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Inver Grove Heights, MN

National, International Award Winning Project



Policy Implications of a Zero Discharge Stormwater System

TRIECA Conference

March 22nd, 2018

Brett H. Emmons, Founding Principal
Bemmons@eorinc.com

Emmons & Olivier Resources, Inc. (EOR)
www.eorinc.com

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.

www.eorinc.com



water

watersheds and water resources



ecology

ecosystem restoration



community

civil eng. & landscape arch.



Introduction

- Brett Emmons, Founding Principal
- Emmons & Olivier Resources, Inc.

Stormwater 101

- Why it matters

Low Impact Development (LID)

- Stormwater Management
- Goals of LID
- Types of BMP's

IGH, Argenta Hills Story

- Inver Grove Heights Context
- Planning Process
- Zero Stormwater Discharge
- Award-Winning Design

Why Stormwater Matters: Local

Recreation



Quality of Life



Environment



Why Stormwater Matters: **Global**



Hypoxic Zone in Gulf of Mexico

Why Stormwater Matters?



Development

- New Stormwater Practices/LID Required
- Stormwater Service is a Key Need to Open Development
 - IGH Needed Cost Effective Sol'n



Sustainability

- Planners often lead in incorporating Green Design
- Interdisciplinary gives better outcomes - Engineers, Landscape Architects, Planners, Architects



Client & Public Interests and Demands

- LID technologies can bring Cost Savings
- Clients like multi-benefits of GI (amenity-rich spaces)
 - users want “green values” reflected in their purchases

Typical Pre-development Conditions



**Natural
Watershed**



Typical Post-development Conditions

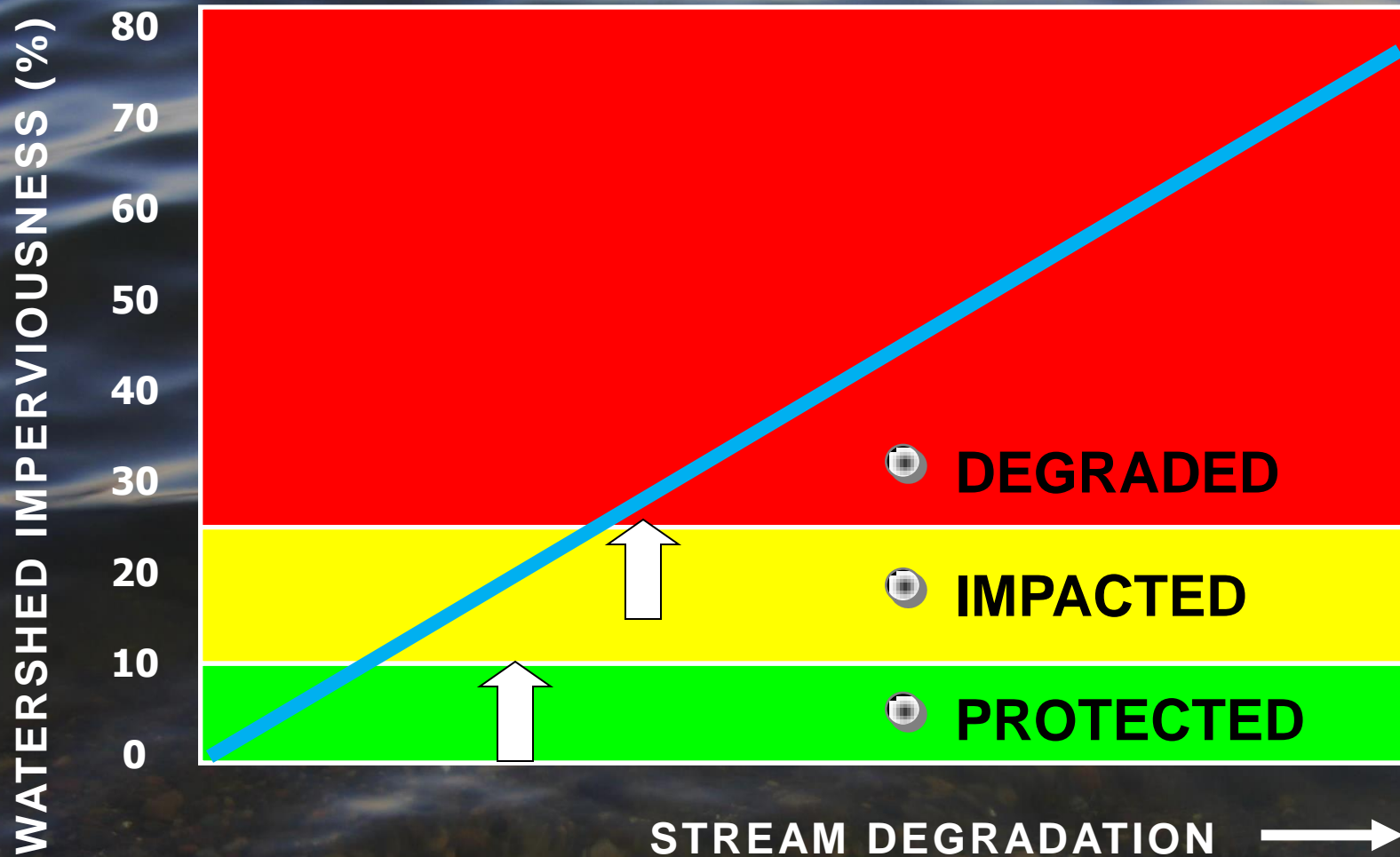


550% of Natural!

**Urban
Watershed**



Waterway Health & Imperviousness



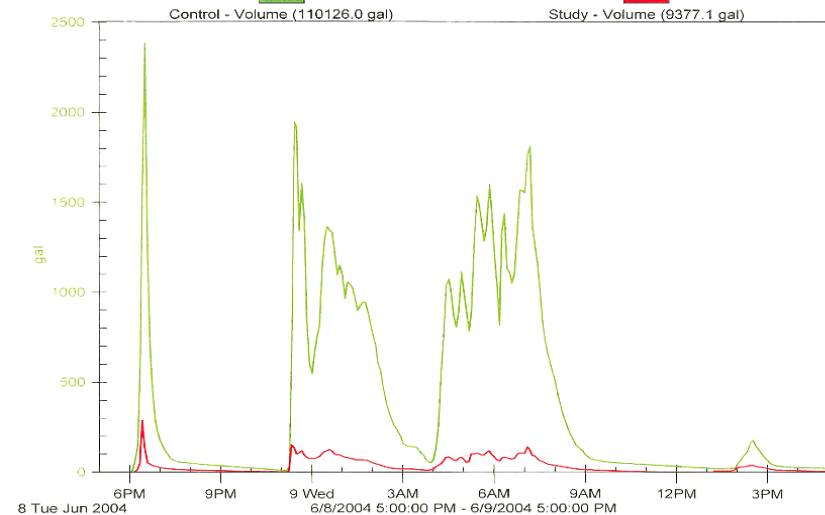
Stormwater: *Runoff Volume* has Emerged as “The Issue”

Incremental increases
in runoff volume is the
crux of stormwater impacts

“...recommended that the stormwater program focus less on chemical pollutants and more on the increased volume of water.”

National Research Council of NAS, 2009.

Post-Construction Runoff Volume = 1.46” Rainfall



Low Impact Development (LID)



- **Better Site Design (BSD) – Start at the Beginning**
- **Mimics Natural Systems – keep near to source**
- **Treats Stormwater as a Resource Rather Than a Waste Product**
- **Promotes the Natural Movement of Water Within an Ecosystem or Watershed**

Works to make this...



Function Like *THIS*



Low Impact Development

**Conserve natural areas and
maintain natural drainage patterns**

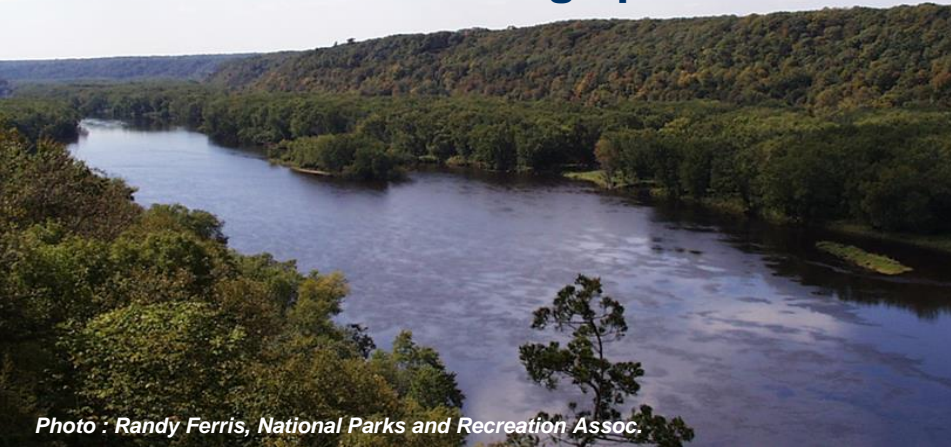


Photo : Randy Ferris, National Parks and Recreation Assoc.



Minimize development impacts



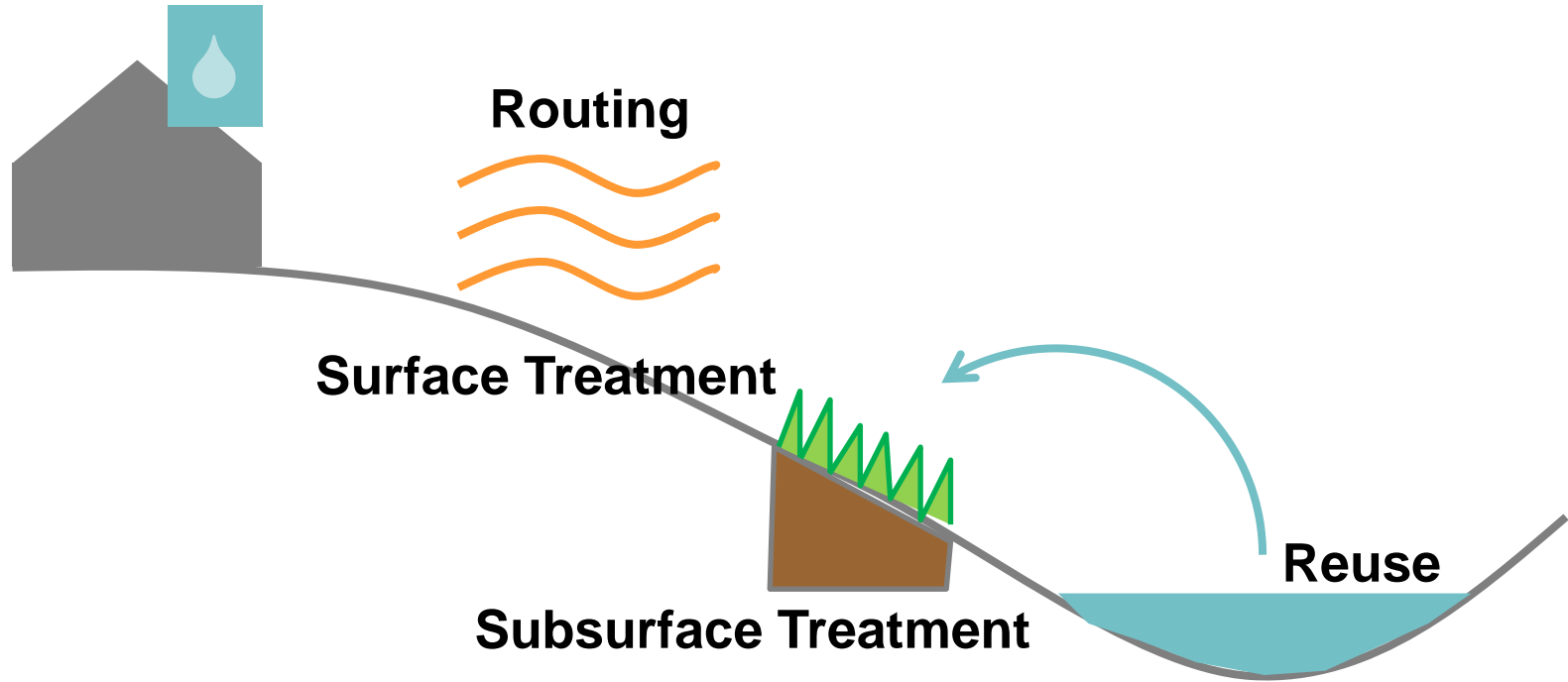
Keep soils healthy






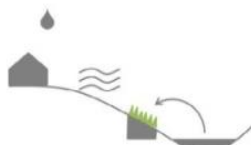


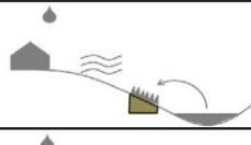

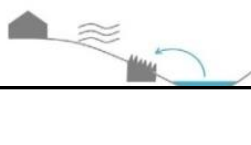
**Treat stormwater at the source to
mimic natural hydrology**

How LID Works

Source Control



BMP Performance

	VOLUME REDUCTION BMP	LOCATION IN THE LANDSCAPE	HYDROLOGIC BENEFITS			SURFACE WATER POLLUTANT REMOVAL				
			INFILTRATION	EVAPO-TRANSPARATION	RUNOFF VOLUME REDUCTION	TP	TN	TSS	Metals	GROUNDWATER CONTAMINATION RISK
SOURCE CONTROL	Impervious Cover Reduction		✓	✓	40%	30-55%	64%			
	Soil Amendments/Decompaction		✓	✓	50-75%	50-75%	50-75%			
	Pervious Pavements		✓		45-85%	30-80%	60-80%		90%	
	Downspout Disconnection		✓	✓	25-50%	25-50%	25-50%			
	Green Roofs			✓	45-90%	highly variable	20-90%	70-90%	80%	
ROUTING	Level Spreaders		✓	✓	50-75%	50-75%	50-75%			
	Filter Strips		✓	✓	25-75%	30-80%	35%	75-90%	80%	
	Dry Swales		✓	✓	10-60%	15-75%	55-75%			
SURFACE TREATMENT	Bioretention Devices (without under drain)		✓	✓	65-85%	90%	90%		30-99%	
	Bioretention Devices (with underdrain)			✓	40-45%	55-65%	45-65%	85%	95%	
	Tree Trenches		✓	✓	variable	75%	70%	85%	80%	
	Infiltration Basins		✓	✓	50-90%	15-90%	60-90%			
SUBSURFACE TREATMENT	Below-ground Recharge Systems		✓		85%	50-80%	40-70%	70-90%	70-90%	
REUSE	Rainwater Harvesting				40%	40%	40%			
	Stormwater Harvesting		✓	✓	20-75%	45-95%				

Non-Structural LID BMP's



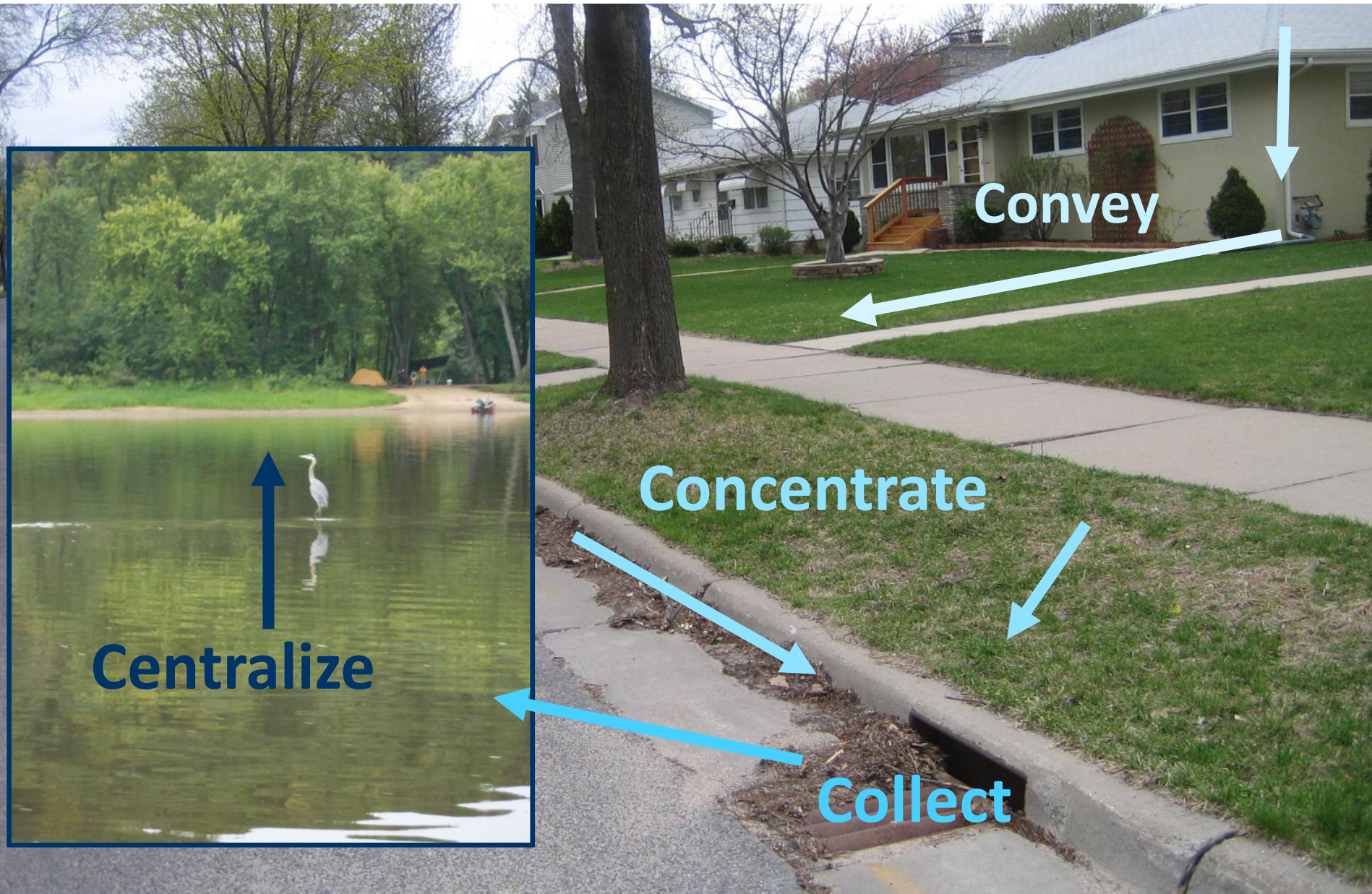
Planning/ Design

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

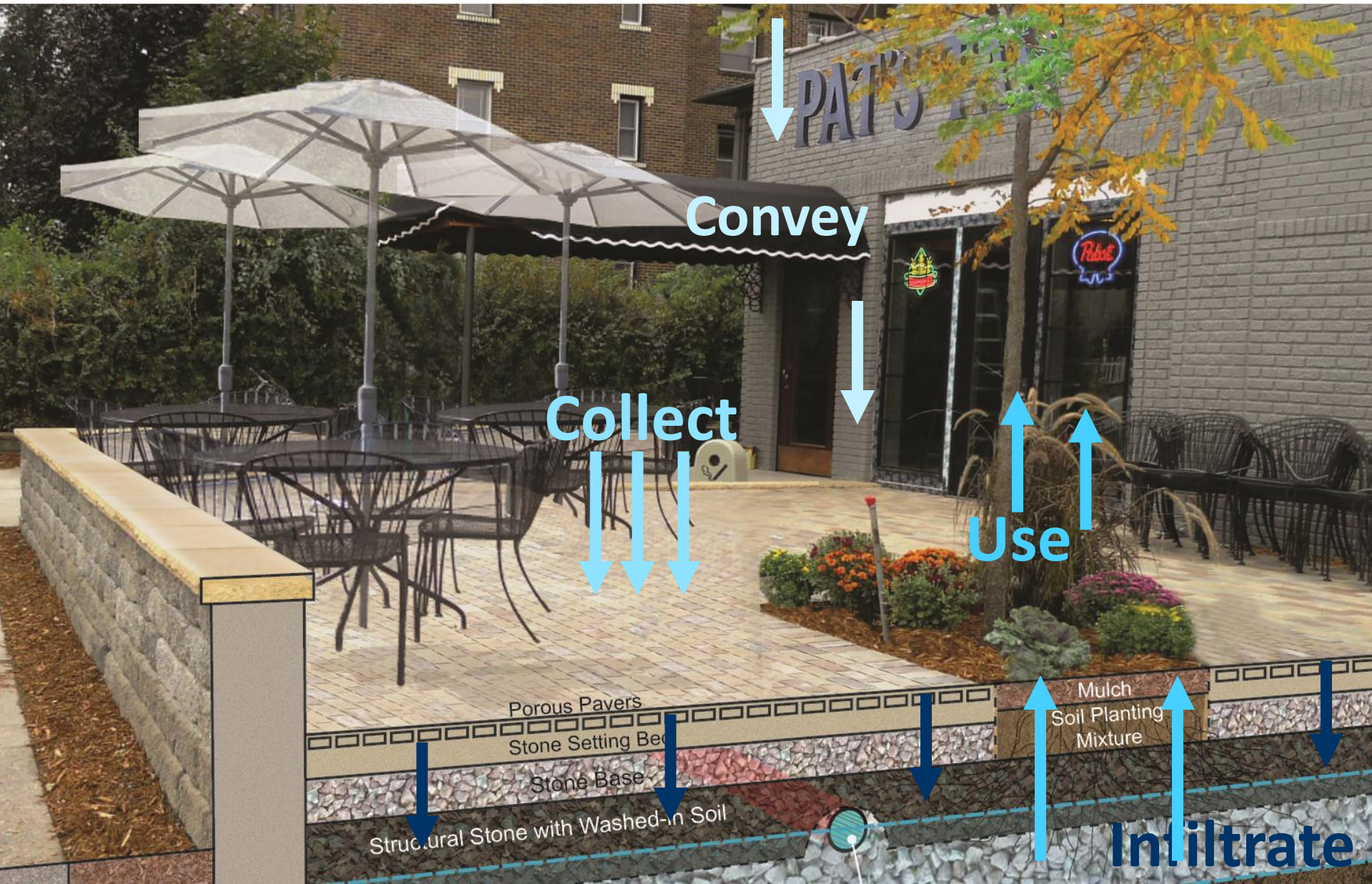
Maintenance/ Operations

- Street Sweeping
- Education
- Signage

Traditional Stormwater Management



LID BMP stormwater management



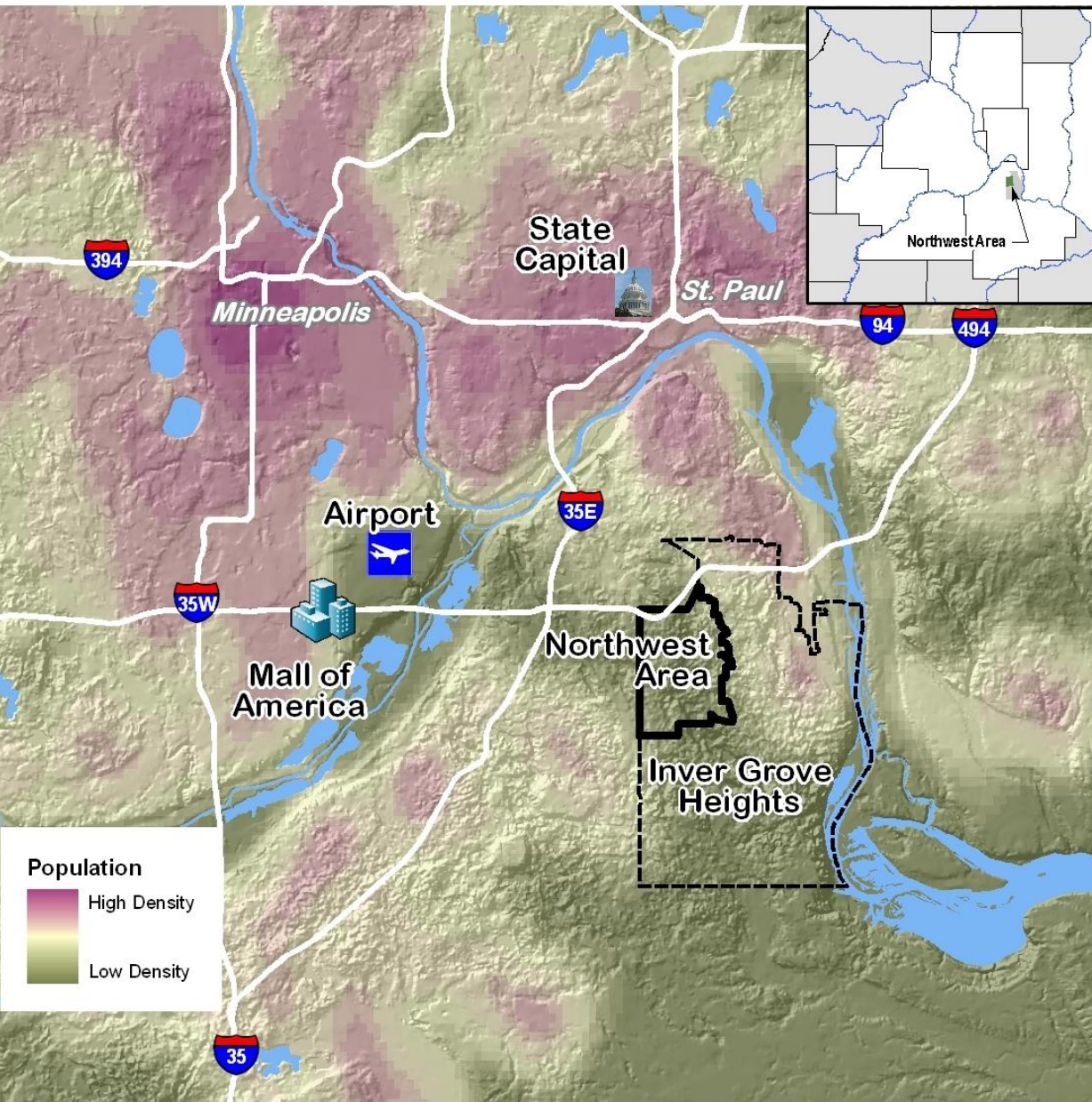
The Inver Grove Heights Northwest Area Story



Location: Inver Grove Heights, MN



Project Location: IGH Minneapolis – St. Paul Metro



Near to Urban Core

- Mpls/St. Paul
- Interstate 494
- Airport
- Mall of America

Large Urban Expansion Area for Inver Grove Heights

- ~3,000 Ac.

Challenging Site for Infrastructure



Marcott Lakes

- High value natural resource for the area
- Groundwater-fed lakes

North West Area

- Land locked basins

Dispose of the Stormwater

- Pumps & Pipes
- Outlet to Miss. River

 = Marcott Lakes

Concerns:

- Costly Infrastructure
- Quality Lakes; New Outlet to Mississippi River
- Typical “Sprawl” – Character?

Landowner Group Goals:

- Reduce Costs
- Why Not Use the Natural Systems that Works Well (without Outlets)?
- Retain Unique “Feel” of Landscape



**Low Impact
Development (LID)**



- **Rain Gardens**
- **Infiltration Trenches**
- **Permeable Pavements**
- **Green Roofs**
- **Green Streets**
- **Soil Restoration**
- **Harvesting/Reuse/
Irrigation**

Can Development and Natural Systems Coexist? Could it be Zero Discharge??



No Precedent in the U.S. for Zero Discharge System

Modeling Studies/Analysis:

- Hydrologic/Water Budget Modeling at Multiple Scales
- Rainfall-Runoff Monitoring
- Calibrate Models (Data From a 100-Yr Event)

➡ **Planning & Zoning Standards - Encourage & Require LID and Remove Barriers**



- **Volume control requirements for 5-yr event by *matching* pre- and post-runoff volumes** - *supported with monitoring and scientific data.*
- **Pretreatment *before* reaching volume control devices** - *ensures longevity and reduces maintenance.*
- ***Natural depressions preserved* via a regional basin map and comprehensive plan** - *provides predictability to developers and City; improves corridors, trails, and neighborhood quality.*
- ***Contingency: 3-tiered Freeboard and overflow* for extreme flood control created**
 - *increases flood protection with robust safety zone and “perched” overflows.*

Unique Stormwater Standards:

A. Matching 5-yr volume

POLLUTION PREVENTION

Good
housekeeping



SOURCE CONTROL

Runoff
Minimization



SITE CONTROL

At Source



REGIONAL STRUCTURE

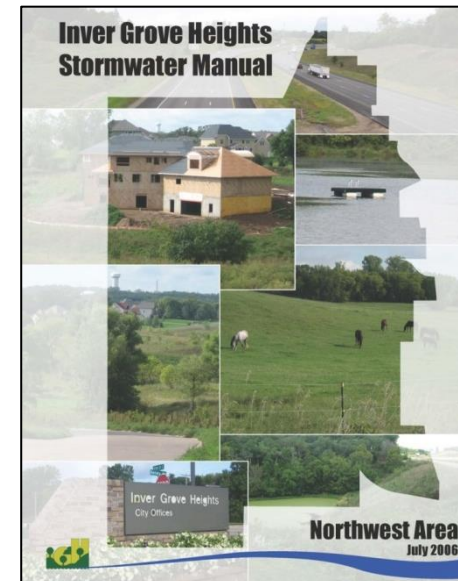
End of Pipe



\$/ lb treated



\$\$\$ /lb treated

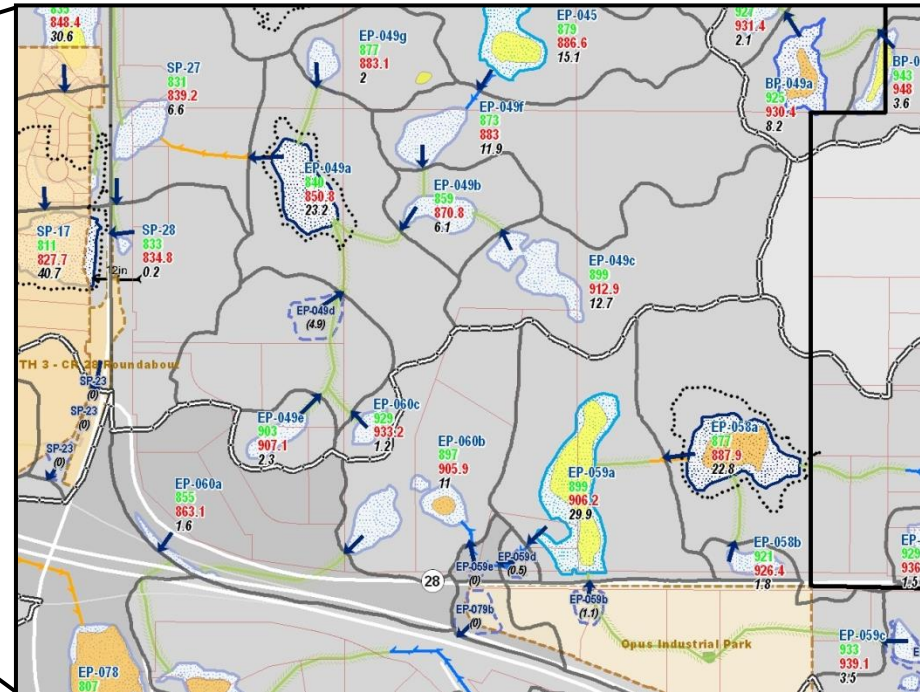


Unique Stormwater Standards:

B. Pretreatment



EOR water
ecology
community



Unique Stormwater Standards:

D. Contingency Overflows

Freeboard Standards, Establishing Lowest Floor Elevation, & Overflow

STEP 1: Basin Depth

A.) 6ft. and less

B.) 6ft – 18ft

C.) 18' and greater

STEP 2: Lowest Floor Elevation (LFE)

A.) $HWL + 2ft.$ or $NOF + 1ft.$

B.) $HWL + 6ft.$

C.) $HWL + 10ft.$

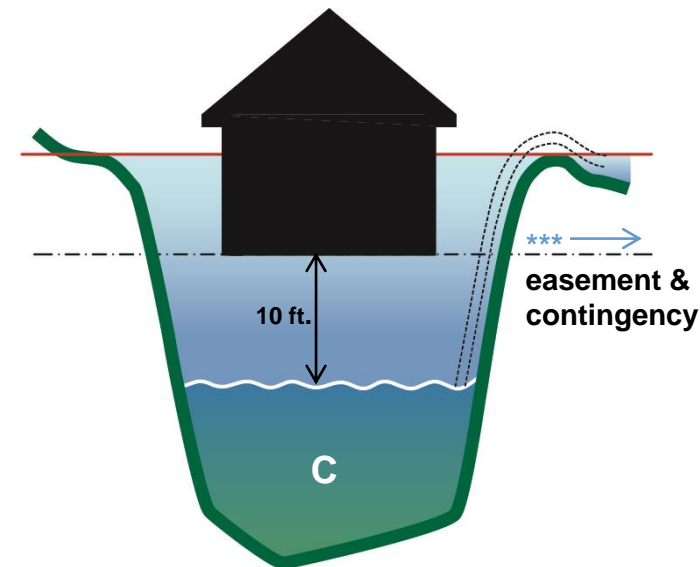
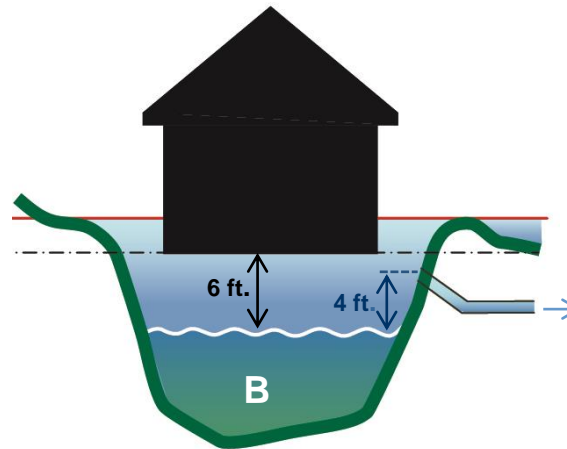
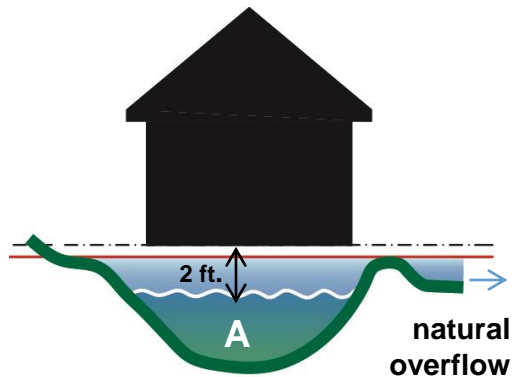


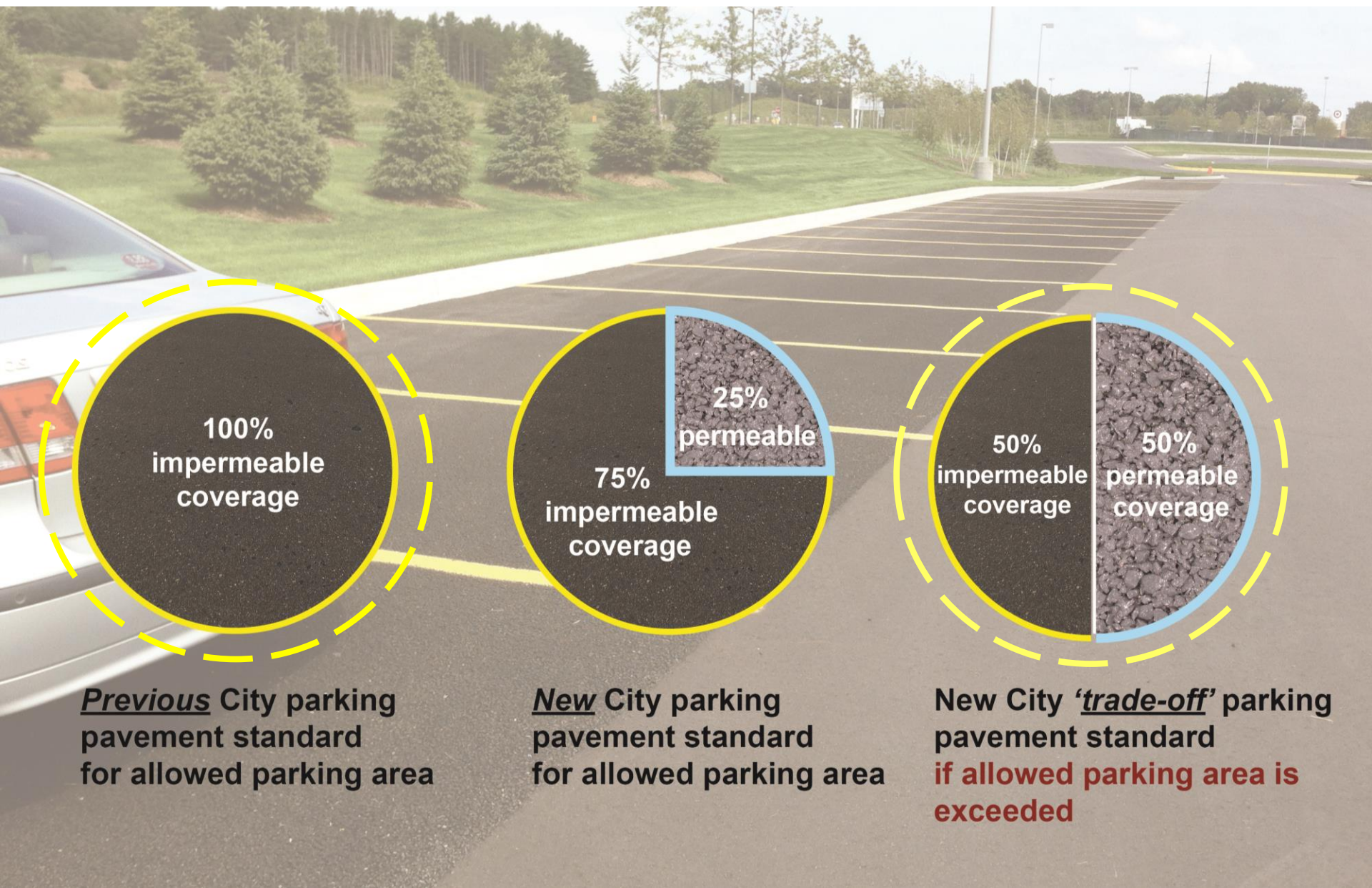
Illustration Key:

Natural Overflow Level (NOF) _____

Lowest Floor Elevation (LFE) _____

High Water Level (HWL) ~~~~~

Policy Development: New Parking Standards



100%
impermeable
coverage

Previous City parking
pavement standard
for allowed parking area

75%
impermeable
coverage

New City parking
pavement standard
for allowed parking area

25%
permeable

50%
impermeable
coverage

New City 'trade-off' parking
pavement standard
if allowed parking area is
exceeded

50%
permeable
coverage

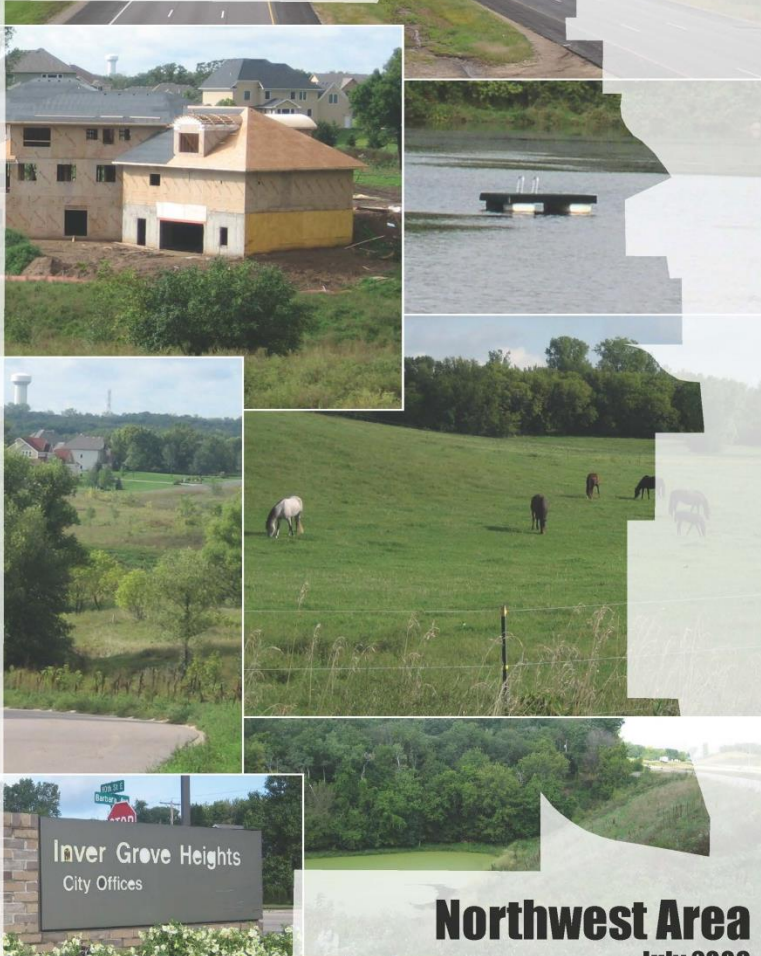
Typical Zoning Standards

Uses	Zoning District (Percentages Represent Maximums)				
	R-1C	R-2	R-3A or R-3B	R-3C	MU-PUD
Single-family dwellings	100 percent	100 percent	10 percent	10 percent	10 percent
Twin homes/two-family dwellings	30 percent	100 percent	30 percent	10 percent	15 percent
Multiple dwelling unit building (4 or fewer units)	10 percent	30 percent	100 percent	40 percent	100 percent
Multiple dwelling unit building (5+ units)	0 percent	0 percent	50 percent	100 percent	100 percent

Increased Flexibility Across Districts

Allows developers to maintain their desired units per acre by increasing density to preserve open space

Inver Grove Heights Stormwater Manual



Northwest Area
July 2006

Green Space Preservation

- 20% contiguous green space required; in addition to lawns/small landscaping

Zoning Flexibility - unit counts are preserved with flexibility to increase density (Mixed Use), reduced setbacks, and reducing infrastructure.

Parking Lot Standards - reduces parking lot sizes, permeable pavement for high parking counts, and reduced development costs for marginally used parking.

Reduced Street Widths – flexibility for 28' public roads, private roads, cul-du-sac green/treatment islands.

Cost Analysis & Fees - system has 75% lower capital/initial cost and 57% lower life-cycle costs (system wide) and provides a fee structure.



Original Plan:

Typical “Pumps & Pipes”

- 13 Pump Stations
- 24 Miles of Trunk Storm Piping
- New Outlet to Miss. River (4 miles)



Enhanced LID Plan:

- Utilize New LID/GI Tools
- Better Outcomes – W.Q., Volume Control, Open Space
- Replenish Groundwater
- 75% Up-front Cost Savings!

Total Costs

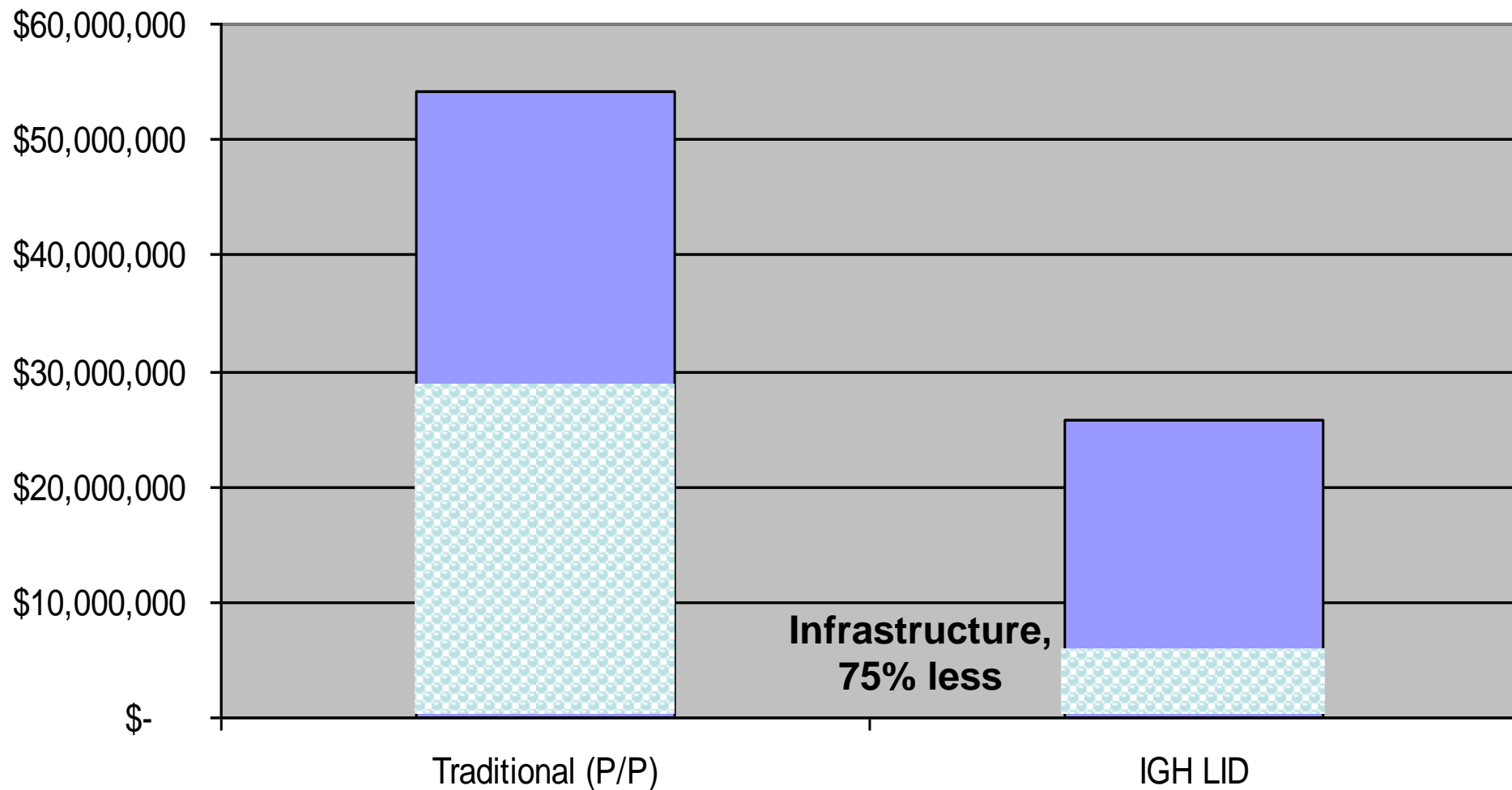
- Infrastructure Costs
- O&M Costs (Present Worth over 30 yrs)

	Traditional	Proposed (LID)
Infrastructure	\$29,635,000*	\$ 6,520,000
O & M	\$24,553,000	\$19,153,000
Total	\$54,188,000	\$25,673,000

Updated costs, 1/10/07, Jan. 2006 dollars (ENR Index of 7660)

**Includes approx. same land costs as LID (\$3,750,000)*

30 Year Life Cycle Costs (includes O&M)



Policy Commencement: Council adoption 2007



Rendering Courtesy of Close Landscape Architects

Ordinance (By-Law)

- Section 515, Subd. 39 NWA Overlay District

Manual

- Stormwater Manual for the Northwest Area

SATURDAY, JUNE 23, 2007 A 3B

INVER GROVE HEIGHTS

Construction can begin on Northwest Area

City plans alternative storm-water system

BY LIALA HELAL
Pioneer Press

Now that the planning is in place for the Northwest Area, construction can begin.

Beginning late this summer

"As we went through the studies, we found out that there's a strong environmental benefit to it as well," said Tom Link, the city's community development director. "The City Council decided this is the

"We'll take advantage of the natural abilities of this land to absorb and evaporate the water."

Implementing Zero Runoff: Locally-Driven, LID Initiative



City & Landowner Goals:

- **Reduce Costs**
of Development / Infrastructure
- **Retain Character**
of Unique Landscape (30% OS)
- **Use Natural Systems**
that Function



Solution:

**Use a Low Impact Development
(LID) Approach:**

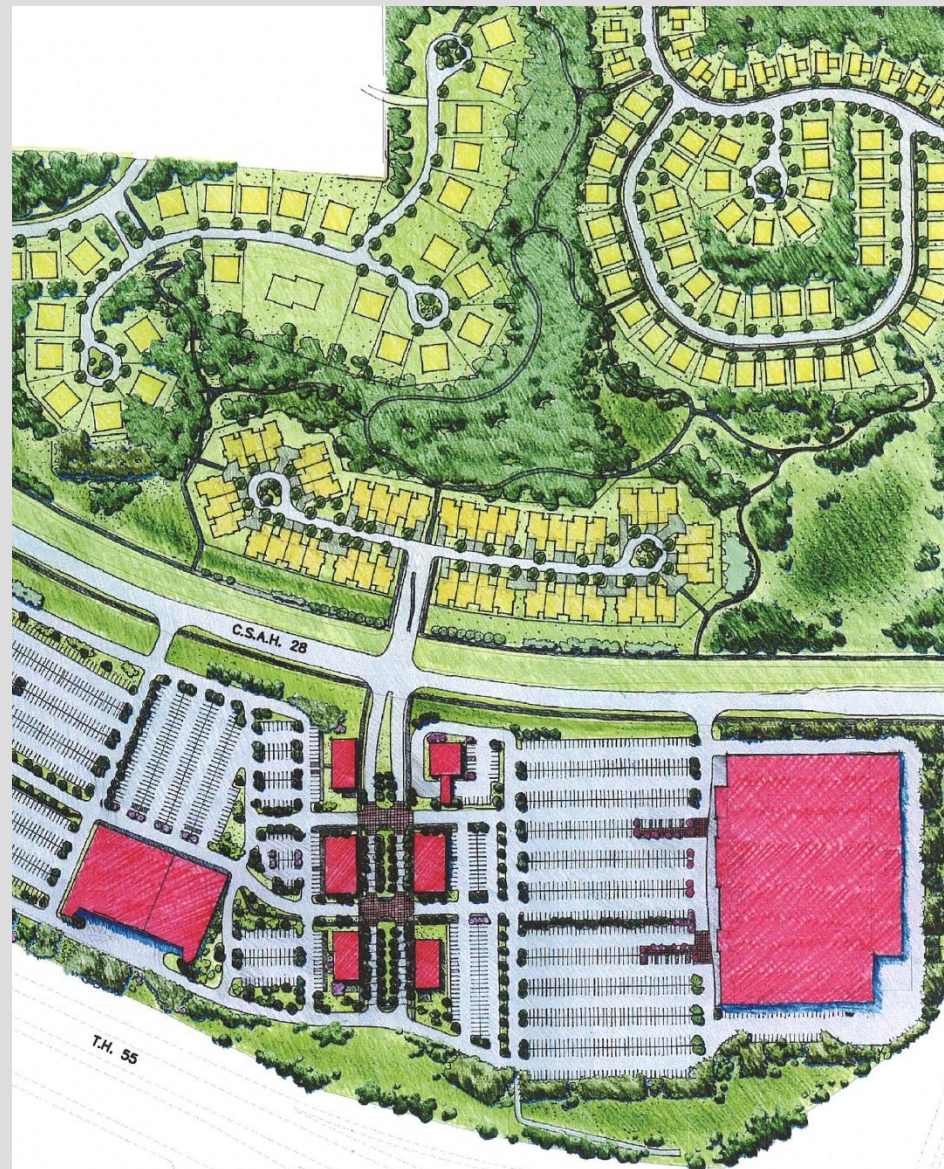
1. Land Use
2. Stormwater Management

Benefits of LID/GI Integration



- Improves Water Quality
- Reduces Flooding & Increases Resiliency
- Reduces Cost
- Preserves Landscapes, Stream, Wetlands, etc.
- Replenishes Aquifers
- **Uses less land than Ponds!**

Case Study: Argenta Hills Development

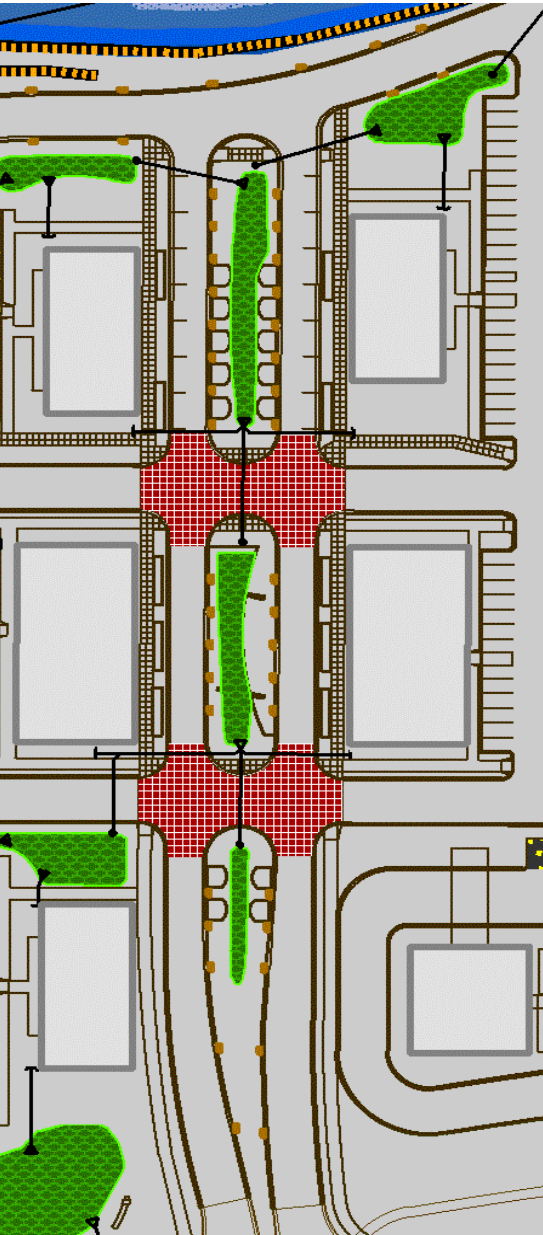


Case Study: Argenta Hills Development



Image courtesy of Close Landscape Architecture

Main Street - Site Map



Main Street - Porous Paver Section



Argenta Hills Phase 1

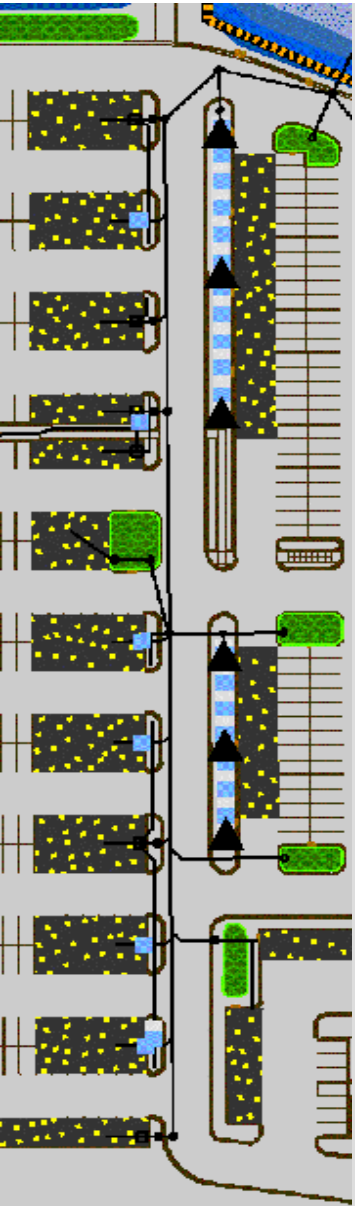


Argenta Hills Phase 1



Traffic Island Rain Garden

Prior to Paving



Porous Paving



Porous Pavement

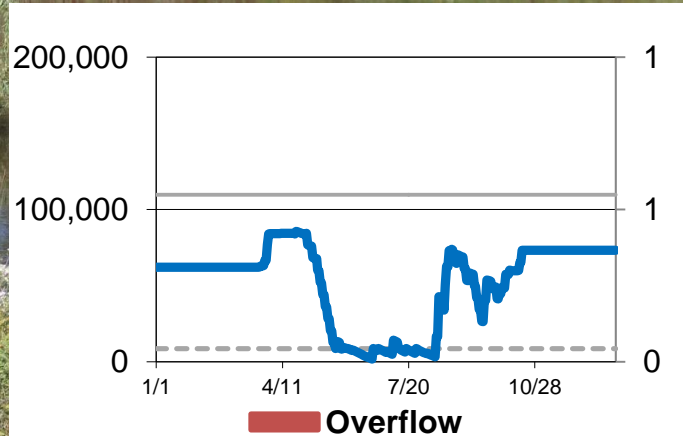


Argenta Hills Phase 1



Argenta Hills Phase 2-4

Natural drainage patterns,
Stormwater Harvesting

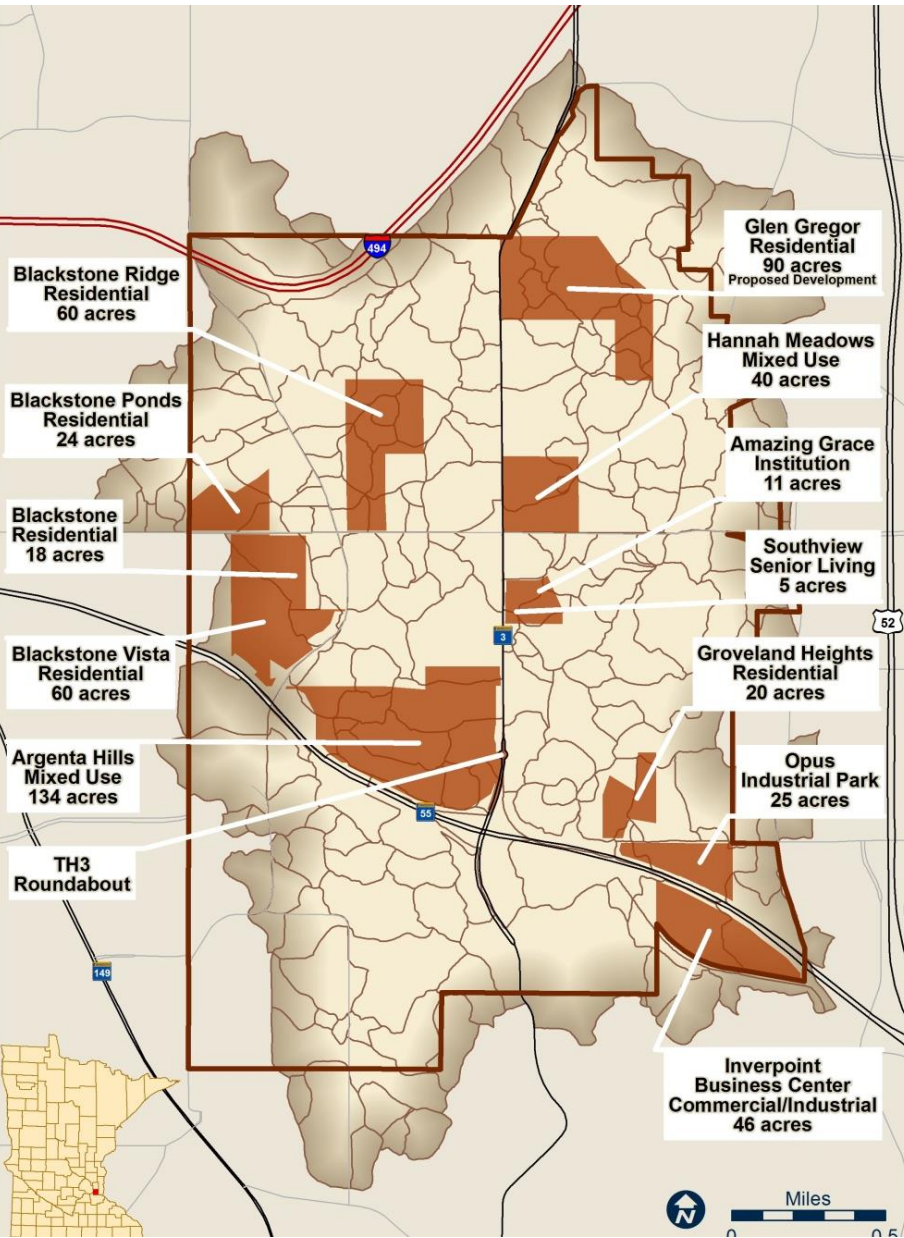


Cul-de-sac filtration gardens



Open/green space planning





Development Projects:

- Argenta Hills – Mixed Uses
- Senior Housing
- Office/Business Park
- Residential (SFR, MFR)
- Road Projects



State, National, & International Engineering Awards

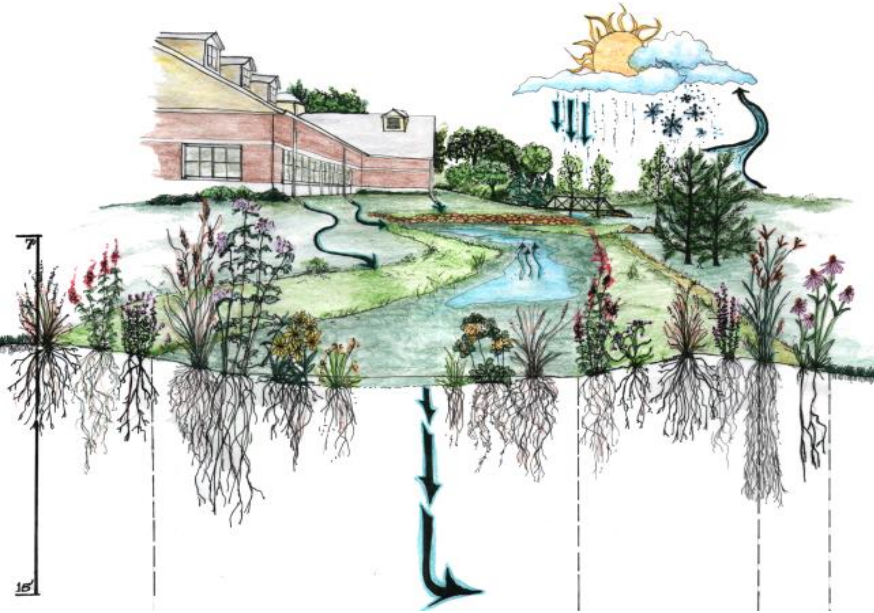


NW Area Plan Honored

- **American Council of Engineering Companies (ACEC) National Award**
- **1 of 8 Grand Awards across U.S.**
- **International FIDIC Top 20 Award**
- **Success Story:
Doing what 'Cannot be Done'
- IGH as a Model**
- **Weaving Green Infrastructure (GI)
into our Built Environment**
- **Integrating Planning
and Engineering**
- **Trend of the Future**



Summary - How Zero Discharge Works? (Mimic Hydrology)



Keep Water at the Source
(Understand & Mimic Natural Hydrology) – LID & GI

Integrate Planning for both Land Use & Stormwater
Use Natural Landscape/Assets
– Depressions, Soils

Strong Resources
– Ordinances/By-Laws, Manual, O&M, Fees Structure



Acknowledgements



City:

Inver Grove Heights, MN
City Council and City Staff

Planners:

Hoisington-Koegler Group Inc.

Argenta Hills

Developers & Contractors:

McGough, Tradition, Kimley-Horn, & Enebak

A Unique, Sought-After Community:

“This brand new neighborhood is just minutes from downtown, yet you feel as though you’re in the country with acres of trees and preserved open space, and trails... a perfect place for you and your family to call home.”

Thank You

Questions?

Brett H. Emmons, Founding Principal
bemmons@eorinc.com / 651.770.8448

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