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## Intelligent Transportation Systems

### Dynamic traffic management promises more efficient evacuations



When disaster strikes, effective traffic management can mean the difference between life and death for people who need to evacuate. Assistant professor [Henry Liu](#) and graduate student Saif Jabari of the civil engineering department have developed a model of an adaptive traffic control system that could help public safety agencies more effectively route vehicles and deploy officers during evacuations. The research was sponsored by the [Minnesota Department of Transportation](#).

Unlike much of traditional evacuation planning practice, which focuses on modeling specific evacuation scenarios, Liu and Jabari's work aims to develop a mechanism to dynamically manage the transportation network during an evacuation using real-time data. Few previous studies have investigated real-time evacuation management, and existing real-time models are largely dependent on dynamic network modeling techniques that may not be able to capture the rapidly changing and uncertain traffic characteristics during mass evacuations.

Traffic flows during evacuations can change dramatically within a short time period, and panicked evacuees may travel without a planned destination and may select non-optimal routes in their haste to move away from danger. To deal with such a dynamic and uncertain situation, Liu and Jabari's approach relies on adaptive control theory, which focuses on adjusting control parameters in response to changes in the state of the underlying process. As the name implies, this ability to adapt quickly makes adaptive control systems powerful tools for dealing with unpredictable, dynamic situations.

After developing a theoretical framework for real-time adaptive traffic management, the researchers created a prescriptive "reference" model of evacuation traffic and a descriptive "real-world" model representing the traffic network under analysis. In operation, the real-world model receives data on the state of traffic in the field. By comparing the state of the real-world model to the ideal behavior of the reference model, the evacuation traffic management system can tune the traffic control system to produce better performance across the road network. The evacuation management system also includes a solution technique for determining where to deploy traffic control officers at critical locations.

[Responding to the Unexpected: Development of a Dynamic Data-Driven Model for Effective Evacuation](#) (MnDOT 2009-36) is available from the ITS Institute Web site.

## Transportation and the Environment

### Abandoned gravel pits offer benefits for wetland mitigation

Northeastern Minnesota still retains much of the wetland that existed before European settlement. That's good news for waterfowl and other species that depend on wetlands, but a challenge for transportation engineers tasked with replacing wetlands lost due to road construction because there are few non-wetland sites available in the area to add restored wetlands.

Researcher [Kurt Johnson](#) of the University of Minnesota's [Natural Resources Research Institute](#) (NRRI) hypothesized that the abandoned gravel pits that dot the region could serve as sites for wetland reclamation. The NRRI and [Minnesota Department of Transportation](#) (Mn/DOT) recently established a pair of one-hectare wetland creation sites to study the process. The research was sponsored by Mn/DOT and the [Minnesota Board of Water and Soil Resources](#).

The research was carried out alongside the reconstruction of U.S. Trunk Highway 53, a project that affected approximately 34 acres of wetland.



The affected area comprised several distinct types of wetland typical of northeastern Minnesota, including wet meadow, shrub swamp, wooded swamp, and bog areas. The research team used the two mitigation sites to reconstruct different types of wetlands. The task of creating new wetlands was made easier by the large amount of high-quality excess soil generated by the road reconstruction.

Treatment plots were established within each site to study the effects of different species, materials, and techniques. From July 2007 through September 2009, researchers monitored water levels during the growing season and recorded data on plant species and plant cover. To date, the study has demonstrated that abandoned gravel pits are good potential sites for creating wet meadow and shrub swamp wetlands—especially if the mitigation efforts are integrated with the road construction project. Unusual flooding during the study period hampered the researchers' effort to create wooded swamp and bog areas.

Results of the study are presented in [Wetland Mitigation in Abandoned Gravel Pits](#) (Mn/DOT 2010-11), available from the CTS Web site.

## Transit, Bicycling, and Walking

### Benefits of light-rail transit line shown in Minnesota research



The Hiawatha Light-Rail Transit (LRT) line serving Minneapolis and points south has increased access to employment for low-wage workers and raised property values in many adjacent areas, according to research by [Yingling Fan](#) and Ed Goetz of the University of Minnesota's [Hubert H. Humphrey Institute of Public Affairs](#). Synopses of their findings are available in two research briefs published by CTS.

The research was conducted under the auspices of the [Transitway Impacts Research Program](#), sponsored by a coalition of state, regional, and local governments and nonprofit organizations.

In her study of job access, Fan found that residents of areas near light rail stations could reach approximately 14,000 more low-wage jobs within 30 minutes of transit travel after construction of the Hiawatha line and related transit system improvements, and that areas with direct light-rail/bus connections could access roughly 4,000 more jobs.

Further, Fan found that the number of low-wage jobs located near station areas has also increased. She estimates that more than 5,000 such jobs have been brought into areas near downtown Minneapolis and suburban Bloomington stations. Low-wage workers are also choosing to locate near LRT stations to take advantage of the line's transportation benefits.

Goetz examined changes in property values beginning in 2004, the year the Hiawatha line opened. His research focused mainly on the areas around stations located in neighborhood areas with mixed land use types. These areas were compared with control areas located outside the immediate vicinity of the line.

He found that the average value of a single-family home in a station area has increase by more than \$5000 and the value of a multi-family home has increased by more than \$15,000. In total, the area around the LRT line has realized more than \$47 million in increased property values between the opening of the line in 2004 and 2007.

Some areas near the line have experienced negative effects on property values due to nuisances such as increased noise, Goetz found. Overall, however, these decreases have been more than offset by increases in property values for most residential properties.

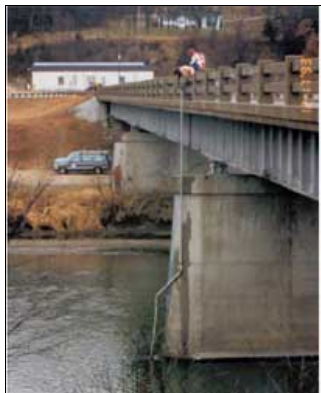
Goetz also found a significant amount of new housing construction near the Hiawatha line. He notes that the data available (through 2005) on land use does not show significant changes, but additional land use changes may occur in the future.

The Transitway Impacts Research Program (TIRP) was launched in 2006 and has grown to include a mix of funding partners and program supporters, including [Anoka County](#), the [Center for Transportation Studies](#), the [Center for Urban and Regional Affairs](#), the [City of Minneapolis](#), the [City of St. Paul](#), [Dakota County](#), the [Federal Transit Administration](#), [Hennepin County](#), the [Hubert H. Humphrey Institute of Public Affairs](#) [State and Local Policy Program](#), the [Itasca Group](#), the [Metropolitan Council](#), [Metro Transit](#), the [Minnesota Department of Transportation](#), [Ramsey County](#), the [University Metropolitan Consortium](#), and [Washington County](#).

[How Light-Rail Transit Improves Job Access for Low-Wage Workers](#) (CTS Research Brief 2010-02) and [The Hiawatha Line: Impacts on Land Use and Residential Housing Value](#) (CTS Research Brief 2009-02) are available from the [Transitway Impacts Research Program Web site](#).

## Transportation Infrastructure

### Research produces a framework for understanding bridge scour monitoring



There's a lot going on beneath the surface of a river—riverbeds can erode away or change their positions over time, causing damage to otherwise healthy bridges. Past research has suggested that scour and stream instability are responsible for up to 60% of bridge failures in the United States. Detecting and monitoring the erosion of riverbeds is a top priority of bridge maintenance engineers. [Jeff Marr](#), associate director of the University of Minnesota's [St. Anthony Falls Laboratory](#), has developed a new Scour Monitoring Decision Framework (SMDF) to help engineers select the best methods for monitoring scour at bridge sites. The research was supported by [Mn/DOT](#).

In developing the SMDF, Marr reviewed research literature on bridge scour monitoring from across the United States to identify significant issues affecting long-term scour monitoring. Among the issues Marr found were the maintenance requirements of monitoring equipment and the potential for equipment to be damaged by floating debris. He also studied the characteristics of bridges, streams, and scour incidents in Minnesota based on bridge plans and scour calculations.

Data on scour monitoring deployments were gathered from all installations in Minnesota as well as from many significant installations in other states. Scour monitoring data confirmed the data gathered from the literature review, and led to the identification of 24 critical attributes that were incorporated into the SMDF.

To use the SMDF, a user inputs data about a specific bridge site into a Microsoft Excel workbook. Applications software embedded in the workbook processes the site-specific data and returns a list of scour monitoring instruments suitable for use at the site and notes potential deployment issues. The SMDF can also show the importance of each characteristic for a given site, and illustrate how well a selected instrument is expected to satisfy the requirements of a specific characteristic.

The SMDF was tested by applying it to five demonstration sites in Minnesota that were identified as having a high likelihood of scour, ranging from a two-lane single-span bridge to an interstate bridge. Results from the SMDF analysis matched well with engineers' understanding of scour at the sites, and the framework was found to be successful at conveying site-specific issues to the user.

A final report on the project, [Bridge Scour Monitoring Technologies: Development of Evaluation and Selection Protocols for Application on River Bridges in Minnesota](#) (Mn/DOT 2010-14) is available from the CTS Web site.

## **Upcoming Events**

### **June 6-9**

[2010 TRB Environment and Energy Research Conference](#), Raleigh Convention Center, Raleigh, NC

### **June 8-10**

[2010 APWA Sustainability in Public Works Conference](#), Hilton 1001 Marquette Ave. South, Minneapolis, MN

### **June 15-16**

[Minnesota Highway Design Course: Horizontal Alignment Design](#), Mn/DOT Training and Conference Center, 1900 West County Road I, Shoreview, Minnesota

### **June 22-23**

[Minnesota Highway Design Course: Vertical Alignment Design](#), Mn/DOT Training and Conference Center, 1900 West County Road I, Shoreview, Minnesota

### **June 27-29**

[Annual Meeting of the Institute of Transportation Engineers Midwestern District](#), Minneapolis, MN

### **July 11-14**

[TRB Joint Summer Meeting: Planning and Performance Measurement for all Modes](#), Minneapolis, MN

### **July 22-23**

[4th International Symposium on Transportation Network Reliability](#), McNamara Alumni Center, University of Minnesota

### **August 20**

[TERRA Innovation Series event](#), Madison, WI