Who is this guy?

Introductions

A collaborative group of environmental and design professionals passionate about protecting our waters, restoring healthy ecosystems, and enhancing our community's unique sense of place.

watersheds and water resources

ecosystem restoration

civil engineering & landscape arch.

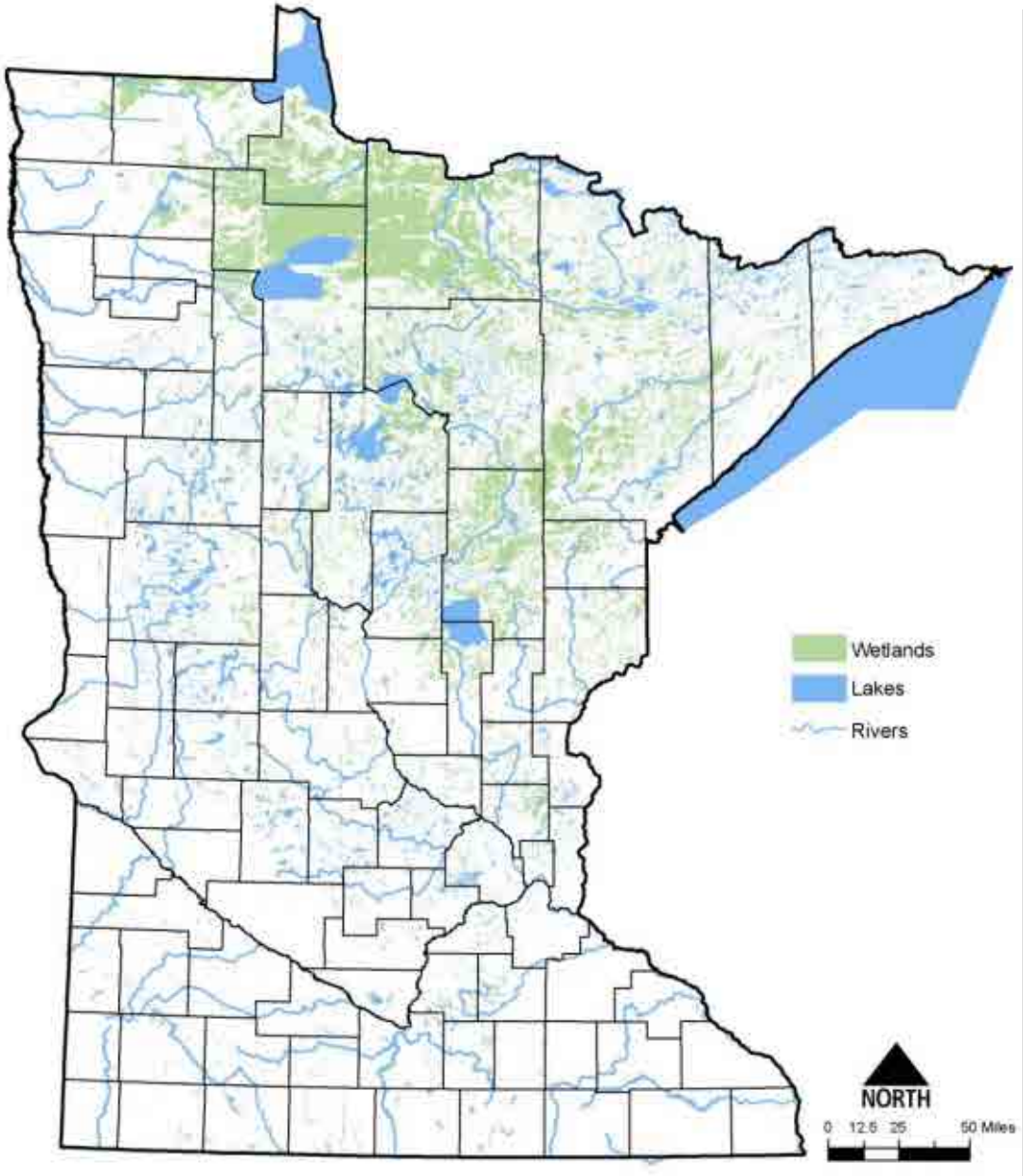

TIME
The Good Life In Minnesota
Gov. Wendell Anderson

The Land of 10,000 Lakes

11,642 lakes > 10 acres

69,200 miles of rivers/ streams

9.3 million acres of wetland



TOURISM

Boating, fishing, hunting, camping, swimming, wildlife watching, and more…


$13 Billion


JOBS JOBS JOBS
250,000
JOBS JOBS JOBS

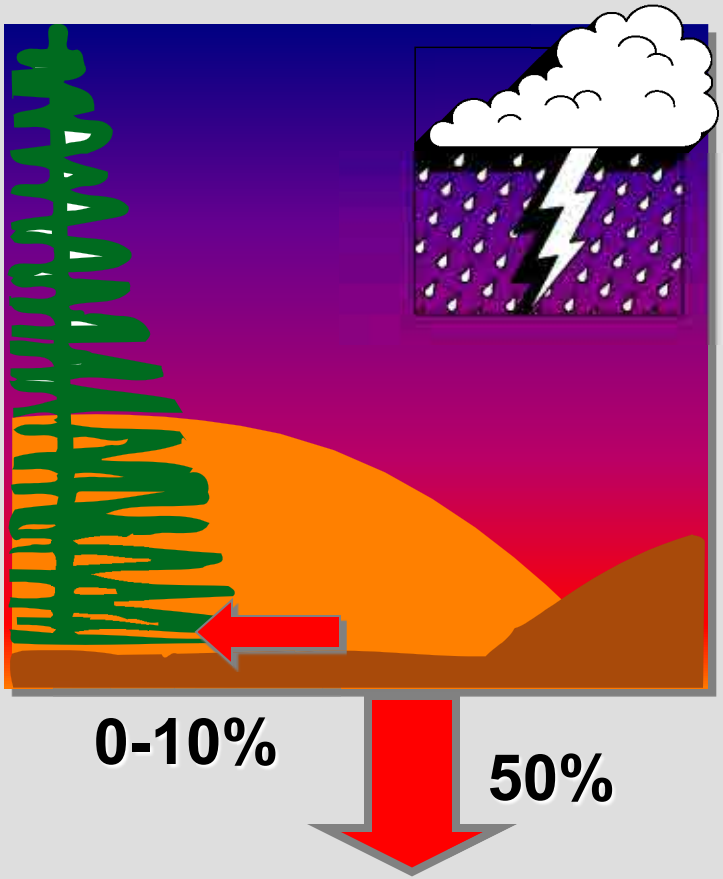
But all is not well…

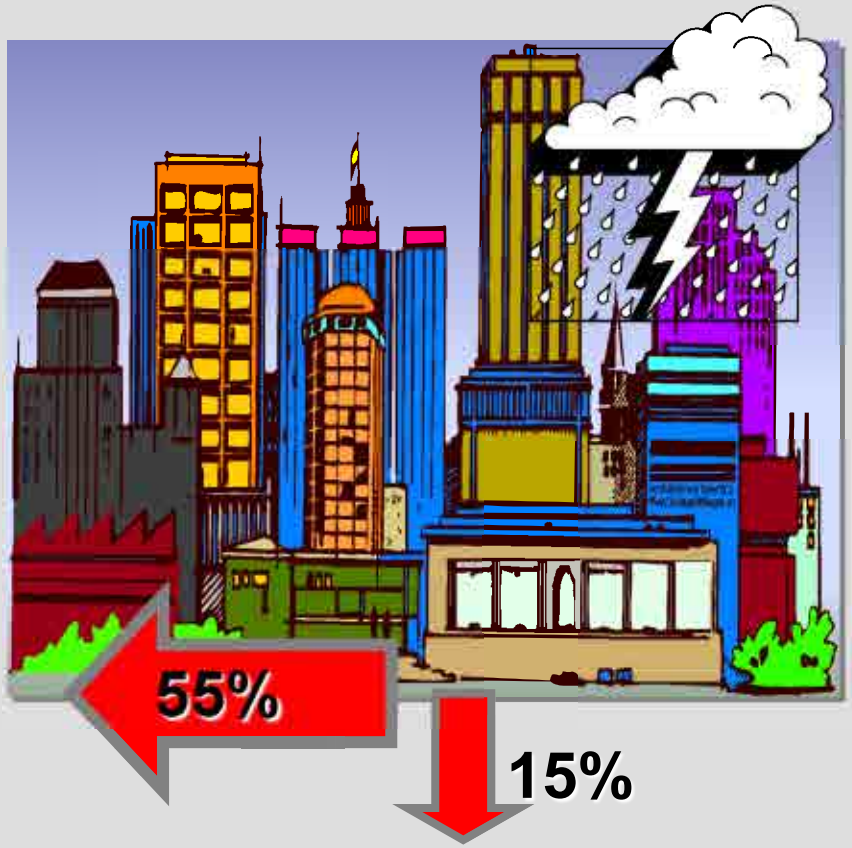
40% OF MINNESOTA SURFACE WATERS ARE FOUND TO BE IMPAIRED

- 2008 Impaired Waters List (303d)
  - 2,575 impairments
- 2010 Impaired Waters List (303d)
  - 3,049 impairments
- 2012 Impaired Waters List (303d)
  - 3,638 impairments
- 2014 Impaired Waters List (303d)
  - 4,122 impairments
- 2016 Impaired Waters List (303d)
  - 4,607 impairments
- 2018 Impaired Waters List (303d)
  - 5,086 impairments

WHY?

Development Impacts on the Water Cycle

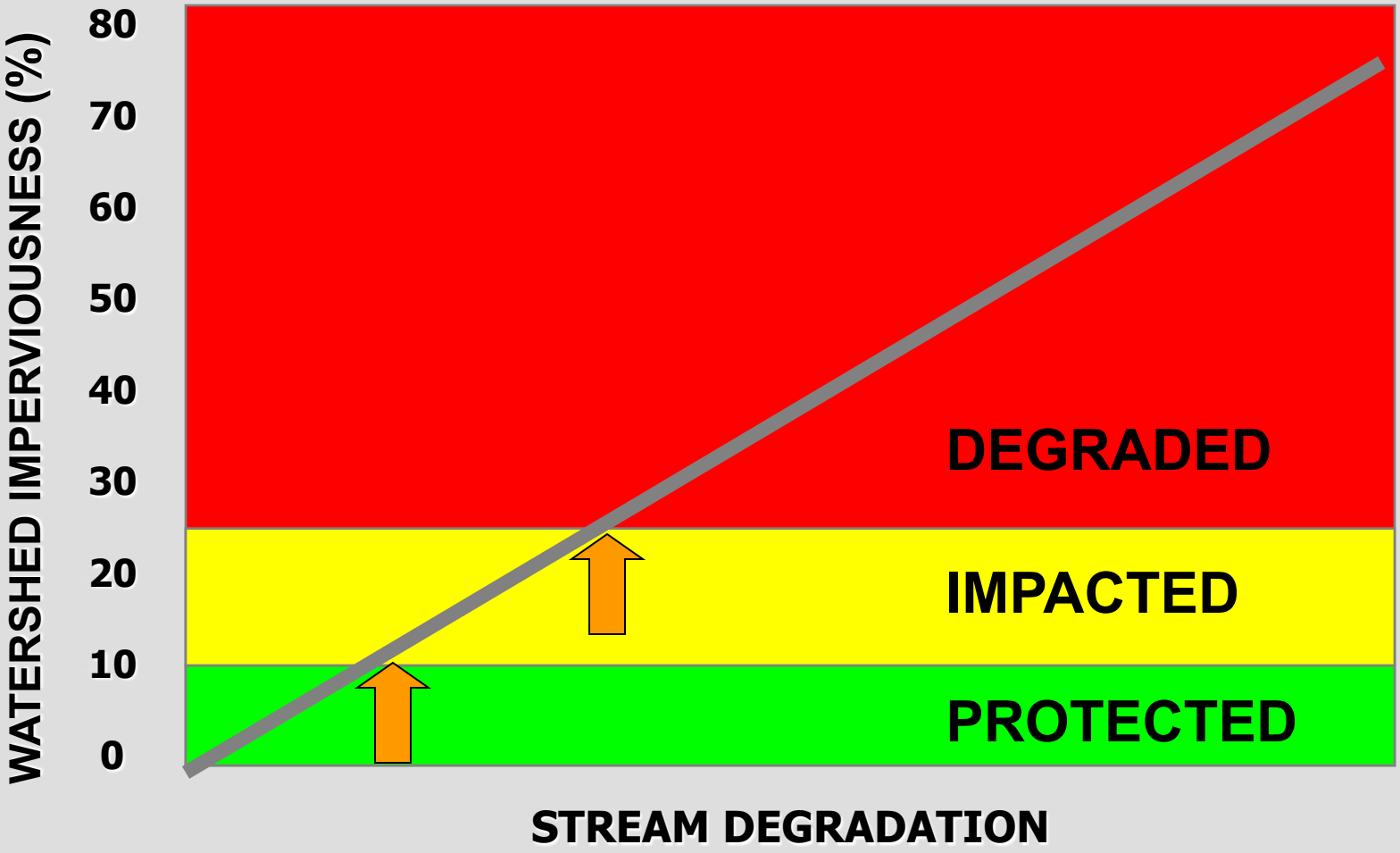




IMPERVIOUS SURFACES

Materials like cement, asphalt, roofing, and compacted soil that prevent percolation of runoff into the ground.

WATERWAY HEALTH & IMPERVIOUSNESS



ADAPTED FROM SCHUELER, ET. AL., 1992

WATER *QUANTITY* IMPACTS

- Disruption of Natural Water Balance
- Increased Flood Peaks
- Increased Duration of Flows
- Streambank Erosion
- Habitat Loss
- Lower Summer Base Flows

WATER *QUALITY* IMPACTS

Nutrients
Pathogens
Sediment
Toxic Contaminants
Debris
Thermal Stress

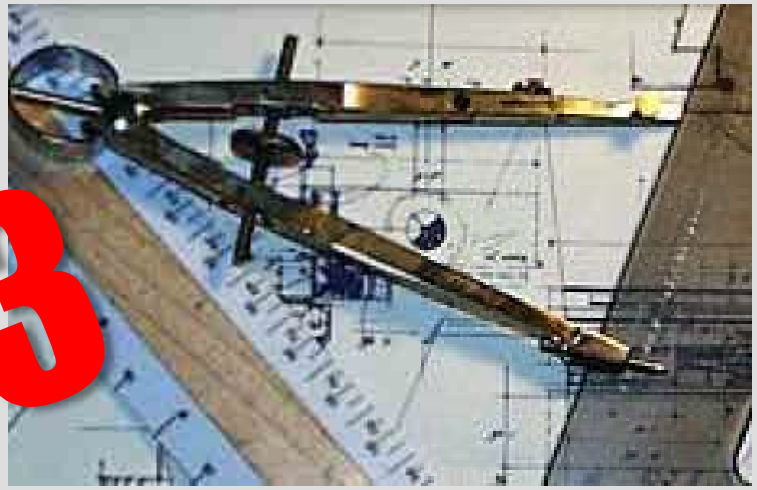
Increased quantity
Decreased quality

A BIG IMPACT…

THE BEGINNING OF MANAGEMENT

National Urban Runoff Program

1983

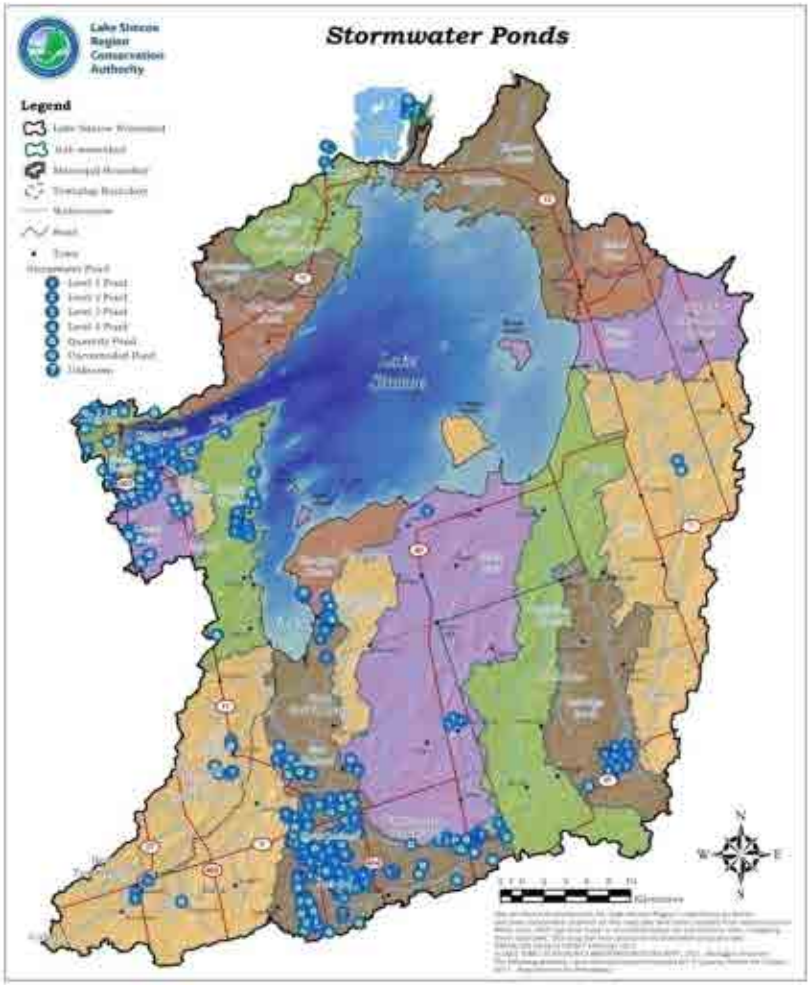


- Technical studies that compiled data about urban runoff
- Resulted in treatment recommendations and easy to apply standards for design and review
- Led to proliferation of ponds


FACT: A Canada Goose Can poop up to 92 times a day
FACT: One adult goose drops 2 lbs of poop per day

Need for Change: Current SWM Practices

- Since 1995 all new development has been required to install stormwater controls, (stormwater ponds),
- Despite this the health and quality of many urban rivers and streams continues to decline,
- In 2010 a study was conducted to answer the question: Are stormwater ponds working?



Are Stormwater Ponds Working?

Maintenance

- Lack of pond maintenance decreases the available storage volume increasing the risk of flooding.

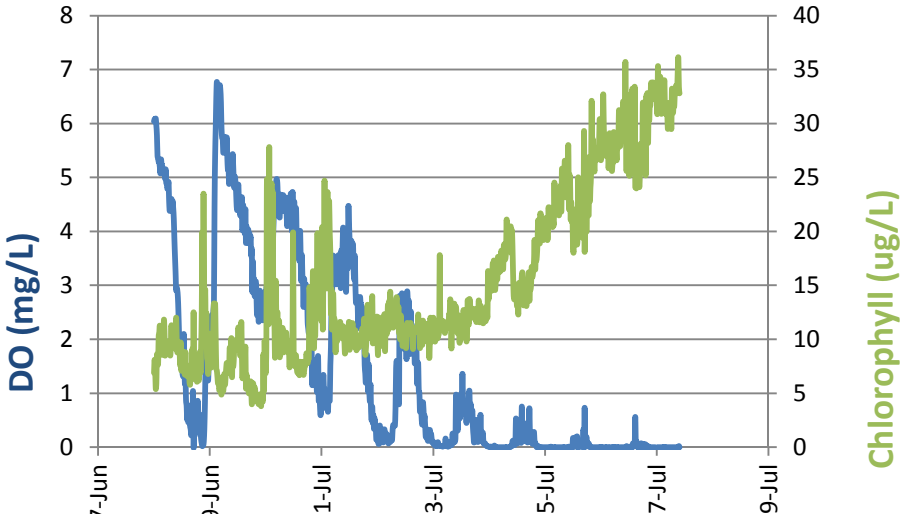
- 56 of the 98 ponds require maintenance at an estimated cost of $18.5 million.
- Assumes the 50,000 m^3 is not contaminated.

Nutrient Attenuation

- Lack of maintenance results in 1.1 T/y loading increase, 1.5% of total annual phosphorus load,

Anoxic Nutrient Release

- Under low oxygen soluble phosphorus can be released from the sediment turning stormwater ponds into nutrient sources.



Risk Management and Liability

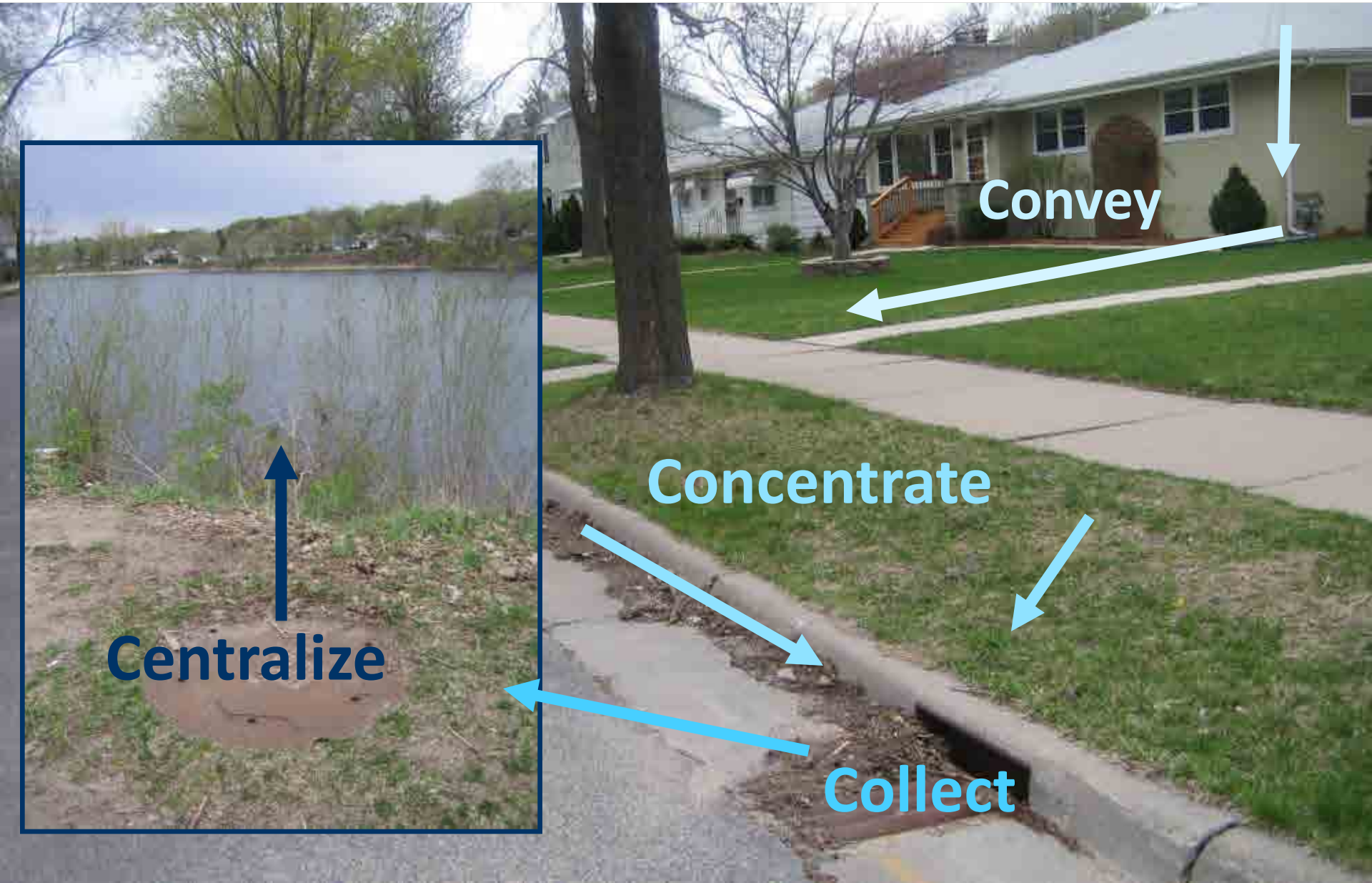
- Municipalities and CA's have a legal obligations,
- Section 21 of the Conservation Authorities Act the LSRCA has the power to control surface waters to reduce their adverse impact and prevent flooding,
- Climate change is dramatically increasing this risk.

Recent Litigation

Minnesota cities sue refiners over cost of cleaning up polluted stormwater ponds

Seven cities say cleanup of carcinogenic chemicals should rest with manufacturers.
By Chris Serres Star Tribune
JANUARY 2, 2019 — 8:21PM

Traditional Stormwater Management



THE NATIONAL ACADEMIES

REPORT IN BRIEF

Urban Stormwater Management in the United States

The rapid conversion of land to urban and suburban areas has profoundly altered how water flows during and following storm events, putting higher volumes of water and more pollutants into the nation's rivers, lakes, and estuaries. These changes have degraded water quality and habitat in virtually every urban stream system. The Clean Water Act regulatory framework for addressing sewage and industrial wastes is not well suited to the more difficult problem of stormwater discharges. This report calls for an entirely new permitting structure that would put authority and accountability for stormwater discharges at the municipal level. A number of additional actions, such as conserving natural areas, reducing hard surface cover (e.g., roads and parking lots), and retrofitting urban areas with features that hold and treat stormwater, are recommended.

Stormwater has long been regarded as a major culprit in urban flooding, but only in the past 30 years have policymakers appreciated its significant role in degrading the streams, rivers, lakes, and other waterbodies in urban and suburban areas. Large volumes of rapidly moving stormwater can harm species habitat and pollute sensitive drinking water sources, among other impacts. Urban stormwater is estimated to be the primary source of impairment for 13 percent of assessed rivers, 18 percent of lakes, and 32 percent of estuaries—significant numbers given that urban areas cover only 3 percent of the land mass of the United States.

Photo by Roger Bannerman

Urbanization—the conversion of forests and agricultural land to suburban and urban areas—is proceeding at an unprecedented pace in the United States. Stormwater discharges have emerged as a problem because the flow of water is dramatically altered as land is urbanized. Typically, vegetation and topsoil are removed to make way for buildings, roads, and other infrastructure, and drainage networks are installed. The loss of the water-retaining functions of soil and vegetation causes stormwater to reach streams in short concentrated bursts. In addition, roads, parking lots, and other "impervious surfaces" channel and speed the flow of water to streams. When combined with pollutants from lawns, motor vehicles, domesticated animals, industries, and other urban sources that are picked up by the stormwater, these changes have led to water quality degradation in virtually all urban streams.

In 1987 Congress wrote a new section into the Clean Water Act's National Pollutant Discharge Elimination System to help address the role of stormwater in impairing water quality. This system, which is enforced by the U.S. Environmental Protection Agency (EPA), has focused on reducing pollutants from industrial process wastewater and municipal sewage discharges—"point sources" of pollution that are relatively straightforward to regulate. Under the new "stormwater program,"

THE NATIONAL ACADEMIES
Advisers to the Nation on Science, Engineering, and Medicine

National Academy of Sciences • National Academy of Engineering • Institute of Medicine • National Research Council

"Past practices…have been ineffective at protecting water quality in receiving waters and only partially effective in meeting flood control requirements"

"Stormwater control measures that harvest, infiltrate, and evapotranspirate stormwater are critical to reducing the volume and pollutant loading of small storms"

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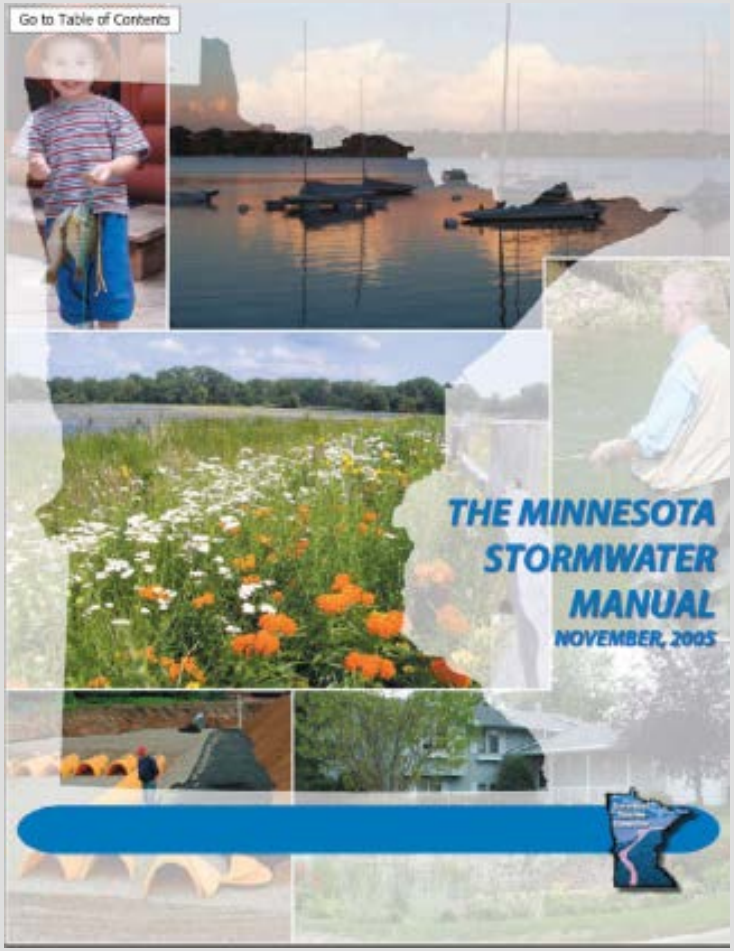
STORMWATER MANAGEMENT

EOR water ecology community

A PARADIGM SHIFT

Now changing to focus on water quality, primarily through small event volume control.

Rain events between 12 and 38 mm are responsible for about 75% of runoff pollutant discharge – “First Flush”



THE CHALLENGE: How do you make this..

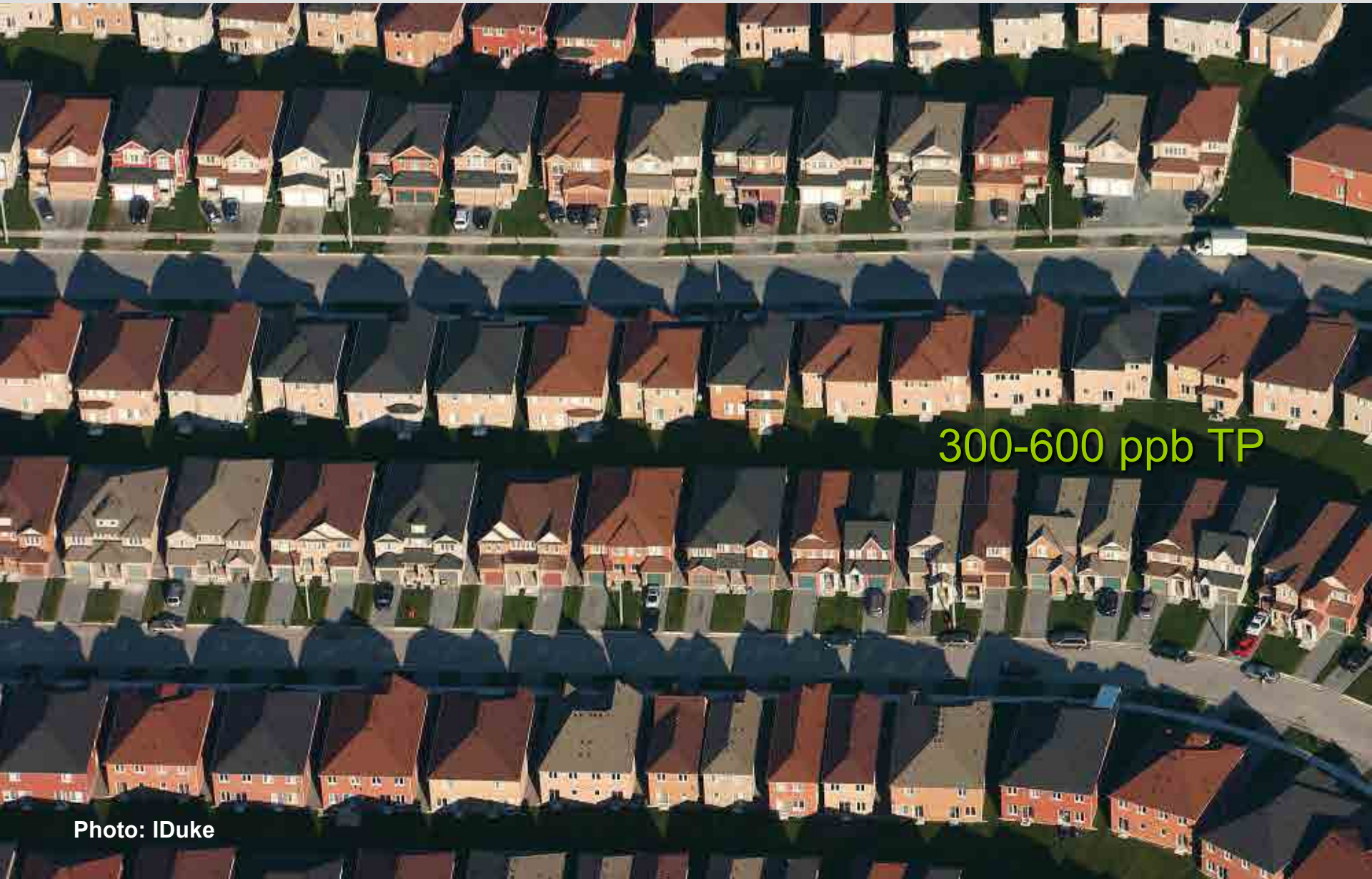
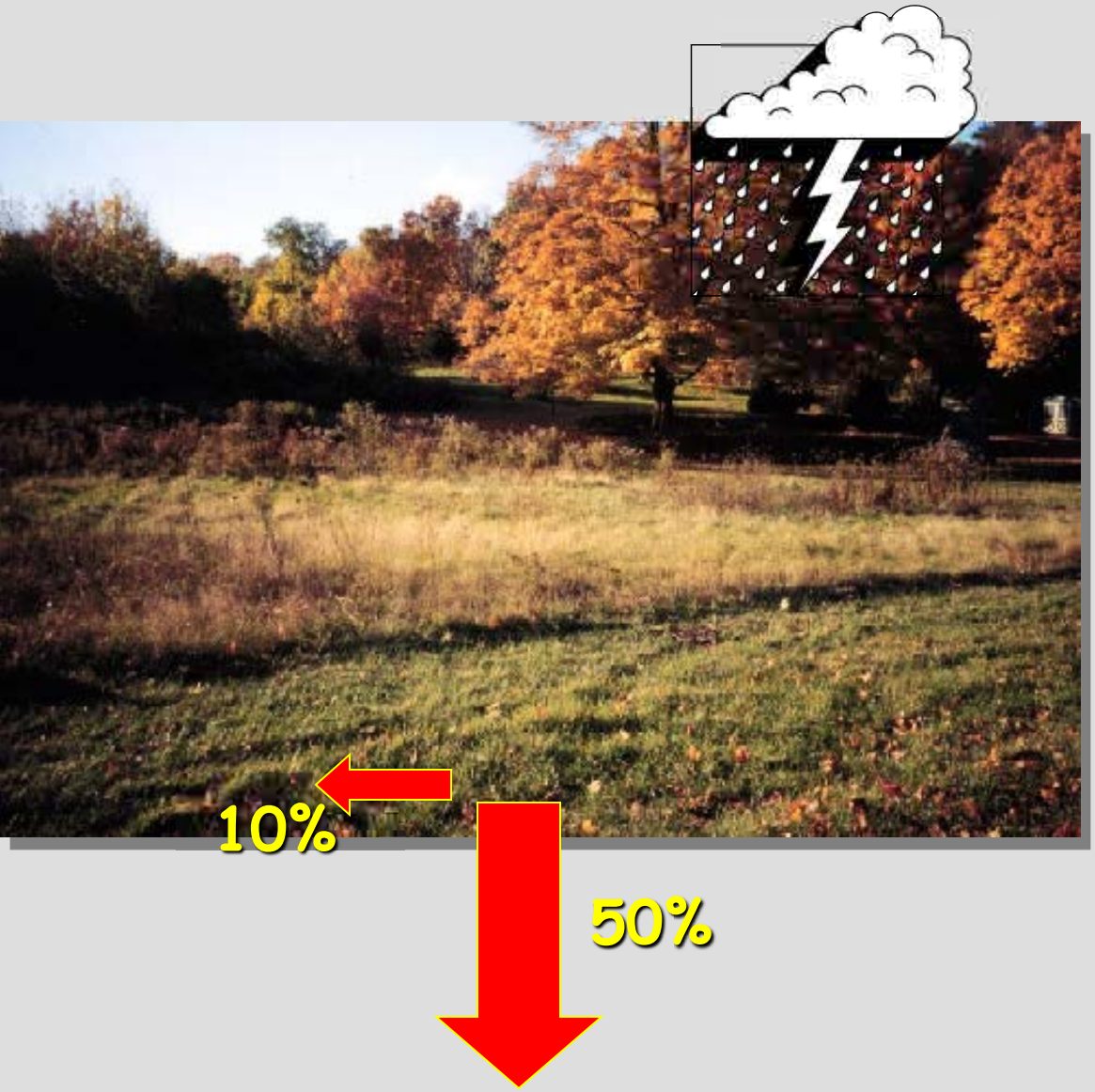


Photo: IDuke

Function like *this*?

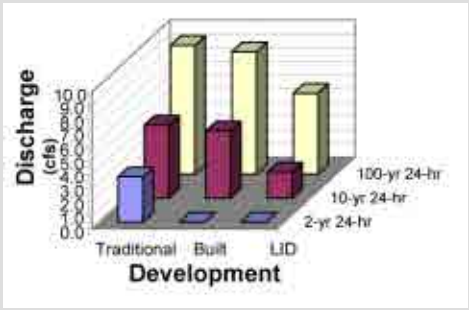
DESIGN PRINCIPLES



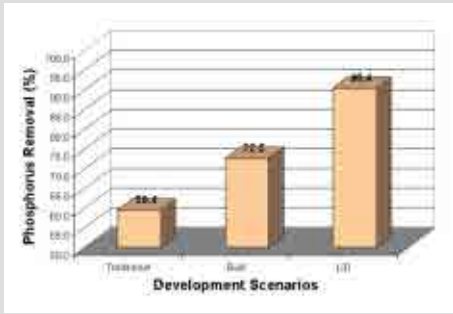
Retain & Restore the Natural Landscape

Low Impact Development (LID)

Conventional Development



Low Impact Development



PRIMARY GOAL OF LID

Design each development site to protect, or restore, the natural hydrology of the site so that the overall integrity of the watershed is protected. This is done by creating a "hydrologically" functional landscape.

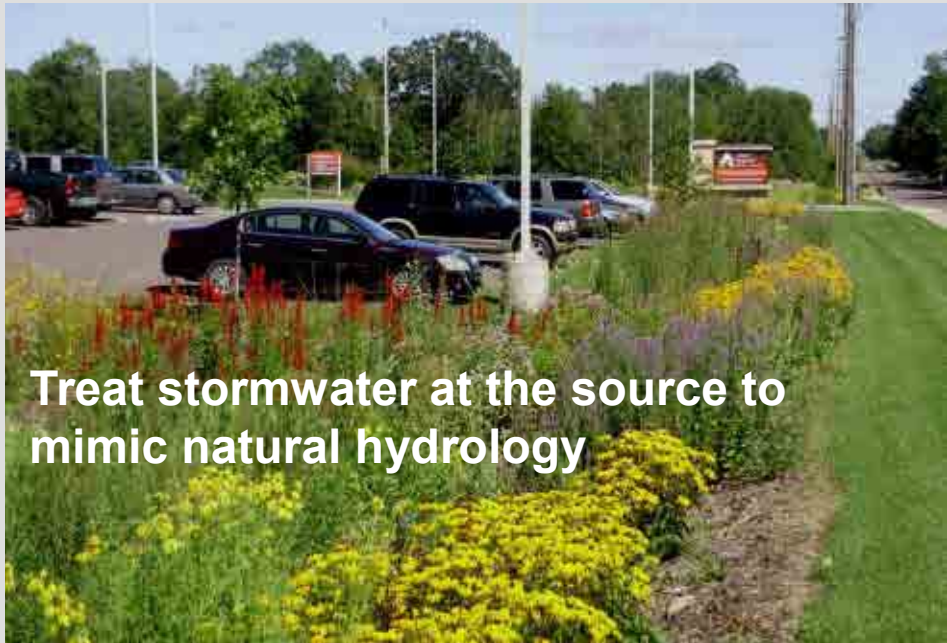
Low Impact Development (LID)

EOR water ecology community

Conserve natural areas and maintain natural drainage patterns

Minimize development impacts

Keep soils healthy



Treat stormwater at the source to mimic natural hydrology

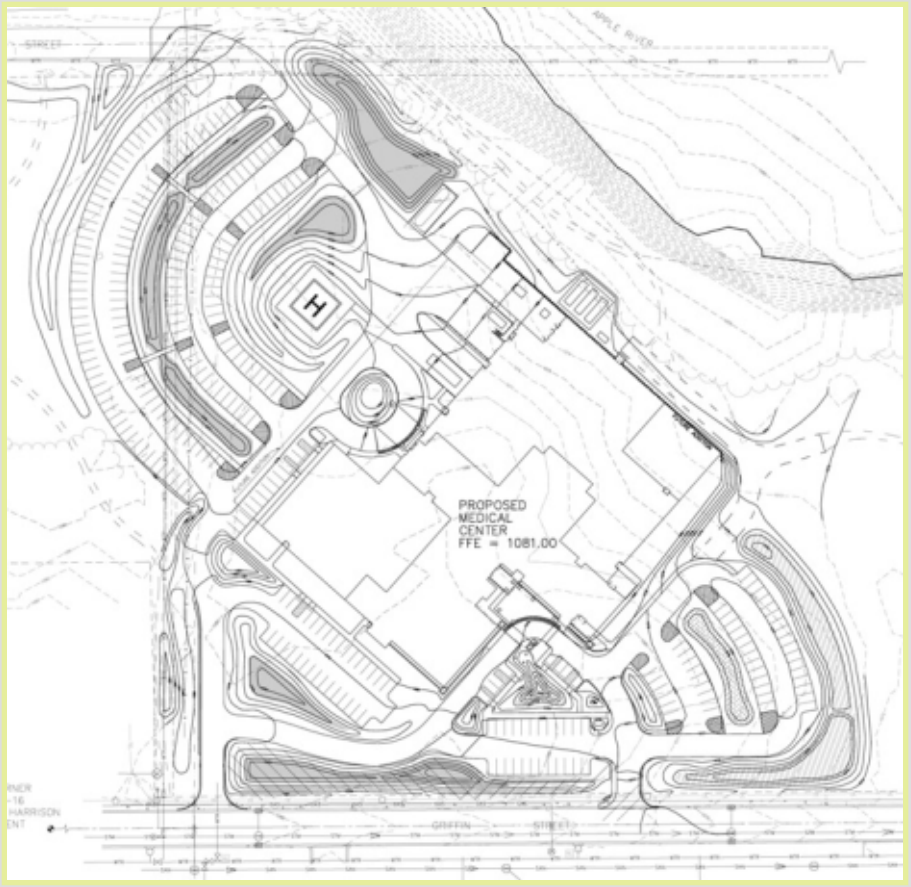
Non-Structural LID Tools

Planning/ Design

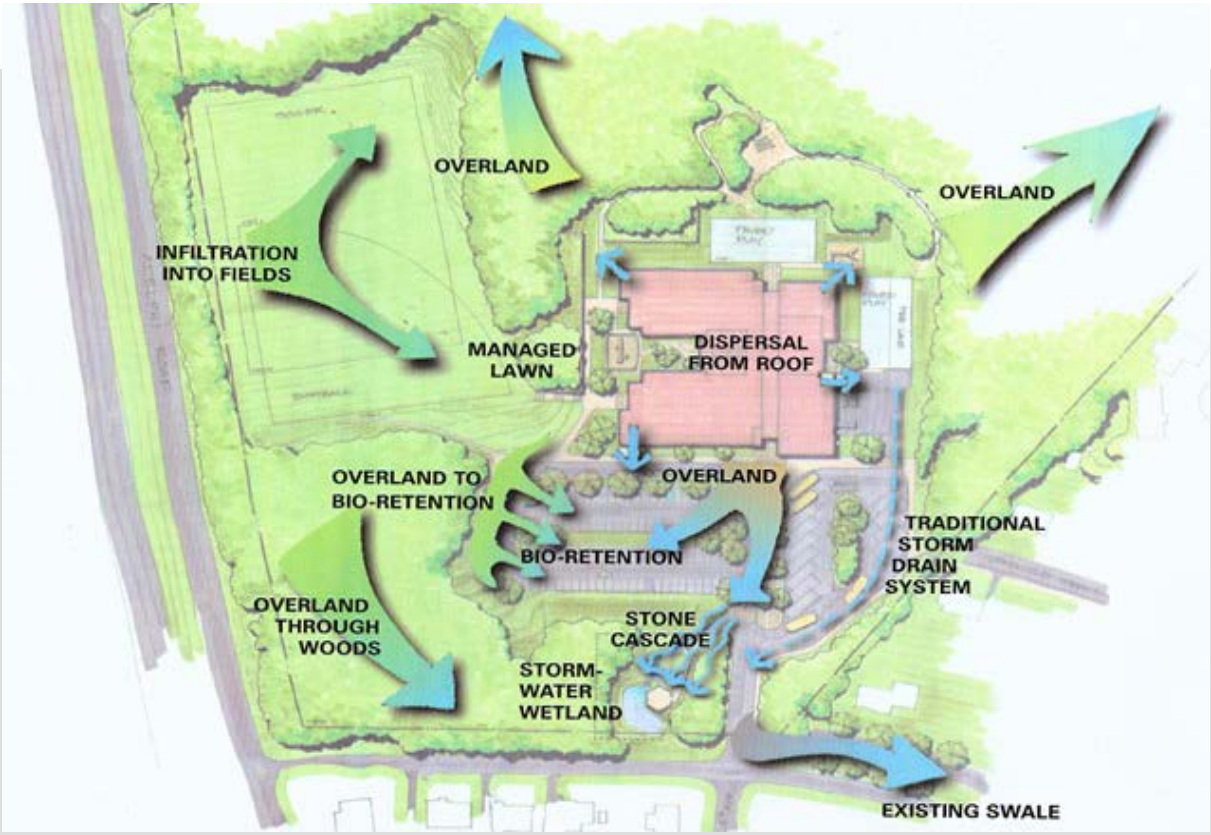
- Cluster Development, Conservation Design
- Minimize total disturbed area
- Protect natural flow pathways
- Protect riparian buffer areas
- Protect sensitive areas
- Reduce impervious areas
- Impervious disconnection

Structural LID Tools

- Infiltration practices
  - Bioretention (rain gardens, urban forestry)
  - Infiltration trenches
  - Detention basins with infiltration design
- Vegetated swales, filter strips, biofiltration
- Vegetation: native landscaping, trees (uptake and evapo-transpiration)
- Green Roofs
- Capture / Reuse (cisterns, rain barrels, ponds)
- Permeable hard surfaces (pavers, roads, parking, driveways, sidewalks)
- Landscaping Soil Quality: protection or restoration (amendments, de-compaction)

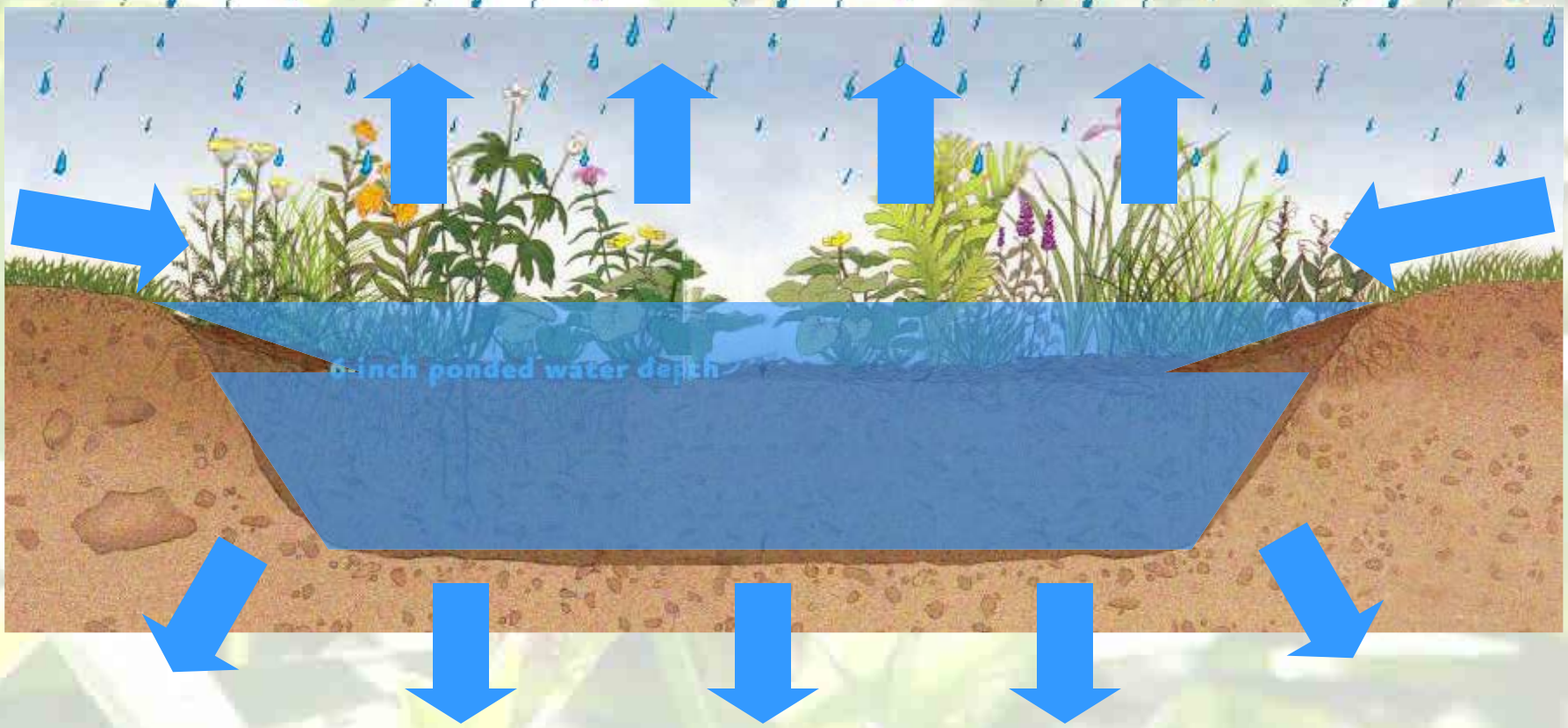


Creating Functional & Sustainable Landscapes



Bioretention/Raingardens

(Capture/Filtration/Infiltration/Evapotranspiration)



Just like a regular planting, but able to absorb rainwater and breakdown pollutants

Concept - Gregg Thompson, Illustration - Taina Litwak, Animation - Ron Struss

Bioretention/Raingardens

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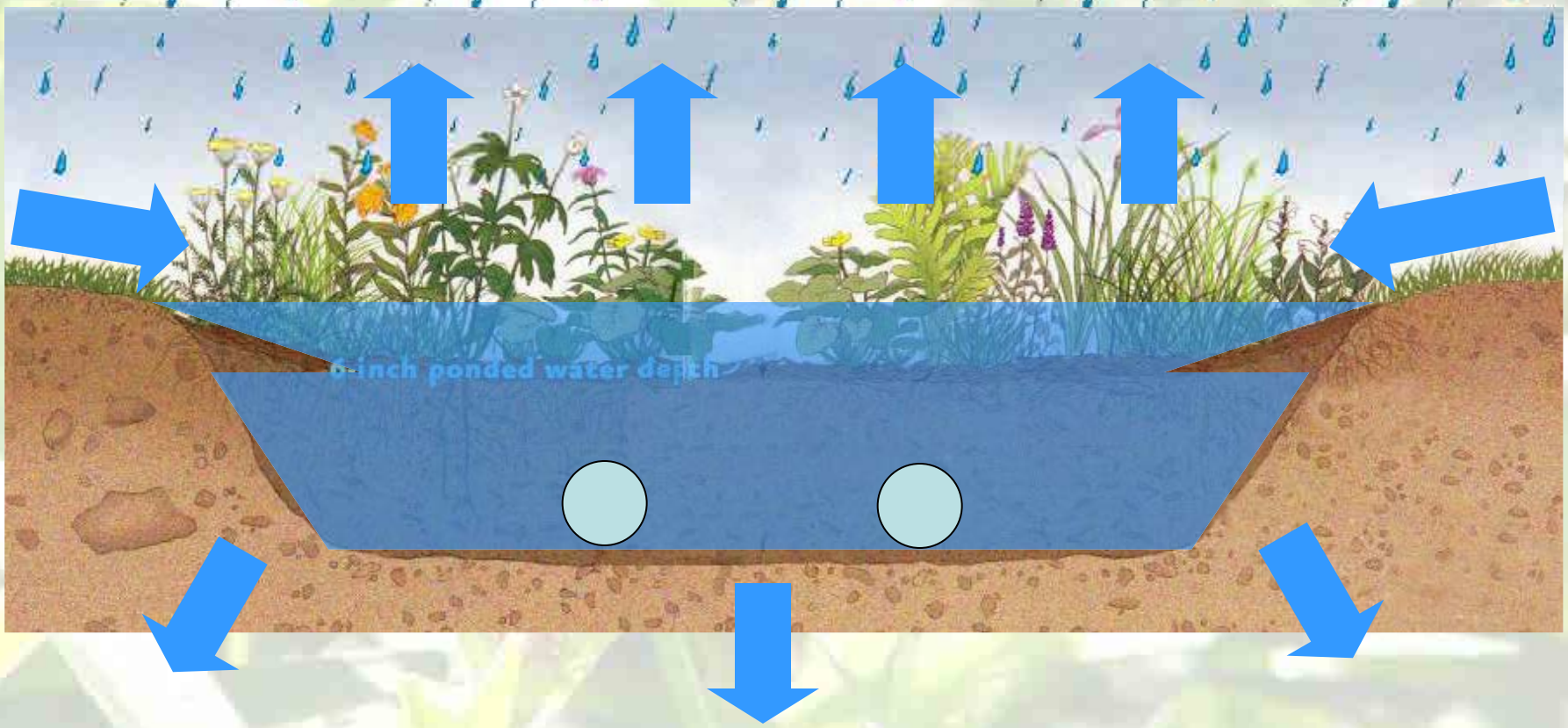

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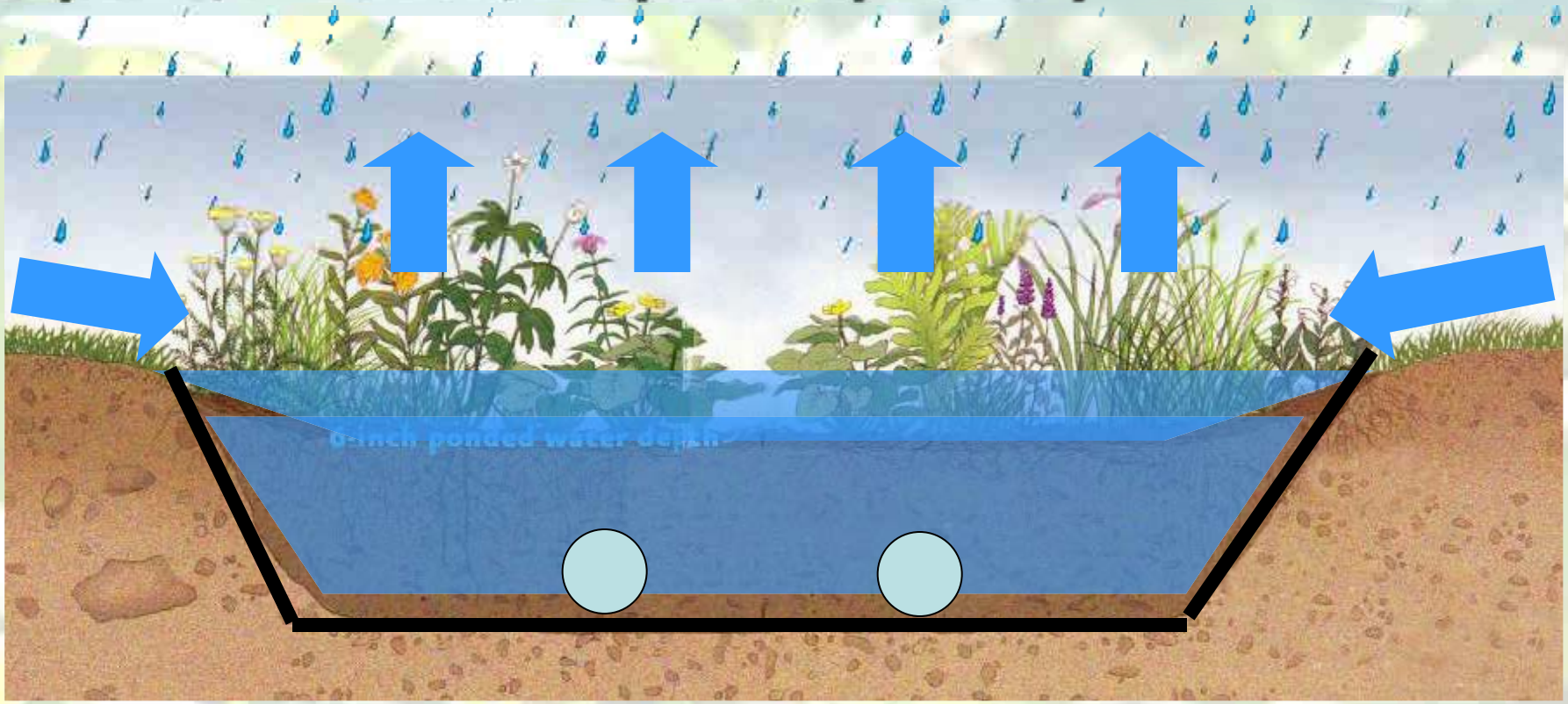

Just like a regular planting, but able to
absorb rainwater and breakdown pollutants

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BIG BENEFITS

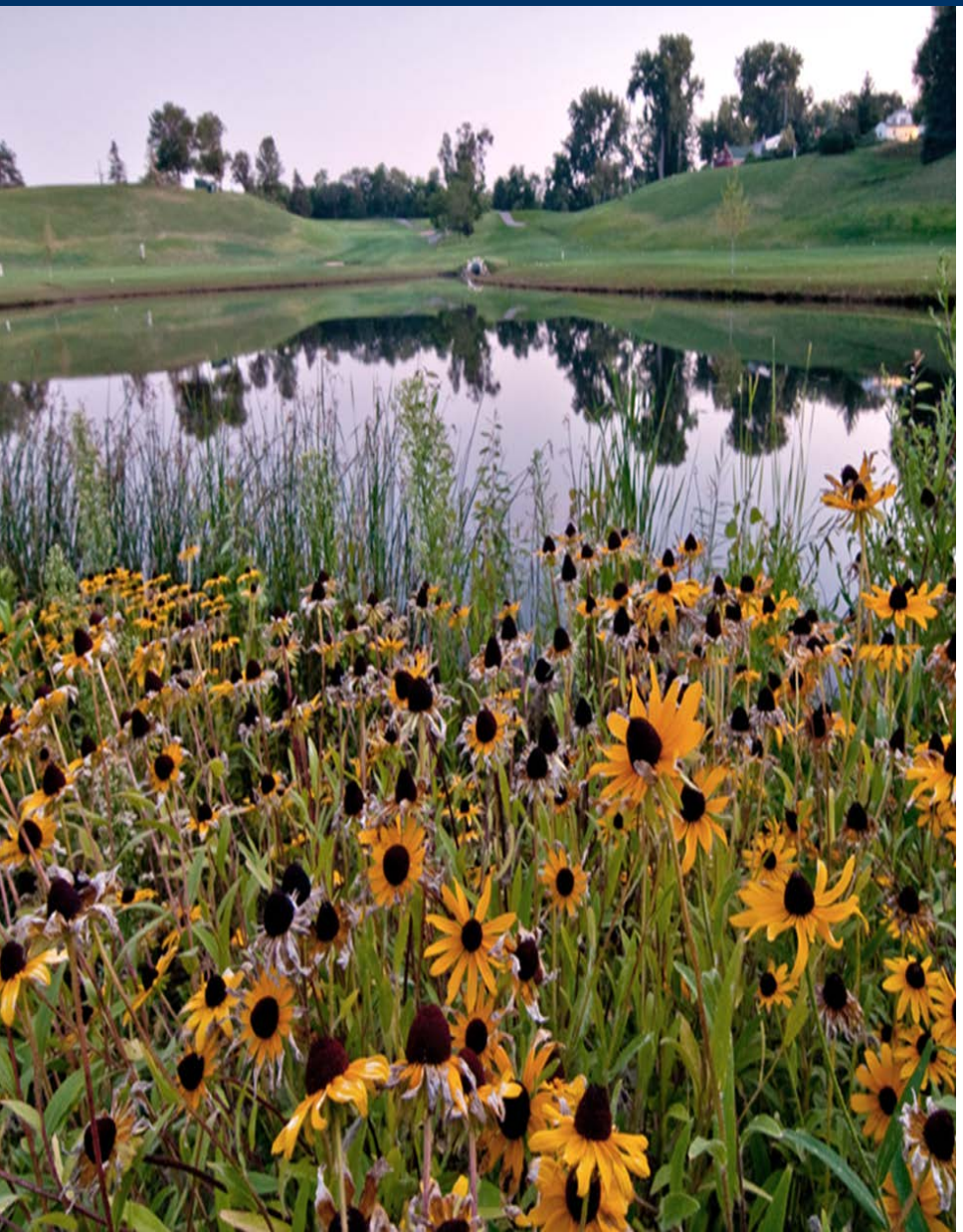
Research increasingly shows the benefits of:

vegetated vs. piped systems

open vs. closed systems

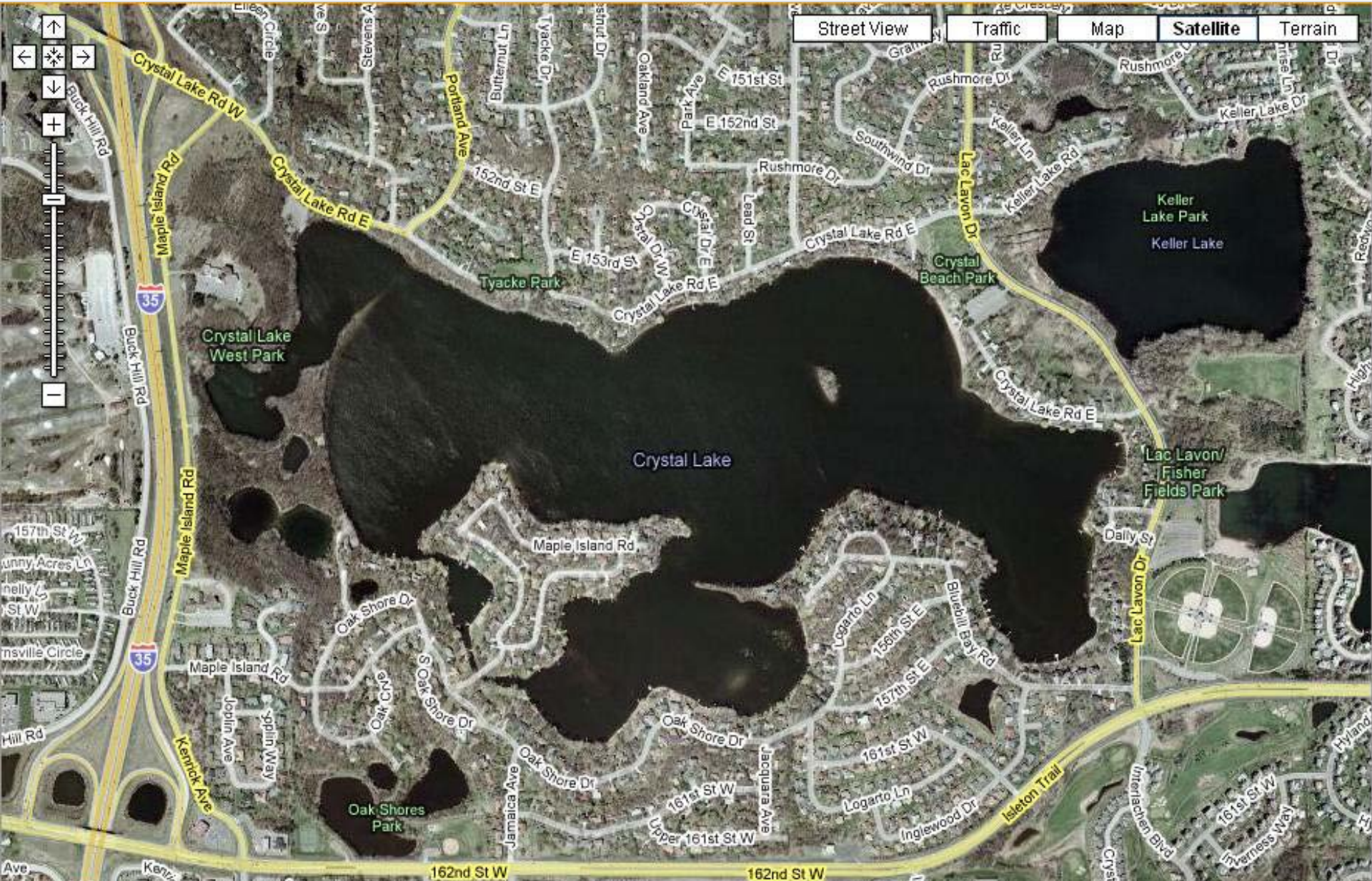
Infiltration/retention vs. detention

Misconceptions in Volume Retention LID



- They do not perform well in cold climates
- They do not play a role in flood mitigation
- They are not as efficient as pipe replacement for under-sized systems
- They are very expensive to maintain
- They lose efficiency with time

CRYSTAL LAKE: A Case Study



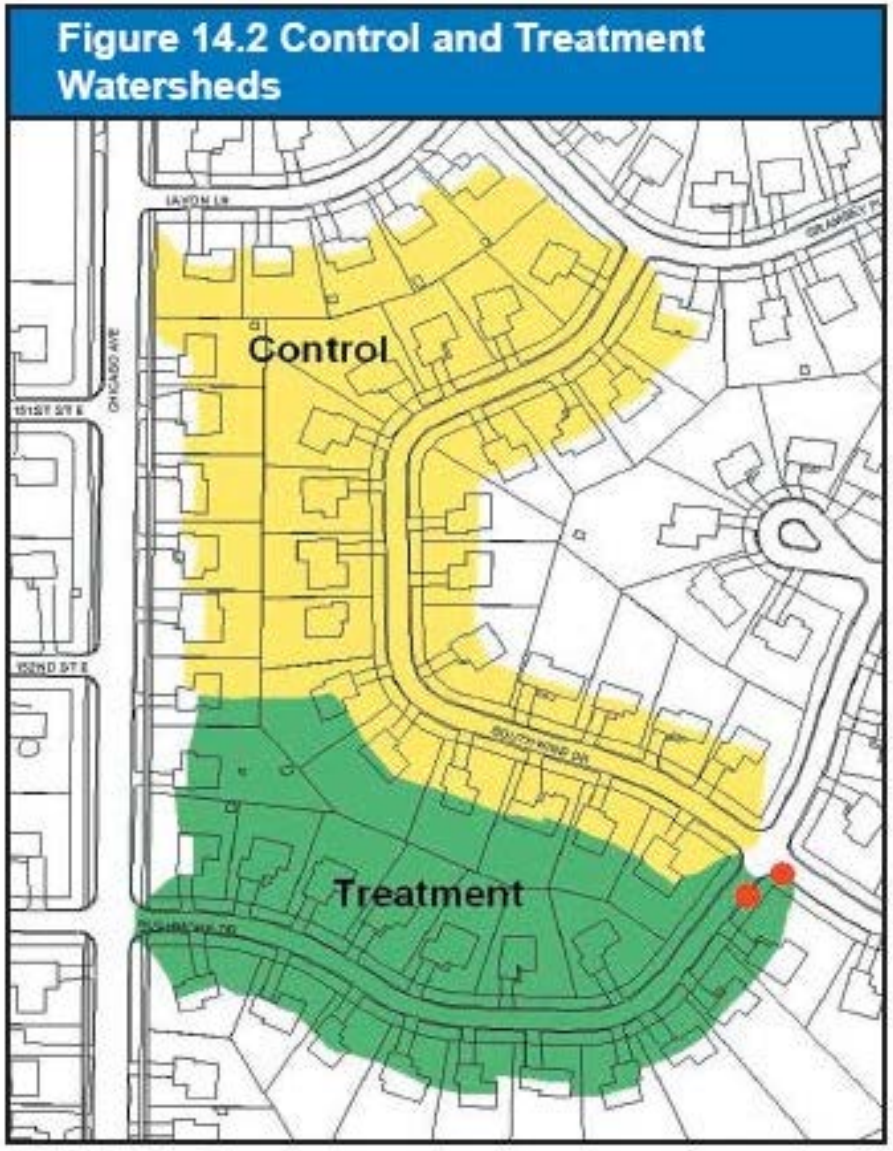
Burnsville, MN: Rushmore Street

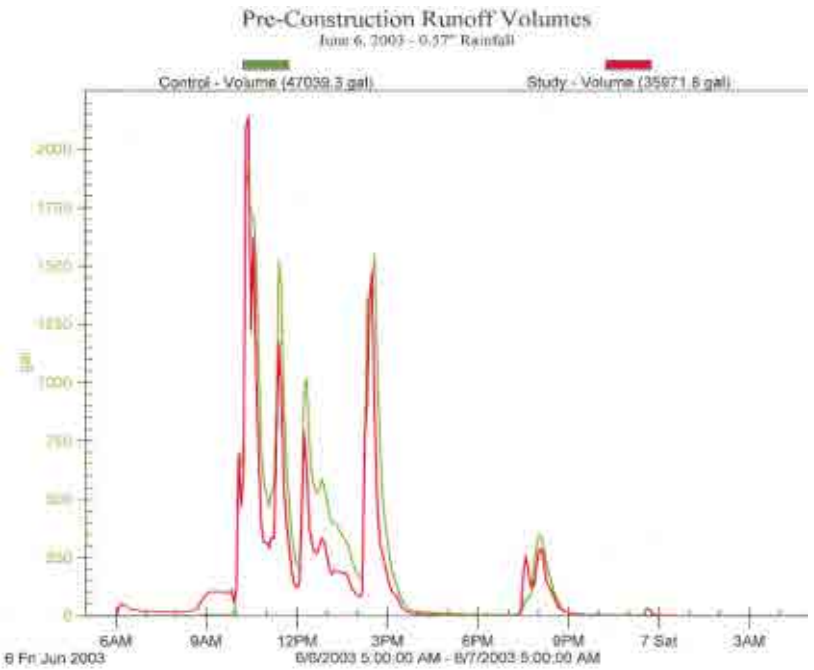
Burnsville – Rushmore Street

5.3 acres – 25 homes – 17 raingardens

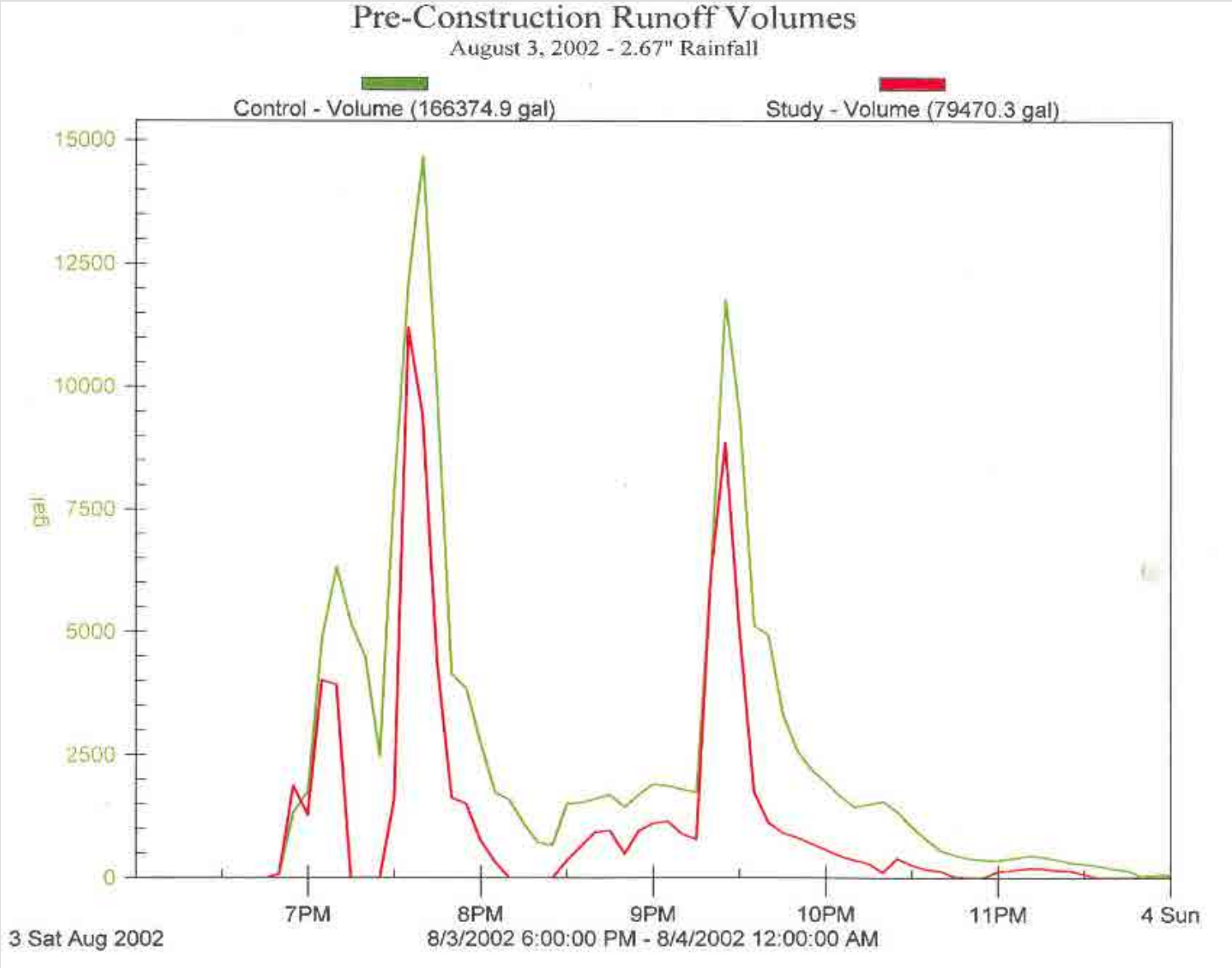
Designed by: Barr Engineering

MONITORING RESULTS

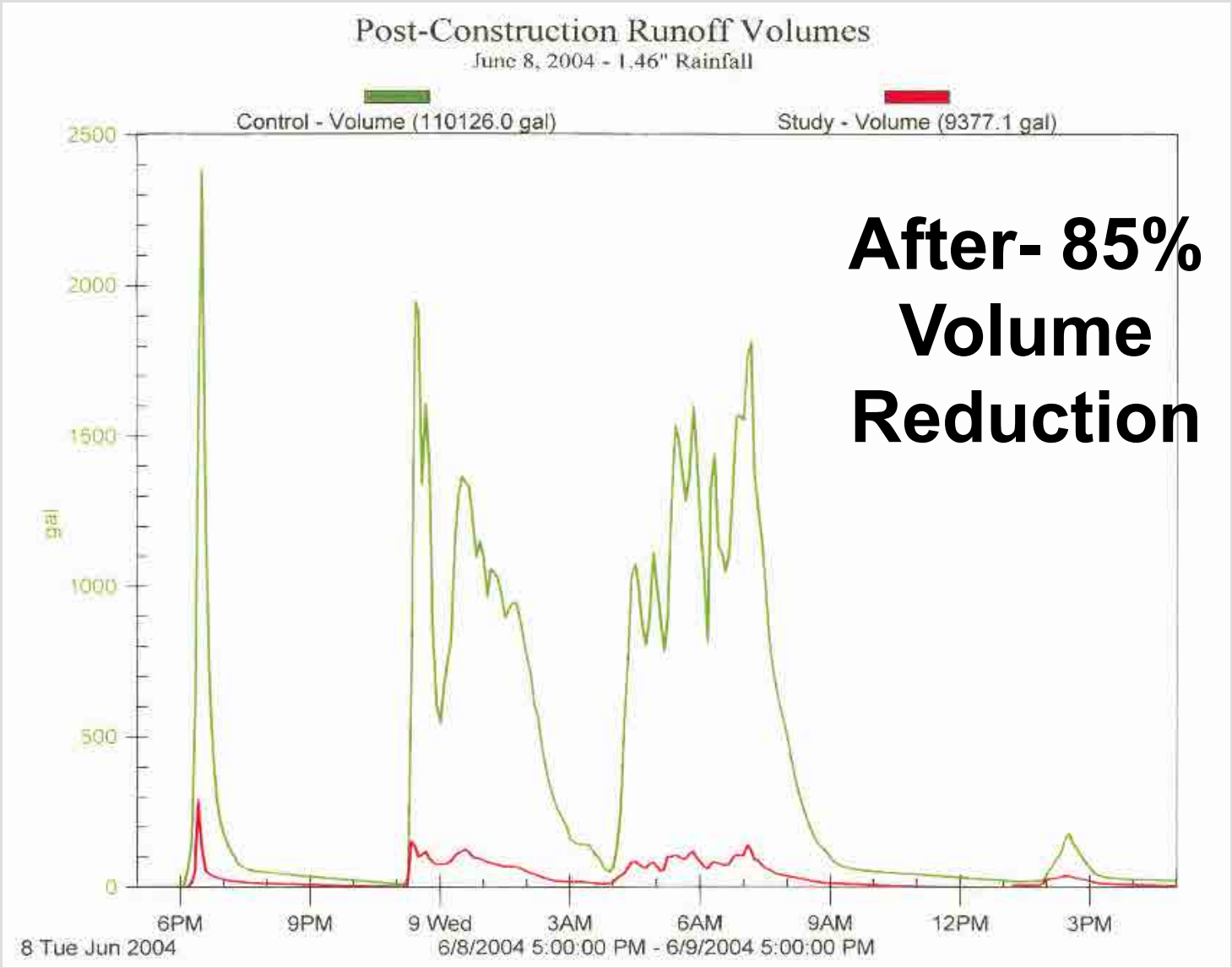




Pre-Construction Runoff Volumes



Post-Construction Runoff Volumes



After- 85% Volume Reduction


photo: City of Burnsville
BEFORE


photo: Fred Rozumalski
AFTER

THE GREEN LINE: A Case Study

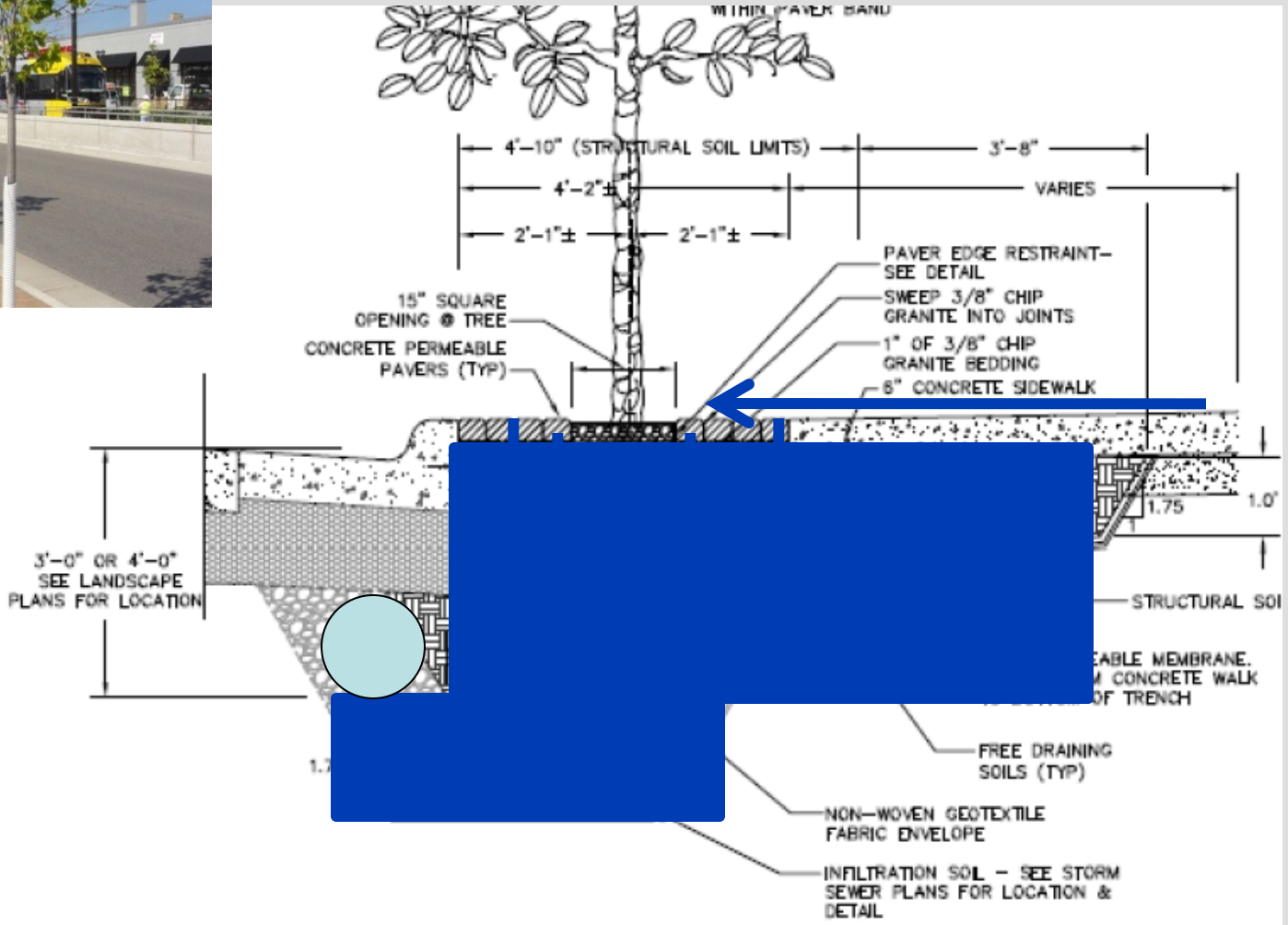
University Avenue Light Rail Project

Connecting Minneapolis to Saint Paul

6-mile Linear Project

Ultra Urban

LINEAR TREE TRENCHES



MAPLEWOOD MALL: A Case Study

1974: Mall Opened

2010: Parking Lot Stormwater Retrofit

BEFORE:

7 Acres Impervious

Severely compacted soils

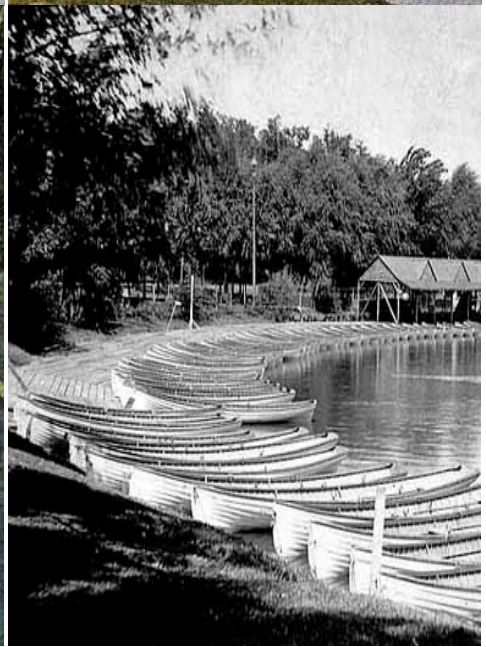
Photos: Ramsey Washington Metro Watershed District

SUBURBAN PARKING LOT RETROFIT

- 55 Rainwater gardens (19 enhanced sand filters)
- 6,733 SF Permeable Pavers
- 1 Mile of Tree Trenches
- 375 New Trees
- 20 million gallons of stormwater intercepted each year (67% of total)

Photos: Ramsey Washington Metro Watershed District

Como Lake Area Background:



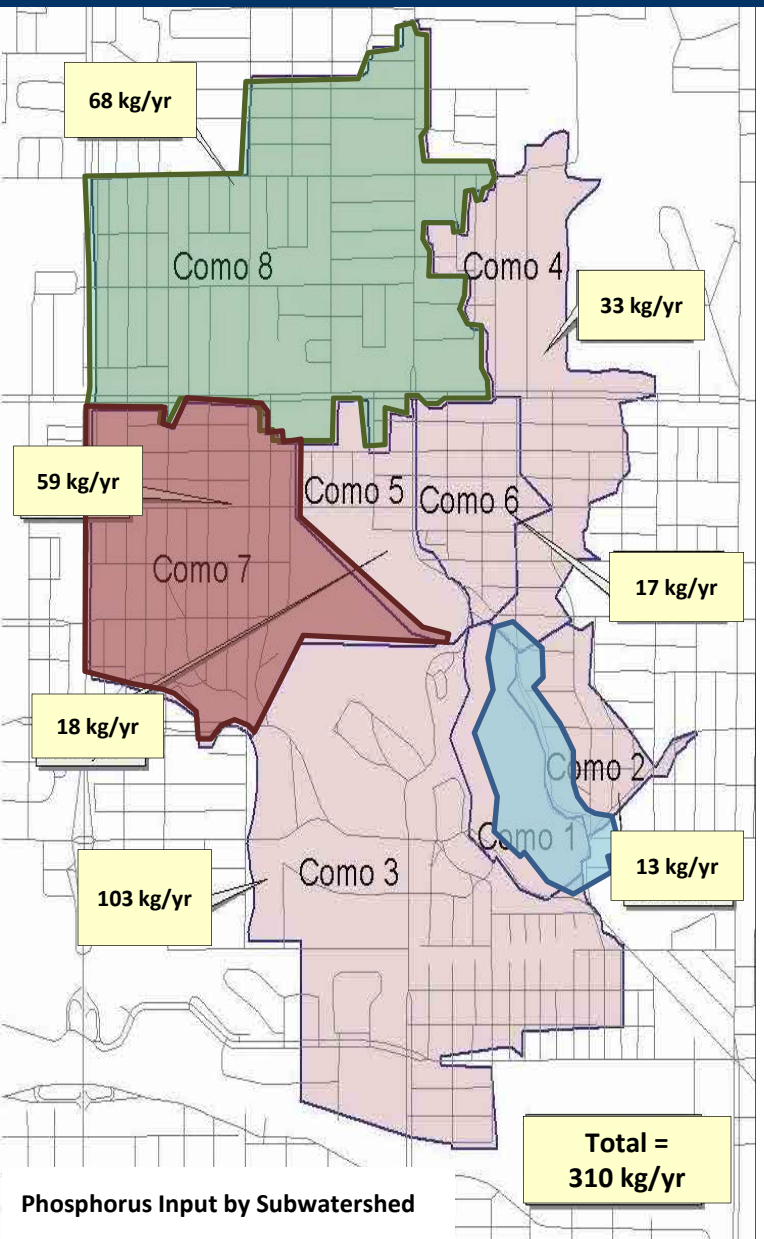
Historic Residential Community & Regional Recreational Amenity:

- **100 year** old neighborhoods
- Como Lake (41 ha) served as a celebrated **recreation amenity** for the growing City of St. Paul
- Como Lake and the Como Park area is a major recreational destination with over **1.9 million visitors a year**

History: Big Picture Planning to Construction

- CRWD Watershed Management Plan 2000
- Como Lake Strategic Lake Mgmt. Plan 2002
- Como7 & 8 Subwatershed Plan/Modeling 2003
- BMP Feasibility and Design 2004 - 2006
- BMP Construction 2007
- Monitoring/Performance Assessment 2007-10
- Monitoring/Performance Checking 2011-18

Como Lake WQ Targets (2002):

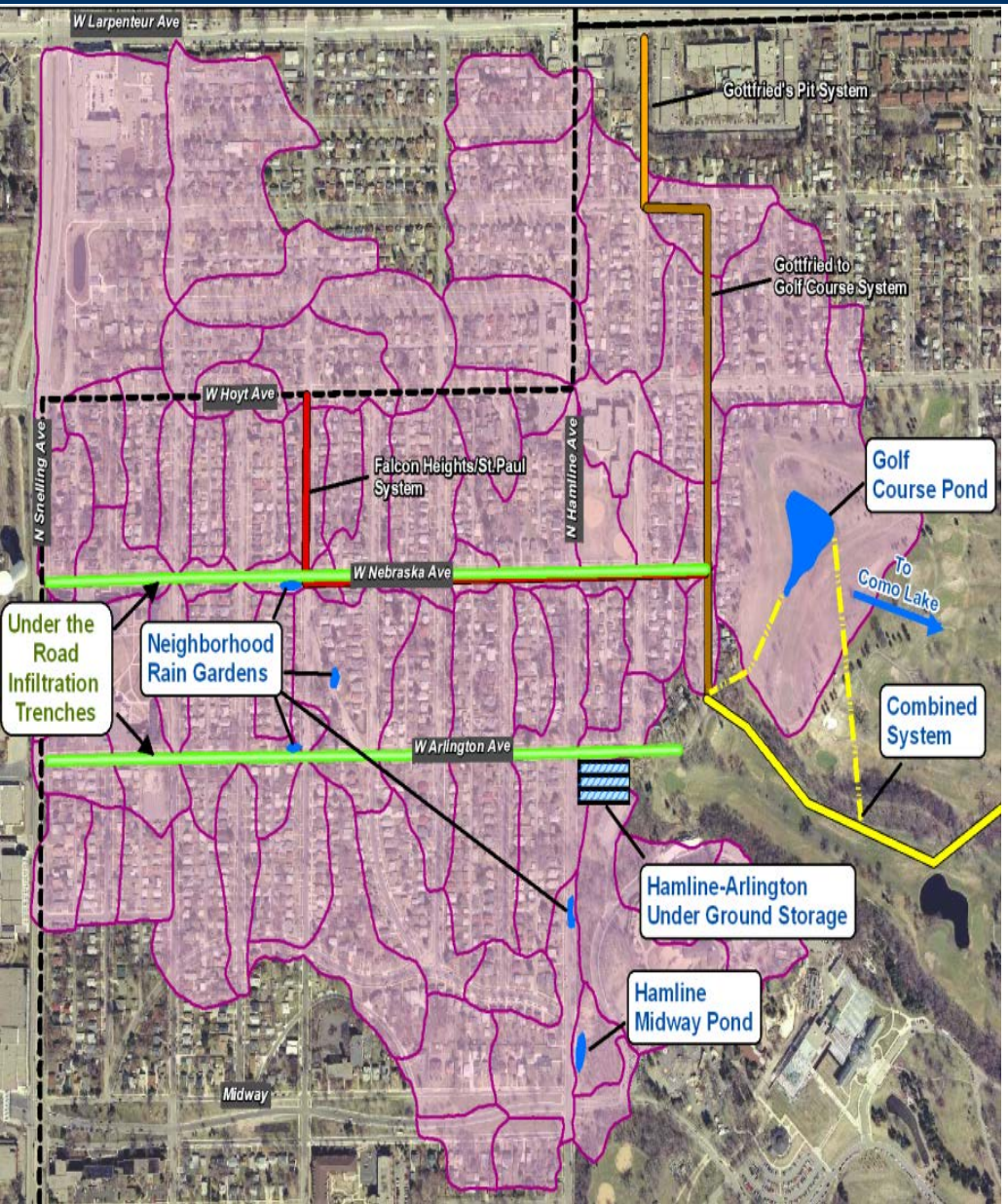


Phosphorus Input by Subwatershed

- **Minimize frequency of nuisance algal blooms**
- **60% reduction in P Inputs (186 kg/yr.)**
  - ***62 kg/yr. Re-development & Good Housekeeping***
  - ***124 kg/yr. LID/Capital Improvements***

TP Reduction Goal for Como 7 & 8: 43 kg/yr

Como 7 & 8 BMP Goals (2003):



- Achieve **43 kg/year** TP removal
- **Partnering** with City of St. Paul to achieve:
  - Reduction of **local street flooding** without increasing pipe sizes/capacity
  - Eliminate **manhole blow outs** and the need for a 1,525 mm **parallel pipe** ($2.5 million in savings)
  - Coordinate with St. Paul's **street reconstruction schedule** (50% - 60% cost savings for CRWD)

Project BMP Components:

Project BMPs & their drainage areas:

- **Golf Course Unlined Pond**
- Underground Infiltration Tank
- Raingardens (7) and Infiltration Basin
- Under-the-Road Linear Infiltration Trenches

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- **Under-the-Road Linear Infiltration Trenches**

BMP: Raingardens

Before


Detail

Concept

After

BMP: Raingardens

Before

Detail

Concept

After

BMP: Raingardens

Concept

After

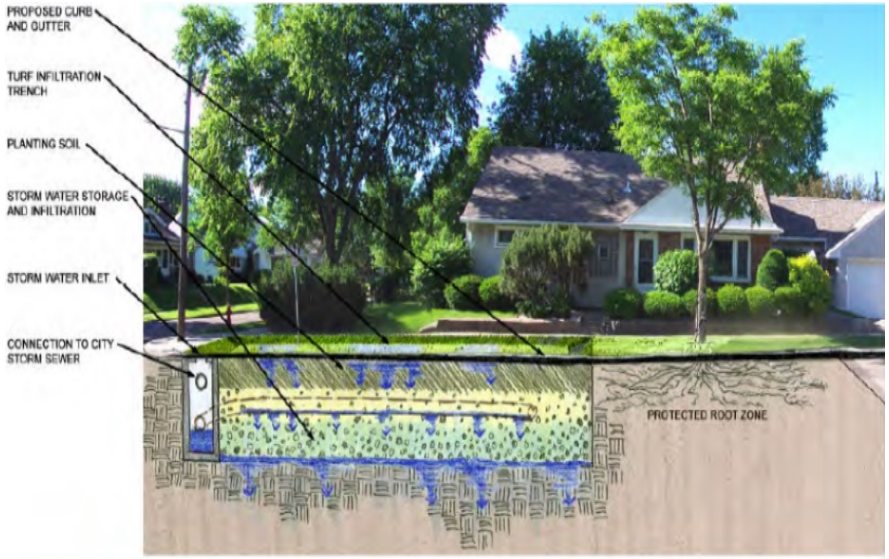
BMP: Raingarden Pre- Treatment

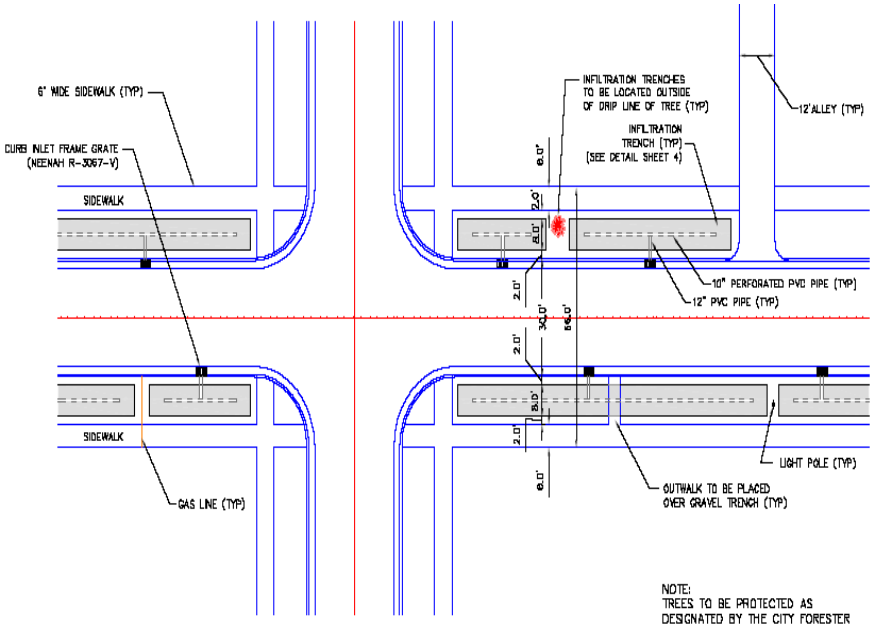
BMP: Infiltration Basin

BMP: Infiltration Basin

BMP: Infiltration Basin/Signage

BMP: UTR Infiltration Trenches





- Originally designed as **boulevard trenches**, yet limited space for open trench
- Reviewed to **underground boulevard** location, yet utilities in the way
- An **under-the-road (UTR) infiltration trench** was the final solution
- **Innovative** concept at the time, and still is

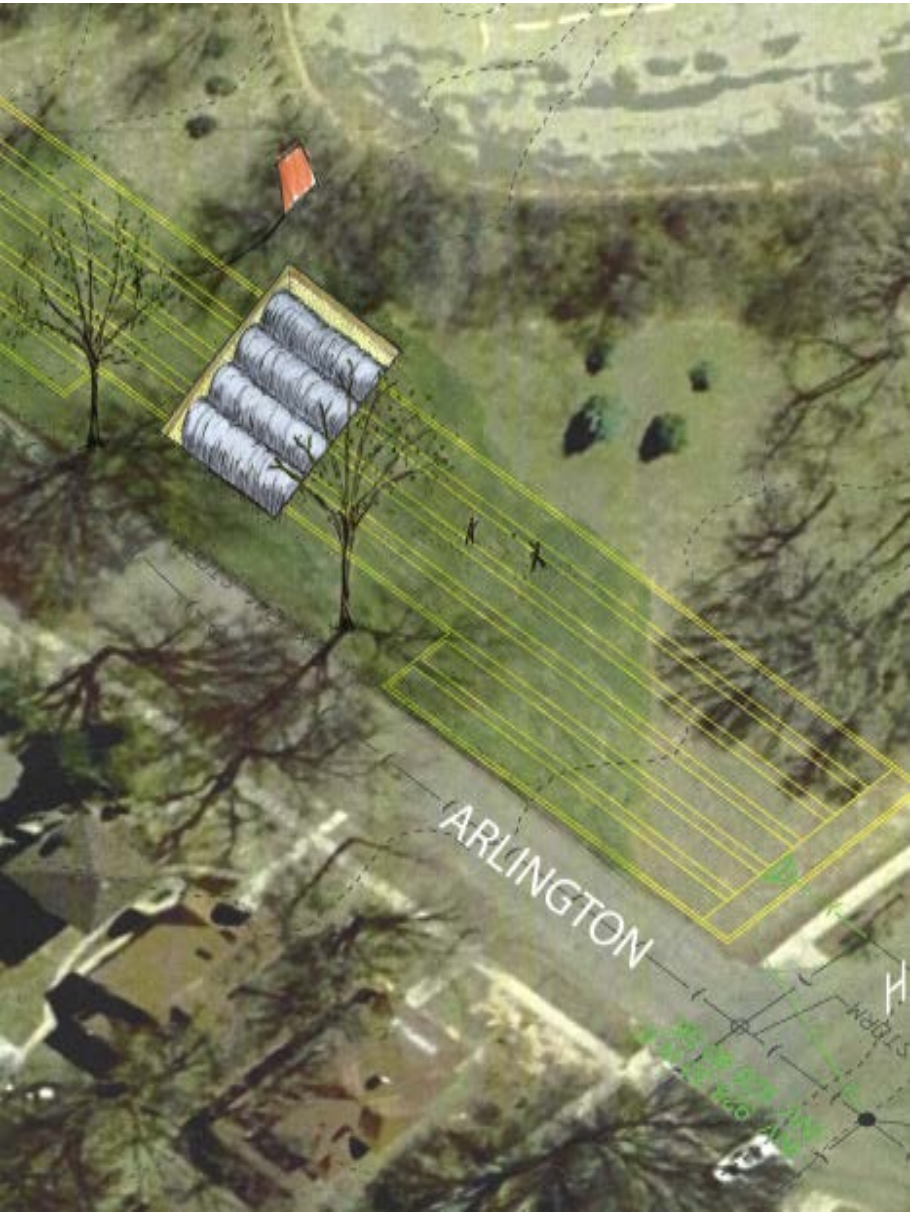
BMP: UTR Infiltration Trenches

BMP: UTR Infiltration Trenches


Before


After

BMP: Underground Infiltration Tank

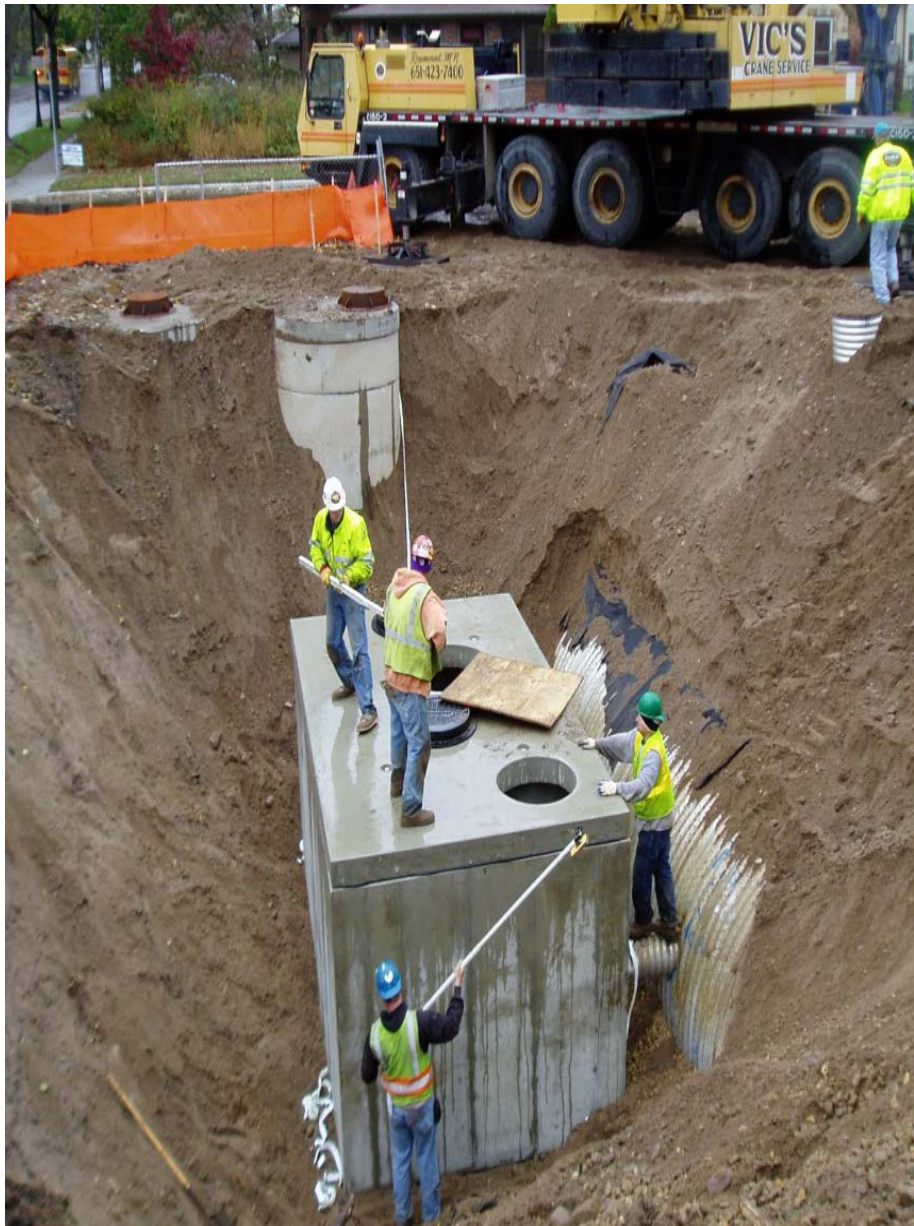


- Storage volume: **2,470 m^3**
  (largest at that time in the midwest)
- Drainage Area: **35 ha.**
- **3-year** storm is diverted
- **275m of 3m** diameter, corrugated, perforated metal pipes
- **Hydrodynamic** Pretreatment unit
- Park asked to **keep use** of recreation area

BMP: Underground Infiltration Tank

BMP: Underground Infiltration Tank

Pre-treatment Unit

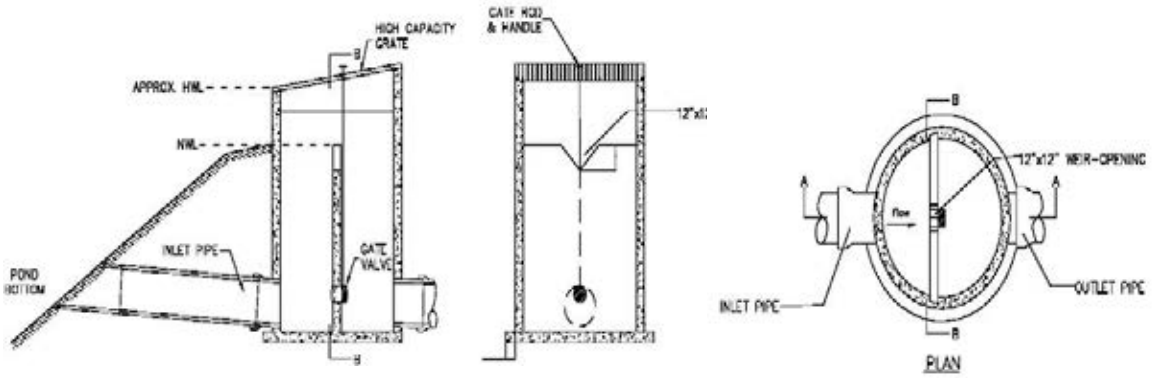


BMP: Underground Infiltration Tank

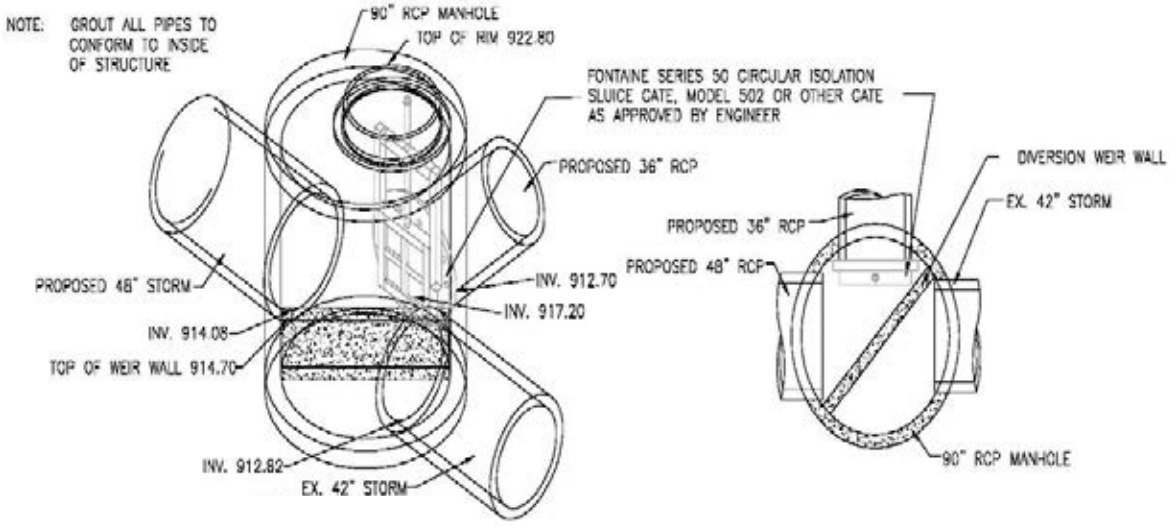
site - before

site - after

BMP: Golf Course Pond – outlet + diversion



Outlet structure

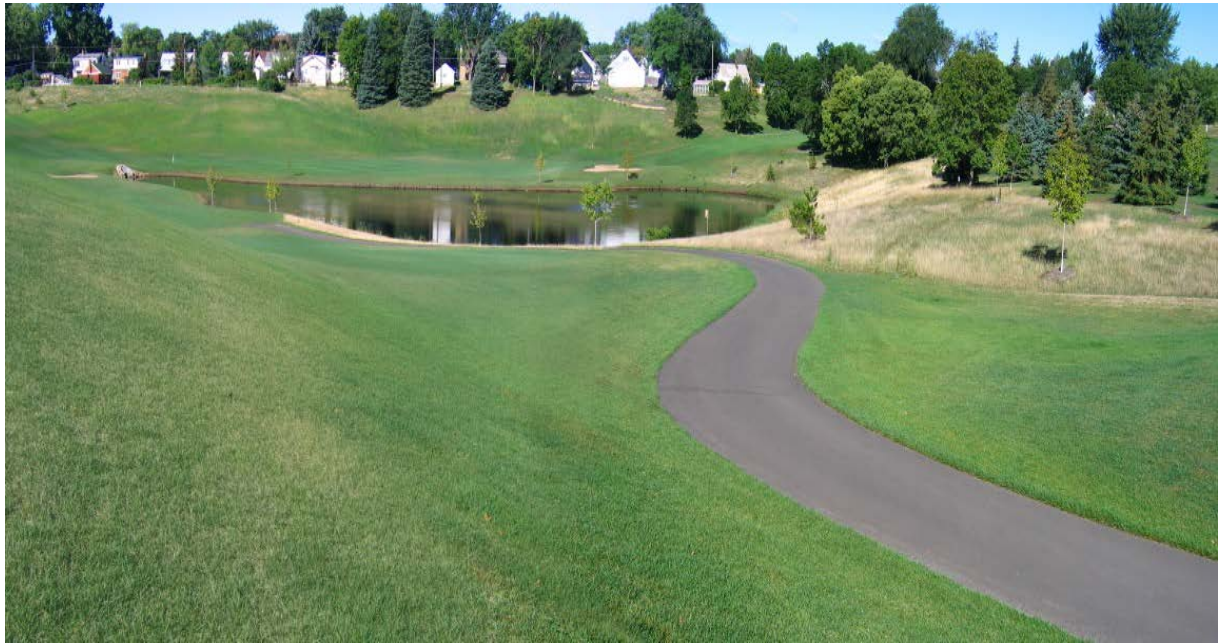


Diversion structure

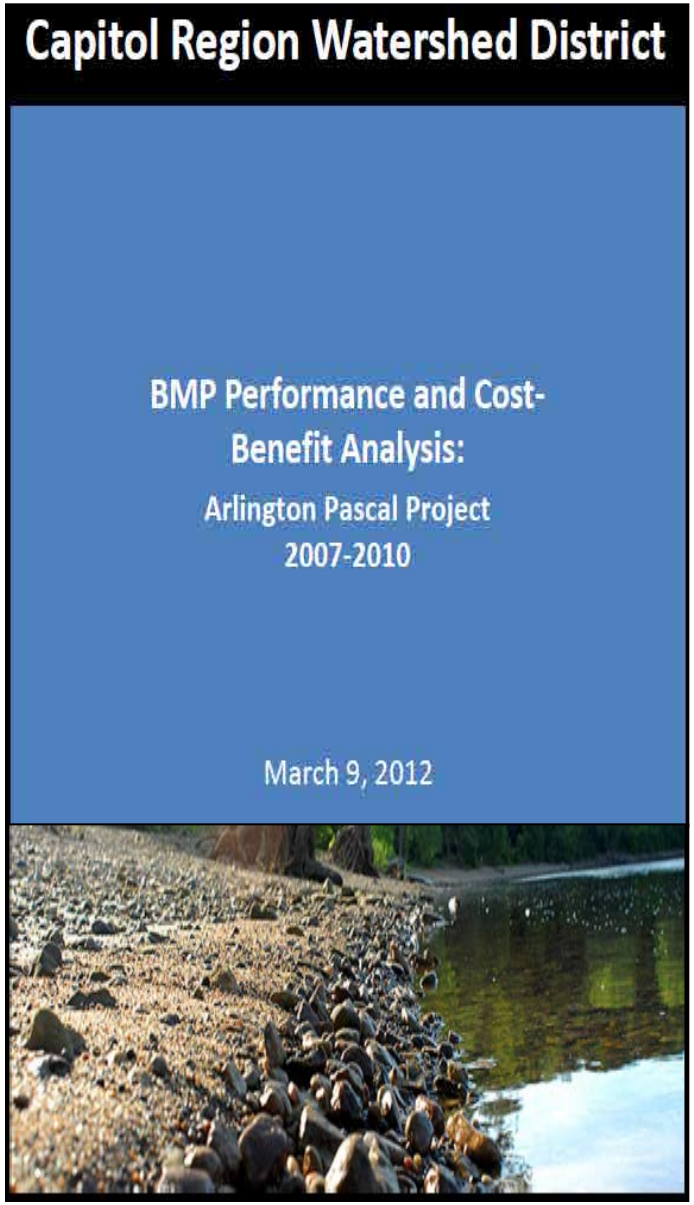
BMP: Golf Course Pond

760 mm directional boring

BMP: Golf Course Pond



Project Performance: 2007-2010



Field Monitoring:

- 2007 to 2010 field seasons
- Flow at inlet – outlet every 10 minutes
- 15 min. rain gauge
- Water quality sampling at inlet and outlet

Project Performance: Water Quality

TP Reduction Target	43 kg/year
Modeled TP Reduction	35 kg/year
Actual TP Reduction 2007-2010 monitoring	61 kg/year
TP Reduction for Average Precipitation (762 mm/yr.)	70 kg/year

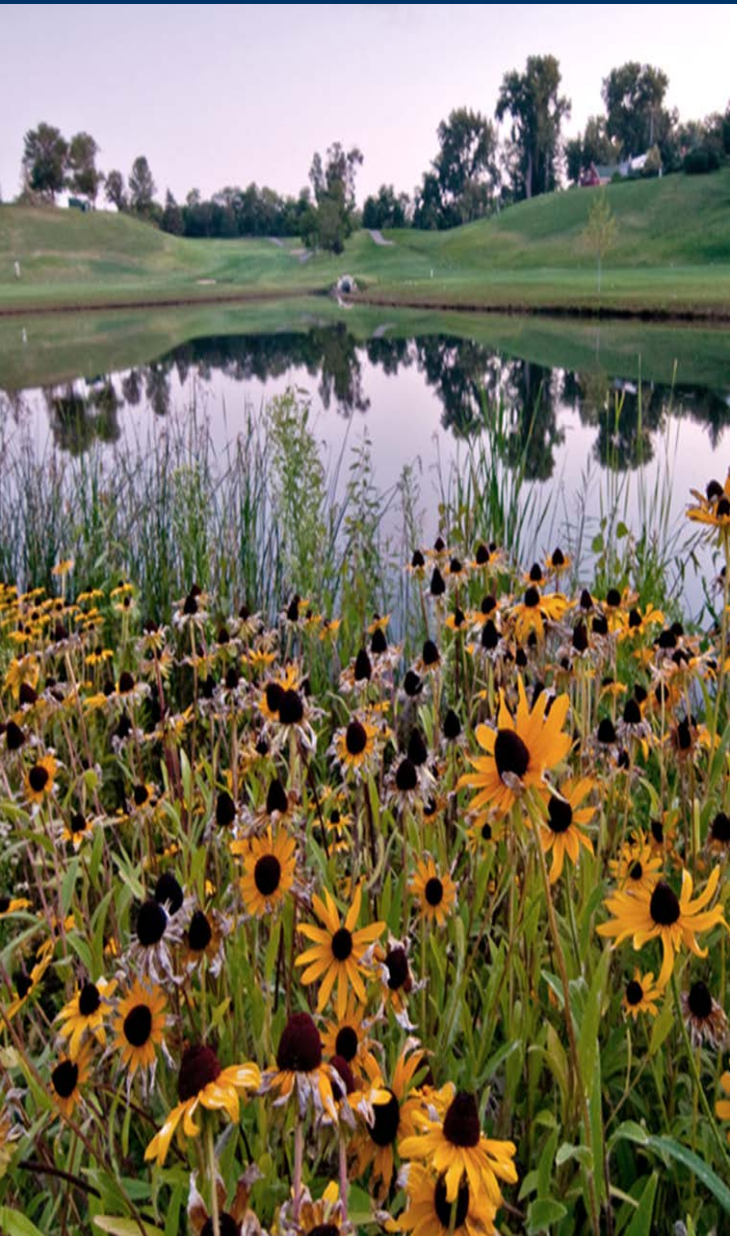
Project Performance: Water Quantity

- Local flooding addressed. No need for pipe size upgrade in areas where trenches/ raingardens were incorporated (10-year capacity)
- No need for expensive 1,525 mm parallel pipe (~$2.5 million saved)
- Manhole blow-outs eliminated

Project Performance: 2011-2018

- Spot monitoring shows overall performance has been maintained or increased
- Raingarden performance has increased
  - *Mature root system*
  - *Diligent about pre-treatment clean-up (2x year)*
- UTR infiltration trenches maintain performance. Vacuumed only once in the fall
- Underground Infiltration tank continues to infiltrate at a very high rate with no overflow
- No maintenance needed in the tank, only pre-treatment structure cleaning once a year

Checking Back on LID Misconceptions



THEY DO NOT PERFORM WELL IN COLD CLIMATES

- They do if properly designed.

THEY DO NOT PLAY A ROLE IN FLOOD MITIGATION

- They do at local level. Cumulative effect.

THEY ARE NOT AS EFFICIENT AS PIPE REPLACEMENT FOR UNDER-SIZED SYSTEMS

- Yes they are; plus water quality benefit.

THEY ARE VERY EXPENSIVE TO MAINTAIN

- Not if properly designed and pre-treatment.

THEY LOSE EFFICIENCY WITH TIME

- Not the case as 12 years of monitoring show.

Project Recognition:

2007 Golden Blooms Award
- St. Paul Parks and Recreation

2007 Sustainable St. Paul Award
- The City of Saint Paul

2008 Watershed Project of the Year
- Minnesota Association of Watershed Districts

2010 Water Resources Eng. - Grand Award
- American Council of Eng. Companies - MN

2010 Environmental Initiative Award
- The Environmental Initiative

Thank you

Minimal Impact Design Standards (MIDS)

The development of **Minimal Impact Design Standards is based on low impact development (LID) — an approach to stormwater management that mimics a site's natural hydrology as the landscape is developed.** Using the low impact development approach, stormwater is managed on site and the rate and volume of predevelopment stormwater reaching receiving waters is unchanged. The calculation of predevelopment hydrology is based on native soil and vegetation. (Minnesota Statutes, section 115.03, subdivision 5c).

Minimal Impact Design Standards (MIDS)

Minimal Impact Design Standards (MIDS) represents the next generation of stormwater management and contains three main elements that address the following challenges:

- A higher clean water **performance goal** for new development and redevelopment to provide enhanced protection for Minnesota's water resources.
- New **modeling methods and credit calculations** that will standardize the use of a range of innovative structural and nonstructural stormwater techniques.
- A **credits system and ordinance package** that will allow for increased flexibility and a streamlined approach to regulatory programs for developers and communities.

MIDS Workgroup

MIDS: Performance Goals

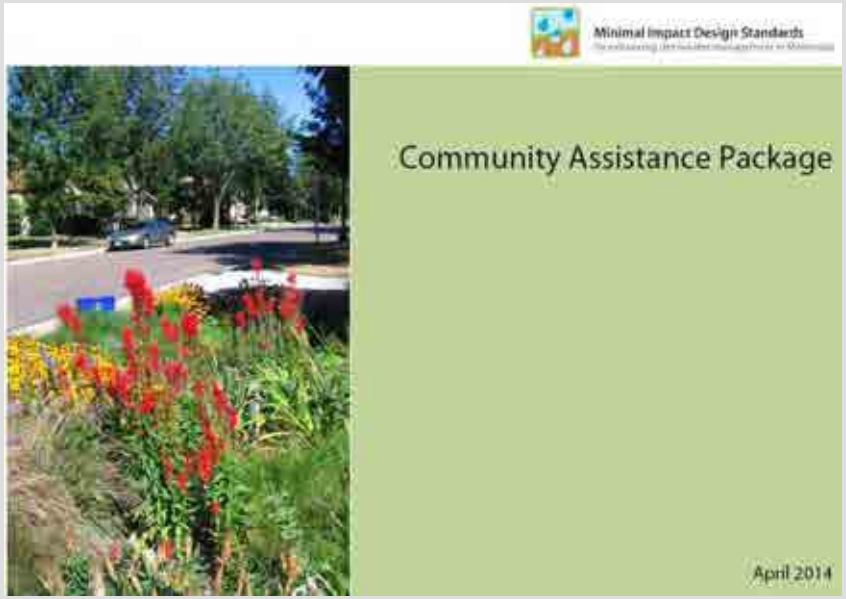
New development

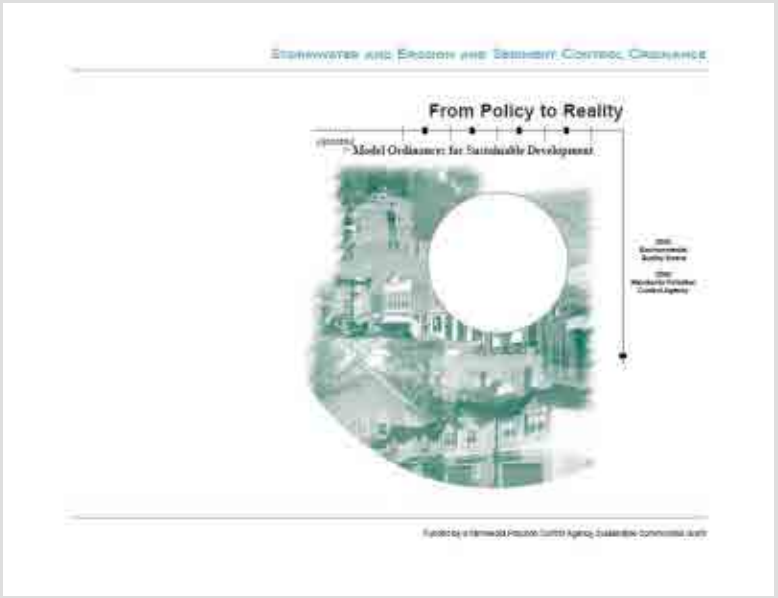
Redevelopment

Linear Projects

Flexible Treatment options – when a site just cannot meet the goal.

MIDS: Community Assistance Package





- Background on MIDS
- How to use the package
- Long form stormwater and erosion control ordinance
- Short form stormwater and erosion control ordinance
- Illicit discharge ordinance
- Subdivision ordinance
- Conservation subdivision ordinance
- Shoreland standards (forthcoming)
- Development checklist
- Planning process checklist
- Sample adoption resolution for ordinance changes

Better Site Design

What is Better Site Design?

Techniques applied early in the design process to:

- Preserve natural areas
- Reduce impervious cover
- Distribute runoff
- Use pervious areas to treat stormwater

The Beginning of the Lake Simcoe Effort

Lake Simcoe Stormwater Management Policy Working Group

BILD & Local Consulting Firms
City of Barrie
City of Kawartha Lakes
City of Orillia
EOR
LSRCA
Ministry of the Environment
Municipal Affairs and Housing
Ryerson University
Town of Aurora
Town of Bradford West-Gwillimbury
Town of East Gwillimbury
Town of Georgina
Town of Innisfil
Town of Newmarket
Town of Uxbridge
Town of Whitchurch-Stouffville
Township of Brock
Township of King
Township of Oro-Medonte
University of Guelph
York Region

Policy Becomes Rule

- Stakeholder group meets monthly to contribute to and review draft language
- Model By-law (ordinance) developed
- Policy becomes effective September 1, 2016
- Sets the path for implementation of Lake Simcoe Phosphorous Offset Program January 1, 2018
- Requires developers to work toward zero phosphorous from new development
- Offset charge of establishes funding pool for retrofit of existing infrastructure

Low Impact Development Stormwater Management Guidance Manual

Ministry of the Environment , Conservation and Parks

Questions?