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SEALING STORMWATER SYSTEMS CRITICAL TO PREVENTING SUBSURFACE CONTAMINATION

Pamela J. Dugan, P.G.

Dealing effectively with surface water contamination is a serious concern, but when surface water enters into the subsurface environment through unsealed storm/drainage systems, this contamination becomes a much greater danger. And while it is difficult to track surface water flows accurately, the prospect of attempting to track or control underground flows is impossible.

There are many processes available that help break down contamination present in surface water. Evaporation, aerobic activity, hydraulic degradation, ultraviolet and heat radiation from sunlight, filtering and settlement from surface vegetation, and detention through pervious surfaces all serve to provide "treatment" of surface water. But when surface water is directed underground, these mitigating influences are lost.

In my research on contaminant hydrology and groundwater remediation, we see directly the challenge and expense associated with remediation of nonpoint source pollution.

Since groundwater comprises ~80% of our total drinking water supply, it is critical to keep



Pamela J. Dugan, PhD Candidate, Colorado School of Mines

surface contaminants from entering the groundwater system, and the only reliable method to accomplish this is to seal collection systems watertight.

Let's take a moment to look at what happens with unsealed stormwater systems. During the first flush of a storm event, direct precipitation onto impervious surfaces quickly incorporates contaminants remaining on these surfaces since the last event.

These contaminants exist in several states: as dry solids which may be placed into the waste stream by either dissolution

or suspension, or as fluids which have settled in low areas below the base gravity flow line of the system.

Of course, contaminant concentrations are greatest during the initial flows. This is also the period during which the unsealed system is most active in exfiltration. Although exfiltration diminishes as the internal/external system hydraulics equalize, the damage is already done. The heaviest concentrations of contaminants are already released into the ground. As this contaminant plume spreads around the collection system, it comes into contact with groundwater and is rapidly incorporated. Isolation and remediation of the contaminant becomes virtually impossible.

By sealing storm water collection systems, we can reduce the potential for polluting our precious groundwater resources while we lay the groundwork for future stormwater treatment options. In that way, we can prevent one contribution to the pollution problem, and we can prepare for the eventual solution to stormwater contamination ■

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SEALED STORMWATER SYSTEMS CREATE A WIN/WIN SCENARIO

Fort Wayne, Indiana – Like most mature cities in the Midwest and Northeast, the City had a problem with storm drains and sewers. Having installed most of its stormwater collection system during the late 1800's and early 1900's, and benefiting from the foresight of city boosters and planners, Fort Wayne had a complex, well-built, and generously-sized system. As was common practice in the past, the vast majority was a combined storm and sanitary system. Well-built lines (brick, clay, and PIP concrete) of up to 120-inches throughout the main part of the city carried water to one of the three rivers which trisect the downtown area. The system was designed to quickly remove large amounts of surface water, as well as run-off from roofs and parking lots, and the usual taps from other major water users.

In dry conditions, flows were carried east to the treatment plant and the effluent received treatment to high standards. But when the heavens opened up and the rains came the systems carried what they could to the treatment plant and the rest overflowed through a series of 42 combined sewer overflow (CSO) points along the community's three rivers. These rivers include the St. Mary's, which flows in from the south, the St. Joseph, which flows in from the north and the Maumee, which is formed by the confluence of the St. Mary's and St. Joseph and flows out towards the east to Toledo and Lake Erie, and then to the CSO retention treatment plant for subsequent remediation. But when things really start to let loose, a not infrequent event in an area that can receive rain events in excess of 2in/hour during a "thunderstorm event", the floodgates will literally open at some 70 points within the jurisdiction of the City stormwater system, and untreated storm/combined sewage would flow directly into the three rivers. These form a confluence in downtown Fort Wayne and become the Maumee, which flows northeasterly to Toledo and into Lake Erie. Along the way several towns and small cities tap into the Maumee for drinking water.

A Need for Better Sewers and Better Streets

The City recognized early on that something needed to be done and has been working on reducing the problem of combined sewers since the early 1900's. The sewage treatment plant was upgraded in the 1960's. In the 1980's, total treatment capacity was increased to 60 mgd, and several surrounding communities were added to the treatment plant, eliminating their treatment responsibilities and subsequent discharges. These efforts received additional attention when the EPA issued an administrative order in 1995.

The City was also tired of the frequent repairs required around the existing stormwater system. Mortar joints in catch basins, manholes, pipes, and other system components were allowing uncontrolled infiltration into the system. This led to wash-outs around pipes and structures, and pavement collapse. The usual surface repairs, besides being expensive and time-consuming,

didn't fix the root cause of the problem, just the most visible symptom. And local taxpayers were feeling the bumps in their tax rates, as well as the bumps in their roads.



**Greg Meszaros, Director,
Public Works and Utilities**

The City Responds

Greg Meszaros, Director of Public Works & Utilities for the City of Fort Wayne, provides some background about how the City has come to grips with its stormwater needs. In the early 1990's, The City of Fort Wayne developed a separate stormwater department to better emphasize the stormwater infrastructure of the City. Among the first efforts made was a review of all specifications and standards. Many contemporary products and techniques, such as pipe-bursting and cured-in-place pipe liners, were not even mentioned, let alone specified and standardized.

In addition to specifications, a long-term stormwater plan and budget was developed that spanned a ten-year period and provided for \$100 million in stormwater improvements. Much of this was directed toward separation of combined sewers. This yielded three distinct benefits: improved capacity at the sanitary treatment facility due to reduced flows during storm events, improved stormwater effluent quality, and reduced backups of stormwater and basement drains (a serious problem in some neighborhoods). A citizens advisory group was formed by the City to help keep lines of communication open and to provide feedback to the City through monthly meetings.

To date, some \$50 million has been invested in stormwater system improvements. Most of these have focused on a "separation strategy" where new stormwater systems are installed to remove stormwater from the combined sewers. More than 20,000 feet of large diameter (36"-72") storm interceptor lines have greatly reduced the load on the treatment plant, as well as having improved surface water removal and stormwater effluent quality.

Sealed Stormwater Systems Speed Construction and Improve Streets

As an offshoot of the specification revisions, the City now requires that new storm sewer construction be sealed watertight and tested (see sidebar below). This requirement has resulted in faster construction and reduced maintenance requirements of both streets and sewers.



**Ron Sheppard,
Manager,
Engineering Support
Services**

[continued >](#)

NEW STORM SYSTEM DESIGN ALLOWS CITY TO SOLVE MULTIPLE PROBLEMS

Fort Wayne, Indiana - Although the concern of most environmental regulators is to improve stormwater quality prior to its discharge into waterways, local residents frequently have more immediate worries. The combined sewer system used in most areas of the City had downspouts and basement drains connected, as was the common practice at the time. As demands on the system grew, drains became more likely to back up into the home. Home-owners insisted that something be done.

These citizen demands were channeled into action by prioritizing needs and keeping lines of communication open between stormwater planners and the community. In that way, residents knew when they could look forward to the improvement, and they could track progress of the projects.



New Specifications Address Future Needs

In addition, new specifications and more stringent requirements were developed and implemented for construction of the new storm sewers. Along with the changes in basic design, the City added requirements for installation and testing of the system. To make sure that Fort Wayne residents get the system they want, design, installation, and inspection is coordinated through the Stormwater Management Department. Each person knows their role to play.

Miguel A. Trevino, PE, CE, Division Manager for DLZ Indiana, LLC, a full-service architectural and engineering

company, says "Fort Wayne is not the only area requiring sealed storm systems. Indianapolis and northwest Indiana (near the Great Lakes) have developed more strict specifications for storm system design and construction." DLZ serves as the Stormwater Manager for Indianapolis.



Installation and Inspection Ensure Compliance

Design is vital, but installation is where value can be added or lost. To make sure that installation and testing is carried out properly, as well as to trouble-shoot the inevitable problems that arise from construction, DLZ was hired to provide continuous on-site inspection of the project. Ms. Kristine Thurston is the Inspector for this project, one of fifteen she has worked.

According to Ms. Thurston, the contractors involved (Geiger Excavating of Fort Wayne and All-Star Construction of Roanoke, Indiana) can be counted on to keep quality and safety uppermost in their goals. She said the most common concerns are contact damage to pipe or structures. The rigorous backfill and compaction requirements for the system make a little more work for the contractor, but create a system that resists settlement and subsequent performance penalties.



The sealed storm systems "present no problem to either the contractor or to the inspector," says Ms. Thurston. "It cuts down on infiltration and exfiltration of the system. It's easier and faster to install when we use boots."

Ed Foss, President of All-Star Construction, echoes Ms. Thurston, especially when the expense of forming inverts in the field is factored in. "It costs us \$300-\$400 an hour for our crew on this job. Structures for smaller pipe diameters (24" and less) come with inverts and boots installed, so we can insert the pipe and keep moving. That saves us 2-3 hours over having to field-pour inverts." All-Star is installing 15,000 LF of pipe and some 150 structures on this phase of the project. Mr. Foss sees advantages to sealed storm systems, but would like to see the program developed even further, so that cuts in street centers can be drained better than they are now.



Responsible Stewardship of Tax Dollars and the Environment

The City of Fort Wayne has chosen to move ahead of the pack with its stormwater projects. Although the cost of a complete separation of the storm and sanitary systems would be prohibitive (variously estimated at \$250-\$500 million), Fort Wayne recognizes its responsibility to serve the current and future needs of its residents by adopting a progressive specification that works for both local needs and the good of the environment ■

SEALED STORMWATER SYSTEMS CREATE A WIN/WIN SCENARIO *continued...*

According to Ron Sheppard, Manager of Engineering Support Services for the City of Fort Wayne, The switch from conventional construction to sealed storm systems was simple and straightforward: the City developed the specification and educated the consulting engineers and contractors. Ron cited benefits of faster installation of manholes, reduced maintenance of lines, and street surfaces that are much more resistant to the usual wash-outs around the collection system. In an area with an abundance of rainfall and frost events, this is no small savings. As an additional bonus, the systems flow as designed for a longer time before needing cleaning and maintenance, because groundwater/fines infiltration is greatly reduced. As the City of Fort Wayne has experienced, sealing new stormwater systems is an important part of helping to meet the city's environmental obligations and its responsibilities to residents ■

Highlights from the Storm Sewer Design Requirements

City of Fort Wayne, Indiana

- Joints between precast concrete storm sewer manhole elements shall be sealed with one of the following methods:
 - An approved rubber O-ring gasket manufactured and installed in accordance with ASTM C 443, latest revision
 - EZ Stick (preformed butyl joint sealant) or approved equal in accordance with AASHTO M-198
- Pipe connection to manhole for pipes less than 30" diameter, the pipe connections into manhole structures shall be sealed with a resilient connector in accordance with ASTM C 923, either "compression-type" or "boot-type".
- Pipe connection to manhole for pipes 30" diameter and greater, the pipe connections into manhole structures shall be sealed with a seep ring waterstop.
- Manhole joints shall be tongue and groove type and shall be sealed with EZ STIK (preformed butyl joint sealant) or equal.
- Pipes shall be sealed with rubber gaskets in accordance with ASTM C 443 or ASTM F 477.
- Pipe Diameters less than 30" shall best tested with low pressure air (4 psi) after completion of the run.
- Pipe diameters 30" and greater shall be tested by individual joint air testing to 4 psi.

THE AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

2005 Report Card for America's Infrastructure

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Bridges	C
Dams	D
Drinking Water	D-
Energy	D
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Rail	C-
Roads	D
Schools	D
Security	I
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America's Infrastructure G.P.A. = D-

Source: ASCE website

PHOTO GALLERY



WANTED: ROAD DAMAGE PICTURE REWARD: \$100.00

The old-fashioned method of using bricks and mortar to join pipes into structures in storm sewer construction gives everybody problems, from the contractor to the customer. Now you can turn one of these cracked messes into enough money for a good dinner for two, just for sharing your photos with "Good Connections". Each issue will feature photos of real-world problems caused by rigid brick and mortar joints. If your photo is selected, we'll send you a check for \$100.00, your reward for helping us educate others about using flexible connectors in storm sewers. Please e-mail your pictures to info@clientlinkusa.com or mail to Client Link, 4099 Landisville Road, Doylestown, PA 18901, ATTN: Faith Sherman



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