"April Showers Bring May Flowers."

I hear that rhyme often during April and rather than anticipating those May flowers, all I can think about is managing stormwater. As the rain falls, I am worried about sediment transport from construction sites or disturbed areas; excavated dirt washing into the street; and city, state, or federal fines. It is enough to give an erosion control manager nightmares. Bigger runoff worries include polluted lakes and streams, eroded channels, and overwhelmed storm sewer systems.

Committed to serving our clients and the public good, TD2’s civil engineers have taken a proactive approach to stormwater management and planning for our urban development projects. This article outlines its definition, existing requirements, regulations, and shows some practical examples from recent TD2 projects.

What is it?

Stormwater sounds self-explanatory, but it is rainfall or snow melt seeping into the ground or running off the land into storm sewers, streams, and lakes; and stormwater management is the use of Best Management Practices (BMP*) to control the discharge rate and quality of the stormwater runoff.

**Stormwater + Urban Development = Runoff**

The impervious surfaces (pavement and buildings) of urban development increase stormwater runoff with damaging consequences:

- Flooding - local and regional
- Road Damage - ditch erosion, loss of support material near structures and pavement edges
- Deposition - silt and debris
- Stream Erosion - degradation and loss of habitat
- Landslides - slope saturation/changes in drainage patterns
- Restriction in groundwater recharge

In addition to physical damages, urban runoff is also a major source of water pollution. As stormwater runoff travels, it collects contaminants. The five main contaminant categories include:

1. Total Suspended Solids (silt and particles)
2. Oil and Grease
3. Trash and Debris
4. Heavy Metals
5. Nutrients

**Construction & Post Construction**

As civil engineers in the construction industry, we are concerned with planning for and managing the stormwater traveling over and through the ground causing issues during and after construction. Construction sites and newly developed or redeveloped areas are significant sources of polluted stormwater runoff carrying sediment and contaminants we want to keep out of our sewer systems and ultimately out of our rivers and streams.
BMPs during and post construction vary in permanence and purpose. Construction site control methods are meant to be temporary during active construction, keeping sediment on-site to provide short-term water quality benefits. Post construction site control methods are permanent, functioning after construction is complete to reduce contamination and provide long-term water quality and flood benefits.

While development usually represents progress, in the case of unmanaged and untreated stormwater, runoff can represent serious danger; and where there is risk there is regulation.

**Regulations**
The U.S. Environmental Protection Agency has identified untreated stormwater as the biggest threat to our nation’s water quality. Federal, State, and Local regulations require careful compliance.

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| In 1972, the Clean Water Act established environmental programs including the National Pollutant Discharge Elimination System (NPDES) permit program requiring cities to regulate stormwater discharges. NPDES permits require Post Construction Stormwater Management to protect property and environmental quality. | To preserve “The Good Life”, the Nebraska Department of Environmental Quality (NDEQ), whose mission is to protect the quality of Nebraska’s environment, is the state agency implementing this national program and who issues NPDES permits. The NPDES stormwater permit program was issued in two phases.  
- Phase I (1993) required municipalities with populations of 100,000 or greater to implement a stormwater management program as a means to control discharges from the Municipal Separate Storm Sewer System (MS4). Lincoln and Omaha operate under Phase I permits.  
- Phase II (1995) required permits for smaller urban areas and added additional requirements for all affected communities. In Nebraska, a total of 24 NPDES permits have been issued to cities, counties, NDOR, Offutt Air Force Base, and the University of Nebraska-Lincoln. | To meet its MS4 permit obligations, Omaha’s Municipal Code’s Stormwater Management program requires:  
- The capture and treatment of the first half inch of runoff on each new site platted and approved after July 1, 2008.  
- A discharge rate not to exceed a pre-development rate for 2, 10, and 100 year events in Combined Sewer Overflow (CSO) areas east of 72nd St.  
- A discharge rate not to exceed a pre-development rate for 2 year events west of 72nd St.  
- The submittal of a Post Construction Stormwater Management Plan (PCSMP) detailing the placement and design of stormwater control methods (identify Best Management Practices).  
- A Maintenance Agreement & Easement. |
Control Strategies

Stormwater control strategies are required:

- Where - on new development, significant redevelopment of 5,000 SF or more, and developments that are part of a larger common development.
- When - reasonably feasible to achieve the requirements of this ordinance.

In a PCSMP, we design for two factors - Quantity or Discharge Rate and Quality or Treatment based on:

- EPA's National Standards
- Local Jurisdictions
- Site Conditions
- Status of Natural Waters

Project goals are defined with a Stormwater Pollution Prevention Plan (SWPPP) which:

- Identifies all potential sources of pollution, which may reasonably be expected to affect the quality of storm water discharges from the site,
- Describes the practices to be used to reduce pollutants in stormwater discharges from the site, and
- Helps assure compliance with the terms and conditions of the permit (when the plan is designed for the individual site and is fully implemented.)

There are many techniques we can use in our planning and design process to hold and treat stormwater ranging from simple rain gardens to complex manufactured filtering systems. Their appropriate, site-specific application results in the most cost-effective approach to stormwater quality management.

Lot-Level BMPs*

- Rain Garden
- Rain Barrels/Cisterns

Structural BMPs*

- Bioretention System
- Constructed Wetland
- Extended Dry Detention Basin
- Grass Swales and Filter Strips
- Green Roof
- Manufactured Systems (settling and filtering)
- Permeable Pavement/Pavers
- Retention Wet Ponds
- Soil Conditioning

*Categories correspond to those posted in Chapter 8 of the Omaha Regional Stormwater Design Manual Rev. 09/2012.

Featured are a few recent project examples demonstrating a variety of techniques selected based on site conditions and project needs.
Projects Examples
Siena Francis House; 17th Nicholas
Green Roof and Linear Bioretention Basin

A practical and “green” site solution was used on all new campus buildings to avoid constructing new stormwater infrastructure. Green roofs use living plant matter and soil on top of a building to absorb, collect, and reuse rainwater while reducing runoff.

A linear bioretention basin was used for parking lot runoff. The landscaped depression slows and ponds on-site stormwater runoff until it absorbs or drains into an inlet with a high overflow.

TD2 Corporate Office; Old Mill
Rain Garden and Pervious Pavement Patio

A swampy area next to the TD2 office was the perfect location for a rain garden with an amended soil base. Designed and constructed using Omaha’s rain garden design standards, the installation serves as a living/learning lab to demonstrate how rain gardens and pervious pavement can work in an urban setting.

Native Nebraska plants (various types of grasses, salvias, and asters) improve infiltration with their deep root systems.

The large aggregate in the concrete mix with little or no sand creates a substantial void content. The pervious concrete patio allows rainwater to flow directly through the pavement surface and seep into the ground.
Metro Credit Union; 72nd Ames
Bioretention Basin

An unused corner of the site was the perfect location for a bioretention basin. It was constructed with an area inlet to accommodate overflow during large rain events. The under drain features an accessible clean-out to facilitate maintenance.

Vegetation softens the hard edges of the site, provides green space, and becomes an attractive stormwater storage and treatment solution.

Greater Omaha Leasing
Subsurface Storage

Expanding parking on a tight site necessitated a subsurface storage system. Stormwater enters through an isolator row that drops sediment out before emptying into the storage chambers. The discharge rate must be designed to be less than the pre-developed discharge rate.

Large Capacity Subsurface Storage

As the size of the project increases, so does the scale of the capture tank. These three 35,000 gallon tanks from a large corporate campus store stormwater for on-site irrigation.
Lessons Learned

We have learned by doing. As we have implemented stormwater management and planning into our projects, we have learned a couple of important lessons.

- Plan early. Stormwater management needs to be an integral part of the design process.
- Identify potential post construction measures to meet ordinances. Perform conceptual sizing analysis for selected measures and identify potential construction considerations.
- Individual site solutions. There is no one size fits all answer. Site conditions and site needs guide the engineer and owner to find the most cost effective solution.
- Installing and maintaining adequate construction control measures is important to ensure the post construction measures work properly.
- Construction methods impact the performance of bioretention basins and rain gardens. Excessive compaction during construction restricts infiltration and vegetation establishment.
- Don’t put it in and forget it. On-going maintenance of stormwater control features are essential for the systems to function effectively.

Conclusion

Stormwater management and planning is an area growing in complexity and regulation. Compliance is a must, not only because of the legal ramifications but for the environmental impact on our water resources.

In the near future, you can expect revisions to Chapters 8 and 9 of the City of Omaha Stormwater Manual and a new NPDES permit to be issued by NDEQ. Omaha is currently operating under an expired permit and in the meantime, NDEQ is considering a short administrative extension.

CONTRIBUTING ENGINEER SPOTLIGHT

Daren Konda, P.E.

A 1999 South Dakota State graduate and TD2 civil engineer since 2000, Daren is a wealth of knowledge about Stormwater Pollution Prevention Plans (SWPPP), Industrial Stormwater Pollution Prevention Plans (ISPPP), Post Construction Stormwater Management Plans (PCSMP), and incorporating these requirements into the overall project design.

A farm kid from New Effington, South Dakota, Daren attributes his interest in civil engineering and stormwater management to his Dad, who as a biology teacher always took the time for the teachable moment to point out the unique life found in our aquatic habitats.

An active runner, Daren is involved in the Omaha Running Club and has competed in the Boston Marathon nine times. At this year’s Boston Marathon, Daren finished well before the bombs went off and was away from the area.

A sobering experience for him, his family and friends, and for TD2; we extend our sympathies to those affected by this tragedy.

Founded in Omaha, Nebraska in 1967, Thompson, Dreessen & Dorner, Inc. (TD2) has established itself as a highly respected and experienced Civil Engineering, Geotechnical Engineering, Structural Engineering, Environmental Engineering, and Land Surveying firm. TD2 meets the demands of today’s residential, commercial, and industrial sectors with a superior level of expertise and professionalism.