

Green Infrastructure, Ecosystem Services and Biodiversity



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Biodiversity Forum: Green Infrastructures for Biodiversity

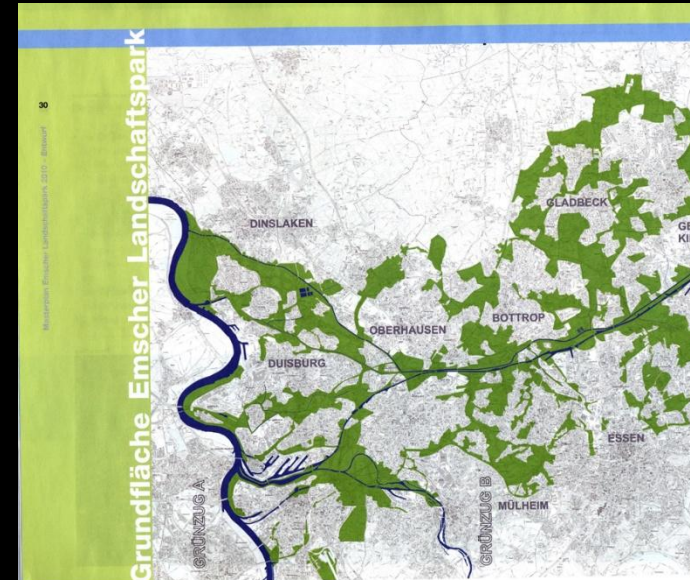
Green Infrastructure

- Protected AND Hybrid/Built Ecosystems
- Provides MULTIPLE ecosystem services
- Strategic “bundling” of biodiversity with other ecosystem services

Green Infrastructure: Defined

Integrated networks/systems of **built** and **protected/managed urban ecosystems** that provide multiple, complementary **Ecosystem** functions in support of urban sustainability (Ahern, 2007)

- **Strategic**, Multifunctional, Functions can be **BUNDLED**
- Structured at **Multiple Scales** - *to support Processes that function at multiple scales*
- **Connectivity across scales is fundamental** – structural and functional networks

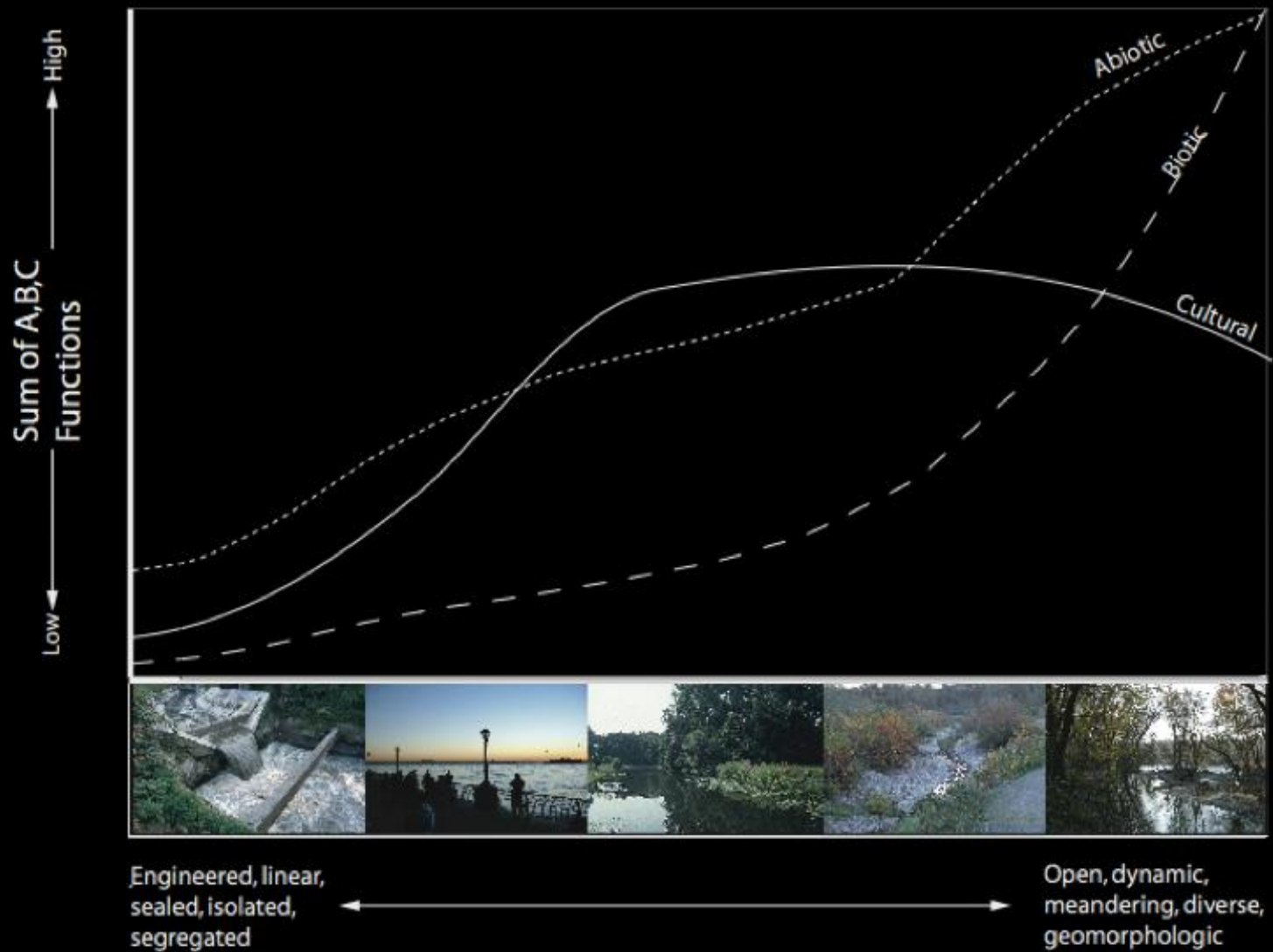


Conventional vs Green Infrastructure

Conventional Infrastructure	Green Infrastructure
Expensive to build and maintain	Lower cost
Energy intensive to operate	Energy conservative, or neutral
Contributes greenhouse emissions	Sequesters carbon
Adds to urban heat island effect	Cooling through evapotranspiration
Stormwater exported – downstream impacts	Stormwater retained, stream flows stabilized
Groundwater levels reduced	Groundwater levels maintained
Encourages auto use	Promotes walking/biking
Mono-functional	Multi-functional
Centralized vulnerable to failure	Decentralized, “fail-safe”

ABC Model of Ecosystem/Landscape Services

Abiotic	Biotic	Cultural
Surface:groundwater interactions	Habitat for generalist, and specialist species	Direct experience of “natural” ecosystems
Soil development processes	Support of flora:fauna interactions	recreation and a sense of solitude and inspiration
Maintenance of hydrological regimes	Species movement routes and corridors	Context for healthy social interactions
Accommodate disturbance regimes	Maintenance of disturbance and successional regimes	Supports urban economy
Buffering of nutrient cycling	Biomass production	Experience and interpretation of cultural history
Storage/Sequestration of Carbon	Provision of genetic diversity	Stimulus for artistic and abstract expression
Buffering of climatic extremes	Food production	Environmental education



Abiotic, biotic and cultural functions/services vary across a continuum of urban hydrology types



More than a “second nature” ?

Typology of Urban Vegetation: species origin + structural diversity

Green Infrastructure = Biodiversity AT WORK

an alternative means to deliver basic urban services (drainage, infiltration, climate stabilization,.....)

Biodiversity is often an opportunistic - collateral benefit of green infrastructure



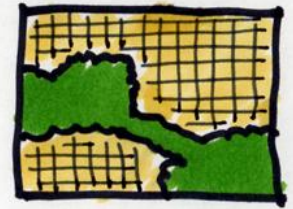
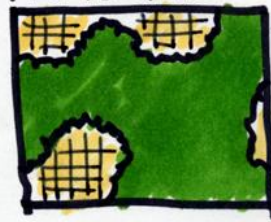
Urban Bio-filter,
Duisberg Inner
Harbour, Germany

Typology of Planning Strategies for Biodiversity

Planning and design interventions function of:

- * land use: land cover history (pattern and composition)
- * planning goals/objectives
- * resources/public support

PROTECTIVE



DEFENSIVE



OFFENSIVE



OPPORTUNISTIC



PRESENT

FUTURE



Protective

Florida Greenways Plan

Defensive

Staten Island Bluebelt

Offensive

Brownfield Restoration

NYC Waterfronts

Walden Passage

Opportunistic

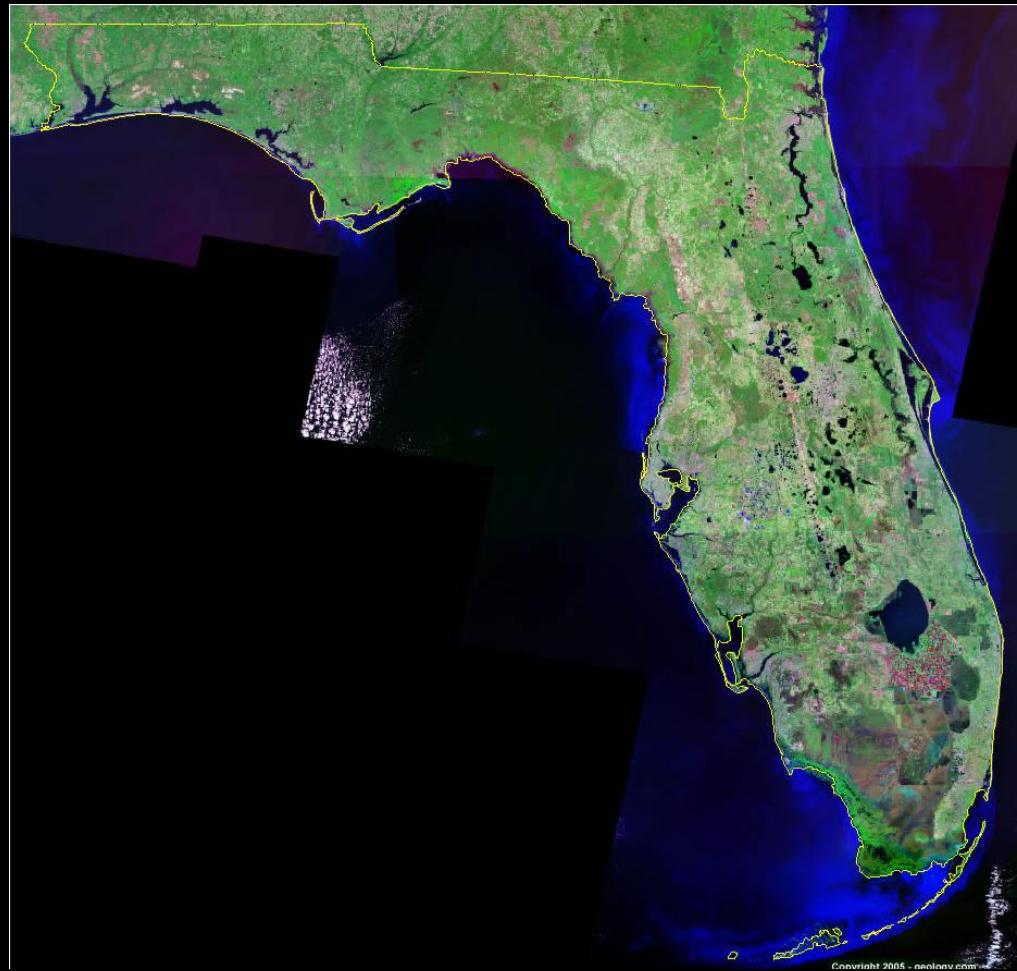
Devens Medical

Sudgelande, Germany

Rain Gardens

State of Florida Greenway Plan

- Concept: a system to link existing priority wildlife habitats, with multifunctional trails
- Significant public input, with resulting compromise/support.





Habitat Modeling as modified/negotiated by public and landowner input

Protective

Florida Greenways Plan

Defensive

Staten Island Bluebelt

Offensive

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Rain Gardens

Staten Island Bluebelt, New York City

- Existing wetlands adapted for water quality improvement and flood protection.
- Collateral functions and benefits: Biodiversity, Recreation, Neighborhood Quality
- >\$50M savings vs traditional storm sewer system





Bluebelt as Green Infrastructure

- Ecosystem Services: contaminants, groundwater recharge, peak flow reduced
- Biodiversity: Wildlife habitat and linkage
- Spatial structure for neighborhoods
- Sustainable urban hydrology

How Does the Bluebelt Work?

Click on the map to the right to see how wetlands preservation and infrastructure improvements provide storm water management.





Bluebelt-created wetland with flow-control structure

Protective

Florida Greenways Plan

Defensive

Staten Island Bluebelt

Offensive

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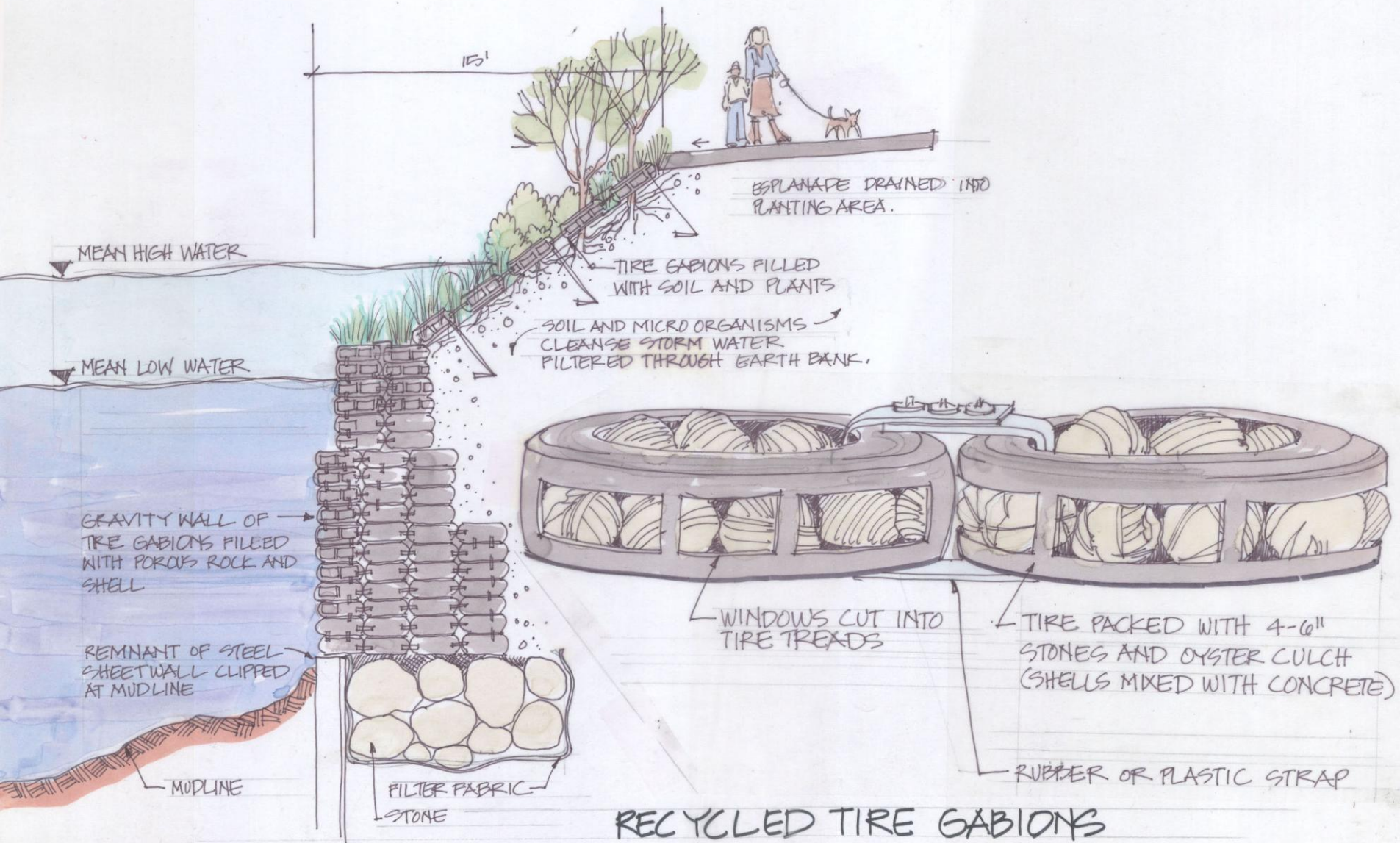
Sudgelande, Germany

Rain Gardens



Harlem River Park - South Tide Pool, Nov, 2009

NYC Harlem River Ecological Waterfront



NYC Harlem River Waterfront: Urban Habitat Creation



NYC Harlem River: “OYSTER-tecture”
(biodiversity “at work” for water cleansing)



Landesburger Tor Community – Berlin
Surface Drainage System – Cleansing Biotopes

Biodiversity Forum: Green Infrastructures for Biodiversity



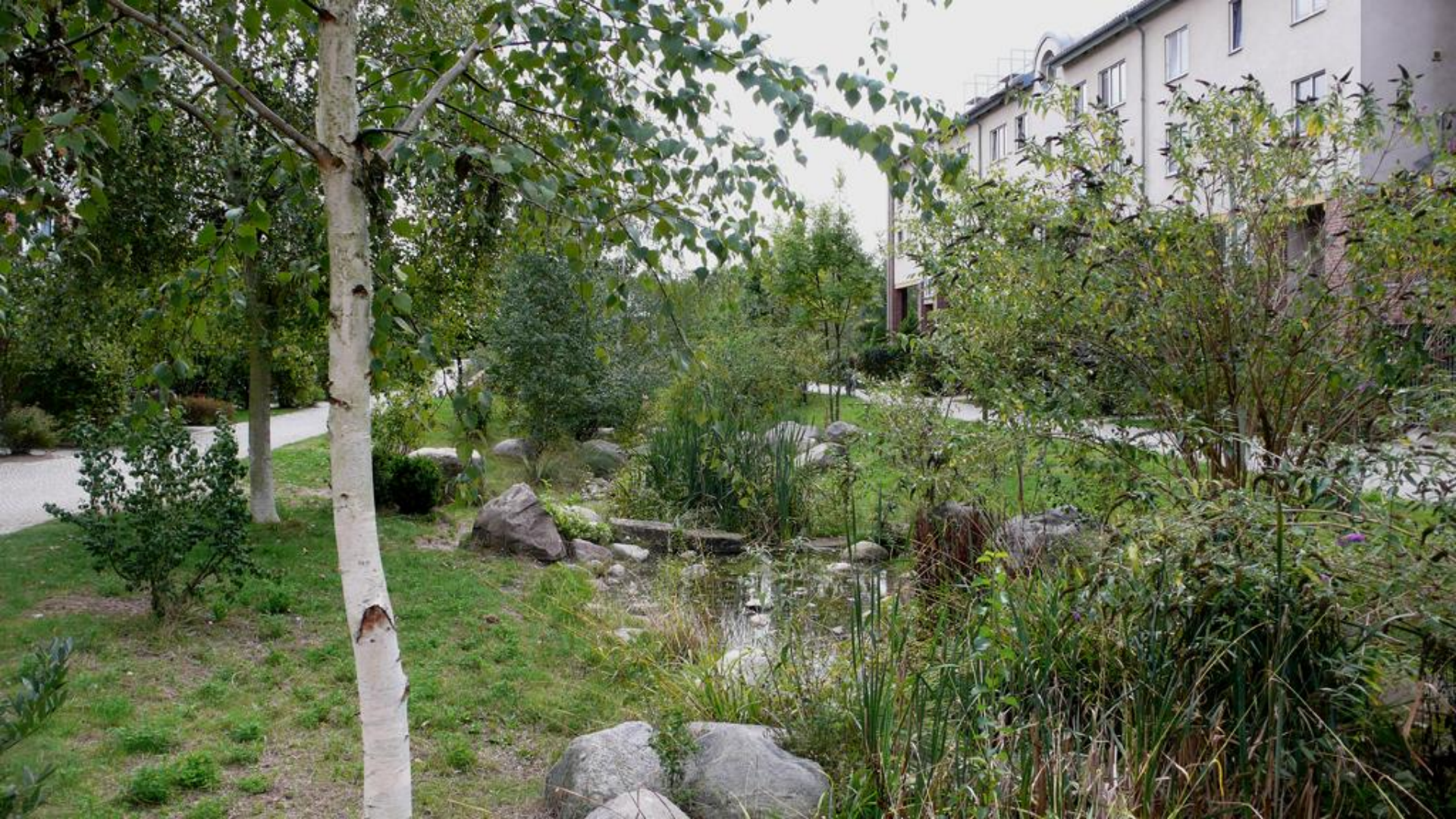
Landesburger Tor Community – Berlin Biodiverse Planted Stormwater Swale

Biodiversity Forum: Green Infrastructures for Biodiversity



Landesburger Tor Community
Berlin
Settling Basin /wetland

for Biodiversity



Landesburger Tor Community – Berlin
Surface Drainage Main Corridor
Biodiversity Forum: Green Infrastructures for Biodiversity

Protective

Florida Greenways Plan

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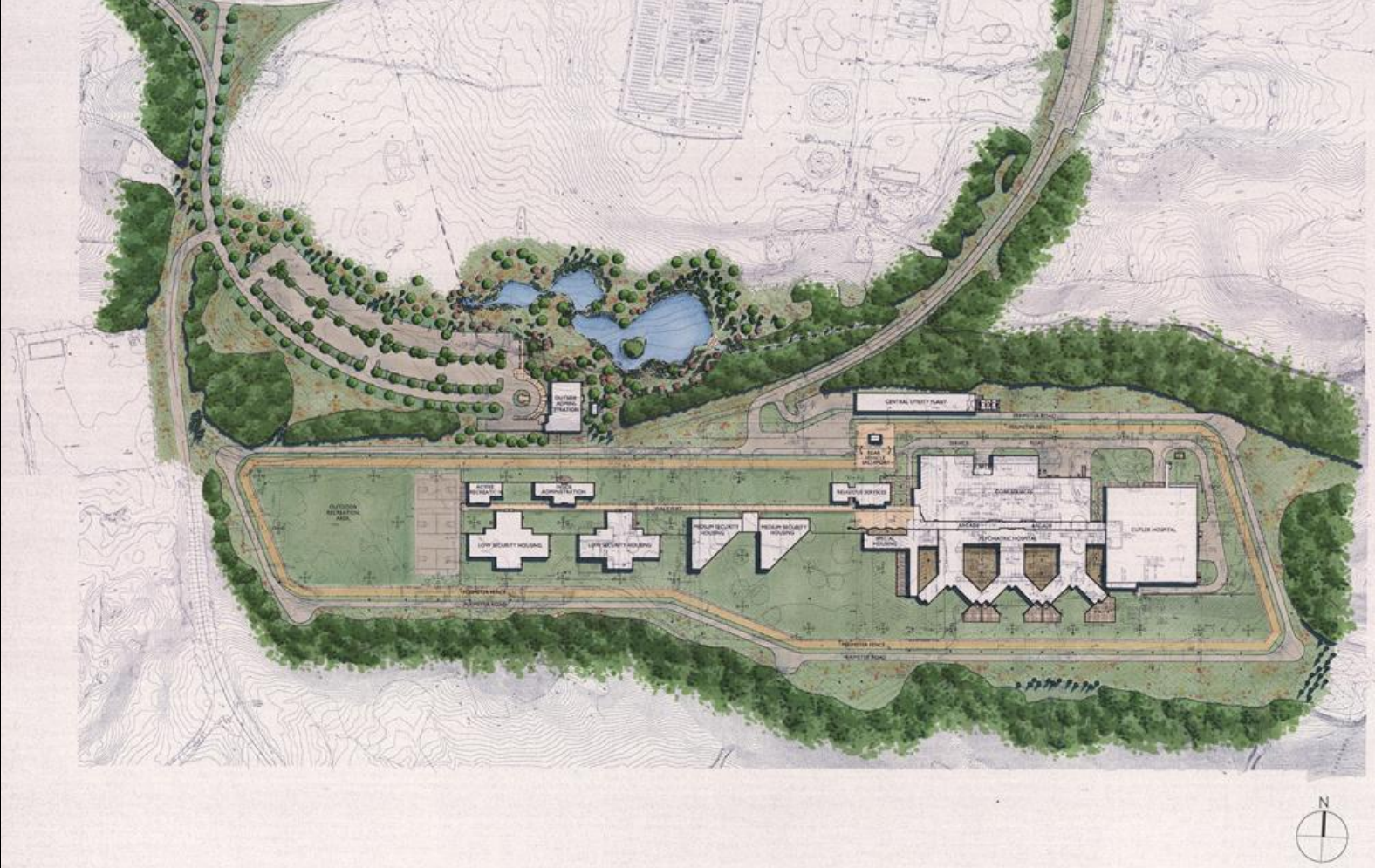
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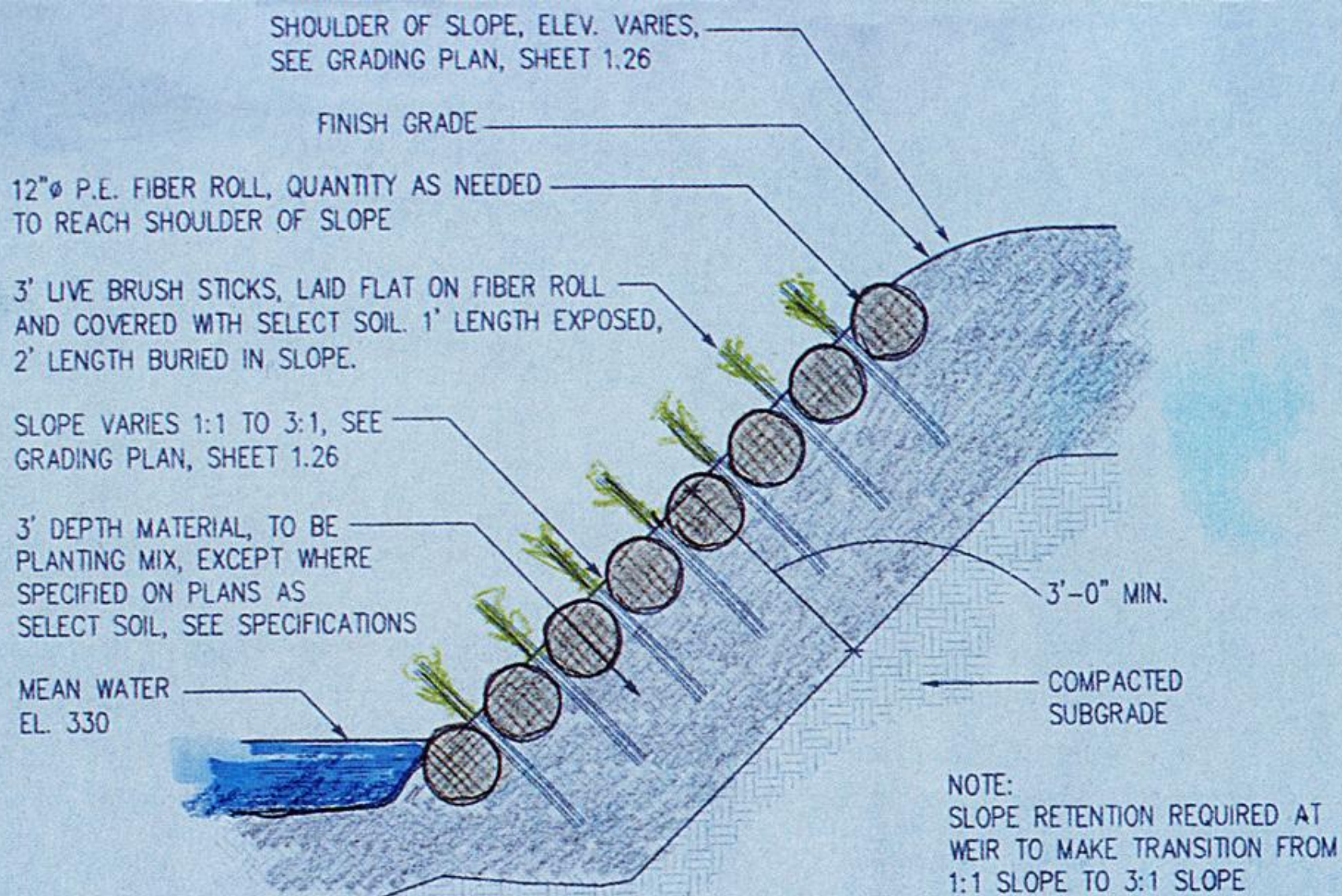


Devins Medical: Stormwater Management as Multifunctional Green Infrastructure

- Wetland creation + water management + habitat improvements
- Strategy: “smooth” the regulatory/approval process



Devens Stormwater Wetland + a diversity of aquatic and terrestrial habitats



Devens: fine-scale green infrastructure, pond-edge bioengineering, created habitat

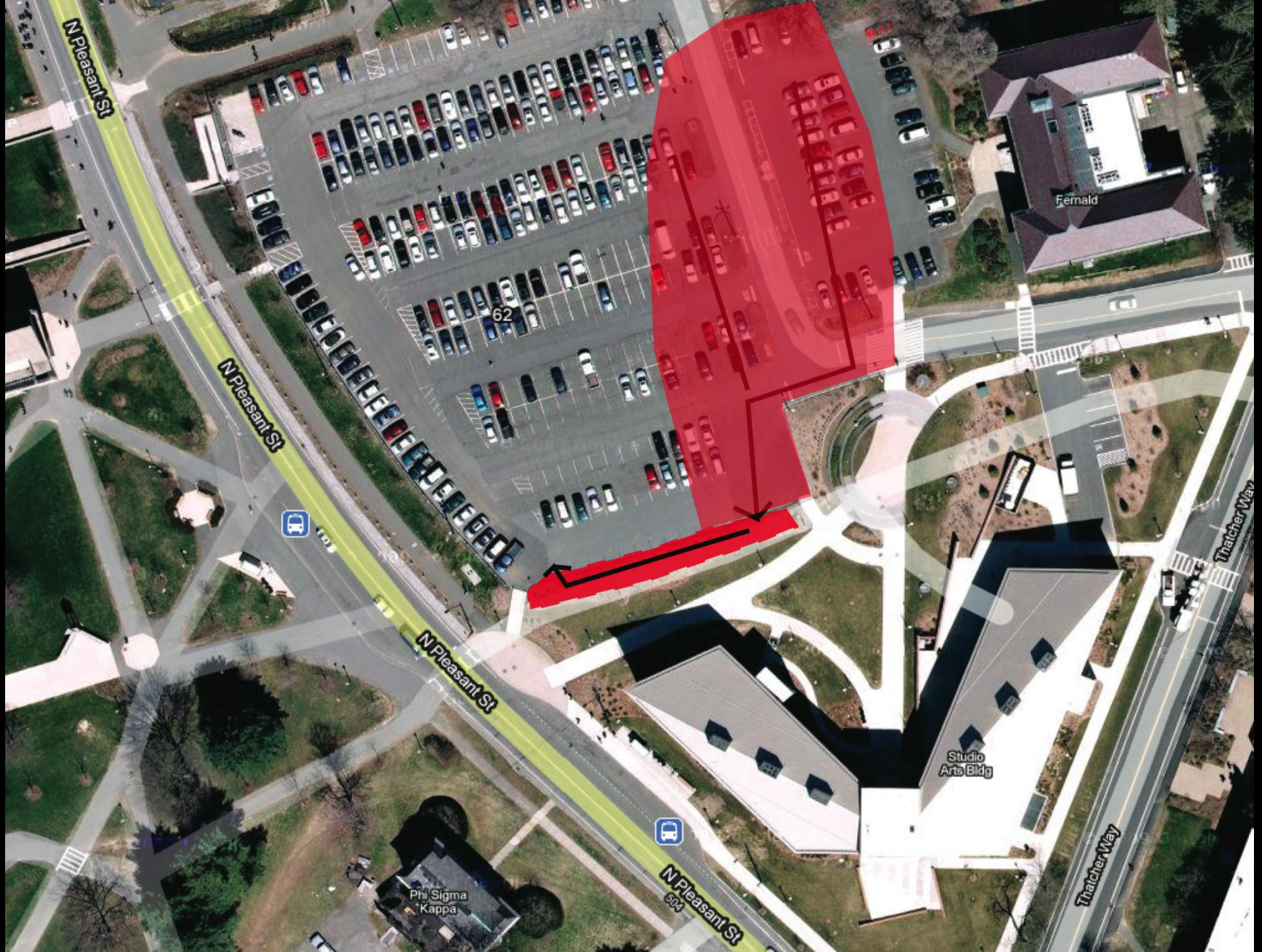
Südgelände Nature Park
Berlin, Germany

Spontaneous urban
Biodiversity in brownfield
conditions

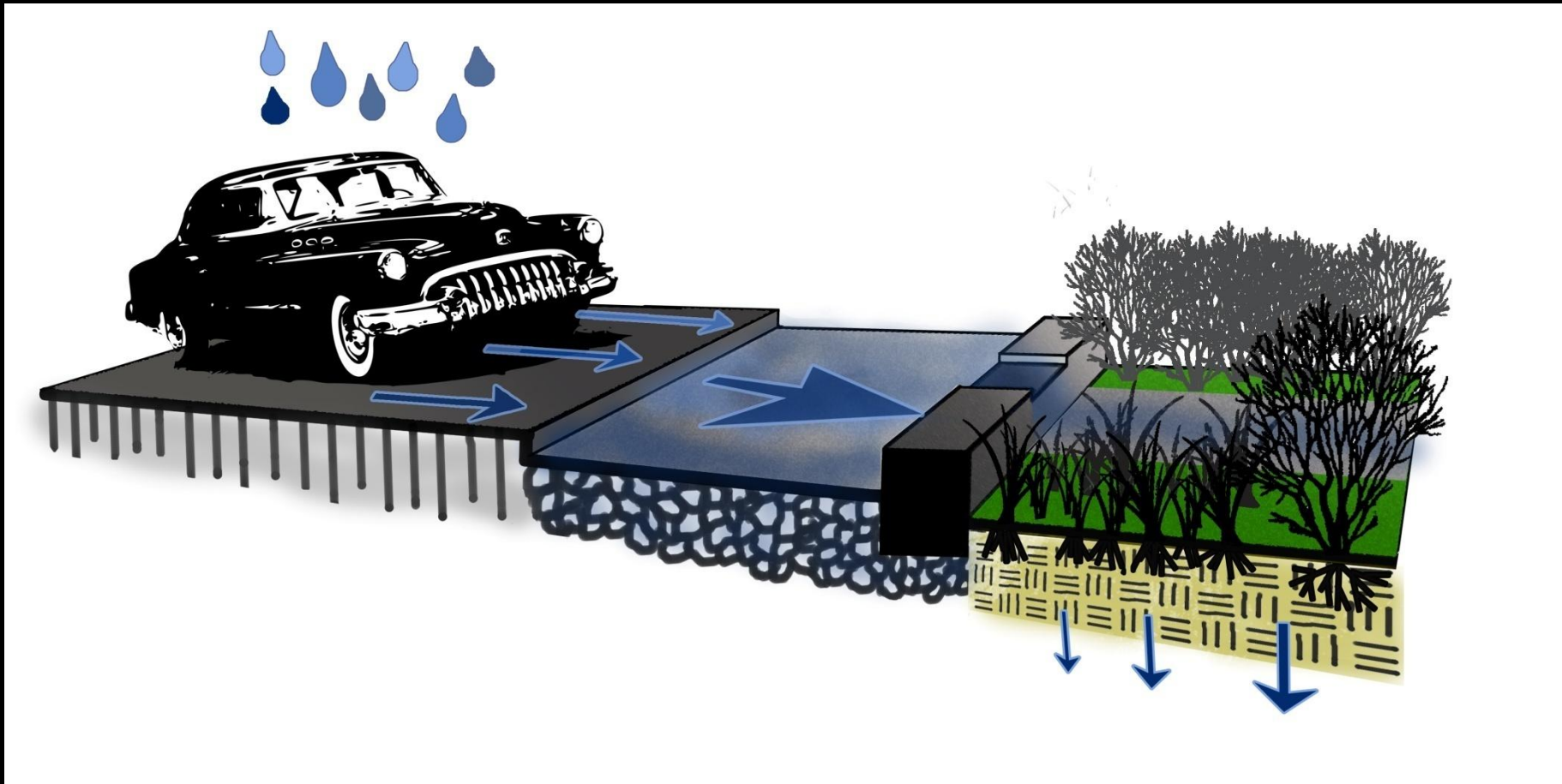




Südgelände Nature Park Berlin, Germany
Spontaneous - biodiverse dry heathland on industrial fill



UMass Rain Garden Site and drainage area (sewer-shed)



UMass Rain Garden Concept:
pavement > forebay > planted infiltration basin

(Max Cohen, 2010)



Raingarden: Planted with native species for water quality renovation and biodiversity value

“Learning by Doing”

Adaptive Design

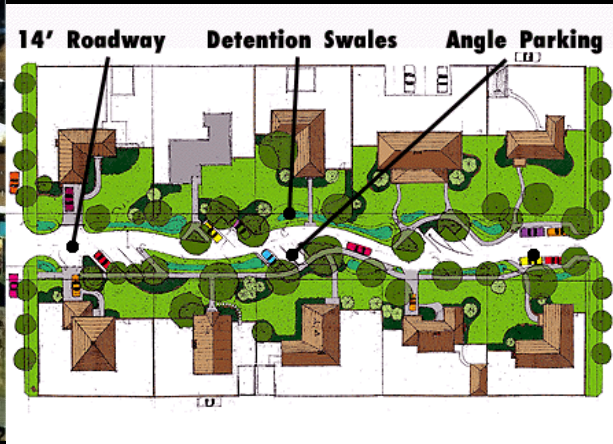
“Safe-to-fail’ Design Experiments

Imperative to act with uncertainty/imperfect knowledge

Culture of Innovation vs culture of Conservative Professionalism

Barriers ? Fail angst? Liability? Monitoring cost?

Adaptive Design “Safe-to-fail Design Experiments”



SEA Street, Seattle, Washington:

98% of wetweather and 100% of dry weather runoff eliminated (Seattle Public Utilities)

Collateral benefits: traffic calming, increased social interactions, aesthetics, wildlife-native plants

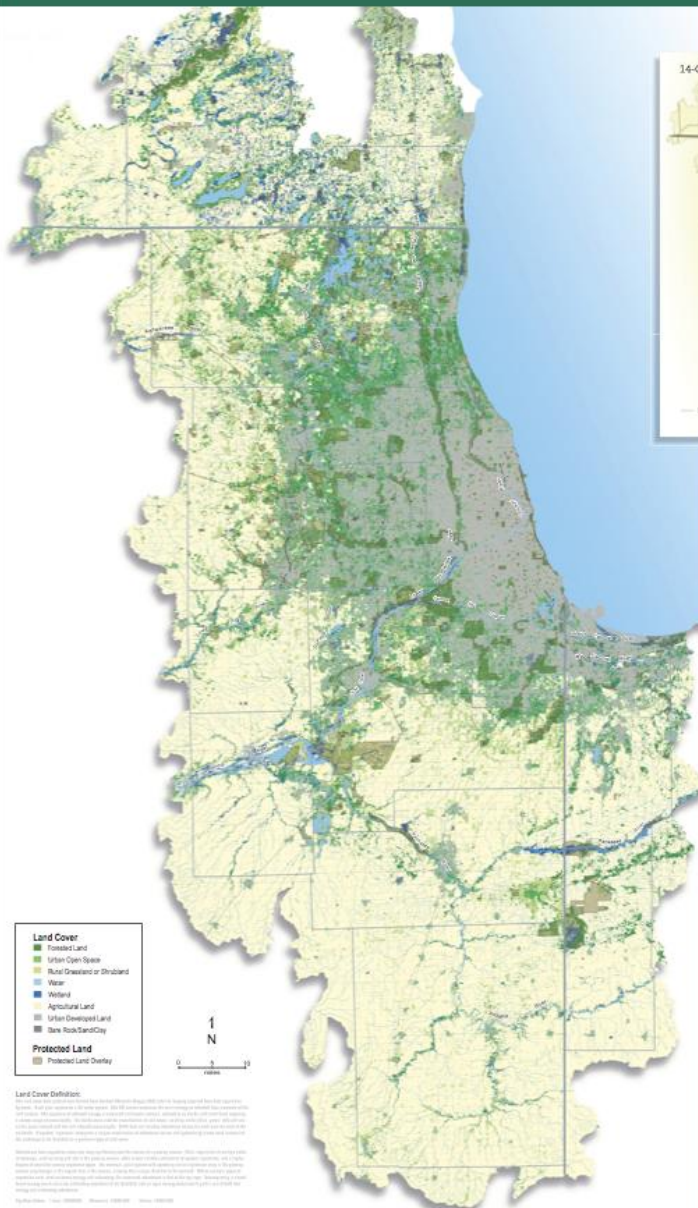
Model for Seattle green infrastructure

Green Infrastructure Ecosystem Services and Biodiversity

- Biodiversity planning requires the practice of multiple planning strategies
- Strategic “bundling” of Biodiversity with other ECOSYSTEM SERVICES
- Multi-scale approach, planning:design
- Urban biodiversity is a particular conception of biodiversity with distinct species, services, and challenges.

Green Infrastructure Ecosystem Services and Biodiversity

Natural Connections: Green Infrastructure in Wisconsin, Illinois, and Indiana



- Land Cover**
- Forest Land
 - Urban Open Space
 - Rural Grassland or Shrubland
 - Water
 - Wetland
 - Agricultural Land
 - Urban Developed Land
 - State Road/County
- Protected Land**
- Protected Land Overlay

Land Cover Definition:
 Forest Land: Forested areas, including natural and planted forests, woodlands, and wooded areas. Includes all types of forests, whether they are managed or not. Includes all types of woodlands, whether they are managed or not. Includes all types of wooded areas, whether they are managed or not.

Land Cover Classification:
 This map uses the National Wetland Inventory (NWI) and the National Wetland Inventory (NWI) to classify land cover. The NWI is a national wetland inventory that identifies and classifies wetlands across the United States. The NWI is used to identify and classify wetlands across the United States.

Protected Land:
 Protected Land: Land that is protected by a state or federal agency. This includes land that is protected by a state or federal agency. This includes land that is protected by a state or federal agency.



What Is Green Infrastructure?

Green infrastructure is the interconnected networks of land and water that supports native species, maintains natural and ecological processes, reduces air and noise pollution, and contributes to the health and quality of life of people and communities.

The need to protect the region's green infrastructure is greater than ever. Rapid changes in land use, increases in non-native species, and other factors threaten the region's natural heritage. Green infrastructure should serve as the strategic framework for conservation and development so that changes and key natural areas can be preserved before development occurs.

Green infrastructure can help to ease the strain on the east from a small neighborhood garden to Lake Michigan. Each piece has its place in the regional fabric. Understanding the relationship between the pieces is important because it will provide a framework for protecting and restoring natural landscapes.

This map uses satellite-derived boundaries to be broken to illustrate how the regional fabric of green infrastructure provides across state and county lines, ignoring political boundaries.

The region's green infrastructure is characterized by rich natural resources, globally rare ecosystems, and historical biological diversity. It also has immense economic value - e.g., wetlands that reduce flooding, trees that cool neighborhoods in the summer, and open spaces that attract tourism and regenerate the spirit. All provide billions of dollars worth of benefits to the region each year.

How to Use This Map
 This map can be used as a tool for creating dialogue between existing protected lands and for identifying opportunities for natural resource protection and restoration. As the map shows, the region has rare green infrastructure resources, but only a limited portion is currently protected and many protected areas are isolated from each other. Strategically located efforts to protect some green infrastructure and create new linkages are crucial.

The overall goal of this map is to provide a platform for green infrastructure cooperation and coordination with respect to protecting green infrastructure. The importance of identifying innovative opportunities was the impetus for creating the boundary region presented on the map. Of course, many highly important natural resources (e.g., the Indiana Dunes) extend beyond the 14-county area and would be excellent subjects of future mapping efforts. If you wish to learn more about protected lands in the region, visit a rare database of the region's green infrastructure, or access other important resources, please go to our website at www.greeningpgh.org.



The Joyce Foundation provided generous support for this project.

CHICAGO METRO Large Protected Patches linked to form a regional-scale green infrastructure system

Natural Connections:
 Green Infrastructure in
 Wisconsin, Illinois,
 and Indiana



Hammarby Sjöstad Ecocity: Stockholm, Sweden



Protected Mature Oak Woodland: Hammarby Sjöstad



Ecoduct linking Hammarby Sjöstad woodland to adjacent habitats



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