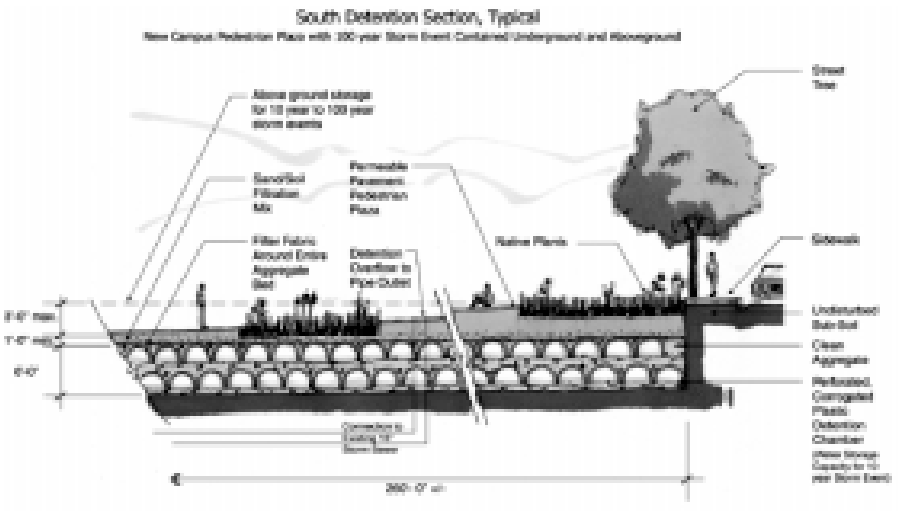
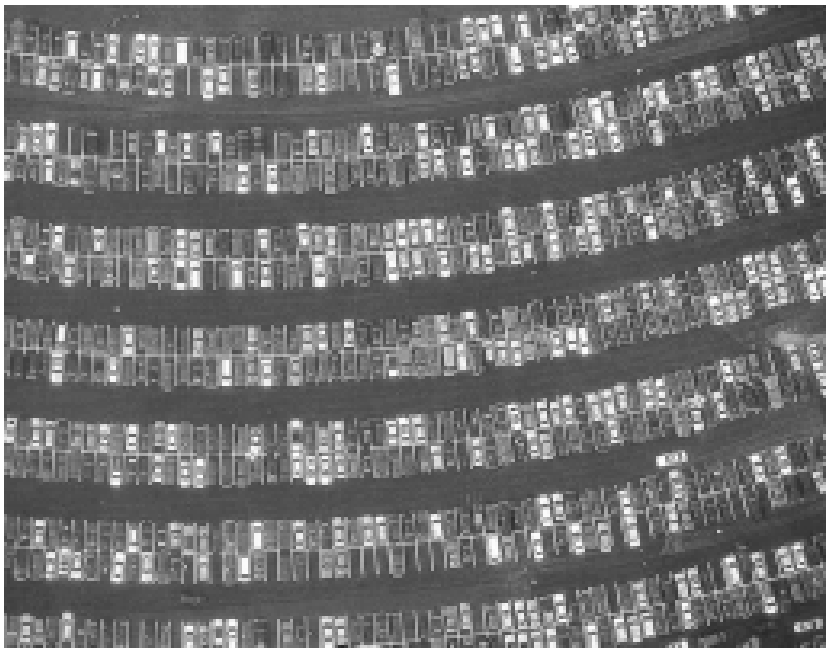
Techniques for Sustainable Urbanism: The Ecology & Culture of Water



A Few Critical Considerations

- Every acre on the surface of the earth is unique unto itself; it has its own cultural and physical heritage formed by the relationships of climate, geology, landforms, soils, hydrology, topography, flora, fauna, and human beings.



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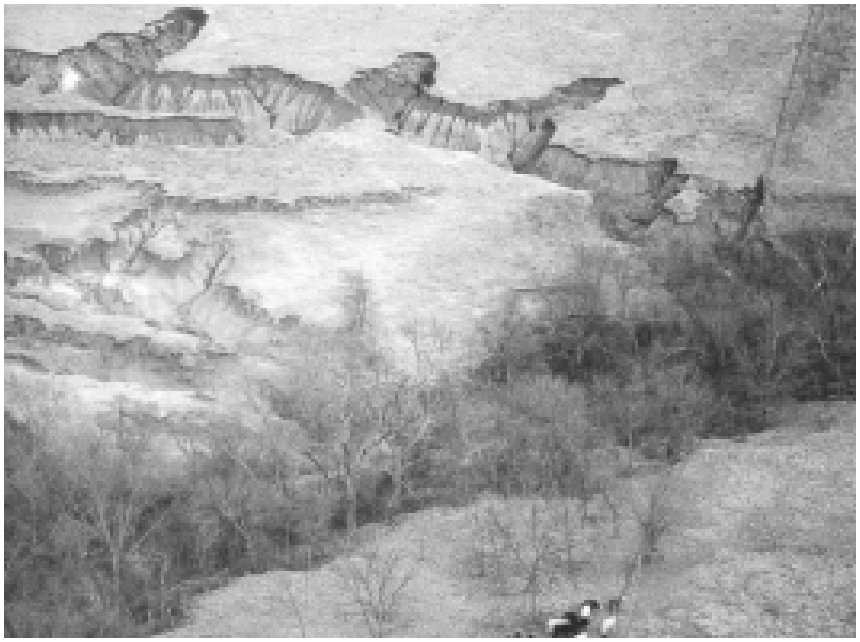
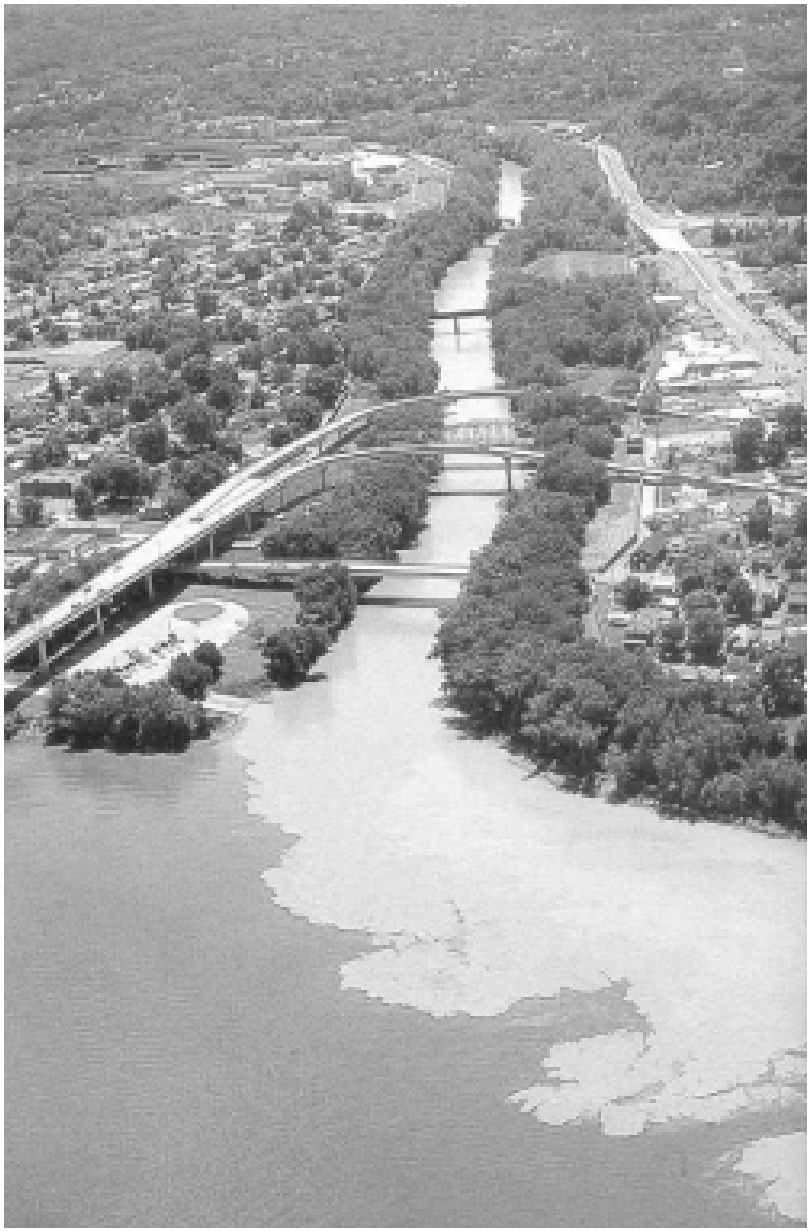
The Physics of Design

"FOR EVERY DESIGN "ACTION",
THERE ARE ENVIRONMENTAL, SOCIAL, AND
PSYCHOLOGICAL "REACTIONS" TO BE OBSERVED."
(NEWTON'S THIRD LAW OF PHYSICS
APPLIED TO DESIGN.)





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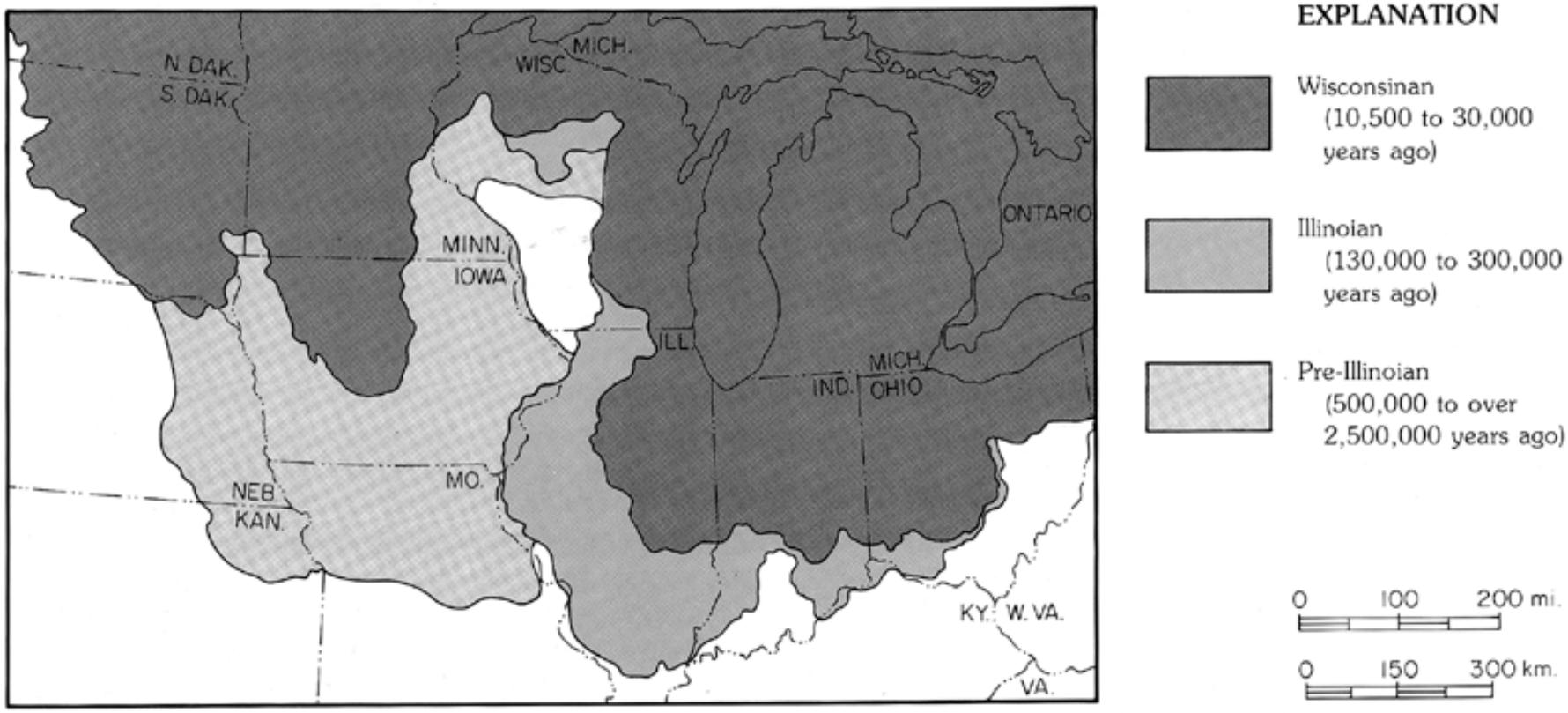
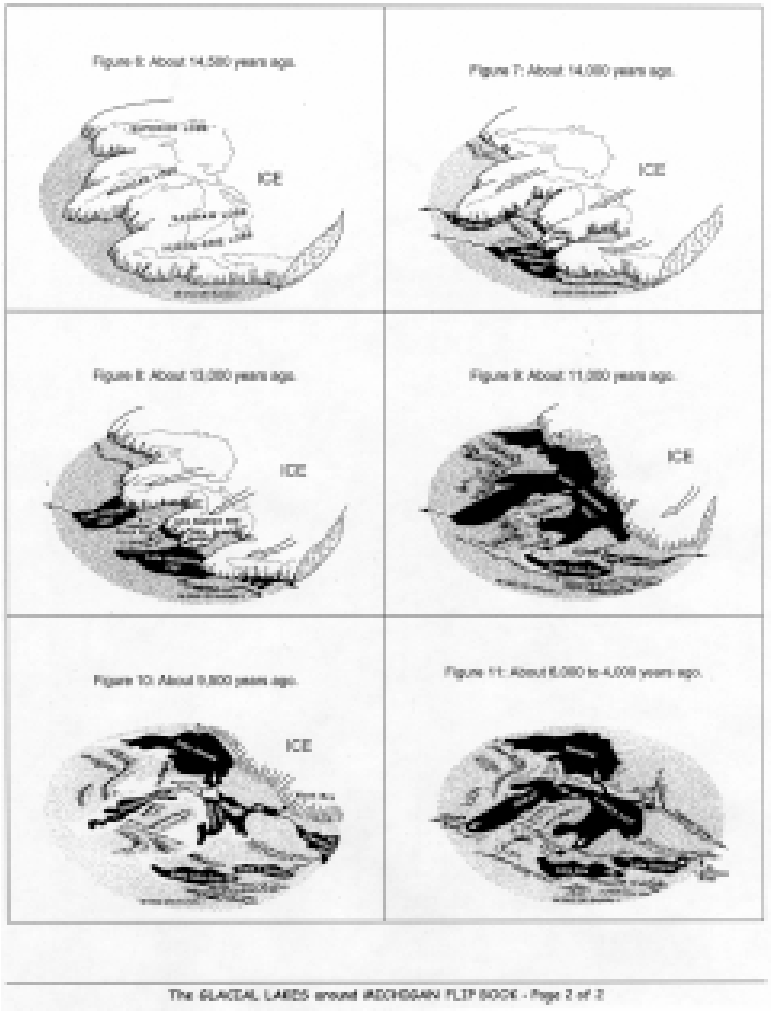
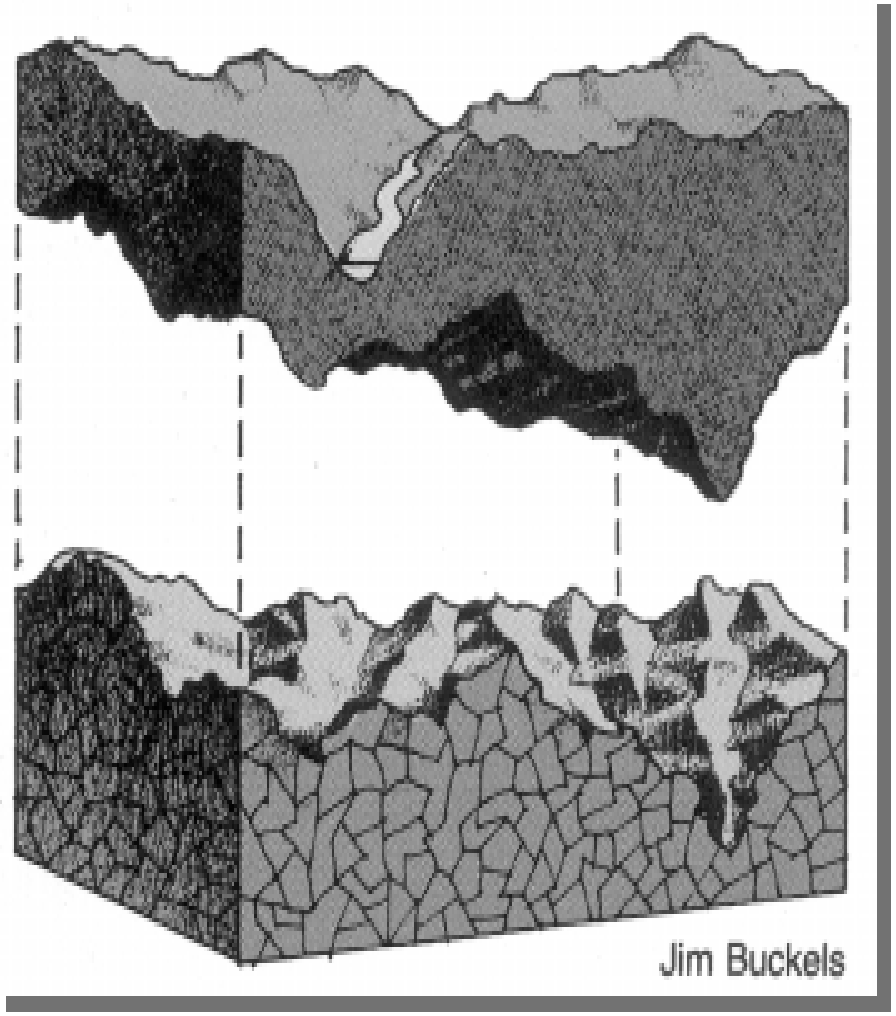
Glacial Advances in the Upper Midwest



Limits of Major Glacial Advances in the Upper Midwest

The Glacial and Landform History of the Midwest





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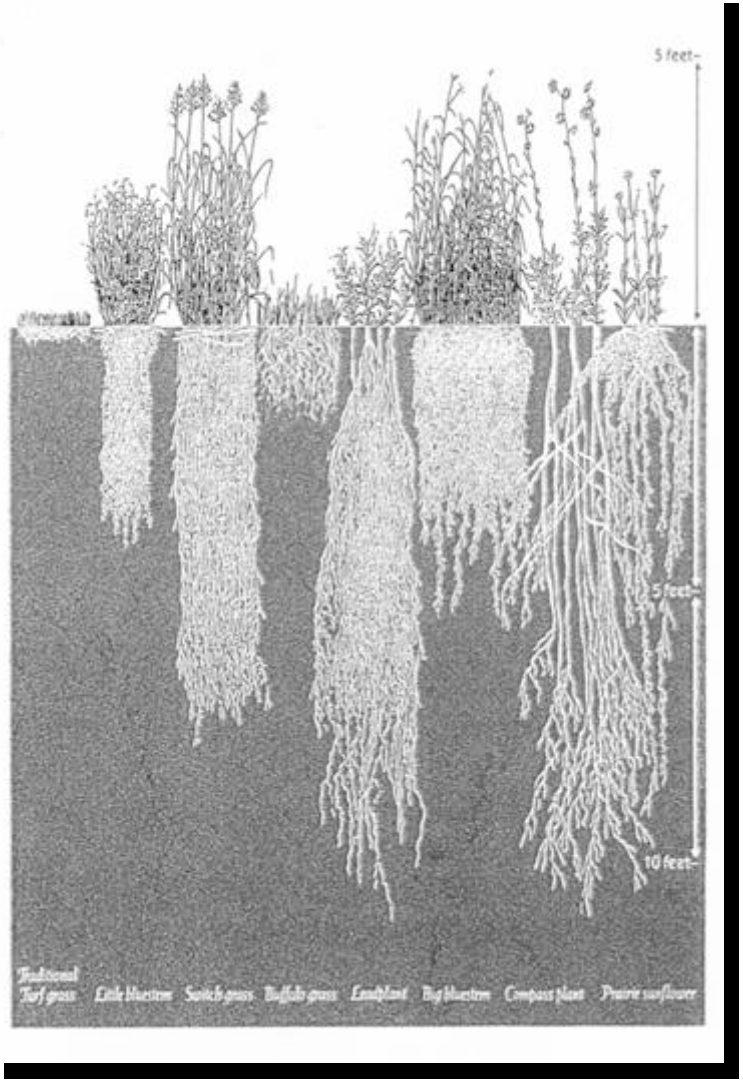
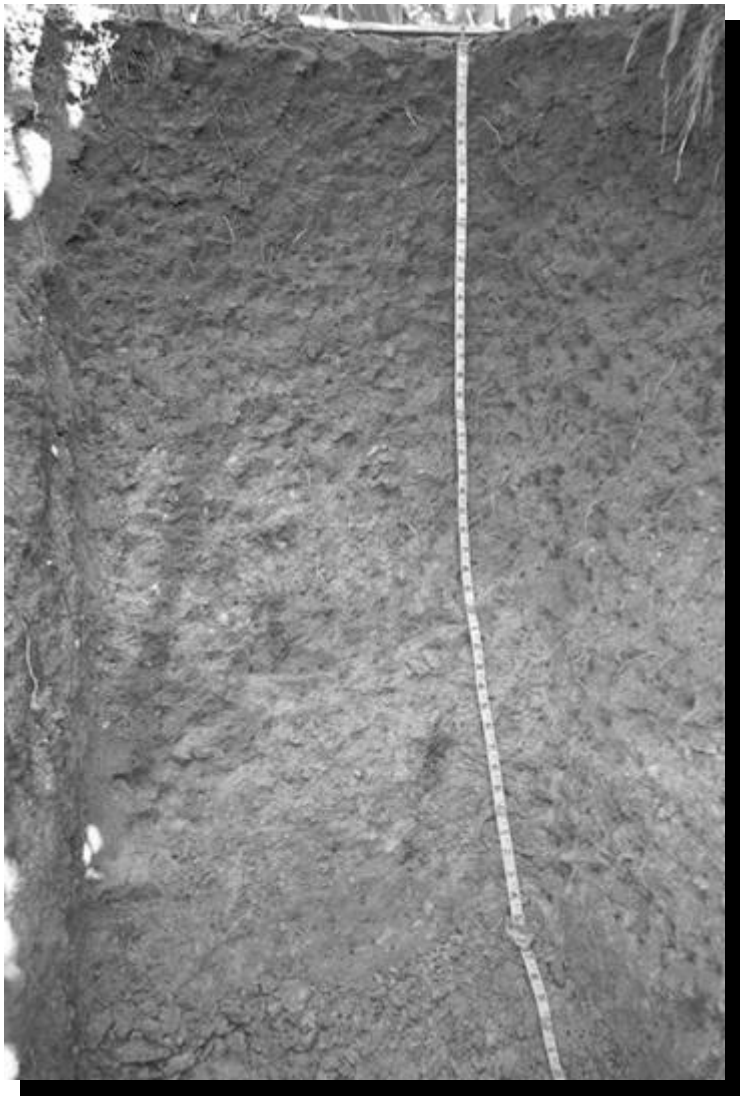
Native Plant Root Structure



Soil Cross Section



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Historical Patterns of Hydrology

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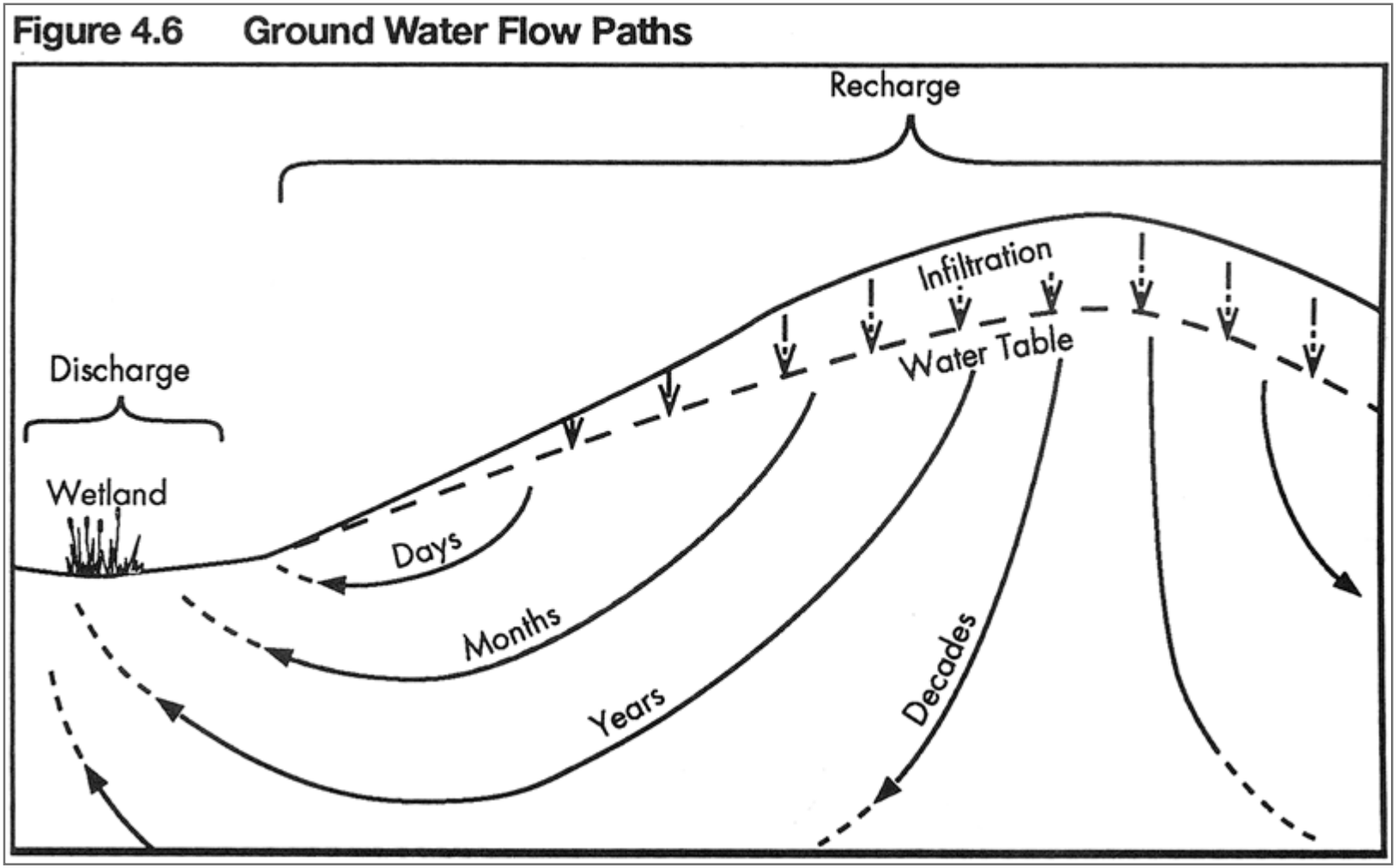
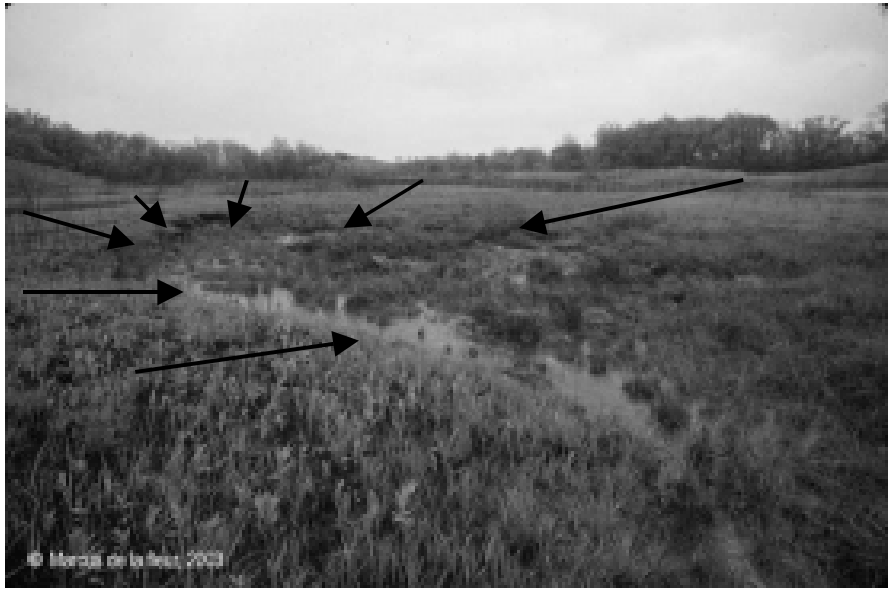


Wetlands and Groundwater in the United States; Stone & Stone



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Water in Contemporary Urban, Suburban & Rural Environments

Traditional Stormwater Management Approach:

Collect and convey water away from the site just as quickly and efficiently as the law will allow through enclosed storm sewer systems designed with concentrated points of discharge that generate a velocity and volume of flow that is nearly impossible to mitigate.

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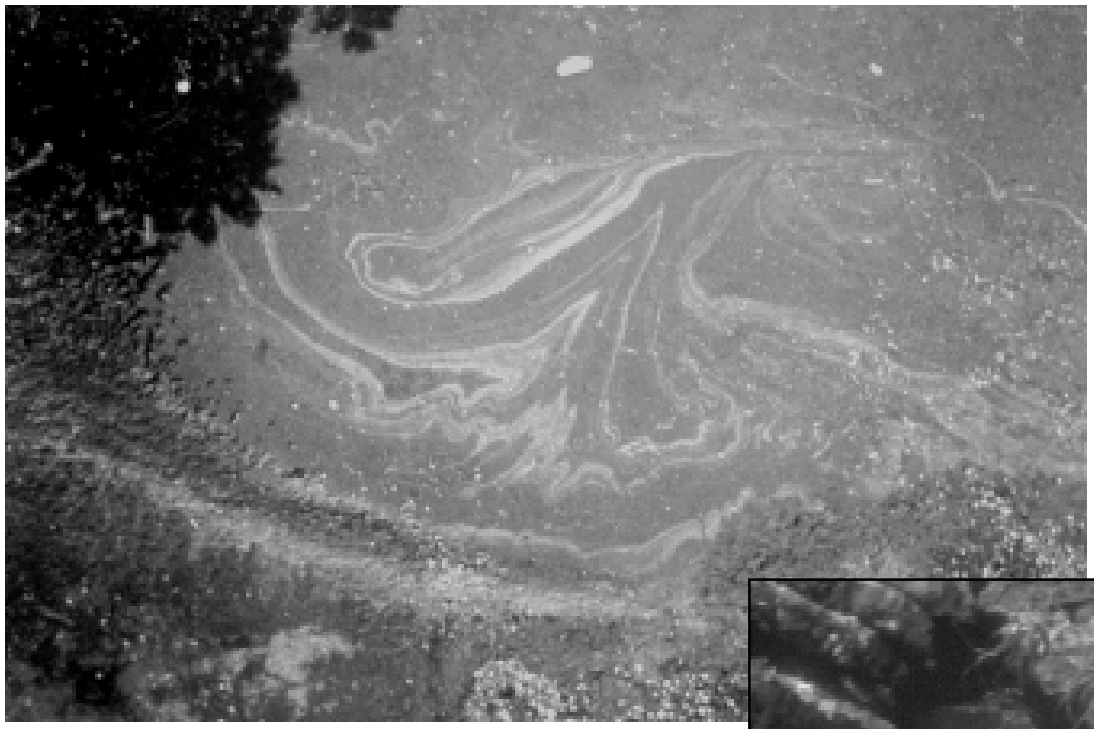

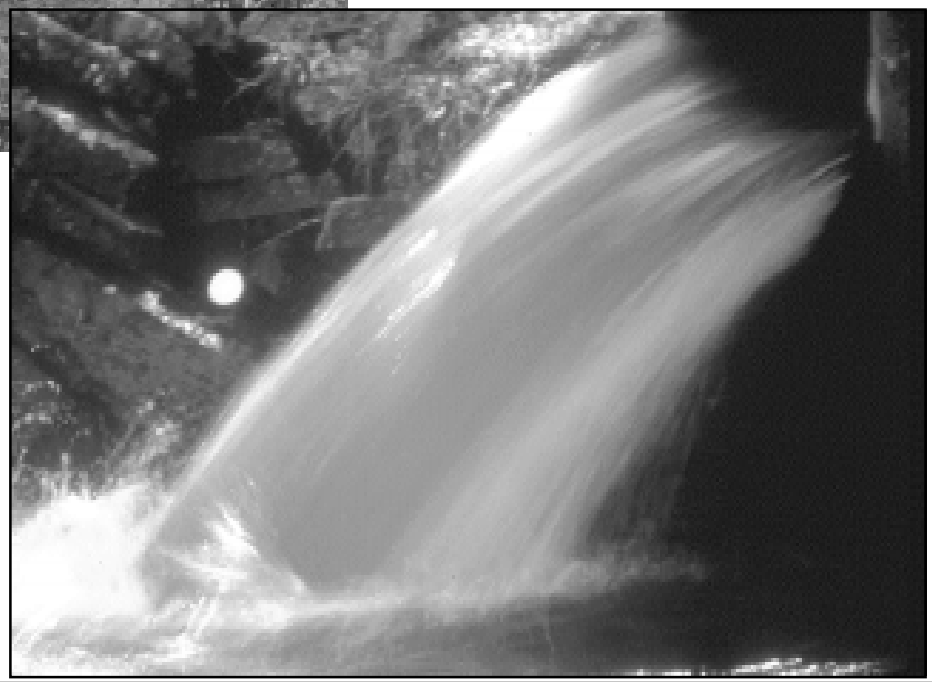

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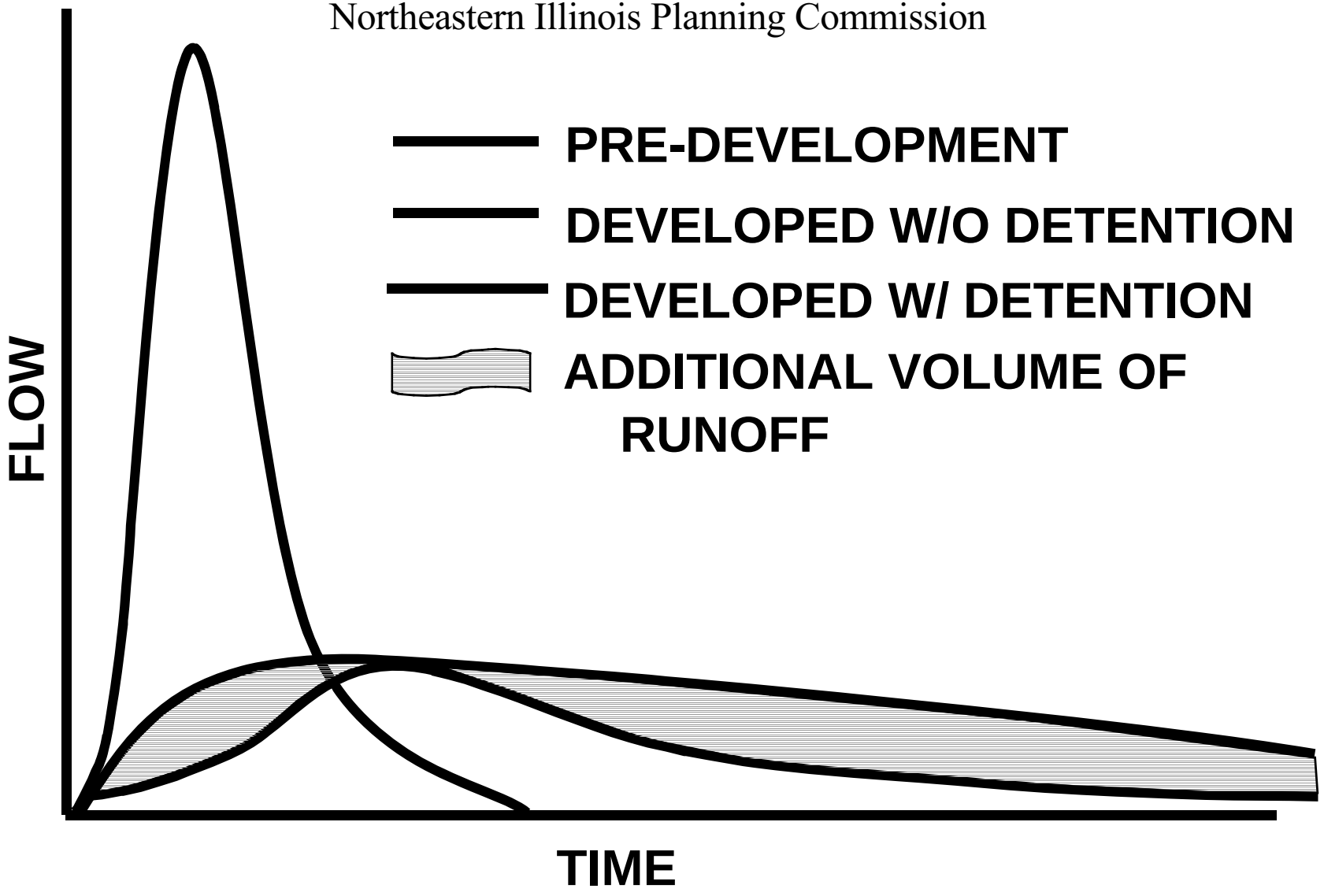
RUNOFF RATES AND VOLUMES

Northeastern Illinois Planning Commission



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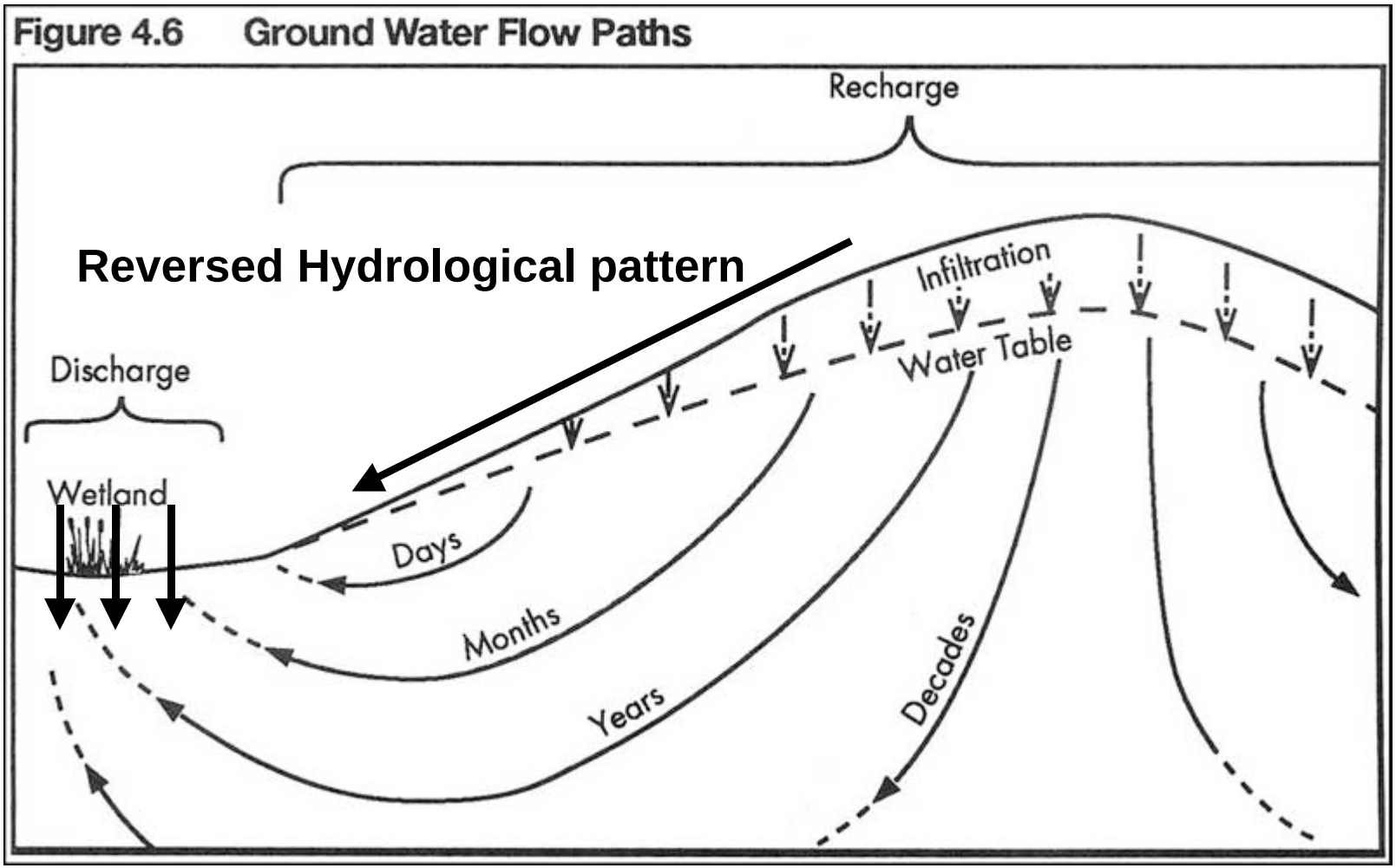
“We blame it on too much rain”

Loss of bio-diversity in flood prone habitats



Contemporary vs. Historical Patterns of Hydrology

Promote Watershed Scale Sustainable Land Use and Integrated Water Resource Management

In Contrast to Conventional Stormwater Management Approaches, Sustainable Water Resource Management Strategies:

Capture rainfall, diffuse flow, cleanse, and absorb on-site, thus restoring historically stable patterns of groundwater dominated hydrology.

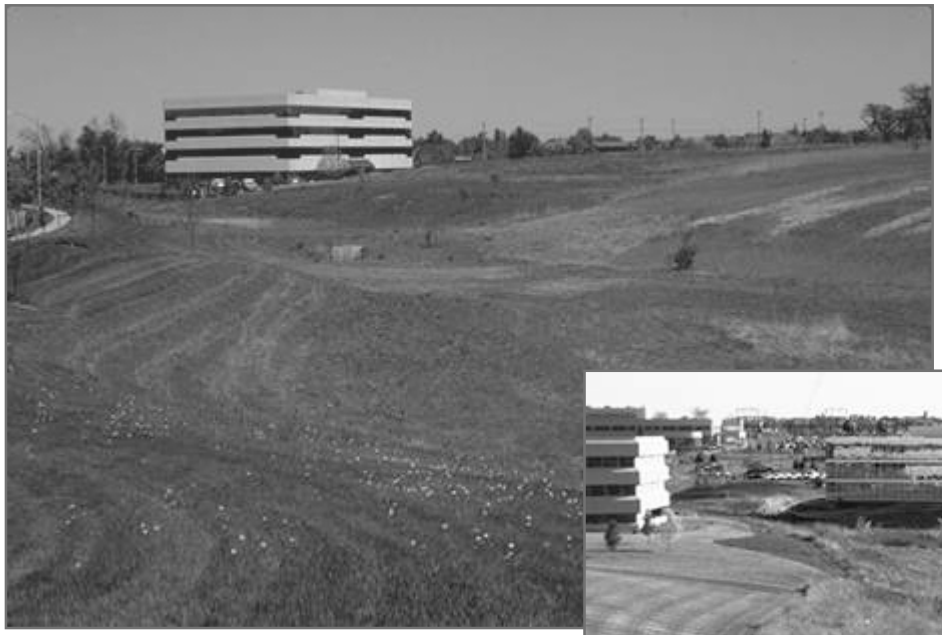
The “Golden Rule” of Sustainable Water Resource Management

“TREAT WATER AS A RESOURCE - NOT A WASTE PRODUCT”

- **Restore Groundwater Dominated Hydrology**
- **Minimize Impervious Surfaces**
- **Avoid Concentrated Points of Discharge – Diffuse & Absorb**
- **Capture & Infiltrate Runoff Onsite - Uplands Most Effective**
- **Preserve Natural Drainage Features & Systems**
- **Avoid Soil Disruption & Restore Soil Health**
- **AVOID SOIL COMPACTION !!!**
- **Celebrate Water as a Precious Resource**

Promote the Integration of Native Landscape Systems into Contemporary Urban, Suburban, & Rural Environments

University Research Park – Madison, WI



Before

After

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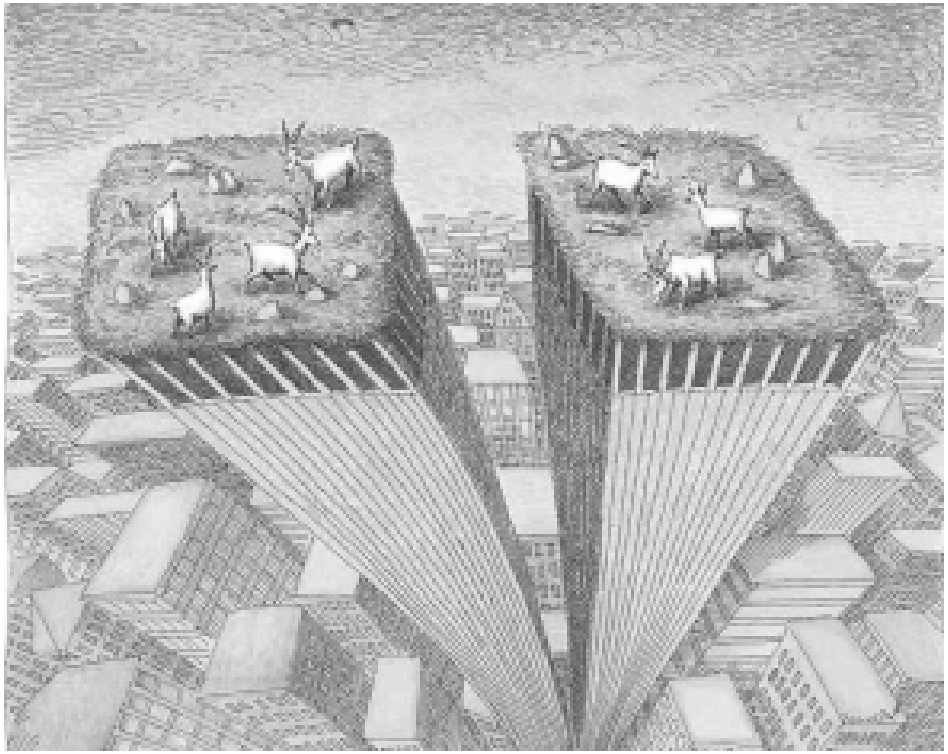
Incorporate Infiltration-Based Infrastructure Design Measures

START AT THE TOP - LITERALLY

Promote Urban Ecology Through the Use of Green Roof Systems & Rooftop Gardens

Techniques for Sustainable Urbanism

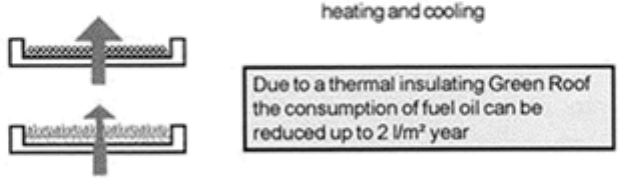


Techniques for Sustainable Urbanism

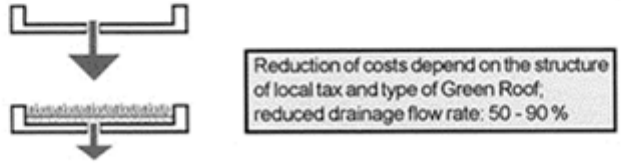
Influences on the profitability for the building owner

- **Extension on the life-expectancy of the roof** → reduced costs regarding repairs and redevelopment

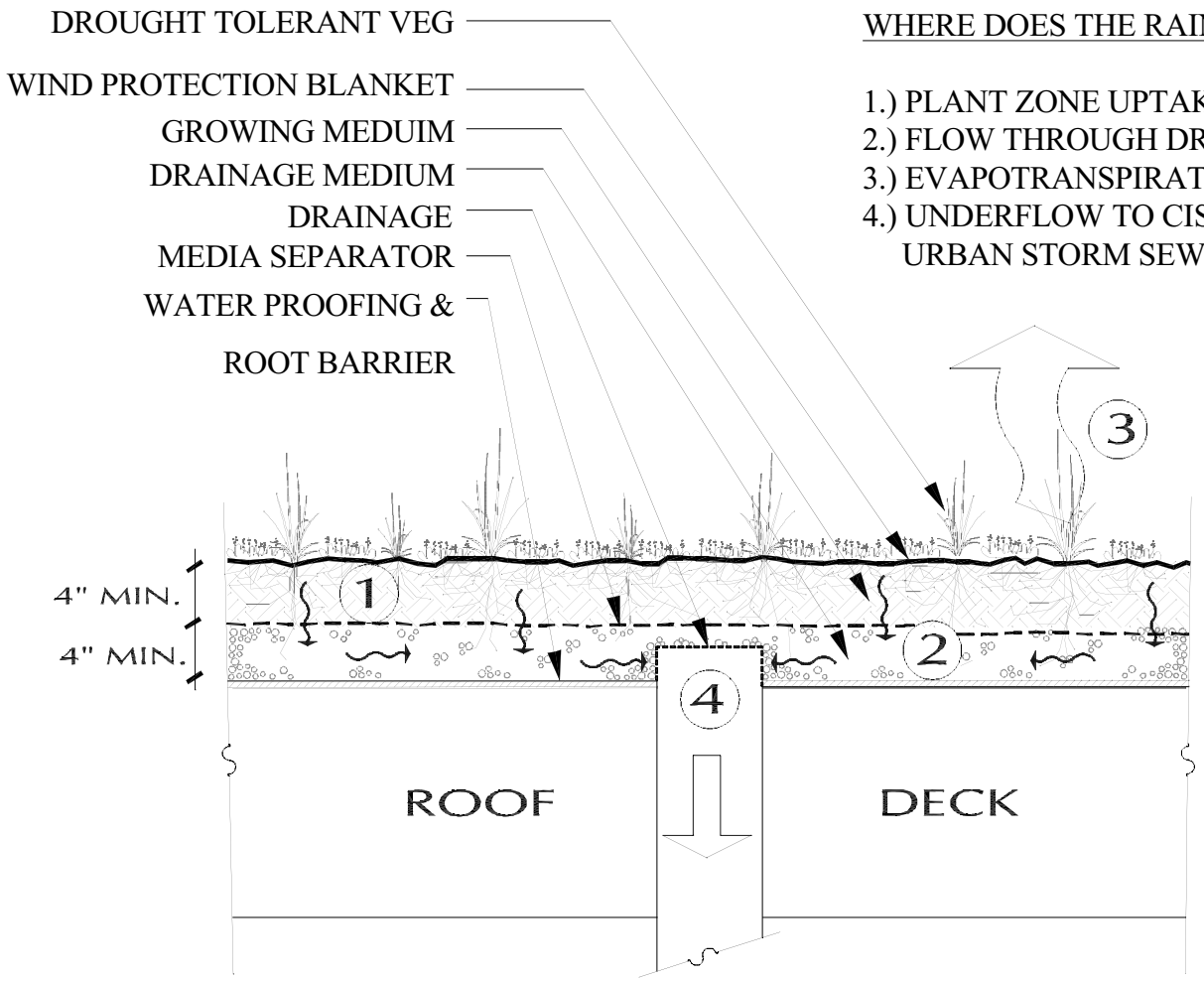
- **Additional thermal insulation** → Reduced costs regarding heating and cooling



- **Reduced drainage flow rates** → Reduced sewage costs (Reduced local tax for sealing landscapes)



→ **Reduction of annual follow-up costs!**



WHERE DOES THE RAINWATER GO?

1.) PLANT ZONE UPTAKE
2.) FLOW THROUGH DRAINAGE MEDIA
3.) EVAPOTRANSPIRATION +/- 70% (ZINCO)
4.) UNDERFLOW TO CISTERN, RAINWATER GARDEN, URBAN STORM SEWER / 30%

GREEN ROOF CROSS SECTION

Extensive (green roof)

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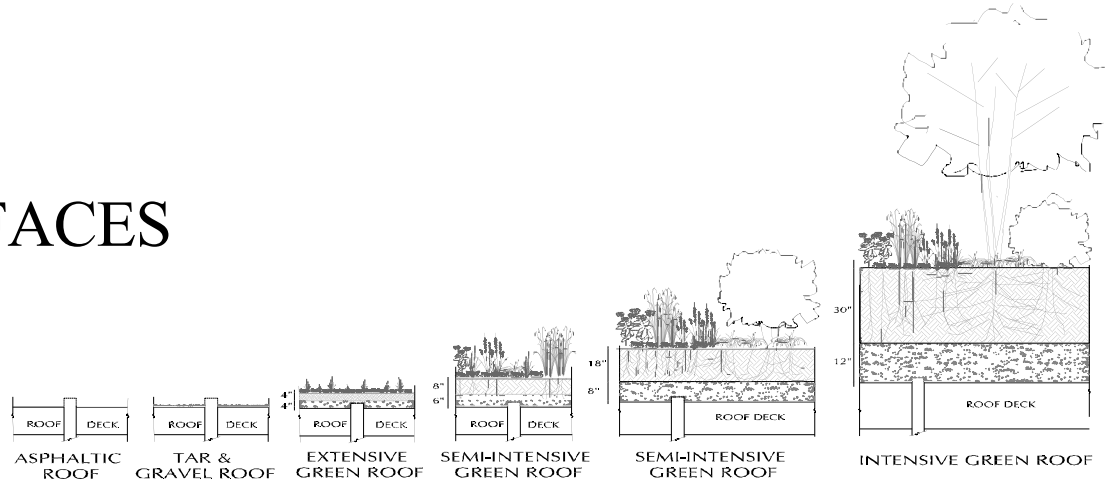
Techniques for Sustainable Urbanism

COMPARING ROOFTOP SURFACES



ECONOMIC	COST SAVINGS OVER LIFE OF BUILDING	N.A.	2X'S	3X'S	4X's	+4X'S?
	INITIAL COST OF ROOF	$6-$8 S.F.	$8-$15 S.F.	$11-$18 S.F.	$15-$25 S.F.	+ 30 S.F.
	SAVINGS ON HEATING/COOLING [1]	NONE	10%?	20-30%	20-30%	50%?
	EFFECT ON PROPERTY VALUES	NONE	INCREASE			SIGNIFICANT
ENVIRONMENTAL	BENEFIT TO WILDLIFE [2]	LITTLE	BUTTERFLIES VISIT 20 STORIES; BIRDS 19			SIGNIFICANT
	EFFECT ON AMBIENT ROOF TEMPERATURE	+ 20	+2	0	-2	-6?
	EFFECT ON AIR QUALITY [3]	POOR	CLEANSING			SIGNIFICANT
	RAIN WATER ABSORPTION [6]	0%	+50% AVE.	+70% AVE.	+80% AVE.	+95% AVE.
	ADDITIONAL WEIGHT ADDED TO ROOF	NONE	20-25 LBS. S.F.		60-90 LBS. S.F.	+100 LBS. S.F.
MECHANICAL	INSULATION VALUE	LOW	MODERATE			HIGH
	LONGEVITY OF ROOF	10-15 YRS.	40 YRS.	60YRS.		+100 YRS?
	MAINTENCANCE OF ROOF	1 PER YR.	1 PER YR.	1-4 PER YR.		MONTHLY
	AESTHETIC VALUE [5]	NEGATIVE				POSITIVE
SOCIAL	OPPORTUNITIES TO GROW FOOD/PRODUCE [4]	NONE	LITTLE	UNIVERSITIES, RUSSIAN PRISONS		HIGH
	PSYCHOLOGICAL BENEFITS [5]	NEGATIVE	POSITIVE			POSITIVE
	RECREATIONAL OPPORTUNITIES	NONE	FEW			UNLIMITED

1) URBAN HEAT ISLAND INITIATIVE PILOT PROJECT FINAL REPORT; J.T. KATRAKIS & ASSOCIATES, 5-19-99 2) LONDON ECOLOGY UNIT, 1993
3) NASA STUDY; PROJECT ATLANTA, 1996 4) DR. MARTIN PRICE, 1997 5) R. KAPLAN, THE ROLE OF NATURE IN THE CONTEXT OF THE WORKPLACE, '93; T. HERZOG, RESTORATIVE ENVIRONMENTS 6) NUMBEROUS STUDIES IN EURPOPE

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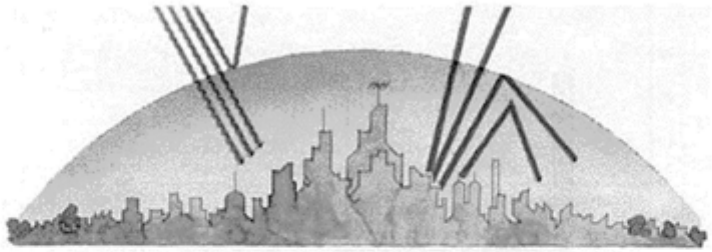
Intensive (roof garden)

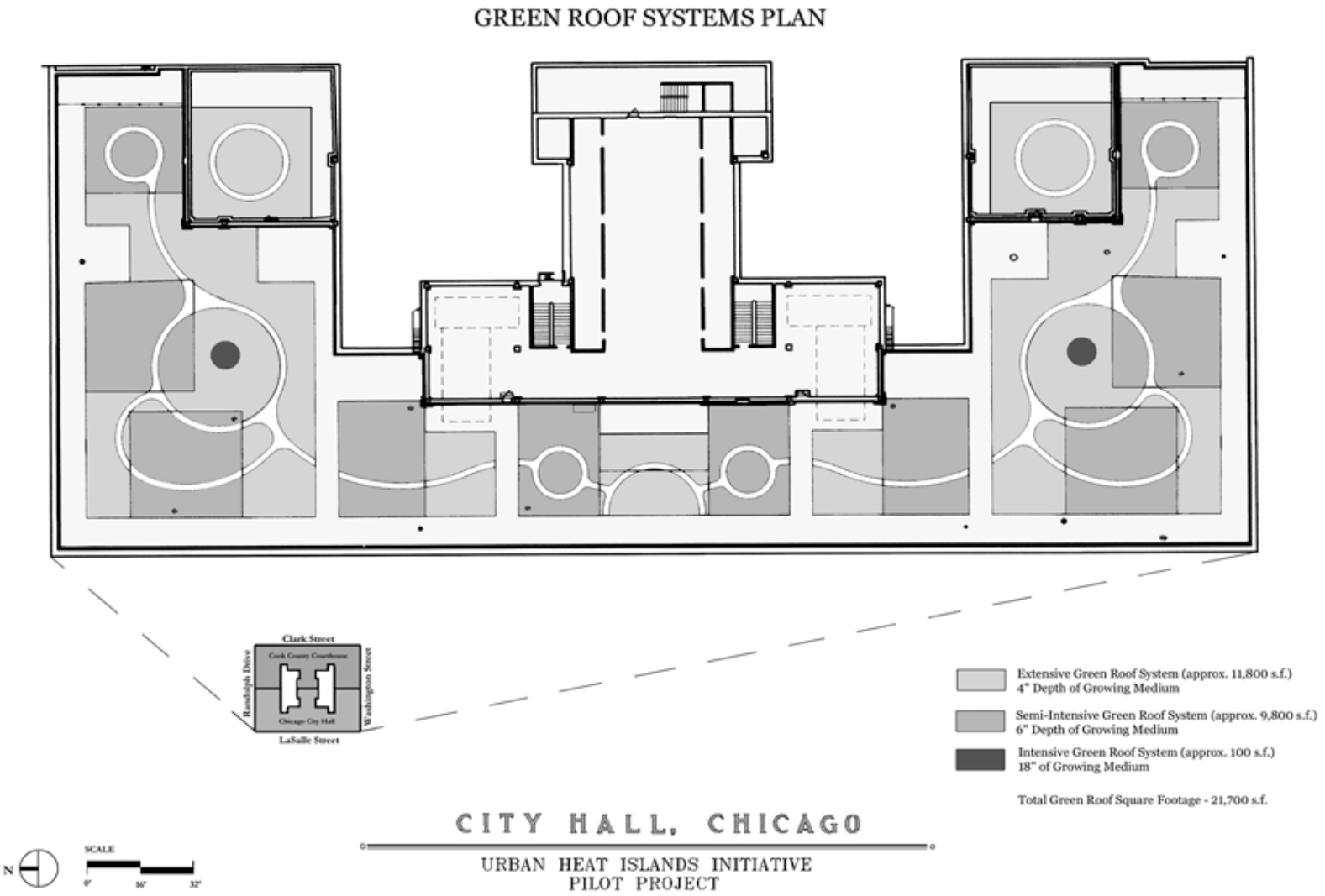
Chicago City Hall 1999

Effects of Green Roofs on the microclimate



Surface temperature of gravel roofs:	up to 50°C
Surface temperature of "naked" roofs:	approx. 70°C up to 90°C
Temperature above Green Roofs: (approx. 5 K more than air temperature)	max 35°C
Amount of evaporation (leaf surface approx. 100 m² per m²) from an intensive landscaped roof on a hot summer day:	up to 50 l/m²
Amount of evaporation (leaf surface approx. 2,4 m² per m²) from an extensive landscaped roof on a hot summerday:	approx. 1,2 l/m²

1 l of evaporated water extracts a heat-amount of 592 Kcal from the surrounding air which reduces a heating up



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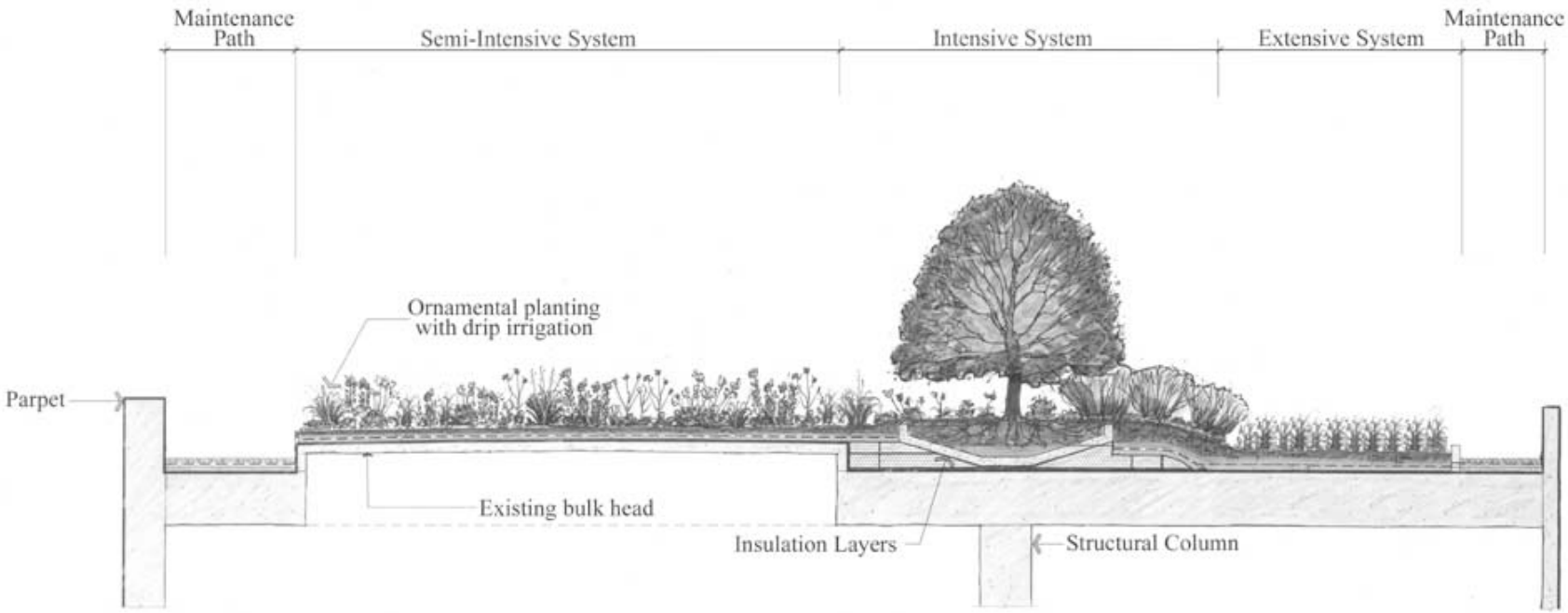

Cross Section of Semi-Intensive, Intensive, and Extensive Systems

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CITY HALL, CHICAGO

URBAN HEAT ISLANDS INITIATIVE
PILOT PROJECT

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