American Council of Engineering Companies – Support to IDEM for Rule 5 Regional Permit and Post Construction Water Quality: How to Comply with the New Requirements

MS4 Annual Conference
May 14, 2019

Brian N. Neilson, P.E., LEED AP

ACEC Indiana

HWC ENGINEERING 30 YEAR ANNIVERSARY 1989-2019

ACEC Technical Support – Rule RGP

ACEC Rule 5 RGP Support Team includes:

- Mary Atkins – Wessler Engineering
- Eric Woodmansee – RQAW
- Dillon Reynolds - RQAW
- Robert Page – HNTB
- Shannon Killion – GAI Consultants
- Kerry Daily – Christopher B. Burke Engineering
- Brian Neilson – HWC Engineering

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Currently the definition of Water Quality Volume (WQV) is:

The volume of runoff generated by one inch of rainfall on a site.

Appendix A – Glossary of Terms
Indiana Storm Water Quality Manual
Planning and Specification Guide for Effective Erosion and Sediment Control and Post-Construction Water Quality
Indiana Department of Environmental Management

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1. Questions regarding the water quality volume equation:

$$WQv = Rv \times A \times P$$

   a. What Precipitation Depth (P) do we use and why?

      i. We know 1 inch rainfall over 24 hours is standard in Indiana. Why is this the standard?

         A depth of 1 inch approximately corresponds to the 90^{th} percentile of precipitation events and therefore, provides treatment for most events.

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1. Questions regarding the water quality volume equation:

$$WQv = Rv \times A \times P$$

   b. What type of Runoff Coefficient (Rv) do we use and why?

      i. There are multiple. We need a state preferred option.

         The standard equation used by Indiana MS4s is $Rv = 0.05 + 0.9i$, where i is the fraction of post-construction impervious surface

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2. How much guidance should we provide on how to keep discharges below 2-, 10-, and 100- year pre-construction numbers?
   a. Do we point to resources such as the Stormwater Drainage Manual 2015 ? Are there any other resources we should provide?

      Yes, the Stormwater Drainage Manual is a good reference. We also suggest guiding readers to standards for nearby MS4 communities which may be regionally applicable.

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3. How do we address Low Impact Development and green infrastructure?

   a. We are thinking a narrative would be sufficient.

      We concur.

   b. Do you have any suggestions on how to build the narrative?

      We suggest using the language below:

      Green Infrastructure (Copied and modified from the Stormwater Drainage Manual 2015 Chapter 10 introduction)

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The term green infrastructure can be used to describe a number of concepts. The concept of green infrastructure can be used on a regional level to describe interconnected greenways and open spaces. Green infrastructure can be used on a neighborhood level to describe clustered development and the reduction of impervious surfaces.

On the site level, green infrastructure has been applied to measures - some new, some old - that are focused on enhancing water quality and reducing the volume and rate of stormwater runoff (Jaffe et al, 2010). These measures are not necessarily capable of addressing flood flows, but rather, the more frequent storm events where there may be opportunities to trap and temporarily (or permanently) store stormwater runoff that would otherwise find its way into the combined sewers, storm sewers or waterways. These methods commonly utilize vegetation and soil to infiltrate runoff into the subsurface. (underline emphasis added)

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The most common applications include porous pavements, green roofs, rain gardens and rain water harvesting systems. It has been recognized that all of these have water quality benefits as well as water quantity benefits.

(underline emphasis added)

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Low Impact Development (from sources noted below)

The term low impact development (LID) refers to systems and practices that use or mimic natural processes that result in the infiltration, evapotranspiration or use of stormwater in order to protect water quality and associated aquatic habitat.

At both the site and regional scale, LID practices aim to preserve, restore and create green space using soils, vegetation, and rainwater harvest techniques. LID is an approach to land development (or re-development) that works with nature to manage stormwater as close to its source as possible. (underline emphasis added)

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LID employs principles such as preserving and recreating natural landscape features, minimizing effective imperviousness to create functional and appealing site drainage that treat stormwater as a resource rather than a waste product. Applied on a broad scale, LID can maintain or restore a watershed's hydrologic and ecological functions. [1.]
The LID approach is based on managing stormwater at the source by the use of LID best management practices (BMP’s).

(underline and black text color emphasis added)

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LID Principles include:

- Maintain pre-project hydrologic functions through natural processes.
- Maintain drainage patterns and watershed timing.
- Minimize development impacts through non-structural practices.
- Use distributed (BMPs) to meet hydrologic goals [2].

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1. US EPA, Polluted Runoff: Nonpoint Source (NPS) Pollution, "Urban Runoff: Low Impact Development" https://www.epa.gov/nps/urban-runoff-low-impact-development
2. Army Low Impact Development Technical User Guide, 4 January 2013, Office of the Assistant Chief of Staff for Installation Management, U.S. Army Corps of Engineers Baltimore District, USACE Engineer Research and Development Center, with support from The Low Impact Development Center, Inc.

Transition Slide

What we have said:

Treat stormwater as a resource rather than a waste product.

What is now happening:

Stormwater is a wastewater that needs to be treated to become a resource.

Low Impact Development – Water Quality Compliance

Transition from Wastewater and Combined Sewer Overflow Abatement to stormwater water quality compliance responsibilities.

Typically this rests with the Transportation group.

NPDES Discharge Requirements – Same compliance requirements for wastewater, combined sewers, and stormwater.

<u>It's all about the Creeks, Streams, and Rivers</u>

Low Impact Development – Water Quality Compliance

There is only one reason to use green infrastructure design practices in a project – **save money**.

Short Term – Direct Project Costs

Long Term – Direct Regulatory Compliance Costs

Of Course, the environmental benefits, water quality standards compliance, as well as the direct and indirect community economic benefits are a plus as well.

Low Impact Development – Water Quality Compliance

Conventional Stormwater Management

Move water as quickly away as possible, usually via an engineered storm system (pipes), to a centralized facility (basin, pond, stream, etc.). All first flush pollutants typically flow directly into the rivers.

Think **Large Storm** Flood Control/Protection. > 1 in. rain

Low Impact Design

The attempt to manage rainfall at the source using uniformly distributed decentralized site-scaled controls. The goal is to mimic pre-developed drainage patterns and hydrology by using design techniques that infiltrate, filter, store, evaporate, and detain runoff close to its source.

Think **Small Storm** Control/Collection. $\leq$ 1 in. rain

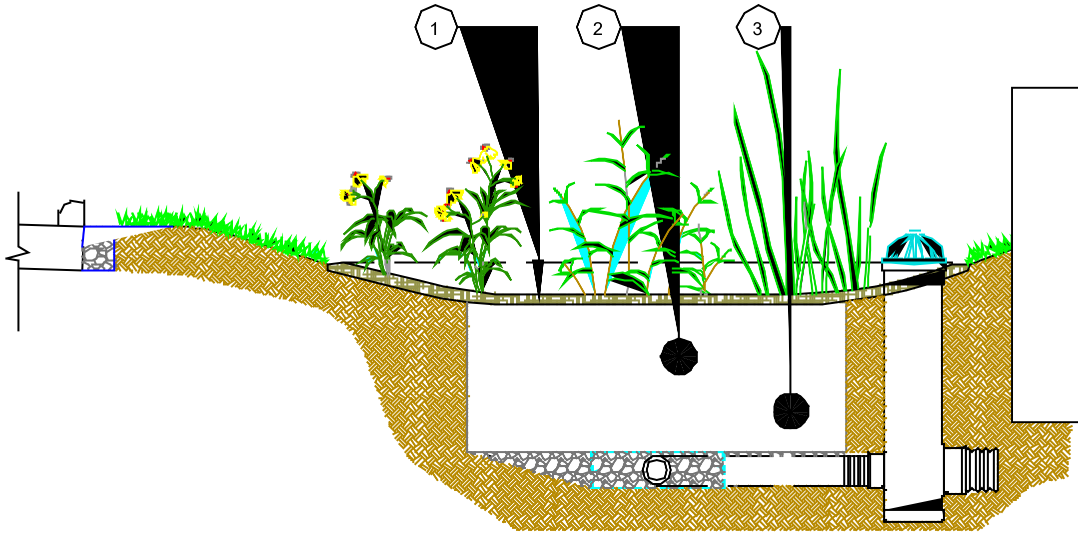
Low Impact Development – Water Quality Compliance

Green Infrastructure can be named with a lot of "flowery" terms, however:

- It is an engineering designed stormwater control and treatment facility.
- It requires specific construction oversight.
- It requires <u>short and long term maintenance for continued long-term performance.</u>

Low Impact Development – Water Quality Compliance

Concept courtesy of Dr. Bill Hunt, PhD., NC State

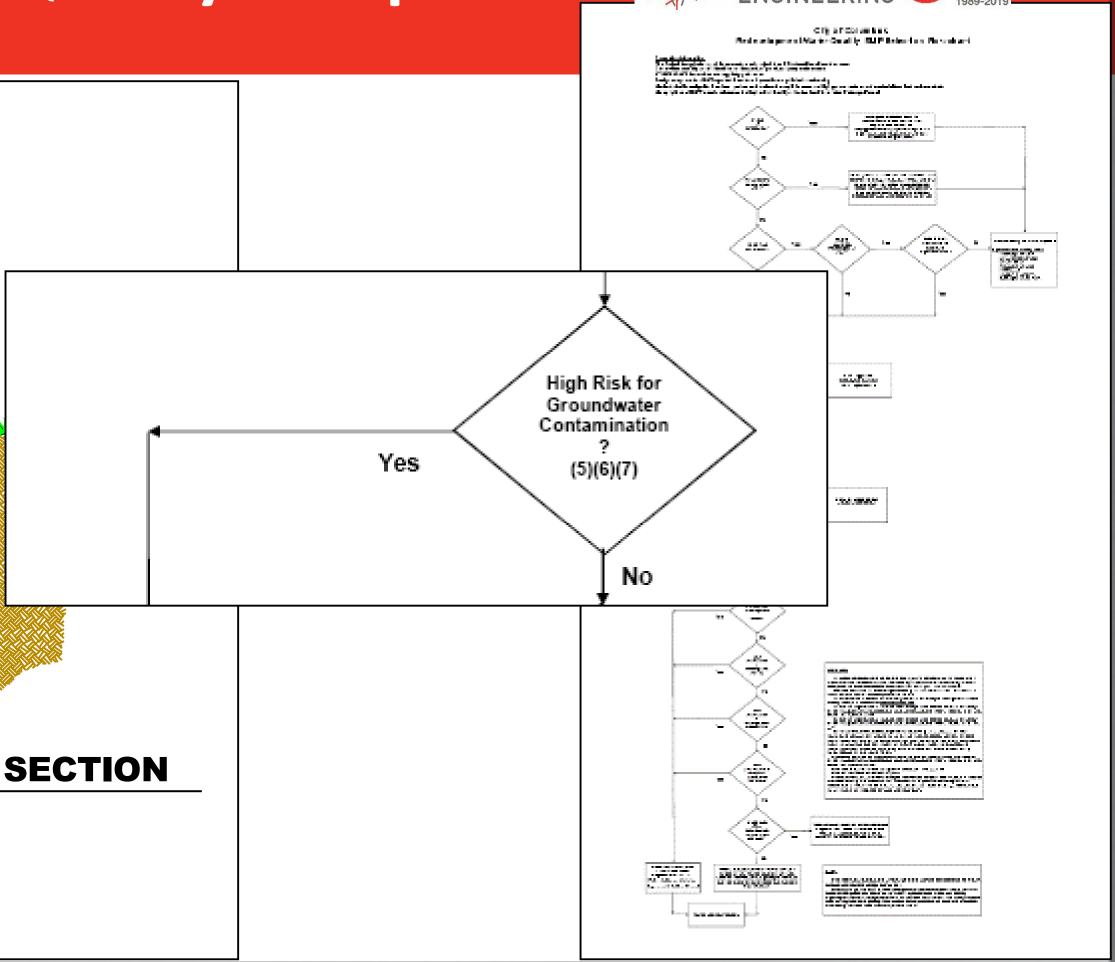


BIORETENTION / RAIN GARDEN BMP SECTION

1 SURFACE - TSS, OILS & GREASE

2 SUB-SURFACE (0-12") - PATHOGENS, PHOSPHORUS, METALS

3 SUB-SURFACE (30"-36") - NITROGEN, TEMPERATURE



Low Impact Development – Water Quality Compliance

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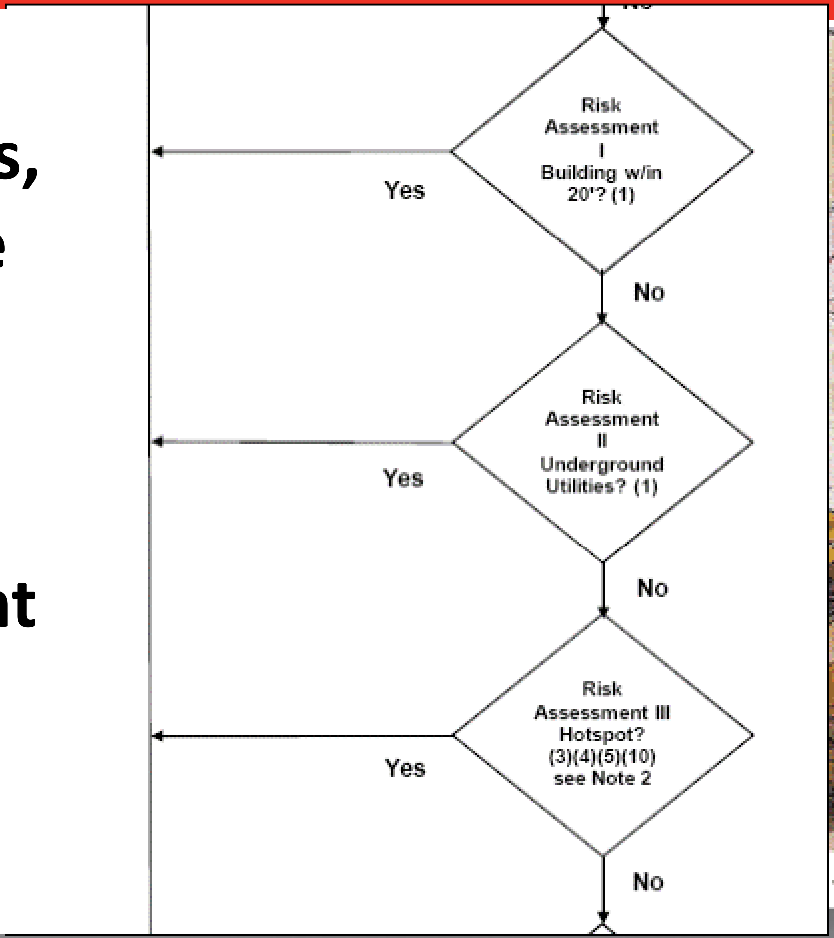
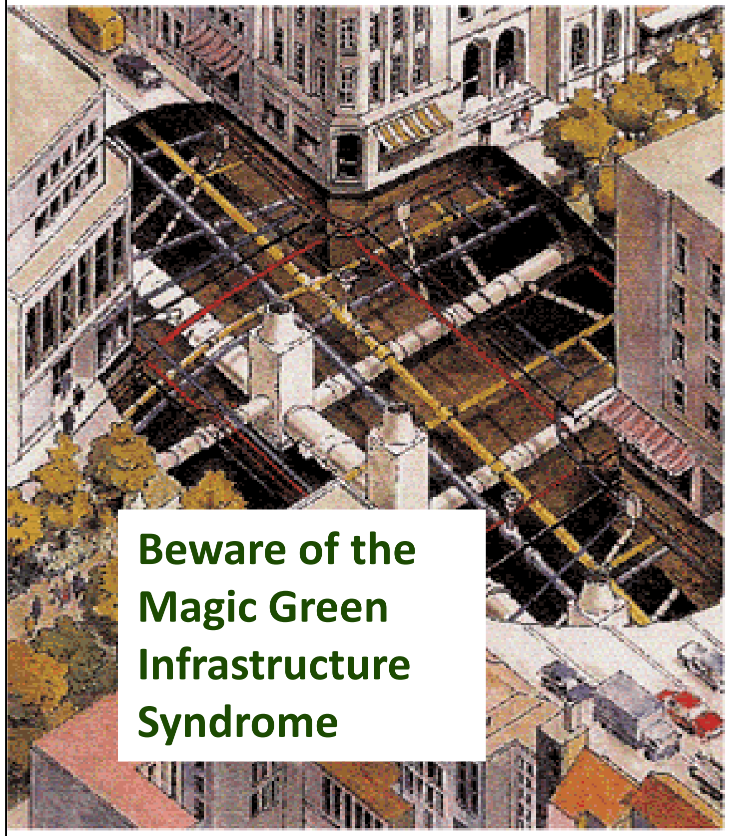
Talk to wastewater treatment operators, do they just assume the wastewater is disappearing magically after it enters the treatment facility???





Underground Congestion.

Low Impact Development – Water Quality Compliance

(1) Post-construction stormwater management measures must be implemented to manage the discharge of storm water run-off to address quality and quantity. Measures must be designed and engineered in accordance with the following standards and at a minimum:

(A) Run-off from the project site must meet local requirements to address storm water quantity as established by ordinance or other regulatory mechanism. When a local requirement does not exist the post-development discharge must not exceed the pre-development discharge based on the two-year, ten-year, and one-hundred year peak events.

(Highlight emphasis added)

Traditional Stormwater Controls

Low Impact Development – Water Quality Compliance

B. Run-off from the project site must be treated to reduce pollutants that are expected to be associated with the final land use. To achieve pollutant reduction goals, measures must be selected and meet the requirements as established by ordinance or other regulatory mechanism. When a local requirement does not exist the post-construction measures must be selected based on correct sizing to treat the Water Quality Volume (WQv) or water quality flow rate to ensure compliance with 327 IAC 2-1-6(a)(1)(A-D) and 327 IAC 2-1.5-8(a) and (b)(1)(A-D)).

C. Utilize one (1) or more post-construction measures working in tandem to treat stormwater run-off and increasing the overall efficiency of individual and specialized measures.

(Highlight emphasis added)

Low Impact Development – Water Quality Compliance

D. In combination with proper post-construction measure selection, design and development strategies must be selected and incorporated into the plan to reduce the contribution of pollutants from the project area to the post-construction measures. These strategies include, but are not limited to:

1) Low Impact Development (LID) and green infrastructure.
2) (sic)
3) Infiltration measures, when selected must take into consideration the pollutants associated with run-off and the potential to contaminate ground water resources. Where there is a potential for contamination, implement measures that pre-treat run-off to eliminate or reduce the pollutants of concern.

(Highlight emphasis added)

Traditional Stormwater Controls

Low Impact Development – Water Quality Compliance

- Wet/Dry Detention Basins – More Suburban then Urban
- Underground Storage
- Manufactured Water Quality Systems
- Media Filters

Traditional Stormwater Controls

Low Impact Development – Water Quality Compliance

Attributes

- Multiple use as a temp sediment basin during construction
- Aesthetics, Land value and Recreation
- Meets most Local stormwater codes (for now)
- Provides storage to reduce peak flow
- Can provide irrigation water for landscape, LEED credit

Fields of St. Croix - stormwater finishing pond
Lake Elmo, MN

Stillwater, MN

Considerations

- Public safety, swimming, ice, etc
- The land area for a basin can be significant.
- Thermal impacts to streams in the summer.
- Geese control

Stormwater Basin

Low Impact Development – Water Quality Compliance

Attributes

- Maximizes developable space
- Can provide groundwater recharge or water harvesting opportunities
- Out of sight
- Increased level of public safety over open ponds

FedEx Indianapolis Airport

Porter Co. Jail Valparaiso, IN

Bloomington, IN KMART

Considerations

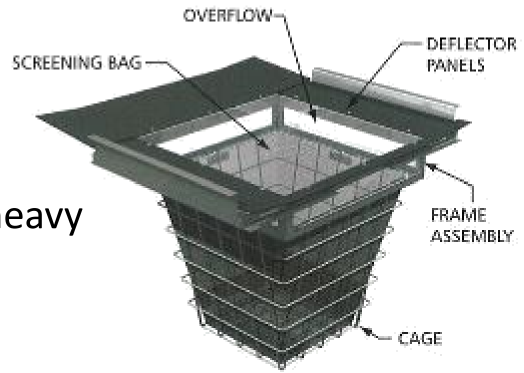
- Costs that can approach $250,000 ac-ft
- Minimal water quality benefits unless they have recharge component
- Maintenance can be expensive
- Pretreatment device recommended/required

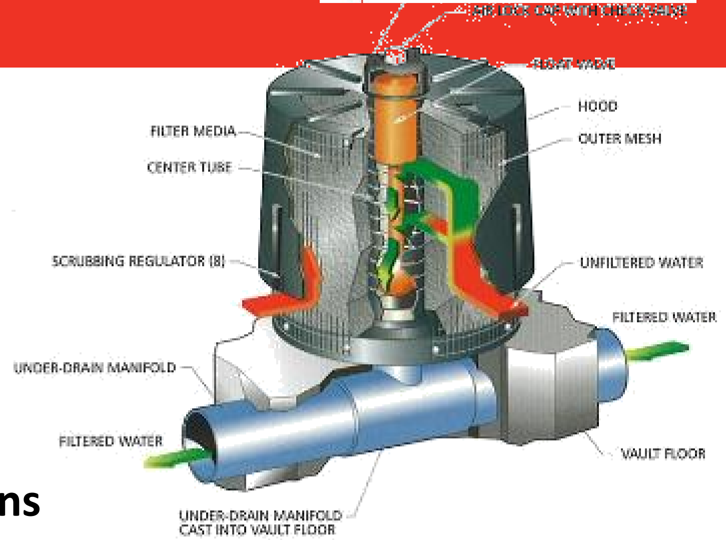
Underground Detention

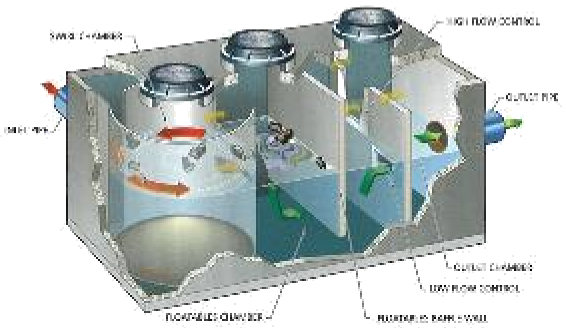
Low Impact Development – Water Quality Compliance

Attributes

- Remove oil, greases and sediment
- Can be used as a pre-treatment device
- Removal efficiency can exceed 80% of heavy particulates







Considerations

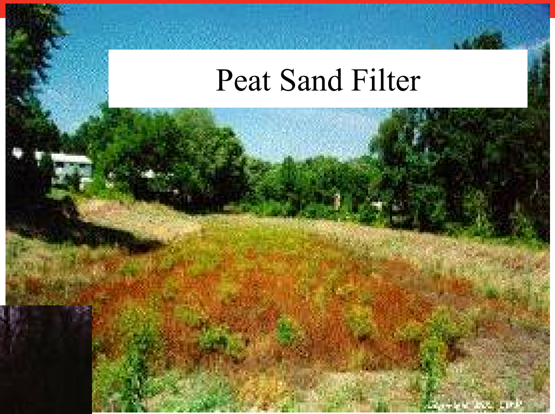
- Can be expensive for service area
- Maintenance is difficult w/out proper equipment
- Does not attenuate peak flows or reduce runoff volume
- Low-to-no removal efficiency for nutrients and/or fine particulates

Manufactured Systems

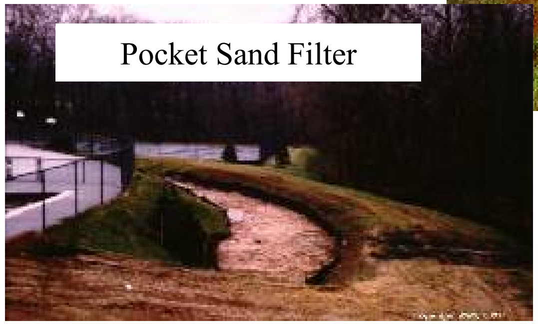
Low Impact Development – Water Quality Compliance

Attributes

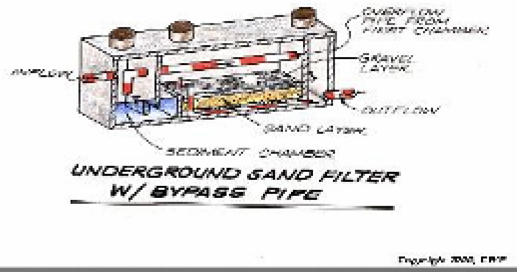
- Remove oil, greases, bacteria and fine particulate sediment
- Can reduce peak flow velocity
- Can be underground


Peat Sand Filter


Compost Filter


Pocket Sand Filter


Perimeter Sand Filter



Considerations

- Expensive for service area
- More intensive maintenance required
- High solids will clog w/out pretreatment
- Certain designs maintain permanent pools
- Need high hydraulic head to push flow through various media

Media Filters

Low Impact Development – Water Quality Compliance

- Bioretention (Distributed Storage)
  - Vegetated Swales (Rain Gardens in Series, conveyance & BMP!)
  - Rain Gardens
  - Bioretention Areas
  - Streetscape Integration
- Permeable Pavement
- Green Roofs
- Water Harvesting
- Watercourse Buffers
- Stormwater Wetlands

Low Impact Development – Water Quality Compliance

- **Attributes**
- Reduces volume of runoff
- Reduces concentrations of metals & nutrients
- Thermal reduction of runoff
- Aesthetically pleasing, Looks identical to traditional landscaped areas
- Meets most Post-Construction water quality standards
- Promotes groundwater recharge
- Reduces size and footprint of detention facilities

Bioretention

Low Impact Development – Water Quality Compliance

Seattle SEA

Taco Bell – Wadsworth, Ohio

Considerations

- Landscaping Costs can be higher then traditional site for native plants
- Requires maintenance similar to a traditional landscape area with extra care for use of native plants
- Construction oversight and sequencing is critical during construction

Bioretention

Low Impact Development – Water Quality Compliance

Attributes

- Lower life-cycle costs when using permeable pavement (concrete & asphalt) or permeable concrete pavers
- Permeable pavers have aesthetic value
- Groundwater recharge for some locations
- Attenuates peak flows and reduces runoff volume
- Reduces size and footprint of detention facilities

Permeable Pavement to Bioretention

Dillon Park, Hamilton County, IN

Considerations

- Initial capital costs can be more than double of traditional asphalt
- Construction sequencing and site stabilization is critical to keep from catastrophic clogging
- Pervious pavements can require additional maintenance as compared to traditional asphalt or concrete

Permeable Pavement

Low Impact Development – Water Quality Compliance

Traditional Concrete has about a 95% runoff coefficient. This means that for the most part the soil's water absorption capabilities are not utilized

The porosity allows an actual pavement infiltration rate up to 400 in/hr. This means that the hydraulic conductivity of the underlying gravel and absorption rate of the underlying soil has more of an impact on the level of overall permeability then the pavement itself (Pilat, 2002)

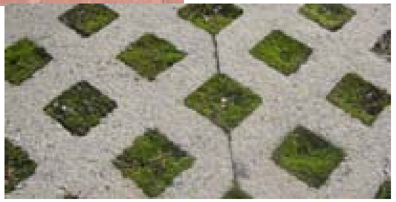
The fear of catastrophic failure after proper construction is fictional. Even if half of the permeable pavement is clogged, the infiltration rate of the remaining sections is more then adequate for any anticipated rain event. (Hunt, 2007)

Photo by Greg McKinnon from Puget Sound Online

Pervious Concrete

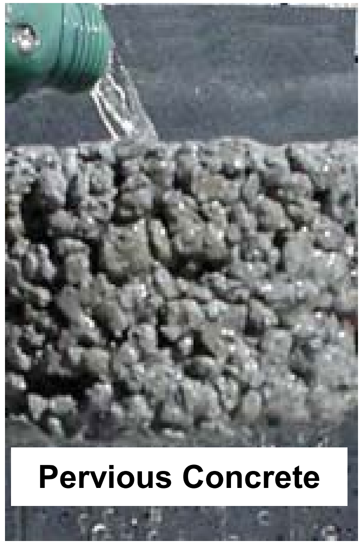
Low Impact Development – Water Quality Compliance

Permeable Interlocking Concrete Pavers (PICP)



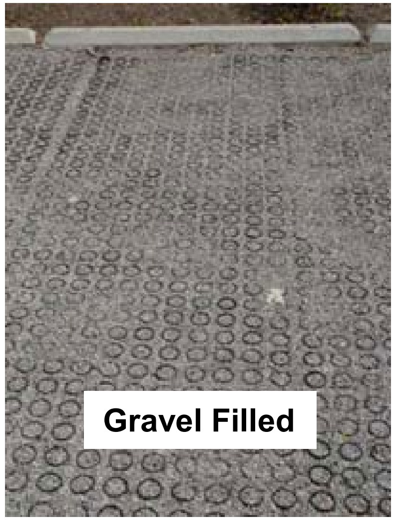
Concrete Grid Pavers (CGP)

Pervious Asphalt



Pervious Concrete

Soil Filled for Grass Growth



Gravel Filled

Pervious Pavement

Low Impact Development – Water Quality Compliance

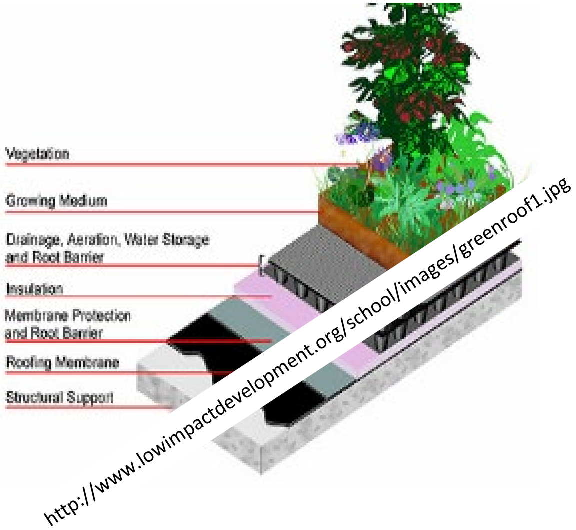
Attributes

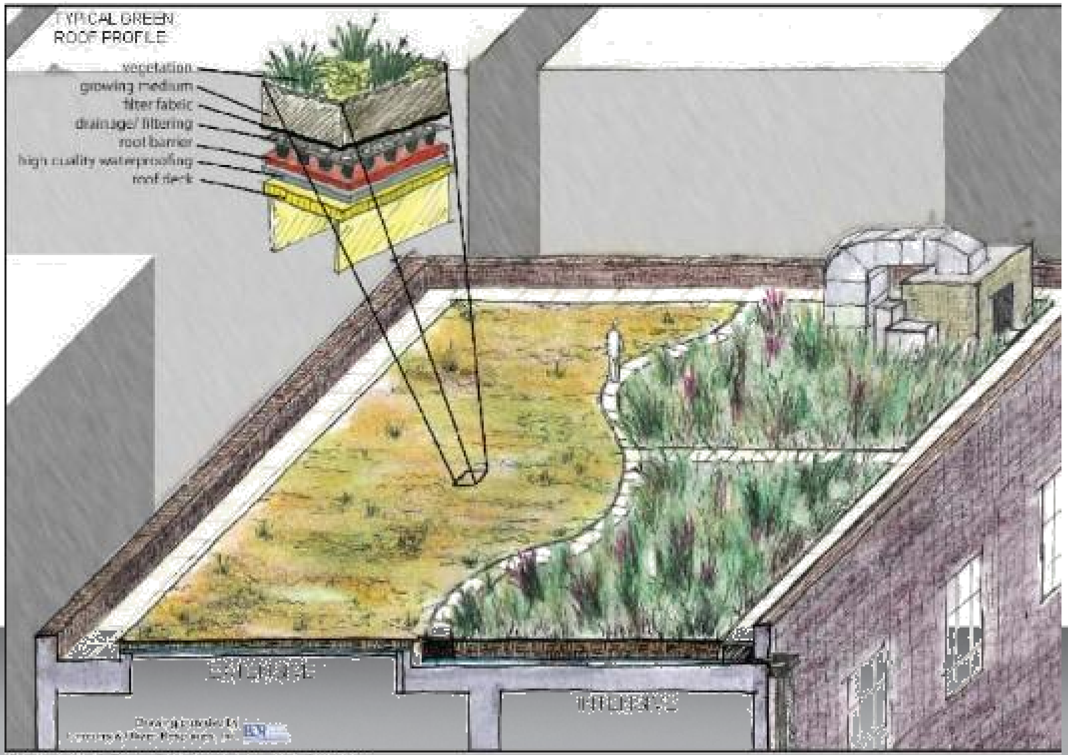
- Attenuates peak flows and reduces runoff volume
- Reduces size and footprint of detention facilities
- Building energy savings

Considerations

- Cost per square foot of treatment is high
- Best suited for high density urban applications
- Inability to treat other areas besides the roof

Courtesy of The Green Institute - Minneapolis, MN





Courtesy of Rice Creek Watershed District

Green Roof

Low Impact Development – Water Quality Compliance

Attributes

- The water is “Free”
- Reduces volume of runoff
- Reduces size and footprint of detention facilities
- Conserves potable water
- Energy savings

Considerations

- Redundant system cost can be higher for re-plumbing and potable backup
- Need to “drain” the BMP in preparation of the next event

Chicago Dept. of the Environment

1500 gallon cistern fed from two gable downspouts.
(Source: Experiments in Sustainable Urban Living)

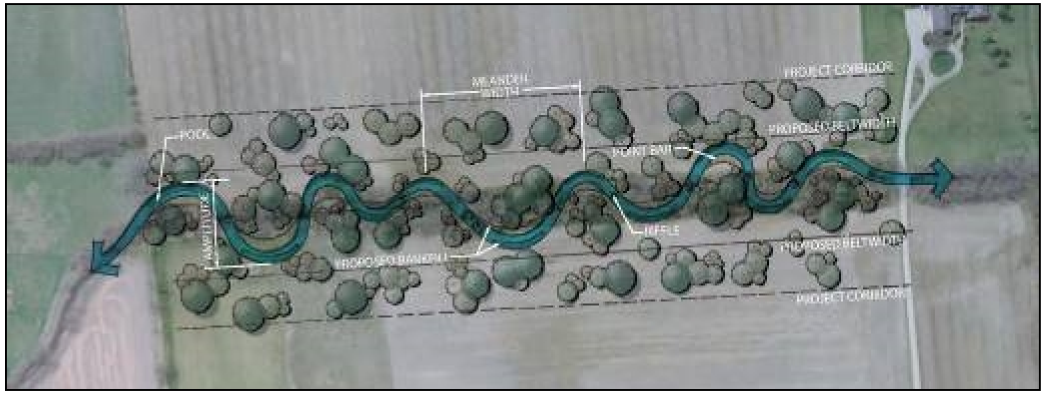
10,000 gallon tank
(Source: American Rainwater Catchment Systems Association)

Water Harvesting

Low Impact Development – Water Quality Compliance

Attributes

- Isolates development from flooding and changing patterns of a stream channel
- Adds value to adjoining land uses
- Preserves wildlife corridors
- Recreational Uses



Considerations

- Costs can be high without any credit for BMP water quality treatment or stream mitigation
- Requires higher level of dedicated maintenance vs. typical ditching

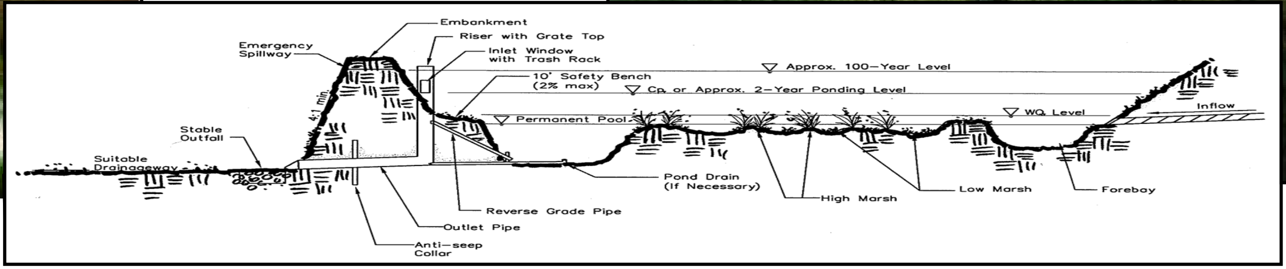
Watercourse Buffer / Stream Restoration

Low Impact Development – Water Quality Compliance

Attributes

- Aesthetics
- Higher level of treatment vs. standard detention pond
- Provide wildlife habitat areas and corridors

Albany Park Stormwater Wetland



Considerations

- Similar safety issues as a wet pond
- Initial intensive maintenance until wetland species are established
- Construction sequencing and site stabilization is critical to keep from catastrophic clogging

Stormwater Wetland (FWS)

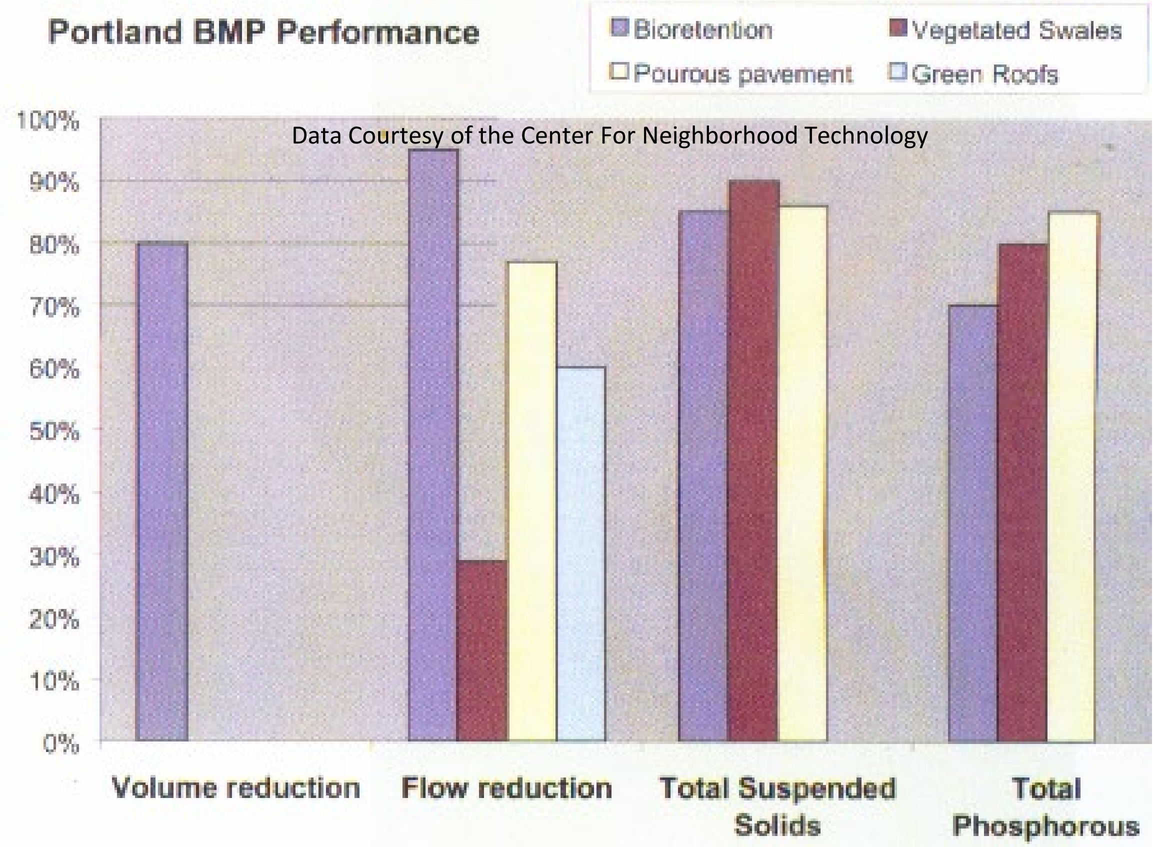
Low Impact Development – Water Quality Compliance

- Research shows that Green Stormwater techniques can be effective in reducing the volume of runoff to predeveloped levels
- Green Stormwater techniques do an excellent job of treating the annual *pollutant load* and *runoff volume* from storm events up to 1” +/- which comprises up to 90% of all annual rainfall events (and up to 80% of the pollutants!)
- When runoff does not leave or get discharged from the BMPs, neither do any pollutants in the water.

Low Impact Development – Water Quality Compliance

Bioswales on Portland's Division Street

Photo courtesy of Portland Bureau of Environmental Services



The Portland Oregon Bureau of Environmental Services performed an effectiveness evaluation of all the BMPs currently in use in the City.

Low Impact Development – Water Quality Compliance

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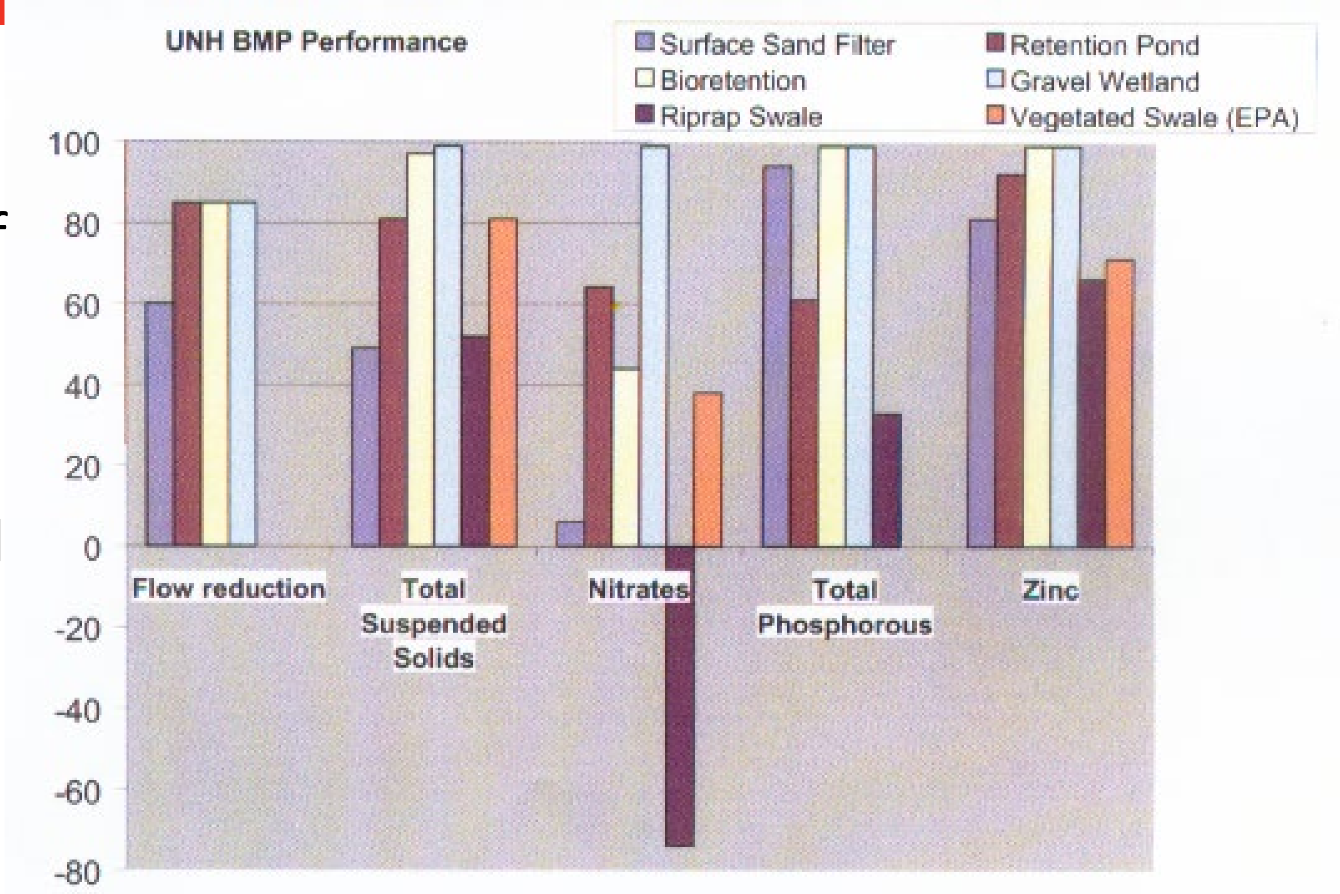
University of New Hampshire

The Stormwater Center compared the performance of conventional stormwater management practices to Green Infrastructure techniques and manufactured devices in a controlled field setting. The site was designed to test each BMP under similar conditions.



Data Courtesy of the Center For Neighborhood Technology

Low Impact Development – Water Quality Compliance

The collaboration efforts of Carmel, Cicero, Noblesville, Fishers, and Westfield with Hamilton County input developed a set of Conventional-to-LID Case Studies.

They are intended to provide an unbiased comparison of associated costs for three (3) different types of typical County development:

- commercial (green field);
- commercial (infill/re-development); and,
- residential (medium density).

Low Impact Development – Water Quality Compliance

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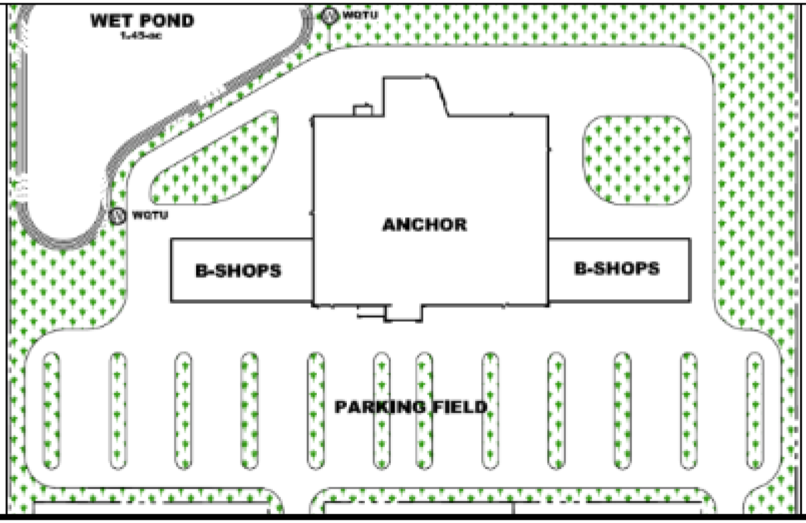
Each alternative uses approved, constructible, engineering based design processes that meet each City's and the County's Stormwater requirements. Calculations were performed for water quality and flood control storage quantities and cost estimates.

To remain conservative, there were no assigned monetary values to intrinsic "quality of life" and/or increased value-per-unit selling values that are typically associated with LID implementation.

Low Impact Development – Water Quality Compliance

Commercial Conventional



Commercial LID

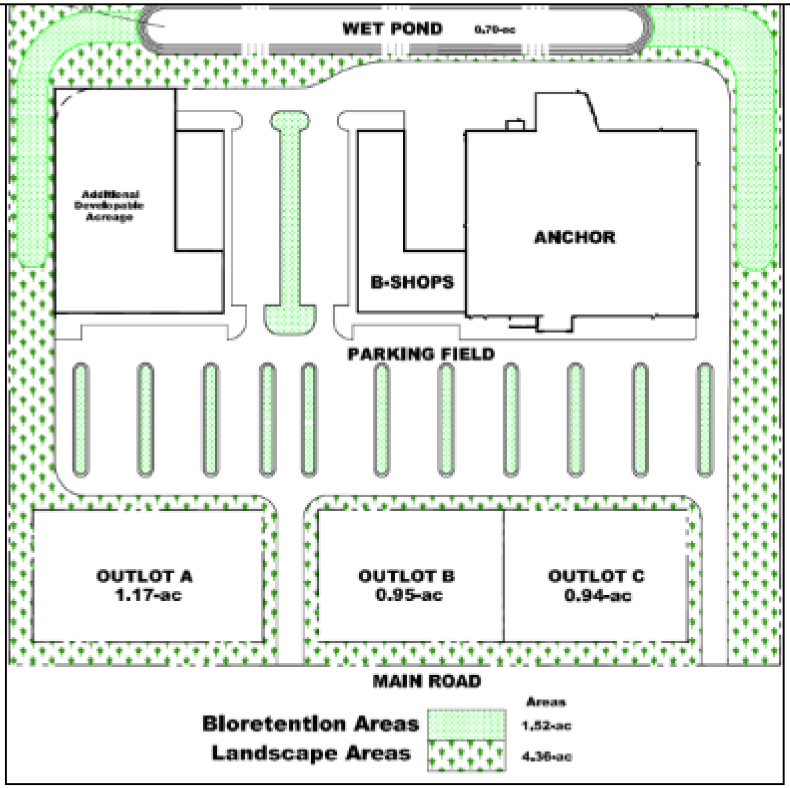


TABLE 1-3 Conventional to LID Direct Cost Comparison

Case Study Technique	Benefits / Savings	Costs	Total Project Cost (Benefits – Costs)
Conventional	$0	($232,500)	($232,500)
LID	$825,000 to $2,495,000	($359,950)	**$465,050 to $2,135,050**
Range of Incremental Benefits of LID		**$697,550 to $2,367,550**	

Information courtesy of the Indiana Cities of Carmel, Cicero, Fishers, Noblesville and Westfield

Things about this update that make you go… Hmmm!?

All permittees must manage stormwater discharges as necessary to meet the narrative water quality criteria (327 IAC 2-1-6(a)(1)(A-D) and 327 IAC 2-1.5-8(a) and (b)(1)(A-D) for any discharge authorized by this permit, with compliance required upon beginning such a discharge.

What does this mean?

Things about this update that make you go… Hmmm!?

327 IAC 2-1-6(a)(1)(A-D) – Minimum surface water quality standards
Sec. 6. (a) The following are minimum surface water quality conditions: (1) All surface waters at all times and at all places, including waters within the mixing zone, shall meet the minimum conditions **of being free from substances, materials, floating debris, oil, or scum** attributable to municipal, industrial, agricultural, and other land use practices, or other discharges that do any of the following: (A) Will settle to form putrescent or otherwise objectionable deposits. (B) Are in amounts sufficient to be unsightly or deleterious. (**C) Produce color, visible oil sheen, odor, or other conditions in such degree as to create a nuisance.** (D) Are in concentrations or combinations **that will cause or contribute to the growth of aquatic plants or algae** to such degree as to create a nuisance, be unsightly, or otherwise impair the designated uses.

327 IAC 2-1.5-8(a) and (b)(1)(A-D) - All surface waters within the Great Lakes system at all times and at all places…

Things about this update that make you go… Hmmm!?

Standard Conditions for General Permits

The following standard permit conditions are incorporated by reference, as applicable to general permits. (partial list)

(a) Duty to Comply	40 CFR 122.41(a)	…must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Clean Water Act.
(e) Proper operation and maintenance	40 CFR 122.41(e)	The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control…installed to achieve compliance with … this permit.
(m) Bypass	40 CFR 122.41(m)	(4) Prohibition of bypass

Things about this update that make you go… Hmmm!?

Let's look at recent legislation regarding Storm Water Pollution Prevention Plans and Implementation. Knowing what you know now, what relief from Rule 5 (or Rule 13) and the Clean Water Act will you receive from:

- 3 days to fix a SWPPP BMP that is malfunctioning?
- Working on property less than 1 acre? On a property greater than 1 acre?
  - New development or re-development?
- The reviewing authority has indicated that construction plan (SWPPP) is substantially complete? (in any timeframe).
- Not requiring treatment more stringent than 327 IAC 15-5?
  - (remember the "Duty to Comply" and "Proper Operation and Maintenance" and "no color"?)
  - And by the way, also in Rule 13.

Things about this update that make you go… Hmmm!?

What do you have in your current ordinances that don't allow:

1. Color
2. Odor
3. Things that could cause aquatic plant and/or algae growth?

I'd ask that you think about what sediment/soil, soluble fertilizers and thermal pollutants may do to any stream?

That last, but not least slide

Remember back when…

<u>Construction Effluent Guidelines</u>

- **Development and <u>Re-development</u> Effluent Guidelines**
- **Impaired waters (TMDLs & IDEM 303(d) list)**
- **Water Quality Standards for the River**
- **Turbidity limit - 380 NTUs**

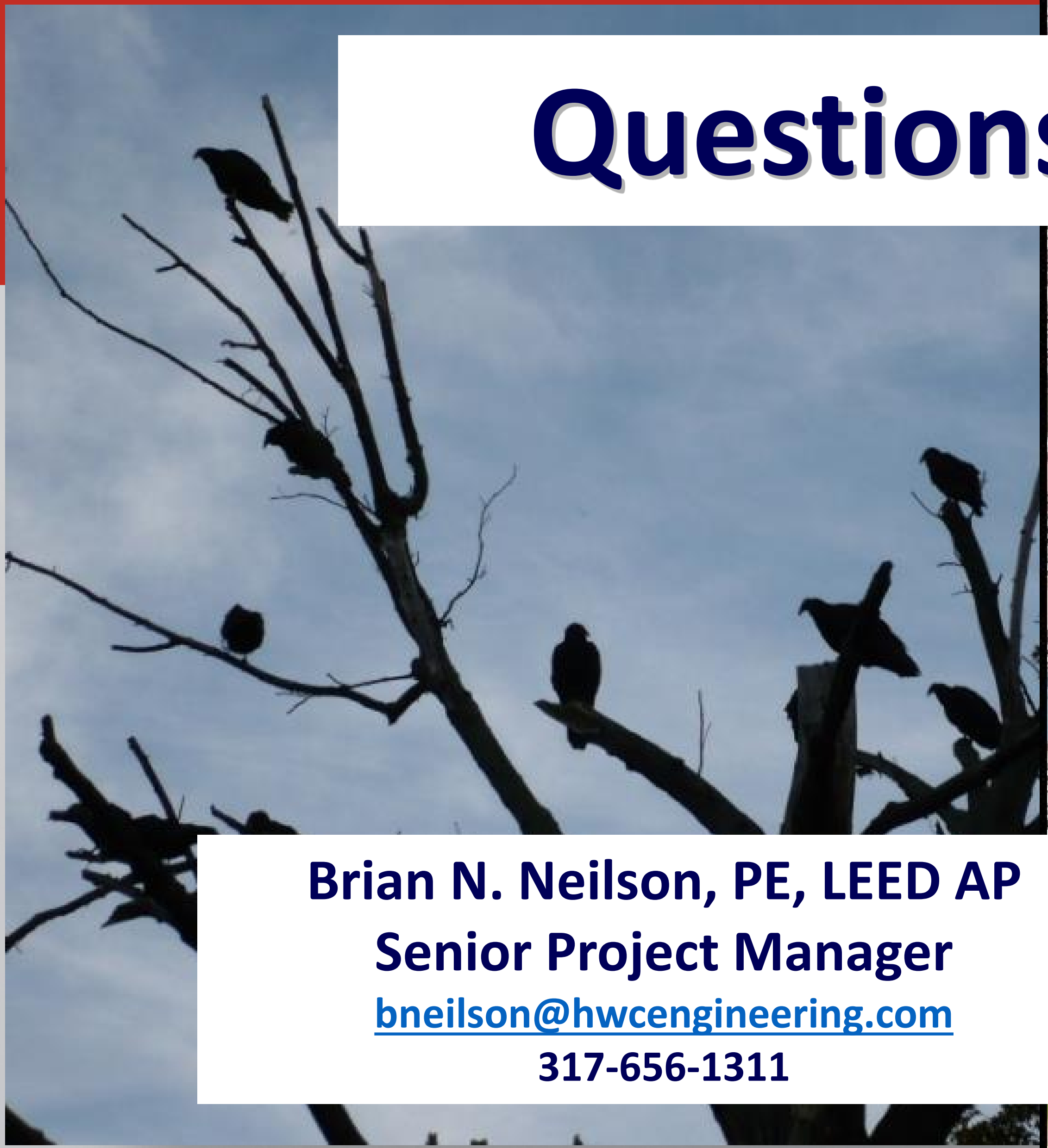
(Nephelometric turbidity units)

(14 to 280 to …)

Which one of these is “color”??

5, 50, and 500 NTUs

Questions / Discussion?



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