

# Real-Time Health Monitoring of Civil Works to Enhance Emergency Action



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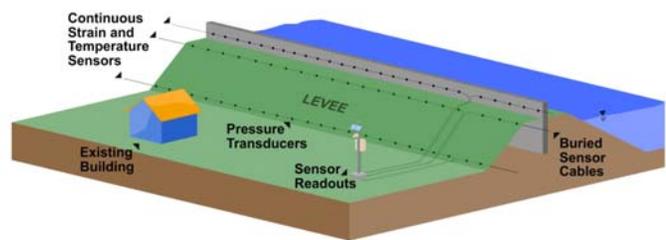
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Effective emergency action plans depend on early and accurate information about an impending failure. The earlier an impending failure can be identified, the more effective the emergency action response can be. One weak link in the information chain has been related to the condition of critical infrastructure such as levees, dams, and other water control facilities. Historically, little information was known to emergency response officials about the actual condition of a critical civil works facility until it was visibly severely distressed or failing.

Modern sensor technologies present a huge opportunity to improve the effectiveness of emergency response plans. The sooner reliable warning data can be obtained, the more effective the emergency response can be to reduce injuries and loss of life and property. Such data could indicate the likelihood of different levels of performance and the potential consequences of the performance which then provides inputs to the decision trees of the emergency action plan for the appropriate responses. Stated another way, warning data can indicate the level of risk for a particular facility based on the latest performance information. Emergency action plans would be structured to deal with the different types and levels of risk indicated by a sensor network.

Technological developments over the past ten years in sensors, data loggers, communications, power supplies and data management software now make it possible to provide cost-effective, real-time, remote monitoring systems on any critical component of our infrastructure. Sensors and data loggers have become more robust, reliable, and lower in cost. Communications have become more ubiquitous, lower in cost, and reliable. This includes low cost wireless systems to transmit data and the Internet to disperse information quickly. Solar panels and battery technologies provide power to run the remote equipment. Data management software running on servers connected via the Internet can maintain constant communication with remote sensor networks to monitor the status of a facility, identify measurements that show unacceptable performance and distribute messages and data for established event scenarios.

Today, Geocomp monitors dozens of facilities with thousands of sensors in real-time from its server facilities in Massachusetts. Our system knows within seconds whether a sensor has detected a measurement that is outside acceptable values. Systems like these create the opportunity to introduce solid facts on physical distress of structures into emergency action plans. The data management systems can also include immediate links to other information about the facility and its design that help emergency personnel assess an unexpected event and determine the appropriate response to that event.



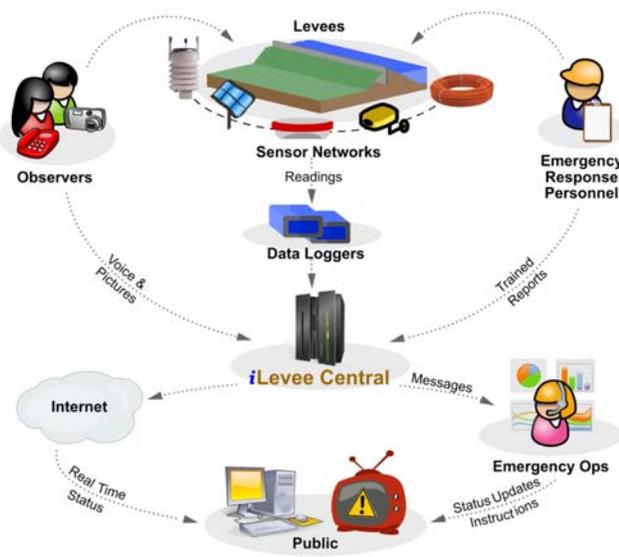
Conceptual Real-Time Monitoring System for Levees

Many facilities currently under construction include sensors to monitor performance of the facility during construction and initial operation. Other sensors provided by governmental agencies provide

information on weather, water levels, seismic activity and other geohazards. However this information is rarely integrated into an emergency action plan, and connectivity between the warning information that can be obtained and the emergency management and public safety communities that may need to act upon it is weak at best. For example, Geocomp has installed and monitored more than ten thousand sensors on projects involving bridges, dams, deep excavation, tunnels, and buildings. While these data are used on a daily basis to control the performance and safety of construction of and around facilities, to our knowledge the results have never been made a part of an emergency action plan, response and recovery protocols and procedures, public warning plans and messaging, and other critical activities necessary to protect public safety. Such sensors could be integrated into a long term operations plan for these new facilities as well as their surrounding communities, and data from the sensors used to indicate emerging problems that might trigger an emergency situation, thus initiating appropriate response activities. Furthermore, while new facilities under construction may incorporate a variety of sensors, many decades worth of construction projects built by the U.S. Army Corps of Engineers and others were not, and few, if any, efforts to retrofit these facilities with instrumentation have been pursued. This represents a significant gap in the flood protection network, and means that ongoing monitoring (and integration of monitoring data into preparedness, response and recovery networks in stakeholder states and nearby communities) is impossible for many of the oldest and most at-risk facilities in our nation.

Ideally sensor networks used for emergency action plans would be coordinated and integrated with the operational and maintenance plans for the facility. The people responsible for the facility would know most about potential failure modes and what to monitor to detect those modes. Sensor networks require maintenance that should be incorporated into the facility’s operational and maintenance plan.

To address these issues, Geocomp is partnering with James Lee Witt Associates (JLWA), one of the nation’s premier emergency preparedness, response, recovery and mitigation firms, to provide a comprehensive solution to the governmental and non-governmental owners of water control facilities and infrastructure. Through this partnership, Geocomp will provide its customers with the cost-effective sensor instrumentation and real-time health monitoring systems for critical infrastructure (both newly constructed and existing). JLWA will draw upon its vast experience and knowledge of emergency management best practices to develop linkages between the monitoring results and the emergency management and public safety communities,



Information Exchange for Emergency Management Systems with Real-Time Monitoring

supporting both facility owners and the communities in which they operate with knowledge for the development of related crisis communications strategies, operations plans, training and exercises, response and recovery protocols, and other critical support systems.



Real-Time Monitoring System  
on USACE Kentucky Lock

Furthermore, the Geocomp and JLWA team will offer full-time, real-time monitoring support for the data collected from the installed sensors, utilizing the power of modern communications systems and computer analytics to immediately identify a variation in instrumentation data, determine its importance and how that effects the infrastructure's risk profile, and initiate warning to both facility owner and potentially-impacted communities so that appropriate response actions can be initiated quickly. Examples of specific services offered by the Witt-Geocomp team include the

following:

- Planning support (operations plans; evacuation plans; mitigation plans; continuity of government / business continuity plans; logistics system assessments; crisis communications plans; other);
- Risk assessment development and evaluation;
- Design of real time monitoring systems for high risk facilities and conditions;
- Installation of real time monitoring systems on new and existing facilities;
- Provide and operate robust server system with links to monitoring systems so 24-7-365 data are available via Internet;
- Provide algorithms to determine when an instrument indicates a warning condition so that false alarms are minimized;
- Provide instant messaging for warning and alert messages when an instrument exceeds its established alert level;
- Response tool-kits (pre-scripted communications products and warning messages; call-down lists; public official guidance documents; etc.);
- Warning system evaluation, protocol development and deployment;
- Evaluation and recommendation of appropriate warning system technologies, if needed, based on risk management;
- Training development and delivery;
- Exercise development and delivery (tabletop, full-scale);
- Public coordination and communication (strategy development, outreach to first responders, outreach to elected officials, planning and facilitation of public meetings, etc.);
- Response system gap analysis to identify opportunities to strengthen capabilities to be better prepared in the event of infrastructure failure; and
- Provide maintenance guidelines and system audits

As stated previously, the earlier an impending failure can be identified, the more effective the emergency action plan can be. Real Time Health Monitoring provides a proactive and comprehensive solution to improve the effectiveness of emergency response plans.

For more information on this Real Time Monitoring program, please contact:

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**Geocomp Corporation** specializes in active risk management for infrastructure projects with a special focus on underground engineering, and real time web-based monitoring of structures during construction and operation. Since 1982, Geocomp has helped clients understand the potential hazards below the ground surface and identify ways to reduce cost and potential damage to property, while increasing safety for the workers and the general public. Geocomp is headquartered in Boston with offices in New York, Atlanta, Pittsburg, and Los Angeles.

Founded in 2001, **James Lee Witt Associates** is a leading crisis and emergency management support and consulting firm based in Washington, DC with offices in Atlanta, Chicago, Little Rock, Trenton and Sacramento. James Lee Witt has more than thirty years of experience in emergency management, including eight years as the Director of the Federal Emergency Management Agency (FEMA), a Cabinet position in the Clinton Administration, and JLWA builds on his unparalleled experience to deliver quality results for its clients. The JLWA team includes over 70 full-time staff and several hundred internationally-renowned subject matter experts in crisis management to assist businesses and governments in preparing for, responding to, recovering from, and mitigating against all types of crises. On March 10, 2006 James Lee Witt Associates joined with GlobalOptions Group, Inc., increasing the firm's capacity by providing additional risk management and security services.