Incorporating a NPDES Program into an Established Annual Inspection Program

Authors: Rocco J. Zucchero and Lisa J. Sagami P.E.

Abstract

CTE Engineers Inc. (CTE) is assisting the Illinois State Toll Highway Authority (ISTHA) in its efforts in preparing for the implementation of Phase II of the National Pollutant Discharge Elimination System program (NPDES). NPDES is a national program in which any discharge of pollutants to waters of the United States must be authorized by a valid NPDES permit. To facilitate this requirement, CTE collected drainage field data from a GPS handheld computing device and processed the data with the Environmental Systems Research Institute's (ESRI) ArcView software. The data collection will be incorporated in ISTHA's Annual Drainage Inspection Program. The challenge of this project was phasing in the use of GIS/GPS technology within the Annual Drainage Inspection procedures with a limited budget and a tight schedule. This paper will discuss the challenges and triumphs of getting the system up and running and will also discuss the process of educating the non-GIS user on the merits of GIS/GPS use before the system is fully established.

Background

National Pollutant Discharge Elimination System (NPDES)

Polluted runoff is the leading cause of water pollution and stormwater often carries harmful pollutants in its runoff into our local water bodies and can upset the ecosystem and threaten our resources for water supply. In an effort to regulate stormwater discharge, the Environmental Protection Agency (EPA) created a two phase NPDES program as outlined in the Clean Water Act. In most instances, the program will be administered by the State; in the case of Illinois, it is administered by the Illinois Environmental Protection Agency (IEPA). In this program, any discharge of pollutants to waters of the United States must be authorized by a valid NPDES permit. If a permit is not applied for, an agency could be subject to fines or may have higher requirements imposed. Phase I of NPDES program was enacted in 1990 to control stormwater runoff from medium and large systems that served populations over 100,000, industrial sites and construction areas of more than 5 acres through the authorization of a NPDES permit. In 1998, the EPA expanded the NPDES program to include Phase II. This phase required that Municipal Small Storm Sewer Systems (MS4) located in urban areas with populations less than 100,000 or construction sites that disturb 1 to 5 acres also obtain a NPDES permit. The NPDES permit is a self-policing program that protects water quality by requiring applicants to reduce pollutants in stormwater to the maximum extent practical through six control measures known as Best Management Practices (BMP). However, it is the applicant who develops a Stormwater Management Program that outlines the maintenance and the inspection of the stormwater infrastructure and implements the methods used to monitor and ensure that acceptable levels of pollutants are maintained. To accomplish this, an inventory of the stormwater infrastructure is needed. Once the inventory is developed, an illicit discharge source into a water body can be identified and corrective action can be implemented or a fine can be charged to the offending party.

The Illinois State Toll Highway Authority (ISTHA)

ISTHA is a user-financed administrative agency of the State of Illinois. The tollroad system is comprised of 274 miles of tollroads in northern Illinois. The tollway system is an important component of the transportation network in Illinois. It is able to provide a high quality, a safe, and an efficient means of transportation in the regions it serves by effectively managing and allocating its resources.

Consoer Townsend Envirodyne Engineers Inc. (CTE) is the general engineering consultant to ISTHA. As part of their Term Agreement, CTE conducts annual inspections of ISTHA's tollway infrastructure to assess its overall condition. Based on the annual inspection findings, CTE would recommend modifications to ISTHA's Program to address needed repairs and priorities. In the past, the inspection encompassed pavements, overhead structures, buildings, drainage and facilities and bridges and culverts. Field inspectors collected and recorded inspection data in field notebooks then transferred the information to inspection data entry forms by hand. These data entry forms were then handed off to another individual whose task was to enter the information into an asset management database through their computer desktop. Because this effort was time-consuming and inefficient, technology such as GIS and GPS which makes more efficient use of available resources was considered for implementation. As a result, ISTHA would have new tools to effectively manage its resources and will enable them to provide or improve the level of service that its patrons have come to expect.

NPDES Drainage Inspection Program

In the winter of 2002, CTE was approached by ISTHA to assist them with their efforts to apply and implement a NPDES Phase II permit. This task was two-fold.

- **Complete the required NPDES Phase II Permit Application forms**
- **Develop and Implement a Stormwater Management Program**

CTE was to develop a Stormwater Management Program which outlines a set of maintenance and inspection activities to be achieved, tracked and reported. To facilitate this effort, an expansion of the Annual Drainage Inspection Program to include an emphasis on stormwater runoff to better satisfy the NPDES Phase II permit requirements was considered. After assessing the current method of collecting drainage information, CTE recommended automating the data collection process in the field by using a handheld computing device with a built-in GPS receiver during the Annual Drainage Inspections. The information would be part of a comprehensive GIS-based NPDES inventory of the stormwater system within ISTHA's right-of-way and would allow ISTHA to manage their maintenance and inspection activities more efficiently. CTE sought an inspection procedure to collect this information; the procedure needed to have the following traits:

- **Produce reliable data**
- **Simple to use**
- **Compatible with existing asset management programs**

ISTHA supported the recommendation but did not adjust the Annual Inspection Program schedule. It was reasoned that the time savings resulting from the use of a handheld computing device would not require an extension to the project schedule. In fact, once the procedure was successfully setup and executed the inspection schedule should be shortened.

The first step in creating the inspection procedure was to determine what stormwater features to collect. Instead of building an entirely new procedure to inventory stormwater features, the current drainage inspection program was expanded to include the collection of additional stormwater features within ISTHA's right-of-way. During the second step, how to collect locational and attribute information of the expanded drainage data was determined and the third step involved how to extract the data from the handheld computing device. Finally, CTE would analyze the data with GIS software and create stormwater system maps for ISTHA's non-GIS staff.

Schedule

Completing the GIS-based stormwater inventory for the NPDES Stormwater Management Program for all 274 miles of tollroads would be spread over a five-year period. This would coincide with the NPDES permit requirement to submit a yearly status report to the IEPA on the implementation of the program.

Year 1: **Identify and incorporate known outlets along approximately 70 miles of roadway. Develop basemaps that included stream crossings, watersheds. The basemaps will be used as a building block for the subsequent years.**

Year 2: **Identify and incorporate known outlets along an additional 70 miles of roadway.**

Year 3: **Identify and incorporate known outlets along an additional 70 miles of roadway. Begin to incorporate outlet data from maintenance sites, plazas and oases.**

Year 4: **Identify and incorporate known outlets along an additional 70 miles of roadway. Continue to incorporate outlet data from maintenance sites, plazas, and oases.**

Year 5: **Finalize the entire system map (274 miles) and QA/QC.**

To meet the Program's completion date, the field work for the 2003 Annual Inspection Program was scheduled to run from April through the end of May. The NPDES field work for 2003 was then scheduled from June through the end of August. The remainder of the year was set aside for data processing, GIS analysis and creating GIS stormwater system maps for newly identified stormwater infrastructure features, inflows, outfalls, stream crossings and flow patterns.

The Role of GPS

Recent developments in mobile technologies present new ways of performing field tasks. ISTHA's data collection procedure would automate the collection and recording of locational and attribute information of stormwater features. To collect locational information, Trimble Navigation's GeoXM handheld computing device with a built-in GPS receiver was employed. To collect attribute information, inspectors would record information through easy to use menu-driven input screens and pull down menus specifically designed to minimize input error and improve data reliability. Both the locational and attribute information would be stored in a relational database. Phasing in the employment of GPS technology will enable ISTHA to streamline and expand their inspection program procedures without compromising its schedule. Once complete, ISTHA and CTE will be able to identify, prioritize, schedule and estimate cost for projects specifically designed to address Tollway needs.

Extract and Analyze Stormwater Data

After assessing NPDES stormwater management needs, CTE also recommended analyzing the stormwater data in the field with ESRI's ArcPad GIS software in addition to ESRI's ArcView software. Using ArcPad software would give ISTHA a tool to integrate GPS, GIS and field mapping for even faster and improved data validation. However, ISTHA did not support the recommendation; ISTHA pointed out that the new field procedure had great potential and ISTHA was willing to invest in the new technologies, however, validation in its effectiveness was needed before any additional mobile GIS software would be considered.

While discussions of ArcPad's employment continued, ISTHA and CTE concluded that ESRI's ArcPad software would allow inspectors to analyze the data while in the field but its use was not realistic in this phase of the program for four reasons:

- **Project Schedule**
- **Training Needs**
- **Programming Time**
- **Budget Constraints**

As mentioned early, the Annual Inspection Program schedule would not be extended. As a result, using ArcPad software would require additional time for analyzing data in the field would compromise the inspection schedule. Secondly, field inspectors were not trained in GIS and would require additional time for ArcPad training that was not available. Third, using ArcPad software would require additional programming time to create easy-to-use screens to aid inspectors with the analysis of field data. Finally, because the Annual Inspection Program and the NPDES data collection were combined; the budget was already stretched and additional resources could not be tapped.

The Role of GIS

Since CTE did not use ESRI's ArcPad software, the GIS analysis was conducted with ESRI's ArcView software. The software spatially track stormwater features and enables GIS analysis on feature attributes stored in a relational database from a desktop computer. This database was also accessible through the asset management software currently used at the tollway offices. ISTHA staff could query stormwater features from either the asset management or through ArcView GIS software. Using the asset management software allowed ISTHA to continue with the established inspection program's activities and reporting requirement. Using ArcView software allowed ISTHA to visualize, manage, create, and analyze geographic data. As a result, the role of GIS would now enable ISTHA to see relationships and identify patterns in new ways for better decision-making and faster problem solving.

Selecting the Equipment

During the Program's first months, the handheld computing device equipment was researched and selected for purchase.

GPS Handheld Device - Trimble - GeoXM

- Operating System: Windows CE
- Accuracy: 2-5 meter accuracy GPS receiver
- Memory: 64 MB RAM 512 MB flash data storage
- Processor: 206 MHz Intel
- Differential Correction: Integrated WAAS/EGNOS
- All day battery
- Portable and Cable-free
- Rechargeable
- Weight: 1.59 lbs
- Rugged design: water-resistant, shock-resistant, and dustproof

Two key issues surfaced during the handheld device selection phase. The first involved the type of mobile unit to purchase. Pen tablets and a smaller handheld computing device were researched. Pen tablets are designed to deliver the same computing capability as a laptop or notebook computer for working mobility in the field. Designed to be held in one hand and used with the other, pen tablets are mobile extensions of desktop computing resources. Pen tablets are best suited for situations that demand a standards-based computer with a high-performance processor, robust graphics, long battery life, and high data throughput without the need for a keyboard. However for ISTHA's inspection procedure, the pen tablet would require the purchase of a GPS receiver as an accessory. The smaller handheld device, on the other hand, is also portable but is a smaller less robust computer, usually handheld or pocket-size. It is ideal for anyone who needs portable information but doesn't want the size or expense of a laptop computer. In the end, the handheld unit with a built-in GPS receiver was purchased. However, additional software programming was required so that the software programs loaded would conform to the unit's screen size.

The second issue brought to light was the accuracy of the GPS receiver. The Trimble Navigations' Geo Series of handheld units were researched. One unit had an accuracy of 2-5m, the other device had submeter accuracy. It was concluded that purchase of a unit with an accuracy of 2-5m would meet ISTHA's current needs. However, once data for the entire system was collected, the bugs were worked out, and its effectiveness was validated, ISTHA would consider an upgrade to the data collection equipment. At that time, cost should begin to come down and a unit of higher accuracy may be within budget.

Determine and design input screens

Next, input screens and the NPDES data dictionary were developed for the handheld computing device. In the past, the Annual Drainage Inspection documented the physical condition of the drainage infrastructure and identified potential problem areas. Table 1.0 list existing drainage items, their elements and state of condition surveyed during previous Annual Inspections:

Table 1.0 – Existing Drainage Inspection Inventory Items

Item	Elements	Condition
Drainage Structures	Concrete culverts Pipes End Treatments	Spalls Moved Walls Crushed or Damaged Eroded Flow Line Missing Clogged

In 2003, ISTHA did not have staff available to program the handheld computing device unit. Instead, ERES Consultants Inc. (ERES) was contracted to create a data dictionary and to custom-design menu-driven input screens for the handheld computing device. ERES collaborated with CTE to develop the data dictionary. To minimize input error, ERES designed the input screens so user could choose a descriptor from a pull down list rather than typing the information from the unit's keypad. Table 2.0 lists the 2003 Annual Inspection Inventory Items developed.

Table 2.0 – 2003 Annual Inspection Inventory Items

Item	Sample value	Description
OBJECTOID	37	Unique identifier to current project
DrainActOID	-2017773588	Unique identifier for a particular drainage item.
PvMainGeneralOID	1336508221	ID automatically assigned for the 'Segments' recordset in CartêGraphe
CgLastModified	7/14/2004 9:23:38 AM	date and time of last modification
CTESurveyor	Dana Borum	Name of CTE inspector
ISTHASurveyor	<null>	Name of ISTHA inspector
Highway	East-West	Tollroad name
Direction	E	Direction of travel
Latitude	4154.174307N	Northing coordinate
Latdec	41.9029051167	y coordinate
Longitude	08845.069376W	Easting coordinate
Londec	-88.751156267	x coordinate
RampInterchange	Route 59	Name of interchange
RampID	A	Labeling convention
NeedsCleaning	0	Cleaning attribute
NeedsRepair	0	Repair attribute
SurveyDate	7/15/2003	date of inspection
Type1	1025	Feature description code
RelativeLocation	ROW	Relative location of feature with respect to ISTHA right-of-way
RelativeDirection	Longitudinal	Relative direction of feature with respect to tollroad
Milepost	17.5	Milepost to 1/10 of mile approximate
CenterlineDistance	50	Distance from roadway centerline
Length	99	Length of feature approximate
Length_unit	ft	unit of measurement
Height	99	Height of feature approximate
Height_unit	ft	unit of measurement
Width	99	Width of feature approximate
Width_unit	ft	unit of measurement
Flow	north	Direction of flow
Material	Concrete	Structure material
Use1	inflow	Intended use
Comment1	Low point	Inspector notes
DrainageID	Danaborum|356987.632014	Inspector capturing GPS locational info and GPS Unit ID Number
TypeDescription	field tile	Description of Item: Type
BeginLat	<null>	Northing coordinate
BeginLatDec	<null>	y coordinate
BeginLong	<null>	Easting coordinate
BeginLongDec	<null>	x coordinate
Slope	good	Overall condition of slope
Condition	fair	Structure's overall condition
Shape	point	Feature type

Field Collection

The field collection activities initiated before beginning data collection included roadway reconnaissance through site visits and documentation review. Once in the field, the inspector would locate a drainage feature, place the unit over it and record the GPS locational information (capture a point). The inspector would then input the feature's attribute information including taking photos of drainage features with a digital camera and cataloging the information through the input screens. Although there are many handheld computing devices that interface with digital cameras we were not able to take advantage of this accessory due to budget constraints. Consequently, disposable digital cameras were purchased and distributed to inspectors.

Field inspectors were required to submit a GPS Metadata Form for their field work to ensure proper paperwork of the process was documented and tracked. Metadata is data about data. The GPS Metadata form describes the content, quality, collection date, accuracy and location of GPS data as well as contact information. The form provides detailed information about the data collection methods, integration and analysis techniques applied to this application to support the preparation of the stormwater system maps.

During the first year, inspectors collected over 1300 stormwater features. This number could have been much higher but the unit had problems receiving a satellite signal and bugs were identified in the unit's software program. One problem that surfaced involved the loss of the GPS receiver's satellite signal. This problem persisted throughout the inspection period but did not prompt the inspector that the satellite connection was lost. The inspectors did not notice any change in conditions and the input screens were functional; as a result, they assumed that the unit was receiving the signal and continued to collect field data. However, once the data was uploaded to the computer network and loaded into ArcView, a number of GPS points would have identical coordinates. When the analyst reviewed the attribute information a number of locations listed different locations and milepost but identical x-y coordinates. Field inspectors were contacted and a review of their field procedure was initiated. Based on these discussions, it was concluded that when the inspector traveled to a different location by vehicle; they would put the handheld GPS unit in sleep mode to conserve the battery life and place the unit in the passenger's seat. According to the unit's literature the unit will maintain a satellite connection as long as the unit is pointed toward the sky and regardless if the unit is in sleep mode. Unfortunately, once the inspector got out of his vehicle, he did not check whether the satellite connection was maintained and would continue to collect field data. The unit would operate as if normal but instead of recording both the locational and attribute information for a feature being inspected, the unit would only record the attribute information of the feature being inspected and would not record its respective GPS coordinate. Once the problem was understood, inspectors were instructed to keep the unit on throughout the day because GPS unit would operate a full 8-hour day without requiring a daily recharging of the battery, check for satellite connection whenever possible and keep the unit pointed toward the sky or in the windshield of their vehicle when driving to a different location.

Once the collection of field data was complete the data was uploaded into the ISTHA's computer network and loaded into the ArcView software. The process of loading the coordinates is simple. Unfortunately, the first attempt at loading the data was unsuccessful. Review of the database indicated that 1) the coordinates were recorded as text instead of numbers and 2) the coordinates were off by large order of magnitude. A query was written in MS Access to convert the x-y coordinates into numbers and the data was reloaded in the ArcView software.

- **Original Data received from the GPS unit**

x-coordinate	y-coordinate
4154.238182N	-08901.888302W

- **Data converted by Query**

x-coordinate	y-coordinate
41.90396970	-89.0314717

The second attempt at loading the data was also unsuccessful. ERES Consultants Inc. was contacted and a bug in the software was found. The algorithm to calculate the coordinates contained a math error. As a result, the number converted by the new query would not reflect the true coordinate of the drainage feature. A patch was required to the software program and another query was written for the data. Finally the third attempt at loading the data into the ArcView software was successful.

Transfer data

The next step of the inspection procedure was to extract and analyze the field data. Because the inspection schedule was not extended, the inspectors needed to spent as much time in the field as possible. Instead of returning to the central office, inspectors stopped at the nearest maintenance facility at the end of the workday to upload their data into ISTHA's computer network. This task proved to be advantageous for two reasons. First, uploading data to ISTHA's computer network from the nearest Maintenance Facility would allow time for the inspectors to meet with maintenance personnel and relay any maintenance issue that required their attention. Secondly, visits to the nearest Maintenance Facility provided an opportunity for the inspectors to coordinate their next day's work schedule with Maintenance Staff.

The upload of the field data to ISTHA's computer network is a three step process:

- **Connect the hardware**
- **Establish a connection in Windows CE**
- **Export data from the unit**

The process of uploading data to the network is quick and simple. First, the serial cable attached to handheld unit is connected to an Ethernet cable into the Cisco router serial port through a network adaptor. The inspector is then walked through the upload process from the input menu on the handheld unit. From the communication panel displayed on the handheld computing device the remote networking module is selected. Once the output device and the speed configuration for data transfer is selected, the upload process begins. The time required to upload the data is dependent on the amount of data. However, on average, the upload of data took less than one minute to complete.

GIS Analysis of Field Data

The GIS-based NPDES Stormwater inventory was developed for the purpose of enforcement of the NPDES permit. More specifically, the inventory would be a part of the Illicit Discharge Detection and Elimination Control Measure in the Stormwater Management Program. This control measure allows flexibility in how to satisfy its requirements but must include a stormwater system map showing the location of all outfalls and the names and locations of all waters that receive discharges from those outfalls. The intent of the stormwater system map is to gain a thorough awareness of the stormwater system and how a source of illicit discharge enters the system while establishing a legal, technical and educational means to eliminate these discharges. The stormwater system map is one of the most important tasks of the permit application. CTE realized that a stormwater system map displaying how stormwater behaves within ISTHA's right-of-way would be of greater value to ISTHA staff than a basemap that only displayed how stormwater enters the system. As a result, the stormwater system map would now identify stormwater discharge entrance and exit locations as well as stormwater flow patterns within ISTHA's right-of-way. With this information readily available, ISTHA would have a better grasp of what is occurring within their right-of-way and will be better able to manage its resources more effectively.

To facilitate this task, CTE analyzed the stormwater field data with ESRI's ArcView software. Seven key stormwater feature attributes were used in combination with the watershed, stream, tollroad and topographic datasets to generate flow pattern maps within ISTHA's right-of-way. These attributes included:

- **Stormwater Feature Type**
- **Relative direction**
- **Relative location**
- **Milepost**
- **Use**
- **Flow direction**

During the field collection of stormwater features the inspector would note through the input screens whether the stormwater feature's location was a high point, low point or conveyance.

When the GIS analyst received the information from the field they could determine how the water was transported throughout ISTHA's right-of-way by piecing the attribute information together at each stormwater feature.

Create Stormwater System Maps

Stormwater System Maps of the study area were quickly generated from predefined templates in ArcView. These files were then converted to PDF files and put on a CD which allowed non-GIS user access to the information.

The upside of this methodology is that both GIS and non-GIS users can utilize the stormwater data as soon as the upload process is complete. In addition, once the non-GIS users become familiar with the data they will gain an awareness of the advantages of having data available in a GIS environment.

The downside of this methodology is that non-GIS users are limited in his/her ability to perform GIS analysis on the data because a pdf file is basically a snapshot of the geographic data. However, once ISTHA staff is trained on the use of GIS, the user will be able to take full advantage of the technology.

The final step of the inspection procedure was to create stormwater system maps of the Stormwater Infrastructure within ISTHA's right-of-way. The mapping templates contained 11 datasets. Three layers were created by ISTHA including:

- **The Illinois State Toll Highway Authority Tollroad Network**
- **The Illinois State Toll Highway Authority Tollroad Centerline Stationing**
- **The Illinois State Toll Highway Authority NPDES GPS data**

This step also included creating metadata for GIS datasets. The metadata was created to document the collection, maintenance, and supply of consistent GIS datasets. To ensure that the GIS data is effectively used, it is vital that the users are aware of what information is available about the GIS data.

Through the stormwater system maps, ISTHA staff including non-GIS users will have access to the stormwater data reducing the need for field visits. As a result, both GIS and non-GIS users will use the technology for better and faster decision-making and will become more responsive to users needs.

Lessons Learned

After the completion of the first year of work, the goals of the inspection procedure were revisited to gage the success of the program-to-date. Four questions were asked including:

- **Was a handheld unit with a built-in GPS receiver able to record reliable data?**
- **Was the handheld unit simple to use?**
- **Did the new inspection procedure use available resources more efficiently?**
- **Was headway made in educating ISTHA's non-GIS users on the merits of using a Geographic Information System?**

With any project, problems will be encountered; it is part of the process. Fortunately, none of the problems were detrimental to the fate of this project. The learning process was challenging and required collaboration in order to reach a resolution. However, by working through the problem, team members gained an understanding of each member's role.

Losing the GPS signal was the most severe problem encountered; it made the analysis difficult at times. As a result, data integrity was compromised on much of the drainage inspection data and was not used. The attribute information was adequate for the Annual Inspection reporting but the drainage data taken during the Annual Inspection could not be used in ArcView. Fortunately, having the project spread over a 5-year period allowed time for the project team to resolve many of the problems. In fact, during the 2004 inspection season, the software program will be modified to prompt the inspector when the GPS locational information is captured in order to keep the inspector aware of any GPS signal loss.

Looking back, more testing of the handheld unit and the GIS software was needed before the actual field collection began. This error in judgment could be attributed to the fact that field personnel were unfamiliar with GIS software and how GPS data is used in a GIS environment. Another lesson learned was that communication between the GIS project team with the Annual Drainage Inspection team was needed. Looking back, both teams needed to communicate how the information collected could benefit the other project's goals and thus, promote a team building environment.

Was the unit simple to use? Yes, however, there were too many keyboard entries which became time consuming. However, in the 2004 season, the software program has been modified to cut down the keystrokes.

Using the GIS/GPS technology was compatible with the existing asset management software, however, the program to transfer data between the asset management software and the GIS software needed to be available before the inspection began so that the NPDES GIS analysis could begin as soon as the data was collected.

The question of whether the procedure used available resources more efficiently has not been realized yet. However, hours are being tracked and the data collection effort for the remaining four years will be compared to gage its success.

Finally, headway in educating ISTHA's non-GIS users in the merits of using a Geographic Information System was made. However, ISTHA did not receive the CD with the Stormwater system mapping for the initial 70 miles until recently. But response from ISTHA staff has been positive and they are looking forward in having the complete set stormwater system maps available. ISTHA is also in the process of developing an enterprise Geographic Information System for their central office.

Future

The Stormwater Management Program is an ever-evolving program; as the Program moves forward, new procedures and possibilities exit. For example, once the GIS-based stormwater inventory is complete, it can be expanded to include impact modeling. By performing spatial analysis on an impact model, basins, and a flow accumulation grid of pollutants or those impacted by it could be identified. By having this information available, ISTHA will gain an awareness of the severity of any illicit discharge that occurs within their right-of-way and will allow them to take corrective actions to minimize the impact to the environment.

Also, the Stormwater System mapping can be expanded to include cadastral information. By having this information available, ISTHA will be able to identify an illicit source and could create an illicit source offender report. The report could automate the notification to offending parties that corrective action is needed or they could automate the issuance of an illicit discharge fine. ISTHA will then have the tools in place for faster response and even better decision-making. As a result, ISTHA will continue to be responsive to users needs and will continue to effectively manage their resources.

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Summary

CTE is assisting the Illinois State Toll Highway Authority in its efforts to implement a National Pollutant Discharge Elimination System Program. To facilitate this effort, the project team created a method for collecting ISTHA's stormwater inventory as part of the Annual Drainage Inspection Program. Using GIS/GPS technology with a handheld computing device, inspectors were able to automate the capture and cataloging of locational, as well as, attribute information from custom designed menu-driven, user friendly input screens. Using this method reduced input error and improved data reliability. The data would be used to build a comprehensive GIS-based stormwater data inventory and once complete, will provide ISTHA with a tool to effectively monitor and ensure that acceptable levels of stormwater runoff pollutants are maintained within ISTHA's right-of-way.

Although use of mobile technology had not been attempted before, the project team was successful in its deployment. However, it required a coordinated effort and strategic planning that focused on assessing ISTHA's inspection needs, the NPDES permit application needs, understanding how information would best be used to address these needs and by tailoring the new technology's deployment to fit the available budget. As a result, the inspection procedure use of a handheld computing device for data logging and GIS software for data analysis will allow ISTHA's staff to see relationships and identify patterns in new ways for better decision-making and faster problem solving.

As the Stormwater Management Program moves forward, the following benefits will be introduced, especially when complete:

- Increased efficiency
- Streamlining the data collection procedure
- Reduce input error and improved data reliability
- Reduced Inspection Program schedule
- Aids the understanding of stormwater runoff properties within ISTHA's ROW
- Supports environmental and program planning
- Better control of activities along all 274 miles of toll roads
- Stormwater infrastructure information will be readily available to ISTHA staff
- Foster collaboration between environmental planning staff and maintenance and operation staff to ensure compliance of the Stormwater Management Program.

The NPDES project team is committed in providing ISTHA with a long-term successful Stormwater Management Program, so as this project moves forward, additional application will be implemented that will enable ISTHA to continue to effectively manage its resources and be responsive to their patrons and their environment.

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Hardware

- Dell PC running Windows 2000 PC
- GPS Handheld Computing Device: Trimble GeoXM
- SQL Database Server
- HP Designjet 1055CM Color Plotter

Software

- ArcView GIS version 8.3 – The Environmental Systems Research Institute, Inc.
- Pavement*view* Management module - CartêGraphe System Inc.
- Maintenance Survey System - ERES Consultants Inc.
- Microstation version 7.01.01.57 - Bentley System Inc.

Data

- ISTHA Tollroad GIS Network
  Source: Illinois State Toll Highway Authority
- ISTHA Tollroad Centerline Stationing
  Source: Illinois State Toll Highway Authority
- ISTHA Stormwater Infrastructure Data
  Source: Illinois State Toll Highway Authority
- County Boundaries
  Source: Illinois Department of Natural Resources
- Municipalities Boundaries
  Source: Illinois Department of Natural Resources
- State Boundary
  Source: Illinois Department of Natural Resources
- Road Data
  Source: Illinois Department of Natural Resources
- Stream Data
  Source: Illinois Department of Natural Resources
- Watershed Data
  Source: Illinois Department of Natural Resources
- 1998-1999 Illinois Digital Orthophoto Quad Data
  Source: Illinois Department of Natural Resources
- Topography Data - Illinois Digital Raster Graphics Data (1:24,000 scale)
  Source: Illinois Department of Natural Resources

Coordinate System and Geodetic Datum

- State Plane Coordinate System – Illinois East (FIPS 1201 Feet)
  Geodetic Datum - NAD 83

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Joe Catalano
Bob Griffis
Brian Hamm
Catherine Judd
Brian Smith
Dave Stromberg
Dave Taggart

<u>Annual Inspection Team:</u>
Duane Buchko
Bridget Hamman
Don Childress

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Authors: Rocco J. Zucchero and Lisa J. Sagami P.E.

Author Information

Rocco Zucchero
Senior Environmental Planner
Illinois State Toll Highway Authority
rzucchero@getipass.com

Lisa J. Sagami P.E.
Senior Project Engineer
Consoer Townsend Envirodyne Engineers Inc.
lisa.sagami@cte-eng.com

Illinois State Toll Highway Authority
2700 Odgen Avenue
Downers Grove, Illinois 60515
630-248-6800
www.illinoistollway.com

Consoer Townsend Envirodyne Engineers Inc.
303 East Wacker Drive, Suite 600
Chicago, Illinois 60601
312-938-0300
www.cte-eng.com