July–September 2015

Technology NEWS

Providing transportation technology transfer for Iowa's cities and counties

Iowa LTAP
Local Technical Assistance Program

Inside this issue

Iowa Local Technical Assistance Program

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IOWA STATE UNIVERSITY
Institute for Transportation

What is LiDAR? Can it work for you?

Often technologies that promise to save us time or give us more and more accurate data don't always live up those promises. Although LiDAR may never replace traditional ground-based surveying, it does have its advantages in many potential public works applications. Some examples include hydraulic modeling for floodplain mapping, earthwork calculations for preliminary route planning, and line-of-sight distance analysis.

Alice Welch, a transportation engineer specialist in the Office of Design at the Iowa DOT, provides a bit of an overview about LiDAR and its capabilities.

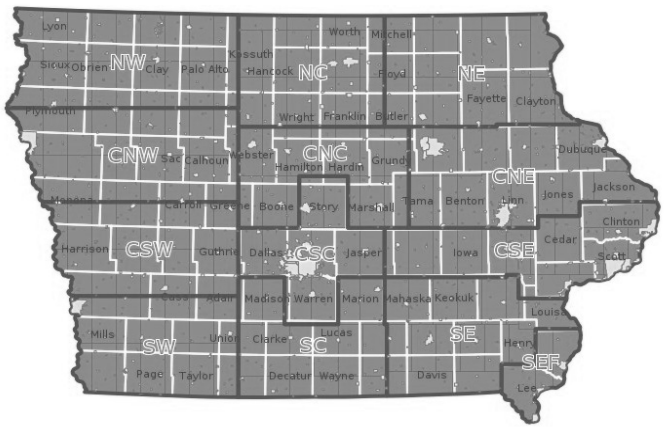
What is LiDAR?

LiDAR (Light Detection and Ranging) is a remote sensing technology that uses a sensor to emit laser pulses that hit objects that then reflect back to the sensor at the speed of light. The time interval between the transmitted pulse and the detection of the reflected signal is used to determine the range, or distance, to the surface of objects. Position and orientation data derived from the Global Positioning System (GPS) and inertial measurement units (IMU) at the sensor is combined with range data to generate horizontal and vertical positions for each reflected signal. Scanning objects with rapid laser pulses result in a precise, three-dimensional point cloud that defines the shape and surface characteristics of objects. The point clouds are used to generate geospatial products, such as digital elevation models, tree canopy models, building and structure models, and contours that can be used in standard design programs.

LiDAR point clouds are provided in a LiDAR data exchange file or "LAS" format. In this format, each point can be assigned a classification code that defines the type of surface that reflected the laser pulse. Classifications can be bare ground, building, vegetation, and water. Classification of the points allow users to filter the data to access only the points relevant to their application.

LiDAR has the feature of providing multiple returns for a laser pulse. The laser beam is reflected by the first object it strikes, but the beam will split and part of the beam can continue on to hit additional objects in its path and thus reflect up to five returns per pulse. The reflected light from each return can be captured, the last return being ground. This feature makes it possible for LiDAR to penetrate tree canopy.

LiDAR continued on page 3



Iowa LiDAR Mapping Project, available at www.geotree.uni.edu/lidar/

Acronyms and Abbreviations in *Technology News*

AASHTO	American Association of State Highway and Transportation Officials
APWA	American Public Works Association
FHWA	Federal Highway Administration
IHRB	Iowa Highway Research Board
InTrans	Institute for Transportation (at ISU)
Iowa DOT	Iowa Department of Transportation
ISU	Iowa State University
LTAP	Local Technical Assistance Program
MUTCD	Manual on Uniform Traffic Control Devices
NACE	National Association of County Engineers
TRB	Transportation Research Board

U.S. Department of Transportation
Federal Highway Administration

IOWA DOT

About LTAP

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Printed with soy ink

From the director:
Be "ever vigilant"

I decided to write a different type of column this quarter.

I recently visited Santa Fe, New Mexico, in August. It is one of my favorite places. The high desert in August experiences a "little bit" of heat, but storms can appear quickly over the mountains. The beauty is incredible and often distracting. The changing colors and shadows as the sun moves. But, there is also a danger out there that can't be ignored. The need for water and certain types of "not so nice" wildlife come to mind. Being who I am, however, as I walked around, all this led me to think about safety.

Whether in the field, shop, or the office, there is a need for that constant vigilance and making safety foremost in everything that happens. And that also led to me to think about the safety courses Iowa LTAP is offering this fall. We have our local road safety series, bridge inspection (both refresher and the two week in 2016), OSHA, MUTCD signing, and excavation safety. We also continue to do our work zone and flagger trainings, and we can assist with safety assessments and audits. The National Rural Safety Center connection with InTrans also has us bringing in a NHI instructor to do four hours on local roadside safety down in St. Joseph, Missouri, after the MINK Conference.

When I was in New Mexico, I also went up to Los Alamos. A place that transformed from a boys school ("that dry air will do you good") to the Manhattan Project in what sounded like just a few months. That distinction, once again, between the beauty of the landscape and the harsh reality of the job that was being done there. Of course, I found myself thinking about how they accommodated all the public works needs of the people coming up to this remote area and working/playing. One can't help but note the road into town that hugs the canyon wall.

All of us are constantly building, adjusting, and improving in an attempt to serve the public better. At Iowa LTAP, we are always looking for suggestions about a more efficient and effective process or approach to serve local transportation agencies better. We have gained new capabilities as people have walked through our door. What that means will continue to evolve and change. In addition, by the time this newsletter goes to print I hope we have our Multi-Disciplinary Safety Team (MDST) statewide coordinator or facilitator in place. In addition, we are also attempting to set up a process to loan out our retroreflectometer. We'll let you know when these are in place.

Also, as ever, if there is something you need, please ask. We'll see what we can do.

Remain "ever vigilant."■

Keith

LiDAR continued from page 1

Differences between airborne and terrestrial LiDAR

Airborne LiDAR systems consist of a laser source and detector, a scanning mechanism and controller, GPS and IMU equipment, as well as computers and data recorders. The aircraft altitude and pulse rate during a LiDAR mission determines the point density and therefore the accuracy of the point cloud. Airborne LiDAR in helicopters and fixed wing aircraft perform well for large project areas where a bare earth surface is desired.

A recent development in airborne LiDAR systems is the introduction of LiDAR in unmanned aerial vehicles (UAV). The size and weight of the equipment mounted on a UAV is one of the challenges for implementing LiDAR on a UAV platform. A UAV can fly much closer to the ground than a traditional aircraft, which improves the accuracy, but covers a smaller area.

Terrestrial LIDAR uses instruments mounted on a tripod. Because the sensor is on the ground and closer to the intended target, the measurements have a different perspective and a higher accuracy than airborne applications. Terrestrial scanning can be used to create 3D models of complex objects such as piping networks, archeological sites, buildings, bridges, etc.

Mobile terrestrial LiDAR uses laser scanning equipment mounted on a vehicle in combination with GPS and IMU to safely collect a highly accurate point cloud along a transportation route (i.e., highway, rail, or water) in a short period of time.

LiDAR resources in Iowa

Statewide airborne LiDAR data collection initiated by the Iowa Department of Natural Resources began in 2006 and continued until 2010. Details about this project are available at www.iowadnr.gov/Environment/GeologyMapping/MappingGIS/LiDAR.aspx.

The statewide dataset is available at www.geotree.uni.edu/lidar/.

Advantages of LiDAR

- Ability to penetrate forest canopy and map the ground beneath trees
- Objects can be measured remotely, making operations such as data collection on roadways under traffic much safer
- Equipment can operate with cloud cover and any sun angle (even at night), which means more hours of operation and greater efficiency with faster results (while minimizing disruption to traffic)
- Data can be captured in a short amount of field time and extracted from the point cloud in the office, which provides designers first hand access to a dense point cloud of the project site and the ability to extract any measurements needed

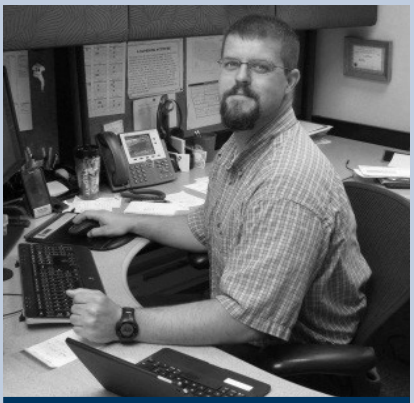
Disadvantages of LiDAR

- Accuracy on steep slopes and in dense vegetation may not be sufficient for engineering and design applications
- Difficult to map plan features with high accuracy
- Systems produce large amounts of data, requiring additional storage and processing power

Iowa agencies currently using LiDAR

The Iowa Department of Natural Resources and the Iowa Natural Resources Conservation Service originally partnered in the collection of the statewide LiDAR data and still actively use it. Cities, counties, engineering firms, and utility companies across Iowa all have the potential to use LiDAR.■

Meet Paul LaFleur, FHWA engineer



Paul LaFleur, FHWA engineer

I joined the Iowa Division of the FHWA in April as their safety engineer, taking over for Jerry Roche. I also have transportation engineer duties for District 5. This isn't my first time in Ames though. I graduated from Iowa State University in 2000 and then went off to Chicago, Illinois, to work for the Illinois DOT. I spent five years with them before leaving to work for a private consultant in the Chicago area for 1.5 years. Then I settled in at the Kane County DOT as their Assistant Chief of Design. Kane County is located on the edge of the Chicago suburbs. Half the county is suburban while the other half is rural farmland. I spent eight years there doing preliminary and final engineering and some construction engineering.

Originally I am from Carrollton, Texas, a suburb of Dallas. I was born and raised in Texas and left for only one year to live in Singapore when I was 13 years old. As I said before, I came to ISU for college and then spent the last 15 years in Illinois. I spent eight years in the Naval Reserve, enlisted both with the Seabees and as an officer in the Civil Engineer Corps. I am married to a fellow ISU graduate, a teacher, and together we have 10 year old boy/girl twins who will soon be entering the sixth grade. I like to be active in the community, you will often see me at community events, and, in the past, I have served on a county board commission, a park district board of commissioners, and in the parent-teacher association. In the spare time I am able to carve out, I enjoy running, biking, and camping with my family.■

Iowa LTAP Mission

To foster a safe, efficient, and environmentally sound transportation system by improving skills and knowledge of local transportation providers through training, technical assistance, and technology transfer, thus improving the quality of life for Iowans.

Hamilton County adapts cell phones as cost-efficient AVL system

When the Federal Communications Commission required land-mobile radio users to change to a "narrowband" format by the start of 2013, many public agencies had to reexamine their communication systems.

About Hamilton County

In Hamilton County, Iowa, the Secondary Roads Department was one local agency that either had to invest in pricey new radios or change to something new.

The county opted for "something new"—a cellular phone system, which has served the county well, according to Dan Waid, Hamilton County engineer.

How did they do it?

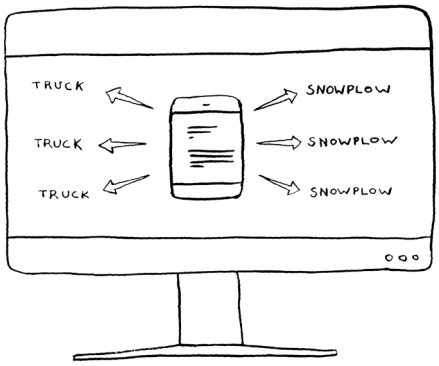
The county uses cell phones and a mobile resource management software package for communication, vehicle location, and data transmission among its vehicle operators and maintenance shop staff. The cell phones are a cost-efficient alternative to standard GPS automatic vehicle location (AVL) systems.

"It is primarily a communication system that we can also use for AVL," says Waid. "We wanted a communication system as good as or better than our radios. That's when we started looking at cell phones."

Waid compared several systems, but because the Secondary Roads Department needed to communicate to and from the field and because it has more vehicles than staff, cell phones made sense. "Most GPS systems have a sensor in each vehicle, and there would have been an added expense to have sensors in vehicles not in use."

Benefits

The cell phone system, which uses Field Force Manager software, tracks the real-time location of equipment operators and other Secondary Roads Department staff and can transmit data, such as fuel usage or safety and maintenance information. In addition, workers use the phones to check in and check out of their work shifts. The phones also make it easy to send group messages out to workers in text or voice.



Mock illustration of cellular phone AVL system

Waid is pleased with the AVL system. County staff can view on a computer monitor the location of all the crews out in the county, which is handy when the need arises to see what crew can most easily be diverted to a different locale. In the winter, county staff can see where snowplows have been to ensure no unplowed gaps exist between routes.

"It's a way to be more efficient and productive with our time," says Waid.

Although each vehicle does not have a device to transmit data automatically, operators only have to key in a minimal amount of information to transmit, for example, fuel usage data back to the maintenance shop.

Cell phones provide another benefit that Waid said he did not think they would use—the cameras. "We can take and send photos out to the field or back to the office, and that has saved us some trips."

For more information

For additional questions regarding how cell phones have been successfully used as an alternative to the standard GPS AVL system in Hamilton County, contact Dan Waid at dwaid@hamiltoncounty.org.■

The important role of personal protective equipment to a safety program

By Kim Karr, WV LTAP

Public works employees are faced with hazardous situations every day, including working around or operating heavy equipment, dealing with motorists, working with dangerous products, and exposure to environmental issues (such as excessive heat or cold, poisonous plants, ticks, etc.) The number of potential hazards that road crews and other public works employees face is extensive, which is why it is important to have an understanding of common safety practices, foster a culture of safety, and have procedures for safe operations in place. The most important thing to remember in terms of safety is to use common sense and have the right attitude. If these two things are present, the rest will fall into place much easier.

Personal protective equipment (PPE)

A basic foundation of any safety program is a focus on personal protective equipment (PPE). This includes items such as safety vests, gloves, hard hats, steel toe work boots, eye protection, ear protection, dust masks, chaps, and so forth. From a management standpoint, it is essential that each employee is provided with training on who is required to wear PPE and when and why they are required to wear it.

Common PPE and barriers

Most workers appreciate the value of safety, but they often don't like the inconvenience of wearing PPE, or they don't think an accident will happen to them. Hearing protection is an item that some employees balk at. As a supervisor or manager, you may hear statements such as, "If I wear it, I can't hear other workers." "I'm used to the noise." "Protectors are uncomfortable." "I've already lost some of my hearing." Explain that the reality of not wearing hearing protection can lead to hearing loss—even complete hearing loss.

In some instances, workers may be required to wear hard hats. This is another PPE that workers sometimes balk about wearing. "It makes it hard to see." "It's not really going to help save my life if something falls on my head." As a manager, facts are important here. Educate your employees about how hard hats resist and deflect blows to the head, how they act as shock absorbers, and that they shield the employee's scalp, face, neck, and shoulders against splashes, spills, and drips. Also, remember as a general rule, hard hats should be replaced every two years if worn every day. Additionally, if the hard hat has had direct impact, such as by falling debris, it needs to be replaced immediately.

Reflective vests and uniforms are another great PPE, but again, some employees are resistant to wearing these items. "They're not comfortable." "The lime green color attracts bugs." "They're too hot." All of these statements may be true, but the benefits of wearing this PPE outweigh the potential risks and discomfort. Explain that by wearing this PPE, motorists and fellow workers have a better chance of seeing the

PPE continued on page 7

Iowa LTAP Workshops/Training

The following are workshops and training offered through the Iowa LTAP. Watch for these sessions in your area on the online calendar at http://www.iowaltap.iastate.edu/. For more information contact the Safety Circuit Rider, David Veneziano, at dvenez@iastate.edu or 515-294-8103.

Iowa Local Road Safety Workshops

This series of annual workshops provides the most current information and advice for improving safety on local agencies' roads and streets in terms of planning, law enforcement, education, and engineering. The workshops provide participants, which include planning agencies, law enforcement, engineering, consulting, and other disciplines from all levels of government, with an opportunity to meet, learn, interact, and share experiences, opinions, and suggestions for strengthening and expanding the overall safety program for local roads and streets in Iowa. One of the results of the workshops is the identification and addressing of safety concerns in a multi-disciplinary manner.

Work Zone Safety Workshop

This workshop provides training to local agencies, utilities, and contractors in the basic design, installation, and maintenance of temporary traffic control for construction and maintenance activities on streets and roads in Iowa. The major references used include Part 6 of the MUTCD and Iowa Department of Transportation specifications and road standards. The information presented is intended to keep attendees current with requirements and recommendations for safe temporary traffic control.

Work Zone Safety and Flagger Training

This workshop presents basic flagging principles and work zone safety. It is intended for county and city staff that perform flagging on the job or supervise flaggers. The workshop teaches the basic principles of flagging, its common applications, and demonstrates recommended flagging techniques. The workshop also covers materials from the MUTCD Part 6 on work zones, including principles, elements, traffic control devices, and pedestrian and worker safety. The workshops are presented on site at the request of an agency, and it meets the minimum requirements of Iowa Department of Transportation specifications.

Erosion control tips for road and bridge work

By Pat Weaver, Executive Director, Kansas University Transportation Center

Certain road and bridge construction and maintenance projects require plans for erosion and storm water control to be prepared by an engineer or erosion control specialist, according to federal and state regulations. However, there are some basic principles to keep in mind, even for those projects that don't require a specific plan or permit. This article will highlight erosion control methods typically recommended for use on low-volume roads, culverts, and bridges and work on shallow slopes (less than 10 ft). We'll also provide resources for more detailed information.

The basics of erosion control

The purpose of erosion control is to prevent the loss of surface soil through proactive measures. This is a more effective approach than sediment control that attempts to capture the soil once it has washed away. The three most common types of erosion are surface, rill, and gully. Surface erosion occurs when soil on the surface is dislodged during rainfall and the water and soil flow down a slope. Rill erosion occurs when small, narrow channels form on slopes not protected from erosion, and gully erosion is simply rill erosion that combines and erodes into a gully (Fay, Atkin, and Shi 2012).

Without surface slope protection, slope failure occurs due to erosion, creating the potential for both maintenance and safety issues. Factors such as removing vegetation, topsoil, or other organic matter without re-covering it; reshaping the land; and allowing gullies to continue to grow are all contributors to erosion. The goal of surface slope protection is to minimize erosion caused by disturbed sites and to limit sediment washed away from these sites. In general, the flatter the slope the less erosion will occur; sites with steep slopes near waterways need more controls than flat sites farther away.

General approach to erosion control

In general, preserving existing vegetation and minimizing the amount of land disturbed at one time will go a long way toward reducing the impact of any roadway project. Your objective should be to keep the soil at its original location if at all possible and, if not, to keep the soil close to its original location and onsite. For disturbed soil or mulch, seed bare soil immediately for the best and cheapest erosion protection (*KDOT Temporary Erosion-Control Manual* 2007, *Kentucky Erosion Prevention and Sediment Control Field Guide*).

Tips for reducing or eliminating erosion

Skorseth and Selim (2000) in their *Gravel Roads Maintenance and Design Manual*, provide some good basic tips for reducing or eliminating erosion. Here are a few of those common-sense recommendations:

- Some regions have certain times in the year when frequent and heavy rainfall can be expected. Try to avoid major reshape work during those periods of time.
- Keep disturbed areas small. The more earth you disturb, the greater the risk of soil erosion.
- Set work boundaries and don't let work crews get outside of them.
- Consider stabilization of disturbed areas. Silt fences, mulching, erosion control blankets, and other means should be considered.
- Removing vegetative cover and topsoil generally increases the amount and speed of runoff. Keep water velocity low by keeping slopes as shallow or gentle as possible. Divert upland runoff around exposed soil. Shorten drainage runs and work to get vegetative cover reestablished as soon as possible after work is finished.
- Keep sediment within work boundaries. Sediment can be retained by filtering water as it flows (as through a silt fence), and ditch checks will retain dirty runoff water for a period of time until the soil particles settle out.
- Protect slopes and channels from gullying. Inspect recent work. This is vital to make sure channels haven't formed in ditch bottoms or on slopes, or around and under controls that were used. Be particularly vigilant after heavy rains.

Conclusion

The purpose of erosion control is not to delay construction projects, but to conduct them in such a way as to minimize the impact on waterways. Federal laws and regulations require land disturbance activities (construction) to control erosion and sediment. Federal and state regulations require a construction storm water permit for land disturbance activities when the disturbed area is one acre or greater, and for maintenance five acres or greater. Construction projects near waters of the US of less than one acre of disturbed area require a Project Water Pollution Prevention Plan. There are a number of resources available to you to learn more about erosion control techniques and associated regulations. Regardless of the regulatory requirements for your specific project, the tips laid out in this article will help minimize the impacts of your projects.

The following short list includes additional resources on erosion control that you may find helpful.

Reprinted with permission from the Spring 2015 issue of the *Kansas LTAP Newsletter*, a publication of the Kansas Local Technical Assistance Program (LTAP) at the Kansas University Transportation Center

Cited resources

Fay, L., Akin, M., and Shi, X. 2012. ***Cost-Effective and Sustainable Road Slope Stabilization and Erosion Control***, NCHRP Synthesis 430, Washington, D. C. Available at onlinepubs.trb.org/onlinepubs/nchrp/nchrp_syn_430.pdf.

KDOT Temporary Erosion-Control Manual. Available at www.ksdot.org/Assets/wwwksdotorg/bureaus/burConsMain/Connections/ecm.pdf.

Kentucky Erosion Prevention and Sediment Control Field Guide. Available at water.epa.gov/polwaste/npdes/stormwater/upload/esc_guide.pdf.

Skorseth, K. and A. A. Selim. 2000. ***Gravel Roads Maintenance and Design Manual***, South Dakota Local Transportation Assistance Program. Available at water.epa.gov/polwaste/nps/upload/2003_07_24_NPS_gavelroads_gravelroads.pdf.

Erosion continued on page 7

Conference calendar

Date	Event Name	Location	Contact
October 2015			
8	Local Road Safety Workshop	Cherokee	David Veneziano
9	Local Road Safety Workshop	Red Oak	David Veneziano
14	Local Road Safety Workshop	Ottumwa	David Veneziano
15	Local Road Safety Workshop	Cedar Rapids	David Veneziano
16	Local Road Safety Workshop	Waverly	David Veneziano
20-22	NHI–Bridge Inspection Refresher Training	Ames	Devin Happe
22	Local Road Safety Workshop	Ames	David Veneziano
26	Excavation Safety	Ames	Paul Albritton
27	Excavation Safety	Ames	Paul Albritton
28	Excavation Safety	Ames	Paul Albritton
December 2015			
8-10	ICEA Annual Conference	Ames	Keith Knapp
February 2016			
23-25	NHI–Bridge Inspection Refresher Training	Ames	Devin Happe

Contact information

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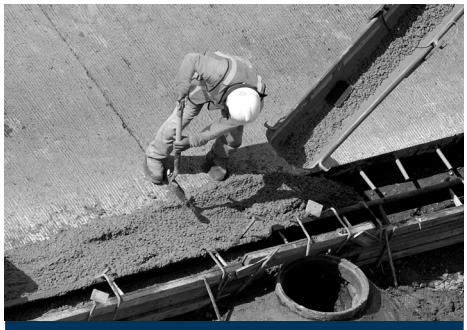
Devin Happe, 515-294-2969, dmhappe@iastate.edu
Paul Albritton, 515-294-1231, palbritt@iastate.edu
Keith Knapp, 515-294-8817, kknapp@iastate.edu■

Event details and online registration

Watch for details and online registration information, by specific dates and events, on the online calendar, www.intrans.iastate.edu/mors/calendar/.■

PPE continued from page 5



PPE in use at construction site

employee, which helps decrease their risk of getting hit, run over, seriously injured, or even killed. Explain why there are different standards for vests for night work versus day work. Also, educate employees on why it is important to keep vests relatively clean and to replace them periodically. A vest that is dirty will often cover the reflective stripes, thus decreasing the visibility and effectiveness of the garment. Keep in mind that vests will need to be replaced after they have been washed the designated number of times, which is indicated by the manufacturer on the garments' label.

Getting buy-in from employees

If you are on the management side and looking into purchasing new PPE, solicit feedback from your employees on what items they like and have found most comfortable. Find out what their experience has been with PPE that you are looking to reorder or replace. While you might not be able to provide everyone with their first choice, by incorporating your employees' feedback in the process you'll often end up with better products and a better attitude toward your PPE and safety program.

Adapted from *WV LTAP Newsletter*, Spring 2015■

Erosion continued from page 6

View of low-volume road in Iowa

Iowa-specific resources

Iowa Stormwater Management Manual, Iowa Department of Natural Resources. Available at www.iowadnr.gov/Environment/WaterQuality/WatershedImprovement/WatershedBasics/Stormwater/StormwaterManual.aspx.

Iowa Construction Site Erosion Control Manual, Iowa Department of Natural Resources. Available at www.iowadnr.gov/InsideDNR/RegulatoryWater/NPDESStormWater/Permits,GuidanceForms.aspx

How to Control Streambank Erosion, Iowa Department of Natural Resources. Available at www.iowadnr.gov/InsideDNR/RegulatoryWater/NPDESStormWater/Permits,GuidanceForms.aspx

Iowa Storm Water Education Program (ISWEP). More information available at www.iowastormwater.org/.■

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