. It is recommended that the follow-up training provide instruction on overall information gathering strategies and use of various types of information, including the various RWIDS data, in support of specific types of winter maintenance decisions as well as the use and benefits of road weather information to make proactive decisions about treatments (such as anti-icing).

- **Market RWIDS to the public.**

- **Consider more fully integrating RWIDS and the remainder of the Road Report.** The general public and commercial vehicle operators are interested in the "traditional" Road Report closure and conditions information as well as information on the RWIDS webpage. It is recommended that ITD consider integrating these information types, including possibly using RWIDS data to enhance the traditional roadway-specific Road Report advisories. Such integration could occur as part of the planned ITD implementation of a comprehensive traveler information system.

- **Develop system performance monitoring capabilities and monitor the utilization and effectiveness of RWIDS.** Currently, ITD does not have effective mechanisms for monitoring the utilization of the RWIDS webpage by either the public or ITD

maintenance personnel. In fact, limitations in this regard, such as the inability to clearly distinguish all ITD RWIDS user sessions, impacted this evaluation. In order to support a continuous quality improvement process it is recommended that the ITD implement mechanisms that will allow for tracking of RWIDS utilization and that they routinely analyze that data.

- **Monitor broader national developments in road weather information sharing and position ITD to capitalize on advances.** The ITD should be aware of FHWA activities to promote technology transfer of the Federal MDSS prototype, which integrated road weather and resource information to provide route-specific treatment recommendations. In addition, the USDOT Clarus Initiative is one of the most important activities that ITD should be aware of, and if possible, participate in. That initiative is focusing on integration of all weather and pavement condition observations from transportation agencies and shares the same philosophy in data integration with this ITD earmark project.

- **Continue to consider opportunities to further synthesize road weather information for winter maintenance personnel, including a Maintenance Decision Support System.**

1.0 Introduction and Background

1.1 Introduction

This report presents the results of the Federal Highway Administration (FHWA) evaluation of the Idaho Transportation Department's (ITD) integration of their Road-Weather Information System (RWIS). This introduction provides an overview of the RWIS integration project and the approach to the evaluation. The remainder of the report presents the evaluation results and conclusions.

The ITD RWIS project received approximately $396,400 in funding through the FHWA Intelligent Transportation System (ITS) Integration Program. The ITD reports that the total cost of the project was approximately $300,000. The ITD RWIS project was selected for a national evaluation from the population of ITS Integration Program projects earmarked for the Fiscal Year 2000. The selection was based on the findings of a site visit conducted in November 2002 at which time the evaluation team met with the ITD RWIS project manager and several other project participants. It was concluded that the project held significant potential to generate lessons learned and other findings that would be useful to other RWIS operators and those planning for such systems.

In particular, this project offered an opportunity to study the potential benefits and impacts on public travel and state highway maintenance practice associated with the integration of ITD RWIS data with non-transportation weather data, and the improved information access. The findings of this evaluation could provide useful insights to USDOT's ongoing Clarus initiative which intends to *"demonstrate an integrated road weather observation network and data management system to reduce the effect of adverse weather on all road users and operators."* Clarus—the Nationwide Surface Transportation Weather Observing and Forecasting System—aims to leverage state investments in Environmental Sensor Stations (ESS) to minimize weather impacts on safety, mobility and productivity.

The evaluation of the ITD RWIS integration project employed a before-and-after study approach. The before (pre-deployment) data was collected and analyzed in 2001 and 2002. The RWIS project became operational in November 2002. Collection of after (post-deployment) data focused on the second winter season of operation from October 2003 through May 2004. The post-deployment evaluation was delayed one year in order to allow ITD maintenance personnel to be trained and to gain experiences with the integrated system.

1.2 Problem Statement

The ITD RWIS project was intended to address four problems. The problems and associated high-level project objectives are as follows:

1. **Lack of a Consolidated, Internet-Accessible ITD RWIS User Interface –** Data from two different brands of ITD RWIS were accessed separately via two different proprietary user interfaces. Data from the two different systems were in different formats. Many

ITD field maintenance sheds did not have convenient access to the data (dial-up connections were used). This project established a single user interface and data format for all ITD RWIS data and made it available to maintenance personnel with Internet access. The overall objective related to this problem was to improve the accessibility of ITD RWIS data for ITD maintenance personnel. A related secondary objective was, by improving accessibility to the RWIS and providing training to maintenance personnel, to promote their utilization of RWIS in winter maintenance decision-making.

2. **Inability to Integrate Various Brands of Environmental Sensor Stations into a Single RWIS** – ITD operated two separate RWIS, one for each brand of ESS. (ESS, which are also known as weather stations and RWIS stations, are the field components of an RWIS.) It was not possible to integrate information from the different brands of ESS and therefore ITD felt confined to one of the two existing ESS brands when expanding coverage. This project defined and established a common data platform that allows ESS from different vendors, who develop a compliant interface, to be integrated. The overall objective related to this problem was to create a common data platform to facilitate integration of additional ITD RWIS ESS of different brands, thereby allowing ITD to make cost-effective selections.

3. **Lack of Public Access to RWIS Information** – Public information on weather and road conditions was limited to the ITD "Road Report" phone line and website (http://164.165.237.41/apps/roadreport/), which did not include RWIS information. This project makes RWIS information available to the public through the addition of a Road-Weather Integrated Data System (RWIDS) webpage to the Road Report website. The overall objective related to this problem was to share RWIS and other weather information with the public via the Internet.

4. **Inadequate ESS Coverage** – ITD operated about 34 RWIS sensors statewide and there were many critical gaps in coverage. This project made available, in a common format, data from approximately 120 additional ESS of various types operated by other organizations within and adjacent to Idaho. Access to these other stations was made possible through ITD's participation in the MesoWest weather information sharing consortium coordinated by the University of Utah. MesoWest is a cooperative project to share access to weather data collected by a large number of public and private organizations throughout the western United States, including state departments of transportation; various Federal agencies including the Bureau of Land Management, Bureau of Reclamation, and National Weather Service; and universities and private companies. The overall project objective related to this problem was to cost-effectively fill in some of the many gaps in statewide RWIS coverage.

1.3 The Road Report Website

The impact of the RWIS project on public information dissemination strategies of the ITD focused on the Road Report system. The ITD has operated the Road Report traveler information system for approximately eight years. The system includes both an Internet website and telephone information system. The only significant change to the Road Report phone line or

website over the last several years was the addition of the RWIDS webpage in 2002 as part of the RWIS integration project. The "traditional" Road Report website information, that is, the information that has traditionally been provided and which is still provided, consists of information on construction, detours, road closures, and roadway surface and weather information (e.g., "surface: icy spots"; "weather: cloudy").

The pavement condition and weather information on the Road Report website is based on field reports from ITD maintenance foremen. During the winter months, at four scheduled times each day, the Idaho State Communications Department contacts each ITD foreman and collects this information. During severe weather, the foremen can phone in updates at any time. The State Communications Department then relays this information to the ITD Public Information Office, which inputs the information into the Road Report website and records the telephone version of the information.

Figure 1-1 presents the Road Report homepage, circa late 2002, just prior to the addition of the RWIDS webpage. The left portion of Figure 1-2 shows an example of the type of roadway information available on the website. The upper table shows the information organized by geographic area. The lower table shows the information organized by specific roadway, in this case I-84. The links on the right side of the homepage consist of a link to the National Weather Service website and various types of static information, including general information on ITD winter maintenance practices ("ITD Winter Maintenance") and various ITD transportation maps and data ("Highway Data Quest").

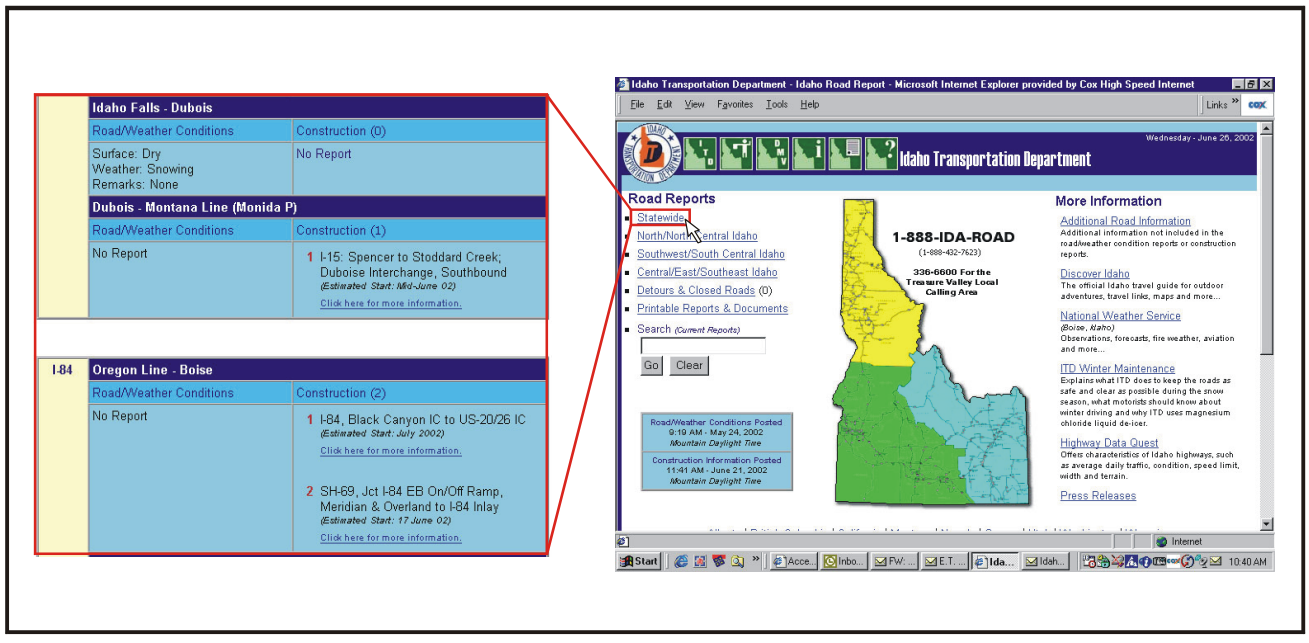


Figure 1-1. Road Report Homepage (pre-RWIDS)

The impact of the ITD RWIS Integration project was limited to the addition of a new link on the Road Report website homepage. That link, "Weather/Pavement Conditions and Webcams" (the RWIDS webpage) is shown in Figure 1-2, which presents the Road Report homepage circa 2004.

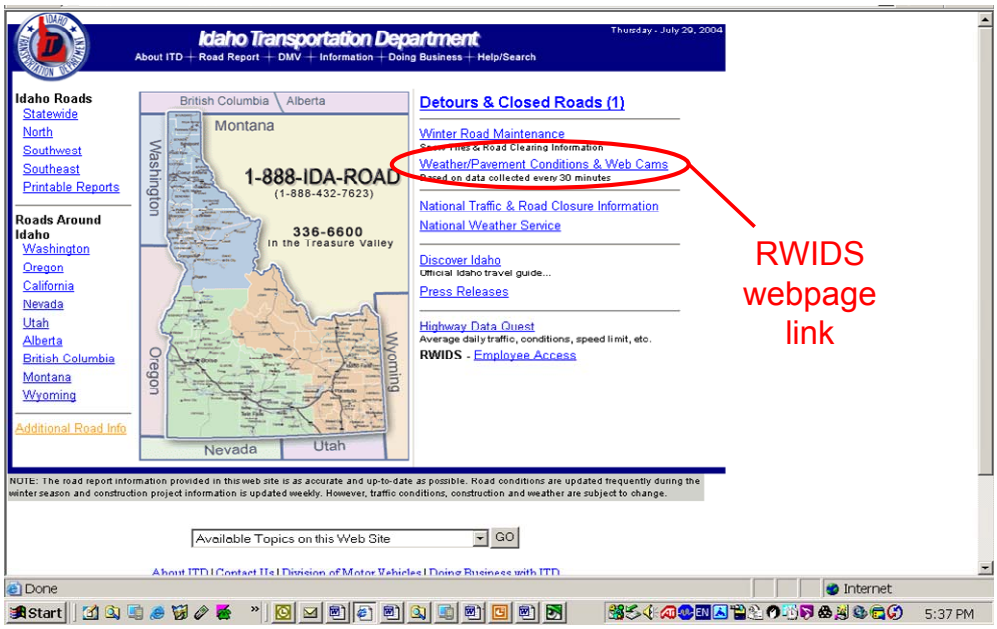


Figure 1-2. Road Report Homepage (post-RWIDS)

The RWIDS webpage that was created through the ITD RWIS Integration project is shown in Figure 1-3. The homepage includes a statewide map showing current weather conditions (temperatures and cloud conditions). The information displayed on the map can be changed by the user to show either wind speed and direction (in arrows) or barometric pressure at locations throughout the state.

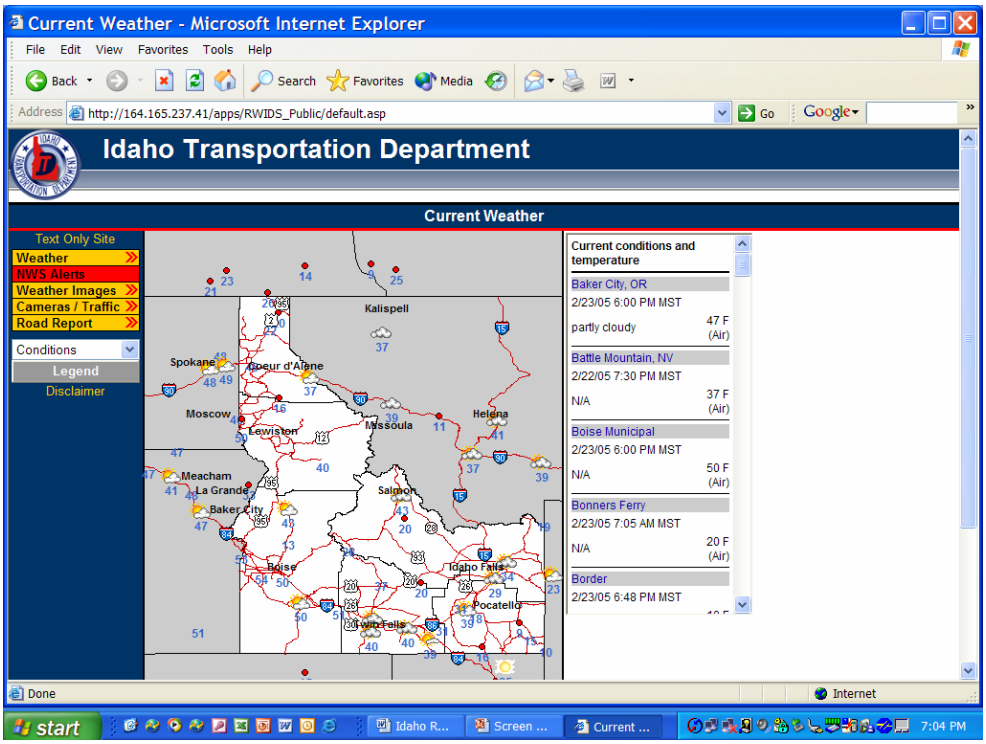


Figure 1-3. RWIDS Webpage

In addition to the weather map on the homepage, the RWIDS webpage contains a wide range of weather and road-weather information in the following major categories (examples of these data are shown in Appendix A):

- **Weather and Pavement Data** – Current weather from individual reporting stations, including the approximately 30 ITD ESS and the many ESS operated by other organizations; National Weather Service weather forecasts for individual locations; and pavement data from individual ITD pavement sensors.

- **National Weather Service Alerts** – Watches and warnings (shown as shaded areas on a map) and avalanche alerts. Additional information can be obtained for each avalanche alert by clicking on an individual alert icon.

- **Weather Images** – Satellite, Doppler radar, composite radar, Isobars, jet stream, and Pacific loop satellite images linked from other organization's websites, including the National Weather Service. See Appendix A for example images.

- **Roadway Images** – Snap shots from any of 40 cameras located throughout Idaho and surrounding states, consisting of some ITD traffic cameras and ESS cameras, as well as cameras operated by other organizations.

- **Road Report** – A link back to the Road Report homepage and a map graphically displaying road closures, based on information from the "traditional" (non-RWIDS) Road Report.

All of the above information is available to general public users of the Road Report website. ITD maintenance users can view this information as well using the same webpage as the public. However, there is an optional ITD employee user log-in feature on the Road Report homepage ("RWIDS employee access", in the lower right portion of Figure 1-2). Using a password, ITD employees can log on to the RWIDS webpage and gain access to a slightly enhanced version of the webpage. The enhanced version includes two special features not available to the public: alerts and printing functions.

The alerts feature allows ITD users to set one or more alerts keyed to one or more variables for various ESS. When conditions reach the level specified in the alert, an e-mail notification is automatically sent to the user. For example, an alert could be set that provides an e-mail notification when temperatures drop below freezing and when wind speeds exceed 30 miles per hour at the Boise Municipal ESS. The printing function allows users to graph and print any of a variety of data from the RWIDS webpage for up to a 24-hour period.

1.4 Evaluation Approach

The evaluation approach was developed to assess the impacts associated with the major project objectives referenced in the Problem Statement (Section 1.2) and to gather lessons learned and other insights useful to ITD and other RWIS implementers. Table 1-1 presents the evaluation hypotheses. The last chapter of this report summarizes evaluation findings for each hypothesis.

Table 1-1. Hypotheses Addressed by the Evaluation

Associated Problem (Section 1.2)	Project Objective	Hypothesized Project Impacts
1. Lack of a Consolidated, Internet-Accessible ITD RWIS User Interface.	Provide convenient access to consolidated RWIS data for ITD headquarters, district and foreman area staff, and for the consolidated state dispatch office.	ITD staff will consult the integrated RWIDS website and will view the resource positively.
	Increase the utilization of RWIS data in winter maintenance decision-making (e.g., where and when to deploy snow plows), especially by Foreman Area personnel, who are responsible for many real-time maintenance decisions.	ITD winter maintenance staff will integrate the use of RWIDS information from the website into their winter maintenance decision making.
		The effectiveness of ITD winter road maintenance activities will be improved, such as may ultimately manifest as reduced winter-weather related crashes.
		The productivity of ITD winter road maintenance activities will be improved, such as may manifest as reduced labor or materials cost for equivalent work performed or service provided.
2. Inability to Integrate Various Brands of Environmental Sensor	Provide a cost-effective means to integrate future RWIS sensors, regardless of their brand, and to integrate other future ITS	Future integration of various brands of ESS, and other ITS devices, will be possible.

Associated Problem (Section 1.2)	Project Objective	Hypothesized Project Impacts
Stations into a Single RWIS	devices such as dynamic message signs and highway advisory radio.	
3. Lack of Public Access to RWIS Information	Provide the public convenient access to consolidated RWIS information in a form that will facilitate the use of information in making travel decisions.	Travelers (e.g., commuters, recreational travelers, and commercial vehicle operators) will consult the RWIDS webpage and will view the resource positively.
		Travelers will utilize the RWIDS webpage and will call the ITD less frequently for road-weather information.
		Use of the RWIS website will allow travelers to avoid or better prepare for driving during adverse road weather conditions.
4. Inadequate Environmental Sensor Station Coverage	Provide the ability to expand ITD RWIS coverage in a cost-effective manner through the integration of data from sensors operated by other organizations.	Expansion of ITD RWIS coverage in a cost-effective manner through the integration of data from sensors operated by other organizations.

The evaluation approach was developed to test each of the hypotheses identified in Table 1-1 and included the following major analyses:

1. Key Informant Interviews – Post-deployment key informant interviews constitute a primary source of information on lessons learned and evaluation of hypothesized impacts related to maintenance personnel utilization of the RWIS integration project. Interviews were conducted with several ITD headquarters personnel consisting of the RWIS project manager, the state maintenance engineer, the Public Information Officer, and the Road Report webmaster. Interviews were also conducted with 10 maintenance foremen and 4 lead workers, representing 13 of the 45 ITD foreman areas and 3 of the 6 ITD Districts.

2. Web Usage Data Analysis – This analysis focused on project objectives related to providing the public and ITD maintenance personnel with a convenient source of a wide range of road-weather information. Public and ITD maintenance personnel usage of the enhanced Road Report website, including the RWIDS webpage, was analyzed using website system data (server log files). The analysis examined the relative usage levels of various types of Road Report information as well as the relationship between usage of "traditional" Road Report information and the new RWIDS data. The analysis of public Road Report web usage included before-and-after comparisons. The analysis of ITD maintenance usage focused only on the RWIDS webpage and considered only the post-deployment period (the RWIDS webpage did not exist prior to this project).

3. Accident Data Analysis – The accident data analysis focused on the assessment of RWIDS impacts on accident risk by comparing the before-and-after winter weather-related accident data. The hypothesized safety benefits are expected from two sources. First, the "better" winter maintenance practice of ITD resulting from the use of RWIDS is expected to provide safer roadways. Second, upon consulting with the RWIDS information, the general public would be more informed of the road-weather conditions and would make travel decisions that reduce the likelihood of accident occurrence.

4. Maintenance Resources Analysis – Like the accident data analysis, this analysis focused on hypothesized impacts stemming from project-related improvements in winter maintenance practices. This analysis intended to assess potential RWIDS impacts on winter maintenance resources by comparing the before-and-after maintenance resource consumption of labor and various key materials.

5. Public Web Survey – Identical RWIDS information was provided to ITD maintenance staff as well as the general public through the ITD Road Report website. An on-line web survey was conducted as part of this evaluation to understand the general public's perception on the RWIDS as traveler information. The objectives of the survey were to better understand who the users were of the new RWIDS information as well as the traditional road condition reports. The survey was designed to investigate what kinds of trips they were planning with the information they derived from the site, the RWIDS features they used and how useful they found these features to be for their trip planning, and suggestions they might have for enhancing the overall value of the site.

6. Commercial Vehicle Operator Interviews – Like the public web survey and the public portion of the usage analysis, this analysis focused on hypothesized impacts related to travelers' utilization and satisfaction with the enhanced Road Report website. In this case, the focus was a subset of the traveler information market: commercial vehicle operators. Interviews were conducted with 22 representatives of commercial trucking companies active in Idaho. The interviews examined general traveler information strategies as well as awareness, use, and satisfaction with the Road Report website, including the RWIDS webpage.

2.0 Key Informant Interviews

This analysis examined interview input from ITD headquarters and field maintenance personnel. The methodology, results, and conclusions of the analysis are presented in this section.

ITD interviews were a critical source of information for the evaluation. Interview data played an important role in assessing many of the project objectives, contributed to the testing of several hypotheses, and were a primary source of management and deployment issues information—"lessons learned" and the like.

Interview data from field personnel, foremen, and "lead workers" (senior maintenance crew personnel) played the primary role in evaluating the fundamental project objective to provide a consolidated, easily accessed source of information useful in District and shed-level winter maintenance decision-making. Interviews with field personnel also provided supporting data for the evaluation of several other objectives related to traveler information, safety, and maintenance resource utilization.

In the case of traveler information, it was hypothesized that the RWIDS webpage might reduce the number of information requests received by ITD maintenance personnel. In the case of safety and winter maintenance resource utilization benefits, the interviews helped establish a general expectation as to whether measurable benefits in these areas are likely, and how best to identify those benefits. Benefits in those areas that could be attributed to the RWIDS project depend first on the maintenance personnel utilizing the new resource and altering their decisions and practices as a result. There are also many other variables that influence safety and resource utilization which cannot easily be controlled in an evaluation. Therefore, field maintenance personnel input regarding the role of the RWIDS webpage in influencing their decisions and practices, as well as perspectives on other factors influencing these variables, was useful in shaping the safety and resource utilization analyses.

2.1 Methodology

2.1.1 Development of Discussion Guides

Interview discussion guides were developed for each type of interview:

- ITD Headquarters – project and senior management
- ITD Headquarters – information technologies (IT) staff
- ITD Headquarters – public information officer
- Field Maintenance – foremen and lead workers

The interview with headquarters project and senior management personnel focused on overall project objectives, lessons learned in developing, implementing and operating the RWIDS webpage, and coordination of the RWIDS project with other ITD maintenance and public information activities. The interview with headquarters IT staff focused on technical issues associated with the website itself. The interview with the ITD public information officer focused

on the overall ITD traveler information program, the relationship between RWIDS and that program, feedback from travelers, and any marketing of the RWIDS webpage. The interviews with the maintenance personnel focused on the following topics:

- Usage and usefulness of the RWIDS webpage – frequency of use and overall usefulness.
- RWIDS data types – use of various data types and preferences.
- Website special features – experience with the RWIDS webpage features not available to the public. Those features consist of the ability to graph and print data from individual ESS and the ability to set e-mail alerts, based on any of several types of data (wind speeds, temperatures, etc.) at any individual ESS.
- Benefits of the RWIDS webpage – benefits stemming from the website and how the information makes those benefits possible.
- Other types and sources of information – other (non-RWIDS) information utilized in support of winter maintenance.
- Feedback from the public – the impact, if any, of the RWIDS webpage on public requests to ITD maintenance personnel for winter travel information.
- Training – level of participation and material covered.
- RWIDS webpage layout and data formats – reactions to existing webpage and suggested modifications.
- Next steps – perspectives on useful changes to the RWIDS webpage and information for maintenance decision-making in general.

The preceding discussion topics for the field personnel interviews were developed in conjunction with the ITD RWIDS project manager. The specific questions asked during the interviews and their sequence of topics varied somewhat among the interview sessions. The overall objective was to stimulate a constructive dialog around these themes and to follow the useful discussion threads that surfaced.

In addition to the specific discussion topics, all of the interviews were framed by the four basic RWIDS project components and associated objectives (see Section 1.2.1), which the interviewers summarized in the introduction to the interview sessions.

Interviews with ITD Headquarters personnel were conducted individually (two members of the evaluation team speaking with one ITD representative). The interviews with ITD field personnel were conducted in groups ranging from 6 to 10 ITD personnel.

2.1.2 Selection of Interviewees

Identification of ITD headquarters interview subjects was straight forward. There were few personnel associated with the project and the evaluation team was acquainted with those individuals from interactions during the planning and baseline data collection and analysis phases of the evaluation.

ITD Headquarters interviewees consisted of the following:

- Mr. Bryon Breen, assistant maintenance engineer and RWIDS project manager
- Mr. David Jones, maintenance engineer, responsible for ITD's overall maintenance program
- Mr. Jeff Stratten, public information officer
- Mr. Greg Clark, information technologies, RWIDS webmaster.

Selection of field maintenance personnel for interviewing was more involved. The ITD winter maintenance decision-making process is decentralized, with most decisions made at the foreman area level or by individual maintenance vehicle operators. The objective was to interview a sampling of foreman area personnel—foremen and lead workers—from as many of the 6 ITD districts as possible. There are three levels of jurisdictions in ITD maintenance, namely, district, foreman area, and maintenance shed. There are 6 districts statewide with a total of 45 foreman areas. Figure 2-1 shows the foreman area boundaries in relation to the district boundaries. Each foreman area includes, at a minimum, one maintenance shed, where the foreman offices are located and where all activities for the foreman area are coordinated. If there are multiple sheds, as there are in most foreman areas, the other sheds are typically smaller and used primarily for vehicle and materials storage.

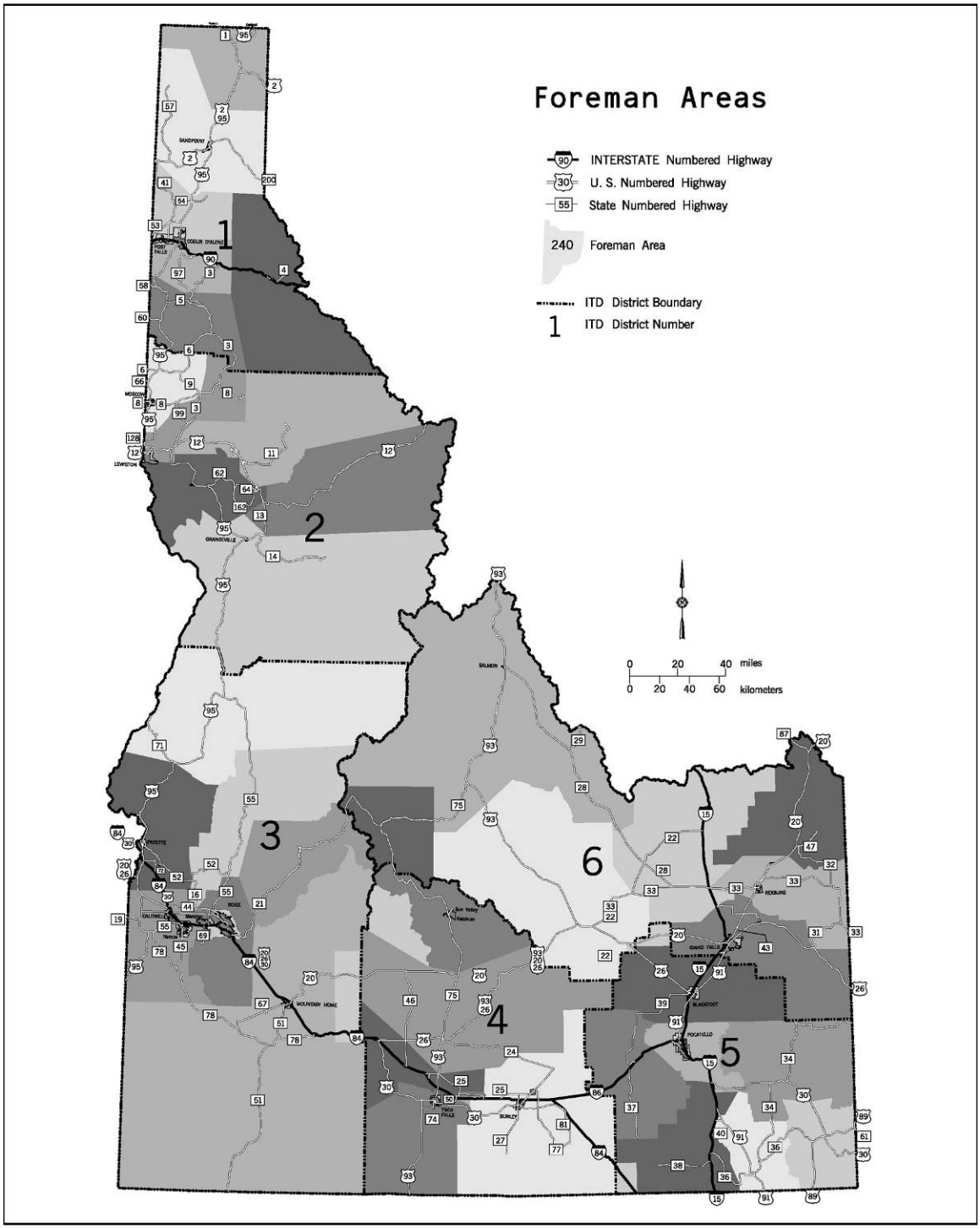


Figure 2-1. Foreman Areas

In selecting ITD maintenance interviewees, a variety of viewpoints were sought, reflecting varying conditions related to:

- Type of Internet access
- Winter weather conditions
- Topography and transportation system characteristics
- Urban/rural character
- Levels of RWIDS usage and satisfaction

The pool of candidate interview subjects consisted of the foreman and lead workers from the 45 ITD foreman areas. The interviews targeted the foremen and individual workers rather than district personnel because most of the decisions for which RWIDS would play a role are made by foremen and workers.

The recruitment of foreman and lead worker interview subjects was aided by a brief e-mail survey of foremen. A six-question survey was developed with the input of the ITD RWIDS project manager. The survey was e-mailed to all of the maintenance foremen shortly before their June 2004 annual maintenance meeting in Boise. The meeting provided an opportunity to encourage completion and submittal of the surveys. A total of 31 surveys were returned, 26 from foremen (58 percent of the total 45 foremen statewide), one from a district engineer, and four from lead workers.

The screening survey provided input to the finalization of the interview discussion guide by providing an overall sense of the usage and reaction to the RWIDS webpage. The survey was also useful in identifying the specific usage and reactions to the website of individual foremen. Later, as foremen responded to the interview invitation, this information allowed the evaluation team to track the composition of the interviewee pool by those variables. Finally, the survey gauged the extent to which foremen had utilized the employee log-in feature. That feature had been added to the website for the express purpose of tracking usage by individual maintenance shed. That information was useful in assisting the interpretation of the results of RWIDS usage analysis (see Section 3.0). The results of the survey were reported in conjunction with the interview results in the section that follows.

All but one of the foreman interviews were conducted in person. One interview with the District 5 Maintenance Supervisor was conducted by telephone. The results of that interview are included with the results from the on-site interviews.

ITD headquarters personnel assisted the evaluation team in identifying three locations for the interviews. Once the locations and dates for the interviews were identified, invitations were sent to all of the foremen throughout the state. A set of 14 interviewees, representing 12 foreman areas and 3 Districts was identified. Twelve of the 14 interviewees were among those who completed the initial screening survey.

Table 2-1 identifies the locations represented by the interview subjects, organized by the three interview sessions. Table 2-1 also identifies a number of salient characteristics of the

interviewees in each session (including data from the survey, presented in full in Table 2-2 as part of the interview results) and the areas they represent.

Table 2-1. ITD Field Personnel Interviewees

Interview Session	Attendees	ITD Districts	Key Characteristics
Mountain Home, Idaho	Foreman – Area 350 Lead Worker – Area 350 Foreman – Area 450 Foreman – Area 460 Foreman – Area 480	3 & 4	• South central portion of the state; rural and small urban areas. Some high elevation areas. • Experienced RWIS users (pre-RWIDS); considered to be among the more progressive, technology-savvy personnel. • Many ESS in the area (~3 ITD and ~17 non-ITD stations). • Interconnections variable (2 high-speed (WAN) and 2 dial-up). • All completed survey. • All use RWIDS more than once a week. • Included some areas with heavier than normal winter weather in '03-'04.
Orofino, Idaho	Foreman – Area 220 Foreman – Area 260 Foreman – Area 270 Foreman – Area 290	2	• Northwestern portion of the state; rural and small urban areas. Many high elevation areas. • Very few ESS (~1 ITD RWIDS site and ~3 non-ITD ESS). • Internet connections variable (1 high-speed (WAN) and 3 dial-up). • All completed survey. • Usage of RWIS varies considerably; some heavy, some little to no use. • Included some areas with heavier than normal winter weather in '03-'04.
Boise, Idaho	Foreman – Area 330 Foreman – Area 340 Lead Worker – Area 350 Lead Worker – Area 360 Foreman – Area 370	3	• Southeastern portion of the state; includes rural, small urban, and large urban areas (Greater Boise-Treasure Valley Region). Some high elevation areas. • Experienced RWIS users (pre-RWIDS). • Many weather ESS in the area (~7 ITD and ~2 non-ITD ESS). • All have high-speed Internet connection (WAN). • 3 completed survey. • 3 heavy RWIDS users (>1/week). • Winter weather in '03-'04 was typical.

2.1.3 Data Collection

Interviews were conducted over the period of `August 3-6, 2004. Headquarters personnel were interviewed at the ITD headquarters building in Boise, Idaho. Foremen and lead workers were interviewed at three ITD maintenance sheds (see Table 2-1): Mountain Home, Orofino, and Boise. Each interview was conducted by two members of the evaluation team. Headquarter interviews were approximately one hour in length. Field interviews were approximately two hours in length.

2.2 Results

2.2.1 ITD Headquarters – Project and Senior Management

Overall, both the Project Manager and State Maintenance Engineer believe that the RWIDS project has been very successful. They feel that three of the four major project objectives have been well accomplished—those related to establishing a consolidated, easily accessed source of new information for ITD maintenance personnel; establishing a common data platform capable of accommodating various types and brands of Environmental Sensor Station input; and enhancing coverage by including data from other organizations. The one area where they felt the project had not been fully successful was the public traveler information aspect of the project. The assessment of each of these objectives is discussed below.

The successful implementation and operation of the RWIDS webpage constitutes the basic measure of success for the project objective related to providing maintenance personnel with a convenient access to a wide range of weather information. Aside from a two-month period immediately following the system launch in November 2002 when data was not always updated, the system has operated as intended, and very reliably. The RWIDS webpage is easily accessed via the Internet and contains most of the very wide range of data in which maintenance personnel expressed interest during the project design. ITD headquarters maintenance personnel acknowledged that the foremen and maintenance workers will ultimately judge the usefulness of the website. However, based on the accomplishment of the basic design objectives and the encouraging anecdotal feedback they had received from some maintenance users, they felt this aspect of the project has been very successful.

The objective of establishing a common data platform to support expansion of the ITD RWIS was also considered successful. The RWIDS system rolled out in November 2002 accomplished the first objective of combining data from the then two different brands of RWIS procured by the ITD. Since the RWIDS launch, the system had also proven the ability to accommodate additional brands of ESS. The incorporation of data from additional sensors was performed by ITD staff and required no support from the RWIDS system integration consultant. No longer constrained to the one or two "incumbent" brands of ESS, ITD had been able to comparison shop and had saved money. The cost to deploy four sites using one of the two new brands of ESS was about 12 percent lower than the bid submitted by the former incumbent vendor. ITD estimates that in that particular procurement, the flexibility provided by the RWIDS platform provided a savings of about $30,000, or about $7,500 per site.

ITD headquarters maintenance personnel felt that the RWIDS project had definitely accomplished the objective of providing a quick, relatively low-cost means of greatly enhancing statewide weather data coverage. The RWIDS project provided access to approximately 120 additional ESS throughout and adjacent to Idaho operated by other organizations—three times the number of ITD-operated stations. There were disadvantages associated with using other organizations' stations. Most of those stations did not include pavement sensors; they were often not ideally suited to support roadway-related maintenance decisions; and the level of calibration and maintenance of the non-ITD stations was inconsistent. Despite these drawbacks, headquarters personnel felt these additional stations had significant value in providing at least basic atmospheric data. Although they were considering the options of enhancing some of the non-ITD stations with pavement sensors and possibly implementing ITD ESS in some of the locations, they felt that in many cases the non-ITD sites represented a viable, fairly long-term alternative.

The headquarters maintenance management personnel that were interviewed point to the public traveler information area as the one area in which the project has not yet fully accomplished its objectives. They also emphasized that the public traveler information objective was not an after thought or a byproduct, but was, from the beginning, as important as the other ITD maintenance-oriented objectives. The RWIDS webpage is available to the public, via the Road Report homepage. However, the maintenance management staff's concerns were that it has not been well integrated into the overall Road Report or overall ITD public information strategy, and that the RWIDS site had not been marketed. They were not sure that the value of the RWIDS information for both ITD and public users was fully appreciated throughout the organization.

Very few significant technical challenges were encountered in implementing the RWIDS project. The most significant had to do with securing access to the incumbent RWIS vendor's raw data, which necessitated a software purchase and took considerable time to accomplish. Although ITD actually owned the RWIS components (i.e., field ESS, communications systems and central computers), traditionally, what they purchased from an RWIS vendor was actually a processed data stream, accessible only via the vendor's proprietary user interface. Integrating various brands of data into a common, ITD designed interface necessitated collecting the raw ESS data themselves from the vendors, a product that was not previously provided.

The ITD project manager was asked about possible plans to provide foremen with more synthesized information and/or a Maintenance Decision Support System (MDSS). For the near-term at least, the ITD intends to continue to provide discrete pieces of information and let the users utilize that information as they see fit. They indicated that the MDSS concept is a good one, but that smaller steps toward such an ultimate system are necessary. They also questioned whether, given the extremely complex, highly variable (across the state) and changeable weather environment in Idaho, current MDSS are sufficiently sophisticated.

The ITD project manager was also asked whether he thought the RWIDS project has generated any measurable safety and resource utilization benefits. He thought that productivity has improved, based on the anecdotal feedback he heard from maintenance personnel, but was doubtful that benefits can be successfully quantified given the many exogenous factors. He noted that ITD has been conducting a similar safety and productivity analysis as the one

performed in this evaluation, focusing on freeze-point depressant chemical (magnesium chloride) utilization. Although there was considerable evidence that the freeze-point depressant chemical was very useful, they were unable to isolate quantitative safety and productivity benefits.

2.2.2 ITD Headquarters – Information Technologies (IT) Staff

The IT staff interviewee served as the RWIDS webmaster and provided technical support for the integrated RWIS. The interview focused on his experiences in maintaining the RWIDS system, including integrating new Environmental Sensor Stations. Overall, few significant technical challenges were encountered, and the webmaster thought the project has been successful. The RWIDS system developer, a consultant, was retained for a period of one year after the RWIDS roll-out to provide technical support. That contract expired in late 2003 and ITD has had full responsibility for operating and maintaining the system since that time. The system has been stable and integration of data from differing brands of new ESS has been performed in-house without difficulties.

As noted by the ITD project manager, the greatest challenge encountered in the development of RWIDS was in obtaining the raw data from the incumbent RWIS vendor and integrating it into the system. This necessitated discussions with that vendor and ITD purchase of a software module enabling the interface with the proprietary data format.

The ability of RWIDS to accommodate data from additional brands of ESS was proven when several stations of two different brands were implemented in District 5. Overall, that effort went smoothly and was performed entirely by the RWIDS webmaster, working with the vendors. No support from the RWIDS vendor was required. That integration included use of SQL database tools to retrieve the proprietary RWIS data and development of an XML program to translate that proprietary data into the common format used in RWIDS.

2.2.3 ITD Headquarters – Public Information Officer

The ITD public information officer indicated that the full potential of the RWIDS project as an information source for the traveling public has not been realized, and feels that the traveler information objective of the project is not yet successful. That lack of success, he said, was primarily a result of two factors: lack of a single ITD "owner" for the Road Report website, and the lack of a clear, overall ITD traveler information vision and motivation.

The public information officer indicated that no single ITD group is fully responsible for the Road Report website. There is therefore no single vision for the website and no one group with authority and accountability. "Ownership" of the Road Report system is split between the Public Affairs Office, which operates the system and interacts with the public, and the Maintenance Department, which provides the information for the system. The traditional, non-RWIDS Road Report information is phoned in several times a day during the winter months by individual maintenance foremen. The Road Report has, in a sense, a "dual personality"—partly an "engineering" project and partly a "public affairs" project. These two viewpoints have traditionally been very different and not integrated at ITD.

In addition to the lack of single owner for public traveler information, the failure to fully capitalize on the traveler information potential of RWIDS is a result of the lack of a clear, overall ITD traveler information program vision—one integrating the various current information dissemination strategies. The lack of a clear vision was the result of several factors. Several mild winters in the years leading up to the RWIDS deployment reduced the need for winter weather information. Perceiving that the traditional Road Report website and phone system were effective, and given the excess capacity in the phone system, there was no strong motivation for ITD to change their winter weather traveler information strategy. In addition to the lack of an overall, department-wide vision for traveler information, the public information officer did not fully realize the potential usefulness of the RWIDS webpage for the traveling public. The public information officer indicated that he viewed the traveler information aspect of the RWIDS project as something of an after thought or byproduct of what he viewed as, in essence, a maintenance resource.

As a result of all of these factors, the RWIDS information was not integrated with the traditional Road Report information. Instead, a link to the separate RWIDS webpage was merely placed, not particularly conspicuously, on the Road Report homepage. There has also been no marketing of RWIDS to the public. The only way travelers become aware of the new resource is by happening upon the RWIDS link on the Road Report homepage, or by word-of-mouth. The public information officer indicated that the current approach is something of a "kitchen sink", with a collection of discrete RWIDS information and no integration or relationship with the traditional Road Report information. The information is not easily digested; there is no clear "bottom line" that reflects all of the available information.

Conditions have improved since implementation of RWIDS, at least in terms of progress toward the development of an overall ITD traveler information vision. After a previous unsuccessful start, the department is now engaged in planning both a 511 telephone information system and a comprehensive traveler information program to incorporate 511, dynamic message signs, highway advisory radio and the Road Report website (including the RWIDS webpage). A motivated new ITD Director with successful statewide traveler information experience, several recent colder and wetter winters, and an Road Report phone system that did not provide sufficient capacity during major winter storms, have combined to "light a fire" under the recent traveler information initiatives.

There are currently few specific plans in regard to the RWIDS information, but the idea of moving camera images to the Road Report homepage is being considered. The public has expressed a great deal of interest in camera images. There are no plans to eliminate the traditional Road Report highway condition information based on the maintenance foreman reports. That information leverages all of the knowledge and judgment of the foremen, is intuitive, and has been popular with the public and the media.

2.2.4 Field Maintenance – Foreman and Lead Workers

The results of the maintenance foremen and lead workers interviews are organized according to the major discussion topics described in Section 2.1.1.

Usage and Usefulness of the RWIDS Webpage

Overall, most of the ITD maintenance personnel that were interviewed use RWIDS frequently and find the website useful. Frequency of use and perceptions of usefulness do vary somewhat by location, however. Interviewees in the south-central portion of the state, Districts 3 and 4, uniformly found RWIDS to be a very useful tool and used it frequently. In the north-central part of the state, in District 2, reactions were more mixed and frequency of use was more variable. This is directly related to the number of ESS in the area and the level of experience in working with RWIS data. There are very few ESS—ITD or other organizations'—within or adjacent to District 2, whereas there have been for several years many stations of interest to Districts 3 and 4. Also, personnel in District 2 who did not find RWIDS as useful and who used it less frequently were quick to point out that their perception was based primarily on the lack of relevant Environmental Sensor Stations.

The general perception of RWIDS as a useful new tool was also supported by the ITD maintenance foreman survey results. Table 2-2 presents the full survey results. Information on usage and usefulness is presented in the first two rows of the table. On average, respondents used the RWIDS webpage more than once a week during the winter, and 40 percent reported using the site on a daily basis. Fifty percent of respondents find the website at least "very useful". Ninety-seven percent of the respondents find the website at least "somewhat useful".

Table 2-2. ITD Maintenance Survey Results

Question (and response categories)	Percentage (or Number) of Responses	Overall Average Response	Total Number of Responses
Frequency of Use – *Over this last winter (2003-2004) how often did you use the new RWIDS webpage? (select one answer).*		4.0	31
1 = Never	3%		
2 = About once a month	13%		
3 = About once a week	6%		
4 = More than once a week	38%		
5 = Daily	40%		
Usefulness – *How useful is the RWIDS webpage information for your winter maintenance activities? (select one answer).*		3.2	30
1= Not at all useful	3%		
2 = Somewhat useful	27%		
3 = Useful	20%		
4 = Very useful	47%		
5 = Critical	3%		
Benefits – *What benefits have resulted from your use of the RWIDS webpage information? (Select all that apply.)*		3 benefits selected per respondent	31
None or no response (no benefits selected)	10%		
Limit the amount of time you have to have drivers in the field observing roadway and weather conditions?	45%		
Improve the timing of your winter road treatments, e.g., start sooner or wait until the best time rather than committing too early, etc.?	61%		
Improve the selection of what type of material to apply (magnesium chloride, salt, sand, etc.)?	39%		
Improve your ability to send your people and vehicles to the right locations?	35%		
Improve your ability to deploy the right number of people/vehicles, e.g., avoid unnecessary overtime call-outs, etc.?	42%		
Improve your ability to forecast the resources/materials needed for a particular storm event	58%		
Improve your ability to provide useful information to the public or the media?	35%		

Question (and response categories)	Percentage (or Number) of Responses	Overall Average Response	Total Number of Responses
Suggested Improvements – *What one change could be made to the RWIDS webpage to make it more useful to you?*			
More ESS	12 responses	NA	22
More frequent/reliable data updating	3 responses		
Additional types of data (Doppler radar most mentioned)	4 responses		
More location-specific weather forecasts	1 response		
Public education/marketing of the RWIDS webpage	1 response		
Make website more reliable (reduced downtime)	1 response		
Provide for mobile access (via vehicles)	1 response		
Amount of Adverse Winter Driving Conditions – *How would you describe the amount of adverse winter driving conditions (snow, ice, winds, freezing roads, etc.) you had in your area this last winter? (select one answer).*			
1 = Little to none	0%	3.0	28
2 = Light	4%		
3 = Moderate	25%		
4 = Heavy	54%		
5 = Very heavy	18%		
Use of Log-in Feature of Website	NA	57% of the	10

Generally, the maintenance interviewees view the RWIDS webpage as a useful new tool in their toolbox, but not a panacea. Several interviewees indicated that they continued to seek out weather and road condition information through their traditional channels, including book marking National Weather Service webpage of their maintenance areas, weather reports on commercial radio and television, and information from ITD maintenance personnel in neighboring areas via telephone or voice radio.

Although the RWIDS webpage is primarily intended to support winter maintenance decision-making, several interviewees indicated that they used the site during other times of the year as well. Specifically, the weather information helps support decisions on when to apply herbicides (high winds must be avoided) and when to patch roadway surfaces (rain must be avoided).

The number of ESS in the maintenance area and the level of experience with RWIS data clearly impacted the usage and perceptions of usefulness of RWIDS. The other factors noted were the reliability of individual Environmental Sensor Stations, that is, data not being updated as it should be, and some difficulties with the log-in feature of the website. In District 3 in particular where many interviewees had extensive experience with the pre-RWIDS method of accessing ITS RWIS data, the log-in feature was viewed as inconvenient. This appears to have prompted several interviewees to bypass the log-in feature by logging in once, and then book marking a sub-page of RWIDS for later visit.

RWIDS Data Types

Nearly all of the interviewees used several types of data from the RWIDS webpage. Many interviewees used all or almost all of the information types. Camera images and basic weather information (e.g., air temperature, precipitation, etc.) are among the most popular data, though it was noted that not all cameras are equally useful. Those associated with non-ITD ESS are often not ideally situated to support roadway maintenance decisions. Several interviewees also indicated that lights at camera locations would also be useful, noting that rain and snow can be hard to distinguish at night.

Only two types of information appear to be used infrequently or by only a few users: isobars and avalanche alerts. Few of the interviewees seemed to be able to translate the isobar data into useful information. Avalanche alerts were specifically identified as very useful by several interviewees. It appears that the only reason this information is not more widely used is that many maintenance personnel are not located in areas prone to avalanches.

Several interviewees distinguished data types that are especially useful in longer term planning, that is, 12 hours or more. These include satellite images, jet stream images, Pacific Loop satellite images, and data from ESS located west of Idaho, from which direction comes most winter storms. It was noted that radar images would be more useful if a legend was included explaining the color codes.

Several interviewees continued to rely on the Idaho State Communications Department for winter storm alerts, in addition to the RWIDS. During winter, the foremen are in constant communication with the State Communications Department as they provide pavement condition information to the traditional road conditions portion of the Road Report website. Traditionally, State Communications has been reliable in passing on NWS alerts to the maintenance foremen during these interactions.

Most interviewees found data from non-ITD ESS useful. Many made no distinction between ITD Environmental Sensor Stations and other organizations' ESS. However, several interviewees indicated that, although useful, the non-ITD stations could not fully replace the surface transportation-oriented ESS, and additional ITD ESS would be useful. This is likely due to the less than optimal locations of the non-ITD devices, the absence of pavement condition information, and the variability in the type of data available among non-ITD stations.

A few of the maintenance personnel actually preferred the pre-RWIDS method for accessing the ITD RWIS data. These interviewees, located in Districts 3 and 5 (one telephone interview was conducted with the District 5 maintenance engineer) indicated that there was some subscribed forecast data (provided by an RWIS vendor and accessible only by using the vendor's password protected web site) previously available that is not included on RWIDS. They indicated incorporation of those forecast data, in the same format, into the RWIDS webpage would represent the "best of both worlds."

Benefits and Impacts

Although there were perceived benefits of RWIDS, the maintenance personnel identified several factors that could limit the RWIDS impacts on their maintenance practice. They noted that there is considerable "political pressure", as well as their own appreciation for their public safety responsibility, to continue extensive field checking of conditions. They noted that it only takes one instance where dangerous conditions are unreported to draw public criticism.

Some maintenance personnel also indicated that their resource commitment decisions are inherently inelastic, and therefore even with better information there may not be dramatic cost savings or increase in effectiveness. Most of their resource investment decisions are "lumpy", that is, go or no-go in nature, and if there is any doubt, they typically commit the resources. In the case of manpower, individual employees in reasonable chunks of time must be utilized, rather than keeping them on-call 24 hours a day, seven days a week. They also noted that conservatism is rewarded; they were seldom criticized for sending trucks out when not needed, but the reverse is not true.

Website Special Features

Very few of the maintenance personnel used the special features (e.g., e-mail alert, printing and graphing) available only to ITD maintenance personnel when assessing the RWIDS using the employee log-in. In fact, many of them were unaware of those special features. In the few cases where the interviewees had used the special features, the experience was limited to the setting of alerts. Their concern is that the ESS coverage is not sufficient and data is not always current enough to allow them to rely on alerts as a primary mechanism for anticipating bad weather. One foreman had tried the alerts function but after getting no alerts he assumed the function was not working correctly or that he was not using it correctly. A couple of foremen indicated that they rely on Idaho State Communications to provide them with National Weather Service (NWS) alerts and therefore did not need the alerts function. None of the interviewees had any experience with the weather data graphing or printing special features.

Other Types and Sources of Information

Maintenance personnel considered RWIDS a useful, new source of consolidated information but they still rely on other sources. Those sources include commercial radio and television reports, other websites (e.g., NWS website), Idaho State Communications Department (who passes along NWS alerts) and maintenance personnel in neighboring areas. Although RWIDS incorporates some NWS information, the appeal of going to the book marked NWS site for a particular region appears to be that the NWS site loads faster and includes NWS forecast "discussion notes" that are not available on RWIDS. In the case of information from other maintenance personnel, a couple of foremen indicated that listening in on other district or other foreman area radio conversations is a good way to monitor coming weather. Foremen also call each other directly to exchange information.

Public Feedback

Maintenance personnel interacted directly with the public to some extent, primarily when travelers or residents call them to request information on driving conditions. Several foremen

indicated that they received telephone inquiries from many commercial vehicle operators in particular who apparently obtained their number from telephone directory or by being transferred from other ITD offices. The introduction of the RWIDS webpage has not influenced either the volume or the nature of the interactions between the maintenance personnel with the general public.

None of the interviewees had heard anything from the public specifically about the RWIDS webpage, although the foremen did offer a couple of observations based on their general familiarity with travelers' information needs. First, travelers would be interested in camera images which are intuitive and self-explanatory. Second, the foremen speculated that the public may have difficulties synthesizing the wide array of discrete data on the RWIDS webpage. Travelers are looking for clear "bottom line" information on their selected route with explicit advice (i.e., "should I take this route or not?").

Training

Many of the interviewees felt that additional RWIDS training is needed and would increase the benefits associated with the system. The initial training provided shortly after the system roll-out, in the winter of 2003-2004, was considered a useful tutorial to the RWIDS interface. However, trainings focusing on strategies of utilizing the data in support of specific maintenance decisions would be very useful. As one interviewee put it, "we're asking personnel to be forecasters; putting them in a position of making resource commitment decisions." We need to provide them the tools and the training to do so.

Opinions were somewhat mixed as to whether the additional training should include reiteration of the system basics. Some users thought that a refresher would be very useful, noting that they could not absorb all of the first round of training since they had no experience with the system at that point, and that people tend to forget details (like the special features). Others thought that only new material should be presented. Several interviewees felt that, without additional training, usage of RWIDS among maintenance personnel will not increase, and is likely to slowly drop off, as ambivalent RWIDS users quit using the site.

A couple of interviewees felt that in order to be effective, any additional training should be hands on, with each trainee having a computer in front of them. These personnel felt strongly that in order to be useful, any additional training would need to be focused and of high quality.

RWIDS Enhancements – Next Steps

Maintenance personnel from all three interview sessions had specific ideas for how the RWIDS webpage should be improved, but opinions varied systematically by location. The Mountain Home meeting included a very experienced, "early adopter" foreman from the eastern portion of District 3 as well as several foremen from District 4 who were experienced RWIS users, including one individual who had participated in the early RWIDS design discussions. Given these backgrounds, it is not surprising that the Mountain Home interviewees focused on the as yet only partially realized public traveler information potential of the system. They felt that the system has not accomplished its objectives in that area, due to a lack of integration of the RWIDS information more fully into the Road Report and a lack of marketing. These

interviewees also expressed interest in mobile Internet access, which would allow maintenance personnel in the field to access RWIDS. Mobile access would also allow foremen to enter their Road Report information directly into the system, rather than relaying it verbally to State Communications who in turn relay it to the Public Affairs Office which inputs the information to Road Report.

District 2 personnel, where the Orofino interview session was held, have much less RWIS experience, since there are very few ESS of interest to them. In contrast to Districts 3 and 4, District 2 has only the slower dial-up Internet access, and generally does not have as many computers in maintenance sheds. Understandably, District 2 personnel were primarily interested in adding more ESS to the system and receiving more computers.

The Boise interview session included maintenance personnel from the Boise metropolitan area as well as the western, more rural portions of District 3. These personnel have had much more experience with RWIS so their perspectives were similar to those of foremen at the Mountain Home interview session. District 3 personnel identified several relatively minor improvements, which have been discussed in previous sections (including adding subscribed forecast information to the RWIDS, adding lights to cameras, etc.). Where the Boise interviewees differed from the Mountain Home group is in their perceptions of the public information objectives of system. Not having been involved in the scoping of the RWIDS project, these individuals were unaware of such objectives and did not identify recommended actions to address them.

Interviewees from all three sessions shared the same perspective on one issue. None of them felt that a more sophisticated, decision-support tool for winter maintenance decisions is currently needed. Some interviewees saw the potential for such a system but felt that neither the technology nor ITD maintenance personnel were ready for such a leap. Others did not see the future potential of such a system, feeling strongly that humans can do the best job of synthesizing a wide range of information. They felt that the winter maintenance decision-making environment is too complex and too changeable for any other approach.

The results from the ITD Maintenance Foreman survey, shown in Table 2-2 are generally consistent with the input from the interviews, although they tend to focus on more pragmatic, near-term issues. Twenty-one of the 31 survey respondents provided specific suggestions. By far the most common suggestion, made by 12 of the 31 respondents, was to add more ESS. The only other commonly mentioned suggestion was to add Doppler radar data.

2.3 Conclusions

- **The RWIDS project is viewed by many interviewees as successful.** The system was deployed and operates as intended and provides the intended functionality. No major compromises were made. The project is viewed as very successful in accomplishing three of the four major project objectives: providing a convenient, integrated source of data; establishing a platform that facilitates integration of varying brands of new equipment; and augmenting ESS coverage statewide, and at a much lower cost than implementing an equal number of ITD ESS. The RWIDS webpage has been used frequently by many ITD

maintenance personnel. Those personnel found it to be very useful and felt that RWIDS has benefited their winter maintenance practice. Maintenance personnel, by and large, used a very wide range of data available on the RWIDS website. They also considered the data from non-ITD stations useful, if not necessarily as useful as data from the ITD ESS due to the less optimal location and lack of pavement sensors of non-ITD stations.

- **The RWIDS project has been widely viewed as less than fully successful in regard to the public traveler information objective.** All of the interviewees, including RWIDS project personnel, the statewide maintenance program leader, the Public Information Officer, and the field maintenance personnel, felt that the potential of the RWIDS website as a traveler information resource has not been realized. All parties agreed that this is due to a lack of marketing and, to a lesser extent, to a failure to meaningfully integrate RWIDS information into the traditional Road Report website. These shortcomings were attributed to the lack of an overall ITD traveler information strategy and the lack of a single "owner" of the Road Report website. ITD is now moving forward with a traveler information strategy and intends to reconsider how the RWIDS information is being presented to the general public.

- **Most ITD maintenance personnel were generally satisfied with the RWIDS webpage but had identified several desired enhancements.** Perspectives are largely a function of the number of ITD ESS and the level of experience in using RWIS information. Overall, the most common suggestions by far were that additional ITD ESS and improved internet connection are needed to promote the use of RWIDS. These concerns are greatest in remote areas like District 2 where very few (ITD or non-ITD) ESS currently exist and dedicated network connections are lacking. Some maintenance personnel were concerned about the amount of (in particular ITD's) ESS downtime. Most ITD foremen believed that additional training would stimulate usage and promote more effective utilization of the RWIDS data. That training should be hands-on and should include instruction on how to use the various RWIDS data in making specific winter maintenance decisions.

- **Most ITD maintenance personnel were comfortable with synthesizing a wide range of discrete data and drawing their own conclusions.** Although a few of the less experienced personnel felt somewhat overwhelmed with the quantity of information, no one had a problem with the lack of decision support, or synthesized, "bottom line", information. Most ITD foremen believed that experienced maintenance personnel can do a better job of synthesizing information and developing strategies than can any sort of decision support expert system. They did not feel that such systems can cope with the very complex and transitory nature of the winter maintenance decision-making environment. They also felt that ESS coverage is not yet dense enough to support such systems.

- **Few technological challenges were encountered in developing the system.** The one major challenge was in integrating the data from the two incumbent RWIS vendors into a single user interface (the RWIDS webpage). This required considerable coordination with the vendor to obtain the "raw" data in their proprietary format and the purchase (at a modest cost) of a software module to allow interface with that data.

- **Many ITD maintenance personnel felt strongly that the system improved overall winter maintenance practice, but they were pessimistic about the ability to quantify associated safety and productivity gains.** Many ITD maintenance personnel believed that the RWIDS webpage helps them utilize resources more efficiently and to more effectively maintain safer roadway conditions. However, they did not feel that these improvements can be easily isolated and quantified. They viewed safety and productivity "end results" as the product of many factors, including better road weather information. They also identified several factors that, even given better decision-making, limit the productivity benefit potential of RWIDS. First, winter maintenance resource allocations are inherently conservative. Committing resources, even unnecessarily, is less risky and far less likely to be criticized than failing to commit resources. Second, labor resource commitments in particular are "lumpy", that is, mostly go/no-go rather than highly scalable. Staff cannot be kept continuously on-call, to be quickly scrambled and put to work based on constantly changing weather conditions. So, marginal improvements in decision-making of the sort associated with RWIDS may not manifest in quantifiable productivity gains. Third, although much improved, existing ESS coverage and reliability is not sufficient to significantly reduce the amount of field observation (snow patrols) necessary.

- **Although a very useful addition, RWIDS does not replace other traditional sources of information for maintenance decision-making.** Nearly all of the maintenance personnel valued the RWIDS data, but they viewed it as "just another tool" rather than a comprehensive, definitive source of information. They continued to utilize other sources of information, including commercial radio and television reports, Idaho State Communications (for NWS alerts), maintenance personnel in other areas, and considerable field observation.

- **ITD has had no specific feedback on RWIDS from the public.** Neither maintenance personnel nor the Public Affairs Office had received much feedback from the public regarding RWIDS. This reinforces their perception that the site is probably not widely used by travelers. Foremen and other field maintenance personnel report that the significant volume of calls they received from travelers seeking road condition information and specific advice about routes had not changed since the RWIDS implementation.

3.0 Web Usage Data Analysis

This analysis examined both public and ITD maintenance staff use of the Road-Weather Integrated Data System (RWIDS) webpage. The methodology, results and conclusions of the analysis are presented in this section.

3.1 Methodology

3.1.1 Public Website Usage Analysis

The RWIDS webpage was added to the ITD Road Report traveler information website in November 2002. The focus of this analysis is to determine how the addition of the RWIDS information to the Road Report website influenced usage of Road Report, including the overall volume of usage and usage of the various types of RWIDS information. Two analyses have been performed to address this question, a before-and-after comparison of the number of website user sessions and an after-only examination of the various types of RWIDS information viewed.

Pre-deployment (before) data was analyzed for the two winter seasons that immediately preceded the November 2002 RWIDS launch. Those two winter seasons encompass the periods November 1, 2000 through May 31, 2001 and October 2001 through May 31, 2002. Post-deployment data from one winter season was analyzed, encompassing the period October 2003 through May 2004—the second winter of RWIDS operation. As with all of the evaluation analyses, it has been assumed that the second winter season provides a more accurate representation of the RWIDS system. By the second winter the public and ITD staff had time to become familiar with the system and the system itself had been "broken in" (the first winter of operation included some prolonged periods where RWIDS data was not updated as frequently as intended due to server outages).

The data utilized in this analysis consisted of ITD web server log files. Data manipulation was accomplished via custom Microsoft Access database routines. Off-the-shelf website analysis tools like *WebTrends* did not provide the needed capabilities. Public users were differentiated from ITD users based on the Internet Protocol (IP) address of the individual web pages viewed. All Road Report web pages accessible by the public include "public" in the IP address.

This analysis focuses strictly on user sessions and does not consider the users themselves. It was not possible to analyze changes in the number of discrete public website users because data on individual users is not available (the "incoming" or user IP addresses in the log file are dynamic across sessions for most users and are not directly linked to a specific user).

The post-deployment analysis RWIDS information types examined the number and percentage of total user sessions that included viewing of various types of information. Omitted from this analysis are several types of information, including avalanche warnings, composite radar, isobars, and Pacific Loop radar for which usage is not tracked in the ITD server logs. These data are resident on other organizations logs and when selected, a separate web browser window is opened, directed to the other organization's server, thus leaving no trace on the ITS server.

3.1.2 ITD Website Usage Analysis

The focus of this analysis is to determine how much ITD maintenance staff used the RWIDS webpage and which RWIDS information was viewed most frequently. Two analyses were conducted to address these issues, one examining the volume of RWIDS utilization and one addressing the type of RWIDS information accessed. This analysis only considered the post-deployment period because the focus is on the RWIDS information, which was not present in the pre-deployment period.

Like the public website usage analysis, this analysis considers only the 2003-2004 winter season only (October 1, 2003 – May 31, 2004), the second full winter of RWIDS webpage operations. The analysis did not consider the first winter of operation because the system was still being refined and training was still being conducted.

Data for this analysis came from the same source used for the public website usage analysis—ITD web server log files. The ITD maintenance staff RWIDS utilization presented here represents a conservative estimate, that is, somewhat less than actual usage. This is because it was not possible to differentiate one particular type of ITD maintenance user session from general public sessions: those conducted from home or from one of the 37 maintenance sheds that do not have access to the ITD wide area network (37 of the total 71 sheds statewide) *and* where the publicly accessible version of RWIDS, rather than the ITD-only version, was viewed. (The public version contains the same information in the same format but excludes the "alerts" feature.) Any user session from a wide area network (WAN)-connected computer, or who viewed the ITD-only version of the site were discernable in the server log files, and those sessions have been analyzed.

Unfortunately, it is not possible to estimate the number of "missing" ITD maintenance RWIDS sessions, and therefore estimate how many additional ITD sessions may have occurred in addition to those captured in this analysis. Based on feedback from ITD maintenance staff who were interviewed and those who participated in the e-mail survey used to identify interview candidates (results presented in Section 2.0), it appears that this could be a substantial number of sessions. A number of staff indicated that they were either unaware of the ITD-only version of the RWIDS page, or wished to avoid the user log-in required to access it, and therefore used the public version of RWIDS.

Although it is not possible to estimate the actual number of missing sessions, a likely upper limit to the number of those sessions can be estimated. Specifically, that the actual number of total ITD sessions is no more than twice the number captured in this analysis. If every user session from non-WAN connected sheds—about half of the total sheds—viewed the public version of RWIDS, and assuming the level of RWIDS usage for this group is not significantly more than among WAN-connected users (a reasonable assumption given that WAN connections are faster), the missing sessions would represent no more than about the same number of sessions captured in this analysis. Thus, the total number of sessions is unlikely to be more than twice the number described here.

Once ITD user sessions were differentiated in the ITD server log file, the total number of sessions per month was calculated. The number of sessions featuring viewing of the various

types of RWIDS information was also calculated, based on the web page IP address information in the log files. As was the case with the public usage analysis, ITD access of a number of types of information could not be calculated because the information is actually resident on another server, appears in a separate window when selected, and leaves no trace in the ITD server log.

3.2 Results

3.2.1 Public Website Usage Analysis

Usage Volume

Figure 3-1 compares pre- and post-deployment monthly Road Report website sessions. For most months, usage of the Road Report website increased dramatically in the post-deployment period. Overall, the average number of monthly user sessions increased by 169 percent, from 41,000 sessions per month to about 109,000 sessions per month. In both the pre- and post-deployment periods, use of the website peaks in the middle of the winter season when the most adverse winter driving conditions occur, and is much lower in the early and late portions of the season. This is consistent with the fact that the website is focused on winter traveler information.

Figure 3-2 decomposes the post-deployment Road Report user sessions by type, showing the relative proportion of sessions in which only "traditional" Road Report content was viewed (content of the type included on the pre-RWIDS version of the Road Report website); sessions in which only RWIDS content was viewed; and sessions in which content of both types were viewed. It is clear that the large increase in overall usage included sizable gains in traditional Road Report usage, which increased by about 90 percent, and which constitutes the bulk of total post-RWIDS Road Report usage (about 71 percent of all sessions). However, it is also clear that the RWIDS webpage was utilized considerably and the addition of the RWIDS webpage accounts for about half of the total increase in Road Report website usage. Further, most (85 percent) of the RWIDS-related usage increase featured sessions where *only* RWIDS sessions were viewed. These sessions account for about 25 percent of Road Report website sessions. It seems clear that a significant portion of the growth in Road Report usage is related to the introduction of the RWIDS webpage.

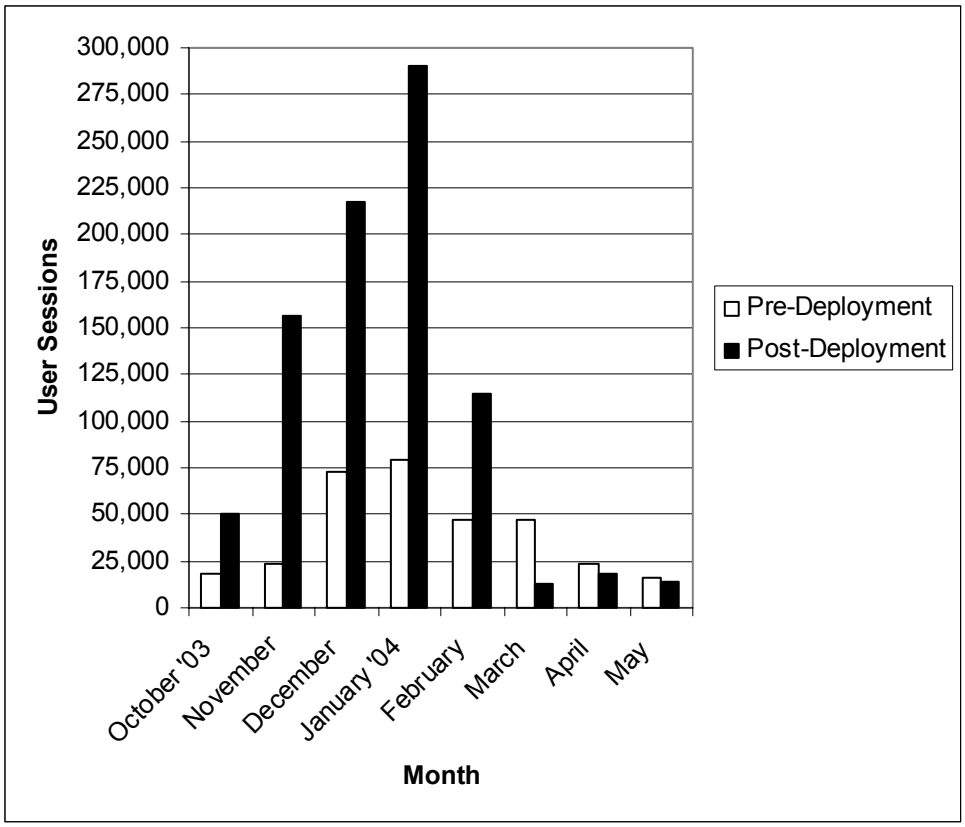


Figure 3-1. Public Monthly Road Report Website Usage

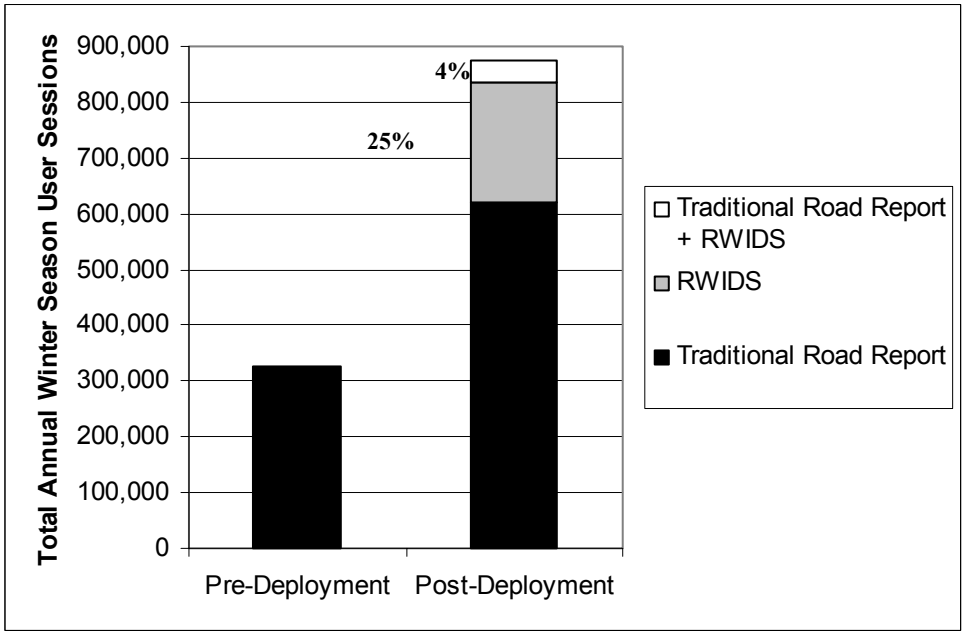


Figure 3-2. Post-Deployment Public User Sessions by Content Viewed

As indicated in Figure 3-2, very few Road Report website user sessions—about 4 percent—include viewing both traditional Road Report content and RWIDS content. Both types of information are popular, and so much as the introduction of RWIDS has not reduced traditional Road Report sessions, the two information sources can be viewed as complimentary (they do in fact provide very different types of information). Complimentary though they may be, the two information sources do not appear to be synergistic. If in fact travel planning decisions for a given trip are usually made based on a single user session, than on a decision by decision (i.e., trip by trip) basis, it appears that decisions are usually influenced either by the traditional Road Report data or by the RWIDS data, but seldom by both.

Although it is not clear why RWIDS and the traditional Road Report information would not be used in combination, there are a couple of possible explanations. It may be that users consult the sources for different types of travel decisions: the traditional Road Report for route-specific roadway conditions—when they want to know about conditions along the route to their destination, and RWIDS for point-specific information on overall weather conditions—when they want to know what weather they expect at their destination. Aside from pavement condition information, which is not listed on the RWIDS main page (it is a subitem under the weather menu, which must be selected in order to see the pavement option), the RWIDS webpage provides weather information (e.g., air temperatures, cloud cover, winds) as opposed to information on roadway conditions.

An alternative theory is that many users consult RWIDS primarily for the camera images, a premise supported both by anecdotal information from ITD headquarters staff that the public is traditionally most interested in camera images and by that fact that camera images are the most popular type of RWIDS information. After becoming familiar with which routes include cameras and which do not (like most states, camera coverage is still sparse on a statewide basis) users only visit RWIDS for the trips that they know include cameras along their routes. When they know in advance that there are no cameras of interest for a particular trip decision, they view only the Road Report information. This theory does rely heavily on the debatable assumption that frequent users come to remember specific camera locations.

Usage by RWIDS Information Type

Figure 3-3 presents the percentage of total RWIDS sessions (both RWIDS-only and RWIDS plus traditional Road Report) using various types of RWIDS information. Omitted from Figure 3-3 are a number of information types where the information does not reside on the ITD server, and where users are directed to another organization's server and the information appears on the Road Report website in a separate, inset, web browser window. This includes information on avalanches, composite radar images, isobars, jet stream, and Pacific Loop radar.

Expectedly, the RWIDS homepage, through which any public user would necessarily pass if not accessing an RWIDS subpage via a previous bookmark, is the most commonly viewed portion of the RWIDS webpage, included in almost 95 percent of all sessions. In addition to providing the gateway to various specific information, the homepage also contains a map of Idaho showing temperatures and cloud cover (e.g., sunny, cloudy, partly cloudy, etc.) for locations throughout the state.

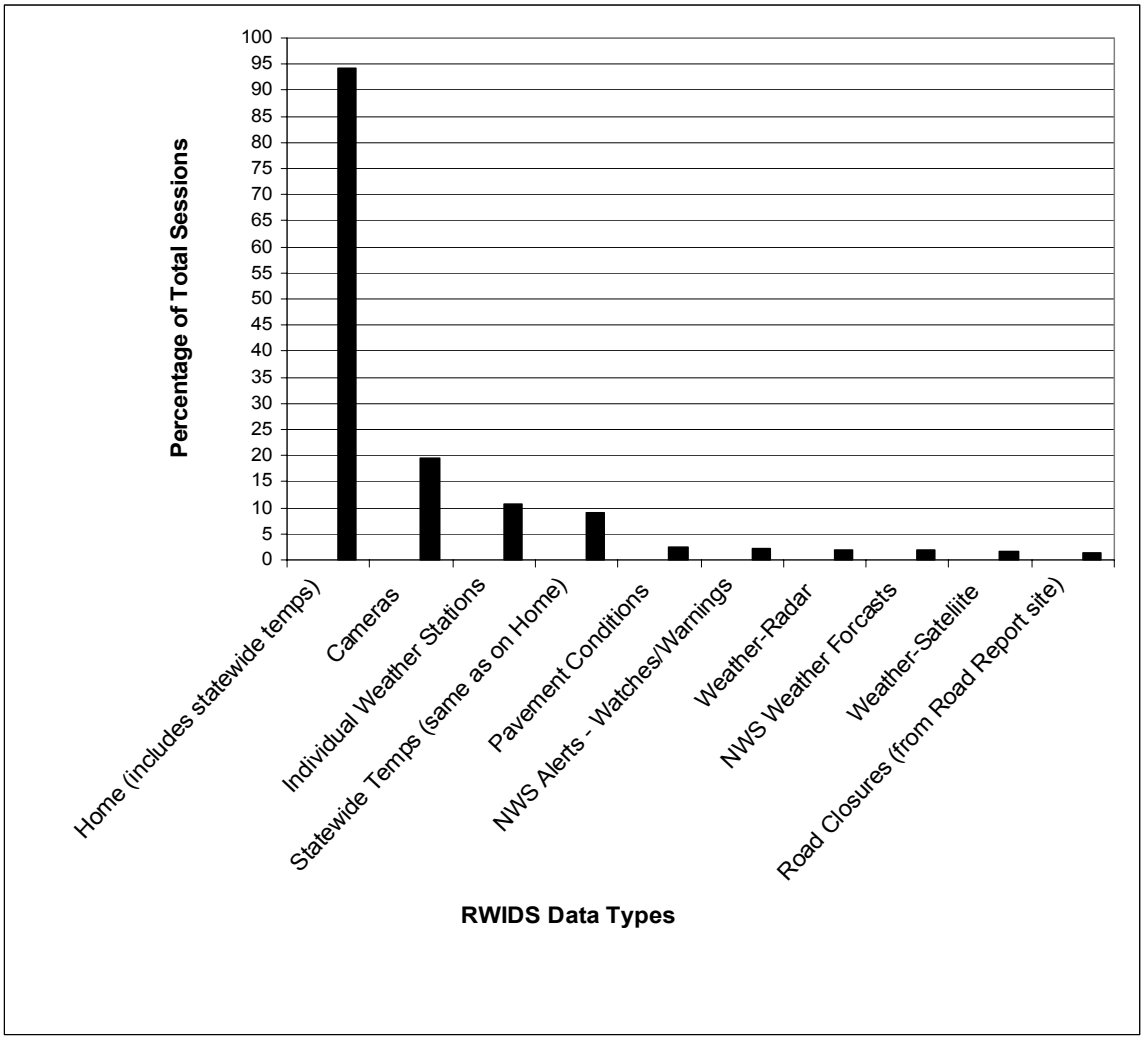


Figure 3-3. Public RWIDS Information Viewing by Data Type

Among the other specific information available on the RWIDS webpage, the most popular are camera images, included in about 20 percent of all sessions. Cameras are followed by individual ESS, included in slightly over 10 percent of all sessions. Users can select a specific station from a long scroll-down list of locations and view several types of information, including temperatures, wind, dew point, and cloud cover. Following ESS, at slightly under 10 percent of all sessions, is the statewide weather map—the same map that appears on the homepage. These selections are most likely made by users who have been navigating through the RWIDS webpage and do not want to hit the "back" button repeatedly to return to the homepage (there is no "home" button on most of the subpages) or who have not entered RWIDS via the homepage (that is, have entered via a bookmarked subpage). Usage of the remaining information types falls off quickly to 3 percent or less of total sessions.

There is clearly no data type aside from the homepage which is accessed most of the time. Even cameras are accessed, on average, only in about one of every five user sessions (20 percent), and frequencies for the remaining data types drop off quickly. The lack of a popular single data type

besides the homepage could mean that the statewide temperature and cloud cover information on the homepage is the primary RWIDS attraction among public users. Alternatively, it could be that a lot of the public user sessions are "one-time" sessions, with the user investigating the RWIDS homepage, never to return.

3.2.2 ITD Website Usage Analysis

Usage Volume

Figure 3-4 presents ITD maintenance staff RWIDS sessions by month for the 2003-2004 winter season (October through May). The data in Figure 3-4 constitute a conservative estimate of ITD maintenance staff usage in so much as it excludes sessions from non-WAN-connected maintenance sheds in which the public version of the RWIDS webpage was accessed. Although the number of these missing sessions cannot be estimated, it is likely they represent no more than the same number of sessions reflected in Figure 3-4.

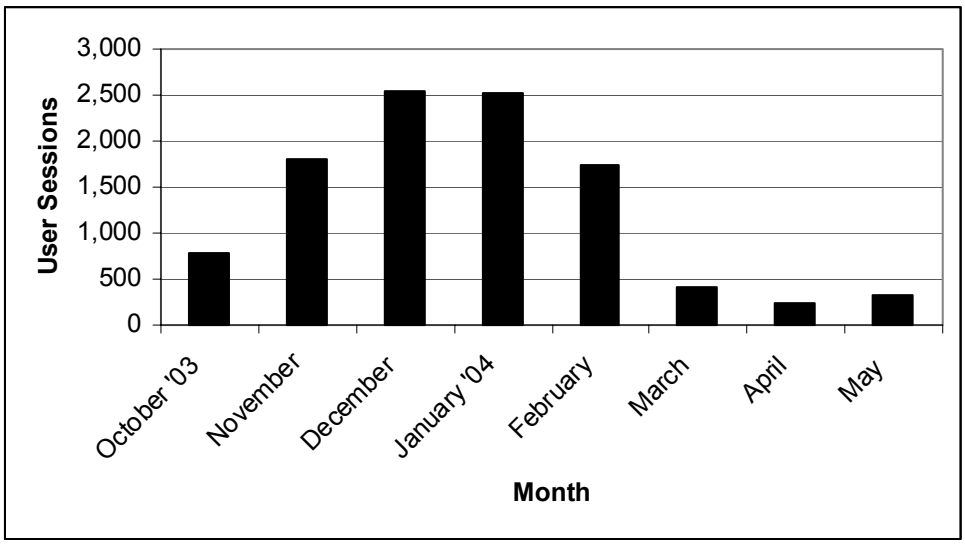


Figure 3-4. ITD Maintenance Staff RWIDS Sessions by Month

Monthly ITD RWIDS sessions ranged from about 300 during the late winter/early spring months up to about 2,550 sessions during December and January. For reference, if usage during the peak month, December 2004, was spread evenly across the 71 maintenance sheds, it would amount to about 36 sessions per shed, an average of a little more than one session every day.

Usage by Information Type

Figure 3-5 identifies the percentage of total ITD maintenance staff sessions in which particular RWIDS data types were viewed—an indicator of the relative popularity of the diverse RWIDS data. Omitted from Figure 3-5 are several data types where usage could not be tracked from the

ITD server log files, consisting of composite radar images, isobars, NWS avalanche alerts, jet stream weather images, and Pacific Loop satellite images.

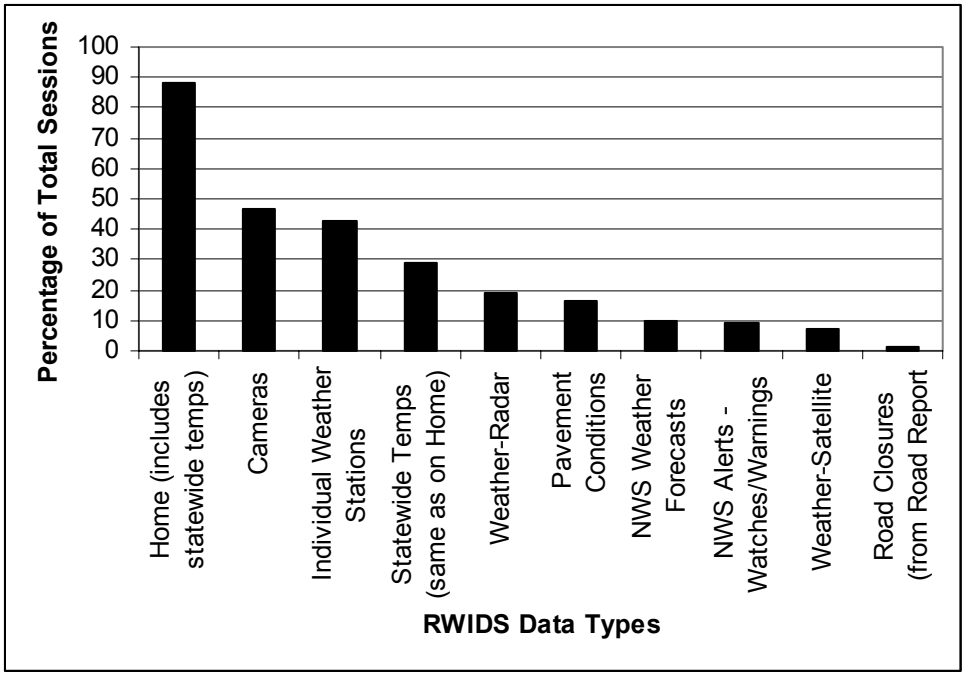


Figure 3-5. ITD Maintenance Staff RWIDS Information Viewing by Data Types

The most frequently accessed portion of the RWIDS webpage, viewed in nearly 90 percent of all sessions, is the homepage. This could be because most users pass through the homepage before accessing more specific RWIDS data (the alternative would be to access that specific data directly, via a bookmark, without passing through the homepage). Or it may be because the statewide weather conditions map (temperatures and cloud cover) included on the homepage represents a popular data type. Aside from the homepage, there is no single type of RWIDS data that is accessed during the majority of sessions. The next most commonly viewed data types are cameras and individual ESS, both viewed between 40 and 50 percent of all sessions. Although there are clearly more and less popular data types, the results suggest that there is no "go-to" data type that is always or almost always viewed. Rather, different types of data are viewed in different sessions, which may suggest that some data types are more useful for some situations and the associated decision-making.

The top four most popular data types among ITD users are the same as among public users. There are two major distinctions between ITD staff and public users' access of RWIDS information. First, public users aren't very interested in anything other than the homepage. Aside from camera images, none of the other data types are accessed very often (all are accessed in less than 10 percent of all sessions). ITD users, on the other hand, demonstrate interest in nearly the full range of RWIDS data—only two data types are viewed in less than 10 percent of

all sessions. The second distinction is that even though there is no "silver bullet", nearly always-viewed data types among either set of users, the most popular data types among ITD are much more popular than the data types most frequently viewed by the public. Camera images—the second most popular data type among both public and ITD users—are viewed in only about 20 percent of all public sessions. By comparison, camera images are viewed in a high percentage of ITD user sessions, about 46 percent. Even though there is no "always viewed" data type for either group, there are several very frequently accessed data types among ITD users. Public users, on the other hand, do not show high levels of interest in anything other than the homepage.

Although ITD users seldom view, in RWIDS, the road closure information available from the Road Report, they do in fact use the "traditional" Road Report data (that is, the data that was on Road Report pre-RWIDS, and still is). Approximately 19 percent of all ITD user sessions view only traditional Road Report information, indicating that, as is the case with the public, both types of data have value to at least some ITD users, that is, they are complimentary. The number of ITD sessions that included viewing both traditional Road Report and RWIDS data may be even higher. About 45 percent of all ITD sessions included a presence on both the traditional Road Report webpage and the RWIDS webpage. However, it is known that some percentage, perhaps a very large percentage, of those Road Report visits were restricted to the homepage, which the ITD user visited only to access the ITD RWIDS page log-in.

Figure 3-6 identifies the popularity of various types of traditional Road Report data types among ITD users. Expectedly, the most popular information is, in fact, the primary Road Report information—brief text descriptions of the travel conditions on individual roadway segments. That information is one of only two types of real-time, regionally relevant, roadway information on the webpage (the other being semi-real time information on roadway detours and closures). None of the other types of information are frequently accessed by ITD users. That information includes static (non-real time) general interest information such as press releases and an overview of ITD winter maintenance practices ("Winter Road Maintenance"). It also includes "Additional Road Information," brief descriptions of maintenance, and construction-impacted travel conditions. Following the Idaho road condition information, the most popular selection on the Road Report webpage among ITD maintenance users is the RWIDS employee log-in.

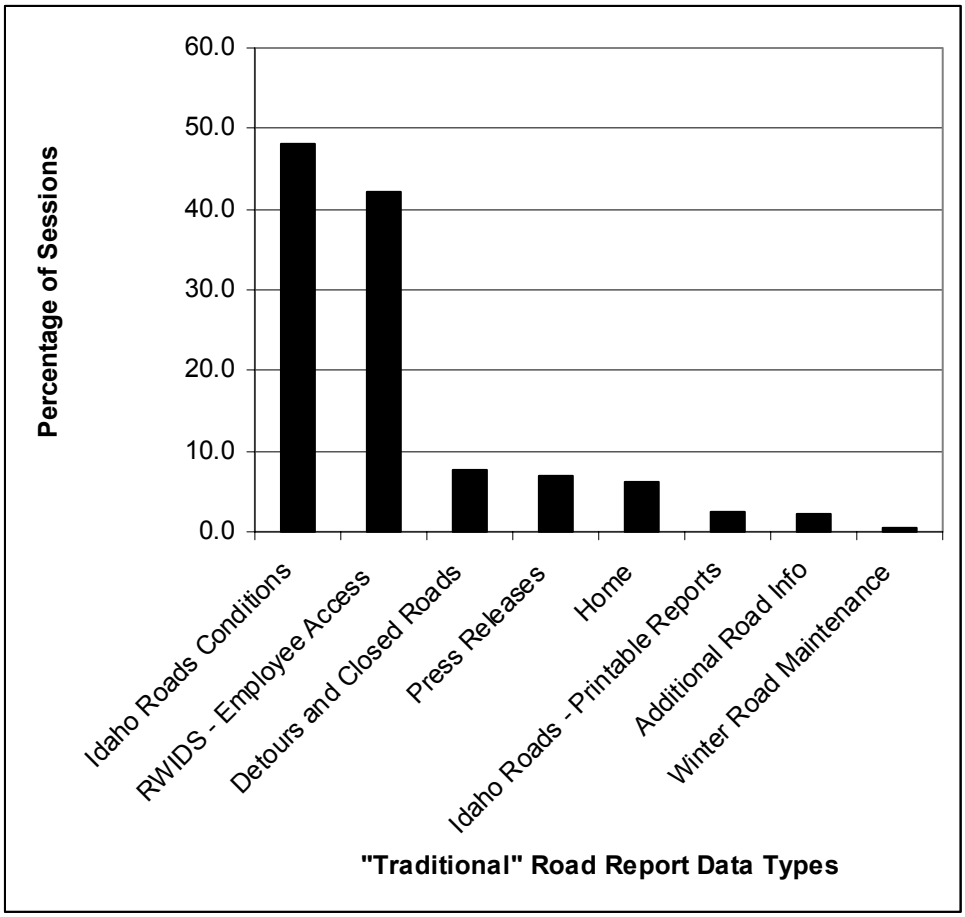


Figure 3-6. Traditional Road Report Data Accessed by ITD Users

3.3 Conclusions

- **Overall public Road Report usage in the post-deployment period is strong and increased significantly in the RWIDS era.** Usage peaked at nearly 300,000 user sessions per month in mid-winter 2004. Usage in the second winter after RWIDS deployment is 169 percent higher than pre-RWIDS levels. Much of this increase probably reflects a strong general upward trend in Road Report usage and is independent of the RWIDS addition—71 percent of the post-deployment sessions included viewing of only traditional Road Report information.

- **The RWIDS webpage was utilized to a considerable extent and the addition of RWIDS accounts for a significant portion of the overall growth in Road Report usage.** There was an average of about 218,000 sessions each month that featured only RWIDS information access, accounting for about 20 percent of the total growth in Road Report usage. These figures are particularly positive in light of the fact that the ITD conducted essentially no marketing in support of the RWIDS roll-out. The only way the public would find their way to the RWIDS webpage would be by stumbling into the link on the Road Report webpage.

- **The public values both RWIDS and traditional Road Report information (it appears complimentary) but they don't use them in concert (they are not synergistic).** Very few public Road Report sessions, about 4 percent, include viewing both RWIDS and traditional Road Report content. This suggests they use the different types of data under different circumstances to address different travel planning needs. The role of the different information types is not clear. RWIDS may be of interest to users seeking information on their *destination*—discrete (not summarized into an overall advisory) information—which is how RWIDS presents information. They may use the traditional Road Report for synthesized, advisory information on their *travel route* (the information is organized by roadway segment). RWIDS information is diverse and unconsolidated, lacking a specific "bottom line". Users are left to synthesize it on their own, and therefore may use it when they are only interested in a specific piece of information, like what it's like at their destination (thus explaining the popularity of camera views and individual ESS data). Road Report information is consolidated and although not necessarily prescriptive, it provides clear summaries of roadway conditions—little synthesis is required of the user.

- **The public doesn't appear to be frequently interested in most specific RWIDS information.** Most public user sessions penetrate no further than the RWIDS homepage, either because they are only interested in the statewide temperature and cloud cover map presented there or they are making an exploratory visit to RWIDS and are not looking for specific information. The most popular specific RWIDS data type (subpage) is camera images, which are only accessed in about one in five sessions. There is little or no apparent interest in pavement conditions, National Weather Service watches and warnings, weather radar images, National Weather Service forecasts, weather satellite images, or road closure information. This may suggest that the public is not sure how to synthesize and derive benefit from the various discrete information types on RWIDS, or that they are not interested in investing the effort to do so.

- **ITD maintenance personnel demonstrated significant interest in the RWIDS webpage; they used it fairly frequently.** Average monthly sessions range from about 300 during the late fall and early spring months to slightly over 2,500 sessions during mid-winter (January and February).

- **ITD maintenance users are interested in a wide variety of RWIDS information.** Only two of the ten RWIDS data types for which usage could be analyzed are consulted in less than about 10 percent of sessions: weather satellite images and road closure and detour information. This is consistent with the desire for a very wide variety of information expressed by maintenance personnel during the design of the RWIDS webpage and in the post-deployment interviews. The breadth of ITD user interest is in sharp contrast to the public who show only limited interest in one or two types of information. This suggests that institutional users are more willing and able to synthesize a variety of discrete information—none of which provides clear direction or advice. It may also be that the much wider range of decisions faced by maintenance users calls for a wider range of data. Public users, usually facing a "go/no-go" or "how much time do I allow?" travel decision may prefer a single data type, consisting of an easily interpreted advisory message, such as that found on the Road Report.

- **ITD maintenance users are more interested in RWIDS information than are most public users.** In addition to being interested in a wider variety of information, maintenance users are simply more interested in the data. Of the ten data types analyzed, maintenance users accessed 8 of them in 10 percent of their sessions or more; the two most popular (cameras and individual ESS data) in more than 40 percent of sessions. This suggests that RWIDS information is more critical to maintenance decisions than general travel decisions, or its manner of presentation is less attractive to public users.

- **ITD maintenance users are also interested in traditional Road Report information.** In a significant number of user sessions, about 19 percent of all ITD sessions *only* traditional Road Report information was accessed (does not include any RWIDS information access). There appears to be value in the traditional Road Report information for both the public and institutional users and that for at least some maintenance personnel, RWIDS has not made the Road Report information obsolete. The most popular information is the primary, traditional focus of the Road Report: advisory information on the weather-influenced travel conditions.

- **Relatively low ITD user interest in pavement information may be due to limited coverage.** ITD maintenance personnel would seem to have an interest in pavement condition information, as an input into winter roadway treatment decisions—certainly more so than the general public, who might be expected to have more difficulty in interpreting such microscopic data. ITD users did demonstrate more interest than public users (about 18 percent of sessions versus about 2 percent), but the limited number of pavement sensors and very large (almost district-wide) gaps in coverage would seem to limit the usefulness of pavement data overall.

- **Cameras are very popular among all users.** Consistent with the sporadic anecdotal feedback received by ITD from public users and the opinions expressed by ITD maintenance interviewees, camera images appear to be the single most useful type of information. This is probably because they provide fairly comprehensive and easily interpreted information. Maintenance personnel indicated that they utilize the cameras to observe precipitation and visibility, to some extent to determine certain pavement conditions (e.g., depending on lighting and visibility they can determine if the pavement is wet or dry and whether there is snow on the pavement) and maintenance effectiveness (e.g., whether the road appears to have been plowed, whether freeze-point depressant chemical appears to be working, as evidenced by wet pavement, etc.).

4.0 Accident Data Analysis

This analysis intended to assess the potential impacts of RWIDS on the occurrence of traffic accidents in the winter. It was hypothesized that the ITD use of RWIDS information could result in better and safer roads during the winter season. In addition, with RWIDS, the general public could be better informed of the road conditions thus reducing the likelihood of accident occurrence.

4.1 Methodology

This analysis compared the before-and-after changes in winter weather-related accident rates using Idaho statewide accident data between 1996 and 2004. The accident data was obtained by querying the accident database by a number of relevant criteria:

- Occurred during winter (December-February)
- Winter weather/pavement-related accidents
- Occurred on interstate and state routes (excluding local streets)

While it is desirable to assess safety impacts by analyzing the accident statistics, several threats to validity in this and other accident data analyses need to be acknowledged. The identification of winter weather-related accident records can be obscured by the fact that the presence of snow or ice does not always indicate that the weather or pavement condition is the cause of the accident. For example, driver behavior was often cited as the main contributing factor regardless of the environmental conditions and therefore the reported presence of snow may or may not be a contributing factor. Since accidents on rural freeways are relatively rare events, arbitrations in accident data coding could have potentially significant impacts on the analysis outcome.

When assessing safety impacts, the accident frequency (counts) must be normalized by the exposure. The exposure data in this analysis include Vehicle Miles Traveled (VMT) and winter precipitation level. Ideally, vehicular volume data is needed for all segments of roadway of interest (i.e., state routes). However, the ITD database (like most other states) only contains Annual Average Daily Traffic (AADT) which is derived and adjusted for seasonal variation using a few days worth of traffic counts on various freeway segments.

The winter weather severity data is obtained from the National Climatic Data Center (NCDC) operated by the National Oceanic and Atmospheric Administration (NOAA). A winter weather severity index is computed by normalizing the accumulative precipitation[1] over the winter season (i.e., December to February).

One limiting factor in this analysis is the ITD outdated route number and mile post definitions. ITD has failed to update the route numbering and the correspondent mile post definition as new

[1] Monthly precipitation data for state of Idaho from National Climatic Data Center (NCDC): http://lwf.ncdc.noaa.gov/oa/climate/research/cag3/id.html

freeways were built and some freeways merged/connected. The inconsistent route number and mile post definitions have impacted the location reference in accident reporting on rural freeways. This limits the ability to perform analysis of the accident statistics based on specific geographic areas (e.g., maintenance districts and foreman areas).

Given the above limitations, the accident analysis was performed at statewide level using winter weather-related accident data and Vehicle Miles Traveled (VMT), as exposure data, aggregated over all Transportation Analysis Zones (TAZ) in the state of Idaho. VMT is derived based on the AADT counts and adjusted for the total roadway mileage within an area and thus an adequate exposure measure for state level analysis. The analysis compared the before accident rates (normalized for winter weather severity) since 1996 with one year (winter 2003-2004) of post-deployment accident rate data. The analysis results are presented in the following section.

4.2 Results

Approximately fifty-six (56) percent of accidents occurred during the winter months (i.e., October-March). Among those, about thirty-eight (38) percent are winter weather-related. The accident rates were computed by dividing the accident frequency by the exposure data, total vehicle miles traveled (VMT). The unit of the accident rate is the number of accidents per 100 million vehicle miles traveled. The post-deployment winter 2003/2004 shows an increase in the accident rate compared to the previous years. However, winter 2003/2004 experienced more precipitation than the previous three years. When winter severity is considered, the post-deployment accident rate is slightly decreased from the previous year.

Table 4-1. Accident and Exposure Statistics

Winter	Before RWIDS							After
	1996/ 1997	1997/ 1998	1998/ 1999	1999/ 2000	2000/ 2001	2001/ 2002	2002/ 2003	2003/ 2004
No. of Winter-Related Accidents	1,759	1,736	1,620	1,795	1,884	1,308	1,623	2,153
VMT (100 millions)	12,924	13,112	13,644	14,328	14,299	14,303	14,400	14,825
Accidents per 100 million VMT	0.14	0.13	0.12	0.13	0.13	0.09	0.11	0.15
Total Winter Precipitation (inches)	9.00	5.83	6.99	7.91	6.19	4.41	5.20	6.83
Winter Severity Index	1.38	0.89	1.07	1.21	0.95	0.67	0.79	1.04
Accident Rate Normalized by Winter Severity)	0.099	0.149	0.111	0.104	0.139	0.136	0.142	0.139

Figure 4-1 shows the trend of the winter weather-related accident rates between years 1996 and 2004. The vertical bars in the figure show the range of plus and minus one standard deviation from the mean.

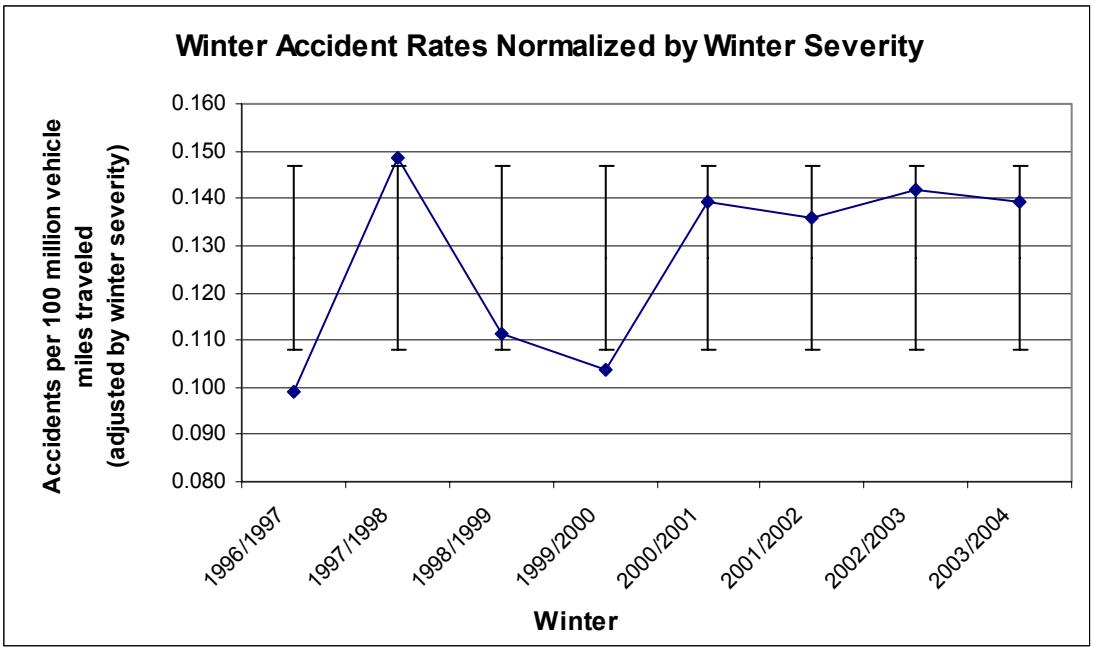


Figure 4-1. Statewide Winter Weather-Related Accident Rates

Figure 4-1 shows that the accident rate of winter 2003-2004 (post-deployment of RWIDS) decreased slightly from the previous winter. However, 2003-2004 accident rate falls within one standard deviation from the statistical mean and thus is not considered statistically different from the previous years.

As discussed in the methodology section, it is difficult to assess the impacts with very small sample size (7 years before and 1 year after). In addition, arbitration in accident data coding and the lack of accurate exposure data may prevent the detection of relatively subtle changes in the rare events like accidents.

4.3 Conclusions

- **Inconclusive evidence of RWIDS' impact on accident reduction.** There was no statistically significant change in the statewide winter weather-related accident rate during the one year period (2003-2004) after the completion of RWIDS. The post-deployment winter weather-related accident rate decreased slightly from the previous year. However, the decrease was found to be within the statistical variance using accident data since 1996. Due to the coding problem, the accident data did not support the analysis by smaller geographical areas such as the ITD maintenance district or foreman area.

- **Exogenous factors.** In this evaluation, the hypothesized safety benefits are expected from two sources. First, the "better" winter maintenance practice of ITD resulting from the use of RWIDS is expected to provide safer roadways. Second, upon consulting with the RWIDS information, the general public would be more informed of the road-weather conditions, thus

reducing the likelihood of accident occurrence. However, there are exogenous factors that could have direct and more significant impacts on the safety outcome. For example, there has been much change in winter maintenance practice during the past years as a result of ITD's aggressive promotion of freeze-point depressant chemical (magnesium chloride). Arguably, the change of road maintenance doctrine might have more direct impacts on the road safety than the improved road-weather information brought about by the RWIDS (though good information is essential in freeze-point depressant applications). Because the adoption of freeze-point depressant took place incrementally around the state and over the study period, it created additional complications in measuring the safety improvement. Similarly, it is difficult if not impossible to isolate the safety benefits resulting from better provision of road-weather information to the general public.

- **Recommendations for future safety analyses.** A number of fundamental problems must be addressed in the Idaho statewide accident reporting system to allow geographic-based accident analysis. The current accident report uses route number and mile post for location reference in rural areas. However, ITD's mile post and route numbering systems are grossly outdated, inconsistent, and confusing due to the changes of the rural freeway system in the past decades and the failure of ITD to revise the definition system accordingly. A revamp of the route and mile post definitions is needed to support any geographic-based accident data analysis using Geographic Information System (GIS) tools. The same problem was encountered by the ITD in their recent effort of assessing the safety benefits of the use of freeze-point depressant chemical.

5.0 Maintenance Resource Analysis

This analysis intended to assess and attribute changes in winter maintenance resource utilization to the deployment of RWIDS. The hypothesis examined by this analysis is that less winter maintenance resources are needed due to better maintenance decision-making by ITD as a result of the better road-weather information from RWIDS.

5.1 Methodology

The evaluation and ITD maintenance headquarter staff identified a number of key measures of winter maintenance resource, including:

- labor hours
- pass kilometers plowed
- usage of sand and salt combination
- usage of sand
- freeze-point depressant chemical (magnesium chloride)

Computer records for eight winters worth of data (winter 1996-1997 and winter 2003-2004) were acquired from the ITD maintenance system. These data were provided by maintenance district, foreman area, and summarized by month.

One of the expected exogenous factors in this analysis is the severity of winter weather. Arguably, the usage level of winter maintenance resources is positively correlated with the duration, type and amount of precipitation as well as pavement temperatures. However, it was infeasible to obtain the monthly precipitation data (preferably by type, snow, rain, etc.) aggregated over the intended analysis unit, the ITD maintenance foreman area.

The maintenance resource usage data of winter 2003-2004 (post-deployment of RWIDS) was compared to the previous years. Statistical variance was computed to determine if the winter maintenance resource has significant changes after the deployment of RWIDS.

5.2 Results

Maintenance resource data including labor hours, pass kilometers plowed, usage of sand and salt combination (cubic meters), usage of sand (cubic meters), and usage of deicer (liters) were summarized by month, by foreman area, and by corresponding maintenance district. The statewide consumption of various winter maintenance resources is summarized in Table 5-1.

Table 5-1. Summary of Idaho Statewide Winter Maintenance Material Consumption

	Before RWIDS							After
Maintenance Resources	1996/ 1997	1997/ 1998	1998/ 1999	1999/ 2000	2000/ 2001	2001/ 2002	2002/ 2003	2003/ 2004
Winter Severity Index	1.38	0.89	1.07	1.21	0.95	0.67	0.79	1.04
Labor Hours	223,173	181,201	202,277	189,365	216,260	137,916	73,632	134,880
Pass Kilometers Plowed	4,982,416	3,295,689	3,642,395	3,340,901	3,592,636	3,373,122	1,889,338	3,438,828
Salt and Sand (Cubic Meters)	206,934	177,194	187,303	191,491	209,368	186,998	67,225	175,791
Sand (Cubic Meters)	52,170	40,387	42,755	37,961	40,428	33,973	13,766	25,878
Freeze-point depressant chemical (Liters)	1,132,979	1,485,833	2,038,528	4,212,346	6,857,723	6,603,637	3,622,211	6,366,150

To analyze the trends of resource consumption, the values in Table 5-1 were normalized and presented in number of standard deviations from mean value, as shown in Figure 5-1.

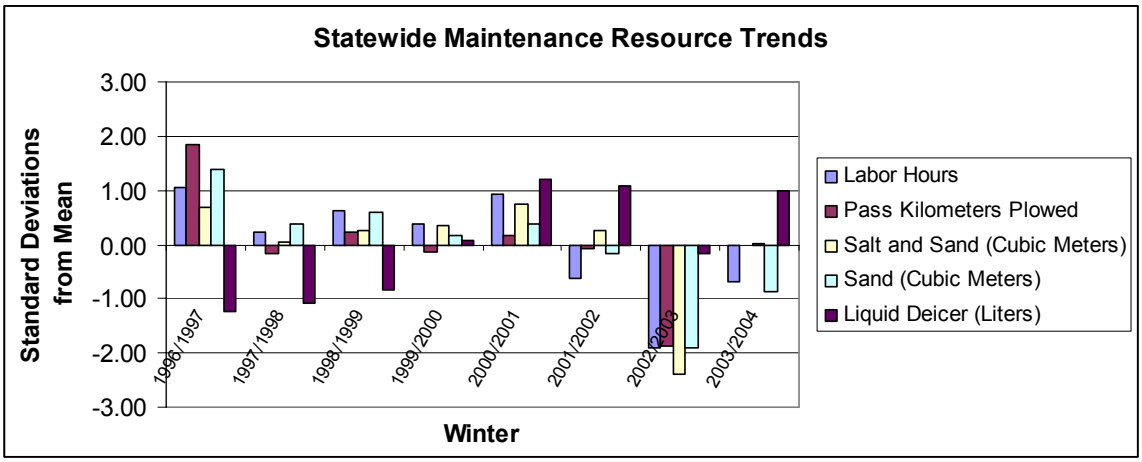


Figure 5-1. Trends of Idaho Statewide Winter Maintenance Material Consumption

The results showed a distinctive pattern that there was an overall decrease in labor hours, pass kilometers plowed, salt and sand, sand, and a clear trend of increased use of freeze-point depressant chemical. Significant correlations were found between the use of freeze-point depressant chemical and labor hours (r=-0.28), pass kilometer plowed (r=-0.26), salt and sand

(r=0.07[2]), and sand (r=-0.41). This implies that the use of freeze-point depressant chemical has resulted in the decrease of traditional winter maintenance resources.

As shown in Figure 5-1, winter 2002-2003 was associated with a significant decrease in all winter maintenance resources, likely due to the reportedly mild winter. As for the post-RWIDS winter of 2003-2004, despite the increase from the previous winter, the resource usage (except the freeze-point depressant chemical) was below the average (statistical mean). However, it is inconclusive if any of the decrease of traditional resource usage can be attributed to the deployment of RWIDS, given the correlation between the use of freeze-point depressant chemical and other (traditional) resources.

The data was then further analyzed at maintenance district level. Figures 5-2 to 5-7 show the trends of winter maintenance resource usage by ITD maintenance district. The resource consumption by district is summarized in Appendix B.

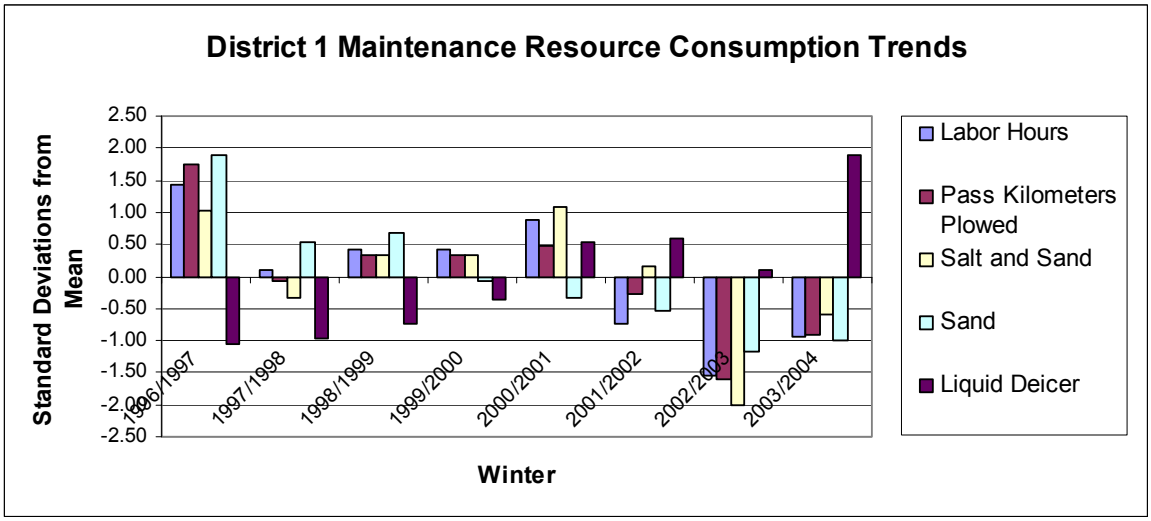


Figure 5-2. District 1 Maintenance Resource Consumption Trends

[2] The positive sign suggests that the use of freeze-point depressant chemical did not contribute to the decrease of mixed sand and salt use.

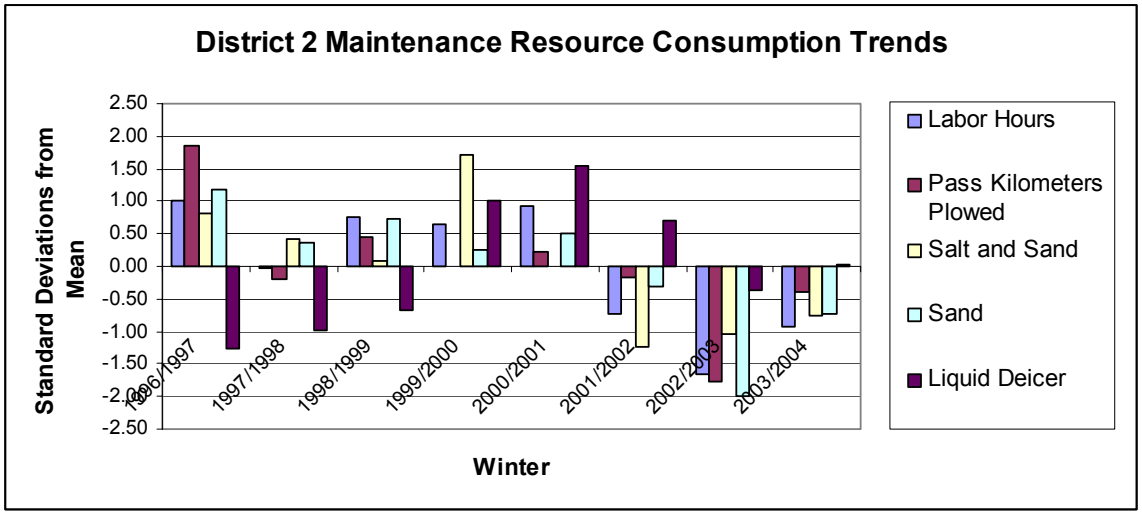


Figure 5-3. District 2 Maintenance Resource Consumption Trends

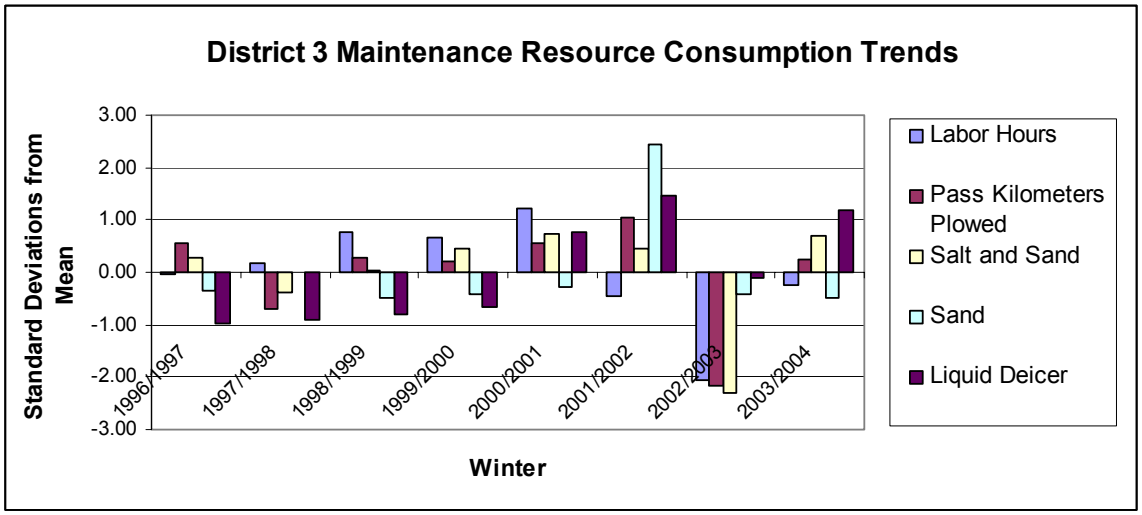


Figure 5-4. District 3 Maintenance Resource Consumption Trends

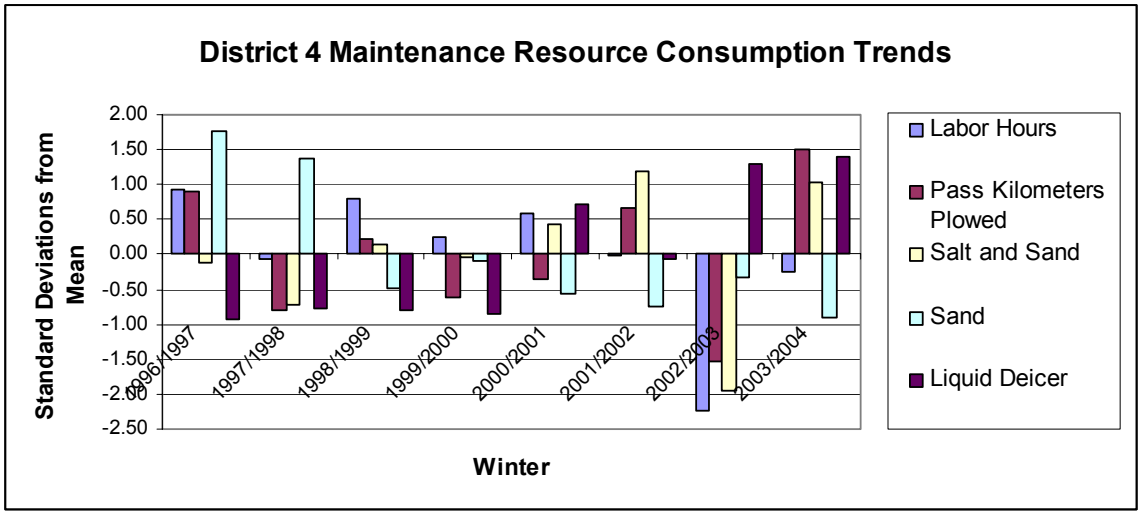


Figure 5-5. District 4 Maintenance Resource Consumption Trends

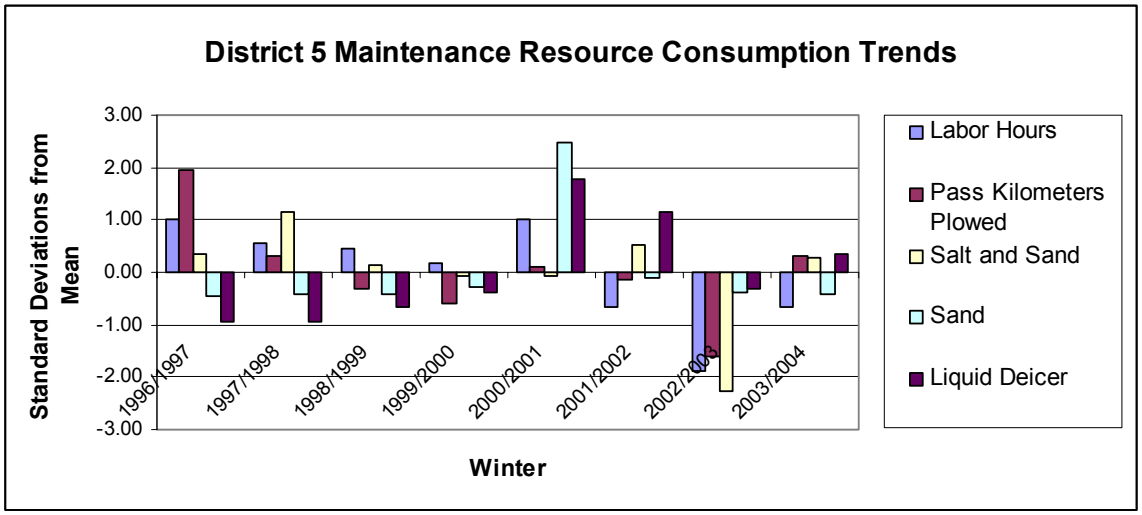


Figure 5-6. District 5 Maintenance Resource Consumption Trends

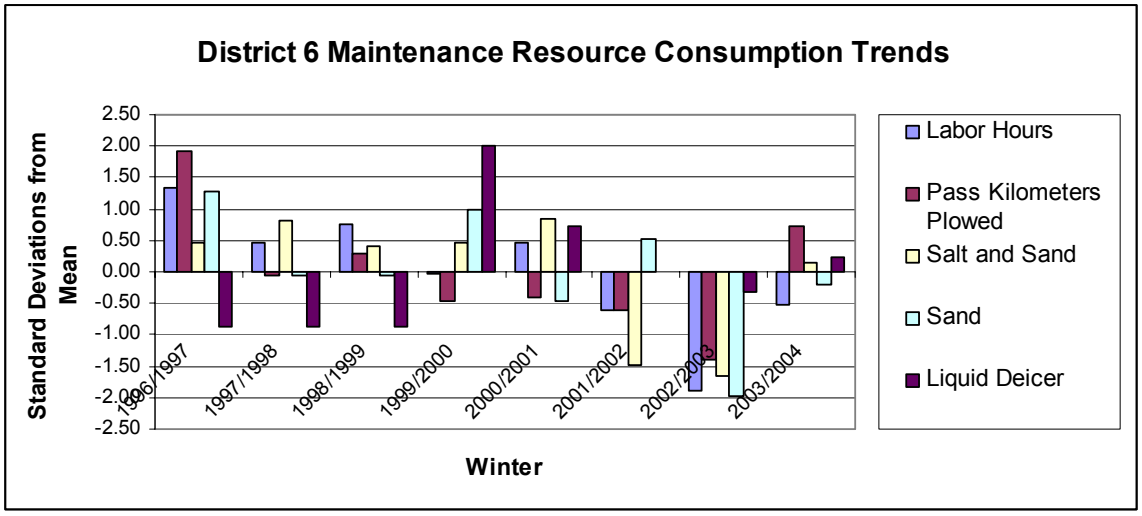


Figure 5-7. District 6 Maintenance Resource Consumption Trends

The district level analyses showed a similar pattern suggesting that the ongoing promotion of freeze-point depressant chemical had direct and significant impacts on the winter maintenance practice that resulted in reduced consumption of other maintenance resources.

Therefore, it is unlikely that impacts on winter maintenance resource consumption from other more subtle and indirect "treatment", like the deployment of RWIDS, can be reliably measured, given the known exogenous factors such as the promotion of freeze-point depressant chemical and the associated changes in the winter maintenance doctrine.

5.3 Conclusions

- **RWIDS did not result in verifiable impacts on maintenance resource consumption.** The maintenance resource analysis results show that it was infeasible to attribute the changes in resource consumption to the use of RWIDS by ITD. The maintenance resources analyzed included labor hours, pass miles plowed, sand and salt combination, sand, and freeze-point depressant chemical (magnesium chloride). These data showed that change in winter maintenance resource utilization during the year after the completion of RWIDS (2003-2004) was within the statistical variance when compared to the data since 1996. The only exception is the steady increase in the use of freeze-point depressant chemical that has been aggressively promoted by ITD maintenance headquarters since the mid-1990s. This, however, confounds the hypothesis that RWIDS would yield reduction in material consumption. The strong negative correlations between the utilization of freeze-point depressant chemical and other winter maintenance resources suggests that the use of freeze-point depressant chemical and the associated change of winter maintenance practice (e.g., pre-treatment) might have more profound impacts on the consumption of traditional maintenance resources than the improved weather information.

- **Limited RWIDS impacts on winter maintenance practice.** Despite the usage by the ITD maintenance staff during the winter season, as shown in the web usage analysis, RWIDS might have not significantly altered winter maintenance practices. This reinforces the interview findings that RWIDS does not replace other traditional sources of information for maintenance decision-making.

- **Nature of resource investment decision.** As discussed in the interviews with ITD maintenance staff, most of their resource investment decisions are "lumpy" in nature. That is, a "go or no-go" decision, and if there is any doubt, they tended to commit the resources. Therefore, it is difficult to measure and attribute any marginal savings in the winter maintenance resource to the improvement of information such as those brought upon by the RWIDS.

6.0 Public Web Survey Analysis

A web survey was conducted to investigate the general public's satisfaction with the RWIDS information in comparison with the traditional Road Report information. Figure 6-1 shows an annotated screen shot of the ITD Road Report home page (http://164.165.237.41/apps/roadreport/).

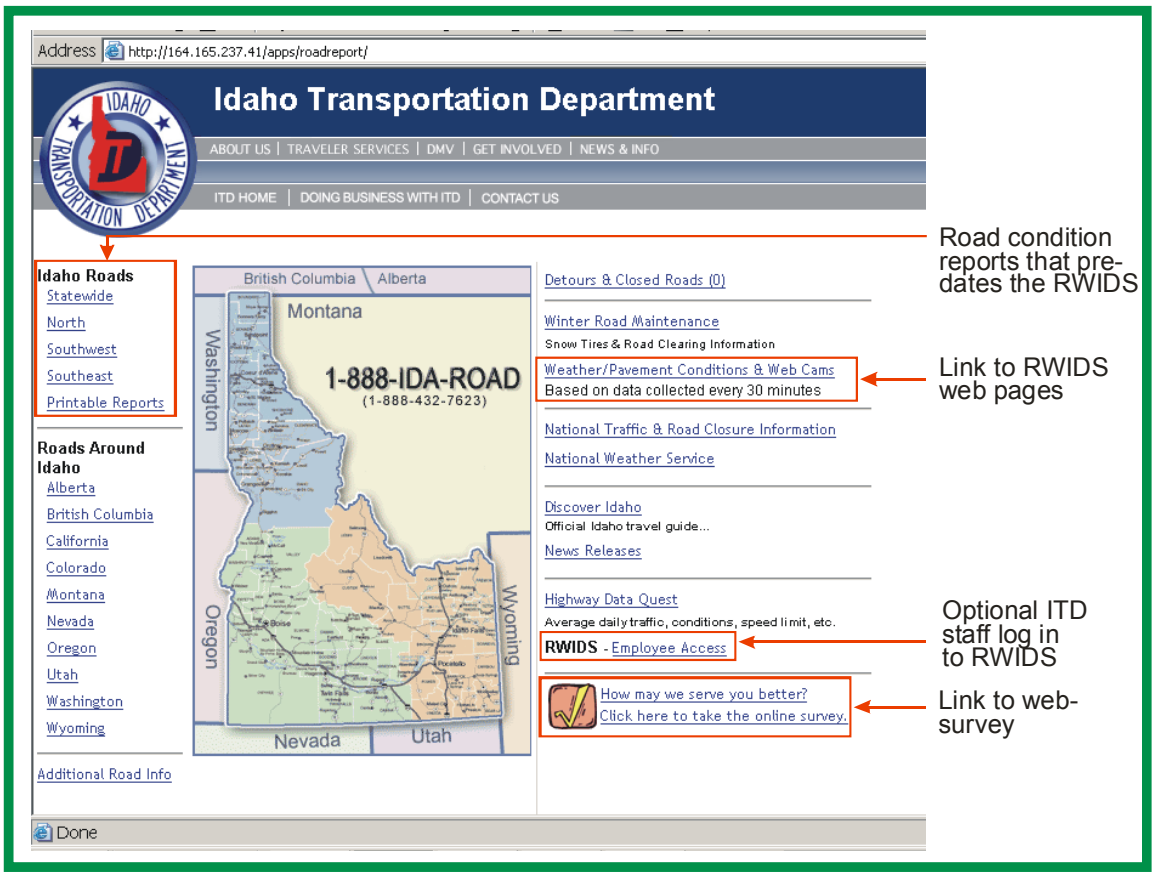


Figure 6-1. Web Survey Screen Explained

6.1 Methodology

Visitors to the ITD Road Report website were invited to participate in an on-line survey during the winter of 2003-2004. During that time, 134 members of the public completed the survey. The objectives of this survey were to better understand who the users were of the new RWIDS information as well as the traditional Road Report information; what kinds of trips they were planning with information they derived from the site; the RWIDS features they used and how useful they found these features to be for their trip planning; and suggestions they might have for enhancing the overall value of the site.

A graphical icon and a hypertext link were added to the lower-right corner of the ITD Road Report website to invite users to participate in the web survey. Upon clicking on the survey link, a screening question is presented to insure that the participants are not related to the ITD or its employees and thus their opinions are not biased. The web survey was hosted on a separate, high bandwidth computer server in order to facilitate the transmission of large numbers of images data (screen shot of web features) used in the survey.

The basic approach of the survey is to identify those who have used either the traditional Road Reports (reside under the "Idaho Roads") and/or the new RWIDS information (reside under the "Weather/Pavement Condition and Web Cam"). The participants were asked to rate the usefulness of each used feature in support of their trip planning. The Road Condition Reports have been providing road surface conditions of all the state routes based on observations phoned in by the ITS maintenance staff four times a day during the winter season. One of the ancillary objectives of this evaluation is to investigate the impacts of the RWIDS on the existing road-weather information services. A replica of the web survey can be found in Appendix C and the results of the survey are summarized in Appendix D.

6.2 Results

In interpreting findings from this survey, it is important to point out that respondents are self-selected; that is, the results of this survey reflect the opinions of only those individuals who decided on their own to respond. Since the sample of respondents was not scientifically selected, their opinions do not necessarily reflect the opinions of all ITD Road Report site users or of the general population of travelers in and around the state of Idaho. Nevertheless, these respondents represent a diverse and interested group of users of road-weather information available on the Internet. Their opinions are helpful in better understanding what types of road-weather information are most useful, how that information is being used, and how web features such as RWIDS can potentially be improved so that they can better serve the general traveling public.

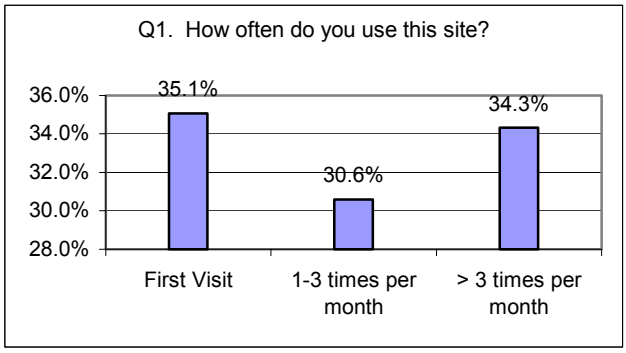


Figure 6-2 (Q1). Frequency of Site Use

As Figure 6-2 (Question 1) shows, a little over one third (34.3 percent) of the respondents are frequent users of the ITD Road Report website (more than three times a month), more than one-third (35.1 percent) of the respondents said they were visiting for the first time. Many of the survey questions were designed to probe the experiences with the veteran users of the site and the survey questionnaire was designed to skip those questions for the first time users.

Figure 6-3 (Question 2) excludes the first time users and shows that about 70 percent of the experienced users have used this website for more than one year. Figure 6-4 (Question 3) shows how often this website was used during the four seasons. It seems fair to conclude that there is more frequent access to this website during winter and spring than other seasons.

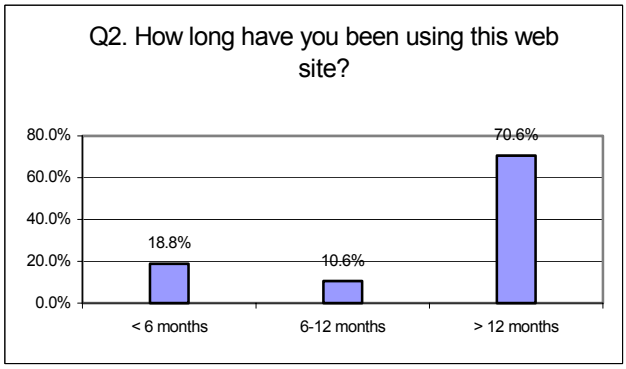


Figure 6-3 (Q2). Length of Time Using the Site

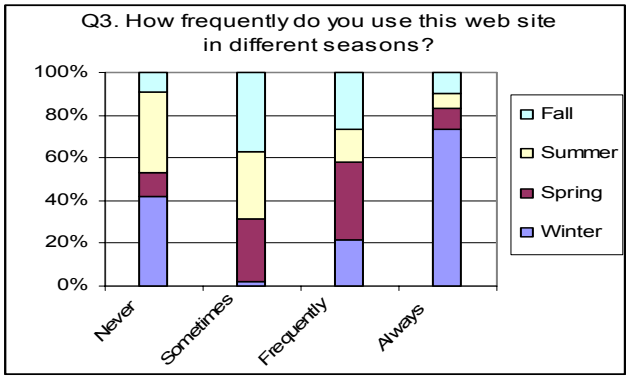


Figure 6-4 (Q3). Frequency of Use in Different Seasons

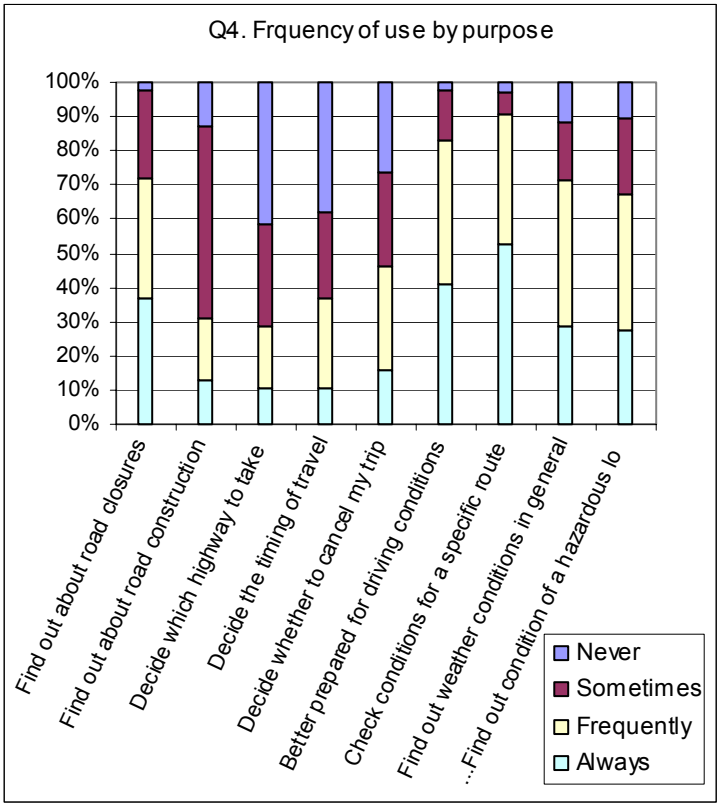


Figure 6-5 (Q4). Frequency of Use by Purpose

Figure 6-5 (Question 4) presents the usage frequency by purpose. Most frequent (frequently and always) reasons for using this website include "check condition for a specific route" (91 percent), "better prepared for driving conditions" (84 percent), "find out weather condition" (72 percent), "find out about road closures" (72 percent), and "find out condition of a hazardous location" (68 percent). Those reasons indicate a general need for road-weather-related information in the primarily rural setting of the state of Idaho. On the other hand, road construction is relatively of lesser concern in terms of travel planning. Determining which highway to take, travel timing, or whether to cancel a trip are the less likely reasons for using this site. Understandably, those decisions are subject to the availability of alternatives and flexibility in schedule that vary from case to case.

Figure 6-6 (Question 5) shows how the information provided by this site was used for various trip types. It is not a surprise to see that recreational (47 percent) and personal (40 percent) trips are rated higher than commuting trips (19 percent) as the top two reasons the ITS website were consulted upon, possibly due to the rural nature of the state. The results did show that the usage by commercial drivers is somewhat limited; long haul freight carriers (9 percent) and driving as part of business (22 percent).

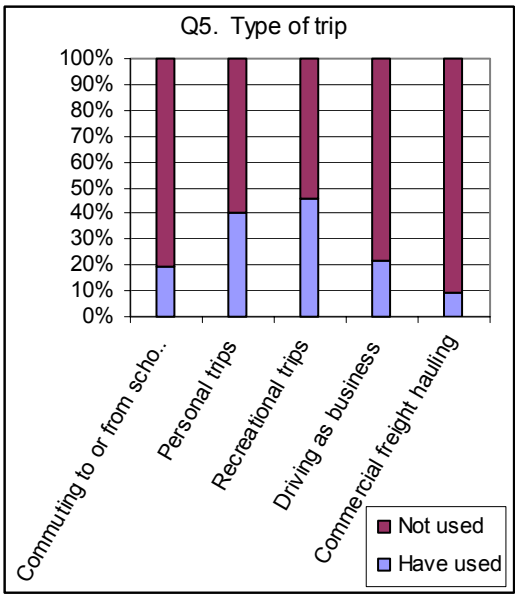


Figure 6-6 (Q5). Type of Trip

Figure 6-7 (Question 6.1) indicates what features on the ITD Road Report home page have been used by respondents. The most accessed feature is the Idaho Roads (87 percent) which contains the traditional (pre-RWIDS) information reported by ITD maintenance. RWIDS (residing under "weather pavement conditions and web cams") was the second most frequently used feature (80 percent). Figure 6-7 shows that the features containing dynamic travel related information (weather, traffic, pavement conditions, constructions, etc.) are among the most accessed; as opposed to the more static or specialized information such as press release, highway data quest (providing color coded maps of various highway statistics). This indicates that there is a demand for up-to-date information on road and weather condition by the general public.

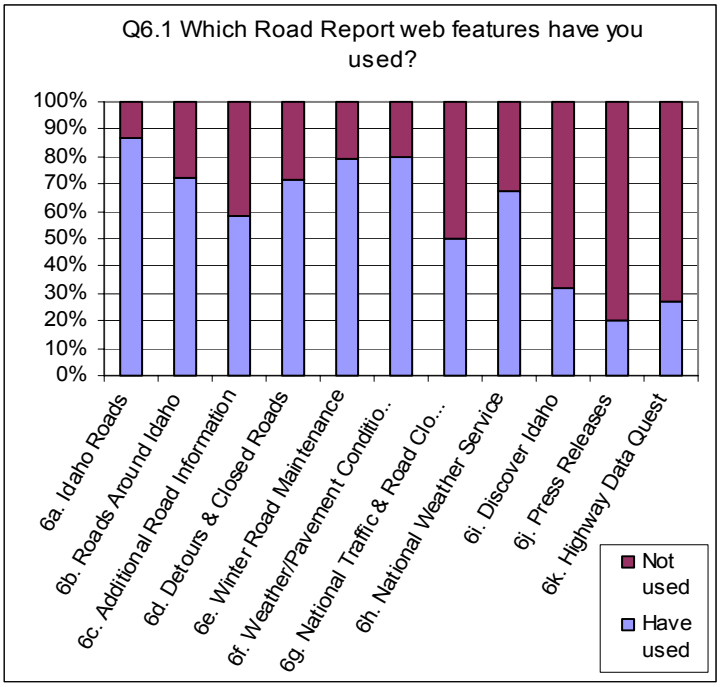


Figure 6-7 (Q6.1). Web Features Used

As a follow up to the previous question, the survey asked the respondents to rate the usefulness of each Road Report web feature (Figure 6-8, Question 6.2). The percentages of respondents who indicated a feature being very useful generally correspond to the results shown in Figure 6-7. It is consistent that a large percentage of respondents have found the features containing dynamic travel-related information (weather, traffic, pavement conditions, constructions, etc.) useful.

Those respondents who indicated they have used "Weather Pavement Conditions and Web Cams" (i.e., RWIDS) were asked about which RWIDS features they used. Figure 6-9 (Question 6af1) shows that the most accessed RWIDS features are weather-current (87 percent), Idaho roads (a link to the existing Idaho roads that is not part of the RWIDS development) (86 percent), weather-forecast (84 percent), weather-pavement (82 percent), cameras (79 percent), and road closures (a link to the road closure features that are also accessible from the home page) (78 percent). Clearly, among less accessed features are those more technical or specialized information such as NWS Alerts, avalanche alerts, and various weather images (satellite, radar, jet stream, isobars, etc.).

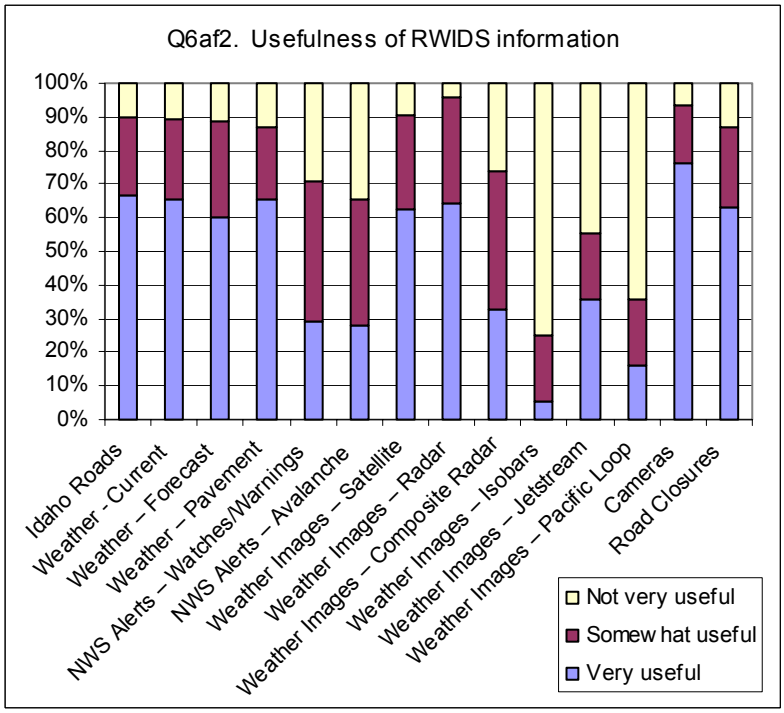


Figure 6-8 (Q6.2). Usefulness of RWIDS Information

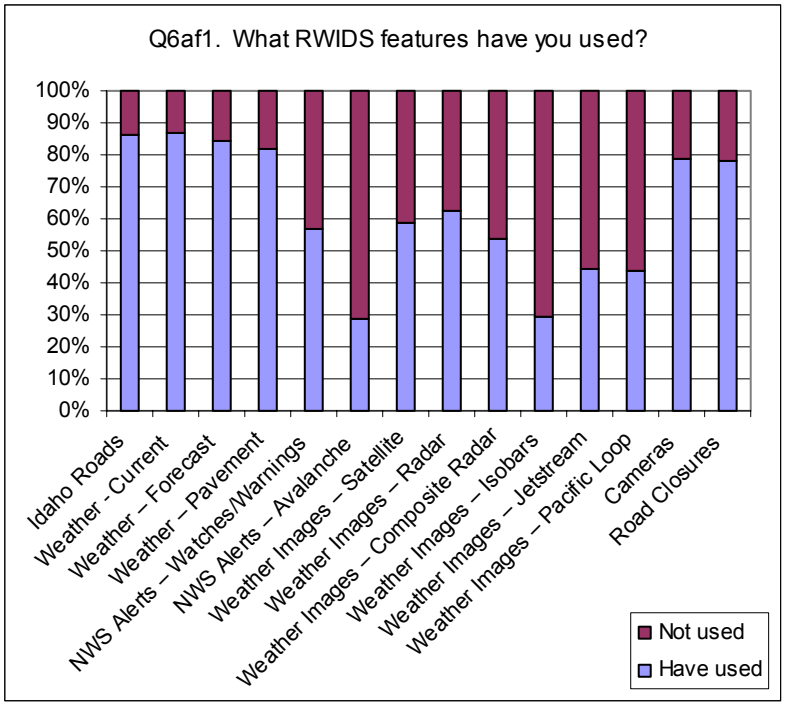


Figure 6-9 (Q6af1). RWIDS Features Used

Figure 6-10 (Question 6af2) presents the results of respondents' rating on usefulness of each RWIDS feature. The usefulness ratings are in general agreement with the results of the previous question. The most useful RWIDS feature is "cameras" which provides snap shots of image from video/ camera-equipped ESS. Different from Figure 6-9, a significant portion of respondents have found images from satellite (63 percent) and radar (64 percent) very useful, based on a relatively smaller percentage of respondents who indicated they have used these features.

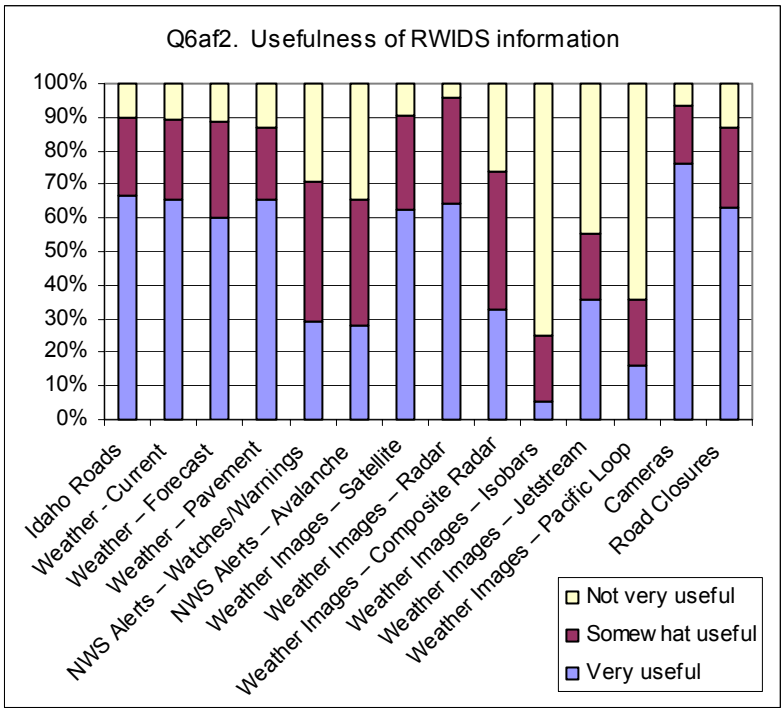


Figure 6-10 (Q6af2). Usefulness of RWIDS Information

Figure 6-11 (Question 7) shows the agreement with the various statements regarding the attributes of the ITD Road Report website. Sixty-five percent of the respondents agreed that the Road Report website is well organized. Fifty-eight percent agreed that the information provided is up to date. Sixty-two percent agreed that the forecast information is accurate. Eighty percent agreed that the information helped them better prepare for road weather conditions, 77 percent drove more carefully, 63 percent changed time to travel, and 48 percent canceled their trips based on the information provided by the ITD Road Report website.

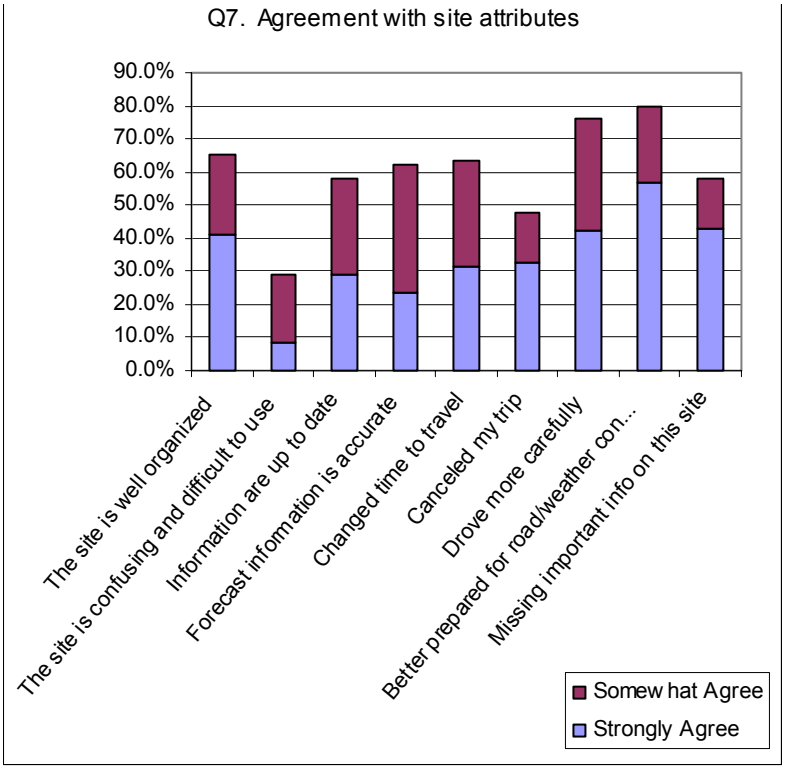


Figure 6-11 (Q7). Agreement with Site Attributes

Figure 6-12 (Question 8) shows the other travel information sources the respondents also consulted with. Seventy-five percent of the respondents also listen to the commercial radio for road-weather related information; 67 percent watched television, and 60 percent used other websites for road-weather information. It is somewhat surprising that the long time ITD operated interactive telephone number 1-888-IDA-ROAD was only used by 27 percent of the respondents. Weather radio and newspaper are used by relatively smaller percentage of the respondents.

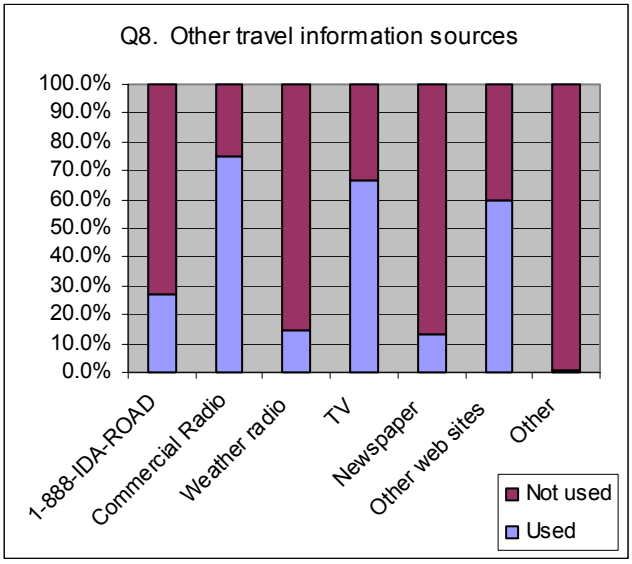


Figure 6-12 (Q8). Other Travel Information Sources

Question 9 of the survey provides an opportunity for respondents to provide their suggestions for future improvements of the ITD Road Report website. The representative comments are summarized in the following. The parentheses indicate number of similar comments.

- Like to see more cameras (18)
- Need to make this website (Road Report) more user friendly (15)
- Information is not always up to date (8)
- The website sometimes take too long to load (9)
- Very happy with this website (10)
- Like to see truck-related information (1)
- Graphics and text too small (3)

Figure 6-13 (Question 10) shows that 86 percent of the respondents live in the state of Idaho with 39 percent from southeastern, 38 percent from southwestern, and 8 percent from northern Idaho. Figure 6-14 (Question 11) shows the age distribution of the respondents. According to the results of question 12 (not shown) 62 percent of the respondents were male and 28 percent female.

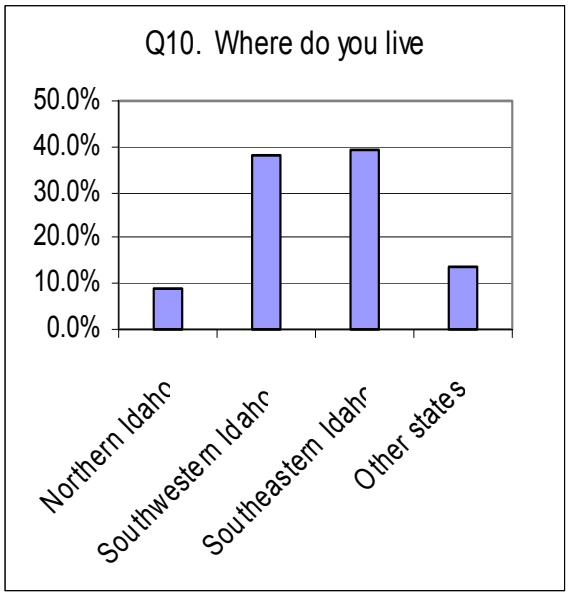


Figure 6-13 (Q10). Location of Participants

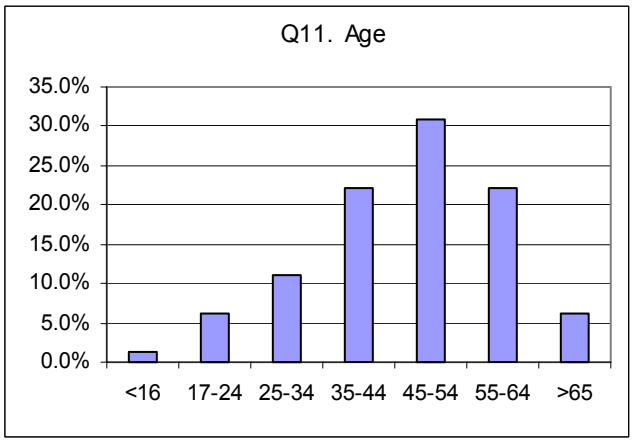


Figure 6-14 (Q11). Age of Participants

6.3 Conclusions

- **The RWIDS information was positively received by the survey respondents.** Overall, the survey respondents were pleased to have a single Idaho-specific website that provides useful travel-related information. Among the information provided under RWIDS (weather/ pavement conditions and web cams), general road-weather information such as weather conditions (current, forecast, pavement), Idaho roads (pavement condition by route), followed by camera and road closures (also accessible from ITD Road Report home page) are the most accessed information. Information such as various weather images (satellite, radar, jet stream, pacific loop), and weather and avalanche alerts/watches/warning are among the least accessed. This is consistent with the finding of web usage analysis and remarks from ITD maintenance staff that certain technical information (e.g., jet stream, isobar) in the RWIDS might not be useful to the general public.

- **Camera images are useful.** Cameras were highly rated among the most accessed and useful information by the survey respondents. Several comments from the survey respondents expressed the needs for more cameras. This finding is in agreement with other similar studies as well as the general interests of the ITD maintenance staff.

- **Integration of RWIDS and traditional Road Report (i.e., Idaho roads and road closure information).** The Idaho roads and road closures that predate the RWIDS are among the most accessed and are considered useful by the survey respondents. The survey results also showed that RWIDS is complimentary to and does not replace the Idaho roads and road

closures based on observations phoned in by ITS maintenance staff. Logically, better integration between the descriptive information from the Idaho road, road closures, and the more discrete information from the RWIDS will be beneficial to the general public in reducing the efforts in synthesizing useful road-weather information from multiple sources.

- **Road-weather information contributed to safer travel.** Most of the respondents (80 percent) agreed that the information provided by this website helped them better prepare for road-weather conditions, and 76 percent of the respondents indicated that the information helped them drive more carefully. Sixty-three percent of respondents indicated that the RWIDS has resulted in the change of time of travel (e.g., departure time) and 48 percent had canceled their trips. Despite that RWIDS was not specifically developed for the travel information services, general public are making use of the available information in assisting their trip decisions. It is desirable, as several server respondents suggested, to make this website more user-friendly.

- **Better promotion of ITD Road Report website.** More than one third (35 percent) of the respondents were first time users. About 76 percent of the veteran users have been using this website for more than 12 months. However, the fact that there is no intuitive web address (http://164.165.237.41/apps/roadreport/) and that there has been no official marketing campaign for the RWIDS or the ITD Road Report website, it is conceivable that the potential of this website in serving the general public is yet to be realized. A recommendation would be to provide an intuitive Universal Resource Locator (URL) address for the ITD Road Report website and publicize the new address using existing web resources (e.g., link from other Idaho state agency websites) and other public information outlets (e.g., DOT printed material and the interactive telephone services 1-888-IDA-ROAD).

7.0 Commercial Vehicle Operator Interviews

This analysis considered commercial vehicle operator (CVO) perspectives on the RWIDS webpage and on the Road Report website and traveler information overall. Commercial vehicle operators were addressed in a separate analysis because they constitute an important subset of the traveler information user base and may have unique needs and perspectives. Commercial vehicle operator input was collected through telephone interviews. This section presents the methodology, results, and conclusions associated with the CVO interviews.

7.1 Methodology

A target of 25 completed interviews was established by the evaluation team, a number that could be supported with available resources and which was thought could encompass a reasonable range of operator characteristics and perspectives. A list of potential CVO interviewees was developed with the assistance of the Idaho Transportation Department and the Idaho Trucking Association (ITA). The ITA provided their membership list, which included approximately 156 commercial carriers. That list included a wide range of operators, from single vehicle local operators to multi-state operators of very large vehicle fleets. The types of vehicles operated by these carriers range from small delivery trucks and vans to semi-tractor combinations. The ITA membership list included operators based in Idaho as well as carriers based in other states but which operate in Idaho.

In an initial attempt to narrow down the list of potential interviewees, the ITA identified 26 carriers that they felt would be most likely to have useful perspectives on the Road Report website (including the RWIDS webpage) and traveler information in general. These consisted of carriers that ITA believed, based on personal familiarity, to be most willing to participate and have perspectives to contribute.

Several attempts were made to contact each of the 26 carriers. When it became clear that this initial list was unlikely to yield more than a half dozen or so interviews, the evaluation team identified an additional 50 carriers from the ITA membership list as candidates. An attempt was made to identify a mix of small, medium, and larger firms.

A total of 22 interviews with representatives of 22 different carriers were completed. In nearly all cases the interviews were conducted with dispatch or other office staff who provide traveler information to the vehicle operators and are generally familiar with operators' needs and preferences. All were conducted by telephone in September and October of 2004.

A questionnaire was developed to facilitate the interviews and was provided to the interviewees in advance. The questionnaire included three main areas of inquiry:

1. Operator profiles – Information on the interviewee and their organization, including the size of the operation, service area, type of cargo, and types of vehicles operated.

2. General traveler information strategies – Types of information consulted, frequency of use, use of the information by vehicle operators (role in decision making), satisfaction levels, and suggested improvements.
3. ITD traveler information utilization – Use of the Road Report phone line and website (including the RWIDS webpage), frequency of use, type of information consulted, satisfaction, benefits, and suggestions.

7.2 Results

7.2.1 Operator Profiles

As indicated in Table 7-1, the 22 interviewees represented operations of varying sizes, from a few vehicles to more than 30. The largest carriers interviewed operate over 200 semi-tractors.

Table 7-1. Interviews by Fleet Size

Size	Number of Vehicles	Number of Interviewees
Large	More than 30	10
Medium	10 to 30	8
Small	Less than 10	4
Total		**22**

Most of the medium and large carriers operate in between 7 and 11 western states, including Idaho, Colorado, Utah, Montana, Washington, Nebraska, Oregon, Arizona, Nevada, Wyoming, and California. Some of the large carriers provide service nationwide. The small carriers generally provide service either only in Idaho or Idaho plus a few neighboring states. Most of the carriers that were interviewed operate semi-tractor trailers, that is, "18-wheel" units.

In seeking the specific interviewees, the objective was to speak with office employees who have a good overall understanding of how road weather information is used throughout the organization, or dispatchers who personally consult information sources and are aware of vehicle operator perspectives. Few of the 22 interviewees identified themselves by title as "dispatchers", but nearly all of them either participated in obtaining and disseminating traveler information or were aware of overall traveler information strategies and issues. Many of the interviewees identified themselves as General Manager, President, Director of Operations, Director of Safety, and the like.

7.2.2 General Traveler Information Strategies

Information Sources and Frequency of Use

All of the interviewees indicated that their organizations do utilize traveler information. A variety of sources are consulted, including Internet websites (mostly operated by State Departments of Transportation), telephone information systems (mostly operated by State Departments of Transportation), commercial radio and television reports, and reports from drivers in the field. In this area of questioning, interviewees were asked only open-ended questions about sources consulted; the ITD Road Report was not mentioned. However, many interviewees referenced the Road Report website or phone number. Information is consulted both by dispatchers and by the individual drivers. In the case of drivers, sources are typically limited to CB radio (other drivers), commercial radio, contacting dispatch, and roadside dynamic message signs. For the most part interviewees consult road-weather information frequently during the winter months, several times a week or even multiple times a day. Neither information sources nor frequency of use varied markedly according to the size of the interviewee's organization.

Drivers' Utilization of Traveler Information

Most drivers are not free to make route or schedule changes autonomously based on road or weather conditions. Typically they must receive approval from dispatch. However, in the case of the four small operators, drivers appear to have more autonomy.

Drivers often modify their travel plans or driving behavior based on road-weather information. The most common strategy is to delay the trip (60 percent), followed by changing routes (46 percent), pulling over to wait out bad conditions (33 percent), being more alert to conditions (27 percent), and departing earlier (7 percent). None of the interviewees reported that changes in vehicles are made in response to road-weather conditions.

Satisfaction and Suggested Improvements

Most of the interviewees were generally satisfied with the type of information available. Many interviewees identified camera images as especially useful. Suggestions focused on the need for more frequent updating of information, more cameras, more dynamic message signs (and less general interest information, e.g., Amber Alerts), more detailed information for specific locations, plow status for specific roads, and subscription e-mail alerts for specific roads.

7.2.3 ITD Traveler Information Utilization

Usage of the Road Report Webpage

Fifteen (68 percent) of the 22 carriers have used the ITD Road Report website. Based on their responses to open-ended questions about information sources (Section 7.2.2) many of the carriers also utilize the Road Report phone system.

Most (68 percent) of the Road Report users consult the website at least once a day. Information is both "pushed" to drivers from dispatchers and "pulled" by drivers from the dispatchers. That is, dispatchers often check conditions and contact impacted drivers proactively, and drivers often contact dispatchers to seek out particular information.

Information Accessed

Interviewees were asked what type of information they most often seek on the Road Report and were asked specifically about each of the major types of information on the RWIDS webpage. In answer to the more general question, 17 (77 percent) of the interviewees indicated that they seek out information on road closures. That information is available on the traditional Road Report homepage and is available as an individual menu item on the RWIDS webpage.

About 45 percent (10) of the 22 interviewees utilize the RWIDS webpage. Utilization of the various specific types of RWIDS information is summarized in Figure 7-1. CVO users are interested in the most basic information on road conditions. The most popular type of information is road closures. A little over one-third (36 percent) of the interviewees have consulted that type of information. The second most commonly viewed RWIDS data types are camera images and NWS watches and warnings; both consulted by about 20 percent of the interviewees. Other data types of interest include weather (current and NWS forecasts), at about 15 percent, and satellite images, at around 10 percent. None of the interviewees reported viewing information on pavement conditions, avalanche alerts, wind conditions, or pressure.

Satisfaction

All 15 of the CVO interviewees who have used the Road Report website are generally satisfied with it in terms of accessibility, quality, and the type of information available. The average rating of the website was 8.2 on a scale 10. Representative of some of the more satisfied users, one interviewee stated "Please keep up the good work; your Road Report helps make our highways safe."

Suggested Improvements

Many interviewees had no specific suggestions for how to improve the Road Report. Those that did focused on the same issues referenced in the discussion of traveler information sources in general:

- More frequent information updates.
- More cameras at key locations, including Island Park, Henry's Lake, Monida and Ashton (all in Idaho).
- Automatic e-mail alerts, including specific road information.
- More dynamic message signs and more messages pertaining to road and weather conditions.

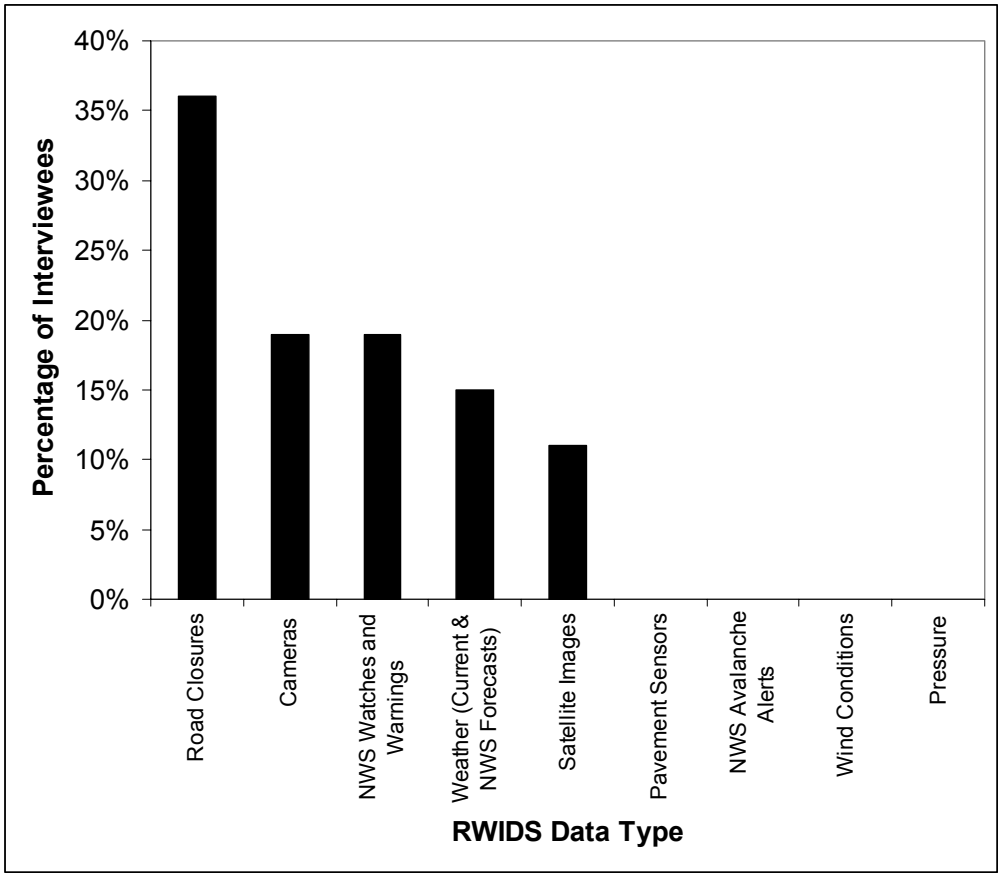


Figure 7-1. CVO Use of RWIDS Data

7.3 Conclusions

- **Commercial trucking companies use traveler information routinely and have specific expectations and opinions.** Nearly all of the interviewees regularly used one or more sources of information and most were aware of the Road Report. Many also had very specific opinions about how traveler information could be improved, most commonly that traditional Road Report information be updated more frequently and that more cameras be installed.

- **Traveler information utilization and preferences appear similar to the general travel audience.** Generally, commercial trucking companies appear interested in the same types of information as the general traveling public.

- **There is interest in RWIDS information.** Many (47 percent) of the interviewees are familiar with the RWIDS portion of the Road Report and utilize several types of RWIDS information. It isn't just the "traditional" Road Report information that is of interest. Thus it appears that the addition of the RWIDS information represents an enhancement of the Road Report website.

- **The CVO target audience includes both dispatch staff and individual drivers.** Most interviewees indicated that both individual drivers as well as dispatchers seek out traveler information. Understandably, the sources of information tend to vary among these groups. In addition to relayed information from dispatchers, drivers rely on convenient "in-cab" sources like commercial radio and CB radio, and roadside sources like dynamic message signs. Dispatchers utilize websites and telephone information systems heavily and also rely on commercial radio and television reports.

- **Most of the interviewees are satisfied with the Road Report.** Although many interviewees had suggestions for improvements, most were generally satisfied with the Road Report traveler information, including the RWIDS data.

- **Data updating is a key concern.** The most common suggestion for improvement—and the reason for dissatisfaction among the relatively few interviewees—was that information should be updated more frequently. They did not specify either the traditional Road Report or RWIDS information in particular. However, the suggestion of "once an hour" updates made by one interviewee suggests that part of the concern is with the traditional Road Report information. That information is currently updated only a few times a day, whereas the RWIDS data (assuming all of the individual reporting stations are working) updates every 30 minutes.

- **Cameras are very popular and more are desired.** Consistent with the input from ITD headquarters staff and maintenance personnel indicating that cameras are very popular with travelers in general, many CVO interviewees singled out cameras as especially useful. Additional cameras are desired.

- **Interest in RWIDS data is greatest for the most basic information.** The CVO interviewees were not at all interested in some of the more specific data on the RWIDS webpage. For example, none of them reported viewing information on pressure. They are most interested in the fundamental information: which roads are closed and what's the basic weather situation? The latter they gather from cameras, current and forecasted weather, and satellite images. Somewhat surprisingly, none of the interviewees expressed any interest in pavement data or wind speed and direction information that can be displayed on the RWIDS homepage weather map. Presumably, pavement condition and winds would be of interest. It may be that pavement data is too discrete to be of use, lacking any specific advisory information. The same may be true of wind information. Rather than seeing direction and speed at individual reporting stations, trucking companies may be more interested in high wind advisories for specific roadways. That is, in the case of both types of data, they may not be willing to draw conclusions based on a review of individual data.

8.0 Conclusions and Recommendations

This section presents conclusions based on the evaluation findings and recommendations for making further improvements to the ITD Road-Weather Integrated Data System. The objectives and hypothesized impacts originally proposed in the Evaluation Plan are revisited in light of the data and findings.

8.1 Evaluation Hypotheses and Findings

The evaluation hypotheses of the ITD RWIS Integration project were identified and discussed in the Evaluation Plan.[3] The evaluation investigated each of the hypothesized impacts. Table 8-1 presents each of the hypotheses and summarizes the evaluation findings relevant to each. Overall, many of the hypothesized impacts were fully or partially supported by the evaluation findings, indicating that the project was largely successful. Non-supported impacts consist of those related to quantifiable roadway safety and maintenance resource utilization gains. The RWIS integration project was, and is, intended to promote safety and resource utilization efficiency. However, from the outset the ITD believed that project impacts in these areas probably could not be quantified, primarily due to the many exogenous variables. The interviews with ITD maintenance personnel identified a number of other factors related to the basic nature of winter maintenance decision-making and practices that contribute to the difficulty in identifying project safety and resource utilization benefits.

8.2 Conclusions

This section summarizes the major conclusions of the evaluation of the ITD Road-Weather Integrated Data System. More detailed and comprehensive treatments of findings and conclusions associated with each evaluation analysis have been provided in the previous sections of this report. The conclusions in this section are organized in three categories:

1. RWIDS as an ITD Maintenance Information Resource
2. RWIDS as a Traveler Information Resource
3. RWIDS as a Data Integration Platform

[3] Evaluation Plan: Idaho Transportation Department Road Weather Information System (RWIS) Integration, prepared by Battelle for the ITS Joint Program Office, Federal Highway Administration, December 19, 2001.

Table 8-1. Hypotheses Addressed by the Evaluation

Project Objective	Hypothesized Project Impacts	Evaluation Findings
Provide convenient access to consolidated RWIS data for ITD headquarters, district and foreman area staff, and for the consolidated state dispatch office.	ITD staff will consult the integrated RWIDS website and will view the resource positively. [SUPPORTED]	• Monthly ITD RWIDS sessions ranged from about 300 during the late winter/early spring months up to about 2,550 sessions during December and January. For reference, if usage during the peak month, December 2004, was spread evenly across the 71 maintenance sheds, it would amount to about 36 sessions per shed, an average of a little more than one session every day. • Seventy-eight percent of the 31 ITD maintenance personnel who were surveyed (including 28 of the approximately 45 ITD Maintenance Foremen statewide) reported utilizing the RWIDS website more than once a week during the winter. Forty percent used the site daily. • The average usefulness rating among survey respondents was 3.2 (on a scale of 1-5 with 1=not at all useful and 5=critical). Fifty percent found the site at least "very useful". • Roughly three-quarters of the 14 maintenance personnel that were interviewed indicated that they use the site and find it useful. Most of the personnel not satisfied with the site are located in portions of the state where there is still very little sensor station coverage, where computers are less common in maintenance sheds, and where Internet connections are often slower (dial-up).
Increase the utilization of RWIS data in winter maintenance decision-making (e.g., where and when to deploy snow plows), especially by Foreman Area personnel, who are responsible for many real-time maintenance decisions.	ITD winter maintenance staff will integrate the use of RWIDS information from the website into their winter maintenance decision making. [SUPPORTED]	• 78% of the 31 ITD maintenance personnel who were surveyed (including 28 of the approximately 45 ITD Maintenance Foremen statewide) reported utilizing the RWIDS website more than once a week during the winter. Forty percent used the site daily. • The average usefulness rating among ITD maintenance survey respondents was 3.2 (on a scale of 1-5 with 1=not at all useful and 5=critical). Fifty percent found the site at least "very useful". • All 31 of the ITD maintenance survey respondents identified at least one way in which the RWIDS webpage has improved their decision making. Almost all respondents cited multiple benefits; on average 3 of the 7 potential benefits listed on the survey were cited. Approximately 35% of the respondents cited all 7 benefits. The most commonly cited benefits were: improved timing of road treatments (start earlier or later) and improved ability to forecast resources for a particular storm event. Both of these benefits were cited by 60% (19) of the 31 respondents. • Many ITD maintenance personnel that were interviewed cited similar improvements in decision-making.

Project Objective	Hypothesized Project Impacts	Evaluation Findings
	The effectiveness of ITD winter road maintenance activities will be improved, such as may ultimately manifest as reduced winter-weather related crashes. [NOT SUPPORTED]	• Most of the ITD maintenance personnel that were interviewed who had convenient access to RWIDS information of interest (sites in their area) indicated that the RWIDS webpage was another useful tool. However, they don't think quantifiable, traceable improvements in roadway safety are likely at this point. They cite the many other variables that impact safety and the positive, but marginal impact of the RWIDS webpage on their maintenance effectiveness. • The accident analysis showed inconclusive results if the deployment of RWIDS has led to verifiable reduction in accident rate, due to small sample size and data arbitration.
Provide a cost-effective means to integrate future RWIS sensors, regardless of their brand, and to integrate other future ITS devices such as dynamic message signs and highway advisory radio.	Future integration of various brands of RWIS, and other ITS devices, will be possible. [PARTIALLY SUPPORTED]	• Both of the two new sets of ESS implemented since completion of the RWIDS project—of differing brands and both new brands to ITD—have been successfully implemented. The integration was performed by the ITD with no assistance from the RWIDS project consultant. • The ITD project manager states that with the flexibility provided by the new RWIDS non-proprietary platform, the ITD was able to select from more cost-effective vendors. He estimates that, in the two implementations that have occurred since completion of RWIDS, this flexibility has resulted in a savings of approximately $7,500 per ESS. • Thus far, the ITD has not investigated, nor attempted, integration of any other sorts of ITS devices into the RWIDS platform or using the RWIDS integration model.
Provide the public convenient access to consolidated RWIS information in a form that will facilitate the use of information in making travel decisions.	Travelers (e.g., commuters, recreational travelers, and commercial vehicle operators) will consult the RWIDS webpage and will view the resource positively. [SUPPORTED]	• Despite no marketing of the new RWIDS webpage and essentially no integration of the new information with the more familiar traditional Road Report website data, Road Report website usage increased dramatically (169%) following the introduction of the RWIDS webpage. About half of the additional sessions featured RWIDS content viewing, and 85% of those new sessions featured viewing of *only* RWIDS information. • Despite the relatively small sample size (134 complete survey), the web survey results showed that other than the 37% of the first time users, 63% of veteran users have used the RWIDS information for planning their trips. • Approximately 45% (10) of the 22 commercial vehicle operators that were interviewed indicated that they use the RWIDS webpage.
	Travelers will utilize the RWIDS webpage and will call the ITD less frequently for road-weather information. [PARTIALLY SUPPORTED BUT NOT FULLY TESTABLE]	• As noted in the preceding findings discussion, overall Road Report website usage increased dramatically (169%) and about 25% of the gain consisted of user sessions that only included the RWIDS webpage. • It was not possible to obtain quantitative data on telephone calls to ITD for information. However, several of the ITD maintenance personnel reported that they continue to receive calls from the public.
	Use of the RWIS website will allow travelers to avoid or better prepare for driving	• 80% of the web survey respondents who used RWIDS agreed that the information provided by this website

Project Objective	Hypothesized Project Impacts	Evaluation Findings
	during adverse road conditions. [SUPPORTED]	helped them better prepare for road-weather conditions. • 76% of the web survey respondents indicated that the information helped them drive more carefully • 63% of web survey respondents indicated that the RWIDS has resulted in the change of time of travel and 48% had canceled their trips.
Provide the ability to expand ITD RWIS coverage in a cost-effective manner through the integration of data from sensors operated by other organizations.	Expansion of ITD RWIS coverage in a cost-effective manner through the integration of data from sensors operated by other organizations. [SUPPORTED]	• Via participation in the MesoWest weather data-sharing consortium, the ITD successfully integrated approximately 120 ESS of various types operated by other organizations within and surrounding Idaho. The only significant reported costs to do so were those associated with the overall RWIDS implementation. (The ITD was not able to ascribe a specific percentage of the $396,421 total project cost to the integration associated with the other organizations' stations.) Now that the system is operational, the ITD RWIDS project manager expects that integrating any new stations via the MesoWest consortium will be at nominal cost. • Although most ITD maintenance personnel that were interviewed indicated that not all of the new, non-ITD stations provide comprehensive data, they generally indicated that the data were quite useful; certainly better than nothing.

8.2.1 RWIDS as an ITD Maintenance Information Resource

- **RWIDS represents an important evolutionary, but not a revolutionary, advance for ITD winter maintenance decision-making.** The RWIDS project has been very successful in its objective of making available a much more convenient, consolidated source of ITD RWIS data, and a vast wealth of additional weather data, to ITD maintenance personnel. Personnel with good access to the Internet in areas where RWIDS coverage is good find the site very useful. However, even the RWIDS proponents view it as "just another tool in the tool box" that has incrementally enhanced their decision making, rather than as a revolutionary improvement. This perspective is shaped significantly by the fact that many of the strongest advocates of RWIDS were proactively seeking out and using similar (in some cases identical) data from primary sources prior to the RWIDS website implementation. Further, a number of these personnel continue to use those other sources because they provide data not available on RWIDS or in a different format than on RWIDS (e.g., forecast data from ITD ESS through subscription to RWIS vendor). These considerations do not diminish the success of the project but rather serve to put those successes in perspective.

- **The usefulness of the current version of RWIDS varies widely for ITD maintenance personnel throughout the state, and can be enhanced.** A number of factors impact utilization and perceptions of usefulness. Expectedly, the system is much less useful in areas with few or no sensor stations, and there are still significant portions of the state with no stations. Also, although other organizations' weather sensors do provide some useful information, and are better than nothing, there is a preference for ITD stations. Presumably,

one of the most powerful motivations for any maintenance user to consult RWIDS would be to consult ITD stations in their area. Other factors that impact usage and valuation of RWIDS include lack of high-speed Internet access in many areas, and even more fundamentally, the scarcity of maintenance shed personal computers. Finally, the level of personnel prior experience using Internet weather information and particularly ESS data in maintenance decision-making is an important factor. To some extent this factor is related to the variation across Foreman Areas and Districts in overall attitudes toward technology and new practices.

- **ITD maintenance personnel are generally comfortable synthesizing discrete weather data to draw conclusions and make decisions.** Only a couple of personnel indicated that it was difficult to make sense of the wide range of RWIDS data and that perspective is probably primarily a result of their overall lack of experience with using the RWIDS website and other Internet information. Most maintenance personnel that were interviewed expressed little interest in expert systems for maintenance decision support. They don't feel that the technology is sufficiently sophisticated to effectively deal with what they perceive as a very complex and changing decision-making context. They also expressed concerns that ESS coverage and reliability are not sufficient to support such systems now or in the foreseeable future. It was clear that the interviewees tend to associate more synthesized information and suggested actions with an "automated" system. Therefore, their distrust of decision support does not necessarily imply that they would be likely to reject more synthesized information. In fact, several maintenance personnel cited the synthesized weather summaries prepared by NWS employees as among the most useful type of weather information to help coordinate shift changes.

- **Most ITD maintenance personnel are interested in a wide range of data, but are most interested in the same basic information popular with the public.** Many maintenance personnel utilize a wide range of the RWIDS data, including some of the less direct information like Pacific Loop radar and Jet Stream images. However, the RWIDS information consulted most frequently and which seems to be most valued is the same information most appreciated by the general public and commercial vehicle operators: cameras and basic current and forecasted weather information.

- **RWIDS might not generate quantifiable improvements in roadway safety or the utilization of ITD winter maintenance resources.** There was no statistically significant change in statewide winter weather-related accident rates during the one-year period after implementation of RWIDS. The absence of measurable, traceable improvements in safety is not unexpected given the many exogenous factors; the modest, incremental improvement in decision-making associated with RWIDS; the fact that not all maintenance personnel utilize RWIDS; and the inherently conservative and relatively inelastic nature of many ITS winter maintenance resource commitment decisions.

- **Although demonstrable safety improvements are lacking, travelers perceive that their safety is enhanced through the use of the RWIDS webpage.** Eighty percent of on-line survey respondents who used RWIDS agreed that the information helped them better prepare

for road-weather conditions and 76 percent of the respondents indicated that the information helped them drive more carefully.

8.2.2 RWIDS as a Traveler Information Resource

- **The addition of the RWIDS webpage accounts for a sizable percentage of the overall increase in Road Report website utilization.** Utilization of the Road Report website in general has risen consistently and dramatically in the year following implementation of the RWIDS webpage (169%). About half (47%) of the new user sessions included RWIDS viewing. Further, 85 percent of all sessions that included RWIDS viewing featured *only* viewing of RWIDS content. A full 25 percent of post-RWIDS Road Report sessions feature viewing of only RWIDS information.

- **The traditional Road Report information, fed by ITD maintenance foreman reports, is not "replaced" by the RWIDS website.** Although "RWIDS-only" user sessions account for a significant portion of the overall growth in Road Report website utilization (about 47%), most of the growth, and most of the total current utilization is for traditional Road Report information (the road closure and conditions information provided by maintenance foremen).

- **RWIDS has probably not reached its full potential as a public information resource, since it has not been marketed or integrated.** The ITD has not marketed the RWIDS webpage. Although significant levels of usage have occurred as result of users happening across the new webpage, and presumably through some word-of-mouth, it seems likely that marketing could significantly increase usage. Also, since it is clear that users still value—and separately consult—the traditional Road Report closure and condition information, that overall Road Report usage might be further enhanced if the RWIDS information was integrated with the traditional information.

- **Public RWIDS users, including commercial vehicle operators, are most interested in camera images and basic current and forecasted weather information.** Camera images are very popular and are the most frequently accessed RWIDS data. Like the ITD maintenance personnel, respondents to the on-line survey and commercial vehicle operators feel that additional cameras would be very useful.

8.2.3 RWIDS as a Data Integration Platform

- **RWIDS has successfully leveraged a wealth of data from other organization's ESS.** The RWIDS webpage provides access to approximately 120 ESS operated by other organizations, including other state department of transportation ESS. Most maintenance personnel find these other stations useful, although they prefer ITD operated ESS.

- **Other organization's ESS supplement but do not necessarily replace ITD ESS.** Data from other organizations' stations provide a low-cost means to greatly enhance data coverage. However, even in the case of Idaho which acquired access to a large number of such stations, such stations do not necessarily address all, or even the most critical (hot spot),

data coverage gaps. Further, although they provide some value, other organizations' stations do not provide a standard, full compliment of information. For example, very few non-transportation department stations provide pavement data. Non-transportation agency stations are typically not ideally sited to support roadway maintenance-related data collection. Finally, other organizations may not maintain their stations at levels needed to support public traveler or highway maintenance information needs.

- **RWIDS has allowed ITD to pursue more cost-competitive ESS procurements.** Since completion of the RWIDS data platform, two sets of new ITD ESS have been successfully integrated into the system. Both of the procurements featured different brands of stations, and both brands are different than either of the two pre-RWIDS ("incumbent") brands composing the ITD road-weather information system. Before RWIDS, when considering new stations, ITD was essentially restricted to one of the two incumbent brands. Installing equipment of any other make would have necessitated a third, separate proprietary user interface. By providing access to multiple brands of ESS via a single user interface, RWIDS has allowed the ITD to select from among a wider, more cost-competitive range of offerings and thereby significantly reduce the costs of new stations. The ITD estimates that the cost to deploy four sites using one of the two new brands of stations is about 12 percent lower than the bid submitted by the primary "incumbent" RWIS vendor. In that particular procurement, the flexibility provided by RWIDS resulted in a savings of about $30,000, or about $7,500 per site.

8.3 Recommendations

A number of recommendations have been developed based on the findings of the evaluation. They are presented in the spirit of suggestions for consideration not only for ITD but also for other state transportation departments who may be considering RWIS deployment or integration.

- **Continue to fill gaps in ESS coverage.** Although the addition of the approximately 120 other organizations' ESS to the ITD RWIS provided an immediate improvement in data coverage, many critical gaps remain. In some cases, even if there is another organization's station in a given general area, the specific placement or type of information gathered may not fully meet winter maintenance decision making needs. Overall, although helpful, other organizations do not completely eliminate the need for additional ITD ESS. The ITD may also consider adding certain sensors to existing ESS operated by other organizations, most notably pavement sensors, which are not included on most non-ITD stations. Based on the fact that the ITD continues to implement their own ESS it is clear that they agree that continued investment in ITD stations is a necessary part of the overall RWIS strategy.

- **Improve the reliability of ESS.** A number of maintenance employees expressed concerns about the reliability of both ITD and non-ITD stations, noting that particular stations have been inoperative for extended periods. Such unreliability obviously significantly limits the usefulness of the RWIDS website and it is recommended that the ITD continue to work to improve the reliability of stations. In cases where other

organizations' stations located in key locations are unreliable, consideration may be given to implementing ITD stations in those locations.

- **"Level the playing field" statewide with respect to personal computers and Internet access.** Even more fundamental to the use and usefulness of RWIDS than ESS coverage is that maintenance sheds have personal computers and Internet access; preferably high-speed access. It is strongly recommended that ongoing ITD efforts in this area continue and be accelerated if possible.

- **Provide additional, focused training to ITD maintenance personnel.** Most of the maintenance personnel that were interviewed expressed interest in receiving a second round, or more, of training on the RWIDS webpage. Many of them also indicated that it's important that the training be hands-on, with computers at each training station. It is recommended that the follow-up training provide instruction on overall information gathering strategies and use of various types of information, including the various RWIDS data, in support of specific types of winter maintenance decisions as well as the use and benefits of road weather information to make proactive decisions about treatments (such as anti-icing). Such information represents a natural evolution in ITD headquarters efforts to encourage efficient and effective winter maintenance and was specifically requested by a couple of the maintenance personnel. It is also recommended that training on the use and benefits of road weather information to make proactive decisions about treatments (such as anti-icing) be considered.

- **Market RWIDS to the public.** Although a substantial number of Road Report users have "found their way" to the RWIDS page in the absence of any marketing, it would seem that marketing of the RWIDS webpage could significantly increase utilization.

- **Consider more fully integrating RWIDS and the remainder of the Road Report.** The general public and commercial vehicle operators are interested in the "traditional" Road Report closure and conditions information as well as information on the RWIDS webpage. It is recommended that ITD consider integrating these information types, including possibly using RWIDS data to enhance the traditional roadway-specific Road Report advisories. Such integration could occur as part of the planned ITD implementation of a comprehensive traveler information system.

- **Develop system performance monitoring capabilities and monitor the utilization and effectiveness of RWIDS.** Currently, ITD does not have effective mechanisms for monitoring the utilization of the RWIDS webpage by either the public or ITD maintenance personnel. In fact, limitations in this regard, such as the inability to clearly distinguish all ITD RWIDS user sessions, impacted this evaluation. In order to support a continuous quality improvement process it is recommended that the ITD implement mechanisms that will allow for tracking of RWIDS utilization and that they routinely analyze that data. For example, it is possible to configure the RWIDS server logs so as to capture information on the use of RWIDS webpage data that appears in pop-up windows, accessed from another organization's server. This analysis could not quantify such usage because the logs were not configured to preserve such data. Likewise, there are various

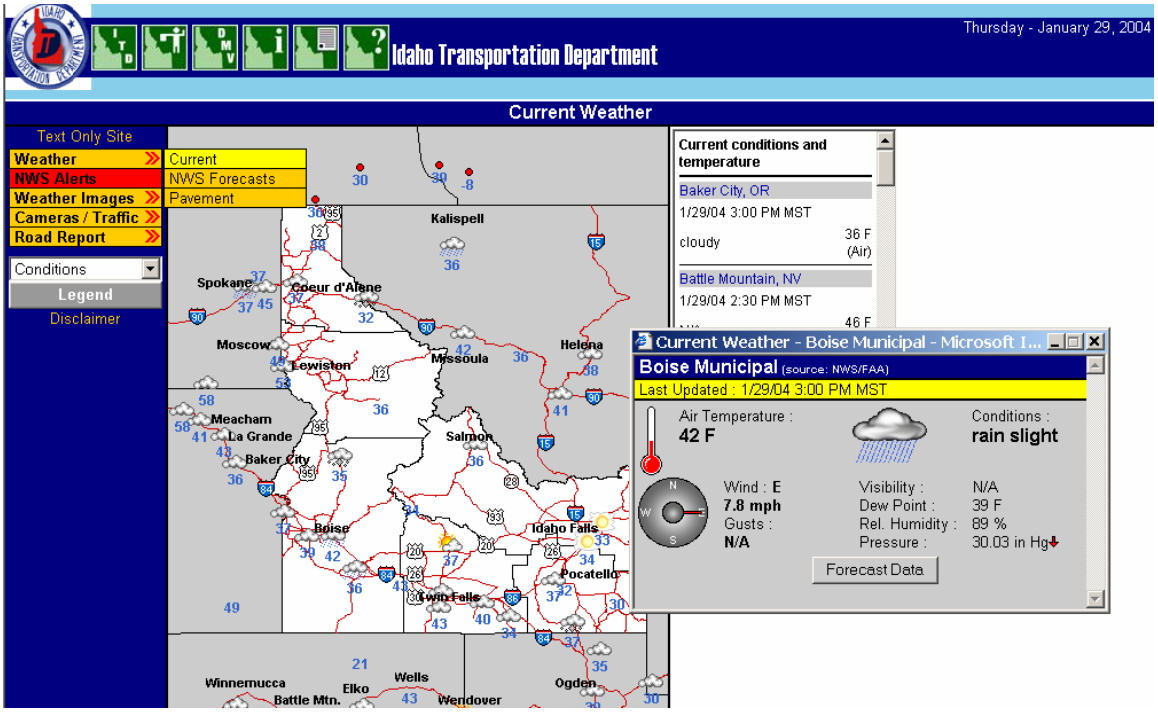
options for tracking RWIDS usage by individual maintenance sheds. Such geographic resolution was not possible in this analysis because so many of the maintenance personnel chose not to use the employee log-in feature. The log-in access included an obvious "back door" that allowed them to effectively utilize the site without logging in.

- **Monitor broader national developments in road weather information sharing and position ITD to capitalize on advances.** Road weather information sharing and utilization of road weather information in maintenance decisions are topics being considered by transportation agencies throughout the United States. The ITD should be aware of FHWA activities to promote technology transfer of the Federal MDSS prototype, which integrated road weather and resource information to provide route-specific treatment recommendations. In addition, the USDOT Clarus Initiative is one of the most important activities that ITD should be aware of, and if possible, participate in. That initiative is focusing on integration of all weather and pavement condition observations from transportation agencies and shares the same philosophy in data integration with this ITD earmark project. The specific RWIDS project approach to leveraging data from the MesoWest consortium has been successful, but monitoring and participation in the Clarus Initiative Coordinating Committee can help keep ITD in a position to benefit from information processing and dissemination that may result as a part of that initiative.

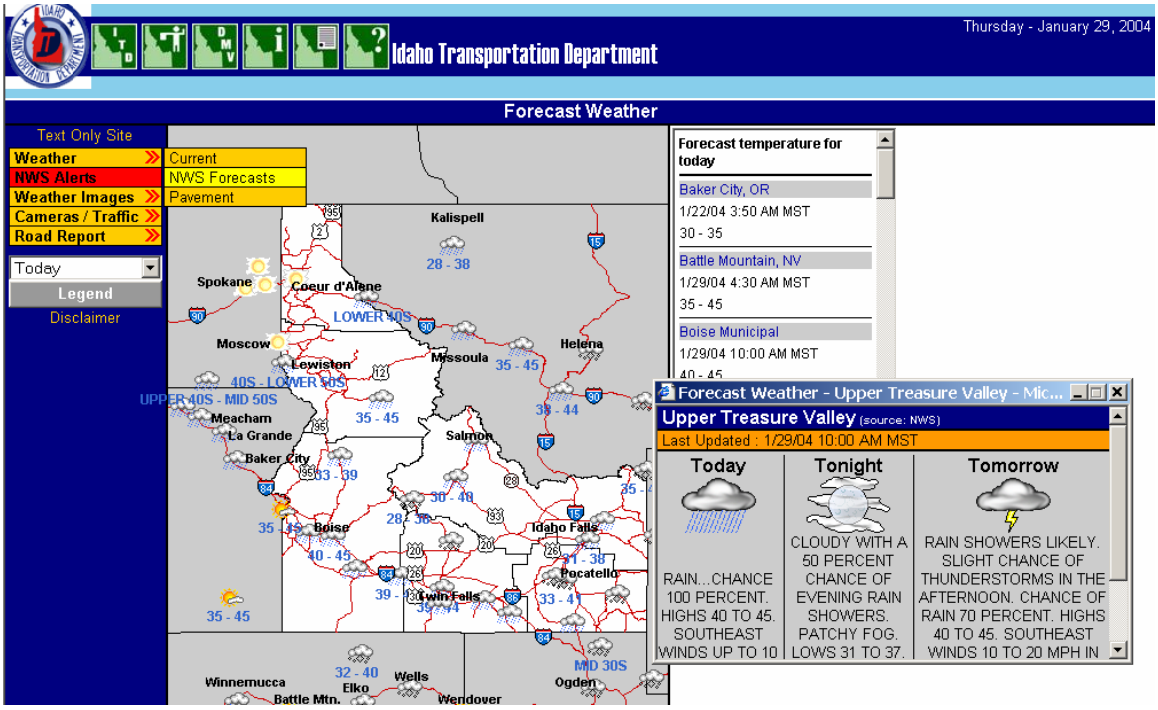
- **Continue to consider opportunities to further synthesize road weather information for winter maintenance personnel.** When asked about their interest in software tools that could provide recommendations for maintenance actions based on RWIS and other data, several maintenance personnel reacted negatively, seeming to interpret any sort of computerized decision support with a move toward minimizing or eliminating their role in decision-making. Also, most of the maintenance interviewees are generally content with synthesizing a wide range of discrete data themselves. However, this does not suggest that maintenance personnel would not benefit from, and adopt if properly introduced to, a Maintenance Decision Support System. Maintenance Decision Support Systems use state-of-the-art weather forecasting and data fusion techniques and merge them with computerized winter road maintenance rules of practice. The result is a set of guidance for maintenance managers that provides a precise forecast of surface conditions and treatment recommendations customized for specific routes. These systems do not make decisions, but rather make recommendations which personnel can choose to implement. It is recommended that ITD keep an open mind to the possibility of introducing maintenance decision support.

Appendix A.

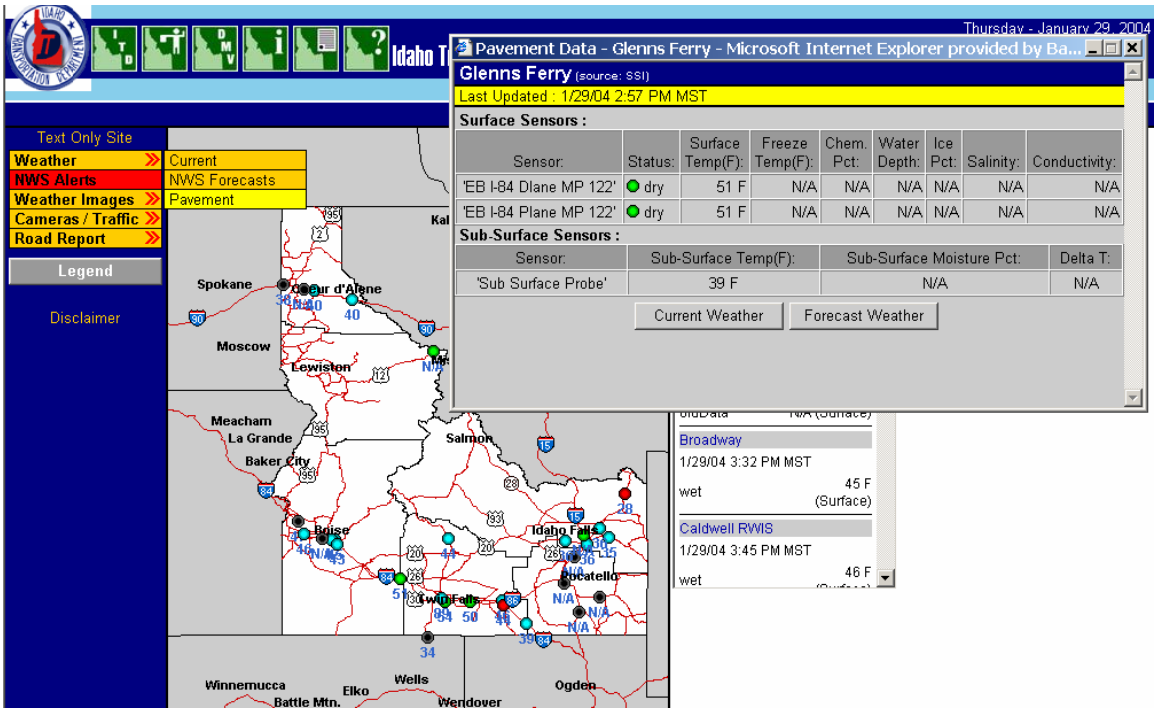
RWIDS Webpage Screen Captures



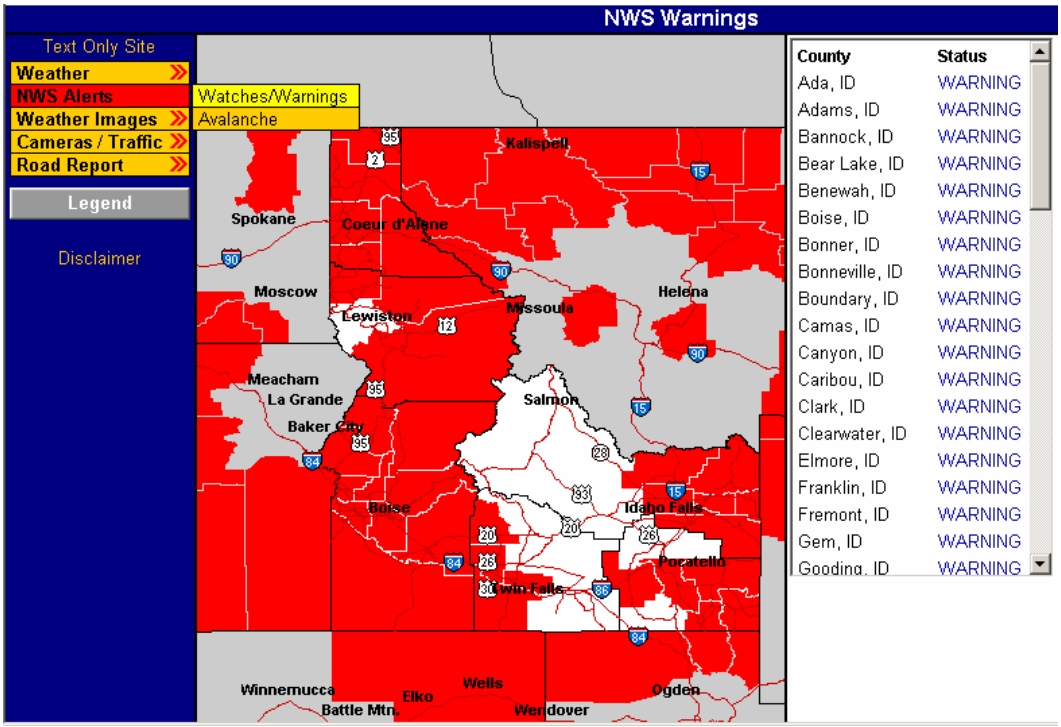
RWIDS Current Weather



NWS Forecasts

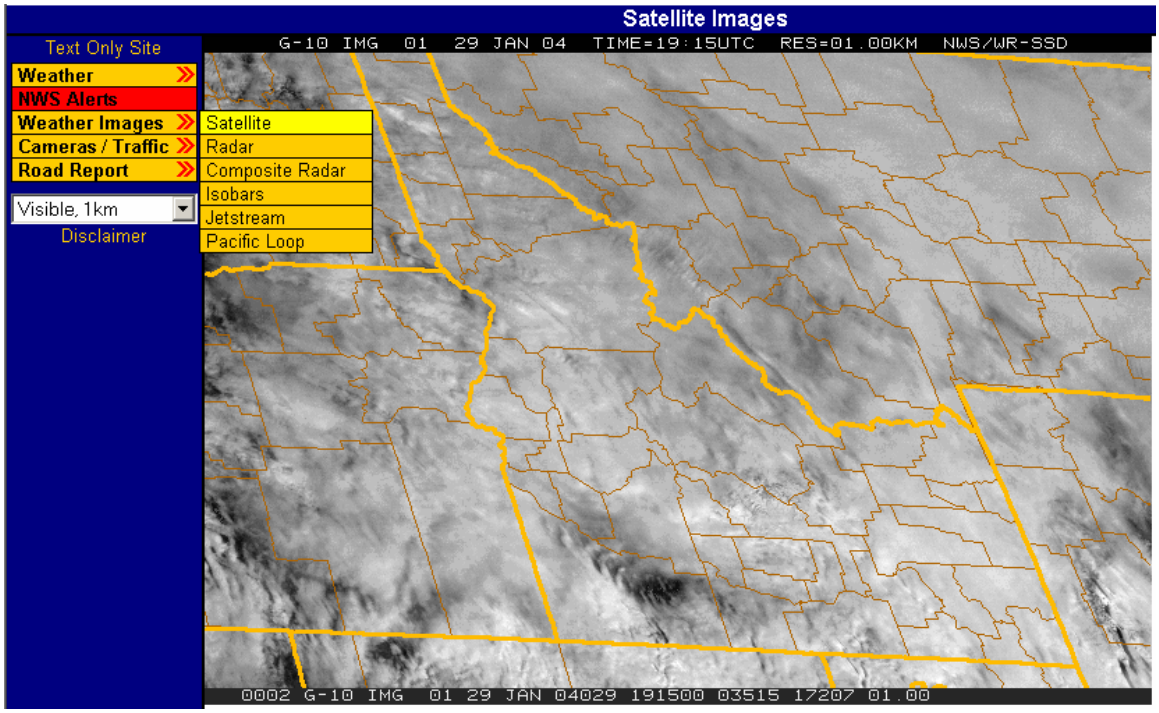


RWIDS Pavement Data

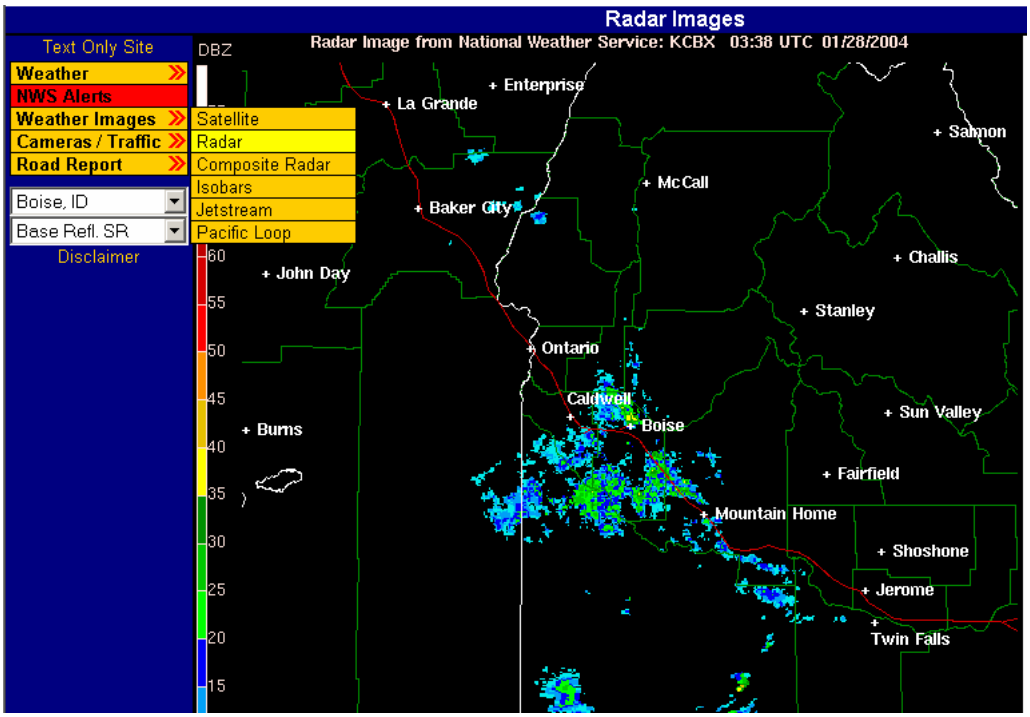


RWIDS National Weather Service Watches/Warnings

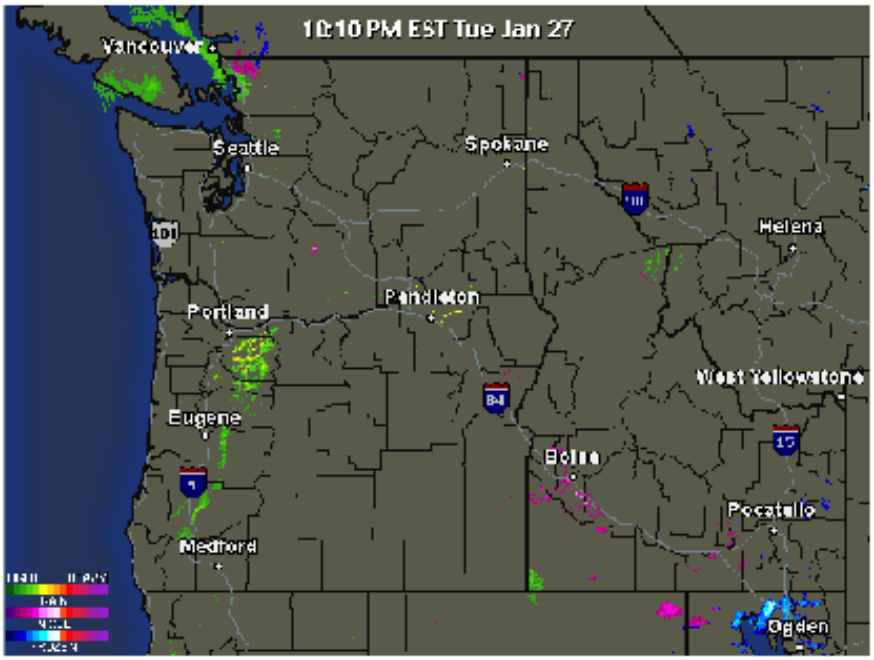
RWIDS Avalanche Alerts



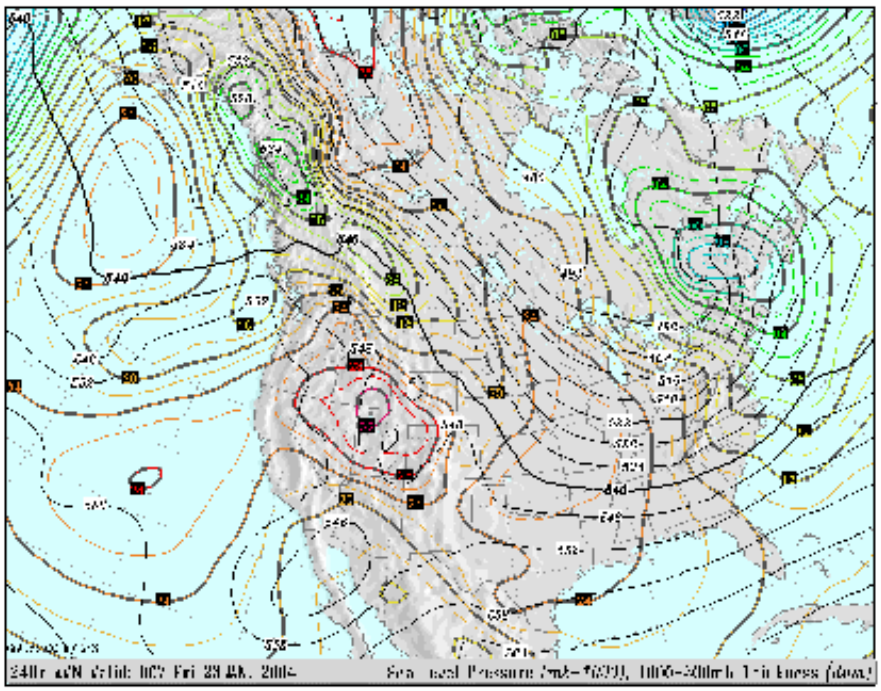
RWIDS Satellite



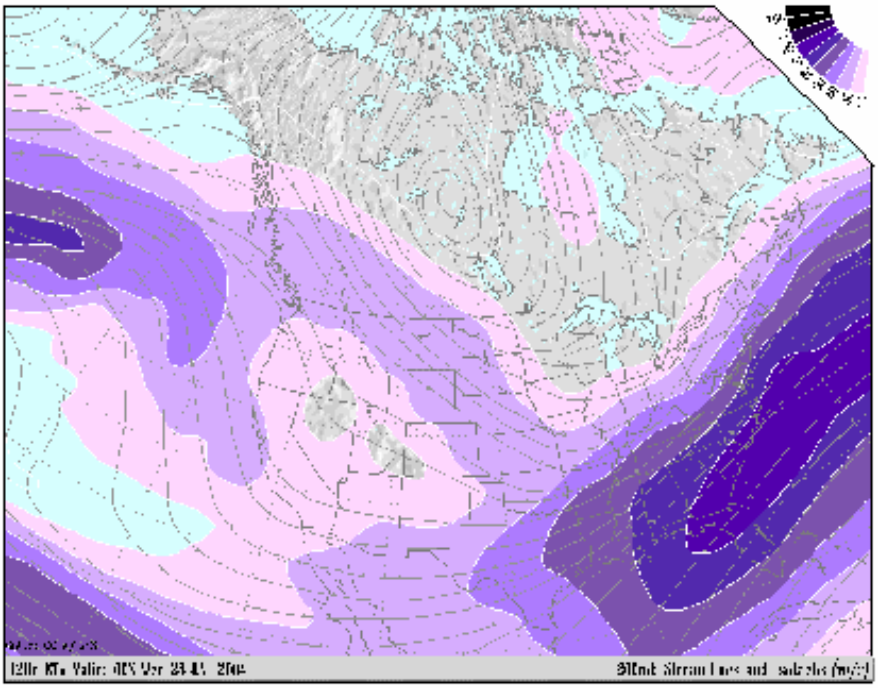
RWIDS Radar



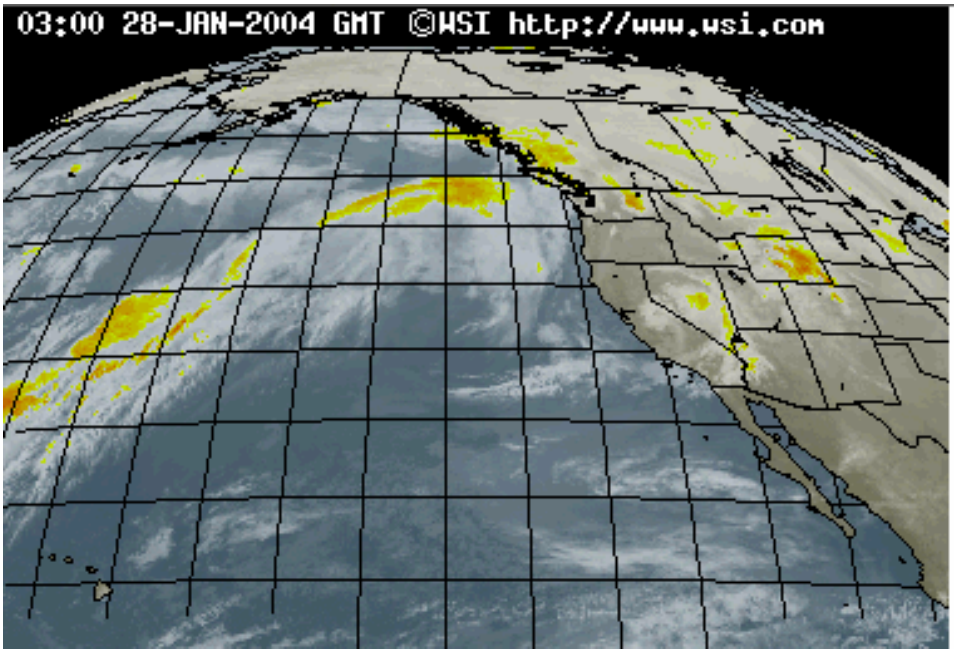
RWIDS Composite Radar



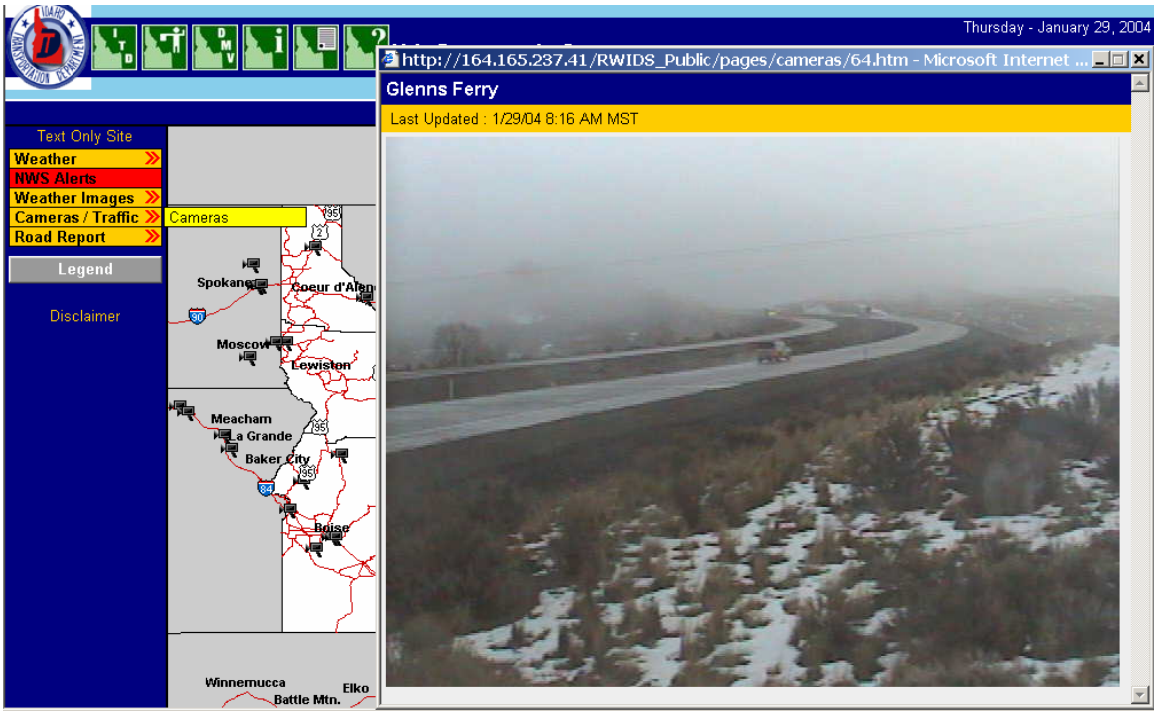
RWIDS Isobars



RWIDS Jet Stream



RWIDS Pacific Loop Satellite



RWIDS Cameras

Appendix B.

Winter Maintenance Resource Consumption by Districts

Appendix B

ITD Winter Maintenance Resource Consumption by Maintenance Districts

ITD District 1

	Before RWIDS							After
Maintenance Resources	1996/ 1997	1997/ 1998	1998/ 1999	1999/ 2000	2000/ 2001	2001/ 2002	2002/ 2003	2003/ 2004
Labor Hours	58,136	38,182	42,674	42,881	49,765	25,418	13,099	22,248
Pass Kilometers Plowed	1,167,013	595,907	719,045	722,078	770,208	527,531	109,844	330,245
Salt and Sand (Cubic Meters)	82,615	52,895	67,758	67,295	83,912	63,490	17,395	47,343
Sand (Cubic Meters)	9,603	5,528	5,961	3,688	2,903	2,346	393	949
Freeze-point depressant chemical (Liters)	766,663	810,619	939,052	1,135,904	1,611,065	1,646,289	1,386,937	2,347,759

ITD District 2

	Before RWIDS							After
Maintenance Resources	1996/ 1997	1997/ 1998	1998/ 1999	1999/ 2000	2000/ 2001	2001/ 2002	2002/ 2003	2003/ 2004
Labor Hours	30,404	22,160	28,445	27,422	29,814	16,487	8,922	14,877
Pass Kilometers Plowed	671,337	420,365	497,929	443,835	470,987	423,256	226,363	393,774
Salt and Sand (Cubic Meters)	7,066	5,962	4,879	9,833	4,668	936	1,577	2,381
Sand (Cubic Meters)	34,700	28,041	30,913	27,153	29,207	22,744	9,152	19,317
Freeze-point depressant chemical (Liters)	155,284	400,507	665,531	2,146,074	2,596,258	1,857,602	922,684	1,277,551

ITD District 3

	Before RWIDS							After
Maintenance Resources	1996/ 1997	1997/ 1998	1998/ 1999	1999/ 2000	2000/ 2001	2001/ 2002	2002/ 2003	2003/ 2004
Labor Hours	33,824	35,559	40,556	39,610	44,298	30,139	16,736	32,039
Pass Kilometers Plowed	619,254	497,104	591,462	584,135	619,039	665,880	358,450	587,491
Salt and Sand (Cubic Meters)	26,068	21,258	24,331	27,275	29,211	27,197	7,799	28,824
Sand (Cubic Meters)	122	394	26	70	183	2,295	56	11
Freeze-point depressant chemical (Liters)	211,032	268,271	371,647	517,331	1,854,303	2,539,883	1,029,263	2,260,803

ITD District 4

	Before RWIDS							After
Maintenance Resources	1996/ 1997	1997/ 1998	1998/ 1999	1999/ 2000	2000/ 2001	2001/ 2002	2002/ 2003	2003/ 2004
Labor Hours	23,590	19,323	23,099	20,712	22,159	19,576	9,859	18,513
Pass Kilometers Plowed	592,209	436,458	530,777	453,145	475,914	570,690	370,500	645,729
Salt and Sand (Cubic Meters)	26,900	22,698	28,866	27,612	31,023	36,414	13,913	35,289
Sand (Cubic Meters)	817	695	136	256	117	60	184	15
Freeze-point depressant chemical (Liters)	0	6,436	5,925	2,704	72,422	37,494	97,642	102,350

ITD District 5

	Before RWIDS							After
Maintenance Resources	1996/ 1997	1997/ 1998	1998/ 1999	1999/ 2000	2000/ 2001	2001/ 2002	2002/ 2003	2003/ 2004
Labor Hours	34,088	29,914	29,024	26,748	34,160	19,253	8,615	19,391
Pass Kilometers Plowed	886,891	628,786	527,523	485,309	594,287	556,268	327,005	630,994
Salt and Sand (Cubic Meters)	50,961	59,807	48,430	46,187	45,906	52,680	20,828	49,841
Sand (Cubic Meters)	0	40	23	141	2,718	305	65	41
Freeze-point depressant chemical (Liters)	0	0	56,373	114,259	558,884	430,275	127,498	263,500

ITD District 6

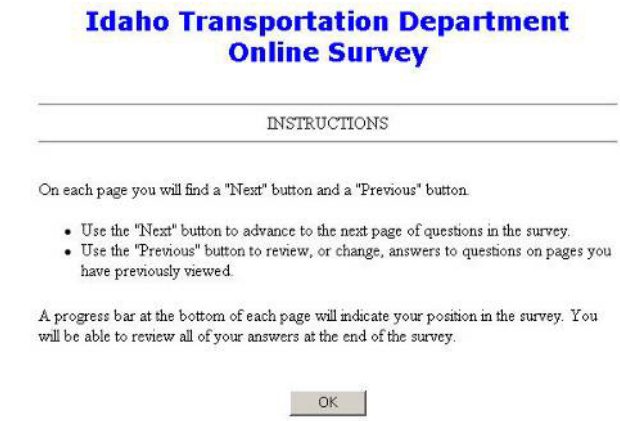
	Before RWIDS							After
Maintenance Resources	1996/ 1997	1997/ 1998	1998/ 1999	1999/ 2000	2000/ 2001	2001/ 2002	2002/ 2003	2003/ 2004
Labor Hours	43,131	36,063	38,479	31,992	36,064	27,043	16,401	27,812
Pass Kilometers Plowed	1,045,712	717,069	775,659	652,399	662,201	629,497	497,176	850,595
Salt and Sand (Cubic Meters)	13,324	14,574	13,039	13,289	14,648	6,281	5,713	12,115
Sand (Cubic Meters)	6,928	5,689	5,696	6,653	5,300	6,223	3,917	5,546
Freeze-point depressant chemical (Liters)	0	0	0	296,074	164,791	92,093	58,187	114,186

Appendix C.

Public Web Survey Interface

Appendix C

Public Web Survey Interface



Idaho Transportation Department
Online Survey

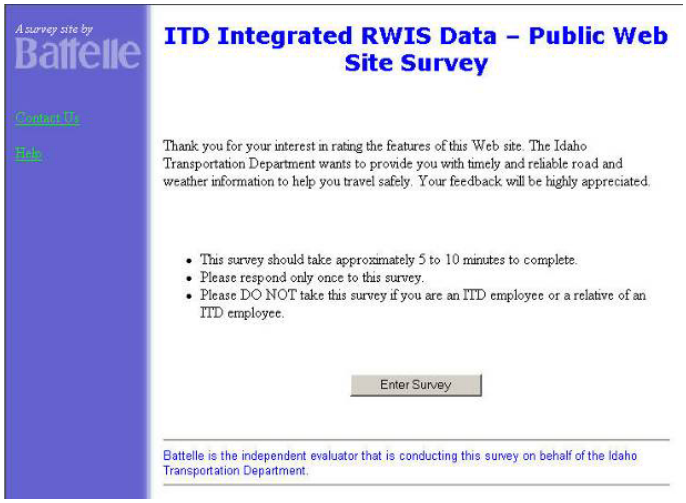
INSTRUCTIONS

On each page you will find a "Next" button and a "Previous" button.

- Use the "Next" button to advance to the next page of questions in the survey.
- Use the "Previous" button to review, or change, answers to questions on pages you have previously viewed.

A progress bar at the bottom of each page will indicate your position in the survey. You will be able to review all of your answers at the end of the survey.

OK



A survey site by Battelle

Contact Us

Help

ITD Integrated RWIS Data – Public Web Site Survey

Thank you for your interest in rating the features of this Web site. The Idaho Transportation Department wants to provide you with timely and reliable road and weather information to help you travel safely. Your feedback will be highly appreciated.

- This survey should take approximately 5 to 10 minutes to complete.
- Please respond only once to this survey.
- Please DO NOT take this survey if you are an ITD employee or a relative of an ITD employee.

Enter Survey

Battelle is the independent evaluator that is conducting this survey on behalf of the Idaho Transportation Department.

1. How often do you use this web site?

- This is my first visit (skip to Question #6)
- I visit this web site one to three times a month
- I visit this web site more than three times a month

Next

2. How long have you been using this web site?

- Less than 6 months
- 6 months to a year
- More than a year

Previous Next

4. How often do you use this web site for the following reasons? (Please check one response for each reason, a through k.)

	Frequency of Use			
	Never	Sometimes	Frequently	Always
a. To find out about road closures	○	○	○	○
b. To find out about road construction	○	○	○	○
c. To decide which highway to take	○	○	○	○
d. To decide the timing of travel	○	○	○	○
e. To decide whether to cancel my trip	○	○	○	○
f. To be better prepared for driving conditions	○	○	○	○
g. To check weather conditions for a specific route	○	○	○	○
h. To find out about weather conditions in general	○	○	○	○
i. To find out about road condition of a potentially hazardous location	○	○	○	○
j. Other reason [ ]	○	○	○	○
k. Other reason [ ]	○	○	○	○

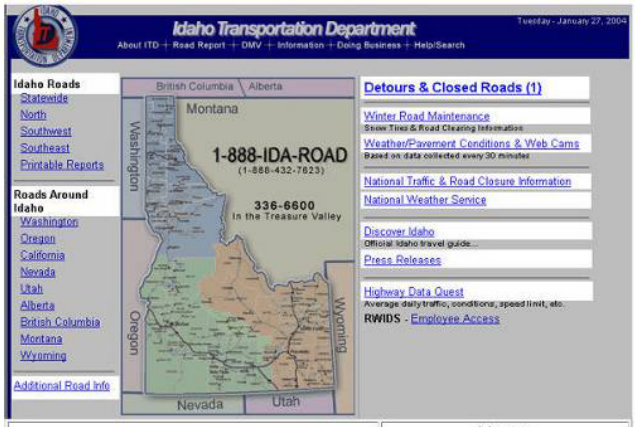
Previous Next

5. Indicate all the types of trips for which you have used this site for trip planning (check all that apply), and indicate the trip type for which you use this site most frequently (check only one)

	Have Used (check all that apply)	Most Frequently Used (check one)
a. Commuting to or from school or work	☐	☐
b. Personal trips (shopping, pickup children, doctor appointments, etc.)	☐	☐
c. Recreational trips	☐	☐
d. Driving as part of your job or business (goods delivery, taxi, sales)	☐	☐
e. Commercial freight hauling (long distance)	☐	☐
f. Other trips. Specify: [ ]	☐	☐

Previous Next

6. In questions 6a. to 6k., please indicate whether or not you have used the indicated feature available at this web site. See the sample web page for reference. (Please make a selection for each feature.)

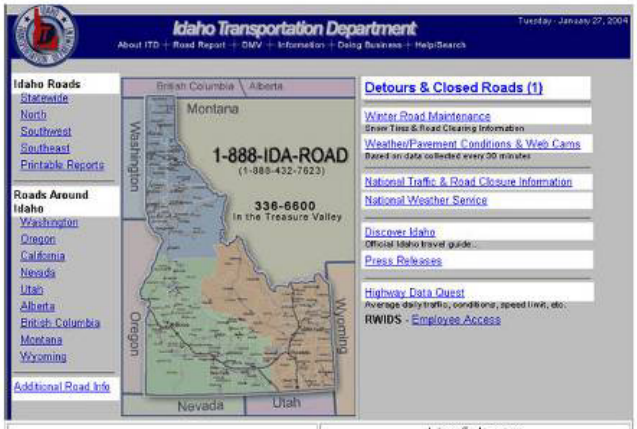


	Usage	
6a. Idaho Roads	Have Used ○	Not Used ○
6b. Roads Around Idaho	Have Used ○	Not Used ○
6c. Additional Road Information	Have Used ○	Not Used ○
6d. Detours & Closed Roads	Have Used ○	Not Used ○
6e. Winter Road Maintenance	Have Used ○	Not Used ○
6f. Weather/Pavement Conditions & Web Cams	Have Used ○	Not Used ○
6g. National Traffic & Road Closure Information	Have Used ○	Not Used ○
6h. National Weather Service	Have Used ○	Not Used ○
6i. Discover Idaho	Have Used ○	Not Used ○
6j. Press Releases	Have Used ○	Not Used ○
6k. Highway Data Quest	Have Used ○	Not Used ○

Previous Next

6. (Follow-up)

In questions 6a. to 6k., you indicated that you used the features listed below. See the sample web page for reference. Please rate the usefulness of each of those features. (Please make a selection for each feature.)

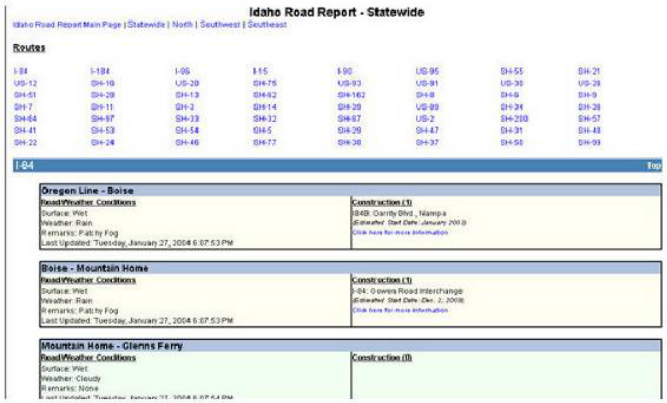


	Usefulness		
6a. Idaho Roads	Very Useful ○	Somewhat Useful ○	Not Very Useful ○
6b. Roads Around Idaho	Very Useful ○	Somewhat Useful ○	Not Very Useful ○
6c. Additional Road Information	Very Useful ○	Somewhat Useful ○	Not Very Useful ○
6d. Detours & Closed Roads	Very Useful ○	Somewhat Useful ○	Not Very Useful ○
6e. Winter Road Maintenance	Very Useful ○	Somewhat Useful ○	Not Very Useful ○
6f. Weather/Pavement Conditions & Web Cams	Very Useful ○	Somewhat Useful ○	Not Very Useful ○
6g. National Traffic & Road Closure Information	Very Useful ○	Somewhat Useful ○	Not Very Useful ○
6h. National Weather Service	Very Useful ○	Somewhat Useful ○	Not Very Useful ○
6i. Discover Idaho	Very Useful ○	Somewhat Useful ○	Not Very Useful ○
6j. Press Releases	Very Useful ○	Somewhat Useful ○	Not Very Useful ○
6k. Highway Data Quest	Very Useful ○	Somewhat Useful ○	Not Very Useful ○

Previous Next

6. (follow-up)

6.a.1. Please rate the usefulness of the features of "Idaho Roads".

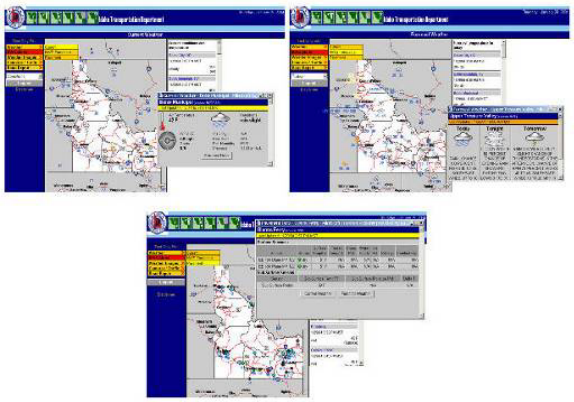


	Usefulness		
Idaho Road Report	Very Useful	Somewhat Useful	Not Very Useful
	○	○	○

Previous Next

6. (follow-up)

6.f.1 Please rate the usefulness of each of the features under "Weather/Pavement Conditions & Web Cam" (Please make a selection for each feature.)

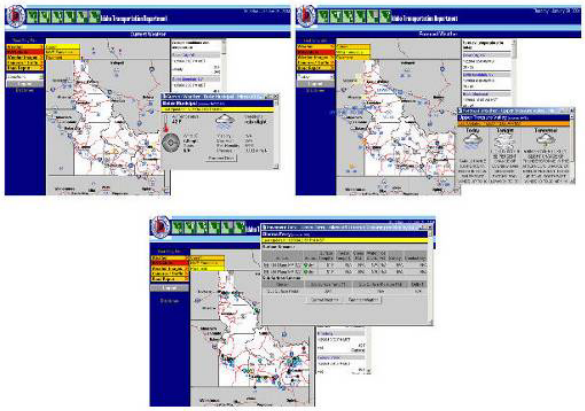


Feature	Usage	
	Have Used	Not Used
Weather - Current	○	○
Weather – Forecast	○	○
Weather - Pavement	○	○

Previous Next

6. (follow-up)

6.f.1 Please rate the usefulness of each of the features under "Weather/Pavement Conditions & Web Cam" (Please make a selection for each feature.)

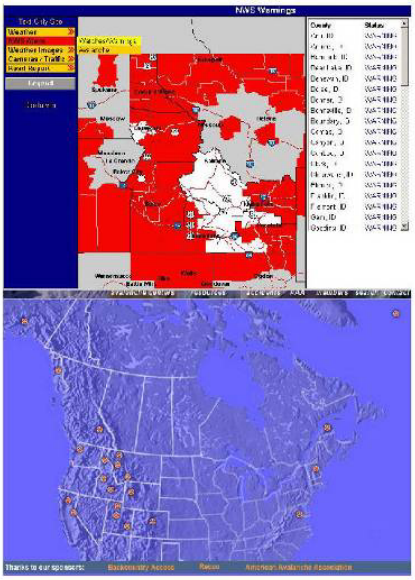


Feature	Usefulness		
	Very Useful	Somewhat Useful	Not Very Useful
Weather - Current	○	○	○
Weather – Forecast	○	○	○
Weather - Pavement	○	○	○

Previous Next

6. (follow-up)

6.f.2 Please rate the usefulness of each of the features under "Weather/Pavement Conditions & Web Cam" (Please make a selection for each feature.)

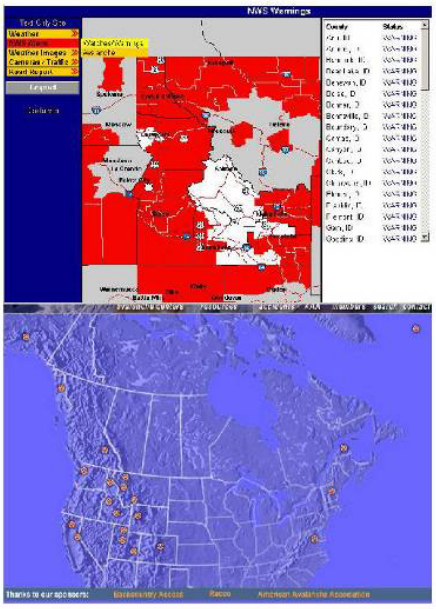


Feature	Usage	
	Have Used	Not Used
NWS Alerts – Watches/Warnings	○	○
NWS Alerts - Avalanche	○	○

Previous Next

6. (follow-up)

6.f.2 Please rate the usefulness of each of the features under "Weather/Pavement Conditions & Web Cam" (Please make a selection for each feature.)

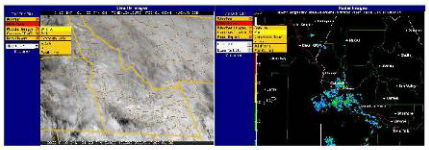


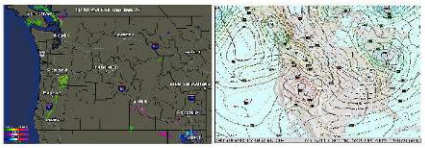
Feature	Usefulness		
	Very Useful	Somewhat Useful	Not Very Useful
NWS Alerts – Watches/Warnings	○	○	○
NWS Alerts - Avalanche	○	○	○

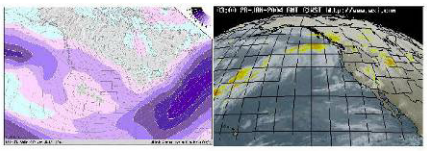
Previous Next

6. (follow-up)

6.f.3 Please rate the usefulness of each of the features under "Weather/Pavement Conditions & Web Cam" (Please make a selection for each feature.)





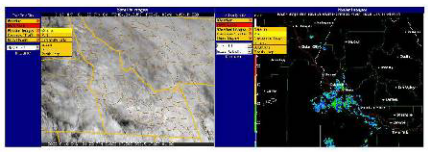


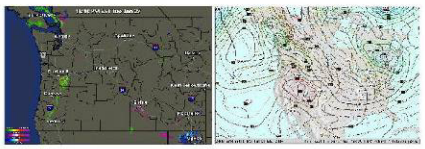
Feature	Usage	
	Have Used	Not Used
Weather Images – Satellite	○	○
Weather Images – Radar	○	○
Weather Images – Composite Radar	○	○
Weather Images – Isobars	○	○
Weather Images – Jetstream	○	○
Weather Images – Pacific Loop	○	○

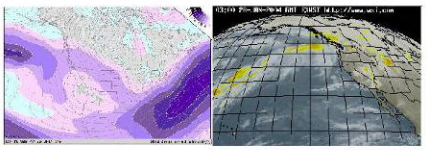
Previous Next

6. (follow-up)

6.f.3 Please rate the usefulness of each of the features under "Weather/Pavement Conditions & Web Cam" (Please make a selection for each feature.)







Feature	Usefulness		
	Very Useful	Somewhat Useful	Not Very Useful
Weather Images – Satellite	○	○	○
Weather Images – Radar	○	○	○
Weather Images – Composite Radar	○	○	○
Weather Images – Isobars	○	○	○
Weather Images – Jetstream	○	○	○
Weather Images – Pacific Loop	○	○	○

Previous Next

6. (follow-up)

6.f.4 Please rate the usefulness of each of the features under "Weather/Pavement Conditions & Web Cam" (Please make a selection for each feature.)

Feature	Usage	
	Have Used	Not Used
Cameras	○	○

Previous Next

6. (follow-up)

6.f.4 Please rate the usefulness of each of the features under "Weather/Pavement Conditions & Web Cam" (Please make a selection for each feature.)

Feature	Usefulness		
	Very Useful	Somewhat Useful	Not Very Useful
Cameras	○	○	○

Previous Next

6. (follow-up)

6.f.5 Please rate the usefulness of each of the features under "Weather/Pavement Conditions & Web Cam" (Please make a selection for each feature.)

Feature	Usage	
	Have Used	Not Used
Road Closures	◉	○

Previous Next

6. (follow-up)

6.f.5 Please rate the usefulness of each of the features under "Weather/Pavement Conditions & Web Cam" (Please make a selection for each feature.)

Feature	Usefulness		
	Very Useful	Somewhat Useful	Not Very Useful
Road Closures	○	○	○

Previous Next

7. Based on your experience using this site, please evaluate the site in terms of the following aspects. Indicate your level of agreement or disagreement with each of these statements:

Statements	Strongly Agree	Somewhat Agree	Neither Agree nor Disagree	Somewhat Disagree	Strongly Disagree
a. The site is well organized.	○	○	○	○	○
b. I find this site confusing and difficult to use.	○	○	○	○	○
c. In my experience, the information provided about current conditions is up to date.	○	○	○	○	○
d. In my experience, the information provided about the forecast conditions is accurate.	○	○	○	○	○
e. I have adjusted time of travel based on the information provided in this web site.	○	○	○	○	○
f. I have canceled my trip based on the information provided in this web site.	○	○	○	○	○
g. I have driven more safely based on the information provided in this web site.	○	○	○	○	○
h. This site helps me to be better prepared for road and weather conditions when I travel.	○	○	○	○	○
i. There is important information missing from this web site that should be provided.	○	○	○	○	○

Previous Next

8. What other travel information sources do you consult? (check all that apply)

- ☐ 1-888-IDA-ROAD - ITD Road Report telephone number
- ☐ Commercial Radio
- ☐ Weather radio (operated by NWS)
- ☐ TV
- ☐ Newspaper
- ☐ Other web sites

Please specify

- ☐ Other

Please specify

9. Please also indicate in your own words how this web site 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.

Previous Next

10. Please indicate the region in which you live.

- ○ Northern Idaho
- ○ Southwestern Idaho
- ○ Southeastern Idaho
- ○ Other states

Please specify

11. Please check your age category.

- ○ 16 years or younger
- ○ 17 to 24
- ○ 25 to 34
- ○ 35 to 44
- ○ 45 to 54
- ○ 55 to 64
- ○ 65 years or older

12. Please check your gender.

- ○ Female
- ○ Male

Previous Next

Thank you for your participation.

At this time, you may review your answers by clicking the "Review" button.

If, however, you are satisfied your responses best reflect your opinions and experience, simply click the "Submit" button. Please be aware that after you press the "Submit" button, you will no longer be able to view, modify, or add information (i.e. your survey will be closed).

Previous Review Submit

Appendix D.

Public Web Survey Results

Appendix D
Public Web Survey Results

1. How often do you use this web site?

	Frequency	Percent
This is my first visit (skip to Question #6)	47	35.1
I visit the site one to three times a month	41	30.6
I visit the site more than three times a month	46	34.3
Totals:[4]	134	100.0

2. How long have you been using this web site?

	Frequency	Percent
Less than 6 months	16	18.8
6 months to a year	9	10.6
More than a year	60	70.6
Totals:	85	100.0

3. How frequently do you use this web site in different seasons?
   a. Winter.

	Frequency	Percent
Never	0	0.0
Sometimes	4	4.8
Frequently	32	38.1
Always	48	57.1
Totals:	84	100.0

   b. Spring.

	Frequency	Percent
Never	7	8.6
Sometimes	36	44.4
Frequently	34	42.0
Always	4	4.9
Totals:	81	100.0

[4] Total responses for each question in the survey reflect only the number of individuals who actually answered the question. Since some respondents skipped one or more questions, the total number of responses for each question is typically somewhat less than 140.

c. Summer.

	Frequency	Percent
Never	25	30.9
Sometimes	39	48.1
Frequently	14	17.3
Always	3	3.7
Totals:	81	100.0

d. Fall.

	Frequency	Percent
Never	6	7.4
Sometimes	46	56.8
Frequently	25	30.9
Always	4	4.9
Totals:	81	100.0

4. How often do you use this web site for the following reasons? (Please check one response for each reason, a through k.)

a. To find out about road closures.

	Frequency	Percent
Never	2	2.5
Sometimes	20	25.3
Frequently	28	35.4
Always	29	36.7
Totals:	79	100.0

b. To find out about road construction.

	Frequency	Percent
Never	10	13.0
Sometimes	43	55.8
Frequently	14	18.2
Always	10	13.0
Totals:	77	100.0

c. To decide which highway to take.

	Frequency	Percent
Never	32	41.6
Sometimes	23	29.9
Frequently	14	18.2
Always	8	10.4
Totals:	77	100.0

d. To decide the timing of travel.

	Frequency	Percent
Never	29	38.2
Sometimes	19	25.0
Frequently	20	26.3
Always	8	10.5
Totals:	76	100.0

e. To decide whether to cancel my trip.

	Frequency	Percent
Never	20	26.3
Sometimes	21	27.6
Frequently	23	30.3
Always	12	15.8
Totals:	76	100.0

f. To be better prepared for driving conditions.

	Frequency	Percent
Never	2	2.6
Sometimes	11	14.1
Frequently	33	42.3
Always	32	41.0
Totals:	78	100.0

g. To check weather conditions for a specific route.

	Frequency	Percent
Never	2	2.6
Sometimes	5	6.6
Frequently	29	38.2
Always	40	52.6
Totals:	76	100.0

h. To find out about weather conditions in general.

	Frequency	Percent
Never	9	11.7
Sometimes	13	16.9
Frequently	33	42.9
Always	22	28.6
Totals:	77	100.0

i. To find out about road condition of a potentially hazardous location.

	Frequency	Percent
Never	8	10.4
Sometimes	17	22.1
Frequently	31	40.3
Always	21	27.3
Totals:	77	100.0

j. Other reason.

	Frequency	Percent
Never	5	41.7
Sometimes	0	0.0
Frequently	3	25.0
Always	4	33.3
Totals:	12	100.0

k. Other reason.

	Frequency	Percent
Never	5	62.5
Sometimes	0	0.0
Frequently	2	25.0
Always	1	12.5
Totals:	8	100.0

5. Indicate all the types of trips for which you have used this site for trip planning (check all that apply), and indicate the trip type for which you use this site most frequently (check only one).

	Have Used Frequency (percent)	Most Frequently Used Frequency (percent)
a. Commuting to or from school or work	17 (19.5)	23 (26.4)
b. Personal trips (shopping, pickup children, doctor appointments, etc.)	35 (40.2)	13 (14.9)
c. Recreational trips	40 (46.0)	39 (44.8)
d. Driving as part of your job or business (goods delivery, taxi, sales)	19 (21.8)	16 (18.4)
e. Commercial freight hauling (long distance)	8 (9.2)	11 (12.6)
f. Other trips. Specify _____	8 (9.2)	6 (6.9)

6. In questions 6a. to 6k., please indicate whether or not you have used the indicated feature available at this web site. See the sample web page for reference. (Please make a selection for each feature.)

	Usage	
	Have Used Frequency (percent)	Not Used Frequency (percent)
6a. Idaho Roads	96 (86.5)	15 (13.5)
6b. Roads Around Idaho	80 (72.1)	31 (27.9)
6c. Additional Road Information	63 (58.3)	45 (41.7)
6d. Detours & Closed Roads	77 (71.3)	31 (28.7)
6e. Winter Road Maintenance	84 (79.2)	22 (20.8)
6f. Weather/Pavement Conditions & Web Cams	89 (80.2)	22 (19.8)
6g. National Traffic & Road Closure Information	53 (50.0)	53 (50.0)
6h. National Weather Service	74 (67.3)	36 (32.7)
6i. Discover Idaho	34 (32.1)	72 (67.9)
6j. Press Releases	21 (19.8)	85 (80.2)
6k. Highway Data Quest	29 (27.1)	78 (72.9)

6. (Follow-up)

In questions 6a. to 6k., you indicated that you used the features listed below. See the sample web page for reference. Please rate the usefulness of each of those features. (Please make a selection for each feature.)

6a. Idaho Roads:

		Frequency	Percent
Very Useful		50	57.5
Somewhat Useful		28	32.2
Not Very Useful		9	10.3
	Totals:	87	100.0

6b. Roads Around Idaho:

		Frequency	Percent
Very Useful		43	59.7
Somewhat Useful		25	34.7
Not Very Useful		4	5.6
	Totals:	72	100.0

6c. Additional Road Information:

		Frequency	Percent
Very Useful		29	48.3
Somewhat Useful		25	41.7
Not Very Useful		6	10.0
	Totals:	60	100.0

6d. Detours and Closed Roads:

		Frequency	Percent
Very Useful		46	62.2
Somewhat Useful		25	33.8
Not Very Useful		3	4.1
	Totals:	74	100.0

6e. Winter Road Maintenance:

		Frequency	Percent
Very Useful		42	51.2
Somewhat Useful		36	43.9
Not Very Useful		4	4.9
	Totals:	82	100.0

6f. Weather/Pavement Conditions and Web Cams:

		Frequency	Percent
Very Useful		47	56.6
Somewhat Useful		23	27.7
Not Very Useful		13	15.7
	Totals:	83	100.0

6g. National Traffic and Road Closure Information:

		Frequency	Percent
Very Useful		24	48.0
Somewhat Useful		22	44.0
Not Very Useful		4	8.0
	Totals:	50	100.0

6h. National Weather Service:

		Frequency	Percent
Very Useful		44	63.8
Somewhat Useful		24	34.8
Not Very Useful		1	1.4
	Totals:	69	100.0

6i. Discover Idaho:

		Frequency	Percent
Very Useful		8	26.7
Somewhat Useful		19	63.3
Not Very Useful		3	10.0
	Totals:	30	100.0

6j. Press Releases:

		Frequency	Percent
Very Useful		2	9.1
Somewhat Useful		17	77.3
Not Very Useful		3	13.6
	Totals:	22	100.0

6k. Highway Data Quest:

		Frequency	Percent
Very Useful		5	17.9
Somewhat Useful		18	64.3
Not Very Useful		5	17.9
	Totals:	28	100.0

6.a.1. Please rate the usefulness of the features of "Idaho Roads".

a. Idaho Road Report:

	Frequency	Percent
Very Useful	48	57.1
Somewhat Useful	27	32.1
Not Very Useful	9	10.7
Totals:	84	99.9

6.f.1 Please rate the usefulness of each of the features under "Weather/Pavement Conditions & Web Cam" (Please make a selection for each feature.)

	Usage	
	Have Used Frequency (percent)	Not Used Frequency (percent)
Weather – Current	67 (87.0)	10 (13.0)
Weather – Forecast	65 (84.4)	12 (15.6)
Weather – Pavement	63 (81.8)	14 (18.2)

Weather – Current:

	Frequency	Percent
Very Useful	42	65.6
Somewhat Useful	15	23.4
Not Very Useful	7	10.9
Totals:	64	100.0

Weather – Forecast:

	Frequency	Percent
Very Useful	38	60.3
Somewhat Useful	18	28.6
Not Very Useful	7	11.1
Totals:	63	100.0

Weather – Pavement:

	Frequency	Percent
Very Useful	40	65.6
Somewhat Useful	13	21.3
Not Very Useful	8	13.1
Totals:	61	100.0

6.f.2 Please rate the usefulness of each of the features under "Weather/Pavement Conditions & Web Cam" (Please make a selection for each feature.)

	Usage	
	Have Used Frequency (percent)	**Not Used Frequency (percent)**
NWS Alerts – Watches/Warnings	42 (56.8)	32 (43.2)
NWS Alerts – Avalanche	21 (28.8)	52 (71.2)

NWS Alerts – Watches/Warnings:

		Frequency	**Percent**
Very Useful		24	57.1
Somewhat Useful		18	42.9
Not Very Useful		0	0.0
	Totals:	42	100.0

NWS Alerts – Avalanche:

		Frequency	**Percent**
Very Useful		9	42.9
Somewhat Useful		12	57.1
Not Very Useful		0	0.0
	Totals:	21	100.0

6.f.3 Please rate the usefulness of each of the features under "Weather/Pavement Conditions & Web Cam" (Please make a selection for each feature.)

	Usage	
	Have Used Frequency (percent)	**Not Used Frequency (percent)**
Weather Images – Satellite	43 (58.9)	30 (41.1)
Weather Images – Radar	45 (62.5)	27 (37.5)
Weather Images – Composite Radar	38 (53.5)	33 (46.5)
Weather Images – Isobars	21 (29.2)	51 (70.8)
Weather Images – Jetstream	32 (44.4)	40 (55.6)
Weather Images – Pacific Loop	31 (43.7)	40 (56.3)

Weather Images – Satellite:

		Frequency	**Percent**
Very Useful		27	65.9
Somewhat Useful		12	29.3
Not Very Useful		2	4.9
	Totals:	41	100.0

Weather Images – Radar:

	Frequency	Percent
Very Useful	29	64.4
Somewhat Useful	14	31.1
Not Very Useful	2	4.4
Totals:	45	100.0

Weather Images – Composite Radar:

	Frequency	Percent
Very Useful	23	60.5
Somewhat Useful	12	31.6
Not Very Useful	3	7.9
Totals:	38	100.0

Weather Images – Isobars:

	Frequency	Percent
Very Useful	15	68.2
Somewhat Useful	4	18.2
Not Very Useful	3	13.6
Totals:	22	100.0

Weather Images – Jetstream:

	Frequency	Percent
Very Useful	21	67.7
Somewhat Useful	7	22.6
Not Very Useful	3	9.7
Totals:	31	100.0

Weather Images – Pacific Loop:

	Frequency	Percent
Very Useful	22	66.7
Somewhat Useful	6	18.2
Not Very Useful	5	15.2
Totals:	33	100.0

6.f.4 Please rate the usefulness of each of the features under "Weather/Pavement Conditions & Web Cam" (Please make a selection for each feature.)

	Usage	
	Have Used Frequency (percent)	**Not Used Frequency (percent)**
Cameras	55 (78.6)	15 (21.4)

Cameras:

		Frequency	**Percent**
Very Useful		39	70.9
Somewhat Useful		10	18.2
Not Very Useful		6	10.9
	Totals:	55	100.0

6.f.5 Please rate the usefulness of each of the features under "Weather/Pavement Conditions & Web Cam" (Please make a selection for each feature.)

	Usage	
	Have Used Frequency (percent)	**Not Used Frequency (percent)**
Road Closures	54 (78.3)	15 (21.7)

Road Closures:

		Frequency	**Percent**
Very Useful		34	63.0
Somewhat Useful		13	24.1
Not Very Useful		7	13.0
	Totals:	54	100.0

7. Based on your experience using this site, please evaluate the site in terms of the following aspects. Indicate your level of agreement or disagreement with each of these statements:

a. The site is well organized:

	Frequency	Percent
Strongly Agree	33	41.3
Somewhat Agree	19	23.8
Neither Agree nor Disagree	16	20.0
Somewhat Disagree	10	12.5
Strongly Disagree	2	2.5
Totals:	80	100.0

b. I find this site confusing and difficult to use:

	Frequency	Percent
Strongly Agree	7	8.8
Somewhat Agree	16	20.0
Neither Agree nor Disagree	16	20.0
Somewhat Disagree	15	18.8
Strongly Disagree	26	32.5
Totals:	80	100.0

c. In my experience, the information provided about current conditions is up to date:

	Frequency	Percent
Strongly Agree	23	29.1
Somewhat Agree	23	29.1
Neither Agree nor Disagree	10	12.7
Somewhat Disagree	12	15.2
Strongly Disagree	11	13.9
Totals:	79	100.0

d. In my experience, the information provided about the forecast conditions is accurate:

	Frequency	Percent
Strongly Agree	19	23.8
Somewhat Agree	31	38.8
Neither Agree nor Disagree	23	28.8
Somewhat Disagree	6	7.5
Strongly Disagree	1	1.3
Totals:	80	100.0

e. I have adjusted time of travel based on the information provided in this wet site:

	Frequency	Percent
Strongly Agree	25	31.6
Somewhat Agree	25	31.6
Neither Agree nor Disagree	19	24.1
Somewhat Disagree	5	6.3
Strongly Disagree	5	6.3
Totals:	79	100.0

f. I have canceled my trip based on the information provided in this wet site:

	Frequency	Percent
Strongly Agree	26	32.5
Somewhat Agree	12	15.0
Neither Agree nor Disagree	25	31.3
Somewhat Disagree	4	5.0
Strongly Disagree	13	16.3
Totals:	80	100.0

g. I have driven more safely based on the information provided in this wet site:

	Frequency	Percent
Strongly Agree	34	42.5
Somewhat Agree	27	33.8
Neither Agree nor Disagree	13	16.3
Somewhat Disagree	2	2.5
Strongly Disagree	4	5.0
Totals:	80	100.0

h. This site helps me to be better prepared for road and weather conditions when I travel:

	Frequency	Percent
Strongly Agree	45	57.0
Somewhat Agree	18	22.8
Neither Agree nor Disagree	11	13.9
Somewhat Disagree	1	1.3
Strongly Disagree	4	5.1
Totals:	79	100.0

i There is important information missing from this web site that should be provided:

	Frequency	Percent
Strongly Agree	34	43.0
Somewhat Agree	12	15.2
Neither Agree nor Disagree	12	15.2
Somewhat Disagree	10	12.7
Strongly Disagree	11	13.9
Totals:	79	100.0

8. What other travel information sources do you consult? (check all that apply)

	Frequency	Percent
1-888-IDA-ROAD - ITD Road Report telephone number	37	
Commercial Radio	35	
Weather radio (operated by NWS)	20	
TV	45	
Newspaper	18	
Other web sites Please specify	30	
Other Please specify	1	
Totals:	186	

9. Please also indicate in your own words how this web site 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.

10. Please indicate the region in which you live.

	Frequency	Percent
Northern Idaho	7	8.9
Southwestern Idaho	30	38.0
Southeastern Idaho	31	39.2
Other states Please specify	11	13.9
Totals:	79	100.0

11. Please check your age category.

	Frequency	Percent
16 years or younger	1	1.2
17 to 24	5	6.2
25 to 34	9	11.1
35 to 44	18	22.2
45 to 54	25	30.9
55 to 64	18	22.2
65 years or older	5	6.2
Totals:	80	100.0

12. Please check your gender.

	Frequency	Percent
Female	31	38.8
Male	49	61.3
Totals:	80	100.0