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IMPLEMENTATION OF RWIS IN NEW HAMPSHIRE

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1. OVERVIEW

Winter driving conditions can be expected anytime from October through April in the state of New Hampshire. Many traffic accidents in the state usually occur during these situations. As part of a long range plan to address this problem, the New Hampshire Department of Transportation (NHDOT) began working with neighboring states to establish a Road Weather Information System (RWIS). As an initial effort, NHDOT established a prototype RWIS site on the Little Bay Bridge in Newington, NH in 1997 and developed plans for a network of additional sites to cover the state.

The deployment of RWIS is in support of the Tri-State Rural Advanced Traveler Information System (TRIO), a multi-state Intelligent Transportation Systems (ITS) project carried out jointly by the states of Maine, New Hampshire, and Vermont. Data provided by RWIS will support the following activities:

- Optimize allocation of NHDOT maintenance resources
- Optimize NHDOT construction and maintenance activities including snow maintenance
- Minimize chemical application for winter maintenance
- Identification of adverse weather conditions and issuance of traveler advisories
- Issuance of pavement forecasts for specific roadway segments
- Dissemination of meteorological data to government agencies and educational institutions

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NHDOT issued a request for proposal (RFP) for deployment of RWIS in early 2005. Surface Systems Incorporated (SSI), Saint Louis, MO, was selected by an evaluation committee composed of NHDOT maintenance engineers and information technologists, as well as representatives from the Judd Gregg Meteorology Institute (JGMI) at Plymouth State University (PSU) and the Federal Highway Administration (FHWA).

2. RWIS SPECIFICATIONS

Each RWIS site will contain Environmental Sensing Systems (ESS) sensors which will measure ambient air temperature, relative humidity/dew point, and visibility. An ultrasonic anemometer was selected for inclusion for enhanced reliability in cold weather situations and will be mounted on a heavy duty fold over aluminum 9.1 m (30 ft.) tower. Precipitation sensors will differentiate between rain, snow, and drizzle, and will measure actual precipitation rates as water equivalent and accumulation in in./hr. Figure 1 shows an example of an RWIS site. Additionally, traffic counters will be installed at some site to provide data on vehicle counts, traffic speeds, and vehicle lengths.

Sub surface temperature probes at each RWIS site will determine temperature approximately 47 cm below the roadway surface and can help to determine frost depth. Also, at least two pavement sensors will be installed in the roadbed adjacent to each RWIS location. Sensors will ascertain pavement temperature and provide roadway surface conditions. Specifically, each pavement sensor will report pavement as either dry, damp, wet, snow/ice covered, as well as whether or not an anti-icing chemical as been applied to the roadway surface.

Ozone sensors manufactured by the University of New Hampshire (UNH) will be deployed on all RWIS sites. The instrument is a low power, inexpensive instrument designed to measure atmospheric ozone from 0 to 200 ppbv based on

the established method of absorption of ultraviolet light at 253.7 nm (Troop 2004).

Figure 1. Example RWIS/ESS Site. Manfredi et al, (2005)

Each RWIS/ESS site will have a Remote Processing Unit (RPU) which will collect data from all ESS sensors. The RPU will feature an 8-slot card cage with ISA back plane and embedded Linux operating system. The RPU is capable of handling 20 differential and 11 single ended channels which will provide the ability to add additional sensors to each ESS site for future applications. All components (including sensors and RPUs) are designed to be compliant with the National Transportation Communications for ITS Protocol (NTCIP)

3. SITE SELECTION

RWIS/ESS site selection criteria were based on both environmental and logistical considerations. The majority of ESS sites were selected to be placed along the Interstate Ninety-Three corridor in order to provide road maintenance engineers and researchers with a uniformly spaced resolution in a North/South orientation throughout the state. Where feasible, locations were selected near existing NHDOT facilities in order to take advantage of existing infrastructure, thus minimizing both installation expenses and ongoing utility costs. In some cases, RWIS/ESS sites are located in order to provide weather observations which are representative of regional conditions. In other cases, sites were selected to provide observations at roadway locations which regularly experience storm related problems and which represent specific maintenance concerns for NHDOT maintenance engineers. Figure 2 shows the locations of 11 RWIS sites.

NHDOT project managers coordinated site selection tours by assembling a team with expertise in a variety of areas. Maintenance engineers from each NHDOT district were invited to participate in the site survey process in order to supply localized knowledge of micrometeorological effects in local areas, as well as to provide information on logistical considerations. New Hampshire Department of Environmental Services (NHDES) personnel provided information regarding wetlands areas adjacent to proposed ESS locations, while representatives from the New Hampshire Office of Information Technology (NHOIT) provided guidance related to communications issues. JGMI/PSU meteorologists provided advice regarding standards for instrumentation siting.

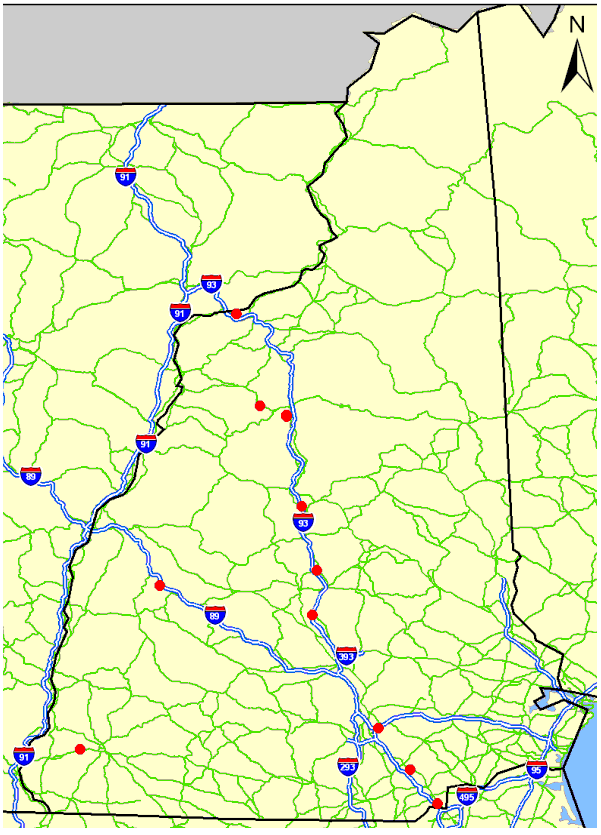

Figure 2. ESS Site Locations

4. COMMUNICATIONS/DATA FLOW

The goal of the communication system design is to provide reliable communications between RWIS RPUs and central servers at a minimum recurring cost. All RWIS sites will be polled at twenty minute intervals. A central server will be located at NHDOT headquarters at Concord, NH, and will allow simultaneous polling at all sites, along with the capacity for accommodation of future sites. In cases where RPU sites are situated adjacent to NHDOT facilities with existing broadband internet connections, NHDOT intranet will be utilized. Other sites will rely on dial-up modem connections. In these cases, RWIS RPUs will be equipped with either a cellular modem or connected to a surface based telephone line.

Hardware specifications for the central server include a 2.4 Ghz processor with 1024 Megabytes of memory, two 36 Gigabyte mirrored hard drives, gigabit Ethernet controller, and dual 350 Watt power supply. The server will also be configured to allow NHDOT engineers to access real-time data remotely over the internet by a password protected web site.

In order to provide additional redundancy for the overall system, enhance system security, and allow for timely transmission of observational data, JGMI will have an additional server located at NHDOT Headquarters. The server provided by SSI will be configured to deliver observations to a mounted samba file system on the secondary server. The secondary server will be configured with Unidata Local Data Manager (LDM) software to allow for transmission of real time data to other PSU servers, as well as to the Meteorological Assimilation Data Ingest System (MADIS) at the NOAA Forecast Systems Laboratory (FSL). Figure 3 illustrates the flow of data from RWIS RPUs to the user community

5. FUTURE DIRECTIONS

Over the next five years, additional RWIS sites are expected be deployed throughout New Hampshire which will provide an observation network allowing investigation into a number of meteorological research problems. Microclimatology will be studied in the White Mountains. Transportation meteorology courses at PSU will benefit. It is envisioned that data from TRIO sites will be incorporated into locally based pavement models and MDSS systems. As an example, cameras at most RWIS sites could provide still images of traffic and roadway surface conditions.

6. ACKNOWLEDGEMENTS

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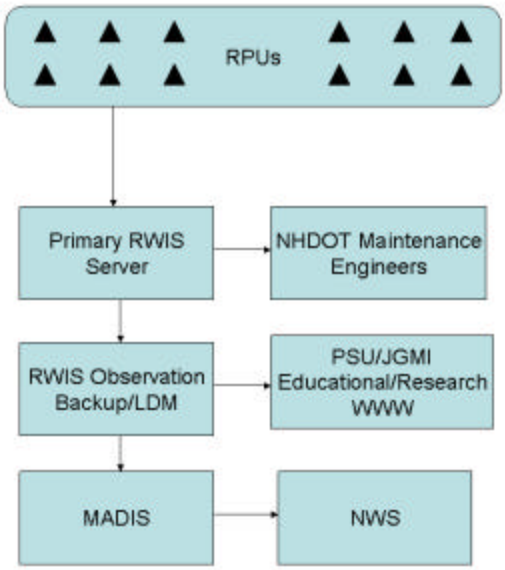

Figure 3: RWIS Data Flow

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